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Interactive comment on "Wind-driven transport of fresh shelf water into the Labrador Sea Basin" *by* Lena M. Schulze and Eleanor Frajka-Williams

Anonymous Referee #1

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This manuscript looks at the exchange of fresh shelf water into the Labrador Sea using a high resolution numerical model and Lagrangian trajectories. The authors find that much of the freshwater that reaches the interior of the Labrador Sea comes from the West Greenland Current (which isn't a new result). But they expand on this work, by showing two seasonal pulses, associated with different geographical positions (south-east, northwest) and different salinity waters. Where this work truly expands upon previous studies is showing the key role of wind-driven Ekman transport compared to the typical view of eddy driven exchange.

Given this is an important topic (fate of enhanced high latitude freshwater on water formation in the Labrador Sea), this work is appropriate for the journal. It is a well written paper, easy to follow and understand. Thus it is definitely will be eventually

suitable for publishing in Ocean Science. However, there are a few places where the manuscript could be improved upon. Thus I recommend minor revisions. Details of my comments are given below.

Introduction General: Although the introduction provides a good summary, it feels a bit short. More discussion of previous work related to offshore exchange in the Labrador Sea can be added. Both with respect to observational studies, but especially with respect to previous modelling works. Since the authors are going to dispute the commonly held paradigm that eddies are the main exchange mechanism from the WGC, they need to discuss the previous modelling works that have highlighted that mechanism (and then in the discussion try to bring out why the present results are different). Beyond papers listed such as Chanut et al, there are newer studies such as McGeehan and Maslowski, Gelderoos et al., Kawaski and Hasumi, Saenko et al., Dukhovskoy et al to name a few.

Page 2, Line 11: ? in the references needs to be filled in

Page 2, Line 28: But doesn't the Cooke paper use a very coarse resolution model, making it easy for freshwater to leave the Labrador Current. If so, this point could be clarified

General: At some places in the manuscript the authors report salinities as dimensionless, and in others places use psu as a unit. At the very least the authors must be consistent.

Page 4, Line 19: More detail on the lateral boundary conditions in the region, and the impact of that choice would be useful.

Page 4, Line 31 – is used. . .

Page 5, 1st paragraph: Changes implemented in the model are listed as 1), 2) and 4). Where is number 3?

Page 5 – in terms of evaluation, given the importance of the West Greenland Current

to the paper, it might be good to see further evaluation of the model representation of this feature. I.e. Don't just focus on the EKE in terms of observational comparisons.

Page 6, Line 22: Badly worded sentence with place/placed used an extra time

Section 2.6 – The calculation of Ekman transport is discussed here, but the sections for which it is computed are not shown until the white line in figure 7. Be good to show that earlier. Additionally, how close is that line to the actual isobaths in the model? Does the line follow a model grid line?

Page 10, line 12 – looks like there is weak EKE in late summer too.

Section 4.2.1 – Does the 3 month averaging remove eddies and thus the damp the potential importance of this term?

Page 12, Line 20: The statement "in the NEMO model. . ." is not correct. The authors mean in their configuration of the NEMO model, with the given forcing, they find. . .

Page 12, Line 32: With respect to the statement about higher resolution being needed, doesn't Chanut et al argue that at least 1/15 degree is needed?

Page 13, line 21: Do any of the years mentioned stand out in terms of freshwater transport, melt from the Greenland ice sheet, very positive NAO, etc.?

Table 1: within is one word; Additionally I don't like the phrasing "Crossing Later" – the authors can be more precise and quantitative.

Figure 1: Why are the observations and model field plotted for different time periods (1990-2009 vs 2002-2012)? Can't the results be subsampled to plot everything over the same time period to allow a fairer comparison? Also for the model mixed layer depth, is it based on the default NEMO threshold method? If so, Courtois et al, 2017 show this approach significantly overestimates the actual model mixed layer in deep convection regions.

Figure 4 – Why does it say 'Salt' in the middle of Greenland?

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