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Scientific Committee on Solar-Terrestrial Physics
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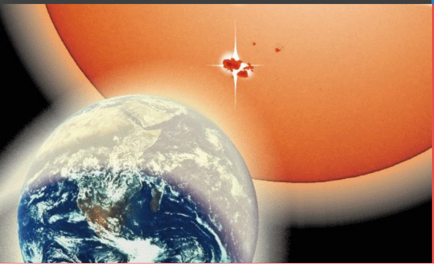

VarSITI Newsletter

Inside this issue

Project SPeCIMEN

Article 1:

Arase (ERG) Launch

Yoshizumi Miyoshi
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I. Shinohara[1], T. Takashima[1], K. Asamura[1], N. Higashio[2], T. Mitani[1], S. Kasahara[3], S. Yokota[1], Y. Kazama[4], S-Y. Wang[4], Y. Kasahara[5], Y. Kasaba[6], S. Yagitani[5], A. Matsuoka[1], H. Kojima[7], Y. Katoh[6], K. Shiokawa[8], K. Seki[3], and ERG project group
[1]ISAS/JAXA, Sagamihara, Japan, [2]JAXA, Tsukuba, Japan, [3]University of Tokyo, Tokyo, Japan, [4]ASIAA, Taipei, Taiwan, [5]Kanazawa University, Kanazawa, Japan, [6]Tohoku University, Sendai, Japan, [7]Kyoto University, Kyoto, Japan, [8]ISEE, Nagoya University, Nagoya, Japan

Yoshizumi Miyoshi

The ERG (Exploration of energization and Radiation in Geospace) project is a Japanese geospace exploration project. The project focuses on relativistic electron acceleration mechanisms of Van Allen radiation belt and dynamics of space storms in the context of the cross-energy coupling via wave-particle interactions, especially, whistler mode chorus waves. The project consists of the satellite observation team, the ground-based network observation team, and integrated-data analysis/simulation team (Figure 1) [1].

The satellite was launched on December 20 2016 as shown in Figure 2. The satellite has been nicknamed, "Arase（あらせ）"

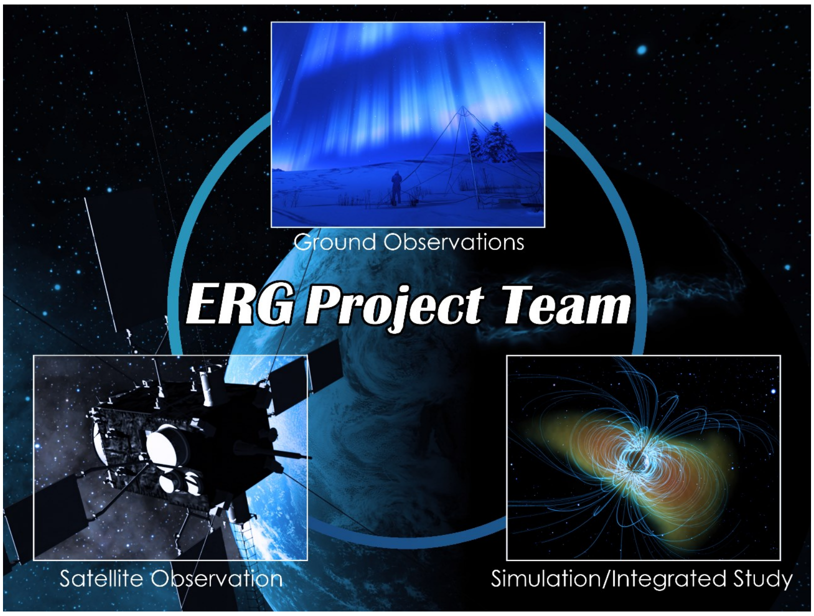

Figure 1. ERG project team.

for the following reasons, (1) ERG starts a new journey to Van Allen radiation belts, located in the Earth's inner magnetosphere, where energetic charged particles are trapped. "ARASE", a Japanese word for a river raging with rough white water is a fitting description for the journey that lies ahead of ERG. (2) After Arase River, which runs Kimotsuki, Kagoshima, where JAXA's Uchinoura Space Center is located. Arase River has a local folktale of bird's beautiful singing. Since ERG observes "chorus", it conveys the significance well. The Arase satellite is sun-aligned spin stabilized with 7.5rpm. The apogee altitude is about 6 Re and the perigee altitude is higher than ~300 km. The inclination angle will be 31deg.

The comprehensive observations for plasma/particles, fields and waves near the magnetic equator are important for understanding the cross energy coupling for relativistic electron accelerations and dynamics of space storms [1]. Various instruments for plasma/particles, and field/waves are installed in the satellite as shown in Figure 3. The energy range of four electron sensors (LEP-e, MEP-e, HEP, XEP) cover from 17 eV to ~20 MeV and two ion sensors (LEP-i, MEP-i) cover from 10 eV/q to 180 keV/q with mass discrimination. Two field instruments (PWE/MGF) observes wide frequency range for both electric fields (DC – 10 MHz) and magnetic fields (DC – 100 kHz). After the launch, Arase has listened to beautiful

Figure 2. Arase launch at 20:00JST on December, 20, 2016. (Photograph by Dr. S. Matsuda of ISEE/Nagoya University).

