

# ***Interactive comment on “Data assimilation of GRACE terrestrial water storage estimates into a regional hydrological model of the Rhine River basin” by N. Tangdamrongsub et al.***

## **Anonymous Referee #2**

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This Discussion Paper presents results of a data assimilation experiment in which GRACE Terrestrial Water Storage anomalies were assimilated to a distributed hydrological model in simulations of the Rhine River basin. These experiments offer a welcome contribution to the GRACE-DA literature. While the general assimilation approach is similar to previous studies, the choice of land surface model is new, the presentation of different forcing and parameter datasets is novel, and the density of in situ observations in this (relatively) small basin allows for more complete model evaluation than was performed in previous GRACE-DA studies.

The paper is technically sound and well-written throughout. Small concerns with the

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interpretation of results have already been addressed in the authors' response to previous comments, and I will not repeat them here.

I have only minor technical/clarification comments, and they echo some of the points made by Reviewer #2:

1. Are GRACE observations averaged across the basin, or are they assimilated as gridded data? If the latter then how were horizontal error correlations taken into account?
2. GRACE observations are assimilated once every 5 days and, if I understand correctly, no smoothing is applied. Are any temporal discontinuities seen in model state variables or related fluxes (e.g., ET, runoff) due to this episodic application of increments? None are obvious in the time series presented in the paper, but it would be useful for the authors to comment on any artifacts that do exist or to discuss how this was avoided.
3. GRACE products are now distributed with gridded error estimates, and a method for estimating basin-wide error using these estimates is provided on the GRACE Tellus website. How does the error calculated from these estimates compare to the 20mm estimate used in this study?
4. Also related to the question of GRACE errors: did the authors perform any sensitivity study by varying the GRACE error estimate? Figures 5,7, and 8 indicate that the DA run falls very close to GRACE, suggesting that the observations were weighted very heavily in the EnKF update. Is this optimal? A higher GRACE error estimate would relax the DA simulations back towards OL, and it would be interesting to see how this affects metrics of simulation performance.
5. I am confused by the authors' comments regarding adjustment for "dry snow." Why, exactly, does this need to be corrected for in the GRACE observations?

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