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“Variability of manometric sea level from reanalyses and observation-based products over the Arctic and North Atlantic Oceans and the Mediterranean Sea” by

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Reply to Anonymous Reviewer 1

We thank the reviewer for the careful reading, the encouraging comments, and the many suggestions to improve the quality of the manuscript. We report below a point-by-point answer to the Reviewer’s comments (Reviewer in bold font, our reply in regular font). Additionally, please note the limits in terms of the number of words and the number of figures for this type of submission, which we already exceeded in the original version; therefore we cannot add new figures/text but only improve/change/rearrange the original manuscript.

Finally, the GRACE dataset went through reprocessing, and we have replaced the previous dataset with the most recent one, which shows some non-negligible changes in the North Atlantic and Arctic regions.

Main comments

This is a short and to the point paper, but perhaps it is a bit too short: I am missing some details and information that I think would make it stronger and more informative/appealing, as at the end, I’m left with the question: is there one method really better than the others? The authors write that ‘The results are intended to (..) guide users in the choice of the specific product, depending on the region of interest’ (L282-283), but to me it is not clear what the choice should then be based on, as with this information it is not possible to pick a ‘best’ approach, or is there something I’ve missed?

We are adding a few sentences on this in the last section (say lines), also incorporating the comments from the second reviewer about reliability of the data in the Arctic region, observational sampling, etc.

Uncertainties. There is very little attention to the spread in the results, and uncertainties are only sparingly mentioned or shown. For instance, Figure 1 (or any of the figures and most of the tables) shows no uncertainties, while this should be possible (?), given that for instance the GRACE dataset is an ensemble of 120 solutions. Including the uncertainties is essential to get a feeling for the consequences of using different methods in the manometric sea level in the different basins, and as it stands the three methods can only be compared very qualitatively.

Adding uncertainties in Figure 1 would decrease the legibility of the figure, already very busy. Note also that Table 2 (and related discussion) already contains (last column) the time-averaged uncertainty for each dataset and basin. In the revised version of the manuscript, we aim to add the uncertainty bars on the yearly mean lines of Figure 1.

Comparison to the global mean/total sea level change. Is it possible in figure 1 to also include (a panel showing) the global mean barystatic change for the three methods? (or at least GRACE and SLB, given the argumentation in I161?). Now showing only the global barystatic from SLB in Fig 1 feels a bit arbitrary as the reader does not know how similar (or different) these global time series are. In fact, showing the total sea level change (not only the manometric) for the global mean and the basins might be interesting too for reference, especially since for instance I.200 refers to the total change?

As mentioned above, the length of the manuscript is limited, so we cannot add any more figures. The reviewer may refer to Barnoud et al., 2023b (reference available in the manuscript) for comparing the barystatic sea level changes from the SLB and GRACE methods. We will add a sentence on this in the revised version of the manuscript.

Regional differences. Is it possible to include maps: how does the manometric signal vary spatially in these basins? I understand that time series are difficult, but the authors could for instance plot the linear manometric trend (mm/yr)?

This is an interesting point; however, as we mentioned above, we already exceeded the length of the manuscript and the number of total figures. Unless the editor grants us the possibility of adding another figure, to remain within the manuscript limits we cannot add a figure. We will comment on the spatial distribution in the revised version in a new sentence, adding, however, “(not shown)”.

Figures. Please, can the figures be constructed in a colour-blind friendly way by choosing different colours (figs 1&2) and/or line styles (fig 1)? I'd suggest to change the colour bar of Fig 2 into a gradual one (choosing one colour which gets darker for higher correlation), as the colours now make it near impossible to interpret this figure. (see <https://www.nature.com/articles/s41467-020-19160-7> for reasons why the rainbow scale is not a good scale to use). Alternatively: wouldn't it make sense to provide this fig3 information in a table format, so that uncertainties can also be included? Fig 1; Would it make sense to plot the linear trends in figure 1? (it may become too busy though). Fig 2; given that these correlations are mirrored, wouldn't it make sense to only show the half matrices, as basically one only needs the three blocks in the upper left corner of each correlation plot. Fig 3; can uncertainties whiskers be included on the bars?

Thanks for the suggestion, we will replot the figures in a color-blind-friendly palette. Regarding the additions: figure 1 is already too busy, especially if we add the uncertainty bars. Figure 2: we can explicitly state that the correlation matrices are symmetric by construction; however, we already tried to plot half matrix only, and the plot is less aesthetically appealing than plotting the full matrix. Figure 3: yes we will add the uncertainty.

Minor comments

Is there a specific reason for focusing on these three basins? The data covers the global ocean, doesn't it?

We chose these basins as a compromise between geographical interests (basins of interest for the European communities and, thus, the Copernicus Marine Service, excluding however too small basins - Black and Baltic Seas, etc. - which won't be enough constrained by the observing networks used, and for which the recourse to regional modeling systems would be more appropriate). We will add a short sentence on this.

L 85. 'assessing the multi-method mean signal' – I don't think this is done in the paper? I could only find this for the separate methods?

Thanks for spotting this inconsistency. Indeed, this objective was planned in a preliminary version but has not been treated in the present manuscript, and will therefore be removed in the revised version.

L184 'significantly different' – is this statistical significance?

The basins show many statistically significantly different metrics, but here it was meant in a more general (not statistical) sense, so we remove "significant" for clarity.

L186-188; 'except during the first and last years'? ; is it only due to the final year that the trend is this high? How sensitive is the trend to those first and last years?

Thanks for pointing this out. Indeed, the bootstrapping technique used to quantify the trend uncertainty removes part of the timeseries, and thus exactly quantifies the sensitivity of the trend to individual years. We add a sentence on this to explicitly point it out.

L190 add a cross-ref to Table 3 here

It will be added in the revised version

L200 'the global barystatic signal'?

The barystatic is defined as the mass component of the global mean sea level changes (Gregory et al., 2019). Therefore, referring to the global barystatic is a repetition (tautology). We thus prefer to use one (global signal) or the other (barystatic signal).

I203 – unclear what 'the total trend' is: is this the total barystatic trend, and is it in the basin or the global mean? How can the trend in a basin 'explain' a total trend? (the other way around sounds more logical?)

"total sea level trend" means the SSH trend (manometric plus steric) as seen by altimetry. We will clarify this point in the revised version.

L212 – 'generally': in the NA and Medi, the correlations between GRACE and other datasets are always lower than for the SLB-GREP combo, isn't it?

Thanks, you are right. We will modify the sentence accordingly, removing the adverb "generally".