

Final Response Letter Template (EGU/Copernicus)

Title: Author Response to Referee Comment(s) on egusphere-2025-3810

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Manuscript Title: SODA4: a mesoscale ocean/sea ice reanalysis 1980-2024

Dear Riccardo Farneti and Reviewers,

We would like to thank the reviewers for their constructive comments and suggestions, which have helped improve the manuscript. Below, we provide a point-by-point response to all comments.

Response to Referee #1

Comment 1: The paper presents the new eddy-resolving SODA4 reanalysis, which represents a step forward in the reconstruction of the ocean climate with the inclusion of mesoscale signals.

As such, it is broadly interesting for the ocean community, the included verification shows very good performances, and I recommend the publication after a few issues are addressed, mostly, but not all, minor. In some cases, the authors could spend some more time describing the specificities without indicating references, so that the SODA4 description appears self-contained in the manuscript.

Response: Many thanks for these comments/feedback/suggestions. We've tried to make the modifications recommended below. The large (19 figure) supplemental materials section is designed to provide the technical details that might interrupt the reading of the main paper.

Minor points

Comment 2: L74-75: Change of advection scheme may have an impact on temporal consistency of momentum and energy; can you specifically comment on the changes in the main text?

Response: [A comment is added to the text on the lines 76-77 referring to Section 3.](#)

Comment 3: L114: More details needed. Is the difference of heat or freshwater spread/pushed into purely input fields (shortwave and precipitation)? Or are the net fluxes bias corrected with climatological analysis increments corrected to fluxes?

Response: [The former. The details are added to the text on the lines 114-118.](#)

Comment 4: L152: So is assimilation also performed every 10 days? Using observations in the previous 10 days?

Response: Explanation of the recycling of observations is added in the text on the lines 152-155.

Comment 5: Figure 6: The salinity panel is not really informative; the palette should be changed

Response: fig. 6 salinity shade levels have been increased.

Comment 6: Section 3: I feel this could go in an appendix, in order not to interrupt the scientific discourse

Response: Most of Section 3 has been moved out of the main text as requested, to Supplemental Materials (Text S2 and Table S6), except for the discussion of the four streams and the impact of changing advection schemes (L181-187 and 191-199).

Comment 7: L203 : It would be useful to quantify the depth below which there are discontinuities due to the change of stream. The upper ocean is likely unaffected, but the deep and abyssal layers are, so users should be aware of such discontinuities.

Response: Text has been modified (L185-191) and an additional figure added to Supplemental Materials (Fig. S8b) to quantify the depth below which there are noticeable changes due to the change of stream and advection schemes .

Comment 8: L204: As mentioned earlier, to say whether this changes energy/momentum

Response: The text earlier on lines 75-77 now mentions this possibility.

Comment 9: L210: The authors need to mention that this is not an independent dataset (as EN4 relies mostly on WOD). Comparison with altimetry should be carried out, as this is a completely independent dataset, and I recommend including it.

Response: The reviewer is correct about the similarities of the input profile data sets for SODA4 and EN4. The text in lines 209-217 has been modified to emphasize this point. A comparison of sea level to satellite altimetry has been added as Section 4.3 (lines 256-265) along with an additional figure added to Supplemental Materials (Fig. S19) at the request of another reviewer. We focus on the eddy-rich western boundary current regions for the sea level comparison.

Comment 10: Section 4: I suggest adding a comparison of heat transports where known (RAPID, etc.).

Response: We considered adding discussion of heat and salt transports but decided that those calculations would raise scientific issues that deserve separate studies. We are also concerned that vertically integrated heat transport estimates would be impacted by the changes in the advective schemes.

Comment 11: Table 3: Is there a reason why OSNAP-West is excluded?

Response: OSNAP-West, which is separate from OSNAP-East, has a low ~2.7Sv net volume transport 75% of which enters through narrow Davis Strait which is reported in Table 2.

Comment 12: Also, the time period changes across observation-based estimates. Is this considered in the Table when the mean is computed?

Response: We have not attempted to provide estimates of how the observed volume transports might depend on the time interval during which the measurements were being collected. Such estimates relate to the interesting issue of long-term changes in transports and AMOC. We think this deserves a separate study.

Comment 13: Additionally, simple scores like correlation that quantify the correctness of the temporal evolution of the transports should be included as well (with a statistical significance statement).

Response: The time evolution of the SODA4 passage and overturning transports are presented in Supplemental Materials (Figs. S15-S18) rather than the main text partly because the observed mooring time series cover only a small portion of our 45-year period of interest. One of these, the RAPID AMOC volume transport time series, is included as a black line on Fig. S18. Based on Fig. S18 we think the large uncertainty in volume transports associated with day-to-day variability would give low correlations with high uncertainties. We think comparison of means are the most reliable comparisons. We'd prefer to leave the issue of the processes driving transport variability on different time-scales for a separate study.

Typos/Language

Comment 14: L11-12 "The method of construction" (of what?) is unclear, needs to be reworded

Response: phrase modified to: 'The method of construction of SODA4'

Comment 15: L37 broken sentence, to be rewritten

Response: not really sure where the problem is

Comment 16: L108 the use of 15 to indicate ERA5 (considering ERA15 existed) is quite cryptic and unfortunate. Is it not possible to change it?

Response: The numbering cannot be changed now. ERA5 is the 15th surface forcing product we have used in the SODA project. Incidentally, number 5 was ERA20C.

Comment 17: L155 "Since..." broken sentence

Response: Fixed. Thank you

Comment 18: Caption of Figure 8: "monthly means" I guess here

Response: Fixed. Thank you

Comment 19: L223 “300-1000”

Response: [Fixed](#)

Comment 20: Figure 9’s caption: “temperature anomaly”

Response: [Fixed](#)