

Dear Reviewer,

we want to thank you for patience, time and for the opportunity to further revise our manuscript.

We would like to apologize for the repeated omissions and inconsistencies that occurred during the manuscript update process. Several rounds of revisions and document modifications unfortunately resulted in some changes not being properly reflected in the submitted version.

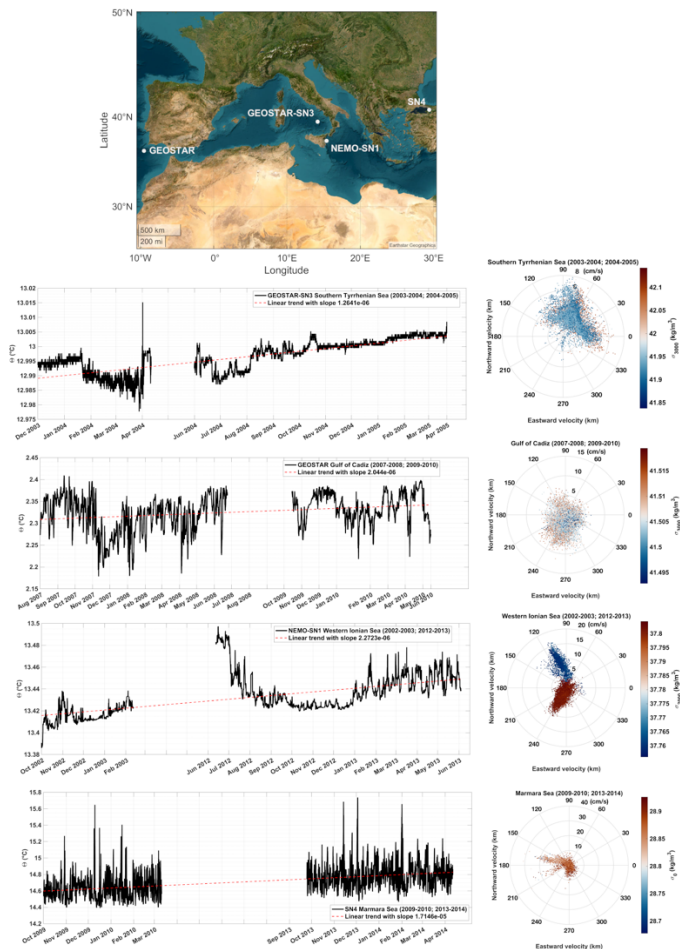
We have now carefully reviewed the entire manuscript once again and addressed all remaining comments, including the minor and editorial suggestions, according to the indications received. We have also verified the consistency of the references, figures, tables, and text revisions throughout the manuscript.

We are grateful for the time and effort invested in improving the quality of our work, and we hope that the revised version satisfactorily addresses all the remaining concerns.

6. Nevertheless, despite the improvements made to Figure 7, it is still hardly readable in a printed version of the manuscript. The legend of the different time series are small, as well as tick labels, and colorbar label. I understand the difficulty that the author is facing to present two time series and a map in the horizontal. I propose an alternative on the next page for the layout which would make the different elements easier to read.

I also detected that σ_{2000} , σ_0 and σ_{3000} are used in this figure. I would recommend the author to change “ σ_{2000} , calculated with reference pressure of 2000 dbar” (L425) to “ σ_0 , σ_{2000} , and σ_{3000} , calculated with reference pressure of 0, 2000, and 3000 dbar respectively”

Thanks for your comment. We changed σ reference as suggested, and also we have optimized again the image hoping this new vertical version can be more suitable.



8, 9, 10. I appreciated to read the revised version of the manuscript concerning the point 7, and I think the text is now more balanced. For the comments 8 and 9, the manuscript still appears to present an ambiguity. In L.444 (previously L.404 – comment 8) I am still concerned with what the author wrote “*providing a coherent and reliable estimate of a decadal-scale warming process*”. This interpretation does not appear balanced enough: the trend is derived with a time series constituted of 5 months between 2002 and 2003 (October 2002 to February 2003) and one year from June 2012 and June 2013 which question its reliability for the detection of a decadal-scale warming process. The manuscript mention changes in density and current direction, as well as changes in deep water masses properties. I encourage the author to clarify whether the dynamic in the at NEMO-SN1 is due to a decadal warming scale process, a change in the deep-water mass, or a combination of both.

Before answering, please read the comment for the answer 10.

I thank the author for this clarification. I understand the intention of the author to distinguish the long-term trend observed across the different sites and the Ionian Sea BiOS-related variability. The author's answer "These processes may be interconnected: modifications of deep thermohaline properties, can influence the density structure of water masses and potentially contribute to circulation changes at larger spatial and temporal scales" is appropriate. But the text is less balanced ("reliable", "coherent", "real change"). I would suggest that the author use his response to refine my comments for the answer 8 and 9, explicitly distinguishing decadal variability in the Ionian basin and long-term temperature trend.

We thank the reviewer for this additional clarification and agree that some of the wording used in the manuscript may have overstated the strength of the interpretation. This study is not focused on the analysis of the underlying physical processes governing the observed variability. Its primary objective is to present standardized, quality-controlled long-term observations from deep-sea observatories and to highlight the presence of a consistently positive temperature signal in the deep Mediterranean.

