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Advance the understanding of the Mississippi basin freshwater system by comparing multiple observational data types with the Water Global Assessment and Prognosis (WaterGAP) model outputs

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To support the global sustainable development, a consistent estimation of spatially and temporally heterogeneous water resources and how they are used and impacted by anthropocentric activities are required. In the last decade, Global hydrological modelling advanced our understanding of freshwater systems extensively; however, modelling uncertainties have become more clear. To limit the uncertainty, it is essential to not only use the best available input data for modelling but also make use of observations of a broad range of model output variables. This study, as part of GlobalCDA project, aims to improve the understanding of freshwater systems by using multiple optimally processed in-situ , geodetic and remote sensing data in a hydrological modelling approach. In this study, we applied The Water Global Assessment and Prognosis (WaterGAP) model, which has been extensively used in global water resources assessments and climate change impacts. The latest version of the model was calibrated and applied to estimate the Mississippi basin water components. The model outputs were compared with different observational data types: in-situ streamflow observations, GRACE total water storage (TWS) and the extent of open water bodies. The results showed improved simulations of almost all variables; however, the performance was still poor compared to the observed values. Furthermore, a better fit for one variable did not necessarily lead to a better fit of another variable. Besides, in our scheme, the observational time series had to cover the same time period which significantly limits applicability. The results of this study showed the necessity of a major improvement through combining state-of-the-art hydrological modelling and multiple optimally processed geodetic and remote sensing data in an ensemble-based calibration and data assimilation approach to provide a flexible parameter (calibration) and state (data assimilation) adjustment for the modelling purpose.