Commission G

2012-2014 Triennial Report

Chair: J. D. Mathews, USA

1 In Memoriam

The following friends and colleagues from the URSI Commission G Community passed away during the triennium:

- Klaus Bibl (USA)
- Santimay Basu (USA)
- Robert D. Hunsucker (USA)
- P. V. S. Rama Rao (INDIA)
- Shoichiro Fukao (JAPAN)

2 Chair's Comments

General

My considerable thanks to immediate past chair Mike Rietveld and to past chair Paul Cannon for their advice and help with Commission activities. I would also like to thank vice chair Iwona Stanislawska as well as the GA conveners and WG leaders for their help and suggestions.

Commission G remains a very active commission as reflected in the reports below and in the active participation in URSI meetings. At this date we have 281 abstracts, including joint sessions, for the Beijing General Assembly. This response leads all other commissions.

Funding

The URSI board provides to the Commission Chairs a sum of money at the start of each triennium, to be administered for the good of the community. During this triennium a sum of EUR 9000 was made available. Approximately EUR 7500 was spent in supporting various meetings, typically with 500 or 1000 Euros. The remaining EUR 1500 is being used to support General Assembly attendance for two scientists—one a young scientist and the other from Africa. More detailed meeting sponsorship is summarized in Section 5.

Website:

The Commission website is found via a link at URSI http://www.ursi.org/en/commission.asp?com=G. This link is http://www.ursi.org/files/G/Homepage.htm and also gives access to the Commission G mailing list.

Beijing GASS

Program: Including joint sessions, Commission G currently has ~280 papers at the GA. This is an excellent

showing matching that at the last two GAes and the largest number of any commission. The Commission G tutorial paper is to be given by Dr. Bodo Reinisch, on “Ionosphere and Plasmasphere Electron Density Profiles”.

Working Groups
Commission G working groups are the primary focus for active collaborative research. During the triennium 2008-2011, URSI Commission G has been active through a number of WGs - reports from these WGs are provided in Section 4.

3 Comments on the Radio Science Bulletin

The primary responsibility of the commission vice-chair is soliciting, and editing papers for the Radio Science Bulletin. As usual this task has proven difficult! PLEASE consider submitting a review-type paper to the RSB. These issues and the 50th anniversary of Arecibo Observatory led me to become RSB Associate Editor for Historical Papers. This has led to two papers, listed below, that were published in RSB. As always, my thanks go to Dr Ross Stone, RSB Editor, who has enabled these activities. I also thank Kristian Schlegel, RSB editor for Book Reviews and editor of the journal History of Geo- and Space Sciences (HGSS), who got all of this started with a HGSS history series on the large geophysical radars. I especially encourage the more senior members of Commission G to submit histories or memoirs from a radio science perspective to RSB or to HGSS.

The history-related papers were published in RSB No. 346, September 2013 and are:

“My Time with Arecibo Observatory: An Exotic Experimental, Scientific, and Personal Challenge” by Jürgen Röttger.

“Fifty Years of Radio Science at Arecibo Observatory: A Brief Overview” by J. D. Mathews.

4 Working Groups Reports

The following Working Groups reports have been prepared by the Working Group Chairs in cooperation with their co-chairs.

4.1 G1: Ionosonde Network Advisory Group

Chair: I.A. Galkin (USA), Vice-Chair: J.B. Habarulema (RSA), INAG Bulletin Editor: P. Wilkinson (Australia)

Over the 45 years of INAG service, its primary advisory function has been to ensure the best quality of the ionogram-derived data provided by the ionosonde network for research and applications. Originally, the INAG was principally responsible for implementation of the uniform rules for the *manual* ionogram interpretation across the growing international network of ionosonde observatories. The INAG Bulletin, with its first issue in October 1969, became the reference and the communication means for the worldwide community of ionosonde data analysts. The INAG membership quickly reached triple digit registration; its current roll remains fairly constant at about 300.

