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Hydrodynamic clustering of droplets in turbulence RUDIE KUNNEN, ALTUG YAVUZ, GERTJAN VAN HEIJST, HERMAN CLERCX, Eindhoven University of Technology — Small, inertial particles are known to cluster in turbulent flows: particles are centrifuged out of eddies and gather in the strain-dominated regions. This so-called preferential concentration is reflected in the radial distribution function (RDF; a quantitative measure of clustering). We study clustering of water droplets in a loudspeaker-driven turbulence chamber. We track the motion of droplets in 3D and calculate the RDF. At moderate scales (a few Kolmogorov lengths) we find the typical power-law scaling of preferential concentration in the RDF. However, at even smaller scales (a few droplet diameters), we encounter a hitherto unobserved additional clustering. We postulate that the additional clustering is due to hydrodynamic interactions, an effect which is typically disregarded in modeling. Using a perturbative expansion of inertial effects in a Stokes-flow description of two interacting spheres, we obtain an expression for the RDF which indeed includes the additional clustering. The additional clustering enhances the collision probability of droplets, which enhances their growth rate due to coalescence. The additional clustering is thus an essential effect in precipitation modeling.

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