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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "An analysis on temporal scaling behavior of extreme rainfall of Germany based on radar precipitation QPE data" *by* Judith Marie Pöschmann et al.

Anonymous Referee #4

Received and published: 3 November 2020

In this paper radar derived Quantitative Precipitation Estimates with high temporal and spatial resolution are used to derive depth-duration relation for Germany. The result indicates that the scaling behaviour between the maximum rainfall depth and duration curves don't follow a power law function as previously derived by historical records. Instead, three distinct scaling regimes are identified which boundaries are 1h and 1d. The results are shown for different quantile levels and cities in Germany. Moreover the maximum rainfall depth-relation curves are derived for all radar pixels and clustered according to their shapes. This gave a presentation of the spatial relations and the different rainfall event type occurring over each pixel. The topic is very interesting and relevant and justifies a publication, however the manuscript suffers from several issues

that need to be addressed/discussed.

Major comments

In the introduction, a lot of focus is put on PMP estimation. This is part of the story, however, other aspects related to this topic should be considered and discussed here as well, e.g. rainfall extremes, the problems associated with radar QPE, rainfall extremes as not being a point event but rather a space-time phenomena, scaling properties of extremes, trading space for time, etc. Furthermore, I would expect the extremes detected by radar to look differently depending on the distance from the radar and the height above ground since the size of the radar bins increase with increasing distance and so does the elevation above ground. Thus, I would expect less severe extremes towards the outer areas of the radar circles. For example, many of the 5 min extremes in Figure 7 seem to be located near the sites of the radars. Last but not least, even though data correction was applied by the DWD, there is still uncertainty in the observed data, especially for extreme events. This should be mentioned since the results are derived from this product

I'm not convinced by the clustering applied for the scaling behaviour. The number of 6 clusters seems arbitrary and section 2.2.3 is poorly written, also with respect to the missing values. The k-means does not provide any measure for the quality of the classification. This all has implications on the results discussed in Section 3.5. How would the results look like if you chose 4 or 7 clusters? Did you perform a sensitivity analysis on how the results change of the number of clusters is changed? Could e.g. a fuzzy-logic based algorithm maybe yield better results?

Furthermore, I do not understand the concept behind Figure 8b. It shows the maximum difference before and after a gap, but what does this mean if >50% data are missing as e.g. in the northernmost part in Germany? Could you explain this more clearly? Why are the values generally higher the closer they are to the radar site? Could this also point to the different behaviour of extremes depending on the distance from the radar?

Minor comments

In general, the manuscript should be proof-read again, there a many awkward formulations, spelling mistakes, etc.

Specific Comments:

P1L17ff.: This whole sentence sounds weird, fatal disasters don't react to anything

P1L20: Introduce the acronym PMP here

P2L24: PMP can be estimated

P2L52: AR(1) -> first-order autoregressive process?

P3L58: Breña-Naranjo (this needs to be corrected in the references as well)

P3L63: 16 years

P4L77: Aren't there currently 17 C-Band Radars?

P4L78: delete "free and purchasable"

P4L81: ground information

P4L90f.: I find the justification that "Due to comparison reasons with another study at our institute only years 2001 to 2016 had been used for this study" rather weak. It would have been worthwhile to use the data until 2018, since you also mention that "With longer available time series of radar in the future, the deviation can be further investigated and tested" in the discussion.

P4L95-100: there is no need to mention the data size or how the data was saved.

P4L99: Why don't you use "NaN" for missing values?

P5L103-105: Are data of overlapping radar coverage areas similar? Since the data was measured by two different radars, the values can differ significantly (e.g. Yan and Bárdossy, 2019)

P5L107ff.: This whole paragraph is difficult to read, please rewrite this in a clearer way.

P6L115: How was the aggregation done considering the missing values? And how where events separated? Did you use a threshold? If yes, which?

P6L116: Durations of up to 3 h or 3 d? This whole sentence is difficult to read.

P6L130: Is the scaling relationship formulas are not correct

P7L138: Please reformulate sentence (also see major comments above)

P7L143: The temporal resolution of the ground truth reference should be mentioned. Furthermore, "world record" should be used (also in caption of Fig. 4)

P8L149: what are "very distant places of Germany"? Distant from what?

P8L151f.: Which temporal resolutions did you use for your analysis? 5 Min increments up to 16h? 3 days? Please specify!

P8L156: Data uncertainty is mentioned here but it's effect is not discussed!

P8L163: the first two quantiles are identical

P8L167: development the rainfall-duration → development of the rainfall-duration

P8L170f.: The statement that extreme rainfall events share common characteristics such as peak rainfall depth and correlation structure regardless of time-scale is a 'strong' statement that somehow contradicts the fact the rainfall extreme are spatially and temporally variant and their correlation structure differs.

Figure 6: A discrete colour bar should be used, moreover the spacing between the durations does not reflect the real spacing. An additional suggestion would be to add a second colour bar showing the associated rainfall values. This can help relate the quantiles to the rainfall values.

Figure 6: Why are the 0.99 quantiles are mostly located in the south of Bayern?

Figure 7: please redo with a discrete colour bar and maybe scale it to the values so the details in the map are more visible.

P12L180: avoid formulations such as “really high”

P12L185: Stuttgart

P12L187: who

P12L188 what do you mean with “real rainfall process”?

Figure 8: How are curves for the cities calculated, mean of all cells in the city or maximum cell? This might be relevant to explain why neighbouring cities show very distinct behaviour. P13L193ff. Rewrite this paragraph and be more specific, what is “successfully classified”, what is a “certain colour”, etc.

P13L193: dept-duration → depth-duration

P13L199: “that pour for around 1 h and move on or weaken” -> rewrite this

Figure 9: Does this relate to topography?

Figure 9: Legend of plot ‘mm/uration’ → mm/duration

Figure 9: How would the clustering and this map look, if the data was divided between summer and winter period? Did you look into this?

P15L204f.: If the look similar and occur together why do you distinguish these categories? (c.f. major comments above)

P15L205: a slope is steeper instead if higher

P15L213: the term ‘super-daily’ is confusing, please consider changing it.

P15L219: saying that areas with category 5 have never been hit by any ‘extreme’ extreme event needs more evidence. It could be that the occurred events were not well captured due to data uncertainty.

P15L232: areas don’t “experience” a rainstorm...

P16L232: ... the same goes for pixels!

P16L264f.: Reformulate this sentence

Figure 10: Please add legend and increase the grid visibility.

P17L268f. If you have the data until 2018, why didn’t you use them? (c.f. P4L90f.)

References: Several issues with capitalization of titles and author’s names.

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