

Dear Editors,

We thank both referees for their insightful comments on the manuscript, and we appreciate the opportunity to address these in a revised version. Below, please find the points raised by each referee (in bold text), our responses to each point (in plain text) and details of the specific changes made to the text in the revised manuscript (in italics).

Sincerely,
Shilpa Lal and co-authors

Comments from Anonymous Referee #1

The authors have studied the characteristics of marine heatwaves (MHWs) across twelve Pacific Island countries and territories (PICTs) using multiple sea surface temperature products and an ocean reanalysis. The paper addresses an important topic, given the reliance of these island nations on marine resources and the growing concern over climate-change-related impacts on coastal and pelagic ecosystems.

By considering spatial and vertical extent, seasonality, and differentiating between large-scale and coastal events, the study provides insights that are both scientifically relevant and of practical value to stakeholders in the region. The methods are sufficiently outlined and the conclusions are clear. The study builds upon existing knowledge on MHWs in the study area, while taking a step forward by providing information that is usable for stakeholders.

In my view, the manuscript could be further strengthened by briefly expanding on:

i) how results could be practically used by stakeholders (e.g., coral reef management, early warning systems).

We thank the reviewer for their comments and for this suggestion. As recommended, we added some discussion in the Discussion, Section 5.4”, expanding on how the results from this study could be used by stakeholders. (Lines 818 to 886):

“Better knowledge of past MHW characteristics around each country allows us to relate past bleaching or mass mortality events observed by the local populations to historical MHWs, or to other external disturbances. It also helps to predict the types of MHWs that will occur in the

future and their probability of occurrence. By revealing which coastal areas experienced more MHWs, in which season, our results inform the countries on the relative vulnerability of certain areas and ecosystems (e.g. those more susceptible to coral bleaching, mass mortality of sessile marine species or thermal stress on resident, site-attached fishes). For the macroscale events, our data on MHW vertical extent, and the percentage of the EEZ affected by MHWs can help to better assess MHWs impacts on mobile pelagic fishes.

Here, we have provided detailed spatial maps of past MHW characteristics (number of MHW days, mean duration, mean maximum intensity, Fig. 12, 13) along the coastlines of Fiji, New Caledonia and Tonga, Solomon Islands and Vanuatu in Supplementary, indicative of potentially sensitive areas to ecological impacts of MHWs. This is of strong interest to stakeholders in these PICTS as it points out to the fact that not all coastal areas may be subjected to the same MHW maximum intensity impacts.

We also show the regions where significant climate trends in MHW characteristics arise (Fig. 14, Fig. S4) pointing out also to regions of higher vulnerabilities to climate change when considering future management of coastal ecosystems. Not all regions are affected similarly and such information is useful when prioritizing areas for MHW impact management in the present and future climates.

In the context of Pacific Island communities, marine management would involve several stakeholders; the local communities who claim rights and ownership over particular reef areas, resource users, local government authorities, national government institutions, nongovernmental organisations and funding bodies. Any species or area management plan therefore requires engagement of multiple stakeholders who hold interests in that species or area. Unless it is certain that MHWs affect a species or resource, the motivation to include MHW information for resource management may not be a priority. For many species, the impact of MHWs may not be easily identified because of coarse resolution of temperature products used in MHW detection, the definition of MHWs not being sensitive enough to capture MHWs and MHW properties which are ecologically relevant or species and area showing resilience and no visible symptoms of thermal stress. Without knowing which species are affected or what areas are affected and how, effective conservation, management plans can't be made.

The results presented in this paper can help local authorities to conduct outreach and consultation with stakeholders of reef areas that are showing a positive trend in MHW maximum intensity and MHW duration. Citizen science initiatives can greatly help in surveillance of sensitive reef areas. As the concept of MHWs is relatively new, having only been formally defined in 2016, many stakeholders may not yet be familiar with it. Nonetheless, they may recall historical ecological impacts in vulnerable reef areas based on their lived experiences, which need to be documented and compared with MHW event timelines from SST products. These observations can help identify species that are prone to experiencing thermal stress so that conservation plans can be made to understand and manage them better for greater reef resilience. Once the vulnerable species and the nature of MHWs affecting them are identified, MHW forecast systems can be developed to help inform local communities and resource users of forthcoming events, so that they can plan their fishing effort and economic activities to offset the negative impact a MHW may bring.

