

Response to reviewer 1

- The reviewer's comments are **bold**, our response is in *italic*.

**The manuscript covers the catchment and climate controls on the drought duration in near-natural catchments. The topic is of great interest and I think the authors provide a nice overview of the difference between different catchments in Europe and the US. The manuscript is well written, however I have some comments that need to be addressed before publication.**

*We are grateful for the reviewer's relevant comments and suggestion on how to improve the manuscript. In this reply, we respond to each comment in order of appearance. The final implementation of the comments will be presented in the revised version of the manuscript. To avoid duplication in responses to the reviewers, we sometimes refer in this response to the response on reviewer comments of Henny van Lanen.*

### **Major comments**

**The authors aim to provide a global assessment of the control on the drought duration using near-natural catchments. However, they only use data from Europe and the US. I understand that the authors are limited by the data availability and that a real global analysis might be difficult to perform. This in itself is not a real problem. I think the authors could do a better job on generalizing the conclusions. At the moment they separate the two continents in all analysis, while I think the manuscript might be helped by a better comparison between the two continents. Why not us one analysis and pool all catchments for a specific climate or BFI and perform the analysis on the combined data. If the goal is to find the impact of climate on the drought duration, I think it would be better to group catchments with that climate, independent of their geographical location. This would strengthen the analysis and make it more general and hence also more applicable to other catchments on other continents.**

*We had reasons to separate the two regions for this analysis (described in the response to major comment 1 by Henny van Lanen) and did not specifically aim to provide a global analysis. However, in terms of generalizing the results, we agree that it is beneficial to include the analysis for the entire dataset. We suggest to present this in combination with the already presented analysis for each region (USA and Europe separated). The new exemplary figures are presented in Fig. 2, 5 and 6 of the reply to the reviewer comments of Henny van Lanen.*

**Linked to the previous comment, I miss one reference to analyse the differences between the drought durations. For each continent a separate reference is used. This does not allow the reader to compare similar climate, BFI or other controls that are located in difference continents. I think, that for example Figure 3, would benefit from 1 reference so that I can compare similar KG, AI or other indicators directly.**

*The newly suggested Fig. 3 (see Fig. 2 and response to major comment 1 by Henny van Lanen) will contain for each climate classification system and individual control:*

- *the average DDC of each class of the whole dataset*
- *the average DDC of each class of the two regions (Europe and USA)*
- *the difference between average DDC USA and average DDC Europe*

*This way, we directly present information about differences between Europe and the USA as well as the results based on the entire dataset and thus one common reference.*

**Although information on the uncertainty is mention in the discussion, I do miss that information in the Figures or in a table. I think the manuscript would be strengthened if this information is provided so that the reader can see how significant the difference between KG or AI are instead of just providing the ensemble mean for the class. The authors mention that the obtained results might help in understanding the catchment behavior in drought conditions. However, I'm not convinced that only information on the drought duration of the long droughts would provide sufficient information. As stated by the authors they leave out the information on the frequency of drought with this analysis. I'm aware that this would require some work, but I was wondering if the authors could not add information on the intermittency of the events (the time between drought events). If this information is provided the reader would also know if the long drought tend to follow one another or that a long drought is always an isolated and rare event. Maybe this is beyond the scope of the paper, but I was wondering if the authors have any ideas regarding this question.**

*We applied statistical tests to provide a measure of similarity. We used a common significance level (0.05) to check if DDC values at percentiles between 81 and 100 were significantly different. Fig. 4 and the corresponding minor comment in the response to Henny van Lanen illustrate that the long duration droughts (red line) match well with previously described major drought events. The short duration droughts (blue) do not really reflect these, but provide more or less a constant base-signal over the entire period of record. Based on this, we conclude that these long duration droughts provide sufficient information on the historical drought events that we are interested in. Another reason to focus on long duration droughts was based on the larger variation in DDC after the 81<sup>st</sup> percentile (Fig. 2a, current manuscript). Nevertheless, as raised by reviewer Henny van Lanen, we will clarify our motivation for objectives and focus in this study.*

**Finally, how could the obtained results be used in an early warning system, like mention in the abstract? Maybe this could be discussed in the Discussion. I think if the authors can show how to use the obtained results can be used in these systems; it would increase the social relevance of the paper.**

*We will remove or revise these statements.*

#### **Minor comments**

**Page 12878 Line 5-6; currently lacking is a large-scale evaluation of the relation between climate and hydrologic drought characteristics, I do not agree. Multiple studies have tried to tackle this topic and the first author is part of some of these studies.**

*Thanks for pointing this out. We were aware of the use of modeled data in the cited studies and intended to refer to "observed hydrologic drought characteristics" but mistakenly did not do it. We will change this in the revised manuscript.*

**Page 12879 Line 7-9 Add reference**

*We will add a reference in the revised manuscript*

**Page 12884 Line 9 Why is the Koeppen classification from Kottek (derived from global forcing data) and not compute the KG class based on the local catchment forcing? This would remove potential problems with the global data compared to the local conditions.**

*For this analysis, we used the method (not the map) described in Kottek et al., 2006 (pg 12884, line 9) to calculate the KG for each basin based on meteorological data for that basin (corresponding to individual controls P and T). We will clarify this in the manuscript.*

**Page 12889 Line 3-5 Why could the difference in the DDC for both E climates not be related to the topography. In the US the topography in the E climate is rather flat while in Europe this is not necessarily the case.**

*We agree. Furthermore, the difference in correlation between precipitation and elevation could contribute to this difference (negative for the USA, positive for Europe, presented in Fig. 1 of the response to the review comments by Henny van Lanen). We will consider adding a note on this in the revision.*

**I miss a proper caption. You need the main manuscript to understand the Figure. I think the reader would benefit if a longer caption would be provided to inform the reader on all the complex figures and information that is provided in Figure 3.**

*We will clarify the caption in the revised manuscript.*