Annual Report 2020-21

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

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IIG Headquarters, Navi Mumbai

INDIAN INSTITUTE OF GEOMAGNETISM

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From the Director's Desk.....

Another successful year capped off at the Indian Institute of Geomagnetism (IIG), with the staff being equally delighted at the achievements in research programs conducted during the year. This report proceeds to tell about the breakthroughs created by our researchers amid difficult times, proving the fact that the staff of IIG always display quality even during tough times. The impact of our research was given some important recognition by several professional institutes, further strengthening the bonds with these institutes. Following these excellent achievements, IIG also continued to expand and diversify various research programs.

Even with the rise in global problems faced by our employees, our focus changed from survival back to success. The rise of the COVID-19 pamdemic did not hinder the determination of IIG staff as they continued to strive for success. Our response to the guidelines directed by the Government of India to keep our staff and Institute safe has been impeccable as we have and will continue to thrive amid these unexpected challenges. These extraordinary times called for extraordinary steps and measures taken by IIG as it stood tall throughout this difficult yet successful year. This report does tell about the achievements and research done in the previous year but IIG is also looking forward to face these unexpected challenges ahead as a pioneer research institute.

Looking back, IIG takes immense pleasure to share its research programs done and the response measures created for the emerging challenges in the fields of the lithospheric, ionospheric and magnetospheric sciences. The research shows the immense complexities in these areas and also predicts the most important challenges to be faced in the coming years. IIG instrumentation team worked hard in mitigating problems at all observatories during this pandemic period by giving guidance remotely to staff members stationed therein. During the cyclone Nisarga in Konkan Maharashtra, all the Instruments in our prime observatory Alibag were secured to safe place and reinstated within few days after the cyclone had passed by.

Singular Spectrum Analysis (SSA) is applied to the daily and monthly mean hourly values of in-situ observations of solar wind and interplanetary parameters for the period 1965 – 2006 that covers four complete solar cycles (20, 21, 22 and 23) along with Horizontal Component (H) of the Earth's magnetic field at Alibag. While Long term changes are associated to the solar magnetic activity, the short term changes are related to the modulation of solar wind features due to rotation of the Sun.

Under the program Studies on atmospheric and ionosphere coupled system, a unique Equatorial Plasma Bubble (EPB) observation is presented from Equatorial Atmosphere Radar (EAR) that provides hitherto undisclosed evidence for the smaller (3-meter) scale irregularities initially developing at higher altitudes and subsequently developing to lower altitudes. This is likely to have significant impact on the latitudinal development of L-band scintillations. The case of intense and periodic EPBs observed during April 8-9, 2013 by the 47 MHz EAR at Kototabang, Indonesia has been investigated in view of its possible connection with the tropical cyclone Victoria. It is found that the secondary gravity waves generated by the dissipation of primary gravity waves associated with tropical cyclone Victoria could have served as a seeding source on the generation of periodic EPBs during these two consecutive days. The study about the duration of the evolving/active phase of freshly generated ESF indicates that the active phase duration of EPBs is larger on disturbed days as compared to the usual post-sunset generation of EPBs on quiet days, and it is controlled by both solar flux and strength of geomagnetic activity. Highlighting the development of an empirical model of TEC over the African region using B splines using radio occultation measurements done by the COSMIC satellites, scientists are of the view that this model can estimate TEC fairly well that

would be measured by ionosondes over locations which do not have the instrument. Another importance of this study is the fact that it has shown the potential of using basis spline functions for modelling ionospheric parameters such as TEC over the entire African region. The magnetic field due to gravity and pressure-gradient currents present in the ionosphere may be important while studying the ionospheric currents using low-Earth-orbiting (LEO) satellite measurements. Results suggest that there is no need of correction for gravity and pressure-gradient currents if the satellite orbit is above 700 km, if the satellite orbit is during night to morning times, and if the satellite traverses during a period of low solar flux.

Under the program Space Weather- Observations and Modelling, the exclusive role of solar wind density changes on the prompt equatorial electric field disturbances using the long term observations of equatorial electrojet (EEJ) from the Indian sector has been studied. The underlying physical mechanisms for the prompt equatorial electric field disturbances has been discussed in light of enhanced high-latitude convection and additional field-aligned currents due to sudden enhancement of solar wind density. Planar magnetic structures (PMS) are often observed in sheath regions driven by interplanetary coronal mass ejections (ICMEs) and in corotating interaction regions (CIRs). Statistical studies of plasma properties within planar and non-planar ICME sheath regions using in situ data from the Advanced Composition Explorer (ACE) spacecraft revealed that the strength of the southward/northward magnetic field component is almost double in planar sheath regions compared with non-planar sheath regions and that planar sheaths are more geo effective than non-planar sheaths.

Simulation of charged particles trapped along the magnetic field line in the Earth's inner magnetosphere has been studied. These particles keep performing gyration, bounce and drift motions until they enter the loss cone and get precipitated to the neutral atmosphere. These simulations demonstrate that the existing theoretical expression sometimes overestimates or underestimates the magnetic mirror point latitude. Furthermore, the simulations show that the particles with lower equatorial pitch angles have their mirror points inside the high or mid-latitude ionosphere. A three-dimensional test particle simulation model is developed in which the relativistic equation of motion is solved numerically using the fourth and sixth-order Runge-Kutta methods. The study implies that a simulation model with sixth-order Runge-Kutta method can be applied to the time-vary, non-analytical form of magnetic configuration in future studies to understand the dynamics of charged particles trapped in Earth's magnetosphere. A new class of ion-acoustic solitons that can exist below the critical Mach number is reported for the first time in three-component plasma consisting of hot electrons, and two counter-streaming ion beams. This new class of slow ion-acoustic solitons can exist in the parametric regime where the system is stable to counter-streaming ion beams instability. The longitudinal structure of the oxygen torus in the inner magnetosphere for a specific event found on 12 September 2017, using simultaneous observations of the Van Allen Probe B and A rase satellites is investigated. It is found that Probe B observed a clear enhancement in the average plasma mass. In the afternoon sector, both Probe B and A rase found no clear enhancements in plasma mass. This suggests that the oxygen torus does not extend over all MLT but is skewed toward the dawn. A crescent-shaped torus or a pinched torus centered around the dawn may be a general feature of the O+ density enhancement in the inner magnetosphere. The new finding is that the electromagnetic ion cyclotron (EMIC) wave in the H+ band appeared coincidently with the oxygen torus. The oxygen torus in the inner magnetosphere may play an important role in excitation of EMIC waves.

Under the Dynamical and Electro-dynamical coupling of Equatorial Atmosphere program, ionospheric response to two consecutive earthquakes in Canada during October 2018 has been studied using TEC data. It has been observed that an increase in TEC anomalies of moderate earthquake events occurred on the geomagnetically quiet days. Besides, increases in the TEC anomalies have shown wave-like structures in the ionosphere and it may have associated with acoustic waves generated by earthquakes. The faulting mechanism of the earthquake and the propagation velocity of waves by TEC have confirmed the presence of acoustic wave activity. Observations of Maxwell's current (air-earth current) for a short period during lightning hours and fair weather days of 2019 at an equatorial station Tirunelveli have been investigated to understand the behaviour of air-earth current system during severe meteorological disturbances. Unusual lighting activity was noted during the peak summer and corresponding electric variability in air-earth current amplitude and phase charge in electric field were measured. During fair weather days, the current density is only a few pico amps. However, a tenfold increase in the current density was noted during disturbed weather conditions. This indicates that a rise in temperature led to enhanced convection during mid-day hours, which in turn, contributed to source activity. It is reported for the first time that the rise in temperature is covariant to source activity. It is found that the wind flow to be moderately south-westerly during the period of observation.

Under the flagship program Coupled Lithosphere-Atmosphere-Ionosphere-Magnetosphere system, anisotropy of magnetic susceptibility (AMS) of earthquake induced liquefaction dikes display prolate or triaxial AMS ellipsoids and that of depositional layers display a sedimentary AMS fabric from Dhubri fault region, Assam. Extensive analysis of 59 dip-slip earthquakes is carried out to study the effect of focal depth on CIP amplitudes. The analysis shows that deep earthquakes generate smaller Coseismic Ionospheric Perturbations (CIP) amplitudes. The sudden ground movement during earthquakes is responsible for the transfer of seismic energy to the atmosphere. The study shows that CIP amplitudes are not only sensitive to earthquake magnitude but also to their focal depth. CIP amplitudes appear to scale with the maximum values of vertical surface displacement rather than their average. Thus, the energy transfer is more efficient during shallow earthquakes.

In Polar Science program, a series of sub-storms called high-intensity long-duration continuous AE activity events (HILDCAAs) were studied. To understand the mechanism, global Cosmic Noise Absorption (CNA), auroral images by a space-based Imager, energetic electron flux data from geostationary satellites and magnetic field measurements covering almost all latitudinal and local time sectors were studied. These shock-induced super-substorms (SSSs) have extremely high intensities and long durations. The possible mechanism proposed to explain the anomaly in the present context is viscous interaction via Kelvin Helmholtz instability. Also adiabatic compression, and field aligned current intensification can lead to particle injection during impulse induced substorms.

Under the Hazards Evolution and Resources program, scientists have studied the Deccan Volcanic Province (DVP) of Maharashtra with several objectives. Variations in magnetic susceptibility and chemical weathering indices from Jawale sediments, Pravara valley, DVP, suggest that chemical weathering was more intense because of increased rainfall in the bottom of the section and slackened monsoon decreased the chemical weathering in the top of the section. Preliminary magnetic experimental work is performed for some sediment samples in a 1 m trench near Unhavre spring. Thermomagnetic results infer the magnetic mineralogy is controlled by magnetite. The preliminary Anisotropy of magnetic susceptibility results obtained from these sediments is used to understand the magnetic fabrics and their palaeo-current directions. The reconstructed palaeo-current directions are in NE-SW. Audiomagnetotellurics (AMT) a Magnetotelluric (MT) surveys were carried out along E –W profiles across Aravali, Tural and Rajawadi geothermal springs to decipher the geoelectric structure and possible source zone of hot water springs. 2D modeling of AMT data across Aravali, Tural and Rajawadi profiles brings out a dipping conductor (~ 5-10 Ohm-m) at a shallow depth that may represent a zone of fracturing within the sedimentary basin through which hot water is brought to the surface. These anomalous structures are associated with the geothermal field. MT studies revealed a conductive zone associated with a fracture/fault zone sandwiched between two resistive blocks. This zone extends to greater depths and could be a source for Deccan volcanism. These fracture/fault zones have facilitated magma spreading both vertically as well as horizontally. Comparison of VLF and ground magnetic data suggests that the magnetic lows correspond to high conductive anomalies while highs correspond to low conductivity anomalies. The high conductivity anomalies were interpreted as representing water in fracture zones at shallow depth levels. Integration of data helped to map the depth and lateral extent of these conductive zones in and around the Rajawadi spring. The Moho depth and crustal thickness variation over the Comorin Ridge and adjoining regions were computed through three dimensional inversion of Complete Bouguer Anomalies (CBA) and Mantle Residual Gravity Anomalies (MRGA). The Moho depths thus computed were compared with those inferred from available seismic reflection and receiver function studies in the region and a reasonably good agreement is obtained for the Moho depth derived from the inversion of MRGA. Magnetic susceptibility (MS) and NRM intensity measured on the samples collected from Raksha Shear zone, Chhatarpur, Khajuraho and Mahoba regions of Bundelkhand Craton suggested two groups of palaeomagnetic ChRM directions corresponding to (i) NW-SE directed dyke swarms and (ii) E-W trending Mahoba dyke of Bundelkhand Craton. AMS investigations on the specimens revealed the presence of Prolate and Oblate shaped magnetic grains in equal proportion.

This annual report shows how successful and creative year IIG has faced. The research findings published by the IIG scientists totals into 77 research papers with a cumulative impact factor of 201.261. A total of 8 Ph.D.s were produced during the year. Along with 3 invited lectures, IIG researchers presented 10 papers in national and international conferences. Over the duration of the year, IIG staff members participated in 19 specialized workshops and training courses. Indian Institute of Geomagnetism was bestowed upon with the opportunity to organize a Hindi Essay writing competition under the aegis of TOLIC. Admist the highly appreciated event, an IIG staff member bagged a prize in the competition. Under the Science Outreach Programs, IIG was given the honor to organize the "games and toys" event for the 6th edition of the Indian International Science Festival 2020, with more than three thousand registered participants across the country.

All the staff members of IIG would like to express their gratitude to the Governing Council of IIG, the Research Advisory and the Finance Committee for their immense cooperation and their valuable support. It is due to their belief IIG was able to cap off this successful year.

During the year there was never once a moment with a false note as IIG soared in these challenging times. As I come to an end of an eventful innings at IIG, I am eternally thankful for the creative breakthroughs made by all my colleagues. I am happy to announce that the grit shown by the staff has paid off duely. I am very sure that the next person at the wheel would enjoy this journey as much as I did. It was an honor to work with such amazing group of people.

I wish every colleague of mine at IIG a very happy and prosperous Golden Jubilee year and pray for the well-being of all. Thank you.

D.S. Ramesh
Director

August 23, 2021

GEOMAGNETIC DATA BASED RESEARCH

MAGNETIC OBSERVATORIES– DATA, DISSEMINATION AND DEVELOPMENT (MOD3)

Chief Coordinator : Ashwini K. Sinha

Members : All technical staff of ODA at HQ and other observatories; All instrumentation division staff at HQ; All WDC staff and All computer section staff, Geeta H. Vichare, Gopi K. Seemala

Observatory maintenance and installation

Institute's magnetic observatories uses indigenously developed PPMs for absolute observations. To equip the observatories with PM-7 (0.1nT), 2 units of PPMs were assembled, tested and calibrated in the laboratory. These units were compared with Alibag standard PPM and were installed at Jaipur and Shillong observatories.

IIG instrumentation team helped in mitigating problems at all observatories during this pandemic period by giving instructions remotely to staff members stationed therein. During the cyclone Nisarga in Konkan Maharashtra, all the Instruments in our prime observatory Alibag were secured to safe place and reinstated within few days after the cyclone had passed by.

The glitches of Overhauser PPM at Silchar, Rajkot, and Nagpur Observatories were solved by online communication. The DFM electronic consoles of Vishakhapatnam, Allahabad, and Pondicherry were repaired and replaced. Four units of data loggers with GPS were assembled and sent to Nagpur, Vishakhapatnam, and Shillong observatories as replacement.

WDC Colaba and INTERMAGNET

IIG hosts the World Data Centre (WDC) for Geomagnetism, Mumbai as part of the World Data System (WDS) established by ICSU. Users from all over the globe get registered and access/download the data from the WDC website (http://wdc iig.res.in) for their scientific usage. The process of switching over from MPLS (Multi-Protocol Label Switching) technology to ILL (Internet Lease Line) technology for point to point connectivity link between observatories and HQ with enhanced bandwidth for better communication facilities to transfer data and video conference, has been completed.

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). The downloaded data files from the FTP and web servers till April 2021 is shown in Figure 1.

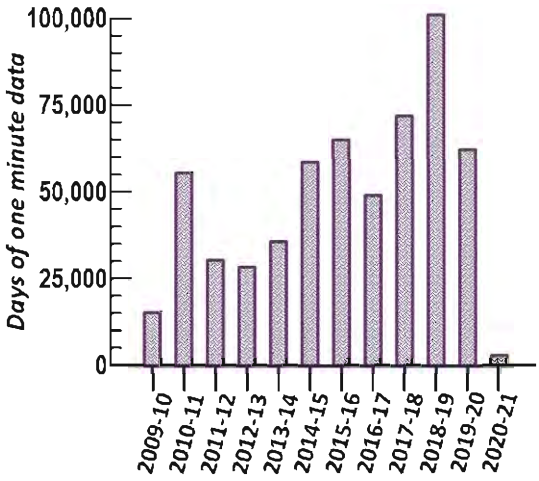

Figure 1 Alibag data downloaded from FTP and web servers.

Development of Instrumentation

Following development work continued in order to achieve the target during the year which was critically marred by the pandemic Covid-19.

1) Linux based data logger was developed at preliminary level and is being tested on Ubuntu 8.4.5 platform. Data is being recorded in text format. Work on graphical presentation and consolidation is in progress.

2) Preliminary study is going on for temperature regulation using an alternative method that will not induce noise and maintain stability.

3) As an ongoing process of PPM upgradation, electronics are being tested for improved precision and sensitivity.

Short and long term periodicities in geomagnetic field variations and interplanetary parameters during 20-23 solar cycles

Impact of solar wind at the Earth's magnetosphere changes the ground magnetic field variations at multiple time scales. To explicate different periodicities, Singular Spectrum Analysis (SSA) is applied to the daily and monthly mean hourly values of in-situ observations of solar wind and interplanetary parameters for the period 1965 – 2006 that covers four complete solar cycles (20, 21, 22 and 23) along with Horizontal Component (H) of the Earth's magnetic field at Alibag. Long term changes such as 22-year (Hale cycle)

and 11-year (Solar cycle) are related to the solar magnetic activity. However, the short term changes of 25- 27-days are related to the modulation of solar wind features due to rotation of the Sun. Figure 2 shows the time variation plots of the significant reconstructed components in H-range at Alibag, which possesses long term periodicities such as 10.5 year, 5.5 year, annual, semi-annual, 40-month, 11-month etc.

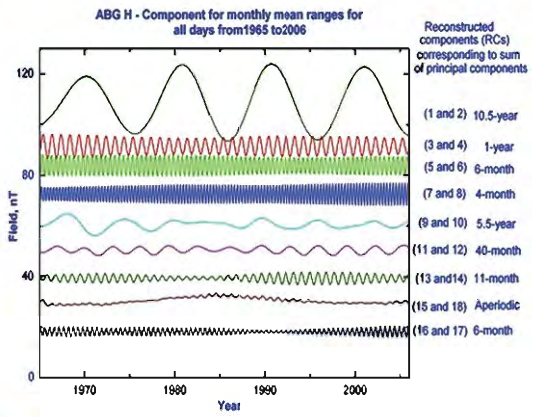

Figure 2 Time variation plots of nine significant reconstructed components (RCs) of monthly mean ranges of H-field at Alibag isolated through adaptive filtering by singular spectrum analysis for all days from 1965 to 2006 for solar cycles 21-23.

Observatory Calibration reports

An eighty page report was prepared entitled "Azimuth Calibration and Gradient Survey for Magnetic Observatories under Indian Institute of Geomagnetism" and was submitted to the institute on 28th September 2020.

A "Real Time Data monitoring system", is being developed at Pondicherry Observatory. This system helps in monitoring the status of all the variation instruments running at this observatory by displaying the plots of the data being recorded in mobile phone. This system helps in reducing the downtime of instruments and the data loss (Figure 3).

Figure 3 Mobile screen of Real time data monitoring of Pondicherry Observatory.

UPPER ATMOSPHERIC RESEARCH

STUDIES ON ATMOSPHERIC AND IONOSPHERE COUPLED SYSTEM (STATICs)

Chief Coordinator : S. Gurubaran

Coordinator : Geeta H. Vichare

Members : Rajesh Singh, S. Sripathi, S. Tulasiram, Bharti Kakad, G. K. Seemala, Mala S. Bagiya, A. P. Kakad, S. Sathishkumar, R.Ghodpage, P.Mahavarkar, P. T. Patil, V.C. Erram, R. Rawat, K. Jawahar, C. Selvaraj, N.Venkatesh, K. Emperumal, P. Tiwari and S. Banola

Early development of topside 3-meter scale irregularities

The Equatorial Plasma Bubbles (EPBs), once developed, grow nonlinearly into topside ionosphere and simultaneous secondary instabilities lead to the development of shorter scale irregularities. The altitudinal growth and generation of smaller scale irregularities determines the spatio-temporal occurrence and the intensity of ionospheric scintillations at wide spectrum of radio waves and have significant implications on the GNSS/Satellite Based Augmentation Systems. As the bubble grows into topside ionosphere, the significant reduction of ion-neutral collisions and increased ratio of F- to E-region field-line integrated conductivities give rise to more rapid development of intermediate-to-shorter scale irregularities at topside compared lower altitudes. The greater structuring of EPBs in the topside ionosphere is found to be one of the important factors explaining the much stronger L-band scintillations at low-latitudes compared to equatorial latitudes besides the higher background density and larger density gradients. This study presents a unique EPB observation from Equatorial Atmosphere Radar (EAR) that provides hitherto undisclosed evidence for the smaller (3-meter) scale irregularities initially developing at higher altitudes and subsequently developing to lower altitudes which would have significant impact on the latitudinal development of L-band scintillations (Figure 4).

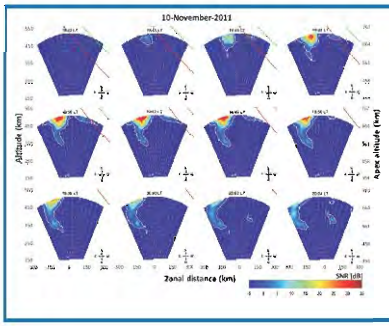

Figure 4 Unique observational evidence for the early development of 3-m scale irregularities initially at the topside region of an Equatorial Plasma Bubble and subsequently at lower altitudes.

Periodic development of EPBs due to gravity waves originated from a Tropical Cyclone

The interesting cases of intense and periodic EPBs observed during 08 and 09 April 2013 by the 47 MHz Equatorial Atmosphere Radar at Kototabang, Indonesia have been thoroughly investigated in view of its possible connection with the tropical cyclone Victoria. The periodic EPBs are separated by about 200-250 km and were found to initiate before the sunset. The pre-sunset onset and development of these periodic EPBs were discussed in light of the gravity waves (GWs) excited in connection with the deep convection due to the tropical cyclone Victoria. The outgoing long-wave radiation measurement by very high-resolution radiometer (VHRR) onboard Indian meteorological satellite Kalpana-1 shows the occurrence of deep convective activity during these days. The presence of upward propagating gravity waves from the deep convective region associated with TC Victoria was confirmed using the GPS radio occultation observations. The GW signatures at ionospheric altitudes were also observed from the Ionosonde observations over magnetic equator and medium scale (~300 km) GWs were observed from the GPS- TEC data near to the magnetic equator and cyclone center. From the GW parameters observed from GPS-TEC and GPS-RO, it is surmised that the secondary GWs generated by the dissipation of primary GWs associated with TC Victoria could have served as a seeding source on the generation of periodic EPBs during these two consecutive days (Figure 5).

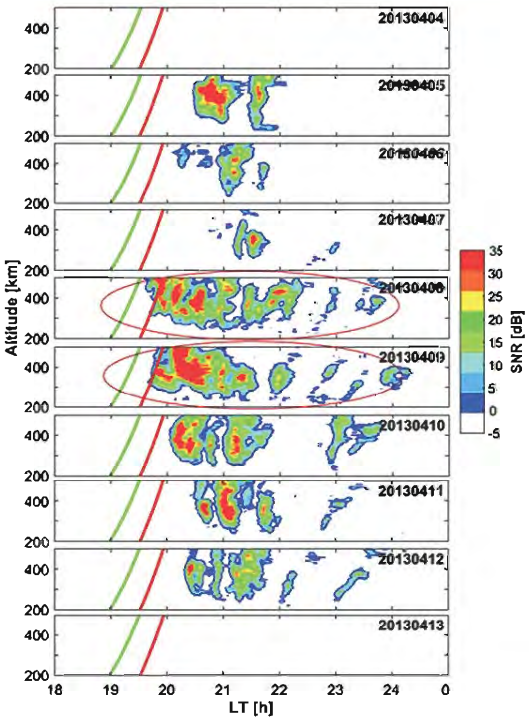

Figure 5 The intense and periodic development of several equatorial plasma bubbles over Southeast Asian region in connection with the gravity waves originated from deep convective region associated with the tropical cyclone, Victoria.

Active / evolving phase durations of equatorial plasma bubbles (EPBs)

Usual generation of ESF irregularities in the post-sunset hours on quiet days, and midnight or post-midnight generation of ESF irregularities on magnetically disturbed days is well known. However, there is little information about the duration of the evolving/active phase of these freshly generated ESF. The duration of active/evolving phase of FESF refers to the duration for which the perturbation electric field associated with equatorial plasma bubbles (EPBs) drifting over Tirunelveli is alive. The active phase of FESF irregularity has been identified and estimated their duration for quiet and disturbed days. The study indicates that the active phase duration of EPBs is larger on disturbed days as compared to the usual post-sunset generation of EPBs on quiet days, and it is controlled by both solar flux and strength of geomagnetic activity (Figures 6 and 7).

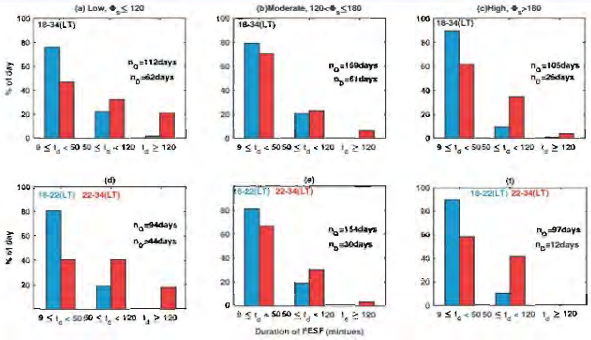

Figure 6 Percentage of days having active phase durations (td, in minutes) in three different bins are shown for low, moderate and high solar flux periods. These percentages are shown in panels (a-c) for 18-34 LT for quiet (blue) and disturbed (red) days. Whereas percentages shown in panels (d-f) corresponds to 18-22 LT for Q-days (blue) and 22-34 LT for D-days (red).

