



EGUsphere, referee comment RC2
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Comment on egusphere-2022-979

Marc Schleiss (Referee)

Referee comment on "Brief communication: On the extremeness of the July 2021 precipitation event in western Germany" by Katharina Lengfeld et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-979-RC2>, 2022

This is an interesting and relevant study about a major rain event in July 2021 in Germany. Overall, the paper is in good shape. The previous reviewer already made some good points. Below, I would like to add a few of my own.

Main point of criticism: I only found one major issue that needs to be addressed before publication, which is the lack of a proper uncertainty assessment. The authors could and should do more to quantify the uncertainty on the estimated return periods in the GEV, and how this uncertainty propagates to the WEI and xWEI. These are very important issues given the short available data record and the fact that the differences between the top 5 events aren't that large.

Additional, general comments:

1) On the usefulness and need to rank extremes: I see value in studying extremes and their characteristics. However, I also wonder how useful it is to rank extremes over a given range of scales. Who needs such a ranking? And what can you really learn from a ranking that keeps changing over time as more data get available? Also, wouldn't such a ranking strongly depend on the lower/upper bounds for the calculation of xWEI?

Suggestion: add some discussion about the practical usefulness of ranking extremes and the scientific/practical limitations of the approach.

2) Alternative approaches: One limitation of WEI and xWEI is that they do not really tell us anything about how extreme an event was relative to others. Furthermore, the metrics involve the fitting of a GEV model, which comes with large uncertainty. Perhaps a different metric or different way of quantifying relative extremeness across scales

should/could be considered?

Suggestion: add a few words about possible, alternative approaches to WEI and xWEI.

3) Temporal structure: Some information about the temporal structure of the July 2021 event would help the reader understand why this event was extreme over multiple scales, and how the water was distributed over time.

Suggestion: show a time series and/or give some information about peak rainfall rates, intermittency and standard deviation of rainfall rate over time for a fixed location. Fig1 covers the spatial aspect but there is no information about the time aspect so far.

4) Stationarity assumption: There is an implicit stationarity assumption behind the whole study that should be mentioned.

Suggestion: Clearly mention the assumptions underlying your approach and the consequences they could have on the calculation of return values and (x)WEI. To reassure readers, I suggest you check whether there is a trend in the precipitation extremes data over time. You can check this by fitting alternative GEV models with time-dependent shape or scale parameters and applying model selection based on likelihood ratio tests or AIC.

5) Equation 1:

Eq.1 Please provide units for all quantities (A, T and E).

Eq.1 what does the index i represent? The text does not say. Same for the index t .

Eq.1 please use $\ln()$ instead of $\log()$ to avoid ambiguity about the base of the logarithm.

6) Table 1:

Table 1: please provide units for WEI and xWEI

Table 1: I struggle to understand what you mean by "Duration". The caption says that the "Duration" is the timescale at which the maximum extremity was reached. But there are only two values (24h and 48h) for 5 events. I would have expected each event to have a peak at a different time scale. More generally, I think it would be useful to clarify what you consider to be an "event" and what the difference is between the "Duration" and the length of an "event". For example, is the average precipitation depth calculated at the event scale or over the duration indicated in the table?

Table 1: it would be useful to indicate the change in WEI and xWEI for the other events as well. I understand that you are primarily interested in the changes for the July 2021 event. However, I also think that it's important to convey a general sense of how sensitive the WEI and xWEI metrics are to the inclusion/exclusion of particular year of data.

7) Min/Max bounds for integration: Section 3: For the calculation of WEI and xWEI, please clearly state the minimum/maximum bounds you took for integrating over the duration and area.

8) Other minor things:

I.87 The term "characteristic" duration was not properly defined.

I.103: I don't understand why the July 2021 could be considered a compound event. Please justify.

According to Leonard et al. (2014), "A compound event is an extreme impact that depends on multiple statistically dependent variables or events". According to Zhang et al. (2021), compound extremes are defined as 1) two or more extreme events occurring simultaneously or successively, 2) combinations of extreme events with underlying conditions that amplify the impact and 3) a combination of events that are not extreme individually but lead to an extreme event or impact when combined.

In the case of the July 2021 event, I do not see why this event should be labeled as "compound". It just appears to have been extreme over multiple spatial and temporal scales at the same time. Please elaborate!

References:

- Leonard, M., Westra, S., Phatak, A., Lambert, M., van den Hurk, B., McInnes, K., et al.

(2014a). A Compound Event Framework for Understanding Extreme Impacts. *Wires Clim. Change* 5, 113–128. doi:10.1002/wcc.252

- Zhang W, Luo M, Gao S, Chen W, Hari V and Khouakhi A (2021) Compound Hydrometeorological Extremes: Drivers, Mechanisms and Methods. *Front. Earth Sci.* 9:673495. doi: 10.3389/feart.2021.673495