Over the years, the main focus of INAG recommendations has shifted from the consistent manual ionogram interpretation and standards for data exchange to the *automatic* ionogram scaling and quality of the autoscaled data. This transformation reflected the strengthening role of the ionosonde as a fully autonomous 24/7 instrument for prompt specification of the bottomside ionosphere, in which the ionogram autoscaling plays a critically important part. The early efforts to build a space weather forecast system driven by the autoscaled near-real-time (nRT) data were made in the 1980s; however, it was not until the advent of new concepts for ionosonde engineering, ionogram autoscaling, and assimilative nRT modeling in the 2005-2014 period that the original call became an operational reality.

Two key enabling technologies developed for the nRT ionospheric monitoring task in recent years were (1) the Global Ionosphere Radio Observatory (GIRO), http://giro.uml.edu/, first announced in December 2008 to comprise over 80 ionosondes under a uniform operating framework, and (2) the IRI Real-Time Assimilative Mapping (IRTAM) project, http://giro.uml.edu/RTAM, first announced in January 2013, that uses the nRT data feeds from GIRO stations to produce 15-minute global maps of the ionospheric peak density and height, as well as their deviations from the quiet-time climatology. With improved quality of ionosonde instrumentation, higher reliability of autoscaling, faster networking solutions, and greater robustness of the assimilation techniques to the real-life artifacts of

unattended operations, a new quality of ionospheric specification has emerged under the guidance of INAG. In March 2012, the GIRO data acquisition software was expanded to accept data from a variety of ionosonde observatories as long as they comply with the URSI "SAOXML" format convention for the ionogram-derived data. The AUTOSCALA software for ionogram scaling, developed at INGV, Italy, was enhanced to comply with the SAOXML standard, thus expanding the list of potential contributors of nRT data. The GIRO is thus getting ready to accept and unify the individual observations from the ionosondes of the world to assimilate them in IRTAM and produce both near-real-time maps and retrospective timelines of the ionospheric conditions. With a word of appreciation, INAG welcomes new nRT GIRO participants from USA, China, Italy, Poland, Guam, Australia, and Brazil, as well as acknowledges long-time participants throughout the world. The INAG will continue to be the communication point for contributing observatories.

The academic research using ionosonde data has always been in the center of INAG attention. Regretfully, with the passing of Prof. Henry Rishbeth in 2010, the INAG had lost one of its avid members of the ionosonde-related science advisory panel, responsible for the "Rishbeth List" of proposed investigations. Sustaining the List legacy and filling the void on the science panel will be important aspects of the INAG operation in the upcoming triennial period.

4.2 G2: Studies of the ionosphere using beacon satellites

Vice-Chairs: P. Doherty (USA); P.V.S. Rama Rao (India) and Honorary Chair: R. Leitinger(Austria)

The Beacon Satellite Group (BSG) is interdisciplinary, servicing science, research, applications, and engineering interests. The prime objective is to study the ionosphere using beacon satellite signals.

This workshop group continued to be active in its traditional fields, namely compilation, exchange and dissemination of information, communication and exchange of experience of various organizations of relevance (augmentation systems for GPS based satellite navigation, international and national advisory bodies, the United Nations Office for Outer Space Affairs (UNOOSA), the Institute of Navigation, the NASA International Space Weather Initiative (ISWI) and others), providing advice and collaboration on request. These activities were carried out by correspondence and through attendance at conference and other meetings.

The most important activities of the BSG are the Beacon Satellite Symposia. After a fore runner organized at the Max-Planck Institut fur Aeronomie at Lindau, Germany, in 1970 the series started in 1972 with the first Symposium at Graz, Austria and continued at time intervals between two and four years. To date, there have been 18 symposiums held in different countries including Russia, USA, Italy, India, Finland, China, Argentina, the United Kingdom, Hungary and Spain. All of these events were organized by the Chairs of the BSG together with a local chair and organizing committee consisting of URSI Commission G members.

