Review 3

The authors present an interesting study on the "assumed preparedness" of different geographic locations to extreme precipitation events based on the year of the record and the "risk", defined based on the percentiles of precipitation at a given location.

Thank you for reviewing our manuscript. We are pleased that you find our study interesting. We have made changes based on both your comments and those of the other reviewers, and we hope you find the new version worthy of publication.

We also identified an error in the calculation of the 99th and 99.5th percentile data. This error correction has led to a change in the risk metric and the threshold used to differentiate between categories in the preparedness framework. It has impacted the magnitude and leads to small changes in the spatial pattern. Some shift in location categories has occurred (as most obvious when comparing the incorrect and corrected Fig. 6). However, the conclusions of the paper are unaltered.

Below are point-by-point responses, with changes to the text in italics with line numbers – as in the tracked changes version – indicated.

I very much like the concept of the study but am a bit sceptical of the applicability of the results given the assumptions of the risk metric, especially given potential climate change-induced increases in precipitation extremes. While the authors do discuss at length the limitations of this aspect in the final section I wonder why the authors did not use a more complex approach to assess the risk of an extreme at a given location. For example, using climate projection data and calculating the probability of exceeding an extreme threshold in the future climate.

Our risk metric is based on the current, observed, distribution of daily rainfall (1950-2025). As highlighted in introduction, and expanded on in the discussion, we do not consider climate change explicitly. As we use observational data climate change will be implicitly included as shown by the increase in record event over the more recent years.

In the discussion, we acknowledge that climate model datasets could be used in extension work – for instance using large ensembles to enable further insights into the tails of the distribution. However, using climate model data leads to different assumptions – that the climate models do adequately model the poorly-sampled extreme events. Therefore, in this study, we choose to only use observational datasets.

We have added to the discussion highlighting that climate projection data could be used:

Line 417: *Using model datasets from different climate states, transient simulations, or future climate projections the changing likelihood of exceeding different extreme thresholds in the future could be assessed (Kelder et al., 2020; Masukwedza et al., 2025).*

Inline comments

L48-51: Which "people" are you referring to here? I don't think most of the general public think in terms of precipitation amounts in millimetres or percentages. They may however wonder if a flood event with large damage/loss of life is possible in their city.

Perhaps not all (or many) people would think in such terms – therefore we have altered the text to add the more basic question:

Line 67: *For example, people worry about potentially experiencing a similar event: "Stations near Valencia saw 600 mm in a day, so could that happen where I live? If it did happen where I am, are we prepared?" More simply, they may ask: 'Could a flood with such large damages occur in my town?'*

L50: You state that the rainfall was 30% of the yearly total but on L37 you state rainfall totals were greater than the region's yearly total? I suggest rewording L48-51 for clarity.

Both statements are correct - using E-OBS we show that parts of the Valencia region experienced 30% of their yearly total, but individual stations show values greater than the annual total. To remove the confusion, and in-line with the last comment, the inclusion of 30% of the yearly total in the text at line 50 has been removed.

L84: Please include in the caption how 0.2 can be interpreted on the y-axis.

The values on the y-axis have been removed, as this is intended to be a schematic and is therefore unnecessary at this stage. The 0.2 value is explained later in the methods/results.

L102-104: I suggest being more explicit here regarding why you also apply it to the second dataset.

This is now stated explicitly:

Line 130: *To improve confidence in the results…*

L109-117: I'm not sure I fully understand the rationale behind Metric 2. If I understand correctly, if the extreme is far from the 99th percentile this location would be considered to be at a low risk, why?

We have rephrased this section to better explain the rationale:

Line 146: *Generally, where the record is closer to P_{99} there is a high likelihood of a new record - the current record is less of a statistical outlier. Where the record is further above P_{99} a new record is less likely as the current record is a statistical rarity and thus more difficult to beat. This is represented by the denominator.*

L116-117: The climate change signal for precipitation is not spatially constant, i.e. increases in precipitation extremes are not expected to be homogenous in space across Europe.

We do not discuss this in the Methods (line 116-117) but do explain further in the discussion.

