

Please find below our point-by-point replies to the Editor and Referee #5 (red text). All page and line numbers refer to the revised version of the manuscript unless otherwise specified.

Editor

Dear Alfonso Senatore,

Following the reviewer reports, and after reading the manuscript again, I am returning it to you for revision.

Please carefully consider all reviewer comments and provide a detailed point-by-point response explaining how each comment has been addressed. I agree with the reviewers that parts of the manuscript are not written clearly and will therefore require substantial revision of the text. Please also note that HESS no longer provides language editing. This means that, if the manuscript is accepted, it will be published in its submitted linguistic form. I therefore ask you to ensure that, in addition to improving the clarity and conciseness of the scientific content, you thoroughly revise the English and correct all grammatical and stylistic errors. In addition, I would like to ask you to move Table 1, Table 2, and Appendix A to the Supplementary Material.

I look forward to receiving your revised manuscript.

Sincerely,
Nadav Peleg

Dear Editor,

Below are our detailed responses to the reviewer's comments. Regarding your comments:

- *Clarity and conciseness of the text:* Although the manuscript underwent numerous review rounds without any particular objections raised regarding its clarity, we reread it carefully once more and, supported by professional language-editing tools, made several changes shown in the tracked-changes version of the manuscript. In addition, by condensing the text and removing redundant paragraphs, we reduced the main body of the article by more than 30 lines (in addition to removing the Appendix, whose content has been moved entirely to the Supplementary Material). The total length of the paper (including also abstract and captions, not counting references) is now approximately 6800 words. We hope the Editor will find that the revised manuscript meets the journal's high standards.
- *Moving Tables and Appendix to the Supplementary Material:* We accepted this suggestion and moved the tables and appendix to the Supplementary Material.

We believe these additional changes further improve the paper's quality, and we look forward to your feedback.

Anonymous Referee #5

This study investigates how rising sea surface temperatures can influence heavy rainfall in a Mediterranean region, using high-resolution (2 km) WRF simulations of 20 events from the intense 2019 rainy season in southern Italy. While I acknowledge the authors' efforts to remove a substantial portion of their original analysis, the remaining sections of the manuscript have undergone only minimal revisions. Modelling studies of this nature are valuable for understanding how warming sea surface in the Mediterranean influences the intensification of extreme precipitation. However, the current version of the manuscript fails to clearly articulate its objectives, the modelling framework designed to address them, and most critically its key findings.

We have carefully considered the Referee's comments and have responded constructively to all points, including the additional issues raised in this review round where further clarification was requested. Below are our point-by-point responses.

Major comments:

Overall, this paper is still lengthy and lacks focus, particularly in the introduction, discussion, and even the title. The introduction, for example, includes irrelevant details about general features of climate change in the Arctic or Asian Monsoon regions, which detract from the core focus on the Mediterranean. Paragraphs addressing the Mediterranean climate and its modifications in response to anthropogenic influence are more insightful. Similarly, in the discussion, numerous studies with completely different focus and/or objectives are cited and discussed, which tends to blur the key outcomes of this work, making it difficult for readers to follow the central arguments. The paper also suffers from unnecessary complexity in its presentation. For instance, Figure 7 presents a complex analysis, whereas simple maps of change for different types of precipitation events during the season could be shown. Such maps could clearly show both the eastward shift and associated changes in intensity. While I understand that all precipitation events cannot be shown simultaneously, the authors could summarize key findings in the main text, as they do with column precipitable water and CAPE in Figures 8 and 9.

