Review on “Oxygen export to the deep ocean following Labrador Sea Water formation” by Koelling et al.

General comments

Using moored data at the exit of the Labrador Sea (~53°N), Koelling et al. reported the seasonal variability of oxygen concentration in the outflowing boundary current. The origin of the oxygen signal in the boundary current was further discussed by comparing property fields between the boundary current and basin interior, and by tracking spreading pathways of newly-convected Labrador Sea Water (LSW) with Argo floats. Finally, the importance of Labrador Sea convection was emphasized by estimating the oxygen supply from the Labrador Sea to the deep North Atlantic.

I find the manuscript well-written and the focus on oxygen export is of interest to many people in physical oceanography and biogeosciences. Even so, I still have one major suggestion. The Labrador Sea has been extensively studied, both in terms of the boundary current variability and the spreading pathways of LSW. Some of the findings in the current study, such as the seasonality and LSW pathways, are similar to previous work. Besides the oxygen export estimates, what new/different information is revealed by the current study? Specifying the novel findings in a Conclusion paragraph will greatly enhance the importance of this work.

Below I list specific comments.

Specific comments

[1]. “The export of oxygen from subpolar gyre is ~71% of the oxygen consumed annually in the upper NADW layer in the Atlantic Ocean between EQ and 50N”. This number was only roughly estimated in the Discussion and should not be listed as a key point in the Abstract.

[2]. Lines 62-64: I believe the importance of LSW in supplying oxygen to global ocean is well known, as stated at the beginning of the Introduction. I suggest the authors to refine their conclusions and implications by specifying the novel findings of the study.

[3]. Figure 2 caption: Please check “σ_θ”.

[4]. Lines 88-89: Please include 27.74 isopycnal in Figure 2.

[5]. Line 94: It may not be appropriate to call the saltier waters in the Labrador Current as “remnant of Irminger Water” since the waters are significantly mixed. “Remnant” sounds like that a part of Irminger Water is not mixed but retains in the boundary current. Maybe you can simply say it is a mixture of Irminger Water and convective water.

[6]. Line 116: You are defining the export from interior Labrador to the boundary current, instead of the export out of the Labrador Sea (stated in Line 110). Floats that once exported to the boundary current (and stayed for at least 2 cycles) could possibly re-enter the basin interior. A more rigorous selection would be to choose floats that entered the boundary current and stayed there until they exited the Labrador Sea (53N). That would give a smaller number of usable floats but appear to be more appropriate.

[7]. Figure 3 caption: Suggest using “convective interior” or “interior” instead of “convection”.

[8]. Figure 4: Please make y-axis consistent between panels. The increase of oxygen in March 2018 is quite sharp compared to March 2017. Could you please include a few comments on that?

[9]. Figure 5: Why are some high oxygen profiles (~10 $\mu molL^{-1}$) associated with relatively high temperature (~3.5C) and salinity (~34.9) at K10? Does that indicate a different source/route of the oxygen input?

[10]. Lines 175-176: If convection occurs in the boundary upstream of 53N, wouldn't the density anomalies propagate downstream to the array? Do you see that density signal at 53N?

[11]. Line 211: I do not think everyone is familiar with spiciness. I suggest including a paragraph describing how the variable is calculated.

[12]. Lines 238-240 & Figure 9b: If you separate the exported LSW from convection in the boundary current, will the temporal variability of LSW input be different?

[13]. Lines 246-248: I do not think I fully understand this statement. Could you elaborate?

[14]. Line 252: The 12-month time series of LSW input is heavily smoothed (5 months). The 1-month lag could be entirely artificial.

[15]. Line 266: What is "the boundary with of the LC"?

Line 273: What is "the border of the LC and DWBC"? I suggest showing the velocity structure superimposed with the mooring locations for better illustration.

[16]. Lines 290-291: This contradicts Figure 2, which shows smaller oxygen concentrations at K10 compared to the other moorings.

[17]. Line 349: I do not think ISIW, the locally convected water in the Irminger Sea, is the same as Irminger Water. The IW is the saltier and warmer Atlantic-originated water that flows in the boundary current. What enters the Labrador Sea is likely a mixture of ISIW and IW.

[18]. Lines 377-378: I think this is a very intriguing estimate. If recirculation at K10 is considered, how will the (net) export percentage change?

[19]. Line 434: Again, recirculation is not considered and the percentage (71%) could be an overestimation.