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Direct numerical simulation of incompressible acceleration-driven variable-density turbulence[1] ILANA GAT, California Institute of Technology, GEORGIOS MATHEOU, California Institute of Technology, NASA Jet Propulsion Laboratory, DANIEL CHUNG, University of Melbourne, PAUL DIMOTAKIS, California Institute of Technology — Fully developed turbulence in variable-density flow driven by an externally imposed acceleration field, e.g., gravity, is fundamental in many applications, such as inertial confinement fusion, geophysics, and astrophysics. Aspects of this turbulence regime are poorly understood and are of interest to fluid modeling. We investigate incompressible acceleration-driven variable-density turbulence by a series of direct numerical simulations of high-density fluid in-between slabs of low-density fluid, in a triply-periodic domain. A pseudo-spectral numerical method with a Helmholtz-Hodge decomposition of the pressure field, which ensures mass conservation, is employed, as documented in Chung & Pullin (2010). A uniform dynamic viscosity and local Schmidt number of unity are assumed. This configuration encapsulates a combination of flow phenomena in a temporally evolving variable-density shear flow. Density ratios up to 10 and Reynolds numbers in the fully developed turbulent regime are investigated. The temporal evolution of the vertical velocity difference across the shear layer, shear-layer growth, mean density, and Reynolds number are discussed. Statistics of Lagrangian accelerations of fluid elements and of vorticity as a function of the density ratio are also presented.

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