Reply to Reviewer #2

This is a study of the characteristics of marine heatwaves in the Barents Sea. It aims to investigate the occurrence of surface and bottom heatwaves in four different environments in the Barents Sea, to explore the differences in marine heatwaves characteristics when changing baselines, and to focus on the most severe MHW events in their study area.

Overall, I vacillated between rejecting the paper and accepting it with major comments and decided to give the authors another chance to improve their work. I have major and minor comments, such as the following:

Reply: We would like to thank the reviewer for giving us a second chance and providing thoughtful comments and suggestions which helped improve the manuscript.

Major comments:

The language used to describe the results of this work is very general and has nothing to do with the MHW topic. To be more clear, there are some terminologies that are known to be used by researchers of different scientific topics, here in this paper they used different terminologies that are far from what should be used in a study like the MHWs, and this led to a lot of confusion when I read their paper. I doubt that the authors used some sort of paraphrasing software that caused these repeated mistakes in their manuscript. Here are examples of the mistakes to which I refer:

Line 9: It was written "Determining the amplitudes and extent of marine heatwaves". For MHWs, the term "**intensity**" was used to describe the level that the SST reached above the threshold climatology, while the term "amplitude" is usually used for ocean waves, sound waves, etc., not for MHWs. Also, the extent of the MHWs could be a vertical or spatial extent, so please specify which one you are referring to, and I think you mean vertical extent since you don't have any spatial maps in your paper.

Reply: Thank you for pointing out this lack of appropriate terminology. We have changed the terminology throughout the manuscript to align it with the standard terminology of other MHW studies.

Lines 13 – 14: The authors used the word "expression" in two different places and this word does not mean the same thing in the 2 places. The first time it said "to explore the frequency, intensity, and duration of marine heatwaves in the Barents Sea, as well as 13 their regional expression", and I suspect they were referring to the **regional occurrence** of MHWs. The second place was, "We find that major marine heatwaves are rather coherent throughout the region and have comparable surface and bottom expressions", and I believe using words like **occurrences or events** is more representative in this case. Please change it through the entire manuscript.

Reply: We have changed the terminology and made the text clearer and more coherent throughout the manuscript.

Line 23: "temperatures above the 90th percentile based on a fixed baseline", Hobday et.al., 2016 define an MHW when the SST exceeds either **the 90th percentile of the moving climatological**

average or **a fixed threshold**, so the above statement is not correct, please correct it. Also superscript the "th" that is after 90.
Reply: We will revise the text to be consistent with the method we have applied.

Line 24: "Climate normal", it is usually referred to as climatological average or climatological mean, please change it.
Reply: Thank you for pointing out this. We have changed to ***climatological average*** throughout the manuscript.

Line 32: "When MHW are calculated for a whole region, regional heterogeneities will be lacking, thereby reducing the applicability of such an index" ??? which index???????
Reply: We have rephrased the sentence to clarify our point: "*When MHW are calculated **as a timeseries** for a whole region, regional heterogeneities will be lacking **and** thereby reducing the applicability of **using the timeseries as** an index.*"

In the introduction: you refer to other studies in the literature (e.g., line 37 (see e.g., Jakobsen and Ozhigin (2011) for a comprehensive overview)). Instead, try to make your introduction richer and like a story that gives the reader an idea of the topic you are studying. There are so many studies on MHWs and one of them deals with the Barents Sea (https://doi.org/10.3389/fmars.2022.821646). So you can use their work to introduce yours, and the authors should also mention how their work differs from the previous one. Also, you have a very unique area of study. I would have expected you to describe it in more detail in your introduction. This will help the reader to know more about the circulation in the Barents Sea, the physical properties and the atmospheric conditions, so that later when you talk about it, they can compare the normal and the extreme conditions.
Reply: Thank you for bringing this up. We agree that the introduction, as it reads now, require some background knowledge about the region. Part of the motivation was to keep the manuscript short, but we will expand the introduction to familiarise better the reader with the area.