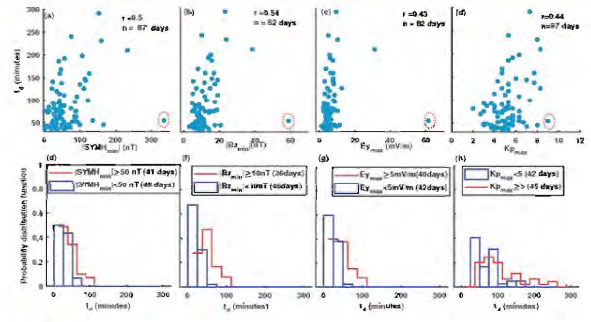

Figure 7 The active phase duration of FESF observed at Tirunelveli as a function of (a) SYMHmin, (b) Bzmin (c) Eymax and (d) Kpmax. The Bzmin, SYMHmin, Eymax and Kpmax are considered as a proxy to measure the strength of geomagnetic activity for magnetically D-days on which the generation of FESF is observed. The probability distribution function of td for two levels of (e) SYMHmin, (f) Bzmin, (g) Eymax and (h) Kpmax are shown.

Signatures of storm - time disturbances on the generation and evolution of post - midnight EPBs

The storm induced disturbance winds and disturbance electric fields can cause the generation and evaluation of post-midnight Equatorial Plasma Bubbles (EPBs) and zonal drifts reversals even during weak magnetic disturbance. This study has been conducted using CADI located at dip equatorial station, Tirunelveli, all-sky imager (ASI) observations at low latitude station Panhala and GIRI radar at Gadanki which is situated a few degrees towards east and south of Panhala on 02-03 February 2017 night (Figure 8). During this night, IMF Bz showed its periodic variation starting from 16:00 UT to 23:00 UT accompanied by decrease in SYM-H to as low as -35 nT indicating the onset of weak magnetic storm. The analyzed results suggested that cause of post-midnight EPBs could be due to manifestation of fluctuating eastward/westward electric field due to combined under-shielding/over-shielding Electric Fields and disturbance dynamo electric fields that led to rise and fall of the F-layer over dip equator. The westward drift of EPBs at Panhala and its anti-correlation with vertical drifts has been confirmed from CADI zonal/vertical drifts (Figure 9). The study also investigated the role of storm induced vertical Hall electric field as a possible cause for westward drifts and its anti-correlation with vertical drifts.

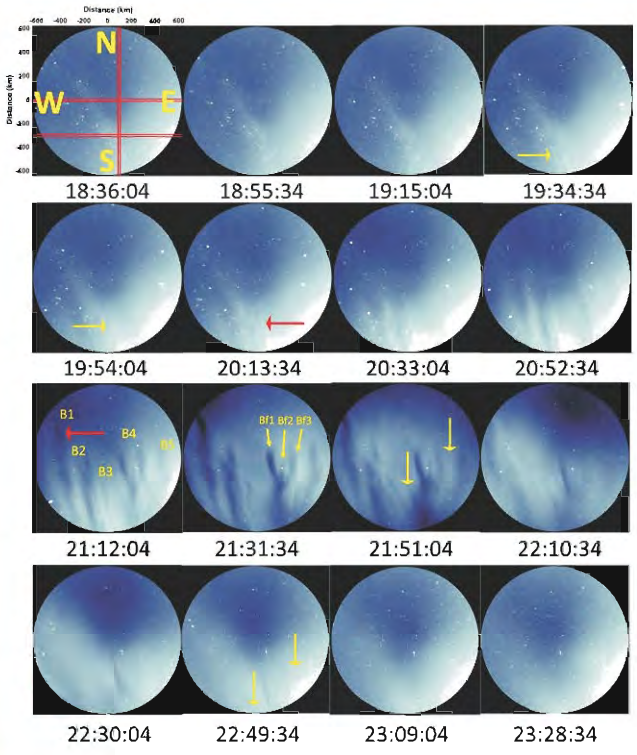

Figure 8 :Sequences of OI 630.0 nm unwrapped images for the night of 02-03 February 2017 over Panhala. The equidistant projection and directions are depicted in first image at 18:36 UT (~00:00 IST). The horizontal and vertical red lines depict the keograms taken for EW and NS direction respectively. The yellow and red horizontal arrow depicts the direction of EPBs.

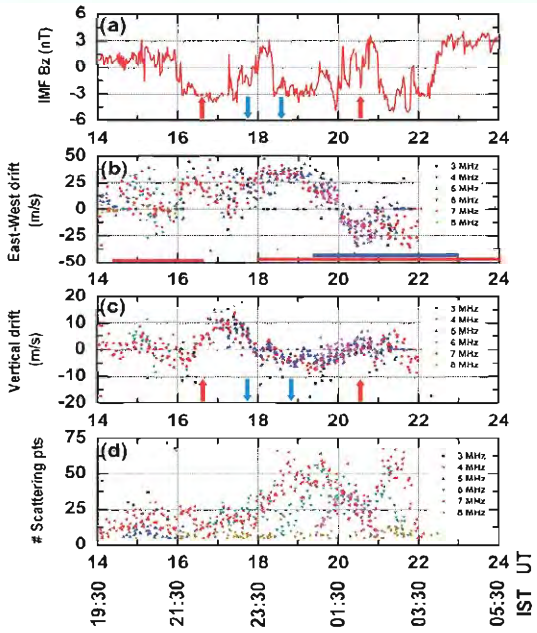

Figure 9 :The temporal evolution of (a) IMF Bz, (b) east-west drifts, (c) vertical drifts and (d) No. of scattering sources as obtained from CADI ionosonde on 02-03 February 2017 over Tirunelveli. Indian Standard Time (IST) is also shown in the bottom. The red and blue arrows indicate the eastward and westward penetration of electric field.

Role of Pre - R eversal - Enhancement (PRE) in pre - conditioning the EIA crest region

The results presented here highlights the important role of the PRE in pre-conditioning the EIA crest region using 10 years (2010–2019) of vertical TEC data from Ahmedabad (23.0°N, 72.6°E, dip angle 35.2°) and campaign based OI 630.0 nm airglow intensity measurements from Mt. Abu (24.6°N, 72.7°E, dip angle 38.0°). It is shown that plasma density over the EIA crest region increases in varying degrees during post-sunset hours (2000–2100 LT) in magnetically quiet periods. The post-sunset peak in VTEC precedes the corresponding peak in airglow intensity. By comparing post-sunset VTEC enhancements with ionosonde observations from Tirunelveli, it is shown that PRE of the zonal electric field causes these enhancements over the EIA crest region. These observations are supported by TEC measurements by GAGAN, the Indian SBAS. Comparison of average VTEC variations with global empirical model drifts reveals that the post-sunset enhancements in VTEC occurs ~ 1.7 h after the PRE and are significant only during December solstice and equinoctial months in high solar activity years similar to seasonal variations in PRE amplitudes. This time delay (response time of EIA crest) is almost half compared to the average response time (3–4 h) associated with the daytime fountain. Based on the latitudinal gradient in SBAS-TEC, it is proposed that the PRE drives plasma from 5°N to 10°N magnetic latitudes to the EIA crest region leading to shorter response time.

Development of TEC empirical model using B splines

The results analyzed here highlight the development of an empirical model of TEC over the African region using B splines. For this, the TEC data were obtained from radio occultation measurements done by the COSMIC satellites. Data during geomagnetically quiet time for the years 2008–2011 and 2013–2017 were binned according to local time, seasons, solar flux level, and geographic longitude and latitude. B splines were fitted to the binned data to obtain model coefficients. The model was validated using actual COSMIC TEC data. The validation exercise revealed that approximation of observed TEC data by our model produces a root mean square error (RMSE) of 5 TEC units. Moreover, the modelled TEC data correlated highly with the observed TEC data (r = 0.93). The model is able to reproduce well-known TEC features such as local time, seasonal, solar activity cycle, and spatial variations over the African region. Further validation of this model has been done using TEC measured by ionosonde stations over South Africa at Hermanus, Grahamstown, and Louisville revealed r values >0.92 and RMSE <5.5 TECU. These validation results imply that this model can estimate TEC fairly well that would be measured by ionosondes over locations which do not have the instrument. Another element of significance of this study is the fact that it has shown the potential of using basis spline functions for modelling ionospheric parameters such as TEC over the entire African region.

Role of solar flux on the occurrence characteristics of EPBs over Kolhapur

Here, the occurrence characteristics of the EPBs using OI 630.0 nm ASI night airglow observations over Kolhapur during the solar cycle-24 are investigated. The important findings of this study are: 1) increase in the occurrence of EPBs with respect to the solar activity; 2) suppression of EPBs on 71 disturbed nights, while enhancement of EPBs on 22 nights under magnetic disturbance; 3) EPBs occurrence during equinox months is found to be higher than winter months during ascending phase of solar cycle-24; and, 4) EPBs are mostly observed in the pre-midnight sector in the high solar activity (HSA) period, while they are seen in the post-midnight to dawn sector during the low solar activity (LSA) period. The results further suggest that non-occurrence of EPBs during equinox in the year 2018 seems to be peculiar to Kolhapur which needs further investigations.

An interesting Equatorial Plasma Bubble (EPB) event during the night of 22-23 March 2017 over Panhala

To investigate the dynamics of observed EPBs, the multi-instrument observations from an all-sky imager (ASI), Canadian Advanced Digital Ionosonde (CADI) from Tirunelveli and ionospheric backscatter echoes data of Gadanki Ionospheric Radar Interferometer (GIRI) radar from Gadanki over Indian regions have been utilized. The optical observations from Panhala reveal clear signatures of EPBs from 1630 UT onwards which were also recorded in the Range-Time-Intensity maps obtained by GIRI and corresponding ESF occurrence was also noted in CADI at Tirunelveli. On this night, two EPBs (EPB1 and EPB2) were observed with an inter-depletion distance of ~600 km. The EPB1 drifts eastward and evolves with time as bifurcated structures while the trailing EPB2 drifts eastward initially and eventually drifts westward. It is believed this is the evidence of differential drifts of EPBs imaged through ASI over narrow longitudinal zone over the Indian region.

Causes of the Diurnal Variation observed in Gamma-ray Spectrum using NaI (Tl) Detector

The presence of a distinct diurnal pattern in the total number of gamma ray counts detected by the NaI detector has been reported. The counts start decreasing after sunrise and show gradual recovery after sunset. The amplitude of this variation is quite significant (>10%) at the observation site Tirunelveli. However, further investigation based on different energy ranges reveals that the mentioned diurnal pattern is actually present only in the energies related to the terrestrial background radioactivity. The study demonstrates that the pattern is associated with the radioactivity of isotopes of radon (222Rn and 220Rn) and their daughter radionuclides. The amplitude of the diurnal variation is found to have seasonal dependence, with the lowest amplitude during June-October (~ 2%), and highest in April-May months (~14%). The observed diurnal pattern is attributed to the generation of the inversion layer. The distribution of concentration of radon and thoron progenies in an air column changes with the vertical mixing and atmospheric boundary layer (ABL), resulting in the diurnal variation of - rays. The observed lower amplitudes in the months of June-October may be due to the presence of downward winds restricting the radon movement to a thin layer, giving smaller amplitudes of the diurnal variation in total gamma ray flux resulting in seasonal variation.

Computations of Gravity and Pressure-gradient currents using COSMIC satellite data

The currents due to gravity and plasma pressure-gradients flow in the Earth's ionosphere, whose contribution in the ground magnetic field measurements is negligible compared to that of ionospheric dynamo. However, considering the magnetic field due to gravity and pressure-gradient currents present in the ionosphere may be important while studying the ionospheric currents using low-Earth-orbiting (LEO) satellite measurements. Above the F region peak where LEO satellites generally fly, the directions of these two coexisting currents are opposite and the net magnetic field along the ambient magnetic field is non significant. In view of the diamagnetic corrections being applied to the LEO magnetic field measurements to account for the pressure-gradient currents, it is imperative to compute the magnetic field effects of these currents using actual observations of ionospheric electron densities. The gravity and pressure-gradient currents has been estimated using altitude profiles of electron density obtained from the Constellation Observing System for Meteorology, Ionosphere, and Climate

(COSMIC) satellite cluster. The magnetic variations due to these currents are estimated at different heights, latitudes, solar fluxes, and local times (Figure 10). The study suggests that there is no need of correction for gravity and pressure-gradient currents in the magnetic field measurements by the LEO satellite if the satellite orbit is above 700 km, if the satellite orbit is during night to morning times, and if the satellite traverses during a period of low solar flux.

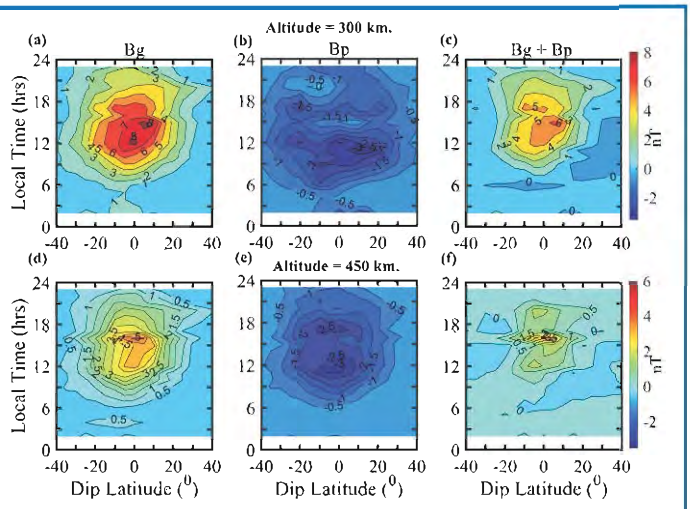

Figure 10 The local time structure of magnetic field variations due to gravity currents, pressure-gradient currents and sum of both at 300 km and 450 km in the top and bottom. panel respectively.

SPACE WEATHER: OBSERVATIONS AND MODELING (SWOM)

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Characteristics of escaping magnetospheric ions associated with magnetic field fluctuations

The four Magnetospheric Multiscale (MMS) spacecraft observed energetic (E > 50 keV) ion bursts exhibiting an inverse dispersion in the magnetosheath on 28 December 2015. It was examined if these ions originated from the magnetosphere. The ion composition ratios, flux levels, and the spectral slopes of the energetic ion energy spectra observed in the foreshock and in the magnetosheath resemble those in the outer magnetosphere but differ significantly from those seen further upstream from the bow shock at ACE. The particle gyrocenters lie earthward from the spacecraft, indicating that the maximum ion fluxes come from close to the magnetosphere. A 3-D global hybrid simulation shows that escaping magnetospheric ions can be scattered and transported across the magnetosheath. Based on ground magnetometer observations, it has been suggested that the inverse energy dispersion event can be explained by a magnetic field rotation that connects MMS to the subsolar magnetosphere, enabling high-energy particles from deep within the inner magnetosphere gain access to the magnetopause and magnetosheath.

Ionospheric disturbances over the Indian sector during 8 September 2017 geomagnetic storm: Plasma structuring and propagation

The series of X and M class flares and associated coronal mass ejections that occurred on the first days of September 2017 induced significant perturbations on the low-latitude ionospheric electrodynamics. On 8 September in the Indian sector, the storm caused a severe modification of the equatorial electrojet (EEJ) with a consequent variation of the ionospheric structuring and dynamics. An original method to isolate and identify EEJ variations from geomagnetic data has been proposed and the presence of equatorial plasma bubbles (EPB) have been detected from L-band total electron content (TEC) data in order to understand their movement. The EPB (or EPBs) occurring in the south of India is/are freshly generated just above the magnetic equator, and is/are likely triggered by the sudden increase of EEJ just before the local sunset, acting as a pre-reversal enhancement. The EPB appearing in the North-East Indian region is associated with a migrating structure, resulting in a northward movement with a velocity of about 650 m/s, possibly testifying the passage of a large-scale traveling ionospheric disturbance. The occurrence of severe post-sunset scintillations in the northeastern sector suggests a possible cascade process forming small-scale irregularities from the migrating EPB.

Effects of IMF By on ring current asymmetry under southward IMF Bz conditions observed at ground magnetic stations: Case studies

The role of IMF By on the asymmetry of the ring current during the main phase of geomagnetic storms is evaluated. The mean H variations have been calculated using 31 ground magnetic stations over magnetic latitudes of 09-45° and the magnetic local time (MLT) variations in the H-component at these stations w.r.t. the mean H were investigated for three cases of geomagnetic storms with varying southward IMF Bz and IMF By conditions. The primary role of IMF Bz on the asymmetry of the ring current is observed from these cases. More importantly, the investigation brings out for the first time, the additional role of IMF By influencing the MLT distribution of ring current observed at ground magnetic stations (Figure 11). Under southward IMF Bz conditions, it is shown based on SuperDARN and AMPERE data that IMF By can alter the MLT distribution of ring current under suitable conditions. The timescales of IMF By also play very important role in determining the asymmetry in the ring current. Under steady

convection state, IMF By can rotate the convection cells based on its polarity, which in turn can change the MLT distribution of ring current observed by low latitude ground stations. This investigation, thus, brings out the important role of IMF By on the asymmetric MLT distribution of ring current under southward IMF Bz.

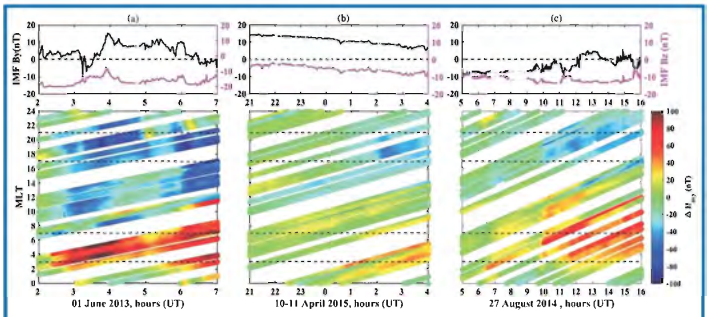

Figure 11 The MLT variation of ΔHasy (bottom panels) in response to the variations of IMF Bz and By (top panels) during the main phase of the magnetic storms.

The Extreme Space Weather Event in 1903 October / November : An Outburst from the Quiet Sun

While the Sun is generally more eruptive during its maximum and declining phases, observational evidence shows certain cases of powerful solar eruptions during the quiet phase of the solar activity. Occurring in the weak Solar Cycle 14 just after its minimum, the extreme space weather event in 1903 October – November was one of these cases. Here, the time series of geomagnetic activity is constructed based on contemporary observational records. With the mid-latitude magnetograms, the 1903 magnetic storm is thought to be caused by a fast coronal mass ejection (~1500 km/s) and is regarded as an intense event with an estimated minimum Dst of ~−513 nT. The reconstructed time series has been compared with the equatorward extension of auroral oval (~44.1° in invariant latitude) and the time series of telegraphic disturbances. This case study shows that potential threats posed by extreme space weather events exist even during weak solar cycles or near their minima.

Comparative statistical study of characteristics of plasma in planar and non-planar ICME sheaths during solar cycles 23 and 24

Planar magnetic structures (PMS) are often observed in sheath regions driven by interplanetary coronal mass ejections (ICMEs) and in corotating interaction regions (CIRs). Here, plasma properties are statistically studied within planar and non-planar ICME sheath regions using in situ data from the Advanced Composition Explorer (ACE) spacecraft. The study includes 420 ICME-driven sheaths from 1998–2017. It is found that 146 (~35%) ICME-driven sheaths are planar, whereas 274 (~65%) are non-planar. This study found that the average plasma temperature, density, speed, plasma beta, thermal pressure and magnetic pressure are higher in planar sheaths than in non-planar sheaths. This implies that high compression plays an essential role in the formation of PMS in sheath regions. Interestingly, this analysis reveals explicitly that the strength of the southward/northward magnetic field component is almost double in planar sheath regions compared with non-planar sheath regions. This suggests that planar sheaths are more geoeffective than non-planar sheaths.

On the response of the ionosphere to the three major space weather events of 2015 using meridional chain of ionosondes and GPS receivers over India

Seasonal response of the equator and low latitude ionosphere to three major storms in 2015 namely St. Patrick's Day storm, 22-23 June and 19-20 December has been studied using ionosondes and GPS receivers. As these storms fell on three seasons, the study examined the role of electric fields vis-à-vis meridional winds under these seasons for the storm-time changes in the composition, winds and waves and their role in the occurrence of plasma irregularities and positive and negative ionospheric storms. It is noticed that the positive (negative) storms occur in December (June) during the main phase. It is also noticed that the positive (negative) storms occur at equator (low latitude) during March in the recovery phase. The h'F at equator is modified significantly by the orientation and magnitude of storm-time zonal electric field. While the St. Patrick's day storm showed abrupt increase of h'F due to absence of low latitude Es layers and addition of eastward electric field to the existing post-sunset enhancement of eastward electric field leading to the generation of severe plasma irregularities and L-band scintillations at wide latitudes, they are suppressed during June in the mid-night sector due to westward electric field. However, during December, simultaneous increase of h'F in the pre-dawn sector caused generation of plasma irregularities. The results suggest that ionosphere over India is significantly modified by the storm processes in the night sector during winter due to efficient coupling.

The solar wind density control on the Prompt Penetration electric Field and Equatorial Electrojet

Prompt penetration of convection/overshielding electric fields to equatorial and low-latitudes during the southward/northward turnings of interplanetary magnetic field (IMF Bz) has been widely known. The other types of penetration electric fields due to sudden changes in the solar wind dynamic pressure, IMF By and during the onset of substorms have also been recognized. This study brings out the exclusive role of solar wind density changes on the prompt equatorial electric field disturbances using the long term observations of equatorial electrojet (EEJ) from the Indian sector. In response to the sharp increases in the solar wind density, prompt increases/decreases in the EEJ indicating the eastward/westward PPEF of ~20 minute periods have been consistently observed on the day/night

sides. The prompt equatorial electric field disturbances of the opposite polarity have also been observed when the density decreases sharply. Further, the polarity of these PPEF disturbances do not show any clear dependency on the direction of IMF Bz and By. This study is the first report with a statistically significant number of observations on the characteristics of equatorial electric field disturbances in response to the sudden enhancements/decreases in the solar wind density alone on both day and night sides. The underlying physical mechanisms for the prompt equatorial electric field disturbances have been discussed in light of enhanced high-latitude convection and additional field-aligned currents due to sudden enhancement of solar wind density (Figure 12).

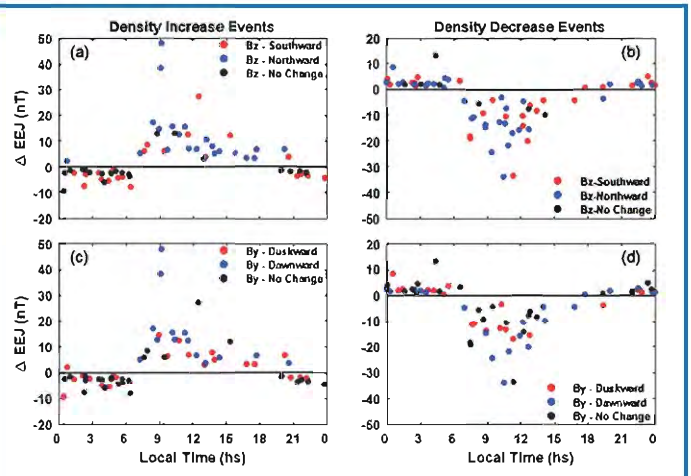

Figure 12 Changes observed in EEJ (ΔEEJ) in response to the sharp density enhancements (left panels) and reductions (right panels) as a function of local time.

Space Plasmas : Observations, Theory and Simulations (SPOTS)

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Motion of Charged Particles Trapped in Earth's Magnetosphere

In the Earth's inner magnetosphere, there exist regions like plasmasphere, ring current, and radiation belts, where the population of charged particles trapped along the magnetic field lines is more. These particles keep performing gyration, bounce and drift motions until they enter the loss cone and get precipitated to the neutral atmosphere.

The test particle simulations are performed to model these motions. These simulations demonstrate that the existing theoretical expression sometimes overestimates or underestimates the magnetic mirror point latitude depending on the value of L-shell, energy and gyro-phase due to underlying guiding center approximation. For heavier particles like proton and oxygen, the location of the mirror point obtained from the simulation deviates considerably (~ 10°–16°) from their theoretical values when energy and L-shell of the particle are higher (Figure 13). Furthermore, the simulations show that the particles with lower equatorial pitch angles have their mirror points inside the high or mid-latitude ionosphere.