We carefully reread the manuscript and revised it throughout with the aim of improving clarity, conciseness, and overall readability. All modifications are documented in the tracked-changes version of the manuscript. Concerning the specific comments raised by the Referee, we respond as follows:

- We consider the title to remain consistent with the central scope and objectives of the study, also in line with previous editorial guidance indicating that the removal of the trend-analysis component would better align the manuscript with its present focus. Nevertheless, we have introduced a minor revision to the title in order to further improve precision and readability.
- The first paragraph of the Introduction, including the example referred to by the Referee, was intended to frame the broader climatic context of the study, particularly the poleward expansion of the Hadley cell and its relevance to Mediterranean hydroclimatic change. We nonetheless acknowledge that some elements may have

- appeared overly broad in relation to the core topic. Accordingly, the paragraph has been shortened, and references to other geographical settings have been streamlined.
- We would have appreciated more specific guidance regarding the studies cited in the Discussion section that were considered to have a substantially different focus. In the absence of more detailed indications, it was not straightforward to identify precisely which references were being questioned. However, we carefully reassessed the section as a whole and refined the discussion where appropriate to improve focus and coherence.
 - We respectfully consider Figure 7 to be both clear and scientifically valuable, as it synthesizes one of the key spatial signals emerging from the analysis in a concise and accessible form. For this reason, we propose to retain it in the revised manuscript. In our view, the alternative solution suggested by the Referee would likely require multiple additional panels, increasing manuscript length and reducing the immediacy of interpretation. We therefore consider the current presentation to remain the most effective balance between completeness and clarity. For full transparency and reproducibility, the daily precipitation fields simulated by the high-resolution WRF innermost domain (D02) are publicly available at <https://doi.org/10.5281/zenodo.16356046> for all three SST scenarios.

The abstract and introduction, still fail to clarify which aspect of extreme precipitation the authors analyse, i.e. the frequency, the intensity, or both? This comment was already raised, yet the authors' response remains unclear and unconvincing. As stated in the discussion, it is not possible for the authors to conclude on changes in frequency with their event-based framework (l. 368-369). However, in the conclusions, and in the abstract, the authors present changes in frequency, e.g. "The numerical experiments explained the enhancement of overland heavy precipitation events' frequency but did not indicate an increase in peak rainfall accumulation since the most extreme events should tend to produce their highest rainfall totals over the sea before reaching land." (l. 416-418). This contradiction undermines the credibility of this work and leaves readers uncertain about the actual focus and findings of the study.

In the previous version of the manuscript, we had already indicated that both frequency and intensity were considered (e.g., L110, L409), specifically in relation to the isolated effect of SST increase/decrease, i.e. with all other factors held constant. For instance, only a few lines above the sentence cited by the Referee, we explicitly stated that "we isolated the impact of sea surface warming" (L412). We nevertheless acknowledge that this distinction may not have been sufficiently clear to all readers. For this reason, we have revised the text throughout the manuscript to make the intended interpretation more explicit, with particular attention to the Abstract and Introduction.

Specifically, the Abstract now states (L8):

"The WRF simulations accurately reproduce cyclone tracks and precipitation patterns, indicating that, with all other factors held constant, increased SSTs could boost the frequency of heavy rainfall over land by intensifying otherwise weaker events."

Likewise, the Introduction now states (L108):

"The overall analysis, focusing specifically on impacts on land areas, provided comprehensive insights into changes in heavy precipitation intensity, spatial patterns, and, indirectly, frequency (as many previously weaker events intensify with higher SSTs) across the northern coastal Mediterranean under sea surface warming."

Consistent clarifications have also been introduced in the Discussion and Conclusions sections, as highlighted in the tracked-changes version of the manuscript.

The English throughout the manuscript requires improvement. For example, I proposed revisions for the abstract, and this review alone highlights the need for considerable modifications. The rest of the manuscript would benefit from similar attention to clarity and precision.

The Referee suggests that further improvements to the English language would be beneficial, referring in particular to comments on the Abstract. We have considered these points carefully. We also note that language-related issues had not been raised to the same extent during the previous review rounds and that the manuscript had already undergone substantial revision, including professional language-editing support. Nevertheless, we welcomed this additional opportunity to further refine the text and carried out a careful linguistic revision throughout the manuscript, as documented in the tracked-changes version.

