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Breaking internal waves on the pycnocline of the Labrador Sea

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High-frequency internal waves in the upper ocean have been shown to be a source of turbulence, mixing, and vertical heat fluxes through the base of the seasonal mixed layer (e.g. Wijesekera and Dillon (1991), Lien et al. (1996), Polton et al. (2008)). Small-scale turbulence in deep convection regions is not well documented, but the shallow pycnocline that forms during restratification is conducive to internal wave generation from surface events. With the weak background stratification after convection, internal waves are readily trapped on the pycnocline and can propagate laterally away from their generation site, and break to produce turbulence.

We present here microstructure measurements from the Labrador Sea during the spring restratification period after deep convection. These measurements were made with the Air-Sea Interaction Profiler (ASIP), a novel, autonomous, untethered, upwardly-rising microstructure instrument that is capable of measuring turbulence to within centimeters of the ocean surface. Thirty profiles of high-resolution temperature, conductivity, and velocity shear over the upper 100m are presented, with a profile rate of about 8 minutes. ASIP's rapid profiling capabilities captured high frequency (1 cph) waves with 10-m amplitude on the 60-m pycnocline. An isolated patch of elevated turbulence was observed at the crest of one of the waves from a breaking event. The dissipation rates here equal or exceed those observed in other regions of deep convection, suggesting that such high frequency waves may be an important source of turbulence in the Labrador Sea and similar convection regions.