The NEMO-SN1 example is presented to illustrate how changes in deep-water thermohaline properties can be associated with modifications in circulation patterns, as evidenced by the observed density and current-direction changes. The mechanisms linking deep-sea warming, water mass transformations, and decadal circulation variability remain the subject of ongoing process-oriented investigations and are discussed in dedicated studies, some of which have already been published by our group and are cited in this paper (Artale et al., 2011; Giambenedetti et al., 2024). Therefore, rather than providing evidence of a specific climatic or decadal process, the observations presented here emphasize that measurable changes are occurring in the deep layer and that these changes may contribute to variability and circulation adjustments at larger spatial and temporal scales. We have revised the text to avoid terms such as "reliable", "coherent", and "real change", and to more clearly distinguish between the observed positive temperature signal and the interpretation of the physical

The higher value observed in the Ionian Sea reflects the fact that it was derived from two time series collected a decade apart, [providing observational evidence of a positive temperature tendency in the deep layer](#).

In the NEMO-SN1 case in the Ionian Sea, the variability observed over one decade does [not represent a simple warming signal but also changes in deep-water mass properties and circulation patterns](#) (Malanotte-Rizzoli et al., 1999; Hainbucher et al., 2006; Artale et al. 2018).

11. I appreciated the modification of the manuscript by the author which is now more balanced. I would still suggest the author to also introduce this balance in the conclusion as I wrote in my earlier comment. In "*the reconstruction of longer and more continuous records increase the resolution and robustness of spectral estimates...*" _the "robustness" may not guarantee by reconstruction especially with SSA/OI and in "*the application of advanced analytical methods [...] minimized spectral leakage and enhances the reliability of frequency domain diagnostics*", the article did not show a leakage reduction quantitatively, neither a quantitative validation for the "reliability".

Following the reviewer's suggestion, we have revised the conclusion to adopt a more balanced wording as follows:

Standardizing these methods ensures [data consistency and facilitates the effective](#) use and sharing of information essential to understanding deep-sea variability, still among the most poorly characterized components of the climate system. Beyond data collection, [the analytical approaches](#)

presented in this study provide a framework for investigating the temporal variability of oceanographic records and identifying dominant modes of variability across a range of time scales. Furthermore, the reconstruction of longer and more continuous records can facilitate spectral estimates by reducing data gaps and improving the characterization of periodic signals, thereby supporting a more comprehensive interpretation of the frequencies associated with the observed oceanographic processes.

Secondary comments

12. I thank the author for the modification of the manuscript. He may have missed on L.109 where sensor efficiency is still referred as storage efficiency.

We thank the reviewer for pointing this out. We were unable to identify the reference at L109 mentioned in the comment, likely due to the evolution of the manuscript and the line numbering changes introduced during the revision process. However, we found an additional occurrence of the term "storage efficiency" in Section 3.2 (formerly around L195) and have revised it to ensure consistency throughout the manuscript.

14. I thank the author for the modification of the manuscript. He may have missed on Fig.3 caption where it is still referred as "horizontal (U) velocity"

Now Fixed

18. The author may have missed to change the manuscript, as he mentioned "done" in the answer. I kindly ask the author to check it.

I apologize for this oversight, now corrected as follow It also helps prevent the storage and analysis of erroneous data, while enabling prompt corrections that can minimize inaccuracies during critical monitoring periods. (L281)

19. Could the author tell me where he added the reference for Table 3?

We thank the reviewer for pointing this out. For some reason, these references were inadvertently omitted from the latest version of the manuscript. We have now reinserted them (Millot 2005 and Robinson 2001) both in the reference list and in the main text (L302).

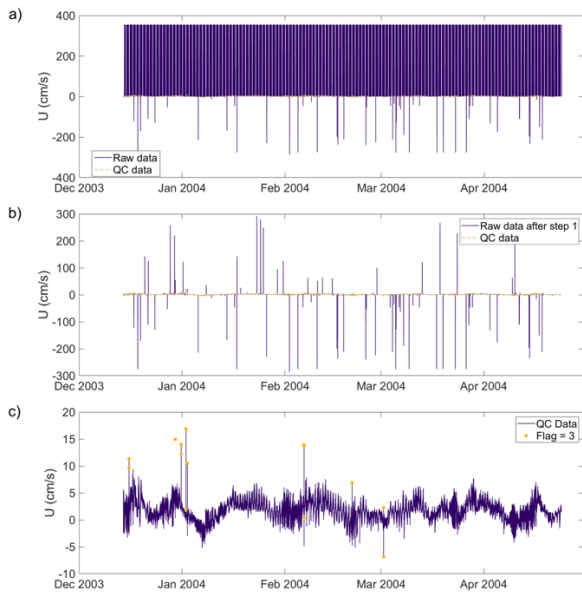
20. The author answered that "The reference to the models has been removed" but it is still present in the revised manuscript I downloaded

I tried to better explain this part separate comparison from correction, as follow

In contrast, delayed mode QC provides a more comprehensive review to improve data accuracy. It involves comparing measurements with reference datasets, historical records, and, where appropriate, model outputs to assess the consistency of the observations. This process supports the identification and correction of errors that may have been missed during real-time processing.

25. No change appears in the revised manuscript for the Fig.5 while the author wrote "improved" as an answer.

The updated figure is shown below. For some reason, it was not included in the latest version of the manuscript. We have now restored it in the revised manuscript.



Other small comments (editorial corrections, rephrasing, missing reference in the list)

All small comments were now addressed and solved.