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Ionospheric Electron Concentration Profiles Using IRI Ionosphere Model, COSMIC Radio Occultation Measurements, GPS and Ionosonde Data

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In this paper, several complementary techniques were applied to drive ionospheric electron density profiles over Europe. The results from well established standard, global ionosphere model – IRI (International Reference Ionosphere) – were compared with the results from ionosondes and new techniques based on GPS measurements. Satellite radio occultation measurements from Formosat-3/COSMIC (Constellation Observing System for Meteorology, Ionosphere and Climate) were used to derive ionosphere electron density profiles. COSMIC has an unique ability of performing both rising and setting occultation, producing as much as 2000 profiles of the ionospheric electron density per day. Also, the measurements provided by European digisondes (Pruhonice, Juliusruh, Ebre, Rome) were used as another independent source of electron density profiles. The obtained daily profiles were compared for the period of 2006-2008. In addition, ground-based GPS data from the IGS (International GNSS Service) network were used to obtain TEC (total electron content) measurements.

Comparison of COSMIC profiles with profiles derived from the ionosonde measurements generally (but not always) shows a good agreement for the F2 layer peak electron density (NmF2) and the bottomside F layer profile for both quiet and stormy ionospheric conditions. While IRI predicts quiet-time conditions quite well, noticeable discrepancies are observed during periods of geomagnetic/ionospheric disturbances.

Another analysis of the time series of TEC derived from IRI and IGS global ionosphere maps for almost a full solar activity cycle (1999-2008) confirms the discrepancies during active geomagnetic/ionospheric periods. These results indicate that both, COSMIC occultation-derived profiles and GPS TEC data, are valuable data sources for the improvement of the IRI model.