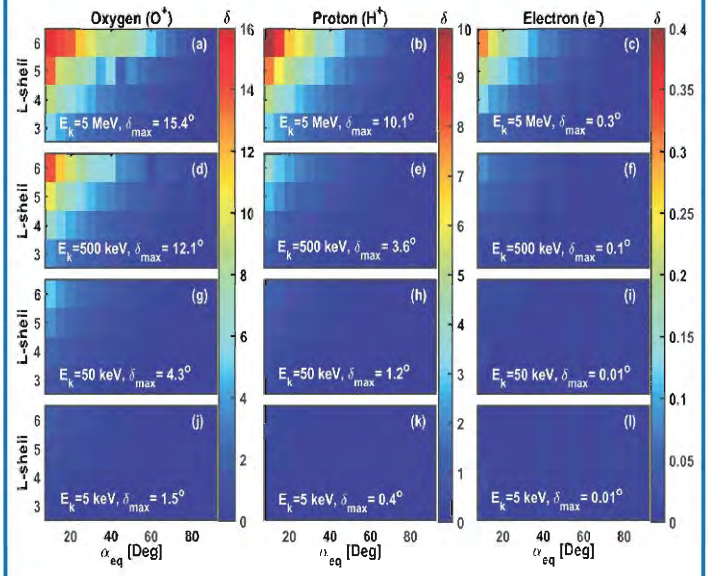

Figure 13 The deviation of the theoretical and simulation results of magnetic mirror points as a function of the equatorial pitch angle for different L-shells. a, d, g, j are for oxygen ions, b, e, h, k are for proton, and c, f, i, l are for electrons. The magnitude of the absolute deviation is shown by the colour bar.

A three-dimensional test particle simulation model is developed in which the relativistic equation of motion is solved numerically using the fourth and sixth-order Runge-Kutta methods. The stability of the simulation model is verified by checking the conservation of total kinetic energy and adiabatic invariants linked with each type of motion (Figure 14). It is found that the sixth-order Runge-Kutta method is essential to trace the complete trajectories (gyration, bounce and drift) of both proton and electron of a wide energy range, 5 keV to 250 MeV for L = 2 – 6. The study implies that a simulation model with sixth-order Runge-Kutta method can be applied to the time-vary, non-analytical form of magnetic configuration in future studies to understand the dynamics of charged particles trapped in Earth's magnetosphere.

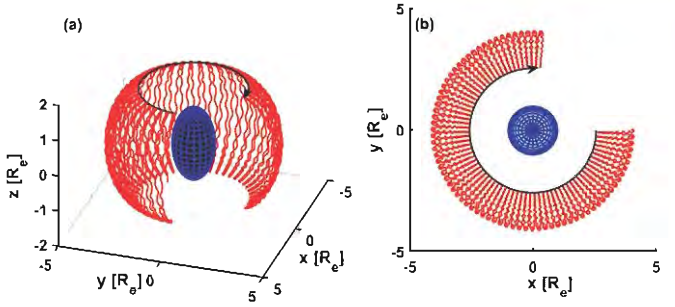

Figure 14 The trajectories of proton of energy 5 MeV at L= 4 with pitch angle of αeq =30°in Earth's dipolar magnetic field for 120 s. The dipole moment is in z-direction. The black arrows show westward motion of proton due to ∇B x B drift. (a) Shows three-dimensional trajectory of proton (b) the top view of the proton motion in xy plane as seen from the north magnetic pole.

Theory of Ion Holes in Space and Astrophysical Plasmas

Coherent bipolar electric field structures ubiquitously found in various space and astrophysical plasma environments. They play an important role in plasma transport and particle acceleration. A new theory is provided to give satisfactory explanation to ion-hole observations by Magnetospheric Multiscale (MMS) spacecraft (Figure 15). A salient point is that this theory incorporates the electron dynamics in the theoretical formalism, which removes ambiguities associated with existing theories, thus showing that the new theory for ion holes may be widely applicable for space and astrophysical plasmas.

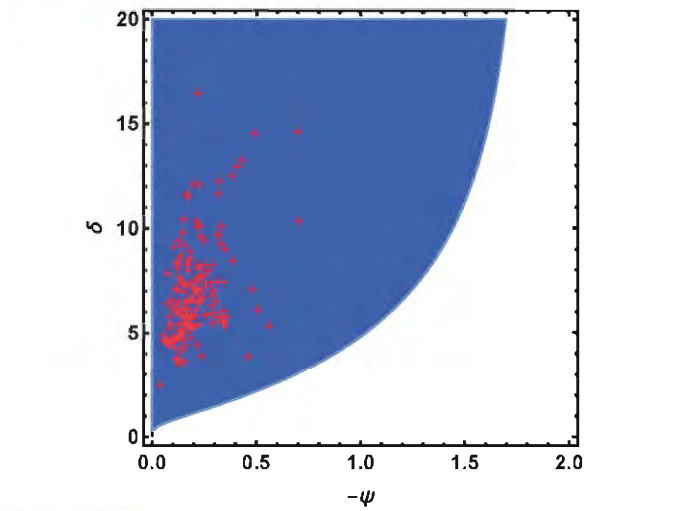

Figure 15 The width and amplitude of all the observed ion holes (shown with `+' symbols) are superimposed on the physically allowed regions predicted by our theoretical model, with the observed value of temperature ratio (Tr= 0.4). This figure exemplifies that the developed theoretical model is on a par with the spacecraft observations.

A new class of ion - acoustic solitons that can exist below the critical mach number

It is commonly believed that ion-acoustic solitons can only exist above the critical Mach number in a plasma system. A new class of ion-acoustic solitons that can exist below the critical Mach number is reported for the first time in a three-component plasma consisting of hot electrons, and two counter streaming ion beams. The analysis is based on the Sagdeev pseudopotential technique, and considers a simple case of two counter streaming proton beams with equal density and streaming velocity. Linear stability analysis shows that the slow ion-acoustic modes become unstable due to ion beam instability when the beam velocity is in the range of (0.55 - 1.14) C_a, where C_a is the ion acoustic speed. When the streaming velocity is below or at a threshold value, U_{th} =1.14 C_a, only the regular solitons having Mach numbers greater than critical Mach number can exist. However, when the streaming velocity exceeds the threshold value (all modes are stable), both regular and the new class of ion-acoustic solitons can exist. Hence, the new class of slow ion-acoustic solitons can exist in the parametric regime where the system is stable to counter streaming ion beams instability (Figure 16).

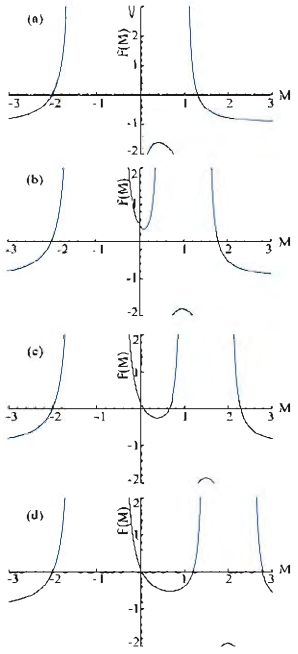

Figure 16 :Variation of F(M), the second derivative of the Sagdeev pseudopotentialat ϕ=0, versus the Mach number M for the normalized ion densities: $n_{01}=n_{02}=0.5$, and ion temperatures $\sigma_1 = \sigma_2= \sigma_p=0.1$. Panel (a), ion beam speed, $U_0=0.0$, and critical Mach numbers occur at $M_0=\pm1.1402$. Panel (b), $U_0=1.0$, only two critical Mach numbers (fast ion-acoustic) are real occurring at $M_0= \pm$ 1.9124, the other two roots are complex. Panel (c), $U_0=1.5$, and there are four real critical Mach numbers occurring at $M_0= \pm$ 2.404 (fast ion-acoustic) and ± 0.566 (slow ion-acoustic).

Electromagnetic Ion Cyclotron Waves in the Inner Magnetosphere

The longitudinal structure of the oxygen torus in the inner magnetosphere for a specific event found on 12 September 2017, using simultaneous observations of the Van Allen Probe B and Arase satellites is investigated. It is found that Probe B observed a clear enhancement in the average plasma mass (M) up to 3–4 amu at L = 3.3–3.6 and magnetic local time (MLT) = 9.0 hr. In the afternoon sector at MLT ~ 16.0 hr, both Probe B and Arase found no clear enhancements in M. This result suggests that the oxygen torus does not extend over all MLT but is skewed toward the dawn. A crescent-shaped torus or a pinched torus centered around the dawn may be a general feature of the O^+ density enhancement in the inner magnetosphere. The new finding is that the electromagnetic ion cyclotron (EMIC) wave in the H^+ band appeared coincidently with the oxygen torus. The linear dispersion relation for EMIC waves suggests that both He^+ and O^+ ions inhibit EMIC wave growth and its stabilizing effect is stronger for He^+ than O^+. Therefore, when the H^+ density or M is constant, the denser O^+ ions are naturally accompanied by the more tenuous He^+ ions, resulting in weaker stabilizing effect (i.e., larger growth rate). From the Probe B observations, it is found that the growth rate becomes larger in the oxygen torus than the adjacent region in the plasma trough and the plasmasphere. The oxygen torus in the inner magnetosphere may play an important role in excitation of EMIC waves(Figure 17).

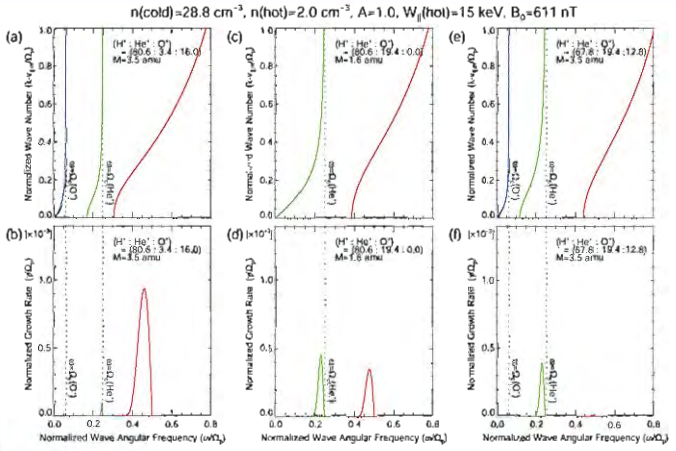

Figure 17 Solution of the linear dispersion relation for electromagnetic ion cyclotron (EMIC) waves. (a) Wave number and (b) growth rate as a function of wave angular frequency for the oxygen torus case, that is, ion composition of (H^+:He^+:O^+) = (80.6:3.4:16.0). Red curves show the branch of the H^+ band EMIC waves. Parameters used in the calculation are displayed in the top of panels. (c, d) Same as in Figures 17a, b except for the no O+ ion case, that is, the ion composition of (H^+:He^+:O^+) = (80.6:19.4:0.0). (e, f) Same as in Figures 17a, b except for M identical to the oxygen torus case (3.5 amu) with less O^+ ions, that is, the ion composition of (H^+:He^+:O^+) = (67.8:19.4:12.8).

Nonresonant instability of kinetic Alfvén waves

The nonresonant instability of kinetic Alfvén waves (KAWs) is studied in the presence of non-Maxwellian κ-electrons considering ion beam and velocity shear as the sources of free energy in a theoretical model comprising of the background ions and beam ions having Maxwellian distribution and kappa-distributed electrons. In the presence of κ- electrons, the velocity shear alone as a source is able to excite the KAWs nonresonant instability for a purely growing mode, whereas, ion beam as a single source is unable to do that. The combined sources of ion beam and velocity shear can excite nonresonant instability of KAWs with a finite real frequency. The presence of κ-electrons narrows down the wave unstable region and also restricts the wave to propagate close to 90°. It is observed that for smaller value of plasma beta (β), two distinct wave eigen modes are found and the coupling starts at a critical value of β and for further larger value of β, the coupling continues to exist. Once the coupling happens, it is difficult to distinguish between the two waves modes. In the presence of κ-electrons, the coupling occurs at a comparatively larger value of plasma beta (β) and smaller value of wave real frequency as compared to the Maxwellian electrons(Figure 18).

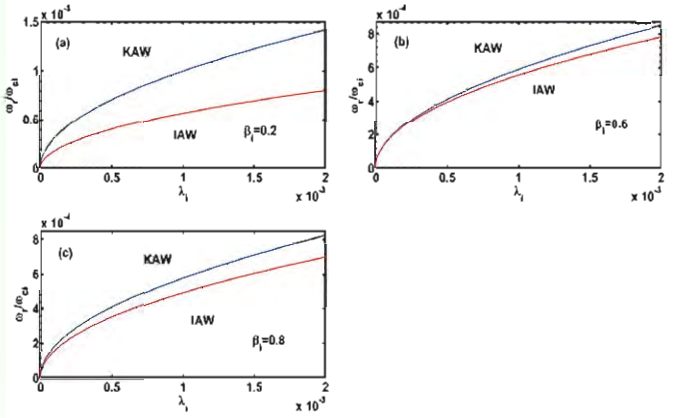

Figure 18 Coupling of KAWs and IAWs in presence of kappa (κ)-electrons for plasma parameters, ion to electron temperature ratio, Ti/Te = 0.1; angle of propagation, θ= 84.3°, κ= 2 and for different values of ion plasma beta, βi = 0.2 for (a), 0.6 for (b) and 0.8 for (c), respectively.

New and Ongoing projects

A statistical study of EMIC wave occurrence and relevant plasma parameters, along with their dependence on various geomagnetic indices and solar wind parameters will be investigated. It is planned to use multiple magnetosphere missions to conduct this study and bring together the wave and plasma dynamics in order to construct a comprehensive picture of magnetospheric dynamics.

DYNAMICAL AND ELECTRO-DYNAMICAL COUPLING OF EQUATORIAL ATMOSPHERE (DECEA)

Chief Coordinator : Sathishkumar, S.

Coordinator : Navin Parihar

Members : C.P. Anil Kumar, R. Selvamurugan, P. Mahavarkar, K.U. Nair, K. Jeeva, C. Panneerselvam, P. Elango, K. Jawahar, K. Emperumal, S. Sankaran, N. Venkatesh and Sarvesh Chandra

High velocity plasmas and Field Aligned Currents at high latitudes

The interaction of high velocity plasma with Earth's magnetic field is fundamental and offer many questions on high latitude electrodynamics. The problems associated with influence of electric field and Field Aligned Current (FAC) generation is investigated with the aid of spherical cap harmonic analysis at 83° Mag. Lat. in southern hemispheres. The investigation is done on the cases with different Interplanetary Magnetic Field (IMF) conditions after the earth directed solar events. The helio-plasma parameters viz., density, velocity, energy, electron temperature are also noted during the field aligned current studies. It seems that, due to external magnetic field influence polarization of plasma electric field take place (reorientation of the convective cells). It happens with different orientation as per the magnitude and direction of By and Bz component and the horizontal currents. It is noted that the FAC value also depends on kinetic energy of the plasma streams and conductivity of external loading. As the plasma decelerates by force J_{sw} X E_{sw}, the resultant current may extend along the field lines. Increases in the FAC density are seemed to be proportional to the transmission function.

Ionospheric response to two consecutive earthquakes in Canada

Recently, two successive earthquakes with the magnitude of 6.8 and 6.5 which have occurred at 200 km southwest of Port Hardy, Canada (49°N, 129°W) during October 2018 have been considered for study. The TEC data has been acquired from nearby stations of these two events. It has been observed that an increase in TEC anomalies of about 0.1 TECU of moderate earthquake events occurred on the geomagnetically quiet days. Besides, increases in the TEC anomalies have shown wave-like structures in the ionosphere and it may have associated with acoustic waves generated by earthquakes. The faulting mechanism of the earthquake and the propagation velocity of waves by TEC have confirmed the presence of acoustic wave activity.

Maxwell's current density during lightning hours and fair weather conditions

A study of the global electric circuit can help to understand the electrical environment of the Earth's atmosphere. This approach provides a good frame work for exploring interconnections and coupling of various regions of the Earth's upper atmosphere. With the aim of understanding the behaviour of air-earth current system during severe meteorological disturbances, the observations of Maxwell's current (air-earth current) for a short period during lightning hours and fair weather days of 2019 at an equatorial station Tirunelveli (8.7° N, 77.8° E) have been investigated. Unusual lighting activity was noted during the peak summer of 2019 over this location and corresponding electric variability in air-earth current amplitude and phase charge in electric field were measured. During fair weather days, the current density is only a few pico amps; however, a tenfold increase in the current density was noted during disturbed weather conditions. The analysis indicates that a rise in temperature led to enhanced convection during mid-day hours, which in turn, contributed to source activity. Possibly, this is the first report that brings out that the rise in temperature is covariant to source activity. It is found that the wind flow to be moderately southwesterly during the period of observation.

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

Chief Coordinator : S. Gurubaran

Coordinator : A.K. Singh

Members : D.S. Ramesh, P.S. Sunil, S. Sripathi, K. Vijayakumar, B.V. Lakshmi, Gopi Seemala, Nitin Sharma, Mala S. Bagiya, Shantanu Pandey, Susheel Kumar, N. Hazarika, G. Surve, M. Ponraj, S. Amirtharaj, Sujit Kr. Pradhan, Abhilash K.S., Raj Kumar, A.S. Sunil, Dhanya Thomas, Srinivas Nayak and Nilesh Chauhan

Anisotropy of magnetic Susceptibility (AMS) from Dhubri fault region, Assam

Anisotropy of low-field magnetic susceptibility (AMS) analysis is a rapid and sensitive technique for measuring preferred orientations of magnetic grains and, therefore holds great potential for acquiring fabric information. Theoretical and field data show that an idealized suite of AMS ellipsoids develops as primary sedimentary fabrics are progressively overprinted by tectonic fabrics. Foliation and lineation of a magnetic fabric may form as a result of transport, deposition, and deformation of rocks. These features are commonly associated with AMS, which has been used to resolve current directions in sediments and flow directions in magmas. AMS has also been correlated with strain in rocks and tectonic deformation of sediments, and

has been used to characterize soft-sediment deformation. AMS is used to distinguish between depositional and earthquake induced injection features. Tauxe's terminology; Kmax, Kint and Kmin correspond to maximum, intermediate, and minimum values of the magnetic susceptibility, respectively is adopted. In sedimentary rocks, a well grouped vertical Kmin direction and dispersed Kmax and Kint directions within a horizontal plane (hereafter termed sedimentary fabric) is expected and characterized by an oblate AMS ellipsoid. In moderate currents, grain imbrications result in slightly off-vertical Kmin directions and Kmax directions (in lower-hemisphere projection) are antiparallel to the flow direction. In high energy currents with particles entrained, Kmax directions are perpendicular to the flow direction, and Kmin directions are commonly streaked, resulting in prolate or triaxial AMS ellipsoids.

Anisotropy of magnetic susceptibility (AMS) was studied for sediments in Dhubri fault Zone, Shillong Plateau (Figure 19). It is hypothesized that depositional layers will display a sedimentary AMS fabric and that earthquake induced dikes will display prolate or triaxial AMS ellipsoids. The earthquake induced dikes, have different and distinctive AMS fabrics (Figure 20). In these dikes, the Kmax directions are well grouped, sub horizontal, and parallel to the dike strike, the Kint directions are well grouped and the distributions of the Kmin directions are subvertical. P values range between 1.02 and 1.09 and shape parameter (T) shows prolate fabric. The fabric of the depositional layer is typically sedimentary (Figure 21) and exhibits an oblate AMS ellipsoid. The degree of anisotropy (P) values range between 1.05 and 1.14 and shape parameter (T) shows oblate fabric. In addition, thermomagnetic curves of samples taken from depositional sediments and dike infill exposed show that the magnetic carrier is titanomagnetite.

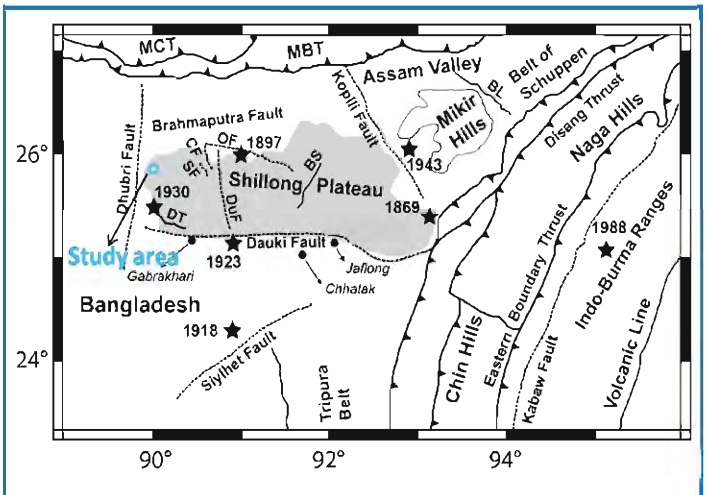

Figure 19 Location map of study area Dhubri, Shillong Plateau.

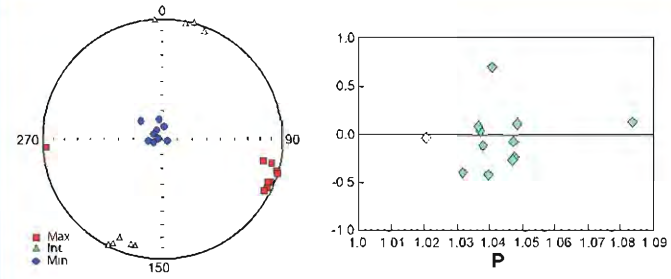

Figure 20 Anisotropy of magnetic susceptibility (AMS) for earthquake induced feature: Lower-hemisphere, equal-area projections of AMS orientations.

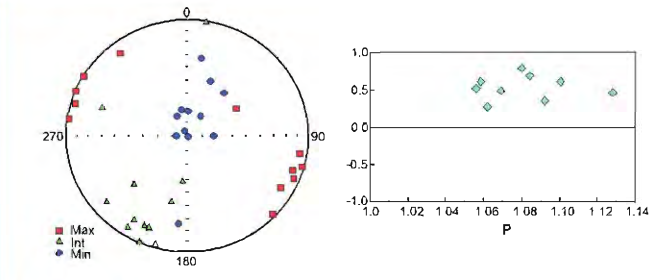

Figure 21 Anisotropy of magnetic susceptibility (AMS) for depositional layer: Lower-hemisphere, equal-area projections of AMS orientations.

Earthquake Seismology (ES):

The ambient noise data processing procedure is divided into five principal stages: (1) single station data preparation, (2) cross-correlation and temporal stacking, (3) measurement of dispersion curves, quality control and selection of the acceptable measurements, (4) Rayleigh surface wave dispersion maps and (5) the depth inversion for earth structure. Commonly, surface wave analysis of ambient noise-based studies focuses on crustal and upper mantle investigations ranging from global to local scale.

The topic is ambient noise tomography which is in developing stages. The possible outcome from it will be: (a) Surface wave 3D velocity model using ambient noise.

Installation of new broadband seismographs (BBS) stations and maintenance of BBS network is progressing as per planned schedule. Data management and cataloguing is kept update.

Ionospheric Seismology (IS):

A small part of energy released during earthquakes transfer to the atmosphere in terms of mechanical waves. For large magnitude earthquakes (generally Mw>6.5), the atmospheric amplification of such seismically induced waves can generate disturbances in ionospheric electron density

termed as Coseismic Ionospheric Perturbations (CIP). The moment magnitude of earthquakes mainly controls the amplitude of ionospheric perturbations. Extensive analysis of 59 dip-slip earthquakes is carried out to study the effect of focal depth on CIP amplitudes. The analysis shows that deep earthquakes generate smaller CIP amplitudes (Figure 22).

The sudden ground movement during earthquakes is responsible for the transfer of seismic energy to the atmosphere. The study shows that CIP amplitudes are not only sensitive to earthquake magnitude but also to their focal depth. Though the integrated displacement field is insensitive to the earthquake depth, its distribution is very different, concentrated in a narrow area for shallow earthquakes, spread over a wide region for deep earthquakes (Figure 23). CIP amplitudes appear to scale with the maximum values of vertical surface displacement rather than their average. Thus, the energy transfer is more efficient during shallow earthquakes.

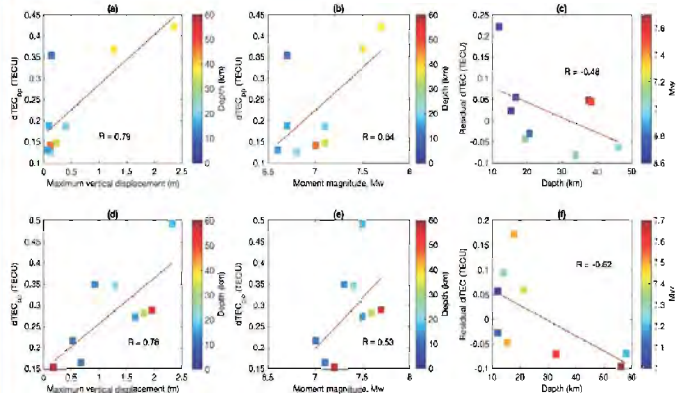

Figure 22 Correlation analysis (a) & (d) maximum vertical displacement and peak to peak dTEC amplitude (b) & (e) moment magnitude and dTEC amplitude (c) & (f) focal depth and residual vertical dTEC amplitude. In (c) and (f), the magnitude dependency in dTEC amplitudes is removed by subtracting the linear trend of (b) & (e) respectively. Corresponding correlation coefficients (R) are shown in each subfigure. Top panels include events occurred within geomagnetic inclination angle ±40° and the bottom panels consists of events occurred beyond ±40°.

