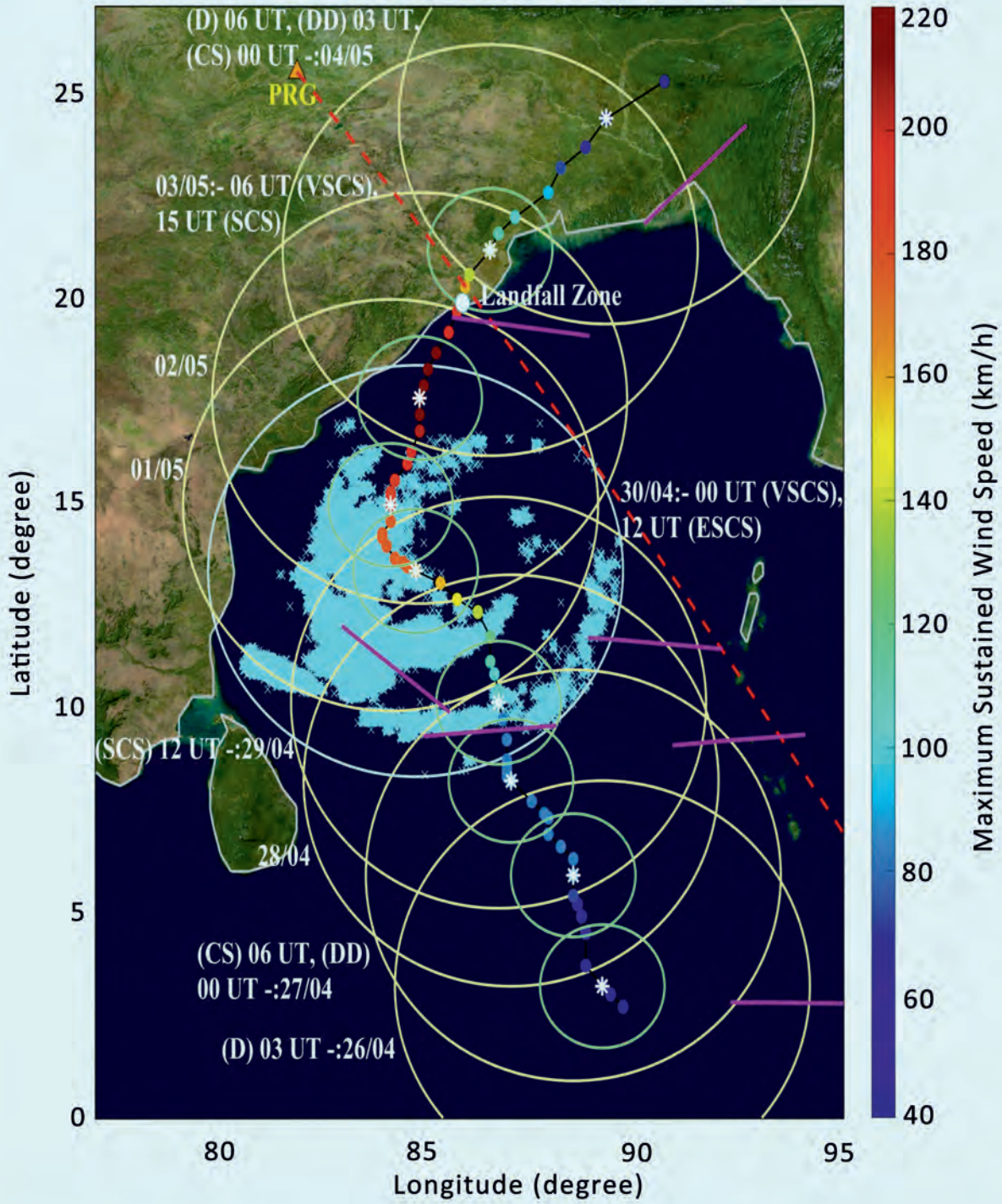
ANNUAL REPORT
2023-24



INDIAN INSTITUTE OF GEOMAGNETISM

New Panvel, Navi Mumbai.

Indian Institute of Geomagnetism

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AUTONOMOUS RESEARCH INSTITUTE
UNDER
DEPARTMENT OF SCIENCE AND TECHNOLOGY
GOVERNMENT OF INDIA

Publication Committee

Satyavir Singh, B. Veenadhari, Gautam Gupta, Remya Bhanu, B. I. Panchal, Smita Chandra, Jeetendra Kamra

Cover Page:

The figure depicts the path of Extremely Severe Cyclonic Storm (ESCS) Fani (26 April – 04 May 2019) over the Bay of Bengal. Multiple ground and space-based datasets used in deciphering atmosphere-ionosphere coupling studies are also shown.

INDIAN INSTITUTE OF GEOMAGNETISM

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Director's Foreword

In the realm of scientific exploration and technological advancements, the role of meticulous research and innovation cannot be overstated. This document encapsulates a year of rigorous scientific endeavors, collaborations, and breakthroughs that define the essence of our institution's commitment to pushing the boundaries of knowledge. As we navigate through the various projects and milestones achieved, it becomes evident that our collective efforts are contributing significantly to the broader scientific community and society at large.

The journey of scientific discovery is rarely a solitary endeavor. It thrives on the collaboration of brilliant minds, the sharing of knowledge, and the relentless pursuit of answers to some of the most pressing questions of our time. This document serves as a testament to the hard work and dedication of our researchers, scientists, and staff who have worked tirelessly to advance our understanding of various scientific phenomena and develop cutting-edge technologies.

One of the standout achievements this year has been the development of the Overhauser Magnetometer with a one-second sampling interval. This advancement marks a significant milestone in precision measurement technology. The successful programming and installation of this magnetometer at the Alibag Observatory have enabled us to undertake rigorous testing and calibration, ensuring that the data collected is of the highest accuracy. This improvement is not just a technical upgrade; it enhances our ability to monitor geomagnetic fluctuations with unprecedented temporal resolution, thereby contributing valuable data to the global scientific community.

Furthermore, the establishment of a dedicated Overhauser Sensor Development Area at our headquarters has been instrumental in advancing our research capabilities. This state-of-the-art facility is focused on the creation and refinement of chemical solvents essential for the fabrication of Overhauser sensors. The team's meticulous efforts in this area underscore our commitment to maintaining a leading edge in sensor technology, paving the way for innovative applications in both terrestrial and space borne environments.

Our participation in international scientific expeditions to the Polar Regions has yielded invaluable insights into the Earth's magnetic field and space weather phenomena. The Indian Scientific Expedition to Antarctica, with members stationed at both Maitri and Bharati research stations, has provided continuous and critical data on geomagnetic field variations. The systematic decline in the magnetic field observed at Maitri is particularly significant, shedding light on the dynamic processes occurring in the Earth's outer core.

In the Arctic, the installation of the Secondary Cosmic Ray Experiment at Ny-Ålesund has been a notable success. This experiment, involving the NaI(Tl) scintillation detector, aims to study the flux of cosmic rays and its dependence on solar and geomagnetic activity. Such research is crucial for understanding the interactions between the Earth's magnetosphere and cosmic radiation, which has implications for both space weather prediction and the safety of space missions.

Our efforts in upper atmospheric research have also seen remarkable progress. The development of new methods for the inversion of virtual heights to true heights from ionosonde measurements represents a significant leap in ionospheric studies. The Iterative Gradient Correction (IGC) method, in particular, has shown superior accuracy in deriving true height profiles, which is essential for understanding ionospheric dynamics and its impact on radio wave propagation.

Additionally, the use of All Sky Imager (ASI) data for cloud and climate studies has provided new insights into pre-monsoon cloud behaviour and its potential implications for climate change. By analyzing cloud speeds and movement patterns over several years, our researchers have contributed to a better understanding of how climate warming in the Northern Hemisphere might affect large-scale atmospheric and hydro-climatic systems.

The initiative to adapt the Overhauser Magnetometer for space missions is an evidence to our forward-thinking approach. Developing a space-qualified prototype and testing it on sounding rockets is a bold step towards integrating our technology into space exploration missions. This endeavor not only expands our technological horizons but also positions us as key contributors to the future of space research.

Our commitment to enhancing data processing capabilities is reflected in the development of MATLAB-based graphical user interfaces (GUIs) for ionogram and skymap visualization. These tools significantly improve the efficiency of data analysis and interpretation, enabling researchers to process large datasets with ease and accuracy. Such advancements are crucial for staying at the forefront of ionospheric and atmospheric research.

The study of ionospheric plasma blobs, the dynamics of ring currents, and the role of lightning activity in atmospheric gravity waves during severe cyclonic storms are crucial areas of research that contribute significantly to our understanding of the Earth's and Mars's space environment. This volume delves into these intricate phenomena, shedding light on their occurrence, variability, and underlying mechanisms.

The investigation of ionospheric plasma blobs in the Martian atmosphere represents a cutting-edge endeavor in space science. By developing automated programs to detect and analyze these plasma signatures from extensive MAVEN database records, this research advances our knowledge of Martian ionospheric behavior, potentially informing future missions and the broader understanding of planetary atmospheres.

On Earth, the dynamics of ring currents, particularly during geomagnetic storms, have long been a focal point of study. This research illustrates the complex interactions between energetic ions circulating around the Earth and the resulting magnetic field variations. By modeling these interactions using circular loops of uniform current, new insights are gained into the potential impacts of significant geomagnetic events, such as the historic Carrington event, enhancing our preparedness for future space weather phenomena.

The role of lightning activity in generating atmospheric gravity waves (AGWs) during tropical cyclones, such as the extremely severe cyclonic storm Fani, underscores the interconnectedness of atmospheric and ionospheric processes. By examining the coupling between the troposphere and the mesosphere-lower thermosphere-ionosphere (MLTI) region, this study highlights the profound influence of cyclones on the upper atmosphere. The detailed analysis of lightning activity and its correlation with AGW characteristics offers a deeper understanding of these complex dynamics, with implications for weather prediction and climate modeling.

Understanding the Earth's lithosphere, atmosphere, ionosphere, and magnetosphere as interconnected systems through the Coupled Lithosphere-Atmosphere-Ionosphere-Magnetosphere System (CLAIMs) provides a comprehensive view of Earth's dynamic processes. This integrated approach is essential for studying seismic impacts on atmospheric and ionospheric conditions, which influence magnetospheric behaviors. Investigations into past seismic activities in Northeast India, focusing on historical earthquakes like the 1950 Assam and 1869 Hojai events, reveal critical insights into seismic hazards. Combining paleoseismological findings with magnetic studies enhances our understanding of regional seismic risks. Analyzing seismic anisotropy via shear wave splitting (SWS) in Northeast India offers valuable information on crustal and upper mantle deformation. These studies deepen our understanding of the region's geodynamic evolution and tectonic processes. Research on volcanic eruptions highlights how plume heights influence Earth's free oscillations. Higher atmospheric penetration of volcanic energy results in stronger acoustic coupling and more pronounced oscillatory modes, aiding in predicting future volcanic impacts.

Studies in the Deccan Volcanic Province (DVP) elucidate the stratigraphy and magnetic properties of the region, contributing to our understanding of the geological history and volcanic evolution of the Deccan Traps. Research on sediments' environmental magnetic properties reveals past geomagnetic field variations, offering insights into the Earth's magnetic history and aiding geophysical and archaeological studies. Analyzing the chemical weathering of Deccan basalt provides insights into the weathering dynamics and geological history of the region, particularly through studies of lateritic profiles. Studies on gravel deposition in central Italy demonstrate the impact of glacial melt-water pulses on sediment deposition, offering a unique perspective on glacio-eustatic events and past climate dynamics. Exploration of the Rio Grande Rise

reveals red clays indicating a hiatus in volcanic activity, shedding light on the chemical weathering processes during the Eocene epoch and the geological history of the rise. Pollen analysis in the Purna basin reconstructs historical vegetation changes and climatic conditions, providing insights into past climate-vegetation interactions and informing conservation strategies.

Utilizing SRTM data and GIS tools, the Nag River Basin in Maharashtra was analyzed, revealing a dendritic drainage pattern and slopes influenced by geological factors. This research is vital for the region's conservation and development. Electrical resistivity imaging identified water-saturated weak zones at shallow depths in Joshimath, indicating perched water bodies surrounded by high-resistivity rocks. Magnetic property analysis of soil samples further corroborated these findings. A study on the Konkan coast of Maharashtra compared resistivity models, demonstrating the superiority of the SVD-based inversion method in identifying saline water-contaminated aquifers. The development of advanced geophysical instruments and methodologies, such as the 32-probe Electrical Resistivity Tomography (ERT) system for groundwater and mineral exploration is a technological advancement representing a significant leap in the capabilities of geophysical surveys, enabling more detailed and accurate subsurface imaging, which is crucial for sustainable resource management.

Magnetotelluric analysis of the Kaladgi Rift Basin revealed significant geological features, including sediment thickness variations and major tectonic faults, offering insights into the region's tectonic framework. A magnetotelluric study of the Cambay Rift Basin highlighted the spatial heterogeneity of its lithosphere, influenced by the Réunion mantle plume, and revealed significant geological structures beneath the basin.

Ground magnetic surveys in the Deccan Volcanic Province generated a crustal magnetic anomaly map, revealing significant geological lineaments and updating the composite magnetic anomaly map of India. A comparison of global gravity models with ground gravity data in the Deccan Volcanic Province demonstrated the effectiveness of satellite-derived gravity data for regional geological interpretation, especially in smoothly varying topographic regions. These studies provide critical insights into India's geological and geophysical landscape, enhancing our understanding and management of these regions.

The Director's Research Group has undertaken significant research into the effects of solar and geomagnetic variability on weather patterns and climate systems. The study on Solar Variability and Tropical Cyclone Activity examines how solar variability, using sunspot numbers, influences tropical cyclone (TC) activity across five global regions. Findings show that TCs, particularly extreme ones, are more frequent during periods of lower solar activity, especially in the North Atlantic. Research on active geomagnetic conditions and Northern Atlantic Oscillations highlights their impact on atmospheric wind patterns and geopotential heights. A detailed analysis of geomagnetic events from 1980 to 2022 reveals significant changes in zonal and meridional winds, indicating energy transfer from the upper stratosphere to the lower troposphere. Another investigation links solar activity to Indian summer monsoon rainfall, showing correlations between solar cycles and large-scale atmospheric circulations. The study reveals distinct differences in monsoon behavior during solar maximum and minimum periods. These studies highlight the crucial connections between solar and geomagnetic variability and their effects on Earth's weather and climate, improving our ability to predict and respond to these changes.

The Geoscience and Applications Program (GAP) has established a network of GNSS stations in the Eastern Himalayas to monitor seismic activity and tectonic movements. This network enhances our understanding of the region's kinematics and strain rates.

Recognizing the importance of continuous learning and knowledge sharing, we have conducted several workshops and training sessions. The Observatory and Data Processing workshop at EGRL Tirunelveli is a prime example, where participants from various observatories gathered to calibrate instruments and share best practices. These workshops not only enhance the technical skills of our staff but also foster a culture of collaboration and innovation.

This annual report provides comprehensive evidence of a challenging and innovative year. The research findings are showcased in 53 research papers published by IIG scientists, resulting in a cumulative impact factor of 141.772. Additionally, 47 papers were presented at national and international conferences. Six research scholars successfully obtained their Ph.D. degrees, and numerous awards and recognitions were conferred upon both staff and students. As part of the capacity building program, IIG scientists trained summer interns and dissertation students throughout the year. Notably, the annual IMPRESS program was held at IIG HQ in Panvel, attracting 80 students from various parts of the country. In the Science

Outreach program, apart from celebration of National Science Day, the institute was also actively involved in various state and national scientific expositions, including the India International Science Festival.

As we reflect on the achievements documented herein, it is clear that our institution is making significant strides in scientific research and technological innovation. Each project and initiative undertaken is a step towards a deeper understanding of our natural world and the advancement of technology for societal benefit. The dedication and hard work of our researchers and staff are the driving forces behind these accomplishments.

The entire staff at IIG extends their sincere gratitude to the outgoing Governing Council of IIG, the Research Advisory Committee, and the Finance Committee, for their untiring support and cooperation, enabling us to accomplish our objectives during the year. The Institute also welcomes the new Governing Council of IIG, the Research Advisory Committee, and the Finance Committee.

Looking ahead, we are committed to continuing this journey of discovery and innovation. We will strive to push the boundaries of what is possible, leveraging our expertise and resources to address the scientific and technological challenges of tomorrow. It is with great pride and optimism that we present this Annual Report, confident that the knowledge and advancements captured within will inspire future generations of scientists and researchers.

A.P. Dimri
Director
August 22, 2024

GEOMAGNETIC DATA-BASED RESEARCH

MAGNETIC OBSERVATORIES AND GEOMAGNETISM FROM THE INDIAN SUBCONTINENT AND POLAR REGIONS (MOGPR)

Chief Coordinator : Geeta Vichare

Members : All technical staff of ODA at HQ and other Magnetic Observatories; All instrumentation division staff at HQ and EGRL; All WDC staff, Gopi K. Seemala

Effect of the brightest gamma-ray burst (GRB 221009A) on low energy gamma-ray counts at sea level

A gamma-ray burst, named GRB 221009A, occurred on 9 October 2022 and is the brightest ever observed GRB, whose frequency is now estimated as once in 10,000 years. This GRB was reported to be observed from many space missions, VLF receivers, and ground observations in optical and radio data. Additionally, a strikingly large number of very high energy (VHE) photons associated with this GRB were observed by the gamma-ray and cosmic ray observatory LHAASO. With RA = 288.3° and Dec = 19.8°, the exceptionally bright fluence of this GRB was geographically centred on India. The effects of this GRB using gamma-ray data in a low energy range (0.2–6) MeV are examined using NaI (Tl) detectors located at Tirunelveli (Geographic coordinates: 8.71°N, 77.76°E), India. No significant change in the observations associated with GRB 221009A was found. The reported observations are discussed and explained in view of the extent of attenuation of gamma-rays in the atmosphere. Furthermore, the study explores the possibility of detecting gamma-rays (less than 10 MeV) from a more intense hypothetical GRB through ground observation. It also estimates key parameters, including the distance, fluence, and isotropic energy of such a GRB.

Applicability of Direct Analytic Method (DAM) to Normal Modes of Poloidal Oscillations

A working Direct Analytic Method (DAM) model is envisaged to explain the normal modes of Poloidal Alfven waves in the Earth's magnetosphere. The model solves the ideal, cold, magnetohydrodynamic (MHD) equations associated with transverse components of the magnetic perturbations in a dipolar magnetic field. DAM model is used to study the transverse poloidal waves in different regions of magnetosphere characterized by their *L*-value and different plasma variability. The eigen frequencies and spatial structures are obtained analytically under different ideal ionospheric boundary conditions. DAM's application in the computation of eigen frequency as well as plasma density is demonstrated under different observational scenario (Figure 1).

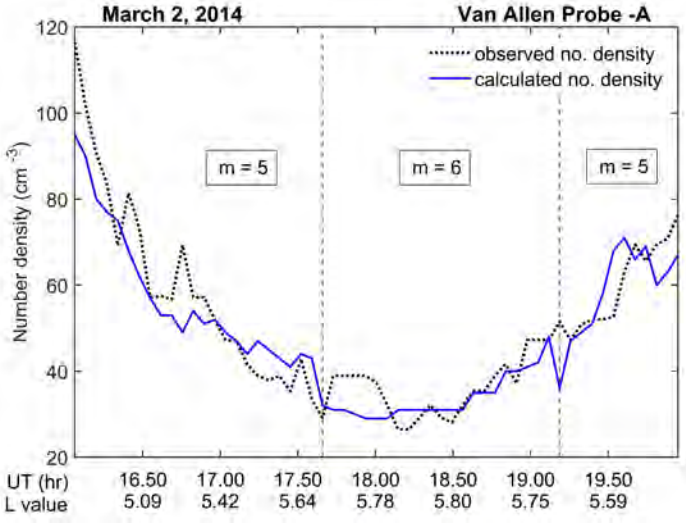

Figure 1 Dynamic spectra of B_x (a), B_y (b) components and ellipticity (ϵ) (c) as an example of IAR observed at Shillong station.

Ionospheric irregularities:

Two geomagnetic storms, the St. Patrick's Day storm of 17th March 2015 and another low intense storm of 8th June 2014, were chosen to understand the effects of PPEF over equatorial ionization anomaly. The ionospheric density was enhanced during the relatively less intense geomagnetic storm compared to the St. Patrick's Day storm. In these two events, large-scale ionospheric irregularities were observed from ROTI values during the local daytime hours, but no ionospheric scintillation was detected (S4 index).

POLAR SCIENCE RESEARCH

Magnetic field variations at Maitri and Bharati stations

During geomagnetic quiet conditions, Indian Antarctic stations are considered to be located outside the auroral oval: Maitri (CGM coordinates: 63.3°S, 54.2°E) is equatorward and Bharati (CGM coordinates: 74.8°S, 98.4°E) is poleward of the auroral oval. Simultaneous observations of magnetic

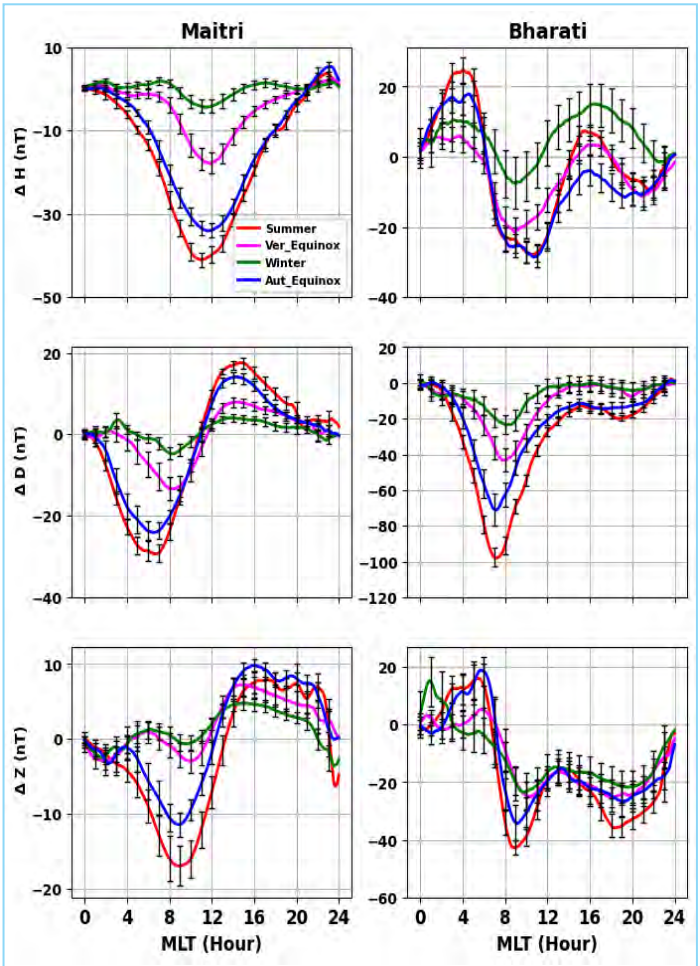

Figure 2 Diurnal pattern of magnetic field variations observed at Maitri and Bharati stations.

field variations at these two locations for 10-years (2013-2022) provide an opportunity to study quiet-time magnetic field patterns, if any. Geomagnetic quiet days with $\Sigma Kp \leq 3$ are selected, during which the lower values of solar wind and interplanetary parameters are also confirmed. Maitri station exhibits clear southern hemispheric solar quiet (Sq) type of magnetic field variation on geomagnetic quiet days in all seasons, indicating the influence of ionospheric dynamo due to thermospheric winds. Interestingly, Bharati station also displays regular and systematic magnetic field variations in all three components. The D-component at Bharati exhibits very strong variation at early morning hours (7-8 MLT), which is ~ 2 to 4 times stronger than that of H-component, driving strong equatorward/northward currents during all seasons. Both stations show annual type of seasonal variation with peak amplitude during summer and least during winter. The schematic illustration of global and polar Sqs proposed here explains the results obtained through 10-years' statistical study (Figure 2).

Ionospheric variation at Bharati station

In this study of ionosphere variability over Bharati station (69.41° S, 76.19° E), an Indian Antarctic research base at Larsemann Hills, was carried out. The ionosphere at polar is highly dynamic and acts as a major sink for the solar-terrestrial energy transfer processes, different magnetospheric and space weather events. The variation of ionosphere for diurnal, seasonal, and solar activity was studied using the TEC data for the years 2010-2022 which covers the solar cycle 24. The TEC diurnal pattern is strong even during polar days and nights with a peak at local noon. The seasonal variability was distinctly observed with about 50% increase in TEC during equinoxial months compared to summer months during high solar active year 2014. However, during low solar active year there is a marginal increase of TEC in equinoxes compared to summer. (Figure 3).

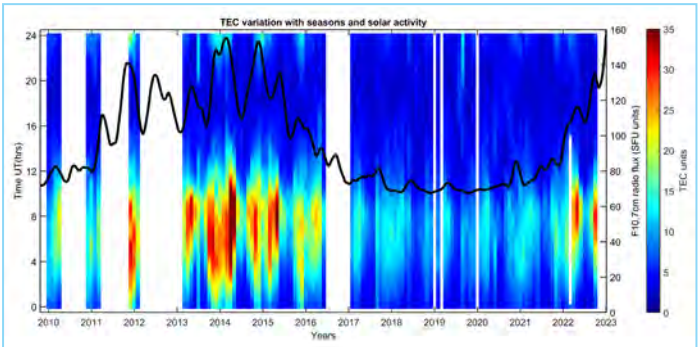

Figure 3 Variation of mean variation of TEC with time and the years depicting seasonal and solar variation. The smoothed mean solar flux variation is represented black line the with its scale on the right side of figure.

Atmospheric Electric field studies at Maitri and Bharati stations

Simultaneous dual station observations of the atmospheric electric potential gradient (PG) at Bharati and Maitri studied for the period 2014-2016. This brings out a new regional diurnal pattern of fair-weather PG for the coastal Antarctic region, perhaps the ubiquitous characteristics of the PG for the coastal Antarctic region. It is a broad minimum in the Carnegie-type PG variation. The surface wind distorts the fair-weather diurnal pattern of PG over Bharati more significantly than at Maitri. This particular signature distorts the expected global pattern of the PG at Bharati. Data quality is improved by measuring the PG using the EFM flush mounted with ground EFM rather than from an elevated site. This position reduces the wind effects on the PG and favours the detection of globally representative data (Figure 4).

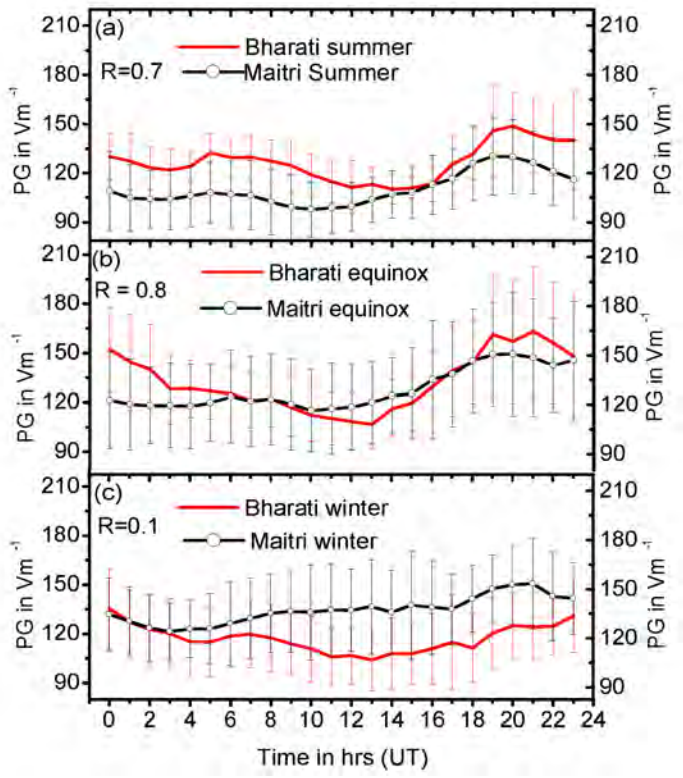

Figure 4 Seasonal variation of PG at Bharati and Maitri (a) Mean PG curves for the Austral summer months, (b) Mean PG curves for equinox months, and (c) Mean PG curves for the Austral winter months.

Hemispheric comparison of solar flare associated cosmic noise absorption (SCNA) from high latitude stations: Maitri and Abisko

The effects of solar flares in the D-region ionosphere at two high-latitude stations: Maitri (70.75°S, 11.75°E) and Abisko (68.4°N, 18.9°E), located in different hemispheres are studied. 37 M-class flares and 6 X-class flares of the year 2014, which occurred when either or both stations were in the sun-lit side of the Earth are analyzed. Cosmic Noise Absorption (CNA) curves are obtained using the datasets of riometers located at the two stations and are analyzed for all the 43 events to investigate: 1) relationship between CNA and flare magnitude, 2) relationship between CNA and solar zenith angle (SZA), 3) hemispheric asymmetry in the observed solar flare associate CNA (or SCNA), and 4) the effect of background ionospheric condition in the SCNA magnitude at the two high latitude stations. It is observed that the solar flare effect in SCNA strongly depends on the SZA and flare intensity. The analysis reveals that the flare response in SCNA for the year 2014 was stronger at Abisko than at Maitri. There is an observed hemispheric asymmetry in the solar flare ionization at D-region ionosphere for the given latitude. This asymmetry can be attributed to the previously enhanced background ionospheric ionization during particle precipitation processes. The study demonstrates the need to establish an empirical relationship between the observed CNA and flare intensity, SZA, and latitudinal position, particularly at higher latitudes.

OBSERVATORY MAINTENANCE

Institute's magnetic observatories house various instruments such as DFM, DIM, PPM and Overhauser magnetometer for magnetic field measurements. Indigenously developed PPMs for absolute magnetic field observations are used in all the IIG observatories. IIG is helping MO Sabhawala operational under Survey of India. Recently the DFM console of MO Sabhawala has been repaired.

Two number of DFM Electronic consoles were repaired and tested at MO Alibag. The Overhauser PPM for MO Nagpur and MO Silchar has been repaired. Also the PPM at MO Port Blair has been repaired and installed. Two data loggers were assembled for replacement of faulty data loggers at MO Nagpur and EGRL, Tirunelveli. Data transfer link at KSKGRL, Prayagraj, was repaired, and installation of DFM is underway.

In order to get clean data during repairing work of the variometer room at MO Alibag, it was planned to shift one of the DFM to the outside chamber. DFM2 is installed in a specially constructed non-magnetic chamber at MO Alibag campus, away from variometer room. Data is compared and it is matching well with DFM in the variometer room.

OBSERVATORY WORKSHOP

Observatory and Data Processing workshop was conducted at EGRL, Tirunelveli during August 30 to September 1, 2023. One member from each of the observatories participated in this workshop. Calibration of the instruments that were brought from the observatories was performed. .

INTERMAGNET

INTERMAGNET is a global network of observatories, monitoring the Earth's magnetic field, adopting modern standards for measuring and recording equipment in order to facilitate high resolution data exchange in near real time. IIG is a participating Institute in this programme. Earth's magnetic field data received from ALIBAG and JAIPUR are processed and emailed to Kyoto GIN in near real time. These data can be viewed as Quick-Look plots at the Kyoto website (http://wdc.kugi.kyoto-u.ac.jp/plot_realtime/intermagnet/index.html).

DEVELOPMENT OF INSTRUMENTS

Development of Overhauser Magnetometer with 1 second sampling

The successful programming of the Overhauser magnetometer to operate at a 'one-second' sampling interval marks a significant milestone in its development. With this achievement, the unit has been carefully installed at the Alibag Observatory, where it will undergo rigorous testing.

Concentration Analysis

The concentration analysis of the solvent utilized in the sensor has been meticulously conducted. In this comprehensive study, two distinct sensors were developed, each employing different solvents. These sensors were subjected to rigorous testing, involving various sampling intervals, in order to assess and compare the performance of the diverse solvents. The findings from this investigation will provide valuable insights into the effectiveness and suitability of each solvent for the sensor's intended application.The improved magnetometer is again installed to Alibag MO for its continuous operation and testing.

Establishment of Overhauser Sensor development Area

A designated and exclusive area has been devotedly allocated at IIG H.Q. for the establishment of a cutting-edge sensor development facility. Within this facility, the focus lies on the creation and refinement of the chemical solvents indispensable for the fabrication of the Overhauser sensor. The dedicated team has made substantial progress in their efforts, and the completion of the work is now within sight. With the final touches being applied, the laboratory is poised to become fully operational in the coming days, ready to contribute to ground breaking advancements in sensor technology.

Overhauser magnetometer development for Space borne experiments

It is a new initiative to make the existing IIG Overhauser to be compatible for space missions. The space qualified prototype will be tested on sounding rocket experiment.

INDIAN SCIENTIFIC EXPEDITION TO ANTARCTICA

Two winter members i.e. one each for Maitri and Bharati and one summer member for Maitri were deputed for the expedition. All the experiments at both stations are running uninterrupted. Measurements of total magnetic field at Maitri in campaigns and by IGRF model had indicated large decline in magnetic field (~ 110 nT/year) during the last few decades. However, the continuous monitoring of geomagnetic field at Maitri indicates that recently it is reducing at a rate of approximately 65 nT/year. A systematic rapid decline in the Earth's complex main magnetic field is important for monitoring the evolution of the physical processes occurring in the outer core of the Earth.

PARTICIPATION IN ARCTIC EXPEDITION

Installation of Secondary Cosmic Ray Experiment at NyAlesund, Arctic

NaI(Tl) scintillation detector to study Secondary Cosmic Ray (SCR) was installed at NyAlesund, Arctic. As incident flux of cosmic rays depends upon the solar and geomagnetic activity, this experiment is important for the Space Weather and Solar-Terrestrial Relationship. Figure 5 and Figure 6 displays the SCR set up at Gruvebadet Laboratory, NyAlesund, and Indian Arctic Station, Himadri, respectively.

Figure 5 NaI(Tl) scintillation detector installed at Gruvebadet, NyAlesund, Arctic.

Figure 6 Dr. Geeta Vichare at Himadri station, NyAlesund, Arctic.

UPPER ATMOSPHERIC RESEARCH

NEUTRAL AND ELECTRODYNAMICAL COUPLING OF THE ATMOSPHERE-IONOSPHERE SYSTEM (NECLAS)

Chief Coordinator : S. Sripathi

Coordinator(s) : B. Veenadhari and S. Tulasiram

Members : S. Gurubaran, Geeta Vichare, Mala S. Bagiya, R. Ghodpage, Manohar Lal, Technical staff at EGRL/ KSKGRL/MF Radar Facility and Research Scholars

New method of inversion of Virtual heights to true heights from the Ionosonde

Inversion of precise true height electron density profile from the Ionosonde measured virtual heights is quite challenging and ill-posed problem. To address this problem, a new method is developed to compute the true height profiles from ionograms that relies on computing the propagation path of radio waves with time. This method does not use predefined polynomial functions to fit the vertical electron density distribution; hence, it is free from fitting errors. Instead, this method implements iterative corrections in the electron density gradient between the successive points and progressively reconstructs the true height profile. This Iterative Gradient Correction (IGC) method assures minimizing the error to below a tolerance limit at all sampled points on the ionogram. The true height profiles derived from this method exhibit better accuracy than those derived from the widely used POLAN, particularly, at cusp and F2-peak regions (Figure 7). Further, the IGC method gives the best results at higher sampling resolutions of ionograms and is less sensitive to scaling errors.

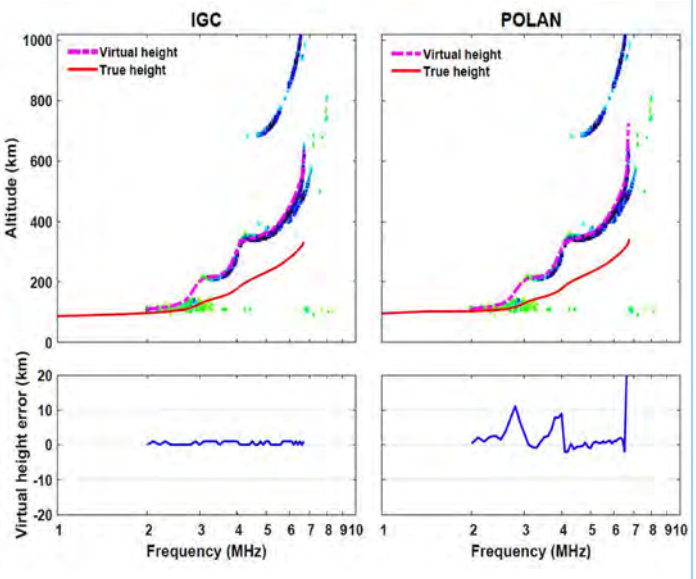

Figure 7 Comparison between the electron density profiles (red curve) obtained from Iterative Gradient Correction (IGC) method (left) and POLAN (right). The bottom panel shows the error in the synthesized virtual heights when compared to the ionogram

All Sky Imager for cloud and climate studies

The study investigates the feasibility of employing an advanced photogrammetric technique, which is commonly used for satellite measurements. Here, All Sky Imager (ASI) night airglow observations is used from the low latitude station Kolhapur for the years 2016 to 2019 (March to May months). Image processing is required for better visualization of target elements, noise removal and target cloud identification. This study estimates the cloud speeds which range from 10 m/s to 18 m/s during the period under consideration. The slowest speed of 10±3 m/s was evidenced in 2017, while it takes value of 15±3 m/s over other years. The clouds are found to move in a south-westerly direction during the time period under consideration. The cloud cover fraction varies in between ~ 0.178 to 0.594 over 2016 to 2019. The analysis indicates systematic changes in the pre-monsoon cloud fraction and direction of the cloud movement. The observed trend indicates that the monsoon pattern is somewhat changing and that the climate warming in the Northern Hemisphere may cause large-scale hydro-climatic changes. There are some other parameters being computed. On cloudy days, airglow data is not useful for the intended study; however, this data has been utilized to examine the lower atmosphere and estimate cloud parameters.

Honga Tonga volcano induced EPB observations on 15 January 2022

The study investigates the occurrence of intense Equatorial Spread-F (ESF) over the Indian region, which is believed to have been triggered by perturbations in the atmosphere-ionosphere system caused by the 15 January 2022 Hunga Tonga Hunga Ha'apai Volcanic Eruption (HTHH-VE). The investigations are made using Canadian Advanced Digital Ionosonde located at Tirunelveli (8.67^{0}N, 77.81^{0}E) and Prayagraj (25.41^{0}N, 81.93^0 E). In addition, the Equatorial Electrojet (EEJ) strength, NASA ICON satellite observations of thermospheric winds and AQUA satellite observations of brightness temperature in the stratospheric altitudes

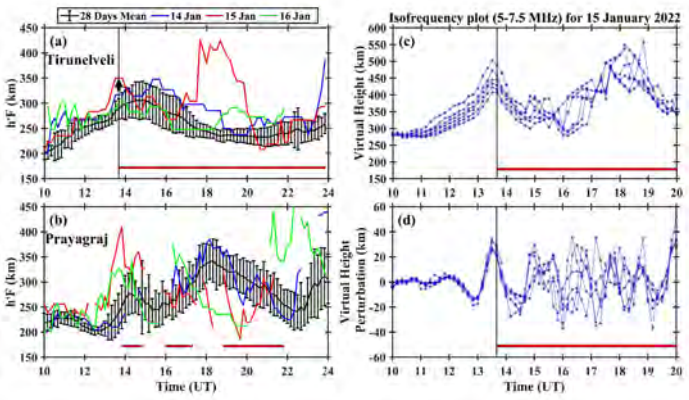

Figure 8 Temporal variation of the F-layer base height (h'F) for January 2022 over Tirunelveli and Prayagraj. (c,d) Temporal variations in the virtual height and perturbation in the virtual height for different isofrequencies (5–7.5 MHz) at Tirunelveli.

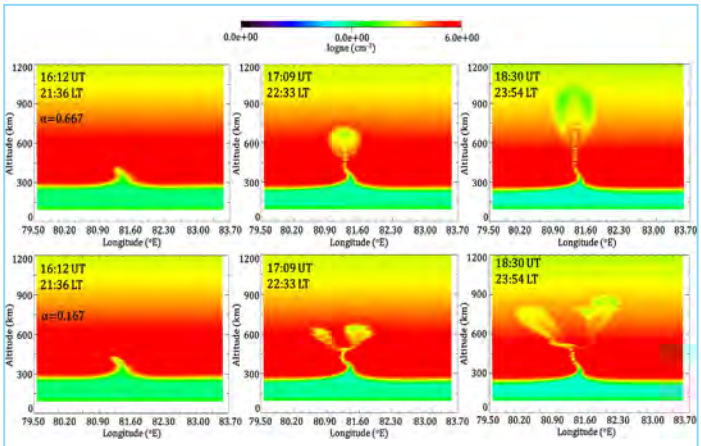

Figure 9 SAMI3 simulation of Equatorial Plasma Bubbles during St Patrick's day geomagnetic storm performed using HPC system at IIG with different diffusion coefficients.

were examined. The present case study reveals unique observation of the occurrence of simultaneous ESF at equatorial (Tirunelveli) and low-mid latitude (Prayagraj) stations. It is believed that Honga-Tonga Volcano induced lamb waves propagated globally. The same Lamb waves are propagated towards the Indian region and possibly induced gravity wave type of oscillations resulted in the occurrence of such spread-F in the Indian longitude. Isofrequency analysis over Tirunelveli indicates the presence of gravity wavelike oscillations that may be seeding the equatorial spread-F (Figure 8). The hodochrone plot obtained using GPS-Total Electron Content (TEC) observations from 4 stations (Tirunelveli, Rajkot, Jaipur, and Shillong) showed the dominant Travelling Ionospheric Disturbances (TIDs) travelling at a speed of 350m/s similar to propagation of Lamb waves.

SAMI3 Simulation of equatorial plasma bubbles during 2015 St Patrick's Day storm

An attempt has been made to study the generation and evolution of equatorial plasma bubble during St.Patrick's Day geomagnetic storm using SAMI3/ESF model. For this study a background ionosphere is simulated using SAMI3 model by running it for 48 hours with the required parameters. The plasma parameters (density, temperature, and velocity) are used to initialize the SAMI3/ESF model at each magnetic longitudinal plane. The 3D model uses a grid with magnetic apex heights from 85 km to 2000 km, and a longitudinal width of 4° (e.g., ≃444 km) centered at 81°. The grid is (*nz*, *nf*, *nl*) = (204, 124, 144) where *nz* is the number grid points along the magnetic field, *nf* the number in 'altitude,' and *nl* the number in longitude. This grid has a resolution of ~10 km × 5 km in altitude and longitude in the magnetic equatorial plane. The grid is periodic in longitude. In essence, the study simulates a narrow 'wedge' of the ionosphere during the post-sunset period (Figure 9).

Simultaneous Radar and scintillation observations

The investigation focused on ionospheric scintillations observed on VHF and L-band radio signals while the Indian MST Radar (53 MHz) at Gadanki (13.50 N, 79.20 E), a low latitude station, was operated simultaneously in ionospheric mode. The spaced VHF receiver scintillation experiment is carried out at various locations across India to study the association between scintillations and radar plumes. Ionosonde observation of h'F (km) at Tirunelveli, an equatorial station has been utilized to examine the PRE in zonal electric field. While radar is sensitive to meter scale irregularities, scintillations arise mainly from the intermediate to kilometer scale size irregularities. The study examined

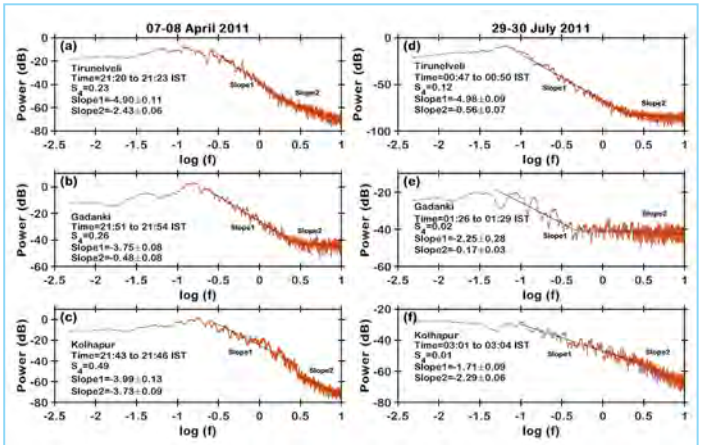

Figure 10 (a-f) Spectral characteristics of VHF scintillations at (a) Tirunelveli, (b) Gadanki, and (c) Kolhapur stations in the post-sunset sector (left) on 07-08 April 2011 and in the post-sunset sector (right) on 29-30 July 2011, respectively.

