VALUATING SEVERAL TEC RETRIEVAL APPROACHES USING SINGLE FREQUENCY POSITIONING

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Key words: TEC, Differential code biases, IRI2007, Global ionosphere maps, Single frequency positioning

Abstract.

Estimation of total electron content (TEC) from dual frequency GPS observations has been carried out for ionospheric studies or positioning applications for more than a decade. On the other hand, a number of empirical or physical models have been developed to describe spatial and temporal variation of ionospheric parameters including TEC. Some of these models have assisted GNSS community to correct ionospheric delay on single frequency observables. Most notably NeQuick, International Reference Ionosphere (IRI), Parameterized Ionosphere Model and Klobuchar have been used either by research community or as standard models for real- time single frequency point positioning. Whereas precise GPS phase geometry-free observables can provide precise time- differenced TEC estimates, absolute TEC values from commonly used algorithms can be systematically affected. This is mainly due to the receiver and satellite differential code biases (DCB) affecting pseudoranges. The goal of this paper is to compare station-by-station GPS TEC estimation approaches with those from GNSS global ionosphere maps, and some of the widely used empirical models. This study includes inter-comparisons among retrieved vertical TEC values from various estimation strategies or models as follow:

- 1. Result of a simplified single layer ionospheric model on GPS phase-levelled code ionospheric observables (the so-called geometry-free) using a commonly used mapping function. This approach is employed while estimating one set of DCB per satellite per day; or using satellites DCB from external sources and estimating one station DCB per day.
- 2. An enhanced version of the above model by estimation of an extra parameter to improve mapping TEC from slant to vertical as a function of solar hour angle; and similar to above in terms of satellites DCB handling.
- 3. Extraction of vertical TEC from global ionosphere maps; this includes IGS combined rapid and final maps and those from individual analysis centers.

- 4. Predicted values from the latest version of IRI model (IRI2007).
- 5. Klobuchar model values from GPS broadcast messages.

In order to evaluate the TEC values in position domain, a single frequency point positioning scenario is carried out. Single frequency positioning results using different vertical TEC values are compared with true position values. In order to carry out a statistically meaningful study, several stations at different Canadian latitudes in both geomagnetically quiet and disturbed periods will be processed.