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Inside this issue

Article 1:

Similar patterns of tropical precipitation and circulation changes under solar and greenhouse gas forcing

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In response to surface warming caused by a radiative forcing agent, global precipitation increases at an almost fixed rate of about 2.4-2.6% per degree of global warming, independently of the nature of the agent [1]. While global precipitation change is relatively constrained, regional patterns of forced responses are highly uncertain as they depend on dynamics. Our understanding on the mechanisms constraining the past, current and future variability of the tropical precipitation and circulation could be improved by studying responses to different forcings in idealized modelling studies.

In a recent study [2], we have compared the regional precipitation response to Total Solar Irradiance (TSI) versus greenhouse gas (GHG) forcing in a) idealized simulations of Precipitation Driver Response Model Intercomparison Project (PDRMIP) [3] and b) last millennium (850-2005) ensemble of the Community Earth System Model (CESM-LME) [4]. Specifically, we make use of the idealized PDRMIP experiments that consider the effects of an abrupt doubling CO2 concentration (PDRMIP-CO2, hereafter) and 2% increase in TSI (PDRMIP-SOL, hereafter). We additionally analyse single forcing runs from CESM-LME consider-

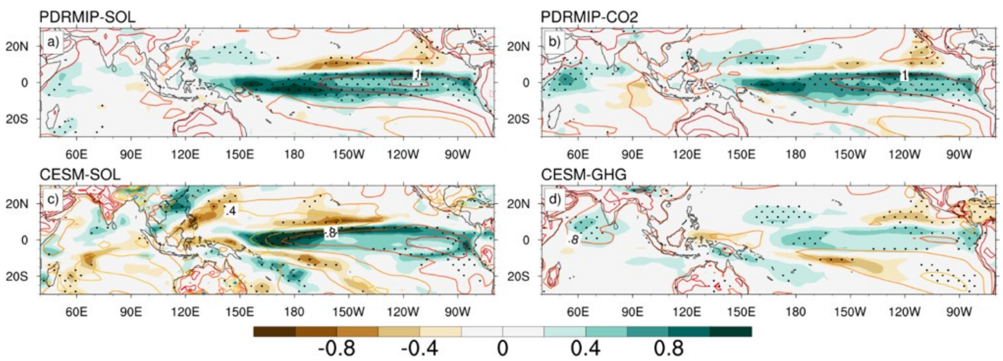

Figure 1. Spatial patterns of ensemble mean filtered precipitation (shaded, in mm/day/K) and surface temperature (contours, in K/K) regressed onto the filtered global mean surface temperature in a) PDRMIP-SOL, b) PDRMIP-CO2, c) CESM-SOL and d) CESM-GHG simulations. Stippling indicates regions of chance probability $p < 0.05$ according to a t-test. Contour spacing is 0.2 K/K.

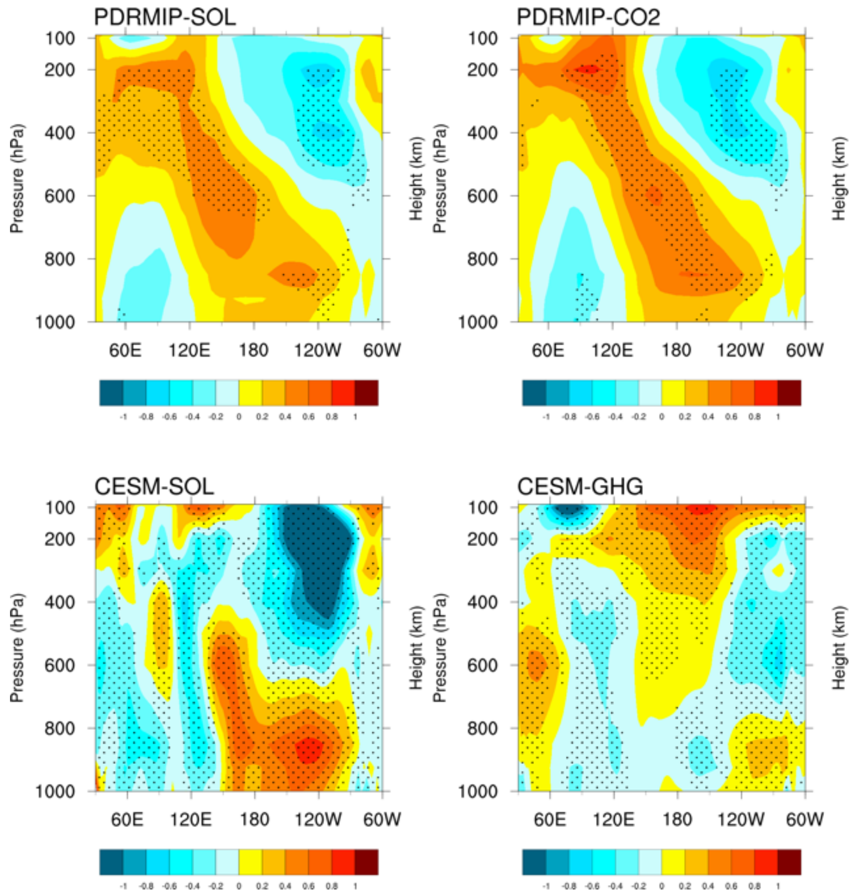

Figure 2. Spatial patterns of ensemble mean filtered equatorial (5°S-5°N) winds (m/s/K) regressed onto the filtered global mean surface temperature in a) PDRMIP-SOL, b) PDRMIP-CO2, c) CESM-SOL and d) CESM-GHG simulations. Stippling indicates regions of chance probability $p < 0.05$ according to a t-test.

ing a) centennial variations in TSI (CESM-SOL) and b) GHG only (CESM-GHG). All signatures are presented as regression coefficients of low-pass filtered timeseries to the corresponding global mean temperature change.

We demonstrate similar patterns of forced precipitation response, stronger for TSI given an equal global mean surface warming (Figure 1). We identify in PDRMIP the strongest absolute changes over the equatorial Pacific irrespective of the forcing. CESM-SOL shows similar patterns of precipitation response to PDRMIP, as the excess rainfall is found in the western and central equatorial Pacific. This pattern is also detected in the CESM-GHG ensemble, albeit of reduced amplitude that is likely due to the muted global hydrological sensitivity under the influence of historical GHGs.

Precipitation responses in the tropical Pacific are highly dependent on changes in the Walker circulation. The PDRMIP simulates a similar reduction of the Walker circulation in response to TSI and CO2 (Figure 2). Interestingly, both PDRMIP-SOL and PDRMIP-CO2 simulate positive anomalies of the filtered equatorial zonal winds over the Pacific, suggesting an overall reduction of the Walker circulation. Comparison of the CESM-SOL and PDRMIP-SOL results shows that variations of TSI at centennial time scales cause similar changes in the Walker circulation. CESM-GHG on the other hand, does not support the evidence from PDRMIP for anomalous westerlies.

Previous analysis of last millennium simulations have suggested that periods of high solar forcing increase sea-surface temperature gradients in the equatorial Pacific Ocean and decrease rainfall, while increasing GHG concentrations have the opposite effect [5]. In contrast, the CESM-LME and PDRMIP simulations analyzed in this study provide evidence that solar and GHG forcings cause very similar patterns in the tropical Pacific characterized by an ocean warming, enhanced precipitation in the central Pacific, and a weakening and eastward shift of the Walker circulation. Our analysis also provides qualitative support to the observational evidence for a slowdown of the Walker circulation and enhanced precipitation in the Central Pacific [6], but the role of internal variability needs to properly assessed by considering large ensemble simulations.