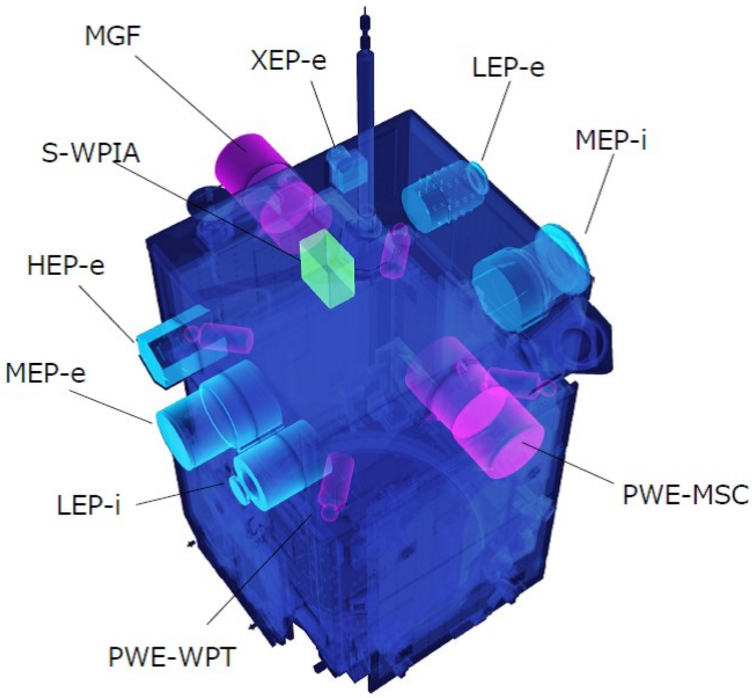

Figure 3. Appearance and Science Instruments of the Arase satellite.

chorus sounds from wave-burst mode observations [http://www.kanazawa-u.ac.jp/wp-content/uploads/2017/03/chorus8.wav]. Besides these conventional measurements, a newly developed wave-particle interaction analyser (WPIA) has been installed, which measures direct energy conversion process between particles and waves. These data will be archived as CDF files and opened to the public after the necessary calibration As the integrated data anlysis, SPEDAS[2] can be used for the data analysis and ERG plug-in tools are available through the ERG Science Center [http://ergsc.isee.nagoya-u.ac.jp/]. Moreover, Arase satellite provides quasi-real time space weather data that includes high energy electrons from HEP and XEP, and magnetic field from MGF. While these data are not well calibrated, the data will be useful to monitor current space weather condition. The Arase space weather data can be looked at JAXA/SEES [http://sees.tksc.jaxa.jp/fw_e/dfw/SEES/English/Top/top_e.shtml].

The ground-based observations, magnetometer, VLF antenna, optical imagers, riometers, standard radio wave receivers are installed at several stations in the world. Moreover, the ERG project has collaborated with Van Allen Probes, THEMIS, Cluster, and EISCAT, SuperDARN and other satellite missions and ground based observations. Multi-point observations are realized through the international partnership, which are essential for comprehensive understanding of geospace and radiation belts.

The first observation campaign between Arase and ground-based observations is going from the end of March to April, 2017, and several geospace storms occurred during the period. This campaign observation has also been regarded as a campaign of "VarSITI/SPeCIMEN", and several international collaborations have been established. We ERG team hope that the ERG project contributes to scientific achievements of VarSITI and look forward to great collaborations with VarSITI projects.

Project Manager: I. Shinohara (JAXA), Project Scientist: Y. Miyoshi (Nagoya Univ), Mission Manager: T. Takashima, LEP-e Project Manager and Project Engineer: S-Y. Wang(ASIAA), Y. Kazama (ASIAA), LEP-i PI: K. Asamura (JAXA), MEP-e PI: S. Kasahara (U. Tokyo), S. Yokota (JAXA), MEP-i PI: S. Yokota (JAXA), S. Kasahara (U. Tokyo), HEP PI: T. Mitani (JAXA), XEP PI: N. Higashio (JAXA) PWE PI: Y. Kasahara (Kanazawa Univ), PWE Co-PI: Y. Kasaba (Tohoku Univ), S. Yagitani (Kanazawa Univ), H. Kojima (Kyoto Univ), MGF PI: A. Matsuoka (JAXA), S-WPIA PI: H. Kojima(Kyoto Univ), S-WPIA Co-PI: Y. Katoh (Tohoku Univ), Ground-based observation PI: K. Shiokawa (Nagoya Univ), Simulation/Integrated Study PI: K. Seki (U. Tokyo).

