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Local Available Potential Energy in Simulations of Stratified Turbulence with Uniform and Non-uniform Ambient Density Gradients¹ GAVIN PORTWOOD, STEPHEN DE BRUYN KOPS, University of Massachusetts Amherst, TURBULENCE SIMULATION LABORATORY TEAM — In stratified flows, the maximum amount of potential energy that can be converted to kinetic energy is the difference between the potential energy in the instantaneous flow and that in the flow if the fluid parcels were adiabatically sorted to produce the lowest energy configuration. Lorentz (1955) defines this global quantity as available potential energy (APE). Holliday and McIntyre (1981) introduces the concept of local available potential energy (E_a) associated with a fluid parcel, and Molemaker and McWilliams (2010) develop the transport for this quantity for a viscous, Boussinesq fluid. Here, we characterize E_a in simulations of a vortex street with uniform and non-uniform stabilizing ambient density gradients. In pseudo-spectral direct numerical simulations resolved on up to $4096 \times 2048 \times 2048$ grid points, we find that the majority of APE is due to fluid parcels displaced a small distance, relative to the buoyancy length scale, from their locations in the sorted density field. By computing each term in the transport equation for E_a , we observe by how much E_a of a fluid parcel changes in time due to local dipycnal mixing, and by how much global mixing alters the position of the local parcel in the sorted density field.

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