2024年度　03)国際ワークショップ　目次詳細

2024　03)ISEE / CICR International Workshop
List

3 件

＊所属・職名は2025年3月現在

＊Affiliation and Department displayed are current as of March 2025.

研究代表者 Principal Investigator	所属機関* Affiliation	所属部局* Department	職名* Job title	研究課題名 Project Title	頁 Page	備考 Remarks
Monica Laurenza	Istituto Nazionale di Astrofisica (INAF), Italy	Istituto di Astrofisica e Planetologia Spaziali (IAPS)	Research Scientist	Next Scientific Program (NSP) Committee meeting of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)	94	
Jean Francois Ripoll	Commissariat à l'Energie Atomique (CEA), France	Physics division	Director of research	Multi-satellite Observations and Modeling of the Earth's Radiation Belts (MOMERB 1)	95	
Pekka Verronen	Finnish Meteorological Institute/Oulu University, Finland	Sodankylä Geophysical Observatory	Professor	Chemical Aeronomy in the Mesosphere and Ozone in the Stratosphere (CHAMOS) 2024 Workshop	97	

(Form03-2)

Next Scientific Program (NSP) Committee meeting of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP)

Monica Laurenza (Istituto Nazionale di Astrofisica (INAF))
Kazuo Shiokawa (Institute for Space-Earth Environmental Research, Nagoya Uni.)

This workshop was held by the Next Scientific Program (NSP) committee of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) on 18-21 June 2024 at the Institute for Space-Earth Environmental Research (ISEE), Nagoya University. SCOSTEP formed the NSP committee in 2024 to identify the SCOSTEP's next scientific program after PRESTO (2020-2024). The members of the Next Scientific Committee are: Carine Briand, Maria Graciela Molina, John Bosco Habarulema, Natalie Krivova, Kanya Kusano, Hanli Liu, Monica Laurenza (chair), Hilde Nesse, Jana Šafránková, Jie Zhang, Qiugang Zong. The SCOSTEP Representatives, Kazuo Shiokawa (President), Bernd Funke (Vice President), and Nat Gopalswamy (Past President) also joined the committee.

Eighteen on-site participants and seven on-line participants were joined in this workshop. The participants discussed the scientific program based on participants' expertise in the solar-terrestrial physics (STP) and the inputs received from the STP community. Finally, the work plan for the next (final) workshop in October 2024 was also discussed. Based on these two workshops, the NSP committee identified the next program as COURSE: Cross-scale cOUpling pRocesses in the Solar-tErrestrial system. The COURSE program is organized in three main scientific Focus Areas: 1) Sources of Space Weather and Space Climate: 2) Solar wind, Magnetosphere, and Ionosphere coupling; 3) External impacts and internal dynamics of the Earth atmosphere. For each Focus Area the NSP committee has identified: 1) long-standing goals, i.e., key questions persistent through SCOSTEP scientific programs; and 2) objectives, i.e., precise outcomes that can be addressed over the 5-year program duration, which contribute to achieving the goals over the long term. In addition, the committee envisions the implementation of the program through identified novel methods, including machine learning (ML) and Artificial Intelligence (AI) techniques; integrated models; new missions; the combination of multipoint in-situ data with ground observations; improved metadata; and adoption of Findable, Accessible, Interoperable, and Reusable (FAIR) principles.

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MOMERB 1: Multi-satellite Observations and Modeling of the Earth's Radiation Belts

Jean-François Ripoll (CEA, France)

We organized the "Multi-satellite Observations and Modeling of the Earth's Radiation Belts" (MOMERB 1) workshop at the Institute for Space-Earth Environmental Research (ISEE) of Nagoya University the week from February 27 to February 31 2025. We were 17 scientists with 9 from Nagoya, 3 from Japan universities, and 4 from foreign universities and national laboratories (Europe and America) with 5 young scientists among us. Our goal was to conduct observationally-oriented studies to investigate the dynamic processes that govern relativistic electrons and energetic ions in the near-Earth space environment. Some of these studies would be supported by state-of-the-art simulations. A fundamental question that remains unanswered is how energetic particles are distributed along the magnetic field lines from one hemisphere to the other. This broad knowledge has great value for practical space weather applications which seek to know and predict the radiation environment for thousands of satellites evolving in the near-space Earth.

More specifically, we looked for a global description of the energetic particle and electromagnetic wave distributions by combining datasets from two main satellite missions observing the radiation belts: JAXA's Arase (ERG) mission (Japan) and NASA's Van Allen Probes (RBSP) mission (USA). Each mission brings a different and complementary latitudinal view of the electromagnetic wave environment and radiation belts to deliver a full description along the field line. Eventually, we also compared these radiation belts fluxes with the ones measured by the Low Earth Orbit ELFIN cubesat.

During the week of the workshop, we had 20 presentations from the workshop members related to the main problematics above. These presentations were made in targeting the questions which had to be addressed by our group during the week and following months. Work sessions were organized in parallel in order to either work together to bring specific answers or to think and plan future actions to solve as longer-term studies that will be performed by the workshop team members within the coming year. This required looking at particular satellite dataset or simulations. For the most advanced studies for which most of the results were gathered during the week, we organized article design sessions at the end of the workshop, during which we assembled the main results we had identified for a given study in order to form the skeleton of the upcoming article. Three science articles were advanced that way. We summarize in following the main studies that were covered at MOMERB-1, gathering them in three main themes

A major study and achievement of MOMERB-1 has been to assemble and compare electron radiation belt fluxes measured by both Arase and Van Allen Probes for the 2018 year, the year during which both satellites were in operation. New statistics and distributions, with various dependences, were computed for the two satellites, with a transfer of the methods from the Van Allen Probes to Arase. The comparison of these flux shows very good agreement between Arase and Van Allen Probes in most of the high flux regions of the radiation belts, particularly in the dynamic outer radiation belt. This result has great implications for the JAXA

mission and its operation planned till 2032. In the region of very-low flux, Arase has a tendency to saturate at a high level of low flux, which was interesting to find out and to characterize. Some energy channels behave better than others, which knowledge will facilitate future analysis. In addition, the formalism for computing the total radiation belt content from the flux measurements was presented with the goal to apply it in the future to Arase data. This could become a global index for the radiation belt strength classification.

