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PRESTO

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Inside this issue

Article 1:

Project "Role of the Middle Atmosphere in Climate" : Phase 2

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The atmosphere plays an important role in climate change from global to regional scales. Especially in the middle atmosphere, i. e., from the upper troposphere to the lower thermosphere (approx. 10 to 100 km), far-reaching changes due to anthropogenic influences are already observed, and a further increase in the coming decades is predicted. The importance of the middle atmosphere for the climate is based on diverse interactions of these layers with the troposphere (approx. 0- 10 km) and can be roughly divided into a) climate effects in the middle atmosphere, and b) influence of the middle atmosphere on the troposphere.

Changes in the composition of the middle atmosphere influence the radiation budget of the entire atmosphere and thus also the climate in the troposphere. The middle atmosphere and troposphere are dynamically coupled with each other in a variety of ways, especially by waves on very different spatial and temporal scales. For a few years it is clear that not only does the middle atmosphere react to anthropogenic activities, but that e.g. stratospheric circulation changes can influence the regional climate.

In order to better understand the role of the middle atmosphere for climate and to be able to take it into account in future projections, our understanding of these coupling mechanisms must be improved.

Figure 1: Institutes involved in the second phase of ROMIC (GEOMAR = Helmholtz Centre for Ocean Research, IAP=Leibniz Institute of Atmospheric Physics, MPMet = Max-Planck-Institute for Meteorology, MPS = Max-Planck-Institute for Solar System Research, FZ = Research Centre, KIT = Karlsruhe Institute of Technology, DLR/IPA = German Aerospace Centre/Institute of Atmospheric Physics)

The middle atmosphere is also a key region through which changes in solar activity and large volcanic eruptions affect the climate. The importance of the middle atmosphere for the troposphere becomes clear from the fact that weather services have meanwhile extended their operational forecast models to the mesosphere (approx. 50-100 km) because this improves the predictions.

The German Federal Ministry for Education and Research (BMBF) has launched a program called ROMIC (Role Of the Middle atmosphere In Climate). The first phase was successfully performed in the years 2014 –2018. The second phase (ROMIC-2) started with some projects in 2019, and in full extent in 2020. It is expected that ROMIC-2 will last until 2023.

The main research topics of ROMIC-2 are: i) Trends in the middle atmosphere, ii) Forcing by solar radiation, greenhouse gases, and stratospheric aerosols, and iii) Coupling between the troposphere and the middle atmosphere. These tasks are addressed in the following 8 projects where most of them are run by a speaker and several coinvestigators (CoI), usually from various institutes within Germany.

Solar/climate variability + trends

1. SOLCHECK (Solar contribution to climate change on decadal to centennial timescales), Speaker: Ulrike Langematz, FU Berlin, CoIs: Katja Matthes, GEOMAR, Kiel, Holger Pohlmann, MPMet Hamburg, Miriam Sinnhuber, KIT, Karlsruhe.
2. ISOVIC (Impact of SOlar, Volcanic and Internal variability on Climate), Speaker: Ralf Koppmann, Universität Wuppertal, CoIs: Claudia Timmreck, MPMet Hamburg, Natalie Krivova, MPS, Göttingen.
3. TIMA (Trends In the Middle Atmosphere), Speaker: Franz-Josef Lübken, IAP, Kühlungsborn.

Dynamics

4. QUBICC (The Quasi-Biennial Oscillation in a Changing Climate), Speaker: Marco Giorgetta, MPMet, Hamburg, CoIs: Ulrich Achatz, Universität Frankfurt, Manfred Ern, FZ Julich, Oliver Reitebuch, DLR-IPA, Oberpfaffenhofen
5. WASCLIM (Role of gravity WAves in the Southern hemispheric circulation and CLIMate), Speaker: Markus Rapp, DLR, Oberpfaffenhofen, CoIs: Thomas Birner, LMU, München, Jorge Chau, IAP, Kühlungsborn, Peter Preusse, FZ Jülich, Wolfgang Woweide, KIT, Karlsruhe

