

## NEWSLETTER

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### 1. Message from the President

*Greetings!*

Hope you had an excellent summer. We just officially entered into autumn 2016.

It was great seeing many of you during the First VarSITI General Symposium, which was a great success. This newsletter brings a summary of a lot of SCOSTEP activities over the past few months.

First of all, I should congratulate the SCOSTEP 2016 Award winners Professor Solanki, and the young scientists Drs. Carter, Pedatella, and Cheng. I also take this opportunity to thank the Awards committee chaired by Professor Archana Bhattacharyya for processing and coming up with the final selections.

Please welcome the new VarSITI/SPeCIMEN leaders Shri Kanekal (NASA/GSFC) and Yoshi Miyoshi (Nagoya University) to work with the current leaders in enhancing SPeCIMEN activities.

SCOSTEP welcomes Mexico (United Mexican States) as the newest member. Dr. Juan Americo Gonzalez Esparza is the National Representative of Mexico.

The capacity building activities are in full swing. The 2015 class of the SCOSTEP visiting scholars (SVS) program have completed their visits. It is great to see a couple of them have written papers based on their visits to be published soon. The 2016 class has also been selected and they will start their visits soon.

Congratulations to the 2016 SVS Scholars. Thanks also to the hard work of Professor Nicole Vilmer and her committee in coming up with the selections.

We continue the collaboration with the International Space Weather Initiative (ISWI) in organizing International Space Science Schools. The next one will be in Sangli, Maharashtra, India hosted by the Smt. Kasturbai Walchand College of Science & Arts in Sangli ([http://www.iiap.res.in/meet/school\\_meet/index.php](http://www.iiap.res.in/meet/school_meet/index.php))

It is unfortunate that the COSPAR-SCOSTEP session on the future of solar-terrestrial physics did not take place in Istanbul last month due to a situation beyond COSPAR's control. We do not give up and will continue to work along these lines. The next opportunity is a Town Hall meeting during the Fall AGU meeting in San Francisco. Please make it a point to attend and contact Marianna if you have a specific input.

We are preparing for the Second VarSITI General Symposium in Irkutsk (Russia) and the STP14 in Vancouver. Looking forward to a productive Fall 2016!

*Nat Gopalswamy  
September 22, 2016*

### 2. SCOSTEP 2016 Awards

The SCOSTEP 2016 Awards for Distinguished Scientist and Distinguished Young Scientist were presented on June 6, 2016 at a ceremony during the 1<sup>st</sup> VarSITI General Symposium held in Albena, Bulgaria from June 6 to June 10, 2016. The SCOSTEP Distinguished Scientist Award is given in recognition of an outstanding contribution of a scientist to SCOSTEP science, while the SCOSTEP Distinguished Young Scientist Award is given to a young scientist who has achieved considerable success in solar-terrestrial physics and has taken an active part in SCOSTEP-related activities.



**Professor Sami Khan Solanki**, Director of the Max Planck Institute for Solar System Research, Germany is the recipient of the **SCOSTEP Distinguished Scientist Award** for 2016 for his profound contributions to all aspects of the influence of solar variability on Earth's climate, including development of physics-based irradiance

models, which provide a basis for understanding the spectral solar irradiance variability, as well as to a broader understanding of solar magnetism

The SCOSTEP Distinguished Young Scientist Award for 2016 was given to **Dr. Brett Anthony Carter**, from the Space Research Centre, at RMIT University in Melbourne, Australia and **Dr. Nicholas Michael Pedatella** from the University Corporation for Atmospheric Research (UCAR) in Boulder, USA.



Dr. Brett A. Carter was recognized for his innovative approach in the study of the occurrence of equatorial plasma bubbles and of geomagnetically induced currents to obtain results of considerable importance for the understanding of the origin and manifestation of these

phenomena.



Dr. Nicholas M. Pedatella was recognized for his work on atmospheric variability and data assimilation and ground-breaking contributions to the understanding of the influence of lower atmospheric waves on the spatial and temporal variability of the

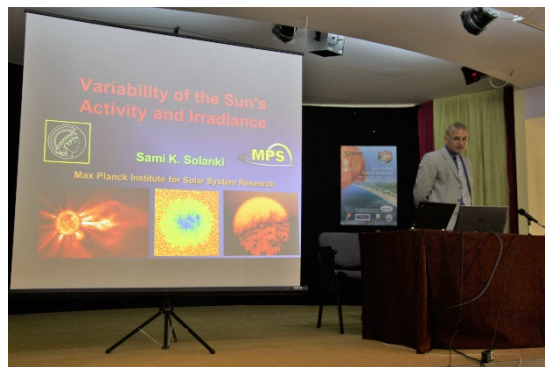
mesosphere, ionosphere, and thermosphere.

