Reply to reviewer

The revised version of the manuscript is improved but it still needs some work to refine the text with the final aim to convey clear messages.

We thank the reviewer for the time they put in our manuscript. Please, find below our responses to their remaining comments. For ease of reference, the reviewer's comments are presented in blue and the authors' responses are presented in black font.

Fig.1. It is very hard to see the two dashed red lines which defines the three regions. Please use a thicker line or any other way to make the boundaries more evident. Furthermore, I do not find in the text how the three regions have been chosen.

Thank you for this comment. Figure 1 has been updated including thicker lines for marking the boundaries. The separation into the three sub-basins shown in Fig1a is now introduced also in Methods Sect. 2.2.

Section 3.2, in particular the first part related to Fig.2, needs to be revised and focus on some key messages otherwise the text now sounds simply as a description of the figure. The few considerations are not clear, for example the comment on the maximum severity index (lines 213-217) should be explained better. But the most important thing is to revise the text in order for the readers to capture more easily the relevant results and understand which are the main differences in the three regions and for the different metrics and the following implications.

Thank you for this comment. We agree that the description of Fig. 2 and Table 2 should be revised for clarity. We have updated this part in the revised manuscript, where all changes with respect to the previous version are tracked. Below we provide the improved explanation of the "contrasting" behaviour of I_{max} and SI_{max} specifically mentioned by the reviewer:

The maximum intensity (I_{max}) shows a higher positive trend in the western (0.38 $degC.dec^{-1}$) than in the eastern sub-basin (0.32 $degC.dec^{-1}$) (Fig. 2b). In contrast, the maximum severity index (SI_{max}) exhibits a stronger increasing trend in the eastern (0.3 $units.dec^{-1}$) than in the western sub-basin (0.23 $units.dec^{-1}$) (Table 2). This pattern arises potentially due to SI_{max} quantifying the extremity of MHW intensity relative to a fixed climatological threshold (Eq. 4). Since this threshold remains constant over time, the larger increase in SI_{max} in the eastern sub-basin suggests that maximum intensities in this region are becoming proportionally more extreme compared to historical conditions. The observed differences in trends between I_{max} and SI_{max} across sub-basins highlight that absolute MHW intensities are increasing more rapidly in the western sub-basin, while their relative extremity compared to the historical baseline is increasing more in the eastern sub-basin.

Section 3.2. The results of EXP2 and EXP3 show opposite behavior with respect to EXP1 for the mean intensity TAR in terms of the percentage of the total number of

Mediterranean grid points (Fig.4). Can you suggest any hypotheses for this? Why do the two different climatologies have an opposite impact and which are the implications? You might want to see two recently relevant published papers:

-Smith, Kathryn E., et al. "Baseline matters: Challenges and implications of different marine heatwave baselines." Progress in Oceanography 231 (2025): 103404.

-Capotondi, A., Rodrigues, R. R., Sen Gupta, A., Benthuysen, J. A., Deser, C., Frölicher, T. L., ... & Wang, C. (2024). A global overview of marine heatwaves in a changing climate. Communications Earth & Environment, 5(1), 701.

Thank you for your thoughtful question.

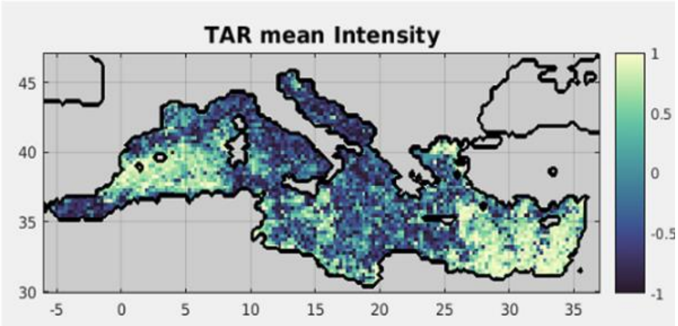
The sensitivity tests aimed to assess whether the approach used to compute the climatology affects results on the origin of MHW trends. EXP1 follows the approach of Marin et al. (2021) using a detrended baseline for the computation of climatology in the non-detrended dataset, while EXP2 and EXP3 use fixed baselines with reference periods spanning 1982-2023 and 1982-2002, respectively.

TAR values indicate that mean intensity (Imean) is the only metric whose trends are significantly affected by interannual variability. In turn, these sensitivity tests reveal a further differentiation of Imean, this time in relation to the climatology used. The relative role of mean SST warming against the interannual variability decreases from EXP2 to EXP3 for Imean, while the origin of trends for all other metrics shows negligible sensitivity to the choice of climatology. In particular, EXP2 shows the greatest percentage of grid points with positive Imean TAR (46%) compared to EXP1 (34%), whereas EXP3 exhibits a lower percentage (30%).

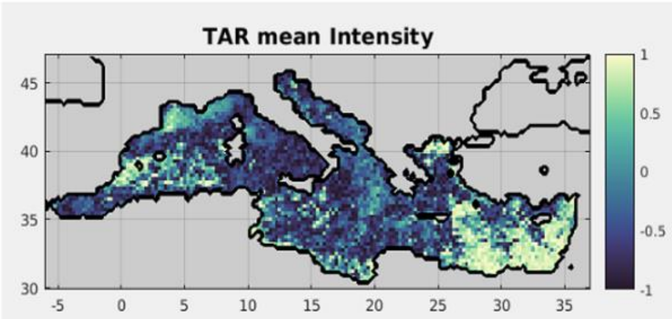
As expected, EXP3 has a cooler baseline and threshold compared to EXP2, leading to generally higher MHW activity in EXP3. We note here that recent research shows less intense MHWs for shorter baseline periods (e.g., Richaud et al., 2024; Darmaraki et al., 2025), which, however, is due to the shorter period spanning more recent and thus warmer years. In our study, for all examined metrics, we find higher values and trends for EXP3 relative to EXP2 throughout the basin, except for Imean, which shows lower trends in EXP3 relative to EXP2 in the western basin.

