

# VarSITI Newsletter

## Inside this issue

Article 1:  
Introducing the NCAR Whole Atmosphere Community Climate Model with Thermosphere and Ionosphere Extension (WACCM-X 2.0) .....1

Article 2:  
Coordinated investigations of topside H<sup>+</sup> ions: new results for inner magnetosphere .....3

Article 3:  
Complex catalogue of high speed streams and geomagnetic storms during solar cycle 24 (2009 – 2016) .....5

Highlight on Young Scientists 1:  
Jian Du/ USA .....7

Highlight on Young Scientists 2:  
Diana Besliu-Ionescu/ Romania .....9

Highlight on Young Scientists 3:  
Emma Douma/ New Zealand .....11

Highlight on Young Scientists 4:  
Lauri Holappa/ Finland, USA .....12

Meeting Report 1:  
Promoting a new generation of Chinese-American collaboration in space .....14

Meeting Report 2:  
13-th conference "Plasma Physics in the Solar System" .....14

Meeting Report 3:  
Dynamic Sun II: Solar Magnetism from Interior to the Corona .....15

Meeting Report 4:  
International School on Equatorial and low-latitude ionosphere (ISELION 2018) .....15

Meeting Report 5:  
IAU Symposium 340 .....16

Meeting Report 6:  
Particle Dynamics in the Earth's Radiation Belts .....16

Upcoming Meetings .....17

Project ROSMIC

### Article 1:



## Introducing the NCAR Whole Atmosphere Community Climate Model with Thermosphere and Ionosphere Extension (WACCM-X 2.0)

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The Whole Atmosphere Community and Ionosphere Extension (WACCM-X) Climate Model with Thermosphere is a general circulation model (GCM) that

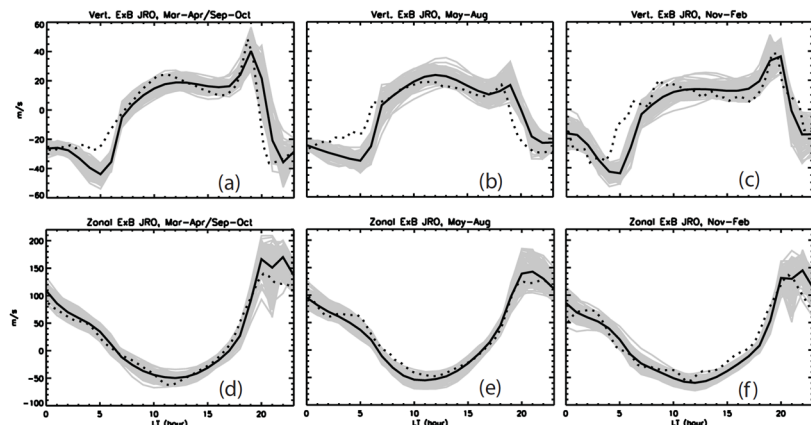
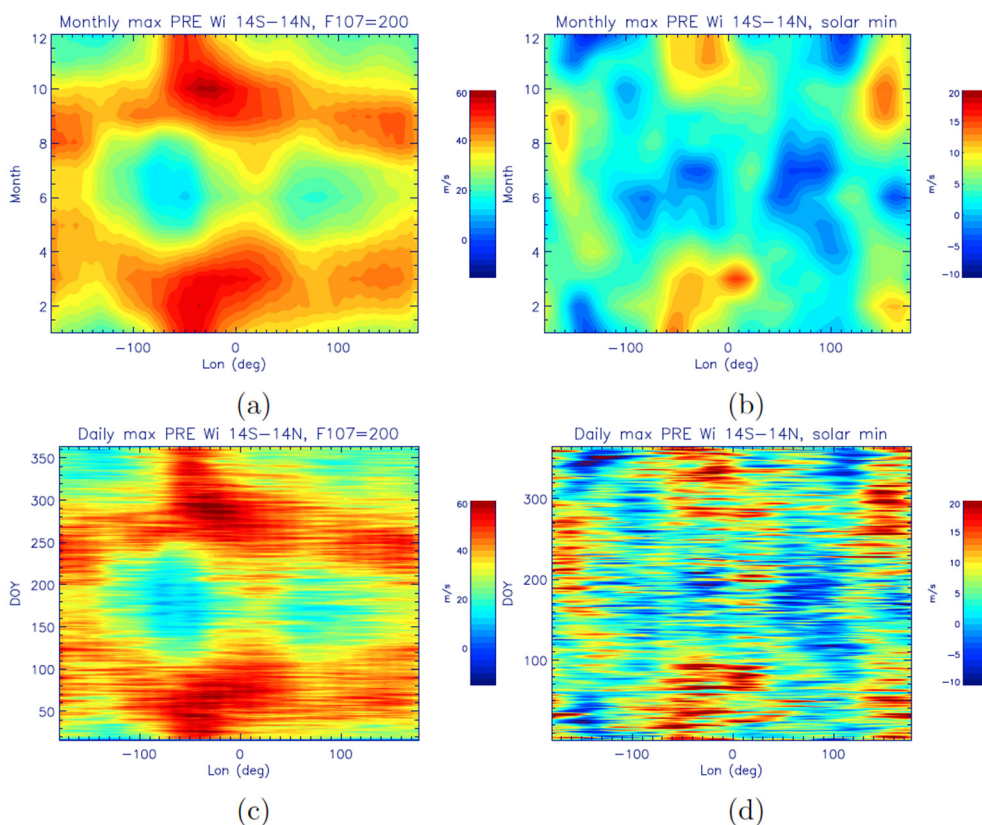


Figure 1. Vertical (a-c) and zonal (d-f) components of ExB drifts for the time periods of equinoxes (March-April and September-October), southern winter (May-August), and northern winter (November-February), respectively. Black/grey lines: average/daily model values over the respective time periods at 12.3°S/77.5°W and ~380 km. Dotted lines: climatological drift values obtained from Jicamarca Radio Observatory observations (Fejer et al., 1991). F10.7: 200 sfu for model simulations; 194, 174 and 168 sfu for JRO equinoctial, winter and summer observations, respectively [H.-L. Liu et al., 2018].

spans from the Earth's surface to the exobase. The main scientific goals of WACCM-X are to study the solar impacts on the Earth atmosphere system and to understand and quantify coupling processes between atmospheric layers on different temporal and spatial scales. Several key developments have recently been made to the model, including the self-consistent solution of ionospheric electrodynamics and F region O<sup>+</sup> transport. Other ionosphere developments include time-dependent solution of electron/ion temperatures, metastable O<sup>+</sup> chemistry, and high-cadence solar EUV capability. Additional developments of the thermospheric components are improvements to the momentum and energy equation solvers to account for variable mean molecular mass and specific heat, a new divergence damping scheme, and cooling by O(<sup>3</sup>P)

fine structure. This new version of the model (WACCM-X 2.0) is described in a recent paper [H.-L. Liu et al., 2018]. Model results have been examined and compared with thermospheric and ionospheric observations under different solar conditions [H.-L. Liu et al., 2018; J. Liu et al., 2018], and general agreements have been found. For example, Figure 1 shows that the simulated ExB drifts in the equatorial region are in good agreement with the climatology from drift measurements made at Jicamarca Radio Observatory [Fejer et al, 1991]. The longitudinal and seasonal variations of the pre-reversal enhancement (PRE) from the model simulations also show good agreement with satellite observations, and the daily results of PRE reveal strong day-to-day variability (Figure 2).



**Figure 2. (a-b): Monthly averaged values of maximum pre-reversal enhancement (PRE) between 14°S—14°N from WACCM-X simulations under solar maximum and solar minimum conditions, respectively. (c-d) Similar to (a-b) but daily values of PRE [H.-L. Liu et al., 2018].**

WACCM-X 2.0 has been used to simulate anthropogenic global change through the entire atmosphere under constant low solar activity conditions [Solomon et al., 2018]. The basic result was that even as the lower atmosphere gradually warms, the upper atmosphere rapidly cools. Global mean annual mean temperature increased at a rate of +0.2 K/decade at the surface and +0.4 K/decade in the upper troposphere, but decreased by about -1 K/decade in the stratosphere-mesosphere, and -2.8 K/decade in the thermosphere. Near the mesopause, temperature decreases were small compared to the interannual variation, so trends in that region are uncertain. Results were similar to previous modeling confined to specific atmospheric levels, and compared favorably with available measurements.