In terms of early-warning systems to forecast the occurrence of MHW, products are increasingly being made available to aid resource managers prepare for their occurrence (e.g. BoM-CSIRO Marine Heatwave Seasonal Prediction Project by CSIRO and Bureau of meteorology, Coral reef watch made by NOAA, other forecast products developed by Copernicus). They inform local communities and resource users of forthcoming events, so that they can plan their fishing effort and economic activities to offset the negative impact a MHW may bring. These tools typically track the formation and movement of pools and fronts of warm-water to forecast out to 3-months. However, the ecological impact of forecasted MHWs may not be easily identified because of coarse resolution of temperature products used in MHW detection. The mean, standard deviation and trend values summarise the nature of the event but they do not imply ecological impact. Our results show that the extent, maximum intensity and timing of MHW in the Pacific region can be more nuanced than just the presence of warm-water. We expect that as these forecasting tools mature they will include greater clarity on the expected impact of forecasted MHW (particularly as the forecast window shortens). Our results identify additional parameters that can be used to build forecast systems with increased information of the expected impact of MHW events.

When communities and stakeholders are prepared, the negative impacts of stressors can be lessened, or sometimes mitigated (Woods et al., 2022). Hobday et al. (2023) proposed a table

of action, which can be used by researchers, industry, managers, policy makers and governments, to respond to potential MHW arrival in several stages. The first step to take before any action plan is to assess the risk, revisiting past MHW statistics for regions of interest, and determining, in particular, the reaction window. This is exactly what we did here. Our findings indicate that the rate of onset of MHWs in summer, for all countries, is in the upper range of the values observed at the global scale (Fig. 3 in Spillman et al. (2021)): MHWs develop quickly, and the preparation window for countries is rather short. This preparation window is longer for coastal events, and for winter MHWs. Marine managers should be prepared for rapid responses based on warning bulletins, as MHWs develop and evolve.

The next steps will be to work closely with ecologists and anthropologists to identify the vulnerable species, populations and ecosystems, and to define threshold limits and bio-cultural indicators to better assess the risk. In the interdisciplinary project that supported this study, MaHeWa (<https://mahewa.fr>), we work closely with biologists and anthropologists to produce adapted indices of MHWs impacts for Pacific Island countries, useful for marine managers. Through the work presented in this paper, and these next steps, we hope to help PICTs and their communities to become prepared for the threats that MHWs will represent in the near future.”

ii) the uncertainties associated with differences between products, since these may influence stakeholder confidence in the results. The latter will also increase the paper’s contribution to the ongoing discussion within the MHW community on the dependence of MHW characteristics on different products and methods.

We agree with the reviewer that quantifying the differences between products, both in terms of MHW detection, and the associated uncertainties in the resulting MHWs metrics, is very important for the community and stakeholders. We have thus expanded on this in the Discussion, Section 5.3, adding some preliminary results from a recent paper (Chevillard et al., submitted to Ocean Sciences). More precisely, we replaced lines 688-689: “To reinforce

confidence in the statistics obtained, a multi-ensemble approach for MHW analysis would be needed (Marin et al., 2021).” with the following (Lines 788 to 798):

“We briefly showed that different products and methods can result in different output in terms of MHW characteristics. Here however, we only considered 2 SST products of different nature to illustrate the range of uncertainties. We concentrated on identifying and discussing features that were robust across these 2 products. However, a recent paper (Chevillard et al., submitted to ocean science) specifically focussed on quantifying the differences between different SST products and associated uncertainties in MHW metrics. In that work, they systematically analyse MHW parameters across four gridded SST products, a reanalysis product and an ensemble mean. The conclusions are that the dispersion among SST products can be very high, especially for some metrics such as the onset and decline rates. Their recommendation is that MHW studies should account for the uncertainty associated with SST product choice when reporting MHW metric estimates. When feasible, the use of several SST datasets can substantially increase the robustness of the results, by defining upper and lower bounds of metric estimates.”

