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# Entrainment and Mixing of the Faroe Bank Channel Overflow

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The continuous, swift flow of cold water over the sill of the Faroe Bank Channel, the deepest passage from the Nordic Seas to the North Atlantic Ocean, contributes to the ventilation of the deep North Atlantic Ocean. The amount of bulk entrainment and mixing of the overflow along its path was previously estimated from coarsely spaced currentmeters and water-mass considerations; however remain poorly constrained. The spatial distribution of mixing remains unknown due to lack of direct measurements. Here we report from the first direct turbulence measurements conducted in June 2008, supplemented by moored observations. The shipboard survey covers the first 120 km downstream of the sill, and includes vertical profiles of hydrography and velocity (from a conductivity-temperature-depth package equipped with lowered-acoustic Doppler current profilers), and of turbulent dissipation rate from a vertical microstructure profiler (Rockland Sci. Int.).

The dynamic properties and mixing of the overflow plume as it descends toward the Iceland Basin are described. The plume has a vertical structure composed of a 70 $\pm$ 35 m thick well-mixed bottom layer overlaid by a 120 $\pm$ 60 m thick stratified interfacial layer. The vigorously turbulent plume is associated with intense mixing and enhanced turbulent dissipation near the bottom and at the plume-ambient interface, but with a quiescent core. The latter is due to weak shear production of turbulent kinetic energy near the velocity maximum, located typically deeper than the interface. Enhanced mixing at the stratified and highly-sheared interface is mostly due to coexisting shear instabilities and internal wave-turbulence transition. Entrainment velocity inferred from dissipation measurements show strong lateral variability. A pronounced transverse circulation is observed consistent with rotating plume dynamics. The transverse circulation actively dilutes the bottom layer of the plume. The bulk entrainment parameterizations mainly devised for non-rotating, two-layer gravity current plume dynamics, and the traditional turbulence closure models that lack the internal-wave/turbulence transition will be inadequate in representing the mixing of the Faroe Bank Channel overflow.