WACCM-X 2.0 has the option to constrain the troposphere and stratosphere by reanalysis (named specified-dynamics or SD configuration). This is particularly valuable for comparison with observations for a specific time period. SD-WACCM-X simulations for 2000-2012 can be accessed through Earth System Grid (<https://www.earthsystemgrid.org/>, then search fxsd).

Data assimilation capability has also been developed for WACCM-X, using the Data Assimilation Research Testbed (DART) ensemble adjustment Kalman filter [Pedatella et al., 2018]. The middle and upper atmosphere variability is well reproduced in WACCMX+DART reanalysis fields during the 2009

major sudden stratospheric warming (SSW). Hindcast experiments show that the model has good predictive skill, and can forecast the middle and upper atmosphere variability associated with the SSW ~10 days in advance.

**W**ACCM-X 2.0 will be released for community use, as part of the NCAR Community Earth System Model version 2 (CESM 2). Once released, the model source code, as well as model documents, can be accessed from the CESM website (<http://www.cesm.ucar.edu/>). CESM tutorials are given each year, and the tutorial information can also be found under CESM Events (<http://www.cesm.ucar.edu/events/tutorials/>). A WACCM-X tutorial session was held during the 2017 NSF CEDAR Workshop, and the tutorial materials can be accessed at [http://cedarweb.vsp.ucar.edu/wiki/index.php/2017\\_Workshop:WACCM\\_X\\_Users\\_Group](http://cedarweb.vsp.ucar.edu/wiki/index.php/2017_Workshop:WACCM_X_Users_Group).

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M., Pedatella, N. M., Qian, L., Richmond, A. D., Roble, R. G., Solomon, S. C., Vitt, F. M., & Wang, W. (2018). Development and validation of the Whole Atmosphere Community Climate Model with thermosphere and ionosphere extension (WACCM-X). *Journal of Advances in Modeling Earth Systems*, 10. doi:10.1002/2017MS001232.

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Solomon, S. C., H.-L. Liu, D. R. Marsh, J. M. McInerney, L. Qian, and F. M. Vitt (2018). Whole atmosphere simulation of anthropogenic climate change. *Geophysical Research Letters*, 45, 1567. doi:10.1002/2017GL076950.

#### Article 2:



## Coordinated investigations of topside H<sup>+</sup> ions: new results for inner magnetosphere

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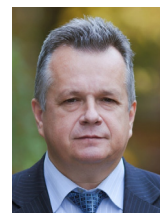
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Maryna Shulha



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Igor Domnin

**A**tomistic hydrogen (H) is a crucially important constituent of the Earth's atmosphere. These atoms form the geocorona which directly impacts the dissipation of the ring current during the recovery phase of magnetic storms [Ilie *et al.*, 2013]. The H<sup>+</sup> ions, which are produced by the charge exchange reaction of H with ionospheric O<sup>+</sup>, are primarily responsible for existence of the plasmasphere and its refilling after the emptying by severe storms [Richards and Torr, 1985].

**O**ur previous studies in 2015-2016 revealed that the NRLMSISE-00 neutral atmosphere model underestimated the H density by a factor of 2 to 3 during the period of extremely low solar activity 2006–2010 [Kotov *et al.*, 2015, 2016]. We noted also that this finding was the key to explaining the lower than normal O<sup>+</sup>-H<sup>+</sup> transition heights (height where H<sup>+</sup> becomes the dominant ion) as well as significant enhancements of the nighttime peak of the electron density (*NmF*<sub>2</sub>).



**Figure 1. The main antenna of Kharkiv incoherent scatter radar (diameter 100 meters).**

**G**iven the importance of the problem the question that we posed to solve was as follows:

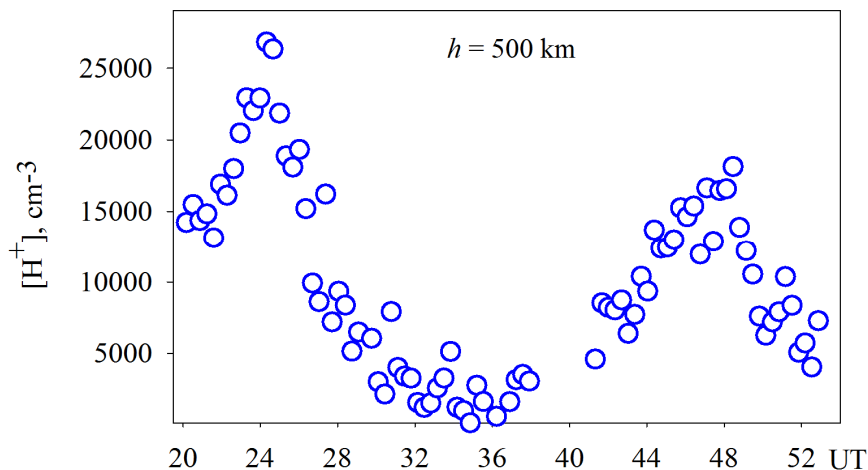
*'Is such a high neutral H density an attribute of the unique minimum of the solar cycle 23<sup>rd</sup> or this is usual situation when NRLMSISE-00 model underestimates hydrogen density for low solar activity?'*

**T**o answer the question, we proposed a new VarSITI campaign to continue thermospheric H density stud-

ies in the current solar minimum (2016–2017). In 2017, we carried out four observations (2–3 days duration) near the equinoxes and solstices with the Kharkiv incoherent scatter radar (49.6 N, 36.3 E) (Figure 1) to measure the H<sup>+</sup> ion density (see example in Figure 2) and another ionospheric plasma parameters. Then, we used the field line interhemispheric plasma (FLIP) model to perform the observational based simulation and, as the result, we estimated H density.

**A** meeting to analyze the results of the Campaign was supported by the VarSITI grant and it was organized in the Institute of Atmospheric Physics, Prague, Czech Republic in October 6-10, 2017.

**T**he main conclusion follows from our investigations is that MRLMSISE-00 model underestimated hydrogen density during the period of 2016–2017. We are preparing a paper for peer-reviewed journal to summarize the results of the Campaign and we believe that our findings will be useful for all scientists who deal with studies of unresolved space weather problems. The results may be also especially interesting because the current solar minimum follows a much weaker solar maximum than the one that preceded the 2006–2009 solar minimum.



**Figure 2. An example of H<sup>+</sup> ion density observed by Kharkiv IS radar during the VarSITI Campaign 2017: December 24-26, 2017, altitude 500 km.**

#### Acknowledgements:

This work was supported by the VarSITI/SCOSTEP grant and by the Ministry of Education and Science of Ukraine (project 0116U006807).

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Kotov D.V. et al. (2016), The importance of neutral hydrogen for the maintenance of the midlatitude winter nighttime ionosphere: Evidence from IS observations at Kharkiv, Ukraine, and field line interhemispheric plasma model simulations, *J. Geophys. Res. Space Physics*, 121, 7013–7025, doi:10.1002/2016JA022442.

## Article 3:



# Complex catalogue of high speed streams and geomagnetic storms during solar cycle 24 (2009 – 2016)

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The High Speed Streams (HSSs) in the solar wind are travelling through the heliosphere towards the Earth's orbit and beyond, inducing a lot of interplanetary disturbances that could cause geomagnetic storms (GSs), polar auroras and even the geomagnetically induced currents in the large extent terrestrial technological systems. A series of previous works identified and analysed the HSSs during the solar cycles (SCs) nos. 20–23. Thus, the works of the Swedish team (1,2,3) or the Greek team (4,5) catalogued these currents in the solar wind for the period of three SCs, 1964–1996. HSSs during SC 23 were determined and published by other three co-authors teams (6,7,8).

