COST ACTION 296: MIERS
MITIGATION OF IONOSPHERIC EFFECTS ON RADIO SYSTEMS

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OVERVIEW

Commencement date: 4 February 2005
Scheduled completion date: 3 February 2009

COST (European Co-operation in the field of Scientific and Technical Research, www.cost.esf.org) Domain: TIST (Telecommunications and Information Science and Technology)

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at M€ 31 in 2004 prices

Chairperson: Dr Lj. R. Cander, RAL, UK
Vice-Chairman: Dr B. Zolesi, INGV, Italy
Secretary: Mrs. A. Vernon, RAL, UK

RAL is the Grant-Holder for COST Action 296

COST296 signatories; Austria, Belgium, Bulgaria, The Czech Republic, Cyprus, Finland, France, Germany, Greece, Hungary, Italy, Poland, Portugal, Romania, Spain, Turkey and the UK.

Non-COST members; University of Massachusetts Lowell, USA; St Petersburg State University, St Petersburg, Russia; IZMIRAN, Moscow, Russia; Polar Research Institute of China, Shanghai and China Research Institute of Radiowave Propagation, Beijing,China.

In the process: Geomagnetic Laboratory, Ottawa, Canada and Universiti Kebangsaan (UKM), Malaysia.

MAIN OBJECTIVE

Develop an increased knowledge of the effects imposed by the ionosphere on practical radio systems, and for the development and implementation of techniques to mitigate the deleterious effects of the ionosphere on such systems.

OTHER OBJECTIVES

Support and enhance the existing European facilities for historical and real-time ionospheric data collection;

Exchange information on methods and algorithms to mitigate the effects of ionospheric perturbations and variations on radio systems by creating an effective computing infrastructure and developing an integrated approach to ionospheric modelling;

Make results available to the ITU-R, ESA, ESF, European Space Programme (ESP);

Strengthen the existing areas of expertise by stimulating closer cooperation between scientists and users.

IONOSPHERIC MONITORING WITH OBLIQUE SOUNDING

Ionospheric oblique sounding measurements between Inskip, UK (53.50°N; 2.5°W) and Rome,Italy (41.8°N; 12.5°E) have been performed since November 2003 and are still running.

A second ionospheric oblique sounding link between Inskip and Chania, Crete, Greece (35.7° N; 24.0° E) was established in April 2005.

COST 296 WORKING GROUPS

WG 1 - Ionospheric monitoring and modelling: *Dr J. Laštovička and Dr I. Stanislawska*

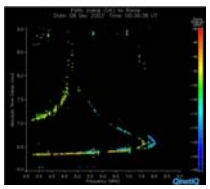
- Near Earth space plasma monitoring: *Dr D. Altadill and Mr R. Stamper*
- Data ingestion and assimilation in ionospheric models: *Dr D. Buresova and Dr B. Nava*
- Near Earth space plasma modelling and forecasting: *Prof I. Kutiev and Dr H.J. Strangeways*
- Climate of the upper atmosphere: *Dr J. Bremer and Dr E. Turunen*

WG 2 - Advanced terrestrial systems: *Prof A. Bourdillon and Prof E. Tulunay*

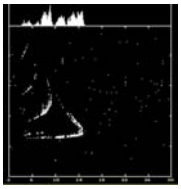
- Radar and radiolocation: *Dr C. Bianchi and Dr M. Warrington*
- HF/MF communications: *Prof J. M. Andujar and Dr P. Lassudrie-Duchesne*
- Spectrum management: *Prof L. W. Barclay and Prof A. M. Casimiro*

WG 3 - Space-based systems: *Dr N. Jakowski and Prof R. Leitinger*

- Space plasma effects: *Prof S. Radicella and Dr P. Sauli*
- Special mitigation techniques: *Dr U. Foelsche and Prof R. Warnant*
- Scintillation monitoring and modelling: *Dr Y. Beniguel and Dr V. Romano*



Oblique Ionogram Inskip – Rome



Oblique Ionogram Inskip – Chania

SPACE WEATHER

Space weather aspects of the MIERS Action present important technological problems for telecommunications. They are complementary to ongoing studies from the COST 724 Action on "Developing the Scientific Basis for Monitoring, Modelling and Predicting Space Weather". Close collaboration between the two actions has started in many areas such as catalogues of data, models and websites. This 2nd European Space Weather Week is one of the joint actions. The next action is Joint School on Space Weather, May 2006, ICTP, Trieste.

