CC1 'Comment on egusphere-2024-1468', Iana Strigunova, 10 Oct 2024

The manuscript introduces a kilometre-scale ensemble modelling approach to ocean processes in the end-of-century (RCP8.5) scenario in the Adriatic Sea. The modelling chain ensemble is achieved by utilising the ROMS modelling system forced by the SMHI-RCA4 Regional Climate Model, driven by five different climate models and two different realisations of the same model.

While the current version requires modifications, its scientific value (considering trade-offs between high resolution and decadal climate projections) and the region's importance as a climate change hotspot, for instance, are evident. Please find the suggestions for the manuscript's improvement below.

Thank you very much for carefully reading our manuscript and taking the time to participate in the discussion. You suggestions are most appreciated and they will definitely improve the quality of the result.

The 3.1.4 subsection ('Extreme thermal events') discusses the evaluation of thermal extremes identified from Trieste harbour station (Fig. 12). While the comparison is completely valid for one point, it does not provide an understanding of how these extremes are simulated for the subdomains of the Adriatic Sea, which are used to describe the difference in the statistics of the present and future MHWs and CSs (Fig. 16).

Thanks for pointing this out. Taking your suggestion, we have repeated the calculation for each subdomain using the sea surface temperature observations from from the L4 Optimal Interpolation (L4OI) Mediterranean Advanced Very High Resolution Radiometer (AVHRR) SST Analysis dataset (Pisano et al., 2016). The results (Figure 1 to Figure 8) essentially confirm the findings from the pointwise observation in Trieste and, although for the sake of brevity we will not include this set of plots in the revised version, we will mention that this verification was carried out and the results shown for Trieste are representative of the performance in the whole domain.

Minor comments

The study greatly explores the possibility of an ensemble modelling approach for the Adriatic Sea. Could these results apply to other parts of the Mediterranean Sea or even to other global regions? By addressing this question, the manuscript may be attractive for more readers.

Some parts of the abstract seem unnecessarily wordy, making them hard to read and potentially hampering readers' understanding of the study's real significance. For instance, while the abstract's first two sentences extensively discuss the study's importance, they do not clearly explain why it is essential to study the Adriatic basin or why this study could interest researchers not directly dealing with the Adriatic Sea. In this regard, I would suggest two changes: 1) please consider moving these sentences to the introduction and 2) perhaps rephrase it in a bit more concise manner so readers familiarise themselves with the study's significance quickly. The clarity of the abstract could be improved by starting from the sentence in line 9 ('This work presents…').

Thank you for this suggestion, in the revised version we will sharpen the abstract and provide a wider view on the possible implications of this study beyond its regional setting. In this direction, we will highlight that, alongside with useful elements from the methodological/modelling point of view, this study presents a large dataset that can be used for the analysis of coastal and

continental margin processes of general interest, e.g. dense water dynamics and the role of the interplay of different factors such as basin preconditioning, buoyancy fluxes and circulation patterns in its formation and spreading.

Lines 6-9: "…a description of the possible evolution of the physical oceanographic processes is the baseline for addressing the multi-disciplinary challenges set by climate change, … ". I would be more cautious stating in this way. It is one of the key processes, but others are no less important (biogeochemistry processes and human influence, for instance).

Thanks, "baseline" will be changed into "one of the key requirements" in the revised version

Line 33: "Due to the coexistence of manifold meteo-oceanographic processes…''. It is not clear what it implies. Perhaps readers who are not familiar with specific regional features will not understand the importance.

Thanks for pointing this out, in the revised version we will briefly outline the main processes that characterize the Adriatic Sea making it a "natural laboratory for marine science".

Lines 38 and 153: I am unfamiliar with the 'EO analysis' and 'BiOS' abbreviations. Could you please clarify what does it mean?

Here we use "EO" as an acronym for "Earth Observation", while BiOS refers to the Bimodal Ionian Oscillation, a decadal modulation of the Eastern Mediterranean circulation patterns affecting the pathways of water masses and in particular the exchanges between the Adriatic and Ionian seas (for a broad review on this concept I would suggest the recent work by Civitarese et al., 2023, and references therein). We clarify both these acronyms in the revised version.

Lines 208-213: The paragraph logically flows from the previous ones, but there is no reference to Fig. 4, which is discussed in the previous paragraph. Would it be possible to change the order or add a part about Fig. 4 in the last paragraph for a more comprehensive summary and a following conclusion?

Thanks for this suggestion, in the revised version we will add a reference to Fig. 4 in the conclusion of this paragraph.

Lines 363-376. This paragraph has many numbers based on Fig. 15, which hinders understanding of what they actually mean. I would suggest modifying the paragraph in the following way: adding a summary table with numbers and modifying the text so that only the essential findings with no numbers are kept. That would allow to describe Fig. 15 and interpret the results in a clearer manner.

Thanks for this suggestion. Actually, our feeling is that a summary table would not add much with respect to Fig. 15, and therefore could look somewhat redundant. In any case, in the revised version we will try and reshape this part aiming at improving its readability.