It is known that geomagnetic activity and other associated phenomena are more influenced by the variation of the solar wind stream speed  $dV/dt$  rather than by the absolute value of the solar wind particles speed (1). For

this reason in the attempts to define HSSs the criterion of speed variation rather than its absolute value has been used. We chose the same selection procedure of the streams as Swedish team because this one allows more precisely to determine the HSS beginning and end. So, we selected as HSS a solar wind flow having  $\Delta V I \geq 100$  km/s that lasted for at least two days, where:  $\Delta V I$  was the difference between the smallest three-hours (3-hr) mean plasma velocity for a given day ( $V_0$ ) and the largest 3-hr mean plasma velocity for the following day ( $V_1$ ). A complex catalogue for SC 24 (2009–2016) that includes HSSs produced by solar coronal holes (CHs) and their associated GSs is presented here. Two screenshots of this catalogue (<http://www.geodin.ro/varsiti/>) are shown in Fig. 1 (part of the main page) and Fig. 2 (HSSs during 2010).



## HSS catalog VarsITI Grant 2017

A complex catalog of the High Speed Streams (HSSs) produced by Coronal Holes (CHs) and their effects in terrestrial magnetosphere as geomagnetic storms for Solar Cycle (SC) 24, from 2009 to 2016 is presented here. The HSSs in the solar wind have a lot of definition given by different authors; the simplest is often the best: a large increase in the solar wind velocity lasting for several days. We selected as „high-speed stream” a solar wind flow having  $\Delta V_1 > 100$  km/s that lasted for two days, where:  $\Delta V_1$  is the difference between the largest 3-hr mean plasma velocity for a day ( $V_1$ ) and the smallest three-hours (3-hr) mean plasma velocity for the previous day ( $V_0$ ). The HSSs were determined using software developed by Ovidius Mariş (Institute of Space Science) during a previous national collaboration (HELIOTER, Contract nr. 81-021/2007) and improved by our team (with special thanks to Daniela Lacatus și Alin Paraschiv), using C and IDL. We thank Ovidiu Mariş for making this software available to our team.

The first part of the catalog lists basic parameters of the high speed streams: start time (calendar date by year, month, and day), the initial ( $V_0$ ) and  $V_1$  – maximum velocity in the second day of the stream (km/s),  $\Delta t_1$  – time interval between  $V_0$  and  $V_1$  (in number of 3-hr intervals), the maximum ( $V_{max}$ ) speed (in km/sec), the duration (in days), the maximum gradient of the plasma speed (in km/s):  $\Delta V_1 = V_1 - V_0$ ,  $\Delta V_M = V_{max} - V_0$  – maximum gradient of the plasma velocity, the intensity of the stream defined as  $I = \Delta V_{max} \times d$ , ( $d$  – duration of HSS) and, their solar CH (Coronal Holes) sources. The main interplanetary magnetic field polarity during streams is also mentioned.

The second part of the catalog contains all geomagnetic storms (GS) having Dst minimum value less or equal to  $-30$  nT (from minor to strong GS) associated to each HSS, by listing their Dst minimum value, the moment of this minimum given by the calendar date format: month, day and hour (mm:dd:hh), a description of its commencement (storm with sudden commencement – SSC). The minimum negative values of the southern component

### DEPARTMENTS

- THE ROLE OF FLUIDS IN THE DYNAMICS OF LITHOSPHERE
- ENDOGENE PROCESSES, NATURAL HAZARDS AND RISK
- NATURAL FIELDS
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- GEODYNAMIC OBSERVATORIES
- SYSTEMS OF COMPLEX ANALYSIS

### Site map

- Home
- General Information
  - Short Overview
  - History
  - Research Infrastructure
  - Statutes
  - International Cooperation
  - Accreditation
  - PhD School
- Organization
- Scientific Events
- Activities
- Journals

Figure 1. Screenshot of the main page of the complex catalogue of HSSs and GSs for SC 24.

The first part of the catalogue lists basic parameters of the HSSs (detailed presented on the main page). The second part of the catalogue contains all GSs having  $Dst_{min} \leq -30$  nT (from minor to strong GS) associated to each HSS, by listing their  $Dst$  minimum value, the moment of this minimum given by the calendar date format: month, day and hour (mm:dd:hh), a description of its commencement (storm with sudden commencement, SSC). The minimum negative value of the southern component of the heliospheric magnetic field ( $B_z$ , in nT) registered just before the minimum  $Dst$  value and its time (mm:dd:hh) is also included. In order to give more information on the GS evolution and characteristics, our catalogue also includes estimated values for the energy deposited in the magnetosphere from solar wind (for

GSs with  $Dst \leq -50$  nT), computed using the Akasofu parameter (9),  $\epsilon$ , integrated over the main phase of the geomagnetic storms and an improved version of this formula given by Wang et al. (10),  $W$ . Generally, one single GS is induced by a HSS. However, there are some cases when, during a complex HSS, two or even more (minor) GSs are registered; in such cases, the parameters of the successive geomagnetic storms will appear on successive rows in the catalogue. Recently many scientists have begun to use the SYM-H geomagnetic index instead of classic index  $Dst$ . The last two columns of the monthly tables give the SYM-H value and its time (month, day, hour, minute). The main advantage is that SYM-H has 1-min time resolution compared to the 1-hour time resolution of  $Dst$ .

Figure 2. Screenshot of the HSSs and GSs during 2010.

### Acknowledgements:

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## Highlight on Young Scientists 1:



## Understanding Tidal “Weather”

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Jian Du

Highlight

on Young Scientists

Although the importance of atmospheric tides is by now without dispute, the present understanding of their ionosphere/thermosphere (IT) impacts is limited to seasonal “climatological” time-scales of variability. Figure 1 gives an example of the short-term tidal variability (periods < 30 days) of the migrating diurnal tide (DW1) from the extended Canadian Middle Atmosphere Model (eCMAM) [Fomichev et al., 2002] and the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) satellite measurements in 2006. It is evident that tidal amplitudes vary by a factor of two or more within a few days.

Funded by NASA, we are currently investigating the short-term tidal variability with information-

al theory [Larson, 2012]. Figure 2 clearly shows the individual PDFs are Gaussian like but the shapes of the PDFs change with time. Broader PDFs indicate a larger range of tidal short-term variability, whereas narrower PDFs indicate a smaller range of tidal variability. A simple FFT on the peaks of the PDFs shows that there are long-term variations governing the shapes of the PDFs. There are 4-, 6-, 12- month peaks in the FFT and a peak associated with the quasi-biannual oscillation (QBO) period. We are currently investigating how and why these changes are present.

