Natural Hazards and Earth System Sciences Discussions

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Reply on RC1

Sarra Kchouk et al.

Author comment on "A geography of drought indices: mismatch between indicators of drought and its impacts on water- and food securities" by Sarra Kchouk et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-152-AC1, 2021

Dear reviewer,

Thank you very much for your positive and constructive review.

When we revise our manuscript, we intend to incorporate all the suggestions. We have also responded to comments regarding confusion in understanding the manuscript.

Individual responses to the points you raised can be found below.

We will here respond to the main concern raised.

We acknowledge that the title we chose for our paper could be misleading in suggesting a broader content than what was actually investigated. We agree that the initial title, the abstract and introduction mentioning "drought impacts" suggested an investigation of all potential impacts including those mentioned in the review that we didn't consider. Indeed, we focused only on food and water securities.

To align the study content and your pertinent suggestions, we will modify our title, abstract and introduction. We reformulated our title to "A geography of drought indices: the mismatch between drivers and impacts". We aim to be clearer that the focus is on food and water related impacts early in the abstract and introduction.

On behalf of all co-authors,

Sarra Kchouk

Major comments

- The authors should emphasize that only impacts related to water security and food security are considered. This should be very explicit in the title, abstract, introduction and discussion. This limits considerably the scope of the paper as impacts related to forestry, energy security, transport and even tourism are disregarded. Furthermore, this results in a bias in the outcome regions with a higher number of studies. E.g. if forestry was considered, I think there would be more studies in EUA and Europe

We agree and will clearly state that the focus is on food and water related impacts early in the abstract and introduction.

- Line 99: It should be further stressed in the introduction that a country comparison was conducted. I think the way the search was done can introduce biases. It could be that a studied investigated, West African countries for instance or that it investigated the Tyrol region or it could also be that just the name of a City/state were mentioned and not the country itself.

We agree. We will include earlier in the introduction (l55) that the search was done on the base of the countries mentioned and not regions. We will also raise this point in the discussion; certain studies might be missed because they focus on regions rather than countries. We, however, expect that this effect is fairly evenly distributed across the globe and don't necessarily expect it to introduce a bias.

- I would suggest making a correlation between the number of driver studies and the number of impact studies. You could either have a plot or a table with this for different countries or for different regions. This way we can visualize better the existing ratio. This will help to support your discussion. This could be used instead of Figure 4

Yes, thank you for the useful suggestion. A correlation between drivers and impacts would improve the visualization of the ratios and this will be incorporated in a new figure.

- Section 4.1, besides the descriptive analysis, I think a more critical judgment is needed here. What are important indices that are hardly applied? Why they are hardly applied?

Yes, thank you for the suggestions of analysis. We are explaining in this section 4.1, the preferred application of indices, over others, justified by the physical conditions of the area. In the three following sections, we bring other and deeper elements of analysis being the socio-economic conditions, the data availability and the scientific interest and orientation. We believe that these elements of analysis fall under what you suggest to further discuss. We also think that it can be difficult and out of the scope of our study to analyse what important indices are hardly applied and why, even if relevant. This would imply investigating and discussing what indices can be considered as important, which is another different research question.

Later in our recommendation section (4.5), we suggest to use indices based on the SDGs. We hypothesize that these are hardly ever applied in drought research because there are multiple factors that influence these indices, drought being just one of them. This calls for a complete change of perspective compared to the current paradigm in the drought/DEWS community – impact centred rather than drought centred. As reviewer 3 formulated it in her/his review: what is the contribution of drought to food and water security? – rather than an assumed linearity between drought indices and food and water security.

- The discussion in 4.3 is directly related to 4.1 I would suggest to join them.

We agree that both sections are directly related, the second depending on the first. However, both represent different problems that we believe are better discussed independently. Section 4.1 focuses on the climate and water resources of the area, Section 4.3 focuses on the capacity of a country for data collection and analysis. We suggest following your advice to some extent by making the current Section 4.3 directly follow 4.1 (so to be the section 4.2 in an updated version), and making the link between

the two sections more evident.