Section 4 ('Conclusions') opens up with a summary of what the authors did. Starting from line 407, it is more of a discussion form until line 419. The main results are summarised in lines 425-439. Perhaps authors could allocate a separate section for lines 407-418 and keep all summary points together in the Conclusions to make it clearer for readers.

Thanks for pointing this out. At present, the discussion part in this paragraph is mostly aimed at recalling the potential use and main limitations of this work and the associated dataset, and in our view it should fit with an overview on what was done, its strength points and caveats, and take-home messages. In any case, the narrative could and probably should be improved, and in the revised version we will take care of this.

Technical comments

Lines 23-24 (440-442): Could you please specify why this type of information is repeated across the manuscript? Mentioning data availability on specified repositories and request to the corresponding author are finely placed in the "Data availability" section.

This information is recalled as one of the purposes of this work is to open the way to a variety of future studies about climate change in the Adriatic Sea, and in this direction we strive to provide guidance and encourage the use of the AdriE dataset.

Line 35: "… the presence of highly-exposed sites of outstanding natural and cultural value…". This part seems unnecessarily wordy. What do you mean by 'highly-exposed' sites? It is not completely clear.

Here we refer to "exposure" in terms of the importance of the assets subject to coastal hazards. We will adjust this part to improve clarity and readability.

It would be beneficial to extend Table 1 by adding information on horizontal resolution. Additionally, having each centre's name to the model's name (NCC, IPSL, MPI, etc.) appears redundant since they have already been used in the first column.

Thanks for this suggestion. Actually the horizontal resolution is the same for all runs (0.11°), so a possible additional column would not really bring relevant information. Concerning the naming of the runs, true it is that there is some repetition between the "Run" and the "Driving GCM" column, but this does not hold for all runs (e.g. EV and EV), and in any case the "Driving GCM" reflects the CORDEX nomenclature allowing experiment repetition and/or expansion.*

Table 3: the "Name" column should be wider to enable each name to fit in one row.

Thanks, this will be fixed in the revised version.

Fig. 1 and 2 could also be reallocated to the rest of the figures or the other figures placed within the main text for consistency.

Thanks for this suggestion. In the revised version we will provide a more consistent positioning of the figures, although we expect that the final adjustment will be performed in the copyediting phase if the manuscript is accepted for publication.

The caption of Fig. 1: Maybe I missed it, but have you introduced the 'AS ' abbreviation?

Thanks for pointing this out, the abbreviation can definitely be removed and in the revised version we just refer to "Adriatic Sea".

Line 198: '…(>15 ms−1, see Mears et al. 2022) wind speed)…' it seems the extra ')' symbol can be removed.

Thanks, fixed.

Line 278: "*theta*" Please correct if needed.

Thanks, this has been corrected.

Line 315: "… of Marine Heat Waves (MHWs) and Cold Spells…' to "… of Marine Heat Waves (MHWs) and Cold Spells (CS) …' Please correct if needed.

Thanks, corrected into "Marine Heat Waves (MHWs) and Cold Spells (CSs)".

Line 353: "σ*theta*" Please correct if needed.

Thanks, corrected.

References

Civitarese, G., Gačić, M., Batistić, M., Bensi, M., Cardin, V., Dulčić, J., Garić, R., & Menna, M. (2023). The BiOS mechanism: History, theory, implications. In Progress in Oceanography (Vol. 216). Elsevier Ltd. https://doi.org/10.1016/j.pocean.2023.103056

Pisano, A., Buongiorno Nardelli, B., Tronconi, C., and Santoleri, R.: The new Mediterranean optimally interpolated pathfinder AVHRR SST Dataset (1982–2012), Remote Sensing of Environment, 176, 107–116, https://doi.org/https://doi.org/10.1016/j.rse.2016.01.019, 2016.