IONOSONDES IONOSPHERIC MONITORING

The whole week from 16 January 2005 was dominated by one single big sunspot group, that was clearly visible on the solar disk (http://sidc.oma.be) and produced two severe geomagnetic storms with Kp up to 7 on 17 January and Kp equal 8 on 21 January 2005. The ionospheric density and composition experience significant changes both globally and locally during these geomagnetic storms. Variability of foF2 both in space and time is shown in Figure 1 by plotting hourly foF2 values measured at five ionospheric stations in Europe during 17-19 January 2005. During this period the first geomagnetic storm created ionization disturbances that were predominantly positive at all stations on 17 January. Significant ionization depletion in foF2 at Juliusruh occurred on 18 January, when a similar negative storm effect in foF2 only started to appear at Pruhonice and Chilton. It is evident that the storm did not produce a similar negative effect at stations around 40º N Tortosa and El Arenosillo even on 19 January when the negative storm developed fully at three stations at latitudes > 50º N.

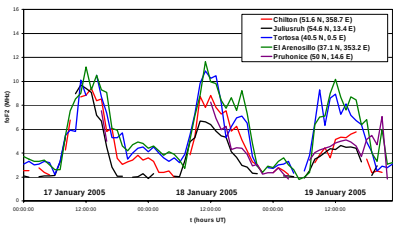
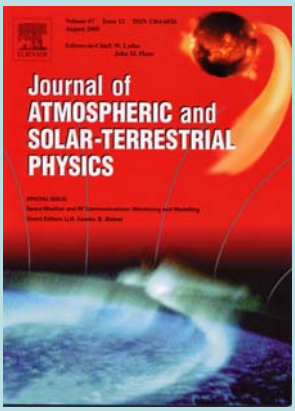


Figure 1. Hourly foF2 values measured at five ionospheric stations in Europe during 17-19 January 2005.

PUBLICATIONS

Annals of Geophysics, Vol. 48, June 2005, contributions at the Solar-Terrestrial Sciences session ST17 on "Effects of the Ionosphere on Terrestrial and Earth-Space Communications", EGS, AGU and EUG, Nice, France, 6 – 11 April, 2003.

Journal of Atmospheric and Solar-Terrestrial Physics, Vol. 67, August 2005, contributions at the Solar-Terrestrial Sciences session ST14 on "Space weather and RF communications: monitoring and modelling", EGU, Nice, France, 25 – 30 April, 2004.



GPS IONOSPHERIC MONITORING

The ionosonde measurements were then compared to vTEC data obtained from a few European IGS GPS receivers. Typical multi-point derived vTEC results are given in Figure 2, displaying the evaluation of the 10 minutes vertical TEC values from observation on 16 to 23 January 2005. It can easily be seen that the total ionospheric content was highly disturbed both in time and in space over the European area. As expected, the positive ionospheric storm is detected from midday 17 January to late night on 18 January. Figure 2 shows vTEC depletions of different scale relative to the TEC values on the quiet ionospheric day that are observed at all sites after 18 January. The observed structures in the ionospheric/plasmaspheric ionisation with some common foF2 and vTEC features as well as distinctly different irregularities during this space weather event display complex behaviour even within such a limited area of mid-latitude Europe.

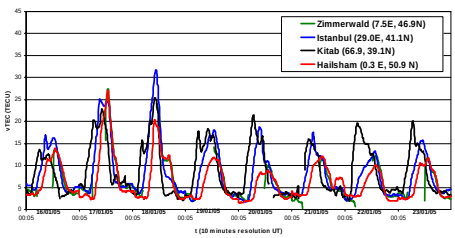


Figure 2. 10 minutes vTEC values at four GPS receivers in Europe during 16 - 23 January 2005.

HTTP://WWW.COST296.RL.AC.UK