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ORIGINAL ARTICLE

Single-frequency single-site VTEC retrieval using the NeQuick2 ray tracer for obliquity factor determination

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Abstract A single-frequency single-site GPS/Galileo algorithm for retrieval of absolute total electron content is implemented. A single-layer approximation of the ionosphere is used for data modeling. In addition to a standard mapping function, the NeQuick model (version 2) of the ionosphere is now applied to derive improved mapping functions. This model is very attractive for this purpose, because it implements a ray tracer. We compare the new algorithm with the old one using an effective global height of the ionosphere of 450 km. Combined IGS IONEX gridded data sets serve as reference data. On global average, we find a small improvement of 1 % in precision (standard deviation) of the NeQuick2 mapping method versus the conventional approach on global average. A site-by-site comparison indicates an improvement in the precision for 34 % of the 44 sites under investigation. The level of improvement for these stations is 0.5 TECU on average. No improvement was observed for 41 % of the sites. Further comparisons of the single (code ranges and carrier phases) versus dual-frequency (carrier phases only) single site algorithm show that dual-frequency VTEC estimation is more accurate for the majority of the stations, but only in the range of 0.3 TECU (2.6 %) in average.

Keywords Vertical total electron content (VTEC) · NeQuick ionosphere model · Single-frequency ionosphere monitoring

Abbreviations

API	Application programming interface
CMC	Code-minus-carrier (linear combination)
DGR	Di Giovanni and Radicella model (of the ionosphere)
ICTP	International Centre for Theoretical Physics
STEC	Slant total electron content
TEC	Total electron content
VTEC	Vertical total electron content

Introduction

The idea of using single-frequency GPS measurements for ionospheric delay estimation and/or correction has been recognized by several authors, although publications on this topic are relatively rare compared to the more common dual-frequency (network based) methods. Xia (1992) describes an experiment to retrieve absolute ionospheric delay errors from a single-frequency GPS receiver. This approach indicates that the use of a code range minus carrier phase combination (CMC) enables us to determine the total electron content, although the author admitted that his study was a very first step and a demonstration of the technique. Cohen et al. (1992) present a paper of similar contents at the same conference. Two years later, Qiu et al.

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