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Interactive comment on "Mean circulation and EKE distribution in the Labrador Sea Water level of the subpolar North Atlantic" *by* Jürgen Fischer et al.

Anonymous Referee #1

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This is a review of "Mean circulation and EKE distribution in the Labrador Sea Water level of the subpolar North Atlantic" by Fischer et al. on Ocean Science Discussions.

This manuscript is primarily a technical demonstration of fine resolution gridding of Argo trajectory data at mid-depth. It uses the YoMaHa07 trajectory dataset (based on differencing surfacing positions, divided by the time between surfacings) to derive an estimate of the 10-day mean velocity at the Argo float parking depth (typically 1000 m or 1500 m). The authors use two gridding procedures which preferentially grid data along f/H contours which, in the high latitudes of the Labrador Sea/subpolar North Atlantic means gridding across a longer distance along isobaths than across isobaths.

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Discussion paper

They use all available Argo float trajectories over the Argo period to date to create an average circulation in the subpolar gyre, and then look at the residuals to this average circulation to create a gridded estimate of mid-depth EKE. The scientific analysis is limited to estimate a Peclet number (ratio of advection to horizontal diffusion, i.e., ratio of the mean velocity map to the EKE map) and note areas where advection dominates or diffusive processes are expected to be large. The main new findings of this paper are the remarkable maps of the high resolution currents including the expected strong boundary currents against topography, but also the notional pathways of the North Atlantic Current crossing the Atlantic from west to east, and northwards in the eastern subpolar gyre. It also shows some remarkable eddy activity which would be difficult to observe in a statistically robust fashion any other way. While the final calculation of the Peclet number is somewhat simplistic, I believe the paper is worthy of publication and will be of interest to a great many oceanographers concerned with the Atlantic in this region of climate sensitivity and climate forcing.

The methods and approach are valid and justified, though the authors could provide more detail on the underlying dataset (YoMaHa) particularly with regards to any biases that may occur during the profiling time of the floats. While the time spent profiling is much less than that spent at parking depth, in much of the world's oceans, this can have a marked influence on the overall trajectory determined as velocities tend to be surface intensified. This may be less of an issue in the subpolar North Atlantic where velocities are more barotropic. I think this would be straightforward to show using the mooring data available to the authors (which was also used to validate their mapped product).

The presentation quality is of high standard, and well written, save for a few comments on the text noted below by line number.

The paper has relatively few references for a region that is so well studied, both observationally and numerically. Many of the boundary currents seen in the mean maps are well-established. I would recommend referring the reader to a few papers on these,

perhaps when going through the description of the currents in section 3.1. There are several summary papers that could be used to catch all in a small handful of references.

In summary, this is a lovely technical demonstration of Schmidtko's gridding procedures applied to an underutilized dataset (the YoMaHa trajectories). It is timely, given the recent new observational efforts in the subpolar gyre (OSNAP), and the publication of the dataset and derived velocity/eke fields may be useful to researchers trying to understand both the horizontal circulation in the subpolar gyre and it's role in the AMOC. The result is a remarkable fine resolution picture of the mean circulation in the subpolar gyre (particularly Fig 8) as well as the identification of a few deep regions of EKE which are likely important to the spreading of the properties in the DWBC more broadly in the subpolar gyre. I recommend this paper for publication in OS after minor textual revision.

L57 1990ies -> 1990s

L77 proof -> prove

L100 structured like -> structured as

L121 Yomaha07 -> YoMaHa07 (and later in the paper)

L151 define potential vorticity. f/H?

L183 "with only little influence of the depth-difference." awkward. I suggest "with little influence of the underlying bathymetry" or "with less influence due to the water depth difference"

L186 result in noisier -> results in noisier

L187 result in a smoother -> results in a smoother

L188 I could not parse what was meant by "could be applied to both, irregular target locations, and regular grid locations". I suspect it is a problem of punctuation and that perhaps what was meant is "could be applied to both irregular target locations and

regular grid locations."

L196-197. There is reference to shading in the figure, but at least in my printed copy this is difficult to see. Perhaps use a pale blue shading so that the eye is not tricked into seeing clusters of thin black lines as part of the grey shading.

L198 current residual -> residual velocity (suggested)

L203 Eddy kinetic Energy -> Eddy Kinetic Energy or better "eddy kinetic energy". There are quite a few words that I don't believe should be punctuated throughout, e.g., "Boundary" in "Boundary current"

L216 remove space "latitudinal direction , longitudinal" before comma

L242 Suggest replacing "control" to "direct". I typically associate the word "control" with something dynamical, and the exchange may be influenced by topography but I don't believe it has been shown to be controlled by topography.

L258-259. The table is useful, but it would be helpful to have the moorings called out (e.g., K10) with their lat/lon in the text so that the reader does not need to use the text, then the table then the figure to see the area that is being referred to.

L260 rotation -> circulation, were -> where

L251 remove comma after Both

L252 remove comma after shelf break

L264 Quantify how weak "extremely weak" is? What flow speeds are observed here?

L267 Provide lat/lon for Orphan Knoll

L282 Write out acronyms on first usage, e.g. OSNAP and OOI. Suggest also including a reference for at least OSNAP (perhaps Lozier et al., 2017)

L288 were -> where

L297 Can you quantify a wavenumber/wavelength even if by eye? Looks to me to be about 7 degrees or roughly 700 km

L339 remove comma after both

L341 Comparable -> Comparably

L351 Define beta, and don't capitalise

L354 larger -> greater

L355 depth -> depths

L355 and 356, remove second and third instance of "there are"

L356 a priory -> a priori

L359 Specify what you are calling diffusion here. I expect that it is EKE as a sort of horizontal diffusion, but this can be specified (and referenced)

L361 empiric -> empirical

L369 don't capitalise "boundary currents", also L371

L409 were -> where

L420 which is important -> which is an important

L435 were -> where

L567 Provide web links for the three sources: YoMaHa, Aviso and Coriolis DAC.

Fig 3. I don't know what the labels within the figures mean "UV-map" seems straightforward, but perhaps Velocity or mean velocity map. But for 3b "UPVP"? This is perhaps u'v'?

Fig 8. These figures are striking and beautiful. It is a shame that the vectors in panel A cannot be more clearly seen over the chosen colormap. Can you un-saturate the blue

end of the color scale so that the boundary currents in the Labrador Sea and around Greenland are clearly visible?

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