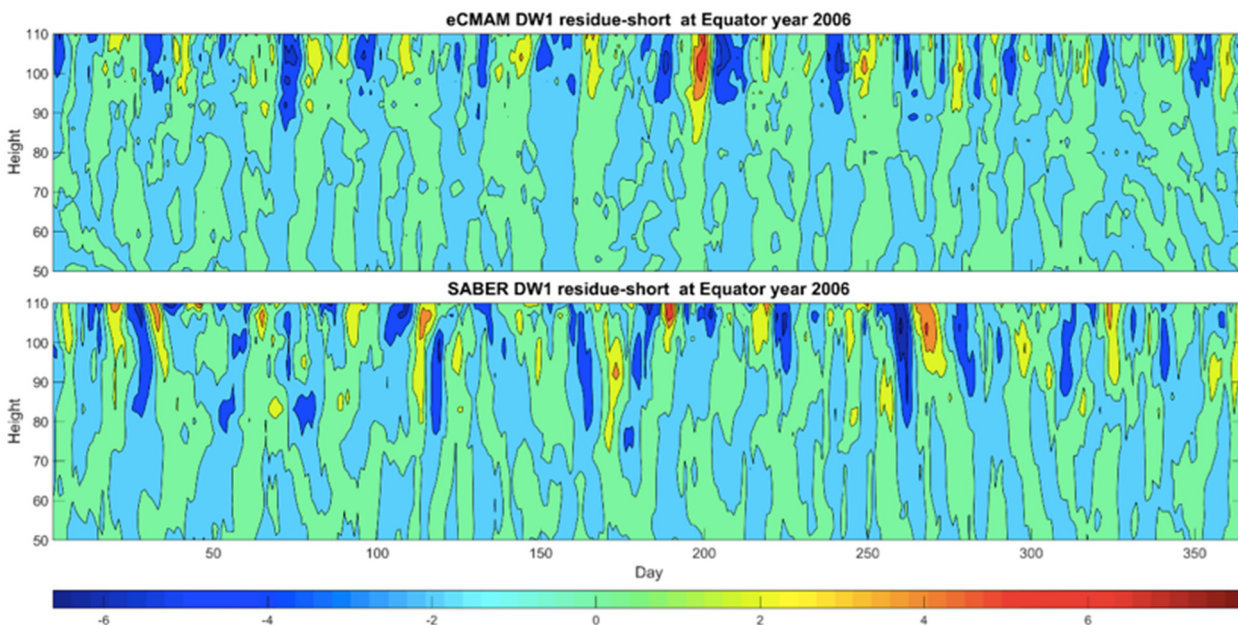
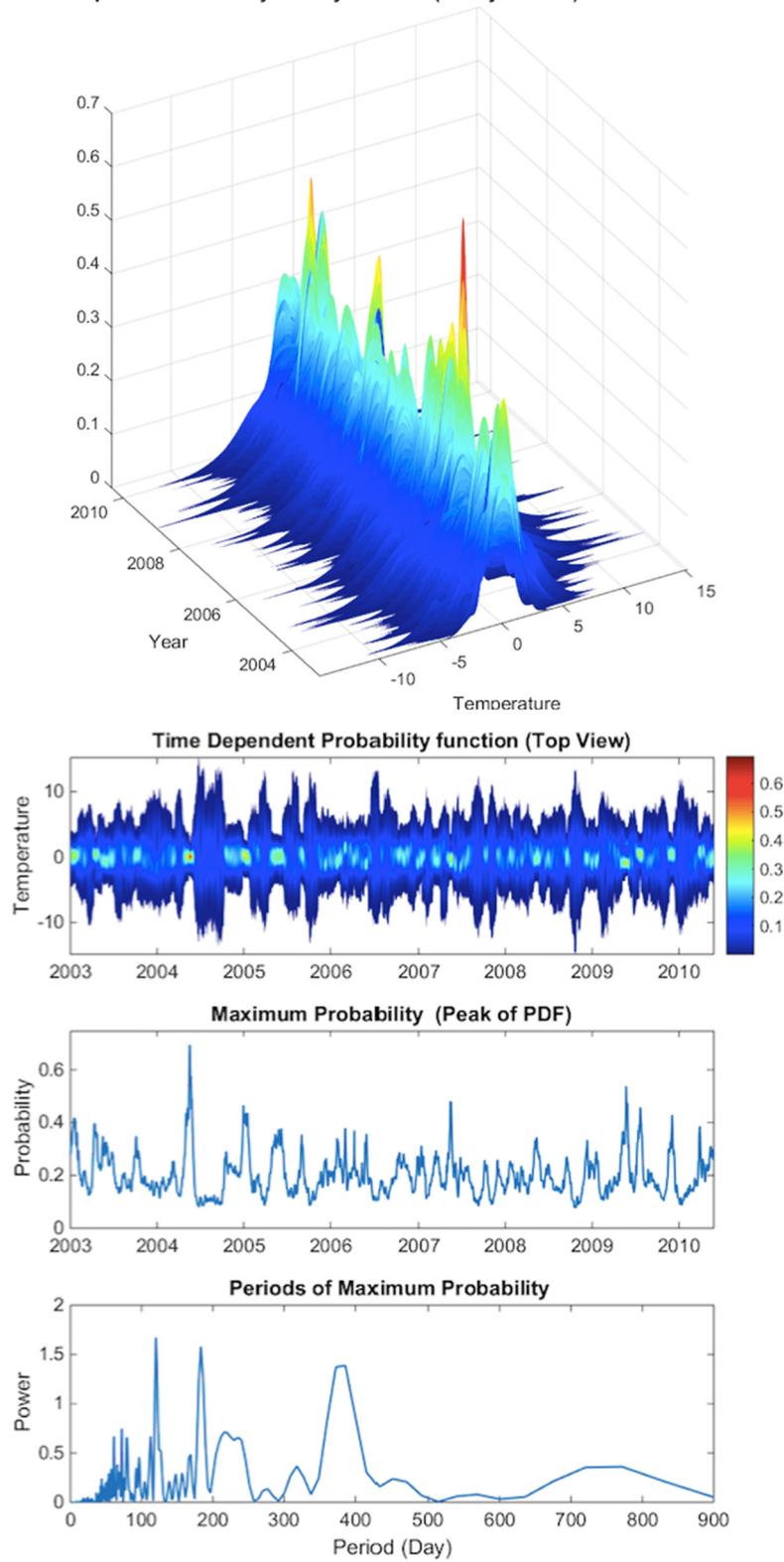


Figure 1. Short-term tidal variability (periods < 30 days) of the migrating diurnal tide (DW1) as a function of day in 2006 and height from the eCMAM (top) and SABER (bottom).

Time Dependent Probability Density Function (30 day window) eCMAM residue short



**Figure 2. Top: Time dependent Probability Density Functions (PDFs) of the short-term DW1 variability (periods < 30 days) at 100 km and the equator from January 2003 and June 2010. Second from top: same as the Top figure but the top view. Second from bottom: the peak of the PDFs as a function of time. Bottom: Fourier transform of the maximum probability.**

**References:**

Fomichev, V. I., W. E. Ward, S. R. Beagley, C. McLandress, J. C. McConnell, N. A. McFarlane, and T. G. Shepherd (2002), Extended Canadian Middle Atmosphere Model: Zonal mean climatology and physical parameterizations, *J. Geophys. Res.*, 107 (D10), 4087, doi:10.1029/2001JD000479.

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## The Journey of a CME in the heliosphere in June 2015

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Diana Besliu-Ionescu

Studying the solar-terrestrial connections is of a great importance for applications in everyday life as well as in scientific research. Therefore, understanding the consequences of a coronal mass ejection (CME) upon the Earth's magnetosphere can be a relevant contribution to this connection.

On June 22, 2015 a large active region of  $\beta\gamma\delta$  complexity was situated at N13W14 (223", 183") on the solar disk. An M6.6-class solar flare started to be recorded by GOES around 17:39 UT, at heliographic coordinates N12W08. It lasted

for 44 minutes and peaked at 18:23 UT.

A Halo CME was registered by the SOHO/LASCO coronagraph ([https://cdaw.gsfc.nasa.gov/CME\\_list/](https://cdaw.gsfc.nasa.gov/CME_list/)) at 18:36:05 UT. Although all its measured velocities exceeded 1000 km/s, this was not the fastest CME during that month. With a linear speed of 1209 km/s and a final height speed of 1147 km/s, it decelerated by  $25.1 \text{ m/s}^2$ . Figure 1 shows the evolution of the CME as seen in LASCO-C2 running difference images.

