



## Estimating ocean-shelf flux and exchange with tracked drifters

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The project FASTNEt – Fluxes across sloping topography of the North East Atlantic – attempted to measure overall cross-slope transport by various means including drifters. In areas of complex topography, it can be difficult to define “along-slope” or “cross-slope” direction, yet transport estimates from mooring data are sensitive to these definitions. Moreover, identifying “along-slope” with current direction sets to zero part of what we want to estimate. Drifters were deployed in 2012 at the Celtic Sea shelf edge, in 2013 at the Malin shelf edge and in 2014 in the Faroe-Shetland Channel. Subsequent drifter positions and hence corresponding water depths were recorded every three hours. Thereby we have information on cross-slope movement of the drifters and hence by the water, assuming that the drifters followed the water.

Drifter crossings, of selected depth contours between successive position fixes, were analysed approximately month by month. Relevant water-depth changes  $\Delta h$  and displacements  $(\Delta x, \Delta y) \equiv$  (east, north) were related to estimate a “slope” (magnitude dependent on direction). Then displacement mean and departures from the mean were converted to estimates of cross-slope flux  $\hat{u}$  and exchange  $|\hat{u}|$  (velocities) by dividing by (“slope” x 3 hours).

The analysis raises questions which are discussed:

1. Choices in how to relate  $\Delta h$  to  $(\Delta x, \Delta y)$  without averaging out complex topography experienced by the drifters, and consequent weakened dependence of “slope” on direction
2. Bias from analysing only time-intervals when contours were crossed
3. Use of daily 24-hour-average positions to filter out most of the tidal contribution to flux and exchange
4. Bias from initial deployment location of drifters
5. Susceptibility to “events”
6. Combination with a tracer (salinity) to estimate a specific water mass transport (Atlantic Water onto the Malin shelf)

Typically, Biscay exchanges  $|\hat{u}| >$  Malin exchanges  $>$  Faroe-Shetland Channel exchanges, but Faroe-Shetland exchanges were large across the 500 m contour. Exchanges across the 500 m and 200 m contours were typically comparable and less than across the 150 m contour (again excepting large Faroe-Shetland exchanges across the 500 m contour). These comparisons seem to reflect slope steepness (less at 150 m depth allowing freer cross-contour flow), strong Biscay tides and meanders of the strong slope current in the Faroe-Shetland Channel and beyond.

All the estimates are large: typically 6 m<sup>2</sup>/s transport and 10 m<sup>2</sup>/s exchange from the 3-hourly values at 150 m depth; typically 2.3 m<sup>2</sup>/s transport and 7 m<sup>2</sup>/s exchange from daily values and allowing for bias (question 2).