

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2  
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## **Comment on hess-2022-244**

Anonymous Referee #2

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Referee comment on "Spatial variability in Alpine reservoir regulation: deriving reservoir operations from streamflow using generalized additive models" by Manuela Irene Brunner and Philippe Naveau, Hydrol. Earth Syst. Sci. Discuss.,  
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This paper introduces a methodology and analysis of estimating reservoir operations across 74 different catchments in the Alps using general additive models. The goals were to identify groups of catchments with similar reservoir operations and assess how catchments differ with diff operation differ in location and catchment characteristics (how do different operations affect locations and areas). The approach of using GAMS was indeed a really interesting idea, however, I found the manuscript to be too vague and light on details to be confident in the results or for the methods to be reproduced.

### **Major Edits by Section:**

Methods:

- General Data Section
  - Can correlations be made if we are not looking at the same time periods? Can this be expanded on?
  
- Climate data was from gridded dataset, averaged over the full time period, moving time window to and replaced NA with mean flow
  - Does it make sense to replace NA with mean flow? If you want to keep mean flow, perhaps filling with monthly averages would be better.
  - How was the disaggregation done?
  - What was done to normalize or standardize the other data used

- GAMs Section
  - I'm not sure subtracting the mean standardizes your streamflow timeseries. Perhaps, it would be better to normalize by subtracting the mean and dividing by the standard deviation
  - Do you test for outliers in the Streamflow data? The peak in Figure 5 a around 2000 could be a result of an extreme weather event or an outlier in the observed data. What do you do to fix these if they occur, or do you simply assume that by normalizing you remove all the outliers?
    - Is it observed – natural for your comparison? If it is not, then the phrasing around line 140 needs to be changed.
  
- Signal Variation Analysis (2.3)
  - I think this section would benefit from a graphic explaining the workflow or at least demonstrating how the clustering is going as this felt like the most information rich section with a lot of steps.
  - I would also add more details on the previous Brunner et al., 2020 paper.
  - My main concern is that figures 3,4,5 only focus on the single catchment and not all the catchments. Would it be possible to include all the catchments.
  - Figure 1: I would zoom out a bit from the map so we can see the full Rhine and be more oriented in the catchments, Also what are the differences between the purple and black outlines? Denote that in the figure caption
    - Also, may be useful to put a map of the reservoirs so we can see where they are spatially located
  
- Figure 5: I would shade the release periods vs storage periods in panel c so that the reader has an easier visualization for what periods are storage and which ones are releases.

#### Results:

- This section felt very choppy as there was one figure then a few lines of text. I think this could be more clear by grouping the results and creating panel plots. I do like that this section had all the catchments on it
- Figure 6: I'm not sure this figure adds too much to the discussion. Perhaps you could panel your reservoirs by bigger basin or by similar characteristics ( ie peaks in summer, peaks in winter). Another option is to color them by region or use, although I do think paneling or grouping would be useful to the viewer.
  - Also, after seeing Figure 7, I think you can cut figure 6 and use that space to add a graphic about the workflow in 2.3
  - I would also add a legend to this plot to denote what green and blue mean. Additionally, I would pick more colorblind friendly colors to be more inclusive.

- Figure 8 should have a map of the larger area so we can situate ourselves a little better
- You could combine figure 9 and 8 into one panel so this section doesn't feel as choppy
- Figure 10's results tie directly into the map created in Figure 8. I would definitely panel some of these plots (Figure 8,9,10) in order to make this section flow smoothly and not feel as choppy. I would also reorganize the results about figure 10 and the reservoir location to be next to the map.

#### Discussion:

- I do not feel that you did a strong job of linking catchment elevation to reservoir operations, Perhaps that is due in part to the shorter results section. I think main use is a bigger takeaway as you specifically state that higher elevation reservoirs are more hydropower vs lower elevation being water supply

#### Minor Edits:

- Figure 2: I would add a dashed line when the reservoir came online so we have a better idea of when those changes occurred.
- Figure 4: the grey on the natural flow is hard to see. Perhaps using a dashed line or something like that would be useful?
- Figure 3: I really liked this figure!

#### Notes from HESS specific questions:

- Does the paper address relevant scientific questions within the scope of HESS?
  - Yes. It looks at how humans have impacted the hydrology of certain regions by deriving reservoir operations from generalized models
- Does the paper present novel concepts, ideas, tools, or data?
  - I believe it does, but I think the authors could emphasize why this is so novel.
- Are substantial conclusions reached?
  - I personally felt that the conclusions reached could have been more direct
- Does the title clearly reflect the contents of the paper?
  - I think there could be a more informative title (something like "Deriving reservoir

operations from streamflow using GAMS), because you make the case in your introduction that your main takeaway is the ability to derive reservoir operations directly from streamflow, climate, etc