

This study compares the performance of 13 GHMs and LSMs in capturing amplitude and phase of TWSC in global major rivers against GRACE data, including comparisons across climate zones and model version (R1 and R2). This detailed comparison facilitates improved parameterization model process. However, limitations of this study include overly detailed descriptions of the comparisons of different basins so that it is difficult for the reader to get to the point, and the figure lacks summarization.

Major comments:

1. The configuration of the modules of each model should be clearly stated, and some differences may be due to missing modules, e.g., snow, permafrost, groundwater, etc., which would also be useful for analyzing the causes of deviations. And, if key modules are missing does it still make sense to compare changes in TWSC between the model (GHMs and LSMs) and GRACE.
2. This study did not analyze in depth the causes of amplitude and phase differences, especially 4.1 section
3. Line67, "due to human intervention and climate change respectively", the underestimation is due to anthropogenic interventions and climate change, doesn't that have anything to do with model performance, shouldn't model performance be the main reason?
4. Line 89, amplitude and phase of "polar" zone was not analyzed in result section
5. Line 139, Why not CSR and JPL on average?
6. The difference in the length of the text in parts 3.1 and 3.2 is too large. 3.1 section over-emphasis on basin comparisons.
7. The figures are not summarizing enough, too many similar comparisons, e.g., I think Figures 5-8 should be in the Appendix, and the main results should be put in the main text, e.g., the overall results for the different climatic zones in one fig.
8. I suggest to add the spatial distribution map of biases in amplitude and phase.
9. Figure 1-4 suggests the addition of lines for the GHM and LSM model averages, which facilitates comparison of the two types of models
- 10.

Minor comments:

1. Line 4, "(e.g., the amount and" misses the corresponding right parentheses.
2. Line68, "Other studies focused on the seasonal cycle of TWSC to identify" to "Other studies on the seasonal cycle of TWSC focus on identifying" is more suitable? "disparities", specifically what are the disparities?
3. Line 75, "northern basins" is vague, please specifically point
4. Line 84, "replicate water storage against the latest release (RL06) of GRACE TWSC.", this sentence indicates the result? this place is to say what is to be studied