Specific comments:

Abstract:

Line: less intensity -> lower intensity.

Thank you for pointing this out. This has been fixed.

Sect. 3.2

Line 282: Keep the term max intensity throughout the text, as the manuscript currently switches between intensity and max intensity.

Thank you for pointing this out. This has been fixed to maximum intensity in the text.

Line 283: Is this an hypothesis or is it derived from an analysis not included? I suggest supporting it better, or, if it is an assumption based on literature, rephrasing accordingly.

This is derived from an analysis: using our macroscale events, we investigated the long-duration events occurring in this equatorial region 3, and found that the events all occurred during El Nino years. We rephrased the sentence as follows:

“We isolated the long duration, large-scale MHWs in this region and found episodes in 1982-83, 1987, 1991-92, 1997-98, 2009, 2010, and 2015-2016 (not shown). They are thus systematically associated with El Nino events, in accord with Sen Gupta et al. (2020), and consistent with processes associated with the eastward displacement of the Warm Pool waters and deepening of the thermocline in the region during the development of El Nino events (e.g. Picaut et al. 2001).”
(Lines 315 to 319)

Sect. 3.3

Line 357-8: as above, keep the term max intensity, or state at the beginning that intensity refers to maximum intensity in the context of this work (same for lines 437, 441, 549).

Thank you for pointing this out. This has been fixed to maximum intensity in the text.

Sect. 4.1

Line 429: are typically short duration -> are typically of short duration

Thank you for pointing this out. This has been fixed.

Line 437-440: There is some repetition in the first two sentences, I suggest rephrasing for clarity

Thank you for pointing this out. This has been rephrased to:

“Overall, we have found that Fiji, New Caledonia, Vanuatu and Tonga experience higher maximum intensity events compared to other countries in the study region and longer lasting events, especially in the cold season, with deeper vertical extent. In the hot season, all countries experience MHWs of similar duration (less than 25 days). These are short duration events but of maximum intensity comparable or slightly higher than cold season (central and eastern Pacific countries). The results suggest that these cold-season, long-duration, high-intensity events may or may not translate into ecological disturbances in the Solomon Islands, Fiji, New Caledonia, Vanuatu, and Tonga, and therefore warrant continued monitoring”. (Lines 489 to 495)

Fig. 11: I like the visualization approach for combining season/severity/extent. However, using more distinct colors (and line styles in the legend) would improve readability.

We kept the colors and line styles because we thought that it gave enough contrast, however, we modified the figure legend to simplify the readability of the figure.

Sect. 4.2

Line. 461: Consider mentioning (possibly in Methods) why these specific cases are analyzed (same for the previous section)

Thank you for the suggestion. The paragraph has been modified with the addition of the following sentence.

“The Fiji and New Caledonia coastlines are used here as examples because they provide interesting insights into the nature of MHWs along large coastline oceanic islands. Their long coastlines offer diverse interactions between MHWs and local oceanographic conditions allowing us to gain further insights into the nature of coastal MHW events.” (Lines 535 to 538)

Line. 465: MHW -> MHWs

Thank you for pointing this out. This has been fixed.

Line 472: Any idea why in GLORYS12 we observe more MHW days, longer durations and higher max intensities in both seasons compared to OSTIA? It would be interesting advancing this discussion even through hypothesis.

Results in Chevillard et al. (submitted) suggest that MHW detection is particularly sensitive to the high frequency variability of the SST signal. Their analysis of the variance of the high frequency (< 15 days) SST signal suggest that spiky signals with stronger high frequency variability like OSTIA detect higher maximum intensity, but lower duration, and lower number of MHW days per year. On the contrary, smoother products like GLORYS12v1 with lower high frequency variability detect lower maximum intensity, but higher duration, and higher number of MHW days per year.

