

Earth Syst. Dynam. Discuss., author comment AC2
<https://doi.org/10.5194/esd-2021-52-AC2>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Reply on RC2

Aloïs Tilloy et al.

Author comment on "A methodology for the spatiotemporal identification of compound hazards: wind and precipitation extremes in Great Britain (1979–2019)" by Aloïs Tilloy et al., Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2021-52-AC2>, 2022

We thank anonymous referee # 2 [R2] for their time in reading and commenting critically on our manuscript ESD-2021-52 "A Methodology for the Spatiotemporal Identification of Compound Hazards: Wind and Precipitation Extremes in Great Britain (1979–2019)". We believe that the changes to our manuscript based on the reviewer comments (combined with those from referee # 1, see online discussion) will significantly improve it, and we hope this will be of use to the broader natural hazards' community. Below we respond in detail to the reviewer.

[R2–1] "This manuscripts provides a clear and effective contribution to discerning and evaluating compound natural hazards, basically taking into consideration spatiotemporal clustering procedures to detect and classify the aggregation of such hazards with well explicated metrics (though naturally there are a lot of nuances and details enriching the work). Overall, the work is very transparent, well explained and operationable, especially bearing into account the provided supplements with data and code that can be aptly worked on in an understandable manner. As such, this provides a valuable contribution not only at scholarly level but also in operational services. This being said, and having seen the previous reviewer report, I will not repeat what is already there and to which I naturally concur. My minor remarks thus come down to the following aspects."

[Reply to R2–1] We thank the reviewer for their positive comments and providing four minor remarks to which we reply to below. We added to the manuscript some precisions about the method used to cluster extreme events and included extra references associated with identification of compound extremes, clustering and the physical interpretation of the results.

[R2–2] "To those who might wonder, why use the metrics and assumptions sustaining the methodological development and deployment in the manuscript, rather than other alternative ways to detect and potentially attribute the diagnostics made in the paper?"

[Reply to R2–2] We thank the reviewer for this comment. To the knowledge of the authors, there are relatively few studies which attempt to spatially and temporally cluster extreme meteorological (or other) variables and with a focus on compound hazards. Two examples of existing methodologies consider a space-time cube where extremes are clustered (Zscheischler et al., 2013); Vogel et al., 2020) and two separated dimensions with different clustering rules (Birant and Kut, 2007). We adopted the former approach

and we used the spatiotemporal ratio (Section 4.2.1) to control the relationship between space and time. Two sentences have been added at the end of Section 2 to highlight the specificity of the method used in this article and as exemplars of existing studies, we now discuss and have added AghaKouchak et al. (2020), Catto and Dowdy (2021), Zhang et al. (2021) and De Angeli et al. (2022).

AghaKouchak, A., Chiang, F., Huning, L. S., Love, C. A., Mallakpour, I., Mazdiyasni, O., Moftakhari, H., Papalexiou, S. M., Ragno, E. and Sadegh, M.: Climate Extremes and Compound Hazards in a Warming World, *Annu. Rev. Earth Planet. Sci.*, 48, 519–548, <https://doi.org/10.1146/annurev-earth-071719-055228>, 2020.

- Catto, J. L. and Dowdy, A.: Understanding compound hazards from a weather system perspective, *Weather Clim. Extrem.*, 32(May 2020), 100313, <https://doi.org/10.1016/j.wace.2021.100313>, 2021.
- De Angeli, S., Malamud, B.D., Rossi, L., Taylor, F.E., Trasforini, E. and Rudari, R.: A multi-hazard framework for spatial-temporal impact analysis, *Intl. J. Disast. Risk Re.*, 102829, <https://doi.org/10.1016/j.ijdr.2022.102829>, 2022. [In-Press]
- Zhang, Y., Sun, X. and Chen, C.: Characteristics of concurrent precipitation and wind speed extremes in China, *Weather Clim. Extrem.*, 32, 100322, <https://doi.org/10.1016/j.wace.2021.100322>, 2021.

[R2–3] “Several methodologies for spatiotemporal compound event identification fall prey to the self-fulfilling prophecy of detecting what we want to detect through tuning the methodologies. Fortunately in this paper the procedure is sufficiently objective to minimise such risk. Could the authors elaborate in brief terms how their methodological choices fare better in this regard than the panoply of traditional process-blind statistical methods?”

[Reply to R2–3] Thank you for your comment on the method. We believe that the method we use in our manuscript for clustering occurrences of extreme meteorological variables to detect compound hazard clusters, blends an existing method with a new approach and methodology that differs from previous methods looking at compound hazards. This is highlighted in Section 4.3 of the revised manuscript. The method developed here relies on the DBSCAN algorithm, which is not a statistical tool but rather an unsupervised machine learning tool. We therefore rely on the procedures of this method to detect as objectively as possible our hazard clusters. The neighbour parameter can be set with an automated approach; however, for the definition of the extreme threshold, density threshold and spatiotemporal ratio, the authors relied on physical assumptions about the minimum size of extreme events to be detected and damage relevant threshold as explained in the methodology section of the manuscript (Section 4). Precisions about where our method stands in the literature have been given at the beginning of Section 2. A new sentence has now been added at the beginning of section 4, summarising the nature of the assumptions taken in the clustering procedure.

[R2–4] “In keeping the interdisciplinary inter-domain philosophy of the ESD journal in mind, could the authors elaborate a little further on the physical interpretation of the results, namely linking to ocean-atmospheric and land-atmospheric aspects that might help explain the results?”... “...beefing up the geophysical reasoning to further help the more physically minded readers make further sense of the results and potentialities of the study, besides what was already made clear in that regard.”

[Reply to R2–4] In Appendix A, the seasonality of single and compound hazard clusters is analysed. The link between weather systems and compound wind and precipitation extremes is discussed in Appendix A 1.770. Figure A3 highlights hotspots for compound wind and precipitation events. Two sentences linking the patterns of Fig. A3 to characteristics of the British climate are now added to our revised manuscript. We also agree that a deeper dive in seasonal patterns with a link to weather regimes (as

suggested by reviewer 1) would allow us to extend the physical interpretations of the results, but do not delve into this deeply in this current manuscript.

[R2-5] "Overall, this is a solid contribution, clearly one of the rare occasions in which the preprint itself would already be a worthy final paper. By addressing the concerns of the other reviewer and minor ones remaining here, this review report intends essentially to slightly raise the bar of the work from very good to excellent. ... Again, very good work, a short notch away from excellence."

[Reply to R2-5] Thank you for these comments.