IAGA/ URSI Joint Working Group on

VLF/ELF Remote Sensing of Ionospheres and Magnetospheres Newsletter

Editor: Craig J. Rodger No. 25, December 2010

Dear Colleagues,

I have pleasant and stimulating memories of meeting with many of you over the last year, and of course reading the scientific papers produced by many of our community during 2010. I enjoyed chatting with so many of our community during the 2010 VERSIM workshop in Prague, Czech Republic, but also took the chance to catch up with colleagues in Germany, South Africa, Canada, Switzerland and Antarctica during the year. I hope to meet many of you all again in 2011, given that both our parents bodies, URSI and IAGA will be running large meetings next year. As always, I would like to start by thanking all of the researchers who took the time to prepare and send me material for the newsletter. The newsletter contains 17 reports from 16 different countries, spanning both hemispheres and all longitudes. I can see from those reports that there has been a lot of activity! We also have an update on the IAGA resolution on open access software from Owen Story.

The primary VERSIM gathering from 2010 was the VERSIM Workshop 2010 which took place in September 2010 in Prague (Czech Republic). The workshop attracted 40 participants from 15 countries, ranging from New Zealand to Russia (ordered by latitude), and included 45 presentations. A report on the 4th workshop has been prepared, and the minutes of the VERSIM business meeting held during the workshop are also available. I would once again like to thank our Czech colleagues for hosting us in Prague, and giving us the chance to meet one another in their country. Congratulations again to Eva Macúšová (Czech Republic) who was nominated for the IAGA Young Researcher Award!

2011 is looking like a very busy year, in terms of scientific meetings. One of our parent organisations, IAGA, is holding its biennial large conference in June/July 2011, and for the first time in many years is coming to the Southern Hemisphere. This IUGG conference will be held in Melbourne, which is probably my favourite Australian city. It will be a matter of pride to our Australian colleagues that this very large meeting runs smoothly. Back in 2007 I was asked by the VERSIM community to take multiple concerns and complaints surrounding the 2007 Perugia IUGG meeting to the highest levels of IAGA. Although I am not involved in the organisation of the Melbourne IUGG, I do have confidence that it will be vastly more professional than the 2007 IUGG, while maintaining some aspects (like the quality of the local wine).

In 2011 our other parent body, URSI, will also hold its primary meeting, the triennial General Assembly. Thus in mid-August 2011 we will gather in Istanbul, Turkey, and once again, several VERSIM-supported scientific sessions have been organised. I would like to remind the VERSIM community of the URSI Young Scientists programme, which has supported so many of us to attend URSI General Assemblies early in our careers. You, your colleagues or students might be eligible, so please draw the deadlines to their attention.

In addition, there are several additional meetings which are likely to be relevant to VERSIM scientists over many different topics. I have listed some of the most relevant meetings at the end of these comments. The Prague meeting was a particularly good opportunity to meet and discuss with members of our community, and I very much enjoyed the discussions with you during the various breaks and social occasions. I look forward to seeing people at the many conferences of 2011. I known I will not be at all of them, but I will do my best. I hope the New Year finds you prosperous and happy, and of course scientifically productive too! Best wishes,

Craig J. Rodger
IAGA co-chair VERSIM working group

Upcoming meetings

- 3rd HEPPA Workshop (High Altitude Particle Precipitation into the Atmosphere), 9-11th May 2011 in Granada, Spain.
- IUGG 2011, 28 June, 7 July 2011 in Melbourne, Australia.
- AGU Chapman Dynamics of the Earth's Radiation Belts & Inner Magnetosphere, 17-22 July 2011, St. John's, Canada.
- IUGG 2011, 28 June, 7 July 2011 in Melbourne, Australia.
- AOGS 2011, 8 to 12 August 2011 in Taipei, Taiwan.
- ICAE 2011, 8-12 August 2011 in Rio de Janeiro, Brazil.
- 30th General Assembly of URSI, 13-20 August 2011 in Istanbul, Turkey.
- 2011 Fall Meeting, 5-9 Dec. 2011 in San Francisco, USA.

Report on IAGA resolution on open-access scientific software Updated

At the business meeting[1] held on 25 August 2009 during the IAGA Scientific Assembly, the members present put forward an IAGA resolution to encourage the development of open-access scientific software, based on a position paper[2] by L.R.O. Storey. Their resolution[3] was submitted to the drafting committee for IAGA Division II, where, after further modification, it was put first in the list of seven resolutions for 2009. We have copied the text below. However, the scope of this version is narrower than was proposed by VERSIM: our proposals are endorsed only insofar as they concern the needs for software in our discipline, and their implementation is entrusted to us, with support from IAGA in the form of space at the IAGA website. This and the other resolutions will not be adopted definitively until the IUGG Assembly in Melbourne, in June–July 2011.

To prepare for confirmation of the resolution (expected at next years IUGG meeting), L.R.O. Storey has been working on a website which would serve repository for VERSIM-related software. Janos Lichtenberger showed the VERSIM business meeting[4] at the Prague VERSIM workshop a draft of the front page of the website, and noted that it was to be hosted by his institution in Hungary (and linked to from the IAGA main website). There are already plans for Japanese-developed open source ray tracing software to be available through the website.

Since the Prague VERSIM workshop meeting, the complete software for the website has been delivered and is being tested. Also the documentation for the site is being written: Author Guide, User Guide, and an example program. It is hoped that this site can be put into service early next year. Meanwhile, the open-source ray-tracing software developed in Japan by Prof. Iwane Kimura and his collaborators is already available on line at http://waves.is.t.kanazawa-u.ac.jp/

Division II Resolution on software

IAGA, noting that

- the Association has played a prominent role in data management through its leadership of the Electronic Geophysical Year, and that IUGG has formed a new organization to support data management,
- nevertheless some other aspects of scientific research in the IAGA disciplines are still hindered by the scarcity of software in the public domain,

recognizing that

- despite increasing pressures on scientific budgets, there is a need to provide support for research in developing countries and encourage new collaborations,
- it is central to IAGA's charter to promote international science by encouraging world-wide open access to the means for pursuing research,
- the necessary means include scientific software, in particular for modelling and for simulating physical processes (where excellent examples exist already in some areas of IAGA science), and for theoretical research,

resolves to

- through the URSI/IAGA Joint Working Group on VLF/ELF Remote Sensing of the Ionosphere and Magnetosphere (VERSIM), take an initiative similar to those already taken in data management, aimed at making software for data analysis, modeling, simulation and theoretical research more freely available to the scientific community,
- investigate
  - the need for large-scale open-access software,
  - how its development could be funded,
- for smaller items of software, create a public space on the IAGA website, where researchers can freely upload their code and download the code of their colleagues, and that this section of the website be also used as a portal by which larger items of software can be listed and described, and links to them provided.

