Dear Reviewer,

We appreciate your precious time in reviewing our work. Your valuable and insightful feedback has improved the manuscript. We have carefully considered your comments below in black and tried to address them point-by-point in red. We refer to a modified pdf where all the modifications are highlighted in red.

Main concerns.

The work is based on the application of SOM with a huge number of neurons and then grouping them using the HAC. The input layers correspond to the zonal and meridional velocities as well as the OW parameter. Then, at different sub regions statistics for the different parameters are evaluated including seasonal variations of clusters. If the objective of the Ms is to understand the mesoscale dynamics of the EMS the approach would be first to perform a temporal SOM analysis to the (ug,vg) velocities (or alternatively the MKE) to obtain the zones of co-variability. This would also provide the time series of the velocities in each of the patterns. This has to be done in conjunction with a spatial SOM that will give the main mesoscale structures in the basin. The BMUs of these spatial patterns decomposition will give the seasonality that the authors want to explain. However if the objective is to analyse the eddy activity in the area I suggest to change for the input data the EKE, MEKE and the OW parameter. In the paper no mention is given to which SOM they are applying nor the 5 clusters that they finally ended.

Minor concerns.

I assume that the data corresponds to daily velocities, but this is never stated in the Manuscript. Why using daily data and not weekly or monthly if the objective is to analyze mesoscale structures?

We thank the reviewer for this question. We could use weekly data because mesoscale structures extend from a few days to several weeks. However, since the current field in the Levantine Sea is characterized by a high Spatio-temporal variability (*Menna et al. 2012*), and eddies can appear/disappear or evolve quickly, we preferred to use daily data to avoid missing such short-time scale events.

Figure 1 and 2 can be merged.

Done

Figure 3. What are the units in the colorbar?

We added the values in the colorbars of the topological maps of each parameter (figure 2A,B,C)

Figure 4A. What is the message in this figure?

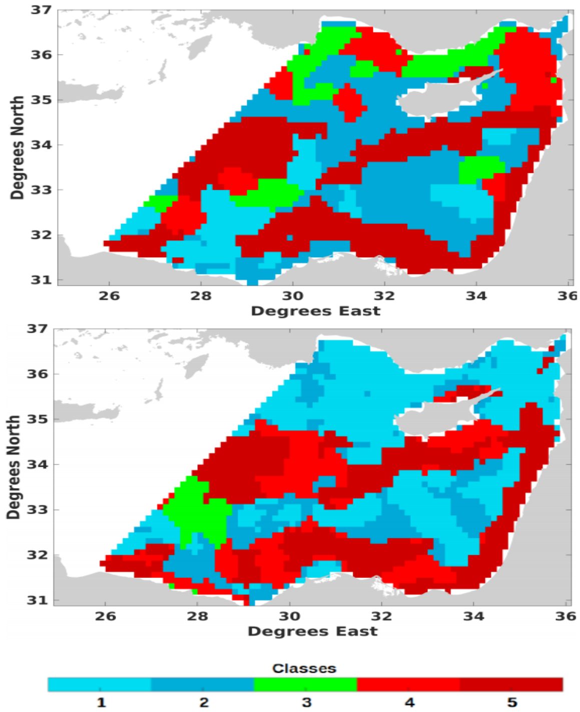
This figure shows the positions of the clusters in respect to the topological map

Figure 5. I suggest defining the areas directly with the SOM (see main concern)

We thank the reviewer for his suggestion. However, we find that this suggestion consists of an independent study, and that our choice of subregions of interest is justified in the paper.

To give a clear answer and to show how different the output is with such data re-organization, we performed the suggested classification, and we state the followed procedure below:

First, we structured the data set following each pixel's daily time series (from 1993 to 2018). In other terms, the data set corresponds to pixels of an image as rows and daily values as columns. We performed two independent classifications using 1) U, V and OW, 2) EKE, MKE, and OW. All variables were normalized to homogenize their weights and therefore their contribution to delimit clusters.



