SCOSTEP
Scientific Committee on Solar-Terrestrial Physics

SCOSTEP/PRESTO NEWSLETTER

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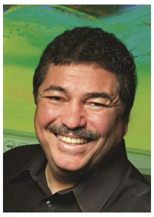
Article 1:

Introducing PRESTO – Predictability of the Variable Solar-Terrestrial Coupling

R.E. Lopez[1], K. Matthes[2,3] and J. Zhang[4]
[1]University of Texas at Arlington, Arlington, TX, USA
[2]Helmholtz Center for Ocean Research Kiel, Kiel, Germany
[3]Christian-Albrechts-Universität zu Kiel, Kiel, Germany
[4]George Mason University, Fairfax, VA, USA


Ramon E. Lopez


Katja Matthes


Jie Zhang

PRESTO (PREdictability of the variable Solar-Terrestrial cOupling) is a science program that seeks to improve the predictability of energy flow in the integrated Sun-Earth system on times scales from a few hours to centuries through promoting international collaborative efforts. PRESTO is sponsored by

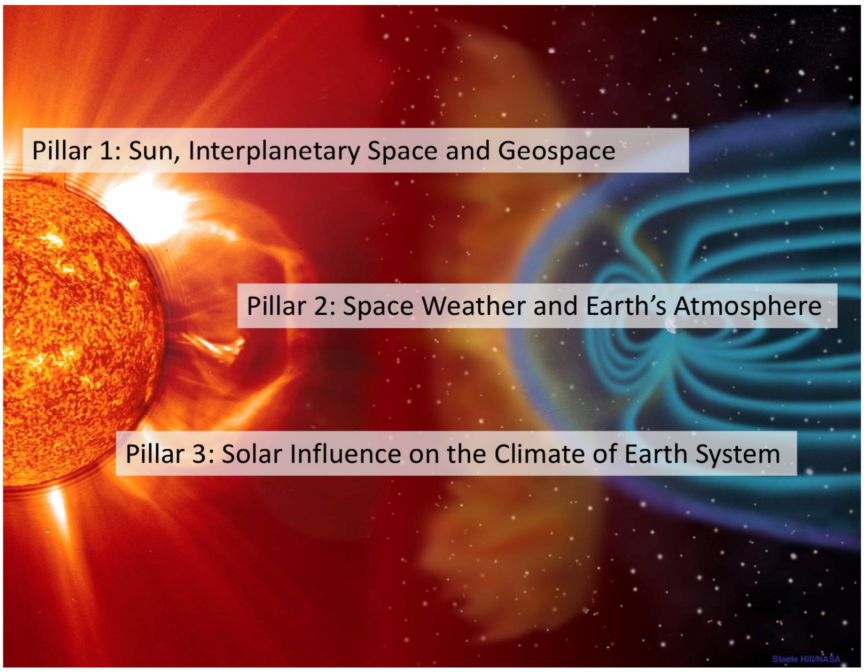


Figure 1. Three Pillars of PRESTO program.

