Geophysical Research Abstracts
Vol. 21, EGU2019-12118, 2019
EGU General Assembly 2019

Improving QZSS precise orbit determination by considering the solar radiation pressure of the L-band/communication antenna

Yiting Zhu, Yongqiang Yuan, Jiande Huang, Jiaqi Wu, and Yun Xiong
Wuhan University, School of Geodesy and Geomatics, China (zhuyt26@126.com)

The Japanese Quasi-Zenith Satellite System (QZSS) has become a four-satellite constellation in 2017, including three Inclined Geosynchronous Orbit (IGSO) satellites and one Geostationary Earth Orbit (GEO) satellite. In this study, refined solar radiation pressure (SRP) models are proposed for QZSS IGSO and GEO satellites, by taking the L-band antenna and the communication antenna into consideration, respectively. The performances of the new proposed models in precise orbit and clock determination are evaluated in comparison with the Empirical CODE Orbit Model (ECOM), extended ECOM (ECOM2) as well as the a priori SRP model based on generic box-wing assumption.

Each IGSO satellite has a large L-band antenna cover on the PZ (Earth direction) plane. The shape of the antenna can be assumed as the combination of a circular cylinder and a circular truncated cone. Therefore, the "box-wing-hat" acceleration can be calculated and used as the a priori values to augment ECOM model. With the a priori box-wing-hat model, the stability of estimated SRP parameters can be significantly improved when compared to ECOM, ECOM2 and the a priori box-wing model. As of QZSS satellite laser ranging (SLR) residuals, the a priori box-wing-hat model achieves the smallest STD values of 5.6 cm, 5.5 cm and 5.3 cm for QZS-1, QZS-2 and QZS-4, respectively, compared with the other three SRP models. The a priori box-wing-hat model also reduces the SLR residual dependencies on the orbital angle as well as the Sun elongation angle. Furthermore, the a priori box-wing-hat model has the smallest 3-dimensional 24-h orbit overlapping RMS of 12.4 cm, with improvements of 80.6 %, 24.7 % and 19.6 % when compared with ECOM, ECOM2 and the a priori box-wing model, respectively. Similarly, box-wing-hat model can also improve the clock accuracy by 55.8 %, 34.9 % and 1.2 % compared with ECOM, ECOM2 and box-wing model, respectively.

The GEO satellite QZS-3 carries a large communication antenna (CA) on the +X panel, pointing to the Earth direction. Since the area of the CA (9.1 m^2) is even larger than the +Z and –Z panels, an acceleration of almost the same magnitude could be generated when the CA is illuminated. Besides, it is worth noting that there will be times when the shadow of the CA will be projected on the +X panel, hence the change of illuminated area of +X panel should be taken into consideration. By modeling the two contributions above, the SLR residuals can be slightly reduced compared with the other three SRP models.