Geophysical Research Abstracts
Vol. 20, EGU2018-13217, 2018
EGU General Assembly 2018

Reprocessed GOCE gravity gradients for gravity field recovery: first results with the time-wise approach

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The Gravity field and Ocean Circulation Explorer (GOCE) satellite mission was in orbit from 2009 to 2013 to observe the static part of the Earth's gravity field. The novel concept of a gradiometer in space was used to measure the second derivatives of the Earth's potential. After a calibration and preprocessing, level 1B (L1B) gravity gradients can be deduced which are then used to estimate the static part of the Earth's gravity field as a spherical harmonic model. Especially the medium and short wavelength part can be derived from the gradiometer measurements with a high precision. GOCE based global gravity field models including all mission data currently provide the best knowledge in that resolution.

Since the release five of the global models, numerous studies were performed to identify improvements in the preprocessing and calibration of the L1B gravity gradients and the analysis procedures used to determine the gravity field models. It was shown, that with an improved preprocessing and calibration higher quality L1B gravity gradients can be derived, significantly reducing non-gravitational signal. Consequently, higher quality gravity gradients are available for gravity field determination. In addition to the input data, the analysis algorithms of the used time-wise approach were improved as well, yielding gravity field models improved by 10 percent, even using the original L1B data compared to the release five gravity field models (EGM_TIM_RL05). Mainly, the estimation procedure of the decorrelation filters was robustified to better account for the non-stationarity of the error characteristics of the highly correlated gravity gradients. The discussed updates and improvements are applied within an official reprocessing campaign of all GOCE products funded by ESA.

Within this contribution, the newly reprocessed L1B gravity gradients are used to demonstrate the gain of the mentioned improvements for global gravity field recovery. For that purpose, some periods of the GOCE time series are analyzed in detail and gradiometer-only gravity field models are derived from different gradient components. The effects of the proposed updates for the different gradient components are studied and discussed. Comparisons with the old data and the formally used analysis procedures are done to highlight the improvements of the discussed changes in processing. The results with the updated L1B data are used to discuss whether further updates in the processing and decorrelation algorithms are required.