In 2016 the SCOSTEP Bureau decided to institute the **Honorable Mention Award** as a part of the Distinguished Young Scientist Award.



The **Distinguished Young Scientist 2016 - Honorable Mention Award** was given to **Dr. Xin Cheng** from the School of Astronomy and Space Science in Nanjing University, China for conducting original research on the origin and evolution of coronal mass

ejections (CMEs), the key component of the solar-terrestrial relationship.



*Photo 1: Prof. Sami K. Solanki speaking at the SCOSTEP Awards Ceremony*



*Photo 2: The recipients of the SCOSTEP 2016 Awards posing with the SCOSTEP Executives.*

### 3. SCOSTEP Distinguished Young Scientist – Research Highlights

#### 3.1 Dr. Brett A. Carter

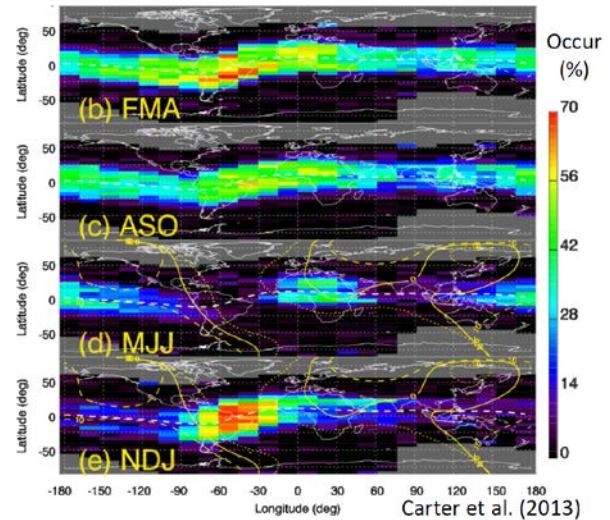
Dr. Brett Carter's primary research focus is the occurrence of Equatorial Plasma Bubbles (EPBs) in the nighttime ionosphere, which adversely impact satellite positioning and communications systems; e.g., GPS. EPBs are well-known to exhibit a peculiar seasonal/longitudinal dependence that is understood to be largely controlled by the magnetic field orientation with respect to the day-night terminator. However, far less understood is the daily variability in the EPB occurrence, particularly during peak EPB seasons, such as during the equinox months. Dr. Carter's recent research has demonstrated that coupled global ionosphere-thermosphere models are well-suited to describing the daily occurrence variability of EPBs

during peak EPB seasons at multiple low-latitude locations around the globe.

The daily variations exhibited by the model in his research were found to be caused by the model's geomagnetic activity forcing, which primarily controls the location and strength of the high-latitude electric potential field pattern (i.e., plasma flow). This parameterization of the geomagnetic activity influences the neutral wind dynamics throughout the system. Dr Carter has found that relatively small changes in geomagnetic activity could ultimately influence neutral winds at the equator a few hours later, which then have a direct impact on the growth conditions of EPBs shortly after local sunset. It was shown that minor increases in geomagnetic activity in the model could effectively suppress the growth of EPBs a few hours later. These findings were followed up by a 5-month EPB prediction campaign in the African and Asian sectors, in which the Wing Kp predictions were used as inputs to the model. The campaign showed that coupled global ionosphere-thermosphere models are capable of predicting EPB suppressions hours ahead of time during peak EPB seasons. However, the prediction of EPBs during off-peak and transitional EPB periods still remains a significant challenge.

Another research interest of Dr Carter is Geomagnetically Induced Currents (GICs), particularly at equatorial latitudes. GICs are well-known to be one of the most important impacts of space weather on broader society, due to our heavy reliance on continental-scale power infrastructure. GICs are caused by sudden changes in magnetic field that rise due to sudden changes in magnetospheric and/or ionospheric currents. The auroral currents in the high latitudes are known to be highly variable during geomagnetic storms, and as such, the GICs in these regions are typically the strongest and most studied. GICs at mid, low and equatorial-latitudes, however, have been far less investigated. Following some recent research that has shown increased GIC activity at the geomagnetic equator, Dr Carter has confirmed that the equatorial electrojet current is the primary cause of this localized activity. Further, he has showed that the magnetic signature of interplanetary shock arrivals (i.e., sudden impulses) was locally amplified by sudden changes in the equatorial electrojet, independently of whether a geomagnetic storm followed or not. These results have important implications for low-latitude power grids

that have not been designed to cope with variable space weather.



