TOPSIDE IONOSPHERE IMPROVEMENTS FOR THE ELECTRON DENSITY MODEL NEQUICK

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Abstract:

The three dimensional and time dependent electron density model NeQuick has been developed at the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, and at the University of Graz, Austria. It is a quick-run model designed for trans-ionospheric propagation applications that allows to calculate both vertical or slant electron density profile and total electron content (TEC). It has been adopted by the ITU-R recommendation P.531-6 as a suitable method for modeling TEC and it has been proposed to the European Galileo project for use in single frequency positioning operations.
The source code for basic applications is available at ttp://www.itu.int/ITU-R/software/study-groups/rsg3/databanks/ionosph/.
The formulation of the topside electron density in NeQuick model has been analysed looking at possible improvements of the model performance. The present topside formulation is based on a semi-Epstein layer with a height-dependent thickness parameter, which allows to take into account in a simplified way the electron content up to plasmaspheric heights. The shape of the topside profile is determined by an empirical parameter k, which has two different formulations for different months of the year. The original relations were based on TEC and ionosonde data recorded at mid-latitude stations. In the last few years a large amount of experimental topside sounders profiles of electron density have been made available to the scientific community. The global distribution of these data allows model tests under a wide range of conditions. A revision of the empirical parameter k governing NeQuick topside shape has been studied on the basis of these perimental profiles. A unique formulation valid for all months of the year has been proposed, involving F2 layer peak parameters (foF2 and hmF2), the thickness of the bottom-side F2 layer and solar activity. The present work analyses the global behavior of the proposed new formulation, considering its effects on satellite to ground electron contents computed by the model. Possible anomalous high values of TEC in the equatorial anomaly region for very high solar activity conditions could be avoided using the new formulation. A validation of model performances has been performed comparing observed and modeled slant TEC. Both the present and the proposed formulation of NeQuick topside have been used for analysis and the year 2000 of high solar activity has been chosen. TEC observations were obtained from the GPS receiving stations of the IGS service. For the statistical analysis of model performances, the stations chosen have a homogeneous coverage of the earth including a similar number of sites at low, middle and high latitudes.