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GRACE data assimilation into WGHM: Validation of updated water states and fluxes in the Mississippi Basin

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The Gravity Recovery And Climate Experiment (GRACE) satellite mission provides the unique opportunity of observing the water storage changes including soil, surface and groundwater with global coverage. However, the relatively coarse spatial (few 100 km) and temporal resolution (monthly) and the necessary disaggregation of total water storage anomalies (TWSA) into individual water storage compartments provide challenges for hydrological studies. The GRACE-derived TWSA fields are increasingly used for data assimilation into hydrological models for model improvement and downscaling of GRACE data. Recently, Eicker et al. (2014) proposed a new ensemble Kalman filter (EnKF) method that integrates gridded TWSA fields into the WaterGAP Global Hydrology Model (WGHM) and simultaneously calibrates its parameters. Application to the Mississippi River Basin showed promising results when comparing post-assimilation model-predicted TWSA to GRACE observations.
Here, we carry out an extensive validation of the reported assimilation results with independent data sets. The focus is on individual water compartments, such as snow, soil, surface water and groundwater, and fluxes, like river discharge. The validation data includes in-situ data (e.g. groundwater well observations, river discharge) and remote sensing data (altimetry). In addition, we compare to GRACE and to snow, lake, river and sub-surface estimates from the Global Water Cycle Re-analysis product, independently derived through GRACE assimilation into a multi-model ensemble. The results demonstrate that the established calibration and data assimilation framework enables an improved fit of modeled TWSA with observations. Moreover, we show to what extent estimates of individual water compartments and fluxes improve.

Eicker, A., Schumacher, M., Kusche, J., Döll, P., Müller Schmied, H. (2014): Calibration/Data Assimilation Approach for Integrating GRACE Data into the WaterGAP Global Hydrology Model (WGHM) Using an Ensemble Kalman Filter: First Results. Surveys in Geophysics, Vol. 35, No. 6, pp. 1285-1309.