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Orbit analysis impacts on GPS reference frame realizations

Thomas A Herring
MIT, EAPS Room 54-820A, Cambridge MA, United States (tah@mit.edu, 001 617 2587401)

The effects of in-accurate modeling of GPS satellite orbits still poses problems for long- and short-term realizations of both global and regional reference frames. Evidence of these deficiencies comes from the sensitivity of the estimates of the origin of the reference frame to the treatment of once-per-revolution orbit parameters, and the appearance of draconic periods (i.e, periods associated with the Sun being in the orbit plane of a satellite) in position time series. Each of these phenomena is likely related to radiation forces on the satellites. We examine the effects of the treatment of GPS satellite orbits on the realization of terrestrial reference frames and the effects that these treatments have on regionally dense networks of GPS sites realized in these frames. In addition to the direct effects of solar radiation, the albedo of the Earth leads to perturbing forces on the satellites. These variable forces have lead to many different methods of estimating the effects of solar radiation pressure on the GPS satellite orbits. There is an impact of the methods used to estimate the effects of radiation pressure forces on the terrestrial frame realization. In particular, the recovery of the location of the center of mass of the Earth is greatly affected by the treatment of once-per-revolution type radiation parameters. On the other hand, terrestrial scale is not so affected by these parameterizations. Terrestrial scale is affected mostly by the treatment of the phase center variations and location of the phase center on the satellites. We investigate if the impact of once-per-revolution parameterization can be reduced with integration of longer GPS orbital arcs. We also examine the impact of the orbit and reference frame treatments when regional data sets are incorporated into a global reference frame. Here we specifically examine results from some regional networks such as the Plate Boundary Observatory (PBO), which includes the 1000-station GPS network spread across the United States.