Geophysical Research Abstracts
Vol. 19, EGU2017-14411, 2017
EGU General Assembly 2017
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Impact of GNSS orbit modeling on LEO orbit and gravity field determination

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On January 4, 2015 the Center for Orbit Determination in Europe (CODE) changed the solar radiation pressure modeling for GNSS satellites to an updated version of the empirical CODE orbit model (ECOM). Furthermore, since September 2012 CODE operationally computes satellite clock corrections not only for the 3-day long-arc solutions, but also for the non-overlapping 1-day GNSS orbits. This provides different sets of GNSS products for Precise Point Positioning, as employed, e.g., in the GNSS-based precise orbit determination of low Earth orbiters (LEOs) and the subsequent Earth gravity field recovery from kinematic LEO orbits. While the impact of the mentioned changes in orbit modeling and solution strategy on the GNSS orbits and geophysical parameters was studied in detail, their implications on the LEO orbits were not yet analyzed.

We discuss the impact of the update of the ECOM and the influence of 1-day and 3-day GNSS orbit solutions on zero-difference LEO orbit and gravity field determination, where the GNSS orbits and clock corrections, as well as the Earth rotation parameters are introduced as fixed external products. Several years of kinematic and reduced-dynamic orbits for the two GRACE LEOs are computed with GNSS products based on both the old and the updated ECOM, as well as with 1- and 3-day GNSS products. The GRACE orbits are compared by means of standard validation measures.

Furthermore, monthly and long-term GPS-only and combined GPS/K-band gravity field solutions are derived from the different sets of kinematic LEO orbits. GPS-only fields are validated by comparison to combined GPS/K-band solutions, while the combined solutions are validated by analysis of the formal errors, as well as by comparing them to the combined GRACE solutions of the European Gravity Service for Improved Emergency Management (EGSIEM) project.