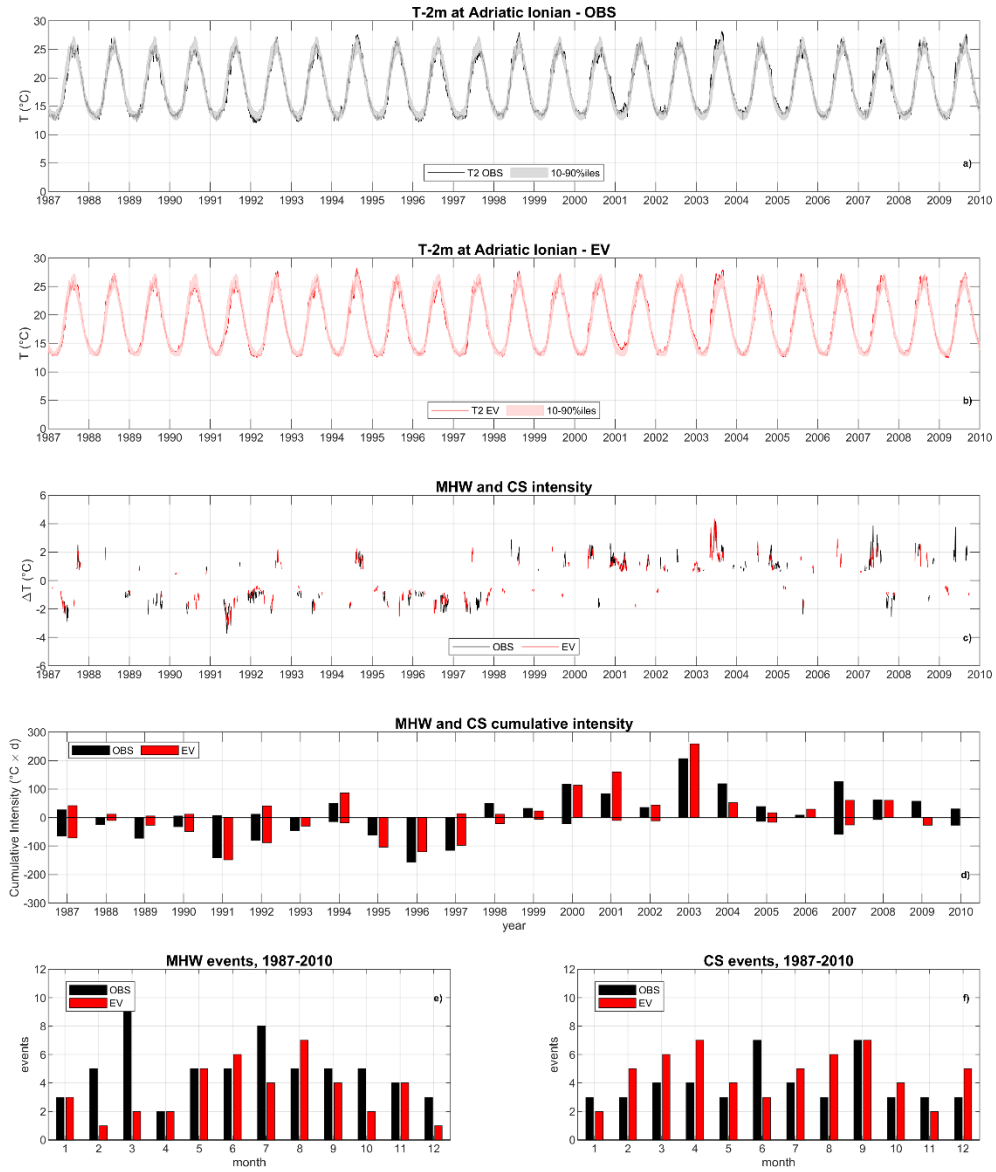

Figure 1: Comparison of modelled (EV) and observed (OBS) thermal extreme events in the Adriatic-Ionian subdomain. Panels (a-b) represent respectively the observed and modelled time series alongside with the identification of the 10th and 90th daily percentiles for the period (here computed as a moving average within a 15-day sliding window); (c) highlights the events found in either series and their intensity; (d) compares the yearly cumulative intensity of the extreme events, and (e-f) compares for each month the observed and modelled number of MHWs and CSs respectively).

