

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
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Comment on hess-2021-645

Anonymous Referee #2

Referee comment on "A reexamination of the dry gets drier and wet gets wetter paradigm over global land: insight from terrestrial water storage changes" by Jinghua Xiong et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-645-RC2>, 2022

The authors present a re-examination of the dry gets drier, and wet gets wetter paradigm over global land, based on terrestrial water storage estimates from different sources. They make use of GRACE reconstructions, global hydrological models, and land surface models, as well as CMIP6 models for the future perspective. They conclude that the DDWW paradigm is challenged both in the historical period but also in the future.

I think that the topic is interesting and fits well the journal, and the use of the complete terrestrial water storage for the analysis of the DDWW paradigm adds another perspective compared to previous studies. However, the paper currently lacks some important information and has a substantial methodological issue which requires major revision.

My main concerns are:

- The use of percentage of grid cells for the presentation of many of the results is not appropriate and hinders the proper interpretation. It's necessary to present the corresponding numbers as percentage per land area (i.e., by weighing the grid boxes according to their effective km² area) in order not to give excessive weight to higher latitudes. This will most likely have impacts on the overall conclusions of the paper.
- The choice of the eight CMIP6 models is not transparent. Why didn't the authors choose a larger model ensemble based on the CMIP6 archive? Based on which criteria were these eight models selected?
- Also, given the large uncertainties between the CMIP6 models on the one hand, but also within the DATASET ensemble (cf. Fig. S8), the impact of the applied ensemble mean approach on the results should be discussed in more detail.

Specific comments:

Line 20: "and freshwater availability" instead of "and fresh availability"

Line 83/84: Which of the available meteorological forcings for these reconstructions did you consider (MSWEP, GSWP3 or ERA5)? Did you take the mean over the three forcings for each of the two calibrations?

Line 125: Based on which criteria did you select these 8 models?

Line 136: "to match the observed data" instead of "to match the observed results"

Line 144 (Equation 1): The dash in $TWS - DSI$ could be confused with a "minus". I suggest changing it to an "_" or at least a short dash.

Line 152: "all the land area except for the Greenland and Antarctica"

Line 157: "CMIP6 archive" instead of "CMIP6 achieve"

Line 168-170: Why poorer performance when NRMSE is lower?

Line 180: "greater" instead of "slighter"? The fluctuations of CMIP6 are larger than the ones of DATASET (Fig. S4).

Line 180: "the effective bias correction performance" Why effective? CMIP6 deviates more from GRACE than DATASET.

Line 212: Here and throughout the results the use of percentage of grid cells is not appropriate and needs to be changed to percentage of land area for proper interpretation.

Figure 2: Nice plot, however quite crowded. The region names are often barely readable. You could just refer to the Supplementary Figure 1 for the definition and naming of the regions. The same applies to Figure 4.

Line 234: There's no stippling on these figures? Please revise the caption and also explain the meaning of the pie charts.

Line 235: Same title as for Section 3.1. I guess this is an oversight.

Line 257 and following: I assume these percentages are again based on the grid cells only, not based on the actual area?

Conclusion: The conclusions need to be extended. What's new compared to previous studies? What are the implications?