Dear Referee #1,

we would like to thank you for the careful reading of the manuscript and the constructive comments that substantially helped to improve and clarify the paper. Answers to all your comments are detailed hereafter. Corrections to the English grammar were adopted in the revised version of the manuscript according to the reviewer's recommendations, but are not reported or discussed here. All authors agree with the modifications made to the manuscript. The comments by the referee are reported in bold followed by our response (in blue). The text added to the revised manuscript is reported in italic font. The line numbers reported in the answers referred to the revised manuscript. The revised manuscript that includes track changes is also provided in pdf format.

In the following answers, we use 'Figure' to identify the figures in the updated manuscript and we use 'Plot' to identify the figures in this document.

General comments:

The manuscript describes a dataset of MHW events built on ESA CCI SST. The dataset is geographically limited to Southern Europe and Western Asia, even if the SST dataset is global. The approach is rooted in Hobday et al 2016 framework, but introducing refined statistical methods for the detection of marine heatwaves.

I have enjoyed reading the manuscript; it is well written, the length is just about right, it is clear and concise. The description of the dataset is appropriate. I easily downloaded the dataset and was able to inspect it without problems.

From a methodological point of view, the manuscript is certainly interesting for the community. The proposed methodology to take into account shifts toward warmer climate is something we have to deal with and the way the authors tackle this is worth reading. The clustering analysis of macro events is valuable, although the authors did not attempt to associate driving synoptic (atmospheric) conditions to each clusters, something that was the reason for the clustering in Stefanon et al 2012. However, this is likely beyond the mere description of the dataset required by ESSD.

Major comments:

Even if I find the methodological part very interesting, I am a little bit doubtful about the relevance of the dataset itself. The reduced geographical boundaries limit the number of potential users, while it would have been straightforward to run the methodology on the global dataset. The STL-method needs to be re-run every time ESA CCI SST is updated (e.g., including recent years), otherwise the dataset gets quickly outdated. The fact that this dataset is inevitably linked to a specific SST dataset may limit its relevance. Scientists may want to rerun the methodology but on different or newer SST datasets. The significance of the dataset itself, in my opinion, is thus limited.

We thank the referee for the comment on the methodology. Pastor and Khodayar (2022) in a very recent paper highlighted the need to establish a universal definition of MHWs events, which does not rely only on the grid-cell definition, to ensure intercomparison of results.

Moreover, in another very recent paper, Sun et al. 2022 suggest that defining an MHW event under the spatiotemporal framework provides a more fruitful description of MHW characteristics. Our dataset is an attempt to aggregate single events by defining the macroevents, and building a consistent framework that would increase comparability among MHWs studies.

Since in the interactive discussion with the editors we have already addressed some of the points raised by the referee, in the following paragraphs we just report a modified and updated version of that discussion (https://doi.org/10.5194/essd-2022-343-AC1).

Based on the review criteria of ESSD journal (https://www.earth-system-science-data.net/peer_review/review_criteria.html), we think that the dataset has its significance. The significance criterion is divided into three sub-criteria: uniqueness, usefulness, completeness.

Since SEWA-MHWs is the first effort in literature in archiving extreme hot sea surface temperature macroevents, we think that the SEWA-MHWs dataset could be considered as unique. The advantages of the availability of a MHWs macroevents dataset are to avoid waste of computational and/or time resources to process SST data to detect MHWs.

The dataset can be considered useful as well, because, alone or in combination with other data sets, can be used in future interpretations, for the comparison to model output or to verify other numerical experiments or observations. In particular, as stated before, it could help to fill the knowledge gaps about the drivers and the marine ecosystems impacts of these extreme events. For example, the dataset could be used in the analysis of compound events, i.e., when conditions are extreme for multiple potential ocean ecosystem stressors such as temperature and chlorophyll (Gruber et al., 2021, Le Grix et al., 2021). Moreover, our attempt to provide a complete dataset in a consistent framework would increase comparison among MHWs studies that will use SEWA-MHWs dataset and, on top of that, SEWA-MHWs dataset provides a ready-to-use dataset to be compared to other studies which apply different MHW definition, without waste of computational and/or time resources. Lastly, the SEWA-MHWs dataset can be considered complete as it covers one semi-closed basin and two closed basins for the entire period of ESA CCI SST v2.1.

Nevertheless, as the referee pointed out, we are aware that the dataset has some limitations:

1) The reduced geographical boundaries limit the number of potential users. This is certainly true. However, besides the fact that the method is too computationally demanding to be applied globally, not all the datasets arise as global. Moreover, for climate change and in particular, for this specific phenomenon, the Mediterranean is a hot spot (Garrabou et al., 2009, Giorgi et al. 2006, Cramer et al., 2018, Pastor et al., 2020, Garrabou et al., 2022, Pastor and Khodayar, 2022). Mediterranean SST satellite data analysis has shown a positive trend in the last 40 years with progressively higher temperatures extending longer within the annual cycle but also with more frequent and intense SST extremes (Pastor et al., 2020). This SST warming has been linked to the increasing occurrence of MHWs in the last decades in the Mediterranean (Ciappa, 2022). In addition, the Mediterranean Sea is generally recognized as an exemplar model to assess the ecological effects of climate change (Garrabou et al 2022, Cramer et al., 2018). Although the Mediterranean Sea represents only 0.32% of the total

volume of the oceans, its unique geomorphological history led to a markedly high level of biodiversity with 7%–10% of all known marine species and a large proportion of endemic species (Bianchi & Morri, 2000; Coll et al., 2010). Marine heatwaves caused unprecedented biological impacts in the Mediterranean Sea (Garrabou et al 2022, Cramer et al., 2018; Marbà et al., 2015; Rivetti et al., 2014,), seriously affecting marine biodiversity (Juza et al., 2022). Therefore, the MHWs Mediterranean community is increasing constantly and new projects that could benefit from our work have already started (e.g. CareHeat, https://eo4society.esa.int/projects/careheat/). The relevance of MHW events occuring in the Mediterranean Sea is also shown by news recently reported on various international newspapers or websites, e.g. https://www.lemonde.fr/en/environment/article/2022/07/30/marine-heat-waves-mean-deadly-fate-for-large-number-of-mediterranean-flora-and-fauna_5991965_114.html, https://www.esa.int/Applications/Observing_the_Earth/Mediterranean_Sea_hit_by_marine_heatwave, https://www.mercator-ocean.eu/actualites/marine-heatwaves-mediterranean-summer-2022/, https://www.reuters.com/business/cop/mediterranean-marine-heatwaves-threaten-coastal-livelihoods-2022-11-13/, https://news.mongabay.com/2022/09/mind-blowing-marine-heat-waves-put-mediterranean-ecosystems-at-grave-risk/.

