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Article 1:

A new journey of the Arase satellite to the 25th solar cycle

Yoshizumi Miyoshi[1] and Iku Shinohara[2]

[1]Institute for Space-Earth Environmental Research, Nagoya University, Nagoya, Japan

[2]Space and Planetary Research Group, ISAS, JAXA, Sagamihara, Japan

Yoshizumi Miyoshi

Iku Shinohara

The geospace explanation satellite Arase (ERG) was launched in December 2016 and has observed since March 2017 [1] (Figure 1). The five years of observations covered the transition period from the declining phase of the 24th solar cycle to the beginning phase of the 25th solar cycle (Figure 2).

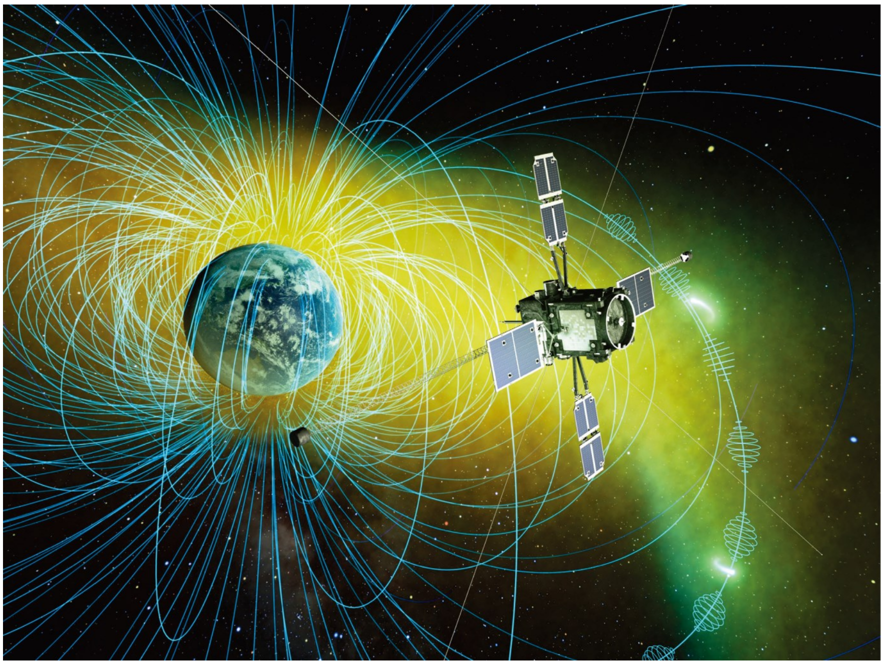

Figure 1. Conceptual image of Arase (ERG) satellite in the inner magnetosphere (copyright: ERG Science Team).

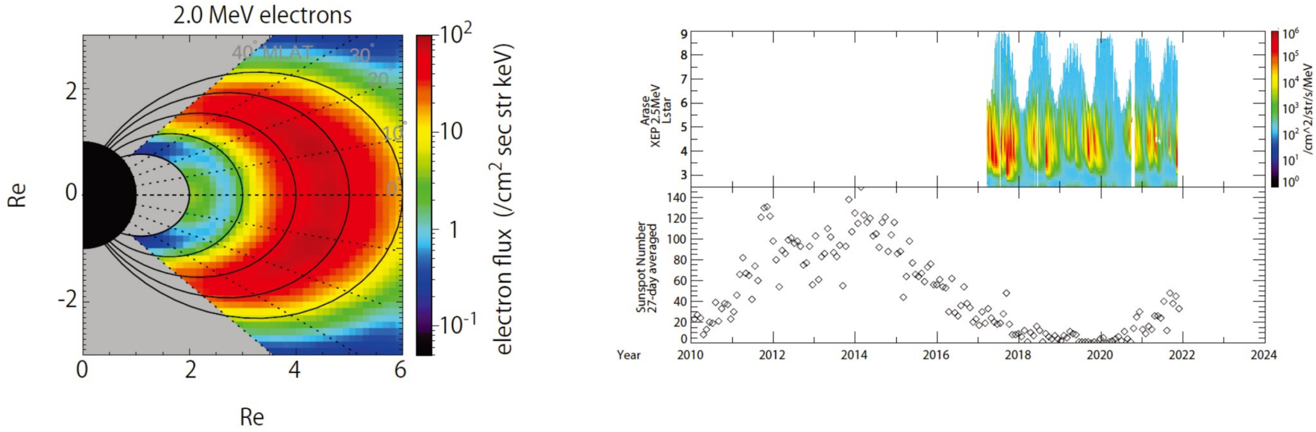

Figure 2. (left) Spatial distributions of 2 MeV electrons from the Arase satellite. (right) Long term variations of 2 MeV electrons and sunspot number.