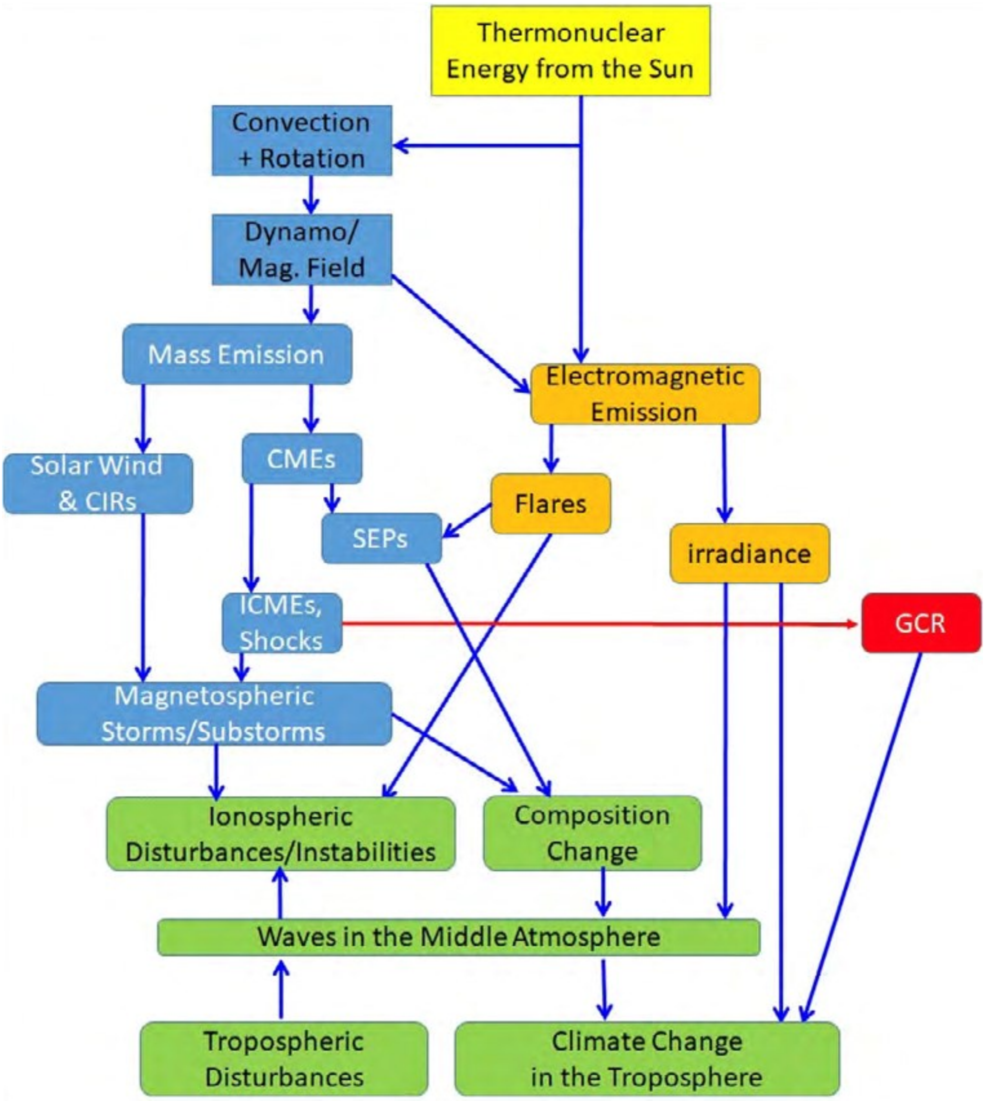


Figure 2. Energy flow in the solar-terrestrial system.

SCOSTEP, the Scientific Committee on Solar Terrestrial Physics. SCOSTEP is the only organization dealing with the coupled solar-terrestrial system under the umbrella of the International Science Council (ISC). PRESTO (2019 – 2023) is the latest program of SCOSTEP in the modern space era, following a number of programs such as CAWSES (2004-2008), CAWSES-II (2009-2013) and VarSITI (2014-2018).

The Sun is a variable star and its variability influences the Earth's space environment. Furthermore, changing solar magnetic fields, radiative and energetic particle fluxes force the Earth's atmosphere and climate. Transient energetic events such as flares, coronal mass ejections (CMEs), interplanetary shocks, stream interaction regions (SIRs), corotating interaction regions (CIRs) and energetic particles adversely impact critical technologies based in space and on Earth that our society is increasingly dependent upon. At the same time, the middle and upper atmosphere/ionosphere are impacted by processes originating at lower altitudes, e.g., by atmospheric gravity waves, tides and planetary waves and changes in radiatively active gases. Solar influence on climate is gaining increasing attention since variations in solar activity do not only impact middle atmosphere chemistry and physics, but have been shown to impact decadal variability at the Earth surface. This is in particular interesting and important for decadal climate predictions. With the enhanced understanding of causal connections in the Sun- Earth system maturing over the last several decades, fueled by both observations and theoretical modelling, we are in the position to transform this understanding to improved predictions of the Sun-Earth coupled system, which is of relevance to the society and the focus of the current PRESTO program.

PRESTO is comprised of 3 pillars, Pillar 1: Sun, Interplanetary Space and Geospace; Pillar 2: Space Weather and the Earth's Atmosphere; Pillar 3: Solar Activity and Its Influence on the Climate of the Earth System. A detailed PRESTEO presentation is available at http://www.issibj.ac.cn/Publications/ Forum_Reports/201404/ W020190620592906717714.pdf.

