Commission Report
2017-2021

Commission Triennial Report

Commission H

1. In Memoriam

Pavel Tříska (1931– 2018). Pavel Triska was one of the founders of the Ionospheric Department of the Geophysical Institute in Prague. Together with colleagues, he proposed launching a satellite with a subsatellite to carry out measurements that allow separating spatial and temporal effects in the observed phenomena. This resulted in a series of MAGION subsatellites, which made a great contribution to the study of the Earth's ionosphere and magnetosphere. Pavel Triska enjoyed great respect and was an indisputable authority among his colleagues in Intercosmos.

Jan Šmilauer (1935–2018). Jan Šmilauer was one of the key collaborators of the Ionosphere Department of the Geophysical Institute (later of the Institute of Atmospheric Physics) in Prague. He was engaged in the development of instruments for measuring the ionic composition and plasma temperature on satellites. For many years, he ensured the operation of the ground receiving station Panská Ves, also during dramatic events with the MAGION 5 subsatellite. He operated information reception from the INTERKOSMOS, Interball, Cluster satellites, and the MAGION subsatellites. Jan Šmilauer was a broad-minded person with a wide range of knowledge and interests, a truly intelligent and respectful person.

Donald Leland Carpenter (1928 – 2019) died on February 5th 2019. He is best known as the discoverer of what is now called the 'plasmapause' (affectionately also known as 'Carpenter's Knee'), the sharp drop in the density of plasma that co-rotates with the Earth and plays a fundamental role in the physics of the upper atmosphere.

Born on January 3, 1928, in Spokane, Washington, Don graduated from Grant High School in Portland, Oregon and served in the U.S. Navy from 1946 to 1948. He then studied international politics and language at Willamette University and in 1951 moved to New York City to pursue his Master's degree in Political Science at Columbia University. Ultimately, discovering his true calling, as described in his contribution to the 1997 AGU publication *Discovery of the Magnetosphere*, Don settled in the San Francisco Bay Area, attending Stanford University for his MS and PhD in Electrical Engineering. He was a research professor for over 40 years at the Space Telecommunications & Radio Science Laboratory (STAR Lab) at Stanford University, a career he truly enjoyed. Using naturally-occurring and manmade very low frequency (VLF) waves as a tool to probe the upper atmosphere, Don made significant contributions to many areas of magnetospheric physics until he was well into his eighties. At age 87 Don authored a book on the history of radio research at Stanford entitled *Very Low Frequency Space Radio Research at Stanford 1950 – 1990*. In 2002, he was nominated by Belgium and awarded the John Howard Dellinger Medal by the International Union of Radio Science "For his discovery of the plasmapause, for pioneering studies of the plasmasphere structure and dynamics and for development and use of whistler-mode waves as diagnostic probes of the magnetosphere." In the same year he was elected a Fellow of the American Geophysical Union.

Richard Mansergh Thorne (1942-2019) died on July 12 2019. He was a distinguished Professor Emeritus at the University of California, Los Angeles. He was best known for his work on wave-particle interactions in the radiation belts at the Earth and magnetized planets. For further details, see "In

memoriam: Richard Mansergh Thorne" by Richard B. Horne; Bruce Tsurutani; Wen Li; Jacob Bortnik, URSI Radio Science Bulletin, 370, 2019

Iwane Kimura passed away on December 3, 2019. He was 86 years old. His research covered the theory and application of radiowave propagation and technology. He was a pioneer in whistlermode ray tracing.

For further details, see "In memoriam: Iwane Kimura" by Kozo Hashimoto, URSI Radio Science Bulletin, 371, 2019

Yuri Mikhailovich Mikhailov (1932-2021). Professor, Doctor of sciences Yuri Mikhailov was the head of VLF Department of IZMIRAN. He made a significant contribution to the study of low-frequency wave processes in near-Earth space. Under his leadership, equipment for recording low-frequency waves in space plasma was developed, which for years successfully operated on the satellites INTERKOSMOS-18, 19, 24, 25, Oreol-3, Kosmos-1809. Yuri Mikhailov was an active participant in the "VEGA" project. He was engaged in investigations of seismo-electromagnetic phenomena using satellite and ground data. He was active to the end of his life, writing a book, preparing scientific instruments for satellites of the "Ionosphere" project.

