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Article 1:

Progress of Chinese Meridian Project (CMP) and International Meridian Circle Program (IMCP)

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Monitoring and investigating the solar-terrestrial space environment has always been a significant challenge for humans in space age. To provide comprehensive and nationwide surveillance of the space environment from the

Figure 1. Layout of the observation sites of Chinese Meridian Project.

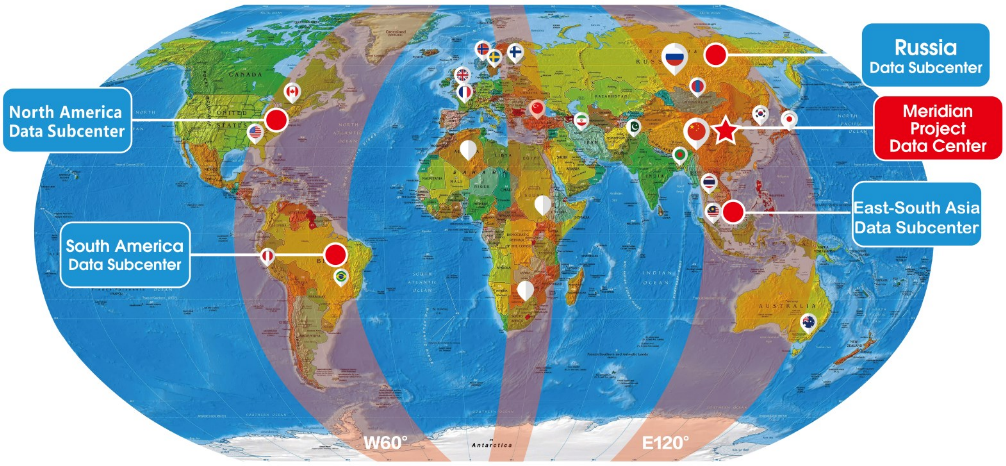

Figure 2. International Meridian Circle Program at a glance.

Sun to the Earth, China has constructed an extensive ground-based space environment monitoring system consisting of ~300 instruments deployed at 31 sites across the Chinese Mainland and the polar regions (Figure 1), known as the Chinese Meridian Project (CMP, [1, 2]). Through a dedicated construction effort in two phases (Phase-I: 2008-2012 and Phase II: 2019-2024), the CMP has become the largest and most comprehensive ground-based space weather observation network in the world. CMP employs a well-structured monitoring framework, known as "One Chain, Three Networks, and Four Focuses", to achieve stereoscopic and comprehensive monitoring of the entire solar-terrestrial space with high spatial-temporal resolution. The "One Chain" refers to a solar-interplanetary motoring chain, which utilizes optical, radio, interplanetary scintillation, and cosmic ray instruments to track the causal chain of space weather disturbances from the solar surface through interplanetary space to geospace. The "Three Networks" refer to grid-like monitoring networks across China that measure the ionosphere, middle and upper atmosphere, and geomagnetic fields, respectively. Additionally, some advanced monitoring facilities and large-scale instruments have been deployed in four key regions of interest, each with unique geographical/geomagnetic and topographical characteristics. These regions, referred to as the "Four Focuses", include the high-latitude polar region, mid-latitude region in northern China, low-latitude region around Hainan Island, and the Tibet plateau region. Overall, the CMP employs a diverse array of instruments, utilizing geomagnetic (electrical) measuring, radio remote sensing, optical remote sensing, and other methods to continuously monitor various physical parameters, such as solar magnetic field, solar monochromatic radiation, solar wind speed, atmospheric density, atmospheric temperature, electron and ion density and temperature, electric and magnetic field, neutral wind field, plasma drift speed, etc. The CMP data are accessible to the scientific community through the data center website (http://www.meridianproject.ac.cn).

The establishment of the CMP will enhance coordinated ground-based and space-borne observation alongside key satellite missions in China's Strategy Priority Research Program, such as ASO-S (Advanced Space-based Solar Observatory) and SMILE (Solar wind-Magnetosphere-Ionosphere Link Explorer). ASO-S was launched on 08 October 2022, with scientific objectives that include simultaneously observing the full disc vector magnetic field, non-thermal images of hard X-rays, and initiation of Coronal Mass Ejection (CME), as well as to understand the causality between magnetic field and flares, magnetic field and CMEs, and flares and CMEs. SMILE is a joint mission between European Space Agency and Chinese Academy of Sciences, which is scheduled for launch in 2025. The scientific goal of SMILE is to investigate the dynamic response of the Earth's magnetosphere to the solar wind impact via simultaneous in situ measurements of solar wind, magnetosphere, and global aurora distribution. With valuable datasets from the CMP and these key satellite missions, significant progress has been and will continue to be made in advancing our understanding on the propagation, evolution, and impact of space weather events on the solar-terrestrial environment [3].