Chemistry + trace gases

6. SCI-HI (Surface Climate Impacts of Halogen Induced stratospheric ozone changes), Speaker: Björn-Martin Sinnhuber, KIT, Karlsruhe, CoIs: Andreas Engel, Universität Frankfurt, Jens-Uwe Grooß, FZ Jülich, Klaus Pfeilsticker, Universität Heidelberg
7. TroStar (The transport of trace gases via the tropopause region in the Western Pacific observed by FTIR spectrometry), Speaker: Mathias Palm, Universität Bremen
8. SOCTOC (Effects of anthropogenic Stratospheric Ozone Changes on climate sensitivity and Tropospheric Oxidation Capacity), Speaker: Hauke Schmidt, MPMet, Hamburg, CoI: Roland Ruhnke, KIT, Karlsruhe

A kickoff-meeting of the ROMIC-2 program took place online on 26. February 2021. In total, more than 100 scientists and students participated in this meeting. ROMIC is part of BMBF's high-tech strategy for climate protection within the framework of research for sustainable development (FONA). The initiative ROMIC is intended to help reduce existing uncertainties in understanding climate and to allow for an important step in the direction of improved predictability of climate change.

The scientists and institutes involved in ROMIC thank the BMBF for introducing this funding opportunity. Although ROMIC concentrates on institutes in Germany, international cooperation is highly recommended and results are presented (amongst others) in a special session at the annual international EGU symposium in Vienna.

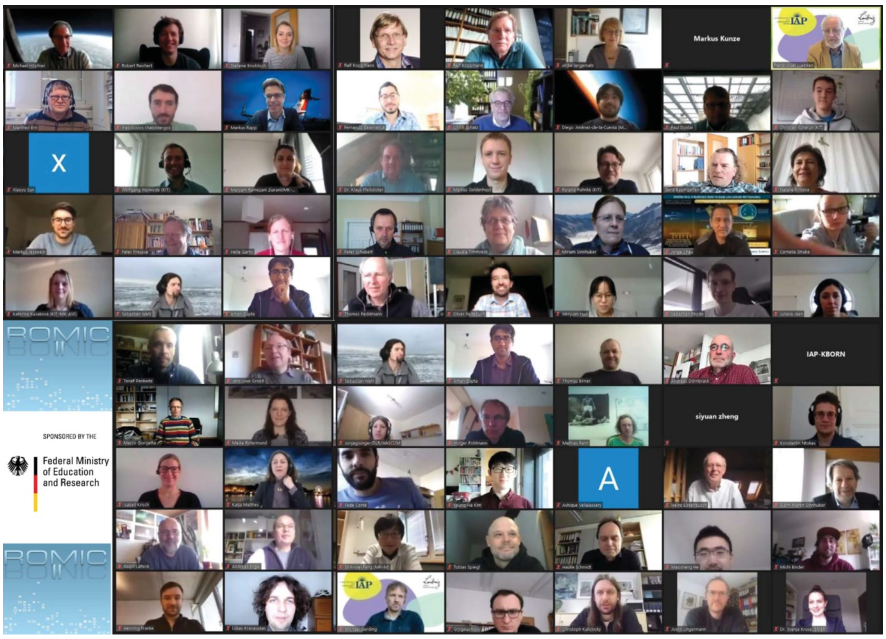


Figure2: Some part of the participants in the ROMIC-2 online meeting held on 26. February 2021.

Article 2:

Closure of the Onagawa Magnetic Field Observatory of Tohoku University

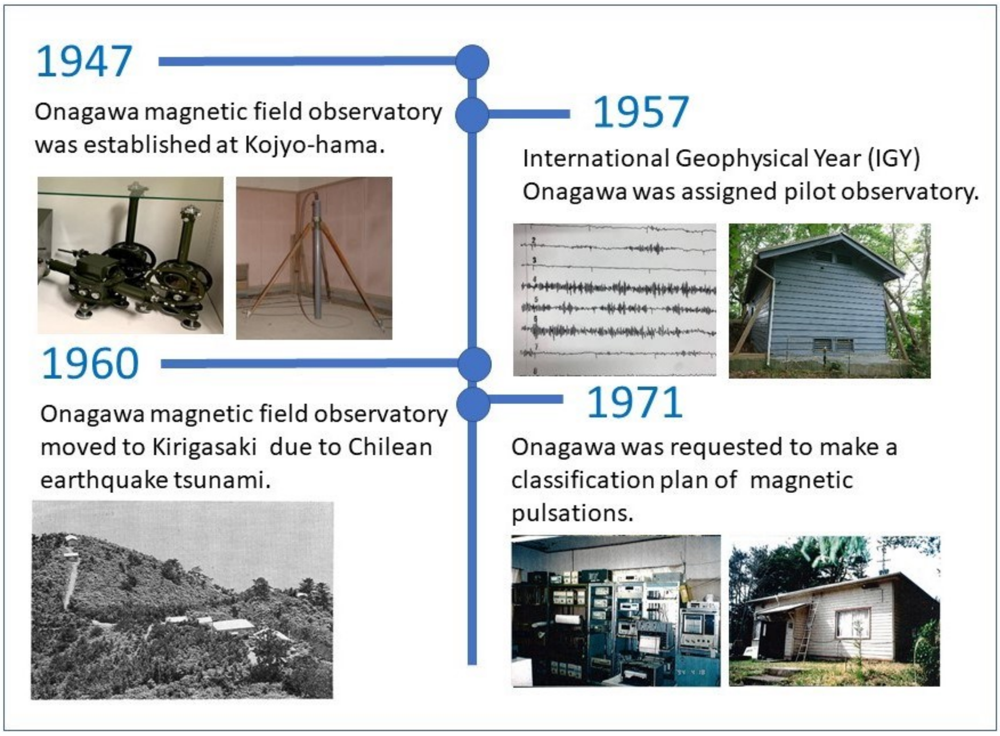
Takahiro Obara

Takahiro Obara[1]
[1]PPARC, Tohoku University

The magnetic field observatory of Tohoku University at Onagawa Town in Miyagi Prefecture closed at the end of March in 2021 with an illustrious history of over 60 years. This article is an overview of the history of the observatory during the past 60 years. Its various scientific achievements are also highlighted.

The Onagawa Magnetic Field Observatory of Tohoku University was built at Kojyo-hama in 1947 with the assistance of Onagawa Town. Facilities are equipped with government building, a laboratory with absolute observation room and a detector room. A state-of-the-art induction magnetometer and an electron tube automatic equilibrium magnetometer were also installed. In 1957, the Onagawa observatory was assigned as a magnetic pulsation pilot observatory. Since then, Onagawa observatory has been internationally recognized as a leading magnetic observatory. Kojyo-hama rapidly urbanized and precise measurements were in jeopardy due to artificial disturbances. In 1960, the Chile earthquake and tsunami struck Onagawa Town, and the observation room and the magnetometer were destroyed. So, the observatory was relocated to the current Kirigasaki location and it continued fully automated electronic measurement there. Research on the geomagnetic pulsation based on the magnetometer observations extensively progressed. The phenomenon "Pc" and "Pi" were named here. These names were certified by the IAGA in 1971. They have become terms widely used by researchers all over the world. Research on magnetic pulsation has extensively progressed, especially in the studies of Pc-3 to Pc-5 and Pi-2 magnetic pulsations. More than one hundred scientific papers have been published up to now on these topics.

The international research project STEP was started in 1990, and Onagawa observatory played an important role as a key station of the observation network along the geomagnetic longitude 210°. Joint research in Japan and overseas has been performed involving Nago-



ya University, Kyushu University, Hokkaido University, Tohoku Institute of Technology, and Stanford University. In addition, the development of magnetometer mounted on "Akebono" satellite and an interplanetary probe "Sakigake" were performed by Prof. Fukunishi and Prof. Saito, respectively.

Due to the reorganization of Tohoku University in 1999, Onagawa observatory was re-assigned to the Planetary Plasma and Atmospheric Research Center (PPARC), and the new main building was opened in 2000. At that time, the Internet was connected, and thus fully automatic observation became possible and this data has been available on the website.

