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Multi-GNSS ionospheric modeling and differential code bias estimation: Benefits and challenges

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Abstract

It is well known that the ionosphere model and differential code bias (DCB) are of great significance for GNSS based precise positioning. The rapid development of GNSS and the IGS Multi-GNSS Experiment (MGEX) provide great opportunities and challenges for global ionospheric modeling and DCB estimation. In this contribution, we develop a global ionosphere model based on GPS+GLONASS+BeiDou+Galileo observations. The ionospheric modeling with GPS only, GPS+GLONASS, GPS+BeiDou, and GPS+GLONASS+Galileo observations are also performed to evaluate the contribution of each system for current global ionospheric modeling. The obtained global ionospheric maps (GIMs) are compared with the GIM products of Ionospheric Associate Analysis Centers (IAACs) to validate their accuracy and reliability. Our GIM results show excellent agreement with the IAACs products. The DCBs of GPS, GLONASS, BeiDou and Galileo are also estimated based on the observations collected by the MGEX stations. The computed DCB results are validated with the products from German Aerospace Center (DLR) and Institute of Geodesy and Geophysics (IGG). Especially, the effect of GLONASS inter-frequency bias on the differential code bias estimation and ionospheric modeling is also investigated. The results show that the effect of GLONASS inter-frequency bias on DCB estimation can reach several nanoseconds, but it has little effect on current ionospheric modeling. Furthermore, some studies on the ray-tracing mapping function and high precision fitting function are also carried out for improving the precision of ionospheric modeling.

Keywords: ionospheric modeling; differential code bias; GPS, GLONASS, Galileo and BDS; Multi-GNSS fusion