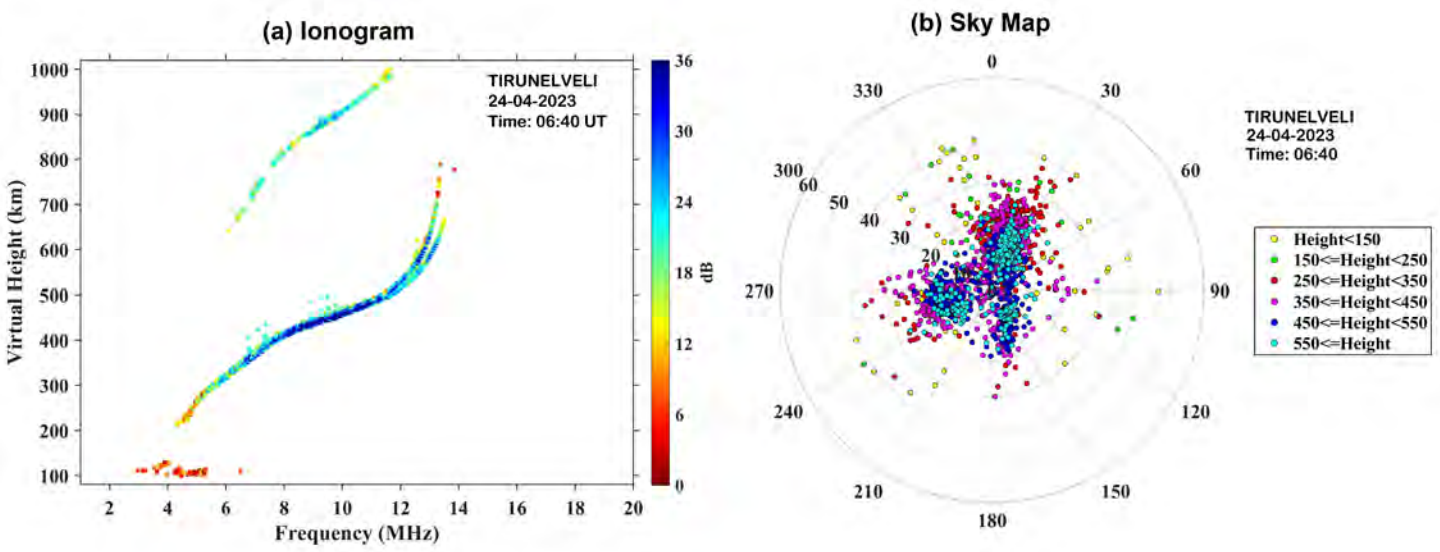

Figure 11 Typical Ionogram and skymap obtained using new GUI for cadi ionosonde data over Tirunelveli

the behavior of spectral slopes during the post-sunset and post-midnight sectors (Figure 10). The spectral analysis suggests the presence of shallower and steeper slopes under post-sunset and post-midnight sectors respectively. The results suggest that scintillation parameters such as S4 index, spectral index and cross correlation index in addition to spectral width from the radar could be useful in characterizing the structure and dynamics of the equatorial plasma irregularities and their latitudinal extent which has potential implications for the scintillation predictions.

Development of MATLAB-based GUI for ionograms and skymap visualization

The ionosphere, a region of Earth's upper atmosphere, plays a critical role in the propagation of radio waves and influences various communication and navigation systems. Ground-based ionosondes are valuable instruments used to study the ionosphere by providing vertical profiles of electron density, known as ionograms. The Canadian Advanced Digital Ionosonde (CADI) is a powerful tool that captures detailed ionospheric data. This report focuses on the development of MATLAB-based GUIs to visualize the data as ionograms and skymap plots (Figure 11). The implementation of these GUIs significantly enhances data processing efficiency, providing a user-friendly solution to analyze and interpret ionospheric data.

Tropical cyclone generated gravity waves in the mesosphere and lower thermosphere over Kolhapur

High-resolution wind data acquired by the Medium Frequency (MF) radar at Kolhapur (16.69ºN, 74.24ºE) are utilized to study the high frequency gravity waves (20-60 min) associated with the tropical cyclone named "Vayu" formed in the Indian Arabian Sea in June 2019. An enhancement of the gravity wave (GW) activities in the meridional wind is observed during 13-15 June 2019. Figure 12 depicts the longitude–latitude cross-section of the convective precipitation associated with the cyclone. The parameter being referred to is the total amount of precipitation that is produced by the convection scheme in the ECMWF

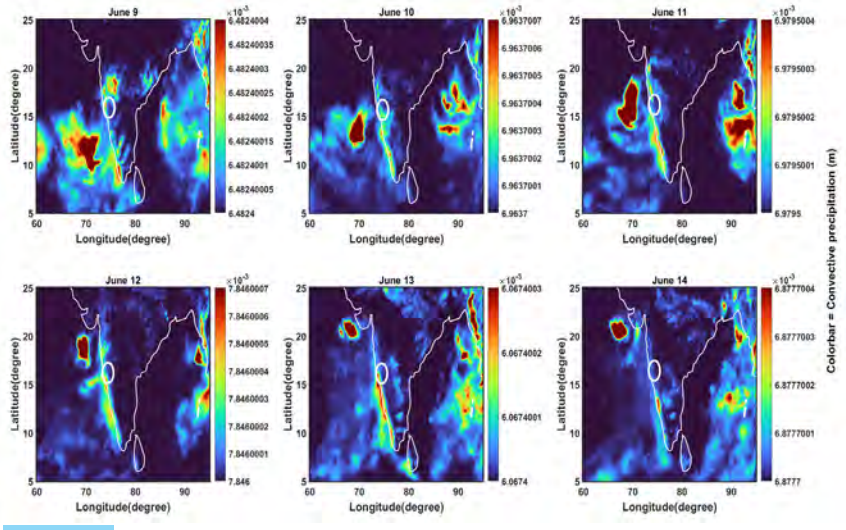

Figure 12 Daily convective precipitation over Kolhapur during June 09 -14 June 2019

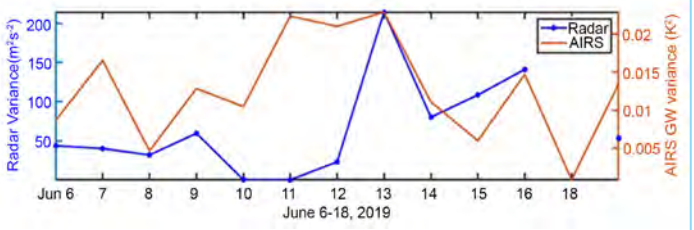

Figure 13 Shows the daily variation of meridional gravity wave (variance (20-60 mins) at 88 km obtained from Kolhapur MF radar (Blue) and AIRS (red) GW variance at Stratospheric height during June 06-19 2019.

Integrated Forecasting System (IFS) and eventually falls onto the surface of the Earth. Figure 13 depicts the gravity wave variance in the MF radar meridional winds in the mesopause at 88 km and AIRS (red) gravity wave variance in brightness temperature (BT) measurements in the stratosphere from 6 June to 19 June 2019. The AIRS gravity wave variance is averaged between for the latitudes16ºN ± 3º and longitudes between 74ºE ± 3º. Both the gravity wave variance in the mesopause winds from MF radar and BT in the AIRS are highly positively correlated. MF radar data provides information about the mesospheric gravity wave activity while AIRS gives information about the stratospheric gravity wave activity from radiance measurements in the 4.3 and 15 μm CO_2 fundamental bands. It can be observed that both MF radar and AIRS data show enhancements in the gravity wave activity during the cyclone period of 12–13 June 2019. These results indicate that the gravity wave observed in both the stratosphere and mesosphere are mostly generated due to tropical cyclone. AIRS stratospheric gravity wave observations, combined with MF radar mesospheric gravity wave data, reveal the vertical propagation of gravity waves, demonstrating the vertical coupling between the stratosphere and mesosphere.

Investigation of Ionospheric Response to Tropical Cyclone Ockhi at Tirunelveli

The investigation focused on the ionospheric response to Tropical Cyclone Ockhi in November 2017, aiming to understand atmosphere-ionosphere coupling during extreme weather conditions associated with cyclones such as Ockhi. The findings highlight the dynamic nature of the ionosphere during such meteorological events, emphasizing Traveling Ionospheric Disturbances (TIDs) and Gravity Waves (GWs) as indicative of interactions between the lower and upper atmospheric layers. Examining atmospheric/ionospheric parameters such as neutral temperature, foF2, h'F, and TEC, the study reveals the cyclone's impact on these parameters, disrupting the

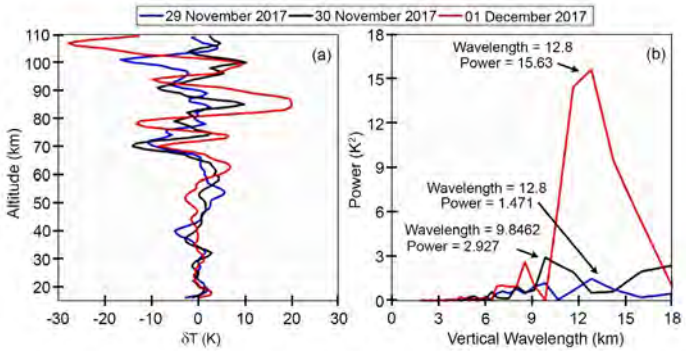

Figure 14 The temperature perturbations obtained from SABER temperature profiles on 29 November, 30 November, and 01 December 2017 are visualized in Figure 1. Panel (a) represents the temperature perturbation, while panel (b) showcases the FFT analysis outcomes corresponding to the specified dates.

typical electron density distribution. Ionosonde observations during the cyclone's passage provide direct evidence of ionospheric disturbances, capturing irregular echoes and Spread F phenomena. Additionally, AIRS brightness temperature perturbations and SABER temperature profile analysis indicate fluctuations resembling Concentric Gravity Waves (CGWs) and Gravity Waves in the lower and middle atmosphere. Spectral analysis helps elucidate gravity wave-induced fluctuations in the Mesosphere and Lower Thermosphere (MLT) region and the ionosphere, providing insights into their characteristics. The observed gravity wave fluctuations in the MLT region exhibit a vertical wavelength of approximately 9-13 km and a periodicity of around 35-50 minutes, contributing crucial information about the nature of the gravity waves generated by Tropical Cyclone Ockhi (Figure 14).

Optical Investigations of Mesosphere-Lower-Thermosphere-Ionosphere (MLTI) system

i) A multi-wavelength photometer (MWP) was operated at EGRL, Tirunelveli during 2015-16 to record intensities of the P1 lines of the OH(6,2) band. The P1 line intensities are utilized to estimate temperatures at the Mesosphere Lower Thermosphere (MLT) region. The MWP-derived temperatures correlate well with concurrent overhead SABER temperatures. The average temperature difference between these two instruments is found to be ~15 K.

ii) A study on the distribution of Inter-depletion distances (IDDs) of equatorial plasma bubbles (EPBs) is carried out with the help of Oxygen redline (630 nm) emission data obtained with theall-sky airglow imager installed

at EGRL. The maximum occurrence of EPB IDDs is found in the range of 50-100 km, followed by 100-150 km and 150-200 km ranges, respectively. EPB IDDs correlate positively with the solar activity level (F10.7 index). No apparent seasonal variations in EPB IDDs are observed.

iii) Inter-comparison between the MLT temperatures obtained from the Arecibo Observatory (AO) Ebert-Fastie spectrometer (EFS), AO Potassium Lidar (K-Lidar), and overhead SABER passes has been carried out for the period of February-April 2005. It is observed that comparison between altitude-resolved (e.g., K-Lidar & SABER) and altitude-integrated (e.g., EFS) temperature measurements improves when a weighting function that utilizes time-varying peak altitudes and FWHMs is used instead of a weighting function that has a fixed peak altitude and a fixed FWHM for the whole night. It was also found that statistically Gaussian weighting functions and those resembling the shape of SABER OH VERs produce similar mean temperature differences between altitude-resolved and altitude-integrated temperature measurements. By applying time-varying weighting functions, the mean temperature difference between the AO EFS and K-Lidar was found to be approximately 13 K. On average, the EFS and K-Lidar temperatures are greater than the SABER temperatures by 15.6 K and 6.8 K, respectively (Figure 15).

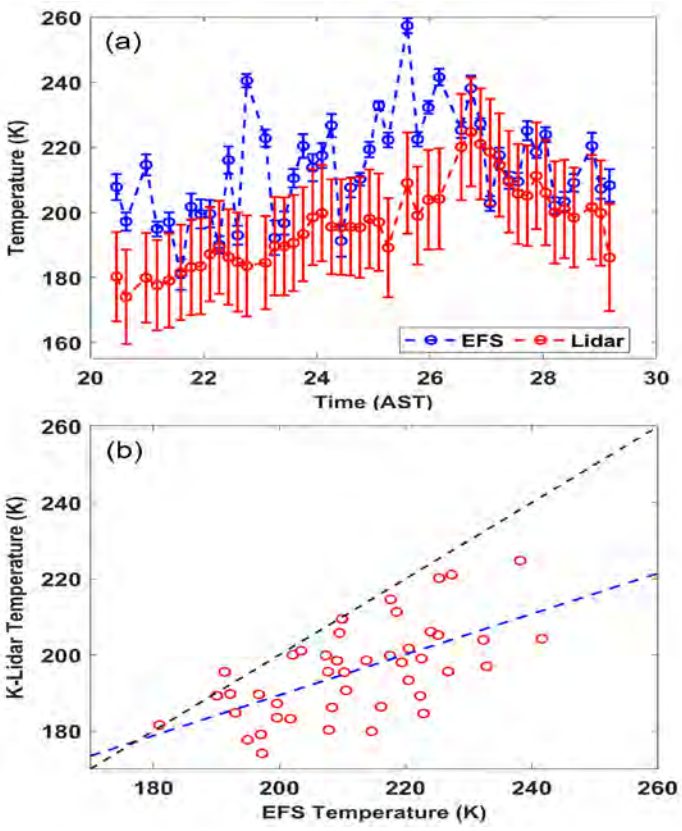

Figure 15 **(a)** Comparison of the AO EFS rotational temperatures (blue color) and weighted AO K-Lidar temperatures (red color) for 09 April 2005. Vertical lines of the corresponding color show the uncertainties in these two sets of temperatures. (**b**) Scatter plot of weighted AO K-Lidar temperatures as a function of AO EFS temperatures for the same night as in panel (a). The blue dotted line is the linear fit between these two temperatures while the black dotted line represents a linear fit having slope=1. The correlation coefficient between the two temperatures is 0.62.

SPACE WEATHER – OBSERVATIONS AND MODELLING (SWOM)

Chief Coordinator : Mala S. Bagiya

Coordinator : S. Tulasiram

Members : B. Veenadhari, Geeta Vichare, S. Sripathi, Gopi Seemala, Rahul Rawat, S. Banola and Research Scholars

Energetic Ion Variations during Substorm intervals using the Van Allen Probes data

The study investigates ion flux variations for the substorms in the inner magnetosphere. The effect of substorm-induced magnetic field dipolarization on the O^+ and H^+ ion flux is analysed for 22 events from the year 2018 using the Helium, Oxygen, Proton, and Electron (HOPE) Mass Spectrometer data on board the Van Allen Probes (VAP/RBSP) satellite. RBSP orbits are shown in (Figure 16). The clear dipolarization signatures are observed using the Electric and Magnetic Field Instrument Suite and Integrated Science (EMFISIS) suite from the VAP. The major findings analysed are as follows. The time scale of the magnetic field dipolarization is approximately 5 minutes. The reconfiguration of the magnetic field is accompanied

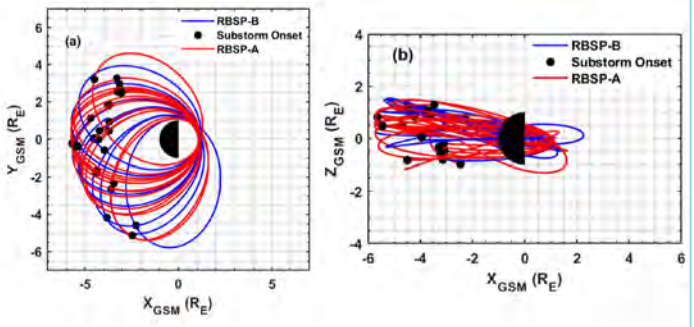

Figure 16 Orbit of RBSP-A and RBSP-B spacecrafts during the selected Substorm events in the x-y (a) and y-z (b) planes in geocentric solar magnetospheric coordinates.

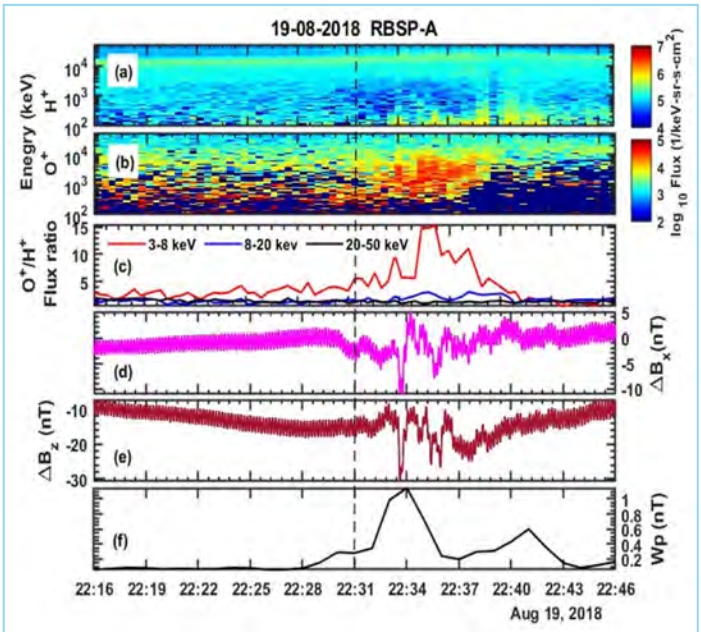

Figure 17 Energy spectra of H^+, and O^+ ions during the preonset and postonset intervals.

by an enhancement in the flux of O^+ and the H^+ ions at energies 1-50 keV. The enhancement in O^+ ion flux for the particular energy range of 20-50 keV appears to be greater in magnitude compared to the enhanced H^+ ion flux (Figure 17). The observed increase of O^+ ion flux at energies above 20 keV during the substorm strongly depends on the strength of the IMF Bz, the solar wind velocity Vsw, and the higher AE index with correlation coefficients of 0.78, 0.66, and 0.63 respectively. The peak of the O^+/ H^+ ion flux ratio centred near midnight around 23:00 to 00:00 MLT for the energy range of 8-20 keV, whereas the O^+/ H^+ ion flux ratio of the energy 20-50 keV is high within the post-midnight i.e., from 00-03:00 MLT.

Equatorial electrojet (EEJ) response to interplanetary (IP) shocks

Interplanetary (IP) shocks are known to cause significant modifications in Earth's magnetospheric and ionospheric current systems. The sudden enhancement of solar wind dynamic pressure (PDyn) associated with IP shocks could induce convection electric fields at high-latitude ionosphere which can promptly penetrate to equatorial and low-latitude regions. Additionally, prompt penetration electric field disturbances may also be induced due to the sudden eastward/westward turnings of the interplanetary electric field (IEFy) during IP shocks. The resultant electric field disturbances can significantly alter the ionospheric electrodynamics and equatorial electrojet (EEJ). To address this, the EEJ responses to a large number of IP shocks that occurred during 2001–2021 have been investigated. The magnitude of the EEJ response to IP shocks shows clear local time dependence and varies linearly with the change in solar wind dynamic pressure (Figure 18). The EEJ response is also found to depend considerably on the solar activity (F10.7 solar flux) and the polarity changes in IMF Bz associated with IP shocks. For the first time, an empirical relation is derived that can

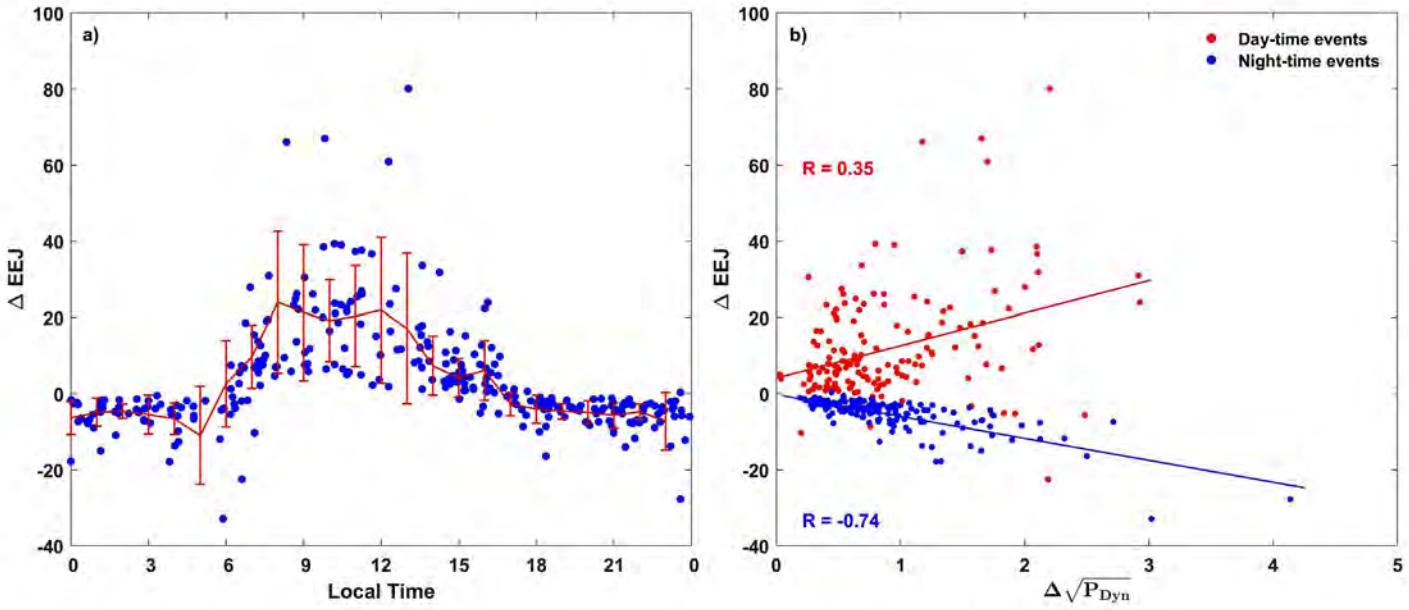

Figure 18 The EEJ responses during the impact of Interplanetary (IP) shocks, and its dependence on (a) Local Time and (b) change in solar wind dynamic pressure (ΔP_{Dyn}).

quantitatively estimate the EEJ response to IP shocks using a large number (306) of events that occurred over a span of two solar cycles. The derived empirical relation is found to be very accurate in predicting the response of the EEJ and exhibits an excellent correlation with observations.

How to identify and forecast severe space weather events?

Severe space weather (SvSW) is defined as those causing damage of ground installations such as transformers resulting in power outage and/or telecommunication networks resulting in communication failure; normal space weather (NSW) does not cause such severe effects. Severe space weather events are caused by very energetic coronal mass ejections (CMEs) from the Sun, in particular by the sharp changes at their leading edge or front. It is shown that (1) the ICME (interplanetary CME) front of large velocity jump ΔV by over 275 kmps and sufficiently large southward interplanetary magnetic field (IMF Bz) at and beyond the velocity jump that causes SvSW. (2) a derived parameter of the geomagnetic storms called impulsive strength (IpsDst) giving the average value of Dst during the storm main phase (MP) can distinguish between SvSW and NSW (Figure 19) (3) the product of the observed velocity jump and associated IMF Bz southward (VBz) ≤ -15000 kmps nT or -15 mV/m) can be used for forecasting SvSW. (4) if one can estimate ΔVBz at the Sun-Earth L1 point based on observations such as from the Advanced Composition Explorer (ACE) satellite, it is possible to forecast an SvSW event with an advance warning time of about half an hour.

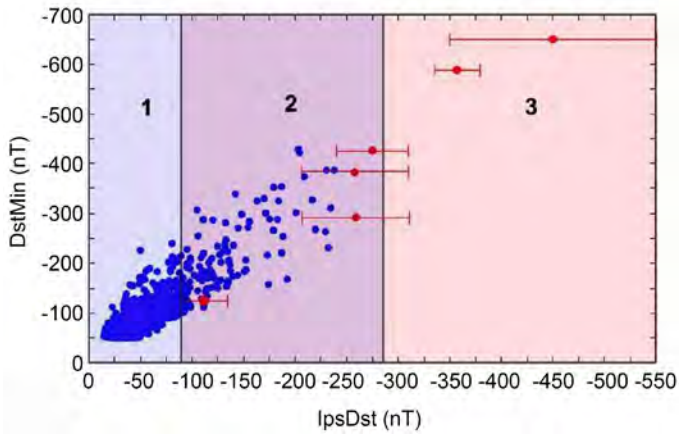

Figure 19 Scatter plot of IpsDst against DstMin for the geomagnetic storms occurred during 1957–2007. Red and blue dots correspond to SvSW and NSW events.

Calculating the high latitude ionospheric electrodynamics using a machine learning based field-aligned current model

A new ML_AIM framework that solves a current continuity equation by utilizing the ML model of Field Aligned Currents, auroral conductance model, and the solar irradiance conductance models is developed. Two ML-AIM simulations are carried out for a weak geomagnetic activity interval on 14 May 2013 and a geomagnetic storm on 7–8 September 2017. ML-AIM produces physically accurate ionospheric potential patterns such as the two-cell convection pattern and the enhancement of electric potentials during active times (Figure 20). The cross polar cap potentials (CPCP) from ML-AIM, the Weimer model, and the SuperDARN data-assimilated potentials, are compared to the ones from 3204 polar crossings of the Defense Meteorological Satellite Program F17 satellite, showing better performance of ML-AIM than others. Plans are underway to improve ML-AIM performance by including a fully ML network of models of aurora precipitation and ionospheric conductance, targeting its characterization of geomagnetically active times.

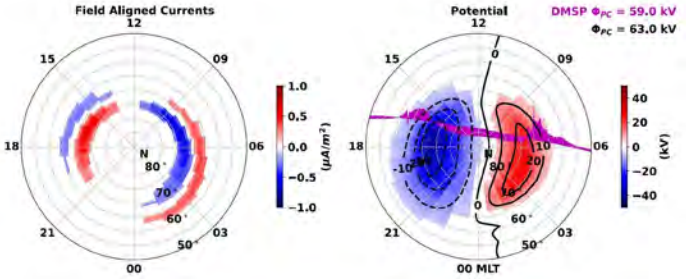

Figure 20 Magnetic Local Time (MLT) and Magnetic Latitude (MLAT) maps of Field Aligned Current density and potential computed using the new ML_AIM framework at 12:44 UT on 14 May 2013.

Ionospheric response to the 23-24 April 2023 geomagnetic storm and the occurrence of Traveling Ionospheric Disturbances (TIDs) over Indian longitudes

Low latitude ionospheric response to April 2023 geomagnetic storm has been analysed using (a) ground and space based observations and (b) SAMI2 model simulations by incorporating the ionosonde derived vertical drifts. The analysis of ionosonde observations suggests presence of TIDs during the time of ionospheric disturbances during geomagnetic storm (Figure 21). The electron density in the F layer experienced significant variations, leading to ionospheric density oscillations. The wave characteristics of the density oscillation/TIDs are obtained using four GNSS receivers located DGAR (7.27ºS, 72.37ºE), IISC

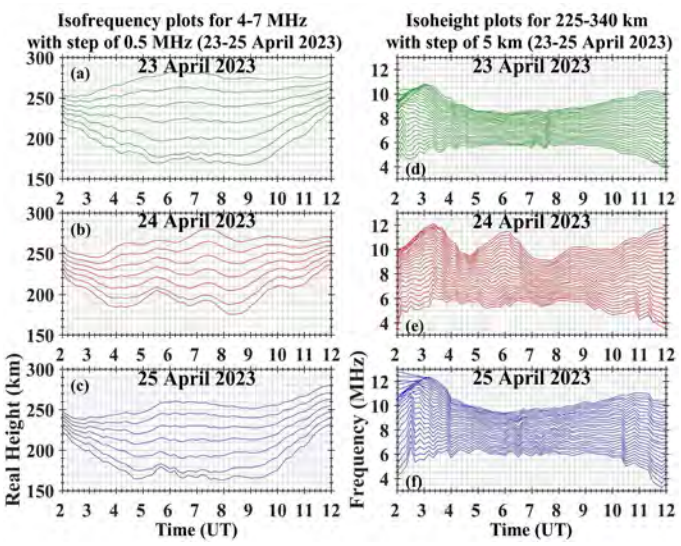

Figure 21 Isoheight and isofrequency analysis showing density oscillations on 24 April 2023 (middle panels) in ionosonde at Tirunelveli during 23-25 April 2023 Geomagnetic storm.

(13.02ºN, 77.57ºE), HYDE (17.42ºS, 78.55ºE), and CHUM (42.99ºN, 74.75ºE) and one ground-based ionosonde located at Tirunelveli (8.67ºN, 77.8ºE). The results show the occurrence of equatorward TIDs during the recovery phase of the geomagnetic storm. Equatorward TIDs are associated with intensified auroral activity resulting from geomagnetic storm conditions. Their propagation characteristics such as velocity, and temporal evolution were analyzed to gain insights into the underlying mechanisms governing their generation and propagation. SAMI2 model simulations showed significant modifications in the electron density from the quiet time behavior but the model couldn't reproduce TID oscillations possibly due to failure to account for disturbance dynamo winds/waves (Figure 22).

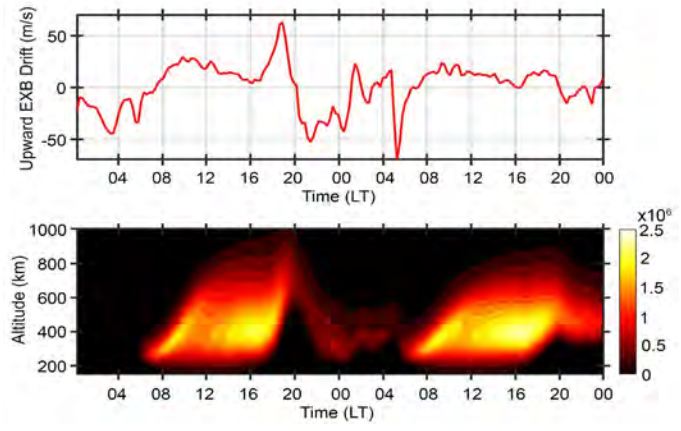

Figure 22 (top) Storm time vertical drifts from ionosonde at Tirunelveli during 23-24 April 2023 which is ingested into SAMI2 model. Contour map of SAMI2 simulated electron density profiles based on ingested ionosonde drifts (bottom)

Signatures of storm-time disturbances on the evolution of ionospheric irregularities over the equatorial and low latitude ionosphere on 23-24 April 2023

The results presented here highlight the role of storm-induced disturbance electric field and disturbance winds on the evolution of equatorial and low latitude ionospheric irregularities. This study has been conducted through a multi-instrument analysis using ground-based GPS and magnetometer data along with space-based observations from SWARM, and GOLD. Notably, abrupt fluctuations in IMF Bz, solar wind density, and speed took place between 18:00-22:00 UT on 23 April 2023. SYM-H reached a minimum of -233 nT on 24 April making it the strongest event during the last few years. The (Figure 23) shows the rate of change of the TEC index (ROTI) which is used as a proxy to detect the presence of ionospheric irregularities. Ionospheric irregularities (from ROTI) were observed on 23 April at most longitudes except South America and on 24 only over the west of South America and Africa. The electron density fluctuations over 12-35°W extended up to the middle latitude (~40°N and ~30°S geographic latitude) that were observed through both SWARM and GOLD satellites. The presence or absence of irregularities could be due to the manifestation of fluctuating eastward/ westward electric fields due to the undersheilding/ oversheilding electric fields and disturbance dynamo electric fields that led to the rise or fall of the F-layer. Such

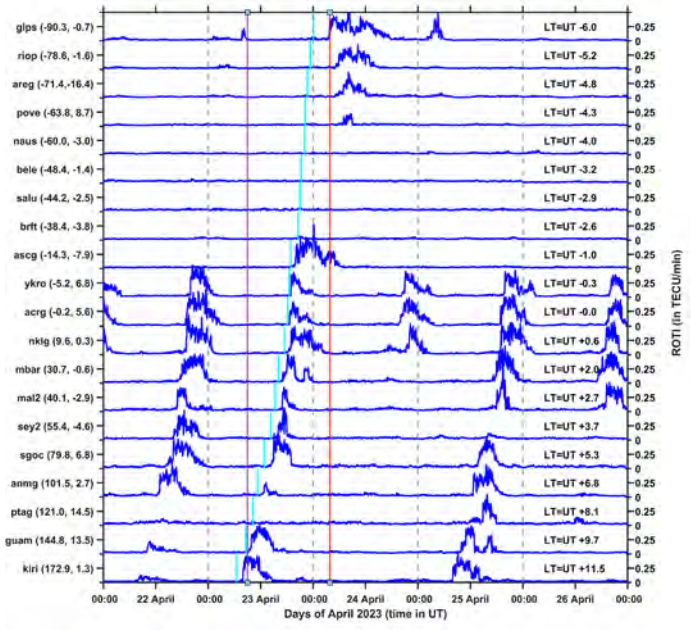

Figure 23 ROTI index in the magnetic equatorial belt, showing presence or absence of irregularities during 22-26 April 2023 plotted in Local time. The purple and red solid line represent the start time of main phase and time of peak SYM-H during the storm respectively.

contrasting observations over different longitudes across the globe provide new insights into the day-to-day variability of their occurrence, which needs further investigation.

Impact of the Solar Wind Dynamic Pressure Changes on Ionospheric Electron Density during 23 March 2023 Geomagnetic Storm

An unforeseen G3-G4 class geomagnetic storm impacted Earth on March 23, 2023, following a Coronal Mass Ejection (CME) that took place on March 20, 2023. The interaction of the sheath region of this unusual CME (lacking a forward shock) with Earth's magnetosphere caused intense magnetic field disruptions globally for several hours. This storm was primarily characterized by a sudden solar wind dynamic pressure drop (SWDPD). The ionospheric electron density variations during the SWDPD were studied, for the first time, using Global Positioning System (GPS)-Total Electron Content (TEC) measurements. The SWDPD caused a significant reduction in TEC over high-latitude regions across all local time sectors (Figure 24). This sudden reduction in solar wind pressure also led to the formation of a westward electric field in high latitudes, causing an overall depletion of TEC across all local time sectors. Towards the lower latitudes, the penetration of the westward field probably weakened, and a moderate storm-induced enhancement in thermospheric O/N_2 was also observed. The competing effects between these led to no change in TEC at mid-low latitudes. This research provides valuable insights into the impact of a surprise geomagnetic storm triggered by an unusual CME event, enhancing our understanding of the ionosphere's behavior under conditions of sudden solar wind pressure changes.

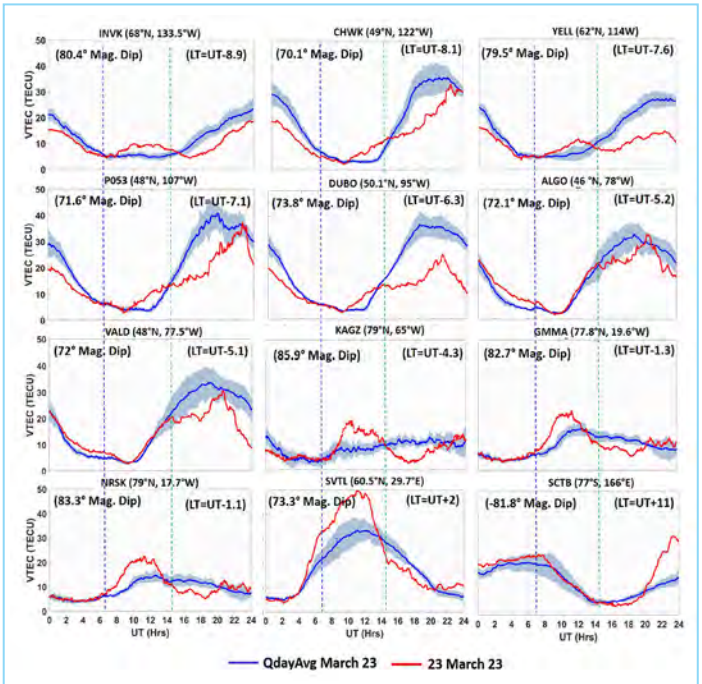

Figure 24 TEC variations during geomagnetic storm of 23 March 2023 over high latitude stations along different longitude sectors. The blue dashed vertical line indicates the onset time of the geomagnetic storm; the Green dashed vertical line indicates the time of sudden change in solar wind dynamic pressure.

EARTH MAGNETOSPHERE, SOLAR WIND INTERACTION WITH PLANETARY MAGNETOSPHERE AND IONOSPHERES–THEORY, OBSERVATIONS AND SIMULATIONS (EPTOS)

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Characterization of high-frequency waves in the Martian magnetosphere

Various high-frequency waves in the vicinity of upper-hybrid and Langmuir frequencies are commonly observed in different space plasma environments. Such waves and fluctuations have been reported in the magnetosphere of the Earth, a planet with an intrinsic strong magnetic field. Mars has no intrinsic magnetic field and, instead, it possesses a weak induced magnetosphere, which is highly dynamic due to direct exposure to the solar wind. The presence of high-frequency plasma waves in the Martian plasma environment by making use of the high-resolution electric field data from the Mars Atmosphere and Volatile Evolution missioN (MAVEN) spacecraft has been investigated. The medium frequency (100 Hz–32 kHz) burst mode-calibrated electric field data from the Langmuir Probe and Waves instrument onboard NASA's MAVEN mission is utilized for this study. A total of 19 wave events with wave activities around electron plasma frequency were identified by examining high-resolution spectrograms of the electric field. These waves were observed around 5 LT when MAVEN crossed the magnetopause boundary and entered the magnetosheath region. These waves are either narrowband-(See Figure 25) or broadband-type (See Figure 26) with distinguishable features in the frequency domain. The narrowband-type waves have a spectral peak above the electron plasma frequency. However, in the case of broadband-type waves,

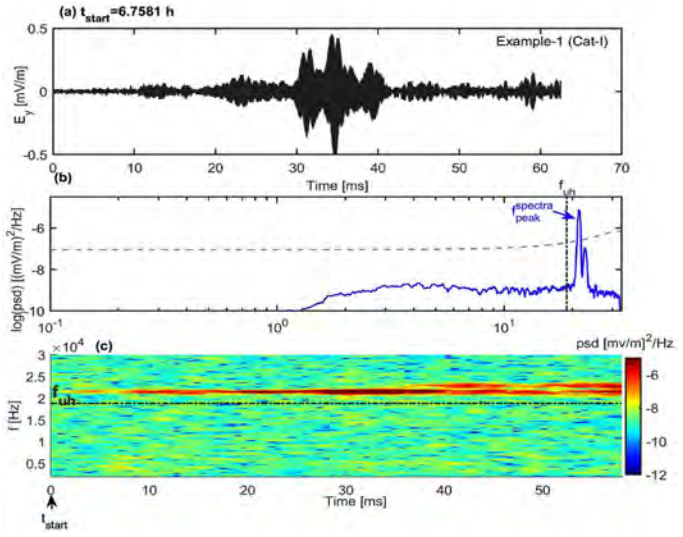

Figure 25 Example of narrowband-type high-frequency wave. The electric field recorded by LPW instrument on MAVEN spacecraft is plotted as a function of time in milliseconds after the start time of this event(in UT), fast Fourier spectra of these electric field variations and its spectrograms (frequency-time representation) are plotted in panels a, b, and c, respectively. The black dashed-dotted vertical line in panel b and horizontal line in panel c indicate the upper-hybrid wave estimated from ambient plasma parameters. The spectral peak is well above the 90% statistical significance marked by dashed grey line in panel b.

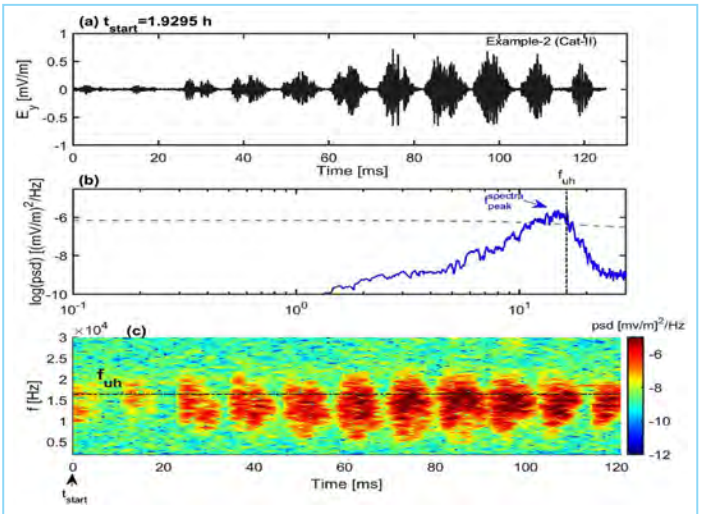

Figure 26 Example of broadband-type high-frequency wave. The electric field recorded by LPW instrument on MAVEN spacecraft is plotted as a function of time in milliseconds after the start of this event (i.e., t_{start}), the fast Fourier spectra of these electric field variations and its spectrograms (frequency-time representation) are plotted in panels a, b, and c, respectively. The black dashed-dotted vertical line in panel b and horizontal line in panel c indicate the upper-hybrid wave frequency estimated from ambient plasma parameters. The spectral peak is above the 90% statistical significance marked by the dashed grey line in panel b.

the spectral peak always occurred below the electron plasma frequency. The broadband waves consistently show a periodic modulation of 8–14 ms. The high-frequency narrowband-type waves observed above the electron plasma frequency are believed to be associated with upper-hybrid or Langmuir waves. This is the first observational evidence of a new type of two distinct features of high-frequency waves in the Martian magnetosphere.

Mars crustal field effects: Nearly eight years (4 Martian years) of magnetic field and electron density data from MAVEN have been analysed to construct global maps of magnetic field and electric density. The results show a clear enhancement in electron density (Ne) over the regions of crustal magnetic fields in the southern hemisphere. The enhancement is prominent above a height of approximately 250 km. Also there is a strong north-south asymmetry with much higher electron densities in the southern hemisphere.

Ionospheric Plasma blob: This study looks into the occurence, variability and possble physical mechanisms related to plasma blobs in the Martian ionosphere. An automated programme is being developed to detect and extract plasma blobs signature from the long MAVEN database.

Electrostatic Solitary Waves in the Venusian Ionosphere

Electrostatic solitary waves (ESWs) in the Venusian ionosphere are investigated using a homogeneous, collisionless, and magnetized multicomponent plasma consisting of Venusian H^+ and O^+ ions, Maxwellian Venusian electrons and streaming solar wind protons, and suprathermal electrons following κ− distribution. The model supports the propagation of positive potential slow O^+ and H^+ ion-acoustic solitons. The evolution and properties of the solitons occurring in two sectors, viz., dawn-dusk and noon-midnight sector of the Venus ionosphere at an altitude of (200–2000) km, are studied. The theoretical model predicts positive potential solitons with amplitude ~(0.067–56) mV, width ~(1.7–53.21) m, and velocity ~(1.48–8.33) km s^{-1}. The bipolar soliton electric field has amplitude ~(0.03–27.67) mV m^{-1} with time duration ~(0.34–22) ms. These bipolar electric field pulses when Fourier transformed to the frequency domain occur as a broadband electrostatic noise, with frequency varying in the range of ~9.78 Hz–8.77 kHz. The results obtained here can explain the observed electrostatic waves in the frequency range of 100 Hz–5.4 kHz in the Venus ionosphere by the Pioneer Venus Orbiter mission. The model can also be relevant in explaining the recent observation of ESWs in the Venus magnetosheath

by the Solar Orbiter during its first gravity assist maneuver of Venus.

Ion acoustic waves in Venusian Ionosphere and lunar wake plasma

Kinetic dispersion of the ion acoustic waves has been explored for an unmagnetized five component plasma system comprising of Venusian protons, Venusian oxygen ions, Venusian electrons, solar wind protons, and kappa electrons. The solar wind protons and electrons are assumed to be streaming along the ambient magnetic field. Analysis revealed that two modes, viz., ion acoustic mode and beam driven mode, are excited for the considered plasma parameters. The ion acoustic mode exists due to the Venusian ions, and its growth rate is influenced by the solar wind beam electrons. The beam driven mode's existence and its growth rate depend on the solar wind beam protons. It is conjectured that the ion acoustic mode and the beam-driven mode could be useful in explaining the electrostatic noise in the Venusian ionosphere, specifically in the range of several hundreds of Hz to 1 kHz and several tens of kHz, respectively.

