21st National Space Science Symposium

31 January - 4 February 2022

IISER Kolkata

Abstract Booklet

NSSS 2022

<u>21st National Space Science Symposium</u>

The 21st National Space Science Symposium (NSSS) will be a hybrid event with the primary scientific sessions held completely online. Nation wide public outreach activities and in-person local events, including a space science exhibition, are planned in the city of Kolkata. Details of the scientific sessions are available in the Program section, details of public engagement events are available in the Outreach section, the registration form is available in the Registration section, abstract submission form is available in the Abstract section and constitution of organizing committees is available in the Committees section. Registration for the main scientific program is free and is open to scientists, students, press and outreach personnel working in India. Students and the general public can participate in the outreach events which will take place online and locally.

<u>Symposium Statistics</u>

Total No of Registrations: 2008

Invited Speakers: 29

Plenary Session	Oral	Poster (Flash)	Poster
PS1	62	29	6
PS2	58	0	51
PS3	36	20	68
PS4	39	26	21
PS5	33	15	0
Total	228	90	146

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Conference Schedule

DAY 1 : MONDAY, 31 JANUARY, 2022		
OPENING CEREMONY (10:30 - 11:30)		
Session moderator	**Dibyendu Nandi (Chairperson, Local Organizing Committee, IISER Kolkata)**	
Time (IST)	**Title**	**Speaker (Affiliation)**
10:30 – 10:35	Welcome address	Sourav Pal (Director, IISER Kolkata)
10:35 – 10:40	Introduction to NSSS 2022	AS Kiran Kumar (Chairperson, National Organizing Committee)
10:40 – 10:45	Welcome remarks	R. Umamaheswaran (Scientific Secretary, ISRO)
10:45 - 11:00	**Inaugural address and formal opening of Symposium**	**S. Somanath (Chairman, ISRO and Secretary, Department of Space)**
11:00 - 11:20	Interaction with Chairman, ISRO	Moderator: Tirtha Pratim Das, (Director, SPO, ISRO HQ)
11:20 - 11:21	Playing of the National Anthem of India	
END OF OPENING CEREMONY		

POPULAR SCIENCE LECTURE (11:30 - 12:30)		
Session chair	**Shri Shantanu Bhatawdekar (Director, EDPO, ISRO)**	
Time (IST)	**Title**	**Speaker (Affiliation)**
11:30 - 12:30	Climate Change: An Indian Perspective	MadhavanRajeevan (Distinguished Scientist and Ex-Secretary, Ministry of Earth Sciences, Government of India)

SYMPOSIUM LOGISTICS (12:30 - 13:00)		
Time (IST)	**Title**	**Speaker (Affiliation)**
12:30 - 13:00	Online Accessibility and Introduction to Management Team	LOC Team
Lunch Break (13:00 - 14:00)		

PLENARY SESSION 1

SPACE BASED METEOROLOGY, OCEANOGRAPHY, GEOSPHERE-BIOSPHERE INTERACTIONS

Convenor	**M. Venkat Ratnam (NARL)**
Co - convenor	**D. Jagadheesha (ISRO), Sunil Kumar S V (VSSC), Kiran Kumar N V P (VSSC ISRO)**

PS 1 | SESSION A

Session chair	**M. Venkat Ratnam (NARL)**
Session co-chair(s)	**Mukunda M Gogoi (SPL)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00-14:40	Aerosol Radiative Forcing over India from space and ground based observations	Suresh Babu, (ISRO)
2	14:40-15:00	Studies on Brown Carbon Aerosols in India: Current Status and Way Forward	Neeraj Rastogi, (PRL)
3	15:00-15:10	Climatological aspects of size-resolved column aerosol optical properties over Gadanki, India	Bomidi Lakshmi Madhavan, (NARL)
4	15:10-15:20	Studies on Black Carbon aerosols in relation to Boundary Layer Height and Rainfall over sub urban Ch	M. Ashok Williams, (Atmospheric Science Research Laboratory, SRM IST)
5	15:20-15:30	Effect of aerosols and meteorology on precipitation enhancement over Kerala during August 2018	Jasmine Mary Kuriakose, (Assumption College)
6	15:30-15:40	Carbonaceous Aerosol Variability & their Association with Meteorological Parameters in	Saurabh Sonwani, (University of Delhi)

		Delhi, India	
7	15:40-15:50	Estimation of ACRI over a tropical atmosphere using a synergy of in-situ measurements	Renju Nandan, (NARL)
8	15:50-16:00	Space based meteorology, oceanography, geosphere-biosphere interaction	D Mriganka, (IIT KGP)
Break (16:00 - 16:30)			
PS1 | SESSION B			
Session chair	**M. Venkat Ratnam (NARL)**		
Session co-chair(s)	**T V Lakshmi Kumar (SRM-IST)**		
9	16:30-16:50	BACIS: New observational techniques to understand aerosol effects on Clouds	Varaha Ravi Kiran, (NARL)
10	16:50-17:00	Role of aerosol microphysical properties on CCN activity over a tropical coastal location	Ajith TC, (SPL)
11	17:00-17:10	Sensitivity of cloud condensation nuclei concentration to aerosol loading in column model	Kavita Patnaik, (NARL)
12	17:10-17:20	Integrated Monsoon Rainfall Observation Programme: Defining Monsoon Rainfall Measuring Satellite (MRMS)	T V Lakshmi Kumar, (SRM IS&T)
13	17:20-17:30	Variability in atmospheric DMS over the Bay of Bengal during the post-monsoon season	Mansi Gupta, (PRL)
14	17:30-17:40	Long-term trends in the Aerosol Optical Depth obtained using Multi-satellite measurements	Gopika Gupta, (NARL)
15	17:40-17:50	Retrieval of near-surface PM2.5 over India using satellite lidar observations	Lakshmi N B, (NCESS)
16	17:50-18:00	Variability and comparison of aerosol and PWV from the measurement of satellite over Darjeeling	Shyam Mehta, (Bose Institute)
17	18:00-18:10	What drives the prevalence of atmospheric water-soluble organic aerosols over the tropical hill station	D.K. Deshmukh, (SPL)

		in the Western Ghats?	
18	18:10-18:20	Probing the genesis of extreme BC episodes over a polluted metropolis near land-sea boundary	Gargi Rakshit, (Institute of Radio Physics and Electronics)
19	18:20-18:30	Variation of trace gases in Kannur Town, a coastal South Indian city	Nishanth T, (Sree Krishna College Guruvayur)

PLENARY SESSION 2

MIDDLE ATMOSPHERE, ATMOSPHERIC COUPLING, DYNAMICS AND CLIMATE CHANGE

Convenor	**Kishore Kumar K (SPL)**
Co - convenor	**Tarun Pant (SPL), Dr. D. BalaSubrahamanyam (SPL), NirvikarDashora (NARL)**

PS2 | SESSION A

Session chair	**Tarun Pant and NirvikarDashora**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00-14:45	Atmospheric Sciences With the ST Radar Facility	Ashik Paul, (University of Calcutta)
2	14:45-15:00	Study of daytime E-region ionospheric zonal drifts and high-low latitude coupling.	Tarun Kumar Pant, (VSSC, ISRO)
3	15:00-15:15	New data analysis tool on digisonde observations for scientific investigations	Janardana Reddy G, (National Atmospheric Research Laboratory, Gadanki)
4	15:15-15:30	Equatorial ionospheric study using GMRT	SarveshMangla (IIT Indore)
5	15:30-15:45	Observations of Summer Night-Time FAI Using University of Calcutta ST Radar	Tanmay Das (Calcutta University)
6	15:45-16:00	Thermospheric neutral winds and temperature: First results from an Indian equatorial station	Md. Mosarraf Hossain (Space Physics Laboratory, VSSC)

Break (16:00 - 16:30)

PS2 | SESSION B

Session chair	Tarun Pant and Nirvikar Dashora		
7	16:30-16:45	Assesment on the day-to-day variability of the equatorial plasma bubble	Suman Kumar Das, PRL
8	16:45-17:00	A study of Fascinating Equatorial Plasma Bubble Event Imaged through All-Sky Imager Over Indian Sect	Onkar Gurav (Bharati Vidyapeeth, Pune)
9	17:00-17:15	Daytime thermospheric wave dynamics and day-to-day variability in the occurrence of ESF	Subir Mandal, PRL
10	17:15-17:30	Intermediate Descending Layers [IL] over the equatorial location of Thiruvananthapuram	Mridula N (SPL, VSSC)
11	17:30-17:45	Tidal influence on the generation of post-midnight F region irregularities	Meenakshi S (National Atmospheric Research Laboratory, Gadanki)
12	17:45-18:00	Automatic detection of Sporadic E event in the CADI ionograms for the study of its effect on F layer	T. Venkateswara Rao (KL University, Vijayawada)
13	18:00-18:15	Ionospheric vertical plasma drift model developed for the Indian and Indonesian sectors	Pavan Chaitanya (National Atmospheric Research Laboratory, Gadanki)
14	18:15-18:30	Performance evolution of IRI Plas and SAMI2 models during solar minimum around 100°E	Angkita Hazarika (Dibrugarh University)

PLENARY SESSION 3

SOLAR AND PLANETARY SCIENCES

Convenor	Dipankar Banerjee (ARIES)
Co - convenor	Sankarasubramaniyan K (URSC), Satheesh Thampi (VSCC), Shyama Narendranath (URSC)

PS3 |SESSION A

Serial No.	Time (IST)	Title	Speaker (Affiliation)
Session chair	**Dipankar Banerjee (ARIES)**		
Session co-chair(s)	**Smitha V Thampi (SPL)**		
1	14:00 - 14:45	Observing Solar Activity from Ground and Space	Nandita Srivastava, (PRL)
2	14:45 - 15:05	Magnetic Reconnection and Particle Acceleration in High Lundquist Number Systems	Arghyadeep Paul, (IIT Indore)
3	15:05 - 15:25	Propagation characteristics of a Coronal Mass Ejection throughout inner solar system from multipoint	Shirsh Lata Soni,(VSSC ISRO)
4	15:25 - 15:45	Magnetohydrodynamic simulations of the impact of a coronal mass ejection on the global magnetosphere	Souvik Roy, (CESSI, IISER Kolkata)
5	15:45 - 16:05	Multiple particle injections in the Earth's Magnetosphere by an isolated IP Shock	Ankush Bhaskar, (VSSC ISRO)
Break (16:05 - 16:30)			
PS3 | SESSION B			
Session chair	**Satheesh Thampi (SPL)**		
Session co-chair(s)	**Divya Oberoi (NCRA)**		
6	16:30 - 16:50	A study on the coupling between IMF Bz and Dst under 22nd and 23rd solar cycles	Amrutha S, (University of Kerala)
7	16:50 - 17:10	Corotating Interaction Regions during Solar Cycle 24: A Study on Characteristics and Geo-effectiveness	Jibin V Sunny, (IIT Indore)
8	17:10 - 17:30	Recent Results on Martian Space Weather Events	Smitha V Thampi, (VSSC ISRO)
9	17:30 - 17:50	A magnetohydrodynamic trip to the Martian environment	Arnab Basak, (CESSI, IISER Kolkata)
10	17:50 - 18:10	The correlation analysis of SF parameter with SEP parameter based on the impulsive time of SF and	Biji M. S, (University of Kerala)

		originated from the western hemisphere	
11	18:10 - 18:13	Observations of Summer Night-Time FAI Using University of Calcutta ST Radar	Tanmay Das, (Institute of Radio Physics and Electronics, University of Calcutta)
12	18:13 - 18:16	Study of periodicities of Sunspot Number and seasonal Kerala rainfall using Wavelet Analysis	Elizabeth Thomas, (Mar Thoma College, Kerala)
13	18:16 - 18:19	Morphology of Quietest and Most Disturbed days during 24 Solar Cycle	Chogyel Wangchuk, (Goyal Shimla University)
14	18:19 - 18:22	A Comprehensive Study on the Impact of Solar Flare X-ray Flux on Geomagnetic Field Disturbance	Gopika S Vijayan, (University of Kerala)
15	18:22 - 18:25	Particle Bursts InGeotail Observed By CLASS On Chandrayaan-2	Kiran Sreekumar, (Amrita University)

PLENARY SESSION 4

ASTRONOMY AND ASTROPHYSICS

Convenor	**Santosh Vadawale (PRL)**
Co - convenor	**Radhakrishna V (URSC), Ritaban Chatterjee (Presidency University), Mousumi Das (IIA)**

PS4 | SESSION A

Session chair	**MousumiDas (IIA)**
Session co-chair(s)	**Santosh Vadawale (PRL)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00 - 14:40	Future Vision for Astronomy and Astrophysics in India	G. C. Anupama, (IIA)
2	14:40 - 15:00	Science with proposed UV space mission: INSIST	MaheswarGopinathan,(IIA)
3	15:00 - 15:20	Daksha: Indian eyes on transient skies	Varun Bhalerao, (IIT Bombay)

4	15:20 - 15:40	UVIT study of T-Tauri Stars	Prasanta Kumar Nayak, (TIFR)
5	15:40 - 16:00	Minerals in the ISM are Made in an Instant	Arijit Roy, (PRL)
Break (16:00 - 16:30)			
PS4 | SESSION B			
Session chair	**P. Manoj (TIFR)**		
Session co-chair(s)	**V. Radhakrishna (URSC)**		
6	16:30 - 16:50	A UVIT look at Star Formation in Merging and Interacting Galaxies	Mousumi Das, (IIA)
7	16:50 - 17:10	Discovery of a large, diffuse star-forming galaxy using UVIT and MUSE	Jyoti Yadav, (IIA)
8	17:10 - 17:30	Non-isothermal vertical density distribution of stars in the Milky Way	Suchira Sarkar, (IISc)
9	17:30 - 17:50	Star-dust geometry as main determinant of dust attenuation in galaxies	Sonali Sachdeva, (RRI)
10	17:50 - 18:10	Clues of Dark Matter Distribution in Galaxies from Bar Buckling	Ankit Kumar, (IIA)
11	18:10 -18:13	Spectral Characterization of M-Dwarf Stars with ASTROSAT-UVIT	Prasanta Kumar Nayak, (TIFR)
12	18:13 - 18:16	Photometric Variability in Young Brown Dwarfs to Probe their Atmospheric Properties	Rajib Kumbhakar, (SNBNCBS)
13	18:16 - 18:19	Short-Timescale Variability of the Blazar Mrk 421 from AstroSat and Simultaneous Multi-Wavelength	Susmita Das, (Presidency University Kolkata)
14	18:19 - 18:22	Hot horizontal branch stars in NGC 2298: Clues about their origin from AstroSat/UVIT study	Gajendra Pandey, (IIA)
15	18:22 - 18:25	Gaia 20eae: A newly discovered episodically accreting young star	Arpan Ghosh, (ARIES)
16	18:25 - 18:28	Photoionization Modeling of the Dusty Nova V1280	Ruchi Pandey, (SNBNCBS)

		Scorpii	

PLENARY SESSION 5

ENABLING TECHNOLOGIES FOR SPACE EXPLORATION

Convenor	**Tirtha Pratim Das (ISRO HQ)**
Co-convenor	**N. Raghu Meetei (ISRO HQ), M Durga Rao (NARL), V. K. Rana (RRI)**

PS5 | SESSION A

Session chair	**Tirtha Pratim Das (ISRO HQ)**
Session co-chair(s)	**M Durga Rao (NARL)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00 -14:45	Science Experiments with PSLV Stage-4 (PS4) Orbital Platform	K Rajeev, SPL ISRO
2	14:50 -14:52	NiCoZn Ferrite: burn rate enhancer for AP/HTPB based propellant and its catalytic study	Pragnesh N Dave, Sardar Patel University
3	14:52-14:54	Simulation studies of NMPCC for a nonlinear model of Hexsoon Edu 450 Quadrotor	Sonu N, Manipal Institute of Technology
4	14:54-14:56	Martian Rover for Extraterrestrial Research	Antariksh Ray, SRMIST Kattankulathur
5	14:56-14:58	Fortifying the development of Mars colonization and space biology research in India	IlankuzhaliElavarasan, Space Development Nexus
6	15:00-15:20	Space Science Research with Sounding Rockets	Binoy Joseph, VSSC
7	15:20-15:40	ISRO’s Sounding Rockets: Overview of Instrumentation System for Space Science Experiments	Virender Katewa, VSSC
8	15:40-16:00	Scientific payload electronics for electron and ion density measurements onboard ISRO’s sounding rockets	Sreelatha P, SPL-VSSC

Break (16:00 - 16:30)			
PS5 | SESSION B			
Session chair	**N. Raghu Meetei (ISRO HQ)**		
Session co-chair(s)	**V. K. Rana (RRI)**		
9	16:30-16:50	**Discussion Break**	Manju G, SPL-VSSC
10	16:50-17:10	Design and development of tropospheric zero pressure balloons and flight control instrumentation	Suneel Kumar Buduru, TIFR
11	17:10-17:30	Control instrumentation for high altitude balloon experiments	Kapardhi Bangaru, TIFR
12	17:30-17:50	1U CubeSat and GM counter testing using High Altitude Balloon platform	Binukumar Gopalakrishnan Nair, IIA
13	17:50-18:10	TIFR balloon-borne experiment for far-infrared (FIR) spectroscopic mapping of star-forming region	Pradeep Sandimani, TIFR
14	18:10-18:30	SETI India: Using uGMRT to search for advanced extraterrestrial life	Avinash Kumar, Amity University Mumbai

DAY 2 : TUESDAY, 1 FEBRUARY, 2022		
INTERDISCIPLINARY SESSION 1 : HIGHLIGHTS FROM ISRO SPACE SCIENCE MISSIONS		
Session chair	**S. Seetha (RRI)**	
Time (IST)	**Title**	**Speaker (Affiliation)**
10:00 – 10:45	Science Accomplishments from the Astrosat Mission	Dipankar Bhattacharya (IUCAA)
10:45 – 11:30	Science from the Chandrayaan-2 and Mars Orbiter Missions	Anil Bhardwaj (PRL)
INTERDISCIPLINARY SESSION 3 : REMOTE SENSING AND METEOROLOGY FROM SPACE		
Session chair	**Tarun Pant (SPL-VSSC), D.Jagadheesha (ISRO HQ)**	
Time (IST)	**Title**	**Speaker (Affiliation)**
11:30 – 12:15	Equatorial Ionospheric Research Relevant to Navigation and Communication Applications - Current Status and Way Forward	Amit Patra (NARL)
12:15 - 13:00	Hydrated Moon: New Findings through Remote Sensing	Prakash Chauhan (IIRS Dehradun)
Lunch Break (13:00 - 14:00)		

PLENARY SESSION 1

SPACE BASED METEOROLOGY, OCEANOGRAPHY, GEOSPHERE-BIOSPHERE INTERACTIONS

Convenor	**M. Venkat Ratnam (NARL)**
Co - convenor	**D. Jagadheesha (ISRO), Sunil Kumar S V (VSSC), Kiran Kumar N V P (VSSC ISRO)**

PS1 | SESSION A

Session chair	**Sunil Kumar S V (VSSC)**		
Session co-chair(s)	**B. L. Madhavan (NARL)**		
Serial No.	**Time (IST)**	**Title**	**Speaker (Affiliation)**
1	14:00-14:40	Exploring the Oceans from Ground and Space	Sunil Kumar Singh, (CSIR-National

			Institute of Oceanography)
2	14:40-15:00	Photochemical evolution of air in tropical urban environments of India: A model-based study	Narendra Ojha, (PRL)
3	15:00-15:10	Demonstrating the capability of machine learning to simulate atmospheric trace gases	Imran A. Girach, (SPL)
4	15:10-15:20	Spatio-temporal variation and gas-particle partitioning of PAHs and Nitro-PAHs in the atmosphere of	Puneet Kumar Verma, (Dayalbagh Educational Institute)
5	15:20-15:30	Total column ozone from Indian geostationary satellite INSAT-3DR: Improved infrared retrieval and validation	Prajjwal Rawat, (ARIES)
6	15:30-15:40	Bayesian inverse modeling of CH4 fluxes over the peninsular India	Anjumol Raju, (SPL)
7	15:40-15:50	Emissions of biogenic VOC from Achanakmar-Amarkantak Biosphere Reserve (AABR)Forest in Central India	TanzilGaffar Malik, (Space and Atmospheric Sciences Division, PRL)
8	15:50-16:00	C02 variability over a coastal urban station	Sandhya K Nair, (SPL)
Break (16:00 - 16:30)			
PS1 | SESSION B			
Session chair	**Sunil Kumar S V (VSSC)**		
Session co-chair(s)	**Ghouse Basha (NARL)**		
9	16:30-16:50	Local emission and long-range transport impacts on the CO, CO2, and CH4 concentrations	Chaithanya D. Jain, (NARL)
10	16:50-17:00	Is the ABL altitude or strong thermal inversions that control the vertical extent of aerosols?	P. Prasad, (NARL)
11	17:00-17:10	Do the large-eddy simulations yield deeper atmospheric boundary layers in comparison to the RANS?	RoshnyS. , (SPL)

12	17:10-17:20	Impact of COVID-19 lockdown on Surface, ABL, and Instability parameters over India	Ghouse Basha, (NARL)
13	17:20-17:30	Anomalous radiative warming by clouds over a sub-region within the Indian summer monsoon region	V. Sathiyamoorthy, (ISRO)
14	17:30-17:40	An approach for tropospheric humidity retrieval from radio occultation refractivity profiles	D. Jagadheesha, (ISRO)
15	17:40-17:50	Retrieval of atmospheric profiles from microwave radiometer using AI	Renju R, (ISRO)
16	17:50-18:00	Impact of Satellite Based Geographical Data on Simulation of Rainfall over North Eastern Region of I	Rekha BharaliGogoi, (North Eastern Space Applications Centre)
17	18:00-18:10	Spatio-temporal signature of anomalous positive and negative IOD events using remote sensing data	Amit Kumar Jena, (IIRS)
18	18:10-18:20	Comparative Analysis of Binary Classifiers for Rainfall Prediction in Mumbai region	Kaustav Chakravarty, (IMD, Pune)
19	18:20-18:30	Rapidly intensified, Long duration North Indian Ocean Tropical Cyclones: validation and dynamics	Arpita Munsi, (NARL)

PLENARY SESSION 2

MIDDLE ATMOSPHERE, ATMOSPHERIC COUPLING, DYNAMICS AND CLIMATE CHANGE

Convenor	**Kishore Kumar K (SPL)**
Co - convenor	**Tarun Pant (SPL), Dr. D. BalaSubrahamanyam (SPL), NirvikarDashora (NARL)**

PS2 | SESSION A

Session chair	**Tarun Pant and NirvikarDashora**		
Serial No.	**Time (IST)**	**Title**	**Speaker (Affiliation)**
1	14:00-14:15	The supersubstorms of solar cycle 24: The sources,	SritamHajra (National Atmospheric

		energy coupling and impacts on the SW-M-I system	Research Laboratory, Gadanki)
2	14:15-14:30	On the seasonal response of the equatorial and low latitude ionosphere to major geomagnetic storms	Sripathi S (Indian Institute of Geomagnetism, Mumbai)
3	14:30-14:45	Distinct Ionospheric response to three different geomagnetic storms during 2016 using GPS-TEC	Duvvu Lissa (Andhra University)
4	14:45-15:00	Spatio-temporal confinement of ionospheric responses over during St. Patrick's Day storm of March 20	SkSamin Kader (National Atmospheric Research Laboratory, Gadanki)
5	15:00-15:15	Aspects related to variability in radiative cooling by NO, and TEC&O/N2 during Halloween Storm	Alok Kumar Ranjan (Indian Institute of Technology Roorkee)
6	15:15-15:30	Atmospheric and Ionospheric response to Major Sudden Stratospheric Warming (SSW) Episodes	JineeGogoi (Dibrugarh University)
7	15:30-15:45	Lower atmosphere-ionosphere coupling: Observations of HUDHUD cyclone using AIRS and GPS network	V.K.D. Srinivasu (National Atmospheric Research Laboratory, Gadanki)
8	15:45-16:00	Association between earthquake and equatorial wave	Manohar Lal (Indian Institute of Geomagnetism)
Break (16:00 - 16:30)			
PS2 | SESSION B			
Session chair	**Tarun Pant and NirvikarDashora**		
9	16:30-16:45	Impact of stratospheric ozone and mesospheric tides on enhanced occurrence of 150-km echoes in 2019	Reetambhara Dutta (National Atmospheric Research Laboratory, Gadanki)
10	16:45-17:00	OI 630 nm nightglow variability during post-sunset time over low-latitude thermosphere	SovanSaha, (PRL)
11	17:00-17:15	3-D characterization of daytime gravity waves obtained using optical and radio measurements	Sunil Kumar, (PRL)
12	17:15-17:30	Terdiurnal and gravity wave influences on OH(3-1) brightness and its rotational temperatures measured by	Ravindra Pratap Singh, (PRL)

		PRL Airglow InfraRed Spectrograph (PAIRS)	
13	17:30-17:45	Discrimination of Doppler Shift In Atmospheric Gravity Wave Signatures Due To Horizontal Background Wind Using Dictionary Learning	Varanasi Satya Sreekanth, (National Atmospheric Research Laboratory, Gadanki)
14	17:45-18:00	Detection of Lightning Induced Gravity Wave from NavIC Signal and Ground Data	Soumen Datta, (IIT Indore)
15	18:00-18:15	Planetary wave dynamical variability at low latitude middle atmosphere during September 2019 SSW	Gourav Mitra, (PRL)
16	18:15-18:30	Response of Brewer-Dobson Circulation to SSWs over the Northern and Southern Hemisphere	Veenus Venugopal, (SPL ISRO)

PLENARY SESSION 3

SOLAR AND PLANETARY SCIENCES

Convenor	**Dipankar Banerjee (ARIES)**
Co - convenor	**Sankarasubramaniyan K (URSC), Satheesh Thampi (VSCC), Shyama Narendranath (URSC)**

PS3 | SESSION A

Session chair	**K. Sankarasubramanian (URSC)**
Session co-chair(s)	**Bhuwan Joshi (PRL)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00 - 14:45	Radio studies of the dynamic solar corona	Divya Oberoi, (TIFR)
2	14:45 - 15:05	Signatures of ubiquitous magnetic reconnection in the lower solar atmosphere	Jayant Joshi, (IIA)
3	15:05 - 15:25	Soft X-ray Spectral Diagnostics of Multi-thermal Plasma in Solar Flares with Chandrayaan-2 XSM	Mithun N. P. S., (PRL)
4	15:25 - 15:45	Coronal Magnetic fields and Sensitivity Requirements for Spectropolarimetry Channel of VELC/Aditya-L1	K. Sasikumar Raja (IIA)

5	15:45 - 16:05	Propagation of acoustic-gravity waves in magnetized regions in the lower solar atmosphere	Hirdesh Kumar, (PRL)
Break (16:05 - 16:30)			
PS3 | SESSION B			
Session chair	**Shyama Narendranath (URSC)**		
Session co-chair(s)	**M Shanmugham (PRL)**		
6	16:30 - 16:50	Solar Ultraviolet Imaging Telescope (SUIT) Forward Modeling	Soumya Roy, (IUCAA)
7	16:50 - 17:10	Coupling of CME kinematics from inner to outer corona, and influence of their source regions	Satabdwa Majumdar, (IIA)
8	17:10 - 17:30	Recent developments in space weather research with high fidelity low-frequency spectro-polarimetric	DevojyotiKansabanik, (NCRA)
9	17:30 - 17:50	Constraining the source of an anomalous impact melt deposit on the lunar far side: New insights	Deepak Dhingra, (IIT Kanpur)
10	17:50 - 18:10	A machine learning framework for global Mg-Spinel detection based on Chandrayaan-1 data	Suchit Purohit, (Gujarat University)
11	18:10 - 18:13	Simulation of solar coronal mass ejections due to twisted flux rope emergence	Samriddhi Sankar Maity, (IISc)
12	18:13 - 18:16	Study of lunar crater floor deformation induced by the magma intrusion	P. Achintya, (IIST)
13	18:16 - 18:19	Moon Imaging using Advanced Indian MST Radar	Ashish, (NARL)
14	18:19 - 18:22	Mg-Spinel exposures in the South-Pole Aitken (SPA) basin region on the Moon	Garima Sodha, (IIT Kanpur)
15	18:22 - 18:25	Petrogenesis of non-KREEP lunar basalts: an	Yash Srivastava, (PRL)

		unidentified Fe-rich mantle source	

PLENARY SESSION 4

ASTRONOMY AND ASTROPHYSICS

Convenor	**Santosh Vadawale (PRL)**
Co - convenor	**Radhakrishna V (URSC), Ritaban Chatterjee (Presidency University), Mousumi Das (IIA)**

PS4 | SESSION A

Session chair	**Gulab Dewangan (IUCAA)**
Session co-chair(s)	**Sarita Vig (IIST)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00 - 14:40	The Emerging Field of Sub-mm Astronomy	BhaswatiMookerjea, (TIFR)
2	14:40 - 15:00	Understanding of Pre-main Sequence Stars in Galactic Star-Forming Regions	Soumen Mondal, (SNBNCBS)
3	15:00 - 15:15	ALMA detection of the glycine precursor amino acetonitrile towards hot molecular core G10.47+0.03	Arijit Manna, (Midnapore City College)
4	15:15 - 15:30	A Gaia kinematic study of ages of debris disks and exoplanet host stars: Are Jupiter-hosting stars young?	Mayank Narang, (TIFR)
5	15:30 - 15:45	Are giant planet-hosting stars young? Evidence from galactic chemical evolution	Swastik Chowbay, (IIA)
6	15:45 - 16:00	Cosmic rays diffusion and gravitational collapse in radiative molecular clouds	Ram Prasad Prajapati, (JNU)

Break (16:00 - 16:30)

PS4 | SESSION B

Session chair	**Preeti Kharb (NCRA)**
Session co-chair(s)	**Ritaban Chatterjee (Presidency University)**

7	16:30 - 16:45	Validating different modes of AGN feedback through X-ray observations	Rudrani Kar Chowdhury, (The University of Hong Kong)
8	16:45 - 17:00	RMS-Flux Relation and Disc-Jet Connection in Blazars in the Context of the Internal Shocks Model	Aritra Kundu, (Presidency University Kolkata)
9	17:00 - 17:15	Relative Contribution of X-ray Reprocessing and Disk Fluctuations in the Long-term Optical Variability of the Radio Galaxies 3C 120 and 3C 111	Nabanita Das, (Presidency University Kolkata)
10	17:15 - 17:30	Decoding the largest radio galaxies in the Universe	Pratik Dabhade, (Observatoire de Paris, France)
11	17:30 - 17:45	Study of External Compton Mechanism in the Context of Astrophysical Jets	SriyasritiAcharya,(IIT Indore)
12	17:45 - 18:00	A 325 MHz Survey of the Lockman Hole Field using the GMRT	AishrilaMazumder, (IIT Indore)
13	18:00 - 18:03	Discovery of 2716 hot emission-line stars from LAMOST DR5	Shridharan Baskaran, (Christ University)
14	18:03 - 18:06	Identification of a rare class of emission-line stars between PMS and MS phase	Suman Bhattacharyya, (Christ University)
15	18:06 - 18:09	Study of classical Be stars using optical spectroscopy	Gourav Banerjee, (Chirst University)
16	18:09 - 18:12	Characterizing the behaviour of SN 2013he: a luminous, short plateau supernova	Darshana Mehta, (ARIES)
17	18:12 - 18:15	Revealing lack of X-ray/UV correlation in narrow line Seyfert 1 galaxy Mrk 1044	Samuzal Barua, (Gauhati University)
18	18:15 - 18:18	A comparative study of the optical and IR variability of NLSy1 and BLSy1 galaxies	Aratrika Dey, (IIA)
19	18:18 - 18:21	Fullerenes and their derivatives in interstellar environments	Akant Vats, (Banaras Hindu University)
20	18:21 - 18:24	Broad-Line Region and Black-hole Mass of	Shivangi Pandey, (ARIES)

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PLENARY SESSION 5

ENABLING TECHNOLOGIES FOR SPACE EXPLORATION

Convenor	**Tirtha Pratim Das (ISRO HQ)**
Co-convenor	**N. Raghu Meetei (ISRO HQ), M Durga Rao (NARL), V. K. Rana (RRI)**

PS5 | SESSION A

Session chair	**N. Raghu Meetei (ISRO HQ)**
Session co-chair(s)	**M Durga Rao (NARL)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00 -14:45	Scientific Instrumentation for Space Missions	Tirtha Pratim Das, ISRO
2	14:50-14:52	Design studies on MEMS Quadrupole Mass Filter for Miniature Mass Spectrometer	S. Ashwath, ISRO
3	14:52-14:54	Electronics Development of Neutral and Ion Mass Spectrometer	Piyush Sharma, PRL
4	14:54-14:56	Graphene based soft X-ray windows	Aiswarya P S, Christ University,
5	14:56-14:58	Modeling in-orbit radiation environment using Geant4 simulations for the XSPECT instrument	Kiran M Jayasurya, ISRO
6	15:00-15:20	Neutral Mass Spectrometer on Articulated Payload Platform for Space-borne Experiments	M B Dhanya, VSSC ISRO
7	15:20-15:40	Design and Development of an Instrument for Electric Field Measurement in Planetary Atmosphere	Sanjeev Kumar Mishra, PRL
8	15:40-16:00	Experimental Study of the Response of Space-borne Channel electron multiplier detectors to intermittent high He ion flux	Abhishek JK, SPL- VSSC
Break (16:00 - 16:30)			

PS5 | SESSION B			
Session chair	**M Durga Rao (NARL)**		
Session co-chair(s)	**V. K. Rana (RRI)**		
9	16:30-16:50	Near Infrared astronomical projects at TIFR	MILIND B. NAIK, TIFR
10	16:50-17:10	Geometric Phase Polarimeter	ATHIRA B S, CESSI
11	17:10-17:30	Development of a SDD based Large Area X-ray Spectrometer with ASIC readout for future planetary missions	Nishant Singh, PRL
12	17:30-17:50	Indigenous 18m antenna at IDSN for planetary and deep space missions	Dharma Narayan Rath, Isro
13	17:50-18:10	Planetary Rover prototype: Mars Amity Surface Characterization & Operations Trainer (MASCOT- 1)	Saksham Bhadani, Amity University Mumbai
14	18:10-18:30	Development of a Compton Imaging Camera for Space Astrophysics	Abhijeet Ghodgaonkar, IIT - Bombay

DAY 3 : WEDNESDAY, 2 FEBRUARY, 2022		
INTERDISCIPLINARY SESSION 3 : REMOTE SENSING AND METEOROLOGY FROM SPACE (CONTINUED)		
Session chair	**Tarun Pant (SPL-VSSC), D.Jagadheesha (ISRO HQ)**	
Time (IST)	**Title**	**Speaker (Affiliation)**
10:00 – 10:45	Remote Sensing for Ecology, Conservation and Human Sustainability	Harini Nagendra (Azim Premji University)
INTERDISCIPLINARY SESSION 4 : INTERDISCIPLINARY SCIENCES		
Session chair	**Dipankar Banerjee (ARIES), Ajit Kembhavi (IUCAA)**	
Time (IST)	**Title**	**Speaker (Affiliation)**
10:45 - 11:30	Modeling Climate Change	Krishna Achutarao (IIT Delhi)
11:30 - 12:15	Space Weather: Predicting our Space Environment	Dibyendu Nandi (IISER Kolkata)
12:15 - 13:00	Exploring New Worlds beyond the Solar System	T. Sivarani (IIA)
Lunch Break (13:00 - 14:00)		

PLENARY SESSION 1

SPACE BASED METEOROLOGY, OCEANOGRAPHY, GEOSPHERE-BIOSPHERE INTERACTIONS

Convenor	**M. Venkat Ratnam (NARL)**
Co - convenor	**D. Jagadheesha (ISRO), Sunil Kumar S V (VSSC), Kiran Kumar N V P (VSSC ISRO)**

PS1 | SESSION A			
Session chair	**Kiran Kumar N V P (VSSC ISRO)**		
Session co-chair(s)	**K. V. Subrahmanyam (SPL)**		
Serial No.	**Time (IST)**	**Title**	**Speaker (Affiliation)**

1	14:00-14:40	Assessment of mangroves from space	Gnanappazham L, (IIST)
2	14:40-15:00	Indian summer Monsoon: A combat between deep convection and the upper tropospheric humidity inferred	K. N. Uma, (SPL)
3	15:00-15:10	Simulation of impact of surface infrared heating on growth of the cloud	Subhrajit Rath, (NARL)
4	15:10-15:20	Improving InSAR based DEMs using Successive Best Pixel Selection approach for DEM fusion	PritiGirohi, (IIRS)
5	15:20-15:30	Numerical Study on the Impact of Cyclonic Storm Ockhi on Sea-breeze Circulation over the Arabian Sea	Freddy P Paul, (ISRO)
6	15:30-15:40	Mumbai monsoon – unravelling the morphology of clouds and microphysics of precipitation	Kaustav Chakravarty, (Indian Institute of Tropical Meteorology, Pune)
7	15:40-15:50	The role of bright band characteristics of stratiform rain on the altitudinal variation of raindrop	Lavanya S, (SPL)
8	15:50-16:00	Multicomponent multiphase model for stratification and compressibility of Earth's Atmosphere	Debojit Sarkar, (NARL)
Break (16:00 - 16:30)			
PS1 | SESSION B			
Session chair	**Kiran Kumar N V P (VSSC ISRO)**		
Session co-chair(s)	**Imran A. Girach (SPL)**		
9	16:30-16:50	Regional Distribution of Black Carbon Aerosols over India from Satellite (GOSAT-2 CAI-2) and Ground	Mukunda M Gogoi, (SPL)
10	16:50-17:00	Prediction of Atmospheric Water Vapour from Indian Navigation Data Using Deep Learning Techniques	Chandrani Chatterjee, (IIT Indore)
11	17:00-17:10	New insights into the asymmetries in the precipitation days during the Indian summer	Kandula V Subrahmanyam,

		monsoon and the	(SPL ISRO)
12	17:10-17:20	Role of circulation dynamics on cloud distribution over the Indian summer monsoon region	Prijith S. S., (SPL ISRO)
13	17:20-17:30	Estimation and validation study of Soil Moisture using GPS-IR technique over a tropical region: Vari	G. N. Madhavi, (NARL)
14	17:30-17:40	From Humidity to Precipitation: Observed Relations among the Hydrological Cycle Components	Edwin V Davis, (SPL ISRO)
15	17:40-17:50	Impact of Tropical Clouds on Atmospheric Heating: Estimations from Spaceborne Radar Observations	Aswathy R S, (University of Kerala)
16	17:50-18:00	Association of deep convective cloud cores with sea surface temperature over the tropical oceans	Sisma Samuel, (SPL ISRO)
17	18:00-18:10	Use of 53MHz Radar of Calcutta University to quantify the Lower Atmospheric Wind Characteristics	Debyendu Jana, (University of Calcutta)
18	18:10-18:20	Comparison of prediction models for time series forecasting over a tropical region	Arijit De, (DEMR, ONERA/ CNES)
19	18:20-18:30	Verification of mesoscale model prediction of Tropical Cyclones occurred over North Indian Ocean	Goriparthi Pavani, (NARL)

PLENARY SESSION 2

MIDDLE ATMOSPHERE, ATMOSPHERIC COUPLING, DYNAMICS AND CLIMATE CHANGE

Convenor	**Kishore Kumar K (SPL)**
Co - convenor	**Tarun Pant (SPL), Dr. D. BalaSubrahamanyam (SPL), NirvikarDashora (NARL)**

PS2 | SESSION A

Session chair	**Kishore Kumar K and Dr. D. BalaSubrahamanyam**

Serial No.	Time (IST)	Title	Speaker (Affiliation)

1	14:00-14:45	Space Weather Research from Space-based Platforms	D. Pallamraju, (PRL)
2	14:45-15:00	Equatorial upper mesospheric mean winds and tidal response to strong El Niño and La Niña	S. Sridharan, (National Atmospheric Research Laboratory, Gadanki)
3	15:00-15:15	New insights into the Mesospheric Quasi-biennial Oscillation: Observations and Model Simulations	K. Kishore Kumar, (SPL VSSC ISRO)
4	15:15-15:30	Study of long-term variability in the mesospheric mean winds observed by MF radar over Kolhapur	Gouri Prashant Naniwadear, (Shivaji University, Kolhapur)
5	15:30-15:45	Intraseasonal oscillations in the equatorial middle atmosphere	AmitavaGuharay, (PRL)
6	15:45-16:00	Long-term variability and tendencies in diurnal tide from WACCM6 simulations	K. Ramesh, (SPL VSSC ISRO)
Break (16:00 - 16:30)			
PS2 | SESSION B			
Session chair	**Kishore Kumar K and Dr. D. BalaSubrahamanyam**		
7	16:30-16:45	On the anomalous weakening of migrating diurnal tides in the mesosphere lower thermosphere	Prijith S. S., (SPL VSSC ISRO)
8	16:45-17:00	Initial observations of atmospheric ozone with NARL DIAL system	K. RaghuNath(National Atmospheric Research Laboratory, Gadanki)
9	17:00-17:15	Performance characteristics of Single cell Raman gas mixture for DIAL Ozone lidar	M Roja Raman (CRSG, Sathyabama Institute of Science and Technology, Chennai)
10	17:15-17:30	Hadley Cell Dynamics in IITM- Earth System Model: Evaluation using ERA-5 reanalysis	Sneha Susam Mathew, (SPL VSSC ISRO)
11	17:30-17:45	Influence of southern hemispheric upper troposphere PV intrusion events on the SWMR	M Sandhya, (Providence Women's College, Calicut)

12	17:45-18:00	An overview of the vertical distribution of the UTLS chemical composition over ASMA	Hemanth Kumar (National Atmospheric Research Laboratory, Gadanki)
13	18:00-18:15	Asian Summer Monsoon Anticyclone (ASMA) and its Variability	Sanjay Kumar Mehta, (SRM Institute of Science and Technology, Kattankulathur)
14	18:15-18:30	Defining the upper boundary of the Asian Tropopause Aerosol Layer (ATAL) using the Static Stability	Akhil Raj S T, (NARL, Gadanki)

PLENARY SESSION 3

SOLAR AND PLANETARY SCIENCES

Convenor	**Dipankar Banerjee (ARIES)**
Co - convenor	**Sankarasubramaniyan K (URSC), Satheesh Thampi (VSCC), Shyama Narendranath (URSC)**

PS3 | SESSION A

Session chair	**N V Rao (NARL)**
Session co-chair(s)	**Megha Bhatt (PRL)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00 - 14:45	Exploring the lunar neutral and plasma environment	M B Dhanya, (VSSC)
2	14:45 - 15:05	Understanding the M3 layer in the Martian dayside ionosphere using MAVEN observations	VrindaMukundan, (NCESS)
3	15:05 - 15:25	What controls V1 layer: A study using Akatsuki and Venus Express measurements and One dimensional Photochemical model	Ambili K M, (SPL ISRO)
4	15:25 - 15:45	The Martian dust cycle: Understanding dust devils	Varun Sheel, (PRL)
5	15:45 - 16:05	MOM and MAVEN Observations of the Effects of the 2018 Global Dust Event on the Martian Thermosphere	N V Rao, (NARL)

Break (16:05 - 16:30)			
PS3 | SESSION B			
Session chair	**Varun Sheel (PRL)**		
Session co-chair(s)	**Dr Rajesh V J (IIST)**		
6	16:30 - 16:50	Mapping global lunar elemental abundance: A systematic study of CLASS and M3 data	Megha Bhatt, (PRL)
7	16:50 - 17:10	Boulder Fall Ejecta on Mars: Present day activity	S. Vijayan, (PRL)
8	17:10 - 17:30	Potential role of water and debris-flows in gully formation on Mars	Rishitosh Kumar Sinha, (PRL)
9	17:30 - 17:50	Geological characterization of a floor-fractured crater in North-Central Arabia Terra, Mars: Implications for possible igneous processes in the earlier epochs	Alka Rani, (PRL)
10	17:50 - 18:10	Unravelling the complexities in central peak morphology of lunar complex craters: A global study	Roshan A. Shukla, (IIT Kanpur)
11	18:10 - 18:13	Evidence for fluvial activities in an impact crater in Ma'adimVallis region of Mars.	S Tuhi, (Anna University)
12	18:13 - 18:16	Latitudinal and Seasonal Asymmetries of the Helium bulge in the Martian Upper Atmosphere	Neha Gupta, (IIST)
13	18:16 - 18:19	SHARAD detection of extensive sedimentary deposition in unnamed crater near Mangala Fossa, Mars	Rajiv R. Bharti, (PRL)
14	18:19 - 18:22	Chemistry of water, nitrogenated and deuterated ions and escape rate of H2O on Mars	Siddhi Shah, (PRL)
15	18:22 - 18:25	Morphometric characterization of aeolian dominated landscape proximal to the landing site of Mars 2020 Perseverance rover in Jezero Crater, Mars.	Nitika Sachdeva, (Delhi Technological University)

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PLENARY SESSION 4 ASTRONOMY AND ASTROPHYSICS			
Convenor	**Santosh Vadawale (PRL)**		
Co - convenor	**Radhakrishna V (URSC), Ritaban Chatterjee (Presidency University), Mousumi Das (IIA)**		
PS4 | SESSION A			
Session chair	**RanjeevMisra (IUCAA)**		
Session co-chair(s)	**Anuj Nandi (URSC)**		
Serial No.	**Time (IST)**	**Title**	**Speaker (Affiliation)**
1	14:00 - 14:40	Exploring the X-ray Universe	Biswajit Paul, (RRI)
2	14:40 - 15:00	Probing the accretion flow properties of NS LMXB 4U 1608-52 using AstroSat observations	Biplob Sarkar, (Tezpur University)
3	15:00 - 15:20	Thermonuclear X-ray Bursts from Low-mass X-ray Binary 4U 1636-536 observed with AstroSat and NuSTAR	Pinaki Roy, (IISER Mohali)
4	15:20 - 15:40	An in-depth X-ray look at two magnetars: CXOU J010043.1–721134 and SGR J1935+2154	Rwitika Chatterjee, (URSC ISRO)
5	15:40 - 16:00	Effect of nuclear symmetry energy on neutron star properties	Vivek Baruha Thapa, (IIT Jodhpur)
Break (16:00 - 16:30)			
PS4 | SESSION B			
Session chair	**Indraneel Chattopadhyay (ARIES)**		
Session co-chair(s)	**M. C. Ramadevi (URSC)**		
6	16:30 - 16:50	Accretion flows around strongly magnetised neutron stars	Shilpa Sarkar, (ARIES)
7	16:50 - 17:10	The life cycle of magnetars: a novel approach to estimate their ages	Tushar Mondal, (ICTS)

8	17:10 - 17:30	AstroSat and NuSTAR view of GRS 1758-258 and 1E 1740- 2942:Evidence of Relativistic Disc Reflection	Bhuvana G.R, (Dayananda Sagar University)
9	17:30 - 17:50	Broadband X-ray Spectral and Temporal Properties of NGC 55 ULX1	Jithesh. V, (SARBTM Govt. College)
10	17:50 - 18:10	Spectral Investigation of Rapid Variability in Narrow-Line Seyfert 1 (NLS1) Galaxy NGC 4051	Neeraj Kumari, (PRL)
11	18:10 - 18:13	X-Ray Properties of TX Cnc, an Eclipsing Solar-Type Contact Binary of W Uma Type	Gurpreet Singh, (ARIES)
12	18:13 - 18:16	3D Simulation of Advective Thick Accretion Disk onto a non-rotating Black Hole	Sudip K Garain, (GITAM)
13	18:16 - 18:19	Discovery of dip in the RGS light curve of GX 13+1 with XMM-Newton	Rabindra Mahato, (Science College Kokrajhar)
14	18:19 - 18:22	Multi-mission probe into low luminosity phase of GRS 1915+105	Athulya Menon, (Dayananda Sagar University)
15	18:22 - 18:25	Broad-band studies of X-ray pulsar 1A 0535+262 during outburst in 2020 using the Chandra and NuSTAR	Manoj Mandal, (Midnapore City College)
16	18:25 - 18:28	Weak Correlation between the Accretion Disc and Jet Power in a Large Sample of Fermi Blazars	Garima Rajguru, (Presidency University)

PLENARY SESSION 5

ENABLING TECHNOLOGIES FOR SPACE EXPLORATION

Convenor	**Tirtha Pratim Das (ISRO HQ)**
Co-convenor	**N. Raghu Meetei (ISRO HQ), M Durga Rao (NARL), V. K. Rana (RRI)**

PS5 | SESSION A

Session chair	**V. K. Rana (RRI)**
Session co-chair(s)	**M Durga Rao (NARL)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)

1	14:00 - 14:45	Science in Space: Potential Science Experiments onboard Human Space Missions	N. Raghu Meetei, ISRO
2	14:50-14:52	Daksha: Design and performance of front end electronics	Shriharsh Tendulkar, TIFR
3	14:52-14:54	Artificial Intelligence (AI) in space exploration: an evolutionary opportunity	Prabhat Kumar, BHU
4	14:54-14:56	Comparison Of Solid And Hollow Cylindrical Antennas For Planetary Lightning Detection	Sonam Jitarwal, PRL
5	15:00-15:20	Spider Bio-mimetic Based Reconfigurable Planetary Rover	Kumar Harshit, ISRO
6	15:20-15:40	**Discussion Break**	
7	15:40-16:00	Adaptive hyperspectral imaging using structured illumination in a SLM-based interferometer	Amar Deo Chandra, CESSI
Break (16:00 - 16:30)			
PS5 | SESSION B			
Session chair	**M Durga Rao (NARL)**		
Session co-chair(s)	**V. K. Rana (RRI)**		
8	16:30-16:50	Development of miniaturized front-end electronics for a EUV photometer onboard future missions	Chandan Kumar, PRL
9	16:50-17:10	Crystal based focusing optics for high energy X-rays beyond 100 keV	Vineeth Valsan, Christ University
10	17:10-17:30	Object Detection in Space (ODiS)	Deepak Mishra, IIST
11	17:30-17:50	Space based system for remote sensing solar induced Fluorescence from vegetation - A proposal	Bhavani Kumar Yellapragada, NARL
12	17:50-18:10	Characterization of Silicon Photomultiplier (SiPM) for future Venus orbiter mission	Deepak Kumar Painkra, PRL
13	18:10-18:30	Enabling virtual reality technologies for teaching and training in space science	Sreehari VM, SASTRA Deemed University

DAY 4 : THURSDAY, 3 FEBRUARY, 2022

INTERDISCIPLINARY SESSION 2 : VISION FOR FUTURE SPACE SCIENCE MISSIONS

Session chair	G. C. Anupama (IIA)	
Time (IST)	**Title**	**Speaker (Affiliation)**
10:00 - 10:45	Astronomy from Space	Annapurni Subramanian (IIA)
10:45 - 11:30	Heliophysics Exploration Program	Sankar Subramaniam (ISRO)
11:30 – 12:00	Panel Discussion on Future Vision	G. C. Anupama (IIA)
12:00 - 13:00	Poster highlights from all plenary sessions	

Lunch Break (13:00 - 14:00)

PLENARY SESSION 1

SPACE BASED METEOROLOGY, OCEANOGRAPHY, GEOSPHERE-BIOSPHERE INTERACTIONS

Convenor	**M. Venkat Ratnam (NARL)**
Co - convenor	**D. Jagadheesha (ISRO), Sunil Kumar S V (VSSC), Kiran Kumar N V P (VSSC ISRO)**

PS1 | SESSION A

Session chair	D. Jagadheesha (ISRO)		
Session co-chair(s)	**Siji Kumar (SPL)**		
Serial No.	**Time (IST)**	**Title**	**Speaker (Affiliation)**
1	14:00-14:20	Long term variability in lightning occurrences over the Congo Basin Africa	Rohit Chakraborty, (IISc)
2	14:20-14:30	Spatio-temporal survey of mined land in North East India	D. Sai Sowjanya, (NESAC)
3	14:30-14:40	Google Earth Engine based approach for flood mapping of inland area using remote sensing data	Supriya Sharma, (IIRS)

4	14:40-14:50	Isolation, identification and characterization of thermophiles and halophiles from Ladakh.	Sahaj Bharindwal, (Amity centre of excellence in astrobiology at Amity University)
5	14:50-15:00	Planetary albedo decline interlinked with land cover modifications and near surface warming	S.V.S. Sai Krishna, (NRSC)
6	15:00-15:10	Understanding the vertical structure of clouds observed over a high altitude station of North East I	Arundhati Kundu, (NESAC)
7	15:10-15:20	Supervised Classification Approach for Differentiating Alpine Landcover Features of Sikkim Himalayas	Jumoni Boruah, (NESAC)
8	15:20-15:30	Effect of AOD to lightning Flash Rate and relation with NO2 over Kolkata, India	Arijit De, (DEMR, ONERA/ CNES)
Break (15:30 - 16:00)			
PS1 | SESSION B			
Session chair	**D. Jagadheesha (ISRO)**		
Session co-chair(s)	**S. S. Prijith (SPL)**		
9	16:00-16:03	Variation of Nitrogen Dioxide (NO2) over metropolitan areas of India	Vaibhav Trivedi, (St. Xavier's College, Ahmedabad)
10	16:03-16:06	Radiocarbon-based source characteristics of paddy-residue burning derived aerosols	M Devaprasad, (PRL)
11	16:06-16:09	Real-time measurements of NR- PM2.5 during Covid19 lockdown in Ahmedabad	Rohit Meena, (PRL)
12	16:09-16:12	Impact of Climate Change on Meteorological Parameters over Mountainous Region	Saurabh Verma, (IIRS)
13	16:12-16:15	Assessment of surface ozone at Dehradun: a valley site in Himalayan and its comparison with other ce	MahendarRajwar, (ARIES)

14	16:15-16:18	Observed climatology and trend in relative humidity, CAPE, and CIN over India	Imran Khan, (Department of Electronics and Communications Engineering)
15	16:18-16:21	An analysis of the Tropical Cyclones and Atlantic Hurricanes during 1979 to 2018 with the variation	Dhruba Banerjee, (Swami Vivekananda Institute of Science and Technology)
16	16:21-16:24	Sodar observations of wintertime sea breeze characteristics over Visakhapatnam	K. Jagadesh, (Sri Vasavi Engineering College, Tadepalligudem, Andhra Pradesh)
17	16:24-16:27	Integral turbulence statistics over Anantapur, a semi-arid location in peninsular India	Nagireddy Siva Kumar Reddy, (SPL)
18	16:27-16:30	Evaluation of similarity theory in wintertime surface layer over a coastal station Thumba	Nagireddy Siva Kumar Reddy, (SPL)
19	16:30-16:33	Thermodynamic structure of the Coastal Atmospheric Boundary Layer (CABL) during different sky condit	Sachin K Philip, (SRMIST)
20	16:33-16:36	GNSS-Reflectometry using NavIC-L5 signals for Earth Observation	Bushra Ansari, (IIT Delhi)
21	16:36-16:39	Application of GNSS water vapour for severe weather studies in Uttarakhand Himalaya	Tanmay Dhar, (Uttaranchal University)
22	16:39-16:42	Long-term investigations of AOD Observed from MERRA-2 reanalysis data Over Andhra Pradesh state in I	PelatiAlthaf, (KLEF)
23	16:42-16:45	Analysis of Multi-Layer Atmospheric Clouds over Ahmedabad	HarithasreeSreedevan, (PRL)
24	16:45-16:48	Simulation of specific cyclone cases in the Bay of Bengal through Regional Ocean Modeling System (RO	Tarumay Ghoshal, (DIT University)
25	16:48-16:51	ANN modeling for the dependency of seasonal long	Raj Kishore Tiwari, (Govt. Madhav SadashivraoGolvalkar

		range rainfall with climate parameters	college Rewa)
26	16:51-16:54	Verification of mesoscale model prediction of Tropical Cyclones occurred over North Indian Ocean	Nizy Mathew, (SPL)
27	16:54-16:57	Role of tropical cyclone in the redistribution of aerosols over Indian subcontinent	Betsy K B, (SRMIST)
28	16:57-17:00	The inter-seasonal variation of rainfall microphysics as observed over the urban city of Pune	AalishaLanjewar, (VIIT Pune)
29	17:00-17:03	The characteristic features of rainfall microphysics as observed over the orographic region	Kaustav Chakravarty, (IITM)
30	17:03-17:06	Quantification of absorbing aerosol types over the IGP region from AERONET: Comparison with models	Kamran Ansari, (PRL)
31	17:06-17:09	Statistical Relationship Between Atmospheric Parameters And Their Impacts On Climate Change	Sandra Vasudevan, (St. Joseph's college for women)
32	17:09-17:12	Altitudinal variation of raindrop size distribution over northern Indian ocean observed during ICARB	Dr. NVP Kiran Kumar, (ISRO)
33	17:12-17:15	Distribution of Particulate matters over Delhi during 2017-2019: Linkages to micro meteorology	Chetna, (University of Delhi)
34	17:15-17:18	Case studies of different types of Precipitation over Arctic	Saurabh Das, (IIT Indore)
35	17:18-17:21	Study of spatio-temporal variations in aerosol-cloud properties over Western India and Arabian Sea	Ruchita Shah Pandit, (Deendayal Energy University, Raisan)
36	17:21-17:24	Oxidative Potential and Risk Characterization of Heavy Metals in PM1 during Foggy and Non-Foggy at a	Isha Goyal, (Dayalbagh Educational Institute)
37	17:24-17:27	Atmospheric PM2.5 and NO2 concentration during lockdown & post-lockdown period in 5 Indian cities	Simran Bamola, (Dayalbagh Educational Institute)

38	17:27-17:30	Degradation of Air Quality of Delhi due to Crop Residue Burning in Haryana	Pallavi Saxena, DES, (Hindu College, University of Delhi)

PLENARY SESSION 2

MIDDLE ATMOSPHERE, ATMOSPHERIC COUPLING, DYNAMICS AND CLIMATE CHANGE

Convenor	**Kishore Kumar K (SPL)**
Co - convenor	**Tarun Pant (SPL), Dr. D. BalaSubrahamanyam (SPL), NirvikarDashora (NARL)**

PS2 | SESSION A

Session chair **Kishore Kumar K and Dr. D. BalaSubrahamanyam**

Serial No.	**Time (IST)**	**Title**	**Speaker (Affiliation)**
1	14:00-14:15	ARIES Wind Profiler: First Central Himalayan VHF ST Radar	Samaresh Bhattacharjee, (ARIES)
2	14:15-14:30	Atmospheric Investigations During COVID19 Pandemic	Som Kumar Sharma, (PRL)
3	14:30-14:45	Diagnosing the stratospheric water vapour to climate change	Siddarth Shankar Das, (SPL VSSC ISRO)
4	14:45-15:00	Effect of cirrus on the thermal structure of TTL inferred from MPL and Radiosonde observations	Saleem Ali, (SRM Institute of Science and Technology, Kattankulathur)
5	15:00-15:15	In situ observations of super-saturation and its association with cirrus clouds over Indian region	Maria Emmanuel, (SPL VSSC ISRO)
6	15:15-15:30	Cirrus Fraction and Cirrus Reflectance with Respect to Precipitation Characteristics Over Indian Sub-Continent.	Priya J S, (TKM College of Arts & Science, Karicode, Peroor, Kollam)
7	15:30-15:45	Characterising the layers of enhanced turbulence using VHF radar over central Himalayan site	Aditya Jaiswal, (ARIES)
8	15:45-16:00	A new approach to explore Hadley Cell Dynamics at regional	Anjana, (SPL VSSC ISRO)

		scales using Radio Occultation Technique	
Break (16:00 - 16:30)			
PS2 | SESSION B			
Session chair	**Kishore Kumar K and Dr. D. BalaSubrahamanyam**		
9	16:30-16:45	Balloon borne aerosol-cloud interaction studies (BACIS): New observational techniques to understand	Ravi Kiran V, (National Atmospheric Research Laboratory, Gadanki)
10	16:45-17:00	Long term changes in aerosol and its impact on cloud, temperature and rainfall over northeast monsoon region Chennai (12.82°N, 80.04°E)	Aravindhavel A, (SRM Institute of Science and Technology, Kattankulathur)
11	17:00-17:15	Aerosol-cloud-precipitation relationship under maritime and anthropogenic polluted conditions	Shivali Verma, (National Remote sensing Centre, Hyderabad)
12	17:15-17:30	Unraveling the characteristics of Atmospheric Boundary Layer over Ahmedabad	SouritaSaha, (PRL)
13	17:30-17:45	Atmospheric boundary layer height detection using the wavelet covariance transform	TV Ramesh Reddy, (SRM Institute of Science and Technology)
14	17:45-18:00	Variation of Surface Latent Heat Flux (SLHF) as observed during high magnitude earthquakes	Pooja Sharma, (Manav Rachna University ,Faridabad)
15	18:00-18:15	Impact of Covid-19 Lockdown on Land Surface Albedo (LSA) and associated climatic variables over metr	V Keerthi, (NRSC, ISRO)
16	18:15-18:30	Decadal changes in atmospheric methane emissions over the Eastern Himalayan region: source apportion	ArshiniSaikia, (Dibrugarh University)

PLENARY SESSION 3

SOLAR AND PLANETARY SCIENCES

Convenor	**Dipankar Banerjee (ARIES)**

Co - convenor	**Sankarasubramaniyan K (URSC), Satheesh Thampi (VSCC), Shyama Narendranath (URSC)**		
PS3 |SESSION A			
Session chair	**Ambili K M (SPL)**		
Session co-chair(s)	**BhalaShivaraman (PRL)**		
Serial No.	**Time (IST)**	**Title**	**Speaker (Affiliation)**
1	14:00 - 14:45	Exo-planetary atmospheres and their link to planetary formation	Liton Majumder, (NISER)
2	14:45 - 15:05	The effect of metallicity on the Atmospheric compositionof Exoplanets atmospheres	Vikas Soni, (PRL)
3	15:05 - 15:25	VUV spectra of Thermally Processed CS2 - NH3 Ice mixtures – Implications to icy solar system objects	Pavithraa Sundararajan, (PRL)
4	15:25 - 15:45	Investigation of polycyclic aromatic hydrocarbons (PAHs) on a sample of comets	Arijit Roy, (PRL)
5	15:45 - 16:05	Amino acids in astrochemical impact induced shock conditions: Implications to the origins of life	Surendra V Singh, (PRL)
Break (16:05 - 16:30)			
PS3 | SESSION B			
Session chair	**Deepak Dhingra (IIT Kanpur)**		
Session co-chair(s)	**Vijayan S (PRL)**		
6	16:30 - 16:50	Neon in Terrestrial planets	Satvika Jaiswal, (Banasthali)
7	16:50 - 17:10	Gas-phase Modeling of the Cometary Coma of the Interstellar Comet 2I/Borisov	Sana Ahmed, (PRL)
8	17:10 - 17:30	On fragmentation of long lasting overdense meteor trail echoes detected with Gadanki MST radar	K. Chenna Reddy, (Osmania University)

9	17:30 - 17:50	Diversity in Mineralogy of Mukundpura Meteorite	Dipak Kumar Panda, (PRL)
10	17:50 - 18:10	In-situ exploration of the lunar polar regions: A mission in study phase	S. Megala, (ISRO)
11	18:10 - 18:13	Studying the Properties of the Extra-solar Planet Atmospheres	MousamMaity, (Presidency University Kolkata)
12	18:13 - 18:16	Seasonal variation in the composition of Martian upper atmosphere	Koyena Das, (LATMOS, France)
13	18:16 - 18:19	Chemical weathering and laterization of Sivagangai formation, India A potential Mars analogue	K Vigneshwaran, (Government Arts College, Salem)
14	18:19 - 18:22	Early thermal evolution of Earth's embryos due to 26Al and impact-generated steam atmosphere	Gurpreet Kaur Bhatia, (Maharishi Markandeshwar)
15	18:22 - 18:25	Impact-induced deformation features from the target rocks of Ramgarh Crater, Rajasthan, India	Aneesh Kumar V, (University of Kerala)

PLENARY SESSION 4

ASTRONOMY AND ASTROPHYSICS

Convenor	**Santosh Vadawale (PRL)**
Co - convenor	**Radhakrishna V (URSC), Ritaban Chatterjee (Presidency University), Mousumi Das (IIA)**

PS4| SESSION A

Session chair	**Poonam Chandra (NCRA)**
Session co-chair(s)	**Vivek Agrawal (URSC)**

Serial No.	**Time (IST)**	**Title**	**Speaker (Affiliation)**
1	14:00 - 14:40	Hunting for Gravitational Waves from Ground and Space	Sanjit Mitra, (IUCAA)
2	14:40 - 15:00	Black hole mass dichotomy in barred and unbarred galaxies of IllustrisTNG-100 simulations.	Sandeep Kumar Kataria, (SJTU Shanghai)
3	15:00 - 15:15	Classification conundrum in Gamma Ray Bursts: Signatures of collapsars in high redshift short GRBs	Dimple, (ARIES)

4	15:15 - 15:30	Properties of high-redshift starburst galaxies and their local analogs contributing to reionization	Abhishek Paswan, (IIA)
5	15:30 - 15:45	Our peculiar motion from Hubble diagram of SNeIa and implications for Cosmological Principle	Ashok Kumar Singal, (PRL)
6	15:45 - 16:00	Dynamical conditions and causal transport of spherical collapse in f(R,T) gravity	Sarbari Guha, (St. Xavier's College Autonomous Kolkata)
Break (16:00 - 16:30)			
PS4 | SESSION B			
Session chair	**Harvinder Kaur Jassal (IISER Mohali)**		
Session co-chair(s)	**Kuntal Mishra (ARIES)**		
7	16:30 - 16:50	Probing the nature of Luminous blue variables	Yogesh Joshi, (ARIES)
8	16:50 - 17:10	TESS Observations of TX Col: Rapidly Varying Accretion Flow	Dr. J. C. Pandey, (ARIES)
9	17:10 - 17:30	Investigation of Rocket Effect in Bright-Rimmed Clouds using Gaia EDR3	PiyaliSaha, (IIA)
10	17:30 - 17:50	Abundance analysis, production sites and ages of r-process enhanced stars using GTC	Pallavi Saraf, (IIA)
11	17:50 - 18:10	An extremely metal-poor star, contaminated with products of both i- and s-process nucleosynthesis	ParthaPratim Goswami, (IIA)
12	18:10 -18:13	Image Improvement and Restoration in Optical Time Series	Yash Gondhalekar, (BITS Pilani)
13	18:13 - 18:16	Efficient Modeling of Cosmic Reionization using SCRIPT	BarunMaity, (NCRA-TIFR)
14	18:16 - 18:19	Density perturbation and cosmological evolution in the presence of magnetic field in f(R) gravity	Samarjit Chakraborty, (St. Xavier's College Autonomous Kolkata)
15	18:19 - 18:22	Search for merger ejecta emission in Short Gamma Ray Bursts from very late time radio observations	Ankur Ghosh, (ARIES)

16	18:22 - 18:25	uGMRT study of ELAIS-N1 field: the radio-IR relations up to z~2	Akriti Sinha, (IIT Indore)
17	18:25 - 18:28	A Radio and X-ray view of merging cluster A1351	Swarna Chatterjee, (IIT Indore)

PLENARY SESSION 5

ENABLING TECHNOLOGIES FOR SPACE EXPLORATION

Convenor	**Tirtha Pratim Das (ISRO HQ)**
Co-convenor	**N. Raghu Meetei (ISRO HQ), M Durga Rao (NARL), V. K. Rana (RRI)**

PS5 | SESSION A

Session chair	**N. Raghu Meetei (ISRO HQ)**
Session co-chair(s)	**M Durga Rao (NARL)**

Serial No.	Time (IST)	Title	Speaker (Affiliation)
1	14:00 - 14:45	In-Situ Resource Utilisation (ISRU) for Moon and Mars Missions	P. Ganesh, ISRO Propulsion Complex, Mahendragiri
2	14:50-14:52	#RADatHomeIndia 9 years of Indian citizen science research in astronomy	Ananda Hota, RAD@home
3	14:52-14:54	Design and Development of Laboratory-Based Microgravity Experimental Setup	Jaya Krishna Meka, PRL
4	14:54-14:56	Development of Spectrograph in FUV region for a possible ISRO flight	Ghatul Shubham Jankiram, IIA
5	14:56-14:58	Space Exploration using Artificial Intelligence for Human Health	Akhilesh Kumar, BHU
6	15:00-15:20	Development of Position Sensitive Sub-MeV Detectors for Daksha Mission	Mithun N. P. S., PRL
7	15:20-15:40	Optical Design of the Infrared Spectroscopic Imaging Survey (IRSIS) Satellite Payload	Satheesha S. Poojary, TIFR

8	15:40-16:00	The Direction of Arrival with Orthogonally Co-located Dipole Antenna for SEAMS	Harsha A. Tanti, IITI
Short break (16:00 - 16:05)			
PS5 | SESSION B			
Session chair	**N. Raghu Meetei (ISRO HQ)**		
Session co-chair(s)	**V. K. Rana (RRI)**		
9	16:05 - 16:50	Humanoid Robots for Space Exploration	Sangeetha G R, VSSC ISRO
10	16:50-17:10	Design and Deployment of Medium Volume Aerostat to Provide Wi-Fi Communication at Remote Sites	Stalin Peter Godi, TIFR
11	17:10-17:30	Effect of microgravity on the growth of Stevia rebaudiana callus: Preflight development	Abigail Fernandes, Amity University Mumbai
12	17:30-17:50	Autonomous Life Growth Experiment–1 (ALGE-1): effect of microgravity on the growth of Stratospheric and non- stratospheric bacterial isolates	Shreya Fadanavis, Amity University Mumbai
13	17:50-18:10	Development of object visibility tool for the SING payload	Shanti Prabha, IIA
14	18:10-18:30	Commercialisation of Enabling Technologies for Space Exploration:Legal Vision with Reference to India	Dr. Malay Adhikari, Amity University, Kolkata

DAY 5 : FRIDAY, 4 FEBRUARY, 2022		
PUBLIC OUTREACH EVENTS AND INTERACTION WITH SCIENCE COMMUNICATORS (10:00 - 12:00)		
Session chair	**Niruj Mohan Ramanujam (Co-Chair, Outreach Committee, IIA)**	
Time (IST)	**Title**	**Speaker**
10:00 - 10:15	Overview of symposium associated public engagement events	S. Seetha (Chairperson, Outreach Committee, RRI)
10:15 - 10:45	Prize distribution ceremony for Quiz, Poster and Outreach Video competitions	Guests of Honour: Competition Judges
10:45 - 11:30	Showcase of winning science communication entries	
11:30 - 12:00	Interaction with students, public and science communicators	
CLOSING CEREMONY(12:00 - 12:30)		
Moderator	**V. Girish (Deputy Director, SPO, ISRO HQ)**	
Time (IST)	**Title**	**Speaker (Affiliation)**
12:00 - 12:10	Report on symposium activities and future outreach events	Dibyendu Nandi (Chairperson, Local Organizing Committee, IISER Kolkata)
12:10 - 12:15	Closing remarks	A S Kiran Kumar (Chairman, National Organizing Committee)
12:15 - 12:20	Open mike and remarks, if any, by attendees	
12:20 - 12:30	Vote of Thanks	V. Girish (Deputy Director, SPO, ISRO HQ)
END OF CLOSING CEREMONY		

Symposium Details

Host

1. Center of Excellence in Space Sciences India
2. Indian Institute of Science Education and Research Kolkata

Sponsoring Organisations

1. Indian Space Research Organization, Department of Space
2. Indian Institute of Science Education and Research Kolkata
3. S. N. Bose National Centre for Basic Sciences, Kolkata

Outreach Partners

1. Science City, National Council of Science Museums, Kolkata
2. M. P. Birla Planetarium, Kolkata
3. Indian Institute of Astrophysics, Bangalore
4. Paschim Banga Vigyan Mancha
5. Presidency University, Kolkata
6. St. Xavier's College, Kolkata
7. Calcutta University

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4. Anil Bhardwaj, *Director, PRL*
5. Annapurni Subramaniam, *Director, IIA*
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7. A K. Patra, *Director, NARL*
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13. Chitradeep Saha, *IISER Kolkata*
14. Souvik Roy, *IISER Kolkata*
15. Suvadip Sinha, *IISER Kolkata*

Invited Speakers

Climate Change: An Indian perspective

M Rajeevan[1]

[1]Ministry of Earth Sciences

Changes in Earth's climate system can occur due to natural variability, and anthropogenic activities. Since 1950s, due to industrial revolution and other anthropogenic activities like land use and deforestation, concentration of greenhouse gases in the atmosphere has been increasing appreciably. The increase in greenhouse gases ultimately leads to changes in the mean and variability of the climate system. Associated with these changes, an increase in extreme weather and climate events and associated damages and casualties are expected.

For the first time, Ministry of Earth Sciences (MoES) has recently brought out, the National Climate Change Assessment Report. This reports deals with basics of climate system, observed climate change over the Indian region and what are the changes expected in future for different scenarios using state of the art Earth System models. In this invited lecture, I would be discussing the salient aspects of the report and what are its implications on different sectors like agriculture, water resources, health, Energy etc. In the lecture, the important role of space based earth observations will be discussed.

Presentation Mode: Oral, **Popular Science Lecture**

Presenting Author: M Rajeevan

Registration ID: NSSS-20211216125447

Science Highlights of the AstroSat Mission

Dipankar Bhattacharya[1]

[1]IUCAA

India's first dedicated space astronomy observatory, the AstroSat mission, has now completed over six successful years in orbit. The mission is still actively gathering astronomical data. This is a proposal-driven observatory operating in Ultraviolet to Hard X-ray bands using five different scientific payloads. So far the observatory has carried out over 2400 pointed observations and, in addition, has detected nearly 500 transient events. The science results span a wide variety - from solar system objects to distant galaxies, from compact stars to diffuse gas. Over 200 scientific publications and more than 450 circulars and notices have resulted from this mission till now, and this number is increasing rapidly. Much of the data acquired by AstroSat are publicly available and are being used for scientific investigations by a wide, international community. In this talk some of the highlights of the science results obtained by the mission will be presented.

Presentation Mode: Oral, **Interdisciplinary Session 1**

Presenting Author: Dipankar Bhattacharya

Registration ID: NSSS-20220112065904

Science from the Chandrayaan-2 and Mars Orbiter Mission

Anil Bhardwaj[1]

[1]PRL

The planetary exploration program in India started in the new millennium with the launch of Chandrayaan-1 orbiter mission to the Moon in 2008, which was a highly successful and celebrated mission since it discovered water on the Moon. The next Indian planetary mission was to Mars: the Mars Orbiter Mission (MOM), launched in November 2013 and arriving on Mars in September 2014. The MOM planned for 6-month lifetime, is still working after more than 7-years in Martian orbit with five science experiments onboard. The MOM placed India on a unique pedestal - being the first country in the world to have a successful insertion of an orbiter around the Mars in the first attempt. The second India mission to Moon is the ongoing Chandrayaan-2 mission; the orbiter is working well and providing high-quality science data. India will be launching soon the Chandrayaan-3 Lander-Rover mission to study the Moon in-situ. This talk will briefly discuss the Indian planetary missions, related challenges, and highlight the science derived from them, focusing mainly on the MOM and Chandrayaan-2 mission.

Presentation Mode: Oral, **Interdisciplinary Session 1**

Presenting Author: Dr. Anil Bhardwaj

Registration ID: NSSS-20211228112651

Astronomy from space

Annapurni Subramaniam[1]

[1]IIA

Astronomical studies in pursuit of understanding our universe are being carried out using the ground as well as space based experiments. There have been various international space missions that contributed to the multi-wavelength studies of various astrophysical phenomena in the past. India's first space observatory, AstroSat has got significant attention in the international scene with its wide-ranging scientific output. In this talk, I will summarise the current and the future landscape of space astronomy in the Indian and international scene. I will discuss the topical areas and science questions that are being prioritised internationally for the next decade, and how these can be accomplished by the planned missions. I shall also share my thoughts on possible areas where India's future missions can make an impact.

Presentation Mode: Oral, **Interdisciplinary Session 2**

Presenting Author: Annapurni Subramaniam

Registration ID: NSSS-20220109044810

Heliospheric Exploration

Sankarasubramanian, K[1]

[1]U R Rao Satellite Centre, ISRO

Heliosphere is a region influenced by Sun. It is considered as outermost atmospheric layer of the Sun and its the region influenced by solar wind before interstellar plasma start to dominate. Exploration of Heliosphere started as early as 20th century and with opportunities in space, this field has grown over the last two decades. Currently, there are missions sampling the heliosphere closer to the Sun and also all the way up to Heliopause. Newer and exciting first time observations are carried out recently both in the inner heliosphere as well as outer heliosphere. This presentation will cover the recent understanding of the heliosphere from these observations focusing mostly on the inner heliosphere where plenty of observations exist. The upcoming inner heliospheric missions and its exploration capabilities will also be discussed and will conclude with the thoughts of possible future direction including outer heliospheric exploration.

Presentation Mode: Oral, **Interdisciplinary Session 2**

Presenting Author: Sankarasubramanian K

Registration ID: NSSS-20220113034553

Equatorial ionospheric research relevant to navigation/communication applications- current status and way forward

Amit Kumar Patra[1]

[1]National Atmospheric Research Laboratory

Equatorial ionosphere has been a subject of intense investigation due to its impact on satellite based communication/navigation, HF communication and Over-The-Horizon radar applications. While the basic processes responsible for the ionospheric variations are fairly well understood, forecasting the equatorial ionosphere still remains a challenging task. The greatest challenge is the forecasting the occurrence of equatorial plasma bubble and the vigour of plasma depletion and irregularities, which are highly detrimental for satellite based communication/navigation applications. This presentation aims to provide an account of the equatorial ionospheric variabilities and plasma irregularities with emphasis on the recent progress in forecasting the ambient ionosphere and equatorial plasma bubble. The presentation also discusses on a new HF radio experiment as a way forward to improve the forecast strategy.

Presentation Mode: Oral, **Interdisciplinary Session 3**

Presenting Author: Amit Kumar Patra

Registration ID: NSSS-20220110101131

Hydrated moon : New findings through remote sensing

Prakash Chauhan[1]

[1]IISR

Scientific exploration of planets and their satellites provide significant insight into the various processes operating over their surfaces and surrounding environment. Indian planetary exploration programme gained momentum with the launch of Chandrayaan-1 in 2008, the first spacecraft from India to go around Moon. In addition to strengthening the satellite develop, design, operation and control technology it also provided significant data by remotely exploring its surface and environment that led to many new discoveries related to mineralogy, surface processes and presence of volatiles on lunar surface. Successful launch of Chandrayaan-2 in 2019 with its orbiter still providing excellent data in different part of electromagnetic spectrum relating to lunar geology, mineralogy, and volatile detection. The Moon with its airless surface, short-lived geological activity, origin related to Earth provide huge opportunities to explore its surface to study and examine the solar-terrestrial processes and understand the geological evolution of terrestrial planets, especially our Earth. Chandrayaan-1 has to its credit some important discoveries that includes finding of water signature, detection of spinel, lunar lava tubes, evidences of recent volcanism, impact-triggered boulder movements etc. on the surface of Moon.

Presentation Mode: Oral, **Interdisciplinary Session 3**

Presenting Author: Prakash Chauhan

Registration ID: NSSS-20220118073323

Remote Sensing for Ecology, Conservation and Human Sustainability

Harini Nagendra[1]

[1]Azim Premji University

Since at least the 1970s, satellite remote sensing has emerged as a powerful tool for research on global environmental change. A major focus of remote sensing studies has historically been to understand, map and quantify changes in land cover such as deforestation, agricultural expansion, and urbanization. In more recent decades, remote sensing has also been extensively integrated with social science research using a "people and pixels" approach, to study the social and institutional conditions that facilitate ecological and environmental protection, and human sustainability. Drawing on three decades of remote sensing research, this presentation will discuss how to integrate remote sensing information with field observations to understand the anthropogenic processes driving changes in ecology and conservation in different regions of the tropics. The interdisciplinary approaches used illustrate how complex questions that impact human sustainability can be addressed by combining approaches from the social and natural sciences. The presentation ends with a discussion of how the availability of big data, cloud computing capacities and advances in artificial intelligence can open up new frontiers for remote sensing.

Presentation Mode: Oral, **Interdisciplinary Session 3**

Presenting Author: Harini Nagendra

Registration ID: NSSS-20220103020030

Modeling Climate Change

Krishna AchutaRao[1]

[1]Indian Institute of Technology Delhi

Climate models are indispensable tools in the study of climate change. Models have been used to understand changes in the past and project changes that may occur in the future. From the early climate models in the 1980s to the present day, models have increased in complexity of processes that are represented and the resolution at which they represent them. State of the art Earth System Models (ESMs) can simulate changes to the Earth's climate under various scenarios of socio-economic changes that are vital to actions for mitigating future climate change. However, many gaps still remain as far as our understanding of climate change is concerned – especially at the regional scale. This talk will examine the current state of climate models and touch upon remaining challenges of particular importance to India.

Presentation Mode: Oral, **Interdisciplinary Session 4**

Presenting Author: Krishna AchutaRao

Registration ID: NSSS-20220113100633

Space Weather: Predicting our Space Environment

Dibyendu Nandy[1], Arnab Basak[1], Lekshmi, B.[1], Prantika Bhowmik[1], Soumyaranjan Dash[1], Om Gupta[1], Sanchita Pal[1], Souvik Roy[1], Vishal Singh[1], Suvadip Sinha[1]

[1]Center of Excellence in Space Sciences India, IISER Kolkata

Space weather refers to the changing electromagnetic, particulate and magnetic environment in space governed by the dynamic activity of the Sun. While slow variations in the Sun's plasma wind and radiative output impacts planetary atmospheres and climate, rapid energetic events such as solar flares and coronal mass ejections impact planetary technologies such as satellite operations, telecommunications, navigational networks, electric power grids, air-traffic on polar routes. Solar energetic events are also hazardous to human spaceflight program. Developed nations with significant investments in space-reliant technologies have therefore evolved programs to assess and predict space weather in order to mitigate its adverse effects. In this talk, we shall highlight the comprehensive space weather prediction program being developed at the Center of Excellence in Space Sciences India at IISER Kolkata. The development of these indigenous space weather prediction capabilities relies on a synergy of techniques including satellite data analysis, computational modelling, machine learning and artificial intelligence approaches and is driven by the desire to make India self-reliant in understanding and forecasting our space environment.

Presentation Mode: Oral, **Interdisciplinary Session 4**

Presenting Author: Dibyendu Nandy

Registration ID: NSSS-20220110074007

Exploring New Worlds beyond the Solar System

T. Sivarani[1]

[1]Indian Institute of Astrophysics

We have progressed a long way since the first discovered extrasolar planet by Mayor and Queloz in 1995. There are more than 4000 exoplanets known currently, and most of them do not resemble our Solar System planets. The dominant exoplanet populations are the super-Earths and mini-Neptunes. The current focus in this field is to discover and characterize Earth-like habitable-zone distant worlds and detect biosignatures in their atmospheres. The talk will present the landscape of exoplanet studies and the concerted effort from various science areas to reach the above goals. We will also discuss the synergy between space-based and ground-based observational facilities for exoplanet studies. We summarise the current endeavors in the country in this area.

Presentation Mode: Oral, **Interdisciplinary Session 4**

Presenting Author: T. Sivarani

Registration ID: NSSS-20220113041436

Aerosol Radiative Forcing over India from Space and ground based observations

S. Suresh Babu[1]

[1]ISRO, VSSC, Space Physics Laboratory

Aerosols affects the radiation balance of the earth – atmosphere system through direct (scattering and absorption) and indirect (modifying the cloud properties) radiative forcing and alter regional and global climate. However, scientific understanding of the various processes responsible for the climate impact of aerosols were limited, especially over South Asian region. For the systematic characterization of the spatio-temporal properties of atmospheric aerosols, their optical and microphysical properties over the Indian region and assessing their implications for radiation balance and climate forcing, Aerosol Radiative Forcing over India (ARFI) project was formulated by ISRO. Currently, ISRO maintains the largest network of aerosol observatories (ARFINET) over India covering distinct landmass regions in India and marine regions around it. Besides this, several multi- platform field campaigns were conducted onboard research ship, aircraft and high-altitude balloons. Combining the ground-based observations with satellite data, ARFI Project of ISRO -GBP has bought out several interesting results which improved our understanding of the climate impact of atmospheric aerosols over South Asia in general and India in particular. This invited talk highlights the major scientific results from the ARFI Project.

Presentation Mode: Oral, **Plenary Session 1**

Presenting Author: S Suresh Babu

Registration ID: NSSS-20220110093313

Features of lower atmospheric winds and ionospheric Field-Aligned Irregularities observed using Univ

Ashik Paul[1]

[1]University of Calcutta

The region around the north-eastern part of Bay of Bengal adjoining the Indo-Gangetic Plain presents some relatively unexplored phenomena which are believed to influence regional weather pattern. This region around the northern crest of the Equatorial Ionization Anomaly (EIA) is also the seat of some of the most intense ionospheric irregularities. Coupled with the long tradition of upper atmospheric research and seminal contribution made by University of Calcutta in this field makes this an important location for studying atmospheric dynamics and coupling processes. With this objective, University of Calcutta is implementing a Stratosphere Troposphere (ST) Radar at Ionosphere Field Station, Haringhata (22.93N, 88.5E; magnetic dip:35N) of the University. Two components of horizontal winds (zonal and meridional) measured by the Pilot version of this radar have been validated with 90 collocated simultaneous balloon-borne radiosonde observations during July and August 2019. A good correlation of the order of 90-99% and 75-95% up to 8km has been observed between the radar and radiosonde measured zonal and meridional winds respectively. These results are unique being some of the first to be reported from this new radar facility located in the transition region from the tropics to the sub-tropics. Ionospheric backscatter echoes of Field-Aligned Irregularities (FAIs) observed from this location are mostly found to occur in the form of descending echoing region that includes continuous, quasi periodic and discrete patches of echoes. The FAI echoes display large day-to-day variations and tend to occur more during the morning (06–09IST) and evening (18–21IST). These characteristics are very similar to those of off-equatorial low latitudes and mid-latitudes and reveals remarkable difference with the Gadanki radar in the echo occurrence, day-to-day variability and Doppler velocity, in spite of the small difference in ionospheric pierce points between these two stations.

Presentation Mode: Oral, **Plenary Session 2**

Presenting Author: Ashik Paul

Registration ID: NSSS-20211225045620

Observing Solar Activity from Ground and Space

Nandita Srivastava[1]

[1]Udaipur Solar Observatory, Physical Research Laboratory

Monitoring solar activity is an important task for understanding the physics of the sun and also for space weather research. Major space weather disturbances at Earth have their origin in energetic phenomena from the Sun in the form of solar flares, coronal mass ejections (CMEs) and solar energetic particles. In this talk, I will discuss the importance of coordinated observations of solar activity both from ground-based and space-based instruments.

The ground based observations of the Sun have been traditionally obtained in the visible range of the spectrum, mostly in H-alpha which enables us to track and study the evolution of sunspots, filaments, filament eruptions, and Moreton waves. The routine monitoring of the Sun is crucial to identify the source regions of CMEs which helps us to understand their initiation. Once the CMEs are launched, the associated shocks and bursts in the radio wavelengths observed from the ground are also helpful in understanding the physics of flare/CME relationship. More recently, the studies of CME evolution and propagation in the heliosphere, became possible through space-based observations particularly with the advent of coronagraphs and Heliospheric imagers. Also, the in-situ osbervations made using space-based instruments to monitor the impact of CMEs at L1 point and subsequently at the Earth using ground-based magnetometers are being routinely used for cradle-to-grave studies of the geoeffective events. Thus, almost the entire wavelength range is available to solar observers. It is obvious, that joint observations of the Sun from ground and from space in a wavelength regime which are inaccessible from ground offer an enormous potential for expanding our understanding of solar activity and space weather.

Presentation Mode: Oral, **Plenary Session 3**

Presenting Author: Nandita Srivastava

Registration ID: NSSS-20220110075331

Future Vision for Astronomy and Astrophysics in India

G.C. Anupama[1]

[1]IIA

Astronomy & Astrophysics research in India covers a wide range of topics from understanding various details of the nearest star, our Sun, to the origin and evolution of the Universe. Significant contributions have been made by Indian astronomers in theoretical studies of black holes, gravitational waves, the cosmic microwave background and the large scale structure of the Universe. The latter half of the last century saw the establishment of new observatories and development of facilities in optical, near-IR and radio regions. Utilisation of these facilities, as well as data from international facilities has enabled significant research in the areas of exoplanets, stellar abundances, star formation in the MilkyWay and other galaxies, star clusters, pulsars and compact objects, active galactic nuclei, structure and evolution of galaxies, clusters of galaxies, activity in stars and galaxies and transients such as novae, supernovae, gamma-ray burst sources and gravitational wave sources. Today, India is a partner in several international mega projects such as the Thirty Meter Telescope, the Square Kilometer Arrary and the LIGO. It is the right moment for us to gather our thoughts on the directions to be taken in the future so that we remain globally competitive. In this talk I will present the ongoing efforts of the astronomy community in the development of a vision document for the next decade or so. Some key science questions to be addressed and the facilities required to address them will be discussed.

Presentation Mode: Oral, **Plenary Session 4**

Presenting Author: G.C. Anupama

Registration ID: NSSS-20220112101841

Science Experiments with PSLV Stage-4 (PS4) Orbital Platform

K. Rajeev[1]

[1]Space Physics Laboratory, Vikram Sarabhai Space Centre, ISRO

Indian Space Research Organisation (ISRO) has realized an innovative idea of converting the spent 4th stage of India's versatile rocket PSLV (PS4) to an orbital platform which can be used for conducting space-borne scientific experiments up to 6 months. The PS4 platform has several features required for a variety of in-orbit experiments including orbit manoeuvring, stabilisation, standard interfaces, power, telemetry and tale-command. It can be used to carryout experiments of various nature, including atmospheric and space science experiments, microgravity experiments, robotic arm demonstration and small satellites technology development. Through the announcement of opportunity, ISRO has offered it to the scientific community to effectively design, develop and execute space-borne experiments, which otherwise is a rather sparse and costly affair. This lecture will present the potential of PS4 orbital platform for science experiments of various nature and highlight the scientific experiments conducted on-board PS4 and a cross-section of the experiments proposed in future missions.

Presentation Mode: Oral, **Plenary Session 5**

Presenting Author: K. Rajeev

Registration ID: NSSS-20220104012617

Exploring the Oceans from Ground and Space

Sunil Kumar Singh[1]

[1]CSIR-National Institute of Oceanography

The ocean dominates Earth's surface and impart great influence on humans by regulating Earth's climate, the hydrological cycle, Earth's biodiversity, food and mineral resources, safeguarding national defence, providing inexpensive means of transportation and providing ultimate shelter for the waste products human generates. The global ocean needs to be studied in great detail to better understand its role in controlling global biogeochemical, hydrological, and climate processes. The role of ocean circulation and the coupling of the ocean and atmosphere are basic to understanding Earth's changing climate. Further, the anthropogenic activities alter the chemical composition of the ocean and atmosphere and impact the biological composition of Earth. To understand the large-scale oceanographic processes and their interaction with atmosphere, a global and synoptic observations with high temporal and spatial resolutions are required. A spatial resolution from meters to kms on a synoptic scale of 100 km to 10000 km with a temporal repeatability minutes to months are required. Such high-resolution global coverages will not be possible to manage with the traditional ship-based observations. Even in-situ sensors will not be able to cater the need of the hour. Such high-end study can only be possible by space-based observations with help of remote sensing. The use of space satellite data for ocean observations allows marine scientists to view biological, chemical, and physical interactions within the oceans on regional and global scales. Such observation allows us to measure a range of oceanic parameters in a synoptic and recurrent manner not possible with in-situ observations. They are useful in applications from the coastal/local/regional scale to the large/global.

My talk will highlight some of these issues and the urgent need of space based large-scale observations in the Indian Ocean.

Presentation Mode: Oral, **Plenary Session 1**

Presenting Author: Sunil Kumar Singh

Registration ID: NSSS-20220118113951

Radio studies of the dynamic solar corona

Divya Oberoi[1], Present and past members of NCRA solar physics group

[1]NCRA-TIFR

The solar atmosphere and the corona are coupled to solar interior via the all permeating magnetic fields. The phenonmena related to these magnetic fields are the underlying cause of all variations observed in solar radio emissions from time scales spanning solar cycles to micro-seconds. In addition to the temporal variability, the coronal radio emissions also show a large variety of spectral structures. The spectrally smooth and slowly varying thermal bremsstrahlung background forms the background metrewave radio emission from the MK corona. Superposed on it are a diverse variety of non-thermal emissions spanning large ranges in brightness temeratures - 10^4 K for gyrosynchroton emissions from the energetic electrons in the Coronal Mass Ejection (CME) plasma to 10^15 K for the so called type III solar radio bursts. Due to the nature of emission mechanisms involved, the information provided by radio emissions is complementary to that from most other wave bands. Additionally, unlike high energy bands, radio observables are sensitive to magnetic fields. However, the variation in structures at small temporal and spectral scales have long posed a challenge for solar radio imaging. Only recently, the march of technology has enabled instruments which can provide the snapshot spectroscopic imaging with high imaging dynamic range and fidelity and the challenge has shifted to building software pipelines capable of extracting the relevant information from the truly voluminous data. Our group has implemented unsupervised imaging pipeline capable of providing high dynamic range and fidelity full Stokes images. These polarimetric images represent the state-of-the-art and have opened up interesting parts of exploration phase space which had remained inaccessible. This talk will present an overview of the role modern radio observations in solar physics using examples of work by our group, synergies with the upcoming Aditya-L1 mission and aspects of Space Weather.

Presentation Mode: Oral, **Plenary Session 3**

Presenting Author: Divya Oberoi

Registration ID: NSSS-20220110041050

The Emerging field of Sub-mm Astronomy

Bhaswati Mookerjea[1]

[1]TIFR, Mumbai

The sub-millimeter (sub-mm) sky is a unique window for probing the architecture of the Universe and structures within it. This is because the cold component of the Universe emits predominantly at sub-mm wavelengths through the continuum emission of dust (refractory molecules) and the spectral lines of molecular gas. From the discovery of dusty sub-mm galaxies, to the ringed nature of protostellar disks, our understanding of the formation, destruction, and evolution of objects in the Universe requires a comprehensive view of the sub-mm sky.

In this talk, I will review the existing and upcoming sub-millimeter facilities and will also motivate the need for medium-sized mm/sub-mm telescopes that are capable of observing large areas of the sky in a reasonable time. These moderate resolution telescopes are valuable for exploration and identification of interesting regions in the sub-mm sky which can be followed up with high angular resolution telescopes/interferometers.

Presentation Mode: Oral, **Plenary Session 4**

Presenting Author: Bhaswati Mookerjea

Registration ID: NSSS-20211230041336

Scientific Instrumentation for Space Missions

Tirtha Pratim Das[1]

[1]ISRO

Scientific instrumentation for onboard applications is a different ball game as compared with ground-based instrumentation. It is even more complex when it comes to the development of sensitive scientific payloads that are supposed to work in deep space. Development and qualification of such grades of scientific instruments necessitate following a set of protocols and guidelines for ensuring their reliability in the harsh space environment. In this lecture, the guidelines, norms, protocols, and challenges for developing scientific instruments for space exploration will be covered.

Presentation Mode: Oral, **Plenary Session 5**

Presenting Author: Dr. Tirtha Pratim Das

Registration ID: NSSS-20211224050009

Assessment of Mangroves from Space

L Gnanappazham[1], K Arun Prasad[1], V K Dadhwal[1]

[1]IIST

Mangroves are biologically important and productive ecosystems endowed with diverse flora and fauna providing economic and ecological services to the coastal community. Mangroves are distributed along the sedimentary tropical coastlines between 30_N and 30_S latitudes of over 123 nations covering an area of around 0.15 million sq.km. World's largest mangrove ecosystem, Sundarbans is located in the extensive deltaic region shared by India and Bangladesh. The region is characterized by flat terrain formed from the sedimentation of an intricate system of rivers such as the Ganges, Brahmaputra, Meghna, and many other tidal channels. However, mangroves face threats from both anthropogenic and natural hazards. Assessment and monitoring of this critical and vulnerable habitat of the coastal ecosystem could play a major role in implementing conservation and management plan compatible with Sustainable Development Goals (SDGs). Mangroves by their geographic confinement in coastal/marshy areas are difficult to conduct field survey for their assessment and monitoring thus RS & GIS tools paved way to overcome such constraints. Developments in the field of remote sensing and Geographic Information System (GIS) in the last few decades have made a hassle free field surveys in the process of assessing various attributes of mangrove ecosystem such as mapping, monitoring the health of mangrove cover, assessing their diversity, characterization of their biophysical and biochemical properties, as well as monitoring the conservation and restoration activities. Advanced space and sensor technologies at multi-altitudinal level provide very high spatial resolution multispectral, hyperspectral, microwave, and LiDAR data that have substantially improved characterization and monitoring of mangroves. Contemporary Data Science methods on storage, geospatial data analytics, and advanced automated algorithms in handling the BIG Data available (archive and real-time data/ desktop and cloud) contrib

Presentation Mode: Oral, **Plenary Session 1**

Presenting Author: L Gnanapapzham

Registration ID: NSSS-20220113060320

Space Weather research form space-based platforms

Duggirala Pallamraju[1]

[1]Physical Research Laboratory

Space Weather refers to the physical conditions within the space environment on the sun and in the space between the sun and the earth. This includes the solar atmosphere, interplanetary medium, earth's magnetosphere and ionosphere-thermosphere regions. While the dynamics on the solar atmosphere is the main source, most of the consequences are experienced in the Earth's upper atmospheric regions. Adverse Space Weather conditions can cause disruption of satellite operations, communications, navigation, and power grids, leading to several of socio-economic losses. This is a harsh reality we have to live with in the present times as we are increasingly dependent on the satellite systems and sub-systems in our social life. This is a frontier area of research for the global scientific community and various methods and approaches are being pursued to predict the adverse Space Weather conditions on the Earth -- which is a great challenge. Information is required on the plasma and neutral dynamics, composition, number densities, electric fields, temperatures, particle and solar flux, and their time variation with day/night, geomagnetic storms, and solar activity. A comprehensive understanding of the near-earth environment and atmospheric regions at different spatial and temporal scales is essential. In order to address several aspects of Space weather the Indian atmospheric community came up with a proposal for ISRO's Aeronomy small satellite mission called, DISHA (Disturbed and quiet time Ionosphere thermosphere System at High Altitudes). DISHA will be of dual satellite configuration in low earth orbit, with one in high- and the other in low-inclination angles. This talk will give a broad overview of the importance of the scientific issues, that are required to be studied and as to how the measurements of the dual satellite DISHA mission will help in advancing our understanding of the ionosphere thermosphere system and consequently of space weather.

Presentation Mode: Oral, **Plenary Session 2**

Presenting Author: Duggirala Pallamraju

Registration ID: NSSS-20220110122655

Exploring the Lunar Neutral and Plasma Environment

M B Dhanya[1], Team members of SARA on Chandrayaan-1, CHACE-2 on Chandrayaan-2

[1]Physical Research Laboratory

The Moon, the natural satellite of Earth, is generally known to be an airless non-magnetised body. However, the Moon possesses a tenuous atmosphere, known as surface boundary exosphere. Also, there are regions on the Moon, where localised magnetic fields, known as lunar magnetic anomalies (LMA), do exist. The surface of the Moon is continuously exposed to the solar radiation, micro-meteorite bombardment, and the magnetised plasma flow from the Sun, known as the solar wind. Interaction of the Moon with these agents results in a variety of processes, which contributes to the exosphere, energetic neutral and the plasma environment of the Moon. Recent lunar missions like Chandrayaan-1, Kaguya, Chang'E-1, LADEE, ARTEMIS and Chandrayaan-2 have provided new insight into these processes thereby advancing our knowledge in this area. An overview of the recent findings on neutral and plasma environment of the Moon, with emphasis on the revelations from Chandrayaan-1 & Chandrayaan-2 will be presented.

Presentation Mode: Oral, **Plenary Session 3**

Presenting Author: M B Dhanya

Registration ID: NSSS-20211208044531

Exploring the X-ray Universe

Biswajit Paul[1]

[1]Raman Research Institute

All extreme physical conditions in the universe are conducive for production of high energy radiation. This makes X-ray astronomy a versatile medium for study of the extremes of the universe in density, gravitational field, magnetic field, temperature, ionization state, speed etc. In 60 years since discovery of the first X-ray source beyond the Solar System, X-ray astronomy has progressed in leaps and bounds in imaging, spectroscopic, and timing studies and X-ray polarimetry is also set to join the bandwagon soon. Most of X-the sources being highly variable at a wide range of timescales, the all sky X-ray monitors have also been very useful in X-ray astronomy, especially in the last three decades. Along with a brief review of the major X-ray astronomy observatories of past, present, and near future, this talk will highlight some of the key science issues that have caught wider attention among astronomers, scientists, and science enthusiasts.

