EGU21-7708, updated on 23 Jan 2022
https://doi.org/10.5194/egusphere-egu21-7708
EGU General Assembly 2021

Time-variable gravity field recovery from kinematic positions of Low Earth Orbiting satellites

Thomas Grombein, Martin Lasser, Daniel Arnold, Ulrich Meyer, and Adrian Jäggi
University of Bern, Astronomical Institute, Bern, Switzerland (thomas.grombein@aiub.unibe.ch)

For the monitoring of mass transport and mass distribution in the Earth's system, the gravity field and its temporal variations provide an important source of information. Dedicated satellite missions like GRACE and GRACE-FO allow to resolve the Earth's time-variable gravity field based on ultra-precise inter-satellite ranging. In addition, any (non-dedicated) Low Earth Orbiting (LEO) satellite equipped with an on-board GNSS receiver may also serve as a gravity field sensor. For this purpose, the collected GNSS data is used to derive kinematic LEO orbit positions that can subsequently be utilized as pseudo-observations for gravity field recovery. Although this technique is less sensitive and restricted to the long wavelength part of the gravity field, it provides valuable information, particularly for those months where no inter-satellite ranging measurements are available from GRACE or GRACE-FO. Furthermore, the increasing number of operational LEO satellites makes it attractive to produce combined Multi-LEO gravity field solutions that will take advantage of the variety of complementary orbital configurations and can offer additional sensitivities to selected coefficients of solutions based on inter-satellite ranging.

At the Astronomical Institute of the University of Bern (AIUB) GPS-based kinematic orbits are routinely processed for various LEO satellites like missions dedicated to gravity (GOCE, GRACE/-FO), altimetry (Jason, Sentinel), or further constellations of Earth-observing satellites like SWARM. Beside conventional ambiguity-float orbits, also ambiguity-fixed orbits are recently being computed based on new phase bias and clock products of the Center for Orbit Determination in Europe (CODE). The kinematic orbit positions offer the opportunity to derive time series of monthly gravity field solutions for the different LEO satellites that are eventually combined on the level of normal equations.

In this contribution, we will present first results of our effort to generate a combined time series of monthly gravity field solutions based on the kinematic orbits of multiple LEO satellites. In a first step, the focus is laid on the GRACE/-FO missions that provide the longest time series in terms of collected GNSS data and that will therefore serve as a backbone for future combinations. We analyze the impact of accelerometer data on the recovery of time-variable mass variations. This will be particularly important for the handling of non-dedicated gravity missions, for which accelerometer measurements are usually not available. Furthermore, we study and compare the performance of gravity field recoveries based on ambiguity-float and ambiguity-fixed kinematic orbit solutions. We assess our results with respect to superior gravity field models based on inter-

satellite ranging for selected areas with strong mass change signals like in Greenland, West-Antarctica or the Amazon river basin.