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# Satellite orbit and gravity field determination at AIUB

DS and high-performance computing, e.g. work using the UBELIX cluster

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## Abstract

Many of the satellites in Low Earth Orbit (LEO) carry GNSS (Global Navigation Satellite Systems) receivers on board, the data of which can be used for the positioning with accuracies reaching cm or even sub-cm levels. These accuracies are mandatory for many Earth observation missions, e.g., for satellite altimetry, measuring global sea level and its changes.

The aforementioned positioning accuracies can only be reached by substantial efforts in modeling of both the satellite dynamics and the GNSS measurements. Active research in both areas is performed at AIUB's satellite geodesy group and in particular in its subgroup "Orbit and Gravity Field Determination". Based on the high-quality products for the GNSS constellations computed at AIUB's Center for Orbit Determination in Europe, we process data of numerous LEO satellites using our in-house Bernese GNSS Software.

A particular application of some satellites in LEO is the measurement of Earth's gravity field and its time variations, e.g., by means of the currently on-going mission GRACE-Follow On. The global Earth gravity field provides key insights into geophysical processes and is essential to observe the system Earth and to quantify its changes, e.g., induced by climate change. Both GNSS-derived satellite orbits and additional dedicated measurements are key to resolve the global gravity field over a wide frequency domain. The computational effort is substantial: The generation of a monthly Earth gravity field model from GRACE Follow-On data up to degree and order 120 in spherical harmonics expansion requires the processing of far more than 1 million measurements and the estimation of more than 20'000 parameters. These numbers can still become significantly larger in the computation of gravity field models of other celestial bodies, e.g., of the Moon from the processing of tracking data of planetary probes, which is as well an active area of research at AIUB.

We present selected results in the mentioned areas and discuss in particular the computational requirements to achieve them.