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Mixing and transformation in the Denmark Strait Overflow

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The Denmark Strait Overflow (DSO) is one of the major export routes for the dense waters from the Nordic Seas to the North Atlantic. However, the observations of the DSO are limited to a few locations and poorly resolve mixing processes that transform the dense waters and hence influence propagation of hydrographic signals from the Arctic to the Atlantic.

We use a high resolution circulation model to diagnose mixing processes involving the DSO in the Irminger Basin. We focus on mesoscale (10-100km) processes, the most prominent being dense cyclonic boluses making up the overflow plume. The subgrid turbulent processes are represented by the K-profile parameterization. We map the horizontal and vertical eddy diffusivities derived from Lagrangian particles, the model vertical mixing coefficient and eddy fluxes. Our results are consistent with observations suggesting enhanced vertical mixing during the initial ($\sim$ 200km) descent of the dense plume and increasing importance of horizontal mixing downstream. The model also shows enhanced mixing along the dense water pathways in the Kangerdlugssuaq Trough on the East Greenland Shelf involving fresh Polar Waters. However, the most intense mixing is induced by mesoscale boluses of dense water cascading down the sill and the associated internal wave field. Frequent occurrence of a neutrally stratified mixed layer in the dense plume poses a challenge for the turbulent scheme of the model. We advocate for an observational campaign that would corroborate these results and help develop novel parametrizations of the vertical mixing processes in the DSO.