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Mixing efficiency dependence on overturning and turbulence intensity in stratified shear layers C. P. CAULFIELD, BP Institute & DAMTP, U. of Cambridge, ALI MASHAYEK, EAPS, MIT, W. R. PELTIER, Physics, U. of Toronto — It is well-known that both the total amount of irreversible mixing and its efficiency in stratified shear flows are strongly time-dependent. We consider shear layers that are susceptible to primary Kelvin-Helmholtz instabilities, developing relatively large billow overturnings that in turn are subject to various secondary instabilities which trigger turbulence transition. Valuable insights can be gained by considering the time-dependence of three characteristic length scales of the flows: the overturning Thorpe scale L_T; the largest turbulence scale unaffected by stratification known as the Ozmidov scale $L_O = \sqrt{\epsilon/N^3}$; and the Kolmogorov scale $L_K = (\nu^3/\epsilon)^{1/4}$, where ϵ is the kinetic energy dissipation rate, ν is the kinematic viscosity, and N is the buoyancy frequency. Provided L_O/L_K is sufficiently large, we show that L_T first grows as the primary billow develops, but then falls rapidly as the turbulence onsets and L_O increases in turn and then decays more slowly, leading to a typical monotonic increase in the ratio L_O/L_T with time. Both the most efficient and the most vigorous mixing occurs when $L_T \simeq L_O$, which has important implications for the interpretation and modelling of real oceanic mixing events.

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