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Numerical study of the motion of microscopic oil droplets under high turbulence. MURRAY SNYDER, United States Naval Academy, OMAR KNIO, JOSEPH KATZ, Johns Hopkins University, OLIVIER LE MAÎTRE, Université d'Evry Val d'Essonne — The rise of small oil droplets in water undergoing isotropic turbulence is analyzed computationally to explain the observations of Friedman and Katz (2002), where the rise velocity of droplets smaller than 800 μm diameter is enhanced by turbulence whereas rise of larger droplets is retarded. The study explores whether these effects can be explained using a one-way coupling model combining DNS of the field with Lagrangian tracking of droplets using a dynamical equation with buoyancy, virtual mass, pressure, drag, lift and history forces. Results indicate that using empirically-determined drag and lift coefficients, the observed droplet behavior is not reproduced. Lift and history forces are shown to not to account for the observed mean droplet rise. From correlations for settling of heavy particles under intense turbulence, suppression of drag and virtual mass for droplet diameters near ten times the Kolmogorov lengthscale was postulated. Analysis indicate that the model then recovers observed small droplet rise enhancement and large droplet rise retardation. Results underscore difficulties in modeling the motion of small particles under high turbulence, especially when the particle size is near the turbulence microscale.

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