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Coupled Population Balance and Large Eddy Simulation model for Polydisperse Droplet Evolution in a Turbulent Round Jet ADITYA AIYER, CHARLES MENEVEAU, Johns Hopkins University — A population balance model coupled with large eddy simulations (LES) is adapted and applied to study the evolution of oil droplets in an axisymmetric turbulent jet including the effects of droplet breakup. We develop a hybrid approach where the inlet condition is prescribed using a one dimensional (1D) parcel model that accounts for the evolution of the dispersed phase along the jet centerline due to the combined effects of advection, radial turbulent transport and droplet breakup. LES results are compared to published experimental data, with good agreement and we examine the statistics of the velocity field and the concentration of the polydisperse oil droplet plumes for two droplet Weber numbers. We find that the centerline decay rate of the concentration for different droplet sizes is modified in the breakup dominated zone. Moreover, the transverse dispersion of larger droplets is suppressed due to trajectory crossing effects. Unlike Reynolds averaged approaches, LES also allows us to quantify size distribution variability due to turbulence. We quantify the radial and axial distributions and the variability of key quantities such as the Sauter mean diameter, total surface area and droplet breakup time-scale and explore their sensitivity to the Weber number.

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