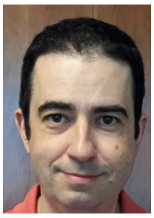
Article 2:

Pillar 1: Sun, interplanetary space and geospace

A. Jaynes[1], E. Kilpua[2] and S. Patsourakos[3]
[1]Department of Physics & Astronomy, University of Iowa, Iowa City, IA, USA
[2]University of Helsinki, Helsinki, Finland
[3]Section of Astro-Geophysics, Department of Physics, University of Ioannina, Ioannina, Greece


Allison Jaynes


Emilia Kilpua


Spiros Patsourakos

Background

Heliospheric transients originating from the Sun, stream interaction regions (SIRs), fast streams, coronal mass ejections , as well as Solar Energetic Particles (SEPs) are key agents driving disturbances in geospace. Their formation and evolution, solar wind - magnetospheric coupling and ensuing magnetospheric dynamics form a complex chain. Predicting accurately and reliably various geospace disturbances, including changes in near-Earth plasma waves and radiation environment, requires understanding the key aspects of related phenomena, physical processes and their interplay from Sun to Earth operating over timescales ranging from milliseconds to days. Despite significant advancements in the field, long-lead time predictions require still major improvements. There are for example often significant uncertainties, related to CME parameters and boundary conditions that are fed into the advanced numerical simulations, empirical and semi-empirical forecasting models. Improved physical understanding of their nature and geometry and complex interaction properties will also improve predictions.

Science questions

Question 1.1: Under what conditions are solar eruptions, CMEs, and SEPs produced, and which indicators of pre-CME and pre-flare activity are reliable?

Question 1.2: What are the required/critical model input parameters for most successfully forecasting the arrival of SEPs and the geoeffectiveness of CMEs, SIRs/CIRs and the consequences of the interactions between SIRs/ CIRs and CMEs?

Question 1.3: How are different magnetospheric disturbances and waves (which are critical for the ring current and radiation belt dynamics) driven by variable solar wind structures, and/or internal magnetospheric processes?

Plan of action

The plan of key actions includes

- Set-up designated working groups to address Questions 1.1-1.3;
- Build a database of events populated with the corresponding observational and simulation data along the entire Sun-to-geospace chain (e.g., solar source regions, coronal and IP evolution, geospace response);
- Perform synergistic studies of these events with main focus the predictability of various key parameters thereof;
- Take full advantage of current (e.g., SoHO, Hinode, STEREO, SDO, PSP, DKIST, THEMIS, MSS, Van Allen Probes, Arase) and upcoming (SolO, BepiColombo) space and ground-based observations;
- Take full advantage of recent advances in modeling (e.g., increase of realism of initial and boundary conditions in solar, heliospheric and magnetospheric simulations; data-assimilation techniques, ensemble studies) and explore their optimal coupling of these models;
- Identify areas of improvement in the corresponding sub-domains (solar, IP and geospace) as well as of their coupling;
- Supply recommendations for future studies, instrumentations and models.

Article 3:

Pillar 2: Space weather and Earth's atmosphere

L. C. Chang[1], D. Pallamraju[2] and N. M. Pedatella[3]
[1]Department of Space Science and Engineering, National Central University, Taoyuan City, Taiwan
[2]Space and Atmospheric Sciences Division, Physical Research Laboratory, Ahmedabad, India
[3]High Altitude Observatory, National Center for Atmospheric Research, Boulder, CO, USA


Loren C. Chang


Duggirala Pallamraju


Nick M. Pedatella

The thermosphere and the ionosphere are conventionally known to be directly affected by the varying magnitudes of solar activity. When incidence of solar flux or energetic charged particles increases suddenly due to the occurrence of solar flares or coronal mass ejections combined with magnetic reconnection in the Earth's magnetosphere, the adverse effects witnessed in the ionosphere-thermosphere (IT) system as a whole are referred to as Space Weather effects. Consequently, these space weather effects lead to adverse effects in several space and ground-based applications as illustrated in Figure 1. These effects and consequences are to be understood at both fundamental and applications levels.

More recently, it has been recognized that waves originating in the lower atmosphere are an additional important source of IT variability. These waves encompass a vast range of temporal (minutes to weeks) and spatial (few kms to global) scales, and introduce a similarly large range of spatial and temporal variability in the IT. Changes in the IT due to wave-driven processes can reach magnitudes similar to moderate geomagnetic storms, illustrating their importance in modifying the IT system. Furthermore, wave-driven processes introduce variability in the entirety of Earth's atmosphere, as shown in Figure 2, which illustrates the numerous aspects of atmospheric variability that occurs in large scale phenomenon such as in sudden stratospheric warming events.