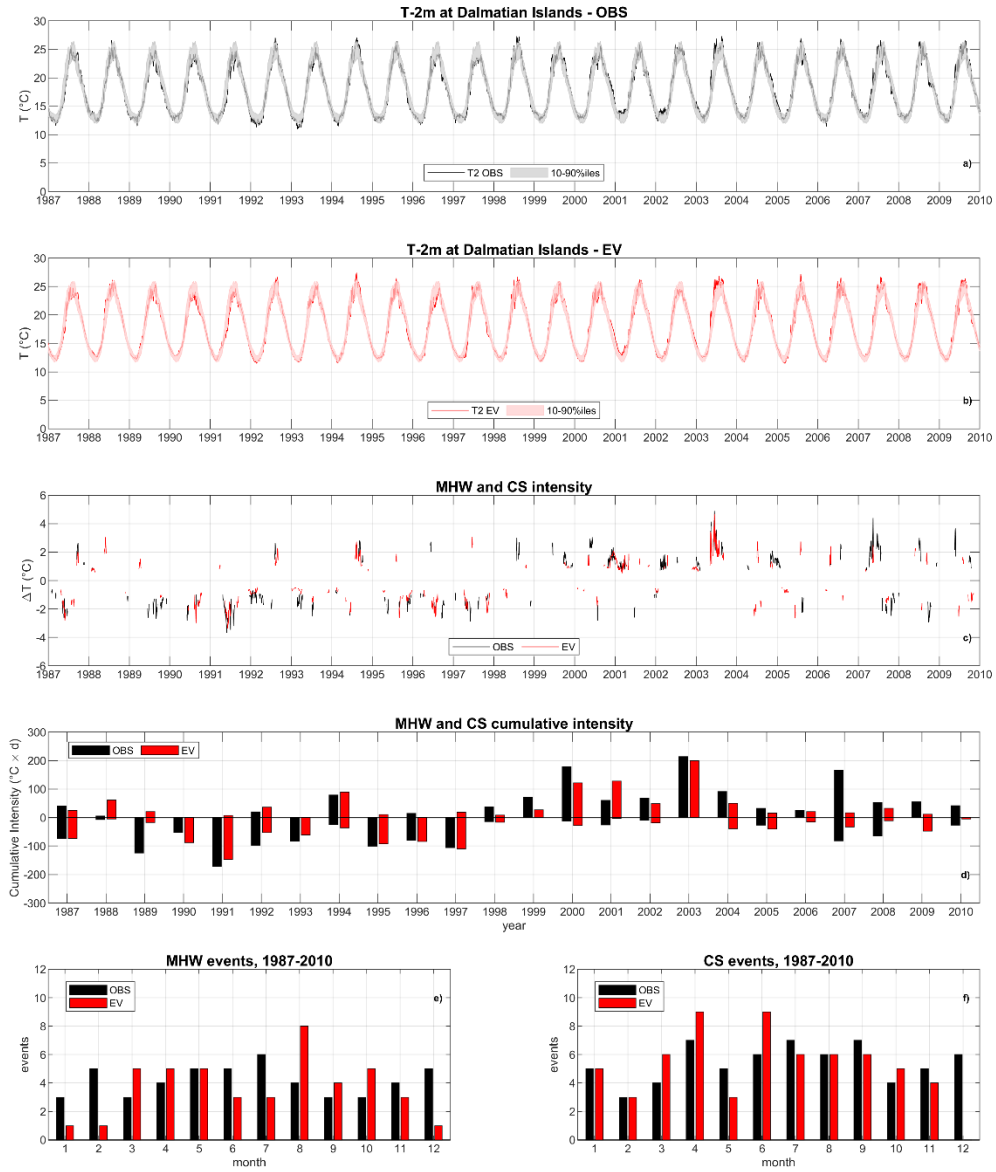

Figure 2: Same as Figure 1, with reference to Dalmatian Islands subdomain

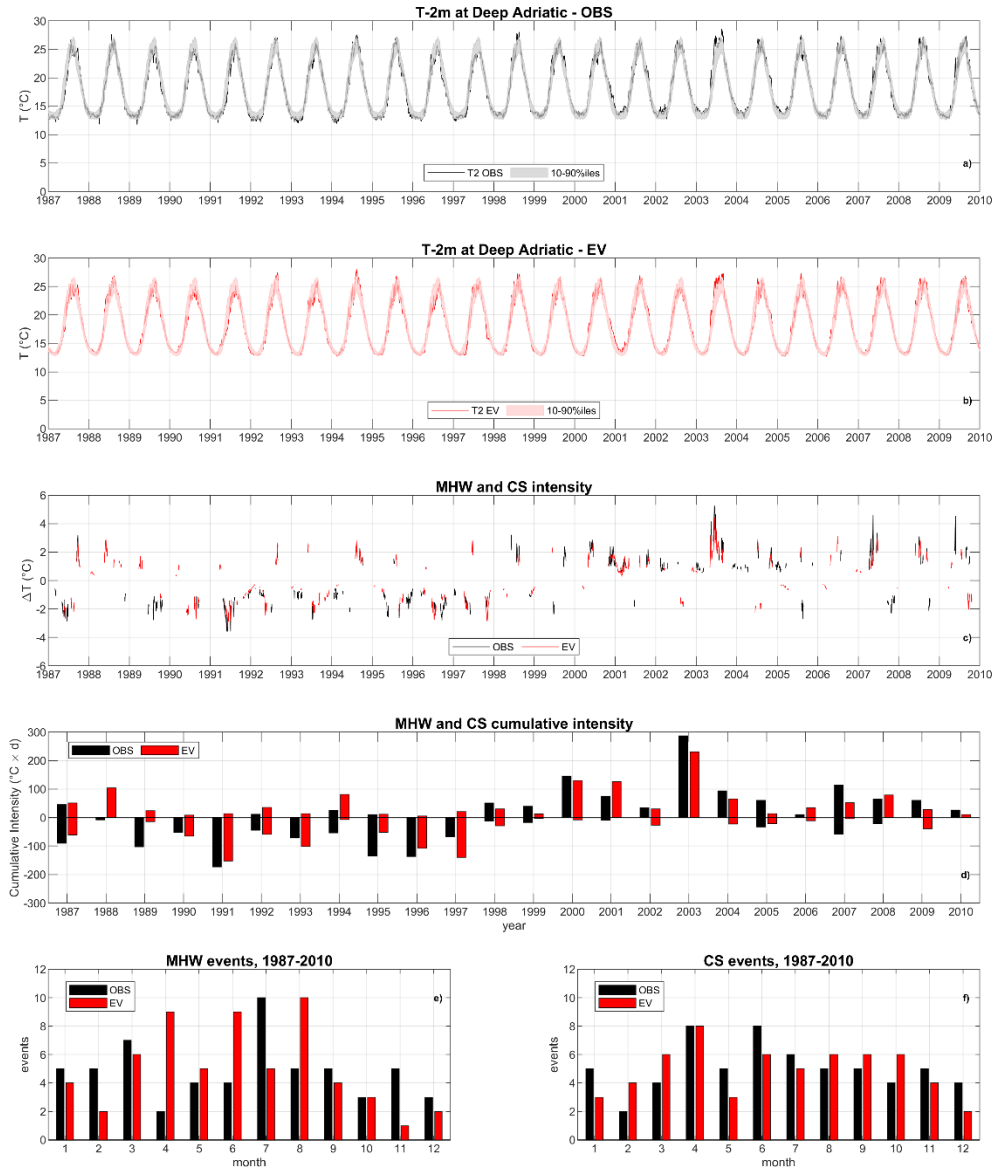

