

Response to Anonymous Referee #RC4

Ref #RC4: *The claim at the end of the abstract, that the reconstruction is useful for studies of long-term variability in other regions has a good perspective to become true when the reconstruction is analyzed with respect to dynamics and climatic change in other regions. The paper is an important and useful contribution by evaluating the potential of the global sea level reconstruction of Dangendorf et al., 2019. I would recommend publication in Ocean Science after minor revisions.*

Response: The referee is thanked for the positive comments. Indeed, a follow up research now underway is looking at the dynamics of other regions- it was important though to first demonstrate the potential usefulness of the reconstruction at one region, as done here.

Ref#RC4: *The region defined to calculate the GS-MAB proxy does not include some of the strongest signals shown in the maps in Fig. 1. It would be useful for the reader to have some sort of statement about the sensitivity of the conclusions from Section 3.1 on the definition of the GS-MAB region.*

Response: New Fig. 1 (see below) shows the 2 chosen regions and compares the RecSL with altimeter data. The text explains that these are the regions with SSH gradients that can be used as a proxy for the GS. The change in SSH (now Fig. 2) is aimed at showing changes around the GS regions and the subtropical gyre that connects them. Since the results are area-averaged, they are not very sensitive to slight changes in the chosen regions.

Ref#RC4: *The caption of Fig. 1 suggests that the sea level differences between individual years are shown. The text describing Fig. 1 does not specify details. As the authors point out, the interannual variability (Fig. 2) in the southwestern North Atlantic is high and the maps in Fig. 1 might not be representative for sea level rise in the 20-year periods shown. Maybe a form of average sea level rise during the different 20-year periods would be more appropriate?*

Response: The caption (new Fig. 2) and associated text were edited and are clearer now. We think that showing the spatial changes (new Fig. 2) and temporal changes (new Fig. 3) are sufficient demonstrations of the differences between global and regional changes, while the focus of the paper should be on the dynamics in the following sections.

Ref#RC4: *I appreciate the placement of the findings into the larger picture in paragraph from 1179 to 1206. It is on the other hand more like a discussion of the results and the authors might consider to move this part to Section 4.*

Response: Following suggestions by Referee #RC1, the organization of the paper has been largely changed to make the results and conclusions more logical and clearer.

Ref#RC4: *Fig. 8d and Fig. 9a show a somewhat different correlation between the GS-MAB proxy and the FC transport. It would be interesting to discuss whether this difference is related to the lengths of the time series or to other factors.*

Response: Thanks for the suggestion, a very good point. Indeed, the FC record used by RAPID (new Fig. 11d) is shorter than the entire FC measurements (new Fig. 7a), thus the differences in modes captured and in correlations- an explanation of this point was added (lines 360-362).

Ref#RC4: 1378: *long-term variations in regional dynamics can be captured quite well by this global reconstruction, therefore providing a useful tool for studies of long-term past variability in other regions as well. This statement is probably true, but it has to be shown in the future.*

Response: As mentioned before, we are studying now the RecSL in other regions, with some promising preliminary results.

Ref#RC4: Technical details:

Response: All those typos and text edits were corrected. Thanks again.

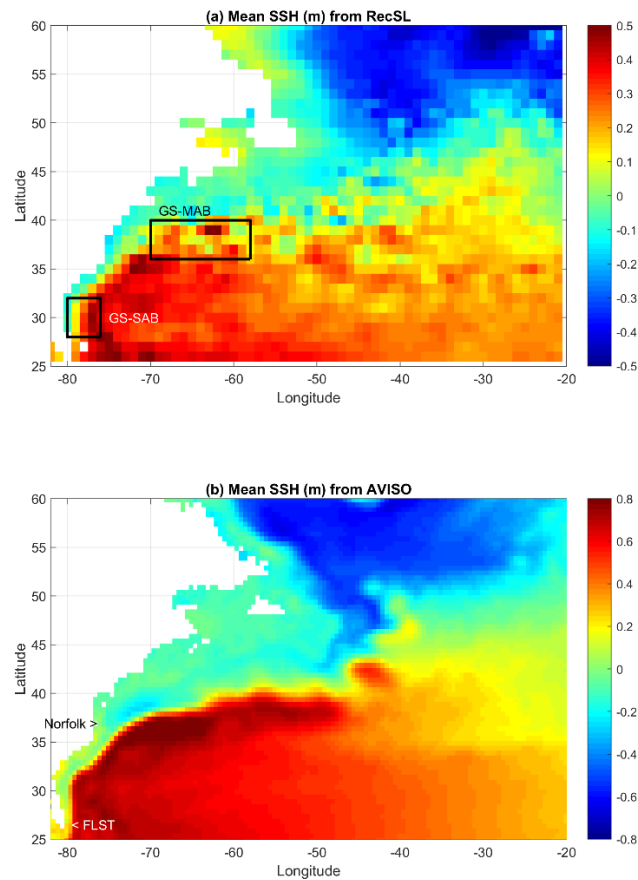


Fig. 1. Mean sea surface height in the North Atlantic Ocean during the satellite era (1993-2015) obtained from (a) the RecSL reconstruction on a $1^{\circ} \times 1^{\circ}$ grid and (b) the AVISO altimeter data on a $1/4^{\circ} \times 1/4^{\circ}$ grid. Note the different color scale. The regions where the proxy Gulf Stream is defined in the Mid-Atlantic Bight (MAB) and the South Atlantic Bight (SAB) are marked in (a) and the location of the observations of the Norfolk sea level and the Florida Current transport at the Florida Straits (FLST) are marked in (b).