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Sensitivity Study of Contrail Development: Large Eddy Simulation and Parameterized Model ALEXANDER NAIMAN, SANJIVA LELE, MARK JACOBSON, Stanford University — The development of aircraft condensation trails is sensitive to factors including ambient relative humidity, aircraft type, and environmental turbulence. The effect of these parameters on the transition from linear contrails to induced-cirrus clouds is a key uncertainty in estimating the impact of contrails on climate. A sensitivity study of these parameters has been conducted using a three-dimensional Large Eddy Simulation (LES) of the first twenty minutes of contrail development. The LES solves the incompressible Navier-Stokes equations with a Boussinesq approximation. The numerical scheme uses a second-order finite volume spatial discretization and an implicit fractional-step method for time advancement. Lagrangian contrail particles grow according to a model of ice deposition and sublimation. We present results in which turbulence, wind shear, and aircraft type were varied. Additional cases include variations in microphysical processes and in initial conditions. Results from the LES are compared to a simple parameterization of plume dynamics developed to model aircraft emissions in a global climate model. The parameterized model is shown to be valid for the late stages of the LES model results. Additional LES work will be required to validate the parameterized model to time horizons later than twenty minutes, which are relevant for the transition from linear contrail to induced cirrus.

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