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Temporal disaggregation of update increments for the assimilation of GRACE data into hydrological models

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For water management and other applications, it is important to quantify freshwater fluxes and storage changes from basin to global scale. For this purpose, hydrological models provide daily simulations based on measured or reanalysis precipitation and other climate data. In addition, monthly Total Water Storage Anomalies (TWSA) provided by the Gravity Recovery And Climate Experiment (GRACE) satellite mission can be utilized to quantify large-scale changes of continental hydrology. Previous studies have shown that it is very beneficial to combine both, data sets and model simulations. However, major challenges exist when assimilating spatially and temporally limited resolved GRACE observations into models.

In this study, we investigate the problem of temporal disaggregation of monthly GRACE data into daily values that is the (typically) time step of global water balance models. In particular, we assimilate synthetic monthly GRACE TWSA into the WaterGAP Global Hydrology Model (WGHM), using an Ensemble Kalman Filter (EnKF) approach for the Ganges-Brahmaputra Basin. We set up a synthetic experiment to systematically assess and validate different methods for (i) computing EnKF increments (e.g., with/without model rewinding, temporal averaging) and (ii) applying EnKF increments for updating the modelled water states each month.