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Solar radiation pressure model of GPS and GLONASS satellites considering potential surface radiator impact

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Within the IGS (International GNSS Service), precise orbit and clock products of GPS and GLONASS satellites as well as Earth rotation parameters (ERPs) are routinely generated by individual analysis centers. As the dominant non-gravitational perturbation, solar radiation pressure (SRP) is modeled differently by different centers. Without surface properties, the empirical CODE orbit models (ECOM, ECOM2) are mostly used. We find that the ECOM models are not optimal for GLONASS satellites, especially during the eclipsing seasons. Also, the use of a conventional a priori box-wing (BW) model does not help much. By assessing the ECOM estimates we conclude that there are potential radiators on the –x surface of GLONASS satellites causing orbit perturbations in eclipse as well. Based on this finding, we firstly adjust optical properties of GLONASS satellites considering the potential radiator and thermal radiation effects. Then, we introduce all the adjusted parameters into a new a priori model and jointly use it together with the ECOM models. Results show that orbit misclosure between two consecutive arcs reduces by about 30 % for the ECOM model during the eclipsing seasons. In addition, the spurious pattern of the satellite laser ranging (SLR) residuals is greatly reduced. Also, we have repeated the same adjustment of optical properties for GPS satellites by using 6 years' data (2014 - 2019). We evaluate GPS orbits, ERPs and geocenter products calculated with different SRP models (ECOM, ECOM+BW, ECOM2, ECOM2+BW, adjustable BW, GSPM) and present corresponding systematic errors of each product at harmonics of the GPS draconitic year.