During this period, the Arase satellite revealed many interesting phenomena in the inner magnetosphere and the radiation belts. Especially, the Arase satellite has shed light on the importance of cross-energy coupling via non-linear wave-particle interactions to cause variations of enhancement and loss of energetic electrons and ions. The Arase satellite discovered that electrons are scattered into the loss cone due to chorus-wave particle interactions and resultant pulsating aurora [2, 3]. The Arase observed the rapid acceleration of electrons by non-linear chorus-wave particle interactions [4, 5]. Identifications of energy transfer between waves and particles are achieved by direct measurements of dot product between velocity vector v and electric field E of waves [6, 7]. And high-energy electron precipitations and resultant ozone destructions are observed by Arase and EISCAT coordinated observations [8]. Moreover, many international collaborations with NASA/Van Allen Probes and other satellites, and ground-based observations were realized [9]. All data from the Arase satellite are publicly available from the Center for Heliospspheric Science (https://ergsc.isee.nagoya-u.ac.jp/index.shtml.en).

Very recently, the project has undergone a mission extension review by JAXA, and the extension has been approved until the end of FY2032. The extended mission contributes to comprehensive observations of the inner magnetosphere and dynamics of the radiation belts by observations of the whole cycle 25. On the other hand, no large magnetic storms have been observed during this period. In the upcoming cycle, we expect to have more opportunities to encounter large geospace storms during the 25th solar cycle and to observe the drastic change of geospace. It is well known that geospace shows different variations depending on the large-scale structure of the solar wind, for example, CME and CIRs, which occurrence depends on the solar cycle. The Arase satellite will conduct observations over the solar cycle to clarify the solar wind-magnetosphere interaction by observing the different types of geospace storms. Furthermore, it will play a role in international geospace exploration by collaborating with ground-based observations such as EISCAT_3D, and by conducting joint observations with other satellites/ground-based observations. We look forward to the Arase mission for the cycle 25 and collaboration with SCOSTEP colleagues.

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Article 2:

NASA's Moon to Mars Space Weather Analysis Office

Yaireska Collado-Vega[1], Anna Chulaki[1,2], Robert Loper[1,2], Michelangelo Romano[1,2], Carina Alden[1,2], Mary Keenan[1,3], Mary Aronne[1,2], Mattie Anastopulos[1,2], Chris Stubenrauch[1,2], and Hannah Hermann[1,2]
[1]NASA Goddard Space Flight Center, Greenbelt, MD, USA
[2]Catholic University of America, Washington, DC, USA
[3]ADNET SYSTEMS INC., Bethesda, MD, USA

Space weather, mostly driven by our Sun's activity, can result in solar storms that cause damage to our satellite's instruments, interfere with GPS signals and communication systems, and even disrupt power grids. An important consideration for human deep space exploration missions is the hazardous radiation environment created by the effects of space weather that can impact astronaut safety. As NASA plans for missions beyond Low-Earth Orbit (LEO), there is a need to improve space weather environment modeling capabilities, real-time space weather data analysis, and assessments of radiation risks and how these can be communicated to the crew. NASA's Space Radiation Analysis Group (SRAG) supports the US crew members aboard the International Space Station (ISS). SRAG monitors and operates a console that includes analysis of satellite imagery and energetic charged particle measurements. Due to the mid-inclination LEO orbit of the ISS, crews aboard the ISS are protected from ionizing radiation by Earth's magnetic field most of the time. As NASA's human spaceflight goals extend beyond LEO, astronauts will experience a more hazardous environment. These

