

Response to Editor

Dear Ms. Van Loon,

We are very grateful for your thorough review of the manuscript and the many helpful suggestions that helped improving the text. Below, each of your comments (in italics, indicated by "EC") is followed by our answer (normal font, indicated by "AC"). Changes in the manuscript are written in bold. Lines indicated in the authors' comments refer to the revised manuscript without markups.

EC: Dear authors,

Thanks for doing the effort to restructure the paper. I think it has removed massively now. I like Section 3.1 that explains the implicit assumptions and the figures are clearer. A few changes are still needed to further improve the paper. Please address the suggestions below.

AC: Thank you very much for the positive feedback.

EC: I suggest the authors to remove the word "risk" from the paper when they are talking about monitoring drought risk, assessing drought risk, etc. because (as the reviewer indicated) the paper only includes hazard, while exposure and vulnerability are not included. A few examples:

- L.11: "monitoring drought risk" >> "monitoring drought"

- L.19: "assessing the drought risk of" >> "assessing the drought hazard of"

AC: We implemented your suggestion and replaced the word "risk" by "hazard" (L. 2, 21, 84, 299, Table 1, rows 1 and 2, L. 332, and 709) or removed it (L. 11 and 334). We now use the word "risk" only when we refer to the risk system or the targeted risk of a drought assessment as well as in one citation (L. 41).

EC: - L.21-22: "habituation of the risk system" I still find 'habituation' a very unclear term. After reading the paper a few times I understand what you mean, but for first time readers it is not very helpful. Also 'risk system' is not clear. I suggest to either find different words / terms (for example 'adaptation', like in l.601) or define them at the start of the abstract and of the introduction and then refer back to this.

AC: In the abstract (L. 12), we added the following definitions for the terms "habituation" and "risk system":

We recommend considering the habituation of the system at risk (**e.g., a drinking water supplier or small-scale farmers in a specific region**) to the streamflow regime when selecting indicators, **i.e., users of the DEWS should determine to which type of deviation from normal (e.g., a certain interannual variability or a certain relative reduction of streamflow) the risk system of interest has become used and adapted.**

AC: In the introduction (L. 68), we added:

Also, in most descriptions of drought indicator calculations, it is not made explicit what is assumed to be "normal", **i.e., to what people and ecosystems are used and adapted, hereafter referred to as "habituation"**.

AC: After the introduction, the words "habituation" and "risk system" are again used in Sect. 3. Here, we added a reference to the definitions section 1 in L. 284 and 285:

In the following Sect. 3.1, aspects that relate to the conceptual drought definition are discussed comprising the description of the targeted drought risk and the system at risk (**see Sect. 1**). In particular, assumptions about the habituation (**see Sect. 1**) of the system at risk to the streamflow regime are discussed, [...].

EC: - L.417: “monitoring different drought risks” >> “monitoring different drought hazards”

AC: We implemented your suggestion.

EC: *The selection of gauging stations and time periods is much more logical and justifiable now. For the time periods you select two drought events in Europe for testing global-scale drought hazard indicators. I strongly suggest to replace one of them with a drought event in a different continent where processes (and habituation) may be different. I.421-422: “The indicators are illustrated in global maps for two example months, July 2003 and July 2015, with known drought events in Europe.”*

AC: We replaced July 2015 with September 1993, where a drought occurred in South Africa. We adjusted the following text sections:

L. 424: **The indicators are illustrated in global maps for two example months capturing known drought events in Europe (July 2003) and South Africa (September 1993), two regions that are characterized by different streamflow regimes and assumed habituation.**

L. 440: **In September 1993, SSI1 indicates a higher drought hazard than EP1 for the Orange River along the Namibia-South Africa border, but a lower hazard in a few grid cells in central South Africa and Lesotho.**

L. 449: Grid cells where gamma fitting was rejected in the calendar months July **and September** based on the KS test (Sect. 2.3.1) are shown in grey in Figs. 2a and S3a [...].

L. 491: **For instance, the drought event in 2003 in central and eastern Europe (Fig. 3) identified by CQDI1(Q80) is not indicated by CQDI1(WUs), while the latter shows an additional drought hazard in the northern part of South Africa (Fig. S4). This is because CQDI1(WUs) strongly depends on surface water stress, which is generally low in Europe and high in South Africa (Fig. A1c).**

L. 436 and 559: “July 2015” replaced by “September 1993”.

AC: In the supplement, we replaced Figs. S3 to S5 with the results for September 1993.

EC: *You need to increase the resolution of the maps and also make them bigger, because if you want the reader to look at the drought in Europe, then Europe should be distinguishable in the figures.*

AC: We increased the resolution of the global maps from 600 dpi to 1200 dpi. Figures 2, 3, S3, and S4 are now full-page figures. We increased the size of Figs. 5 and S5 as much as possible.

Minor comments:

EC: *What do you mean with “that is also relevant for meteorological or soil moisture drought” in I.12? Please remove or make into a separate sentence.*

AC: We removed this part of the sentence.

EC: *I.16-17: remove “and other drought hazard indicators”*

AC: Done.

EC: *I.19-20: “suitable for assessing the drought risk of 1) river ecosystems, 2) water users without access to large res-*

ervoirs, 3) water users with access to large reservoirs, and 4) that are suitable for informing reservoir managers” point 4 is not part of the list, so change to >> “suitable for assessing the drought hazard of 1) river ecosystems, 2) water users without access to large reservoirs, and 3) water users with access to large reservoirs, and that are suitable for informing reservoir managers”

AC: We implemented your suggestion.

EC: I.40-43: “A stakeholder survey encompassing 33 regional to global drought early warning systems (DEWS) revealed that streamflow drought hazard indicators (SDHIs) are rarely applied in DEWS” >> this needs a reference. Or, if you did this yourself, methods and results should be included (in supplementary material?).

AC: We added the reference Bachmair et al. (2016).

EC: I.46: “European Drought Monitor” >> do you mean “European Drought Observatory”?

AC: Yes, thank you. We changed the name accordingly.

EC: I.137-138: “First, the 30 monthly streamflow values per calendar month were fitted to the gamma distribution using the R package fitdistrplus.” >> the other way around, a gamma distribution was fitted to the streamflow data.

AC: We corrected the sentence.

EC: I.597: “are to inform” >> “aim to inform”

AC: We replaced “are” by “aim”.