TAR fields for Imean are shown below also for EXP2 and EXP3 (not included in the manuscript). While the spatial distribution of TAR is very similar to EXP1, slightly lower TAR values are observed in EXP3 compared to EXP2. As shown in Fig. 4, fewer positive-TAR grid points (i.e. where mean warming dominates interannual variability) are observed in EXP3 compared to EXP2, which, as illustrated in the TAR fields, is more pronounced in the southwestern basin.

EXP2:



EXP3:



Overall, the sensitivity tests confirm the key conclusions of the main experiment (EXP1) for all examined metrics and highlight the distinct behaviour of Imean both with respect to other metrics and to different approaches for climatology. Importantly, previous studies have also noted distinct characteristics of MHW intensity. Marin et al. (2021) have shown that Imean trends are highly affected by internal variability and exhibit significant sensitivity (in contrast to other metrics) to different datasets. In addition, Oliver et al. (2019) have found a less clear origin of the trends of MHW intensity at global scale, though based on the maximum MHW intensity. Moreover, Schlegel et al. (2019) have shown that while the effect of linear trends on MHW duration is a significant increase, the effect on the maximum intensity can be either positive or negative. Their finding aligns with our results on the increased uncertainty associated with mean intensity; however, since it is based on the maximum intensity of averaged MHWs, it cannot directly comparable to ours.

We believe that further study should address the cause behind Imean's exception by investigating its behavior under different methodological choices (especially datasets and baselines) following an ensemble approach to ensure robustness. The revised conclusions section now includes the additional studies mentioned above in relation to the discussed finding and notes that further investigation is needed to understand the reasons behind the distinct behavior of mean intensity—whether in terms of trends, trend attribution, or sensitivity to climatological baselines.

Darmaraki, S., Krokos, G., Genevier, L., Hoteit, I., and Raitsos, D. E.: Drivers of marine heatwaves in coral bleaching regions of the Red Sea, Commun. Earth Environ., 6, https://doi.org/10.1038/s43247-025-02096-5, 2025.

Richaud, B., Hu, X., Darmaraki, S., Fennel, K., Lu, Y., and Oliver, E. C. J.: Drivers of Marine Heatwaves in the Arctic Ocean, J. Geophys. Res. Ocean., 129, https://doi.org/10.1029/2023JC020324, 2024.

Schlegel, R. W., Oliver, E. C. J., Hobday, A. J., and Smit, A. J.: Detecting Marine Heatwaves With Sub-Optimal Data, Front. Mar. Sci., 6, 1–14, https://doi.org/10.3389/fmars.2019.00737, 2019.

Conclusions. Lines 346-353. I found the consideration regarding the difference between the results of this work on the results from Martinez et al. (2023) complicated to follow. Can you please try to clarify which is the main message here?

Thank you for your comment. We agree that this part should be better explained. We provide below the revision of the lines referring to the discussed difference between the two studies:

Revised text:

In addition, Martinez et al. (2023) suggest that the intensification of MHW conditions in the Mediterranean Sea is primarily driven by the mean SST warming in the basin. Their analysis focuses on MHW duration, cumulative intensity, spatial extent, frequency and maximum intensity, with the latter being the only metric directly comparable to our study. A difference with respect to our results appears in the maximum intensity derived from detrended SST data: While Martinez et al. (2023) report an insignificant positive trend (basin-averaged), we detect a significant positive trend—more pronounced in the western basin. Notably, both studies agree on the dominant contribution of mean warming to the long-term trends of maximum intensity (and the rest of the metrics as well) though through different approaches. Martinez et al. (2023) base their conclusion on the insignificant long-term trends of basin-averaged metrics obtained from the detrended dataset, while our study relies on weighting the mean SST warming and interannual SST variability within the TAR framework. Specifically, TAR for maximum intensity confirms the dominant role of the mean SST warming, in line with Martinez et al. (2023), but also highlights non-negligible contributions from interannual SST variability, particularly in the Alboran and Ligurian Seas.

Changes to the manuscript

We have revised the manuscript, according to the additional comments of the reviewer. All modifications are visible in the manuscript version that includes tracked changes. Please, note that references to lines are based on the revised document's line numbering.

Line 4: Typo correction

Data and methods:

Line 109: The separation into the three sub-basins shown in Fig1a is now introduced in Methods

Results:

Figure 1 has been updated including thicker lines for marking the boundaries

Lines: 204-243: Revision of results' description to improve explanations and highlight key findings.

Summary and conclusions:

Lines: 342-353: Revision of text to provide a cleared description of the comparison between the studies

Lines: 359-369: Updated discussion on the distinct behavior of the mean intensity.

References

Line 389: Addition of reference:

Schlegel, R. W., Oliver, E. C. J., Hobday, A. J., and Smit, A. J.: Detecting Marine Heatwaves With Sub-Optimal Data, Front. Mar. Sci., 6, 1–14, https://doi.org/10.3389/fmars.2019.00737, 2019.

Financial support

Line 384: Update of Financial support field