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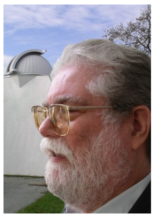
Article 2:

Digitization of 29,296 Drawings of Sunspots on the Solar Disk made at the Zürich Observatory since 1883



Leif Svalgaard
Stanford University, Stanford, CA, USA

Leif Svalgaard

An accurate and agreed upon record of solar activity is important for a space-faring World increasingly dependent on an understanding and reliable forecasting of the activity on many time scales. Several workshops have been held by the solar physics community over the past several years [Clette et al., 2016] with the goal of reconciling the various sunspot series and producing a vetted and agreed upon series that can form the bedrock for studies of solar activity and its effects throughout the entire solar system. Understanding the past is key to predicting the future. Much effort is therefore expended on retrieving and digitizing sunspot records from centuries past. A series of systematic sunspot drawings at the Zürich Observatory started on 21 December 1883, sheet Nr.1 by Alfred Wolfer and ended on 27 December 1995, sheet Nr. 29,296 by Hans Ulrich Keller. Figure 1 shows an example

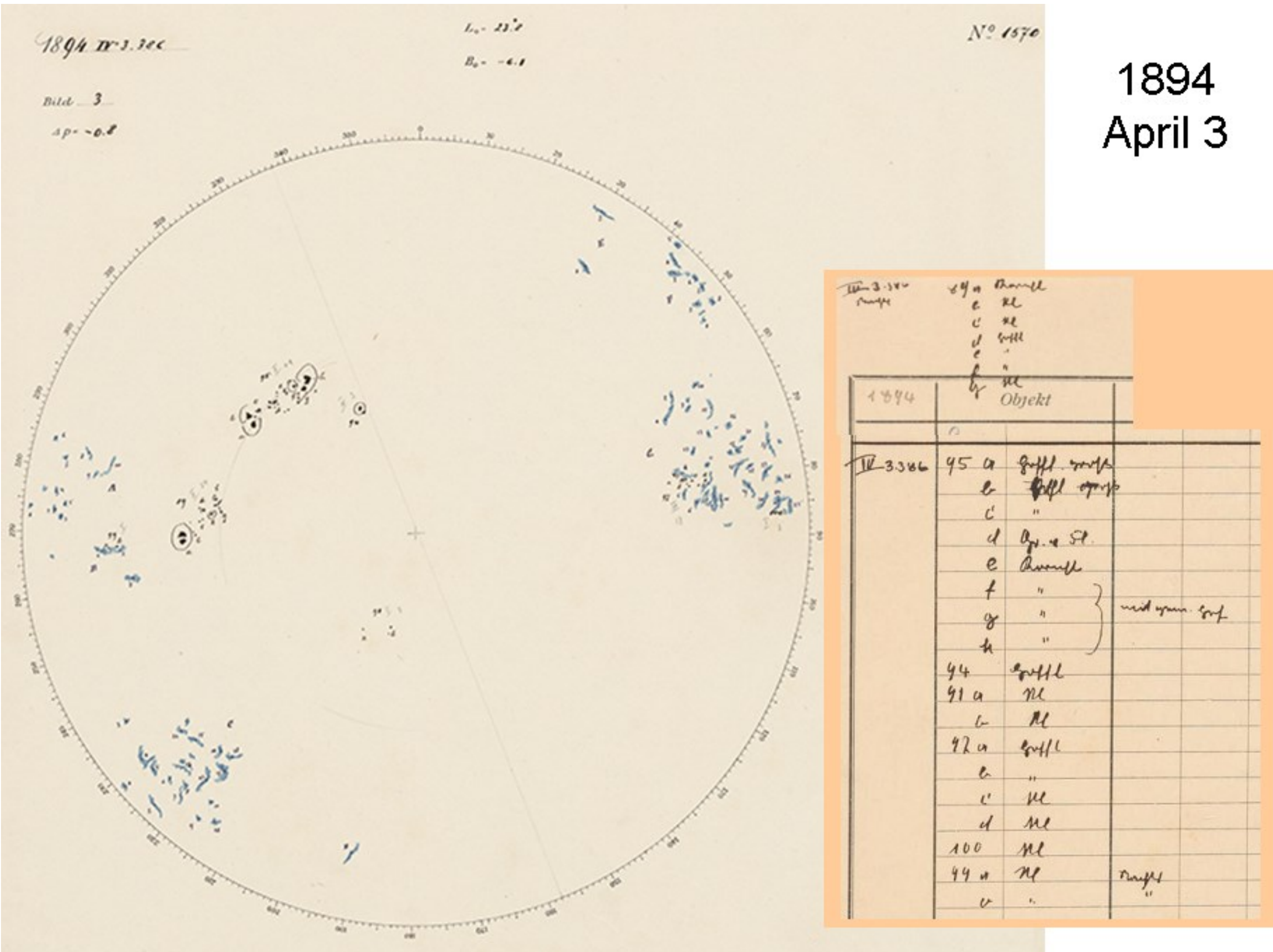


Figure 1. Drawing of the solar disk made 3rd April 1894. Sunspot groups are numbered and individual spots in each group are designated by letters (with a short description). It is easy to count the number of groups. The quality of the drawings (and of the digital copies) is considerately better than the reproduction here.