Figure 3: Same as Figure 1, with reference to Deep Adriatic subdomain

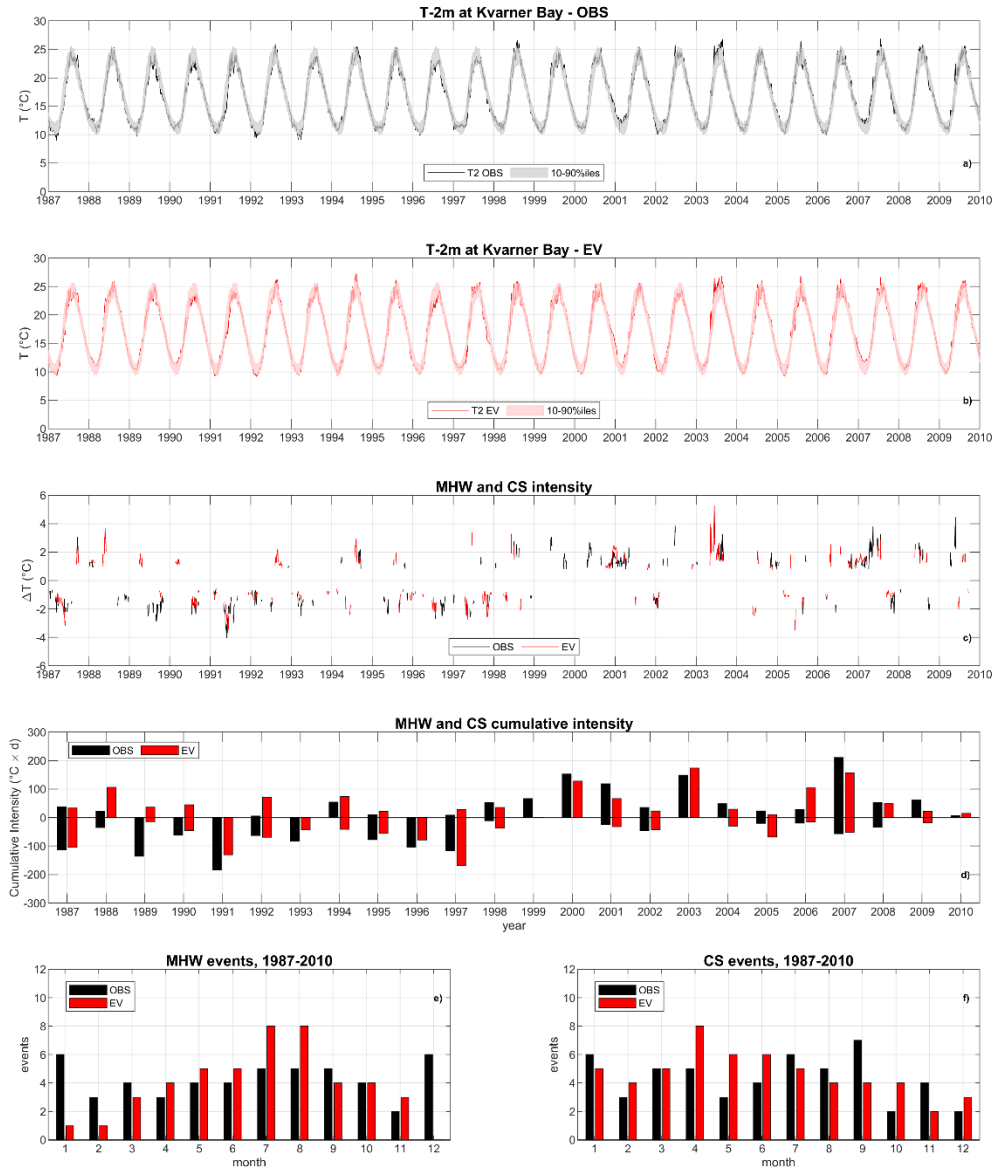

Figure 4: Same as Figure 1, with reference