Geophysical Research Abstracts
Vol. 20, EGU2018-18062, 2018
EGU General Assembly 2018

Swarm precise orbit determination and its application in deriving geocenter variations in combination with ground observations

Kangkang Chen (1,2) and Markus Rothacher (1)

(1) Institute of Geodesy and Photogrammetry, ETH Zürich, Switzerland, (2) College of Geology and Geomatics Engineering, Chang'an University, 710054 Xian, China

Swarm is the fourth Earth Explorer mission of the European Space Agency (ESA) to study dynamic processes in the Earth and its space environment. The mission consists of three identical satellites, flying in carefully selected near polar orbits with two spacecraft flying side by side at low altitude and one flying at a slightly higher altitude. After a 3 months commissioning phase, 4 years normal mission provides a wealth of data to investigate variations in Earth's interior, the atmosphere, the ocean, and in near-Earth space. The onboard GPS receivers, star cameras, and laser retro-reflectors make the Swarm mission an interesting candidate to explore its contribution in combination with other satellite missions or ground observations.

Each Swarm satellite is equipped with an 8-channel, dual-frequency Global Positioning System (GPS) space-borne receiver. Precise knowledge of the Phase Center Variations (PCV) of the GPS antenna is crucial for precise absolute orbit determination. We used two methods to correct the PCV: one way is to correct the phase center variations using the empirical PCV map derived in an antenna-fixed coordinate system as bin-wise mean values of GPS carrier phase residuals from Swarm reduced-dynamic orbit determination. Another way is to estimate the coefficients of a spherical harmonics representation for the receiver PCV in daily data processing. The two approaches and their effectiveness are compared here in detail.

During the orbit determination process, empirical accelerations were estimated to compensate the mis-modelling of satellite dynamics. The reduced-dynamic and kinematic orbits were calculated and evaluated. The phase residuals of the Ionosphere-Free (IF) linear combination were significantly reduced by the PCV corrections and the agreement with the independent Satellite Laser Ranging (SLR) data was improved.

Combining the GPS tracking data collected onboard the Swarm mission with ground-based observations is a promising way to improve the realization of the terrestrial reference frame, especially the estimation of geocenter coordinates. To assess the improvement of the geocenter coordinates, we processed a network of about 50 globally distributed IGS stations together with the three Swarm LEOs over the whole year 2016. Preliminary analyses were also done involving observations from additional LEO satellites. We present the significant impact of the individual LEOs and the combination of several LEOs on the geocenter coordinates.