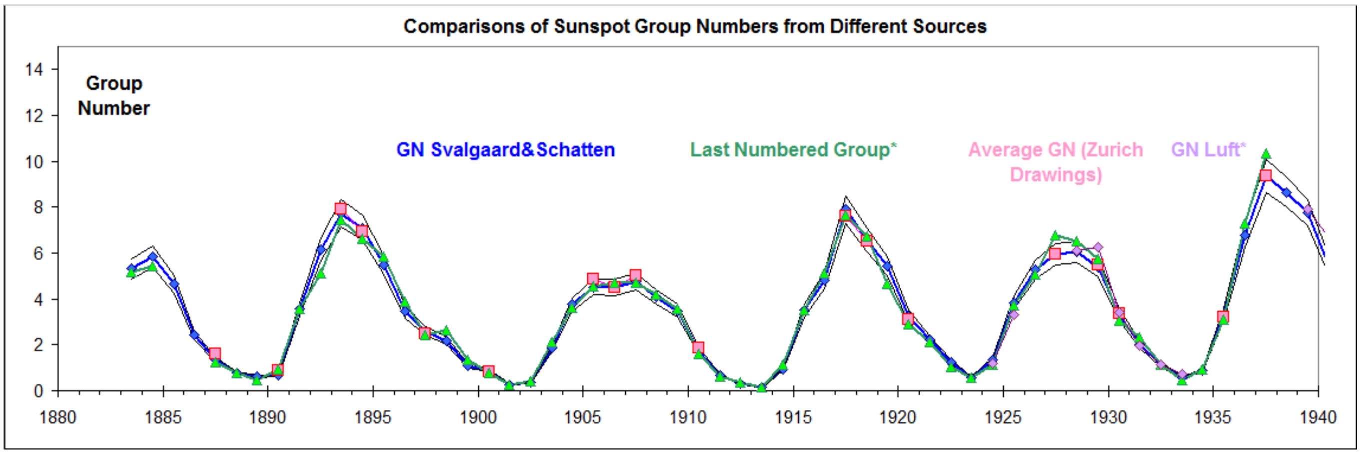


Figure 2. The annual mean Number of Groups on the Solar Disk from the reconstruction by Svalgaard & Schatten [2016] (blue diamonds with confidence interval), from the Observatory Reports of the number of groups observed (green triangles), from the observer Herbert Luft [2013], and from the count of groups on the Zürich Drawings (pink squares).

of a drawing with the observer's count of sunspots and sunspot groups. The drawings are in the process of being digitized and scientifically processed. To date, the digitization is complete up through the year 1937, with the rest hopefully finished this year (ETH, 2017). I here report on the progress so far. The observations were made with a 16-cm refractor fabricated by the optical firm Kern in Aarau, Switzerland. After the closure of the Zürich Observatory, the telescope was disassembled. It is now in Aarau again, and awaits renovation. This later point is important because it will allow us to replicate the observations by modern observers.

Figure 2 shows the annual mean Number of Groups on the Solar Disk from the count of groups on the Zürich Drawings (pink squares) compared to several other reconstructions. The various sources agree closely giving us confidence that the we are zeroing in on a robust dataset for the period covered and that the remaining drawings (1938-1995) will be useful in settling an issue about the effect of weighting of the sunspot counts apparently introduced around 1947 by the Zürich observers [Svalgaard et al., 2017].

This (and ongoing) research is supported by a grant from SCOSTEP/VarSITI.

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Highlight on Young Scientists 1:

Determining global ionospheric conductivity in the satellite and data assimilation age

Ryan McGranaghan[1, 2]

[1]Cooperative Programs for the Advancement of Earth System Science (CPAESS), University Corporation for Atmospheric Research (UCAR), Boulder, CO, USA

[2]NASA Jet Propulsion Laboratory, Pasadena, CA, USA

Ryan McGranaghan

Upper atmospheric conductivity is a fundamental, but unmeasured, link between the ionosphere and magnetosphere. Despite highly dynamic nonlinear behavior, models of the magnetosphere-ionosphere (M-I) system generally specify conductivity with simple empirical relations [1] and as a height-integrated quantity (e.g. conductance).

Using a data set of ~100 million precipitating particle spectra from Defense Meteorological Satellite Program (DMSP) satellites, a model of upper atmospheric electron transport [2], and modern computational methods, we have estimated the fundamental modes of variability of ionospheric conductance (*figure 1*) [3] and fully three-dimensional conductivity [4]. These fundamental modes, captured as empirical orthogonal functions (EOFs), provide new insight into M-I coupling.

With these EOFs we created a data-driven, optimally constrained solution for estimating global conductance patterns and demonstrated that the new global distributions produce better agreement between ground- and space-based data (*figure 2*) [5]. Therefore, this work is capable of enhancing consistency in the diverse M-I observational system, and the benefit is particularly pronounced during periods of active geomagnetic conditions. Our method also produces fully height-specific conductivity distributions, enabling robust three-dimensional investigation of upper atmospheric electrodynamics.

