Response to Reviewer 1

Recommendation: Reconsider after major revisions

Scope of this review: one major concern (attribution/causality) and a few minor comments focused on clarity, methodological transparency, and consistency of interpretation.

Response: First, we sincerely thank the reviewer for their valuable time and effort in reviewing our manuscript. The comments and suggestions provided are very helpful and have significantly improved the quality of the manuscript. The response to the reviewer's comments is shown in blue.

Summary

The manuscript assembles multiple observational and reanalysis products to describe Medicane Daniel and its co-occurrence with a warm-core eddy (WCE) and a moderate marine heatwave (MHW). The analysis is potentially useful as a case study, but the current framing advances causal interpretations that are not yet supported by discriminating evidence. The revision should primarily address whether upper-ocean anomalies played a determining role in the intensification, or whether the results support a more limited conclusion of oceanic modulation under favorable atmospheric forcing.

Major comments:

Attribution of intensification to the WCE/MHW is not yet demonstrated "Along the path of …..making Daniel a deadly storm"

The results demonstrate spatial and temporal co-occurrence of (i) elevated upper-ocean thermal indicators (SST anomaly, OHC) and (ii) the period of storm intensification. However, the manuscript does not establish that the intensification point was exceptional relative to other environments sampled along the storm track.

I suggest, For each 6-hr track point, compute SST anomaly, OHC anomaly, surface enthalpy anomaly and then show a percentile rank of the intensification point. Right now we only see aboslute values not relative rarity.

Response: We sincerely thank the reviewer for this insightful suggestion. To address this, we have now extended our analysis by computing the SST and OHC anomaly at each 6-hourly track position, with particular emphasis on the maximum cyclone intensity (Max-CI) Location. We modified Figure 1 (Given below as Figure R1), in which we have added daily high-pass (500 km filtered to highlight mesoscale features) SST and OHC anomalies and along-track evolution during medicane Daniel (8-10 September 2023) using a 2-degree search radius using the Cressman technique (roughly representing the medicane core). This approach allows us to quantify the relative extremity of oceanic conditions encountered during intensification.

The results show that the intensification point coincides with high values of SST and OHC anomalies, indicating that the medicane Daniel intensified over thermodynamically favorable conditions that were among the most anomalous along its tracks. This strengthens the interpretation that the co-occurrence is not merely coincidental but reflects an alignment between intensification and increased availability of oceanic heat content. We believe this addition significantly improves the robustness of the analysis.

