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Estimation of BDS-3 Difference Code Biases with Satellite Phase Center Offset Correction Applied

Ningbo Wang[1,2], Yang Li[1,2], Zishen Li[1,2], Liang Wang[1], and Zongyi Li[1,2]
[1]Aerospace Information Research Institute (AIR), Chinese Academy of Sciences (CAS), 100094 Beijing, China
[2]University of Chinese Academy of Sciences (UCAS), 100049 Beijing, China

The precise different code bias (DCB) correction information is basically required in the high-precision applications of multi-frequency Global Navigation Satellite Systems (GNSS). It is noted that the phase center offset (PCO) errors have not yet been properly handled in the generation of GNSS DCBs. In this paper, we first checked the variation characteristics of satellite PCOs of BeiDou global navigation satellite system (BDS-3), and analyzed the PCO effects on the generated BDS-3 DCBs. The empirical PCO correction model for DCBs (i.e., PCO-corrected-DCB) is then proposed, and the DCB estimation method with PCO correction applied (i.e., PCO-estimated-DCB) is also presented. Using BDS-3 observation data from the International GNSS Service (IGS) stations, the BDS-3 C2I/C1P/C1X-C6I DCBs with/without PCO corrections are estimated. The BDS-3 C2I/C1P single-frequency standard point positioning (SF-SPP) utilizing precise satellite orbits and clocks is performed to check the quality of the generated DCBs. Results show that the differences between DCBs estimated with and without PCO corrections reach 0.60 ns. The DCB discrepancy between different satellite types of BDS-3 is up to 1.16 ns, indicating the PCO errors in the generated DCBs can not be ignored in the associated positioning applications. Compared to the BDS-3 SF-SPP result applying DCBs without PCO corrections, the positioning accuracy improves by 1.0% and 9.6% in horizontal and vertical components for PCO-corrected-DCBs, which corresponds to 5.6% and 15.7% for PCO-estimated-DCBs. Since the temporal variation of PCO errors is properly handled in the estimated DCBs with PCO correction applied, the notable improvement in PCO-estimated-DCB based positioning can be foreseen, compared to the PCO-corrected-DCB based solution.