

Commission G

Session	Title	Convener names & e-mails	Number of slots
G01	Data Assimilation for Space Weather	Bruno Nava, Sean Elvidge bnava@ictp.it, s.elvidge@bham.ac.uk	12
<p>Space weather events can negatively affect satellites, the electricity grid, satellite navigation systems and human health. Such consequences have caused space weather to be recognized as a hazard of national concern in numerous countries around the world. To help mitigate against such events a range of different models are used to nowcast and forecast space weather drivers and phenomena. As with meteorology and oceanology, data assimilation has become an important tool for specifying and forecasting space weather disturbances, particularly with regard to the ionosphere-thermosphere system. The increased use of data assimilation techniques is a result of both the availability of numerous empirical and physics-based models that can be used to describe the background state and the significant increase in the data available for assimilation. However, the data assimilation in space weather faces challenges that are not encountered in metrological data assimilation such as poorly understood generation mechanisms and being strongly forced. The session will focus on new research related to data assimilation: models, techniques, data sources and validation.</p>			

Session	Title	Convener names & e-mails	Number of slots
G02	Advances on high accuracy GNSS solution	Giorgiana De Franceschi, Fabio Dovis, Sreeja V. Veettil giorgiana.defranceschi@ingv.it, fabio.dovis@polito.it, reeja.Veettil@nottingham.ac.uk	12
<p>The availability/interoperability of different GNSS signals/systems (GPS, GLONASS, Beidou, Galileo) improves the ability to monitor and model the atmosphere, as well as other sources of interference, helping their detection and classification as well allowing the development of error mitigation strategy that can improve positioning accuracy. This session welcomes contributions on the recent advances in atmospheric (ionosphere and troposphere) modelling and forecast, real time precise orbits and clock, interference and atmospheric (ionosphere and troposphere) effects mitigation, new solutions to improve high accuracy positioning, particularly in near real time. Research contributions are also welcome on the IT approaches that better support the near real time operational needs of advanced positioning solutions as well the strategies that can be adopted to facilitate the penetration of the new solutions within the varied application markets. In addition this session will exploit the developments currently taking place in the scope of TREASURE (Training REsearch and Applications Network to Support the Ultimate Real-Time High Accuracy EGNSS Solution), a four year project (www.treasure-gnss.eu) funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie Actions.</p>			

Session	Title	Convener names & e-mails	Number of slots
G03	International Reference Ionosphere: Improvement, Validation and Usage	Dieter Bilitza, David Altadill, Michael Pezzopane dieter.bilitza-1@nasa.gov, david_altadill@obsebre.es, michael.pezzopane@ictp.it	12

The session is organized by the URSI/COSPAR International Reference Ionosphere (IRI) Working Group. IRI is an empirical model built with a large volume of space- and ground-based data, with modeling and improvement inputs from a working group of now more than 60 international experts, including members of the ground and space observations communities. Parameters represented by the IRI model include electron density, ion composition, electron temperature, ion temperature, ionospheric total electron content, vertical ion drift at equatorial latitudes, F1 layer and spread-F occurrence probabilities, and a kp-driven representation of auroral oval boundaries. This session aims at reviewing the status of the IRI project and invites slots and posters that report on improvements, validation, and usage of the IRI model. Contributions that introduce new modeling approaches or new data sources are particularly welcome. Of special interest are studies that use assimilative techniques to bring IRI closer to representing real-time conditions.

