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Motion of Heavy Particles in a Bidisperse Turbulent Suspension[1]
LIAN-PING WANG, ORLANDO AYALA, University of Delaware, WOJCIECH GRABOWSKI, National Center for Atmospheric Research (NCAR) — We consider the motion of small heavy particles in a turbulent carrier flow, in terms of both particle-laden flow and micro- aerodynamics. The particles are assumed to be at least one order of magnitude smaller than the Kolmogorov length of the undisturbed carrier-flow turbulence, with a volume faction on the order of 10E-5 as in the recent experiments of Alisesa et al. (2002, or ACHL02) and Yang and Shy (2005, or YS05). A hybrid direct numerical simulation (HDNS, Wang et al. 2005, J. Atmos. Sci. 62: 2433) approach is used to simulate the turbulent suspension, in which the disturbance flows due to particles are treated analytically by a superposition method and the undisturbed air turbulence is simulated by a pseudospectral method. First, in order to validate the HDNS approach, we simulate the conditions used in the experiments of ACHL02 and YS05 and compare the HDNS results with the experimental results. We focus on the average settling rate of particles and study how the preferential concentration and local aerodynamic interactions enhance the settling rate. Second, we will explore how the HDNS approach could be further extended to include the effect of particles on the energy spectrum of the carrier flow turbulence (i.e., two-way coupling).

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