Extended validation of NeQuick 2 model for navigation applications

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Abstract

The electron density model NeQuick is designed for trans-ionospheric propagation applications. It allows calculating both vertical or slant profiles and total electron content (TEC). It has been recently upgraded to a new version, including changes in the profile formulation, both in the bottom-side and topside ionosphere. This paper presents an analysis of the capability of NeQuick 2 model to reproduce the slant TEC values measured at stations worldwide distributed. The data used cover complete years of high (2000) and moderate solar activity (2004). A comparison with GPS Ionospheric Correction Algorithm (ICA), the Klobuchar model, is also presented.

1. Summary

The three dimensional and time dependent electron density model NeQuick [1] has been developed at the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy, and at the University of Graz, Austria on the basis of the original DGR (Di Giovanni-Radicella) profiler [2]. It is a quick-run model designed for trans-ionospheric propagation applications. It allows calculating both vertical or slant electron density profile and total electron content (TEC).

The NeQuick model has been recently upgraded to a new version [3], which includes changes in the electron density profile formulation, both in the bottom-side [4] and topside ionosphere [5] along with an updated representation of the magnetic reference frame used. It maintains the representation of the electron density profile through semi-Epstein layers, for the E, F1 and F2 layers of the ionosphere. The model uses the ITU-R monthly sets of coefficients to provide the seasonal and solar cycle variations of the ionosphere maximum electron density value.

For navigation purposes the NeQuick model is driven by an effective ionization level parameter Az. In Galileo system application, sets of coefficients describe its variation with respect to modip [6]. They are computed using data from stations globally distributed and updated every 24 hours. Users can compute the slant delays by numerical integration of the electron density profile along the ray-path from user location to each satellite in view.

This paper presents an analysis of the capability of NeQuick 2 model to reproduce the slant Total Electron Content (TEC) values measured at selected International GNSS Service (IGS) stations. For the statistical analysis of model performances, these testing stations have a homogeneous coverage of the Earth globe including a similar number of sites at low, middle and high latitudes. The data used are from a complete year of high solar activity (2000) and a complete year of moderate solar activity (2004). Suitable Az coefficients have been obtained for each day from slant TEC data of 20 different IGS stations. They have been used to compute slant TEC values at the testing stations for the following day. The TEC values computed using NeQuick have been compared to the observed data with a sampling interval of 10 minutes. A comparison with GPS Ionospheric Correction Algorithm (ICA), the Klobuchar model, is also presented.

2. References


