

Note the following errata in the first submission that will be addressed in the revised publication:

In the whole text, the potential temperature indicator is said to be taken as the mean potential temperature between 925 and 750 hPa. We actually used the potential temperature at 700 hPa for the calculations as specified in the literature, the "750" in the text is a typing error. The authors want to apologize in advance.

**General Comments:**

This manuscript is devoted to studying Saharan warm air intrusions in the Western Mediterranean during a historical period (1959-2022), emphasising not only their identification methodology (considering different intrusion types according to their location), and the resulting creation of a catalogue of events, but also the assessment of their impacts on air temperature extremes and the analysis of the large-scale atmospheric driving mechanisms, namely upper-tropospheric anomalies over North Africa. Overall, the topic of research is within the scope of WCD and pertinent under a climate change context and increasing occurrence of temperature extreme events. The datasets used (daily tropospheric variables obtained from the ERA5 reanalysis) are adequate for the purposes of the study, whereas the methodology to identify the different intrusion types provides some novelty. The methodological approach for the detection of Sahara air intrusions in Western Europe is simple and effective, with low computational costs. The results are scientifically sounding, based on sufficient evidence provided by the authors and are in line with previous research outcomes. Generally, the figures are of good quality and the length of the manuscript is adequate. Therefore, I recommend the publication of the manuscript after some revisions that are outlined below in the specific comments.

We want to thank the reviewer for taking the time to read the text and provide feedback that will greatly improve the quality of the text

**Specific Comments:**

Abstract: You mention four ITs. However, depending on the season, different numbers are obtained and considered in the manuscript. Please revise.

Thanks for pointing this out, it will be addressed in the revised version. The number of ITs per season will be specified.

Section 1: There is some unnecessary repetition of citations to previous studies (e.g., Sousa et al. 2019), while other relevant references are still missing (e.g., 10.3402/tellusa.v67.26032, among others). I suggest a more in-depth literature review, as many previous studies have already linked temperature extremes in the Western Mediterranean to atmospheric large-scale mechanisms and anomalies. This is particularly pertinent to corroborate the present study results and provide a good state-of-the-art on this topic of research, giving sufficient credit to other preceding studies.

Thanks for pointing this out. The literature on the link between temperature extremes in the Western Mediterranean and atmospheric large-scale mechanisms and anomalies will be expanded in the introduction.

Ln 50-65: I would avoid bullet-point lists. Providing more compact text is commonly preferable in scientific manuscripts.

Thanks for the suggestion. We considered bullet-point lists to make the objectives and structure of the work more explicit. We would like to keep the objectives as a list to make them more visually available, but we will merge the sections into the text as the reviewer suggests.

Ln 54: please avoid using "etc". Be more specific.

Thanks for pointing this out, it will be changed to "spatial distribution, seasonality and trends"

Section 2: The dataset selected for the analysis was ERA5. Although this choice is adequate for the goals of the study, it should be complemented with weather station data (e.g., from ECA&D), as reanalyses commonly present important biases in near-surface weather conditions, particularly in capturing small-scale spatial variability and local weather/climate patterns. The use of maximum temperatures (TX) recorded at local weather stations would help validate the occurrence of temperature extremes. Hence, I suggest the incorporation of some weather station data to confirm and better quantify the intensity of the extreme events. From my point of view, this is an important limitation on the robustness of the study, though it is not expected a major impact on the results.

We want to thank the reviewer for their comment as adding some observational results will make the study more robust. Therefore, we will include results from some ECA&D stations in the Euro/Mediterranean region. As depicted in the reworked Figure R2-1 (corresponding to the initial submission Figure 7). A table in the supplementary material will be added to document the stations used.