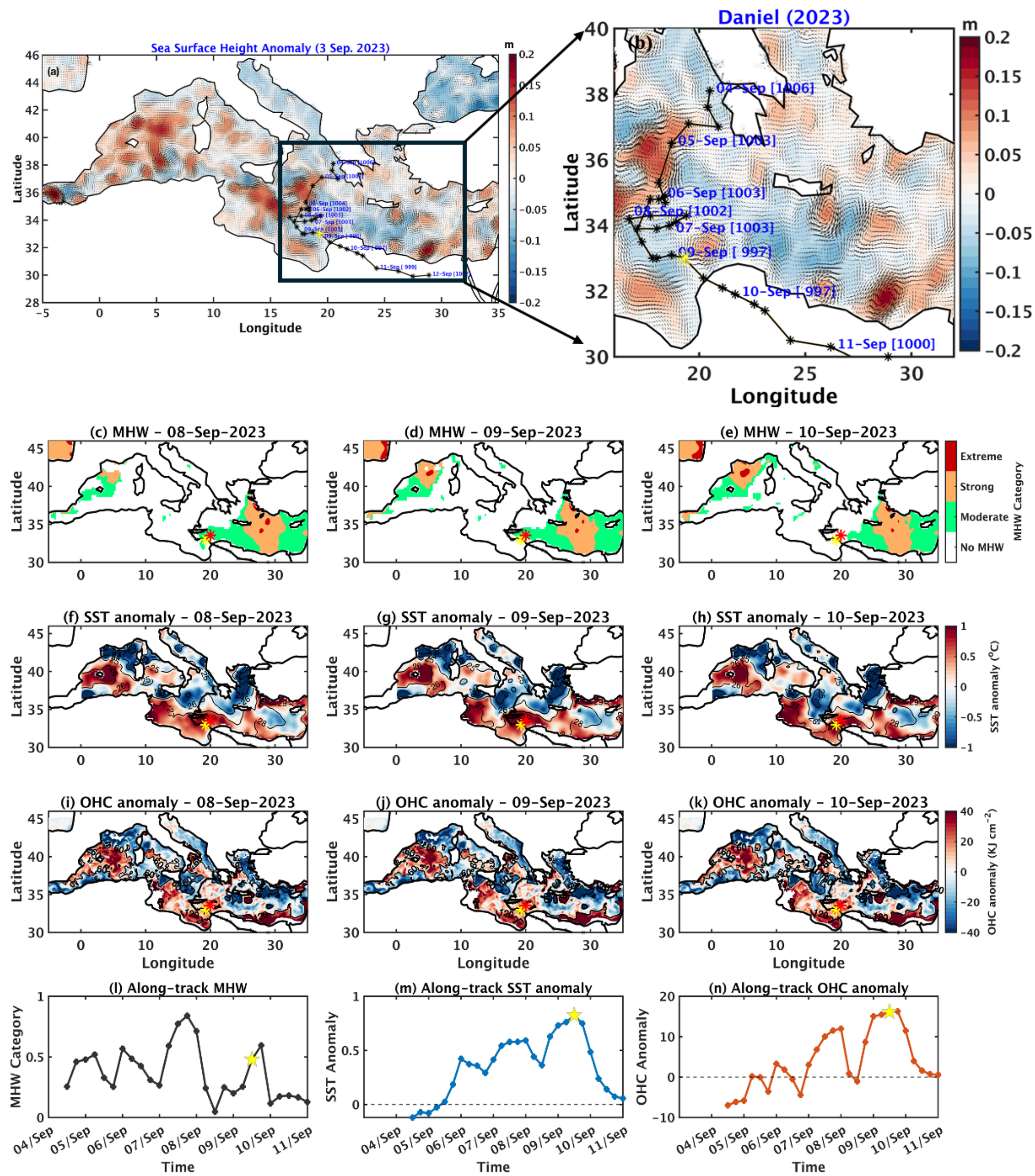

Figure R1: (a, b) Sea level anomaly (shading) with geostrophic currents (arrows). The *medicane track is overlaid on (c-e) marine heatwave (MHW) and (f-h) sea surface temperature (SST) anomalies (500 km radius high-pass filter), and on (i-k) ocean heat content (OHC) anomalies (500 km radius high-pass filter). In panels f-k, absolute values are indicated by contours. Panels (l-n) show along-track values of MHW, SST, and OHC anomalies. The yellow stars (pentagons) in panels a-k (l-n) mark the location of maximum cyclone intensity (Max-CI), while the red pentagons mark the Max-CI location defined by the minimum mean sea-level pressure. The red star marker in panels l-n indicates the position of the warm-core eddy. Dates for each panel are shown along the track.*

Minor comments:

Page 1, lines 27–28:
Keywords include "deadliest Medicane," which is subjective and non-scientific in tone. Consider removing or rephrasing to a neutral descriptor.
Response: Thank you for this helpful suggestion. We modified it as 'Medicane Daniel'.

Page 1, lines 31–32 (Key Points):
The statement implies a causal enhancement of precipitation by WCE/OHC/MHW that is not demonstrated by the analysis. This is an interpretation issue and should be softened to reflect co-occurrence or possible modulation.

Response: Thank you for this important comment. We agree that the original phrasing may imply a direct causal relationship, which is not fully demonstrated by the present analysis. Our results show that the presence of WCE, MHW, and high OHC coincide with the intensification phase of Cyclone Daniel (as shown in Figure 1) and with enhanced precipitation (Figure 2).

Page 2, lines ~45–50:
“Warm Core Eddy” and “warm-core eddy” are used inconsistently; please standardize capitalization and hyphenation throughout.
Response: Thank you, we made it consistent throughout the manuscript.

Page 2, lines ~52–55:
“Marine Heat Wave” and “Marine Heatwave” are used interchangeably; please adopt a single convention (e.g., *marine heatwave* following Hobday et al.).
Response: Thank you for your suggestion. We made it consistent throughout the manuscript.

Page 2, line ~60:
Abbreviation “CCE” appears before being formally defined in the text.
Response: Thank you. CCE referred to a cold-core eddy. We have mentioned it in the text as well.

Page 3, lines ~95–100:
The term “air–sea interaction” is used broadly; consider clarifying whether this refers specifically to surface heat fluxes, momentum fluxes, or upper-ocean thermodynamic response.
Response: Thank you for this helpful suggestion. In the revised manuscript, we have specified that it refers to key processes including surface heat fluxes, momentum fluxes, and upper-ocean thermodynamic responses that influence cyclone development and intensification. We modified it as ‘To improve the prediction of Mediterranean cyclones and mitigate associated risks, a deeper understanding of air-sea interaction processes, specifically surface heat fluxes, momentum fluxes, and upper-ocean thermodynamic responses, and the role of pre-existing oceanic conditions in cyclone genesis and intensification is essential.’

Page 4, lines ~135–140:
The description of SWOT capabilities could be clarified to distinguish improved spatial resolution of SSHA from direct observation of air–sea coupling processes.
Response: Thank you. We added a new paragraph as ‘Unlike traditional altimeters, SWOT's wide-swath coverage enables improved detection of mesoscale and sub-mesoscale eddies, frontal gradients, and filaments that regulate ocean heat distribution and air-sea exchanges. These features are often underrepresented in low-resolution datasets, limiting their ability to capture localized processes such as eddy-cyclone interactions and cyclone-induced mixing. By resolving these fine-scale physical structures, SWOT also provides a framework for interpreting biogeochemical responses. While coarse datasets show bulk chlorophyll changes, SWOT helps identify localized regions of enhanced mixing and upwelling that drive nutrient supply and biological variability. This allows for a clearer linkage between physical forcing and biogeochemical response. Overall, SWOT overcomes key limitations of conventional altimetry by preserving high-frequency spatial gradients, enabling a more accurate representation of the ocean state during extreme events such as Medicane Daniel.’

Page 6, lines ~248–249:

The definition of MHW intensity categories introduces the symbol \theta without explicitly defining it at first use.
Response: Thank you for pointing this out. We have now defined the θ in the revised manuscript at its first occurrence, along with the corresponding equation, to improve clarity.

We modified the entire section as "MHW intensity was classified following Hobday et al. (2018) into four categories based on the metric θ, where θ represents the normalized SST anomaly relative to the climatological threshold. It is defined as:

$$\theta = \frac{SST - SST_{climatology}}{SST_{90Th_{percentile}} - SST_{climatology}} \quad \ldots\ldots(5)$$

Where SST is the daily sea surface temperature, $SST_{climatology}$ is the climatological mean SST, and $SST_{90Th_{percentile}}$ is the seasonally varying 90th percentile threshold.

Based on this metric, MHW intensity is categorized as follows: moderate (1 ≤ θ ≤ 2), strong (2 ≤ θ ≤ 3), severe (3 ≤ θ ≤ 4), and extreme (θ ≥ 4)."

Page 7, line ~262:
Temperature is referred to without clearly stating whether it is expressed in °C or K in the context of energy calculations.
Response: It is mentioned that the temperature is in °C. For the computation of TCHP only, we converted it to Kelvin.

Page 8, Figure 5 caption:
The caption includes interpretive language (e.g., "indicates," "confirms") that would be better placed in the main text; captions should focus on describing what is shown.
Response: We revised the caption to focus on a clear and objective description of the figure content.

Page 8, Figure 5 panels (h–k):
Green and purple arrows are not clearly identified as schematic; this should be explicitly stated in the caption to avoid implying direct diagnostics.
Response: According to your suggestion, we have mentioned it in the figure caption.