Presentation Mode: Oral, **Plenary Session 4**

Presenting Author: Biswajit Paul

Registration ID: NSSS-20220110023226

Science in Space: Potential Science Experiments onboard Human Space Missions

Raghu Meetei Ningthoujam[1]

[1]ISRO

Space is considered to be the natural laboratory for scientists and engineers and it provides ample opportunity to test many of the scientific theories and valuable insights of it. The experiments can be conducted either in standalone mode or assistance from astronauts or robots. However, human presence in human flight missions provides flexibility and freedom in the choice of the experiment and design. Over ages, several scientific experiments have been conducted onboard various space laboratories with man or without man. In this lecture, some of the potential science experiments onboard human space missions will be discussed, giving specific context to Gaganyaan missions. The potential experiments shall include experiments from Quantum and Space Biology fields. The lecture will discuss the potential experiments to test the effect of gravity on quantum phenomena like quantum entanglement in space using satellites either in the same orbit or different orbits via Hohmann transfer. Quantum Teleportation between optical ground station on Earth and Astronauts crew module in space will be discussed. Entanglement Swapping Experiment onboard Gaganyaan for relaying quantum information as a precursor experiment for establishing quantum satellite constellation shall also be touched upon. The effect of gravity on astronauts' health is a common scientific goal since the inception of the human space flight and the scientific understanding is being evolved. The lecture will also cover brief aspects of the new area of Formative bio-fabrication, Space Bio-3D printer which can manage tissues and organs in microgravity, 3D cell-differentiation and Automated cell culture system system in space. Anti-atrophy experiment for muscle cell in microgravity condition and lack of physical activity shall also be discussed.

Presentation Mode: Oral, **Plenary Session 5**

Presenting Author: Raghu Meetei Ningthoujam

Registration ID: NSSS-20211224065824

Exoplanetary atmospheres and their link to planetary formation

Liton Majumdar[1]

[1]National Institute of Science Education and Research (NISER), Bhubaneswar, India

One of the most exciting developments in astronomy and planetary science is the discovery of planets around stars, other than our own Sun, termed as "Exoplanets." The discoveries of these exoplanets have revealed an astonishing diversity in their physical characteristics - masses, temperatures, radii, orbital properties, and host stars. Exoplanets known today range from super Jupiters to Earth-size rocky planets over a wide range of temperatures, including several in the habitable zones of their host stars. In this talk, I will discuss how we study the atmospheres of these exoplanets using the combination of ground and space-based observations, atmospheric physicochemical models, retrieval techniques, and thereby characterize them. I will also briefly discuss how modeling the atmospheres of exoplanets from first principles aid fundamental understanding of the planetary formation. Finally, I will discuss the near future of this emerging frontier in the context of significant advances expected from facilities such as JWST, ARIEL, and large ground-based facilities (including TMT).

Presentation Mode: Oral, **Plenary Session 3**

Presenting Author: Liton Majumdar

Registration ID: NSSS-20220103055101

Hunting for Gravitational Waves from Ground and Space

Sanjit Mitra[1]

[1]IUCAA, Pune

Gravitational Wave Astronomy had an exciting beginning. More than ninety binary mergers have been detected in five years after the first discovery. Nevertheless, it is still the very beginning of a new field of astronomy. Only one kind of source has been detected in one specific frequency band. Different kinds of gravitational wave sources are expected to be observed in a widely separated range of frequency bands, and an enormous amount of science is expected to be unravelled through these new windows to the universe. Apart from vastly enriching our understanding of astrophysics and cosmology, the binaries themselves contain ground-breaking science potential, e.g., precise localisation of the binary mergers can break the tension in Hubble constant measurement, observation of the ring-down signal from black hole mergers and extreme/intermediate mass ratio inspirals can meaningfully probe the validity of Einstein's general theory of relativity. Detection of primordial gravitational waves can provide a snapshot of the very early universe. These observations will, however, require multiple ground- and space-based detectors to cover the wide frequency range. This presentation will briefly summarise the present status of gravitational wave astronomy and prospects for future observations.

Presentation Mode: Oral, **Plenary Session 4**

Presenting Author: Sanjit Mitra

Registration ID: NSSS-20211217103346

In-Situ Resource Utilization for Moon and Mars Missions

Ganesh P[1], Vignesh G[1], Chellathurai B[1], Narayanan Appu[1], Alaguvelu K[1]

[1]ISRO Propulsion Complex, Mahendragiri

In-Situ Resource Utilization (ISRU) covers all aspects of using or processing local resources for the benefit of robotic and human exploration of Moon, Mars and other planets. It represents a shift in the concept of classical approach of ""taking everything with you"" towards a philosophy of ""living off the land"". In-Situ Propellant Production (ISPP) is one of the important subset of ISRU that focuses on producing propellants from local resources. This propellant may be used e.g., in ascent vehicles, hoppers as well as in rovers and other surface mobility systems. ISPP requires the least amount of infrastructure to support and provides immediate benefits to mission plans. Development of ISPP technology plays a vital role to achieve human or robotic exploration to Moon and Mars. In the roadmap of ISRO's interplanetary exploration, ISPP shall be a prime technology which needs to be investigated in detail towards design and development.

Detailed feasibility study of potential processes for ISPP considering Moon and Mars exploration is carried out through benchmark case studies. Through the detailed feasibility study & system engineering, potential processes to be developed are identified by considering the utilization of resources available in Moon and Mars. Potential processes identified for the development are (1) Synthesis of Oxygen using lunar regolith through vacuum pyrolysis towards ISPP for Lunar exploration; (2) Synthesis of Methane and Oxygen using resources of Mars such as CO2 from atmosphere & water from regolith towards ISPP for Mars exploration. Challenges and criticalities in design and demonstration of a prototype system is presented in detail.

Presentation Mode: Oral, **Plenary Session 5**

Presenting Author: Ganesh Paramasivan

Registration ID: NSSS-20220113012056

Humanoid Robots for Space Exploration

Sangeetha G R[1]

[1]ISRO

Humanoid robots, enabled with artificial Intelligence-based capabilities, have immense potentioal for space explorations. This lecture would cover the concept of a 95 degrees of freedom (DoF) biped humanoid robot with anthropomorphic look, consisting of head, torso, arms, hands and lower limbs. The system level specifications will also be discussed. The major subsystem that make up the humanoid robot along with the key capabilities envisaged for the system will be elucidated in the lecture. The lecture will discuss on the technologies involved for the development of a humanoid robot for space exploration, and the thrust areas which specifically require attention and impetus for development, along with the technological challenges involved in each will also be covered.

Presentation Mode: Oral, **Plenary Session 5**

Presenting Author: Sangeetha G R

Registration ID: NSSS-20220106060123

Plenary Session 1

Space Based Meteorology, Oceanography, Geosphere-Biosphere Interactions

This session will focus on applications of remote sensing in meteorology, space-based observations for land-cover and ecosystem assessment, applications in agriculture and human sustainability, oceanography and geosphere-biosphere research.

Studies on Brown Carbon Aerosols in India: Current Status and Way Forward

(Lead talk)

Neeraj Rastogi[1]

[1]Geoscience Division, Physical Research Laboratory, Navrangpura Ahmedabad- 380009

Organic aerosols (OA) are shown to be a large fraction of atmospheric aerosols and have profound effects on air quality, atmospheric chemistry, and climate forcing. Until recently, all the OA were considered as scattering type species. Recent studies have shown that a fraction of OA can be light absorbing and referred them as brown carbon (BrC), which absorb light in near UV and visible region. Primary emissions from biomass and fossil-fuel burning, and secondary formations in the atmosphere are considered to be the major sources of atmospheric BrC. Global models estimate that light absorption by BrC in different regions of the world may be 27–70% of that due to black carbon (BC) absorption. Further, BrC immersed in clouds/snow can absorb light and facilitate their evaporation/dispersion/melting. The direct radiative forcing of BrC in climate-modeling studies is highly variable (+0.03 to + 0.57 W/m2) due to complexity involved in assessing their concentrations and characteristics. Owing to their importance in climate forcing, BrC has drawn considerable attention in recent years. However, studies on BrC are limited, especially over Indian subcontinent. It has been studied over different parts of India and surrounding oceans through offline and online measurements. These studies inferred that: (1) BrC is composed of variety of chromophores including at least humic-like substances and nitro-organics, (2) Biomass burning derived primary BrC is most absorbing followed by that derived from fossil-fuel burning; whereas, secondary aged BrC is least absorbing (3) absorbing property of BrC diminishes with atmospheric ageing/oxidation and photo-bleaching, (4) BrC have variable optical properties under different ambient conditions, and (5) Relative radiative forcing of BrC with respect to BC is considerable that cannot be ignored in climate models. A better parameterization of BrC through systematic studies over strategic sites shall enhance its utilization in climate models.

Presentation Mode: Oral

Presenting Author: Neeraj Rastogi

Registration ID: NSSS-20211202090859

Climatological aspects of size-resolved column aerosol optical properties over Gadanki, India

B.L. Madhavan[1], A. Sai Krishnaveni[1], M. Venkat Ratnam[1], V. Ravi Kiran[1]

[1]National Atmospheric Research Laboratory (NARL), Gadanki, India

We present the long-term (2008-2018) climatological characteristics of column aerosol optical properties from the Sky Radiometer at Gadanki (13.48 deg. N, 79.18 deg. E), a typical rural site in southern peninsular India. A method to separate the fine and coarse mode spectral aerosol optical properties was presented. The climatological aspects related to the diurnal, monthly, and intra-annual variations of observed aerosol optical properties exhibited both seasonal and spectral dependence. While the size-resolved aerosol optical depth (AOD), absorption aerosol optical depth, and asymmetry parameter exhibited a decreasing trend, single scattering albedo (SSA) showed an increasing trend from shorter to longer wavelengths in all seasons with distinct magnitudes. Seasonal asymmetry in the diurnal variation of AOD and Angstrom exponent was observed. Intra-annual variability clearly indicated distinct fine and coarse mode dominance during winter and monsoon, respectively, while mixed contributions were found in other seasons. This is attributed to the influence of prevailing air masses on the column aerosol properties. Annual mean SSA values indicated the dominance of moderately absorbing (0.91) to weakly absorbing (0.95) aerosols. On evaluating the size-resolved AOD (at 500 nm) with those from extended Spectral Deconvolution Algorithm (SDA+), the observed differences are found to be remarkable for coarse mode AOD although the correlations for both fine and coarse AODs were observed to be 0.96. Lastly, the Dark Target and Deep Blue merged AOD (at 550 nm) from MODIS Terra/Aqua are evaluated to examine the consistency with ground measurements and both have shown a systematic underestimation with an increase in the magnitude of AOD strongly dependent on the seasons. These results form a basis for the comprehensive characterization of aerosol types and associated radiative impacts that are vital for understanding the regional climate change.

Presentation Mode: Oral

Presenting Author: B.L. Madhavan

Registration ID: NSSS-20211220071214

Studies on Black Carbon aerosols in relation to Boundary Layer Height and Rainfall over sub urban Ch

M. Ashok Williams[1], T.V. Lakshmi Kumar[1]

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Seasonal variations of Surface Black Carbon Mass Concentration (SBCMC) obtained from the Aethalometer (AE-31) has been studied for the period of January-2016 to February-2019 over a semi urban location (12.81°N, 80.03°E) in Chennai. Boundary Layer Height (BLH) data deduced from the Mini Micro Pulse LiDAR (MPL 532-C) is used to study the short term variations of SBCMC during the fumigation period for different seasons. Further the paper focuses on wet scavenging of black carbon aerosols during different rainy days. Raindrop distribution from the laser precipitation monitor is used to study the wet scavenging coefficient over the study area. The results show that BLH during sunrise is lesser than BLH when BC attains the peak due to fumigation effect. This feature is conspicuous in southwest and northeast monsoons compared to other seasons. The scavenging ratio obtained from the SBCMC is substantially correlated (r = + 0.84) with the scavenging coefficient that has been obtained for different raindrop sizes.

Presentation Mode: Oral

Presenting Author: Ashok Williams Meruga

Registration ID: NSSS-20220110060004

Effect of aerosols and meteorology on precipitation enhancement over Kerala during August 2018

Jasmine Mary Kuriakose[1], Marina Aloysius[1], Reethu Jayaprakash[1], Fathima C. P.[1], S. S. Prijith[2], Mannil Mohan[2]

[1]Assumption College, Changanacherry, [2]Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram

Kerala received unprecedented rainfall over a few days beginning August 13, 2018, which was followed by catastrophic floods. This study investigates the meteorological parameters and aerosol conditions during the event. The analysis of AOD along with the cloud parameters like, Cloud Fraction, Cloud Condensation Nuclei,Cloud Water Liquid Water Path, and Cloud Top Temperature indicated that there is a close association with aerosols and the cloud properties over the region on these days of high precipitation. Deep convective clouds over the study zone were shown in the lidar browse images of CALIPSO, along with dust in the higher atmospheric layers. These two observations points to the possibility of an aerosol- cloud- precipitation interaction under suitable meteorological conditions.Aerosol layers seen using CALIPSO profiles, MERRA-2 reanalysis data, and HYSPLIT back trajectory analysis revealed that dust was transported from arid gulf areas to the Kerala coast by summer monsoon winds. The existence of dust aerosols over and around the research domain was also suggested by the high value of the OMI-derived UV absorbing aerosol index over the Arabian Sea.

Moisture enhancement over the study domain by 13 August and its intensification during the heavy precipitation days were evident from the relative humidity profile generated. This could have been huge enough to overcome the moisture decrease, caused by the absorbing aerosols. During the study period, strong vertical winds prevailed over the domain as observed in the analysis, which could have helped in supplying the moisture to the higher altitudes and sustain the aerosol and moisture in the higher atmospheric levels, thus facilitating the cloud formation at these levels.

Thus, the rain cloud formation in the study region during the high precipitation days was supported by the orographically supportive topography of the region, strong updrafts, high moisture buildup and higher than normal inflow of dust aerosols.

Presentation Mode: Oral

Presenting Author: Jasmine Mary Kuriakose

Registration ID: NSSS-20211215082741

Carbonaceous Aerosol Variability & their Association with Meteorological Parameters in Delhi, India

Saurabh Sonwani[1], Pallavi Saxena[2], Anuradha Shukla[3]

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Carbonaceous aerosols (organic carbon and elemental carbon) were determined during the summer monsoon (SM) and winter monsoon (WM) seasons in 2016–2017 at an industrial site in New Delhi, India. Chemical and morphological characterization and seasonal distribution of carbonaceous aerosol were identified. The OC concentration was 70.3±53.7 and 94.3±40.3 μgC/m3 during the SM and WM, respectively, with an overall average of 79.9 ±44.9 μgC/m^3, and the EC concentration was 50. ± 53 and 62.6 ±49.8 μgC/m^3, respectively, with an overall average of 58.3±46.7 μgC/m^3. The morphological observations of collected particles were studied and the char/soot particles, iron-rich particles, and aggregates of calcium sulfate particles were observed during both seasons. The study showed the predominance of the combustion-derived carbonaceous particles released from thermal power plants, industries, and traffic during both seasons. The predominance of combustion-derived particles such as soot and char was higher in the WM than in the SM. The relationship of carbonaceous aerosol with meteorological variables was found that temperature, atmospheric stability, wind direction, and rain intensity significantly affect the levels of OC as compared to that of EC during both seasons.

Presentation Mode: Oral

Presenting Author: Saurabh Sonwani

Registration ID: NSSS-20220110111901

Estimation of ACRI over a tropical atmosphere using a synergy of in-situ measurements

Renju Nandan[1,2], M. Venkat Ratnam[1] , V. Ravi Kiran[1], B.L. Madhavan[1], Dinesh N. Naik[2]

[1]National Atmospheric Research Laboratory, [2]Indian Institute of Space Science and Technology

Aerosol Complex Refractive Index (ACRI) is a key microphysical parameter used for modeling their radiative effects. The uncertainty in the estimation of aerosol optical properties, which indirectly depends on their microphysical properties, is one of the main reasons for the large uncertainty in estimating the effects of aerosols on climate. The traditional approach of determining ACRI is from bulk chemical compositions and known values of refractive indices of pure components based on volume mixing rules. But in view of its importance, many studies were focused on developing different approaches for estimating the ACRI. An approach, based on Mie theory for spherical particles, is developed to estimate the ACRI using a combination of surface-based measurements (2008-2015) from the Aerodynamic Particle Sizer, the integrating nephelometer, and the aethalometer over a rural location in the southern peninsular India. The estimated imaginary parts are found to be high during pre-monsoon season suggesting the dominance of the increased absorption type aerosols. This is in line with the high concentration of black carbon aerosol observed during the pre-monsoon. In addition, the retrieved ACRI values are within the range of refractive index of aerosol particles obtained from possible combination of cations and anions obtained using rainwater analysis over Gadanki during north-east and south-west monsoons. The significance of ACRI of surface aerosols in columnar properties is also analysed by using the columnar single scattering albedo and aerosol optical depth observations from sky radiometer. During winter season, the contribution to the total columnar scattering and absorption are mainly from surface or below the atmospheric boundary layer aerosols, whereas in monsoon season 80-90% contribution is from aerosols above. ACRI of elevated aerosols also needed to be studied in order to completely understand the total scattering and absorption in the atmosphere by the aerosols.

Presentation Mode: Oral

Presenting Author: Renju Nandan

Registration ID: NSSS-20211222060940

Space based meteorology, oceanography, geosphere-biosphere interactions

D Mriganka[1]

[1]IIT Kharagpur

The formation of ultrafine particles from the gaseous precursors and their subsequent growth to larger size has been observed globally in distinct environments, but it's still one of the intensly investigated topics due to prevalent gaps in the understanding study, fine the ultrafine particle concentrations from the campaign based measurements during summer 2014 and 2015 carried out over a high altitude forsted locations , Ooty (11.3*N ,74.4*E ,2240 M amsi) , considered as the highest peak in south India , have been examined. The total number concentrations are meager in general (^1200cm-3) ,but during the periods of ultrafine particles burst significant increase (2-4) folds in particles concentrations are observed . several such day time ultrafine particles bursts amount of nucleations mode partcles concentrations (Nnuc) are observed. These nucleations have not followed typicall well defined " banana" pattern rather they resembled,narrow, upright sticks extending from the nucleation mode all the way upto the Aitken mode. The dependence of aUPF burst on the solar radiation and air temperature is weak suggesting that photochemistry is not solely responsible for this events , which is gonna corroborated by the weak association between Nnuc and So2 (which is proxy to sulphuric acid , the major processors to UFP) Concentrations . The examination of the wind velocities reavealed that UPF burst are gonna noticed on the mountain top observatory predominantly , when the winds are form south/South West directions , where the valley region with anthroprogenic activities is located. The strong association between Nox and Nnuc suggested the influence of anthropogenic plumes on the observed UPF burst .

Presentation Mode: Oral

Presenting Author: D Mriganka Dash

Registration ID: NSSS-20211231102348

BACIS: New observational techniques to understand aerosol effects on Clouds (Lead Talk)

Varaha Ravi Kiran[1], Madineni Venkat Ratnam[1], Masatomo Fujiwara[2], Herman Russchenberg[3], Frank G. Wienhold[4], Bomidi Lakshmi Madhavan[1], Mekalathur Roja Raman[5], Nandan Renju[1], Sivan Thankamani Akhil Raj[1], Alladi Hemanth Kumar[1], Saginela Ravindra Babu[1]

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Better understanding of aerosol-cloud interaction processes is an important aspect to quantify the role of clouds and aerosols in the climate system. There have been significant efforts to explain the ways aerosols modulate cloud properties. However, from the observational point of view, it is indeed challenging to observe and/or verify some of these processes because no single instrument or platform is proven sufficient. With this motivation, a unique set of observational field campaigns named Balloon borne Aerosol Cloud Interaction Studies (BACIS) is proposed and conducted using balloon borne in-situ measurements in addition to the ground-based (Lidars, MST radar, LAWP, MWR, Ceilometer) and space borne (CALIPSO) remote sensing instruments from Gadanki (13.45° N, 79.2° E). So far, 15 campaigns have been conducted as a part of BACIS campaigns from 2017 to 2020. This paper presents the concept of observational approach, lists the major objectives of the campaigns, describes the instruments deployed, and discusses results from selected campaigns. Consistency in balloon borne measurements is assessed using the data from simultaneous observations of ground-based, space borne remote sensing instruments. A good agreement is found among multi-instrumental observations. A combination of the Compact Optical Backscatter AerosoL Detector (COBALD) and Cloud Particle Sensor (CPS) sonde is employed for the first time to discriminate cloud and aerosol in an in-situ profile. Using the data from balloon measurements, the relationship between cloud and aerosol is quantified for the liquid clouds. A statistically significant slope (aerosol-cloud interaction index) of 0.77 (0.86) found between aerosol back scatter from 300 m (400 m) below the cloud base and cloud particle count within the cloud indicates the role of aerosol in the cloud activation process. In a nutshell, the results presented here demonstrate the observational approach to quantify aerosol-cloud interactions.

Presentation Mode: Oral

Presenting Author: Ravi Kiran Varaha

Registration ID: NSSS-20220109015855

Role of aerosol microphysical properties on CCN activity over a tropical coastal location

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Aerosol microphysical properties (size, composition, mixing state) are critical for determining their direct and indirect radiative effects. Cloud condensation nuclei (CCN) activation ability of aerosols, which is one of the prime parameters required to address aerosol-cloud interactions, is largely affected by the variability in aerosol microphysical properties. Field studies showed contrasting reports on the relative importance of particle chemical composition, size, mixing state on the CCN estimation. Though CCN activation of highly hygroscopic inorganics is well known, significant uncertainties exist when organics dominate the aerosol population. Varying sources, hygroscopicity, and lifetimes of constituent components within organics complicate the CCN estimation in organics-dominated regions. To better understand the relative role of organics on CCN activation, intensive observations were conducted during winter (Jan-Feb 2019) from a tropical coastal location, Thumba, in southern peninsular India. Results revealed that the aerosol characteristics depicted varying submicron chemical composition and CCN activation ratios (~ 0.45-0.70) within a day due to prevailing contrasting air masses associated with mesoscale land-sea breeze circulation. Overall, organics dominated the sub-micron mass (>60 to 78%), while the photochemical and aqueous-phase formation of sulfate aerosol resulted in an enhanced contribution of inorganics during the daytime. Sea-breeze consists of hygroscopic, larger particles with lower chemical heterogeneity than less CCN-active aerosol system during land-breeze. We estimated the CCN concentrations using κ-Köhler theory following different mixing state and organics-hygroscopicity assumptions. It is found that consideration of organics-hygroscopicity is critical than mixing state assumption for better CCN estimation. We suggest that, apart from inorganics, the role of secondary organics in the CCN activation needs to be considered in models.

Presentation Mode: Oral

Presenting Author: Ajith T C

Registration ID: NSSS-20220110101239

Sensitivity of cloud condensation nuclei concentration to aerosol loading in column model

Kavita Patnaik[1,2], Subhrajit Rath[1,2], Amit Kesarkar[1], Jyoti Bhate[1], Anantharaman Chandrasekhar[2], Ramakumar Giri[3]

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Atmospheric aerosols act as cloud condensation nuclei (CCN) and ice nuclei (IN) and support cloud development through heterogeneous nucleation. The aerosol number concentration modulates the cloud development directly and indirectly, as well as the aerosol chemistry modulates the characteristics of aerosols and consequently alters the amount of precipitation. However, their limited understanding causes uncertainty in the simulation of aerosol-cloud interaction and, hence, precipitation processes. Therefore, we have formulated a single-column chemistry model and designed idealized experiments using it in this work. The chemistry solver accounts for the gas and particle-phase chemistry, calculates reaction rates of solves 1369 chemical reactions, and the number of 916 chemical components. The heavy rainfall evidences over Delhi, Kolkata, Chennai, Mumbai, and Bhopal have been identified by analyzing IMD daily rainfall observation for the years 1980-2014. The radiosonde dataset provided by IMD was used for calculating maximum likelihood estimates (MLE) of the temperature at different altitudes. The idealized experiment was designed using the Monte Carlo method with 1000 perturbations in radiosonde temperatures on extreme precipitation days over these stations. The chemistry module was solved using the Gear solution method for perturbed temperature profiles. The vertical profiles of the simulated chemical elements have been validated using the vertical profiles of H_2O, CO, O_3, CH_4, CO_2, HNO_3, N_2O, and SO_2 provided by CLIMCAPS algorithms using AIRS and CrlMSS sounders datasets. The results indicated that the simulated profiles matched those provided by CLIMCAPS. After development, the chemistry solver will be integrated into the microphysics module to predict extreme precipitation better.

Presentation Mode: Oral

Presenting Author: Kavita Patnaik

Registration ID: NSSS-20220110112246

Integrated Monsoon Rainfall Observation Programme : Defining Monsoon Rainfall Measuring Satellite (MRMS)

T V Lakshmi Kumar[1], M S Narayanan[1], Sanjeev Dwivedi[1], Manoj Thakur[1], K Subrahmanyam[1]

[1]SRM IS&T, IMD, Tribhuvan University, & SPL

Since the limited success of Megha Tropiques satellite in 2012, India's contribution to the Global Precipitation Programme (GPM) has largely been confined to using the very high resolution product, IMERG, generated by NASA. This global product is produced from the microwave imager observations from GPM – core and ten other orbiting satellites by filling the time gap by the morphing technique. Since 1964, ten International / National programmes have been conducted over India and neighbourhood to understand the various aspects of Indian monsoon. Despite rainfall being the most important meteorological parameter for understanding Indian monsoon, none of these ten campaigns focused on observations related to rainfall. To further improve the IMERG product, particularly over the Indian region, it is important that India launches a TRMM - type of microwave imaging satellite, with high spatial resolution sensors. Towards launching a suitable satellite and defining its specifications, a comprehensive, integrated year – long Monsoon Rainfall Observation Programme (MROP) is suggested by using the existing global satellite data, INSAT data, DWRs and ground raingauge network spread across the country. This paper summarises the past efforts towards using the INSAT and IMERG satellite rainfall products and the need for an intensive coordinated programme.The level of accuracy needed from the perspective for the next 5 – 10 years, from satellites vis a vis IMD grid data can be broadly summarised as follows based on Indian studies:

- The seasonal all India cumulative satellite – estimated rainfall product should be within 5% of the IMD gridded products for picking the the Interannual Variations (IAV).
- At the daily all India scale the accuracy should be within 10% of IMD product, for the study of intraseasonal oscillations. . .

The above effort will also help India consolidate in defining an appropriate orbiting Monsoon Rain Mapping Satellite (MRMS) o

Presentation Mode: Oral

Presenting Author: T V Lakshmi Kumar

Registration ID: NSSS-20220110113610

Variability in atmospheric DMS over the Bay of Bengal during the post-monsoon season

Mansi Gupta[1,2], Nidhi Tripathi[1], Arvind Singh[1], L. K. Sahu[1]

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Dimethyl sulfide (DMS) is the most abundant volatile organic sulfur compounds present in the remote marine atmosphere and plays a major role in the global sulphur cycle. The production of DMS in seawater is mainly by the enzymatic breakdown of disolved dimethylsulfoniopropionate(DMSP), which is an algal metabolite, primarily released from phytoplankton. The primary source of DMS in the marine atmosphere is the air-sea exchange, which depends on the biogeochemical processes in the surface seawater and physical parameters like wind turbulence, wave breaking, sea surface temperature, solar flux, etc. DMS is the largest contributor to sulphur emissions from a natural source in the atmosphere, contributing around 13-37 Tg of S year-1 at global scale. DMS is the major precursor of secondary sulphur aerosols in the marine atmosphere due to its higher reactivity with the oxidants(OH, NOx, halide radical). Hence, it plays a significant role in modulating cloud coverage and radiation balance of the Earth. Despite being critically important in chemistry-climate interactions, in situ measurement-based studies of DMS in the marine atmosphere over the northern Indian Ocean are very limited. The measurements of DMS in the marine atmosphere over the southern Bay of Bengal (BoB) and the Andaman Sea (AnS) were conducted during post-monsoon season in September-October 2021. The average atmospheric DMS measured during the campaign was 0.41 ± 0.22 ppbv. However, significantly elevated levels(> 1.5 ppbv) of DMS were observed in the AnS, with concurrent dense bloom patches and higher wind speeds. Our measurements reveal distinct spatiotemporal variations and diurnal patterns of the DMS concentration in the marine atmosphere over the region. The link between DMS emission and chlorophyll-a was also investigated using satellite data. A detailed discussion of spatial distribution of atmospheric DMS, its meteorological dependence and variation with biogeochemical parameters will be presented.

Presentation Mode: Oral

Presenting Author: Mansi Gupta

Registration ID: NSSS-20220104121559

Long-term trends in the Aerosol Optical Depth obtained across the globe using Multi-satellite measurements

Gopika Gupta[1,2], M. Venkat Ratnam[1], B.L. Madhavan[1], C.S. Narayanamurthy[2]

[1]National Atmospheric Research Laboratory, [2]Indian Institute of Space Science and Technology

Long-term AOD trends are obtained between 2001 and 2020 using multi-satellite measurements from MODerate resolution Imaging Spectral-radiometer, Multi-angle Imaging Spectral-Radiometer, and Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) observations across the globe. Although numerous studies have examined the implications of aerosols on climate using Aerosol Optical Depth (AOD) but its effects due to the prevailing background conditions, still remain uncertain, for which a multivariate regression trend model has been implemented in this study. Before evaluating the trends, a detailed comparison has been made with the ground-based AEronet RObotic NETwork observations from nearly 80 stations covering the globe. A high (above 0.7) to medium (from 0.3 to 0.7) correlation is noticed among all the satellite measurements except the CALIOP (over a few sites) observations. In addition, Modern-Era Retrospective analysis for Research and Application version-2 AOD dataset is also able to simulate the mean as well as trend values across the globe. A decreasing trend in AOD is mostly seen in connection with the implementation of emission control policies (Eastern North America, Europe, and Eastern and Central China), reduction in forest fires (South America), and the stilling of surface winds over arid regions (Western North Africa). On the other hand, AOD trends perceived over the South Africa region have increased in comparison to the values reported earlier. Surprisingly, the CALIOP sensor has shown a rather significantly decreasing trend values over the Middle-East region. When compared, the region-wise linear regression trend analysis declined to give any statistically significant values over huge aerosol variability regions such as North Africa, South Africa, Middle-East, China, and the Indian regions. These robust findings will form a firm basis to further evaluate the dependence of physical and chemical characteristics of aerosol on the observed AOD trends.

Presentation Mode: Oral

Presenting Author: Gopika Gupta

Registration ID: NSSS-20211222064950

Retrieval of near-surface PM2.5 over India using satellite lidar observations

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Monitoring Particulate Matter (PM) assumes great importance in the context of air quality and pollution-induced health hazards. The present study estimates the PM2.5 mass concentration at the surface over the Indian landmass using near-surface observations of aerosol backscatter (2006 - 2021) by Cloud-Aerosol Lidar with Orthogonal Polarization onboard CALIPSO satellite. Average PM2.5 mass concentration over Indo-Gangetic Plains and northwest India show 3-fold increases compared to relatively cleaner Peninsular India (~ μgm-3). The middle part of Indo-Gangetic Plains shows the highest concentration of PM2.5 compared to the eastern and western parts with a 2-fold increase. Surface-level PM2.5 mass concentration during winter shows statistically significant positive trends over the Indian landmass. It increases at a rate of ~3% over IGP and arid regions of northwest India, and ~4% over Peninsular India during the last fifteen years (2006 - 2020). Crop burning activity over the western IGP during November is the dominant controlling factor in producing near-surface PM2.5 concentration during the winter season over the Indian subcontinent. The influence of crop burning during November over western IGP spatially extends up to Peninsular India and might contribute significantly to the aerosol plumes persisting over the Northern Indian Ocean during Winter. Regulations need to be implemented during November to effectively reduce the far-reaching implications of post-monsoon burning activity over the western IGP.

Presentation Mode: Oral

Presenting Author: Lakshmi N B

Registration ID: NSSS-20211126061858

Variability and comparison of aerosol and PWV from the measurement of satellite over Darjeeling, India

Shyam Mehta[1], Sanjay Mehta[2],Jagabandhu Panda[3]

[1]Bose Institute Kolkata

We present the single scale variability of derived measurement of satellite in the term of aerosol optical depth (AOD) at the wavelength of 550 nm and precipitable water vapor-infrared (PWV – IR) total column through the MODIS of terra and Aqua for the study of throughout the year in 2010 over the lower eastern Himalaya Darjeeling (27.01° N and 88.26° E). AOD and PWV are estimated in the daily diurnal, comparison between terra and aqua, HYSPLIT model and the probability distribution of frequency occurrences respectively. The results are produced such that the AOD is varying minimum (0.1) and maximum (1.2) and PWV are varying minimum (0.5 cm) and maximum (7 cm). The aerosols are showing enhanced during the pre-monsoon and winter while the aerosols enhancements are decreasing during the monsoon seasons. We found the correlations coefficient of AOD (R2 = 0.65) during the winter, (R2 = 0.28) during the pre-monsoon, (R2 = 0.33) during the post-monsoon and throughout the year (R2 = 0.26). In the other side, water vapor showed enhanced during the monsoon and pre-monsoon seasons. The water vapor well behaved in the correlations coefficient such as during the winter (R2 = 0.42), during the summer (R2 = 0.50), during the monsoon (R2 = 0.11), during the post-monsoon (R2 = 0.38), during pre-monsoon (R2 = 0.18) and throughout the year (R2 = 0.57). Since water vapor correlation gives better than the AOD correlations in the measurement from satellites, however, both are well performed over Darjeeling.

Presentation Mode: Oral

Presenting Author: Shyam Mehta

Registration ID: NSSS-20220109012422

What drives the prevalence of atmospheric water-soluble organic aerosols over the tropical hill station in the Western Ghats?

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Aerosol particles enriched with water-soluble organic compounds serve as cloud condensation nuclei and have an impact on the radiative forcing of the Earth. Regardless of their significance, they remain a considerable challenge to atmospheric scientists due to the diversity of their origins and formation processes. The PM1.1 aerosol samples collected during 31 January to 15 March in 2020 from the tropical hill station (Ponmudi: 8.8°N and 77.1°E) located at an altitude of about 1 km over the mountain ranges of the Western Ghats in peninsular India are analyzed for a series of dicarboxylic acids and related polar compounds together with organic carbon (OC), elemental carbon (EC), water-soluble organic carbon (WSOC) and major ions to unravel the factors driving the prevalence of water-soluble organic aerosols (WSOAs) in the free troposphere. The location is remote from the town and devoid of any anthropogenic sources. Molecular distributions of dicarboxylic acids showed the predominance of oxalic acid (C2), whereas glyoxylic acid (ωC2) dominated among ω-oxocarboxylic acids and methylglyoxal (mGly) was found to be more abundant than glyoxal (Gly) in the aerosols at Ponmudi. The concentration ratios of malonic to succinic (avg. 0.60) and fumaric to maleic (avg. 0.52) acids indicated that photochemical processing of WSOAs at Ponmudi was not widespread during the sampling campaign. Interestingly, the measured water-soluble organic compounds carbon to total carbon (TC) ratios ranged from 6 to 11% (avg. 9%), implying that aerosols collected at this tropical hill station in the Western Ghats contain more water-soluble organic compounds possibly produced by oxidations of precursor compounds. It is found that biogenic sources had a significant impact on the composition of WSOAs at Ponmudi site. This elucidation is further supported by the diagnostic mass ratio of phthalic to azelaic acid (avg. 0.78) and the comparatively high abundance of mGly, which is the oxidation product of isoprene produced from biogenic sources in the atmosphere. Our findings imply that biogenic volatile organic precursors possibly unsaturated fatty acids and isoprene followed by their oxidation play a key role in the formation of secondary organic aerosols over a tropical hill station in the Western Ghats.

Presentation Mode: Oral

Presenting Author: D.K. Deshmukh

Registration ID: NSSS-20211230103342

Probing the genesis of extreme BC episodes over a polluted metropolis near land-sea boundary

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The dominance of anthropogenic heat-absorbing aerosols, such as black carbon (BC), influences the temperature profile of the troposphere, affecting the thermodynamic normality of the atmospheric boundary layer over a range of wavelengths ranging from UV to IR. According to IPCC 2021, the world needs to limit global warming to 1.5Â°C in order to prevent the catastrophic effects of climate change. BC, emitted from the incomplete combustion of biomass burning, and fossil fuel, is chemically inert and has an average lifetime of several days to weeks. Owing to its location near the land-sea boundary, Kolkata (22.57^o N, 88.37^o E) is subject to contrasting seasonal maritime airflow from the Bay of Bengal and continental air mass from the Indo-Gangetic Plain (IGP), which may modulate the local BC concentration. This provides a unique opportunity to investigate the influence of varying airflow patterns on local BC activities over Kolkata, yet to be comprehensively investigated. The atmospheric dynamics and origin of aerosol transport associated with high and low BC activities over Kolkata have been analyzed using BC variation during 2012-2015. Observations from an aethalometer, microwave radiometer (RPG-HATPRO), HYPSLIT model output, ERA-5, and MEERA-2 re-analysis data are used to highlight the following insights.

1. The study revealed that westerly winds during pre-, post-monsoon, and winter seasons from the IGP region towards Kolkata add to the locally generated BC loading, also contributing to the anomalous increase in BC concentration during weekends and holidays when local emissions are low.
2. The diurnal variability of the atmospheric boundary layer associated with high and low BC concentration is examined using ERA- 5 hourly data.
3. Enhanced BC concentration caused increased ambient heating and negative radiative forcing at the surface.

The present study will serve as inputs for developing comprehensive regional climate models to better predict climate change.

Presentation Mode: Oral

Presenting Author: Gargi Rakshit

Registration ID: NSSS-20220106024127

Variation of trace gases in Kannur Town, a coastal South Indian city

Nishanth T[1]., Resmi CT[1]., Satheesh Kumar MK[1], Valsaraj KT[1]

[1]Sree Krishna College Guruvayur

The present work describes diurnal and seasonal variations of trace air pollutants include surface ozone (O_3), oxides of nitrogen (NO_x), carbon monoxide (CO), volatile organic compounds (Benzene, Toluene, Ethyl Benzene, Xylenes which are classified as BTEX)), ammonia (NH_3), sulphur dioxide (SO_2), and meteorological parameters observed at Kannur town (11.87º N, 75.37º E, 2m msl) for a period of one year from September 2019. Seasonal variations of trace air pollutants exhibit a daytime maximum during winter due to the enhanced local emission and long-range transport, and minimum during the monsoon period. Surprisingly, air pollutants except O_3 show a reduction in concentration in the months of April 2020 due to countrywide lockdown in the wake of restricting the spread of COVID 19. Weekday/weekend variations of air pollutants reveal that high concentrations of O_3 are found on weekends compared to weekdays, unlike the concentrations of all other pollutants are found low duri ng weekends. From the analysis of the chemical coupling between NO, NO_2, NO_x, O_3, and OX (=O_3+NO_2), it is found that OX has both regional and local contributions on NO_x. Intercorrelations between trace pollutants showed a strong positive correlation between O_3 and CO, a negative correlation between O_3 and NO_x.

Presentation Mode: Oral

Presenting Author: Nishanth T

Registration ID: NSSS-20220110085041

Photochemical evolution of air in tropical urban environments of India: A model-based study

(Lead Talk)

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The photochemical processes in tropical India profoundly impact the air composition over local to global scales, however, studies on detailed air chemistry remain few in this part of the world. In this regard, we have combined state-of-the-art measurements with the Master Mechanism model to study the chemical evolution of air over Ahmedabad and Delhi. Model environments have been set up by including meteorological conditions, overhead ozone, and aerosol loading, etc. Nitrogen oxides (NO_x), carbon monoxide (CO), ozone (O_3), and several volatile organic compounds (VOCs) have been initialized based on in situ measurements. The model predicts strong O_3 build-up (115 ppbv) in the urban outflow before a gradual decrease. Additionally, large amounts of secondary inorganics and organics are also produced. The trajectory analysis further suggests outflow of ozone-rich air from Ahmedabad towards the Arabian Sea in agreement with measurements and global model results. Sensitivity simulations are further performed to quantify the relative effects of meteorology and different precursors on ozone production over Ahmedabad and Delhi. The model results show good agreement with the observational trends during a period of minimal anthropogenic emissions (COVID-19 lockdown).

Presentation Mode: Oral

Presenting Author: Narendra Ojha

Registration ID: NSSS-20220110110031

Demonstrating the capability of machine learning to simulate atmospheric trace gases

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Trace gases in the atmosphere, despite of very low concentrations, have paramount significance in atmospheric chemistry, climate, air quality, and geosphere-biosphere system. While some of the trace gases (e.g., CO_2) are greenhouse gases influencing the earth's climate, others (e.g., tropospheric ozone; O_3) are crucial in chemistry, climate and determine the quality of air that we breathe. Therefore accurate modeling of variability in trace gases is of vital importance. Machine learning (ML), in recent times, have emerged as a highly valuable tool in the advancement of atmospheric sciences. Here, we demonstrate the capability of ML model to simulate the variability of carbon dioxide and surface ozone at different background sites. Model trained with past variation of CO_2 residue (i.e., detrended deseasonalised CO_2) and various input parameters, reproduced 72% of observed variability in CO_2 residue with an error of 0.45 ppmv over Mauna Loa. The cumulative temperature anomaly is found to play a key role in the simulation of CO_2 residue, highlighting that the signature of minute variation in CO_2 lies in the cumulative temperature anomaly. However, the model shows limitation in capturing spikes likely caused by strong local/regional influences. We also conducted simulations for urban ozone variations and find that the model successfully reproduced independent observations ($r2 > 0.7$) based on meteorology or precursors. Our study highlights strong potential of ML modeling for filling data gaps for important climate forcing pollutants in sparsely sampled tropical Indian subcontinent. ML based simulations of trace gases can complement the computationally expensive global/regional chemistry-transport models.

Presentation Mode: Oral

Presenting Author: Imran Girach

Registration ID: NSSS-20220109090728

Spatio-temporal variation and gas-particle partitioning of PAHs and Nitro-PAHs in the atmosphere of

Puneet Kumar Verma[1,2], Dinesh Sah[1], R.V. Satish[2], Neeraj Rastogi[2], K. Maharaj Kumari[1], Anita Lakhani[1]

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Atmospheric gas and particulate phase samples of 16 priority polycylic aromatic hydrocarbons (PAHs) and 2 Nitro-PAHs were determined from November 2016 to November 2017 at a rural and traffic site in Agra, a large city located in the Indo-Gangetic Plain. Samples were collected using a high volume Polyurethane Foam (PUF) air sampler and analyzed for PAHs and Nitro-PAHs using Gas Chromatograph-Mass Spectrometer in Selected Ion Monitoring mode. The sum of the total mean concentration of gas and particulate phase PAHs were 720 and 1299 ng mâˆ'3 at the rural and traffic sites, respectively, whereas the sum of the total mean concentration of gas and particulate phase Nitro-PAHs at the rural site and traffic site was 37.2 and 116 ng mâˆ'3, respectively. Concentrations of both PAHs and Nitro-PAHs were highest during the winter period followed by summer, post-monsoon and monsoon at both the sites. Seasonal variation in the gas-particle partitioning of PAHs was observed. Gas particle partitioning during winter is explained by the dual model indicating the dominance of both physical adsorption and absorption on soot, while during the summer and monsoon the gas-particle partitioning appeared to be controlled by physical adsorption that could be explained by the Pankow model.

Source identification through Principal Component Analysis (PCA) and diagnostic ratios, indicated contributions of vehicular exhaust, biomass combustion and mixed sources. Correlation analysis of PAHs, Nitro-PAHs, O_3 and NOX indicates that the gas phase concentrations of Nitro-PAHs at the rural sites depend on the gas-phase radical initiated reactions whereas at traffic site Nitro-PAHs depend on primary emissions.

Key Words: PAHs, Nitro-PAHs, Seasonal gas-particle partitioning, Source apportionment.

Presentation Mode: Oral

Presenting Author: Puneet Kumar Verma

Registration ID: NSSS-20211202033224

Total column ozone from Indian geostationary satellite INSAT-3DR: Improved infrared retrieval and validation

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The ozone has a unique vertical distribution among various trace gases and plays different roles at different altitudes. The beneficial stratospheric ozone absorbs harmful UV radiations, while tropospheric ozone, a powerful greenhouse gas, adversely affects living beings and vegetations. In Asian countries, the increasing anthropogenic emissions, higher solar radiation, and water vapor further intensify ozone photochemistry. Moreover, long-term observation of total ozone is essential to understand its interactions between radiation and climate in a changing atmosphere and its recovery rate. Thus the continuous monitoring from space-based instruments is necessary. Nowadays, ozone monitoring via satellite-based remote sensing has gained vast importance in both UV/Vis and IR spectrums. The Indian geostationary satellite INSAT-3D/3DR is accomplishing this need for India. Apart from the meteorological sounding, it is also incorporated with a 9.6 µm strong ozone absorption channel for ozone observations. We have assessed the INSAT-3DR retrieved total ozone with respect to our ozonesonde observations. The total ozone column from INSAT-3D showed a maximum difference of upto 10%. To mitigate these deviations or errors, we have checked the radiance biases in INSAT-3D/3DR observations by inter-calibration with MSG-SEVIRI for collocated pixels and observed a bias in ranges 4 - 6 K in INSAT-3D. Further, in the new retrieval algorithm based on a feed-forward neural network and the optimal estimation (1D Variational assimilation) method, we have inculcated these biases and observed very significant improvements in the INSAT-3D/3DR ozone. We have used an improved NWP forecast for the apriori in physical retrieval to minimize the statistical errors of INSAT-3DR total ozone compared to S5-P/TROPOMI and MetOp/IASI measurements.

Presentation Mode: Oral

Presenting Author: Prajjwal Rawat

Registration ID: NSSS-20220105022416

Bayesian inverse modeling of CH_4 fluxes over the peninsular India

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Atmospheric methane (CH_4) is a significant greenhouse gas which influences the radiative properties of atmosphere and hence affects the Earth's climate system. Recent analysis shows that the atmospheric concentration of CH_4 has increased by 2.6 times compared to the pre-industrial period value. This enhancement is mainly attributed to the anthropogenic activities. Relatively shorter atmospheric lifetime of CH_4 makes it a potent species for climate change mitigation. Towards this end, it is essential to understand the geographical distribution as well as the adequate quantification of CH_4 sources and sinks. Here, the state-of-the-art Bayesian inverse modeling methodology is used to optimize the CH_4 fluxes over the peninsular India by incorporating an atmospheric transport model, prior fluxes and atmospheric CH_4 concentration measurements. Source-receptor relationship obtained from the particle dispersion model FLEXPART is used as the transport component for inversion. Prior CH_4 fluxes include anthropogenic emission, geological emission, emission from wetland, termites and wildfire and soil sink. CH4 measurements from three stations such as Thumba (8.5°N, 76.5°E), Sinhagad (18.35°N, 73.75°E) and Gadanki (13.5°N, 79.2°E) during the years 2017 and 2018 are used to carry out inversion. After the inversion, enhancement in fluxes are mainly observed over southern and eastern peninsular India. The north-western peninsular India, adjacent to Sinhagad, shows a reduction in the posterior flux. The root-mean square error value of modeled and observed concentration is reduced after inversion.

Presentation Mode: Oral

Presenting Author: Anjumol Raju

Registration ID: NSSS-20220104013833

Emissions of biogenic VOC from Achanakmar-Amarkantak Biosphere Reserve (AABR)Forest in Central India

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Isoprene and monoterpenes are the most abundant biogenic volatile organic compounds (BVOCs) emitted in large quantities from terrestrial plants. The annual global BVOCs emission budget (~1150 Tg C Year-1) from the terrestrial ecosystem is almost comparable to that of methane (~1000 Tg C Year-1). The main global source of isoprene and monoterpene are tropical or subtropical and temperate forests. However, the measurements of BVOCs in the Indian sub-continent are limited. We have estimated the isoprene and monoterpene emission capacities from dominant tree species in the Achanakmar-Amarkantak Biosphere Reserve (AABR). The AABR is located in the Anuppur and Dindory forest divisions of Madhya Pradesh and Bilaspur and Marwani forest divisions of Chhattisgarh. It covers an area 3,835.51 sq km, with forest coverage of 2437.85 sq km (63.56%). It has highly diverse flora, comprised of 1527 species, most of which are moist deciduous forests (63%). Among 1527 species, (BVOC) emission capacities for forty-nine tree species that cover more than 90% of AABR forested areas were determined in this study. At standard conditions (30 °C Temperature and 1000 μmol m−2 s−1 PAR) the average emission capacities across different species showed large variability. For instance, the maximum emission capacity of isoprene was found in Dalbergia sissoo (71.12 μg C g-1h-1) and emission capacities for Terminalia arjuna and Acacia catechu were below the detection limit (BDL). Isoprene was the dominant BVOCs emitted from the selected plant species. The emission capacity of isoprene was ~7 times higher than that of monoterpenes. The average isoprene emission capacity of the AABR was 4% more than that of a forest region in Haryana. However, monoterpene emission capacity was found to be lower 13% than that of isoprene from the same area (AABR). This study highlights the need to estimate BVOCs emission capacities in other Indian tropical forests to understand their role in regional atmospheric chemistry.

Presentation Mode: Oral

Presenting Author: Tanzil Gaffar Malik

Registration ID: NSSS-20220110095954

CO_2 variability over a coastal urban station

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Recognizing the role of Carbon dioxide (CO_2) in altering climate research and air pollution, direct measurements carried out over a coastal urban station using Li-COR CO_2/H_2O analyser. The objective of the present study is to examine CO_2 variability during December-March. Day-to-day variability of CO_2 ranges from 380-550 ppm with a mean (423.1) and standard deviation (29.2). Monthly mean diurnal variability of CO2 is maximum during midnight to early morning hours and minimum during afternoon. Overall diurnal variation is similar during the entire months. The diurnal CO_2 variability is associated with the competing source/sink mechanisms. The link between CO_2 concentrations with Wind speed (WS), Wind direction (WD), Atmospheric temperature (T) is examined. Wind speed varies inversely with CO_2. CO_2 concentration is low in the southwest sector compared to northern side of site. Atmospheric temperature shows an exponentially decaying relation with CO_2. The CO_2 forcing is estimated and varies from 0.75 to 3.5 Wm-2 with temperature change from 0.75 to 2.00C.

Presentation Mode: Oral

Presenting Author: Sandhya K Nair

Registration ID: NSSS-20220110044531

Local emission and long-range transport impacts on the CO, CO_2, and CH_4 concentrations

(Lead Talk)

Chaithanya D. Jain[1], Vikas Singh[1], Akhil Raj S. T.[1], B. L. Madhavan[1], M. Venkat Ratnam[1]

[1]National Atmospheric Research Laboratory

Local emission and long-range transport impacts on the observed concentrations (dry air mole fractions) of CO, CO_2, and CH_4 have been investigated. All the three gases have shown strong seasonality and diurnal variations. Trend analysis showed a significant decreasing trend in CO (14.3 ± 0.2 ppbv/year) whereas, increasing trends in CO_2 (2.5 ± 1.2 ppmv/year) and CH_4 (11.1 ± 0.03 ppbv/year). CO_2 and CH_4 trends are marginally higher than the global trends (2.2 ± 0.004 ppmv/year and 7.0 ± 0.001 ppbv/year, respectively) for the same period highlighting the sustained local emission impact on the observed concentrations. Among the three species, CO is found to be the most local emission impacted species wh4en compared to CO_2 and CH_4. Long-range transport impact dominance over the local emission is observed in CO_2 and CH_4 during all the seasons. Analysis using MODIS fire count data, Concentration Weighted Trajectory (CWT) and FLEXPART have reconfirmed the combined effect of local and long-range transport impacts on the observed concentrations. Comparison of the IASI MetOp and AIRS satellite data products with surface measurements showed the significant bias and poor representation of the seasonality demonstrating the limitations on the sensitivity of satellite trace gas measurements within the boundary layer.

Presentation Mode: Oral

Presenting Author: Chaithanya D. Jain

Registration ID: NSSS-20220110111732

Is the ABL altitude or strong thermal inversions that control the vertical extent of aerosols?

P. Prasad[1], Ghouse Basha[2], M. Venkat Ratnam[3]

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Atmospheric boundary layer (ABL) plays a significant role in controlling the variability of atmospheric constituents (aerosols and trace-gases) both diurnal and seasonal at the surface. However, on several occasions, high aerosol concentration in the lidar measurements is observed even above the ABL altitude. This raised a question that up to what extent ABL altitude acts as a capping layer for these pollutants? From the detailed analysis carried out using long-term (2010-2018) lidar observations and simultaneous radiosonde profiles obtained from Gadanki, India, we show that 'there exist thermal inversions (TI),which are stronger than the ABL inversions, that fully control the vertical extent'. The detailed characteristics of TI (inversion strength (IS) and inversion depth (ID)) are also obtained. The results revealed that aerosol concentrations below the TI altitude increases with IS (ID) up to 3-4K(300-400m) during winter whereas in pre-monsoon it increases up to 2-3K (100-200m). Thus, IS of up to 2-4K is required to fully trap the aerosol concentrations and this TI coincide with the ABL inversions for 51.7% only, particularly during the winter and pre-monsoon seasons. The observed results provided further evidence that the vertical distribution of aerosols is restricted to the maximum extent by the TI but not the ABL altitude. These observations lead us to propose a hypothesis that 'trapping of aerosols fully occurs up to particular IS and ID only and the ABL altitude is not the deciding factor most of the time for capping the aerosol vertical distribution'. These findings will greatly help in modelling the diffusion and transport of air pollutants in the lower troposphere.

Presentation Mode: Oral

Presenting Author: P. Prasad

Registration ID: NSSS-20220105050106

Do the large-eddy simulations yield deeper atmospheric boundary layers in comparison to the RANS?

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The turbulent nature of the atmospheric boundary layer (ABL) and its vertical thickness is enforced by a variety of internal and external factors, resulting in a strong diurnal variation in the meteorological parameters. These variations are directly influenced by several factors such as the amount of incoming solar radiation, presence of clouds, convection, turbulence, and surface-layer energetics, to name a few. The regional atmospheric models based on the Reynolds Averaged Navier-Stokes technique, as well as the large eddy simulations (LES), have the potential ability to reproduce the diurnal variations in the ABL characteristics. In this paper, we investigate the major differences in the characteristics of diurnally evolving ABL from RANS and LES techniques for a clear-sky and a cloudy day over Thiruvananthapuram (8.5^{o} N, 77.0^{o} E), a coastal station in India, under the influence of a tropical cyclone named Ockhi. The Parallelized LES Model (PALM) is used for the LES simulations, whereas the Consortium for small-scale modelling (COSMO) model represents the RANS approach. The growth and decay of ABL during the forenoon and evening hours was smoother in the LES, whereas it was more rapid in the COSMO simulations. The ABL heights inferred from the PALM model tend to be deeper than that in the COSMO, in turn indicating the development of vigorous turbulence and convection in LES. Both the PALM and COSMO models showed the formation of a very stable boundary layer during the late evening and nocturnal hours. The study also evaluates the sensitivity of the PALM model to initial and lateral boundary conditions for the model domain.

Presentation Mode: Oral

Presenting Author: D. Bala Subrahamanyam

Registration ID: NSSS-20211126050025

Impact of COVID-19 lockdown on Surface, ABL, and Instability parameters over India

Ghouse Basha[1], M. Venkat Ratnam[1]

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We assess the detectability of COVID-19 like emission reduction in surface meteorological parameters, the Atmospheric Boundary Layer (ABL) height and the instability parameters (CAPE and CINE) using a suite of surface, radiosonde and model simulations. Results showed a unique footprint of COVID-19 lockdown in all the parameters. Our results indicated the increase in visibility, temperature, and wind speed, while relative humidity decreases during the lockdown. These responses are significant in inland stations compared to coastal stations. The spatial variation of temperature, (wind speed) and relative humidity shows an increasing and decreasing pattern over the Indo Gangetic Plain (IGP) and central parts of India by 20% (100%) and 40%. The results clearly indicated the response of lockdown is significant over inland compared to coastal regions. An increase in ABL height is large over the Indo Gangetic Plain and central parts of India by 80% during lockdown days (DLD) of 2020 compared to 2019. Instability (CAPE) decreases by 140% in the IGP and central parts of India, where it shows an increasing pattern in other parts of India. A prominent strengthening of CINE in the IGP and a weakening elsewhere is also noticed. These changes in CAPE and CINE can be mainly attributed to the dearth of saturation in lower troposphere levels, which prevented the development of strong pseudo-adiabats during DLD. These results provide a comprehensive observation and model-based insight for lockdown induced changes in the meteorological parameters.

Presentation Mode: Oral

Presenting Author: Ghouse Basha

Registration ID: NSSS-20220110042802

Anomalous radiative warming by clouds over a sub-region within the Indian summer monsoon region

V. Sathiyamoorthy[1]

[1]ISRO

Clouds influence the top of atmosphere (TOA) radiation balance by reflecting part of the incoming shortwave solar radiation and blocking part of the earth emitted outgoing longwave radiation. Net radiative effect of the tropical deep convective clouds is nearly zero as the shortwave cooling and longwave warming effects nearly cancel out. But Indian summer monsoon clouds are known for their net radiative cooling effects. Shortwave cooling effects of the Indian monsoon clouds dominate longwave warming effects. In the present work, anomalous warming exerted by monsoon clouds in a sub-region around south Peninsular India and Sri Lanka (SPSL) is reported. Reason behind this unusual warming over SPSL is investigated using 10-year TOA radiative flux data from Clouds and the Earth's Radiant Energy System payloads onboard Aqua and Terra satellites and International Satellite Cloud Climatology Project (ISCCP) cloud data. TOA net radiative forcing is as high as +15 Wm-2 over this sub-region. Comparison of cloud data over the head Bay of Bengal with net radiative cooling and SPSL with net radiative warming suggests that cloud cover amount of high-level cirrostratus (Cs) and cumulonimbus (Cb) clouds is significantly less over the SPSL. This sub-region is characterized with atmospheric subsidence due to orographic effect. Clouds, including Cs and Cb clouds thin out over the SPSL region due to subsidence motion. These two clouds significantly influence the radiation balance over the SPSL when compared to other cloud types. Reduction in the coverage of these clouds hence results in net radiative warming. It is also observed that when the magnitude of shortwave cloud radiative forcing is below a certain threshold then the magnitude of longwave cloud radiative forcing is more than the magnitude of shortwave cloud radiative forcing which results in net radiative warming. Net radiative warming is observed in ~65% of the grid points over the SPSL during summer monsoon season.

Presentation Mode: Oral

Presenting Author: V. Sathiyamoorthy

Registration ID: NSSS-20220110093645

An approach for tropospheric humidity retrieval from radio occultation refractivity profiles

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Here a technique to retrieve humidity from neutral atmospheric refractivity is discussed. There are methods which assumes some additional information like temperature and pressure at a lower level is known. Additional information used is fraught with uncertainties many a times (e.g., remote oceans without any meteorological observations). Each refractivity profile contains information on humidity that can be decoded without any such additional in-situ or atmospheric reanalysis information. Identification of such features is important from climate monitoring perspective as well. In this paper various signatures of humidity that can be identified without any auxiliary information are discussed with emphasis on tropical region (30^{o} N to 30^{o} S) leading to development of a technique for retrieval of humidity without any auxiliary information.

Presentation Mode: Oral

Presenting Author: Deveerappa Jagadheesha

Registration ID: NSSS-20211217054252

Retrieval of atmospheric profiles from microwave radiometer using AI

Renju R[1]

[1]VSSC, ISRO

The ground-based Microwave Radiometer Profiler (MRP) provides valuable information on the atmospheric profiles in the lower troposphere with high temporal resolution (~1 min data) under all-weather condition and are vital inputs for characterization of the atmospheric boundary layer, convective systems and for studying the atmospheric dynamics. The instrument measures the brightness temperatures at K and V band frequencies and different retrieval algorithms such as linear statistical inversion, the optimal estimation method, the one-dimensional variational (1D-VAR) retrieval method and neural networks are used to derive atmospheric profiles. Neural networks (NN) can offer the best performance for the solution of nonlinear relationships in the model, which is important for the retrieval of humidity profiles. A deep learning approach - batch normalization and robust NN (BRNN) is used to retrieve temperature and humidity profiles from a ground-based MRP. It consists of two hidden layers and the rectified linear unit as the activation function because it can overcome the problems of saturation and vanishing gradients and is much faster. Optimal estimation (OE) is a widely used physical retrieval method that combines measurements, prior information, and the corresponding uncertainties based on Bayes's theorem to find an optimal solution for the atmospheric state. In this technique forward model is used to calculate the brightness temperature using Liebe's radiative transfer (RT) model. These deep learning approaches are are used to retrieve the atmospheric profiles and the performance of various retrieval techniques are inter-compared.

Presentation Mode: Oral

Presenting Author: Renju R

Registration ID: NSSS-20211228083758

Impact of Satellite Based Geographical Data on Simulation of Rainfall over North Eastern Region of India

Rekha Bharali Gogoi[1], Akriti Yadav[2], Shyam S Kundu[1], S P Aggarwal[1]

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The performance of any numerical weather prediction model is critically dependent on the model initial condition as well as surface-level geographical information such as land use land cover (LULC) and terrain condition of the study area. The topography of the Northeastern region (NER) of India is very complex that imposes considerable challenges in rainfall forecast over this region. In this study, high-resolution rainfall simulations are conducted using Weather Research and Forecasting (WRF) model for pre-monsoon and monsoon season in the year 2018. Two sets of terrain data are used namely, WRF default USGS and CartoDEM, and the LULC data are taken from USGS, MODIS, and NRSC, ISRO. In the present study, the efficiency of the WRF model is assessed by comparing the model simulated rainfall with GPM rainfall. In addition, model-simulated surface level meteorological parameters are compared with ERA5 reanalysis data. Significant improvement in rainfall forecast using CartoDEM over Brahmaputra valley, Mizoram, and Tripura are observed mainly for the high-resolution model simulations compared to the USGS experiment. Furthermore, the results suggest that the high resolution and updated LULC data obtained from ISRO has the potential to improve biases of the rainfall forecast over the north-eastern region of India mainly over the western and central part of Assam covering the Brahmaputra valley. Among the different LULC experiments, ISRO LULC simulations show an improved forecast of surface-level meteorological parameters such as wind, temperature, and relative humidity compared to USGS and MODIS simulations.

Presentation Mode: Oral

Presenting Author: Rekha Bharali Gogoi

Registration ID: NSSS-20220104100202

Spatio-temporal signature of anomalous positive and negative IOD events using remote sensing data

Amit Kumar Jena[1], Sachiko Mohanty[1]

[1]Indian Institute of Remote Sensing

The equatorial Indian Ocean (IO) experienced anomalous negative and positive Indian Ocean Dipole (IOD) events during 2016 and 2019 respectively. The surface signature of anomalous events of the IOD are observed using sea surface temperature anomaly (SSTA), sea surface height, sea surface salinity, zonal and meridional wind components from remote sensing data. Eastern equatorial IO gets exceptionally cold and western equatorial IO becomes unusually warm during the mature phase (September-October-November) of pIOD in 2019. Warm SSTA boosts atmospheric convection in the western part of IO which is favourable for strong Indian monsoon. The anomalous wind along the Somali coast causes strong coastal upwelling which enhances the marine ecosystem. Excess precipitation and upwelling lead to low and high sea surface salinity along the western and eastern equatorial IO. Density gradient leads sea surface height trough along eastern and crest along central and western equatorial IO. The reverse phenomena characterized by warmer SSTA, enhanced convection, higher sea surface height and low sea surface salinity in the eastern and cooler SSTA, lower sea surface height and high sea surface salinity along western equatorial IO in 2016 negative IOD year.

Presentation Mode: Oral

Presenting Author: Amit Kumar Jena

Registration ID: NSSS-20220106084354

Comparative Analysis of Binary Classifiers for Rainfall Prediction in Mumbai region

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Rainfall prediction is one of the major challenges for the meteorological department due to the inherent unpredictability of the factors affecting it. Timely and accurate predictions of rainfall can be helpful in various sectors which can help in reducing human and financial loss. Santa Cruz, Mumbai, which is known for having the 2nd busiest airport in the country can take the help of accurate rainfall prediction for proper planning to reduce economical loss. In this study, we carry out a set of experiments that involve the use of prevalent machine learning techniques to build models to predict whether it is going to rain tomorrow or not, in Santa Cruz, based on weather data of previous days. This comparative study is conducted concentrating on three aspects: modeling inputs, modeling methods, and pre-processing techniques. We procured 48 years of raw daily meteorological data (1969-2017) from the Indian Meteorological Department. Using correlation and descriptive analysis, we decided the number of lag variables for each parameter. The data was then divided into three datasets- (i)1969 to 2011 was used as the training set for analysis and prediction, (ii) 2012 to 2017 was used as the test dataset. We used the training data to train various Binary classifiers based on machine learning algorithms like Logistic Regression, Decision trees, Naive Bayes, K-Nearest neighbors, ANNs, Random Forest, XGBoost, CatBoost, and LightGBM. To achieve the best performance of the trained models, the validation set was used to tune their hyperparameters. Using the test data, we performed a comparative study of these validated models using various evaluation metrics to find the best-performing model for the prediction purpose. Three days prior data was used as an input to the model for predicting the next day's rainfall prediction. The comparative analysis demonstrated that the best classification accuracy (up to 93%, F1 Score up to 91%) was achieved with Random Forest.

Presentation Mode: Oral

Presenting Author: Ishan Deshpande

Registration ID: NSSS-20220109094034

Rapidly intensified, Long duration North Indian Ocean Tropical Cyclones: validation and dynamics

Arpita Munsi[1,2], Amit Kesarkar[1], Jyoti Bhate[1], Abhishek Panchal[1], Kasturi Singh[1], Govindan Kutty[2], and Ramkumar Giri[3]

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High-resolution (2km×2km) reanalyses have been generated using the WRF-ARW model and three-dimensional variational-Ensemble Kalman Filter (3DEnKF). The six-hourly cyclic downscaling methodology has been used for simulating the life cycle of three rapidly intensified long-life tropical cyclones (TCs) viz. Fani, Ockhi, and Luban occurred over North Indian Oceans. The available surface and upper-air observations, radiance data, and scatterometer/radiometer wind data have been assimilated. The surface wind was validated using the RAMA buoys observations showed a better correlation at the cyclonic stage and severe cyclonic stage compared to the very severe cyclonic stage. Comparing wind distribution at 850 hPa to the ERA5 showed that the analysis successfully captured more intense TC stages. The significant wind structure features in the surface, lower, middle, and upper tropospheric observed by Scatsat-1 and INSAT3D satellites have been simulated by analysis. The simulated and the Global Precipitation Measurement (GPM) accumulated rainfall distribution was found to be collocated, especially over heavy rainfall regions.This developed reanalysis has been used to study dynamics and thermodynamics of these three TCs. Analysis of vorticity budget showed that the strengthening of the relative vorticity tendency terms were due to stretching (TC Fani) and middle tropospheric advection (TCs Luban and Ockhi). The increase or decrease in upper-tropospheric divergence led to RI through two different mechanisms. The increase in upper divergence strengthens the vortical convection (in TC Luban and Fani) and its decrease caused a reduction in the ventilation flow followed by moisture accumulation, enhanced diabatic heating, and strengthened the warm core (TC Ockhi). RI led unorganized, weak, discontinuous vertical vortex columns to become organized with intense vertical velocity throughout the column. TC core was dominated by vorticity than strain, since deep depression (DD) stages.

Presentation Mode: Oral

Presenting Author: Arpita Munsi

Registration ID: NSSS-20220110085333

Indian summer Monsoon: A combat between deep convection and the upper tropospheric humidity inferred

(Lead Talk)

K. N. Uma[1], Bukya Sama[1], S.S. Das[1]

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High spatial and temporal resolution measurements of the Outgoing Long-wave Radiation (OLR) and the Upper Tropospheric Humidity (UTH) from the Indian Geostationary satellite Kalpana from 2010 to 2015 have been utilized to find the contest between the OLR and UTH. The lead-lag analysis reveals that over the Indian landmass, the UTH leads deep convection by 2-4 hours, indicating the upper troposphere (UT) is already moist before the occurrence of convection. The moistening of the UT is mainly through Tropical Easterly Jet rather than monsoon convection. The UTH lags (2-6 hours) convection over nearby oceans, thereby convection is moistening the UT. For the first time a mechanism is proposed, in which, if the UTH leads deep convection, thick/dense high-altitude clouds form that can lead to negative feedback to convection through radiative cooling. Thin clouds form when UTH lags convection thereby can result in positive feedback for convection. However, this feedback to convection is controlled by the presence of the Low-level jet and Tropical easterly jet.

Presentation Mode: Oral

Presenting Author: K. N. Uma

Registration ID: NSSS-20220110051839

Simulation of impact of surface infrared heating on growth of the cloud

Subhrajit Rath[1,2], Kavita Patnaik[1,2], Amit Kesarkar[1], Jyoti Bhate[1], Govindan Kutty[2]

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The cloud-radiation interaction modulates the growth of the cloud in two ways. The infrared heating causes an increase in the evaporation rate of cloud liquid/ice on the surface. Further, it alters the vertical velocity inside the cloud and causes near boundary turbulence. Moreover, prominent optical processes like multiple scattering and absorption occurring inside the cloud lead to redistribution of heat inside the cloud layers. We have developed a cloud radiative transfer- microphysics interaction solver which caters to cloud lateral heating due to direct and diffused solar radiations, redistribution of heat inside the cloud due to multiple scattering/absorption, and changes in vertical velocity due to temperature gradient (associated with radiative heating/cooling). The turbulence diffusivity inside the cloud causes rapid mixing and increased momentum, heat, and mass transfer rates, altering the growth. The developed solver integrates Advection diffusion equations (ADEs) using the finite volume method with 1m × 1m horizontal resolution. The heating due to radiation absorption was calculated using absorption coefficients provided by High-Resolution Transmission Molecular Absorption Database (HITRAN) and coupled with ADE. The developed model integrated the idealized cloud of 10 km × 10 km horizontal extent and 10 km height. The thermodynamical temperature, pressure, and wind speed profiles were initialized using ERA5 reanalysis. The spline algorithm is used for interpolation of these parameters. The equations mentioned above are solved to understand the impact of surface heating on the development of the cloud. The results from the simulations will be presented in the symposium.

Presentation Mode: Oral

Presenting Author: Subhrajit Rath

Registration ID: NSSS-20220110085604

Improving InSAR based DEMs using Successive Best Pixel Selection approach for DEM fusion

Priti Girohi[1], Ashutosh Bhardwaj[1]

[1]IIRS, ISRO

Digital Elevation Models (DEMs) are the key and primary input for numerous modelling and quantifying processes that utilize information of earth's topography. SAR Interferometry generates high-spatial-resolution and quality DEMs. The accuracy and quality of generated DEMs depend on various factors such as geography, topography, slope, aspect and landform types. In this study, multiple image pairs are selected with varying parameters such as different wavelengths, critical baselines and viewing angles. The produced InSAR based DEMs can be improved by following the fusion approach which produces better output by minimising the inherited errors in DEMs due to primary acquisition technology, processing steps and characteristics of terrain. This study is based on developing a novel algorithmic methodology referred to as the Successive Best Pixel Selection Approach for improving the Interferometry based DEMs. Each pixel in the input DEMs has an elevation and a corresponding coherence value. The proposed model will check for the larger coherence value at each pixel and select the corresponding elevation value for the output, testing each successive pixel of the input DEMs and further the nearest values are selected. This gives the improved elevation and the best coherence image containing the greater coherence values from both the inputs. The improved output is further compared with the range of elevation values from the toposheet. The obtained fused output accuracy is assessed with the ICESat-2 spaceborne LiDAR ATL08 photon dataset as reference data for error estimation. The RMSE values show an improvement in the output DEM with an RMSE of 0.98 m, with RMSE of 1.58 m for input DEM 1 and 1.20 m for input DEM 2 when only near ground points are considered. Further, multi-source, multi-temporal and multi-baseline datasets fusion can lead to future scope of this approach for producing better results.

Presentation Mode: Oral

Presenting Author: Priti Girohi

Registration ID: NSSS-20211227043611

Numerical Study on the Impact of Cyclonic Storm Ockhi on Sea-breeze Circulation over the Arabian Sea

Freddy P Paul[1], Roshny S[1], T J Anurose[1], D Bala Subrahamanyam[1], Radhika Ramachandran[1]

[1]ISRO

In the first week of December 2017, Comorin Sea region witnessed the genesis of a very severe cyclonic storm Ockhi that passed through the Arabian Sea and made landfall over Gujarat coast. The present investigation takes advantage of the presence of Ockhi close to the Kerala coast to investigate the influence cyclonic storm on the meso-scale sea-breeze circulations over two Kerala coastal stations namely, Cochin (COK) and Thiruvananthapuram (TVM). For this investigation the numerical weather prediction model COSMO is simulated for 16 consecutive days from 24 November to 10 December 2017 based ICON global model initial conditions. Results obtained from the study showed the weakening of sea breeze circulation during the passage of Ockhi, which is attributed to the dip in the sea-breeze flow and associated increase in coastal-breeze flow, resulting in SBC/CBC low value. After the demise of the storm, both the coastal stations showed prominent sea-breeze circulation with clear return flow aloft. One of the striking features is the clear visibility of return flow of sea-breeze circulation during the dissipation stage of the storm which is otherwise difficult to discern over these coastal stations during this study period.

Presentation Mode: Oral

Presenting Author: Freddy P Paul

Registration ID: NSSS-20220110015625

Mumbai monsoon – unravelling the morphology of clouds and microphysics of precipitation

Kaustav Chakravarty[1], G.Pandithurai[1]

[1]Indian Institute of Tropical Meteorology, Pune

The urban megacity of Mumbai which is situated on the western coast of Indian subcontinent experiences heavy rainfall spells during the pre-monsoon and monsoon periods from the cloud systems originating from the eastern and western part of the region respectively. The present study highlights the vertical structure of clouds and microphysical features of precipitation during the inter-seasonal and intra-seasonal phases of monsoon over Mumbai for a continuous period of 4 years (2018-2021). The study will also portray the cause and the impact of the severe rainfall events of Mumbai which creates severe flooding at the city quite frequent during the monsoon times. The study has been accomplished by using a Joss-Waldvogel Disdrometer data set up at IMD campus in Santacruz along with the radar reflectivity data from S-band Doppler Weather Radar placed at Colaba in southern Mumbai. The wind direction and corresponding rainfall observation over Santacruz shows that Mumbai receives rain primarily from easterly winds during the pre-monsoon time which then shifts to the south-westerly winds during the monsoon period. A distinct diurnal variation with three rainfall peaks was noted for the pre-monsoon period. The dominance of urban convective environment in the pre-monsoon period and the impact of moisture supply from the marine sources over the city during the monsoon months are considered to be contributing factors for the contrasting diurnal pattern of rainfall for these inter-seasonal phases of monsoon. The corresponding vertical profile of radar reflectivity also shows that the rainfall peaks are complimented with clouds and hydrometeors yielding higher reflectivity during pre-monsoon season. The microphysical characteristics of rainfall shows, larger diameter raindrops dominate the pre-monsoon months with respect to the monsoon period. Finally, the study will also highlight a comparative analysis of the rainfall over Mumbai with that of Chennai.

Presentation Mode: Oral

Presenting Author: Kaustav Chakravarty

Registration ID: NSSS-20220110015417

The role of bright band characteristics of stratiform rain on the altitudinal variation of raindrop

Lavanya S[1], Kirankumar N.V.P.[1]

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The simultaneous observations of vertical profiles of Micro rain radar (MRR) and surface based disdrometer collected during 2006-2015 and 2018 were analyzed to investigate the role of bright band characteristics on the altitudinal variation of raindrop size distribution during stratiform rain events over the coastal region Thumba. Due to the attenuation of MRR signals during convective and transition rain regimes, only stratiform rain events are considered in this study. Results shows that there exists a distinct variation seasonal variation in the altitudinal profiles of DSD parameters for bright band (BB) and non-bright band (NBB) events within the stratiform rain. Present results highlight that i) the mean profiles of DSD parameters show lower values during BB compare to that of NBB cases except Dm. iii) Irrespective of the seasons, the percentage of occurrence of Î¼<0 (concave up) is higher at the higher altitudes for BB and the negative values of Î¼ are dominant, particularly between 2 to 3 km during pre- and post, -monsoon seasons compared to the monsoon season. However, the probability of the occurrence of negative Î¼ decreases with the decreasing height considerably. The potential reason for such events is discussed.

Presentation Mode: Oral

Presenting Author: Lavanya S

Registration ID: NSSS-20220110091206

Multicomponent multiphase model for stratification and compressibility of Earth's Atmosphere

Debojit Sarkar[1,2], Amit P. Kesarkar[1], Jyoti Bhate[1], Abhishek Panchal[1], P. Vamsi Krishna[3], Anantharaman Chandrasekhar[2]

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The multicomponent multiphase flow of the planetary atmosphere comprised of gases, particles, ions, and hydrometeors exist in different phases. The phase of the system depends on macroscopic hydrodynamic properties of the system, characteristics of the ambient, and the path followed by the system to achieve a definite change in state to acquire equilibrium. This paper has formulated a generalized model for stratifying the multicomponent-multiphase system through a density interface and applied it to the Earth's atmosphere. We have developed an expression for generalized chemical potential in the presence of external potentials like gravitational potential, electrochemical potential, photochemical potential, mechanochemical potential, magnetochemical potential, and tribochemical potential. The equations for generalized entropy, equation of states, and vertical stratification have been formulated based on the generalized chemical potential equation. Radiosonde/GPSsonde data sets for the year 2020 obtained from the prepbufr dataset provided by NCEP have been used to calculate the compressibility profile of the atmosphere and the stratification of chemical components. The comparisons of the different real gas equations of states have been made to identify the appropriate equation of state for the real atmosphere. The statistical analysis viz. bias, root mean square error, standard error, and correlation coefficient have been calculated for the estimated values of physical parameters with global radiosonde/GPS sonde observations for the year 2020. The results obtained from the study will be presented in the symposium.

Presentation Mode: Oral

Presenting Author: Debojit Sarkar

Registration ID: NSSS-20220110085646

Regional Distribution of Black Carbon Aerosols over India from Satellite (GOSAT-2 CAI-2) and Ground

(Lead Talk)

Mukunda M. Gogoi[1], S. Suresh Babu[1], Ryoichi Imasu[2], Makiko Hasimoto[3]

[1]Space Physics Laboratory, Vikram Sarabhai Space Centre, ISRO, Thiruvananthapuram, India; [2]Atmospheric and Ocean Research Institute, University of Tokyo, Japan; [3]Space Technology Directorate I, Earth observation research center, Japanese Aerospace Exploration Agency, Japan

The light-absorbing Black Carbon (BC) aerosols have a very important role in affecting the Earth's radiation budget and climate. Concerted efforts have been made to understand the spatio-temporal variability and radiative properties of BC on a regional and global perspective through observation and modelling. However, the ground-based observations of BC aerosols have limited spatial coverage, whereas model simulations suffer from large biases due to the uncertainties arising from inaccurate model inventories and meteorological input available for the simulations. In this context, retrieval of BC from satellite-based observations synchronizing with the ground-based point-measurements is a novel idea to quantify and classify the real BC environment across distinct geographic regions of the globe. In this study, we present the regional distribution of BC concentrations over the Indian region based on satellite retrieval from Cloud-Aerosol Imager - 2 (CAI-2) observations on-board Greenhouse gas Observing Satellite – 2 (GOSAT-2). Simultaneous ground-based observations of BC are obtained from the Aerosol Radiative Forcing over India Network (ARFINET) of aerosol observatories. The results indicate that, despite the seasonal biases, the overall regional distribution of BC is very well represented by the CAI-2 retrieval, with close agreement with the ground-based measurements. The validation and closure studies between the two data sets show RMSE < 2, with absolute difference < 2 µg m-3 during winter ($R = 0.79$) and pre-monsoon ($R = 0.74$) months. Regionally, the satellite retrieval is better over the northern part of India where the mass concentrations of BC are also, in general, higher than the rest of the country. The study highlights the effectiveness of the retrieval of BC from satellite (CAI-2) measurements and identification of the regional hotspots and seasonal features of BC, which could be effectively used for the regular monitoring of vehicular/ industrial/ biomass.

Presentation Mode: Oral

Presenting Author: Mukunda M Gogoi

Registration ID: NSSS-20220110105559

Prediction of Atmospheric Water Vapour from Indian Navigation Data Using Deep Learning Techniques

Chandrani Chatterjee[1], Soumen Datta[1], Saurabh Das[1]

[1]Indian Institute of Technology, Indore

Accurate measurement of atmospheric water vapour is crucial in forecasting any weather extremity. The complex dynamics of the same, however, makes the process extremely challenging. The conventional techniques (e.g. Radiosonde) used to measure atmospheric water vapour is very costly. Moreover, such measurement can be attempted only a few times a day. The uninterrupted signal from navigation satellite can facilitate the continuous measurements of atmospheric water vapour. This study has developed a deep learning regression model solely based on the data of newly launched India navigation system. The model has been trained with the range error which contains the error due to water vapour and some other un-quantified stochastic parts and weighting function based on the position of the receiver and the satellite elevation angle for all the satellites. The measured range has been corrected for all the major error sources like charged atmospheric error, clock error etc.. The model has been tested on a completely unforeseen data and error of prediction seemed to lie within +/-10 %.

Presentation Mode: Oral

Presenting Author: Chandrani Chatterjee

Registration ID: NSSS-20220110035053

New insights into the asymmetries in the precipitation days during the Indian summer monsoon and the

Kandula V Subrahmanyam[1], Karanam Kishore Kumar[1]

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It is known that precipitation falls disproportionately in time and region. It has been noted that there is skewed distribution in number days having no rain fall, light rain fall and extreme rainfall across the Indian region during summer monsoon. This precipitation unevenness or asymmetry has a great impact on various societal sectors and indicates how asymmetric precipitation is distributed over a period of time. However, the degree of asymmetry in the precipitation day distribution and its changes has been seldomly quantified across India, where extreme precipitation events are on increase. In this regard, the present study is carried out to quantify the asymmetry in precipitation days over the Indian region using 120 years (1901-2020) of daily gridded rainfall data from India Meteorological Department. A metric based on number of days it takes to have half of the seasonal rain fall during ISM is devised to investigate the asymmetry in the precipitation days. The analysis showed that on an average it takes only 12 days of rainfall to contribute 50% of seasonal rainfall during ISM over the Indian region. However, there is significant regional distribution of this metric, which serves as a very good tool for investigating the changing regional precipitation patterns over the ISM region. Further, the long-term evolution of this metric is studied in order to investigate the trends, which showed increased asymmetries in the recent years. It is noted that the increased asymmetry in the proposed metric indicates the significant broadening of the dry spells and thus increase in volatile precipitation events. The present study thus provided new insights into the distribution of precipitation days using historical precipitation data across India, which is envisaged to shed light on changing precipitation pattern in the current warming scenario.

Presentation Mode: Oral

Presenting Author: Kandula V Subrahmanyam

Registration ID: NSSS-20211129060923

Role of circulation dynamics on cloud distribution over the Indian summer monsoon region

S. S. Prijith[1], C. B. Lima[2], M. V. Ramana[3], M. V. R. SeshaSai[4]

[1]Space Physics Laboratory, Vikram Sarabhai Space Centre, Indian Space Research Organisation, [2]Physical Research Laboratory, [3]National Remote Sensing Centre, Indian Space Research Organisation, [4]National Remote Sensing Centre, Indian Space Research Organisation

Changes in cloud amount and distribution assume importance, as far the regional weather systems and climate are concerned. The present study quantifies long term trends of cloud properties over the Indian region using satellite observations. The study is carried out using measurements of cloud properties from MODIS-Terra and MODIS-Aqua during the periods, from 2000 to 2017 and 2002 to 2017 respectively. The analysis shows contrasting trends in cloud properties over the Northwest regions of Indian Ocean, in summer monsoon period. Cloud amount and cloud top height are observed to be decreasing over Northwest Indian Ocean in June and July, whereas the same are seen to be increasing over the same region in August and September. Consequently, mean cloud top temperature over this region increases in the first half of the season and decreases in the second half. Causative mechanisms for the observed changes in cloud properties are further examined, using three dimensional wind fields from MERRA2 reanalysis products. The analysis shows significant changes in atmospheric circulation pattern over the north Indian Ocean during the first and second half of summer monsoon. These changes in circulation pattern favor westward spread of clouds at higher altitudes and hence lead to increase in cloud amount and mean cloud top height over Northwest Indian Ocean in the second half. However, changes in atmospheric circulation prevent this westward spread in the first half and hence lead to opposite trends in cloud amount and cloud top properties in the first half. These contrasting trends in cloud properties in the first and second half of the season would have significant impacts on the summer monsoon rainfall over the Indian region.

Presentation Mode: Oral

Presenting Author: Prijith S. S.

Registration ID: NSSS-20211219101533

Estimation and validation study of Soil Moisture using GPS-IR technique over a tropical region: Vari

G. N. Madhavi[1], P. Sharath Kumar[1], R. A. Chipade[2], Jyoti Bhate[1], T V C Sarma[1]

[1]NARL, [2]ISRO

In this study, Global Positioning System - Interferometric Reflectometry (GPS-IR) technique was used to estimate SM. This method analyses changes in the reflected multipath signals recorded in Signal-to-Noise Ratio (SNR) data called as interferograms. These multipath reflections are directly proportional to dielectric properties of the reflecting surface. Estimated SM data has been validated and compared with collocated in-situ probe, Soil Moisture and Ocean Salinity (SMOS) satellite measurements, ECMWF ERA-5 and NASA Global Land Data Assimilation System (GLDAS); the former shows a good correlation of 0.98 but the magnitudes of SMOS, ERA-5 and GLDAS data are overestimated. Vegetation effects are also included in the algorithm which significantly improves the accuracy between the GPS derived SM and in-situ probe measurements. The success of this technique indicates its high value and could be gainfully employed over a large geographical area like India with the existing receivers due to its advantage of uniformity over several sensors which is highly suitable for several applications like assimilation using models for the better understanding of crop yield, floods and drought monitoring and ground water management studies. Variability of SM with rainfall and energy fluxes like latent and sensible heat fluxes from ERA-5 and GLDAS data are investigated. Observed SM values are positively correlated with rainfall during the study period. Seasonal variations of rainfall and SM in different monsoons are clearly noticed. Latent heat fluxes are more during spring, summer months and positively correlated with rainfall whereas sensitive heat fluxes show negative correlation.

Presentation Mode: Oral

Presenting Author: Gummadipudi Nagsai Madhavi

Registration ID: NSSS-20220110111330

From Humidity to Precipitation: Observed Relations among the Hydrological Cycle Components

Edwin V Davis[1], K. Rajeev[1]

Space Physics Laboratory, Vikram Sarabhai Space Centre, ISRO, Thiruvananthapuram

Atmospheric water vapour is highly variable in space and time and has the most crucial role in regulating the occurrence of clouds, precipitation, hydrological cycle, weather and climate. Though the variations of water vapour, clouds and rainfall are strongly coupled, investigations on the co-variations among these components of hydrological cycle are extremely sparse. Multi-year (2010-2017) high resolution microwave radiometer profiler (MRP) observations of the altitude profiles of specific humidity and cloud liquid water content (CLWC) together with the simultaneous and independent measurements of cloud occurrence and rain rate at the tropical coastal region, Thumba, provide a unique opportunity to investigate their coupled variations. The present study investigates the seasonal mean altitude-time variations of specific humidity and cloud liquid water content and the corresponding variations of integrated water vapour content (IWVC), integrated cloud liquid water content (ICLWC), cloud occurrence frequency and rain rate based on multi-year continuous observations and quantify the coupled variations among the above parameters based on the observations averaged over time intervals of <10 min. The ICLWC nonlinearly increases with IWVC, especially when IWVC is <64 mm. Generally, clouds formed are thicker with ICLWC >3mm when the IWVC exceeds 64 mm. The hourly accumulated rain rate varies widely in the range of 0.1–100 mm hr-1 for the values of IWVC between 50 and 75 mm. On average, the rain rate increases from ~3 to 13–20 mm hr-1 for an increase of IWVC from 60 to 68 mm. The linear relationship between the average rain rate and IWVC exists only for IWVC values between 60 and 68 mm, with a slope of about 1.2 to 2.0 mm hr-1 increase in accumulated rain rate for 1 mm increase in IWVC. Considerably less variation of the rain rate with IWVC occurs for IWVC>68 mm, indicating that the addition of more moisture after IWVC>68 mm is quickly lost through precipitation.

Presentation Mode: Oral

Presenting Author: Edwin V Davis

Registration ID: NSSS-20220110125500

Impact of Tropical Clouds on Atmospheric Heating: Estimations from Spaceborne Radar Observations

Aswathy R S[1],Rajeev K[2]

[1]University of Kerala, [2]Space Physics Laboratory,VSSC,Thiruvananthapuram

Clouds are the largest modulators of energy balance in the earth-atmosphere system. These energy modulations appear in the form of cloud radiative forcing and latent heating and are primarily responsible for the feedback effect of clouds, which is among the most uncertain and least understood atmospheric processes. The latent heat taken from the surface and released into the atmosphere during cloud formation is the strongest mechanism for the vertical transfer of heat from the surface to the atmosphere, which balances the energy budget at the surface and the atmosphere. The radiative and latent heating by clouds depend primarily on the altitude variation of cloud water content (CWC) and cloud phase. The Cloud Profiling Radar (CPR) onboard CloudSat satellite, operating at 94GHz, provided the first-ever observations to derive the global three-dimensional distribution of optically thick clouds and CWC with high vertical (240 m) and along-track spatial (1.7 km) resolutions. Its minimum detectable signal sensitivity is -30 dBZ, and hence can detect clouds with a water content of >0.4 mg/m3. However, CloudSat cannot detect optically thin clouds. Such clouds can be detected by the spaceborne lidar, CALIPSO, which has the same sub-satellite track as the CloudSat with a time lag of less than 15 seconds and hence sample the same cloud system. Both CloudSat and CALIPSO make observations only along the orbital track and hence the across-track spatial resolution and temporal sampling are limited by the 16-day orbit cycle. This study investigates the monthly mean 3-dimensional variations of CWC and the shortwave and longwave cloud radiative heating over tropics (averaged over 20° longitude bands) based on the combined analysis of CloudSat and CALIPSO observations during 2006-2010. Among the major findings, for the first time, this study brings out the vertical structure of double ITCZ over the tropical oceans and the role of cloud diabatic heating in its maintenance.

Presentation Mode: Oral

Presenting Author: Aswathy R S

Registration ID: NSSS-20220110031228

Association of deep convective cloud cores with sea surface temperature over the tropical oceans

Sisma Samuel[1], Nizy Mathew[1]

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In the tropical region, convection is highly associated with sea surface temperature (SST). The convective cores of the deep convective clouds, which exclude the non-precipitating anvils, account for a significant fraction of tropical rainfall and strongly impact large-scale dynamics of the free troposphere. In the present study, association between the occurrence of deep convective cloud cores (DCCCs) and SST over the tropical region is examined using three years (2012-2014) of brightness temperature (TB) data of the water vapour absorption channels of Sondeur Atmosphérique du Profil d'Humidité Intertropicale par Radiométrie (SAPHIR), aboard Megha-Tropiques satellite. The present study covers the characteristics of Megha-tropiques satellite, the methodology adopted in deriving deep convective cloud cores. The association between Occurrence frequency of DCCCs (OFD with SST, surface latent heat flux, free tropospheric humidity, and downwelling shortwave flux are examined over two dedicated deep convective regions, namely the equatorial Indian Ocean (EIO) and the western Pacific Ocean (WPO), for all seasons by applying the lead-lag correlation. The present study shows that the response of DCCCs to SST is faster over the EIO than over the WPO. Over the EIO and the WPO, DCCCs lag SST by 7 days and 12 days, respectively. When the SST-DCCC relation is analysed after removing the response time or lag, occurrence of DCCCs increases with SST even above 30.5◦C. Though similar studies have been done with precipitation, the tropical DCCCs are attempted for the first time. The observed lags are a few days shorter than those derived for precipitation.

Presentation Mode: Oral

Presenting Author: Sisma Samuel

Registration ID: NSSS-20211208033813

Use of 53MHz Radar of Calcutta University to quantify the Lower Atmospheric Wind Characteristics

Debyendu Jana[1], P. Nandakumar[1], Tanmay Das[1], Gopal Singh[1], Ashik Paul[1]

[1]University of Calcutta

Abstract-Summer monsoon over India exhibits large variabilities in its characteristics across the country due to varying topography, various internal factors like temperature difference between land and ocean and external factors like increasing greenhouse gas concentrations etc. Currently, five numbers of MST/ST wind profiler radars are established/under implementation in the country. As part of investigating the diurnal cycle of monsoon winds in different latitudinal belts during the onset phase and subsequent northward progression of monsoon, campaign mode observations have been conducted by all the five ST/MST Radars installed across the country during the monsoon of 2021. In this paper, monsoon characteristics have been studied using Doppler Beam Swinging (DBS) technique on data received from Stratosphere Troposphere (ST) radar, which is being implemented at Ionosphere Field Station, Haringhata of University of Calcutta (latitude-22.93^{o}N, longitude:88.50^{o}E geographic), located about 50km north-east of Kolkata. The experiment was carried out with a Pilot version of the radar which is presently operational. With this Pilot version, beams are formed at 15 off-zenith and radial vectors of winds were determined in East, West, North and South directions. From the calculated radial velocities, three components of wind velocities, namely, Zonal (U), Meridional (V) and Vertical (W) along with wind speed and wind direction were computed. The zonal and meridional wind pattern exhibit low disturbances or interference up to maximum altitudes of 8km, which is due to existence of cloudy weather and precipitation during the entire operational time period of monsoon with this Pilot version. It is found that the atmospheric echoes have been received from the 2 to 3.5 km of height with a maximum velocity of 11 to 16.4 m/s for zonal wind and corresponding values for meridional wind is 4.5 to 12.5 m/s during monsoon, 2021.

Keywords: Three component wind velocities, Doppler

Presentation Mode: Oral

Presenting Author: Debyendu Jana

Registration ID: NSSS-20211219080449

Comparison of prediction models for timeseries forecasting over a tropical location

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Climate change has a significant impact on human civilization and climate dependent systems such as agriculture, food production, water supply, and health in the 21st century. Temperature and rainfall are the two most important parameters, whose effect can be directly observed due to climate change. Future predictions of the above meteorological parameters are of much importance for a nation to forecast on agricultural outcome and natural disasters like flood, drought etc. Accurate prediction of above meteorological parameters may improve to mitigate the effect of the natural hazards. In the present study, the performance of some well-known prediction models has been investigated for the temperature and rainfall. The Gridded monthly precipitation and mean temperature data obtained from the Global Precipitation and Climate Centre (GPCC V7) are utilized for this study over the study location Kolkata, India for the period 1901-2014. Kolkata is located near the land-ocean boundary and substantial annual rainfall occurs over this region. The performance of Auto Regression (AR), Autoregressive Integrated Moving Average (ARIMA), and Seasonal Autoregressive Integrated Moving-Average (SARIMA) model has been studied for the present report. The temperature and rainfall data for different seasons, namely, winter (December-February), pre-monsoon (March-May), monsoon (June-September), and post-monsoon (October-November) has been predicted for the period 2001-2014, based on the input data for the period 1901-2014. The predicted value of temperature and rainfall for the period 2001-2014 has been compared with the GPCC obtained data for different seasons. Root mean square error (RMSE) shows the best performance for the ARIMA model with RMSE values 0.51, 0.56, 0.28 and 0.68 for winter, pre-monsoon, monsoon, and post-monsoon season. For rainfall, a high RMSE value has been observed for all the entire prediction model. The highest RMSE is observed in monsoon season. In recent years, th

Presentation Mode: Oral

Presenting Author: Arijit De

Registration ID: NSSS-20220108092755

Verification of mesoscale model prediction of Tropical Cyclones occurred over North Indian Ocean

Goriparthi Pavani[1], Jyoti Bhate[1], Amit Kesarkar[1]

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Tropical cyclones (TCs) are extreme weather events that cause significant damage to life and property. The damage can be reduced by timely and accurate prediction of TCs track, intensity, associated winds, and rainfall. We have simulated the 25 tropical cyclones that occurred over the north Indian ocean for 2016 to 2020 using the mesoscale model WRF and examined the predictability and forecast accuracy for the lead time up to 5 days. We have analyzed model generated track, intensity, surface, and upper-level winds and rainfall and compared with the IMD and satellite data sets like SCATSAT-1, INSAT-3d, and IMERG. The Direct Position error (DPE) over NIO varied from 72 km to 480 km and intensity error from 4 ms -1 to 12ms -1 for 6 hr-120 hours forecast lengths with higher DPE values over the Arabian Sea (AS) than over Bay of Bengal (BOB). The forecast track is on the southeastward of the observed track till 72 hours lead time and to the northwestward at later lead times. The model forecast tends to underestimate the wind speed compared to INSAT-3D AMVs during high-intensity stages and overestimate the same during low-intensity stages at lower (950-700 hPa), middle (600-400 hPa), and upper (350-100 hPa) levels. The Contiguous Rain Area (CRA) analysis for the landfalling TCs indicated that pattern error was the major contributor to the total rainfall forecast error for light to moderate rain thresholds and displacement error for moderate to heavy rain thresholds. The model overestimated the rainfall when compared with the IMERG rainfall. Furthermore, CRA adjustment has greatly improved longer forecast lead times, especially for heavy rainfall thresholds, since TC track errors directly affect the rain center location. The detailed analysis will be presented in the symposium.

Presentation Mode: Oral

Presenting Author: Goriparthi Pavani

Registration ID: NSSS-20220110012300

Long term variability in lightning occurrences over the Congo Basin Africa (Lead Talk)

Rohit Chakraborty[1], Parth Sanjeev Menghal[2], Marikundam Harshitha[3], Sodunke Mobolaji Aduramo[4]

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Lightning activities constitute the major destructive component of thunderstorms as they cause serious damage to life and property. In the recent past, some research efforts have depicted the equatorial regions of central Africa, to be the most lightning-prone region on the globe. Hence, we attempt to decipher the spatio-temporal distribution of lightning at this location with the help of ~95,800 high-resolution satellite passes of the tropical rain measurement mission satellite during 1998-2014. Subsequent analysis on the complete dataset revealed a prominent maximum of lightning frequency over the eastern mountainous boundary of the basin region (0-3oS 26-29oE). along with a secondary and slightly weaker blob over the eastern side of the basin (2oN-3oS, 19-22oE). This spatial maxima in lightning over the mountainous locations can be attributed to orographic convection as also depicted in previous studies over the Indian region. Next, the diurnal timing of such activities was recorded, and it was observed that most of the flashes are observed mainly in mid-afternoon times (13-14 LST) which can also be linked to the extreme surface heating induced local convective genesis at that time of the day. The seasonal variations of lightning frequencies depicted two prominent peaks around early March and late September which also correspond to maximum solar radiation received over the equatorial regions during the above-mentioned periods. Next, the long-term trends of lightning frequency are plotted for both the regions which revealed a prominent increase of ~1% per year (r2=0.366) over the lightning maxima; however, the trend value is much weaker ~0.5% per year (r2=0.182) in the plain land region. The reason for this climatic inhomogeneity is currently being studied by understanding its relationships with all possible driving factors according to previous literature like moisture content, atmospheric instability, and aerosol nucleation.

Presentation Mode: Oral

Presenting Author: Rohit Chakraborty

Registration ID: NSSS-20211227011359

Spatio-temporal survey of mined land in North East India

D.Sai Sowjanya[1]

[1]North Eastern Space Application Centre (NESAC)

Open pit mining activity can easily be monitored using remote sensing techniques. However, the monitoring process has till date been largely dominated by manual digitization techniques. This makes it difficult to extend the monitoring activity over large areas or large periods of time. A certain degree of automation was made possible by the thresholding of spectral indices and the use of supervised machine learning algorithms. However, implementation in a spatio-temporally large domain remains challenging due to the computational complexity of the task. Several free to use cloud computing platforms geared for the use by the remote sensing community have come up in the past few years. In this study, we used Google Earth Engine to perform supervised classification of satellite imagery to aid the automatic delineation of mined lands. Support Vector Machine (SVM), a supervised machine learning method is used for classification of mined lands. As the spectral reflectance characteristics of mined lands is similar to that of natural cover tops like barren land, sand; monitoring using spectral indices like NDVI, EBBI, IBI, NDBI, NBaI in tandem existing bands with SVM is more appropriate. We used the JavaScript and Python API and extended the same to the open source GIS software, QGIS, for visualization.

Presentation Mode: Oral

Presenting Author: Devarakonda Sai Sowjanya

Registration ID: NSSS-20211231120739

Google Earth Engine based approach for flood mapping of inland area using remote sensing data

Supriya Sharma[1], C. M. Bhatt[1], Arijit Roy[1]

[1]IIRS, ISRO

Flooding is one of the most notable natural disasters, causing widespread loss of life and property. Remotely sensed data can play a vital role in assessment of the extent of flood inundation and can be effectively used over remote or inaccessible areas. In this study, a tool has been developed over the Google earth Engine (GEE), to map the extent of flood inundation in the state of Bihar, India. This interactive tool can calculate the area and extent of flood inundation using data from either Sentinel-2 or Sentinel-1 series, thus making use of both optical satellite imagery and Synthetic Aperture Radar (SAR) imagery. The elevation of the study area is taken into account to eliminate areas with less water retention. In order to compute the flood inundation using optical data, Normalized Difference Water Index (NDWI) was calculated for pre, during and post flood time periods using green (560nm) and NIR (835 nm) bands of the Sentinel-2 dataset and compared to map the flooded areas at a spatial resolution of 10 m. Using SAR data from Sentinel-1, median composites are generated for the same time periods. The composite images are smoothened and pixels having slope greater than five degrees are masked out using the HydroSHEDS Digital Elevation Model (DEM). A threshold is applied on the difference of the two images to classify the flooded and non-flooded areas. The area of water coverage in the flood and pre-flood season is also calculated and compared. Thus, making use of the capabilities of cloud based platform such as GEE and openly accessible remotely sensed data, a tool has been developed to determine the extent of flood inundation and the amount of area inundated by the flood.

