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Vertical mixing in the marginal ice zone of the Barents Sea

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The temporal and spatial responses of vertical mixing processes to the interplay between physical forcing and water column stability are not fully understood. This is particularly the case in ice covered waters, where ice modifies the exchange of momentum with the atmosphere and melting and freezing produces strong buoyancy fluxes which directly affect the budget of turbulent kinetic energy.

During the CABANERA project we have collected a unique data set of upper-ocean microstructure and turbulent mixing from ice drift stations in the marginal ice zone of the Barents Sea. A variety of forcing conditions, from low-energy situations to strong winds and extreme tides over shallow topography, showed a large range of responses in vertical diffusivity within the surface mixing layer and the pycnocline.

The distribution of dissipation within the surface mixing layer is found to be affected by the under-ice topography. The depth of enhanced mixing is seen to correlate well with measured forcing (e.g. wind, currents) when modified scaling relationships and closure schemes are applied. The roles of different forcing mechanisms within and below the pycncline are also explored, including double-diffusive convection which is seen to occur in lower-energy locations. Vertical mixing efficiency and resulting heat fluxes are quantified and discussed in relation to other ice covered areas.