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Terrestrial Reference Frame Realization from Combined GPS/LEO Orbit Determination

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Accurate and consistent determination of the GPS spacecraft orbits and clocks over many years provides the foundation for stable realization of the terrestrial reference frame (TRF) from GPS. Our precise orbit and clock determination (POD) strategy is tuned for TRF realization: we utilize 9-day "long-arc" solutions to capitalize on spacecraft dynamics, and a homogenous ground network of stations equipped with choke-ring antennas. For the GPS spacecraft, we use transmitter antenna calibrations derived from TOPEX/Poseidon and GRACE measurements, and estimate white-noise clock, constant position and velocity, and empirical once- and twice-per-revolution accelerations in the spacecraft-sun coordinate frame. Ground station antenna calibrations are based on test range measurements, and constant positions are estimated with loose constraints. The resulting TRF is, thus, realized without apriori ties to the ITRF. Our contemporary solutions span ten years and – relative to ITRF/IGS08 at 2005.0 – achieve an origin offset and rate (3D) of 4 mm and 0.6 mm/yr, respectively, and scale bias and drift of 2.7 ppb and -0.04 ppb/yr.

We now extend our long-arc strategy to process terrestrial and low earth orbiter (LEO) GPS measurements simultaneously. We will investigate possible improvements with LEO data which have different error sources than ground based GPS receivers and different dynamics than the GPS spacecraft. We initially add the GRACE-A spacecraft to our TRF solutions for the period spanning 2006-2010. Complete TRF realizations and details on tuned reduced-dynamic LEO POD strategies will be presented. We also explore the inclusion of additional LEO spacecraft (e.g., Jason-1/2) in the POD solutions.