The most recent symposium was held in 2013 in Bath, UK. This event was hosted by the University of Bath with Dr. Cathryn Mitchell of the University of Bath as the local organizing Chair. This symposia was a great success. It was attended by nearly 150 scientists from 28 countries including in alphabetical order: Belgium, Brazil, Canada, Croatia, China, Finland, France, Germany, Greece, India, Indonesia, Italy, Japan, the Netherlands, Nigeria, Norway, Peru, Poland, the Russian Federation, Slovenia, South Africa, Spain, Taiwan, Turkey, the United Kingdom and the United States of America. There were 8 major sessions centering on scintillations, TEC measurements and analysis, ionospheric modeling, multi-instrument techniques, space weather studies and initiatives with Beacon satellites, ionospheric effects on navigation and new techniques and advances in ionospheric measurements.

The presentations and poster session were of excellent quality and they included many papers by young scientist. To showcase the best papers of this symposia, a special issue of Radio Sceince is in progress with Patricia Doherty service as an associate editor of Radio Science for this issue.

The Beacon Satellite Group is grateful for the generous support from our sponsors including URSI, the University of Bath, Boston College, the Office of Naval Research, the Institute of Navigation, Spirent and Septentrio. These supporting funds made it possible to waive registration fees for students and to provide some travel support for a number of participants from developing countries.

At the close of this very successful Beacon Symposium, Patricia Doherty led a working group meeting where members discussed the way forward and voted to continue our studies group with URSI Commission G approval. The International Centre for Theoretical Physics in Trieste, Italy has already agreed to host the next symposium in

2016. The working group also endorsed its present leadership. Finally, since both the traditional and new activities are well within the terms of reference of this working group, the working group did not suggest a change of these terms.

To summarize, the Beacon Satellite Group continues to be active and to have relevance to the interests of URSI Commission G. As such, we request that URSI Commission G approves that the BSG group continues and supports our plan to host the 19th Beacon Satellite Symposium in Trieste, Italy in 2016.

4.3 G3: Incoherent scatter Working Group

Chair: M. McCready (USA), Vice-Chair: I. McCrea (UK)

4.3.1 Introduction

The global network of incoherent scatter radars (ISR) provides observations of fundamental properties of the atmosphere, ionosphere, and magnetosphere. Coordinating World Day (WD) experiments conducted by the ISRs and associated instrumentation is the major activity of the URSI Incoherent Scatter Working Group (ISWG). The ISWG publishes schedules of the World Days as part of the International Geophysical Calendar. Links to the current and previous schedules may be found at http://www.isr.sri.com/wd2014 and ftp://ftp.ngdc.noaa.gov/STP/publications/igc_calendars.

This report will include general information about World Days, the procedure to request World Days, and descriptions of the experiments carried out since the last report and planned for the remainder of 2014.

World Days provide for coordinated operations of two or more of the incoherent scatter radars (ISRs) for common scientific objectives. The ISRs that participate in this program are listed here from geographic south to north.

Jicamarca, Peru
Arecibo, Puerto Rico
MU Radar, Japan
Millstone Hill, USA
Kharkov, Ukraine
Irkutsk, Russia
Poker Flat (PFISR), USA
Sondrestrom, Greenland
EISCAT Mainland, Scandinavia
Resolute-North (RISR-N), Canada
Svalbard (ESR), Norway

The use of the ISRs is open to all qualified scientists, and the data are freely disseminated to a broad community of users for research and in the development and validation of models and instrumentation via prompt submission to the CEDAR, Madrigal, and/or other databases as appropriate. In view of the ongoing activities in this field, we ask URSI to keep this working group active.

4.3.2 Process for Requesting World Day experiments

Radar observing time is allocated (1) to individuals or groups through either formal or informal requests to the institutions responsible for operating the facilities, and (2) for World Day observations coordinated through a plan developed annually by the URSI Incoherent Scatter Working Group (ISWG). The high demand for ISR observations, in particular for extended and multi-radar operations, requires certain procedures to help ensure that the highest priority scientific research is addressed by the coordinated World Day schedule within the limits imposed by the costs and technical restrictions of ISR operations.

