

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
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Comment on hess-2021-331

Anonymous Referee #2

Referee comment on "Quantifying multi-year hydrological memory with Catchment Forgetting Curves" by Alban de Lavenne et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-331-RC2>, 2021

This study works on catchment memory and performs a kind of sensitivity analysis to quantify the influence of past conditions on streamflow variability. The general topic of the paper is in the scope of HESS. Catchment Forgetting Curves (CFC) are introduced as a metric to characterize catchments' memory. As other reviewers mentioned already some concerns, I try to focus on other details here. Overall, language and structure is a little bit cluttered, however I can follow the story of the paper, but some analyses should be revised. May be this is a personal issue, but I don't think that the word "pluriannual" is the best choice as "multi year" is more common in the community.

Major comments:

- L12-18: What about human water use? This aspect is also missing in the introduction (long term effects) (L103-110). I see the short paragraph (L139-144) about human influences on catchment memory, but this should be more integrated into the introduction (looks like a marginal note here). The word 'human' is only mentioned two times in the manuscript, I recommend to put more focus on this potential driver of catchment memory (at least in Introduction/Discussion).
- L36-50: The difference between water age and catchment memory is very important to explain. Authors can consider to embed research in this field in other studies, e.g. different storage concepts in Staudinger et al.(2017). Catchment water storage variation with elevation. *Hydrological Processes*, 31(11), 2000-2015.
- L115-L119: I am not convinced here as there are a lot of studies finding large(r) groundwater storages in (relatively small) alpine headwater catchments (e.g., Staudinger et al., 2017 or other studies in Switzerland). Has the Merz et al. (2016) study in L120 multiple catchments in their analyses (with variation in size and elevation)? If so, is there a correlation between storages and elevation or area?

- L127-134: I am not sure if the examples from the Tropics and Sahara Desert are a valid justification of "baseflow importance".
- For me it looks like that the choice of "1 year" as temporal resolution may be not appropriate to answer the research questions: The "1 year" includes all effects 7 up to 17 months, "2 years" embeds everything from 18-30 month, right? This classification might be really critical and as the data allows for a more comprehensive analysis (e.g., seasons, months).
- The authors stated that short-term memory is not considered (L23+24) but in Fig. 5 I found a short- vs. long-term analysis. This is confusing. By the way where is short- vs. long-term memory defined?
- It is stated that in Sweden 5% of catchments are regulated and that there is no regulation in French catchments (i.e., those are excluded). What kind of regulation is this and has it influence on the outcomes of the study?
- L245-248: This is not clear to me. Is about those drier catchments have a longer memory? If so, why they are drier as longer memory most likely come along with larger storages (which in turn will lead to more continuous flow, or?) Here more explanation is needed.

Minor comments:

L12: "biota", do you mean vegetation?

L19: 'past climatic sequences', could you please make a more precise statement about this?

L24: Just a comment, the word 'pluriannual' is not very common, perhaps considering to switch to multi-year (cf. L88)

L162: What is exactly meant with 'not regulated' (only no dams?).

L165: Please state shortly the relevant variables to estimate E0.

L172: How many Swedish catchments have what amount of lake area?

L184-190: How is the maximum of parameter w (=5) justified? I can think about some catchments that have 'a longer memory' than five years.

L192ff: Might be easier to understand to name it x- and y-axis although the description of

axes is correct.

L221: This sentence is not clear to me: "This shows that..."

L254: "thinner soils"; is there data/analysis on that (in more detail)?

L285: "is spread out", perhaps consider to rephrase here.

L326/327: Just a comment, perhaps a more in-depth differentiation between dry and wet years/seasons would be beneficial to better understand how variability in CFCs could be explained?

Fig. 5: Might be helpful to switch to another graph type here as boxplots may hide bi-modal distributions. Perhaps violin plots are more helpful here or the data points can be added with a jitter to the visualization.

Comments on the maps: I like the way French and Swedish catchments are compared with the point-maps. However, I suggest to reduce the point size a little bit to avoid too much overplotting. As the rest of Europe is not relevant for this study it might be also an improvement to have outlines of both countries next to each other to gain more space for the actual visualization (i.e., variability across the countries).

Please revise paragraph structure (e.g., often line breaks seem to be redundant, for example in the abstract?) Examples: L156, L109