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Computational and experimental analysis of particle clustering in a shearless turbulent mixing layer PETER IRELAND, GARRETT GOOD, ZELLMAN WARHAFT, LANCE COLLINS, Cornell University — Entrainment, the drawing in of external fluid by a turbulent flow, is ubiquitous to both industrial and natural turbulent processes. This mechanism is particularly important in atmospheric clouds, where the entrainment of dry air by turbulence can affect precipitation mechanisms. We use parametrically matched wind-tunnel experiments and direct numerical simulations with inhomogeneous particle seeding to explore particle clustering in a shearless turbulent mixing layer. We find high degrees of clustering, both visually and statistically, even for particles with negligible inertia. These particle clusters have characteristic sizes on the order of the integral lengthscale of the turbulence and are thus much larger than those resulting from particle inertia. The degree of clustering at a particular location generally decreases as the mixing layer evolves and depends on both the turbulent kinetic energy ratio in the mixing layer and the magnitude and orientation of gravity. We observe the same qualitative trends in both the experiments and the simulations. We anticipate that a better understanding of particle clustering in entraining flows will lead to, among other things, improved cloud evolution predictions and more accurate climate models.

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