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REGIONAL AND LOCAL IONOSPHERIC MODELS AS INPUT DATA FOR THREE-DIMENSIONAL (3-D) IONOSPERE ELECTRON DENSITIES

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ABATRACT

Ionospheric models are important for many research, engineering and educational purposes in providing global specification of the three-dimensional (3-D) ionosphere densities. Although most of them are global as for example the International Reference Ionosphere (IRI) (Bilitza and Reinisch, Adv. Space Res., 2008)[1], and the NeQuick (Radicella, Annals of Geophysics, 2009)[2], regional and local ionospheric models can be important complements to characterize those features that may be easily smeared out in global models. They are also good validation tools for global models and should be considered as a significant part of the global IRI or any other ionospheric modelling efforts.

Real-time ionosonde observations provide an extremely valuable data source for addressing vital scientific issues related to ionospheric nowcasting. Based on these data, much progress has been made in recent years in constructing empirical regional and local ionospheric models. One of them is a real-time updated simplified ionospheric regional model for the European area SIRMUP (Zolesi et al., Radio Science, 2004)[3], which has been successfully applied in the European area for the DIAS project (Belehaki et al., Space Weather, 2006)[4]. The strength of the model is that in addition to the software tools for the real-time mapping of the regional and local ionosphere, it can assimilate a variety of different data types, including bottomside Ne profiles from ionosondes as well as models like IRI and NeQuick.

Under the assumption of space-sparse ionospheric measurements, data assimilation is the process of merging measurement data with a model to estimate the states of an area that is not directly measured. By means of data assimilation, it is possible to expand the effectiveness of limited measurements by using the model and, at the same time, increase the accuracy of model estimates using the measurements. In this study in particular, a model was used to specify the 3-D ionosphere electron density in the Central Mediterranean. The SIRMUP model and a data assimilation algorithm, as a basis for assimilating a diverse set of real-time (or near real-time) measurements, Fig.1, provide nowcasting on a spatial grid of foF2 and M(3000)F2 that can be regional, or local.

The primary output is continuous reconstruction of the IRI and NeQuick models three-dimensional electron density distribution at the specific altitude *h* on a 2°-by 2° fixed grid.

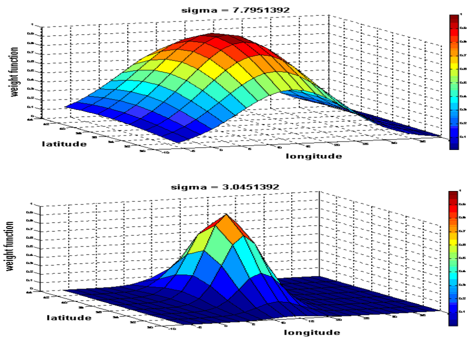

Fig. 1: Interpolation function between real time measured values and those calculated by the models.

A preliminary example of the data assimilation algorithm presented here has been performed with the ionogram from San Vito (40.6°N, 17.8°E) recorded on 24 September 2009 at 10:00UT (see Fig. 2).

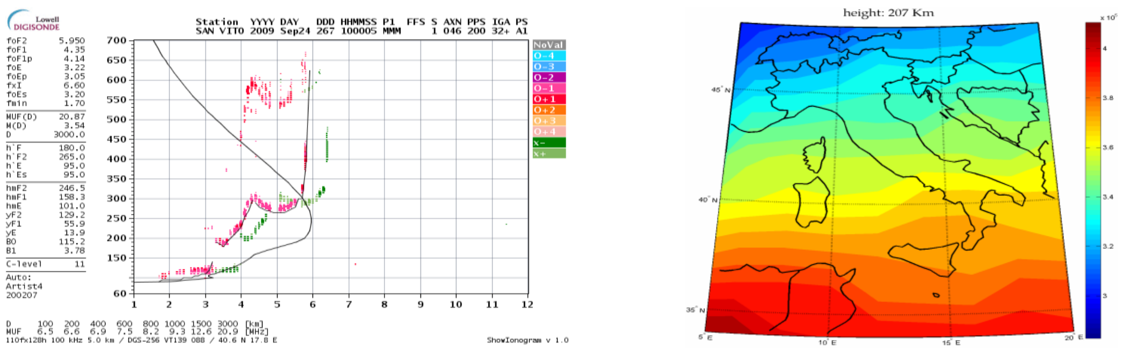

Fig. 2: (Left) Ionogram recorded at San Vito on 24 September 2009 at 10:00UT and (right) corresponding 2D map at 207 km of altitude

This paper gives an overview of the method used, some examples of the main results and application to IRI and NeQuick as their input data source. These results have already been proven as a useful facility for large number of users concerned with terrestrial and Earth- space telecommunication systems in the Central Mediterranean area.

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