[1] www.physics.otago.ac.nz/versim/VERSIM_business_meeting_IAGA_GA_2009.pdf
[2] Flashversim e-mailing, 11 August 2009.
[3] www.physics.otago.ac.nz/versim/IAGA_DivisionII_Resolution_software_Sopron_2009.pdf
[4] http://www.physics.otago.ac.nz/versim/VERSIM_business_meeting_VERSIM10.pdf

Reports from VERSIM research groups 2010

This based on information received by the IAGA co-chairman, Craig Rodger, by email from the VERSIM membership. Some reports have been slightly edited so the newsletter has consistent formatting. Hopefully this has not introduced any significant typos.

Belgium - Belgian Institute for Space Aeronomy (IASB-BIRA), Belgium, report by Fabien Darrouzet.

We have started a project to detect whistlers with VLF measurements. A VLF antenna has been installed in October 2010 in Humain, Belgium (Lat~50.11ºN, Long~5.15ºE), in order to detect whistlers and determine electron densities along propagation paths. The VLF antenna is made of two perpendicular magnetic loops, oriented N-S and E-W and with an area of approximately 50 m^2 each.

This antenna will be part of AWDAnet, the Automatic Whistler Detector and Analyzer system's network. This network covers low, mid and high magnetic latitudes including conjugate locations. It has been initiated by J. Lichtenberger (Hungary). In Europe, 6 antennas are currently active and 5 are in development (including the one in Humain). Worldwide, 9 antennas are in operation and 9 are planned/in construction.

Fiji - The University of the South Pacific, Suva, Fiji, report from Dr. Sushil Kumar.

We continue participating in the *World Wide Lightning Location Network (WWLLN).* Using the WWLLN set-up we have been running the SoftPAL data acquisition system. The early VLF perturbations on signals NWC, NPM, VTX, and NLK transmitter signals received at Suva were analysed. The long recovery events (5-10 min) with slow onset have been detected. The WWLLN data were analysed to determine the VLF perturbations events associated with narrow and wide angle scatterings. Further analysis of data is in progress.

We also record the ELF-VLF data using the Atmospheric Weather Electromagnetic System for Observation Modeling and Education (AWESOME). New data recording software has been installed and trial runs were made. The amplitude of NWC and NPM signals have been utilized to find the monthly and seasonal variation of sunset and sun-rise minima and waveguide mode parameters. The initial results obtained from the analysis of AWESOME were presented in the VLF Sharjah-Stanford Workshop, Sharjah, 22-24 February, 2010.

A GSV4004B receiver specifically designed for TEC and ionospheric scintillation measurements was installed this year in July. This can locate up to 11 GPS signals at two frequencies of L_1 and L_2 signals (1575.42 MHz and 1227.6 MHz) and measures phase and amplitude at 50-Hz rate and code/carrier divergence at 1-Hz rate for each satellite being tracked. It computes TEC from combined frequencies pseudorange and carrier phase measurements. This system along with the SoftPAL will provide an opportunity to study both lower (D-region) and upper (F-region) ionosphere particularly under the strong *space weather* (geomagnetic storm and solar flare) conditions.

Finland - University of Oulu/Sodankylä Geophysical Observatory, Sodankylä report by Jyrki Manninen.

ELF-VLF research in Finland has been returned back to previous level, because Jyrki Manninen has returned back to SGO after being 2.5 years working for Sodankylä municipality. At that time Prof. Tauno Turunen has improved the analysis package for SGO ELF-VLF data.

All recent campaigns have been reanalysed using updated programs. Now one-minute plots (0-5 kHz) have been produced for quick-look purposes. They will be publicly available from early 2011. That will be announced via VERSIM mailing list.

A huge amount of interesting natural events have been found. Some hints about other type of events at higher frequencies (20-40 kHz) have also been noticed.

Detailed instruction manual for analysis package is under preparation. One ELF-VLF campaign has been planned for March 2011.

France - Laboratoire de Physique et Chimie de l'Environnement et de l'Espace, Orleans report by Michel Parrot and Jean-Louis Pincon.

After more than 6 years in orbit, the micro-satellite DEMETER was shut down on December 9, 2010. Up to now more than 120 scientific papers have been published on various topics (seismic activity, man-made activity and active experiments, thunderstorm activity, and ionosphere in general) and it is not finished. The list is available on the web site of the mission (item, science, publications). The DEMETER data will continue to be open to guest investigators until the end of 2011 (http://demeter.cnrs-orleans.fr). After the data will be available on the CDPP (http://cdpp.cesr.fr) but with less facilities.

However, this information was immediately followed up by more positive news. On Thursday December 9th, the CNES board directors officially announced the decision to proceed with phases C/D/E1 of TARANIS. The scientific objective of the TARANIS satellite is the study of impulsive transfers of energy between the Earth's atmosphere and the space environment (TLEs and TGFs). The launch is scheduled for beginning of 2015.

The physics of thunderstorms and atmospheric coupling is a research domain involving a large, multidisciplinary, and very active scientific community. By 2015, the combination of TARANIS with ASIM and GLIMS (space based measurements), COBRAT (balloon based measurements), and the existing ground based networks will provide this community with the necessary data to answer the remaining issues about TLEs and TGFs.

Germany - University of Applied Sciences, Osnabrueck report by Ernst D. Schmitter.

Continuing last years activity 2 VLF receivers 35 km apart at 52ºN 8ºE are constantly monitoring VLF/LF transmitters: NRK (37.5 kHz), Iceland, NSY (45.9 kHz) Sicily, JXN (16.4 kHz), Norway. Also the local E-W magnetic field component is monitored. Daily uploads to: www.electricterra.com/Ernst/

The propagation path NRK-52ºN 8ºE proved as a reliable remote sensor for precipitation activity within the auroral oval domain. During the participation at the VERSIM 2010

workshop in Prague a talk about this topic has been given and a publication appeared (see below).

Current and ongoing work is done by analyzing synchronously monitored data from the propagation paths of the NRK (64ºN 23ºW) transmitter to 52ºN 8ºE, Sodankylä (67ºN 26ºE) and Ny Alesund (79ºN 12ºE) and comparing them to propagation calculations using model electron/ion density profiles. The 3 paths have very nearly equally great circle lengths (2200 km) and cover 90 degrees of bearing range from NE to SE.

Schmitter, E.D. Remote auroral activity detection and modelling using low frequency transmitter signal reception at a midlatitude site, Annales Geophysicae, 28, 1807-1811, 2010

Greece - University of Crete report by Christos Haldoupis.

The Ionospheric Physics Laboratory, at the Physics Department, University of Crete continued this past year the operation of an automated Stanford VLF receiver which performs routine narrow band VLF measurements. The Crete VLF station is part of the AWESOME VLF network deployed and administered by the Stanford University (http://nova.stanford.edu/~vlf/awesome).