- A main limitation is that the definition of drought impact is very narrow. Important studies related to forestry in Europe and USA were completely ignored, for instance. In the recommendation section, if would be beneficial to add that future studies could look into impacts for other sectors. Examples of papers that give a good overview of potential impact types that could be investigated include:

https://iopscience.iop.org/article/10.1088/1748-9326/aba4ca

https://nhess.copernicus.org/articles/16/801/2016/

Thank you very much for this suggestion and for the references that we will utilise. The limitations section will be extended incorporating this information. Both suggested references are great examples of how text mining (in these cases based on media reports) has the potential to advance drought research.

- A further limitation is that you work only with word frequencies. It could be that many of the impacts or indices are just mentioned in the abstract, but that the study does not really investigate it. For example, it could be that the abstract says "research is needed to help us understand food security". You could perhaps manually validate part of the abstracts and see what is the percentage of papers that fall into this category. In any case, this limitation should be clearly stated.

We agree and will add this clarification to the extended limitations section. We will also conduct a manual check as suggested to evaluate how commonly impacts may have been mentioned but not investigated.

- Here you try to link drivers and impacts by using simple linear approach. There are some quite interesting studies that actually try to link these data. I suggest adding a paragraph to the discussion session regarding the linkage of the physical aspects to the socio-economic ones. Some suggestion of studies that could be used to write this paragraph include:

https://hess.copernicus.org/articles/20/2779/2016/

https://www.nature.com/articles/s41467-019-12840-z

https://iopscience.iop.org/article/10.1088/1748-9326/10/1/014008/meta

It was by no means our intention to give the impression that drivers and impacts are linked in a linear fashion. Rather, we discuss the important role of local context, which hampers any generally applicable linear link between the two. The suggested literature are indeed studies that aim to directly link drivers and impacts and are therefore of relevance to our manuscript. We would, however, like to go even one step further as also specified earlier in this review, and suggest to change the perspective: start from the impact rather than the drought driver, because drought is just one of many drivers that leads to the final impacts. We will add this to the discussion, including the suggested literature.

Minor comments

- Line 68: What is meant by "categorized" geographic areas?

We did not find the term "categorized" in l68 but in l58 at the end of the introduction; we assume that is what was meant. "Categorized" was used to mean "grouped" in the sense that we grouped the countries according to geographic regions. We will change this term, as suggested in one of the major comments.

- Line 75-76: The sentence is not clear. Metrics for what? Do you mean for selecting which indices were going to be reviewed?

Thank you for this comment. We meant by "metrics" the equivalent of "unit" and we will reformulate it to explain this more clearly in the manuscript.

- Table 1: please mention that this top 3 areas are retrieved from scopus

We agree and will amend the table as suggested.

- The Soil Moisture Index (SMI) is missing from the agriculture indices, or is it related to other of the mentioned indices? Please check. Here some references:

https://iopscience.iop.org/article/10.1088/1748-9326/11/7/074002/meta

https://hess.copernicus.org/articles/18/2485/2014/

Yes indeed, the SMI is missing from our listed agricultural drought indices. This is primarily because, as mentioned in our methodological section, we based our non-exhaustive list on two main publications: the IDMP handbook of drought indicators and indices (Svoboda and Fuchs, 2016); and a scientific study (Bachmair et al., 2016) where the authors gathered the most used drought indices in EWS by drought managers. In both publications, the SMI was not mentioned. A second reason is that we include very similar indices in AD indices: the Soil Moisture Anomaly (SMA), the Soil Moisture Deficit Index (SMDI) and the Soil Water Deficit Index (SWDI). We propose to include this clarification in the methodology section.