Presentation Mode: Oral

Presenting Author: Supriya Sharma

Registration ID: NSSS-20220110043031

Isolation, identification and characterization of thermophiles and halophiles from Ladakh

Sahaj Bharindwal[1], Nidhi Goswami[1], Abigail Fernandes[1], Siddharth Pandey[1], Pamela Jha[1], Renitta Jobby[1]

[1]Amity centre of excellence in astrobiology at Amity University Mumbai

The union territory of Ladakh is a cold, high altitude (~3000-5700m above sea level) Himalayan desert located in northern India. The region offers a diversity of extreme environments including glacial deposits, dune fields, permafrost region, hot springs and hypersaline lakes. The geological setting, saline lakes, and rain-shadowed region of Ladakh can be potential analogues to water bodies that existed on early Mars. Our project focuses on the study of extremophilic (halophilic and thermophilic) diversity from Puga hot springs and hypersaline Tso Kar lake using culture-dependent techniques. Our research focuses on isolation, identification and preservation of these organisms which may serve as potential model organisms for astrobiology. Thermophilic microorganisms were cultured in nutrient broth and incubated 50℃ for 48h. Halophilic microorganisms were cultured in sea salt media in different concentrations (10, 20 & 30%) and incubated at room temperature. These isolations were done till pure culture was obtained and preserved in glycerol stocks at -80℃. The isolates will further be identified by 16S rRNA sequencing using universal primers. 9 hermophiles were isolated from water and sediment samples of the Puga hot spring and standard biochemical tests were done to characterize them. Four of the thermophilic isolates were also observed for the production of exopolysaccharides. In addition, 47 halophiles were isolated from water samples of the Tso Kar region. Some of the halophiles also showed pigmented colonies which included yellow, pink, pale pink, orange colours. Some of the isolates also showed antimicrobial properties and the production of exopolysaccharides. The next steps will be to identify all the isolates and further characterize them for polyextremophilic nature and their potential of industrial applications.

Presentation Mode: Oral

Presenting Author: Sahaj Bharindwal

Registration ID: NSSS-20220110115207

Planetary albedo decline interlinked with land cover modifications and near surface warming

S.V.S. Sai Krishna[1], S.S. Prijith[1], M.V. Ramana[1]

[1]ISRO

The increase in frequency and severity of heat waves during the pre-monsoon season over Northwest India (NWI) in recent decades is alarming. This study investigates the causative mechanism for warming through forcing induced by planetary albedo changes over NWI, a hotspot for land-cover change. We use satellite-measured planetary albedo (伪) and satellite-derived land-use-land-cover (LULC) data to estimate the impact of LULC changes from 2001-2018 on 伪 and the associated radiative forcing. Over NWI, significant area under native land-cover, viz., barren, shrub and grass-lands, has been converted to cropland. The associated land-cover-induced changes have perturbed the radiation-budget by modifying the absorption of shortwave radiation, thereby contributing to the pronounced reduction of 伪. The diurnal-mean 伪 has decreased by 0.016卤0.001 from 2001-2018 during pre-monsoon season which dominates 伪-decrease during the annual cycle over NWI and contributes to the overall decreasing trend over India. Conversion of barren and shrub-lands to cropland is observed to be the greatest contributor to the 伪-decrease as compared to other land-cover changes. Radiative forcing due to decline in diurnal-mean 伪 over Northwest India from 2001-2018 is highest during pre-monsoon at 5.99 卤 0.34 W/m2. This 伪-induced forcing averaged over the global land surface (0.02 W/m2) is equivalent to the corresponding direct forcing from rise in atmospheric methane concentrations during this period. We find an enhancement in near-surface heating to be associated with change in 伪; the decreasing trend in 伪 during pre-monsoon has enhanced near-surface extreme effective temperatures by 3.15 卤 2.61K thus far and may further lead to more extreme heatwaves in future. Further, our findings highlight a decreasing (warming) and increasing (cooling) trend in clear-sky planetary albedo respectively over NWI and coastal regions, suggesting sudden climate change could occur if one forcing dominates over the other.

Presentation Mode: Oral

Presenting Author: S.V.S. Sai Krishna

Registration ID: NSSS-20220107044042

Understanding the vertical structure of clouds observed over a high altitude station of North East India

Arundhati Kundu[1,2], Shyam S Kundu[1], Som Kumar Sharma[3], Rahul Mahanta[2], Trisanu Banik[4], Manasi Gogoi[1], Arup Borgohain[1]

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The presence of clouds and their depth in the atmosphere can affect the incoming and outgoing radiation, thereby can have a serious influence on the radiative equilibrium, water cycle, and climate. Cloud vertical structures are always complex but we try to classify them into manageable categories as it can help us to understand the cloud dynamics, microphysical processes, and hydrometeor distributions over any place. Active space-based sensors have already proved to be a powerful approach in studying cloud morphology, but they have poor temporal observations. For eg. During March 2019 – February 2021, only 8 CALIPSO cloud profiles were available in a circle of 10 km around Umiam, a high-altitude station on the Shillong Plateau (25.67N, 91.91E, 1042 m AMSL), and 30 profiles in a circle of 50 km. Literature available using RADAR or other methods is limited too over complex terrains of North-East India and therefore, should be studied to properly understand their possible roles in radiative forcing and climate change. So, a combination of in-situ and satellite observation has been used to understand vertical structures of single-layered Orographic clouds over Umiam. Simultaneous CBH and CTH measurements are taken from the Ceilometer and the MODIS Level 2 cloud dataset respectively and categorized into classes to get dominant structures in seasons. It is seen that Cloud geometrical thickness (CGT) is having considerable seasonal variation where taller clouds are abundant during Pre-monsoon (36.58% - 50%) and Monsoon (34.96% - 46.75%). On some occasions, clouds are reaching as high as the Tropopause layer (~16km). Low to medium height clouds are visible too, most of their probabilities are higher during Post-monsoon (40%). Shallow clouds having lower bases are noticed during Winter having origin from fog or cooler stable layer of air. But most noticeable is the presence of terrain-following orographic clouds having a mid-level base and higher top.

Presentation Mode: Oral

Presenting Author: Arundhati Kundu

Registration ID: NSSS-20220110064256

Supervised Classification Approach for Differentiating Alpine Landcover Features of Sikkim Himalayas

Jumoni Boruah[1]

[1]North Eastern Space Application Centre

The glaciers in the Himalayan mountain ranges are melting faster than the global average ice mass. Hence it is of utmost importance to appropriately map and monitor these glaciers. This study aims to evaluate advanced supervised classification algorithms for glacial mapping on a large scale using the cloud computing platform Google Earth Engine. Sentinel 1 and Sentinel 2 data are used in this endeavor. The study area of the North Sikkim district was selected based on a preliminary analysis using the GLIMS dataset. The Random Forest, Support Vector Machine, and Minimum Distance classifiers were trained on samples for 3 cases: Sentinel 1 bands, Sentinel 2 bands, dimension reduced of Sentinel 2 bands (using Principal component analysis). For each classifier, a tuning grid was used to identify be the optimal choice of hyperparameters. Random forest classification with Sentinel 2 data and PCA-derived dimension reduced data performed best with an overall accuracy of 0.92. Having obtained promising results for the study region, Earth Engine-based extension to other portions of the Himalayas and varying temporal scales have been carried out.

Presentation Mode: Oral

Presenting Author: Jumoni Boruah

Registration ID: NSSS-20220101054446

Effect of AOD to lightning Flash Rate and relation with NO_2 over Kolkata, India

Arijit De[1], Arpita Adhikari[2]

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Lightning is a strong discharge phenomenon associated with severe weather conditions, like precipitation, thunderstorm, tornado etc. Lightning can cause casualties, forest fires, damage of properties etc. Aerosol has an important impact on lightning activity. The influence of lightning on climate occurs via the production of nitrogen dioxides. Lightning discharge is one of the most important contributor of NO_2 in the atmosphere. Nitrogen oxides affect the abundance of ozone (O_3), which has impact on radiative forcing. The enhanced aerosol loading helps to develop convection and strong updraft which transports plenty of smaller droplets above the freezing level to form ice particles. This ice particles are participated in the electrification process to produce more lightning flashes. In the present study, an attempt has been made to observe the variation of lightning with Nitrogen di-oxide (NO_2) and aerosol optical depth (AOD) over a tropical location, Kolkata for the period 2005-2010. Gridded Lightning flash rate (FR) Data has been obtained from the combined measurement of Lightning Imaging Sensor (LIS) and Optical Transient Detector (OTD). OMI/ AURA satellite data for less than 30% cloud fraction has been utilized to track tropospheric column NO_2. AOD at 550 nm has been observed from the MODIS satellite. The results show that the FR is positively correlated with the NO_2 ($R = 0.79$) and AOD ($R = 0.56$).

Presentation Mode: Oral

Presenting Author: Arijit De

Registration ID: NSSS-20220108092755

Variation of Nitrogen Dioxide (NO_2) over metropolitan areas of India

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The continuous monitoring of pollutants like Nitrogen Dioxide (NO_2) is a mandatory step towards the understanding of the air quality of the region and public health. In this study, we analyzed the variation and seasonal trend of Nitrogen Dioxide (NO_2) over all the metropolitan areas of India which are as follows. Ahmedabad, Kolkata, Hyderabad, Kochi, Madurai, Bangalore, Chennai, Coimbatore, Delhi, Jaipur, Jodhpur, Kanpur, Kozhikode, Mumbai, Nagpur, Patna, Pune, Salem, Surat, Thiruvananthapuram, and Vishakhapatnam. All of these locations are having the significant contribution to nation's NO_2 concentration. We have analyzed over the years 2019 and 2020. For this study, we derived the data from TROPOMI instrument onboard ESA's Sentinel-5P satellite. To understand the seasonal variation of NO_2 concentrations over the years 2019 and 2020, The mean of daily data is carried out for monthly mean NO_2 concentration to understand the seasonal variation. This COVID-19 pandemic in the year 2020 led us to a lockdown period. We can see the effect of lockdown brought by the COVID-19 pandemic in results. On average over all the regions, NO_2 concentration reduced about -20.14% during lockdown because of less traffic, many industries were gone under shut down. So, the NO_2 emission sources were fewer available during the lockdown compared to the normal days. After the lockdown, with resuming of daily life, the concentrations were increased up to 17.25% over all the regions. The seasonal trend of NO_2 concentration in all areas in year 2019 was like Pre - monsoon < Summer < Post– monsoon < Summer. In year 2020, this trend remains same but an average decrease of -7.57% was detected on it across all metropolitan areas in the year 2020 with compared to the year 2019. This massive fall in seasonal trends can be explained by the lockdown effect of the COVID-19 pandemic. Therefore we can see that how significant the impact of COVID-19 lockdown over NO2 concentration.

Presentation Mode: Poster (Flash)

Presenting Author: Vaibhav Trivedi

Registration ID: NSSS-20211217093255

Radiocarbon-based source characteristics of paddy-residue burning derived aerosols

M. Devaprasad[1], N. Rastogi[1], R. Satish[1], A. Dabi[1], R. Bhushan[1]

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A large-scale paddy-residue burning (PRB) happens every year in the northwestern Indo-Gangetic Plain (IGP) during the post-monsoon season (October-November). It emits a large amounts of air pollutants in the atmosphere that can adversely affect regional air quality and climate. Further, winds can transport these pollutants to long distances in the downwind direction up to northern Indian Ocean (NIO), and affect not only the regional air quality and climate but also the surface ocean biogeochemistry of NIO. In this study, day-night pairs of fine aerosol samples were collected every day during October–November over Patiala (30.2° N, 76.3° E, 250 m amsl). A wide variety of chemical species and dual carbon isotopes (13C and 14C) were measured to understand the source characteristics of PRB derived aerosols. Radiocarbon is the most reliable proxy to characterize biomass vs. fossil-derived sources of carbonaceous aerosols, as the latter has no contribution to 14C in aerosol samples. The fraction of biomass-derived carbonaceous aerosols (fbio, calculated using 14C) varied from 73% to 97% during the entire sampling period, confirming that the biomass burning was the dominant source. We have calculated the characteristics ratios of chemical species derived from PRB by considering only the samples with fbio higher than 95%. Organic carbon (OC) to elemental carbon (EC) ratio (OC/EC) is found to be 14.3±3.4, potassium (K+) to EC ratio (K+/EC) is 0.86±0.33, levoglucosan (LG) to K+ ratio (LG/K+) of 0.87±0.18, and OC to LG ratio (OC/LG) as 20.4±3.1 for PRB emissions. We suggest to use these characteristics ratios for PRB emissions in the source apportionment and modelling studies.

Presentation Mode: Poster (Flash)

Presenting Author: M Devaprasad

Registration ID: NSSS-20220104114010

Real-time measurements of NR- PM2.5 during Covid19 lockdown in Ahmedabad

Rohit Meena[1], Jay Dave[1], Atinderpal Singh[1], Neeraj Rastogi[1]

[1]Geosciences Division, Physical Research Laboratory

This study investigates the effect of reduced anthropogenic emissions during covid-19 lockdown on the abundances and characteristics of non-refractory particular matter ≤ 2.5 μm aerodynamic diameter (NR-PM2.5) and black carbon (BC) over Ahmedabad. Real-time measurements were performed using a HR-ToF-aerosol mass spectrometer and an aethalometer during the three periods: February 29 to March 23 (before lockdown, P1), April 10 to May 01 (during the lockdown, P2), and June 1 to June 16 (post lockdown, P3). It has been observed that the organic aerosols (OA), NO3-, SO42-, NH4+, Cl-, BC at 370 nm (BC370), and BC at 880 nm (BC880) were reduced by 52, 64, 43, 62, 86, 52, and 57%, respectively, during P2 compare to P1 due to reduction in anthropogenic emissions. During P1, OA contribution to NR-PM2.5 was about 62%, followed by SO42- (18%), NH4+ (11%), NO3- (7%), and Cl- (2%). During P2, the composition was still dominated by OA (63%) followed by SO42- (22%), NH4+ (9%), NO3- (5%) and Cl- (1%); whereas, the contribution of OA to NR-PM2.5 was 55% followed by SO42- (24%), NH4+ (12%), NO3- (8%) and Cl- (1%) during P3. Further, BC (370/880) mass ratio varied from 0.7 to 1.9 during the whole study period (avg: 1.2 ± 0.1), suggesting that BC predominantly came from fossil fuel combustion with a noticeable contribution of biomass burning. Source apportionment of total OA using positive matrix factorization analysis revealed three factors: hydrocarbon–like organic aerosol (HOA, 26%), low volatile oxygenated OA (LV-OOA, 44%), and semi-volatile oxygenated OA (SV-OOA, 30%), indicating the dominance of secondary/aged aerosols (74%) over the fresh POA. Diurnal trends of measured species observed during P2 reflect the regional background concentrations of these species coming mainly from the natural and a few anthropogenic sources unaffected by lockdown. Such studies are crucial in assessing the effects of reduced anthropogenic emissions on the air quality of big cities.

Presentation Mode: Poster (Flash)

Presenting Author: Rohit Meena

Registration ID: NSSS-20220105043934

Impact of Climate Change on Meteorological Parameters over Mountainous Region

Saurabh Verma[1], Charu Singh[1]

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Climate change over the Himalayas (comprised of five ranges, viz., Pir Panjal, Great Himalayas, Zanskar, Ladakh, and Karakorum) is critical for rising energy demand in downstream region where hundreds of millions of people live. The Ladakh region is the northernmost state of India lies immediately south of the Karakorum, and has unique cold-arid climate with scarce renewable energy resources. The objective of this study is to understand the meteorological parameters that show high sensitivity and vulnerability to climate change and may help in the generation of renewable energy over Ladakh region. For that purpose, we have used ERA5 reanalysis datasets at 0.25°×0.25° horizontal resolution and 1-hour temporal resolution to analyse the past and present trends of surface temperature and wind speed. The student t-test is used to justify the robustness of statistical analysis at 95% confidence level. Except for Reasi, study Oraldemonstrate that the surface temperature over Leh and Kargil has warming trend associated with increased wind speed during day (0400-1200 UTC) and night (1600-0000 UTC) time. The reduced surface wind speed over Reasi may be attributed due to strong vegetation over the region.

Presentation Mode: Poster (Flash)

Presenting Author: Saurabh Verma

Registration ID: NSSS-20211231045753

Assessment of surface ozone at Dehradun: a valley site in Himalayan and its comparison with other ce

Mahendar Rajwar[1,3], Manish Naja[1], Yogesh Kant[2], Rakesh K.Tiwari[3]

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Air pollution and climate change has become a serious concern all over the globe especially over the south Asian region, mainly due to rapid industrialization and urbanization. The tropospheric ozone is a secondary air pollutant and an important greenhouse gas. Excessive amounts of ozone have detrimental effects on human health, ecosystem and crop productivity. Different model and satellite studies have also pointed to the elevated level of ozone over the north Indian region that is also home to the Indo-Gangetic Plain, a highly polluted region. Despite these, only few observations are available over the Indian region, particularly in the north India. In light of these conditions, we have started the observations of surface ozone at different sites in Uttarakhand. Here, we present observations made at Indian Institute of Remote Sensing (IIRS), Dehradun (30.34°N, 78.04°E, 700 m a.m.s.l.), it is very near to the central Himalayan mountain range and compare it with other sites. Here we present the results obtained from September 2009 to Aug 2018 and compare them with observations made at Nainital, Pantnagar and Haldwani. We observed diurnal variations in ozone with higher values during daytime and lower values during nighttime as like a polluted atmosphere. Daytime build-up in ozone is observed throughout the year except in the monsoon period (June and July). During the daytime, the role of in situ photochemistry of ozone precursors like NOx, CO, and NMHCs results in production of ozone. A comparative study showed higher levels of ozone at night at Dehradun as compared with other polluted sites (Ahmadabad, Delhi and Pantnagar) except Gadanki. The observed monthly variation of ozone shows springtime maximum and monsoon time minimum concentration at all three sites. The observations are compared with results from CAMS model that shows agreement in the monthly ozone variation at Dehradun. Detailed analysis will be presented during the conference.

Presentation Mode: Poster (Flash)

Presenting Author: Mahendar Rajwar

Registration ID: NSSS-20220107090500

Observed climatology and trend in relative humidity, CAPE, and CIN over India

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Atmospheric water vapor increases with the raise in surface temperature, which causes further warming. Thus, understanding the primary causes of atmospheric water vapor change is vital in climate change research. Long-term changes in atmospheric water vapor over India vary regionally as well as locally, but have not been explored using long-term observation data. This study aims to characterize the long-term seasonal variation of Relative Humidity (RH) convective available potential energy (CAPE) and convective inhibition (CIN) from surface and radiosonde observations during 1980- 2020. Results show that, very high values of RH are depicted during monsoon season and low values during pre-monsoon season. West coast station represents large values of RH compared to other regions. RH variability differs from coastal regions to other regions of India. Irrespective of the season, the coastal regions show high RH values, where stronger in west coast during monsoon season. During pre-monsoon, coastal region high values of RH, whereas during monsoon season other regions shows large values. North-west India shows sharp increase in RH with a rate of 5.4 % followed by West coast, Central and Southern part of India. Increase in water vapor leads to raise temperature, which alters the instability conditions. Our results demonstrate that, CAPE follows a similar pattern of RH in terms of seasonal variation. Central India and west coast region show sharp increase in CAPE, while south India depicts declining trends. Opposite features are observed in CIN with respect to CAPE variability over India.

Presentation Mode: Poster (Flash)

Presenting Author: Imran Khan

Registration ID: NSSS-20220110041638

An analysis of the Tropical Cyclones and Atlantic Hurricanes during 1979 to 2018 with the variation

Dhruba Banerjee[1]

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The variation of occurrence of the Atlantic Hurricanes (AHU) over Atlantic and East Caribbean region and Tropical Cyclones (TC) over Bay of Bengal and Arabian Sea during 1979 to 2018 has been studied in this paper. A correlation and regression analysis has also been done between solar activity and the occurrence of Atlantic hurricanes and Tropical cyclones in Indian Ocean. As a proxy of solar activity the 10.7cm solar flux (F10.7) and the Sun spot number (SSN) has been used . In order to find the correlation , we derived a normalised occurrence rate of AHU based on the data of National Hurricane Center-NOAA and National Ocean services –NOAA. Here also we used the data of Indian Meteorological Department(IMD) like Bestpara data, Besttrack data and data from Cyclone e-atlas for TC. Using these distribution , we calculate the correlation coefficient which amount 0.646 for f10.7 solar flux and 0.82 for SSN with significance of 83% in the case of TC. On the other hand the correlation coefficient is 0.65 for f10.7 solar flux and 0.82 for SSN with significance of 78% in the case of AHU. In addition we calculate the correlation coefficient of Lyman Alpha flux and Total Solar Irradiance (TSI) with the occurrence of AHU and TC in Indian Ocean regions.

Presentation Mode: Poster (Flash)

Presenting Author: Dhruba Banerjee

Registration ID: NSSS-20220110084034

Sodar observations of wintertime sea breeze characteristics over Visakhapatnam

K. Jagadeesh[1], N.V.P. Kiran Kumar[2], K. Niranjan[3]

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Influence of prevailing winds on sea breeze (SB) flow over the coastal station Visakhapatnam (17.7°N, 83.3°E) was investigated using sodar observation during the winter season (December 2011-February 2012). Results reveal that the strength of SB show significant changes between offshore, along-shore and onshore synoptic wind flow. The thermal forcing i.e. temperature difference between land and sea is larger for offshore and least for onshore flow, resulting the delayed arrival of SB in former cases compared to that of later events. The depth of SB is found to be higher (~220 m) for offshore than onshore large-scale circulation (~160 m). The statistical analysis of SB circulation was carried out in this study highlights the distinct behavior in the structure and evolution of SB under different synoptic-scale wind flow. Such statistical results are sparse over the industrialized coastal zones like Visakhapatnam where air pollution is a major concern, as well as for better understanding on the vertical mixing of aerosols and trace gases, and air-pollution dispersal.

Presentation Mode: Poster (Flash)

Presenting Author: K. Jagadeesh

Registration ID: NSSS-20220110091622

Integral turbulence statistics over Anantapur, a semi-arid location in peninsular India

N. Siva Kumar Reddy[1], N.V.P. Kiran Kumar[1], K. Rama Gopal[2]

[1]SPL, VSSC, ISRO, [2]SK University

The characteristics of atmospheric surface layer parameters and their behaviour during different seasons over a semi-arid region, Anantapur, are studied using fast response ultra-sonic anemometers (25 Hz) mounted at two levels (10 m and 18 m) above ground level on a 32-m meteorological tower. The components of wind and sonic temperature were measured using sonic anemometer. Sector wise planar fit method was used for tilt corrections. Integral turbulence statistics —dimensionless components of wind and temperature, standard deviations and correlation coefficients for momentum and heat transfer—were calculated. The turbulence statistics were plotted as a function of stability parameter (z/L) (where L is the Obukhov length and z is the height above ground); the mean values of $\sigma i / u_*$ values (i = u, v,w) for neutral conditions for different seasons were estimated. The correlation coefficients for heat and momentum were analyzed with respect to stability and results show that the correlation coefficient of momentum is higher than heat in the neutral conditions whereas heat flux are higher in the strong unstable conditions. Scaled-variable analysis shows that the turbulence characteristics agree with the Monin-Obukhov similarity relationships. The qualitative dependency of normalized velocity variances on stability agrees with past studies.

Presentation Mode: Poster (Flash)

Presenting Author: Nagireddy Siva Kumar Reddy

Registration ID: NSSS-20220110103007

Evaluation of similarity theory in wintertime surface layer over a coastal station Thumba

N. Siva Kumar Reddy[1], N.V.P. Kiran Kumar[1]

[1]SPL, VSSC, ISRO

This paper presents the observations of the structure of the atmospheric surface layer over a coastal station Thumba (8.5° N, 76.9° E). The observations of wind components and sonic temperature were recorded from fast response sonic anemometer sensors during the winter season (DJF) for the years 2012-13 (mounted at 3 m) and 2019-20 (mounted at 11.33 m). Co-ordinate rotation and tilt corrections have been applied using sector-wise planar fit method before estimating turbulence parameters. Turbulence statistics were estimated using eddy correlation method and then normalized according to Monin–Obukhov similarity theory (MOST), and plotted the longitudinal ($\sigma u/u_*$), lateral ($\sigma v/u_*$) and vertical wind velocity fluctuations ($\sigma w/u_*$) with respect to stability parameter z/L. Results for the normalised velocity variances follow MOST both in unstable and stable regimes. The mean values of $\sigma_u/u_* > \sigma_v/u_* > \sigma_w/u_*$ in the near-neutral regime where the MOST is found to be valid and agree well with other locations albeit magnitudes. Present results show the dependency of $\sigma_{i=u,v,w}/u_*$ on z/L and show an increasing trend with the increase in z/L to confirm the validity of MOST in the surface layer, demonstrating that u_* decreases with an increase instability.

Presentation Mode: Poster (Flash)

Presenting Author: Nagireddy Siva Kumar Reddy

Registration ID: NSSS-20220110103007

Thermodynamic structure of the Coastal Atmospheric Boundary Layer (CABL) during different sky condit

Sachin Kakkanattu Philip[1], S. K. Mehta[1]

[1]SRMIST

The thermodynamic structure of the atmospheric boundary layer (ABL) over the coastal station has important implications for local weather conditions due to the frequent occurrence of the land-sea breeze. The different structures of the ABL especially the mixing lines are investigated using the Conserved Variable Analysis (CVA) method. In this study, regular radiosonde observations from IMD Chennai over Meenambakkam (13.0°N, 80.18°E, 16 m above MSL) and Micropulse lidar (MPL) observations over Kattankulathur (12.82 N and 80.04 E) are utilized. The temperature and moisture profiles from radiosonde and normalized relative backscatter (NRB) from MPL are analyzed for different sky conditions such as non-convective (NC), very shallow convective (VSCC), shallow convective (SCC), convective (CC), deep convective (DC), very deep convective (VDCC) days that are categorized based on the infrared brightness temperature data (IRBT) data. It is observed that the single and double mixing line structures occur frequently during winter and north-east (NE) monsoon seasons while single, double, and triple mixing lines during pre-monsoon and south-west (SW) monsoon seasons. However, the double mixed layer structure was found dominating irrespective of the sky conditions. The height of the first mixed layer is relatively higher during the summer monsoon and post-monsoon seasons due to the prevailing convections. To understand the influence of the surface parameters on the mixed layers, the turbulent flow depth (TFD) is also calculated. TFD shows the strong seasonal variation that coincides with the first mixed layer during winter and pre-monsoon while it lies below during southwest (SW) and north-east (NE) monsoon seasons. The occurrence of double mixed layer structure over the coastal station is mainly attributed due to the advection from different boundary layers.

Presentation Mode: Poster (Flash)

Presenting Author: Sachin K Philip

Registration ID: NSSS-20220110100737

GNSS-Reflectometry using NavIC-L5 signals for Earth Observation

Bushra Ansari[1], Sanat K. Biswas[2]

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Advancements in various global (GPS, GLONASS, GALILEO, BeiDou) and regional (NavIC, QZSS) navigation satellite systems have revolutionized space-based technologies. Besides the conventional positioning, navigation and timing (PNT) information, GNSS signals are now used for space-based remote sensing, and this technique is termed GNSS-Reflectometry (GNSS-R). GNSS-R utilizes the GNSS signals reflected from the Earth's surface in a bistatic radar configuration to estimate the land geophysical parameters. The reflected signal carries the information about the reflecting surface in the form of change in SNR, reflected signal power, path delay Doppler shift and carrier phase. In our research, we have used the NavIC L5 signals for land surface remote sensing using the GNSS-R technique. NavIC (NAVigation with Indian Constellation) is an Indian regional navigation satellite constellation developed by India, with a service area of 1500 km around India. We will discuss the development of a hardware-in-loop simulation testbed for NavIC L5 reflectometry receiver and its application for soil-moisture estimation. The RF NavIC signals from a NavIC constellation simulator are acquired using software-defined radio (SDR) receiver and processed to generate the Delay-Doppler Map (DDM), which is the 2D representation of the power/amplitude distribution of the received GNSS signal. The DDM peak power is utilized to estimate the surface dielectric constant, which depends on the soil moisture. This technique is a cost-effective complement of existing Earth-observing systems, as this technique utilizes already existing satellite infrastructures as the transmitters. Additionally, the GNSS-R technique makes real-time monitoring and on-demand estimation of land geophysical parameters feasible. It will be helpful for climate monitoring, agricultural resource optimization, cyclones, floods and drought forecasting and monitoring.

Presentation Mode: Poster (Flash)

Presenting Author: Bushra Ansari

Registration ID: NSSS-20220109014829

Long-term investigations of AOD Observed from MERRA-2 reanalysis data Over Andhra Pradesh state in I

P. Althaf[1], K. Raghavendra Kumar[2]

[1]KLEF

The investigation of atmospheric aerosols is necessary because it shows effects on public health, air quality and climate change is more. The present work describes an extensive analysis on the aerosol optical depth (AOD) over Andhra Pradesh state in India. For this purpose, the AOD data retrieved from the Modern-Era Retrospective Analysis for Research and Applications, Version 2 (MERRA-2) is used for the 4-decadal period during 1981-2020, The AOD datasets are compared and validated with that observed from the Moderate Resolution Imaging Spectroradiometer (MODIS) for the collocated period. The annual analysis from MERRA-2 data, showed high AOD in the North and gradually decreases in the South region with a moderate values in the central part. From the inter-decadal changes of AOD, it is observed that AOD starts increasing in the North region from the second decade onwards all over the state indicates changes in anthropogenic emissions due to rapid urbanization, industrialization and increased population density. However, the seasonal analysis revealed a maximum AOD during monsoon in the North and minimum in the south during Post monsoon. On a monthly basis, an increase of AOD from March to June is noticed followed by a decrease during September-November and increases again from December, except in January and February. For the statistical analysis, the two non-parametric methods Mann-Kendall's, and Sen's slope test are used to know the magnitude (in terms of slope) and significance of trend.

Presentation Mode: Poster (Flash)

Presenting Author: Pelati Althaf

Registration ID: NSSS-20220110120625

Analysis of Multi-Layer Atmospheric Clouds over Ahmedabad

Harithasree Sreedevan[1], Dharmendra Kamat[1], Som Sharma[1], Sourita Saha[1]

[1]Physical Research Laboratory

Clouds play a very important role in the hydrological cycle, Earthâ€™s radiation budget, and in various other atmospheric processes. The height of the clouds plays a crucial role in modulating these processes. The study focuses on understanding, how the Cloud Base Height (CBH) varies with different seasons of the year. This study employs CBH measurements up to three cloud layers (CL) from the Ceilometer lidar operational at PRL, Ahmedabad for about one year during, 2021. The presence of CLs can be detected with a peak in the lidar backscatter profile. It was found that three CLs are usually present during monsoon, two during post-monsoon, and only a single CL is observed in winter and pre-monsoon seasons. Strong updrafts and downdrafts could be identified from the temporal CBHs from the sudden change in CBHs, also revealing potential locations where very heavy rainfall could occur. CBH1 has the highest frequency and CBH3 has the least. About 80% of CBH1 and 85% of CBH2 occurs in the monsoon. The three CLs were further classified into Low (0-2km), Mid (2-6km), and High (>6km) Level Clouds (LLC, MLC, HLC), and the frequency of each type is studied. It was found that the single CLs in winter and pre-monsoon are high clouds. All of the second layer clouds that occur during summer are low-level clouds. About 20% of the third CL during monsoon is mid-level and the rest are low level. The range of the CBH of the first CL within a day for each month showed that the CBH1 has maximum variability of about 5-6 km during the monsoon months and least variability, about less than 2 km during winter and pre-monsoon months.

Presentation Mode: Poster (Flash)

Presenting Author: Dharmendra Kamat

Registration ID: NSSS-20220110110031

Simulation of specific cyclone cases in the Bay of Bengal through Regional Ocean Modeling System (RO

Dr. Tarumay Ghoshal[1], Meher Walia[2], Arun Chakraborty[3]

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The Bay of Bengal (BoB) is very much prone to cyclone activities. The reasons are attributed to the unique geographical setting as well as thermodynamic features of the basin. The monsoon conditions, high sea surface temperature are also prime initiating factors. The basin also faces influence of river discharges and oscillating Kelvin and Rossby waves. Mostly, cyclones are studied with insitu and satellite data only for both atmospheric and ocean perspectives. Those data are sometimes not efficient in terms of temporal and spatial resolution. The reasons depend on sensor characteristics and atmospheric influence. So, for detailed studies numerical simulation is helpful. Because the simulation results provide continuous data at desired time and depth intervals. Moreover, if assimilated data are used in simulation the results can be far better provided data assimilation is good. So, these aspects have been attempted in this study where Regional Ocean Modeling System (ROMS) have been used to study several cyclone cases in the BoB to observe thermodynamic variability during and post cyclonic events. Results show immense effect of cyclone induced upwelling and mixing in the oceanic variables. Various iterations with data have been tested in simulations.

Keywords: BoB, cyclone, ROMS, Upwelling

Presentation Mode: Poster (Flash)

Presenting Author: Tarumay Ghoshal

Registration ID: NSSS-20220110122448

ANN modeling for the dependency of seasonal long range rainfall with climate parameters

Raj Kishore Tiwari[1]

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Study on the dependency of seasonal long range rainfall (in mm.) with parameters of climate variables such as Sun Spot Number, Cosmic Ray Intensity, Geomagnetic indices, Maximum Temperature, Minimum Temperature, Maximum Relative Humidity, Minimum Relative Humidity,WindSpeed,are examined over Rewa District of Madhya Pradesh. Wherein, merely Cosmic Ray Intensity, Geomagnetic indices, Minimum Temperature, and Maximum Temperature, have found physically connected with monsoon rainfall for long period while, Sun Spot Number, Relative Humidity and wind speed are not providing any influence.Thus an ANN Modeling to forecast future monsoon rainfall over this region is established through these physically connected independent parameters. It is found that ANN modeling performance was up to 74% and 73% accuracy during training and testing period respectively.

Presentation Mode: Poster (Flash)

Presenting Author: Raj Kishore Tiwari

Registration ID: NSSS-20220110103815

Verification of mesoscale model prediction of Tropical Cyclones occurred over North Indian Ocean

Nizy Mathew[1], Sisma Samuel[1], V. Sathiyamoorthy[1]

[1]Space Physics Laboratory

Deep convective cloud cores are significantly different from the anvil part of a deep convective system in different ways. Radiative flux in the core region, upper tropospheric humidity, latent heat, and surface wind convergence are significantly higher in the core region. Conventionally, the Infrared (IR) brightness temperature (Tb) thresholds are being used to identify the deep convective clouds. However, since the IR brightness temperatures map the cloud top temperatures, the convective cloud core regions cannot be delineated from the convective anvils. SAPHIR payload aboard Megha-Tropiques satellite has 6 channels centred around 183.31 GHz. A method has been developed to identify the deep convective cloud cores using these channels. Based on the analysis of the OFD, the location of ITCZ and their interannual variability can be investigated over various land and oceanic regions over the tropics from 2012-2018. The presentation covers the data set and the methodology used in this study and also the application of deep convection in identifying ITCZ.

Presentation Mode: Poster (Flash)

Presenting Author: Nizy Mathew

Registration ID: NSSS-20220110012300

Role of tropical cyclone in the redistribution of aerosols over Indian subcontinent

Betsy K B[1],Sanjay Kumar Mehta[1]

[1]SRMIST, Kattankulathur Chennai

The tropical cyclone (TC) is an important low-pressure circulation system associated with very deep convection. Such a vast system leads to three-dimensional changes in the various meteorological variables including distributions of the atmospheric aerosols. Circulation plays the role in the redistribution of the aerosol horizontally; deep convection transports the aerosols vertically and rainfall caused the scavenging of the aerosols. Thus, TC though occurs for a short duration of about less than a week significantly modifies the aerosol loading and hence local radiation budget of the atmosphere in all three dimensions as well as with time. In this study, the redistribution of the atmospheric aerosols following the Amphan cyclone is carried out. The Super Cyclone Amphan was the strongest TC on record in the Bay of Bengal (BOB). It originated as a low-pressure area that occurred in the near Equatorial Easterly wave over the south Andaman Sea and adjoining southeast Bay of Bengal (BOB) on 16th May 2020 and further intensified into Super Cyclonic Storm (SuCS). Cyclone Amphan weakened its intensity and made landfall at 17.30 hours local time on 20th May as a low-pressure system. In the pre-cyclonic period, high aerosol loading off the west coast is dominant. The cyclonic circulation washes out the tropospheric aerosols around it and during the post-cyclonic period, the aerosols are loaded over western India and off the west coast. In the study, spatiotemporal variation of aerosol loading and wind flow patterns is being investigated during, before, and after the tropical cyclonic period which will be presented during the conference.

Presentation Mode: Poster (Flash)

Presenting Author: Betsy K B

Registration ID: NSSS-20220110125500

The inter-seasonal variation of rainfall microphysics as observed over the urban city of Pune

Aalisha Lanjewar[1], Kaustav Chakravarty[2], Pradnya Dixit[3]

[1]VIIT Pune, [2]IITM Pune

The recent decades have witnessed a dramatic increase in global urbanization which resulted for an instant change in land use/cover scenario. While the temperature effects due to urbanization are well studied and understood but the research related to the effect of landscape feedback on rainfall is quite sparse over the Indian region. This is because the variation of rainfall changes are dynamic and depend on a number of other factors like - heating at the surface, winds, aerosols etc. Under such circumstances, the present paper studies in detail the inter-seasonal features of raindrop size distribution (RSD) over Pune, which is a rapidly developing urban city of Indian sub-continent and situated on the leeward side of the Western ghat mountain range. The analysis for 5 years of RSD reveals that raindrops of diameter 1.5 mm and above dominate the pre-monsoon rainfall over Pune which is followed by the post-monsoon and monsoon rainfall. This is basically due to the severe convective nature of the rainfall (~ 14% during pre-monsoon and ~ 2% during monsoon) during the pre-monsoon period which forces the smaller drops to move aloft and thereby allowing the larger drops to precipitate locally. Correspondingly, upon analyzing the temporal variation of rainfall, it has been observed that the period from 16:00 – 20:00 hrs during the pre-monsoon period are dominated by higher rainfall supported by larger raindrops whereas during the monsoon months, no such strong diurnal variations are visible. Further study reveals that along with other parameters, the surface temperature plays an important role for this temporal variability of RSD. The detail features related to the variation of integrated rainfall parameters during the inter-seasonal phases of monsoon will be thoroughly discussed in the coming presentation.

Presentation Mode: Poster (Flash)

Presenting Author: Aalisha Lanjewar

Registration ID: NSSS-20220110021741

The characteristic features of rainfall microphysics as observed over the orographic region

Kaustav Chakravarty[2], Pradnya Dixit[3]

[1]VIIT, [2]IITM

Western Ghat (WG) mountain range, which runs parallel to the western coast of Indian peninsula, is considered to be one of the hottest bio-diversity hotspot of the world. Several stations of the WG mountain range are known as the "rain capital of southwest India". On the above context, our present study will focus on the details investigation of rainfall microphysics as observed over High Altitude Cloud Physics Laboratory in Mahabaleshwar, a severe rainfall station of WG mountain range, whose annual average rainfall for the last 100 years (1922-2021) amounts to 5870 mm. Upon analyzing the 10 years raindrop size distribution (RSD) data over Mahabaleshwar, it has been found that raindrops of diameter 2 mm and above dominates the pre-monsoon and post-monsoon period with respect to the monsoon months. On careful observation of the above variation with respect to the rainfall sectors, it has been found that the contrasting features related to the variation of RSD are more prominent in the lower rainfall regimes than that with respect to the higher ones. Upon analyzing the diurnal variation of rainfall, it is seen that a distinct variation of rainfall are visible in the pre-monsoon and post-monsoon season with respect to the monsoon months. A prominent peak in rainfall occurrences supported by larger raindrops are seen around 17 hours and 15 hours during the pre-monsoon and post-monsoon period respectively, while such signatures are absent during the monsoon period. Literature reveals that the surface temperature plays a significant role for this variation of rainfall distribution. More details information related to the contrasting features of inter-annual variability of rainfall microphysics along with other integrated rainfall parameters will be discussed thoroughly in the conference.

Presentation Mode: Poster (Flash)

Presenting Author: Rohit Gaikwad

Registration ID: NSSS-20220110032001

Quantification of absorbing aerosol types over the IGP region from AERONET: Comparison with models

Kamran Ansari[1], S. Ramachandran[1]

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Indo-Gangetic Plain (IGP) is a highly polluted global aerosol hotspot. Aerosol optical depth (AOD) and single scattering albedo (SSA) are two crucial aerosol parameters necessary to estimate aerosol radiative forcing accurately. Aerosol radiative forcing is still about a factor of three uncertain due to the inaccuracies in quantifying the aerosol types. In this context, it is important to note that studies connecting AOD and SSA with different aerosol species, scattering, and absorption AOD (AAOD) are minimal over IGP region. A comprehensive study of all physical, optical, and chemical columnar characteristics of aerosols over two locations with distinct environmental settings in the IGP region, namely, Kanpur (urban and industrial area) and Gandhi College (rural area) are investigated using high-quality columnar aerosol datasets obtained from ground-based AERONET observations during the recent 5-years (2015-2019). For the first time, two high spatial resolution models (MERRA-2 and CAMS) simulated absorbing aerosols species (black carbon (BC), dust, and brown carbon) AOD and AAOD are compared and contrasted with AERONET observations over the IGP region. AOD, fine mode fraction (FMF), and Angstrom exponent (Î±) exhibit a strong seasonal variation with higher values in winter and post-monsoon seasons. MERRA-2 SSA underestimates significantly due to an overestimation of BC AOD and BC AAOD. Both models show a decreasing gradient in dust AOD from Kanpur to Gandhi College; however, observations reveal interesting features in dust AOD when co-analyzed with air back trajectory analyses. Detailed results obtained on absorbing types of aerosols and their quantification on a seasonal scale obtained using AERONET are compared with model results, and inferences drawn will be presented. Such quantitative and comparative analyses will yield a better and more accurate estimation of aerosol radiative effects and help to improve the aerosol processes and parameterizations in models.

Presentation Mode: Poster (Flash)

Presenting Author: Kamran Ansari

Registration ID: NSSS-20220106011829

Statistical Relationship Between Atmospheric Parameters And Their Impacts On Climate Change

Remya Remanan[1], Sandra Vasudevan[2]

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Climate change has become one of the greatest challenges of the world nowadays. The present work deals with the anthropogenic greenhouse effect and its impact on climate. The effect of carbon dioxide as a greenhouse gas has been proved undoubtedly from the warming trend. A significant rise in sea level is found, when the global mean temperature follows the increase in atmospheric carbon dioxide. It is found that the warming trend was irrespective of the variation of the activity of the sun. Thus it can be inferences that apart from the natural greenhouse effect, the anthropogenic contributions have a major role in the overwhelmed heating. Temperature anomaly over 1880-2020 was analysed. It proves the phenomenon of global warming with an average increase of 0.46 degree Celsius per decade. The increase in atmospheric temperature during 2020 was found to be 1.2 degree Celsius when the concentration of carbon dioxide was 414 ppm in the atmosphere. From the analysis of Carbon dioxide over 1880 – 2020, it can be summarised that the increase in warming is mainly due to the increase in Carbon dioxide that serves as a greenhouse gas. The correlation studies also strengthen these arguments. As implicated by the correlation coefficients, an increase in carbon dioxide alone has not much influenced the thinning of the ozone layer and ozone depletion doesn't play a much significant role in the increased warming. The sea-level analysis over the years 1992 to 2020 also shows a significant rise of 0.2 m per decade which can be summarised as a consequence of global warming. All these changes in the climate are due to human activities which is the main driving force over the last century.

Presentation Mode: Poster (Flash)

Presenting Author: Sandra Vasudevan

Registration ID: NSSS-20220110050549

Altitudinal variation of raindrop size distribution over northern Indian ocean observed during ICARB

Kirankumar NVP[1], Lavanya S[1]

[1]ISRO

This paper presents a unique opportunity of collecting oceanic rainfall using the altitudinal profiles of the raindrop size distribution (DSD) obtained from micro rain radar along with the simultaneous surface-based disdrometer carried on-board Oceanographic Research Vehicle (ORV), Sagar Kanya, during 16 January to 13 February 2018 over the northern Indian Ocean (NIO). These results are first of its kind to characterize the in-situ DSD over the NIO region. In this study, two distinct rain events (weak stratiform rain and mesoscale convective system) are considered. In general, the mean profiles of mass-weighted mean diameter increases with decreasing height, indicating the presence of larger size drops in the lower heights compared to the higher heights. The mean profiles of the slope parameter (and shape parameter (μ) varied significantly with height indicating the modifications in the DSD shape associated with microphysics of rain at various altitudes. During stratiform cases, DSD shapes shifts from concave upward (μ<0) in the higher heights to concave downward (μ >0) in the lower heights indicates the increase in the concentration of the midrange drop diameter due to the collision-coalescence and breakup processes amongst raindrops. Similar to μ, Λ also shows an increasing trend as raindrops reach the ground, indicating truncation of DSDs toward the midrange diameters from large diameters. During the transition cases, DSD shapes show concave downward, indicating μ>0 at various altitudes. This campaign reveals that there is a reduction in the small drop diameter range over the ocean when compared to that of the coastal DSD.

Presentation Mode: Poster (Flash)

Presenting Author: NVP Kiran Kumar

Registration ID: NSSS-20220110061943

Distribution of Particulate matters over Delhi during 2017-2019: Linkages to micro meteorology

Chetna[1] , Surendra K. Dhaka[2] , Vinay Kumar[2],Vivek Panwar[2], Shristy Malik[3], A S Rao[3], Narendra Singh[4], A. P. Dimri[5], Y. Matsumi[6], T. Nakayama[7], Sachiko Hayashida[8]

[1]University of Delhi, [2]Rajdhani College, Delhi Univ, [3]Delhi Technological Univ, [4]ARIES, [5]JNU, [6]Nagoya Univ, [7]Nagasaki Univ, [8]RIHN

Particulate matter (PM) is the prominent air pollutant across Delhi, India. Meteorology strongly influences the mass concentration of PM and hence the ambient air quality of a region. The present study utilizes the high resolution measurements from four stations of Delhi made during 2017-2019, in order to examine the inter-relationship between particulate matter (PM10 and PM2.5) and local meteorological parameters over the mega city at various time scales. PM2.5/PM10 ratio indicates the dominance of coarse particles over fine particles in summer (0.35) and monsoon (0.36) whereas post monsoon (0.59) and winter (0.65) seasons were dominated by fine particles, due to increased fossil fuel combustion and biomass burning activities. Pearson linear correlation and regression analysis have been done for each season to study the correlation between meteorological variables and PM (PM10 and PM2.5). Wind speed and rainfall showed significant negative linear correlation with PM10 and PM2.5 whereas surface pressure showed positive correlation. Correlation coefficient showed seasonal variation. Distinct seasonal trends were found for PM10 and PM2.5 with maximum concentration in winter followed by post monsoon, summer and minimum in the monsoon season. The annual average level of PM10 and PM2.5 were 233 Â± 113 Î¼gm-3 and 108 Â± 84 Î¼gm-3 respectively in 2019 which were ~ 10 times greater than WHO limits (20 Î¼gm-3 and 10 Î¼gm-3 annual mean for PM10 and PM2.5 respectively) and ~ 2-3 times Indian National Ambient Air Quality Standards 2009 (NAAQS) (mean annual limits for PM10 = 60 Î¼gm-3 and PM2.5 = 40 Î¼gm-3). Such a study would help in emphasizing on the strict measures to be taken to achieve the targets of good air quality in Delhi.

Presentation Mode: Poster (Flash)

Presenting Author: Surendra Kumar Dhaka

Registration ID: NSSS-20220110020336

Case studies of different types of Precipitation over Arctic

Saurabh Das[1], Lekhraj Saini[1], Nuncio Murukesh[2], Sourav Chatterjee[2], M.P. Subeesh[3]

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Arctic precipitation holds important clue about our changing climate. Micro rain radar and Parsivel Disdrometer OTT2 measurements over an Arctic site, Ny-Ã…lesund, Svalbard shows presence of different rain and snowfall types, with different growth mechanism. In this paper, we present some of the case studies of different types of precipitation and associated synoptic conditions based on one years of data. The results are useful to assess the climate change impact on the arctic precipitation.

Presentation Mode: Poster (Flash)

Presenting Author: Saurabh Das

Registration ID: NSSS-20211129081755

Study of spatio-temporal variations in aerosol-cloud properties over Western India and Arabian Sea

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[2]Space and Atmospheric Sciences Division, Physical Research Laboratory, Navrangpura, Ahmedabad, India

To understand uneven precipitation patterns, present study focuses on spatio-temporal and vertical variability of aerosol-cloud properties over Western India (WI) and the Arabian Sea (AS). Study of these two regions play an important role as extreme precipitation events as well as droughts over WI are majorly influenced by the AS. Present study has been conducted for the duration of 2000-2018 with the help of various data sets from Moderate Resolution Imaging Spectroradiometer (MODIS), Tropical Rainfall Measuring Mission (TRMM) satellites and Regional Climate Model (RegCM 4.6). Along with that, in-situ measurements of precipitation rate from the Indian Meteorological Department (IMD) have been also used for the WI. In this analysis, higher values of Aerosol Optical Depth (AOD) ranging from 0.21 to 1.10 has been observed for deficit rainfall condition whereas it has a lesser range of values (0.15-0.85) during excess rainfall condition over WI. Over both the regions, spatial values of seasonal AOD and Cloud Effective Radius (CER) as well as AOD and PR exhibits negative linear correlation for excess, normal and deficit rainfall conditions, with variations in correlation coefficient values as well as slope values during all the three monsoon scenarios. In general, over both the regions higher slope values are observed for excess rainfall condition signifying a greater rate of change in CER and PR with change in AOD for excess rainfall condition. Variations in RH are also observed for low altitudes, hence we deduce that during excess rainfall conditions, higher contribution in precipitation is obtained through low cloud cover. Whereas over Sea we observe opposite and prominent changes across different rainfall conditions for high cloud cover, along with variations observed in CLW for high altitude. Further detailed study would be discussed further in the paper.

Presentation Mode: Poster (Flash)

Presenting Author: Ruchita Shah

Registration ID: NSSS-20220110041246

Oxidative Potential and Risk Characterization of Heavy Metals in PM1 during Foggy and Non-Foggy at a

Isha Goyal[1], K. Maharaj Kumari[1], Anita Lakhani[1]

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The exposure to ambient sub-micron particulate matter (PM1) can induce oxidative stress, contributing to global burden of diseases. The evaluation of the oxidative potential (OP) of PM1 is thus critical for the health risk assessment. The present study was conducted at a campus site of Agra to determine concentrations of crustal and trace elements in submicron mode (PM1) particles to reveal the detrimental effects of PM1-bound metals (Cr, Cd, Mn, Zn, Ba, Pb, Cu and Ni) and their association with oxidative property in PM1 samples collected in the foggy (1 November 2019 – 27 December 2019) and non-foggy periods (1 April 2019–30 June 2019). The oxidative property of PM1 components was also assessed by the dithiothreitol (DTT) assay. Mass concentration of PM1 was 106.5±16.2 and 42.1±23.9 μg/m3 during foggy and non-foggy period, respectively. The volume- and mass-based dithiothreitol (DTTv and DTTm) activities of PM1 were significantly higher in foggy period than non-foggy period. Seasonal variations in DTTv and DTTm were much larger than mass concentrations of PM1, indicated specific chemical components are responsible for PM1 derived OP. Strong correlations ($r > 0.700$, $p < 0.01$) were found between DTT activity and water-soluble transition metals (Cr, Cu, Mn and Ni). In both periods, Mn has the highest Hq (hazard quotient) value and Cr has the highest IlcR (Incremental Lifetime Cancer Risk) value for both adults and children.

Keywords: Sub-micron Particle, Heavy metals, Oxidative potential, Health risk ·

Presentation Mode: Poster (Flash)

Presenting Author: Isha Goyal

Registration ID: NSSS-20220110010725

Atmospheric PM2.5 and NO_2 concentration during lockdown & post-lockdown period in 5 Indian cities

Simran Bamola[1], Anita Lakhani[1]

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The outbreak of COVID-19 turned into a global pandemic and forced the Government of India to implement restrictions like complete lockdown from March 2020 till June 2020 to curb the alarming cases and hiking mortality rates. Decrease in anthropogenic activities during lockdown ultimately turned down the air pollutants level in the atmosphere. However, with unlocking again in the year 2021, human activities again proliferated the pollutants level in the atmosphere. In the present study air quality during lockdown and post lockdown period was estimated and found better in 2020 (during lockdown) in comparison to 2021 (post-lockdown). The concentration of PM2.5 and NO_2 along with meteorological parameters were estimated across the five most polluted cities in the Indo-Gangetic Plain (Delhi, Faridabad, Agra, Hisar and Kanpur). The percent change in the NO2 is significantly higher than PM2.5 during the lockdown and post lockdown period. The concentration of NOx was 85.6, 57.3, 52.7, 38.3 and 28.5 µg/m3 in Faridabad, Delhi, Kanpur, Hisar, and Agra respectively during 2020. An increase in NOx concentration by 30.6%, 32.7%, 0.7% in Delhi, Kanpur and Hisar and declined by 52.7%, 14.9% in Agra and Faridabad was observed during 2021. It is also observed that after lockdown, the annual mean concentration of PM2.5 across the cities increased up to 110.3, 91.3 and 80.2 µg/m3 in Delhi, Faridabad and Hisar, which is an increase of 15.7%, 11.7% and 14.8% respectively, during post lockdown year 2021. However, cities like Agra and Kanpur witnessed a reduction of 1.5% and 7.6% in the annual mean PM2.5 concentration. The observed PM2.5 concentration were found 3-4 times higher than the annual limits set by WHO 2021 (5µg/m3). The findings of the study suggest that a cleaner atmosphere and healthy environment can only be regained by implementing effective policies such as short-term lockdown and relocating all the polluting industries by the government.

Presentation Mode: Poster (Flash)

Presenting Author: Simran Bamola

Registration ID: NSSS-20220110062627

Degradation of Air Quality of Delhi due to Crop Residue Burning in Haryana

Pallavi Saxena[1], Saurabh Sonwani[2], Ananya Srivastava[3], Madhavi Jain[4], Anju Srivastava[5], Akash Bharti[6], Deepali Rangra[7], Nancy Mongia[8], Shweta Tejan[9], Shreshtha Bhardwaj[10]

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Crop residue burning (CRB) over Northern India is an alarming issue and leads to human health effects. The present study aims to study the impact of PM10, PM2.5, NO2 and SO2, emitted during CRB activities in Haryana on the air quality of Delhi. The transition from pre-burning to burning period, in both rabi and kharif seasons, shows considerable increase in pollutant concentrations. PM10 and PM2.5 concentrations exceeded NAAQS limits by 2–3 times, while NO_2 and SO_2 stayed within the limits. MODIS fire observations used to estimate CRB fire counts (confidence >80%) shows that rabi (burning period) fires in Haryana are ~3 times higher and more intense than in kharif. Furthermore, backward trajectories shows air mass movement from Haryana, Punjab and Pakistan. Thus, pollutants emitted reach Delhi via air masses, deteriorating its air quality. Meteorological conditions influence pollutant concentrations during both seasons. Frequent dust storms in rabi, and Dusshera and Diwali firework celebrations in kharif season exacerbate air pollution. In rabi, PM10 and PM2.5 have a significant negative association with (relative humidity) RH and positive association with (air temperature) AT. High AT during pre-monsoon, accompanied by low RH, loosens up soil particles and they can easily disperse. Stronger winds in rabi season promote NO_2 and SO_2 dispersion. In kharif, lower AT, higher RH and slower winds exist. Both PM10 and PM2.5 have a negative association with AT and (wind speed) WS. With lower temperature and slower winds during winter, pollutants are trapped within the boundary layer and are unable to disperse. As expected, NO_2 has a significant negative association with AT in Haryana. However, in case of Delhi, the association is significant but positive, and could be due to the odd-even scheme imposed by the Delhi government. More research is needed to determine the health effects of Haryana's rabi CRB activities on Delhi.

Presentation Mode: Poster (Flash)

Presenting Author: Pallavi Saxena

Registration ID: NSSS-20220110084039

Examining land use land cover changes over North kashmir and their linkage with climate change

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Changing climate may have adverse impact on land surface types. Understanding the interactive and cumulative impacts of climate and land-use changes are very crucial as it will affect the distribution, composition, condition and vulnerability of regional biomes including forests, grasslands, and human managed systems. Impacts from agriculture, urbanization, energy and infrastructure development have already and will continue to directly modify land-cover through habitat loss, degradation, and fragmentation. To date, anthropogenic activities have been the primary source of land-use and land- cover changes; however, climate change is expected to exacerbate and accelerate impacts on terrestrial, hydrological and climatic regimes. Adaptation and mitigation strategies that account for climate change interactions with multiple anthropogenic stressors are critical to minimize further loss of terrestrial habitats that support important ecosystem services such as primary production, nitrogen and carbon cycling. Predicted increases in precipitation and temperature extremes will exacerbate the impacts of many landscape-scale stressors on natural and cultural resources. I propose to examine the land-use and land-cover changes over north Kashmir using remote sensing and GIS tools. Regional climate change over the study area will be examined to explore a possible link between observed land-use and land-cover changes. In-depth research on adaptation and mitigation actions is also planned.

Presentation Mode: Poster

Presenting Author: Mohammad Suhail Meer

Registration ID: NSSS-20220104060514

Assessment of Land use changes and its impact on water resources – A case study of Thiruvannamalai w

Marykutty Abraham[1], S. Pushparaj[1]

[1]Sathyabama Institute of Science and Technology

Water demand will increase by 55% globally between 2000 and 2050, while water resources are more strained. It is expected that more than 40% of the world population, will be living under severe water stress, located in highly urbanized areas. India is rapidly urbanizing, consequently the demand for water is increasing in most cities as every urban citizen requires almost double the amount of water that a rural citizen requires. The water requirement is increasing to meet the demand of growing population due to urbanisation. With the impact of climate change, more droughts and floods are expected. It has been calculated that 6 billion people, or 20% of the world population, will live at risk from floods by 2050. The study pertains to a scientific approach to access the available surface water potential for Thiruvannamalai watershed to augment the utilisable water in the context of fast urbanization. Against this background, scientific approach using remote sensing and geographic information system is used to assess the land use/ land cover changes in the watershed during the past two decades to identify the changes in surface water availability. Hydrological modeling is used to assess surface water potential for various land use scenarios.

Presentation Mode: Poster

Presenting Author: Marykutty Abraham

Registration ID: NSSS-20220107052406

Atmospheric Pollution Over Calcutta-A Mega City In India-A Case Study

Dr. Gudi Sudhakar[1]

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Air pollutants released from various sources affect directly or indirectly man and his environment. Pollutants are substances which, when present at high enough concentrations, produce harmful effects on people and/or the environment. Air pollution was first perceived as a local problem in urban industrialized areas, hence taller smoke-stacks for industries and power plants were a ready solution. Urban population is growing very rapidly throughout the world, besides the world population is urbanizing much faster than is growing. Air pollutants in mega cities arise from a wide variety of sources although they are mainly a result of combustion processes. Today, the largest source of pollution in most urban areas is motor vehicles, and to a lesser extent industry. Traffic-generated pollutants include nitrogen oxides, carbon monoxide, volatile organic compounds and particulates. On warm summer days the strong sunlight leads to a buildup of ozone through the oxidation of volatile organic compounds (VOCs) such as benzene in the presence of nitrogen oxides. However, due to the special atmospheric chemistry of ground level ozone, levels are very often lower in urban areas than in the countryside.

Air pollutants consist of gaseous pollutants, odors, and SPM, (suspended particulate matter) such as dust, fumes, mist, and smoke. The concentration of these in and near the urban areas causes severe pollution to the surroundings. The largest sources of human-created air pollution are energy generation, transportation, and industries that use a great deal of energy sources. Depending on their source and interactions with other components of the air, they can have different chemical compositions and health impacts. Since these pollutants are generally concentrated in and around urban areas, the outdoor urban pollution levels are far higher than in the rural areas. Some of the gases mentioned below can seriously and adversely affect the health of the population and should be given d

Presentation Mode: Poster

Presenting Author: Gudi Sudhakar

Registration ID: NSSS-20220110104758

Variation of different atmospheric parameters using INSAT-3D/3DR during the 2019-21 pandemic

Souvik Manik[1], Sabyasachi Pal[1], Manoj Mandal[1]

[1]Midnapore City College

We have studied the evolution of different atmospheric parameters over the Indian subcontinent to look for the air quality variation and variation of ozone concentration during the worldwide pandemic. In this present work, we studied the variability and trend of Total Column Ozone (TCO) and Aerosol optical depth (AOD) derived PM 2.5 using tropical Indian National Satellite (INSAT-3D & 3DR) observations over the different Indian ground-based monitoring stations (Kolkata, Delhi, Gujrat, Kanpur, Jaipur, and Pune) during 2019-2021. We used linear regression to estimate PM 2.5 using INSAT-3D AOD data and ground-based PM 2.5 station data from the OpenAQ database. We found a clear improvement in air quality and a significant reduction in PM 2.5 due to the lockdown imposed during the COVID-19 crisis.

Presentation Mode: Poster

Presenting Author: Souvik Manik

Registration ID: NSSS-20211219063143

Effect of the COVID-19 lockdown on air quality over India

Sarvan Kumar[1]

[1]Veer Bahdur Singh Purvanchal University, Jaunpur, India

The novel Coronavirus (COVID-19) was identified in Wuhan, Hubei Province, China, in December 2019 and has created a medical emergency worldwide. We have investigated the association of aerosols (AOD) and other pollutions (NO2) with COVID-19 cases during the study period and also during the lockdown period (25 March-31 May) in India. During the lockdown period, aerosols (AOD) and NO2 reduced sharply with a maximum percentage drop of about 60 and 45, respectively. We have also found a reduction in surface PM2.5 PM10 and NO2 for the six megacities of India during the lockdown period.

Keywords: COVID-19, Lockdown, Air quality

Presentation Mode: Poster

Presenting Author: Sarvan Kumar

Registration ID: NSSS-20220110120256

Influence of Air Pollutants on the Mortality Rate during the Second Wave of COVID

Muskan Agarwal[1]

[1]Dayalbagh Educational Institute

The Covid-19 is a highly contagious disease which becomes a serious global health concern. COVID-19 not only took lives in 2020 but it also marked its presence in more disastrous way in 2021. SARS CoV-19 virus accompanied with the sudden increased concentration of air pollutants after the first lockdown was the major cause for the more devastated scenario of second wave. As per researchers, the second wave made things more vulnerable than the first wave. To combat this 2nd wave of COVID-19 disease in April–May 2021, the Indian government imposed a night curfew, then a full lockdown. It has already reported that COVID-19 pandemic also affect environment in a positive way. As during the full lockdown in 2020, the concentration of air pollutants had been noticed at lower level as if compared to few years back. But the sudden increase in the concentration has also been observed during second wave. This study suggests the influence of the concentration of air pollutants to the mortality rate particularly during the second wave of COVID-19. This can be achieved by correlating the concentration of air pollutants with the mortality rate highly-dense city of India. Here, Agra has been taken under consideration to show the comparing data during the second wave. As per reported results, it was observed that the mortality rate during second wave was way higher than first wave. It was observed that the percentage change in the average concentration of PM2.5 from Jan 2021 to Mar 2021 in Sanjay Place, Agra was 37.2%, when the lockdown was not imposed. Whereas, the percentage change for Apr 2021 to Jun 2021 was 62.7%. Similarly, the percentage change for NOx at same site from Jan 2021-Mar 2021 and Apr 2021-Jun 2021 were 40.2% and 46.2% respectively. According to district administration data, Agra district, on 12 May 2021 registered around 10,000 excess deaths, 103% more than 2019-20 and 56 times more than the official death toll of 178.

Presentation Mode: Poster

Presenting Author: Muskan Agarwal

Registration ID: NSSS-20220110055454

Plenary Session 2

Middle Atmosphere, Atmospheric Coupling, Dynamics And Climate Change

This session will focus on studies of different layers of the Earth's atmosphere, their forcing by the space environment, atmospheric dynamics and climate change.

Study of daytime E-region ionospheric zonal drifts and high-low latitude coupling

Tarun Kumar Pant[1]

[1]Space Physics Laboratory, Vikram Sarabhai Space Centre, Trivandrum-695022

There are no direct methods available for the continuous measurement of the E region electric field, which drives the electrodynamics of the ionosphere. The study of variation in the electric field is important to understand the response of ionosphere to various solar conditions. The 18 MHz HF radar at Thumba gives an opportunity to study the plasma irregularities of scale size 8.3m in the EEJ. The Doppler shifts obtained from the radar echoes correspond to the zonal drifts of the irregularities, from which the electric field can be estimated. Continuous daytime ionospheric measurements were carried out in campaign mode during 15th -30th July 2021 and 20th September-5th October 2021. The drift velocities of the irregularities measured by the 18MHz radar during the period 21st July 2021 to 20th August 2021 shows large day to day variability with different trends. Our study reveals that the drifts on any given day during this period are very strongly influenced by the polarity and the variability of the north-south component of the interplanetary magnetic field, IMF Bz. The north-south fluctuations of the IMF Bz are direct indicators of the direct coupling of solar wind with earth's magnetosphere. This daytime changes in the polar/auroral region manifest promptly through electric field coupling with the equatorial ionosphere. The importance of this study is in the fact that the effect of space weather changes in the equatorial electrojet region at 8.3 m scale size of irregularities have not been studied systematically so far. These results will be presented and discussed in detail.

Presentation Mode: Oral

Presenting Author: Tarun Kumar Pant

Registration id: NSSS-20220110051456

New data analysis tool on digisonde observations for scientific investigations

G. Janardana Reddy[1], A. K. Patra[1]

[1]National Atmospheric Research Laboratory

Digisondes are in use since long time for ionospheric research. Modern digisondes are equipped with interferometry and Doppler capabilities which can provide vital information in understanding ionosphere not pursued earlier. Despite, most of the times digisondes are used in conventional way as have been done in the past. We have developed new analysis tools for observations made using DPS-4D digisonde located at Gadanki (13.5oN, 79.2oE). These analysis tools provide range-time displays of radio frequency, signal to noise ratio (SNR) and angle of arrival of reflected/scattered echoes, which provide ambient and disturbed states of ionosphere. The range-time SNR map also shows the occurrence of ESF irregularities, which are found to be well correlated with the plume structures in the Gadanki Ionospheric Radar Interferometer (GIRI) height-time SNR map. In the absence of backscatter radar, the digisonde range-time SNR maps can be used in a limited sense like backscatter radar maps, representing plume structures. The estimation of angle of arrival incorporates interferometry technique to obtain both the zenith and azimuth angles of ionospheric sources, which helps in understanding the reflected/scattered echoes from ionosphere. This capability has been used to study wave like variations of the echoes from ionosphere and provides the wave periods, wavelengths and propagation direction of wave like structures. ESF irregularities observed in digisonde were found to come much wider zenith angle unlike the meter scale irregularities from backscatter radar. This provides new insight on the field alignment nature of decametre scale irregularities. The results obtained using new tools will be presented and their potential will be discussed in furthering scientific investigations.

Presentation Mode: Oral

Presenting Author: G. Janardana Reddy

Registration id: NSSS-20220107093338

Equatorial ionospheric study using GMRT

Sarvesh Mangla[1], Abhirup Datta[1]

[1]IIT-Indore

Radio interferometers have recently been used to model the Earth's ionosphere, in addition to studying celestial sources. To minimize the effects of the ionosphere, observations taken from radio telescopesÂ require a rigorous calibration method; additionally, the same calibration data can be used to examine the ionosphere at low frequencies. Our motivation is to study the Equatorial Ionization Anomaly (EIA) region, which has a prominent plasma turbulence effect. The location and configuration of the Giant Metrewave Radio Telescope (GMRT) array are well suited to study geophysically sensitive regions between the northern crest of the EIA and the magnetic equator because this region comes under the highest concentration of electron-ion density. The observational data has been taken from a bright radio galaxy (3C68.2) at the sub-GHz frequencies to demonstrate the capability of GMRT to detect small-scale ionospheric variability. The observed ionospheric phase for the pair of antennas is proportional to the difference in the total electron content (TEC). Our study reveals for the first time that the GMRT can measure differential TEC between two antenna elements with precision about the order of a few mTECU, which is more sensitive than current GPS-based TEC measurements. Furthermore, measurement of the TEC gradient has been computed for the GMRT array, and small scale fluctuations in the two-dimensional TEC values have been observed. These fluctuations are used for measuring micro-scale variation in the ionospheric plasma. The obtained results show that a sensitive instrument like GMRT can be a perfect probe for ionospheric fluctuations.

Presentation Mode: Oral

Presenting Author: Sarvesh Mangla

Registration id: NSSS-20220110122537

Observations of Summer Night-Time FAI Using University of Calcutta ST Radar

Tanmay Das[1,2], Arkadev Kundu[2], Ashik Paul[1,2]

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A fully active VHF phased-array operated at 53 MHz is being established by University of Calcutta at Ionosphere Field Station (22.93°N, 88.50°E geographic; magnetic dip: 36.2°N), Haringhata situated near the northern crest of the equatorial ionization anomaly (EIA). This is a unique facility at this frequency in the eastern and north-eastern parts of India as well as in the south-east Asian longitude sector. Ionospheric E region irregularities are normally observed from Kolkata during summer daytime and winter night-time. Ionospheric backscatter signatures have been observed using the University of Calcutta Stratosphere Troposphere Radar (CU-STR) in the range of 110–145 km during early evening hours to midnight of the summer months of 2019 and 2020, which are quite prominent. The observed Doppler velocities were in the range of -90-120 m/sec with spectral width limited to 110 m/s. The observed E region Field Align Irregularities (FAI) signatures at Haringhata are very much similar to signatures observed generally at off-equatorial low and mid-latitudes. Most of the occurred signatures are descending and continuous in nature with patchiness. This paper presents, using the CU-STR, detailed statistics of occurrences of E-region FAIs during night-time of the summer months of low to moderate solar activity period of 2019 and 2020 from Haringhata.

Keywords: Doppler, SNR, Ionospheric backscatter, FAI

Presentation Mode: Oral

Presenting Author: Tanmay Das

Registration id: NSSS-20211213072319

Thermospheric neutral winds and temperature: First results from an Indian equatorial station

Md. Mosarraf Hossain[1], Tarun Kumar Pant[1]

[1]ISRO

We report first measurements of nocturnal thermospheric neutral wind and temperature using a Doppler Fabry-Perot Interferometer (DFPI) from Trivandrum, a geomagnetic equatorial Indian station, during low solar activity period of June 2017 to April 2018. Monthly mean meridional and zonal wind speeds throughout seasons remain respectively within -70 to 65 m/s and -14 to 80 m/s. Meridional winds are found to agree with NASA's wind model HWM14 remarkably well. Further, we find excellent corroboration of DFPI meridional winds using ionosondes measurements, one of them is collocated with DFPI. Meridional winds clearly exhibit signatures of inter-hemispheric flow. Agreement between model and DFPI zonal wind is relatively poor. Zonal winds over Trivandrum are found weaker compared to African and Brazillian sectors due to less pre-reversal enhancement (PRE). It appears that (1) PRE is relatively stronger in solstices than in equinoxes similar to one earlier study from Trivandrum during low solar activity period between 1988 to 2008 and (2) notably, unlike that study, present investigation suggests existence of PRE in summer solstice. DFPI temperature agrees well with NRL's MSISE-00 model. Like the model, DFPI temperatures post-sunset are seen maximum and thereafter, there is an overall decrease till the end of observation. It is significant to note that monthly mean temperature in vernal equinox as low as 427 ºK, which is about 240 ºK less than the corresponding model value, has been observed. In autumnal equinox and winter solstice (a) A double hump structure in DFPI temperature is seen at post evening ~ 22:00 hrs. and pre-dawn period of 02:30 hrs. (± ½ hour) and (b) Temperature minimum termed as midnight temperature minimum (MTMI) between 00:00 to 01:00 hrs. are prominent features rather than the midnight temperature maximum (MTM). Above features observed for the first time are representative of thermospheric energetics and dynamics over the equatorial Indian region.

Presentation Mode: Oral

Presenting Author: Md. Mosarraf Hossai

Registration id: NSSS-20220110054223

Assesment on the day-to-day variability of the equatorial plasma bubble

Suman Kumar Das[1], Amit Kumar Patra[1], Kandula Niranjan[2]

[1]National Atmospheric Research Laboratory, [2]Department of Physics, Andhra University

In this paper, the day-to-day variation in the development of equatorial plasma bubble (EPB) has been addressed using simultaneous observations made by the 30 MHz Gadanki Ionospheric Radar Interferometer (GIRI) and ionosonde (DPS-4D) from Gadanki and C/NOFS. It has been found that wave-like variations with horizontal wavelengths of 200–660 km observed before sunset have a close connection with EPB spacings. It is also found that the locations of EPB development at their origins, which varied on a day-to-day basis, were as large as 2600 km from Gadanki. A detailed analysis clearly reveals the cause of such variability and provides a clue as to where the background ionospheric conditions led to the growth of the Rayleigh-Taylor (RT) instability generating EPB and where they failed. Results clearly show that while ionosonde observations show great potential for understanding day-to-day variation and predicting EPB development overhead (within ±1° longitude), they are inadequate to assess the growth potential of EPB at longitudes away from a longitude zone of about ±1° from overhead. A detailed analysis suggests that the day-to-day variability in EPB development is governed by large-scale wave structures (LSWS) and it is inferred that the LSWS troughs (low electron density) are the sites for EPB development. Results further suggest that LSWS with the horizontal wavelength of 200–660 km acts as a seed for the growth of the RT instability resulting in EPBs with the same spacing. While the sources of LSWS remain to be identified, it is suggested that observations with longitudinally distributed ground-based sensors, viz., ionosonde, preferably separated by 250–300 km, would be an immediate step forward in this effort.

Presentation Mode: Oral

Presenting Author: Suman Kumar Das

Registration id: NSSS-20220105050648

All-Sky Imager Over Indian Sect

O.B. Gurav[1], R. N. Ghodpage[2], A. Taori[3], S. Sau[4], P. T. Patil[2], V. C. Erram[2], S. Sripathi[5]

[1]Department of Physics, Bharati Vidyapeeth (Deemed to be University), Yashwantrao Mohite College of Arts, Science and Commerce, Pune, Maharashtra, India, [2]Medium Frequency Radar Facility, Indian Institute of Geomagnetism, Kolhapur, India, [3]National Remote Sensing Centre, Hyderabad, India, [4]Arecibo Observatory, Puerto Rico, USA, [5]Indian Institute of Geomagnetism, Navi Mumbai, India

We observe peculiar features of Equatorial Plasma Bubbles (EPBs) during the night of March 22–23, 2017. To understand the dynamics associated with these observed EPBs, we use data obtained from different instruments such as all-sky imager (ASI) from Panhala (16.48°N, 74.6°E, 11.1°N Dip. Lat.), Canadian Advanced Digital Ionosonde (CADI) from Tirunelveli (8.73°N, 77.7°E, 1.6°N Dip. Lat.) and data of Gadanki Ionospheric Radar Interferometer (GIRI) from Gadanki (13.5°N, 79.2°E, 6.5°N Dip. Lat.) over Indian regions. The airglow (630.0 nm emission) observations from Panhala show clear EPBs whose onset starts from 1600 UT onwards. Further, Equatorial Spread F (ESF) occurrence is seen in CADI at Tirunelveli during the same time. Backscatter echoes are also recorded in Range time intensity map obtained by GIRI after 17:45 UT. We observe two EPBs (EPB1 and EPB2) during this night with inter-depletion distance of 600 km. The EPB1 drifts eastward throughout the night and grows with time into bifurcated structures however the trailing EPB2 drifts eastward initially for a while and ultimately drifts westward. In a nutshell, we observe two opposite drifts of EPBs and we believe that this is the first evidence of differential drifts of EPBs imaged through ASI over a narrow longitudinal zone over the Indian sector.

Keywords: Equatorial Plasma Bubbles (EPBs), Westward Drift, Bifurcation etc.

Presentation Mode: Oral

Presenting Author: Onkar Gurav

Registration id: NSSS-20220110015210

Daytime thermospheric wave dynamics and day-to-day variability in the occurrence of ESF

Subir Mandal[1], Duggirala Pallamraju[1], Tarun Kumar Pant[1]

[1]Physical Research Laboratory, Ahmedabad, India

Equatorial spread-F (ESF) is one of the many manifestations of plasma irregularities, which occur on some nights in the equatorial ionosphere and severely affect the trans-ionospheric radio wave communications. Understanding the day-to-day variability in the ESF occurrence and predicting its occurrence well in advance are still challenging problems in the field of equatorial physics. Based on earlier findings, thermosphere in the daytime is known to prepare the background conditions to be conducive or otherwise for the generation of ESF in the nighttime. We have studied the vertical propagation activity of gravity waves in the daytime thermosphere using digisonde data of Trivandrum, an equatorial station over the Indian longitudes. Gravity wave activity is found to be higher on the days prior to ESF occurrence than those when ESF was not present. Further, it is seen that there are days with counter electrojet occurrence (CEJ) prior to the ESF onset. Incidentally, gravity wave activity as discussed in this work has been found to be more on these CEJ days as well, indicating the importance of these wave features serving as seed perturbations even though CEJ days are considered to be less correlated with that of ESF occurrence in the night as on these days the equatorial electrodynamic activity is generally suppressed. Some of these results on the daytime wave dynamics on ESF & non-ESF days and how these parameters can be used to predict the ESF much earlier than its actual occurrence will be presented in detail.

Presentation Mode: Oral

Presenting Author: Subir Mandal

Registration id: NSSS-20220109013243

Intermediate Descending Layers [IL] over the equatorial location of Thiruvananthapuram

Mridula N[1], Tarun Kumar Pant[1]

[1]Indian Space Research Organisation

The atmospheric region lying between ionospheric E and F layers, in the height range of 110 km to 150 km is known as intermediate region and is a major source of energy and momentum to the F region above and E region below. This region is regularly populated by layers referred to as the Intermediate Descending layers [IL]. They are important tracers of the electrodynamis as well as neutral dynamics operational over this region. Hence the various aspects of occurrence of Intermediate Descending Layers [IL] over the dip equatorial location of Thiruvananthapuram is studied for the period from 2000 -2008 using ionosonde observations. Diurnally, the IL occurrence exhibits a double peak pattern with maximum occurrence in the post noon, followed by early morning. The IL has a solsticial maximum [both summer and winter] probability of occurrence with minima during equinoxes. The solar cycle variability of IL is brought out using data from solar cycle 23. The occurrence is found to be high during solar minimum period and low during solar maximum period. The role of gravity waves propagating from the lower atmosphere in determining the above stated features of occurrence is being proposed.

Presentation Mode: Oral

Presenting Author: Mridula Neelakantan

Registration id: NSSS-20220106044132

Tidal influence on the generation of post-midnight F region irregularities

Meenakshi S[1],S Sridharan[1],J Solomon Ivan[1]

[1]NARL

Understanding and predicting the occurrence of F region irregularities is important for better radio communication and geopositioning. The irregularities normally occur in the post- sunset hours of equinox months of solar maximum years through Rayleigh Taylor instability (RTI). Recently, they have also been observed at a delayed time around post-midnight hours. Investigation of Kototabang Equatorial Atmosphere Radar observations shows a higher percentage of occurrence (PO) of the post-midnight irregularities (PMI) during the June solstice of solar minimum years when migrating semi-diurnal tide (SW2) dominates migrating diurnal tide (DW1). Besides, an unusually high PO of the PMI is observed in the September equinox of 2019 over Kototabang and Ascension Island sectors where SW2 is dominant over DW1 over dip equator, whereas the PO is low over Jicamarca where DW1 dominates. The consistent enhancement of SW2 when PMI occur reveals that the dominant SW2 impinges semi- diurnal variation in the electric field, which is westward and not favouring the RTI during post- sunset hours but turns eastward around midnight and lifts the F layer to higher heights, thereby creating favorable conditions for the RTI leading to the formation of PMI.

Presentation Mode: Oral

Presenting Author: Meenakshi S

Registration id: NSSS-20220110083451

Automatic detection of Sporadic E event in the CADI ionograms for the study of its effect on F layer

T. Venkateswara Rao[1,2], M. Sridhar[1], D. Venkata Ratnam[1], B Suneel Kumar[2]

[1]KL University, [2]Balloon Facility of TIFR

Automatic identification of Sporadic E (Es) event in the digital ionograms is necessary for analyzing the large ionogram datasets to understand the behavior of ionosphere in response to the neutral wind influence on the E layer. However, manual identification of Es events in the ionograms is tedious and time-consuming since the number of ionograms generated per day from a single station and globally is large. In the present work, a new methodology is presented on an open-source (Python) platform to detect the Es traces or events in the ionograms using statistical methods. The ionogram Es events are detected automatically by de-noising the ionogram, segmenting and quantifying the frequency and height points. The performance of the proposed technique is evaluated with the Canadian Advanced Digital Ionosonde (CADI) ionograms data recorded at a low latitude station, Hyderabad, India (Lat: 17.47Â°N, Long: 78.57Â°E). The proposed technique output results are compared with the manual detection results using the Univap Digital Ionosonde Data Analysis (UDIDA) software. The proposed auto-detection technique successfully detected the Es events with an efficiency of 96.71%. The inhibition of spread F in the respective layer due to the presence of Es is evaluated during the adverse space weather condition (22nd to 24th June 2015). The proposed technique output show the significant performance of the results to initiate the protocols of the ionospheric space weather alerts in high-frequency communications and GPS systems.

Presentation Mode: Oral

Presenting Author: Tanneeru Venkateswara Rao

Registration id: NSSS-20220105093204

Ionospheric vertical plasma drift model developed for the Indian and Indonesian sectors

[1]P. Pavan Chaitanya, [1]A. K. Patra

[1]National Atmospheric Research Laboratory

Vertical plasma drifts are important for studying ionospheric electrodynamics and plasma instabilities. Vertical plasma drifts have been traditionally measured by incoherent scatter radar and satellite born in-situ probes. In the recent past the vertical plasma drifts in equatorial region during daytime have been estimated using the Doppler shifts of 150-km echoes detected by radars with much less powerful than the incoherent scatter radar. In the Indian and Indonesian sectors the vertical plasma drifts during daytime have been measured by Indian MST radar, Gadanki, and Equatorial Atmosphere Radar, Kototabang, respectively. We have developed vertical plasma drift model for the Indian and Indonesian sectors using the radar measurements from Gadanki and Kototabang. These models have been developed using the neural network technique. We have used a feed forward neural network with error back propagation to train the network. The model output provides daytime vertical plasma drift with maximum RMSE of ~2.7 ms-1. The model output have been compared with independent measurements made by CINDI onboard the C/NOFS for the two longitude sectors, which show very good agreement between observation and model. A one to one comparison of Gadanki and Kototabang model drifts are found to show remarkable difference, indicating the longitudinal variation of vertical plasma drift. These models can now be used for studying equatorial electrodynamics in the two longitudinal sectors in detail. The model results and the comparison with observations will be presented and discussed.

Presentation Mode: Oral

Presenting Author: P. Pavan Chaitanya

Registration id: NSSS-20220107091701

Performance evolution of IRI Plas and SAMI2 models during solar minimum around 100°E

Angkita Hazarika[1], Kalyan Bhuyan[1], Bitap Raj Kalita[1], Arup Borgohain[2]

[1]Dibrugarh University, [2]North Eastern Space Application Centre, Umium

The prediction efficiency of the International Reference Ionosphere extended to Plasmasphere (IRI-Plas) model under solar minimum quiet time period around 100°E is examined by comparing with the total electron content (TEC) obtained from a chain of Global Navigation Satellite Systems receivers. The IRI-PLAS data is generated by assimilating the TEC derived from GPS (GPS-TEC) and Global Ionospheric Map (GIM-TEC) into the model code. The "no input" option of the model is used as a reference to study the effect of data assimilation on the model's efficacy. It is observed that with "no input" option the model overestimates the quiet time TEC in all stations. However, the assimilation of GPS TEC and GIM-TEC into the model code reproduces TEC quite well for all the quiet days considered. IRI-Plas simulation is then compared with SAMI2 is Another Model of the Ionosphere (SAMI2) simulation for the same space time configuration. SAMI2 also overestimates the quiet time observed TEC during daytime peak hours in all northern and southern stations. Based on observed results changes are made to the SAMI2 model inputs. By changing the ionizing EUV and neutral density a good agreement between the simulated and measured data is obtained. Of the two models, SAMI2 provides better results than IRI-PLAS with no external input. Thus, the plasmaspheric model used in IRI-PLAS may need further modification for low solar activity period.

Presentation Mode: Oral

Presenting Author: Angkita Hazarika

Registration id: NSSS-20211220055944

The supersubstorms of solar cycle 24: The sources, energy coupling and impacts on the SW-M-I system

Sritam Hajra[1], Nirvikar Dashora[2]

[1]National Atmospheric Research Laboratory, Gadanki

This study presents robust and quantitative analyses of 3 supersubstorms from the solar cycle 24 identified by the super magnetic lower (SML) index <-2500 nT. These events have been associated with moderate geomagnetic storms. The energy input and total energy dissipation in all these cases have been found to be a few orders more than that of an average 'Akasofu-type' substorm. This is found to depend upon the energy coupling rates and coupling parameters rather than solar activity. Clear imbalance between magnetospheric energy input and energy dissipation through magnetospheric-ionospheric sinks indicates presence of other energy sources and channels of energy flow. The dissipation through Joule heating and ring current has been found to be the most and the least among the major energy sinks; with unique features during the expansion and recovery phases. The SW-magnetosphere and the magnetosphere-ionosphere coupling efficiencies range about 0.6%-2.2%, and 37.7%-77.9%. The magnetometers located in the co-latitude bands of 56o-63o show complete reversal (positive) of phase of the H-component observations during the maximum depression in the SML index. A strong inter-hemispheric asymmetry in H-component variations is observed which is attributed to the seasonal dependence of the growth and decay of high-latitude ionospheric currents. The rate of change of geomagnetic flux (dB/dt) during supersubstorms is observed to be the highest in the latitude band 60-75 degree leading to enhanced induced currents. The peaks of dB/dt occur differently over different stations and even beyond the supersubstorm periods which underscore a serious space weather threat to modern technological infrastructure. Finally, the solar cycle 24 is found to be the weakest in the space-age in terms of the occurrence of supersubstorms with no occurrence during solar maximum.

Presentation Mode: Oral

Presenting Author: Sritam Hajra

Registration id: NSSS-20220110112308

On the seasonal response of the equatorial and low latitude ionosphere to major geomagnetic storms

S Sripathi[1], Ram Singh[2]

[1]Indian Institute of Geomagnetism, [2]Chungnam National University, South Korea

A comparative study has been made on the response of the equator and low latitude ionosphere to three major storms in 2015 namely 17-18 March (St. Patrick's day), 22-23 June and 19-20 December using ionosondes and GPS receivers over Indian sector. We use observations of foF2 (MHz), h'F (km), Equatorial Spread F, L-band scintillations and TEC for this study. As these storms fell on three seasons, the study examines the role of storm-time changes in the composition, winds, waves and electric fields and their interaction with density under these seasons for the occurrence of plasma irregularities and positive and negative ionospheric storms. We noticed positive (negative) storm in December (June) in the main phase. We also noticed positive (negative) storm at equator (low latitude) during March in the recovery phase. The h'F (km) at equator is modified significantly by the orientation and magnitude of storm-time zonal electric field. While the St. Patrick's day storm showed abrupt increase of h′F(km) due to absence of low latitude Es layers and addition of eastward electric field to the existing post-sunset enhancement of eastward electric field leading to the generation of severe plasma irregularities and L-band scintillations at wide latitudes, they are suppressed during June in the mid-night sector due to westward electric field. However, during December, simultaneous increase of h′F(km) in the pre-dawn sector caused generation of plasma irregularities. The results further suggest that ionosphere over India is significantly modified by the storm processes in the night sector during winter due to efficient coupling.

Presentation Mode: Oral

Presenting Author: S Sripathi

Registration id: NSSS-20220110075410

Distinct Ionospheric response to three different geomagnetic storms during 2016 using GPS-TEC

D. Lissa[1], K. Venkatesh[2], D S V V D Prasad[3], and K. Niranjan[4]

[1]Andhra University, [2]Physical Research Laboratory

The ionospheric response during three typical moderate geomagnetic storms occurred during the year 2016 is investigated using GPS-TEC data from five different Indian equatorial and low latitude locations. The first geomagnetic storm occurred on 20 January 2016 with a minimum Sym-H of -95 nT at 1700 UT (2230 LT); the second geomagnetic storm occurred on 6 March 2016 with a minimum Sym-H value of -110 nT at 2100 UT (0230 LT); and the third geomagnetic storm took place on 13 October 2016 with minimum Sym-H value of -114 nT at 2400 UT (0530 LT) have been considered. These three geomagnetic storms are different from one another in the sustenance of the main and recovery phases and occurred at three different local times corresponding to Indian longitudes. This study brings out the major differences of these three storms and their distinct effects on the equatorial and low latitude ionospheric responses. Significant changes in the VTEC during main and recovery phases of these three storms are found to be mainly associated with the prompt penetration electric fields and thermospheric neutral compositional changes. During the storm of 20 January 2016, irrespective of increased solar wind velocity and disturbed prompt penetration electric fields, the disturbed TEC comes to its quiet time level during recovery phase. The complete main phase for the 6 March 2016 geomagnetic storm was occurred during night time and no changes in VTEC has been identified, which could be due to the weak background electron density. The main phase of the 13 October 2016 geomagnetic storm started during noon time around 1130 LT and continued till the morning hours (0530 LT) of the subsequent day. It is noticed that the TEC did not show any changes during the day time on 13 October 2016, while the positive storm effect is seen in the night time main phase and following recovery phases. The positive storm effect can be attributed to CIR induced enhanced thermospheric winds.

Presentation Mode: Oral

Presenting Author: Duvvu Lissa

Registration id: NSSS-20211217050338

Spatio-temporal confinement of ionospheric responses over during St. Patrick's Day storm of March 20

Sk samin Kader[1], Nirvikar Dashora[2]

[1]NARL, Gadanki, India

The present study aims to provide deeper insights into the effects of the most intense St. Patrick's Day storm of 17-18 March 2015. Simultaneous observations from multiple satellites and 85 GPS (global positioning system) stations are analyzed to infer spatio-temporal confinement of ionospheric responses between -20 degE and 150degE longitudes. The main results of this study show multi-step growth of the storm due to energization through plasma sheath and magnetic cloud which resulted in episodic variations in merging electric field during the main phase (MP). The longitudinal differences in episodic equatorward expansions of the auroral oval are shown to produce varying impacts over different local times. Confinement of equatorial irregularities over the Pacific and Indian sectors during MP is established by tracing four major ion density depletion patterns. The observed equatorward wind surge is found only to produce strong westward winds and hence, the sluggish westward irregularity drift could be better explained by the ion-drag effect. The enhanced ionization at the first sub-main phase is not observed in the immediate response of penetration fields, however, the same are found during the second sub MP on 17 March. The sustained negative storm even over the dip equator in eastern regions is induced only under combined O/N2 and disturbance dynamo effect. Intriguingly, during the recovery phase, the African sector shows pre-noon enhanced ionization confined within 40o magnetic latitudes around the dip equator between -20 degE and 60 degE longitudes. Finally, the effect of DD is observed in the post-noon sector with westward movement as the recovery phase progressed.

Presentation Mode: Oral

Presenting Author: Sk Samin Kader

Registration id: NSSS-20220110090922

Aspects related to variability in radiative cooling by NO, and TEC&O/N2 during Halloween Storm

Alok K Ranjan[1], M. V. Sunil Krishna[1], Akash Kumar[1], S. Sarkhel[1]

[1]Indian Institute of Technology Roorkee

Halloween storm (late October, 2003) was one of the most complex solar storm during the solar cycle 23. It was comprised of three intense-geomagnetic storms (storm1 with Dst(min) = -151 nT, storm2 with Dst(min) = -353 nT, and storm3 with Dst(min) = -377 nT). We have investigated the effects of Halloween storm on various aspects of thermosphere and ionosphere by utilizing the TIMED/SABER (Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics/Sounding of the Atmosphere using Broadband Emission Radiometry),GUVI (Global Ultraviolet Imager), SCIAMACHY, and MITGPS datasets. It was observed that NO cooling emission fluxes exiting the thermosphere were larger during the storm2 despite the successor storm3 being stronger in magnitude. It has been shown to be due to the longer duration of the main phase of storm2 in addition to the quicker recovery of storm3. The high temperature and AE-index during storm2 also corroborates this fact very well. This study suggests that the night-time polar region experiences more cooling due to NO as compared to the daytime polar region. The local time asymmetries in electron precipitation play a significant role in controlling the NO infrared radiative flux (IRF) and the differences are attributed to the prompt penetration of energetic particles into the night side. The connections between the mid- and low-latitude enhancement in NO IRF with the propagation of LSTIDs (Large-scale traveling ionospheric disturbances) in combination with the O/N2 variability, and the altitudinal variation in NO flux with the progression of the storm are also established in this study. MITGPS datasets has been used to correlate the northern hemispheric TEC with O/N2 ratio. A simultaneous increase in both the parameters were seen near north America. This study also shows the diffusion and large-scale enhancement of NO into the mesospheric altitudes during these particular space weather events.

Presentation Mode: Oral

Presenting Author: Alok Kumar Ranjan

Registration id: NSSS-20220105031542

Atmospheric and Ionospheric response to Major Sudden Stratospheric Warming (SSW) Episodes

Jinee Gogoi[1], Kalyan Bhuyan[1]

[1]Dibrugarh University

Sudden stratospheric warmings (SSWs) are large-scale thermodynamical phenomena in winter Polar Regions, in which large and rapid temperature increases in the winter polar stratosphere are associated with reversal of the climatological wintertime westerly winds. A comparative study of Major SSW events which occurred in the Northern Hemisphere over 2002–2020 has been carried out. European Centre for Medium-Range Weather Forecasts Reanalysis 5th generation (ERA5) and Modern-Era Retrospective analysis for Research and Applications (MERRA2) reanalysis data and Modélisation Isentrope du transport Méso-échelle de l'Ozone Stratosphérique par Advection (MIMOSA) model data have been used for studying the stratosphere. The stratospheric parameters show different behaviors depending on the type of SSW, the pattern of polar vortex throughout the events (displaced or split), and, sometimes, the number of events in a particular winter. The temperature profiles have been obtained from the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) onboard Thermosphere-Ionosphere-Mesosphere Energetics and Dynamics (TIMED). We have also investigated the variations of critical frequency of the F2 layer (foF2) and base height of the ionosphere (h’F) during the SSW events. Ionospheric data are obtained from three ionosonde stations located at Okinawa (26.21˚N, 127.68˚E), Yamagawa (35.45˚N, 133.62˚E) and Wakkanai (45.16˚N, 141.75˚E). Clear latitudinal variability has been noticed during all the events, with more prominent effects over lower latitudes.

Presentation Mode: Oral

Presenting Author: Jinee Gogoi

Registration id: NSSS-20211213064220

Lower atmosphere-ionosphere coupling: Observations of HUDHUD cyclone using AIRS and GPS network

V. K. D. Srinivasu[1] N. Dashora[1]

[1]National Atmospheric Research Laboratory

Present study gives a robust analysis of the GPS based low latitude observations of ionospheric perturbationsduring a severecyclonic storm Hudhud formed over Bay of Bengal during 7-14 October 2014. Observations of the total electron content (TEC) from 11 different GPS stations from NARL-network and UNAVCO-network are used in this study.The main results from this study include cyclone-generated concentric gravity waves (CGWs) in the stratospheric brightness temperature by AIRS (atmospheric infrared sounder) payloadand widespread, synchronized, simultaneous perturbations in TEC during this cyclone. The observations evidently indicate towards coupling between the CGWs and its wave-like imprints at the ionospheric altitudes.The results of the present study show the CGWs with horizontal wavelengths ranging from ~300-540 km, periods~10-20 minutes and phase speeds ~450-600 m/s, whichare observed at for a distance ranging between ~900 and ~2500 km from the eye of the cyclone. Uniquely, a composite wavelet analysis of TEC perturbation component is performed which is obtained from the band pass filtered VTEC. The wavelet analysis showsthat the cyclone induced TEC perturbations are enhanced at periods 10-40 minuteswith mean radial phase speed ranging from 100-200 m/s. The results are in conformity with some of the previous studies on the ionospheric impact of the typhoons over low latitudes. The distributed and dense observations of GNSS ground receivers provide a great opportunity to understand the spatio-temporal coupling between the lower atmospheric and ionosphere during such extreme events.

Presentation Mode: Oral

Presenting Author: V.K.D.Srinivasu

Registration id: NSSS-20220110081640

Association between earthquake and equatorial wave

Manohar Lal[1]

[1]Indian Institute of Geomagnetism

In the present study, efforts has been made to correlate the equatorial planetary waves in Outgoing Longwave Radiation (OLR) and to seismic activities in South East Asian region. The OLR data has been obtained from NOAA Climate Prediction Centre web site. The earthquake information has been obtained from USGS earthquake information centre. This paper present observations for the two earthquakes, i.e., 26 January 2001, Bhuj, India and 26 December 2004, Sumatra, Indonesia. The normal days OLR has been compared to the OLR recorded during the seismic events. It has been observed that there is significant enhancement in OLR, few days before the earthquake event. The Morlet 6.6 wavelet analysis shows the presence of planetary waves in equatorial OLR for period about 6 days, during and about 80 days before the earthquake. The OLR data were analysed in such a way that the other possible effects are minimized. The anomalous increase and presence of planetary waves before 80 days of seismic event shows great potential in providing early warning of a disastrous earthquake. It should be noted that planetary waves is generated only in the equatorial region irrespective of strong/severe earthquake location.

Presentation Mode: Oral

Presenting Author: Manohar Lal

Registration id: NSSS-20220110121616

Impact of stratospheric ozone and mesospheric tides on enhanced occurrence of 150-km echoes in 2019

Reetambhara Dutta[1,2], S. Sridharan[1], S. Meenakshi[1,2], Sayantani Ojha[2]

[1]National Atmospheric Research Laboratory, Gadanki, [2]Indian Institute of Space Science and Technology, Valiamala

The origin of daytime ‘necklace’ shaped 150-km radar echoes with multiple thin echoing layers, from the valley region of the equatorial and off-equatorial ionosphere is befuddling. They are classified as weaker (low SNR) type-A and stronger (high SNR) type-B echoes, based also respectively on whether the spectral width and SNR are related or not. Observations from Kototabang (0.20°S, 100.3°E) Equatorial Atmosphere Radar, which can only detect high SNR type-B echoes, show maximum occurrence of these echoes in boreal summer (June-August) and winter (December-January) of low solar activity years 2016-2019. However, anomalously high occurrence of these echoes is observed during the solar minimum year 2019, particularly in September 2019, when there is a major austral stratospheric warming event with increase in ozone volume mixing ratio over equatorial latitudes. Moreover, the descending rate of the high SNR echoing layers is similar to the descent rate of the semi-diurnal tidal phase. These results reveal that the possible source of the 150-km echoes could be the semi-diurnal tide. The migrating diurnal tide (DW1) generated due to solar radiation absorption by stratospheric ozone and tropospheric water vapour can have phases opposite to each other, resulting in the suppression of DW1 and thereby leading to the relative dominance of SW2 tide over DW1 tide during 2019. It is suggested that the SW2 tide generated meridional wind shear may result in the interchange instability developed on the gradient of daytime descending ion layer along with the solar minimum conditions can provide the required plasma irregularities responsible for these echoes.

Presentation Mode: Oral

Presenting Author: Reetambhara Dutta

Registration id: NSSS-20220110090442

OI 630 nm nightglow variability during post-sunset time over low-latitude thermosphere

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Airglow emissions act as a passive remote sensor to understand the behaviour of the altitudinal regions from where they originate in the upper atmosphere. OI 630 nm emissions originate from an altitude region of about 100 km centred at a height of around 250 km. We have carried out nighttime OI 630 nm emission measurements from a low-latitude location Gurushikhar, Mt. Abu (24.6 N, 72.7 E, 16 Mag N) using an in-house built optical instrument called High Throughput Imaging Echelle Spectrograph (HiTIES). A photo-chemical model has also been developed which provides an estimate of night time OI 630 nm emissions. Digisonde measured electron densities are used as inputs in this estimation, which shows a good correlation with the measured emissions (correlation value > 0.9). This enables us to extend the database when the optical measurements are hindered by the moonlit and cloudy sky conditions. Different kinds of emission variabilities have been observed in the OI 630 nm nocturnal behaviour. After the sunset, as the ionization stops, the emission generally decreases monotonically. But, on several nights we have found a bell-shaped enhancement in emissions during the post-sunset time instead of monotonic decrement in emissions. Out of a total of 142 nights during the period Jan-Mar in the years 2013, 2014, and 2016, we have observed enhancement in emissions for around 60% of nights. The enhancements in emission are mostly observed around 20-21 hrs local time for about 2 hours. Detail investigations of Equatorial electrojet (EEJ), pre-reversal enhancement (PRE), neutral winds, have been carried out to understand the cause of such enhancement. The solar flux and the seasonal variations have also been studied with regard to this emission enhancement. The overall nocturnal emission variations in OI 630 nm emission will be discussed in detail in the context of post-sunset emission enhancement, the electrodynamic, neutral, solar flux, and seasonal effects on it.