Here, we observe that GLORYS indeed detect more MHW days, MHWs of longer duration, in both seasons, which is consistent with Chevillard et al.(submitted) results. The contrast is not as clear for the maximum intensity.

We added in the manuscript:

“These findings (more MHWs days of longer duration in GLORYS12 compared to OSTIA) are consistent with the conclusions from Chevillard et al. (submitted) that compared SST products, and can be explained by a larger variance of the high frequency SST signal (from 2 to 15 days) in OSTIA, compared to a smoother GLORYS12 product.” (Lines 555 to 558)

Line 518: Clarify what exactly corresponds to the 95th percentile

Thank you for your suggestion.

The paragraph has been modified with the following sentences.

“Are open ocean marine heatwaves also observed at the coast? To answer this question (1), Figure 11 shows the percentage of the coastline (dashed line in magenta) in MHW state for New Caledonia and Fiji, superimposed on the percentage of each EEZ (dashed line in black) in MHW state. The green and black horizontal dashed lines indicate the 95th percentile of the percent of EEZ covered by macroscale events and the percentage of coastline in experiencing MHW events respectively.” (Lines 599 to 603)

Line 525: What do you mean by "coastal MHW days" ? Please, rephrase.

The sentence has been rephrased to the following:

“A similar pattern was observed in Fiji. Sixty eight percent of large macroscale events in the Fiji EEZ coincided with a large part of the coastline being in a MHW state as well, with 60% of large-scale coastal events (greater than 60% of the coastlines, corresponding to the 95th percentile) not detected as macroscale events in the EEZ (Fig. 11 c).” (Lines 610 to 613)

Fig. 12: The caption reads a bit confusing to me, an alternative could be: Total number of MHW days, mean Duration and mean Max Intensity in coastal New Caledonia: a,b,c in OSTIA and d,e,f in GLORYS12, hot season; g,h,i in OSTIA and j,k,l in GLOSYS12, cold season.

Thank you for this suggestion. The caption has been changed to the following:

“Total number of MHW days, mean Duration and mean Maximum Intensity in coastal New Caledonia: a,b,c in OSTIA and d,e,f in GLORYS12, hot season; g,h,i in OSTIA and j,k,l in GLOSYS12, cold season. The colorbar in a,g has been adjusted to reflect the spatial variability in the number of MHW days in OSTIA’s hot and cold seasons for the New Caledonia coastline.”

Fig. 14: “The data in the maps refer to average changes in these metrics per decade over the 29 years”. I am not sure if this sentence adds information here. Also, since the mapped trends are only the significant ones, this should better be noted in the caption.

The reviewer is correct. The caption has been changed to the following:

Figure 14 Significant trends in the annual number of coastal MHW days in New Caledonia, a, and coastal Fiji, b. MHWs detected using OSTIA from 1993 to 2022.

Sect. 5.1

Line 605: no need for acronym here

The sentence has been changed to the following:

“On the contrary, in subregion 4 (the “Southeastern Australia eddy region”), where it has been shown that eddies are ubiquitous, most of the MHWs detected are of small scale and short duration, and extend very deep.” (Lines 708 to 709)

Sect. 5.3

Line 700: I suggest adding in Methods a brief explanation on the choice for fixed baseline.

Thank you for this suggestion. The methods section (2.2 MHW detection method and product intercomparison) has been modified with the following sentence:

“No trend was removed to account for total heat exposure that is consider both, temporary extreme heat events and long-term warming (see also discussion in Section 5.3). We however also apply the Hob16 detection method on linearly detrended SST data, to investigate trends in MHW parameters when the long-term warming trend has been removed (Fig. 7, 8).” (Lines 168 to 171)

Line 701: I suggest replacing “because we think that...” with “in order to capture total heat exposure, encompassing both temporary...”

Thank you for this suggestion. This sentence has been modified to the following:

“We chose the fixed 1993-2019 baseline in order to capture total heat exposure, encompassing both temporary extreme heat events and long-term trends.” (Lines 809 to 810)

Sect. 5.4

Line 724: You refer to global results from previous studies? Not clear. If yes, add references here.