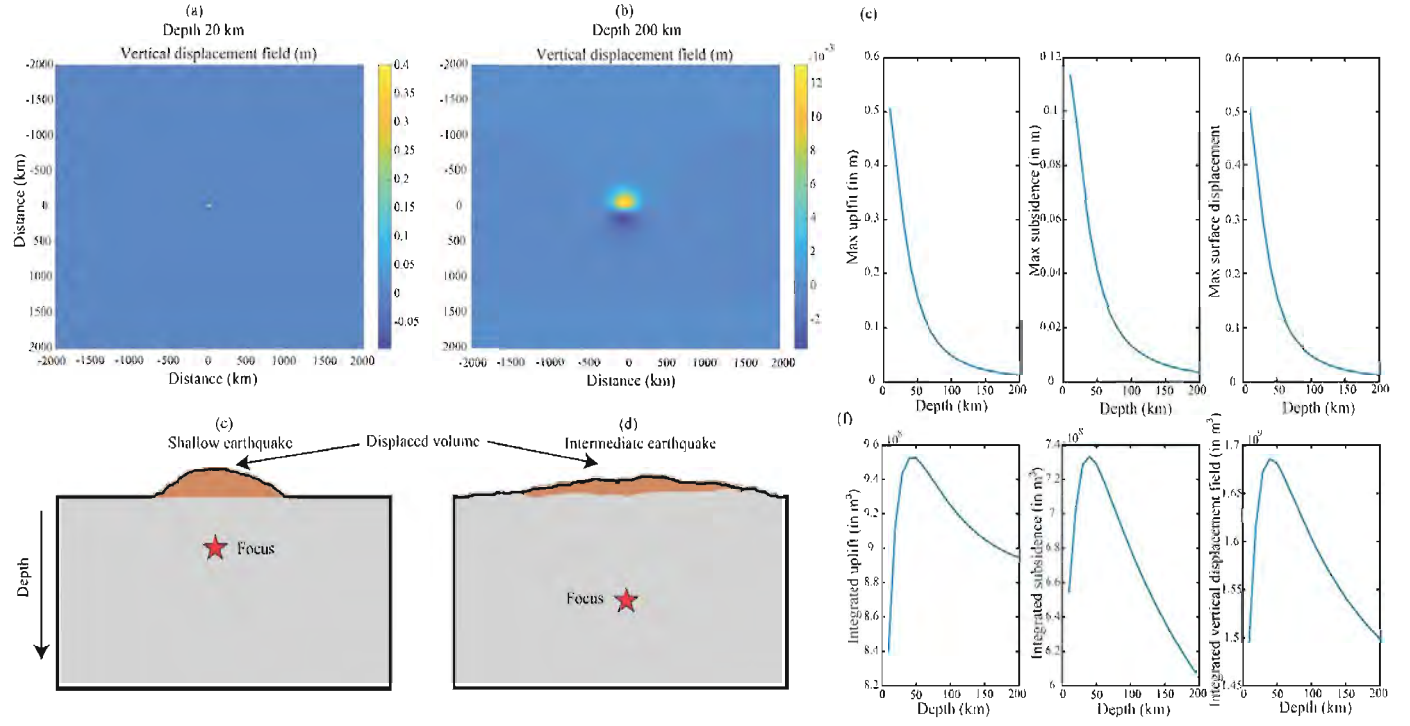

Figure 23 Synthetic test illustrating the variation of co-seismic ground deformations with focal depth. Pure dip-slip earthquakes are considered with magnitude of Mw 7.2 and dip angle 20°. (a) Vertical ground displacement when the focal depth is 20 km. Maximum vertical displacement estimated is ~0.4 m. (b) When the focus is shifted to 200 km depth. Maximum uplift is reduced to ~0.013 m in this case. (c) and (d) represent the displacement fields for different focal depths. (e) and (f) show the synthetic test results for a depth range of 10 to 200 km. (e) shows the maximum uplift, subsidence and vertical surface displacements. The maximum displacement fields decrease logarithmically with increasing focal depth. (f) shows the integrated displacement fields (volumes of the uplifted/subsided material) which do not change significantly with depth.

POLAR SCIENCE RESEARCH

GEOPHYSICAL STUDIES IN POLAR REGIONS (GPSP)

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Coordinator : K. Jeeva

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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 experiments at both stations are running uninterrupted.

Studies of Antenna types for Air Earth current monitoring at Indian Antarctic Station Maitri

Study has been carried out to find a suitable antenna design to detect the conduction current observed at the Indian Scientific Research Station at Maitri (70.8°S 11.7°E), Antarctica. Two long wire antennas and two plate antennas are simultaneously used to monitor the air-Earth current in the open space at this station. The experiments reveal that the currents recorded by the long-wire antenna and plate antenna display similar characteristics but differ in magnitude and response to the varying current. On a fair-weather day the mean current density obtained for 41 m long-wire antenna is ~0.4 pA m^{-2}, for 10 m long-wire antenna is 2.5 pA m^{-2}, for 0.25 m^2 plate antenna is 3.5 pA m^{-2}, and for 1 m^2 plate antenna is 4.2 pA m^{-2}. The current sensed by 1 s and 1000 s R–C time constant do not show any significant difference in the hourly mean diurnal variation as well as in the magnitude. The study revealed that a plate antenna is a better option for the long term monitoring of air-Earth current. The simultaneously monitored potential gradient at this station and Vostok (78.4° S, 106.8° E) are used to identify the local and global electric signals as shown in (Figure 24).

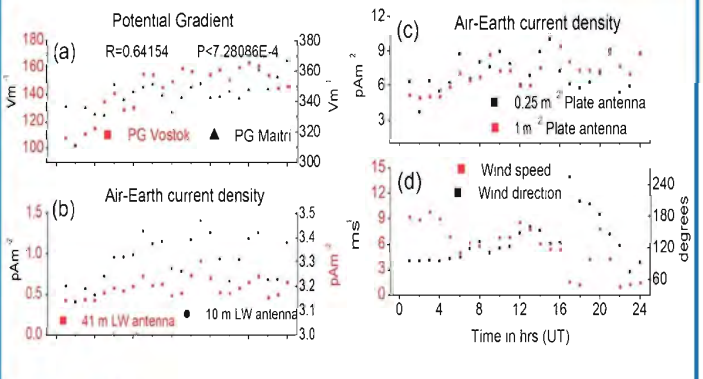

Figure 24 Variation of potential gradient, Air-Earth current density and wind in Maitri, Antarctica.

Studies of Cosmic Noise Absorption characteristics during substorms

A series of substorms called HILDCAAs, high-intensity long-duration continuous AE activity events, which are typically isolated events and are only loosely related to magnetic storms were studied. These very intense substorms are termed as supersubstorms or SSS events. SuperMAG AL (SML) peak intensity < -2500 nT for the SSS events is chosen as threshold value for the selection of events. Two Interplanetary Shocks Inducing Magnetospheric Supersubstorms (SML<−2500nT) were observed with unusual Auroral Morphologies and Energy Flow. For a better understanding of the mechanism, the CNA aspect of these events was looked into. These shock-induced supersubstorms (SSSs) have extremely high intensities (peak SML −4418 and −2668 nT) and long durations (~1.7 and ~ 3.1 hr). The events occurred on 2005 January 21 and 2010 April 5, respectively. The auroras associated with the SSSs did not have the standard midnight onset and following expansion. This event is studied here with additional data of global Cosmic Noise Absorption (CNA), auroral images by a space-based Imager, energetic electron flux data from geostationary satellites and magnetic field measurements covering almost all latitudinal and local time sectors. Focus has been mainly on the first ~11 minutes after the substorm onset at 17:11 UT. Some of the peculiar observations associated with this event are: (1) The time of CNA onset and substorm onset coincide in the narrow belt of magnetic latitude near 65° and there is a time delay as we move away from this belt. The delay is small (~ 2 minutes) on the dayside and longer (~ 11 minutes) on the night side. (2) The auroral onset and expansion takes place from the dayside. (3) Maximum intensification of westward electrojet and highest CNA are observed in the dawn sector, which otherwise are expected to be observed in the midnight sector. The observed aurora and CNA may be due to the combined effect of shock-related or substorm-related processes occurring simultaneously. The possible mechanism proposed to explain the anomaly in the present context is viscous interaction via Kelvin Helmholtz instability. It is believed that particle injection through only magnetic reconnection and precipitation from the night side following the field line should not limit the description of substorms. Various other processes such as viscous interaction, adiabatic compression, and field aligned current intensification can also lead to particle injection during impulse induced substorms. The study of more events of this kind should be carried out for a better understanding of the phenomena and CNA characteristics, in order to understand the mechanism behind such events.

SOLID EARTH RESEARCH

HAZARDS EVOLUTION RESOURCES OF DECCAN VOLCANIC PROVINCE (HERD)

Chief Coordinator : S.P. Anand
Coordinator : Gautam Gupta
Members : A.K. Singh, B.V. Lakshmi, K. Vijaykumar, P. B.V. Subba Rao, K. Deenadayalan, Pravin B. Gawali, B.N. Shinde, M. Ponraj, S. Amirthraj, M. Laxminarayana, Awadhesh K. Prasad, G. Shailaja, K. Priyesh, P. Radhika, P.V. Vijaya Kumar, N. Suneetha, Aditi Singh, Tabish Khan, Monica Rawat, V. Deshmukh, Mujaheed Baba, K. Tahama, K. Pati

Correlation of magnetic and geochemical analysis Jawale sediment section, Pravara Valley, DVP

Attempt to reconstruct the rainfall of the climate of Jawale sediment section (Figure 25) from variations in magnetic susceptibility and geochemical data. Profiles of metal/Al ratios and magnetic susceptibility for Jawale sediments from Pravara valley, DVP are plotted in Figure 26. Chemical weathering is an important feature of the global hydrogeochemical cycle of elements. Ratios like K/Al, Ti/Al and K/ Na are good indices of chemical weathering intensity. The warm and humid climatic conditions enhance the chemical weathering intensity (CWI) as reflected by increase in metal/Al ratios such as K/Al, Mg/Al, Ti/Al, Zr/Al etc. The intensity of chemical weathering is strongly affected by climatic parameters, principally rainfall and temperature. In the tropics the chemical weather is controlled by rainfall (temperature being nearly constant), CWI indices can be interpreted as indicators of rainfall variations. K/Al, Ti/Al and K/Na ratios of TK sediments have been used as proxies for CWI which, in turn, reflect rainfall in the catchment.

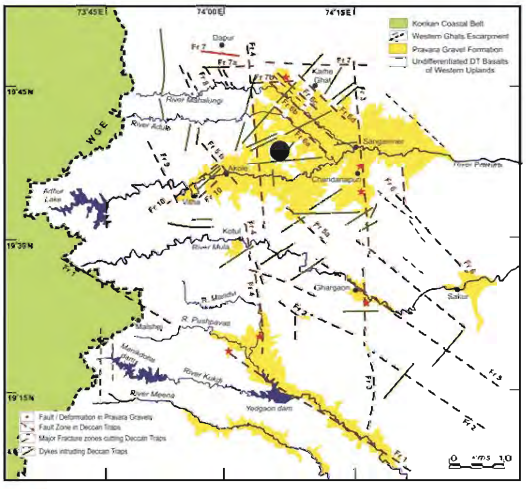

Figure 25 Location map of study area Jawale, Pravara Valley, Maharashtra, DVP.

The metal/Al profiles show similarity with the χlf profile, indicating that the magnetic minerals have a terrigenous source. Particular emphasis is laid on the similarity between the χlf, Fe/Al and Ti/Al profiles. Like χlf, Fe/Al and Ti/Al ratios that are good indicators of terrigenous sources, are also well correlated with other parameters (except Na/Al, Mg/Al and Ca/Al). Correlations are less pronounced with Na/Al, Mg/Al and Ca/Al because Na, Mg and Ca are depleted in the particulate phase due to chemical weathering and perhaps also because Ca and Mg may be derived to a small extent from the precipitation of carbonates during arid periods when rainfall is much reduced and the well. Na/Al is most poorly correlated with all other parameters probably because it is depleted in sediments due to its leaching from primary minerals during chemical weathering.

Potassium is associated with K-feldspar and with biotite and muscovite. Increased values of K/Al in sediments provide evidence of strong weathering of feldspars and micas in the catchment. Titanium is a high-field-strength (HFS) element and is mainly concentrated in accessory heavy minerals. Ti/Al ratio suggests differences in grain size and can be associated with the intensity of transport processes. Low K/Na ratios in sediments indicate the erosion of less weathered soil profiles in the catchment, whereas high ratios characterize the erosion of deep weathered soil profiles. The indices of CWI, namely Ti/Al, K/Al and K/Na, along with χlf are plotted in (Figure 26). All these indices register an increasing trend in the bottom of the section suggesting that chemical weathering was more intense because of increased rainfall. The χlf record also shows an increasing trend indicative of higher rainfall. The CWI indices are low in the top of the section and hence the rainfall too must have been low. This is also reflected in the low χlf values in the top of the section. Several previous studies have used geochemical data to infer the intensity of chemical weathering, interpreted the high Ti/Al and K/Al ratios in South China Sea sediments as due to more intense chemical weathering beginning 29.5 Ma in the source region. Few studies also related the K/Al, Ti/Al and Zr/Al ratios of Niger Fan sediments to the high intensity of chemical weathering and the African monsoonal precipitation. Input of more weathered materials to Lake Iznik, Turkey from the high K/Na ratio has been reported.

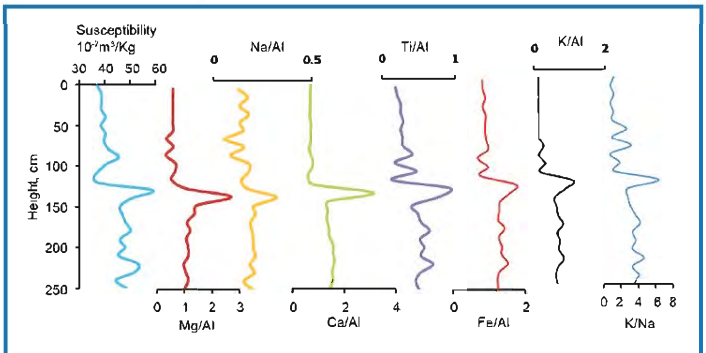

Figure 26 Magnetic susceptibility and geochemical data from the Jawale sediment section.

Heavy metal pollution assessment around Unhavare Geothermal Springs, West coast, Maharashtra

Pollution indices are a powerful tool for environmental quality assessment. In the present study, index of geoaccumulation (Igeo), contamination factor (CF), degree of contamination (DC) and pollution load index (PLI), were used. These pollution indices for the studied samples were determined to build a broad overview of the extent of contamination of the area by the various heavy metals.

The calculated geoaccumulation index for the studied samples is illustrated in Figure 27. The Igeo of Mn, Cu, and Zn showed no pollution. While the majority of soil samples are moderately contaminated with Ni. Moreover, the obtained Igeo revealed that most of the sample considers heavily to extremely contaminated with Cr and Co. The calculated contamination factor indicates that all the soil samples are highly polluted with Cr and Co (CF > 6). The CF of Ni, Mn and Cu showed moderate contamination. The CF of Zn showed low contamination. According to the DC values, all samples are at high contamination degree. The results of pollution load index were found to be high (PLI > 1) in all the investigated samples (Figure 28). This indicates the high load of heavy metals in the studied soil samples. These results indicate probable environmental pollution especially with Cr and Co.

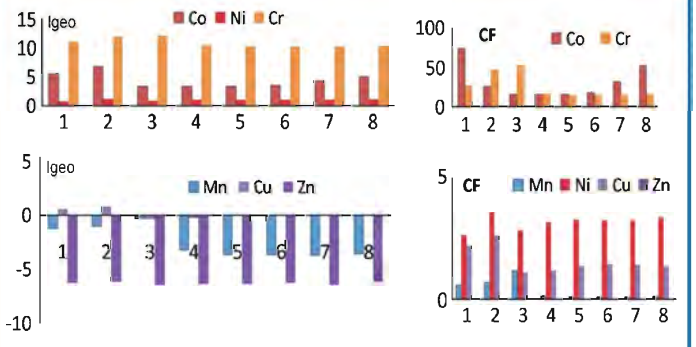

Figure 27 Geoaccumulation index (Igeo) and contamination factor (CF) for the studied samples from Unhavare thermal spring

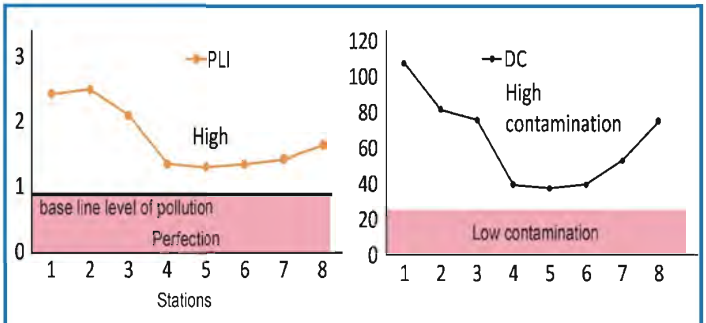

Figure 28 Degree of contamination (DC) and pollution load index (PLI) for the studied samples from Unhavare thermal spring.

Pre - historic geomagnetic field variations using archaeological artifacts

Accurate and reliable geomagnetic records have been available since the establishment of magnetic observatories in the early nineteenth century, prior to which geomagnetic field changes could be indirectly deciphered from archaeological materials. India is a large subcontinent with a glorious history and rich archaeological heritage spanning thousands of years. It is therefore important to generate and increase the pool of India-specific archaeomagnetic data, to help build and improve upon the Indian secular variation curve. The rock-magnetic studies were undertaken on baked clay artifacts from Keeladi archaeological site in Tamil Nadu. Based on the dating and historical evidence, archaeologists are of the estimation that age of Keeladi archaeological site corresponds to 5th Century BCE. Rock-magnetic studies offered critical information about the magnetic-concentration, -grain size, -composition and thermal stability of the archaeological artifacts.

The predominant reversible χ-T curves indicate that a lack of major mineralogical alteration occurred during heating. It also shows Curie temperatures in the range 580-590°C, suggesting the presence of thermally stable magnetite (Figure 29). The hysteresis based high field susceptibility quantifies contributions of constituent paramagnetic and diamagnetic matrix, while low field susceptibility, the slope of the induced hysteresis component at low field, cumulates all induced magnetizations. The values of χferri% were largely ~99%, changes in χferri% values between 93.7 and 99.3 in all samples clearly indicate the dominant presence of low-coercivity magnetite (Figure 30). Keeladi archaeological artifacts has well acquired the thermoremanent magnetization and their rock-magnetic studies together with thermal stability, consistent with fine magnetite, causing them suitable for archaeointensity determination.

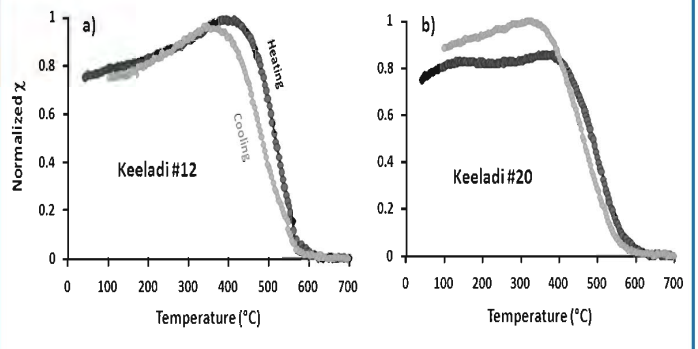

Figure 29 Typical magnetic susceptibility versus temperature plots (χ-T curves) for representative samples from Keeladi artifacts.

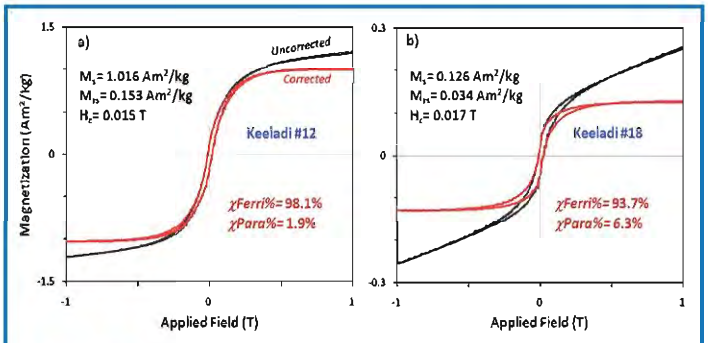

Figure 30 Representative hysteresis loops until 1 Tesla of Keeladi samples.

Demarcation of aquifer boundaries and hydro-geologic characterization can help in proper management and conservation of groundwater resources of a coastal region

To identify and delineate the groundwater-bearing zones and protection of freshwater aquifers from saltwater ingress in the northern parts of Sindhudurg district, western Maharashtra, India, a total of 86 vertical electrical soundings (VES) were carried out by Schlumberger electrode arrangement to infer the sub-surface lithology around Kankavali, Vijaydurg, and Malvan. The Dar-Zarrouk parameters were computed to generate the spatial variation maps of transverse resistance (T), longitudinal conductance (S), transverse resistivity (ρ_t), and longitudinal resistivity (ρ_l), to decipher the resistivity contrast of fresh water and salt water-bearing formations. The results demonstrate that these parameters provide a better resolution in delineating the seawater intrusion in coastal aquifers. The overburden aquifer protective capacity computed from the longitudinal conductance suggests that 59% of the area has poor aquifer protection, while 23% has weak, 11% has moderate and 7% falls in good protective capacity rating. This parameter reveals the infiltration of contaminants and the health of the aquifer. The electrical anisotropy (λ) value ranges from 0.9 to 5.1, suggesting an increase from SW to NE and also from SE to NW. The fracture porosity (φf) ranges from 10^{-8} to 0.65, which corroborates with the high and low λ values, reflecting that fracturing is due to anisotropy and significant reserves of groundwater could be exploited in this coastal region (Figure 31).

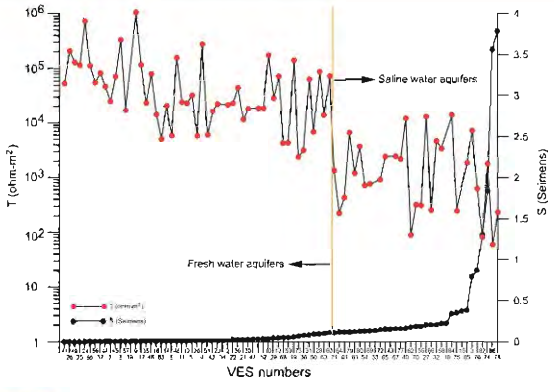

Figure 31 Discerning saline and fresh groundwater aquifers using S and T plots corresponding to VES points.

Major role of groundwater-rock interaction and marginal saltwater intrusion effect in the coastal Sindhudurg district, Maharashtra

The hydrochemistry of groundwater samples from the northern part of coastal Sindhudurg district, Maharashtra, India, was studied with an aim to comprehend its suitability for domestic and irrigation use. Groundwater samples were collected from 66 dug wells distributed over the study area (Figure 32). The results of the chemical analysis indicate that the groundwater is alkaline in nature and are mainly characterized by Ca^+-Mg^{2+}-HCO_3^-, Ca^+-Mg^{2+}-Cl^- and Na^+-Cl^- facies. The molar ratios of $Na^+/Cl^->1$, both Mg^{2+}/Na^+ and Ca^{2+}/Na^+ ratios <1, $(Ca^{2+} + Mg^{2+})/ (SO_4^{2-} + HCO_3^-) = 1$ suggest that the rock-water interaction of silicates / schistose rocks (quartz, chlorite, amphibolites, schist etc.) and ion exchange reaction are the major controlling factors of groundwater chemistry (Figure 33). Lower molar ratios of $Cl^-/ HCO_3^-< 0.5$, $NO_3^-/Cl^-<0.3$ observed reflect freshwater regime. Three samples which are in proximity to the Arabian Sea, deduce the effect of secondary contributions (saline water and anthropogenic sources). In order to determine the probable sources of groundwater contamination, principal component analysis was also carried out. The first three principal components with eigen value 1 or more are responsible for 71.31 %, 12.38% and 8.32% of the total variance in the data set, indicating major role of groundwater-rock interaction and marginal saltwater intrusion effect in the study area. Groundwater quality index computed for drinking purpose indicate that about 96% of the water samples lie within the permissible limits stipulated by the World Health Organization and Bureau of Indian Standards, and fall under the good to excellent category, suggesting its suitability for drinking purpose in the area (Figure 34). Suitability of irrigation water quality index signifies that most of the water is of excellent to good quality for irrigation, except for a few coastal samples.

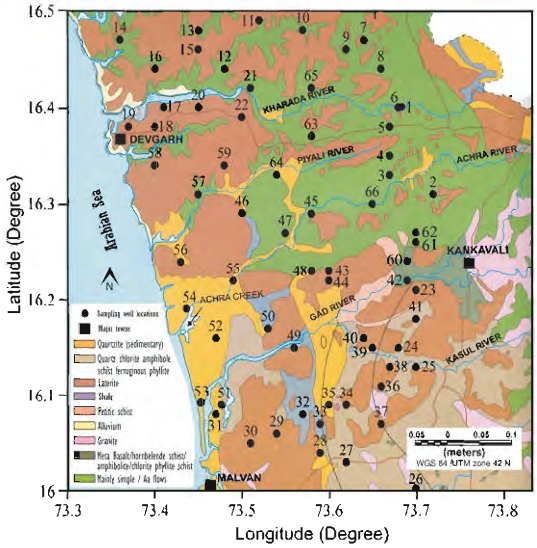

Figure 32 Map of the study area showing geology and the well location points.