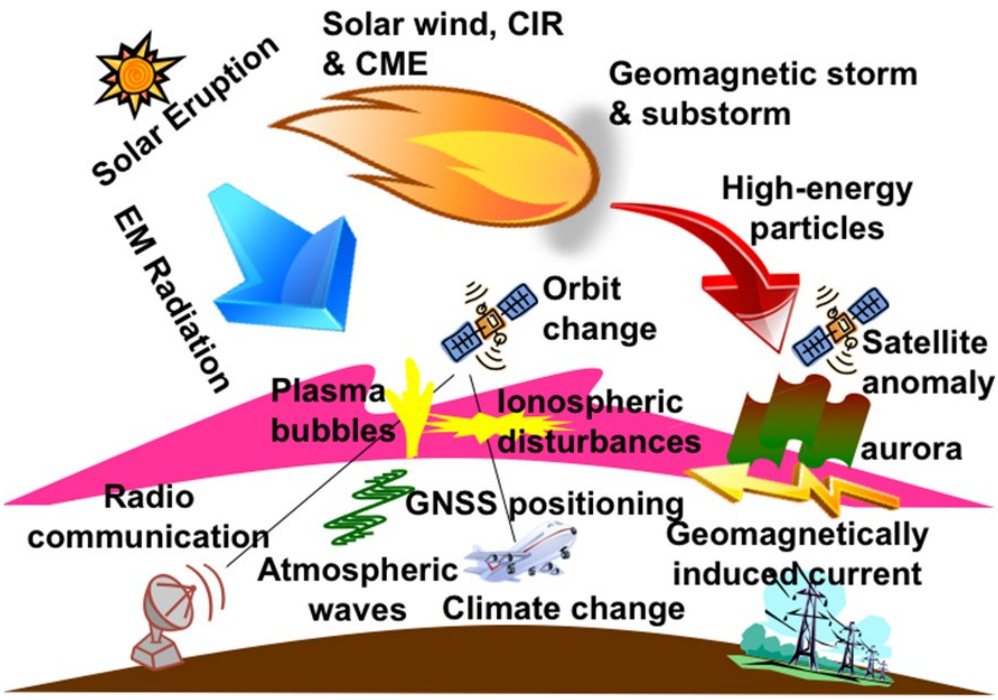


Figure 1. Illustration of the sources of ionosphere-thermosphere variability, as well as the effects of Space Weather on societal infrastructure. (Image credit: K. Shiokawa, reproduced from No. 13 of Taikong Magazine available online: http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf)

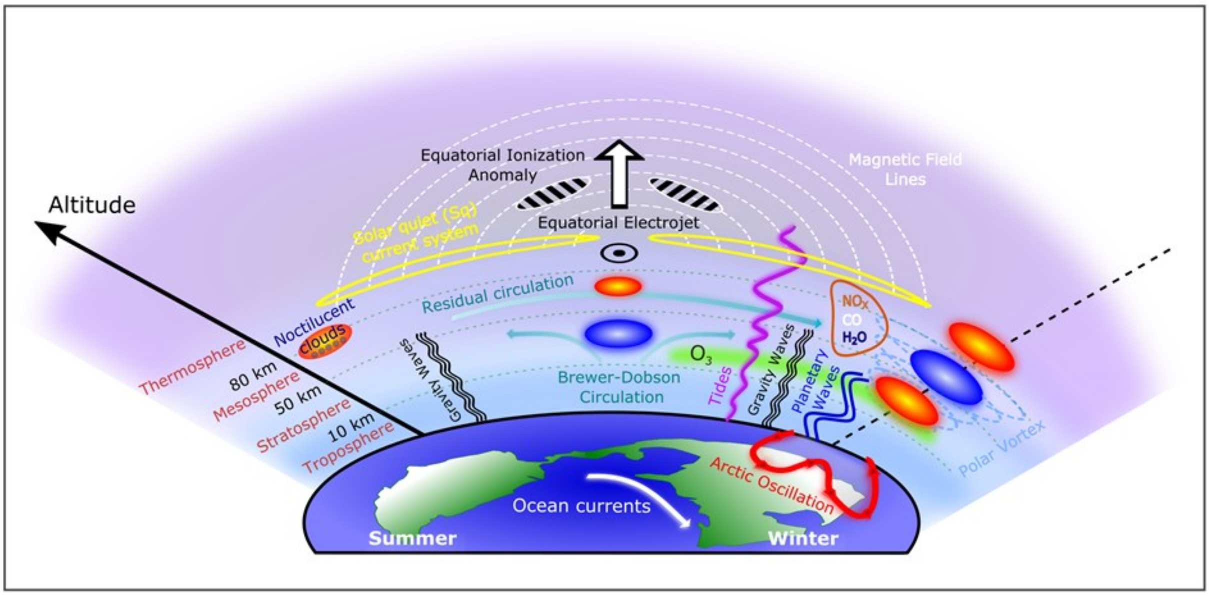


Figure 2. Schematic diagram of the coupling processes that occur throughout the whole atmosphere during sudden stratosphere warming (SSW) events. Red and blue circles denote regions of warming and cooling, respectively. (From Pedatella et al., 2018; https://eos.org/features/how-sudden-stratospheric-warming-affects-the-whole-atmosphere).

