

***Interactive comment on* “Technical note: Space-time analysis of rainfall extremes in Italy: clues from a reconciled dataset” by Andrea Libertino et al.**

Andrea Libertino et al.

andrea.libertino@polito.it

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We greatly appreciate the insightful comments from the reviewer. The comments from the reviewer have been reproduced in italic below, interspersed with our responses.

The paper presents a data-set of extreme rainfall in Italy. I believe that the information that is provided here is potentially very interesting. An important question today is whether short duration precipitation has been impacted by climate change. Extreme rainfall with sub-hourly duration is relevant for the generation of flash-flood events that are a reason of concern for small to medium size catchments, which are numerous in the Alpine region. Flash floods recently caused several deadly events in Italy whose

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frequency is markedly increasing in recent times, therefore pointing out the need for mitigation strategies. These latter need to be designed basing on updated information on extreme rainfall, with sub-hourly duration, that is rarely available. For this reason, I found this paper extremely interesting as it provides an example to follow and paves the way for elaborating and addressing very important research questions. I believe the paper is well written and organized. I have minor suggestions to forward to the authors.

1. Abstract: I would avoid the term “explosive rainfall”. I understand the reason why the authors introduced it in the first sentence of the abstract, but I still believe that it would be advisable to use terms with a well-defined technical meaning.

We have used the term “explosive rainfall”, recently become popular in the media and in the common language, to more easily reach a wider audience. The term is not commonly adopted by the average scientific community to which this journal is addressed, while meteorologists and climatologists are more incline to relate heavy thunderstorms to explosive cyclones (see e.g. Koroutzoglou et al, 2011) and this motivates the adoption of the term. However, we accept the suggestion to refer to a more technically sound term, and we will try to clarify with a separate sentence and with simple words the significance of the phenomena under study.

2. Table 1: I do not understand the meaning of “under request”. Does this mean that data are not yet available? Were the data already requested? Figure 2 shows that information for some of the regions labeled as “under request” is already available and therefore the whole picture is not completely clear to me.

As we explained in the answers to reviewer 1 and 4, we were referring to those cases in which the agencies do not provide data directly on their websites but they provide it “upon request”. In the revised manuscript the “Under request” wording will be substituted by the more explicit “available upon request”.

3. Page 3, line 11: it is stated that “Considering that most of the provided data have

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been validated from the related authorities, they are considered reliable and, at first, included directly in the I-RED” It would be interesting to discuss the validation tests that have been considered by the authorities. Extreme rainfall data may be affected by relevant uncertainty, it would be useful to mention the gauging methods, what kind of checks have been considered by the authorities and so on.

The reviewer is right. We can not provide fully detailed information on the measurement methods and on the validation, which are certainly under the WMO standards but not necessarily free of possible instruments inaccuracies. This detailed information is not generally provided by the surveying authorities. Part of the data are from manual gauges and most of them are from automatic gauges, but this basic kind of information is also lacking. We will further contact the authorities and/or explore their websites for investigating the existence of additional published or unpublished works providing information on the gauging and validating operations. Such information will be eventually translated (most of them are in Italian) and summarized as supplementary material.

4. Page 9, line 14: “A record-breaking event is defined as the annual value that exceeds all the previous ones.” Such definition implies a greater frequency of events at the beginning of the record. Did the authors consider identifying record-breaking events by fixing a threshold for rainfall intensity, basing on information that may be extracted by the whole record of observations (without introducing any assumption on the underlying probability distribution. 5. Page 9, line 14: it is stated that “At this stage, only nationwide record-breakings are considered, pulling up all the data together year by year.” I do not understand how data were pulled together. Did the authors pool together sites with different climatic behaviours? Does this mean that record-breaking events at the local level may have been discarded?

At this stage we provide a unique answer to the two questions, as they deal with the same topic. We are aware that to carry on analysis that involves pooling up of the data requires homogeneity controls and the wide domain under analysis does not warrant for climatic homogeneity. However, we propose a countrywide record-breaking analysis

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to provide a general assessment on the large rainfall amounts we are referring to when speaking about the “extremes of the extremes”. Location of the record breaking also point out their distribution in space. This analysis does not allow to consider record breaking events at the local level. We will clarify this in the revised version of the manuscript. On the other hand, our research on the topic is ongoing, as we are trying to identify a meaningful threshold for selection of homogeneous extraordinary events at the country scale. This additional analysis is still under development and will require a significant amount of efforts. We have then decided to devote a different paper to this analysis, that can have implication in terms of significance of increasing trends of short duration rainstorms.

6. Data availability is a potential issue. Data-bases are useful when they are readily available. It would be interesting to discuss data availability in the body of the paper.

The reviewer is right. As we have previously declared in the answers to the other reviewers, data availability is one of our main concern. In essence, as the data owners want to supervise their use, we only have permission to use them for purposes connected to our project. Consequently, we can provide the full database access only to research individuals or groups who join our project. Nevertheless, some individual regional databases can be provided upon evidence of permission received by the regional agencies, in particular, those that release data upon request. Taking into account these limitations, clarifications on the procedure to access the data that we have merged and harmonized in the I-RED will be added in the revised version of the manuscript and additional information will be attached in the supplementary material.

Overall, I am strongly in favor of publication. I believe this paper may pave the way for setting up transboundary initiatives for putting together extended information on extreme rainfall. Such data would provide an essential information for better understanding flash floods and climate change.

References

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Kouroutzoglou, J., Flocas, H. A., Keay, K., Simmonds, I., Hatzaki, M. (2011). Climatological aspects of explosive cyclones in the Mediterranean. *International Journal of Climatology*, 31(12), 1785-1802.

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