**Figure 1:** EPBs (and scintillation events on GPS and UHF systems) are most common during the equinoxes across all longitude sectors near the magnetic equator.

For Dr. Brett Carter's selected publications please see: <https://scholar.google.com.au/citations?user=-5c8WegAAAAJ&hl=en>

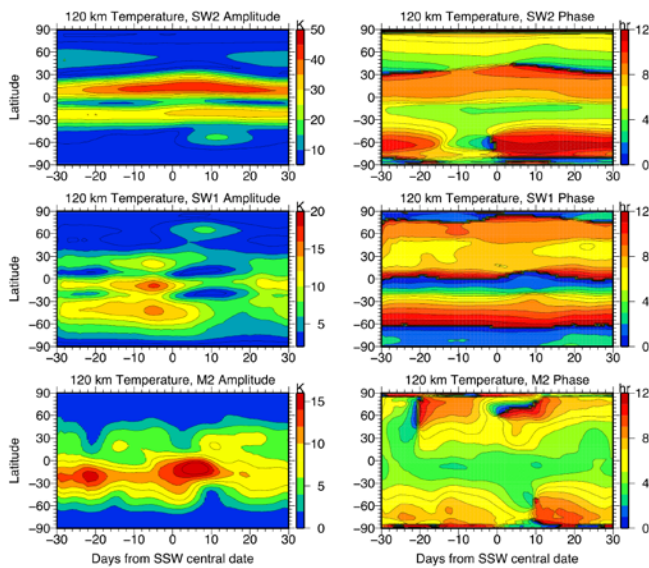
### 3.2 Dr. Nicholas M. Pedatella

The focus of Dr. Nicholas Pedatella's recent research is on understanding the mechanisms that generate ionosphere variability during sudden stratosphere warmings (SSWs). SSWs are dynamical disturbances in the high latitude wintertime stratosphere and are associated with large changes in the zonal mean temperatures and winds in the stratosphere, mesosphere, and lower thermosphere. During the recent solar minimum (2008-2010), observations revealed that the low latitude ionosphere exhibits large, systematic, variations during SSW events. The variations are most evident in equatorial vertical plasma drift velocities and electron densities (or total electron content, TEC), and the changes in electron density can reach nearly 100% of the values expected from climatology (i.e., a near doubling of the TEC).

Though observations have demonstrated that the low latitude ionosphere is significantly disturbed during SSWs, they only provide limited insight into the mechanisms responsible for the variability. Dr. Pedatella has performed numerical experiments using



the National Center for Atmospheric Research (NCAR) Whole Atmosphere Community Climate Model (WACCM) and Thermosphere-Ionosphere-Mesosphere-Electrodynamics General Circulation Model (TIME-GCM) to gain insight into the mechanisms that generate the ionosphere variability during SSWs. These experiments have shown that the changes in the zonal mean zonal winds in the middle atmosphere that occur during SSWs result in more favorable propagation conditions for the atmospheric solar (SW<sub>2</sub>) and lunar (M<sub>2</sub>) semidiurnal tides, leading to large increases in the SW<sub>2</sub> and M<sub>2</sub> amplitudes at mesosphere and lower thermosphere (MLT) altitudes (~90-120 km).



**Figure 2:** Changes in the mean winds during SSWs generate the SW<sub>2</sub> and M<sub>2</sub> variability. The SW<sub>1</sub> variability is due to nonlinear interaction between PW<sub>1</sub> and SW<sub>2</sub>.

The SW<sub>2</sub> and M<sub>2</sub> tidal enhancements have two notable impacts on the upper atmosphere. First, they modulate the E-region dynamo generation of electric fields, which leads to the observed changes in equatorial vertical drift velocities. The equatorial vertical drift velocity perturbations in-turn influence the equatorial and low latitude electron densities through modulation of the equatorial ionization anomaly. The numerical experiments further revealed that the tidal enhancements influence the neutral composition of the thermosphere. In particular, the ratio of atomic oxygen to molecular nitrogen ( $[O]/[N_2]$ ) is decreased during SSWs throughout the thermosphere. The  $[O]/[N_2]$  decrease occurs due to changes in the lower thermos-

phere circulation that are induced by the dissipation of the enhanced SW<sub>2</sub> and M<sub>2</sub>. A near global decrease in the zonal and diurnal mean F-region electron density occurs due to the influence of the  $[O]/[N_2]$  depletion on production and loss of ions and electrons.