This is indeed the case: we refer to results shown at the global scale from Spillman et al.'s (2021) paper. The sentence has been modified to:

“Our findings indicate that the rate of onset of MHWs in summer, for all countries, is in the upper range of the values observed at the global scale (Fig. 3 in Spillman et al. (2021)): MHWs develop quickly, and the preparation window for countries is rather short.” (Lines 875 to 877)

Comments from Anonymous Referee #2

The authors present a study on the characteristics of marine heatwaves (MHWs) in the South Pacific, with a focus on their spatial distribution, vertical extent, seasonality, and long-term trends. Using multiple observational and reanalysis products, the paper contributes to our understanding of MHWs. The study is innovative in its filtering of MHWs by size and seasonality, and in quantifying their vertical structure. The methodology is generally well described, and the figures are informative, although some improvements in clarity and consistency would strengthen the presentation.

In my view, the manuscript could be improved by clarifying the criteria for regional subdivision and considering whether detrending would provide additional insights into the drivers of long-term changes. Overall, the paper addresses an important and timely topic, advancing our understanding of MHWs in the South Pacific. In general, I suggest a minor revision, and more detailed comments are coming as follows:

Section 2.2:

Why is the data not detrended? The long-term trend in water temperature affects both the detection and duration of MHWs, and it also influences ecological processes and fisheries. The author should either explain why they don't detrend the data or provide some comparisons between with/without detrend.

Thank you for this suggestion. To better explain why we chose not to detrend the timeseries, the methods section (2.2 MHW detection method and product intercomparison) has been modified with the following sentence:

“No trend was removed to understand the impact of total heat exposure (to account for both temporary extreme heat events and long-term warming (see also discussion in Section 5.3)). To understand if the trends that we are seeing is due to long term warming, we detrended the SST and calculated trends on MHWs detected on the detrended SST (Fig. 7, 8).” (Lines 168 to 171).

We indeed think that it is important for the stakeholders to have this information on total heat exposure to relate our results to ecological impacts (see Amaya et al. 2023 discussion). This is discussed in more detail in section 5.3.

We also redid the computation of trends in MHW metrics on detrended timeseries, to understand if the trends observed are only due to the long-term warming in the region. The results are shown on the new Figure 7 and new Figure 8.

Figure 1: Please fill the land areas with color (e.g., using gray patches) to better illustrate the land of each country. The current light gray outlines make the contrast between land and ocean unclear, especially since the EEZ boundaries are also marked with light gray curves.

Thank you for pointing this out. Land areas are now filled in with light gray in Figure 1.

Section 3, line 245: The phrase “eddy-rich region” is unclear for readers unfamiliar with the South Pacific. I suggest including an additional figure or a new layer in Figure 3 to illustrate this region, which seems to correspond to the areas highlighted in magenta

We added a box to highlight the eddy-rich region (150-167E, 35S-26S) in Figure 3, and modified the caption accordingly with useful citations.

Line 262 and Figure 4: It is unclear what metric was used to quantitatively divide the research region. It appears that the authors used MHW days as a criterion, but the boundaries look unnaturally straight. It seems that the five subregions were drawn by eye based on Figure 4a, rather than from a quantitative method. Please clarify.

We chose to divide the study area into five subregions. The subregion division was inspired by Longhurst (2007) and Houssard et al. (2017). While these authors made the divisions based on ecological reasons for example due to nitrogen biogeochemistry at the base of marine food chains, ours has been modified to consider important climatological processes in the region, including the expected location of the SPCZ (subregions 1, 2, South-SPCZ and North-SPCZ), the transition between the western Pacific and the central eastern Pacific (subregion 3, Equatorial central region), presence of high energy eddies generated by the East Australian Current (subregion 4, Southeastern Australian eddy region) and the more homogenous subtropical region (subregion 5, Subtropical region), which is part of the south Pacific subtropical gyre in Longhurst (2007) and Houssard et al. (2017). We have named our subregions to reflect our choice of classification. These also correspond to different properties in MHW metrics, as seen in Figures 4, 5 and 6.