The achievements of the CMP not only provide a robust foundation but also serve as a reference model for the International Meridian Circle Program (IMCP). The IMCP, which involves over 1000 ground-based instruments from over ten countries, aims to establish an integrated global monitoring network along the meridian circles of 120°E and 60°W (Figure 2) to study the space weather and related system sciences encompassing space, atmosphere, and Earth's surface [4]. Its goal is to understand how solar wind disturbances affect our planet and how disturbances originating from the Earth's surface and atmosphere might impact the space environment [5, 6]. Significant progress has been made over the past two years on the IMCP. For example, the second phase of construction for the China -Brazil Joint Laboratory for Space Weather has been completed, the North Pole and Southeast Asia networks are actively under construction, the regional space weather warning center in China has been reorganized at the IMCP center to provide operational space weather services, IMCP space weather school has been successfully held twice and supported by SCOSTEP. Therefore, by leveraging a wide range of international collaborations, the IMCP will enable global-scale observations and investigations via real time monitoring, data sharing, and joint research activities. This will provide a scientific basis for addressing space weather issues, mitigating Earth-related disasters, and making informed decisions on space security in the near future.

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Article 2:

InnerShock: A Database of Shock Waves Observed in the Inner Heliosphere

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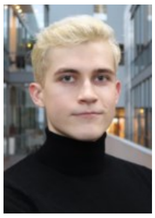
Simon Good


Timo Mäkelä


Juska Soljento

A conspicuous signature of the active star at the heart of our solar system is the presence of shock waves in interplanetary space. These shock waves propagate through the collisionless solar wind plasma and are typically fast-mode, characterised by discontinuous increases in the magnetic field strength, bulk solar wind speed, temperature and density when propagating away from the Sun in the plasma rest frame. Most fast shocks in the heliosphere form ahead of coronal mass ejections and at the interface between fast and slow solar wind streams. Collisionless shocks are associated with fundamental nonlinear processes in space plasmas, making them of significant interest to fundamental plasma physics. Also, the ability of interplanetary shocks to accelerate charged particles to high energies make them potentially hazardous to human activity in space, and thus an important driver of space weather. A thorough presentation of shock physics is given by Burgess and Scholer (2015).

The space physics group at the University of Helsinki maintains IPShocks (https://ipshocks.helsinki.fi/; Kilpua et al. 2015), an extensive database that lists key parameters of more than 2700 shocks observed by 11 spacecraft over a 40-year period. A benefit of the database is that it applies a standardised approach to the shock analysis, allowing direct comparison between

Figure 1. The InnerShock team at work: T. Mäkelä on the left, J. Soljento on the right.

