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Interactive comment on "Inferred inflow forecast horizons guiding reservoir release decisions across the United States" *by* Sean W. D. Turner et al.

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Referee Comment: This paper contributes 1) the novel notion of "horizon curve", i.e., a week-by-week assessment of the forecast horizon that is most relevant to release decision during a certain week, and 2) a methodology to derive this curve, with an application to a number of CONUS dams. This methodology is complemented by a random forest analysis to link results with dam characteristics, and with an illustration that integrating horizon curve within a release rule can improve the fit with observations. The idea is creative and very timely, as modelers are working to improve the representation of reservoir release rules within hydrological models. Its strength lies in

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trying to summarize complex forecast processes, based on disparate and often site-specific information (as authors discuss in the paper), with a single vector mapping the forecast horizon as a function of time of year. Authors are able to substantiate their results with supplemental analysis, and to interpret the results for a range of different situations (this also demonstrates that the methodology works well enough to adapt the results to these different configurations). The paper is also well-written. Overall, this fits well within the remit of HESS both in terms of scope and quality.

Author Response: Thank you very much for your time and for your thoughtful and constructive review.

Proposed changes to manuscript: N/A

Referee Comment: Authors correctly identify (line 113-136) that stationarity in operations and forecast availability is a necessary assumption (and / or limitation) here, but they don't actually use the word or relate it to hydrological (non-)stationarity. I would advise authors to move that paragraph to the discussion and relate their assumption to climatic, operational and forecast stationarities: all of them refer to sources of information that reservoir operators may rely on and that may (or do) vary over time.

Author Response: We agree that the term stationarity would help readers better understand this limitation and that the issue should, in part, be related to hydrological non-stationarity (although we suspect the most important driver of non-stationarity in operating rules would be introduction of environmental flow regulations). Another interesting source of hydrological non-stationarity would be a change in operations at an upstream dam (as opposed to climate-driven).

Proposed changes to manuscript: We propose to expand the discussion of non-stationarity as suggested by the reviewer.

Referee Comment: Discussion and Figure 8: it is unclear what the release rule is and how exactly the horizon curves have been incorporated to it. Improved results from

integrating horizon curves within the release rule representation are the exclamation point to this paper (and authors are right to mention in the abstract), so the appropriate details should be given. This should be presented in the methodology (Section 2) as an example of how horizon curves can be implemented in practice. Then results should be described at the end of Section 3 instead of in the discussion. Then lines 21-23: the statement is far too general and assertive. Authors only show that integrating forecast information CAN improve performance, using an unspecified release rule at selected sites.

Author Response: Thank you for highlighting this missing piece of information. The release is computed from the set of optimal piecewise functions (one for each week) that result in the closest fit when generating the horizon curve for each dam. For example, if the best piecewise function for water week X uses a 7-week ahead horizon, then that function will be used to determine the release in re-simulation for week X. We agree that we should expand the method to clarify this for readers.

Proposed changes to manuscript: We will follow the reviewer's suggestions to: (1) expand the method section to describe how the release rule is generated as part of the horizon curve derivation; (2) move the associated figure into results, and (3) change the text in the abstract so that our claim (horizon curve improves simulation performance) reflects the limited nature of the simulation analysis involving eight reservoirs.

Referee Comment: With this Figure 8 description of how accounting for the horizon curve can improve the representation of reservoir operations, authors may be missing an opportunity by only using the RMSE of release as a performance indicator. This is a general comment that could be better qualified by focusing on very high or very low simulated flows. For instance, they could use goodness-of-fit indicators especially designed to highlight the quality of the fit for high or low flows (see van Werkhoven et al., Advances in Water Resources 32 (2009) 1154–1169). Alternatively, they could define a reservoir's spill as the outflow beyond the maximal quantity of water that can go through hydropower turbine in a day, and look at spill RMSE. Integrating forecast

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would likely have a significant effect on spills, e.g., in a case like Lake Powell.

Author Response: We had actually looked at some other metrics and decided to present just RMSE for simplicity (we reach similar conclusions with NSE and KGE). We agree that the metrics that assess performance of low flows would be a useful addition.

Proposed changes to manuscript: We will tabulate performances across two or three different performance metrics for each reservoir, and also show results for goodness of fit of the storage and spill time series where observations permit.

Referee Comment: A final, general comment is that in the absence of pointers on what the forecast information is, the forecast information might well be the expected average inflows conditions – involving no actual forecast at all. This should be clarified.

Author Response: Please see the separate comment, posted immediately following this review, that addresses this comment exclusively.

Proposed changes to manuscript: We will re-write this section of the manuscript to demonstrate clearly that our procedure avoids detecting foresight in operations as a result of expected average inflows.

Referee Comment: - Line 59: please replace “hydrology” by “hydrological” - Line 93: mention that October 1st is the start of the hydrological year. - Line 106: it would be good to tell right there (maybe with an equation) how exactly fit is computed, and justify choice of formula. - Section 2.4 and line 271: it would be useful to precisely define F1 score, precision and recall.

Author Response: We agree with all of the minor changes above.

Proposed changes to manuscript: We will implement all of these adjustments, corrections, and clarifications.

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