# PRESTO - Predictability of the variable solar-terrestrial coupling
# The new SCOSTEP's scientific program in 2020-2024

Kazuo Shiokawa[1], Ramon Lopez[2], Eugene Rozanov[3], and Jie Zhang[4]

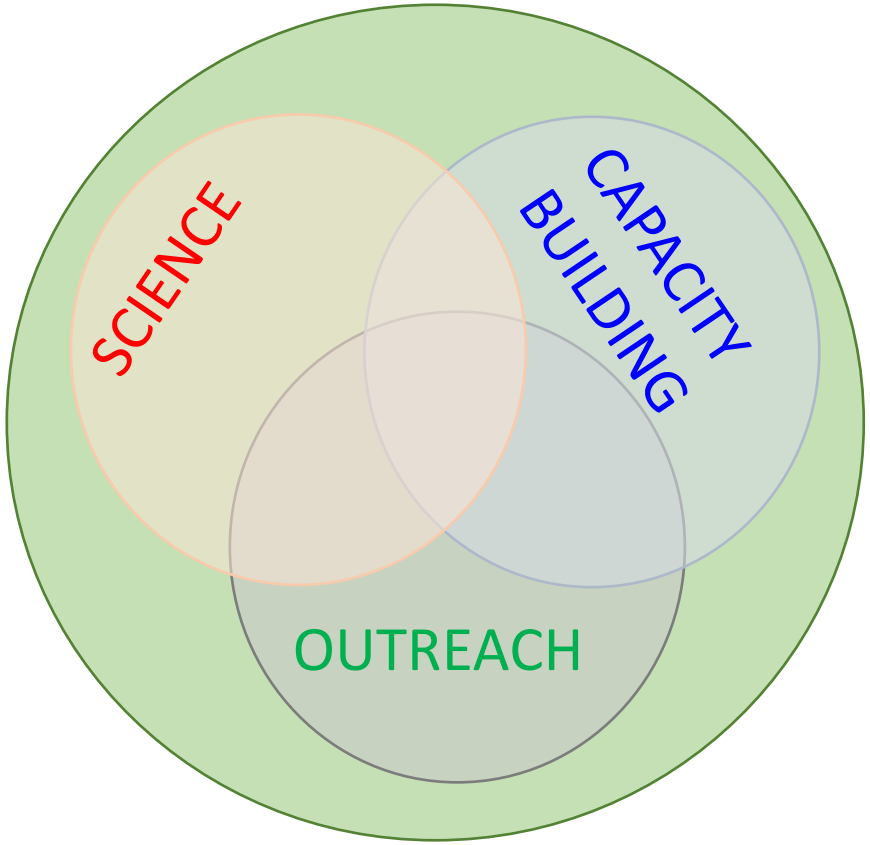
[1]SCOSTEP President, ISEE, Nagoya University, Japan.
[2]PRESTO Chair, University of Texas at Arlington, USA.
[3]PRESTO Co-chair, PMOD/WRC and IAC ETHZ, Switzerland.
[4]PRESTO Co-chair, George Mason University, USA.

# SCOSTEP

## Scientific Committee on Solar-Terrestrial Physics

- one of the Thematic Organizations of the International Science Council (ISC).
- permanent observer at the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS).
- Runs long-term (4-5 years) international interdisciplinary scientific programs of solar terrestrial physics since 1966
- Interacts with national and international programs involving solar terrestrial physics elements
- Engages in Capacity Building activities such as via annual Space Science Schools
- Disseminates new knowledge on the Sun-Earth System and how the Sun affects life and society as outreach activities

SCOSTEP
Scientific Committee on Solar-Terrestrial Physics



SCOSTEP
Scientific Committee on Solar-Terrestrial Physics


# *PRESTO*:

# Predictability of the variable Solar-Terrestrial Coupling

## The SCOSTEP's new Scientific Program

SCOSTEP
Scientific Committee on Solar-Terrestrial Physics

# International interdisciplinary programs in solar-terrestrial physics operated by SCOSTEP

1976-1979: IMS (International Magnetosphere Study)
1979-1981: SMY (Solar Maximum Year)
1982-1985: MAP (Middle Atmosphere Program)
1990-1997: STEP (Solar-Terrestrial Energy Program)
1998-2002: Post-STEP（S-RAMP, PSMOS, EPIC, and ISCS)
2004-2008: CAWSES (Climate and Weather of the Sun-Earth System）
2009-2013: CAWSES-II (Climate and Weather of the Sun-Earth System-II）
2014-2018: VarSITI (Variability of the Sun and Its Terrestrial Impact)
2020-2024: PRESTO (Predictability of the variable Solar-Terrestrial Coupling)

# SCOSTEP's Next Scientific Program (NSP) committee

**In October 2017, the SCOSTEP Bureau established the NSP committee with the following members:**

**Ioannis A. Daglis, Chair (National and Kapodistrian University of Athens, Greece)**
**Loren Chang (National Central University, Taiwan)**
**Sergio Dasso (Universidad de Buenos Aires, Argentina)**
**Olga Khabarova (IZMIRAN, Russia)**
**Emilia Kilpua (University of Helsinki, Finland)**
**Daniel Marsh (National Center for Atmospheric Research, USA)**
**Katja Matthes (GEOMAR and Christian-Albrechts Universität, Germany)**
**Dibyendu Nandi (IISER Kolkata, India)**
**Annika Seppälä (University of Otago, New Zealand)**
**Rémi Thiéblemont (Univ. Pierre et Marie Curie, France)**
**Qiugang Zong (Peking University, China)**