In order to enhance the predictive capability of the IT spatial and temporal variability, it is necessary to understand how the IT system is affected by both coupling from above and below. Several features that are formed and/or affected due to these effects are plasma irregularities, plasma bubbles, ion-drifts, ionospheric currents, thermospheric densities and composition, neutral winds and waves, etc. These features adversely affect trans-ionospheric radio communication, high frequency terrestrial radio propagation, thermal and drag environments for spacecraft in the increasingly congested Low Earth Orbit (LEO, < 2000 km) region. In order to improve the understanding and predictability of the middle and upper atmosphere, Pillar-II of PRESTO aims to address the following main scientific questions:

Q2.1 How does the thermosphere and ionosphere respond to various forcings from above and from below?

Q2.2 How do atmospheric waves and composition changes impact the middle and upper atmosphere?

Q2.3 What is the magnitude and spectral characteristics of solar and magnetospheric forcing, needed for accurate predictions of the atmospheric response?

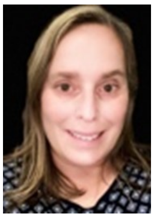
Q2.4 What is the chemical and dynamical response of the middle atmosphere to solar and magnetospheric forcing?

Recent improvements in observational and modeling capabilities make addressing these questions timely. Current global observational infrastructure provides an unprecedented view of the IT system from both ground and space based instrumentation. Combined with recent modeling developments, such as whole atmospheric models that extend from the surface to the upper thermosphere, it will be possible to make significant progress in addressing Q2.1-2.4 in the coming years. We invite and encourage active participation from the global community in advancing understanding of any of the questions mentioned above.

Article 4:

Pillar 3: Solar activity and its influence on climate

O. Coddington[1], J. Jiang[2] and E. Rozanov[3]
[1]LASP, University of Colorado, Boulder, CO, USA
[2]Beihang University, Beijing, China
[3]PMOD/WRC, Davos and IAC ETHZ, Zurich, Switzerland


Odele Coddington


Jie Jiang


Eugene Rozanov

Background

The next 5 years spanning the start of Solar Cycle 25 through its (near) peak provide an excellent opportunity for evaluating our understanding and ability to predict solar activity on decadal time scales. Predictability requires improved understanding of the physical pathways wherein solar variability impacts the atmosphere, from the magnetosphere through the troposphere. The nonlinear and stochastic mechanisms which modulate the solar cycle and affect the scope of the prediction and predictability of the solar cycle are still open questions. In some areas, decadal-scale solar forcing remains to be quantified to climate-relevant accuracies, which challenge our ability to determine causal connections in the pathways explaining solar forcing impacts on climate. Furthermore, due to wave-driven coupling in the atmosphere, improving predictability of solar forcing also requires improved characterization of the atmosphere-ocean response to the forcing.

The activities of this PRESTO pillar are organized around these science questions:

1. How will future solar activity vary over different timescales and what are the physical reasons for the variations?
2. How will the solar forcing on the Earth's system evolve in the future?