When proposals are received, the ISWG Chair initiates an interactive review process, enabling experimenters to provide additional input as needed. Every effort is made to accommodate all requests. The ISWG meets during the summer of each year to review all proposals with the aid of external reviewers solicited by the Chair as appropriate. The group then determines how the global network of ISRs can best satisfy the approved observational requests and ensures that the experimental configurations, numbers of radars involved, time distribution and total time allocated are appropriate for the specified science goals. This process normally takes place at the annual CEDAR meeting.

4.3.3 Observations

A description of the coordinated incoherent-scatter radar runs that were performed during the last three years are given here, with a brief description of their goals.

The **2011** World Day observations totaled **515** hours and are listed here.

Synoptic, three-day runs in February and March to measure basic ionospheric parameters and to capture the end of the extended solar minimum.
ISRs needed: All.
Contacts: J. Sojka, I. Häggström.

Meteors (Global Measurements of the Meteor Input Function), two-day runs in March and September to study the sporadic meteor distribution throughout the hemisphere, and to study sporadic *E*-layer fluctuations not influenced by strong meteor flux variations.
ISRs needed: All.
Contacts: A. Pellinen-Wannberg, C. Szasz, J. Kero, D. Meisel, I. Häggström.

Planetary Waves, a 10-day run in August to investigate planetary-scale waves in the ionosphere. This included measurements of the neutral wind throughout the mesosphere-lower thermosphere region, the response of the *F* region to atmospheric waves, and examining the mechanisms responsible for modulating the global-scale structure of the ionosphere at low and middle latitudes.
ISRs needed: All.
Contacts: S. England, Q. Zhou, G. Liu.

The **2012** World Day observations totaled **484** hours and are listed here.

StratWarm (Stratospheric Warming), a 10-day run during a month-long alert window spanning January and February, to measure neutral winds and electron and ion temperatures in the lower thermosphere before and during sudden stratospheric warming; to compare variations in temperature and winds to average variations observed by ISRs during the winter; to compare variations in temperatures and winds to mesospheric response as given by MF and meteor radars and lidars; to extend studies of stratospheric warming effects to the lower thermosphere and investigate possible coupling with the ionosphere; and to examine the mechanisms responsible for variations in lower thermospheric dynamics and temperatures.
ISRs needed: All, although the response at Arecibo and Jicamarca may be weak.
Contacts: L. Goncharenko, P. Hoffman, S. Azeem, W. Ward.

Synoptic, three-day runs in June, September and December to measure basic ionospheric parameters and to capture the beginning of the new solar cycle.
ISRs needed: All.
Contacts: J. Sojka, M. McCready.

The **2013** World Day observations totaled **508** hours and are listed here.

StratWarm (Stratospheric Warming), a 10-day run during a one-month alert window spanning January and February, to measure neutral winds and electron and ion temperatures in the lower thermosphere before and during sudden stratospheric warming; to compare variations in temperature and winds to average variations observed by ISRs during the winter; to compare variations in temperatures and winds to mesospheric response as given by MF and meteor radars and lidars; to extend studies of stratospheric warming effects to the lower thermosphere and investigate possible coupling with the ionosphere; and to examine the mechanisms responsible for variations in lower thermospheric dynamics and temperatures.
ISRs needed: All, although the response at Arecibo and Jicamarca may be weak.
Contacts: L. Goncharenko, J. Chau, H. Liu, P. Hoffman.

Synoptic, three-day runs in April and November, to measure basic ionospheric parameters and to capture the beginning of the new solar cycle.
ISRs needed: All.

Contacts: J. Sojka, M. McCready.

