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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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Thank you for your review and thoughtful discussion! Broadly, we will make alterations to the manuscript to more clearly describe the rationale for comparing these specific methods. We will also clarify some of the discussion and insights.

Issue #1 Response: The reviewer is correct in that there are a number of reservoir routing methods available that we did not choose to study. We describe why we chose these methods in lines 134-141 of the manuscript. We heavily reviewed existing reservoir routing methods and limited our study to Döll et al. (2003) and Hanasaki et al. (2006) because these are parsimonious approaches that require only readily available

variables, reservoir storage and inflow. Unlike, recent methods such as Burek et al. (2013) and Zajac et al. (2017), the Döll and Hanasaki models do not require a number of operational states. We describe these assumptions in lines 84-104. We will alter the manuscript to better describe how our study's objectives are linked to utilizing the most parsimonious approaches available and that the limits to this study are linked to our emphasis on being parsimonious. We will investigate additional methods, beyond those listed in the literature review, and either use these methods in the study or describe why they were not chosen as well. The reviewer is also correct concerning the pairing of non-data-driven methods with statistical fitting techniques. Data-driven methods are described in lines 66-78 of the manuscript. They are approaches that require a training dataset in order to be implemented. Non-data-driven methods are described in Lines 80-83. No doubt other approaches not studied here could be more appropriate in certain contexts, however, the primary aim here is evaluating methods for use in hydrologic forecasting schemes applicable across the global domain. The authors do not assume that subsets of training data are available to characterize operations, nor do they assume that real-time insights related to current reservoir levels can be known in a forecast setting. Non-data-driven methods are conceptualizations of reservoir operations that can be adapted to be a data driven approach but do not require training data in order to be implemented. We will alter the manuscript to describe that non-data-driven methods can be linked to statistical fitting techniques but that they are capable of being employed independent of such pairings.

Issue #2 Response: The run-of-the-river assumption is what we consider our "baseline" approach (lines 217-221). In other words, the utility of either method is based on whether the method outperforms the run-of-river assumption. And the timestep (daily vs. monthly) is does affect performance as discussed in Section 3.5. In general, the results might suggest negligible improvements over run-of-river for the Hanasaki et al. (2006) scenario at the daily timescale, as discussed in this paper. Alternatively, the improvement over the baseline condition, even at the daily timestep, was generally positive for the Döll et al. (2003) method when the release coefficient is adjusted for the daily timestep. See Section 3.1 for a description of this. We note that there are limitations to the implementation of Döll et al. (2003) through the discussion of system specific examples. We also note in Section 3.6 the potential issue for instability. Thus, we discuss the model limitations. We kindly disagree that these models cannot in all cases adjust for flood control or hydropeaking. There are a small subset of simulations that perform worse than the baseline simulation using Döll et al. (2003). We will alter the manuscript to analyze and discuss the causes for this underperformance.

Issue #3 Response: This is beyond the scope of this manuscript. The use of observed inflow is a proxy for this scenario. A follow up study would be required to analyze this.

Issue #4 Response: We cannot make an assertion either way about the operating objective influencing the routing performance since the vast majority of reservoirs we considered are for flood control (see Section 2.2). The authors will note this limitation in Section 3.7.

Issue #5 Response: Calibration of the k coefficients would be better suited for the insertion of the Doll Method into a hydrologic routing scheme. The current study is investigating the feasibility of these methods and is a precursor to an additional study were the methods may be implemented in a large scale hydrologic routing scheme. In this study, we may calibrate the routing scheme using the k coefficients. However, there is limited benefit from calibrating the k coefficients in this study, given that it is an initial investigation into whether varying the k coefficients is beneficial. In addition, reservoir outflow information is rarely available at global scales, calibrating the k coefficients for an operational forecasting model would be very difficult (see the discussion in Zajac et al. (2017) of an open access database for daily reservoir records). When outflow information is available, the authors agree that it is advisable to calibrate. However, the authors do assume this type of information is available globally. We will include these details within the revised manuscript.

Issue #6 Response: We will alter the manuscript to improve the flow of ideas.

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