František Jiříček (1932 –2021). Fr substantially contributed to the investigation of properties of electromagnetic low frequency waves occurring in the ionosphere and magnetosphere. He investigated various ways in which lightning generated whistlers propagate in space plasmas but his research also included whistler mode chorus emissions and other types of electromagnetic waves. For his studies he mainly used data from instruments built by his colleagues in the ionospheric department of the Geophysical institute of the Czechoslovak Academy of Sciences in Prague. The instruments that he used were carried by spacecraft of the Intercosmos program, especially by the Magion sub-satellites. From 1965 to 1972, František Jiříček was a member of the Czechoslovak National Committee of URSI, representing the magnetospheric Commission IV.

2. Meeting Support

During the 2017-2021 'triennium', Commission H spent 3700 EUR to support the following meetings financially (mode B) with a contribution between EUR 1000 – 2000:

1. 8th VERSIM VLF/ELF Remote Sensing of Ionospheres and Magnetospheres Workgroup meeting, Apatity, Russia,19-23 March 2018
2. 9th VERSIM VLF/ELF Remote Sensing of Ionospheres and Magnetospheres Workgroup meeting, Kyoto, Japan,21-25 November 2020

Commission H also provided support in mode A (without financial aid) for the following meetings:

1. RADIO 2017, IEEE Radio and Antenna Days of the Indian Ocean 2017, Cape Town, South Africa, 25-28 September 2017
2. APMC 2018, Asia-Pacific Microwave Conference 2018, Kyoto, Japan, 6-9 November 2018
3. SPIN 2019, 6th Int. Conference on Signal Processing and Integrated Networks, New Delhi, India, 7-8 March 2019
4. URSI-JRSM 2019, 2019 URSI-Japan Radio Science Meeting, Tokyo, Japan, 5-6 September 2019

5. RFI 2019 Workshop, Coexisting with Radio Frequency Interference, Toulouse, France, 23 - 26 September 2019
6. ISAP 2020, 2020 International Symposium on Antennas and Propagation, Osaka, Japan, 25-28 January 2021
7.

3. Working Group Activities

3.1 Working Group of Commissions H and J: Computer Simulations in Space Plasmas

Co-Chairs for Commission H : Y. Omura (Japan) and B. Lembege (France)
Co-Chair for Commission J : K. Shibata (Japan)

Report received from Y. Omura

The numerical simulation activity keeps in expanding in different fields. Strong efforts by governments have been invested to renew the large-scale computers (LSC) park, which strongly impacts simulation activities in space plasmas. This means that more and more realistic simulations (in dimension, parametric conditions, etc.) are progressively approached. Some collaboration agreements have also been established between countries to make accessible a noticeable number of computing time of some LSC to other "neighboring" countries (e.g., PRACE project: Partnership for Advanced Computing in Europe- between European countries which is excellent for establishing an efficient network in terms of HighTech communication, in terms of collaboration, education etc.). This impacts also simulation activity in space plasma

On the other hand, small scale computers (as big PCs) or Cluster's are spreading everywhere and allows to make simulation activity very accessible to students and post docs. Some language (as Python) becomes more popular which allows to combine easily and together calculations and graphics (for diagnosis).

In order to facilitate these simulation activities in space plasma science and promote international collaborations, the URSI Commission H working group has been organizing International School/Symposium for Space Simulations (ISSS) since 1982. The 14th ISSS was planned to be held in Kobe Japan in 2020 under the leadership by Prof. Hideyuki Usui of Kobe University as the chair of the local organizing committee, but it has been postponed to 2022 because of the continuing COVID-19 pandemic. The new dates for the ISSS-14 are still in discussion, but it will be held as an in-person meeting around September or during the summer in Kobe, Japan.

