

Review – hess-2023-197

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.

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.
- 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.
 - 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.
 - 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).

Minor revisions:

Abstract:

- A more concise abstract would definitely help the reader to grasp the main results quicker.

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)...*).
- 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?
- 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)).

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?
- 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?
- 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.
- 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 V_{700} , 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. WS_{700} 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.

4. Results

- Maybe colour coding could help Table 1 and 2 to be read more intuitively?
- 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)?
- 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.
- 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.
- 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.
- 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.
- 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.

- 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?

Appendix A:

- Line 411: “*We keep to alone..*” This probably is an old remainder.

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.
- Subplot letters (a, b, c, ...) would be handy when referring to the subplots.