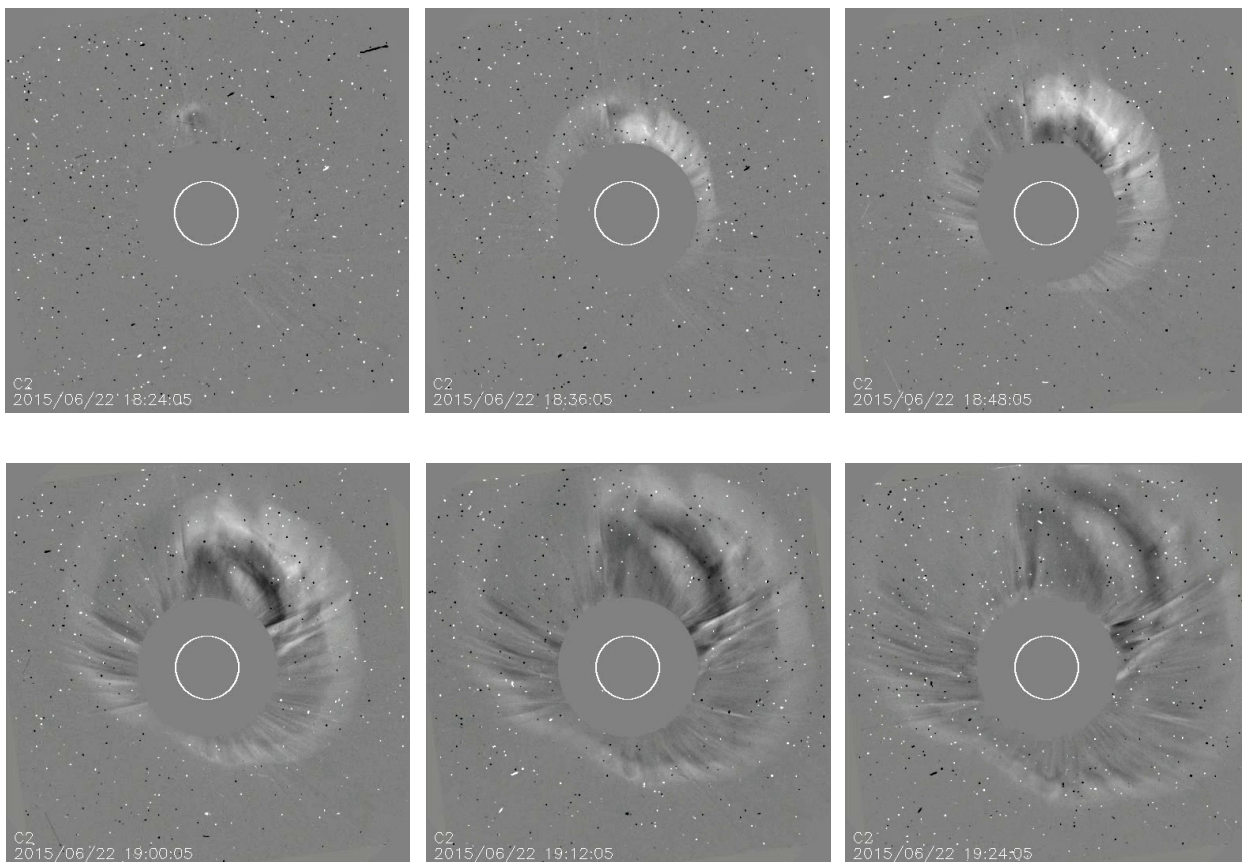


Figure 1. CME evolution as seen in LASCO-C2 running difference images. (credits: <https://lasco-www.nrl.navy.mil>)

The associated interplanetary CME (ICME) was reported on the online catalogue available at <http://www.srl.caltech.edu/ACE/ASC/DATA/level3/icmetable2.htm>. It caused a geomagnetic disturbance on June 24 at 13:29 UT without a sudden commencement (SSC) detected, ~43 hours after the first appearance of the CME. The ICME started at 10:00 UT on June 25 and ended on June 26, at 06:00 UT.

From the online high speed streams (HSS) catalogue available at <http://www.geodin.ro/varsiiti/>, we can observe that a HSS was detected during this period starting on June 24, 2015 in the fourth 3-h

interval and lasted for 4.5 days.

Following this combination of ICME and HSS the geomagnetic index Dst showed a significant decrease to a minimum value of -86 nT. The temporal profile of Dst index along with the interplanetary magnetic field evolution (total intensity and Bz component) are shown in Figure 2 (left panel) where the red straight line represents the starting time of the disturbance, the two dotted red lines represent the main phase of the geomagnetic storm, while the black dashed lines mark the ICME start and end time.

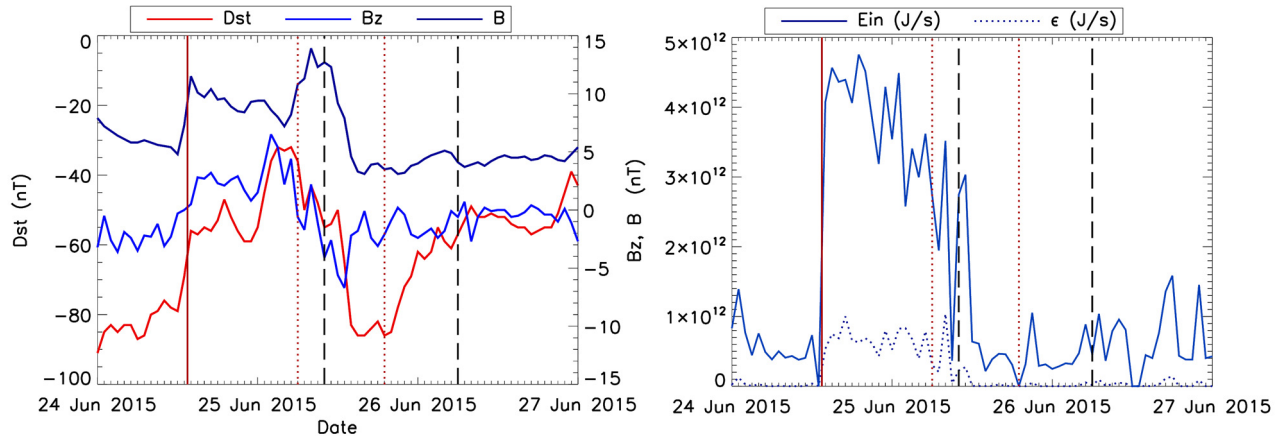


Figure 2. Time series of the geomagnetic index Dst, total and southern component of the interplanetary magnetic field (left panel) and of energy values (Akasofu parameter and Wang formula) variations (right panel).

In order to understand the variation of the geomagnetic index we studied the energy transfer from the solar wind into the magnetosphere using the Akasofu parameter  $\epsilon$  (Akasofu, 1981) and an improved version of its formula denoted here by EIN calculated by Wang et al. (2014). We computed the two quantities using the OMNI data (<https://omniweb.gsfc.nasa.gov/form/dx1.html>) as input in an IDL program. The two quantities are shown in Figure 2 right panel,  $\epsilon$  being represented by a blue dotted line, while  $E_{IN}$  is represented by a blue continuous line. We can observe that the energy transfer starts at exactly the same time as the disturbance preceding the ICME.

It is evident that the energy input is not limited to the main phase of the storm. The energy transfer from the solar wind into the magnetosphere is considered to happen only during the main phase of the storm. We computed the total energies transferred during the main phase as being  $\epsilon_{tot}=1.46e16$  J/s and  $E_{IN-TOT}=2.13e17$  J/s.

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# Properties of Relativistic Electron Microbursts

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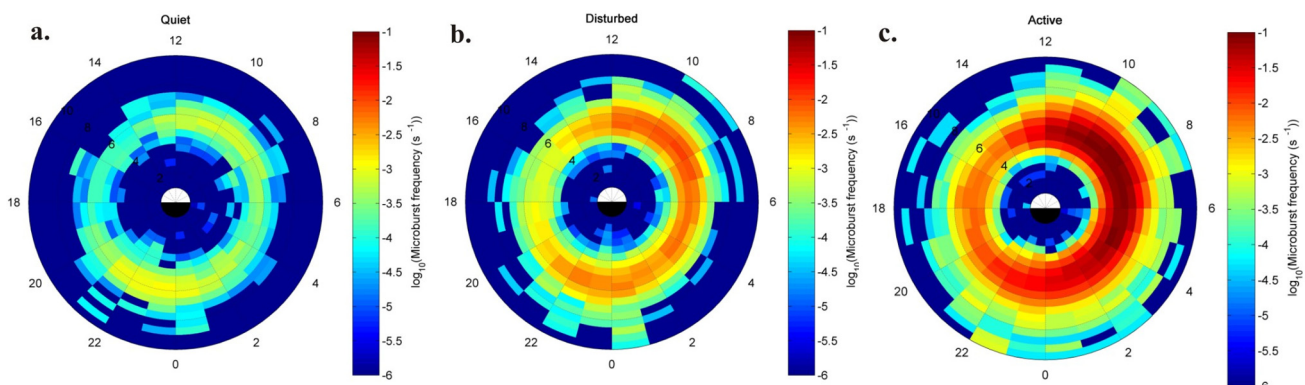
Relativistic electron microbursts are intense short-duration ( $< 1$  s) precipitation events of  $> 1$  MeV electrons from the outer radiation belt into the atmosphere [1].

