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Ocean Science Discussions

Interactive comment on "Storm-driven across-shelf oceanic flows into coastal waters" *by* S. Jones et al.

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>L101-104: What is the weight we can attach to two drifter observations? The region has been extensively studied using drifter deployments. Are there other historic records that provide context to the occurrence of such a transport pathway? Further in the MS, the authors use a numerical model to provide context, but I wonder if the historic observational record should also be further explored.

To our knowledge, the relevant historical drifter studies in the region are: i) Burrows and Thorpe (1999) who deployed 42 drifters drogued at 50 m, of which only two crossed onto the Malin Shelf north of Ireland, ii) Booth (1988) in which drifters were entrained in Rockall Trough eddies and did not cross the shelf edge, and iii) Pingree et al., (1999)

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who released an Argos float drogued at 45 m in the Celtic Sea which subsequently travelled ∼1600 km in the slope current but did not provide any insight into on-shelf flow in the Malin region. While many near-surface drifter trajectories exist, we were primarily interested in deeper flows. We therefore felt that while these studies add important context to understanding of currents in the region, we were justified in considering the present study in isolation. Added references in text to acknowledge the contributions of Booth (1988) and Pingree et al., (1999) (line 68).

>L159-161 & Figure 3: Are these the blue points in Figure 3a? Please edit the caption of Figure 3a appropriately.

Yes, the blue points are particle release locations. Added to label of Figure 3.

>L161-162: Why was the experiment repeated five times? Is this to provide more tracks with a CPU-manageable method, or did the five different experiments have different parameters?

We re-ran the experiment several times to sample a range of diffusive random walks resulting from the diffusive component of particle motion. Clarification added in text (line 164). Also corrected mistake in text as particles were released for 40 days preceding observation period AND during the 10-day observation period. Thus (40+10 days) x 5 repeats = 250 particles released at each location.

>L169: Is T in Equation 2 the same as t in Equation 1?

Yes, modified in text for clarity.

>L170-172: How sensitive are these results to the chosen horizontal eddy diffusivity?

We re-ran the experiment with horizontal eddy diffusivity values between 0.5 and 3 m2 s-1 and found that the results were robust with respect to this coefficient (line 176).

>L202-205: Where does off-shelf transport occur? Does this transport contribute fully to the pathway which leads into the North Sea?

Largely towards the North Sea but the bottleneck imposed by the Minch will force much of the flow around the Outer Hebrides, bringing it back onto the outer shelf. An average off-shelf transport occurs near the base of the water column into the Faroe-Shetland Channel north of 58 N (Figure 2 in Graham et al., 2018). We would surmise that a portion of the imported water makes its way back off-shelf via this region of shelf edge with the rest continuing into the North Sea. We have added a paragraph summarising the above in the manuscript (line 322).

>L212-218 and Figure 9: Although not yet part of the UK Met Office/Met Eirean storm naming, these winter storms were named. I would recommend including their name as part of the text and Figure 9, as these are often used in other analyses: Xaver (5-6 December), Bernd (18-19 December) and Dirk (23-24 December).

Many thanks for this information, storm names have been added to the text and figure captions.

>L226-230: The choice of words here ("backward particle tracking experiments") is confusing. From my understanding, the authors performed a particle tracking experiment where particles were released from a source, and only those tracks which reached the observation location during the observation period were further analysed (see L162- 163).

We agree that this term is confusing and have removed it from the text.

>L244-246: Why were two different experiments used? Are these two from the five mentioned on L161-162? Or are these two times an experiment with 5 particle tracking simulations?

The figures were produced using separate batches of particle release experiments for computational reasons. Each batch consisted of the full release schedule (5 x 50 days = 250 releases per location). Clarified in test (line 254)

> L302-304: Does the TPM record show such occurrences, i.e. where the temperature

also changes in line with the salinity change?

We see evidence that late season HSPs are sometimes associated with up to 0.5 °C of warming in the TPM time series, where temperature and salinity observations overlap. A note added to reflect this (line 319).

