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Evaluating multiphase turbulence statistics using mesoscale DNS of gravity-driven particle-laden flows RODNEY FOX, Ecole Centrale Paris, JESSE CAPECELATRO, OLLIVIER DESJARDINS, Cornell University, LABORATOIRE EM2C-UPR COLLABORATION, SIBLEY SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING COLLABORATION — Flow instabilities encountered in fluid-particle flows subjected to a body force (i.e., gravity) can lead to mesoscale structures that control the underlying fluid turbulence. The wide range of length and time scales associated with such flows pose great challenges in understanding and predicting key features. In our recent work, the exact Reynolds-average (RA) equations for monodisperse collisional particles in a constant-density fluid were derived. The turbulence model solves for the RA particle volume fraction, the phase-average (PA) particle velocity, the PA granular temperature, and the PA particle turbulent kinetic energy. Unlike most previous derivations, a clear distinction is made between the PA granular temperature, which appears in the kinetic theory constitutive relations, and the particle-phase turbulent kinetic energy, which appears in the turbulent transport coefficients. Fully coupled Eulerian-Lagrangian simulations are used to evaluate the unclosed terms that arise in the RA equations. A two-step filter is employed during the interphase exchange process, providing a separation of length scales between the microscale and mesoscale structures. The same filtering process is used to evaluate turbulence statistics and modeling constants appearing in the RA model.

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