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Quantifying mixing and available potential energy in vertically periodic simulations of stratified flows[1] CHRISTOPHER HOWLAND, JOHN TAYLOR, DAMTP, University of Cambridge, COLM-CILLE CAULFIELD, BPI/DAMTP, University of Cambridge — In a stably stratified Boussinesq fluid, irreversible diapycnal mixing describes the conversion of available potential energy (APE) to background potential energy (BPE). In some settings the APE framework is difficult to apply and approximate measures are used to estimate this mixing. For example, numerical simulations of stratified turbulence often use triply periodic domains to increase computational efficiency. In this setup however, BPE is not uniquely defined and the method of Winters et al. (1995, J. Fluid Mech., 289) cannot be directly applied to calculate the APE. We propose a new technique to calculate APE in periodic domains with a mean stratification. By defining a control volume bounded by surfaces of constant buoyancy, we can construct an appropriate background buoyancy profile $b_*(z,t)$ and accurately quantify diapycnal mixing in such systems. This new framework is consistent with the definition of a local APE density, useful for identifying mixing mechanisms. The evolution of APE is analysed in various turbulent stratified flow simulations. We show that the mean dissipation rate of buoyancy variance χ provides a good approximation to the mean diapycnal mixing rate, even in flows with significant variations in local stratification.

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