EURIPOS: Observing and Modeling the Earth's Ionosphere and Plasmasphere

PREFACE TO THE TOPICAL ISSUE

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This Topical Issue of *Acta Geophysica* contains papers related to the EURIPOS objectives, most of them presented in ST12 session “EURIPOS: Observing and modeling the Earth’s ionosphere and plasmasphere” organized in the frames of the European Geosciences Union General Assembly held in Vienna from 19 to 24 April 2009.

The ST12 session was devoted to the presentation of joint research activities aimed at the establishment of the **European Research Network of Ionospheric and Plasmaspheric Observation Systems (EURIPOS)**. Access to reliable standardized observational data that characterize the Earth’s ionosphere-plasmasphere system is of vital importance for theoretical and applied geospace research, including space weather nowcasting and forecasting, and a key issue for various operational applications relevant to satellite navigation, earth observation and telecommunications.

The EURIPOS initiative, with the participation of 16 research establishments all over Europe, aims to provide a wider and more efficient access to and use of the ground and space-based ionospheric sounders and the Global Navigation Satellite Systems (GNSS) receivers existing in different European countries and to coordinate and optimize their operation and evolution in conjunction with all possible space missions providing data from the near-Earth plasma regimes. This session thus also encompasses efforts aiming at

the development of a new generation of models and tools designed to improve the specification, forecasting and prediction of the near geospace environment, focusing on ionospheric/plasmaspheric interactions, exploiting all possible available data sets including observations from related space missions.

This Topical Issue consists of six scientific contributions, proposing models and methods to be adopted by EURIPOS.

Kutiev *et al.* (this issue) present a new model-assisted technique (TaD model) to construct the topside electron density profile, extending above the transition height up to plasmaspheric heights. This technique is based on the Topside Sounder Model (TSM), which provides the plasma scale height, H_T , O^+H^+ transition height, h_T , and their ratio $Rt = H_T/h_T$, derived from topside sounder data of Alouette and ISIS satellites, using the model quantities as anchor points for the construction of topside density (Ne) profiles and the Digisonde derived parameters in the $hmF2$ height. It has been demonstrated that in order to reconstruct the profiles using the Digisonde derived F-region topside scale height Hm , this need to be adjusted by a correction factor that depends strongly on local time and slightly differs from station to station. In addition, it was found that the plasmaspheric scale height strongly depends on latitude and its ratio with the F-region scale height expresses large day-to-day variability. A validation of the TaD model has been attempted by Belehaki *et al.* (this issue) with systematic comparisons between electron density profiles and TEC parameters extracted from TaD model with (a) CHAMP-derived TEC parameters, (b) CHAMP reconstructed profiles, (c) ground based GPS-derived TEC parameters, and (d) profiles reconstructed from RPI/ IMAGE plasmagrams. In all cases TaD follows the general trend of plasmaspheric observations derived from the above datasets. Especially during storm cases, TaD shows remarkable agreement with the variations of the ground based GPS-derived TEC parameters. Overall the comparison of results shows that TaD method can be adopted by EURIPOS to provide the electron density distribution up to plasmaspheric heights in real-time.

Another important technique that can be pursued in the context of the EURIPOS initiative is the ionospheric correction of space radar data, proposed by Hapgood (this issue). The paper raises awareness that LEO objects are embedded in the envelope of relatively dense plasma that co-rotates with the Earth (ionosphere–plasmasphere system) and thus accurate tracking must correct for the group delay and refraction caused by that system. This paper highlights the need to customize correction to the altitude of the tracked object and prevailing space weather conditions, that ionospheric correction may be particularly important as an object approaches re-entry.

Benefiting from the large database with TEC parameters planned to be developed in the frames of EURIPOS, Cander and Ciruolo (this issue) have shown that there are still open questions related to the large electron density variations during weak disturbances requiring additional study for both their relevance to different Global Navigation Satellite Systems (GNSS) applications and their role in the formation and evolution of the daytime ionosphere at middle latitudes.

A significant part of EURIPOS activities concern the improvements in bottomside models to provide accurate lower boundary conditions for the topside extrapolation. In this context, two important contributions are presented here:

Tsagouri *et al.* (this issue) demonstrated the efficiency of the effective sunspot number, $R12_{\text{eff}}$, implemented in DIAS system, to improve ionospheric specification through accurate mapping of the ionosphere over Europe. Most importantly, the deviation of the real-time $R12_{\text{eff}}$ estimates from the reference values, $\Delta R12_{\text{eff}}$, was found to be highly correlated with the f_oF2 storm-time disturbances, especially during large scale effects indicating that DIAS- $R12_{\text{eff}}$ can provide a reliable estimator of the ionospheric activity level over a substantial part of Europe and a powerful tool for ionospheric specification applications.

Pezzopane *et al.* (this issue) proposed the use of the Autoscala software to automatically scale ionospheric characteristics from ionograms, independently of the type of the sounder. The software has been applied in different types of ionosondes (the AIS-INGV ionosondes in Rome, Gibilmanna and Tucumán, the AIS-Parus in Moscow, and the VISRC2 in Warsaw). The implementation of the Autoscala software for the purposes of EURIPOS will enhance the performance of the bottomside network, exploiting data from ionospheric stations that until recently were not able to scale in real time the ionograms.

Finally, I would like to thank Dr Lili Cander and Dr Bruno Zolesi for their kind collaboration and assistance to edit this collection of papers, and I am grateful to Acta Geophysica publishers who accepted to host it.