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# Climate-driven water storage changes over the last century: an evaluation of different data sources

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In this contribution, we investigate continental-scale water storage changes using estimates based on four different approaches, covering a wide spectrum of the latest data sources, ranging from model outputs to observational databases.

We first present a century-long (1901-2010) reconstruction of water storage variability that is based on a statistical model calibrated with satellite observations from the Gravity Recovery And Climate Experiment (GRACE) mission (Humphrey et al. 2017). We compare these estimates with hydrological model simulations from a recent model inter-comparison experiment (Schellekens et al. 2017). Although there is a large spread in the amplitude of modelled water storage changes (partly due to differences in model storage capacity), all models agree on a significant temporal variability at inter-annual time scales. We show that the simulated residence time of the various water storage reservoirs directly controls the memory of the hydrological system which exacerbates anomalies in precipitation patterns caused by large-scale changes in atmospheric circulation.

In addition, we compare these model outputs with an updated dataset of basin-scale water balance, derived from atmospheric moisture flux convergence and conventional streamflow measurements in 341 large river basins (Hirschi and Seneviratne, 2017). These estimates represent a valuable alternative to statistical and hydrological models, but still rely heavily on the quality of atmospheric reanalyses. Finally, we use the recently developed Global Streamflow Indices and Metadata Archive (GSIM), which provides monthly runoff data at more than 35 thousand stations (Gudmundsson et al., in revision). We use this unprecedented dataset to investigate the degree to which the relationships between water storage and runoff can be used to evaluate the quality of long-term reconstructions of continental-scale water balance.

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