Referee report:

A Methodology for the Spatiotemporal Identification of Compound Hazards: Wind and Precipitation Extremes in Great Britain (1979–2019). Tilloy et al.

1 Overview

The authors present a method to identify compound hazards, in both space and time. The description of the method is very detailed and precise. A large catalogue of observed wind-precipitation hazards is additionally provided. It is used to assess the hazards identified by the algorithm applied on wind and precipitation data from the reanalysis dataset ERA-5.

The appendix also contains several results that would deserve to be interpreted more in detail, and summarized in the article itself. The hit rate between events from the catalogue and events identified by the algorithm is quite high. However, it would be nice to see a discussion on the events that were not captured.

This study is relevant and well described, this article deserves publication after minor revisions.

2 Comments

1. l. 8 "Compound hazards are two different natural hazards". Actually two or more, as written in conclusion l.629
2. Even if you are not using it, consider mentioning methods of threshold selection, in the context of spatio-temporal clustering (e.g. Kholodovsky and Liang, 2021)
3. l.50 space missing between period and 1979-2019.
4. l.56 the paragraph is a repetition of the previous one.
5. l.67 repetition e.g.
6. Maybe don't introduce acronyms/variables if you don't use them more than twice (CHE l.87, x and y l.90)
7. l.171 You mention the literature regarding the quality assessments of ERA-5 precipitation, but not on ERA-5 wind. Even if there is none, it can be worth mentioning it.
8. Sometimes the word "footprint" refers to spatial footprint only, sometimes spatio-temporal footprint. I would recommend being consistent, and maybe always write "spatial footprint" when it is only about spatial considerations.
9. It should be "Fig- 5."
10. A general remark about the figures: when plotting continuous variables, instead of qualitative color maps, I would highly recommend using sequential color maps, with homogeneous brightness gradient. Consider changing color maps in figures 5., 11a., A2, A3 and A6.
11. l.259 Please motivate a bit more the choice of $r = a/b$ (earlier or/and in more details than in the discussion part)
12. l.271 I do not fully understand yet the definition of μ " number of neighbours a point needs to be considered a core point, and therefore generate a new cluster". Does it refer to a maximum size of a cluster, beyond which the remaining gridpoints are considered as another cluster? And l.272 why does this value have to be larger than the number of dimensions plus one?
13. l.274 Please provide some reference about the tendency of ERA-5 to smooth extremes.
14. I can see that l.276 and 277 are some background to motivate the choice $\mu = 10$, but the link is not clear to me yet. l.279 "from at least 1 to 10 hours", is 10 hours a maximum duration? the "area between 5200 and 400km^2" is a duration of 1 h associated with maximum 5200 km, and 10h with maximum 400km^2 ? Are those value chosen to capture the convective events only, described in the previous sentences?

15. l. 285 about the "knee in the plot", maybe give some more details in Supplement 1 about how is exactly defined the knee. Is it the location of a specific value of the gradient?

16. l.295 it should be Fig. 6.

17. Why does the $10 - NN$ neighbourhood include $n_{max} = 44$ points?

18. Fig 7. This figure is a very good added value for understanding the definition of compound events you use. I guess the blue dashed lines mark out the compound event defined in the end. As it is present in the schematic of temporal overlap, maybe you can add it in the one of spatial overlap. And maybe use another color, so that it is more visible in a) b) c) and d).

19. l.331 Could you comment about the relevance of the choice AND for spatial and OR for temporal, in terms of impact?

20. l.345 Can you justify the choice of maximum precipitation as intensity attribute, and not accumulated precipitation over the period of the event?

21. l.371 "This confrontation highlights not only our methodology's capabilities, but also the ability of the ERA5 reanalysis to detect different types of extreme events in Great Britain": this is true if you find an agreement between the two datasets. In case of disagreement, how can you identify the source of it, between your methodology's capabilities and ERA5 performance?

22. l.497 "Among these 147 events, 64 (43.5%) have one corresponding cluster" maybe add "exactly" "Among these 147 events, 64 (43.5%) have *exactly* one corresponding cluster"

23. l.500 The reader can be confused between the origins of the hazards (the catalogue of observations and the output of your method), you can be a bit more specific, e.g. "109 are identified *by our algorithm* as compound hazard events".

24. l.515 I would recommend to use the variables you introduces in table 1, to be more specific: "sorted p_a or w at each gridpoints" instead of "the sorted sample"

25. In the caption of figure 13: describe in the corresponding order "Spatial-quantile plot for 18,086 precipitation, 6190 wind, and 4555 compounds cluster"

26. l.547 The spatial footprint is defined by the percentage of gridpoints concerned. However, the "real" size of the gridpoints depends on the latitude. Can this have an impact when comparing hazards in different regions of the studied area, in Figure 13?

27. l.560 I do not fully understand the end of the paragraph, could you reformulate your point?

28. l.565 maybe say that the event 136 is the one presented in figure 12b.

29. Can you comment on the 10 events present in the catalogue that the algorithm did not detect?

30. Briefly discuss about the identification of compound hazards in the context of climate change.

31. There are lots of results in appendix. You could maybe summarized them somewhere in the article itself?

32. l.637 *complementary*

33. Figure A1 why is the proportion of CE strictly increasing with the footprint area, and not with the duration? Maybe you can interpret a bit further Fig A1.

34. l.689 LMF is interesting to study in this context. I would repeat the argument of the colorbar choice here: it should differentiate LMF greater and lower than one.

35. l.706 Can you interpret the seasonality in terms of weather regimes?

36. l.713 Fig. A5?

37. l.731 It is the empirical probability, right?

38. Fig.A6, consider adding on the plots the cell of reference.

References

Kholodovsky, V. and Liang, X.-Z. (2021). A generalized spatio-temporal threshold clustering method for identification of extreme event patterns. *Advances in Statistical Climatology, Meteorology and Oceanography*, 7(1):35–52.