Finally, it is worth stressing that the application of the methodology described in the paper could be extended beyond the Mediterranean, and, in principle, could be applied to the global ocean. Therefore, we provide scripts to rerun the method over other regions. In particular, we provided the code to detect MHWs and their characteristics (MHW_stl.ipynb), the code to generate the MHWs macroevents (MED_LABEL.ipynb), and the code to filter out the smallest macroevents (MED_filter.ipynb). The scripts are available in the Zenodo repository (Bonino et al., 2022).

2) The dataset misses recent years. This is certainly true, but to build our dataset we used the most updated version of the ESA CCI SST. Nevertheless, we provide scripts to rerun the method on the updated ESA CCI SST v3 dataset. In particular, we provided in the Zenodo repository (Bonino et al., 2022) the code to detect MHWs and their characteristics (MHW_stl.ipynb), the code to generate the MHWs macroevents (MED_LABEL.ipynb), the code to filter out the smallest macroevents (MED_filter.ipynb).

3) The dataset is inevitably linked to a specific SST dataset. This is certainly true, but we think that this is an intrinsic characteristic of all the datasets that are produced from or reuse high-quality data. Inevitably, they depend on the data used to generate them. However, it is worth mentioning that the methodology proposed in the paper is independent of the specific SST dataset. Thus, it can be easily rerun on new SST datasets. To facilitate this, we provided the code to detect MHWs and their characteristics (MHW_stl.ipynb), the code to generate the MHWs macroevents (MED_LABEL.ipynb), and the code to filter out the smallest macroevents (MED_filter.ipynb) in the Zenodo repository (Bonino et al., 2022).

To clarify point 1 we added the following text in the introduction at lines 67-73:" *We have focused on SEWA basins because they represent a well known "Hot Spot" region for climate change (Giorgi, 2006) and, in particular, for this specific phenomenon (Garrabou et al., 2009, Giorgi et al. 2006, Cramer et al., 2018, Pastor et al., 2020, Garrabou et al., 2022, Pastor and Khodayar, 2022, Ciappa et al., 2022). Marine heatwaves caused unprecedented biological impacts, especially in the Mediterranean Sea (Garrabou et al 2022, Cramer et al., 2018; Marba* *et al., 2015; Rivetti et al., 2014,), seriously affecting marine biodiversity (Juza et al., 2022). The Mediterranean Sea is recognized as an exemplary model for assessing the ecological and biological impacts of climate change (Garrabou et al 2022, Cramer et al., 2018). "*

For points 2 and point 3, we added the following paragraphs to the data and code availability section, which we moved before the summary and outlooks: "*The SEWA-MHWs dataset, that consists in daily fields of MHWs macroevents, their characteristics, and relevant atmospheric variables, is stored in the Zenodo archive (Bonino et al., 2022). The MHW detection methodology described in Section 3 is applied to the SEWA region, but it could be, in principle, applied to the global ocean or to other basins. Morevorer, the SEWA-MHWs dataset is inevitably linked to the ESA CCI SST dataset; indeed, all the datasets that are produced from or reuse high-quality data depend on the data used to generate them. Even though the routines are computational and time demanding, we provide scripts to rerun the method over other regions or using other and updated SST datasets. We provide the code to detect MHWs and their characteristics (MHWs_stl.ipynb), the code to generate the MHWs macroevents (SEWA_LABEL.ipynb), and the code to filter out the smallest macroevents (MHWs_filter.ipynb). The codes are also available in the Zenodo repository. Please refer to the dataset description in Bonino et al., 2022 for any details on the netcdf files and on the codes"*

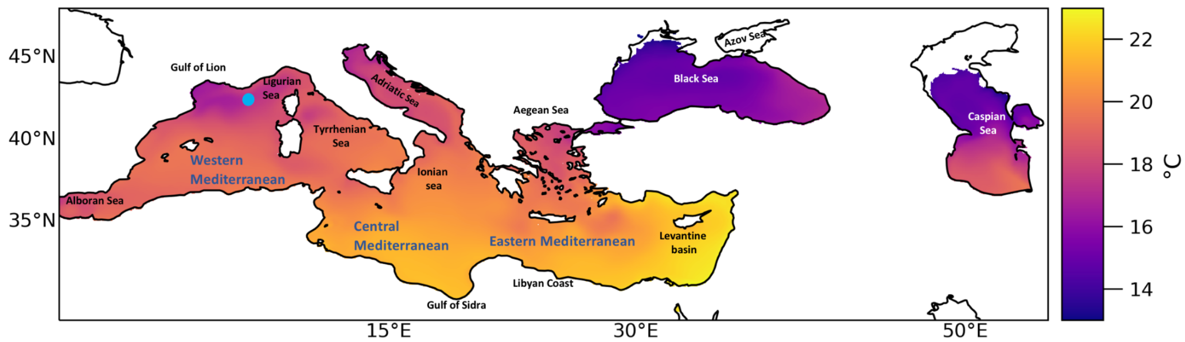
Moreover, following the suggestion of the reviewer#2 Peter Minnett, we added some relevant atmospheric variables from ERA5 dataset to make the dataset more attractive to potential users. In particular to encourage the study of the drivers, following the work of Sen Gupta et al. 2019, we added the mean sea level pressure, the latent heat, the sensible heat, the incoming solar radiation and the wind speed at 10 m. Moreover, following Peter Minnett's suggestion, we also add the air temperature at 2m to encourage studies on heatwaves relationship.

This is clarified at lines 258-266:'' *Moreover, since the drivers and the impacts of MHWs are still not well understood, we included as components of the SEWA-MHWs dataset also some relevant atmospheric parameters taken from ERA5 dataset (Hersbach et al., 2020) to further encourage the use of the SEWA-MHWs dataset. In particular, to promote the study of the drivers and following the work of Sen Gupta et al. (2020), we added the mean sea level pressure, the latent heat, the sensible heat, the incoming solar radiation and the wind speed at 10 m. In addition, air temperature at 2 m is also available to promote studies on the relationship between MHWs and land heatwaves. The area extracted for these meteorological parameters is slightly bigger than the SEWA region, allowing the investigation of remote influences and/or responses of these variables in relationship with MHWs macroevents. All the details, units and names of variables available in SEWA-MHWs dataset are explained in the Zenodo repository(Bonino et al., 2022)."*

Specific remarks:

1) **Geographical names cited in the text should be shown somewhere, to help readers unfamiliar with the region**

   We agree with the reviewer, and we added the geographical names in Plot 1 (Figure 1a in the manuscript).



