## Spreading dynamics of dense overflows in the western North Atlantic: eddy resolving simulations with a passive tracers

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Southward flow and mixing of dense North Atlantic overflow waters involves concentrated deep western boundary currents (DWBCs) and broader interior pathways, a process that is very sensitive to seafloor topography. In the Labrador Sea, Denmark Strait Overflow Water (DSOW) is denser than the Antarctic Bottom Water (AABW) entering the North Atlantic across the Equator, yet AABW is the deepest water mass of the Atlantic (as is beautifully evident in the Worthington & Wright atlas, 1970). Diapycnal mixing beneath the North Atlantic Current and Gulf Stream dilutes DSOW so that it lies dominantly at 3500m-4500m in the subtropics. The spreading and deepening of DSOW in the western North Atlantic is investigated here using results from two 1/12 eddy-resolving Atlantic simulations, including a passive tracer injected north of the Denmark Strait sill.

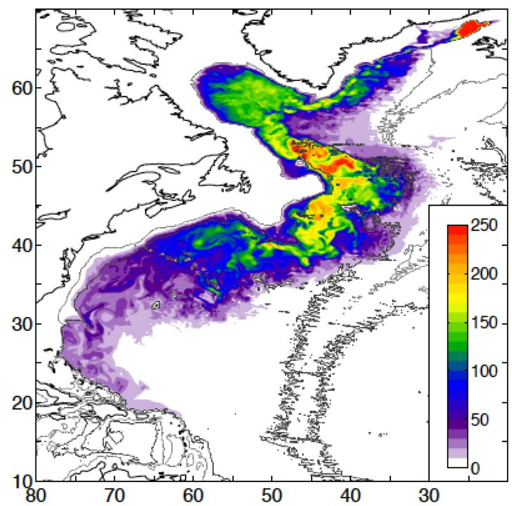


*Figure: DSOW Tracer inventory 15 years after initiating release in Denmark Strait*

The deepest layers of DSOW transition from a relatively narrow DWBC in the southern Irminger Sea into widespread westward flow across the central Labrador Sea, which remerges along the Labrador Coast around the Hamilton Bank. A ~200m thick layer of DSOW thus covers the entire 500km wide Labrador Sea floor, actively responding to topographic features as small as the North Atlantic Mid-Ocean Channel.

Farther downstream in the Newfoundland Basin, DSOW again exhibits flow separation from the continental slope, and deepens, near the abrupt topographic change at Orphan Knoll (51N). A series of deep recirculation cells forms, driven by the meandering of the North Atlantic Current in the upper ocean; this leads to accumulation of DSOW offshore of Orphan Knoll, precisely where a local maximum of CFC inventory has been observed. At Flemish Cap, eddy variability carries about 20% of the total tracer transport from the boundary current into the interior, thus contributing to the high tracer inventory found in the offshore deep basin in both observations and models. Deepening and mixing of DSOW is most intense in the Irminger Sea and the Newfoundland Basin.

The potential vorticity environment of topographic slopes, promontories, and escarpments is shown to control the splitting of DSOW into DWBCs and offshore branches. Broadening of DWBCs at a transition from steep to less steep continental rise topography occurs as a consequence of conservation of their quasi-uniform potential vorticity while, at abrupt topographic features, DWBCs can escape the boundary as separated, non-conservative potential vorticity flows.

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