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Convectively Driven Turbulent Mixing in the Upper Ocean

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ABSTRACT

Two experiments were performed to study the characteristics of turbulence in convective mixed layers in the upper Ocean. In the first, a diurnal convective mixed layer developed in the Bahamas under the influence of the cycle of daytime solar heating and nighttime evaporative cooling. The mixed layer reached as deep as 100 m each night and restratified each day. In the second, the mixed layer of a warm-core Gulf Stream ring deepened from less than 50 m to more than 150 m in a little more than a day, when subjected to rapid cooling during a cold air outbreak. Although individual profiles of ϵ , the rate of viscous dissipation of turbulent kinetic energy, had considerable spatial and temporal variability, the mean dissipation profiles were similar to those in convecting atmospheric boundary layers. The ϵ is established by the surface buoyancy flux, J_b^0 ; $\epsilon/J_b^0 = 0.61$ and 0.72 in the Bahamas and ring data, respectively, compared with 0.64 in convecting atmospheric mixed layers. The mean profiles decrease gradually, no more than a factor of 3, through the mixed layer and drop abruptly, by 1 to 2 decades, at the mixed layer base.

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