Plot 1: Mean SST climatology detected by STL with geographical names. Blue circle identifies the Western Mediterranean location of the time-series shown in Figure 4.

2) **Section 3.2 the definition of macro event is >64km2 (4 pixels), while the definition of macro event in 1 is >100000 km2. I think this is confusing and the first definition is not really about "macro events", maybe the authors should call the filtering out of few pixels in other way.**

   We thank the reviewer for the comment. Actually, the definition of macroevent is >64km^2 (4 pixels). We then filtered out macroevents with an area less than 100000 km^2 to study the largest macroevents and to cluster them. We clarified this point at lines 269-271:" *In order to highlight the added value of the SEWA-MHWs dataset we studied the largest macroevents out of the 68068 identified by our methodology. In particular, we classified and aggregated the largest MHWs macroevents that share characteristics, taking advantage of statistical clustering methods….. We identified 187 largest macroevents out of 68068 macroevents."*

3) **Figure 3: it is not clear to me if the % is on counted events in a category or total days within a category**

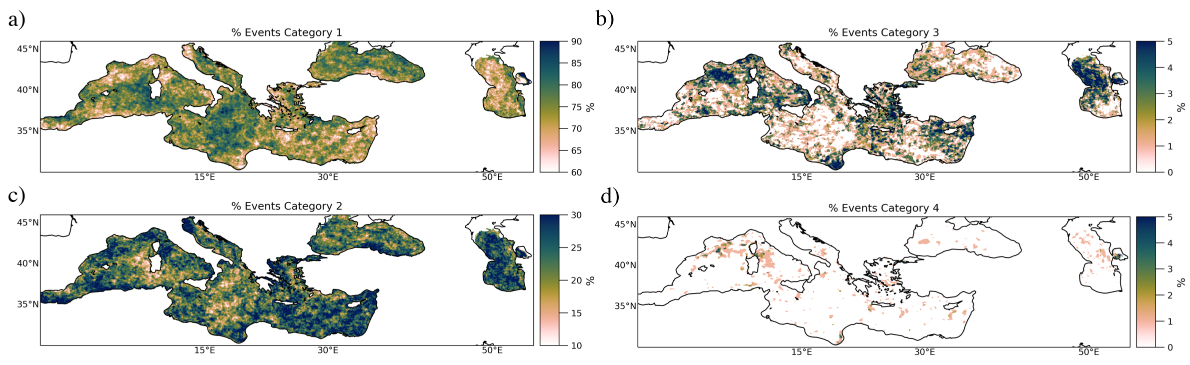
   We thank the reviewer, we modified the caption of the new Figure 6: "*Percentage (%) of counted MHWs events in a) Category 1, b) Category 2, c) Category 3, d) Category 4*"

4) **The title of Cleveland et al 1990 in the references is incomplete. Also, title of figure 2D should be "Remainder", not Reminders.**

   We thank the reviewer. We corrected the reference and the title.

5) **Figure 4C and 4D: 0 in the colorbar should be in white color**

   We agree with the review and we revised Figure 6 (Plot 2).



Plot 2: Percentage (%) of counted MHWs events in a) Category 1, b) Category 2, c) Category 3, d) Category 4

6) **I have the visual feeling that fig6a and fig 6b are not consistent. For example, the average intensity in phase 5 in fig 6a is always >0.5 while in fig 6b it is hardly above 0.5. Am I wrong?**

We agree with the reviewer. Actually, Figure 6a and 6b show two different intensities. The time-series in Figure 6a shows the daily mean intensity of the active points i.e. points which simultaneously experienced the labeled MED-MHW-2003 in that day. Whereas Figure 6b shows the MHW mean intensity for each grid point, computed as the sum of the MHWs daily intensities, which could be zeros during some days, divided by the duration of the phase. We clarified this point in the caption of Figure 8 (Figure 6 in the old manuscript): " *a) Active points, i.e. points which simultaneously experienced the labeled MED-MHW-2003 (blue line) and mean intensity of active points (orange) during the 2003 MHW, b) Average of the mean intensities during the MED-MHW-2003 period (1) and during its phases (2,3,4,5,6), computed as the sum of the MHWs daily intensities divided by the duration of the phase.* " We also add this clarification at lines 221-224: "*The spatial patterns of the average mean intensities in Figure 8b are computed, for each grid point, as the sum of the MHWs daily intensities divided by the duration of the phase. The time-series of Figure 8a gives us information about the daily spatial mean of the MED-MHW-2003 intensities, while the spatial patterns shown in Figure 8b teach us about the time mean of intensities during MED-MHW-2003 phases. Table 1 summarizes the characteristics of the MED-MHW-2003 phases.*" Moreover, we expanded and revised the description of the phases and we added Table 1, as suggested by the reviewer#2 Peter Minnett, to summarize the characteristics of the MED-MHW-2003 phases.

Phase	Date	Duration	Area	Max spatial mean intensity	Max time mean intensity
1	2003-05-01 2003-06-01	31 days	Central Mediterranean Sea	2.2°C	2.1°C
2	2003-06-01 2003-07-15	44 days	Western, Central Mediterranean Seas Adriatic Sea	3.2°C	3.6°C
3	2003-07-15 2003-08-10	26 days	Western, Central Mediterranean Seas	2.2°C	3.1°C
4	2003-08-10 2004-09-15	36 days	Western Mediterranean Sea	2.2 °C	3.3°C
5	2003-09-15 2004-02-20	158 days	Central Mediterranean Sea	1.2°C	0.5 °C

Table 1. Summary of the MED-MHW-2003 phases.

7) **Line 267 pg 13: "during the last decades (2011-2016)". 5-years period cannot be decades … also, "as instead reported in Dayan et al., 2022": you may want to specify why you get different results**

We agree with the reviewer, we revised the sentence at lines 325-328: "*Moreover, we do not report an increasing number of MHWs during the last six years (2011-2016), … Actually, the majority of the macroevents in almost all the clusters occurred during the first two decades of the studied period (Figure 12). This is likely linked to the fact that we considered the trend in the baseline climatology estimation (see section 3.1.1).* ".

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Sun, D., Jing, Z., Li, F., and Wu, L.: Characterizing Global Marine Heatwaves Under a Spatio-temporal Framework, Progress in Oceanography, p. 102947, 2022.