# SCOSTEP Next Scientific Program (NSP) Forum at ISSI-Beijing, China, 2018

**Detailed documentation is available at:**
**http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf**

- Amal Chandran, Nanyang Technological University, Singapore
- Ioannis A. Daglis, NSP Committee Chair / National and Kapodistrian University of Athens, Greece
- Sergio Dasso, NSP Committee Member / IAFFE, Argentina
- Katya Georgieva, VarSITI / Bulgarian Academy of Sciences
- Nat Gopalswamy, SCOSTEP Bureau / NASA GSFC, USA
- Mamoru Ishii, NICT, Japan
- Olga Khabarova, NSP Committee Member / IZMIRAN, Russia
- Kanya Kusano, Nagoya University, Japan
- William Liu, National Space Science Center, CAS, China
- Shinobu Machida, Nagoya University, Japan
- Takahiro Obara, Tohoku University, Japan

**Figure 6:** Group picture of the participants of the Forum in 2018.

# SCOSTEP Next Scientific Program (NSP) Forum at ISSI-Bern, Switzerland, 2019

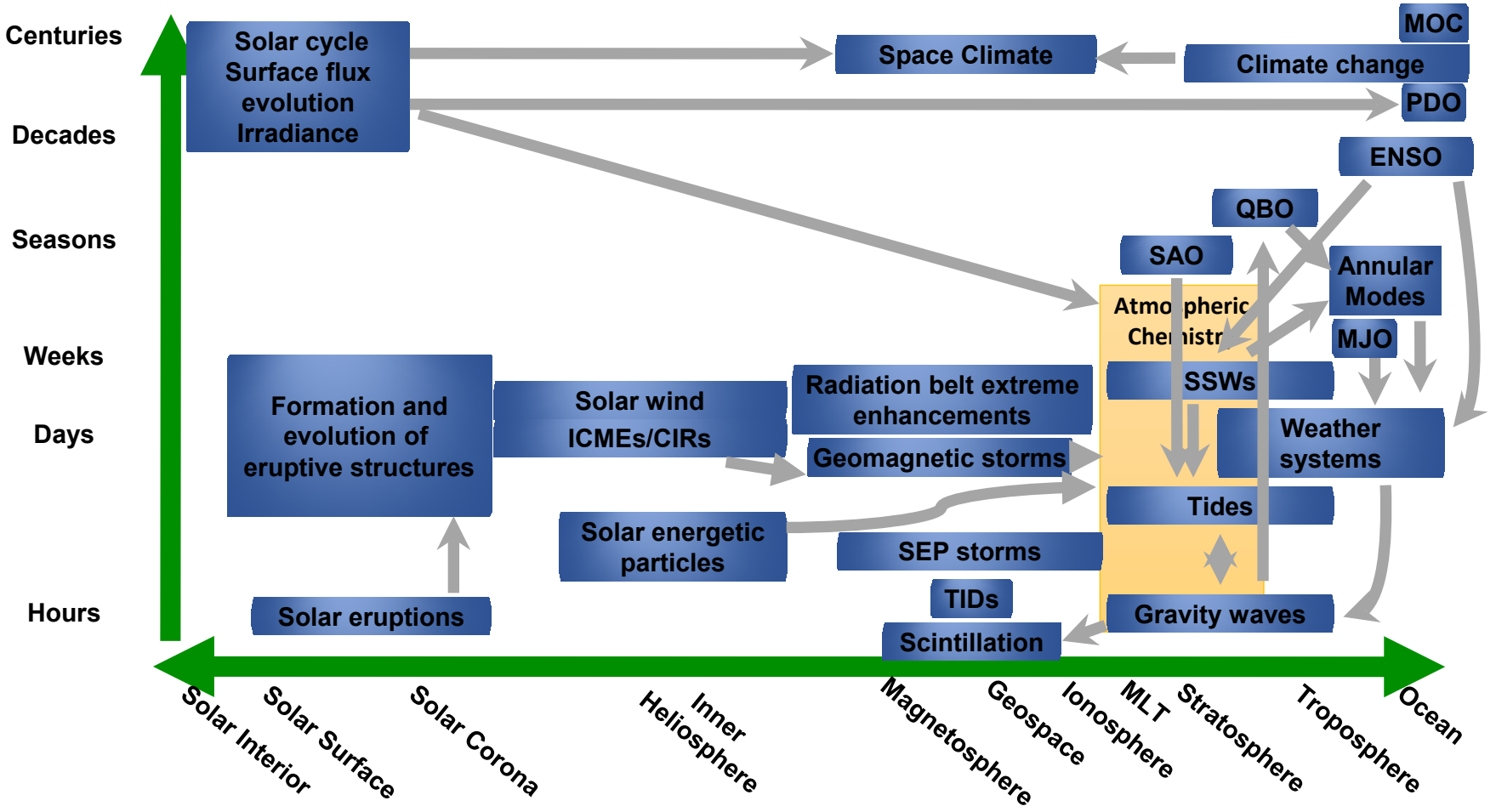
- Seth Claudepierre, The Aerospace Corporation and UCLA, USA
- Ioannis A. Daglis, NSP Committee Chair / National and Kapodistrian University of Athens, Greece
- Patricia Doherty, Boston College, USA
- Katya Georgieva, VarSITI / Bulgarian Academy of Sciences
- Nat Gopalswamy, SCOSTEP Bureau / NASA GSFC, USA
- Olga Khabarova, NSP Committee Member / IZMIRAN, Russia
- Emilia Kilpua, NSP Committee Member / University of Helsinki, Finland
- Petra Koucká Knížová, Czech Academy of Sciences
- Vladimir Kuznetsov, SCOSTEP Bureau / IZMIRAN, Russia
- Franz-Josef Luebken, SCOSTEP Bureau / IAP, Germany
- Daniel Marsh, NSP Committee Member / NCAR, USA
- Dibyendu Nandi, NSP Committee Member / IISER Kolkata, India
- Nick Pedatella, UCAR, USA
- Eugene Rozanov, PMOD and ETH, Switzerland
- Marianna Shepherd, SCOSTEP Bureau / York University, Canada
- Kazuo Shiokawa, VarSITI / Nagoya University, Japan
- Alphonse Sterling, NASA MSFC, USA
- Manuela Temmer, University of Graz, Austria
- Rémi Thiéblemont, NSP Committee Member / IPSL, France
- Qiugang Zong, NSP Committee Member / Peking University, China