Kinetic theory of low frequency electrostatic waves is carried out in the lunar wake plasma modelled by kappa electrons, kappa-beam electrons, Maxwell–Boltzmann distributed protons and doubly charged Helium ions. The present work is motivated by observation of electrostatic waves on the outbound side of the first lunar wake flyby of the mission Acceleration, Reconnection, Turbulence and Electrodynamics of the Moon's Interaction with the Sun (ARTEMIS) probe P1. The dispersion characteristics of electrostatic waves which are identified as ion-acoustic waves are carried out for the observational plasma parameters. The frequencies of the ion acoustic waves derived from the model corresponding to peak growth rates are f 6 0:02f pe; (f pe being electron plasma frequency) which matches with the frequency of the waves observed by wave burst 1 (WB1) in the lunar wake. The theoretical analysis reveals that inorder to excite the low-frequency wave modes, low-energy electron beams are required which are not apparent in the observations.

Particle Dynamics in Presence of Ring Current Driven Magnetic Field Variations

The development of the ring current through a westward circulation of energetic ions around the Earth in the low latitude region during geomagnetic storms has been known to us for the past several decades. The symmetric part of the ring current exists in the form of a ring around the Earth

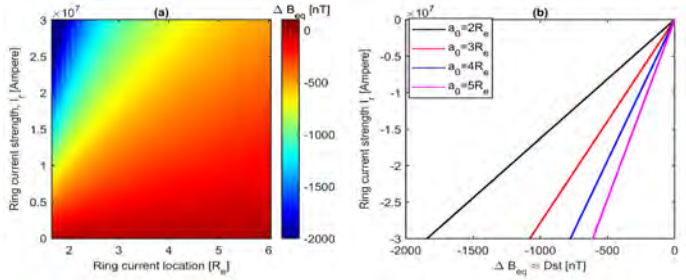

Figure 27 (a) Shows a variation of decrease in the ground magnetic field (ΔBeq) that is resulting from the constant ring current having strength Ir placed at a distance of a0. Theoretically estimated ΔBeq can be considered as a proxy for the Dst. (b) vertical profiles at a0 = 3Re 4Re,5Re and 6Re from the left panel are depicted to get the estimates of ΔB_{eq} for different values of the ring current strength.

at a distance of ≈3-7Re from the center of the Earth. The presence of such external current forms the additional mini magnetic dipole in the vicinity of the Earth's space, which eventually affects the geomagnetic field configuration. The magnetic field produced due to the ring current opposes the geomagnetic field inside and adds to the geomagnetic field outside the location of the ring current. This scenario has been modelled by using a circular loop of uniform current around the Earth to represent the ring current flow around the Earth. It is noted that the decrease in ground magnetic field of 1700 nT or more, which is similar to the geomagnetic field variation observed during the historic Carrington event, is possible with the peak ring current strength of 20–30 MA situated (see Figure 27) at a distance of 2Re or less from the center of the Earth.

Nonlinear electrostatic structures and stopbands in a three-component magnetosheath plasma

Large amplitude parallel propagating electric field structures of nonlinear electron-acoustic waves are examined in unmagnetized magnetosheath plasma. The plasma on magnetosheath side of the ion diffusion layer is modeled by 3-component adiabatic fluid dynamic plasma consisting ofcold magnetospheric (MSP) electrons, magnetosheath electrons, and background ions. Using the Sagdeev pseudo potential technique, for the plasma parameters recorded by the Magnetospheric Multiscale (MMS) mission in the magnetosheath sideof the ion diffusion region, existence regime of the nonlinear electrostatic solitary wave structures is obtained with the possibilities of stopbands (forbidden gap region). Stopbands or the forbidden gap region exists even when the drift velocity ofthe cold electron beam is zero. The forbidden gap region becomes wider and the Mach numbers of the regions supporting solitary structures

become larger by an increase in the drift velocity of the cold electron beam. The results agree with the magnetosheath electrostatic waves having amplitudes of 100s mV/m and frequencies up to 3.2 kHz observed by theMMS.

Mechanism for Large-Amplitude Parallel Electrostatic Waves Observed at the Magnetopause

Large-amplitude electrostatic waves propagating parallel to the background magnetic field have been observed at the Earth's magnetopause by the Magnetospheric Multiscale (MMS) spacecraft. These waves are observed in the region where there is an intermixing of magnetosheath and magnetospheric plasmas. The plasma in the intermixing region is modeled as a five-component plasma consisting of three types of electrons, namely, two counter-streaming hot electron beams and cold electrons, and two types of ions, namely, cold background protons and a hot proton beam. Sagdeev pseudo-potential technique is used to study the parallel propagating nonlinear electrostatic solitary structures. The model predicts four types of modes, namely, slow ion-acoustic mode, fastion-acoustic mode, slow electron-acoustic mode and fast electron-acoustic modes. Except the fast ion-acoustic mode, all other modes support solitons. Whereas slow ion-acoustic solitons have positivepotentials, both slow and fast electron-acoustic solitons have negative potentials. For the case of 4% cold electron density, the slow ion-acoustic solitons have electric field (40–120) mV m^{-1}. The Fast Fourier Transforms (FFT) of slow ion-acoustic solitons produce broadband frequency spectra having peaks between 100 Hz to 1000 Hz. These theoretical predictions are in good agreement with the observations. The slow and fast electron-acoustic solitons could be relevant in explaining thelow-intensity high (>1 kHz) frequency waves which are also observed at the same time.

Kinetic Alfvén Waves Excited by Multiple Free Energy Sources in the Magnetotail

The generation of kinetic Alfvén waves (KAWs) is investigated through a three-component theoretical model incorporating ion beam and velocity shear as the sources of free energy in a non-Maxwellian κ-distributed plasmas.The model considers Maxwellian distributed background ions, drifting-Maxwellian beam ions, and κ-electrons as its constituent species. It is found that the combination of either positive velocity shear with counter-streaming beam ions or parallel streaming beam ions with negative velocity shear favors the excitation of KAWs. For the plasma parameters pertinent to the magnetotail region of Earth's magnetosphere, the model is able to produce KAWs in the frequency range of ≈(5–67) mHz, whichmatches well with the recent 'Time History of Events and Macroscale Interactions during Substorms (THEMIS)' observations in the near-Earth magnetotail region.

Role of Lightning Activity in Deciphering Atmospheric Gravity Waves (AGWs) induced D-region Ionospheric perturbations during Extremely Severe Cyclonic Storm (ESCS) Fani

A tropical cyclone (TC) is illustrious by its low-pressure core escorted by strong winds which are spiraling inward towards the center. The additional distinctive feature of a cyclone is a precipitation-free eye encircled by an eyewall and deep convection cores in the spiral inner and outer rain bands outside the eyewall. Concerning their lower atmospheric effects, TCs can cause strong turbulence, wind shear, storm surges, gusts and gales, thunderstorms, lightning discharges, heavy rainfall, and other severe weather conditions. Not limited to this, TCs have a profound influence in the mesosphere-

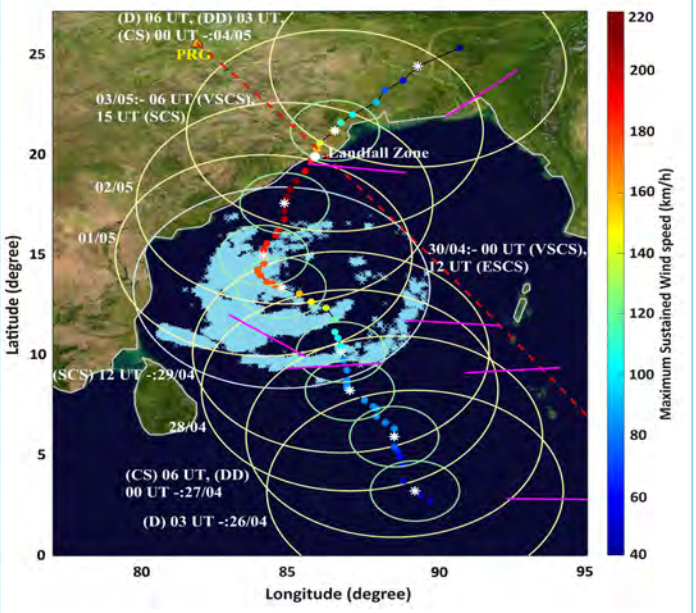

Figure 28 The track of ESCS Fani starting from its genesis (~2.70 N, 89.70E) on 26 April to its dissipation on 04 May 2019. The track is color-coded with the maximum 3-minutes sustained wind speed in km/hr. The yellow color circles (5-degree radius) with center along the track is the region from which lightning data is used. As an example, the lightning activity on 30 April is depicted in one circle. The small green circles (1.5-degree radius) along the track are the region from which pressure and MSWS of the cyclone are used. Magenta lines are the depiction of SABER paths over the region during the cyclone. The red line is the great circle path (GCP) of NWC (19.8 kHz) VLF signal crossing the cyclone track to the recording station Prayagraj.

lower thermosphere-ionosphere (MLTI) region as well. Convection associated with TCs or mesoscale convective systems (MCS) generates a spectrum of GWs that couple the troposphere with the MLTI region and affect its mean state. To understand the processes involved in atmosphere-ionosphere coupling and the specific role of lightning activity from the mesoscale convective system (MCS) during a cyclone, a tropical cyclone with a long life span of approximately 10 days from the Bay of Bengal was specifically selected. Fani had life span starting from 25 April to 04 May 2019 (Figure 28). The Extremely Severe Cyclonic Storm (ESCS) Fani is unique because the cyclone of the ESCS category occurred over the Bay of Bengal about 30 years back. It was observed that high Tropical Cyclone Heat Potential (TCHP) and Sea Surface Temperature (SST) values above ~30°C (consistently above the threshold for cyclogenesis) starting from 23 April helped in the genesis and intensification of Fani. Just before the landfall on 03 May the highest recorded wind speed was ~210 km/hr, whereas the lowest sea-level pressure was 932 hPa on 02 May. During the intensification stage, the Cloud Top Temperature (CTT) reached low values of ~-80°C, and the maximum Cloud Top Altitude (CTA) attained was ~17 km (Figure 29). These conditions point to the presence of extreme convection in the towering cumulonimbus rain bands.

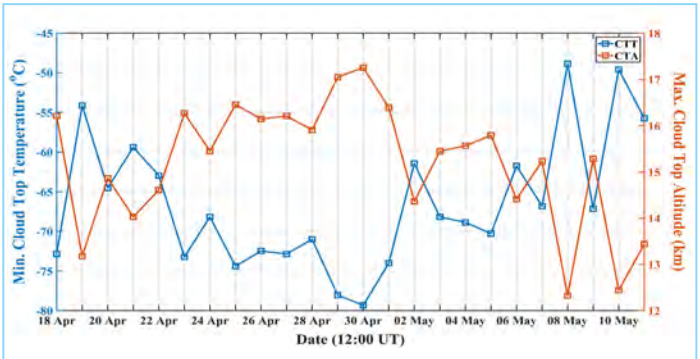

Figure 29 Shows estimated Cloud top temperature (blue) and corresponding Cloud top altitude (red) from 18 April - 11 May 2019 at 12:00 UT. The pre- (green), post- (blue) and cyclone (red) days are marked.

Strong convection in the rain bands of Fani led to increased lightning activity in lower levels of the atmosphere. The average flash rate during the intensification stages from 27 April to 01 May was ~240 min^{-1}. The maximum flash rate of ~375 min^{-1} was observed on 30 April (Figure 30). Heavy lightning activity is considered as a very good generator of AGWs. During pre- and post-cyclone days flash rate was found to be ~23 min^{-1} and ~14 min^{-1}, respectively. The

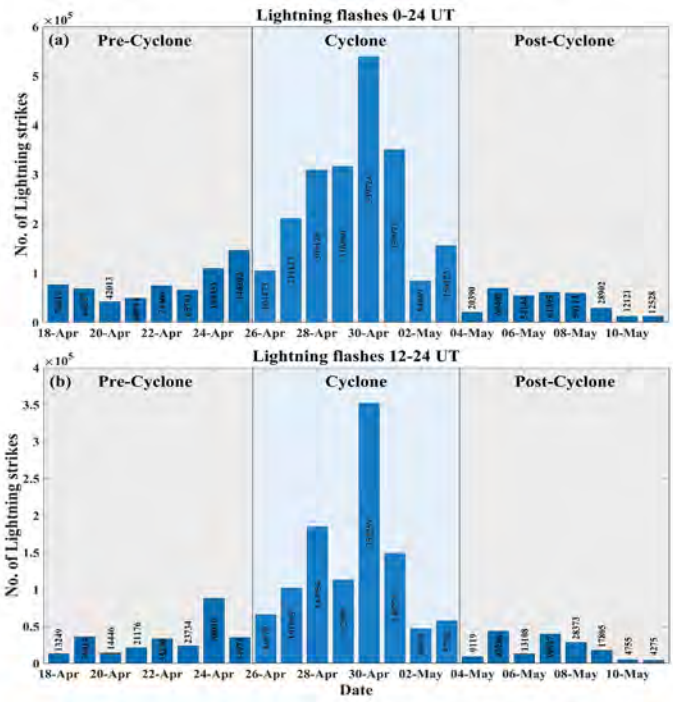

Figure 30 (a) Total number of lightning discharges in a daily 24-hour interval for days starting from 18 April to 11 May 2019. (b) Total number of lightning discharges during intervals of 12-24 UT (local night time) for days starting from 18 April to 11 May 2019. The pre- (green), post- (blue) and cyclone (red) days are marked.

role of lightning activity in three regions of a cyclone i.e. eye wall (0-60 km), inner (60-180 km), and outer (180-500 km) rain bands was also scrutinized. The lightning activity in the outer rain band of Fani was found to be more intense in comparison to the eyewall and inner rain band. Lightning activity in the rain bands strongly correlates with meteorological parameters like intensity, pressure and wind speed of Fani ESCS.

The extreme MCS activity during Fani generated atmospheric gravity waves (AGWs) energetic enough to travel upwards through the mesosphere and disturb the Ionosphere from below. It is pertinent from the observations that lightning activity in the inner and outer rain bands seems to be a major source of observed AGWs during Fani ESCS. The propagation of AGWs from the lower atmosphere to the ionosphere, through the middle atmosphere is confirmed from SABER temperature profile observations. Figure 31(a) shows temperature variation during the cyclone days of 27, 28, 29, 30 April, and 02, 03 May. Clear temperature oscillations are seen in comparison to the average (black dash line) of pre- (18-25 April) and post-cyclone days (04-11 May). The temperature oscillations are maximum on 30 April, below 90 km altitude during the ESCS phase of

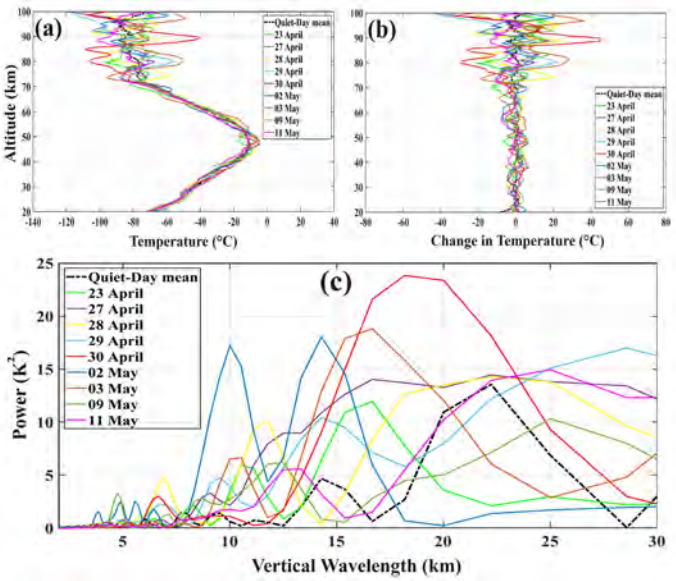

Figure 31 (a) SABER temperature profiles for pre-, post- and cyclone days (color coded), and mean of quiet days in black dashed line (mean of pre- and post-cyclone days). (b) Temperature (ΔT) perturbation for pre-, post- and cyclone days (color coded), and mean of quiet days in black dashed line. (c) Vertical wavelength (km) versus power (K^2) plot for pre-, post- and cyclone, and mean of quiet days.

Fani. The increasing fluctuations of temperature during the cyclone days in the upper atmosphere indicate the presence of strong AGWs during ESCS Fani. Figure 31(b) represents the change in temperature (ΔT) versus altitude profile on the same days. The ΔT is the value of change in temperature of the day with respect to the mean temperature during quiet day. The maximum temperature difference observed is approximately 50 K near an altitude of 89 km compared to a quiet day. To analyze the ESCS Fani-induced wave features, the vertical wavelength (km) versus power (K^2) was derived, as illustrated in Figure 31(c). High power wave oscillations are observed during cyclone days in comparison to quiet day. The maximum power was again observed on the ESCS day of 30 April, which is double the power of quiet day. This urges and confirms the existence of strong AGW's launched by the deep convection process during ESCS Fani cyclone period.

Finally, to decipher the AGWs-induced coupling of the lower atmosphere with the ionosphere, the NWC (19.8 kHz) VLF signal recorded at Prayagraj (PRG), India, was used. The great circle path (GCP) of the NWC-PRG signal was found to be ideally positioned because GCP was intersecting the track of ESCS Fani. Hence was used NWC VLF signal to probe the D-layer of the ionosphere to study the wave

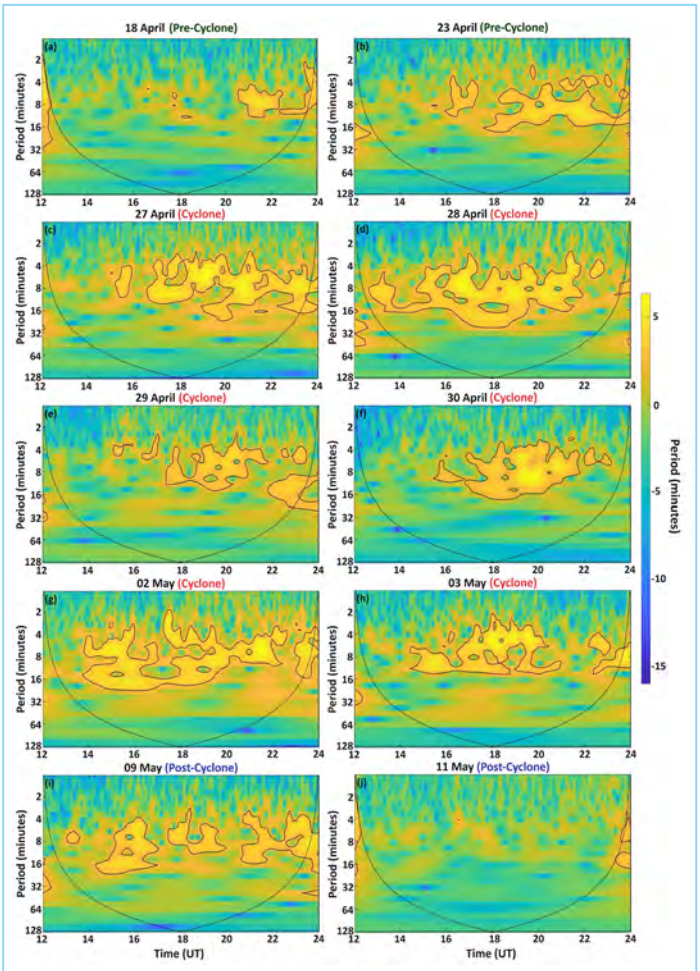

Figure 32 Wavelet spectra based on the Morlet wavelet analysis of NWC signal during intervals 12- 24 UT during selected days of pre-, post-, and cyclone days. In each panel, the pre-cyclone (green), post- (blue), and cyclone (red) days are labeled in brackets

characteristics of the disturbances induced by AGWs from ESCS Fani (Figure 32). The wavelet analysis of the VLF signal disturbance clearly showed increased AGW activity in the D- layer ionosphere during cyclone days, compared to the pre- and post-cyclone days. The peak time period of the gravity waves varied between ~13-20 minutes in the cyclone interval (Figure 33). The period of AGWs observed by analysis of VLF data strongly correlates with the combined lightning activity in both the inner and outer rain bands of cyclone Fani. The results from the study of Fani ESCS indicate that the mesoscale convection system and associated lightning activity play a major role in the generation of AGWs. Hence it is very important to decipher the role of lightning activity in the perturbation of the ionosphere from below.

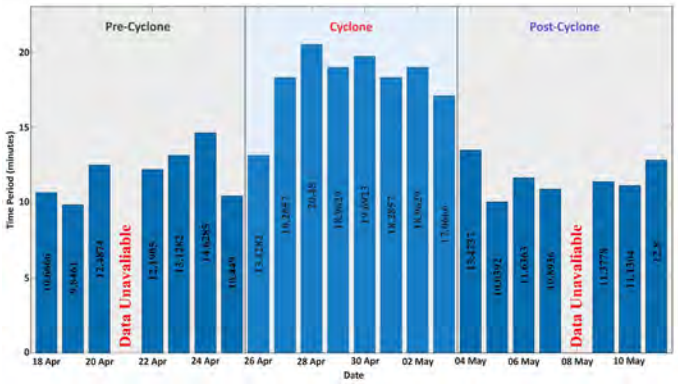

Figure 33 Variation in the peak time period of atmospheric gravity waves from 18 April - 11 May, 2019. The pre- (green), post- (blue), and cyclone (red) days are shown in the shaded section

COUPLED LITHOSPHERE - ATMOSPHERE - IONOSPHERE - MAGNETOSPHERE SYSTEM (CLAIMs)

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Members : S. Gurubaran, S. Sripathi, K. Vijay Kumar, Gopi K. Seemala, B.V. Lakshmi, K. Deenadayalan, Shantanu Pandey, Rabin Das, Susheel Kumar, Ganpat Surve, M. Ponraj, Nava Hazrika, S. Amirtharaj,Sujit K. Pradhan,M.B. Nongkhlaw, Abhilash, K.S., Subrata Moulik, P.K. Das and Nilesh Chauhan

Paleoseismological and magnetic studies, NE India

Paleoseismic investigations were carried out in the meizoseismal area of 1950 Assam and 1869 Hojai earthquakes, to explore the possibility of identifying and dating past seismic events through documentation of liquefaction features and radiocarbon (14C) dating. Trenching along the Disang and Pokriyar rivers resulted in the identification of liquefaction features as evidences of large to great earthquakes. The age constraints in terms of respective lower and upper bound age brackets for individual features suggest four-time intervals of their formations i.e. (i) between 105±.35 and 60±30 yr BP and (ii) between 116±.35 and 90±30 yr BP, (iii) between 135±30 and 140±30 yr BP and (iv) between 1860±30 and 4330±30 yr BP (Figure 34).

Remanent magnetic measurements performed for horizontally layered beds and liquefaction dykes from the 3 sites namely NB, BG and MP. ChRM in the samples was

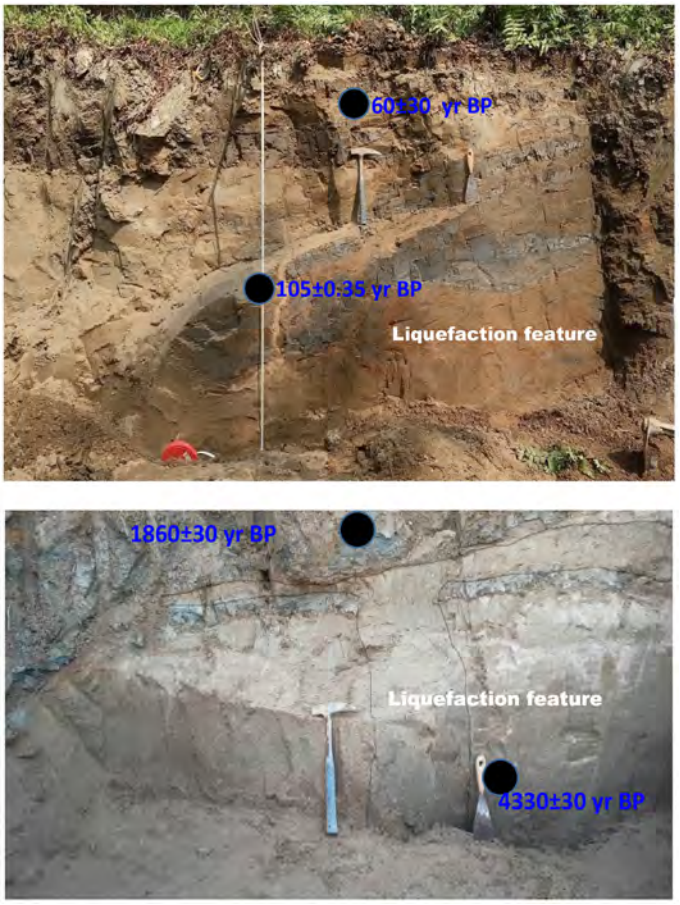

Figure 34 Photographs showing deformational features in the form of Liquefaction sand dykes in the meizoseismal area of 1869 earthquake. The age constraints in terms of respective lower and upper bound age brackets for individual features suggest time intervals of their formations i.e. (i) between 105±.35 and 60±30 yr BP and (ii) between 1860±30 and 4330±30 yr BP.

established by subjecting them to AF demagnetisation. The sample remanent magnetic directions from each site were averaged out to get site mean remanent magnetic directions (Dm and Im) for all the sites using Fisher's statistical methods. Stereo-plots of the ChRM from the horizontally bedded layers represent the geomagnetic field direction at the time of deposition and from the liquefaction dykes, stereo-plots must predominantly represent the geomagnetic field direction at the time of the earthquake event. The ChRM for NBLD dyke is Dm 57.6, Im 49.7˚ and that of NBRD Dm, Im are 336.8˚ and 34.5˚respectively for the NB site (Figure 35). In the BG site, the ChRM of the host sediment shows 188.8˚ (Dm) and 39.9˚ (Im) respectively. The Dm and Im for the liquefied dyke from the BG site are 336.8˚ and 34.5˚. Likewise in MP site host sediment has mean magnetic directions of 170.0˚ (Dm) and 50.8˚ (Im) and liquefied dyke has Dm and Im 346.8˚ and 32.9˚ respectively.

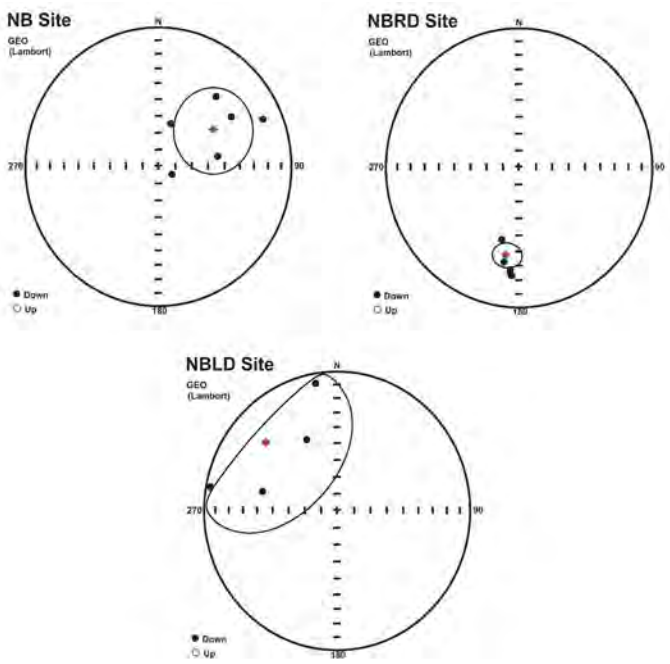

Figure 35 Lower-hemisphere, equal area projection of mean characteristic directions of the host sediments and earthquake induced liquefaction sites. Solid (open) circles are projections on the lower (upper) hemisphere.

Seismic Anisotropy: Shear wave splitting

Investigated seismic anisotropy in NE India utilizing data from 8 BBS stations deployed and operated by IIG, strategically located in various tectonic settings of NE India along with previously published seismic datasets. Shear-wave splitting (SWS) analysis indicates crustal and upper mantle deformation. Spatial coherency analysis suggests that the anisotropy originates in the asthenosphere-lithosphere transition or asthenosphere mantle at depths of 160-320 km. Back azimuthal analysis indicates two-layer anisotropy along the Eastern Himalaya, Shillong plateau and South of the Dawki fault contiguous to the Indo-Burma arc.

Anisotropy of the Near-Field Coseismic Ionospheric Perturbation Amplitudes Reflecting the Source Process: The 2023 February Turkey Earthquakes

Fault dislocations in earthquakes cause vertical movement of the surface and excite acoustic waves (AWs) in the overlying atmosphere which propagate upward with increasing amplitudes. Such waves reach the ionosphere and disturb electron density distribution there, causing disturbances in numbers of electrons along the line-of-sights connecting ground GNSS receivers and satellites. So far, such near-field co-seismic ionospheric perturbations are modeled by assuming single acoustic pulse from the surface, although large earthquakes often involve ruptures of multiple fault segments spanning hundreds of kilometers. Here it is demonstrated that interference of AWs from these multiple sources makes differences in the perturbations amplitudes and periods at GNSS stations in different azimuths from the epicenter.

The East Anatolian Fault in southern Turkey ruptured on 6 February 2023, causing an earthquake of Mw 7.8 (EQ1), one of the largest strike-slip events recorded on land. Around 9 hr later, an earthquake of Mw 7.7 (EQ2) occurred to the north of EQ1 (Figure 36). Near-field coseismic ionospheric perturbations (CIP) caused by acoustic waves (AWs) excited by coseismic vertical crustal movements along the fault were investigated. It was found that the

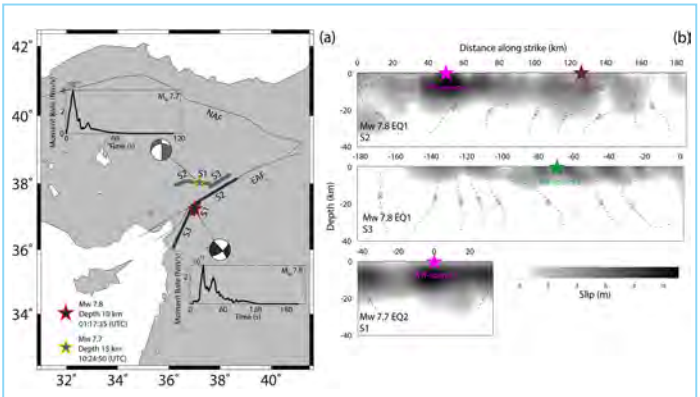

Figure 36 (a) Map showing the East Anatolian Fault, North Anatolian Fault and locations of EQ1 and EQ2 epicenters and their focal mechanisms. Both events ruptured three segments, shown as S1, S2, and S3 (segment 1, 2, and 3). Moment rate functions for both events (US Geological Survey, 2023) are also shown. (b) Finite fault models from US Geological Survey (2023). The contours in each plot show the rupture propagation in second. Significant slip occurred on S2 and S3 in EQ1 and on S1 in EQ2. Colored stars in panels are the acoustic wave sources which were assumed to generate synthetic ionospheric perturbations in the study.

observed CIP periods were somewhat longer for EQ1 than for EQ2. Additionally, EQ1 exhibited an azimuthal dependence in CIP amplitudes that cannot be explained by known factors such as geomagnetism and line-of-sight geometry. Numerical experiments revealed that CIP by EQ1 can be well reproduced by assuming a suite of sources along the fault that successively ruptured. Small but significant dependence of amplitudes and periods on azimuths were caused by interference of AWs from multiple sources (Figure 37).

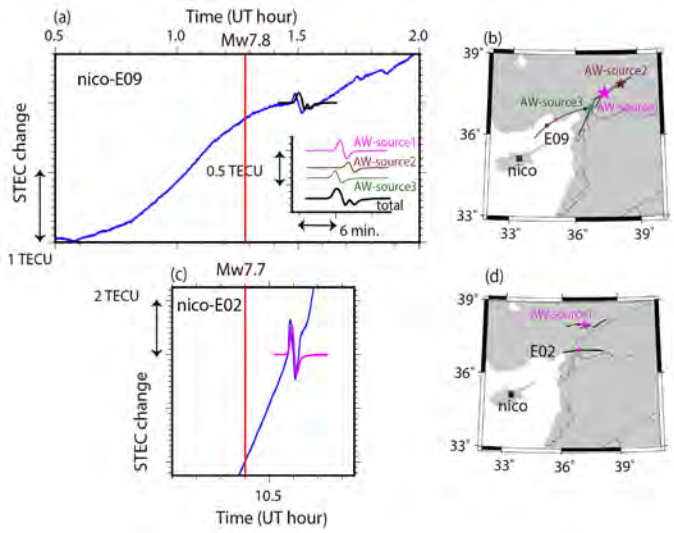

Figure 37 Synthetic coseismic ionospheric perturbations (CIP) for the nico-E09 and nico-E02 pairs for the (a) EQ1 and the (c) EQ2 compared with observed Slant TEC time series. For EQ1, we approximated the entire rupture by three discrete sources of acoustic waves (AWs), AW-source1, AW-source2, and AW-source3, whose positions are shown in panel (b). They were assumed to have ruptured 20 s (AW-source1) and 40 s (AW-source2 and AW-source3) after the rupture onset. For more information, please refer finite fault models shown in Figure 3b. The AW-source2 and 3 are assumed to have an amplitude 2/3 of AW-source1. The sum of the synthesized disturbances explains the longer period of the total CIP than the individual sub-CIPs. Ionospheric pierce point track of E09 is for time window of 0.5–2.0 UT, same as (a). Black disks along the track show hourly time marks, that is, 1.0 UT and 2.0 UT. For EQ2, considering just a single peak in its moment release (Figure 3a), we assumed just one source (d) that ruptured 10 s after the rupture onset. For more details please refer Bagiya et al., (2023).

On the role of volcanic plume heights in excitation of free oscillations of the solid Earth and atmosphere: Case study

Volcanic eruptions are potential sources for generating the Earth's free oscillations at spheroidal modes of 0S29 and 0S37 through acoustic resonant coupling between the Earth and its atmosphere. Then, does every volcano produce Earth's free oscillations? This question is answered by analyzing eight large volcanic eruption events, (i) 15 January 2022 Hunga Tonga-Hunga Ha apai (HTHH), (ii) 13–14 January 2022, HTHH, (iii) 13 August 2021 Fukutoku-Okanoba, (iv) 22 April 2015 Calbuco, (v) 13 February 2014 Kelud, (vi) 4 November 2010 Merapi, (vii) 15 June 1991 Mt Pinatubo, and (viii) 4 April 1982 El Chichon. The main conclusions are summarized as follows:

Penetration of volcanic energy to higher atmospheric heights during large volcanic eruptions resulted in efficient acoustic resonant coupling between the Earth and its atmosphere by producing strong atmospheric modes which excited the strong spheroidal modes of 0S29 during 15 January HTHH, 0S29 and 0S37 during Pinatubo and 0S45 during El chichon eruptions. Lower plume heights excited only weak atmospheric modes resulting in the failure of excitation of spheroidal modes (Figure 38). Quantitative analysis of source efficiency to produce ground motions for different source heights further strengthens our hypothesis.

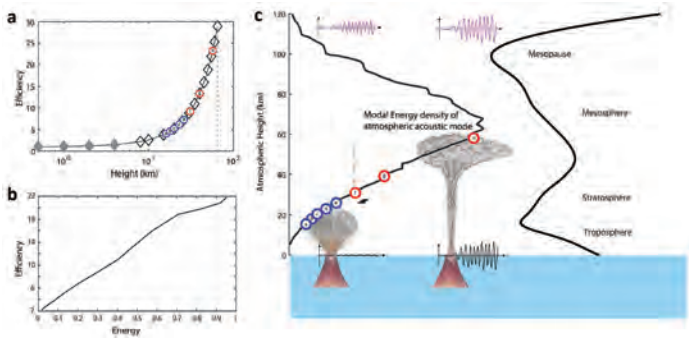

Figure 38 Quantitative analysis of source efficiency to produce harmonic surface oscillations for different source heights. (a) source heights versus efficiency. (b) model energy density of atmospheric acoustic modes versus efficiency (c) schematic illustrating the generation of Earth's free oscillations during volcanic eruptions and their association with volcanic plume height. For more details please refer Tiwari et al (2024).

SOLID EARTH RESEARCH

GEOLOGICAL AND GEOPHYSICAL STUDIES OVER DECCAN TRAPS (GGDT)

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Palaeomagnetic and petrological studies over Malwa Plateau

The Deccan Volcanic Province (DVP) stands as one of the globe's largest continental flood basalt provinces (CFBPs), sprawling across approximately 500,000 km^2 and forming rapidly around 66–65 million years ago. Nestled along the northernmost edge of this volcanic expanse lies the Malwa Plateau, encompassing an area of about 80,000 km^2. Within the Malwa Plateau, the basalts are categorized into five distinct geochemical formations: Narmada, Manpur, Mhow, Satpura, and Singachori Formations, each delineated stratigraphically from lowest to highest. The stratigraphy of the Malwa Plateau spans two magnetic reversals, transitioning from normal-to-reverse and reverse-to-normal polarity. To delve into this geological complexity, two extensive fieldwork campaigns were conducted, resulting in the collection of 19 cylindrical cores and 119 oriented block samples from 24 sites. Subsequent laboratory analyses unveiled noteworthy findings: the mean values for natural remanent magnetization (NRM) and magnetic susceptibility were observed at 19.969 A/m and 2.96 x 10^{-2} SI unit respectively, signifying the presence of robust magnetic components suitable for palaeomagnetic study. Moreover, employing advanced techniques such as alternating field (AF) and thermal demagnetizations, along with stereographic projections, Zijderveld diagrams, and intensity decay curves, facilitated the isolation of primary characteristic remanent magnetization (ChRM) directions. Initial investigations on 34 oriented block samples from 8 sites unveiled two distinct groups of ChRM directions, laying the groundwork for ongoing research endeavors on the remaining samples. AMS analysis was conducted on 174 Malwa plateau flow samples, revealing distinct magnetic grain distributions. The Flinn diagram and Jelinek plot showcased two patterns: equal prolate and oblate grains, and prolate dominance. The latter suggests well-foliated magnetic minerals, likely formed from horizontal surface deposition.

For petrological studies, the majority of the 85 oriented block samples were sourced from quarries, road cuttings, and river sections. Lava samples were predominantly gathered from outcrops in the southern region, chosen for their minimal faulting and maximum elevation range, providing optimal exposure to lava formations. On the basis of field observations it has been evidenced multiple pulses (two to three) of lava flows representing different eruptions episodes. All of the samples are plagioclase-phyric, with plagioclase phenocrysts ranging from grain size ~0.5 to 10 mm in dimension, commonly occurring in glomerocrysts. Clinopyroxene is also present as a phenocryst phase, as is olivine, which is ubiquitously replaced by secondary alteration products.

Investigating Environmental Magnetism in the Eastern region of Prayagraj city, Uttar Pradesh, India: Revealing Magnetic Susceptibilities and Analysis through Scanning Electron Microscopy

Growing concerns over particulate matter (PM) and declining air quality, linked to chronic health issues, have spurred heightened awareness. Combining environmental magnetism with Scanning Electron Microscope (SEM) analysis is crucial for assessing and addressing pollution. This Prayagraj, Uttar Pradesh study utilizes Magnetic Susceptibility (MS) and SEM for rapid, cost-effective evaluation of anthropogenic impacts on environmental components. Analyzing 111 samples from dust, soils, and leaf dust using a biomonitoring approach, results reveal significant correlations, categorizing road sections into low, moderate, and high pollution zones. Vehicular traffic, notably along highways and intersections, emerges as the primary pollution source. The study underscores MS and SEM's effectiveness in comprehending and mitigating anthropogenic pollution, highlighting the necessity for strategic environmental protection measures in Prayagraj's eastern region.

Neoarchean magmatism: Evidence from east coast dykes of northeastern Southern Granulite Terrain, India

New findings reveal the ages of two east coast dykes (ECD) in India's Southern Granulite Terrain (SGT) through Sm–Nd whole rock-mineral isochron dating. The ages determined are 2514 ± 13 Ma (MSWD = 0.79) and 2651 ± 95 Ma (MSWD = 7.4). These ages, derived from representative mafic dyke samples, align with the intrusion time of the ECD into the eastern region of SGT. This suggests the presence of an older Archean crust in SGT, particularly near the Pondicherry

coast. Additionally, this study sheds light on Neoarchean (2.8–2.5 Ga) palaeogeographic reconstructions involving Pilbara, Kaapvaal, Singhbhum cratons, as well as northern SGT (encompassing the southern Dharwar Craton). These findings open avenues for further research, particularly focusing on dykes within SGT, offering valuable insights into the geological history of the region.

Environmental magnetic properties of Holocene sediments from Parad section, Purna basin, Deccan Volcanic Province (DVP)

The broad objective of the study is reconstruction of palaeoclimatic/palaeoenvironmental conditions based on Environmental magnetic methods and other proxy methods. Two field survey were carried out in Purna basin, to select the sites and collect samples for magnetic, geochemical, radiocarbon and Luminescence dating studies to reconstruct palaeo-environmental conditions. The collected sediments from the sections were analysed and the chronology of the sediment section was constrained by four AMS ^{14}C dates. A 7.65 m sediment section was collected from Parad, Purna basin and environmental magnetic analysis was carried out for all the samples (112) and the chronology of the sediment section was constrained by four AMS ^{14}C dates. The magnetic experiments performed were used to decipher the mineral magnetic proxies for palaeoenvironmental reconstruction. The trends exhibited by the concentration-dependent parameters – χlf, χARM and SIRM – are almost similar. All of them are strongly correlated with χlf. The sedimentary χlf record shows episodes of high and low detrital influx which, in turn, may be related to relatively high and low precipitation respectively. Most of the concentration-dependent magnetic parameters exhibit similar trends with χlf. Based on the down-core variations of mineral magnetic parameter values, three phases of climate shift may be distinguished during the past 5300 kyr BP. Phase 1 (~5330–1600 years B.P.): This period is characterized by low detrital influx which is evident from the low values for concentration dependent magnetic parameters (χlf, χARM and SIRM). The low rainfall caused by intensified monsoon would have carried less magnetic mineral grains. Hence, weak monsoonal conditions must have prevailed during this period. Phase 2 (~1600–1300 years B.P.): This period was characterized by high detrital influx and catchment erosion as evident from the high values for concentration-dependent magnetic parameters. This indicates high rainfall during the period. Towards the end of this period, rainfall exhibits a decreasing trend. Phase 3 (~1300 years B.P. to the Present): Detrital influx exhibits wide variations during this period. Overall, it shows decreasing trend. Precipitation was overall low when compared to Phase 2. However, it was interspersed with a few high-precipitation intervals.

Pollen analysis has been performed for Parad sediment section, Purna basin. The presence of arboreal taxa namely Syzyzium, Bombax, Sapotaceae, and Butea in the pollen assemblages are suggestive of the good monsoonal activities in and around the study regions during 3400 to 1600 yrs. BP. The pollen data display the open dry deciduous forest during 1600 to 470 yrs. BP, the arboreal pollen taxa are relatively lower in abundance than the preceding phase. The comparatively low abundance of arboreal pollen taxa namely, Bombax, Syzygium, and Moraceae and increased values of non-arboreal taxa such as non-cereal, Convolvulaceae, Justicia, Euphorbiaceae, and Asteroideae in the pollen assemblages is suggestive of the deteriorated forest under the relatively less warm and humid climatic condition in the region. In the third phase around 470 yrs. BP to present, the arboreal taxa are almost negligible which indicates the high deterioration of forest vegetation in and around the study region under climatic amelioration.