We have continued research work on abrupt VLF signatures which are known to have an association with transient luminous events, mostly sprites, halos and elves. Also we continued collaboration with colleagues and institutions from Denmark, Spain, Hungary, Italy, UK, and USA. For a summary of our activities, scientific contributions as well as paper reprints see webpage at: http://cal-crete.physics.uoc.gr/VLF-sprites/VLFmain.html

Research highlight: Our research resolved a long going, and for some controversial, problem regarding the relationship between sprites and early VLF perturbations in the lower D region. By using the dense AWESOME VLF network and EuroSprite observations we produced unambiguous evidence showing that visible sprites are accompanied always by early VLF perturbations and that a one to one correspondence exist between the two phenomena. This has an important implication, that is, the sprite generation mechanism triggers also the sub-ionospheric conductivity disturbances (most likely electron density enhancements) which cause the "early VLF events".

Publications and results:

1) C. Haldoupis, N. Amvrosiadi, B. R. T. Cotts, O. van der Velde, O. Chanrion and T. Neubert: More evidence for an one-to-one correlation between Srites and Early VLF perturbations, J. Geophys. Res., 115, A07304, doi: 10.1029/2009JA015165 , 2010.

2) O, van der Velde, J. Bór, J. Li, s. A. Cummer, E. Armone, F. Zanotti, M. Füllekrug, C. Haldoupis, S. Naitamor, and T, Farges: Multi-instrumental observations of a positive gigantic jet produced by a winter thunderstorm in Europe, J. Geophys. Res., 115, In press, 2010.

International conferences/workshops presentations:

1) An Update on the Crete studies of Early VLF perturbations, C. Haldoupis, The 2nd AEWSOME VLF workshop, Sarjah, UAE, February 22-24, 2010.

2) Sprites and early VLF perturbations, C. Haldoupis, N. Amvrosiadi, B. R. T. Cotts, O. van der Velde, O. Chanrion, and T. Neubert, European Geosciences Union General Assembly 2010, April, 02-07, Vienna, Austria, 2010.

Hungary - Space Research Group, Eötvös University, Budapest report by János Lichtenberger.

The Space Research Group of Eötvös University continued the theoretical modeling and model-calculations of monochromatic and transient (Ultra Wide Band) electromagnetic signals and the evaluation and comparison of the results with the measured data-base registered at terrestrial stations and on board of satellites.

In the field of the theoretical model development of the full wave solutions of the Maxwell's equations in the last year beside the applications of the models developed earlier more new results appeared: 1) We finished the development of the derivation of full wave solutions in moving media if the moving media and the velocity field of the media-motion are inhomogeneous inside the validity of the special relativity. The application of the new model was tested successfully also in a case, in which exact measured data are known from earlier propagation experiments. 2) In the case of ducted waves the first results of theoretical modeling were derived successfully if the axis of the wave-guide is not a straight-line, however, it is curved. 3) The earlier guided wave-propagation model for UWB signals was applied in wave guides containing simply polarized medium. 4) The propagation of transient electromagnetic signals propagating in lossy, multicomponent anisotropic plasma was solved, too. 5) The results of the propagation of electromagnetic signals was generalized by the solution of acoustic and elastic wave-equations for real transient UWB signals by the application of the Method of Inhomogeneous Basic Modes (MIBM).

Detailed high accurate analysis of VLF signals were performed on simultaneous ground (Tihany, Hungary; Dunedin, New Zealand) and onboard (DEMETER) measurements. Some anomalous propagation events could have been found and identified.

1) The appearance of the onboard measured whistler on the ground station (Tihany) were significantly delayed, the propagation time were 5 times more than expected

2) The originating sferics of whistlers with dispersion of multihop propagation could be identified at the same location (Dunedin), explaining that whistlers occur without sferics on the other Hemisphere.

We have extended the Automatic Whistler Detector and Analyzer Network with four new nodes, one at in Humain, Belgium in cooperation with Belgian Institute for Space Aeronomy and three others in India: at Allahabad (Indian Institute of Geomagnetism), in Lucknow (University of Lucknow) and Varanasi (Banaras Hindu University). We analyzed the first data acquired during the first 6 month of operation at Palmer (US, in Antarctic peninsula) to make a statistic of whistler rate. We found an extremely high whistler activity, about 7,500,000 whistler traces during this 6 months. We also made studies to locate the potential source area of these whistlers. The most probable area is over the sea, east to the east-coast of US (200 km east to Charleston over the sea) over the Gulf-stream, but the Caribbean may contribute significantly. A new algorithm has been developed to determine plasmaspheric electron density measurements from whistler traces, based on a Virtual (Whistler) Trace Transformation, using a 2‑D fast Fourier transform transformation. This algorithm can be automated and can thus form the final step to complete an Automatic Whistler Detector and Analyzer (AWDA) system. In this second AWDA paper, the practical implementation of the Automatic Whistler Analyzer (AWA) algorithm is discussed and a feasible solution is presented. The practical implementation of the algorithm is able to track the variations of plasmasphere in quasi real time on a PC cluster with 100 CPU cores. The electron densities obtained by the AWA method can be used in investigations such as plasmasphere dynamics, ionosphere‑plasmasphere coupling, or in space weather models.

Our group continued to analyze ionospheric impulse propagation in satellite wideband VLF datasets. Accurate incident direction analysis of different type of fractional-hop whistlers was performed, using DEMETER six-component ELF burst recordings and matched filtering. Latitude dependent oblique wave propagation, modelled previously with our UWB propagation code was confirmed. Systematic analysis of DEMETER VLF spectra started with the scope of global mapping space weather processes in the upper ionosphere.

Israel - Report by Colin Price (Tel Aviv University) and Yoav Yair (Open University of Israel)

The VLF group at Tel Aviv University is running two VLF stations (Sde Boker and Mt. Hermon) both in broadband and narrow band formats. Graduate student Yuval Reuveni (under guidance of Prof. Colin Price) has recently published 2 papers on VLF observations related to a) background noise statistics (Radio Science), and b) the influence of meteor showers on VLF noise levels (J. of Atmos. Electr.). Yuval Reuveni has submitted his PhD thesis for review. In addition, a new graduate student (Israel Silber) has started working on the narrow band VLF measurements obtained at our stations. We are interested in the long term variability of these signals.

The ILAN sprite team [http://tau-geo.tau.ac.il/ilan/Links.aspx] continues their winter sprite observations in Israel. The campaign of 2010/2011 will utilize new remote-controlled cameras positioned at the Wise observatory in Mizpe-Ramon, in addition to the (old) Tel-Aviv station. The calibrated optical observation are aimed at finding spatial and temporal relationships between meteor showers and sprites, as well as to relating sprite properties to the characteristics of the parent lightning flash. They are supported by ELF and VLF measurements, in collaboration with groups from Japan (Y. Hobara) and Hungary (J. Bor).