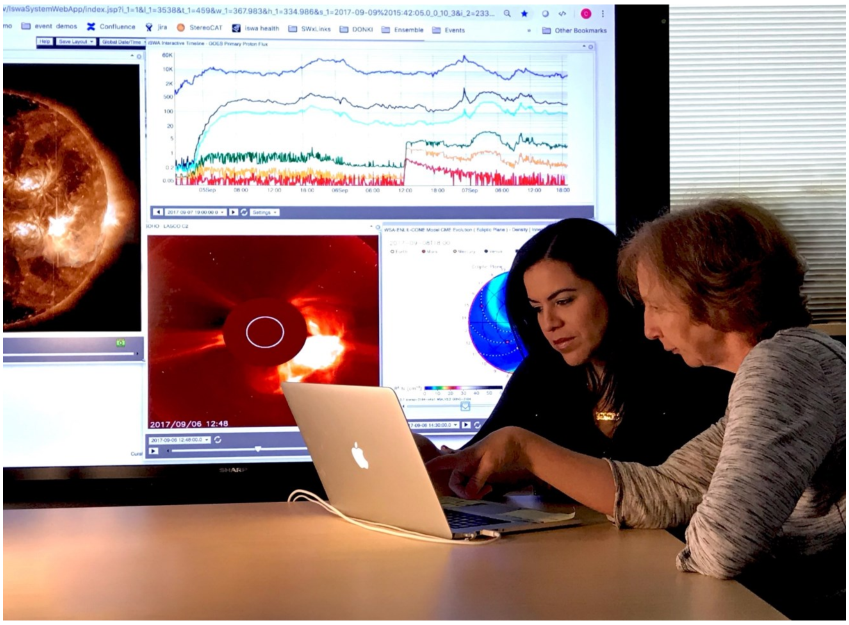


Figure 1. Yaireska (Yari) Collado-Vega (left-M2M Director) discussing an analysis with Anna Chulaki (right-M2M Deputy Director).

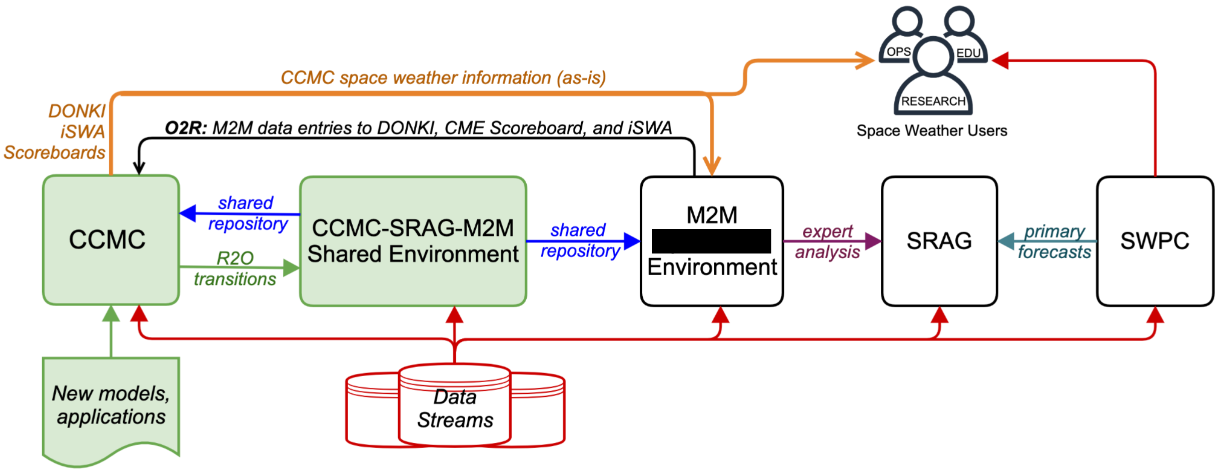


Figure 2. CCMC-SRA-M2M Collaboration - NASA's in house R2OO2R pipeline for human space exploration. Credit: CCMC.

future missions will be flying in deep space and will no longer have the Earth's protective magnetic field shielding them from the ionizing radiation associated with solar storms.

