The manuscript "Changes in Mediterranean flood processes and seasonality" by Y. Tramblay et al. is an interesting study analysing changes in flood event characteristics, flood types and their seasonality in 98 catchments in Southern France. The results presented are coherent with other recent literature about flood changes in the Mediterranean and demonstrate and confirm that soil moisture is the primary driver of flood changes in this region. The manuscript is overall well written and logically organised. Please find my comments below.

We would like to thank you for reviewing our work and your positive feedback.

Major comments:

My main concern is about the reliability/suitability of the reanalysis product used for the retrieval of precipitation and soil moisture information for the catchments (L135-136). What is the spatial resolution of this product? Is the spatial resolution fine enough for the relatively small catchments in the analysis? At L394-395 the authors state "[…] despite the large sample of basins considered, the patterns are consistent and homogeneous across different basin sizes and locations". Could this be due to the (coarse) spatial resolution of the reanalysis data compared to the (small) size of the catchments?

It is true we forgot to mention the spatial resolution of the French reanalysis, thank you for pointing this, we added in the revised manuscript: "The SIM product is available at 8x8 km (64km²) and is considered the reference dataset for hydro-climatic analyses over France". SIM reanalysis assimilates the data of about 4000 meteorological stations in the metropolitan France. Actually, most basins are much larger than one pixel size (83% of basins) and the mean catchment area is 480 km², so the results are not influenced by a potential scale mismatch notably due to the fact we are using mean areal rainfall.

Specific comments:

L46-47: "[…] the mean flood date being on average advanced by one month". Please specify that the shift refers to two sub-periods.

We added "between 1959-1990 and 1991-2021".

L116-117: I suggest adding in the introduction (and discussion) one recent study by Tarasova et al. (2023) about changes in flood processes in Europe. Tarasova, L., Lun, D., Merz, R. *et al.* Shifts in flood generation processes exacerbate regional flood anomalies in Europe. *Commun Earth Environ* 4, 49 (2023).https://doi.org/10.1038/s43247-023-00714-8

Thanks for this suggestion, we actually discovered this highly relevant paper that has been published online just a couple of days after ours was published in the HESS discussion. Very similar conclusions have been reached, about the decrease of floods induced by wet soil conditions and an increased proportion of short-rain floods in Mediterranean basins. Given that both studies are using different approaches and data, it reinforces the robustness of the findings for the Mediterranean region.

L155: in other words, did you adopt a peak-over-threshold (POT) approach?

Yes, we added it in the text.

L163-167: it's unclear how the maximum precipitation is calculated. Is it the maximum daily precipitation within the same time interval where total precipitation is calculated?

Yes, we added "The maximum daily precipitation is extracted from the same time interval used to compute total event precipitation".

L213: does the first period start in 1959 or in 1950 (as stated in the abstract)? Please check.

1959, thanks for pointing this out, we corrected in the abstract.

L214-215: it is not clear how the pivot year is selected and used in the analysis. Is the extension of the two periods always the same in all catchments (as also shown in all figure legends) or does it vary? Please clarify.

No, it is not exactly the same in the different catchments. We choose different dates, depending on data availability, to ensure that the two sub-periods have the exact same length. As indicated in the method section, this pivot year is for the majority of basins within 5 days around 1991 for all basins. But actually, since we compute the regional significance on the whole time series using a MK test, this pivot year has whatsoever no influence on the results and it is just a matter of presenting the relative changes in maps and tables.

L230: I suggest renaming this section "Results and discussions" as it also contains, alongside with the results, a considerable amount of interpretation of the findings in the context of the literature.

We agree, since we actually merged results and discussion in this section.

L234: please specify that the changes refer to the difference between the two periods. This also applies to subsequent occurrences in the manuscript, especially in the caption of the figures, where it is not always clear what exactly "changes" refers to.

We added: "between the two sub-periods, 1958-1990 and 1991-2021". Also, in the figure captions.

L256: how is the runoff coefficient calculated for each event?

We added in the method section: "the runoff coefficient was computed for each event as the ratio of direct runoff depth and total event precipitation".

L258-261: Correlations between antecedent soil moisture and runoff coefficients are analysed and reported in the text. I suggest adding a table or adding these results as a panel of figure 3 (or modifying figure 3) to make it easier to follow. The same suggestion (i.e. adding a table/plot) for L395-399 and L401-405.

