

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1  
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## **Comment on nhess-2022-144**

Anonymous Referee #1

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Referee comment on "A new index to quantify the extremeness of precipitation across scales" by Paul Voit and Maik Heistermann, Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2022-144-RC1>, 2022

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The paper introduces the "cross-scale weather extremity index" (xWEI) as an extension and complement of WEI, aiming at integrating extremeness of an event over significant spatio-temporal scales.

The authors manage to convince the reader that xWEI provides complementary information to WEI, and that it is not just a duplicate of it but rather an extension of it. The two indices are of course quite related (see Fig. 5). Nonetheless, Sec. 4.2.2 shows a good example where the two indices differ and explain the reasons (Fig. 7, which shows a pronounced peak which determines WEI but has less influence on xWEI). The database of extreme events used (over Germany) is numerous enough to support the authors conclusions. xWEI is well described and a good number of examples are presented. The choices of the authors on the configurations adopted to obtain the examples are well motivated and generally well described. The same is for the computation of GEV parameters. In Sec 4.3, the authors discuss the sensitivity of xWEI to the implementation choices and that is an important factor.

In my case, after reading the article, a general question that remains is the following. The motivation that leads to the definition of WEI is quite clear, we can say -simplifying a lot- that WEI takes the "maximum of maximums" to classify an extreme event. On the other hand, xWEI is somewhat closer to an average WEI across spatio-temporal scales. In this sense, the final xWEI ranking of events might not differ from one obtained using simpler metrics, such as the total precipitation amount integrated over the same spatial scales (e.g. upscale the amounts on coarser grids, by averaging, then integrate).

The message I would like to convey is that it might be worth showing that the index is more informative than coarser/simpler quantifications. In fact, among important users of indices like xWEI there are the providers of climate services. For them, it is quite important that the information delivered conveys an immediate message to the final user. In this sense, a ranking of the events based on e.g. rainfall intensity, rainfall duration, or return period/probability of exceedance may be more appealing. For future research, I

suggest you focus also on the comparison against ranking of extreme events based on simpler indicators. It would be interesting to understand the additional information content of xWEI in terms of correlation with registered damages after a catastrophic event, for instance.

My advice to the Editor is to publish the paper after the authors have addressed the comments that follow. The comments mostly deal with the presentation of the work.

Major comments:

- Title. You may consider to add "quantifying extremeness of precipitation across scales using the cross-scale weather extremity index xWEI"
- Abstract. The abstract can be shortened significantly. Try to be short and snappy. For instance, your first 12 lines could be rephrased as (what follows is just an example) "Quantifying the extremeness of a heavy precipitation event is important to classify it. The impact of an event depends on its spatial extent and duration, many indices neglect at least one of these aspects. The weather extremity index (WEI) quantifies the extremeness of an event and identifies the spatial and temporal scale at which the event was most extreme. However, the WEI does not account for the fact that an event can be extreme simultaneously at various spatial and temporal scales. To better understand and detect the compound nature of precipitation events, we suggest to complement the original WEI, and refer to this complement as the "cross-scale weather extremity index" (xWEI). xWEI does not aim to detect the spatio-temporal scale of maximum extremeness, instead it integrates extremeness over relevant scales."
- Sec. 2.1. Line 118. When you write that "RADKLIM provides a promising dataset for climatological application", do you mean that it is consistent in time? Can you be a bit more specific?
- Sec. 3.2. I like your idea of using an example to introduce the WEI. However, I think that: i) you should better describe the initial configuration of your example. At line 174, before "Starting with the pixel..." you may consider adding something like "we will refer to the following example, shown in figure 1, let's consider an event as follows ..."; ii) the definition of the area A is a critical point of the procedure that you discuss again in Sec. 4.3.1, I think that you should let the reader know that you are going to discuss further this point and introduce a reference to Sec 4.3.1 within Sec 3.2. In general, try to create better links between related sections.
- Sec 3.3. The ratio behind the definition of xWEI is explained in a clear way. I do not completely understand why you need to interpolate the WEI value onto a regular grid (Fig. 2c). It looks to me that one may sum all the areas of the colored curves in Fig 2b and that's it. Since Fig 2b should include all the durations that a user may be interested in, I do not see the risk of overemphasising long durations. Could you add something more on this point?
- Fig 2a. If this is the same as Fig. 1d, then I think you should write it explicitly somewhere in the caption.

Minor comments/typos (search for the text in the document):

- "xWEI in top of WEI" -> "xWEI on top of WEI"
- "Complimentary" -> "complementary"