

## **URSI/IAGA Joint Working Group on VERSIM (VLF/ELF Remote Sensing of the Ionosphere and Magnetosphere)**

Business meeting - Thursday 21 July 2005

There was a meeting of the VERSIM working group during the International Association of Geomagnetism and Aeronomy Scientific Assembly, held in Toulouse (France), at 1715 on Thursday 21 July 2005.

Present: CJ Rodger (New Zealand) in the chair, M Parrot (France), M Clilverd (United Kingdom), U Inan (USA), C Haldoupis (Greece), NR Thomson (New Zealand), F Nemecek (Czech Republic), O Santolik (Czech Republic), T Ogawa (Japan), Th Ulich (Finland), J-P Raulin (Brazil), A Rodger (United Kingdom)

### Chairman's Report:

Craig Rodger (the IAGA co-chairman), described the purpose and nature of the working group, and outlined activities of the working group since the previous IAGA meeting, held in Sapporo (Japan) as part of the IUGG meeting. The last VERSIM meeting was during last years VLF workshop held in Sodankylä (Finland) in September 2004. The chairman's report included a brief discussion on the yearly VERSIM newsletter, which is well supported by the community through a large number of reports made from many countries.

### Reports from VERSIM research groups:

The chair suggested that participants should send in brief reports by email to ensure the details of national reports were correctly recorded and communicated to the wider VERSIM community. Oral reports were made to the meeting by M Parrot (France) and J-P Raulin (Brazil). Emailed reports have been received from J-P Raulin (Brazil) and NR Thomson (New Zealand). CJ Rodger (New Zealand) has also added a report.

**Brazil** CRAAM (Center for Radioastronomy and Astrophysics Mackenzie) is led by Pr. Kaufmann and has a long tradition in VLF research for more than 3 decades. Three researchers and few students are involved in VLF works.

The group has installed two new VLF receivers at the Radio Observatory of Itapetinga (Atibaia, São Paulo, Brazil) to measure phases and amplitudes. Once tested, one system will be installed at the Comandante Ferraz Brazilian Antarctic Station.

Using phase data during the period 1989-1997 from Atibaia receivers, complemented by Inubo published data, we have been interested in the response of the low ionospheric D region to X-ray excesses during solar flares. We focus on whether or not the X-rays associated to a given solar flare were responsible for a Sudden Phase Anomaly (SPA) event, independently of the characteristics of the SPA. Approximately 1300 and 200 solar events were found to cause an ionospheric event, during periods of high and low solar activity respectively. The main results of our study are: (i) definite spectral characteristics

are required to produce a measurable SPA; (ii) the probability of SPA occurrence due to faint solar flares of X-ray class C1-C2 or lower, is higher during solar minimum; (iii) the same probability for more intense solar flares (C3 class or higher) does not depend on the solar activity conditions. Our observations suggest that the low ionosphere has different sensitivities depending on the solar activity, being more sensitive when the Sun is less active. These results also constitute an observational confirmation of recent findings showing that the ionospheric reference height is lower (of about  $\leq 1$  km) during solar minimum epochs.

Also studied are the characteristics signature of a particular phenomenon (localised ionospheric disturbance) in the detected VLF signal, generated by Van Allen belt's electron precipitation induced by lightning-generated whistler waves, and known as TRIMPI events detected in the nighttime ionosphere. We are interested in the characteristics and the understanding of several TRIMPI properties.

**New Zealand** AbsPAL VLF phase and amplitude observations have been used to extend the solar flare response of D-region electron densities up to the level of the great X45 flare of 4 November 2003. The VLF signals used at Dunedin were NLK (Seattle, 24.8 kHz), NPM (Hawaii, 21.4 kHz), NDK (25.2 kHz, North Dakota), and 'Omega Australia' (13.0 kHz, Sale). Also used were NPM signals recorded at Ny Alesund, Spitzbergen. The size of the Great Flare was determined by extrapolating the GOES X-rays fluxes (which saturated at X17.4) using the VLF phase changes (which did not saturate!) using the VLF phase changes which tracked the GOES fluxes very well. In addition (and independent of VLF measurements) the XL/XS ratio (i.e., the flux ratio of the long, 0.1-0.8 nm, and the short, 0.05-0.4 nm, X-ray bands) during big flares also gives X45 for the Great Flare. AbsPAL VLF phase and amplitude recordings are continuing in Dunedin and (on Study Leave) in Cambridge.

