Comment on wcd-2021-6
Anonymous Referee #2

Referee comment on "Reconstructing winter climate anomalies in the Euro-Atlantic sector using circulation patterns" by Erica Madonna et al., Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-6-RC2, 2021

The paper presents an analysis on the ability of different circulation patterns frameworks to describe the seasonal wintertime precipitation and temperature anomalies over Europe, using ERAInterim reanalysis data. Three different frameworks are used: the two NAO phases, blocking over three different regions and five Atlantic jet stream clusters.

The paper is clear and well written in all parts, and covers a current hole in the literature regarding circulation patterns, presenting original results which can be very useful for the community. I therefore recommend the article for publication in Weather and Climate Dynamics, once the following minor comments are considered.

General comments/suggestions

- I was very pleased to see the topic of this work, which I think was missing in the literature, and really enjoyed its reading. As a minor comment, I don't really understand the authors' choice not to consider - amongst the sets of circulation patterns - the "classical" four Euro-Atlantic weather regimes framework, which has been (and still is, to my knowledge) the most used in literature. I think it would be in the authors' interest to show the main results (e.g. Fig. 6 and 7/9) also for the 4 regimes framework, which would be of interest for many works on regimes when discussing the related impacts. I respect the authors' choice and I'm not asking to repeat the analysis for the k=4 case, but maybe some comments in the text and conclusions referring to the correspondence between the k=5 and k=4 regimes would help the reader "translating" the results to that framework.

- As discussed by the authors, one of the problems of the reconstruction is the underestimation of the seasonal anomalies, due to the limits of the mean composites. Maybe a simple estimate of how much does the variability impact the reconstruction in the different regions would be given by the ratio between the standard deviation and the mean of the composite patterns. Just a suggestion.

Specific comments

- L35. "..the North Atlantic jet stream can assume five different configurations..": the
number of clusters to be considered is a matter of debate in literature and probably will not lead to a conclusive "best number", since all choices retain some level of arbitrariness. Please acknowledge here that this is the authors' choice, while other choices for the number of regimes are possible (e.g. as in Madonna, 2017).

- L70. Please briefly comment on the choice of 10%. Have you tried with other thresholds? Are the results sensitive to this choice?

- L83. How is \( d \) calculated? Please show the formula here or add a reference.

- L86. Is this method and the threshold of 0.5 used elsewhere? If so, please add a reference here. Instead please briefly discuss the choice and its possible impacts on the results.

- L105. How close to a zero anomaly are the undefined days? I imagine the mean is very close to zero, but this may also come from cancellation of opposite anomalies. I'd suggest to show the standard deviation of the anomalies for the unclassified days (in the supplementary), to assess whether their exclusion might impact the skill of the reconstruction. The underestimation of the amplitude of the seasonal anomalies might also be linked to the filtering, since the denominator in equation 2 is always 90, but the number of assigned days is usually much less.

- L129. CE>0.25. Is this threshold used elsewhere? If so, please add a reference.

- L135. Is the "/" a typo?

- Section 2.2.2. I found it quite hard the reading of the section before reading Section 3.3 and looking at Figure 8. To make this easier, I suggest to explicitly refer to Section 3.3 and Figure 8 in the text. Also, a possibility would be to move Section 2.2.2 to the beginning of Section 3.3, since the scaling factors are not used till then.

- L138. "small". with respect to the mean?

- L163. "are placed to allow easy comparison": has some automatic matching of the wind patterns been performed (e.g. maximizing the pattern correlation)?

- L174. The S-jet cluster is made up by less days, so that would probably enlarge the anomalies.

- L178-179, L197. In the comparison with NAO+, the usual 4 regimes would look more natural to me. Probably a sum of the tilted and central jet states would show similar anomalies, as it is said in the text, and also correlate better with the NAO+ timeseries. It might be worth adding a comment on this in the text.

- L200. The unblocked days are different from the undefined/neutral days, so I won't put them in the same category. I expect (at least part of) them to correlate with positive NAO and have similar anomalies. I suggest to add a comment on this in the text.

- L201. See comment at line 105. I think it would be interesting to show the mean (even if close to zero) and standard deviation for these days in the additional material.

- Section 3.2. Have the reconstructions been performed for the wind also? Table 2 and L260 seem to suggest so. Why are the results not shown? It might be worth commenting on this briefly in the text.

- L216. "that" -> than?
- L224. Also over France the blocking method has substantially better skill.

- L227-8. "...regions with poor correlation skill mostly have low temperature variability..". Is this referred to the NAO phases or to all methods? I don't think this is true in general. For example Spain and southern Italy show low temperature variability but good skill for blocking/jet regimes.

- L240. A large skill is also apparent over North Africa/the Mediterranean, I'd add a comment on this in the text. Also, if the figures are already available, it might be worth showing the equivalent of Figure S3 for the correlation also.

- L292-297. I'd comment on the case of France as well, which is well represented only by the blocking framework.

- L302-304. Also, this might be related to the filtering, see comment at line 105.

- L311. The "classical" 4 Euro-Atlantic weather regimes are usually calculated using larger domains, extending up to 40 degrees east. Do you think this could increase the skill in central/eastern Europe?