Page 9, lines ~436–440:
The interpretation of subsurface "secondary circulation" below ~200 m is speculative; language such as "may indicate" is appropriate but should be consistently maintained throughout the paragraph.
Response: Thank you for pointing this out. We have made it consistent throughout the paragraph.

Page 9, line ~441:
"DCM" is used without being defined at first appearance.
Response: Thank you for pointing this out. Here, DCM refers to the Deep Chlorophyll Maximum, and we have mentioned it in the revised manuscript.

Page 10, lines ~512–514:
The phrase "determine the intensity and destructiveness of these storms" overstates the conclusions; consider revising to reflect combined influence or modulation.
Response: Thank you for this important suggestion. We have revised the text to: "The findings suggest that, similar to tropical cyclones in other ocean basins, medicanes may be significantly influenced by the interplay of oceanic heat content, eddies, and atmospheric dynamics. These factors could be responsible for the intensification of the cyclone and the destruction caused by the medicane."

Line 395-396:

Clarify the Ekman pumping formulation and separate it from storm-driven turbulent mixing; provide sufficient methodological detail to reproduce the Ekman pumping estimate: input wind product, curl computation method (grid/metrics/smoothing), the source of relative vorticity (if used), and sign conventions. Also, be mindful of the 2nd and subsequent key points in page 1 and 2.

Response: We already mentioned the formulation in Section 3.2.3; the sign convention is also stated in the methodology. According to your suggestion, we substantially improved the section as 'Ekman pumping was computed using the wind stress components $\tau=(\tau_x, \tau_y)$ from ERA5, namely Eastward Wind Stress (EWSS) and Northward Wind Stress (NSSS), which is available for 0.25° × 0.25° and hourly/daily temporal resolution. To compute the wind stress curl ……………………………………………………………
introduced by Stern (1965) to account for the effect of the ocean currents on upwelling, is calculated using equation 8'

Throughout the manuscript:
Some colorbars in multi-panel figures use small font sizes and inconsistent unit formatting (e.g., mg m^{-3}); please standardize for readability.

Response: Thank you for pointing this out. We have increased and standardized the font size in the figures to improve readability. We hope the revised figures are now clearer, consistent, and easier to read.s

Response to Reviewer 2

First, we would like to sincerely thank the reviewer for their valuable time and effort in reviewing our manuscript and considering it after the 'minor revision'. The comments and suggestions provided are very helpful and have significantly contributed to improving the quality of the manuscript. The reviewer's comments are shown in blue, and the corresponding revisions have been incorporated into the revised manuscript.

1. Caption Figure 1: The red dot is not visible, and the yellow star mark is not visible on the white background, so it is difficult to visualise.

Response: Thank you for pointing this out. We have revised and improved the figure accordingly. We hope that the updated figure is now clearer and easier to visualize.

2. Line 345-350: What are the dates?

Response: Thank you for pointing this out. The dates (2nd September to 7th September 2023) were already mentioned in the text; however, to improve clarity and avoid any ambiguity, we have now explicitly included them in the text.

3. Line 351: Significance

Response: We modified it by 'Importance.'

4. Line 365: Is it the total water column for the precipitation?

Response: This is not precipitation; rather, it refers to Total Column Water (TCW), which represents the sum of water vapor, cloud liquid water, cloud ice, rain, and snow integrated over the atmospheric column from the surface to the top of the atmosphere.

5. Line 368-372: Did the meso-scale eddy and MHW coincide?

Response: Yes, the mesoscale-eddy and MHW coincide here, which makes the cyclone 'Daniel' the deadliest recorded cyclone.

6. Line 392 for Figure 3: The dates on panels a, b, c, and d may not be correct. The date fr the chlorophyll difference is not mentioned. Ekman pumping is positive in (f), which is associated with the downwelling at the chlorophyll location. So it is not clear to me how Ekman pumping is associated with the high chlorophyll concentration. It would be more meaningful if the Ekman pumping showed as a difference, like chlorophyll.

Response: The dates shown in Figure 2 are correct. The reviewer may have been confused by the repeated dates; however, SWOT data are not available on a daily basis. Fortunately, we obtained SWOT observations on the specific dates when the eddies were covered. Therefore, we used these dates to represent warm core eddy 1 and warm core eddy 2 and to facilitate comparison with the AVISO SLA data.

We now present daily Ekman pumping fields (shown in Figure R1), which clearly show that during the passage of the cyclone, positive Ekman pumping (i.e., upwelling) dominates, leading to increases in chlorophyll concentration. It is important to note that downwelling starts from 10 September, when it is already over the land, as seen in the new SI Figure (also shown below).

