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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evaluating robustness of dynamic reservoir management under diverse climatic uncertainties: Application to the Boryeong Reservoir in South Korea" *by* Kuk-Hyun Ahn and Young-Il Moon

Anonymous Referee #2

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The paper "Evaluating robustness of dynamic reservoir management under diverse climatic uncertainties: Application to the Boryeong Reservoir in South Korea" aims to understand the impact of forecasts on reservoir operations in South Korea. This is done by using a hydrologic model forced by synthetic climate data and a synthetically generated forecast index to test the robustness of reservoir operations in the region. The overall research is interesting, however, there are a number of issues that need to be addressed before it is ready for publication.

First, the paper structure makes it difficult to follow and understand what is being done.

In fact, the methodology was not completely clear until the results. The authors need to rethink the structure of the paper, especially relative to the way the methodology and results are presented. For example, the discussion of the synthetic forecast index made little sense until the results section. It would be much clearer, if the ENSO results were presented in the methodology section in order to motivate and describe the methodology of synthetic forecast index.

Next, the methodology is limited by the highly calibrated hydrologic model and the synthetic climate forcing and forecast index as they assume climate stationarity. In terms of the hydrologic model, as the climate changes will there be feedbacks that change the hydrologic response? With a heavily calibrated model there is no room for this to change. This is not to say that other models do not have calibrated parameters, but there are certainly models that have a stronger connection to the climate through more realistic representations of vegetation, snow and land cover. It would strengthen the study by including a more processed based hydrologic model to see how it performed and how important this assumption is to the results. In terms of the synthetic climate forcing, it assumes a constant variability, spatial connection between the two basins and connection between the region and SSTs. A straight forward way to address this would be to use future projections of climate models would capture the evolution of spatial connections between the basins and the SSTs and would provide a more processed based solution. While ideally a future version of this paper would include this additional analysis, at the very least it must be discussed as a limitation of the results presented.

Lastly, there is very little discussion about the DRI index developed and why and how it is useful for assessing reservoir forecasts. Furthermore, the choice of 0.7 as the threshold is arbitrary and there is no attempt to justify the choice with statistical test or other analysis that would justify the choice. This index needs a more thorough discussion and development.

Overall, this is a very interesting paper and with further analysis and revisions will be a

great addition to the scientific literature in the area of reservoir operations and climate. Specific comments for additional improvement are also given below.

Other Revisions:

The paper needs revisions in terms of the flow and construction of the sentences as there are a number of awkward or confusing sentences that need revision. Here are a few examples: 49-50, 75-76, 79-80, 83-85, 101-105, 131-133,180-182

Line 183: The term “real-option” is not very descriptive of the inter-basin connection. Consider a new term that is more descriptive.

Lines 269-270: Most models represent the soil into multiple zones, this is not a unique or novel feature of SAC-SMA.

Line 316: Still not sure where the 117 came from. I tried to go back and figure it out, but there needs to be a better description so the reader does not have to go back and do all of the math again.

Line 365: This information should really be in the introduction as it helps setup the study.

Line 405: Why would C* and C** be determined by the stochastic model? Based on the description, these are storage levels at which water restrictions kick in. Shouldn’t this be the same for all simulations?

Line 413: The term “depleting storage” is confusing here, the transfers should increase storage?

Lines 434-449: It is unclear how these observations are used in the methodology. There needs to be more description about what data is used for what. It would be nice if this was summarized in a table so it was clear.

Line 460: Is this streamflow from the gauge or the model simulation. Please be specific.

Lines 467-471: Is all of this done in a PCA framework. Seems like PCA was mentioned in the introduction, but there was no discussion here about PCA.

Lines 472-478: This would be better suited for the methods. The methods section on developing the forecast index is severely lacking and leaves a lot of questions. This helps answer these questions and would make it much clearer if these results were presented in the methods section.

Line 997: While it is helpful to have a smaller picture showing the basin relative to South Korea, it is not clear how the small picture connects with the main picture. The lightly yellowed basin looks like the larger picture, but what is the orange colored basin? Try to make the connection clearer.

Line 1020: There is not much discussion about this figure and the caption is not very descriptive. Also, the adjectives used to describe the scenarios is misleading as extreme storage would indicated too much storage? Consider changing the descriptions. Just changing “storage” to “level” makes it less confusing.

Line 1051: Subplots (b) and (d) need units on the y-axis and assuming that they have the same units would mean that the figures are flipped as it does not make sense that the seasonal average would be less than the seasonal low flow.

Line 1076: This plot is difficult to read due to the grey stripes and all the box plots. It is also unclear as to what is from “climate simulations” and what is from “observed”, both are mentioned in the caption.

Line 1101: It would helpful if this plot included the KGE and other metrics on the figure for both the calibration and validation period. It is also very difficult to see the difference in the lines because it shows such a large time period.

Line 1123: What are the different colors for? There is nothing in the legend about color.

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