References:

1) Allan, et al., Ann. N.Y. Acad. Sci., 2020

2) Misios, et al., Environ Res Lett, 2021

3) Myhre, et al., 2016

4) Otto-Bliesner, et al., 2015

5) Liu, et al., 2013

6) Misios, et al., PNAS 2019

Article 2:

SCOSTEP General Council Meeting

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A meeting of the SCOSTEP General Council was held virtually on February 25, 2022. The meeting was conducted following the conclusion of the 15th Quadrennial Solar-Terrestrial Physics Symposium (STP15) hosted by Dr. Subramanian Gurubaran of the Indian Institute of Geomagnetism.

Dr. Kazuo Shiokawa, President of SCOSTEP, opened this meeting stating that much has happened since the last General Council meeting in 2019. This included transitions in leadership and the launch of the new scientific program PRESTO (Predictability of Solar-Terrestrial Coupling). At nearly the same time the COVID pandemic escalated worldwide, rendering travel, face-to-face meetings, workshops and schools nearly impossible. However, our work did not stop as many opportunities continued as virtual events. Dr. Shiokawa stated that our work cannot stop as understanding solar-terrestrial coupling processes is essential due to the increasing use of space by humans and for the importance of climate change.

The meeting was attended by a number of National Adherent Representatives, Bureau Members, PRESTO chairpersons, and Scientific Discipline Representatives. General Council Meetings are held every two years to determine scientific priorities, consider scientific proposals, and review financial and administrative arrangements, and at alternate meetings to elect the President and Vice President. These elections will be held at the next General Council Meeting in 2023.

The prime topics of the General Council meeting included introductions of SCOSTEP leadership; introductions of new National Adherents and their representatives; the transition of the office of the Scientific Secretary; a report on PRESTO goals and activities; a report on the STP15; updates on SCOSTEP's collaboration with the International Science Council (ISC), the International Space Weather Initiative (ISWI) and the UN Office for the Peaceful Uses of Outer Space (UNCOPOUS). Presentations were also made on the SCOSTEP Visiting Scholar Program and other outreach activities that supported schools and workshops; online capacity building lectures; the delivery of quarterly newsletters; the translation of the SCOSTEP comic book series into additional languages; the annual SCOSTEP Awards; and the introduction of new SCOSTEP Fellow opportunities.

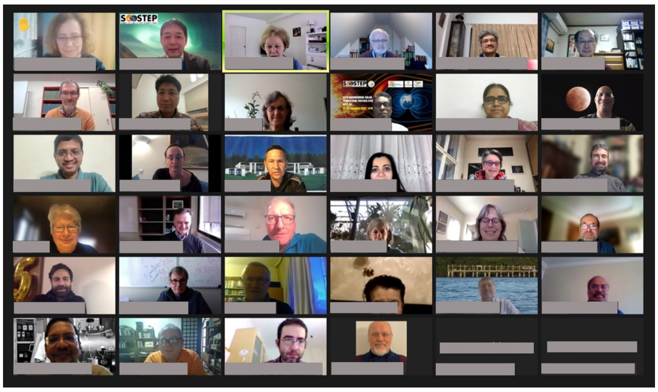

Figure 1. Online group photo of the participants of the SCOSTEP General Council Meeting.

A full presentation on the Financial State of SCOSTEP was provided by the Scientific Secretary. This presentation revealed that SCOSTEP is in good financial order with a steady flow of income, anticipated annual expenses and a growing cash balance. Dr. Shiokawa presented plans to develop Bylaws that would identify the purpose and responsibilities of the various committees of SCOSTEP that are not identified in the Constitution.

Finally, Dr. Shiokawa presented a proposal to amend the SCOSTEP Constitution to account for several changes in the organization. Dr. Shiokawa explained the process for Amending the Constitution which includes presenting it to the General Council for a vote. As not all General Council members were able to attend this meeting, the Scientific Secretary sent the information to all General Council members for their consideration and vote.

This meeting of the General Council generated lively discussion and confirmed significant interest in SCOSTEP activities by the membership. A full copy of the minutes of the General Council meeting can be found on the SCOSTEP website at: https://scostep.org/meeting-minutes-archive/.

Highlight on Young Scientists 1:

Seasonal Variations of EEJ and Counter-EEJ during quiet times from 2014 to 2018 Swarm constellation observations

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EEJ as a band of non-uniform intense eastward ionospheric current flows within a latitudinal extent of ±3^0 on either side of the dip equator at a lower altitude E region centered at around 106±2 km (Onwumechili, 1997; Rabiu et al, 2017).

This work describes new insights on seasonal variations of equatorial electrojet (EEJ) currents. The study used observations of Swarm-A and Swarm-B satellites. Quiet day (Kp ⩽3) measurements from 2014 to 2018 are analyzed in such away that enable to characterize the seasonal/periodic variations of EEJ and its counter electrojet (CEJ) currents. Data of all dayside longitudinal sectors are ploted against latitude in a usual seasons (Equinoxial and solictice). Besides, EEJ is periodic feature is studied for specific longitudinal region (30^0 to 60^0).

The EEJ recorded from Swarm-A shows a pronounced minimum during the March equinox and a maximum in the September equinox. Results reveal that during the occurrence of strong EEJ over the deep equator, a corresponding strong CEJ occurs at about ±5^0 latitude. This might be due to a back drag effect of the main current on the dip equator over the current away from it. The observations also shows that the conclusion made by Richmond (1973) and Rabiu et al. (2017) on the seasonal variation of EEJ is not always true. Of course, as mentioned on the introduction they did their studies with limited data. For instance, look the December solictice in 2018 Swarm-A measurements and December solictice again in 2017 and 2018, by Swarm-B, they show relatively strong EEJ current from other seasons. The measurements between 30^0 and 60^0 longitude

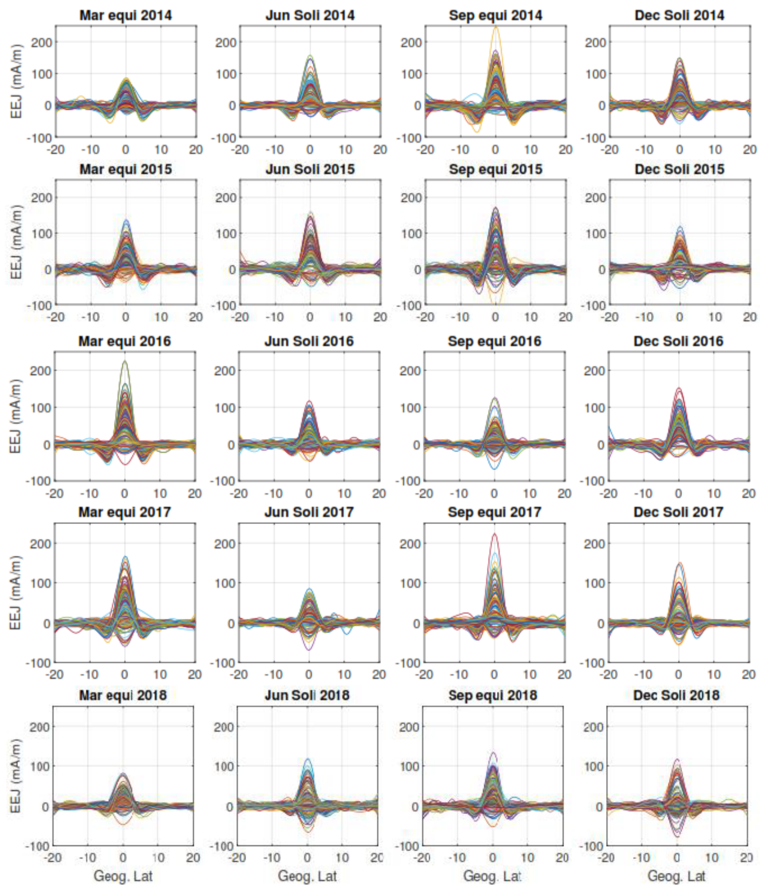


Figure 1. Seasonal variability of EEJ from Swarm-A observations (-180^0 to 180^0).