3.2. Working Group of URSI and IAGA: VLF/ELF remote Sensing of the Ionosphere and Magnetosphere (VERSIM)

Co-Chair for URSI Commissions H and G: M. Clilverd (UK)
Co-chair for IAGA: A. Demekhovk (Russia), replacing Jacob Bortnik (USA) in 2019.

Report received from M. Clilverd

This report covers the activities of the VERSIM working group over the last URSI "Triennium" 2017-2020 (2021). This includes two VERSIM workshops: the 8th VERSIM Workshop, Apatity, Murmansk region, Russia, March 2018, and the 9th VERSIM Workshop, Online, Kyoto, Japan, November 2020. In addition we held a business meeting at IUGG in July 8-18, 2019 at the Palais des Congrès in Montréal, Québec, Canada. There are currently over 100 scientists from about 26 different countries on the VERSIM mailing list.
The 8th VERSIM workshop was hosted on March 2018 by The Polar Geophysical Institute (PGI) located above the Arctic circle in the city of Apatity, Russia. The workshop was supported by SCOSTEP/VarSITI, IAGA and URSI. Our conference program focused on all traditional VERSIM topics, such as Sprites and effects of lightning in the ionosphere, wave-particle and wave-wave interactions, wave generation in the magnetosphere, with additional radiation-belt themed reports after their successful integration into the 7th VERSIM meeting. In all, 42 scientists attended this very successful meeting.

During the 8th VERSIM workshop the idea of a Journal Club was developed, in which presentations of published papers of interest to the VERSIM community encouraged scientific discussion between students and scientists. To date 27 online journal discussions have taken place in a friendly and lively environment where students can learn, engage, and build their scientific confidence. The journal club thrives at: http://www.iugg.org/IAGA/iaga_ursi/versim/journal_club.html

The 9th VERSIM workshop took place during a particular time in everyone's lives. Due to the COVID-19 pandemic we had to change our format to an entirely online meeting and shift the meeting to November 2020 instead of the original date of March. However, despite these difficult times and audiences with many different time zones, we not only had great invited talks but also the largest attendance of any previous workshop reaching more than 100 listeners during the online oral and poster presentations. Scientific topics included: Plasma structures and boundaries - morphology and dynamics, wave-particle and wave-wave interactions, wave-induced particle precipitation, wave propagation in magnetosphere and ionosphere, sprites and the effects of lightning on the ionosphere, results of recent space missions such as Arase, MMS, and Van Allen Probes.

Approximately 20 scientists attended the VERSIM business meeting in IUGG, Montreal 2019. A vote for continuation of the working group was passed unanimously. Several traditional VERSIM session topics were proposed for the next IAGA meeting in India (remote meeting now) in 2021. VERSIM scientists have continued to provide leadership, session suggestions, and conveners for URSI 2021.

3.3 Working Group of Commissions E,G, and H: Seismo-Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling)

Report by Co-chair for Commission H: H. Rothkaehl (Poland)

GEH: Seismo Electromagnetics (Lithosphere-Atmosphere- Ionosphere Coupling) , GASS 2017 Montreal

The session gathered around 19 contribution in 3oral slot and poster presentation and was led by Sergey Pulinets, Yasuhide Hobara, Hanna Rothkaehl

GEH: Seismo Electromagnetics (Lithosphere-Atmosphere- Ionosphere Coupling) , GASS 2020(2021) Rome,

During the session it will be presented around 23 contribution in oral slot and poster presentation and is leading by Sergey Pulinets, Yasuhide Hobara, Hanna Rothkaehl

The aim of organized sessions is to demonstrate progress in understanding the ionospheric and electromagnetic effects preceding strong earthquakes and tsunami including experimental findings and theoretical investigation on lithosphere-atmosphere-ionosphere coupling. Multi-parameter measurements in seismically active regions and cross validation of results obtained by different groups will help to understand the background physics of the observed anomalies and also to develop new insights in understanding the seismic imprints in near space environment.

3.4 Working Group of Commissions EHG on Solar Power Satellites

Co-chair for Commission H: K Hashimoto (Japan) indicated that there was no activity of the WG in this triennium. They are discussing with members in Japan if they will continue the WG.