**Detailed documentation is available at: http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf**

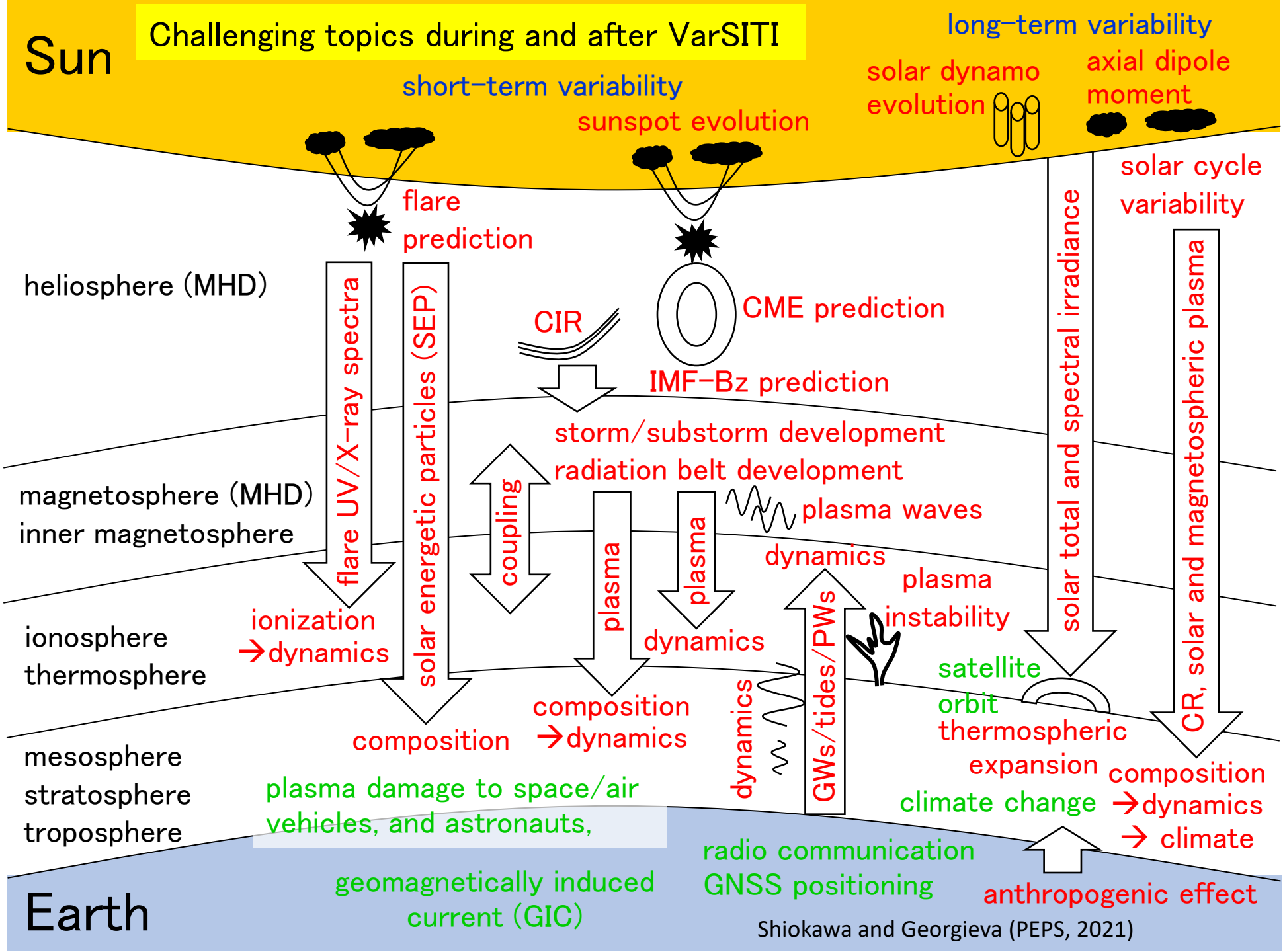
**Figure 7:** Group picture of the participants of the Forum in 2019.

# An integrated view of solar-terrestrial prediction

Overlap of various Solar-Terrestrial phenomena with various spatial & temporal scales



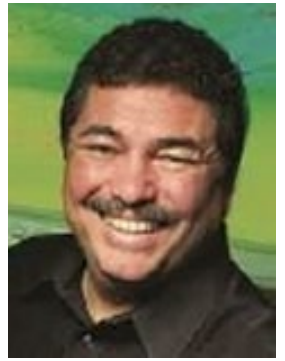

**Detailed documentation is available at:**
**http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf**




Shiokawa and Georgieva (PEPS, 2021)

# SCOSTEP/PRESTO
## Predictability of the Solar-Terrestrial Coupling

PRESTO 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 SCOSTEP, the Scientific Committee on Solar Terrestrial Physics.



