

## **Response to the Editor for sp-2022-11**

Considering the comments of the reviewers, your manuscript is returned for a minor revisions (review by the editor).

Thank you.

Please consider carefully the residual comments of reviewer 1.

We responded the reviewer 1 below as requested.

Further, I think that the differences among the various datasets should be commented more in detail. Could you add to the manuscript a plausible explanation of the different trends emerging from the various datasets?

Thank you. We add the following interpretation of ours for the differences in trends among different products. *“The differences in trend in different products that we used are mainly due to the discrepancies at the beginning of the timeseries. The weak consistency among the reanalyses visible during the first decade is likely due to the lack of observations not sufficient to constrain the different models which use different physics and initialization (e.g., Masina and Storto, 2017). The reduction of the spread among the products evolves in parallel to the increase of the observational coverage after the advent of the ARGO network. The observational products will be impacted from the scarcity of the observations in the ‘90s, since they rely on statistical methods.”*

Could you describe the geographical difference of the trends? Are there areas where there is substantial agreement and other areas where uncertainties are large?

In Table 1, we present the trend in the eastern and western basins separately. In Fig. 2d, we show the geographical distribution on the map for the MEDREA24 which is the closest product to the ensemble mean. We add the following interpretation to the manuscript *“Differences among different products, especially the objectively-analysed observations and GREP, for the trend is larger in the western basin. They are more confined around the mean in the eastern basin which may explain also the lower spread in this area as discussed below in Fig. (3b).”*

Please provide a revised version, that accounts for the comments of reviewer 1 and for my requests, a copy of your manuscript where all your changes are annotated and the list of your detailed answers to the reviewers' comments.

We hope that the actions taken to revise the manuscript address the suggestions from the reviewer and the editor precisely and accurately.

## **Response to the Reviewer #1 for sp-2022-11**

The authors have done a good job to answer all my previous concerns, and extend the discussion to several important points (e.g. reanalyses vs objective analyses, reference period, etc.). Therefore, I am happy to recommend the manuscript for publication, beside a couple of additional minor requests.

We thank again the reviewer for kindly commenting on the revised version of our manuscript and appreciate the modifications that we did following their suggestions. Below are our point-by-point responses to the issues raised on the general aspects and minor suggestions. The reviewer comments are highlighted with italic typeset with grey fonts while our response is in default typeset.

1) The sentence "In the CORA, the objective analysis is performed on measurement's anomalies relative to a first guess, at the 15th day of each month" is not very clear to me. Is the background also a climatology? Or a persistence? In any case, one additional suggestion for the authors is to add in Figure 2 (a-c) a climatology like WOA18, which will definitely shed light on how much OAs are close to climatology, or instead pre-Argo data were partly sufficient to sample the basin-averaged upper ocean salinity.

We thank the reviewer for this comment and suggestion. The methodology used to produce the CORA product (INSITU\_GLO\_TS\_OA\_REP\_OBSERVATIONS\_013\_002\_b) is extensively presented in the product quality information document (QUID) listed in Table 3. Briefly, it reads as "*The first guesses are built on the basis of the monthly climatology developed by the World Ocean Atlas 2013 ([www.nodc.noaa.gov/oc5/woa13](http://www.nodc.noaa.gov/oc5/woa13)). The monthly climatologies covering the period 1985- 1994, 1995-2004 and 2005-2012 are interpolated to provide monthly temperature and salinity fields centered the 15 of each month. This method allows us to provide accurate first guess reproducing the climate tendencies over the covered decade.*" Therefore, the dataset is already quality controlled with respect to WOA. Therefore, with all our respect, we have to say that we find it beyond the scope of this work to assess the quality of CORA and ARMOR3D products considering the purpose of this study. To make the sentence mentioned by the reviewer clear, we substitute "*In the CORA, the objective analysis is performed on measurement's anomalies relative to a background, at the 15th day of each month while in the ARMOR3D the first guess is adopted from World Ocean Atlas 2018.*" with "*In the CORA, the objective analysis is performed on measurement's anomalies relative to a first guess provided by World Ocean Atlas 2013 monthly climatology for different decades, to accurately reproduce the climate tendencies, is interpolated and centered at the 15<sup>th</sup> of each month. Instead in ARMOR3D, the first guess is adopted from World Ocean Atlas 2018.*"

2) Figure 2d: I think a more intuitive unit can be used, like  $\text{psu} \cdot \text{decade}^{-1}$

Thanks. We replaced the Figure 2d, as suggested by the reviewer, but with  $\text{psu} \cdot \text{year}^{-1}$  to be consistent throughout the text and with earlier studies referred.

## References

Masina S., and Storto, A., 2017. Reconstructing the recent past ocean variability: status and perspective. *Journal of Marine Research*, 75, (6), pp. 727-764(38).