An Update to the US SCOSTEP Coordinating Group

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www.yorku.ca/scostep
A BRIEF HISTORY OF SCOSTEP

- 1966: ICSU established the Inter-Union Commission on Solar-Terrestrial Physics (IUCSTP), the predecessor of SCOSTEP.
- 1972: ICSU reorganized IUCSTP as a special committee with responsibility for interdisciplinary solar-terrestrial physics programs of finite duration.
- 1973: SCOSTEP took effect after the ratification of a new Constitution by the ICSU Executive Board and General Committee.
- 1978: SCOSTEP became a Scientific Committee of ICSU charged with the long-term responsibility to promote international interdisciplinary programs in solar-terrestrial physics.
- 1982: SCOSTEP held its first General Council Meeting under the new Constitution. The Constitution was revised in 1988.
What is SCOSTEP?

- The Scientific Committee On Solar TErrestrial Physics is an Interdisciplinary body (IDB) of the International Council for Science (ICSU)
- Other relevant IDBs are COSPAR, SCAR, & CODATA
- SCOSTEP is governed by a Bureau. The Bureau comprises of SCOSTEP’s President, the Vice President, the Representatives of the ICSU Participating Bodies, and the Scientific Secretary (ex. officio).
- The Participating Bodies are the five scientific unions (IAGA/IUGG, IAMAS, IAU, IUPAP, URSI) and two IDBs (COSPAR, SCAR)
- SCOSTEP General council comprises of National Adherent Representatives
- Scientific Discipline Representatives (SDRs) is an international group that provides advice to SCOSTEP about scientific programs, serves as links between national and regional activities, and helps define new scientific programs
Organization: Bureau

- Nat Gopalswamy (USA) President
- F.-J. Luebken (GER) Vice President
- Marianna Shepherd (CAN) Scientific Secretary
- Vladimir Kuznetsov (RUS) IAGA/IUGG
- Lee-Ann McKinnell (SA) URSI
- Mei Zhang (CHI) IAU
- Mark Lester (UK) IUPAP
- David Siskind (USA) IAMAS
- Annika Seppälä (FIN) SCAR
- Takuji Nakamura (JAP) COSPAR

Executives

Unions

IDBs
What Does SCOSTEP do?

Runs long-term international interdisciplinary scientific programs in solar terrestrial physics since 1966

Interacts with national and international programs involving solar terrestrial physics elements

Engages in Capacity Building activities such as the annual Space Science Schools

Disseminates new knowledge on the Sun-Earth System and how the Sun affects life and society (e.g. comic books)
Capacity Building: Space Science Schools

Indonesia (Sep 2012); Kenya (October 2013), Peru (2014)
Partnered with International Space Weather Initiative (ISWI)
SCOSTEP Outreach: Comic Books

• To raise the public awareness on selected scientific topics (currently 9)
• Translated into many languages
• Available online: yorku.ca/scostep
• Printed and distributed at meetings
SCOSTEP Science

• Define and Execute long-term scientific programs of current interest to promote a better understanding of solar terrestrial relationship
• Conduct Quadrennial Solar Terrestrial Physics Symposia to highlight recent scientific achievements
• Interim symposia to showcase results from the current scientific program
• Conduct scientific campaigns to gather high-quality data and analyze them using theory and modeling
• Publish and disseminate scientific results as widely as possible
Climate and Weather of the Sun-Earth System (CAWSES) is the Current Scientific Program

Mass and electromagnetic output from the Sun affect Earth’s atmosphere and space environment on short and long time scales.
CAWSES II Task Groups/Leaders

- **Task Group 1**: What is the solar influence on climate? Katja Matthes (GER), Annika Seppälä (FIN), Cora Randall (USA)
- **Task Group 2**: How will geospace respond to a changing climate? Dan Marsh (USA), Jan Lastovicka (CZE), G. Beig (IND)
- **Task Group 3**: How does short-term solar variability affect the geospace environment? Kazunari Shibata (JPN), Joe Borovski (USA), Yihua Yan (CHN)
- **Task Group 4**: What is the geospace response to variable inputs from the lower atmosphere? Jens Oberheide (USA), Kazuo Shiokawa (JPN), S. Gurubaran (IND)

- E-Science and Informatics: Peter Fox, Janet Kozyra
- Capacity Building: Bureau, SCOSTEP

Co-chairs
2009-10: S. Avery & A, Rodger
2011-13: J. Davila & T. Tsuda

CAWSES

- One of the longest-run SCOSTEP programs
- Two books were published
- A collection of papers will soon appear in the Bulletin of Astronomical Society of India
- CAWSES –II Symposium in Nagoya attracted nearly 400 scientific papers
- CAWSES-II original research papers will be published in a special issue of Earth Planet and Space (EPS)
- Six review articles will be published in Progress in Earth and Planetary Science (PEPS)
Culmination:
International CAWSES-II Symposium
(November 18-22, Nagoya, Japan)

