Review of "Ocean Heat Content in the Iberian-Biscay-Ireland regional seas" by Pascual-Collar *et al* (2022) for 7th edition of the Copernicus Marine Service Ocean State Report (OSR 7)

Summary

This work reports on Ocean Heat Content (OHC) trends over the Iberian-Biscay-Ireland (IBI) region based on Copernicus Marine products. Averaged over the entire region, OHC from 0 to 2000m shows a positive trend of 0.5 ± 0.4 W/m^2. Regional values display an interesting dipole pattern, with negative trends affecting the offshore ocean north of 38˚N, and a positive 'tongue' between 31˚N and 38˚N. The authors then link the OHC trends with the main water masses in the region, revealing how mainly the Mediterranean Outflow Water impacts the region. As OHC is considered an Ocean Monitoring indicator, linking OHC with water masses is a relevant issue, as it brings insights in the mechanisms driving OHC changes. Hence, the preprint is of scientific value and in the scope of the Ocean State Report. However, there is a divergence between the values reported in Figure 1 and the ones reported in the text. Depending on which value is correct, the interpretation of the results can change a lot, and so the conclusions found in the text. With this issue being solved, and the general remarks below being addressed, I believe this would be a good addition to the Report.

General comments:

1. As mentioned in the summary, there is a divergence between the values reported in Figure 1 and the ones reported in the text: Figure 1 reports a trend of 0.4 ± 0.3 of OHC integrated from surface to 150m and of 0.1 ± 0.1 from surface to 700m, while in the text the authors report the 0.4 ± 0.3 being from 0-700m.
2. Structure: The structure of the report could be improved. There are methodological details in the results that belong in Data & Methods Section, and results in the Conclusion (which will be indicated in the specific comments).
3. Data & Methods: The methods section could also benefit from explaining how trends were compute (e.g., ordinary least-squares, auto-regressive models, mann-kendall, …), and by giving some brief details about the data sets used in the analysis. Why were only these 4 datasets used? There are other global products besides GLO-REA, CORA and ARMOR which could have been used (for example, CGLOR and ORAS-5 (GLOBAL_REANALYSIS_PHY_001_031)), why were these ones selected? It is also important to mention if the same source of temperature and salinity data are included in these products, since you present an ensemble mean in the results. It would also be relevant to mention here that GLO-REA is used as boundary condition for IBI-REA (and the possible implications of this for the ensemble mean).
4. Discussion: There is a lack of discussion with previous works. For example, in the introduction it is mentioned that previous reports "detected warmings of 0.9±0.4 W/m^2 in the upper 700m in the study region". The present study reports a trend of 0.1±0.1 (or 0.4±0.3, depending on which value is correct). The divergence of values should be discussed in the manuscript: how come such smaller trends have been detected now?

5. Region map: This is more of a suggestion, but I think the Introduction could benefit from a map showing the IBI region and indicating the main water masses which are discussed in the text. This would make the text of the introduction read easier, and the interpretation of the results.

Specific comments:

-   L10: I would change 'model' to 'reanalysis', or say 'model reanalysis' (as in L106).
-   The abstract and short summary mention that the work provides an "exhaustive analysis", which made me expect either a lot of data sets included in the analysis, or a lot of results. I think the world "thorough" or another one would be better suited here.
-   L39: Could you add some examples of Ocean Monitoring Indicators?
-   L42: It is said that the product "GLOBAL_OMI_OHC_trend" will hereafter be referred as GLO-OMI-trend, but in the next sections it is referred mainly as "GLOBAL_OMI_OHC_trend" (for example in paragraph 2 of section 4).
-   L49: for which period is the trend of 0.9 ± 0.4 W/m^2 from? Can you also add reference to the works that reported such trend?
-   The paragraph about water masses (L60-67) in the study region should come before the paragraph describing how previous studies linked these water masses with OHC (L49-59). This would be a good place to actually introduce the study region.
-   L68-70: Are these results also for the IBI region? This should be mentioned. And I guess this example belongs to the paragraph from L49-59.
-   L72: You say MOW does not dominate the changes in the Mediterranean Sea Water... could you mention what does then?
-   L81-83: Here the objective of the work is described. I think should also mention for which periods OHC trends will be analyzed.
-   L102: You mention "a collection of data sources", do you mean several Copernicus products (such as CORA, Glorys, ...) or several sources of temperature and salinity data (such as Argo gloats, CTDs, XBTs, ...)? It was not clear for me. Also "several data sources" (L101) refers to which? If it's to the products in table 4, I don't think 4 products can be classified as 'several'.
-   L114: Here should be mentioned which grid resolution was selected for the ensemble mean.
-   L116-119: this should be in the methods section.
-   Analysis of OHC timeseries: I was wondering if instead of only integrating the values from the surface until the reference depth (150, 700 and 2000m), the analysis could benefit from integrating in intervals? From 0-150m, 150-700m, 700-2000m. This way the actual contribution from each layer would be clearer. With always integrating from the surface, the contribution and uncertainties become cumulative, and not independent, so the results from 0-2000m should reflect the behavior from 0-700m, in addition to the contribution of 700-2000m.
-   L123-L127: not only this change in the uncertainties is 'remarkable'. I also found very interesting how the uncertainties are much wider from 99-2002. Could you comment on what could be the cause of that? Would it be related to climate fluctuations, or also to the quality (and quantity) of data?
-   L128-L131 & Figure 1: Here is where the results of Figure 1 and the text do not match. The text says the trend of 0.4±0.2 is for the upper 700m, which are in the figure the