Latitudinal variation of the vertical electric field in the *E* region, a four-day run in July to measure the vertical and geomagnetic zonal ion drifts in the *E* and *F* regions in order to study the height variation of the *E*-region electric field and its relationship to the *F*-region electric field.
ISRs needed: All.
Contact: Q. Zhou

The **2014** World Day observations are planned to total **525** hours and are listed here.

StratWarm (Stratospheric Warming), a 10-day run during a one-month alert window spanning January to February, to measure neutral winds and electron and ion temperatures in the lower thermosphere before and during sudden stratospheric warming; to compare variations in temperature and winds to average variations observed by ISRs during the winter; to compare variations in temperatures and winds to mesospheric response as given by MF and meteor radars and lidars; to extend studies of stratospheric warming effects to the lower thermosphere and investigate possible coupling with the ionosphere; and to examine the mechanisms responsible for variations in lower thermospheric dynamics and temperatures.
ISRs needed: All, although the response at Arecibo and Jicamarca may be weak.
Contacts: L. Goncharenko, J. Chau, H. Liu, P. Hoffman.

Hemispheric and Latitudinal Storm Time Behavior, one four-day run during either alert period near both equinoxes, to measure the latitudinal variations and the east-west hemispheric differences during solar storms. This run was performed in early April.
ISR needed: All, and coordinated with the Chinese meridian chain of instruments.
Contact: S. Zhang, G. Yang, Z. Huang, J. Foster.

Northern Deep Winter Observations, this seven-day run will be performed in December near new moon to exploit the high-latitude dark skies near winter solstice, to study polar cap aurora; sun-aligned arcs; global trans-polar coupling; polar cap patch evolution, decay, structure and transport; reversed flow events; flow channel propagation; the formation, evolution and decay of SAPS (sub-auroral polarization streams) and SED (storm-enhanced densities) by measuring the penetration electric fields at low latitudes; and the formation of SAPS electric fields and SED at mid-latitudes.
ISRs needed: All.
Contact: K. Oksavik, Y. Dåbakk, H. Dahlgren, J. Semeter, A. Wood, H. Carlson

4.4 GF: Middle Atmosphere

Acting Co-Chairs for Commission G: Jorge L. Chau, Erhan Kudeki
Co-Chair for Commission F: none

(The following is reported by co-chair for Commission G, Juergen Röttger, who has now stepped down.)
The MST-13 Workshop (13th International Workshop on Technical and Scientific Aspects of MST Radar) was held March 2012 in Kühlungsborn (Germany). It was noted that the first International Workshop on this subject had been organized at the MPAe in Lindau-Katlenburg. That workshop should be called “MST-0” and was held in August 1978. Sponsors were URSI and SCOSTEP.

The 7th International School on Atmosphere-Ionosphere Radar ISAR-NCU-2012, took place from 12-17 November 2012 at the National Central University in Jhongli (previously Chung-Li) Taiwan. The 8th Radar School ISAR-NCU-2013 took place from 11-20 November 2013 also at the NCU. In both schools, Dr. Juergen Röttger acted as International Director and as NCU Chair-Professor. These Schools are designed for attendees from South-East-Asia and is financed completely by the NCU and the NSC (National Science Council) of Taiwan. Ideally it is sponsored by SCOSTEP and URSI.

4.5 GH: Active experiments in Space plasmas

Co-Chair for Commission G: Todd R. Pedersen
Co-Chair for Commission H: M. Kosch

During the period from 2012 to 2014 there were a number of developments in active experiments in space plasmas. In particular, several rocket experiments were carried out at Kwajalein Atoll and new results continued to come in from the HAARP facility.

The Equatorial Vortex Experiment (EVEX) used tri-methyl aluminum (TMA) and lithium clouds released from sounding rockets as tracers in the equatorial dusk sector to examine neutral winds and plasma convection forming a vortex-like structure in the pre-reversal enhancement in the ionosphere. During this same campaign, the Metal Oxide Space Clouds (MOSC) experiment created artificial plasmas in the bottomside equatorial ionosphere in an attempt to prevent the natural Rayleigh-Taylor instability from occurring and generating plasma turbulence which adversely impacts radio-based communication and navigation systems. A variety of RF propagation measurements were also performed during the experiments.