Japan - University of Electro-Communications, Chofu, report by Yasuhide Hobara and Masashi Hayakawa.

The study of winter lightning in the Hokuriku area of Japan and its associated sprites is continued by means of coordinated measurements (optical measurement, ELF observation in Moshiri, VHF lightning observation, and field mill network). Theoretical computer simulations on sprite problems are going on. Then, the direct effect of those winter lightning onto the ionosphere (Trimpi's) will be made as well by using our VLF/LF subionospheric network.

The ELF observation is continued at Moshiri (Hokkaido) with the measurements of two horizontal magnetic field and one vertical field component. The ELF Schumann resonance data are utilized to study the global warming and ELF transients are used to monitor the global distribution of huge lightning. Additional few more ELF stations will be established in Japan (one station was established in Kyushu). Global mapping of lightning discharges is going on based on the inversion of Schumann resonance data observed at three stations in the world.

The coordinated measurement of ELF transients on the ground (Moshiri) and on a satellite (DEMETER) is used to study the propagation characteristics of ELF waves from the source to the satellite.

The study of electromagnetic phenomena associated with earthquakes is going on. Recently we have published two papers [Hayakawa et al., JGR, JASTP, 2010] indicating the significant statistical correlation of ionospheric perturbations as detected by subionospheric VLF/LF waves and earthquakes (large magnitude and shallow), and the mechanism of such seismo-ionospheric perturbation is being pursued in terms of atmospheric gravity wave channel.

New Zealand - University of Otago, Dunedin, report by Craig J. Rodger.

We continue to operate the following experimental measurements locally in Dunedin: 1) the VLF Doppler Experiment which monitors whistler-mode signals from VLF transmitters which have propagated through the plasmasphere predominantly inside whistler ducts. 2) several narrowband receivers (OmniPAL, AbsPAL, SoftPAL and Ultra MSK) which log changes in the phase and amplitude of powerful VLF communications transmitters (~13-30 kHz) to study subionospheric propagation. 3) an Automatic Whistler Detector and Analysis (AWDA) receiver operating in collaboration with Eötvös University. 4) a receiver and central processing computer of the World Wide Lightning Location Network (WWLLN). We also operate UltraMSK narrow-band loggers in Antarctica (near Scott Base, with support from Antarctica New Zealand), and Ministik Lake (near Edmonton, Canada, with support from the University of Alberta). Both of these instruments are part of AARDDVARK and also provide real-time observations to the WWLLN lightning consortia. We are continuing to collaborate with French researchers who operate the DEMETER spacecraft and this has provided invaluable additional measurements and context to our studies. We have also been working to better understand POES data to provide some similar contextual information (radiation belt particles), albeit with lower energy resolution and multiple caveats.

In late June 2010 Neil Thomson travelled to New Brunswick, Canada to make near-field measurements of the powerful US Navy VLF transmitter, NAA. This is part of his continuing research programme to improve the description of the D-region electron density profiles used in VLF propagation modelling. In October 2010 a 2-man team comprising of Craig Rodger and Mark Clilverd (BAS) travelled to Edmonton, Canada to install the new Ministik Lake AARDDVARK receiver. In late November 2010 the same team travelled to Scott Base, Antarctica to undertake maintenance of our AARDDVARK receiver at Arrival Heights, and to gather up data. In addition, we graduated two Space Physics research students, Robert McCormick (modelling of electromagnetic propagation in the Earth-ionosphere waveguide) and Sarah Dietrich (comparison of ground and satellite observations during relativistic electron microburst precipitation events), both completing with Masters degrees. Sarah's MSc research has led to a paper accepted in JGR [paper 7].

Selected research results from the group in 2010.

- Worked to better understand the energetic electron observations from the instruments onboard the DEMETER and POES spacecraft. In particular, we have produced maps showing the expected radiation belt 'populations' (trapped, drift loss cone, bounce loss cone, etc) observed for different locations across the Earth and different orbital directions [papers 1,2].

- Continued our efforts to extract the flux for energetic electron precipitation events from AARDDVARK subionospheric propagation measurements. Our modelling tools are progressively improving, such that we can produce >100 day continuous observations of precipitation fluxes across the North Atlantic in the local summer [paper 3], for

recurring changes in solar wind conditions [paper 4] and look in detail during a geomagnetic storm [paper 5]. The latter paper shows that the changes in neutral atmospheric chemistry from a multi-week long precipitation event into the power winter atmosphere is comparable to .a mid-sized solar proton event

- Neil Thomson's 2009 campaign measurements produced a paper on mid-day tropical/equatorial ionosphere electron density profiles appropriate for solar minimum [paper 6].

- We have continued our focus on man made VLF transmitters as drivers of radiation belt precipitation, and shown that, contrary to theoretical prediction, non-ducted waves are vastly less effective at pitch scattering radiation belt electrons when contrasted with ducted waves. This used experimental observations from DEMETER and POES, to produce a direct 'like with like' contrast in the two different situations [paper 7].

An up to date listing of our publications is available from the Groups website: www.physics.otago.ac.nz/research/space/spacehome.html. This includes PDFs of our published work, where-ever possible.

1. Rodger, C J, M A Clilverd, J Green, and M-M Lam, Use of POES SEM-2 observations to examine radiation belt dynamics and energetic electron precipitation in to the atmosphere, J. Geophys. Res., 115, A04202, doi:10.1029/2008JA014023, 2010.

2. Rodger, C J, B R Carson, S A Cummer, R J Gamble, M A Clilverd, J-A Sauvaud, M Parrot, J C Green, and J-J Berthelier, Contrasting the efficiency of radiation belt losses caused by ducted and non-ducted whistler mode waves from ground-based transmitters, J. Geophys. Res., 115, A12208, doi:10.1029/2010JA015880, 2010.

3. Clilverd, M A, C J Rodger, R J Gamble, Th Ulich, T Raita, A Seppälä, J C Green, N R Thomson, J A Sauvaud, and M Parrot, Ground-based estimates of outer radiation belt energetic electron precipitation fluxes into the atmosphere, J. Geophys. Res., 115, A12304, doi:10.1029/2010JA015638, 2010.

4. Clilverd, M A, C J Rodger, T Moffat-Griffin, E Spanswick, P Breen, F W Menk, R S Grew, K Hayashi, and I R Mann, Energetic outer radiation-belt electron precipitation during recurrent solar activity, J. Geophys. Res., J. Geophys. Res., 115 (A8), A0832, doi:10.1029/2009JA015204, 2010.

5. Rodger, C J, M A Clilverd, A Seppälä, N R Thomson, R J Gamble, M Parrot, J A Sauvaud and Th Ulich, Radiation belt electron precipitation due to geomagnetic storms: significance to middle atmosphere ozone chemistry, J. Geophys. Res., 115, A11320, doi:10.1029/2010JA015599, 2010.