In 2018, NASA SRAG started a collaboration with the Community Coordinated Modeling Center (CCMC) to transition solar energetic particle (SEP) models from the research community into a platform that could be used operationally to support upcoming space missions. The CCMC developed a tailored version of their SEP Scoreboard concept and needed an organization to support the testing and evaluation of this application in a semi-operational setting. To address this need, the Moon to Mars (M2M) Space Weather Analysis Office was established to support NASA's SRAG with human space exploration activities by providing novel capabilities to characterize the space radiation environment. M2M will work as the proving grounds and testbed for capabilities that can eventually be transitioned to operational agencies. M2M also supports NASA robotic missions with space weather assessments and anomaly analysis. To support the transition of models from research to operations, the M2M Office will conduct an event-based validation in which the real-time model outputs for specific events of interest *(e.g., SPEs/ESPEs or ICME arrivals)* are evaluated. This is a crucial step to assess model accuracy and performance in a real-time operational setting. The M2M Office will employ NASA-specific operational model execution, data products, and displays to leverage capabilities developed in collaboration with CCMC, SRAG, and the broader research community.

Highlight on Young Scientists 1:

The Latitudinal and Inter-Hemispheric Variations of the Ionospheric Semi-diurnal Lunitidal Perturbations during the Sudden Stratospheric Warming event

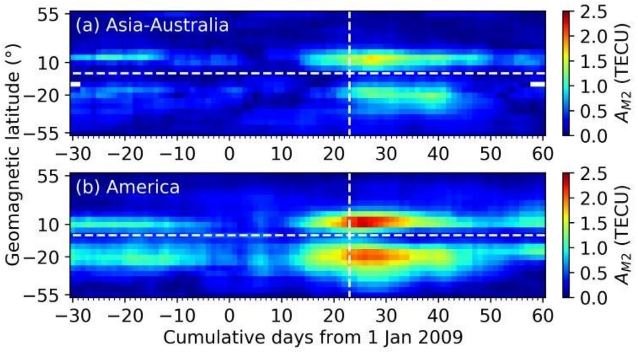
Jing Liu

Jing Liu[1]
[1]School of Earth and Space Science, Peking University, Beijing, China

The SSW event is a polar stratospheric phenomenon caused by the breakdown of the polar vortex due to its interaction with the enhanced planetary wave (Matsuno, 1971). During the SSW, the ionosphere was reported to experience characteristic perturbations (Goncharenko & Zhang, 2008; Pedatella et al., 2018). Studies on the unexpected SSW-ionosphere relationship greatly benefit our understanding of the lower atmosphere-ionosphere coupling. Nevertheless, the manifestation and mechanism of such characteristic perturbations are not thoroughly documented and understood. Most previous related studies focused on the low-latitude and there lacks comprehensive pole-to-pole observations (Goncharenko et al., 2022).

In addition to the longitudinal differences of the semi-diurnal lunitidal (M2) perturbations in the low latitude (Liu et al., 2019), my recent studies focused on the latitudinal and inter-hemispheric variations of the ionospheric M2 perturbations during the SSW. We mainly used the ground-based vertical total electron content (TEC) data, either from the Madrigal database or calculated from the Global Navigation Satellite System (GNSS) data. The amplitude and phase of different wave components were extracted with harmonic analysis.

Figure 1 shows the TEC M2 amplitude (A_{M2}) variations during SSW events as a function of cumulative days and geomagnetic latitudes. It shows that TEC M2 perturbations enhance around the SSW peak temperature. A_{M2} peaks around the crest regions of the Equatorial Ionization Anomaly and the northern A_{M2} crests are closer to the geomagnetic equator than the southern ones. We suggest wind effect on the equatorial plasma fountain may be a key contributor to this characteristic. In addition, clear A_{M2} enhancements extend to middle latitudes only in the Southern Hemisphere. Meanwhile, there are also longitudinal differences in the A_{M2} magnitude and in the M2 manifestation in the southern middle latitude. For detailed results and discussions, please refer to our papers (Liu et al., 2021, 2022a, 2022b).