> Figure 2 shows gaps in the salinity record at TPM, are more temperature data available which would then potentially allow an analysis of HSP-like events in the temperature record? On L413-414 there is a suggestion that the TPM had temperature data prior to 1994, which could be analysed in such a manner.

The gaps in the salinity record reflect gaps in mooring deployments so impact all observations. The longer temperature time series obtained from current meters at the TPM shows that while the storm events sometimes impact coastal water temperatures, the effect is less pronounced than for salinity. Fig. 1 shows daily temperature anomalies with instances of storm events overlaid. As noted by Inall et al., (2009), the dominant mode of variability in TPM temperature anomalies is inter-annual and is correlated with the upper waters of the Rockall Trough. We did not feel that this figure contributed much beyond the findings of Inall et al., (2009).

>L346-347, Figure 2 and L253: If a cluster of low-pressure systems is a pre-requisite for the occurrence, are HSPs a winter-only phenomenon? How many HSPs occur outside the winter season? Could Figure 2 be edited so the identified HSPs are also plotted on (maybe a marker along the 33.5 or 35.5 salinity level)? I would also recommend changing L253 to say “winter storms”.

Based on the available TPM salinity data, HSPs are a winter-only phenomenon. This is probably due to reduced frequency of storms in the summer, coupled with an increase in inner-shelf stratification which presents more of a barrier to the ingress of oceanic water. Note added in text (line 397). Ticks also added to Fig. 2 to highlight HSPs as suggested.

>Bathymetry contours in figures: The model bathymetry is based on the EmodNet data product. I would suggest contours based on this product in all plots.

Agreed; plots depicting model data recreated with EmodNet bathymetry.

>Figure 2: In the discussions PDF, this figure didn't occupy the full width. This could be due to the editorial system, but I would recommend for the authors to check there is no unnecessary white space in the image. I think this figure merits a full A4 width space, to make sure it is legible.

Modified as recommended.

>Figure 8, caption: please add "(in red)" after "Bathymetry contours". As far as I could tell, this was also only the 500 m one, so I would suggest "Bathymetry contour (red) ... "

Modified as recommended.

References

Booth, D.A., 1988. Eddies in the Rockall Trough. Oceanologica Acta, 11(3), pp.213-219. Burrows, M. and Thorpe, S. A.: Drifter observations of the Hebrides slope current and nearby circulation patterns, Ann. Geophys., 17(2), 280–302, 1999.

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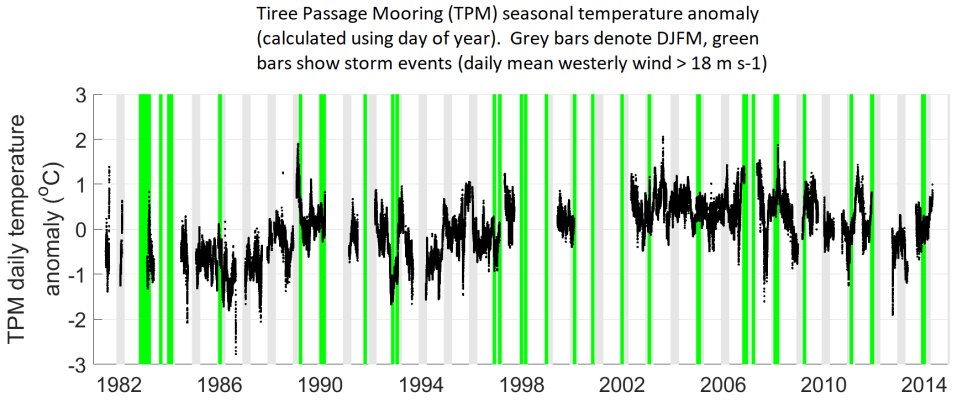

Fig. 1. Temperature anomalies at the Tiree Passage Mooring, at 20 m. Grey bars denote winter months (DJFM). Green lines show instances of daily mean westerly winds on Malin shelf exceeding 18 m s-1.

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