We thank Referee RC2 for his/her insightful reviews that have helped us improve the manuscript.

Review on “Deep through-flow in the Bight Fracture Zone and its imprint in the Irminger Sea” by Petit et al.

Summary

Using deep Argo-float and hydrographic data, Petit et al. have investigated the transport and property evolution of the Iceland-Scotland Overflow Water (ISOW) when it flows through the Bight Fracture Zone (BFZ). Possible attributions of the evolution, including isopycnal and vertical mixing in the fracture zone, as well as the property imprint in the Irminger Sea were discussed. Overall, I found the paper well-written and the focus on ISOW branch through the BFZ, which was less studied before, is of interest to the oceanographic community. Observation- based descriptions on transport and property structures were quite thorough. However, their temporal and spatial variabilities observed by the data need better explanations.

Major comments

[1]. It is still unclear of what determines the transport/property difference between years at the BFZ. In 2015, the ISOW at east section is saltier, denser and the transport core is located at the center of the section. In 2017, on the other hand, the ISOW at east section is fresher, lighter and the maximum transport is attached to the northern bathymetry. Is this temporal difference attributable to a different source in the East Reykjanes Ridge Current (e.g. either from west of 30W or between 29-30W)? Or is the interannual variability of the ERRC itself responsible for this downstream difference?

Our dataset is not adequate to investigate the interannual variability of the ISOW transport through the BFZ. The East section was carried out a few kilometres upstream in the entrance channel in 2015 as compared to 2017. Thus the difference in velocity structure could also be due to the difference in the location of the sections. In addition, the East section was carried out in 2015 and 2017, while the Middle Section was carried out in 2015 and 2018.

We only describe the interannual variability of the ISOW salinity at the entrance of the BFZ between the 4 years of observations at the end of the manuscript without going deeper in the investigation because this would be speculation.

We clarified this point in Section 3.1 as follow:

“*Our dataset does not allow us to determine whether these differences are due to temporal variability of the inflow from the Iceland Basin, or to differences in the local bathymetric constrains within the narrow channel of the BFZ entrance, as the East section in 2015 is localized slightly upstream in the channel as compared to the East section in 2017 (Figure 1b).*”

[2]. A related question is whether the difference of cyclonic pathway at the middle section is related to the different transport structure at the east section between 2015 and 2018.

See answer above.

Minor comments

[1]. Line 19 & 234: I think "ISOW" may not be the appropriate name for the deep water in the Irminger Sea because mixing has eroded much of the ISOW characteristics (e.g. high salinity). I would suggest calling it Northeast Atlantic Deep Water.

We agree with Reviewer 1 and Reviewer 2 that the overflow water circulating in the Irminger Sea is a modified version of ISOW with a large range of density that includes LSW and DSOW. Following Fried & DeJong (2022), we now use the name North-Atlantic Deep Water (NADW) to call the deep water circulating in the Irminger Sea.

[2]. Figure 1: The blue dots are indistinguishable from the background color.

We changed the colour of the dots to make them more distinguishable form the background colour.

[3]. Table 3: The ratio of ISOW transport to top-to-bottom transport seems to be quite steady over years. This implies a barotropic transport variability through the BFZ. What might be responsible for this barotropic variability? This is related to my major comment.

See answer above. Nevertheless, we agree that the similar ratio of ISOW/top-to-bottom transports between these two years suggests an impact of the top-to-bottom circulation on the ISOW transport. This is now indicated in the text: "*The similar ratio of ISOW/top-to-bottom transports between 2015 and 2017 suggests that the BFZ through-flow is influenced by local barotropic circulation, as observed at the CGFZ (Bower & Furey, 2017; Bower & von Appen, 2008; Racapé et al., 2019).*"

[4]. Line 182: I think you are referring to Figure 1d (instead of Figure 1c). Also, the trajectories in Figure 1d, especially the blue ones, are not easy to track. Please enlarge the trajectories for better illustration.

Thank you for indicating the mismatch, we changed into "*Figure 1d*" in the text. As for your comment #2, we changed the colour and enlarged the floats trajectory.

[5]. Lines 200-205: It is interesting to see a homogenization of the ISOW in terms of temperature within the BFZ. By looking at Figure 4a, there is an increase of bottom depth from east section (station 99) to the middle section (station 104). Could this topographic change result in vertical mixing observed here?

We agree that this topographic change can induce vertical mixing. We now discuss this hypothesis in section 4: "*The cyclonic circulation of ISOW in the rift valley is associated with a strong homogenization of the ISOW layer, which highlights a vertical mixing within the layer. This vertical mixing is possibly due to a downslope acceleration of the bottom flow, downstream of the eastern sill, which induces instabilities and mixing.*"

[6]. Lines 239-241: Where are you referring to as "Eastern and Western sills"?

These two sills are indicated in Figure 1c and described in section 2.1. For clarity, we changed the text into the "*upstream sills*" and, when possible, we refer to the name of the sections throughout the text.

[7]. Line 260: This sentence may need to be re-written. Previous studies have shown a discontinuity of the boundary current from the CGFZ northward based on hydrographic sections (Stramma, 2004) and floats (Zou et al., 2020).

We agree that these papers show a discontinuity of the boundary current at the exit of the CGFZ. We clarified the sentence, which now reads: "*A combination of new and insightful data sets allows us to investigate the role of the BFZ as a new source of ISOW for the NADW spreading in the Irminger Sea*."

References

Stramma, L. et al. Deep water changes at the western boundary of the subpolar North Atlantic during 1996 to 2001. Deep Sea Res. Part I: Oceanographic Res. Pap. 51, 1033–1056 (2004).

Zou, S., Bower, A., Furey, H., Susan Lozier, M. and Xu, X., 2020. Redrawing the Iceland–Scotland Overflow Water pathways in the North Atlantic. Nature communications, 11(1), pp.1-8.