Use of a modified NeQuick2 for the evaluation of different 3D Ionospheric algorithms

R. Orus Perez (1), B. Nava (2), J.Parro (1)

(1) Wave Interaction and Propagation Section (TEC-EFW), ESA-ESTEC, Noordwijk, Netherlands;
(2) The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy; e-mail: bnava@ictp.it

As it is well known, to obtain the electron density from the GNSS observations, and in particular from 2 frequency GPS observables, the so-called *geometry free combination* (PI and/or LI) has to be used. In the same way that in positioning techniques, it is possible to use different kinds of observables: the code pseudorange, which is affected by large amount of noise, especially due to multipath at low elevations, but it is unambiguous; and the carrier phase, which is ambiguous but it has less noise, (about a factor of 10 for GPS observables and 5 for Galileo). Thus, many techniques can be used in order to retrieve the TEC since this problem can be considered as a member of the so-called *inverse problem family*. In general, regardless if the code or carrier phase is used, these techniques can be divided in two main families, depending on which kind of model is used to describe the *STEC*. These are: models that consider the ionosphere is concentrated in an infinitesimal layer with no thickness (2D), i.e. thin shell approximation; and models that consider the ionosphere in its volume (3D), i.e. Ionospheric tomography.

On the other hand, a good method to evaluate the accuracy of the chosen model in retrieving the Ionospheric delay is hard to find, since the absolute ionospheric delay is part of the problem that we are dealing with. Therefore, a methodology to evaluate the accuracy of the different retrieval algorithms and to fine-tune the different involved parameters in the inverse model would be of a great help for the ionospheric community. Thus, in this work a method based on a modified NeQuick2 model is presented in order to perform exactly this task in a controlled environment. This environment could be from a pure climatological data to an adjusted vTEC from a Global Ionospheric Map (GIM). The proposed methodology allows testing different 3D ionospheric retrieval algorithms (voxel, multi-layer, spherical harmonics, and 2D spherical harmonics for baseline) and allows fine-tuning the parameters for the retrieval algorithm. The accuracy of the different retrieval algorithm will be tested with synthetic data (generated by this methodology). Moreover, the ionospheric retrieval algorithms and their adjusted parameters will be used to retrieve the ionospheric delay with actual data (calm and disturbed ionospheric conditions). Thus, the performance will be measured by using uncombined precise point position (single and multi-frequency solutions). This test will allow evaluating the benefits of each algorithm as well for accuracy as for converge time in the position solution.