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Comment on hess-2021-366

Anonymous Referee #2

Referee comment on "Enhancing the usability of weather radar data for the statistical analysis of extreme precipitation events" by Andreas Hänsler and Markus Weiler, Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-366-RC2>, 2021

This manuscript deals with the important and timely topic of determining design storms with return periods of up to 100 years from rather short time series of precipitation data from radar observations. The authors present a method to statistically extend time series of weather radar rainfall estimates by combining regional frequency analyses with subsequent bias correction. The results show improvement over the sampling approach by Goudenhoofd et al. (2017) that is used as basis for their method, but uncertainties, e.g. a bias in the radar data for design storms with large return periods, still remain.

The study fits in the scope of HESS and is of interest to the research community. However, I suggest to address some major aspects, that I listed below, before publishing the paper. I'd be happy to discuss my suggestions with the authors in the open discussion and clear up possible misunderstandings.

Major comments:

1. A major concern is the minimum distance of the radar cells that are considered to statistically extend the time series of the cell of interest. As far as I understand the cells have to be at least 4 km apart. The authors mention that the typical size of a convective cell in Germany is 40 km for hourly events according to Lengfeld et al. 2019 (p.4, l.121 in this manuscript). Therefore, the minimum distance of 4 km seems a bit too small to me, especially when considering also daily events that have a much larger typical spatial extent. Did the authors perform any kind of independence check for the time series from the cells that are combined to a long time series, e.g. the correlation of the time series or the percentage of time steps with rainfall in the cell of interest but no rainfall in the other cells of the sample? How do you make sure that the 258 events are actually taken from all 5 time series and not only taken from the 19 year time series of the COI? I was also wondering if the same set of cells are used throughout the study or if the samples vary for the three durations that are considered.

2. The authors only consider precipitation data from April to October, because this is the main season of convective events of short durations. The statistical approach to determine designs storms is based on a partial time series consisting of e (Euler's number) times the

number of years. I was wondering, if this approach is still valid if only 7 out of 12 months of the year are considered. Although it is common knowledge that most of the convective storms occur during summer, some events might still be missed, especially for the design storms with 24 h durations that might also be associated with advective weather situations. To my understanding, the reference data sets KOSTRA and BW-Stat consider all months and might not be comparable to the radar based data set. I would suggest to take all months into account or the authors should provide some kind of validation for their choice of selecting only summer months.

3. Section 2.2 about the reference data sets is quite short. More information about both data sets (e.g. how many stations are considered, length of the time series, interpolation methods, etc.) and on the differences in the statistical approaches to determine design storms from those data sets are desirable. The method for BW-Stat is briefly described in section 2.4. Maybe it would be better to have a general section about the methods first and then describe the data sets and their differences. E.g. that a two parameter GEV distribution is used in KOSTRA, instead of GPD for BW-Stats and the radar-based data set, is only mentioned in the discussion. This is important information that should be given in the method section.

4. A more detailed description of the sampling process, the generation of the ensemble members, the bootstrapping method and the bias correction is needed to allow for better understanding of the results and of the choices made by the authors (e.g. why 5 ensemble members?).

Minor comments:

p.3, l.75: "... which leads to a spatially..." □ "...which leads to spatially..."

p.3, l.92: To my knowledge, the KOSTRA-DWD-2010R data set has a resolution of about 8.2 x 8.2 km. Did the authors perform some kind of remapping to achieve the 5 km x 5 km resolution?

p.5, l151-152: Almost the same sentence is repeated on p.6, l.161-162.

p.6, l.174-176: The radar data are adjusted to the 1 year design storms of the station-based BW-Stat data set. In the results section both data sets are also compared to design storms with 100 year return period derived from KOSTRA. For a better assessment of the differences between 100 year design storms from KOSTRA and the other two data sets it would be beneficial to also compare the 1 year design storms. Do they show the same features in the spatial pattern? How large are the differences?

p7., l.205: "... located more the centre..." □ "...located more to the centre..."

p.8, l.222: "...time steps can attributed..." □ "...time steps can be attributed..."

What is meant by "lower spatial distribution"? Lower spatial resolution?

p.8, l.230: "...as well as the for the bias-corrected..." □ "...as well as for the bias-corrected..."

p.8, l.238: Isn't the 24 h design storm from KOSTRA shown in Fig.4? Or is that something else the authors refer to here?

p.8, l.249: REGNIE is first mentioned here and should be explained.

p.9, l.257: Which figure do the author refer to here regarding the 20 year design storms?

p.9, l.269: 10 th □ 10th

p.9, l.276: "... in in the case..." □ "...in the case..."

p.9, l.283: "...relatively larger uncertainty..." □ "...relatively large uncertainty..." or "...larger uncertainty..."

p.10, l.299-303: This might fit better in the result section.

p.10, l.310: "...can be seen as a rather robust..." □ "...can be seen as rather robust..."

p.11, l.318: "...difference...become..." □ "...difference...becomes..."

p.11, l.319: "...between in rainfall estimates..." □ "...between rainfall estimates..."

p.11, l.331: "...in future" □ "...in the future"

p.14, l.417-418: "...based on distance to cell of interest..." □ "...based on the distance to the cell of interest..."

p.14., l.420: "...is marked with in red..." □ "...is marked in red..."

April to October of which years?

p.15, l.426: It should either be "for a single member" or "for single members"

p.15, l.430: Remove one of the brackets.

p.16, Figure 4: It would also be interesting to see the differences between KOSTRA and RAD-BC.

p.17, l.440: What is meant by "four different event"? I assume it is supposed to be "for different event durations"?

p.17, l.443: Why is the 96th percentile chosen here instead of the 95th percentile?

P18, l.450: There is no comma needed after "regions".