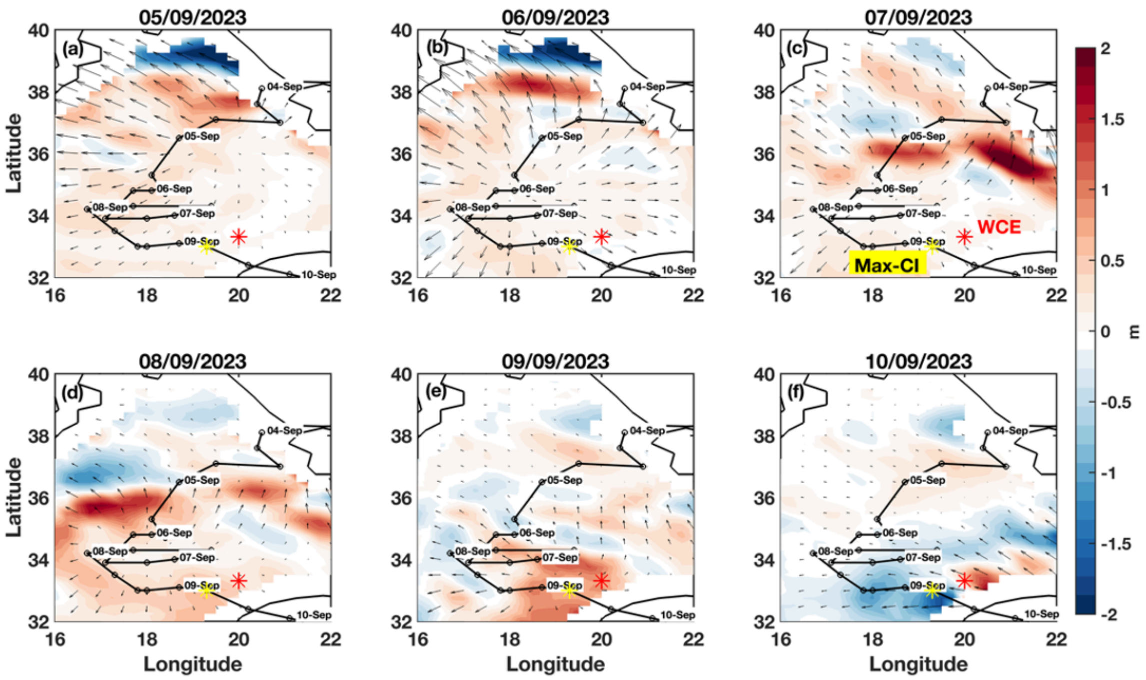

Figure R1: Daily Stern Ekman pumping (m day^{-1}) and Ekman transport vectors over the Mediterranean Sea during 5-10 September 2023. Ekman pumping is shown as shaded contours, red (positive) indicating upwelling and blue (negative) indicating downwelling, and white representing near-zero values. Black arrows denote Ekman transport vectors. The track of Storm Daniel is overlaid in black, with red markers highlighting the cyclone's position on each corresponding day. The yellow star indicates the location of maximum cyclone intensity, while the red star marks the warm core eddy location. Coastlines are shown in black.

7. Line 410-412: It is confusing without mentioning the dates used here. I suggest that the authors must mention the dates. Figure 4 is not clear to me; the caption does not show what the variables are in panels a-g in terms of physical and biogeochemical. Also, if these variables a-g are computed as a difference of two days before and after, then how are they represented on dates in the x-axis? The figure caption is not detailed enough to understand the analysis. The signature of MHW and WCE is not visible in the temperature (4a). It would also be informative if the authors had shown the MLD in all the variables from Fig. 4a-g.

Response: The dates appear to be the same because the profiles were taken along the track of the cyclone. Therefore, the “2 days before” corresponds to the same date as the observed values at that location 2 days before, while “2 days after” represents the values at the same location two days later. Thank you for your suggestion; we have now added the MLD to the figure.

Line 413: It is also not clear to me why the salinity decreases in the top 50 m. Is it related to the increased frehening, possibly?

Response: Yes, the decrease in salinity in the upper 50 m is mainly due to the massive influx of freshwater from heavy rainfall during the cyclone, which reduces the surface salinity. We have now added this to the text as well as 'The salinity also decreases on the surface, which could be because the massive influx of freshwater from heavy rainfall during the cyclone reduces the surface salinity. (Figure 4b).'

Line 413-418: It is difficult to anticipate. I suggest that the author take the difference between 2 days after and 2 days before, and plot the anomalies of the variables from 2 days before the genesis to 2 days after the landfall, which will be more informative.

Response: Thank you for this insightful suggestion. We agree that analyzing anomalies relative to pre- and post-storm conditions can provide a clearer representation of cyclone-induced changes. However, directly taking the difference from absolute values between the selected periods or computing anomalies first and then differencing yields equivalent results. The approach adopted in our study effectively captures these variations and improves the interpretation of the biological response, while clearly highlighting cyclone-induced variability.

Line 421: "DCM." I strongly suggest that the authors avoid using jargon and acronyms; e.g., DCM is a term they use without explaining it. This manuscript uses excessive jargon and acronyms, making it difficult to read and understand. Hence, I strongly recommend that the authors address this to improve readability. This should also be followed in the figure panel titles and figure captions.

Response: Thank you for pointing this out. Here, DCM refers to the Deep Chlorophyll Maximum, and we apologize for any confusion caused. We have mostly used well-known abbreviations such as OHC, WCE, CCE, and DCM. Reviewing the manuscript again, we decided to remove the abbreviation, which is less known.

Line 428-430: It is not clear to me what the authors want to convey. It would be informative if the Brunt-Vaisala frequency were shown here, or at least supported by a reference citation.
Response: Thank you for your suggestion. We have revised the text to describe the role of cyclone-induced subsurface mixing better. The updated text clarifies that the observed subsurface structure reflects weaker but still active mixing below the mixed layer, which becomes more relevant during storm conditions.

Line 432-442: Adding MLD to the plot (b-g) will provide the necessary understanding, as well as the change in MLD for h-k.
Response: Thank you for the suggestion. We have added the MLD in the figure for better representation.

Figure 7: The schematic shown here is confusing, and it is difficult to draw a conclusion from the schematic, e.g. drop vs sudden drop, etc. Also, the author must avoid using acronyms and jargon. I guess the WS in the schematic is wind speed. I strongly encourage the authors to remove all jargon and acronyms to improve readability for the broad scientific community.

Response: Thank you! We have improved the Figure as well as the jargon as much as possible to improve the readability.

Response to Reviewer 3

The manuscript, "Air–Sea Interactions and Biogeochemical Responses to Medicane Daniel" by B. Jangir and E. Strobach, investigates air-sea interactions during Medicane Daniel and examines the role of warm- and cold-core eddies, marine heat waves, and ocean heat content in influencing the storm's intensity. The study also analyzes how the ocean responds to the storm, focusing on both physical and biogeochemical changes.

