A New Model for Real-Time Regional Vertical Total Electron Content and Differential Code Bias Estimation Using IGS Real-Time Service (IGS-RTS) Products

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The international global navigation satellite system (GNSS) real-time service (IGS-RTS) products have been used extensively for real-time precise point positioning and ionosphere modeling applications. In this study, we develop a regional model for real-time vertical total electron content (RT-VTEC) and differential code bias (RT-DCB) estimation over Europe using the IGS-RTS satellite orbit and clock products. The developed model has a spatial and temporal resolution of 1°×1° and 15 minutes, respectively. GPS observations from a regional network consisting of 60 IGS and EUREF reference stations are processed in the zero-difference mode using the Bernese-5.2 software package in order to extract the geometry-free linear combination of the smoothed code observations. The spherical harmonic expansion function is used to model the VTEC, the receiver and the satellite DCBs. To validate the proposed model, the RT-VTEC values are computed and compared with the final IGS-global ionospheric map (IGS-GIM) counterparts in three successive days under high solar activity including one of an extreme geomagnetic activity. The real-time satellite DCBs are also estimated and compared with the IGS-GIM counterparts. Moreover, the real-time receiver DCB for six IGS stations are obtained and compared with the IGS-GIM counterparts. The examined stations are located in different latitudes with different receiver types. The findings reveal that the estimated RT-VTEC values show agreement with the IGS-GIM counterparts with root mean-square-errors (RMSEs) values less than 2 TEC units. In addition, RMSEs of both the satellites and receivers DCBs are less than 0.85 ns and 0.65 ns, respectively in comparison with the IGS-GIM.