Presentation Mode: Oral

Presenting Author: Sovan Saha

Registration id: NSSS-20220110051006

3-D characterization of daytime gravity waves obtained using optical and radio measurements

Sunil Kumar[1,2], Subir Mandal[1], Duggirala Pallamraju[1]

[1]PRL, [2] IIT Gandhinagar

Gravity waves (GWs), planetary waves, and tides of different spatial and temporal scales are found in the Earth's upper atmosphere (UA). Among these, the GWs, which are generated due to different processes/mechanisms, are considered to be omnipresent in the UA and play an important role in the dynamics of these regions. For the UA, variations in the airglow emission rates in time/space can be used to estimate the temporal/spatial scales of the GWs. As the plasma and neutrals share the same volume of the UA, these neutral waves leave their imprint on the plasma densities as well. Information on these wave features present in the thermosphere is very much limited in the daytime owing to the difficulties of successfully carrying out optical measurements in presence of strong solar background. We have carried out large field-of-view (1400 i.e., around 750 km of spatial coverage) measurements of dayglow emission in a campaign mode with bi-directional operations at 630.0 nm using an in-house built multi-wavelength imaging spectrograph using echelle grating (MISE) to obtain the gravity wave characteristics in the zonal and meridional directions in the daytime. Measurements of plasma parameters using digisonde from Ahmedabad (230 N, 730 E, 150 MLAT), India were used to derive gravity wave characteristics in the vertical direction. Thus, the horizontal and vertical propagation characteristics of GWs are obtained from dayglow observation and digisonde measurements, respectively. Such analyses have been carried out for 12 days of data and the time periods, horizontal speeds, vertical speeds, horizontal wavelengths, and vertical wavelengths of the GWs have been found to vary in the ranges of 1.19-1.76 h, 13-81 ms-1, 16-74 ms-1, 85-243 km, and 79-279 km, respectively. In this way, 3-D characteristics of gravity waves in the daytime have been obtained for the first time. The details of these results will be presented.

Presentation Mode: Oral

Presenting Author: Sunil Kumar

Registration id: NSSS-20220110095001

Terdiurnal and gravity wave influences on OH(3-1) brightness and its rotational temperatures measured by PRL Airglow InfraRed Spectrograph (PAIRS)

Ravindra Pratap Singh[1], Duggirala Pallamraju, Pradip Suryawanshi, and Shashank Urmalia

[1]Space and Atmospheric Sciences Division, Physical Research Laboratory, Ahmedabad

Measurement of nightglow brightness using passive remote sensing technique is a widely used method for studying complex upper atmospheric dynamics. Rotational temperatures derived from the observed emission spectra of OH molecules have been used extensively for the study of the dynamics, chemistry, and the thermal state of the MLT region under varying geophysical conditions. The mesosphere lower thermosphere (MLT) region extending from around 60-110 km altitude region is an important coupling region replete with many dynamical processes due to gravity waves (GWs), tidal waves, and planetary waves. In this paper, we present the results on deriving terdiurnal and gravity wave characteristics obtained by PAIRS observations from the optical aeronomy observatory, Thaltej Campus, Ahmedabad (23.0o N, 72.6o E). Data cadence achieved by PAIRS is 100 seconds that is significantly lower than the atmospheric Brunt-Väisälä periods at OH emission altitude. This makes PAIRS suitable for the study of short periodic oscillations present due to the high frequency GWs, GW-tidal interaction, high frequency waves during convection and thunderstorm, and due to ripple phenomena in the MLT region. The short period GWs having periodicities less than one hour deeply affect the MLT structure and dynamics including large-scale general circulation from the summer to winter mesosphere which alter the thermal structure of the high latitude mesosphere. PAIRS provides us with an opportunity to investigate characteristics of these GWs, in general, and short period GWs, in particular. In this paper, we present details of the instrument and results pertaining to the wave characteristics using PAIRS measured OH(3-1) brightness and its rotational temperature.

Presentation Mode: Oral

Presenting Author: Ravindra Pratap Singh

Registration id: NSSS-20220106104156

Discrimination of Doppler Shift In Atmospheric Gravity Wave Signatures Due To Horizontal Background Wind Using Dictionary Learning

Varanasi Satya Sreekanth[1], Karnam Raghunath[1], Deepak Mishra[2]

[1]NARL, [2]IIST

Before analyzing for the signatures of Atmospheric Gravity Waves in temperature perturbations, it is essential to remove the effect of atmospheric background sources such as temperature, wind, and planetary waves that trigger instabilities. These instabilities are sometimes misinterpreted as Gravity waves. In this work, the effect of background wind that results in frequency shift(Doppler shift) of observed frequency obtained using Rayleigh Lidar is reduced with Multi-Scale Dictionary Learning by promoting sparsity, and Instantaneous Frequency Estimation technique. The Dictionary Learning is performed in Wavelet analysis domain using Singular Value Decomposition. The Doppler shift profiles are compared with GPS Radiosonde and Meteor Radar. The removal of background wind is successful when the mean of remnant temperature perturbations is less than the sum of the system uncertainty and the uncertainty due to the method used for atmospheric temperature retrieval. The seasonal variations of Doppler shift will vary from a minimum of 0.32mHz to a maximum of 1.7mHz.

Presentation Mode: Oral

Presenting Author: Varanasi Satya Sreekanth

Registration id: NSSS-20220110091153

Detection of Lightning Induced Gravity Wave from NavIC Signal and Ground Data

Soumen Datta[1], Saurabh Das[2]

[1]Indian Institute of Technology Indore

An electric current up to few kilo ampere can be inducted in the global electric circuit due to cloud-to-cloud and cloud-to-ground lightning during severe thunderstorm. Here we present a study on the signature of lightning induced gravity wave propagation over the study location Kolkata. The lightning strike information has been obtained from the World Wide Lightning Location Network (WWLLN). The signature of the gravity wave has been investigated based on the variation of the ionospheric total electron content measurement from Indian Regional Navigation System (NavIC) signal and other Global Navigation Satellite System (GNSS) network data. Additional fixed ray paths have been achieved due to the recently launched Indian navigational satellite system (NavIC) which provides another unique opportunity of 24hr. monitoring of its all satellites by its geo constellation. This provides the spatial as well as the temporal coverage of the ionospheric waves above the thunderstorm area by using our India's indigenous navigation system for the first time and validate it with other GNSS ground measurement.

Presentation Mode: Oral

Presenting Author: Soumen Datta

Registration id: NSSS-20220110053756

Planetary wave dynamical variability at low latitude middle atmosphere during September 2019 SSW

Gourav Mitra[1], Amitava Guharay[2], Paulo Prado Batista[3], Ricardo Arlen Buriti[4]

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Planetary wave (PW) associated dynamical variability in the equatorial and extratropical middle atmosphere during the September 2019 Southern hemisphere minor sudden stratospheric warming (SSW) is investigated utilizing meteor radar wind observations from São João do Cariri (7.4°S, 36.5°W) and Cachoeira Paulista (22.7°S, 45°W) and reanalysis data. Signature of the mesospheric warming in conjunction with the stratospheric cooling is found at low latitudes. The strong westerly wind at low latitudes decelerates notably near 65 km at the onset of the warming episode, although no wind reversal is observed. The wind spectra reveal a prevalent quasi-16-day wave (Q16DW) prior to the SSW and existence of a quasi-6-day (Q6DW) wave after the warming event. Possible existence of barotropic/baroclinic instability in the low and mid - latitude middle atmosphere may be responsible for exciting the Q6DW. Both traveling and stationary waves exhibit notable activities during the warming event. Although involvement of both zonal wavenumbers 1 and 2 PWs are found in the event, planetary wave with zonal wavenumber 1 seems to play a vital role in preconditioning the same. Furthermore, significant latitudinal mixing of airmass between the tropics and high latitudes is evident in the potential vorticity map. The Eliassen-Palm (EP) flux diagnosis shows the propagation of the Q6DW and Q16DW from mid to low latitudes during the warming event.

Presentation Mode: Oral

Presenting Author: Gourav Mitra

Registration id: NSSS-20211206115738

Response of Brewer-Dobson Circulation to SSWs over the Northern and Southern Hemisphere

Veenus Venugopal[1], Siddarth Shankar Das[2], K. N. Uma[3]

[1] Space Physics Laboratory, VSSC, ISRO

The stratospheric global mass circulation, the Brewer-Dobson Circulation (BDC), has an upwelling branch across the tropical tropopause layer and it transports air through the stratosphere to extratropical troposphere. BDC modulates the cold point tropopause temperature and affects the stratospheric distribution of water vapor and ozone among other stratospheric trace constituents. The residual circulation is driven by dissipating planetary-scale Rossby waves originating from the troposphere. The present study deals with the intensity variation of BDC due to the changes in wave activity during sudden stratospheric warming events (SSWs). SSWs are characterized by a rapid temperature increase of the order of 10s of kelvins over the polar cap below 10 hPa, along with a zonal wind reversal at these levels in the case of major SSWs. The reversal or deceleration of winds leads to downward circulation in the stratosphere resulting in adiabatic heating. These warming episodes are observed in the northern hemisphere during half of its winters. There was only one major SSW observed in the Southern Hemisphere, where the wintertime polar winds are more stable than their Northern Hemisphere counterparts. The Southern Hemispheric vortex breaking events results in a diminished ozone hole caused by a disruption of the isolated Antarctic polar vortex. In the present work, the intensity variation of BDC in response to SSWs in the Northern and Southern hemispheres is studied in detail. The resulting distribution anomalies in ozone and water vapor over the tropical upper troposphere lower stratosphere region (UTLS) is analysed using space-borne observations and in-situ measurements. The changes in these radiatively active constituents influence the thermal structure of the stratosphere and also the surface weather. The detailed results will be presented in the upcoming symposium.

Presentation Mode: Oral

Presenting Author: Veenus Venugopal

Registration id: NSSS-20220110034923

Equatorial upper mesospheric mean winds and tidal response to strong El Niño and La Niña

S Sridharan[1]

[1]NARL

What causes seasonal and interannual variabilities of the mesospheric mean zonal winds is stil unknown. Though the role of waves generated in the lower atmosphere in driving the mesospheric winds has been suggested, no major effort has been taken to link the mesospheric winds to the variabilities of the waves, particularly the migrating diurnal tide tide (DW1) which is the most dominant westward momentum source among tides, gravity waves and planetary waves. The upper mesospheric winds observed by the meteor radar at Kototabang (0.2°S, 100.3°E) show equinoctial asymmetry with larger westward winds in March–April during the strong La Niña years, 2008 and 2011. However, the winds are comparable in both equinoxes in the strong El Niño year 2015. The migrating diurnal tide (DW1) estimated from Sounding of Atmosphere by Broadband Emission Radiometry (SABER) temperature at 80–90 km shows larger amplitudes in March than in September in 2008 and 2011, but comparable amplitudes in both March and September during 2015. These results demonstrate the influence of variations in the surface weather and oscillations on the upper mesospheric winds through migrating tides, which can provide much larger westward momentum than gravity waves, drive large westward acceleration in winds and thereby induce large variabilities in them at seasonal and interannual time scales.

Presentation Mode: Oral

Presenting Author: S Sridharan

Registration id: NSSS-20220107044012

New insights into the Mesospheric Quasi-biennial Oscillation: Observations and Model Simulations

Karanam Kishore Kumar[1], K. Ramesh[1], N. Koushik[2], M. Pramitha[3], K.V. Subrahmanyam[4], S.S. Prijit[1]

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The interannual variability of various geophysical parameters in the equatorial middle atmosphere comprising of stratosphere and mesosphere is dominated by a long-period oscillation known as quasi-biennial oscillation (QBO). The stratospheric QBO is relatively well characterized as compared to its mesospheric counterpart. In the present study, using long-term ground based meteor radar as well as space based observations, the mesospheric QBO is characterized in terms of its periodicity, amplitude and vertical structure. It is noted that mesospheric QBO is relatively weak as compared to the stratospheric QBO in contrast with the earlier observations using satellite measurements of mesospheric winds. It is also noted that the QBO amplitudes are insignificant in certain years indicating its intermittency. The absence of MQBO signal during certain years is discussed in terms of large westward winds in the upper stratospheric altitude. The spaced based measurements are employed to study the global structure of MQBO, which provided new insights into the secondary peaks in its latitudinal distribution. A prominent peak is noted in the MQBO amplitudes over northern hemispheric mid-latitude. This particular observation provided observational evidence of extra-tropical existence of MQBO. Further, the interaction of mesospheric QBO with other large-scale oscillation such as El Nino-southern oscillation (ENSO) is also investigated to study the modulations of the former by the later. These observations are employed to evaluate the Whole Atmosphere Community Climate Model (WACCM) simulations of mesospheric QBO. The significance of the present study lies in bringing out the time evolution of the MQBO and addressing a few outstanding issues on its intermittency and discrepancies in its amplitudes.

Presentation Mode: Oral

Presenting Author: S Sridharan

Registration id:NSSS-20220110113306

Study of long-term variability in the mesospheric mean winds observed by MF radar over Kolhapur (16.

G.P.Naniwadekar[1], S.Gurubaran[1], R.N.Ghodpage[1], P.T.Patil[1], D.S.Burud[1]

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We represent the study of mesospheric winds at the height of the range 78-98 km height range with the help of medium frequency(M.F.) radar located at low-latitude station Kolhapur (16.8o N, 74.2oE), India. The sequential wind profiles over the period of 2014-2019 were obtained by this radar operated at 1.98 MHz are used for this particular study. To study the characteristics of mesosphere and lower thermosphere (MLT) region we use the hourly mean values of horizontal wind velocities. We represent a detailed study of the seasonal, annual and inter-annual variations and also the climatology of mean motion in zonal (East-West) and meridional (North-South) components in the MLT-region over the period 2014-2019. We observe a clearly indication of pronounced inter-annual variability in the tidal activity. A strong semi-annual oscillations (SAO) with westward winds during equinoxes and eastward wind during solstices below 90 km in the zonal wind has been observed. While above 90 km, annual oscillations (AO) are seen to be dominant. The annual oscillations (AO) observed in mean meridional wind with pole ward motion during winter and all other time is equator ward. At higher altitudes (above 92 km) northward wind motion weakens and southward wind flow becomes strong and remains constantly southward. The meridional components have larger amplitudes than the zonal components. Keywords- Wind profiles, MF radar, lo

Presentation Mode: Oral

Presenting Author: Gouri Prashant Naniwadear

Registration id: NSSS-20211225075517

Intraseasonal oscillations in the equatorial middle atmosphere

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Wind observations in the mesosphere and lower thermosphere (MLT) from Southern hemispheric equatorial stations are utilized to investigate intraseasonal oscillation (ISO) signature in the period band ~ 20-110 days. The ISO shows conspicuous downward propagation of the peak amplitude indicating the role of the dissipating upward propagating waves for its generation. The eastward propagating waves and tides are surmised to be responsible for communicating the ISO signature from the lower atmosphere to the MLT. The ISO signature shows refraction in the lower stratosphere in course of propagation.

Presentation Mode: Oral

Presenting Author: Amitava Guharay

Registration id: NSSS-20220107071500

Long-term variability and tendencies in diurnal tide from WACCM6 simulations

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Long-term variability and tendencies of both migrating and non-migrating diurnal tides have been investigated using a three-member ensemble of historical simulations of National Center for Atmospheric Research, NCAR's Whole Atmospheric Community Climate Model latest version 6.0 (WACCM6) for 165 years during 1850-2014. The WACCM6 is run as the atmospheric component of NCAR's Community Earth System Model, Version 2 (CESM2). The climatological features of the tides in temperature (T), zonal wind (U) and meridional wind (V) have been studied and compared with observations. The responses of the tidal variabilities to natural and anthropogenic forcings including solar cycle (SC), quasi biennial oscillation at 10 hPa and 30 hPa, El Niño-Southern Oscillation (ENSO), ozone depleting substances (ODS), carbon dioxide (CO2), and stratospheric sulfate aerosol (volcanic eruptions) have been investigated using multiple linear regression (MLR) analysis. It is found that the annual mean tidal amplitudes in all the three parameters (U, V, and T) increase in the upper mesosphere and lowermost thermosphere (0.0001– 0.01 hPa) region due primarily to the increasing CO2 and secondarily to the ODSs. Furthermore, the seasonal and latitude-pressure variations of the tidal responses to the above seven indices have been studied and the results will be presented and discussed during the meeting.

Presentation Mode: Oral

Presenting Author: K. Ramesh

Registration id:NSSS-20211203064053

On the anomalous weakening of migrating diurnal tides in the mesosphere lower thermosphere

S. S. Prijith[1], K. Kishore Kumar[1]

[1]Space Physics Laboratory, Vikram Sarabhai Space Centre, Indian Space Research Organisation

Among the various atmospheric waves, which propagate from the lower to the upper atmosphere, the migrating diurnal tides are the strongest. The migrating tides not only couple the various layers in the atmosphere but also modulate the ionospheric processes. Owing to the importance of tides and their short-term variability, monthly variations in their characteristics at different altitudes in the Mesosphere-Lower Thermosphere (MLT) region (80-100 km) are examined. The study is carried out using hourly measurements of zonal and meridional winds in the MLT region, for a period of ~10years (February 2006 â€“ December 2015), from the SKiYMET meteor wind radar located at a low-latitude station, Thumba (8.5Â°N, 76.9Â°E). Diurnal tidal characteristics are extracted by employing least square best fit method, on four day moving window average of hourly wind measurements. Monthly mean values of tidal characteristics are examined for investigating the interannual variability. Analysis shows anomalous weakening of solar diurnal tides, in January-February in 2010 and 2012. Decrease in tidal amplitudes in the meridional winds is observed to be as high as ~30m/s in February 2010, compared to the mean value of that in the same month during the period from 2006 to 2015. Fourier analysis of meridional winds shows occurrence of strong quasi two-day wave (QTDW) events, during the periods of anomalous weakening of tidal amplitudes. The study further examines characteristics of these quasi two-day waves and the non-linear interaction between QTDW and diurnal tides, comprehensively. The significance of present study lies in bringing out the physical processes responsible for the observed anomalous reduction in the tidal amplitudes, using a decade of meteor wind radar measurements.

Presentation Mode: Oral

Presenting Author: Prijith S. S.

Registration id: NSSS-20211219101533

Initial observations of atmospheric ozone with NARL DIAL system

K Raghunath[1], M Venkatratnam[1], V Satya Sreekanth[1], T Rajendra Prasad[1], G Sandeep[1]

[1]National Atmospheric Research Laboratory

NARL DIAL system was installed and set up for measurement of atmospheric ozone. The system generates ON and OFF wavelengths with Excimer and Nd:YAG laser in the ozone absorption wavelength region. The receiver contains two telescopes and PMT is used as detector with good quantum efficiency in UV region. The ratio of backscattered signal due to ON and OFF wavelengths gives an estimate of ozone concentrations. The values are compared with ozonesonde measured seasonal mean ozone concentrations and found good. These results will be presented.

Presentation Mode: Oral

Presenting Author: K Raghunath

Registration id: NSSS-20220110075402

Performance characteristics of Single cell Raman gas mixture for DIAL Ozone lidar

M. Roja Raman[1,2], Wei Nai Chen[2]

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The conversion efficiency and flexibility of using single Raman cell with mixture of high pressure Raman active gases H2 and CH4 with and without the addition of buffer gases like He and Ar has been tested and reported in this study. The conversion efficiency of independent Raman active gases excited with frequency quadrupled Nd:YAG laser is examined initially and the mixture of gases with different total cell pressure and different laser excitation energies is also examined in detail. Though the higher conversion efficiency could be achieved with independent gases, the pre-mixed gas combination of CH4+H2 with 50%:50% volume ratio could emit a coaxial beam of three wavelengths 288.4nm, 299.1nm and 314.9nm with optimum conversion efficiency of about 15% each along with the residual 266nm coaxial beam. The addition of buffer gas He or Ar to the Mixture of H2+CH4 doesn't give great improvement and thus can be ignored. The generation of coaxial beam of multiple Raman wavelengths with a single Raman cell provides a great advantage of simple optical configuration for the DIAL system for the simultaneous measurement of Ozone (O3) and Sulphur dioxide (SO2) concentrations in the atmospheric layers.

Presentation Mode: Oral

Presenting Author: M Roja Raman

Registration id: NSSS-20220110041521

Hadley Cell Dynamics in IITM- Earth System Model: Evaluation using ERA-5 reanalysis

Sneha Susan Mathew[1], Karanam Kishore Kumar[1]

[1]Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram

Hadley Circulation (HC) is the tropical circulation which is responsible for the typical wet climate of the tropics and the dry climate of the sub-tropics. Studies have brought out that the circulation exhibits a poleward expansion ~0.5-1 degree latitude per decade, with significant regional and seasonal variability. It is thus important to delineate the HC ascending and descending regions and resolve the long term changes in width of these regions in the present warming climate. It is also important to evaluate these changes by means of observational studies, and project their evolution in a future warming scenario from the perspective of formulation of adaptation strategies. The current study employs the climate model simulations from Indian Institute of Tropical Meteorology-Earth System Model (IITM-ESM) archived in the latest Coupled Model Inter-comparison Project 6 (CMIP6) to identify the long term changes in the width of the ascending and descending branches of the HC and validate it against the latest generation ERA5 reanalysis. The HC ascent and descent regions are identified from IITM-ESM using the meridional mass stream function metric and the same are validated using ERA5. Time series of evolution of width of the HC ascent and descent regions from since 1850 is made using historic simulations from IITM-ESM. Future trend in the evolution of the width of these regions up to 2100 under two different high-forcing scenarios is charted out. Results show that the model successfully captures the observed changes in the total width of the HC and its ascending regions and that the HC undergoes significant expansion in the southern hemisphere. It is for the first time that a model from India that is tailored to well represent the atmospheric phenomena over the south Asian region is evaluated for its efficiency in representing the HC dynamics as well as its future projections under high forcing scenarios.

Presentation Mode: Oral

Presenting Author: Dr. Sneha Susan Mathew

Registration id:NSSS-20211217093307

Influence of southern hemispheric upper troposphere PV intrusion events on the SWMR

M Sandhya[1], S Sridharan[2]

[1]Providence Women's College, [2]National Atmospheric Research Laboratory

The possible influence of potential vorticity (PV) intrusion events into the southern low-latitude upper troposphere over the longitude region 0-90oE during June-September on the southwest monsoon rainfall is investigated using ERA interim potential vorticity data and high resolution gridded IMD (India Meteorological Department) rainfall data. It is found that unlike in the northern hemisphere, the PV intrusion events are more frequent in the southern low-latitudes 0-90oE during June-September and they present irrespective of the phase of the El Nino Southern Oscillation (ENSO). More PV intrusion events in to the southern hemispheric low-latitude upper troposphere are observed during the negative rainfall anomaly years. The cross-equatorial flow is observed to be weak during the intrusion events. It is suggested that the weakening of the cross equatorial flow induced by the PV intrusion event may have prevented moisture transport to India resulting in more break spells and hence the reduced rainfall. (Acknowledgment SR/WOS-A/EA-34/2018).

Presentation Mode: Oral

Presenting Author: M Sandhya

Registration id: NSSS-20211126061028

An overview of the vertical distrubution of the UTLS chemical composition over ASMA

Hemanth Kumar,A[1], Venkat Ratnam, M[1]

[1]National Atmospheric Research Laboratory

The Asian summer monsoon anticyclone (ASMA) is an important large-scale circulation in the upper troposphere and lower stratosphere (UTLS) region in the northern hemisphere. The observational and modelling studies confirmed the signature of the anthropogenic emission in the UTLS region is due to the coupled influence of the deep convective transport of the local emissions and dynamical confinement of the ASMA. The studies reported the variability of the ASMA structure, spatial extent and the location of its centre is due to the changes associated with the variability of the dynamics associated with it. The center of the ASMA is not stationary and oscillates between longitudes 50◦-92.5◦E exhibiting three modes namely IP (Iranian Plateau), TP (Tibetan Plateau) and Elongated mode respectively. Studies linking the change in position of ASMA centre and its influence on the variability of the chemical constituents on time scales in the UTLS region shorter than the seasonal scale (monthly, intraseasonal, daily, diurnal) are very sparse. Using satellite remote sensing observations and reanalysis datasets, a novel approach has been developed to understand the influence of dynamics during different modes on the vertical distribution of the chemical composition over the ASMA at shorter time scales. The enhancement of tropospheric species (CO and WV) throughout the upper troposphere over eastern region (SE and NE) of ASMA is found indicating deep convective transport of pollutants (local emissions) to UTLS region over these regions. Similar enhancement is seen only near tropopause over western region (SW and NW) of ASMA due to the combined influence of convective uplifting over SE where local emissions are predominant and strong horizontal advection towards western regions. By making use of the COVID-19 lockdown period, this study mainly highlights the influence of dynamics alone on the vertical distribution of the chemical composition when there no local emissions.

Presentation Mode: Oral

Presenting Author: Hemanth Kumar Alladi

Registration id: NSSS-20220110055951

Asian Summer Monsoon Anticyclone (ASMA) and its Variability

Sanjay Kumar Mehta[1], S. Tegtmeier[2], and Masatomo Fujiwara[3]

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The Asian summer monsoon is a prominent climatological feature of the global circulation during the boreal summer. During the monsoon season, strong convergence occurs over the lower troposphere and a strong anticyclonic circulation is observed in the upper troposphere of the monsoon domain. The location, strength, and shape of the Asian Summer Monsoon Anticyclone (ASMA) show significant variability in intraseasonal, interannual and decadal time scales. In this paper, we have studied the ASMA, carbon monoxide (CO), and Ozone (O3) variability during active and break phases of the Indian summer monsoon during the period 2004-2019. The ASMA region is defined based on the 14.32 km geopotential height contour at the 150 hPa pressure level during July and August. The characteristics of CO and O3 are studied during different characteristics phases which shows different characteristics. During active monsoon days, the ASMA region expands and maximum expansion is in the longitudinal direction. Longitudinal extension of ASMA region during active and break days are 8oE-137oE and 18oE-130oE respectively. The variabilities in ASMA during active and break phases of monsoon can affect the chemical composition of trace gases and aerosols over the region. The concentration of upper tropospheric CO over the Indian region is more during break days than active days. The result of the present study will be discussed during the conference.

Presentation Mode: Oral

Presenting Author: Sanjay Kumar Mehta

Registration id: NSSS-20220110064351

Defining the upper boundary of the Asian Tropopause Aerosol Layer (ATAL) using the Static Stability

S. T. Akhil Raj[1], M. Venkat Ratnam[1], J. P. Vernier[2,3], A. K. Pandit[2], Frank G Wienhold[4]

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The Asian Tropopause Aerosol Layer (ATAL) is located in the Upper Troposphere and Lower Stratosphere (UTLS) during the Asian Summer Monsoon. However, what separates the ATAL from the well-known stratospheric ‘Junge layer’ is not yet clear. In this study, using the in-situ (Radiosonde, Ozonesonde, backscatter sonde and cryogenic frost-point hygrometer) observations from multiple locations in India (Gadanki (13.45o N, 79.18o E), Hyderabad (17.47o N, 78.58o E) and Varanasi (25.27o N, 82.99o E)) and multi-satellite observations ((Cloud-Aerosol Lidar and Infrared Pathfinder Observation, (CALIPSO) and Constellation Observation System for Meteorology, Ionosphere and Climate (COSMIC) Global Position System (GPS) Radio Occultation (RO) (COSMIC GPS-RO)) we show that the ATAL can exist up to the layer of maximum stability (LmaxS), located a few km above the tropopause, determined using the square of Brunt Väisäla frequency. These in-situ observations over Indian stations collected during the ISRO-NASA Balloon Measurement Campaigns of the Asian Tropopause Aerosol Layer (BATAL) show that the ATAL top can reach up to ~442 K potential temperature level over the Indian region. The LmaxS delineated from COSMIC GPSRO observations over the Asian Summer Monsoon Anticyclone (ASMA) region indicates that the top of ATAL can reach up to 454 K potential temperature level, which is lower than the earlier Lagrangian transport model predicted 460 K. The temperature inversion at LmaxS acts as a lid and constrains the direct transport of aerosols to higher altitude.

Presentation Mode: Oral

Presenting Author: Akhil Raj S T

Registration id: NSSS-20220109060902

ARIES Wind Profiler: First Central Himalayan VHF ST Radar

Samaresh Bhattacharjee[1], Manish Naja[2], Aditya Jaiswal[3], Kishan Singh Rawat[4]

[1] ARIES , [2]ARIES, [3]ARIES , [4] Graphic Era

The Himalayan region plays an important role in determining the metrological status of the Indian subcontinent. Therefore, to understand the environment of the Himalayas in depth, there is a need for continuous observation of wind patterns in this region. Wind Profiler Radar has become the most efficient tool for continuous monitoring of wind parameters of the atmosphere with very high temporal and spatial resolution under all weather conditions. Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital installed the world's first compact VHF wind profiler radar system operating at 206.5 MHz in the foothills of the Himalayan region near Nainital, Uttarakhand (29.4N; 79.2E; 1958m amsl) India. The complete radar system has been provided within a 30 m x 30 m two storey building for better utilization of available space in hilly terrain. In an innovative way, 12 groups of 49 elements have been placed on the roof top with the required precision in a semicircular aperture fashion. As in the VHF band, the average clutter signal strength from mountain regions is significant; a metal fence of 3.5 - 4 m height was designed and installed along the perimeter of the top of the roof to improve the detection of weak atmospheric signal. Activation and integration of clusters of systems proceeded with extensive calibration of each individual Transmit Receive Module (TRM) attached to each antenna.The system is now in operation and is providing data beyond 20 km for frontline atmospheric research in the Himalayan region. Winds from this radar have been compared extensively with balloon-borne GPS radiosonde. Several experiments have been conducted in clean air, during precipitation and detailed study made on turbulence. The technical implementation of the system, the design parameters of the fence, verifications and some of the latest observations will be discussed during the presentation. In addition, in-house development activity including development of hardware and

Presentation Mode: Oral

Presenting Author: Samaresh Bhattacharjee

Registration id: NSSS-20220110104551

Atmospheric Investigations During COVID19 Pandemic

Som Sharma, Sourita Saha, Dharmendra Kamat, Prashant Kumar

Physical Research Laboratory, Ahmedabad, India, Space Application Centre, Ahmedabad, India

Coronavirus disease (COVID-19) is a highly infectious disease. There are varying signs and symptoms of the infections by the COVID-19 virus. The most common symptoms of infections by the virus are mild-moderate to high fever, respiratory problems, coughing, selective loss of taste and smell. The COVID-19 infection spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes and/or touches the infected surfaces. The COVID-19 pandemic changed emission regimes all over the world due to various restrictions such as complete lockdown, state restrictions, selected containment zones, and many more limitations/curbs. It is found that weather parameters play an important role in the spreading of COVID-19 infection. In the present study, we have worked on the association of COVID-19 virus transmission with atmospheric and air quality parameters like temperature, moisture, etc. The variation of reproduction number (R0; a measure to reflect infectiousness of the disease) for COVID-19 transmission has been calculated for tropical and mid-latitude regions. Our findings reveal that mid-latitude atmospheric conditions are more favorable to the transmission of COVID-19 than the tropical atmosphere. Moreover, the present study has also been extended to understand the impact of global/Indian lockdowns on air quality and R0 value for COVID-19 transmission. Regular Lidar observations over Ahmedabad Lidar have provided interesting findings of the Atmospheric Boundary Layer (ABL) during the complete lockdown and limited state restrictions. Furthermore, a significant reduction of air pollution over India in strict lockdown situations also indicates exploring the clean energy prospects in the future. In this paper, a study on atmospheric variations during the COVID-19 pandemic will be presented.

Presentation Mode: Oral

Presenting Author: Som Kumar Sharma

Registration id: NSSS-20220107073735

Diagnosing the stratospheric water vapour to climate change

Siddarth Shankar Das[1]

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Water vapour (WV) is one of the most important greenhouse gases which play a vital role throughout the Earth's atmosphere in both chemistry and global radiative balance, especially in the upper troposphere and lower stratosphere (UTLS). It is estimated the climate feedback of about +0.3 Wm-2 K-1 due to an increase in the stratospheric water vapour (SWV), which is about 5-10% responsible for the global warming from all the greenhouse gases. The primary source of hydroxyl ion (OH) in the Earth's atmosphere is WV, and these OH-radicals control the lifetime of a shorter-lived greenhouse gas like ozone and long-lived like methane. Any variations from hourly to annual scale in the WV distribution have a significant impact on the global climate-weather system. It is observed that any increase in SWV acts to cool the stratosphere but warm the troposphere. WV is a major source of the OH-radical in the UTLS region and a key oxidant that leads to the destruction of stratospheric ozone and change the atmospheric chemistry. Thus, the SWV plays an important role in stratospheric ozone chemistry and therefore, the global radiation budget. There are few studies on global scale which indicate that stratospheric WV has been increasing by 1 % per year on average over the few decades. Short-scale variation, in general, is associated with the large and well-defined cycle in solar heating during the day and is accounted as the most fundamental component for the variability of the climate-system, whereas the longer-scale variability is in response to different atmospheric circulations, ENSO and QBO. The strong coupling between WV and temperature, can provide the basis for a strong positive WV feedback that amplifies the initial temperature changes induced by other greenhouse gases. The main intent of this study is to present and discuss the different scales of variability of WV in the lower and middle atmosphere to climate change using long-term satellite measurements.

Presentation Mode: Oral

Presenting Author: Siddarth Shankar Das

Registration id: NSSS-20220110052013

Effect of cirrus on the thermal structure of TTL inferred from MPL and Radiosonde observations

Saleem Ali[1], Sanjay Kumar Mehta[1]

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An extensive investigation on the effect of cirrus clouds on the thermal structure of the tropical tropopause layer (TTL) is presented using collocated measurements of Micro Pulse Lidar system and Radiosonde over a tropical coastal station, Kattankulathur (12.82°N, 80.04°E), India during 2016-2018. While Radiosonde observations are available at 17:30 IST and 05:30 IST, lidar observations span between 15:00 IST of day one to 11:00 IST of day two. A maximum occurrence of cirrus clouds (~40%) is found during SW and NE monsoon seasons and a minimum (~25%) during winter seasons. A distinct diurnal pattern of late evening (~30-40%) and early morning (~10-20%) single layered cirrus clouds are also observed and they are further utilized for the current study in collocation with RS. The occurrence of cirrus in the upper troposphere significantly alters the thermodynamical structure and their effect enhances with an increase in optical thickness. Out of 202 collocated single layer cirrus clouds occurrence with Radiosonde; 26,155 and 21 cases are obtained for the categories of cirrus occurrence 'at the tropopause', 'within TTL', and below the TTL' respectively and they treated separately to elucidate their effect on TTL. The radiative effect of the cirrus on the TTL is studied using Fu-Liou Radiative transfer calculation. CPT is observed to be cooler, higher, and has a lesser radiative heating rate when SVC cirrus clouds occur within the tropopause, however, its effect significantly varies when the cirrus occur at the tropopause and below the TTL.

Presentation Mode: Oral

Presenting Author: Saleem Ali

Registration id: NSSS-20220110071911

In situ observations of super-saturation and its association with cirrus clouds over Indian region

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Direct (in situ) measurement of water vapour in the upper troposphere and lower stratosphere (UTLS) carried out using Cryogenic Frost-point Hygrometer (CFH) over Trivandrum, Hyderabad and Kolkata during the period 2014-2017 are used to examine the occurrence of supersaturated layers in the upper troposphere. Relative humidity with respect to ice (RHi) and the occurrence frequency of RHi>100% shows a double peak structure (peaks at ~ 12-14 km and 14-16 km) in the upper troposphere in all the seasons. The occurrence of super-saturation layers are found to be more frequent during the summer monsoon season. Concurrent CALIPSO observations showed the presence of high altitude clouds at the altitude of super-saturated layers. While the cloud-base showed a double peak structure similar to that observed in occurrence of RHi>100% in the upper troposphere, the occurrence of cirrus-top shows a single peak at 16-17 km. This indicates the presence of thin cirrus overlying thick cirrus. CFH observations revealed the presence of supersaturated layers up to a kilometre above CPT altitude, especially in pre-monsoon and summer monsoon seasons. Similarity in the spatial structure of occurrence of cirrus clouds, RHi and occurrence of deep convection indicates that the lower cirrus layer is closely associated with the deep convective outflows near the TTL-base. The upper cirrus layer which is well within the tropical tropopause layer could be of in situ origin.

Presentation Mode: Oral

Presenting Author: Maria Emmanuel

Registration id: NSSS-20220109012632

Cirrus Fraction and Cirrus Reflectance with Respect to Precipitation Characteristics Over Indian Sub-Continent

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The current work focuses on the tropical cirrus fraction and cirrus reflectance over the Indian sub-continent using the MODIS Terra data sets for eight years. Cirrus clouds being high-altitude clouds plays a vital role in the radiation budget of the earth and the determination of the local and global weather. But the link between cirrus characteristics and precipitation characteristics is much not analysed. The data set from 2013-2021 analyses the seasonal as well as annual variation of cirrus fraction and cirrus reflectance with respect to precipitation over the Indian sub-continent. The sub-continent is divided into different regions. Also, the combined GPM - IMERG data is used to study the precipitation over the study region. The correlation studies between the cirrus fraction, cirrus reflectance and precipitation has been done on the MODIS aboard the Terra satellite and GPM - IMERG data sets.

Presentation Mode: Oral

Presenting Author: Priya J S

Registration id: NSSS-20220110114243

Characterising the layers of enhanced turbulence using VHF radar over central Himalayan site

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Turbulence is the ubiquitous phenomenon in the atmosphere which causes exchange of mass and energy flux at different levels. It also plays an important role in diffusion of trace species and cloud microphysics. VHF radars have proved to be effective in the quantification of critical turbulence parameters. However most of these radars are situated over plane terrain and hence the reporting of turbulence studies over mountainous terrain is negligible. It is vital to understand the complexity of the turbulence process over mountains due to involvement of orographic gravity waves. Recently, a ST radar operating at frequency of 206.5MHz has been established at high altitude site of Nainital (29.4N,79.5E;1.8km amsl) in the central Himalayan region. Simultaneous observations from radar and GPS radiosonde have been used for the estimation of the turbulence parameters and their generation mechanism. Elevated layers of enhanced turbulence at 3, 4, 5.8 and 7.5 km with lifetime 3–4 hours and thickness of 225–300m have been observed during different case studies. These stratified turbulent structures were formed at the base of layer of high humidity (RH~30–70%). Strong wind shear and low Richardson number (Ri<0.25) have been observed in these layers with turbulent kinetic energy dissipation rate as high as 10-1.5 m2s-3. During one case study, occurrence of Kelvin Helmholtz instability (KHi) for the duration of about 160 minutes at an altitude of 3 km was observed. The braided structure in radar reflectivity was similar to KHi billows with crest to trough amplitude of 300 m. Out of phase vertical air motion exceeding 25 cm/s with periodicity of 11 minutes were observed within KHi. TKE dissipation rate enhanced from 10-3.2 to 10-2.5 m2s-3 during KHi phase. These results will be significant in verifying the results of various turbulence models involving Large Eddy Simulation over mountainous region and identifying potential hazardous zones of high turbulence for aviation.

Presentation Mode: Oral

Presenting Author: Aditya Jaiswal

Registration id: NSSS-20220110110845

A new approach to explore Hadley Cell Dynamics at regional scales using Radio Occultation Technique

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Turbulence is the ubiquitous phenomenon in the atmosphere which causes exchange of mass and energy flux at different levels. It also plays an important role in diffusion of trace species and cloud microphysics. VHF radars have proved to be effective in the quantification of critical turbulence parameters. However most of these radars are situated over plane terrain and hence the reporting of turbulence studies over mountainous terrain is negligible. It is vital to understand the complexity of the turbulence process over mountains due to involvement of orographic gravity waves. Recently, a ST radar operating at frequency of 206.5MHz has been established at high altitude site of Nainital (29.4N,79.5E;1.8km amsl) in the central Himalayan region. Simultaneous observations from radar and GPS radiosonde have been used for the estimation of the turbulence parameters and their generation mechanism. Elevated layers of enhanced turbulence at 3, 4, 5.8 and 7.5 km with lifetime 3–4 hours and thickness of 225–300m have been observed during different case studies. These stratified turbulent structures were formed at the base of layer of high humidity (RH~30–70%). Strong wind shear and low Richardson number (Ri<0.25) have been observed in these layers with turbulent kinetic energy dissipation rate as high as 10-1.5 m2s-3. During one case study, occurrence of Kelvin Helmholtz instability (KHi) for the duration of about 160 minutes at an altitude of 3 km was observed. The braided structure in radar reflectivity was similar to KHi billows with crest to trough amplitude of 300 m. Out of phase vertical air motion exceeding 25 cm/s with periodicity of 11 minutes were observed within KHi. TKE dissipation rate enhanced from 10-3.2 to 10-2.5 m2s-3 during KHi phase. These results will be significant in verifying the results of various turbulence models involving Large Eddy Simulation over mountainous region and identifying potential hazardous zones of high turbulence for aviation.

Presentation Mode: Oral

Presenting Author: Aditya Jaiswal

Registration id: NSSS-20220110110845

Balloon borne aerosol-cloud interaction studies (BACIS): New observational techniques to understand

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Better understanding of aerosol-cloud interaction processes is an important aspect to quantify the role of clouds and aerosols in the climate system. There have been significant efforts to explain the ways aerosols modulate cloud properties. However, from the observational point of view, it is indeed challenging to observe and/or verify some of these processes because no single instrument or platform is proven sufficient. With this motivation, a unique set of observational field campaigns named Balloon borne Aerosol Cloud Interaction Studies (BACIS) is proposed and conducted using balloon borne in-situ measurements in addition to the ground-based (Lidars, MST radar, LAWP, MWR, Ceilometer) and space borne (CALIPSO) remote sensing instruments from Gadanki (13.45Â° N, 79.2Â° E). So far, 15 campaigns have been conducted as a part of BACIS campaigns from 2017 to 2020. This paper presents the concept of observational approach, lists the major objectives of the campaigns, describes the instruments deployed, and discusses results from selected campaigns. Consistency in balloon borne measurements is assessed using the data from simultaneous observations of ground-based, space borne remote sensing instruments. A good agreement is found among multi-instrumental observations. Balloon borne in-situ profiling is found to complement the information provided by ground-based and/or space borne measurements. A combination of the Compact Optical Backscatter AerosoL Detector (COBALD) and Cloud Particle Sensor (CPS) sonde is employed for the first time to discriminate cloud and aerosol in an in-situ profile. Using the data from balloon measurements, the relationship between cloud and aerosol is quantified for the liquid clouds. In a nutshell, the results presented here demonstrate the observational approach to quantify aerosol-cloud interactions and paves the way for further investigations using the approach.

Presentation Mode: Oral

Presenting Author: Ravi Kiran V

Registration id: NSSS-20211224064629

Long term changes in aerosol and its impact on cloud, temperature and rainfall over northeast monsoon region Chennai (12.82ºN, 80.04ºE)

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In this study, the long-term changes in aerosol optical depth (AOD), Angstrom exponent (AE), aerosol extinction coefficient (AEC) and its impact on cloud fraction (CF), cloud albedo (CA), cloud liquid water path (CLWP), Temperature and Rainfall (RF) has been extensively studied using satellite-based MODIS, CALIPSO and ground-based radiosonde measurements over the northeast monsoon region Chennai (12.82oN, 80.04oE) during the period of 2001 – 2020. The positive linear relationship between AOD and CF and CA indicates the study location is strongly influenced by the aerosol semi-indirect effect. Further, the positive Aerosol cloud interaction (ACI) values observed for the CLWP at 1 -20, 40-60, 60-80, 160-180, and 180 – 200 g/m2 respectively. The increase in AOD result in a decrease (increase) in BL (FT) temperature indicates the high FT aerosol load cause the surface dimming. The negative linear relationship between AOD, AE with RF suggests the high aerosol loading of fine mode particles delays the precipitation process. The long-term trend of AOD and AE are found statistically increasing with a level of significance of 0.14±0.07 and 0.122± 0.04 per decade. The cloud parameters CER (CF) statistically decreasing (increasing) with the level of significance -0.06± 0.0013 (0.06± 0.0011) per decade. The FT temperature statistically increased with a level of significance 00.56 ± 0.28 K. whereas other parameters are found to be negligible change either increasing or decreasing over the period of 2001 – 2018.

Presentation Mode: Oral

Presenting Author: Aravindhavel A

Registration id: NSSS-20220110080356

Aerosol-cloud-precipitation relationship under maritime and anthropogenic polluted conditions

Shivali Verma[1], Lima C.B.[1], Shivasai Krishna[1], Prijith S.S.[1], M.V. Ramana[1]

[1]ISRO

Climate monitoring can be greatly improved through accurate long-term cloud observations, the importance of which has gained recognition in recent years. Understanding the role of clouds in the climate system requires measurements of cloud micro and macro-physical properties, their diurnal, seasonal and inter-annual variations. The evolution of cloud properties is better captured by geostationary satellites with higher sampling frequency (~30 mins) as compared to polar satellites (~2/day). Cloud properties are retrieved from satellite remote sensing through inversion procedures consisting of cloud detection and retrieval schemes which operate on the satellite-measured top-of-atmosphere radiances. We investigate the effect of aerosols on clouds under anthropogenic polluted conditions and relatively maritime conditions over Arabian Sea, under the influence of the same large-scale meteorology and spatio-temporal domains. The relationship between diurnal mean Cloud Fraction (CF) and Cloud top temperature (CTT) parameters from INSAT-3D and aerosol properties, from MODIS, have been examined for winter months of 2018. The strength of aerosol-cloud interaction on CF and CTT are respectively 0.3 and -0.02 for polluted conditions and 0.1 and -0.005 respectively for maritime conditions, with an increase in aerosol index from 0.0 to 0.6. We find that clouds grow in horizontal and vertical extent with rise in aerosol concentrations. Remote sensing of cloud-top parameters by imaging satellites can be further supplemented by cloud-base and within-cloud observations from ground-based measurements. Additionally, Doppler weather radar (DWR) and Micro rain Radar (MRR) helps to establish the relationship between cloud properties and associated precipitation. Retrieval of cloud physical properties from satellites and ground-based sensors will be useful for monitoring climate change and to evaluate parameterizations of cloud processes in weather and climate prediction models.

Presentation Mode: Oral

Presenting Author: Shivali Verma

Registration id: NSSS-20220106112240

Unravelling the characteristics of Atmospheric Boundary Layer over Ahmedabad

Sourita Saha[1], Som Sharma[1], Niranjan Kumar Kondapalli[2],Dharmendra Kamat[1]

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Atmospheric Boundary Layer (ABL) is the lowermost layer of the atmosphere in contact with the Earth's surface. It plays a major role in heat circulation and pollutant dissipation. ABL is an important parameter that goes into the climate models. Thus, an accurate estimation of the ABL is of utmost importance for bridging one of the uncertainties in the model predictions. In this study, we have investigated the characteristics of the ABL over a western Indian semi-arid urban region, Ahmedabad, using a ground-based Ceilometer Lidar, in conjunction with radiosonde, ERA-5 reanalysis, and COSMIC GPS RO satellite. Strong diurnal variations of ABL are observed during 2019, the observation period. There is a stark winter-summer difference in ABL, with summer Boundary Layer Height (BLH) exceeding winter BLH by 1-1.5 km. ABL usually collapses during monsoon and is equivocal due to the presence of thick clouds on top of ABL. The ABL is thicker during the onset of monsoon in contrast to active monsoon, rises again during the withdrawal of monsoon. Lidar observed ABL have been compared with satellite, radiosonde, and ERA5 datasets. ERA5 shows good agreement with differences within 500 m; radiosonde observations have under-estimated ground-based measurements, especially during summer. Satellite observations highly overestimated BLH. This comparative study reveals the importance of ground-based lidars in continuous monitoring of ABL at high resolution because radiosonde, satellite, and reanalysis datasets have coarser resolutions and sparse observations. Such quantitative evaluation of ABL is formerly unavailable over this region, which can now be used to improve the representation in numerical models and thereby estimates of radiative and climate effects due to ABL.

Presentation Mode: Oral

Presenting Author: Sourita Saha

Registration id: NSSS-20220110061809

Atmospheric boundary layer height detection using the wavelet covariance transform

T.V Ramesh Reddy[1]. Sanjay Kumar Mehta[1], Aravindhavel Ananthavel, Saleem Ali[1] , D. Narayana Rao[1]

[1]SRM Institute of Science and Technology

Accurate representation of the atmospheric boundary layer height (ABLH) is important and it detection mainly depends on vertical profiles metrological variables or aerosols. Micro pulse Lidar is a powerful tool to retrieve the ABLH and by using the wavelet covariance transform (WCT) method ABLH retrieved by the detection of the vertical distribution of aerosols concentration. Over the coastal regions frequent occurrence of sea breeze make the complexity to identify accurate ABLH. In this paper we investigate the sea breeze impact on diurnal evolution of boundary layer height over the tropical coastal station Kattankulathur (12.83Â° N, 80.04Â° E) during different seasons. The TIBL formation is very frequent during pre-monsoon (71 %), winter (40%) and less during the summer monsoon, post monsoon seasons. The maximum SBL and CBL height observed during SW-monsoon and minimum during the NE-monsoon season. The maximum growth rates are above 50 % is 100m/hr during the winter and post monsoon seasons. In pre-monsoon and SW monsoon seasons the maximum growth rates are between 100-200m/hr. In all the seasons the decay rate is maximum at 100m/hr. The mean ABLH and surface temperatures revels that except summer monsoon season maximum mean PBLH and temperature observed at 13:00 IST later it started to decrease with time due to the sea breeze and the decay rate also strong, whereas in summer monsoon the maximum mean ABLH and temperature observed at 14:30 IST later slowly decrease with time. The seasonal mean ABLH strong during summer monsoon and weak during the post monsoon seasons.

Presentation Mode: Oral

Presenting Author: TV Ramesh Reddy

Registration id: NSSS-20220110011740

Variation of Surface Latent Heat Flux (SLHF) as observed during high magnitude earthquakes

Ananna Bardhan[1], Raj kumari[2] , D.K.Sharma[1], Pooja Sharma[1]

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Various Precursory Signatures are observed over ocean-land-atmosphere due to seismic activities. Earthquake creates lot of destruction to life and property. Therefore the understanding and monitoring of various geophysical parameters are required to study the precursory signature for early warning and prediction of earthquake. In this present work surface thermal parameter-Surface latent heat flux (SLHF) has been analysed for recent high magnitude ($M \geq 6.0$) earthquake. For this purpose, surface latent heat flux data have been retrieve from NCEP (http://iridl.ldeo.columbia.edu/) .The analysis of the surface latent heat has been done through Climatological Analysis for seismic precursor Identification (CAPRI) algorithm. A significant change in the surface latent heat flux has been observed prior to the seismic activity. On an average, it was found that the maximum increase of surface latent heat flux was found to be 10-15 days prior to the main earthquake events. The earthquake sequence was analysed in terms of surface latent heat flux for the period of 2 months and compared with the past 37-years trend. The increase in the surface latent heat flux prior to the main earthquake event may be attributed to the thermal infrared (IR) around the epicentral and near surrounding area.

Presentation Mode: Oral

Presenting Author: Pooja Sharma

Registration id: NSSS-20220110121459

Emissions of biogenic VOCs from Achanakmar-Amarkantak Biosphere Reserve (AABR) Forest in Central India

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Isoprene and monoterpenes are the most abundant biogenic volatile organic compounds (BVOCs) emitted in large quantities from terrestrial plants. The annual global BVOCs emission budget (~1150 Tg C Year-1) from the terrestrial ecosystem is almost comparable to that of methane (~1000 Tg C Year-1). The main global source of isoprene and monoterpene are tropical or subtropical and temperate forests. However, the measurements of BVOCs in the Indian sub-continent are limited. We have estimated the isoprene and monoterpene emission capacities from dominant tree species in the Achanakmar-Amarkantak Biosphere Reserve (AABR). The AABR is located in the Anuppur and Dindory forest divisions of Madhya Pradesh and Bilaspur and Marwani forest divisions of Chhattisgarh. It covers an area 3,835.51 sq km, with forest coverage of 2437.85 sq km (63.56%). It has highly diverse flora, comprised of 1527 species, most of which are moist deciduous forests (63%). Among 1527 species, (BVOC) emission capacities for forty-nine tree species that cover more than 90% of AABR forested areas were determined in this study. At standard conditions (30 Â°C Temperature and 1000 Î¼mol mâˆ'2 sâˆ'1 PAR) the average emission capacities across different species showed large variability. For instance, the maximum emission capacity of isoprene was found in Dalbergia sissoo (71.12 Î¼g C g-1h-1) and emission capacities for Terminalia arjuna and Acacia catechu were below the detection limit (BDL). Isoprene was the dominant BVOCs emitted from the selected plant species. The emission capacity of isoprene was ~7 times higher than that of monoterpenes. The average isoprene emission capacity of the AABR was 4% more than that of a forest region in Haryana. However, monoterpene emission capacity was found to be lower 13% than that of isoprene from the same area (AABR). This study highlights the need to estimate BVOCs emission capacities in other Indian tropical forests to understand their role in regional atmospheric chemistry.

Presentation Mode: Oral

Presenting Author: Tanzil Gaffar Malik

Registration id: NSSS-20220110083350

Decadal changes in atmospheric methane emissions over the Eastern Himalayan region: source apportion

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Among Short-Lived Climate Pollutant (SLCPs), methane (CH4), has higher global warming potential than CO2 and is an efficient precursor of tropospheric O3 and the second most important greenhouse gas in terms of radiative forcing, is increasing globally and over Eastern Himalaya Region (EHR), as revealed by multiple datasets (CAMS ~0.087 Tg Yr -1, EDGARv4.3.2 ~0.11 Tg Yr-1, and RCP8.5 ~0.16 Tg Yr-1). Around 60% of emissions are contributed by anthropogenic activities and 40% from natural wetlands over the Eastern Himalayan region (EHR). CH4 emissions over the EHR are stronger than the global trend due to increased anthropogenic sources like transportation, industry and energy sectors, wastewater treatment, livestock, etc. During 1990-2016, CH4 emissions from anthropogenic and wetlands increased by 20% and 10% over EHR. Land type change analysis reveals a conversion of ~0.42% forest area to cropland and an increase of 0.018% urban built-up area, 0.098% total wetland, and 0.033% water-bodies from 2001 to 2018. Future projections reveal a 2-fold (32.7 Tg CH4 Yr-1) increase in CH4 emissions by 2050 and up to a 3-fold (~48.2 Tg CH4 Yr-1) by the year 2100 from the base year level (14.6 Tg CH4 Yr-1) in 2000. CH4 impacts on global and regional (EHR) radiative forcings (RF) estimated by the CAMS reanalysis and CMIP5 model during 2003-2017 and 1851-2100 reveal the higher regional increasing trend. The predicted global/EHR RF trend for the period 2006-2100 is higher (0.0093 Wm-2 Yr-1/0.0095 Wm-2 Yr-1) than the historical trend (0.0038 Wm-2 Yr-1/0.0037 Wm-2 Yr-1) during 1851-2005. The resultant land surface temperature increase induced solely by CH4 is higher over EHR (0.0062Â°C Yr-1) than at the global rate (~ 0.0036Â°C Yr-1).

Presentation Mode: Oral

Presenting Author: Arshini Saikia

Registration id: NSSS-20220106044101

Formation of the evening time F3 layer investigated using Jicamarca ISR observations

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The formation of the evening time F3 layer remains elusive. One of the hypotheses for the formation of the evening time F3 layer relies on the height gradient in the vertical plasma drift. In this paper, we test the validity of the hypothesis using Jicamarca incoherent scatter radar (ISR) observations of height profiles of electron density and vertical plasma drift. Results show that the evening F3 layer could occur when the plasma drift is moderate and the height gradient in the vertical plasma drift is small or insignificant. Given that the production in the evening hours is negligible, these results call for interpretation for understanding the formation of the evening F3 layer. We propose that in addition to the known role of vertical plasma drift, the height variation in the recombination loss of electrons plays an important role in the formation of evening F3 layer over the geomagnetic equator.

Presentation Mode: Poster

Presenting Author: K. Venkatesh

Registration id: NSSS-20220109081643

Characteristics of IRNSS signals as received at Shimla beyond the northern crest of EIA

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A small-form receiver of the Indian Regional Navigation Satellite System (IRNSS), rechristened as NavIC (Navigation for Indian Constellation), is operated at AP Goyal Shimla University, Shimla by the Institute of Radio Physics and Electronics, University of Calcutta since November 2019. This receiver provides data from the 7-satellite GEO/GSO constellation at L5 frequency (1176.45 MHz) in NMEA format at a sampling interval of 1s. The location of this station is important from the geophysical perspective being situated beyond the northern crest of Equatorial Ionization Anomaly (EIA). Ionospheric observations from this region are relatively less which falls in the transitional low-to-mid latitudes. The main scientific objective behind operating this receiver at Shimla stems from the fact that interactions between the low latitude and transitional mid-latitude generated irregularities are rarely reported from the Indian longitudes. The present low solar activity conditions will help to understand the ambient signal-in-space conditions from this region for use as a possible reference during adverse ionospheric conditions. Diurnal variations of received signal-to-noise ratios (SNRs) from this station form an interesting picture with different spatial coverage for the geostationary and geosynchronous satellites. In March 2020, on a particular day, the longitude swath covered by the combined zone of reception of the constellation varies from 74-84E and the corresponding latitudinal extent varies from 24-32N. While the SNRs for the geostationary satellites (IRNSS 1C, 1F and 1G) remains more-or-less at 43 dB, the corresponding values for the geosynchronous satellites (IRNSS 1B, 1D and 1E) varies from 38-44 dB. The receiver position deviations are found to be bounded within ±10m in latitude and ±20m in longitude.

Presentation Mode: Poster

Presenting Author: Ashik Paul

Registration id: NSSS-20211216080750

Characterizing the occurrence of ionospheric irregularities using the SCINDA receiver at Calcutta

Anamika Das[1], Trisani Biswas[1], Ashik Paul[1]

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Institute of Radio Physics and Electronics, University of Calcutta is part of the international SCIntillation Network Decision Aid (SCINDA) network of US Air Force Research Laboratory. Under this program, a dual frequency GPS receiver is operational since November 2006. The location of this station assumes importance from the geophysical perspective being situated near the northern crest of the Equatorial Ionization Anomaly (EIA) in the Indian longitudes. Observations of ionospheric scintillations at L-band from this station are subject to early evening upwelling of irregularity structures to altitudes exceeding 1200km over the geomagnetic equator and subsequent movement towards the anomaly crest. The period from 2017-2021 has been extremely quiet in terms of occurrence of ionospheric scintillations as observed by GPS links from this station. However, in October 2021, there were few cases of amplitude scintillations noted on some GPS satellite links. These observations were made on October 21, 26, 27 and 28, 2021 during local post-sunset to midnight time sector under geomagnetic quiet conditions. Amplitude scintillations with peak S4 of 0.8 were noted on SV4 link around 20:40LT on October 26th at an elevation angle of around 45. On this night, SV1 and SV9 were also affected by ionospheric irregularities. Corresponding fluctuations were found in carrier-to-noise ratios (C/No) of these transionospheric satellite links. Similar observations were made on October 28th also. More detailed analyses on characterizing these cases are presently underway and will form the major theme of this paper.

Presentation Mode: Poster

Presenting Author: Anamika Das

Registration id: NSSS-20211217091817

Role of Cosmic Rays in Modulating the Earth's Climate: An Investigation on the Possible Influence

Misha Roy[1]

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Climate change and global warming are attributed to an increase in greenhouse gases in the atmosphere. However, in addition to this other possible contributors are constantly being searched. Since solar irradiance acts as a possible driver of climate change and the solar cycles have a known effect on the cosmic rays, it has been speculated that cosmic ray variations may have an impact on the climate. The cosmic rays (CR) are the high-energy charged particles that penetrate the earth's lower atmosphere and are filtered by its geomagnetic field. The primary CRs undergo hadronic interactions upon interaction with the atmosphere resulting in the formation of secondary CRs. Despite a good deal of evidence relating to the influence of cosmic rays on climatic changes, the exact mechanism is still not clear. A possible link connecting these two is the influence of cosmic rays on the atmospheric processes. This is given through the influence of the cosmic ray effects on the global electric circuit, lightning, cloud formation, and cloud coverage. The "ion-aerosol clear-air" hypothesis suggests that ionization from cosmic rays affects the rates of nucleation of cloud condensation nuclei (CCN). The result would be an impact of the rate of cosmic rays on cloud formation that would subsequently impact the reflection of incoming short wavelengths radiations and the trapping of outgoing long radiation; more cosmic rays would lead to more clouds and will affect the atmospheric temperature by creating an umbrella effect. In this paper, we review the experimental and theoretical shreds of evidence to investigate cosmic ray–climate links. The link seems to be a probable driver which effectively operates on large time scales, but its exact mechanism and relative importance are still unexplored. It is however suggested that cosmic rays affect the long-term variation in the climate.

Presentation Mode: Poster

Presenting Author: Misha Roy

Registration id: NSSS-20220104050920

Enhanced GW activity in the MLT region over Tirunelveli as a response to the tropospheric convective

Krishnapriya K[1], Dr. Sathishkumar[2], S. Sridharan[3]

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Enhanced Gravity Wave activity in the Mesosphere Lower Thermosphere region over Tirunelveli as a response to tropospheric convective event. Simultaneous observation of medium frequency (MF) radar winds acquired at Tirunelveli (8.7oN, 77.8oE) and Kolhapur (16.4oN, 74.2oE) during February â€“August 2019 are used to examine the gravity waves in the equatorial and low latitude mesosphere and lower thermosphere (MLT) region. Gravity wave variances of 10-60 mins period and spectra are obtained. Previous studies suggest that mesospheric GWs are stronger during equinox than the solstice condition in the low latitude. The GW variance shows a peak during the month of June 2019 over Tirunelveli as compared to Kolhapur, we focused on the gravity wave variance and its relation to tropical convection in the month of June. The lower atmosphere sources on the presence of GW in the MLT are examined with convective precipitation from ERA-5 reanalysis and outgoing longwave radiation (OLR) from NOAA during June 2019.The air temperature data obtained from SABER/TIMED is used to evaluate the background conditions to the presence of GW in the MLT region to support our observations. GW activity in the MLT region exhibits anticorrelation with low OLR yields strong convection associated with peak wave activity in the MLT region. It clearly suggest that a possible connection between observed gravity wave and the variation in the deep tropical convection.

Presentation Mode: Poster

Presenting Author: Krishnapriya.K

Registration id: NSSS-20211221060235

Network observations of D-region ionospheric disturbances during the two recent solar eclipses

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Low-latitude D-region (60-90 km) ionospheric disturbances during the two recent solar eclipses of 2019 and 2020 are presented in this paper. The D-region ionosphere is monitored using low-cost Very Low Frequency (VLF) radio receivers from several places (~12) in West Bengal, India. In addition to natural VLF signals from lightning, the VLF receivers continuously record signal amplitudes of several navigational VLF transmitters such as VTX (18.2 kHz, India), NWC (19.8 kHz, Australia), JJI (22.2 kHz, Japan), and DHO (23.4 kHz, France). VLF signal amplitudes are perturbed by the solar eclipse obscuration while propagating from transmitter to receiver via earth-ionosphere waveguide with respect to the normal conditions and thus help us to investigate the lower ionospheric modification along the propagation path during any solar eclipse period. Depending on the eclipse obscuration over the propagation path, propagation distance, and frequency of the signal, increase or decrease of signal amplitudes compared to normal days were observed on the solar eclipse day. The possible reason behind the amplitude perturbations is explained based on the Long Wave Propagation Capability (LWPC) code.

Presentation Mode: Poster

Presenting Author: Sujay Pal

Registration id: NSSS-20211219034556

Dynamical Complexity analysis of Ionospheric Perturbations at Caribbean Region during Geomagneticall

Prince P.R.[1], Sumesh Gopinath[1]

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The total electron content (TEC) in the ionosphere largely influences Global Navigation Satellite Systems (GNSS) especially for crucial applications where positional errors may get induced in the GNSS measurements. The variations in TEC can be used as a tool in studying space weather phenomena such as geomagnetic storms which produce disruptions in the ionosphere. The Caribbean region hosts a variety of ionospheric processes mostly dominated by the electrodynamics of mid-latitude region with a large magnetic dip (I~50Â°). Arecibo (29Â°N, 5.5Â°E; L=1.43 at 300 km; dip angle: 46Â°). In general, the Caribbean region is unaffected by the electrodynamical processes typically associated with the equatorial/low-latitude ionosphere. But, it is well known that the Arecibo region spans the strong latitude gradient toward the northern crest of the equatorial ionization anomaly (EIA) and this leads to an interesting phenomenon due to intrusion into the mid-latitude domain of typical equatorial/low-latitude processes, well-known as the midnight collapse, observed at Arecibo. The prominent characteristic properties in the night time ionosphere at Arecibo are the downward motion of the F-layer at near midnight which induces a height change of typically 50-100 km. In the present work, we study the variations of the total electron content with solar activity in the Caribbean sector using the method of Jensen Shannon Divergence of dynamical complexity between geomagnetic activity and ionospheric TEC perturbations. The results of the study not only strengthen the regional understanding of ionospheric properties on solar activity in the mid-latitude region but also act as a database for the ionospheric modeling of the mid-latitude region. The results can contribute towards the global efforts for mid-latitude ionospheric modeling which increases the reliability on navigation as well as trans-ionospheric communication.

Presentation Mode: Poster

Presenting Author: SHIBU R

Registration id: NSSS-20220109113431

A study on the variation in Joule heating due to changes in geomagnetic activity during solarcycle24

Aswini Thampi S.L[1]., Sumesh Gopinath[1], Prince P.R.[1]

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At high-latitudes, energy is accumulated in Earth's upper atmosphere through solar extreme ultraviolet (EUV) radiation, Joule heating from electric currents, auroral particle precipitation, and propagation of gravity waves from the lower atmosphere. During geomagnetically calm times, forcing from the lower atmosphere is significant, while during disturbed periods, auroral particle precipitation and Joule heating play a major role. Thus, during geomagnetic storms, due to Joule heating, a significant amount of the solar wind energy traversing the magnetopause reaches the high-latitude thermosphere-ionosphere system, leading to remarkable consequences which are global in nature. We study, Joule heating in high latitude upper atmosphere, during different geomagnetically disturbed periods of solar cycle 24, and discuss its relationship with the solar wind forcing. We have used Weimer model to calculate the Poynting flux flowing onto the Earth's ionosphere and associated Joule heating due to the solar wind-magnetosphere-ionosphere dynamo. The investigation reveals that the variations in Joule heating is having a correlation with changes in geomagnetic activity

Presentation Mode: Poster

Presenting Author: Aswini Thampi SL

Registration id: NSSS-20220109043142

Anomalous variation in GPS-TEC prior to the earthquake at Pakistan-Iran border at low latitude station Rajkot,India.

Himanshi N.Rajyaguru[1], Chintan Jethava[1], H.P.Joshi[1]

[1]Saurashtra University

Possible ionospheric VTEC anomaly variation examined related to 16 April 2013,Ms 7.8 Pakistan-Iran border(Lat.28.10Â°N, Long.62.05Â°E) earthquake, using Global Positioning System (GPS) installed at Rajkot(gogr.Lat.22.29Â°N ,Long.70.74Â°E).Results showed that enhancement and depletion accrued 1-15 days prior to the earthquake.

Key words: VTEC,GPS, Earthquake

Presentation Mode: Poster

Presenting Author: Himanshi Natavarlal Rajyaguru

Registration id: NSSS-20220109041627

Characterization of Atmospheric Boundary Layer over High Altitude Station, Umiam

Manasi Gogoi[1,3], Arup Borgohain[1], Shyam S. Kundu[1], Som Sharma[2], Pradip K. Bhuyan[3], Arundhati Kundu[1], Nilamoni Barman[4], P.L.N. Raju[1]

[1]North Eastern Space Applications Centre, [2]Physical Research Laboratory, [3]Centre for Atmospheric Studies, Dibrugarh University, [4]Central Ground Water Board, Kolkata

Atmospheric Boundary Layer Height (ABLH) is a key determinant of vertical and horizontal distribution and dispersion of atmospheric pollutants in the atmosphere. Accurate information on elevated layer (EL) of aerosols and atmospheric parameters are of dire importance and for that in situ measurements are essential for proper understanding of regional ABL. The most common method of estimating ABLH or the maximum vertical mixing of the pollutants taking place in the atmosphere i.e. the Mixed Layer Height (MLH) is sounding data. But it cannot give us regular continuous measurement of ABLH, therefore a remote sensing technique; Vaisala Ceilometer (VCEIL) has been used in this study to characterize ABL over high altitude station Umiam from December 2019 to November 2021 along with 106 radiosonde launches with the help of meteorological balloon since 2009 to 2020. Seasonally averaged MLH from the radiosonde showed highest during winter followed by pre - monsoon, monsoon and minimum during post - monsoon. The backscattering signal of the ceilometer is strong in the ABL where particle concentration is higher and thus distinct diurnal and seasonal variation have been observed with BLH evolution. Maximum BLH is observed during pre - monsoon where the backscattering signal clearly indicates well mixing of particles up to an average height of about 1616.5 m in the afternoon and minimum during monsoon where BLH is around 769.5 m and particles seem to be concentrated near to the surface within the BL. Comparison between MLH retrieved from Pisharoty radiosonde and VCEIL showed good correlation.

Presentation Mode: Poster

Presenting Author: Manasi Gogoi

Registration id: NSSS-20220110065411

Response of the Mid-latitude Ionosphere Over Nicosia, Cyprus to a Geomagnetic Storm: A Case Study

Blessy Varghese[1], Dr. Tiju Joseph Mathew[1], Ankitha N.[1]

[1]Department of Physics, Research Centre of University of Kerala, Christian College, Chengannur, Kerala, India

The response of mid-latitude ionosphere over Nicosia, Cyprus (geographical Coordinates: 35Â°N, 33Â°E, I = 51.7Â°) to a moderate geomagnetic storm is analyzed and presented in this work. The observed event is a G2 storm occurred on 7-10 June, 2014 associated with multiple sub storm onsets. During the main phase and recovery phase, former lasts for about 20 hours and latter lasts for about 35 hours, a series of substorm onsets were identified in the SUPERMAG database. This disturbed time is also characterized by frequent and rapid reversals in the z component of the Interplanetary Magnetic Field (IMF Bz). The F2 layer critical frequency foF2, the F2 layer peak height hmF2 and F layer vertical plasma drift velocity (Vz) obtained using the Digisonde at Nicosia (DPS-4D) are used in the present work. A significant reduction in the day time F2 layer critical frequency (foF2) (negative ionospheric storm) around 7:30 UT (10:30 LT), followed by a rapid increase (positive ionospheric storm) is observed on June 8, 2014. The effect of storm is also identified in the vertical drift as a large downward excursion, though quiet time mid-latitude ionosphere is characterized by low vertical drift velocity during day time. Simultaneously, the peak height hmF2 decreased sharply followed by a sudden enhancement. A sharp increase in the AL index observed during the negative storm indicates the presence of strong westward auroral electrojet current. The effect of the Geomagnetic storm on the ionosphere over Cyprus and its possible mechanism will be presented and discussed.

Presentation Mode: Poster

Presenting Author: Blessy Varghese

Registration id: NSSS-20211215042016

Study of MSNA and Pre-sunrise minimum value of foF2 at mid-latitude station, Nicosia

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The present work studies the variation of critical frequency (foF2) in the ionospheric F2 layer over a mid-latitude station Nicosia, Cyprus (geographical Coordinates: 35oN, 33oE, geomagnetic lat. 29.38oN, I = 51.7o). The F2 layer critical frequency foF2, the F2 layer peak height hmF2 and scale height (H) obtained using the digital Ionosonde in Nicosia for different solar activity levels within a span of seven years (2009 - 2015) were used for the study. The critical frequency, in general, enhances during day time, peaks around noontime and after sunset it starts decreasing and reaches a minimum just before sunrise. The minimum value critical frequency prior to sunrise is named as pre-sunrise minimum critical frequency (foF2min). But mid-latitude ionosphere exhibits an enhancement in electron density during night, more evident in summer, which is referred to as mid-latitude summer night time anomaly (MSNA). To quantify the pre-sunrise minimum value of foF2 relative to day time peak value, an index called fmin index was defined and its variations were analysed. From the observations, the fmin index is found to be decreasing linearly with solar flux in summer and increases in other seasons. The pre-sunrise minimum value of critical frequency, foF2min also shows seasonal variations, i.e., higher in summer than winter and equinox. From the average solar flux and day time peak foF2 an empirical relations to find the pre-sunrise minimum value of critical frequency in summer, equinox and winter were obtained and discussed.

Presentation Mode: Poster

Presenting Author: Ankitha N

Registration id: NSSS-20211219042648

Characteristics of the tropical tropopause and tracers over the north east monsoon region

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The variability of the tropical tropopause strongly influences the transport of the pollutants and trace gases into the lower stratosphere as well as the transport of the ozone into the upper troposphere. The exchange of these trace gases especially water vapour and ozone following deep convection in turn modifies the tropical tropopause height and temperature. In this study, we have utilized the radiosonde observations over Chennai, located in the north east monsoon region, to characterize the tropical tropopause during different seasons and different sky conditions. The cold point tropopause (CPT) height (CPT-H) and temperature (CPT-T), convective tropopause (COT) height (COT-H) and temperature (COT-T), lapse rate tropopause (LRT) height (LRT-H) and temperature (LRT-T) and the tropical tropopause layer (TTL) are obtained over the period 2014-2020. The TTL thickness is defined as the difference between CPT and COT heights. Using water vapor and ozone data from microwave limb sounder (MLS) simultaneous to the radiosonde observations, the relationship between them is analysed for different convective conditions which will be presented during the conference.

Presentation Mode: Poster

Presenting Author: Pooja Purushotham

Registration id: NSSS-20220110074749

Explanation For The Observed Whistlers During Geomagnetic Storm

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The lightning generated very low frequency (VLF) wave (3-30 kHz) travels along the geomagnetic field lines within a channel or duct from one hemisphere to another hemisphere on a certain favorable conditions and can be detected thousands of kilometers away from the sources known as whistler mode waves. The whistlers recorded at ground provide interest to study the ionosphere/magnetosphere at different conditions/times and sources of the locations. The spectral properties of the whistlers depend on the electron density and magnetic field along their propagation path. Hence whistlers are useful to estimate the propagation characteristics from its source point to observation point. The number of whistler's observation is directly related its propagation characteristics. In this paper, our purpose is to study the characteristics of the propagation path of the whistlers observed during St. Patrick's Day geomagnetic storm period of 16-23 March, 2015. These whistlers were recorded and analyzed by Automatic Whistlers Detector (AWD) installed at Low Latitude Indian Station, Varanasi (geomag. lat. 140 55/ N, geomag. long. 1530 54/ E). We attempt to correlate the whistler's occurrence with the lightning strikes (sources) and the geomagnetic storm's effect. The correlation between the causative sferics of the recorded whistlers and the causative lightning strikes has been found ~ 80%. The origins of these lightning's strikes are lying within 500 km radius of the conjugate point of the Varanasi. By analyzing recorded whistlers, we have computed different ionospheric/magnetospheric parameters.

Presentation Mode: Poster

Presenting Author: S.B.Singh

Registration id: NSSS-20220103034334

Variation in OI 630 nm dayglow emission due to the equatorial electrodynamics and meridional winds

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In the lower thermosphere over low-latitudes, the tidal winds generate the eastward electric field which gives rise to an upward drift in the presence of the northward horizontal geomagnetic field. The vertical drift uplifts the plasma from the equatorial region which gets deposited over the low-latitudes. This effect of the equatorial electrodynamics in both hemispheres can be modulated by the thermospheric winds. The dynamics of the upper atmosphere and ionosphere-thermosphere coupling processes can be investigated by measuring dayglow emissions. The capability to measure dayglow emissions over a large field-of-view using a multi-wavelength imaging spectrograph using echelle grating, MISE, gives us a unique opportunity to investigate the behavior of the upper atmosphere over a large spatial extent. Data from two such spectrographs that are in operation from Hyderabad (17Â° N, 78Â° E, 9Â° MLAT) and Ahmedabad (23Â° N, 73Â° E, 15Â° MLAT), have been used in this study in a spatial coverage of over 130 in latitude from 5Â°-18Â° MLAT. Investigations have been carried out during January-February 2020 (winter season) when solar flux variation was almost constant (68-72 sfu) in order to investigate the effect of other dynamics (equatorial and winds) can be studied. The latitudinal variations in the oxygen dayglow emission rates have been analyzed to assess their response to the variations in the strength of the equatorial electrodynamics and the meridional winds. It is found that the effect of the equatorial electrodynamics decreases only slightly with latitudes whereas the poleward meridional wind greatly affects the dynamics in the low-latitudes. With regard to dayglow emissions, enhancements were observed closer to the magnetic equator and decrements as one moves away from the equator. This is interpreted to be due to the altitudinal variation in plasma density as a function of meridional wind magnitudes. The details of these results will be presented.

Presentation Mode: Poster

Presenting Author: Sunil Kumar

Registration id: NSSS-20220110095001

Chilian GPS eyeball monitoring of 14th December 2020 South American Total Solar eclipse

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We present the influence of the South American total solar eclipse happened on 14th December 2020 on the upper ionosphere. The eclipse influence is analyzed using the continuously operated Chilean Global Positioning System (GPS) sites across the totality path. The totality path with eclipse magnitude 1.012 passed through the Villarrica (Lon. 72.2308°W and Lat. 39.2820°S) in south Chile during 14:41:02.0 UTC to 17:30:58.1 UTC and maximum occurred ~ 16:03:49.5 UTC around the local noon. The vertical total electron content (VTEC) derived by GPS sites across the totality path for two PRN’s 29 and 31 show almost 20–40% of reduction with reference to ambient values. The percentage reduction was maximum close to totality site and decreases smoothly on both sides of totality sites. Interestingly, the atmospheric gravity waves (AGWs) with a period ~ 30–60 min obtained using wavelet analysis of VTEC timeseries show the presence of strong AGWs at the GPS sites located north of the totality line. The background wind direction was observed easterlies during that time, which favored northward propagation of AGWs. But the AGWs do not show any significant effect on the VTEC values to these sites. The background plasma density was also analyzed, which show there was the fewer day-to-day variability on each day at all the station considered in the analysis. Thus, the results suggest an interplay between the eclipse effect on the ionosphere plasma density and eclipse generated AGWs induced plasma density perturbation supported by day-to-day background plasma density variation may explain the observed peculiar features in GPS TEC at different stations.

Presentation Mode: Poster

Presenting Author: Ajeet Kumar Maurya

Registration id: NSSS-20220110101746

Conjugate hemisphere ionospheric response to extreme solar activity conditions

Prantika Nath[1] , Dr. Bitap Raj Kalita[2], Prof. Pradip Kumar Bhuyan[1], Prof. Kalyan Bhuyan[1,2]

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The growth and decay of the EIA and corresponding ionization in both hemispheres are mostly asymmetric and it varies during extreme solar conditions. State of the ionosphere of conjugate hemisphere vary from solar maximum to solar minimum due to changes in the ionizing solar irradiance. Here, a comparative study of the Total Electron Content of the two magnetically conjugate station pair Dibrugarh (27.5Â°N, 94.9Â°E, 43Â°dip) and Cocos Island (12.2Â°S, 96.8Â°E 43Â°dip) was performed during cycle 24 maximum and cycle 24/25 minimum. To quantitatively characterize the relative inter hemispheric asymmetry, an asymmetry index (AI) which represents the fractional summer to winter TEC difference is analyzed. A strong time dependent interhemispheric asymmetry is observed which also varies in both solar conditions.

Presentation Mode: Poster

Presenting Author: Prantika Nath

Registration id: NSSS-20211220054841

The seasonal and intra-seasonal variation of daytime conjugate hemispheric asymmetry along 100Â°E lon

Bitap Raj Kalita[1], P.K.Bhuyan[2], S.Nath[2], D.Chakrabarty[3],K.Wang[4], K. Hozumi[5], P. Supnithi,T. Komolmis[6],C. Y. Yatini[7],M. L. Huy[8]

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The hemispherical asymmetry of the low latitude region along 100Â°EÂ±5Â°E is critically examined for the year 2015 at magnetically conjugate points on seasonal and intra-seasonal time scales. Two conjugate Ionosonde station pairs are used- one pair in the inner valley and other in the outer slopes of the EIA region. The asymmetry is at the stations is assessed using the difference of low latitude NmF2 from the dip equatorial NmF2 in the same meridian. The monthly mean for Match-April, June-July, September-October and December-January is used for seasonal and intra-seasonal investigations. The asymmetry at the conjugate stations is highly asymmetric even during equinoctial months of March and October whereas it is nearly symmetric during April. During June/July, the morning time hemispheric asymmetry (larger in winter side) temporarily reduces in the midday period and then reverses sign (larger in summer) in the afternoon. The reversal from morning to afternoon is not observed in December solstice but in October. The observations indicate that the position of sub solar point with respect to the dip equator is correlated with symmetry. The monthly variations of the Î”NmF2 suggest a shift of the trough or the valley region of the EIA towards summer. The hmF2 variations across the chain suggest a strong role of meridional winds at both the inner and outer stations. The hmF2 at outer stations differ greatly from June to December and indicate a varying response of the two conjugate hemispheres to seasonal changes in thermospheric winds. Theoretical (SAMI3/SAMI2) and empirical model (IRI) simulations indicate that the EIA region moves meridionally with the subsolar point. The hemispheric movement of the EIA trough and crest region is replicated in the GIM-TEC along 100Â°E for 2015. This shifting of the EIA trough and the crest region is attributed primarily to the variation of the meridional wind with the shifting position of sub solar point relative to the field line geometry.

Presentation Mode: Poster

Presenting Author: Bitap Raj Kalita

Registration id: NSSS-20220110102404

Evaluation of Climate Models with Observational Datasets for Understanding Indian Summer Monsoon

Manali saha[1] , Charu singh[1]

[1]Indian Institute of Remote Sensing, ISRO

This study is aimed at evaluating the climate coupled models on the basis of the observational and reanalysis dataset. The monthly averaged datasets of twelve coupled climate models from the Coupled Model Intercomparison Project phase 6 (CMIP6) outputs are compared with the observational data of ground based networks, satellite and reanalysis datasets for the study period of 1980-2014 for the investigation of the Indian Summer Monsoon. The analysis between the historical simulation of the models with the observational/reanalysis datasets show differences but few models like CESM2, CESM2-WACCM, and MRI ESM2.0 well captured the pattern of ISM. Significant Inter model differences are also noted in this study. The regression and correlation analysis conducted for evaluating the CMIP6 models with the observational data show significant correlation at 5% level. It was concluded that the CMIP6 models are robust enough to replicate the ISM Scenario significantly. Detailed results will be presented during the conference.

Presentation Mode: Poster

Presenting Author: Manali Saha

Registration id: NSSS-20220110105007

Variability of atmospheric electric parameters during Covid-19 lockdown phases – Tirunelveli (8.70 N)

C.P.Anil Kumar[1], N.Venkatesh[1], Arul Asir[2] , C.Selvaraj[1]

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We got unique opportunity to carry out the globally improved air pollution based atmospheric electricity experiments during lockdown phases of the Covid-19 pandemic from Southern Indian peninsular station, Tirunelveli (8.70N,77.80E), in Tamil Nadu. A comparative study of atmospheric electric parameters (AEP) has been made between pre-pandemic period and during the lockdown period (imposed to control the spread of novel Corona Virus infection) and with the aid of ground-based indigenously developed atmospheric electric instruments. The analysis of both 2020 to 2021 data showed a marked difference in electric field and air-Earth current (A.E current) density. The difference and vivid in the AEP pattern articulated to some extent to the decrease in aerosol loading cause by minimum human activities, drastically reduced emissions from industry, building construction, quarrying and mining, cement plants, vehicular emission and stoppage of particulate matters etc, which seem to reduce resistive loading in global electric circuit (GEC).

Presentation Mode: Poster

Presenting Author: C.P.Anil Kumar

Registration id: NSSS-20220110104251

LiDAR and Satellite observations of middle atmospheric gravity wave activity over Southern hemisphere

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The climatological characteristics of the gravity wave activity and thermal structure of middle atmosphere are studied using temperature profiles obtained from Rayleigh lidar located at Reunion Island, Southern Hemisphere over a period of 15 years and also at Gadanki, Northern Hemisphere. Usually this is the blank region, where VHF radars are unable to provide winds and temperatures. The study has been performed over the height range from 30 to 65 km. While there is no clear signature of seasonal oscillation in the stratopause height. The stratopause temperature shows distinct maxima during the periods March-April and October-November. In addition, the temperature profiles are compared with different satellite datasets (HALOE,SABER,CHAMP AND COSMIC) and the results are found to be in good agreement. The GW characteristics in terms of time (frequency), height (wave number) and GW associated Potential Energy and their seasonal dependences are presented. The wave activity is clearly visible with the wave periods ranging from 260 min to 32 min over the southern hemisphere. It is found that the seasonal variation of potential energy is maximum during summer in the upper stratosphere and lower mesosphere. A semiannual variation is seen in the gravity wave activity over all height ranges in the months of February and August.

Presentation Mode: Poster

Presenting Author: Vishnu Prasanth P

Registration id: NSSS-20211221112709

Estimating the Ionospheric Scintillation from ROTI values over the Indian region

Chandan kapil[1],Gopi K. Seemala[2], Dadaso J Shetti[3], Rajat Acharya[4]

[1]IIG,[2]IIG,[3]Smt Kasturba Walchand College,[4]ISRO

Ionospheric irregularities can be assessed through the rate of change of total electron content (TEC) indicated by ROT, which can be derived from dual-frequency GNSS receiver at a time interval of 5 min, Pi et al (1997). However most of the GNSS receivers do not provide scintillation data due to the high sampling rate of at least 50 Hz thus ROTI can be used as a proxy for scintillations. In most of the past studies it is shown there is some correlation between ROTI and S4. There are certain limitations which are inherent in the data. Understanding the limitations of the data is important for a proper understanding of the prevailing geophysical phenomena. In the present study correlation between ROTI and S4 is analyzed using GAGAN data, sampled at 30 seconds. The significant capturing of the scintillation is validated by plotting the temporal variation of S4 for all the 25 stations under GAGAN for the year 2014. Unless correlating the simultaneous values of two indices, the main focus is on establishing a relation or probable S4 values to a given ROTI. The correlation of the two indices is highly subjected to the factors like geographical locations, elevation mask angle as well as on the time interval used to calculate ROTI. Thus in this study, ROTI is calculated for three different time intervals at 3 min, 5min, and 10 min for 8 stations. Also, the dependence of correlation measurements is checked with an increasing elevation angle of the satellite and other factors. It is observed from this intense study that ROTI calculated for 3min time interval gives slightly better correlation with S4 in Indian sector. The probable range of S4 that corresponds to ROTI shows some systematic increase with increasing latitude in the India sector from Trivandrum to Kolkata which is the EIA region, with 80 percent probability range.

Presentation Mode: Poster

Presenting Author: Chandan kapil

Registration id: NSSS-20220110110013

Finding the Missing Link for 2021 Rainfall: Atlantic Nino

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In India, agriculture and other water needs are mostly fed by monsoon rainfall. Indian Summer Monsoon (ISM) has been the topic of discussion for a while now, but still, there are some loose ends in numerical models that lead to uncertainties in the monsoon predictability. Having agriculture as the backbone of our Indian economy, it is essential to learn about the rainfall patterns ahead of time for better preparedness. In recent times, the uneven distribution of rainfall patterns has become a common phenomenon all over the world. In this study, we have explored the different root causes of the unusual September rainfall in 2021. We have made a comparison of rainfall patterns in 2019, 2020 and 2021 using the ERA-5 Reanalysis dataset and ground-based disdrometer. It has been found that 2019 witnessed lesser rainfall in June, but it ended with above-normal ISM rainfall in September. There was a clear link to this rainfall with highly positive Indian Ocean Dipole (IOD). The onset of ISM in 2020 was on time, with normal seasonal rainfall in June-July-August (JJA), but September received little rain. The ISM in 2021 showed a peculiar behaviour with deficit rainfall during JJA and heavy rain during September. Through our study, we have found a teleconnection between the Atlantic Ocean Sea Surface Temperature and the Indian Ocean, with the Rossby waves, propagating towards the Indian Ocean, affecting the air temperature. This modulates the land-ocean thermal contrasts, which also change the number of Low-Pressure Systems. This phenomenon was certainly missed by the numerical models, which thereby led to the misprediction of this year's rainfall. In addition to the Atlantic Nino, late September rains in 2021 were caused by Cyclone Shaheen in the Arabian Sea. A take-away note from this study includes the necessity of incorporating the effects of Atlantic Nino in the numerical models for better estimation of rainfall patterns.

Presentation Mode: Poster

Presenting Author: Dharmendra Kamat

Registration id: NSSS-20220110110031

Explicit lightning forecasting Over North Eastern India: Preliminary results

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This work is an attempt to demonstrate the utility of an explicit electrification module coupled with the weather research and forecasting model (WRF) to forecast lightning activity over north_x0002_eastern India. In the lightning forecast model, both inductive and non-inductive charging scheme of hydrometeors are considered along with polarization of cloud water, and the exchange of charge during collisional mass transfer. This module calculates explicitly the three components of the ambient electric field through a computationally efficient multigrid elliptic solver. A bulk discharge scheme is also included, wherein charge within a volume is reduced whenever the magnitude of the electric field exceeds the local breakdown threshold. Several case studies have been evaluated over the study region. An extensive analysis has been carried out for thunderstorms events on 3 April and additional days over north-eastern India. The simulated flash origin densities (FOD) are evaluated against observed total lightning from the Earth Networks ground based sensors. Together with the electrification module, a lightning assimilation technique has also been employed in EWRF to better represent the observed lightning on the innermost convection-allowing grid (3 km) during the analysis. This study further focuses the sensitivity analysis of EWRF and its validation for the complete pre-monsoon season of 2019. Different statistical score have been calculated for the whole season to assess the model performance over north astern part of India.

Presentation Mode: Poster

Presenting Author: Trisanu Banik

Registration id: NSSS-20220110074028

Asian summer monsoon anticyclone and its relationship with TEJ and SWJ

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Asian Summer monsoon anticyclone (ASMA) is a prominent upper-tropospheric circulation pattern that plays an important role in the redistribution of the atmospheric pollutant and tracer to the global scale. Various pollutants and tracers such as CO, NO2, SO2 mainly transported from the surface in the ASMA are prone to enter the lower stratosphere and finally towards the poles due to Brewer-Dobson circulation. ASMA shows a large spatial extent both horizontally and vertically which varies on a short time scale. Thus, the ASMA region is very challenging to define accurately on a day-to-day basis due to its highly dynamic nature. The extent of the AMSA is defined by using the modified potential vorticity (MPV) and zonal wind circulation which closely coincides with 14.32 km geopotential height at 150 hPa. ASMA is also defined as the region surrounding the 16.77 km geopotential height at 100 hPa. These two different geopotential heights are generally used to study the ASMA region. ASMA is characterized as a dynamically varying system having an east-west quasi-biweekly oscillation along with north-south variability. It is bounded by the subtropical westerly jet (SWJ) stream in the north and the tropical easterly jet (TEJ). In this study, we have investigated the geopotential height contours within the bounding of TEJ and SWJ and its relationship with ASMA.

Presentation Mode: Poster

Presenting Author: Musaid P P

Registration id: NSSS-20220110043805

Investigations of mid-latitude upper atmosphere

Kshitiz Upadhyay[1,2], Duggirala Pallamraju[1]

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The naturally occurring airglow emissions are very sensitive to ionospheric/thermospheric changes and thus become a good tracers to investigate upper atmosphere dynamics. The high spectral resolution airglow data was obtained using a ground-based instrument High Resolution Imaging Spectrograph (HIRISE) from a mid-latitude station Boston (42.36°N, 71.06°W), during 2003-08 (i.e. high to low solar activity period of solar cycle 23). HIRISE has a large field of view and provides daytime airglow emissions at multiple wavelengths (557.7 nm, 630.0 nm & 777.4 nm). The atomic oxygen 630.0 nm dayglow emissions are used in this work for investigating the daytime upper atmospheric dynamics over mid-latitudes on both temporal and spatial scales. The dayglow observations obtained form HIRISE are compared with those obtained by the WINDII Empirical Model (WEM). In addition, measured dayglow emissions are also compared with the photochemical model - GLOW. Electron densities obtained from digisonde (located at Millstone Hill) were used as an input to the GLOW model. The optical measurements agree well with GLOW model emissions on geomagnetically quiet days. However, they differ in magnitude of emission intensities on geomagnetically disturbed days. There are also deviations between optical measurements and empirical model (WEM) estimates on disturbed days, which are indicative of ionosphreric/thermospheric changes happening during geomagnetic storm time. These features will be presented which offer greater insights into the mid-latitude upper atmosphere.

Presentation Mode: Poster

Presenting Author: Kshitiz Upadhyay

Registration id: NSSS-20220110040805

Spectrum of Atmospheric Boundary Layer Height Variations over a Tropical Coastal Station

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The atmospheric boundary layer (ABL) plays a pivotal role in the vertical mixing of water vapour, aerosols and pollutants in the lower atmosphere. In response to the strong diurnal variation of surface radiation balance and consequent changes in the temperature at the soil top and near-surface, the ABL height over tropical coastal and continental regions undergoes significant diurnal variation in any season, with rapid growth during the forenoon period. The daytime development of convective ABL (CABL) is a controlling factor that governs the exchange of aerosols and trace species between the ABL and free-troposphere and their subsequent long-range transport. In addition to the systematic diurnal variations, the ABL height over coastal and continental regions also undergoes significant intraseasonal, annual and interannual variations. Ground-based microwave radiative profiler (MRP) observations provide an opportunity to continuously profile the troposphere up to about 10 km altitude at a given location during both clear and cloudy periods (except during precipitation) and have high temporal (~3 min) and vertical (50–250m) resolutions to address a wide spectrum of atmospheric variability of temperature and humidity and ABL height. Based on multi-year (2010-2017) MRP observations carried out at the tropical coastal station, Thumba, this study presents the spectrum of temporal variations of ABL height from diurnal to interannual scale and quantifies the role of downwelling shortwave flux, soil skin and near-surface atmospheric temperatures and atmospheric stability in regulating the daytime peak ABL height. Mechanisms responsible for the rapid forenoon growth of ABL and the effects of clouds as well as onshore and offshore winds in modulating the CABL growth are investigated. The MRP observations and reanalysis data are used to investigate the intraseasonal variations of the daytime peak ABL height and the effect of synoptic circulation in driving such variations.

Presentation Mode: Poster

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Study of effect of sudden stratosphere warming on poles and tropics during 2018 warming

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The SSW during the year 2018 is studied at poles and tropics. The effect of warming is only observed in the North Pole and tropics but not at South Pole, i.e the effect of warming is limited to tropics and North Pole. The TEC is measured at 4 sites in NP, 3 sites at tropics and 4 sites in South pole along the similar longitudes for study. A minor warming is recorded during the last week of December 2017 at all the sites in North Pole, with a rise in temperature of ~ 20 K. During the mid of February 2018, the major warming occurred and found its effect even in tropics whereas at South Pole there weren't any traces of Warming. Over a period of week, the temperatures raised by 50K and sharp wind reversals were noticed at North Pole, while at tropics, the temperatures raised by only 20K – 25 K and Wind reversals were also noticed but prior to the peak noticed at North Pole. There is a significant raise in TEC over North Pole and Tropics whereas TEC is depleted during the Warming at South Pole. Polar vortes also found to be displaced. It is also noticed that there is a gradual shift in SSW in the past decade. From the above results we may conclude that during the Sudden Stratospheric Warming events, the polar stratospheric temperature rises concurrently zonal-mean zonal flow weakens over a short period of time. As the zonal flow weakens, the stratospheric circulation becomes highly asymmetrical and the stratospheric polar vortex is displaced off the pole.

Presentation Mode: Poster

Presenting Author: Rakesh Chandra Narwa

Registration id: NSSS-20220110012330

Extended summer & warmer winter: could this be the new norm over Eastern Himalayan Foothills region?

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The Eastern Himalayan Foothills region (EHF), comprising the North East Indian states and surrounding territories, is crucial in terms of atmospheric chemistry and its implications. The atmospheric composition of the region is found to be altered under the influence of dust advection from the Indian deserts through westerlies, anthropogenic emissions from the Indo Gangetic Plains (IGP), marine emissions from the Bay of Bengal, and local biogenic emissions from large vegetation cover, including primary and secondary bioaerosols as well as local anthropogenic emissions (e.g., biomass burning, fossil fuel burning, oil and gas fields, etc.). The anthropogenic changes over the region are primarily due to the the growing population accompanied by increasing urbanization, changes in land use, major roadway expansions, increased deforestation, biomass burning, fossil fuel consumption, leading to an increasing concentration of gaseous constituents including greenhouse gases (GHGs) and aerosols. The latter is evident from the Spatio-temporal distribution of most of the constituents like AOD, PMs CO, CH4, NO, CO2, NO2, and O3 showing an increasing trend over the past two to four decades. The 2m-temperature also exhibited an increasing trend for all months of the year during 1979 - 2020, implying that the compositional changes including an increase in GHGs in the atmosphere have possibly impacted the surface temperature. Further, 2m mean temperature data revealed a steeper increasing temperature in September followed by February, thus partially explaining an extended summer and warming winter, indicative of a non reversible climate change effect in the region.

Presentation Mode: Poster

Presenting Author: Rohit Gautam

Registration id: NSSS-20211209035016

A comparative study of Ionospheric-Tropospheric delay over equatorial latitude during extreme low so

Roshni Atulkar[1], M.S. Abd-Elghany[2]

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The ionospheric and atmospheric (tropospheric) propagation delay is one of the main error causes of space geodetic techniques whereas their radio signals propagate through the atmosphere, e.g.(GPS) Global Positioning System. In the present paper, we have studied the diurnal, annual, monthly, seasonal and solar activity variability of TEC(Total electron content) and Zenith tropospheric delay (ZTD), Temperature and Relative Humidity (RH) of ZTD (zenith tropospheric delay) over the GNSS station Bengaluru (Geographic Latitude 13.02°N, Geographic Longitude 77.57°E; Geomagnetic Latitude 4.58°N), located at the northern crest of equatorial ionization anomaly region, during the extreme low solar activity period from January to December 2009. In the Comparison of GPS-TEC with various Solar Indices, we noticed that TEC follows a synchronous variation. The TEC exhibits an extremely good association with the solar radio flux F10.7 cm, Sunspot number, and Solar EUV flux than that of with the Dst and Ap occurrence. The TEC shows a hysteresis effect with solar radio flux F 10.7 cm and solar EUV Flux (24 -36 nm and 0.1-50nm). The hysteresis effect is missing in other the solar indices. The highest values of TEC are recorded during spring, but we observed the highest value of ZTD in the month of post- monsoon, while the lowest values are recorded in the month of summer but the minimum value of ZTD is recorded in the month of winter. The maximum average of RH is observed in September and the minimum average of Relative Humidity is observed in February.

Presentation Mode: Poster

Presenting Author: Roshni Atulkar

Registration id: NSSS-20220110011443

Solar Cycle Dependence of the Solar wind-Magnetosphere Coupling during Geomagnetic Storms

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The Solar Cycle 23 and Solar Cycle 24 are special since they had a prolonged solar minimum period between the peak of both the cycles. This provides us with a unique opportunity to explore the physics of the coupled solar wind-Magnetosphere (SM) system. The uniqueness of each solar cycle in its duration, minimum, peak intensity, and solar wind conditions result in a distinct impact on the magnetosphere. The current study carried out an in-depth investigation of the solar cycle influence of the SM coupling. We present the results of statistical analysis of relationships between the various solar wind parameters like the total interplanetary magnetic field (B) and its component Bz, solar wind density (Nsw) and solar wind speed (Vsw), SYMH indices, and the amplitude, duration, and profile of the geomagnetic storms in course of 23–24 solar cycles. This study investigates the influence of solar cycle variation on geomagnetic activity and the efficiency of solar wind energy transfer to the magnetosphere.

Presentation Mode: Poster

Presenting Author: Ashna Vm

Registration id: NSSS-20220110023731

Mid-latitude ionospheric disturbances due to the super geomagnetic storm of March 2015

Sushanta K. Mondal[1], Sujay Pal[2,3], Arnab Sen[1], Mahbub Rahaman[1], Subrata K. Midya[4]

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We present response of the mid-latitude D-region ionosphere to the super geomagnetic storm of 17th March, 2015 using radio remote sensing technique. This geomagnetic storm, resulted from the coronal mass ejection on 15th March, was the strongest storm of 24th solar cycle. We have analysed the VLF signals from various mid-latitude receiving stations spreaded over Europe and USA. It is seen that, the storm enhanced the entire diurnal signal by 3-5 dB in the EW propagation paths, recovery of the signal to the pre-storm state took about 10 days. Model calculation showed that electron density in the D region during this time increased by many fold, prolonged energetic electron precipitations in the region, verified from the POES satellite data, ss found to be the cause of long duration VLF signal disturbances in the midlatitude ionosphere.

