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A multi-platform study of entrainment by submesoscale processes in the Denmark Strait overflow plume.

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The Denmark Strait overflow contributes roughly half (∼3.4 Sv) of the total volume transport of the Nordic overflows. The overflows double their volume by entraining ambient water as they descend into the subpolar North Atlantic, and together with Labrador Sea Water feed the deep branch of the AMOC. The variability of the overflows is thus expected to reflect on the properties and strength of the AMOC. Beyond 200 km from the sill, entrainment into the Denmark Strait overflow is dominated by mesoscale eddies. In the region of strongest entrainment, between 100 km and and 200 km downstream of the sill, smaller scales processes (e.g. internal wave breaking, Kelvin-Helmholtz instabilities) are thought to dominate the mixing. However, this small scale mixing and its contribution to overall variability of the overflow is still poorly understood. Here we present results from a 2-month experiment carried out in the region of strong entrainment, combining measurements from CTD, moored instruments and microstructure probes mounted on profilers and an AUV, with the latter used for horizontal profiling of dissipation and hydrography. The multi-platform strategy was designed so that variability on scales ranging from ∼30 km down to tens of meters were observed. The hydrographic properties and currents are dominated by variability with time scales of 1.5–2 days, associated with mesoscale eddies. In addition, strong sub-tidal fluctuations were observed. The dissipation is shown to vary with current speed in the turbulent shear zone above the overflow plume. The role of these small scale processes for mixing and entrainment is discussed with reference to the mesoscale background.