
Decoupling between inertial and gravitational effects in the dynamics of particles in turbulence

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Résumé

Volcanic ash transport, atmospheric pollution, and aeolian dust are examples of turbulent flows laden with particles. Understanding the dynamics of heavy inertial particles in turbulence remains a major challenge, particularly due to the coupling between inertial and gravitational effects. In this study, we experimentally investigate the dynamics of heavy spherical particles in turbulence by exploring several particle-to-fluid density ratios and particle diameters, corresponding to different Stokes numbers. To isolate inertial effects from gravitational settling, experiments are conducted under micro-gravity conditions. A dedicated experimental facility was designed and implemented in the Dryden Drop Tower at Portland State University, providing 2.1 seconds of micro-gravity. Particle Tracking Velocimetry (PTV) enables simultaneous measurement of inertial and tracer particle trajectories, allowing direct access to one-point and two-point statistics as well as slip velocity dynamics. This approach provides new insight into the role of inertia in particle–turbulence interactions in the absence of gravitational bias.

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