Bachmair, S., Stahl, K., Collins, K., Hannaford, J., Acreman, M., Svoboda, M., Knutson, C., Smith, K. H., Wall, N., and Fuchs, B.: Drought indicators revisited: the need for a wider consideration of environment and society, Wiley Interdisciplinary Reviews: Water, 3, 516-536, 2016.

Svoboda, M. D., and Fuchs, B. A.: Handbook of drought indicators and indices, World Meteorological Organization Geneva, Switzerland, 2016.

- Line 81-95: This information should come before the table 1

We agree and will move this paragraph before the table and adjust l77-78 accordingly.

- Figure 1: It is not possible to read some of the classes in the figure.

Indeed. We thought that it was not necessary for all the name of the indices to appear in

the figure because the focus was to show the dominance of use of 3 main ones. We will change the dimensions of the figure and add leader lines.

- Line 122: I do not think there is a significant difference. For me they follow all the same pattern with some minor differences. "exceptions are Australia-Oceania and Sub-Saharan Africa, where AD indices are most frequently reported". Can you add confidence intervals to the plot?

Thank you for the comment and suggestion. We don't see an opportunity to include a confidence interval because what is represented is not a sample but all the studies we found by using the queries. However, we will include a label mentioning the share of each type of MD/AD/HD studies, in percentage, to make the difference appearing clearer.

- I am not convinced of using the acronyms MD, AD, HD. The terms "meteorological drought", "agricultural drought", etc are not so long, and I think it would be better for the reader to use them instead of MD, AD and HD

We will use the full terms rather than the acronyms.

- Figure 2: If you opt to use the acronyms, it would be useful to add (MD), (AD), (HD) to the Figure. The acronyms are new and if you repeat then in the figures it makes it easier to read the text without needing to come back every time at the first time they were mentioned.

We will use the full terms in the text.

- Line 140: Again, I am not convinced of the use of SSA and similar acronyms. I had to go back in the text multiple times.

We agree. We will use the full terms.

- Figure 4: it is a nice plot, but does not add any new information. I suggest adding it to the supplementary material. I think this figure could be substituted by one where you show the ratio of driver vs impact studies.

Yes. We will elaborate the previously suggested figure. We will thus evaluate and compare the information brought by the current Figure 4 and consider whether to move it to the supplementary materials or integrate it to the Fig.5 to facilitate the reading of the cartograms.

- Figure 1: I like the innovative visualizations, but I think a traditional choropleth map would convey information in an easier way

We assume the reviewer refers to Figure 5. We opted for a cartogram for many reasons. Firstly, it is what we thought to be the most obvious way to eliminate a "visual" bias where there would be more studies because a country is larger. To eliminate this bias, the number of studies should be standardised to either the total number of studies (of MD, AD and HD) or the size of the country; which in our opinion introduced more uncertainty. Secondly, this type of visualisation is print and colour-blind friendly. A recent publication (Crameri et al., 2020) highlighted how colour maps visually distort data through uneven

colour gradient and can be unreadable to those with colour-vision deficiency. Our aim was for the analysis and understanding of our figure to be independent from the used colours.

Crameri, F., Shephard, G. E., and Heron, P. J.: The misuse of colour in science communication, Nature Communications, 11, 5444, 10.1038/s41467-020-19160-7, 2020.

- Line 360: I would change "countries" by "regions", as for most of the analyses you aggregated the data.

Our analysis is mainly presented at the continental level, but our data was analysed at the country level. Therefore, we would like to keep referring to countries.

- Line 413-414: I do not think the results showed that "Our results revealed that drought is mainly depicted through a conceptual lens". I would remove the conceptual lens part as you have just focused on a word frequency and have not analysed the papers in detail

We will remove this statement,

- Line 358-363: This is not a limitation. The first sentences could be moved to the discussion above. The last sentences are a lot of speculation that should either be removed or backed up by other research

We agree that explaining the scale used for the search and the analysis of study (l358-360) is not a limitation. We propose to move these lines to the methodological section.

Lines 362-363 will be removed.