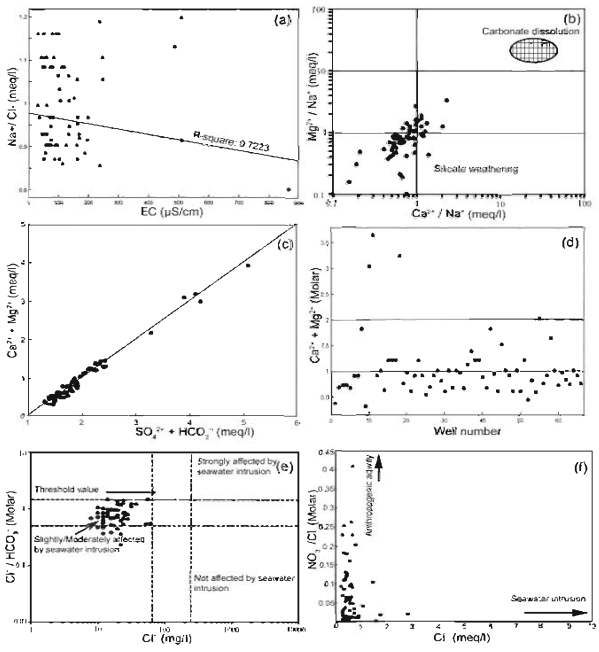

Figure 33 a) The ratio plots of a Na^+/Cl^- (meq/L) vs EC (µS/cm) b) The bivariate plot of Mg^{2+}/Na^+ (meq/L) vs Ca^{2+}/Na^+ (meq/L) c) The bivariate plot of $Ca^{2+}+Mg^{2+}$ (meq/L) vs $SO_4^{2-} + HCO_3^-$ (meq/L) d) Molar ratio plot of Cg^{2+}/Mg^{2+} vs sample in the study area e) The relationship between Cl^-/HCO_3^- vs Cl^- concentration in the study area f) Cl^- versus EC indicating seawater intrusion.

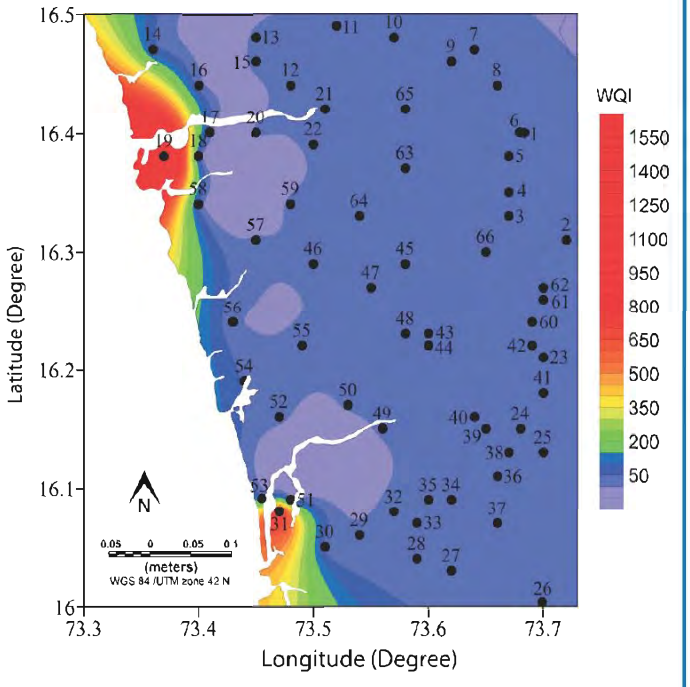

Figure 34 Spatial distribution map of drinking water quality index.

AMT studies across Aravali, Tural and Rajawadi geothermal zones, western Maharashtra, India

Thermal springs Aravali, Tural and Rajawadi are located in western part of Maharashtra (Figure 35) and are covered by Deccan basalts. These springs are running parallel to Western Ghats and geochemical studies denote that hot water springs are of meteoritic origin emerging from basement. Audiomagnetotellurics (AMT) survey was carried out along E –W profiles across Aravali, Tural and Rajawadi geothermal springs with a station spacing of about 1-1.5 km. 2D inversion was carried out jointly for transverse electric and transverse magnetic data after distortion and decomposition analysis. 2D geoelectrical modeling across Aravali profile brings out such a fault/fracture zone of crustal scale (C1) through which Deccan volcanism may have taken place. Another intermediate conductivity anomaly C2 in the form of intrusive dyke within the resistive host rock is observed towards east of Aravali geothermal zone. 2D modeling of AMT data across Aravali, Tural and Rajawadi profiles brings out a dipping conductor (~ 5-10 Ω-m) at a shallow depth that may represent a zone of fracturing within the sedimentary basin (associated with the geothermal field) through which hot water is brought to the surface. S1 and S2 may represent high resistive source rocks in Tural and Rajwadi geothermal springs over which meteoritic water circulation takes place. Thus, hot water temperature recorded at Tural and Rajwadi geothermal zones is about 62° C and 58° C respectively and for Aravali spring it is about 42° C, (Figure 35).

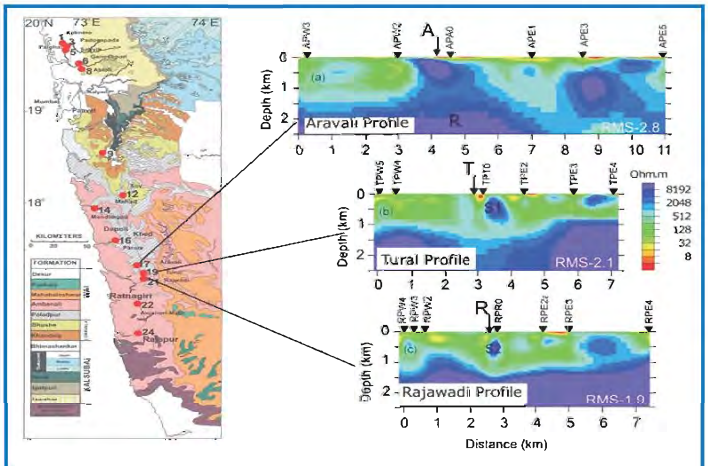

Figure 35 Geological map showing the geothermal springs in western Maharashtra. AMT survey was carried out across Aravali, Tural and Rajawadi profiles. 2-D Geoelectric depth section (TE + TM mode) along Aravali (A), Tural (T) and Rajawadi (R) geothermal zones are shown. All these hot springs are underlain by a high resistive basement (R1) and geothermal zones are reflected as high conductivity anomaly at a shallow depth. It may represent fracture/fault zone through which hot water gushes to surface. It is interesting to note that Tural and Rajawadi profiles are underlain by high resistive rocks (consolidated magma chambers, S1 & S2) and act as a heat source for meteoritic water circulation.

Geophysical Mapping of the Deccan Volcanic Province of Maharashtra

The Moho depth and crustal thickness variation over the Comorin Ridge and adjoining regions were computed through three dimensional inversion of Complete Bouguer Anomalies (CBA) and Mantle Residual Gravity Anomalies (MRGA) assuming crustal densities of 2670, 2790 and 2850 kg/m^3. A mean Moho depth of 15km, from published models and seismic reflection studies and a mean density contrast of 450 kg/m^3 for the Moho interface were also assumed for the inversion. The Moho depths thus computed were compared with those inferred from available seismic reflection and receiver function studies in the region. A reasonably good agreement is obtained for the Moho depth derived from the inversion of MRGA (Figure 36) with crustal density 2850 kg/m^3. Over the Comorin Ridge, the Moho depth decreases progressively from ~24 km in the north, to ~18km in the middle and ~15 km in the south over a length of 500km. Similarly, the crustal thickness decreased from north to south along the axis of the ridge. Further south of the Comorin Ridge, in the central Indian Ocean, the Moho depth decreases to less than 8km, typical oceanic crustal thickness. There is a sharp change in the crustal thickness in the eastern flank of Comorin Ridge while it is more gradational in the western side. The sudden variation in crustal thickness along the eastern flank of the Comorin Ridge indicates a significant crustal boundary as suggested by earlier studies. In the region, east of Comorin Ridge and south of Sri Lanka, Mesozoic magnetic anomalies were previously identified, while there were no magnetic anomalies identified over the Comorin Ridge. Above 4°N, in the north-west region of the Comorin Ridge, the Moho depths are comparatively higher. This indicates that the Comorin Ridge and its north-western region up to Chain Kairali Escarpment are associated with significant crustal thickening compared to the eastern side of the Comorin Ridge. In the region, east of Chain Kairali Escarpment (CKE) the Moho depths are larger as compared to its western side and the highs in the Moho depth tends to extend up to 4°N and breaks further south. The Moho depth over the Mannar Basin increases gradually in a NNE-SSW direction. As expected, the continents and continental margins of India and Sri Lanka are associated with higher values of Moho depth, while the lowest values are found to be in the Central Indian Basin.

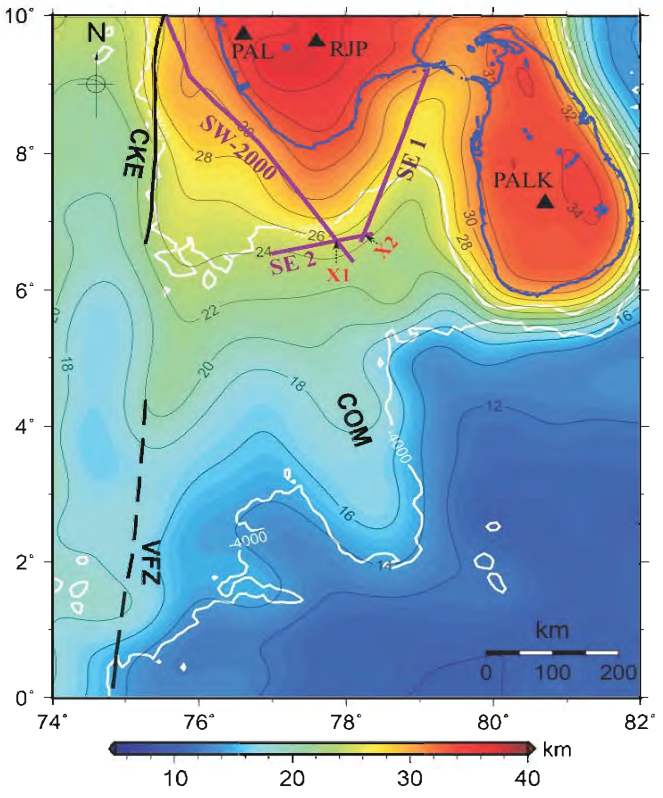

Figure 36 Moho depth variation over the Comorin ridge and adjoining region derived from the inversion of MRGA-2850 gravity anomalies. The violet thick lines represent the location of the seismic reflection sections (DGH, India). The solid triangle represents the location of the broadband seismic station where Moho depths were available through the receiver function studies (Pathak et al., 2006; Sharma et al., 2015). COM- Comorin Ridge, CKE – Chain Kairali Escarpment, VFZ- Vishnu Fracture Zone.

INTEGRATED GEOPHYSICAL STUDIES ACROSS BUNDELKHAND CRATON (IGBC)

Chief Coordinator : C.K. Rao

Coordinator : S.K. Patil

Members : Anup K. Sinha, R.K. Nishad, V. Purusshotam Rao, P. B.V. Subba Rao, Amit Kumar, D. Nagarjuna

Magnetic susceptibility (MS) and NRM intensity were measured on the samples collected from Raksha Shear zone, Chhatarpur, Khajuraho and Mahoba regions of Bundelkhand Craton using MS-2B magnetic susceptibility meter and JR-5 Spinner magnetometer respectively. The mean values of magnetic susceptibility (MS) and NRM intensities for dykes were noted as 4597 x 10^{-6} SI and 1.47 x 10^{2} A/M respectively while the granitoids mean MS and NRM intensity values were found as 71 x 10^{-6} SI and 1.89 x 10A/m. Following the MS and NRM measurements to isolate the characteristic remanent magnetization (ChRM) directions, AF and thermal demagnetizations techniques were applied on the selected specimens. For AF and thermal pilot study, a total of 150 (75 for AF and 75 for thermal) specimens from all the dykes were selected. The AF and thermal demagnetization steps used were as 50, 75, 100, 150, 200, 250, 300, 350, 400, 500, 600, 800, 1000 Oe and 100, 200, 300, 350, 400, 450 500, 530, 560, 580, 600°C respectively. Through detailed AF and thermal cleaning techniques two groups of palaeomagnetic ChRM directions were isolated corresponding to (i) NW-SE directed dyke swarms and (ii) E-W trending Mahoba dyke of Bundelkhand Craton. AMS investigations on 478 specimens revealed the presence of Prolate and Oblate shaped magnetic grains in equal proportion in the studied samples. Rock magnetic investigations revealed that SD+MD and MD type magnetite was prominent in the dykes, whereas, the granitoids showed hematite content. Petrological studies on representative Mafic dykes samples indicated sub-ophitic to ophitic textures and the presence of plagioclase, clinopyroxene, opaque minerals. Plagioclase occurs both as phenocryst and groundmass. The opaque may be mostly magnetite and ilmenite and occur as anhedral to subhedral grains distributed throughout the rock.

FIELD SURVEYS

1. Survey for the installation of broadband seismometers of new station at Jorhat and data retrival and servicing of exsisting stations at Bongaigaon, Namsai, Diphu, Agartala and Aizawl during March 15-20, 2021.

2. Installation of new broadband seismograph (BBS) vault at ICAR-National Research Centre on Yak campus, Dirang, Arunachal Pradesh during February 24-March 5, 2021.

3. A state-of-the-art All-Sky Airglow Imager (ASAI) was recently procured as part of Institute's efforts to carve out a regional centre at Port Blair from the present magnetic observatory running from this station. Considering the COVID-19 pandemic situation, it was not possible to move the instrument to Port Blair. However, the imager was moved to Panhala to test its performance and qualify the instrument for future observations. Panhala is a strategic location for low latitude ionospheric studies and is also near to Kolhapur from where IIG is operating the medium frequency radar for mesosphere-lower thermosphere studies. Two observational campaigns were conducted from Panhala during March-April 2021 under moonless, cloudfree conditions. Besides a couple of intense equatorial plasma bubble events observed in the OI 630.0 nm emission, the imager could also detect several gravity wave manifestations like fronts and ripples in the mesospheric OH and OI 557.7 nm emissions. Analysis of the data collected during this period is currently under progress.

PUBLICATIONS

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Evolution of ion acoustic solitary waves in pulsar wind. *Monthly Notices Royal Astron. Soc.*, **500(2)**, 2021, 1612–1620, https://doi.org/10.1093/mnras/staa3379.

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Gravity and pressure-gradient currents using ionospheric electron density measurements from COSMIC satellites. *J. Geophys. Res. (Space Physics)* , **125**,e2020JA028401, 2020,https://doi.org/10.1029/ 2020JA028401.

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A study on the response of the ionosphere to the three major space weather events of 2015 using meridional chain of ionosondes and GPS receivers over India. *J. SunGeosphere,*https://doi.org/10.31401/SunGeo. 2018.02.08, 2020.

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Association of ionospheric signatures to various tectonic parameters during moderate to large magnitude earthquakes: Case study. *J. Geophys. Res. (Space Physics)*, **126,** e2020JA028709. https://doi.org/10.1029/2020JA028709.

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Lower-Band "Monochromatic" Chorus Riser Subelement / Wave Packet Observations. *J. Geophys. Res. (Space Physics)*, **125**,e2020JA028090, 2020, doi: 10.1029/2020JA028090

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Dilatory and downward development of 3 - meter scale irregularities in the Funnel-like region of a rapidly rising Equatorial Plasma Bubble. *Geophys. Res. Lett.*, 2020, https://doi.org/10.1029/2020GL087256.

IMPACT FACTOR OF PUBLICATIONS DURING 2020-2021

Journal Name	Impact Factor	No. of Papers
Acta Geod. Geophys.	0.909	01
Advances Space Research	1.746	04
Ann. Geophys.	1.49	02
Asian J. Res. Reviews Phys.	NA	01
Astrophys. J. Lett.	8.198	01
Astrophys. J.	5.745	02
ApJ Supplement Series	7.95	01
Astrophys. Space Sci.	1.43	02
Bull. Pure Appl. Sci. (Geol.)	6.929	01
Curr. Science	0.756	01
Earth Planets Space	2.075	03
Earth Sci. India	NA	01
Earth Surface Processes Landforms	3.694	01
Geophys. J. Int.	2.574	01
Geophys. Res. Lett.	4.5	02
Ind. J. Geo Marine Sci.	0.328	01
Ind. J. Geosciences	0.368	01
Ind. J. Radio Space Phys.	0.19	01
J. Atmos. Solar-Terr. Phys.	1.503	03
J. Coast. Conserv.	1.374	01
J. Colloid Interface Sci.	7.489	01
J. Earth Environ. Sci. Res.	NA	01
J. Geophys. Res. (Space Physics)	2.799	13

Journal Name	Impact Factor	No. of Papers
J. Ind. Geophys. Union	0.313	01
J. Geol. Soc. India	0.899	02
J. Magnetism Magnetic Materials	2.717	02
J. Mater. Sci: Mater. Electron	2.195	01
J. Sun Geosphere	NA	01
J. Superconductivity Novel Magnetism	1.161	01
Lithosphere	2.72	01
Marine Petroleum Geology	3.79	01
Measurements	3.364	01
Monthly Notices Royal Astron. Soc.	5.356	05
Nat. Haz.	2.427	01
Phys. Scr.	1.985	02
Polar Sci.	1.389	01
Radio Sci.	1.43	01
Remote Sensing Lett.	2.298	01
Res. Astron. Astrophys.	1.512	01
Results Phys.	4.019	01
Scientific Reports	3.998	01
Solar Phys.	2.503	01
Space Weather	1.166	04
Tectonics	3.54	01
The European Physical J. Plus	0.762	01

INVITED TALKS AND LECTURES

Dr. S. Tulasiram
Gave a talk on "Equatorial Electric Field Circuit, Science Meet on Space Weather research using small satellite constellation", (virtual, host: ISRO, Bangalore), September 22, 2020.

Dr. Amar Kakad
Gave a talk on "Plasma Wave Processes in the Earth's Magnetosphere", as a part of the R.J. College Popular Lecture series, Dept. of Physics, R.J. College, Mumbai, January 5, 2021.

Dr. Rajesh Singh
Delivered a talk on "D-region ionosphere remote sensing by Radio Waves" organized by Department of Physics, Doon University, Dehradun, October 6, 2020.

Dr. S. Pandey
Delivered a lecture on "Surface wave tomography" as a part of Mathematics Seminar on Science and Engineering application , organised by BIT Mesra, February 12, 2021.

PARTICIPATION IN CONFERENCES/MEETINGS/SEMINARS

NATIONAL

6th Shear Zones and Crustal Blocks of Southern India (online conference) conducted by Department of Geology, University of Kerala, Trivandrum, November 5-10, 2020

Anand. S.P.
Aeromagnetic Signatures of Peninsular India.

INTERNATIONAL

VERSIM (VLF/ELF Remote Sensing of Ionospheres and Magnetospheres), Kyoto University, Japan, November 16-20, 2020

Veenadhari, B., M. Pandya, Y. Ebihara and **S.G. Kanekal**
Study of Electron PAD evolution using Van Allen Probes.

Upadhyay, A., B. Kakad, A.P.Kakad, Y. Omura and **Ashwini K. Sinha**
Occurrence Characteristics of Electromagnetic Ion Cyclotron Waves at Sub-Auroral Ground Station Maitri.

Ojha. B, Y. Omura and **S.V. Singh**
Multipoint analysis of source regions of EMIC waves by THEMIS spacecraft and rapid growth of subpackets.

AGU (American Geophysical Union) Fall Meeting 2020, December 1-17, 2020 (Online)

Upadhyay, A., B. Kakad, A.P. Kakad and **Ashwini K. Sinha**
Characteristics of the EMIC waves observed at the Indian Antarctic station Maitri.

Ojha, B., Y. Omura, **S.V. Singh** and **G.S. Lakhina**
Electromagnetic Ion cyclotron waves observed by THEMIS spacecraft in Magnetosphere.

Barik, K.C., S.V. Singh and **G.S. Lakhina**
A comprehensive model for the kinetic Alfvén waves in space and astrophysical plasmas.

13th International Conference on Plasma Science and Applications (ICPSA), Ravenshaw University, Cuttack, December 26-28, 2020 (Online)

Barik, K.C., S.V. Singh and **G.S. Lakhina**
Nonresonant Instability of KAWs and its coupling to IAWs.

43rd COSPAR Scientific Assembly (Virtual), Sydney, Australia, 28 January - February 4, 2021 (Online)

Sreelakshmi, J. and **G.H.Vichare**
Gravity-driven and Pressure-gradient Current Contributions in the Magnetic field Recorded by LEO Satellites.

Datar, G. and **G.H.Vichare**
Study of Thunderstorm Ground Enhancement (TGE) events from Tirunelveli, India.

STUDENTS CORNER

N. Suneetha was awarded Ph.D. degree for the thesis entitled, "Imaging saline water ingress in coastal aquifers of Maharashtra using electrical resistivity technique constrained by geochemical data" by Department of Geophysics, Andhra University, Visakhapatnam, under the supervision of Dr. Gautam Gupta.

G. Shailaja was awarded Ph.D. degree for the thesis entitled, "Appraisal of groundwater recharge potential zones in parts of semi-arid region of Maharashtra: a geoelectric and hydro-geomorphic approach" by Department of Geophysics, Andhra University, Visakhapatnam, under the supervision of Dr. Gautam Gupta.

Priyesh Kunnummal was awarded Ph.D. for the thesis entitled "Crustal Architecture and Isostasy of Aseismic Ridges in the North Central Equatorial Indian Ocean using High Resolution Satellite derived Gravity Data" by Andhra University, Visakhapatnam under the supervision of Dr. S.P. Anand.

Radhika P.R. was awarded Ph.D. for the thesis entitled "A Geopotential Approach to Reveal the Buried Basement Structure of the Kutch Rift Basin, Western India" by Andhra University, Visakhapatnam under the supervision of Dr. S.P. Anand.

P. V. Vijaya Kumar has been awarded Ph.D. degree by Department of Geophysics, Andhra University Visakhapatnam, for thethesis entitled "Electromagnetic induction studies in Saurashtra region" under the supervision of Dr.P.B.V.Subba Rao.

Padma Gurram was awarded the Ph.D. degree by Andhra University, Visakhapatnam for the thesis entitled "Quiet and disturbed time dynamics of low latitude F- region" under the guidance of Dr. Bharati Kakad.

Megha Pandya was awarded the Ph.D. degree by University of Mumbai, Mumbai for the thesis entitled "Solar sources and Interplanetary drivers of Space weather events and their Geoeffectiveness" under the guidance of Dr. B. Veenadhari.

Adarsh Dube was awarded the Ph.D. degree by University of Mumbai, Mumbai for the thesis entitled "Thunderstorms effect on coupled Atmosphere-Ionosphere System in the Indian Low Latitude region" under the guidance of Dr. Rajesh Singh.

DEPUTATIONS/VISITS ABROAD

Name	Country visited	Duration	Conference/workshop/symposium
Dr. B. Veenadhari	Japan	27 January- 25 May 2020	1) Visited ISEE, Nagoya University, Nagoya, to work with Arase project at ISEE
Shri B.Ojha	Japan	29 February - 28 May 2020	1) RISH, Kyoto University, Kyoto, Japan for collaborative work with Prof. Yoshiharu Omura

Antarctic/Arctic Expeditions

Name	Country visited	Duration	Expedition
Shri Pranjal Saikia	Maitri, Antarctica	40th ISEA	Winter member, Maitri
Shri Atul Kulkarni	Bharati, Antarctica	40th ISEA	Winter member, Bharati

HONOURS AND AWARDS

Dr. K. Deenadayalan

Appointed as Referee to examine and report on the Ph. D. thesis entitled "Palaeomagnetism, Rock magnetism and Palaeointensity studies of Rajmahal and Sylhet Traps, India" of Osmania University, Hyderabad.

Dr. S. Tulasiram

Nominated as a Principal Coordinator for the special event "Games and Toys" in the India International Science Festival (IISF)–2020.

Nominated as a guest editor for the special issue on "Recent Advances Equatorial Plasma Bubbles and Ionospheric Scintillation" in Earth and Planetary Physics (EPP) journal.

Dr. Vinit C.Erram

Invited as Chief Guest and Speaker in National Science Day Celebrations at Rajaram College, Kolhapur on March 12, 2021, where he talked on "Applications of Geomagnetism".

Shri Krushna Chandra Barik

Selected for the SCOSTEP Visiting Scholar (SVS) Program 2020.

Received URSI Senior Membership.

Shri Biswajit Ojha

Selected for the SCOSTEP Visiting Scholar (SVS) Program 2020.

PARTICIPATION IN SPECIALIZED WORKSHOPS/TRAINING COURSES

B.V. Lakshmi

Participated in the online training programme on "Statistical Analysis using SPSS" during May 26-30, 2020.

Participated in online training programme on "Practical Aspects of Remote sensing and Geographical Information System (GIS)" from June 5-7,2020.

Participated training programme on "GIS online training programme" during July 13-August 2, 2020.

B.V. Lakshmi and **S. Pandey**

Attended International Virtual Workshop on "Global Seismology and Tectonics" during September 14-25, 2020 at CSIR-NEIST.

Attended AOGS-EGU Natural Hazards Virtual Meeting: The AOGS-EGU Joint Conference Series on "New Dimensions for Natural Hazards in Asia", during September21-23, 2020.

