EGU2020-5985
https://doi.org/10.5194/egusphere-egu2020-5985
EGU General Assembly 2020

A new solar radiation pressure model for BDS-3 satellites

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Currently, with the rapid development of the third generation of BeiDou satellite system (BDS-3), the corresponding solar radiation pressure (SRP) forces should be well and soon modeled in order to enhance the performance of precise orbit determination (POD) and precise clock estimation (PCE) for high-precision applications. In this contribution, the BDS-3 post-processed and ultra-rapid PODs have been realized by fully exploiting data provided by the International GNSS Service (IGS). We firstly test the Center for Orbit Determination in Europe (CODE) SRP model (ECOM1) and ECOM2 models and notice a large disagreement of overlapping orbits at the boundary of two adjacent days within an eclipse period. The reason for this could be that the ECOM2 model is over-parameterized or an extra periodic SRP term should be considered. Furthermore, our numerical analyses confirm that the cosinus terms must be excluded and the fourth- and sixth-order SRP sinus terms are significant in the Sun direction for the SRP model of BDS-3 satellites. Therefore, a new SRP model is developed herein to improve BDS-3 orbits, especially for eclipse season. Using the new SRP model, the large fluctuations of 20 cm can be reduced to below 10 cm for the radial-track component of overlapping orbits over eclipse seasons and SLR residuals are improved by a factor of 2 compared to that of ECOM1 and ECOM2. For the predicted orbits, the improvement due to the new SRP model is also demonstrated and the mean offsets of overlapping orbit differences over the eclipse periods can be reduced from -9.3 cm, -18.9 cm, and 39.9 cm to -5.5 cm, 8.3 cm, and 12.7 cm in the radial, cross, and along directions, respectively.