## Labrador Sea oxygen export and North Atlantic oxygen demand estimates

Reviewers 1 and 3 both pointed out that the intrinsic uncertainty of the back of the envelope calculation of oxygen demand in section 4.2 was not sufficiently addressed.

To add an uncertainty to the oxygen export estimate, we will change our calculation as follows: Rather than using the current speed, section width, and layer thickness for the calculation (lines 372-373), we will use the published value of mean LSW layer transport from Zantopp et al. (2017), 14.5 ± 3.8 Sv, multiplied by the LSW concentration change and integrated over time. Note that this corresponds to only a small change in transport, as the currently used values are equivalent to 14.25 Sv, and the corresponding annual O2 export estimate would slightly increase from 1.57 Tmol/year to 1.60 Tmol/year. Using the Zantopp et al value allows us to use their uncertainty value of 3.8 Sv to add an uncertainty to the oxygen export estimate, which would correspond to 0.42 Tmol/year, or 0.21 Tmol for the summertime increase

Another comment was that there may be issues with using a single deep ocean value for aOUR and a mean layer thickness of uNADW to estimate the oxygen demand (lines 386-389). To address this, we repeated the same calculation using the profile of aOUR as a function of depth obtained from the Karstensen et al. (2008) reference (their equation 3) instead of a constant value. We calculated the vertical extent of the uNADW layer at each grid point, and vertically integrated the aOUR calculated from the equation. The integral of this aOUR estimate over the Atlantic Ocean from 0-50N is 3.79 Tmol/year, which would bring the contribution of LSW down to 42% of the annual oxygen demand.

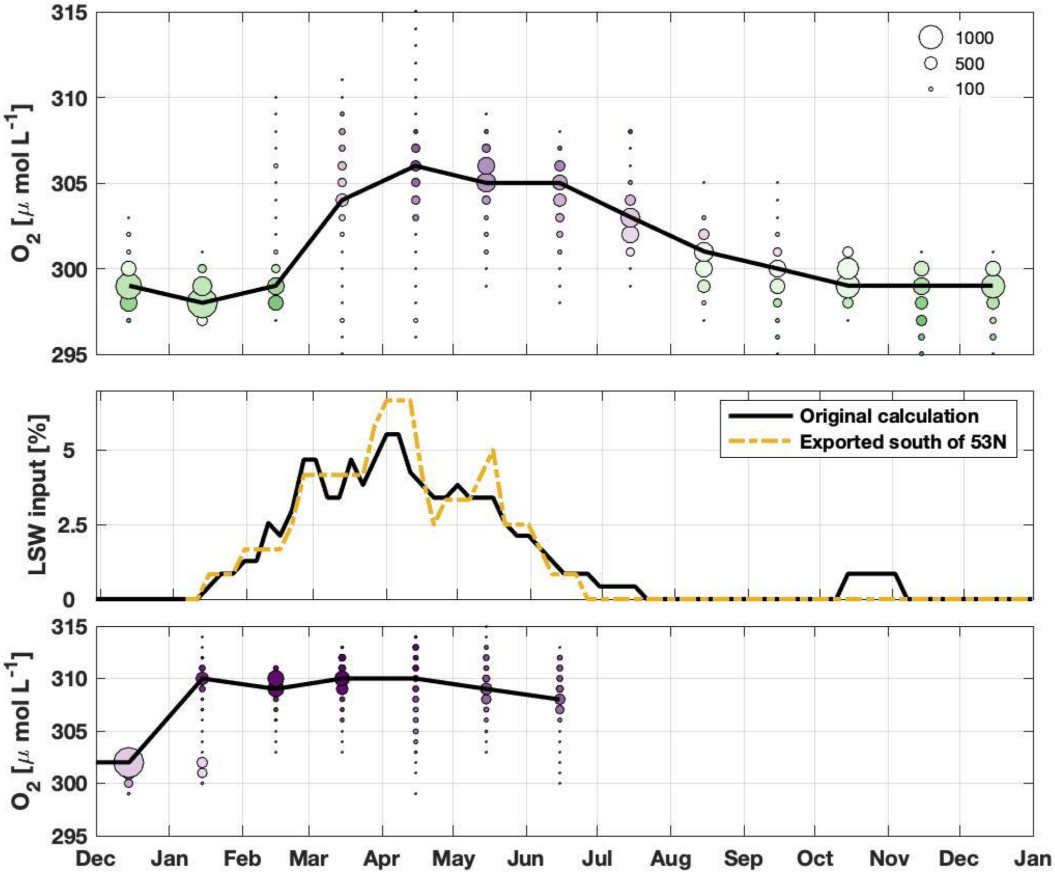
We will include this estimate in the revised manuscript along with the original calculation, to show the range of possible values based on the assumptions.