Participated in DST sponsored online training programme on "Climate Change: Challenges and Response (for women scientists)", held at Centre for Disaster Management (CDM), Lal Bahadur Shastri National Academy of Administration (LBSNAA), Mussoorie during October 5-9, 2020.

Attended training on "Hill area environment, development with focus on earthquakes, landslides and floods" from October 21-23, 2020 by National Institute of Disaster Management.

Participated in International Geoscience Colloquium during November 10-13 and 27, 2020.

Khan Tahama

Attended International Webinar on 'GIS Applications & Career Opportunities' organized by Geography Dept., RPS Degree College, Balana, Haryana and Netra Institute of Geoinformatics Management & Technologies Foundation Dwarka, New Delhi, May 08, 2020.

Nominated to participate in the Online training under (SERB) Scientific Social Responsibility Policy (SSRP) of the ongoing research and development (R&D) project entitled "Dyke intruded fractured rock characterization using discrete dual porosity and neural network modelling of geo-electrical data for water resource management", organized by Department of Applied Geophysics, IIT (ISM), Dhanbad, July 31, 2020.

Attended a session titled "Inversion and Machine learning applications to geophysical data" conducted by Department of Applied Geophysics, IIT (ISM), Dhanbad, October 17, 2020, under the aegis of Vaishwik Bharatiya Vaigyanik (VAIBHAV).

Dr. Gautam Gupta and **Khan Tahama**

Attended webinar on 'Subsurface Utility Engineering-Introduction to Ground Penetrating Radar' organized by AF Academy, New Delhi, May 15, 2020.

Attended a webinar on "Groundwater Recharge and Aquifer Management" organized by FICCI, New Delhi, July 15, 2020.

Attended a National level Webinar on "Geomedical Health Hazards and Environment Problems in Tribal Areas: Issues, Challenges and Opportunities" organized by School of Environmental and Earth Sciences, KBC North Maharashtra University, Jalgaon, September 17, 2020.

Dr. S.P. Anand

Nominated to attend the winter school on "Physical Geodesy & Its Applications" conducted by National Center for Geodesy, IIT Kanpur under SPARC (Scheme for promotion of Academic and Research Collaboration) during February 15-24, 2021.

Shri Krushna Chandra Barik

Attended VLF/ELF Remote Sensing of Ionosphere and Magnetosphere (VERSIM) Virtual Meeting, November 16-20, 2020, Kyoto University, Japan.

Attendedthe 3rd ISEE Symposium PWING-ERG Conference and School on the inner Magnetosphere, ISEE, Nagoya University, Japan, March 8-12, 2021.

Attended Magnetosphere online weekly Seminar Series, NASA, 2020-21.

Shri Biswajit Ojha

Participated in an online workshop on "Outer planet moon – solar wind interaction" ESA/ESTEC, Noordwijk, The Netherlands, November 5-6, 2020.

OFFICIAL LANGUAGE (HINDI)

Rajbhasha Adhikari	:	Ashwini K. Sinha
Asst. Director (Official Language)	:	J. Kamra
Hindi Advisor	:	Manju J. Singh
L. D. C	:	K. Shelatkar

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

The Institute organized 'Hindi Mah' during September-October, 2020. The Hindi competitions organized during this period included Essay Writing and Slogan Competition (through submission) for the Institutes logo, which were well attended by the members & research scholars and a total number of 8 prizes were given in these competitions.

The Institute celebrated the World Hindi Day on 10th January, 2021 and organized Hindi dictation and Crossword competitions, which received overwhelming response with more than 25 participants in each competition. These competitions were conducted during re-open period in Seminar Hall with considerable physical distance in the wake of COVID-19 pandemic.

The Institute organized a Hindi Essay writing competition during October, 2021 under the aegis of TOLIC, in which more than 20 officers/staff participated from the member organizations. The competition was highly appreciated by the TOLIC authorities and the participants. Shri Nitesh Dubey, Sr.Technical Assistant of the Institute bagged the 2nd prize in this competition. The winner of the competition shall be awarded with cash prize in the forthcoming half yearly meeting of the TOLIC to be held during June/July, 2021.

Hindi House Magazine "SPANDAN" was published on six monthly basis, which includes scientific & technical articles as well. The magazine is being sent to various scientific & educational institutes of the country.

During the year, Two Hindi Workshops (1 with physical distancing and 1 in virtual mode) were organized on different topics for the staff of the Institute, in which a total of 72 members participated.

Under the annual incentive scheme, during the Annual Day Celebrations 9 staff members of the Institute were awarded with cash prize for doing their official work in Hindi.

The 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

Science Day 2021 was celebrated in virtual mode at HQ. Chief Guest Dr. Rajan, Academic and Research Advisor (ARA), Department of Archaeology, Government of Tamil Nadu delivered a lecture entitled "Application of Science in Archaeology" on February 28, 2021 which was attended by staff members of IIG HQ, its Regional Centers and Magnetic Observatories apart. Several faculties and students from other Universities also joined the lecture.

World Water Day was celebrated on March 22, 2021. During this occasion, Prof. D.B. Panaskar of Swami Ramanand Teerth Marathwada University, Nanded delivered an online lecture on the topic: "Application of Remote Sensing and GIS Technique for Groundwater Management of Asna River Basin, Nanded".

IIG participated in the 6th India International Science Festival (IISF), December 22-25, 2020. The footfall at IISF was quite heartening and several thousands of visitors visited participated in the event virtually.

During the year, IIG Science Outreach published 46 popular science articles; conducted 5 online quiz contests; and 3 online talks. Apart from these a total of 4 research work was highlighted on DST website.

COMPUTER FACILITIES

Chief Coordinator	:	Mahendra Doiphode
Member	:	Nanda S. Shah

Computer section has performed exceptionally well amid COVID19 restrictions and various degree of lockdowns during the financial year. It could provide uninterrupted web/VPN/virtual meetings/email services to all staff members including those working from home with zero system downtime.

During this period IIG's official email services is moved to NIC email server from in house aging email services, resulting into more secure and reliable official communications. Computer Center also facilitated office virtual meetings, video conferences and scientific seminars/webinars through Webex collaboration solution. Centre is also managing the HPC cluster restoration work.

LIBRARY AND DOCUMENTATION

Chief Coordinator : Ashwini K. Sinha

Coordinator : Smita Chandra

Members : B.I. Panchal, Neetesh Dubey
A. Selvarajeshwari

Library

Library and Documentation Services plays an important role in catering to the information needs of the IIG researchers and staffs. The library works closely with staff, scientists, students and researchers to ensure that print and online collections align with learning, teaching and research activities of the institute. During the year, the library added e-books, reprints and conference papers on areas of research within the institute. Hindi books were also acquired. The library subscribes to online copies of all international journals. Hard copies of only the journals from Indian publishers were subscribed to. The library had an excellent usage statistics of the online library resources. Library also provides the Inter library loan facility, Reprographic facility, Information display through Digital Notice Board. Book procurement, Current Awareness Service, Discovery service etc. It also procured documents on inter-library loan for its users and also provided documents to other libraries under this service.

The library was committed to meeting the needs of staff and students even during Covid-19 times, by providing timely user service, supporting research, learning and teaching, and ensuring that facilities and services are accessible to everyone. The services were extended to outside users from universities and other organizations. Some of the ways the library functioned during Covid-19 are as follows:

Physical services for following Covid-19 norms: All material issued or returned to the library was fully sanitized. The books returned were air dried with pages open before being stacked. The library and its equipments were sanitized on a daily basis. The library staff followed all Covid-19 norms set forth. All attempts were made to maintain distance in user reading spaces. Stock verification for the year and report preparation was done with utmost caution.

Digital Services Provided during Covid-19 times: All attempts were made to acquire abstracts to be sent for publication for IPR approval, in digital format. IPR and final approval from competent authorities was taken with minimum paper work.

The library acquired e-books in English during this period and cataloguing was done using remote log in. Bibliometric services comprising of analysis of research papers published by institutions, impact statistics, cited research area, publication trend, calculating author's productivity, journal preferences, impact factor analysis, subject growth trend analysis and any other services were provided when asked for in the digital format. Inputs were provided regarding Article Publication Charges (APCs), type of journals, scope for waiver, etc, in the digital format. New guidelines were formulated for APCs and circulated amongst users.

Plagiarism prevention was enabled using the iThenticate software for scientists, technical staff and students of the institute. The Institutional Repository software was upgraded from Dspace 3.4 to Dspace 6.0. Metadata was regularly updated to the Institutional Repository (IR) and the contents of the IR being harvested by the National Digital Library (NDL) at IIT Kharagpur. The library website was further upgraded to enhance services by providing access to all resources, via the library website (http://iigm.res.in/library/library-and-documentation). Through the NKRC (library consortium of DST-CSIR laboratories), users were provided full text access to more than 20 publisher resources. Access to online copies of journals was given to all observatories and centers via the RemoteXs.

Documentation

Documentation continued all the support services to the scientists and students. During the year, various work related to scanning and digitizing the Ph.D. thesis was accomplished. Other routine services like, rendering help in preparation of posters & brochures, editing of photographs, designing/ layout of institute publications and photography of magnetograms was undertaken. In-house designing & printing of banners and posters for various occasions was also undertaken. In-house designing and printing of Coffee Table Book for DST's 50 years was accomplished. Another important task of this section is to ensure the proper functioning of CCTV cameras installed in the campus. This is very important as far as security issues are concerned and thus considerable amount of time goes into checking the intricacies of the same.

SPECIAL EVENTS

Curtain Raiser of 6th India International Science Festival - 2020

Though science is not bound by any country, the country itself has its own brand of science and scientific culture. India has deep roots in science and technology personified by the likes of Aryabhata and Sushruta. Indian science, in ages long gone, was at the forefront of unprecedented wisdom and understanding. The majestic universities at Nalanda and Takshashila imparted knowledge to scholars coming from far and wide.

India International Science Festival (IISF) is an annual event with a unique combination of seminars, workshops, exhibitions, lectures, panel discussions and debates with interactive forms of engagement including hands-on demonstrations, film and magic shows, interactive dialogues with experts, and science-related theatre, music and poetry. The theme for IISF-2020 is "Science for Self-Reliant India and Global Welfare". IISF-2020 provides a virtual platform for people from different fields to come together for sharing their scientific and innovative ideas.

6th India International Science Festival – 2020

The "Games and Toys" a special event featured in the 6th edition of India International Science Festival - 2020 (IISF-2020) with more than three thousand registered participants across the country, was organized. Inaugurated on December 22, 2020 through video message by Dr. Harsh Vardhan, Hon'ble Union Minister for Science & Technology, Earth Sciences and Health & Family Welfare, this event has been graced by several eminent personalities like Padma Bhushan Shri Pullela Gopichand, the Chief-national badminton coach and international player. Smt. Anita Karwal, Secretary, Secondary School Education and Literacy, and Shri. Harshad P. Shah, Vice Chancellor of Children's Unviersity, Gandinagar also took part in the inauguration of this event as special guests.

A special panel discussion was specially designed in this event to showcase the cultural heritage of toys and games in our country and deliberated on how one can transform the traditional games and toys to the modern toys and video games; the scope of Indian gaming industry and career opportunities. About 6 special webinars by eminent personalities/professionals like, Shri. Harshad Shah (Vice-Chancellor of Children's University, Gandinagar), Shri. Manish Jain (Professor in IIT Gandhinagar), Shri. Arvind Gupta (Padma Shri award recipient), Smt. Mital Salia (Game Therapist and women entrepreneur) and Dr. Jayant Joshi (senior scientist in UGC-DAEC) have been conducted. The theme of these webinars are mainly focused on the role of Games and Toys in the intellectual and psychological development of children, how to make simple toys with simple things around you, how to explain science principles

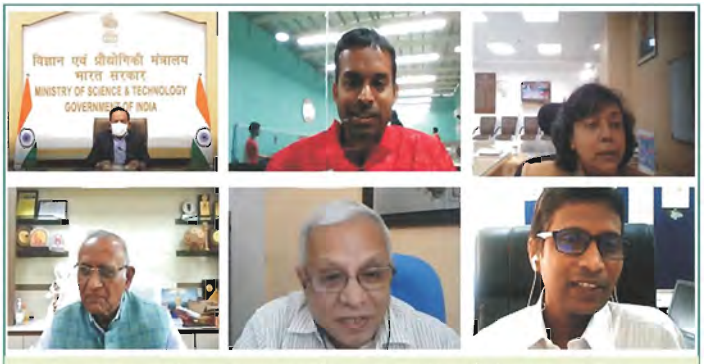
Indian Institute of Geomagnetism (IIG) has hosted the Curtain Raiser event of the IISF-2020 jointly with the Vijnana Bharati (VIBHA) on December 14, 2020. This event has been graced by eminent personalities like Hon'ble Secretary of Department of Science and Technology, Prof. Ashutosh Sharma and Hon'ble Vice Chancellor of University of Mumbai, Prof. Suhas Pednekar. The curtain raiser event was streamed live on YouTube and a large number of audiences from several institutions, colleges and schools participated.

Esteemed dignitaries during the Curtain Raiser event of IISF - 2020.

very easily using simple toys that children used to play in their everyday life. A lot of curiosity and enthusiasm was shown by the young participants by asking several questions and interactions with the speakers.

Besides the webinars, a video exhibition of toys and games made by the participants from the different parts of the country has been showcased. Best video exhibits in both toys and games categories have been awarded with special prizes and certificates.

Finally, the event concluded on December 24, 2020 with a valedictory session chaired by Dr. Abhay Karandikar, Director, IIT Kanpur. This event was organized by Prof. S. Tulasiram, Indian Institute of Geomagnetism as Principal Coordinator.



Eminent Personalities who graced the inauguration of Games and Toys event

IIG STAFF WELFARE AND RECREATION CLUB

Indian Institute of Geomagnetism will celebrate its Golden Jubilee in 2021. In this connection the institute organized a Logo design competition. Staff members and students of IIG HQ, Regional Centres and Observatories participated in this competition.

The staff members of the Institute bid farewell on superannuation to Shri V.J. Jacob on May 31, 2020; Dr. S.S. Ghosh on December 31, 2020 and Dr. C.K. Rao on February 28, 2021.

The co-operation and support extended by staff members are deeply acknowledged.

STAFF WELFARE MEASURES

Various staff welfare measure, such as, Benevolent Fund Scheme, Canteen facility etc. is being provided to the staff members.

All IIGians observed the Anti-Terrorism Day on May 21, 2020 by taking a pledge at 10.30 a.m.

The Vigilance Awareness week was observed from October 27-November 2, 2020. The observance week commenced with a pledge on October 27, 2020 at 11.00 a.m. The theme this year was "Satark Bharat, Samriddh Bharat (Vigilant India, Prosperous India)".

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):

Prof. A.K. Singh, (Professor E)
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

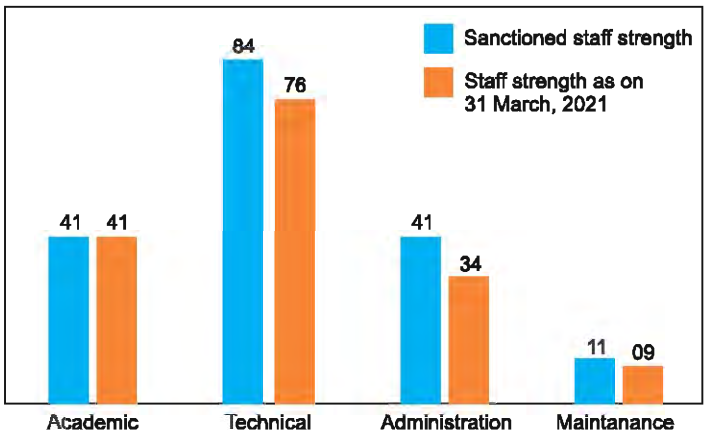
Appellate Authority:

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.

STAFF PROFILE



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 2020–2021.

MOBILIZATION OF RESOURCES

The Institute has been constantly making endeavors to mobilize resources by extending its scientific and technical expertise to organizations like ISRO, DRDO, AAI etc and by selling magnetic data to outside organizations. During the year 2020–2021, the Institute received funds for carrying out the objectives of various sponsored projects. The gains from sponsored projects in terms of academic activity are immense.

In Service of the Nation.....

With the world facing the coronavirus crisis, the pandemic has wreaked havoc and altered human lives forever. Its impact and the untoward consequences will be felt long after the virus diminishes.Yet, in times like this, hope is a powerful healer. Mankind stands united in its struggle against the Covid 19 pandemic and life will surely triumph. Scientists at IIG silently worked towards the betterment of the society by developing several sophisticated tools and models so as to realize the commitment in decoding the processes taking place within and above the Earth.

In its pursuit to maintain and modernize Magnetic observatory network and to set up facilities for other observations for generating high quality data through Observatory network, IIG researchers developed a Linux based data logger at preliminary level and is being tested on Ubuntu 8.4.5 platform. A "Real Time Data monitoring system", is being developed at Pondicherry Observatory. This system helps in monitoring the status of all the variation instruments running at this observatory by displaying the plots of the data being recorded in mobile phone. This system helps in reducing the downtime of instruments and the data loss.

While the Sun is generally more eruptive during its maximum and declining phases, observational evidence shows certain cases of powerful solar eruptions during the quiet phase of the solar activity. Occurring in the weak Solar Cycle 14 just after its minimum, the extreme space weather event in 1903 October – November was one of these cases. The time series of geomagnetic activity based on contemporary observational records were reconstructed. The reconstructed time series has been compared with the equatorward extension of auroral oval and the time series of telegraphic disturbances. This study shows that potential threats posed by extreme space weather events exist even during weak solar cycles or near their minima.

In earthquake Seismology, the ambient noise data processing procedure is divided into five principal stages: (1) single station data preparation, (2) cross-correlation and temporal stacking, (3) measurement of dispersion curves, quality control and selection of the acceptable measurements, (4) Rayleigh surface wave dispersion maps and (5) the depth inversion for earth structure. Commonly, surface wave analysis of ambient noise-based studies focuses on crustal and upper mantle investigations ranging from global to local scale. To achieve this, installation of new broadband seismographs (BBS) stations and maintenance of BBS network in North East India is underway.

In order to understand the Air Earth Current monitoring at Indian Antarctic station, Maitri, research has been carried out to find a suitable antenna design to detect the conduction current. Two long wire antennas and two plate antennas are simultaneously used to monitor the air-Earth current in the open space at this station. The experiments reveal that the currents recorded by the long-wire antenna and plate antenna display similar characteristics but differ in magnitude and response to the varying current.This study revealed that a plate antenna is a better option for the long term monitoring of air-Earth current.

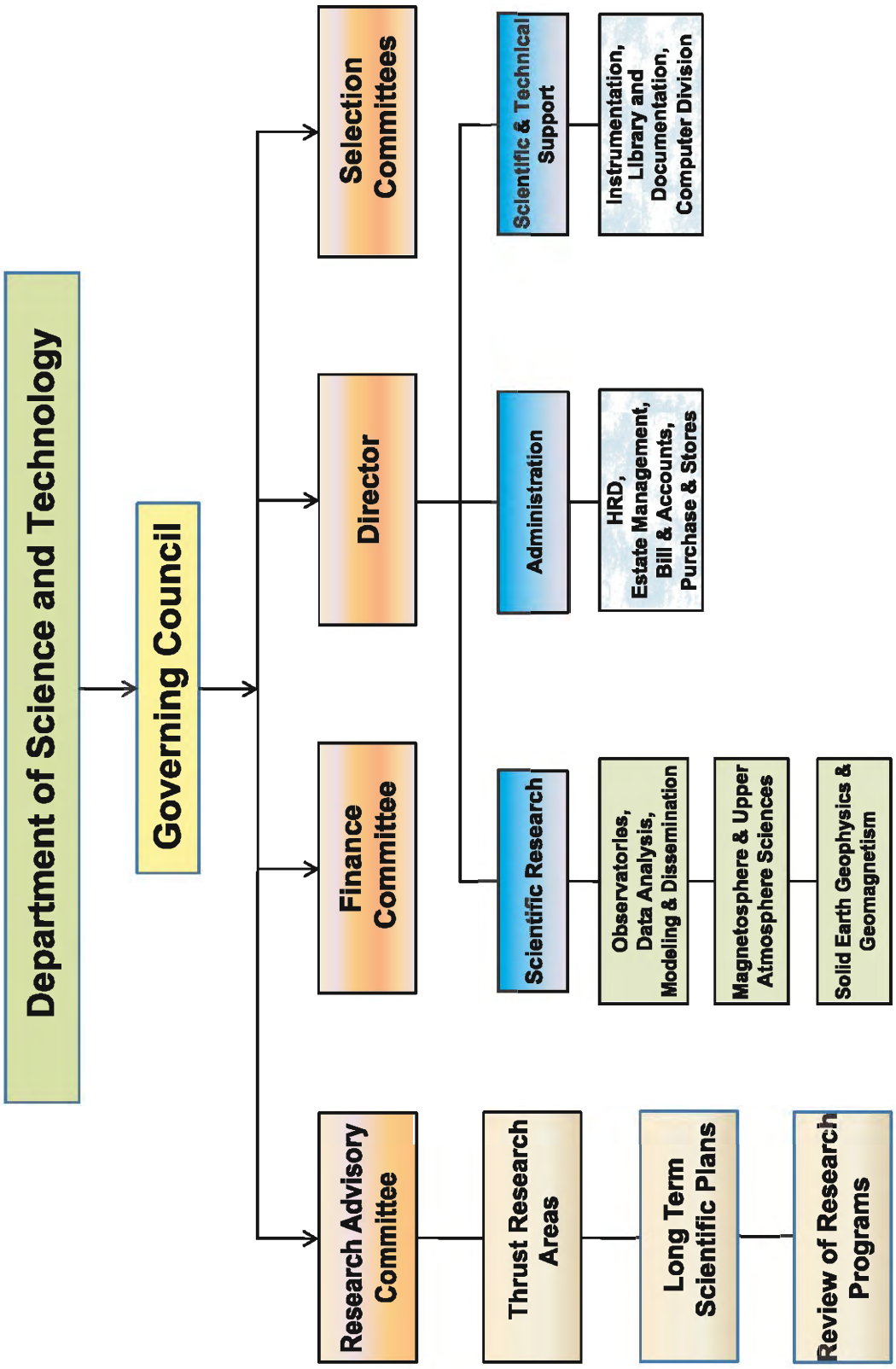
Pollution indices are a powerful tool for environmental quality assessment. The index of geoaccumulation (Igeo), contamination factor (CF), degree of contamination (DC) and pollution load index (PLI), were computed over the Unhavare geothermal spring in west coast Maharashtra to build a broad overview of the extent of contamination of the area by the various heavy metals.The preliminary results indicate probable environmental pollution especially with Cromium and Cobalt.

Accurate and reliable geomagnetic records have been available since the establishment of magnetic observatories in the early nineteenth century, prior to which geomagnetic field changes could be indirectly deciphered from archaeological materials. India is a large subcontinent with a glorious history and rich archaeological heritage spanning thousands of years. It is therefore important to generate and increase the pool of India-specific archaeomagnetic data, to help build and improve upon the Indian secular variation curve. Rock-magnetic studies were undertaken on baked clay artifacts from Keeladi archaeological site in Tamil Nadu. Based on the dating and historical evidence, archaeologists are of the estimation that age of Keeladi archaeological site corresponds to 5th Century BCE. Rock-magnetic studies offered critical information about the magnetic-concentration, -grain size, -composition and thermal stability of the archaeological artifacts. These studies suggest that the Keeladi archaeological artifacts well acquired the thermoremanent magnetization and their rock-magnetic studies together with thermal stability were consistent with fine magnetite, causing them suitable for archaeointensity determination.

Research work initiated to determine the extent and severity of saline water ingress and to delineate the areas suitable for groundwater exploration in Konkan coast of Maharashtra, using geophysical methods reveal that overburden aquifer protective capacity is poor in 59% of the area, while 23% has weak, 11% has moderate and 7% falls in good protective capacity rating. The fracture porosity corroborates with the high and low electrical anisotropy values, reflecting that fracturing is due to anisotropy and significant reserves of groundwater could be exploited in this coastal region. While defining the water chemistry in this region to assess groundwater quality and its suitability to potable and

irrigational purposes, it is found that the groundwater is alkaline in nature. Also the rock-water interaction of silicates / schistose rocks (quartz, chlorite, amphibolites, schist etc.) and ion exchange reaction are the major controlling factors of groundwater chemistry. Three samples which are in proximity to the Arabian Sea, deduce the effect of secondary contributions (saline water and anthropogenic sources).Groundwater quality index computed for drinking purpose indicate that about 96% of the water samples lie within the permissible limits stipulated by the World Health Organization and Bureau of Indian Standards, and fall under the good to excellent category, suggesting its suitability for drinking purpose in the area. Suitability of irrigation water quality index signifies that most of the water is of excellent to good quality for irrigation, except for a few coastal samples.

The Institute has been constantly making endeavours to mobilize its resources by extending scientific and technical expertise as a part of Technology Development program, Consultancies and Services. Capacity building for scientific research is a key mission of the Institute. To attract, motivate and train young talent to undertake research in geomagnetism and allied areas, initiatives like Dr.Nanabhoy Moos Post-Doctoral Fellowship are offered to research scientists. Under the Science Outreach program, the Institute participated in online mode several scientific exhibitions. IIG participated in the 6th India International Science Festival (IISF) during December 22-25, 2020. The footfall at IISF was quite heartening and several thousands of visitors visited participated in the event virtually. During the year, IIG Science Outreach published 46 popular science articles; conducted 5 online quiz contests; and 3 online talks. Apart from these a total of 4 research work was highlighted on DST website.Several awards and recognitions were also conferred on staff and students.


