The manuscript "Evolution of flood-generating processes under climate change in France" presents an analysis of trends in flood magnitudes and flood-generating processes for 3727 catchments in France. Using a hydrological model and 22 climate simulations, flood events were predicted for the time period 1975 to 2100. The authors find four distinct clusters of future flood changes in France. Flood magnitudes in the North are increasing. The driver in the North-East is a decrease in snowmelt floods and an increase in soil water excess floods. The driver in the North-West is less clear. The authors attribute the change to an increase in short rain floods, though the model agreement for this change is low (Figure 6). In the South, flood trends and drivers can be clustered into mountainous regions with a decrease in flood magnitude, explained by a decrease in snowmelt-influenced floods and an increase in short rain/long rain floods. The other cluster in the South collects the Mediterranean catchments, which show no trend or a decreasing trend in magnitude, explained by a decrease in saturation excess floods and an increase in short rain and long rain floods.

Overall, I find distinguishing future flood development by generating process highly relevant, and the method of analysis very good. However, the reason I summarised the four clusters, is that the manuscript could benefit from more clarity and consistency in describing the trends, drivers, and clusters. At the moment, there are some statements that contradict each other, or contradict the results shown in the figure (see detailed explanation below). Since I find the underlying method, analysis, and figure to be sound, I am sure the authors will be able to easily address these points.

Thanks for this positive and constructive evaluation of the manuscript. We addressed the different issues below.

Specific comments:

The statements regarding trends in the contribution of short rain floods are not consistent between the abstract and the results/figures. In the abstract, it says:

"The proportion of floods linked to soil saturation excess is decreasing while the proportion of floods linked to infiltration excess related to extreme rainfall is increasing, particularly in the southern Mediterranean regions."

Whereas in Section 3.3 and Figure 6, it is clearly discussed that the strongest increase in most catchments is the increase in saturation excess floods, with the exception of the Mediterranean region, which only makes up a small number of catchments compared to the catchments in the North.

Thank you for noticing that, we realized that the abstract was an old version not updated with the final results.

The sentence: "The proportion of floods linked to soil saturation excess is decreasing while the proportion of floods linked to infiltration excess related to extreme rainfall is increasing, particularly in the southern Mediterranean regions", has been replaced by:

"The proportion of floods linked to soil saturation excess is increasing in the Northeast, while decreasing in the southern Mediterranean regions. In these Mediterranean regions, the frequency of floods linked to infiltration excess related to extreme rainfall is increasing."

Since there is quite a lot of information being presented (trends in magnitude, trends in drivers, trends in process frequency, correlations between drivers and magnitude) that all contribute to explaining changes in flooding, I would recommend increasing clarity by:

1. **Being very clear about if a mentioned increase/decrease/trend is referring to changes in magnitude, or frequency.**
2. **Use consistent terms for the flood drivers (e.g. infiltration excess vs rainfall on dry soil, soil water excess vs saturation excess)**
3. **Giving the clusters more descriptive names as well as showing how many catchments are included in each cluster. In Section 3 the clusters are referred to only by number, but then in the conclusion, they are suddenly only mentioned by regions (Mountainous, Mediterranean, North, temperate oceanic zone…). I find these descriptions actually more helpful and would recommend adopting them earlier, together with a visual summary of what the distinguishing aspects of each cluster are.**

We agree. We clarified everywhere it was needed the trends in magnitude and/or frequency, in the methods and result sections. About your comment above that "The driver in the North-West is less clear. The authors attribute the change to an increase in short rain floods, though the model agreement for this change is low (Figure 6)", we better explained the results. For this region, there is indeed not a sharp increase in the frequency of short rain floods (figure 6). But from figure S5 and S6, it can be seen a increase in the magnitude of the event associated with Soil water excess, Short rain and long rain floods, fully in line with increase in heavy rainfall (Figure 3), that can likely explain the increase in flood magnitude in this region. This is indeed a good example of the interplays between changes in the flood event frequency and flood event magnitudes. We modified a bit the conclusion to stress this point.

We also improved the consistency of the terms describing floods drivers, notably to clearly assign to a given class the corresponding process at play (ie. soil infiltration excess vs. soil saturation excess).

We changed the names of the clusters; indeed, it is a good idea to use more descriptive names by the regions, and include the number of catchments in each region. We updated figures 7 and 8.

Further comments:

Basins located in Cluster 1 show a clear increase in short rain and long rain flood contributions (Figure 6). Why do the flood magnitudes decrease (Figure 1), if particularly short rain floods are associated with higher magnitude events (Figure 5, line 568/569)?

The basins in cluster 1 are the mountainous regions of the Alps and the Pyrenees. In these basins, the dominant processes are snowmelt and rain and snowmelt floods, as shown in Figure 4. So, given that there is a sharp reduction of the intensity of floods related to these processes, this is the reason why the flood magnitude is decreasing, when considering all processes together as in Figure 1.