## LSW export calculation

Reviewer 2, 4, and 5 all had concerns or questions about the methodology and implications of calculating export from Argo floats, including

- Definition of export: Does the method of requiring 2 of the next 3 profiles to be in the boundary current capture export, or could floats later re-enter the interior, leading to an overestimate of export? Would a better criterion be to only select profiles that subsequently exit the Labrador Sea in the boundary current through the 53N section?
- How is the “input” of LSW from Figure 9b defined?
- Does the smoothing of the time series lead to artificial peaks that are not based on the actual data?
- Is there a difference in timing between boundary current and interior convection?

These questions are addressed in the discussion and figures below:




*New version of Figure 9, including a curve showing a stricter export criterion*

The figure above shows a revised version of Figure 9, adding to the central panel a second line of export calculated with the same criterion (2/3 following profiles in the boundary current) but also requiring the float to later be exported south of 53N, compared to the original curve. Adding this additional constraint further reduces the number of floats used in the calculation from 47 to 24 but does not significantly change the resulting LSW input estimate.

We propose leaving the analysis as in the original manuscript, but noting in the methods section that results would be similar if using a stricter criterion, and/or showing the line in the figure as shown above.

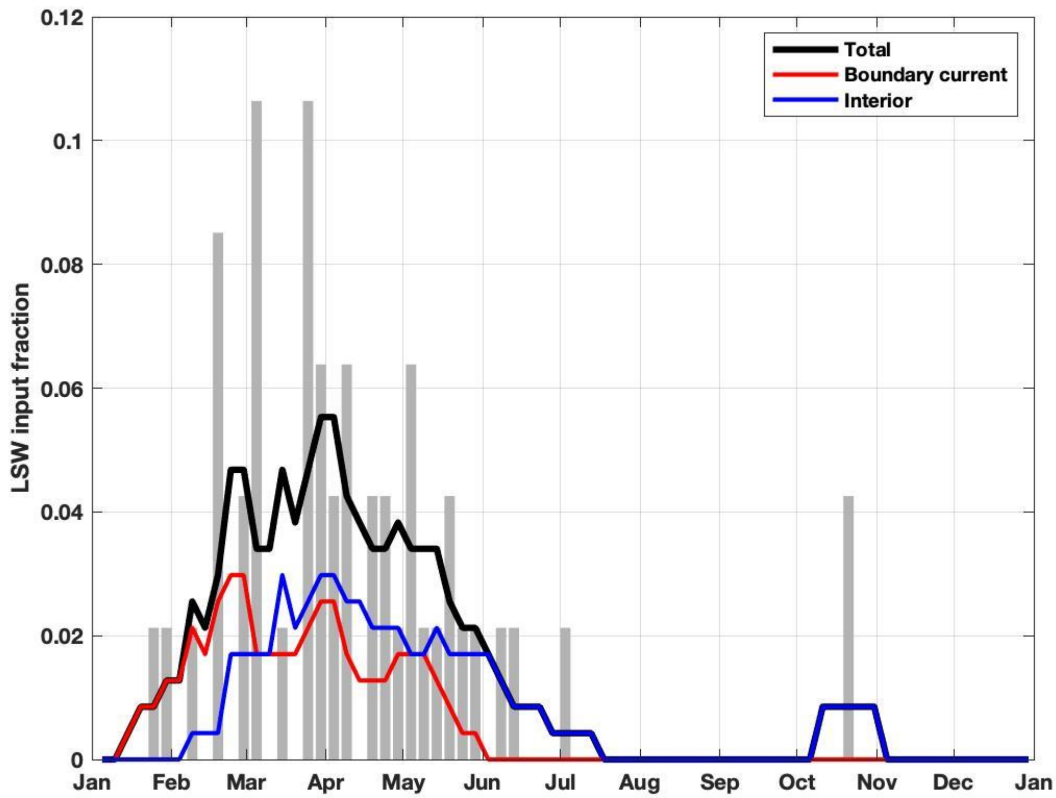



*Figure showing the curve from Figure 9b, along with original histogram in 5-day bins (gray bars), and individual curves for boundary current and interior convection.*

The input in Figure 9b is defined simply as the fraction of total exported floats that enter the boundary current during a certain time. 47 floats are considered to be exported, so a 5-day period with 5 exported floats would correspond to 10.6% LSW input, and a 5-day period with one exported float would be 2.1%. The resulting time series in 5-day bins is then smoothed with a 5-point (20-day) running mean to arrive at the curve shown in the figure. The figure above also shows the original data in 5-day bins, which we could include in the revised manuscript to better represent the timing of the input.

The red and blue lines show the difference in timing between the input of LSW originating in the boundary current and interior. The two curves are similar in shape, but shifted by about 1 month relative to each other, suggesting again that more of the early export is due to boundary current convection, while the interior contributes more strongly towards the end of the convection period. Peak total export occurs during March and April, when both are near their maximum.

While the exact numbers are likely uncertain due to the nature of the dataset and limited number of floats, this further underlines the distinction between boundary current and interior convection, and is a result that could be of interest to the community. We therefore propose to include the additional curves shown above in the revised manuscript to figure 9b.