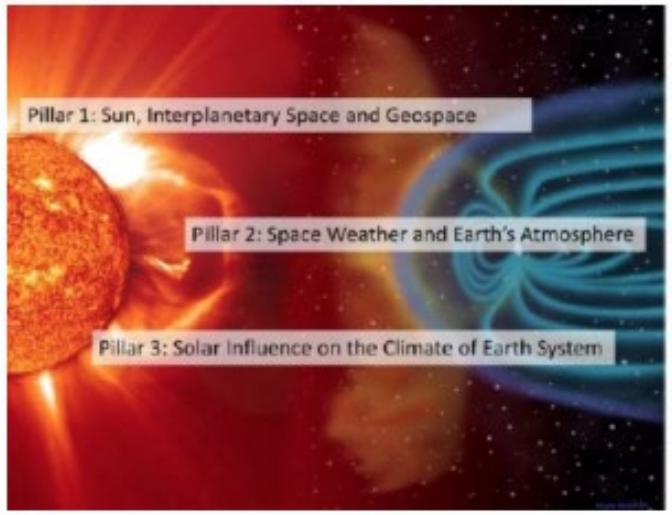
Chair: Ramon Lopez

Co-chair: Jie Zhang

Co-chair: Eugene Rozanov

PRESTO is comprised of 3 pillars:

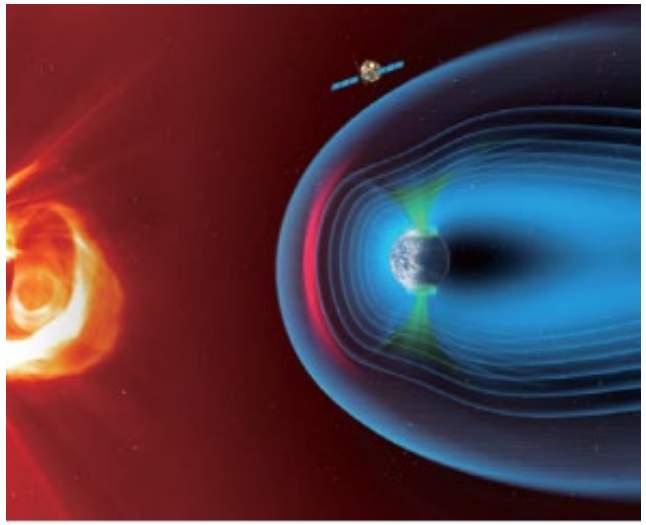
- **Pillar 1: Sun, Interplanetary Space and Geospace**
- **Pillar 2: Space Weather and the Earth's Atmosphere**
- **Pillar 3: Solar Activity and Its Influence on the Climate of the Earth System.**




The PRESTO Science Program is featured in the **SCOSTEP/PRESTO Newsletter Volume 22**

https://scostep.org/newsletter-archive/

# Pillar 1: Sun, Interplanetary Space and Geospace



http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf

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.

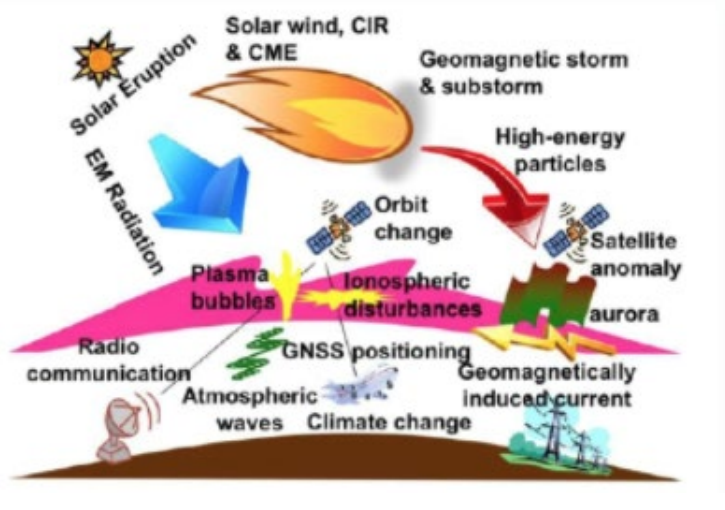
Pillar 1: Co-Leaders

Allyson Jaynes

Emilia Kilpua

Spiros Patsourakas

# Pillar 2: Space Weather and Earth's Atmosphere




Space weather meets Earth's atmosphere

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 the figure above. These effects and consequences are to be understood at both fundamental and applications levels.

Pillar 2: Co-Leaders

Loren C. Chang

Duggirala Pallamraju

Nick Pedatella

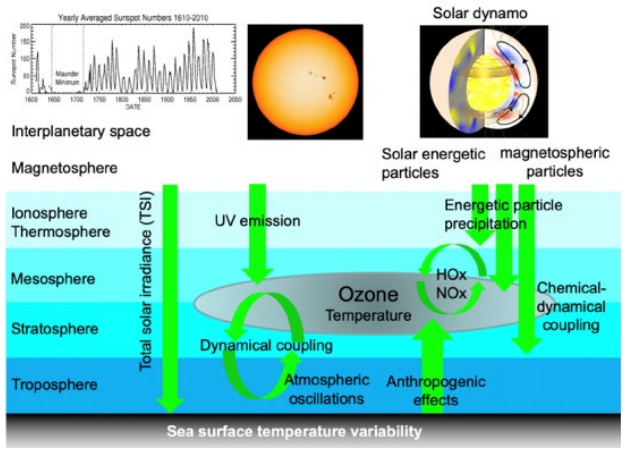
# Pillar 3: Solar Activity and its Influence on Climate

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.