Session	Title	Convener names & e-mails	Number of slots
G04	Science with Modern Ionosondes and Associated Instrumentation and Models	Ivan Galkin, John Bosco Habarulema ivan_galkin@uml.edu, JHabarulema@sansa.org.za	20

Years after the inaugural F-region sounding at Slough observatory, ionosondes are back in the focus of attention. Modern HF ionosphere sounders have evolved into one of the very few providers of real-time sensor data for several important research and application domains. Space weather nowcast, sensing dynamics of the plasma irregularities, geolocation of HF emitters, ranging over the radio horizon are only a few scenarios in which ionosondes are uniquely instrumental to the task. The session will review state-of-the-art ionosonde related science and engineering advances including: digital HF technologies, intelligent systems for data interpretation, detection and evaluation of traveling ionospheric disturbances, information science for timely network data acquisition and dissemination, assimilative modeling of 3D plasma-distribution in the ionosphere, sensing the vertical and horizontal plasma transport, concepts and designs for topside ionospheric sounding, and other relevant topics. We also welcome contributions on cooperative ionosonde observations with other instrumentation for monitoring the ionospheric plasma.

Session	Title	Convener names & e-mails	Number of slots
G05	Advances in Irregularities and Scintillation Studies	Charles Rino, Kshitija Deshpande, Luca Spogli Charles.rino@bc.edu, crino@comcast.net, DEHPANK@erau.edu, luca.spogli@ingv.it	12
<p>This session emphasizes the latest developments in modeling and diagnostic measurements of ionospheric structure. Papers that analyze scintillation effects on satellite-based communication, navigation and Synthetic Aperture Radar (SAR) systems at low and high latitudes are encouraged. This session's scope also includes new developments in the theory of scintillation, in statistical studies of scintillations, and multi-technique observations of irregularities including in situ observations, relevant to possible prediction of scintillations.</p>			

Session	Title	Convener names & e-mails	Number of slots
G06	Innovations in Geospace Science Using Incoherent Scatter Radar Techniques	Philip Erickson, Roger Varney, Dave Hysell, Anders Tjulin pje@haystack.mit.edu, roger.varney@sri.com, david.hysell@cornell.edu, anders.tjulin@eiscat.se	12
<p>This session will focus on advances in technique and scientific results within the field of incoherent scatter radar (ISR) observations of the geospace environment. The ISR technique represents the most powerful ground-based probe of the ionospheric plasma, and allows extensive and precise studies of processes and features in the ionosphere, atmosphere, plasmasphere, and magnetosphere. The session provides a platform concentrating on results from coordinated, multi-radar experiments along with opportunities for discussion of upcoming plans using existing and future facilities. Topics of interest include long-period continuous runs for long term trend studies, World Day program operations and suggested changes, sensor fusion analysis with ISR data as a central feature, harmonization of ISR data outputs, and advanced derived scientific products. Contributions are also welcome regarding planning of next generation observations using future advanced ISR facilities and networks.</p>			

Session	Title	Convener names & e-mails	Number of slots
G07	Design and Application of HF and OTH Radar Systems	Manuel Cervera, Richard Todd Parris, Kate Zawdie manuel.cervera@dst.defence.gov.au, richar.parris.1@us.af.mil, kate.zawdie@nrl.navy.mil	12
<p>This session is focused on sky-wave High Frequency radar, including operational over-the-horizon radars and the SuperDARN ionospheric research radars and their support instruments. Research topics include :</p> <ul style="list-style-type: none"> • Antenna design, • HF waveforms (radar and sounders), • HF digital receivers, • Signal processing techniques • HF radio wave propagation in the ionosphere • Space weather monitoring with HF radar observations • HF sounding of the ionosphere at all latitudes • Ionospheric disturbances and their impacts on HF and OTH systems • Application of satellites to HF propagation studies • Coordinate registration and multi-mode management • Ionospheric Absorption (measurements and modeling) • Directional HF noise and interference (measurements and modeling) • HF mapping of the terrestrial surface 			

Session	Title	Convener names & e-mails	Number of slots
G08	Ionospheric Space Weather	Anthea Coster, Vincenzo Romano, Ashik Paul, Seebany Datta-Barua ajc@haystack.mit.edu, vincenzo.romano@ingv.it, ashik_paul@rediffmail.com, sdattaba@iit.edu	20
<p>This session will focus on the ionospheric and space weather events that may impact telecommunications and navigation systems. It will also cover all areas of ionospheric space weather research including modeling, data assimilation, and novel observations, especially those using radio wave techniques. Of special interest are papers describing the assessment and validation of space weather models, and the justification of the need for new ground and space-borne measurements. Studies and investigations addressing the modeling, forecasting and/or mitigation of ionospheric phenomena due to space weather events, such as large scale ionospheric gradients or medium- and small-scale irregularities, are also welcome.</p>			