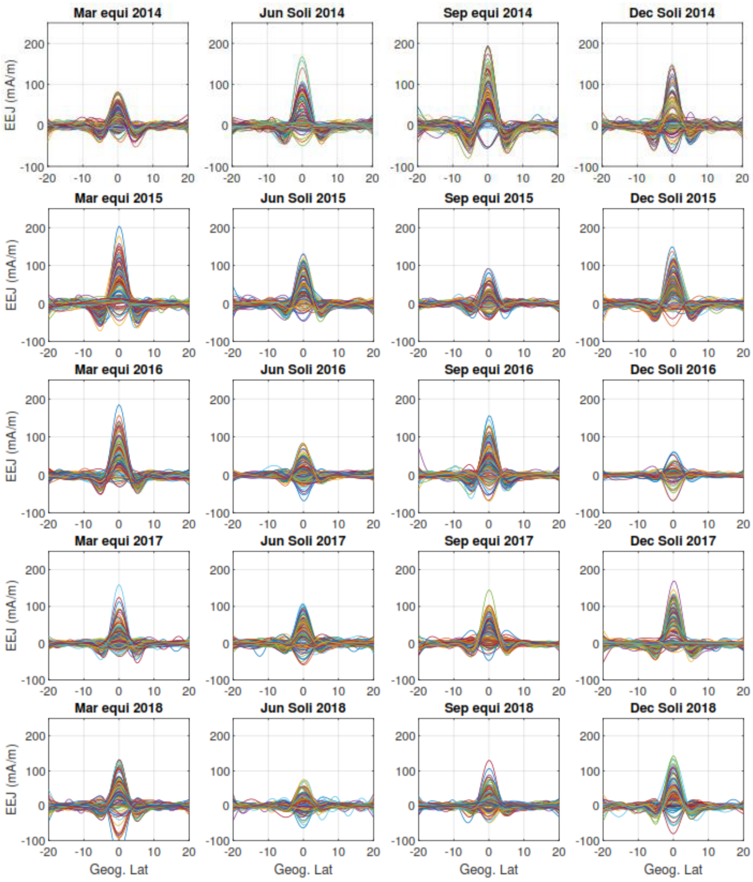


Figure 2. Seasonal variability of EEJ from Swarm-B observations (-180^0 to 180^0).

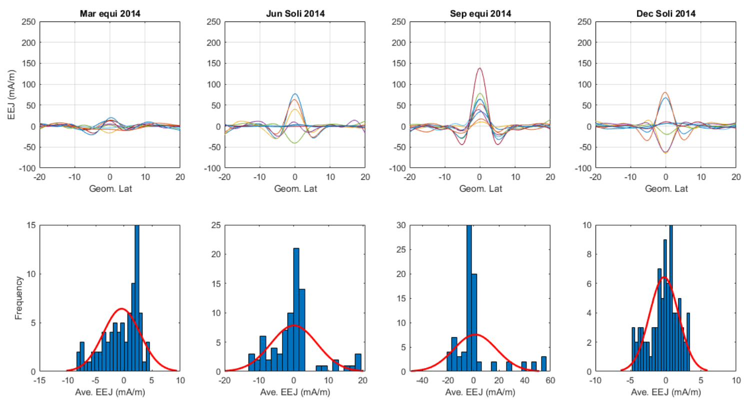


Figure 3. EEJ variations and occurrence frequency of CEJ in 2014 from Swarm-A (between 30^0 and 60^0 longitude sector).

also show weak EEJ in the March equinox than the June and December solictices. This non-patterned variations of EEJ actually will make the seasonal modeling difficult.

Therefore, one can conclude that the morphology of EEJ is not a uniformly/periodically patterned. The commonly understood seasonal description does not apply to the EEJ variability according to the analysis of this work based on the data mentioned above. In addition, the results reveal that as the EEJ get stronger the occurrence of CEJ decreases. However, these results should be considered as preliminary outcomes.

References:

Rabiu, et al., (2017), Ann. Geophys., 35, 535–545.

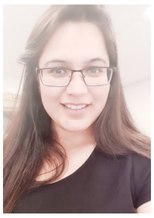
Richmond, (1973) , J. Atmos. Terr. Phys., 35, 1083-1103.

Onwumechili, (1997), Gordon and Breach Science Publishers, the Netherlands, pp 627.

Thomas, N., Vichare, G., & Sinha, A. K. (2016), Advances in Space Research, 59(6), 1526–1538. doi:10.1016/j.asr.2016.12.019.

Highlight on Young Scientists 2:

Neural Networks for Detection and Prediction of Dst Index



Ishita Gulati

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Despite the existence of the Sun and the Earth from 4.5 billion years ago, society's awareness of space weather and its impact on technology/humanity has substantially increased only in the recent few decades. This is, because, with the advent of technical and scientific upheaval, we are now in a far more vulnerable position than we ever were.

Current space science research focuses on accurately predicting solar occurrences to warn consumers of impending storms. However, this level of forecast accuracy is not yet available, and extensive research is being conducted to make it possible.

In the early stages of my research, I analyzed the consequences of space weather at low, middle, and high latitudes [1,2]. Inspired by the impact these events can have, I recently began to apply Machine Learning techniques to study the effects of the Sun-Earth interaction on GNSS. One of my recent publications (in press), involves building a Long Short-Term Memory (LSTM) neural network model that detects the Dst index on storm days with an accuracy of up to 83.47 percent. This involves feeding the network with geomagnetic index data from 2012 to 2016, that includes IMF parameters, plasma proton density, AE index, and flux above 10 MeV. Once the model is trained, it is validated on the top five geomagnetic storms of 2017. The results show that the model can detect low-moderate storms reliably. The model predicted the Dst for all 365 days of 2017 and fig. 1 shows the actual and anticipated Dst on the storm day of May 28 which infers the prediction of a time lagged Dst. The model's accuracy also confirms Dst's seasonal behaviour, allowing us to conclude that the model works well for the Vernal Equinox.

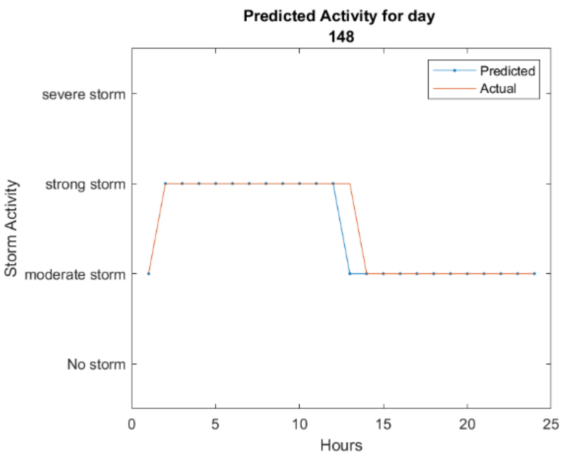

Figure 1. Predicted Dst vs Actual Dst on 28 May 2017.