This is now added in the manuscript, lines 286 to 295.

Lines 265–266: Please keep the figure references consistent (e.g., Figure 5 → Fig. 5; Figure 6 → Fig. 6).

Thank you for pointing this out. This has been fixed. Where the sentence starts with “Figure” or if the figure is a subject of discussion in a sentence (not just as a reference), I have kept the full form. Where a figure is only being used as a reference, I have kept the short form “Fig.”.

Section 3.3.

Long-term trend and Figure 7: From my perspective, there is a clear geophysical distribution of increasing MHW days across regions 1, 2, and 5, which is consistent with the increasing duration (as indicated by the black arrow in the attached supplement). This raises questions about whether there are underlying physical processes driving this pattern, and whether the criteria for subregion division (Section 3.2) are appropriate for analyzing long-term trends.

The subdivision chosen allowed us to describe different behavior in all MHWs metrics. Indeed, it is not appropriate for all MHW characteristics, in particular for analyzing long-term trends, that may be explained by physical processes different from the ones generating MHWs. We do not think this calls our subdivision into question.

Figure 8 shows results without detrending. It would be informative to also include a detrended version of Figure 7. Is climate warming the primary driver of increased MHW states over the past 40 years? What other drivers might also play a role?

Thank you for this important and interesting suggestion. We now show, in new Figure 7 and Figure 8, linear trends computed on MHW metrics calculated on detrended SST data, in addition to trends on MHW metrics calculated on raw SST data.

The results obtained show that the increase in the number of MHW days during the last decades is clearly due to the long-term warming. A large part of the increase in MHW duration is also reduced or even disappears on the detrended version. Also, on the detrended version, we now have a decrease in maximum intensity over the last decades, whereas there is no trend on the initial version.

I have thus modified section 3.3 Long-term trends with the following:

“The previous figures showed the mean MHW properties over the 1981-2023 period. A key question now is whether, and how, these properties have changed over time. This was investigated in H22. They found that, except for the central equatorial subregion 3, there has been an increase in the number of events per year, but with no strong or consistent trend in maximum intensity or duration.

Figure 7 shows trends in the annual number of MHW days, annual mean duration, and annual mean maximum intensity, with hatched areas indicating significant trends (p -value < 0.05). More specifically, for subregions 1, 2, and 5, the number of MHWs per year significantly increased over time in the original version and decreased significantly between subregions 1 and 2 in the detrended version. As the 12 countries studied in detail are located in these three regions, all countries have also experienced significant positive trends in the annual number of MHW days in the past decades (Fig. 7 a). Region 1 experiences between 12 to 24 MHW days per year on average (Fig. 4 g); this number was multiplied up to four times during the last 4 decades around the Solomon Islands, New Caledonia, and Vanuatu (Fig. 7 a). The same is true for the trend in MHW duration, with MHW events becoming longer over the past decades (Fig. 7 c). Average MHW duration is between 5 – 30 days over most of the countries (Fig. 4). The mean duration has doubled per decade, since 1982, especially in subregion 1, in the Solomon Sea. On the contrary, and consistent with H22 findings, there is no strong and significant trend in MHW maximum intensity (Fig. 7 e). The only significant pattern is a decreased maximum intensity in the Warm Pool area (subregion 2), where the maximum intensity was already the smallest in the whole region. No significant trends were observed over most parts of the study region in terms of the vertical extent (Figure not shown).

