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Discussions

Interactive comment on "Deduction of Reservoir Operating Rules for Application in Global Hydrological Models" *by* Hubertus M. Coerver et al.

Anonymous Referee #1

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Review of "Deduction of reservoir operating rules for application in global hydrological models" by H. Coerver, M. Rutten and N. van de Giesen for potential publication in HESS

The manuscript describes an approach to derive reservoir release rules at a monthly time scale based on inflow and storage observe information with the goal of improving upon generic operating rules and forward looking optimization schemes used in global hydrology – reservoir models presently. The fuzzy approach is applied over 11 reservoirs globally with sensitivity test on the fuzzy rules and predictors (shapes, inflow and storage across different time steps interdependencies).

Overall comments:

The approach and motivation of the paper are of high interest to the HESS community following up on previous large scale water modeling. There is a need for such an approach in order to improve upon the generic operating rules while within the constraints of an optimization without forward looking optimization. While the approach is very sound, it fails to evaluate the improvement upon generic operating rules .

The generic operating rules take into consideration the expected inflow, reservoir storage, seasonality of flow and release for water demand and environmental constraints. The generic operating rules are therefore calibrated for the specifics of each reservoir, using data available for all of them in a consistent manner. They also allow ensuring that constraints are met at a finer temporal resolution in addition to monthly release targets (spill, environmental flow). The rules also allow for inter-annual variability. The rules have been further improved with storage targets (Voisin et al. 2013), which improves the pattern of release which is goal and storage dependent oriented. The rules overall mimic the seasonality in regulation although do not necessarily follow the operational rules and there still could be large differences with respect to reality. The current approach explores the optimization of the rules based on observed inflow and storage, and tries to match observed releases, therefore could allow for a more realistic seasonality in the rule curves. However it is unclear how they improve upon the generic rules while global hydrologic modeling has been more focused on improving other physically based processes (groundwater) rather than generic operating rules (Wada et al. 2016).

1/Applicability to GHMs : This paper presents an approach presently using the best case scenario (observed input data) and will likely lead to other evaluation within GHMs using GHMs flow and reevaluation. In order to meet a first objective of the paper which is to improve the representation of reservoir release in GHMs, I would recommend discussing the anticipated applicability in a GHM context:

o significant errors in inflow? o the cascade of errors in release between cascading reservoir along major rivers? o Lack of observed release for most reservoirs? o Isolate the non stationarity in rule curves as more reservoirs and water uses were built during the inflow, release and storage observation periods?

Those points should be further discussed in the paper in order to support the approach and its application to GHMs despite presented here as a proof of concept.

2/ technical evaluation:

2.1. comparison with generic operating rules

Another objective is to demonstrate the improvement upon the generic operating rules - I would also suggest to make an explicit comparison with the operating rules. Those are simple enough the recreate using an excel table and could be derived using the 10 year training dataset and tested over the same two years. What is unclear is if a simple calibration of the generic rules parameters could outperform the fuzzy approach. Despite the shortcoming of the fuzzy approach (data centric, etc), is the improvement toward more realistic rule curves such that it should be implemented over as many reservoirs as possible, data permitting, while completed with generic rules?

2.2. longer evaluation approach in order to capture trends and insight based on flow seasonality and reservoir characteristics

The experimental approach consists in exploring the parameterization and variability in parameterization across multiple types of reservoirs. From a mathematical perspective it sounds very valid but the paper presently lacks in insight from a physical perspective and in particular what we already know or what we learn with respect to water management. For example, the manuscript mentions operational constraints such as end of the year carry over or storage targets as a major driver of rules. Yet the current approach does not seem to simulate the carry over storage target. GHM have been used to understand terrestrial water variations (Doell et al. 2012, Pokhrel et al. 2012, Wada et al. 2016). This is an important aspect that is not represented by the operating rules. The fuzzy approach does not take it into consideration either. I would suggest putting

some of the exploration discussion in supplemental material and add insight with respect to what has been done so far and the scientific and realism results contribution of the approach,

Specific comments:

Section 2: before into going into the technical methodology, describe how you anticipate the approach to complement or build upon previous approaches and how you will measure it, and address the scientific questions

Table 1: how were those reservoir selected out of the 6000 large reservoir globally?

Section 4: average performance is shown for 2 reservoirs. Please define average performance.

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