The new 2-frequency heater at the Arecibo Observatory in Puerto Rico, which utilizes the large dish reflector to create a powerful vertically-oriented beam, has been mostly installed in the dish and is expected to be available for experiments by the end of 2014. Continuing research at the High-Frequency Active Auroral Research Program (HAARP) facility has resulted in creation of artificial layers that persist for long periods and optical measurements have allowed the energy spectrum of accelerated electrons to be estimated. However, based on media reports, the future of the HAARP facility is uncertain as the Air Force has indicated that it no longer intends to be the operator of the facility.

In the period 2012-2014, the EISCAT facility exploited the fact that it now has 4 radars co-located, i.e. 930, 224, 56 and 7.9 MHz. All radars were used during Polar Mesospheric Summer Echo (PMSE) modulation experiments, the shorter and longer wavelengths addressing electron diffusion and dust charging physics, respectively. By combining the pump-modulated PMSE backscatter at different wavelengths, it is possible to determine the dust density, dust radius and charge state uniquely. First results for pump-modulated PMSE at HF wavelengths have been published. It has also been found that pump-modulated PMSE may be observed at very high aspect angles (~70 degrees), not predicted by theory.

EISCAT experiments have been successful in producing ion up-flow along the magnetic field line by increasing the upward plasma pressure gradient. Applying these observations to the ion-momentum equation allows the thermospheric ion-neutral collision frequency and therefore neutral density to be estimated at ~350 km altitude, or the field-aligned anomalous electric field and anomalous resistivity to be estimated above 400 km altitude. Both are consistent with expectations.

Large apparent pump-induced plasma density enhancements have been observed in the radar data covering large altitude ranges in the F-region. However, analysis of the rise and fall times shows that the apparent density enhancements cannot be real. The nature of the plasma instability affecting the incoherent scatter spectrum over >100 km altitude remains unknown at this time.

A comparison between O-mode resonant and X-mode non-resonant plasma heating has been made. Resonant O-mode plasma pumping is clearly much more effective and efficient, and also produces supra-thermal electrons. Power stepping of the pump has allowed experimental testing of the threshold of various plasma instabilities, i.e. upper-hybrid resonance, parametric decay instability and thermal parametric instability. In all cases the theoretical prediction has proven to be accurate. These quantitative experiments require accurate knowledge of the HF pump loss in the D-region due to absorption and the realisation that the pump itself changes the D-region absorption.

4.6 URSI/COSPAR on International Reference Ionosphere (IRI)

Chair: Dr Lee-Anne McKinnell (South Africa), Vice Chair for COSPAR: Dr Shigeto Watanabe (Japan), Vice Chair for URSI: Dr Vladimir Truhlik (Czech Republic), Secretary: Dr Dieter Bilitza (USA)

Key Events

The newest version of the IRI model was released in 2012 with a number of improvements and additions: (1) A new model was introduced for the bottomside electron density based on a large volume of ionosonde data resulting in an improvement of up to 40% (Altadill et al., Ebro, Spain) ; (2) For the first time auroral boundaries are included based on TIMED/GUVI data (Y. Zhang et al., APL JHU, USA); (3) Data from another TIMED instrument, SABER, were used to develop a model for the storm effects on the auroral E-region (Mertens et al., NASA LRC, USA); (4) The electron temperature model was improved with the inclusion of solar cycle effects based on satellite in situ measurements (Truhlik et al., IAP, Czech Republic); (5) A new model for the ion composition in the bottomside based on the well-established photochemistry for this region as applied in the FLIP model (Richards et al., GMU, USA); (6) In addition IRI-2012 includes the newest version of the standard atmosphere model, NRLMSISE00, and the Correct Geomagnetic (CGM) coordinate system.

