IAGA/URSI
Joint Working Group on

VLF/ELF Remote Sensing of Ionospheres and Magnetospheres

Editor: A J Smith | Newsletter | No. 15 — June 2001

Dear colleagues,

In this *VERSIM Newsletter* are details of both the VERSIM related session to be held at the forthcoming IAGA 9th Scientific Assembly in Hanoi, and a VERSIM business meeting to be held at the same assembly. I look forward to meeting some of you there. There is also information about next year's URSI General Assembly in the Netherlands, and news items from various research groups of the VERSIM international community. Many thanks to those who contributed. Like the last *Newsletter*, this one is being distributed entirely electronically. It will be available to be downloaded from the VERSIM website (address on the last page).

IAGA, 2001

The 9th Scientific Assembly of IAGA will be held in Hanoi, Vietnam, 18–30 August 2001. It will be a combined meeting with IASPEI. Full details are on the web at: `http://www.IAGAandIASPEI.org.vn/`.

Whistlers, Particle Precipitation and Low-latitude VLF Phenomena

This session was originally proposed and approved at the VERSIM meeting in Birmingham as a joint Division II/III session. It is now the half-day session G2.07 in the Division II programme, convened by A.J. Smith (British Antarctic Survey, UK) and A.R.W. Hughes (Natal University, South Africa), and is on the subject of whistler waves in the magnetosphere and ionosphere, their propagation and interaction with particle populations, and the induced effects in the ionosphere, particularly precipitation.

The session will take place 0900–1140 on Tuesday 28 August 2001 in ICC-Salon 2, and the programme will be as follows:

0900 *The triggering of atmospheric discharges by whistler induced electron precipitation*, A.R.W. Hughes and W.K.M. Rice

0920 *Weekend decrease and sunlit ionosphere effect found in ELF/VLF emissions observed at geomagnetically conjugate stations*, H. Yamagishi, N. Sato, I. Nagano and Th. Saemundsson

0940 *The source regions and generation mechanisms of Type-I and Type-II Quasi-Periodic VLF emissions*, A.J. Smith, M.J. Engebretson and A. Halford

1000 *Automatic whistler detector: first results*, J. Lichtenberger, L. Bodnar, Cs. Ferencz, O.E. Ferencz and D. Hamar

1020 Viewing of the POSTER paper: *Stochastic phase space diffusion in electron-whistler WPI; estimate of diffusion coefficient*, W. Wykes, S.C. Chapman and G. Rowlands

1040 Break

1100 *Whistler Observations at Great Wall Station: Activities with Geomagnetic Storms*, F.-L. Peng, H.-F. Chen, K. Tang and W. Xu

1120 *Coordinated study of very low frequency(VLF) phenomena at low and high latitudes*, A.K. Gwal

1140 End

Other sessions at Hanoi

Other sessions scheduled for IAGA 2001 which may be of particular interest to the VERSIM group include:

G2.01 *Transient Effects of Lighting on the Middle and Upper Atmosphere: Sprites and Other Effects.* Conveners: D. Sentman and H. Fukunishi.

G3.08 *Waves, Instabilities and Transport Associated with Substorms.* Conveners: C.Z. Cheng, A. Roux and T. Ogino.

G3.09 *The Role of Waves and Instabilities in Field-Aligned Currents and Auroral Particle Acceleration.* Conveners: R. Lysak and R. Rankin.

VERSIM Business meeting

There will be a meeting of the VERSIM working group during the IIanoi Assembly, at **1145 on Tuesday 28 August 2001** in ICC-Salon 2, i.e. immediately after the VERSIM session G2.07, and in the same room. The draft agenda is: 1. Chairman's Report; 2. Future of the working group; 3. Reports from VERSIM research groups; 4. Symposia at future IAGA and URSI Assemblies; 5. Any other business. If you have any specific issues you would like to discuss, please let one of the co-chairmen know (see below for addresses, etc.). Especially if you have any proposals for symposia for the IAGA/IUGG Assembly in 2003 in Sapporo, let me know, as this may need to be proposed at a Commission II/III business meeting occurring before the VERSIM business meeting. **All are welcome!**

URSI, 2002

The 27th URSI General Assembly will be held in Maastricht, the Netherlands, 17-24 August 2002. For details, see the website `http://www.URSI-GA2002.nl/` or email the Local Organising Committee at `URSI2002@tue.nl`. There will be no specifically VERSIM session, but the following topics have been proposed for symposia at Maastricht, which, together with the Open Sessions, should cover all areas of interest to VERSIM: *Wave and Coherent Structures in Space Plasmas*, *Plasmaspheric Structure and Phenomena*, *Spacecraft and Ground Observations of Stimulated and Natural Space-Plasma Waves*, *Lightning Effects in the Ionosphere and the Radiation Belts*, *Analysis methods for plasma waves and turbulence.* There will be a VERSIM business meeting arranged during the assembly; more details will be provided nearer the time.