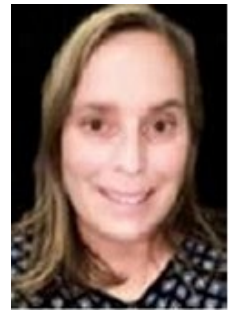
In some areas, decadal-scale solar forcing remains to be quantified to climate-relevant accuracies, which challenge our ability to determine causal connections in the pathways explaining solar forcing impacts on climate.

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.




http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf

Pillar 3: Co-Leaders



Odele Coddington

Jie Jiang

Stergios Misios

# SCOSTEP/PRESTO Opportunities


To get involved in PRESTO, contact the chairs or relevant pillar leaders.

Join the SCOSTEP Mailing list. Send a note of introduction to scostep@bc.org with your request to join the mailing list.

SCOSTEP/PRESTO provides support for organizing international campaigns and meetings. The activities should be strictly related to one or more PRESTO Pillars and contribute to PRESTO activities.

Funding for campaigns and meetings is up to $5000.
**The deadline for 2021 proposals is extended to December 31, 2020.**

Go to the following website for guidelines on these proposals:
https://scostep.org/grant-proposals/

To get involved in PRESTO, contact the chairs and /or relevant pillar leaders.

Watch for upcoming online seminars.

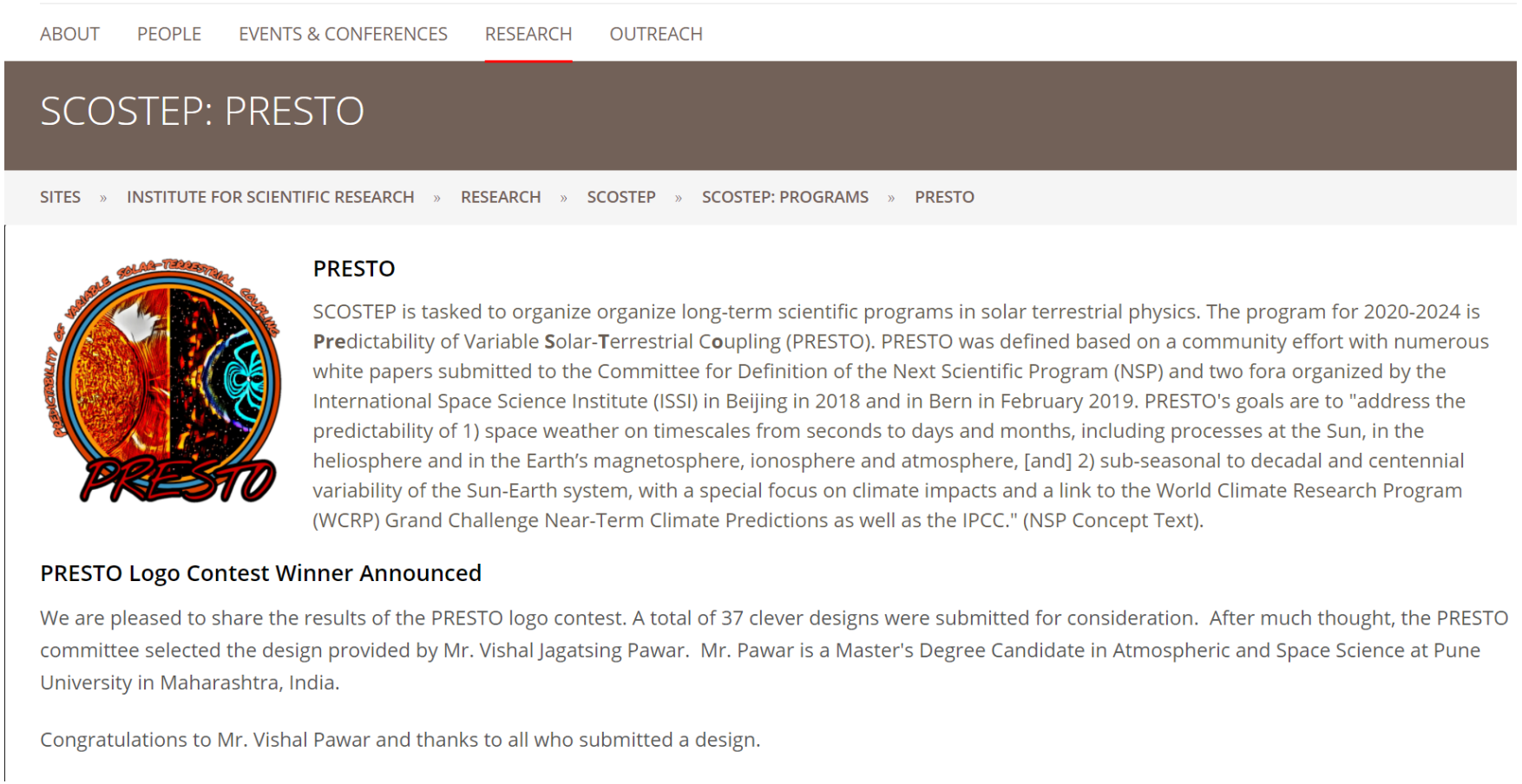
Join the SCOSTEP Mailing list.

For all information: https://scostep.org/presto/

SCOSTEP
Scientific Committee on Solar-Terrestrial Physics

For subscription on the SCOSTEP-all mailing list: drop e-mail to "scostepprequest@bc.edu".