Presentation Mode: Poster

Presenting Author: Sushanta Mondal

Registration id: NSSS-20211126020523

Trade Wind Anomalies And Zonal Wind Enhancement Over Central Pacific

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The atmosphere and oceans are two earth systems that are intricately linked with each other and are responsible for the earth's weather and climate. The primary objective of the present study is to analyze the long-term trend of tropical Pacific trade winds and to understand the fundamental drivers of this long-term trend. Efforts are made to address the long-term trend of trade winds over the tropical Pacific. Changes in the frequency and intensity of the prevailing northeast and east trade winds from 1980-2020 are analysed and observed that when the annual mean trade wind velocity peaked, that particular year witnessed a La Nina event and whenever the annual mean trade wind velocity felt to minimum value, the corresponding year had had an El Nino event. Persistence of winds are also calculated for both the study regions for the entire study period. In the winter months, the ratio stays high and the most striking feature is the extremely low persistence during the summer months. It is also observed that a nearly continuous smooth transition from lower to higher ratios from winter to summer, The South west Pacific region shows tremendous variation in persistence and a very inconsistent steadiness of the winds throughout the year. This may look alarming, the results are not very surprising as and although large-scale trade winds may play a role. Our findings are also relevant to the topic of future response to global warming, which remains hotly debated in view of the delicate balance among various amplifying and damping feedbacks. Zonal wind enhancement also intensifies mean upwelling and hence dynamical damping, leading to a further weakening of El Niño events.

Presentation Mode: Poster

Presenting Author: Dr. Veena Suresh Babu

Registration id: NSSS-20220110031455

Interesting Airglow observations during COVID 19 pandemic over Indian sector

Rupesh N. Ghodpage[1], Alok Taori[2], O. B. Gurav[3], and P. T. Patil[1], M. K. Patil[4]

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Airglow emissions which originate from the mesospheric and thermospheric altitudes have been routinely being monitored at Kolhapur using ground base remote sensing Imagers. We note that the observable amplitudes of very small-scale waves during April 2020 were significantly smaller than the regular observations. We investigate the reason for these low observable amplitudes (~0.5%). It is noted that drastic improvement in the quality of images was due to better contrast, which is attributed to significant reduction in greenhouse gases and aerosol loading in the atmosphere by the complete shutdown of local man-made emissions. Results suggest that lockdown had an important repercussion on the visibility through the improved air quality and thus better viewing conditions, which were reflected in the remotely sensed observations made with airglow imager.

Keywords: Airglow, Image Measurements, Aerosol, Air quality.

Presentation Mode: Poster

Presenting Author: Rupesh Ghodpage

Registration id: NSSS-20220110011213

Study of multi instrument observation of ionospheric response to 26 December 2019 solar eclipse

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The response of the ionosphere to 26 December 2019 solar eclipse on the equatorial and low latitude ionosphere has been investigated using ground and space based observations. The high resolution Ionosonde observations at Tirunelveli, GPS TEC observations from a chain of GPS receivers along and across the eclipse path, TIMED-SABER and lonospheric connection explorer (ICON) satellites were utilized to investigate the eclipse induced variations in electron density and thermospheric cooling. Tremendous increase in bottom side altitude of F-region resembling Pre-Reversal Enhancement (PRE) was observed. Near eclipse maximum, strong blanketing sporadic E layer was observed at Tirunelveli with top frequency 18MHz for 1 hour 26 minutes. Additional ionogram traces known as satellite traces (ST) and 'U' shaped ionograms were noticed for the first time over Tirunelveli during eclipse maximum and eclipse ending respectively. Presence of 'ST' and 'U' shaped traces in the ionograms indicate the short period gravity waves or TID type of wave perturbations over Indian region. A maximum of ~5 TECU decrease in TEC is observed on the eclipse day. Periodogram analyses of TEC data showed the presence of wavelike structures with periodicities of 18-24 min for different stations. Simultaneous observations from ICON satellite showed increase and decrease in hmF2 and NmF2 which matches well with ionosonde at Tirunelveli respectively. The temperature profiles from TIMED-SABER and ICON satellites showed a reduction and enhancement in the lower and upper E region respectively during eclipse.

Presentation Mode: Poster

Presenting Author: Rajesh Kumar Barad

Registration id: NSSS-20220110122617

Microphysical Evolution of a non-conventional Tropical Squall in Conjunction with NavIC signal

Saurabh Das[1], Chandrani Chatterjee[1], Nitig Singh[1]

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Increasing weather extremities have now emerged out as the severe most threat to human lives and resources. Tropical squalls are among the most destructive presentations of such extremities. The proper understanding of the mesoscale systems responsible for such events are crucial in proper modeling and prediction of these events. The precipitation growth and development of tropical squalls are not yet well understood. This work has attempted to study the microphysical evolution of a squall causing severe destruction from a location situated in Inter Tropical Convergence Zone (ITCZ) line, Kolkata. An intense squall line has been observed in the mesoscale system developed over the city. However, the even did not show the conventional trailing strartiform edge but continued with a very intense rainfall throughout the time. The event caused 38 mm of rain in one hour with a maximum rain intensity of 200.3 mm/h. The study presented significant variation in the regular weather parameters during the event. Severe lightning activities were witnessed by the city and its surrounding. Notable degradation of signal quality has been observed in the S band frequency of Indian Regional Navigation Satellite Navigation System (IRNSS).

Presentation Mode: Poster

Presenting Author: Saurabh Das

Registration id: NSSS-20211129081755

Comparison between NavIC-TEC measurements and the NeQuick model results over Hyderabad Station

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Osmania University

This paper discusses the investigations of the monthly TEC variations in the low latitude ionosphere to explore the performance of NeQuick model with Indian NavIC (Navigation with Indian Constellation) signals over Hyderabad station during low solar activity year 2017 of 24th solar cycle. The performance of the model evaluated for quiet and disturbed days due to IRNSS 1B, IRNSS 1C, IRNSS 1D, IRNSS 1E, IRNSS 1F and IRNSS 1G (Indian Regional Navigation Satellite System) signals. The VTEC variations are also predicted due to IRI 2016 model up to the height of 2000 km for each NavIC satellite at their corresponding IPP (Ionospheric Pierce Point) and due to NeQuick model up to the height of each NavIC satellite (above 36000 km). Also, VTEC estimations verified up to the height of 2000 km and respective satellite heights with NeQuick model. The results show that the contribution of plasmaspheric part of TEC (above 2000 km) is not more than 3 TECU due to NavIC signals. The NeQuick results indicate a good representation during the daytime at low latitudes. The maximum variations of TEC observed up to the height of 2000 km for all satellites. The obtained results are statistically analyzed by computing RMSE, correlation (R) with all satellites and percentage of error difference between NeQuick RMSE and IRI RMSE for each satellite. Despite the differences in the models' performance, they perform fairly similarly. The maximum percentage of error difference between models is observed for disturbed days compared to quiet days. The obtained results in this paper will be helpful for ionospheric studies and future updates of the models over low latitude regions.

Presentation Mode: Poster

Presenting Author: Kavitha Devireddy

Registration id: NSSS-20220110042040

Initial results of GNSS-based Total Electron Content (TEC) monitoring from Purulia, West Bengal

Supratick Adhikary[1,2], Sushanta K. Mondal[1], Sujay Pal[2,3]

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Initial results of monitoring of ionospheric Total Electron Content (TEC) from Purulia, West Bengal (23.3322° N, 86.3616° E) located within the northern crest of equatorial ionization anomaly (EIA) region are presented here. A multi-frequency and multi-constellation high-end NovAtel GNSS receiver has been installed at the Department of Physics, SKBU, Purulia in late 2017 for space weather monitoring. The measurement of GNSS-based TEC is important not only to correct range-delay errors introduced by the ionosphere but also to monitor the state of the ionosphere continuously. A preliminary analysis of GPS TEC data of 2018 and 2019 has been done here. Mainly, the diurnal and seasonal variations of vertical TEC at Purulia are presented and then compared with the IRI-2016 model. Further, TEC variation obtained from the GALILEO and GLONASS constellations are also compared.

Presentation Mode: Poster

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Statistical Relationship Between Atmospheric Parameters And Their Impacts On Climate Change

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Climate change has become one of the greatest challenges of the world nowadays. The present work deals with the anthropogenic greenhouse effect and its impact on climate. The effect of carbon dioxide as a greenhouse gas has been proved undoubtedly from the warming trend. A significant rise in sea level is found, when the global mean temperature follows the increase in atmospheric carbon dioxide. It is found that the warming trend was irrespective of the variation of the activity of the sun. Thus it can be inferences that apart from the natural greenhouse effect, the anthropogenic contributions have a major role in the overwhelmed heating. Temperature anomaly over 1880-2020 was analysed. It proves the phenomenon of global warming with an average increase of 0.46 degree Celsius per decade. The increase in atmospheric temperature during 2020 was found to be 1.2 degree Celsius when the concentration of carbon dioxide was 414 ppm in the atmosphere. From the analysis of Carbon dioxide over 1880 – 2020, it can be summarised that the increase in warming is mainly due to the increase in Carbon dioxide that serves as a greenhouse gas. The correlation studies also strengthen these arguments. As implicated by the correlation coefficients, an increase in carbon dioxide alone has not much influenced the thinning of the ozone layer and ozone depletion doesn't play a much significant role in the increased warming. The sea-level analysis over the years 1992 to 2020 also shows a significant rise of 0.2 m per decade which can be summarised as a consequence of global warming. All these changes in the climate are due to human activities which is the main driving force over the last century.

Presentation Mode: Poster

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Ionospheric Scintillation Intensity Fading studies at EIA region using NavIC

Deepthi Ayyagari[1], Abhirup Datta[1], Sumanjit Chakraborty[1]

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Studies on ionospheric scintillations have always been important to understand the behaviour of the ionosphere particularly at low as well as equatorial latitudes. A low latitude study of ionospheric scintillation, especially around the Equatorial Ionization Anomaly (EIA). It is essential to understand the dynamics of ionospheric variation and related physical processes like TID's and plasma bubble formation. The results that have been obtained during our analysis emphasize the need for such characteristic studies. The study involves NavIC (The Indian Regional Navigation Satellite System, with an operational name of NavIC-Navigation with Indian Constellation) amplitude scintillation (S4c) observations over Indore, located near the northern crest of the EIA, under disturbed ionospheric conditions on September 8, 2017, which essentially falls in the declining phase of 24th solar cycle. The observations clearly show that the scintillation of the NavIC signal follows the Nakagami-m distribution along with the α-μ distribution. This is a clear depiction of the fading effect caused by scintillation on NavIC signals for September 8, 2017, where the values of the carrier to noise ratio (dB-Hz) for PRNs 2, 5 and 6 have dropped below 30 dB-Hz and have approached to value of zero between 22:00 to 0 LT(h). The severity of S4c index during that time peaked beyond the value of 0.5 as observed from PRN 2 of NavIC and the value of intensity fading that has reached up to -8dB. This paper, for the first time, conducts an intensity fading study over the region near EIA using NavIC for an intense geomagnetic storm observed on September 8, 2017, where the Dst Index has dropped to a minimum value of 124nT.

Presentation Mode: Poster

Presenting Author: Deepthi Ayyagari

Registration id: NSSS-20220112070606

Investigation of Very Low Frequency (VLF) Range of Radio-Waves for the Sub-ionospheric Perturbations

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VLF range of radio waves is extensively used to investigate the subionospheric perturbations in possible association of earthquakes. VLF signal data of Turkey, Bafa Transmitter have been used to examine the statistical correlation between the VLF propagation anomaly (trend, night-time fluctuation) and Turkey earthquakes with shallow depth. This study has provided the possible connection with earth-space propagation phenomena through seismogenic effects. It is found that radio waves propagation anomaly shows variations just few days before the earthquakes. Statistical parameters indicating the presence of ionospheric perturbations is significantly correlated with earthquakes. Increase in night-time VLF signal strength is observed before the earthquakes. This study shows the seismo ionospheric perturbations present before the earthquake and look as earthquake precursors.

Presentation Mode: Poster

Presenting Author: Suryanshu Choudhary

Registration id: NSSS-20211225041517

Signature of Travelling Ionospheric Disturbances observed at low-mid latitude Indian station, New Delhi: Ionosonde Observations.

Arti Bhardwaj[1], Sumedha Gupta[2], Ankit Gupta[3], Qadeer Ahmed[4], Arun Kumar Upadhayaya

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In this study, we investigated the potential ionospheric effects caused by the earthquake events during the year 2020 that occurred over the vicinity of New Delhi, India ((28.6°N, 77.2°E, 19.2°N geomagnetic latitude, 42.4°N dip). We used the manually scaled ionogram records to look for notable characteristic signatures of travelling ionospheric disturbances (TIDs) following the earthquakes seen as a distortion of ionogram trace (Y-forking). Based on our examination of the ionogram data from Digisonde station, we found that the suspected TID signatures started to appear over these stations from 30 minutes to a few hours after the earthquake events. Precursors to earthquake were also observed during these earthquake events.

Presentation Mode: Poster

Presenting Author: Arti Bhardwaj

Registration id: NSSS-20220110105638

Effect of Geomagnetic Storm on Vertical Total Electron Content over low latitude station Varanasi fo

[1]Kalpana Patel, [1]Sunil Kumar Chaurasiya, [2]Sanjay Kumar, [2]Abhay Kumar Singh

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Total Electron Content (TEC) estimation through the Global Positioning System (GPS) is a significant device to concentrate on the ionosphere. The ionosphere is a dispersive medium, influences radio transmission and communication that causes a scope of defects in communication through GPS. This kind of error is connected with the TEC of the ionosphere. Communication and navigation is likewise impacted by geomagnetic storms also. The geomagnetic storm is classified as weak ($-50 \leq$ Dst ≤ -30), moderate ($-100 \leq$ Dst ≤ -50), and intense (Dst ≤ -100 nT). Keeping in view, the impact of geomagnetic storms on the correspondence and route framework, the impact of geomagnetic storms on the total electron content has been examined for the day dated 17 and 18 of March for the low latitude station Varanasi (Geographic scope 25°, 16' N, longitude 82°, 59' E) during the Solar Maximum year 2015. Connected with this analysis, the investigation has been finished by concentrating on the impact of Kp index with VTEC, Dst index variation with universal time, variation of VTEC with days of events, and rate of change of VTEC with universal time for the low latitude station Varanasi. The outcomes presented are examined with the results presented by others.

Presentation Mode: Poster

Presenting Author: Dr. Kalpana Patel

Registration id: NSSS-20220110105638

GNSS/GPS based variations in ionospheric vertical total electron contents (TEC) during the total sol

Adarsh kumar[1]

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The effect of total solar eclipse on ionospheric total electron contents (TECs) over the Philippines region has been studied using GNSS/GPS based retrieved data. Continuous TEC analysis in conjunction with total solar eclipse of 09 March 2016 has been made from 08 to 10 March 2016 at Quezon city of Philippines sector (2O 59’ S, 104O 46’ E). Over Quezon GNSS/GPS station of Philippines, around ~81 % of maximum obscurity of solar eclipse was observed. The eclipse event reached its maximum developments at 01:58:19 UTC on 9 March 2016 with magnitude 1.045 and duration around 249 sec (4m 9s). Results of the ionospheric vertical total electron contents (VTEC) during the total solar eclipse of 09 March 2016 over Philippines region show a considerable decrease in VTEC concentration on the eclipse day in comparison with the normal days.

Presentation Mode: Poster

Presenting Author: Adarsh kumar

Registration id: NSSS-20220110083624

Evidence of Prompt Penetration during 2017 September Geomagnetic Storm: A Case Study

Vibin Thomas[1], Dr. Tiju Joseph Mathew[1], Blessy Varghese[1], Dr. Ligi Cherian[1], Dr. Abraham A[1]

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This work investigates the impact of September 2017 geomagnetic storm on the Earth's Equatorial Ionosphere. Two strong Geomagnetic Storms with very short time gap have been induced during September 7-8 by subsequent X- class solar flares and two earth directed Coronal Mass Ejections occurred during this period. DST index drops to values of -124nT and -109nT respectively. Southward turning of Interplanetary Magnetic Field (IMF) Bz is identified preceding both the storms using data obtained by ACE satellite. The effects of storm on equatorial ionosphere have been studied by analysing the ionospheric parameters such as F2 layer critical frequency (foF2) and F2 layer peak height (hmF2) of Fortaleza station (3.9° S, 321.6° E) obtained from GIRO database. A negative ionospheric storm is observed during main phase of first geomagnetic storm. A steep decrease in foF2 accompanied by a fall in hmF2 is observed. A sudden downward drift of ionospheric plasma is also observed. This ionospheric storm can be manifested as the effect of prompt penetration of Interplanetary Electric fields into the Ionosphere over Fortaleza.

Presentation Mode: Poster

Presenting Author: Vibin Thomas

Registration id: NSSS-20220110052954

Revised empirical reference atmosphere from surface to 100 km over the Indian region

K. N. Uma, Radhika Ramachandran, V. Adimurthy

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The present study attempts to provide an empirical model for the temperature over the Indian region using ground and satellite based observations. Radiosonde observations spanning over 44 years, M-100 Rocket over 20 years and SABER for 17 years have been used to generate the model. The monthly mean is obtained from each of the measurement techniques from surface to 110 km. The monthly means are used to extract the amplitudes and phases of Annual Oscillation (AO), Semi-Annual Oscillation (SAO), Ter-Annual Oscillation (TAO) and Quasi-Biennial Oscillation (QBO). TAO shows two distinct peaks one in the stratosphere (40-50 km) other in the mesosphere (70-80 km). The SAO peaks in the stratosphere (40-50 km) and the AO shows maxima near the tropopause (16-17 km). QBO is maxima between 25 and 30 km. SAO and QBO are observed to dominant compared to TAO and AO over Trivandrum. The amplitude in the temperature of TAO is 2 K in the stratosphere and 3.5 K in the mesosphere. The SAO shows maximum amplitude of 6 K between 35 and 40 km. At 80 km we observe another peak of about 9 K. The AO shows two peaks one near the tropopause with an amplitude of about 2 K and other in the mesosphere (70-80 km) of amplitude 3.5 K. The QBO shows two amplitude peaks of 2.5 K and 3.5 K in the stratosphere and mesosphere respectively. The phase profiles of all the oscillations that had significant peaks below 60 km show downward phase propagation. The amplitudes and phases obtained are used to generate the reference empirical atmosphere. The monthly mean temperature obtained from the observations and the model compares well below 20 km, however we observed differences between the two above 20 km. The seasonal variation in the temperature. The RMSE increases with respect to altitude and it is observed to < 4 K during the first epoch (1975-1990). During the second epoch (2002-2018) similar behavior is observed, and above 60 km the RMSE is about 7 K and reaches about 12 K at 110 km.

Presentation Mode: Poster

Presenting Author: K. N. Uma

Registration id: NSSS-20220110051839

Ring current sources and stochastic noise in SYM-H and Dst during geomagnetic storms of SC23

Devi R Nair[1], Prince P R[1]

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Geomagnetic storms occur during various intense solar activities which is measured as a perturbation in Earth's magnetic field. This perturbation is caused due to the enhancement of equatorial ring current by energetic particles of ionosphere and solar wind origin and is measured using hourly Dst index or 1 minute resolution SYM-H index. The major contributors to ring current enhancement are O+ and He++ ions whose injection rate increases during storm expansion phase and decays during the recovery phase. The presence of stochastic noise in SYM-H and Dst during geomagnetic storms and solar minimum quiet periods of SC23 was studied using potential analysis tool. Existence of different noise levels during these periods resulted in different states of its potential wells. More noisy states are observed during Dst/SYM-H quiet periods compared to highly disturbed periods. Analysis shows high number density of O+/H+(9.4-212keV/67keV) ratio during the expansion phase while number density of He++/H+ (9.4-212keV/67keV) ratio was more significant during undisturbed periods. Quiet time analysis of He++ /H+ ion ratio during solar minimum quiet period showed high peaks while O+/H+ ratio almost settled to quiet values. The drastic change of noiseless state to noisy states can be associated with the sudden variations in these two ion ratios during ring current enhancement. The main phase of severe storms takes place during frequent intense auroral substorm activities. There can be plausible injection of such substorm particles into storm time ring current, whose direct evidence has not been studied yet, which can be one of the causes of varying noisy states in magnetic field perturbations measured using these storm indices.

Presentation Mode: Poster

Presenting Author: DEVI R NAIR

Registration id: NSSS-20220110040918

Observations of ionospheric depletions using 150 and 400 MHz beacon from CRABEX near the anomaly crest

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The equatorial and low-latitude ionosphere continues to present exciting challenges for applications related to satellite-based communication and navigation systems. As part of ISRO's Coherent Radio Beacon Experiment (CRABEX), a receiver is operational at Ionosphere Field Station, Haringhata (latitude: 22.93°N, longitude: 88.5°E geographic; magnetic dip 36.2°N) of University of Calcutta since 2015. This receiver is capable of receiving beacons at 150 and 400 MHz from Low Earth Orbiting (LEO) satellites. The transit of these satellites above an elevation threshold normally ranges from 8-12 minutes and hence presents an opportunity to study an instantaneous snapshot of the ionosphere. This assumes importance in view of the fact that information about the spatial gradient of ionization occurring around the northern crest of the Equatorial Ionization Anomaly (EIA), which passes nearly overhead the station, could be used as a possible metric for prediction of adverse ionospheric conditions. This receiver provides at its output satellite elevation, azimuth and relative Total Electron Content (TEC) along with a host of other parameters as a function of UTC. One of the important observations made from this location was the occurrence of post-midnight to early morning depletions in TEC, which could have resulted from decaying irregularities, ruling out possible fresh generation at the corresponding local post-midnight hours. Although the amplitudes of such depletions are nominal in the range of few TEC units, they assume significance in the light of precision position information in the mm range, as mandated in certain applications. Collocated GPS observations further validate these observations.

Keywords : CRABEX , TEC, EIA

Presentation Mode: Poster

Presenting Author: Dyutis Garai

Registration id: NSSS-20211213072319

Spatio-temporal variation in SO2 over Indian subcontinent from Space-borne observations

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Sulfur dioxide (SO2) column densities from Ozone Monitoring Instrument (OMI) provide important information on its Spatio-temporal distributions and emission trends. In the present study, the distributions of PBL (planetary boundary layer) SO2 column densities along with the seasonal variation over the Indian sub-continent from 2005 to 2020 and their associated driving mechanism are investigated based on satellite retrieved data sets. SO2 spatial distribution exhibits several hotspots, especially over eastern India and regional enhancement over western Indo-Gangetic Plain, besides profound seasonality (wintertime maximum and monsoonal low). The hotspots over eastern India show the spread over a period of 2005 to 2020 with the statistically significant increasing trend of 0.054 Â± 0.006 DUyr-1 over the region. The increasing trend indicates the significant increase in the emissions of SO2 around the coal-belt region of eastern India. In all the other regions, the trend is statistically insignificant. However, CAMS (Copernicus Atmosphere Monitoring Service) reanalysis shows limitations in capturing the increasing trend over eastern India due to the inadequacy of emission inventory. Interestingly, except eastern region, there is a reduction in a positive trend over most parts of India during 2013-2020. Analysis of boundary layer SO2 to tropospheric NO2 ratio suggests that most of the SO2 hotspots over India are corresponding to point sources except a hotspot over the southeast coast which is mainly due to emissions from mobile sources (transport sector). Stringent emission control measures and stricter implementation of existing policies are essential to avert poor air quality, especially over eastern India.

Presentation Mode: Poster

Presenting Author: Revathy S Ajayakumar

Registration id: NSSS-20220110094200

Characteristics of the Atmospheric Boundary Layer Processes during Transient Monsoon Conditions

Seetha C. J[1], Sanjay Kumar Mehta[1]

[1]SRM Institute of Science and Technology

The All-India summer monsoon rainfall (ISMR) is defined as the rainfall received during June to September over India. The ISMR plays a vital role in both agriculture as well as the economy of the country. The ISMR shows different variabilities on the spatiotemporal domain and these variabilities arise from both internal and external feedback. During the summer monsoon season (June to September), a substantial component of variability arises from the fluctuation in the intra-seasonal scale between active spells with good rainfall and weak/break spells with intermittent rainfall. The role of the active and break monsoon conditions on the atmospheric boundary layer (ABL) height is being reported in the present study. It is known that the ABL height is higher during break monsoon conditions while it is lower height during active monsoon conditions. However, on the short scale (Day to day scale) the role of active and break monsoons on the ABL is not straightforward. As the active and break spells are identified using the central India monsoon rainfall which represents the synoptic-scale processes. However, ABL is mainly governed by the micro-scale process. Thus, relative roles of micro scale surface forcings and synoptic-scale forcings on the short-scale variability of the ABL will be presented during the conference.

Presentation Mode: Poster

Presenting Author: Seetha C J

Registration id: NSSS-20220110113212

Decadal changes in atmospheric composition over EHF region and implications on climate change

Rohit Gautam[1], Binita Pathak[1,2], Barlin Das[1], Anindita Borah[1], Krishnanka J. Baishya[2], P K Bhuyan[2]

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The Eastern Himalayan Foothills region (EHF), comprising the North East Indian states and surrounding territories, is crucial in terms of atmospheric chemistry and its implications. The atmospheric composition of the region is found to be altered under the influence of dust advection from the Indian deserts through westerlies, anthropogenic emissions from the Indo Gangetic Plains (IGP), marine emissions from the Bay of Bengal, and local biogenic emissions from large vegetation cover, including primary and secondary bioaerosols as well as local anthropogenic emissions (e.g., biomass burning, fossil fuel burning, oil and gas fields, etc.). The anthropogenic changes over the region are primarily the growing population accompanied by increasing urbanization, changes in land use, major roadway expansions, increased deforestation, biomass burning, fossil fuel consumption, leading to an increasing concentration of gaseous constituents including greenhouse gases (GHGs) and aerosols. The latter is evident from the Spatio-temporal distribution of most of the constituents like AOD, PMs CO, CH4, NO, CO2, NO2, and O3 showing an increasing trend over the past two to four decades. The 2m-temperature also exhibited an increasing trend for all months of the year during 1979 - 2020, implying that the compositional changes including an increase in GHGs in the atmosphere have an impact on surface temperature. Further, 2m mean temperature data revealed a steeper increasing temperature in September followed by February, thus partially explaining an extended summer and warming winters, indicative of a climate change in the region.

Presentation Mode: Poster

Presenting Author: Rohit Gautam

Registration id: NSSS-20211209035016

Plenary Session 3

Solar and Planetary Sciences

This session will focus on solar physics, planetary sciences, lunar science, exoplanetary science, solar-system and heliospheric physics and space-based exploration of solar system bodies

Magnetic Reconnection and Particle Acceleration in High Lundquist Number Systems

Arghyadeep Paul[1], Bhargav Vaidya[1]

[1]Indian Institute of Technology Indore

Magnetic reconnection is a ubiquitous phenomenon in laboratory and astrophysical plasmas and is believed to be an essential process of energy conversion and particle acceleration in such environments. The process of reconnection is prevalent in the solar corona and turbulent regions where multiple current sheets exist close to each other is common. Such current sheets are often also accompanied by the presence of a parallel velocity shear. Reconnection is also attributed to be the key process responsible for mass and energy transfer from the solar wind to the earth's magnetospheric system. We have investigated the evolution of a plasmoid dominated double current sheet system exhibiting an explosive reconnection phase in the presence of a parallel shear flow using resistive magnetohydrodynamic simulations in a 2D slab geometry and have explored the mechanisms of particle acceleration and their dependence on the shear flow in such rapidly evolving systems. Our results show a deviation in the reconnection rate from the theoretical scaling and the same is found to be dependent on the structure of the magnetic islands past the early evolution stage. The results from our test particle simulations also demonstrate the effects of various mechanisms such as magnetic island merger and island contraction in the acceleration of particles in a manner to produce a power-law spectrum of the non thermal population of accelerated particles. Furthermore, as an extension of the study to more realistic and complex environments, we perform 3D global MHD simulations with adaptive mesh refinement (AMR) to study the formation, evolution and large scale effects of flux rope structures produced due to bursty magnetic reconnection at the dayside magnetopause of an Earth like planet possessing a dipolar magnetic field. Such flux transfer events or FTEs are responsible for the impulsive injection of large amounts of mass and energy into the planet's magnetospheric system.

Presentation Mode: Oral

Presenting Author: Arghyadeep Paul

Registration id: NSSS-20211216014353

Propagation characteristics of a Coronal Mass Ejection throughout inner solar system from multipoint

Shirsh Lata Soni[1], Smitha Thampi[1], Satheesh Thampi[1]

[1]SPL, VSSC, ISRO, India

Interplanetary coronal mass ejections (ICMEs) propagate across the solar system, and multipoint spacecraft observations provide a unique opportunity to constrain their spread. Early in 2012, a favorable alignment of inner solar bodies provided an ideal opportunity to study an interplanetary Coronal Mass Ejection that occurred on March 7, 2012. Magnetic field data obtained from MESSENGER (MAG) for Mercury, Venus EXpress (VEX: MAG) for Venus, ACE, WIND, and Geostationary Operational Environmental Satellite (GOES) at Earth, and Mars EXpress (MEX: ELS) for Mars were used. Initialization and subsequent fast expansion from low coronal heights of hot channeled structures were found as their first eruption signals in SDO pictures. We use the WSA-Enlil+Cone model to confirm the arrival of ICME at various locations. We found that multipoint observations are essential for refining ICME propagation simulations as two very different ICMEs can appear very similar in just one observational location. The use of MAG data from MESSENGER and VEX in combination with OMNI and GOES data, as well as ELS data from MEX, provides a consistent picture of the ICMEs in terms of relative magnitude, arrival times, and overall characteristics. The significance of these findings for understanding solar transient propagation is discussed. This could be extremely beneficial for future space weather investigations as well as the validation of heliospheric models in general.

Presentation Mode: Oral

Presenting Author: Shirsh Lata Soni

Registration id: NSSS-20211217013505

Magnetohydrodynamic simulations of the impact of a coronal mass ejection on the global magnetosphere

Souvik Roy[1], Dibyendu Nandy[1,2]

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The high energetic plasma and the embedded magnetic field of coronal mass ejections interact with planetary magnetospheres giving rise to transient perturbations such as geomagnetic storms. Predicting the geomagnetic impact of such interplanetary coronal mass ejections (ICME) is of utmost importance for the protection of our technological infrastructure that is affected by space weather. We use 3D compressible magnetohydrodynamic simulation of a star-planet system to model and study an ICME-Earth interaction event of 20th November 2003. In the modelled interaction, we observe a change in magnetopause shape and stand-off distance on ICME impact, day and night side reconnections, and induction of high currents in the magnetosphere. We also notice the formation of a ring of strong equatorial current around the Earth, leading to a reduction of the geomagnetic field. We calculate the simulated reduction in the magnetic field and compare that to the observed geomagnetic indices in order to establish a predictive approach for geomagnetic storms. These simulations are expected to illuminate the physical processes that result in space weather impacts of stellar magnetic storms in planetary and exoplanetary systems.

Presentation Mode: Oral

Presenting Author: Souvik Roy

Registration id: NSSS-20220110111038

Multiple particle injections in the Earth's Magnetosphere by an isolated IP Shock

Ankush Bhaskar[1], Tarun Pant

[1]SPL/VSSC/ISRO

The sudden compression of the magnetosphere by the impact of Interplanetary (IP) shock results in a transient variation of particles. The present study investigates multiple particle injections associated with the impact of an isolated IP shock. The IP shock is identified by Advanced Composition Explorer and Wind spacecraft upstream of the solar wind. The Relativistic Electron Proton Telescope (REPT) and Magnetic Electron Ion Spectrometer (MagEIS) were used to identify and analyze particle injections. The origin and spatial extent of the injection region are inferred by using multipoint measurements and particle tracing. The underlying mechanisms of such unique observations are discussed in the frame of the present understanding.

Presentation Mode: Oral

Presenting Author: Ankush Bhaskar

Registration id: NSSS-20220110081946

A study on the coupling between IMF Bz and Dst under 22nd and 23rd solar cycles

Amrutha S[1], K Unnikrishnan[2], Abraham A[1], Syamily P[1]

[1]Department of Physics, Christian College,Chengannur,University of Kerala, [2]N S S Hindu College, Changanaserry, M G University

In the present work, the interdependencies between geomagnetic storm index (Dst) and z component of interplanetary magnetic field (IMF Bz) during major and minor magnetic storms under different phases of 22nd and 23rd solar cycles were analysed using statistical tools. Here, we studied major and minor storms by accounting the correlation between the various parameters IMFBz, Dst, and sun spot numbers (SSN). The correlation between yearly average of maximum values of IMF Bz and that of corresponding Dst values of each year of 22nd solar cycle, is found to be strong. It indicates that a linear dependency exists for Dst maximum observed during geomagnetic storms with the corresponding maximum value of IMF Bz. Based on the analysis of sunspot number variations, it is observed that the yearly average strength of storms is positively correlated with corresponding yearly average of sunspot numbers.

Presentation Mode: Oral

Presenting Author: Amrutha S

Registration id: NSSS-20211217055821

Corotating Interaction Regions during Solar Cycle 24: A Study on Characteristics and Geoeffectiveness

Jibin V Sunny[1], Rajkumar Hajra[1]

[1]Indian Institute of Technology Indore

Corotating interaction regions (CIRs) form in the interaction region between the solar wind high-speed streams and slow streams, leading to compressed plasma and magnetic fields. Using the solar wind measurements upstream of the Earth, we identified 292 CIRs encountered by Earth during January 2008 through December 2019 (solar cycle 24). The occurrence rate is the maximum during the solar cycle descending phase (≈ 33 /year), followed by occurrences during the solar minimum (≈ 24 /year), the ascending phase (≈ 22 /year) and the solar maximum (≈ 11 /year). At 1 AU, CIRs are found to be large-scale interplanetary structures, with average (median) duration of ≈ 26 h (≈ 24 h), and radial extent of ≈ 0.31 AU (≈ 0.27 AU). CIRs are characterized by average (median) plasma density of ≈ 29 cm-3 (≈ 26 cm-3), ram pressure of ≈ 11 nPa (≈ 9 nPa), temperature of ≈ 5×10^5 K (≈ 4×10^5 K), and magnetic field magnitude of ≈ 15 nT (≈ 14 nT). The CIR characteristic features exhibit no clear solar cycle phase dependence. About 30% of the CIRs are found to be geoeffective causing geomagnetic storms with the peak SYM-H ≤−50 nT; 25% caused moderate storms (−50 nT ≥ SYM-H > −100 nT), and 5% caused intense storms (SYM-H ≤ −100 nT). The geoeffectiveness is found to decrease with the decreasing solar flux. CIRs during equinoxes are found to be more geoeffective compared to those during solstices. On average, SYM-H exhibits a strong association with the CIR plasma characteristic parameters (anti-correlation coefficient r = −0.65 to −0.89), while the association is weaker for the AE index (r = 0.41 to 0.67).

Presentation Mode: Oral

Presenting Author: Jibin V Sunny

Registration id: NSSS-20220106102249

Recent Results on Martian Space Weather Events

Smitha V. Thampi[1], C. Krishnaprasad[2], Anil Bhardwaj[3], Tarun Kumar Pant[1], R. Satheesh Thampi[1]

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The scope of space weather studies and applications has now expanded beyond Solar-Terrestrial relationship to understand the solar influences on planetary environments. In this paper, we summarize the observed impacts on Martian plasma environment to different space weather events that were observed during the 2016-2018 period, primarily using MAVEN observations. These studies as well as the discovery of supra-thermal Argon exosphere of Mars from the MOM observations [Bhardwaj et al., 2017] have important implications as far as the atmospheric escape is concerned.

A spectacular space weather event at Mars occurred during September 2017, when the AR12673 produced a strong and wide CME. This caused a major space weather event at Mars on 12–13 September [1]. The particle instruments on board MAVEN observed the impact of this event at Mars. Topside ionospheric compression and depletion were observed by LPW whereas STATIC instrument showed significant presence of ionospheric heavy ions along with intense solar wind penetration b Interestingly, similar level of topside ionospheric response was also observed during a stealth CME event t during August 2018 [2].

The declining phase of solar cycle 24 also showcased another interesting aspect of space weather impact at Mars. Recurrent energetic particle enhancements (during CIR arrival) and associated radio black-outs (observed by MARSIS/MEX) were observed Mars, during August to October 2016 [3]. The results from these three studies will be presented and discussed.

[1] Krisnaprasad et al., Planetary and Space Science, 2021

[2] Thampi et al., MNRAS, 2021

[3] Krishnaprasad et al., ApJ, 2020

Presentation Mode: Oral

Presenting Author: Smitha V Thampi

Registration id: NSSS-20211218060415

A Magnetohydrodynamic trip to the Martian environment

Arnab Basak[1], Dibyendu Nandy[1,2]

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The planet Mars lost its global magnetosphere billions of years ago due to the halting of its internal dynamo. In the absence of proper magnetic shielding, the bombarding solar wind particles eroded away a major part of the Martian atmosphere, thereby reducing it to a thin layer surrounding the planet. We present results of three dimensional compressible magnetohydrodynamic simulations of the solar wind interaction with Mars, using the Star Planet Interaction Module (CESSI-SPIM) developed at CESSI, IISER Kolkata. The mechanisms that lead to the formation of an imposed magnetosphere around the planet are discussed vividly along with consequences of atmospheric loss from the perspective of planetary habitability. The results are found to be in agreement with observational data from Mars missions such as Mars Global Surveyor (MGS) and Mars Atmosphere and Volatile EvolutioN (MAVEN) and are expected to complement data from the recent missions. The study lays foundation for forecasting space weather and is relevant for the exploration of planets in the solar and exoplanetary systems. [Basak, A. and Nandy, D., MNRAS 502, 3569 (2021)]

Presentation Mode: Oral

Presenting Author: Arnab Basak

Registration id: NSSS-20220109024220

The correlation analysis of SF parameter with SEP parameter based on the impulsive time of SF and originated from the western hemisphere

Biji M. S[1], Prince P.R.[2]

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Solar Proton Events (SPE) are one of the most important solar activities which are generated by Coronal mass ejections or/and solar flares. The solar flares associated with SPE events shows several distinct features. The longitude of solar source, flare and/or CME, associated with SPE also plays an important role in understanding the characteristics of SPEs. The longitudinal dependence of SPEs showed that the occurrence of SPE probability is remarkably high in western hemisphere.

In this present work we have selected the SPE events observed by the SOHO Energetic and Relativistic Nuclei and Electron (ERNE) instrument during the 23rd and 24th solar cycle and originated from the western longitudinal area, W0- W90 and investigated the correlation of SPE properties like proton peak flux and proton fluence with SF peak flux and SXR fluence. The investigation is carried out for protons with average energy of ~ 25MeV/n and ~68 MeV/n based on the impulsive time of the SF, impulsive time $\leq$ 0.3 hr.(case 1) and impulsive time $\geq$ 0.3 hr.(case 2). Impulsive time is defined as the time difference between flare start time and peak time. The correlation coefficients of SF parameter, SXR fluence with the proton fluence and proton peak flux in case 1 are 0.46,0.53 and 0.49,0.51 respectively for the two proton energy values. The CCs of SF peak flux with the proton fluence and proton peak flux in case 1 are 0.41, 0.53 and 0.36, 0.39 respectively. The corresponding CCs in case 2 are 0.52, 0.55; 0.42, 0.52 and 0.47, 0.59; 0.40, 0.68 respectively. The correlation analyses indicate that events with greater impulsive times are more correlated than the events with less

Presentation Mode: Oral

Presenting Author: Biji M. S.

Registration id: NSSS-20220110102215

Signatures of ubiquitous magnetic reconnection in the lower solar atmosphere

Jayant Joshi[1], Luc H. M. Rouppe van der Voort[2], Jaime de la Cruz RodrÃ-guez[3]

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Ellerman Bomb-like brightenings of the hydrogen Balmer line wings in the quiet Sun, also known as quiet Sun Ellerman bombs (QSEBs), are a signature of the fundamental process of magnetic reconnection at the smallest observable scale in the lower solar atmosphere. We analyze high spatial resolution observations (0.1 arcsec) obtained with the Swedish 1-m Solar Telescope to explore signatures of QSEBs in the Hβ line. We find that QSEBs are ubiquitous and uniformly distributed throughout the quiet Sun, predominantly occurring in intergranular lanes. We find up to 120 QSEBs in the field of view for a single moment in time; this is more than an order of magnitude higher than the number of QSEBs found in earlier Hα observations. This suggests that about half a million QSEBs could be present in the lower solar atmosphere at any given time. The QSEB brightenings found in the Hβ line wings also persist in the line core with a temporal delay and spatial offset toward the nearest solar limb. Our results suggest that QSEBs emanate through magnetic reconnection along vertically extended current sheets in the lower solar atmosphere. The apparent omnipresence of small-scale magnetic reconnection may play an important role in the energy balance of the solar chromosphere.

Presentation Mode: Oral

Presenting Author: Jayant Joshi

Registration id: NSSS-20220110113916

Soft X-ray Spectral Diagnostics of Multi-thermal Plasma in Solar Flares with Chandrayaan-2 XSM

N. P. S. Mithun[1,2], S. V. Vadawale[1], B. Mondal[1], A. Sarkar[1], B. Joshi[1], P. Janardhan[1], A. Bhardwaj[1], G. Del Zanna[3], H. E. Mason[3]

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Solar flares result from impulsive energy release due to magnetic reconnection in the solar atmosphere. Observational evidence suggests that the flaring plasma consists of a thermal distribution of particles heated to higher temperatures during the process and a non-thermal distribution of particles. As this hot plasma emits copiously in the X-ray wavelengths, X-ray spectral measurements provide a wealth of information on the physical conditions of the flaring plasma providing insights into the particle acceleration process in magnetic reconnection. Solar X-ray Monitor (XSM) onboard Chandrayaan-2 mission provides broad-band disk integrated soft X-ray solar spectral measurements in the energy range of 1-15 keV with high resolution and time cadence. We model the X-ray spectra obtained with XSM to investigate the evolution of the plasma parameters for a few C class flares. Using the soft X-ray spectra consisting of the continuum and well-resolved line complexes of major elements like Mg, Si, and Fe, we investigate the consistency of isothermal and multi-thermal assumptions on the higher temperature components of the flaring plasma. We found that the observed X-ray spectra near the peak of flares are inconsistent with isothermal models and require a broader differential emission measure (DEM) distribution. We present the evolution of DEM during the course of the flares as estimated from the soft X-ray spectra.

Presentation Mode: Oral

Presenting Author: Mithun N. P. S.

Registration id: NSSS-20220105082703

Coronal Magnetic fields and Sensitivity Requirements for Spectropolarimetry Channel of VELC/Aditya-L1

K. Sasikumar Raja[1], Suresh Venkata[1], Jagdev Singh[1], B. Raghavendra Prasad[1]

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Understanding solar coronal magnetic fields are crucial to address the long-standing mysteries of the solar corona and solar wind. Although routine photospheric magnetic fields have been available for decades, coronal magnetic fields are rarely reported. Visible Emission Line Coronagraph (VELC) onboard Aditya-L1 mission (planned to launch in the near future) can directly measure the magnetic fields in the inner solar corona. This can be achieved with the help of spectropolarimetric observations of the forbidden coronal emission line centered at 1074.7 nm over a field of view 1.05 - 1.5 solar radii. This talk will summarize various existing direct and indirect techniques present in the literature to estimate the magnetic fields at different wavelength regimes. Further, we will discuss the expected sensitivities required to estimate magnetic fields using the spectropolarimetry channel of VELC.

Presentation Mode: Oral

Presenting Author: K. Sasikumar Raja

Registration id: NSSS-20211203091234

Propagation of acoustic-gravity waves in magnetized regions in the lower solar atmosphere

Hirdesh Kumar[1], Brajesh Kumar[1], S. P. Rajaguru[2] , Shibu K. Mathew[1]

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Acoustic waves are generated inside the convection zone via highly turbulent convection. These waves interact with the magnetic fields and propagate in the form of magnetohydrodynamic waves. The plasma beta~1 and the magnetic canopy play crucial role in the propagation of these waves. Apart from this, the surface and atmospheric gravity waves which are generated by the buoyancy force are also influenced by the magnetic fields. The physical characteristics of the propagation of these waves is important not only for the energetics of the solar atmosphere but also for the recovering background thermal and magnetic configurations. We have extensively analyzed the propagation of acoustic-gravity waves in the magnetic network, plage and sunspot regions utilizing photospheric and chromospheric Dopplergrams and intensitygrams obtained from HMI, AIA instruments onboard SDO spacecraft and Ca II line scan observations obtained from NBI with the MAST operational at Udaipur Solar Observatory. We have constructed two height velocity-velocity and intensity-intensity cross-spectra, and study k-omega phase and coherence signals and their association with the background magnetic fields. We find the signatures of downward propagating waves at chromospheric heights in the acoustic wave regime, which we associate with the possible refraction and reflection within the magnetic canopy. A comparison of the k-omega phase diagrams of network, plage and sunspot regions reveals that gravity waves are suppressed or scattered by the stronger magnetic fields of plage and sunspot. We also find signatures of reflection of gravity waves back into the lower atmosphere even in the quiet Sun with weak vertical magnetic fields. In this talk, I will discuss the results obtained from analysis of propagation of acoustic-gravity waves in the lower solar atmosphere.

Presentation Mode: Oral

Presenting Author: Hirdesh Kumar

Registration id: NSSS-20211223042221

Solar Ultraviolet Imaging Telescope (SUIT) Forward Modelling

Soumya Roy[1], A. Bhasari[2], V. Witzke[2], Durgesh Tripathi[1], P. Sreejith[1], A. N. Ramprakash[1], S. Alexander[2], S. Solanki[2]

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The Solar Ultraviolet Imaging Telescope (SUIT) is an instrument onboard the Aditya L1 mission to observe the Sun and measure the Solar radiation in the near Ultraviolet range (200-400 nm). SUIT will have the capability of probing various layers of the Sun with its 11 science filters (eight narrow bands and three broad bands). SUIT will provide full-disk and partial disk images of the Sun with a pixel size of 0.7 arcsec. Here, we use MPS-Atlas simulation to create mock observations for SUIT using the data obtained from the MURaM (MPS/University of Chicago Radiative MHD) simulation. MURaM is a multidimensional MHD code designed to facilitate realistic simulations of Solar magneto-convection and other related magnetic features (such as pores and emerging flux) in the upper convection zone and photosphere. The simulation includes the effects of non-gray radiative transfer, partial ionization, full compressibility and open boundary conditions. The simulation gives us various physical quantities like density, temperature, magnetic flux density etc. The MPS-Atlas code allows us to solve the Radiative Transfer equation through the MURaM cubes for the SUIT filter profiles. We convolve these simulated flux maps computed for various filters with the SUIT PSF to create the mock observations. These results will help us understand and interpret the SUIT observations.

Presentation Mode: Oral

Presenting Author: Soumya Roy

Registration id: NSSS-20220103015004

Coupling of CME kinematics from inner to outer corona, and influence of their source regions

Satabdwa Majumdar[1], Ritesh Patel[1], Vaibhav Pant[1], Dipankar Banerjee[1,2]

[1]ARIES, [2]IIA

Despite studying coronal mass ejections (CMEs) for several years, we do not yet have a complete understanding of their kinematics. To this end, it is essential to understand the change in kinematics of the CMEs as they travel from the inner corona (<3 R) up to the higher heights of the outer corona. We conduct a follow-up statistical study of several 3D kinematic parameters of 59 CMEs previously studied by Majumdar et al. (2020). The source regions of these CMEs are identified and classified as active regions (ARs), active prominences (APs), or prominence eruptions (PEs). We study several statistical correlations between different kinematic parameters of the CMEs. We show that the CMEs' average kinematic parameters change as they propagate from the inner to the outer corona, indicating the importance of a region where the common practice is to perform averaging. We also find that the CME parameters in the outer corona are highly influenced by those in the inner corona, indicating the importance of the inner corona in the understanding of the kinematics. Furthermore, we find that the source regions of the CMEs tend to have a distinct imprint on the statistical correlations between different kinematic parameters, and that an overall correlation tends to wash away this crucial information. The results of this work supports the possibility of different dynamical classes for the CMEs from ARs and prominences, which gets manifested in their kinematics.

Presentation Mode: Oral

Presenting Author: Satabdwa Majumdar

Registration id: NSSS-20220110015340

Recent developments in space weather research with high fidelity low-frequency spectro-polarimetric

[1]Devojyoti Kansabanik, [1]Divya Oberoi

[1]National Centre for Radio Astrophysics, Tata Institute of Fundamental Research, Pune, India

Low-frequency radio observations have been proven to be an important tool for space weather observations over decades ranging from coronal mass ejections (CMEs) to solar winds. Radio observations can be done from the ground, which allows observations at the high temporal and spectral resolution, which is otherwise difficult for space-based instruments. With the advent of new generation radio interferometers, like Murchison Widefield Array (MWA), which is a future square kilometer array precursor instrument, it is become possible to use it for space weather monitoring using type-II radio bursts, radio emissions from CMEs, and interplanetary scintillation (IPS). Recently, we have successfully implemented precise polarization calibration of the instrument, which allows us now to use the polarization information also. Here we will show some new interesting science results important from a space weather perspective and also discuss the future possibilities. These include measuring the plasma parameters and magnetic fields of CMEs up to 8.5 solar radii (highest heliocentric distance reported in the literature) using gyrosynchrotron modeling to measurements of heliospheric Faraday rotation using numerous background radio sources even with the Sun in the field of view. At the end, we will discuss how these spectro-polarimetric observations combined with simultaneous IPS measurements and other space-based solar observatories (like SDO, SOHO, Aditya-L1) would become a routine space weather monitoring method. The achievements obtained over the last few years in space weather research using MWA have built the confidence of good solar and heliospheric sciences and new discoveries using the future SKA or SKA like solar arrays (Frequency Agile Solar Radiotelescope; FASR).

Presentation Mode: Oral

Presenting Author: Devojyoti Kansabanik

Registration id: NSSS-20211216062401

Constraining the source of an anomalous impact melt deposit on the lunar far side: New insights

Deepak Dhingra[1], Satyendra Kumar[1], Ritwick Sen[2], Rajit Das[1]

[1]Dept. of Earth Sciences, IIT Kanpur; [2]Dept. of Geology and Geophysics, IIT Kharagpur

We have utilized multi-mission imaging and spectral datasets to constrain the source of an anomalous impact melt deposit on the lunar far side first reported by Robinson et al. (2016) and which has been dated to be geologically very young (~26 Ma). Unlike conventional impact melt deposits, this deposit does not surround an impact crater and therefore its emplacement process and the source crater are not well constrained although some possibilities have been suggested [Robinson et al., 2016; Bandfield et al., 2017]. We have used crater ejecta patterns of the suggested source craters to rule out five out of nine craters. Further, detailed morphological evaluation of the region using narrow angle camera (NAC) images have led to the detection of new exposures of this geologically very young impact melt deposit. It has significantly increased the areal coverage of this impact melt deposit and has direct implications for the search of the source crater. Lastly, we have used spectral data from Chandrayaan-1 Moon Mineralogy Mapper (M3) to make first order comparisons of the anomalous impact melt deposit with the impact melt surrounding the suggested source craters. This integrated analysis is helping constrain the source of this young impact melt deposit. The understanding of the emplacement dynamics of this deposit would further enrich the learning of the impact cratering process.

References

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Presentation Mode: Oral

Presenting Author: Deepak Dhingra

Registration id: NSSS-20211126024959

A machine learning framework for global Mg-Spinel detection based on Chandrayaan-1 data

Suchit Purohit[1], Megha Bhatt[2], Parth Patadiya[1], Karan Bhuva[1], Hetvi Julasana[1], Deepak Dhingra[3], Urs Mall[4]

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The analysis of hyperspectral imaging data of Moon Mineralogy Mapper (M3) [1] from Chandrayaan-1 mission [2] discovered a new feldspathic rock type with the presence of Mg-spinel mineral at small localised areas on the Moon [3,4,5]. These detections are the outcome of the site specific studies based on identification of a broad absorption band around 2000 nm and absence of any significant absorption band around 1000 nm. The distinct petrological characteristics of Mg-spinel have triggered substantial interest in global investigation of its presence and distribution. We explore the use of machine learning techniques applied to the global coverage of M3 level 2 data [6] for detecting new Mg-spinel exposures, and for understanding underlying relations within this large dataset. We define the labels for three distinct spectral classes; 1) Mg-spinel 2) pyroxenes and 3) matured soil with no distinct absorption features. We used the Synthetic Minority Oversampling Technique (SMOTE) method to increase the number of samples in the Mg-spinel class and balanced the training dataset. We trained 1D convolutional neural network (CNN) for the detection of Mg-spinel spectral class and applied to the M3 global data coverage. The trained CNN model outcome is a set of 1067 spectra out of 1.12 billion spectra which are predicted as the most probable candidate having Mg-spinel type spectral shape. We validate our framework qualitatively at the already published locations [3,4,5]. In addition to already reported locations, we detected Mg-spinel spectral signature from 32 new locations that includes 3 exposures at farside high latitudes. We demonstrate the ability of the machine learning approach in detecting a specific mineral signature at the global scale. We will be applying this developed model to the Chandrayaan-2 Imaging Infrared Spectrometer data in near future.

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Presentation Mode: Oral

Presenting Author: Deepak Dhingra

Registration id: NSSS-20211126024959

Understanding the M3 layer in the Martian dayside ionosphere using MAVEN observations

Vrinda Mukundan[1], Smitha V. Thampi[2], Anil Bhardwaj[3]

[1]NCESS, [2]SPL, [3]PRL

Every class of scientific instrument to measure the ionosphere of Mars to date has shown the occasional appearance of local enhancements in electron densities above the main peak, effectively, a topside "bulge," at 160–220 km altitude. The layer, generally named as M3 layer, has not been characterized as much as the well-studied M2 and M1 layers which are the primary and secondary peaks, respectively, seen in the Martian electron density profiles. In the present study, we analyze the M3 layer in the Martian dayside electron density profiles measured by the Radio Occultation Science Experiment (ROSE) onboard the Mars Atmosphere Volatile EvolutioN (MAVEN) mission. By applying a Chapman fit to the chosen profiles, we identify the M3 layer, its peak density, altitude of occurrence, distance from the M2 layer, and the ratio of M3 density to the M2 density. We identified the M3 layer in 50% of the analyzed profiles and find that the typical altitude of occurrence is at ~ 178 km with an average density of 9 x 10^3 electrons cm-3. The M3 parameters seem sensitive to changes in latitude and solar long itude but are irresponsive to variations in solar zenith angle. We also report that the two widely-cited possible reasons for the formation of M3: (1) sudden enhancement in electron temperature, and (2) the presence of the crustal magnetic field could not be the reason for the formation of the sporadic layer.

Presentation Mode: Oral

Presenting Author: Vrinda Mukundan

Registration id: NSSS-20211130041424

What controls V1 layer: A study using Akatsuki and Venus Express measurements and One dimensional Photochemical model

Ambili K M[1] , Raj Kumar Choudhary[1]

[1]Space Physics Laboratory

The source of the V1 layer of the Venus ionosphere is as enigmatic as its very existence itself. The existence of the V1 layer in the Venus ionosphere was first reported during the PVO era and was surmised to be caused by soft X-ray emissions. A detailed study on its characteristic was made later using radio occultation experiment (VeRA) onboard Venus Express. We now know that it exists at about 125 km altitude, and has a varying shape and features depending upon the solar activity conditions. A characteristic feature of this layer as well as consensus on its source, however, is yet to emerge mostly because of the lack of observation opportunities and theoretical studies. In this context, radio occultation measurements of the Venus ionosphere using Akatsuki Radio Science experiments assume significance as these not only add to the database but also give measurements from the low latitude regions which have remained least explored during previous missions due to satellite trajectory. In this paper, we have studied the characteristic features of the V1 layer using radio occultation measurements done using Venus Express and Akatsuki missions . Akatsuki provided some thirty profiles since 2016, while about a hundred profiles are available from the Venus express mission. In our analysis, we considered only those profiles which were for the sunlit side of Venus with the solar zenith angle less than 85 degree. We got several profiles from the low latitude regions of the Venus ionosphere showing interesting features of the V1 layer. Distinct V1 layers were not visible in many cases; in some profiles they appeared as a ledge while there were a few examples when a very distinct peak was also visible. The origin for such features has been explored using an in-house developed one dimensional photochemical model for the Venusian ionosphere (1DPCM) . Though both the peak V1 layer height and density get neatly reproduced in the model, in most of the cases we note that the model V1 layer appears only as a shoulder. A detailed comparison of the model and Venus Express and Akatsuki derived altitude profiles of the Venus ionosphere under varying solar conditions would be provided and reasons for the occurrence of V1 layers of varying characteristics would be discussed.

Presentation Mode: Oral

Presenting Author: Ambili K M

Registration id: NSSS-20211217101323

The Martian dust cycle: Understanding dust devils

Varun Sheel[1], Shefali Uttam[1]

[1]Physical Research Laboratory

Dust has a strong impact on Martian atmosphere's thermal and dynamical state, thus affecting the climate and environment of Mars. Dust laden convective vortices, called dust devils, are a source of dust injection into the atmosphere. But its quantitative contribution to the total dust loading in the atmosphere and relative dust loading within the dust devil, are not well understood. We model the spatial distribution of dust concentration within a steady state Martian dust devil. On the other hand, we have detected several dust devils in Gale crater, by analysing data from the Rover Environmental Monitoring Station (REMS), onboard the Curiosity rover during Martian Year 33. We draw important conclusions on the characteristics of these devils. A seasonal study for dust devil occurrences based on UV flux data shows an increase in their frequency during the local southern summer season.

Presentation Mode: Oral

Presenting Author: Varun Sheel

Registration id: NSSS-20211229101636

MOM and MAVEN Observations of the Effects of the 2018 Global Dust Event on the Martian Thermosphere

N V Rao[1], Neha Gupta[1], Umesh R Kadhane[2]

[1]National Atmospheric Research laboratory, Gadanki, Tirupati, India, [2]Department of Physics, IIST, Trivandrum, India

Response of the Martian upper thermosphere to the lower atmospheric dust activity is studied using unique observations made together by the Mars Orbiter Mission (MOM) and the Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft. The Mars Exospheric Neutral Composition Analyzer (MENCA)/MOM and the Neutral Gas and Ion Mass Spectrometer (NGIMS)/MAVEN have simultaneously (on the same day) measured the neutral densities in the Martian thermosphere on 5, 8, 10, 13, 16, and 29 June 2018. The measurement period falls in the onset and progression time of the planet-encircling dust event (PEDE) in the Mars lower atmosphere. During this time, the inbound trajectories of MAVEN and MOM spacecraft occurred on the dawnside and duskside, respectively. Using these observations, we found that thermospheric densities both on the dawnside and duskside are enhanced associated with the onset and growth of PEDE-2018. The enhancement, however, is more on the duskside than on the dawn, showing the dawn-dusk asymmetry. The densities on the duskside reach their maximum on 29 June 2018, close to the time of peak dust activity. These results are explained by considering the local time asymmetries in radiative heating of the lower atmosphere and subsequent expansion of the thermosphere due to PEDE-2018. Furthermore, O/CO2 ratios below 220-km altitude become one on the dawnside, whereas they are always <0.2 at the dusk. This indicates that radiative cooling is more effective on the dawnside than the duskside.

Presentation Mode: Oral

Presenting Author: N V Rao

Registration id: NSSS-20220107064814

Mapping global lunar elemental abundance: A systematic study of CLASS and M3 data

M. Bhatt[1], S. Narendranath[2], Netra S Pillai[2], C. Wöhler[3], N. Srivastava[1], and A. Bhardwaj[1]

[1]PRSS, PSDN, PRL, [2]SAG,URSC,ISRO, [3]Image Analysis Group, TU Dortmund University

The mapping of refractory elements at local and global scales is an important for revealing the petrological characteristics of the Moon and for understanding its geological evolution. The direct approaches (X-ray and Gamma ray spectroscopy) mainly provide elemental abundances at spatial resolution of tens of kilometers. In contrast, the indirect approaches (UV-VIS-NIR spectroscopy) provide spatial resolution of tens to hundreds of meters but they are influenced by space-weathering and topographic effects and majorly based on empirical relationships between band parameters and the chemical composition of returned samples. We are working towards developing an integrated framework for deriving global elemental abundance maps at tens to hundreds to meters spatial resolution using the global coverage of Chandryaan-2 Large Area Soft X-ray Spectrometer (CLASS) at resolution of 150kmX12.5 km and the Chandrayaan-1 Moon Mineralogy Mapper (M3) data at 300 pixels per degree. The relationship between spectral parameters obtained in the NIR wavelength region from M3 and CLASS-derived elemental abundances will be presented using conventional regression methods and machine learning approaches. The limitations and advantages of the proposed integrated approach will be discussed considering complex lithologic mixtures and regions that are heavily cratered.

Presentation Mode: Oral

Presenting Author: Megha Bhatt

Registration id: NSSS-20211222082834

Boulder Fall Ejecta on Mars: Present day activity

S. Vijayan, Harish[1], K.B. Kimi[1], S. Tuhi[1], K. Vigneshwaran[1], R.K. Sinha[1], S.J. Conway[1], B. Sivaraman[1], Anil Bhardwaj[1]

[1]PRL

On Mars, high-resolution images have revealed numerous boulder falls on the surface. Such boulder falls indicate recent active mass wasting processes and these tracks are ubiquitous on steeply sloping terrain, and where particularly abundant have been used to infer active seismicity. The HiRISE images of the same place taken at different times, revealed that all new boulder falls have ejecta which we call boulder fall ejecta (BFE). Boulder falls with ejecta are an archive of recent surface activity on Mars, however, determining how recently they fell remains elusive. Here we systematically surveyed HiRISE images from 2006 to 2020 to find recent boulder falls which have ejecta along the track. We searched all the images and found BFE present in large numbers suggesting recent falls are common and widespread. First systematic survey of BFE revealed ~4500 tracks whose total integrated track length is ~900 km. Our study revealed that the BFE fade in as little as ~2-4 Mars years whereas some BFE can persist more than 6 Mars years. This study revealed that nearly 30% of BFE are observed in the Cerberus Fossae region which implies that it is one of the seismically active regions on Mars. Our major conclusion suggests that on Mars BFE is direct evidence for present day activities. The presence of BFE in planetary bodies provide a comprehensive evidence for occurrence of recent activity within a few decades.

Presentation Mode: Oral

Presenting Author: S Vijayan

Registration id: NSSS-20211213054951

Potential role of water and debris-flows in gully formation on Mars

Rishitosh Kumar Sinha[1], Dwijesh Ray[2]

[1]Physical Research Laboratory, [2]Physical Research Laboratory

Until the past decade or so, gullies on Mars have been thought to have formed from the recent flow of ice/snow melt water. However, some of the recent studies focused on analyzing present-day activity in gullies denied the role of water for the observed changes in the gullies and rather postulated gullies to have ever formed from a dry process, i.e. by sublimation of CO2 ice. While it is possible that the present-day pressure-temperature conditions are not conducive to sustain any surface flow of water, but to say that the Mars' past (~10 Ma) might have also not anticipated such conditions where water can flow on the surface to carve gully channels and entrain debris flow is still a matter of debate and warrants detailed investigation.

The aim of this work is to investigate the role of water in the formation of gullies and decipher the dominant sediment transport process. We performed a global morphological and morphometric analysis of categorized system of Martian gullies between 30 - 75° N and S using the High Resolution Imaging Science Experiment (HiRISE) images and Digital Elevation Models (DEMs). Gully systems are categorized according to the presence and/or absence of latitude dependent mantle (LDM) and glacial landforms on the walls/floors of the studied craters. Our observations reveal that (1) morphological evidence (viz. overlapping tongue-shaped terminal lobes, levees, channel backfilling, plug formation, and clast distribution) for the presence of debris-flow deposits occur in many craters, (2) fan gradient of gully categories is statistically distinct and longitudinal profiles of ~90% of investigated gully fans is linear, and (3) majority of present-day changes occur on the floor of sand (loose, unconsolidated sediments) filled gullies. These new results substantiate that a debris-flow-like process is responsible for the majority of sediment transport in gullies. Together, our work adds value into the potential role of water in gully formation on Mars.

Presentation Mode: Oral

Presenting Author: Rishitosh Kumar Sinha

Registration id: NSSS-20211213051422

Geological characterization of a floor-fractured crater in North-Central Arabia Terra, Mars: Implications for possible igneous processes in the earlier epochs

Alka Rani[1] , Amit Basu Sarbadhikari[1], Rishitosh Kumar Sinha[1]

[1]PRL

The highly cratered plain of Arabia Terra is one of the oldest provinces of Mars, situated at a crucial geologic division between the Martian highland-lowland boundary. A recent 'plain-style caldera complexes' report at the northern portion of Arabia Terra resembles the terrestrial supervolcanoes. This new type of volcanism changes the previous understanding of igneous activities on early Mars. In this context, we discuss previously unrecognized evidence of intrusive igneous process at the central portion of an unnamed floor-fractured crater (FFC; diameter: ~85 km; centered at 28º N, 28º E) North-Central Arabia Terra. The fundamental aim of this study is to address whether the observed geomorphic features are related to impact cratering or provide evidence of a regional-scale intrusive activity during the earlier epochs. Our study reveals the presence of igneous processes such as cones and dikes, which were previously unrecognized at the central portion of the crater.

The unidirectionality of the observed dikes and the azimuth of the cones and dikes depict the regional stress along NW-SE at the time of fracture formation, unlike the concentric and radial fractures developed by the impact process. Moreover, the orientation of the large linear tectonic features of Arabia Terra is also comparable with the features inside the studied crater. Together, from our study, we propose that the remnant structures inside study FFC correspond to plausible evidence of igneous activity in response to an intrusive regional event that the Arabia terra as a whole or in part might have experienced in the past. The studied crater represents a new class of diminutive volcanic centers in Arabia Terra resulting from tectono-volcanism and provides us new insights into the early magmatic processes on Mars.

Presentation Mode: Oral

Presenting Author: Alka Rani

Registration id: NSSS-20220110083606

Unravelling the complexities in central peak morphology of lunar complex craters: A global study

Roshan A. Shukla[1], Deepak Dhingra[1]

[1]Indian Institute of Technology, Kanpur

Enormous diversity exists in geomorphological characteristics of central peaks of the Lunar complex craters which could be linked to the conditions of impact and may help explain how the same process results in such diverse expressions.

We have undertaken a global study (60ºN-60ºS latitudes) using optical imagery under different illumination conditions from the Wide-Angle Camera (WAC) aboard the LRO mission along with the elevation data from SLDEM to develop a database of 247 complex craters with central peaks.

Some important results are:

1. Connection of central peaks with crater walls: In ~12.5% of the craters the central peak appears to be connected to the crater wall. An additional 14% of the craters have peaks where this connection occurs as discontinuous segments.

2. Number of peaks: We found that the central peaks occur more commonly as an isolated rise (~80%) compared to a group of peaks.

3. Peak geometry: The classifiable peaks exhibit various geometries and have been divided into various classes: Elongated peaks (~40%), Conical peaks (~18%), Fused peaks (~31%) include segments having elongated or conical shape but connected at the base and a Mixed geometry (11%) include spatially distinct peaks with conical and elongated nature located within the same crater. We were able to classify ~69% of the peaks while 31% of them are too complex to be assigned any class.

We can interpret that globally impact conditions favour the formation of a single large uplift. Also,the case of connection of the peak to the crater wall raises the question whether such peaks can be explained by the conventional peak formation hypothesis. It has important implications for understanding the source depth of central peak material and is under investigation.

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Presentation Mode: Oral

Presenting Author: Roshan A. Shukla

Registration id: NSSS-20211208105733

The effect of metallicity on the Atmospheric composition of Exoplanets atmospheres

Vikas Soni[1], Kinsuk Acharyya[1]

[1]Physical Research Laboratory

Exoplanets, i.e., planets outside the solar system, show a vast range of parameters, including temperature, size, orbital properties, chemical parameters, and metallicity. These parameters can affect the atmospheric composition of these exoplanets. Atmospheric metallicity is one such parameter, which affects the equilibrium abundance and chemical conversion time scales and the location of the quenching point. We constructed a model to study atmospheric compositions and studied how metallicity affects a reaction's quenching. The model solves the mass continuity equation with chemical kinetics, transport-flux (eddy and molecular diffusion), and photochemistry. Furthermore, it calculates the photodissociation rates using the two-stream approximation. To understand the effect of metallicity as the temperature and pressure change in the atmosphere, we ran a series of models to make a 3D grid in the temperature, pressure, and metallicity space. First, we studied the effect of metallicity on the equilibrium abundance and compared our results with the literature, and then we studied the effect of metallicity on the CH4-CO conversion time scale on the 2D T-P grid using a chemical network with H-C-N-O elements in the presence of transport. We found that the CH4/CO equal abundance curve moves towards low temperature and CO2/CO abundance curve moves towards high temperature with increased metallicity for solar ratio. The rate-limiting step in the conversion between CH4-CO slightly changes its dominance region in the T-P space marginally. The quenching point of CO lies in the high-pressure region compared to the CH4 quenching point. The CO quenching point moves from low-pressure region to high-pressure region with metallicity, and the CH4 quenching point moves from high to low-pressure region for moderately high metallicity ([Fe/H] < 300 x solar) and from low to high-pressure region for high metallicity ([Fe/H] > 300 x solar).

Presentation Mode: Oral

Presenting Author: Vikas soni

Registration id: NSSS-20220110084926

VUV spectra of Thermally Processed CS2 - NH3 Ice mixtures – Implications to icy solar system objects

S Pavithraa[1], R Ramachandran[1], J K Meka[1], J I Lo[2], S L Chou[2], B M Cheng[2], B N Rajasekhar[3], A Bhardwaj[1], N J Mason[4], B Sivaraman[1]

[1]PRL, India, [2]NSRRC, Taiwan, [3]BARC, Mumbai, [4]University of Kent

Comets are known to harbour several simple to complex molecules ranging from water to amides. The thermal processing of cometary ices as it approaches the Sun leads to the synthesis of more complex molecules. Carbon disulphide (CS2) and ammonia (NH3) are well known to be present on many comets. Reactions involving CS2 and NH3 leads to the formation of complex molecules. Thermal processing of CS2 and NH3 ice mixture was known to leave ammonium dithiocarbamate residue, nevertheless, the Vacuum UltraViolet (VUV) spectral signatures required for its identification on the icy bodies, including comets, in the solar system are limited. Therefore, we carried out laboratory analogue experiments containing CS2 and NH3 ices in a synchrotron based VUV beamline.

The CS2 and NH3 ices were deposited as (i) layered and (ii) mixed ices on an Lithium Fluoride (LiF) substrate kept at a temperature of 10 K in an ultrahigh vacuum chamber. The deposited ices were warmed to higher temperatures and a VUV photoabsorption spectra were recorded. Significant changes were observed in the VUV spectra while warming the ices from 10 K to higher temperatures. In this meeting, we will discuss the experimental details and the results obtained.

Presentation Mode: Oral

Presenting Author: Pavithraa Sundararajan

Registration id: NSSS-20220110121332

Investigation of polycyclic aromatic hydrocarbons (PAHs) on a sample of comets

Arijit Roy[1], V Venkataraman[2], B N Rajasekhar[3], Anil Bhardwaj[1], N J Mason[4], B Sivaraman[1]

[1]Physical Research Laboratory, Ahmedabad, India, [2]Space Physics Laboratory, VSSC, [3]Trivandrum, India, Atomic and Molecular Physics Division, Bhabha Atomic Research Center, Mumbai, India, [4]University of Kent at Canterbury, UK

Comets are believed to preserve the building blocks of the presolar molecular cloud and the primitive stages of the primordial solar nebula. They are considered to have formed in the outer regions of the early protosolar nebula at a temperature around 30 K. During their approach towards the Sun it looses a substantial portion of its mass to produce coma that are quite prominent in UV and mid-infrared wavelengths. Polycyclic aromatic hydrocarbons (PAHs) that are observed in the interstellar medium (ISM) and external galaxies are believed to be frozen in the comets. The spectroscopic signatures of PAHs were investigated for a sample of comets using the Space Telescope Imaging Spectrograph (STIS) onboard Hubble Space Telescope (HST) and Infrared Spectrometer onboard Spitzer Space Telescope (SST) at UV and mid-infrared wavelengths respectively. The detection of PAHs and their implication on the link between the ISM and the origin of comets will be discussed.

Presentation Mode: Oral

Presenting Author: Arijit Roy

Registration id: NSSS-20220110034640

Amino acids in astrochemical impact induced shock conditions: Implications to the origins of life

Surendra V Singh[1], Haritha D[2], V Jayaram[3], J K Meka[1], T Vijay[2], S Vijayan[1], A Bhardwaj[1], N J Mason[4], B Sivaraman[1]

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Impacts are ubiquitous in the Solar System. Impact induced shock creates a high temperature and pressure which provides chemical pathways for large-scale molecular synthesis. With evidence of impact history over solar system bodies, the impact-induced shock could be a profound source for complex chemistry. Previous studies suggest that biomolecules such as amino acids and peptides can be synthesized by such a process. However, the fate of such biomolecules in such extreme environments largely remains unexplored. Here, we present experimental evidence of complex macroscale structure formation due to shock processing of amino acids, utilizing a 7-meter-long shock tube in the laboratory, which can provide a post-shock temperature range of 1500 to 8000 K. Microscopic observation of shock processed residue suggests that amino acids polymerized to form complex structures resembling twisted and folded threads, ribbons, and tubes, with complex textures and floral structures. The chemical analysis of these residues shows the formation of long polypeptide chains. The tendency of amino acids towards the formation of complex macroscale structures provides evidence for the evolution of the building blocks of life under impact shock conditions. These findings shed light on the importance of impact events in the origins of life.

Presentation Mode: Oral

Presenting Author: Surendra Vikram Singh

Registration id: NSSS-20220110020157

Neon in Terrestrial planets

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Noble gases are most important tracers of the history of planetary atmosphere as they can reveal the history of a planet. Terrestrial planetsare believed to have formed by the accretion of early solar system objects that are represented by primitive meteorites, chondrites.Eucrites, howardites and diogenites (HED) is a group of differentiated meteorites believed to be derived from asteroid Vesta. HED srepresent different parts of Vesta and hence we can learn the geology and the processes that occurred deep within and on the surface of this asteroid.Neon shows widely differing isotopic compositions in different reservoirs. In the present work we calculated neon trapped componentin eucrites and diogenites, and compare the data set with basaltic rocks of Earth and Mars. Neon gas abundances in bulk samples of Mid Ocean Ridge Basalt(MORB) and oceanic island basalts(OIB) (mantle of Earth)and Chassigny (mantle of Mars)are used to compared the trapped component in the terrestrial objects. The three-isotope plot of 20 Ne/ 22Ne vs. 21Ne/ 22Ne ratios of eucrites and diogenites indicates that all thesamples are lie in the spallation component line and there is no evidence of solar wind gases. We thancompare the concentrations of trapped noble gases of eucrites and diogenites with carbonaceous chondrites, the accreting material of the parent bodies, MORB, OIBand Chassigny.The concentrations of 20Ne in theeucrites, diogenites, MORB, OIB and Chassigny are differ to the primitive chondrites.The abundance of trapped noble gases in eucrites, diogenites, MORB, OIB and Chassigny are dissimilar to each other. There is variation in abundances of neon gas, which is imprint of the different geologicalevolution of objects.The distinct isotopic ratios of eucrites, diogenites,MORB, OIB and Chassigny that represent the interior of differentiated objects suggesting a different degassing history of the differentiated parent body.

Presentation Mode: Oral

Presenting Author: Satvika Jaiswal

Registration id: NSSS-20211210033243

Gas-phase Modeling of the Cometary Coma of the Interstellar Comet 2I/Borisov

Sana Ahmed[1], Kinsuk Acharyya[1]

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A fundamental question in astrochemistry is to gain an understanding of the chemical evolution of protoplanetary disks and the origin of the primordial compositions of planetary systems like ours. Comets are the least-altered objects surviving from the protoplanetary disk that formed the Solar System. Therefore they preserve the signature of the physical processes and the chemical stratification that prevailed due to the spatial and temporal variation of volatiles in the disk. The first interstellar comet observed in the Solar System is the comet 2I/Borisov, discovered on 30 August 2019. Observations of the comet show that the CO/H2O ratio is higher than what has been observed in Solar System comets at a heliocentric distance < 2.5 AU. We aim to study the gas-phase coma of comet 2I/Borisov and to see the effect of the high CO/H2O ratio on the coma chemistry. We use a multi-fluid chemical-hydrodynamical treatment, whereby the neutral species, ions and electrons in the coma are considered to flow as three separate fluids. The chemical network used contains more than 400 chemical species connected by about 4500 reactions. Energy exchange between the three fluids due to elastic and inelastic scattering, and radiative losses are considered. Our model output results show that the presence of a large amount of CO in the coma of comet 2I/Borisov results in high abundance of CO+ and HCO+ ions. These two ions affect the creation/destruction rates of other ions such as H2O+, H3O+, N-bearing ions and large organic ions. We also find that the presence of CO leads to a higher abundance of large organic ions and neutrals such as CH3OH2+, CH3OCH4+ and CH3OCH3, as compared to a typical H2O-rich Solar System comet.

Presentation Mode: Oral

Presenting Author: Sana Ahmed

Registration id: NSSS-20220110061153

On fragmentation of long lasting overdense meteor trail echoes detected with Gadanki MST radar

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In this work, we report on a new category of long lasting meteor trail echoes occasionally detected with the Gadanki (13.5◦N, 79.2◦E) MST radar. These echoes are peculiar in nature having specular reflection over several seconds of duration with overdense trail formation in one or two range-bins that show the evidence of fragmentation irregularities. Here, we present few light curve examples of such long lasting trail echoes recorded with the narrow beam Gadanki VHF radar and described their morphological characteristics. These examples are analysed and discussed on a case by case basis and it is reported that the evolution of these echoes can be explained by the processes of meteoroid fragmentation. Such overdense echoes provide valuable insight into the role of diffusion and plasma instabilities in the formation and evolution of meteor trail. From the observations, it has been noticed that the overdense trail formation is consistent irrespective of altitude. The obtained results allow us to conclude that the dynamics of a long lasting overdense trail are conditioned by the background winds and meteoroid fragmentation.

Presentation Mode: Oral

Presenting Author: Chenna Reddy, K

Registration id: NSSS-20220110043643

Diversity in Mineralogy of Mukundpura Meteorite

Dipak Kumar Panda[1], Anil D Shukla[1]

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Carbonaceous chondrites, the most primitive meteorite, allow an opportunity to explore the chemical and physical conditions in the early Solar System. CM type of meteorites are one of the most primitive meteorite groups and are fragments of primitive asteroids. The CM meteorites are undergone through aqueous alteration. Hence CM types are significant to understand extra-terrestrial water in the solar system. Mukndpura, classified as CM type, is a highly altered meteorite. The aqueous alteration alters the primary minerals to produce secondary minerals like phyllosilicates, carbonates, phosphates, etc.

The thick section has been prepared for mineralogical studies. High-resolution mosaic images of this section were prepared using Scanning Electron Microscope (SEM model JEOL IT300) coupled with Energy Dispersive System (OXFORD instruments) integrated. The BSE images were captured using an optimum operating condition of 15 keV 500 pA. The X-ray map for Si, Mg, Fe, Ca, Al. K, S, Ni, Cr, and P were obtained using EDS. The initial chemical composition was also obtained using EDs. The quantitative chemical composition was obtained using the Cameca SX-100 Electron Micro-Probe Analyzer operated at 15 KeV, 15 nA.

The petrological and chemical analysis shows that Mukundpura is a highly altered meteorite. More than 75% of the matrix has been dominated by phyllosilicates and POP (Poorly characterized phases). Both partially altered and completely altered chondrule are present in Mukundpura. The partially altered chondrule exiting in Mukundpura are Type IA, Type IIA, and bird olivine. The anhydrous silicate (olivine) is converted into phyllosilicates both in matrix and chondrule. The Mesostatic phases are altered to Mg-rich phyllosilicates. Other than this, secondary minerals mineral-like calcite, dolomite, magnetite are also present in Mukundpura meteorite. The metal inside the chondrule is altered to PCP, while the metal nodule within the forsterite is unlettered. In Mukundpura

Presentation Mode: Oral

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In-situ exploration of the lunar polar regions: A mission in study phase

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India's lunar exploration program began in 2008 with the Chandaryaan-1 mission. A major finding from Chandrayaan-1 was the discovery of widespread presence of surface water and evidence for sub-surface water in polar regions. The Chandrayaan-2 Orbiter, launched in 2019, carried multiple payloads that provides new observational capabilities to refine the presence and distribution of surface and sub-surface water for the whole Moon.

Looking beyond the current Chandrayaan-2 and Chandrayaan-3 missions, the scientific interest on Moon is heavily focused on quantifying the water resource in the polar region. Recently, the lunar polar regions attracted global interest due to (i) possibility of existence of water-ice ii) in-situ resource utilisation i.e propellant, drinkable water, breathable oxygen, lunar concrete etc. This will have major impact on future exploration scenarios and activities using the Moon.

ISRO and Japan Aerospace Exploration Agency (JAXA) are conducting a feasibility study for a joint lunar polar exploration mission (tentatively, LUPEX) to characterize the volatiles and its composition in the lunar polar region. To accomplish this, both ISRO and JAXA will have payloads on Rover to perform in-situ sample analysis.

The Rover is expected to explore both the sunlit and shadowed craters in the south polar region. Ground Penetrating Radar, Neutron Spectrometer and NIR Spectrometer will observe the presence of water on the surface and sub-surface. The crucial element in this mission is the drill which penetrates 1.5m depth and scoops samples which will then be analysed by in-situ payloads.

Mission concept, uniqueness, science payloads and objectives, status of the mission will be presented in this paper. With the global interest in Moon undergoing a resurgence, it is imperative that the Indian Lunar Science program is sustained with greater vigour and momentum. This mission presents such an opportunity to the lunar science community.

Presentation Mode: Oral

Presenting Author: Megala S

Registration id: NSSS-20211230103158

Evidence for fluvial activities in an impact crater in Ma'adim Vallis region of Mars

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Alluvial fans, a type of sedimentary deposit on Mars, provide evidence for the evolution and nature of fluvial activities on the planet. Alluvial fans are landforms formed by the deposition of sediments transported by flowing water and provide an understanding of surface water on Mars. The hydrological history can also be studied through preserved mineralogy of the region. In this context, we discuss the diverse geomorphology and mineralogy of an unnamed crater (diameter ~ 22km) impacted on the wall Ma'adim Vallis, Mars. Ma'adim Vallis is an irregular flat floor valley incised due to the outflow of water from the Eridiana basin region. We used Mars Reconnaissance Orbiter (MRO)-Context Camera (CTX) and High-Resolution Imaging Science Experiment (HiRISE) images for geomorphological mapping. MRO-Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) is used for mineralogical analysis and Mars Global Surveyor (MGS) - Mars Orbiter Laser Altimeter (MOLA) is used for topographical analysis. The rim of the unnamed crater is breached at multiple locations and it hosts an alluvial fan of area ~ 50 km2. The spectral signatures obtained from the rim and floor of the crater show absorptions pertaining to Mg-rich olivine, and the spectra obtained from fan deposits indicate the presence of Mg smectite. Mg smectite was plausibly transported through water or formed in-situ while the region was initially rich in Mg olivine. The Crater Size Frequency Distribution (CSFD) plot of the unnamed crater suggests an age of~3.7 Ga. This age represents the crater retention age of the crater and suggests that the crater was formed during Noachian /Hesperian period or earlier, probably witnessing the last stage of water activity in the Vallis. In conclusion, this study substantiates episodic water activity in Ma'adim Vallis which is a source for rim incision and fluvial deposits within the unnamed crater.

Presentation Mode: Poster (Flash)

Presenting Author: Tuhi Saumya

Registration id: NSSS-20211215071433

Observations of Summer Night-Time FAI Using University of Calcutta ST Radar

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A fully active VHF phased-array operated at 53 MHz is being established by University of Calcutta at Ionosphere Field Station (22.93°N, 88.50°E geographic; magnetic dip: 36.2°N), Haringhata situated near the northern crest of the equatorial ionization anomaly (EIA). This is a unique facility at this frequency in the eastern and north-eastern parts of India as well as in the south-east Asian longitude sector. Ionospheric E region irregularities are normally observed from Kolkata during summer daytime and winter night-time. Ionospheric backscatter signatures have been observed using the University of Calcutta Stratosphere Troposphere Radar (CU-STR) in the range of 110–145 km during early evening hours to midnight of the summer months of 2019 and 2020, which are quite prominent. The observed Doppler velocities were in the range of -90-120 m/sec with spectral width limited to 110 m/s. The observed E region Field Align Irregularities (FAI) signatures at Haringhata are very much similar to signatures observed generally at off-equatorial low and mid-latitudes. Most of the occurred signatures are descending and continuous in nature with patchiness. This paper presents, using the CU-STR, detailed statistics of occurrences of E-region FAIs during night-time of the summer months of low to moderate solar activity period of 2019 and 2020 from Haringhata.

Keywords: Doppler, SNR, Ionospheric backscatter, FAI

Presentation Mode: Poster (Flash)

Presenting Author: Tanmay Das

Registration id: NSSS-20211213072319

Studying the Properties of the Extra-solar Planet Atmospheres

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More than four thousand planets have been discovered orbiting other stars outside our solar system in the last two decades. Going beyond discovering more such planets, the recent focus of the astronomy community is to attempt to study the atmosphere of those exoplanets. In this project we have used a publicly available and computationally efficient software named PLanetary Atmospheric Transmission for Observer Noobs (PLATON), which calculates transmission spectra for exoplanets and extracts atmospheric characteristics based on their observed spectra. Using PLATON, we have studied the dependence of transmission spectra on atmospheric temperature. Then we have determined the absorption signature of various chemical species, such as, sodium, water, ammonia, methane, carbon dioxide, and several others by simulating transmission spectra using PLATON. We studied how the absorption signature of a given species changes due to a change of the abundance of that and other species as well as the atmospheric temperature. Finally, we have retrieved the planetary and atmospheric parameters of two exoplanets from published data and compared with results from the literature.

Presentation Mode: Poster (Flash)

Presenting Author: Mousam Maity

Registration id: NSSS-20211217041642

Study of periodicities of Sunspot Number and seasonal Kerala rainfall using Wavelet Analysis

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In this work, we employ Fourier and wavelet analysis on time series of rainfall over Kerala and sunspot number. We use 146 years data (1871-2016) for sunspot numbers from World Data Center SILSO, Royal Observatory of Belgium, Brussels and rainfall data for the state of Kerala (in mm) from Indian Institute of Tropical Meteorology, Pune, India . Both the data were considered on annual scale, and grouped into various seasonal months – winter, pre-monsoon, monsoon and post-monsoon. The periodicity of sunspot number and rainfall estimated by Fourier analysis is in agreement with wavelet analysis. FFT of sunspot number of all seasons gave similar significant period around 10.7 years and rainfall of all seasons shows significant periodicities around 2-6 years. Wavelet results give common powers with varying significance for winter and monsoon season around 2-3 years. Common features in the wavelet power of the two time series are clearly visible at 8-12 years with varying significance. We conclude the seasonal rainfall of Kerala and the sunspot activity shows common power at different periods, indicating a possible relationship between them.

Presentation Mode: Poster (Flash)

Presenting Author: Elizabeth Thomas

Registration id: NSSS-20211211064928

Morphology of Quietest and Most Disturbed days during 24 Solar Cycle

Chogyel Wangchuk[1], Babita Chandel[1]

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The relation amongst solar proton density, solar proton temperature, interplanetary magnetic field |B| (IMF) and disturbed storm time (Dst) were analyzed for both quietest and most disturbed days of the month between 2008 to 2018 of 24th solar cycle. The analysis highlights only those months in which the Dst index is <-100 nT for most disturbed days and the quietest days of same months having least Dst values. The event days were analyzed for 20 months from 2011 to 2018 since the earlier years had no Dst index <-100 nT. Each of these months selected were based on highest negative Dst index of that month. For the most disturbed days, the solar proton density reached its maximum value of 24.33 cm-3 at 19:00 UTC on 5th August, 2011. The solar proton temperature reached the maximum value of 4.37 x 1005 kelvin at 00:00 UTC on 6th August, 2011. The IMF and Dst values are 30.366 nT at 20:00 UTC and -115 nT respectively on 5th and 6th of August, 2011. But for quietest days, the solar proton density was 0.197 cm-3 at 9:00 UTC and the solar proton temperature is 1.81 x 1005 kelvin at 15:00 UTC on 22nd and 21st of August, 2011 respectively. The IMF and Dst values are 8.521 nT at 17:00 UTC and -4 nT respectively on 22nd and 21st of August, 2011. The overall analysis showed that the disturbance started a day before the event and then peaked on the day of the event. Then, the day after the occurrence of the event, the disturbances returned to its recovery phase. The solar proton density was followed by solar proton temperature with time lag and IMF was also followed by Dst index with time lag. During the most disturbed days in any month, the solar parameters were strictly followed. Unlike the pattern of occurrence observed for most disturbed days, the data from the quietest days showed that the solar parameters were not strictly followed. The analysis shows that the change in the solar parameters caused the most disturbed and quietest days of the month on the Earth.

Presentation Mode: Poster (Flash)

Presenting Author: Babita Chandel

Registration id: NSSS-20211220103042

Latitudinal and Seasonal Asymmetries of the Helium bulge in the Martian Upper Atmosphere

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‘Helium bulge’ in planetary upper atmospheres refers to the accumulation of helium on the nightside-polar regions. The upwelling of winds on the dayside and their downwelling on the nightside, combined with large-scale circulation, is the primary driver of the bulge formation. Here, we analyzed the helium densities measured in the Martian upper atmosphere by the Neutral Gas and Ion Mass Spectrometer (NGIMS) aboard MAVEN mission. The data used here spans from Feb 2015 to Jun 2020. Only those data obtained during nominal dust conditions are used. The results of the present study show that the nightside helium bulge is a persistent feature of the Martian upper atmosphere in all seasons. The helium densities inside the bulges are 1–2 orders of magnitude greater than those on the dayside. In solstices, the bulges are observed in the winter polar region, which is in accordance with the model predictions. In equinoxes, however, the bulges are observed to extend from mid-latitudes into the southern polar regions (>60°S), which is contrary to the model predictions at mid-latitudes. These anomalous bulges are predominantly observed in the northern spring equinox. A comparison with the helium densities predicted by the Mars Global Ionosphere Thermosphere Model (M-GITM) shows that the measured densities inside the anomalous bulges are 10 – 30 x greater than the modeled ones. We also used the horizontal winds measured by the NGIMS instrument. We found that at locations where anomalous bulges are observed in the autumnal equinox, the observed winds depart from the modeled winds. Furthermore, the observed winds point to the southern polar regions where the bulges are observed. Thus, the results of the study indicate that in equinoxes the regions of local vertical advection, that are responsible for the formation of the bulges, are displaced towards the southern polar regions. Thus it point to the need for a larger wind database in southern polar region, particularly, in equinoxes

Presentation Mode: Poster (Flash)

Presenting Author: Neha Gupta

Registration id: NSSS-20211203074746

SHARAD detection of extensive sedimentary deposition in unnamed crater near Mangala Fossa, Mars

Rajiv R. Bharti[1,4], Isaac B. Smith[2,3], S. K. Mishra[1], N. Srivastava[1,4], Shital H Shukla[4]

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Shallow Radar (SHARAD) observations of an unnamed crater near the Mangala Fossa region reveal a low dielectric subsurface material. The unnamed crater centered at 21.0° S, 150.6° W. Multiple subsurface reflections inside the crater indicate that crater infilling occurred in at least four successive events. Our analysis reveals that the first unit is a low loss tangent and low dielectric subsurface material. The derived loss tangent is in the range of 0.008-0.009. We conceptualize a three-layer model to calculate the dielectric constant of the subsurface material, and the average dielectric constant derived through our model is ~5.6. These values are much lower than the previous Tharsis region lava flow study. Lava flows dominate the surface and surrounding region, and SHARAD investigations of lava flows in the Tharsis region have detected higher values. Based on the surrounding geomorphology and observed geophysical evidence, we purpose that the subsurface unit in the crater is moderate density sedimentary material buried by a layer of lava. These results are significant because they add more context to this highly studied region and provide compelling evidence that water moved large volumes of sediment into this basin. The derived dielectric constant and observed time delay from the SHARAD radrgram, the thickness of the uppermost unit, is ~40m thick and fills ~150 km3 of the crater. Our study validates that a significant quantity of the sedimentary material is buried by lava units in the crater.

Reference: Icarus (https://doi.org/10.1016/j.icarus.2021.114713)

Presentation Mode: Poster (Flash)

Presenting Author: Rajiv R Bharti

Registration id: NSSS-20220107054438

Particle Bursts In Geotail Observed By CLASS On Chandrayaan-2

Kiran Sreekumar[1], S. Narendranath[2]

[1]Amrita University, [2]Indian Space Research Organisation

Earth is encased in a bullet shaped magnetic bubble formed by the interaction of solar wind with its magnetic field called the magnetosphere. The magnetosphere extends from about 60 000 km sun ward and trails out more than 300 000 km away from the Sun in the magneto tail. In this work, we explore the temporal variability in the distant magneto tail or geotail. Data collected from the Chandrayaan 2 Large Area Soft X-ray Spectrometer (CLASS) during geotail passages is used for this. CLASS data was downloaded from the PRADAN web portal as fits files comprising of 8 s exposure counts vs channel spectrum. The data is filtered by taking counts which are 3-sigma above the base level to identify geotail activity. Spectra of bursts and non-bursts were separated and compared. A hardness ratio is defined to look for spectral changes during the geotail bursts. We find that the hardness ratio changes significantly during a burst.

Presentation Mode: Poster (Flash)

Presenting Author: Kiran Sreekumar

Registration id: NSSS-20211218040236

Study of lunar crater floor deformation induced by the magma intrusion

P. Achintya[1],K.B. Kimi[2],Harish[3],S. Tuhi[4],V.J. Rajesh[5],S. Vijayan[6]

[1]IIST, [2]PRL, [3]PRL, [4]Anna University, [5]IIST, [6]PRL

Post-impact mechanisms on the moon lead to morphological and topographical modifications in pristine craters. These modifications may include crater floors exhibiting fracture patterns or upliftments centred in or around the central peak. Both of these deformations hint towards endogenic processes transpiring in the lunar interior. We test magma intrusion as a possible explication for such modifications in this work. A comprehensive study of crater floor upliftment by magma intrusion at depth below the crater was done by Michaut (2014). One marked aspect of this work was a criterion to delineate convex/flat crater floor profile which stated $4\Lambda \geq R$ as a necessary condition for a crater to have convex floor type of upliftment and $4\Lambda \ll R$ for plate or flat floor type of upliftment, where Λ is the flexural parameter and R is the crater diameter. Our work estimated this flexural parameter using the methodology as given in Michaut(2014) and Gilbert's model(Johnson and Pollard,1972) for a crater located near the south pole region to establish a relationship between flexural parameter and specific intrusional characteristics. The Lunar south pole is an exciting location because of the occurrence of water ice and volatiles in permanently shadowed regions(PSRs). One such crater considered for our study is the Amundsen crater which is explored for possible floor uplift with PSR. As an extension of our work, we adopt an integrated analysis of Michaut's criterion, the study of Amundsen crater topography and morphology to understand the source of this water ice and volatiles in the PSR region of this crater.

Presentation Mode: Poster (Flash)

Presenting Author: Achintya Paliwal

Registration id: NSSS-20220109041759

Moon Imaging using Advanced Indian MST Radar

Ashish[1], M. Durga Rao[1], P Kamaraj[1], G Janardana Reddy[1], A. K. Patra[1]

[1]National Atmospheric Research Laboratory, Gadanki

The imaging of the moon's surface has been successfully done at 50 MHz using the Jicamarca Radar Observatory. Considering the potential application of Advanced Indian MST Radar (AIR) in this field, it has been used to probe the moon's surface including imaging. In this paper, we describe the experiments conducted using the AIR and the analysis technique used for imaging the moon. The entire 32x32 array was used for transmission as well as reception of the signals. The received signals were found to be 25 dB above the noise level. These echoes were then used to study the angular power law of the moon. Further, the delay Doppler technique was employed on the received signals for imaging the moon. However, the North South Doppler ambiguity of the received signals needs to be resolved to generate the image. Towards this purpose, a 4x4 Yagi antenna array was constructed outside the campus along the North, providing a baseline long enough to carry out interferometric analysis of the moon echoes. Experiments were conducted successfully and the observations are promising. The initial results and future plan are presented and discussed.

Presentation Mode: Poster (Flash)

Presenting Author: Ashish

Registration id: NSSS-20220110041247

Chemistry of water, nitrogenated and deuterated ions and escape rate of H2O on Mars

Siddhi Shah[1], S. A. Haider[1]

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The Nadir and Occultation for Mars Discovery (NOMAD) onboard ExoMars Trace Gas Orbiter (TGO) have provided mixing ratios of H2O and HDO at Solar Zenith Angle (SZA) ~ 71o in the lower atmosphere of Mars. The H escape rates are measured in the exosphere by SupraThermal and Thermal Ion Composition (STATIC) onboard Mars Atmosphere and Volatile EvolutioN (MAVEN). These observations were made in absence and presence of Global Dust Storm (GDS) 2018. For the first time we have implicated these observations in the modelling of the lower ionosphere. The production/loss rates of H2O and the densities of water, nitrogenated and deuterated cluster ions are estimated between 0 km and 70 km. In presence of dust storm, the ion densities and escape rates were increased by a factor of 5-10 than that produced before or after the dust storm. We have estimated total escape rate of H2O ~ 5 x 1025 s-1 and 6 x 1026 s-1 before and during the dust storm.

Presentation Mode: Poster (Flash)

Presenting Author: Siddhi Shah

Registration id: NSSS-20220110050922

Mg-Spinel exposures in the South-Pole Aitken (SPA) basin region on the Moon

Garima Sodha[1], Deepak Dhingra[1]

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Mg-Spinel is considered as an ancient lithology on the lunar geological timescale. More than half of the known Mg-Spinel deposits on the Moon are associated with the impact basins. The basin ring association of these deposits has been used by earlier workers to propose that this lithology existed before the basin formation era and was exposed by later impact events [1]. South-Pole Aitken (SPA) is the largest and one of the oldest lunar basins on the Moon. Due to its enormous size, excavation depth, and geologic age, SPA is a potential candidate for exposing any pre-existing (ancient) Mg-spinel lithology on the surface. In this work, we have searched for the exposures of Mg-spinel lithology in the SPA basin region to explore any systematic relationships. At present, Mg-Spinel deposits have been identified by the various workers at three craters: Thomson (117 km), McKellar (50 km), and Hausen (163 km) within the SPA basin [2]. Although the exposures are linked to the individual crater forming events rather than the SPA basin impact but on the regional scale, all these deposits are associated with the SPA basin rings, suggesting a potential association with the SPA impact event and formation of Mg-Spinel lithology before SPA formation. This work has direct implications for providing better constraints related to the age and origin of the Mg-Spinel lithology on the Moon. References: [1] Pieters C.M. et al. (2014) American Mineralogist, 99, 1893-1910. [2] Sun Y. et al. (2017), Earth and Planetary Science Letters, 465, 48–58.

Presentation Mode: Poster (Flash)

Presenting Author: Garima Sodha

Registration id: NSSS-20211201092000

A Comprehensive Study on the Impact of Solar Flare X-ray Flux on Geomagnetic Field Disturbance

Gopika S Vijayan[1],Abraham A[1],Tiju Joseph Mathew[1],Asha Anie Varghese[1]

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This work examines the correlation between solar flare X- ray flux and the impact of these solar flares on the geomagnetic field using the daily Vertical Variance (VV). The VV is a modified form of the VV index which is a time-dependent function varying within specified temporal end points. It is a numerical method that expresses the amount of fluctuations in the data. The impact of 40 solar flares that occurred in the year 2012, a year of high solar activity during the solar cycle 24 is examined. The VV - solar flare flux diagram identifies three categories of flares; flares with minor, moderate and high impact on geomagnetic field. Further analysis of these flares was done using examination of space weather and geomagnetic conditions. The geomagnetic indices: Auroral Electrojet (AE), Disturbance Storm Time (Dst), Solar wind velocity components (Vx, Vy and Vz) and Interplanetary Magnetic Field (IMF) data were used to study the dynamics corresponding to the geomagnetic variations caused by these solar flare events. It is found that enhancement of geomagnetic field at the time of flares depends mostly on solar wind velocity rather than on the solar flare X- ray flux.

Presentation Mode: Poster (Flash)

Presenting Author: Gopika S Vijayan

Registration id: NSSS-20211217061747

Petrogenesis of non-KREEP lunar basalts: an unidentified Fe-rich mantle source

Yash Srivastava[1,2] and Amit Basu Sarbadhikari[1]

[1]PRL, [2]IIT-Gandhinagar

Non-KREEP lunar meteorite basalts span over wider lunar volcanic history with the oldest age of ~ 4.35 Ga (Kalahari 009) to ~2.9 Ga (NWA 032) than the typical mare basalts from Procellarum KREEP Terrain (PKT; 3.8-3.2 Ga). The non-KREEP lunar basalts are typically low-Ti (0.45 – 2.05) and Fe-rich (Mg# 33-49) variety. In addition, the low initial 87Sr/86Sr (0.699-0.700) and high positive εNd (+0.8 - +7) further envisages the absence of KREEP component having high 87Sr/86Sr (~0.703) and low negative εNd (-2 to -4) at their mantle source. These high Fe-rich mare basalts are suggested to be the result of extensive fractional crystallization, and this is currently the prevailing model for many such Fe-rich mare basalts. However, the range of compositions observed in mare basalts and volcanic glasses, and modeling and experimental simulations of LMO crystallization all show signs of highly heterogeneous lunar mantle that was most likely not thoroughly homogenized by mantle convection. Therefore, there is no reason to conclude a priori that the fractionation event that resulted in the low-Mg#. The origin of these mare basalts thus becomes important not only to understand the compositions of their source regions that were melted to form these lithologies but also to understand the evolution of thermal state of the Moon. In this study, we carried out petrology of YAMM (Y-793169, A-881757, MIL 05035 and MET 01210) group of lunar meteorites and our results demonstrate that these high Fe, non KREEP related rocks are in all likelihood were formed by low degree partial melt of a more primitive source.