numbers for the upper 150m. Then it is concluded that "such a trend does not affect the mixing layer. This result suggests a dominance of the variability at intermediate-deep-levels over the OHC trend". Considering the mixing layer is within the upper 150m (as stated in L100, but could actually be reinforced here). If the numbers in Figure 1 are correct, then I would interpret as: the upper 150m have a positive trend; the upper 700m have an insignificant trend, dominating the variability of OHC, instead of the trend; the overall integrated OHC in the upper 2000m is a positive trend.

- L131: "It can be appreciated a change of trend after the year 2006". What does this mean exactly? Do you mean that if we would analyse trends from 1993-2006, then we would see a negative one and a positive one for 2006-2020? Or do you mean an acceleration in the rate…? Could this be quantified (by a breakpoint analysis for example)?

- L135-138: this should be in the methods section.

- L138: The IBI-REA grid was used as a reference, which is the one with the higher spatial resolution. This mean that CORA and ARMOR had to be downscaled to match this grid resolution, meaning than that each grid cell is not independent anymore (1 value was split into more). Could you comment on effect of this for your analysis? Would your results change if instead of matching IBI-REA resolution, you would match the data set with coarser resolution?

- L144: what do you mean by "inhomogeneity of uncertainties"?

- L148-152: You talk here about some of the divergencies of the ensemble and the OMI product. Might also be worth mentioning that positive trends are seen in the ENS in along the Northwestern European shelf, but this is not seen in the OMI product.

- Another thing that caught my eye in Figure 2 is between 30-36°N the trends are not significant for 0-150 and 0-700m, but they are from 0-2000m. Suggesting that the uncertainties become smaller when the deeper layers are added, which seems counterintuitively to me. Or maybe is just an artifact of the intensification of the trends with the deeper layers (as stated in L155)? Could you comment on that?

- L162-L165: this should be in the methods section.

- L175: It was unclear to me what was meant by 'yearly basis'. Did you use yearly values for the diagrams? Looking at Figure 3 and the results, I believe you used trends of temperature and salinity for the diagrams... but this was unclear.

- Figure 3: Just a suggestion: since you discuss the water masses, maybe you could actually add boxes in the T/S diagrams indicating where is each water mass? (I had to go back and forth between the definition of the water masses and the figures to know which one was at the surface and which one was the intermediate and the bottom one.

- L185: "a positive trend of temperature entails a positive trend of salinity". Is it only temperature influencing salinity, or vice-versa?

- L198: you state that the positive trends in LSW could be explained by the connection between the MOV and LSW. But what about box 49N, in which MOW has negative trends? Then the positive trends seen in LSW in that box could not be due to the MOW influence…

- L209-210 and L218: these conclusions are wrong if the values in Figure 1 of 0-150m are correct.

- L220-228: This is more of results than conclusion. Maybe would fit better in the previous section.

Technical corrections:

- L44: Here is the first time the acronym "IBI" is used in the main text. You should write it out Iberian-Biscay-Ireland the first time it is mentioned.
- L45: Typo: 'info' -> information
- L46: Typo: 'regions closed to coastal areas -> close
- L49: OSRs is mentioned for the first time, without being defined (and appears written out in L91). I suggest just using the expanded version in both places, since the texts already has a lot of acronyms.
- L54 and L63 both define Mediterranean Outflow Water (MOW). An acronym is usually only defined once.
- L57-59: You should either use 'although' or 'nevertheless', but not both in the same sentence. If you keep 'although', then the semi-column after limited should be replace by a period. And in the last part of the sentence "these studies give some…" you can remove "these studies" and change "give" to "giving".
- L80: NAO hasn't been defined. And it actually appears written out in L218.Again, I suggest just using the expanded version in both places, since the texts already has a lot of acronyms.
- L103-105: "Since the objective of this work is the analysis of OHC in the IBI region integrating results from surface down to a maximum of 2000 m depth., Tthis study has included all Copernicus Marine products that provide gridded data of potential temperature with vertical coverage from surface down to at least 2000 m. '
- L146: typo: booth -> both
- L155: It should be 'larger' instead of 'bigger': "the larger the integration depth, the larger is the observed trend".
- L208: "being these indicators useful …" -> "these indicators are useful …"
- L210: "Despite the regional analysis …" -> "While the regional analysis …"
- L213: end of the line, between OHC and Table 2 should be a period and not a comma.