NB: also not required by the Reviewers, we propose to change the title into “A statistical framework to link the torrential event occurrence to regional and local driving atmospheric conditions – the case of the Northern French Alps”, in order to 1) better highlight the fact we conduct a statistical analysis rather than an event-based analysis (“A statistical framework”), 2) better highlight the generality of the method that could be applied elsewhere (“the case of the Northern French Alps”), 3) better stress that we only use dates of events and no other hydrometeorological data (“torrential events occurrence”).

Answer to Reviewer #2

The article isolates discriminant atmospheric variables in combination with differing weather types during torrential events around Grenoble. The findings follow a thorough combination of products and methods and contribute to a better understanding of the atmospheric origin of torrential events. The hydro-meteorological/hydro-climatological approach is part of the scope of the journal. I find that the results are worth a publication in HESS, but I recommend major revisions regarding the placement of the results in the hydro-climatological context and the presentation of the results.

=> We thank the Reviewer for his/her encouraging review.

Major revisions:
- The article lacks a proper discussion. While parts are interwoven in the results, there is no placement of the results in the hydrological/climatological context. There are similar studies about atmospheric conditions during torrential events in the US or in the rest of Europe. Mentioning and comparing the results with a wider variety of references – other than mainly referring to Turkington et al. (2014) – will provide a valuable overview and add additional strength to the article.

=> We understand the point of view of the Reviewer that the paper lacks a proper discussion and this was also noted by Reviewer #1. As stated, in the current version the results and discussion are mixed in Section 4, which we understand is confusing. Thus we propose to split Section 4 in 2 parts: a “Results” Section that would only be about the NEP values (including Figs 4, 5, 9), and a “Discussion” Section that would comment on the maps of the discriminant variables of each class (including Figs 6, 7, 8) and discuss how they differ from what we know of flooding in the literature. However, although we are aware of many works on the atmospheric conditions generating riverine flooding (including those of the co-authors of this article), we aren’t aware of much work on the subject for torrential floods in Europe. There is of course Turkington et al. (2014) in France that we cite a couple if times and to which we could compare. There is also Prenner et al. 2019 in Austria but their work differ from ours since they link torrential flows to hydrometeorological processes (long-lasting rainfall, short-duration storm, intense snow melt) rather than to atmospheric conditions (please note that we don’t have the hydrometeorological data to conduct such an analysis in our region). There is a more active literature on torrential rainfall to which we could probably compare although torrential rainfall and torrential floods can differ. In particular, we have found a quite comprehensive literature on torrential rainfall in Spain (e.g. Milan et al. 1995 – but linking torrential rainfall to sea surface temperature that we do not consider in this article; Grimalt-Gelabert et al. 2021 – but linking torrential rainfall to weather types as the LWT of this article, rather than to atmospheric variables). There is also a very comprehensive literature on heavy rainfall in the Mediterranean Basin, e.g. the review of Dayan et al. 2015 that links heavy rainfall to atmospheric processes at different scales. We will make our best to compare our results to these studies but to the best of our knowledge there is a hole in knowledge regarding torrential floods. We would be grateful if the reviewer could provide us with further studies on the subject he/she is aware of.

- A clearer structure of the work and some more target-oriented descriptions will help to better convey the results:
o The results section is very long and interwoven with comparisons and even methods (line 334). This mix blurs the line between results and related work (e.g. line 293/294 appears misleading in the first read) and I would recommend to separate results from discussion and move the method paragraphs to chapter 3.
=> As said above, we agree with this suggestion and we will separate results and discussion in separate sections.
o More subchapters could be introduced to the results section. 4.1 and 4.2 might be followed by e.g. atmospheric parameters during specific weather types, local-regional differences or seasonal analyses.
=> Well noted, we will reorganize the results section.

o Parts of 2.2.2 and 2.2.3 could be considered a part of the introduction, more details are explained in the minor revision section below.

- The claim for results before 1950 should be reduced as the authors themselves conclude, that the data quality is too coarse for real interpretations (e.g. lines 12/13, line 362).
=> You're right. We will remove the analysis of 20CR prior to 1950 since anyway we conclude that the quality of 20CR in the remote past is less good. Thus we will in the next version focus on three databases: 20CR-Alps on 1950-2014, ERA5-Alps on 1950-2029, ERA5-Grenoble on 1950-2019. The mentioned lines will thus be removed.

