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# Orbit and Phase Center Model Effects on GPS Reference Frame Realizations

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We examine the effects of the treatment of GPS satellite orbits and the models of the satellite phase center on the realization of terrestrial reference frames. GPS satellites under go complex orbit perturbations due to the effects of solar radiation pressure acting on the satellite surfaces. The most important surfaces are the solar panels that are controlled to point to the Sun but due to control precision will not always point exactly at the Sun. In some satellites, momentum wheel failures lead to very poor alignment of the panels with the Sun, which leads to large variations in the radiation pressure. In addition to the direct effects of solar radiation, the albedo of the Earth also 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 radiation parameters. On the other hand, terrestrial scale is not so affected. In addition to the complex radiation forcing, there are effects from the phase of the transmission antennas as a function on nadir angle and azimuth. These variations are difficult to decouple from terrestrial antenna phase center variations and strongly couple to the terrestrial scale estimates. We discuss the impact of the radiation parameter estimation and phase center models on terrestrial frame realization and examine how much of the effect can be accounted for with translation, rotation, and scale of the frame. 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 the Plate Boundary Observatory (PBO), which includes the 1000-station GPS network spread across the United States.