

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-503

Francesco Marra (Referee)

Referee comment on "The role of morphology in the spatial distribution of short-duration rainfall extremes in Italy" by Paola Mazzoglio et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-503-RC1>, 2021

This study examines the impact of elevation and other geomorphological factors on the distribution of the average annual maximum precipitation of durations of 1 and 24 hours in Italy. The topic is of high scientific interest and relevant to the readers of this journal. The paper has a practical and data-driven cut, and provides quantitative analyses of use to practitioners and local stakeholders.

I think it can represent a suitable contribution to this journal, provided some aspects are addressed.

The list below only includes references not present in the manuscript. Their purpose is to support the reasoning and should not be considered as recommended.

- While the paper has a clearly practical cut, I am missing an attempt toward the understanding of the physical reasons behind what is found. I think this should be at least attempted in the discussion, possibly putting the findings in perspective with what is already known on the topic.
- The state of the art presented in the manuscript mostly focuses on the examined study region (Italy), and is implicitly limited to cover what is relevant to this specific study (i.e. mean annual maxima). However, I feel a wider perspective should be provided, especially when claiming: "The impact of the orography on extreme rainfall depths and [...] are still not sufficiently understood for sub-daily rainfall events" (lines 29-30). Specifically, since not much is known, but something has been done, I think that the state of the art should be presented with some more detail. Some examples include Panziera & al 2016, Papalexiou & al 2018, Rossi & al, 2020. Marra & al 2021 is also relevant and currently cited in the manuscript but, to my view, supporting a sentence that is not directly addressed by these authors, so it should be either removed or appropriately presented.
- One of the main findings presented in the study (lines 14-17) is that elevation alone is

as important as (or less important than) geographic location (lat, lon, distance from the coast) in explaining the average annual maximum precipitation, and that the impact of orography emerges more clearly at the local scales (lines 18-20).

I have some trouble with this reasoning. I'll try to explain: (a) what the authors present as a finding seems to me rather obvious: geographic location dominates over orography, unless we expect extremes in Caltanissetta (southern Sicily, 568 m a.s.l.) to be more similar to extremes in Aosta (western Alps, 583 m a.s.l., ~1000 km away) than to extremes in Agrigento (southern Sicily, 230 m a.s.l., ~50 km driving from Caltanissetta) due to the similar elevation. I'm not sure how this can be presented as a finding; my underlying hypothesis would be exactly what here is presented as a finding, i.e. that geographic location is more important than elevation, and that elevation modulates the extremes, for example by altering some properties of the storms that occur in a given area; (b) once one accepts the above hypothesis (or finding), the need for "countrywide" analyses on which the authors put emphasis in the introduction loses part of its scientific interest, while indeed maintaining vast practical interest. To my view, this aspect might require some work on rephrasing introduction and presentation of these results.

- As the authors mention in lines 23-26, orography affects precipitation in rather different ways when one considers the lee side and the wind side of an orographic barrier. This is expected to differently alter the characteristics of extremes at multiple durations, as shown by Avanzi & al. 2015 for the very same region examined in this study, and by other authors in other regions.

I wonder why this information is not included among the factors examined in this study (for example separating typically-wind sides from typically-lee sides), and whether it could represent a relevant explanatory factor in the used models

- As the authors mention, only few "countrywide" analyses are published, and one of them is indeed in Italy (Avanzi & al 2015) – others are for example Papalexou & al 2018 and Panziera & al 2016. However, since countries are characterized by vastly different spatial extents, orographic settings and climatic conditions, I suggest using a more general term to define and discuss the examined scale (e.g., continental/regional/local or something on this line, as opposed to "countrywide").
- Lines 97-99: did you check the intermediate durations? If yes, it would be important to mention the results in the text (one sentence is probably enough). Otherwise, one could object that monotonous behaviors between 1 hour to 24 hours were indeed reported in previous studies, but also important deviations from the simple scaling for durations close to 1 hour were found (e.g., Marra & al 2021), asking whether such deviations could imply non-linear or even non-monotonic changes between durations.
- Line 176-177: why did the authors explore a radial limit of 5 km for the computation of the geomorphological factors? Are 5 km sufficient to explain local orographic impacts at multiple durations?

Minor:

Line 11: my understanding is that the study focused on the average annual maxima, perhaps it is better to directly state this instead of "average of rainfall extremes", because extremes are subject to a number of definitions.

Lines 70-74: it should be perhaps mentioned explicitly that this is the "simple scaling" approximation

Line 120: "compared to"

The symbol used for elevation changes between z and Z . I suggest to choose one for consistency.

Line 180 and following: usually boldface italic fonts are used to represent vectors (<https://www.hydrology-and-earth-system-sciences.net/submission.html>).

Line 186-188: something sounds off with this sentence

Line 202-207: I wonder whether the equations contain too many significant digits, but I leave this to the authors to assess

References

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Papalexiou, S. M., AghaKouchak, A., & Foufoula-Georgiou, E. (2018). A diagnostic framework for understanding climatology of tails of hourly precipitation extremes in the United States. *Water Resources Research*, 54(9), 6725–6738. <https://doi.org/10.1029/2018WR022732>

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