Session	Title	Convener names & e-mails	Number of slots
G09	Radio Occultation and Reflectometry: ionosphere compensation, monitoring and modelling	Riccardo Notarpietro, Keith Groves, Riccardo.Notarpietro@eumetsat.int keith.groves@bc.edu	12
<p>Radio Occultation is a well-established and modern remote sensing technique which is applied to GNSS data normally acquired on board Low Earth Orbiting (LEO) satellites to provide accurate high resolution atmospheric profiles for meteorology, climate monitoring and space weather specification and forecasting. GNSS Reflectometry is even more modern and exploits signals which are reflected from the Earth's surface enabling remote sensing of oceans, winds, ice, soil moisture and other surface parameters.</p> <p>Both techniques involve extended trans-ionospheric radio wave propagation and, depending on the application, the associated ionospheric effects may constitute either the desired signal of interest or an unwanted component. In the former case, such effects can be exploited for monitoring and modelling ionospheric parameters, while the latter may require efforts for its compensation and filtering. Moreover, most of the LEO satellites carry on-board GNSS receivers and upward-directed antennas for precise orbit determination purposes. Dual frequencies signals measured on these systems can therefore be used to estimate topside total electron content, opening the doors for probing the plasmasphere and space weather monitoring.</p> <p>The aim of this session is to provide an overview of the most recent observations, model results and techniques developed to compensate for, monitor and model the ionosphere, plasmasphere and space weather using GNSS data collected for Radio Occultation or Reflectometry purposes.</p>			

Session	Title	Convener names & e-mails	Number of slots
G10	Radio Studies of Mid and Low Latitude Aeronomy	Marcio Muella, Claudio Cesaroni, Castro Olwendo. mmuella@univap.br, Claudio.cesaroni@ingv.it, castrajoseph@yahoo.com	12
<p>Contrary to the low latitude ionosphere, the mid latitude region has been considered as quiet region with an easily predictable behavior. However, recently, the dynamics of the mid latitude ionosphere have been deeply studied to observe and model the development of plasma instabilities (MSTIDs, Sporadic E-layer, etc). Moreover, the effect of MIT coupling and of the disturbances due to the interaction with the high latitude ionosphere (PPEF) and with the neutral atmosphere (DD), make the mid latitude ionosphere a complex system that deserves to be deeply investigated. This session welcome presentations dealing with the investigation of low and mid latitude instabilities using active and passive radio instruments during quiet and disturbed geomagnetic conditions. Studies on magnetic conjugate points by means of ground based and space born instrument network are encouraged. This includes E and F region coupling, computer simulation and modeling, climatological studies, ionospheric irregularities, neutral atmosphere processes and wave phenomena. The session also seeks presentations that highlight the importance of install and maintain regional continuous network of multi-sensors stations to improve the capabilities of modelling small and large scale plasma instabilities at low and mid latitudes.</p>			

Session	Title	Convener names & e-mails	Number of slots
G11	International Beacon Satellite Studies	Patricia Doherty, Andrzej Krankowski, Bruno Nava Patricia.Doherty@bc.edu, kand@uwm.edu.pl, bnava@ictp.it	12

This session welcomes papers relevant to the interests of the Beacon Satellite Studies Group of Commission G. The session will begin with a historical view of this studies group and its goals for the future. It will also recap the success of the most recent Beacon Satellite Symposium that was held in 2019. Additional papers are invited that will include all aspects of satellite signals observed on the ground and by receivers on-board satellites. This may include distributed arrays of multi-instruments used for ionospheric monitoring and scientific investigations that span all regions of the globe together will more focused regional investigations. Papers from the developing world are also encouraged.