Minor revisions:
Abstract:
- A more concise abstract would definitely help the reader to grasp the main results quicker.
=> We will work on the abstract to make it more concise.

1. Introduction:
- The 2nd and 3rd paragraph are a clean list of work done in the field. It could be rewritten to focus on the content, instead of the authors that looked at it. In other words, the flow of the text is missing (Author 1 did something. Author 2 did something else…). Please reformulate to have a more flowing text (e.g. An interesting finding was this (Author 1), whereas something contrasting was found later (Author 2)…).
=> We agree with this suggestion and we will reformulate these parts.

- An introductory paragraph about the general synoptic and atmospheric conditions during torrential events would help to set the scene. What was already known about atmospheric conditions during torrential events? Are they of advective or convective nature?
=> Torrential events in the Alps are mainly convective in summer and spring (this concerns most of the events). In autumn, events can be either convective or advective, while in winter they are mainly advective. We will add a paragraph on what is known about atmospheric conditions during torrential events but, as already mentioned, little seems actually to be known for the Alps. We will however state what is known about torrential rainfall since there is a wider literature on this subject (see the aforementioned references).

- The research gap and contributions are clearly formulated ("our work makes three contributions to the work of Turkington et al. (2014)"), but should be reformulated with respect to the general contributions of the study to the scientific field (instead of just referring to Turkington et al. (2014)).
=> We agree with that and this was also mentioned by the Reviewer #1. We will reformulate this part.

2. Data

- There is a very long description of the torrential events in 2.2.1, about how many days they can last. Based on 2.2.1, I understand, that all major floods are counted as a torrential event. Is this the correct definition? Maybe the events could be grouped: Is there a difference about the origin of the torrential events (caused by advective (often not only local) or convective rainfall, or seasonality)? Are events that might only indirectly be caused by precipitation e.g. snowmelt filtered out of the data set?

=> First, all “major floods” are considered as events but only those involving torrents are considered in this study (purely riverine events are discarded because they involve different spatial and temporal scales as the torrential events). Second, we do not filter the events that could be caused by snowmelt but 1) let us recall that the considered events are extreme – the torrential events correspond to return periods of order 2-3 years at the scale of the conurbation and of 15-170 years at the scale of the torrential units. We don’t think it is possible de get such extreme torrential events due to snowmelt or saturation processes only. Extreme rainfall is a prerequisite and snowmelt is only the cherry on the top (see Marra et al. 2016). 2) We actually don’t have the information about what caused the event. Actually, we have no data else than the date of events. Our analysis merely links torrent event occurrence to the atmospheric conditions, without any other data. This is an important point that we will clarify in the Data section of the article, as well as in the last part of the introduction that will be partly rewritten. We also propose to mention “torrential event occurrence” in the title to make clearer that we use dates only. For this reason, we are not able to group the events according the type of rainfall. Finally, grouping the events by season would lead to too small groups apart for N-W in winter and SE-SW in summer, so only these two cases could be studied. And even there, subsampling by weather types would lead to too small groups. This is probably debatable but we prefer keeping the weather pattern subsampling because it gives interesting results regarding the different atmospheric variables at play depending on the weather type.

- In the abstract it is stated that “torrential events are triggered by very local precipitation” (line 23/24). Does this match the study´s findings also during west-wind weather patterns and advective rainfall?

=> Summer and spring torrential events are mainly convective, so they are triggered by local precipitation. In winter, they are mainly advective corresponding to widespread rainfall but that can be larger in some parts. We will repharse this sentence to make it clearer.

- As the seasonality of events is touched e.g. in lines 122/123, 260-262 and 316, did the authors consider a more systematic analysis regarding that? I would expect events in winter being triggered by advective rainfall, westerly weather patterns, and summer events by southern weather patterns and convective rainfall. This could imply e.g higher CAPE values during convective events. It may be worth to clearly analyse the data that way and discuss it in a paragraph or subchapter.

=> You’re right, summer events are mainly convective with southern WPs and winter events mainly advective with westerly WPs. We will complement Figure 3 with a figure showing the % of events classified in each class for each season to make that more explicit. However, as mentioned above, grouping the events by season would lead to too small groups apart for N-W in winter and SE-SW in summer, so only these two cases could be studied. This is probably debatable but we prefer keeping the weather pattern subsampling because it gives interesting results regarding the different atmospheric variables at play depending on the weather type.

