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A numerical investigation of cluster fall velocity in vertical particle-laden turbulent pipe flow JESSE CAPECELATRO, OLIVIER DESJARDINS, Cornell University, NATIONAL RENEWABLE ENERGY LAB COLLABORATION — Particle clusters are known to play a key role in the multiphase dynamics as well as secondary processes such as heat transfer and catalytic conversion within vertical pipe flows. For example, vertical risers in circulating fluidized bed reactors consists of a dilute suspension of particles that ascend in the core of the flow, then condense into clusters and descend at the walls. In this work, an Euler-Lagrange strategy is used to study particle cluster dynamics in turbulent risers for a range of Archimedes numbers and density ratios. The simulations are conducted in the framework of NGA, a high-order fully conservative code tailored for turbulent flows. The particles are solved in a Lagrangian framework and the two phases are coupled using a two-step filtering process to ensure conservation, as well as convergence during mesh refinement. Normal and tangential collisions are computed via a soft-sphere model. A conservative immersed boundary method is used to represent the 3D cylindrical geometry on a Cartesian mesh. Simulation results are compared with experimental correlations in terms of cluster fall velocity and size. The role of the carrier fluid on the cluster behavior is also studied.

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