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Inversion of the Earth spherical albedo from radiation-pressure

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We are studying the retrieval of the spherical albedo and net radiation of the Earth from the perturbations caused by the planet's radiation on the dynamics of its satellites. The spherical or Bond albedo gives the ratio of the fluxes incident on and scattered by the planet. The net radiation represents the net heat input into the planet's climate system and drives changes in its atmospheric, surface, and ocean temperatures. The ultimate aim of the study is inverting the problem and estimating the Earth albedo based on observations of satellites, simultaneously improving the space-geodetic positioning accuracy.

Here we investigate the effect of the spherical albedo on satellite orbits with the help of a simplified model. We simulate the propagation of satellite orbits using a new simulation software. The simulation contains the main perturbing forces on medium and high Earth orbits, used by, e.g., navigation satellites, including the radiation pressure of reflected sunlight from the Earth. An arbitrary satellite shape model can be used, and the rotation of the satellite is modeled. In this first study, we use a box-wing satellite model with a simple surface BRDF. We also assume a diffusely reflecting Earth with a single global albedo value. We vary the Earth albedo and search for systematic effects on different orbits. Thereafter, we estimate the dependence of the albedo accuracy on the satellite positioning and timing data available. We show that the inversion of the spherical albedo with reasonable accuracy is feasible from the current space-geodetic measurements.