The next part of my research involves a forecast model that can predict the Dst index. The early findings of this model were presented during the 2021 AGU Fall Meeting [3].

The LSTM model is used to forecast the strength of a geomagnetic storm using a series of time steps of Dst index, sampled every 1-hour for the year of 2015 as shown in fig. 2.

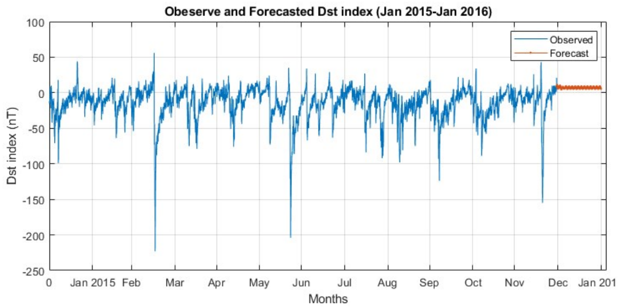

Figure 2. Initial forecast of Dst.

A sequence-to-sequence regression LSTM network is trained for 250 epochs with 'adam' and a predetermined gradient threshold to avoid the problem of gradient descent. The response of each prediction is saved as (t+1), which first updates the current state, and is then used to predict the next Dst time step.

After the model has been fully trained, it is tested on the Dst data from January 2016. The neural network's performance was evaluated under various storm situations, and the findings suggest that it was capable of forecasting Dst. On January 1, 2016, a G-2 geomagnetic storm occurred, resulting in Dst depressions of up to -110nT. We saw a significant change in the RMSE value from 21.16 to 4.6, indicating a 78 percent increase in the model's accuracy in forecasting the Dst as shown in fig. 3.

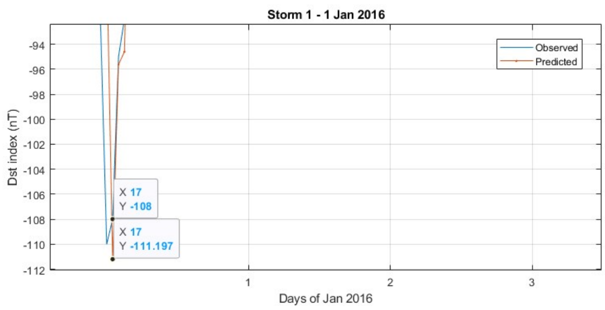

Figure 3. Dst forecast for 1 Jan 2016.

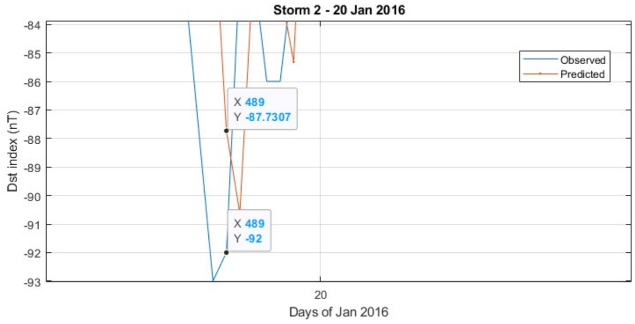

Figure 4. Dst forecast for 20 Jan 2016.

Further results reveal that the model was able to predict another storm caused by a CME and C-class flares that occurred in the same month of January, 20-21 January, with a maximum magnetic depression of -93nT as shown in fig. 4. The LSTM's promising nature on time series data like Dst is demonstrated by the error reduction of a factor of 5, making it a good choice for studying storms induced by SRBs, CMEs, flares, etc. with extra geomagnetic data as input parameters or features.

References:

1. I. Gulati, H. Li, S. Stainton, M. Johnston and S. Dlay, "Investigation of Ionospheric Phase Scintillation at Middle-Latitude Receiver Station," 2019 International Symposium ELMAR, 2019, pp. 191-194, doi: 10.1109/ELMAR.2019.8918653.
2. I. Gulati, R. Tiwari, M. Johnston and S. Dlay, "Impact of Solar Flares on HF Radio Communication at High Latitude," 2019 International Conference on Automation, Computational and Technology Management (ICACTM), 2019, pp. 550-554, doi: 10.1109/ICACTM.2019.8776851.
3. I. Gulati, H. Li, and S. Dlay, “"Using LSTMs to Forecast Disturbance Storm Time (Dst) In-

Highlight on Young Scientists 3:

Flux feeding mechanism of solar magnetic flux rope eruptions

Quanhao Zhang

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Coronal magnetic flux ropes are generally considered to be the core structure of solar eruptions. Observations found that solar eruptions could be initiated after a sequence of flux feeding episodes, during which chromospheric fibrils rise and merge with the prominence above (Zhang et al. 2014). To shed light on the physical essence of this phenomenon, we use numerical simulations to investigate the influence of flux feeding on coronal magnetic flux ropes, including both the stable Bald-Path-Separatrix (BPS) configuration (Fig. 1(a)) and the meta-stable Hyperbolic-Flux-Tube (HFT) configuration (Fig. 1(b)). The rising fibril in the scenario of flux feeding is represented by a small flux rope emerging from the photosphere (dark green curves in Fig. 1).

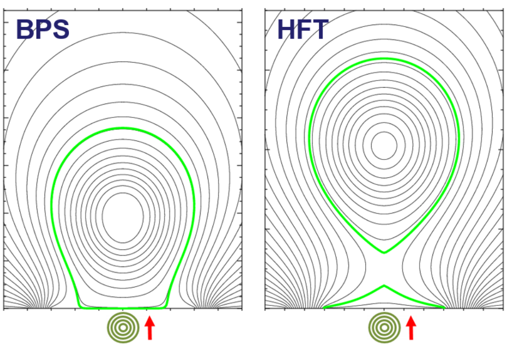

Figure 1. Predicted Dst vs Actual Dst on 28 May 2017.

During flux feeding, the small emerging rope rises and merges with the pre-existing coronal magnetic flux rope, as shown in Fig. 1(a)-1(b) for the BPS case, and Fig. 1(f)-1(g) for the HFT case. The pre-existing coronal flux rope erupts after flux feeding in these two cases, demonstrating that flux feeding is efficient in causing solar eruptions in both the BPS and the HFT configurations. By calculating and comparing the axial magnetic flux of the pre-existing rope before and after flux feeding, we find that axial flux is injected into the rope by flux feeding.

To reveal the eruptive mechanism, we simulate many cases with different intensities of flux feeding. As shown in Fig. 3, the stronger the flux feeding (larger C_E), the greater the axial flux of the resultant rope after flux feeding, indicating that more axial flux is injected. The flux rope does not always erupt after flux feeding; the non-eruptive (small circles in Fig. 3) cases and eruptive cases (black dots in Fig. 3) are well separated, implying critical axial flux of the rope. Therefore, flux feeding can cause solar eruptions, provided that the amount of the axial flux injected by flux feeding is large enough so that the critical axial flux of the rope (horizontal dotted lines in Fig. 3) is reached.