Dear Dr. Peter Minnett,

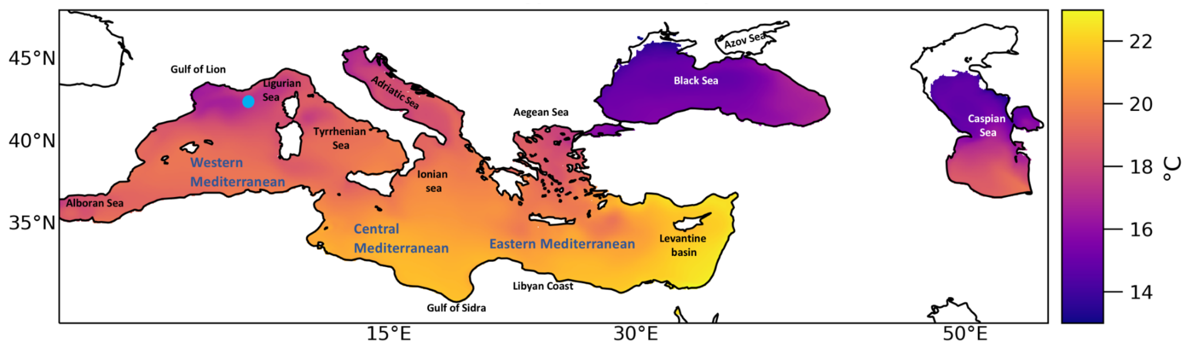
we would like to thank you for the careful reading of the manuscript and the constructive comments that substantially helped to improve and clarify the objectives of the paper. Answers to all your comments are detailed hereafter. Corrections to the English grammar were adopted in the revised version of the manuscript according to the reviewer's recommendations, but are not reported or discussed here. All authors agree with the modifications made to the manuscript. The comments by the referee are reported in bold followed by our response (in blue). The text added to the revised manuscript is reported in italic font. The line numbers reported in the answers referred to the revised manuscript. The revised manuscript that includes track changes is also provided in pdf format.

In the following answers, we use 'Figure' to identify the figures in the updated manuscript and we use 'Plot' to identify the figures in this document.

Major comments

1) The paper would benefit from the addition of a new figure showing the study area with the latitudes and longitudes of the boundaries of the region clearly given. The areas referred to in the text should be clearly identified as not all readers will be familiar with the names of the internal seas of the study area.

We agree with the reviewer, and we added the geographical names in Plot 1 (Figure 1a in the manuscript).



Plot 1: Mean SST climatology detected by STL-method with geographical names. Blue circle identifies the Western Mediterranean location of the time-series shown in Figure 4.

2) A fuller discussion of the CCI SST data that are the input to these analyses is needed. In particular, what are the limitations implicit the CCI SST time series that might result from the availability of L2 data, especially in the early period of the analyses? Which satellites contributed measurements to the time series? How was diurnal heating treated in the generation of the CCI SST fields? And is this a weakness in the SEWA-MHW database given the results of Marullo et al., (2016), who showed neglecting diurnal heating in the Mediterranean Sea has significant consequences? How does the inevitable loss of spatial

resolution in going from L2 to L4 in the generation of the CCI SST fields, including filling the gaps in the coverage cause by clouds, influence the contents of your database?

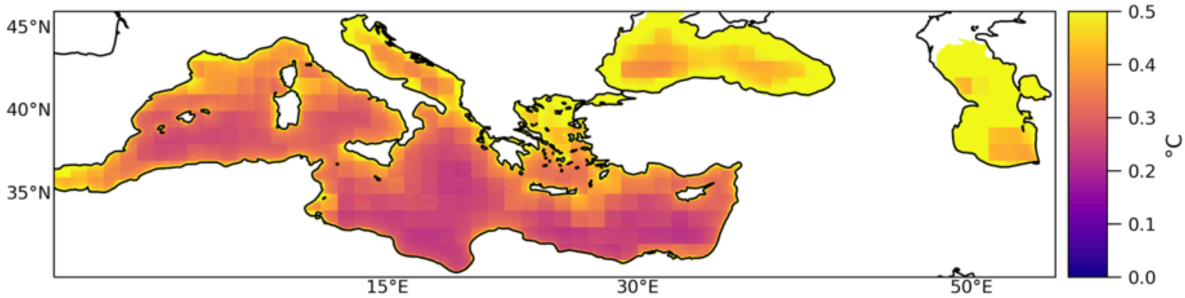
In order to address the reviewer's questions we added the following text to better present the ESA CCI SST data.

To describe the missions, we added the following sentence at lines 87-89: " *17 missions from 1981 to 2016 contributed to the ESA CCI SST dataset (e.g. NOAA-6, ATSR-1, Metop-A) and they are fully described in Merchant et al. (2019) (see their Figure 3).*"

To discuss the adjustment performed to deal with the diurnal heating we added the following paragraph at lines 94-103: "*The ESA CCI SST L4 is adjusted to 20 cm depth to be comparable with drifter and historic bucket temperature measurements. Moreover, the dataset is also adjusted in time to address the SST diurnal heating allowed by different overpass times of satellites that differentially sample SST. In particular, the temporal adjustment is applied as an estimate of the change in SST between the observation time and the nearest of 10.30 or 22.30 local mean solar time, which is a good approximation of the SST daily mean (Morak-Bozzo et al., 2016). Observation data from 1991 onwards needed only minimal adjustment, being always available a mid-morning satellite observation. Therefore, the diurnal heating is somehow taken into account in the ESA SST CCI L4 data processing. The data are adjusted in depth and in time to be more representative of the daily SST mean, the meaningful data frequency to define MHW events. The neglected diurnal warming in the SST dataset (e.g SST provided at the foundation depth or SST provided each day at the nominal time 00:00 UTC) could have otherwise compromised the estimation of the extreme events (Marullo et al., 2016).* "

As regards the last question, we do not think that the spatial resolution and the gap-filled of L4 analysis, unlike L2 data, heavily influence our dataset. It is clear that the higher resolution of the L2 product could have improved the detection of local extremes. However, the spatial resolution of L4 data is comparable to other satellite-based datasets (e.g. OSTIA) and to ocean models outputs. In addition, to define spatiotemporally connected MHWs we need the data continuity in space and in time which characterizes L4 data. We added the following paragraph at lines 105-109: *"It is worth mentioning that passing from Level-2 to Level-4 degrades resolution and increases uncertainties, slightly compromising the detection of extremes, especially the most geographically localized ones. Nevertheless, the interpolated, gap-filled L4 analysis is perfectly suitable for our purpose to archive and describe MHWs over the SEWA region. In particular, ~5 km of horizontal resolution of ESA CCI SST L4 is in line with other satellite-based datasets (e.g. OSTIA, Stark et al., 2007) and with state-of-art regional ocean models outputs Clementi et al., 2021 and, in addition, the continuity in time and in space guaranteed by this dataset is needed to define spatiotemporally connected MHWs."*

