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A multi-platform study of entrainment by (sub-)mesoscale processes in the Denmark Strait overflow plume

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The Nordic overflows double their volume by entraining ambient water as they descend into the subpolar North Atlantic. To study small-scale processes associated with entrainment a multi-platform experiment was carried out 180 km downstream of Denmark Strait in the pathway of the overflow plume. Moored observations revealed pronounced eddy-activity with periods near 1.6 days. Temperature along horizontal profiles observed from an autonomous underwater vehicle (AUV) in the transition layer between the overflow plume and the ambient water revealed pronounced variance on wavelengths between 20 and 500 m. This band cuts across from the turbulent motions into the internal wave regime. During episodes of elevated turbulent dissipation (as observed by the AUV), increased temperature variance on wavelengths less than 200 m was found with a wavenumber-dependence characteristic of turbulence. Besides topographically induced mixing, the AUV captured strong turbulence near the edge of an energetic eddy, implying that eddy-driven horizontal advection and vertical mixing act in concert to entrain ambient water into the plume.