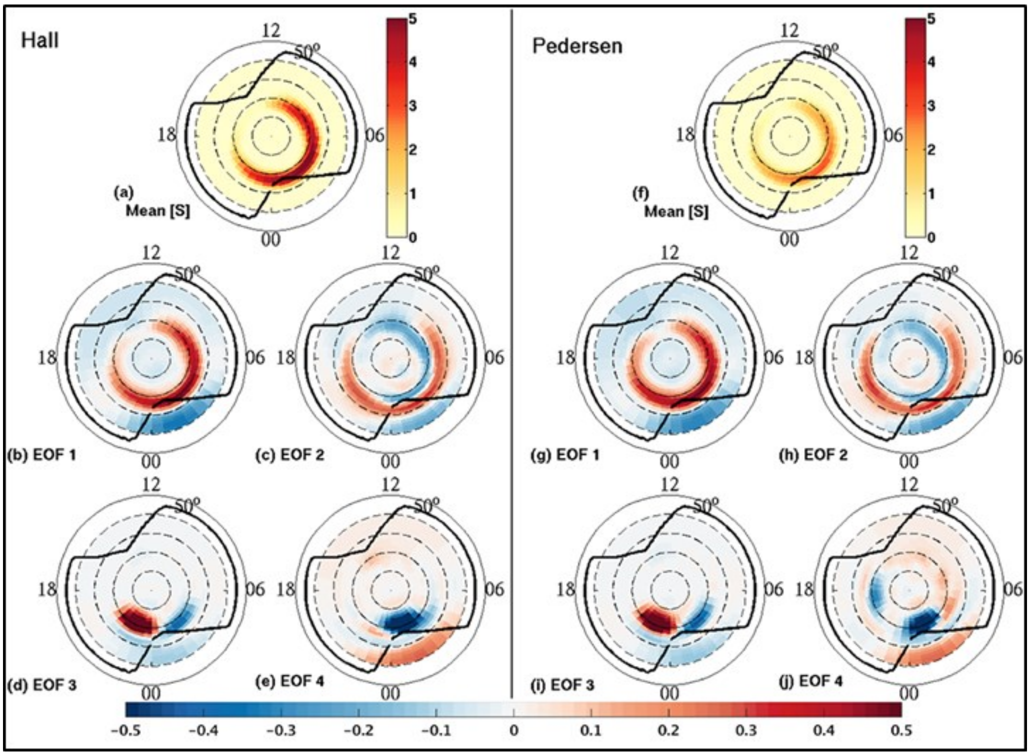

Figure 1. EOF results for the Hall and Pedersen conductances. Mean and first four EOFs for (a–e) Hall and (f–j) Pedersen conductances, in magnetic coordinates. The low-latitude limit on all polar plots is 50° and dashed lines are plotted at 10° increments up to 80°. The solid black curves indicate the boundaries of observational support. The first four EOFs capture 52.9% and 50.1% of the total variation for the Hall and Pedersen conductances, respectively. EOFs 5–8 describe an additional 10% for each conductance. Figure derived from [3].

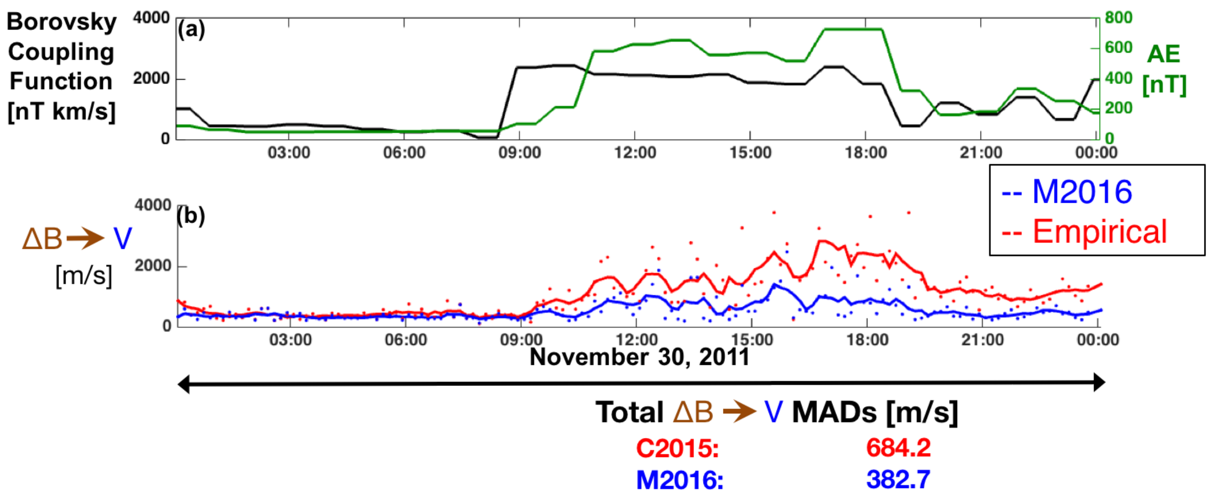

Figure 2. Temporal dependence of observation-prediction median absolute deviations (MADs) using (b) AMPERE magnetic perturbation observations to predict SuperDARN plasma drift observations (ΔB→V) for 30 November, 2011. For these comparisons AMPERE magnetic perturbation measurements were used to estimate a global magnetic potential distribution at each time step. One of two global conductance models was then applied: 1) optimally interpolated conductances [5] (M2016, blue trace in b); or 2) empirical conductances estimated from the Robinson formulas [1] (Empirical, red trace in b) to estimate global electric potential distributions. Finally, SuperDARN plasma drifts were predicted and compared to test each conductance model. Below the figure total MADs over the entire day are given, showing ~50% prediction improvement using the M2016 conductance model. (a) The Borovsky solar wind coupling function (black trace, left y axis) and AE index (green trace, right y axis) over the same period. Figure derived from [5].