Presentation Mode: Poster (Flash)

Presenting Author: Yash Srivastava

Registration id: NSSS-20220110064736

Impact-induced deformation features from the target rocks of Ramgarh Crater, Rajasthan, India

Aneesh Kumar V[1], Dr. Sajin Kumar K S[1]

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Terrestrial impact craters owe its importance because of the capability to decipher the planetary surface processes. With the scanty number of impact craters on the Earth, scientists were able to construe several geological processes and hence, any new discovery of impact craters will reveal a plethora of information on paleo-planetary processes. Ramgarh crater in Eastern Rajasthan, India, is such a new crater, where information are being explored. In the present study, we have probed for petrographic and geochemical evidences from the target rocks of Ramgarh crater. Petrographic study unveils the presence of shock fabrics such as Planar Fractures, decorated Planar Deformation Features, brecciation, melted grain boundaries, diaplectic glass, and vitrified matrix. The presence of multiple sets of decorated PDF with fluid inclusions are developed in a water bearing target, an environment supported by Kenkmann et al. (2020). The target sandstones show high Chemical Index of Alteration(CIA) values, implies that the sandstones underwent intense chemical changes, which might have annihilated shock features. However, the whole rock geochemistry of sandstones and quartzite are comparable with that of some craters such as Gardnosand Barringer. Relative abundance of Cr, Ni, Cu and with respect to chondrite normalized value shows comparatively elevated levels. The elevated level of Cr, Ni and Cu in the target rocks indicates interaction with an extra-terrestrial object. The average Rb to Sr ratios of sandstone and quartzite are similar to silica-rich zhamanshinite of Zhamanshin impact crater, Kazakhstan. Similarly, the average La/Sm ratios and negative Eu anomaly of sandstones in the study area are similar to that of arenite target rock in Sudbury Crater, Canada, indicates highly fractionated chondrite normalized REE pattern with enrichment of LREEs. The identical fractionation trends in similar target lithologies indicate impact induced geochemical signatures for target rock

Presentation Mode: Poster (Flash)

Presenting Author: Aneesh Kumar V

Registration id: NSSS-20220110121939

Simulation of solar coronal mass ejections due to twisted flux rope emergence

Samriddhi Sankar Maity[1,2], Piyali Chatterjee[1]

[1]IIA, [2] IISc

Coronal Mass Ejections (CMEs) can drive interplanetary shocks that energise solar particles and are responsible for the significant space weather effects on Earth. We present a model for the generation and evolution of the coronal mass ejection with a realistic three dimensional magneto-hydrodynamic simulation using the Pencil Code. We have assumed a high-temperature coronal plasma as an ideal gas where magnetic flux rope (MFR) emerging at the lower boundary and pushing a pre-existing coronal potential arcade field. We have found that with the rising of the MFR, its overlying field is strongly stretched and squeezed below the MFR. When the imposed flux emergence at the lower emergence stopped the flux rope settles into a quasi-static rise phase and then begins to accelerate and erupts. We find sudden decrease in free magnetic energy as well as increase in the kinetic energy when the eruption happens. At the onset of eruption the centre of the flux rope reaches a height at which the corresponding overlying field declines at a steep rate, consistent with the torus instability of the flux rope. We also observed writhing motion of the MFR so the helical instability is expected to develop in our case. The result imply that, in addition to the torus instability, the writhing motion during the eruption may also play a significant role in our solar eruption simulation.

Presentation Mode: Poster (Flash)

Presenting Author: Samriddhi Sankar Maity

Registration id: NSSS-20220109021606

Morphometric characterization of aeolian dominated landscape proximal to the landing site of Mars 2020 Perseverance rover in Jezero Crater, Mars.

Nitika Sachdeva[1], Rishitosh K Sinha[1]

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Perseverance rover touched down inside the Jezero crater (~45 km diameter; 18.4°N, 77.7°E) on 18 February 2021. The landing site is found to contain yardangs that extend several hundred meters in length. Numerous TARs (Transverse Aeolian Ridges) of varying geometry and with active surfaces are evident in the spacing between the yardangs. The rover is on its way to one of the primary science investigation sites; however, before that, the rover is very likely to encounter the aeolian landforms, in particular the TARs. Therefore, it is imperative to determine the morphometric characteristics of the TARs, which is to get a pre-traverse idea of the length, width, height, and slope of the TARs for reducing any chance of traversability risk to the rover. Our study is focused on determining the morphometric details of the TARs in this unit. We have used High-Resolution Imaging Science Experiment (HiRISE) images and digital elevation models (DEMs) for analyzing the distribution, morphology, and morphometry of TARs. Our preliminary investigation has revealed that: (1) TARs are feathered type – an intermediate type between simple and networked TARs, (2) crest-ridge width (W) of TARs commonly vary from ~25-75 m, (3) the down-wind TAR length (L) range between 3-10 m, and (4) the ridge-to-ridge spacing (λ) between TARs is within 10-20 m. We found that the height of most of the TARs ranges from 0.5 to 1 meter, and the slopes of the windward-leeward side of TARs are generally less than 15°. However, we have found some of the TARs that have steep slopes in the range of >20°, which we mark as potentially hazardous TARs. Together, our study provides new insights into the meter-scale morphometric characteristic of the dusty unit and gives the mission team a safe traverse path and some idea of the terrain complexities that the rover is expected to encounter on its way to the main science targets for detailed in-situ investigation.

Presentation Mode: Poster (Flash)

Presenting Author: Nitika Sachdeva

Registration id: NSSS-20220110013637

Chemical weathering and laterization of Sivagangai formation, India A potential Mars analogue

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Cellular slag-like Laterite is a scoriaceous mass. The many empty cavities are separated by ferruginous material similar in appearance to that which separates the earthy substance like clay material in vesicular Laterite.[Laterite is the residual and in situ rock that was formed under wet and semi-arid conditions under chemical weathering. It exhibits episodic water flow and has dry seasons. The laterite is formed from various kinds of parent rocks rich in iron oxides and alumina. For example, In Sivagangai, The Gondwana clay and cretaceous sediments are overlain by the Laterite formation, Deccan basalt and charnockite are the parent rocks for western ghats Laterite and in Usgaon, Goa parent rock is a meta basalt . In this work, we study and compare the weathering process and consequent products that were formed at the Earth's surface to analogue Mars. After the laterite formation, it weathered to form clayish lateritic soil and spherules as well. The humidity and wind activity form a thin Mn-rich layer to form crust on the rocks surface . The process was similar to the desert varnish. The Laterite contains Fe ,Al ,Mn and Ti , clay minerals, carbonates . Nickel and chromium and other REE associated based on the parent rock . We observed the Laterite process and spherules from the perseverance rover images and curiosity rover images. From the images we interpret the process of Laterite spherules separation from the rock. The presence of such high Mn concentrations in rocks at Gale crater indicates the precipitation of Mn mineral phases, which is only possible in a highly oxidizing, aqueous environment . The laterization helps to understand the Martian surface and these analogue studies can expose the Martian past history and future exploration. It will assist to study about the possibility of future habitability on mars.

Presentation Mode: Poster (Flash)

Presenting Author: Vigneshwaran K

Registration id: NSSS-20220110021110

Early thermal evolution of Earth's embryos due to 26Al and impact-generated steam atmosphere

Gurpreet Kaur Bhatia[1]

[1]Maharishi Markandeshwar (Deemed to be University)

Recent planet formation theories and isotopic studies have suggested that the embryos of Earth (building blocks) accreted very early within the initial 2 Ma of the formation of solar system [1-2]. The early accretion implies the role played by the short-lived radionuclide (SLR) 26Al in the large-scale heating of embryo's interiors [3-4]. Further, the new isotopic measurements have recommended that the Enstatite chondrites contain enough hydrogen to deliver sufficient water to Earth [5]. It implies the formation of an impact-induced steam atmosphere on the surface of embryos during accretion [6]. Based on these new findings, we performed numerical simulations to study the early thermal evolution and core-mantle segregation of Earth's embryos (0.2ME-0.6ME) by considering heat of SLR 26Al and blanketing effect of the impact-generated steam atmosphere during accretion [7]. The results of this study show the formation of the magma ocean of several depths at surface of growing embryos because of significant blanketing by the impact-generated steam atmosphere. Further, the core-mantle segregation in the interior was complete within the initial ~5 Ma of the formation of the solar system if the embryos accreted in the initial ~1.3-1.5 Ma after the formation of CAIs. These results seem to be consistent with the results of new findings on rapid differentiation of Earth's main accretion phase within the initial ~5 Ma of the solar system [8].

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Presentation Mode: Poster (Flash)

Presenting Author: Dr. Gurpreet Kaur

Registration id: NSSS-20220109011516

Seasonal variation in the composition of Martian upper atmosphere

Koyena Das[1], Sonal Kumar Jain[2], Abhirup Datta[3]

[1]LATMOS, France, [2]LASP, USA, [3]IIT Indore, India

The distribution of CO2 density over the entire planet has been plotted for all seasons, using data taken from the MAVEN-NGIMS from Martian year 33 to 35. CO2 density fluctuates throughout the year as the gas freezes out from the atmosphere at very low temperatures (when temperatures become less than the frost point of this gas). Studying the variation of CO2 gas in all seasons helped us understand the different physical processes affecting the upper atmosphere. In this work, the ffect of seasonal processes like changes in solar insolation, dust storms, and atmospheric circulation were observed only. Also, unexpected warming was observed in the southern polar region during summer and the northern polar region during winter. This polar warming was understood in detail and compared between the two seasons.

Presentation Mode: Poster (Flash)

Presenting Author: Koyena Das

Registration id: NSSS-20220112071302

Theory of Solar Coronal Heating

Antony Soosaleon[1]

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Solar Coronal Heating Problem has been analysed using magnetohydrodynamical equations, for which a general dispersion (DP) relation has been derived for gravitational plasma in the lower hybrid (LH) frequency range. The analysis of DP reveals that the electrons and ions undergo LH oscillation induced by gravity, which results in multiple ionisation ions. The LH oscillation is a coupled oscillation between ions and electrons under cyclotron motion with Coulomb force. During this oscillation, both the electrons and ions undergoing cyclotron resonance and absorb photons. The electron cyclotron resonance (ECR) in LH oscillation is a pre-phase damping which strengthen the LH coupling. During ECR, the kinetic energy of electron increases and hence the cyclotron radius and the resonance wavelength which is a multi-wavelength absorption. The ion cyclotron resonance (ICR) in LH oscillation is a close field interaction happens when the cyclotron radii of electrons and ions are same. During this process, several electrons are scattered out, which results in the deficit of field energy and this deficit is compensated by the absorption of several photons causing multiple ionisation. During ICR, the orbital radius does not change and hence all the absorbed photons are same energy, which is a multi-photon absorption. The lost out electrons are compensated by the ionised electrons and which are coupled back in the LH oscillations. The ionised state is highly unstable for which the ions immediately under de-ionisation by emitting all the absorbed photons as a single radiation of high energy photon. A general formula for the ion cyclotron resonant emission frequency has been deduced from the DP, which is a convergent of fundamental coronal variables. The complete EUV solar spectrum has been generated using the formula and the prominent questions over coronal abundance such as FIP, Q/M effect and Fe abundance and why Zn is the highest observed elements are answered.

Presentation Mode: Poster

Presenting Author: Antony Soosaleon

Registration id: NSSS-20211126060540

Development of NIRUPAMA model: A case study of Venus and Mars

Masoom Jethwa[1]

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The ablation of cosmic dust injects various metallic ions and neutrals into planetary upper atmospheres. In this study, the contribution of metals from three cosmic dust sources (JFCs, AST & HTCs) in the atmospheres of Venus and Mars is estimated by 1-D Neutral & Ion Reactivities UPon Atmospheric Meteoroid Ablation (NIRUPAMA) model. The predicted flux of cosmic dust particles at Venus and Mars are ~ 31 ± 18 and 2 ± 1 tonne/day. A novel ion-neutral NIRUPAMA model is developed and implemented to quantify atmospheric ablation in Venus and Mars. The model incorporates more than 30 ion-neutral chemical reactions coupled with metallic ions in the planetary atmosphere. The continuity equation for various metallic ions is simultaneously solved, assuming steady-state photo-chemical conditions to determine different metallic ion densities. The production rates and ion densities of Mg^+, Fe^+, Si^+ are estimated for Venus and Mars. The detailed analysis of this work will be discussed during presentation.

Presentation Mode: Poster

Presenting Author: Masoom Jethwa

Registration id: NSSS-20211201093742

Nitrogen isotopes in CV3 chondrites

Ramakant R. Mahajan[1]

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Carbonaceous chondrites are primitive materials formed in the early stage of solar system. Chondrites have preserved relics of these processes which otherwise have been destroyed by heating, melting and differentiation of the rocky bodies in solar system. Their study provides us the understanding of physicochemical processes in early solar system. Carbonaceous chondrites contain various "anomalous" isotopic abundance patterns of many elements indicating the distribution of these elements very heterogeneously within each meteorite. Nitrogen has two stable isotopes with masses of 14 and 15. Nitrogen isotopic composition in extra-terrestrial materials have become an important aspect of research on the origin and early evolution of the solar system as large variation of 15N/14N ratio observed in various reservoirs of the solar system. If we assume that nebular gas composition as same as that of solar wind and carbonaceous chondrites have trapped nitrogen gas from this, the trapped N isotopic signature should reflect the solar wind nitrogen. On the other hand, assuming Q-gas as the nebular gas, the trapped N isotopic signature in carbonaceous chondrite should reflect the Q-nitrogen signature. Trapped nitrogen 15N can also be used as a powerful indicator to trace volatile inventory of the parent bodies, chemical processes involving enrichment of 15N, aqueous alteration and loss of volatiles by the thermal metamorphism. Nitrogen is involved in both the cases, formation mechanism of the meteoritic materials in the solar nebula and alteration processes occurred during their stay on the parent body. It is anticipated that a study of this element in the carbonaceous chondrites may help to constrain their formation conditions and evolution of their parent bodies. Nitrogen isotopic systematics in CV3 chondrites will be discussed.

Presentation Mode: Poster

Presenting Author: Ramakant R. Mahajan

Registration id: NSSS-20211126085817

Constraint to Formation History and Regolith Evolution in Ordinary Chondrites

Avadh Kumar[1], R. R. Mahajan[1]

PRL

Meteorites are the space messenger rocks that came from the outer space due to collisions and continuum impacts on its parent asteroid body. The ordinary chondrites are the largest class of meteorites in our collection; it had almost 87% of existing, The group of H chondrites (high iron content, approx. 28%), L chondrites (~22%) and LL chondrites (very low iron) are together known as Ordinary Chondrites. This Study had Neon noble gas compilation of around 300 L chondrites from published literature.

The process of interaction of Galactic Cosmic Rays (GCR, energy in GeV range) with the meteoritic body, resulting in the production of cosmogenic nuclides. The Cosmic Ray Exposure (CRE) age of the meteorite is defined as how much time it spends after ejection from parent body. We calculated 21Ne cosmic ray exposure ages of these meteorites. The histogram distributions of cosmic ray exposure ages of L chondrites enable information about meteorite transport from the parent asteroid body to Earth and it also constraint the ejection event from parent body, Number of peaks constraint the number of parent bodies.

As meteoritic bodies are in continuum exposed to the Solar Wind(SW), Solar cosmic rays (SCR) and Galactic cosmic rays(GCR). So in this study, we have plotted three neon isotopic plot of these L chondrites. Few L chondrites shows the Solar wind signature while most of chondrites fall near the Galactic cosmic radiation (GCR) region due its high penetration depth (1-2-meter range). We have also calculated the concentration of trapped 20Ne in these L chondrites. The average value of the concentration of trapped 20Ne of L type of chondrite is 6.78 x 10-8 cm3 STP/g with the range of trapped 20Ne as (0.054 to 248.90) x 10-8 cm3 STP/g. The average value of trapped 20Ne concentration Carbonaceous chondrites is higher than L chondrites.

Presentation Mode: Poster

Presenting Author: Avadh Kumar

Registration id: NSSS-20211213041928

Effect of charge fluctuation on dust levitation over Moon

Trinesh Sana[1], Sanjay K. Mishra[1]

[1]Physical Research Laboratory

A notion of the dusty plasma environment over the Moon comes from the images of lunar horizon glow captured by Surveyors 6 & 7 and the observations by Apollo 17 astronauts where the glow appears due to sunlight scattering by the charged dust particles floating near the lunar surface.

Under the exposure of dominant solar radiation along with solar wind plasma, the sunlit lunar surface (and floating dust) generally acquires a positive charge and generates photoelectrons. The photoelectrons and floating charged dust form a dusty photoelectron sheath in the vicinity of the lunar surface. The dust particles floating within the sheath maintain dynamic equilibrium and acquire charge through the charging currents on its surface due to photoemission, solar wind, and ambient plasma collection.

These charging currents, however, undergo natural random fluctuations. Due to the natural randomization of the dust charging currents, the charge on the floating dust particles is found to be distributed over a wide range (∼100 e). An altitudinal variability (approximately 10%) in the mean location within the sheath, caused by a change in the static equilibrium of the floating dust particles due to charge fluctuation, is observed. At higher latitudes (around the terminator zone) and greater lunar altitudes, the effect of dust charge and consequent altitudinal oscillations has been observed to be strong. The hypothesis and results suggest that the natural fluctuation of the dust charge may be one of the reasons why strict dust levitation under static force equilibrium is less likely to occur over sunlit lunar surfaces. Predictions based on natural dust charge variations could be useful in planning test trials for future lunar exploration missions.

Presentation Mode: Poster

Presenting Author: Trinesh Sana

Registration id: NSSS-20211201062248

On the variation of Helium abundance over solar cycles and ICMEs

Yogesh[1], D. Chakrabarty[1], N. Srivastava[1]

[1]PRL

The abundance of Helium with respect to hydrogen, generally expressed as AHe =(nH/nHe*100) % in general, varies significantly in different layers of the Sun. The changes in its behavior in the last four solar cycles are not comprehensively known. We show that AHe variations are distinctively different in solar cycle 24 compared to the previous three cycles. The inter-calibrated AHe data obtained from the first Lagrangian point of the Sun-Earth system are used for this work. We have shown that the frequency of AHe = 2 – 3% events is significantly higher in slow/intermediate solar winds in solar cycle 24 as opposed to the dominance of the typical AHe = 4 – 5% events in the previous three cycles. Further, a significant reduction in the occurrence of AHe > 10% events is observed in cycle 24. Not only that, the changes in the delay between AHe and sunspot numbers variation are less sensitive to changes in solar wind velocity in cycle 24. The investigation suggests that the coronal large-scale magnetic field configuration started undergoing systematic changes from cycle 23. This affected the way Helium got processed and depleted in the solar atmosphere.

Not only AHe varies in the timescale of the solar cycle but it also varies significantly in ICMEs. Interestingly, AHe enhancements are observed in some ICMEs and not observed in some others ICMEs. In order to investigate this aspect, measurements by the ACE satellite along with the OMNI database are used. Systematic comparisons between AHe and different charged states, charge state ratios, and first ionization potential (FIP) proxies are used to address the possible causes of AHe enhancement. These comparisons suggest that coronal temperature and the FIP effects are not the only factors that control the AHe enhancement in ICMEs. We explore the possible roles of the other important processes like chromospheric evaporation and gravitational settling in determining the AHe enhancements in ICMEs.

Presentation Mode: Poster

Presenting Author: Yogesh

Registration id: NSSS-20211201123338

The response of Venusian plasma environment to the June 2012 Space Weather Event

Smitha V. Thampi[1], Diptiranjan Rout[2], Anil Bhardwaj[3]

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The interaction between Sun and plasma environments of planets depends on the solar wind conditions, presence or absence of intrinsic planetary magnetic field and the properties of the planetary thermosphere, ionosphere and magnetosphere. Venus is a perfect candidate for studying the impact of space weather events to an un-magnetized planet with a significant atmosphere. Due to the lack of an intrinsic magnetic field, the ionosphere of Venus directly interacts with the incoming solar wind. During 13-16 June 2012, two interacting Coronal Mass Ejections and flux ropes were observed near Venus and Earth. During this period, these two vantage points were separated by about 0.28 au in radial distance and only 6 degree in heliographic longitude. We analyzed the data from Sun-Earth L1 point as well as from the Venusian orbit to understand the characteristics of the ICME. It is found that at Venusian orbit, these CMEs had distinct signatures, whereas they merged and reached Earth ∼15 hours after it was observed near Venus. Venus Express observed the terminator regions and plasma sheet region in the wake side of Venus. The region within the inbound bow shock and the IMB showed enhanced electron fluxes during the event, and there was enhancement in energized H+ ions within the IMB region, as well as in the wake region. The elevated heavy ion flux in the wake region suggests the occurrence of increased plasma outflow during the passage of ICME. The study shows the importance of having multiple vantage points to understand the propagation of space weather events.

Presentation Mode: Poster

Presenting Author: Smitha V Thampi

Registration id: NSSS-20211218060415

Physics-based Algorithm for Solar Wind using Adaptive Numerical Framework

Prateek Mayank[1], Bhargav Vaidya[1], Dibyendu Chakrabarty[2]

[1]IIT Indore, [2]PRL

Solar Wind streams, acting as a background, govern the propagation of coronal mass ejections in the heliosphere and drive geomagnetic storm activities. Therefore, predictions of the solar wind parameters are the core of space weather forecasts. Typically, line-of-sight observations of a magnetogram are used to derive the global coronal magnetic field structure and then a solar wind model is used for forecasting solar wind plasma parameters. Here, we present an indigenous 3D Solar Wind model aiming to compliment the in-situ measurements of Aditya-L1, in particular, we will discuss our recent results of data-driven solar wind prediction at L1. This numerical framework for forecasting the ambient solar wind is based on a well-established scheme that uses a semi-empirical coronal model and a physics-based inner heliospheric model. We will demonstrate a more generalized version of WSA relation which provides speed profile as an input to the MHD domain. We will also confer how final results are affected based on the choice of input magnetograms. Conclusively, we are going to validate our results by comparing essential solar wind magnetic and plasma properties at L1 for multiple Carrington rotations and also review the directional dependent characteristic features of stream interaction regions (SIRs) which will be observed by ASPEX (Aditya-L1). Additionally, we will present our magnetic field outputs that will complement the in-situ measurements of MAG (Aditya-L1).

Presentation Mode: Poster

Presenting Author: Prateek Mayank

Registration id: NSSS-20211126110520

Infilled craters, Moon: window to understand post crater modification

KB Kimi[1], Harish[1], S Vijayan[1]

[1]PRL

The floor of impact craters provides a window to decipher the post crater modification processes. Several crater floors are modified by lava infilling known as infilled craters; such craters are globally spread over the Moon. Infilled craters have anomalous shallow crater floors and generally appears flat in the visible imagery. Some of these craters have domed, fractured, and subsided floors, and some have central peaks. This study provides a detailed understanding of the extent of lava infilling varying in the infilled craters. Datasets from Lunar Reconnaissance Orbiter (LRO)-Narrow-Angle Camera (NAC), Wide Angle Camera (WAC), Chandrayaan(CH2)-Terrain Mapping Camera(TMC2), and Lunar Orbiter Laser Altimeter(LOLA), merged LOLA and Selenological and Engineering Explorer (SELENE)-Terrain Camera (TC) digital elevation model(DEM) are combined for identifying and characterising of infilled craters on the lunar surface. We have identified 329 infilled craters with enclosed rims, extending from ~4 km up to ~270 km crater diameter, and based on the characteristic, infilled craters are categorised into five classes. Overall our study demonstrates variation in infilled crater morphology due to variation in the extent of lava infilling/magmatism. Our study suggests that impact craters have played a significant role in infilling the crater's floor.

Presentation Mode: Poster

Presenting Author: Kimi Khungree Basumatary

Registration id: NSSS-20211218062834

Study on the significance of X-ray diffractometry in planetary in-situ measurements

Nalin Gupta[1], Shyama Narendranath[2]

[1]Physics Department, University of York, [2]UR Rao Satellite Centre, ISRO

X-ray diffractometry is an essential tool to determine the presence of phases and the molecular structure of said phases in a sample. It is a widely used technique in laboratories for the accurate identification and quantification of mineral phases. Such methods as in-situ experiments in planetary missions are essential for significant enhancement in scientific output as well as to serve as pre-selection experiments in sample return missions. In this work, Bragg-Brentano (reflexion) powder diffractometry is examined as a possible method of in-situ measurement of planetary soil samples. Anorthositic samples of varying grain sizes (LSS ISAC-1) were subject to XRD measurements at IISc and Christ University. Further, full-pattern (Rietveld) refinements were performed to study the effects of grain size on X-ray diffraction (XRD) data. It was noted that with increasing grain size, the number of phases detected using X-ray diffraction was reduced. At a range of 600-1000 µm, the peaks corresponding to the most abundant phase were lost. Also, at larger grain sizes, the crystallinity of the soil samples was increased, evidenced by the reduced width of the strongest peaks. We will present the mineral phases identified in LSS ISAC- 1 and the effect of grain size on retrieval. XRD is presented as a promising technique for future planetary missions with in-situ exploration.

Presentation Mode: Poster

Presenting Author: Nalin Gupta

Registration id: NSSS-20211220063647

Unique regolith characteristics of the Reiner Gamma swirl

M. Bhatt[1], C. Wöhler[2], K. Aravind[1], J. Rogall[2], S. Ganesh[1], A. Bhardwaj[1]

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Lunar swirls are bright irregular markings generally associated with localized magnetic anomaly regions but not associated with distinct topography. The swirls are extensively studied using spacecraft multispectral and hyperspectral imagers in order to understand their spectral properties. However, very limited polarimetric information is available which is essential for revealing physical properties, i.e., grain size and roughness distributions, for understanding possible regolith alteration processes. We present results obtained from imaging polarimetric observations of the Reiner Gamma swirl. The observations were obtained at multiple phase angles from the Mount Abu IR Observatory between January and March, 2021. We derived the total intensity, amplitude, linear polarization fraction, and orientation angle as a first step. We geo-registered the telescopic images and derived the surface roughness and amplitude of the opposition effect by applying the Hapke model. By using polarimetric data, we computed the median grain size by applying the technique of Dollfus et al. (1998). Our results suggest variations in the micro-structure of the regolith of Reiner Gamma compared to its surroundings and confirm the occurrence of surface alteration processes that might have disrupted the regolith microstructure on the Reiner Gamma swirl. We found that the regolith properties of Reiner Gamma cannot be explained by a reduced solar wind flux due to magnetic shielding alone, but an external mechanism, such as interaction between the regolith and the gaseous hull of a passing comet, is likely to have occurred.

Presentation Mode: Poster

Presenting Author: Megha Bhatt

Registration id: NSSS-20211222082834

New science from recent lunar missions

Debabrata Banerjee[1]

[1]PRL Ahmedabad

As a series of landers, rovers and orbiters arrive on the Moon or are under planning by various international space agencies, this presentation will outline new perspectives of lunar exploration. Radioisotope dating of basaltic samples returned by Apollo and Luna missions have revealed that basaltic magmatism occurred on the Moon between ~4.4 Ga and ~2.9 Ga. However relative ages estimated using crater-counting chronology suggests that volcanism may have continued till 1.2 Ga. Recently, Pb-Pb ages of ~2 Ga have been reported for basalt fragments returned by the Change-5 mission providing confirmation for the first time that lunar volcanism continued at least until 2 Ga. This ~2 billion-year age reported for lunar basalts returned by Change-5 implies that the impact flux rate may have been lower than previous estimates based on youngest Apollo and Luna basalts, but requires confirmation from additional studies. Additional radiometric ages are necessary from future missions to confirm this finding and to provide calibration points for ages determined using crater counting. Further, the μ value (238U/204Pb) of the source of the melt which formed the basalt was observed to be ~ 670-680 and is indicative of a KREEP-poor source. This suggests that the idea of KREEP-induced heating for producing young lunar magmas requires investigation or other novel mechanisms require to be proposed. Water abundances measured in returned samples suggest a range between 0.3–200 μg g-1 for the mantle source region. However, a maximum mantle water abundance of 1-5 μg g-1 has been derived from measurements of water abundances of apatite and ilmenite inclusions from Change-5 basalts, implying that the mantle source of these basalts had become dehydrated around 2 billion years ago. It remains unclear whether the derived water abundances of mantle sources of lunar basalts imply a heterogeneous distribution of water in moon's interior.

Presentation Mode: Poster

Presenting Author: Debabrata Banerjee

Registration id: NSSS-20211227070543

Dependence of Radiation Belt Flux Depletions on Different Solar Drivers During Intense Geomagnetic S

Sneha Gokani[1], Desheng Han[1], R Selvakumaran[1], Tarun Pant[1]

[1]Space Physics Laboratory, VSSC

The true loss of outer radiation belt electron flux is widely studied in terms of the mechanism that brings in these losses. Also, there are few studies, which attempted to explain the interplanetary conditions that favor the depletions. However, as the Sun is the prime cause of any changes happening in the magnetosphere, it is important to look at the solar drivers that bring in such changes. In this paper, for the first time, we attempt to understand the effect of solar structures and substructures on the loss of radiation belt high energy electrons during intense geomagnetic storms. The superposed epoch analysis is used to observe any peculiar changes in GOES electron flux data during the storms that are associated with solar structures like CME and CIR, ICME substructures like magnetic cloud, magnetic cloud with sheath, ejecta, ejecta with sheath and only sheath.The long-term data also gave an opportunity to compare the flux decrease during solar cycle 23 and 24. It is observed that (a) sheath related storms bring out higher flux decrease, (b) CIR associated storms cause comparatively higher flux decrease than CME associated storms, and (c) No significant change in flux for the storms of both the solar cycles. These observations are attributed to maximum solar wind pressure and speed, minimum IMF Bz, and northward IMF Bz before turning southward. These results hold true for the electron depletions occurring only during intense geomagnetic storms and may alter otherwise.

Presentation Mode: Poster

Presenting Author: Sneha Arunkumar Gokani

Registration id: NSSS-20211229080946

Analysis of non-thermal solar plasmas in κ-modified polytropic GES model framework

Pankaj Sarma[1], P. K. Karmakar[1]

[1]Tezpur University

The gravitoelectrostatic sheath (GES) model, originally formulated to see the surface origin of solar wind plasma (SWP) originating from the solar interior plasma (SIP) through the quasi-linear coupling solar surface boundary (SSB), is revisited. In our model, we consider the non-thermal (κ-distributed) electrons and inertial ions as the constitutive fluids embedded in a uniform magnetic field in a turbulent background (Larson logabarotropic law). A new type of κ-modified polytropic equation of state is constructed and applied herein for the first time. The astronomical governing equations for the plasma description on both the SIP and SWP scales are developed. A numerical illustrative platform is built up on the basis of the previous GES input values to characterize the new κ-polytropic GES structure. It is found that the new SSB is formed at a radial distance of 3.5 on the Jeans scale. The SSB location gradually shifts inward towards the heliocenter with the enhancement of the degree of non-thermality (κ). This new SSB feature is attributable to the combined action of the logabarotropic pressure effects, magnetic pressure effects, and κ-polytropicity previously remaining unexplored. The new solar plasma potential, flow, and other relevant characteristics are studied elaborately in light of the current solar plasma parametric scenarios with an applicability from the plasma-wall interaction viewpoint focally stressed upon.

Presentation Mode: Poster

Presenting Author: Pankaj Sarma

Registration id: NSSS-20211217015344

First in-situ observation of surface Alfvén wave

Omkar Dhamane[1], Anil Raghav[1], Kalpesh Ghag[1], Utsav panchal[1], Mayuri Katvankar[1]

[1]Department of physics, University of Mumbai

Alfvén waves (AWs) are inevitable to study since they are infused in space and astrophysical plasma. The AWs play a crucial role in various physical processes in plasma and have become a subject of intense research in solar-terrestrial physics. The simulation studies proposed the generation of AWs along the surface of the cylindrical flux rope refers as Surface AWs (SAWs). But the observational verification of this distinct wave was elusive to date. We report the first in-situ observations of SAWs in interplanetary coronal mass ejection flux rope. We apply the Walén test and wavelet analysis techniques to identify them. The Elsässer variables are used to estimate the characterization of these SAWs. It may be excited by the movement of the flux rope's foot-points or by instabilities on the plasma magnetic cloud boundaries. Sometimes, the change in the plasma density or field strength in the surface-aligned magnetic field may trigger SAW waves.

Presentation Mode: Poster

Presenting Author: Omkar Dhamane

Registration id: NSSS-20211214032739

Critical Analysis of Space-based Transit Observations : Improved Physical Properties of Exoplanets

Suman Saha[1]

[1]Indian Institute of Astrophysics

Several space-based telescopes have been widely used to detect and characterize Exoplanets using the transit method. The Transiting Exoplanet Survey Satellite (TESS) is one such instrument, which is the part of a survey to detect new Exoplanets around nearby bright stars. The most important advantage that the space-based telescopes provide over their ground-based counterparts is that the observed data is free from any noise component due to the interference of Earth's atmosphere. However, the noise components due to various instrumental effects and the stellar activity and pulsations still affect the photometric precision of the observed data, which limits the effectiveness of these facilities.

To tackle this, we have developed a critical noise treatment algorithm, using cutting-edge noise reduction techniques, such as the Wavelet denoising and the Gaussian process regression, to treat the photometric lightcurves and reduce the noise components both correlated and uncorrelated in time, originating from different sources. We have demonstrated the effectiveness of this algorithm by applying it to TESS transit photometric observations for five Exoplanets, namely KELT-7 b, HAT-P-14 b, WASP-29 b, WASP-95 b and WASP-156 b. By comparing the parameter values estimated by using our critical noise treatment algorithm to those without using it, we have shown how both the accuracy and precision of the estimated parameters have significantly improved. We have also compared our estimated results to the best-known parameter values of these targets from the previous studies, which shows a few orders of magnitudes improvements for every parameters, demonstrating the capability of these space-based observations when combined with the critical noise treatment techniques. The algorithm developed in this work can further be extended to other Exoplanets and will play a significant role in the study of Exoplanet atmospheres using next-generation telescopes, such as JWST.

Presentation Mode: Poster

Presenting Author: Suman Saha

Registration id: NSSS-20220108071254

Hypothesizing Possible Life Forms in Venusian Clouds

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Recent studies have suggested that Venus, situated near the edge of the habitable zone, has conditions that could possibly harbor life in its atmosphere in the clouds hovering roughly 48-60 kilometres above the surface. They have temperatures of around 333K and may have signs of life in spite of the high acidity. The traditional way of looking for life in outer space has been based on our definitions of life on Earth. However, here we went for a rather bottom-up approach to try and construct life forms that could survive in these conditions. Using the current knowledge of extremophiles on earth and the biomolecules like proteins that they need to survive and achieve high levels of endurance, we predict the possibility of existence of similar hyper-resistant biomolecules in the hostile Venusian environment. The existence of extremophilic versions of important enzymes in extremophiles on Earth tells us that similar hyper-extremophilic versions of enzymes could exist in the microorganisms in the Venusian atmosphere if life is found. They might be made of a different chemical backbone separate from the carbon backbone of life found on Earth; however, they may share many structural similarities like disulphide bridges to achieve high levels of thermal stability. This enables us to construct a possible life form where major biomolecules play the role of a scaffold. An anaerobic, poly-extremophilic chemoautotroph is possibly the best model. Additionally, we also propose a modification to Oparin and Haldane's model of origin of life, where life originated in the once shallow oceans of Venus (as hypothesized by NASA research) and in order to adapt to the drastic climate changes found refuge in the clouds. Here, some selective life forms found habitable conditions just like how life gradually shifted to land on Earth.

Presentation Mode: Poster

Presenting Author: Ayush Bagchi

Registration id: NSSS-20220109014250

Geology of Mare Marginis on the Moon: Implications for volcanism in the region

Neha Panwar[1,2], Neeraj Srivastava[1]

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Mare Marginis (13.3°N, 86.1°E) is a small mare at the eastern nearside - farside boundary on the Moon. It lies toward the east of the Crisium Basin and north of the Smythii Basin, lying close to the intersection of the rings of these basins. This renders a unique geological setting for the volcanism in this region. It also has a system of arcuate wrinkle ridges running through it, suggesting local tectonics in this region. Previous studies have suggested related source regions for the basalts in the Mare Marginis region and the Smythii Basin having similar FeO wt% (15-17 wt%) and TiO2 wt% (2,6-3.6 wt%). Despite the compositional similarity, the volcanism in both these basins occurred at different time. Results from crater counting indicate that the Mare Smythii basalts (3.14-3.48 Ga) are younger than the Mare Marginis basalts (3.38 to 3.88 Ga). Several craters that have excavated into the crust provide a window to study the crustal profile in the region. This study aims at using high resolution datasets from the Moon Mineralogy Mapper (M3) on-board Chandrayaan-1 to examine the mineralogical composition in the Mare Marginis region and how similar it is to the basalts from the Smythii Basin. It also uses topography data of SLDEM2015 to look at the geomorphology of this region. The study aims to understand the geological evolution of the Mare Marginis region on the eastern limb of the Moon and the role played by large impact basins in influencing the volcanism in the region.

Presentation Mode: Poster

Presenting Author: Neha Panwar

Registration id: NSSS-20220109035134

A study on the variations in Joule heating due to changes in geomagnetic activity during solar cy 24

Aswini Thampi S.L.[1], Sumesh Gopinath[1], Prince P.R.[1]

[1]University college, University of Kerala, Thiruvananthapuram

At high-latitudes, energy is accumulated in Earth's upper atmosphere through solar extreme ultraviolet (EUV) radiation, Joule heating from electric currents, auroral particle precipitation, and propagation of gravity waves from the lower atmosphere. During geomagnetically calm times, forcing from the lower atmosphere is significant, while during disturbed periods, auroral particle precipitation and Joule heating play a major role. Thus, during geomagnetic storms, due to Joule heating, a significant amount of the solar wind energy traversing the magnetopause reaches the high-latitude thermosphere-ionosphere system, leading to remarkable consequences which are global in nature. We study, Joule heating in high latitude upper atmosphere, during different geomagnetically disturbed periods of solar cycle 24, and discuss its relationship with the solar wind forcing. We have used Weimer model to calculate the Poynting flux flowing onto the Earth's ionosphere and associated Joule heating due to the solar wind-magnetosphere-ionosphere dynamo. The investigation reveals that the variations in Joule heating is having a correlation with changes in geomagnetic activity.

Presentation Mode: Poster

Presenting Author: Aswini Thampi S L

Registration id: NSSS-20220109043142

Science Goals of the Solar Ultraviolet Imaging Telescope onboard Aditya-L1

Janmejoy Sarkar[1,2], Durgesh Tripathi[1], A. N. Ramaprakash[1], Sreejith Padinhatteeri[1,3], Nigar Shaji[4], SUIT Team

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The Solar Ultraviolet Imaging Telescope (SUIT) is an off-axis Ritchey-Chrétien solar telescope onboard Aditya-L1, India’s first and upcoming dedicated space solar observatory to be placed in a halo orbit around the Lagrange point L1 of the Sun-Earth system. SUIT shall study the Sun with its 8 narrowband and 3 broadband filters in the near UV spectral range of 200nm-400nm. It will provide high contrast images of the Sun with good spatial resolution (~1.5 arcsec) and high cadence.

SUIT primarily intends to address four science goals, viz. 1. Study of coupling and dynamics in the solar atmosphere from the photosphere to the upper chromosphere by near simultaneous observations of the Sun; 2. Study of prominences, filaments and their dynamics in near ultraviolet light; 3. Capture early stages of flare trigger and to study solar flares and their chromospheric effects which will better explain the early phase kinematics of coronal mass eruptions; 4. Study of solar influence on our climate and the effect of UV irradiance variation on the chemistry of Earth’s upper atmosphere.

Augmented with data from other solar observatories like SDO, Hinode, DKIST and MAST, SUIT data shall provide us with a multiwavelength insight of the Sun and help establish our scientific conclusions with more reliability. This presentation will put forward the SUIT specifications, capabilities, instrument design, data formats and how these intend to target the primary science goals of the project.

Presentation Mode: Poster

Presenting Author: Janmejoy Sarkar

Registration id: NSSS-20220109042500

Energy dependent response of the dayside Martian ionospheric electrons to solar forcing

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We study the response of the Auger, photo, and thermal electrons in theMartian ionosphere to the solar soft X-ray (SXR, 0.1-7 nm), 30.5 nm, and ExtremeUltraviolet (EUV, 20-90 nm) irradiances, respectively. For this purpose, weused the suprathermal electron fluxes measured by the SWEA and the thermalelectrons densities by LPW instruments, both on the MAVEN spacecraft. The solarirradiances are taken from the EUVM instrument onboard MAVEN and also from theFlare Irradiance Spectral Model for Mars. The results of the present study showthat the fluxes of the suprathermal electrons and densities of the thermalelectrons are low in the solar minimum. The Auger electrons are correlated wellwith the SXR irradiance. They have an almost linear relationship and are observed tobe independent of altitude. The photo and thermal electrons are related to their respective solar irradiances by power exponents. The photoelectrons show maximum response and correlation at 200 km which decreases with an increase in altitude. In the case of thermal electrons to EUV flux and their correlation are maximum at 250-350 km and decrease above and below. To explain these results, the roles of the electron temperatures, neutral densities, and electron energy cascade are invoked.

Presentation Mode: Poster

Presenting Author: Pavan D Gramapurohit

Registration id: NSSS-20220110043257

Mesoscale meteorology of the Martian atmosphere

Shefali Uttam[1], Varun Sheel[1]

[1]PRL

The Planetary Boundary Layer (PBL) is the lowest part of the atmosphere that is directly influenced by the surface. It responds to the surface forcing in a timescale of an hour or less, therefore the vertical mixing is strong here. The Spatio-temporal variability of turbulence within the atmosphere is not completely studied in the Martian atmosphere due to lack of observations. Such studies become important if one wants to account for the effect of planetary surface forcing and the topography in the generation of dust lifting from the surface into the atmosphere. The local topography and solar radiation play a key role in guiding the local and regional scale meteorology of the atmosphere, which cannot be computed by a global scale model. For this, we use a mesoscale model (LMD-Mars Mesoscale Model) to study about the local and regional scale meteorology of Mars. The mesoscale models solve for the equations of motion for the atmospheric fluid which are integrated on a grid, with a resolution of tens of meters to a few kilometers. The spatially varying surface properties like topographic height, and surface roughness is taken from the observations of MOLA, whereas the albedo and thermal inertia are taken from observations of TES. We have run the model for these locations: (1) Arsia Mons (~8°S, ~120°W); and (2) Gale Crater (~5°S, ~137°E). The computations are carried out for ~10 days during the southern summer season (Ls = ~297º). We will discuss about the mesoscale meteorology of these two different areas on Mars and show some preliminary results from our analysis.

Presentation Mode: Poster

Presenting Author: Shefali Uttam

Registration id: NSSS-20220110053542

Variability of longitudinal structures in Martian thermosphere observed by NGIMS/MAVEN

Vulapati Leelavathi[1], N. V. Rao[1], S. V. B. Rao[2]

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Longitudinal structures are the global-scale oscillations in the Martian thermosphere which consist of thermal tides and planetary-scale waves. In this study, these longitudinal structures are extracted from CO2 densities measured by the Neutral Gas and Ion Mass Spectrometer on board the Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft. Measurements from Ls ~ 290°, in MY 32 to Ls ~ 240° in MY 35 are used in the present study. The results of the present study show that the longitudinal structures comprise primarily of three waves modes, with wave-2 being the dominant one, followed by wave-3 and wave-1; which are in accordance with the previous studies. The results further show that while the amplitudes of these waves increase with altitudes during night-time, they do not show much altitude variation during daytime. The amplitudes of the longitudinal structures (averaged between 160-200 km) are 9%, 13% and 18% for MY 33, MY 34 and MY 35 respectively, which increase with decreasing solar irradiance. Furthermore, correlation between amplitudes of these structures and solar EUV irradiance is moderate during aphelion and strong during equinoxes and perihelion.

Presentation Mode: Poster

Presenting Author: Vulapati Leelavathi

Registration id: NSSS-20220110053346

CME production by the magnetic-arcade-blowout triggered by a compact B-class solar flare: SDO and XS

Bhuwan Joshi[1], Prabir K. Mitra[1], N. P. S. Mithun[1], Anil Bhardwaj[1], Santosh V. Vadawale[1], Astrid M. Veronig[2]

[1]PRL, Ahmedabad, India, [2]Univ. of Graz, Graz, Austria

In this paper, we address the flare-CME relation for a special category of eruptive flares where the compact flare location exhibits a noticeable offset with respect to the source region of the associated CMEs. For the purpose, we analyse multi-wavelength and multi-instrument observations of a B5 solar flare that occurred in the active region NOAA 12810 on 2021 March 22. The active region displayed a simplest α-type magnetic configuration and during the occurrence of the flare under study it was located favorably close to the disk center at N18W13 for a reliable coronal magnetic field modeling. The observations from the Solar X-ray Monitor (XSM) on board Chandrayaan-2 reveal a gradual yet extended phase of X-ray emission during the flare for approximately one hour at energies up to 8 keV. The flare X-ray emission was predominantly thermal with a maximum temperature of T~7.5 MK with very weak non-thermal excess only at the peak time. The AIA/SDO EUV images reveal large-scale twin coronal dimmings that show a considerable spatial offset from the flaring location. NLFFF coronal magnetic field modeling confirms a system of large-scale coronal loops (i.e., a magnetic arcade) that connect the twin dimming regions. From the synthesis of the multi-wavelength observations, we find that the flare ejecta is not directly related to the CME production. We propose that the ejecta from this minor event successfully triggered the eruptive expansion of the large magnetic-arcade which in turn produced the twin-coronal dimmings at its conjugate foot-points.

Presentation Mode: Poster

Presenting Author: Bhuwan Joshi

Registration id: NSSS-20220110055322

A Simple Radial Gradient Filter for batch-processing of Coronagraph images

Ritesh Patel[1,2], Satabdwa Majumdar[1], Vaibhav Pant[2], Dipankar Banerjee[1,2]

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The images as observed by different white-light coronagraphs include the K and F corona and suffer from a radial variation in intensity. These images require separation of the two coronal components with some additional image processing to reduce the intensity gradient and analyse the structures and processes occurring at different heights in the solar corona within the full field of view. To process the bulk of coronagraph images with the steep radial intensity gradients, we have developed an algorithm, Simple Radial Gradient Filter (SiRGraF). It is based on subtracting a minimum background created using long-duration images and then dividing the resultant by a uniform intensity gradient image to enhance the K corona. In this presentation, we demonstrate the utility of this algorithm to bring out the short time scale transient structures of the corona. We have successfully tested the algorithm on images of Large Angle Spectroscopic COronagraph (LASCO) C2 on-board Solar and Heliospheric Observatory (SOHO), and COR-2A on-board Solar TErrestrial RElations Observatory (STEREO) with good signal to noise ratio (SNR) along with low SNR images of STEREO/COR-1A and KCor. We also compared the performance of SiRGraF with an existing widely used algorithm, Normalising Radial Gradient Filter (NRGF). We found that when hundreds of images have to be processed SiRGraF works faster than NRGF providing similar brightness and contrast in the images and {separating the transient features}. Moreover, SiRGraF works better on low SNR images of COR-1A than NRGF providing better identification of coronal dynamic structures throughout the field of view. We discuss the advantages and limitations of the algorithm. The application of SiRGraF on COR-1 images could be extended for an automated coronal mass ejection (CME) detection algorithm in the future which will help in our study of the CMEs' characteristics in the inner corona.

Presentation Mode: Poster

Presenting Author: Ritesh Patel

Registration id: NSSS-20220109105055

Compositional analysis of Sinus Aestuum region on lunar nearside using M3 and CLASS datasets

[1]Nabamita Chaudhuri, [1]K.N. Kusuma, [2]Netra S Pillai, [2]S. Narendranath

[1]Pondicherry University, [2]U R Rao Satellite Centre, ISRO

The Sinus Aestuum (SA) region on the nearside of the moon is a site of one of the prominent pyroclastic deposits of the lunar surface. Unlike the other major pyroclastic deposits, the SA region is unusually water deficit. It is also the only known location where Fe and Cr rich spinel is detected using orbiter datasets like Moon mineralogy mapper of Ch-1 and Spectral Profiler of Kaguya mission. M3 has helped us to detect Mg-spinel as one of the major lithologies of the lunar surface. Surprisingly, despite having a vast presence of spinel, the Sinus Aestuum region lacks any Mg-Spinel signature and has predominantly an Al-Fe rich pleonaste spinel. Geomorphologically, these spinels are seen within fresh craters chiefly exposing highland materials and is expected to have a more widespread distribution. Also, the spinel is undisputedly associated with the pyroclastic Dark mantle deposits (DMDs) which may hint at their co-genetic relationship. This work is a detailed compositional analysis of the SA region using two major orbiter datasets i)M3 of Ch-1 and ii)Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS) of Ch-2 mission. Both of these datasets use 2 different regions of the electromagnetic spectrum to give compositional outputs at two different spatial scales. We are using the CLASS datasets to understand the regional elemental distribution at a larger footprint but bigger coverage area. These results are used to corroborate the results derived from the M3 image analysis at a better spatial and spectral resolution.

Presentation Mode: Poster

Presenting Author: Nabamita Chaudhuri

Registration id: NSSS-20220108060832

Solar X-ray monitor onboard Ch-2: Inflight performance and the assessment of radiation damage of SDD

M.Shanmugam[1], Arpit Patel[1], N. P. S. Mithun[1], Santosh Vadawale[1]

[1]Physical Research Laboratory

The Solar X-ray Monitor (XSM) on-board Chandrayaan-2 mission is designed to carry out broadband spectroscopy of the Sun from lunar orbit. It measures the spectrum every second in the soft X-ray band of 1 to 15 keV. Though the XSM measurement will aid in quantitative interpretation of elemental composition of the Moon by the companion instrument Chandra's Large Area Soft x-ray Spectrometer (CLASS), but the XSM observations can independently be used to study the Sun as well. The Chandrayaan-2 mission was launched on 22 July 2019, and the XSM began nominal operations, in lunar orbit, from September 2019. The in-fight observations, so far, have shown that its spectral performance has been identical to that on the ground. It also has been demonstrated that the XSM is sensitive enough to detect solar activity well below A-class as expected. XSM uses new technology, Silicon Drift Detector (SDD) which provides superior spectroscopic performance. The XSM instrument is designed to provide the energy resolution of ~175 eV at 5.9 keV for the detector operating temperature of ~ -35°C. XSM also has stable spectral performance for the count rates up to ~105 counts/s. It is known that the performance of any silicon detector, and hence its energy resolution, degrades, due to environmental effects as well as radiation damage. The energy resolution of the SDD based X-ray spectrometer mainly depends on the leakage current and the noise contributed by the readout electronics. We have implemented a novel technique in the XSM instrument to continuously monitor the detector leakage current. This directly gives the measure of radiation damage on the SDD around the lunar orbit. Before Ch-2 launch, the measured leakage current is ~0.5 pA and increased to ~2.2 pA after the mission passed through the radiation belts. After two years of mission, the increase in the leakage current is ~4 pA. In the conference, we will present the overall performance of XSM since launch to till date.

Presentation Mode: Poster

Presenting Author: M. Shanmugam

Registration id: NSSS-20220110074047

Spotless days as the predictors of solar cycle 25

Dipali S. Burud,Rajmal Jain, Arun K. Awasthi

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We study the sunspot activity in relation to spotless days (SLDs) during the descending phase of solar cycle 11-24 to predict the amplitude of sunspot cycle 25. A very strong correlation of the SLD (R=0.68) during the descending phase of a given cycle with the maximum amplitude of next solar cycle has been estimated. The empirical relationship led us to deduce the amplitude of cycle 25 to be 99.13±14.97 and reveal that the solar cycle 25 will be weaker than cycle 24. Further we derive that the maximum of cycle 25 is likely to occur between February and March 2024. While the aa index has been used extensively in the past, this work establishes SLDs as another potential candidate for predicting the characteristics of the next cycle.

Presentation Mode: Poster

Presenting Author: Dipali S. Burud

Registration id:NSSS-20220110080033

Processing electronics of ASPEX payload for Aditya L-1 Mission

Arpit Patel[1], M Shanmugam[1], Tinkal ladiya[1], Hitesh adalja[1],Pranav Adhyaru[1], Manan shah[1], Shivkumar goyal[1], Prashant kumar[1], santosh vadawale[1], D Chakrabarty[1], ASPEX team

[1]PRL

Aditya solar wind particle experiment (ASPEX) is a payload for the Aditya-L1 orbiter mission which has two subsystems Solar Wind Ion Spectrometer (SWIS) and Supra-Thermal Energetic Particle Spectrometer (STEPS). Both the subsystems are working independently and have independent processing electronics. The processing electronics package contains the FPGA-based processing electronics, power sub-system, data command interface, and telemetry/telecommand interfaces. Mechanically, the PE package is common for SWIS and STEPS, but electrically it is independent.

The SWIS subsystem is top-hat based design that has a resistive anode readout. FPGA PCB has an interface with 5 chains (Four from top hat-1 and one from top hat-2) of front-end which gives 10 shaping amplifier outputs (2 outputs per quadrant of the resistive anode). The STEPS instrument is configured with nine silicon detectors and three scintillator detectors to look at six different directions. Shaping amplifier output from twelve analog channels is coming to the FPGA card for further processing. The weight of package is 3Kg and its power consumption is 14watt. Both the processing PCB contains Microsemi make RTAX2000 one-time programmable FPGA to process the data onboard and control the peripheral devices. FPGAs are full-filling the functional requirements like data command decode, onboard data processing, spectral data generation, storing the data, packet making, health parameter readout, controlling modes of operation, Digital telemetry interface, generation control signals for devices like Peak detector, ADC, DAC, etc. The detail of processing electronics will be presented during the symposium.

Presentation Mode: Poster

Presenting Author: Arpit Patel

Registration id: NSSS-20220110083739

Study of High Energetic Solar Proton Events 23rd solar cycle and Associated Secondary Neutrons

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High energy solar particles predominantly protons (greater than 100 MeV) erupted from the Sun during high speed Coronal mass Ejections (CMEs). When these protons hit Earth's atmosphere, they produce a showers of secondary particles, some of which rain down on Earth's surface. Among these particles secondary neutrons count as a proxy for high energetic solar protons. In this paper CMEs with fast-mode Magnetohydrodynamic (MHD) shocks are analyzed to understand relative timings of the release of protons at the Sun and associated secondary neutrons detected as a Ground Level Enhancement (GLE) event in Oulu neutron monitor. Total 16 CMEs of 23rd solar cycle are identified which responsible for such GLE events. The Oulu neutron monitor has shown sudden increase in cosmic ray intensity and count neutrons (> 0.8 GV) as a proxy for high energetic solar protons events.

Presentation Mode: Poster

Presenting Author: Rajiv Vhatkar

Registration id: NSSS-20220110085218

Alpha Particle X-ray Spectrometer on-board Chandrayaan-3 Rover

M. Shanmugam[1], S. V. Vadawale[1], Arpit R. Patel[1], N. P. S. Mithun[1], Hitesh Kumar[1], Tinkal Ladiya[1], S. K. Goyal[1], Nishant Singh[1], Sushil Kumar[1], Deepak Painkra[1], Anil Bhardwaj[1]

[1]Physical Research Laboratory

"In-situ elemental abundance measurements have been an integral part of previous explorations on planetary bodies like Mars/Moon with un-manned rovers. India's forthcoming Lunar landing mission Chandrayaan-3 includes a Rover to explore the regions close to landing site with two instruments on-board to perform in-situ elemental abundance measurements. Alpha Particle X-ray Spectrometer (APXS) is one amongst them which employs techniques of Particle Induced X-ray Emission (PIXE) and X-ray Fluorescence (XRF) for identifying and quantifying major and minor rock forming elements present in the Lunar surface. X-ray and Alpha particle radiation from the radioactive source included in APXS excites the elements to generate X-ray fluorescence and the Silicon Drift Detector (SDD) of the instrument records this X-ray spectrum.

The flight model of the APXS instrument has been integrated with rover and has undergone various environmental tests. The developed APXS instrument provides energy resolution of < 150 eV at 5.9 keV when the SDD is cooled to ~ -35°C with low energy threshold of ~800 eV. In order to derive elemental composition from observed fluorescence spectrum, extensive calibration experiments have been carried out with standard Geo-chemical reference samples from USGS. The APXS spectra of these samples are fitted with multiple mono-energetic lines convolved with the response matrix of the instrument and empirical correlations between elemental line fluxes and abundances are derived. Further, overall uncertainties in the estimated abundances and limiting sensitivity for various elements are also computed. Here we present various aspects of design, realisation and calibration of APXS."

Presentation Mode: Poster

Presenting Author: M. Shanmugam

Registration id: NSSS-20220110074047

The bidirectional reflectance of a lunar highland and mare analogue: A comparative assessment

Neeraj Srivastava[1], Abhishek J. Verma[1], Megha Bhatt[1], K. Durga Prasad[1], P. Kalyana Reddy[1], Janmejay Kumar[1], Varun Sheel[1], Anil Bhardwaj[1]

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"The reflectance of planetary surfaces in the visible and near-infrared is significantly influenced by the variation in solar illumination angle and viewing geometry. The photometric scattering properties of materials are a function of composition and physical properties such as grain size, surface roughness, and porosity. Bidirectional reflectance of surfaces acquired at a variety of incidence (i), emission (e), and phase angles (ϕ) provide the data essential to model the bidirectional reflectance distribution function (BRDF) that endeavors to approximate the scattering behavior of the surfaces based on radiative transfer theory. These models are used to normalize spectral reflectance data (point data/imageries) acquired from spacecraft at different times of the day to common illumination and viewing geometries, thus allowing their direct comparison.

Spectro-goniometric measurements of planetary analogs in laboratory provide observations favorable for inter-comparisons of the photometric scattering properties of planetary surfaces, particularly when applied to the observations from spacecraft. In this study, we have acquired visible/near-infrared (0.35–2.5 micron) hyperspectral reflectance measurements of various grain sizes of lunar soil simulants JSC1A (a mare analogue) and Sitampundi Anorthosite (a highland analogue) as a function of illumination and emission angles using the newly developed PRL Spectro-goniometric facility. This facility provides an opportunity to acquire bi-directional reflectance factor (BRF) of target surfaces at various zenith and azimuthal angles of illumination and emission. Here, we provide an account of this newly developed facility and provide a comparative assessment of the scattering behavior of JSC1A and Sitampundi Anorthosites. Measured around the principle plane, spectral reflectance has been found to increase with decrease in grain size and reduction in phase angle in both cases; however, their intensities are different."

Presentation Mode: Poster

Presenting Author: Neeraj Srivastava

Registration id: NSSS-20220110063625

Characterization of a Dust Sensor using Pulse Laser

Srirag Nambiar[1], Jayesh Pabari[1], Rajesh Kumar Singh[2], Sonam Jitarwal[1], Rashmi[1], Kinsuk Acharyya[1]

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Interplanetary Dust Particles, also known as micro-meteoroids or cometary particles form an immense source of information for early solar system processes. They originate from a range of sources like the Asteroid belt, comets, Kuiper belt objects, planetary bodies, and even from other stars. These particles vary dynamically evolve in the solar system under the influence of gravitational and non-gravitational forces. For planets with an atmosphere, they are responsible for an ionospheric layer at lower latitudes because of ablation, and in the case of planets lacking an atmospheric layer these particles directly impact the surface and continuously churn the upper layer. Studying the distribution, source, and sink of these particles will also help in better modeling the zodiacal cloud.

An Impact Ionization Detector (IID) can be utilized to study such particles. It works on the principle of impact ionization, where particles hitting a metal target at high velocity generate plasma which is captured to determine the physical properties of the particle. A Venus Orbiter Dust Experiment (VODEX) is proposed for future Venus mission to study the dust particles in interplanetary space and around Venus. To calibrate such a detector, a dust accelerator is required where a particle of known mass and velocity is impacted onto the detector and calibration constants are derived. However, for initial characterization, a pulse laser facility can be utilized. A nanosecond pulsed laser can simulate a dust particle impact owing to the similarity in the interaction time of laser and test and the output signal produced by both cases. We have set up a pulse laser test facility at IPR, Gandhinagar for the initial characterization of our instrument, and based on the experiment we have tried to derive a relation between laser energy and particle energy which depends on mass and velocity. The equivalence relation is useful to test the detector in the proposed detection range.

Presentation Mode: Poster

Presenting Author: Srirag Nambiar

Registration id: NSSS-20220110090021

Study of Meteor Showers during LADEE Observation Time

Jayesh P. Pabari[1], Zeel P. Patel[1]

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The Lunar Atmosphere and Dust Environment Explorer (LADEE) [1] observed lunar exosphere and dust in the Moon's vicinity during September 2013 to April 2014. During this time frame, Earth encountered few meteor showers. Moon, being Earth's natural satellite, may also encounter dust shower during the LADEE observation time. Any dust impact causes ejecta in the lunar environment [2] which may be captured by instrument on LADEE mission [3, 4, 5]. In this work, we have carried out study of meteor showers occurring during the LADEE observation time. We present the parameter estimation of a few meteor showers, which may cause ejecta on Moon and subsequently captured by the instrument on LADEE mission. Further work on ejecta estimation and NMS observations is underway.

References: [1] Online, 10 January 2022. Available: https://www.nasa.gov [2] Pabari et al. (2020) Icarus, 338, 113510. [3] Benna et al. (2019), Nature Geoscience, 12, 333-338. [4] Szalay et al. (2018), MNRAS, 474, 4225-4231. [5] Bernardoni et al. (2021), The Planetary Science Journal, 2:67, 11.

Presentation Mode: Poster

Presenting Author: Zeel P. Patel

Registration id: NSSS-20220110105945

Study of Ionospheric Space Weather During Solar Moderate Year Over Varanasi

Mukulika Mondal[1], Sanjay Kumar[1], Abhay Kumar Singh[1]

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Radio signal suffers fluctuations in both phase and amplitude during their passage through the irregular ionosphere which results failure in radio communication and navigation systems. These fluctuations in phase and amplitude of the signal are known as phase and amplitude scintillations respectively. The present study is carried out to observe the variation of occurrence of amplitude scintillations during ascending phase of solar cycle from November 2020 to October 2021 over equatorial anomaly region Varanasi (latitude 25.31° N, longitude 82.97° E). We have taken GNSS data from multifrequency GNSS receiver to study the occurrence of scintillation index S4. To study the seasonal variation of S4, three seasons are considered i.e., winter (November, December, January and February), Equinox (March, April, September and October) and summer (May, June, July and August). Diurnal and monthly variation of S4 index is also analyzed. During the month of March 2021 maximum scintillation occurrence has been observed and scintillation activity is more prominent during night-time hours than daytime. We have taken solar moderate period to observe the effect of solar activity on S4. Two solar indices Sun Spot Number (SSN) and F10.7 (solar radio flux at 10.7 cm) are compared with S4 individually to study the solar activity dependence of S4. To study the effect of geomagnetic activity on S4, we have taken an intense solar geomagnetic storm dated on 4th November, 2021 (DSTminimum = -105 nT). Characteristics of various geomagnetic indices related to the storm (DST, Bz, Ey, Kp, Ap) are observed during the storm period. Daily Kpmax is compared with daily S4 during storm time to see whether this storm suppress scintillation or not.

Presentation Mode: Poster

Presenting Author: Mukulika Mondal

Registration id: NSSS-20220110100142

Characterization of Silicon Pin Detector and its readout electronics for the future Venus Mission

Sushil Kumar[1], Deepak k. Painkra[1], M. Shanmugam[1], Tinkal Ladiya[1], Arpit Patel[1]

[1]Physical Research Laboratory

The silicon pin detectors and scintillators are widely used in high energy particle measurements. In one of the instrument proposed for the upcoming Venus Orbiter mission, it is proposed to use a stack of Si PIN detectors and a scintillator detector to measure the particle in the wide energy range. The Si PIN detector directly converts the incident particle energy into the electrical signal whereas the scintillator converts the incident particle into visible photons which are then converted into electrical signal using a suitable photo detector. In this direction, we have developed the readout electronics for Si PIN detectors and characterized the detectors along with the electronics for the various parameters.

We have procured the Si PIN detectors with various thickness ranging from 50 µm to 1500 µm in order to study their suitability in detecting the particles in the energy range of 20 keV to 100 MeV. Each detector has the active diameter of 17mm. We have characterized these detectors individually for the parameters such as leakage current, performance measurement with temperature and the energy resolution. These parameters were tested using X-ray and alpha sources at different energies. The leakage current was measured and found to be in the range of ~0.8 nA to 45 nA for detectors with thickness ranging from 50 µm to 1500 µm. These experiments are carried out to evaluate their suitability to use in Venus Radiation environment monitor experiment proposed for the Venus orbiter mission. The design details and the characterization results will be presented in the symposium.

Presentation Mode: Poster

Presenting Author: Sushil Kumar

Registration id: NSSS-20220110094541

A Deep Learning approach to identify Solar Plages

Rakesh Mazumder[1], Sarvesh Gharat[2], Ritwik Sharma[3]

[1]ARIES, [2]VIIT, [3]DESHBANDHU COLLEGE

"Plages are bright chromospheric features seen in Ca II K solar images. Plages are regions of high magnetic field concentration thus tracer of magnetic activity of the Sun. Plages is one of the most important features to study long-term variability of the Sun as Ca II K spectroheliograms are recorded for more than a century. However, detection of the plages from century-long databases is a non-trivial task and needs significant human resources for doing it manually. Automated detection is helpful but challenging for such kinds of huge non-uniform data-sets is challenging.

In this study we apply object localization techniques using deep learning, in particular, we use YOLO (You Only Look Once) technique for the detection of plages from Ca II K images. We use Kodaikanal Solar Observatory (KSO) data for our study.

The data consists of 405 level 0 images ranging from the year 1994 to 1999. Out of 405 images, 328 are used for training and 77 are used for testing. Our model has trained over 125 epochs which results in maximum precision of 0.8251 and a maximum recall of 0.7045. The minimum training and validation loss as achieved is 0.02964 and 0.02153 respectively."

Presentation Mode: Poster

Presenting Author: Ritwik Sharma

Registration id: NSSS-20220110121653

Effect of Supra-arcade Downflows on Supra-arcade fan region and loop-tops

Arpit Kumar Shrivastav[1], Ritesh Patel[2], [3]Vaibhav Pant, [4]Dipankar Banerjee

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Supra-arcade Downflows (SADs) are intensity depleted structures that descent in the supra-arcade fan region towards the flare loop top. The formation mechanism of SADs is still not fully understood but they are believed to heat the coronal loop tops. We investigate an event consisting of more than 60 SADs observed after an M-class flare on November 29, 2020. Using Differential emission measure (DEM) weighted average temperature of two separate regions, a relation between temperature and number of SADs is established. We found that heating due to SADs peaked about an hour after the flare peak, followed by cooling. The frequency of SADs occurring in two regions can be associated with increased temperature. Earlier On-disk Observations showed heating by the direct collision on loop top due to SADs. We found no evidence of heating by collision in this event and those direct collisions obtained in on-disk observations can be projection effects.

Presentation Mode: Poster

Presenting Author: Arpit Kumar Shrivastav

Registration id: NSSS-20220110054704

Understanding the Global Coronal Magnetic Fields using Data-constrained Magnetohydrodynamic Mode

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Coronal magnetic field evolution modulates our space environment via coronal mass ejections, flares, and changes in solar wind conditions. However, routine observations of magnetic field in the optically thin solar corona are not yet well-developed. Hence understanding the coronal magnetic field distribution using data-constrained global magnetohydrodynamic (MHD) models is of paramount importance nowadays. There are several factors which can drive the evolution e.g. flux emergence, photospheric flows, stratification in thermodynamic variables, solar wind conditions. Simulations using MHD models will help us generate the global magnetic field distribution, which can be constrained using total solar eclipse observations. We discuss the magnetic field distribution for past solar eclipses based on MHD simulations for global solar corona using a variety of approaches based on data-driven surface flux transport models, potential field source surface models and full MHD models.

Presentation Mode: Poster

Presenting Author: Soumyaranjan Dash

Registration id: NSSS-20220103013247

Investigating the coronal heating of quiet Sun: A DEM analysis using AIA and XSM observations

B. Mondal[1], S. V. Vadawale[1], A. Sarkar[1], N. P. S. Mithun[1], P. Janardhan[1], A. Bhardwaj[1], P.S. Athiray[2], G. Del Zanna[3], H. E. Mason[3]

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Coronal nanoflares are thought to be one of the prime candidates that can keep the solar corona at its multi-million Kelvin. These are tiny bursts, releasing energy around 10^24 ergs, either by the process of magnetic reconnection or by the energy deposition of Magnetohydrodynamic (MHD) waves. Because of the technical limitations, detection of individual nanoflare becomes difficult; however, their presence can be inferred using various other techniques such as Differential Emission Measure (DEM) analysis. Using the EUV and X-ray observations by Solar X-ray Monitor (XSM) onboard the Chandrayaan-2 mission and AIA onboard the Solar Dynamic Observatory, we estimate the disk integrated DEM of the quiet Sun at the time of the 24th Solar minimum. Analyzing the quiet sun DEM, we conclude that the hot temperature component (above 1.5 MK) of the DEM originates from the X-ray Bright Points (XBPs) present on the solar disk. We further simulate the DEM of the quiet Sun and XBPs using the EBTEL code assuming the nanoflare heating with different frequencies. Comparing the simulated DEM with the observed one we infer that the quiet Sun heating is dominated by high-frequency nanoflares, whereas the XBPs are heated by low-frequency nanoflares.

Presentation Mode: Poster

Presenting Author: Biswajit Mondal

Registration id: NSSS-20220109051243

Inferring physical parameters of filaments using Bayesian inference

Vaibhav Pant[1]

[1]ARIES, Nainital

High resolution ground and space-based observations have enabled us to observe the fine structures of prominences with unprecedented details. These observations suggested the presence of the longitudinal oscillations, transverse oscillations, or both in the prominence threads. This opens doors for the prominence seismology inversion methods to estimate the physical properties of the prominences that are otherwise difficult to determine by direct means. Often, the solutions of such inversions might not be unique or exist because the observables are less than the unknowns. Therefore, the Bayesian inference method is employed to estimate the magnetic field structure and plasma properties of the prominence using the observed period and damping time of the transverse oscillations. This is, perhaps, the correct methodology to obtain the meaningful inference of the physical parameters from observations. In this seminar, I will talk about our recent efforts of extending the Bayesian inversion technique to the large amplitude longitudinal oscillations (LALOs) and transverse oscillations observed in the same prominence. This allows us to probe the strength of the magnetic field and length of the field lines supporting the prominence material.

Presentation Mode: Poster

Presenting Author: Vaibhav Pant

Registration id: NSSS-20220110010359

Raman spectral analysis from the SHERLOC instrument onboard Mars 2020 Perseverance Rover

Prateek Tripathi[1], Rahul Dev Garg[2]

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The Scanning Habitable Environments with Raman & Luminescence for Organics & Chemicals (SHERLOC) is one of the instruments mounted on the Perseverance rover's robotic arm. It aims to search for mineral species and organics that may contain spectral signatures of hydrous environments and past microbial life. SHERLOC measures the Raman scattering in a narrow wavelength range (246-357 nm) with a significantly stronger fluorescence around 274-355 nm. Here the 40 measurements of Raman spectra from three detectors of SHERLOC, captured on Sol 4 were analyzed. The Dark-subtracted spectrum in calibration mode results in fluorescence signatures with maxima at 276 nm, and Raman peaks similar to amorphous silicates. In the future, combined studies with SuperCam and Mastcam-Z will resolve several astrobiological mysteries.

Presentation Mode: Poster

Presenting Author: Prateek Tripathi

Registration id: NSSS-20211125105503

Laboratory studies of thermophysical properties of lunar analogues under simulated environment

K. Durga Prasad[1], P. Kalyana Reddy[1], Janmejay Kumar[1]

[1]Physical Research Laboratory

The role of laboratory studies under simulated lunar environment in understanding physical properties of materials and their behaviour is multifold. One such aspect is related to the studies of temperature dependent thermophysical properties. For example, in order to properly understand the lunar surface and subsurface thermophysical behaviour, appropriate parameter values for density, thermal conductivity, specific heat etc. and initial boundary conditions for temperatures and incident heat flux are needed. In situ measurements and laboratory analysis of returned samples from Apollo missions showed that these parameters are not constant and are inter-dependent. It was shown earlier that under ambient pressure, a trend of temperature independent thermal conductivity was observed. However, the same is expected to be significantly dependent on temperature under vacuum conditions, but no systematic measurements exist in literature. According to literature, the combined effect of temperature dependent thermal conductivity and Specific heat account for ~20-50% of the diurnal variation of thermal Inertia of lunar surface. Also, to account for radiative and conduction components in porous media, temperature dependent thermal conductivity and specific heat needs to be considered in all numerical studies. However, such a behaviour under lunar environmental conditions is not understood at all. Towards this, we have developed a novel experimental setup and procedure for carrying measurements on the thermophysical properties of lunar analogue samples under simulated environment. Using this setup, experiments have been carried out on selected analogue samples. Results showed a significant dependence of the thermophysical properties both under pressure as well as temperature. Experimental details and some results will be discussed.

Presentation Mode: Poster

Presenting Author: Dr. K. Durga Prasad

Registration id: NSSS-20220110082345

Comparative study of turbulent nature of solar plasma during the solar cycle

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Solar wind variability can exist in a wide range of amplitudes and timescales, from turbulent fluctuations over the 11 year solar cycle. We going to using the data quantile-quantile (DQQ) method to NASA/Wind observations spanning solar cycles 23 and 24, to study how the uniqueness of each cycle maximum and minimum manifests in the changing statistical distribution of plasma parameters in fast and slow solar wind. The DQQ method allows us to discriminate between two distinct components of the distribution: the core region simply tracks the solar cycle in its moments but shows little sensitivity to solar wind state or the specific activity of each cycle. This would be consistent with an underlying in situ process such as turbulence driving the evolution of fluctuations up to an outer scale. In contrast, the tail component of the distribution is sensitive both to the differences between the maxima and minima of cycles 23 and 24, and the fast or slow state of the solar wind.

Presentation Mode: Poster

Presenting Author: Anoop Parsai

Registration id: NSSS-20220110022858

Origin of Sun's Near Surface Rotation Shear Layer: Evidence of Mass accretion

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Helioseismic inferences show that sun's rotational gradient increases and is positive from base of convection zone to 0.935 radius of the sun. Whereas near surface (from 0.935 to 1.0 sun's radius) rotational gradient is decreasing and is negative. Hydrodynamic and MHD simulations reproduce very well the rotational isocontours from base of the convection zone to 0.935 radius of the sun. However, the same studies miserably fail or impossible to reproduce near surface rotational layers for variety of numerical and physical reasons. One serious physical reason is that if one applies MHD criterion for the rotation profile of near surface layer, negative rotational gradient does not satisfies the MHD stability criterion unless the sun has acquired a strong steady large-scale toroidal magnetic field structure. Although helioseismic inferences have inferred such a strong toroidal magnetic field structure, origin of such a field is not understood. Hence, if one accepts such a negative rotational gradient and toroidal magnetic field structure to coexist near surface as inferred by helioseismology, inevitable explanation is probable planetary mass accretion on the surface during early history of the sun. Evidence of such a mass accretion scenario and further implication for solution of "Faint Young Sun Paradox" will be discussed in the meeting.

Presentation Mode: Poster

Presenting Author: Hiremath K M

Registration id: NSSS-20211226110547

CMEs associated with DH type II bursts and their Sun-Earth propagation

Binal D. Patel[1,2], Bhuwan Joshi[1], Kyung-Suk Cho[3], Rok-Soon kim[4]

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We present the characteristics of decameter-hectometer (DH) type II bursts for the Solar Cycle 23 and 24. For the present study, we have classified the bursts according to their end frequencies into three categories, i.e. Low Frequency Group (LFG; 20 kHz ≤ f ≤ 200 kHz), Medium Frequency Group (MFG; 200 kHz < f ≤ 1 MHz), and High Frequency Group (HFG; 1 MHz < f ≤ 16 Mhz). Our analysis shows a drastic reduction of the DH type II events during Solar Cycle 24 which includes only 35% of the total events (i.e. 179 out of 514). Despite having a smaller number of DH type II events in the Solar Cycle 24, it contains a significantly higher fraction of LFG events compared to the previous cycle (32% versus 24%). However, within the LFG group the cycle 23 exhibits significant dominance of type II bursts that extend below 50 kHz, suggesting rich population of powerful CMEs travelling beyond half of the Sun-Earth distance. The profiles relating CME heights with respect to the end frequencies of DH type II bursts suggest that for HFG and MFG categories, the location for majority of CMEs (≈65%–70%) is in well compliance with ten-fold Leblanc coronal density model, while for LFG events a lower value of density multiplier (≈3) seems to be compatible. We further studied the Sun-Earth propagation characteristics of interplanetary CMEs (ICMEs) arriving at 1 AU that are associated with DH type II radio bursts (type II ICMEs). We provide a detailed comparison of ICME parameters (mean ICME speed, magnetic field) at 1 AU along with Sun-Earth propagation parameters (transit time, acceleration) between the type II and non-type II ICME groups. Our results confirm that the ICME characteristics at 1 AU primarily depend on near-Sun CME characteristics and solar wind conditions in the interplanetary medium.

Presentation Mode: Poster

Presenting Author: Binal Patel

Registration id: NSSS-20220110075532

Shear-Driven Formation of Switchback Structures in the Solar Wind

Anmol Kumar, Arpita Roddanavar, Dibyendu Nandy

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The Parker Solar Probe has been continuously making new observations of the solar wind since its launch in 2018, on a mission to "touch" the Sun. One of the key findings has been the omnipresence of sudden magnetic field reversals with respect to the Parker Spiral, which are called "switchbacks". Switchbacks are a host to intense magnetic field configurations, which are believed to be sites of reconnection events responsible for solar wind acceleration. Hence, it is imperative to investigate the origin of switchbacks to understand the dynamics. This work hypothesizes that switchbacks originate in situ due to persistent velocity shears in the solar wind leading to rotational plasma flows. Based on this hypothesis, we perform 2-D kinematic simulations to study the evolution of magnetic field lines aligned parallel to the Parker Spiral under the influence of a vortical flow. The results exhibit reversals in the magnetic field similar to those observed by the PSP. Further, we conduct a detailed parameter space study to determine the effects of flow velocity and magnetic diffusivity on switchback formation time and lifetime. The analysis leads to a positive correlation between the latter two quantities. We performed a similar analysis of the data collected by the PSP FIELDS instrument to obtain a positive correlation between the formation time and lifetime of switchbacks, which is in close agreement with our hypothesis.

Presentation Mode: Poster

Presenting Author: Anmol Kumar

Registration id:NSSS-20220110112126

The GM– IMF coupling loss in association with the Mw 8.1 Earthquake of 29 September 2009

Asha Anie Varghese[1], Abraham A[1], Tiju Joseph Mathew[1]

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This investigatory work is a search for the precursory signatures of earthquakes in the geomagnetic field. Earthquakes are the relative movement of the surface layers of the Earth causing widespread destruction of the natural and man-made environment. This work analyses the local effects of Earthquakes on Geomagnetic Field â€“ Interplanetary Magnetic Field coupling of different stations. The disturbance content in both geomagnetic field (GM) and Interplanetary Magnetic Field (IMF) is gauged using the Vertical Variance (VV) method. The GM-IMF coupling is a global phenomenon. Hence, the GM-IMF VV ratios (R) are well correlated between different stations i.e., the inter-station GM-IMF VVR correlation has a value near unity. However, the values of the GM-IMF VVR between specific geomagnetic stations are observed to fall during periods in association with seismic events. The fall in correlation is read as the breakdown of the GM-IMF coupling owing to the local effects. The inter-station correlations between the geomagnetic field data from Apia, Eyrewell, and Honolulu are investigated in this work. A definitive signature of the large earthquake of the Mw 8.1 of 29 September 2009 is evident in the GM-IMF VVR correlations.

Presentation Mode: Poster

Presenting Author: Asha Anie Varghese

Registration id: NSSS-20220110031435

Detection and localization of solar sigmoids using deep learning

Rakesh Mazumder[1], Adarsh Mahor[2,3], Lipshit Dash[4]

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S or inverse S-shaped features appear in solar, coronal soft X-ray (SXR) images are termed as sigmoids. They are complex magnetic structures in the solar atmosphere with a high magnetic twist. Sigmoids are usually associated with solar flares and solar eruptive phenomenons. Despite their usual high activity, several sigmoids survive from days to weeks. The association of sigmoids to coronal mass ejections (CMEs) made them essential to study from a space weather perspective. Further, despite being an apparent unstable structure, their stability made them very interesting for study to solar physicists. The statistical analysis of sigmoids can provide valuable information about their properties, which can shed light on their formation and stability. It is crucial to identify sigmoids in solar images, in the first point, to do a statistical study of them, or predict solar eruptive phenomenons associated with them.

In this work, we apply modern object detection and localization techniques using deep learning, in particular YOLO (you only look once) algorithm with classical object classification techniques. We have used XRT telescope data onboard the HINODE satellite for our study. A total of 1527 daily XRT images, spanning from 2011 to 2014, are used for our work. Among these images, we use 80% for training and 10% for validation and 10% for testing. Our model has achieved 85% precision with a 0.5 confidence score followed by 74% accuracy for the classification of the sigmoid. The model is ready for deployment in real-time use for detecting the sigmoids.

Presentation Mode: Poster

Presenting Author: Rakesh Mazumder

Registration id: NSSS-20211217024502

Evolutionary constraints on Permanently Shadowed Regions (PSRs) on the Moon

Mishal KT[1], Deepak Dhingra[1]

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Permanently shadowed regions (PSR's) on the Moon are the areas that are expected to have not received direct solar illumination for millions of years. The PSR's at the lunar poles could have evolved as the topographical depressions are strongly influenced by the impact events. The formation of younger impact craters in the polar regions generate topographic depressions, which could become PSR depending on the size and location of the impact. On the other hand, ejecta from large craters and basins could smoothen the topography (which might be supporting a PSR) by erasing/reducing the spatial extent. We intend to evaluate the role of topographic smoothening on the character and spatial distribution of PSRs in north polar terrain (800- 900). The geological map of the north polar terrain reveals that the near side is majorly covered with the northern plains deposits, which have smoothened the terrain to a great extent. These deposits are found widely distributed in the older terrains and pre-Imbrian craters covering an area greater than 37000km2 on the nearside of the north pole. The northern plain forming events might have erased smaller PSR's from the near side terrain, whereas the larger PSR's might have survived with reduced areal extent. The evaluation of PSRs> 10km2 in the north pole (800-900) reveals that the far side hosts a larger areal extent of PSRs when compared with the near side. We conclude that one of the reasons for this estimated reduction in PSR area associated with nearside can be attributed to the northern plain's deposition events. These deposits have reduced the areal extent of PSRs in the Pre-Imbrian craters by shallowing the crater. There are suspected crypto-mare deposits towards the north pole which could have contributed to the observed shallowing. The current distribution of the larger PSR's (>10km2) on the lunar north pole support this argument as the far side hosts much of the larger PSRs.

REF:Mazarico E et al;(2011),Icarus,211(2),1066

Presentation Mode: Poster

Presenting Author: MISHAL KT

Registration id: NSSS-20211126090932

Study of CMEs assosciated with flares and filaments using extensive ML Techniques

Hemapriya Raju[1], Saurabh Das[1], Srijani Mukherjee[2]

[1]IIT Indore, [2]University of Kalyani

Solar eruptions such as CMEs, flares, and filaments disrupt geomagnetic and communication systems on Earth. While flares are abrupt, bright events that occur in the solar atmosphere and emit massive amounts of energy in the 10^28 to 10^32 erg range, CMEs are intense eruptions that hurl plasma into interplanetary space. CMEs can be found in conjunction with flares, filaments, or independent. Although both flares and CMEs are understood as triggered by a common physical process magnetic reconnection, yet the degree of association is unknown. We attempted to use this association of CMEs with flares and filaments through extensive Machine Learning and Deep Learning techniques to study the occurrence of CMEs. Further, since there is significant imbalance between the classes, we had explored approaches such as undersampling majority class, SMOTE and generation of samples using GAN. We achieved accuracy of around 95% for prediction of CMEs associated with flares and around 96% for those associated with filaments.

Presentation Mode: Poster

Presenting Author: Hemapriya Raju

Registration id: NSSS-20211201074225

Temperature structure and variability in Mesosphere--Thermosphere system

Sandhya K Nair[1], Tarun Kumar Pant[1]

[1]Space Physics Laboratory, VSSC

Earth's mesosphere and lower thermosphere are regions in which the transport and exchange of energy occur through subtle and complex processes. The dynamics of the region is dominated by waves and their effects. The basic structure of the region is determined by momentum deposition by small scale gravity waves. We note here that our knowledge on the day-to-day variability is highly limited on regional and global perspective. We report here studies on temperature variability in Mesosphere-Thermosphere region during NH winter using TIMED-SABER satellite data.

Global map of temperature from 850S to 500N latitude and 0 to 3600E longitude belt generated. This has done during northern hemisphere winter month of Dec 2014. North-south asymmetry in temperature and presence of waves are clearly seen in maps. We have done analysis of day to day variability of temperature over different grid boxes and examine its variability in day to day basis at various altitude grids in vertically from 10-110 km region. Presence of waves and its propagations observed. Its link with various processes and radiative energy examined. The solar energy influence and its association with various upper atmospheric processes are in progress.

Presentation Mode: Poster

Presenting Author: Sandhya K Nair

Registration id: NSSS-20220110044531

Geomagnetic field models and their usage in Space Science

Dupinder Singh[1], Duggirala Pallamraju[2]

[1,2]Physical Research Laboratory

Empirical models of Earth's magnetic field are a valuable resource to study the current systems in Earthâ€™s ionosphere and magnetosphere. The International Geomagnetic Reference Field (IGRF) model is a standard mathematical model of Earthâ€™s magnetic field which is routinely released by the International Association of Geomagnetism and Aeronomy (IAGA). IGRF represents the geomagnetic field up to 13 degree and order of spherical harmonics (SH), which suffices to study the main field, its secular variation also forms the basis for the calculation of non-orthogonal magnetic coordinate systems. The recent satellite missions have made possible the development of higher resolution magnetic field models. With the Spherical Harmonic degree and order above 100, these models provide sufficient accuracy to account for the magnetic field of internal origin at satellite altitude, which is crucial to study the ionospheric currents. Future low flying satellite missions will serve to further improve these models.

In this study, we compare various empirical models of Earth magnetic fields and their usage in Space Science research. We also discuss the importance of these models in studying the variability of ionospheric electrodynamic processes over small scales.

Presentation Mode: Poster

Presenting Author: Dupinder Singh

Registration id: NSSS-20220110075926

Lunar Exploration via ChipSats: Micrometeoroid Detection

Anmol Harshana[1], Reet Mhaske[1], Vansh Singhal[1], Aakash[1]

[1]Indian Institute of Technology Bombay

As a part of the Great Lunar Expedition for Everyone (GLEE) Mission initiated by CU Boulder that aims at deploying over 500 ChipSats (small, chip-sized satellites, a new form factor introduced in 2011, each equipped with sensors) on the lunar surface by 2023, we have envisioned a payload that utilizes the data from the accelerometers onboard these ChipSats to gain an understanding of the micrometeoroid flux on the lunar surface. Such an understanding will aid in designing structurally robust lunar missions that can sustain the impact of micrometeoroids.

Accordingly, we have tested various seismic data processing techniques that enable us to quantify the micrometeoroid flux, along with various other parameters of the lunar regolith.

The mission is replete with challenges, right from the uncertainty in a ChipSat's position to its expected time of survival (given their usage of COTS components and randomness inherent to the deployment method), which render standard seismic source localization techniques of little use. We have tried to come up with various innovative techniques, taking into account the challenges of the mission.

We have implemented advanced Optimization Techniques such as the Grey Wolf Optimization and Whale Optimization Algorithms to estimate the position of micrometeoroid impact. We have also explored seismic beamforming techniques and tried combining these techniques with several others like the traditional time difference of arrival. With regards to the data from seismometers, we have implemented signal processing techniques like thresholding and STA-LTA algorithm to identify the wave onset. To generate data to test these algorithms, we have prepared a 3D elastic wave propagation model to simulate the wave propagation on the lunar surface.

To conclude, we have tested algorithms for data processing and estimation of the positions of impacts. We further plan to tackle various complexities arising from multiple impact events and event classification.

Presentation Mode: Poster

Presenting Author: Anmol Harshana

Registration id: NSSS-20220110052709

Effects of Solar eclipse of 21st June 2020 on Equatorial Ionosphere

Lalitha G Krishnan[1], Tarun Kumar Pant[1]

[1]Space Physics Laboratory, ISRO

Solar eclipse is an important transient event to study the behavior of ionosphere-thermosphere system to the sudden changes in the solar radiation. The radar observations on the electrojet irregularities at 8.3m scale size were carried out from Thumba, Trivandrum to understand the electrodynamics of the upper atmosphere during the partial solar eclipse event of June 21, 2020. The E region electric field has been derived from the HF radar measured ionospheric drifts. Thereafter, incorporating the electron density obtained from Ionosonde measurements, the magnetic field that is induced on the ground by the EEJ current has also been estimated and compared with the magnetic field measured using a ground based magnetometer at Thumba. The two have been found to agree closely. The response of the equatorial E and F region to this partial solar eclipse which coincided with the summer solstice will be presented and discussed.

Presentation Mode: Poster

Presenting Author: Lalitha G Krishnan

Registration id: NSSS-20220110052005

Solar Energetic Particles and High-speed CMEs, associated class of solar flare and geomagnetic storm

Priyank Srivastava[1], A.K. Singh[1]

[1]Department of Physics, University of Lucknow

Solar particle events comprise many drastic and explosive phenomena due to the variability in the solar magnetic field with solar cycles of 11 years. This variability in the magnetic field of the sun triggers several events which result in the release of highly energetic particles such as protons, electrons, ions up to Fe, neutrons, and some γ- rays. SEPs are mainly consisting of protons and these are accelerated at the corona or in the interplanetary medium during flares and coronal mass ejections (CMEs) reaching energies up to several GeV. We have studied major SEPs of solar cycle 23(~106 SEPs) and 24(~46 SEPs) associated with high-speed coronal mass ejections and established their relationship with SXR (soft X-Rays) class flares and geomagnetic storms. From the detailed study of data from 1996-2020, we have found that these major SEPs are linked with CMEs advancing in IP space with high speed (>1500 km/s). The flares associated with these SEPs are of class X and M with the highest value of class X.20 on 02/04/2001,21:32 UT and X.28/3b on 04/11/2003, 19:38 UT in solar cycle 23 while in solar cycle 24, a flare of maximum intensity X9.3 on 06/09/2017, 11:53 UT was observed. The Pearson's correlation between proton peak flux for E> 10 MeV and flare intensity is cc = 0.44816 in SC23 and cc = 0.25461 in SC24. The Pearson's correlation between the proton peak flux (pfu) for E> 10 MeV and speed of CMEs shows a moderate correlation (cc=0.48) in SC23 and weak correlation (cc = 0.13) in SC24. We also found that these major SEPs were responsible for severe (G4, Kp=8-9) to extreme (G5 Kp=9) geomagnetic storms.

Presentation Mode: Poster

Presenting Author: Priyank Srivastava

Registration id: NSSS-20220110062055

Observation Of Coronal Loop Oscillation And Related Events

Safna Banu K[1], Ram Ajor Maurya[1]

[1]NIT Calicut

We investigated coronal loop oscillations induced by ejection of plasmoid associated with an X-class flare observed using Atmospheric Imaging Assembly (AIA) on board Solar Dynamic Observatory (SDO). AIA observations showed that the reconfiguration of magnetic field lines started after the initiation of the preflare which triggered the main flare. From the time series analysis, we measure and compare the period of oscillation and related physical parameters associated with coronal loops within the same magnetic arcade.

Presentation Mode: Poster

Presenting Author: Safna Banu K

Registration id: NSSS-20211127053453

Simulated evolution of magnetic flux rope in the quadruple magnetic field configuration

Sanjay Kumar[1], Avijeet Prasad[2], Sushree S. Nayak[3], R. Bhattacharyya[3]

[1]Department of Physics, Patna University, Patna, [2]Rosseland Centre for Solar Physics, University of Oslo, Postboks 1029 Blindern, 0315 Oslo, Norway, [3]Udaipur Solar Observatory, Physical Research Laboratory, Dewali, Badi Road, Udaipur-313001, India

The presented numerical computation simulates the magnetohydrodynamic evolution of a magnetofluid, initiated by a twisted non-force-free magnetic field. The field is constructed from a three-dimensional (3D) force-free magnetic field and the corresponding magnetic field line configuration consist of a quadrupole topology. Interestingly, the geometry of the field lines also resembles observed solar coronal loops. The simulation demonstrates that a favorable deformation of magnetic field lines due to initial Lorentz force leads to magnetic reconnections. Because of these reconnections, a magnetic flux rope is formed. Notably, the rope in the considered quadruple loops has a complex topology than the one which is formed in a bipolar loops system. Further evolution documents the rise of the flux rope governed by reconnections that repeat in time. The onset and ascent of the flux rope, reconnection locations are in general agreement with solar observations.

Presentation Mode: Poster

Presenting Author: Sanjay Kumar

Registration id: NSSS-20220109113224

Data-constrained simulation of solar coronal transients

Ramit Bhattacharyya[1]

[1]Physical Research Laboratory

Solar coronal transients, particularly the solar flares and coronal mass ejections, are the primary drivers of space weather. Generally, the transients are believed to be caused by magnetic reconnection: a process in which, magnetic field lines change their connectivity along with acceleration of charged particles and generation of heat. In absence of a reliable measurement, a novel procedure is to extrapolate the coronal magnetic field using photospheric magnetograms and subsequently use the same as an initial condition to explore magnetic field line dynamics and magnetic reconnection through numerical simulations. In the presentation, focus will be made on these so-called data-constrained simulations and results for selected cases will be discussed.

Presentation Mode: Poster

Presenting Author: Ramit Bhattacharyya

Registration id: NSSS-20220107071507

Flattening of ICME Magnetic cloud: An In-situ evidence

Zubair I. Shaikh[1], Geeta Vichare[1], Anil Raghav[2]

[1]IIG, [2]University of Mumbai

Several decades of remote and in-situ observations along with models, simulation, and kinetic studies, suggest that the cross-section of an ICME can vary from cylindrical, elliptical, toroidal, flattened, pancaked, etc. Here, we proposed a unique morphological characteristic of an ICME magnetic cloud 1 AU, where ICME MC transformed into a flattened quasi-2D structure named planar magnetic structure (PMS), using in-situ data from ACE spacecraft. We statistically shows that out of 469 ICME MCs from 1998 to 2017, 136 ($\sim 29 \%$) ICME MCs shows PMS characteristic (named as planar MCs), whereas 333 ($\sim 71\%$) does not have PMS characteristic (non-planar MCs). Interestingly, the total IMF strength, the average plasma parameters, i.e., plasma density, beta, thermal pressure, and magnetic pressure in the planar MCs, are significantly higher than non-planar MCs. Also, the thickness of planar MCs is less compared to non-planar MCs. These observations suggest that MCs can be transformed into planar-like structures due to the high compression from behind. We also observe the southward/northward magnetic field component's double strength during planar MCs compared to the non-planar MCs. It implies that planar MCs are more geo-effective than non-planar MCs. Furthermore, it remains an open problem: Is an ICME MC's transformation into a PMS-like configuration a local or global phenomenon? To answer this, we investigated multi-spacecraft (STA, STB, and Wind; longitudinally separated with each other) observation of an ICME at 1 AU. The STA and STB are longitudinally separated by about 40.8 degrees, while Wind was situated between them. Our analysis unambiguously confirms that the ICME observed at three spacecraft is highly flattened and has a PMS signature. Thus, the study concludes that the flattening of ICME MC is a global phenomenon. A detailed study is needed in this direction to investigate the origin and the effect of planar MCs on the heliosphere and solar-terrestrial physics.

Presentation Mode: Poster

Presenting Author: Zubair Ibrahim Shaikh

Registration id: NSSS-20211220014713

Comparison of suprathermal particles between the last two solar cycles: Insights

Bijoy Dalal[1], D. Chakrabarty[1], N. Srivastava[1]

[1]PRL

Suprathermal particles with energies from ~10 KeV/n to ~ 1 MeV/n are often characterized by a power law with spectral index of -5 (or -1.5) when considering variations of velocity distribution function with velocity (or, flux with energy). However, in recent times, there are reports of significant variations in spectral index even during the `quiet' times. Mixing of particle populations from various sources in the interplanetary medium into the suprathermal ion pool makes it more difficult to find a unique mechanism that may successfully explain all the observed features in suprathermal populations. It is possible that solar processes significantly alter the compositions and energies of suprathermal ion pool and if so, comparison of characteristic parameters of these particles among different solar cycles should result in variations in those parameters. This is important, especially, in identifying solar effects on the production and variation of suprathermal fluxes in the interplanetary medium. In the present work, suprathermal flux data for H and other heavy ions (4He, 3He, C, O, and Fe) obtained from Ultra Low Energy Isotope Spectrometer (ULEIS) on board the Advanced Composition Explorer (ACE) during solar cycle 23 and 24 are rigorously analyzed. It is found that there are some time delays (lags) between `quiet' suprathermal elements and sunspot numbers on many occasions. Lags and spectral indices corresponding to various elements are then compared between solar cycle 23 and 24. This comparison reveals that processing of suprathermal particles in the interplanetary medium depends on charge to mass ratio and first ionization potential of different elements in different solar cycles. This suggests that there is direct connection between solar variabilities and the production of suprathermal particles. These results will be discussed.

Presentation Mode: Poster

Presenting Author: Bijoy Dalal

Registration id: NSSS-20220107122318

Nonthermal Magnetoactive GES-based Solar Plasma Stability

Souvik Das[1], Pralay Kumar Karmakar[1]

[1]Tezpur University

A laboratory plasma-based astrophysical gravito-electrostatic sheath (GES) model, which has originally been reported to establish the solar surface emission mechanism of the solar wind in the framework of plasma-wall interaction processes, is herein methodologically applied to study the dynamic stability of the entire non-thermal turbumagnetoactive solar plasma system. The effects of non-thermality, fluid turbulence, and magnetic pressure are simultaneously considered in the formulation of the original GES structure equations. The adopted spherically symmetric formalism couples the solar interior plasma (SIP, internally self-gravitating, bounded) and the solar wind plasma (SWP, externally point-gravitating, unbounded) through the diffused solar surface boundary (SSB). The SSB is developed with a unique kind of exact gravito-electrostatic force-balancing condition. A normal spherical mode ansatz applied herein results in a generalized linear quadratic dispersion relation on the modal fluctuations on both the SIP and SWP scales separately. A constructive numerical platform reveals the evolution of both dispersive and non-dispersive modal features of the modified GES collective wave excitations. The reliability of the derived dispersion laws is concretized with the help of an exact shape matching with the previous results reported in the literature. The thermo-statistical GES stability depends mainly and sensitively on the magnetic field, plasma density, and plasma temperature. It is speculated that dispersive features are more pronounced in the gravitational domains against the electrostatic ones. The magneto-thermal interplay introduces decelerating (accelerating) and destabilizing (stabilizing) influences on the SIP (SWP). It may hereby offer a validated reliability of the proposed GES-based solar plasmic fluctuation analysis paving the way for further applicability in the future helioseismic direction extensively.

Presentation Mode: Poster

Presenting Author: Souvik Das

Registration id: NSSS-20220106043513

Study of two major forbush decrease events of 2017

Dr. vibha chaudhary[1], Dr. M. L. Chauhan[1]

[1]Government. science college,jabalpur,m.p.

The major forbush decrease events were recorded on july 2017and september 2017. Cosmic ray intensity data are taken from Moscow neutron monitoring station.The observed forbush decrease event are analysed with different interplanetary parameters.It has been observed that the cosmic ray intensity shows a decrease during the low Dst values in both FD events. The correlation study between CRI and Sun spot number(SSN),solar wind velocity,Ap-index etc. reveals that thease is a strong relationship of FD's with solar activities. The intense solar flares may be the cause of such large decrease in cosmic ray intensity.

Presentation Mode: Poster

Presenting Author: Dr. vibha chaudhary

Registration id: NSSS-20220108091547

Stability Dynamics Of Non-thermal Solar Plasma Fluctuations In Turbu-magnetized GES Model Framework

Souvik Das[1], Pralay Kumar Karmakar[1]

[1]Tezpur University

A laboratory plasma-wall interaction-based astrophysical gravito-electrostatic sheath (GES) model, which has originally been reported to investigate the solar surface emission mechanism of the solar wind, is herein methodologically applied to analyze the dynamic stability of the entire non-thermal solar plasmas. The effects of non-thermality, fluid turbulence, and magnetic pressure are simultaneously considered in the formulation of the original GES structure equations. Accordingly, the entire GES-based solar plasma system, which is an amalgamation of the self-gravitating subsonic solar interior plasma (SIP, bounded) and non-gravitating supersonic solar wind plasma (SWP, unbounded), is destabilized relative to the GES equilibrium. Application of normal spherical perturbation mode ansatz herein divulges the evolution of both dispersive and non-dispersive modal features of the modified GES collective wave excitations dictated by a distinct pair of linear dispersion laws on both the SIP and SWP scales. The utmost reliability of the proposed dispersion laws is concretized with the help of an exact dispersion shape matching with the previous results available in the literature. It is herewith inferred that the thermostatistical GES stability depends mainly and sensitively on the magnetic field, plasma density, and plasma temperature. A numerical platform illustrates the various especial stability properties of the plasma fluctuations. It is demonstrated with the help of both color and line profiles. It is speculated that dispersive features are more pronounced in the gravitational domains (SIP) against the electrostatic ones (SWP), and so forth. Its rigorous non-local analysis for the non-thermal quasilinear gravito-acoustic interaction mechanisms behind it in a helioseismic characteristic direction is in progress.