to Kvarner Bay subdomain

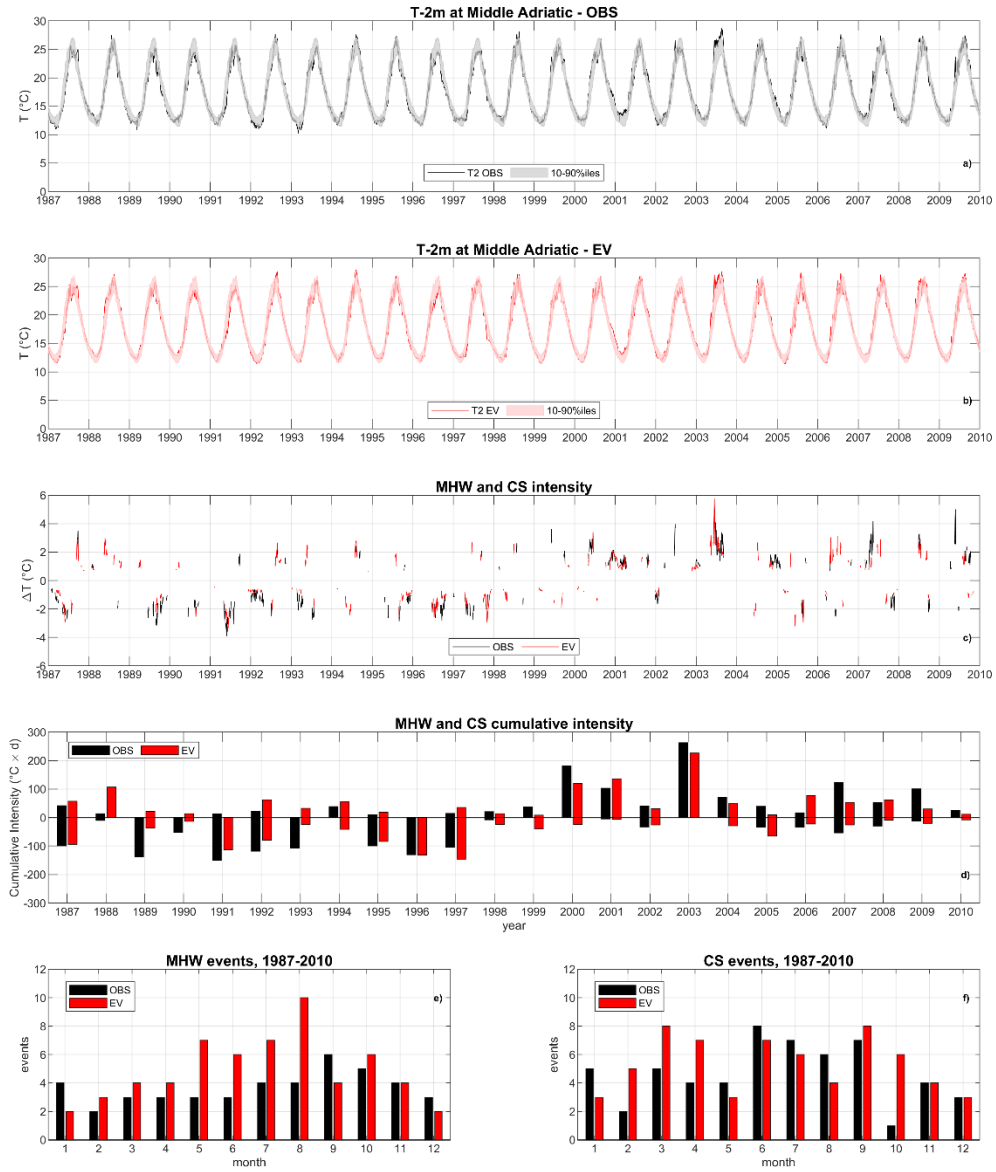

Figure 5: Same as Figure 1, with reference to Middle Adriatic subdomain

