

Hydrol. Earth Syst. Sci. Discuss., referee comment RC3  
<https://doi.org/10.5194/hess-2021-331-RC3>, 2021  
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## **Comment on hess-2021-331**

Anonymous Referee #3

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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-RC3>, 2021

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This paper with the issue of catchment memory, it asks a novel question and is well in the scope of the journal. I have some issues that worry me, and should be clarified.

1 I think the analysis should be done using hydrological years and not calendar years. It is common in hydrological modelling studies to refer to the years starting in September, where the catchment storage is low and so catchment memory. Using calendar years, there is a higher chance that the meteorological conditions from the end of the summer, when the wet season starts, will have an impact on the runoff in the following months. This effect is largely related to meteorology, and has little to do with the catchment memory that the authors are trying to investigate, which instead, should reflect a catchment property.

2 Care should be taken to the fact that there is a spurious correlation between the variables  $Y=Q/P$  and  $H=P/E0$ , when such quantities are calculated for the same year. Both equations in fact contain the same variable P. I think the authors should recognize this fact and reflect on it, as it can have a strong impact on the analysis.

3 An improved mathematical notation could help. Since the authors are working in two

dimension, difference from average and difference in time, it would be helpful to explicitly write what e.g.  $\Delta$  is differentiating. Moreover, the capital  $\Delta$  symbol should be used, as this is standard when calculating discrete differences, perhaps with some subscript to indicate in which dimension the difference is calculated.

4 Figure 1 shows that not only there is a lag 1 correlation between the Q-P and the P-E anomaly, but also that there is an autocorrelation of the P-E anomaly. This is largely an autocorrelation in climate properties, thus reflective of climate memory, rather than catchment memory. Such autocorrelation of climate should be analysed, and its effect removed or at least studied and recognized, otherwise there is a confounding effect.

5 It is unclear how the data are organized in order to enable the calibration of Equation 3. Moreover, it is unclear how  $\epsilon^2$  is calculated. Finally, once the authors will explain how they sort the data into an histogram in order to enable the calibration of Equation 3, it is unclear why the  $\omega$ s cannot be calculated directly from the histograms, thus without having to fit a distribution.

6 The results and discussion section poses several questions and corresponding analyses that are not anticipated in the method. Thus, that section reads more like a newspaper than like a scientific article. The question and analyses are interesting, but the methods should be organized to anticipate the structure of the analyses.

7 I am not sure that Figure 5 in the way it is formatted really conveys the message. Why not doing simply scatter plots, perhaps showing Spearman correlation values? I have the impression that this more classical way of plotting results might be more informative.