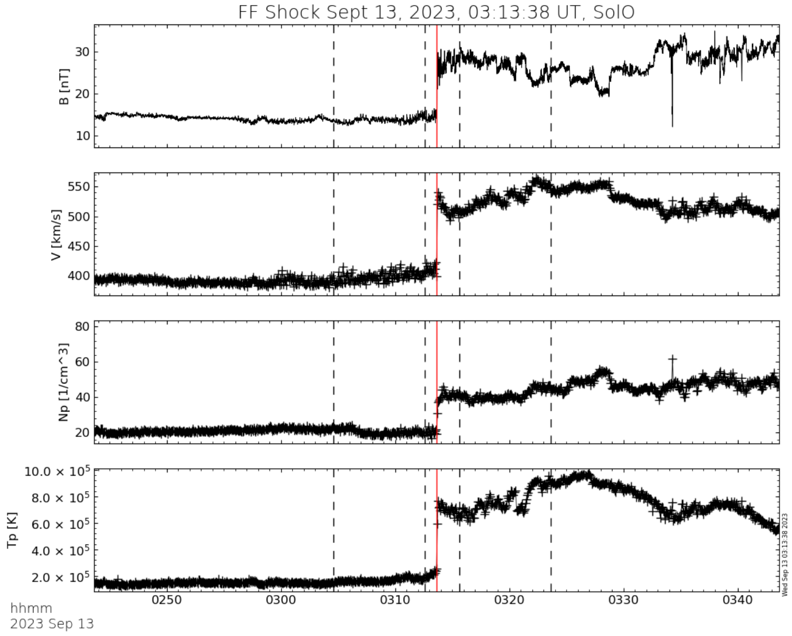


Figure 2. A quasi-parallel (θ_{Bn} = 31°) fast-forward shock observed by Solar Orbiter at 0.56 au. From top to bottom, the panels show the magnetic field magnitude, bulk solar wind speed, proton density and proton temperature. The red line marks the shock arrival time and dashed lines mark the 8-min upstream and downstream averaging windows used to calculate the shock parameters.

shocks observed across a wide domain. Parameters that fully characterise each shock, including upstream-to-downstream ratios of plasma parameters, Mach numbers, shock normal directions and shock – B-field angles, among many others, are listed in the database.

This summer, the InnerShock project has sought to update the IPShocks database with shocks recently observed by Parker Solar Probe (PSP; Fox et al. 2016) and Solar Orbiter (SolO; Müller et al. 2020), two spacecraft now exploring the inner heliosphere (r < 1 au). The properties and dynamical evolution of shocks in the inner heliosphere are observationally less well understood or constrained than at 1 au; PSP and SolO allow us to study this evolution with high-cadence plasma and magnetic field measurements for the first time, and complement the near-Sun shock observations made by the Helios spacecraft during the 1970s and 80s.

Figure 1 shows some of the InnerShock team at work during the summer. Tasks have included the translation of analysis codes from IDL to Python in order to facilitate future database updates, testing of machine-learning code to identify shock candidates, and the verification and analysis of newly identified shocks at PSP and SolO. Figure 2 shows an example of a shock observed by SolO at 0.56 au. A relatively complete list of SolO shocks is now available for use by the scientific community at IPShocks. The PSP shock list is still being finalised, but we are hopeful that it will be made available by the end of the year.

Acknowledgements:

The InnerShock project has been partly supported with a SCOSTEP/PRESTO grant for database development, with additional support from the European Union's Horizon 2020 programme grant 101004159 (SERPENTINE) and Research Council of Finland Centre of Excellence grant 336807 (FORESAIL).

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Müller, D. et al., 2020, A&A, 642, A1.

Highlight on Young Scientists 1:

Large scale changes in the polar ionosphere during CME and CIR storms, its relation to Sub-Auroral Polarization Streams (SAPS) and particle precipitation

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The Subauroral Polarization Streams (SAPS) encompass phenomena like Polarization Jets (PJ), Subauroral Ion Drifts (SAID), and auroral surges. These occur in a sunward plasma channel below the auroral oval during geomagnetic storms, driven by poleward-directed electric fields. SAPS significantly impact storm-time processes such as plasma erosion and density troughs, contributing to space weather effects in the midlatitude ionosphere.

Early studies connected SAPS to substorms, but recent observations have shown their persistent presence during geomagnetic activity, with varying intensity and spatial extent. Initial insights came from DMSP satellite data and Millstone Hill radar, while later SuperDARN measurements enhanced understanding of SAPS' relationship with magnetosphere-ionosphere dynamics and geomagnetic conditions. These studies suggest that SAPS may involve distinct driving mechanisms, requiring further investigation.

This research compares SAPS characteristics during CIR (Corotating Interaction Region) and CME (Coronal Mass Ejection) driven storms to identify their differences.

Initial classification of geomagnetic conditions was done using solar wind data from ACE and WIND satellites (https://cdaweb.gsfc.nasa.gov/) and the Dst index from the World Data Centre, Kyoto (http://wdc.kugi.kyoto.u.ac.jp). SAPS boundaries were analyzed using DMSP observations, with auroral oval data from the Cedar Madrigal database (http://cedar.openmadrigal.org/). SuperDARN velocity data and GPS-TEC measurements (https://stdb2.isee.nagoya.u.ac.jp/GPS/GPS-TEC/) were employed to study convection, with AMPERE field-aligned currents (https://ampere.jhuapl.edu/) used for comparison.