Department of Science and Technology
Governing Council
Selection Committees
Director
Finance Committee
Research Advisory Committee
Scientific & Technical Support
Instrumentation, Library and Documentation, Computer Division
Administration
HRD, Estate Management, Bill & Accounts, Purchase & Stores
Scientific Research
Observatories, Data Analysis, Modeling & Dissemination
Magnetosphere & Upper Atmosphere Sciences
Solid Earth Geophysics & Geomagnetism
Thrust Research Areas
Long Term Scientific Plans
Review of Research Programs

AUDIT REPORT
2020-2021

P. B. SHETTY & CO.
CHARTERED ACCOUNTANTS

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, 2021, 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. 3 (b) under notes to accounts relating to delay in capitalization of fixed assets;
ii) Note no. 7 under notes to accounts relating to non-accounting of property in occupation of the institute which was previously belonging to IMD;
iii) Note No. 9 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);
iv) Note No. 13 under notes to accounts regarding amount recoverable for movable property lost in transit (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.

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

106, VIDYA CHAMBERS, 305 TARDEO ROAD, NANA CHOWK, MUMBAI - 400 007
Tel. : 022-23884288, 022-23895950, 022-23804067
Email : pbshettyca@gmail.com

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 P. B. SHETTY & CO.
Chartered Accountants
Firm registration number - 110102W

Brijesh Shetty
Partner
Membership number - 131490
UDIN - 21131490AAAAES8407
Place: Mumbai
Date: 04-08-2021

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 Technology (DST), Government of India. The Institute's main activity is Scientific research in the field of Geomagnetism.

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 recognised 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 recognised 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 recognised 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 organisation. Such benefits are classified as defined contribution schemes as the organisation 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.

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

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	Assessment Year	Current Year Amount in Rupees	Previous Year Amount in Rupees
TRACES demand	Various assessment years	1,61,990	65,750

Institute has applied for rectification to Income Tax Department and the same is pending for rectification. Institute does not expect any cash outflows for the same.

3. Contingent Advances –

a) Contingent Advances balance as on 31st March, 2021 is Rs.9,22,952 (Previous year Rs.2,38,52,912).

b) Advances given to NIC amounting to Rs.1,91,41,834 towards various projects, have been partly settled during the current financial year. Settlement of advance during the current financial year comprises assets aggregating to Rs.1,71,30,218 relating to Computers and networking equipment had already been delivered and put to use since the financial year 2017-2018.

Due to delay in capitalisation, depreciation pertaining to financial year 2017-2018 to financial year 2019-2020 amounting to Rs.68,52,127 has been debited in the current financial year.

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. During the year, physical verification of assets has been carried out by the management. The reconciliation of the physical quantities with the books and records is in process and discrepancy if any will be adjusted after the reconciliation is complete with approval of competent authority

K.R. Salvi

6. Capital work in progress as on 31stMarch, 2021 is verified and certified by management / respective authorities.

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

7. 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.

8. a) In General Provident Fund (GPF) no. of employees as at 31st March 2021 is 77. 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.

9. Provision for Gratuity Liability, Leave Encashment and Commuted Pension have been provided as at 31st March, 2021for those employees who are going to retire in the next financial year. Amount provided for as at 31st March,2021is Rs.2,75,46,056 (Previous year: Rs.1,95,54,807). 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, 2021is not determined and provided. The unfunded obligation will be made good by the Ministry on request of the Institute.

10. Government Grants to the Institute
    The Institute has received the following grants during the year =:

Particulars	Current Year		Previous Year	
	As per Income & Exp. Account/ Capital Fund	Actual grant received	As per Income & Exp. Account/Capital Fund	Actual grant received
Grant-in-aid-Salary	29,56,00,000	29,56,00,000	32,83,84,000	32,83,84,000
Grant-in-aid-General	10,25,00,000	10,25,00,000	8,72,51,000	8,72,51,000
Grant-in-aid-Capital	6,40,00,000	6,40,00,000	7,78,06,000	7,78,06,000

11. Amount recoverable under GST as per various GST Acts as at March 31, 2021 is Rs.2,31,82,926(Previous year Rs.2,30,52,742.23/-). Recovery of 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.

12. Loans and advances to employees and others outstanding as at 31st March, 2021is Rs.50,97,248 (Previous Year Rs.2,89,30,057/-). Adjustment will be made as and when the approvals are communicated to the accounts department.

13. Amount of Rs.6,68,000/- paid in 2012-2013 which represents the cost of lab equipment was lost in transit. Against which an appeal filed by the Institute with State Consumer District Redressal Commission, Presiding Judicial member has granted the claims of damage of Rs.6,68,000/- plus interest at the rate of 9% per annum and other reimbursements in favour of the Institute. As on March 31, 2021, this claim is still pending to be received from Safe express Private Limited. Accounting entries to give effect to this matter will be made in the year in which the damages claimed will be recovered.

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, 2021 Rs.6,59,66,367 (Previous year Rs. 6,16,18,881/-)) consisted assets side Fixed Deposits Rs.6,59,66,367 (Previous year Rs. 6,16,18,881/-), Bank of India Bank balance Rs.NIL (Previous year Rs.178,446/-) and Liability side represents Earmarked/Endowment Funds (Pension) Rs. 6,59,66,367. These are taken in respective heads in IIG Main Financial Statements.

16. Interest income amounting to Rs.34,75,991 earned on SDR during the year ended March 31,2021 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. Previous year's figures have been regrouped/reclassified wherever necessary.

As per our Report of even dated.

For P. B. SHETTY & CO.
Chartered Accountants
Firm registration number – 110102W

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

Brijesh Shetty
Partner
Membership number – 131490

Place: Mumbai
Dated: 04 August, 2021

For INDIAN INSTITUTE OF GEOMAGNETISM

IN-CHARGE ACCOUNTS

THE DIRECTOR FOR TRUSTEE

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 2021 तक का तुलन पत्र / BALANCE SHEET AS AT 31ST MARCH 2021

(राशि / Amount – रु./Rs.)

पूंजिगत निधि एवं देयताएं / CAPITAL FUND AND LIABILITIES	अनुसूची Schedule	वर्तमान वर्ष / Current Year as on 31/03/2021 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2020 के अनुसार
पूंजिगत निधि / CAPITAL FUND	1	6815,18,078	6633,88,703
आरक्षित एवं अधिशेष / RESERVES AND SURPLUS	2	-	-
विशिष्ट प्रयोजनों / अक्षय निधियां / EARMARKED / ENDOWMENT FUNDS	3	659,66,366	617,97,327
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	409,06,786	336,20,064
कुल / TOTAL		**7883,91,230**	**7588,06,094**
परिसम्पति / ASSETS			
अचल परिसम्पति / FIXED ASSETS	8	5909,51,510	5796,45,582
निवेश - अक्षय एवं विशिष्ट प्रयोजनों की निधियों से प्राप्त INVESTMENTS – FROM EARMARKED / ENDOWMENT FUNDS	9	659,66,366	616,18,881
निवेश - अन्य / INVESTMENTS – OTHERS	10	2,750	2,750
वर्तमान परिसम्पति, ऋण, अग्रिम इत्यादि CURRENT ASSETS, LOANS, ADVANCES ETC.	11	1314,70,604	1175,38,881
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		**7883,91,230**	**7588,06,094**

खातों के साथ जुड़ी टिप्पणियां देखें - अनुसूची 24

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

कृते पी. बी. शेट्टी एन्ड कंपनी
For P.B.SHETTY & CO.
चार्टर्ड अकाउंटेंट / Chartered Accountants
फर्म सं./Firm No.110102W

ब्रिजेश शेट्टी/ Brijesh Shetty
सदस्यता क्र/Membership No. : 131490
भागीदार / Partner

स्थान / Place : मुंबई / Mumbai
दिनांक / Dated : 04/08/2021

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 भारतीय भूचुम्बकत्व संस्थान
For INDIAN INSTITUTE OF GEOMAGNETISM

लेखा प्रभारी
IN CHARGE ACCOUNTS

निदेशक, कृते न्यासी
THE DIRECTOR FOR TRUSTEE

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 2021 तक का आय तथा व्यय खाता
INCOME AND EXPENDITURE ACCOUNT FOR THE PERIOD / YEAR ENDED 31ST MARCH 2021

(राशि / Amount – रु./Rs.)

आय / INCOME	अनुसूची Schedule	वर्तमान वर्ष / Current Year as on 31/03/2021 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2020 के अनुसार
बिक्री / सेवाओं से आय / Income from Sales / Services	12	0	0
वृत्ति / अनुदान / Grants / Subsidies	13	3981,00,000	4156,35,000
शुल्क / अभिदान / Fees / Subscriptions	14	4,38,072	5,42,891
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	54,724	3,70,526
परिसम्पति की बिक्री होने पर अन्य आय / मुनाफे Other Income / Profit on sale of assets	18	32,52,572	54,47,476
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)		**4018,45,368**	**4219,95,893**

K.P.Shetty

P.B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

D.S.Ram

Cont...II

(राशि / Amount – रू./Rs.)

व्यय / EXPENDITURE	अनुसूची	वर्तमान वर्ष / Current Year as	पिछला वर्ष / Previous Year as
स्थापना खर्च / Establishment Expenses	20	2946,33,036	3086,14,836
अन्य प्रशासनिक खर्च इत्यादि / Other Administrative Expenses etc.	21	793,74,954	1060,39,050
वृति, अनुदान इत्यादि पर खर्च / Expenditure on Grants, Subsidies etc.	22	3,45,829	8,92,800
ब्याज / Interest	23	-	-
परिसम्पति की बिक्री होने पर घाटा / Loss on sale of Asset			11,63,120
अवमूल्यन / Depreciation	8	733,62,174	604,32,941
कुल / TOTAL (B)		**4477,15,993**	**4771,42,747**
व्यय से अधिक आय की शेष राशि (A-B) **Balance being excess of Income over Expenditure (A-B)**		**(458,70,625)**	**(551,46,854)**
विशेष आरक्षित में स्थानांतरण (प्रत्येक बताएं) / Transfer to Special Reserve (Specify each)			
आय तथा व्यय खाते में / से स्थानांतरण / Transfer to / from Income			0
समग्र / पूजिगत निधि में लिए गए घाटे की शेषराशि **Balance being deficit carried to Corpus / Capital Fund**		**(458,70,625)**	**(551,46,854)**

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 पी. बी. शेट्टी एन्ड कंपनी
For P.B.SHETTY & CO.
कर्म सं./Firm No.110102W

ब्रिजेश शेट्टी/ Brijesh Shetty
सदस्यता क्र/Membership No. : 131490
भागीदार / Partner

स्थान / Place : मुंबई / Mumbai
दिनांक / Dated : 04/08/2021

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

लेखा प्रभारी
IN CHARGE ACCOUNTS

निदेशक, कृते न्यासी
THE DIRECTOR FOR TRUSTEE

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 2021 तक तुलन पत्र के विभिन्न अनुसूची के भाग

SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2021

(राशि / Amount – रू. / Rs.)

अनुसूची 1 / SCHEDULE 1 : पूंजिगत निधि / CAPITAL FUND		वर्तमान वर्ष / Current Year as on 31/03/2021 के अनुसार	पिछला वर्ष /Previous Year as on 31/03/2020 के अनुसार
वर्ष के आरंभ में शेष राशि / Balance as at the beginning of the year		6633,88,703	6407.29,557
जोड़े : Add :	पूंजिगत निधि हेतु अंशदान Contributions towards capital Fund	640,00,000	778,06,000
जोड़े : Add :	आय तथा व्यय खाता से स्थानांनतरित निवल आय की शेषराशि Balance of net income transferred from the Income and Expenditure Account	(458,70,625)	(551,46,854)
वर्ष के अंत में शेषराशि / BALANCE AS AT THE END OF THE YEAR		**6815,18,078**	**6633,88,703**

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
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Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2021
(राशि / Amount – रू. / Rs.)

अनुसूची 2 : आरक्षित एवं अधिशेष / SCHEDULE 2 : RESERVES AND SURPLUS	वर्तमान वर्ष / Current Year as on 31/03/2021 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2020 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 31/03/2021 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2020 के अनुसार
IIG PENSION FUND	659,66,366	617,97,327
कुल / TOTAL	659,66,366	617,97,327

अनुसूची 4 : सुरक्षित ऋण एवं उधारी SCHEDULE 4 : SECURED LOANS AND BORROWINGS	वर्तमान वर्ष / Current Year as on 31/03/2021 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2020 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 31/03/2021 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2020 के अनुसार
	NIL	NIL
कुल / TOTAL	NIL	NIL

अनुसूची 6 : आस्थगित उधार देयताएं / SCHEDULE 6 : DEFERRED CREDIT LIABILITIES	वर्तमान वर्ष / Current Year as on 31/03/2021 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2020 के अनुसार
	NIL	NIL
कुल / TOTAL	NIL	NIL

P. B. SHETTY & CO. MUMBAI

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 2021 तक तुलन पत्र के विभिन्न अनुसूची के भाग

SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2021

(राशि / Amount – रू. / Rs.)

अनुसूची 7 - वर्तमान देयताएं एवं प्रावधान			वर्तमान वर्ष / Current Year as on 31/03/2021 के अनुसार	पिछला वर्ष /Previous Year as on 31/03/2020 के अनुसार
A. वर्तमान देयताएं / CURRENT LIABILITIES				
1	स्वीकृत बिल / Acceptances		-	-
2	विविध लेनदार / Sundry Creditors:			
	a)	सामग्री हेतु / For Goods	-	-
	b)	अन्य / Others	30,66,435	52,77,137
3	प्रतिभूति जमा देय / Security Deposit Payable		43,64,932	44,26,919
4	उपार्जित किन्तु अप्राप्य ब्याज / Interest accrued but not due			
	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	18,49,472	5,99,760
6	अन्य वर्तमान देयताएं / Other current Liabilities		3475991	31,57,540
	प्रतिधारण राशि / Retention money		-	-
कुल / TOTAL (A)			**12756830**	**134,61,357**
B. प्रावधान /PROVISIONS				
1	जीपीएफ ब्याज पर घाटा / Loss on interest for GPF		-	-
2	आनुतोषिक / Gratuity		7999398	65,75,690
3	सेवानिवृति / निवृति वेतन / Superannuation / Pension		12453175	82,73,069
4	संचित छुट्टी नकदीकारण / Accumulated Leave Encashment		7093483	47,06,048
5	प्रयोगशाला उपकरण के लिए प्रावधान Provision for Lab Equipment		603900	6,03,900
6	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)			**28149956**	**201,58,707**
कुल / TOTAL (A + B)			**40906786**	**33620064**

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
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Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2021 तक तुलन पत्र के विभिन्न अनुसूची के भाग
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2021

(राशि / Amount – रू. / Rs.)

अनुसूची /SCHEDULE 8 :	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 01/04/2020	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 31/3/2021	वर्ष के आरंभ में लागत / मूल्य /As at the beginning of the year 01/04/2020	वर्ष के दौरान परिवर्धन / On additions during the year	वर्ष 2020-21 हेतु / For the year 2020-21	वर्ष के दौरान कटौती पर / On deductions during the year	वर्ष के अंत तक - कुल / Total up to the year – end 31/03/2021	वर्तमान वर्ष के अंत तक / As at the current year-end 31/03/2021	पिछला वर्ष के अंत तक /As at the previous year-end 31/03/2020
A. अचल परिसम्पति / 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	564,66,353	-	-	564,66,353	225,10,538	-	-	-	225,10,538	339,55,815	339,55,815
2 भवन-निर्माण / BUILDINGS:											
a) पूर्ण स्वामित्व भूमि पर/ On freehold Land	2724,02,346	55,69,368	-	2779,71,714	1177,08,710	77,11,331	2,78,468	-	1256,98,509	1522,73,205	1546,93,636
b) पट्टे की भूमि पर / On	2538,29,342	1,25,492	-	2539,54,834	1131,40,618	70,28,161	6,275	-	1201,75,054	1337,79,780	1406,88,724
d) स्वामित्व आवास/परिसर /	-		-	-	-	-	-	-	-	-	-
e) भूमि पर अधिरचना इकाई से	-		-	-	-	-	-	-	-	-	-
3 प्रयोगशाला उपकरण / LABORATORY EQUIPMENT	5858,14,513	178,03,027	-	6036,17,540	4162,60,088	254,33,164	12,98,127		4429,91,379	1606,26,161	1695,54,425
4 मोटर कार वाहन / MOTOR CAR VEHICLE	58,69,807		-	58,69,807	46,25,276	-	1,86,680	-	48,11,956	10,57,851	12,44,531
5 फर्नीचर, मरम्मती / FURNITURE, FIXTURES	310,89,058	2,24,635	-	313,13,693	206,28,711	14,859	10,46,035		216,89,605	96,24,088	104,60,347
6 कार्यालय उपकरण / OFFICE EQUIPMENT	353,18,599	31,51,319	-	384,69,918	240,86,663	47,545	16,84,790	7,131	258,26,129	126,43,789	112,31,936
7 कंप्यूटर तथा सॉफ्टवेयर / COMPUTER & SOFTWARE	1620,90,509	218,94,087	-	1839,84,596	1467,01,243	61,55,706	183,84,734		1712,41,683	127,42,913	153,89,266
9 विद्युत अधिष्ठापन / ELECTRIC INSTALLATIOS	45,20,991		-	45,20,991	37,96,181		1,08,722	-	39,04,903	6,15,088	7,24,810
10 पुस्तकालय किताबें / LIBRARY BOOKS	604,48,573	49,08,075	-	653,54,648	529,55,369	39,77,577		-	569,32,946	84,21,702	74,91,203
वर्तमान वर्ष का कुल / TOTAL OF CURRENT YEAR(A)	14713,41,457	536,76,003	-	15250,17,460	9224,13,397	503,68,343	229,93,831	7,131	9957,82,702	5292,34,758	5489,28,059
PREVIOUS YEAR	14463,92,081	369,06,749	119,57,374	14713,41,456	8730,28,592	78,66,507	525,66,434	110,48,236	9224,13,397	5489,28,059	5733,63,389
B. पूंजीगत कार्य जारी / CAPITAL WORK IN PROGRESS	307,17,523	370,66,593	60,67,364	617,16,752					-	617,16,752	307,17,523
					TOTAL					5909,51,510	5796,45,582

(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)

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

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

अनुसूची / SCHEDULE – 8A(1a)

वर्ष समाप्ति 31.03.2021 / YEAR ENDING 31.03.2021

पूर्व स्वामित्व वाली भूमि / FREEHOLD LAND

31/03/20 को / AS ON 31/03/20	विवरण / PARTICULARS	31/03/21 को / AS ON 31/03/21
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	ई.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 31.03.2021 / YEAR ENDED 31-03-2021

भूमि एवं भवन निर्माण /Land And Building

स्थिर परिसंपतियां - अचल संपति (पूर्ण स्वामित्व की भूमि पर)

Fixed Assests - Immovable Property (On Freehold land)

अनुसूची / Schedule : 8A 2(a)

अनु. क्र. Sr. No	परिसम्पति का विवरण Particulars Of Assests	सकल खड / Gross Block				अवमूल्यन / Depreciation					निवल खड / Net Block	
		31.03.2020 को लागत/मूल्य Cost/Value at 31-03-20	वर्ष के दौरान परिवर्धन Additions during the year	वर्ष के दौरान कटौती Deduction during the year	लागत / मूल्य Cost/Value at 31-03-21	01.04.20 पर मूल्य /On Value 01/04/20	वर्ष के दौरान परिवर्धन पर / On addition during the year	वर्ष 2020-21 हेतु / For the year 2020-21	कटौती पर / On deduction	वर्ष के दौरान कटौती पर / Deduction during the year	31.03.21 तक Upto 31-03-21	31-03-20 को लागत / Cost as at 31-03-20
1	भवन-निर्माण - पूंजीगत कार्य Building - Capital Works	107,30,610	-	-	107,30,610	70,65,853	-	1,83,238	-	72,49,091	34,81,519	36,64,757
2	भवन-निर्माण -बेलापुर क्वाटर्स Building - Belapur Quarters	209,36,622	-	-	209,36,622	138,71,772	-	3,53,243	-	142,25,015	67,11,607	70,64,850
3	भवन-निर्माण - गुलमर्ग / Building - Gulmarg	1,70,337	-	-	1,70,337	1,53,203	-	857	-	1,54,060	16,277	17,134
4	भवन-निर्माण - नागपुर / Building - Nagpur	23,41,689	-	-	23,41,689	13,33,179	-	50,426	-	13,83,605	9,58,084	10,08,510
5	भवन-निर्माण - अलिबाग मावेक्स Building - Alibag Mavacs	2,25,000	16,69,243	-	18,94,243	1,76,841	83,462	2,408	-	2,62,711	16,31,532	48,159
6	भवन-निर्माण - पूर्वनिर्मित संरचना Building - Prefabricated Structure	1,55,235	-	-	1,55,235	1,28,539	-	1,335	-	1,29,874	25,361	26,696
7	भवन-निर्माण - अंतरिक्ष विज्ञान प्रयो., कोल्हापुर Building - Space Sci.Lab. Kolhapur	1,53,338	-	-	1,53,338	1,20,516	-	1,641	-	1,22,157	31,181	32,822
8	भवन-निर्माण - विल्टन हॉल Building - Wilton Hall	5,31,375	-	-	5,31,375	4,87,417	-	2,198	-	4,89,615	41,760	43,958
9	भवन-निर्माण - पी.आर. रडार टावर कोल्हापुर Building - P.R. Radar Tower Kolhapur	9,72,012	-	-	9,72,012	6,61,904	-	15,505	-	6,77,409	2,94,603	3,10,108
10	भवन-निर्माण - पुदुचेरी/Building-Puducherry	71,88,726	-	-	71,88,726	20,31,920	-	2,57,840	-	22,89,760	48,98,966	51,56,806
11	भवन तथा क्वाटर्स - ईजीआरएल Building & Quarters - EGRL	90,47,394	-	-	90,47,394	56,75,379	-	1,68,601	-	58,43,980	32,03,414	33,72,015

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P.B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

अनु. क्र Sr. No	परिसम्पति का विवरण Particulars Of Assests	सकल खंड / Gross Block: 31.03.2020 को लागत/मूल्य Cost/Value at 31-03-20	वर्ष के दौरान परिवर्धन Additions during the year	वर्ष के दौरान कटौती Deduction during the year	लागत / मूल्य Cost/Value at 31-03-21	अवमूल्यन / Depreciation: 01.04.20 पर मूल्य /On Value 01/04/20	वर्ष के दौरान परिवर्धन पर / On addition during the year	वर्ष 2020-21 हेतु / For the year 2020-21	कटौती पर / On deduction	वर्ष के दौरान कटौती पर / Deduction during the year	निवल खंड / Net Block: 31.03.21 तक Upto 31-03-21	31-03-20 को लागत / Cost as at 31-03-20
12	भवन-निर्माण - अलिबाग क्वार्टर्स Building - Alibag Quarters	85,42,804	9,30,845	-	94,73,649	53,66,491	46,542	1,58,816	-	55,71,849	39,01,800	31,76,313
13	भवन-निर्माण - विशाखापट्टनम Building - Vishakhapatnam	25,42,924	-	-	25,42,924	7,71,334	-	88,580	-	8,59,914	16,83,010	17,71,590
14	भवन-निर्माण - जयपुर / Building - Jaipur	57,43,532	-	-	57,43,532	35,60,518	-	1,09,151	-	36,69,669	20,73,863	21,83,014
15	भवन-निर्माण - जीआरएल इलाहाबाद Building - GRL Allahabad	877,42,986	30,000	-	877,72,986	397,40,518	1,500	24,00,123	-	421,42,141	456,30,845	480,02,468
16	भवन-निर्माण - राजकोट / Building - Rajkot	51,28,110	-	-	51,28,110	23,60,150	-	1,38,398	-	24,98,548	26,29,562	27,67,960
17	भवन-निर्माण - शिलॉंग (बाहरी दीवार) Building - Shillong	113,64,669	-	-	113,64,669	38,64,252	-	3,75,021	-	42,39,273	71,25,396	75,00,417
18	भवन-निर्माण, अतिथि गृह, हॉस्टेल - ईजीआरएल Building, Guest House, Hostel-EGRL	487,19,083		-	487,19,083	215,94,875		13,32,857	-	229,27,732	257,91,351	271,24,208
19	भवन-निर्माण - सिल्चर / Building - Silchar	192,28,889	-	-	192,28,889	55,04,091	-	6,86,240	-	61,90,331	130,38,558	137,24,798
20	भवन-निर्माण - कुलाबा (डब्ल्यूडीसी)/ Building-Colaba (WDC)	12,32,611	29,39,280	-	41,71,891	3,43,779	1,46,964	44,442	-	5,35,185	36,36,665	8,88,832
21	भवन-निर्माण पोर्टब्लेयर / Building-Portblair	297,04,400	-	-	297,04,400	28,96,179	-	13,40,411	-	42,36,590	254,67,810	268,08,221
कुल / TOTAL		2724,02,346	55,69,368	-	2779,71,714	1177,08,710	2,78,468	77,11,331	-	1256,98,509	1522,73,164	1546,93,636