**PRESTO Website at Boston College: www.bc.edu/scostep/**




- **SCOSTEP/PRESTO Grants to support meetings and campaigns**
- **SCOSTEP capacity building grant to support schools and capacity building activities**

# SCOSTEP-PRESTO ONLINE SEMINAR SERIES


**1st SCOSTEP/PRESTO Online Seminar**
**Title: A challenge to Physics-based Prediction of Giant Solar Flares**
**Author: Kanya Kusano (Institute for Space-Earth Environmental Research (ISEE), Nagoya University, Japan)**
**Date/time: May 26 (Tue), 2020, 12:00-13:00 UT**

**2nd SCOSTEP/PRESTO Online Seminar**
**Title: Extreme solar events: A new paradigm**
**Author: Ilya Usoskin (University of Oulu, Finland)**
**Date/time: July 20 (Mon), 2020, 12:00-13:00 UT**

**3rd SCOSTEP/PRESTO Online Seminar**
**Title: Developing a Highliy Predictable Geomagnetic Index to Gauge Magnetospheric Activity and Space Weather**
**Author: Joe Borovsky (Space Science Institute, USA)**
**Date: September 10, 2020, 22:00-23:00 UT**

**4th SCOSTEP/PRESTO Online Seminar**
**Title: The Ionospheric Connection Explorer - Results from the first year on orbit**
**Author: Thomas Immel (University of California Berkeley, USA)**
**Date: November 17, 2020, 23:00-24:00 UT**

**5th SCOSTEP/PRESTO Online Seminar**
**Title: Magnetospheric Response to Interplanetary Shocks: ULF Wave-Particle Interaction Perspective**
**Author: Q.-G. Zong (Peking University, China)**
**Date and Time: Jan 14 (Thu), 2021, 00:00-01:00 UT**

**6th SCOSTEP/PRESTO Online Seminar**
**Title: Utilizing galactic cosmic rays as signatures of interplanetary transients**
**Author: Mateja Dumbović (University of Zagreb, Croatia)**
**Date and Time: Jan 19 (Tue), 2021, 12:00-13:00 UT**

# SCOSTEP/PRESTO Newsletter vol.21–26

## Articles, Highlight of young scientists, Meeting reports, and Short news


SCOSTEP/PRESTO NEWSLETTER
Vol. 21, December 2019

Inside this issue

Article 1: SCOSTEP Executives and Bureau Members
Kazuo Shiokawa
Center for International Collaborative Research (CICR), Institute for Space-Earth Environmental Research (ISEE), Nagoya University, Nagoya, Japan

The elections for the new SCOSTEP Executives took place during the IUGG assembly in Montreal, Canada on July 13, 2019. Dr. Kazuo Shiokawa, of Nagoya University in Japan, was elected President. Professor Daniel March, of the National Center for Atmospheric Research (USA) and the University of Leeds (UK) was elected Vice President. Dr. Nat Gopalswamy, who served SCOSTEP as President since 2011, will continue to serve as Past-President. Patricia Doherty, of Boston College, was appointed as the Scientific Secretary on July 1, 2019.

The SCOSTEP Bureau is comprised of the Executives together with representatives of participating organizations. The representatives are appointed by the Secretary General of their organizations. For the quadrennial beginning in July 2019, the bureau members include:

Kazuo Shiokawa (President), Daniel Marsh (Vice President), Nat Gopalswamy (Past President), Patricia Doherty (Scientific Secretary, ex-officio), Yoshizumi Miyoshi (COSPAR), Renata Lukianova (IAGA/IUGG), Peter Pilewskie (IAMAS), Kyung-Suk Cho (IAU), and Prasad Subramanian (IUPAP), Annika Seppälä (SCAR), Jorge Chau (URSI), Aude Chambodut (WDS).

Figure 1. The 2019-2022 SCOSTEP Bureau.


SCOSTEP/PRESTO NEWSLETTER
Vol. 22, January 2020

Inside this issue

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

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

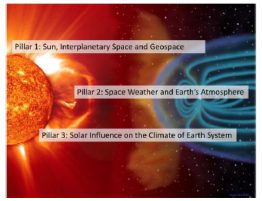


Figure 1. Three Pillars of PRESTO program.


SCOSTEP/PRESTO NEWSLETTER
Vol. 23, April 2020

Inside this issue

This is a special issue containing 9 reports of SCOSTEP Visiting Scholars (SVSs) as "Highlight on Young Scientists."

Article 1: Characterization of Coronal Mass Ejections with High Frequency type II Solar Radio Bursts
Ange Cynthia Umuhire
University of Rwanda, Kigali, Rwanda
Host Institute: NASA – GSFC, Greenbelt, MD, USA

Introduction
The SCOSTEP Visiting Scholar (SVS) program is a capacity building activity of SCOSTEP. The SVS program complements the current scientific program, PRESTO, and SCOSTEP's public outreach activities. One of its objective is to train graduate students in well-established solar terrestrial physics laboratories and institutions, for periods of between one and three months. I am one of 2019 SCOSTEP visiting scholar at National Aeronautics and Space Administration-Goddard Space Flight Center (NASA-GSFC).

Summary of results obtained during my visit at NASA-GSFC
Shocks appearing ahead of Coronal Mass Ejections (CMEs) in the solar


Figure 1. The left side is the 13 January 2013 type II burst of solar radio spectrometer. As observed in figure 1(left), there harmonic structure of type II burst, which followed a type II frequency of the fundamental emission is 155 MHz. Figure 1 CME shock associated with the January 13, 2013 burst, it w after the appearance of type II.