In the March of 2011, a massive earthquake caused the magnetometer to collapse, and it was ruined. The situation was getting worse because it hindered the maintenance of other observation equipment. Hence, unfortunately, it was closed at the end of March in 2021. Before the closure of the observatory, Planetary Plasma and Atmospheric Research Center transferred the Kyushu University magnetometer to the site of Zao observatory at the foot of Mt. Zao.

Highlight on Young Scientists 1:

Impact of ICME Sheath Regions on Outer Radiation Belt Electrons

Milla Kalliokoski

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Turbulent sheath regions form in front of interplanetary coronal mass ejections (ICMEs). ICMEs are key drivers of geomagnetic activity and variability in the Earth's outer radiation belt electron fluxes. The ICME structures (shock, sheath and ejecta) have distinct impacts (Kilpua et al., 2017), and we focused on how sheaths drive the radiation belt system in Kalliokoski et al. (2020).

Statistical study of 37 sheaths between 2012-2018 revealed elevated chorus and ultra-low frequency (ULF) wave activity during sheaths. In contrast to previous studies, we investigated the outer belt response immediately after the sheath to exclude variability caused by the ejecta. Fig. 1 shows the energy-dependence of the response. Sheaths enhance electron fluxes at low energies (10s to 100s keV) and deplete the high-energy (> 1 MeV) populations. The energy range where depletion occurs narrows toward the heart of the outer belt, likely caused by energy-dependent wave-particle interactions dominating there, whereas losses at the magnetopause with contributions from ULF-driven radial transport dominate further out. We additionally found that sheaths driving geomagnetic storms lead more often to both energization and loss throughout the outer belt, but nongeoeffective sheaths can also cause significant changes in the outer belt electron fluxes.

To confirm the physical mechanisms determining the electron dynamics during sheaths, we have continued this work with phase space density (PSD) analysis in Kalliokoski et al. (2021). Fig. 2 compares the evolution

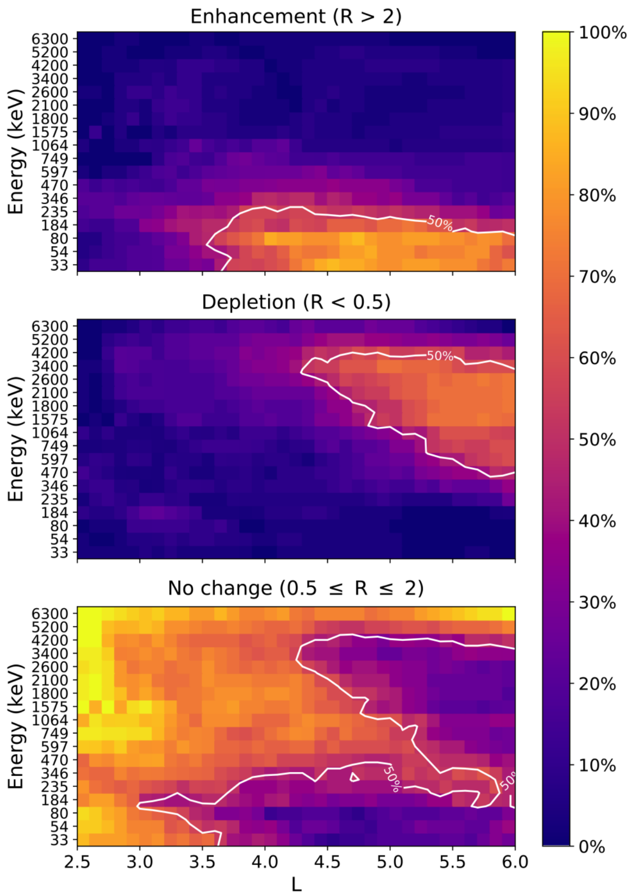

Figure 1: Percentage of sheaths causing enhancement, depletion or no significant changes in electron fluxes throughout the outer belt at a wide range of energies observed by Van Allen Probes. The response is calculated as R = <post-sheath flux>/<pre-sheath flux> where <> denotes averaging over 6 hours.

of PSD radial profiles at ultrarelativistic energies during two sheaths with opposite responses. The geoeffective sheath (left) generated a growing peak in PSD, evidencing local acceleration by chorus. The nongeoeffective sheath (right) led to effective magnetopause shadowing via the combined process of magnetopause compression and ULF-driven outward radial transport. Understanding the immediate outer belt response to different solar wind drivers, regardless of their geoeffectiveness, is key in forecasting the belt dynamics.

