Geophysical Research Abstracts
Vol. 13, EGU2011-12263, 2011
EGU General Assembly 2011

GPS satellite antenna parameters from combined ground-based and space-borne data processing

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We derive phase center offsets (PCOs) and variations (PCVs) for almost all GPS Block II/IIA/IIR/IIF transmitting antennas by processing multi-year GPS dual-frequency code and phase observables from Jason-1/2 together with ground-based data from a globally well-distributed set of International GNSS Service (IGS) tracking stations in a common least-squares (LS) analysis. To alleviate the effect of unmodelled Jason-1/2 receiving antenna PCOs and PCVs propagating into the GPS transmitting antenna parameters, we estimate the PCOs and PCVs for Jason-1/2 as well. The quality of the new antenna corrections, in particular with regard to the IGS standard, and their impact on precise orbit determination (POD) of low-Earth orbiting (LEO) satellites will be discussed.
The 1336-km orbital altitude of the Jason-1/2 spacecraft is particularly favourable as it allows determination of the GPS antenna PCVs up to 17° boresight angle without the need of setting up additional troposphere parameters. Rather than introducing the ephemeris and clocks of the GPS satellite constellation as fixed quantities into the LS analysis and post-fitting observation residuals for recovering the phase center characteristics, as proposed by other authors, the orbit and clock parameters of all spacecraft involved are jointly estimated along with the GPS and LEO satellite antenna parameters. Since the orbital scale (mean altitude) of Jason-1/2 is well-determined from the dynamical POD constraint (GM), we do not have to adopt the scale of an external terrestrial reference frame (TRF) solution in order to solve for the PCOs' vertical components (z-offsets). Thus, our z-offset estimates are not affected by uncertainties inherent in the particular TRF.