

Review – Egusphere-2025-1629

Thank you for responding to my comments on the initial manuscript submission. However, some of my previous comments (RC1) do not appear to have been fully addressed, and I believe they should be considered before the manuscript can be published.

- Major initial comment: “*Since the analysis focuses on extreme dry–hot and wet–cold years, how does the model perform during drier years (e.g., MAP < 25th percentile) and wetter years (e.g., MAP > 75th percentile)?*” I believe my initial comment may not have been sufficiently clear. My question refers to the model’s performance under years with relatively low (<25th percentile) and high (>75th percentile) precipitation during the analysis period (2001–2019). Evaluating model performance under these conditions is important because hydrological models often perform well during “normal” years, while their accuracy may decline during particularly dry–hot or wet–cold years.

Response to Reviewer: We evaluated the model performance for the two percentiles mentioned MAP < 25th percentile and MAP > 75th percentile. The evaluation was carried out for the same twelve watersheds where the simulated discharge was validated due to the availability of sufficient data. The previously described selection criteria for these twelve watersheds are also applicable to this analysis. For each watershed, the individual extreme years were identified using the percentiles for dry and wet periods. Using monthly discharge values R^2 , RMSE and bias were calculated between observed and simulated discharge. The results are presented in supporting tables (Table S4), which show that the model performs reasonably well in extreme dry-hot and wet-cold years. The validation method and results were briefly mentioned in the manuscript in section 2.1 and section 3.1.1

- Minor initial comment: “*Figures 8 and 9: I suggest presenting the anomalies as percentages or standardized anomalies to better account for spatial variability across Germany.*” Your response was: “*Thank you for the suggestion. Presenting anomalies as percentages or standardized values would indeed help account for spatial variability. However, implementing this transformation for all watersheds would require additional data processing beyond the resources available for the current revision. We appreciate the recommendation and will consider incorporating standardized anomaly analyses in future work.*” While I understand that addressing this comment requires additional effort, the necessary data already appear to be available, as the simulations span from 2001 to 2019. Therefore, computing the anomalies (e.g., standardized anomalies) should be feasible using the existing dataset. For example, standardized anomalies could be calculated as follows:

$$Z_{2013} = \frac{X_{2013} - \bar{X}_{2001-2019}}{\sigma_{2001-2019}}$$

This is important because a decrease of –100 mm does not have the same meaning for annual precipitation and water yield. Similarly, the magnitude of the anomaly has a different interpretation for watersheds with low versus high carbon sequestration.

Response to Reviewer: We developed the required standardized anomaly plots (unitless). They are provided in supporting figures (Fig S4 and Fig S5). The results, in essence, provide similar patterns, but they are clearer and easier to discern in the standardized anomaly. However, in the manuscript, we would like to keep the original anomaly analysis because it provides the absolute difference between the extreme year and the mean. The absolute values give us a clear indication of the impact of extreme events in units easier to understand. Furthermore, it is consistent with other previously published studies using the same WaSSI Model (Sun, G. et al., 2011; Sun, S. et al., 2016). We refer to the standardized anomaly plots in the manuscript in section 3.2.4.

Sun, G., Caldwell, P., Noormets, A., McNulty, S. G., Cohen, E., Myers, J. M., Domec, J.-C., Treasure, E., Mu, Q., Xiao, J., John, R., & Chen, J. (2011). Upscaling key ecosystem functions across the conterminous United States by a water-centric ecosystem model. Journal of Geophysical Research: Biogeosciences, 116(G3). <https://doi.org/10.1029/2010JG001573>

Sun, S., Sun, G., Cohen, E., McNulty, S. G., Caldwell, P. V., Duan, K., and Zhang, Y.: Projecting water yield and ecosystem productivity across the United States by linking an ecohydrological model to WRF dynamically downscaled climate data, Hydrol. Earth Syst. Sci., 20, 935–952, <https://doi.org/10.5194/hess-20-935-2016>, 2016.

- Minor initial comment: “Figure 2: Add the performance metrics in each panel. You can order the panels according to a criterion such as watershed area, natural/transformed land-cover area, or annual precipitation.” As with my previous comment, addressing this suggestion would require some additional effort, but it does not appear to be beyond the scope of the current revision. Reordering the panels according to simple criteria, such as watershed area, could improve the figure's clarity (e.g., first panel: smallest watershed; last panel: largest watershed).

Response to Reviewer: We revised the plots and ordered them according to area (largest to smallest), included the performance metrics in each panel and increased the resolution of the plot from 300dpi to 600dpi. The new Fig 2 is presented in the manuscript.