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Investigating different filter and rescaling methods on simulated GRACE-like TWS variations for hydrological applications

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By operating for more than one decade now, the GRACE satellite provides valuable information on the total water storage (TWS) for hydrological and hydro-meteorological applications. The increasing interest in use of the GRACE-based TWS requires an in-depth assessment of the reliability of the outputs and also its uncertainties. Through years of development, different post-processing methods have been suggested for TWS estimation. However, since GRACE offers an unique way to provide high spatial and temporal scale TWS, there is no global ground truth data available to fully validate the results.
In this contribution, we re-assess a number of commonly used post-processing methods using a simulated GRACE-type gravity field time-series based on realistic orbits and instrument error assumptions as well as background error assumptions out of the updated ESA Earth System Model. Three non-isotropic filter methods from Kusche (2007) and a combined filter from DDK1 and DDK3 based on the ground tracks are tested. Rescaling factors estimated from five different hydrological models and the ensemble median are applied to the post-processed simulated GRACE-type TWS estimates to correct the bias and leakage. Time variant rescaling factors as monthly scaling factors and scaling factors for seasonal and long-term variations separately are investigated as well. Since TWS anomalies out of the post-processed simulation results can be readily compared to the time-variable Earth System Model initially used as "truth" during the forward simulation step, we are able to thoroughly check the plausibility of our error estimation assessment (Zhang et al., 2016) and will subsequently recommend a processing strategy that shall also be applied for planned GRACE and GRACE-FO Level-3 products for terrestrial applications provided by GFZ.

Kusche, J., 2007:Approximate decorrelation and non-isotropic smoothing of time-variable GRACE-type gravity [U+FB01]eld models. J. Geodesy, 81 (11), 733–749, doi:10.1007/s00190-007-0143-3.

Zhang L, Dobslaw H, Thomas M (2016) Globally gridded terrestrial water storage variations from GRACE satellite gravimetry for hydrometeorological applications. Geophysical Journal International 206(1):368–378, DOI 10.1093/gji/ggw153.