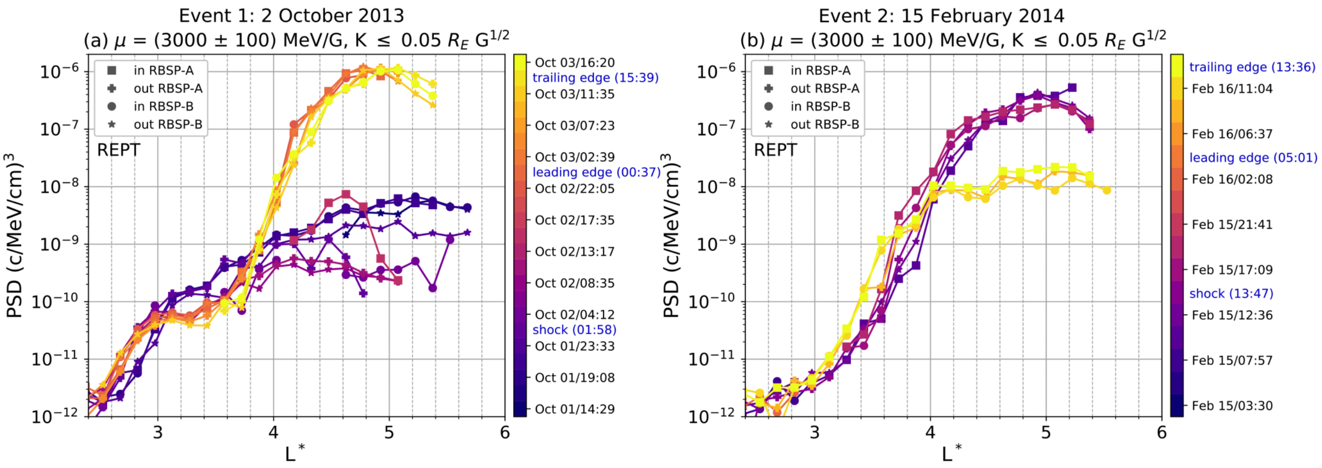

Figure 2: PSD radial profiles of nearly equatorially mirroring electrons at ultrarelativistic energies for (a) a geoeffective and (b) a nongeoeffective sheath. Each profile corresponds to an inbound or outbound pass of the two Van Allen Probes, color-coded by time as shown on the color bar.

Acknowledgements

This work was supported by the Finnish Centre of Excellence in Research of Sustainable Space (Academy of Finland grant 1312390). We thank the Van Allen Probes team for making the electron flux data publicly available.

References

Kilpua, E. K. J., Koskinen, H. E. J., & Pulkkinen, T. I. (2017). Coronal mass ejections and their sheath regions in interplanetary space. *Living Rev. Sol. Phys.*, 14(1), 5. doi:10.1007/s41116-017-0009-6

Kalliokoski, M. M. H., Kilpua, E. K. J., Osmane, A., Turner, D. L., Jaynes, A. N., Turc, L., George, H., Palmroth, M. (2020). Outer radiation belt and inner magnetospheric response to sheath regions of coronal mass ejections: a statistical analysis. *Ann. Geophys.*, 38(3), 683-701. doi:10.5194/angeo-38-683-2020

Kalliokoski, M. M. H., Kilpua, E. K. J., Osmane, A., Jaynes, A. N., Turner, D. L., George, H., Turc, L., Palmroth, M. (2021). Phase Space Density Analysis of Outer Radiation Belt Electron Energization and Loss during Geoeffective and Nongeoeffective Sheath Regions. *ESSOAr.* doi:10.1002/essoar.10507312.1 (preprint)

Highlight on Young Scientists 2:

Exploring Small-Scale Magnetic Features That Trigger Solar Eruptions

Yumi Bamba

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Solar eruptions, such as flares and coronal mass ejections (CMEs), are sometimes disturb space environment around the Earth. However, it is not easy to forecast when solar eruptions occur because eruption onset is highly sensitive to very small magnetic disturbance the solar surface.

