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Assessing the Impact of Earth Radiation Pressure Acceleration on Low-Earth Orbit Satellites

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The orbits of satellites are influenced by several external forces. The main non-gravitational forces besides thermospheric drag, acting on the surface of satellites, are accelerations due to the Earth and Solar Radiation Pressure (SRP and ERP, respectively). The sun radiates visible and infrared light reaching the satellite directly, which causes the SRP. Earth also emits and reflects the sunlight back into space, where it acts on satellites. This is known as ERP acceleration. The influence of ERP increases with decreasing distance to the Earth, and for low-earth orbit (LEO) satellites ERP must be taken into account in orbit and gravity computations. Estimating acceler- ations requires knowledge about energy emitted from the Earth, which can be derived from satellite remote sensing data, and also by considering the shape and surface material of a satellite.

In this sensitivity study, we assess ERP accelerations based on different input albedo and emission fields and their modelling for the satellite missions Challenging Mini-Satellite Payload (CHAMP) and Gravity Recovery and Climate Experiment (GRACE). As input fields, monthly 1°x1° products of Clouds and the Earth's Radiant Energy System (CERES), L3 are considered. Albedo and emission models are generated as latitude-dependent, as well as in terms of spherical harmonics. The impact of different albedo and emission models as well as the macro model and the altitude of satellites on ERP accelerations will be discussed.