Gravity field models derived from Swarm GPS data

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Introduction

The Swarm satellites continue to provide high-quality GPS SST data. We use these data to derive time-varying gravity field of the Earth at 1500km resolution, on a monthly basis since December 2013. We combine the gravity field solutions computed with the data of all three satellites, as provided by the Astronomical Institute (ASU), Astronomical Institute of the University of Bern (AIUB) and Institute of Geodesy (IfG) and demonstrate that this uninterrupted time series of gravity field models are in good agreement with the temporal variations observed by the GRACE satellites.

The GPS SST data gathered by the Swarm satellites can be used to study large-scale mass changes globally, e.g. in the context of low-latency applications, such as the European Gravity Service for Improved Emergency Management project (http://egsiem.eu), ii) in those months where GRACE solutions are not available, and iii) as an important source of independent information for mitigating the GRACE/GRACE Follow-On gap.

Swarm gravity field models

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Gravity field model pre-processing

- Truncation to degree 20
- $C_{20}$ replaced with value from GRACE Technical Note 07
- Temporal variations relative to GGM05S
- Low-pass smoothing with 750km radius ($\approx$ degree 13)

Gravity field model combination

We combine the models described using simple arithmetic averaging:

$$C_\ell^m = \sum_i C_\ell^m (i) \times \left( \frac{1}{n} \right)$$

(1)

Conclusions

- Capable to detect large mass transport processes at $\approx$ 1500km scale
- Long-term trends differ from GRACE by a factor of 2
- Large scatter in (smaller) catchments, disorder water storage history
- Unreliable in the first 5 months of the mission, due to high ionospheric activity and sub-optimal GPS receiver settings
- Later months with $\approx$ 1 cm geoid height difference w.r.t. GRACE
- Likely remain with comparable accuracy during GRACE/GRACE-FO gap

References


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