Experimental study of inertial particle settling in turbulence under gravity

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Résumé

We report experimental measurements of inertial particle settling in turbulence, in which both enhanced and hindered settling velocities are observed. Simultaneous volumetric Lagrangian particle tracking is performed for finite-size inertial particles and tracer particles. A particle Froude number defined for finite-size inertial particles is identified as a key dimensionless parameter governing the transition between enhanced and hindered settling. Particles of moderate density and small size, corresponding to moderate inertial and small finite-size effects, exhibit enhanced settling in turbulence owing to increased slip velocity and preferential sampling of downward flow. As finite-size effects increase with particle size, particles continue to preferentially sample downward flow but experience a reduction in slip velocity, resulting in hindered settling. For heavy particles with strong inertial effects, settling is consistently hindered by turbulence and is associated with reduced slip velocity and preferential sampling of upward flow.

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