Mineral Magnetic properties of sediments from Vadnagar archaeological site

Vadnagar is an archaeologically important town of Mehsana district of North Gujarat (India) and is known for its rich cultural heritage. Aarchaeological excavations at Vadnagar revealed continuous sequence of seven successive cultures from the Early historic (6th century BCE to 4th century BCE) period till present. The seven different cultural Periods are: VII (18th-19th century CE), VI (14th century-18th century CE), V (11th century-13th century CE), IV (5th century -10th century CE), III (1st-3rd century CE), II (2nd century BCE-1 st century

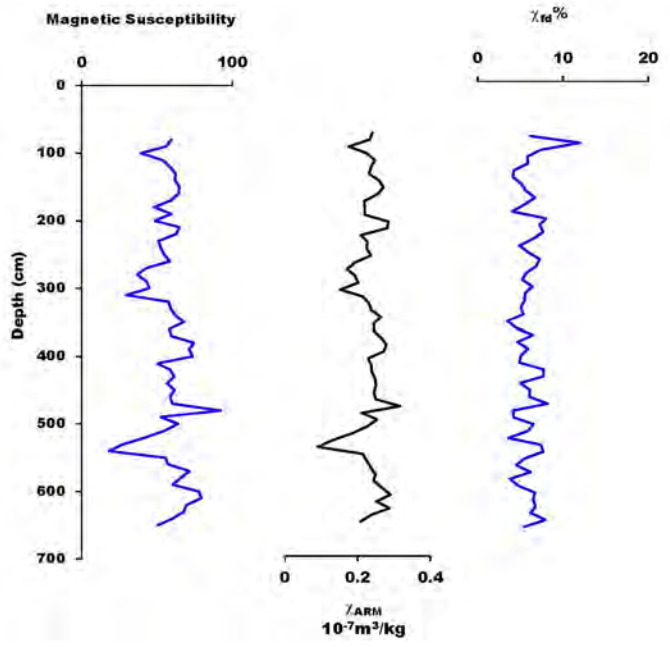

Figure 39 Environmental magnetic properties (magnetic concentration, grain size and composition) of Vadnagar section sediments

CE), I (> 2nd century BCE) and a total of 152 sediment samples were collected (3 from period VII, 21 from period VI, 34 from period V, 51 from period IV, 43 from period III).

Environmental magnetic parameters of sediments from Periods VII, VI and VI analysed for magnetic concentration, grain-size and mineralogy. Magnetic susceptibility (χlf) indicates the total concentration of magnetic minerals present in a natural sample. The χlf values during the three (VII, VI and V) periods vary between 18.05× 10^{-8} m^3 kg^{-1} and 92.30 × 10^{-8} m^3 kg^{-1} (Figure 39). Percent frequency-dependent susceptibility (χfd%) indicates the proportion of superparamagnetic (SP) grains. The formation of SP grains is mainly due to pedogenesis or fire activity. The χfd % values for the sediments vary from 3.58% to 12%. Such high values suggest that the samples have a high content of SP and fine grained magnetic minerals. The susceptibility of anhysteretic remanent magnetization (χ_{ARM}) is biased towards magnetic minerals of stable single domain (SSD) grain size. Values of χARM vary between 0.15 × 10^{-5} m^3 kg^{-1} and 0.29 × 10^{-5} m^3 kg^{-1} (Figure 39). Isothermal remanent magnetization and thermomagnetic (χ-T) curves (Figure 40 & 41) for selected samples indicates magnetite and hematite (small contribution) are the main contributing magnetic minerals.

Pre-historic geomagnetic field variations using archaeological artifacts

Instrumental geomagnetic records have been available since the establishment of magnetic observatories in the early 19th century, prior to which geomagnetic field variations could be indirectly deciphered from archaeological artifacts. Archaeomagnetic investigation helps to investigate the past times history of the signatures of the Earth's magnetic field from archaeological artifacts, it is also used to develop the

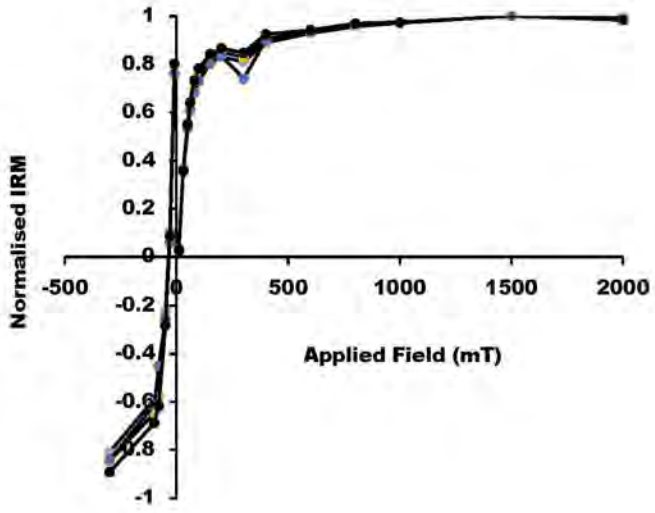

Figure 40 Magnetic mineralogy of Vadnagar section sediments (a) Isothermal remanent magnetisation curves (IRM)

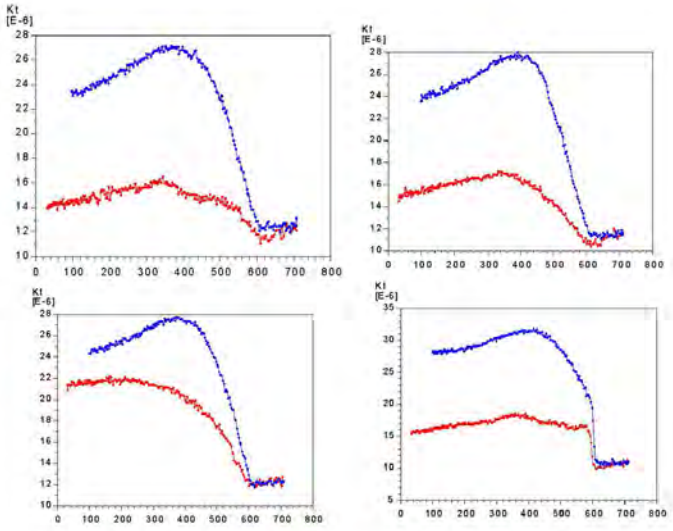

Figure 41 Temperature dependent magnetic susceptibility variation curves (χ-T curves)

secular variation in the region. It is important to generate and increase the pool of India-specific archaeomagnetic data, to help build and improve upon the Indian palaeosecular variation curve from detailed archaeomagnetic study. Archaeointensity determinations have been performed on eighty artefacts from Vadnagar, Gujarat. Archaeointensity results obtained using Coe's modified Thellier method are plotted on Arai diagrams (Figure 42), in which the thermal demagnetization of the cumulative NRM loss is plotted against TRM gained with respect to temperature. The Arai and Zijderveld plots show acceptable constancy of the remanence magnetization, whereas the Zijderveld plot helps to isolate secondary component influence in the samples. The orthogonal vector plots were also used to examine the thermal demagnetization behaviour of the samples. However, few samples showed some secondary component of magnetization in the orthogonal vector plots, and such altered samples were rejected in the archaeointensity calculation. The samples that did not show

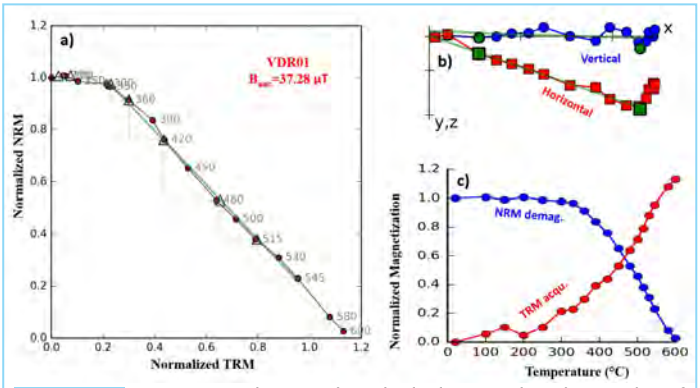

Figure 42 Representative archaeological sample (VRD01) of successful Thellier and Thellier experiment with a) Arai plot; b) Zijderveld diagram; and c) Magnetization plot

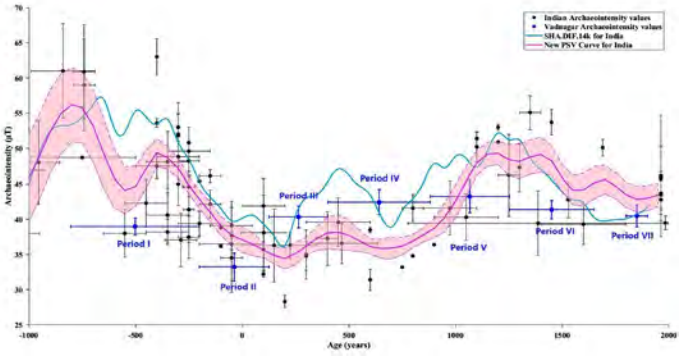

Figure 43 Archaeointensity data for India region with new archaeointensity from Vadnagar.

any deviation from the linear trend were accepted for further analysis.

The specific Thellier and Thellier method was used to obtain archaeointensity from Vadnagar archaeological artefacts samples, also cooling rate and anisotropy of the thermoremanent magnetization corrections were applied and the corrected intensities were used to calculate a mean archaeointensity value for the Vadnagar archaeological artefacts. The results are listed with different time period intervals, period I (502±302 BCE) is B_{anc}= 38.98 ±1.2 μT; period II (36±163 BCE) is B_{anc}= 33.22 ±1.9 μT; period III (264±137 CE) is B_{anc}= 40.34 ±1.5 μT; period IV (642±240 CE) is B_{anc}= 42.42 ±1.8 μT; period V (1067±185 CE) is B_{anc}= 43.24 ±2.3 μT; period VI (1451±198 CE) is B_{anc}= 41.38 ±1.3 μT and last period VII (1850±50 CE) is B_{anc}= 40.5 ±1.5 μT. The new geomagnetic intensity values are included in the Indian palaeosecular variation curve and are shown in Figure 43. The Vadnagar artifacts were small subsets of nearly seven intensity of past Earth's magnetic field values (F) and useful for geomagnetic applications, like global field modeling and archaeomagnetic dating curve development.

Palaeoweathering of the Deccan basalt

The Deccan basalt has undergone different stages of the chemical weathering, which is reflected in the various types of the palaeoweathering profiles such as palaeosols and laterites. In this work, the aim is to understand the weathering characteristics of the laterites exposed in the regions of the Ratnagiri districts, Southern Deccan Traps. Five lateritic profiles of varying thickness ~2 to 9 m were sampled at close intervals. A detailed environmental magnetic property is being analyzed to understand the magnetic minerals and magnetic grain size variations from parent basalt to saprolite and then to laterite. Preliminary results highlight abundance of antiferromagnetic minerals such as hematite and goethite in the lateritic zone, and mixed ferrimagnetic and antiferromagnetic minerals in the saprolite zone. These variations highlight oxidation of primary magnetic minerals of the parent basalts to secondary iron oxides as weathering progress (Figure 44).

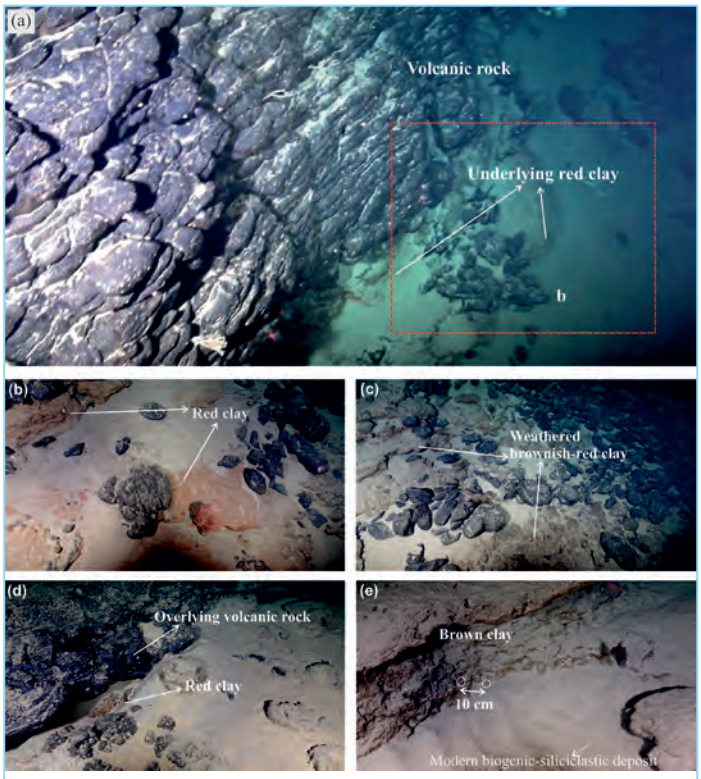

Figure 44 High-definition images captured by the ROV HyBIS showing different red and brown colored clays between dark-colored lava flow exposed on the southern scarp of the Cruzeiro do Sul Rift, Rio Grande Rise, South Atlantic. (a) Thick vertical volcanic rock escarpment overlain on the red colored clay; (b) enhanced image of the red clay shown in the (a); (c) thick weathered brownish-red clay; (d) very thin exposed red clay overlain by massive volcanic rock; (e) exposed brown clay with two laser red dots. The laser dots are 10 cm apart indicating the thickness of red and brown clays are > 10 cm at several places. The greyish silt-sandy deposits seen at all sites are modern siliciclastic-biogenic deposits.

Massive gravel deposition in Central Italy's river basins

The purpose of this study was to prove the direct correlation of successions of gravel-clay beds recovered in borehole with the melt-water pulses associated with the sea-level oscillations indicated in the $\delta^{18}O$ record in the time-span preceding the 100-kyr glacial cycles. Aimed at this scope, a combined $^{40}Ar/^{39}Ar$ and palaeomagnetic constraints is provided to a set of seven aggradational successions recovered from a 120 m deep borehole drilled in the buried Palaeo-Tiber delta in Rome (central Italy). The geochronologic constraints enable the correlation of each aggradational succession, characterized by a sudden transition from coarse gravel at the base to sandy clay sediments, with periods of sea-level rise indicated by the $\delta^{18}O$ curve encompassing MIS 37 through MIS 19, from 1250 to 780 ka. This stratigraphy provides a unique and

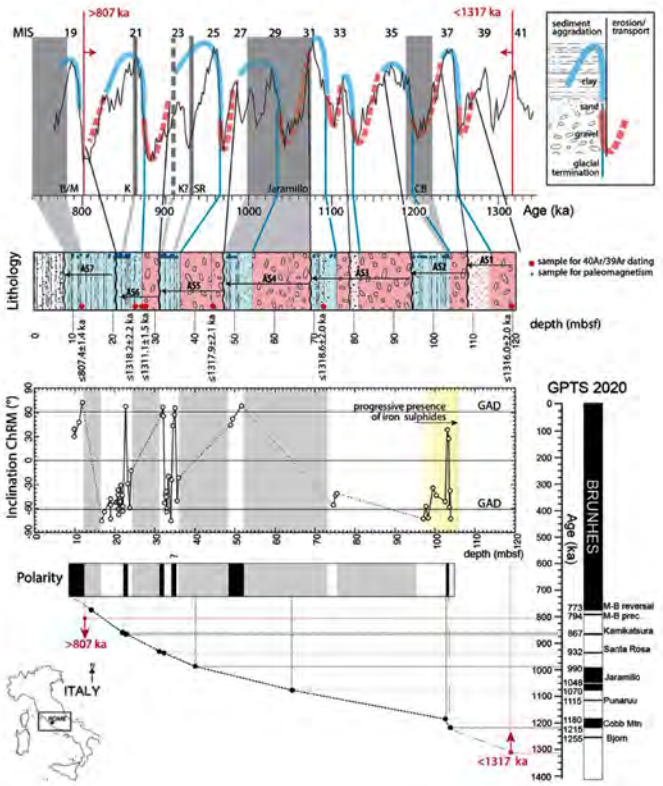

Figure 45 Correlation of the aggradational successions recovered in borehole PR1, Rome, Italy and the sea-level oscillations detected by the $\delta^{18}O$ record, based on geochronologic and paleomagnetic constraints.

unprecedented well-dated evidence of glacial/deglacial events, matching the global benthic $\delta^{18}O$ stack during this time frame. Furthermore, this study validates the hypothesis that gravel deposition in the catchment basin and the delta of the main rivers in central Italy is triggered by the melting of glaciers in the Apennines Mountain range. It demonstrates the significant potential of these deglaciation proxies to be used worldwide to unravel the chronology of glacio-eustatic events (Figure 45).

Discovery of red clays from the Rio Grande Rise, South Atlantic

Autonomous underwater vehicle (AUV) mapping of the western Rio Grande Rise (RGR), South Atlantic, and subsequent exploration and photography of horizontal lava flows exposed in near vertical, faulted escarpments, showed occurrences of red clays/weathered volcanic tops trapped between successive alkaline lava flows. These red clays indicate a hiatus in successive volcanic eruptions. Mineralogical, geochemical, and rock magnetic characteristics of one such distinct red clay dredged from ~ 650 m water depth in the western RGR are studied. The mineral constituents of the red clay are kaolinite,

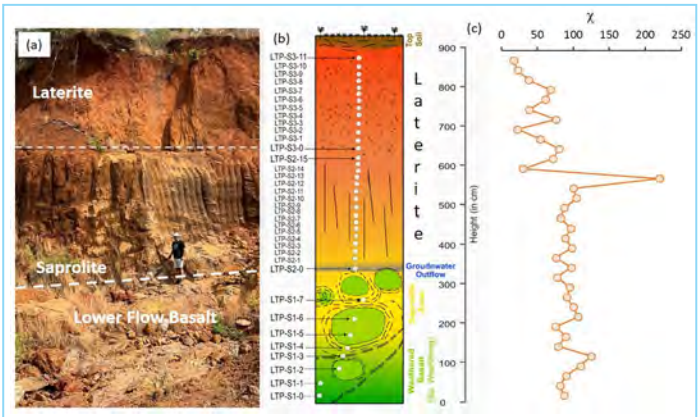

Figure 46 (a) Field photograph of a laterite section (LTP) exposed in the Khed region, southern Deccan Traps, (b) lithology of the LTP section and sampling intervals, and (c) mass normalized magnetic susceptibility (χ) data shown along with the depth and different zonation of the LTP section. The χ data is in $10^{-8}m^3kg^{-1}$.

magnetite, oxidized magnetite (/maghemite), hematite, and goethite, with biogenic calcite and halite occupying voids or precipitated on the surface of the red clay. The chemical index of alteration (CIA) has a value of 93, showing that red clay is a product of extreme chemical weathering of the lava flows. The alkaline volcanic rocks recovered from nearby show an age of ~ 44 Ma, indicating an Eocene age for the volcanism. It is observed that the red clays are a product of sub-aerial chemical weathering of these Eocene volcanic rocks, in a warm-wet climate, before the thermal subsidence of the RGR to its modern-day bathymetric depth (Figure 46).

Numerical modeling to define saline and freshwater aquifer boundaries along west coast Maharashtra

Electrical resistivity and ground magnetic methods serve as vital tools for identifying groundwater potential zones and mapping sub-surface structures. The electrical resistivity technique can distinguish between saline water ingress and freshwater bodies, crucial for coastal regions. This study aims to delineate the saline-freshwater interface and map faults and lineaments in parts of Kudal-Vengurla and the surrounding coastal area of western Maharashtra. Conducting 30 vertical electrical soundings with the Schlumberger configuration (AB/2 = 100m), data analysis employed the IPI2WIN algorithm for automatic and manual interpretation. Pseudo cross-sections revealed saline water flow, influenced by lineaments. Additionally, 122 ground magnetic data points were analyzed using SURFER software, indicating NW-SE trends parallel to the coastline, attributed to coastal tectonics. The study delineates structural elements and magnetic sources within the region.

Morphometric analysis of Nag River Basin, Maharashtra

Analyzing the Nag River Basin in Maharashtra, India, through morphometric methods promises benefits for its conservation and sustainable development. Utilizing SRTM data and GIS tools, this approach efficiently extracts the basin and assesses its morphometric parameters, including basic geometry, drainage network, relief, and texture. Implementing the Strahler method for stream ordering in ArcGIS 10.3, the study reveals a dendritic to sub-dendritic branching pattern in an east-west direction across the 810 square kilometers of the basin. Relief analysis indicates slopes ranging from 1.2 to 23 degrees, influenced by geological and geomorphological factors. Additionally, the basin's mean stream length ratio of 0.55 km suggests an elongated shape with gentle slopes. These findings underscore the influence of subsurface lithology on the development of the Nag River watershed and its streams (Figure 47).

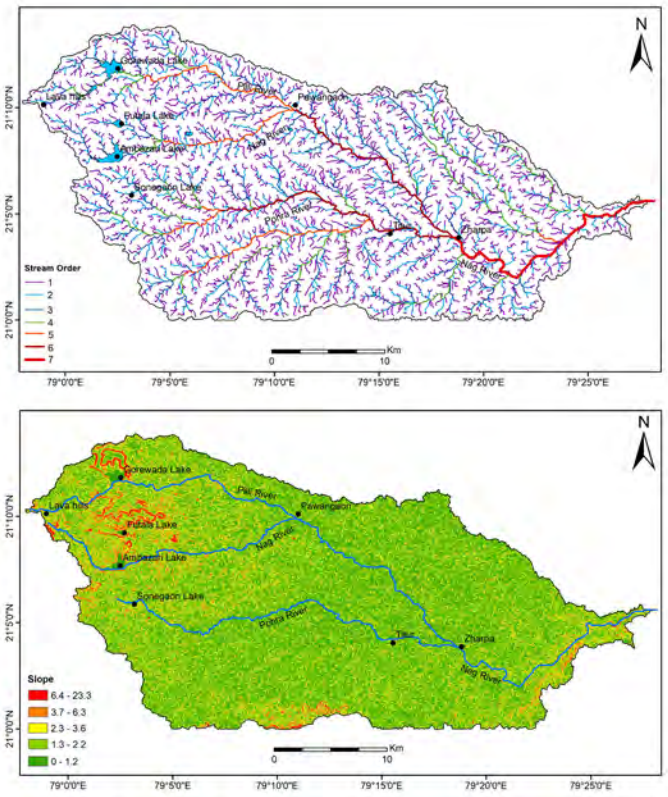

Figure 47 Drainage and Slope maps of Nag River Basin.

Geophysical studies in Joshimath

Electrical resistivity imaging (ERI) was conducted at six locations in Joshimath and surrounding areas using the IRIS SYSCAL R1plus switch 48 system, with electrodes spaced 5 meters apart. Employing a robust inversion method for 2D field data revealed an absolute error of 5.7% to 9.7% across all six profiles, indicating persistent noise. ERI studies identified a high resistive feature with numerous blocks of moderately and highly resistive materials, while lower profiles consistently displayed moderately resistive characteristics. Weak zones saturated with water were observed at Narsing Mandir, Manohar Bagh, Jaypee, and Marwari sites, indicating perched water bodies at shallow depths of about 15 m, surrounded by high resistivity rocks (Figure 48). Seven soil samples were collected at 15 cm depth

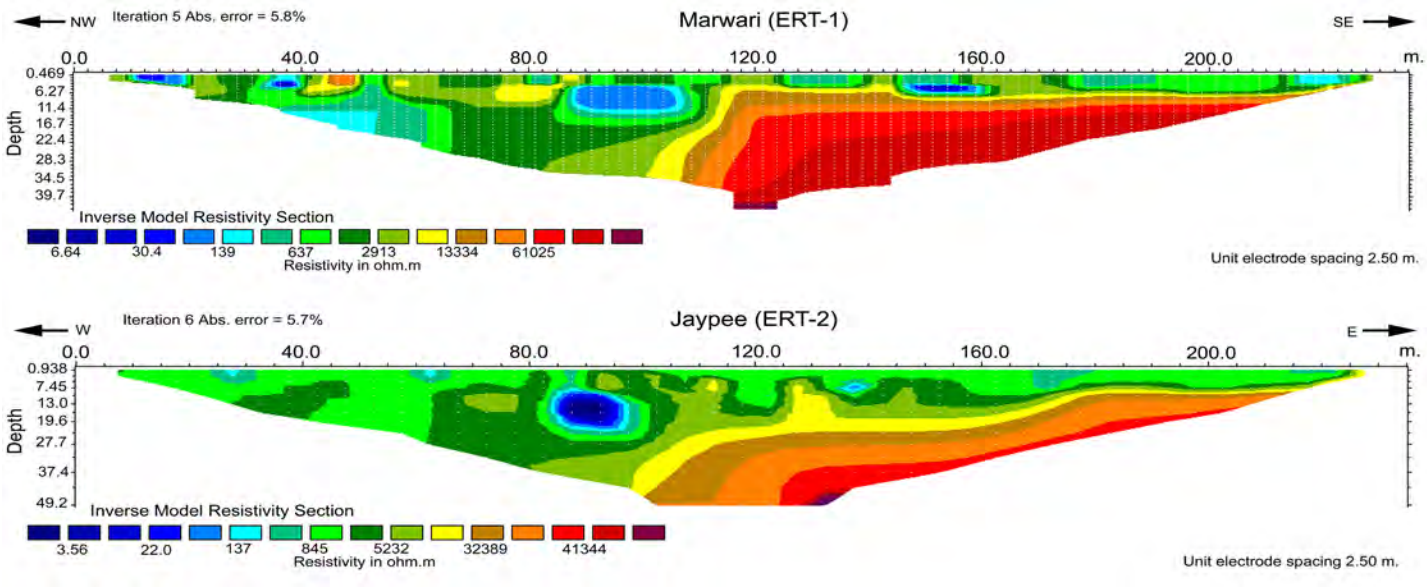

Figure 48 Inverted resistivity models of profile Marwari (ERT-1) and Jaypee (ERT-2) (using Wenner–Schlumberger configuration).

from ERI sites, showing variations in magnetic properties. Strong correlations between magnetic parameters χ and χfd%, as well as χ and SIRM, were evident, with S-ratio values indicating concentrations of ferrimagnetic minerals. Grain size-dependent parameters revealed the presence of extremely fine-grained superparamagnetic fractions in some samples.

Comparing SVD-based and automated geophysical inversion for Schlumberger VES data: A case study from Konkan coast, Maharashtra

A comparison is made between the resistivity modeling results obtained from Singular value decomposition (SVD) based geophysical inversion method and a semi-automated inversion scheme to assess the robustness of the SVD method. A total of 30 vertical electrical soundings (VES) data were collected from the hard-rock area of Konkan coastal Maharashtra and modeled using the new method. The results are interpreted so as to identify the coastal aquifers contaminated with saline water in the study area. The SVD- based inversion results suggest a very high resistivity formation in the north-eastern part of the area, presumably due to the presence of laterites at the top, followed by hard and compact basalts beneath. In the south-eastern part of the study area, a very high resistivity zone is evident, due to the presence of laterites and basalts. A very high conductive zone is revealed in the south-western part near the coast signifying extensive influence of saline water ingress, which diminishes from south-west to north-eastern part of the region. It is also seen that the results obtained from the SVD-based algorithm is superior to the conventional inversion scheme.

Lithotectonic structure of the Paleoproterozoic Intracratonic Kaladgi Rift Basin, southwest India: Insights from Magnetotelluric analysis

Peninsular India hosts several significant Paleoproterozoic rift basins, with the Kaladgi rift basin standing out prominently. In this study, Magnetotelluric (MT) findings from the eastern section of the Kaladgi rift basin are presented. Data collection involved a ~120 km profile spanning Belavanik-Bagalkot-Ukkali regions, encompassing the Paleoproterozoic Kaladgi rift basin, the Cretaceous Deccan volcanic province, and the Archean gneisses/granites/greenstones of the Dharwar craton. The lithospheric electrical structure was derived through joint inversion of TE- and TM-modes data. Results indicate Kaladgi sediments of ~500-1000 m thickness over a highly fractured crystalline basement. Proterozoic sediments are exposed beneath the Deccan basalt cover and within shallow fractured zones. Conductive-resistive transitions correlate with major tectonic faults and deformed crustal rocks, while the ~50 km depth boundary defines the electrical Moho. A ~25 km wide, steep conductive feature extending to upper mantle depths (~180-200 km) is interpreted as the Chitradurga Suture Zone (CSZ). Crustal heterogeneity, conductivity variations, and resistive lithosphere reflect the region's geological history, including Archean collisional events and Reunion hotspot reactivation. Crustal conductors are associated with mafic intrusions and sulfide mineralization in fault zones. This MT study offers valuable insights into the deep tectonic framework of the region.

Spatial heterogeneity in the lithospheric architecture of the Cambay Rift Basin and adjacent Aravalli-Delhi Fold Belt, western India: Synthesizing magnetotelluric findings

The evolution of the Cambay rift basin (CRB) is linked to the separation of the Indian continent from Africa and subsequent interaction with the Réunion mantle plume, causing significant alterations in the lithospheric structure of western India, particularly in the CRB. To further understand this, a magnetotelluric (MT) study with 31 sites across the CRB was conducted. The resulting 2D geoelectric model unveils a mix of conductive and resistive formations. Resistive blocks indicate Archaean lithosphere to the west, uplifted crust within the CRB, and various Precambrian structural units to the east, suggesting continuity of the Aravalli-Delhi Fold Belt trend beneath the CRB into Saurashtra. Conductive anomalies beneath the CRB imply magmatic underplating from the upper mantle due to Réunion plume interaction. Integration of geophysical data suggests a spatially heterogeneous lithosphere, possibly a blend of Archaean and Proterozoic lithospheres beneath the CRB. The Proterozoic lithosphere appears more susceptible to Réunion plume influence compared to the Archaean lithosphere. Sedimentary thickness heterogeneity within the CRB correlates with the Archaean-Proterozoic lithosphere contact, influencing basin structure and sediment deposition.

Crustal magnetic anomaly map over the Deccan Volcanic Province

The aeromagnetic map of India prepared earlier reveals a glaring data gap over the region covered by the Deccan Traps. This is possibly because the magnetic data are

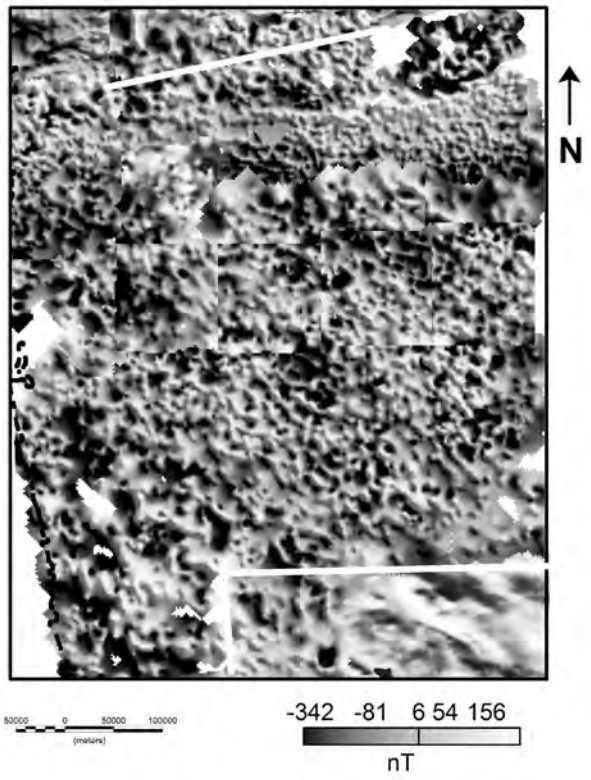

Figure 49 Crustal magnetic anomaly map (unprocessed) of the Deccan Volcanic Province. White line demarcate the region above/below which aeromagnetic data is used.

expected to be very noisy due to the varying magnetic polarity of the basalts and it is thus believed that it is not possible to get information below the Deccan Traps using magnetic data. However, ground magnetic data collected, processed and interpreted by IIG in the region bounded by 72 to 78°E longitude and 16 to 20°N latitude provided useful insights into the sub-basalt structures. Under the current science plan, ground magnetic survey of in the region bounded by 20 to 22.5N latitude was undertaken and used to generate a crustal magnetic anomaly map of DVP (Figure 49), the first of its kind. First observation of this map suggests the westward continuation of the arcuate shaped Main Peninsular Shear (MPS), several NW-SE lineaments that have linkage with Dharwar craton in addition to several NE-SW lineaments, high frequency anomalies related to traps etc. The NE-SW lineaments cuts across the NW-SE lineaments giving rise to a block like geometry within the DVP. This map was further used to update the composite magnetic anomaly map of India and adjoining regions published in 2006 using data collected from different platforms.

Comparative study between various Global Gravity Models with the Bouguer anomaly derived from ground gravity data in Deccan Volcanic Province

These days open source satellite gravity models are regularly used for crustal and lithospheric studies. To assess the appropriateness of open-source satellite gravity data in comprehending shallow underground features, a comparative study of the data from popularly used gravity models (like EGM2008, EIGEN-6C4, and XGM2019e_2159) and ground data specifically focusing on the Deccan Volcanic Province (DVP) were carried out. Visual interpretation techniques, mathematical approaches, and signal processing were utilized to compare the Bouguer Gravity Anomaly (BGA) obtained from various Global Gravity Models (GGMs) with the Bouguer anomaly derived from ground gravity data. To eliminate high-frequency noise and the impact of long wavelength isostatic features, different filters were applied. All anomaly maps displayed similar and well-correlated results after the filtering process. In the DVP region, the mean difference between the ground data-based anomaly and the anomalies derived from EGM2008, EIGEN-6C4, and XGM2019e_2159, are found to be -0.03 mGal, -0.07 mGal, and -0.005 mGal, respectively, indicating only a slight deviation between the datasets. The standard deviation of the differences between the ground data and EGM2008, EIGEN-6C4, and XGM2019e_2159, were found to be 1.07 mGal, 1.02 mGal, and 0.72 mGal, respectively. In smoothly varying topographic regions, the correlation coefficient between the BGA obtained from the GGMs and the ground data, exceeded 95 percent, whereas it was less than 60 percent in areas with significant topographic variations. This study suggests that when the terrain is smooth, all three GGMs provide similar results. However, in areas with diverse and complex terrain, like the western part of DVP, it is found that XGM2019e_2159 outperforms both EGM2008 and EIGEN-6C4. Consequently, through rigorous statistical analysis comparing the satellite data-based BGA with the BGA from ground data, it can be inferred that the satellite data can be effectively employed in comprehending intermediate and deep underground features within the DVP. However, it is crucial to conduct prior analysis of topographic information ie. Satellite-derived gravity data can be used for regional scale interpretation or planning a high-resolution ground gravity survey, as long as prior analysis of topographic information is conducted with caution.

Development of 32-probe Electrical Resistivity Tomography System

Development of indigenously user friendly 8-probe electrical resistivity tomography (ERT) instrument for groundwater and mineral exploration is accomplished. The development of 32-probe ERT System is underway and the necessary circuits have been designed. The 4 nos. relay modules are planned to be used for the 32 probes ERT system. Each relay module which has 32 relays will be connected to 8 probes. The PCB design and the fabrication for the same are done. Raspberry Pi 3 will be used as a data logger for which the Python program is written to control the ERT system for acquiring the data.The ERT system can be configured to use all 32 probes or the required number of probes depending on the field area available at the site. The Wenner or Schlumberger or hybrid of both methods can be selected to configure the probes for the measurement. The program for the same is developed in Node-red. The ERT system can be controlled by Laptop or Mobile phone through Wi-fi.

GEOSCIENCE AND APPLICATIONS PROGRAM (GAP)

Coordinator/ Project Investigator : Anand, S.P.

Members : M. Ponraj, Ajish P. Saji, Eleazer Wanniang, K.M. Sreejith (External Member), SAC (ISRO)

Completed the establishment of the planned network of GNSS stations for the objective of the estimation of contemporary kinematics and interseismic strain rates for the Eastern Himalayas. Presently a total of 8 campaign and 8 permanent GNSS stations were established constituting a network running along two transect profiles A and B cutting across the major thrust systems of the Eastern Himalayas. The regions covered include Arunachal Pradesh and parts of Assam.

DIRECTOR'S RESEARCH GROUP

Chief Coordinator : Geeta Vichare

Members : A.P. Dimri, Jayashree Bulusu, Chinmaya Nayak, B. Remya, T. Sreeraj, Vasundhara Barde

Possible effects of solar variability on tropical cyclone (TC) activity

The current study explores the relationship between solar variability and tropical cyclone (TC) activity using sunspot number (SSN) and TC best track data as respective proxies. Five regions of the globe were considered: EP (Eastern Pacific), NA (North Atlantic), NI (North Indian), SI (South Indian), SP (South Pacific), and WP (Western Pacific). The results show strong anti-correlation between yearly TC counts and yearly SSN while considering their 11-year moving averages. However, this is true only for the North Atlantic region (Figure 50). Overall, more TCs are observed during lower solar activity periods (SSN < 50) as compared to higher solar activity conditions (SSN > 100), even when we consider all regions together. Extreme TC events with a maximum wind speed of 137 knots and higher (category 5) are highly probable during lower solar activity conditions. More importantly, the extreme TCs are most likely to occur during the declining phase of a solar cycle and least likely to occur during the declining phase or the maximum phase

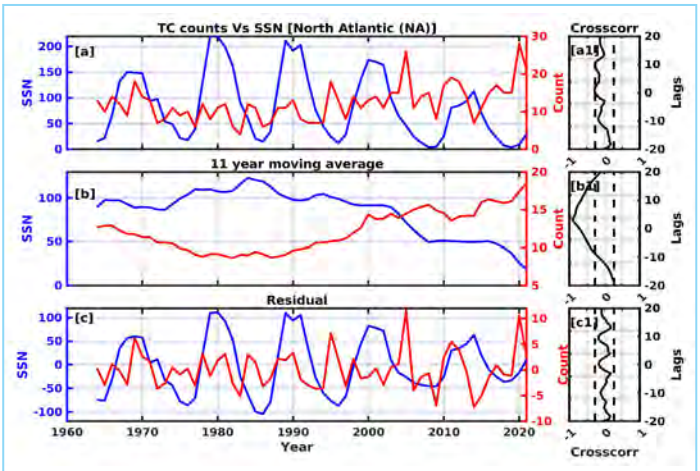

Figure 50 Variability of yearly TC counts (red) and the yearly averaged SSN (blue) over the North Atlantic (NA) region. The SSN and TC counts are represented by the left and right y-axes, respectively. (a-c) shows the absolute values, their 11 year moving averages and the residual values (absolute - 11 year moving average), for both parameters. (a1-c1) represent the corresponding cross-correlation functions. The dashed line shows the 95% confidence bounds.

(Figure 51). The exact physics and dynamics behind such behaviour is not clearly understood. It would require a proper modeling framework to understand and explain how solar variability contributes towards TC activity.

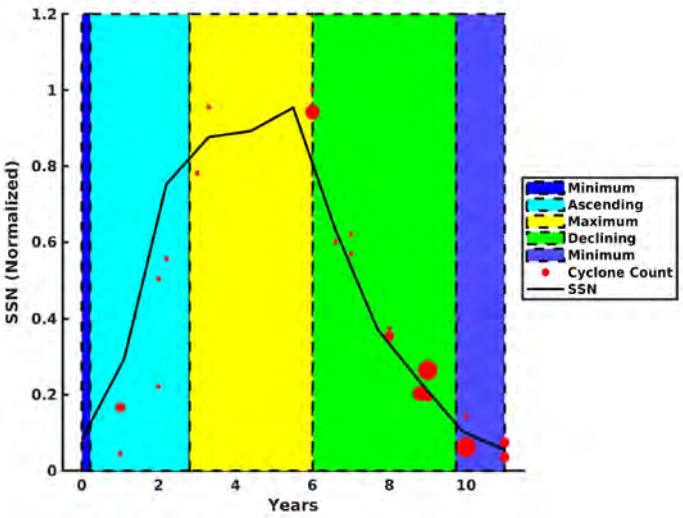

Figure 51 The distribution of extreme TCs during different phases of the solar cycle. The black curve shows the mean solar cycle (average of last 3 solar cycles under the study) and has been normalised to unity. The red circles represent the yearly counts of the extreme TCs . The position of the extreme TCs have been mapped as per their occurrence in their respective solar cycle.The blue, cyan, yellow and green represent minimum, ascending, maximum and declining phases of a solar cycle. The results show that the extreme TCs are more probable during the declining phases and are least probable during the ascending phases of the solar cycle.

Possible impacts of active geomagnetic conditions on Northern Atlantic oscillations

Under this objective, one case study for the active geomagnetic condition (on 17 March 2015), is discussed and its possible effect at different pressure levels were showcased. The 250 hPa geopotential height anomaly and corresponding changes in the wind amplitude were reported. Investigations of 72 active geomagnetic conditions (|AL|> 1000 nT) during 1989-2015 showed a short term variability of NAO index at 500 hPa. Using all geomagnetic activity cases from 1980-2022 over December, January, February and March (DJFM) months a total of 215 events were identified with (|AL|> 1000 nT. The climatological effect of these events was considered at 3 hPa, 10 hPa and 250 hPa. Additional student t test was performed to assess the significance of variability up to 95 %. It is seen that the auroral substorms have some influence over the zonal and meridional wind pattern at different pressure heights suggesting translation of energy from upper stratosphere to lower troposphere. The effect is seen to last till 20 hPa which marks the bottom side of stratosphere. A weakening of the easterlies and increase in the westerlies is also clearly seen after the active geomagnetic condition that lasts for several days after the active geomagnetic condition. The signatures in v′ component also show this feature with weakening of northerly and strengthening of southerlies around the event. It can be seen that the wind does propagate downward in altitude especially around the 2 days after the active day.

From long term observation of active geomagnetic conditions it is seen that during most of the period, the active conditions are seen to dominate the March and October equinox. Hence, all active geomagnetic conditions during March from 1990-2020 have been investigated. A total of 99 events were identified in March. It is earlier reported that U, V and temperature during active geomagnetic condition vary with both longitude, latitude and pressure levels. In order to address the regional variations, five longitudinal regions are classified based on land and ocean mass as Western Pacific (WP:180˚-135˚W), Canadian region (CAD: 135˚-85˚ W), Northern Atlantic (NAO: 85˚ W-15˚ E), Asian Region (Asian: 15˚ -135˚E) and east Pacific (EP: 135˚ -175˚ E) respectively.

Figure 52 denotes the pressure level-latitude variation of zonal wind: climatology U (CLM-U) in left panels, active condition U (Event-U) in middle panels and its composite (U′) in right panels for different longitudinal sectors indicating ocean and land. From top to bottom, the regions are indicated as WP, CAD, NAO, Asian and EP. As 72 model level data set is used, it can provide the variations till the lower level of mesosphere. The upper most pressure level is at 0.01 hPa, corresponding to 78 km in altitude. An interesting thing to note is that the zonal wind strengthens by a minimum of 10 m/s (significant as per student t-test) in 60°-80° N in the WP, CAD and EP sectors. In the NAO region there is 5 m/s increase near polar latitudes. In Asian

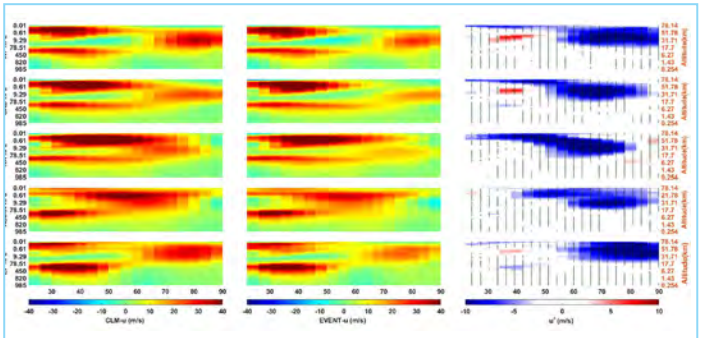

Figure 52 Pressure Level-Latitude variation of zonal wind: climatology u (CLM-u) in left panels, active condition u (Event-u) in middle panels, and its composite (u′) in right panels for different longitudinal sectors indicating Ocean and land. WP: western Pacific, CAD: Canadian Sector, NA: Northern Atalantic sectors, Asian: Asian Sector and EP for East Pacific sector. A total of 99 active geomagnetic conditions in March during 1990-2020 are included in this picture. The black dots indicates significance values obtained from student t test at 95%.

sectors, there is a 2 m/s easterlies are seen at polar region at 20-50 km. The westerlies strengthen at 40°-60° N in Asian sector.

Solar variability and Indian summer monsoon Rainfall variability

Via large-scale circulations, the role of solar variability on the Indian summer monsoon is investigated. Standardized anomaly is used to identify solar maximum and minimum years. Statistical analysis such as moving mean, empirical mode decomposition, and wavelet analysis are used to determine the plausible relationship between solar variability, large scale circulations such as El- Niño 3.4 SST anomaly, Dipole Mode Index (DMI), and Atlantic Multidecadal Oscillation (AMO), and Indian summer monsoon rainfall (ISMR). In addition, the National Centers for Environmental Prediction /National Center for Atmospheric Research (NCEP-NCAR) reanalysis data collection is used to assess time-averaged composite anomalies of wind, latent heat, geopotential height during maximum/minimum solar activity years. The 31-years moving mean of DMI shows significant negative correlation (-0.35) with sunspot number and with 31-years moving mean ISMR (-0.28). Similarly, 31-years moving mean of AMO exhibits a substantial positive connection with ISMR (0.68) and Niño 3.4 SST shows significant negative correlation (-0.62) with ISMR. Using intrusive mode function analyses it has noted that India receives rainfall for both phase of solar forcing but from wind studies at 850 hPa and 200 hPa, it is found that the phenomena for ISMR is different during solar maximum and minimum conditions.