Using multiple satellite and reanalysis datasets, the authors examine atmospheric and oceanic parameters relevant for cyclone dynamics, as well as pre-storm, during-storm, and post-storm changes in chlorophyll. They show that the presence of a warm-core eddy and the marine heatwave in the path of the storm contributed to the intensification, primarily through enhanced moisture convergence. The study also uses high-resolution SWOT data to detect mesoscale ocean structures that may influence cyclone intensity, providing a better understanding of the relationship between Mediterranean cyclones and underlying ocean features. Finally, the manuscript investigates the response of ocean biogeochemical parameters to the passage of the storm, including enhanced chlorophyll concentrations associated with cyclone-induced mixing and upwelling.

The manuscript contains interesting scientific analyses which are relevant to the community, especially as it uses SWOT data for highlighting finer eddy structure and better heterogeneity on biogeochemical parameters. However, in my opinion, the manuscript requires substantial revisions in terms of structure and overall presentation to improve readability and clarity. In addition, it requires further discussion to put the findings in a better context; for example, the methodology and rationale behind each section should be described more clearly. The study should also discuss the potential limitations of the data used and interpretation, such as causation vs association. My comments are following:

Response: We sincerely thank the reviewer for their time, careful evaluation, and constructive feedback on our manuscript. Below, we address each concern in detail. All reviewer comments have been carefully addressed. The reviewer's comments are in black, and our response is in blue.

General Comment:

In its present form, the manuscript attributes cyclone intensification primarily to the presence of warm-core eddies and marine heat waves along the storm track. However, the analysis is, right now, showing an association, rather than causation. Though showing such an association is important and scientifically justified, as this study is mainly observation-based, probable limitations or other factors that may support or contradict these findings must be discussed.

The manuscript requires clear separation between two components: how existing oceanic conditions influence the storm, and then how the storm influences the ocean, which could be done with a better presentation and restrructing if the write-up. In its current form, many important finding lost or require multiple readings of the manuscript. Also, how authors own previously published articles as cited show similar findings, it would benefit how this case study contributes to existing literature over would significantly improve the impact of the work.

Response: We acknowledge that the distinction between oceanic influence on the storm and storm-induced ocean response was not sufficiently clear in the original version. In the revised manuscript, we have restructured the study into two clearly defined components:

1. The role of oceanic features, such as mesoscale eddies and marine heatwaves, in supporting cyclone intensification.

2. The impact of the cyclone on ocean biogeochemistry, including changes in chlorophyll and productivity.

This restructuring improves readability and ensures that key findings are presented more clearly.

Furthermore, we have strengthened the discussion on how this study contributes to existing literature. Previous studies have largely focused on documenting the impact of cyclones on ocean biogeochemistry; however, the underlying physical mechanisms are often not clearly explained. In this study, we make two key contributions:

- We demonstrate the utility of SWOT satellite data in resolving mesoscale features during such events.

- We provide a clearer mechanistic explanation for the observed increase in chlorophyll and productivity, particularly over regions influenced by eddies and marine heatwaves, through analyses of Ekman pumping and related physical processes.

The reported increase in chlorophyll and nutrient concentrations following the cyclone is interesting; however, the mechanisms responsible for these changes remain unclear. In some sections, the manuscript attributes the increase in chlorophyll to enhanced Ekman pumping and cyclone-induced upwelling, while later the discussion indicates that Ekman pumping is negative (i.e., downwelling) at the same location and instead suggests subsurface mixing as the dominant mechanism. These differing explanations create ambiguity regarding the physical processes responsible for the observed biological response. Clarifying the dominant mechanism and ensuring consistent terminology throughout the manuscript would strengthen the interpretation.

Response: We appreciate this important point. In the revised manuscript, we have clarified this issue as follows: We now present daily Ekman pumping fields (shown in Figure R1 below and also included as SI Figure 7), which clearly show that during the passage of the cyclone, positive Ekman pumping (i.e., upwelling) dominates, leading to enhanced nutrient supply and subsequent increases in chlorophyll concentration at the surface. It is important to note that downwelling starts from 10 September, as seen in the new SI Figure 7 (also shown below). Because of this, when we calculate the total Ekman pumping from 5 to 10 September, the inclusion of 10 September introduces a negative (downwelling) signal at the intensification location. In the new Figure 3f (now we replaced it as Figure 6c), we decided to exclude September 10 from the average. This does not change our conclusions, as on the 10th, the cyclone was already above land. This point is now further clarified in the revised manuscript.