In the last year we have undertaken significant studies in collaboration with the British Antarctic Survey, focused on particle precipitation into the ionosphere. This includes increasing our understanding of whistler induced particle precipitation (WEP), both in terms of the ionospheric effects and the significance as a loss process in the inner radiation belt and slot region. This has combined theoretical analysis with experimental observations, particularly of Trimpi observed in Antarctica and New Zealand. Recently we have been focusing on the effects of Solar Proton Events (SPE) on the high-latitude ionosphere. This has involved experimental observations made using OmniPAL receivers in Antarctica, Finland, and Spitzbergen. Working with the University of Oulu and Finnish Meteorological institute, we have examined the importance of SPE to atmospheric chemistry, particularly the production of ozone destroying chemicals.

The groups studies have also focused on the growing World Wide Lightning Location Network (WWLLN), which now has ~22 receiving locations spread across the world. This VLF based lightning detection and location network sends lightning observations back across the internet to central processing computers in Seattle, USA (University of Washington) and Dunedin, NZ (LF\*EM Research). The WWLLN is unlike any other global scientific lightning detection system in that it operates in real-time, with only a

few seconds delay before a lightning location is registered. Working with the PIs of the network Professors Dowden (LF\*EM Research) and Holzworth (University of Washington), we have a growing understanding of the capabilities of the WWLLN. Both cloud to ground and cloud lightning are detected, although the WWLLN is strongly biased to high peak current discharges. The University of Otago group is now focused on working on the detection efficiency of the WWLLN, with the intention of developing methods to describe the peak currents of detected lightning.

### VERSIM Workshop in 2006

Last year a VLF Workshop was held in Sodankylä, Finland (27th September to 1st October 2004), hosted by our colleagues from the Sodankylä Geophysical Observatory. This meeting providing a fresh venue for the VLF community to gather and exchange information, and was a great success. After discussions amongst the participants, it was decided to run another workshop in 2006 (as no URSI or IAGA meeting will take place that year), with the possibility of the VLF Workshop becoming a "standard" feature of the VERSIM scientific community. We hope for some limited financial support from URSI and IAGA, and so may be able to assist some participants with accommodation costs.

At Toulouse, we discussed possible dates for a VERSIM workshop in Sodankylä, following on from the 2004 workshop. Based on feedback from those at the working group meeting, the preferred start date is **Monday 18 September 2006** (to avoid clashes with North American teaching times). We have identified the following subject areas as probable sessions which will appear at the workshop.

*Triggered Emissions and Nonlinear wave phenomena*  
*VLF waves and the radiation belts (acceleration and loss)*  
*ELF/VLF as a geophysics remote sensing tool (upper atmosphere, magnetosphere)*  
*Effects of ELF/VLF radiation on the atmosphere (lightning/sprites, etc)*  
*Instrumentation (as a poster session)*

If you feel your VERSIM-Science area is not represented here, contact Craig Rodger ASAP, who will pass it onto the Local Organising Committee.

Mark your diaries now for the 2006 VERSIM workshop!

### VERSIM Science Topics

It has been suggested that the VERSIM community could identify Science "Topics" that are of current interest to the wider international community. Obviously, groups in different regions will be better suited to support different topics. For example, ground based observations at high latitudes can provide important information on triggered emissions, which is extremely unlikely for observations made from equatorial locations.

However, such locations are more likely to provide important data on lightning and red sprites.

A set of VERSIM suggested Science topics might aide some newer members of the community to focus their observations towards international "hot topics". In addition, groups who are working on a VERSIM Science Topic would be able to use this to support their local grant applications. The chair (Craig Rodger), has suggested that the community should put together a short listing of current topics, which would be placed upon our webpage. The VERSIM Science Topic list would involve a few sentences describing the topic-area, plus a few relevant references, and a contact name (or two).

This idea was first launched (in public) at the Toulouse working group meeting, having been suggested to Craig Rodger earlier in the year. There was support for this idea at Toulouse. Craig will check the on the opinion of our community at this years URSI General Assembly (New Delhi). If positive, he hopes we will start moving ahead with this through discussions on the VERSIM mailing list.

#### Symposia at future IAGA and URSI Assemblies:

It was decided that the working group would not suggest any sessions for the future IAGA meeting to be held in Perugia (Italy) in 2007. There was discussion on the title of a planned session on thunderstorm effects on the upper atmosphere which has been put forward by another working group. It was felt that we didn't want to overload people at this stage, and confidence that the IAGA Division II and III business meetings would produce sessions relevant to our science (which seems to have happened).

#### Future of the working group:

It was unanimously agreed to recommend that the working group continue in existence for the period up to the next IAGA meeting (2005-2007). At this time the issue will be put to the VERSIM community again. This does not reflect a feeling that the working group should necessarily be wound up, it simply reflects the normal process for reporting to our parent bodies (IAGA and URSI).

#### Other business:

None.

There was a brief discussion on the value of brief, focused working group meetings. The VERSIM meeting broke up at around 17:50.