3D Electron Density Modelling with GNSS Radio Occultation and POD Data

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A 3D-model approach was developed by Prol and Hoque [1] to describe the electron density of the topside ionosphere and plasmasphere. The main relevance of the model is that only Global Navigation Satellite System (GNSS) measurements onboard low Earth orbit satellites are used as input source. The proposed approach, therefore, does not depend on any external ionospheric/plasmaspheric model to adapt to the most recent data distributions. To this end, the electron density profiles derived from ionospheric Radio Occultation (RO) data are extrapolated to the upper ionosphere and plasmasphere based on a linear Vary-Chap function and Total Electron Content (TEC) measurements. The model assessment was carried out in 2013 and 2018 using independent TEC data as reference, as well as in-situ electron density measurements from satellites and peak parameters from ionosondes. As Figure 1 shows, a systematic better specification was obtained in comparison to NeQuick in terms of electron density. In addition to this example, improvements around 15% at 800 km, 26% at the top-most region (above 10,000 km) and 26% to 55% in terms of TEC were achieved. Our investigation shows that the developed model follows a known variation of electron density with respect to geographic/geomagnetic latitude, altitude, solar activity level, season, and local time.

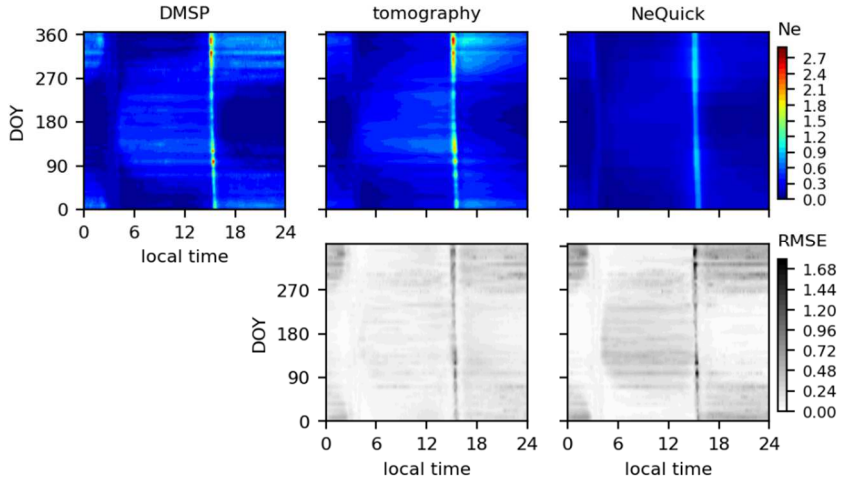

Figure 1. Electron density and root mean square error in 2013 for the in-situ data (DMSP), NeQuick and the developed approach (tomography). The electron density Ne (el/m^3) was estimated with daily averages.

1. F. S. Prol, and M. M. Hoque, "Topside Ionosphere and Plasmasphere Modelling Using GNSS Radio Occultation and POD Data," *Remote Sens.*, **13**, 2021, pp. 1559. doi: 10.3390/rs13081559.