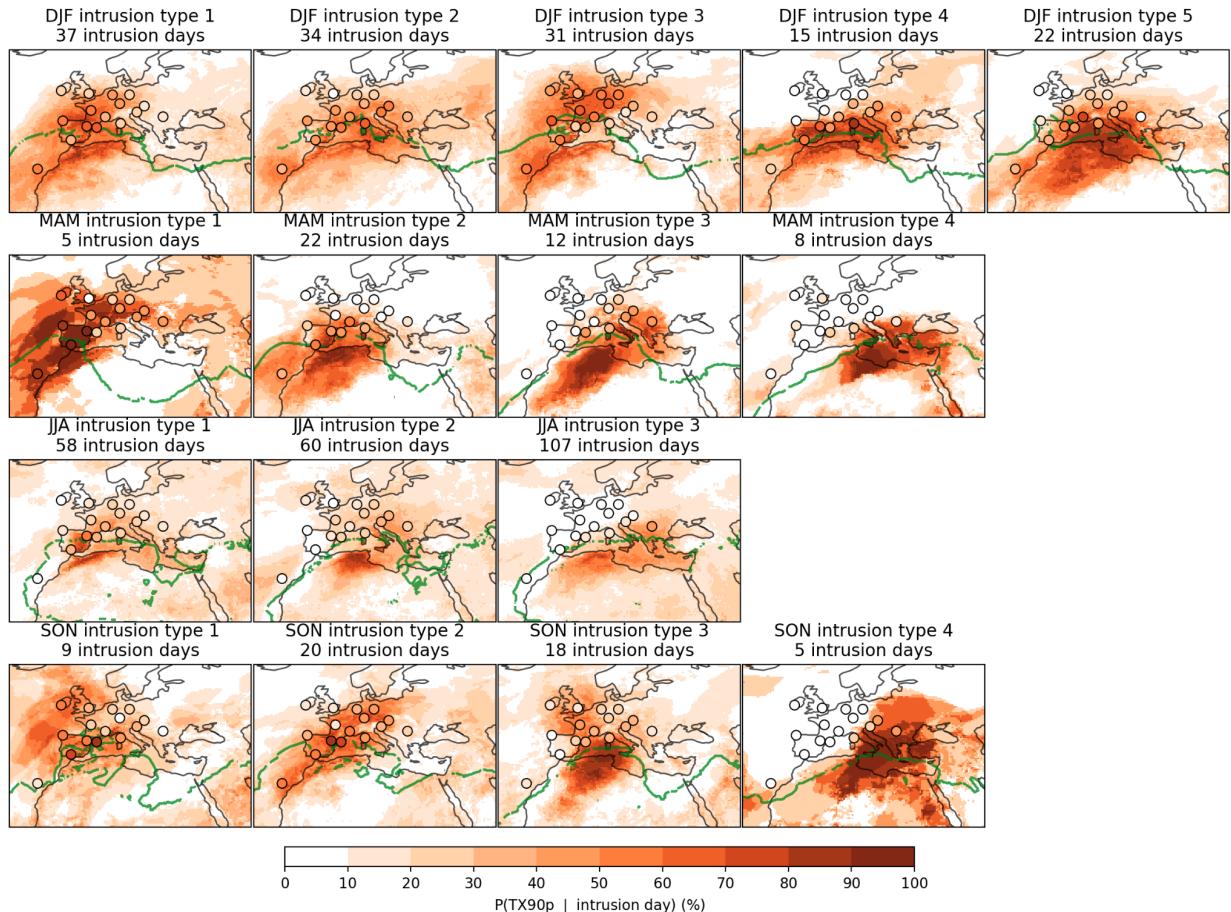


Figure R2-1: Impact of the Saharan warm air intrusions on extreme temperatures in the EM region for the different seasons (rows) and ITs (columns). The impact is measured as the percentage of intrusion days that coincide with an extreme temperature day (TX90p). The amount of intrusion days for each season and IT is specified in the title of each panel. Colored dots are results from ECA&D station data. The area of impact is displayed in green contours, and represents the amount of Saharan air masses recorded in the historical period for a specific IT. The values of the contours go from one Saharan air mass event to the maximum number of days recorded in a gridpoint. Note that the outer contour always represents one recorded day in presence of a Saharan air mass.

### Section 3:

- Please do not use physical units in italic font. It will be addressed in the revised text.
- $R_d$  is the "dry air gas constant". Thanks for pointing this out, it will be addressed in the revised text.
- $C_p$  should be  $c_p$  (lowercase C). Thanks for the suggestion, the text will be modified.

Figure 1: the dashed black box within the Western Mediterranean box is not sufficiently explained in both the caption and text. It seems that the selected day for Fig. 1 does not fulfil the corresponding area requirement.

Thanks for pointing this out. This point will be explained in a better way in the revised text.

Ln 101: "rolling" or "moving"?

In the text we use "rolling" and "moving" (means or windows) interchangeably. We will homogenise all instances to "rolling" to be coherent.

Ln 103 & 104: "red shaped" or "orange"? It will be addressed.

Figure 2 shows a strong positive correlation between both variables. The same is clear in Figure 4. This hints at the high level of redundancy (colinearity) between variables and the information they bring to the analysis. This point should be better discussed, namely its potential implications on the results and the reasoning for their use under the occurrence of temperature extremes driven by Saharan warm air intrusions. For instance, why are you using two variables that deliver similar information and not using variables that complement each other?

The two variables are correlated but not perfectly, and therefore they can complement each other. Using the geopotential thickness and the mean potential temperature aims at identifying air masses with a sufficiently high temperature, and a consistent air mass volume. Furthermore, the potential temperature is more resistant to perturbations, such as Rossby wave propagation, than the geopotential thickness as it should only be affected by diabatic processes. We want to thank the reviewer for this question, and we will expand this reasoning in the text.

Figure 3: the colour scales are not adequate for representing potential temperature (I suggest a rainbow scale or similar). Please revise. Further, colours are not consistent between panels and the description in the caption.

Thanks for pointing this out, the problem we find with the rainbow map is that it is not suited for certain types of colorblindness. We will maintain the Colormaps with python's "inferno" ([https://matplotlib.org/stable/gallery/color/colormap\\_reference.html](https://matplotlib.org/stable/gallery/color/colormap_reference.html)) coloring if there are no major objections.

Ln 140: please remove ", similar to". It will be addressed in the revised text.

Section 7: I suggest splitting the Discussion and Conclusions section into two separate sections.

Due to the nature of the current work the authors believe the Conclusions and Discussions are more suited together than split into two sections.

Ln 275: IPCC in uppercase. It will be addressed

Ln 292: "as in (Sicard et al., 2022)". Please revise the citation formats throughout the manuscript. [Thanks for the suggestion. They will be addressed in the revised text.](#)

Last paragraph of Section 7: the possible linkage of the upper-tropospheric anomalies underlying the onset and establishment of Saharan intrusions to the westerly eddy-driven jet stream over the North Atlantic, including anticyclonic/cyclonic wave-breaking processes, should be discussed.

[Thanks for the suggestion, we will expand this discussion in the revised version.](#)