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Observations of turbulence at a near-surface temperature front in the Arctic Ocean

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Measurements made at an Arctic thermohaline front show turbulence production through convection and forced symmetric instability, a mechanism drawing energy from the frontal geostrophic current. Destabilizing surface buoyancy fluxes from a combination of heat loss to the atmosphere and cross-front Ekman transport by down-front winds reduce the potential vorticity in the upper ocean. The front, located in the Nansen Basin close to the sea ice edge, separates the cold and fresh surface melt water from the warm and saline mixed layer. High resolution temperature, salinity, current and turbulence data were collected in the upper 100 m, on 18 September 2018 across the front from a research vessel and an autonomous underwater vehicle. The AUV was deployed to autonomously collect high resolution data across the front using adaptive sampling. Both front detection and sampling location were decided by a state-based autonomous agent running onboard the AUV, optimizing data collection across and along the front.

In addition to convection by heat loss to atmosphere and mechanical forcing by moderate wind in the mixed layer, forced symmetric instability contributed with comparable magnitude in generation of turbulence at the front location down to 40 m depth. This turbulence was associated with turbulent heat fluxes of up to 10 $W.m^{-2}$, eroding the warm and cold intrusions observed at respectively 35 and 55 m depth. A similar frontal structure has been crossed by a Seaglider in the same region 10 days after our survey. The submesoscale-to-turbulence scale transitions and resulting mixing can be widespread and important in the Atlantic sector of the Arctic Ocean.