After the completion of my Ph.D. I was delighted to join the Ionospheric and Remote Sensing Group at the NASA Jet Propulsion Laboratory in January 2017, where I continue to pursue understanding in the M-I system. I am energized by the prospect of a 'new frontier' in space science research, characterized by the union of physics-based understanding with new data-driven techniques and computational tools.

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Highlight on Young Scientists

Project SEE

Highlight on Young Scientists 2:

Observing solar wind related climate effects in the Northern Hemisphere winter

Ville Maliniemi
ReSoLVE Centre of Excellence, Space Climate Research Unit, University of Oulu, Oulu, Finland

Ville Maliniemi

Solar wind feeds energy to the magnetosphere and accelerates energetic particles, which can precipitate into the atmosphere. These particles are able to penetrate to middle atmosphere and create ozone destroying compounds. Ozone depletion occurs in the high latitudes during winter. This leads to dynamical alteration of polar vortex in the stratosphere, which is also connected to the tropospheric circulation. Thus, precipitating particles can influence winter climate in the Northern Hemisphere.

Our results show statistically significant relation between precipitating particle activity and measurements of surface temperature or sea-level pressure (SLP) in winter [Maliniemi et al., 2013; 2014; 2016; Roy et al., 2016]. We have used satellite measurements of precipitating electrons, geomagnetic activity and sunspots to confirm this. Predominantly positive values of the NAO (North Atlantic Oscillation) index are observed during the declining phase of the sunspot cycle, when the high speed solar wind streams are more frequent and precipitating particle/geomagnetic activity increases. Figure 1 shows the winter SLP variability related to the aa index of global geomagnetic activity. This relation is obtained since the latter half of the 19th century. In addition, this relation is modulated by the stratospheric quasi-biennial oscillation (QBO). During the easterly QBO phase relation between geomagnetic activity and NAO is substantially stronger than during westerly QBO phase (Figure 2).

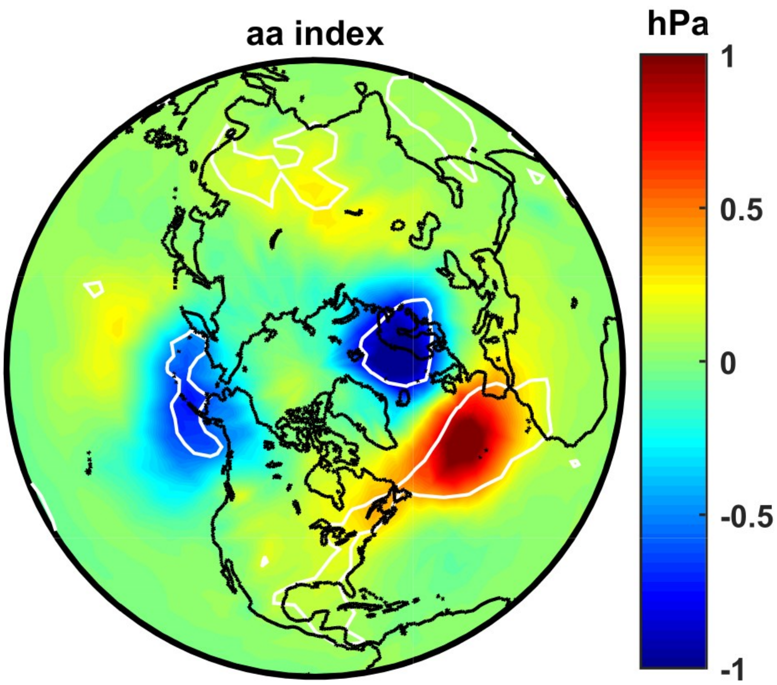

Figure 1. Regression coefficient of aa index for SLP in winter (Dec/Jan) during 1868-2014. Map shows the variation in SLP (hPa) related to one standard deviation increase in aa index. White lines represent the p-value of 0.05.

