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GPS-based gravity field recovery from reprocessed GOCE precise science orbits

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ESA's satellite mission GOCE observed the Earth's gravity field between November 2009 and October 2013 with an unprecedented accuracy and a high spatial resolution. While the core instrument for gravity field measurements was a three-axis gravity gradiometer, two dual-frequency GPS receivers were used as primary instruments for orbit and low-degree gravity field determination.

Within the framework of the GOCE reprocessing campaign of the High-level Processing Facility (HPF), the GPS-based Precise Science Orbits (PSOs) have been recomputed at the Astronomical Institute of the University of Bern (AIUB) to provide improved and homogeneously reprocessed orbits for the entire GOCE mission. With respect to the operational GOCE PSOs, dedicated weighting strategies have been applied to mitigate ionosphere-induced effects in the GPS data, without significantly degrading the orbit quality.

In this presentation, we use the 1-sec kinematic positions of the reprocessed GOCE PSOs as pseudo-observations to perform gravity field recovery with the Celestial Mechanics Approach (CMA), and derive spherical harmonic coefficients of the Earth's gravity field up to degree and order 120. We demonstrate that with the reprocessed GOCE PSOs a substantially improved quality for the lower spherical harmonic degrees between 10 and 50 is obtained. In the spatial domain, the improvements in this spectral band correspond to a strong reduction of ionosphere-induced artifacts along the geomagnetic equator. By additionally introducing observed accelerometer data in the gravity field determination with the CMA in a rigorous way, considerable improvements are also achieved for the lowest spherical harmonic degrees below 10. This makes it possible to exploit the full potential of the time-variable gravity field signal captured by the GOCE satellite.