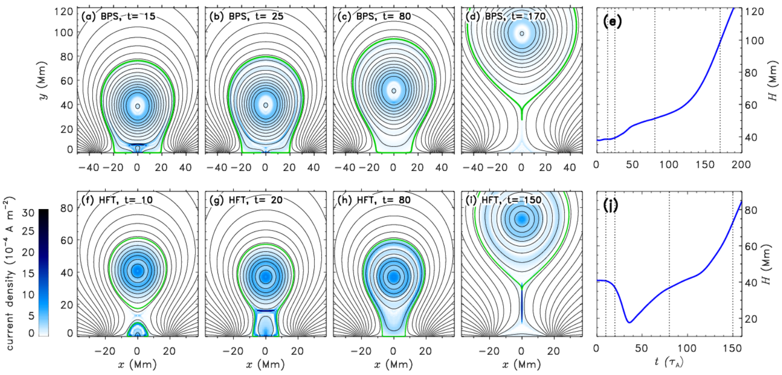

Figure 2. Eruptions caused by flux feeding. Panels (a)-(d) show the evolution of the magnetic configuration during the eruption of the flux rope in BPS configuration, with the blue color depicting the distribution of electric current; panel (e) is the corresponding height-time profile of the rope axis. Panels (f)-(j) are those for the HFT case.

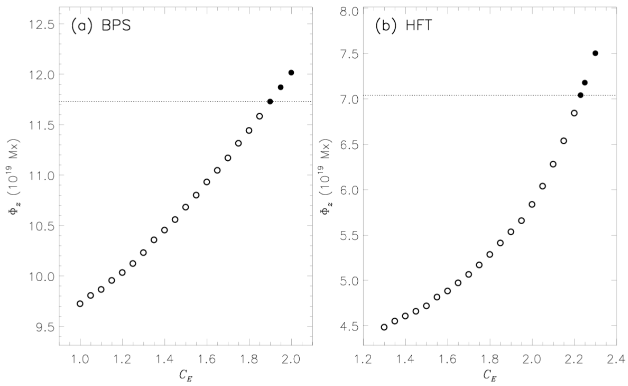

Figure 3. Axial magnetic flux of the resultant rope after flux feeding processes with different intensities. Larger C_E implies stronger flux feeding. The eruptive and non-eruptive cases are plotted by black dots and small circles, respectively.

References:

[01-Observation] Zhang, Quanhao, Liu, Rui, et al. (2014), "A prominence eruption driven by flux feeding from chromospheric fibrils", The Astrophysical Journal, 789, 133, doi: https://doi.org/10.1088/0004-637X/789/2/133.

[02-Simulation in BPS] Zhang, Quanhao, Wang, Yuming, et al. (2020), "Eruption of Solar Magnetic Flux Ropes Caused by Flux Feeding", The Astrophysical Journal Letters, 898, L12, doi: https://doi.org/10.3847/2041-8213/aba1f3.

[03-Simulation in HFT] Zhang, Quanhao, Liu, Rui, et al. (2021), "How flux feeding causes eruptions of solar magnetic flux ropes with the hyperbolic flux tube configuration", Astronomy and Astrophysics, 647, A171, doi: https://doi.org/10.1051/0004-6361/202039944.

Highlight on Young Scientists 4:

Relationship Between Geomagnetic Storms Occurrence and Ionospheric Irregularities on the West Sector of Africa During the Peak of the 24th Solar Cycle

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To measure the actual impact of the solar events on technology, we investigated the correlation between geomagnetic storm index Disturbance storm time index, Dst and ionospheric irregularities occurrences, in our case using the rate of change of TEC index (ROTI).

According to Loewe, (1997), geomagnetic storms can be classified into five groups based on the minimum value of Dst: weak ($-30 \geq Dst > -50$ *nT*), moderate ($-50 \geq Dst > -100$ *nT*), strong ($-100 \geq Dst > -200$ *nT*), severe ($-200 \geq Dst > -350$ *nT*), and great ($Dst \leq$ -350 *nT*).

ROTI is a good indicator of the existence of ionospheric irregularities and ROTI ≥0.5 indicates the occurrence of irregular ionospheric activities relevant to ionospheric scintillation (Yang & Liu, 2016). Ma & Maruyama, (2006), defined 4 levels of ROTI. He divided them in four distinct categories: 0 < ROTI < 0.5; 0.5 < ROTI < 1; 1 < ROTI < 1.5; 1.5 < ROTI < 2, and ROTI > 2.

The Global Navigation Satellite Systems (GNSS) data for our work was obtained from the Nigerian Permanent GNSS Network (NIGNET) and selected such that the receiver stations fell within the better part of Nigeria. The receivers majorly received data from satellites on the GPS and Global Navigation Satellite System (GLONASS) constellations. The geomagnetic data was obtained from the World Data Center in Kyoto (http://swdcdb.kugi.kyoto-u.ac.jp/dstdir/) for the entire period of study.

Observed were Periods Associated with the ROTI values. These were diurnal, semi-diurnal, a period of 12 hours-variation and a seasonal signature; the two seasons were believed to be equinoxes and the solstices.

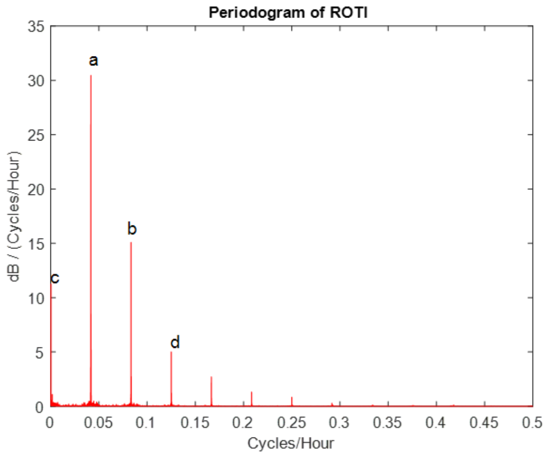

Figure 1. Periodogram of Hourly ROTI values for the year 2012.The peaks marked a to d are respectively centred at 0.04169, 0.08331, 0.00024, and 0.12500 Cycles/Hour respectively.

Next observed was minimal morning and daytime irregularities. In this work, some artificial seeding mechanisms could not be overruled just as it was in the case of Li et al., (2018).

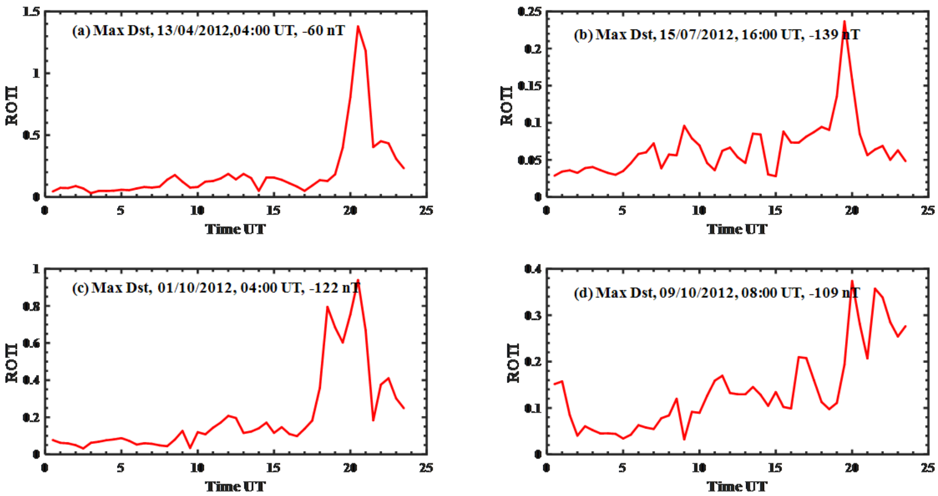

Figure 2. The variation of ROTI collectively computed from all stations in Table 1, with the time of the day, during geomagnetically active days. The minimum Dst indices ranged from -139 nT to -60 nT. The ROTI was calculated at 30 minutes' interval.

