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On the diapycnal diffusivity in homogeneous stably stratified turbulence DEREK STRETCH, University of KwaZulu-Natal, SUBHAS VENAYAGAMOORTHY, Colorado State University — Quantifying the irreversible diapycnal mixing that occurs in stably stratified turbulence is fundamental to the understanding and modeling of geophysical flows, and for predicting dispersion in these flows. In this study, data of diapycnal mixing from direct numerical simulations of homogeneous stably stratified turbulence, both with and without shear, and from grid turbulence experiments, are reviewed and analyzed to investigate the scaling of the diapycnal diffusivity. In these homogeneous flows the instantaneous diapycnal diffusivity is given exactly by $K_d = \epsilon_\rho / \left(\partial\overline{\rho}/\partial z\right)^2$ and may be expressed in terms of the large scale properties of the turbulence as $K_d = \gamma L_E^2/T_L$, where $L_E = (\overline{\rho'^2})^{\frac{1}{2}}/|\partial\overline{\rho}/\partial z|$ is the Ellison overturning length-scale, $T_L = k/\epsilon$ is the turbulence decay time-scale, and γ is half the mechanical to scalar time-scale ratio. Our results show that L_E and T_L can explain all the variations in K_d over a wide range of shear and stratification strengths (including shear-free and neutrally stratified cases) while γ remains approximately constant. This result is also found to be independent of Prandtl (or Schmidt) number.

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