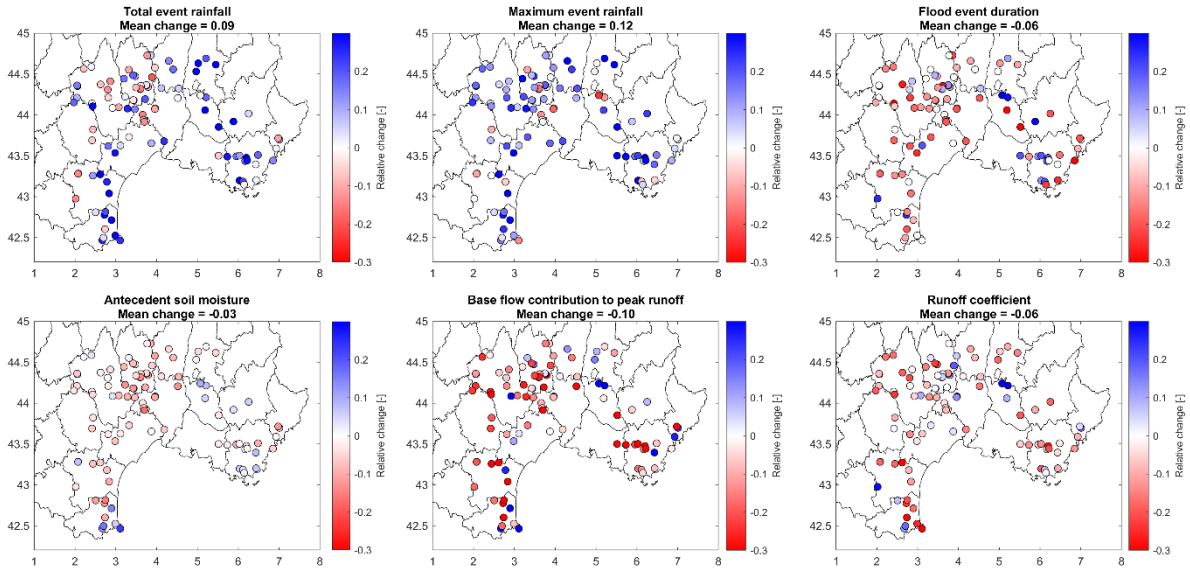
L258-261: we added a boxplot of the correlations in supplementary Figure S1 since this information is a bit redundant to figure 3.

For L395-399, we are just giving two correlations (ie. between the % of excess rain or short rain with catchment size), that are actually quite low and not very informative (this is why we added the correlation coefficient, to show that despite significant correlations, the values are low). Given the already high number of figures we think it is not necessary here. We also added in the text that this correlation is low and probably not very relevant.

For L401-405, we are talking about the basins where the percentage of excess rain floods is very high, we added a figure S2 in supplementary materials.

Figure 2: I suggest inverting the colours of the colorscale and adding the units of the relative change to the axis.

We changed the figure:



L293: a mountain range is mentioned. To facilitate reader that are not familiar with this area I suggest adding a label to the map of Figure 1 to locate the mountain range.

We changed the figure:

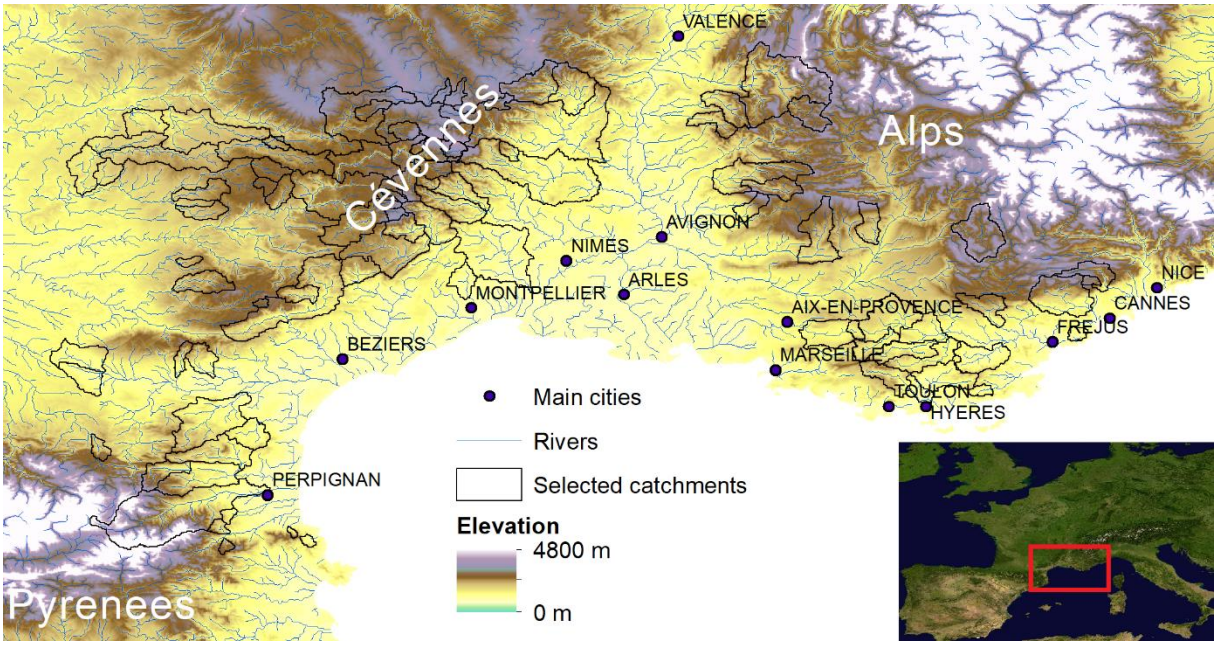
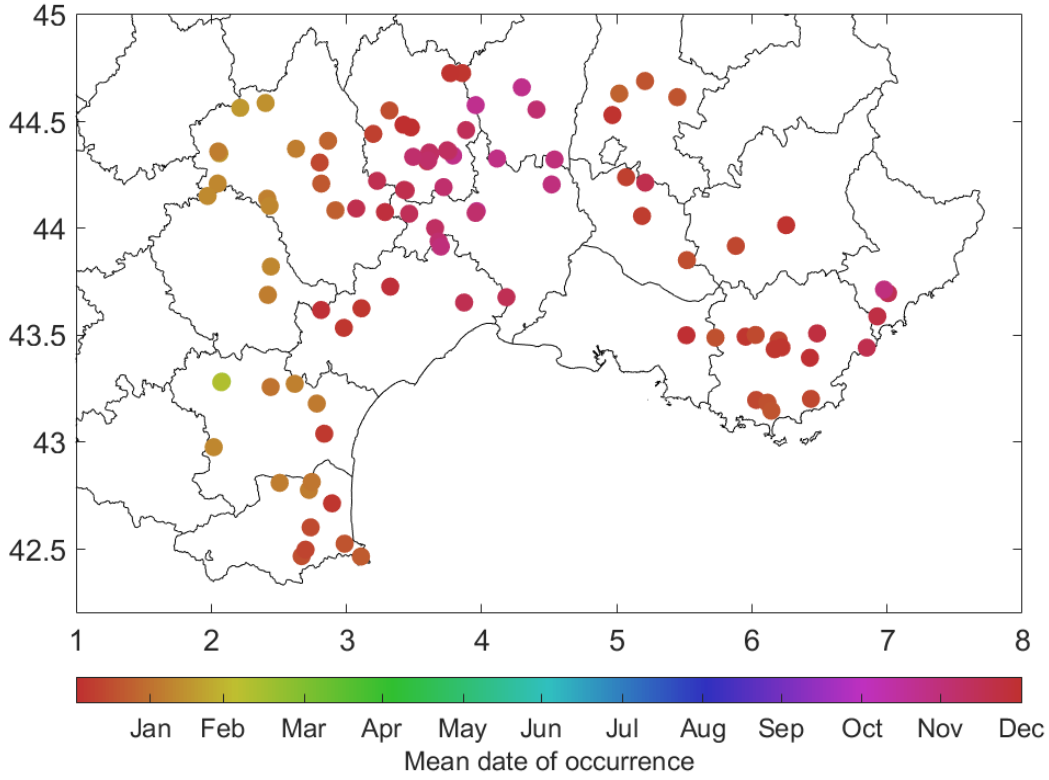


Figure 4: the coloured dots look all a bit brownish and therefore the map is not so easy to read. I suggest making the colours brighter.

Figure changed to:



L330: "Association between flood occurrence and weather patterns". How is the association done? Is the WT selected based on the date of occurrence the flood peaks or the preceding days? Please specify it here or in the method section.

We added in method section 3.2: "To associate flood events and weather types, for each rainy day corresponding to flood events, the weather type has been extracted from the weather types classification.".