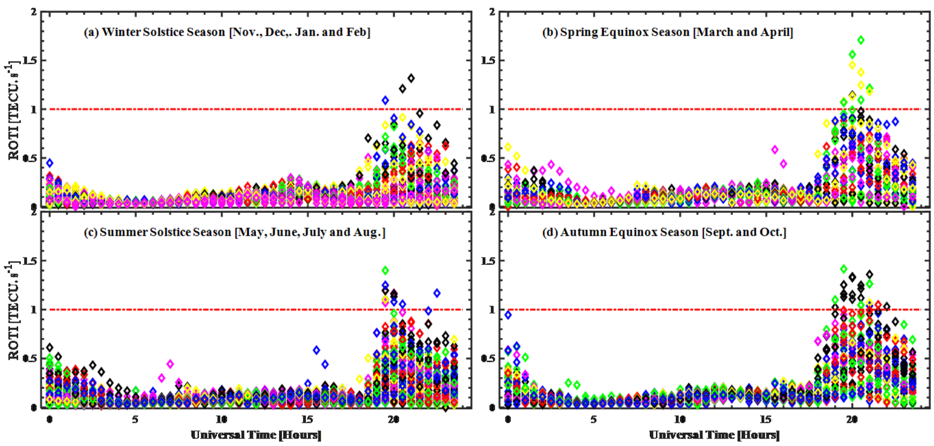

Figure 3. The seasonal Variations of the times of occurrences of the ionospheric irregularities as determined using ROTI. The horizontal red lines are put arbitrarily to help in comparison of the trends across the seasons.

We also observed irregularities predominantly at night. The nighttime irregularities were believed to be due to ionospheric plasma irregularities in the equatorial ionospheric F region. They developed under the unique condition of the low inclination geomagnetic field lines that confine the F region plasma to its low-latitude conjugate E layers.

It was evident that the geomagnetic storms were not absolutely responsible for technological impairment which could be occasioned by ionospheric irregularities as measured by ROTI. There were minimal correlations between geomagnetic indices, Dst and the irregularity parameters, ROTI.

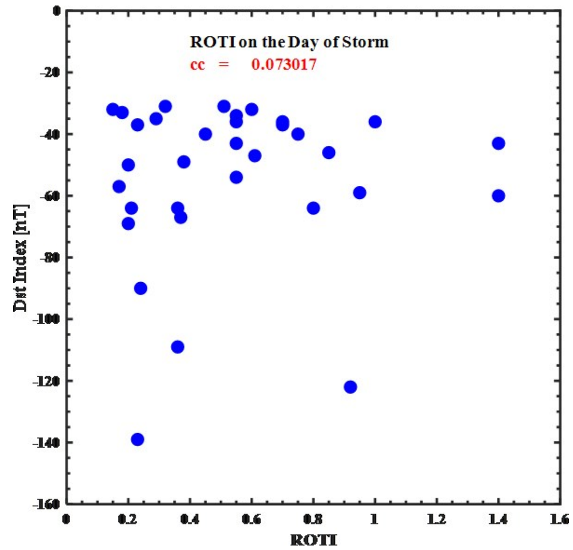

Figure 4. The plot of Dst against the ROTI on the day of storm. The value, cc, on the plot represent the correlation coefficient of the parameters plotted. Not all the Storm events were associated with ionospheric disturbances. Out of the 56 storms identified in Table 3, 36 were associated with nighttime ionospheric irregularities as evident by ROTI.

Statistical analysis of the seasonal variations indicated that the Equinox months had the highest percentage occurrences of ionospheric irregularities in general. This was in line with the finding of Makela et al., (2004).

Finally, during the peak of the 24th solar cycle, and particularly, 2012, there were more CME generated geomagnetic storms that CIR generated storms.

Storms Classification in Terms of Strength	Total CME Generated Storms (% In Brackets)	Total CIR Generated Storms (% In Brackets)	Grand Total No. of Storms Considered
Weak Storm	23(41.07)	3(5.36)	26(46.43)
Moderate Storm	11(19.64)	13(23.21)	24(42.86)
Strong Storm	0	6(10.71)	6(10.71)
Grand Total	34(60.71)	22(39.29)	56

Figure 5. A summary showing the Classification in terms of strength of all geomagnetic storms of Dst≤30 nT for the period between January 2012 and December 2012.The values in brackets represent the percentages.

Acknowledgements:

We appreciate the source of GNSS data. We also acknowledge the World Data Centre (WDC) for Geomagnetism, Kyoto Japan from whose website the geomagnetic data was obtained. We thank the Scientific Committee on Solar Terrestrial Physics (SCOSTEP), for providing him with the visiting scientist award 2020, which helped him carry out his work at the Space Environment Research Laboratory of the Centre for Atmospheric Research, Abuja. Special thanks to the Centre for Atmospheric Research, National Space Research and Development Agency (CAR-NASRDA), Nigeria for hosting me, facilitating the research work, for the financial and technical supports they gave, and for providing all that was necessary for the research.

References:

Li, G., Ning, B., Abdu, M. A., Wang, C., Otsuka, Y., Wan, W., Lei, J., Nishioka, M., Tsugawa, T., Hu, L., Yang, G., & Yan, C. (2018). Daytime F-region irregularity triggered by rocket-induced ionospheric hole over low latitude. Progress in Earth and Planetary Science, 5 (1). https://doi.org/10.1186/s40645-018-0172-y.

Loewe, C. A. (1997). Journal of Geophysical Research Volume 102 issue A7 1997 [doi 10.1029_96ja04020] Loewe, C. A.; Prölss, G. W. -- Classification and mean behavior of magnetic storms.pdf. 102.

Ma, G., & Maruyama, T. (2006). A super bubble detected by dense GPS network at east Asian longitudes. Geophysical Research Letters, 33(21), 1–5. https://doi.org/10.1029/2006GL027512.

Makela, J. J., Ledvina, B. M., Kelley, M. C., & Kintner, P. M. (2004). Analysis of the seasonal variations of equatorial plasma bubble occurrence observed from Haleakala, Hawaii. Annales Geophysicae, 22(9), 3109–3121. https://doi.org/10.5194/angeo-22-3109-2004.

Yang, Z., & Liu, Z. (2016). Correlation between ROTI and Ionospheric Scintillation Indices using Hong Kong low-latitude GPS data. GPS Solutions, 20(4), 815–824. https://doi.org/10.1007/s10291-015-0492-y.

