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Decaying Turbulence with Non-uniform Density Stratification
DAVID HEBERT, STEPHEN DE BRUYN KOPS, University of Massachusetts Amherst — Density stratification in environmental flows is often non-uniform in height (e.g. thermohaline staircase, atmospheric layer transition). The description of these flows, however, is often considered in terms of the average density change with height, and in numerical simulations this simplification is almost always made because it greatly simplifies the calculations. In this presentation, high resolution direct numerical simulations of an idealized turbulent late wake with non-uniform density stratification are analyzed to understand the consequences of assuming linear stratification. The simulations are initialized with a vortex street, each vortex having a vertical mean velocity profile $\mathrm{sech}^2(\mathrm{z}/\delta_\mathrm{U})$. An ambient density $\overline{\rho} = \tanh(\mathrm{z}/\delta_\rho)$ and stratification profile $d\overline{\rho}/dz = \mathrm{sech}^2(\mathrm{z}/\delta_\rho)$ are imposed on the flow. The vertical scale of $d\overline{\rho}/dz$ is varied by changing δ_ρ while holding δ_U constant. An analysis of flow behavior for several ratios $DR = \delta_\rho/\delta_U$ will be presented, including methodology for calculating potential energy for non-uniform density stratification.

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