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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Using GRACE in a streamflow recession to determine drainable water storage in the Mississippi River Basin" *by* Heloisa Ehalt Macedo et al.

Anonymous Referee #2

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The paper aims to estimate the amount of drainable water storage in a basin using GRACE satellite and streamflow data. They develop a forward-looking, low flow filter to isolate base flow; while transforming GRACE based storage anomalies to provide estimates of absolute drainable water storage in the Mississippi River Basin. The work is of interest and suitable for this journal as it deals with a fundamental aspect of hydrology, and provides useful technique to investigate storage-outflow relationships of large watersheds. Overall, the paper is written well and the figures are clear. The paper, however, would benefit from some major revisions, especially with regards to the introduction and methods section. For this reason, I suggest the editor consider the revisions suggested below prior to making a decision on this manuscript.

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Discussion paper

Major comments:

- The authors reference other studies that have used remote sensing to estimate water storage in basin; after looking at the titles of those journal articles, it seems that at least 2 of those studies (Tourian et.al., 2018; Riegger, 2018) have attempted to estimate total drainable water storage in a basin using GRACE data. How are the methods used in the present study different from those analysis? If the methods are different, then why was a different method developed? If there is a significant overlap in methods, then what is the novel contribution of this study? The answers to these questions should be clearly integrated into the introduction, as the original contributions of the authors seem unclear. - As pointed out by referee#1, the methods section needs to be written better especially with regards to how Qb was estimated. It seems unclear as to which "20% of the number of pairs (months)" were used to get the minimum value. Also, it would be useful to include a figure that shows the sensitivity of the model to n in the supplementary document to solidify that 20% was indeed a correct forward looking limit. - The justification of using Q-S relationship in a highly regulated systems (like the Missouri River) needs to be added. Can the storage values obtained in these systems still be considered as the total drainable water storage? How do the reservoir operational policies affect the low flow values obtained? It might be useful to go deeper into one of these regulated systems to explain why the estimates obtained are still useful/valid there. - The authors claim that the total drainable storage volumes they obtain cannot be validated. Can large-scale hydrological models like PCR-GLOBWB be used to obtain similar values? There should be some acknowledgement of the ability or inability of large-scale hydrological models to estimate a similar value. - The conclusions section currently seems to be a summary of the methods used in the study and the scope of future work. This section should be expanded further to include some of the results obtained, as well as a discussion of why/where it is important to know the total drainable storage of a basin.

Minor comments:

P1 L24-26: The sentence does not read correctly. I suggest having a separate sentence to describe/summarize the remote sensing that has contributed to estimating watershed storage. P2 L11: “the desire” seems redundant. Suggestion: “The motivation was to create a functional relationship. . ..” Figure 1: It would be useful to include the sub-basin boundaries on the map to help orient the readers P4 L25-34: While it is implied that the authors use this expression to estimate the absolute water storage, it might be useful to explicitly state that here. P5 L3-7: It would be more useful to integrate this paragraph into the methods section as there seems to be no results here. P5 L24: Replace with “which corresponds to the mean” P7 L2: Replace with “of such an amount”

References: Riegger, J., Quantification of Drainable Water Storage Volumes in Catchments and in River Networks on Global Scales using the GRACE and/or River Runoff, Hydrol. Earth Syst. Sci. Discuss., 2018, 1-27, doi: 10.5194/hess-2018-38, 2018. Tourian, M. J., Reager, J. T., and Sneeuw, N.: The Total Drainable Water Storage of the Amazon River Basin: A First Estimate Using GRACE, Water Resources Research, 54, 3290-3312, doi: 10.1029/2017WR021674, 2018.

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