SCOSTEP/PRESTO NEWSLETTER
Vol. 24, July 2020

Inside this issue

Article 1: An Overview of the Total and Spectral Solar Irradiance Sensor (TSIS-1) Mission
Odele M. Coddington and Thomas N. Woods
Laboratory of Atmospheric and Space Physics, University of Colorado Boulder, Boulder, CO, USA

The Total and Spectral Solar Irradiance Sensor (TSIS-1) launched to the International Space Station (ISS) in December, 2017 and has been making daily measurements of solar irradiance since early 2018 (Figure 1). The instruments comprising the TSIS-1 mission are the Total Irradiance Monitor (TIM), which measures the total solar irradiance (TSI) in Watts per square meter and the Spectral Irradiance Monitor (SIM), which measures the wavelength-dependent distribution of solar irradiance, known as the solar spectral irradiance (SSI), in Watts per square meter per nanometer. The TSIS-1 TIM and SIM instruments draw their heritage from NASA's SOlar Radiation and Climate Experiment (SORCE) mission. The SORCE mission was passivated in February, 2020 after providing more than 17 years of daily solar irradiance observations. TSIS-1 is now NASA's flagship solar irradiance mission and its overall goal is to provide accurate

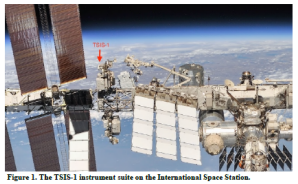
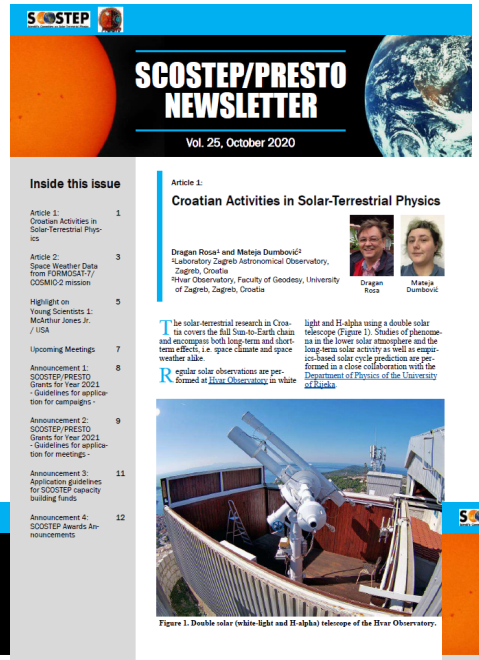


Figure 1. The TSIS-1 instrument suite on the International Space Station.


SCOSTEP/PRESTO NEWSLETTER
Vol. 25, October 2020

Inside this issue

Article 1: Croatian Activities in Solar-Terrestrial Physics
Dragan Rosa[1] and Mateja Dumbović[2]
[1]Laboratory Zagreb Astronomical Observatory, Zagreb, Croatia
[2]Hvar Observatory, Faculty of Geodesy, University of Zagreb, Zagreb, Croatia

The solar-terrestrial research in Croatia covers the full Sun-to-Earth chain and encompass both long-term and short-term effects, i.e. space climate and space weather alike.

Regular solar observations are performed at Hvar Observatory in white light and H-alpha using a double solar telescope (Figure 1). Studies of phenomena in the lower solar atmosphere and the long-term solar activity as well as empirics-based solar cycle prediction are performed in a close collaboration with the Department of Physics of the University of Rijeka.


Figure 1. Double solar (white-light and H-alpha) telescope of the Hvar Observatory.


SCOSTEP/PRESTO NEWSLETTER
Vol. 26, January 2021

Inside this issue

Article 1: How Small-Scale Current Sheets and Magnetic Islands in the Solar Wind Help Understanding the Nature of Large-Scale Processes Behind Space Weather
Olga Khabarova[1,2]
[1]Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radiowave Propagation of the Russian Academy of Sciences (IZMIRAN), Troitsk, Moscow 108840, Russia; habarova@izmiran.ru
[2]Space Research Institute of the Russian Academy of Sciences (IKI), Moscow 117997, Russia.

Current sheets (CSs) occur in the solar wind ubiquitously, owing to both local dynamical processes and dipole/multipole nature of the solar magnetic field. Their typical elongation size ranges from many AUs, e.g. in the case of the quasi-stable heliospheric current sheet (HCS) and CSs formed within high-speed flows/streams, to several proton gyroradii in the case of CSs involved in the turbulent cascade. The width of CSs is about several proton gyroradii independently of their origin, therefore, in this term, CSs are very small-scale structures.

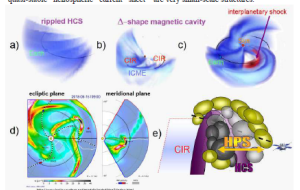


Figure 1. Magnetic cavities in which magnetic islands and CSs are intensively formed in the interplanetary space. a) Cavities inside the HCS ripples; b) Cavities formed by co-existing streams/flows; c) HCS distorted by an approaching ICME-driven interplanetary shock. Magnetic cavity can be formed between the HCS and the shock. Panels a)-c) are based on STEL reconstructions of the solar wind speed from http://stel.ucsd.edu/kcw_rawfiles.html (Khabarova et al. 2015, 2016). d) ENLIL reconstructions of the HCS (white line) distortion by propagating streams (green and yellow areas), see http://www.helioweather.net/ for details. In the meridional plane, it is seen that the HCS is crossed twice – before and after the stream gastage. Magnetic cavities are formed between the stream and the HCS. e) Sketch illustrating a complex distortion of the HCS/HPS-magnetic island system by an approaching CIR. Magnetic islands within the HPSs are grey and outside are yellow. Since the HCS/HPS is strongly bended by the CIR, some of magnetic islands are located inside the ripple representing a semi-closed magnetic cavity (Adhikari et al. 2019).