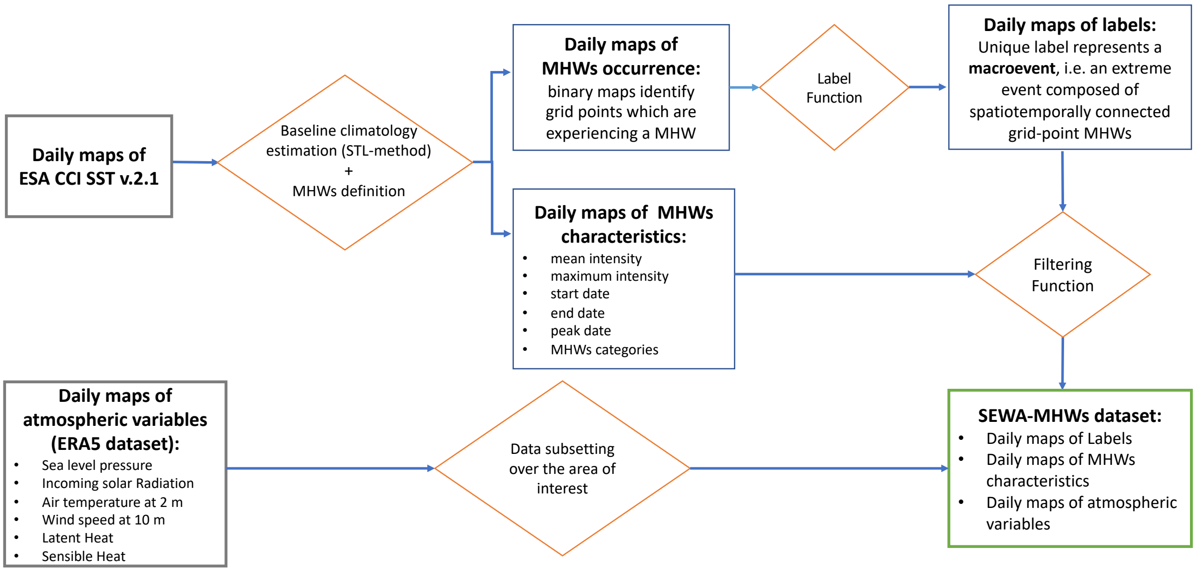
Moreover, the ESA CCI SST L4 also provides daily maps of uncertainties. Plot 2 shows the mean SST uncertainties over the entire period. We added this plot as Figure 1b in the new manuscript and we added sentences on the uncertainties and on the early-stage limitation of the dataset at lines 110-115: "*It is worth mentioning that the ESA CCI SST L4 mean uncertainties over all the studied period ranges, in the Mediterranean Sea, from 0.1 to 0.25℃ in the open ocean and around 0.5℃ along the coast. Over the Black Sea and the Caspian Sea, the uncertainties exceed 0.3℃ in the open ocean and 0.5℃ along the coast (Figure 1b). In particular, the largest discrepancies in the dataset occur during the 1980s, reflecting the deficiencies of in situ observations in space and in time at that time, and the fact that only one AVHRR sensor at a time was available (Merchant et al. 2019).* "



Plot 2: Mean SST uncertainties during 1981-2016 period.

3) A flow diagram of the data processing to generate the SEWA-MHW would be very useful to the reader, especially if it clearly explains the specific terms, such as "macroevents", "labels", and "clusters", used in the text.

We thank the reviewer for the suggestion. Plot 3 (Figure 2 in the new manuscript) shows the flow diagram. We inserted the following sentence at lines 118-123: "*The flow diagram in Figure 2 illustrates and summarizes the data processing to generate the SEWA-MHWs dataset, it also highlights the keywords used in the following paragraphs. We first detected the grid cell-based MHWs applying a new baseline climatology estimation strategy and we detected the MHWs metrics (Section 3.1). Then, we identified spatiotemporally connected MHWs to define MHWs macroevents (Section 3.2). The MHWs metrics, the MHWs macroevents together with some relevant atmospheric variables, taken from ERA5 dataset, form the SEWA-MHWs dataset (Section 3.3). In this Section we also evaluated our method describing a well know macroevent in comparison with the literature (Section 3.2.1).*" Moreover, we referred to the flow diagram in the text at lines 133/170/176/193/257.



Plot 3: Flow diagram of the data processing to generate the SEWA-MHW dataset. Gray squares indicate data input; Blue squares indicate intermediate or output data; green square indicates the final output (SEWA-MHWs dataset); orange rhombuses indicate the function/process applied.

4) The choice of critical parameters for the generation of your database is quite well justified in the text, but is there a way of ensuring they are optimized to produce correct outcomes? For example, in Figure 5, can you be confident that the green area in the southern Adriatic Sea in the 19/10/1983 chart is distinct from the larger, adjacent lilac area in the Ionian Sea? Similarly, is the red area close to the Turkish coast in the Aegean Sea, that also occurs in the chart of a week later, also distinct? And what about the lilac area near Cyprus that persists over four weeks – is this really part of the larger lilac area that has several disconnected parts? The identification of these is presumably a direct consequence of the algorithms and parameters you selected, but I suspect the algorithms do not consider the physics that cause the MHWs. I appreciate this is not an easy issue to address, but I am sure I will not be alone in wondering whether the extensive lilac areas represent a single macroevent, even though it is fractured, and whether it is different from the green and red areas.