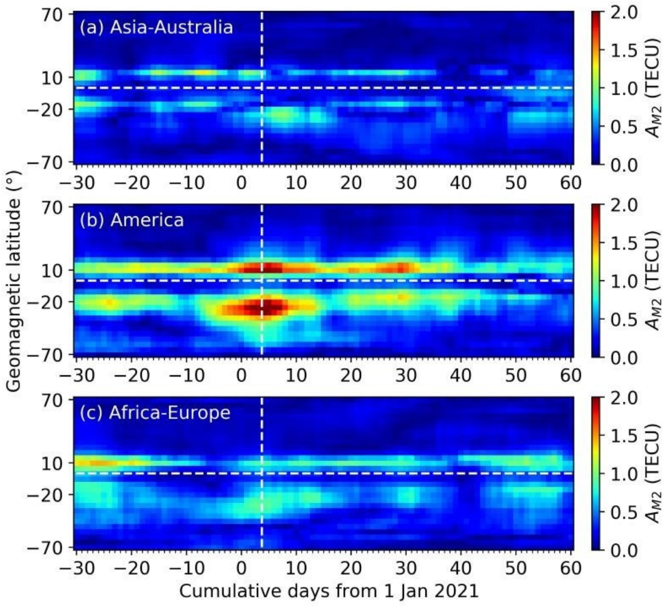


Figure 1. The TEC M2 amplitude variations during the 2009 (left) and 2021 (right) SSW events as a function of cumulative days and geomagnetic latitudes. The horizontal dashed lines represent the geomagnetic equator. The vertical dashed lines mark the occurrence of the SSW peak temperature.

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Highlight on Young Scientists 2:

An Analysis of Bifurcating Region 2 Field-Aligned Currents Using AMPERE

Harneet Kaur Sangha

Harneet Kaur Sangha[1]
[1]University of Alabama in Huntsville, Huntsville, AL, USA

The Earth system has a number of different components coupled together, influencing one another as they change. Field-aligned currents connect different regions of the solar wind-magnetosphere-ionosphere-atmosphere system and therefore provide a valuable window to view changes occurring within these linked regions. Iijima and Potemra (1978) were the first to identify the average structure of the FACs and show two rings of current, one poleward and one equatorward, termed the Region 1 (R1) and Region 2 (R2) currents, respectively.

Using the Active Magnetosphere and Planetary Electrodynamics Response Experiment (AMPERE) to study the FACs, we identified a novel phenomenon previously unseen in this dataset, which we denoted Region 2 Bifurcations (R2Bs). This event can be seen in Figure 1. Figure 1 shows a series of AMPERE polar plots from 2 June 2011, initially presented by Sangha et al. (2020) and followed up by Sangha et al. (2022).

In the first panel, the standard R1/R2 FAC pattern is evident. As time moves on, the FACs move poleward indicating a contracting polar cap. At 07:44, both the dawn and dusk R2 FACs are showing a secondary peak in the FAC density, approximately between 02 to 09 MLT and 12 MLT to 20 MLT. By 08:06, these secondary peaks have begun bifurcating from the original R2 FACs (indicated by the arrows), and at 08:12 the dusk-side R2 current has entirely disconnected from the original.

This example clearly shows the creation and development of an R2B in both the dawn and dusk regions simultaneously. This is rare as this event is predominantly seen at dusk. We suggest there is a relationship between R2Bs and Sub-Auroral Polarization Streams (SAPS), and substorms. These connections are explored further by Sangha et al. (2020) and Sangha et al. (2022).