For instance, the largest magnetic storm in solar cycle 24, so-called the St Patrick's day storm, is originated in a tiny magnetic disturbance that triggered a huge filament eruption on 15 March 2015 in solar active region (AR) NOAA 12297 (Bamba et al. 2019). Magnetic field structure surrounding the AR was complicated: several filaments including big filament that erupted (Figure 1a) were rooted in the AR. Especially, closed magnetic fields that sustained the erupting big filament rooted into north of a satellite sunspot (Figure 1b). Additionally, there is locally but highly twisted magnetic structure, i.e., small magnetic flux rope existed at the northern end of the satellite sunspot, and it was represented by a small filament (Figures 1a, 1b).

It is noteworthy that a tiny precursor brightening (Figure 1c) with a spatial scale of a few hundred kilometers on the solar surface that is inferred to be caused by a small magnetic disturbance was observed under the small flux rope. The big filament was disturbed just after the precursor brightening was observed, and it erupted following an eruption of the small flux rope with a C2.4 flare (Figure 2d).

Our results suggest that the big filament eruption with several diameters of the Earth was triggered by the tiny (only a few hundred kilometers on the solar surface) magnetic disturbance. Further, the magnetic disturbance can be represented by the small and transient precursor brightening. Therefore, analysis of magnetic field change (spatial and temporal) and corresponding precursor brightening is effective to identify a "trigger" of solar eruptions.

Reference

Bamba Y., Inoue S., and Hayashi K., 2019, The Astrophysical Journal, 874:73 (11pp), doi: 10.3847/1538-4357/ab06ff

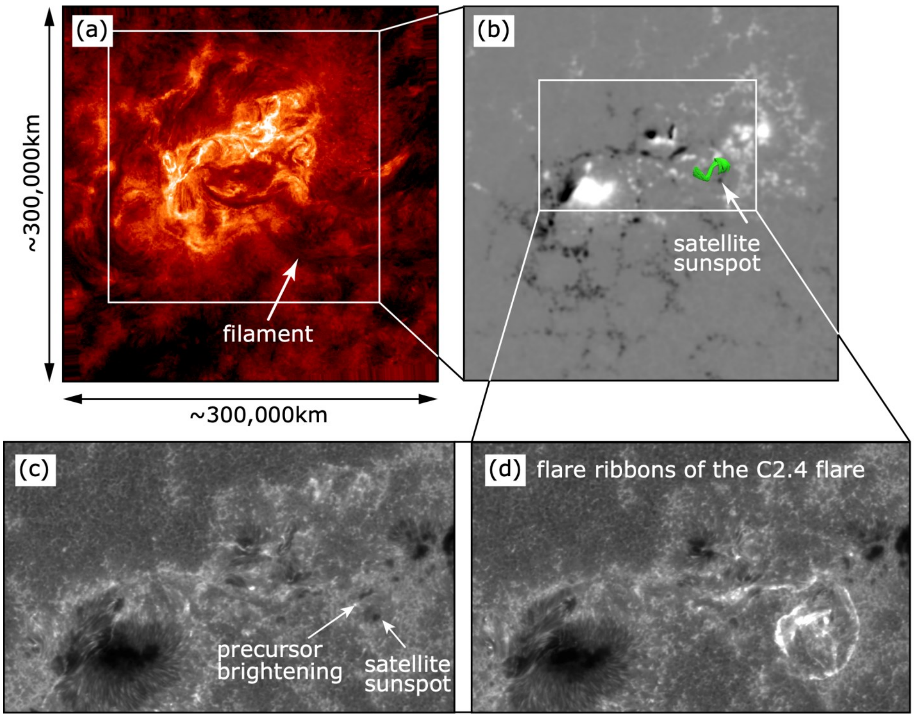

Figure 1: Global and local structures of the AR 12297. (a) The big filament that erupted and the small filament. (b) Magnetic field structures in/around the AR. There was the small magnetic flux rope that corresponding to the small filament in the north of the satellite sunspot. (c, d) The precursor brightening (in panel c) and the C2.4 flare ribbons (in panel d) in the chromosphere. The tiny precursor brightening that represents a small magnetic disturbance was observed approximately an hour before the C2.4 flare onset.

