Biogeosciences Discussions

Biogeosciences Discuss., author comment AC5
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Reply on RC5

Jannes Koelling et al.

Author comment on "Oxygen export to the deep ocean following Labrador Sea Water formation" by Jannes Koelling et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-185-AC5, 2021

Dear Reviewers,

Thank you all for taking the time to read our manuscript and provide constructive and helpful feedback that we believe will improve the final version of the paper. We hope that despite the unusually high number of reviewers we were able to sufficiently answer all of your comments. There were two main suggestions for more significant changes that were each picked up by several reviewers, with some overlap in the reviewer's comments: The estimates of oxygen export from the Labrador Sea and oxygen demand in the Atlantic Ocean in section 4.2, and the definition of LSW "export" used for Figures 7 and 9b. We found it appropriate to address all these comments together in a comprehensive manner, rather than responding to each reviewer separately. The answers to the reviewer's comments on these topics and proposed changes for the revised manuscript are summarized in a supplement file which we uploaded along with each author comment, and the individual response to each reviewer's more specific comments is found below.

Kind regards,

Jannes Koelling

Reviewer 5

Minor comment

Since the authors discuss the differences between the properties of the Labrador Sea Water (LSW) and the Irminger Water (IW) I would expect a comparison of the temperature and salinity (and maybe oxygen?) ranges of these two water masses with previous studies. Last, it is not clear until almost the end of the manuscript that the authors refer to the water mass that is formed during convection in the Irminger Sea as Irminger Water.

The temperature and salinity ranges from previous studies are what is used in Figure 5 to define the IW and LSW properties. We will also add a reference to Yashayaev & Loder

(2016, JGR: Oceans) to refer the reader to section plots of T, S, and O2 to help with interpretation.

Specific comments

Line 61: *(and elsewhere) change analyse to analyze.*

Figure 3*: The second paragraph within the caption should be moved to the main text.*

Line 114: *Please add a reference for the definition used to calculate the MLD.*

Suggested changes above will be included

Line 116: *The definition of the export of a float is not very clear. Do you define as export when a float crosses the 3000 m isobath and then reaches to a certain location to be considered out of the Labrador Sea or when a float enters and remains into the boundary current?*

Export is defined when a float enters and remains in the boundary current, but using a stricter criterion such as requiring export past 53N does not change the results (see supplement file)

Figure 4: *Would it be better to have all the stations in one plot with different line colors? Otherwise, please keep the same limits on y-axis for each panel.*

(Copied from response to Reviewer 2) The y-axis is the same for K8-K10, and is only shifted down by 5uM for K7 since mean concentrations are lower, but the vertical extent of each axis is the same. This is done to "zoom in" as much as possible on the curves to highlight the variability while still showing all data points. We will add this information in the caption, but we can also adjust the axes limits to be consistent between all panels if preferred.

Figure 7: *Do all these floats reach the 53°W section after subduction?*

No, these are just the floats that are exported by entering the boundary current; about half of them later reach 53N. However, the timing of floats entering the boundary current does not change if we only consider those that are later exported south of 53N - see supplement file for more details

Line 201: *Please specify the number of floats instead of mentioning "handful".*

Exact number will be added

Line 235 and Figure 9: *I understand that the LSW input into the boundary current is*

defined based on the float data introduced in section 3.1, but could you specify a bit more the calculation of the LSW input?

LSW input is simply based on the number of floats exported (as defined above), see supplement file for more details. A more thorough explanation will be added to the methods section

Figure 8: *Is the separation between LSW and IW in terms of spiciness arbitrary or is it based to previous studies?*

The values chosen for spiciness are arbitrary, but the difference in T and S properties are well established from previous studies (i..e Pacini et al., 2020)

Line 348-349: *I believe that this explanation should be also mentioned earlier in the text.*

As pointed out by Reviewer 2, our statement regarding ISIW is actually incorrect; ISIW is not the same as IW, but rather is mixed into IW in the boundary current of the Irminger Sea. We will change the statement to reflect this.

Please also note the supplement to this comment:
https://bg.copernicus.org/preprints/bg-2021-185/bg-2021-185-AC5-supplement.pdf