# PRESTO Officers

## PRESTO chair/ co-chairs

chair
**Ramon E. Lopez**
USA

co-chair
**Jie Zhang**
USA

co-chair
**Eugene Rozanov**
Switzerland

## Pillar 1: Sun, Interplanetary space and geospace

co-leader
**Allison Jaynes**
USA

co-leader
**Emilia Kilpua**
Finland

co-leader
**Spiros Patsourakos**
Greece

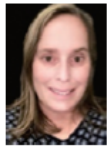
## Pillar 2: Space weather and the Earth's atmosphere

co-leader
**Loren Chang**
Taiwan

co-leader
**Duggirala Pallamraju**
India

co-leader
**Nick Pedatella**
USA

## Pillar 3: Solar activity and its influence on the climate of the Earth System



co-leader
**Odele Coddington**
USA

co-leader
**Jie Jiang**
China

co-leader
**Stergios Misios**
Greece

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 by promoting international collaborative efforts. PRESTO is sponsored by SCOSTEP, the Scientific Committee on Solar Terrestrial Physics.

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 also impact decadal variability at the Earth's surface. This is of particular interest and importance for decadal climate predictions. With the enhanced understanding of causal connections in the Sun- Earth system over the last several decades, fueled by both observations and theoretical modelling, we are in a 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.

## International interdisciplinary programs conducted by SCOSTEP

1976-1979: IMS (International Magnetospheric Study)
1979-1981: SMY (Solar Maximum Year)
1982-1985: MAP (Middle Atmosphere Program)
1990-1997: STEP (Solar-Terrestrial Energy Program)
1998-2002: SRAMP (STEP-Results, Applications, & Modeling Phase)
: PSMOS (Planetary Scale Mesopause Observing System)
: ISCS (International Solar Cycle Study)
: EPIC (Equatorial Processes Including Coupling)
2004-2008: CAWSES (Climate and Weather of the Sun-Earth System)
2009-2013: CAWSES II
2014-2018: VarSITI (Variability of the Sun and Its Terrestrial Impact)
2020-2024: PRESTO (Predictability of the Variable Solar-Terrestrial Coupling)

# PRESTO Leaflet

# PRESTO

Predictability of the Variable Solar-Terrestrial Coupling

2020-2024

SCOSTEP
Scientific Committee on Solar-Terrestrial Physics

https://scostep.org

# 3 Pillars of PRESTO and their science questions

# PRESTO Leaflet

## Pillar 1: Sun, interplanetary space and geospace

**Question 1.1:**

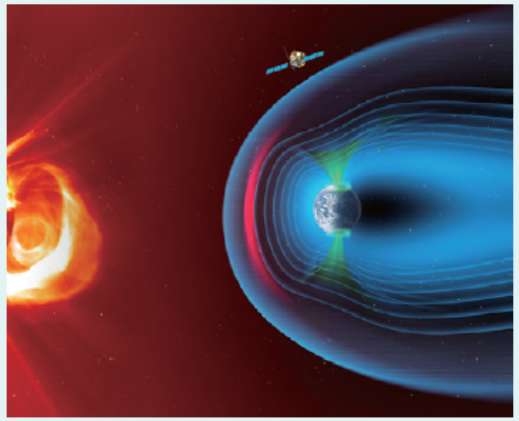
Under what conditions are solar eruptions, CMEs, and SEPs produced, and which indicators of pre-CME and pre-flare activity are reliable?

**Question 1.2:**

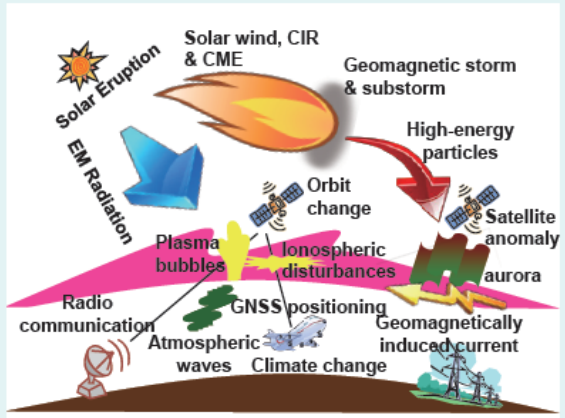
What are the required/critical model input parameters for most successfully forecasting the arrival of SEPs and the geoeffectiveness of CMEs, SIRs/CIRs and the consequences of the interactions between SIRs/ CIRs and CMEs?

**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?



http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf




http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf

## Pillar 2: Space weather and Earth's atmosphere

**Question 2.1:**

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

**Question 2.2:**

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

**Question 2.3:**

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

**Question 2.4:**

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

## Pillar 3: Solar activity and its influence on climate

**Question 3.1:**

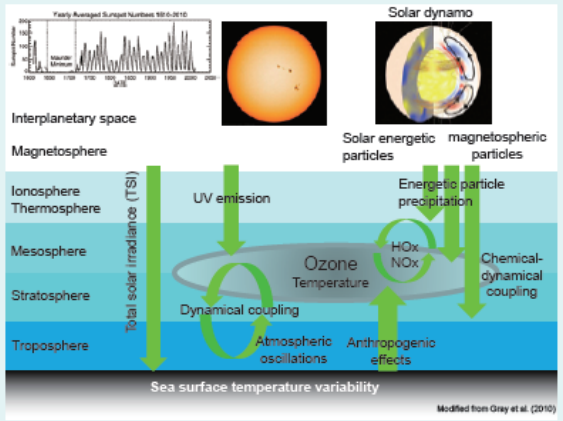
How will future solar activity vary over different timescales and what are the physical reasons for the variations?

**Question 3.2:**

How will the solar forcing on the Earth's system evolve in the future?

**Question 3.3:**

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?




http://www.issibj.ac.cn/Publications/Forum_Reports/201404/W020190620592906717714.pdf