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Improving GPS-Based Determination of the Terrestrial Reference Frame

Jan Weiss (1), Willy Bertiger (1), Shailen Desai (1), Bruce Haines (1), and Aurore Sibois (2)

(1) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA, (2) Colorado Center for Astrodynamics Research, University of Colorado, Boulder, CO, USA

Accurate and consistent determination of GPS spacecraft orbits and clocks over many years provides the requisite framework for defining the terrestrial reference frame (TRF) from GPS. We present GPS precise orbit determination (POD) strategies that are tuned toward improving the accuracy and stability of the GPS-derived TRF. To provide a realization of the TRF that is independent of other frames (e.g., ITRF, WGS84), we utilize GRACE-derived transmitter calibrations and ground station antenna calibrations from test range measurements. We additionally employ a "long arc" POD strategy with weekly solutions spanning 9 days to capitalize on the dynamics of the GPS spacecraft orbits. We limit the ground station network to sites with similar types of choke-ring antennas, and explore using a fixed number of sites as well as a variable number of sites that balance the north-south distribution of the network over time. Our results are promising: over a period of 10 years, relative to ITRF, we achieve x, y, and z translation biases of -3 mm, -1 mm, and 13 mm, with drifts of -0.5 mm/yr, 0.2 mm/yr, and -1.2 mm/yr, respectively, and scale bias and drift of 1.8 ppb and -0.02 ppb/yr. We expect to present further developments, including improvements to the accuracy of the TRF z-component.