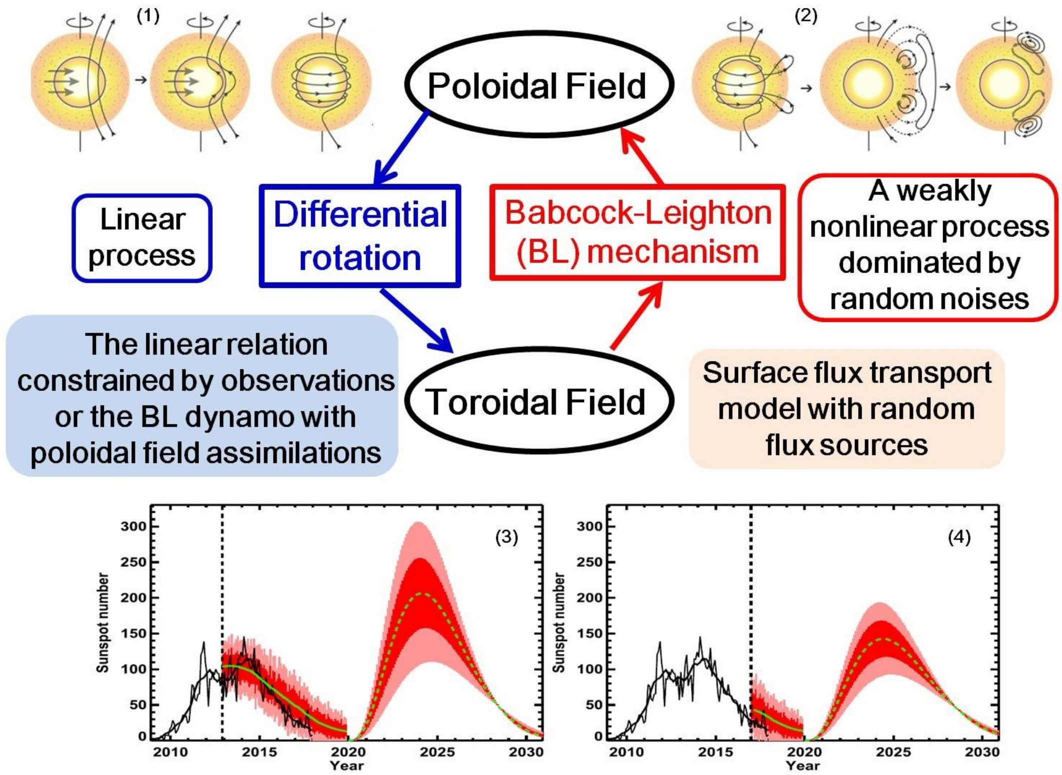


Figure 1. Scheme of the physics-based solar cycle prediction/predictability. The loop shows the major physical processes of the Babcock-Leighton-type dynamo with the illustrations by the cartoons (1) & (2) (from Sanchez et al.,2014). The texts within the rounded rectangle textboxes give the properties of the oscillation between the poloidal field and the toroidal field. The shaded frames present the methods/models to predict the solar cycle at different phases of the cycle. The lower panels, i.e., (3) & (4) from Jiang et al. (2018), are to emphasizing that the random noises in the poloidal field generation bring the uncertainty of the poloidal field generation at cycle minimum, which determines the subsequent cycle strength. The uncertainty accumulates with time. This significantly limits the scope of the cycle prediction. (Credit: Jie Jiang)

3. What is the role of the coupling between atmospheric regions in the realization of the long- and short-term solar influence on the Earth system and how are those responses affected by increasing green-house gases?

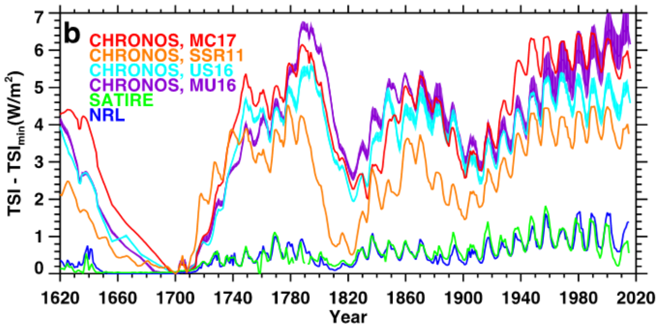


Figure 2. Reconstructions of the total solar irradiance evolution since 1620 (Egorova et al., 2018). The figure emphasizes uncertainties in the solar irradiance reconstructions. This figure is courtesy of Tatiana Egorova (PMOD/WRC).

Goals and objectives

1. Understand physical reasons behind the variations of solar magnetic activity on different time scales.
2. Characterize different types of the direct solar forcing on the Earth's system: spectral solar irradiance, open flux, and energetic particles.
3. Evaluate solar activity and solar forcing evolution in the past including extreme events.
4. Develop scenarios of the solar magnetic activity and direct solar forcing variations in the future.

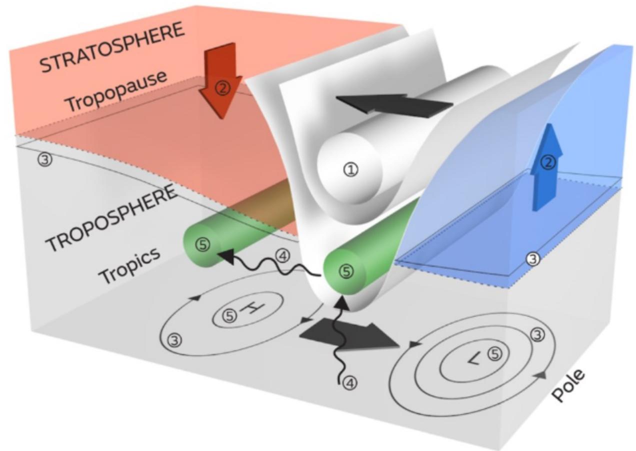


Figure 3. Schematic diagram of the stratospheric downward influence. Speed up of the stratospheric jet caused by solar UV or energetic particle precipitation enhancements invokes the chain of physical processes (Kidston et al., 2015) resulting in a net poleward shift of both the tropospheric jet and the tracks of surface cyclones. This figure is courtesy of Steven Hardiman, Adam Scaife, and Neal Butchart (Met Office Hadley Centre). The figure illustrates how direct stratospheric impact of the solar spectral irradiance or energetic particle forcing can propagate down and modulate surface climate/weather.