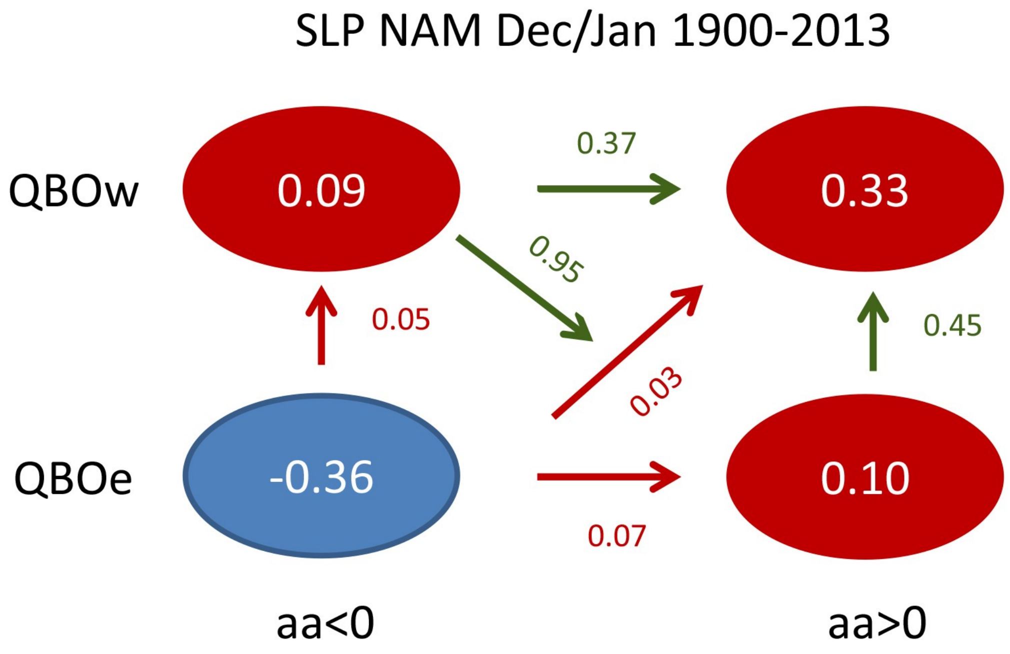

Figure 2. Mean northern annular mode (NAM, closely related to NAO) values in four cases (QBO east/low aa, QBO west/low aa, QBO east/high aa and QBO west/high aa) during Dec/Jan 1900-2013. NAM and aa are standardized over the whole time period. Significance of the difference between each case is shown with the arrows (red arrows represents p-values less than 0.1 and green arrows p-values larger than 0.1).

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Meeting Report

Project SPeCIMEN / ROSMIC

Meeting Report 1:

40th Annual Seminar "Physics of the auroral phenomena", Apatity, Russia, 13-17 March 2017

Figure 1. Group photo of participants.

Irina Despirak

Irina Despirak
Polar Geophysical Institute, Apatity, Murmansk region, Russia

The 40th Annual Seminar "Physics of the auroral phenomena" has been held during 13-17 March 2016 in Apatity (Murmansk region, Russia). The organizer of the seminar is the Polar Geophysical Institute (PGI) of the Russian Academy of Science.

The main scientific goal of this Seminar was to discuss newest results on the space physics processes in the polar cap, auroral and subauroral regions. The program covers different aspects of the solar-terrestrial relations, from the physics of the Sun and solar wind to the influence of the solar activity on the biosphere.

About 90 representatives from 24 universities and research institutes distributed across Russia (Moscow, Nizhniy Novgorod, Saint-Petersburg, Yakutsk, Irkutsk, Kaliningrad, Murmansk, Apatity) and several scientists from abroad (China, Peru, Finland, Germany, Bulgaria) took part in the Seminar. The VarSITI program was a co-sponsor of the Seminar and partially supported the participation of some young scientists, students and invited speakers.

The received abstracts and program are available at http://pgia.ru:81/seminar/abstracts_book.pdf and http://pgia.ru:81/seminar/Programm.pdf. The Seminar will follow by publication of the proceedings, which will be available both online at http://pgia.ru/seminar/archive/ and in print.

Project ISEST

Meeting Report 2:

The '10 Years Neutron Monitor Data Base' Workshop

Figure 1. Group photo of participants.

Helen Mavromichalaki

Helen Mavromichalaki
National and Kapodistrian University of Athens, Athens, Greece

The '10 Years Neutron Monitor Data Base' Workshop took place in Athens in March 20 – 23, 2017, an event celebrating 10 years of continuous and reliable operation of the NMDB community. During this meeting more than 70 participants from 26 Institutes from 16 countries representing 45 Neutron Monitor Stations, had the opportunity to communicate their work and research, on a wide range of topics (cosmic rays, solar proton events, GLEs, space weather forecasting, etc), within the scientific community. The scientific program included 30 oral and 18 poster presentations by young students, scientists, researchers, well – respected professors and experts on neutron monitor technology. The presence of the European Space Agency (ESA) was greatly welcomed. This meeting served as a chance for all the groups of the neutron monitor collaboration and its visitors to reflect on their progress so far, to evaluate their current activities and applications and to lay the foundations for future plans.

All presentations are available online at http://cosray.phys.uoa.gr/index.php/workshops2/10-years-nmdb/88-workshops/97-program.

Meeting Report 3:

Summary report of Data Analysis Workshop on Coronal Mass Ejection (CME) and Radio Bursts: Mekelle, Ethiopia


Gebregiorgis Abraha

Gebregiorgis Abraha
Department of Physics,
College of Natural and Computational Science, Mekelle University,
Mekelle, Ethiopia

The workshop was organized by Mekelle University in collaboration with COSPAR, SCOSTEP, ISWI and Adigrat University to introduce a system that can help to understand space and ground based data to explore and expand research practice on interplanetary shocks.


Figure 1. The team taking part in the workshop and the CALLISTO antenna.

Six distinguished experts from USA, India, Europe and thirty three participants from six countries of Africa were taking part in the workshop conducted from February 19-25/2017. As part of the workshop, a CALLISTO instrument was installed and is providing data on line.

The workshop consisted of scientific talks and training focused on the elaboration of the diverse phenomena of CME, solar flare, solar radio bursts with special focus on type II bursts and the correlative data analysis on CMEs and associated shocks.


Figure 2. Prof. Nat Gopalswamy, Keynote speaker.

