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Can GOCE help to improve temporal gravity field models ?

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The main objective of the GOCE mission is to determine the static part of the Earth's gravity field with unprecedented accuracy and spatial resolution. In the original mission profile, two separate measurement phases of about six months duration each were foreseen to collect gradiometer observations at a very low orbital altitude, separated by a hibernation phase of about 3.5 months where no data from the core instruments were available. However, as opposed to the original schedule it turned out that it is technically feasible to probe the Earth's gravity field continuously also during the long eclipse (hibernation) phases, and due to the mission extension until December 2012 even for a much longer time period.

In this paper it shall be investigated to what extent GOCE can support and improve time-variable GRACE gravity field estimates. Although GRACE is superior in the low to medium wavelengths of the gravity field spectrum due to its low-low satellite-to-satellite tracking concept, data analysis indicates that GOCE can indeed contribute to temporal gravity field modelling, making benefit of the fact that, in contrast to GRACE, the error structure of the GOCE observation type is isotropic.

The restriction of temporal gravity field estimates derived from GRACE to the very long wavelengths is a major limitation affecting many hydrological, cryospheric and geophysical applications, and any improvement of the present situation towards shorter wavelengths would be extremely valuable. Another important aspect is, that with GOCE a second, independent estimate of the Earth's gravity field is available, which can be used for a better understanding of the errors in GRACE models.

The feasibility to improve GRACE temporal gravity field solutions by supporting them with the new measurement type of GOCE gravity gradients shall be assessed in a systematic way. GRACE normal equations are combined with GOCE for (bi-)monthly periods, and possible improvements of the temporal gravity field models and their covariance structure are analyzed. The resulting solutions are also compared with GRACE-only models in target regions with strong hydrological signals.