

Comment on os-2021-100

Anonymous Referee #2

Referee comment on "Changes in Surface Salinity Gradient and Transport Quantify the Different Entrainment Rates Along the Irminger Current" by Nathan Paldor et al., Ocean Sci. Discuss., <https://doi.org/10.5194/os-2021-100-RC2>, 2021

This paper introduced an analysis method, Freshening Length, and applied this to determine the changes of Irminger Current on the both sides of Greenland using SODA reanalysis data.

I have four major concerns/comments for their consideration:

- Many times the authors stated in the paper that the West Greenland Current (WGC) is a continuation of the Irminger Current. In fact before becoming the WGC, the Irminger Current has merged with East Greenland Current on the east side, referred to as EGC/IC (or EGIC) (e.g., Cuny et al, 2002; Sutherland and Pickart, 2008). I would suggest the authors to improve the introduction with more up-to-date references.
- The author determined the Irminger Current by the maximum salinity at surface. To do that, the authors seem to believe the Irminger Current only contain Irminger Water and this water situates at surface. However, the EGC/IC and WGC contain multiple water masses vertically and the Irminger Water resides away from the surface ($\sim 500\text{m}$ depth, Pacini et al., 2020). As such, the results shown in the paper can reflect neither the change of Irminger Current nor Irminger Water.
- I am confused by the Freshening Length. The q needs to be better defined. What is the unit of q ? m/s ? otherwise the equation doesn't make sense as the unit of HU is m^2/s . How to determine the H ? The L on the east is 5 times more than the one on the west. My understanding is that the less L means freshening in a shorter distance or faster freshening in a certain distance, namely the water freshening is 5-time faster on the west than on the east. I am still confused how it can lead to the conclusion that only 20% of Irminger Current contributes to WGC.
- The authors also stated that the amount of Irminger Current supporting the WGC was previously unknow and they determined that only 20% of Irminger Water rounds Cape Farewell using the Freshening Length. First, the authors should be aware of the studies by Le Bras et al. (2018) and Pacini et al. (2020). The former computed the transport of each boundary current in the east of Greenland using the Overturning in the Subpolar North Atlantic Program mooring data, while the latter reported the transports in the west of Greenland using the multiple-year mooring array on the west side. Their results

clearly suggested that the most of the boundary currents in east Greenland flow towards the west Greenland with only a few recirculation at Cape Farewell (interacting with Eirik Ridge). How could the authors explain the discrepancy between the main conclusion of this paper and the compelling observations?

Specific comments:

Line 19. should be Faroe Bank Channel.

Line 20. The connection is not only with Greenland Sea. I would suggest to say Nordic Seas instead.

Line 21. EGC doesn't have to be fresh, particularly in the deep layer it also contributes the dense overflow water.

Line 26-27. What currents are they talking about? I don't see the difference. The currents flow continuously northward in Fig. 1a as well.

Figure 1. The two schematics have some discrepancies which add confusions, e.g. EGC and IC are two separate currents in upper panel, while in the bottom panel they are referred as a single merged current – EGIC (green). Why not just show one up-to-date schematic?

Line 80-85. Mark your study region somewhere in Fig.1 or Fig. 2. Label all of the geographic names that were mentioned in the paper, e.g., Cape Farewell.

Line 95-100. How could the mean surface hydrography suggest a cyclonic circulation?

Line 140. It IS important... and did you mean Fig. 1?

I suggest to change the subtitle to Discussion and Conclusions.

Line 155. Downwelling can flux the saltier water towards the coast in the upper layer, while upwelling can transport the fresher water offshore which may influence the water carried by WGC.

Last paragraph. As I said above, the authors should be aware of the published mooring studies. Also the authors can easily check whether their method works out by using the same SODA reanalysis, e.g., compare the volume transports on the both sides of Greenland.