Dr. Pedatella's research has provided important new insights into the mechanisms that generate upper atmosphere variability during SSWs. Though his research has focused on SSWs, similar mechanisms are likely to couple variability in the lower atmosphere to the upper atmosphere during other time periods. Given that the lower atmosphere can introduce significant variability in the upper atmosphere, understanding the mechanisms that generate this variability is critical in order to fully understand the sources of upper atmosphere variability.

Dr. N. Pedatella's selected publications can be found at: <https://staff.ucar.edu/users/nickp>

#### 4. SCOSTEP Visiting Scholarship

The SCOSTEP Visiting Scholarship (SVS) program was established in the fall of 2014 with the objective of providing training to young scientists and graduate students from developing countries in well-established solar-terrestrial physics laboratories and institutions, for periods of between one and three months. The aim is to fund four scholars each year, one related to each of the four SCOSTEP VarSITI themes (<http://www.varsiti.org/>). The training will help the young scientists to advance their career in solar terrestrial physics using the technique/skill they learned during the training. SCOSTEP provides travel support, while the hosting institution provides support for the living expenses (lodging, meals, ground transportation, visa fees and other incidentals).

On June 5, 2016 all applications submitted to the SCOSTEP Secretariat in response to the 2016 SVS Announcement of Opportunity were sent for evaluation by the SVS Selection Committee, led by Prof. Nicole Vilmer (France). On July 27, 2016 the recipients of the SVS grants were announced. They are Dr. S.G. Sumod, Dr. K. Sasikumar Raja, Ms Sneha A. Gokani, and Dr. Olawale Segun Bolaji. *Congratulations!*



**Dr. S.G. Sumod**, Assistant Professor, at the Department of Physics, Sacred Heart College Mahatma Gandhi University, Kerala, India receives a SVS grant for his proposal “Investigation of high latitude - low latitude coupling during geomagnetically quiet times”. Dr. Sumod’s SVS

tenure will be with the Institute for Space-Earth Environmental Research, Nagoya University.



**Dr. Kantepalli Sasikumar Raja**, National Post-Doctoral Fellow, Indian Institute of Science Education and Research, receives a SVS grant for his proposal to perform the preliminary observations of the Sun and calibrator sources and data analysis employing the MingantU

SpEctral Radioheliograph (MUSER). During the SVS tenure at the NAOC, China Dr. K. Sasikumar Raja will work on the development of the MUSER as well as will be involve in testing, fabrication or building of the telescope.



**Ms Sneha A. Gokani**, Indian Institute of Geomagnetism, PhD candidate, Mumbai University, India, receives a SVS grant for her proposal “Comparative study between low and mid-high latitude whistlers”. The SVS tenure will be from September to November, 2016 (inclusive) at the

South African National Space Agency (SANSA).



**Dr. Olawale Segun Bolaji**, University of Lagos, Nigeria, receives a SVS grant for his project “Response of equatorial ionization anomaly to March 2015 geomagnetic storm and its roles in triggering/modulating ionospheric irregularity”. The SVS tenure

will be from December 2016 to February 2017, with the School of Earth and Space Science, University of Science and Technology of China.

## 5. Request for Information: Future Directions in Solar-Terrestrial Physics

SCOSTEP has initiated an effort to develop community consensus in defining its future activities based on surveys of (i) current status, (ii) knowledge gap, and (iii) future directions in observations and modeling to fill the gaps. As a first step, a COSPAR-SCOSTEP joint Session on Solar-Terrestrial Physics was organized to be held during the 41<sup>st</sup> COSPAR scientific assembly in Istanbul on August 5-6, 2016, which unfortunately did not take place due to the cancellation of the COSPAR Scientific Assembly. However, SCOSTEP is continuing with the work envisioned and asks the SCOSTEP scientific discipline representatives (SDRs), COSPAR Main Scientific Organizers (MSOs) and SCOSTEP/VarSITI leaders to contribute to this discussion. SCOSTEP solicits input from the community on the key issues that need to be addressed in making progress in solar terrestrial physics. In particular, the community is requested to send their input to the original invited speakers, who will incorporate the community input on the following topics:

*Solar Dynamo and the Solar Cycle (Dibyendu Nandi)*

*Solar Activity in the Coming Decades (Robert Cameron)*

*Solar electromagnetic emission and climate (Sami Solanki)*

*Solar mass emission and climate (Kalevi Mursula)*

*Solar Flares and their Geospace impact (Nicole Vilmer)*

*CMEs and their Geospace Impact (Sarah Gibson)*

*Coronal Holes and their Geospace impact (Bojan Vrsnak)*

*Energetic particles in the inner heliosphere (Olga Malandraki)*

*Geospace and Atmospheric Impact of Energetic Particles (Bernd Funke)*

*New Developments in Magnetospheric Studies (Qiugang Zong)*

*Space Weather (Ian Mann)*

*Terrestrial Weather – Space Weather Connection (Jens Oberheide)*

We anticipate that these inputs will be compiled and developed into a document that will be used in defining future SCOSTEP scientific programs. Please send a copy of your input to the SCOSTEP Scientific Secretary

(mshepher [at] yorku.ca). The next opportunity for a discussion will be at the Town Hall meeting during the Fall AGU meeting, Dec 12-16, 2016 in San Francisco.

*Nat Gopalswamy*  
*SCOSTEP President*

## 6. Reports on International Meetings

### 6.1 First VarSITI General Symposium

The current SCOSTEP scientific program VarSITI (Variability of the Sun and Its Terrestrial Impact) (<http://www.varsiti.org/>) held its 1<sup>st</sup> General Symposium during June 6 – 10, 2010, in Albena, Bulgaria. VarSITI focuses on the interconnections in the Sun-Earth system. Four scientific projects are being carried out under VarSITI: (1) Solar Evolution and Extrema (SEE), (2) International Study of Earth-Affecting Solar Transients (ISEST/MiniMax24), (3) Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN), and (4) Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC).

The objective of the Symposium was to overview the progress of various activities in the four projects at the midpoint of the five-year program, while promoting the interconnection among these projects and developing and strengthening collaboration among the VarSITI scientific community.



*Photo 3: Group photo of the participants in the 1<sup>st</sup> VarSITI General Symposium.*

More than 100 scientists from 24 countries attended this scientific event, giving 114 scientific talks and poster presentations in the 7 sessions of the Symposium: Solar and Heliospheric Drivers of Earth-Affecting Events; Long-term Variation of the Sun and Climate; Under-

standing the Earth's space environment and its connection to space weather; Sun to Mud Campaign Study of March 15-17, 2015 Event and other significant events; Modeling the connection from Sun to Mud (and all steps in between); Data archiving; Special session on Heliospheric Cataloguing, Analysis and Technique Service (HELCATS). The presentations can be found at <http://newserver.stil.bas.bg/VarSITI2016/Presentations.html>. A special issue of the Journal of Atmospheric and Solar-Terrestrial Physics is planned based on the papers presented at the Symposium.

### 6.2 6<sup>th</sup> International HEPPA-SOLARIS Workshop 2016

The 6<sup>th</sup> International HEPPA-SOLARIS Workshop was held on 13-17 June, 2016, at the Finnish Meteorological Institute in Helsinki, Finland. The 2016 workshop focused on observational and modeling studies of the influences of solar radiation (SR) and energetic particle precipitation (EPP) on the atmosphere and climate, continuing the series of meetings organized since 2008 in Finland, USA, Spain, and Germany. HEPPA-SOLARIS 2016 covered a broad range of topics: a) the causes and phenomenology of SR and EPP variability, b) mechanisms by which SR and EPP forcing affect atmospheric chemistry and dynamics, c) contributions of SR and EPP forcing to variations in space, atmosphere, and climate, and d) the current state of the art and outlook for relevant observations and models. HEPPA-SOLARIS 2016 was attended by 57 scientists from 14 different countries: Finland 14, USA 9, Germany 9, Norway 6, UK 5, Sweden 3, Greece 2, Spain 2, Switzerland 2, Czech Republic 1, Egypt 1, France 1, Japan 1, New Zealand 1. A total of 65 scientific presentations were given: 7 invited and 35 oral presentations, as well as 23 posters. Most of the invited talks were given by early-career scientists, addressing the current difficulties and the future of SR and EPP measurements, and stratospheric ozone and climate connections. Two invited talks were given on the solar forcing recommendation for Coupled Model Inter-comparison Project Phase 6 (CMIP6) which is based on a joined analysis work by the SPARC/SOLARIS-HEPPA community and for the first time includes both SR and EPP. The oral program ran throughout the week with sessions before and after lunch time, to provide a plenty of the time for posters and informal.

