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The role of two-way coupling and preferential sweeping on particle settling velocities in turbulence[1] ANDREW BRAGG, JOSIN TOM, Duke University, MAURIZIO CARBONE, Max Planck Institute for Dynamics and Self-Organization — In a recent article (Tom & Bragg, J. Fluid Mech., 871, pp. 244–270, 2019), we used theory and Direct Numerical Simulations (DNS) to explore how the preferential sweeping mechanism that generates enhanced particle settling velocities in turbulence operates at different scales of the flow. We showed that the scales that contribute to preferential sweeping depend on the particle Stokes number, settling parameter, and the flow Reynolds number. That analysis, however, assumed one-way coupling. When the particle mass loading is small, although the effect of the particles on the global flow properties is weak, the particles may nevertheless strongly modify the local flow in their vicinity, dragging the surrounding fluid down with them as they fall, significantly influencing their settling velocities (Monchaux & Dejoan, Phys. Rev. Fluids 2, 104302, 2017). We use theory and DNS to explore how this fluid-dragging effect introduced by two-way coupling competes with the preferential sweeping mechanism at different scales in the flow, and for different particle and flow parameters. The analysis provides new insights into the scales where one mechanism dominates over the other, and the parameter regimes where two-way coupling effects are important for particle settling velocities.

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