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Comment on acp-2021-297

Anonymous Referee #1

Referee comment on "The impact of atmospheric blocking on the compounding effect of ozone pollution and temperature: A copula-based approach" by Noelia Otero et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-297-RC1>, 2021

Review of "The impact of atmospheric blocking on the compounding effect of ozone pollution and temperature: A copula-based approach" by N. Otero, O. Jurado, T. Butler, and H. W. Rust.

The study looks into the influence of atmospheric blocking on the occurrence of temperature and surface ozone extremes in Europe. It considers both, temperature extremes and ozone extremes alone as well as their co-occurrence using three cases: AND, OR, and Conditional. For all cases the authors show an influence of blocking on the occurrence probabilities.

The manuscript addresses the very timely topic of compound events and adds to the research in this field. It is generally well written and the figures are well-made and informative. However, it would also benefit from careful proofreading. I found a number of small mistakes in grammar and content. Also some figures miss units and some could use improvement in several details as by my minor comments.

On a technical level I find that the description of methods lacks detail at several points as pointed out below. My only major comment is therefore conditional on my interpretation of temperature extremes: I assume that the authors treat all days equally in their distribution (e.g., in line 177/figure 2 for the exceedances of the 95th percentile of temperature). To me this is flawed as the authors consider the months April-September and the probability for temperature extremes is not equally distributed across these months. So, e.g., days in July are way more likely to be in the upper tail (even if they are not exceptional), while this might even be impossible for days in April. This should be clarified and/or resolved.

Minor comments:

line 78: "Maximum daily average 8h [...] concentrations" I am sorry but it is unclear to me what that means exactly.

l86: How are the gridded temperatures and station data of ozone brought together? Would it not be better to use ERA5 or even E-Obs as dataset for the temperature? Both are on a 0.25 degree grid and E-Obs is closer to the observations.

l95: I assume it should be 10^6 ? Similar for l97.

l104: "For two random variables random variables"

l113: Could the authors explain in a bit more detail what $BI=1$ means? Is blocking only considered if it is co-located similar to, e.g., Pfahl et al. 2012 or in a larger region similar to, e.g., Brunner et al. 2017?

Figure 1:

- "calculated with respect the MDAO3 concentrations over the whole period" I assume temperatures are not relative to MDAO3 concentrations?
- Do I assume correctly that there are hardly any non-significant cases? I only found one in Ireland. - In Ireland there seem to be two dots missing for ozone but that could be due to the fact that they are white and do not have a contour?
- This is just a suggestion but maybe it would be more insightful to provide relative anomalies or anomalies in StdDevs in order to make clear how far outside the norm conditions during blocking are?

l173: "west-east gradient" That is not obvious to me from figure 1b. Could also be a north-south gradient, right?

If the authors want to make this argument, I would suggest to provide a (density-weighted) average for west vs east (or other regions) to support that argument. Also from briefly looking into Brunner et al. 2017 they also do not seem to support this statement (or maybe the citation is only referring to the radiative heating?)

figure1: It should also be noted again that the number of days going into the blocked average shown can differ for each station depending (I assume).

Figure S2: Missing units

l177: Do I assume correctly that the threshold criterion (95th percentile) is only variable spatially? It should be noted that when using the entire period (rather than say a window around the day of the year considered) for temperature most exceedances will be in summer and not in April, May or September, correct?! This might lead to not very extreme (relatively speaking) summer days being selected over exceptional days from, e.g., April.

Figure 2:

- Is there a reason to use a diverging colorbar in this figure? This seems to suggest that somehow blue dots have less blocking than the climatology at first glance with is not the case, right?
- Could the authors indicate significance here as well? (E.g., by using a bootstrap approach?) It seems to me that maybe in the UK there might be some non-significant values for ozone? (around 20% blocked days versus about 15% blocking climatology)
- I personally find the non-integer categories of the colorbar confusing, is there a reason for that?

Figure 3: The category 0-0.1 indicates positive correlation and should be in warm colors I assume?

Figures 3 and 4: Since the authors are mostly interested in the difference between the blocked and unblocked cases, would it not be better to just show this differences instead of the two cases beside each other? Or all three options like in figure 5?

Figure S5: "Bold black lines" Maybe change to "bold black boxes"?

Figure 5: "Black contours represent statistically significance at the confidence level of

95%" Only for the right column, I assume?

I226: Could the the authors put this in context? I assume that 2.5% is still significantly more than we would expect for to completely uncorrelated variables?

I245: Have the authors also investigated the XOR case (assuming this is not what is done in the second cased discussed here): so cases where only and only one of the two is true. I think it would be interesting to look into the spatial pattern of that as well if it is not too much effort.

I285: Neither of the two studies cited here seem to support/investigate the statement that 70% of temperature extremes coincide with blocking in northern Europe to my knowledge (without having re-read them in detail). Could the authors double-check that?

I393: Please fix: "<https://doi.org/Online> at: <https://frevamet.fu-berlin.de/about/blocking/>"