Presentation Mode: Poster

Presenting Author: Souvik Das

Registration id: NSSS-20220110082441

Effects of Solar Variability on Modulation in Galactic Cosmic Rays

B.K.Tiwari[1]

[1]Department of Physics, A. P. S. University, Rewa (M.P.) 486003, India

The variability of the Sun's magnetic activity is drives changes in the near- Earth space environment, the heliosphere, and interplanetary medium. Solar variability occurs over a broad range of spatial and temporal scales. The structure of the heliosphere and produce changes in Galactic cosmic rays (GCRs) intensity controls by solar variability. The observation based on data taken from Omniweb data centre for solar- interplanetary parameters and count rate of cosmic ray intensity (CRI) variation data from Oulu / Moscow Neutron Monitors (with their cutoff rigidities Rc=0.80 GV & Rc=2.42 GV) during Solar Cycles 23/24 . It is observed that the sunspots is low and the strength of the interplanetary magnetic field has been falling off low levels , reduces the GCR entering inner- heliosphere and it is high anti-correlation (-0.80) between sunspot number & GCR intensity . It is also observed that 10.7 cm Solar Radio Flux (SRF), Solar Wind Velocity (SWV) and the strength and turbulence of the interplanetary magnetic field with count rate of cosmic ray intensity are inverse correlated.

Presentation Mode: Poster

Presenting Author: B.K.Tiwari

Registration id: NSSS-20220110103233

Comparative geomagnetic disturbance analysis of stations within the South Atlantic Anomaly

Syamily P, Gopika S. Vijayan[1], Amrutha S.[1]

[1]Christian College Chengannur (Under University of Kerala)

This work analyses the geomagnetic field disturbance of stations in the South Atlantic anomaly region using the Vertical Variance method. Vertical Variance(VV) is a mathematical index , which can exactly quantify the amount of temporal variations in any time series. In the South Atlantic Anomaly region, the Earth's magnetic field becomes weak compared to an idealized Earth centered dipole field. This leads to an increased flux of energetic particles in this region.

In this study, we compare the geomagnetic field disturbance of same latitude stations inside and outside of the South Atlantic Anomaly region. We take the vertical variance of magnetic field and plot contour maps for each year connecting stations of equal disturbance. It has been found that the geomagnetic field disturbance of inside anomaly stations of Hermanus(GM Lat:-42.08) and Port Stanly(GM Lat:-38.96) is very low compared to the outside station Canberra(GM Lat:-43.54) with nearly the same latitude. Similarly, Trelew(GM Lat:-29.98) inside the anomaly region also has a very low disturbance as compared to the outside station of Learmonth(GM Lat:-31.41). We repeat this study for different years of 24th solar cycle for consistency.

Presentation Mode: Poster

Presenting Author: Syamily P

Registration id: NSSS-20211222060606

Development of an AOTF based NIR Spectro-polarimeter to Study Disc-integrated Earth

Swapnil Singh[1], Anand Jain[1], Bhavesh Jaiswal[1,2], Reenu Palawat[1], Smrati Verma[1], Brajpal Singh[1], Ravishankar BT[1] , Anuj Nandi[1]

[1]U R Rao Satellite Centre, [2]Indian Institute of Science

We present the instrument configuration of an Acousto-Optic Tunable Filter (AOTF) based Near-Infrared (NIR: 1 – 1.7 μm) spectro-polarimeter to observe the spectro-polarimetric signatures of Earth. The AOTF, consisting of a birefringent crystal (TeO2), is the heart of the instrument along with the sensor element: Linear Array Indium-Gallium-Arsenide (InGaAs) detector. The AOTF is driven by a radio frequency signal generated with the in-house developed radio frequency (RF) system. On application of the RF signal, the AOTF filters the incident light and produces two diffracted narrow-band beams, which are polarized in mutually perpendicular directions. The instrument optics with FOV ~ 2.6 deg is configured to focus the two output beams onto two InGaAs detectors. In-house front-end, processing and power electronics have been developed to read out the data from the detectors which is packetized in the specified format for further processing. Performance study of the AOTF has been carried out in order to understand the Frequency-Wavelength relation, spectral bandpass and the Mueller matrix of the AOTF in the desired wavelength range. Laboratory demonstration of the detectors with the full chain of electronics was also carried out to study the noise and pixel-wise performances for various integration times. The instrument is designed to carry out a disc-integrated spectro-polarimetric study of Earth from space, the only known habitable planet till date. Linear Polarization of water and ice clouds and spectral signatures from various gas species (such as H2O, CO2, O2) will be probed. These observations will be useful in benchmarking the future phase-resolved observations of Earth-like Exo-planets.

Presentation Mode: Poster

Presenting Author: Swapnil Singh

Registration id: NSSS-20220110090803

The Effect of HSWS on Geomagnetic Field Disturbances From 1986 to 2021

Praveen Kumar Vishwakarma[1]

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It is well known that geomagnetic activity is controlled by the solar wind. Geomagnetic indices are basically related to the Earth though a possible relationship with solar phenomena the geomagnetic activity often increase several hours after some solar events and speculated that solar corpuscular emissions from M regions were responsible for this increase. While studying the Sun and its impact on geomagnetic indices for last two complete Solar Cycles and up to high Sunspot time period of recent Solar Cycle we found that on long-term basis, total annual number of HSWS events and annual average of geomagnetic Ap-index show significant positive correlation for the entire period of 1986-2021.

Presentation Mode: Poster

Presenting Author: Praveen Kumar Vishwakarma

Registration id: NSSS-20220110091250

Plenary Session 4

Astronomy and Astrophysics

This session will focus on diverse topics in astronomy and astrophysics ranging from stars, galactic and extragalactic astronomy, physics of compact objects, high energy astrophysics, cosmology and the early Universe, gravitational wave astronomy and other fundamental astrophysics research enabled by space-based observations.

Science with proposed UV space mission: INSIST

Maheswar Gopinathan[1], Annapurni Subramaniam[1], INSIST Science Team[1]

[1]Indian Institute of Astrophysics

Following up on the highly successful UltraViolet Imaging Telescope (UVIT) instrument onboard Astrosat, the Indian astronomical community interested in the UV domain has submitted a proposal for a next-generation UV-Optical mission, the INdian Spectroscopic and Imaging Space Telescope (INSIST) in response to a call for proposals by the Indian Space Research Organisation. This proposal is led by the Indian Institute of Astrophysics partnering with ARIES, IUCAA, PRL, TIFR, Christ University and other national and international institutions. The INSIST science team has identified some of the key science topics that define the telescope baseline specifications and the choice of instruments for the observatory. Combination of high spatial resolution, wide-field UV-optical photometry and medium resolution multi-object spectroscopy from INSIST will be powerful for addressing a wide range of astrophysical questions. In this presentation I will highlight some of these key science cases and discusses their impact and possible synergy with the upcoming ground and space-based facilities.

Presentation Mode: Oral

Presenting Author: Maheswar Gopinathan

Registration id: NSSS-20220110083703

Daksha: Indian eyes on transient skies

Varun Bhalerao[1]

[1]IIT Bombay

Daksha is an ambitious proposed mission to build the most sensitive high energy time domain telescopes in the world, with the goal of studying explosive transients in the cosmos.

High energy phenomena like Gamma Ray Bursts and Gravitational Wave sources have the most extreme environments in the universe. Studying these sources allows us to probe fundamental physics at scales not possible in laboratories. While considerable progress has been made by existing missions like India's AstroSat or international missions like Swift and Fermi, it is clear that these missions are inadequate for pushing the boundaries of this research in the coming decade.

Daksha is being designed with higher sensitivity and coverage than these missions, and will be the most sensitive all-sky monitor in the world. Daksha can become the workhorse for high energy transient discovery and characterisation in the coming decade. Daksha will be able to detect the faint electromagnetic counterparts to GW sources, discover the most distant gamma ray bursts from the infancy of the universe, perform broadband spectroscopy (1 keV - 1 MeV), study temporal evolution of transients, and even measure polarisation of GRB jets.

In this talk, I will define the scientific goals and sensitivity requirements for this next-generation mission. I will discuss the Daksha design that will meet these goals, and show how it outperforms current and other proposed missions from around the world. I will conclude by showing the current status of the mission design and laboratory models.

Presentation Mode: Oral

Presenting Author: Varun Bhalerao

Registration id: NSSS-20220110020226

UVIT study of T-Tauri Stars

Prasanta K Nayak[1], Mayank Narang[1], Manoj Puravankara[1], Uma Gorti[2], Annapurni Subramaniam[3], Nayana George[4], Chayan Mondal[5]

[1]TIFR, [2]SETI/NASA Ames, [3]IIA, [4]MG University at Kerala, [5]IUCAA

T Tauri stars (TTSs) are low-mass pre-main-sequence (PMS) stars. Accreting TTSs are known as Classical TTS (CTTS) and are characterized by strong H-alpha line emission and significant continuum excess emission in the UV and IR over photospheric values, whereas non-accreting disk-less TTSs are called weak-lines TTS (WTTS) as they show weak H-alpha emission. Emission from strong accretion shocks is thought to be the reason for the UV excess in CTTS, whereas comparatively low UV excess in WTTS is due to chromospheric activity. Another defining characteristic of TTS is that they show variability in line luminosities as well as in UV and optical continuum. The variations in UV line luminosities are also found to be correlated with variations in optical bands. The main source of variability is thought to be the change in accretion rate. The time scales of variability can be as short as a few hours to weeks, months, years, or longer. Though there have been many studies on TTS in optical and IR regions, their UV properties are relatively less studied despite the importance of UV photons in disk heating and influencing gas chemistry within the disk. We will present preliminary results from multiband photometric and FUV spectroscopic observations of young TTS and discuss what the UV properties of young stars can tell us about accretion and disk evolution. This will be the first UVIT study of TTS. We will also discuss the excellent capabilities of UVIT (in both photometry and spectroscopy) to study accretion variability in young TTS.

Presentation Mode: Oral

Presenting Author: Prasanta Kumar Nayak

Registration id: NSSS-20211126070237

Minerals in the ISM are Made in an Instant

Arijit Roy[1], V S Surendra[1], J K Meka[1], R Ramachandran[1], D Atri[2], B N Rajasekhar[3], P Janardhan[1], A Bhardwaj[1], N J Meson[4], B Sivaraman[1]

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Dust, especially silicate types, are detected in different astrophysical regions using the characteristic IR spectral features. Similar spectral signatures are also observed in different comets, asteroids, and Interplanetary Dust Particles (IDP), and meteorites. The formation pathways of mineral dust at ISM have not been well understood to date. Various experimental and theoretical methods have been proposed by various groups to understand the formation route of mineral dust at ISM. These are like Sol-Gel technique, melting and quenching technique, gas phase condensation, laser pyrolysis, and ion irradiation.

Shock waves are known to play a vital role in the chemical enrichment of ISM as well as on the surface of the air-less planetary bodies. Shock waves of various intensities have been observed at different parts of the ISM. The high-velocity shock waves (> 50 km s^{-1}) are known to contribute to different dust destruction processes like sputtering, grain charging, shattering, etc. On the other hand, low-velocity shock waves (1-10 km s^{-1}) have been proposed to chemically enrich the propagating medium.

We have investigated the shock-induced formation pathway of mineral dust using the High-Intensity Shock Tube for Astrochemistry (HISTA) housed at PRL, Ahmedabad, that can simulate shock waves up to 6 Mach. We prepared stoichiometric mixtures of Mg, Fe, and SiO_2 and subjected the mixture to high-intensity shock (~ 7000 K, 2 ms). The processed samples were collected and examined using spectroscopic and imaging techniques. Preliminary results will be discussed in this meeting.

Presentation Mode: Oral

Presenting Author: Arijit Roy

Registration id: NSSS-20220109061513

A UVIT look at Star Formation in Merging and Interacting Galaxies

Mousumi Das[1], Rubinur Khatun[2], Jyoti Yadav[1]

[1]IIA, [2]NCRA

The interactions and mergers of gas rich galaxies are known to produce star formation which often leads to nuclear activity as well. The star formation activity is ideally mapped by FUV and NUV emission which traces star formation for longer timescales compared to other wavelengths such as Halpha emission. In this study we present UVIT FUV and NUV observations of merging and interacting galaxies in our nearby universe. We first present a sample of merging galaxies of which many have dual nuclei. The UV is associated with the spiral arms, the individual nuclei, as well as star formation due to AGN/stellar feedback from the nuclei. We discuss one galaxy in detail, MRK212, which hosts a dual AGN. The star formation in MRK212 is mainly associated with the spiral arms due to the merging process, but there is also nuclear UV emission due to star formation possibly triggered by jet cloud interaction. We describe a few other cases where the UV emission is closely associated with the nuclei. We also present results of the UV emission around a triple AGN system, NGC7733-7734, where the UV emission traces the interaction between a small group of 4 galaxies, 3 of which show AGN activity. The UV traces star formation in the spiral arms, along the bars and in extended tidal features between the galaxies. Thus UV is a powerful tool to study the interaction and nuclear activity in galaxies.

Presentation Mode: Oral

Presenting Author: Mousumi Das

Registration id: NSSS-20211210055208

Discovery of a large, diffuse star-forming galaxy using UVIT and MUSE

Jyoti Yadav[1], Mousumi Das[1], Sudhanshu Barway[1], Francoise Combes[1]

[1]Indian Institute Of Astrophysics

A low-surface-brightness galaxy, or LSB galaxy, is a diffuse galaxy with a surface brightness that is at least one magnitude fainter than the ambient night sky. The LSB galaxies may account for up to 15 % of theÂ mass of the universe. However, they are difficult to study due to the observational challenges in detecting them because of their inherent faintness. In this study, we present serendipitous discovery of a nearby diffuse galaxy that shows intense star formation in its inner disk using Ultraviolet Imaging Telescope (UVIT) and Multi-Unit Spectroscopic Explorer (MUSE) data. The galaxy was not detected earlier due to its superposition with the background galaxy NGC 6902A. They were together mistakenly classified as an interacting system. While studying a known interacting galaxy NGC6902A we noticed that south-west outer region of galaxy NGC 6902A shows diffuse blue emission. This south-western region shows prominent star forming regions in the FUV image. Further investigations revealed that these star forming regions are at a distance of around 136 million light-years, whereas the distance of NGC 6902A is around 825 million light-years. This means that the diffuse blue emission was from a foreground galaxy, which we discovered using FUV and MUSE data. We named it UVIT J202258.73-441623.8 based on the UVIT telescope that helped us to discover the galaxy. Our study suggests that powerfulful instruments such as UVIT and MUSE thus opens a gateway to searching for similar cases, where blue diffuse tidal features in interacting galaxies may not be the remnant of a merger but instead a separate foreground and/or background galaxy. This study has been accepted in A&A Letters.

Presentation Mode: Oral

Presenting Author: Jyoti

Registration id: NSSS-20220103061708

Non-isothermal vertical density distribution of stars in the Milky Way

Suchira Sarkar[1], Chanda J. Jog[1]

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The vertical density distribution of stars in a galactic disc is traditionally obtained assuming an isothermal vertical velocity dispersion of stars. But recent observed data from Gaia, LAMOST, RAVE show that this dispersion increases with height from the mid-plane. We theoretically study the dynamical effects of such non-isothermal dispersion on the vertical distribution of the thin disc stars in the Milky Way. We apply a linear gradient of +6.7 km/s/kpc in the dispersion values based on the observed data. We find that the mid-plane density is lower, and the scale height is higher in the non-isothermal case than the corresponding values for the isothermal distribution, by ~35% in the solar neighborhood for a stars-alone disc. The non-isothermal distribution shows a wing at high vertical distance, and is fitted well by a double sech^2 profile , which could be mis-interpreted as the existence of a second, thicker disc, specially in external galaxies. Further, the total local mid-plane density i.e, the Oort limit value, calculated using the realistic multi-component system of stars, gas in the field of dark matter halo, is reduced by 16% in the non-isothermal model. For details of this work, see- Sarkar & Jog, MNRAS, 499, 2523 (2020).

Presentation Mode: Oral

Presenting Author: Suchira Sarkar

Registration id: NSSS-20211220015829

Star-dust geometry as main determinant of dust attenuation in galaxies

Sonali Sachdeva[1], Biman Nath[1]

[1]RRI

Analyzing a large representative sample of local galaxies (16908), we find that the shape of the dust attenuation curve, i.e., the normalized slope of the curve in ultraviolet and optical wavelengths, is intimately tied to both the dominant structure of the galaxy and its star formation activity. However, no such connection is seen for either the total stellar mass or the inclination of the galaxy. The attenuation curve for star-forming galaxies as compared to the passive ones is nearly twice as shallow. Similar findings are reflected in terms of the structure where the curve is twice as steep for spheroid dominated compared to disc dominated galaxies. The steepness of the curve for spheroids and passive galaxies is driven by minimal attenuation of optical emission compared to the emission in UV wavelengths, underlining the lack of dusty birth-clouds that are integral to complex star-dust geometry. Also, within a particular class, i.e., that of star-forming, passive, discs or spheroids, the slope values are constrained to a narrow range depicting no variation with total dust mass. All evidence indicates that the presence or lack of complex star-dust geometry is the main determinant of galaxy's attenuation properties.

Presentation Mode: Oral

Presenting Author: Sonali Sachdeva

Registration id: NSSS-20220106100124

Clues of Dark Matter Distribution in Galaxies from Bar Buckling

Ankit Kumar[1], Mousum Das[1], Sandeep Kumar Kataria[1]

[1]Indian Institute of Astrophysics, Bengaluru

2/3 of the spiral galaxies harbour a stellar bar in their centers. The dynamics and morphology of the bar change quite significantly during its evolution. Some edge-on galaxies show the thick boxy or peanut shape structure in their centers. These boxy or peanut shape structures are always associated with the bar. One mechanism that leads to the formation of boxy or peanut structures is bar buckling, where the bar bends out of the galaxy's plane. In this presentation, I shall talk about our recently published work - the effect of dark matter halo shape on bar buckling and boxy/peanut bulges. Using N-body simulations of disk galaxies in oblate, spherical, and prolate dark matter halos, we found that oblate halos delay bar formation, so the buckling of the bar. In contrast, prolate halos show early bar formation, which leads to early buckling. All of our models go through two buckling episodes, but the most prolate halo shows three distinct buckling episodes. Three buckling events cumulatively increase the detectability of buckling event in the prolate halo. But the rare detection of buckling events in observation indicates that most of the barred galaxies may have spherical or oblate halos rather than prolate. As a result of multiple bar buckling, prolate halo also shows the thicker boxy or peanut structure.

Presentation Mode: Oral

Presenting Author: Ankit Kumar

Registration id: NSSS-20211218064800

Understanding of Pre-main Sequence Stars in Galactic Star-Forming Regions

Soumen Mondal[1], Alik Panja[1], Somnath Dutta[2], Samrat Ghosh[1], Siddhartha Biswas[1], Rajib Kumbhakar[2]

[1]S. N. Bose National Centre for Basic Sciences, Saltlake, Kolkata, [2]Academia Sinica Institute of Astronomy and Astrophysics, Taipei, Taiwan

Galactic star-forming regions are the formation sites of young stars in Pre-Main Sequence (PMS) different stages, including massive O, B type stars in H II regions. Multi-wavelength studies on such regions help to understand the census of PMS stars, their formation process, and the interaction of expanding H II regions with its natal molecular clouds. PMS stars first came into the spotlight due to their photometric variable characteristics. Variability studies have been performed on understanding of their rotation rates and the role of angular momentum in their stellar evolution. The variability in a PMS star is thought to be originated via various mechanisms e.g., magnetically induced cool star spots or magnetically channeled variable accretion flows generating hot spots on the star surface, eclipsing binary, opacity due to non-uniform dust distribution, etc. In this presentation, we like to highlight some of our results obtained from our multiwavelength observations.

Presentation Mode: Oral

Presenting Author: Soumen Mondal

Registration id: NSSS-20220110101702

ALMA detection of the glycine presursor amino acetonitrile towards hot molecular core G10.47+0.03

Arijit Manna[1], Sabyasachi Pal[1]

[1]Midnapore City College

In the interstellar medium, the simplest amino acid glycine has an important role in the origin of life in the Universe. In the last 40 years, all surveys for the searching of the amino acid glycine have failed in the interstellar medium in millimetre and submillimeter radio wavelengths. Since the detection of glycine in the interstellar medium was highly difficult, so we aimed to search for the direct precursor of glycine. After the deep searches, we successfully identified the emission lines of the glycine precursor molecule amino acetonitrile towards the hot molecular core G10.47+0.03 between the frequency range of 129.50-160.43 GHz using the Atacama Large Millimeter/Submillimeter Array (ALMA) interferometric radio telescope. The estimated statistical column density of amino acetonitrile using the rotational diagram method was $(7.1\pm0.52)\times10$ 17 cm $^{-2}$ with rotational temperature 150±2.8 K.

The Markov Chain Monte Carlo (MCMC) approach was also used to fit the Local Thermal Equilibrium (LTE) model on observed amino acetonitrile transitions. The estimated fractional abundance of amino acetonitrile was 5.259×10 $^{-8}$ where N (H_2) = 1.35×10 25 cm^{-2} . We also presented the possible linking between amino acetonitrile and the simplest amino acid glycine towards the hot molecular core regions.

Presentation Mode: Oral

Presenting Author: Arijit Manna

Registration id: NSSS-20211217030337

A Gaia kinematic study of ages of debris disks and exoplanet host stars: Are Jupiter-hosting stars young?

Mayank Narang[1], Manoj, P.[1]

[1]Tata Institute of Fundamental Research

Understanding the dependence of planet properties on the host star age can provide us with important clues to the planet formation processes and the galactic evolution of planetary systems. Since individual age measurements of main-sequence stars are difficult, we have used velocity dispersion as a proxy for stellar age. We used Gaia EDR3 to calculate the velocity dispersion for a sample of stars hosting debris disks, exoplanet host stars, and field stars in the solar neighborhood. Our study shows that exoplanet host stars and field stars have similar velocity dispersion and hence similar ages. We demonstrate that the stars hosting debris disks, on average, are younger than field stars and exoplanet host stars. We in this work further show that as the planet mass increases, the velocity dispersion of the host stars decreases, indicating that Jupiter-like planets are found around younger host stars (< 5-7 Gyrs) compared to smaller planets. We also find that the host stars of hot-Jupiters (period <10 days) have a smaller velocity dispersion and are, therefore, younger (<3-4 Gyrs) than host stars of warm and cold Jupiters. We discuss our results and, in combination with the velocity dispersion-stellar metallicity relation, examine the implications of our results for planet formation in the context of galactic evolution.

Presentation Mode: Oral

Presenting Author: Mayank Narang

Registration id: NSSS-20211219052211

Are giant planet-hosting stars young? Evidence from galactic chemical evolution

Swastik Chowbay[1], Ravinder K Banyal[1], Mayank Narang[1], Manoj P, T Sivarani[1]

[1]Indian Institute of Astrophysics

The observed metallicity-mass correlation for star-planet properties is well known in exoplanet research. In the past, numerous studies have confirmed that Jupiter-like planets are commonly found around metal-rich stars, while that is not necessarily the case for low-mass planets. In most previous studies, the iron abundance [Fe/H] was used as a proxy for the overall metallicity of the star. This work analyzed the detailed chemical abundances of alpha and iron-peak elements for a sample of over 981 exoplanet host stars drawn from different radial velocity and transit surveys. We correlate the abundance trends with the planet mass. Our results indicate that parent stars of giant planets (Jupiter analogues) belong to the young stellar population. This is further validated by the age of the host stars obtained from isochrone fitting. We interpret these findings in the framework of galactic chemical evolution. The imprints of stellar nucleosynthesis and chemical evolution of the galaxy can be seen in different stellar populations, with early-type stars showing higher alpha-element abundances while the later generation was becoming more enriched with iron-peak elements. The later enrichment of protoplanetary material with iron-peak elements is also consistent with the core accretion process. Higher metal fraction is conducive for rapid core growth, thus, providing a plausible route for the formation of giant planets. This study lends independent support to the core-accretion process and further shows that observed trends in stellar abundances and planet mass are more likely a natural consequence of galactic chemical evolution.

Presentation Mode: Oral

Presenting Author: Swastik Chowbay

Registration id: NSSS-20211215022436

Cosmic rays diffusion and gravitational collapse in radiative molecular clouds

Ram Prasad Prajapati[1]

[1]School of Physical Sciences, JNU

Cosmic rays (CRs) are believed to play a significant role in the ionization of interstellar gas and its dynamics in the interstellar medium (ISM). The effects of cosmic rays (CRs) diffusion and finite Larmor radius (FLR) corrections have been studied on the linear gravitational instability of thermally conducting plasmas typically in the H II region of molecular clouds. The hydrodynamic fluid-fluid approach is considered to interact CRs with gravitating, magnetized, and thermally conducting gas in molecular clouds.

The MHD fluid model is formulated considering gradients of the CR pressure, CRs diffusion, radiative and FLR effects in terms of particles Larmor radius. The dispersion relation of the gravitational instability is analytically derived using the normal mode analysis, and the combined effects of CRs and FLR corrections have been analyzed in longitudinal and transverse modes. It is found that coupling of FLR corrections in terms of magnetic viscosity with CR effects significantly decreases the growth rate of the instability. The CR pressure stabilizes the growth rates of the gravitational and thermal instabilities while parallel CR diffusion destabilizes the growth rate of the gravitational instability. The Jeans length of the system gets increased due to an increase in the CR to gas pressure ratio. The gravitational collapse is supported by the system with high energy (above knee) CR particles with a Larmor radius comparable to the cloud size. The results have been applied in the H II region of molecular clouds to understand the interplay between CR parameters and FLR corrections on the gravitational collapse of the medium.

Reference: R. P. Prajapati, MNRAS (2021) DOI: 10.1093/mnras/stab3420 (In Press)

Presentation Mode: Oral

Presenting Author: Ram Prasad Prajapati

Registration id: NSSS-20211126051544

Validating different modes of AGN feedback through X-ray observations

Rudrani Kar Chowdhury[1,2], Suchetana Chatterjee[2], Ankit Paul[2]

[1]The University of Hong Kong, [2]Presidency University

Majority of the galaxies in our universe harbour super massive black holes (SMBH) having mass 10^6 - 10^9 M_sun. A fraction of this SMBH population accretes material from their adjacent medium, commonly termed as Active Galactic Nuclei (AGN). They radiate enormous energy to the surroundings. The phenomenon in which a part of this emitted energy gets linked to the ambient medium is called AGN feedback. Various studies have established that AGN feedback significantly influences the properties of their host galaxies and dark matter halo. One of the best avenues to study the imprint of AGN feedback on their surrounding medium is observing the diffuse X-ray emission coming from the galaxy clusters. Feedback from the AGN has been incorporated in cosmological simulation to investigate their importance in the AGN-host galaxy co-evolution paradigm. Our work aims to connect the results obtained from cosmological simulation with the X-ray observations of the galaxy groups and clusters in order to understand the importance of different modes of feedback on their environment. We use different cosmological simulations (Khandai et al. 2015, Dave et al 2019) to work with the diverse AGN feedback models and calculate the detailed X-ray emission from the simulated galaxy groups and clusters. This is followed by performing the synthetic observations of the statistical sample of galaxy clusters in the simulation with the Chandra X-ray telescope using the technique of Kar Chowdhury et al (2021). Our study shows that radiative feedback alone is not sufficient in evacuating hot gas from the vicinity of the AGN. Jet and X-ray mode of feedback plays an important role in this regard. We also observe that with the resolution limit of Chandra telescope, feedback signature of the low redshift objects are more resolved compared to the objects at higher redshift. Our study thus makes an avenue to examine the detection probability of the high redshift objects with the upcoming X-ray missions

Presentation Mode: Oral

Presenting Author: Rudrani Kar Chowdhury

Registration id: NSSS-20211205052539

RMS-Flux Relation and Disc-Jet Connection in Blazars in the Context of the Internal Shocks Model

Aritra Kundu[1], Ritaban Chatterjee[1], Kaustav Mitra[2], Sripan Mondal[1]

[1]Presidency University, Kolkata, [2]Yale University

Recent analysis of blazar variability has revealed a proportionality between the mean flux and the root mean squared (rms) fluctuations about the mean flux. Although such rms-flux relation has been previously observed in the accretion disc/corona variability of X-ray binaries and Seyfert galaxies, and has been extensively modelled, its emergence in the jet light curves of blazars calls for a revised theoretical understanding of this feature. In this work, we analyse the time variability properties of realistic multi-wavelength jet light curves, simulated in the context of a simplified version of the internal shocks model, particularly focusing on the rms-flux relation. These shocks accelerate the jet electrons to relativistic energies, which then cool radiatively via synchrotron and inverse-Compton processes. We find that the rms-flux relation may be consistently recovered in the cases, in which the shocks have different amplitudes based on the speed of the colliding blobs generating them as opposed to all shocks having the same amplitude. We observe that the slope of the rms-flux relation depends on the wavelength at which the variability is observed and the energy distribution of the electron population. We find that the accretion disc and the jet variability are anti-correlated, with the latter lagging that of the disc. Our results provide crucial constraints on the physical properties of the jet, and the mode of connection through which the accretion disc and jet may be related.

Presentation Mode: Oral

Presenting Author: Aritra Kundu

Registration id: NSSS-20211206070454

Relative Contribution of X-ray Reprocessing and Disk Fluctuations in the Long-term Optical Variability of the Radio Galaxies 3C 120 and 3C 111

Nabanita Das[1], Tathagata Saha[2], Ritaban Chatterjee[1]

[1]Presidency University, Kolkata, India, [2]Nicolaus Copernicus Astronomical Center of the Polish Academy of Sciences, Warszawa, Poland

The optical and ultraviolet radiation of active galactic nuclei (AGN) originates from the accretion disk and the X-rays are presumably produced at a tenuous distribution of high energy electrons called the corona. The mechanism of the coronal X-ray emission is believed to be inverse-Compton scattering of the optical-UV photons generated in the disk. Part of the optical-UV emission may be due to the reprocessing of the coronal X-rays at the disk. The origin of the optical-UV emission variability has been extensively debated in the literature in the last decade, the main candidates being intrinsic fluctuation of the disk and variability of the X-rays which are reprocessed in the disk. We analyze the long term (few years) time variability of the optical emission of the broad line radio galaxies 3C 111 and 3C 120 in the context of the above disk-corona connection. We have considered the lamp-post model, in which the corona is thought to be a point source above the plane of the disk. We find, for a large parameter space of the model, that reprocessing of the 2-10 keV X-ray emission alone without any intrinsic fluctuation of the accretion disk is not enough to reproduce the optical variability amplitude and flux level in either of the two sources. We model the variability of the underlying disk emission and the X-ray reprocessing in order to reproduce, approximately, the observed variability and the flux levels in the observed R-band light curves. In such a model with a variable disk emission, the reprocessed fraction contributes a minor part, approximately 15%, of the total R-band emission.

Presentation Mode: Oral

Presenting Author: Nabanita Das

Registration id: NSSS-20211215055616

Decoding the largest radio galaxies in the Universe

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The Giant Radio Galaxies (GRGs) represent an extreme and relatively rare class of active galaxies with linear sizes in the range of 0.7 Mpc to ~ 5 Mpc which places them among the largest single astrophysical objects known to us. It is still debated whether the large sizes of GRGs are due to the high efficiency of the radio jets ejected from the powerful central AGN or their sparser environments or a combination of both. To understand the formation, growth and evolution of GRGs, a project called the â€˜Search & Analysis of GRGs with Associated Nucleiâ€™ (SAGAN) was initiated. In order to study their properties from megaparsec to parsec (AGN) scales, multi-wavelength data of large samples selected at different flux density limits are needed. Hence, under the project SAGAN, we have as a first step (a) carried out an extensive search for GRGs from radio surveys, (b) made a complete compendium of all known GRGs uniformly, and (c) studied the AGN and environmental properties of the largest sample of GRGs to date. As a result of our search, we have found ~400 new GRGs, which almost doubled the known GRG population and a GRG-catalogue of ~820 sources has been compiled by us. Using our catalogue we were able to establish that the black hole mass and radio spectral index of GRGs and normal-sized radio galaxies are similar. We classified the AGN excitation type of GRGs and found that GRGs do not have preferential excitation type AGN. We also find that GRGs with high excitation type AGN statistically have larger total radio power, jet kinetic power and Eddington ratio. Our environmental study of GRGs shows that only about 15% of GRGs reside in dense environments.

We have also carried out a study of GRGs with GMRT to study its large scale radio properties and with the IRAM-30m mm-wave telescope to study the molecular gas properties of the host galaxy. The upcoming data will allow us to use GRGs as a probe of the Warm-hot-intergalactic medium to study the missing baryons problem.

Presentation Mode: Oral

Presenting Author: Pratik Dabhade

Registration id: NSSS-20220110013755

Study of External Compton Mechanism in the Context of Astrophysical Jets

Sriyasriti Acharya[1], Indu kalpa Dihingia[1], Bhargav Vaidya[1]

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Blazars, a subclass of AGN jets, are considered to be one of the brightest objects in the universe. The multi-wavelength spectra of these jets are characterized by two humps where the emission mechanisms are believed to be leptonic Synchrotron emission, Inverse Compton (IC) scattering, or hadronic process.

In this work, we incorporate a numerical scheme in the PLUTO code to account for the energy loss due to the Inverse Compton process, where the origin of the target photon field, considered for the Compton scattering is external to the jet such as the BLR region, accretion disk, etc. Such an emission mechanism is typically known as External Compton (EC) process. A Planckian target photon field is considered here for Compton scattering. Since the origin of the target photon field could be anywhere external to the jet, we have considered an anisotropic nature of the photon field.

In addition, we perform a comparative study of the above-mentioned emission mechanisms and study the importance of different parameters responsible for the external Compton process. In particular, the effects of EC emission in the observed features of AGN jets in the presence of MHD instabilities and shocks will also be discussed.

Presentation Mode: Oral

Presenting Author: Sriyasriti Acharya

Registration id: NSSS-20211201092517

A 325 MHz Survey of the Lockman Hole Field using the GMRT

Aishrila Mazumder[1], Abhirup Datta[1] , Arnab Chakraborty[1,2,3]

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This work presents the findings from a 325 MHz survey of the Lockman Hole region using the GMRT. The frequency used is of interest for studying astrophysics of radio selected sources, and also for foreground studies for sensitive radio observations. It covers a field of view of 6 deg^2, with a sensitivity limit of 50 micro-Jy beam^{-1}. Two point correlation function as well as source counts have been obtained for compact sources. The results agree with previous observations and also show some interesting deviations from the detailed semi-empirical SKADS simulation in the terms of the bias parameter and clustering length. This points towards the requirement for more low frequency observations to provide better constraints on underlying cosmology controlling the evolution of matter in the Universe, as well as for development of better models of the radio sky. Angular power spectrum has also been determined for the diffuse emission present in the region. The value of the power obtained lies between 1-100 mK^2, which is very high compared to the expected strength of the cosmological 21-cm signal. This shows that even at locations far away from the galactic plane, diffuse synchrotron emission from the Galaxy pose a major hurdle for sensitive radio observations from the early Universe.

Presentation Mode: Oral

Presenting Author: Aishrila Mazumder

Registration id: NSSS-20220112070107

Probing the accretion flow properties of NS LMXB 4U 1608-52 using AstroSat observations

Biplob Sarkar[1], Ankur Nath[1], Aru Beri[2] and Ranjeev Misra[3]

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We present the broadband results from the study of a neutron star low-mass X-ray binary 4U 1608-52. The source was observed for an exposure time of around 40 ks with AstroSat. The long-term MAXI (soft energy band) and Swift BAT (hard energy band) light curves reveals that the position of AstroSat observation for the source is deviated from the peak in both cases. This gives us a preliminary hint that the source was in the hard-intermediate state during the AstroSat observation period. Analysis of the Hardness Intensity diagram shows that there is a strong positive correlation between source intensity and hardness. Therefore, we perform flux-resolved spectroscopy on the data extracted from SXT, LAXPC 10 and LAXPC 20 counters. The X-ray continuum can be satisfactorily explained using an absorbed thermal Comptonized model together with a blackbody component, but residuals are observed around 6.4 keV, which indicates the presence of Fe-line emission characteristics. Our timing analysis reveals a positive correlation of the fractional r.m.s power with energy bands of increasing energies. We find significant evolution in the photon index with the X-ray flux whereas the electron temperature is found to remain approximately constant. We discuss the implication of our findings on the changes in accretion geometry of the source with the X-ray flux.

References:

1. Nath, A., Sarkar, B., Beri, A., Misra, R., 2022, under preparation.

Presentation Mode: Oral

Presenting Author: Biplob Sarkar

Registration id: NSSS-20211202024911

Thermonuclear X-ray Bursts from Low-mass X-ray Binary 4U 1636-536 observed with AstroSat and NuSTAR

Pinaki Roy[1], Aru Beri[1]

[1]IISER Mohali

Thermonuclear (Type I) X-ray bursts are sudden surges in X-ray emission from an accreting neutron star in a Low-Mass X-ray Binary (LMXB). They result from the unstable burning of hydrogen and helium on the surface of the neutron star. X-ray bursts have been found to recur on timescales of hours or days. Burst occurring within 45 minutes of the preceding burst is conventionally labelled as short waiting time (SWT) burst. In this talk, I will present results from the spectro-timing analysis of 43 X-ray bursts in AstroSat and NuSTAR observations of a neutron star X-ray binary and well-known X-ray burster, 4U 1636−536. We identify five doublets and a triplet. Recurrence time as short as 3.8 minutes is seen in one of the doublets. To the best of our knowledge, this is the shortest recurrence time known for this source. In some of these bursts, thermonuclear burst oscillations (TBOs) are detected at ~581 Hz with five sigma confidence. TBOs are timing features around the stellar spin frequency observed during X-ray bursts because of the asymmetric brightness patches in the burning surface layers of accreting neutron stars. This is the first time a detailed timing study of burst oscillations with AstroSat has been performed. We will discuss the plausible origin of TBOs and SWT X-ray bursts and compare our observational results with proposed models.

Presentation Mode: Oral

Presenting Author: Pinaki Roy

Registration id: NSSS-20211220055858

An in-depth X-ray look at two magnetars: CXOU J010043.1–721134 and SGR J1935+2154

Rwitika Chatterjee[1], Vivek K Agrawal[1], Anuj Nandi[1]

[1]U R Rao Satellite Center

Magnetars are young neutron stars, usually found in isolation, powered by the decay of their extremely strong magnetic fields (10^{13}–10^{15} G). Compared to radio pulsars, they have long (few-second) pulse periods. Over the past few decades, even with highly sensitive X-ray instruments, only 25 sources have been confirmed as magnetars till date. There are two broad classes of magnetars with observationally distinct properties – anomalous X-ray pulsars (AXPs) and soft gamma repeaters (SGRs). We selected one typical source from each category and looked into their archival X-ray observations (XMM-Newton, NuSTAR, NICER), to understand their spectral and temporal characteristics.

CXOU J010043.1–721134, the only known magnetar located in the Small Magellanic Cloud (SMC), is a persistent AXP with ~8-s spin-period, from which no bursting activity has yet been observed. SGR J1935+2154, on the other hand, is one of the highly active magnetars which has exhibited numerous X-ray bursts since its discovery in July 2014. In April 2020, it entered into a new burst-active phase – its most prolific outburst episode yet.

The AXP, with 16 years of observations, was seen to steadily spin-down, with a constant rate of 1.75 x 10^{-11} s/s, whereas preliminary analyses on the SGR revealed an increasing rate of spin-down post its 2020 outburst. We have also detected a previously unreported burst from the SGR, occurring on September 2021. Spectral analysis revealed the AXP, best fitted with a thermal Comptonization model, to maintain a constant flux level throughout the span of observations. In contrast, the SGR exhibited a diminishing hard-band flux after its outburst. The pulse profiles of the two sources are also significantly different, implying possibly different emission regions and properties. In this talk, I will discuss the results of our study of these two magnetars, and their implications.

Presentation Mode: Oral

Presenting Author: Rwitika Chatterjee

Registration id: NSSS-20220105044900

Effect of nuclear symmetry energy on neutron star properties

Vivek Baruha Thapa[1], Monika Sinha[1]

[1]IITJ

The highly dense neutron star matter can not be produced in terrestrial laboratories. Still the properties of such highly dense matter can be extrapolated from the nuclear matter at nuclear saturation density and can be verified from the astrophysical observations of neutron stars. We study the effect of nuclear symmetry energy and its behaviour with density on the neutron star properties and attempt to constrain the matter properties at that much high density. We find that the symmetry energy and its slope with density have substantial effect on radius of stars. With the so far known range of symmetry energy and its slope, we find the theoretically obtained radius of star with only nucleons as well as with baryonic matter with exotic particles matches with the observational measurement of star radius. We also show that the values of symmetry energy and its slope is also consistent with the softness of matter as inferred from gravitational wave observations. However, recent measurement of nuclear symmetry energy and its slope by PREX2 data indicate that the star with only nucleons have larger radius than the observed. We conclude that the existence of hyperons and delta resonances within neutron star can be a possible scenario to fulfill both the nuclear physics and astrophysical data. The value of symmetry energy slope affects the threshold density of appearance hyperons and delta baryons. The symmetry energy and its slope has important influence on the relative abundances of nucleons. We find with new estimated values of these nuclear properties the proton fraction increases substantially making the direct URCA process possible even for the low mass stars. This opens up the possibility of rapid cooling in case of the most stars.

Presentation Mode: Oral

Presenting Author: Monika Sinha

Registration id: NSSS-20211227104751

Accretion flows around strongly magnetised neutron stars

Shilpa Sarkar[1], Indranil Chattopadhyay[1], Kuldeep Singh[1], Philippe Laurent[2]

[1]ARIES, Nainital, [2]CEA, Saclay, France

Neutron stars are one of the exotic and densest objects found in the Universe, with core densities surpassing nuclear densities. They harbour very strong magnetic fields (10^8−15 G) near the surface which dictates the dynamics of the accreted matter. The accretion generally takes place in the form of an accretion disc upto a certain radius after which matter is strictly channelled in the form of accretion funnels along the field lines, until it reaches the poles of the star. The radiation obtained from these systems allows us to investigate the underlying physics present and help probe deeper the nature of these objects. Since electrons are the ones that radiate, an exact computation of the spectrum requires working in the two-temperature regime, which is not trivial. This regime is degenerate because the number of unknowns is more than the set of equations. We hence proposed a general methodology to obtain unique two-temperature transonic accretion solutions around NSs in the ideal magneto-hydrodynamic (MHD) regime. After identifying the correct solution, we analysed the solutions and the corresponding spectrum for a global range of parameter space. The hard surface of an NS always ensures the formation of a primary shock just near the surface. This shock is responsible for the slowing down of the accreted matter and 99.99% of the total luminosity as seen by a distant observer. In addition, a secondary shock might also form for a given range of flow parameters. There is a distinct extended emission spectral signature at higher energies of this shock. We also discuss the effect of NS spin and magnetic field on the spectra of the NSs.

Presentation Mode: Oral

Presenting Author: Shilpa Sarkar

Registration id: NSSS-20220109060256

The life cycle of magnetars: a novel approach to estimate their ages

Tushar Mondal[1]

[1]International Centre for Theoretical Sciences (ICTS - TIFR)

Magnetars are slowly rotating, young, and isolated neutron stars with surface dipole magnetic fields exceeding the quantum electrodynamic magnetic field limit. They exhibit highly energetic behavior, as in the case of soft-gamma repeaters (SGRs) and anomalous X-ray pulsars (AXPs). Recently, they have been studied with paramount interest by almost every modern X-ray telescope. Despite the success, the traditional picture of magnetars has been challenged by the discovery of low-field magnetar, SGR 0418+5729. It remains mysterious over the decades to interpret the evolutionary stage (or age) of such a puzzling source within the magnetar paradigm. Unlike ordinary radio pulsars, the characteristic age is not a reliable indicator for the true age of a magnetar. Here we provide a novel approach to estimate the realistic age of a magnetar. The methodology simultaneously accounts for the surface dipole magnetic field measurement as well. The previous studies for such field measurement are either based on an orthogonal vacuum rotator model or based on a force-free plasma-filled magnetospheric model of pulsars. In general, a real pulsar should be an oblique rotator surrounded by a plasma-filled magnetosphere with particle acceleration gaps to generate pulsar high-energy emissions. In this framework, we solve the self-consistent time evolution for magnetars, including the current state-of-the-art magnetic field decay mechanisms. The rotational period of magnetars increases over time due to the extraction of angular momentum by gravitational-wave radiations, magnetic dipole radiations, and particle winds. These torques also change the obliquity angle between the magnetic and rotation axes. In the peculiar case of SGR 0418+5729, we find a dipolar magnetic field of 1.0Ã—10^{14} G and a realistic age of 18 kyr; both are consistent within the magnetar paradigm.

References

[1] Mondal T., 2021, ApJ Letters, 913, L12

Presentation Mode: Oral

Presenting Author: Tushar Mondal

Registration id: NSSS-20220110040431

AstroSat and NuSTAR view of GRS 1758-258 and 1E 1740- 2942:Evidence of Relativistic Disc Reflection

Bhuvana[1], Aneesha. U[2], Radhika D.[1], Vivek K. Agrawal[3], Samir Mandal[4], Tilak Katoch[5], Anuj Nandi[3]

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We present the results of AstroSat and NuSTAR observations of persistent Galactic black hole X-ray binaries GRS 1758-258 and 1E 1740.7-2942 performed during the period of 2016-2021. The sources are observed to be in a hard state during several occasions where the AstroSat and NuSTAR spectra show presence of a broad relativistic iron line along with the Comptonized continuum. Therefore, we performed relativistic reflection modelling of the broadband AstroSat and NuSTAR energy spectra in 0.6-60 keV and 3-79 keV respectively employing models from relxill family. Our modelling includes a blurred (relxillCp) and an unblurred (xillverCp) reflection model that accounts for the Comptonization continuum as well as the radiation reprocessed by Comptonizing region. Implementing this model prescription to the hard state spectra of both sources, we constrain the inclination angle of GRS 1758-258 and 1E 1740.7-2942 to be 62.49^{o} – 67.69^{o} and 62.35^{o}-75.09^{o} respectively. In addition, our results indicate that the accretion disc of both sources are partially ionized with GRS 1758-258 having an iron abundance of $A_{fe}= 2.75^{+0.22}_{-0.11}$ times solar abundance. We discuss the implications of our findings in the context of accretion dynamics.

Presentation Mode: Oral

Presenting Author: Bhuvana G.R

Registration id: NSSS-20211208061845

Broadband X-ray Spectral and Temporal Properties of NGC 55 ULX1

V. Jithesh[1]

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We investigate the broadband X-ray spectral and temporal properties of ultra-luminous X-ray source (ULX) NGC 55 ULX1 using Swift, XMM-Newton and NuSTAR observations conducted during 2013-2021. ULXs are compact, off-nuclear, X-ray point sources with an X-ray luminosity of greater than 10^{39} erg/s. In these observations, the source flux varies by a factor of ~ 5-6, and we identify the source mainly in the soft ultraluminous (SUL) state of ULXs. We fit the X-ray spectra with a two thermal component model consisting of a blackbody (for the soft component) and a disc (for the hard component), and the soft component dominates in these observations. The soft component in the SUL state shows properties similar to that of ultraluminous supersoft sources, for example, an anti-correlation between the characteristic radius and temperature of the blackbody component. In addition, we observe a positive correlation between the blackbody and inner disc temperatures when the X-ray spectra are fitted with the two-thermal component model. The source exhibits marginal evidence of X-ray flux dips in the Swift and XMM-Newton observations at different intensity levels. The observed spectral and temporal properties of the source can be explained by the supercritical radiatively driven outflow mechanism.

Presentation Mode: Oral

Presenting Author: Jithesh. V

Registration id: NSSS-20220103020831

Spectral Investigation of Rapid Variability in Narrow-Line Seyfert 1 (NLS1) Galaxy NGC 4051

Neeraj Kumari[1], Sachindra Naik[1], Arghajit Jana[1]

[1]Physical Research Laboratory, Ahmedabad

Narrow-Line Seyfert 1 (NLS1) galaxies, a subcategory of Active Galactic Nuclei (AGNs), are known to host Super Massive Black Holes (SMBHs) and accreting matter close to the Eddington limit. In the X-ray band, the NLS1s show rapid and large variability. These objects show complex spectral features such as steep X-ray spectrum with power-law index ~2.0-2.2, signatures of cold and ionized absorption, strong soft X-ray excess below 1 keV and dip at ~7 keV. We performed a detailed spectral analysis of a NLS1 galaxy NGC 4051 in 0.3-50 keV range using simultaneous observations from XMM-Newton and NuSTAR X-ray observatories carried out in November 2018. We divided ~300 ks NuSTAR and overlapping XMM-Newton exposure into three segments, namely; pre-flare, flare and post-flare, where NuSTAR count rate was almost twice in the flaring epoch. We explored the variation of X-ray source properties in different epochs using various phenomenological and physical models. In all the epochs, we found signatures of two absorbers, one probably warm absorbers and the second similar to the Ultra-Fast Outflows (UFOs). We found a higher spectral index in the flaring epoch than the other two epochs, which shows the "softer when brighter" nature of the source. From the variability spectrum in the 0.3-10 keV range (i.e. fractional variability vs. energy), we found higher variability in low energy components such as the soft excess/ionized absorption. In this talk, I will discuss the above results and corresponding interpretations in more detail.

Presentation Mode: Oral

Presenting Author: Neeraj Kumari

Registration id: NSSS-20220110060145

Black hole mass dichotomy in barred and unbarred galaxies of IllustrisTNG-100 simulations.

Sandeep Kumar Kataria[1], Vivek M[2]

[1]SJTU, Shanghai, [2]IIA, Bangalore

In this work, we conduct a statistical study of black hole masses of barred and unbarred galaxies in IllustrisTNG-100 cosmological simulation suites. This work aims to understand the role of the bars in triggering AGN activity. We have looked into 1191 barred galaxies and 2738 unbarred galaxies samples. We use an equal number of barred and unbarred galaxies with a similar distribution of galaxy masses for an unbiased study. We find that the peak of black hole masses distribution for barred galaxies is higher than that of the unbarred one. We also find that mean black hole masses of strongly barred galaxies are higher than weakly barred galaxies. The higher mean accretion rate on the black hole averaged over large redshifts (approx. z~10 to 0) supports the higher mean black hole masses in barred galaxies. Further, we also check these results are unaffected by other surrounding environmental processes like merger histories. Our results have potential implications for triggering AGN activities debated in previous numerical and observational studies.

Presentation Mode: Oral

Presenting Author: Sandeep Kumar Kataria

Registration id: NSSS-20220110082700

Classification conundrum in Gamma Ray Bursts: Signatures of collapsars in high redshift short GRBs

Dimple[1], K. Misra[1], D. A. Kann[1], K. G. Arun[1], A. Ghosh[1], R. Gupta[1], L. Resmi[1], J. F. Agüí Fernández[1], C. C. Thöne[1], A. de Ugarte Postigo[1], S. B. Pandey[1], L. Yadav[1]

[1]ARIES

GRBs are classically categorised into two types - short bursts (T90 < 2 sec) and long bursts (T90 > 2 sec) based on their gamma-ray emission duration. It is widely accepted that the two populations originate from two distinct progenitor channels residing in different host galaxy environments. However, the characteristics of two short GRBs (090426 and 200826A) hinted toward collapsar as plausible progenitors as opposed to compact object mergers. These short GRBs lie at a relatively higher redshift as compared to the median redshift (z=0.47) of short GRBs. We investigate the properties of short GRBs at low and high redshifts employing the prompt, afterglow and host galaxy information. A careful examination of the characteristics of short GRBs at different redshifts reveals that some short GRBs at high redshifts have properties similar to long GRBs indicating a collapsar origin. Further studies can aid in understanding the progenitors of GRBs and the true classification of GRBs.

Presentation Mode: Oral

Presenting Author: Dimple

Registration id: NSSS-20220105113955

Properties of high-redshift starburst galaxies and their local analogs contributing to reionization

Abhishek Paswan[1], Kanak Saha[1], Claus Leitherer[1] and Daniel Schaerer[1]

[1]Indian Institute of Astrophysics (IIA)

One of the outstanding problems of our present observational cosmology is to understand the nature of sources that play a crucial role in the re-ionization of our early universe by leaking their bulk of ionizing photons. In this context, I will present a low-mass, high-redshift, starburst galaxy identified as an extreme Lyman Continuum (LyC) photons leaker. Using its local counterparts, I will further discuss about the physical processes in greater detail that allow such galaxies to leak their ionizing LyC photons.

Presentation Mode: Oral

Presenting Author: Abhishek Paswan

Registration id: NSSS-20211212065401

Our peculiar motion from Hubble diagram of SNe Ia and implications for Cosmological Principle

Ashok Kumar Singal[1]

[1]PRL

Peculiar motion of the solar system, determined from the dipole anisotropy in the Cosmic Microwave Background Radiation (CMBR), has given a velocity 370 km/s along RA=168, Dec=-7deg. Subsequent peculiar motion determinations from the number counts, sky brightness or redshift dipoles observed in large samples of distant radio galaxies and quasars yielded peculiar velocities two to ten times larger than CMBR, though in all cases the directions matched with the CMBR dipole. Here we introduce a novel technique for determining the peculiar motion from the magnitude-redshift (m-z) Hubble diagram of Type Ia Supernovae (SN Ia), one of the best standard candles available. We find a peculiar velocity 1600+/-500 km/s, about four times larger than the CMBR value, along RA=173+/-12, Dec=10+/-9deg, the direction being within ~2 sigma of the CMBR dipole. Since a genuine solar motion would not depend upon the method or the dataset employed, large discrepancies seen among various dipole amplitudes could imply that these dipoles, including the CMBR one, might not pertain to observer's peculiar motion. However, a common direction for various dipoles might indicate a preferred direction in the universe, implying an intrinsic anisotropy, in violation of the cosmological principle, a cornerstone of the modern cosmology.

Presentation Mode: Oral

Presenting Author: Ashok Kumar Singal

Registration id: NSSS-20220110084006

Dynamical conditions and causal transport of spherical collapse in $f(R,T)$ gravity

Sarbari Guha[1] and Uttaran Ghosh[1]

[1]St. Xavier's College (Autonomous), Kolkata

In this paper, we have investigated the non-adiabatic spherical gravitational collapse in the framework of the *f(R,T)* theory of gravity with a locally anisotropic fluid that undergoes dissipation in the form of heat flux, free-streaming radiation, and shearing viscosity. The dynamical equations are analyzed in detail, both in the Newtonian and post-Newtonian regimes. Finally we couple the dynamical equations to the full causal transport equation in the context of Israel-Stewart theory of dissipative systems. This yields us a better understanding of the collapse dynamics and may be connected to various astrophysical consequences. (Eur. Phys. J. Plus (2021) 136:460)

Presentation Mode: Oral

Presenting Author: Sarbari Guha

Registration id: NSSS-20211216084925

Probing the nature of Luminous blue variables

Yogesh Joshi[1]

[1]ARIES

Luminous Blue Variables (LBVs) are unstable, evolved massive stars, and characterized by their frequent outburst activities. They show significant spectrophotometric variability over their outburst phase and exhibit a remarkable change in spectral type between the quiescent and outburst phases. These stars are generally hot supergiant which typically shows broad and strong hydrogen lines, He I, Fe II, and [Fe II] lines in their emission spectra along with P-Cygni profile as well as infra-red excess in their spectral energy distributions (SEDs). The driving mechanism of their outburst activities and the role of these activities in the evolution of massive stars are still not fully understood as there exists only a handful of LBVs in the Local Group. In this talk, I will discuss the photometric and spectroscopic evolution of these exotic stars and present the results of our monitoring of one such LBV, AF And, in the M31 galaxy.

Presentation Mode: Oral

Presenting Author: Yogesh Joshi

Registration id: NSSS-20211209070452

TESS Observations of TX Col: Rapidly Varying Accretion Flow

Nikita Rawat[1], J. C. Pandey[1], Arti Joshi[2]

[1]ARIES, Nainital, [2]Wuhan University, Wuhan

IPs are semi-detached interacting binaries containing a magnetic white dwarf (WD), which accretes material from a Roche- lobe filling red dwarf star. These are asynchronous systems and for the majority of them, the rotation period is typically one-tenth of the orbital period. There are primarily three accepted scenarios for accretion in IPs and the feasibility of each one of them depends on the magnetic field strength of WD and mass accretion rate. The first is the disc-fed accretion, in which an accretion disc is present in the system, which is disrupted at the magnetosphere radius. From this radius, material flows along the magnetic field lines resulting in the formation of 'accretion curtains' near the magnetic poles of the WD. The second is the disc-less or stream-fed accretion, in which the high magnetic field of the WD does not allow the formation of a disc and infalling material is channelised along the magnetic field lines to the pole caps. In the third possibility, known as disc-overflow accretion, disc-fed and stream-fed accretions can simultaneously occur as a part of the accretion stream skims over the disc and then interacts with the magnetosphere of the WD. The presence of spin, beat, orbital, and other sideband frequencies in the power spectra and their amplitudes play a vital tool in distinguishing the mode of accretion in these systems. In the disc-fed accretion, modulation at the spin frequency of the white dwarf occurs, whereas stream-fed accretion gives rise to modulation at the lower orbital sideband of the spin frequency, i.e. beat frequency. For a disc-overflow accretion, modulations at both spin and beat frequencies are expected to occur. We will present a detailed investigation of the long-term optical photometry of an intermediate polar TX Col as observed from the TESS mission. The continuous data allowed us to look thoroughly at the day-wise evolution of the accretion geometry of TX Col confirming its variable disk-overflow accretion nature.

Presentation Mode: Oral

Presenting Author: Dr. J. C. Pandey

Registration id: NSSS-20211217091130

Investigation of Rocket Effect in Bright-Rimmed Clouds using Gaia EDR3

Piyali Saha[1,2], Maheswar G.[1], D. K. Ojha[3], Tapas Baug[2], Neha Sharma[4]

[1]IIA, [2]SNBNCBS, [3]TIFR, [4]FINCA

Stars are the major constituents of the universe, and in spite of significant progress in recent years, there remain unanswered questions about the basic processes of star formation. Massive OB stars have a profound impact on star formation in their surroundings. Their strong UV radiation ionizes the surface of the nearby molecular cloud, causes it to collapse, and thus triggers subsequent star formation, which is known as Radiation Driven Implosion (RDI). Bright-rimmed clouds (BRCs) are ideal candidates to study the RDI mode of star formation as they are potential sites of triggered star formation, located at the edges of HII regions, showing evidence of ongoing star formation processes. BRC 18 is located towards the eastern edge of a relatively closer (~400 pc) HII region ionized by Lambda Ori. Using distances and proper motions from the Gaia Early Data Release 3 (EDR3) of the candidate young stellar objects (YSOs), and by assuming that both the candidate YSOs and BRC 18 are kinematically coupled, we investigated the possible acceleration of BRC 18, away from Lambda Ori, which is known as `Rocket Effect'. The relative proper motions of the candidate YSOs with respect to Lambda Ori are found to show a trend of moving away from the ionizing star. We computed the offset between the angle of the direction of the ionizing photons and the relative proper motion of the candidate YSOs and found it to lie close to being parallel to each other. Using BRC 18 as a prototype, we made our further analysis for 21 more BRCs. For most of them, a similar trend has been found. The Pearson's and Spearman's correlation coefficients are estimated as 0.908 and 0.901, with pnull as 5.326×10^{-9} and 1.119×10^{-8}, respectively. The computed statistic of Kolmogorov-Smirnov test is 0.182 with the pvalue 0.821. The strong correlation between these two angles supports the `Rocket Effect' in the BRCs on the plane-of-sky.

Presentation Mode: Oral

Presenting Author: Piyali Saha

Registration id: NSSS-20220110041744

Abundance analysis, production sites and ages of r-process enhanced stars using GTC

Pallavi Saraf[1]

[1]Indian Institute of Astrophysics

Understanding the formation of heavier elements is one of the key topics in stellar astronomy. The rapid neutron capture process (r-process) is the prime nucleosynthesis mechanism for producing heavy elements. Several sites have been proposed for the r-process nucleosynthesis, such as core-collapse supernovae, neutron star mergers, etc., but none of them is well constrained. Studying heavier elements in the metal-poor stars is the pristine tool to investigate the sites of r-process nucleosynthesis. But, the rarity of r-process enhanced metal-poor stars in the Galaxy makes us difficult to understand its formation sites. So, a large sample of r-process rich stars will help us understand the nucleosynthesis history of these polulation. Here, we have presented the detailed abundance analysis of four r-process enhanced metal-poor stars. These stars were selected from SDSS/MARVEL survey and reobserved with the 10-m class telescope Gran Telescopio CANARIAS (GTC), Spain. The high signal-to-noise ratio at R~25000 spectral resolution of GTC has allowed us to detect 21 neutron-capture elements in four of our program stars. Among these elements, we could detect thorium (Th) in two of our target stars, which we used to estimate their ages. The r-process element abundances of our target stars also matched with the scaled-Solar abundances, confirming the universality of the main r-process pattern (second peak elements), along with the usual scatter for the first and third r-process elements. We have also used our target stars together with already identified r-process rich stars in literature to constraint the nature and origin of the r-process at early times.

Presentation Mode: Oral

Presenting Author: Pallavi Saraf

Registration id: NSSS-20220108034617

An extremely metal-poor star, contaminated with products of both i- and s-process nucleosynthesis

Partha Pratim Goswami[1], Aruna Goswami[1]

[1]Indian Institute of Astrophysics

The elements heavier than Fe are believed to be produced mainly by slow (s-) and rapid (r-) neutron-capture processes. While the production sites of s-process elements are believed to be the interpulse phases of low-mass AGB stars, the r-process that requires very high temperatures and neutron fluxes is expected to occur during supernova explosions and neutron-star mergers. It is seen that these two processes are not enough to explain the observed heavy element abundances in many CEMP-r/s stars. In order to explain the abundance patterns of these stars, an 'intermediate' (i-) process has recently been suggested. For the first time, we came across an object, HE 1005-1439, with a surface chemical composition that exhibits contributions from both s- and i-processes. We performed a detailed, high-resolution spectroscopic analysis of HE 1005-1439 based on SUBARU/HDS spectra. Abundances of ten light elements from C through Ni and twelve heavy elements from Sr through Pb were determined. The observed abundance pattern is unique and has never been observed before. The observed abundance pattern could not be explained based on theoretical s-process or i-process model predictions alone. Parametric-model based analysis clearly indicates its surface chemical composition being influenced by similar contributions from both the s- and i-processes. We found that none of the existing formation scenarios in the literature involving s-process and i-process could explain the observed abundances. We note that, the variation we see in our radial velocity estimates obtained from several epochs may indicate the presence of a binary companion. We therefore, proposed a formation scenario for this object involving effective proton ingestion episodes (PIEs) triggering i-process nucleosynthesis followed by s-process asymptotic giant branch (AGB) nucleosynthesis in the now extinct companion AGB star.

Presentation Mode: Oral

Presenting Author: Partha Pratim Goswami

Registration id: NSSS-20220110012514

Spectral Characterization of M-Dwarf Stars with ASTROSAT-UVIT

Sukrit Ranjan[1,2], Prasanta K Nayak[3], J. Sebastian Pineda[4], Mayank Narang[3]

[1]Northwestern University, USA, [2]NISER Odisha, India, [3]TIFR, India, [4]University of Colorado, USA

The characterization of rocky exoplanet atmospheres is a key priority of the astronomical community, but this search requires an understanding of the UV spectral energy distribution (SED) of the host star. Stellar UV mediates atmospheric escape, atmospheric photochemistry, and planetary habitability, and observations of exoplanet atmospheres can only be understood in the context of the UV SED of the host star. The Hubble Space Telescope (HST) is the main facility for the characterization of the UV SEDs of exoplanet host stars, particularly the observationally favourable but poorly understood M-dwarf stars that are the only plausible targets for rocky planet atmospheric characterization in the next 1-2 decades. However, HST is approaching the end of its lifetime, raising the risk that we will lack the contextual SEDs required to interpret future spectra of rocky exoplanet atmospheres.

Here, we demonstrate the utility of ASTROSAT UVIT for the characterization of the UV SEDs of exoplanet host stars. We present pioneering observations of the nearby M-dwarf HIP 23309 in the FUV and NUV grisms of UVIT. Our NUV spectra are stable between orbits and our FUV spectra are consistent with contemporaneous HST data, demonstrating the suitability of UVIT for such observations. To demonstrate the applications of such data, we apply our measured spectra to simulations of atmospheric escape, photochemistry, and habitability for a hypothetical rocky planet orbiting HIP 23309, and show the controlling role of the UV radiation field. Our work validates UVIT as a tool to complement HST in the characterization of exoplanet host stars and means that the key contextual SEDs can be constrained even if HST fails. We advocate for the retention of UVIT-like UV spectral capability in the upcoming telescope INSIST.

Presentation Mode: Poster (Flash)

Presenting Author: Prasanta Kumar Nayak

Registration id: NSSS-20211126070237

Photometric Variability in Young Brown Dwarfs to Probe their Atmospheric Properties

Rajib Kumbhakar[1], Soumen Mondal[1]

[1]SNBNCBS

Photometric variability studies of very low-mass stars (VLMs) and Brown Dwarfs (BDs) are an important tool to probe the physical nature of their atmospheres. Photometric variability in these dwarf is due to the presence of surface features like magnetic spots (strong magnetic fields) or dust clouds, which cause optical modulation as it rotates, and it is possible to measure the period of rotation of an object from its light curve. The time-series photometric variability is a key probe of atmospheric inhomogeneities in VLMs and BDs. BDs are known to be rapid rotators (period~ hours to days), so the rotation modulation of their light curves gives information about surface features such as magnetic spots or dust clouds, which provides an opportunity to measure the period of rotation in these dwarfs. However, it is very challenging to detect their variability amplitude, which is the order of a few tens milli-magnitudes. We have taken optical I-band time-series photometric observations on a few BDs and VLMs in the Taurus star-forming region. From our preliminary analysis of the observed data in the I-band on CFHT Tau 6 and CFHT Tau 8, we found that CFHT Tau 8 shows significant periodic variability, and we estimate a rotation period of 6.6 hours. While CFHT Tau 6 shows no significant variability with a given accuracy with the observed time-series I-band data.

Presentation Mode: Poster (Flash)

Presenting Author: Rajib Kumbhakar

Registration id: NSSS-20220109034827

Short-Timescale Variability of the Blazar Mrk 421 from AstroSat and Simultaneous Multi-Wavelength

Ritaban Chatterjee , Susmita Das , Archishman Khasnovis, Ritesh Ghosh

Presidency University, Visva-Bharati University

We study the multi-wavelength variability of the blazar Mrk 421 at minutes to days timescales using simultaneous data at gamma-rays from Fermi, 0.7–20 keV energies from AstroSat, and optical and near-infrared (NIR) wavelengths from ground-based observatories. We compute the shortest variability timescales at all of the above wavebands and find its value to be ~ 1.1 ks at the hard X-ray energies and increasingly longer at soft X-rays, optical and NIR wavelengths as well as at the GeV energies. We estimate the value of the magnetic field to be 0.5 Gauss and the maximum Lorentz factor of the emitting electrons ~ 1:6 * 10^5 assuming that synchrotron radiation cooling drives the shortest variability timescale. Blazars vary at a large range of timescales often from minutes to years. These results, as obtained here from the very short end of the range of variability timescales of blazars, are a confirmation of the leptonic scenario and in particular the synchrotron origin of the X-ray emission from Mrk 421 by relativistic electrons of Lorentz factor as high as 10^5. This particular mode of confirmation has been possible using minutes to days timescale variability data obtained from AstroSat and simultaneous multi-wavelength observations.

Presentation Mode: Poster (Flash)

Presenting Author: Susmita Das

Registration id: NSSS-20220110123709

Hot horizontal branch stars in NGC 2298: Clues about their origin from AstroSat/UVIT study

Sharmila Rani[1], Gajendra Pandey[1], Annapurni Subramaniam[1]

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This study examines the horizontal branch morphology of the globular cluster NGC 2298 using the far-UV (FUV) photometry of images obtained with UVIT on AstroSat. We combined the UVIT data with HST UV Globular Cluster Survey (HUGS), Gaia, and ground-based photometric data to construct the UV-optical color-magnitude diagrams (CMDs) for the member stars detected in the central as well as the outer region of the cluster. A blue horizontal branch (BHB) sequence with color as well as magnitude spread and four hot HB stars are identified in all FUV-optical CMDs. The comparison of observed CMDs with theoretical isochrones and simulated HB with distinct helium abundances shows that four hot HB stars are helium enriched compared to the BHB. We characterized the hot HB stars, for the first time, using the spectral energy distribution (SED) fitting technique to throw light on their formation and evolution in the cluster. The effective temperature of three hot stars ranges from 35,000-40,000 K. In contrast, one star has around ~100,000 K. Based on the comparison of the location of the hot HB stars with theoretical evolutionary tracks in the HR diagram, we suggest the following evolutionary scenarios: two stars are likely to be the progeny of extreme HB (EHB) stars formed through an early hot-flasher scenario, one is likely to be an EHB star with probable helium enrichment, and the hottest HB star, which is about to enter the white dwarf cooling phase, could have evolved from the BHB phase. Nonetheless, these are intriguing spectroscopic targets to understand the late stages of evolution.

Presentation Mode: Poster (Flash)

Presenting Author: Sharmila Rani

Registration id: NSSS-20220110050030

Gaia 20eae: A newly discovered episodically accreting young star

Arpan Ghosh[1], et. al.

[1]ARIES

The Gaia Alert System issued an alert on 2020 August 28, on Gaia 20eae when its light curve showed a ∼4.25 magnitude outburst. We present multi-wavelength photometric and spectroscopic follow-up observations of this source since 2020 August and identify it as the newest member of the FUor/EXor family of sources. We find that the present brightening of Gaia 20eae is not due to the dust clearing event but due to an intrinsic change in the spectral energy distribution. The light curve of Gaia 20eae shows a transition stage during which most of its brightness (∼3.4 mag) has occurred at a short timescale of 34 days with a rise-rate of 3 mag/month. Gaia 20eae has now started to decay at a rate of 0.3 mag/month. We have detected a strong P Cygni profile in Hα which indicates the presence of winds originating from regions close to the accretion. We find signatures of very strong and turbulent outflow and accretion in Gaia 20eae during this outburst phase. We have also detected a red-shifted absorption component in all the Ca II IR triplet lines consistent with signature of hot in-falling gas in the magnetospheric accretion funnel. This enables us to constrain the viewing angle with respect to the accretion funnel. Our investigation of Gaia 20eae points towards magnetospheric accretion being the phenomenon for the current outburst.

Presentation Mode: Poster (Flash)

Presenting Author: Arpan Ghosh

Registration id: NSSS-20220110054829

Photoionization Modeling of the Dusty Nova V1280 Scorpii

Ruchi Pandey[1], Ramkrishna Das[1], Gargi Shaw[2], and Soumen Mondal[1]

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Novae are the only objects in which it has been possible to observe directly all aspects of circumstellar grain formation on a frequent basis. Compared to interstellar dust, novae dust forms within a short time frame of 30 to 100 days after an outburst, allowing them to serve as perfect laboratories for understanding the formation and evolution of astrophysical dust. Dust formation in the hostile environment of novae ejecta has been an open question for many decades. Several attempts have been made to understand the physical and chemical conditions required to dust formation in novae ejecta and its relation with the observable parameters. However, due to the inherent complexity of the physical and chemical composition of novae ejecta and the multi-step process of dust grain formation, such attempts could only achieve partial success in explaining it. Thus, a more fundamental approach is required where multiple physical and chemical parameters of the dust forming novae eject a are studied in detail, to estimate favorable conditions for the formation of dust. As a part of this work, we perform photoionization modeling of the dusty nova V1280 Scorpii (V1280 Sco) with the aim to study the changes in the physical and chemical parameters. We model the predust and postdust phase, optical and near-infrared spectra using the photoionization code CLOUDY, v.17.02, considering a two-component (low-density and high-density regions) model. It is found that a very high hydrogen density (10^{13} –10^{14} cm^{-3}) is required for the proper generation of spectra. We also found that the dust condensation conditions are achieved at high ejecta density (3.16×10^{8} cm $^{-3}$) and low temperature (2000 K) in the outer region of the ejecta.

Presentation Mode: Poster (Flash)

Presenting Author: Ruchi Pandey

Registration id: NSSS-20220110083541

Discovery of 2716 hot emission-line stars from LAMOST DR5

B. Shridharan[1], Blesson Mathew[1], S. Nidhi[1], R. Anusha[1], R. Arun[1], Sreeja S. Kartha[1] and Yerra Bharat Kumar[2]

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We present a catalog of 3339 hot emission-line stars (ELS) identified from 451,695 O, B, and A type spectra, provided by the LAMOST DR5 release. We developed an automated python routine that identified 5437 spectra having a peak between 6561 and 6568 Å. False detections and bad spectra were removed, leaving 4138 good emission-line spectra of 3339 unique ELS. We re-estimated the spectral type of 3307 spectra as the LAMOST Stellar Parameter Pipeline (LASP) did not provide accurate spectral types for these emission-line spectra. As Herbig Ae/Be stars show higher excess in near-infrared and mid-infrared wavelengths than Classical Ae/Be stars, we used 2MASS and WISE photometry to distinguish them. Finally, we report 1089 Classical Be, 233 Classical Ae, and 56 Herbig Ae/Be stars identified from the LAMOST DR5. In addition, 928 B[em]/A[em] stars and 240 CAe/CBe potential candidates are identified. From our sample of 3339 hot emission-line stars, 2716 ELS identified in this work do not have any record in the SIMBAD database and they can be considered as new detections. Identification of such a large homogeneous set of emission-line spectra will help the community to study the emission phenomenon in detail without worrying about the inherent biases when compiling from various sources.

Presentation Mode: Poster (Flash)

Presenting Author: Shridharan Baskaran

Registration id: NSSS-20211207045708

Identification of a rare class of emission-line stars between PMS and MS phase

Suman Bhattacharyya[1], Blesson Mathew[1], Gourav Banerjee[1], Anusha R[1], KT Paul[1], Sreeja S Kartha[1]

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Pre-main sequence (PMS) stars evolve into main sequence (MS) phase over a period of time. Interestingly, we found a scarcity of studies in the existing literature that examines and attempts to better understand the stars in PMS to MS transition phase. The purpose of the present study is to detect such rare stars, which we named as ‘Transition Phase' (TP) candidates- stars evolving from the PMS to the MS phase. We identified 98 TP candidates using photometric analysis of a sample of 2167 classical Be (CBe) and 225 Herbig Ae/Be (HAeBe) stars. This identification is done by analyzing the near- and mid-infrared excess and their location in the optical color-magnitude diagram. The age and mass of 58 of these TP candidates are determined to be between 0.1-5 Myr and 2-10.5 $M_{\odot}$ respectively. The TP candidates are found to possess rotational velocity and color excess values in between CBe and HAeBe stars, which is reconfirmed by generating a set of synthetic samples using the machine learning approach.

Presentation Mode: Poster (Flash)

Presenting Author: Suman Bhattacharyya

Registration id: NSSS-20211205084207

Study of classical Be stars using optical spectroscopy

Gourav Banerjee[1], Blesson Mathew[1], K. T. Paul[1], Annapurni Subramaniam[2], Suman Bhattacharyya[1], R. Anusha[1]

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A category of emission-line stars, classical Be (CBe) stars are surrounded by circumstellar gaseous discs and hence provide a wonderful opportunity to study stellar disc physics. Spectral analysis of different emission lines seen in their spectra provides a wealth of information about their discs and the central star itself. However, the disc formation mechanism in CBe stars - the `Be phenomenon' - is still poorly understood. So we analyzed the major emission lines present in a sample of 118 Galactic field CBe stars through Indian facilities, thus providing a collective understanding about the nature of emission lines seen in CBe star optical spectra. Moreover, these stars usually exhibit variability in spectral line profiles. Extreme cases may result in the complete disappearance of the disc. The disc-loss and reappearing phases of CBe stars can be identified by studying their Hα line profiles on a regular basis. Hence, we also performed the first study which discusses the disc formation and dissipation in CBe stars in terms of continuous changes noticed in their Hα line profile. Our results will be helpful in providing knowledge to better understand the timescales of disc dissipation and formation in CBe stars, thus helping in forming a consolidated picture of the `Be phenomenon'.

Presentation Mode: Poster (Flash)

Presenting Author: Gourav Banerjee

Registration id: NSSS-20211127073646

Characterizing the behaviour of SN 2013he: a luminous, short plateau supernova

Darshana Mehta[1], Raya Dastidar[1], Kuntal Misra[1], Andrea Pastorello[1], Subhash Bose[1] on behalf of a larger collaboration

[1]Aryabhatta Research Institute of Observational Sciences (ARIES)

We present the optical photometry and spectroscopy of SN 2013he, a Type II Plateau supernova (SN II-P) in NGC 4774. SN 2013he is a luminous (MV $\lesssim$ -18 mag) event with a relatively short recombination phase, of $\sim$80 days. The distance to the supernova is estimated to be 126.02 $\pm$ 0.30 Mpc using the expanding photosphere method. The spectra display typical features of expanding supernova ejecta including the P-Cygni profiles observed for the H Balmer and He-I components. The evolution of the H-α line profile, shows signatures of ejecta-CSM interaction after the early plateau phases, pointing towards the possibility of significant mass loss prior to the explosion, effectively stripping the progenitor's H-rich envelope. The bolometric light curve and its semi-analytical modeling are used to estimate the explosion parameters of SN 2013he such as ejecta mass and progenitor radius. Our estimates support the idea of a massive red supergiant progenitor, with an initial mass of

roughly 18-20 $M_\odot$. The obtained characteristics of SN 2013he, suggest that it falls in a transitional class of Type II supernovae, the short plateau supernovae (SPSNe), a fairly luminous class of SNe, which also exhibit signatures of early ejecta-CSM interactions.

Presentation Mode: Poster (Flash)

Presenting Author: Darshana Mehta

Registration id: NSSS-20211126061647

Revealing lack of X-ray/UV correlation in narrow line Seyfert 1 galaxy Mrk 1044

Samuzal Barua[1], Oluwashina Adegoke[2], Ranjeev Misra[3], V Jithesh[4], Biman J Medhi[1]

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Investigation for X-ray/UV correlation in active galactic nuclei (AGN) is one of the important studies from which one can have information of the various emitting regions and their inter-connections. We studied the correlated X-ray/UV variability of narrow-line Seyfert AGN Mrk 1044 using two long XMM-Newton observations with an exposure of ~130 ks. Different cross-correlation techniques, such as DCF, ZDCF and JAVELIN employed between the UM2 (CHECK) and X-ray (0.3-10 keV, CHECK) bands. These analyses revealed no significant correlation between X-ray and UV emission in any of these techniques. The observed lack of X-ray/UV correlation in Mrk 1044 is either may be attributed to the fact that the UV emission is not driven by X-rays, or there is a strong relativistic effect close to the black hole. In this meeting, we will present more detail of the findings and discuss them broadly.

Presentation Mode: Poster (Flash)

Presenting Author: Samuzal Barua

Registration id: NSSS-20211231120556

A comparative study of the optical and IR variability of NLSy1 and BLSy1 galaxies

Aratrika Dey (PhD student)[1], Dr. CS Stalin (Professor)[1], Dr. Suvendu Rakshit (Scientist)[2]

[1]IIA, [2]ARIES

Narrow Line Seyfert 1 (NLSy1) galaxies are a special class of active galactic nuclei (AGN) identified by Osterbrock and Pogge about four decades ago. They are classified based on the presence of narrow H_beta emission line with the full width at half maximum 0.8 NLSy1 candidates treating the MgII line at 2800 Angstroms as a proxy for the H_beta emission line. We have carried out a comparative analysis of the long term optical and infrared variability characteristics of the high redshift sample of NLSy1 galaxies vis-a-vis broad line Seyfert 1 (BLSy1) galaxies. The control sample of BLSy1 galaxies were selected such that they match in the optical g-band brightness, redshift and black hole mass to the sample of NLSy1 galaxies. In the optical band, BLSy1 galaxies are found to display a marginal increase in variability compared to NLSy1 galaxies. We also investigated the correlation of optical variability with radio-loudness, relativistic jet power and accretion rate of the sample. Details of the results will be discussed.

Presentation Mode: Poster (Flash)

Presenting Author: Aratrika Dey

Registration id: NSSS-20220108023340

Fullerenes and their derivatives in interstellar environments

Akant Vats[1], Amit Pathak[1]

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The detection of fullerenes (C60 & C70) in interstellar environments allows the search for other fullerene molecules and their derivatives. Since fullerenes show high reactivity with atomic H, there should be a dominance of their hydrogenated forms in interstellar environments (García-Hernández et al. 2010), which can go through deuterium enrichment as well (Cataldo et al. 2009c).

The infrared (IR) spectroscopy and standard enthalpy of formation for neutral and singly ionized hydrogenated and deuterated derivatives of C60 and C70 are reported using Density Functional Theory (DFT).

Presentation Mode: Poster (Flash)

Presenting Author: Akant Vats

Registration id: NSSS-20220110085421

Broad-Line Region and Black-hole Mass of PKS 0736+017

Shivangi Pandey[1], Dr. Suvendu Rakshit[1]

[1]ARIES, NAINITAL

To understand the mass distribution and co-evolution of a supermassive black hole with its host galaxy, it is crucial to measure the black hole mass of AGN. Blackhole masses can be dynamically measured for local AGNs, however, extremely challenging beyond the local volume due to the requirement of high spatial resolution. Spectroscopic reverberation mapping is a unique tool to estimate black hole masses and study the geometry and kinematics of the broad-line region (BLR) surrounding the black hole. We performed spectroscopic reverberation using long-term monitoring data of a radio-loud quasar PKS 0736+01 which shows strong Hβ, Fe II, and Hγ emission lines in the optical spectrum. The Black Hole mass and size of the Broad Line Region for this source were estimated for the very first time, by decomposition of the optical spectrum into continuum and emission lines to generate the lightcurves of 5100Å continuum flux (f 5100), Hβ, and Hγ. The cross-correlation method, JAVEL IN was used to estimate the size of the BLR, and black hole mass was measured using virial relation. The source closely follows the BLR size-luminosity relation of AGNs, however, along with thermal radiation from the accretion disk, non-thermal emission from the jet also contributes to the observed luminosity at 5100Å.

Presentation Mode: Poster (Flash)

Presenting Author: Shivangi Pandey

Registration id: NSSS-20220110092326

X-Ray Properties of TX Cnc, an Eclipsing Solar-Type Contact Binary of W Uma Type

Gurpreet Singh[1], Jeewan C. Pandey[1]

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W Uma-type stars are short-period (0.2–1.5 d) eclipsing contact binaries with solar-type companions. Due to their rapid rotation rates, these stars are expected to have high chromospheric and coronal emission. However, the X-ray flux from these stars is about 4-5 times smaller than that of the fastest rotating single stars. In this study, we present the detailed X-ray properties of such a contact binary, TX Cnc. In the X-ray light curve, we found no signatures of orbital modulation. Based on phase-resolved spectroscopy, the X-ray emission is well explained by a single temperature plasma with a temperature of 0.8 keV. At a confidence level of 95%, we found this temperature component to be variable with the evolution of the orbital phase of the binary. However, the corresponding emission measures and coronal abundances are non-variable. The X-ray flux is found to be 4.2 x 10^{-13} erg/s/cm^2. The L_X/L_{bol} is -3.78, which puts this system in a super-saturation regime in the period-luminosity relation for coronally active stars.

Presentation Mode: Poster (Flash)

Presenting Author: Gurpreet Singh

Registration id: NSSS-20220109074154

3D Simulation of Advective Thick Accretion Disk onto a non-rotating Black Hole

Sudip K Garain[1]

[1]GITAM University

Observations of X-ray binaries containing black holes indicate the presence of geometrically thick, hot, dynamic Compton cloud around the black hole to satisfactorily explain it's spectral and temporal properties. In this work, I present results of a few high resolution, 3D hydrodynamic simulations of such Compton cloud around a non-rotating black hole. Our results demonstrate that the formation of stable, geometrically thick, torus is indeed possible for various accretion flow parameters.

Presentation Mode: Poster (Flash)

Presenting Author: Sudip K Garain

Registration id: NSSS-20211126070634

Discovery of dip in the RGS light curve of GX 13+1 with XMM-Newton

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[1]Department of Physics, Science College Kokrajhar, [2]Department of Physics, Assam Don Bosco University, Guwahati

GX13+1 is one among the 28 neutron star soft X-ray transients (SXT) of LMXB which mostly found to remain in the latent state and have the longest known orbital period of 24.27 days. It radiates comparatively low luminosity during quiescence state, but on rare occasions, outgo sporadic outburst with 100-1000 times increase in its luminosity. The XMM-Newton observatory recorded X-ray emission, emitted out by GX13+1 at a regular interval. Up to 2017, 13 observations were recorded in EPIC and RGS cameras. Literature provides information that the high-resolution X-ray spectroscopy may show dips, bursts, eclipses, etc. in the lightcurve of LMXB. Dips and absorption were observed in the LC of GX13+1 but those were with selective observation and with data recorded with EPIC camera only. In the present work, an attempt has been made to find dips in the lightcurve with data recorded by Reflection Grating Spectrometer (RGS) cameras onboard XMM-Newton observatory, and dipping observed in lightcurve is confirmed by a rise in the hardness ratio. The study of dipping in detail gives us information about the different physical processes involved. The study becomes significant because of its focus on the soft energy range.

Presentation Mode: Poster (Flash)

Presenting Author: Rabindra Mahato

Registration id: NSSS-20211129050424

Multi-mission probe into low luminosity phase of GRS 1915+105

Athulya Menon[1], Anuj Nandi[1]

[1]Dayananda Sagar University

The enigmatic GRS 1915+105 exhibited a few non-generic activities since 2019, when the source exhibited a sudden dimming in X-rays. The then source characteristics pertained to a high obscuration phenomenon around the black hole, which is described using the partial covering absorber tbpcf along the continuum. We probe the nature of accretion dynamics of the source during this low luminosity obscured phase using multi-mission (AstroSat, NICER & NuSTAR) observations. The broadband (0.7 – 60 keV) spectral analysis reveal an additional absorption value (of the order of 10^{23} atoms/cm^2). GRS 1915+105 also exhibited multiple X-ray flares, occasionally accompanied by associated radio flares throughout this obscured phase. The X-ray flare observations, associated with the first radio flare detected during the decay phase, shows significant changes in spectral and temporal characteristics of the source. Broadband AstroSat spectrum for this X-ray flare is described by a multicolor disc, a Comptonised component and a hard tail. Non-flare segment did not show any evidence of a hard tail. The Photon-Index (Γ) decreased from 1.5 - 1.37, while electron temperature (kT_e) increased from 5.24 – 10.98 keV during the flaring and non-flaring segments. Similar variations in `spectro-temporal' properties of the source during the multiple flares between 2019 - 2021 have been studied using near-simultaneous observations of AstroSat, NICER & NuSTAR. The source is also seen exhibiting peculiar variability classes during this low luminosity obscured phase. The spectral analysis of one such variability class (analogous to ρ class) exhibited by the source, as observed by AstroSat during July 2021, shows Fe line emission at ~7 keV with Γ and kT_e increasing with time from 2.01 - 2.68 and 3.23 - 4.94 respectively. We attempt to characterize the source behaviour during this low luminosity obscured phase and discuss the results in the context of accretion dynamics around the black hole.

Presentation Mode: Poster (Flash)

Presenting Author: Athulya Menon

Registration id: NSSS-20211220062543

Broad-band studies of X-ray pulsar 1A 0535+262 during outburst in 2020 using the Chandra and NuSTAR

Manoj Mandal[1], Sabyasachi Pal[1]

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The X-ray pulsar 1A 0535+262 went through a type-II outburst in 2020 and the X-ray flux reached a record value of 12 Crab as detected by the Burst Alert Telescope onboard Swift. A transition from the sub-critical to the super-critical accretion regime was detected which allowed probing several spectral and timing properties of the pulsar during the super-critical state. The pulse profiles were shown significant variation with energy and we observed a dramatic change in pulse profile near cyclotron line energy. The pulse profile also showed significant evolution with luminosity and the pulse fraction also showed significant variation with luminosity and energy. The beaming pattern, emission geometry, and pulse morphology were affected significantly during the state transition. The state transition was also found from the hardness intensity diagram (HID) which showed a transition from horizontal branch to diagonal branch for the first time for the source. A q-like track was observed from the HID.

The Broad-band energy spectrum was studied using Chandra and NuSTAR. The broad-band energy spectrum was fitted using a composite model with two continuum components (a cut-off power law, blackbody emission), and a component to explain the iron emission line at 6.4 keV. We also added a model component to account for the cyclotron absorption feature. We found the Cyclotron Resonant Scattering Feature (CRSF) near 45 keV in the sub-critical regime and the corresponding magnetic field of the pulsar was found to be 5E12 G. A significant variation in the correlation between the photon index and luminosity and pulse fraction with luminosity was detected near the critical luminosity.

Presentation Mode: Poster (Flash)

Presenting Author: Manoj Mandal

Registration id: NSSS-20220110062536

Weak Correlation between the Accretion Disc and Jet Power in a Large Sample of Fermi Blazars

Garima Rajguru[1], Ritaban Chatterjee[1]

[1]Presidency University

We present the results of studying the accretion disc vs jet power for a large fraction of all the blazars detected by the Fermi Gamma-Ray Space Telescope. The disc power is inferred from the emission line luminosities obtained from published results. As indicators of jet power, we use gamma-ray luminosity with and without a correction for beaming, low frequency radio luminosity from the extended jet, maximum speed of radio knots observed in the VLBA monitoring of the pc-scale jets, and kinetic energy of electrons in the jet deduced from the best-fitting theoretical models of their spectral energy distribution. We obtain a significant correlation in most of those cases. However, we find that the correlations are often driven by the common redshift dependence of the compared quantities. In order to remove the redshift bias and probe the intrinsic correlation between the disc and jet power, we compute the partial correlation coefficient as well as the correlation in small redshift bins, and find that the intrinsic disc-jet correlation is weaker. In the cases, in which the common redshift dependence does not affect the result, we find that blazars do not exhibit high jet power for low disc luminosities while there are both high and low jet power for high disc luminosities. This result indicates that a powerful disc is a necessary but not sufficient condition to produce a powerful jet.

Presentation Mode: Poster (Flash)

Presenting Author: Garima Rajguru

Registration id: NSSS-20211205090234

Image Improvement and Restoration in Optical Time Series

Yash Gondhalekar[1], Margarita Safonova[2], Snehanshu Saha[3]

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Globular clusters (GCs) are considered strong candidates for hosting rogue (free-floating) planets. Since traditional detection methods yield sub-optimal results, using gravitational microlensing, which causes transient brightening of background stars by passing foreground masses, proves promising. By employing the image subtraction technique, differential photometry on the time-series images of GCs could be used to build light curves, extract variability events, and inspect them for the presence of microlensing. However, instrumental anomalies and varying observational conditions distort the Point Spread Function (PSF) of stars, which affects the quality of the subtraction process, leading to false-positive transient detection and large-scale noise structure in the subtracted images. We propose an iterative method of image reconstruction, called the Flux Conserving Scaled Gradient Projection (FC-SGP), that successfully restores the shapes of stars while preserving their flux within the photometrically accepted tolerance. We also develop a validation procedure that finds the optimal set of FC-SGP parameters based on a set of pre-defined criteria. We further aim to study the benefits of employing the restored images in the image subtraction process and extend the application to different image formats while maintaining the performance of the proposed algorithm.

Presentation Mode: Poster (Flash)

Presenting Author: Yash Gondhalekar

Registration id: NSSS-20211129052636

Efficient Modelling of Cosmic Reionization using SCRIPT

Barun Maity[1], Tirthankar Roy Choudhury[1]

[1]NCRA-TIFR

According to the standard model of cosmology, the universe was mostly ionized and hot at very early stages. Then it cooled down with time and became predominantly neutral around 380,000 years after birth. Reionization is the era when the universe is again ionized by the photons coming from the first luminous sources.

The ionization and thermal state of the intergalactic medium (IGM) during the epoch of reionization has been of interest in recent times because of their close connection to the first stars. In this work, we present a semi-numerical code that computes the large-scale temperature and ionized hydrogen fields in a cosmologically representative volume accounting for the patchiness in these quantities arising from reionization. The code is an extension to a previously developed version for studying the growth of ionized regions, namely, Semi Numerical Code for ReionIzation with PhoTon Conservation (SCRIPT). The main addition in the present version is the inhomogeneous recombinations which are essential for temperature calculations. This extended version of SCRIPT also implements physical consequences of photoheating during reionization, e.g., radiative feedback. These enhancements allow us to predict observables that were not viable with the earlier version. These include the faint-end of the ultra-violet luminosity function of galaxies (which can get affected by the radiative feedback) and the temperature-density relation of the low-density IGM at z ~6. We study the effect of varying the free parameters and prescriptions of our model on a variety of observables. Our analysis concludes that it is possible to put constraints on the evolution of the thermal and ionization state of the IGM using available observations accounting for all possible variations in the free parameters.

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Presentation Mode: Poster (Flash)

Presenting Author: Barun Maity

Registration id: NSSS-20211212093131

Density perturbation and cosmological evolution in the presence of magnetic field in $f(R)$ gravity

Samarjit Chakraborty[1] and Sarbari Guha[1]

[1]St. Xavier's College(Autonomous) Kolkata

In this paper, we have investigated the density perturbations and cosmological evolution in the FLRW universe in presence of a cosmic magnetic field, which may be assumed to mimic primordial magnetic fields. Such magnetic fields have sufficient strength to influence galaxy formation and cluster dynamics, thereby leaving an imprint on the CMB anisotropies. We have considered the FLRW universe as a representative of the isotropic cosmological model in the 1+3 covariant formalism for $f(R)$ gravity. The propagation equations have been determined and analyzed, where we have assumed that the magnetic field is aligned uniformly along the x-direction, resulting in a diagonal shear tensor. Subsequently, the density perturbation evolution equations have been studied and the results have been interpreted. We have also indicated how these results change in the general relativistic case and briefly mentioned the expected change in higher-order gravity theories. arXiv:2111.14898v1 [hep-th]

Presentation Mode: Poster (Flash)

Presenting Author: Samarjit Chakraborty

Registration id: NSSS-20211216081835

Search for merger ejecta emission in Short Gamma Ray Bursts from very late time radio observations

Ankur Ghosh, S. V. Cherrukuri, L. Resmi, Kuntal Misra, K. G. Arun, Amitesh Omar and N. K. Chakradhari

ARIES, IIST, PRL, CMI, Pt. Ravi Shankar Shukla University, Raipur

Coalescence of inspiral binary neutron stars (BNS) system, giving rise to short Gamma-Ray Bursts (GRBs), are one of the most probable candidates for Gravitational Waves (GWs). If the resultant product of the merger is a millisecond magnetar, a significant proportion of the rotational energy is deposited to emerging ejecta that produces late-time radio brightening from the interaction with the surrounding ambient medium. Detection of this late-time radio emission from short GRBs can have profound implications for understanding the physics of the progenitor. This study presents the deepest and an extensive search for radio emission at late times following a short GRB to date incorporating proper frequency regime, wider observation span, and relativistic correction. Five short GRBs were observed with the Giant Meter Wave Radio Telescope (GMRT) at 1250, 610, and 325 MHz band ~ 2 - 11 years since the burst to search for radio emission from the merger ejecta. The estimated upper limits at the burst location are used to constrain the parameters of the burst and its surrounding environment. The magnetar model, with appropriate modifications, constrains the number density of the ambient medium for these bursts to be between 10^{-4} - 10^{-2} cm^{-3}. Our analysis rules out a stable magnetar with the energy of 10^{53} erg for four out of the five GRBs in our sample.

Presentation Mode: Poster (Flash)

Presenting Author: Ankur Ghosh

Registration id: NSSS-20220110050740

uGMRT study of ELAIS-N1 field: the radio-IR relations up to z∼2

Akriti Sinha[1], Abhirup Datta[2], Aritra Basu[2], Arnab Chakraborty[3]

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The study of diverse source populations at various redshifts is probed with the help of deep radio observations. The synchrotron emissions from the faint radio sources come from the powerful jets in active galactic nuclei (AGN) and from the star-forming regions in the disk galaxies. We study the ELAIS-N1 field using uGMRT observations at 300-500 MHz with the central off-source RMS of 15μJy/beam. These observations cover 1.8 sq. degree of the sky, yielding a source catalog of 2528 objects. We perform multi-wavelength diagnostics for classifying the sources in SFGs and AGN to study one of the tightest relations in astrophysics, i.e., the radio-IR relations up to z~2. We obtained the rest-frame flux values by k-correcting the observed data in both the wavebands. We also study the variation of monochromatic q parameters with redshift at 24 and 70 um and also of the bolometric qTIR integrated between 8 and 1000 um. We find the q24 values to increase with z induced by an increase in dust temperature. The q70 and qTIR values remain mainly unaffected by fluctuation in dust temperature and show a mild decrease with z. A tight correlation is observed between radio luminosity at 1.4 GHz and the total infrared luminosity having super-linear slopes and less scatter for SFGs. We also for the first time study the correlation between both the bolometric radio and IR luminosities. We measure significant non-linear slopes for all the radio-infrared relations highlighting the ambiguity in using q parameters to study the radio-IR relations.

Presentation Mode: Poster (Flash)

Presenting Author: Akriti Sinha

Registration id: NSSS-20220112065559

A Radio and X-ray view of merging cluster A1351

Swarna Chatterjee[1], Majidul Rahaman[1], Abhirup Datta[1], Ramij Raja[1]

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Galaxy clusters are the largest virialized structures in the universe and an ideal laboratory for studying astrophysical plasma processes. They house large-scale diffuse radio emissions in the form of radio halos and radio relics. With the recent advancement in observational techniques in low-frequencies, and the increased sensitivity of telescopes like GMRT, LoFAR, MeerKAT, more peculiar and interesting nonthermal radio features in the ICM are being discovered. The spectral index maps from multi-frequency radio observation and their comparison with X-ray can provide us with significant insight into cluster dynamics, merger history, and the large-scale particle acceleration process. Here we will present some interesting results about a massive merging cluster, A1351. With our radio and X-ray analysis, we will also shed some light on the particle acceleration process going on there.

Presentation Mode: Poster (Flash)

Presenting Author: Swarna Chatterjee

Registration id: NSSS-20220112071416

Propagation of axial and polar gravitational waves in Kantowski-Sachs universe

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We apply the Regge-Wheeler formalism to study axial and polar gravitational waves in Kantowski-Sachs universe. The background field equations and the linearized perturbation equations for the modes are derived in presence of matter. To find analytical solutions, we analyse the propagation of waves in vacuum spacetime. The background field equations in absence of matter are solved by assuming the expansion scalar to be proportional to the shear scalar (so that the metric coefficients are given by the relation $a = b^n$, where n is an arbitrary constant). Using the method of separation of variables, the axial perturbation parameter $h_0(t, r)$ is obtained from its wave equation. Then $h_1(t, r)$ is determined from $h_0(t, r)$. The anisotropy of the background spacetime is responsible for the damping of the axial waves. The polar perturbation equations are much more involved compared to their FLRW counterparts, as well as to the axial perturbations in Kantowski-Sachs background, and contain complicated couplings among the perturbation variables. In both the axial and polar cases, the radial and temporal solutions separate out as product. The temporal part of the polar perturbation solutions are plotted against time to obtain an order of magnitude estimate of the frequency of the propagating GWs, and lies in the range 1000-2000 Hz. Using standard observational data for the GW strain we have placed constraints on the parameters in the polar perturbation solutions. The perturbation equations in presence of matter show that the axial waves can cause perturbations only in the azimuthal velocity of the fluid without deforming the matter field. But the polar waves must perturb the energy density, the pressure and also the non-azimuthal components of the fluid velocity. The propagation of axial and polar gravitational waves in KS and Bianchi I spacetimes is found to be more or less similar in nature. (Physics of the Dark Universe 34 (2021) 100890)

Presentation Mode: Poster

Presenting Author: Sucheta Datta

Registration id: NSSS-20211205023848

Possible Alternate Scenario for short Duration GRBs

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Short gamma-ray bursts are those gamma-ray bursts that have a shorter duration (< 0.2 – 2 s) and a harder spectrum (as compared to 2 – 200 s for long GRBs). Short GRBs are possibly due to the merger of two neutron stars, whereas, the long GRBs are due to the collapse of very massive stars. The spectrum observed is harder because the objects merging to produce the GRB are more compact. In the case of short duration GRB, the energy released is the binding energy of the neutron stars ($\sim 10^{53}$ ergs). Most sources capable of impulsively releasing 10^{53} ergs or more of energy required to power a GRB contain so much matter around them that if the energy released were used to accelerate even a very small fraction ($\sim 10^{-3}$) of the baryons present, only a non-relativistic wind would result. This is known as the baryon-loading problem.

It has been hoped that the geometry of the sources is such that at least some of the energy released is channelled along those directions that are relatively free of baryons, so that relativistic bulk motion and the ensuing beaming of radiation may occur along certain lines of sight. So far, this has not yet been fully demonstrated for any theoretical source of GRBs. In this work, we look at a new class of objects made up entirely of dark matter particles. These objects are possible candidates for short duration gamma-ray bursts that eliminate the baryon load problem.