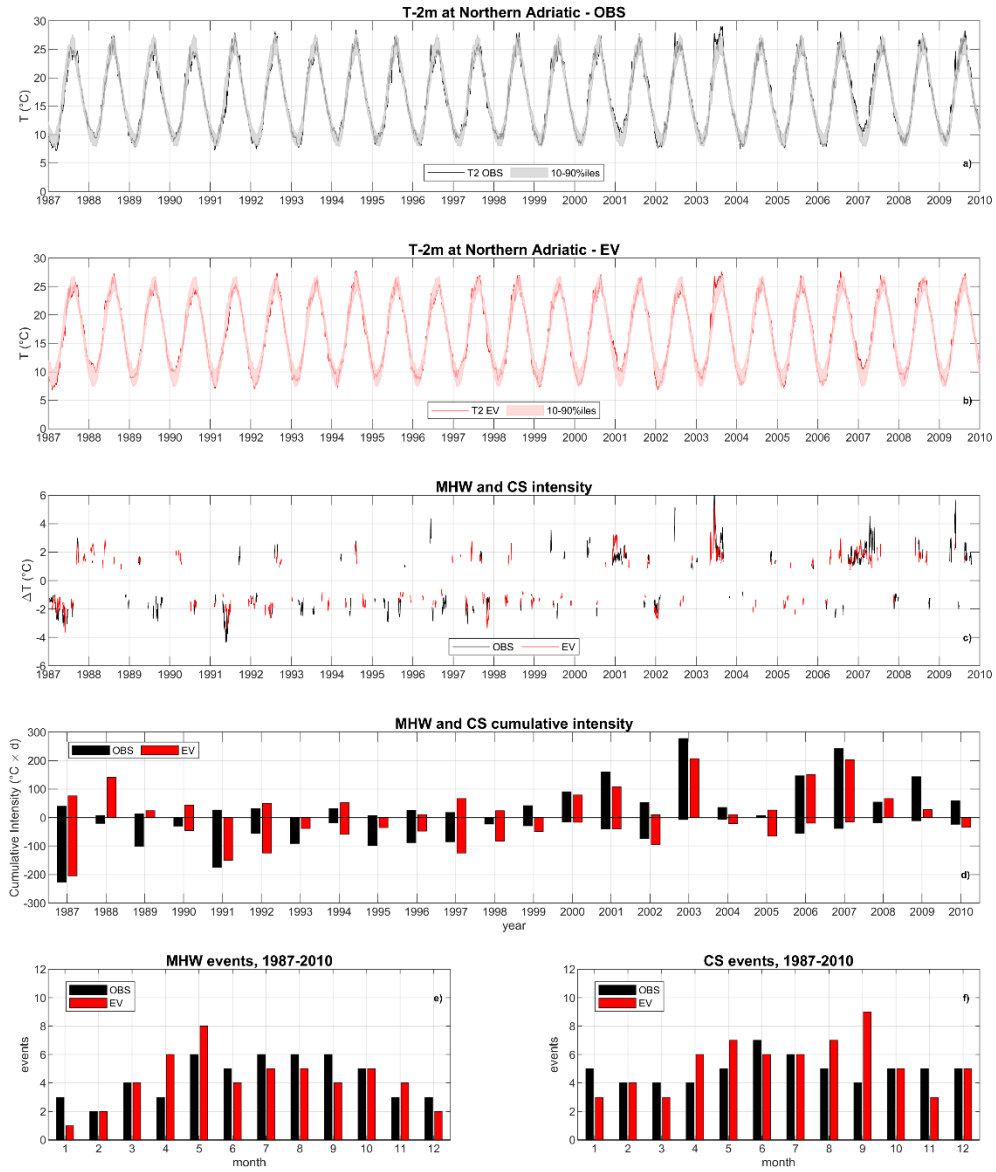

Figure 6: Same as Figure 1, with reference to Northern Adriatic subdomain

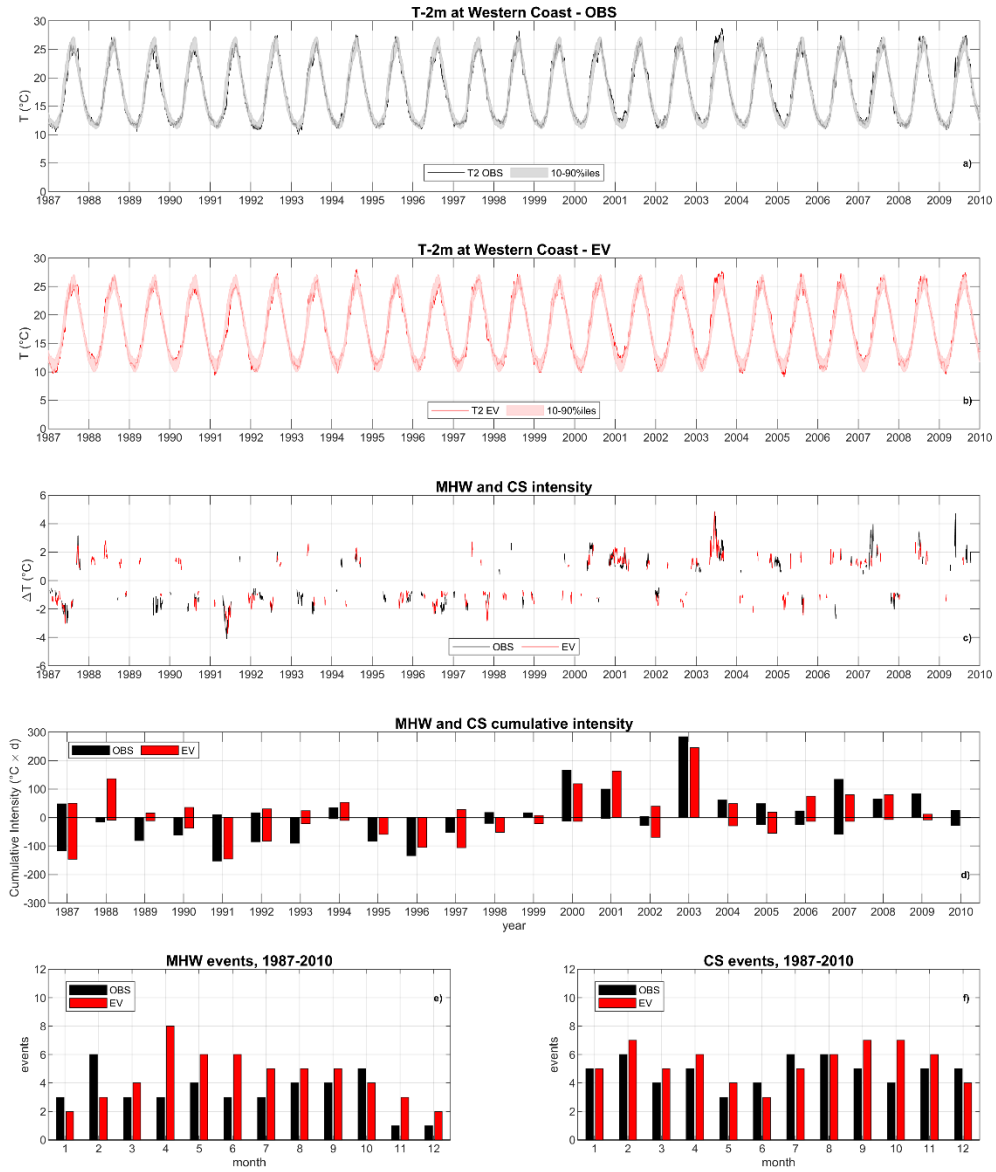