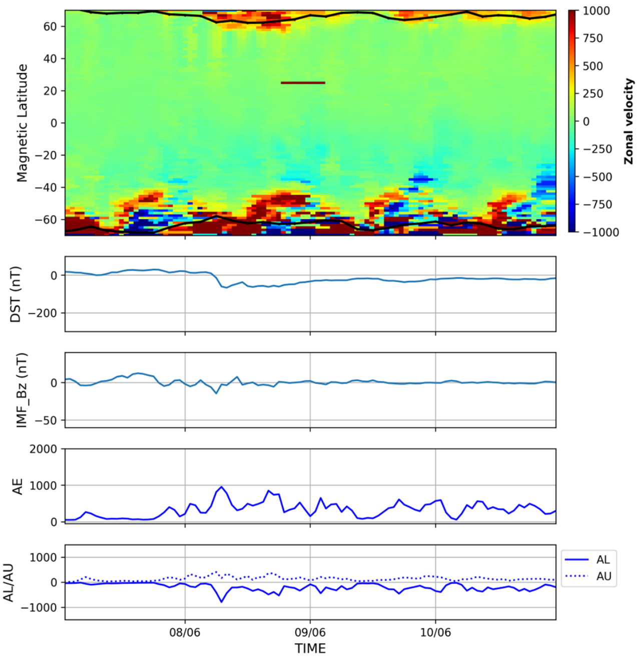

Figure 1. In a geomagnetic storm in June 2015, Subauroral Polarization Streams (SAPS) are observed. The top panel shows residual zonal velocity data from the F16 satellite. The black line indicates the equatorward boundary of the auroral oval, taken from the auroral boundary index. The second and third panels display the temporal evolution of Dst and IMF Bz. The third and fourth panel shows the AE and AL/AU.

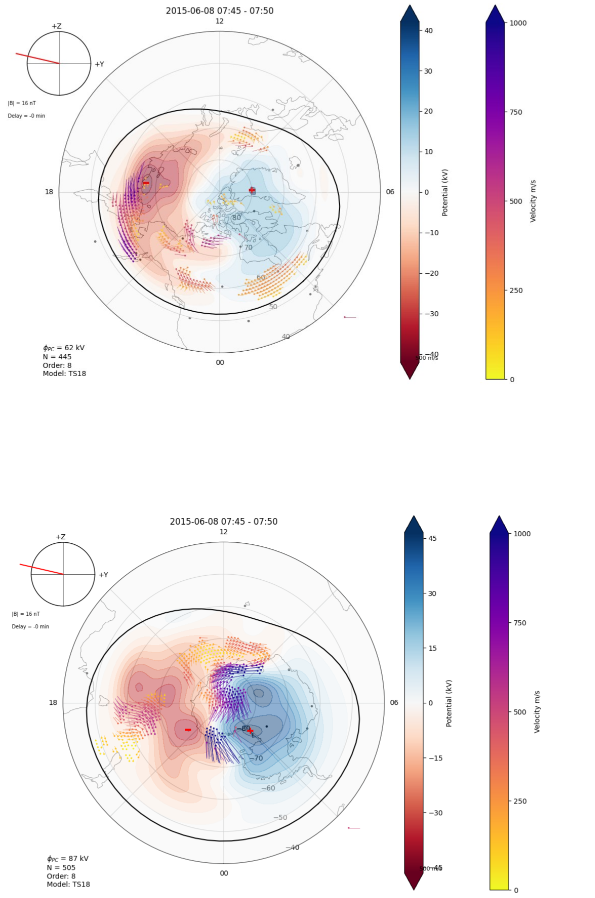

Figure 2. (a). (top) and Figure 2(b). (bottom) shows the line-of-sight velocities and convection map obtained from SuperDARN radar observations for 8th June 2015 in the northern and southern hemispheres respectively between 07: 45-07: 50 local time.

Results reveal that CME-driven storms are intense but brief, leading to rapid plasma transport, while CIR-driven storms are less intense but longer-lasting, causing sustained plasma flow. Seasonal variations were also noted, with asymmetry between hemispheres. Fig. 1 highlights DMSP observations of the event on 8th June 2015, showing interhemispheric differences in zonal velocities. Strong correlations were observed between SAPS and geomagnetic indices like AE and AL, emphasizing the interplay of these phenomena in the Earth's magnetosphere. The SuperDARN convection maps also correlated with DMSP and GPS TEC data, with Fig. 2 (a) and 2(b) showing the line-of-sight velocity distributions and convection patterns in the northern and southern hemispheres, validating the DMSP observations.