K. R. Salu

भारतीय भूचुम्बकत्व संस्थान INDIAN INSTITUTE OF GEOMAGNETISM

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI
वर्ष समाप्ति 31.03.2021 / YEAR ENDED 31-03-2021

भूमि एवं भवन निर्माण /Land And Building

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

Fixed Assests - Immovable Property (On Leasehold Land)

अनुसूची / SCHEDULE – 8A(1)

अनु. क्र. Sr .N	परिसम्पति का विवरण Particulars Of Assests	सकल खंड / Gross Block				मूल्यह्रास / Depreciation					निवल खंड / Net Block	
		31.03.2021 को लागत/मूल्य Cost/Value at 31-03-20	वर्ष के दौरान परिवर्धन Additions during the year	वर्ष के दौरान कटौती Deduction during the year	लागत / मूल्य Cost/Value at 31-03-21	01.04.20 पर मूल्य /On Value 01/04/20	वर्ष के दौरान परिवर्धन पर / On addition during the	वर्ष 2020-21 हेतु / For the year 2020-21	कटौती पर / On deduction	वर्ष के दौरान कटौती पर / Deduction during the year	31.03.21 तक Upto 31-03-21	31-03-20 को लागत / Cost as at 31-03-20
1	भवन-निर्माण - पनवेल Building - Panvel	803,15,582	-	-	803,15,582	476,77,199	-	16,31,919	-	493,09,118	310,06,464	326,38,383
2	रिसर्च स्कॉलर हॉस्टेल Research Scholar Hostel	188,80,074	-	-	188,80,074	99,84,700	-	4,44,769	-	104,29,469	84,50,605	88,95,374
3	अतिथि गृह पनवेल Guest House at Panvel	359,43,070	-	-	359,43,070	171,56,582	-	9,39,324	-	180,95,906	178,47,164	187,86,488
4	भवन-निर्माण - पनवेल में सभागृह तथा भोजनालय Building - Auditorium & Canteen at Panvel	758,76,172	-	-	758,76,172	252,70,411	-	25,30,288	-	278,00,699	480,75,473	506,05,761
5	भवन-निर्माण - निदेशक बंगला, छोटे फ्लैट आवास कर्मचारी निवास स्थान / Building Director Bunglow, Flatlets & Staff Quarters	428,14,444	1,25,492	-	429,39,936	130,51,726	6,275	14,81,861	-	145,39,862	284,00,074	297,62,718
कुल / TOTAL		**2538,29,342**	**1,25,492**	-	**2539,54,834**	**1131,40,618**	**6,275**	**70,28,161**	-	**1201,75,054**	**1337,79,780**	**1406,88,724**

K. R. Bahl

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

भारतीय भूचुम्बकत्व संस्थान / INDIAN INSTITUTE OF GEOMAGNETISM
न्यू पनवेल, नवी मुंबई / NEW PANVEL NAVI MUMBAI
वर्ष समाप्ति 31.03.2021 / YEAR ENDED 31-03-2021

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	01/04/20 को / AS ON 01/04/20	वर्ष के दौरान वृद्धि Additions during the year	वर्ष के दौरान कटौती Deduction during the year	31/03/21को / AS ON 31/03/21
पूंजीगत कार्य जारी - नागपुर Capital work in progress – Nagpur	8,98,999	-	-	8,98,999
पूंजीगत कार्य जारी - राजकोट (सीपीडब्लूडी) Capital work in progress – Rajkot (CPWD)	1,87,605	-	-	1,87,605
पूंजीगत कार्य जारी - अलिबाग (सीपीडब्लूडी) Capital work in progress – Alibag (CPWD)	99,11,085	198,81,112	29,58,492	268,33,705
पूंजीगत कार्य जारी - इलाहाबाद Capital work in progress – Allahabad	44,100	18,42,595	44,100	18,42,595
पूंजीगत कार्य जारी - ईजीआरएल Capital work in progress – EGRL	-	24,92,000	-	24,92,000
पूंजीगत कार्य जारी - पोर्टब्लेयर Capital work in progress – Portblair	-	32,22,325	-	32,22,325
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	85,37,099	66,20,247	1,25,492	150,31,854
पूंजीगत कार्य जारी - छात्रावास / Capital Work in progress - Hostel	-	-	-	-
पूंजीगत कार्य जारी - सिलचर / Capital Work in progress - Silchar	12,72,009	-	-	12,72,009
पूंजीगत कार्य जारी - कुलाबा Capital Work in progress - Colaba	39,63,596	27,06,004	29,39,280	37,30,320
पूंजीगत कार्य जारी - शिलॉंग / Capital Work in progress - Shillong	-	3,02,310	-	3,02,310
कुल / TOTAL	**248,14,493**	**370,66,593**	**60,67,364**	**558,13,722**

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

वर्ष समाप्ति 31.03.2021 / YEAR ENDED 31-03-2021

अनुसूची / SCHEDULE – 8B

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

विवरण / Particulars	01.04.2020 को As on 01.04.2020	वर्ष के दौरान वृद्धि Additions during the year	वर्ष के दौरान कटौती Deduction during the year	31.03.2021 को As on 31-03-21
प्रयोगशाला उपकरण हेतु अग्रिम Advances for Laboratory Equipment (Exp.)	59,03,030	-	-	59,03,030
उपांतिक राशि / Margin Money	-	-	-	-
कुल / TOTAL	**59,03,030**	**-**	**-**	**59,03,030**

पूंजीगत कार्य में प्रगति / CAPITAL WORKS IN PROGRESS

A) अचल संपतियों हेतु अग्रिम ADVANCES FOR IMMOVABLE PROPERTIES	558,13,722
B) चल संपतियों हेतु अग्रिम ADVANCES FOR MOVABLE PROPERTIES	59,03,030
कुल / TOTAL	**617,16,752**

K.R.Salvi

P.B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

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
ame Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 21
31 मार्च 2021 तक तुलन पत्र के विभिन्न अनुसूची के भाग
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2021

(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 31/03/2021 के अनुसार"	"पिछला वर्ष / Previous Year as on 31/03/2020 के अनुसार"
INVESTMENT-IIG PENSION FUND	659,66,366	616,18,881
कुल / TOTAL	**659,66,366**	**616,18,881**

अनुसूची / SHEDULE 10 – निवेश - अन्य / INVESTMENTS – OTHERS		वर्तमान वर्ष / Current Year as on 31/03/2021 के अनुसार	पिछला वर्ष / Previous Year as on 31/03/2020 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 2021 तक तुलन पत्र के भाग के रूप में अनुसूची
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2021

(राशि / Amount – रू./Rs.)

अनुसूची 11: वर्तमान परिसंपत्तियां, ऋण, अग्रिम आदि। SCHEDULE 11 : CURRENT ASSETS, LOANS, ADVANCES ETC.			Current Year as at 31st March-2021	Previous Year as at 31st March-2020
क / A. वर्तमान परिसंपत्तियां / CURRENT ASSESTS				
1)	सामग्री सूची / Inventories			
	क/a	भंडार और अतिरिक्त सामान (भंडार में अधिशेष / Stores and spares (closing bal. in stores)	341259	430439
	ख/	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	2,00,231	49,956
	ख/	अन्य / Others		
	ग/c	श्रीमती निरुपमा तिवारी / Smt.Nirupama Tiwari	-	-
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	366,82,580	113,13,608
		चालू खातों पर - बैंक ऑफ इंडिया, पनवेल / On Current Accounts – Bank of India, Panvel (SERB)	2,359	1,617
		यूनियन बैंक ऑफ इंडिया, पनवेल /Union Bank of India, Panvel	23,28,261	11,82,580
		बैंक ऑफ इंडिया, एलसी खाता 361 /Bank of India, LC A/c. 361	243,70,600	144,59,274
		– Bank of India -IIG PENSION A/c	-	1,78,446
		उपकरणों की खरीद हेतु एसडीआर / SDR against purchase of	334,84,000	352,79,000
5)	एसडीआर में निवेश / Investment in SDR		-	-
6)	फ्रैंकिंग मशीन के लिए अग्रिम / Advance for Franking Machine (Stamp in		41,079	14,174
7)	पूर्वदत्त व्यय / Prepaid Expenses		-	-
	कुल (क) TOTAL (A)		974,89,385	629,48,111

K.R.Kalu

P.B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

INDIAN INSTITUTE OF GEOMAGNETISM

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
FORM OF FINANCIAL STATEMENTS (NON-PROFIT ORGANISATIONS)
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Name Of Entity : Indian Institute Of Geomagnetism, New Panvel, Navi Mumbai – 410 218.
31 मार्च 2021 तक तुलनपत्र के भाग के रूप में अनुसूची
SCHEDULE FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2021

(राशि / Amount – रु./Rs.)

अनुसूची 11: वर्तमान परिसंपतियां, ऋण, अग्रिम आदि। SCHEDULE 11 : CURRENT ASSETS, LOANS, ADVANCES ETC.			Current Year as at 31st March-2021	Previous Year as at 31st March-2020
ख/B. ऋण, अग्रिम एवं अन्य परिसंपतियां LOANS, ADVANCES AND OTHER ASSETS				
1)		ऋण / Loans		
	क/a	कर्मचारी / Staff	49,66,344	45,02,736
	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	30,24,293	238,94,387
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/	पूर्व भुगतान / Pre-payments	-	-
	ग/c	अन्य / Others	20,38,912	20,38,912
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	2,15,692	6,87,225
4)		प्राप्य दावे / Claims Receivable	-	-
5)		प्राप्य टीडीएस, एसजीएसटी, सीजीएसटी और आयजीएसटी, एसडीआर पर ब्याज प्राप्य / TDS /TCS, SGST, CGST & IGST RECEIVABLE	237,35,978	234,67,510
कुल (बी) / TOTAL (B)			339,81,219	545,90,770
कुल (ए + बी) / TOTAL (A + B)			**1314,70,604**	**1175,38,881**

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

वर्ष समाप्ति 31.03.2021 / YEAR ENDED 31-03-2021

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	81,054	1,00,203	1,00,203	81,054
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	1,76,913	1,68,120	1,76,913	1,68,120
विद्युतीय सामान और इलेक्ट्रोनिक पुर्जे / Electrical Goods & Electronic Components	1,32,966	1,25,095	24,637	2,33,424
छायांकन सामान / Photo Goods	39,506	39,506	39,506	39,506
कुल / TOTAL	**4,30,439**	**4,32,924**	**3,41,259**	**5,22,104**

K.R.Salvi

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

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

अनुसूची / SCHEDULE – 11A(2b)

वर्ष समाप्ति 31.03.2021 / YEAR ENDED 31-03-2021

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

AS ON 31/03/20 तक RS. PS.	विवरण / PARTICULARS	AS ON 31/03/21 तक 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
16,510	एमएसईबी और एमएसईबीडी,नागपुर के पास जमाराशि सुरक्षा / Deposit Security Deposit MSEB & MSED, Nagpur	16,510
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	8,59,900
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
20,38,912	**कुल / TOTAL**	**20,38,912**

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

अनुसूची / SCHEDULE 11B(1)

वर्ष समाप्ति 31.03.2021 / YEAR ENDED 31-03-2021

कर्मचारीयों को अग्रिम / ADVANCE TO STAFF

AS ON 31/03/20 तक	PARTICULARS	AS ON 31/03/21 तक
RS. PS.		RS. PS.
5,29,484	यात्रा भत्ता / Travelling Allowance	1,88,292
2,78,146	छुट्टी यात्रा रियायत Leave travel concession	1,57,637
-	स्कूटर / Scooter	-
-	आवास निर्माण / House Building	-
1,14,511	विदेशी टी. ए. / Foreign T.A.	1,14,511
500	कंप्यूटर / Computer	1,46,000
52,080	मोटर गाड़ी / Motor Car	4,000
31,29,904	कठिन कर्तव्य (ड्यूटी) भत्ता / Hard Duty Allowance	43,55,904
68,111	स्थानांतरण पर टीए / TA on Transfer	-
3,30,000	चिकित्सा अग्रिम / Medical Advance	-
45,02,736	**कुल / TOTAL**	**49,66,344**

K.R.Sahi

P.B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
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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 2021 के आय तथा व्यय के भाग के रूप में अनुसूची
SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2021

(राशि / Amount – रू./Rs.)

अनुसूची 12: बिक्री / सेवाओं से आय SCHEDULE 12 : INCOME FROM SALES / SERVICES	31.03.2021 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2021	31.03.2020 पिछला वर्ष को समाप्त / Previous Year as on 31/03/2020
	शून्य / NIL	शून्य / NIL
कुल /TOTAL	शून्य / NIL	शून्य / NIL

	अनुसूची 13: अनुदान / सब्सिडी(अपरिवर्तनीय अनुदान और अनुवृत्ति प्राप्त) / SCHEDULE 13 : GRANTS/SUBSIDIES (Irrevocable Grants & Subsidies Received)	31.03.2021 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2021		31.03.2020 पिछला वर्ष को समाप्त / Previous Year as on 31/03/2020	
1)	केंद्र सरकार - विज्ञान और प्रौद्योगिकी विभाग से प्राप्त /Central Government - Received from Department of Science & Technology	4621,00,000		4934,41,000	
	घटाया : सहायता अनुदान पूंजी का पूंजी खाते में स्थानांतरण किया गय / Less : Grant-in-Aid Capital Transferred to Capital Account	640,00,000	3981,00,000	778,06,000	4156,35,000
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		3981,00,000		4156,35,000

K.R.Salve

भारतीय भूचुम्बकत्व संस्थान INDIAN INSTITUTE OF GEOMAGNETISM Navi Mumbai

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

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 2021 तक तुलन पत्र के भाग के रूप में अनुसूची
SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2021

(राशि / Amount – रू./Rs.)

अनुसूची 14: फीस / अंशदान / SCHEDULE 14 : FEES / SUBSCRIPTION		31.03.2021 वर्तमान वर्ष को समाप्त / Current Year Ended 31st March-2021	31.03.2020 वर्तमान वर्ष को समाप्त / Current Year Ended 31st March-2020
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	18,412	18,967
	ग/c लाइसेंस शुल्क-आयआयजी / License fees – आयआयजी IIG	4,19,660	5,23,924
कुल / TOTAL		**4,38,072**	**5,42,891**

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

P.B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

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

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31 मार्च 2021 तक आय तथा व्यय के विभिन्न अनुसूची के भाग

SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2021

(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)	**31.03.2021 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2021**	**31.03.2020 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2020**
	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)	**31.03.2021 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2021**	**31.03.2020 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2020**
	शून्य / NIL	**शून्य / NIL**
कुल / TOTAL	**शून्य / NIL**	**शून्य / NIL**

K.R.Sahu

भारतीय भूचुम्बकत्व संस्थान IIG INDIAN INSTITUTE OF GEOMAGNETISM New Panvel, Navi Mumbai 410218

P.B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
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SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2021

अनुसूची 17: ब्याज प्राप्त / SCHEDULE 17 : INTEREST EARNED			31.03.2021 वर्तमान वर्ष को समाप्त / Current Year Ended 31st March-2021	31.03.2020 पिछला वर्ष को समाप्त / Previous Year Ended 31st March-2020
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	-	-
	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	-	-
3)		ऋण पर / On Loans	-	-
	क/a	**कर्मचारी वर्ग / Staff Members**	54,724	3,70,526
	ख/b	अन्य / Others		-
4)		देनदार और अन्य प्राप्य पर ब्याज / Interest on Debtors and Other Receivables	0	-
		कुल / TOTAL	54,724	3,70,526
टिपपणी : स्रोत पर कर की कटौती दर्शाई जाए / Note : Tax deducted at source to be indicated				

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
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SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2021

(राशि / Amount – रू./Rs.)

अनुसूची 18: अन्य आय / SCHEDULE 18 : OTHER INCOME			31.03.2021 वर्तमान वर्ष को समाप्त /Current Year Ended 31st March-2021	31.03.2020 पिछला वर्ष को समाप्त /Previous Year Ended 31st March-2020
1)	परिसंपत्तियों की बिक्री / निपटान पर लाभ: / Profit on Sale / disposal of Assets:			
	क/a	स्वामित्व वाली परिसंपत्ति / Owned assets	0	
	ख/b	अनुदान से प्राप्त या मुफ्त प्राप्त परिसंपत्ति / Assets acquired out of grants, or received free of cost	0	-
2)	परियोजना से आय / Income from Project		-	2,50,062
3)	डेटा की बिक्री, पीपीएम और उपकरणों के अंशांकन / Sale of data, PPM & Caliberation of equipment		4,10,770	34,83,327
4)	विविध आय / Miscellaneous Income			
	क/a	छात्रावास / अतिथि गृह से आय / Income from hostel / Guest house	3,67,080	5,05,610
	ख/b	विविध प्राप्तियां / Miscellaneous receipt	24,74,722	12,08,477
	ग/c	वापस न ली गई जमा राशि / Un-claimed Deposit		-
कुल / TOTAL			**32,52,572**	**54,47,476**

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SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2021

(राशि / Amount – रु./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	31.03.2021 वर्तमान वर्ष को समाप्त / Current Year as on 31/03/2021	31.03.2020 पिछला वर्ष को समाप्त / Previous Year as on 31/03/2020
	शून्य / NIL	शून्य / NIL
कुल / TOTAL	शून्य / NIL	शून्य / NIL

अनुसूची 20: स्थापना के व्यय / SCHEDULE 20 : ESTTABLISHMENT EXPENSES		31.03.2021 वर्तमान वर्ष को समाप्त / Current Year Ended 31st March-2021	31.03.2020 पिछला वर्ष को समाप्त / Previous Year Ended 31st March-2020
क/a	वेतन / Salaries	2190,72,662	2287,48,406
ख/b	भते और बोनस / Allowances and Bonus	28,10,713	39,26,812
ग/c	सीपीएफ में नियोक्ता का अंशदान / Employers Contribution to CPF	-	29,720
घ/d)	अन्य निधि में नियोक्ता का अंशदान (निर्दिष्ट करें) - आईआईजी पेंशन खाता / Employers contribution to Other Fund (specify) – IIG Pension A/C	377,11,766	411,12,428
e)	परोपकारी निधि के लिए नियोक्ता का अंशदान / Employers Contribution to Benevolent Fund	-	-
च/f)	कर्मचारी सेवानिवृति और टर्मिनल लाभ पर व्यय / Expenses on Employees Retirement and Terminal Benefits	248,32,070	226,29,262
छ/g)	अन्य (निर्दिष्ट करें) (चिकित्सा व्यय) / Others (specify) (Medical Expenses)	37,36,490	38,49,861
ज/h)	मनोरंजन क्लब में नियोक्ता का अंशदान / Employers contribution to Recreation Club	74,400	80,200
i)	नई अंशदायी पेंशन निधि में नियोक्ताओं का योगदान / Employers contribution to New Contributory Pension Fund	63,94,935	82,38,147
ञ/j)	कर्मचारी मृत्यु लाभ पर व्यय / Expenses on Employees Death Benefits	-	-
कुल / TOTAL		2946,33,036	3086,14,836

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

अनुसूची /SCHEDULE – 20A

31/03/2021 को समाप्त वर्ष / YEAR ENDING 31/03/2021

A. वेतन / SALARIES

विवरण / PARTICULARS	31.03.2021 तक AS ON 31/03/21 रू./RS. पै./PS.
वेतन तथा भत्ते / Pay and Allowances	2045,81,652
शोध छात्रों को रिसर्च छात्रवृत्ति / वजीफा / Research Scholarship / Stipend to Res. students	144,91,010
कुल / TOTAL	**2190,72,662**

K.R.Salvi

P. B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

भारतीय भूचुम्बकत्व संस्थान
INDIAN INSTITUTE OF GEOMAGNETISM

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

अनुसूची / SCHEDULE – 20B

31/03/2021 को समाप्त वर्ष / YEAR ENDING 31/03/2021

भत्ते तथा बोनस / ALLOWANCES & BONUS

विवरण / PARTICULARS	31.03.2021 तक AS ON 31/03/21
	रू./RS. पै./PS.
मानदेय / Honorarium	1,68,500
समयोपरि / Overtime	18,844
कठिन कार्य भत्ता / Hard Duty Allowance	-
भोजन भत्ता / Mess Allowances	1,67,619
संतान शिक्षा भत्ता / शिक्षा शुल्क की प्रतिपूर्ती Children Education Allowance / Reimbursement of Tution Fees	24,55,750
कुल / TOTAL	**28,10,713**

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वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
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SCHEDULE FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2021

(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	2,36,944	4,54,192
2	लेखा-परीक्षा शुल्क / Audit Fees	1,02,070	65,000
3	बैंक प्रभार / Bank charges	1,12,828	20,295
4	बाईडिंग प्रभार / Binding charges	-	1,44,835
5	भोजनालय अनुवृत्ति / Canteen Subsidy	1,26,345	2,66,101
6	विद्युत तथा ऊर्जा / प्रभार / Electricity and power / Charges	99,53,409	139,06,691
7	मनोरंजन / आतिथ्य / Entertainment / Hospitality	2,08,545	1,82,592
8	उद्यान खर्च / Garden Expenses	1,17,318	6,33,083
9	अतिथि गृह रखरखाव / प्रभार, अतिथिगृह वस्तु / Guest house maintenance / Charges Guest house items	2,44,788	6,84,587
10	हिंदी व्यवस्था / पुरस्कार / Hindi expenses / awards	1,18,640	2,57,447
11	गृह संचयन खर्च / House keeping expenses	-	18,77,699
12	भा.भू.सं. वार्षिक दिवस खाता / IIG Annual Day A/c	-	1,73,495
13	बीमा / Insurance	35,177	47,811
14	वर्दी / Liveries	-	-
15	बैठक खर्च / Meeting expenses	57,437	4,04,475
16	अन्य खर्च / Miscellaneous expenses	16,43,910	18,02,007
17	डाक, दूरभाष तथा संचार प्रभार / इंटरनेट प्रभार Postage, Telephone and Communication Charges / Internet charges	50,99,560	54,83,468
	शेष / Balance c/f	**180,56,971**	**264,03,778**

P.B. SHETTY & CO. MUMBAI CHARTERED ACCOUNTANTS

	अनुसूची 21 : अन्य प्रशासनिक खर्च SCHEDULE 21 : OTHER ADMINISTRATIVE EXPENSES	वर्तमान वर्ष Current Year	पिछला वर्ष Previous Year
	आगे लाया गया / Brought Forward	**180,56,971**	**264,03,778**
18	व्यावसायीक प्रभार / सलाहकार प्रभार/ Professional Charges / Consultancy Charges	1,01,437	3,51,100
19	पंजिकरण शुल्क / Registration fees	-	7,34,926
20	किराया, दरें तथा कर / Rent, Rates and Taxes	3,39,198	2,07,816
21	मरम्मत तथा रखरखाव / Repairs and Maintenance	11,27,793	22,39,680
22	विज्ञान सप्ताह समारोह / प्रदर्शनी / Science week celebration / Exhibition	1,53,963	-
23	सुरक्षा सुविधाएं / Security services	401,02,239	513,56,586
24	कर्मचारी कल्याण / Staff welfare	11,040	2,14,400
25	भंडार उपभुक्त / Stores consumed	34,04,760	51,44,679
26	सर्वेक्षण खर्च / Survey expenses	85,921	5,117
27	यात्रा तथा परिवहन खर्च / Traveling and Conveyance Expenses	15,40,237	94,26,489
28	वाहन रखरखाव / Vehicle maintenance	9,04,159	8,97,215
29	अतिथि वैज्ञानिक / संगोष्ठी / शुल्क इत्यादि / Visiting scientist / seminar / fees etc.	19,500	8,600
30	जल शुल्क / Water charges	5,73,743	5,69,049
31	आस्मिक मजदूरों की मजदूरी / Wages to Contingent Mazdoors	95,03,327	59,01,857
32	कर्मचारियों को प्रशिक्षण कार्यक्रम / Training Programme to staff	5,000	1,19,700
33	एएमसी रखरखाव / AMC Maintenance	34,45,666	24,49,975
34	कार्यालय खर्च / Office Expenses	-	8,084
	कुल / TOTAL	**793,74,954**	**1060,39,050**

वित्तीय विवरण प्रपत्र (गैर-लाभकारी संगठन)
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(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-2021	पिछले वर्ष के अंत तक / Previous Year Ended 31st March-2020
a)	संस्थानों / संगठनों को दिया गया अनुदान Grants given to Institutions / Organizations	3,45,829	8,92,800
b)	संस्थानों तथा संगठनों को दी गई अनुवृत्ति Subsidies given to Institutions / Organizations	-	-
	कुल / TOTAL	3,45,829	8,92,800
(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 31/03/2021 के अनूसार	पिछले वर्ष / Previous Year as on 31/03/2020 के अनूसार
	NIL	NIL
कुल / TOTAL	NIL	NIL

K.R.Sahu

Pledge taking ceremony on Constitution day at IIG, Navi Mumbai

DST@ 1971-2021

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE & TECHNOLOGY

DST is celebrating its Golden Jubilee Commemoration year.

भारतीय भूचुम्बकत्व संस्थान
Indian Institute of Geomagnetism
GOLDEN JUBILEE
1971-2021

IIG is proudly celebrating its Golden Jubilee year 2021.

आजादी का अमृत महोत्सव

Azadi Ka Amrit Mahotsav is being celebrated to commemorate 75 years of progressive India.