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Comment on hess-2022-124

Jakob Zscheischler (Referee)

Referee comment on "Global assessment of subnational drought impact based on the Geocoded Disasters dataset and land reanalysis" by Yuya Kageyama and Yohei Sawada, Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-124-RC1>, 2022

General comments

This a valuable contribution as it links drought entries in a recently constructed disaster database (GDIS), which is based on EM-DAT, with actual droughts identified based on a state-of-the-art reanalysis dataset. The work is important because typically disaster databases are not based on information derived from meteorological variables and establishing such links gives credence to the databases but also serves to identify hazard thresholds and differences in vulnerability.

Generally the manuscript is very clear and easy to follow but it would benefit from a more in-depth discussion of a number of points that are only briefly mentioned. More detailed comments and suggestions follow below.

L10: "We found that ERA5-Land soil moisture accurately captured the socio-economic impacts of drought shown in GDIS." I think I understand what the authors mean but as it is this statement is not correct. ERA5-Land cannot capture "impacts of droughts", rather it provides information that droughts actually occurred when disasters labelled as drought-driven where recorded. Similar statements can be found in other places throughout the

text. Please adjust the language to more correctly represent your findings and the relationship between drivers of disasters and the recorded impacts.

L12: "were robust": better us "were less vulnerable"

L106: The authors specify some criteria for the analysed events but it seems the number of analysed events is not affected by this. In line 100 it says "The 282 drought events...were analysed", which suggests that this is the number of events contained in GDIS. In Line 162 it is stated that there are 282 drought events. Please clarify how many events are available in GDIS and how many are finally analysed in this study.

L 163: "We recognized that the drought indices successfully capture the GDIS drought events if the two distributions are not statistically the same." This is only true for the full distribution, not at the individual event level. There could still be many events where no drought is evident from a soil moisture perspective (there is also a strong overlap in the distributions). Furthermore, the test doesn't tell you how the distributions differ. Theoretically it would be possible that all disaster events show less extreme drought conditions compared to the control and the KS test give significant results. Please adjust this statement accordingly and make it more nuanced. This should also be reflected in the abstract.

L 165: unclear what "socio-economic drought events in GDIS" means. I assume "socio-economic droughts" are the droughts events and impacts recorded in GDIS? Better use something like "drought disasters" or similar

L170: Initially I wasn't completely sure what the purpose of the drought clustering is. I

assume the idea is to check whether spatially large droughts typically also lead to impacts (as recorded by EM-DAT/GDIS). Given that the drought definition is percentile-based, every location experiences drought with the same frequency, and differences from a rather homogeneous distribution (as for instance visible in the US, Canada and Russia in Fig. 8) are driven by the distribution of continents and the choice of the spatial cutoff (100000km²). With this background, this could be a useful analysis but it would be good to motivate it better and discuss the results in more detail (e.g. it seems that some regions experience more contiguous/large-scale droughts than others, why?). The finding that drought disasters tend to occur in regions that are characterise by frequent large-scale droughts is then quite interesting and novel, especially because from a meteorological perspective and at a pixel level, the frequency of drought occurrence is the same everywhere (20% of the time in this study). So it seems that drought disasters occur when droughts occur over large areas. These findings could be described and discussed in more detail.

Another point to discuss is that you're using a relative percentile, which means that in generally wet regions, a drought defined in this way might not be that impactful because the absolute amount of available water is still quite high. This will to some extent also determine where drought disasters occur and might confound the vulnerability assessment. It makes sense to use a relative percentile given that ecosystems/societies are usually adapted to the water availability in their region. However, it is worth discussing this choice.

L206: You could mention some more details in the results. For instance, how large are the differences between the medians for the different soil moisture layers in Figs 3 and 4. I assume the SDI for the whole period is approx 1 by definition (Fig. 4)? I would also mention that for clarification.

L219: It maybe worth checking how these regions differ in their absolute SM values (averaged over time). Regions with lower water availability in general might experience drought disasters more frequently even though the relative deviation from normal conditions is small (see the comment higher up). Independent of the findings, the interpretation that the identified regions are more vulnerable to drought probably still holds, but I think it can slightly change the interpretation and consequences for resilience planning. If water is typically abundant, it's much easier to be drought resistant.

L258: Note that the results of Fig. 5 also confirm results from Tschumi & Zscheischler (2020) who also found smaller climate anomalies in less developed countries during EMDAT disasters for different climate variables (their Fig. 9).

L280: unclear what "reproducibility of ERA5-Land" means. Please clarify.

L295: again, unclear what "reproducibility" of reanalysis products means. It seems the authors mean that using different climate datasets, one obtains similar drought maps (which makes sense) whereas this does not hold for socioeconomic impacts. This of course depends on how these things are defined. If the same drought definition is used, the choice of (climate) dataset has only little effect on the analysis as this information is comparably well constrained by observations. For socio-economic impacts, no clear/objective definition of disasters etc. exists and uncertainties in impact estimates are usually high. So a comparison across datasets is difficult also because different datasets use different definitions.

L328: "GDIS only covers about 60% of droughts in EM-DAT" Can you comment on why this is the case? Was more detailed information on the remaining events not available?