In this scenario, unlike in some other models of short duration GRBs, we do expect much lower fluxes of neutrinos and gravitational waves to be simultaneously emitted. This could be a distinct signature of this model. As an additional consequence, this could be another way in which primordial black holes (< stellar mass) can form, apart from Hawking black holes. The masses of these sub-stellar mass black holes depend on the mass of the dark matter particles.

Presentation Mode: Poster

Presenting Author: Arun Kenath

Registration id: NSSS-20211206082202

2D and 3D shapes of elliptical galaxies NGC 1199, NGC 1395 and NGC 1549

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Photometric data from the literature is combined with triaxial mass models to derive 2D and 3D shapes of the light distribution of elliptical galaxies NGC 1199, NGC 1395 and 1549. The inferred shape variation in given by a Bayesian probability distribution, assuming a uniform prior. The likelihood of obtaining the data is calculated by using ensemble of triaxial models. We apply the method to infer the shape variation of a galaxy, using the ellipticities and the difference in the position angles at two suitably chosen points from the profiles of the photometric data. Best constrained shape parameters are found to be the short to long axial ratios at small and large radii, and the absolute values of the triaxiality difference between these radii. I found the shapes parameters, expectation values ($< q_0 >$, $< q_\infty >$) of NGC 1199 (0.66, 0.88), NGC 1395 (0.60, 0.71) and 1549 (0.61, 0.84) and location of the peak values $< q_{0P} >$, $< q_{\infty P} >$ of NGC 1199 (0.76, 0.95), NGC

1395 (0.68 , 0.84) and 1549 (0.51, 0.94) are such quantities.

Presentation Mode: Poster

Presenting Author: Arun Kumar Diwakar

Registration id: NSSS-20211211045142

Modification of Newtonian Gravity: Consequences for dynamics of large-scale structures

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The presence of dark matter and dark energy, which accounts for ninety-five percent of all matter in the Universe, is well established by various observational evidences. Though indirect observations strongly support the existence of DM, it remains undetected by various dark matter detection experiments running for several years. In view of these negative results, we propose alternate models to account for observations (like flat rotation curves) by postulating a minimal field strength (minimal curvature) and also a minimal acceleration. These postulates lead to alternate theories such as the modified Newtonian dynamics (MOND) and modified Newtonian gravity (MONG).

In the standard model, dark matter plays a vital role in the observed dynamics of large-scale structures — one of the key evidences for its presence being in the rotation curves of galaxies. In an earlier work, this observed flat rotation curves of galaxies were accounted for, and the dynamical velocity-distance curve for galaxy clusters such as the Virgo cluster were obtained through our modified model. Here we extend the model of modified gravity to obtain the radial velocity of galaxies in the Virgo cluster. Observations show an inconsistency in the Hubble flow at a mean cluster distance of 17 Mpc, usually attributed to observational biases. This decrease in velocity is an a priori prediction of our model of modified gravity (MONG). The radial velocity versus distance relation for galaxies in the Virgo cluster obtained using MONG is in agreement with observations. We also estimate the angular momentum of galaxies and make similar predictions (for angular momentum) of galaxy clusters. Future observational estimates of galaxy cluster dynamics and angular momenta could support this approach.

Presentation Mode: Poster

Presenting Author: Louise Rebecca

Registration id: NSSS-20211213041846

Characterizing the Quasar Feedback Effect in X-ray and Sunyaev-Zeldovich Signal from Galaxy Clusters

Avinanda Chakraborty[1], Soumya Roy[2], Suchetana Chatterjee[1], Mark Lacy[3], Rudrani Kar Chowdhury[4], Nishikant Khandai[5]

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The thermal Sunyaev-Zeldovich (SZ) effect is the spectral distortion of the cosmic microwave background (CMB) radiation by energetic electrons. The SZ effect can be used as a direct potential probe of energetic outflows which known as feedback from quasars which are responsible for heating the intergalactic medium. In this work, we use the GADGET-3 simulations which include dark matter and gas dynamics, radiative cooling, star formation, black hole growth, and energy-driven feedback (MassiveBlack-II) to compute the SZ effect arising from quasar feedback. From these theoretical simulations, we perform mock observations of the Atacama Large Millimetre Array (ALMA) to characterise the feasibility of direct direction of the quasar-SZ signal. We also compare the simulated ALMA maps of SZ distortion with that of the mock Chandra X-ray maps around the same quasars to perform a joint analysis of these systems. Our work for the first time provides a machinery to perform direct joint X-ray-SZ observations of quasars and extract the feedback energy from them.

Presentation Mode: Poster

Presenting Author: Avinanda Chakraborty

Registration id: NSSS-20211205054944

Fast Estimator for bispectrum of 3D cosmological fields

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In the era of precision cosmology, the study of clustering statistics beyond power-spectrum (Fourier transform of 2-point correlation function) is very crucial to capture detailed features of underlying non-Gaussian cosmological fields. Bispectrum (Fourier counterpart of 3-point correlation function), the lowest order statistics sensitive to non-Gaussianity, of density field distribution in real and redshift space provide great deal of cosmological information regarding the physics of the very early Universe, subsequent growth of structures and constraining various model parameters. However, these statistics are very computationally expansive due to their high dimensionality. It is necessary to develop their fast and accurate estimators to analyse the enormous amount of data from ongoing and upcoming future galaxy surveys like LSST, DESI, EUCLID etc. We have developed a Fast Fourier Transform based estimator of binned bispectrum for 3D cosmological density fields by linearly binning the wave-vector space (k-space) in uniform concentric spherical shells. The parameterization of triangles formed by different wave-vectors (Fourier modes) is taken in such a way that the shape and size dependence of bispectrum, corresponding to each possible closed triangle configuration, can be studied separately. The estimator is also implemented to analyse the monopole moment of redshift space bispectrum of field possessing linear redshift-space distortion caused by peculiar velocities of galaxies. The estimator is very fast and results are in good agreement with analytical predictions. This can further be used to analyse survey data to explore the features of cosmic fields and extract precious cosmological information.

Presentation Mode: Poster

Presenting Author: Sukhdeep Singh

Registration id: NSSS-20211218124813

Exotic dense matter in view of astrophysical observations

Vivek Baruah Thapa[1], Monika Sinha[1]

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Neutron stars (NSs) provide a wide window into the properties of dense nuclear matter. Gravitational waves (GWs) detected from binary neutron star merger events (GW170817, GW190425) and subsequent estimations of tidal deformabilities play a key role in constraining the behavior of dense matter at high density regimes. Massive NS candidates with mass 2 solar mass as well as observations from NICER (Neutron star Interior Composition ExploreR) space mission on mass-radius limits set strict bounds on the dense matter equation of state (EOS). The onset possibility of heavier strange, non-strange baryons, meson condensations in dense matter constrain the theoretical models of nuclear matter comportment at large density regimes. The coupling restrictions for hyperonic sector are extracted from Lambda and Cascade hypernuclei experiments, those in Delta-resonances from scattering off nuclei and heavy ion collision data while in case of (anti)kaons they are constrained by the experimental studies on kaon-nucleon scattering data fits. We analyse coupling parametrizations from two classes based on covariant density functional models: non-linear (NL) and density-dependent schemes (DD). (Anti)kaon condensation is found to be through a first order phase transition satisfying high density observable constraints. We also found that for a 1.5 $M_{\odot}$NS, the stringent limits on GW observables translates to an allowed radius range $11.89 \leq R(1.5)/\text{km} \leq 12.98$. And based on extensive analysis of these EOS models, the lower bound on compactness parameter for a 1.4 solar mass NS is inferred to be $C(1.4) \geq 0.1608$.

Presentation Mode: Poster

Presenting Author: Vivek Baruah Thapa

Registration id: NSSS-20211215073331

Detection of the complex nitrile species ethyl cyanide towards the hot molecular core G10.47+0.03

Soumyadip Banerjee[1], Sabyasachi Pal[1], Arijit Manna[1]

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The analyses of the complex molecular emission lines towards the hot molecular cores in millimeter-wavelength give important evidence regarding the chemical complexity. After the deep searching, We detected the rotational molecular emission lines of complex nitrile species ethyl cyanide towards the hot molecular core G10.47+0.03 between the frequency range 129.50–160.43 GHz using the Atacama Large Millimeter/Submillimeter Array (ALMA). The hot molecular core G10.47+0.03 was located at a distance of 8.6 kpc. We detected a total of eighteen transition lines of ethyl cyanide towards G10.47+0.03. Using the rotational diagram method, We determine the column density of ethyl cyanide was (9.50±0.23)×10 16 cm −2 with rotational temperature 150±3.8 K. We also calculated the fractional abundance of ethyl cyanide towards the hot molecular core G10.47+0.03 relative to H2 was 7.03×10 −9 where N (H_2) = 1.35×10^{25} cm^{-2} . Using the UMIST 2012 astrochemistry chemical network, we discuss the possible formation mechanism of ethyl cyanide towards G10.47+0.03. The presence of ethyl cyanide indicates the possibility of the presence of more nitrile-related molecules towards G10.47+0.03.

Presentation Mode: Poster

Presenting Author: Soumyadip Banerjee

Registration id: NSSS-20211224072311

DETECTION OF EXOPLANETS USING THE RADIAL VELOCITY TECHNIQUE

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[1]University of Kerala, [2]IIST

The Radial Velocity Approach to Finding Exoplanets

The detection of extrasolar planets has provided us with important insights on the formation of planets around stars, their dynamical stability, the diversity of planet properties, their atmospheres, and the prospects of planets elsewhere having conditions conducive for life. Among the available approaches, the radial velocity technique continues to be one of the most efficient ways to indirectly confirm the presence of planets around stars. The technique relies on measuring the dynamical wobble of stars induced by gravitational pull from orbiting planets. As part of my undergraduate dissertation, I developed an algorithm that would simulate the synthetic radial velocity signal for any hypothetical star-planet system. The model, based on orbital mechanics principles, generates synthetic radial velocity curves for a wide range of user-given orbital parameters. Archival radial velocity data of stars with known exoplanets were subsequently constrained using this model to determine the properties of exoplanets. The periodicity in the radial velocity data was determined using a Lomb–Scargle periodogram algorithm. The data was folded for the predicted periodicity, and subsequently fitted with the radial velocity model which I had developed. In the presentation, we will be including results from our estimations of exoplanet properties for a sample of radial velocity data of stars retrieved from the NASA exoplanet archive. Based on estimations of the star-planet separation, and an assumed infra-red optical depth similar to Earth atmosphere, we also estimate whether the planets we analyse inhabit the habitable zone of their host star, which is a crucial first estimate in hypothesising about the potential habitability of exo-worlds.

Presentation Mode: Poster

Presenting Author: Sreebala P S

Registration id: NSSS-20211230021622

Studies of the pre-main sequence stars in the H II region Sh2-87

Siddhartha Biswas[1], Soumen Mondal[1], Alik Panja[1], Somnath Duta[2], Ramkrishna Das[1].

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H II regions are the low-density clouds of ionized gas excited by massive stars (O, early B). The molecular clouds, associated with H II regions and young embedded clusters, serve as the ideal targets to probe the formation of stars as well as star clusters. Here, we identify and characterize the pre-main-sequence stars associated with the H II regions Sh2-87, which is located at a distance of $\sim$ 2.3 kpc and is a member of the Vulpecula OB association. We have utilized both the new spectroscopic observational data as well as several archival catalogues, e.g., IPHAS, WISE, 2MASS. Low-resolution spectroscopic observations revealed the presence of few massive (early-B) sources. Using the near-infrared colour excess, a numerous number of young population (20 Class I and 70 Class II) are identified, that suggest active star-formation activity toward this region. Additionally, the presence of a significant number (20) of Hα emitters indicates strong ionization activity. Thus using multi-wavelength datasets, an overall star formation activity will be presented here.

Presentation Mode: Poster

Presenting Author: SIDDHARTHA BISWAS

Registration id: NSSS-20220108084414

Entropy bound of d-dimensional Reissner-Nordstrom black hole in rainbow gravity

Tanusree Roy[1], Ujjal Debnath[1]

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Inspired by the pronounced effect of gravity's rainbow on black hole thermodynamics, entropy relations and bounds have been investigated for d-dimensional Reissner-Nordstrom (RN) black hole in the framework of rainbow gravity. Basic thermodynamic properties of the black hole have been derived for the event horizon and Cauchy horizon. Except for the horizon radius, they all crucially depend on the rainbow functions. Next, entropy product, irreducible mass product, temperature product, Komar energy product have been calculated along with their sum/difference, and their universality has been checked. Using these relations, bounds of the aforesaid thermodynamic quantities have been deduced for both horizons. Analyzing the specific heat capacity, stability conditions have been obtained. Also, the extremal phase of the black hole has been explored. Further, a comparative study has been carried out to distinguish between the effects of rainbow gravity models on the entropy bound by considering different rainbow gravity functions.

Presentation Mode: Poster

Presenting Author: Tanusree Roy

Registration id: NSSS-20211210084954

Formation of an aromatic ring molecule (3-pyrroline) in the interstellar medium.

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Complex organic molecules (COMs) are thought to form on icy dust grains in the earliest phase of star formation. Interstellar detection of the straight-chain and branched-chain molecules toward the star-forming region, Sgr $B_2(N_2)$ allows the study of other COMs (Belloche et al. 2014). The first detection of COM strongly hints the existence of other linear and ring-shaped molecules.

Here, we suggest new possible formation and destruction pathways of branched aliphatic molecule to aromatic compounds in interstellar environments using Density Functional Theory (DFT).

Presentation Mode: Poster

Presenting Author: Anshika Pandey

Registration id: NSSS-20220110085003

Magnetic Activity of M-dwarfs: Optical and NIR Spectroscopic Studies

Diya Ram[1], Soumen Mondal[1], Dusmanta Patra[1]

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M dwarfs are the most numerous stars in our Galaxy, amounting to about two-thirds in number and about 40 percent in stellar mass. M dwarfs are the lowest-mass hydrogen-burning stars, which are found at the bottom of the main sequence in the H-R diagram. These stars possess masses of 0.08–0.6 $M_{\odot}$ and have effective temperatures of 2500 - 4000 K. We have undertaken optical/Near-IR spectroscopic studies of a unique sample of M-dwarfs including a few M-dwarfs having strong magnetic fields. Using Himalayan Faint Object spectrograph (HFOSC) and TIFR Near-IR spectrograph (TIRSPEC) back-end instruments on the 2-m Himalayan Chandra Telescope (HCT) telescope, we have taken optical and near-IR spectra of a sample of M dwarfs to investigate the chromospheric activity and evolution of the atmosphere of M-dwarfs. Several important atomic and molecular lines in the optical and Near-IR wavelengths (e.g.,(H alpha, Ca II IR triplet, He 10833, Na, CO, etc) will be used to characterize these late-type dwarfs. From a preliminary analysis of our observed spectra, we have detected and identified several important atomic and molecular lines to characterize those dwarfs, and data analysis is ongoing. These observations could be used to establish a road map for future target selection of transit searches around young and old populations of nearby M dwarfs.

Presentation Mode: Poster

Presenting Author: Diya Ram

Registration id: NSSS-20220110045309

Star formation characteristics in the host of the seyfert type AGN NGC 4395

Payel Nandi[1,2], C.S. Stalin[2], S. Muneer[2]

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Relativistic jets/outflows from active galactic nuclei (AGN) can have profound impact on their host galaxies. They can induce or inhibit star formation. Also, we do have evidences of AGN inducing and inhibiting star formation in a single system at the same time. There is thus growing evidence that the interplay between supermassive black holes at the center of AGN and their hosts is complex. Observations at different spatial scales as well as at different wavelengths are needed to build a comprehensive picture of the relation between AGN and their hosts. In this work, we aim to investigate this relation using a case study of a Seyfert type AGN NGC 4395. This AGN is located at a redshift of z =0.001 and powered by a low mass black hole with M ~ 10^5 solar mass. For this, we utilized data in the ultra-violet (UV) bands (both in the far-UV and near-UV) from the ultra-violet imaging telescope (UVIT) on-board AstroSat, infrared data from Spitzer and ground based optical imaging data from the Himalayan Chandra Telescope (HCT), Hanle. The UV observations in conjunction with the narrow band H_alpha imaging observations from HCT have enabled us to identify many star forming regions. Few properties of these star forming regions such as age, star formation rate etc. were determined by comparing models with observations. Star forming regions with few Myrs are found. Many other physical properties of the star forming regions too, were determined using broad band spectral energy distribution modelling. We also investigated the variation of the derived parameters across the galaxy.

Details of this work will be presented.

Presentation Mode: Poster

Presenting Author: Payel Nandi

Registration id: NSSS-20220110083943

Stability behaviours of ion-acoustic wave in relativistic gyromagnetoactive quantum plasmas

Sayanti Dasgupta[1], Pralay Kumar Karmakar[1]

[1]Tezpur University

A relativistic quantum plasma model to analyze the ion-acoustic (IA) mode stability in a gyromagnetoactive plasma system electrostatically confined in a spherically symmetric geometry is theoretically constructed. It includes the conjoint action of several key factors, such as the Coriolis rotation force, electrostatic confinement pressure, Bohm potential, etc. The relativistically degenerate electronic species (water-bag-distributed) provide the restoring force for the proposed IA mode excitation. The inertial force is naturally provided by the heavier relativistic ionic species. An exact normal spherical mode analysis yields a generalized curvature-modified linear dispersion relation (quartic in degree) with no quasi-classic approximation. A numerically illustrative platform developed here depicts the meticulous IA-growth patterns in real compact astrospace parametric windows adopted from the literature. It enables us to infer that, the Coriolis rotation and the magnetic field, act as destabilizing agencies followed by a unique pattern of zero growth-bouncing point (ZGP). As the system rotation increases, the ZGP shifts towards the lower wavenumber regime. If the magnetic field enhances, the corresponding ZGP shifts towards the higher wavenumber side, contrary to the said rotation case. As the plasma system becomes denser, we come across two critical pointsin the wavenumber space. The IA-growth first increases in the lowermost wavenumber regime. It undergoes a unique type of phase reversal behaviour with the ZGP shifting towards the lowerwavenumber regime (first critical point), followed by another new phase reversal feature (second critical point), and so forth. It fairly supports several characteristic signatures of the pulsational modes evolving in white dwarfs and progenitor stars as already reported elsewhere.

Presentation Mode: Poster

Presenting Author: Sayanti Dasgupta, Pralay Kumar Karmakar

Registration id: NSSS-20220108065449

Interstellar Carbon Nanotubes

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The presence of many carbonaceous compounds in several astrophysical objects is well known. These componds are generally: polycyclic aromatic hydrocarbons (PAHs) (Tielens et al. 2008), fullerenes (Cami et al. 2010), amorphous carbon (Pendleton & Allamandola 2002), graphene (Chen et al. 2017) and nanotubes (Chen et al. 2019). The carbon nanotubes are considered as elongated fullerenes (Cruz-Silva et al. 2016). It may be expected that these nanotubes are hydrogenated in the H-rich interstellar environments. Here, we present the electronic spectra of the stable hydrogenated carbon nanotubes using time-dependent density functional theory (TD-DFT). The results are discussed in relation to the astronomical diffuse interstellar bands (DIBs).

Presentation Mode: Poster

Presenting Author: A.K.Vishwkarma

Registration id: NSSS-20220110110329

A catalogue of newly discovered Hybrid Morphology Radio (HyMoR) galaxies from the VLA FIRST survey

Shobha Kumari[1], Dr. Sabyasachi Pal[1]

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Radio galaxies are known to have a supermassive black hole in the center of the galaxy, from where relativistic jets emerge out on both sides of the galaxy. In general, there are two classes of radio galaxies: FR-I and FR-II. Hybrid Morphology Radio (HyMoR) Galaxies are found to be a very rare and unique subclass of radio galaxies that exhibit an FR-I structure on one side and an FR-II structure on the other side together of the galaxy. This unique morphology of radio galaxies is very rare. The availability of a small number of sources restricts us to explore the formation and nature of these galaxies. It is believed that the interaction of jets with the interstellar and intercluster medium plays an important role in the formation of radio galaxies. With the detailed study of these sources, we can understand the FR-dichotomy, a well-debated issue in radio astronomy. In this paper, we present newly discovered HyMoR galaxies using VLA FIRST survey at 1400 MHz. The new finding of these sources will help to broaden the sample of known HyMoRs. From the sources which have known red-shifts, we studied various statistical properties of these sources. A redshift range for HyMoRs in this paper is up to ~0.6. The measured radio luminosities for HyMoRS at 1400 MHz are in the order of 10^{25} W/Hz, which is the same for a typical radio galaxy. The value of radio luminosity for FR-I is less than twice of 10^{25} whereas for FR-II this value is greater than twice of 10^{25}. The value of radio luminosity for sources presented in this paper lies in the border-line of FR-I and FR-II which is as expected for HyMoRs. It is also found that some sources in our catalogue are a bit more luminous than previously detected HyMoRs. Most of the measured spectral indices (α) for these sources in this paper show a steep spectral index ($\alpha>0.5$). Emission and absorption lines from optical spectra are also studied for newly discovered HyMoRs.

Presentation Mode: Poster

Presenting Author: Shobha Kumari

Registration id: NSSS-20211217102506

A detailed comprehensive analysis of Stellar systems

Sukhjit Singh[1], Ruchi Kaur[1]

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A detailed comprehensive analysis of the modeling of stellar systems along with density waves and density-dependent supernovae shockwaves has been proposed here with emphasis to study the strong correlation between local density fluctuations as a result of external perturbations by the aforementioned waves and star-forming rate of the system. Analysis was of the system was done on the basis of variation of transition rates representing the fundamental physical processes guiding the star formation in galaxies. The variable densities of the atomic, molecular, and stellar components also influence the star-forming cycle. Both limit cycle and stationary state conditions come to be seen in the system under the selection of some special parametric conditions consisting of conditions of episodes of both discrete and unstable star-forming cycles converging to a limit point. Analysis of variable density of the supernovae shockwave on low mass stellar systems showed that the system exhibited a limit cycle condition with negligible change in star-forming rate where the rate was found to vary considerably for high mass stellar systems with the existence of stationary states.

Presentation Mode: Poster

Presenting Author: Sukhjit Singh

Registration id: NSSS-20211227091933

Constraints on Variable Chaplygin Gas Cosmological Model from GW Merger Events

Ashley Chraya[1], Yuvraj Muralichandran[2], Nilkantha Namdev Gholap[3], R. Jothika[3], Survi Kumari[4], Geetanjali Sethi[5]

[1]Indian Institute of Science Education and Research (IISER), Mohali, [2]Madras Christian College [3]Amrita Vishwa Vidyapeetham, Coimbatore, [4]Shaheed Rajguru, University of Delhi, [5]St. Stephen's College, Delhi

Observations have the potential to bolster our understanding of the universe, and one such observation of type Ia supernovae suggests that the expansion of the universe is accelerating. Several cosmological models have been used to describe the observed universe. The simplest and most popular candidate for dark energy is the cosmological constant (Λ). A trustworthy model should explain why the present amount of dark energy is so small in comparison to the fundamental scale (fine-tuning problem) and why it is comparable with the critical density today (coincidence problem). The cosmological constant suffers from both these problems. Hence, we investigate the variable Chaplygin gas (VCG) model as a viable cosmological model. The VCG interpolates from a dust-dominated era to a quintessence-dominated era. We examine the VCG model to establish stringent constraints using the latest observational data: SCP ”Union2.1” SN Ia dataset and the GWTC-3 catalog of gravitational wave merger events. Using the constraints on the parameters of the VCG and the Markov chain Monte Carlo (MCMC) method, we inferred the Hubble constant value with SNe-Ia as a standard candle and gravitational waves as a standard siren. We also show that the background evolution for the VCG model is equivalent to that for a coupled dark energy model with dark matter.

Presentation Mode: Poster

Presenting Author: Ashley Chraya

Registration id: NSSS-20211219082001

Extracting the Global 21cm signal from CD/EoR from ground-based observations using ANNs

Anshuman Tripathi[1], Abhirup Datta[1], Madhurima Choudhury[1]

[1]IITI

The evolution of our Universe from the Dark ages to the Epoch of reionization (EoR) remains unexplored. Detection of redshifted HI 21-cm signals is one of the primary scientific goals of radio telescopes like the MWA, SKA, and a promising probe for studying these epochs. The HI signal can be measured by averaging over the entire sky using a single radio telescope, or it can be measured using an interferometer. However, detection of 21-cm is an observational challenge due to the much brighter foreground of the galactic and extragalactic sources. At low frequencies, the Earth's ionosphere distorts the signal significantly. Here, we use Artificial Neural Networks (ANNs) to extract the global 21-cm signal parameters from the composite all-sky averaged signal, containing foreground and ionospheric effects. Ionospheric effects are added considering the effects of refraction, absorption, and thermal emission. This trained model can help us to achieve better results for ground-based observations. Our initial results show significant accuracy in recovering the signal parameters from Cosmic Dawn (CD) and Epoch of Reionization (EoR) using the synthetic observations of global signal experiments.

Presentation Mode: Poster

Presenting Author: Anshuman Tripathi

Registration id: NSSS-20220112070059

Ionization structure and dust characteristics of the compact planetary nebulae MaC 2-1 and Sp 4-1

Rahul Bandyopadhyay[1], Ramkrishna Das[1] and Soumen Mondal[1]

[1]S. N. Bose National Centre for Basic Sciences

We study the characteristics of planetary nebulae (PNe), MaC 2-1 and Sp 4-1. We use 2 m Himalayan Chandra Telescope optical spectra, Spitzer Space Telescope mid-infrared (mid-IR) spectra, Hubble Space Telescope images, and IR photometric data. These PNe have not been individually studied in details earlier. MaC 2-1 shows the presence of silicon carbide (SiC) and magnesium sulphide (MgS) dust. Sp 4-1 hosts polycyclic aromatic hydrocarbon (PAH) molecules. We obtain plasma properties of the PNe from the optical and mid-IR emission line fluxes. We compute photoionization models of the PNe for self-consistent estimation of physical parameters. The characteristic observables are well-reproduced in our modelling. From the complete analysis, we have obtained a detailed description of each PN with results including 3D morphology, gas and dust phase elemental abundances, dust and molecular properties, distance to PN, important physical parameters of the central star (e.g., effective temperature, luminosity, mass, etc.) and the nebula (e.g., hydrogen density profiles, radii, etc.). From our study, we find that both the PNe are in the low- to moderate-excitation class. We estimate that the progenitors of MaC 2-1 and Sp 4-1 had masses of 1.2 and 1.55 times the solar mass, respectively, and both of them seem to have born in metal poor environment. Both are distant PNe, with the estimated distances of 16 and 18 kpc for MaC 2-1 and Sp 4-1, respectively.

Presentation Mode: Poster

Presenting Author: Rahul Bandyopadhyay

Registration id: NSSS-20220109033727

Plenary Session 5

Enabling Technologies for Space Exploration

This session will focus on novel space technology and engineering developments, proof-of-concept instrumentation and vision thereof, that are likely to drive and enable India's future space exploration and space science programs.

Space Science Research with Sounding Rockets

Alex John[1], Binoy Joseph[1]

[1]VSSC-ISRO

Sounding rockets are sub-orbital rockets used for exploring the earth's atmosphere and near space altitude regions; they cater to the requirements in research of the altitude region which are inaccessible by high altitude balloons and artificial satellites and are engineered based on sub-system requirements - propulsion, auxiliary systems and payload that carries scientific instruments to conduct experiments, avionics module, etc. Sounding rockets have advantages of simplicity, short turn-around time and low cost and also serve as a flying test bed for developing technologies.

ISRO's array of sounding rockets can reach altitudes from 60 to 600 km with payloads of mass 10 to 400 kg. ISRO also provides comprehensive infrastructure including laboratories and ground stations at two launch stations - TERLS, Trivandrum and SHAR, Sriharikota.

Advanced Technology Vehicles and Sounding Rockets Project (ATVP) of ISRO has the primary objective of assisting customers in realising payloads that will reliably perform the requirements necessary to meet the scientific and technological objectives of the mission.

Since the inception of the Programme in 1963, there has been more than 3500 flight missions and is a cost effective, quick-response effort that would provide about 10 - 20 flight opportunities per year to space scientists involved in the disciplines of middle and upper atmosphere research, plasma and solar physics, high energy astrophysics, micro-gravity experiments, etc.

Services provided to customers include involvement of the investigators in preparation and execution of the experiment, including mission management, payload layout design, testing and evaluation, analytical studies, tracking, data acquisition and processing.

This presentation discusses the capabilities of ISRO's Sounding Rockets for research in Space Science and aims to improve the awareness among Space Physicists on the avenues of space research through Sounding Rockets.

Presentation Mode: Oral

Presenting Author: Binoy Joseph

Registration id: NSSS-20220107074933

ISRO's Sounding Rockets: Overview of Instrumentation System for Space Science Experiments

Virender Katewa[1], P. Ranganath[1], Binoy Joseph[1]

[1]VSSC-ISRO

Sounding rockets are sub-orbital rockets carrying instruments designed to take measurements for exploring the earth's atmospheric layers which are inaccessible by high altitude balloons and artificial satellites. The payload section normally kept in upper stage carries experimental payloads, vehicle avionic systems and instruments to conduct the desired experiments.

In view of low cost and high environmental levels of sounding rockets, they are also used as a flying test bed for testing prototypes of newly developed avionic packages and subsystems intended for use in launch vehicles and satellites.

ISRO has developed wide range of sounding rockets to explore the atmospheric region from 60 km to 600 km with payload capability of 10 kg to 100 kg. ISRO provides two launch stations with ground support infrastructure for sounding rocket experiments viz. TERLS, VSSC & Sriharikota, SDSC-SHAR. Advanced Technology Vehicles and Sounding Rockets Project (ATVP) of VSSC/ISRO has the primary objective of assisting customers in realising payloads that will reliably perform the requirements necessary to meet the scientific & technological objectives of the mission.

The design of avionic systems and instruments for sounding rocket experiments are quite challenging in terms of miniaturization and their performance in highly dynamic flight environmental levels. VSSC has recently developed new power sources i.e. super capacitor and hybrid capacitor with different capacities, smart MEMS pressure sensors, piezo electric vibration sensors, miniaturized MEMS acoustic sensors, SDR based miniaturized single unit avionic system for data acquisition and down-telemetry of flight measurements.

This presentation discusses the recent developments in avionics and instrumentation system of ISRO's Sounding Rockets for research in Space Science activities and aims to support Space Scientists by providing higher sampling data rates for better resolution and accuracy for their measurement parameters.

Presentation Mode: Oral

Presenting Author: Virender Katewa

Registration id: NSSS-20220110052040

Scientific payload electronics for electron and ion density measurements onboard ISRO's sounding roc

Sreelatha P[1], Pradeepkumar P[1], Rosmy John[1] , Manju G[1]

[1]VSSC, Trivandrum

The sounding rockets provide a low cost platform for insitu measurement of various atmospheric parameters, which are not normally measurable either with ground based systems or with satellite payloads. The altitude for these measurements range from above 60 km, where the nose cone ejection happens, to the peak of the trajectory, and back to the altitude till where the ground radar can track. Some of the ionospheric parameters that can be measured include electron density, ion density, electric field, neutral wind etc. The indigenous Electron density and Neutral Wind (ENWi) Probe combined with a Langmuir Probe (LP) is a scientific payload which addresses measurement of neutral wind and electron density in the E-region of ionosphere. The payload electronics is combined for both these probes and has a common interface with the rocket telemetry. The payload with one set of sensors was successfully flown in RH 300 MKIII and with two sets of sensors in RH 560 MK II as part of the first phase of the SOUnding Rocket EXperiment (SOUREX) programme. Presented here is an insight on the design, realization and onboard performance of the scientific payload electronics.

Presentation Mode: Oral

Presenting Author: Sreelatha P

Registration id: NSSS-20220110044909

Design and Development of an Instrument for Electric Field Measurement in Planetary Atmosphere

Sanjeev Kumar Mishra[1], Chandan Kumar[1], K. Durga Prasad[1], P. Kalyan Reddy[1], Janmejay Kumar[1]

[1]Physical Research Laboratory

Electric Fields in the upper atmospheres of planets, such as Earth or Mars, play a crucial role in their plasma dynamics, especially in the ionosphere and its various regions. Electric fields are one of the driving factors for the atmospheric loss on Mars. Therefore, comprehensive knowledge of the presence and prevalence of electric fields in the ionosphere gains utmost importance. There are very few in-situ measurements of electric fields at Mars. Our current understanding of this subject is mainly based on indirect measurements. For this purpose, we are developing an instrument for the In-situ measurement of electric field using spherical double probes. This will be the first-of-its-kind instrument.

The Spherical double probes work on Langmuir's principle and will be mounted on a boom. The measurement of potential difference between the two sensors gives the value of instantaneous electric field along the direction of the spacecraft. We are working on the design of the electronics and sensor package for the instrument. The electronics of the instrument is divided into 2 main parts- Front End and Backend. The front end consists of the preamplifiers, voltage subtractor, signal shaping, gain, and analog-to-digital conversion. The instrument is being designed to sense electric field in the range of 10 μV/m - 1 V/m with a resolution of 1 μV/m. It will be measuring electric field signals in 3 frequency bands covering the frequency range of DC-10 kHz, 100 Hz. The current version of the front-end card is sensitive to signals of ~ 100 μV/m. Here, we will be presenting some of the details of the design of the front-end electronics of the instrument. As the current version of the front-end card is currently undergoing testing, some of the interesting results on design performance and filter banks performance will also be presented.

Presentation Mode: Oral

Presenting Author: Sanjeev Kumar Mishra

Registration id: NSSS-20220110045952

Control instrumentation for high altitude balloon experiments

Anand Devarajan[1], Anmi Reddy[1], Venkateshwar rao[1], Kapardhi Bangaru[1], Dharmesh Trivedi[1], Ashish Rodi[1], Santosh Koli[1], Devendra Ojha[12]

[1] TIFR Balloon Facility, [2] TIFR

The growth of satellite-based opportunities has not limited the scope of scientific ballooning for research in astronomy, atmospheric sciences, astrobiology etc., as the experiments can be done at a small fraction of cost compared to similar satellite missions. Balloon based platforms are easy to implement, allow quick experiment turn-around times and in-situ measurements of the atmosphere can be done which is not feasible with satellites. In this talk, an overview of balloon support instrumentation provided by the Balloon Facility of Tata Institute of Fundamental Research at Hyderabad, will be presented.

Presentation Mode: Oral

Presenting Author: Kapardhi Bangaru

Registration id: NSSS-20211216081405

1U CubeSat and GM counter testing using High Altitude Balloon platform

B.G. Nair[1], Bharat Chandra[1], Akaash Srikanth[2], Richa Rai[1] , Subham Jankiram[1], Rekhesh Mohan[1], Margarita Safonova[1], and Jayant Murthy[1]

[1]Indian Institute of Astrophysics, Bangalore, India, [2]Vellore Institute of Technology, Vellore, Tamil Nadu

High-altitude balloon experiments are becoming very popular among universities and research institutes as they can be used for testing instruments eventually intended for space, and for simple astronomical observations of Solar System objects like the Moon, comets, and asteroids, which are difficult to observe from the ground due to atmosphere. Further, they are one of the best platforms for atmospheric studies. In this work, we build a simple 1U CubeSat and, by flying it on a high-altitude balloon to an altitude of about 35 km, with the total payload weighed 4.9 kg, and examine how some parameters, such as magnetic field, humidity, temperature, or pressure, vary as a function of altitude. We also calibrate the magnetometer to remove the hard iron and soft iron errors. Such experiments and studies through stratospheric balloon flights can also be used to study the performance of easily available commercial sensors in extreme conditions as well. We also designed and developed a low-cost Geiger Muller (GM) counter for measuring the ionizing radiation up to an altitude of 40 km. GM counter was also flown on the high-altitude balloon platform. We present the results of the first flight, which helped us study the functionality of the various sensors and electronics at low temperatures reaching about -40 degrees Celsius. Further, the motion of the payload has been tracked throughout this flight. Using the results from this flight, we identify and rectify the errors to obtain better results from the subsequent flights.

Presentation Mode: Oral

Presenting Author: Binukumar Gopalakrishnan Nair

Registration id: NSSS-20220103095916

TIFR balloon-borne experiment for far-infrared (FIR) spectroscopic mapping of star-forming region

Pradeep Sandimani[1]

[1]TIFR

TIFR 100 cm (T100) balloon borne telescope is used for the FIR observation with the Japanese Fabry Perot Spectrometer (FPS) as a focal plane instrument. FPS is tuned to the [CII] line at ~158 micron to study Galactic star forming regions. The FPS consists of two Fabry Perot Interferometer, one with movable plates to scan the wavelength and the other with fixed plates which acts as an order sorter. T100 along with FPS is being flown regularly from TIFR Balloon Facility, Hyderabad. FPS is operated in two primary modes called as chopped and unchopped modes. In the chopped mode, secondary mirror of the T100 telescope wobbles at 10 Hz in two different positions so as to subtract the background emission and to get meaningful results. In the unchopped mode, background subtraction is done separately. Existing ground based T100 sub-systems of the telemetry and telecommand have been upgraded, as existing hardware are quite old and needed modifications. We designed and developed few microcontroller based encoders which can be interfaced with the windows OS. We developed a software in LabVIEW to receive the telemetry data over the Ethernet (as UDP packets) and plot them as per our requirements. We also developed an onboard telemetry data storage module using the single board computer. We have made a provision for an offline telemetry data analysis in the LabVIEW on a standalone PC. The present single pixel FPS focal plane instrument is being upgraded to 5x5 pixels detector array, which would improve resolution of the image from 90â€ to 40â€œ, and the spectral resolution from ~1800 to ~10000. This needs change in the Telemetry data rate, frame formats, command rate, command format, data analysis software, etc. Prototypes of the new telecommand interface and onboard telemetry data storage have been developed. Design of the new telemetry interface is at an advance stage. We are also developing a Quick Look Display for the new telemetry data format.

Presentation Mode: Oral

Presenting Author: Pradeep Sandimani

Registration id: NSSS-20211217092737

SETI India: Using uGMRT to search for advanced extraterrestrial life

Avinash Kumar[1], Raghav Girgaonkar[1], Akshay E[1], Arun M[1], Vishal Gajjar[2], Siddharth Pandey[1]

[1]Amity Centre of Excellence in Astrobiology at Amity University Mumbai, [2]University of California Berkeley

The discovery of the ubiquity of habitable extrasolar planets, combined with revolutionary advances in instrumentation and observational capabilities, has ushered in a renaissance in the search for extraterrestrial intelligence (SETI). The Breakthrough Listen (BL) program is a US $100M 10-year effort to conduct the most sensitive, comprehensive, and intensive search for advanced life on other worlds ever performed. Large scale radio SETI activities are now underway at numerous observing facilities; but, there currently exists a dearth in continuous frequency coverage between 300 MHz and 1 GHz. Upgraded Giant Meterwave Radio Telescope's (uGMRT) capability of operation at these frequencies makes it a desired and complimentary instrument with ongoing SETI activities. In this talk, we will outline a new partnership between the BL program and the Amity Centre of Excellence in Astrobiology to start India's first large scale SETI program. We will discuss our ongoing efforts to capture the raw stream of data products from the uGMRT and conduct searches for novel signals likely to be produced by the activities of advanced ETIs. These signals include; (1) continuous-wave narrowband signal with spectral occupancy of < 1 Hz, (2) broadband transient signals with artificial dispersion, (3) signals with embedded wide-band modulations, and (4) anomalous astrophysical events. We will also discuss how we are leveraging advances offered by the modern-day graphical processing units (GPUs) and artificial intelligence for these searches. Furthermore, we will demonstrate that long baselines of GMRT provide band-limited spectral imaging and temporal window imaging capabilities which are useful to scrutinise the extraterrestrial origin of putative signals from ETI.

Presentation Mode: Oral

Presenting Author: Avinash Kumar

Registration id: NSSS-20220110054737

Neutral Mass Spectrometer on Articulated Payload Platform for Space-borne Experiments

Dhanya M B[1], Anirudh R [2], Damodaran P [2], Tarun Kumar Pant [1], R. Satheesh Thampi[1]

[1] Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram, India,
[2]ASMG, MVIT, Vikram Sarabhai Space Centre, Thiruvananthapuram, India

Mass spectrometers on a number of planetary missions have proved to be powerful tools to study the planetary atmospheres by in-situ sampling of the neutral and ion composition thereof. Conventionally, on a spacecraft platform, it is required to orient the field of view of the mass spectrometer along the velocity vector of the spacecraft. In this condition, the mass spectrometer can sample the ambient atmosphere the best, especially in case of tenuous planetary atmospheres. Meeting this condition becomes challenging during a mission especially in view of other payloads on-board with strict Field of View requirements. However, this can be achieved if the mass spectrometer could be mounted on a suitable Articulated Payload Platform (APP) on-board. In addition, in global scenario, some of the space missions had the mass spectrometers operated in scan mode i.e. mass spectrometer on-board scanning the flow of incoming air in both azimuth and elevation direction. Such azimuthal and elevation movements can easily be ensured through the use of APP. In addition, the APP scan also cater to the requirement of mounting the mass spectrometer away from the spacecraft body to mitigate any possible spacecraft outgassing effects. Vikram Sarabhai Space Centre has a heritage of having successfully flown mass spectrometers in several planetary missions of ISRO, such as Chandrayaan-1, Mars Orbiter Mission and Chandrayaan-2, while an APP with experiment(s) is yet to be flown. Development of possible APPs within ISRO has already commenced to bridge this technology gap. The details of the design elements of an articulated platform under development, to be used eventually to manoeuvre the mass spectrometer in space enabling composition measurements in various modes, will be presented. Such a platform has potential use in future missions of ISRO. The utility of this APP with ISRO's mass spectrometer is aimed to be first established on a PS-4 experimental platform, within an year.

Presentation Mode: Oral

Presenting Author: M B Dhanya

Registration id: NSSS-20211208044531

Design and Development of an Instrument for Electric Field Measurement in Planetary Atmosphere

Sanjeev Kumar Mishra[1], Chandan Kumar[1], K. Durga Prasad[1], P. Kalyan Reddy[1], Janmejay Kumar[1]

[1]Physical Research Laboratory

Electric Fields in the upper atmospheres of planets, such as Earth or Mars, play a crucial role in their plasma dynamics, especially in the ionosphere and its various regions. Electric fields are one of the driving factors for the atmospheric loss on Mars. Therefore, comprehensive knowledge of the presence and prevalence of electric fields in the ionosphere gains utmost importance. There are very few in-situ measurements of electric fields at Mars. Our current understanding of this subject is mainly based on indirect measurements. For this purpose, we are developing an instrument for the In-situ measurement of electric field using spherical double probes. This will be the first-of-its-kind instrument.

The Spherical double probes work on Langmuir's principle and will be mounted on a boom. The measurement of potential difference between the two sensors gives the value of instantaneous electric field along the direction of the spacecraft. We are working on the design of the electronics and sensor package for the instrument. The electronics of the instrument is divided into 2 main parts- Front End and Backend. The front end consists of the preamplifiers, voltage subtractor, signal shaping, gain, and analog-to-digital conversion. The instrument is being designed to sense electric field in the range of 10 μV/m - 1 V/m with a resolution of 1 μV/m. It will be measuring electric field signals in 3 frequency bands covering the frequency range of DC-10 kHz, 100 Hz. The current version of the front-end card is sensitive to signals of ~ 100 μV/m. Here, we will be presenting some of the details of the design of the front-end electronics of the instrument. As the current version of the front-end card is currently undergoing testing, some of the interesting results on design performance and filter banks performance will also be presented.

Presentation Mode: Oral

Presenting Author: Sanjeev Kumar Mishra

Registration id: NSSS-20220110045952

Experimental Study of the Response of Spaceborne Channel electron multiplier detectors to intermittent high He ion flux

Abhishek JK[1], Aneesh A N[1], R. Satheesh Thampi[1]

[1]Vikram Sarabhai Space Centre

Channel Electron Multiplier (CEM) detectors are extensively used in both lab equipment-pressure gauges and Residual gas analysers - and spaceborne instruments-plasma analysers and photon counters. In the context of plasma analysers, the variation of key parameters- Gain and Pulse Height Resolution(PHR) as a result of prolong exposure to ion and electron fluxes over the life of mission plays a role in data interpretation. The work presented here examines the response of three CEM detectors to an intermittent high He ion flux of 100,000 particles/sec for 3.5 hours spread over 15 hours, followed by an intermittent low electron flux of 1000 particles/sec for 96 hours spread over 250 hours. The effect of particle impingement and 48-hour recovery gaps on detector performance are presented. The gain degradation observed is consistent with the results of previous modelling studies. We discuss the implication of PHR variation on the lifetime calculations of detectors for space missions. A strategy to correctly estimate the lifetime is elaborated for a scenario wherein CEM is operated under a steady flux.

Presentation Mode: Oral

Presenting Author: Abhishek JK

Registration id: NSSS-20220105105839

Near Infrared astronomical projects at TIFR

Milind B. Naik[1]

[1]TIFR

The Infrared Astronomy Group (IR group) of TIFR has been developing near-infrared (NIR) instruments for ground based Indian telescopes, far-infrared instruments for TIFR 100-cm balloon borne telescope and has recently developed space platforms via IRSIS & other projects.

This talk will present an overview of NIR astronomical cameras developed by the IR group, TIFR. These camera's have been commissioned / used at various observatories in India (e.g. IGO, IUCAA,Pune; MIRO, PRL, Mt Abu; HCT, IIA, Hanle, Ladakh and DOT, ARIES, Devasthal, Uttarakhand).

TIRCAM2 imager and TANSPEC spectrometer/imager camera is currently operational at DOT, 3.6 meter telescope. TIRSPEC spectrometer/imager camera is being operated at HCT.

Talk will also cover a brief overview of the IRSIS satellite payload related work.

Presentation Mode: Oral

Presenting Author: Milind B. Naik

Registration id: NSSS-20211229110618

Geometric Phase Polarimeter

Athira B S [1], Mandira Pal [2], Sounak Mukherjee [3], Jatadhari Mishra [4], Dibyendu Nandy [1], Nirmalya Ghosh [1]

[1] CESSI, [2] Tel Avi Israel, [3] Princeton University, [4] Stanford University

The phase associated with propagating light is dynamical phase which depends on the optical path length. Geometric phase is solely dependent on the evolution of electromagnetic wave and not on the optical path. Light beam carrying spatially varying state of polarization generates one variant of the geometric phase, space varying Pancharatnam-Berry (PB) geometric phase, while propagating through homogeneous anisotropic medium. We show that determination of such space varying geometric phase provides a unique way to quantify the space varying polarization state of light using a single-shot interferometric measurement. We demonstrate this concept in a Mach-Zehnder interferometric arrangement using a linearly polarized reference light beam, where full information on the spatially varying polarization state is successfully recovered by quantifying the space varying geometric phase and the contrast of interference. This approach shows considerable potential for instantaneous mapping of complex space varying polarization of light in not only in astronomy but in, biomedical imaging, nanophotonics, etc., where high precision and near real-time measurement of spatial polarization patterns are desirable.

Presentation Mode: Oral

Presenting Author: Athira B S

Registration id: NSSS-20220110073640

Development of a SDD based Large Area X-ray Spectrometer with ASIC readout for future planetary miss

Nishant Singh[1], M. Shanmugam[1], Arpit Patel[1], Tinkal Ladiya[1], S. Vadawale[1]

[1]Physical Research Laboratory

Silicon detector-based X-ray spectroscopy has been employed for applications varying from solar studies, XRF experiments, X-ray imaging to various astronomical observations. We have already developed a single-channel X-ray spectrometer with discrete components- Solar X-ray Monitor, flown on Chandrayaan-2 orbiter. We propose developing a multi-detector large area X-ray spectrometer using Silicon Drift Detectors (SDD) for future space and astronomical observations. Use of discrete components will lead to a bulky system and hence miniaturized system is desirable for space applications. In this direction, we propose to develop the spectrometer using Application Specific Integrated Circuit (ASIC) based readout which can process the signal from multiple detectors simultaneously. In this application, we use VERDI ASIC which can process the signal from 8 detector and allows us to have required numbers of detectors for the given applications. It is planned to use each SDD with 150 m m2 area.

VERDI ASIC is 3.5 mm x 3.5 mm with multi-channel readout electronics from 8 independent analog inputs from an external charge-sensitive preamplifier. Each channel has a preamplifier, a shaper with adjustable shaping times from 0.25 µs to 8 µs, a peak stretcher with a stable baseline holder for leakage current of 0.1 pA to 11 nA. The system enables to stack multiple SDD modules in a compact assembly with excellent energy resolution in the range of 500 eV to 15 keV with fast readout. We have characterized the ASIC using different signals, replicating the detector, to understand the effect of various parameters such as channel threshold, shaping time, and dynamic range of the ASIC. With the ASIC-based readout, we have achieved a resolution of 136 eV @ 5.9 KeV for the detector operating temperature of ~ -35oC at an optimum shaping time of 2 µs. This translates to a system noise of ~8 electrons at 2 µs shaping time and varies up to 43 electrons at 0.25 µs shaping time. The detailed design and

Presentation Mode: Oral

Presenting Author: Nishant Singh

Registration id: NSSS-20220110050157

Indigenous 18m antenna at IDSN for planetary and deep space missions

D N Rath[1], Ceena Sunil[2], Dr. Senthil Kumar V[3], M R Raghavendra[4], Dr. V VSrinivasan[5]

[1]ISRO, [2]ISTRAC, [3]URSC, [4]ECIL, [5]BARC

Indian Deep Space Network (IDSN) located at Bengaluru comprising 32 and 18meter antenna system that was established in 2008 and conceived as India's initiative to Deep Space accesses, beginning with Chandrayaan-1 mission, currently tracking Mars Orbiter and Chandrayaan-2 missions. In the same campus third new deep space class 18-meter terminal is established to cater to ISRO's multiple deep space missions.The New 18m terminal is realized indigenously by ISTRAC/ISRO in collaboration with ECIL, BARC and other Indian Industries. Mechanical and RF design is carried out by ISTRAC and URSC, ISRO.
Station Specifications:
Antenna Diameter : 18meter
Antenna Mount : EL over AZ Type
Main Reflector Surface Accuracy: 80 Microns
Antenna Pointing Accuracy : 20 millideg.
S-Band Receive : 2200-2300 MHz
X-Band Receive : 8025-8500 MHz
S-Band Transmit : 2225-2120 MHz
X-Band Transmit : 7145-7235 MHz
S-Band Receive G/T : 30.5 dB/K
X-Band Receive G/T : 40.3 dB/K
S-Band EIRP : 75 dBW
X-Band EIRP : 91 dBW
Maximum Velocity (AZ/EL) : 2/1 deg./s
Minimum Velocity (AZ/EL) : 0.1/0.1 millideg./s
Acceleration (AZ/EL) : 0.5/0.5 deg./s2
Receive Data Rates : 10 Mbps Max. (basic)
Timing and Frequency : Atomic Clocks
Coding Standards : CCSDS Turbo, RS & Convolution, 4D-TCM with 8PSK
Ranging Standards : ESA Tone, ESA Code, PN Ranging, USB
Command Standard : CCSDS - COP1 & CLTU
Network Interface : CCSDS – TLE
DSN 18-Meter station is capable of performing transmit and receive operations in both S & X Bands. Low Noise Amplifiers with HEMT devices are used in both the frequency bands. A 500 Watt S-Band and 2.5 KW X-Band High Power Amplifier provides uplink support. The parabolic reflector is shaped to meet high level of operational efficiency as demanded by the deep space missions. The antenna is capable of auto tracking feature in both S and X-Band. The station is remotely operable from ISTRAC Network Control Centre (NCC) and is fully CCSDS compliant facilitating inter-operability.

Presentation Mode: Oral
Presenting Author: Dharma Narayan Rath
Registration id: NSSS-20211217084432

Planetary Rover prototype: Mars Amity Surface Characterization & Operations Trainer (MASCOT-1)

Siddharth Pandey[1], Saksham Bhadani[1], Jibran Ahmad[1], Jonathan Clarke[2]

[1]Amity Center of Excellence in Astrobiology, Amity University Mumbai, [2]Mars Society Australia

Rovers are mobile robotic platforms that provide an ideal solution for sample collection and analysis in harsh and inaccessible terrains. Various space exploration missions utilize such platforms for experiments, collection and analysis of samples. This project presents a mobile test platform for Mars analogue instrument and subsystem testing. It has been developed as a rugged modular system, with the capability to integrate any instrument or sensor for analogue studies.

The rover is capable of traversing through uneven terrains and can operate for prolonged durations at temperatures below 0℃, achieved using multilayer polymer insulation and full metal wheels.

A high throughput communication setup with a Line Of Site range of 7 km has been integrated allowing for a Real-time video and sensor data feed at the base station.

In a typical mission, the rover is remotely scouted to narrow down the sites of interest-based on the visual/geomorphologic features. It can then carry out habitability investigation using an array of atmospheric sensors consisting of an Anemometer, T-VOC, non-contact IR thermal, temperature, pressure & humidity sensors. Additionally, a stereo camera and LIDAR has been integrated for terrain analysis and mapping of specific features. A 20Ah $LiFePO_4$ battery powers the whole system. The rover was tested in the Tso Kar region of Ladakh, where extreme environmental conditions like cold, high UV index, low oxygen levels present excellent analogue to Mars. In addition, the dry glacial lake bed combined with strong winds cause frequent dust devils. Due to different stages of erosions, the topology varies significantly. Accordingly, Navigation tests were performed on 3 different types of strata ranging from small boulders to sand with pebbles to the soft marshy lake bed with salt crystals. The rover has achieved the first set of goals, and multiple experiments have been planned for future missions, the results of which will be used for a variety of studies

Presentation Mode: Oral

Presenting Author: Saksham Bhadani

Registration id: NSSS-20220110093140

Development of a Compton Imaging Camera for Space Astrophysics

Abhijeet Ghodgaonkar[1], Sudhanshu Nimbalkar[1], Sanjoli Narang[1], Pranav Page[1], Amit Shetye[1], Hrishikesh Belatikar[1,2], Sourav Palit[3], Aditi Marathe[1], Siddharth Tallur[1], Varun Bhalerao[1], Santosh Vadawale[4]

[1]IIT Bombay, [2]University of Wisconsin-Madison, [3]Indian Centre for Space Physics, [4]PRL

We present a laboratory experiment to demonstrate the effectiveness of pixelated Cadmium Zinc Telluride (CZT) detector modules for Compton Imaging in the Hard X-ray band. A Compton Imaging camera consists of a pair of detectors: one to scatter incident photons, and the other to absorb them. Using the position and energy information from both detectors, a back-projection algorithm is used to calculate the position of the source on the sky. In our setup the scatterer and absorber are AstroSat-like 5mm thick CZT detectors with a 16x16 pixel matrix. The modular setup consists of a source, a single scatterer, and up to six absorbers mounted inside a radiation-shielded enclosure. The detectors are mounted on individual printed circuit boards (PCB) designed in-house. The setup includes appropriate connections and grounding for using analog, digital and high voltage signals for a single device. A Xilinx Zynq-7000 series FPGA housed on a Pynq-Z2 eval board with custom IPs is used to control the detectors and read out the data. We have implemented the back-projection algorithm on the built-in ARM Cortex-A9 hard-core processor. The highly optimized C code uses just one of the two cores, and calculates a back-projected source image two orders of magnitude faster than the Python implementation on a PC. The FPGA is interfaced to a PC using a Gigabit Ethernet PHY connected directly to an ARM core. This enables commands from the PC, and the transfer of raw data and the processed back-projected image to the PC at rates of 250 Mbps. We have also extensively simulated the setup Cosima, a part of MEGAlib, where varying positions of both the absorbers and source are used to study the angular distribution of Compton events. Our experiment paves the way for stand-alone space-based Compton Imaging instruments, and also sets the foundation for Compton localisation of sources in missions like Daksha.

Presentation Mode: Oral

Presenting Author: Abhijeet Ghodgaonkar

Registration id: NSSS-20220110024007

Spider Bio-mimetic Based Reconfigurable Planetary Rover

Kumar Harshit[1], Amit Kamboj[1], Srinika Selvam[1], Dhruti Ranjan Gaan[1], Prasanna N[1], Dr Shyama K C[1], Sudeesh Balan[1], Dr Alok Kumar Srivatsava[1]

[1]ISRO

Exploration of space and planetary bodies are essential to understand our place in the universe and to plan better utilization of space resources. Sending a rover to the surface of a planetary body is a necessity for a detailed understanding over and above remote sensing measurements. Several rovers have visited inner solar system bodies in the last few decades. However, there are rigid constraints that arise from the rover manoeuvrability that restricts the exploration to limited terrains such as the need for a particular orientation while landing. Also preferred are smooth terrains without steep slopes in addition to slow movement. We propose a new configuration of a planetary rover that aims to overcome such limitations thus providing a greater accessibility to regions unexplored. The design combines rolling and climbing capabilities that will optimize the time for traverse and spot measurements. The proposed rover will bring in entirely new capabilities for our future missions.

Presentation Mode: Oral

Presenting Author: Kumar Harshit

Registration id: NSSS-20211220032048

Adaptive hyperspectral imaging using structured illumination in a SLM-based interferometer

Amar Deo Chandra[1], Mintu Karmakar[1], Dibyendu Nandy[1,2] and Ayan Banerjee[1,2]

[1]Center of Excellence in Space Sciences India, Indian Institute of Science Education and Research Kolkata, [2]Department of Physical Sciences, Indian Institute of Science Education and Research Kolkata

We develop a novel hyperspectral imaging system using structured illumination in a spatial light modulator (SLM)-based Michelson interferometer configuration. In our design, we use a reflective SLM as a mirror in one of the arms of a Michelson interferometer and a checkerboard phase mask of gray level patterns is displayed on the SLM. We scan the interferometer by varying the phase across the SLM display wherein the gray value varies between 0-255 in the checkerboard phase mask, thereby imparting a dynamic phase of up to 262 degrees to the incident light beam. We couple a white light laser source into the interferometer in order to mimic an astronomical object such as the Sun, and choose a central wavelength of 637.4 nm akin to the strong emission line of Fe X present in the solar spectrum. We use a bandwidth of 30 nm, and extract fringes corresponding to a spectral resolution of 3.84 nm which is limited by the reflectivity of the SLM. We also demonstrate a maximum wavelength tunability of about 8 nm by varying the phase over the phase mask with a resolution of around 0.03 nm between intermediate fringes. The checkerboard phase mask displayed on the SLM is adaptive and can be changed in almost real time on time-scales of a few tens of milliseconds to obtain spectral information for other near-contiguous wavelengths. The compactness, low-weight, potential low cost, low power budget, real-time tunability and lack of moving mechanical parts in the setup implies that it can have very useful applications in settings which require near real-time, multi-wavelength spectroscopic applications such as in space astronomy. A few applications in astronomical settings where our technique would be efficacious would include the analysis of optical emission from events such as solar dynamic activity and optical follow-up of transient events such as gamma-ray bursts.

Presentation Mode: Oral

Presenting Author: Amar Deo Chandra

Registration id: NSSS-20220110054450

Development of miniaturised front-end electronics for a EUV photometer onboard future missions

Chandan Kumar[1], Sanjeev Kumar Mishra[1], P. Kalyan Reddy[1], Janmejay Kumar[1], K. Durga Prasad[1]

[1]Physical Research Laboratory

The Ultra-violet (soft x-rays, EUV and FUV) solar irradiance is one of the primary energy inputs responsible for the chemistry and dynamics of the entire ionosphere and upper atmosphere of terrestrial planets. As the solar UV intensity varies continuously as a function of wavelength on all time scales such as diurnal, seasonal, solar flares etc., significant variability in these processes is also observed. While no direct measurement of solar EUV flux is available at Venus, only broadband measurements are available at Mars from the recent MAVEN mission. Given this, we are developing a miniaturised UV photometer to study in situ solar UV flux in the entire range from soft x-rays to FUV using on an orbital platform both at Mars and Venus.

The photometer is being developed at PRL that will carry out observations in both broadband and some specific wavelengths. The Front-End design of the photometer includes multiple detectors followed by sensitive electronics. The electronics is being miniaturised in order to save mass and power budget. In addition, The EUV front-end electronics will be mounted very close to the detector for a better signal to noise ratio. The miniaturised Front-End electronics consists of an electrometer that can measure currents in 0.1nA with a resolution of 10pA, followed by a signal conditioning circuit consisting of programmable gain amplifiers and analog filtering. The present processing electronics uses a microcontroller for 12 bit ADC and checkout interface. There are several challenges, such as electrometer guarding and noise immunity and onboard digital filtering and data compression. The details of the electronics design of the experiment, its developmental challenges, prototype design will be discussed at the conference.

Presentation Mode: Oral

Presenting Author: Chandan Kumar

Registration id: NSSS-20220110015719

Crystal based focusing optics for high energy X-rays beyond 100 keV

Vineeth Valsan[1], Shyama Narendranath[2]

[1]Christ University, [2]ISRO

Hard X-ray focusing is an inevitable part of observations in high-energy astronomy. The conventional way to focus high-energy photons is by exploiting the grazing principles using mirrors. Here we present the feasibility study of focusing high energy X-rays, beyond 100 keV using crystals such as Silicon, Germanium, copper, etc. High energy photons will get refracted by the lattice planes of these crystals. Arranging a sufficient number of crystals in a particular geometry will act like a lens, which will concentrate the photons on a plane. The advantage here is a larger aperture compared to grazing angle mirror telescopes resulting in a larger field of view best suited for applications such as solar imagers and wide-field monitoring of hard X-ray sources.

We will present the results from a prototype made with 20 copper (111) mosaic crystals, modeled and engineered to focus hard X-rays of 100keV. The results are promising and can be tuned to design hard X-ray concentrating elements for future astronomy missions.

Presentation Mode: Oral

Presenting Author: Vineeth Valsan

Registration id: NSSS-20211202011618

Object Detection in Space (ODiS)

Deepesh Deepak[1], Deepak Mishra[1]

[1]IIST Trivandrum

The aim of this work is to come up with a model that will be able to detect space objects (SOs) giving space assets the ability to see and act autonomously. The model will be able to identify and categorize different space objects. Initial prototyping will have a camera as its sensor and Computer vision object

detection algorithms running in the back-end for extracting insights from the camera sensor input in real-time.

Once SOs will have this ability then we can utilize, apply and expand this technology to

develop more sophisticated systems like :

• Autonomous Maneuvering System (AMS)

• Anti-satellite missile(ASAT) Avoidance Systems (AAS)

• Docking Systems

• SOs health inspection, monitoring, and scanning etc.

All the previous results of the testing of the space object detector and tracker were based on satellites from either movie clips or animation which were not thorough as they did not cover all the aspects of the satellite in orbit such as the resolution, illumination, relative speed of the other space objects from the perspective of the space asset in concern. In this sub-part of the above project, the same dynamicity and proper testing of the model has been discussed in order to improve the accuracy of the model in detection and tracking.

Presentation Mode: Oral

Presenting Author: Deepesh Deepak

Registration id: NSSS-20211230090138

Space based system for remote sensing solar induced Fluorescence from vegetation - A proposal

Bhavani Kumar Yellapragada[1]

[1]NARL, ISRO

Remote sensing is a powerful technique helpful in detecting the reflective energy spectrum of emissive surfaces. Multi-spectral mapping operates at discrete spectral bands; however, the recent hyper-spectral remote sensing technique allows continuous monitoring of emission spectra. Compact spectrometer technologies integrated with suitable front-end optomechanics offer high-resolution spectral (hyper-spectral) characteristics of reflective surfaces, which is an advanced approach to the existing multi-spectral mapping/monitoring.

A compact hyper-spectral (HS) sensor was constructed at the NARL site to obtain the high-resolution spectral characteristics of various reflective surfaces, including grasslands/vegetation. It is a portable passive remote sensing instrument suitable for field measurements. The HS sensor is equipped with azimuth and elevation controls that allow the sensor to orient at different solar zenith angles (SZA). The developed HS sensor is a telescope-less instrument with optical fiber connectivity and works with a grating-based spectrometer. The Hyper-spectral resolution possible from the instrument (at a reasonable SNR level) is around 2nm. The HS sensor output is calibrated against the Oxygen absorption O2–A-band, which is at 760 nm in the NIR spectrum. Using this instrument, we have collected various surface reflectance measurements during the sun transit period. It is observed that vegetation surfaces show strong fluorescence in the NIR band associated very low reflective chlorophyll band in the visible range. Solar energy induces photochemical changes in vegetation. Chlorophyll molecules absorb solar photons and undergo photosynthesis and heat-loss processes. . Continuous monitoring of the signature of the fluorescence spectrum informs the healthy/risky conditions of vegetation. This concept extends to space environment helps to know the regional vegetation status.

Presentation Mode: Oral

Presenting Author: Bhavani Kumar Yellapragada

Registration id: NSSS-20211230080749

Characterization of Silicon Photomultiplier (SiPM) for upcoming Venus orbiter mission

Deepak Kumar Painkra[1], Sushil Kumar[1], M. Shanmugam[1], Tinkal Ladiya[1], Arpit patel[1] , S. K. Goyal[1]

[1]PRL

In the recent development of detectors for High Energy Physics and Astrophysics, a new type of silicon detector known as Silicon Photomultipliers (SiPM) has been developed to replace the traditional vacuum-based photo detectors, photomultiplier tubes (PMT). The Silicon Photomultipliers (SiPM) consist of a high-density (up to 100 per mm2) array of small, independent single-photon avalanche diodes (SPAD) sensors, working in a Geiger Mode to achieve gain at a level of ~106. It offers high Photon Detection Efficiency (PDE) up to 40%, low-voltage operation, insensitivity to magnetic fields, mechanical robustness, and excellent uniformity of response, which makes it an attractive alternative to the PMTs for space applications.

We have studied the On-Semiconductor made Micro C series SiPM (30035) having a surface area of 3mmX3mm and 35µm microcell size. We have carried out the Current-Voltage (I-V) Characteristics at a temperature ranging from -30oC to 70oC, and measured the breakdown voltage at different operating temperatures, and the temperature coefficient of breakdown voltage. SiPMs were also connected in series as required for the scintillator readout and characterized for various parameters. A strip of six SiPMs mounted on a single PCB was made and interfaced with Plastic and CsI based scintillators for the photon readout. We have successfully tested with these scintillator detectors and observed the signal output from SiPMs using radio-active sources which emit X-rays and alpha particles. We used BC-408 Plastic scintillator and Thallium doped Cesium Iodide CsI (Tl) scintillator for this experiment as these are planned in the upcoming Venus Orbiter Missions. The experimental design and the results will be presented in the symposium.

Presentation Mode: Oral

Presenting Author: Deepak Kumar Painkra

Registration id: NSSS-20220110050907

Enabling virtual reality technologies for teaching and training in space science

Vinoth E[1], Dr. Sreehari VM[2]

[1]SASTRA Deemed University, [2]SASTRA Deemed University, Thanjavur-613401

The significance for visualizing the real time of space environment lead to the development of Virtual Reality (VR) assisted visual station technology. Currently VR technology is employed in international space station for different purposes. Employing the VR technology from static visualization to simulation visualization of space exploration probes, rockets, satellite, space shuttles, etc., will be a game changing for the research and development in space exploration due to its various advantages. This kind of simulation software will have a set of presets of existing designs (space exploration probes, rockets, satellite, space shuttles), in which it could be examined part by part where the knowledge of design would be understood. The process of modification of design will also be done by inspecting the defects in previous design this features enables the knowledge in educational, training, design understanding and creation. Economically this technology will have a large set of outreach for education purpose as the necessity of the VR sensor headset is minimized in case of only visualization by which the persons can save the money in VR sensor headset as the software (app) will do the function and just a Google cardboard VR box with IoT aided controller which costs very less compared to headsets like Oculus Rift and the VR technology will possible in the hands of every common man. This software will also ensure the real-time environment of space and outer planet which paves the way to the psychological understanding of life in space and other planets to the mankind. This kind of technology ensures the rapid increase in space exploration to large set of audience.

Presentation Mode: Oral

Presenting Author: Mr. Vinoth E

Registration id: NSSS-20220105062822

Development of Position Sensitive Sub-MeV Detectors for Daksha Mission

N. P. S. Mithun[1], C. S. Vaishnava[1], N. K. Tiwari[1], S. K. Goyal[1], S. V. Vadawale[1], V. B. Bhalerao[2], S. Tendulkar[3]

[1]PRL, Ahmedabad; [2]IIT Bombay, Mumbai; [3]TIFR, Mumbai

Daksha is a proposed mission to observe high-energy transients such as electromagnetic counterparts to gravitational wave sources and gamma-ray bursts over a wide energy range from 1 keV to 1 MeV. The proposed configuration of Daksha comprises of three types of detectors to cover the entire energy range: SDDs similar to that flown on Chandrayaan-2 XSM for the low energy (LE) band of 1-30 keV, pixellated CZT detectors similar to that used in AstroSat CZTI for the medium energy (ME) band of 20-200 keV, and another detector sensitive in high energy (HE) band of 100 keV - 1 MeV. In addition to the spectroscopy using individual detector systems, it is also envisaged to use events simultaneously detected in ME and HE detectors for Compton imaging and possibly spectro-polarimetry. For this purpose, the HE detectors are also required to be position sensitive. Here we present the design of the proposed HE detector for Daksha using NaI scintillator coupled with an array of Silicon Photo-Multipliers (SiPMs). The common cathode signal of the SiPM array provides the energy of the incident photon while the interaction position is obtained from the anode signals. We present the overall configuration of the detector system and preliminary results of proof-of-concept study with a scaled-down prototype detector.

Presentation Mode: Oral

Presenting Author: Mithun N. P. S.

Registration id: NSSS-20220105082703

Optical Design of the Infrared Spectroscopic Imaging Survey (IRSIS) Satellite Payload

[1]Satheesha S. Poojary

[1]Tata Institute of Fundamental Research

Infrared Spectroscopic Imaging Survey (IRSIS) is an ongoing small satellite mission, currently under development. Aim of this mission is to perform the spectroscopic survey at NIR and MIR wavelength region, from 1.7-6.4 μm, in two bands simultaneously. The Shortwave (SW) band covers wavelength range from 1.7-3.4 μm, and Longwave (LW) band covers the wavelength range from 3.2-6.4 μm, with spectral resolution of R~100. The major components of this mission are the 30cm Telescope, fiber based Integral Field Unit (IFU) and Spectrograph. Fiber based integral field unit allows spectroscopy of multiple targets simultaneously in each band. The current talk is focused on the optics of the entire instrument viz., 30cm Telescope, IFU, and Spectrograph.

Currently the laboratory model of the IRSIS has been demonstrated. The major subsystems of the IRSIS laboratory model which have been built and tested are the 30cm Telescope, IFU and Spectrograph. The IFU of this laboratory model is populated with few fibers for demonstration, and the spectrograph has limited wavelength coverage from 1.7-2.5 μm, to reduce the cost and due to easy availability of the detector system. The laboratory model report has been submitted to ISRO.

The future task is to build the engineering and flight models of the instrument as per approval from ISRO.

Presentation Mode: Oral

Presenting Author: Satheesha S. Poojary

Registration id: NSSS-20211217090741

The Direction of Arrival with Orthogonally Co-located Dipole Antenna for SEAMS

Harsha A. Tanti[1], Abhirup Datta[1], S. Ananthakrishnan[1]

[1]IITI

The techniques and algorithms used to find the direction of EM wave is known as Direction of Arrival (DoA) or gonio-polarimetry. The current work presents the validation of a low computational complexity DoA estimation algorithm is done for a very low-frequency antenna for an ongoing space mission Space Electric and Magnetic Sensor(SEAMS). The objective of the SEAMS mission is to study low-frequency emission from the Sun along with the Earth's magnetosphere & geo-tail, galactic & extragalactic spectra, 21 cm cosmology, and space plasma. To perform the aforementioned studies the direction of the sources should be known. In this analysis, 3 orthogonally co-located dipoles antennas(tri-dipole) are used. The tri-dipoles are simulated on CST simulation software with plane wave excitation for generating near realistic data for the DoA estimation. To estimate the frequency received at the tri-dipole antennas, the algorithm also utilizes the Matrix Pencil(MP) method and the Least Square method(LSM).

Presentation Mode: Oral

Presenting Author: Harsha A. Tanti

Registration id: NSSS-20220112065702

Design and Deployment of Medium Volume Aerostat to Provide Wi-Fi Communication at Remote Sites

Stalin Peter G[1], B Suneel Kumar[1], D. K. Ojha[1]

[1]TIFR

Aerostats are tethered aerodynamic shaped balloons which use lighter than air gases that provide lift and are used to lift small payloads to certain altitudes (~750m above ground level). These aerostats are used as cost-effective platforms in many applications such as providing communication, surveillance, prototype payloads testing, atmospheric science, biological and agricultural studies etc. Various standard aerostat shapes are already available along with the newly optimized shapes. Linear low-density polyethylene extruded material is generally used as an envelope for the aerostats fabricated at TIFR Balloon Facility, Hyderabad. A 9.9 cu.m volume aerostat is available at the Balloon Facility which can carry a 3 kg payload up to an altitude of 750 m. This aerostat was used to test several payloads. One of such payloads includes the Centre for Development of Telematics (C-DoT), Delhi's Wi-Fi patch antenna that is planned to provide wireless communication in rural areas and also as last-mile communication services during natural calamities and spiritual gatherings. Recently TIFR -BF designed and fabricated 103 cu.m aerostat for lifting medium payloads up to 35 kg. This presentation discusses the design and load capabilities of 103 cu.m aerostat with possible scientific and commercial applications.

Presentation Mode: Oral

Presenting Author: Stalin Peter Godi

Registration id: NSSS-20211220055222

Effect of microgravity on the growth of Stevia rebaudiana callus: Preflight development

Pamela Jha[1], Renitta Jobby[1], Siddharth Pandey[1], Rinkey Shahu[1], Abigail Fernandes[1], Saksham Bhadani[1], Debashree Das[1], Shreya Fadanavis[1], Ashish Jacob[1], Kartik Aggarwal[1], Akshay Ghaywat[1]

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Plant adaptations to reduced gravity environments are critical in determining their viability as a sustainable and economical space food source. The payload, Amity Space Biology Experiment - 1 (ASBE-1), will be co-hosted within the SpaceShare Unit (Satellize Pvt Ltd) to fly on ISRO PSLV PS4 Orbital Platform. This non-recoverable payload is designed to study the effect of microgravity on plant callus and to prevent thermal runout and overheating. However, to define the absolute limits and results in case of discrepancies, multiple tests were carried out targeting individual factors and their combination.

The ASBE-1 module will be exposed to microgravity, low pressure, and temperature at low earth orbit. Hence, in the ground tests, 8 and 9-week old Stevia rebaudiana leaf callus were exposed to reduced pressure (0.9±0.02 atm) and high temperature (50±1 ºC) simultaneously for 2 hours. Phytochemical (total phenolic and flavonoid content), enzymatic (Superoxide dismutase and Catalase) and non-enzymatic (ABTS and DPPH) antioxidant activity of control and stressed calluses were analyzed. An increase in total phenolic content by 1.15 fold and total flavonoid content by 1.36 fold was observed in the stressed callus. Similar pattern was observed in the non-enzymatic antioxidant activity. Enhanced secondary metabolites production in the stress condition could have led to increased activities. Significantly higher ($p<0.001$) total protein content was observed in the control callus than the stressed callus, nonetheless, enzymatic antioxidant activity was higher in the stressed callus. Degradation of protein, when exposed to stress, can result in decreased protein content. Our results are an attempt to understand the strategies devised by the plant callus for adaptation in stress conditions. These findings will further aid in analyzing the adaptation of the callus in another stress condition i.e. microgravity at a standard temperature and pressure.

Presentation Mode: Oral

Presenting Author: Abigail Fernandes

Registration id: NSSS-20220110012616

Autonomous Life Growth Experiment–1 (ALGE-1): effect of microgravity on the growth of stratospheric and non-stratospheric bacterial isolates

Renitta Jobby[1], Pamela Jha[1], Siddharth Pandey[1], Yogesh Shouche[2], Praveen Rahi[2], Abigail Fernandes[1], Shreya Fadanavis[1], Saksham Bhadani[1], Rinkey Shahu[1] , Ashish Jacob[1], Aparna Khanna[1]

[1]Amity centre of excellence in astrobiology at Amity University Mumbai, [2]National Centre for Cell Science, Pune

Extensive research needs to be conducted on biological models to understand their adaptation in space. Bacteria are the simplest to study and can be sent to low Earth orbit to observe their growth profile in a reduced gravity environment. A major stress condition in space is microgravity which can alter the expression of genes, circulation of nutrients and hence, affect the physiological processes. Our group has been selected by ISRO to develop the Autonomous Life Growth Experiment–1 (ALGE-1). The Microbial Growth Module (MGM) part of the ALGE-1 has been developed to study the effect of microgravity on the growth and viability of bacteria. It will monitor the growth of bacteria in nutrient media and a controlled environment. For this experiment, studies are being conducted on a stratospheric bacterial strain, Priestia aryabhattai B8W22T, isolated by NCCS, Pune. It can survive in low pressure and temperature conditions and is resistant to UV radiation. By understanding its adaptation in microgravity, parallels can be drawn to microbes that could survive in extreme environments on other worlds. Two rhizospheric isolates namely Priestia aryabhattai SanPS1 and Bacillus aryabhattai VC1 are also included for comparison. All three isolates were studied under Earth-based gravitational control (1g). Standard microbiological practices were used to determine the gram nature, aerobic growth profile at different temperatures (28ºC and 37ºC), and anaerobic growth profile at 28ºC for each strain. All the strains were gram-positive and rod-shaped. No significant difference was observed in growth at 28ºC and 37ºC. The isolates formed clumps and settled down at the bottom when the growth curve was performed at static anaerobic conditions. In conclusion, the incorporation of a shaking mechanism to ensure uniform growth of bacterial culture throughout the media is necessary for accurate colorimetry. Keywords: Adaptation, Priestia aryabhattai, aerobic, anaerobic

Presentation Mode: Oral

Presenting Author: Shreya Fadanavis

Registration id: NSSS-20220110092400

Development of object visibility tool for the SING payload

Shanti Prabha[1], Margarita Safonova[1], Richa Rai[1], Binukumar G. Nair[1], Bharat Chandra[1], Mikhail Sachkov[2], Shubham Ghatul[1], Rekhesh Mohan[1], Jayant Murthy[1], and Vladimir Shmagin[2]

[1]IIA, [2]Institute of Astronomy, Russian academy of Sciences

SING (Spectroscopic Investigations of Nebular Gas) is a Near-Ultraviolet (NUV) spectrograph, being designed and manufactured at the Indian Institute of Astrophysics (IIA), in collaboration with the Institute of Astronomy, Russian Academy of Sciences. SING was selected by the United Nations Office for Outer Space Affairs (UNOOSA) under an announcement of opportunity to fly scientific payloads on-board the Chinese Space Station (CSS), expected to be operational in 2022. The SING instrument will observe extended diffuse objects, such as nebulae and supernova remnants. We need to know where the instrument is pointing at in the sky at any time during its orbit. To this end we have made an application using the html code. This program uses the two-line elements of the CSS orbit and the Julian date of our interest to determine the pointing of the instrument at that Julian date. As the space station moves in its orbit, SING will scan through the extended objects, with the maximum exposure time fixed by the angular speed of the station. We present a catalog search program to determine what objects lie along the pointing direction of the instrument and the visibility maps.

Presentation Mode: Oral

Presenting Author: Shanti Prabha

Registration id: NSSS-20220110044938

Commercialisation of Enabling Technologies for Space Exploration:Legal Vision with Reference to India

Dr. Malay Adhikari[1]

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India has a rich heritage of astronomy. With the passage of time, the subject astronomy is expanded in different directions and one of its impact is the development of high-end self-reliant space technologies. The country which once upon a time has just planned for social development through space technologies with the guidance of Dr.Vikram Sarabhai, the founding father of India's space mission, now has established itself in the trajectory of commercialisation.

This commercialisation has commenced with the endeavour of ISRO as an impact of developing the national space programme with self-reliant space technology. The technologies that have been developed for national space mission have been commercialised later on. There may be alternative ways of commercialisation like outsourcing the segmented works of national space mission to non-state actors or popularly known as NewSpace actors. This NewSpace is full of private actors and they are from India. These private actors may be entrepreneurs or small private companies developing the outsourced works of national space mission. Therefore commercialisation of enabling technologies could be possible with the initative from the Government. But at the same time these NewSpace actors have already extended their market beyond India. It may be the case that one side of commercialisation has developed due to export. This process of commercialisation may be addressed as commercialisation 1.0, then 2.0, then…

In this background, the role of law or legal vision of India is very significant. Law is the driver or regulator of commercialisation as well as privatisation. This paper will analyse the legal vision of India that will push up enabling technologies for space exploration.

Presentation Mode: Oral

Presenting Author: Dr. Malay Adhikari

Registration id: NSSS-20220110081438

NiCoZn Ferrite: burn rate enhancer for AP/HTPB based propellant and its catalytic study on the decom

Pragnesh N Dave[1] and Ruksana Sirach[1]

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Composite solid propellants (CSPs) have been used as propellants in rocket propellant applications. The major ingredients of these CSPs are metallic fuel, polymeric binder, curing agent and an oxidizer. The oxidizer provides internal source of oxygen and therefore, propellants can burn even when there is no availability of external oxygen. The oxidizer constitutes major portion (70-80%) of CSPs. The oxidizer is a high energetic material that detonates with sudden release of heat and large quantity of gases. Ammonium perchlorate (AP, NH4ClO4) is most widely used as an oxidizer in CSPs and therefore, the thermal decomposition of AP can affect the burning characteristics of CSPs. Addition of nanomaterials reduces the thermal decomposition of AP. In the present work, the catalytic activity of quaternary ferrite- NiCoZn ferrite (NiCoZnF) has been studied. It was found that in the presence of NiCoZnF, high thermal decomposition of the thermal decomposition of ammonium perchlorate reduces from 395 oC to 304.56 oC. The decreament in the activation energy of AP in the presence of NiCoZnF also confirms its excellent catalytic activity. Furthermore, the burn rate of AP/HTPB based propellant in the presence of NiCoZnF was increased from 2.22 mm/s to 3.2 mm/s.

Presentation Mode: Poster (Flash)

Presenting Author: Pragnesh N Dave

Registration id: NSSS-20220103062703

Simulation studies of NMPCC for a nonlinear model of Hexsoon Edu 450 Quadrotor

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This work mainly focuses on the simulation study of the Nonlinear Model Predictive Controller for the trajectory tracking of the Hexsoon Edu 450 quadrotor. Initially, both kinematic and dynamic model for the quadrotor is obtained. Then the different parameters of the Hexsoon Edu 450 quadrotor is calculated. Algorithm for trajectory tracking using NMPC is developed. Then the rectangular trajectory is developed to check the effectiveness of the controller. Developed Nonlinear Model Predictive Controller with trajectory tracking algorithm is implemented on the Hexsoon Edu 450 Quadrotor. The simulation of the system with NMPC is carried to check the effectiveness of the trajectory tracking algorithm. Developed NMPC for the quadrotor smoothly tracks the rectangular trajectory with less error and less computational load. The main aim of the Nonlinear Model Predictive Controller for trajectory tracking is to reduce the tracking error and also to reduce the computational load.

Presentation Mode: Poster (Flash)

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Registration id: NSSS-20220110090337

Martian Rover for Extraterrestrial Research

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We plan to build technologies to aid in space exploration, and one of the major research regarding extraterrestrial life is being uncovered on Mars. The risk and costs of sending an astronaut to Mars can be reduced by using autonomous technologies and bots. The purpose is to build a Martian Rover that is so versatile, it can traverse terrains, perform experiments and provide us with valuable information with regards to extinct and extant life on Mars. As innovators, we wanted to conceptualize a robot that was not bound by funds and resources. We target the Martian caves that are under intense research for extraterrestrial life. Some of us great minds came up with an idea of a Rover that can walk like a spider(hexapod), drive like a Rover and perform onboard scientific research. Two of the spider legs are meant to be hybrid that act as manipulators. Claws and augers on these manipulators are responsible for collecting samples of Martian regolith and passing it on to the onboard science storage. Using onboard sensors, an Organic-cam, and a Spectroscope our Rover can analyse and provide real-time data for the presence of gasses and compounds that lead us to conclusions for extinct and extant life. The Rover consists of an innovative ceiling sample collection mechanism to collect samples of salts and regolith from the top surface. The Rover boasts Heating mechanisms to maintain overall temperature for the onboard embedded systems. All of the tasks can be performed autonomously using LiDAR which is being used to generate a 3D map of the surroundings and aid in the autonomous traversal. The Rover travels to the desired location, collects samples of surface, analyses and provides real-time feedback to the base station along with a video feed. The rover can be controlled using a Dashboard based GUI having a closed-loop feedback system giving us data from in situ analysis and the status of the onboard system.

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Fortifying the development of Mars colonization and space biology research in India

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The Indian space sector has incredible potential with an astonishing student population and with an increasing interest in the space sector, practical training and broader knowledge on niche fields are required more than ever. Thus, multidisciplinary subjects like Astrobiology are gaining a greater affinity amongst Indian students. Moreover, non-profit institutions like Astrobiology India - an initiative of Blue Marble Space Institute of Science, promote and encourage research and education in astrobiology.

However, more outstanding initiatives are required to increase awareness, inclusivity and research in planetary settlement to enhance human space exploration. We propose that blending collaborative educational initiatives apart from conventional classroom education could be the first step. With India's first analog research station at Ladakh by Amity University, Mumbai encouraging planetary field research would be highly feasible. In addition to the field experience, virtual classroom activities and in-person training will allow students to understand the broad field of astrobiology deeply and pursue research, especially during the ongoing pandemic. The blended form of education also includes the newly developed intensive online course on "Mars Settlement and Exploration" by Mars University - a non-profit international academic and research organization. The eight-week course covers information on Mars Geology, Human Factors in Space Operations, Mars Astrobiology, Mars Agriculture, and Mars ISRU taught by internationally renowned scientists and experts.

Thus, exposure to international curriculum broadens the students' perspective and holistically enhances their skills. Benefiting India's international educational partnerships is an added advantage and further, the program hopes to support ISRO and other world space organizations to expedite space technology in propulsion mechanisms and systems engineering for Mars colonization.

Presentation Mode: Poster (Flash)

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Design studies on MEMS Quadrupole Mass Filter for Miniature Mass Spectrometer

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Quadrupole mass spectrometers are widely used to analyze atmospheric composition in space science studies. All space faring nations, including India, have gathered valuable data using this instrument. There is a lot of interest in developing high performance mass spectrometers with low weight, form factor and power consumption. One of the enabling technologies to achieve this goal of miniaturization of science instruments is the silicon micro machining, also called Micro Electro Mechanical Systems (MEMS) technology.

A quadrupole mass spectrometer consists of ionizer, quadrupole mass filter (QMF) and ion detector along with other ion optics elements. The ionizer ionizes the inlet gas into its constituent ion species. The QMF consisting of four electrodes positioned as per certain geometric rules are driven with combined RF and DC electric potentials. Once the ions reach the QMF, the oscillating electric field enables it to selectively allow a particular species to reach the detector. The selectivity is governed by the magnitude of DC and RF potentials. The mass spectrum obtained with ion count as a function of ion mass to charge ratio (m/z) is used for further studies.

MEMS based QMF has its parts with dimensions of the order of micrometers to millimeters. This leads to scaling down of the physical and electrical requirements for the entire system. Tiny elements lead to challenging requirements on dimensional tolerances in the QMF which can be met by MEMS technology. MEMS based QMF can operate at higher pressure than its macroscopic counterparts. This work presents our approach in developing a MEMS based QMF. The efforts involved in achieving an optimum instrument design that operates in the range 1-300 amu with 1 amu resolution is discussed. The analytical calculations, simulations using SIMION and the effect of various parameters on device performance will be discussed. The fabrication process flow proposed to realize the QMF will also be presented briefly.

Presentation Mode: Poster (Flash)

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Electronics Development of Neutral and Ion Mass Spectrometer

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NIMS is based on the concept of quadrupole mass filter (Mass range: 2–200 amu and mass resolution {M/M} >10). A quadrupole mass filter is a dynamic mass filter for positive and negative ions. The mass scale is linear to the applied amplitude of the RF voltage(1-1600Vpp). Mass resolution can be conveniently and electrically set by means of the ratio between the DC voltage U and the high-frequency voltage amplitude V, which is typically maintained at ~0.168. Frequency of operation is kept constant throughout the measurement. Due to its compact dimensions and light weight, NIMS is suitable both as pure Residual Gas Analyzers and, in higher-quality design, as Sensors for gas analysis. NIMS can be programmed to either sweep across a range of (M/q) ratios by varying RF and DC voltages accordingly, or allow only a species of interest to pass, by tuning the instrument to a fixed (M/q). NIMS shall function in two different modes viz. a) The Neutral Mode, which is used to measure neutral species by using Electron impact ionization technique in ionizer section where neutrals are first confined and then converted into ions and b) The Ion mode, where filament of the ionizer section is kept off, in order to measure the positively-charged ambient ions.

Presentation Mode: Poster (Flash)

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Graphene based soft X-ray windows

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Soft x-ray spectroscopy is widely used as a probe to understand the source mechanisms and dynamics in a variety of astrophysical scenarios. Semiconductor detectors are widely used in such applications and it requires an air-tight housing with an integrated, highly X-ray transparent window. Since Si-based detectors are sensitive to electromagnetic radiation in the visible band, filters to block light from reaching the devices are required. At the same time, the filters should minimally attenuate the X-ray signal from the lunar surface. K-alpha X-ray line energies of several important elements including boron (183 eV), carbon (277 eV), nitrogen (392 eV), and oxygen (525 eV) come in low energy range and hence for the detection of lighter elements, low energy x-ray transmission windows are critically needed. The ideal window materials should possess high soft X-ray transmission, vacuum encapsulation capability, electrical conductivity, high mechanical strength, light-blocking capability and non-toxicity. Beryllium, silicon nitride and polymers are the common window materials currently in use, however, the detection of light elements including carbon, nitrogen and oxygen are restricted. Very thin Al filters supported on a polymide film were used in the Chandrayaan-1 X-ray Spectrometer and Chandrayaan-2 Large Area Soft X-ray Spectrometer. The light blocking and conductive coating layer in the windows commonly consist of aluminium which reduces the x-ray transmission of the window and also leads to aluminium stray lines in the spectrum due to x-ray fluorescence. For the light element detection, many windows were designed but all exhibit one or the other drawbacks such as reduced temperature stability, low light-blocking capability and reduced mechanical stability. Here we propose the use of graphenic carbon on various substrates as a promising window material for detectors in soft X-ray spectrometers and present results from a preliminary feasibility study.

Presentation Mode: Poster (Flash)

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Modelling in-orbit radiation environment using Geant4 simulations for the XSPECT instrument

[1]Kiran M Jayasurya, [1]Srikar Paavan Tadepalli

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X-ray Spectrometer and Timing (XSPECT) is a soft X-ray spectrometer in the energy range of 1-15 keV developed by the Space Astronomy Group, URSC onboard the planned XPoSat Mission. It consists of 16 'swept charge devices' which are a non-imaging variant of X-ray CCDs. XSPECT targets the unique opportunity to conduct long-term spectrometric and timing analysis of the astronomical sources of interest. X-ray spectroscopic observations of galactic sources require continuous observation for long periods of time (~ 100ks or more). The expected radiation background must be estimated for planning onboard observations. It is also important to understand the sources of background in-orbit for accurate analysis of data. We carried out detailed full-scale 3D Monte Carlo simulation of the expected background in XSPECT using GEANT4 simulation toolkit. The main elements of the spacecraft with the CAD model of XSPECT at the configured geometry is considered. Galactic Cosmic Rays (GCRs) which is the main source of particles in-orbit is incident on this model. Expected spectra resulting from incident particle radiation and background sources are generated. We compare the simulation results to observed background in CLASS on the Chandrayaan-2 orbiter which has the same X-ray detectors. The results show that the simulated background will be a very close match to that expected on-board. The developed model can be extended to similar space instruments in future.

Presentation Mode: Poster (Flash)

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Daksha: Design and performance of front end electronics

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The proposed Daksha mission will use three types of detector units to obtain broadband spectral coverage from 1 keV to > 1 MeV. Key among these are the Cadmium Zinc Telluride (CZT) detectors, covering the medium energy (ME) range from 20 - 200 keV. These detectors are organised into 17 ME boxes distributed over the satellite, each containing 20 detectors and corresponding front-end electronics. The electronics boards consist of analog and digital components, alongside a high voltage power supply. The detectors will be clocked at microsecond resolution. Each front end board has a single Microchip FPGA that is responsible for communication between all 20 detectors on the board and the central processing electronics (PE). The FPGA can relay commands from the PE to individual detectors for direct operations like enabling or disabling pixels. The FPGA reads data from all detectors, adds timestamps, packetizes the data, and sends it to the PE. We have designed and built the complete electronics for a model of an ME box, and have successfully tested it in the laboratory. In this setup, the PE is replaced by a National Instruments Data Acquisition card (DAQ). Custom labview software has been developed to read the data, visualise it, and store it in convenient file formats. Laboratory testing has yielded satisfactory performance. We present results and comparisons with AstroSat CZTI lab tests.

Presentation Mode: Poster (Flash)

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Artificial Intelligence (AI) in space exploration: an evolutionary opportunity

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Artificial Intelligence (AI) is the replication of human intelligence in robots that are programmed to think and act like humans. We profit from AI and machine learning because we can use them to eliminate human error, automate repetitive tasks, and ensure business continuity. Similarly, artificial intelligence and machine learning technologies have a favorable influence on our support for the complex missions that will define the future of space exploration and national security operations. Mission planning and operations, data collecting, autonomous navigation and maneuvering, and spacecraft maintenance are just a few of the areas where AI and machine learning are being used in current space research missions. Future missions will have to rely on the same methodology. The challenge of planning a voyage to Mars is difficult, but artificial intelligence can help. New space missions have usually relied on information gleaned from earlier research. However, this information is frequently restricted or unavailable. This implies that the flow of technical knowledge is limited by who has access to it and who can share it with other mission design experts. AI has shown to be incredibly adept at intelligently digesting large amounts of data. It's been used to assess urban heat storage and to integrate meteorological data with satellite pictures to predict wind speed. Using geostationary satellite data, AI has also aided in the calculation of solar radiation, among many other uses. AI may be used to process data from satellites. Scientists have evaluated several AI approaches for a remote satellite health monitoring system as part of a recent study. This is capable of analyzing data received from satellites to detect any issues, anticipate satellite health performance, and offer a visualization for informed decision-making.

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Comparison of solid and hollow cylindrical antennas for planetary lightning detection

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Lightning is a sudden electrical discharge of short duration of the order of few tens of microseconds that occurs in the planetary atmosphere. It produces optical signals, extremely low frequency (ELF) and very low frequency (VLF) electromagnetic waves and acoustic waves. On Earth, Lightning primarily gets produced into two categories i.e. cloud-to-ground discharge and intra-cloud discharge. On the Venus, Clouds appears from around 47 km to 65 km [1]. However, the cloud-to-cloud lightning is more likely to occur on Venus [2]. A lightning instrument for Venus (LIVE) is proposed for Future Venus mission to understand the lightning phenomenon on Venus in detail [3]. In order to study lightning, an electrically short dipole antenna may be useful for lightning detection due to its small size and mass.

This paper presents the design and testing results of solid and hollow cylindrical Vee shape antenna configurations. A prototype of both antenna configurations have been fabricated in PRL workshop and tested using artificial source of lightning i.e. Van de Graaff generator. We have captured this lightning discharge pulse using both the antenna configurations at PRL. The signal performance is analyzed using time-frequency representation in MATLAB software. Since mass of the payload is a limiting factor for any planetary mission, it has to be optimized as well. Hence, the two configurations are then compared based on their performance and total mass.

Presentation Mode: Poster (Flash)

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#RADatHomeIndia 9 years of Indian citizen science research in astronomy

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For the first time in the NSSS, we propose to summarise the developments and discoveries achieved by #RADatHomeIndia the first Indian citizen science research (CSR) platform in astronomy. (https://radathomeindia.org/) . Launched as zero-funded, zero-infrasture, nationwide, Inter-University Collaboratory on 15th April 2013, it has grown significantly and achieved both national and international recognition. It has 4700 online members and ~2350 of them are actively learning UV-Optical-IR-Radio image analysis of galaxies using RAD@home-RGB-maker web-tool. Averaged over a year, these members produce ~3 RGB-image posts and ~16 image/text comments, per day. This high level of online activity has been facilitated and complemented by in-person CSR workshops at nearly 30 institutes all over India. Supporting institutions includes ICTS-TIFR, IoP, HRI, UM-DAE CEBS, Vigyan Prasar, Nehru Planetarium (NMML), Vigyan Samagam, Govt of Odisha and Rajasthan, IITs, IISERs, NISER, IISc, NIAS etc.. Discoveries made by citizens during these workshops and/or later on from home have been followed up by the GMRT through the GTAC-approved project (GOOD-RAC). Thus, citizens/students get a Co-I/Co-authorship in proposals/papers and achieve MS/PhD selections or career development. Due to this, we were invited to speak at the 3rd Shaw-International Astronomical Union (IAU) meeting along with CSR-leaders from NASA, Zooniverse, Galaxy Cruize and CosmoQuest. Discovery contributions that will be reported in this presentation include Speca-like spiral-host radio galaxies, new giant and episodic radio galaxies, never-seen-before relic evidence of AGN-feedback as new ~100 kpc size radio bubble, large radio filaments, and ~60 kpc size one-sided radio jet interacting with the stellar shell in two merging galaxies. Note that AI/ML can not replace CSR and our model can easily be expanded to various space science projects with satellite data.

Presentation Mode: Poster (Flash)

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Design and Development of Laboratory-Based Microgravity Experimental Setup

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Physical phenomena that we perceive on Earth are under the influence of entities such as wind and preexisting matter influence on objects. This is not the case when you consider phenomena/interactions of objects in space, therefore it is imperative that we gain a better understanding of phenomena occurring in the space environment. Experiments conducted in Microgravity provide crucial insights into such phenomena. But in reduced gravity environments, which are simulated in Microgravity conditions, simple processes like surface tension become prominent and tend to be counter-intuitive to observations on Earth. This shows the importance of understanding physical phenomena in the microgravity environment. Microgravity experiments can be carried out on different platforms such as Space Stations, Parabolic flights, Drop Balloons, Sounding rockets and Drop Tubes/Towers. Of the various methods used for obtaining microgravity conditions, drop towers offer ground based microgravity platforms. They provide a cost-effective platform for doing short duration, repeatable microgravity experiments.

Drop Tube/towers are long hollow shafts within which the capsule is allowed to undergo free fall in an evacuated drag-free environment. The advantage of such a facility is achieving a controlled microgravity for experiments. A drop tube has three main sections: The headroom, which contains the release unit that holds the capsule; the mid-section is where the free-fall occurs followed by the deceleration unit in the third section of the drop tube. The air inside the drop tube is removed to reduce the drag experienced by the capsule, thus resulting in a very good microgravity condition. After release, followed by free fall, the capsule is then brought to rest using styrofoam balls packed at the bottom of the drop tube.

The design and development details of this laboratory-based microgravity experimental facility and results from preliminary experiments will be presented in this meeting.

Presentation Mode: Poster (Flash)

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Development of Spectrograph in FUV region for a possible ISRO flight

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The FUV (900-1800 Å) is the richest part of the spectrum in terms of emission lines – O VI (1032/1038 Å) and C IV (1548/1550 Å) from hot gas, C III (977 Å) and N III (1750 Å) from warm gas, and the Lyman and Werner bands of molecular hydrogen from cold gas. We plan a proposal-driven mission of emission line spectroscopy of extended sources in the FUV with a spectral resolution, sufficient to separate the O VI doublet and to resolve the molecular hydrogen bands. Our long-slit spectrograph will take simultaneous spectra of multiple locations to track different phases of the gas in extended regions from nebulae to galaxy clusters. The proposed spectral range necessitates a windowless detector for which we have begun a collaboration with the Institute of Astronomy and Astrophysics (IAAT) at the University of Tubingen. They will provide a 40 mm X 40 mm GaN detector with a peak efficiency of 70%. The name of this mission has hence been chosen to be Tubingen-IIA Nebular Investigator (TINI).

Presentation Mode: Poster (Flash)

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Space Exploration using Artificial Intelligence for Human Health

Akhilesh Kumar[1], Awadhesh Kumar[1]

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Any space program that involves long-term human missions will have to deal with significant health hazards. Humans will undertake deep space trips in the near future, despite numerous challenges and hazards. Because of the constraints of human biology, robotic missions may be the only way to make progress in space travel. Remote areas in space that are beyond the purview of manned spacecraft can only be reached by robotic missions, which are today's essence of space exploration. Space robots have the advantage of being immune to the detrimental effects of space radiation and microgravity. They are unaffected by the length of interplanetary travel and are also less expensive than human expeditions. The fundamental drawback of robots in this circumstance is their inadequate ability to recognize and respond to unforeseen events and occurrences. When compared to human cognitive power, robotic 'cognition' is still relatively weak for qualitatively—not just quantitatively—detecting and evaluating observed objects and information. The most likely scenario for future progress in space exploration is purely robotic missions based on intelligent autonomous space robots, and there is no doubt that effective research exploration of new, remote locations in space will necessitate super sophisticated robots with advanced artificial intelligence (AI). In the field of space, AI is being effectively utilized in areas such as better monitoring and diagnostics, prediction, image analysis, and so on.

Presentation Mode: Poster (Flash)

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