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Clustering Instability in Sedimenting Gas-Solid Suspensions and its Influence on Flow Properties. XIAOQI LI, XIAOLONG YIN, Colorado School of Mines, GUODONG LIU, Harbin Institute of Technology — It is well known that sedimentation or fluidization of solid particles through gas is unstable. Instability is usually recognized as particle clusters when the solid fraction is low, or as void 'bubbles' when the solid volume fraction is high. Using particle-resolved numerical simulations, we studied cluster formation in gas-solid systems with gas-to-solid density ratio being 0.01 and 0.001. The particles are uniformly sized spheres with a terminal Re of 30. The solid fraction is 0.25. Up to 4808 particles were used such that the clustering phenomena can be adequately examined. In periodic computational domains whose lateral dimension is about eight particle diameters, nucleated particle clusters quickly coalesce and grow into traveling waves that span the entire width of the domain. Consequently, gas-solid drag is significantly increased compared to that in a homogeneous liquid-solid suspension, the lateral velocity variance is suppressed, and the particle velocity distributions are strongly non-Gaussian. When lateral dimension is increased to about thirty particle diameters, particle clusters never turn into width-spanning traveling waves. As results, the drag is similar to that in a homogeneous suspension, the lateral velocity variance is strongly enhanced and the vertical variance reduced, and particle velocity distributions are nearly Gaussian. These results suggest that the effect of particle clusters should be examined in domains with large lateral dimensions.

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