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Global modelling of water storage changes – sensitivity to different climate data sets

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Continental water storage makes up an essential part of the global hydrological cycle. Little is known about its spatial distribution and temporal variations on a global scale although this information is crucial e.g. for the assessment of water resources worldwide. A varying volume of water stored on or beneath the earth's surface implicates mass transport and mass redistribution causing temporal variations of the earth's gravity field. As the GRACE satellite mission provides very exact gravity field solutions, an increase in our understanding of macro-scale hydrological processes is expected from the application of this additional information from space.

The integral GRACE gravity signal is separated into its individual components which can be attributed to different geophysical phenomena. In order to evaluate the *hydrological* signal obtained from GRACE data, the state-of-the-art WaterGAP Global Hydrological Model (WGHM) is improved and applied to calculate terrestrial water storage change at daily and monthly time scales worldwide.

In WGHM continental water storage is computed as the sum of canopy, snow, soil and groundwater storage as well as water stored in surface water bodies like rivers, wetlands, lakes and reservoirs. Anthropogenic water use for irrigation, industrial and domestic purposes is also taken into account. The model operates with a spatial resolution of 0.5° latitude x 0.5° longitude and an internal time step of one day. It is tuned to observed river discharge at 1235 stations worldwide.

In order to compare GRACE data with results from WGHM, it is important to know the uncertainty of computed terrestrial water storage change. Climate input is an important source of uncertainty for model results. Thus, the model is driven by different climate data sets to get a better understanding especially of the influence of precipitation data on calculated water storage change. Two different monthly precipitation data sets based on gridded station observations are applied: the CRU (Climate Research Unit) TS 2.1 data set, available until 2002, and the GPCC (Global Precipitation Climatology Centre) Full Data Product Version 3, available up to almost real-time. Both data sets are not corrected for measurement errors. Therefore, a general algorithm to account for precipitation undercatch is introduced. In order to improve results at the sub-monthly scale, daily data from the ECMWF operational forecast system are used to construct an additional third daily climate data set by scaling daily precipitation from ECMWF to match the monthly GPCC precipitation totals. Furthermore, the influence of different radiation and temperature data from CRU and ECMWF is evaluated.

Finally, continental water storage change as computed by WGHM - considering the use of different climate input data - is compared with GRACE results for some of the largest river basins worldwide.