6. Thomson, N R, Daytime tropical D-region parameters from short path VLF phase and amplitude, J. Geophys. Res., 115 (A9), A09313, doi:10.1029/2010JA015355, 2010.

7. Dietrich, S L, C J Rodger, M A Clilverd, J Bortnik, and T Raita, Relativistic microburst storm characteristics: combined satellite and ground-based observations, J. Geophys. Res., doi:10.1029/2010JA015777, (in press), 2010.

Russia - Space Research Institute of RAS (IKI), Moscow, report by David Shklyar and Il'ya Kuzichev

A VLF wave that propagates in the Earth's plasmasphere in the whistler mode must be converted into free space mode in order to be observed on the ground. This conversion takes place in collisional and highly inhomogeneous ionospheric plasma, which makes the description of the process not easy. Since an understanding of this process is vital for the analysis of VLF data, it has been in the focus of research since the beginning of whistler studies. A general approach to this problem, which is based on Maxwell's equations in magnetized plasma, is well developed and commonly accepted. However, its direct implementation meets serious difficulties which reveal themselves in numerical swamping. The intrinsic reason behind this is the existence of evanescent mode in the whistler frequency band. This leads to exponential growth of numerical solutions to the general set of equations. Various methods that have been developed to suppress this instability shift a solution of the physical problem to the field of simulation skill, so that the essential part of solution remains largely hidden. In this work we have developed a new approach to the problem in which the evanescent mode is analytically excluded from consideration, making numerical calculations plain and straightforward. Using this approach, we find the field of whistler mode wave incident on the ionosphere from above in the whole span of altitudes, and calculate the reflection coefficient as a function of frequency for a number of incidence angles. We explain a quasiperiodic behaviour of the reflection coefficient by resonance absorption of the waves in the lower ionosphere.

The results were published in: I.V. Kuzichev, D.R. Shklyar, On full-wave solution for VLF waves in the near-Earth space, Journal of Atmospheric and Solar-Terrestrial Physics 72 (2010) 1044–1056, and reported at EGU General Assembly 2010, Vienna, May 2010 (Geophysical Research Abstracts Vol. 12, EGU2010-1833, 2010) and at VERSIM 2010 Meeting, Prague, September 2010.

South Africa - University of KwaZulu-Natal (Durban) and Hermanus Magnetic Observatory (Hermanus), report by Andrew Collier.

Marlie van Zyl, Daleen Koch and two Swedish students, Torbjorn Sundberg and Hanna Dahlgren, travelled to the SANAE IV base in Antarctica during the summer of 2009/10 to perform maintenance on various experiments. The major undertaking of this trip was getting the UltraMSK receiver working properly, which required relocating the signal source from a whip antenna on top of the base to one of the magnetic loop antennas. Later, at the end of the first quarter of 2010, Etienne Koen and Stephen Meyer returned to Marion Island, a small South African territory located in the middle of the "Roaring Fourties", to perform similar maintenance. For the first time in a few decades we were able to send an expedition member, Kari Schoonbee, to Marion Island. Our instruments on the island are now supervised throughout the year and this will result in significantly less loss of data. Kari has been involved in moving from the old to the new base on Marion Island and has thus been responsible for the relocation of all of our experiments: an arduous undertaking given that conditions on the island can often be somewhat more than extreme. Kari has also installed a new Doppler instrument developed at BAS.

The paper documenting the correlation between whistlers detected at Tihany and global lightning activity (doi:10.1029/2008JA013863) was followed by a similar study for whistlers detected at Dunedin, New Zealand (http://www.ann-geophys.net/28/499/2010/angeo-28-499-2010.html). The conclusion of this paper is that, due to the dearth of lightning around the conjugate point, the Dunedin whistlers must originate from thunderstorms further afield. The correlation analysis indicates that the most likely location for these thunderstorms is on the west coast of Central America. A third (and final) paper with an analogous treatment of Rothera whistler data is currently under review.

Four students in the group graduated with MSc degrees: Brett Delport, Sherry Bremner, Remmy Musumpuka and Struan Cockcroft and Etienne Koen. Two of these, Brett and Etienne, have stayed on to do a PhD.

The group has made presentations at the SuperDARN meeting (Hermanus, South Africa, May 2010), COSPAR Scientific Assembly (Bremen, Germany, July 2010), VERSIM Workshop (Prague, Czech Republic, September 2010), South African Institute of Physics (SAIP) Conference (Pretoria, South Africa, September 2010) and the AWESOME/VLF Workshop (Sharjah, United Arab Emirates, February 2010). We were

privileged to have Craig Rodger give a plenary presentation at SAIP this year, which was very well received by the audience. This is the first Space Physics plenary in many years.

During the year a period of intense chorus emissions was observed on Marion Island (L=2.6) during a minor geomagnetic storm in August 2010, indicating that the plasmapause had been significantly displaced. At the same time chorus was also observed at SANAE IV. This event is currently being explored further.

A new WWLLN receiver was installed in Nigeria by Ogbos Okike. This receiver has appreciably improved the coverage of WWLLN over Africa. Furthermore, after being out of commission for more than a year, the Durban WWLLN receiver has been relocated from the Howard College campus to the Westville campus by Brett Delport, where it is currently being recommissioned.

Current research projects: (1) PIC simulations of chorus generation; (2) sub-ionospheric VLF propagation using FDTD techniques; (3) lightning-whistler correlations using DEMETER VLF data; (4) relationship between cosmic rays, cloud cover and lightning; (5) relationship between WWLLN and LIS/OTD lightning distributions; (6) evolution of energetic electron populations in realistic model of Earth's magnetic field and (7) statistical analysis of GEO/LEO response to high speed stream events.

Taiwan - National Cheng Kung University, Tainan , report by Kaiti Wang, Alfred B. C. Chen, Han-Tzong Su, and Simon Huang.

The ELF station at Lulin Observatory (23.47^{o}N, 120.87^{o}E, 2862 m) has operated since 2003 for supporting lightning study of ISUAL (Imager of Sprites and Upper Atmospheric Lightning) team of NCKU. The original sampling rate was 400 Hz and hundreds of ELF-whistlers events between about 60 and 100 Hz were observed from 2003 to 2004. The sampling rate is now increased to 5000 Hz, and these events are continued to be detected. K. Wang has reported possible interpretations for these events in the 4th VERSIM workshop.

Since this year of 2010, a set of VLF antenna measuring 1 kHz to 25 kHz is mounted and operated at ground location not far from our university. S. Huang presents the results from measurements for the VLF antenna in the AGU Fall Meeting in San Francisco. (AE21B-0273 TLEs and their electromagnetic characteristics from 2010 Taiwan ground campaign.) There are still some interfered noises on the data and we are working on solving this problem.

Several master students are using the data measured from the ELF/VLF antennas for their research thesis. The parameters of measured magnetic fields and the signals from lightning are now being investigated.

