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Multi-objective calibration of a global hydrological model with GRACE and river discharge data

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Reduced uncertainties in comprehensive land surface or hydrological models may be reached by introducing observation data from different sources within the parameter tuning process. Within several data assimilation methods a multi-objective calibration of the model, i.e. evaluating simulation results against different arts of observations (during model calibration), provides a straight forward and independent way to accomplish model parameter estimations. Concepts for multi-objective calibration are based on finding a Pareto optimal parameter set. In addition, this parameter set allows for an uncertainty assessment of the model parameters and output.

In this work we perform a multi-objective calibration of the WaterGAP Global Hydrology Model (WGHM). The model simulates the continental water storage including the most important water storage components (soil, snow, groundwater and surface water) at a half degree resolution. Hitherto, WGHM has been calibrated against observed river runoff at 1235 gauging stations world wide. We complement and extend the original parameter estimation by additionally calibrating against variations of total water storage from the GRACE (Gravity Recovery And Climate Experiment) satellites. GRACE, launched in 2002, measures time variations of the Earth's gravity field which are transferable into large-scale water storage changes.

We develop strategies to account for the discrepancy in spatial resolution of the model and the remote sensed data. Furthermore we combine the heterogeneous data coverage of the river discharge measurements with the continuous global coverage of the GRACE data. We present current results of the multi-objective calibration of WGHM

for five big river basins (Amazon, Mississippi, Lena, Ob and Congo). Improvements of the simulation results for large-scale water balances by application of the described methods and strategies are exposed. In this way, we highlight the value of GRACE total storage water variations for data assimilation in large-scale hydrological modelling.