Acknowledgments:

I would like to express my sincere gratitude to Nagoya University's Institute for Space-Earth Environmental Research (ISEE) in Japan for providing the opportunity to conduct this research under the SCOSTEP Visiting Scholar (SVS) program. I am especially thankful to Dr. Nozomu Nishitani, Associate Professor at ISEE and lead researcher for the SuperDARN Hokkaido radar pair, for his invaluable supervision. I also extend my heartfelt thanks to Dr. Shreedevi P. R. for her support and guidance throughout this study.

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Highlight on Young Scientists 2:

Studying high-latitude atmosphere-ionosphere coupling with incoherent scatter radars

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The high-latitude ionosphere is strongly forced by the polar plasma convection (Dungey, 1961). The collisional coupling of the neutral atmosphere and ionosphere allows for Pedersen and Hall currents. Joule heating of the atmosphere-ionosphere and geomagnetic disturbances are consequent space weather effects. The incoherent scattering of radio waves is affected by both neutral atmosphere and ionosphere parameters. Therefore, various information can be obtained from incoherent scatter radar (ISR) observations. This versatility makes ISRs a highly valuable instrument to study atmosphere-ionosphere coupling.

Joule heating is the energy dissipation due to Pedersen currents. Short-scale variability of ionospheric electric fields has a huge impact on the Joule heating rates (Codrescu et al., 1995). As shown in Figure 1, atmosphere-ionosphere models generally underestimate the Joule heating rate which is corrected by an empirically determined scaling factor. We tested the default, constant Joule heating scaling of the TIE-GCM with measurements from the EISCAT ISR at Tromsø, Norway (69.6°N, 19.2°E). We found that the required scaling factor strongly varies with geomagnetic activity, magnetic local time, and the applied plasma convection model (Günzkofer et al., 2024).

The ratio of ion-gyrofrequency and ion-neutral collision frequency ν_{in} determines the altitude of maximum Pedersen conductivity and Joule heating. Dual-frequency ISR observations are a unique possibility for direct ν_{in} measurements (Nicolls et al., 2014). With the first-ever application of the difference spectrum method, we found significant deviations of the ν_{in} profile from

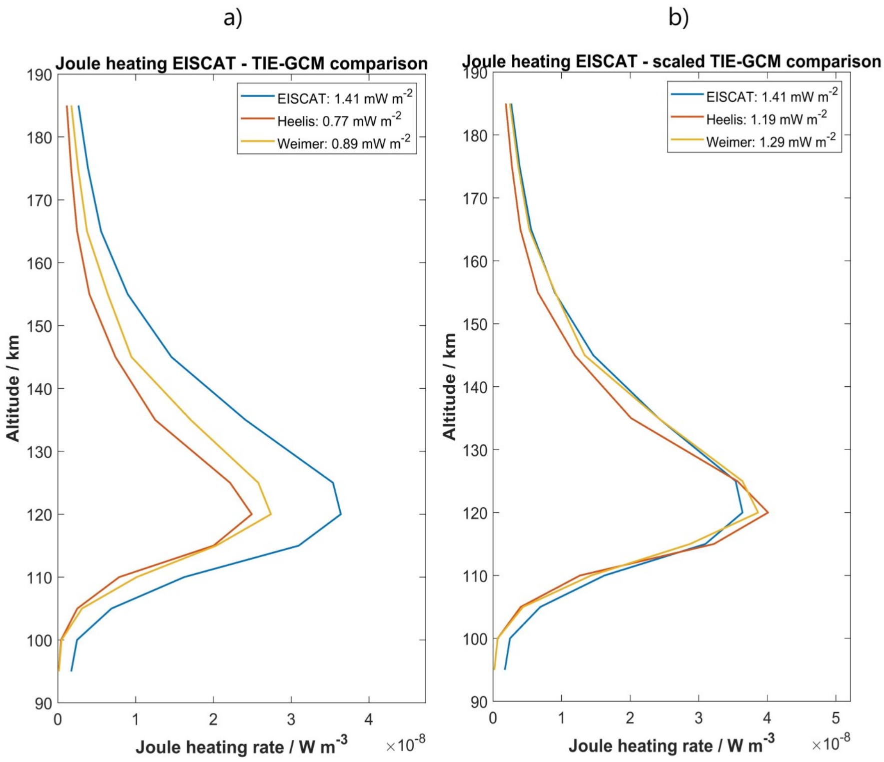

Figure 1. Joule heating rate profiles calculated from EISCAT ISR measurements and the TIE-GCM (with Heelis or Weimer plasma convection). a) No scaling is applied to the Joule heating rates. b) The required scaling determined by a non-linear least-square fit is applied.