The other keystone event during this time period was the unanimous vote by the member countries of the International Standardization Organization (ISO) to make IRI the official ISO standard for the ionosphere (April 15, 2014).

Meetings

The 2011 IRI Workshop was held at the South African Space Agency's Space Science Directorate in Hermanus, South Africa focusing on the performance and improvements of the IRI model over the African sector. In 2012 a session during the COSPAR General Assembly in Mysore, India was organized by the IRI team on the topic of the Global and Regional Representation of Ionospheric Peak parameters for Space Weather Applications. The 2013 IRI Workshop was held at the University of Warmia and Mazury in Olzstyn, Poland from June 24 to 28 on the topic of GNSS Inputs for IRI. The meeting was well organized by Andrzej Krankowski and his team and was attended by over 80 participants with a good percentage of students and young scientists. Several new models for the F-peak height hmF2 were presented based on ionosonde and on COSMIC radio occultation data including also a formulation that describes the effect of ionospheric storms on hmF2. These models will be included as new options in a future version of IRI. Reports from these meetings are available online at http://irimodel.org/docs/iri_workshops.html . Plans and preparations are under way for the 2015 IRI Workshop in Bangkok, Thailand that is being proposed as a COSPAR Capacity Building Workshop.

The Real-Time IRI Task Force meetings continued in early 2014 with a 1-day meeting at the University of Massachusetts Lowell on May 19. Good progress has been made by the UML team with the IRTAM system that assimilates foF2 and hmF2 data from the GIRO digisonde network (real time data from over 40 stations) into the IRI-CCIR models for the peak characteristics, see http://giro.uml.edu/IRTAM/.

Publications

A selection of refereed papers from the 2009 IRI Workshop held in Kagoshima, Japan were published in two issues of the journal Earth, Planets and Space: Volume 63, No.4, 2011 and Volume 64, No. 6, 2012. Papers from the IRI session during the 2010 COSPAR meeting in Bremen, Germany were published in Advances in Space Research (Volume 51, Number 4, February 2013) on the topic of the Representation of the Auroral and Polar Ionosphere in the International Reference Ionosphere. More recently a special issue of Advances in Space Research presented the papers from the 2011 Workshop held in Hermanus, South Africa (Volume 51, Issue 10, November 2013). The issue includes 15 articles that give a good overview of IRI improvement activities with special focus on the African sector.

New members

John Bosco Habarulema (Uganda) was proposed and accepted as a new member for the IRI Working Group. He has worked extensively on TEC and IRI related research and was one of the organizers of the 2011 IRI Workshop in Hermanus and is co-editor of the ASR issue with papers from the Hermanus meeting. His main field of interest is in improving the predictability of TEC using neural networks.

Irina Zkharenkova (Russia) was elected to become a member of the IRI team. Irina is a researcher from the West Department of IZMIRAN in Kaliningrad, Russia, currently working at the Geodynamics Research Laboratory of the University of Warmia and Mazury in Olsztyn, Poland. Irina has made important contributions to determining the plasmaspheric electron content (PEC) from GNSS measurements and to studying the variability of the PEC. As a member of the Local Organizing Committee for the 2013 IRI Workshop she helped to make this a very successful and productive meeting.

4.7 Report of VERSIM (VLF/ELF Remote Sensing of Ionosphere and Magnetosphere) 2011-2014
URSI/IAGA Joint Working Group
URSI Co-Chair for Commission H and G: J. Lichtenberger (Hungary)
IAGA Co-Chair: 2011-2014 C. Rodger (New Zealand), 2014- J. Bortnik (USA)

The working group on VLF/ELF Remote Sensing of the Ionosphere and Magnetosphere (VERSIM) is an international group of scientists interested in studying the behaviour of the magnetosphere and ionosphere by means of ELF (300 Hz - 3 kHz) and VLF (3-30 kHz) radio waves, both naturally and artificially generated. The group

was set up in 1975 by IAGA (International Association of Geomagnetism and Aeronomy) and URSI (International Union of Radio Science).