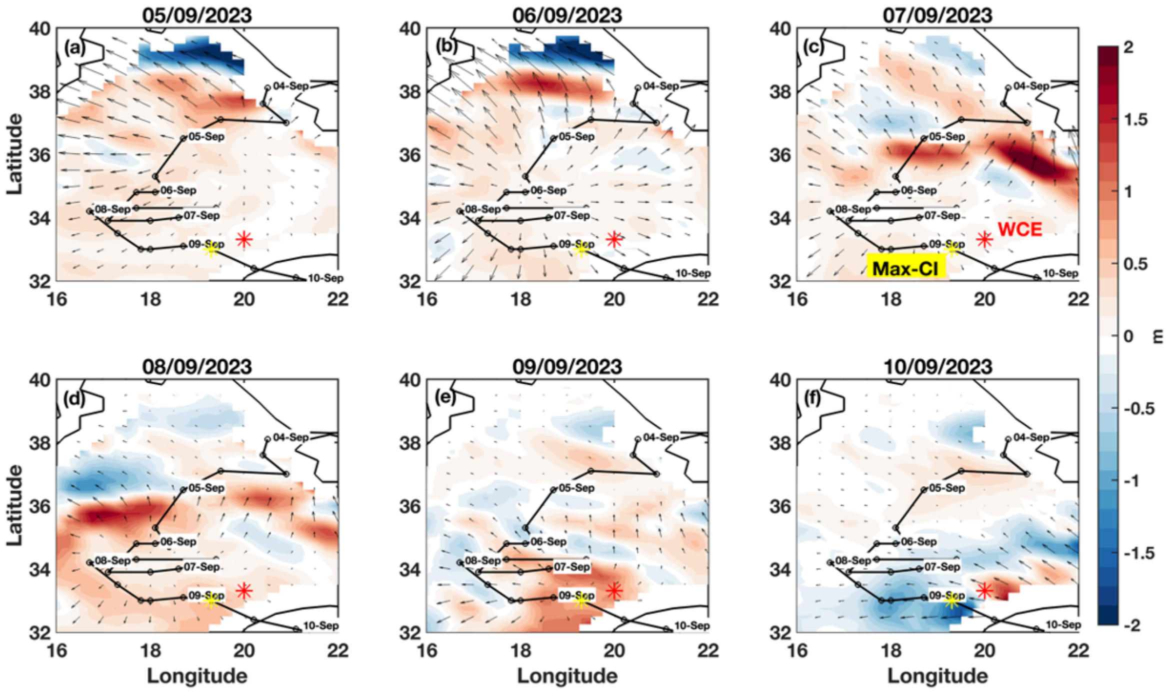

Figure R1: Daily Stern Ekman pumping (m day⁻¹) and Ekman transport vectors over the Mediterranean Sea during 5-10 September 2023. Ekman pumping is shown as shaded contours, red (positive) indicating upwelling and blue (negative) indicating downwelling, and white representing near-zero values. Black arrows denote Ekman transport vectors. The track of Storm Daniel is overlaid in black, with red markers highlighting the cyclone's position on each corresponding day. The yellow star indicates the location of maximum cyclone intensity, while the red star marks the warm core eddy location. Coastlines are shown in black.

The abstract contains too much information, which is relevant and important, but not structured properly, and which could be structured better. Currently, it sounds a bit incoherent.

Response: We have revised the abstract to improve its clarity, conciseness, and logical flow. We hope that the revised abstract addresses your concerns and is now clearer, better structured, and easier for readers to understand.

Minor Comments

L47: “positioned”?

Response: We modified it to ‘Situated’.

L51: “Phenomenon” to “Events” in this context

Response: We replaced it with ‘Events’.

L63-64: phrasing feels a bit odd “*under-researched and often **inadequately** communicated,*” Response: Thank you for pointing this out. We have modified it as 'under-researched and often poorly communicated.'

L168: "originated" to "developed."

Response: We replaced it as you suggested.

L198: recheck ('Total Column Water')

Response: We agree that the terminology needs clarification. In ERA5, the correct variable name is Total Column Water (TCW), which includes all phases of water (water vapor, cloud liquid water, cloud ice, rain, and snow).

L217: I think this warrants a section of its own, which includes a high-level summary of retrievals, gridding and averaging procedure, any potential limitations and uncertainty bound

Response: Thank you for this valuable suggestion. We agree that the satellite chlorophyll dataset and its processing deserve a more detailed description. Accordingly, we have added a dedicated subsection in the revised manuscript, which provides a brief overview of the retrieval methodology, gridding and averaging procedures, as well as potential limitations and associated uncertainties. This addition improves the clarity and reproducibility of the study.

We added the section as 'Daily satellite-derived chlorophyll products (OCEANCOLOUR_MED_BGC_L4_NRT) with a spatial resolution of 1 km were used in this study (Volpe et al., 2019; Volpe et al., 2018; Berthon and Zibordi, 2004). These datasets are archived by the Copernicus Marine Service (https://doi.org/10.48670/moi-00298) and are provided by the Italian National Research Council (CNR, Rome, Italy), with data availability from January 2023 to the present. The multi-sensor product integrates observations from SeaWiFS, MODIS, MERIS, VIIRS, and OLCI, and includes key biogeochemical variables such as chlorophyll a (Chl-a), diffuse attenuation coefficient at 490 nm, and primary production.

Despite their advantages, these datasets are subject to uncertainties arising from atmospheric correction errors, cloud contamination, aerosol effects, and reduced accuracy in optically complex coastal waters. In addition, the gap-filling procedure used to generate continuous fields may introduce smoothing in regions with persistent data gaps. Nevertheless, these products provide robust, high-resolution information on surface biogeochemical variability associated with cyclone-induced ocean processes.'

L221: Better phrasing of what aspects of Medicane, and also this should be a place where you summarize what each subsection will describe, and what relevance they have in your interpretation of results.

Response: Thank you for this helpful suggestion. We modified the section as 'In this study, we investigate the intensification, structure, and impacts of medicane Daniel. This section outlines the methodologies used to analyze the oceanic and atmospheric conditions associated with the event. The analysis focuses on key processes influencing cyclone formation and intensification, including the role of oceanic features such as WCEs and marine heatwaves, the contribution of ocean heat content as a source of subsurface thermal energy, and atmospheric variables such as moisture and wind fields. The methods used for the identification of the sea eddies and MHWs, as well as the computation of ocean heat content, are described below.'

L291: It should have one paragraph, what are the major results that you further divided into subheadings

Response: Thank you for the suggestion. Accordingly, we have added a concise opening paragraph that highlights the key findings, which are then elaborated under the subsequent subheadings for clarity and better organization.

In this introductory paragraph, we clearly highlight the two main aspects of the study:
(i) the role of pre-existing oceanic conditions, including warm-core eddies and marine heatwave conditions, in supporting the intensification of Medicane Daniel, and
(ii) the subsequent impact of the cyclone on ocean biogeochemistry, particularly the observed enhancement in surface productivity. We also clarify the underlying mechanisms responsible for this increase, linking it to cyclone-induced physical processes. We added a paragraph as 'In this section, we present the results of our study on medicane Daniel, focusing on two primary aspects. First, we analyze the influence of pre-existing oceanic conditions, specifically WCEs and MHW conditions, on the cyclone's intensification. Second, we investigate the medicane's impact on ocean biogeochemistry, particularly the observed increase in surface productivity as indicated by enhanced biogeochemical variables. Our findings also explore the physical mechanisms behind these changes, highlighting the interactions between the ocean and atmosphere throughout the lifecycle of medicane Daniel.'

L292-293: "The presence of ocean features, i.e., Eddies, Marine Heat Wave, and Ocean Heat Content along the cyclone track and their Impact on cyclone intensity." This subheading should be shortened

Response: Thank you for the suggestion. We replaced it with "Role of oceanic features in intensification of medicane Daniel."