- I understand that the calculation of the pseudo-adiabatic wet bulb potential temperature is rather extensive and moved to the appendix. The horizontal wind speed calculation could, however, be handy to avoid confusion. As it is named V700, my first thought was, that it would be based on the v dimension only, forgetting the u dimension. So, I think that it could be clearer

to add the formula there, or at least mention that it was calculated from both or change the name to a more general one (e.g. WS700 for windspeed at 700 hPa). The text written in the appendix could be good here, also about IVT and Θ'850, but that is up to the preference of the authors.
=> We will change the notation of V700 to WS700 to avoid confusion.

4. Results
- Maybe colour coding could help Table 1 and 2 to be read more intuitively?
=> Please note that Tables 1 to 3 will be shorter in the next version because we will remove the 20CR case on 1851-2014.

- Table 2 needs a clearer description, that the 3-day sequences are including all moving windows of 3-day sequences, if I understood that correctly (not only the event sequences)?
=> That's true, Table 2 shows all moving window 3-day sequences. We will clarify this.

- Another suggestion would be that Table 1 and 2 could be switched from a logical point of view to move from general to specific to the very specific Table 3.
=> This is a good suggestion, we will start by Table 2, then Table 1 and finally Table 3.

- Line 251: "Events in the HP class are quite discordant between the 2 reanalysis products. … For these reasons, the HP class is removed from the analysis." This in itself should not be the reason, but that there are only very few events in that group. The reasoning would need some rephrasing.
=> We agree with that, the true reason is that it contains too few events. We will reformulate this part.

- In my view, Figure 3 deserves more focus and ideally an entire paragraph or subsection. The seasonal analysis is very hidden, but rather crucial from my understanding.
=> We understand your point of view that the seasonality is important. However, as mentioned above, grouping the events by season would lead to too small groups apart for N-W in winter and SE-SW in summer, so only these two cases could be studied. This is probably debatable but we prefer keeping the weather pattern subsampling because it gives interesting results regarding the different atmospheric variables at play depending on the weather type.

- The results depicted in Figure 4 are not very clear to me and I struggled to understand their message. So, my suggestion would be: (1) The description of the NEPs should be placed more visible, and maybe it deserves a small reminder while describing Figure 4. Something like "CAPE values during torrential events lie within the upper half of all values, that generally occur." (2) The plot description could be clearer. Are raw data all data and daily anomalies the values during the events? It may be helpful to stick to the same wording throughout the paper.
=> Well noted, we will improve the description of Figure 4. The anomalies correspond to NEP values computed on the atmospheric variables after removing the seasonal pattern, see L 209-210: "In order to account for potential seasonality, probabilities of nonexceedance are computed on either the raw daily data or the daily anomalies (substracting the daily climatology from the daily data)". Thus we are able to distinguish the atmospheric variables that are extreme in absolute values (raw data) and those that are extreme for the season (anomalies).

- The Figures 6-8 are very interesting. Their description could be made clearer and more general, to directly make the point why they are shown. With a clear description, the little conclusion (line 236-333) should not be necessary anymore. Right now, it helps understanding the point, but the point should be clear from the beginning of the Figure description.

=> Thank you for this comment. These figures will be moved to the discussion section to give them more weight and the corresponding text will be rewritten.

- Figure 9 could use a clearer description of the “best” variables. Maybe the most discriminant? This choice does however limit comparability between the weather type classes and atmospheric parameters. Why is the colour scale not kept the same? Does it not also say something about which parameters function better during some weather type classes than in others?
=> You’re right, the “best” variables are the most discriminant ones; this will be corrected throughout the text. Also the same color scale will be used for all the classes to better hight the couple of variables that are concomitantly abnormal during the events.

Appendix A:
- Line 411: “We keep to alone..” This probably is an old remainder.
=> Sorry, we mean “we keep it alone”

Figures:
- Fig. 1: Maybe something to consider is, that the Figure is difficult to read, when printed in black and white. Please check the Figures following the HESS standards.
=> Well noted, we will check the standards.

- Subplot letters (a, b, c, …) would be handy
=> Well noted

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