3.5 Working Group of Commissions G and H on Active experiments in Space Plasmas

Report by Co-Chair for Commission H: M. Kosch (South Africa)

We are pleased to note that the HAARP, EISCAT and SURA ionospheric modification facilities continued with their operations and science results successfully. In the period 2017 to the present, EISCAT Heating produced 59 peer-reviewed publications. At this time, there is no plan to discontinue operations at any of these facilities. We celebrate 5 years of new funding for HAARP, starting 2021. We deeply regret the structural failure of the Arecibo facility in 2020, which also resulted in the destruction of the ionospheric modification facility.

An important review paper entitled “Past, present and future of active experiments in space” by Streltsov, Berthelier, Chernyshov, Frolov, Honary, Kosch, McCoy, Mishin, and Rietveld, Space Science Rev., 214, 218, doi.org/10.1007/s11214-018-0549-7, 2018, was produced summarising recent new results and providing guidance for future research directions.

3.6 Working Group of Commissions E, F, G, H and J on RFI Mitigation and Characterization

Report by Co-chair for Commission H: H. Rothkaehl (Poland)

EFGHJ: One-Day Workshop on RFI Mitigation and Characterization (Montreal GASS 2017)

During the GASS meeting One-Day Workshop on RFI Mitigation and Characterization was organized. The 21 presentation was presented which cover the different topics of radio-astronomy, space science and GNSS techniques. It was a very successful meeting, which had an interdisciplinary

character, and the topics discussed concerned issues related to both scientific considerations and technological solutions.

The **RFI 2019 Coexisting with Radio Frequency Interference** in Toulouse France 23-26 September 2019 workshop was organized under the URSI patronage. The main goal of this meeting was to provide an opportunity for the scientific community affected by Radio Frequency Interference (RFI) to meet, report and discuss recent achievements and developments in instrumentation, methodology, and applications in tackling this problem. The meeting gathered about 80 participants from all over the world. The next meeting is planned for the 2021-22 year.

3.7 Working Group of Commissions GJFEH Interdisciplinary Space Weather

Co-Chair for G: I. Stanislawska (Poland, stanis@cbk.waw.pl),Co-Chair for J: R. Fallows (Netherlands, fallows@astron.nl), Temporary Co-chair for H: J. Lichtenberger.

Report by Co-chair for Commission G I. Stanislawska (Poland)Report by Co-chair for Commission

The advanced state of space physics as well as the progress of techniques and technology meant that the development of space weather gained new acceleration. Many phenomena having a significant impact on life on our increasingly-advanced technical civilization have proved to be predictable, forecast and mitigated. This indicated the need to undertake new research directions and intensify others, which, with access to improved, innovative tools and methods, have just become an additional impulse for development. So, recent years have seen an extremely offensive rise in space weather activity. This activity was also marked by the dynamic participation of URSI interdisciplinary Space Weather Working Group members in new bodies.
During the accounting period the members of the Inter-commissions GJFEH actively participated in Space Weather related organizations and associations, many international events (conferences, symposia, workshops) and organizations, also by publishing the results and conclusions:

- International Space Environment Service ISES
- COSPAR International Space Weather Action Teams (ISWAT)
- Horizon H2020, European Space Surveillance Tracking SST
- ESA Space Situation Awareness SSA
- WMO Inter-Programme Team on Space Weather Information, Systems and Services (IPT-SweISS)
- International Space Weather Initiative
- Low-Frequency Array (LOFAR)
- PECASUS - Pan-European Consortium for Aviation Space weather User Services for ICAO

Programs and research conducted in many URSI Committees constitute our significant contribution to scientific and especially in operational works.
The Working group activity has concentrated on the three main subjects:

1. new radio science tools for space weather,
2. radio science challenges for space weather services,
3. radio science in planetary exploration.

