

We appreciate the feedback provided by the reviewers and the opportunity to address the suggestions and concerns raised. Please find hereafter our replies in italics shaded in blue.

Anonymous Referee #1

nominated 28 Mar 2025, accepted 28 Mar 2025, report 07 Apr 2025 [Report #1](#)

The authors have addressed most of my questions. The work is solid, and I appreciate the authors' contribution. However, based on the responses from the previous round, a few concerns remain:

1. Regarding the decision not to remove the seasonal cycle, while it is reasonable that the absolute temperature threshold is more suitable for assessing vegetation health, I still think that relative values of surface wetness—compared to the seasonal average—are more appropriate. If the goal is to capture water stress thresholds, these should vary depending on the growing season, implying a dependency on the seasonal cycle. Vegetation may need different water amount for growing and grown seasons. Without accounting for seasonal variation, most drought events may only be detected during the dry season. Could the authors provide further discussion or clarification?

We acknowledge the importance of accounting for seasonal variations in assessing water stress thresholds. Nevertheless, in the applications foreseen for the Dheed when it was conceived, we are convinced that an absolute local threshold does make sense, highlighting the driest days in absolute independently from the season. We recognise that for regions with a strong seasonal cycle, the detected dry events will always occur in the dry season, which won't correspond to the growing season, especially for grassland ecosystems. For permanent vegetation, however, these extreme dry and hot episodes may have important physiological impacts.

Further justification to this choice has been added to the manuscript at lines 173-175:

In regions with a strong hydrological seasonal cycle, adopting a static threshold will lead to the detection of extreme dryness in the dry season, which does not correspond to the growing season. While annual plants may not be affected by these dry episodes outside the growing season, they may have important physiological effects on permanent vegetation.

2. Some spatial figures include ocean pixels for compound hot and dry events, which seems inappropriate. For instance, why would ocean pixels exhibit drought stress? This issue appears in Figures 2, 8, and 10.

As explained in our methodology, ocean pixels were considered in the detection of the events to ensure spatial connection across water bodies. However, these water pixels were not considered in the final statistics. To avoid confusion, ocean pixels are masked in Figures 8 and 10.

3. The manuscript contains inconsistent font types for certain terms, such as EventCube and YAXArrays.jl. Please ensure consistent formatting throughout.

We *thoroughly reviewed the manuscript* to ensure consistent formatting, particularly for terms like EventCube and YAXArrays.jl, and made necessary corrections.

Anonymous Referee #3

nominated 23 Apr 2025, accepted 23 Apr 2025, report 06 May 2025 [Report #2](#)

The authors have developed a dataset for compound dry and hot extreme events based on ERA5 dataset. However, there are also a number of datasets available for CDHEE, like the paper published by Yin et al., 2025, who developed a global compound events detection and visualisation toolbox and dataset.

While we acknowledge the existence of similar publications, the publication cited by Referee #3 came out long after we submitted our initial manuscript and only a few weeks before we submitted our revised manuscript. More importantly, it is a toolbox rather than a database and the dataset provides annual statistics of threshold exceedances based on grid cell level. As a database, our work provides unique contributions by integrating specific methodological innovations and providing a ready-to-use global database of CDHE, including a comprehensive list of detected events. Besides, the terabytes of necessary storage and computing power to create such a large dataset are not available to everyone, and as such it offers easy access to extreme event footprints as basis for an array of scientific studies. The revised manuscript includes a reference to the aforementioned publication and better highlights these distinctions and the added value of Dheed as follows:

[Line 71] Yin et al. (2025) recently published a Compound Events Toolbox and Dataset, which provides annual statistics of threshold exceedance for dry and hot days based on total daily precipitation and maximum daily temperature, but lacks an explicit spatio-temporal delineation of the detected extreme events allowing to browse through individual events

Also, I do not see any sound methodology or rigor in this manuscript.

We believe Referee #3 misunderstood core aspects of the paper, which we elaborate below and clarify in the revised manuscript.

1) The authors highlighted the dataset in daily conditions. But the datasets only provide the CDHEE for 30, 90, 180 days. There are already studies addressed CDHEE in a more shorter period (e.g., Tripathy, et al., 2023)

Referee #3 appears to misunderstand the core concept of the paper. Our dataset does indeed provide daily basis CDHEE, while detecting drought using a non standardized PEI with these three accumulation periods (30, 90, 180 days). The resulting PEI indices are still at daily timescale, as is our event detection as is clearly explained around lines 149-150. We clarified this also in the abstract.

2) This study used an empirical distribution function rather than parametric distributions and claimed the latter method is difficult for many grid cells. This should be further justified. I think parametric distributions would work for SPEI, especially for a long period larger than 30 days.

We appreciate the feedback on our methodological approach. We chose the empirical distribution function due to its flexibility across diverse grid cells. In the revised manuscript, we provide a more detailed justification for this choice and discuss its advantages over parametric distributions, particularly for long-term analyses in Appendix A.

[Line 181-183]

However, in this study, we do not remove the effect of seasonality, which leads to distributions poorly described by a log-logistic function, especially where hydrological seasons are strongly distinct (see Appendix A).

3) Why the lowest 1% of the empirical cumulative distribution is considered as the threshold for an extreme? For SPEI, there are already thresholds to categorise different dry conditions.

As explained in the manuscript, the drought indicators are not standardised and the 1% threshold was selected based on a compromise to capture extreme events effectively while limiting their spatiotemporal extent. See lines 235-240

4) if 1% is the threshold for SPEI, how about the threshold for hot?

5) The detection for the heatwave is unclear. The thresholds for heatwave, even for 1% probability, is identified for all hot season together, or they are detected day by day (i.e., each day has a threshold) like Man and Yuan (2021).

Our methodology for heatwave detection indeed also involves a 1% threshold, computed locally but for all days of the year. Therefore the winter heatwaves are not detected. This is explained and justified at lines 160-180 and now also appears in the abstract.

Reference:

Yin, C., Ting, M., Kornhuber, K. et al. CETD, a global compound events detection and visualisation toolbox and dataset. Sci Data 12, 356 (2025). <https://doi.org/10.1038/s41597-025-04530-x>

Ma, F., & Yuan, X. (2021). More persistent summer compound hot extremes caused by global urbanization. Geophysical Research Letters, 48, e2021GL093721. <https://doi.org/10.1029/2021GL093721>

K.P. Tripathy, S. Mukherjee, A.K. Mishra, M.E. Mann, & A.P. Williams, Climate change will accelerate the high-end risk of compound drought and heatwave events, Proc. Natl. Acad. Sci. U.S.A. 120 (28) e2219825120, <https://doi.org/10.1073/pnas.2219825120> (2023).

Additional edits to the manuscript:

Press articles, Reports and software packages without a DOI have been removed from the references' list and their webpages entered as footnotes.