A second successful subject of importance during MOMERB-1 was the study of electromagnetic whistler-mode waves, in particular as observed from Arase. The question of noise and power is central, with a vast statistical characterization attempted. A modelling effort was made for developing a new generation of wave models for hiss-mode waves and chorus waves, both waves being determinant for acceleration and loss processes in the radiation belts. These models will be done with/without coupling with the Van Allen Probes data and will allow to cover higher latitudes thanks to Arase orbit. A key feature, which consists in accounting for the wave occurrence rate directly embedded in the model has been discussed, with special concerns on the how-to. Another study we could finish is the determination of power and propagation properties of the electromagnetic signals emitted by the NWC Naval transmitter in Australia and measured by Arase. This study has important applications for the validation of wave propagation models such as ray tracing technics.

The third subject of great importance during MOMERB-1 has been the study of the Gannon storm that occurred on May 10 2024. This is the strongest geomagnetic storm in Earth space since the last 20 years, with aurorae seen at latitudes of south of France. This major storm generated persistent radiation belts at ultra-relativistic energies (> 1 MeV), which some of us saw for the first time at MOMERB-1 thanks to the Arase presentations. We could analyze these unique measurements during the workshop. The first simulation of this storm with the VERB-3D code was also presented. More simulations will be ran during the upcoming months. MOMERB-1 served to discuss how to improve these upcoming simulations and decide which models to use, for instance, with the new wave models in development. Another key required parameter is the ambient plasma density of 1 to 10 eV electrons, highly dynamic during storm times, and rebuilding the following days. Impacting results deduced from Arase cold plasma density measurements were presented. We also worked on gathering that quantity for the upcoming simulations. Different types of simulations will be conducted with some focusing on the high-energy tail and others on the long-term persistence of the radiation belts. For ultra-relatisvistic electrons, the knowledge of EMIC waves is central to the flux decay so that we engaged research actions to obtain satellite or ground-based measurements of these electromagnetic waves and build a new model that can be used. During the Gannon storm, there was some acceleration of energetic ions observed by Arase and associated with the sudden storm commencement. Preliminary results were presented and discussed. More generally, the structure of the radiation belts in (space, energy) is extremely informative of the physical processes and we started to build such flux statistics from the Arase data.

The MOMERB-1 workshop has been a successful, efficient, productive, and engaged workshop, which all participants enjoyed participating to.

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CHAMOS Workshop 2024

Prof Pekka Verronen (Sodankylä Geophysical Observatory, University of Oulu, Finland)

Please write your workshop summary including purpose, period, place, results, and list of (planned) publications in maximum two pages.

CHAMOS Workshops have been organized for more than 20 years to support scientific research on solar energetic particle precipitation (EPP) and its impact on the Earth's atmosphere and climate. CHAMOS activity (https://chamos.fmi.fi) involves institutes in Finland, Japan, Norway, United Kingdom, New Zealand, Spain, and Sweden.

The CHAMOS Workshop 2024 was held from 28th of October to 1st of November, 2024, at the Institute of Space-Earth Environmental Research (ISEE), University of Nagoya, Japan. Attended by 19 scientists from Japan, Finland, and New Zealand, the Workshop provided the forum for exchange of latest scientific results and ideas. On-going and future collaboration were discussed in detail. The Workshop addressed topics from characterisation of EPP atmospheric forcing to its ionospheric and atmospheric impacts. Status of current and planned instrumentation and satellite missions was presented, as well as new results from analysis of both measurement and model simulation data. The CHAMOS publications currently under work are:

Verronen, P.T., A. Mizuno, Y. Miyoshi, T. Nakajima, S.-I. Oyama, T. Nagahama, S. Nozawa, M.E. Szeląg, A. Kero, and E. Turunen, **EEP-Driven Variability of the Upper Atmospheric Nitric Oxide Column Over the Syowa Station in Antarctica**, Ann. Geophys., in preparation, 2024.

Schneider, H., V. Wendt, M. Banys, M. Hansen, M.A. Clilverd, and P.T. Verronen, **Impact of Sudden Stratospheric Warming and Elevated Stratopause Events on the Very Low Frequency Radio Signal**, J. Geophys. Res. Space, in review, 2024.

Seppälä, A., N. Kalakoski, P.T. Verronen, D.R. Marsh, A.Yu. Karpechko, and M.E. Szeląg, **Polar mesospheric ozone loss initiates downward coupling of solar signal**, Nature Comm., in review, 2024.

Häkkilä, T., Grandin, M., Battarbee, M., Szeląg, M.E., Alho, M., Kotipalo, L., Kalakoski, N., Verronen, P.T., and Palmroth, M., **Atmospheric odd nitrogen response to electron forcing from a 6D magnetospheric hybrid-kinetic simulation**, Ann. Geophys. Discuss. [preprint], in review, 2024.