L312-314: rephrase the sentence for better clarity

Response: Thank you for the suggestion. We rephrased the sentence as 'Cyclones extract heat from the ocean, resulting in surface cooling due to enhanced mixing and evaporation, which acts to reduce cyclone intensity.'

L338-340: Calculation of MSLP is not clear, mentioning the Cressman technique without describing details, for example, search radius, etc.

Response: Thank you, we have not included the details in the method section. We added a subsection in the method section as '3.2.4 Computation of various properties along the track of Medicane Daniel.'

To estimate medicane's characteristic MSLP and wind speed along the cyclone track, we applied Cressman averaging (Cressman, 1959). Once the cyclone center was identified, a spatial average within a 2° radius around the center, weighted by inverse square distance, was computed for MSLP and wind speed. This method captures changes within a 2-degree radius of the cyclone centre, while regions outside this radius are not included. Similarly, daily MHW and high-pass filtered (500 km radius) SST and OHC anomalies, along with their along-track evolution during Cyclone Daniel where calculted using the 2-degree search radius and the Cressman interpolation technique. This analysis allows quantification of the relative extremity of the oceanic conditions encountered during intensification. The approach was used to assess variations in cyclone intensity along its path and has been widely employed in previous studies (Jangir et al., 2023). '

L339: warm-core eddy, which region in the plot 2a (I think it would be better to mention the green line), also associated with figure 2, seems distorted.

Response: Thank you for this valuable comment. We have clarified this in the revised manuscript by explicitly referring to the region along the green line in Figure 2a. We mentioned in the figure caption*, and the green box represents the location of the warm core eddy and the marine heatwave.*' Additionally, we have improved the figure quality to address the distortion and ensure better clarity and interpretation.

L337-344: This paragraph mentions at least three eddies; however, in Fig. 2a not shown where they are on the timeline. I think it will be needed for a coherent interpretation. Also, my suggestion would explain systematically and follow the chronological evolution of the storm.

Response: Thank you for this insightful comment. We agree that the identification of multiple eddies in relation to the timeline was not clearly represented in Figure 2a. To improve clarity and coherence, we have revised the figure and corresponding text to explicitly indicate the locations of the eddies along the storm timeline. Additionally, we have reorganized the paragraph to follow the chronological evolution of the storm more systematically, ensuring a clearer interpretation of the results. We have revised Figure 2 accordingly, and the updated version is presented as Figure R3.

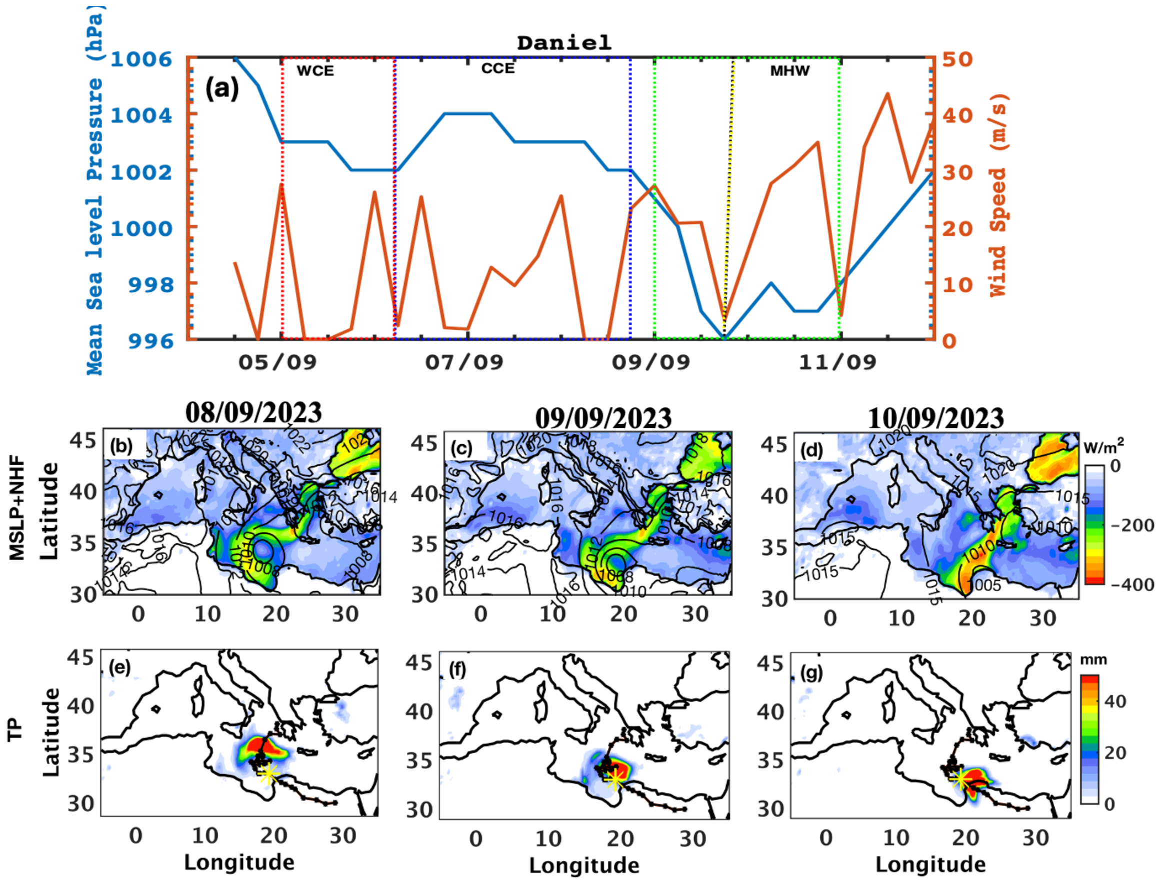

Figure R3: (a) Mean sea level pressure and wind speed computed using the Cressman average along the track of the Medicane Daniel, and the red, blue, and green boxes represent the location of warm core eddy, cold core eddy, and marine heatwave. Max-CI is indicated by a vertical yellow line. (b-d) Medicane track overlaid on Contours of the daily mean of MSLP and daily mean of latent heat fluxes (positive downward). (e-g) total precipitation during the cyclone, on the 8th, 9th, and 10th September 2023. The yellow star represents the max-CI location.