The net flux in the Van Allen radiation belts which surround the Earth is a delicate balance between loss and energization [2], with relativistic electron microbursts likely significant contributors to radiation belt losses. Therefore, we must understand the conditions under which relativistic microbursts occur, and moreover, the physical processes in space driving this type of precipitation.

There are multiple theoretical studies demonstrating how either EMIC [3] or whistler mode cho-

rus waves [4] are the drivers of relativistic microbursts. Recent experimental evidence has shown relativistic microbursts occurring simultaneously with whistler mode chorus waves [5, 6], however this does not rule out EMIC waves as an additional scattering wave capable of causing microbursts.

We statistically processed a satellite dataset of relativistic microburst events in order to describe the conditions characteristic to relativistic microbursts occurrence [7] and the wave activity present on the ground during these events [8]. With this information we hope to help answer the question of which plasma wave is driving relativistic microbursts. We have also used the observed properties to test the likely atmospheric impact [9].



**Figure 1.** The global distribution of relativistic microbursts reproduced from Douma et al. [2017, Figure 6]. The L and MLT distribution of the frequency of relativistic microbursts during three levels of geomagnetic activity as measured by  $AE^*$ . (a) Quiet conditions, defined as  $AE^* \leq 100$  nT, (b) disturbed conditions, defined as  $100 < AE^* \leq 300$  nT, and (c) active conditions, defined as  $AE^* > 300$  nT. Note that all three panels have the same log color scale.

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Highlight on Young Scientists 4:



## Centennial evolution of solar wind and solar magnetic field reconstructed from geomagnetic activity

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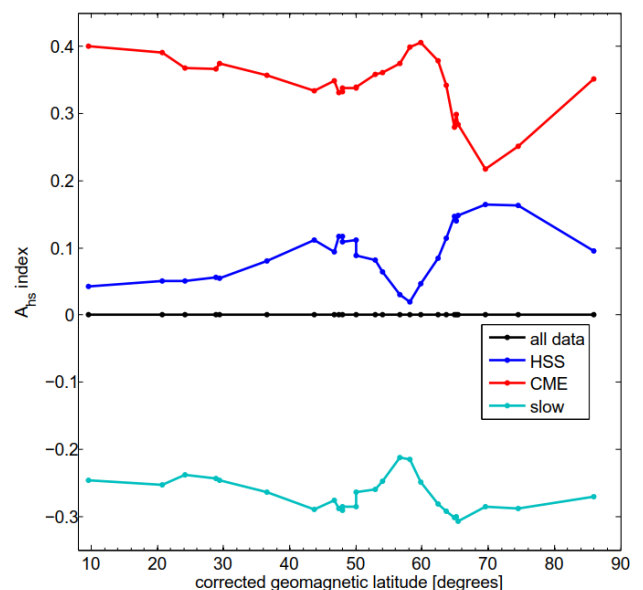
<sup>2</sup>NASA Goddard Space Flight Center, Greenbelt, MD, USA



Lauri Holappa

Geomagnetic activity has been measured at ground-based magnetic observatories since the mid-nineteenth century. The two most important solar wind structures driving geomagnetic activity are coronal mass ejections (CMEs) and high-speed streams (HSSs). These two solar wind structures originate from different sources in the Sun. While CMEs are closely associated with active regions and their occurrence closely follows the solar cycle, HSSs originate from coronal holes maximizing during the declining phase of the solar cycle. Because active regions and coronal holes are related to distinct components of the large-scale solar magnetic field, knowledge of their long-term evolution is critical, e.g., for studies on solar dynamo.

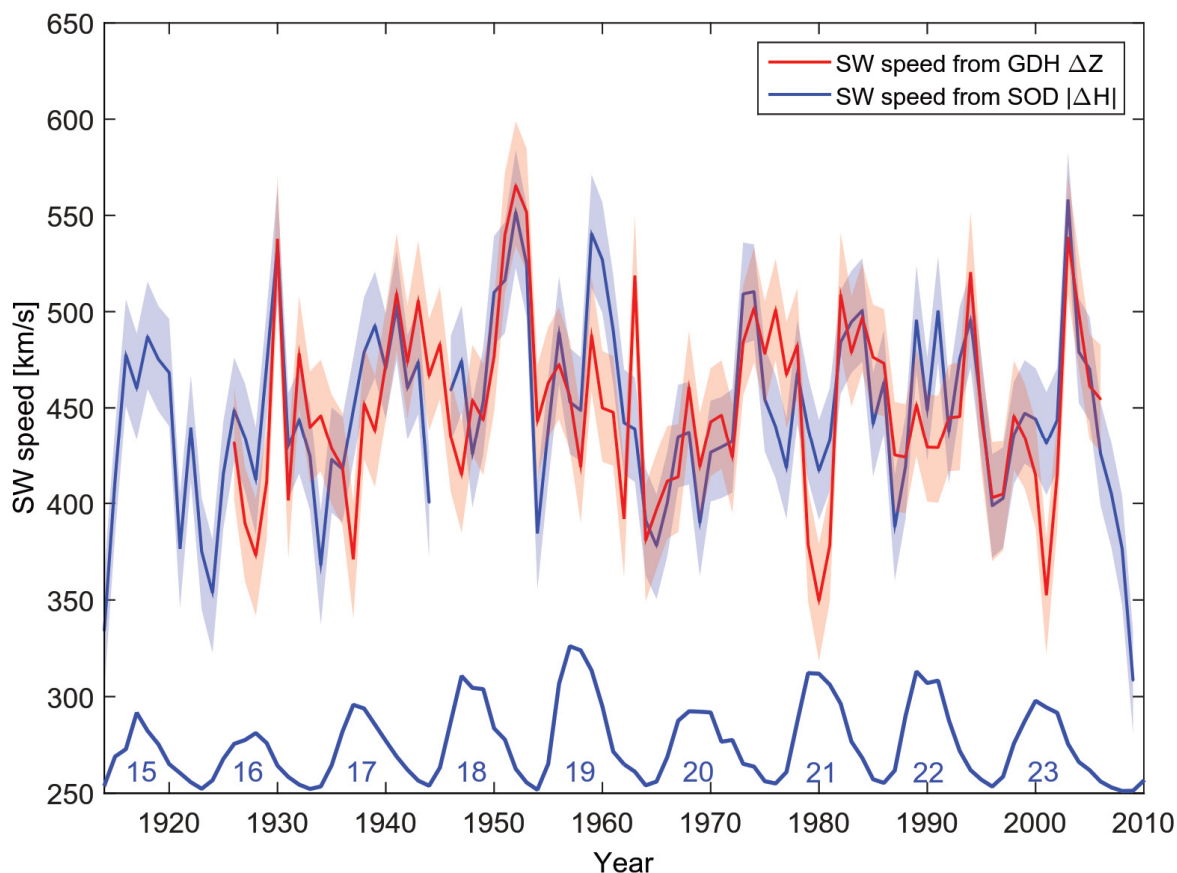
We have recently developed novel methods for extracting information on the occurrence of CMEs and HSSs in solar wind from long-term measures of geomagnetic activity [1-4]. These methods exploit the fact that there are latitudinal differences between CME- and HSS-driven geomagnetic activity (Figure 1). Using auroral region geomagnetic activity we can reconstruct, e.g., annual solar wind



**Figure 1.** Latitudinal distribution of standardized  $A_{hs}$  indices ( $A_{hs}$ ) during CMEs, HSSs and slow solar wind in 1966-2009 [1]. While HSS-driven geomagnetic activity maximizes in the auroral region (about 65°-70°), CME-driven geomagnetic activity maximizes in subauroral (about 60°) and low latitudes.

speeds for the last century (Figure 2). Figure 2 shows that, interestingly, solar wind speeds (and polar coronal holes) maximized during the declining phase of solar cycle 18, preceding the highest solar cycle 19. This also indicates that the strongest solar

polar fields preceded the highest solar cycle 19, giving support for the dynamo theory.



