Joint Assimilation of GRACE Total Water Storage Anomalies and In-Situ Streamflow Data into a Global Hydrological Model

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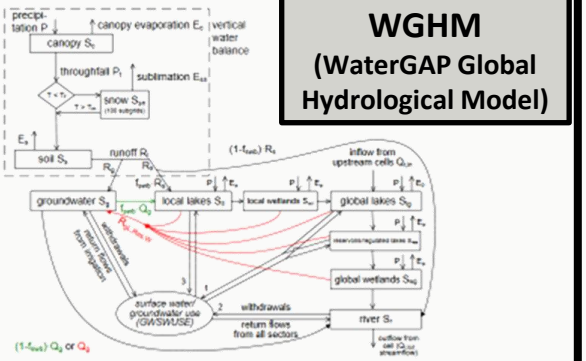
BACKGROUND

WGHM (WaterGAP Global Hydrological Model)

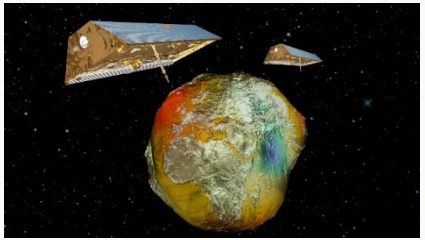


Müller Schmied, Hannes, et al. (2020) "The global water resources and use model WaterGAP v2. 2d: Model description and evaluation."

- Global
- Spatial resolution of ca. 50km
- 10 compartments
- Model uncertainties

→ Requires calibration or data assimilation

GRACE-derived Total Water Storage Anomalies (TWSA)

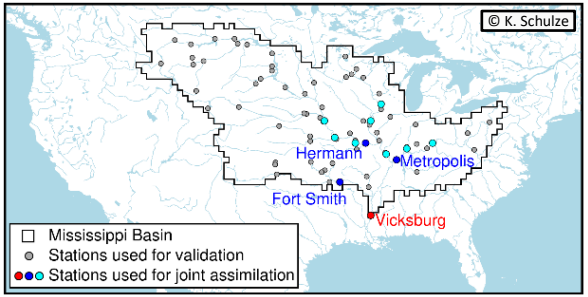


https://www.dlr.de/content/de/artikel/news/2017/20171027_die-deutsch-amerikanische-klimamission-gra ce-endet-nach-15-erfolgreichen-jahren_24627.html

- Global
- Spatial resolution of ca. 300km
- Vertical integration of water column

