

We thank the reviewers for their feedback and wish to address their last comments. Please find hereafter our replies in italics shaded in blue.

Anonymous Referee #3

nominated 20 Sep 2025, accepted 20 Sep 2025, report 22 Oct 2025 Report #2

My concerns have been clarified and resolved. I have no more questions

We thank the reviewer for appreciating our efforts to clarify our work.

Referee #4: De Luca, Paolo paolo.deluca@bsc.es

nominated 04 Oct 2025, accepted 04 Oct 2025, report 07 Oct 2025 Report #1

In the Introduction and/or Discussion you may consider adding:

1) <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2022GL102493>

2) <https://esd.copernicus.org/articles/11/793/2020/esd-11-793-2020.html>

Where 1) uses a different approach for computing dry extremes, i.e. not based on percentile thresholds but on SPEI/SPI thresholds ≤ -1

and 2) uses a compound dynamical system approach based on daily temperature and precipitation.

We thank the reviewer for suggesting to include references to these two relevant publications. We think that the relevance of (1) to our work is not necessarily in the value of the threshold used but rather on the results of the analysis and on the method used to reconcile the different time scales of heat and drought. We have added the following statements in the introduction and the discussion (highlighted in red):

[Introduction]

A typology to guide studies on those types of occurrences has recently been proposed (Zscheischler et al., 2020). Analysing model results and future emissions scenarios from 1950 to 2100, De Luca and Donat (2023) showed that “hot, dry, and compound hot-dry extremes are projected to increase over large parts of the globe by the end of the 21st century” and that “dry extreme changes are sensitive to the index used”. Compound climate extremes often have more detrimental effects on vegetation growth than univariate extremes (Yang et al., 2023; Bastos et al., 2023).

[...]

Various indicators have been developed to characterize drought conditions. The commonly used Standard Precipitation Evaporation Index (SPEI) is a “multi-scalar drought index used to determine the onset, duration and magnitude of drought conditions” (Vicente-Serrano et al., 2010). It is generally calculated from monthly climate data, which then require adjustments to reconcile the monthly time scale of the drought indicator with the daily time scale of the heat indicator. De Luca

and Donat (2023) converted SPEI monthly time series into daily time series by setting the daily values to the same value over all days in a month. Some authors have used the SPEI with daily data to characterize drought dynamics at a finer temporal resolution (Wang et al., 2021).

[...]

[Discussion]

[...]

The compound nature of multi-hazard extreme events could be better apprehended with multivariate distributions. For example, standard multivariate normal kernel has been shown to outperform univariate extreme event detection on synthetic data (Flach et al., 2017) and successfully applied on real Earth system data to detect anomalies (Flach et al., 2021). De Luca et al. (2020) proposed a method based on dynamic systems theory for characterizing dry-hot and wet-cold compound events in terms of the coupling between precipitation and temperature fields, allowing to relate long-term changes in compound events to their underlying physical drivers.

[...]