Abstract View

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Observations of Persistent Mixing and Near-Inertial Internal Waves

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ABSTRACT

Repeated profiles of microstructure and shear alongside a drogued buoy show a 10 m thick mixing zone at the same depth as a near-inertial feature. Because the profile was diffusively stable and free of thermohaline intrusions, internal wave breakdown is the only mechanism capable of producing mixing. Both the near-inertial feature and the mixing patch were observed for over three days and then faded out. It is not possible to determine whether they disappeared because the near-inertial feature was dissipated by the mixing or because the drogue drifted away; both are plausible.

Kinematical models of mixing use a standard internal wave spectrum to predict the frequency of occurrence and persistence of shear instabilities. Observed distributions of ϵ and χ patches thinner than 2 m are similar to the model predictions, although the dissipation rates are low. Most are just at or below the transition dissipation rate ϵ_{tr}. Laboratory experiments have established that if $\epsilon < \epsilon_{tr}$ the turbulence is too weak to produce a net buoyancy flux.

Observed, but not predicted by the models, are patches 5 to 10 m thick, which have average dissipation rates well above ϵ_{tr}. They produce most of the temporal variability in the mixing rates and are mainly associated with near-inertial features. These thicker patches are not described by present kinematical modes, which neglect the mixing in near-inertial features and assume that overturns mix to completion. Because these mixing zones are more intense, thicker, wider, and more persistent than those produced by random superposition of internal waves they are potentially more important. If these measurements are characteristic of the main thermocline, the global distribution of near-inertial futures is a major factor controlling the distribution of mixing.

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