The Plasmasphere rediscovered

The Proceedings of this special workshop, which was convened by **J. Lemaire** and **L.R.O. Storey** in Toronto on 14 August 1999 in honour of Don Carpenter and his achievements in helping to discover and understand the plasmasphere and plasmapause using whistlers, will be published as a Special Issue of the *Journal of Atmospheric and Solar-Terrestrial Physics.* Owen Storcy (`llewelyn.storey@physics.org`) reports that Issue no. 11 of Volume 63 is due to appear next month; a list of contents and an order form may be found on the web at `http://www.magnet.oma.be/ws-h/index.html`.

VLF Doppler receiver and solar powered magnetometers in Antarctica

Report from Mark Clilverd (`m.clilverd @bas.ac.uk`), British Antarctic Survey, UK.

The aims for the 2000/01 Antarctic season were to install 3 solar powered magnetometers and a VLF Doppler system on the Antarctic Peninsula, and retrieve the first 3 months of data in March 2001. The season was highly

successful with all installations being accomplished on time, and data retrieved from 3 of the 4 systems.

Three solar powered magnetometers were installed in isolated locations far away from any possible manmade interference sources. The first installation took place at Port Lockroy on Bills Island (64° 48′S, 63° 32′W) on 27th November 2000. The second magnetometer was installed on Trump Island (66° 02′S, 65° 58′W) 2 days later. At Rothera we installed the final magnetometer system about 10km inland (67° 29′S, 68° 10′W) on 12 December 2000. Data pickups were undertaken in mid-March 2001. System checks and data uplift was accomplished successfully at Bills and Trump Islands. The system at Rothera failed sometime during the summer season, but plasma densities at $L = 2.5$ have been determined from cross-phase analysis of the data from the other two stations.

The VLF Doppler system was installed 200m from the base at Rothera, on the ridge behind the buildings. A small loop aerial system was used - being based on a tubular extension mast 5m high. The equipment was operational by 12 December 2000. Small summary data files are transferred back to BAS HQ via the satellite link automatically each day—average plasmaspheric electron concentration and electric field values for $L = 2.5$ can be estimated from the summary data.

News from South Africa

Arthur Hughes (hughes@nu.ac.za), Univ. of Natal.

Next month we are involved in a rather interesting experiment with Stanford and the Danish Meteorological Institute.

We will be looking for the optical signature of beams of high energy electrons in the conjugate region to sprites. The Danes operating in the Pyrenees will look for sprites over Southern France (European Sprite 2001 campaign) while at the SAAO, Sutherland, we, Tankiso Modise (University of Natal) and Geoff Bainbridge (Stanford) will use a "fly's eye" to detect the optical beam. Experiments will run from 15 July to 15 August. It will be an interesting result if we see something.

News from Japan

Masashi Hayakawa (hayakawa@whistler.ee.uec.ac.jp), Univ. of Electro-Communications.

We report on our recent activity on a few subjects.

Seismo-ionospheric perturbations (seismo-Trimpis) and lithosphere-atmosphere-ionosphere coupling

Short-term earthquake prediction is our final goal of this measurement. In addition to the passive measurement of seismogenic emissions (ULF emissions and VLF emissions), radio sounding with the use of VLF/LF subionospheric signals has been found to be very useful for studying the ionospheric perturbations associated with earthquakes. At the moment we have seven receiving stations in Japan (Moshiri (Hokkaido), Chofu, Chiba, Shimizu, Kasugai (Nagoya), Maizuru (Kyoto) and Kochi) and we receive 4 VLF/LF signals (NWC (Australia), CHI (China), NPM (Hawaii) and JJY (40kHz) simultaneously at each station. Normally the temporal resolution is 20 seconds for this purpose.

Based on the long-term observation during the last few years, we have found a lot of convincing evidence of seismo-ionospheric perturbations, including (1) clear evidence for the Kobe earthquake with the use of our terminator time method, (2) the integrated ionospheric effect associated with the earthquake swarm in Izu peninsula in March, 1997, (3) correlation of ionospheric perturbations at Kasugai with the corresponding earthquakes in Nagoya area, etc. We will continue this observation, and also we have been working on the mechanism of lithosphere-atmosphere-ionosphere coupling (by means of atmospheric waves) using a combination of observational facts and theoretical work.

