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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Comparison of Generalized Non-Data-Driven Reservoir Routing Models for Global-Scale Hydrologic Modeling" *by* Joseph L. Gutenson et al.

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"Comparison of generalized non-data-driven reservoir routing models for global-scale hydrologic modeling", HESS 2019

This study compares two methods for non-data-driven reservoir routing in large-scale hydrologic models, namely those of Doll et al. (2003) and Hanasaki et al. (2006). The methods are compared using 60 reservoirs in the United States over a 6 year period. The sensitivity of method coefficients are examined, as well as daily and monthly timesteps. Performance is measured by KGE, Rˆ2, and RMSE and found to vary under certain geographic and hydroclimatic settings.

The overall motivation is clear - reservoirs have a major influence on flow, and gen-

eralized methods are needed because systems often follow specific rules that cannot be compiled at global scales. The research questions are interesting and framed very well, and the 60-reservoir dataset serves as a nice case study. However, the rationale for comparing these specific methods, and the general insights that can be drawn from the comparison, are less clear. I recommend major revisions based on the following points.

1. While I understand the advantage of methods that require minimal input data, there are many other methods that could be part of this comparison, many of which are mentioned in the literature review. Focusing only on these two makes the study seem thin, especially given that the methods are fairly similar - both are a linear relationship with either reservoir inflow or storage. It is hard to draw any general conclusions from the comparison about which approach works better, or why - or whether another approach not studied here might be more appropriate in certain contexts.

The discussion of results is overly system-specific and does not manage to provide much of this insight. Without including more state of the art methods the paper cannot be a definitive statement about their performance.

Related to this, the distinction with data-driven models is not obvious considering both methods studied here are empirical relationships. The setup of the study does not preclude statistical fitting techniques, and many reservoir routing models are based on some form of regression or machine learning.

2. If I understand correctly, these methods were originally intended for the monthly timescale. Testing at a daily timescale is an interesting experiment, but the results suggest only small improvements over the run-of-river baseline. Neither of these models can account for short-timescale operations such as flood control or hydropeaking. The reservoirs where the models perform well seem to have lower impoundment ratios.

Daily timestep routing is clearly a challenge, and not one that the authors would need to resolve in this paper. My concern is that the models are applied outside of their

intended use, which may have some consequences for how their performance is interpreted. For example, what are the implications for large-scale hydrologic modeling if these reservoir models do not outperform a run-of-river assumption?

3. How would these single-reservoir case studies apply to routing in a larger grid cell in a hydrologic model, where the runoff may incorporate outflows from several reservoirs as well as unregulated tributaries?

4. Is there a relationship between the operating objective of the reservoir (hydropower, flood control) and the routing model performance?

5. It is not clear why the study would compare the model performance prior to calibrating the k coefficients for each reservoir. I would think readers would be most interested in the performance results after calibration.

6. Finally, the paper could be edited to improve the flow of ideas.

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