United Kingdom - British Antarctic Survey, Cambridge, report by Mark Clilverd.

BROADBAND RECORDINGS at Rothera, Antarctica:

Whistler-detection and data collection has continued throughout 2010 from the Hungarian Automatic Whistler Detection system.

The Stanford University AWESOME receiver has also operated throughout 2010, logging broadband and narrow-band data.

VELOX RECORDINGS at Halley, Antarctica:

Continuous (since 1992) recordings of VLF activity in 10 ELF/VLF bands, at 1-s resolution (VELOX and VELOXNET), including spheric counters, have continued at Halley in 2010. The VELOXNET data collection at Halley will continue indefinitely, despite closure of the rest of the VLF science during the 2008-2012 station rebuild period.

NARROW-BAND RECORDINGS:

'Ultra' narrow-band recordings have continued at Rothera (Antarctica) the Australian Casey station (Antarctica), Sodankyla (Finland), Churchill (Canada), and Ny Alesund (Svalbard) throughout 2010. Significant data loss occurred at Ny Alesund in the first half of the year due to disc failure. Basic data collection at all sites is undertaken with at least 0.2 s resolution.

The software VLF Doppler system has continued at Rothera station, Antarctica (L=2.8) in 2010, receiving whistler mode and subionspheric signals primarily from NAA (24.0 kHz).

WWLLN sites:

British Antarctic Survey operated two World Wide Lightning Location Network systems in 2010. Rothera and Ascension Island have provided lighting location information all year.

SFERIX sites:

British Antarctic Survey continued to operate a SFERIX system at Rothera in 2010. However, operation of this system was stopped in mid-October 2010.

United Kingdom - VERRI, Derbyshire, report by Andy Smith.

The most important statistical results from the long-running VELOX instrument at Halley Antarctica, for the first 16 years of operation (1992-2007), were published this year (J. Atmos. Solar-Terr. Phys. 72 463-475, doi:10.1016/j.jastp.2009.12.018).

A paper presented at the VERSIM workshop in Prague showed that although the instrument was changed in 2007, the amplitude data, with a minor correction, could be treated as a single series continuing past 2007 to the present. Daily data files continue to be recorded and may be downloaded from the British Antarctic Survey website. For a link, see the VERRI website www.verri.org.uk

Ukraine - Dept. of Remote Sensing, Usikov Institute for Radio-Physics and Electronics, Nat. Acad. of Sci. of the Ukraine, Kharkov, Ukraine, report by A. Nickolaenko.

This year, Elena Yatsevich got her Ph.D. in Radio Physics after presenting the dissertation entitled "Monitoring of Schumann Resonance and Models of its Source". The Kharkov group (Prof. A.P. Nickolaenko, Dr. A.V. Shvets, Dr. E.I. Yatsevich – Usikov Institute for Radio-Physics and Electronics of NASU of the Ukraine, Kharkov, Ukraine) continues studies of the low frequency radio propagation in the Earth – ionosphere duct. The work is done in a close collaboration with Prof. M. Hayakawa group (the University of Electro Communications, Tokyo, Japan).

Our attention is concentrated in the following directions: fields in mesosphere, space weather and SR radio signals, anomalies in radio signals, inverse SR problems, etc.

Electric field in the mesosphere.

Publication [1] describes the space-time distribution of the pulsed electric field in the middle atmosphere above a positive

Γ–shaped lightning stroke. The channel of such a discharge contains a vertical and a horizontal section. The current wave moves initially vertically and turns horizontally then, so that radiation appears from the vertical electric dipole followed by that from the horizontal dipole. Combined with reflection from the perfectly conducting ground, the source provides the three subsequent pulses in the atmosphere, with the lag being originated owing to the finite velocity of the current wave in the Γ–shaped stroke. The pulses are reproduced by reflections from the air-ground and the air-ionosphere interfaces and the waveform resembles the M component, which is often noted in the negative strokes. The non-stationary fine structure appears in the spatial distribution of electric field, which persists for 2 ms or even more and exceeds the runaway electron threshold. Estimates support the idea of free electron bunching in the mesosphere by the pulsed electric field. Focusing may occur about 10 km away from the point of electron- field interaction; it is delayed by a few ms from the moment of interaction. Data presented might be helpful in realistic modeling of the red sprite formation.

Anomalies and anomalous radio signals

Paper [2] compares peculiarities in the Optical Transient Detector (OTD) and Lightning Imaging Sensor (LIS) data over the South Atlantic Anomaly (SAA), centered near the lower east coast of South America, where cosmic particles precipitate (DEMETER data). Differences in exposure to SAA and filtering procedures of observed optical flashes result in notable differences between OTD and LIS lightning distributions in this region. We draw readers' attention to these differences, and show that filtering may result in systematic loss of information important for Schumann resonance research and Transient Luminous Events studies. We also suggest that high lightning activity in the SAA region, indicated by LIS, may be a manifestation of a link between cosmic and Earth weather, and, possibly, a yet unexplored feedback mechanism between lightning discharges and cosmic particle precipitation.

Paper [3] summarizes anomalous Schumann resonance (SR) phenomena and the SR-like line emissions observed at Nakatsugawa in possible association with the series of nearby earthquakes (EQ). Intensity of particular SR modes increases before large EQs and the excitation of narrow anomalous SR-like lines is observed at frequency shifted by about 2 Hz from the typical SR modes. We suggest that the narrow line emission might be a consequence of an anomalous phenomenon of excitation of gyrotropic waves due to input wave from below with a band from 15 to 20 Hz as an exciter. The theoretical computational results seem to be generally consistent with the observational findings.

Space weather and SR radio signals

Paper [4] treats a possible effect on the Schumann resonance records of the giant γ –ray flare from SGR 1806-20. We show that the dayside ionosphere modification observed by using VLF radio waves was able to cause an abrupt reduction in the power spectra of the global electromagnetic resonance (SR). Spectral modifications fade in time, so that usual pattern recovers in tens of minutes. An application of signal sonogram is suggested for the signal processing around the time of γ–ray burst, which would facilitate detection of the event.

Electromagnetic ELF radio pulse is modeled in paper [5] produced by the abrupt reduction of charged ionosphere over the dayside of the globe. The ionosphere modification is caused by the giant γ –ray flare from SGR 1806-20. The reduction of the charged ionosphere provides the 'positive' vertical electric source that generates a specific 'parametric' Q – burst. The following features of the pulse facilitate its detection. The transient event occurs at the onset of the γ –flare. It arrives from the central 'sub-flare point'. Owing to huge size of the source, the pulse spectrum contains only the lowest SR mode, a wide spectral peak around 60 Hz frequency is also possible, provided that 'parametric' source radiates at these frequencies. In paper [6], we report on the first clear detection of transient Extremely Low Frequency (ELF) emission caused by an extremely intense cosmic γ –ray of December 27, 2004. The ELF pulse (Q – burst) was detected at the Moshiri and Onagawa observatories in Japan. It coincided with the peak time of the flare. The two horizontal field components of the same Q – burst were recorded at the Esrange site in Sweden also showing the clear single Schumann resonance mode waveforms. The source direction determined from the Lissajous method roughly corresponds to the sub-flare point.