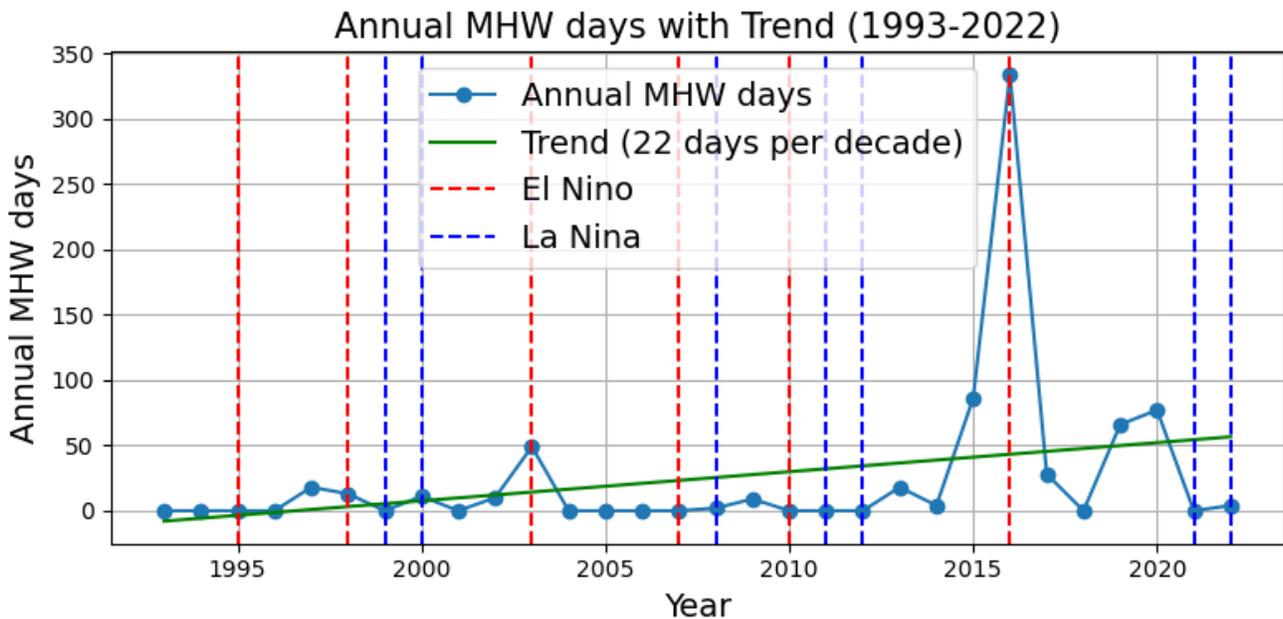
We also present trends on the MHW properties for MHWs detected on the detrended SST. This allows us to investigate if the trends observed are explained by the long warming trend only. The results obtained show that the increase in number of MHW days during the last decades is clearly due to the long-term warming (compare Figure 7 a to Figure 7 b). A large part of the increase in MHW duration in subregion 1 seen in Figure 7 c is also reduced or even disappears on the detrended version, Figure 7 d. Also, on the detrended version, we now have a decrease in maximum intensity over the last decades in some areas, whereas there is no significant trend on the initial version (compare Figure 7 e to f). The trends in MHW metrics are thus largely explained by the long-term warming trend.

Finally, Figure 8 shows the daily time series of the percentage of surface area of the study region in a MHW state, for both GLORYS12 and NOAA-OISST. A significant trend of ~3.5 percent (~70 square degrees) increase per decade is observed (Fig. 8 a). Over the past decade, there has not been a single

day when at least part of the region was not exposed to a MHW. Results from the detrended version (Figure 8 b) indicate that the trend in spatial extent observed in Figure 8 a is also due to the long-term ocean warming.” (Lines 389 - 420).

Page 25, Lines 508–509 and Figure 14b: Most coastal regions are shown in blue to green colors (10–15 days), except for a single pixel at [19°S, 180°] showing 20 days. This location is close to the neighboring coast, so why is there such a large difference? Could this be a numerical artifact from interpolation, or is there a physical explanation?

We thank the reviewer for pointing this out. We checked that this was not an artifact from interpolation. It appears that this location was very strongly affected by El Nino events (years 2003, 2015-2016).



Section 4.3, Figure 15a: The results suggest that Vanuatu has a large seasonal difference in MHW days, while neighboring Fiji does not. The authors attribute this to high-intensity events (Line 553), but this explanation is unconvincing without supporting evidence. Additional justification is needed. Maybe pointing out the specific event observed in the data set.

