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Comment on hess-2021-628

Anonymous Referee #1

Referee comment on "Atmospheric conditions favouring extreme precipitation and flash floods in temperate regions of Europe" by Judith Meyer et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-628-RC1, 2022

Comments on "More frequent flash flood events and extreme precipitation favouring atmospheric conditions in temperate regions of Europe", by Meyer et al., submitted to HESS for possible publication.

The authors examined the temporal trend in the occurrences of flash floods and extreme rainfall over the western Europe based on a compilation of flash flood dataset and radar rainfall retrieval. They link various meteorological parameters extracted from ERA5 reanalysis fields with each flash flood event. They claim that atmospheric conditions favoring extreme rainfall and flash floods are becoming more frequent. While I believe the question the authors are trying to address is absolutely important and is of great interest to the readers of HESS, their dataset and methods adopted in analysis are seriously flawed. The three hypothesis that they raised in the manuscript cannot be validated based on the existing analytical framework (see details below).

Aside from the technical issues, a key problem is that throughout the manuscript the authors do not specially define what is exactly a "flash flood" (in their perspective). We all know flash floods can be different from other types of riverine floods in various ways. However, it is never proper to simply classify floods during the summer months as flash floods (as distinguished from the winter floods). Without clarification of the basic concept, some of the sentences seem logistically biased. For instance, "*The development of flash floos relies on long-lasting, extreme precipitation*" (Line 108). This is not true, since extreme rainfall does not have to be "long-lasting" to generate a flash flood, although it is true for a subset of flash floods (not vice versa).

Another concern of mine is that the flash flood database is not consistent in space and time. Any trend analysis based on the dataset would not be able to generate true insights into the real world. The authors also admit that the database is non-exhaustive. I would suggest the authors to demonstrate their efforts in making the database at least consistent in time. Otherwise, people would argue whether the significant trend is due to sampling biases or not. This corresponds to their first hypothesis (Line 404-405).

In addition, the authors use cumulative statistics to quantify the occurrences of flash floods for each year. Since floods cluster in space and time, the authors need to be aware that the issue of repeated counting. This is relevant to their second hypothesis where they evaluate trend in the occurrences of extreme rainfall. It would be biased to count the number of grids with rain rate exceeding certain thresholds. The statistics thus reflect the combined effect of intensity and spatial coverage of rainfall, not changes in the frequency.

Lastly, I did not see significant increases in the proxy parameters for flash flood potential. This is mainly a concern with Fig. 5. Increases in moisture content are kind of expected according to the Clausius-Clapeyron relationships, but other than that, the other two proxy parameters show negligible significance (especially for DLS). In addition, flash floods are tied to comprehensive combinations of atmospheric conditions. By examining the trend in individual component of the comprehensive conditions as the authors did here offer limited insights into the real changes in flood potential. The threshold values are also chosen in a subjective way that needs further justification.

I would not go into any further details about the presentation of the manuscript. Some of the sections (like Introduction, Discussion) needs to be shortened and merged. These issues are relatively less important compared to the aforementioned concerns of mine.