**Figure 2.** Annual solar winds speeds reconstructed from geomagnetic activity measured at two high-latitude observatories (Godhavn, Greenland and Sodankylä, Finland) [3]. Annual sunspot number (arbitrary scale) and solar cycle numbers are included for reference.

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## Meeting Report 1:



### Promoting a new generation of Chinese-American collaboration in space

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Ryan McGranaghan

On January 23-24 the National Space Science Center of the Chinese Academy of Sciences (CAS) and the Space Studies Board of the U.S. National Academies of Sciences, Engineering, and Medicine convened the 7<sup>th</sup> New Leaders in Space Science Forum (NLISSF) in Guangzhou, China. The purpose of these Forums is to provide opportunities for a highly select group of young space and Earth scientists (i.e., *New Leaders*) to discuss their research activities in intimate and collegial environments in both China and the United States.

New leaders are chosen annually by an international program committee (link to the list of

The 7th CAS-NAS Forum for New Leaders in Space Science  
Jan 23-24, 2018, Guangzhou, China



Figure 1. Participants in the 7th Forum for New Leaders in Space Science.

2018 leaders ([http://sites.nationalacademies.org/cs/groups/ssbsite/documents/webpage/ssb\\_184134.pdf](http://sites.nationalacademies.org/cs/groups/ssbsite/documents/webpage/ssb_184134.pdf)) and are invited to participate in a pair of Forums, one held in China and the other in the United States. In 2018, the 7<sup>th</sup> and 8<sup>th</sup> Forums are devoted to astronomy and astrophysics and solar and space physics. The 7th Forum, occurring over two days, featured presentations and discussions led by each New Leader and several members of the CAS and NAS. Culminating conversations were held to outline new collaborations and important future directions.

The 8th Forum will be held in July 2018 in Pasadena, California. Each of the invitees to the 7th Forum are charged with presenting novel research, independent of the work they shared in Guangzhou.

## Meeting Report 2:



### 13-th conference "Plasma Physics in the Solar System"

Yuri Yermolaev  
Space Research Institute,  
Moscow, Russia



Yuri Yermolaev

The 13-th conference "Plasma Physics in the Solar System" was organized by Space Research Institute (IKI), Moscow, Russia and held in IKI on 12-16 February, 2018. The program of the Conference included the following main traditional sections: 1. Theory and observations of the Sun, 2. Solar wind and heliosphere, 3. Ionosphere, 4. Magnetosphere, 5. Theory of space plasma, 6. Theory and observation of current layers, 7. Turbulence and chaos, as well as Special sections:



Figure 1. Photograph of the 13-th conference "Plasma Physics in the Solar System".

S1. Space weather forecast and applied questions of physics of the magnetosphere and ionosphere, S2. Wave phenomena in space plasma, S3. The impact of space factors on the Earth's atmosphere and climate (see conference web-site: <https://plasma2018.cosmos.ru/en>). There were more 300 participants from 6 countries. A large part of presentations were translated in real time in [https://www.youtube.com/watch?v=Z13PD\\_d9sJA](https://www.youtube.com/watch?v=Z13PD_d9sJA). The conference was supported by VarSITI grant.

## Meeting Report 3:



## Dynamic Sun II: Solar Magnetism from Interior to the Corona

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<sup>2</sup>Northumbria University, Newcastle, UK

<sup>3</sup>Indian Institute of Technology (BHU), Varanasi, India



Viktor Fedun



Sergiu Shelyag



Eamon Scullion



Abhishek K. Srivastava

Dynamic Sun' is a new conference series, which provides a highly visible platform for the observers, theoreticians, numerical modellers and instrumentation experts in solar physics and space science to discuss cutting edge scientific challenges. The Dynamic Sun II meeting, which focused on the re-



Figure 1. Group Photo of the Dynamic Sun II.

cent achievements in understanding photospheric, chromospheric and coronal dynamics, energy transport between the solar interior and the solar atmosphere, and dynamical processes in the confined solar transients, took place on 12-16 February 2018 in Siem Reap, Cambodia. This meeting, supported by VarSITI and AOARD, was highly successful with more than 60 attendees from more than 10 countries.

Special attention was paid to the key goals of the proposed high-altitude and ground-based instruments, e.g., DKIST, EST, Sunrise III, and Aditya-I. To disseminate the results reported during the conference the refereed proceedings will be published as a special issue of *Annales Geophysicae* journal.

## Meeting Report 4:



## International School on Equatorial and low-latitude ionosphere (ISELION 2018)

C. Y. Yatini<sup>1</sup> and K. Shiokawa<sup>2</sup>

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<sup>2</sup>Institute for Space-Earth Environmental Research (ISEE), Nagoya University, Nagoya, Japan



Clara Y. Yatini



Kazuo Shiokawa

The International School on Equatorial and low-latitude ionosphere (ISELION2018) was held at Bandung, Indonesia on 5-9 March 2018. Participants are 39 students and young scientists from 7 countries of Egypt, India, Indonesia, Malaysia, Nepal, Philippines, and Vietnam. Six lecturers (Nurul Shazana Abdul Hamid, Buldan Muslim, Kazuo Shi-



Figure 1. Participants of ISELION2018.

okawa, Yoshimasa Tanaka, Mamoru Yamamoto, and Tatsuhiro Yokoyama) introduced ionospheric dynamics, measurement techniques including radars, Spread-F/plasma bubbles, and space weather for four days of Mon-Wed and Fri. A visit of Sumedang Observatory of LAPAN and practice of ionogram processing was held on Thursday. Participants enjoyed lively discussions with the lecturers and mutual communications during this one-week school. Details of the school are available at <http://pussainsa.sains.lapan.go.id/event/iselion2018/>. This school was supported by LAPAN, ISEE/Nagoya University, JSPS core-to-core program B. Asia-Africa Science Platforms, PSTEP project, National Institute of Information and Communications Technology (NICT), and SCOSTEP.

## Meeting Report 5:



## IAU Symposium 340

## Dipankar Banerjee

Indian Institute of Astrophysics,  
Bangalore, India



Dipankar  
Banerjee

**I**AU Symposium 340 on “Long term datasets for the understanding of solar and stellar magnetic cycles” was held in Jaipur, India – February 18 - 24, 2018. The symposium provided an ideal opportunity for scientists from diverse, interdisciplinary areas such as solar, stellar, space and heliospheric physics to review the status of the different long-term datasets available across the globe. The symposium provided an excellent platform to exchange ideas on the understanding of solar long-term behavior, its effects and prediction. The Kodaikanal Observatory has observed the sun at wavelengths WL, Ca-II K, H-alpha since 1904. The digitization process has been completed recently and raw and calibrated data was made available to the global community through an announcement during the meeting. IAU Symposium 340 enabled a comparison of recent results from a wide variety of scientific disciplines. There were eight sessions with 25 invited talks and 46 contributed presentations. There were 153 poster presenta-

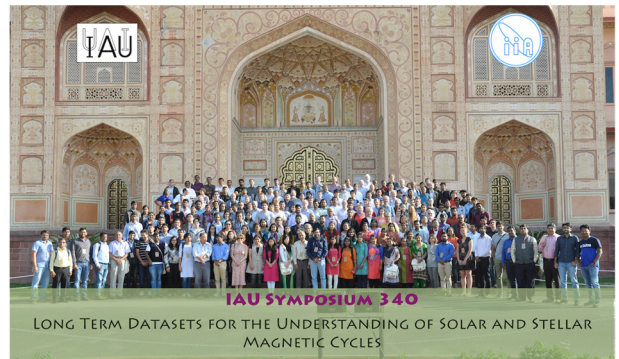


Figure 1. Group Photo of the IAU Symposium 340.

tions and dedicated poster sessions were allotted each day. Each session also attracted poster awards for young scientists. A total number of 233 registered participants attended the symposium, with 157 male and 69 female candidates from 26 different countries across the globe. All the presentations are now posted at the conference website at <https://www.iiap.res.in/iaus340/Home>. There were several education and outreach programs conducted during the conference, including a visit for the conference delegates to the Jantar Mantar, a world heritage site. There were workshops organized for the tourist guides with the theme of understanding the usage of the historical observatory instruments through Positional Astronomy observations. A full day workshop on computer based data analysis on long term solar data sets was also organized for undergraduate and graduate students on the last day of the conference. 90 students attended this workshop. Nat Gopalswamy also delivered a public lecture titled “Our life-giving star, the Sun and its dark side”.

