SLANT TEC DATA INGESTION IN THE MODIFIED NEQUICK IONOSPHERIC ELECTRON DENSITY MODEL

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ABSTRACT

NeQuick is a three dimensional and time dependent ionospheric electron density model developed at the Aeronomy and Radiopropagation Laboratory of the Abdus Salam International Centre for Theoretical Physics (ICTP) - Trieste, Italy and at the Institute for Geophysics, Astrophysics and Meteorology of the University of Graz, Austria. It is a quick-run model particularly tailored for trans-ionospheric applications that allows to calculate the electron concentration at any given location in the ionosphere and thus the Total Electron Content (TEC) along any ground-to-satellite ray-path by means of numerical integration. Above 100 km and up to the F2 layer peak, NeQuick electron density is given by the sum of five semi-Epstein layers with modeled thickness parameters, whereas the model topside is described by a semi-Epstein layer with a height dependent thickness parameter empirically determined. NeQuick model has been proposed to be used for single-frequency positioning operations in the framework of the European Galileo Project and it has been adopted by International Telecommunication Union, Radiocommunnication Sector (ITU-R) Recommendation P. 531-6 as a suitable method for Total Electron Content modeling. After adaptations, the model has been used to develop a near real time reconstruction technique able to provide the electron concentration of the ionosphere at a given epoch above the geographic areas under investigation. The technique is based on the estimate of the model driving parameter Az (effective ionization level) by means of direct ingestion of slant TEC data derived from GPS receivers located in the area of interest. To further improve NeQuick model, a modified formulation for the topside thickness parameter has been adopted and a new procedure to calculate the height of the F2 layer maximum density has been implemented. The present work analyzes the performances of the proposed reconstruction technique when it is used with the modified NeQuick model to give the electron density of the ionosphere during specific time periods. For this purpose two independent validation criteria have been adopted: one based on the comparison between experimental and reconstructed slant TEC and the other based on comparison between experimental and reconstructed foF2. To take into account high solar activity conditions (the most challenging for ionospheric models), data related to several days of different seasons of the year 2000 have been chosen for the statistical analysis. The results indicate the effectiveness of the electron density reconstruction technique based on slant TEC data ingestion in the modified NeQuick model. They also indicate possible strategies that could be followed in order to modify the model formulation with the aim to better adapt the model itself to localized features of the ionosphere.