*P. T. Verronen,*  
*Finnish Meteorological Institute, Finland*





**Photo 4:** Workshop participants (Photo by E. Kyrölä, Finnish Meteorological Institute).

### 6.3 6<sup>th</sup> Workshop on Vertical Coupling in the Atmosphere-Ionosphere System, Taipei, Taiwan

To facilitate the community dialogue crucial to understanding how vertical coupling contributes to the overall variation of the Earth's atmospheric system, the 6<sup>th</sup> Workshop on Vertical Coupling in the Atmosphere-Ionosphere System was held at Academia Sinica in Taipei, Taiwan from July 25 – 29, 2016. This is the first time this Workshop has been held in East Asia, to encourage involvement of researchers in this region.



**Photo 5:** Workshop participants at the conference venue in Taipei.

Participation included colleagues from 16 institutions across 9 countries, with over 40 abstracts received. Topics of interest included upper and middle atmosphere variability induced by atmospheric tides, planetary waves. Ionospheric variations due to solar eclipses, dust storms, earthquakes, and increasing carbon dioxide concentrations were also discussed.

A special edition of the Journal of Atmospheric and Solar-Terrestrial Physics is now open for submission until November 2016. Abstracts and the Workshop program are available online at:

<http://www.ss.ncu.edu.tw/~vcais6/program.html> .

Loren C. Chang  
Institute of Space Science,  
National Central University, Taiwan

### 7. New Adherent Members - Mexico

In December 2015 Mexico applied for admission as a member of SCOSTEP. The application was processed by the SCOSTEP Bureau and recommended to the SCOSTEP Council that Mexico be admitted into SCOSTEP. On August 17, 2016 the SCOSTEP Council unanimously approved Mexico's application for a membership in SCOSTEP. With this Mexico becomes an Adherent member of SCOSTEP effective immediately. We are delighted that the active collaboration between the Mexican solar-terrestrial physics community and many international scientific groups will find a new dimension within SCOSTEP. *Congratulations!*

Dr. Juan Americo Gonzalez-Esparza will be Mexico's National Representative to the SCOSTEP Council.

### 8. Upcoming Events

**Sep. 11-16, 2016:** International Symposium on Recent Observations and Simulations of the Sun-Earth System III, Golden Sands, Bulgaria,  
<http://www.isroses.lanl.gov/>

**Sep. 13-17, 2016:** International Symposium on the Whole Atmosphere (ISWA), Tokyo, Japan,  
<http://pansy.eps.s.u-tokyo.ac.jp/iswa/>

**Sep. 19-23, 2016:** ROSMIC/IAGA workshop on trends and long term variations, Kühlungsborn, Germany,  
<https://www.iap-kborn.de/1/trends2016/>

**Sep. 19-23, 2016:** 7<sup>th</sup> workshop of the VLF/ELF Remote Sensing of Ionospheres and Magnetospheres (VERSIM) working group, Hermanus, South Africa,  
<http://events.sansa.org.za/versim-information>

**Sep. 25-30, 2016:** 14<sup>th</sup> Hvar Astrophysical Colloquium, Zagreb, Croatia,  
<http://oh.geof.unizg.hr/index.php/en/xivth-hac>

**Oct. 9-14, 2016:** International Astronomical Union Symposium 327: Fine Structure and Dynamics of the Solar Atmosphere, Cartagena de Indias, Colombia, <http://iaus327.unal.edu.co/home/>

**Oct. 17-21, 2016:** International Astronomical Union Symposium 328: Living around Active Stars, Maresias, SP, Brazil, <http://www.sab-astro.org.br/IAUS328>

**Nov. 7 - 17, 2016:** SCOSTEP/ISWI International School on Space Science, Sangli Maharashtra, India, [http://www.iiap.res.in/meet/school\\_meet/](http://www.iiap.res.in/meet/school_meet/)

**Nov. 14-18, 2016:** European Space Weather Week, Oostende, Belgium, <http://www.stce.be/esww13/>

**Dec 12-16, 2016:** SCOSTEP Town Hall meeting, AGU – Fall Meeting, San Francisco.

## 9. General Information about SCOSTEP

Information on SCOSTEP can be found at:  
<http://www.yorku.ca/scostep/>

The Scientific Secretary is the main point of contact for all matters concerning SCOSTEP.

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