Vertical distribution of Hadley cell circulation shows an anomalous narrow band of ascending motion in local meridional circulation is seen around 10S to 20N, which afterward becoming descending branch of local Hadley cell between 21N and 38N. It indicates strong circulation over Indian region during maximum solar activity. In case of minimum solar activity, ascending branch of Hadley cell shifts north of equator and two descending branch are observed, indicates weak circulation over Indian landmass. These results showed that during maximum solar activity years, Arabian SST and lhtfl are high, strong Somalian Jet is observed, and strong Hadley cell also lactated, indicating positive rainfall anomaly over north central India. Wave activity flux along with geostrophic stream function at 200 hPa level depicts that during maximum solar activity wave train pattern originates from central east Pacific travel towards Atlantic and then to North Africa. In minimum solar activity years, the wave train is more widespread and intense than in maximum solar activity years, wave train pattern originates from North Atlantic Region travel towards North Africa followed by North India and then North east Pacific.

During solar maximum, a strong Low Level Jet is observed, and during solar minimum, a strong Tropical Easterly Jet is observed. Also, the area of influences of ISMR is different for solar maximum and solar minimum. The mean difference plot of seasonal rainfall shows that during solar maximum, north India receives reasonable amount of rainfall however during solar minimum, south India receives comparatively more rainfall than north India. A weakening of the local Hadley cell during solar minima is also observed.

FIELD SURVEYS

1. Field survey was carried out to reveal the mineral chemistry of pollutants, heavy minerals and metals present in the dust samples in Prayagraj city during the period October 4-10, 2023.
2. Field survey for the acquisition of electrical resistivity imaging (ERI), was carried out in Joshimath region, Uttarakhand during April 19-23, 2023 to delineate the subsurface structure associated with landslide.
3. To study tectonics, evolution and history of earth's magnetic field, palaeomagnetic and petrological field work was carried out in Indore, Bhopal, Itarsi, Khandwa, Ujjain, Dewas, Bhopal, Maheshwar and Dhar regions of Malwa flows Madhya Pradesh, during the period April 22-28, 2023 and December 15-22, 2023.
4. GPS field work was conducted to study the crustal deformation in the microseismic active region of Palghar, Maharashtra, during September 5-11, 2023. Additionally, ground magnetic survey was also conducted in the Boisar-Palghar area of Maharashtra.
5. Repeat campaign mode GPS field work was conducted to understand the crustal deformation in the western Maharashtra region from January 16-February 20, 2024.

6. A detailed field survey was undertaken during December 22-25, 2023, in the regions of the Chiplun, Khed, Lote, Guhaghar and other neighboring regions of the Ratnagiri District, Maharashtra. The primary aim was to collect samples from the weathering profiles (laterite and saprolite) of the Deccan Traps. Based on survey observations, five sites were selected, and a detailed sampling was carried out. The samples include parent basaltic rocks, altered saprolites and top laterite samples. More than 100 samples were collected from these five sites.

7. Geophysical survey was carried out jointly with BSIP and NGRI, in the Bakhira and Surah taal, NE Uttar Pradesh from January 28 to February 10, 2024 to study the Quaternary Monsoon/Climate reconstruction/ Geomagnetic field variations through high-resolution multi-proxy studies of lacustrine archives from Central India (Core Monsoon Zone and Indo-Gangetic Plain). Field work was again conducted for collection of sediment core samples in Surah lake, from March 1-22, 2024.

8. Environment magnetic studies were conducted in and around Purna Basin (Nagpur, Amravati, Akola and around the region) during April 15-26, 2023.

9. To understand the density and magnetization inhomogeneties in the subsurface and to develop 2D crustal model across the Deccan Volcanic Province gravity, magnetic and DGPS survey was undertaken along and EW profile running from Kunkeswar in the west to Yadahalli in the east. The areas surveyed were Kunkeswar, Phonda Ghat, Radhanagari, Nipani, Mahalingpur, Mudhol etc regions of Maharashtra and Karnataka. The survey was carried out from December 4, 2023 to January 12, 2024.

10. Lineament and basement depth mapping using ground magnetic data was conducted in and around Joshimath, Auli, Marwari, Vishnuprayag etc regions of Uttarakhand, during April 8-24, 2023.

11. Establishment of a permanent GNSS station at Kolariang, Arunachal Pradesh (A.P) and parts of Assam along the eastern transect profile, data retrieval/ servicing and re-occupation of the GNSS stations along the eastern transect profile was conducted during June 7-21, 2023.

12. Data retrieval/ servicing and re-occupation of GNSS stations along the western transect profile of the GNSS network established in the North East India was conducted from February 26- March 10, 2024.

Figure 53 In January 2023, several reports on development of cracks in houses, other infrastructural buildings, roads etc were published in social media refereeing to land subsidence in and around Joshimath area. Visual and Electrical Resistivity Tomography (ERT) survey were carried out in these regions during April 2023 to examine the cracks, their orientation and distribution alongwith their causative mechanism(s). (a) & (b) shows respectively a sinking house (in sky blue) and huge cracks in hotel building in the Joshimath town.

Figure 54 IIG team for ERT survey in the Joshimath town.

13. Data retrieval/servicing of Broadband Seismograph (BBS) stations at Bongaigaon, Diphu, Jorhat and Namsai during 16 October 2023 to 21 October 2023

14. Visual survey and Electrical Resistivity Tomography (ERT) survey at Joshimath and adjoining area to inspect the cracks and subsidence at Joshimath and adjoining area during 17-04-2023 to 26-04-2023 (Figure 53, 54).

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26. Kumar, Sarwan, Sushil Kumar and **Rajesh Singh**, Geomagnetic Storm Associated D-Region Anomalies Estimated From VLF Observations at a Low-Latitude Station, Suva, Fiji.*J. Geophys. Res. (Space Physics)*, **128**, e2022JA031253, 2023, doi:10.1029/2022JA031253

27. **Lakhina, G.S., S.V. Singh, T. Sreeraj, S. Devanandhan** and R. Rubia, A mechanism for large-amplitude parallel electrostatic waves observed at the Magnetopause. *Plasma*, **6,** 345-361, 2023, doi: 10.3390/plasma6020024

28. **Lakshmi, B.V., Md. Mujahed Baba** and **P.B. Gawali**, Investigation of past earthquakes in the Kopili Fault zone, NE India: New evidence of paleoliquefaction. *Natural Hazards*, 2023, DOI: 10.1007/s11069-023-06200-w

29. Lissa, D., **Gopi K. Seemala**, K. Venkatesh, D.S.V.V.D. Prasad and K. Niranjan, ROTI and scintillation index correlation under quiet and disturbed periods over an Indian low latitude station, Waltair. *Adv. Space Res.*, 2023, https://doi.org/10.1016/j.asr.2023.09.060

30. Meert, J.G., S.R. Miller, A.F. Pivarunas, M.K. Pandit, P.A. Mueller, **Anup K. Sinha**, G. Kamenov, S. Kwafo and A. Singha, Palaeomagnetism and geochronology of the Gwalior Sills, Bundelkhand craton, Northern India Block: New constraints on Greater India assembly. *Gondwana Res.*, **125**, 29-48, 2024. https://doi.org/10.1016/j.gr.2023.08.004

31. Mondal, Mukulika, Sanjay Kumar, **S. Banola** and A.K. Singh, Occurrence of ionospheric scintillations under different solar and geomagnetic conditions over low latitude station Varanasi.*Adv. Space Res.*, **73**, 3658-3674, 2024, https://doi.org/10.1016/j.asr.2023.12.050

32. Mohamed, A.A.A., P. Maharana, S.S. Phartyal and **A.P. Dimri**, Projected change in precipitation and temperature over undivided Sudan and its major cities. *Meteorol. Atmos. Phys.,***136**, 11, 2024, https://doi.org/10.1007/s00703-024-01017-z

33. Naniwadekar, G.P., **S. Gurubaran, R.N. Ghodpage**, **P.T. Patil**, A.P. Jadhav and D.S. Burud, Studies on the variabilities of mean winds in the mesosphere and lower thermosphere region (MLT) over Kolhapur 16.8ºN, 74.2ºE).*J. Geomatics*, **17(1)**, 87-94, 2023, https://doi.org/10.58825/jog.2023.17.1.78

34. **Nilam, B., S. Tulasi Ram, M. Ankita**, D.M. Oliveira and **A.P. Dimri**, Equatorial electrojet (EEJ) response

to interplanetary (IP) shocks. *J. Geophys. Res. (Space Physics)*, **128**, e2023JA032010, 2023. https://doi.org/10.1029/2023JA032010

35. **Parihar, N.,** A.K. Singh, **S. Padincharapad** and S. Saini**,** On the response of the mesopause region over an Indian Antarctic station Bharati to the geomagnetic storm of 23–24 March 2023. *Polar Sciences***,** 101047**. https://doi.org/10.1016/j.polar.2024.101047**
36. **Pavithran, Adhitya, Jayashree Bulusu**, A.K. Sinha and **Geeta Vichare**, Examining the Applicability of Direct Analytic Method (DAM) to Normal Modes of Poloidal Oscillations under Symmetric and Asymmetric Boundary Conditions. *J. Geophys. Res. (Space Physics),* **129(1)**, e2023JA032119, 2024.
37. Ranjan,A.K., M.V. Sunil Krishna, C. Amory-Mazaudier, R. Fleury, **S. Sripathi** and **Geeta Vichare**, Variability of Ionosphere Over Indian Longitudes to a Variety of Space Weather Events During December 2006. *Space Weather,* **21**(11), e2023SW003595.
38. **Remya, B**., A.J.Halford, D.G.Sibeck, K.R. Murphy and M.-C.Fok, Understanding Quiet and Storm Time EMIC Waves- Van Allen Probes Results. *J. Geophys. Res. (Space Physics)*, **128**, 2023, e2023JA031712, https://doi.org/10.1029/2023JA031712
39. Rubia, R., **S.V. Singh, G.S. Lakhina, S. Devanandhan**, M.B. Dhanya and **T. Kamalam,** Electrostatic solitary waves in the Venusian ionosphere pervaded by the solar wind: A theoretical perspective.*The Astrophys. J.*, **950**:111, 2023, doi: 10.3487/1538-4357/acd237
40. Saharan, S., A.K. Maurya, A. Dube, **O.M. Patil, Rajesh Singh** and H. Sharma, Low latitude ionospheric TEC response to the solar flares during the peak of solar cycle 24. *Adv. Space Res.*,**72,**3890-3902, 2023.https://doi.org/10.1016/j.asr.2023.07.015
41. **Sathishkumar, S.,** S. Sridharan, **K. Krishnapriya** and **P.T. Patil**. Low latitude mesosphere and lower thermosphere (MLT) response to the recent stratospheric warming during 2017-18 and 2018-19.*Front. Astron. Space Sci.,* DOI: 10.3389/fspas.2024.1308198
42. **Sau, S.,** P. Terra, C.G.M. Brum, F.A. Vargas, J. Lautenbach and **S. Gurubaran,** Retrieval of rotational temperatures from the Arecibo Observatory Ebert-Fastie spectrometer and their inter-comparison with co-located K-Lidar and SABER measurements. *Earth Space Sci.*, **11(2)**, 2024.https://doi.org/10.1029/2023EA003323
43. **Seemala, Gopi K., Ipsita Katual, Chandan Kapil** and **Geeta Vichare**, Seasonal and solar activity dependence of TEC over Bharati station, Antarctica. *Polar Science*, **38**, 2023, 101001, https://doi.org/10.1016/j.polar.2023.101001
44. **Shah, B. Trunali, B. Veenadhari,** M. Pandya and M. Nose, Energetic ion variations during substorm intervals using the Van, Allen Probes data. Adv. Space Res.,**73**, 3730-3742, 2024.
45. **Shaikh, Z. I., Geeta Vichare,** A. Bhaskar, A. N. Raghav, and S. Bourouaine, Nature of Turbulence inside Small-scale Magnetic Flux Ropes near the Sun: Parker Solar Probe Observations. *The Astrophys. J.*, **959(1),** 50, 2023.
46. **Sinha, Shipra, Geeta Vichare** and A.K. Sinha, Differences in the characteristics and triggering mechanisms of two successive AL index onsets on 21st January 2005. *J. Earth Syst. Sci.*, 2024. doi.org/10.1007/s12040-024-02304-4
47. **Sinha, Shipra, Geeta Vichare** and A.K. Sinha, Hemispheric comparison of solar flare associated cosmic noise absorption (SCNA) from high latitude stations: Maitri (70.75° S, 11.75° E) and Abisko (68.4° N, 18.9° E). *Front. Astron. Space Sci.,* **11**,1347874, 2024.
48. **Srivastava, P.**, B.J. Murton, L.G. Sant'Anna, F. Florindo, M.B. Hassan, J.T.M. Guerra, V.A. Janasi and L. Jovane, Red clays indicate sub-aerial exposure of the Rio Grande Rise during the Eocene volcanic episode. *Scientific Rep.*,**13**, 19092, 2023.https://doi.org/10.1038/s41598-023-46273-y
49. **Tabish, K., Anand, S.P.** and S.K. Begum, Comparison of Satellite derived gravity models with ground data: Case study from Deccan Volcanic Provinces. *J. Indian Geophys. Union*, **27**, 409-425, 2023.
50. **Tahama, K., G. Gupta** and **M. Flawiya,** Numerical modeling of geophysical data in resolving the saline and fresh water aquifers in west coast Maharashtra. *J. Earth Sci. Tech.*, **4(1)**, 18-30, 2023.
51. **Thakur, Pranali, Gauri Datar, Geeta Vichare** and **C. Selvaraj**, Effect of the brightest gamma-ray burst (GRB 221009A) on low energy gamma-ray counts at sea level. *J. Cosmol. Astropart.*, 2024, JCAP04(2024)086, DOI 10.1088/1475-7516/2024/04/086

52. **Tiwari, S. H., M. S. Bagiya,** S. Maurya, K. Heki, and **A. P. Dimri,** On the role of volcanic plume heights in excitation of free oscillations of the solid Earth and atmosphere: Case study.*Adv. Space Res.*, 2024, https://doi.org/10.1016/j.asr.2024.01.001

53. **Vichare, Geeta, Atul Kulkarni, Rahul Rawat, Gopi K. Seemala, Anoop K. Soman** and **Pritimay Patro**, Climatology of quiet time geomagnetic field variations at two locations in Antarctica.*Polar Science*, **38**, 2023, 100979, https://doi.org/10.1016/j.polar.2023.100979

CHAPTERS IN BOOKS/ BOOKS EDITED/ PROCEEDINGS/ NON SCI JOURNALS

1. Arunbose, S., Y. Srinivas, S. Rajkumar and **E. Karthikeyan,** GIS Based Investigation of Groundwater Vulnerability using DRASTIC Model in Karumeniyar River Basin, Southern Tamil Nadu, India. *Recent Advances in Geology and Earth Sciences*, 2023, (Accepted).

2. Gopinath, **C.P. Anil Kumar**, P.R. Prince, Sherin Ann Abraham, S.Antony., "Non-extensive Tsallis entropy on long-term variation of Joule heating at high latitudes", *Proceedings of the Geophysical Institute*, Serbia, 76-82,1, 2024.

3. Pant N.C., Thamban Meloth, **A. P. Dimri**, Devsamridhi Arora, Recent Indian contribution in the realms of polar studies, (February 2024) *Proceedings of the Indian National Science Academy* DOI:10.1007/s43538-024-00236-7

4. Ravindra, R., A.V. Kulkarni, **A.P. Dimri,** et al. Recent Indian studies in Himalayan cryosphere. *Proc.Indian Natl. Sci. Acad.* (2024). https://doi.org/10.1007/s43538-024-00237-6

5. Raizada, S., C. G. M. Brum, J. Urbina, B. Isham, J. D. Mathews, **S. Sau** et al.,Characterizing the variability and structures in the coupled/complex ionosphere-atmospheresystem, *Bulletin of the American Astronomical Society*, **55**(3), 2023, https://baas.aas.org/pub/2023n3i331/release/1

6. Resmi, T.R., G. Gopinath, P.S. Sunil, M. Praveenbabu, P. Arjun, **R. Rawat,** (2022). Chemical and Isotopic Characterization of Lakes in the Larsemann Hills, East Antarctica. In: Khare, N. (eds) Assessing the Antarctic Environment from a Climate Change Perspective. *Earth and Environmental Sciences Library.* Springer, Cham. https://doi.org/10.1007/978-3-030-87078-2_10

7. Rizvi, S.S., G. Biswas, S. Chemburkar, **K. Tahama**, T. Sultana, S. Mukherjee, S. Hegde, T. Warsi and T. Mitran, Water Contamination and Mitigation Measures in Megacities in India. *Environmental challenges and mitigation measures in megacities*. Springer, 2024, (Accepted).

8. Roshi, A., N. Apnote, E. Araya, H. Arce, L. A. Baker, **S. Sau** et al.,The Next Generation Arecibo Telescope (NGAT), *Bulletin of the American Astronomical Society,***55**(3), 2023,https://baas.aas.org/pub/2023n3i344/release/1

9. **Tahama, K.**, T. Warsi, S.S. Rizvi, S. Chemburkar, S. Hegde, T. Sultana, R. Faraz, G. Biswas, S. Mukherjee, T. Mitran, and **G.Gupta**, Plastic pollution and alternative solutions in megacities. *Environmental challenges and mitigation measures in megacities*, Springer, 2024, (Accepted).

10. DST story on 'Paleoseismic investigations through earthquake induced liquefaction features can trace earthquake history & prepare for future'.

11. DST story on 'Reflection of Earthquake Source Process in the Ionosphere: The 2023 February Turkey Earthquakes'.

12. Ficklin, A. W., A. Bruno, L. Blum, G. A. de Nolfo, T. G. Guzik, R. Kataoka, **B. Remya** and S. Vidal-Luengo on behalf of the CALET Collaboration**,** Statistical analysis into the drivers behind relativistic electron precipitation events observed by CALET on the International Space Station, *Proceedings of Science*, 444(176), 38th International Cosmic Ray Conference ICRC2023, 2023, https://doi.org/10.22323/1.444.0176.

IMPACT FACTOR OF PUBLICATIONS DURING 2023-2024

Sr. No.	Journal Name	No. of Papers	Impact Factor	Sr. No.	Journal Name	No. of Papers	Impact Factor
1.	*Advances Space Research*	08	2.611	17.	*Journal of Geomatics*	01	N/A
2.	*Astronomy Astrophys.*	01	6.24	18.	*J. Geophys. Res. (Space Physics)*	05	2.8
3.	*Bull. Pure Appl. Sci. (Geology)*	01	N/A	19.	*J. Geophys. Res. (Solid Earth)*	01	5.58
4.	*Current Science*	01	1.0	20.	*J. Indian Geophys. Union*	01	N/A
5.	*Earth and Space Science*	01	1.244	21.	*Mar. Pet. Geol.*,	01	4.2
6.	*Frontiers in Astronomy and Space Sciences*	02	3.0	22.	*Meteorol. Atmos. Phys.*	01	1.9
7.	*Geo-Marine Letters*	01	2.1	23.	*Natural Hazards*	01	3.7
8.	*Geophysical Research Letters*	01	5.2	24.	*Phys. Plasmas*	01	2.0
9.	*Geosystems and Geoenvironment*	01	N/A	25.	*Plasma*	01	1.9
10.	*Gondwana Res*	01	6.1	26.	*Polar Science*	04	1.75
11.	*Internat. Res. J. Engg. Tech.*	01	N/A	27.	*Radio Science*	01	1.6
12.	*J. Asian Earth Sci.*,	01	3.0	28.	*Remote Sensing Lett.*,	01	1.4
13.	*J. Atmos. Solar-Terr. Phys.*	03	1.9	29.	*Scientific Rep.*,	02	3.8
14.	*Journal of Cosmology and Astroparticle Physics*	01	6.4	30.	*Space Weather*	02	3.76
15.	*J. Earth Sci. Tech*	01	N/A	31.	*Tectonophysics*	01	2.9
16.	*J. Earth System Sci*.	01	1.9	32.	*The Astrophysical Journal*	03	4.9

Cumulative Impact Factor=141.772

INVITED TALKS AND LECTURES

Dr. Archana Bhattacharyya

Invited Keynote talk on "Living with a Variable Star: Some Aspects of the Solar-Terrestrial Relationship", at *National Seminar on 'Grand Challenges in Earth System Sciences'*, Banaras Hindu University, Varanasi, April 1, 2023.

Invited talk on "Past, Present, and Future of Geomagnetism", at Indian Institute of Geomagnetism, Navi Mumbai, April 3, 2023.

Invited talk on" Earth's Magnetic Field and Geospace, at *Space Science and Technology Awareness Training (START) Program of ISRO* (online), July 21, 2023.

Invited Keynote talk on "Space Weather Effects on GNSS signals at Equatorial and Low Latitudes", at *XXXVth URSI General Assembly and Scientific Symposium*, Sapporo, Japan, August 19 - 26, 2023.

Invited Keynote talk on "Studies of Equatorial Plasma Bubbles using Ionospheric Scintillation Observations", at *3rd International Workshop on Equatorial Plasma Bubble (EPB-3),* Indian Institute of Geomagnetism, Navi Mumbai, September 13-15, 2023.

Dr. Geeta Vichare

"Ground-based observations and upstream solar wind using Aditya-L1 data", *First meeting of "Science from In-situ Measurements of Aditya-L1 (SIMA-01)*" during April 11-13, 2023 at SPL Trivandrum

"Space weather studies" at *NyAlesund Arctic Research center*, October 10, 2023 and *Maitri Station, Antarctica*, December 30, 2023.

Dr. Anup K. Sinha

Delivered a series of lectures on *"Introduction to Geology, Structural Geology, Petrology (igneous, metamorphic and sedimentary rocks), Texture & Mineralogy, and Stratigrahy; Physiographic Division of India, Precambrian geology.; Cratons-Aravalli, Bundhelkhand, Bastar, Singhbum, Eastern and Western ghat,"* during November and December 2023 and March and 1 week of April 2024 (Online mode) at IIG Panvel.

Dr. Gautam Gupta

Delivered an invited Expert Lecture at Dept. of Civil Engineering, Motilal Nehru National Institute of Technology, Prayagraj, on the topic *"Efficacy of Hydro-Geophysics: Challenges and Solutions",* on September 21, 2023.

Delivered a lecture at KSKGRL, Prayagraj, on *"Overview of scientific research at KSKGRL, Prayagraj",* on February 27, 2024.

Dr. S. Tulasiram

"Space Weather and impacts on modern society", at KL University, April 28, 2023.

"AI/ML in Space Weather", at IMPRESS, Indian Institute of Geomagnetism, February 14, 2024.

Dr. Bharati Kakad

"Geomagnetism: A Tool to Probe Space Plasma Processes", at *NCERT, New Delhi, Listening to Learn program* on 19 January 2024.

Dr. Amar Kakad

Invited talk on*"Electrostatic waves in the Martian plasma environment"*, at *3rd International Conference on Plasma Theory and Simulations (PTS-2023), JNU New Delhi,* September 21-23, 2023.

Invited talk on*"Simulation Study of Altitudinal Reach of Earth's Radiation Belt Particles"*at *3rd conference on Plasma Simulations*at Raman Sceince Center, Indian Institute of Astrophysics, Leh Ladakh, India, July 13-15, 2023.

Dr. S. Devanandhan

Gave a talk on *"IIG activities – towards science outreach"*, to Engineering students of Saraswati College, Kharghar, 25.08.2023.

Dr Satyavir Singh

PLENARY talk on*"Generation of Kinetic Alfven Waves in the magnetosphere"*, at 7th Asia-Pacific Conference on Plasma Physics, 12-17 November, 2023 at Port Messe Nagoya**).**

Dr S. Sau

Invited talk on *"Study of the inter-depletion distances of EPBs from the dip equatorial region"*, at 3rd International Workshop on Equatorial Plasma Bubbles (EPB-3), Indian Institute of Geomagnetism, 13-15 September, 2023.

PARTICIPATION IN CONFERENCES/MEETINGS/SEMINARS

NATIONAL

National Seminar on 'Grand Challenges in Earth System Sciences', Banaras Hindu University, Varanasi, April 1, 2023

Bhattacharyya, Archana

Living with a Variable Star: Some Aspects of the Solar-Terrestrial Relationship (**INVITED KEYNOTE**).

NCPS conference at NCPOR, Goa, May 6-19,2023

Jeeva,K., Geeta Vichare, Gopi Seemala, Atul Kulkarni, P. Elango and**Subrato Moulik**

Simultaneous observations of atmospheric vertical potential gradient from coastal Antarctic Stations Bharati and Maitri.

Seemala, Gopi K., Ipsita Katual, Chandan Kapil and **Geeta Vichare**

Seasonal and solar activity dependence of TEC over Bharati station.

Vichare, Geeta, Atul Kulkarni, Rahul Rawat, Gopi Seemala, Anoop K. Soman and**P. Patro**

Quiet time geomagnetic field variations at polar latitudes.

3rd conference on Plasma Simulations at Raman Sceince Center, Indian Institute of Astrophysics, Leh Ladakh, India, July 13-15, 2023

Amar Kakad

SimulationStudy of Altitudinal Reach of Earth's Radiation Belt Particles. (***Invited Talk***)

2nd Indian Space Weather Conference (ISWC-2) on deliberations on the science plans for the utilization of observations from the payloads of Aditya-L1 and DISHA missions, ISRO" held from 19-20 October 2023 at the Physical Research Laboratory, Ahmedabad.

Kakoti, G., M.S. Bagiya, F.I., Laskar and D., Lin

Exploring G1-Class Geomagnetic Storm Effects on the Ionosphere-Thermosphere System: A Case Study of SpaceX's Satellite Loss.

Mane, A.P., S.S. Mahajan, **R.N. Ghodpage**, **P.T. Patil, S. Gurubaran** and O.B. Gurav

Morphological effect of Equatorial Plasma Bubbles on GPS TEC.

Indian Geophysical Union (IGU) Diamond Jubilee Annual Convention, Cochin University of Science & Technology (CUSAT), Kochi, November 22-24, 2023

Monica, R. and **Anand, S.P.**

Lithospheric Anomaly map of the Indian sub-continent and adjoining Ocean - basic corrections and modelling of the satellite data.

Rajapandy, P., Pradnya Mohite, K. Deenadayalan, B.V. Lakshmi and **Priyeshu Srivastava**

New archaeointensity data from the 16th century CE in the historical town of Sindkhed Raja, Maharashtra.

Vishnu, K.N., **Md. Mujahed Baba, B.V. Lakshmi, K. Deenadayalan** and **Priyeshu Srivastava**

Mineral Magnetic and Geochemical properties of Holocene sediments from Dudhnai River, Assam, NE India.

Md. Mujahed Baba, B.V. Lakshmi, K. Deenadayalan, V.M. Rokade and S.N. Patil

Age constraints and magnetic fabrics of earthquake induced liquefaction features in the meizoseismal area of 1943 earthquake, NE India: Current understanding and future directions.

38th National Symposium on Plasma Science and Technology -PLASMA 2023, UPES Dehradun, December 04-08, 2023.

Arya, Neetasha and **Amar Kakad**

A generalized theory of lower hybrid drift instability in space plasmas.

National Space Science Symposium- 2024, Goa University, 26 February -1 March 2024

Ankita, M. and **S. Tulasi Ram**

A new method for deriving true height electron density profile from Ionograms.

Arya, Neetasha and **Amar Kakad**

Lower hybrid drift instability in Earth's magnetosphere.

Datar, Gauri and **Geeta Vichare**

Study of particle energization in the magnetosphere due to solar wind Dynamic pressure charges.

Gayathri B., S Sripathi and **Rajesh Kumar Barad**

Probing the evolution of the Equatorial Plasma Bubbles (EPBs) using ionosonde observations and its implication for their prediction.

Ghodpage, R.N., A. Taori, R.P. Patil, M.K. Patil, O. B. Gurav, **S. Sripathi** and **A.P. Dimri**

Using a ground-based airglow imager to observe cloud parameters.

Gurav, O.B., **R.N. Ghodpage**, A. Taori, **S. Sripathi, P.T. Patil** and A.P.Mane

Evidence of Interaction of Equatorial Plasma Bubbles with Medium ScaleTravelling Ionospheric Disturbances during post mid-night sector over Indian region.

Guru, K. Siba Kiran and **S. Sripathi**

A study on ionosonde derived true-height density profiles using POLynomial ANalysis and its comparison with COSMIC RO density profiles.

Lagad, Shubhangi, Amar Kakad and **Bharati Kakad**

Electron Plasma Wave Activity around the Earth's Magnetopause Region.

Nilam, B. and **S. Tulasi Ram**

The impact of Interplanetary (IP) shocks on Equatorial Electrojet (EEJ) – Empirical Relation.

Parihar, N.

Rare occurrence of off-equatorial edge initiating and equatorward surging plasma depletions observed in OI 630 nm imaging.

Patil, Omkar M., Rajesh Singh and **A.P. Dimri**

Extremely severe cyclonic storm Fani induced ionospheric perturbations.

Patil, P.T., Rupesh, N. Ghodpage and **A. P. Dimri**

Measurements of D-region electron density in the low latitudes station Kolhapur using MF Radar.

Sathishkumar, S., S. Sridharan and **K. Krishnapriya**

Simultaneous observations of terdiurnal and quarterdiurnal tide in the mesosphere and lower thermosphere (MLT) winds from two MF radars at Tirunelveli and Kolhapur.

Sau, S., V.L. Narayanan, D. Singh and **S. Gurubaran**

Comparison between rotational temperatures derived from a multi-filter photometer operated at Tirunelveli and SABER measurements.

Shah, Trunali, B. Veenadhari, Biswajit Ojha and **Satyavir Singh**

Impact of substorm associated dipolarization events on ion flux variations and wave activity observed from Van Allen probes.

Sripathi, S., B. Gayathri and **S. Banola**

Equatorial Plasma Bubbles (EPBs) as investigated using long term ionosonde observations over Tirunelveli and its comparison with satellite observations.

Thakur, Pranali, Gauri Datar, Geeta Vichare and **C. Selvaraj**

Low Energy Gamma-ray Variation on Ground during GRB 221009A.

Tulasi Ram, S. and **B. Nilam**

Extremely large and rapid variation of equatorial geomagnetic field due to impingement of an interplanetary magnetic cloud.

INTERNATIONAL

28th General Assembly of the International Union of Geodesy and Geophysics (IUGG), Berlin Germany, July 11-20, 2023

Bagiya, M.S. and Heki, K.

Observing the geohazards from the space.

Tabish, K. and **Anand, S.P.**

Architecture of sub-basalt structures of Deccan Volcanic province, India.

20th Annual meeting Asian Oceania Geoscience Society (AOGS), Singapore during July 30 to August 4, 2023 (Virtual)

Baba, Md. Mujahed, B.V. Lakshmi, K. Deenadayalan, V.M. Rokade and S.N. Patil

New evidence of earthquake induced liquefaction features in the meizoseismal area of 1897 Shillong earthquake, India.

Shah, Trunali, B. Veenadhari and M. Nosé

Arase and Van Allen Probes observations of variations in energetic ion pitch angle distribution and rapid flux variation during substorm time scales.

XXXVth URSI General Assembly and Scientific Symposium, Sapporo, Japan, August 19 - 26, 2023

Bhattacharyya, Archana

Space Weather Effects on GNSS signals at Equatorial and Low Latitudes.***(Invited Keynote)***.

KICK-OFF meeting EMERGE PROJECT, Ubatuba, Sao Paulo Brazil, August 21-25, August 2023 (Virtual)

Srivastava, Priyeshu

Red clays indicate sub-aerial exposure of the Rio Grande Rise during Eocene flood volcanic episode.

3rd International Workshop on Equatorial Plasma Bubble (EPB-3), Indian Institute of Geomagnetism, Navi Mumbai, September 13-15, 2023

Ankita, M., S. Tulasi Ram, K. K. Ajith and **S. Sripathi**

Deep electron density depletion near sunset terminator on St. Patrick's Day storm and its impacts on Skywave propagation.

Barad, Rajesh Kumar, S. Sripathi, S. Banola and **K. Vijaya Kumar**

Unveiling Tonga Volcano induced ionospheric disturbances and Equatorial Plasma Bubbles(EPBs) over the Indian region.

Bhattacharyya, Archana

Studies of Equatorial Plasma Bubbles using Ionospheric Scintillation Observations.***(Invited Keynote)***.

Kakoti, G., M.S. Bagiya, F.I. Laskar and D. Lin

"SpaceX" Storm of 3 - 4 February 2022: Unveiling the ionospheric-thermospheric conditions and irregularities during the Starlink satellite loss.

Mane, A.P., **R.N. Ghodpage**, S.S. Mahajan, R.S. Vatkar and **S. Sripathi**

Equatorial Plasma Bubbles and their Impact on VHF Scintillation and GPS TEC during January to April 2015 over low latitude station Kolhapur**.**

Sau, S., S. Gurubaran, and V. L. Narayanan

Study of the inter-depletion distances of EPBs from the dip equatorial region. ***(Invited)***

Saha, Sovan, D. Pallamraju, **R.N. Ghodpage**

Gravity Wave Scale Sizes associated with the Equatorial Plasma Bubbles observed over Low- and Off-Equatorial Latitudes in India.

Tulasi Ram, S., K.K. Ajith and **M. Ankita**

On the fresh generation of plasma bubbles around the midnight hours.

3rd International Conference on Plasma Theory and Simulations (PTS-2023) September 21-23, 2023

Amar Kakad

Electrostatic waves in the Martian plasma environment. **(Invited)**

7th Asia-Pacific Conference on Plasma Physics, Port Messe Nagoya, 12-17 November, 2023

Singh, Satyavir, K.C. Barik and **G.S. Lakhina**

Generation of kinetic Alfven waves in the magnetosphere. **(Plenary)**

104 Annual meeting of the American Meteorological Society (In-person), Baltimore, USA, 28 January – February 01, 2024

Hawes, S.S. and **S. Sau**

Preliminary Investigation of the Effects of Major Geomagnetic Storms on Mesosphere and Lower Thermosphere (MLT) Region Temperatures over Arecibo.

STUDENTS CORNER

Ph.D. DEGREES AWARDED FOR THE YEAR 2023-24

Sr. No.	Name of the Candidate	Research Guide	Title of the Thesis	University
1.	Ms. Shipra Sinha	Dr Geeta Vichare	Magnetosphere-Ionosphere Coupling using Integrated Measurements	University of Mumbai
2.	Ms. Gauri Datar	Dr Geeta Vichare	Study of Space Weather and Terrestrial Events using Secondary Cosmic Rays	University of Mumbai
3.	Ms. Adhitya Pavithran	Dr Geeta Vichare	Theoretical and observational studies of ultra-low frequency (ULF) waves relevant to geomagnetic phenomena	University of Mumbai
4.	Ms. Sreelakshmi J.	Dr Geeta Vichare	Investigation of Ionospheric Currents using Multi-spacecraft Swarm Mission	University of Mumbai
5.	Ms. Srinivas Nayak	Dr Mala Bagiya	Terrestrial Resonance Coupling during Great Earthquakes	Andhra University
6.	Ms. Nilam Bhosale	Dr. S. Tulasiram	Studies on Solar Wind - Magnetosphere interactive phenomena under quiet and disturbed space weather	University of Mumbai

Mr. Md. Mujahed Baba, Ms. Pradnya Mohite and **Mr. P. Rajapandy** participated in the CSIR's Integrated Skill Initiative program on *Palaeomagnetism and its applications in Geology, Geophysics, and Geochronology* held at CSIR-NGRI, Hyderabad, during January 1-6, 2024.

Ms. Pradnya Mohite participated in the India International Science Festival (IISF) 2023, held at Regional Centre for Biotechnology (RCB) campus, Faridabad, during January 17-20, 2024.

Shri Rajesh Kumar Barad

Awarded with Scostep Visiting Scholar (SVS) fellowship to visit Institute for Space Earth Environmental Research (ISEE), Nagoya, Japan.

Dr. Nilam Bhosale

Awarded with SCOSTEP's Visiting Scholar (SVS) fellowship to visit NASA-GSFC under SVS.

DEPUTATIONS/VISITS ABROAD

Name	Country visited	Duration	Conference/Workshop/Symposium
Dr. Geetashree Kakoti	Kenya	October 3-12, 2023	Participated in the training workshop on Space Weather and Low-latitude Ionosphere at Kenyan Space Agency, Malindi, Kenya
Mr Rajesh Kumar Barad	Japan	November 2023 to February 2024	Under Scostep Visiting Scholar (SVS) program visited Institute for Space Earth Environmental Research (ISEE), Nagoya, Japan
Dr. Nilam Bhosale	USA	June 2023 to August 2023	Under Scostep Visiting Scholar (SVS) program visited NASA-GSFC
Dr. Satyavir Singh	Japan	November 12-17, 2023	7th Asia-Pacific Conference on Plasma Physics, Nagoya

Antarctic/Arctic Expeditions

Name	Country visited	Duration	Expedition
Dr. Geeta Vichare	Himadri, NyAlesund	Sept-October 2023	-
Dr. Geeta Vichare	Maitri Antarctica	Summer	43rd ISEA
Mr. Subrata Moulik, Station Leader	Maitri Antarctica	Winter	43rd ISEA
Dr. T. Sreeraj	Bharati, Antarctica	Winter	43rd ISEA

DISTINGUISHED VISITORS

Prof. R. K Mall of DST - Mahamana Centre of Excellence in Climate Change Research (MCECCR), BHU Varanasi gave a lecture on “Climate Change : Indian Subcontinent Perspective”, on June 06, 2023.

Mr. Ninad Bhagwat of Montana Technological University Butte, Montana, USA gave a talk on “Modelling of Dynamic Snowmelt Runoff and Hydropower Generation based on Spaceborne Remotely Sensed Snow Cover and Ground Weather Network based Temperature and Precipitation Data”, on July 17, 2023.

Dr. Kieran Hunt, University of Reading, U.K delivered a talk on “Western disturbances and climate variability: a review of recent developments” on July 24, 2023.

Dr. Kalachand Sain, Director, WIHG, Dehradun and Member, Governing Council IIG, and Dr. Sunil K. Singh, Director, NIO, Goa, along with Prof. A.P. Dimri, Director, IIG, visited IIG Regional Centre, KSKGRL, Prayagraj on August 25, 2023. Dr. Gautam Gupta, Head, and Dr. Rajesh Singh, AIC, KSKGRL, accorded a warm welcome to Prof. A.P. Dimri, Dr. Kalachand Sain, and Dr. Sunil K. Singh on their arrival. An interaction session was arranged with the staff members. During the interaction, Dr. Sain deliberated upon the facilities available at the Laboratory and urged the staff to explore opportunities and maximize scientific output. Dr. Singh encouraged the staff and advised to show passion in research and take up new scientific problems and prove the relevance. Director, Prof. A.P. Dimri, counselled the staff to take up criticism and directed that inputs corresponding to purpose should be visible. The dignitaries visited the Petrology and Palaeomagnetic laboratories and showed keen interest in their operation and applications. They were taken around the Upper Atmospheric laboratory wherein the real-time plots acquired from the Observatory instruments, the Canadian Advanced Digital Ionosonde (CADI) and from VLF receiver were shown. The advice and invaluable guidance received will immensely help the Laboratory to move ahead in terms of scientific research. As a mark of remembrance, tree plantation was also organized during the visit.

Prof. H.K. Pandey, and Prof. R.P. Tiwari, Department of Civil Engineering, MNNIT, Prayagraj, visited the Palaeomagnetic and Petrological Laboratory at KSKGRL on September 5, 2023.

Prof. S. Patnaik, School of Physical Sciences, Jawaharlal Nehru University, New Delhi delivered a talk on “New materials for energy and information storage and transmission” on September 08, 2023.

Dr. Kalachand Sain, Director, Wadia Institute of Himalayan Geology, Dehradun gave a talk on “Climate induced phenomena in Himalaya and its plausible mitigations”, on October 06, 2023.

Dr. Sarveshwar Sharma, Scientist, Institute for Plasma Research, Gandhinagar, delivered a lecture on Investigating the effects of electron bounce-cyclotron resonance on plasma dynamics in capacitive discharges operated in the presence of a weak transverse magnetic field on October 13, 2023.

A lecture was given by Mrs. Chhaya Taralekar on the topic “POSH Act 2013 & constitutional rights, way to preserve dignity of women and jurisdication & preventing harassment”, to commemorate the ‘Sexual Harassment at Workplace Prevention Week’, on December 08, 2023.

Shri Brijesh Kumar Mishra, IPS delivered a talk on “A key to Live Happy and Success Life”, on December 15, 2023

Shri Brijesh Kumar Mishra delivering a popular talk on “A key to live happy & successful life”.

Prof. A.P. Dimri felicitating Shri Brajesh Kumar Mishra, IPS, during his visit to IIG, Panvel.

Dr. Sunil Bajpai, Professor, Indian Institute of Technology, Roorkee gave talk on “India’s epic northward Journey from Gondwana to Asia: what do fossils tell us?” onJanuary 05, 2024.

Following Distinguished Visitors visited the Environmental Magnetism Laboratory (EML) during the period April 2023-March 2024,

(i) Dr. S. Nawaz Ali, Scientist from BSIP, Lucknow, visited during July 13-15, 2023.

(ii) Governing Council, IIG visited on October 5, 2023.

(iii) Prof. Abhay Karandikar, Secretary, DST visited on March 8, 2024.

(iv) Dr. Anupam Sharma and Dr.S. Nawaz Ali, Scientists from BSIP, Lucknow, visited during March 11-15, 2024.

(v) Dr. Shweta Yadav, Central University of Jammu, Jammu visited EML.

Prof Abhay Karandikar, Secretary, DST, visited IIG, Panvel on March 08, 2024

DST Secretary Prof. Abhay Karandikar addressing during his visit at IIG, Panvel.

Prof. Abhay Karandikar inguarating the Magnetometer Sensor Laboratory at IIG, Panvel, in the presence of Prof. A.P. Dimri and other dignitaries from DST.

Prof. Abhay Karandikar inguarating the High Performance Computing Laboratory at IIG, Panvel, in the presence of Prof. A.P. Dimri and other dignitaries from DST.

Planting of sapling by DST Secretary Prof. Abhay Karandikar at IIG, Panvel.

Prof. Abhay Karandikar, Prof. A.P. Dimri, dignitaries from DST and staff members of IIG.

HONOURS AND AWARDS

Dr. Geeta Vichare

Member of Subject Expert Committee (SEC) on Earth & Atmospheric Sciences for Women Scientists Scheme (WISE) of DST.

Dr. Bharati Kakad

Member of organizing committee for the international workshop on Women in Plasma Physics (WIPP) held as a part of 7th AAPPS-DPP, 2023, November 12-17, 2023, Nagoya, Japan.

Dr. Gautam Gupta

Member, Board of Studies, Department of Geotechnology, Manonmaniam Sundaranar University, Tirunelveli, 2023.

Associate Editor, Journal of Ground Water Research, ISSN Number (ISSN 2321-4783), 2023-2024.

Member, National Editorial Advisory Board, Bulletin of Pure & Applied Sciences (Geology), eISSN: 2320-3234, 2023-2024.

Dr. S. Tulasiram

Guest Editor, Special issue on SCOSTEP 15th Quadrennial Solar-Terrestrial Physics Symposium (STP-15) in Journal of Atmospheric and Solar-Terrestrial Physics (JASTP).

Dr. Satyavir Singh

Chaired a session on “Wave-Particle Interaction” (SG1, November 13, 2023) at “7th Asia-Pacific Conference on Plasma Physics (AAPPS-DPP 2023)” November 12-17, 2023, Port Messe Nagoya, Japan.

Dr. Amar Kakad

Selected as an Editorial Board member of the journal “Discover Space’ by Springer Nature.

Chaired a session at 3rd conference on Plasma Simulations at Raman Sceince Center, Indian Institute of Astrophysics, Leh Ladakh, India during July 13-15, 2023.

Neetasha Arya and **Amar Kakad**

Best paper award at the 22nd National Space Science Symposium (NSSS) organized by Goa University and ISRO, Goa, 26 February - 01 March 2024, for the paper Lower Hybrid Drift Instability in Earth’s Magnetosphere

TRAINING IMPARTED

Dr. Anand, S.P.

Ms. Mihika Sathe, from Department of Geology, Xavier’s College, Mumbai, carried out summer training during May-June 2023 on the topic “A Comparative study of Geoid, Ellipsoid and EGM 2008 Model”.

Ms. Jishma Jayan, A.P.J. Abdul Kalam Technological University, Kerala, carried out summer training from May to July 2023 on the topic “Magnetic Investigations in geotechnical Engineering: Case Studies”.

Dr. M. Ponraj & Dr. Ajish P. Saji

Shri Eleazer Wanniang, Project Assistant at NEGRL was imparted GNSS instrument hands-on and in-situ field training.