5. Assess the effectiveness of different atmospheric regions for the long- and short-term response of the Earth system to solar influence.
6. Elucidate the dependence of atmospheric response to different solar forcing on the state of the background climate system.
7. Analyze the potential of the solar activity predictions for the improvement of atmospheric prediction on sub-seasonal to decadal timescales.

Structure

The work in these directions will be performed in the framework of three working groups (WGs). The WG activity will be concentrated on solar cycle variability and predictability (WG1); solar forcing (irradiance and energetic particles) variability and predictability (WG2); and solar activity influence on climate and prediction on different timescales (WG3).

Anticipated outcomes

We anticipate making progress in understanding the physical processes driving solar magnetic activity evolution. This knowledge will be used to define several possible scenarios for future solar activity level with their uncertainties and probability estimates. Similar scenarios for the spectral solar irradiance and energetic particle precipitation will be built from the projected level of solar activity. The studies of the Earth's responses to the solar forcing will provide information about its importance for the predictability of the climate on different time scales.

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Jiang, J., Cameron, R., Schüssler, M., Effects of the Scatter in Sunspot Group Tilt Angles on the Large-scale Magnetic Field at the Solar Surface, ApJ, 791, 5, 2014

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Kidston, J., A. Scaife, S. Hardiman, D. Mitchell, N. Butchart, M. Baldwin and L. Gray, Stratospheric influence on tropospheric jet streams, storm tracks and surface weather. Nature Geosci 8, 433–440, doi:10.1038/ngeo2424, 2015.

Sanchez, S., Fournier, A., Aubert, J., The Predictability of Advection-Dominated Flux-Transport Solar Dynamo Models, ApJ, 781, 8, 2014.

Meeting Report 1:

COSPAR Capacity-Building Workshop

C. Kathiravan
Indian Institute of Astrophysics,
Koramangala, Bangalore, India

C. Kathiravan

Figure 1. Group Photo of Participants.

The main objective of the COSPAR Capacity-Building Workshop conducted at Kodaikanal Solar Observatory during January 6-17, 2020 (https://www.iiap.res.in/COSPAR_KSO2020/) is to encourage the scientific use of space and ground based data by scientists and young researchers from developing countries (https://www.iiap.res.in/COSPAR_KSO2020/?q=participants). This two-week workshop had two major components: (1) Introductory Lecturers (first week), and (2) The hands-on training session (second week). Scientists and young researchers from India, Africa, and Sri Lanka, took part in the program. The results obtained during the workshop are available in the form of presentations (https://www.iiap.res.in/ COSPAR_KSO2020/?q=analysis) in the workshop website. It is being planned to publish the results in peer refereed journals. Thus, this Capacity-Building workshop had provided a highly practical training to the young researchers which is expected to promote the research and developmental activities in the related research fields.

Scientific Organizing Committee: Nat Gopalswamy (USA, Chair), Christian Monstein, (Switzerland), Divya Oberoi (India), P. K. Manoharan (India), Nandita Srivastava (India), Pertti Makela (USA), Prasad Subramanian (India), Raffaella D'Amicis (Italy, COSPAR), S. P. Rajaguru (India), K. B. Ramesh (India), R. Ramesh (India), Seiji Yashiro (USA, Data Coordinator), A. Shanmugharaju (India), G. Thejappa (USA), C. Kathiravan (India), E. Ebenezer (India).

Local Organizing Committee: M. N. Anand, E. Ebenezer (Co-Chair), G. V. S. Gireesh, V. Indrajit, C. Kathiravan (Co-Chair), P. Kumaravel, D. Parthiban, M. Rajalingam, R. Selvendran, C. Vivek, A. M. Udayakumar

Sponsors: COSPAR, ISWI, IIA, DST (India), NASA and SCOSTEP

Announcement 1:

Deadline Extension for Submission on JASTP Special Issue of VarSITI2019 and STP-14

Kazuo Shiokawa
Center for International Collaborative Research (CICR), Institute for Space-Earth Environmental Research (ISEE), Nagoya University, Nagoya, Japan

Kazuo Shiokawa

The deadline for submitting papers to the special issue of VarSITI2019 and STP-14 in Journal of Atmospheric and Solar-Terrestrial Physics (JASTP) has been extended to February 28, 2020. For submission of your manuscript, please visit the following website.