Full face-to-face meetings have been very limited, especially in the recent Pandemic period, where most meetings were held online. Nevertheless, an online Radio Heliophysics Catch-up meeting will be held on over 10-13 May in place of a more-formal physical meeting originally planned for December 2020. This has attracted more than 100 registrations, with 21 submitted abstracts covering multiple aspects of radio research across the solar and heliosphere space weather domains.
The results of the work will be presented in aggregate at the GA 2020 workshop in Rome. This workshop is devoted to the novel radio science tools for space weather, radio science in planetary exploration and radio science challenges for space weather services.
Three Panels of experts, including 3 invited presentations in total, and related open discussion towards the three topics that are:

- **NEW RADIO SCIENCE TOOLS FOR SPACE WEATHER**

The aim of this panel is to bring together the scientists using new arrays for space weather purposes (e.g. radio astronomers) and space weather scientists, who may be unfamiliar with the capabilities of these new instruments, to discuss how they can best be used to advance space weather science, and to discuss how these instruments and dedicated space weather instrumentation can best support one another in their respective goals.

- **RADIO SCIENCE CHALLENGES FOR SPACE WEATHER SERVICES**

Knowledge of effects imposed by the space weather on current and new generation operational radio systems, the development and implementation of techniques to mitigate the deleterious effects of the space weather on such systems are the primary scientific goals. The main issue to discuss within this panel is the generation of the novel directions for services to approach current and future radio science challenges.

- **RADIO SCIENCE IN PLANETARY EXPLORATION**

Since the start of the space venture fifty years ago, the interest of the effects of the space weather on the space missions and human exploration has strongly raised. Among the many diagnostic capabilities, radio experiments have proven to be very efficient both for remote and in-situ exploration. The aim of this panel is thus to bring together researchers from planetary and interplanetary past and future missions as well as engineers from radio domains to discuss the results of recent missions (like Mars Express) and address the results foreseen by the future, Solar Orbiter, Parker Solar Probe or Juice.
Résumé will be presented along with the perspective of challenges in this workshop.

4. Preparations for the XXXIIIrd URSI General Assembly and Scientific Symposium in Rome, Italy, 28 August - September 2021

The XXXIIIrd General Assembly was originally scheduled to 2020, but due to the COVID19, it is postponed to 2021. The papers submitted in 2020 were either resubmitted or renewed and complemented with new submissions.

4.1. Scientific Sessions

Commission H sessions:

1. Open Session and latest results - 15 oral papers, 4 posters
2. Macro/micro-scale kinetic processes at natural boundary layers in terrestrial and planetary environments - 11 oral presentations
3. Multipoint and ground-based observations of magnetospheric wave phenomena, remote sensing of plasmasphere - 15 oral papers, 4 poster
4. Remote Sensing and Modeling of the Earth's Plasmasphere and Plasmapause:- 9 oral papers, 1 poster
5. Wave-particle Interactions, Wave-particle Interactions, Their Acceleration and Loss Effects on Planetary Radiation Belts and Drivers - 24 oral presentations, 5 posters
6. Radio Science for Space Weather - 8 oral papers, 1 posters
7. A tribute to Donald Carpenter - 6 oral papers, 1 posters
8. Plasma waves around the moon and small bodies - 5 oral papers

Common sessions with other commissions, lead by Commission H:

1. Joint HJ session on Solar, Planetary, and Heliospheric Radio Emissions- 9 oral papers, 1 posters
2. Joint HG session on Active experiments and radio sounding - 6 oral presentations, , 1 posters
3. Joint HGE session on Atmospheric, Ionospheric, Magnetospheric and High Energy Effects of Lightning Discharges - 21 oral papers, 3 posters

Other sessions related to Commission H:

1. Joint GEH session on Seismo Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling)
2. Joint GH(J) on Polar environment and Geospace
3. Joint EFGH session on Natural Electromagnetic Noise and Radio Sensing Applications in Terrestrial and Planetary Environments
4. Joint GH session on Meteors, collisional EMPs, and other Highly-Transient Space Plasma Events – 12 papers
5. Joint GH session on Plasma Instabilities in the Ionosphere
6. Joint JFGH session Characterisation and Mitigation of Radio Interference
7. Joint GHJ Workshop on Extreme Space Weather