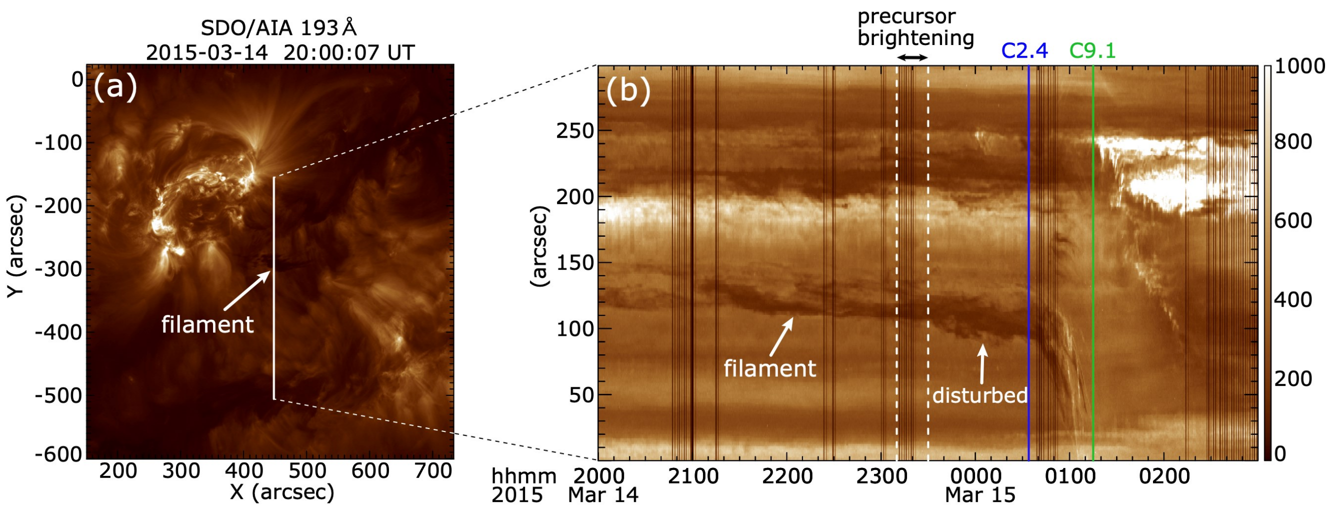

Figure 2: Temporal variation of the erupting big filament observed by SDO/AIA193Å. (a) The erupting big filament is marked by the shite arrow. The line cut is over plotted by the white line. (b) Time-slice image of the erupting big filament, for the period of 20:00 UT on March 14 to 03:00 UT on 2015 March 15. The C2.4 and C9.1 flaring time is indicated by the vertical blue and green lines, respectively. The duration of the small precursor brightening is indicated as between the vertical white dashed lines.

Meeting Report 1:

44st Annual Seminar "Physics of the Auroral Phenomena", Organized Online by PGI, Apatity, Russia, 15 - 19 March 2021

Andrei Demekhov

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The 44st Annual Seminar "Physics of the auroral phenomena" has been held online during 15-19 March 2021. The organizer of the Seminar is the Polar Geophysical Institute (PGI) in Apatity (Murmansk region, Russia).

