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A mathematical model for multi-modality in droplet dispersion CATHAL CUMMINS, OLAYINKA AJAYI, Heriot-Watt University, FELICITY MEHENDALE, ROMAN GABL, IGNAZIO MARIA VIOLA, University of Edinburgh — We present a mathematical model for the dispersion of spherical droplets in the presence of a source-sink pair flow field [Cummins et al. (2020), Phys. Fluids 32 (8)]. The dynamics of the droplets is governed by the Maxey–Riley equation with the Basset–Boussinesq term neglected. In the absence of gravity, our model predicts two distinct behaviors for the droplets: small droplets cannot go further than a specific distance from the source before getting pulled into the sink. Larger droplets can travel further from the source before getting pulled into the sink by virtue of their larger inertia. In each case, their maximum traveled distance is determined analytically. In the presence of gravity, we find that there are three distinct droplet behaviors categorized by their sizes: small, intermediate, and large. Counterintuitively, we find that the droplets with a minimum horizontal range are neither small nor large, but of intermediate size. Furthermore, we show that in conditions of human respiration, these intermediate-sized droplets range in size from a few microns to a few hundred microns. The result that such droplets have a very short range could have important implications for our understanding of the spread of airborne diseases.

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