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Non-Boussinesq effects on buoyancy-driven variable-density turbulence[1] DENIS ASLANGIL, Lehigh University, DANIEL LIVESCU, Los Alamos National Laboratory, ARINDAM BANERJEE, Lehigh University — Non-Boussinesq effects on turbulent mixing of a heterogeneous mixture of two incompressible, miscible fluids with different densities are investigated in terms of properly normalized L^{2m}-norms of density gradient by means of high-resolution Direct Numerical Simulations. In a triply periodic three-dimensional domain, the mixing occurs in response to stirring induced by buoyancy-generated motions between two fluids which are initially segregated in random patches. During the flow evolution, the density gradient can reach high values even at low Atwood numbers indicating that non-Boussinesq effects play a crucial role within the flow. The results cover a broad range of Reynolds numbers and non-dimensional density ratios (Atwood numbers, A) including small (A=0.05), moderate (A=0.25 and 0.5), and high (A=0.75) values. An asymmetric behavior is detected on the probability density function of the density gradient at high Atwood numbers. The evolution of the density gradient and the hierarchy of its higher order norms are also investigated by decomposing the flow into the different flow regions by using density as a fluid marker. It is found that the density gradient is much larger in regions of light fluid compared to regions occupied by the heavier fluid, indicating a strong mixing asymmetry between light and heavy fluids. This shows that Boussinesq models may not be adequate even at low density ratios; contrary to what statistics based on the entire domain.

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