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# Earth radiation pressure model for GPS satellites

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GPS satellite orbits available from the International GNSS Service (IGS) show a consistent bias of 3-4 cm in the SLR residuals. Furthermore the SLR residuals, when plotted in a Sun-fixed reference frame, show a peculiar pattern at the few centimeter level that was suggested to be related to radiation pressure mismodelling. In addition, orbit related frequencies were identified in geodetic time series such as apparent geocenter motion and station displacements derived from GPS tracking data.

Earth radiation (visible and infrared) has a small impact on GNSS due to the large distance between the satellites and the Earth. The effect on the orbits is mainly a reduction of 1-2 cm in the radial component, and smaller perturbations in the along-track and cross-track components. Despite the small magnitude of the effect it has been shown that it can partially correct the bias observed in the SLR residuals and also reduces the spectra at orbit related frequencies observed in ground tracking stations displacements. Not all IGS Analysis Centers are yet modelling Earth radiation pressure. We propose here an easy-to-use model for GPS satellites that can eventually be used within the IGS in the operational processing as well as for reprocessing.

In a previous study the key factors for modelling Earth radiation pressure in a simple but adequate way were identified, in particular the use of a box-wing satellite model (instead of a cannon-ball model) is the most important factor. The proposed model is based on published satellite surface areas and optical properties. The radiation coming from the Earth is modelled by monthly averages of CERES (Cloud and Earth's Radiant Energy System) Earth reflectivity and emissivity satellite data. In addition, a purely analytical model of the Earth radiation (using a value of 0.3 for the albedo of the Earth) is implemented for comparison purposes.

In this work, the Earth radiation pressure model is explained as well as the assumptions needed for its construction, both for the Earth radiation as for the satellite models. The results are presented in terms of the resulting acceleration and compared to model variants: 1) to observe the behaviour of the model for all possible relative positions of Sun, Earth and satellite and 2) for specific day and GPS satellites. Finally the impact on the GPS orbits (using tracking data from the global IGS network) is shown, using a processing scheme similar to the one of CODE (Center for Orbit Determination in Europe).