## Meeting Report 6:



## Particle Dynamics in the Earth's Radiation Belts

## Seth Claudepierre

The Aerospace Corporation,  
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Seth  
Claudepierre

**I**n March of 2018, radiation belt scientists descended upon the beautiful, seaside town of Cascais, Portugal, to discuss and debate the current state of the field. The week-long meeting, *Particle Dynamics in the Earth's Radiation Belts*, was orga-

nized under the auspices of the American Geophysical Union (AGU) Chapman Conference program. The conference was well attended, with roughly 100 attendees representing 14 countries. There was a strong contingent (~25%) of students and early career researchers who were supported by generous travel grants from the United States National Science Foundation (NSF) and the VarSITI program of SCOSTEP. Of particular note is that over half of the invited speakers (<https://chapman.agu.org/particle-dynamics/program-and-invited-speakers/>) were from underrepresented groups. The conference website (<https://chapman.agu.org/particle-dynamics/>) details the full scientific program (<https://agu.confex.com/agu/18chapman2/webprogram/start.html>) and includes .pdf files of nearly all of the oral and poster presentations given at the conference. A special issue of the Journal of Geophysical Research – Space Physics is currently being planned.





## Upcoming meetings related to VarSITI

| Conference  | Date                | Location                    | Contact Information   |
|---|---------------------|-----------------------------|---|
| EGU General Assembly 2018   | Apr. 8-13, 2018     | Vienna, Austria             | <a href="https://www.egu2018.eu/">https://www.egu2018.eu/</a>   |
| DKIST Critical Science Plan Workshop 5: Wave generation and propagation   | Apr. 9-11, 2018     | Newcastle upon Tyne, UK     | <a href="http://eclipse2017.nso.edu/science/dkist/dkist-critical-science-plan/workshop-5/">http://eclipse2017.nso.edu/science/dkist/dkist-critical-science-plan/workshop-5/</a>                           |
| 4th International ANGWIN workshop: Exploration of High-latitude Upper Atmosphere Wave Dynamics                        | Apr. 24-26, 2018    | São José dos Campos, Brazil | <a href="http://www.inpe.br/angwin/">http://www.inpe.br/angwin/</a>   |
| 10th International Workshop on "Long-Term Changes and Trends in the Atmosphere"                                       | May 14-19, 2018     | Hefei, China                | <a href="http://trends2018.ustc.edu.cn/home.html">http://trends2018.ustc.edu.cn/home.html</a>   |
| Japan Geoscience Union (JpGU) Meeting 2018  | May 20-24, 2018     | Makuhari, Japan             | <a href="http://www.jpгу.org/meeting_e2018/">http://www.jpгу.org/meeting_e2018/</a>   |
| COSPAR Capacity-Building Workshop Coronal and Interplanetary Shocks: Analysis of Data from SOHO, Wind, and e-CALLISTO | May 21-Jun. 1, 2018 | Mekelle, Ethiopia           | <a href="http://www.e-callisto.org/cospar2018/COSPAR2018workshopEthiopia.html">http://www.e-callisto.org/cospar2018/COSPAR2018workshopEthiopia.html</a>   |
| 15th AOGS Annual Meeting  | Jun. 3-8, 2018      | Honolulu, Hawaii, USA       | <a href="http://www.asiaoceania.org/aogs2018/public.asp?page=home.htm">http://www.asiaoceania.org/aogs2018/public.asp?page=home.htm</a>   |
| 6th International conference "Atmosphere, ionosphere, safety"   | Jun. 3-9, 2018      | Kaliningrad, Russia         | <a href="http://www.ais2018.ru/">http://www.ais2018.ru/</a>   |
| 10th Workshop "Solar Influences on the Magnetosphere, Ionosphere and Atmosphere"                                      | Jun. 4-8, 2018      | Primorsko, Bulgaria         | <a href="http://ws-sozopol.stil.bas.bg/">http://ws-sozopol.stil.bas.bg/</a>   |
| 2018 GEM Workshop   | Jun. 17-23, 2018    | Santa Fe, NM, USA           | <a href="http://www.cpe.vt.edu/gem/index.html">http://www.cpe.vt.edu/gem/index.html</a>   |
| 7th IAGA/ICMA/SCOSTEP workshop on Vertical Coupling in the Atmosphere-Ionosphere System                               | Jul. 2-6, 2018      | Potsdam, Germany            | <a href="https://www.gfz-potsdam.de/en/section/space-geodetic-techniques/topics/vcais-2018/vcais-2018/">https://www.gfz-potsdam.de/en/section/space-geodetic-techniques/topics/vcais-2018/vcais-2018/</a> |
| SCOSTEP 14th Quadrennial Solar-Terrestrial Physics Symposium  | Jul. 9-13, 2018     | Toronto, Canada             | <a href="http://www.scostepevents.ca/">http://www.scostepevents.ca/</a>   |
| 42nd COSPAR Scientific Assembly   | Jul. 14-22, 2018    | Pasadena, CA, USA           | <a href="https://www.cospar-assembly.org/">https://www.cospar-assembly.org/</a>   |
| 7th Symposium of Brazilian Space Geophysics and Aeronomy Society (SBGEA)  | Aug. 6-10, 2018     | Santa Maria-RS, Brazil      | <a href="http://www.sbgea.org.br/vii-sbgea/">http://www.sbgea.org.br/vii-sbgea/</a>   |
| 45th Annual Meeting on Atmospheric Studies by Optical Methods   | Aug. 27-31, 2018    | Kiruna, Sweden              | <a href="http://45am.irf.se/">http://45am.irf.se/</a>   |
| Annual African Geophysical Society (AGS) Conference on Space Weather  | Sep. 24-27, 2018    | Cairo, Egypt                | <a href="http://www.spaceweather.edu.eg/AGS2018.html">http://www.spaceweather.edu.eg/AGS2018.html</a>   |
| ISEST 2018 Workshop XVIth Hvar Astrophysical Colloquium   | Sep. 24-28, 2018    | Hvar, Croatia               | <a href="http://oh.geof.unizg.hr/index.php/en/meetings/184-isest-2018">http://oh.geof.unizg.hr/index.php/en/meetings/184-isest-2018</a>   |
| 15th International Symposium on Equatorial Aeronomy   | Oct. 22-26, 2018    | Ahmedabad, India            | <a href="http://www.prl.res.in/isea15">http://www.prl.res.in/isea15</a>   |

The purpose of the VarSITI newsletter is to promote communication among scientists related to the four VarSITI Projects (SEE, ISEST/MiniMax24, SPeCIMEN, and ROSMIC).

**The editors would like to ask you to submit the following articles to the VarSITI 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 VarSITI
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 VarSITI
4. Short news— Each short news has a maximum of 100 words length.  
Announcements of campaign, workshop, etc.
5. Meeting schedule

Category 3 (Highlights on young scientists) helps both young scientists and VarSITI 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. Ayumi Asai (a-asai\_at\_isee.nagoya-u.ac.jp). If you have any questions or problem, please do not hesitate to ask us.

**SUBSCRIPTION - VarSITI MAILING LIST**

The PDF version of the VarSITI Newsletter is distributed through the VarSITI mailing list. The mailing list is created for each of the four Projects with an integrated list for all Projects. If you want to be included in the mailing list to receive future information of VarSITI, please send e-mail to "a-asai\_at\_isee.nagoya-u.ac.jp" (replace "\_at\_" by "@") with your full name, country, e-mail address to be included, and the name of the Project you are interested.

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