Figure 7: Same as Figure 1, with reference to Western Coast subdomain

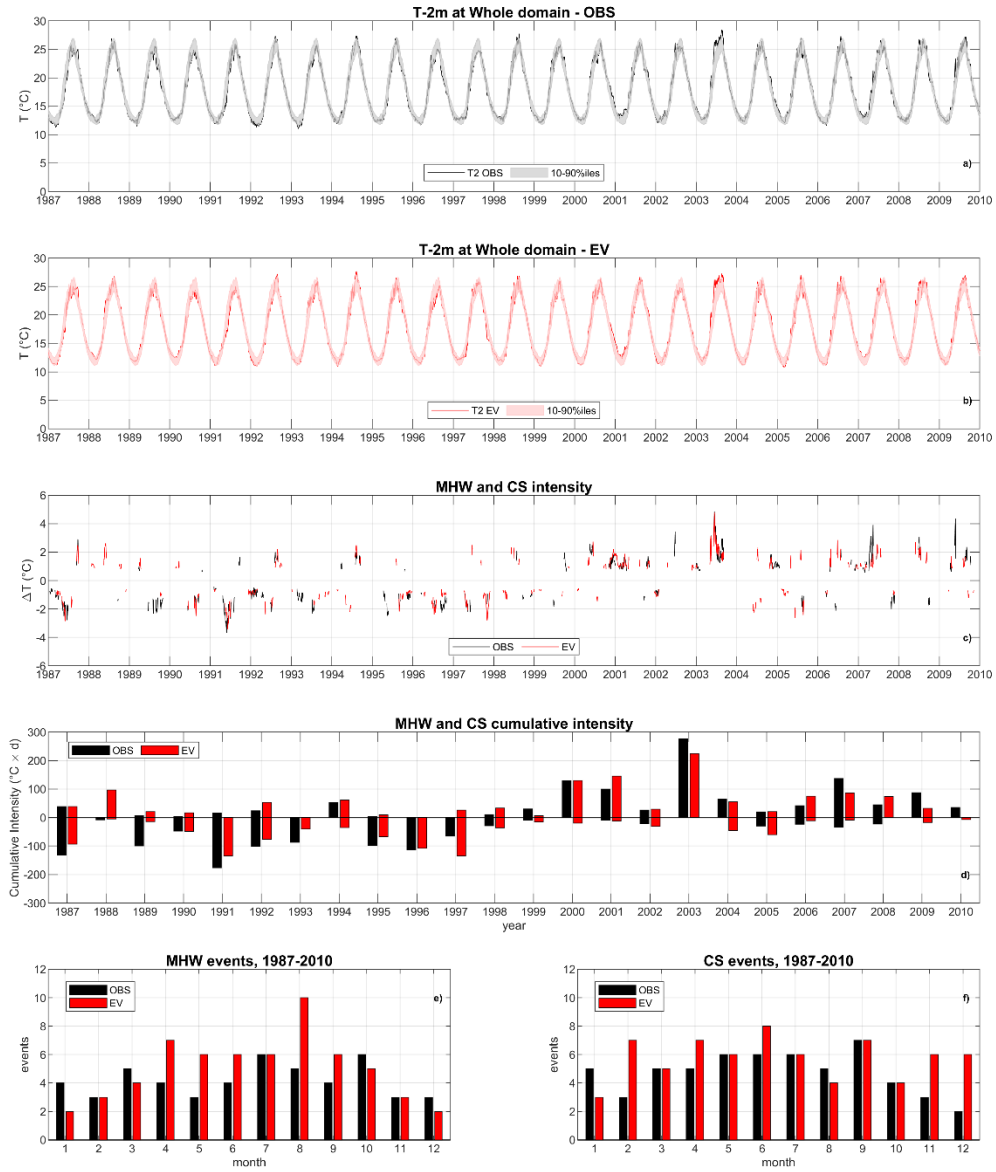

Figure 8: Same as Figure 1, with reference to the whole domain