Lines 70 - 73: "We choose these periods to examine the effect on MHW statistics of using different baseline periods. The first period, 1961-1990, was a relatively cold period in the Barents Sea region, whereas the period 1991-2020 has been relatively warm (e.g., González-Pola et al., 2020)". I don't really see any logic in comparing the MHWs defined by these two baselines, because the result is easy to expect. It was a cold period from 1961 to 1990, so this baseline will result in longer and more intense MHWs compared to the warm period baseline (1991-2020). If the author wants to study the results of MHWs using different baselines, I suggest you try to take a longer or shorter period for climatology, e.g. 25 or 35 years, but within the same period (warm or cold) so that you can check whether using less or more than 30 years of climatology could be reflected in the characteristics of MHWs or not. This will be very helpful for the studies examining the composite events of the MHWs and, for example, low chlorophyll-a events, since the available data for chlorophyll-a start from 1998.
Reply: While the results of our comparison of the two baselines are predictable, our motivation was to demonstrate the aspect that different parts of the ecosystem have different adaptability to

climate variability and change (see also reply to reviewer #1). However, we will perform some new analysis as suggested, using different baseline length.

Lines 101-102: "Here, we compare modelled and observed near-bottom temperatures averaged in time (monthly) and space (see sub-regions, Fig. 1)." How did you manage to define the MHWs using the monthly data? According to the definition you use, it is a daily phenomenon.

Reply: Here we refer to the model evaluation with the aim of assessing the model's ability to represent the temperature variability seen in observations. To clarify that we are referring to the model evaluation and not the MWH analysis, we have changed "*Here*" to "***In this model quality assessment***".

Lines 111 – 114: "We first estimate MHW statistics based on the TOPAZ reanalysis for the full Barents Sea region (see Fig. 1 for area definition). Two distinct MHW events are identified in both the surface and bottom temperature time series. While the strongest MHW, in terms of cumulative effect (degree days), appeared in 2016 both near the surface and near the bottom, the second strongest MHW appeared in 2013 near the surface and in 2012 near the bottom".

Does it make sense that you find only 2 MHW events over 31 years (1991 – 2021)? Especially the other study (Mohammed et.al., 2022) stated that over the 39 years (1982- 2020) In total, 72 MHWs were recorded in the whole Barents Sea over the 39-years study period with a total of 1,068 MHW days.

Reply: There are more than two MHW events identified, but there are two events that clearly stand out among all the events. We have rephrased the sentence as follows to clarify:

"***Among the MHW identified, t****wo events are **distinguished both in terms of intensity and duration** in both the surface and bottom temperature time series.*"

How is it possible to find MHWs on the bottom (2012) that cannot be seen on the surface? Especially your area is very shallow (maximum depth about 400 m), where does the heat come from?

Reply: While the investigation of possible mechanisms behind this finding is beyond the scope of such a short paper documenting MHWs, we will propose some possible mechanisms based on published literature on anomaly propagation and development in the Barents Sea.

Line 115: "When applying the MHW definition provided by Hobday et al. (2016)" . So what was the method used to define MHWs in lines 111 – 114?

Reply: We have deleted this part of the sentence because it provided no necessary information and only acted to provide confusion.

I would like to ask you if you have studied the role of the sea ice cover cycle in the region for the occurrence of MHWs?

Reply: No, we have not done that. While we agree that it might be of interest, we find such additional analysis to be beyond the scope of this manuscript given the length limitations for contributions to the Ocean State Report.

Minor comments:
In your data section please specify the periods that you used for each dataset
Reply: We have added information about the periods covered by the different datasets.

Lines 151 - 152 rephrase it to be "In the Bear Island Trench and Pechora Sea, the maximum intensities of MHW near the surface are about twice the maximum intensities near the bottom".
Reply: Done

The figures: Put labels (A, B, ….etc) on the panels so it easier to be easier to be interpreted.
Reply: Labels have been added to the figures as suggested.