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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Characterising the relationship between weather extremes in Europe and synoptic circulation features" *by* S. Pfahl

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General comments

This paper aims to characterise the European relationship between, on the one hand, blocking and cyclone frequencies and, on the other, intra-daily wind gust, precipitation amount, hot and cold extremes. A statistical methodology similar to composite analysis is used in order to identify eventual remote effects of cyclone and blocking features on these extremes. The paper is clear and well-written. This investigation can bring more constraints on atmospherical mechanisms that induce weather extremes in Europe and help to disentangle the specificity of some "symetric extremes" (summer hot vs. winter cold). The methodology, especially the coordinate system, is interesting because it increases the robustness of the signal and allows reducing the noise of possible gridpoints cherry-picking.

However, I have some major comments that could be summarized in 1) Causality of the relationship and 2) Interpretation of results.

For these reasons, I recommend to accept this paper if clarifications and corresponding revisions are made.

Specific Comments

1- If I understand well, reading section 2, the author calculates the blocking/cyclone frequencies *during* the intra-daily weather extremes. However, the paper aims to interpret the blocking/cyclone frequencies composite maps in terms of remote effects of these features on weather extremes. So, I was wondering whether the temporal coherence is important (i.e blocking/cyclones features before the weather extreme events). Indeed, summer hot (resp. winter cold) extremes can be induced in Europe by specific advected atmospheric circulations and accumulation of sensible heat flux through several days in lower layers of troposphere due to combined depleted soil-moisture and persistent blocking for example (resp. gradual reduction of heat fluxes due to high snow cover and persistent blocking for example). Calculating frequency of blocking/cyclone only during the occurrence of the weather extremes can make more complex the causal relationship claimed by the author. This leads me to my second remark.

2- The author interprets the colocation of cyclone/blocking frequency center with hot extremes as a fingerprint of low/no advection and preferential adiabatic heating mechanism. I think this point is incorrect. Indeed, various authors have reported that in Western Europe, a South-North propagation of heat continental anomalies is coherently observed (e.g Vautard et al., 2007 ; Zampieri et al., 2009 ; Quesada et al., 2012). In another words, advection could be a dominant forcing of european hot extremes occurrence! Moreover, european temperature variability in summer is less dependant of large-scale atmospheric dynamics compared to winter (e.g Cassou et al., 2005 ; Cattiaux et al., 2010). So, my point of view is that blocking frequency is a limited metric to get the full picture: blocking can be inefficient in temperature increase in some regions

(e.g wet Northern regions) and very efficient to trigger feedback amplifications (e.g southern Spain) leading to hot extremes. For example, a blocking event in Southern Europe can have temperature impacts on Northern Europe some days or weeks after, which seems in contradiction with what the author claims in Section 3.3. Therefore, to better explain the temperature extremes occurrence and remote effects, one should take into account: blocking frequency but also soil-state (e.g winter snow or summer soil-moisture) and strength of blocking. How does the author's study fit with previous papers and the above-mentionned considerations?

3- The author points out that "(...) the magnitude of the extreme events (. . .) may be underestimated in ERA-Interim compared to point measurements" but all variables are interpolated at 1 degree resolution. As far as I know, ERA-Interim provides data also at 0.75 degrees resolution. So, could the resolution have an impact on blocking/cyclone features (or e.g on mountainous areas) presented here? Are the results robust with ERA-Interim finer resolution?

4- p1872, The choice of intra-daily (i.e six-hourly) seems arbitrary. For temperature extremes, why did the author not choose daily or multi-daily (waves) indices? The intra-daily indices are more punctual and could be a priori more related to local causes.

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No typing comments

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