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3D electron density specification to support LEO and MEO satellite applications

Specification of the 3-dimensional electron density distribution (3D EDD) of the Earth's ionosphere is an important requirement for many research studies and applications. To specify the 3D EDD over a given region or entire globe, ionospheric data and models are combined in different proportions.

To support topside electron density specification requirements of the European Digital Upper Atmosphere Server (DIAS) which is operated by the European Digisonde Community and hosted by the National Observatory of Athens, the Topside Sounder Model assisted Digisonde (TaD) has been developed and implemented for the real-time DIAS operations. The TaD model provides the vertical electron density profile from the F layer peak h_mF_2 up to the GNSS orbit heights, taking the peak density and height values from Digisonde measurements and adjusting the profile integral to the Total Electron Content (TEC) value from a collocated GNSS receiver. As an upgrade to the single point solution, the 3D EDD approach has been recently proposed and validated with vertical and slant TEC parameters calculated from individual GNSS receivers.

The results provide evidence for the potential of TaD model predictions to accurately specify electron density perturbations due to large scale ionospheric storms and due to large scale travelling ionospheric disturbances. To further assess the model capacity in supporting satellite operations with ionospheric characteristics along the orbit, we perform a comparison between in situ electron density measurements from the Langmuir probe experiment onboard the DEMETER satellite, with the TaD predictions.

Results from the model were extracted for 7,721 short time intervals when DEMETER satellite was crossing over European latitudes in 2009. In this contribution we discuss the results and the potential of the model to further support LEO/MEO satellite operations.