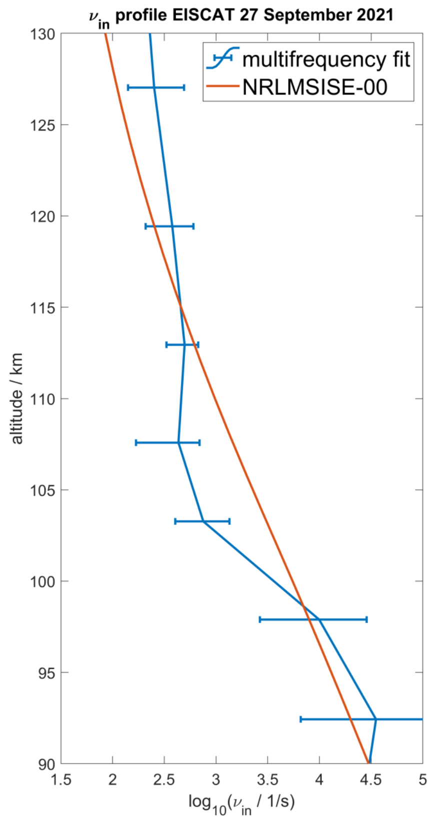

Figure 2. Ion-neutral collision frequency profile inferred from EISCAT ISR dual-frequency measurements compared to the profile calculated from the NRLMSIS climatology.

the climatology as shown in Figure 2 (Günzkofer et al., 2023). Such deviations can be caused by ionospheric heating and, in turn, have a feedback effect on the ionospheric conductivity and Joule heating (Oyama et al., 2012).

The high-latitude ionospheric currents remain a major challenge for future space weather forecasts. The complicated interaction of ionospheric heating and atmosphere-ionosphere coupling needs to be better understood. Incoherent scatter radars and their high measurement versatility will continue to play an important role towards an accurate modeling of the high-latitude atmosphere-ionosphere.

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Meeting Report 1:

16th Workshop “Solar Influences on the Magnetosphere, Ionosphere, and Atmosphere” Primorsko, Bulgaria, 3-7 June 2024

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Katya Georgieva

The Workshop “Solar Influences on the Magnetosphere, Ionosphere, and Atmosphere” is a yearly event during the first week of June organized by the Space Weather Department of the Space Research and Technology Institute of the Bulgarian Academy of Sciences with an international Scientific Organizing Committee. https://www.spaceclimate.bas.bg/ws-sozopol/.

The 16th Workshop was attended by 64 participants from 18 countries: Armenia, Argentina, Azerbaijan, Bulgaria, China, Czech Republic, Greece, France, Hungary, Latvia, Poland, Romania, Russia, Serbia, Turkey, UK, Ukraine, USA. 67 oral and 14 poster presentations were given in 5 plenary, 2 poster, and 3 special sessions.

Figure 1. A group photo of the participants of the workshop.

The program of the Workshop, the Book of Abstracts, and the presentations are available at the workshop’s web site where the Book of Proceedings will also be uploaded.

Meeting Report 2:

COSPAR Capacity Building Workshop

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Zavkiddin Mirtoshev

Nandita Srivastava

The workshop on “Coronal and Interplanetary Shocks: Data Analysis from SOHO, STEREO, SDO, Wind, and Ground-based Radio Data” was conducted at Samarkand State University (SamSU) during August 19-30, 2024 (https://cospar2024samarkand.samdu.uz/). The main objective of the workshop is to encourage the scientific use of space data by scientists in developing countries. This two-week workshop had two major components: (1) Introductory lectures (first week), and (2) The hands-on training session on analysis of solar data (second week). With the installation of a radio spectrometer, during the workshop, SamSU became a part of the e-Callisto network (https://www.samdu.uz/en/news/56232). The workshop was attended by 38 participants from Algeria, Egypt, India, Kazakhstan, Malaysia, Nigeria, Sri Lanka, Tajikistan, Turkey, and Uzbekistan. The results of the analysis obtained by participants are available in the form of presentations (https://cospar2024samarkand.samdu.uz/resources.php) in the workshop website. Thus, the workshop achieved success in providing practical training to the young researchers for research and developmental activities in the related fields.

