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How large is the added value of Swarm time-variable gravity if assimilated into WGHM?

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We assimilate, for the first time, Swarm data into the WaterGAP Global Hydrological Model (WGHM) over the Mississippi basin for the time span 2013 - 2016.

A number of studies have investigated the assimilation of total water storage anomalies (TWSA) from the Gravity Recovery And Climate Experiment (GRACE) satellite mission into hydrological models to improve the physical realism of the simulated storages and fluxes e.g. for drought and flood prediction. However, the GRACE satellite mission completed science observations in October 2017. Also besides several gaps occurring during the last years of the mission, there is now a prolonged gap until the successor to GRACE, GRACE Follow-On (GRACE-FO), will provide monthly TWSA. To bridge the gap between GRACE and GRACE-FO and to fill in missing monthly GRACE solutions, we suggest assimilating TWSA derived from Swarm into the model, in our case WGHM.

Because the primary objectives of the Swarm mission did not include the gravity field, its mission design allows TWSA to be computed with significantly lower spatial resolution than GRACE only. In this study, we therefore assess the contribution of Swarm within an ensemble-based data assimilation (DA) framework. We compare observation-free model runs with GRACE- and Swarm-assimilated runs for the overlapping time period 2013 - 2016 and for different spatial resolutions. Moreover, we investigate for both GRACE- and Swarm-assimilated results the effect of the model parameter calibration within the DA framework. Finally, we validate our results against independent discharge in-situ observations.