Dr. B.V. Lakshmi

Ms. Sreelakshmi, Dept. of Geology, Central University of Karnataka, has done her M.Sc. Project work on “Mineral magnetic and Anisotropy of magnetic susceptibility properties of sediments from selected sites in India”, during February 2024-May 2024.

Dr. Gautam Gupta

Currently one M.Sc. student, Amith Krishnan, Dept. of Geology, Central University of Karnataka is perusing his dissertation work on palaeomagnetic studies of Dalma volcanic, eastern India.

Dr. Anup K. Sinha

Currently one student from Department of Geology, Central University of Punjab is perusing dissertation work in the Palaeomagnetic and Petrological laboratory. She is working on Mandla lobes samples from DVP. One more student from Central University of Karnataka is perusing his dissertation work in petrological studies of Dalma volcanics from Singhbum Craton.

Earlier, a total of 5 M.Sc. students from Department of Geology, Central University of Punjab, completed their dissertation work as part of M.Sc. curriculum, in the

Palaeomagnetic and Petrological laboratory during March-June 2023. They have worked on Environmental study of the roadside dust samples, Palaeomagnetic and Petrological studies on the dykes and granites samples of Singhbhum and Bundelkhand Craton.

Ramesh K. Nishad

Five students from Central University of Punjab and three students from Anna University, Chennai, Tamil Nadu received laboratory training in palaeomagnetic, rock magnetic, and anisotropy of magnetic susceptibility. The training involved reorientation of oriented block rock samples, preparation of standard size specimens, and utilization of instruments such as AF and thermal demagnetizers, KLY-2 Kappabridge, and MS2B Barrington susceptibility instrument. This training spanned one to three months and was part of their dissertation work and summer internship, in the palaeomagnetic laboratory.

Presently One M.Sc. student from Central University of Punjab is doing her dissertation under joint supervision of Dr. Rajesh Singh at KSKGRL, Prayagraj.

Sujit K. Pradhan

Presently, two M.Sc. students from Central University of Punjab and one M.Sc. student from Central University of Karnataka, are pursuing their dissertation work at KSKGRL, Prayagraj.

Dr. Navin Parihar

Internship Guidance rendered to Ms. M. A. Parameswari, M.Sc. (Integrated) Student, Department of Physics, M. S. University, Tirunelveli.

Dr. Rajesh Singh

Mr. Swarnendu Saha, a BS-MS (3rd Year) student from IISER Kolkata was supervised for the summer project ""Understanding the Meteorological Properties of Super Cyclonic Storm over Bay of Bengal" at KSKGRL IIG, Prayagraj.

PARTICIPATION IN SPECIALIZED WORKSHOPS/TRAINING COURSES

K. Deenadayalan

Participated in Brainstorming workshop on "Deccan Magmatism and its Implications on the Evolution of Western Continental Margin of India" held at Department of Earth Sciences, IIT, Bombay during March 29-30, 2023.

B.V. Lakshmi

Online meeting with Scientists of Birbal Sahni Institute of Palaeosciences (BSIP), regarding possible Geophysical survey in lakes, India using Ground penetrating Radar (GPR).

Participated (Nominated) in Brainstorming meeting (hybrid mode) on the "Geophysical aspects of Geological Exploration of Amery Ice Shelf (GeoEAIS)" held at NCPOR, Goa, on May 18, 2023.

Gandla Shailaja

Attended a 1-day Brainstorming workshop on "Exploring Deep Aquifers", organized by Groundwater Surveys and Development Agency (GSDA), Govt. of Maharashtra, on June 16, 2023, and was awarded a certificate of participation.

Gautam Gupta and **E. Karthikeyan**

Attended the Inaugural of IGU- Student Chapter and Azadi ka Amrit Mahotsav lecture on "Structure and Tectonics of the Eastern Continental Margin of India: Constraints regional and basin scale integrated geophysical studies" by Prof. M. Radhakrishna, Dept. of Earth Sciences, IIT Bombay, on September 1, 2023.

Flawiya More

Attended "Applied Remote Sensing Training (ARSET) on Monitoring Water Quality of Inland Lakes using Remote Sensing" (Session - A), organized by NASA on July 18, 20 & 25, 2023.

Attended "The Southbound Resilience Webinars: Water Governance for Ecosystem-based Adaptation" organized by ECOBARI-WOTR on August 22, 2023.

Geetashree Kakoti

Eastern Africa Capacity Building Workshop on Space Weather and Low-latitude Ionosphere, organized by ICTP, and INGV, Italy from 03 - 12 October 2023 at Kenyan Space Agency, Malindi, Kenya.

Navin Parihar

Online Training Programme on "Right to Information - Public Information Officers" conducted by Institute of Secretariat Training and Management (ISTM), New Delhi during 04-06 March 2024.

OFFICIAL LANGUAGE (HINDI)

Rajbhasha Adhikari : Amar P. Kakad
Asst. Director (Official Language) : J. Kamra

In compliance with the provisions of the Official Languages Act, Rules made thereunder, the Annual Programme, and other directives issued from time to time by the Department of Official Language, the Institute regularly undertakes some important and special activities to enhance the progressive use of official language Hindi among its staff members.

The Institute has organized 'Hindi Mah' during September-October, 2023. During this period, Essay Writing, General Knowledge, Word Construction with prefix and suffix, Hindi Typing on computer and Hindi book review competitions were organized which were well attended by the staff members & research scholars. A total number of 40 prizes were given in these competitions.

Shri J. Kamra welcoming the Chief Guest, and giving a brief sketch of the various activities held during Hindi Mah celebrations.

The Chief Guest Shri Kamakhya Narayan Singh addressing the IIGans during celebration of Hindi Mah.

Staff members participating in various competitions during Hindi Mah celebrations at IIG.

The Institute celebrated World Hindi Day on 10th January 2024 during which the winners of competitions under Hindi Mah were awarded prizes by the Director of the Institute Prof. A.P. Dimri.

Prof. A.P. Dimri addressing IIG staff during celebration of World Hindi Day.

During the year, the Institute actively participated in various competitions organized by Navi Mumbai Town Official Language Implementation Committee (TOLIC). The Institute also participated in the best house magazine competition of TOLIC and bagged first prize for its six monthly house magazine 'Spandan' in the central government offices category. The 'Spandan' also bagged second prize among all the autonomous institutes under DST. This award has been initiated by the DST from this year. Dr. Priyeshu Srivastava, Reader and Shri. Varun Dongre, Technical Officer-II participated and presented research work in 'First All India Scientific and Technical Official Language Seminar' organized by ARCI, Hyderabad on 21-22 March, 2024. Dr. Priyeshu Srivastava also Co-Chaired third session of this event. Apart from it, Ms. Madhavi Jadhav,

TO-IV of the Institute received 3rd prize in the article competition organized by Atomic Energy Department under the aegis of TOLIC, Navi Mumbai, and Shri Varun Dongre, TO-II of the Institute received 2nd prize in the Extempore Speech competition organized by TOLIC, Navi Mumbai.

Dr. Priyeshu Shrivastava receiving certificate from Prof. Abhay Karandikar, Secretary and Mrs. A. Dhanalakshmi, Joint Secretary, Department of Science and Technology, New Delhi

Mr. Varun Dongre receiving the award from Mrs. A. Dhanalakshmi, Joint Secretary, Department of Science and Technology, New Delhi

The Hindi House Magazine "SPANDAN" is being published on a six-monthly basis (2 issues annually), which includes both scientific & technical articles. The magazine is being sent to various scientific & educational institutes/universities in the country.

During the year, four Hindi Workshops were organized on different topics for the staff of the Institute, in which around 132 members participated.

Dr. Rakesh Kumar Parashar, Dy.Director, Hindi Teaching Scheme providing guidance to the staff at Hindi Workshop.

Under the annual incentive scheme, during the Annual Day Celebrations, 10 staff members of the Institute were awarded with cash prizes for doing their official work in Hindi throughout the year. Apart from this, 5 children of employees were awarded with cash prizes for excelling in the Hindi/Sanskrit subjects in 10th Class.

Director, Rajbhasha Adhikari, and Asstt. Director (Official Language) of the Institute attended various meetings/ seminars held under the aegis of TOLIC, Navi Mumbai and other organizations.

SCIENCE OUTREACH ACTIVITIES

Indian Institute of Geomagnetism, a premier institute conducting basic and applied research in the field of Space Science and Geomagnetism, is regularly conducting various public outreach activities for the students and common people. In the past year, 2,370 students from more than 30 schools and colleges across the nation have benefited from this program. The public outreach program has been actively operational at all regional centers and magnetic observatories of IIG. Public outreach activities are also carried out in local regional languages to reach out a greater number of young students coming from the grassroots level.

Students being explained the concepts of geomagnetism and allied fields through instruments during IISF curtain raiser program at IIG Panvel campus.

Students of Atharv Engineering College, Mumbai during their visit to IIG, Panvel.

Real-time observations of solar surface and sunspots via telescope are also arranged, which is always been very fascinating. The quiz and slogan competitions, comic books, rock display, audio-video shows are the common features of the public outreach program.

NATIONAL SCIENCE DAY 2024

National Science Day is being celebrated on February 28 every year in commemoration of Sir C.V. Raman's discovery of the Raman Effect on February 28, 1927. The theme for National Science Day 2024 is ***"Indigenous Technologies for Viksit Bharat"***. Its emphasis is to raise awareness and use of indigenous innovations and technologies which can contribute to scientific progress, development and well-being of India's people.

National Science Day popular talk was given by Dr. Sudip Bhattacharyya, TIFR, Mumbai on 28 February 2024 on "AstroSat: an Indian multiwavelength astronomy space mission"

Chief Guest Dr. Sudip Bhattacharyya, TIFR, Mumbai, delivering the National Science Day popular talk on "AstroSat: an Indian multi-wavelength astronomy space mission", at IIG.

Prize winners of various competitions held during Science Week 2024 celebrations.

School & College students, visitors and staff members along with Chief Guest Dr. Sudip Bhattacharyya and Prof. A.P. Dimri during National Science Day 2024 celebrations.

Seminar/workshop/events conducted by IIG under outreach activities:

1. On 26 December 2023, Indian Institute of Geomagnetism conducted a curtain raiser event for IISF 2023 to be held at Faridabad, Haryana during 17-20 January 2024. Over 150 students enjoyed various science outreach activities like talks, rock display, comic books, solar observations, 3D globe etc.
2. Prof. Dibyendu Chakrabarty, Physical Research Laboratory, Ahmedabad delivered a special lecture on Understanding Sun, Solar wind and space weather through Aditya Solar wind Particle Experiment (ASPEX) on board Aditya L1 Mission during IISF curtain Raiser program on December 26, 2023 at IIG New Panvel.

Dr. S. Somanath, Chairman of the Indian Space Research Organisation (ISRO) being explained the research activities of IIG and the concepts of geomagnetism through posters during his visit at the pavilion of IISF at Faridabad.

Dr. Dibyendu Chakrabarty, Physical Research Laboratory, Ahmedabad, delivering a Guest lecture during IISF curtain raiser program at IIG Panvel campus.

Participants of the IISF curtain raiser program at IIG Panvel campus.

3. Drawing and Eassy competitions have been organized at Indian Institute of Geomagnetism as a part of National Science Day.

4. National Science Day celebration at Regional centre and Magnetic observatories of Indian Institute of Geomagnetism.

School students participating in the sit and draw competition during the Science Week 2024 celebrations at IIG.

Students displaying their drawing and painting during the Science Week celebrations.

ERP AND COMPUTER SERVICES

Chief Coordinator : Remya Bhanu

Members : Mahendra Doiphode, Rakesh Nimje, Tejashri Bari, Nanda S. Shah

Computer Section

Implemented new HPC system to fulfill the High computing needs for simulation and modeling purposes for the scientists at the institute. KSKGRL IT and network infrastructure is revamped to obtain seamless IT services. Considering the increasing need for storing the scientific data sets, the new storage units procured and installed successfully under institute's data policy committee initiative. Server virtualization is used to fulfill the increasing needs of various servers for administrative and scientific experiments. Provided regular support to administrative departments and scientific IT related requirements and facilities.

As a routine practice uninterrupted IT services are provided to the staff members. Improved network security at H.Q. network setup and bring all regional centers and observatories under single central security management. The VPN tunnels are also established between all centers and all major observatory locations. Virtual conference setup procured and successfully installed at auditorium and director boards room as part of enhanced virtual communication with regional offices and outside scientific communality.

All necessary Cyber security practices implemented as per cyber security guidelines by the MietY and CERT-In for conducting regular IT security audit from the CERT-In empanelled IT auditor by signing Non disclosure agreement before initiating the IT audit activity. Annual security audit of the IIG website is also conducted from the CERT-In empanelled Security auditor. GIGW SQTC certification is received for IIG website and yearly SSL certification is also availed for IIG website and ERP web application.

ERP

ERP System has been implemented in IIG since January 2019 with the vision of computerization, automating the existing processes & streamlining systems. All the modules related to HRD are made live since last year and are being successfully used by all IIG staff and students. Currently the live modules in ERP are Leave module, tour advance, LTC advance, CEA, property declaration and DakSeva. These live modules are running seamlessly and are being upgraded as per the requirements. As a part of this up gradation APAR forms are added in the ERP Portal so that employees can download APAR forms prefilled with Personal Data from their ERP Portal login.

Along with ERP System NIC forms are also being used for various purposes like JRF & Project Assistant Recruitment, collecting the information regarding iGOT portal from all the employees. These forms provide a platform for quick collection and analysis of data.

ERP portal being used is ensured with Data & Application security. For Data security, routine backups & server for Disaster recovery is set up. This will ensure the availability of latest data in case of any disaster for application security.

Compliance to Cyber Security

The ERP system is web based software application with front end in JSP and backend in My SQL database. Considering the sensitivity of data maintained by this portal, following steps are taken to strengthen the security of the portal and ensure the compliance to CERT-In guidelines

(i) Security audit of the portal is done to ensure that the software is Safe To Host as per CERT-In guidelines by the CERT-In empanelled vendor. During this security audit, remote access of ERP Portal was given to the agency. After the completion of security audit, the access is removed and all the shared credentials are changed.

(ii) Access to the Application and Database of this system is restricted and only authenticate users are allowed. The users of the portal are also authenticated by using the passwords with Captcha for login and auto logout if the portal is idle.

(iii) Access to the portal is secured with SSL Certificate Data is protected by using Java Enabled security & encryption while transmission. SSL is implemented which ensures secure transmission of data over network along with this strong cipher are implemented which will not enable the attackers to decrypt the data in transmit and TLS protocol is upgraded to TLS 1.2 which further strengthens the security of data transmission.

(iv) Periodic backup with the interval of 6 hours is scheduled on the server.

(v) The server for this portal is linux based and is secured with IIG firewall. All the ports of the server are closed except DNS, HTTP, HTTPS, SMTP which are required for public access of the portal over network. Telnet Port with restricted access is open for maintenance of the server.

LIBRARY AND DOCUMENTATION

Chief Coordinator : Satyavir Singh
Coordinator : Smita Chandra

Members : B.I.Panchal, Sachin Jadhav

Library:

The IIG Library continued to render its services of knowledge dissemination to the scientists, students, and technical staff at its headquarters, regional centers, and observatories by means of acquisition, collection management, and dissemination of the library resources. The Library staff with the help of the IIG management delivered quality services both via the online medium and offline physically.

The collections added during the period are as follows:

Sr. No.	Collection	Added during 2023-2024
1.	Books, Thesis, Hindi Books, Project Reports	225
2.	*Journals/e-Journals subscribed by Library	27
3.	Scientific Publications of IIG	75
4.	**Total**	**327**

**(The above list excludes the list of more than 1400 e-journals + Databases subscribed by the CSIR/DST-NKRC Libraries consortia for the IIG library.)*

Besides rendering library help on a daily basis, some of the important activities and services carried out by the library during this period are as follows:

1. The library completed the task of data cleaning and enriching metadata for approximately 12000 records of English Books, Hindi Books, and Ebooks, using Open Source tools like OpenRefine.
2. Data cleaning, enrichment, and refinement of more than 13000 bound volumes, and more than 800 maps for migration to KOHA.
3. New server was acquired and configured for migration to the open source library management software KOHA. Tests were carried out and are on-going with the server for the successful migration of the first batch of records.
4. Selecting an expert in KOHA installation and data migration, getting approvals by the competent authority for the same, at no cost to IIG, and enabling the visit of the expert to IIG after approvals.
5. Working with the expert to resolve and/or reconfigure the new server acquired for KOHA. Helping the expert in the migration of the data of books, ebooks and Hindi books.
6. Learning the new features of the software, creating and migrating entire profiles of patrons for enabling the Circulation system on KOHA.
7. Enabling the transfer of more than 12000 books, ebooks, and Hindi books into the new library management software KOHA 23.05 software.
8. Patron records were created and entire Patron data was updated, both manually as well as via automated means into KOHA 23.05.
9. The Library Web-Page was also made accessible via the KOHA software. This Page not only serves as a Web-OPAC, but also as an interface to Library Information & Services.
10. The Library engaged in the procurement of Books via the tendering process.
11. The institutional repository server and software were upgraded and bugs were identified. Work is going on cleaning the data within the repository. Efforts are on to increase the functionality of the Dspace IR software, using outsourced technical support. More than 250 records were added, during the year, which also included for the first time a collection of Popular Science articles by one of our late IIG staff in Marathi.
12. Generation of Research metrics figures related to the number of publications, the impact factor, the h-index, citations of papers produced during the year, etc. The trends analyzed for the top authors of the institute, the top publishers the scientists chose to publish their article with, and the top journals the scientists chose to publish in for the year were collected, the number of Open Access articles published, etc was prepared by the library using tools like the Web of Science and in-house data collected by the library.

13. Library orientation to new students covered topics like the collection, services, facilities, etc both online as well as physically.
14. The library carried out the Stock-Verification including physical verification and re-arrangement of books and bound journals within the premises and compactor area to make for more space for books/bound volumes in the future.
15. The Library Staff, excelled in the 'Pragya' and 'Parangat' courses of the Rajbhasha Vibhag, and committed to working in Hindi as well.

Ways in which the Library was used by Library Patrons:

1. An Average Daily Footfall for the HQ Library was more than 30 per day.
2. An approximate Circulation transaction of more than 900 during the period.
3. An approximate number of more than 150 Abstracts on Display handled by the Library
4. Hindi Mah Celebrations saw a record number of users borrowing and reading Hindi books from/in the Library at the HQ.
5. The usage of Online Journals, subscribed both via the Library as well as by the CSIR/DST NKRC Library consortia was satisfactory.
6. The Library saw a preference to the OA resources by publishers.
7. The Library saw an increase in the number of students requesting for ID creation for iThenticate software for Plagiarism Checks.
8. The demand of Remote access to resources subscribed by the Library was high as always.
9. Library received a number of new requests for access to more resources, like a Library ID card, Self-Check Circulation Desk, etc.
10. The Online Presence of the Library, via the OPAC/ Web-Page, QR Code, saw fresh students self- help themselves due to the ease of enabling access to resources.

Initiatives for the Future:

1. The Library intends to break barriers to access to Library information from various resources of the Library and give a single search user interface.
2. The Library intends to explore capabilities of AI using various Open Resources currently available for education and research.
3. The Library intends to integrate AIP keys from various publishers into the KOHA Library Management Software, to enable a faster and easier mechanism for library staff to work with.

The Documentation Section provides services like designing, printing, photography, editing, scanning and digitizing etc. to the various activities of the Institute.

a. Science Outreach Activities

- In house designing and printing of Scientific posters and banners for Science Outreach Activities.
- Designing and printing certificates for the winners of various competitions.
- Designing and printing posters in Hindi language for Hindi medium school.
- In the year 2023-24, new brochures and bookmarks showing the achievements of the institute were updated and printed in Hindi and English languages.

b. IIG Website

- Photography of all programs of the Institute for uploading on the website.
- Providing photographs (in specific format) of employees for the IIG website when required.

c. Seminars/ Symposium/ Workshop

- Designing and in-house printing of banners, IMPRESS Students ID cards, certificates and Invitation Cards etc. for IMPRESS 2024.
- Making Flyer document for Website, Designing & Composing 64 pages Abstract Book and printing of 80 copies, Designed Printed In-House ID cards for participants, Banners, Posters & Invitation Cards for **Equatorial Plasma Bubble (EPB-3) Workshop** held at IIG during September 13-15, 2023.

d. Rajbhasha Hindi

- Preparation of scientific posters (with image editing) in Hindi language during the visit of Hindi Parliamentary Inspection Committee 2024 and providing all other necessary support.
- Photography and banner preparation for *Hindi Mah* and International Hindi Day celebration at Institute.

e. IIG Publication

- Involved in editing scientific images and photographs for Annual Report and Spandan hindi magazine as per publication standards.

f. Regular updating of the Magnetic Observatory Network Map.

g. Scientific Publication and Field Survey

- Editing, modification and designing new scientific figures for scientific and technical staff as per their requirement.
- Scanning and printing of topographic maps in multiple parts to facilitate scientific fieldwork.

SPECIAL EVENTS

3rd International Workshop on Equatorial Plasma Bubbles (EPB-3)13-15 September, 2023, Indian Institute of Geomagnetism (IIG), India.

The 3rd International Workshop on Equatorial Plasma Bubbles (EPB-3) has been successfully organized by Indian Institute of Geomagnetism during September 13-15, 2023. This workshop has been formally inaugurated by Dr. Anil Bhardwaj, Director, Physical Research Laboratory on September 13, 2023. Three special plenary lectures have been delivered on each day on important topics like “Plenetary exploration program of India” by Dr. Anil Bhardwaj, “Variability of the Sun from India’s observatory class mission Aditya-L1” by Dr. Dipankar Banerjee and “Understanding the behavior of the Indian Monsoon cross equatorial flow in a warming climate by Dr. R. Krishnan.

Inauguration of the 3rd International Workshop on Equatorial Plasma Bubbles (EPB-3) organized by Indian Institute of Geomagnetism during 13-15 September 2023.

Prof. A.P. Dimri welcoming Chief Guest Dr. Anil Bhardwaj, during the 3rd International Workshop on Equatorial Plasma Bubbles.

Prof. A.P. Dimri addressing the participants during the 3rd International Workshop on Equatorial Plasma Bubbles at IIG Panvel.

Dr. Anil Bhardwaj, Director, Physical Research Laboratory delivering the Special Plenary lecture on “Planetary exploration program of India”, during the 3rd International Workshop on Equatorial Plasma Bubbles at IIG Panvel.

Special Plenary lecture on “Variability of the Sun from India’s observatory class mission Aditya-L1” being delivered by Dr. Dipankar Banerjee during the 3rd International Workshop on Equatorial Plasma Bubbles. Also seen (in inset) Prof. A.P. Dimri felicitating Dr. Dipankar Banerjee.

A total of 51 participants including both foreign and Indian nationals with a fine blend of senior and young scientists have participated in this workshop. The scientific sessions are organized in five thematic sessions that cover a wide range of topics like EPB genesis, morphology, day-to-day variability, geomagnetic storm time variability and societal relevance, and possible prediction. Three keynote talks and thirty invited oral talks have been presented in these five thematic scientific sessions besides a poster session where the young scientists had the opportunity to showcase their work and interact/discuss with the experts at length.

Finally, the workshop concluded with a brief overview on the deliberations and future directions for the EPB research by Dr. A.K. Patra, Director, National Atmospheric Research Laboratory in the valedictory session. The valedictory address is given by Dr. R. Krishnan, Director, Indian Institute of Tropical Meteorology on September 15, 2023.

Valedictory address given by Dr. A.K. Patra, Director, NARL.

Planting of sapling by Dr. Anil Bhardwaj during EPB workshop.

Dr. S. Tulasiram has served as a Convener and Prof. A.P. Dimri has chaired the Local Organizing Committee.

Dr. Anil Bhardwaj and Prof. A.P. Dimri with school students.

World Environment Day – June 5, 2023

Indian Institute of Geomagnetism (IIG) celebrated World Environment Day with various activities about Mission Lifestyle for Awareness (LiFE) with special emphasis on the theme of 'Beat plastic pollution' during June 5-6, 2023. On June 5, 2023, IIG organized a rally to increase the awareness on water conservation, minimizing food wastage and reducing plastic pollution. Notable events included interactive seminars with the expertise of Prof. B.K. Sapra, Head, Radiological Physics and Advisory Division Bhabha Atomic Research Centre, Mrs. Chhaya Taralekar, Eco Warrior, and Dr. Ashish Gupta, Dy. General Manager (HSSE), Bharat Petroleum Corporation Limited, centered on variety of topics like nanoparticles and environment pollution and substitute to plastic for sustainable living. On June 6, 2023, awareness campaigns on water conservation, food wastage and the harmful effects of single-use plastic on the environment were organized in various slum areas of Navi Mumbai. Drawings books and pastel colors along with a theme-based picture on save water for coloring were also distributed to the slum children during these campaigns.

Dignitaries and Participants of the International Workshop on Equatorial Plasma Bubbles.

Indian Institute of Geomagnetism (IIG) celebrated World Environment Day with various activities about Mission Lifestyle for Awareness (LiFE) with special emphasis on the theme of 'Beat plastic pollution'.

Dr. B. K. Sapra delivering a lecture during World Environment Day at IIG, Panvel.

Staff members taking pledge during World Environment Day.

IIG organized a rally to increase the awareness on water conservation, minimizing food wastage and reducing plastic pollution during World Environment Day celebration.

International Day of Yoga –June 21, 2023

International Yoga Day (IDY) was celebrated at Indian Institute of Geomagnetism on 21st June 2023 with participation from IIG's Ph. D. research scholars, staff and their families. Two Yoga Karyashalas based on the Common Yoga Protocol (CYP) by Ministry of Ayush were conducted at the Panvel campus. A lecture on Stress Management at Work was also organised. The staff and scholars of IIG were encouraged to make the Yoga part of their daily life and to promote and propagate the CYP to as many household as possible under 'Har Aangan Yog'. Staff from observatories and Regional Centers of IIG across the India also celebrated the IDY at their respective plavce with great enthusiasm.

Staff members attending lecture with demonstration of various yoga postures and its usefulness during the International Yoga Day celebrations at IIG, Panvel.

Angdaan Mahotsav

As part of the Angdaan Mahotsav, IIG celebrated Indian Organ Donation Day on 03 August 2023. Dr. Dattatray Bhusare, MBBS, MS (Gen. Surgery), MCh, Professor and HOD, Department of Emergency Medicine, MGM Medical

Dr. Dattatray Bhusare, delivered an insightful talk highlighting the importance of organ donation and transplant activities, during the Angdaan Mahotsav on August 3, 2023 at IIG.

Organ donation pledge taken during Angdan Mahotsav

College and Hospital,Navi Mumbai, delivered an insightful talk emphasising the importance of organ donation and organ transplant activity. As NOTTO says, Give the Gift of Life, Become an Orgon Donor. This message was clearly conveyed by the eminent speaker. The talk was followed by the अंगदानप्रतिज्ञा where IIG staff participated enthusiastically.

Har Ghar Tiranga

IIG celebrated 77th Independence Day of India on August 15, 2023 with patriotic fervor. As part of these celebrations, 'Har Ghar Tiranga' and 'Meri Mitti Mera Desh' campaign was organised at IIG on August 14, 2023. The flag hoisting ceremony was performed at IIG, Panvel, its regional centres and observatories on August 15, 2023. The flag hosting was followed by singing of national anthem.

Celebrating Independence Day with pride and unity under the 'Har Ghar Tiranga' and 'Meri Mitti Mera Desh' campaign, as we honour the nation's spirit and the tricolour that unites us all.

Flag hoisting ceremony during 77th Independance Day at IIG New Panvel

The Vigilance Awareness Week 2023

As per the CVC directives, Vigilance Awareness Week 2023 was observed by Indian Institute of Geomagnetism during October 30 to November 05, 2023. The CVC's theme for this year was "Say no to corruption; commit to the Nation". The week began with administering the integrity pledge on October 30, 2023. Prof. A. P. Dimri, Director, IIG administered the integrity pledge to the staff. During the Vigilance Awareness Week, a half-day training on "Procurement through GeM" was organized for all the staff of IIG on November 02, 2023. Shri. J. K. Chatterjee (a GeM expert) from MSME (Micro, Small & Medium Enterprises) Mumbai Division was invited as a trainer to this training program. He elaborated on how efficiently one can use GeM portal for the procurement of goods and services to maintain transparency. During training, he also discussed various aspects of vigilance angles in the procurement of goods and services.

Staff members taking oath during Vigilance Awareness week & Shri. J. K. Chatterjee (a GeM expert) from MSME (Micro, Small & Medium Enterprises) Mumbai delivering a popular talk on GeM portal for the procurement of goods and services to maintain transparency.

G20 Research Innovation Initiative Gathering (RIIG) and Research Ministers Meeting (RMM)

The G20 RIIG & RMM event was held at the Jio World Convention Centre on July 4-5, 2023. Prof. A. P. Dimri, Director, IIG, attended as a Guest Invitee (Green Badge) at this prestigious event. Under the aegis of DST, New Delhi, IIG actively participated in the G20 event, with 18 IIG staff members serving as Liaison Officers (LOs) to both international and national delegates.

Most of the IIG LOs (Yellow Badge) who were associated with international delegations worked alongside an LO from DST. Notably, Dr. Navin Parihar (G20 Team India Orange Badge) served as the primary and sole LO to the Australian Delegation. Additionally, around 10 IIG LOs were assigned as Liaison Officers to Ministers, Secretaries, and Heads of Delegation from countries including Australia, Argentina, Brazil, the Netherlands, Oman, Singapore, Saudi Arabia, South Africa, South Korea, and the United Kingdom. Other LOs supported Secretaries and OSDs from CSIR, DST, DBT, and MoES.

The DST officials issued comprehensive guidelines outlining the duties of LOs. The primary responsibilities of IIG LOs included: (i) establishing contact with the Delegation Accreditation Officer (DAO) to gather essential information, particularly travel plans, and coordinating with DST's G20 Secretariat to relay administrative circulars and relevant program details; (ii) ensuring the smooth, secure, and hassle-free arrival and departure of delegates from the airport to the hotel by coordinating with security and logistics teams for pick-up and drop-off; (iii) informing the Secretariat of any special movement requests for local sightseeing, shopping, etc., seeking directions, and escorting the delegates as required; (iv) keeping delegates informed about the venue, program schedule, bilateral meetings, cultural activities, meals, etc.; and (v) addressing special requests from delegates, such as providing interpreters.

Director IIG interacting with dignitaries during the G20 RIIG & RMM event

With sincerity and dedication, IIG LOs carried out their liaison duties from July 2 until July 7, personally attending to even the smallest needs of the delegates. Their sincere efforts were highly appreciated by DST's G20 Secretariat, as well as by both international and national delegates.

Group Photograph of a few Liaisoning Officers from IIG during the G20 RIIG & RMM event.

Ekta Divas -31 October 2023

Ekta Divasis celebrated on October 31, 2023 to mark the birth anniversary of Sardar Vallabhbhai Patel. A Rashtriya Ekta Diwas Pledge was also read out collectively.

Staff members taking oath during Ekta Divas.

Ayurveda Day-November 09, 2023

Ayurveda Day was celebrated on November 09, 2023 at IIG. Theme for Ayurveda Day for this year was 'Ayurveda for One Health' with a tagline 'Ayurveda for Everyone in Everyday'. Dr Santosh Kumar Pandey delivered a lecture on this occasion which was followed by Nadi Chikitsa session and Checkup for the staff members.

Prof. A.P. Dimri welcoming Chief Guest Dr. Santosh Kumar Pandey, during celebration of Ayurveda Day.

Chief Guest Dr. Santosh Kumar Pandey, addressing the IIGans during celebration of Ayurveda Day.

Republic Day-January 26, 2024

IIG HQ, its regional centres and observatories proudly and fervently celebrated the 75th Republic day to commemorate the adoption of constitution of India.

Honouring the spirit of the Republic, and upholding the values of our Constitution on this proud Republic Day.

Inspiring the Minds of Post-Graduates for Research in Earth and Space Sciences (IMPRESS)

To attract, motivate, and train young talent to undertake research in geomagnetism and allied fields, IIG every year organizes the "IMPRESS" program for post-graduate students from universities. IMPRESS-2024 was organized at the Panvel campus during February 12-15, 2024. This year 150 applications from over 35 national universities and institutes were received. Among these, 80 students covering universities and institutions from across India were selected. The program began with the inauguration and a special inaugural lecture by Prof. S. K. Tandon (Indian Institute of Science Education and Research, Bhopal) and a keynote lecture by Prof. Nitin Karmalkar (Savitribai Phule Pune University).

Prof. A.P. Dimri addressing the participants of IMPRESS 2024.

Prof. A.P. Dimri extending a floral welcome to Prof. S.K. Tandon at IMPRESS 2024.

Prof. A.P. Dimri giving a floral welcome to Prof. Nitin Karmalkar during IMPRESS 2024.

Prof. S.K. Tandon addressing the participants during IMPRESS 2024 at IIG Panvel.

Prof. Nitin Karmalkar addressing the participants at IMPRESS 2024, held at IIG Panvel.

Chief Guests, Prof. A.P. Dimri, Speakers and IMPRESS Participants during IMPRESS 2024

The program consisted of 25 presentations by eminent scientists from different research institutes and universities. They have delivered talks in this program on different interesting topics covering Geology, Geophysics, Atmospheric Science, and Space Physics. In addition to this, a one-day special session on the theme “Space Science Exploration in India” in coordination with ISRO was organized, which provided glimpses of India’s Space programs to the participants. This session covered various topics related to this theme, including an overview of the Indian Space Programme, the Indian Lunar Exploration Programme, India’s Space-Based Solar Observatory Aditya-L1, and India’s Contributions in Space-Based Astronomy. The program concluded with special lectures by Prof. Mahesh Thakkar, Director, Birbal Sahni Institute of Palaeosciences, Lucknow and Ms. A. Dhanalakshmi, Joint Secretary, Department of Science and Technology, GOI).

Prof. A.P. Dimri addressing during the valedictory function at IMPRESS 2024.

Prof. A.P. Dimri extending a floral welcome to Ms. A. Dhanalakshmi, Joint Secretary, Department of Science and Technology, Government of India.

Prof. Mahesh Thakkar, Director, Birbal Sahni Institute of Palaeosciences, Lucknow, delivering a special lecture during the valedictory function of IMPRESS 2024.

Overall, IMPRESS 2024 was a grand success and it is hoped that the 4-day long deliberations would have ignited the young minds motivating them to pursue research as a career in Earth and Space science.

International Woman's Day – March 8, 2024

Dr. Suparna Khera, CMO (NIPHTR) delivered a talk on **"Women health issues and their prevention"** and Dr. Krishnaja N.P., MO (NIPHTR) gave talk on **"Common gynecological issues in young females"** at IIG, New Panvel campus on the occasion of International Woman's Day.

Floral welcome of Dr. Suparna Khera, CMO and Dr. Krishnaja, Medical Officer, NIPHTR, Navi Mumbai, during celebration of International Woman's Day 2024.

Dr. Suparna Khera delivering a talk on the occasion of International Woman's Day 2024.

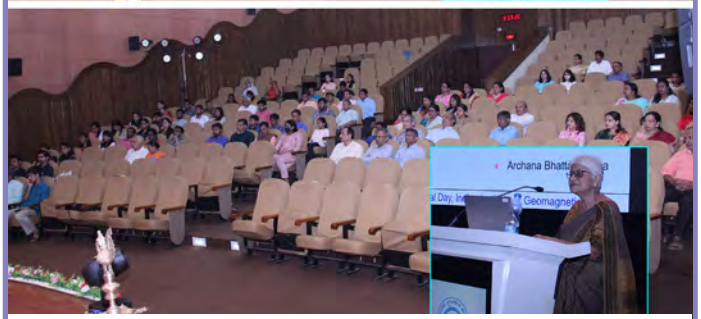
IIG STAFF WELFARE AND RECREATION CLUB

IIG celebrated its 52nd Annual day on April 03, 2023 in a grand manner. Shri Sunil G. Kamble, Head, IMD, Mumbai, Prof. G.S. Lakhina and Prof. Archana Bhattacharyya Former Directors, IIG, Mumbai were the chief Guests.To celebrate this special occasion, staff members, their families and former employees of IIG were invited. The IIG's scientific progress and achievements were on display through posters, models, and scientific instruments for the invitees. Prof. G.S. Lakhina delivered the first Dr. Nanabhoy Moos Memorial lecture on "Geomagnetism and Modern Society" and keynote lecture on "The Past, Present and Future of Geomagnetism" was given by Prof. Archana Bhattacharyya. Guest lecture was given by Shri Sunil G. Kamble on "Observing and Predicting Weather". The chief guests presented long service awards to IIG employees who have completed 25 years of distinguished service. Rajbhasha awards were also presented to staff members. The event concluded with a vote of thanks and recitation of the national anthem. The afternoon session comprised of colourful cultural activities by employees, students, and their family members.

Lighting the traditional lamp by the Chief Guests Prof. G.S. Lakhina, Shri Sunil G. Kamble and Prof. Archana Bhattacharyya along with Prof. A.P. Dimri, Director IIG, during IIG Foundation Day at Panvel campus.

Prof. G.S. Lakhina delivering the first Dr. Nanabhoy Moos memorial lecture on “Geomagnetism and Modern Society”.

Shri Sunil G. Kamble delivering the Guest lecture on “Observing and Predicting Weather”.



Prof. Archana Bhattacharyya delivering the Keynote lecture on “The Past, Present and Future of Geomagnetism”.

Prof. S. Gurubaran felicitating the Chief Guests during IIG Foundation Day celebrations.

Chief Guest Shri Sunil G. Kamble giving away the long service award to staff members.

Chief Guest Shri Sunil G. Kamble giving away the Hindi incentive awards to staff members for doing maximum day-today office work in Hindi language

Haldi Kumkum function was arranged by the club on February 01, 2024 for the female staff and students of Institute.

The club continued to provide recreational facilities to staff members during the allotted time. The co-operation and support extended by staff members are deeply acknowledged.

The Club, on behalf of the Institute, bid farewell on superannuation to the following staff members:

S. No	Name of the Staff	Designation	Work Place	Retired on	No. of year in service
1	Dr. Vijay Kumar	Professor E	New Panvel	30-04-2023	17 Years 7 Days
2	Shri. K. Jeeva	Technical Officer IV	Tirunelveli	31-05-2023	39Y 7M 14D
3	Shri. L. V. Ramana	Technical Officer II	Vishakapatnam	31-05-2023	19Y 7M 2D
4	Shri. Prasad M Patkar	Steno Grade I	New Panvel	31-08-2023	32Y 7M 14D
5	Pradeep K Bhirthare	Technical Officer III	Colaba	31-10-2023	34Y 6M 12D
6	Dr. Ajay Kishore Singh	Professor F	New Panvel	30-11-2023	22Y 8M 15D
7	Shri. Susheel Kumar	Technical Officer IV	New Panvel	31-12-2023	33Y 10M 30D
8	Dr. Sridhar Banola	Technical Officer IV	Alibag	31-12-2023	32Y 4M 4D
9	Smt. Pratik S Pawaskar	Technician III	New Panvel	29-02-2024	36Y 6M

IN SERVICE OF THE NATION

The Indian Institute of Geomagnetism (IIG) is a premier research institute internationally recognized for its research in Geomagnetism, Geophysics, Atmospheric & Space Physics, and Plasma Physics. IIG's research spans from Earth's core to the entire Heliosphere, including all planets and the Sun, with a vision to position India as a global knowledge center in these fields. The institute operates 12 geomagnetic observatories, three regional centers, and participates in Indian Arctic and Antarctic expeditions. It maintains and modernizes magnetic observatories, publishes Indian Magnetic Data volumes, and provides crucial data for understanding electrical current systems that impact satellite navigation. The World Data Center (WDC)-Geomagnetism in Mumbai is part of the International Council for Science-World Data System, and IIG regularly calibrates magnetic compasses for the Indian Navy, Coast Guard, and Naval Air Stations.

IIG's advancements include the Overhauser magnetometer, vital for magnetic field measurement, and its participation in polar expeditions, where continuous geomagnetic field monitoring has shown significant declines. The Secondary Cosmic Ray (SCR) experiment in the Arctic monitors cosmic ray flux, crucial for space weather and solar-terrestrial studies. Research into the upper atmosphere and ionosphere provides insights into complex Earth-space weather interactions. A new method, the Iterative Gradient Correction (IGC), improves the accuracy of ionospheric electron density profiles, aiding in better space weather forecasting.

Significant studies include the investigation of intense Equatorial Spread-F (ESF) triggered by the 2022 Hunga Tonga volcanic eruption, analyzing ionospheric disturbances and equatorial plasma bubbles using various advanced tools. IIG's development of MATLAB GUIs for ionosonde data has improved analysis efficiency, while MF radar at Kolhapur revealed high-frequency gravity waves during Tropical Cyclone Vayu, highlighting atmospheric-ionospheric coupling during extreme weather.

IIG's examination of ion flux changes during substorms has provided insights into space weather impacts on satellite operations. Studies on the Equatorial Electrojet (EEJ) responses to interplanetary shocks and local time-dependent variations have aided in managing geomagnetic disturbances affecting power grids and communication networks. A framework integrating machine learning models, ML_AIM, has improved the prediction of ionospheric behavior during geomagnetic storms, enhancing navigation and communication reliability. Recent research on geomagnetic storms and Mars' magnetosphere has deepened our understanding of space weather's impact on Earth and other planetary environments.

Paleoseismic studies in Assam and seismic anisotropy in NE India have provided insights into the region's geological history and the effects of earthquake fault dislocations on the ionosphere. Research in the Deccan Volcanic Province has revealed significant geological and geophysical findings, while studies in the Purna basin have reconstructed past environmental conditions over 5300 years, revealing changes in vegetation and climate. Additionally, research in Vadnagar, Gujarat, has contributed to India's paleosecular variation curve and global geomagnetic models, while analysis of laterites in Ratnagiri has traced the weathering stages of Deccan basalt.

Groundwater potential and structural features in the Kudal-Vengurla coastal area have been mapped using electrical resistivity and ground magnetic methods. In the Nag River Basin, morphometric analysis has aided in basin conservation and development planning. Magnetotelluric (MT) studies in the Kaladgi rift basin and the Cambay rift basin have revealed complex lithospheric structures and significant conductive anomalies linked to tectonic activity and magmatic processes.

IIG's research into the influence of solar variability on tropical cyclone activity and the Indian summer monsoon has identified significant correlations between solar cycles and weather patterns, aiding in climate modeling. Studies on environmental pollution in Prayagraj, Uttar Pradesh, using environmental magnetism and SEM analysis, have efficiently identified vehicular traffic as a primary pollution source.

These studies collectively enhance our understanding of Earth's interior and space weather phenomena, contributing to the nation's ability to safeguard critical infrastructure from space weather disruptions. Insights gained from planetary studies also support future space exploration and international collaborations in space science.

IIG's capacity-building programs, including training summer interns and dissertation students, and the annual IMPRESS program, have attracted students from across India. Through its Science Outreach program, IIG actively participates in state and national scientific expositions, including the India International Science Festival, and celebrates National Science Day.

The Indian Institute of Geomagnetism (IIG) aims to serve the nation by advancing fundamental and applied research in geomagnetism, maintaining and modernizing India's magnetic observatory network, and training young talent. Through these efforts, IIG significantly contributes to India's scientific and technological advancement.