Meeting Report 1:

STP-15 Symposium

Subramanian Gurubaran

Subramanian Gurubaran[1]
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Indian Institute of Geomagnetism (IIG) hosted the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)'s 15th Solar-Terrestrial Physics Symposium (STP-15) during 21-25 February 2022 (https://stp15.in). SCOSTEP, a worldwide scientific body under the International Science Council (ISC) organizes the Solar-Terrestrial Physics (STP) symposia once every four years. The aim of the STP-15 was to bring together experts, young scientists and young research students from solar, magnetospheric, ionospheric and atmospheric physics communities to discuss and deliberate on the frontline and up-to-date sciences pertaining to STP. Considering the regulations imposed by COVID-19 pandemic, STP-15 was conducted in a completely virtual mode.

The 15th Quadrennial Solar-Terrestrial Physics Symposium featured 8 scientific sessions:

- Session 1 encompassed the several overarching topics in the Sun-Earth Connection, broadly covering the various aspects of solar-terrestrial relationship.
- Sessions 2, 3 and 4 covered presentations from the three pillars of the Predictability of the Variable Solar-Terrestrial Coupling (PRESTO).
- Besides the Science, there were sessions that dealt with the prediction of space weather and its implementation (Session 5), besides modelling and data analysis tools to address challenging problems in STP (Session 6).
- Another session dealt with the new ground- and space-based initiatives for STP research (Session 7).
- As Geomagnetism provides an important link between the Sun and Earth, one special session was dedicated to this topic (Session 8).

The scientific deliberations were spread over 5 days and in 5 time slots, each time slot of 80 min duration, with 2 time slots between 0300 and 0640 GMT and 3 time slots between 1100 and 1630 GMT. There were invited talks of 15 min or 30 min duration. Each solicited paper was of 10 min duration. In total we had 343 papers scheduled over five days. The 30-min breakout sessions following the main sessions were a key feature in the organization of STP-15 and the manner in which they were conducted received applause from a wide section of participants.

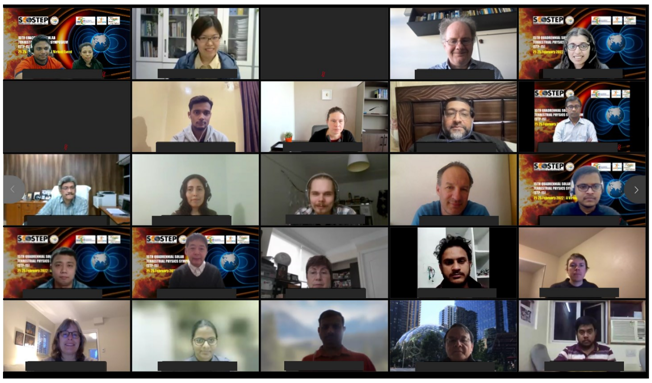

Figure 1. Online group photo of the participants of the STP-15 symposium.

There were 4 Keynote lectures:

- Dr. Drew Turner gave a talk on the solar wind driving of the Earth's magnetosphere-ionosphere-atmosphere system.
- Dr. Thomas Immel spoke about NASA's ICON mission.
- Dr. Robert Cameron provided some thoughts on the physical basis of the solar cycle prediction.
- Dr. Dipankar Banerjee elaborated on the Aditya-L1, India's Space Observatory to study the Sun.

The STP-15 Symposium received an overwhelming response with nearly 480 registered users on https://stp15.in. We had representations from 40 countries with over 350 registered participants. A large number of student and regular participants from colleges and universities of low and middle income group countries were provided with the registration fee waiver.

Just before STP-15, a 2-day student Workshop on Solar-Terrestrial Physics for Students and Young Scientists (STEPSYS) was organized during 19-20 February 2022 for the benefit of students and young researchers by arranging tutorials/lectures by eminent scientists on topics ranging from the Sun, its interior and its atmosphere, through the magnetosphere-ionosphere system and reaching the Earth. The speakers were B. R. Arora, D. Nandi, Ramon Lopez, Jens Oberheide, Annika Seppala, Mamoru Ishii, D. Pallamraju and G. K. Rangarajan. The lectures were of one-hour duration with 30-min interaction with the participants.

Upcoming meetings related to SCOSTEP

Conference	Date	Location	Contact Information
Iberian Science Summer School (i4s 2022)	Jun. 6-10, 2022	Madrid, Spain	https://www.i4s-iberian-space-science-summer-school.com/
14th Workshop "Solar Influences on the Magnetosphere, Ionosphere and Atmosphere"	Jun. 6-10, 2022	Primorsko, Bulgaria	
The Second Summer School on Space Research, Technology and Application	Jul. 3-10, 2022	Rozhen, Bulgaria	https://bulgarianspace.online/second-summer-school_2022/
COSPAR 2022	Jul. 16-24, 2022	Athens, Greece	http://www.cosparathens2022.org/
AOGS 2022	Aug. 1-5, 2022	Online	https://www.asiaoceania.org/aogs2022/public.asp?page=home.asp
International Beacon Satellite Symposium	Aug. 1-5, 2022	Boston, MA, USA	https://www.bc.edu/bc-web/research/sites/institute-for-scientific-research/events-conferences/bss2022.html
16th International Symposium on Equatorial Aeronomy (ISEA-16)	Sept. 12-16, 2022	Kyoto, Japan	http://www2.rish.kyoto-u.ac.jp/isea16/
8th International Space Climate Symposium (SC8)	Sept. 19-22, 2022	Krakow, Poland	https://spaceclimate8.uph.edu.pl/
European Space Weather Week 2022	Oct. 24-28, 2022	Zagreb, Croatia	https://www.stce.be/esww2022/
Summer Space Weather School - Physics and use of tools	In October, 2022	Houphouët Boigny University, Abidjan, Côte d'Ivoire	
AGU Fall Meeting 2022	Dec. 12-16, 2022	Chicago, IL, USA	https://www.agu.org/fall-meeting
IUGG 2023	Jul. 11-20, 2023	Berlin, Germany	https://www.iugg2023berlin.org/
AGU Fall Meeting 2023	Dec. 11-15, 2023	San Francisco, CA, USA	https://www.agu.org/fall-meeting

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

Announcement 1:

SCOSTEP/PRESTO Grants for 2022

Patricia Doherty

Patricia Doherty[1]
[1]Institute for Scientific Research (ISR), Boston College, Boston, MA, USA

SCOSTEP/PRESTO provides annual support for organizing scientific meetings, campaigns and database development. Announcements of opportunity were released in early November 2021 with a December 31, 2021 deadline.

Proposals must be related to one or more PRESTO Pillars and contribute to PRESTO activities. Proposals for these opportunities were announced in October 2021 with a deadline of December 31, 2021.

