Interactive Discussion: Author Response to Referee #1

Brief Communication: On the extremeness of the July 2021 precipitation event in western Germany

Lengfeld et al.
EGUShpere, `doi:10.5194/egusphere-2022-979`

RC: *Reviewer Comment*,   AR: *Author Response*,   ☐ Manuscript text

Dear Referee,

we would like to thank you very much for your willingness to review this paper, and for your swift, positive and constructive response to the manuscript.

Please find our responses to your comments below. These should be considered as preliminary (part of the interactive discussion). The final implementation of changes also depends on another referee report.

Thanks again for your efforts!

Kind regards,
Katharina Lengfeld (on behalf of the author team)

RC: *[...] L3: firstly, the sentence "both rely....GEV parameters" might not be clear to everybody (I am putting myself in the shoes of someone not completely within the topic). Secondly, from how it is written it seems that the GEV distribution is the only one that can be used for the estimation of return periods of extreme events, which is not the case. I would suggest trying to make this sentence clearer and include some details about the link between return period and GEV parameters when you introduce the WEI in the main text.*

AR: We agree that this sentence should be clearer, and it is true that other data or methods could be used to estimate the required return periods. Yet, we should not go too much into the computational details within the abstract. We have tried to rephrase along these requirements.

> [...] Both require the estimation of return periods across different precipitation duration levels. For this purpose, previous studies have used national composite radar data in Germany to determine annual precipitation maxima, and used this to estimate the parameters of a generalized extreme value distribution (GEV). When including the year 2021 [...]

RC: *L26: even if the authors claim that the WEI is increasingly used in the community (I guess they mean the meteorological one), for someone that is not within it the information reported about the WEI (229 log(yr)km) at this point of the paper is not straightforward to understand. The definition of WEI is indeed provided only at L60. I would therefore suggest trying to insert this number into a context and explain briefly what the extremity index is and how it is computed (or at least what variables are considered) such that a broader audience can have a feeling of what this number*

AR: The unit of the WEI is indeed hard to communicate which is why we described the general concept underlying the WEI starting in line 22 of the preprint:

"The WEI identifies the spatial and temporal scale at which an event was most extreme and allows to quantify the extremeness (rarity) of an event."

To put the mentioned value of 229 log(yr)km into context the following sentence in the preprint states:

"With this value, the event outranked all other events based on radar data that were previously classified in the period from 2001 to 2020."

To further clarify this, we will add a cross link to section 3 and the following sentence in line 24:

> The WEI identifies the spatial and temporal scale at which an event was most extreme and allows to quantify the extremeness (rarity) of an event by averaging return periods of all affected pixels and multiplying it with a measure of the spatial extent of this event (see Section 3).

We hope that this is an adequate compromise between summary and detail, given that the "Brief Communication" format provides limited space.

RC: *L57-66: see my comments on L3.*

AR: We will replace, in l. 63 of the preprint, the sentence "We use two different combinations of radar data and GEV parameter estimates" by the following statement in order to make clear that our choice to use DWD radar data together with the GEV distribution builds on previous research in that direction. However, we do not find it useful for the reader, at this point of the manuscript, to go into detail about alternative data or methods in order to retrieve the required return periods.

> Following Lengfeld et al. (2021), we used DWD's national radar composite data to first determine annual precipitation maxima, and then estimate the GEV parameters.
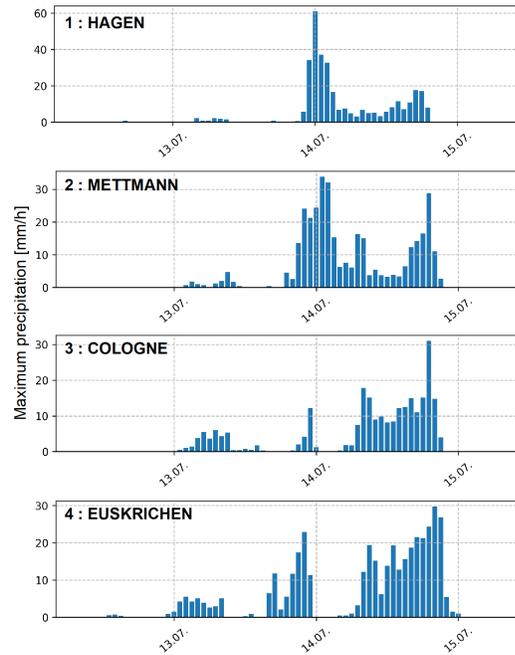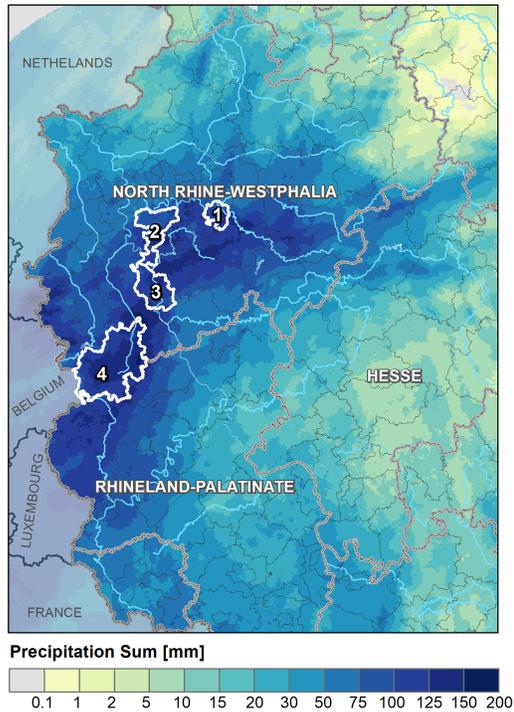
RC: *L69-74: writing explicitly the formula through which the xWEI is computed would be helpful.*