Line 396: *In this assessment, we do not account for spatial variance in climate change. Globally, extreme rainfall is increasing with climate change and this is projected to continue (Seneviratne et al., 2021). There is evidence that variability is increasing, leading to more record breaking extremes (de Vries et al., 2024). We assume a spatially uniform change, but this is unlikely to be true, even just across Europe. Some regions show greater increase due to dynamical changes enhancing thermodynamic changes. Across Europe, a north-south gradient in extreme rainfall trends has been shown in several datasets, with the Mediterranean showing greater increases (Beranová et al., 2025; Hänsel, S. et al., 2022). Changes in daily rainfall also vary seasonally, leading to reduced preparedness at times of the year previously unlikely to experience extreme events. Masukwedza et al. (2025) used the metric of change in return period to incorporate climate change and indicate locations that might not realize that the risk of extreme weather is changing, having not experienced a recent extreme. Over a continental region these assumptions could be considered a valid first estimate however, to assess preparedness over larger regions the assumptions become increasingly invalid and alternative methods should be investigated.*

L144: Figure 2c. Why does this contradict statements that some areas have exceeded their yearly annual rainfall in one day during extreme events? Is this a limitation of the dataset you are using?

Some locations have exceeded their yearly annual rainfall in one day, based on station data (AEMET, 2024). We use the gridded dataset E-OBS with a horizontal resolution of 0.1x0.1 ° - therefore values would be expected to be lower. This is now clarified:

Line 197: *We note, values as high as a year of rainfall in a day are not found, despite reports of such values around Valencia in October 2024 (AEMET, 2024). The E-OBS dataset used in Fig.2 is gridded, and thus does not include the very localised extremes that can be observed within individual station data (Hofstra et al., 2009).*

L145-149: I suggest to explicitly mention “convective precipitation” rather than small localised events. Furthermore, even in western Europe you can see several “spots” presumably related to isolated convective precipitation events.

This has been reworded as you suggest:

Line 185: *Such patches also occur, to a lesser degree, in western Europe. This could be due to convective precipitation causing localised records,*

L170-171: I suggest adding 13% of the data period as with the “since 2000” statistic

This has been added:

Line 215: *26% within the last 10 years of the 75 year long record (13% of the data period).*

L205: Figure 5. Maybe I missed it and it was mentioned already, but it may be worth highlighting the limitation of the “year of the current record” approach in the spatial sense.

We see areas where “sitting duck” borders “recent rarity” however presumably people are informed of local precipitation events and are therefore more prepared.

We comment on this in the discussion:

Line 356: *Similarly, in some regions adaptation may be driven by the greatest event within a larger (e.g. administrative) region rather than just locally*.

However, this is an area that would benefit from further research, examining if adaptation occurs in areas surrounding an impactful event and what factors affect the spatial scale over which adaptation occurs. We highlight that local insight is essential to compliment the assumed preparedness map (line 351).

L232: Figure 6. As the most recent high-profile event, I’d expect to see Valencia on this plot.

The locations in Fig.6 are selected as the most populated 20 urban regions within the study area, as now stated in the manuscript.

The Valencia event is shown in Fig.7, which includes three specific case studies. We note that within our framework Valenica itself is not greatly changed by the event in 2024, as the most extreme rainfall was not co-located with the greatest impacts. This is discussed in the results (Line 351).

L256: “the recent event has reduced the chance of a new record” With the climate change signal such a statement is problematic due to potential shifts in the distribution of precipitation. While limitations are discussed in the following section, I suggest to already add more nuance here.

We add to this section (see the following comment for updated text)

L257-258: Surface runoff and pooling at the bottom of higher terrain were relevant for this event, the authors could elaborate here.

This section has been reworded to enhance the explanation of the lack of spatial coherence between rainfall and impacts:

Line 352: *In the case of the Valencia event (Fig.7b) the greatest rainfall is not over the region where greatest impacts were documented but instead downstream, within the same catchment. There is less change in classification after the event (Fig.7e/h). Further inland there are regions where ‘recently moderate’ (blue) changes towards ‘recent rarity’ (grey) - the recent event has reduced the chance of a new (even greater) record, however, it should be noted that we do not consider the role of climate change. In a warming world such extreme rainfall events are occurring more frequently. The discrepancy between greatest rainfall and greatest impacts will be influenced by the steep terrain and culverted waterways, which led to rapid surface run-off. It may also be that extreme rainfall over Valencia itself occurred over timescales not captured by the daily timeframe of E-OBS. Close to Valencia, records were broken on 1-, 3- and 6-hourly timescales – though not daily (C3S and WMO, 2025).*

L266: This statement seems to ignore any climate change signal.

Throughout the introduction and methods we highlight that our method does not explicitly take climate change into account. To further highlight this we have altered the wording of this statement:

Line 331: *This suggests that in the current climate not everywhere needs to prepare for 30 % of their annual rainfall in a day, as was seen near Valencia in October 2024*.

Minor note: The dpi of the figures should be increased a bit.

The dpi of all figures has been increased, we hope they are clearer.