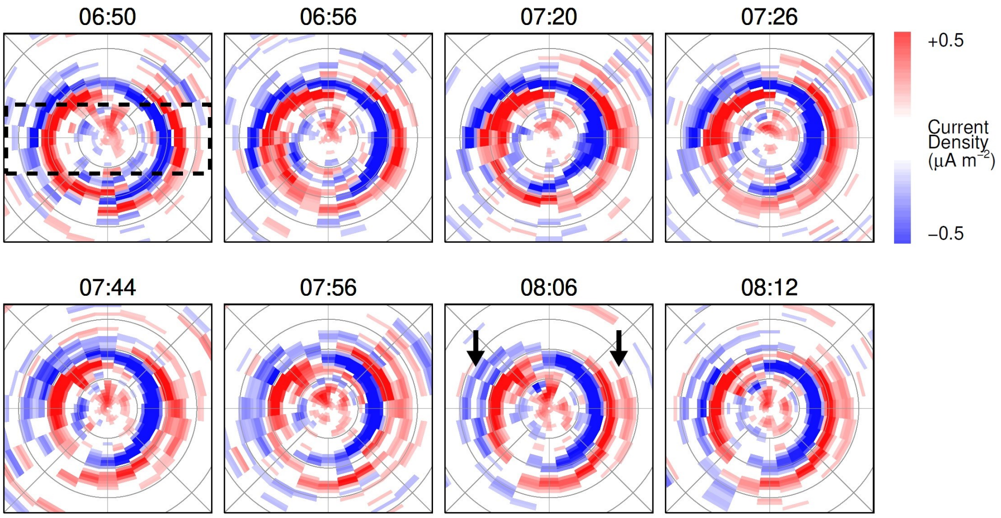

Figure 1. Eight AMPERE polar plots from Sangha et al. (2020) showing the northern hemisphere field-aligned current densities as a FAC bifurcation event develops. The data are from 06:50 to 08:12 UT on 2 June 2011. Upward FACs are shown in red and downward FACs in blue, with the color scale saturating at ±0.5 µA m−2. The gray concentric rings show the colatitude to 35°. 12 MLT is at the top of the panels, 06 MLT on the right. The dashed box indicates the dawn-dusk axis, and the R2B occurrences are shown with the black arrows in panel 08:06 (Sangha et al,. 2020).

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Upcoming meetings related to SCOSTEP

Conference	Date	Location	Contact Information
Summer Space Weather School - Physics and use of tools	In October, 2022	Houphouët Boigny University, Abidjan, Côte d'Ivoire	
The 1st VERSIM school	Nov. 5-6, 2022	Sodankylä, Finland	https://www.sgo.fi/Events/VERSIM/
The 10th VERSIM Workshop	Nov. 7-11, 2022	Sodankylä, Finland	https://www.sgo.fi/Events/VERSIM/
International Workshop on Machine Learning for Space Weather: Fundamentals, Tools and Future Prospects	Nov. 7-11, 2022	Buenos Aires, Argentina	https://indico.ictp.it/event/9840/
AGU Fall Meeting 2022	Dec. 12-16, 2022	Chicago, IL, USA	https://www.agu.org/fall-meeting
5th Symposium of the Committee on Space Research (COSPAR)	Apr. 16-21, 2023	Singapore	https://www.cospar2023.org/
IUGG 2023	Jul. 11-20, 2023	Berlin, Germany	https://www.iugg2023berlin.org/
AGU Fall Meeting 2023	Dec. 11-15, 2023	San Francisco, CA, USA	https://www.agu.org/fall-meeting

The purpose of the SCOSTEP/PRESTO newsletter is to promote communication among scientists related to solar-terrestrial physics and the SCOSTEP's PRESTO program.

<u>The editors would like to ask you to submit the following articles to the SCOSTEP/PRESTO newsletter.</u>

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 SCOSTEP/PRESTO
3. Highlights on young scientists— Each highlight has a maximum of 300 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 SCOSTEP/PRESTO
4. Announcement— Each announcement has a maximum of 200 words length. Announcements of campaign, workshop, etc.
5. Meeting schedule

Category 3 (Highlights on young scientists) helps both young scientists and SCOSTEP/PRESTO 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.

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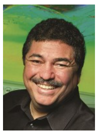
Editors:

Kazuo Shiokawa (shiokawa_at_nagoya-u.jp)
SCOSTEP President,
Center for International Collaborative Research (CICR),
Institute for Space-Earth Environmental Research (ISEE), Nagoya University,
Nagoya, Japan

Keith Groves (keith.groves_at_bc.edu)
SCOSTEP Scientific Secretary,
Boston College, Boston, MA, USA



Ramon Lopez (relopez_at_uta.edu)
PRESTO chair,
University of Texas at Arlington, TX, USA

Newsletter Secretary:

Mai Asakura (asakura_at_isee.nagoya-u.ac.jp)
Center for International Collaborative Research (CICR),
Institute for Space-Earth Environmental Research (ISEE), Nagoya University,
Nagoya, Japan