More than 90 representatives from 20 research institutes and universities distributed across Russia (from Kaliningrad to Yakutsk) took part in the Seminar. Of those, more than 25 people are young scientists from Moscow, St. Petersburg, Kaliningrad, Irkutsk, Apatity, and Murmansk. Among the participants there were about 20 representatives of foreign research institutes, of whom 11 persons (from Argentina, Bulgaria, India, USA, Czech Republic, and Japan) presented their reports. Such a broad participation of foreign scientists in this mostly Russian event has become possible because of its online format and due to its announcing via SCOSTEP mailing list and personal communications.

67 oral and 58 poster presentations were delivered. Posters were presented as short (5 min) elevation talks, accessed online, and discussed at evening sessions in Spatialchat.

The Seminar is devoted to the discussion of the latest results obtained by Russian and foreign scientists on the physical processes in the polar cap, auroral, and subauroral regions, in the solar wind, magnetosphere, ionosphere, and atmosphere. The Seminar subjects cover all aspects of the solar-terrestrial relations: 1) Storms and substorms; 2) Fields, currents, particles in the magnetosphere; 3) Waves, wave-particle interaction; 4) The sun, the solar wind, cosmic rays; 5) The ionosphere and the upper atmosphere; 6) Lower atmosphere, ozone; 7) Heliobiosphere.

The SCOSTEP/PRESTO program was a co-sponsor of the Seminar and partially supported the preparation of our online meeting, such as upgrading zoom license, purchasing Spatialchat license, developing web pages for poster viewing and accessing the presentations, archiving the presentations, reserving DOI for the seminar proceedings, etc. The final Seminar program is available at http://pgi.ru/apsem2021/?id=prog, and the book of abstracts can be found at http://pgia.ru/seminar/abstracts_book2021.pdf. The Seminar will be followed by publication of the proceedings, which will be available both online at http://pgia.ru/seminar/archive/ and in print. The electronic version of the seminar proceedings is published by the Russian Science Electronic Library (https://elibrary.ru/title_about.asp?id=57098).

Upcoming meetings related to SCOSTEP

Conference	Date	Location	Contact Information
The first summer school on space research, technology and application in Bulgaria	Jul. 5-11, 2021	National Observatory Rozhen, South of Bulgaria	https://bulgarianspace.online/space-schoolbg-2021/
ISWI/SCOSTEP Iberian Space Science Summer School	Jul. 26-30, 2021	Online	https://www.i4s-iberian-space-science-summer-school.com/
AOGS 2021	Aug. 1-6, 2021	Suntec, Singapore	https://www.asiaoceania.org/aogs2021/public.asp?page=home.html
IAU 2021 General Assembly	Aug. 16-27, 2021	Busan, Korea	http://www.iauga2021.org/
IAGA 2021	Aug. 22-27, 2021	Hyderabad, India	http://www.iaga-iaspei-india2021.in/
URSI GASS 2021	Aug. 28- Sep.4, 2021	Rome, Italy	https://www.ursi2021.org/
The 30th IUPAP General Assembly	Oct. 20-22, 2021	Beijing, China	http://iupap-ga2020.cps-net.org.cn/
AGU Fall Meeting 2021	Dec. 13-17, 2021	New Orleans, LA, USA	https://www.agu.org/fall-meeting
SCOSTEP's 15th Quadrennial Solar-Terrestrial Physics Symposium (STP-15)	Feb. 21-25, 2022	Alibag, India	https://www.stp15.in/
EGU General Assembly 2022	Apr. 3-8, 2022	Vienna, Austria	https://www.egu22.eu/
COSPAR 2022	Jul. 16-24, 2022	Athens, Greece	http://ww.cosparathens2022.org/
AOGS 2022	Aug. 14-19, 2022	Melbourne, Australia	https://www.asiaoceania.org/society/public.asp?page=home.asp
SUMMER SPACE WEATHER SCHOOL - Physics and use of tools	In October, 2022	Houphouët Boigny University, Abidjan, Côte d'Ivoire	
AGU Fall Meeting 2022	Dec. 12-16, 2022	Chicago, IL, USA	https://www.agu.org/fall-meeting
IUGG 2023	In July, 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

Please send the information of upcoming meetings to the newsletter editors.

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

The editors would like to ask you to submit the following articles to the SCOSTEP/PRESTO 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 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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