On the mixing efficiency of turbulent stratified flows

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Small-scale mixing in the stratified interior of the ocean is a fundamental component of the global Meridional Overturning Circulation (MOC). In the oceanographic community, the mixing efficiency of turbulent stratified flows is typically assumed to be 20%. On this basis it has been argued that the net rate of global overturning implies a specific potential energy demand met by turbulent mixing with energy (and a corresponding dissipation rate) supplied by external forces like tides and wind. However, traditional values for the mixing efficiency are based on results from stably-stratified shear flows under idealized boundary conditions, whereas much of the diapycnal buoyancy flux in the ocean occurs in more complex scenarios, such as regions of deep convection, large overturns, or submesoscale fronts, to name only a few. In this paper, we use a new framework for the energetics of turbulent stratified flows [1] to estimate *a priori* the mixing efficiency of stratified flows with varying degrees of mechanical to buoyancy forcing. In particular, we show that buoyancy-driven flows with an excess of Available Potential Energy (APE), for example convection, exhibit larger mixing efficiencies. We contrast these results with stably-stratified shear flows and discuss implications for ocean mixing.

References

[1] Scotti, A. & White, B. 2014. Diagnosing mixing in stratified turbulent flows with a locally defined available potential energy. *J. Fluid Mech.*, 740, 114-135.

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