It is unclear, both from the abstract and the methods section, if the model simulations are part of the work done for this analysis, or if they have been published previously. From the cited reference Tramblay et al, 2024, I would assume the latter. Please make it clear, that existing simulations are being used. Otherwise, I would expect more model evaluation to be part of this manuscript.

The simulations used in the present study originate from the Explore2 project, and the full database is already presented, in particular the validation of the model, in the following paper currently under review in HESS:

Sauquet E., Evin G., Siauve S., Aissat R., Arnaud P., Berel M., Bonneau J., Branger F., Caballero Y., Colleoni F., Ducharne A., Gailhard J., Habets F., Hendrickx F., Heraut L., Hingray B., Huang P., Jaouen T., Jeantet A., Lanini S., Le Lay M., Magand C., Mimeau L., Monteil C., Munier S., Perrin C., Robelin O., Rousset F., Soubeyroux J.-M., Strohmenger L., Thirel G., Tocquer F., Tramblay Y., Vergnes J.-P., Vidal J.-P., A large transient multi-scenario multi-model ensemble of future streamflows and groundwater projections in France, Hydrology and Earth System Sciences, https://egusphere.copernicus.org/preprints/2025/egusphere-2025-1788/

In table 3 of this paper, it can be shown that several metrics dedicated to extremes have been considered for the validation the hydrological models: Q10, the relative error of the 10% maximum discharge, medtQXJA, the bias on the median occurrence (julian day) of the annual maximum daily streamflow, in addition to the 14 other metrics used for the validation of the models. In table 5 of Sauquet et al., it can be seen that the GRSD model is the one with the smallest errors on high flow in the largest number of basins, so this led us to choose this model for the present study.

In addition, the results for all singles stations are available online (the global report on model performance, 132 pages, https://doi.org/10.57745/S6PQXD, and the individual summary sheet for all stations : https://doi.org/10.57745/LNTOKL). As noted in the data availability section, all the data of the Explore2 project are 100% open access.

We updated the text to explain these points. We also added a validation specific to the 2-year and 20-year quantiles used in the present study.

In regard to the flood process classification, how influential is it, that the antecedent soil moisture is extracted the day before the flood event? Kemter et al (2020, 2023) extract soil moisture the day before time of concentration. Similar for Tarasova et al (2020) where antecedent moisture is extracted before the separated runoff event, and Stein et al (2020) who extracted antecedent moisture 7 days before the flood event. Since the time of concentration based on rainfall distribution is extracted anyway, why not extract antecedent moisture the day before the rainfall event? Otherwise, antecedent moisture will have already been influenced by the rain.

It is a mistake in the text, thank you for spotting it!

We use the exact same approach as in Kemter et al or Tarasova et al. We changed the sentence to: "For each simulated flood event, we extracted: the antecedent soil moisture (i.e. SWI, between zero and one) one day before the concentration time…".

In line 514 you discuss that "correlations with SWI are almost systematically stronger for frequent floods (2-year), than for rarer floods (20-year)." Please discuss how that matches previous findings that frequent floods are more likely to be soil moisture influenced than rare floods (e.g. Wasko et al, 2021).

We added the reference, and also a whole new paragraph at the end of this section to better discuss the results in relation with previous literature.

Technical comments:

L60: What does "The trends in flood magnitude are contrasted, with increasing trends only in the northern regions of France" mean? Currently the sentence does not make sense.

We replaced by: "Increasing trends in flood magnitudes are only found in the northern regions of France, although multi-model convergence rarely exceeds 60 %."

L118: space missing

Fixed, thank you.

Figure 5: Please keep the x axis consistent between the three plots.

Thank you for spotting this, we changed the plot.

Figures: Please ensure for all figures that colors are accessible for people with color vision deficiency (Stoelzle & Stein et al, 2021). This is particularly and issue in Figure 5 and 7

Thank you, we have updated both figures. All images have been created using colors from https://colorbrewer2.org and verified using https://www.color-blindness.com/coblis-color-blindness-simulator/ and https://bioapps.byu.edu/colorblind_image_tester (and verified by one of the co-author with color vision deficiency).

L568: The correct term should be "In contrast, …" not "On the contrary, …".

Changed.

L568: Missing letter in "soil"

Changed.

Stoelzle, M., & Stein, L. (2021). Rainbow color map distorts and misleads research in hydrology–guidance for better visualizations and science communication. Hydrology and Earth System Sciences, 25(8), 4549-4565.

Wasko, C., Nathan, R., Stein, L., & O'Shea, D. (2021). Evidence of shorter more extreme rainfalls and increased flood variability under climate change. Journal of Hydrology, 603, 126994.