Inverse SR problems

Paper [7] treats the Schumann resonance records simultaneously performed at three globally separated stations: Moshiri, Japan (44.365°N, 142.24°E), Lehta, Russia (64.427°N, 33.974°E), and West Greenwich, RI, U.S.A., (41.6°N, 71.6°W). Data covering almost one year were used as source information for mapping the world thunderstorm activity. A two-stage inverse problem was solved aiming on locating of lightning activity distributed over the Earth by using the SR background signal. The first stage includes inversion of the SR magnetic field power spectra into the distance distribution of lightning intensity relative to the above observatories. Distance profiles thus obtained present the source intensity, and these are used as tomographic projections when reconstructing the 2D spatial distribution of sources (the second stage). It is demonstrated that implementation of azimuthal distribution of sources found due to angular patterns of magnetic field sensors sufficiently improves the quality of global lightning mapping for the finite number of observatories. The maps of global lightning distribution obtained by inversions of SR spectra data show that the most active regions move northward or southward on the seasonal time scale and drift from east to west on the diurnal time scale being concentrated over continents in the tropics.

We apply in paper [8] a technique that separates the global and local time variations in integrated Schumann resonance intensity. The orthogonal horizontal magnetic field components were recorded simultaneously at three observatories: Moshiri, Japan (44.365°N, 142.24°E), Lehta, Russia (64.427°N, 33.974°E), and West Greenwich, RI, U.S.A., (41.6°N, 71.6°W). We use the complete magnetic field power in processing. SR intensities were integrated in the frequency band covering three SR modes, and diurnal variations obtained at each site were averaged over every month. Thus we obtained three records each presenting monthly averaged daily variations for the period from August 1999 to December 2001. The records were combined in pairs to separate the UT and LT daily patterns. The other technique was also used based on geometric averaging of the recorded data. A comparison of results acquired by using different processing techniques showed an outstanding similarity in the UT patterns, which represent the global thunderstorm activity.

Supplementary works

In paper [9] we analyze waveforms of natural ELF transient events recorded in 'typical' environment with a considerable industrial 50 Hz interference. We describe the extracting of a natural ELF transient signal from under the industrial noise by using the singular spectral analysis. Similar procedures were used in processing data recorded during extra galactic γ –ray

burst of December 27, 2004. We also show that there is an outstanding similarity among the model and the observed waveforms when the wide band receiver is used.

Measurements are described of 82 Hz radio signals arriving from the Russian ELF transmitter located on the Kola Peninsula, Russia [10]. Two orthogonal calibrated horizontal magnetic field sensors were used together with the vertical electric antenna at the Moshiri observatory, Hokkaido (44.4°N, 142.2°E). The following propagation characteristics were studied: (1) signal amplitude and its variations on the diurnal and seasonal scales, (2) phase difference between the two horizontal magnetic field components (wave polarization), and (3) wave arrival angle. The amplitude detected was compared with the published data and showed a good agreement. The 82 Hz signal is linearly polarized, which allowed for the goniometric finding of the source bearing. The arrival azimuth was consistent with the geometry of the experiment. We also estimated the source current moment by comparing the experimental and theoretical amplitude.

Publications

[1] I.G., Kudintseva, A.P. Nickolaenko, M. Hayakawa. Transient electric field in the mesosphere above a Γ – shape lightning stroke, *Survey in Geophys*., 2010, **31**, 427 –448, 2010, doi: 10.1007/s10712-010-9095-x.

[2] O. Pechony and A. Nickolaenko, The South American lightning puzzle and the South Atlantic Anomaly, *Journal of Atmospheric Electricity*, Vol. 30, No.2, 2010, pp.75 –82.

[3] M. Hayakawa, K. Ohta, V.M. Sorokin, A.K. Yaschenko,J. Izutsu, Y. Hobara, Nickolaenko A.P. Interpretation in terms of gyrotropic waves of Schumann-resonance-like line emissions observed at Nakatsugawa in possible association with nearby Japanese earthquakes. *J. Atmos and Solar-Terrestrial Phys*., **72**, 1292–1298, 2010.

[4] Nickolaenko A.P., M. Hayakawa, Model disturbance of Schumann resonance by the SGR 1806–20 γ –ray flare on December 27, 2004. *Journal of Atmospheric Electricity,* 30 (1), 1 – 11, 2010

[5] Nickolaenko A.P. Parametric excitation of an extremely low-frequency radio pulse by an extragalactic gamma-ray burst on December 27, 2004. *Radiophysics and Quantum Electronics*, doi:10.1007/s11141-010-9219-7, 2010.

[6] Y.T. Tanaka, M. Hayakawa, Y. Hobara, K. Yamashita, M. Sato, at al. Transient ELF emission caused by an extremely intense gamma-ray flare from the magnetar SRG1806 – 20 *GRL*, (submitted).

[7] Shvets, A. V., Y. Hobara, and M. Hayakawa, Variations of the global lightning distribution revealed from three-station Schumann resonance measurements, J. Geophys. Res., doi:10.1029/2010JA015851, in press.

[8] Nickolaenko, A.P., E.I. Yatsevich, A.V. Shvets, M. Hayakawa, Y. Hobara, Universal and local time variations deduced from simultaneous Schumann resonance records at three widely separated observatories, submitted to JASTP.

[9] Nickolaenko A.P., M. HayakawaY. Hobara, Q–bursts: natural ELF transients, *Survey in Geophys*., **31**, 409 –425, 2010, doi: 10.1007/s10712-010-9096-9.

[10] M. Yano, Y. Ida, Y. Hobara, M. Hayakawa, A.P Nickolaenko. Reception of ELF transmitter signals at Moshiri, Japan and their propagation characteristics, *Radio Sci., 45*, RS1009, doi:10.2009RS004224, 2010

USA - University of California, Los Angeles, report by Richard M. Thorne and Jacob Bortnik.

Over the last year the Thorne group at UCLA has studied the excitation and scattering properties of several important magnetospheric waves. We have performed a statistical analysis of THEMIS data to determine the properties of energetic electrons responsible for chorus excitation (1), and have used the RAM code to evaluate the global distribution of chorus excited during a magnetic storm (2). The RAM code simulation of the dynamical evolution of the energetic ring current ion distribution during a magnetic storm has also be used to determine the global excitation of EMIC waves (3), and equatorial magnetosonic waves (6). We have also considered the potential rapid scattering of radiation belt electrons by EMIC waves (4) and identified a new non-resonant process for electron scattering by equatorial magnetosonic waves that is comparable to resonant scattering, but is far more robust and less sensitive to initial wave parameters (5).

