Mediterranean Sea heat uptake variability as a precursor to winter precipitation in the Levant – review

The authors elaborate on the SOM configuration and EOF analysis. However, this analysis raises several additional issues:

1. The approach of the authors towards the SOM analysis gives the impression that it is being mistreated: SOMs do not have a "leading pattern" and are not constructed to minimize the explained variance, nor do they have temporal "amplitudes". Rather, SOM nodes represent cluster centroids and each sample (in this case, monthly anomaly) is assigned to a single pattern, unlike EOF where each sample is constructed by different amplitudes of the EOF modes. SOM nodes are not directional vectors that explain temporal variations either, unlike EOFs. The authors seem to be referring to node frequency as amplitude, in which case it is unclear over which period this frequency is calculated.

2. The supplementary material does not explain the choice of 1X3 SOM configuration using a relevant measure: this should include an elbow-method analysis or minimizing the SOM quantification error. If anything, results shown in the supplementary should motivate the authors to enhance the SOM to at least a 2X3 configuration, drastically raising the total explained variance (though this is not a traditional requirement from a SOM analysis) and obtaining refined spatial patterns. E.g., the key area of the Aegean sits in the low-confidence area of node 3 – suggesting that the association between the AQA and the SOM nodes is weaker than it seems from the composite maps. This may improve with a refined SOM application.

3. Maximizing the variance explained by the "leading" SOM pattern counteracts the primary purpose of the SOM – building clusters with minimal internal variability.

4. Topographic errors in 1D and 2D SOMs are incomparable – the topographic error is asking how many of 2nd-winning neurons are not neighbors of the 1st winning neurons. E.g., in the selected 1X3 SOM most neurons are neighbors by construction, and so the TE of this configuration is not comparable to the 2D configurations and does justify the choice. TEs are used to measure the continuity of the SOM space – e.g., are there non-neighboring neurons that are very similar to each other. For selecting SOM size, the quantification error is more relevant, and even that is only borderline comparable between 1D and 2D SOMs, as 1D networks inherently emphasize one dimension of variability – more suitable for analyzing temporal variability of a local time-series, etc.

5. Moreover, if the conclusion is that EOFs can readily produce similar correlations and seeing that the SOM algorithm is underutilized and treated as an EOF analysis throughout, I recommend switching to the EOF results for clarity.

   In my view, SOM is meant to enter where EOF falls short of capturing the dominant patterns of the system, or if higher precision is sought after. However, this SOM configuration essentially converge to the EOF results – rendering its inclusion redundant.

   Changing to EOF analysis will highlight the importance of the dynamical pathway described here rather than focusing on the clustering approach – which involve several subjective choices that are not justified well by the authors. I believe that EOF serves a more objective, reproduceable, and physically interpretable approach for the purpose of this MS.

Minor comments:

1. The global maps in figure 1 are redundant for the purpose of this MS. If a case is to be made concerning them, it can surely be made using a single map.
2. There is no justification to display and discuss two SOM networks with highly similar results (e.g., SST and Qf). Choose one, and state that similar results are obtained if the other is used. This is not very surprising seeing as the two fields are highly correlated.
3. Most references do not include a doi, making the review process unnecessarily tedious, and are not in line with the WCD format requisites.

I recommend accepting the MS once the issues with the SOM analysis are resolved – either changing entirely to EOF framework or enhancing the SOM analysis to justify its use.