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Comment on hess-2021-72

Anonymous Referee #2

Referee comment on "Water sharing policies conditioned on hydrologic variability to inform reservoir operations" by Guang Yang and Paul Block, Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-72-RC2>, 2021

Review of HESS-2021-72

This paper develops optimal water sharing policies for transboundary systems, focusing on the Grand Ethiopian Renaissance Dam. The technical approach is sound, and this system is an important one to study. The results are convincing because they show the tradeoff between minimizing storage variability (i.e. maximizing hydropower) and minimizing release variability for downstream water supply.

I believe that some moderate revisions to the structure and framing would make this paper a stronger contribution to HESS.

1. My biggest concern is confusion over the methodology, both what is being done, and the reason for the steps. The first step makes sense, optimizing a policy structured as a radial basis function to allow flexible use of information. In my understanding, the steps are: optimize a RBF policy, use it to infer a linear drought constraint, and then use this constraint to re-optimize another RBF policy. Is that correct?

If so, why are these last steps needed? For example, the flow of logic in Figure 3 is very unclear. It seems to repeat optimization steps in places. How is the drought mitigation policy different from the RBF policy, and why is it needed? The RBF is already a function of storage, inflow, and the month. The drought mitigation policy sets minimum annual constraints for water releases. But it seems that this could have been part of the original RBF optimization, and/or enforced in the simulation model to ensure that the constraint is met at all times.

More explanation and structure on these points throughout Sections 1-3 would be very beneficial. While the results are convincing overall, I was not sure that the drought mitigation policy is needed in the end (Fig 14), as there is only a small advantage to these extra steps.

2. It is also not clear how the drought mitigation policy uses forecast information, or why the original RBF policy does not. Especially because around Line 345 the results suggest that the forecast information is not very useful in the optimized policies.

3. Another concern is the novelty of the approach. The study follows best practices for

direct policy search (DPS) and arrives at a convincing result. However, I believe this approach has been used for transboundary systems before. It seems the new component of this study is deriving water-sharing policies (i.e. annual linear constraints) that are specific to drought periods. This may be a novel contribution, but as in point (1) it is not clear why this needs to be done here. The link could also be stronger between the linear constraint and the idea of a negotiated water-sharing policy between transboundary stakeholders.

Last, if the novelty relates to transboundary basins, is there any component of the methodology that is specifically designed for this case? The contribution may be more general, although the transboundary application is critically important.

4. The results are a bit too long, with 14 figures. These could be condensed to sharpen the contributions. In my opinion a few figures that might be removed are: Fig 7, Fig 9 (previous figures already show the change in standard deviation), and Fig 12.

5. In the introduction and methods, there are several places where the references are grouped together in long lists. It would be stronger to highlight individual contributions from these previous studies where possible.

A minor point about the introduction: clearly simulation-optimization is relevant, but why is policy fitting relevant to this study?

6. There are several possible discussion points that could be included briefly. First, the tradeoffs found in this study are based on a period of historical data, but what about the future? Do we expect patterns of variability to be similar? Second, is there a way to better understand the characteristics of the optimized policies so that they could be reported to stakeholders, for example? These can be points for future work but deserve some discussion.