Submission page: https://www.evise.com/profile/#/ATP/login

(Log in with EVISE account, choose Start New Submission. During the submission process, author will be asked to choose an Article Type. Choose VSI: VarSITI2019 and STP-14).

Guest Editors of the special issue

Kazuo Shiokawa (Institute for Space-Earth Environmental Research, Nagoya University, Japan)

Rositsa Miteva (Institute of Astronomy and National Astronomical Observatory, Bulgaria)

Sergio Dasso (Universidad de Buenos Aires, Instituto de Astronomíay Física del Espacio (IAFE), Buenos Aires, Argentina)

Shunrong Zhang (MIT Haystack Observatory, USA)

Duggirala Pallamraju (Physical Research Laboratory, Navrangpura, Ahmedabad, India)

Upcoming meetings related to SCOSTEP

Conference	Date	Location	Contact Information
EGU General Assembly 2020	May 3-8, 2020	Vienna, Austria	https://www.egu2020.eu/
8th International HEPPA-SOLARIS 2020 Meeting	Jun. 8-10	Bergen, Norway	https://heppasolaris2020.w.uib.no/
AOGS 2020	Jun. 28-Jul. 4, 2020	Hongcheon, Korea	http://www.asiaoceania.org/aogs2020/public.asp?page=home.html
SCAR	Jul. 31-Aug. 11, 2020	Hobert, Australia	https://www.scarcomnap2020.org/
COSPAR 2020	Aug. 15-22, 2020	Sydney, Australia	https://www.cospar2020.org/
URSI General Assembly and Scientific Symposium (GASS2020)	Aug. 29-Sep.5, 2020	Rome, Italy	https://www.ursi2020.org/
AGU Fall Meeting 2020	Dec. 7-11, 2020	San Francisco, CA, USA	https://www.agu.org/fall-meeting
EGU General Assembly 2021	Apr. 25-30, 2021	Vienna, Austria	
IAMAS	Jul. 18-23, 2021	Busan, Korea	http://baco-21.org/2021/english/main/index_en.asp
AOGS 2021	Aug. 1-6, 2021	Singapore	
IAU 2021 General Assembly	Aug. 16-27, 2021	Busan, Korea	http://www.iauga2021.org/
IAGA 2021	Aug. 22-27, 2021	Hyderabad, India	http://www.iaga-iaspei-india2021.in/
AGU Fall Meeting 2021	Dec. 13-17, 2021	New Orleans, LA, USA	https://www.agu.org/fall-meeting
SCOSTEP's 15th Quadrennial Solar-Terrestrial Physics Symposium (STP-15)	Feb. 21-25, 2022	Alibag, India	
EGU General Assembly 2022	Apr. 3-8, 2022	Vienna, Austria	
COSPAR 2022	Jul. 16-24, 2022	Athens, Greece	http://www.cosparathens2022.org/
AOGS 2022	Aug. 14-19, 2022	Melbourne, Australia	
AGU Fall Meeting 2022	Dec. 12-16, 2022	Chicago, IL, USA	https://www.agu.org/fall-meeting
IUGG 2023	In July, 2023	Berlin, Germany	
AGU Fall Meeting 2023	Dec. 11-15, 2023	San Francisco, CA, USA	https://www.agu.org/fall-meeting

The purpose of the 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 200 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

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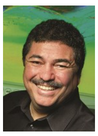
Editors:

Kazuo Shiokawa (shiokawa_at_nagoya-u.jp)
SCOSTEP President,
Center for International Collaborative Research (CICR),
Institute for Space-Earth Environmental Research (ISEE), Nagoya University,
Nagoya, Japan

Patricia H. Doherty (patricia.doherty_at_bc.edu)
SCOSTEP Scientific Secretary,
Boston College, Boston, MA, USA



Ramon Lopez (relopez_at_uta.edu)
PRESTO chair,
University of Texas at Arlington, TX, USA

Newsletter Secretary:

Mai Asakura (asakura_at_isee.nagoya-u.ac.jp)
Center for International Collaborative Research (CICR),
Institute for Space-Earth Environmental Research (ISEE), Nagoya University,
Nagoya, Japan