The activity of our working group can summarized as:

1. **Workshops:** the community organizes biannual topical workshops. During the period of 2011-2014, we have organized two workshops. The 5th VERSIM Workshop was held between 3-6 September 2012 in Sao Paulo, Brazil, where more than 50 participants attended from five continents, assisted by a special session on Radio Science, Natural Disasters and Space Weather on the last day of the workshop. The workshop was organized by the Universidade Presbiteriana Mackenzie, more details can be found on the workshop website (http://http://www.craam.mackenzie.br/versim2/index.html).
2. The 6th VERSIM workshop was held between 20-23 January 2014 in Dunedin, New Zealand, organized by the University of Otago. The workshop attracted 35 participants from 14 countries, with 58 abstracts, see http://www.physics.otago.ac.nz/versim/VERSIM_workshop_Dunedin_2014.html for more details. Reports on the workshops have been/will be published in the URSI Radio Science Bulletin.
3. **Business Meetings:** the community regularly holds business meetings on IAGA/URSI General/Scientific Assemblies and VERSIM Workshops. Thus we had a business meeting at the XXXth URSI General Assembly Istanbul, Turkey, and at the 12th IAGA Scientific Assembly in Mérida, Mexico, as well as at both recent VERSIM Workshops.
4. **Newsletters:** The VERSIM community has a regular, yearly newsletter, edited by the IAGA co-chair. It is based on the submitted report of VERSIM research groups. The newsletters can be downloaded from http://www.physics.otago.ac.nz/versim/#newsletter

4.8 Other Working Groups

Other Working Groups in which Commission G is active are reported on the lead Commission reports. These include:

- Inter-commission Working Group on Solar Power Satellites
  Co-Chair for Commission G: K. Schlegel (Germany)
- EGH: Seismo Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling) Co-Chair for Commission G: S. Pulinets (Russia)
- FG: Atmospheric Remote Sensing using Satellite Navigation Systems
  Co-Chairs for Commission G: Dr. Cathryn Mitchell (G)

5. Sponsored meetings

5.1 Mode A sponsorship

Commission G offered Mode A (no additional funds) support to the following meetings:

- ICEAA-APWC-EMS (9-13 Sept 2013) Torino, Italy
- RADIO 2012 (24-27 September 2013) Mauritius
- HF 13 (LW 13) (12-14 August 2013)Faro Island, Baltic Sea
- SPIN 2014 (20-21 Feb 2014) Noida-Delhi India
- RADIO 2014 (7-10 April 2014) Mauritius
- ICEAA-IEEE APWC (Aruba 3-9 August 2014)
- RADAR 2014 (13-17 October 2014) Lille, France

5.2 Mode B sponsorship

Meetings sponsored under Mode B received (limited) funding from Commission G, and other Commissions in some cases.

- IRI Workshop (10-14 Oct 2011), Hermanus, South Africa
- ISEA-13 (12-16 March 2012), Paracas, Peru
- 5 th VERSIM Workshop (3-6 September 2012) Sao Paulo, Brazil
- International Reference Ionosphere (IRI) Workshop 2013 (24-28 June 2013) Olsztyn, Poland
- ICONSPACE2013 (1-3 July 2013) Malacca, Malaysia
- Beacon Satellite Symposium (8-12 July 2013) Bath UK
- AP-RASC 2013 (3-7 Sept 2013) Taipei, Taiwan
- Regional URSI meeting (2-5 Jan 2014) Pune, India
- 6th VERSIM Workshop (20-23 Jan 2014) Dunedin, New Zealand
- 40th COSPAR Scientific Assembly (2-10 August 2014) Moscow

6. Sponsored Travel for URSI Participation

Commission G additionally is supporting travel to the Beijing GA of an Early Career Representative (ECR) candidate and of a participant from Africa.