4.2 Total number of papers and trends from the last GASS

For the upcoming URSI GASS in Rome Commission H accepted 140 papers (120 oral presentations and 20 posters). Every effort has been made to maximize the number of scheduled oral presentations. Unfortunately, this is a decrease of the total number of papers compared to the last URSI GASS in Montreal in 2017 where Commission H accepted 183 papers (141 oral presentations and 42 posters). This is mainly due to the COVID-19 epidemic, that made the organization as well as the attendance unsure. However, this number is higher then the previous 2 URSI GASS in Beijing in 2014 where Commission H accepted 132 papers (93 oral presentations and 39 posters), as well as to the preceding URSI GASS in Istanbul in 2011 where Commission H accepted 144 papers (86 oral presentations and 58 posters).

4.3 Tutorial Lecture

Commission H tutorial lecture on "Machine learning in space physics and space weather" will be given by Prof. Jacob Bornik from University of California at Los Angeles, Los Angeles, CA, USA.

4.4 Young Scientist Awards

Young Scientist Awards were/will be given both in 2020 ans 2021. In 2020 YSA were given to 10 young scientists from Commission H: Miroslav Hanzelka (Czechia), David Hartley (USA), Shiyong Huang (China), Lilla Juhász (Hungary), Shatoshi Kurita (Japan), Evgenii Shirokov (Russia), Ekaterina Svchnikova (Russia), Shangchun Teng (China), Dedong Wang (Germany) and Caitano da Silva (USA). They presented their papers on-line in September 2020.
In 2020 YSA will be given to 9 young scientists from Commission H: Luisa Capannolo (USA), Miroslav Hanzelka (Czechia), Yikai Hsieh (Japan), Qianli Ma (USA), Evgenii Shirokov (Russia), Kuldeep Singh (India), Shipra Sinha (India), Michele Urbani (Spain), Xiao-Jia Zhang (USA). Congratulations to all awardees!

4.5 Student Paper Competition

The Student Paper Competition call was open both in 2020 and 2021. In 2020, 3 finalists were selected through Commission H: Miroslav Hanzelka (Czechia), Luisa Capannolo (USA) and Melody Pallu (France). Miroslav Hanzelka won the 2nd Prize, congratulations.
In 2021, 2 SPC papers were submitted for Commission H. After the review process, the selected papers for the final round of the competition where the students present their work during the 2021 General Assembly and Scientific Symposium.

5. Recipients of the URSI Awards 2020 related to Commission H

Appleton Award – Richard Horne
For leadership and theories of charged particle dynamics in the Earth and planetary magnetospheres leading to practical space weather forecasting of their high energy particle environment.

Rawer Award – Raj Mittra
For Contributions to Analytical and Numerical Techniques in Electromagnetics and to Antenna Theory and Design.

Basu Award – Xiaolan Xu
For Developments in Wave Propagation and Scattering in Dense Random Media with Applications to Microwave Remote Sensing of Snow.

The URSI awards will be presented to the awardees during the Opening Ceremony of the 2021 General Assembly and Scientific Symposium. Congratulations to all awardees!

6. Commission H Vice Chair Election

The original call for nominations for the new Commission H Vice Chair was sent out on December 12, 2019, but the procedure was interrupted due to the COVID-19. The call was reissued on January 20, 2021. Two excellent candidates have been nominated. Voting is now in progress. The final vote counting will take place during the second Commission H business meeting, which will be held on Monday, August 30, 2021 at the URSI GASS in Rome, Italy.

7. Election of the Commission H Early Career Representative

The call for nominations for the second Commission H Early Career Representative was sent out on December 12, 2019, but the procedure was interrupted due to the COVID-19. The call was reissued on January 20, 2021. Two excellent candidates have been nominated and voting is in progress. The final vote counting will take place during the second Commission H business meeting, which will be held on Monday, August 30, 2021 at the URSI GASS in Rome, Italy.

I would like to take this opportunity to thank the Commission H Vice-Chair Jyrki Manninen, the Commission H Early Career Representatives Wen Li and Frantisek Nemec, as well as the Commission H past Chair Ondrej Santolik, for their valuable advice and support during the last triennium.

János Lichtenberger,
Chair, Commission H