

Author comments in reply to Referee 2

We thank the referee for the valuable suggestions, which we happily take into account for the revised manuscript, and believe will improve its quality. Below we provide a detailed response. Referee comments are in bold, and our responses are in italics and blue.

Jose P. Teran,

On behalf of the authors

This manuscript presents improvements applied to the global CoSWAT modelling approach, focused on improving the representation of human actions, which emphasis on reservoirs. The manuscript is clear and well structured, and the methods are appropriate and include a comparison with other global models. The main limitation of the study is related to the no calibration of the model, but it is acknowledged and proposed for further work. Improving the inflow calibration will surely lead to better performance for reservoir variables and streamflow, but considering the scale of work, the current advances presented in this manuscript already suppose a novelty and an improvement.

I consider the manuscript suits the journal and it is already in a very good shape, so I can only provide few suggestions/comments to improve it if the authors agree.

We thank you very much for your general assessment. The fact that the model is not yet calibrated is indeed a big limitation, and it is a key objective of our future work. We definitely take into account the comments and suggestions to make improvements in the revised version.

Line 44. Fix the phrase

Thank you for the suggestion. We will adjust the line to:

“Drying and wetting trends are intensifying (Bai et al., 2024), accompanied by ecosystem degradation..”

Line 96 and 103. You have more recent examples and using SWAT+ (e.g., <https://link.springer.com/article/10.1007/s11269-024-04071-9>).

This is a great example that we will definitely refer to as another application of SWAT+ with reservoir management on the revised manuscript. Thank you for the suggestion.

Line 98. The fact that the model has not been calibrated may also explain that.

Thank you for noting that. Indeed, this is true, we will include that in the corresponding paragraph.

Line 230. Current storage is also an important factor for this method.

That is completely true, the current storage is another factor affecting the outflow. We will make sure this is mentioned there.

Line 277. Is there not available data to initialize the reservoirs more realistically? Starting with the reservoirs almost full may overestimate storage during a long period.

We thank the referee for this comment. In principle, observations could be used to derive more realistic initial conditions, at least for reservoirs with available data. However, to our knowledge, SWAT+ does not

currently support individually defined initial storage conditions per reservoir. We therefore use the `om_water.ini` file with volume set to maximum ($vol = 1$) for all water bodies, following Vanderkelen et al., (2022) who adopted a similar approach. Defining unique initial conditions per reservoir is nevertheless a valuable direction for future work, which could allow better initialization. We will acknowledge this issue more explicitly in the revised manuscript, and include it as future efforts.

Line 280. These thresholds are questionable.

The KGE threshold of -0.42 follows Knoben et al., (2019), who define this as the point at which a model outperforms the mean of observations. We use this as a minimum acceptable value, meaning the model must at least outperform that benchmark, but we set a positive KGE as the objective for satisfactory performance and 0.4 as good performance, as done in similar applications (Gutenson et al., 2020; Hosseini-Moghari & Döll, 2025). We acknowledge that these thresholds might differ from those commonly used in smaller-scale applications, but we believe they are appropriate given the scale and inherent limitations of a global model with coarse input data, as well as the context and goal of the study.

Figure 5. Inflow simulation and its overestimation clearly affects the simulation of outflow and storage. In part, because the method you are using consider the inflow magnitude to determine the release. I wonder if the decision of running the warm-up period with all the reservoirs as natural lakes is in part responsible for this, especially for cascading reservoirs.

We thank the referee for this insightful comment. Running the warm-up period with reservoirs as natural lakes is a necessary step to populate the reservoir “memory” of past inflows and demands before the H06 scheme begins operating, which then gets continuously updated as the simulation advances. To illustrate an interesting case, we provide an example (Three “chained” reservoirs in the downstream area of the Mississippi River System) on Figure 1, where all of those systems are considered regulated and therefore, start as natural lakes during the warm up period and transition to the H06 scheme afterwards.

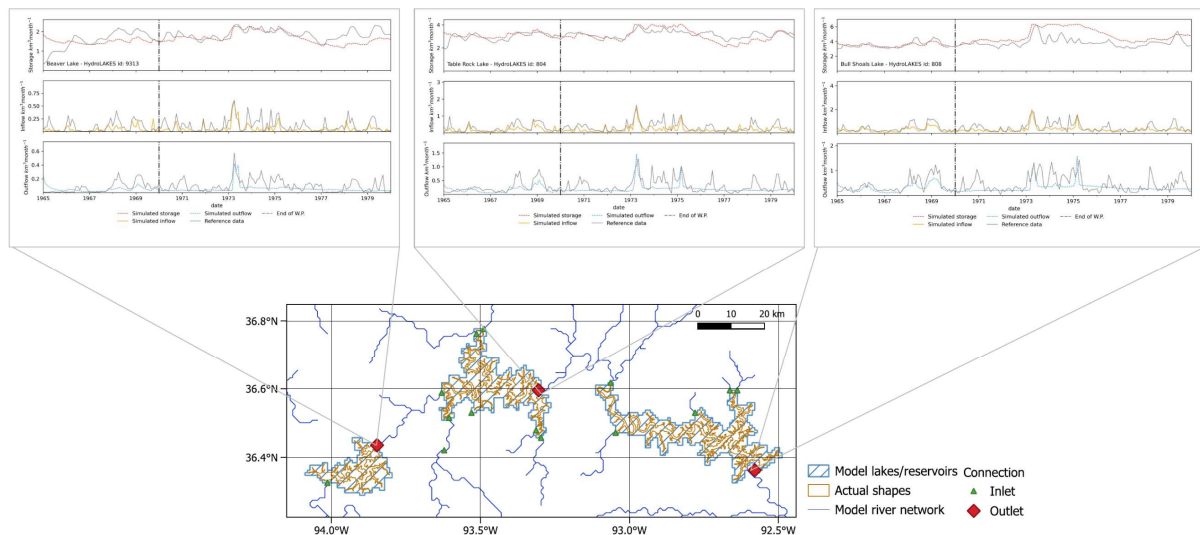


Figure 1: Storage, inflow and outflow results, including the warm-up period (W.P.) for three consecutive reservoirs in the Mississippi River System.

What can be seen is that the simple natural scheme produces relatively stable storage that remains close to long-term average conditions, which is precisely what we aim for so that the H06 scheme initializes at an appropriate level. Looking more closely at the relationships between reservoirs, an inadequately represented outflow from one reservoir after the warm-up period (i.e., with the H06 scheme) can have a comparable impact to simulating it as a natural lake during warm-up. This points back to the broader limitation of the model: beyond general hydrological parameters, individual reservoir scheme parameters

are not calibrated, which is likely consequential especially for cascading reservoirs (Shin et al., 2019; Vanderkelen et al., 2022). We therefore consider the current initialization method our best available option, with possible refinements to the initial storage conditions at the very beginning of the simulation using observations, as noted in a previous comment. While parameter calibration overall being the path to follow for significant improvements.

Line 438. I would consider changing ‘remains similar’ with ‘was slightly reduced’.

Thank you for noting this. That is true and more transparent. We will make that adjustment in the revised manuscript.

References

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