For several decades there has been controversy over the origin of diffuse auroral scattering, but in a recent paper in Nature (8) we have demonstrated that scattering by a combination of upper and lower band chorus is the dominant mechanism for the loss of plasma sheet electrons leading to the global morphology of diffuse auroral precipitation. We have also shown that pulsations in the diffuse auroral precipitation are directly related to a modulation of lower band chorus observed on THEMIS (9).

A recent "frontier" review paper in GRL provides a summary of progress in the field over the last few years in understanding the dynamics of the radiation belts due to wave-particle interactions (7).

1. Li, W., R. M. Thorne, Y. Nishimura, J. Bortnik, V. Angelopoulos, J. P. McFadden, D. E. Larsen, J. W. Bonnell, O. LeContel, A. Roux, K. H. Glassmeier, and U Auster (2010), THEMIS analysis of observed electron distributions responsible for chorus excitation, J. Geophys. Res., 115, A00F11, doi:10.1029/2009JA014845.

2. Jordanova, V. K., R. M. Thorne, W. Li, and Y. Miyoshi (2010), Excitation of whistler-mode chorus from global ring current simulations, J. Geophys. Res., 115, A00F10, doi:10.1029/2009JA014810.

3. Chen, L., R. M. Thorne, V. K. Jordanova, C. H. Wang, M. Gkioulidou, L. R. Lyons, and R. B. Horne (2010), Global simulation of EMIC wave excitation during the 2001 April 21st storm from coupled RCM-RAM-HOTRAY modeling, J. Geophys. Res., 115, A07209, doi: 10.1029/2009JA015075.

4. Ukhorskiy, A. Y. Y. Shprits, B. J. Anderson, K. Takahashi, and R. M. Thorne (2010), Rapid scattering of radiation belt electrons by storm-time EMIC waves, Geophys. Res., Lett, 37, L09101, doi: 10.1029/2010GL042906.

5. Bortnik, J., and R. M. Thorne (2010), Transit time scattering of energetic electrons due to equatorially confined magnetosonic waves, J. Geophys. Res., 115, A07213, doi:10.1029/2010JA015283.

6. Chen, L., R. M. Thorne, V. K. Jordanova, and R. B. Horne (2010), Global simulation of magnetosonic wave instability in the storm time magnetosphere, J. Geophys. Res., 115, A11222, doi: 10.1029/2010JA015707.

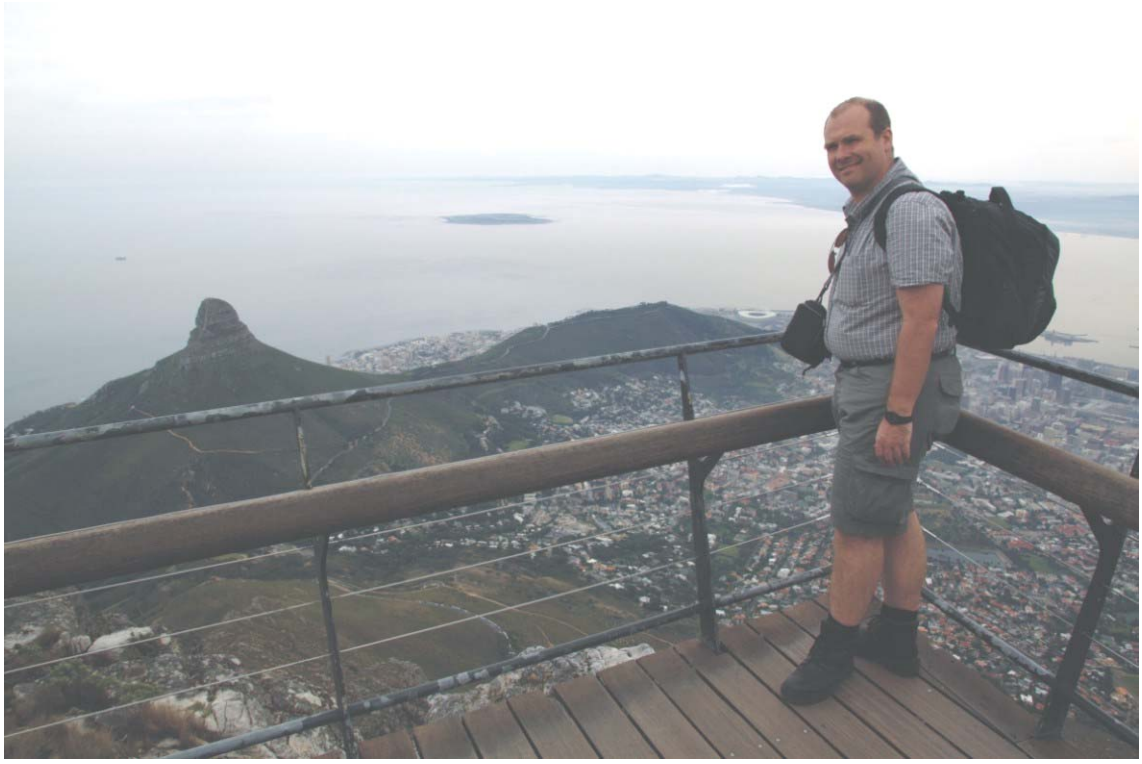
7. Thorne, R. M. (2010), Radiation belt dynamics: The importance of wave-particle interactions, Geophys. Res. Lett., 37, L22107, doi: 10.1029/2010GL044990.

8. Thorne, R. M., B. Ni, X. Tao, R. B. Horne, and N. P. Meredith (2010), Scattering by chorus waves as the dominant cause of diffuse auroral precipitation, Nature, 467, 943-946, doi:10.1038/nature09467.

9. Nishimura, Y., J. Bortnik, W. Li, R. M. Thorne, L. R. Lyons, V. Angelopoulos, S. Mende, J. W. Bonnel, O. LeContel, and U. Auster (2010), Identifying the driver of pulsating aurora, Science, 330, 81-84, doi:10.1126/science.1193186.

Merry Christmas and Happy New Year!

Dr. János Lichtenberger (Eötvös University, Hungary) during a visit to Gyergyóújfalu, Transylvania, which he visited in July to undertake repairs on an AWDANet station. The village is in a basin and the surrounding mountains are rich of various mushrooms. The large one Janos is holding is a penny bun (Boletus edilus), a very tasty mushroom, which he found in surrounding pine forest.



Dr. Craig Rodger (Otago University, New Zealand) on Table Mountain, overlooking Cape Town, South Africa. Craig was visiting South Africa to work with colleagues from Hermanus Magnetic Observatory and the University of KwaZulu-Natal, and to give a plenary lecture at the South African Institute of Physics meeting [6 October 2010].