We thank the reviewer for this useful comment. As you state, the identification of the macroevents is a direct consequence of the algorithm. In Figure 7 (Figure 5 in the old manuscript) we are showing the weekly evolution of these macroevents from October 5th, 1983 to November 23rd, 1983. The lilac event is fractured in these weekly snapshots, but the structure of the algorithm guarantees that each grid-cell MHW labeled as a lilac has been connected in time and/or in space with its neighborhood that was previously labeled as lilac. The algorithm does not consider the physics that causes the MHWs, but ensures that contiguous grid cells simultaneously experiencing a MHW are connected. The method does not exclude the possibility that the green (Adriatic Sea) and red (Aegean Sea) macroevents have been caused by the same drivers, but it guarantees that their spatiotemporal evolutions have been not connected to any grid-cell MHWs which belong to the lilac event. We might have considered different connectivity criteria (e.g. different structure element matrices), but, at least to the best of our knowledge, there is not a robust way of ensuring that one specific criterion is better in producing correct outcomes than another. As Pastor and Khodayar (2022) suggested in a very recent paper, the MHWs scientific community should focus on establishing a universal definition of MHW events which do not rely only on the grid-cell definition in order to ensure intercomparison of results. Moreover, another very recent paper (Sun et al. 2022) suggests that defining a MHW event under the spatiotemporal framework provides a more fruitful description of MHW characteristics. Our dataset is an attempt to aggregate single events by defining the macroevents, and to build a consistent framework that would increase comparability among MHWs studies. In addition, Pastor and Khodayar (2022) also suggest that it should be mandatory to introduce some spatial limitations in the study of MHWs, especially when targeting impacts. Our users could, as we did for the statistical clustering, filter out macroevents based on their needs.

To clarify this point, we added the following sentence at lines 209-215: "*It is worth clarifying that our MHWs macroevent definition does not consider the physics behind an event. As stated before, the connected component analysis is a statistical method to aggregate grid cells which are experiencing MHWs connected in time and in space. Therefore, macroevents that have been labeled differently not being spatiotemporally connected (e.g. green macroevent and lilac macroevent during 9/11/1983 in Figure 7), could have been triggered by the same causes.*"

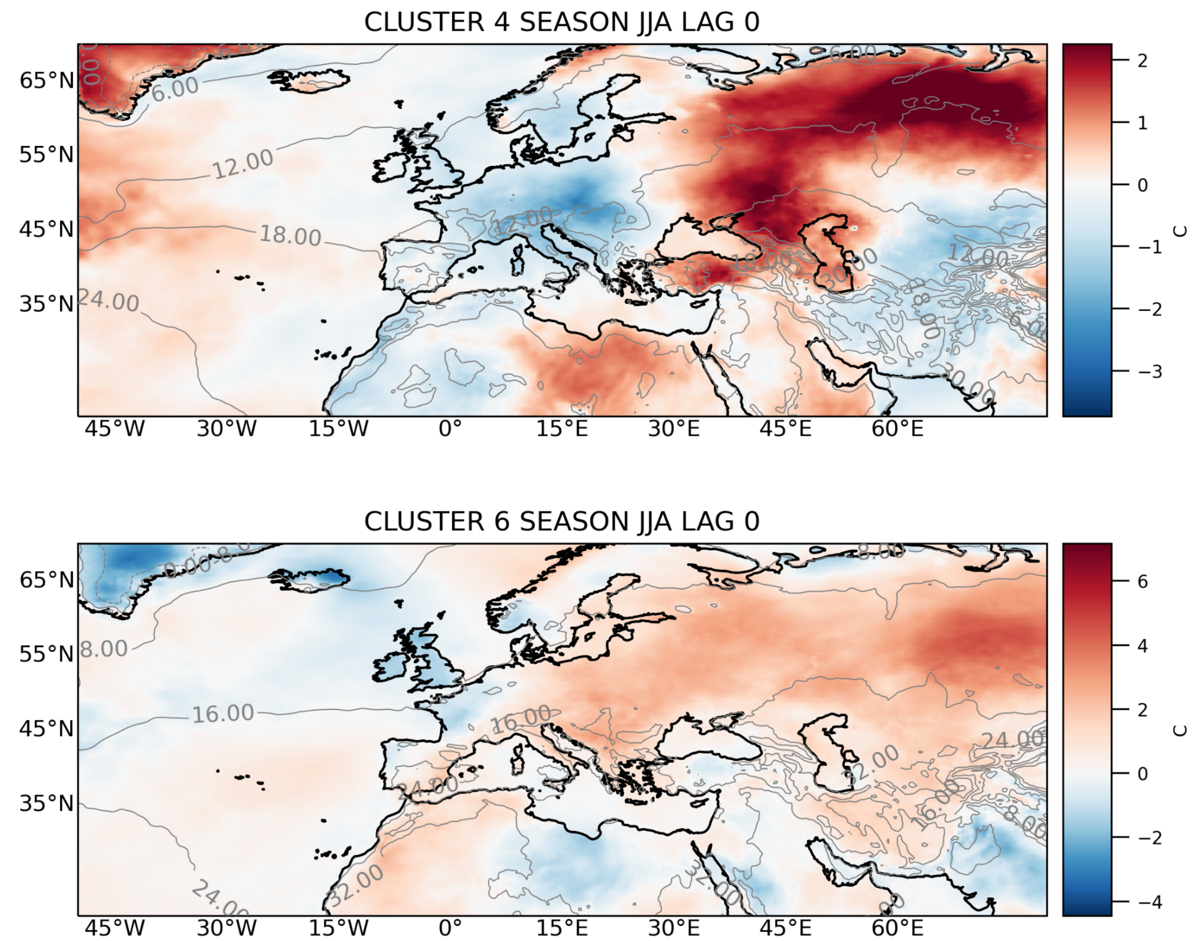
Moreover, we added the Pastor and Khodayar (2022) reference in the introduction at lines 43-45: "*For example, Darmaraki et al. (2019) and Pastor and Khodayar (2022) define the spatiotemporal extent of a MHW when a minimum of 20% and 5% of the Mediterranean basin is affected by grid cell-based MHWs, respectively*."

We added also a sentence in the introduction referring to Sun et al 2022 at lines 47-48: *"More recently, Sun et al. (2022) tracked the evolution in time of constructed snapshots of spatially compact MHWs."*

We also added in the conclusion at lines 363-369 references to Pastor and Khodayar (2022): "*As Pastor and Khodayar (2022) and Sun et al. (2022) suggested in very recent papers, the scientific community should focus on establishing a universal definition of MHWs events which does not rely only on the grid cell definition. Besides the consistency ensured among MHWs studies that will use SEWA-MHWs dataset, SEWA-MHWs dataset also provides a ready-to-use dataset to be compared to other studies which apply different MHW definitions. On top of that, Pastor and Khodayar (2022) also suggest that it should be mandatory to introduce some spatial limitations in the study of MHWs, especially when targeting impacts. Our users could, as we did for the statistical clustering, filter out macroevents based on their needs"*

5) The fact that 4 of the 6 clusters in Figure 8 are close to coasts or in enclosed seas begs the question whether there is a connection to land heat waves. The paper would be strengthened by a discussion of whether or not there is some correspondence to heat waves on the adjacent land.