Figure 1. Group Photo of Workshop Participants.

Meeting Report 3:

International Colloquium on Equatorial and Low Latitude Ionosphere (ICELLI)

Babatunde Rabiu

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The eight edition of the International Colloquium on Equatorial and Low Latitude Ionosphere (ICELLI) was held as an hybrid event with physical event at the Mountain Top University, Prayer City, Ogun State, Nigeria, from 29 July to 2 August 2024.. The Colloquium was co-organized by United Nations African Centre for Space Science and Technology Education; National Space Research and Development Agency, Nigeria; Institute for Space-Earth Environmental Research (ISEE), Nagoya University, Japan; Scientific Committee for Solar Terrestrial Physics (SCOSTEP/PRESTO); UN-International Space Weather Initiative; Network of Space-Earth Environmentalists; Boston College, USA, University of Oslo, Norway; JSPS Program; and the African Geophysical Society. With a total of 74 participants from 19 different countries, the Colloquium featured 29 invited talks and two special half-day scientific sessions on the International Meridian Circle Program "IMCP" and "AfriTEC model". Contributed research papers were also presented at the event.

Figure 1. A group photograph taken immediately after the opening session of 2024 ICELLI on 30th July 2024.

The meeting featured a composition of tutorials, seminars, conference and hands on training on every aspect of research and techniques bordering on the dynamics of equatorial and low latitude ionosphere as well as space weather. The forum served as an effective meeting point for scientists, policy makers, students and designers of space-dependent technologies. Further material can be found here: https://arcsstee.org.ng/international-colloquium/.

Meeting Report 4:

XIV Latin American Conference on Space Geophysics (COLAGE) 2024

A. Gonzalez-Esparza

Americo Gonzalez-Esparza[1]
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The XIV COLAGE, held from April 8 to 12, 2024, in Monterrey, Mexico, gathered 160 participants from 18 countries. The event focused on five key scientific topics, including space weather and solar physics, featuring 140 presentations (65 oral, 75 posters) and 16 invited talks. National and international organizations, including UNAM and SCOSTEP, supported the conference. Thanks to sponsor contributions, 58 participants, including students, received financial support. The main results will be published in Geotisica Internacional. The General Assembly approved amendments to ALAGE's bylaws and elected a new board. The next COLAGE will be hosted in Peru in 2026.

Figure 1. A group photograph of the participants.

Meeting Report 5:

The Solar MHD 2024

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Suzana Silva


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Elena Khomenko


Rahul Sharma

The 2nd Solar MHD meeting on Solar Physics and Space Science (UKUS 7) was supported by SCOSTEP and held in the Instituto de Astrofisica de Canarias, Tenerife, Spain, between 02-05 September 2024 (https://pdg.sites.sheffield.ac.uk/seminars-and-conferences/solar-mhd-2024). During the meeting, we went through an exciting synergy between high-resolution observations and high-performance computing modelling techniques that characterise various observable phenomena and discussed key aspects of solar and space-weather plasma phenomena. This event was very successful and gathered more than 40 participants from 12 countries. A conducive environment for interaction, hands-on experiences, and engaging workshops were fostered by a collaborative atmosphere. In total more than 30 talks and 3 hands-on sessions were presented. After each session, we had in-depth discussions among distinguished scientists, early career researchers, and PhD scholars. The participants shared their perspectives from different solar backgrounds (e.g. solar observations, simulations and machine learning), leading to efficient dissemination of the latest findings and cutting-edge techniques. The discussion of new methodologies for data analysis and numerical modelling provided PhD students and young researchers with new possibilities for exploration and discovery.

Figure 1. Attendees at the Solar MHD (UKUS 7) conference held in Instituto de Astrofisica de Canarias (IAC), Tenerife, Spain. Credit: Inás Bonet (IAC).