- The International CAWSES-II Symposium was held at the Nagoya University in Japan.
- 317 participants from 32 countries attended the symposium.
- Summarized the 2009-2013 CAWSES-II program of SCOSTEP
- Details of the new scientific program known as the Variability of the Sun and Its Terrestrial Impact (VarSITI) discussed.
The New Scientific Program

• Variability of the Sun and Its Terrestrial Impact (VarSITI)
• 2014-2018
• To be launched on January 13, 2014
• Co-chairs: K. Georgieva (BUL) & K. Shiokawa (JAP)
• Four International, Interdisciplinary projects relevant to ICSU bodies

varsiti.org
VarSITI Definition Effort

• White papers were solicited for International, Interdisciplinary programs that can produce significant results in 4-5 years. Nine white papers were received in 2012
• 27 international experts were invited (including the SCOSTEP Bureau and white-paper authors) to meet at the International Space Science Institute (ISSI) in Bern to brainstorm (May 7-8, 2013)
• The ISSI forum on SCOSTEP defined the new scientific Program known as VarSITI: Variability of the Sun and Its Terrestrial Impact
• Further community input received during the CAWSES-II Symposium in Nagoya and AGU Town Hall meeting in December.
VarSITI projects will be dealing with the causes and consequences of weak solar activity during cycle 24
Completed International Interdisciplinary Programs of 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 and Modeling Phase
• 1998-2002 PSMOS: Planetary Scale Mesopause Observing System
• 1998-2002 EPIC: Equatorial Processes Including Coupling
• 1998-2002 ISCS: International Solar Cycle Study
• 2004-2008 CAWSES: Climate and Weather of the Sun-Earth System
• 2009-2013 CAWSES-II: Climate and Weather of the Sun-Earth System-II
VarSITI Themes

• Solar evolution, Solar-stellar connection to understand dynamo and extreme events
• Origin, propagation, and Earth impact of transient events (flares, CMEs, CIRs, SEPs)
• Inner magnetosphere and its connection to geospace and Sun
• Earth’s atmosphere with energy input from above and below
Four Projects of VarSITI

• Solar Evolution and Extrema (SEE)
• International Study of Earth-Affecting Solar Transients (ISEST)/MiniMax24
• Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN)
• Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC)
Solar Evolution and Extrema (SEE)
Are we at the verge of a new grand minimum?

Project Co-Leaders:
Prof. Petrus C Martens, Montana State University, USA
Prof. Dibyendu Nandi, Indian Institute of Science Education and Research, Kolkata, India
Prof. Vladimir N. Obridko, IZMIRAN, Moscow, Russia

Goals & Objectives:
1) Reproduce magnetic activity as observed in the Sunspot record, including grand minima and extended minima in dynamo simulations,
2) Amalgamate the best current models and observations for solar spectral and wind output over the Earth’s history,
3) Determine the size and expected frequency of extreme solar events.

Science Questions:
1) Are we at the verge of a new grand minimum? If not, what is the expectation for cycle 25?
2) Does our current best understanding of the evolution of solar irradiance and mass loss resolve the "Faint Young Sun" problem? What are the alternative solutions?
3) What is the largest solar eruption/flare possible? What is the expectation for periods with absence of activity?

Anticipated Outcome:
1) Dynamo Models for the near future or for an upcoming grand minimum,
2) A timeline of solar activity -- spectral radiation, wind - from the Earth’s formation up to the present,
3) A frequency distribution and likelihood prediction of extreme events.
International Study of Earth-affecting Solar Transients/MiniMax24 (ISEST)

Can we predict the impact of solar transients on space weather?

Project Co-Leaders:
Prof. Jie Zhang, George Mason University, USA
Prof. Manuela Temmer, University of Graz, Austria
Dr. Nat Gopalswamy, USA

Goals & Objectives: Understand the origin, propagation and evolution of solar transients through the space between the Sun and the Earth, and develop the prediction capability of space weather.

1) Carry out campaign study to integrate theory, simulations and observations in order to get a complete view and understand of the chain of cause-effect activities from the Sun to the Earth.

2) Use observations to Identify all Earth-affecting flares, CMEs, SEPs and CIRs during the STEREO era and their solar sources.

3) Use theoretical studies and numerical simulations to understand the structure, evolution and dynamics of CMEs and the global context of transient events.