The following proposals were selected for funding meeting and/or campaigns:

Title	Submitted by	Location of the Event	Date	Requested Amount (US$)	Purpose of the Funds
Meeting Support for European Space Weather Week 2022	Mateja Dumbović	Zagreb, Croatia	24-28 October, 2022	$5,000	Accommodation and registration fees for ~6 people
Meeting on Extreme Solar Particle Storms on Earth	Stepan Poluianov	Rokua, Finland	28-30 March, 2022	$3,000	Accommodation and travel expenses for experts outside Finland
Organization of the 8th International Space Climate Symposium (SC8)	Agnieszka Gil and Kalevi Mursula	Krakow, Poland	19-22 September, 2022	$5,000	Registration fees and living costs for young researchers
Meeting Support for the International Beacon Satellite Symposium	Keith Groves	Boston, MA, USA	1-5 August, 2022	$5,000	Participant expenses for young scientists and/or graduate students to attend the symposium
14th Workshop "Solar Influences on the Magnetosphere, Ionosphere and Atmosphere"	Boian Kirov and Katya Georgieva	Primorsko, Bulgaria	6-10 June, 2022	$5,000	Registration fees, travel, accommodation and per diem for PhD students, postdocs and young scientists

The following proposals were selected for funding database developments:

Title	Project Coordi-	Affiliation	Country	Requested	Purpose of the Funds
Database for Unambiguous identification of Waves in the Inner Heliosphere (DUWI)	Jiansen He	Peking University	China	$5,000	Software, manpower, publication, website maintenance
Database of the ionosonde and magnetometer data recorded during the AIEE campaign in 1992-2001 period	Oliver Obrou	Université Félix Houphouët-Boigny	Côte d'Ivoire	$5,000	Equipment, website design, software building, travel expenses
Argentinian-Chilean validated ionospheric database	Maria Graciela Molina (Argentina) and Elias Ovalle (Chile)	Universidad Nacional de Tucumán and Universidad Adventista de Chile	Argentina and Chile	$3,400	Additional storage in the cloud and server, ionogram interpreters, software developer
Catalog of Auroral Kilometric Radio emissions for solar-terrestrial physics	Corentin Louis and Caitriona Jackman	Dublin Institute for Advanced Studies (DIAS)	Ireland	$5,000	Software intern to refine the code and label the AKR bursts and LFEs in the Wind data
Improvement of GLE database - providing verified records for systematic analysis of strong SEP events and assessment of their terrestrial effects	Alexander Mishev and Ilya Usoskin	University of Oulu	Finland	$5,000	Software development, summer student

Announcement 2:

SCOSTEP 2022 Distinguished Scientist Award

SCOSTEP is pleased to announce that the

2022 Distinguished Scientist Award is given to

David J. McComas

Professor David J. McComas

Princeton University, Princeton, NJ, USA

Citation: For original research, technical leadership and wide-ranging discoveries that have significantly advanced our knowledge and understanding of the global structure and evolution of the solar wind and revolutionized our understanding of its interactive stellar medium.

Professor David McComas is Professor of Astrophysical Sciences at Princeton University, and Vice President for Princeton Plasma Physics Laboratory. He has a long record of contributions to Solar-Terrestrial research in the form of distinguished service and cutting-edge research.

Professor McComas has contributed significantly to experimental physics, to space plasma physics in the magnetosphere and in the interplanetary medium, and to plasma astrophysics. His work has had major impact on theoretical descriptions of space physics. His published work is prolific and highly cited, with approximately 750 refereed papers and more than 41,000 citations on google Scholar. He is a superb leader in service, chairing and participating in key NASA advisory committees, and in the planning of a number of missions of discovery.

Professor McComas is the principal investigator (PI) of important plasma instruments including the plasma instrument in Ulysses (SWOOPS) and the proton-electron instrument in the Advanced Composition Explorer (ACE – SWEPAM). These instruments have been key in discovering much of what we know about the three dimensional structure of the heliosphere and the properties of the interplanetary medium near Earth orbit. Another major area of accomplishment is the Interstellar Boundary Explorer, or IBEX, mission, with instruments of his design and construction. IBEX has during the past decade, returned data that for the first time describes the plasma interaction of the solar system with the interstellar medium. This truly notable accomplishment was among the top NASA science stories a few years ago and continues to inspire many theoretical and numerical studies to explain these findings. David is also PI of the IMAP mission, selected in 2018 and scheduled for launch in 2024. IMAP will dramatically expand the scientific capabilities of IBEX. IMAP also provides a solar wind monitor at the L1 Lagrange point, an essential resource for space weather applications. IBEX and IMAP represent a prodigious legacy of impact on heliospheric physics.

A current mission that is very much in the public eye is the Parker Solar Probe Mission, a monumental community effort in which Prof. McComas once again played a key role in leadership and science. David was Chair of two Science and Technology Definition teams that formulated both the science and required technology to implement this generational mission. He is, furthermore, PI of the ISOIS suite on the Parker Solar Probe, consisting of two energetic particle instruments; these instruments are uniquely responsible for attaining one of the three major science goals of the mission- to understand the origin and propagation of energetic particles in the inner heliosphere.

For all of his accomplishments, Professor David J. McComas has contributed at the highest level within the field of SCOSTEP science and is most deserving of the SCOSTEP Distinguished Science Award.

Announcement 3:

SCOSTEP 2022 Distinguished Young Scientist Award

SCOSTEP is pleased to announce that the

2022 Distinguished Young Scientist Award is given to

Dr. Theodosios Chatzistergos

Max Planck Institute for Solar System Research, Göttingen, Germany

Theodosios Chatzistergos

Citation: For his tremendous and unprecedented work on exploiting the potential of historical solar observations for cardinal improvement reconstructions of past solar variability, a crucial input to climate models.

Dr. Theodosios (Theo) Chatzistergos obtained his BSc in Physics (Astrophysics) from the National and Kapodistrian University of Athens, Greece (2011), MSc in Astrophysics, with distinction, from the Queen Mary University, London, UK (2013), and PhD (2017) from Georg-August University of Göttingen, Germany. Between 2018 and 2020 he was a postdoc at the Istituto Nazionale di Astrofisica (INAF) - Osservatorio Astronomico di Roma, Italy, and is currently a postdoc in the "Solar Variability and Climate" group at the Max Planck Institute for Solar System Research, Göttingen, Germany, working for the project "Modelling and Understanding Solar Irradiance Changes" in frame of the German national programme "Role of the Middle Atmosphere in Climate" (ROMIC), closely related to SCOSTEP.

Since 2013, when Theo started working on his PhD project, his work has focused on uncovering and understanding solar magnetic activity over the past centuries, a topic of immense importance for Earth's climate science and Heliospheric physics. The key input to studies of long-term solar activity and variability are historical solar observations. Unlike the immense richness of data available to those studying the present-day Sun and the heliosphere, understanding the physics and the behavior of the Sun on longer time scales has to rely on data of significantly poorer coverage and quality. Therefore, historical archives, such as sunspot observations or photographs of the Sun, are of irreplaceable value for understanding the long-term changes in the behavior of the Sun. The information stored in such archives, however, must first be "unlocked". That is, the historical data must often be cleaned of artefacts and calibrated before they can be used in a meaningful way. This is where Theo made giant strides. He has literally produced the key to unlocking the unique potential of precious historical solar data. It needs to be stressed that the correction and analysis of the historical data are extremely tricky and challenging. But Theo managed to make almost all the images usable, including many that originally seemed impossible to correct. This work is beneficial to solar-terrestrial research.

Theo's competence, as well as the magnificent quality and thoroughness of his research have already brought high recognition by the international scientific community. He has given invited talks and lectures at international conferences and schools. He was invited to join the international ISSI team on recalibration of sunspot number series and to lead one of the science topic teams on the Indian Aditya-L1/SUIT mission, which is expected to finally shed light on another key question of solar irradiance studies: the magnitude of the irradiance variability in the UV range 200-400 nm. Finally, Theo is also very actively involved in public outreach activities focusing on the solar influence on Earth's climate, by participating in the relevant dedicated events and using internet platforms.

For all of these accomplishments, Dr. Theodosios Chatzistergos is most deserving of the SCOSTEP Distinguished Young Scientist Award.

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.

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