Upcoming meetings related to SCOSTEP

Conference	Date	Location	Contact Information
European Space Weather Week	Nov. 4-8, 2024	Coimbra, Portugal	https://esww2024.org/
COSPAR ISWAT 2025 Working Meeting	Feb. 10-14, 2025	Canaveral, FL, USA	https://iswat-cospar.org/wm2025
The 8th ISEE Symposium Frontier of Space-Earth Environmental Research as Predictive Science	Mar. 5-7, 2025	Nagoya, Japan	https://www.isee.nagoya-u.ac.jp/symp2025/
The 2025 Sun-Climate Symposium	Mar. 31-Apr. 4, 2025	Fairbanks, Alaska	https://lasp.colorado.edu/meetings/2025-sun-climate-symposium/
IAGA / IASPEI Joint Scientific Meeting 2025	Aug. 31-Sep. 5, 2025	Lisbon, Portugal	https://iaga-iaspei-2025.org/
The International Symposium for Equatorial Aeronomy 17 (ISEA-17)	Feb. 9-13, 2026	Costa Rica	

Please send the information of upcoming meetings to the newsletter editors.

Announcement 1:

SCOSTEP/PRESTO Announcement of Opportunity - Grants for campaigns, meetings, and databases

Ramon E. Lopez (PRESTO chair)[1], Odele Coddington (PRESTO co-chair)[2], Jie Zhang (PRESTO co-chair)[3] and Kazuo Shiokawa (SCOSTEP President)[4]

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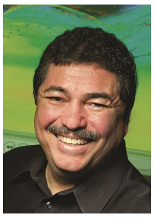
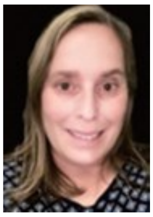


Ramon E. Lopez



Odele Coddington

Jie Zhang

Kazuo Shiokawa

Although the SCOSTEP's PRESTO program will end in 2024, the next SCOSTEP program can be started only from 2026, because the next program committee is now discussing the new program. Under this circumstance, the SCOSTEP Bureau has decided to continue the PRESTO grant in 2025, to support the scientific activities on solar-terrestrial physics, particularly to those related to PRESTO in 2025. Considering the meetings in early 2026, this time we take proposals for activities up to March 31, 2026.

The details of the announcement of opportunities for the campaigns, meetings, and development of databases relevant to the PRESTO topics can be found at https://scostep.org/presto/. Please contact relevant PRESTO Pillar co-leaders on your proposal and explain the relevance of your proposal to the PRESTO activity. Proposals for markedly interdisciplinary activities can be explained directly to PRESTO chair/co-chairs. The deadline proposal submission is December 23, 2024.

The purpose of the SCOSTEP/PRESTO newsletter is to promote communication among scientists related to solar-terrestrial physics and the SCOSTEP's PRESTO program.

The editors would like to ask you to submit the following articles to the SCOSTEP/PRESTO newsletter.

Our newsletter has five categories of the articles:

1. Articles— Each article has a maximum of 500 words length and four figures/photos (at least two figures/photos). With the writer's approval, the small face photo will be also added. On campaign, ground observations, satellite observations, modeling, etc.
2. Meeting reports—Each meeting report has a maximum of 150 words length and one photo from the meeting. With the writer's approval, the small face photo will be also added. On workshop/conference/ symposium report related to SCOSTEP/PRESTO
3. Highlights on young scientists— Each highlight has a maximum of 300 words length and two figures. With the writer's approval, the small face photo will be also added. On the young scientist's own work related to SCOSTEP/PRESTO
4. Announcement— Each announcement has a maximum of 200 words length. Announcements of campaign, workshop, etc.
5. Meeting schedule

Category 3 (Highlights on young scientists) helps both young scientists and SCOSTEP/PRESTO members to know each other. Please contact the editors if you know any recommended young scientists who are willing to write an article on this category.

TO SUBMIT AN ARTICLE

Articles/figures/photos can be emailed to the Newsletter Secretary, Ms. Mai Asakura (asakura_at_isee.nagoya-u.ac.jp). If you have any questions or problem, please do not hesitate to ask us.

SUBSCRIPTION - SCOSTEP MAILING LIST

The PDF version of the SCOSTEP/PRESTO Newsletter is distributed through the SCOSTEP-all mailing list. If you want to be included in the mailing list to receive future information of SCOSTEP/PRESTO, please send e-mail to "scostep_at_bc.edu" or "scosteprequest_at_bc.edu " (replace "_at_" by "@") with your name, affiliation, and topic of interest to be included.

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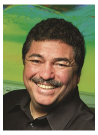

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