



EGUsphere, referee comment RC1
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Comment on egusphere-2022-321

Mojtaba Sadegh (Referee)

Referee comment on "Countries most exposed to individual and concurrent extremes and near-permanent extreme conditions at different global warming levels" by Fulden Batibeniz et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-321-RC1>, 2022

This is similar to my other comment as CC, but here it is again for the sake of formality. Hope the authors find them useful!

This is a valuable study confirming, and bringing nuance to, the mounting evidence that extreme events – including compound extremes – are becoming more likely in a warming climate. The analysis of individual (soil moisture drought, heatwave, extreme precipitation and wind) and their concurrence is indeed interesting, but the paper suffers from a great deal of ambiguity making it hard to follow. For example, it is key for the audience to understand the global warming level scenarios, but the provided description lacks the required details (from text: "The warming levels are defined as the first 30-year period where global mean temperature anomalies exceed the given temperature (e.g. +2.0°C).") Similarly, the abstract provides details of how more frequent extremes will be, but does not clarify compared to what. Furthermore, coherence of the text and relevance of the presented materials to the main topic of the paper – specifically in the introduction section – needs improvement. In the following, I provide specific comments that hopefully are useful as the authors revise their manuscript:

Abstract: Needs more specific details about the presented statistics. View this from the lens of a general audience that might not be climate scientists. Anyone should be able to understand this synopsis of the paper, and at this point the text is too vague. For example: in Line 18, more frequent compared to what? Also, it might be helpful to define the period used to calculate extreme events' stats associated with various warming levels.

Introduction: There are much information that is not relevant to the paper. For example, you are not addressing vulnerability and adaptive capacity in this paper, and I wonder how paragraph starting in line 47 builds up the foundation for your research question? I

would use this information in the discussion, but not introduction. Also, information presented in many paragraphs are not aligned with the topical sentence. For example, I don't know how naming specific countries in lines 40-42 can be helpful in this section. Furthermore, lines 42-45 are neither relevant to the study topic nor aligned with the topical sentence. In general, the introduction section can be sharpened to interest the audience.

Lines 89-90 read: "we investigate here for the first time the human exposure to these concurrent extremes in addition to individual extremes." -> This sentence is not correct. See for example:

Concurrent: Liu, W., Sun, F., Feng, Y., Li, C., Chen, J., Sang, Y.F. and Zhang, Q., 2021. Increasing population exposure to global warm-season concurrent dry and hot extremes under different warming levels. *Environmental Research Letters*, 16(9), p.094002.

Individual: Alizadeh, M.R., Abatzoglou, J.T., Adamowski, J.F., Prestemon, J.P., Chittoori, B., Akbari Asanjan, A. and Sadegh, M., 2022. Increasing Heat-Related Stress Inequality in a Warming Climate. *Earth's Future*, 10(2), p.e2021EF002488.

And many more studies, including some from the authors' group.

Sections 2.5. & 2.6. and across the manuscript: The definitions of individual extremes and compound extremes are confusing. I learned half-way through the manuscript that drought refers to a drought that is not concurrent with heatwave. The entire paper needs to be revisited to clarify what each of the extremes (individual or compound/concurrent) refers to. Also, and importantly, the temporal resolution of extremes needs clarification. I understand how droughts are monthly and heatwaves are daily, and how the authors label a month as observing concurrent drought-heatwaves, but I struggle with how concurrent extreme precipitation and wind is defined. As it stands, it seems like a month that has one of each event is labeled as observing concurrent extreme precipitation and wind, which is not correct (at least in my opinion). The impact of extreme precipitation and wind are most pronounced at the daily scale (or even hourly, but let's stick to daily), and that should be the temporal scale of the analysis. If one occurs at the beginning of a month and the other occurs at the end of the month, that month should not be tagged as having observed a concurrent extreme precipitation and wind.

Line 179 reads "Drought events, on the other hand, tend to decrease for higher GWLs in MHC and STC." This is confusing/misleading for the reason mentioned above. Similarly, lines 223-224 read "Interestingly, STC sees a small decrease in individual drought events in most months for 3°C warming." Which is again misleading due to the definition and lack of clarity of the text.

On a technical note, how reliable are Rx1day simulations/projections? How about wind?

In general, it would be helpful to discuss why certain temporal and spatial patterns are projected. For example, lines 226-228 (among others) can benefit from this.

I struggled to understand how population projections are used in this analysis. It seems like the 2015 population data was used only. Please clarify the text.

I also struggled to understand how the number of events per person on the country basis was calculated. Are you calculating exposure (person-days) and dividing it by the country population? In any case, please clarify. Also clarify what you mean by certain counts of extremes per person. What temporal span does this refer to? Annual? Decadal? 30 years?

Lines 303-304 read "The number of events per person increases gradually across the globe except tropical countries in the African continent and India." While it might be beyond the scope of this paper, it would be interesting to discuss how the decomposition of population dynamics (if it is considered here) and count (e.g., country population) vs extremes frequency trends contributed to these statistics.

Are you using multi-model mean or median? Line 173 says "mean" and line 327 says "median"

Lines 339-341 read "Northern parts of South America especially Bolivia, Chile, Paraguay and Brazil, South Africa, the United States of America, Australia and Mexico are also very vulnerable to this change.". Confusing sentence. The value of naming specific countries in some context and referring to regions in other contexts is not clear to me

Lines 395-396 read "Therefore, using population projections to investigate the human contribution to the change could help understand future risks more". Not clear

Minor comments:

Line 39: "and"->"that"

Compound extremes in this paper refers to concurrent extremes, if I understand correctly. It might be helpful to be specific throughout the paper.