Study of atmosphere-ionosphere coupling

As mentioned in the above item, we have been continuing the observation of ionospheric perturbations. When we increase the temporal resolution up to 100-50 msec, we can use those

data for the space study. ELF waves (up to the frequency of 1kHz) have been continuously measured at Moshiri in Hokkaido, and we measure three field components (two horizontal magnetic and one vertical electric), enabling us to perform the wave impedance and direction finding measurements. In the winter of 1998/99, Tohoku group succeeded in the optical observation of sprites and elves in Japan. We have analyzed our own ELF data and ionospheric trimpi data for those optical events, and then we have studied the interrelationship among lightning (maximum current, charge transfer, polarity etc.), ELF radiation and ionospheric perturbation. We plan to perform a very coordinated measurement for the Hokuriku winter lightning in the Japan sea in the next winter, in order to have better understanding on the atmosphere-ionosphere electromagnetic coupling.

Trimpi modelling

As for Trimpi modelling, we have been working on the use of FEM (finite element method), which is non-Born, but two-dimensional. The Born approximation is not valid for some occasions with large spatial scale and with large density perturbation. Then, we compared our 2-D non-Born method with the 3-D Born method developed by Dr. Nunn.

We are now working on the 3-D exact solution of VLF scattering by ionospheric irregularities, in collaboration with Dr. Soloviev at St. Petersburg. These theoretical results will be compared with the corresponding observational results, in order to have better understanding on the scattering mechanism.

DEMETER

Michel Parrot (mparrot@cnrs-orleans.fr), CNRS, France

The launch of this microsatellite is now expected in 2003 and a call for guest investigators will be issued by CNES at the end of this year.

News from the Czech Republic

Pavel Triska (PTR@ufa.cas.cz) sends the following report.

VLF-ELF measurements onboard the MAGION-4 and MAGION-5 satellites in the inner magnetosphere provided new data on various wave phenomena. Regular broadband wave observations started in September 1995 and cover the region limited approximately by $L = 1.5$–8, altitudes of 4000–12000 km and invariant latitudes of 0°–50°N. The wave-phenomena recorded mostly in the frequency-band up to 22 kHz include ducted and nonducted whistlers, lower hybrid resonance (LHR) noise bands, LHR whistlers, magnetospherically reflected (MR) whistlers, plasmaspheric hiss, chorus, discrete plasmaspheric emissions, and signals of VLF transmitters. Numerical simulations performed together with the analytical consideration provided an understanding of several features of MR whistler spectrograms, e.g., such as principal dependence of a spectrogram on the observation point rather than on the illuminating region. Other results provide strong evidence that LHR noise is nothing but nonducted whistlers, or MR whistlers observed at their reflection point.

MAGION-4 (58.7 kg) launched on 3 August 1995 together with the INTERBALL-1 s/c worked till September 1997 and decayed in the dense atmosphere on October 15, 2000. MAGION-5 (65.5 kg) launched together with the INTERBALL-2 s/c on 29 AUGUST 1996 after only one day of operation, on 30 August, 1996 went out of control and ceased to transmit telemetry data for a critical deficit of power. After analyzing the telemetry data and after spare subsystems laboratory tests it was concluded that the failure was caused by a short circuit in the solar array connected probably with a small mechanical damage immediately before the launch and it was decided to continue periodically in attempts to reactivate the spacecraft. The first telecommand response from MAGION-5 was achieved at the Panska Ves TC/TM station of the Institute of Atmospheric Physics (Czech Academy of Sci.) on 6 May, 1998. Since then MAGION-5 has been operating continuously and more than

1500 hours of broadband analog VLF wave phenomena telemetry were recorded.

MAGION-5 still (June 2001) continues in exploring the inner magnetosphere, the apogee is close to 20,000 km. Once or twice a week the attitude (spin axis directed to the Sun) is corrected using the onboard gas-jet engine. The gas supply is predicted to be sufficient till October 2001.

Some new payloads applicable onboard microsatellites have been developed recently: frequency analyser for VLF plasma wave measurements, magnetic antennas (search-coils) and a new version of the electric antenna - double-probe dipole.

VELOXnet ring of VLF/ELF receivers

Andy Smith, BAS, UK

Four new VELOX receivers are to be deployed at widely spaced longitudes, and with the existing receiver at Halley, Antarctica, will cover all local times. The receivers measure wave power, polarisation, arrival bearing and max/min statistics every second continuously. The science focus is on substorm chorus events. Some of the data will be brought back via the Internet. The new receiver is in its final stages of development and one will be deployed in Finland in the autumn. A second is expected to be set up at the Australian Antarctic station Casey later in the year, and the remaining two stations in Canada and Alaska next year.