4) Carry out campaign study to integrate theory, simulations and observations in order to get a complete view of the chain of cause-effect activities from the Sun to the Earth.

Science Questions: How do coronal mass ejections (CMEs) and corotating interaction regions (CIRs) propagate and evolve, drive shocks and accelerate energetic particles in the heliosphere?

Data/theory/modeling: Establish a database of Earth-affecting solar transient events including CMEs, CIRs, flares, and energetic particle events based on remote sensing and in-situ observations from an array of spacecraft, run observation campaigns such as MiniMax24, develop empirical, theoretical, and numerical models of CME propagation and prediction, validate models using observations.

Anticipated outcome: A comprehensive database of Earth-affecting solar transients will be created, and space weather prediction capability will be significantly improved. A significant improvement of space weather prediction to forecast the arrival time and expected intensity of solar transients.
Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN)

What is the physics behind radiation belt electron flux dynamics to enable the development of predictive models?

Project Co-Leaders:
Dr. Jacob Bortnik, University of California, Los Angeles USA
Prof. Craig J. Rodger, University of Otago, New Zealand

Goals & Objectives: The quantitative prediction and specification of the Earth’s inner magnetospheric environment based on Sun/solar wind driving inputs.

A schematic of the inner magnetosphere, showing the high velocity solar wind impinging upon the Earth’s magnetic field (yellow, left), compressing it, and flowing around the boundary forming the magnetopause. Closer to the Earth are pictured regions of high energy electrons in two distinct zones of radiation (inner belt, outer belt, and slot region separating them), the cool, high-density plasma region known as the plasmasphere, and a region dominated by an electromagnetic wave known as chorus. The formation of the radiation belts is an active area of research which is intimately coupled with the dynamics of the solar wind, plasmasphere, and chorus region.

The SPeCIMEN project is particularly timely given the recent launch of NASA's Van Allen Probes, the most recent mission to investigate the physical processes that control the dynamical behaviour of the Earth’s radiation belts, eponymously named after its discoverer, Prof. James Van Allen. During the 5-year VanGyri programme multiple additional satellites are expected to be launched, providing a constellation of spacecraft focused on the inner magnetosphere.

Anticipated Outcome: A series of coupled, related models that quantitatively predict the dynamical evolution of the inner magnetospheric state (radiation belts, ring current, cold plasma distribution, plasmasheet, convection electric field, and so on).

Science Questions:
Can the state of the Earth’s inner magnetosphere be specified and predicted to high accuracy, based on inputs from the Sun and solar wind?
Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC)

What influence does Solar Forcing have on Climate and Weather?

Project Co-Leaders:
Prof. Dr. Franz-Josef Lübken, Leibniz Institute of Atmospheric Physics, Germany
Dr. Annika Seppälä, Finnish Meteorological Institute, Finland
Prof. William E. Ward, University of New Brunswick, Canada

Goals & Objectives: To understand the impact of the Sun on the terrestrial middle atmosphere/lower thermosphere/ ionosphere (MALT) and Earth's climate and its importance relative to anthropogenic forcing over various time scales from minutes to centuries.

Science Questions:
1) What is impact of solar forcing of the entire atmosphere? What is the relative importance of solar irradiance versus energetic particles?
2) How is the solar signal transferred from the thermosphere to the troposphere?
3) How does coupling within the terrestrial atmosphere function (e.g. gravity waves and turbulence).
4) What is the impact of anthropogenic activities on the Middle Atmosphere, Lower Thermosphere, Ionosphere (MALT)?
5) What are the characteristics of reconstructions and predictions of TSI and SSI?
6) What are the implications of trends in the ionosphere/thermosphere for technical systems such as satellites.

Anticipated Outcome: The development of a better understanding of the impact of solar activity on the entire atmosphere, relative to anthropogenic forcing and natural long term variability.


http://www.yorku.ca/scostep/
New SCOSTEP Initiatives

• Annual Space Science Schools with support from ICSU (Indonesia-2012; Kenya-2013; Peru-2014)
• SCOSTEP Newsletter (Quarterly)
• SCOSTEP Awards: Service, Young Scientist, Science
• Collaboration with the International Space Science Institute (ISSI) in defining VarSITI
• Permanent Observer to the United Nations Committee on Peaceful Uses of Outer Space
• SCOSTEP Visiting Scholar program
• Increasing the membership: Brazil, Nigeria, Switzerland, and are new national members
SCOSTEP Awards

• Three awards, each given every 2 years: service award, science award, and young scientist award
• The first service award was given to Joe Haskell Allen.
• The first science award and the young scientist award will be given during STP13 in XiAn, China in October 2014
STP13

http://stp13.csp.escience.cn

All are welcome!