Finally, numerous studies have already explored the impact of higher (or lower) SSTs on extreme precipitation, Medicanes, and other heavy precipitation systems in the Mediterranean region. The authors do cite many of these studies. I therefore recommend removing all sentences such as “To the best of the authors’ knowledge, this research, for the first time, aims at disentangling the expected influence of sea surface warming, [...]” throughout the text. Research on this topic began years ago (e.g. with the HyMeX program and has continued since then. For instance, two highly relevant studies, recently published but not discussed here, include:

Calvo-Sancho, C., Díaz-Fernández, J., González-Alemán, J. J., Halifa-Marín, A., Miglietta, M., Azorin-Molina, C., ... & Martín, M. L. (2025). Climate change unleashed: physical-based attribution analysis proves human-induced amplification of Valencia's deadly flooding.

Saurral, R. I., Campos, D. A., Grayson, K., Lapin, V., Trascasa-Castro, P., Tourigny, E., ... & Doblas-Reyes, F. J. (2026). The key role of Mediterranean and North Atlantic sea surface temperatures on the 2024 record-breaking Valencia precipitation event. *Weather and Climate Extremes*, 100877.

We thank the Referee for this comment. We understand the concern related to the wording used to describe the novelty of the study in the context of an already substantial literature on SST impacts over the Mediterranean, much of which is already cited in the manuscript, including studies associated with the HyMeX research framework. Our intention was not to imply that the topic itself had not been previously investigated, but rather to emphasise the specific features of the present work, namely the analysis of an entire season comprising 20 events of different intensities at convection-permitting resolution (LL341–342 in the previous version). To avoid any possible misunderstanding, we have revised this wording and introduced similar clarifications elsewhere in the manuscript. We also thank the Referee for drawing our attention to the two recent studies mentioned. As these became available after the release of our preprint, we have reassessed their relevance in the context of the revised manuscript. The 2026 peer-reviewed article has been included, whereas the other reference was not retained at this stage as it is currently available as a preprint.

Minor comments:

Abstract:

I.1: suggest changing for “the evolution of intense rainfall in the Mediterranean with climate change”

We thank the Referee for this suggestion. However, we prefer to retain the original wording, as the phrase “evolving patterns” more accurately reflects the broader scope of the study, which concerns not only changes in rainfall intensity but also shifts in spatial distribution and event characteristics. We therefore consider it more representative of the main focus of the manuscript.

I.2 -4: suggest changing for “We focus on southern Italy as a representative sub-region of the Mediterranean basin. We examine in detail how air-sea-orography interactions and rising sea surface temperatures can intensify heavy precipitation events despite an overall drying trend in this region”.

We appreciate the suggestion. While we preferred to retain a single-sentence structure for conciseness and overall compactness, we have slightly revised the wording to improve readability.

I. 4: remove “consecutive”

We respectfully prefer to retain “consecutive”, as the term is intentional and indicates that the 20 events represent a temporally continuous set within the study season.

I. 5-6: suggest changing for “are reproduced at 2 km with a convection-permitting model using boundary conditions from the ERA5 reanalysis.”

We appreciate this suggestion. Nevertheless, we have chosen to retain the original wording, since the key methodological aspect here is that the WRF simulations were performed at convection-permitting resolution (2 km). We therefore consider this phrasing more accurate and informative for the reader.

I. 7: Suggest changing for “approximating those of 1980”. This is unclear to what SSP specifically you are referring to? Suggest clarifying or changing for “SST increases in line with end-of-century projections”.

We implemented the first suggestion. Concerning the second one, we specified better to what SSPs we’re referring.

I. 9: change for “over land”.

Changed.

I. 10: “peak rainfall accumulation” is rather unclear. Is it peak rainfall intensity, i.e. max value over a specific period, or total rainfall over the episode? Also, “precipitation” is singular.

The sentence was changed.

I. 11: change analyses for simulations

Changed.

I. 11-12: « contributes to clarifying the seemingly contradictory trend of rising daily precipitation extremes despite falling annual precipitation totals in Southern Europe ». This needs clarifications too. Here, are you concluding on the frequency or intensity of daily extremes?

We thank the Referee for this comment. We believe that the revised wording introduced earlier in the Abstract now clarifies this point more explicitly, particularly by distinguishing between the potential increase in the frequency of heavy overland events (through the intensification of otherwise weaker cases) and the limited changes found for the most intense events analysed. We therefore consider the concluding sentence clearer in the revised version.