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Interactive comment on "Representation of Water Management in Hydrological and Land Surface Models" *by* Fuad Yassin et al.

Anonymous Referee #1

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The manuscript provides a review of the representation of reservoir operations in a range of hydrology models, then presents a reservoir operations model which explicitly represents storage zones. The optimization scheme AMALGAM is then used to optimize the releases and reservoir zones parameters toward reproducing observed operations. Authors evaluate the models over 37 reservoirs globally and with respect to other previously established reservoir operations schemes. Authors conclude that this explicit representation of storage zones increases the accuracy of representation of reservoir operations. Caveats include the need for data to support the optimization of the operations and the reliance on good calibration of hydrology models to reduce biases in inflow.

The paper is very well written. The introduction summarizes the use of reservoir oper-

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ations models to complement a range of hydrology models. The explicit representation of reservoir storage zones , optimized/calibrated to match existing reservoir operations is very sound. While the introduction is nicely put together and provides a good review of water management models associated with different scales of hydrology models, it does not support the title. The contribution of the science is mostly in the representation of those new rules. In brief, this model has a very sound and promising concept for reservoir releases, but the models comes out as "oversold" because it lacks the representation of important processes (withdrawals, return flow, dynamic operations etc) and can only be applied on a fraction of reservoirs. A discussion on how it could be implemented in conjunction with existing simplified representations where data is not available, including other driving dynamics such as water withdrawals, would increase the impact of the paper and its leverage by others. As presented, the paper seems to be better suited for a journal presenting geophysical models development and validation, and some clarification of its usage would also be necessary.

1/ Discussion/Contribution to the science

- The specifications for Hanasaki et al. (2006), Haddeland et al. (2006) and other models were specifically to not rely on observed reservoir operations due to the data challenge, and the biases in reservoir inflow estimates. The authors provide some arguments on how satellite data and well calibrated hydrology models are available now. The "why it can be done now" seems to be justified yet the availability and accuracy of those required storage and release observations are not available yet and their accuracy still require research in order to meet water management requirements. This reality decreases the impact of this new model; this data challenge allowed only 37 reservoirs to be represented out of 6000+ reservoir globally with other models.

- The new model is presented to be better for multi objective purposes yet it is compared with reservoirs for flood control mostly (Hanasaki models) because of the lack of water demand information. This is actually a huge deficiency of the new model. All other models explicitly represent not only reservoir operations but also spatially dis-

tributed withdrawals and return flow.

Again, the concept is of multiple zones is very sound and appreciated. The valuation of the model as one that can replace existing models which have been looking at drivers of spatio-temporal redistribution of water resources, does not seem adequate nor properly supported.

2/ Technical comments:

- Title is not adequate because the paper is mostly about the new model

- Literature review needs some clarification:

o Note that for catchment model, the inflow is often bias corrected before input into the models.

o RiverWare , MODSIM and OASIS are widely used across the US. Note that all those models require foresight to decide on the reservoir releases. In that context, this is how Haddeland et al. (2006) differs from Hanasaki et al. (2006): Haddeland et al. (2006) also uses foresight to decide on the reservoir releases. How is this new model handling foresight?

o Existing reservoir operations model in a catchment model: Zhao, G., H. Gao, B.S. Naz, S.-C. Kao, N. Voisin, 2016 : Integrating a reservoir regulation scheme into a spatially distributed hydrological model". Advances in Water Resources, 98, 16-31. 2016. doi : 10.1016/j.advwatres.2016.10.014

o Note that Hanasaki et al. (2006) follow one priority use. Voisin et al. (2003) introduced storage-and-release targets toward combining flood control and irrigation, i.e. multi objective use.

o Although non explicit – storage zones were already implicitly represented in Hanasaki et al. (2006) and other models (Wada, Biemans, etc); Spilling when overflowing (i.e. max reservoir at 95% full), and no release when storage gets below 10% of maximum

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storage. The contribution is in the explicit representation of those storage zones and their calibration, which, again, is a very sound idea and approach.

- Line 20: the time steps seem off in the equation. Given the time delay between precipitation and when runoff is available to drain, the equation does not seem right for an assumed time step ranging from days to half hours.

- Initial storage and inflow sensitivity section – I am not sure about the information brought up by the sensitivity to initial storage. A significant warm up is always required and is larger for large reservoirs. This model is expected to have storage data available so why are those not used? The use of the section needs some clarification.

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