→ Assimilation improves storage but not streamflow simulations

In-situ streamflow observations

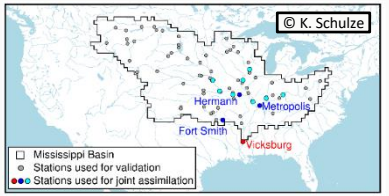


- In-situ stations
- Irregular spatial distribution

→ Commonly used for calibration of hydrological models

→ Data assimilation can combine all information

RESULTS: STREAMFLOW



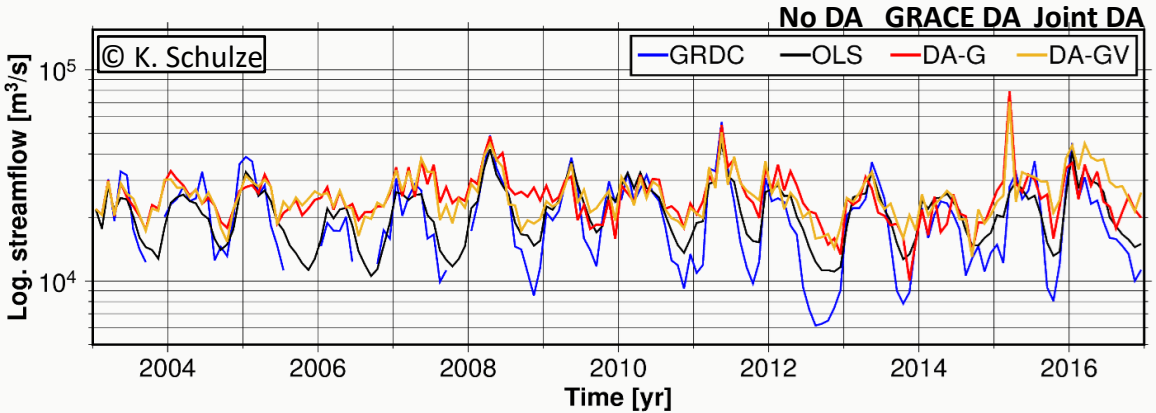
Validation at 65 gauge stations

- GRACE assimilation deteriorates streamflow simulations
- Joint assimilation shows improvements of the simulated streamflow (RMSE, correlations) but cannot completely counteract the GRACE influence

→ Impact on TWSA simulations?

→ Consider more stations in the assimilation?

Improvements | Deteriorations [% of the val. stat]	GRACE DA vs. no DA	Joint DA vs. GRACE DA
RMSE	8 | 92	52 | 46
Correlations	0 | 100	51 | 49
Linear Trend	17 | 83	32 | 83

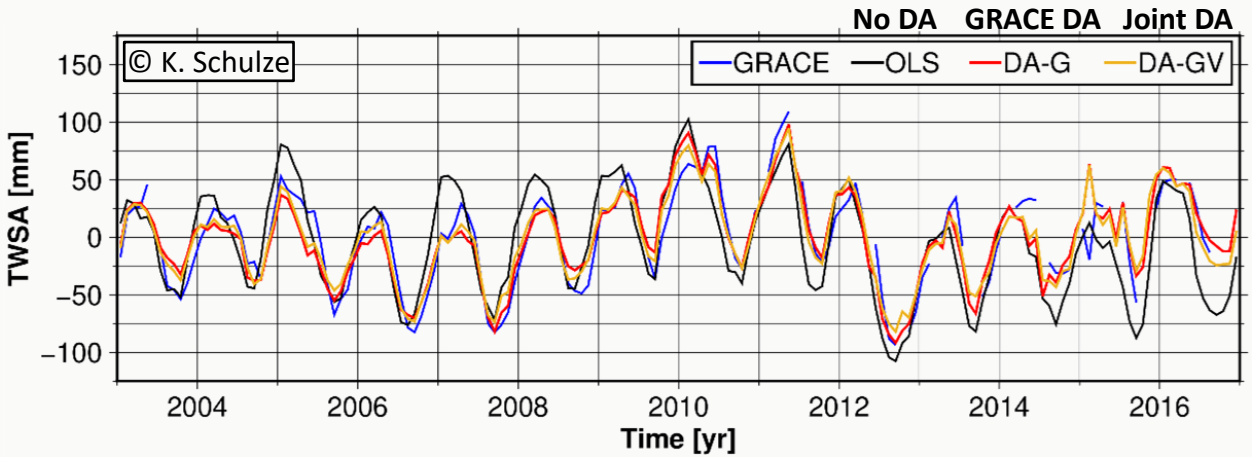


RESULTS:
TOTAL WATER STORAGE ANOMALIES

- GRACE assimilation pulls the TWSA simulations towards the observations
- Joint assimilation further improves the realism of the model simulations

TWSA	Obs	No DA	GRACE DA	Joint DA
RMSE [mm]	---	28	17	15
Correlations [%]	---	80	91	93
Linear Trend [mm/year]	1.3	-1.7	2.0	1.4

DA vs. Obs.



- **Joint assimilation of GRACE-derived TWSA and observed in-situ streamflow** data into the WaterGAP Global Hydrology Model (WGHM) via the Ensemble Kalman Filter

GlobalCDA project
www.globalcda.de
GlobalCDA

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- **Results:**
  - Assimilating GRACE into the WGHM leads to more realistic total water storage simulations BUT decreases the fit of streamflow simulations at 83-100% of the validation stations
  - Assimilating streamflow in addition to GRACE data improves the TWSA simulations and also the streamflow simulations regarding RMSE and correlation

→ **Paper submitted to WRR** also including the influence of
- considering several streamflow stations in the assimilation
- joint assimilation on individual WGHM storages
- joint assimilation on other metrics, e.g. the NSC, RMS, …