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Hydrology and Earth System Sciences
Discussions

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

Anonymous Referee #2

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Review of "Inferred inflow forecast horizons guiding reservoir release decisions across the United States" by Turner et al.

In this submitted manuscript, the authors applied a conceptual method to analyze 316 dams and reservoirs in the U.S. with respect to the roles of forecast information in driving the discharge operations. Using the proposed "horizon curves", authors specifically analyzed the relationship of forecast information and operation for four key dams, in order to test whether the proposed method could improve the modeling capability of large-scale hydrological studies with the interference of reservoirs and dams. The study was originated from the fact that water managers nowadays will rely more and

more on hydrological forecasts as the information of forecast range, resolution, and accuracy have been improved by various methods. However, it is still unknown how important and how influential a forecast could essentially improve the reservoirs and dams operations. One of the contributions of this study is to analyze a large number of dams in the United States based on limited reservoir operation data. In addition, a new concept of "horizon curves" has been proposed by authors. Using the proposed method, this study also tries to answer the question of "how and when do forecasts applied in the field of reservoir operations". In general, the scope of the submitted manuscript is indeed very interesting, and the main contribution & novelty lies in the invention of the concept of "horizontal curve" for reservoir operations. However, the reviewer thinks there are a few key assumptions are questionable when authors develop the "horizon curve" method. Those assumptions are subject to verification and further investigation. In addition, the reviewer also finds the organization of the manuscript is confusing, and few paragraphs in the methodology section are hard to follow due to missing steps or information. Some major issues are listed as follow:

1. Methodology Justification (Line 85-86) The proposed approach is based on the assumption that 1) "the future observed inflows (perfect forecast) may act as a proxy for the actual forecast available to the operator at the time of deciding how much water to release". However, in reality, reservoir operators never trust a single forecast, at least the forecast uncertainty needs to be considered when making any release decision. More importantly, most of the releases are pre-defined by the reservoir "rule curves" with limited influences from the forecasts. Regardless of the forecasts in different ranges and accuracy, reservoir operators always and have to releases a certain amount of water at a certain time following the "rule curves". Therefore, the reviewer is unclear how the forecast information based on the "horizon curves" could actually interact with the existing operating rules. The manuscript seems to omit this linkage between forecasts and the hard rules reservoir operators must follow. The rule curves are even more important in terms of mid to long-term operations, which is the same time range this study has been focused on. Different reservoirs have different rule

curves, and it would vary from one reservoir to another. The proposed method of "horizon curves" seems to be a universal approach for any reservoirs. Reviewer is wondering the applicability of the "horizon curves" as each reservoir will have different settings and "rules" to follow as regulated by USACE or relevant water agencies. How does the proposed "horizon curves" could address different reservoir regulations and functions, such as hydropower reservoir vs. flood control reservoir vs. water supply reservoir vs. environmental demands?

2. The steps of horizon curve method (Line 80-120) The reviewer cannot fully understand the whole process of deriving the horizon curve. For example, in line 98, the authors mentioned the "release-availability" function for the first time in the manuscript and then briefly explained the definition of "availability a". How do the authors define "release-availability" here? How did authors construct the functions of "release-availability"? The possible releases must be from the existing operating rules to prevent overtopping and dead-pool of reservoir storage. Where do authors obtain such information in a national scale? This is a term again not commonly used by water managers, and more explanations would be needed. The authors also wrote, "The inferred policy function fitted to these data is a piecewise linear model with a single breakpoint" in line 99 and the reviewer is wondering what does the "policy function" here refer to? And what do "these data" referred to as? In general, the reviewer thinks this section is hard to follow given lots of non-common terms were used. Those wordings may make sense to authors themselves, however, it is not apparent to water managers and operators. Please re-check some of the literature and especially reservoir operation reports to further explain how the proposed method is constructed in detail. A flowchart or additional figure may be added to explain the steps of creating this horizon curves.

3. The use of Random Forest Classifier (Line 160 - 170): There are few nested issues about the description on the use of Random Forest Classifier, experiment setting, and how will these experiment settings lead to a conclusion related to the forecast information and reservoir operation. First, authors should point out what are the "features"

and "target" when using Random Forest Classifier. The authors mentioned there are 26 features without a tabular form to let readers know what those are. In addition, the "target" used in RF is still unclear. Did the authors intend to figure out which feature has the most important influences on release decisions? Or did the authors intend to classify reservoirs according to their correlation between discharge and inflow forecasts? And how was this realized in RF? The description here reads very short and is not comprehensive. Reviewer is confused about what has been classified based on what inputs, as well as how this experiment setting would lead to a certain conclusion. At least a few additional paragraphs would be necessary to explain the experiments here.

4. data segmentation (Line 160 - 170): Since the methodology used here is Random Forests as one of the machine learning tools, the reviewer is wondering whether there is an overfitting issue? Traditionally, the data should be split into training, validation and test periods to verify there is no overfitting. However, authors only did a training and a test without validation. It is likely the model is overfitted and more experiments on different folds are necessary to justify the proper use of random forests.

5. Gini index Line 305: Can the authors define what is the "Gini impurity of the tree"? Some examples and references using this index would be helpful.

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