L340: "Change in seasonality (of what? Of floods?) can be ascribed to changes in the seasonal occurrence of the weather types"

We added "floods".

L332-347: please check coherence of WT numbers and names in the text and in figure 6. The WT numbers and names seem to be different in some occurrences in the text and in the figure. E.g., WT2 is "Atlantic circulation" in the text but "Steady Oceanic" in figure 6, where Atlantic is WT1 instead.

Thank you for pointing this out. The figure is correct, not the references to WT names in the text. We fixed it.

L340-347: the described changes are tiny in figure 7 and therefore do not seem very significant in the context of the description and interpretation of the results. There are other larger changes in figure 7 that are instead not described. Perhaps figure 7 could be further discussed.

Indeed, statistically these changes are not significant (according to the CHI2 test).

It must be reminded here that we are dealing with extreme events. So, a small number of events. We argue that even small changes in the frequency of flood-inducing weather types might have an impact on flood frequency. And beyond the "statistical significance", we don't know exactly how these changes in numbers may affect seasonal shifts in flood frequency. For example, in August, the frequency of WT4 increase from 8% to 11%, similarly in June from 11% to 14% and overall, this represents an increase of +69 episodes (so 2 per year, that has to be related to the mean occurrence of floods in our study, one per year on average). We added this discussion in the text, also following recommendations of Reviewer n°2, first to clearly state that there are no "significant" changes, but also that more research on that particular topic is required =

"The seasonal patterns observed for the floods are closely related to the occurrence of different weather types in different sub-regions. As shown in figure 6, most basins located east of the Cévennes mountainous range have floods associated with WT4, Southern Circulation, and western basins with WT2, Atlantic circulation. The most frequent pattern associated with 37% of floods, WT4, is known to be triggering intense rainfall events in this region (Ducrocq et al., 2008; Tramblay et al., 2013). Interestingly, the WT6, Eastern circulation, and WT7, Southwestern circulation, are both associated to a lesser extent with floods across the whole region, but without notable spatial differences in the relative frequency of floods associated with these weather types. Change in flood seasonality, to certain extend, could be ascribed to changes in the seasonal occurrence of the weather types (Figure 7): WT4 tends to occur more frequently from March to August during 1991-2021 compared to 1959-1990. However, it should be noted that these change in the frequency of WT4 are not statistically significant according to the chi-square test and the relative increase is rather low, from +0.53% in May to +2.73% in August. When looking at the actual count of WT4 days, this change represents an increase of 69 events during that 6-month period for 1991-2021, so an average of +2.2 days per year. Associated with a warmer Mediterranean Sea over the last decades notably during summer (Pastor et al., 2020), the combination of these two factors could possibly explain the earlier occurrence of floods east of the Cévennes mountainous range. Similarly, there is an increased frequency of WT2 in January, February and March between 1991-2021 and 1959-1990. As for the changes in WT4, these increased frequency of WT2 in January to March is not statistically significant, and represents an increase of +65 days of WT2 during that period that could be possibly related to the later occurrence of floods west of the Cévennes range. Although this change in seasonality is a plausible cause of the observed changes in the flood seasonality, more research is needed to better understand these processes and attribute changes in flood seasonality. Notably, to analyze in more detail the moisture supply from the Mediterranean or Atlantic seas, the interaction with the atmospheric thermodynamics, the duration, localization and the spatial dependence of the rainfall episodes inducing floods."

L402-404: "For short rain and long rain, the maximum contributions observed are 36% and 32%, respectively, but these maximum values are only found in small basins." Do these findings refer to the same 30 basins mentioned above?

No. We changed the sentence to be clearer.

Figure 7: please add a label to the vertical axis

There is already a label: "Frequency"

L513: "[…] related to higher evapotranspiration rates" could you add a reference?

We added Tramblay et al. 2020, already in the reference list.

L470: please specify how the regional distributions in fig 12 are obtained.

We added: "Given that there are different flood sample sizes in the different basins corresponding to different flood-generating processes, we pooled regionally the events. To do so, we computed the specific discharge for each event (i.e. the flood magnitude divided by catchment area)…"

L419 and L426: the word "flood drivers" is here introduced and I believe it refers to the flood types mentioned in the rest of the manuscript. Please use consistent terminology to avoid confusion.

We agree and replaced by "flood types".

L423: is the peak in January or February? (I think February is correct, fig 9)

True, we changed to february

L426: where are the long-term changes shown?

We added a figure S3 in supplementary materials.