South Pole VLF beacon

U.S. Inan (inan@nova.stanford.edu), Stanford University, USA

Our proposal to place/operate a VLF Beacon transmitter at South Pole has been fully approved. We will start working on this within the next month or so, will send materials down this season, and will be setting up the system during the austral summer of 2002-03. I expect the transmitter to be operational in January 2003. It is expected that stations around the Antarctic continent will receive the signals from the beacon, and the data will be used to measure perturbations in the low altitude ionosphere, particularly those caused by the precipitation of highly energetic electrons.

New book: *Whistler phenomena*

The book *Whistler Phenomena*, edited by Cs. Ferencz, O. Ferencz, D. Hamar (spacerg@sas.elte.hu) and J. Lichtenberger is due to be published this month by Kluwer Academic Publishers (ISBN: 0792369955). Synopsis: In this volume, the authors present theoretical explanations for a few basic problems connected with the propagation of extra wide band, short impulses in linear media, and with the propagation of whistlers and megawhistlers in plasmas. In addition, the book provides an overview of ground and space based measurements, digital processing and signal analysis. The theoretical treatment in this volume is original in the sense that, unlike former solutions, the authors present a fundamentally non-monochromatic approach. A key feature of this approach is the application of the "Laplace Transformation" and the "Method of Inhomogeneous Basic Modes" to solve Maxwell's equations. It is shown that when the obtained theoretical results are applied to digital recordings, the wave analysis process becomes so flexible that it can also be used to investigate other wave propagation problems. These are both terrestrial phenomena (like atmospheric and seismic activity, buried target detection, etc.) and phenomena in space (planetary, interplanetary, plasmaspheric, whistler and megawhistler propagation). The book is aimed at a technical and professional audience working on whistler science and/or wave propagation problems.

VERSIM Bibliography

The bibliography on the VERSIM website has been updated to 2000 by Michel Parrot, the URSI co-chairman of the VERSIM working group, who should be contacted at mparrot@cnrs-orleans.fr if you have any additions, modifications, or other comments. The web address is:

http://www.nerc-bas.ac.uk/public/uasd/versim.html#bib

VERSIM Electronic Mailing List

The VERSIM electronic mailing list is available for use by the VERSIM Community. Details (including how to subscribe and unsubscribe) and posting guidelines, are available on the VERSIM website at: http://www.nerc-bas.ac.uk/public/uasd/versim/vrsmeml.html. Please send any information of interest to other members of the working group, directly to the electronic mailing list (see above) at versim@mail.nerc-bas.ac.uk. It will be automatically sent on to everyone who is subscribed to the list. Send any comments to owner-versim@mail.nerc-bas.ac.uk.

The role of the VERSIM Working Group

The working group serves as a forum for workers studying the behaviour of the magnetosphere and ionosphere by means of ELF and VLF radio waves, both naturally and artificially generated. Originally the emphasis was on probing of the magnetosphere by whistlers, but later the scope became somewhat broader. The group aims to promote research in this field by facilitating the exchange of ideas, information and experience between active research workers and other interested scientists. This is done through regular meetings at IAGA and URSI Assemblies, and via the circulation of a newsletter. The group has also been active in sponsoring scientific symposia at IAGA and URSI Assemblies, in areas relevant to its field of interest, and in coordinating observational campaigns. There are currently ∼90 scientists from 21 different countries (Australia, Belgium, Brazil, Canada, China, Czech Republic, Finland, France, Germany, Hungary, Italy, Japan, Netherlands, New Zealand, Norway, Russia, Serbia, South Africa, Ukraine, UK and USA) on the VERSIM mailing list.

IAGA Co-chairman of the JWG:

A J Smith
British Antarctic Survey
High Cross
Madingley Road
Cambridge CB3 0ET, UK

Telephone: +44 1223 221544
FAX: +44 1223 221226
Electronic mail:
A.J.Smith@bas.ac.uk

URSI Co-chairman of the JWG:

M Parrot
Laboratoire de Physique et Chimie de l'Environnement, CNRS
3A, Avenue de la Recherche Scientifique
45071 Orléans Cédex 02, France

Telephone: +33-2-38255291
FAX: +33-2-38631234
Electronic mail:
mparrot@cnrs-orleans.fr

VERSIM World Wide Web page:

http://www.nerc-bas.ac.uk/public/uasd/versim.html