Fig 2b-g: From the caption, these plots are not anomalies; thus, it would be better to show them with some sequential colormap. Also, line contours are not legible

Response: Thank you for the valuable suggestion. We agree that these plots represent absolute values rather than anomalies. Accordingly, we have updated Figures 2b-g using an appropriate sequential colormap to improve clarity. We have also enhanced the visibility of the contour lines by adjusting their thickness and contrast to ensure better readability. We have revised Figure 2 accordingly, and the updated version is presented as Figure R3.

L362: Only Eddy supplied moisture? Or is it a positive association, while other factors may also be influencing moisture convergence?

Response: Thank you for the comment. We referred to eddy-supplied moisture because, in our previous analysis, we identified enhanced moisture convergence over the WCE location, which contributed to cyclone intensification. This is also supported by the results shown in Supplementary Information Figure 4. However, we acknowledge that other factors also influence moisture convergence and cyclone development. We have clarified this point in the revised manuscript to avoid overemphasis on a single factor.

L383: This section, as claimed, is the major focus of the study; however, the discussion does not justify it. It should clearly convey and highlight the contrast of what was not adequately represented in the low-resolution data. Also, it will improve the clarity if you separate the physical and biogeochemical parameters.

Response: Thank you for this important comment. We agree that the role of SWOT data needs clearer justification. In the revised manuscript, we have explicitly highlighted the advantage of SWOT in resolving fine-scale ocean structures that are not captured by lower-resolution altimetry. We have also clarified the distinction between physical and biogeochemical parameters to improve the interpretation of cyclone-ocean interactions.

We added a new paragraph as 'Unlike traditional altimeters, SWOT's wide-swath coverage enables improved detection of mesoscale and sub-mesoscale eddies, frontal gradients, and filaments that regulate ocean heat distribution and air-sea exchanges. These features are often underrepresented in low-resolution datasets, limiting their ability to capture localized processes such as eddy-cyclone interactions and cyclone-induced mixing. By resolving these fine-scale physical structures, SWOT also provides a framework for interpreting biogeochemical responses. While coarse datasets show bulk chlorophyll changes, SWOT helps identify localized regions of enhanced mixing and upwelling that drive nutrient supply and biological variability. This allows for a clearer linkage between physical forcing and biogeochemical response. Overall, SWOT overcomes key limitations of conventional altimetry by preserving high-frequency spatial gradients, enabling a more accurate representation of the ocean state during extreme events such as medicane Daniel.'

L409: One sentence is required to show what those parameters are, as a follow-up to the previous sentence ending "*profiles of key variables along the cyclone's*."

Response: We modified this sentence as 'To investigate the impact of the medicane on oceanic physical (temperature and salinity) and biogeochemical properties (i.e., chlorophyll, phytoplankton, nitrate and phosphate, and oxygen concentration), we analyzed vertical profiles of key variables along the cyclone's track.'

L413: mention the exact box with colors shown in the plot, for example, WCE (red lines) in Fig 4a

Response: Thank you for your suggestion. We modified the sentence as 'The results reveal a notable decrease in temperature along the cyclone path, with a general strong cooling along its path except for a short pause in the cold SST anomaly region in the morning of the 8th (Figure 1n). This region was also relatively outside the MHW domain (Figure 1l)'.

L414: No discussion on salinity, while it is included in plots Fig. 4b?
Response: We have also included a sentence addressing salinity, noting that precipitation associated with the cyclone leads to a decrease in surface salinity. We added in text 'The salinity also decreases on the surface presumably due to a massive influx of freshwater from heavy rainfall, again, except for the morning of the 8th, in which the cyclone was outside the influence of WCEs and MHW (Figure 4b).'

L421: what is “DCM”? It is not defined in the throughput the manuscript, including any of the figure? My suggestion would be to reduce the number of such abbreviations.

Response: DCM stands for Deep Chlorophyll Maximum. We apologize for the inconvenience. We have now added this definition to the text and reduced the use of abbreviations where necessary, in accordance with your suggestion. We reviewed all acronyms again, MR acronym was removed in the new version. All other acronyms are widely used in other studies.

L436: (panels b-d and h-i). of which figure ?

Response: Thank you for pointing this out. We have corrected the reference to Figure 5 and revised the text accordingly for clarity.

L438: “circulation motion starting.” The word “motion” is redundant.

Response: Thank you for the helpful suggestion. We agree that the term “motion” is redundant in this context. Accordingly, we have revised the sentence to improve clarity by removing the word “motion.”

L446: WCE should be panel (a) of Fig 6 if you are discussing this first

Response: Thank you for pointing this out. It should be Figure 5a. We have revised it as follows: “To explore the dynamical mechanisms, Figure 6 shows vertical profiles from 1 to 15 September 2023 of Chl-a at two locations along the same line as in Figure 5a, one inside the Cold Core Eddy (panel a) and the other inside the Warm Core Eddy (panel b).” for better clarity. We hope this revision improves understanding.

L448-455: Needs careful revision, as it is not clear in its current form.

Response: Thank you for the comment. The red line in Figure 5a extends from the cold-core eddy (CCE) to the warm-core eddy (WCE), and the vertical profiles in Figure 6 are extracted along this section, representing both regions. Now we have modified Figure 6, where we have plotted the chlorophyll profile over the location of the cold and warm core eddy locations, which makes our results clearer. For clarity and simplicity, we have revised the corresponding sentence in the manuscript.

L478: Sentence seems incomplete.

Response: Thank you. We have modified the sentence to: ‘This case study provides comprehensive insights into the intensification and impacts of Medicane Daniel, which developed over the MS in September 2023.’