CORPORATE SOCIAL RESPONSIBILITIES

CITIZEN CHARTER

Information/ suggestion on the functioning of the Institute can be obtained/given by the public. The following nodal officers have been nominated for this purpose:

Central Public Information Officer (CPIO):

Dr. A.K. Singh,
(Professor F, till November 30, 2023)

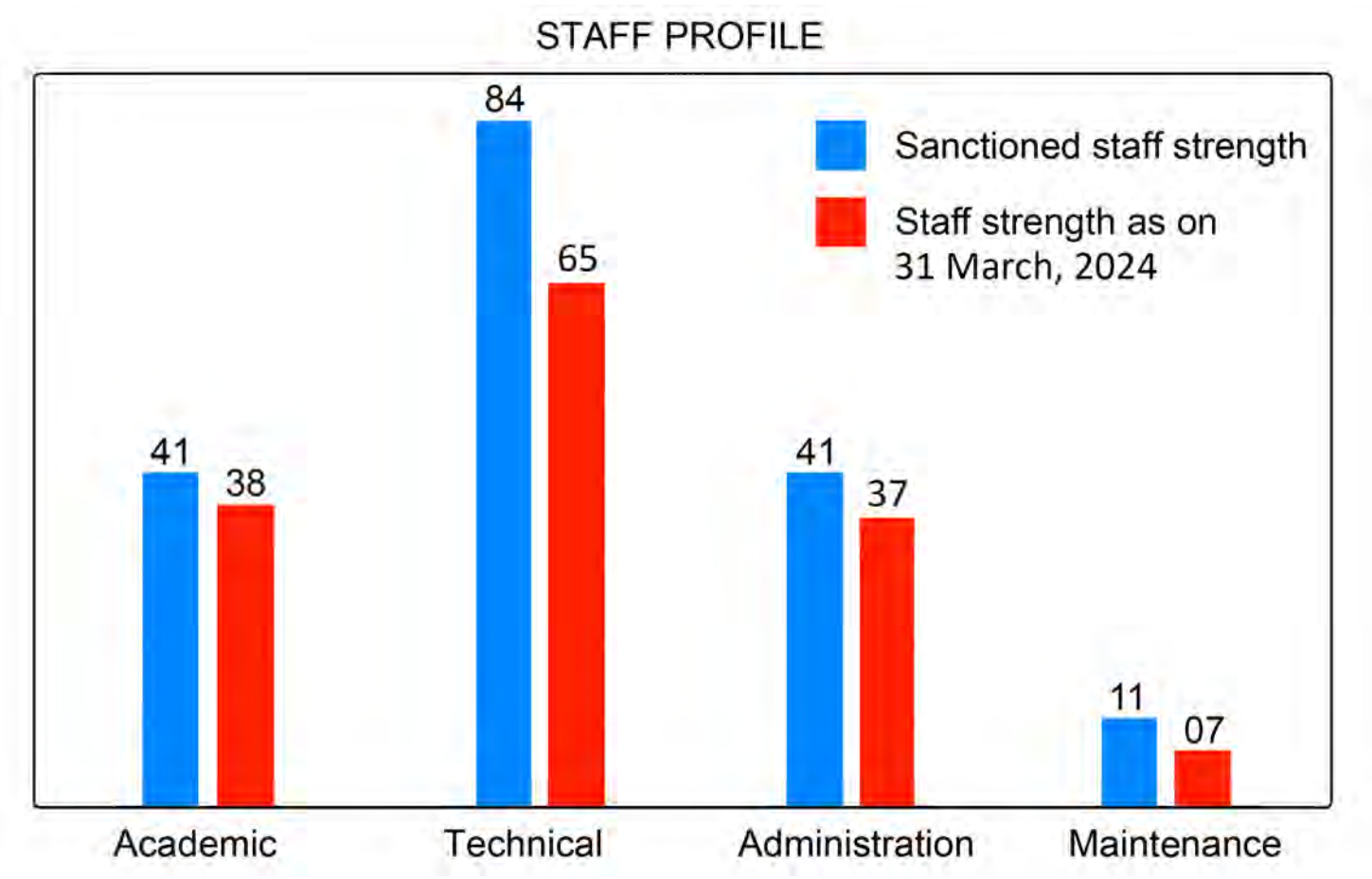
Dr Navin Parihar
(Associate Professor since December 1, 2023)
Indian Institute of Geomagnetism
Plot No. 5, Sector-18
New Panvel (W), Navi Mumbai-410218
Maharashtra
Tel.:022- 27484158
Fax: 022-27480762
E-mail:ajaykishore.s@iigm.res.in
E-mail:navin.parihar@iigm.res.in

Appellate Authority:

Prof. S. Gurubaran, (Professor G)
Indian Institute of Geomagnetism
Plot No. 5, Sector-18, New Panvel (W),
Navi Mumbai-410218, Maharashtra
Tel.:022-27484227
Fax: 022-27480762
E-mail:gurubaran.s@iigm.res.in

RESERVATION POLICY

The Institute has been implementing the reservation policy of the Govt. of India from time to time.



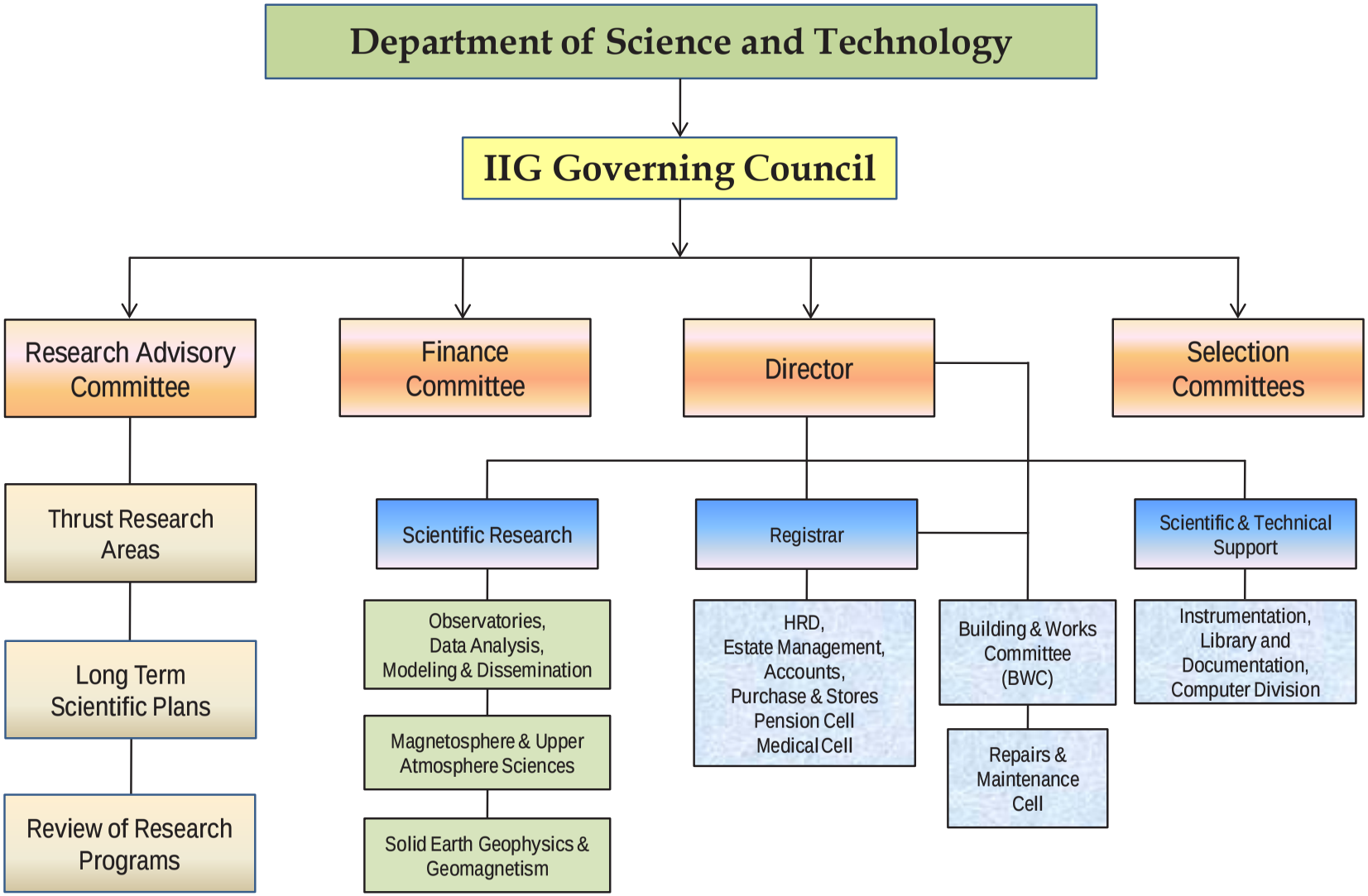
ACTION TAKEN NOTE ON AUDITORS REPORT

No serious adverse comments have been received. However, replies to some of the observations made are appended with the Audit Report of the Institute for the year 2023–2024.

MOBILIZATION OF RESOURCES

The Institute has been constantly making endeavors to mobilize resources by extending its scientific and technical expertise to other organizations.

Organizational chart of the Institute



Audit Report
2023-2024

GRAND MARK

GAMMA Affiliates

INDEPENDENT AUDITOR'S REPORT

To,
The Governing Council,
Indian Institute of Geomagnetism,
Autonomous body formed by Department of Science & Technology, Government of India
(Trust Registration No. AF/2375, Society Registration No. Bom 91/71 GBBSD)
Panvel, Navi Mumbai

Opinion

We have audited the financial statements of Indian Institute of Geomagnetism (hereinafter referred to as 'the Institute') (the entity), which comprise the balance sheet as at March 31, 2024, and the Income and Expenditure Account for the year then ended, and notes to the financial statements, including a summary of significant accounting policies and other explanatory Information (hereinafter referred to as 'the Financial Statements').

Emphasis of matter

We draw attention to:

i) Note no. 8 under notes to accounts relating to non-accounting of property in occupation of the institute which was previously belonging to IMD;

ii) Note No. 10 under notes to accounts relating to non-provision of Gratuity Liability, Leave Encashment and Commuted Pension liability for continuing employees (as fully explained in detail in the Notes);

Basis for Opinion

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by ICAI. Our responsibilities under those Standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the entity in accordance with the Code of Ethics issued by ICAI and we have fulfilled our other ethical responsibilities in accordance with the Code of Ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation of the financial statements in accordance with applicable laws and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error. In preparing the financial statements, management is responsible for assessing the entity's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the entity or to cease operations, or has no realistic alternative but to do so. Those charged with governance are responsible for overseeing the entity's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the entity's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the entity to cease to continue as a going concern.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We also provide those charged with governance with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, related safeguards.

For GRANDMARK & Associates
Chartered Accountants
Firm registration number – 011317N

CA MAHENDAR KUMAR JAIN
Partner
Membership number - 049444
UDIN – 24049444BKAAFZ6810
Place: PANVEL
Date: 12.07.2024

INDIAN INSTITUTE OF GEOMAGNETISM, MUMBAI

Autonomous body formed by Department of Science & Technology, Government of India
(Trust Registration No. AF/2375, Society Registration No. Bom 91/71 GBBSD)

SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO ACCOUNTS

Indian Institute of Geomagnetism is an autonomous body under the Department of Science and Technolc (DST), Government of India. The Institute's main activity is scientific research in the field of Geomagnetisı

A: SIGNIFICANT ACCOUNTING POLICIES:

1) ACCOUNTING CONVENTION:

a) The Financial Statements are prepared under the historical cost convention on the basis of going concern and in accordance with the applicable Accounting Standards issued by The Institute of Chartered Accountants of India (ICAI) except AS-11 relating to Accounting for the Effects of Changes in Foreign Exchange Rates' and AS 15 relating to 'Employee Benefits'

b) The Institute generally follows the mixed system of accounting. It recognizes Government grants and those with significant uncertainties on cash basis and other income and expenditure on accrual basis. Expenditure is recognized based on grant amount available to be utilized during the financial year.

2) FIXED ASSETS:

Fixed Assets are stated at their original cost of acquisition / installation. Fixed assets are shown net of accumulated depreciation without any adjustment of foreign exchange fluctuation gain/ (loss) and capital grant received against the specific asset. Subsequent expenditure related to an item of fixed asset is added to its book value only if it increases the future benefits from existing asset beyond is previously assessed standard of performance. All other expenses on existing fixed assets including day-to-day repairs and maintenance expenditure and cost of replacing parts are charged to the Income and Expenditure Account for the period to which such expenses are incurred.
Losses arising from the retirement of, and gains or losses arising from disposal of fixed assets which are carried at cost are recognized in the Income and Expenditure Account.

3) DEPRECIATION

a) Depreciation is provided on pro-rata basis on Written Down Value method corresponding to the rates prescribed under Section 32 of Income Tax Act, 1961 as tabulated hereunder:

Block of asset	Rate of depreciation
Land and Building	5%
Furniture and Fixtures	10%
Office Equipment	15%
Motor Vehicle	15%
Computer and software	40%
Laboratory Equipment	15%
Books	40%
Electrical installation	15%

b) Assets costing Rs.5000/- or less each is fully expensed out in the year of acquisition.
c) Leasehold land is amortized over the period of lease.

4) CAPITAL WORK IN PROGRESS

Capital Work-in-progress is stated at the amount spent up to the date and advances made to respective parties if backed by asset. If the expenditure is not backed by asset, the same is recorded as Pre-operative Expenses (Project) under the head Miscellaneous Expenditure.

5) GOVERNMENT GRANT

Government grants are accounted on Receipt basis. The Institute receives funds from Department of Science and Technology (DST) under three heads:
a) Grant-in-aid-Salary
b) Grant-in-aid-General and
c) Grant-in-aid-Capital

Grant-in-aid-Salary and Grant-in-aid-General are accounted in Income & Expenditure statement of the Institute. Grant-in-aid-capital plan is accounted in the Balance Sheet under the head "Capital Fund".

6) OTHER INCOME

Subscriptions – Medical subscriptions collected from certain employees towards medical benefits on their retirement is recognized as income on receipt basis in the year of collection.

Interest - Interest income is recognized on a time proportion basis taking into account the amount outstanding and the applicable interest rate on fixed deposits placed with banks.

Other income – This comprises of income from project work, income from hostel/guest house receipts and miscellaneous income. This income is recognized on receipt basis.

7) INVENTORIES

Closing Stock is valued at cost or market price whichever is less on First in First out Method (FIFO) basis and certified by the management of the Institute as to quantity and method of valuation. Items included in inventory are spares and other stationery material.

8) RETIREMENT BENEFITS:

Contribution towards provident fund for all employees is made to a separate fund account that is managed separately by the organization. Such benefits are classified as defined contribution schemes as the organization does not carry any further obligation, apart from the contributions made on a monthly basis.

Gratuity, Leave Encashment and Commuted Pension Liability are provided for those employees who are going to retire in the next financial year. No provision is made for continuing employees. No separate fund is created for the above and Accounting Standard 15 (AS-15) is not followed.

9) CONTINGENT LIABILITIES & PROVISIONS:

No provision is made for liabilities, which are contingent in nature, but, if material, the same are disclosed by way of notes to the accounts and accounted on payment basis.

10) GENERAL:

Accounting policies not specifically referred to above are consistently followed. Any deviation from the existing policy is disclosed in the Notes to Accounts.

B. NOTES TO ACCOUNTS:

1. As per notification no. BPI 1390/317/ (75)-6 dated 5th March 1991 issued by the Government of Maharashtra; this Institute has been exempted from all provisions of the Bombay Public Trust Act, 1950, except those relating to registration contained in Chapter IV of the said Act.

2. Contingent Liabilities –

Nature of Liability	Amount in Rupees
**Traces demand	4,89,930/- *

* As on 09th July, 2024

**Institute has applied for rectification to Income Tax Department and the same is pending for rectification.

3. Contingent Advances –

   Contingent Advances balance as on 31st March, 2024 is Rs.1, 72, 32,187.00

4. The management has carried out physical verification of inventory (consisting mainly of Stores and Spares) as at year end. As per the management there are no discrepancies noticed during the physical verification.

5. The management has carried out physical verification of closing stock as at year end.

6. Physical Verification & reconciliation of fixed assets with book was carried out by management during the year

7. Capital work in progress as on 31stMarch, 2024 is verified and certified by management / respective authorities.

   As per office record repair and maintenance work completed for building in the campus at IIG Colaba Mumbai Rs 18, 98,418/- on 23.04.2022 , whereas the entry passed for capitalization as on 1.4.2023 as per the receipt of Utilisation certificate from CPWD.

   As per office record repair and maintenance work completed for building in the campus at IIG Colaba Mumbai Rs.5, 79,687/- on 24.05.2019, whereas the entry passed for capitalization as on 1.4.2023 as per the receipt of Utilisation certificate from CPWD.

8. Title to Property:
Properties worth Rs.1,13,18,789/- (movable Rs. 8,83,800/- and immovable Rs.104,34,989/-) previously belonging to India Meteorological Department (IMD), another Government department and in occupation of the Institute have not been accounted for in the Balance Sheet as the same have not yet been conveyed to the Institute by the Government of India. The Institute continues use and incur expenses towards maintenance of this premise.

9. a) In General, Provident Fund (GPF) no. of employees as at 31st March 2024 is 53. Contributions of GPF deducted from employees' salaries have been remitted to a special account called "IIG GPF Account" respectively in Bank of India, Panvel Branch. The above doesn't form part of the Institutes books of account.

b) NPS Scheme
The employees joined on or after 01.04.2004 are eligible for "National Pension Scheme". The Institute has remitted the respective contributions (both employee and employer) to "NPS Trust Account" with Axis Bank. The above doesn't form part of the Institutes books of account.

10. Gratuity Liability, Leave Encashment and Commuted Pension have been provided as at 31st March, 2024 for those employees who are going to retire in the next financial year. Amount provided for as at 31st March,2024 is Rs.2,17,17,009/- (Previous year: Rs.5,02,26,594/-). No provision has been made for Gratuity, Leave Encashment and Commuted Pension payable on retirement of continuing employees. The Liability for above is not estimated for continuing employees. Total liability accruing for continuing employees as at 31stMarch, 2024 is not determined and provided. The unfunded obligation will be made good by the Ministry on request of the Institute.

11. **Government Grants to the Institute**
The Institute has received the following grants during the year:

Particulars	Current Year			Previous Year	
	Grant received	Unspent Grant lapsed to Govt. Account	Actual grant received As per Income & Exp. Account/Capital Fund	As per Income & Exp. Account/Capital Fund	Actual grant received
Grant-in-aid-Salary	384000000	0	384000000	369100000	369100000
Grant-in-aid-General	134000000	1078	133998922	90000000	90000000
Grant-in-aid-Capital	28400000	31991	28368009	15000000	15000000

12. Amount receivable under GST as per various GST Acts as at March 31, 2024 is Rs.3,00,07,198/. GST credit available with the Institute as stated above can be set-off only against liability payable towards outward taxable service that may have been incurred or will be provided in future.

13.Loans and advances to employees and others outstanding as at 31st March, 2024 is Rs.72,75,529 (Previous Year Rs. 60,99,598 /-). Adjustment will be made as and when the approvals are communicated to the accounts department.

14. Except for expenditure in foreign currency for travel purposes and Equipment's import, there are no other foreign currency transactions. Hence, AS-11 is not adhered by the Institute.

15. IIG Pension fund balance as at 31st March, 2024 Rs.8,01,65,071/- (Previous year Rs.7,68,38,521 /-) consisted assets side Fixed Deposits Rs. 7,04,06,373/- (Previous year Rs. 7,17,27,116 /-), Bank of India Bank balance Rs.97,58,698 /- (Previous year Rs.51,11,405 /-) and Liability side represents Earmarked/Endowment Funds (Pension) Rs. 8,01,65,701/-. These are taken in respective heads in IIG Main Financial Statements.

16. Interest income amounting to Rs.17, 50,078 earned on SDR during the year ended March 31,2024 needs to be refunded back to the Ministry as per the sanction order. This transfer entry has been accordingly reduced from interest income. The amount payable to Ministry is currently classified under other current liabilities.

17. Loss of interest Rs.7,56,380/- on premature of fixed deposit debited to profit and loss account.

18. Details of Statutory Liability are as under

Particular	FY	Disputed liability	Un disputed Liability
GST *	2017-18	55,57,862/-	
GST	2020-21		37,800/-
GST	2023-24		44,935/-
GST TDS	2023-24		5,02,485/-

*Appeal has been filed by Institute against demand notice on 17/08/2022 & Pre-Deposit paid RS.2,55,398/-

19. Institute not properly disclosed GST Turnover and GST Payable in GST Return for the period 2023-24 with compare to Books of Accounts.

GST Payable for the period 2023-24 is Rs 44,935/-

20. Profit / loss on Sale of Assets amounting to Rs 2,66,506/- comprises of the followings

Particular	Amount in Rs
Profit on sale of Movable Assets	Rs 2,86,650/-
Loss on sale of Movable Assets	Rs 20,144/-
Net Amount	Rs 2,66,506/-

21. Unclaimed EMD & Security deposit outstanding for over 3 years has been credited to Income & Expenditure account during the year.
22. An amount of Rs.43, 74,698 credited under the head of expenses on retirement benefits is due to excess provision made in financial year 2022-23 to meet the unexpected expenses occurred if any.

23. Previous year's figures have been regrouped/reclassified wherever necessary.

As per our Report of even dated.

For G R A N D M A R K & Associates
Chartered Accountants
FRN – 011317N

CA MAHENDRA KUMAR JAIN
Partner
M.NO. – 049444

Place: PANVEL
Dated: 12TH July, 2024
UDIN: 24049444BKAAFZ6810

For INDIAN INSTITUTE OF GEOMAGNETISM

K.R.Salvi
IN-CHARGE ACCOUNTS

S Gurubaran
THE DIRECTOR FOR TRUSTEE

G R A N D M A R K & ASSOCIATES Chartered Accountants
M.N.49444
F.R.N.011317N
Panvel
410206

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON – PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name of Entity : Indian Institute of Geomagnetism, New Panvel, Navi Mumbai – 410 218.

31 मार्च 2024 तक का तुलन पत्र / BALANCE SHEET AS AT 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

पूंजिगत निधि एवं देयताएं / CAPITAL FUND AND LIABILITIES	अनुसूची Schedule	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
पूंजिगत निधि / CAPITAL FUND	1	69,44,70,113	68,88,53,480
आरक्षित एवं अधिशेष / RESERVES AND SURPLUS	2	-	-
विशिष्ट प्रयोजनों / EARMARKED FUNDS	3	8,01,65,071	7,65,38,521
सुरक्षित ऋण एवं उधारी / SECURED LOANS AND BORROWINGS	4	-	-
असुरक्षित ऋण एवं उधारी / UNSECURED LOANS AND BORROWINGS	5	-	-
आस्थगित उधार देयताएं / DEFERRED CREDIT LIABILITIES	6	-	-
वर्तमान देयताएं एवं प्रावधान / CURRENT LIABILITIES AND PROVISIONS	7	3,79,93,460	6,44,63,722
कुल / TOTAL		**81,26,28,644**	**82,98,55,723**
परिसम्पत्ति / ASSETS			
अचल परिसम्पत्ति / FIXED ASSETS	8	60,20,72,424	57,82,45,778
निवेश - विशिष्ट प्रयोजनों की निधियों से प्राप्त INVESTMENTS – FROM EARMARKED FUNDS	9	7,04,06,373	7,17,27,116
निवेश - अन्य / INVESTMENTS – OTHERS	10	2,750	2,750
वर्तमान परिसम्पत्ति, ऋण, अग्रिम इत्यादि CURRENT ASSETS, LOANS, ADVANCES ETC.	11	14,01,47,097	17,98,80,079
विविध व्यय (बट्टे खाते में डालने या समायोजित नहीं होने के स्तर तक) MISCELLANEOUS EXPENDITURE (TO THE EXTENT NOT WRITTEN OFF OR ADJUSTED)		-	
कुल / TOTAL		**81,26,28,644**	**82,98,55,723**

खातों के साथ जुड़ी टिप्पणियां देखें - अनुसूची 24

समान तारीख की हमारी रिपोर्ट के अनुसार / As per our Report of even dated.

मेरी जानकारी तथा विचार से, उपर्युक्त तुलन पत्र ट्रस्ट की निधियों एवं देयदाताओं तथा सम्पत्ति का सही एवं उचित लेखा-जोखा प्रस्तुत करता हैं । The above Balance Sheet to the best of my knowledge and belief contains a true and fair account of the funds and liabilities and property assets of the Trust.

कृते ग्रैंडमार्क एन्ड एसोसिएट्स
For G R A N D M A R K & Associates
चार्टर्ड अकाउंटेंट / Chartered Accountants
कर्म सं./Firm No.011317N

महेन्द्र कुमार जैन/ MAHENDRA KUMAR JAIN
सदस्यता क्र/Membership No. : 049444
भागीदार / Partner

स्थान / Place : मुंबई / Mumbai
दिनांक / Dated : 12.07.2024
UDIN 24049444BKAAFZ6810

GRANDMARK & ASSOCIATES Chartered Accountants M.N.49444 F.R.N.011317N Panvel 410206

कृते भारतीय भूचुम्बकत्व संस्थान
For INDIAN INSTITUTE OF GEOMAGNETISM

K.R. Salvi
लेखा प्रभारी
IN CHARGE ACCOUNTS

S Gunbaran
निदेशक, कृते न्यासी
THE DIRECTOR FOR TRUSTEE

भारतीय भूचुम्बकत्व संस्थान Indian Institute of Geomagnetism IIG New Panvel - 410218. न्यू पनवेल, नवी मुंबई - 410218.

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.

31 मार्च 2024 तक का आय तथा व्यय खाता
INCOME AND EXPENDITURE ACCOUNT FOR THE PERIOD / YEAR ENDED 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

आय / INCOME	अनुसूची Schedule	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
बिक्री / सेवाओं से आय / Income from Sales / Services	12	180000	790800
वृत्ति / अनुदान / Grants / Subsidies	13	51,79,98,922	43,08,02,691
शुल्क / अभिदान / Fees / Subscriptions	14	6,48,033	4,32,766
निवेश से आय (निधियों में अंतरित / विशिष्ट प्रयोजनों / अक्षय निधियों से निवेश पर आय।) Income from Investments (Income on Invest. from earmarked/endow. Funds transferred to Funds)	15	-	-
अधिशुल्क, प्रकाशन इत्यादि से आय / Income from Royalty, Publication etc.	16	-	-
ब्याज अर्जित / Interest Earned	17	1,26,29,582	1,14,88,009
परिसम्पत्ति की बिक्री होने पर अन्य आय / Profit on sale of assets	18	2,66,506	40,582
मुनाफे / Other Income	18(a)	56,47,962	14,15,161
तैयार वस्तुओं एवं जारी कार्य के भंडार में वृद्धि / कमी Increase / (decrease) in stock of Finished goods and works-in-progress	19	-	-
कुल / TOTAL (A)		**53,73,71,005**	**44,49,70,009**

K.R.Dalvi S Gurubaran

Cont...II

RAMDMARK & ASSOCIATES Chartered Accountants M.N.49444 F.R.N.011317N Panvel 410206

भारतीय भूचुम्बकत्व संस्थान Indian Institute of Geomagnetism IIG New Panvel - 410218

(राशि / Amount – रू./Rs.)

व्यय / EXPENDITURE	अनुसूची Schedule	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
स्थापना खर्च / Establishment Expenses	20	35,79,15,603	38,93,66,163
अन्य प्रशासनिक खर्च इत्यादि / Other Administrative Expenses etc.	21	14,02,88,864	11,14,53,953
वृत्ति, अनुदान इत्यादि पर खर्च / Expenditure on Grants, Subsidies etc.	22	4,00,000	6,04,406
ब्याज / Interest	23	NIL	-
परिसम्पत्ति की बिक्री होने पर घाटा / Loss on sale of Asset			-
अवमूल्यन / Depreciation	8	6,15,17,913	5,72,04,803
कुल / TOTAL (B)		**56,01,22,380**	**55,86,29,325**
व्यय से अधिक आय की शेष राशि (A-B) **Balance being excess of Income over Expenditure (A-B)**		**(2,27,51,375)**	**(11,36,59,317)**
विशेष आरक्षित में स्थानांतरण (प्रत्येक बताएं) / Transfer to Special Reserve (Specify each)			
आय तथा व्यय खाते में / से स्थानांतरण / Transfer to / from Income and Expenditure A/c			0
समग्र / पूंजिगत निधि में लिए गए घाटे की शेषराशि **Balance being deficit carried to Corpus / Capital Fund**		**(2,27,51,375)**	**(11,36,59,317)**

खातों के साथ जुड़ी टिप्पणियां देखें - अनुसूची 24
See accompanying Notes to Accounts - Schedule 24
समान तारीख की हमारी रिपोर्ट के अनुसार / As per our Report of even dated.

कृते ग्रैंडमार्क एन्ड एसोसिएट्स
For G R A N D M A R K & Associates
चार्टर्ड अकाउंटेंट / Chartered Accountants
कर्म सं./Firm No.011317N-

महेन्द्र कुमार जैन/ MAHENDRA KUMAR JAIN
सदस्यता क्र/Membership No. : 049444
भागीदार / Partner

स्थान / Place : मुंबई / Mumbai
दिनांक / Dated : 12.07.2024
UDIN 24049444BKAAFZ6810

GRANDMARK & ASSOCIATES Chartered Accountants M.N.49444 F.R.N.011317N Panvel 410206

मेरी जानकारी तथा विचार से, उपर्युक्त आय तथा व्यय खाता ट्रस्ट के आय एवं व्यय का सही एवं उचित लेखा-जोखा प्रस्तुत करता हैं । The above Income and Expenditure A/c to the best of my knowledge and belief contains a true and fair account of the Income and Expenditure of the Trust.

कृते भारतीय भूचुम्बकत्व संस्थान
For INDIAN INSTITUTE OF GEOMAGNETISM

K.R.Balu
लेखा प्रभारी
IN CHARGE ACCOUNTS

S. Gunlara
निदेशक, कृते न्यासी
THE DIRECTOR FOR TRUSTEE

भारतीय भूचुम्बकत्व संस्थान Indian Institute of Geomagnetism IIG New Panvel - 410218 न्यू पनवेल, नवी मुंबई - 410218

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक तुलन पत्र के विभिन्न अनुसूची के भाग
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

(राशि / Amount – रू. / Rs.)

अनुसूची 1 / SCHEDULE 1 : पूंजिगत निधि / CAPITAL FUND		वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष /Previous Year as on 31/03/2023 के अनुसार
वर्ष के आरंभ में शेष राशि / Balance as at the beginning of the year		68,88,53,480	78,80,00,017
जोडे : Add :	पूंजिगत निधि हेतु अंशदान Contributions towards capital Fund	2,83,68,009	1,45,12,779
जोडे : Less :	आय तथा व्यय खाता से स्थानांनतरित निवल आय की शेषराशि Balance of net income transferred from the Income and Expenditure Account	(2,27,51,375)	(11,36,59,317)
वर्ष के अंत में शेषराशि / BALANCE AS AT THE END OF THE YEAR		**69,44,70,113**	**68,88,53,480**

GRANDMARK & ASSOCIATES Chartered Accountants
M.N.49444
F.R.N.011317N
Panvel
410206

K.R.Salvi

S Gunbaran

भारतीय भूचुम्बकत्व संस्थान Indian Institute of Geomagnetism IIG New Panvel - 410218 न्यू पनवेल, नवी मुंबई - 410218.

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

(राशि / Amount – रू. / Rs.)

अनुसूची 2 : आरक्षित एवं अधिशेष / SCHEDULE 2 : RESERVES AND SURPLUS	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
	NIL	NIL
कुल / TOTAL	NIL	NIL

अनुसूची 3 : विशिष्ट प्रयोजना / अक्षय निधियाँ SCHEDULE 3 : EARMARKED/ENDOWMENT FUNDS	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
IIG PENSION FUND	8,01,65,071	7,65,38,521
कुल / TOTAL	8,01,65,071	7,65,38,521

अनुसूची 4 : सुरक्षित ऋण एवं उधारी SCHEDULE 4 : SECURED LOANS AND BORROWINGS	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
	NIL	NIL
कुल / TOTAL	NIL	NIL

अनुसूची 5 : असुरक्षित ऋण एवं उधारी SCHEDULE 5 : UNSECURED LOANS AND BORROWINGS	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
	NIL	NIL
कुल / TOTAL	NIL	NIL

अनुसूची 6 : आस्थगित उधार देयताएं / SCHEDULE 6 : DEFERRED CREDIT LIABILITIES	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
	NIL	NIL
कुल / TOTAL	NIL	NIL

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)

FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)

संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218

Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.

31 मार्च 2024 तक तुलन पत्र के विभिन्न अनुसूची के भाग

SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

(राशि / Amount – रू. / Rs.)

अनुसूची 7 - वर्तमान देयताएं एवं प्रावधान SCHEDULE 7 – CURRENT LIABILITIES AND PROVISIONS			वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष /Previous Year as on 31/03/2023 के अनुसार
A. वर्तमान देयताएं / CURRENT LIABILITIES				
1	स्वीकृत बिल / Acceptances		-	-
2	विविध लेनदार / Sundry Creditors:			
	a)	सामग्री हेतु / For Goods	-	-
	b)	अन्य / Others	1,57,062	1,57,062
3	प्रतिभूति जमा देय / Security Deposit Payable		19,74,722	39,44,681
4	उपार्जित किन्तु अप्राप्य ब्याज / Interest accrued but not due on:			
	a)	सुरक्षित ऋण/उधारी / Secured Loans/borrowings	-	-
	b)	असुरक्षित ऋण/उधारी / Unsecured Loans/borrowings	-	-
5	संवैधानिक देयताएं / Statutory Liabilities:			
	a)	अतिदेय / Overdue	-	-
	b)	अन्य / Others	11,73,863	13,06,666
6	अन्य वर्तमान देयताएं / Other current Liabilities		1,22,44,404	82,24,819
	प्रतिधारण राशि / Retention money		-	-
कुल / TOTAL (A)			**1,55,50,051**	**1,36,33,228**
B. प्रावधान /PROVISIONS				
1	जीपीएफ ब्याज पर घाटा / Loss on interest for GPF		-	-
2	आनुतोषिक / Gratuity		59,73,050	1,73,01,398
3	पेंशन का रूपान्तरण / Commutation of Pension		92,32,999	1,97,94,411
4	संचित छुट्टी नकदीकारण / Accumulated Leave Encashment		65,10,960	1,31,30,785
5	प्रयोगशाला उपकरण के लिए प्रावधान Provision for Lab Equipment		6,03,900	6,03,900
6	Audit & Professional Fees payable		1,22,500	-
7	अन्य वर्तमान देयताएं (दूरध्वनि विद्युत, पानी शुल्क इत्यादि पर हुए खर्च) Others current Liabilities (for expenses on telephone, electricity, water charges etc.)		-	-
कुल / TOTAL (B)			**2,24,43,409**	**5,08,30,494**
कुल / TOTAL (A + B)			**3,79,93,460**	**6,44,63,722**

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक तुलन पत्र के विभिन्न अनुसूची के भाग
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

(राशि / Amount – रू. / Rs.)

अनुसूची /SCHEDULE 8 : अचल परिसम्पत्ति / FIXED ASSETS		सकल खंड /GROSS BLOCK				अवमूल्यन / DEPRECIATION					निवल खंड / NET BLOCK	
DESCRIPTION		वर्ष के आरंभ में लागत / मूल्य / Cost / valuation as at beginning of the year 01/04/2023	वर्ष के दौरान परिवर्धन Additions during the year	वर्ष के दौरान कटौती Deductions during the year	वर्ष के अंत में लागत / मूल्य / Cost / valuation at the year-end 31/3/2024	वर्ष के आरंभ में लागत / मूल्य /As at the beginning of the year 01/04/2023	वर्ष के दौरान परिवर्धन / On additions during the year	वर्ष 2023-24 हेतु / For the year 2023-24	वर्ष के दौरान कटौती पर / On deductions during the year	वर्ष के अंत तक - कुल / Total up to the year – end 31/03/2024	वर्तमान वर्ष के अंत तक / As at the current year-end 31/03/2024	पिछला वर्ष के अंत तक /As at the previous year-end 31/03/2023
A. अचल परिसम्पत्ति / FIXED ASSETS												
1	भूमि / LAND :											
	a) पूर्ण स्वामित्व / Freehold	34,93,366	-	-	34,93,366	-	-	-	-	-	34,93,366	34,93,366
	b) पट्टे की भूमि / Leasehold	5,64,66,353	-	-	5,64,66,353	2,25,10,538	-	-	-	2,25,10,538	3,39,55,815	3,39,55,815
2	भवन-निर्माण / BUILDINGS:											
	a) पूर्ण स्वामित्व भूमि पर/ On freehold Land	29,50,74,324	38,64,005	-	29,89,38,329	14,17,94,538	1,93,200	76,63,991	-	14,96,51,729	14,92,86,600	15,32,79,786
	b) पट्टे की भूमि पर / On Leasehold Land :	26,03,27,476	-	-	26,03,27,476	13,36,48,265	-	43,81,461	-	13,80,29,726	12,22,97,750	12,66,79,211
	d) स्वामित्व आवास/परिसर / Ownership Flats/Premises	-	-	-	-	-	-	-	-	-	-	-
	e) भूमि पर अधिरचना इकाई से संबंधित नहीं है/Superstructures on Land Not belonging to the entity	-	-	-	-	-	-	-	-	-	-	-
3	प्रयोगशाला उपकरण / LABORATORY EQUIPMENT	65,29,79,298	1,20,04,992	44,352	66,49,39,938	49,47,31,385	13,27,687	2,37,37,187	-	51,97,96,259	14,51,43,679	15,82,47,912
4	मोटर कार वाहन / MOTOR CAR VEHICLE	78,57,495	-	70,274	77,87,221	54,03,663	-	3,57,534	-	57,61,197	20,26,024	24,53,832
5	फर्नीचर, मरम्मती / FURNITURE, FIXTURES	3,43,91,932	9,93,368	-	3,53,85,300	2,37,92,972	83,812	10,59,896	-	2,49,39,680	1,04,45,620	1,05,98,960
6	कार्यालय उपकरण / OFFICE EQUIPMENT	5,31,89,068	1,46,83,238	1,00,059	6,77,72,247	3,09,30,238	17,22,958	33,38,834	-	3,59,92,020	3,17,80,227	2,22,58,830
7	कंप्यूटर तथा सॉफ्टवेयर / COMPUTER & SOFTWARE	20,74,11,398	3,71,21,891	20,37,959	24,24,95,330	18,73,75,174	81,57,076	80,14,489	-	20,35,46,739	3,89,48,591	2,00,36,224
9	विद्युत अधिष्ठापन / ELECTRIC INSTALLATIOS	45,20,991	-	-	45,20,991	40,75,867	-	66,769	-	41,42,636	3,78,355	4,45,124
10	पुस्तकालय किताबें / LIBRARY BOOKS	6,60,33,695	1,03,806	-	6,61,37,501	6,25,79,448	13,81,699	28,330	-	6,39,89,477	21,48,024	34,54,247
वर्तमान वर्ष का कुल / TOTAL OF CURRENT YEAR(A)		1,64,17,45,394	6,87,71,300	22,52,644	1,70,82,64,050	1,10,68,42,088	1,28,69,432	4,86,46,481	-	1,16,83,60,001	53,99,04,049	53,49,03,307
पिछले वर्ष/ PREVIOUS YEAR		1,56,54,62,918	7,75,86,770	13,04,294	1,64,17,45,394	1,04,96,37,285	1,00,77,118	4,71,27,685	-	1,10,68,42,088	53,49,03,306	51,58,25,633
B. पूंजीगत कार्य जारी / CAPITAL WORK IN PROGRESS		4,33,42,471	3,15,80,770	1,27,54,866	6,21,68,375					-	6,21,68,375	4,33,42,471
								TOTAL			60,20,72,424	57,82,45,778

(उपरोक्त शामिल किराया खरीद के आधार पर परिसंपत्तियों की लागत के रूप में दिए जाने वाले नोट / Note to be given as to cost of assets on hire purchase basis included above)

GANDHI MARK & ASSOCIATES Chartered Accountants M.N.49444 F.R.N.011317N Panvel 410206

S. Gurubaran

K.R.Sahay

भारतीय भूचुम्बकत्व संस्थान Indian Institute of Geomagnetism IIG New Panvel - 410218. न्यू पनवेल, नवी मुंबई - 410218.

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL, NAVI MUMBAI – 410 218.