Using the new data set, one at a time, we trained a Self-Organizing map, and we proceeded in the same way with a HAC to cluster similar neurons in terms of daily time series. In both cases, 5 clusters were the best choice of cut-off level, at which the dissimilarity between clusters is important.

We reconstructed the temporal classification, and this showed in both cases non-homogeneous regions. In other terms, the clustering presents spatially intermittent regions that do not allow the definition of contingent areas.

This can be explained by the fact that these parameters do not reveal any clear spatio-temporal variability and does not allow to regroup clear regions with same variability.

This finding has been already highlighted by our approach, as seen in the paper (Figure 6 hal2), with the lack of any temporal periodicity or variability while looking at the succession of clusters inside each box.

In our paper, the choice of regions of interest was defined using the same approach as in (Barboni et al., 2021 based on the MDT. In addition to that, we considered in our paper the standard deviation to detect possible features that could be highly variable and unstable that does not appear in the mean signal of ADT (which was the case in CE, Shikmona, and Beirut boxes).

The boxes were spatially extended to include most of the variability within each feature as seen in the figure 3B. The spatial classification that we performed in this paper allowed to isolate different situations based on the parameters used and monitor them through time. The result in Figure 6 highlights the Spatio-temporal differences that occur within each box in response to different mesoscale activity.

Consequently, we hope that these new results are enough to convince the reviewer.

Figures 6-10. I don't understand the message behind these graphics.

By these figures we wanted to show the frequency variation of the five clusters in all the boxes. By figure 4 we showed that the cluster varies from one box to another and from one year to another. In figure 5 we showed the cluster that was daily most frequently cluster in every box and in figure 6 we showed that the energetic clusters (C1 C5) are increasing with time at the expense of weak current cluster C3. We moved the figures of the daily Mean Kinetic Energy and the trends of C1 and C4 to appendix, to reduce the number of figure.

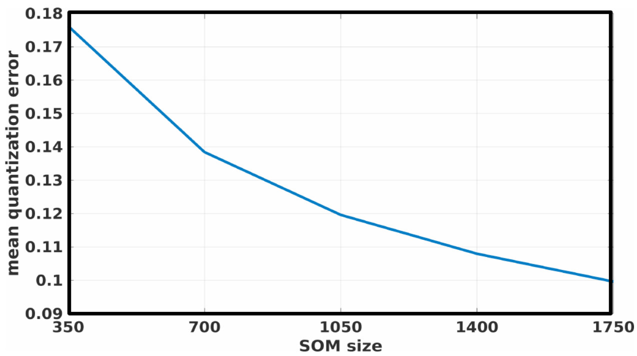
Ln 90. Why using OW and velocities as input? %%

Using velocities was previously done in Jouini et al., 2016 to efficiently characterize the Sicily channel. However, since the Levantine is known for important eddy activity, we used additionally the OW parameter, which represents and allows to differ between stain and vortex-dominated areas. We wanted to base the study on the altimetric data that is with no gaps.

From U and V, we can estimate different mesoscale parameters such as MKE, using non-linear relationships that are conserved through the topology of the SOM.

Page 6. Why 1400 neurons?

We conducted several sensitivity tests to determine the size of the map. while increasing the size of the SOM map, we calculated the mean quantization error, which stands for the error between an observation and its Best Matching Neuron (closest neuron to this observation). For an increasing size of the SOM, this error keeps on decreasing. We chose 1400 neurons as a comprise between the quality of the SOM, its interpretability, and computational requirements.



Lines around 120. What do you mean with "SOM is well organized’’?

We corrected it in the paragraph by adding that the topological map represents a clear gradient of U alongside clusters of intense V and OW. Since V and OW do not have the same gradient as U, it shows that these parameters follow a non-linear relationship.

Line 132, C$ instead of C5

Done

Line 156 "iso-MDT" . There are no isolines in this plot

We removed the “iso-MDT” lines term.

Section 3.1. See Main concerns.