We thank the reviewer for the comment which suggests a connection between land and marine heat waves as an interesting scientific topic to be investigated in future works since we believe it is beyond the scope of the present one. As a very preliminary and qualitative investigation, Plot 4 shows composites of air temperature at 2 m (T2) anomalies during summer (JJA) macroevents in cluster 4 and cluster 6, corresponding to the Caspian and Adriatic Seas clusters (see Figure 10). Both clusters show a strong T2 positive anomaly during the MHWs macroevents. The connection between the MHWs and atmospheric variables is the subject of an ongoing work. Nevertheless, to promote studies in this direction we added to the SEWA-MHWs dataset the air temperature at 2 m from the ERA5 dataset in the SEWA region. We also added to the dataset other relevant atmospheric variables, see response 6 below.



Plot 4: Composites of air temperature at 2 m (T2) anomalies during summer (JJA) MHWs macroevents in cluster 4 and cluster 6.

6) Finally, I think a good opportunity has been lost by not including relevant meteorological parameters. These could have been taken from ERA5 (Hersbach, H., et al., 2020). These variables would have made the SEWA-MHW database much more attractive to potential users.

We agree with the reviewer, and we decided to include relevant meteorological parameters from ERA5. Following Sen Gupta et al. 2019, which try to identify the drivers of MHWs, we added Incoming Solar Radiation, mean sea level pressure, wind speed at 10 meters, latent heat and sensible heat. Moreover, following your suggestion, we also add the T2 to encourage studies on heatwaves relationship. Since the influence of these parameters on MHWs may not be just localized over the SEWA region, we decided to expand the area archived in the dataset for these atmospheric parameters. We added the following text at lines 258-266: "*Moreover, since the drivers and the impacts of MHWs are still not well understood, we included as components of the SEWA-MHWs dataset also some relevant atmospheric parameters taken from ERA5 dataset (Hersbach et al., 2020) to further encourage the use of the SEWA-MHWs dataset. In particular, to promote the study of the drivers and following the work of Sen Gupta et al. (2020), we added the mean sea level pressure, the latent heat, the sensible heat, the incoming solar radiation and the wind speed at 10 m. In addition, air temperature at 2 m is also available to promote studies on the relationship between MHWs and land heatwaves. The area extracted for these meteorological parameters is slightly bigger than the SEWA region, allowing the investigation of remote influences and/or responses of these variables in relationship with MHWs macroevents. All the details, units and names of variables available in SEWA-MHWs dataset are explained in the Zenodo repository (Bonino et al., 2022).*"

Minor comments.

1) It's as useful for authors to remember the purpose of writing a paper is to convey information and knowledge to their readership. This requires helping the readers to understand the intentions of the authors, and this is not well served by putting up obstacles. It would help here if the figures were positioned close to where they are introduced and discussed in the text. It is tedious and soon becomes irritating to have to scroll forward through several pages to find the figures being discussed, examine them, and then try to find where one left off reading. I found the inclusion of URLs in the text, even though they are in parentheses, to be very disruptive. Would it be better to have the URLs as footnotes? Specialized terms must be well defined and there are several here that are used without an explanation of their meaning. The general quality of the figures is high except for some miniscule, illegible labels, for example in Figure 7. So, help your readers rather than hinder them.

We thank the reviewer for this comment. We tried to position the figures as close as possible to where they are introduced. We are using LaTeX as the writing software; LaTeX finds the best way to arrange the figures in the document and makes it look better. We revised the labels of Figure 9 (old Figure 7).

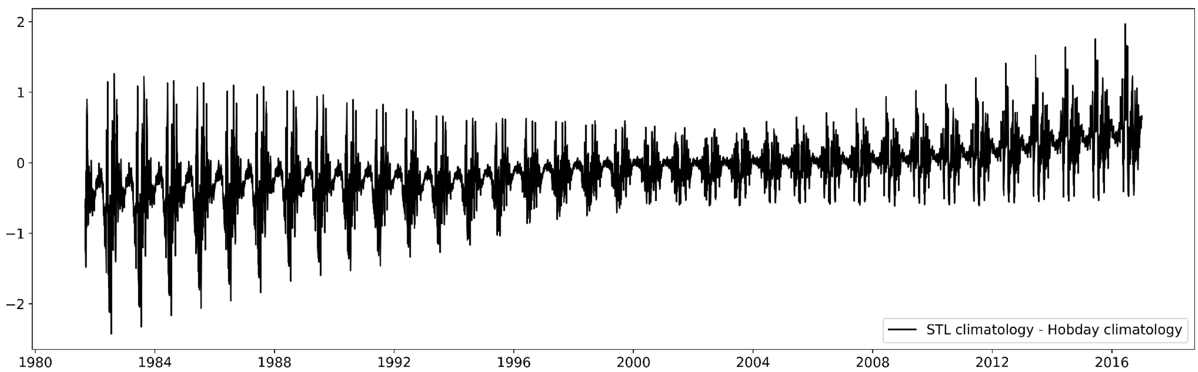
2) Line 11: reconsider the use of the word "pixel". In most remote sensing papers and discussions pixel is the highest resolution measurement and is the native resolution of the radiometer that has taken the measurement. This is the sense in which Merchant et al. (2019) use the term pixel in their paper describing the production of the CCI SST. I suggest you follow their example, and for the data from the CCI SST that you use, refer to it as a grid point or a grid cell and not a pixel.

We thank the reviewer for his comment and suggestion. We replaced "pixel" with "grid cell".

3) Line 142: what are the indices that you refer to as start index, end index and index peak? I presume they are related to position of a data point in the time series at a given place. However, while that may make the analysis more straightforward it does not really convey any scientifically useful information to the reader. Perhaps "date" or "day of year" would be better, as that would tell the reader what you are storing.

We thank the reviewer for the comment, we substituted "index" with "date" in the text (e.g. line 177)

4) It is quite difficult to discern the differences between STL and Hobday in Figure 1b. It would be useful to have a third panel showing a time series of the differences.



Plot 5: Differences between STL mean climatology (orange line) and Hobday mean climatology (blue line) in Figure 4a (old Figure 1b).