अनुसूची / SCHEDULE – 8A(1a)

वर्ष समाप्ति 31.03.2024 / YEAR ENDING 31.03.2024

पूर्व स्वामित्व वाली भूमि / FREEHOLD LAND

31/03/23 को / AS ON 31/03/23	विवरण / PARTICULARS	31/03/24 को / AS ON 31/03/24
रू./Rs पैसे /Ps		रू./Rs पैसे /Ps
10,00,000	इलाहाबाद में क्षेत्रीय केंद्र हेतु भूमि Land for Regional Centre at Allahabad	10,00,000
6,28,726	इ.जी.आर.एल.,तिरूनलवेली हेतु भूमि Land for E.G.R.L., Tirunelvelli	6,28,726
18,64,640	पोर्टब्लेयर हेतु भूमि / Land at Portblair	18,64,640
34,93,366	**कुल / TOTAL**	**34,93,366**

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI
वर्ष समाप्ति 31.03.2024 / YEAR ENDED 31-03-2024

भूमि एवं भवन निर्माण /Land And Building

स्थिर परिसंपत्तियां - अचल संपत्ति (पूर्ण स्वामित्व की भूमि पर)

Fixed Assests - Immovable Property (On Freehold land)

अनुसूची / Schedule : 8A 2(a)

अनु. क्र Sr. No	परिसम्पत्ति का विवरण Particulars Of Assests	सकल खड / Gross Block				अवमूल्यन / Depreciation					निवल खड / Net Block	
		31.03.2023 को लागत/मूल्य Cost/Value at 31-03-23	वर्ष के दौरान परिवर्धन Additions during the year	वर्ष के दौरान कटौती Deduction during the year	लागत / मूल्य Cost/Value at 31-03-24	01.04.23 पर मूल्य /On Value 01/04/23	वर्ष के दौरान परिवर्धन पर / On addition during the year	वर्ष 2023-24 हेतु / For the year 2023-24	कटौती पर / On deduction	वर्ष के दौरान कटौती पर / Deduction during the year	31.03.24 तक Upto 31-03-24	31-03-23 को लागत / Cost as at 31-03-23
1	भवन-निर्माण - पूंजीगत कार्य Building - Capital Works	1,07,30,610	-	-	1,07,30,610	75,88,539	-	1,57,104	-	77,45,643	29,84,967	31,42,071
2	भवन-निर्माण -बेलापुर क्वार्टर्स Building - Belapur Quarters	2,09,36,622	-	-	2,09,36,622	1,48,79,396	-	3,02,861	-	1,51,82,257	57,54,365	60,57,226
3	भवन-निर्माण - गुलमर्ग / Building - Gulmarg	1,70,337	-	-	1,70,337	1,55,647	-	735	-	1,56,382	13,955	14,690
4	भवन-निर्माण - नागपुर / Building - Nagpur	31,27,179	-	-	31,27,179	15,53,604	-	78,679	-	16,32,283	14,94,896	15,73,575
5	भवन-निर्माण - अलिबाग मावेक्स Building - Alibag Mavacs	18,94,243	-	-	18,94,243	4,21,786	-	73,623	-	4,95,409	13,98,834	14,72,457
6	भवन-निर्माण - पूर्वनिर्मित संरचना Building - Prefabricated Structure	1,55,235	-	-	1,55,235	1,32,347	-	1,144	-	1,33,491	21,744	22,888
7	भवन-निर्माण - अंतरिक्ष विज्ञान प्रयो., कोल्हापुर Building - Space Sci.Lab. Kolhapur	1,53,338	-	-	1,53,338	1,25,197	-	1,407	-	1,26,604	26,734	28,141
8	भवन-निर्माण - विल्टन हॉल Building - Wilton Hall	5,31,375	-	-	5,31,375	4,93,687	-	1,884	-	4,95,571	35,804	37,688
9	भवन-निर्माण - पी.आर. रडार टावर कोल्हापुर Building - P.R. Radar Tower Kolhapur	9,72,012	-	-	9,72,012	7,06,133	-	13,294	-	7,19,427	2,52,585	2,65,879
10	भवन-निर्माण - पुदुचेरी/Building-Puducherry	71,88,726	-	-	71,88,726	27,67,409	-	2,21,066	-	29,88,475	42,00,251	44,21,317
11	भवन तथा क्वार्टर्स - ईजीआरएल Building & Quarters - EGRL	1,08,73,312	-	-	1,08,73,312	62,01,961	-	2,33,568	-	64,35,529	44,37,783	46,71,351
12	भवन-निर्माण - अलिबाग क्वार्टर्स Building - Alibag Quarters	1,30,79,984	-	-	1,30,79,984	63,03,892	-	3,38,805	-	66,42,697	64,37,287	67,76,092
13	भवन-निर्माण - विशाखापट्टनम Building - Vishakhapatnam	25,42,924	-	-	25,42,924	10,24,008	-	75,946	-	10,99,954	14,42,970	15,18,[illegible]

V.R.Bakre

अनु. क्र. Sr. No	परिसम्पत्ति का विवरण Particulars Of Assests	सकल खड / Gross Block				अवमूल्यन / Depreciation					निवल खड / Net Block	
		31.03.2023 को लागत/मूल्य Cost/Value at 31-03-23	वर्ष के दौरान परिवर्धन Additions during the year	वर्ष के दौरान कटौती Deduction during the year	लागत / मूल्य Cost/Value at 31-03-24	01.04.23 पर मूल्य /On Value 01/04/23	वर्ष के दौरान परिवर्धन पर / On addition during the year	वर्ष 2023-24 हेतु / For the year 2023-24	कटौती पर / On deduction	वर्ष के दौरान कटौती पर / Deduction during the year	31.03.24 तक Upto 31-03-24	31-03-23 को लागत / Cost as at 31-03-23
14	भवन-निर्माण - जयपुर / Building - Jaipur	57,43,532	-	-	57,43,532	38,71,871	-	93,583	-	39,65,454	17,78,078	18,71,661
15	भवन-निर्माण - जीआरएल इलाहाबाद Building - GRL Allahabad	8,84,97,266	-	-	8,84,97,266	4,66,61,765	-	20,91,775	-	4,87,53,540	3,97,43,726	4,18,35,501
16	भवन-निर्माण - राजकोट / Building - Rajkot	52,72,302	-	-	52,72,302	27,68,989	-	1,25,166	-	28,94,155	23,78,147	25,03,313
17	भवन-निर्माण - शिलॉंग (बाहरी दीवार) Building - Shillong (Boundry Wall)	1,16,66,979	-	-	1,16,66,979	49,41,557	-	3,36,271	-	52,77,828	63,89,151	67,25,422
18	भवन-निर्माण, अतिथि गृह, हॉस्टेल - ईजीआरएल Building, Guest House, Hostel-EGRL	4,87,19,083		-	4,87,19,083	2,54,42,389	-	11,63,835	-	2,66,06,224	2,21,12,859	2,32,76,694
19	भवन-निर्माण - सिल्चर / Building - Silchar	2,05,00,898	13,85,900	-	2,18,86,798	75,85,611	69,295	6,45,764	-	83,00,670	1,35,86,128	1,29,15,287
20	भवन-निर्माण - कुलाबा (डब्ल्यूडीसी)/ Building-Colaba (WDC)	41,71,891	24,78,105	-	66,49,996	8,89,764	1,23,905	1,64,106	-	11,77,775	54,72,221	32,82,127
21	भवन-निर्माण पोर्टब्लेयर / Building-Portblair	3,22,54,652	-	-	3,22,54,652	67,83,458	-	12,73,560	-	80,57,018	2,41,97,634	2,54,71,194
22	भवन-निर्माण - अलिबाग Building - Alibag	58,91,824	-	-	58,91,824	4,95,528	-	2,69,815	-	7,65,343	51,26,481	53,96,296
	कुल / TOTAL	29,50,74,324	38,64,005	-	29,89,38,329	14,17,94,538	1,93,200	76,63,991	-	14,96,51,729	14,92,86,600	15,32,79,786

K.R.Sahu

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI
वर्ष समाप्ति 31.03.202 / YEAR ENDED 31-03-2024

भूमि एवं भवन निर्माण /Land And Building

स्थिर परिसंपत्तियां - अचल संपत्ति (पूर्ण स्वामित्व की भूमि पर)

Fixed Assests - Immovable Property (On Leasehold Land)

अनुसूची / SCHEDULE – 8A(1)

अनु क्र Sr .No	परिसम्पत्ति का विवरण Particulars Of Assests	सकल खंड / Gross Block				मूल्यह्रास / Depreciation					निवल खंड / Net Block	
		31.03.2023 को लागत/मूल्य Cost/Value at 31-03-23	वर्ष के दौरान परिवर्धन Additions during the year	वर्ष के दौरान कटौती Deduction during the year	लागत / मूल्य Cost/Value at 31-03-24	01.04.23 पर मूल्य /On Value 01/04/23	वर्ष के दौरान परिवर्धन पर / On addition during the year	वर्ष 2023-24 हेतु / For the year 2023-24	कटौती पर / On deduction	वर्ष के दौरान कटौती पर / Deduction during the year	31.03.24 तक Upto 31-03-24	31-03-23 को लागत / Cost as at 31-03-23
1	भवन-निर्माण - पनवेल Building - Panvel	8,66,88,224	-	-	8,66,88,224	5,27,61,930	-	16,96,315		5,44,58,245	3,22,29,979	3,39,26,294
2	रिसर्च स्कॉलर हॉस्टेल Research Scholar Hostel	1,88,80,074	-	-	1,88,80,074	1,12,53,403	-	3,81,334	-	1,16,34,737	72,45,337	76,26,671
3	अतिथि गृह पनवेल Guest House at Panvel	3,59,43,070	-	-	3,59,43,070	1,98,36,004	-	8,05,353	-	2,06,41,357	1,53,01,713	1,61,07,066
4	भवन-निर्माण - पनवेल में सभागृह तथा भोजनालय Building - Auditorium & Canteen at Panvel	7,58,76,172	-	-	7,58,76,172	3,24,88,058	-	2,16,906	-	3,27,04,964	4,31,71,208	4,33,88,114
5	भवन-निर्माण - निदेशक बंगला, छोटे फ्लैट आवास कर्मचारी निवास स्थान / Building Director Bunglow, Flatlets & Staff Quarters	4,29,39,936	-	-	4,29,39,936	1,73,08,870	-	12,81,553	-	1,85,90,423	2,43,49,513	2,56,31,066
	कुल / TOTAL	**26,03,27,476**	-	-	**26,03,27,476**	**13,36,48,265**	-	**43,81,461**	-	**13,80,29,726**	**12,22,97,750**	**12,66,79,211**

K.R.Dalvi

अनुसूची / SCHEDULE – 8B(A)

अचल संपत्तियों के पूंजीगत कार्य में प्रगति हेतु अग्रिम (अ)
ADVANCES FOR IMMOVABLE PROPERTIES CAPITAL WORKS IN PROGRESS (A)

विवरण / Particulars	01/04/23 को / AS ON 01/04/23	वर्ष के दौरान वृद्धि Additions during the year	वर्ष के दौरान कटौती Deduction during the year	31/03/24 को / AS ON 31/03/24
पूंजीगत कार्य जारी - नागपुर Capital work in progress – Nagpur	6,13,509	4,03,191	-	10,16,700
पूंजीगत कार्य जारी - राजकोट (सीपीडब्लूडी) Capital work in progress – Rajkot (CPWD)	43,413	-	-	43,413
पूंजीगत कार्य जारी - अलिबाग (सीपीडब्लूडी) Capital work in progress – Alibag (CPWD)	1,39,12,320	1,28,62,803	67,42,555	2,00,32,568
पूंजीगत कार्य जारी - इलाहाबाद Capital work in progress – Allahabad	-	21,85,672	-	21,85,672
पूंजीगत कार्य जारी - ईजीआरएल Capital work in progress – EGRL	21,66,082	-	6,66,082	15,00,000
पूंजीगत कार्य जारी - पोर्टब्लेयर Capital work in progress – Portblair	4,74,542	-	-	4,74,542
पूंजीगत कार्य जारी - छोटे घर/निदेशक बंगला, कर्मचारी आवास / Capital work in progress – Flatlets/Dir Bung, Staff Qtrs	-	-	-	-
पूंजीगत कार्य जारी - विशाखापट्टनम / Capital work in progress – Vishakapatnam	-	-	-	-
पूंजीगत कार्य जारी - पनवेल / Capital work in progress – Panvel	1,08,08,065	83,67,281	5,62,905	1,86,12,441
पूंजीगत कार्य जारी - छात्रावास / Capital Work in progress - Hostel	-	-	-	-
पूंजीगत कार्य जारी - सिलचर / Capital Work in progress - Silchar	12,83,350	-	11,80,500	1,02,850
पूंजीगत कार्य जारी - कुलाबा Capital Work in progress - Colaba	47,02,178	8,05,719	36,02,824	19,05,073
पूंजीगत कार्य जारी - शिलॉंग / Capital Work in progress - Shillong	44,82,173	-	-	44,82,173
पूंजीगत कार्य जारी - बेलापुर / Capital Work in progress - Belapur	41,53,809	10,31,658	-	51,85,467
पूंजीगत कार्य जारी - लेह लद्दाख / Capital Work in progress - Leh Ladak	-	1,04,566		1,04,566
पूंजीगत कार्य जारी - जयपुर / Capital Work in progress - Jaipur	-	27,86,580		27,86,580
कुल / TOTAL	**4,26,39,441**	**2,85,47,470**	**1,27,54,866**	**5,84,32,045**

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI

वर्ष समाप्ति 31.03.2024 / YEAR ENDED 31-03-2024

अनुसूची / SCHEDULE – 8B

चल संपत्तियॉ के पूंजीगत कार्य में प्रगति हेतु अग्रिम / ADVANCES FOR MOVABLE PROPERTIES CAPITAL WORKS IN PROGRESS (B)

विवरण / Particulars	01.04.2023 को As on 01.04.2023	वर्ष के दौरान वृद्धि Additions during the year	वर्ष के दौरान कटौती Deduction during the year	31.03.2024 को As on 31-03-24
प्रयोगशाला उपकरण हेतु अग्रिम Advances for Laboratory Equipment (Exp.)	7,03,030	30,33,300	-	37,36,330
उपांतिक राशि / Margin Money	-	-	-	-
कुल / TOTAL	**7,03,030**	**30,33,300**	**-**	**37,36,330**

पूंजीगत कार्य में प्रगति / CAPITAL WORKS IN PROGRESS

A) अचल संपत्तियों हेतु अग्रिम ADVANCES FOR IMMOVABLE PROPERTIES	5,84,32,045
B) चल संपत्तियों हेतु अग्रिम ADVANCES FOR MOVABLE PROPERTIES	37,36,330
कुल / TOTAL	**6,21,68,375**

K.R.Sahu

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक तुलन पत्र के विभिन्न अनुसूची के भाग
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

अनुसूची / SHEDULE 9 : अक्षय एवं विशिष्ट प्रयोजनों की निधियों से निवेश INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS	"वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार"	"पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार"
INVESTMENT-IIG PENSION FUND	7,04,06,373	7,17,27,116
कुल / TOTAL	**7,04,06,373**	**7,17,27,116**

	अनुसूची / SHEDULE 10 – निवेश - अन्य / INVESTMENTS – OTHERS	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2023 के अनुसार
1)	सरकारी प्रतिभूति में / In Government Securities	-	-
2)	अन्य अनुमोदित प्रतिभूतियाँ / Other approved Securities	-	-
3)	शेयर्स / Shares (रू. .... के शेयरों की संख्या / no. of shares of Rs.....)	2,750	2,750
4)	ऋणपत्र तथा बांड / Debentures and Bonds	-	-
5)	अनुषंगी तथा संयुक्त काश्तकार / Subsidiaries and Joint Ventures	-	-
6)	बैंक के साथ एस.डी.आर. / SDR with Bank	-	-
कुल / TOTAL		**2,750**	**2,750**

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक तुलन पत्र के भाग के रूप में अनुसूची
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

अनुसूची 11: वर्तमान परिसंपत्तियां, ऋण, अग्रिम आदि। SCHEDULE 11 : CURRENT ASSETS, LOANS, ADVANCES ETC.			Current Year as at 31st March-2024	Previous Year as at 31st March-2023
क / A. वर्तमान परिसंपत्तियां / CURRENT ASSESTS				
1)	सामग्री सूची / Inventories			
	क/a	भंडार और अतिरिक्त सामान (भंडार में अधिशेष / and spares (closing bal. in stores) Stores	3,99,075	4,15,665
	ख/b	खुले औजार / Loose Tools		
	ग/c	व्यापार में भंडार / Stock-in-Trade		
		तैयार माल / Finished Goods		
		कार्य प्रगति पर है / Work-in-Progress		
		कच्चा माल / Raw Materials		
2)	विविध देनदार: / Sundry Debtors:			
	क/a	छह महीने से अधिक की अवधि के बकाया ऋण / Debts Outstanding for a period exceeding six months	1,03,304	1,97,231
	ख/b	अन्य / Others	-	1,89,373
			-	-
3)	हाथ में नकद शेष राशि (चेक / ड्राफ्ट और अग्रदाय सहित) / Cash Balances in hand (including cheques / drafts and imprest)		39,017	39,017
	प्रधान कार्यालय / Head Office ---			
	उप कार्यालय / Sub Office	9017		
	आपातकाल के लिए नकदी / Cash for emergency	25000		
	खुदरा नकदी / Petty Cash	5000		
4)	बैंक में शेष राशियां: / Bank Balances:			
	क/a)	अनुसूचित बैंकों के साथ: / With Scheduled Banks:		
		चालू खातों पर - बैंक ऑफ इंडिया, पनवेल / On Current Accounts – Bank of India, Panvel	1,95,49,459	2,44,49,798
		चालू खातों पर - बैंक ऑफ इंडिया, पनवेल / On Current Accounts – Bank of India, Panvel (SERB)	-	-
		यूनियन बैंक ऑफ इंडिया, पनवेल /Union Bank of India, Panvel	50,33,805	5,69,16,771
		बैंक ऑफ इंडिया, एलसी खाता 361 /Bank of India, LC A/c. 361	31,57,429	24,00,472
		ISRO BANK ACCOUNT	1,038	-
		HDFC A/C 50200094100046	1,00,00,000	-
		-- Bank of India -IIG PENSION A/c	97,58,698	51,11,405
		उपकरणों की खरीद हेतु एसडीआर / SDR against purchase of	3,08,92,381	4,06,45,873
5)	एसडीआर में निवेश / Investment in SDR		-	-
6)	फ्रेंकिंग मशीन के लिए अग्रिम / Advance for Franking Machine (Stamp in hand)		62,783	36,824
7)	पूर्वदत्त व्यय / Prepaid Expenses		-	-
	कुल (क) TOTAL (A)		**7,89,96,990**	**13,04,02,429**

K.R.Sali

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक तुलनपत्र के भाग के रूप में अनुसूची
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

अनुसूची 11: वर्तमान परिसंपत्तियां, ऋण, अग्रिम आदि। SCHEDULE 11 : CURRENT ASSETS, LOANS, ADVANCES ETC.			Current Year as at 31st March-2024	Previous Year as at 31st March-2023
ख/B. ऋण, अग्रिम एवं अन्य परिसंपत्तियां LOANS, ADVANCES AND OTHER ASSETS				
1)	ऋण / Loans			
	क/a	कर्मचारी / Staff	72,75,529	60,99,598
	ख/b	संस्थान के समान गतिविधियों / उद्देश्यों में लगे अन्य संस्थान / Other entities engaged in activities / objectives similar to that of the entity		
	ग/c	अन्य (निर्दिष्ट करें) - आकस्मिक अग्रिम / Other (specify)- Contingent Advances	1,72,32,187	93,69,574
	/d	Imprest & Science Outreach advances	4,37,098	2,03,859
2)	प्राप्त होने वाले मूल्य के लिए / नकद वस्तुओं में वसूलने योग्य / अग्रिम और अन्य राशियाँ / Advances and other amounts recoverable in cash or in kind for value to be received			
	क/a	पूंजीगत लेखा में / On Capital A/c	-	-
	ख/b	पूर्व भुगतान / Pre-payments	-	-
	ग/c	अन्य / Others	28,30,644	20,40,122
3)	आय उपार्जित / Income Accrued			
	a)	निर्धारित / अक्षय निधियों से निवेश पर / On Investments from earmarked / endowment funds	-	-
	b)	निवेश पर - एलसी पर एसडीआर का अन्य उपार्जित ब्याज / On Investments – Others Accrued interest of SDR on LC	-	-
	c)	एसडीआर में निवेश पर / On investment in SDR	-	-
	d)	अन्य (जिसमें अघोषित रूप से देय आय शामिल है .....) एचबीए पर ब्याज और प्राप्य ब्याज / Others (includes income due unrealized Rs.....) Accrued interest on HBA & interest receivable	-	-
4)	प्राप्य दावे / Claims Receivable		-	2,65,022
5)	प्राप्य टीडीएस, एसजीएसटी, सीजीएसटी और आयजीएसटी, एसडीआर पर ब्याज़ प्राप्य / TDS /TCS, SGST, CGST & IGST RECEIVABLE		3,33,74,650	3,14,99,475
कुल (बी) / TOTAL (B)			6,11,50,107	4,94,77,650
कुल (ए + बी) / TOTAL (A + B)			**14,01,47,097**	**17,98,80,079**

11

K-R Babu

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI

वर्ष समाप्ति 31.03.2024 / YEAR ENDED 31-03-2024

सामग्रियां / INVENTORIES

अनुसूची / Sch :11 A (1)

विवरण / Particulars	प्रारंभिक शेष / Opening Balance	खरीद / Purchases	अंतिम शेष / Closing Balance	उपभोग / Consumption
कंप्यूटर लेखन-सामग्री / Computer Stationery	97,782	3,396	79,550	21,628
लेखन-सामग्री / लेखा तालिका और सामग्री का मुद्रण: Stationery / Chart Rolls & Printing of stationery : 1) लेखन-सामग्री / लेखा तालिका / Stationery / Chart Rolls 2) लेखन सामग्री का मुद्रण / Printing of stationery	1,97,875	26,06,206	1,86,577	26,17,504
विद्युतीय सामान और इलेक्ट्रोनिक पुर्जे / Electrical Goods & Electronic Components	80,502	22,94,029	93,442	22,81,089
छायांकन सामान / Photo Goods	39,506	1,51,841	39,506	1,51,841
कुल / TOTAL	**4,15,665**	**50,55,472**	**3,99,075**	**50,72,062**

K.R.Sahu

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI– 410 218.

अनुसूची / SCHEDULE – 11A(2b)

वर्ष समाप्ति 31.03.2024 / YEAR ENDED 31-03-2024

अन्य के पास अग्रिम और जमा करें / ADVANCE AND DEPOSITS WITH OTHERS

AS ON 31/03/23 तक	विवरण / PARTICULARS	AS ON 31/03/24 तक
RS. PS.		RS. PS.
74,387	टेली / टेलेक्स एमटीएनएल के पास जमाराशि / Deposit Tele / Telex MTNL	74,387
55,440	एमएसईबी, अलीबाग के पास जमाराशि / Deposit MSEB, Alibag	55,440
14,200	एलपीजी गैस (मुंबई और पनवेल) के पास जमाराशि / Deposit LPG Gas (Mumbai & Panvel)	14,200
62,708	टेलीफोन (सभी आउटस्टेशन) के पास जमाराशि / Deposit Telephones (All outstations)	62,708
3,470	बेस्ट सुरक्षा के पास जमाराशि / Deposit BEST Security	3,470
5,560	आवासीय बेस्ट के लिए सबसे अच्छा जमा / Deposit BEST for Residential Qtrs.	5,560
17,720	एमएसईबी और एमएसईबीडी,नागपुर के पास जमाराशि सुरक्षा / Deposit Security Deposit MSEB & MSED, Nagpur	17,720
19,420	तमिलनाडु बिजली बोर्ड के पास जमाराशि / Deposit Tamilnadu Electricity Board	19,420
2,94,300	एमएसईबी, बेलापुर के पास जमाराशि / Deposit MSEB, Belapur	2,94,300
23,920	बिजली तिरुनेलवेली के पास जमाराशि / Deposit Electricity Tirunelveli	23,920
950	एलपीजी गैस (सभी आउटस्टेशंस) के पास जमाराशि / Deposit LPG Gas (All Outstations)	950
32,090	के पास जमाराशि सिडको भूमि / Deposit CIDCO Land	32,090
9,747	विद्युत कनेक्शन के पास जमाराशि जीआरएल / Deposit Electric Connection GRL	9,747
500	टेलीफोन राजकोट के पास जमाराशि / Deposit Telephone Rajkot	500
8,555	के पास जमाराशि राजस्थान बिजली (बोर्ड) जयपुर / Deposit Rajasthan Electricity (Board) Jaipur	8,555
550	एचपी गैस, पनवेल के पास जमाराशि / Deposit HP Gas, Panvel	550
700	बीएसएनएल जयपुर के पास जमाराशि / Deposit BSNL Jaipur	700
1,000	बीएसएनएल पोर्ट ब्लेयर के पास जमाराशि / Deposit BSNL Port Blair	1,000
3,000	के पास जमाराशि बीएसएनएल राजकोट / Deposit BSNL Rajkot	3,000
48,000	सिडको (डीआईआर बंग और फ्लैट) के पास जमाराशि / Deposit CIDCO (DIR BUNG & FLAT)	48,000
11,000	यूपीपीसीएल (इलाहाबाद) के पास जमाराशि / Deposit UPPCL (Allahabad)	11,000
64,333	बिजली पोर्टब्लेयर के पास जमाराशि / Deposit Elect. Portblair	64,333
2,200	अलीबाग के पास जमाराशि सुरक्षा / Deposit Security MSED Alibag	2,200
3,150	के पास जमाराशि पुष्पक गैस राजकोट / Deposit Pushpak Gas Rajkot	3,150
1,850	एलपीजी गैस पोर्टब्लेयर के पास जमाराशि / Deposit LPG Gas Portblair	1,850
1,900	एलपीजी गैस सिलचर के पास जमाराशि / Deposit LPG GAS Silchar	1,900

Contd.Page-2

1,00,000	असम सिलचर के पास जमाराशि सुरक्षा / Deposit Security at Assam Silchar	1,00,000
1,000	बैंक खाता राजकोट के पास जमाराशि / Deposit Bank A/c. Rajkot	1,000
1,000	बैंक खाता अलीबाग के पास जमाराशि / Deposit Bank A/c. Alibag	1,000
1,000	बैंक खाता विशाखापट्टनम के पास जमाराशि / Deposit Bank A/c. Vishakhapatanam	1,000
1,000	बैंक खाता सिलचर के पास जमाराशि / Deposit Bank A/c. Silchar	1,000
500	बैंक खाता नागपुर के पास जमाराशि / Deposit Bank A/c. Nagpur	500
3,430	बिजली एमएसईडीसीएल, अलीबाग के पास जमाराशि / Deposit Electric MSEDCL, Alibag	3,430
5,170	बिजली विशाखापट्टनम के पास जमाराशि / Deposit Electric Vishakhapatnam	5,170
52,857	नालंदा डेकोर के पास जमाराशि / Deposit Nalanda Decor	52,857
25,000	विक्ट्री ऑटोमोबाइल्स के पास जमाराशि / Deposit Victory Automobiles	25,000
2,430	एमएसईडीसीएल बेलापुर क्वार्टर के पास जमाराशि / Deposit MSEDCL Belapur quarters	2,430
3,720	एमएसईडीसीएल कोल्हापुर के पास जमाराशि / Deposit MSEDCL Kolhapur	3,720
8,59,900	एमएसईडीसीएल पनवेल के पास जमाराशि / Deposit MSEDCL Panvel	16,50,422
1,52,175	एनएचपीसी खाता / NHPC A/c.	1,52,175
66,890	एनएमआरएल/ डीआरडीओ परियोजना / NMRL/DRDO Project	66,890
370	बिजली जमाराशि-नागपुर / Electricity Deposit-Nagpur	370
1,360	बिजली मीटर कोलाबा की सुरक्षा जमाराशि / Security Deposit of Electric Meter Colaba	1,360
1,670	बिजली मीटर कोल्हापुर की सुरक्षा जमा / Security Deposit of Electric Meter Kolhapur	1,670
20,40,122	**कुल / TOTAL**	**28,30,644**

K.R.Sali

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI– 410 218.

अनुसूची / SCHEDULE 11B(1)

वर्ष समाप्ति 31.03.2024 / YEAR ENDED 31-03-2024

कर्मचारीयों को अग्रिम / ADVANCE TO STAFF

AS ON 31/03/23 तक	PARTICULARS	AS ON 31/03/24 तक
RS. PS.		RS. PS.
8,36,303	यात्रा भत्ता / Travelling Allowance	10,33,270
4,98,171	छुट्टी यात्रा रियायत Leave travel concession	1,53,442
-	स्कूटर / Scooter	-
-	आवास निर्माण / House Building	-
-	विदेशी टी. ए. / Foreign T.A.	69,422
79,000	कंप्यूटर / Computer	26,000
-	मोटर गाड़ी / Motor Car	-
46,86,124	कठिन कर्तव्य (ड्यूटी) भत्ता / Hard Duty Allowance	59,93,395
-	स्थानांतरण पर टीए / TA on Transfer	-
-	चिकित्सा अग्रिम / Medical Advance	-
60,99,598	**कुल / TOTAL**	**72,75,529**

K.R.Sahi

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 के आय तथा व्यय के भाग के रूप में अनुसूची
SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

अनुसूची 12: बिक्री / सेवाओं से आय SCHEDULE 12 : INCOME FROM SALES / SERVICES		31.03.2024 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2024	31.03.2023 पिछला वर्ष को समाप्त / Previous Year as on 31/03/2023
1)	डेटा की बिक्री, पीपीएम और उपकरणों के अंशांकन / Sale of data, PPM & Caliberation of equipment	1,80,000	7,90,800
कुल /TOTAL		**1,80,000**	**7,90,800**

अनुसूची 13: अनुदान / सब्सिडी(अपरिवर्तनीय अनुदान और अनुवृत्ति प्राप्त) / SCHEDULE 13 : GRANTS/SUBSIDIES (Irrevocable Grants & Subsidies Received)		31.03.2024 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2024		31.03.2023 पिछला वर्ष को समाप्त / Previous Year as on 31/03/2023	
1)	केंद्र सरकार - विज्ञान और प्रौद्योगिकी विभाग से प्राप्त /Central Government - Received from Department of Science & Technology	54,63,66,931		44,53,15,470	
	घटाया : सहायता अनुदान पूंजी का पूंजी खाते में स्थानांतरण किया गय / Less : Grant-in-Aid Capital Transferred to Capital Account	2,83,68,009	51,79,98,922	1,45,12,779	43,08,02,691
2)	राज्य सरकार / State Government		-		-
3)	सरकारी संस्थाएं / Government Agencies		-		-
4)	संस्थान / कल्याण निकाय / Institutions/welfare Bodies		-		-
5)	अंतरराष्ट्रीय संगठन / International Organizations		-		-
6)	अन्य (निर्दिष्ट करें) / Others (Specify)		-		-
कुल / TOTAL			**51,79,98,922**		**43,08,02,691**

K.R.Sahi

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक तुलन पत्र के भाग के रूप में अनुसूची
SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

अनुसूची 14: फीस / अंशदान / SCHEDULE 14 : FEES / SUBSCRIPTION		31.03.2024 वर्तमान वर्ष को समाप्त / Current Year Ended 31st March-2024	31.03.2023 वर्तमान वर्ष को समाप्त / Current Year Ended 31st March-2023
1)	प्रवेश शुल्क / Entrance Fees	-	-
2)	वार्षिक शुल्क / अंशदान / Annual Fees / Subscriptions	-	-
3)	संगोष्ठी / कार्यक्रम शुल्क / Seminar / Program Fees	-	-
4)	परामर्श शुल्क / Consultancy Fees	-	-
5)	अन्य (निर्दिष्ट करें) / Others (Specify)	-	-
	क/a सीजीएचएस अंशदान / CGHS contribution	-	-
	ख/b सेवा शुल्क-आयआयजी / Service charges – IIG	18,564	15,833
	ग/c लाइसेंस शुल्क-आयआयजी / License fees – आयआयजी IIG	6,29,469	4,16,933
कुल / TOTAL		**6,48,033**	**4,32,766**

नोट: प्रत्येक आइटम के लिए लेखांकन नीतियों का खुलासा किया जाना है / Note : Accounting Policies towards each item are to be disclosed

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)

FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)

संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218

Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.

31 मार्च 2024 तक आय तथा व्यय के विभिन्न अनुसूची के भाग

SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

अनुसूची 15: निवेश से आय / SCHEDULE 15 : INCOME FROM INVESTMENTS (निवेश पर आय : निर्धारित / अक्षय निधियों से निधियों में स्थानांतरित) (Income on Invest. From Earmarked/Endowment Funds transferred to Funds)	31.03.2024 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2024	31.03.2023 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2023
	शून्य / NIL	शून्य / NIL
कुल / TOTAL	शून्य / NIL	शून्य / NIL

अनुसूची 16: रॉयल्टी, प्रकाशन आदि से आय / SCHEDULE 16 : INCOME FROM ROYALTY, PUBLICATION ETC. (निवेश पर आय : निर्धारित / अक्षय निधियों से निधियों में स्थानांतरित) (Income on Invest. From Earmarked/Endowment Funds transferred to Funds)	31.03.2024 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2024	31.03.2023 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2023
	शून्य / NIL	शून्य / NIL
कुल / TOTAL	शून्य / NIL	शून्य / NIL

K.R.Balaji

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक आय तथा व्यय के विभिन्न अनुसूची के भाग

अनुसूची 17: ब्याज प्राप्त / SCHEDULE 17 : INTEREST EARNED			31.03.2024 वर्तमान वर्ष को समाप्त / Current Year Ended 31st March-2024	31.03.2023 पिछला वर्ष को समाप्त / Previous Year Ended 31st March-2023
1)	सावधि जमा पर: / On Term Deposits:			
	क/a	अनुसूचित बैंकों के साथ / With Scheduled Banks	-	-
	ख/b	**अनुसूचित बैंकों (बैंक ऑफ इंडिया) के साथ - एसडीआर * / एलसी में निवेश से / With Scheduled Banks (Bank of India) - From investment in SDR */LC**	-	-
	ग/c	संस्थानों के साथ / With Institutions	-	-
2)	बचत खातों पर / On Savings Accounts		641293	295349
	क/a	अनुसूचित बैंकों के साथ / With Scheduled Banks	-	-
	ख/b	गैर-अनुसूचित बैंकों के साथ / With Non-Scheduled Banks	-	-
	ग/c	डाकघर बचत खाता / Post office Savings A/cs	-	-
	घ/d	अन्य / Others	11988289	11192660
3)	ऋण पर / On Loans		-	-
	क/a	**कर्मचारी वर्ग / Staff Members**	-	-
	ख/b	अन्य / Others		-
4)	देनदार और अन्य प्राप्य पर ब्याज / Interest on Debtors and Other Receivables		-	-
कुल / TOTAL			**1,26,29,582**	**1,14,88,009**
टिपपणी : स्रोत पर कार की कटौती दर्शाई जाए / Note : Tax deducted at source to be indicated				

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)

संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218

Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410

31 मार्च 2024 तक आय तथा व्यय के विभिन्न अनुसूची के भाग

SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MA

(राशि / Amount – रू./Rs.)

अनुसूची 18: अन्य आय / SCHEDULE : OTHER INCOME			31.03.2024 वर्तमान वर्ष को समाप्त /Current Year Ended 31st March-2024	31.03.2023 पिछला वर्ष को समाप्त /Previous Year Ended 31st March-2023
1)	परिसंपत्तियों की बिक्री / निपटान पर लाभ: / Profit on Sale / disposal of Assets:			
	क/a	स्वामित्व वाली परिसंपत्ति / Owned assets	0	0
	ख/b	अनुदान से प्राप्त या मुफ्त प्राप्त परिसंपत्ति / Assets acquired out of grants, or received free of cost	0	0
2)	परियोजना से आय / Income from Project		5,44,000	-
3)	डेटा की बिक्री, पीपीएम और उपकरणों के अंशांकन / Sale of data, PPM & Caliberation of equipment		-	-
4)	विविध आय / Miscellaneous Income			
	क/a	छात्रावास / अतिथि गृह से आय / Income from hostel / Guest house	12,38,929	4,18,275
	ख/b	विविध प्राप्तियां / Miscellaneous receipt	20,69,148	9,96,886
	ग/c	वापस न ली गई जमा राशि / Un-claimed Deposit	17,95,886	
5)	STP 15 Incomes		-	-
	कुल / TOTAL		56,47,962	14,15,161

अनुसूची 18: अन्य आय / SCHEDULE 18 (a) : परिसम्पत्ति की बिक्री होने पर अन्य आय / Profit on sale of assets			31.03.2024 वर्तमान वर्ष को समाप्त /Current Year Ended 31st March-2024	31.03.2023 पिछला वर्ष को समाप्त /Previous Year Ended 31st March-2023
	1	परिसम्पत्ति की बिक्री होने पर अन्य आय / Profit on sale of assets	266506	40582
	कुल / TOTAL		2,66,506	40,582

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.

31 मार्च 2024 तक आय तथा व्यय के विभिन्न अनुसूची के भाग

SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

अनुसूची 19: तैयार माल के भंडार एवं प्रगतिगत कार्य में वृद्धि/ (कमी) के चरण में / SCHEDULE 19 : INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS	31.03.2024 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2024	31.03.2023 पिछला वर्ष को समाप्त / Previous Year as on 31/03/2023
	शून्य / NIL	शून्य / NIL
कुल / TOTAL	शून्य / NIL	शून्य / NIL

	अनुसूची 20: स्थापना के व्यय / SCHEDULE 20 : ESTTABLISHMENT EXPENSES	31.03.2024 वर्तमान वर्ष को समाप्त / Current Year Ended 31st March-2024	31.03.2023 पिछला वर्ष को समाप्त / Previous Year Ended 31st March-2023
क/a	वेतन / Salaries	24,52,03,188	24,63,66,599
ख/b	भत्ते और बोनस / Allowances and Bonus	18,68,252	32,74,840
ग/c	सीपीएफ में नियोक्ता का अंशदान / Employers Contribution to CPF	-	-
घ/d)	पेंशन भुगतान/ Expenses towards Pension payment	7,35,50,931	5,92,12,408
e)	परोपकारी निधि के लिए नियोक्ता का अंशदान / Employers Contribution to Benevolent Fund	-	-
च/f)	कर्मचारी सेवानिवृत्ति और टर्मिनल लाभ पर व्यय / Expenses on Employees Retirement and Terminal Benefits	1,76,57,684	5,60,08,551
छ/g)	अन्य (निर्दिष्ट करें) (चिकित्सा व्यय) / Others (specify) (Medical Expenses)	54,69,847	54,36,175
ज/h)	मनोरंजन क्लब में नियोक्ता का अंशदान / Employers contribution to Recreation Club	71,575	72,675
i)	नई अंशदायी पेंशन निधि में नियोक्ताओं का योगदान / Employers contribution to New Contributory Pension Fund	1,40,94,126	1,89,94,915
त्र/j)	कर्मचारी मृत्यु लाभ पर व्यय / Expenses on Employees Death Benefits	-	-
	कुल / TOTAL	35,79,15,603	38,93,66,163

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI – 410 218.

अनुसूची /SCHEDULE – 20A

31/03/2024 को समाप्त वर्ष / YEAR ENDING 31/03/2024

A. वेतन / SALARIES

विवरण / PARTICULARS	31.03.2024 तक AS ON 31/03/24
	रू./RS. पै./PS.
वेतन तथा भत्ते / Pay and Allowances	22,52,53,045
शोध छात्रों को रिसर्च छात्रवृत्ति / वजीफा / Research Scholarship / Stipend to Res. students	1,99,50,143
कुल / TOTAL	**24,52,03,188**

K.R. Sahu

भारतीय भूचुम्बकत्व संस्थान
INDIAN INSTITUTE OF GEOMAGNETISM

न्यू पनवेल, नवी मुंबई - 410 218
NEW PANVEL, NAVI MUMBAI – 410 218.

अनुसूची / SCHEDULE – 20B

31/03/2024 को समाप्त वर्ष / YEAR ENDING 31/03/2024

भत्ते तथा बोनस / ALLOWANCES & BONUS

विवरण / PARTICULARS	31.03.2024 तक AS ON 31/03/24
	रू./RS. पै./PS.
मानदेय / Honorarium	-
समयोपरि / Overtime	-
कठिन कार्य भत्ता / Hard Duty Allowance	-
भोजन भत्ता / Mess Allowances	-
संतान शिक्षा भत्ता / शिक्षा शुल्क की प्रतिपूर्ती Children Education Allowance / Reimbursement of Tution Fees	18,68,252
कुल / TOTAL	**18,68,252**

K.R.Dalvi

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक का आय तथा व्यय विवरण के भाग की अनुसूची
SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

	अनुसूची 21 : अन्य प्रशासनिक खर्च SCHEDULE 21 : OTHER ADMINISTRATIVE EXPENSES	वर्तमान वर्ष Current Year	पिछला वर्ष Previous Year
1	विज्ञापन तथा प्रचार / Advertisement and Publicity	4,05,070	4,47,521
2	बैंक प्रभार / Bank charges	22,972	41,074
3	बाईंडिंग प्रभार / Binding charges	16,180	69,032
4	भोजनालय अनुवृत्ति / Canteen Subsidy	19,405	1,84,105
5	विद्युत तथा ऊर्जा / प्रभार / Electricity and power / Charges	1,27,81,507	1,23,00,094
6	मनोरंजन / आतिथ्य / Entertainment / Hospitality	3,96,609	3,13,491
7	उद्यान खर्च / Garden Expenses	13,655	66,105
8	अतिथि गृह रखरखाव / प्रभार, अतिथिगृह वस्तु / Guest house maintenance / Charges Guest house items	5,53,700	4,24,941
9	हिंदी व्यवस्था / पुरस्कार / Hindi expenses / awards	3,37,339	3,18,229
10	भा.भू.सं. वार्षिक दिवस खाता / IIG Annual Day A/c	4,30,054	3,45,039
11	बीमा / Insurance	22,374	82,640
12	वर्दी / Liveries	-	18,880
13	बैठक खर्च / Meeting expenses	73,294	-
14	अन्य खर्च / Miscellaneous expenses	2,03,455	14,99,521
15	डाक, दूरभाष तथा संचार प्रभार / इंटरनेट प्रभार Postage, Telephone and Communication Charges / Internet charges	45,20,034	57,14,922
16	व्यावसायीक प्रभार / सलाहकार प्रभार/ Professional Charges / Consultancy Charges	3,21,899	2,00,160
	शेष / Balance c/f	**2,01,17,547**	**2,20,25,753**

K.R.Rao

भारतीय भूचुम्बकत्व संस्थान Indian Institute of Geomagnetism IIG New Panvel - 410218. न्यू पनवेल, नवी मुंबई - 410218.

	अनुसूची 21 : अन्य प्रशासनिक खर्च SCHEDULE 21 : OTHER ADMINISTRATIVE EXPENSES	वर्तमान वर्ष Current Year	पिछला वर्ष Previous Year
	आगे लाया गया / Brought Forward	**2,01,17,547**	**2,20,25,753**
17	पंजिकरण शुल्क / Registration fees	2,19,020	88,785
18	किराया, दरें तथा कर / Rent, Rates and Taxes	11,90,263	3,59,504
19	मरम्मत तथा रखरखाव / Repairs and Maintenance	1,18,41,908	47,84,223
20	विज्ञान सप्ताह समारोह / प्रदर्शनी / Science week celebration / Exhibition	3,52,556	-
21	सुरक्षा सुविधाएं / Security services	5,78,87,592	5,00,41,687
22	कर्मचारी कल्याण / Staff welfare /Momento	25,000	-
23	भंडार उपभुक्त / Stores consumed	54,04,129	55,75,736
24	सर्वेक्षण खर्च / Survey expenses	74,574	3,96,760
25	यात्रा तथा परिवहन खर्च / Traveling and Conveyance Expenses	1,15,91,729	85,62,077
26	वाहन रखरखाव / Vehicle maintenance	9,12,894	7,63,249
27	अतिथि वैज्ञानिक / संगोष्ठी / शुल्क इत्यादि / Visiting scientist / seminar / fees etc. (ODA workshop expenses)	1,14,269	19,500
28	Journal Subscription	36,27,559	1,03,728
29	जल शुल्क / Water charges	3,64,827	4,55,145
30	आस्मिक मजदूरों की मजदूरी / Wages to Contingent Mazdoors	35,30,635	16,91,043
31	कर्मचारियों को प्रशिक्षण कार्यक्रम / Training Programme to staff	66,720	9,600
32	एएमसी रखरखाव / AMC Maintenance	34,99,197	35,78,317
33	कार्यालय खर्च / Office Expenses	11,57,132	1,74,548
34	Wirte off Expenses	1,31,640	-
35	लेख प्रसंस्करण शुल्क / Article Processing Fee	2,50,059	1,33,124
36	आकस्मिकता अनुदान / Contingency Grant	1,05,233	1,53,539
37	Impress expenses	4,79,468	6,94,399
38	विज्ञान आउटरीच खर्च / Science Outreach Expenses	4,63,722	1,73,983
39	मानदेय / Honorarium	1,69,700	3,73,619
40	जीएसटी खर्च / GST Expenses	1,43,738	6,62,638
41	जीएसटी ब्याज / GST Interest & TDS Interest	62,064	17,876
42	देय ब्याज / Interest Payable	1,07,79,527	1,05,64,908
43	स्क्रैप की बिक्री पर सेवा शुल्क / Service charges on sale of scrap	12,596	50,212
44	ईपीबी कार्यशाला व्यय / EPB Workshop expenses	11,99,957	
45	समयपूर्व एसडीआर पर हानि / Loss on Premature SDR	7,56,380	
46	यूनिवर्सिटी की फीस / University Fees	37,57,230	
	कुल / TOTAL	**14,02,88,864**	**11,14,53,953**

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
संस्थान का नाम : भारतीय भूचुम्बकत्व संस्थान, न्यू पनवेल, नवी मुंबई - 410 218
Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2024 तक का आय तथा व्यय विवरण के भाग की अनुसूची
SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

(राशि / Amount – रू./Rs.)

अनुसूची 22 : अनुदान तथा अनुवृत्ति इत्यादि पर हुआ खर्च SCHEDULE 22 : EXPENDITURE ON GRANTS,SUBSIDIES ETC	वर्तमान वर्ष के अंत तक / Current Year Ended 31st March-2024	पिछले वर्ष के अंत तक / Previous Year Ended 31st March-2023
a) संस्थानों / संगठनों को दिया गया अनुदान Grants given to Institutions / Organizations	4,00,000	6,04,406
b) संस्थानों तथा संगठनों को दी गई अनुवृत्ति Subsidies given to Institutions / Organizations	-	-
कुल / TOTAL	**4,00,000**	**6,04,406**
(नोट : संस्थान का नाम, अनुदान / वृत्ति की दी गई राशि के साथ उनकी गतिविधियाँ बताएं / Note : Name of the Entities, their Activities along with the amount of Grants/subsidies are to be disclosed.		

अनुसूची / SCHEDULE 23 : ब्याज़ / INTEREST	वर्तमान वर्ष / Current Year as on 31/03/2024 के अनूसार	पिछले वर्ष / Previous Year as on 31/03/2023 के अनूसार
	NIL	NIL
कुल / TOTAL	NIL	NIL

INDIAN INSTITUTE OF GEOMAGNETISM

PLOT NO.5,SECTOR-18,
NEW PANVEL (W) NAVI MUMBAI

Current Liabilities

Group Summary

1-Apr-2023 to 31-Mar-2024

Particulars	Opening Balance	Nett Transactions	Closing Balance
UTIES & TAXES	**13,06,665.94 Cr**	*1,32,802.94 Dr*	**11,73,863.00 Cr**
rovisions	**5,08,30,494.00 Cr**	*2,83,87,085.00 Dr*	**2,24,43,409.00 Cr**
undry Creditors	**82,08,322.00 Cr**	*39,08,552.00 Cr*	**1,21,16,874.00 Cr**
ANK GUARNTEE	**52,134.00 Cr**		**52,134.00 Cr**
EPOSITS - WARRANTY	**21,774.00 Cr**		**21,774.00 Cr**
PF DEPOSIT	**1,25,233.00 Cr**		**1,25,233.00 Cr**
SIC DEPOSIT	**10,055.00 Cr**		**10,055.00 Cr**
IBRARY / CAUTION MONEY DEPOSIT-305	**2,72,500.00 Cr**	*2,52,500.00 Cr*	**5,25,000.00 Cr**
ERFORMANCE GAURANTEE-304	**4,05,676.00 Cr**	*3,090.00 Cr*	**4,08,766.00 Cr**
ECURITY DEPOSITS-302	**32,14,371.32 Cr**	*22,25,549.12 Dr*	**9,88,822.20 Cr**
ENERAL PROVIDENT FUND-38			
PF ADVANCE-RECOVERY		*15,000.00 Cr*	15,000.00 Cr
SLI SCHEME-37			
G EMP BENEVOLENT FUND -SB -12145-BOI-135	16,497.00 Cr	*20,551.00 Cr*	37,048.00 Cr
G EPF -SB-12146-BOI-130			
G-GPF-SB-12143-BOI-131			
IG-CPF FUND			
NCOME TAX ON -PENSIONERS			
NU REGISTRATION FEES PAYABLE		*23,066.00 Cr*	23,066.00 Cr
IC OF INDIA -35			
IET. SOCIETY -36			
IPS RECOVERY FROM SALARY-41			
ENSION-PAYABLE			
RO-RATA GRATUITY		*52,416.00 Cr*	52,416.00 Cr
ECREATION AND WELFARE FUND-43			
ESEARCH SHOLAR-PAYABLE			
ALARIES PAYABLES A/C			
TAFF BENEVOLENT FUND -45			
Grand Total	**6,44,63,722.26 Cr**	***2,64,70,262.06 Dr***	**3,79,93,460.20 Cr**

K.P.Kale

A joyous moment for the Staff and students of IIG celebrating the Foundation Day of the Institute.

IIG and BSIP Institutes jointly doing the field work at Surah Lake, Uttar Pradesh for collection of Lake Sediment core samples.

BSIP-IIG-NGRI collaboration Geophysical survey at Surah Lake, Uttar Pradesh