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Flocculation of suspended cohesive particles in homogeneous isotropic turbulence KUNPENG ZHAO, University of California, Santa Barbara, Xi'an Jiaotong University, FLORIAN POMES, University of California, Santa Barbara, BERNHARD VOWINCKEL, TU Braunschweig, TIAN-JIAN HSU, University of Delaware, BOFENG BAI, Xi'an Jiaotong University, ECKART MEIBURG, University of California, Santa Barbara — We investigate the dynamics of cohesive particles in homogeneous isotropic turbulence, based on one-way coupled simulations that account for Stokes drag, lubrication, cohesive and direct contact forces. The simulations yield the evolution of floc size and shape due to aggregation and breakage, as function of the governing parameters. Larger turbulent shear and weaker cohesive forces limit the floc size and result in elongated floc shapes. Flocculation proceeds most rapidly when the Stokes number of the primary particles, based on the Kolmogorov length scale and the rms-velocity, is near one. The equilibrium floc size distribution exhibits a preferred size as function of the cohesive number. Consistent with earlier findings, we observe that flocs of size close to the Kolmogorov scale preferentially align themselves with the intermediate strain direction and the vorticity tensor. In contrast, flocs smaller than the Kolmogorov scale tend to align themselves with the extensional strain direction. Based on the numerical data we propose a new flocculation model with a variable fractal dimension, which allows us to predict the temporal evolution of the floc size and shape. Compared to existing models in the literature, the new model has fewer limitations and results in improved accuracy.

Eckart Meiburg
University of California, Santa Barbara

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