Therefore, the workshop has started a collaborative process that could potentially help staff of Mekelle University and the young researchers who participated in the workshop to make progress in Space science, and Sun-Earth connection, Astrophysics and related fields. The workshop also helped participants interact through collaborative research at national and international levels.

Upcoming meetings related to VarSITI

Conference	Date	Location	Contact Information
2017 International Conference on Space Science and Communication	May 3-5, 2017	Kuala Lumpur, Malaysia	http://www.ukm.my/iconspace/
International Space Weather Meridian Circle Program Workshop	May 15-17, 2017	Qingdao, China	http://imcp2017.csp.escience.cn/
JPGU-AGU Joint Meeting 2017	May 20-25, 2017	Chiba city, Japan	http://www.jpgu.org/
the Ninth Workshop "Solar Influences on the Magnetosphere, Ionosphere and Atmosphere"	May 30-Jun. 3, 2017	Sunny beach, Bulgaria	http://ws-sozopol.stil.bas.bg/
Advanced Concepts in Solar-Terrestrial Coupling in the Context of Space Weather - A Concepts and Tools School for Students (during the 2nd VarSITI General Symposium)	Jul. 9-14, 2017	Irkutsk, Russia	http://en.iszf.irk.ru/Space_weather_summer_school_2017
2nd VarSITI General Symposium	Jul. 10-15, 2017	Irkutsk, Russia	http://varsiti2017.iszf.irk.ru
IAU Symposium 335 "Space Weather of the Heliosphere: Processes and Forecasts"	Jul. 17-21, 2017	Devon, UK	http://www.exeter.ac.uk/iaus335
AOGS 14th Annual Meeting	Aug. 6-11, 2017	Singapore	http://www.asiaoceania.org
URSI General Assembly and Scientific Symposium	Aug. 19-26, 2017	Montreal, Canada	http://www.ursi2017.org
IAPSO-IAMAS-IAGA Joint Assembly	Aug. 27-Sep. 1,2017	Cape Town, South Africa	http://www.iapso-jamas-iaga2017.com
Consistency of the Solar Radius: outstanding unsolved points	2017 (TBD)	Switzerland	
2nd International School on Equatorial and Low-Latitude Ionosphere (ISELLI-2)	Sep. 11-15, 2017	Lagos, Nigeria	http://carnasrda.com/iselli-2/
13th International Workshop on Layered Phenomena in the Mesopause Region (LPMR)	Sep. 18-22, 2017	Kühlungsborn, Germany	https://www.iap-kborn.de/1/current-issues/events/lpmr/
International Study of Earth-affecting Solar Transients (ISEST/MiniMax24) Workshop in 2017	Sep. 18-22, 2017	Jeju Island, Korea	http://kswrc.kasi.re.kr/Workshop/isest2017/
The International School on Equatorial and Low Latitude Ionosphere (ISELION 2018)	Mar. 5-9, 2018	Sumedang, Indonesia	
VLF/ELF Remote Sensing of Ionospheres and Magnetosphere (VERSIM) 8th Workshop	Mar. 19-23, 2018	Apatity, Kola Peninsula, Russia	
SCOSTEP 14th Quadrennial Solar-Terrestrial Physics Symposium	Jul. 9-13, 2018	Vancouver, Canada	http://www.yorku.ca/scostep/

Short News 1:

"MiniMax" Julia K. Thalmann received EGU Arne Richter Award

Julia K. Thalmann
Institute of Physics,
University of Graz,
Graz, Austria

Julia K. Thalmann
(Foto: Sissi Furgler)

As a project scientist at the University of Graz, Julia Thalmann's scientific research is focused on the properties and characteristics of the solar magnetic field. In particular, she is concerned with the flare-associated time development of the coronal magnetic field, ever since her PhD at the Max Planck Institute for Solar System Research in Göttingen. Her research attracts high recognition within the international scientific community as it represents a valuable contribution to the understanding of solar flare processes, as well as their interplanetary (possibly geo-effective) consequences such as CMEs. For this reason, Julia Thalmann has been awarded with the Arne Richter Award for Outstanding Early Career Scientists of the European Geosciences Union (EGU). The highly prestigious award was given to Julia during the General Assembly 2017 in Vienna, for recognizing her contribution within the solar-terrestrial physics division.

Figure 1. EGU Arne Richter medal ceremony at the Vienna convention center. From left to right: Hans Thybo (EGU president), Julia Thalmann, Jonathan Bamber (EGU vice-president), Manuela Temmer (ISEST Co-chair). Photo courtesy: Franz Hasewend.

Julia Thalmann completed her undergraduate studies at the University of Graz in 2006, when she obtained her Diploma in Physics. What followed was an extended research stay of more than six years at the Max Planck Institute for Solar System Research (MPS) in Katlenburg-Lindau (now located in Göttingen), during which she successfully completed her PhD (she obtained her doctoral degree in physics from the Technical University Braunschweig in 2010) and further scientifically matured during an extended post-doctoral research period. In 2013, Julia Thalmann returned to the University of Graz, where she is employed as a post-doctoral research scientist within the Solar and Heliospheric Physics research group ever since. In 2016 she has been awarded already with the international Alexander-Chizhevsky Medal for Space Weather and Space Climate.

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. Mai Asakura (asakura_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 "asakura_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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