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Can we use regional runoff models for correcting time series of absolute gravimetry?

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Absolute gravity time series are available at various stations in Norway. The data have mainly been used for investigation of secular variations due to glacial isostatic adjustment. Previous work indicates that some of the estimated gravity trends suffer from unmodeled geophysical effects, like hydrological mass variations. Here we try to correct for hydrological effects by employing a combination of global and regional hydrological models. We use gravity data at two locations in the Norwegian network (NMBU and TRYC) which have frequently been observed with the absolute gravimeter FG5-226.

For computing the gravity corrections, we test various Global Hydrological Models (GHMs) and combine them with a Regional Runoff Model (RRM) for Norway, run by the Norwegian Water Resources and Energy Directorate (NVE). We distinguish between an outer and an inner zone. In the outer zone, Newtonian attraction and loading effects are derived from the GHMs, while the RRM is used in the inner zone. Both types of models provide information on soil moisture and snow layers. The RRM provides groundwater variations in addition. Furthermore, we try to consider the 'umbrella effect' that accounts for local disturbances in subsurface water flow caused by the existence of the building in which the gravity site is located.

Neglecting the GIA trend, both NMBU and TRYC gravity time series show different amplitude and pattern. NMBU shows a lower amplitude, and with no prominent periodic pattern in the data, while TRYC shows the opposite. Significant discrepancies occurring in the NMBU gravity dataset between 2014 and 2015 are likely due to an instrumental effect, such as maintenance. The total modelled hydrological signal ranges from -4 and 4 μGal. Application of the correction reduces the standard deviation in the gravity time series, at its best, by about 33% or 0.8 μGal for NMBU, and by about 43% or two μGal for TRYC. Secular gravity rates have been derived from both, the uncorrected and the corrected time series. We find that application of the hydrological correction improves the fit of the computed secular gravity rates as compared to rates derived from the state-of-the-art Fennoscandian land uplift model NKG2016LU_abs. The uncorrected trends are 75% and 50% of the expected trend (0.77 and 1.12 μGal/year), while the hydrological corrections improve

the fit to 82% and 93% for NMBU and TRYC, respectively.