Cornell Fluid Dynamics Seminar Series

Presents

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"Inertial Particle Dynamics in Turbulent Mixing and Boundary Layers"

12:15-1:15 p.m.
Tuesday, October 27, 2009
178 Rhodes Hall
Pizza and refreshments will be served at noon.

Two-dimensional Lagrangian acceleration statistics of inertial particles in a turbulent boundary layer with free-stream turbulence are determined by means of a particle tracking technique. At the outer edge of the boundary layer, where the shear is weak, the acceleration probability density functions are similar to those previously observed in isotropic turbulence for inertial particles. As the boundary layer plate is approached, the tails of the probability density functions narrow, become negatively skewed, and their peak occurs at negative accelerations. The mean deceleration and its root mean square increase to large values close to the plate. These effects are more pronounced at higher Stokes number. Although there are free-stream turbulence effects, and the complex boundary layer structure plays an important role, a simple model suggests that the acceleration behavior is dominated by shear, gravity and inertia.

In another experiment, motivated by the problem of entrainment of dry air into clouds, mixing of water droplets studied in a shearless turbulence mixing layer: a layer in which there is a step in turbulence intensity across the interface but there is negligible change in the mean velocity. We show that the particle number density is an order of magnitude smaller on the low turbulence side of the turbulent-non-turbulent interface compared with that of a turbulent-turbulent interface with the same initial distribution of inertial particles on one side. We concluded that the turbulent-non-turbulent interface, if present in a cloud boundary, can be considered as an effective barrier preventing escaping particles from a cloud. The intermittency in particle dynamics in the mixing layer is also studied.