

Hydrol. Earth Syst. Sci. Discuss., referee comment RC3  
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## **Comment on hess-2021-336**

Anonymous Referee #3

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Referee comment on "Modeling seasonal variations of extreme rainfall on different timescales in Germany" by Jana Ulrich et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-336-RC3>, 2021

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Review: Modeling seasonal variations of extreme rainfall on different time scales in Germany

### *General comments*

The paper evaluates differences in seasonal extreme rainfall intensity depending on the method used to estimate IDF curves. They primarily evaluate IDF curves created using block maxima at the monthly level, and then compare these curves to those created using annual block maxima, which is the more common approach. The paper is well written and interesting, but rather long. Some suggestions for shortening are listed below.

While the results are informative and supported by extensive analysis, the motivation for this very detailed investigation was not clear from the introduction. IDF curves are typically used for design of long-lived infrastructure systems where monthly variations are essentially irrelevant. The authors discuss a few reasons that monthly IDF curves could be valuable, including to support agricultural or water resources stakeholders. However, these stakeholders typically care about monthly average rainfall, and there is no reasoning in the paper that supports why they would be interested in extremes. Could the authors elaborate and/or find a reference that supports this?

It seems instead that the motivation for the paper is to "increase understanding" of monthly extremes and examine "underlying mechanisms." If so, then what new information do monthly IDF curves bring? Is this simply a convenient way to evaluate monthly extremes and also account for storm duration? Or could monthly IDF curves bring added value to engineering analyses?

The introduction does mention that monthly IDF curves could bring added value compared to annual block maxima by including more data in the analysis. However, there is an existing technique, called "peaks over threshold" (POT), that evaluates all storms in a year over a certain threshold. It is unclear whether the monthly maximum technique brings added value compared to the POT method, but it is clear that the monthly maxima method is not the only way to include more data in the analysis. There are drawbacks to POT, of course, including that the annual return period is no longer directly interpretable since more than one storm per year can be included in the extreme event series. But the POT technique should be mentioned in the introduction as an alternative way to include more data. A comparison of the monthly maximum technique to POT should also be mentioned in the conclusions/future work section.

Based on these points, a distinct motivation for the creating of monthly IDF curves seems to be missing. After reading the results, it seems that monthly IDF curves could bring some added value in terms of uncertainty evaluation and potentially even for parameter fitting. This is of interest to an engineering audience who are developing and using IDF curves. Suggest restructuring the introduction to ensure the typical IDF curve audience understands this before reading the entire, very detailed study.

The motivation or added value for creating monthly IDF curves could also be discussed further (in results or discussion section). Is it worth it to use monthly maximum instead of annual maxima? If so, in which cases: for annual IDF curves in general, or only when we are interested in monthly extremes? Why?

The discussion section, which repeats a lot of the results, could be condensed, or merged with the results section.

### *Specific comments*

Line 25 and line 32- Similar to general comment. Why it is "critical" to provide information about extremes on a monthly basis?

Line 47 – 52 – This is a common problem, not just in Germany. Many places (like the US, NOAA NCDC) have 50 years or more of daily data, with data at sub-hourly resolutions only available in the past decade or so. I suggest making this statement more generalizable, and say this is also the case for Germany, the focus of this study. Many others will also be interested in using the available data more efficiently through pooling information.

Line 59 – 64 – Yes, block maxima typically are only used for annual maximum because other methods like peaks over threshold (see Coles) are used if you want to capture more data and extremes within a year. Why not use the peaks over threshold method instead of monthly block sizes? If monthly variation is relevant, why are periodic functions needed as covariates (instead of a GEV distribution dependent on duration and month)? It seems that later on you clarify this – parameters can be reduced. Suggest clarifying this in the introduction as well and that you will compare the two techniques later on.

Line 65 – Did Fischer et al compare this method to peaks over threshold? More precise quantile estimates compared to what?

Line 74, research question 3 – this question is unclear and should be briefly introduced in the introduction.

Line 137 – 138 – unclear what is meant by “identically distributed precipitation cannot be motivated if an annual cycle exists...” Please clarify. Is it an interannual cycle or intra-annual? Also, do you mean independent identically distributed?

Line 139 – what is meant by “sufficient”? Meaning it can be used? It is a compromise? Also, this sentence is repeated from the introduction. Suggest rewording, shortening, or removing.

Line 215 – choice to keep the shape and theta parameters constant is justified. How so? It seems these parameters are varying in the same fashion as  $\mu$ , the modified location parameter? A bit more explanation here would be useful.

Line 350 – could you comment on what this implies for IDF created with annual block sizes? Does it matter?

Lines 352 – 354. The authors state that the annual maxima originate from effective blocks of different sizes, seasons, etc. Could you comment more on why this is a problem when annual block sizes are used? Wouldn't the annual maxima still be captured? Does it matter when it occurred?

*Editorial remarks*

Line 47 – suggest “weather station” instead of “station”

Lines 103 – 132 – these derivations are rather standard textbook information for extreme values and IDF curves. Suggest shortening this section to provide enough information to introduce equation 8, and putting the rest in Appendix where details can be read if desired. Same comment for MLE, lines 161 to 175.

Line 280 – could you state the 0.9 quantile in terms of probability of occurrence in a given month, or the return period, as in line 295?

Figure 4 – suggest adding the legend again to this figure.

Paragraph lines 322 – 345 could be shortened

Lines 363 – 364 – could you put this information on the figure or in its caption? Would be helpful to interpret the figure.