Plot 5 shows the differences between STL mean climatology (orange line) and Hobday mean climatology (blue line) of Figure 4a (old Figure 1b). We revised the manuscript at lines 161-164: "*In particular, the time series of the differences between the two climatologies in Figure 4b shows an increased seasonality of STL-method climatology. The STL-climatology is higher (lower) with respect to Hobday climatology during summer (winter) season. The differences between climatologies are maxima during 1983-1992 period for the winter season, while* *during the 2012-2016 period the summer discrepancies reach 2℃ due to the fact that STL-method includes an increased trend in the estimation of climatology."*

5) Line 157: where does 4 km come from? As you stated earlier, the CCI SST field has a spatial resolution of 0.05 degrees in latitude and longitude; this is about 5.5 by 4.5 km in your study area. The 0.05 degree is the same resolution as OSTIA, and Donlon et al. refer to it as a ~6 km grid spacing. Is it really a pixel-based data set?

We thank the reviewer for pointing out, we replaced "4 km" with "5 km". It is a pixel-based dataset because the MHWs are evaluated and stored as a single event, being not spatiotemporally connected to each other.

6) Section 3.2 title: what is a "macro event"? Please define this early in this section.

We defined macroevent taking advantage of the flow diagram in Figure 2. Macroevent is an extreme event composed of spatiotemporally connected grid cell MHWs.

7) Caption of Figure 2c: what is a "trend cycle"?

We thank the reviewer for the question. Trend is the long-term variation along the entire studied period, while cycle is the variability associated to shorter periods (e.g. interannual). The cycle is added to the trend to obtain the trend cycle. To avoid misunderstandings we will refer to the plot as "trend".

8) Line 166: please explain "structure element matrix". Is "inspected" the word you really want? The remainder of this paragraph is far from clear, and it should be rewritten.

We replaced "inspected" with "defined". We revised the sentence at lines 197-204: "*The label function calculates connectivity of features to their neighbors based on a structuring element matrix establishing the directions in which connectivity is defined. In our case, the inputs of the function are the 3D binary maps chunked by time (the non-zero values in matrices, i.e. MHWs occurrence, in the matrices are counted by the algorithm as features and zero values are considered the background) and the structuring element matrix is orthogonal which means that the features (i.e. grid cells MHWs) are connected in north-south, west-east directions (see help function[1] for details). Since the algorithm works in parallel, first, each chunk is independently labeled (i.e. connection in space). Then, the independent labels are made consecutive and merged along chunks' faces whenever connected (i.e. connection in time). The algorithm returns connected grid cells with a unique label. Each of these unique labels represents a macroevent."*

9) Figure 5: the color bars at the right-hand side convey no useful information and should be removed.

We removed the colorbar in the new Figure 7.

10) You might consider putting the information in this numbered list in a simple table as that would be more digestible for the reader.

We thank the reviewer for the comment, we summarized the information in the Table below and we added it to the manuscript as Table 1. Nevertheless, we also decided to retain the numbered list with the explicit characterization of the MED_MHW-2003 phases.

Phase	Date	Duration	Area	Max spatial mean intensity	Max time mean intensity
1	2003-05-01 2003-06-01	31 days	Central Mediterranean Sea	2.2°C	2.1°C
2	2003-06-01 2003-07-15	44 days	Western, Central Mediterranean Seas Adriatic Sea	3.2°C	3.6°C
3	2003-07-15 2003-08-10	26 days	Western, Central Mediterranean Seas	2.2°C	3.1°C
4	2003-08-10 2004-09-15	36 days	Western Mediterranean Sea	2.2 °C	3.3°C
5	2003-09-15 2004-02-20	158 days	Central Mediterranean Sea	1.2°C	0.5 °C

Table 1. Summary of the MED-MHW-2003 phases.

11) Figure 6b: what does "event map" mean?; 12) Caption for Figure 6a: what does "active points" mean?

We removed the "event map" in the new Figure 8, we explain it in the following paragraph at line 280. We revised the caption: *"a) Active points, i.e. points which simultaneously experienced the labeled MED-MHW-2003 (blue line) and mean intensity of active points (orange) during the 2003 MHW, b) Average of the mean intensities during the MED-MHW-2003 period (1) and during its phases (2,3,4,5,6), computed as the sum of the MHWs daily intensities divided by the duration of the phase. "*

13) Line 231: please give a short description of cosine distance as some of your readers will not be familiar with this term.

We added a brief description at lines 284-286: *"The cosine similarity is defined as the cosine of the angle between vectors (i.e. vectors of event maps), that is, the dot product of the vectors divided by the product of their lengths. The cosine similarity depends on the angles between vectors, not on their magnitudes."*

14) Line 240: the segment beginning "Moreover" is not very clear and a better discussion is needed, including what we are supposed to understand from the colored shapes in Figure 7b.

We revised the sentence at lines 290-302: "*Figure 9 shows the average silhouette scores obtained for each of these clustering solutions. The silhouette score is a summary of the distance between a member in a given cluster and the members in the neighboring clusters. It ranges from -1 to 1 and provides a way to assess cluster separation (Kaufman and Rousseeuw, 2009). In particular, a large average silhouette score can be considered as an indication of large separating distances among the resulting clusters, thus implying better clustering results. According to Figure 9a, we concluded that the optimal number of clusters is 6. In addition, the individual silhouette scores can also be exploited to investigate the quality of this optimal solution (Figure 9b). Different colors correspond to the different clusters, and the thickness of each colored shape identifies the cluster size (i.e. number of samples, in our case event maps, in each cluster). The red dashed line shows the average silhouette score for this solution (in Figure 9a). Most samples (i.e. event maps) have a silhouette score larger than the average score, especially in clusters 4 and 5. This indicates a favorable clustering result, in the sense that most of the samples seem to be well-separated from the neighboring clusters. Nevertheless, the presence of some values smaller than the average score and negative values suggests that there is some degree of overlap among some of the clusters, with possibly misclassified events.*"

15) Line 252: why do you mention the Aegean Sea as an exception to the western Mediterranean Sea? I do not think the Aegean Sea is part of the western Mediterranean Sea.

Yes, the reviewer is totally right, it was a mistake. We deleted the sentence "with the exception of the Aegean Sea" .

16) Line 272: should the Black Sea also be mentioned given its appearance in Cluster 5? The sentence beginning "The macro events" is not clear.

We revised the sentence at lines 329-332: "*The macroevents result geographically confined to the closed basins (i.e. Caspian Sea and Black Sea) or to the sub-basins of the Mediterranean Sea (e.g. Western Mediterranean Sea), however highlighting some relations between adjacent sea regions (e.g. Adriatic Sea and Aegean Sea, cluster 6).*"

17) References. Please capitalize all journal titles including those on lines 340, 363, 375, 381, 383, and 398. There may be others. The reference beginning on line 395 is incomplete.

We thank the reviewer. We corrected the references.

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