

***Interactive comment on* “Seasonal weather regimes in the North Atlantic region: towards new seasonality?” by Florentin Breton et al.**

Anonymous Referee #2

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The authors utilize the concept of seasonal weather regimes defined based on clustering daily fields of 500 hPa geopotential height from reanalysis and model data. By exploring their frequency and distribution throughout the year, they are able to trace changes in seasonality of European/North Atlantic climate, which are further explored in the course of the study. In addition to the material presented in the main text, the supplementary material contains an impressive body of additional figures illustrating the results of this study in more detail and may be helpful to better understand certain aspects of the authors’ findings. The manuscript itself is concise, well-written and contains (almost) all necessary information needed to fully comprehend the presented analysis. I only have a few minor comments listed below that I would like to invite the authors to consider/address before this work may become published as a regular paper

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in ESD.

My main point concerns some minor clarification on the use of the EM algorithm for clustering the daily Z500 fields. Specifically, I have two questions:

1. Could you please elaborate a bit more explicitly on the meaning of the variable x that you use for clustering? Is it really just the (scalar) PC 1 score (i.e. you collapse the full spatial pattern to the magnitude of the EOF-1 pattern), and you perform a one-dimensional cluster analysis?

2. I would appreciate if you could motivate a bit more explicitly your use of a model-based clustering technique as opposed to other model-free approaches like hierarchical or k-means clustering. How is this related to the choice/type of the variable x that the clustering is based on? Why is a finite Gaussian mixture a reasonable model for the designated purpose? I think that the obtained results are correct and reasonable, I just want to better understand the rationale behind the approach followed here.

Further minor points:

3. I found the description of the detrending procedure a bit hard to follow in the main text. I understand from Appendix C that you take the daily mean of the whole Z500 field and subtract it from all values (thereby removing not only long-term trends, but also seasonality in the regional-mean Z500 amplitudes)? Or is it something different? I have to confess that I am a bit lost with the term “calendar trend” (ll.111 and 215).

4. There are quite a few cases where additional technical results are “not shown”. Since you provide a very detailed supplementary material with many additional figures, I was wondering if it would make sense to also include (some of) the results labelled as “not shown” in this supplement?

5. In Figure 3.1, I would find it more logical to start with showing and discussing the obtained SWRs (i.e., the associated spatial patterns) before focusing on their past changes.

6. Relating to II.139-147: In order to better understand the (dis)agreement between the Z500 fields and SWR distributions obtained from them, some quantitative metrics (like mean spatial correlation, bias, . . .) between the models and ERA-Interim could be added as a table to the supplementary material.

7. L.165: Can you elaborate a bit more on the “new summer regime that did not exist in the past”?

8. The authors consider future changes in SWPs over the European/North Atlantic sector for the RCP8.5 scenario only. Did they check if the corresponding results for more moderate scenarios would be compatible with the reported findings (i.e. show consistent trends but smaller “magnitude” of changes)? I do not request to show any additional results for RCPs, but a brief discussion (e.g. along with what is stated in II.308-309) could be interesting.

Technical suggestions:

* L.2: “insight into”

* L.3: What do you mean by “for human and natural systems”? This reads a bit odd to me. . .

* L.125: “the regimes’ monthly frequencies”

* L.176: “regression coefficients”

* L.186: “the northern continents” – please be a bit more specific, as you do not seem to consider the whole hemisphere

* LI.189-190: “the R1 pattern. . . and the R7 pattern”

* L.195: “the regimes’ spatial patterns”

* L.225: I don’t quite get what “LGI” stands for – please explain

* L.227: “the regimes’ spatial trends” (what is a “spatial trend”?)

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* L.449, Eq. (A4): Please replace \sum_{k}^{t+1} by Σ_k^{t+1} in the LATEX source, the presently shown mathematical symbol is not appropriate here

Interactive comment on Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2020-26>, 2020.

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