Session	Title	Convener names & e-mails	Number of slots
G12	Long term ionosphere forecasting: state of the art and recent advances	Manuel Hernandez Pajares, Anna Belehaki, Luca Spogli, manuel.hernandez@upc.edu, abeleha@otenet.gr belehaki@noa.gr, luca.spogli@ingv.it	12

This session focuses on the current capability to forecast the complex ionosphere environment from hours up to days in advance on regional and global scales. Contributions are solicited on theoretical, empirical and semi-empirical models based on different techniques, including machine learning, data mining and soft computing. Focus should be also given on their validation results. Contributions addressed to the transition of models into real time services are also encouraged

Session	Title	Convener names & e-mails	Number of slots
G13	OPEN SESSION	Patricia Doherty, Giordiana De Franceschi patricia.doherty@bc.edu giordiana.defranceschi@ingv.it	12

This session welcomes all papers related to the Commission G terms of reference, particularly those not covered by the other G and G/H sessions.

Session	Title	Convener names & e-mails	Number of slots
G14	Predictability of the Earth's Ionosphere and Space Weather Dynamics	Massimo Materassi, Sandro Radicella massimo.materassi@fi.isc.cnr.it, rsandro@ictp.trieste.it	12
<p>The question addressed in this Special Session, very relevant for Space Weather modelling, is to which extent the near-Earth plasma is predictable, in the usual sense of physical modelling of dynamical systems. Ionospheric models attempt to predict ionospheric parameters variations, but whatever model one chooses, there will always be a mismatch between modelled quantities and real measurements. To determine and understand the limits of such mismatch in terms of its deterministic and stochastic components is essential to define the predictability of the ionospheric parameters. It has to be considered that the classical physics presumably governing the near-Earth plasmas is highly non-linear, so that, even in its deterministic context, one should expect the predictability limits of classical chaos. The Session welcomes papers dealing with experimental results of prediction methods and theoretical aspects of the problem.</p>			

Session	Title	Convener names & e-mails	Number of slots
G15	PRESTO: The new SCOSTEP space weather and space climate program	Ramon E. Lopez, Patricia Doherty relopez@uta.edu, patricia.doherty@bc.edu	12
<p>This session will provide information about the new SCOSTEP program PRESTO (<u>P</u>redictability of the variable <u>S</u>olar-<u>T</u>errestrial <u>C</u>oupling), which is a follow-on from the previous VarSITI (Variability of the Sun and Its Terrestrial Impact) program. An overview of PRESTO will be presented, along with other presentations that highlight PRESTO scientific questions of particular interest to Commission G. Presenters will also solicit information from the audience about their potential interest in participating in PRESTO activities.</p>			

Session	Title	Convener names & e-mails	Number of slots
G16	Space Weather Impacts on Global Navigation Satellite Systems (GNSS)	Sharafat Gadimova, Patricia Doherty, Bruno Nava Sharafat.Gadimova@un.org, Patricia.Doherty@bc.edu, BNava@ictp.it	12

The field of GNSS continues to develop as an instrument of international cooperation among the satellite operators of current and planned systems and their augmentations. The ability to locate one's position or the position of various objects accurately and reliably is a growing need in our modern economies, with wide-ranging implications for the environment, the management of natural resources, disaster warning and emergency response, to name a few. As society becomes increasingly dependent on space-based systems, it is vital to understand how space weather, caused by solar variability, could affect space systems and human space flight, electric power transmission, high-frequency radiocommunications, GNSS signals, as well as the well-being of passengers in high altitude aircraft. For GNSS users, space weather is a significant factor for differential GNSS users. As more and more nations of the world are becoming dependent on GNSS and their signals, it is increasingly important to inform and educate users about the threat of space weather on GNSS and its relevant applications. This session will include invited speakers together with contributed presentations from the international space weather and GNSS communities.