Observed variations in mixing efficiency in the deep ocean

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Recent progress in direct numerical simulations (DNS) of stratified turbulent flows has led to increasing attention to the applicability of the constant mixing coefficient Γ in the Osborn's eddy diffusivity model, Γ = 0.2. Motivated by lack of observational estimates of Γ particularly in the deep ocean, this study examines variations of Γ using deep microstructure profiles collected in various regions of the North Pacific and the Southern Ocean. It is shown that Γ is not constant but varies significantly with the ratio of the Ozmidov scale to the Thorpe scale R_{OT} in a fashion similar to that obtained by previous DNS studies. Efficient mixing events with Γ ~ $O(1)$ and R_{OT} ~ $O(0.1)$ tend to be frequently observed in the deep ocean, while moderate mixing events with Γ ~ $O(0.1)$ and R_{OT} ~ $O(1)$ tend to be observed in the upper ocean. Furthermore, the observed negative relationship between Γ and R_{OT} is consistent with a simple scaling Γ proportional to $R_{OT}^{-4/3}$ that can be derived from classical turbulence theories. In contrast, the observed results exhibit no definite relationships between Γ and the buoyancy Reynolds number Re_b, although Re_b has long been thought to be another key parameter controlling Γ.

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