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Estimation of global terrestrial water storage change using the WaterGAP Global Hydrological Model

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Terrestrial water storage plays an essential role within the global hydrological cycle. It is of particular importance for the existence of many ecosystems and for the satisfaction of human water demands. Observation based information on the spatial distribution and temporal variation of large scale water storage is limited. Since the GRACE satellite mission was launched in 2002, global gravity field solutions are available with unprecedented high accuracy. We expect an increase in our understanding of macro-scale hydrological processes from the application of this novel information from space.

The state-of-the-art WaterGAP Global Hydrological Model (WGHM) is applied to calculate terrestrial water storage change worldwide. The aim of the modeling exercise is to evaluate the hydrological signal obtained from pre-processed GRACE data. WGHM calculates terrestrial water storage as the sum of snow, soil moisture, canopy storage, groundwater and surface water including lakes, reservoirs, wetlands and rivers.

By now, reservoirs are treated like natural lakes in WGHM. However, it is well known that reservoir operations significantly alter the terrestrial water cycle. Reservoir storage volumes as well as river discharge of downstream areas are strongly influenced by reservoir management schemes depending on the intended purpose of the reservoir, e.g. irrigation, water supply, flood control or hydroelectricity. Therefore, in order to better represent anthropogenic impacts, it is planned to integrate a reservoir operation scheme into the global hydrological model using available global data. These are e.g.

reservoir storage capacity, intended purpose and water demand in the lower reaches. We expect that not only the modeled river discharge but also the total water storage and its seasonal change will be strongly influenced within basins that are dominated by large reservoirs in their river network.

Terrestrial water storage change will be calculated with WGHM applying the improved reservoir algorithm. Results will then be compared to GRACE for selected large river basins.