AR: Practically the xWEI is computed by an interpolation of a surface over Eta-curves Formally this corresponds to a double integral which can be expressed by following formula, which we will add in line 74:

$$xWEI = \int_{ln(t)} \int_{A} E_{tA} \, dA \, d(ln(t)) \tag{1}$$

RC: *Figures are not color-blind friendly, please consider change color scaled such that everyone can appreciate differences and color meanings.*

AR: We prepared Figure 1 and 2 with colorblind-friendly colormaps (see figures below), and we will use these in the manuscript. We used YlGnBu from ColorBrewer 2.0 (https://colorbrewer2.org/type=sequentialscheme=YlGnBun=9) for the colormap in Figure 1 and Tol_muted (https://zenodo.org/record/3381072.Y5MZ0iUxlhF) for the colors in Figure 2.

RC: *Figures 2: do the gray lines represent the WEI of the July 2021 event? If yes, it should be specified somewhere. Moreover, I would rather representing it as a point (with different markers/colors depending on the RADKLIM product used to compute it).*

AR: Yes, the grey lines represent the WEI of the July 2021 event for the two different setups. We will change the lines to symbols and mark the WEI of the realtime setup with a star and of the climatological setup with an X in the new version of Figure 2 as shown in the figure below. We will also add the information to the caption of Figure 2.
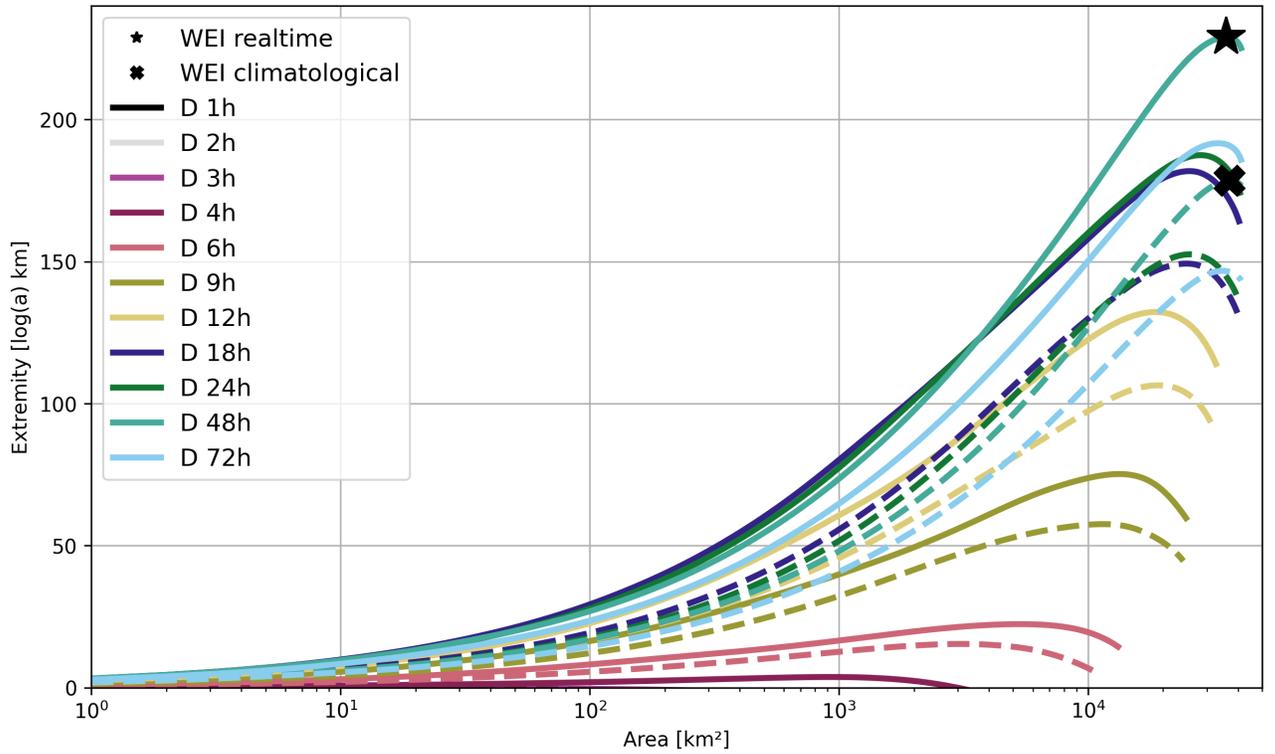
Figure 1: Extremity calculated for 14 July 2021, 23:50 UTC, with operational RADOLAN data and GEV parameters obtained from RADKLIM 2001-2020 (realtime setup: solid lines, WEI marked with a star) and from reprocessed RADKLIM data (Version 2017.002) and GEV parameters from RADKLIM 2001-2021 (climatological setup: dashed lines, WEI marked with an X)