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Calibration of the WaterGAP Global Hydrology Model WGHM with Water Storage Variations from GRACE

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The GRACE satellite mission is a unique data source for hydrology by quantifying mass variations caused by changes in continental water storage at large spatial scales. This offers the possibility of evaluating and calibrating macro-scale hydrological models towards a better representation of the hydrological cycle and global change impacts on water resources.

In this presentation, the WaterGAP Global Hydrological Model (WGHM) is applied. So far, WGHM has been calibrated against ground-based observations of river discharge for more than 700 gauging stations worldwide. With the availability of GRACE data, it is the goal to use temporal water storage variations besides river discharge within a multi-criterial model calibration. The work steps presented here include a sensitivity analysis (Morris method) to identify the most sensitive model parameters with regard to seasonal storage change. These are potential calibration parameters. Secondly, monthly water storage variations are derived at the scale of large river basins both from GRACE gravity fields and the WGHM model, including an assessment of uncertainty. Finally, first calibration runs are presented that use seasonal water storage change as calibration variable. Simulation results are evaluated both in terms of quality of fit to river discharge and water storage change.

Results show that besides the typical model parameter used for calibration against discharge, several additional parameters are relevant for water storage simulations. The sensitive parameter sets change between the river basins, depending on the water stor-

age components that are the most important for the respective environments, such as snow in high latitudes or surface water in basins dominated by lakes and wetlands. Ensemble simulations with different climate input data sets reveal the high sensitivity of precipitation input to give storage change within the range of GRACE data. Model deficiencies can be identified where no satisfactory simulations are obtained for both river discharge and storage change. The value of complementary remote sensing data for model validation, particularly time-variable water level and volume of surface water bodies, is highlighted.