Thank you for pointing out this incomplete explanation. It also appeared that the caption of Figure 15a was not explicit enough. We modified it, so now, the way these box plots are computed is clearer.

Figure 15: Box-and-whisker plots showing MHW properties for coastal events by Pacific Island Country and Territory (PICT) and seasons, a, Duration, b, Maximum Intensity, c, Onset rate,

and d, Decline rate. Lower edge of whisker marks 10th percentile, lower edge of box marks 25th percentile, the line in the middle marks the median, the upper edge of the box marks 75th percentile, and the upper edge of the whisker marks 90th percentile. MHWs detected using OSTIA from 1993-01 to 2023-10.

Caption modified to:

“Figure 15: Spatial and temporal box-and-whisker plots showing MHW properties at the coasts for each Pacific Island Country and Territory (PICT) and seasons. a, Duration, b, Maximum Intensity, c, Onset rate, and d, Decline rate. Lower edge of whisker marks 10th percentile, lower edge of box marks 25th percentile, the line in the middle marks the median, the upper edge of the box marks 75th percentile, and the upper edge of the whisker marks 90th percentile. MHWs detected using OSTIA from 1993-01 to 2023-10. Statistics of MHWs are computed by combining all MHW detected at each coastal point, and then combining all coastal points for one country. It thus includes both spatial and temporal variations.”

When looking at Figure 4, b and d, it appears that the whole region encompassing Vanuatu, but also New Caledonia, Solomon Islands, and Papua New Guinea, is exposed to longer macroscale MHWs than the rest of the Southwest Pacific, including Fiji. Yet, Vanuatu is the only country for which all coastal areas are affected by these long-duration MHWs. This is why the box plots appear different from all others in Figure 15, with longer duration MHWs in winter, as the statistics are made by gathering MHW metrics at all coastal points.

When looking more closely at the timeseries of MHWs encompassing Vanuatu, it appears that these long-duration MHWs are all occurring in winter during La Nina years.

This is now better explained in the manuscript. We removed the sentence “This is an indication of some very high intensity events occurring in the cold season around the coastlines of these six PICTs.”

And added, following: *“The statistical distribution of MHW durations can display much longer MHWs for coastal events (Figure 15) compared to macroscale events in the EEZ (Figure 10). In the cold season, 75% of the events (summed over the whole time period, and over all coastal points) have MHW durations of up to or longer than 80 days in New Caledonia and Vanuatu (Fig. 15 a), compared to up to 40 days during macroscale events (Fig. 10 a). This is especially striking for Vanuatu, which is exposed along its coasts to long-duration MHWs. This is explained by the occurrence of long macroscale MHWs during winters of La Nina years (not shown), that encompass all the coasts of the Vanuatu Archipelago, but not its whole EEZ.”* Lines (648 to 654).

Lines 666–676: The characterization of MHWs along Pacific island coasts is interesting, particularly because the indices and impacts may differ from those observed along continental coasts. The authors could expand their discussion on this point.

Thank you. Indices and impacts are indeed different. Given that the climate, oceanographic conditions, habitat types, species composition, and anthropogenic pressures can differ greatly between continental coastlines and remote oceanic island coastlines, the impacts of MHW events may be felt differently along continental and remote oceanic island coastlines.

Many of the Pacific Islands are surrounded by lagoons or atolls, with exchanges from the open ocean. Thus, the physical processes explaining the signature of MHWs at the coast may be different from those

along the continental coasts. Moreover, most of the marine ecosystems that communities rely on are inside lagoons or close to the coast: the impacts of MHWs there are thus of prime importance for the Island societies.

In the interdisciplinary project that supported this study, MaHeWa (<https://mahewa.fr>), we work closely with biologists and anthropologists to produce adapted indices of MHW impacts for Pacific Island countries, useful for marine managers. This is now included in the discussion section 5.4. Also, in response to comments from Reviewer 1, we have added details on how results from this study, with dedicated indices, can be used by stakeholders in the region to mitigate MHW impacts in this section.