Particles in turbulent flow

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ABSTRACT

In many situations ranging from geophysics to chemical engineering, turbulent drag moves particle clouds. I will present and compare various numerical approaches. On the one hand the mean velocity profile above ground is systematically constructed subtracting momentum loss; on the other hand the intrinsic spatio-temporal fluctuations are imposed from empirical distributions on point-like fluid particles. Various applications are explored. One is saltation, i.e. Aeolian transport of sand, discovering that the onset of particles flux exhibits a first order transition with hysteresis. The inclusion of mid-air grain collisions is found to increase the flux considerably due to the formation of a floating "soft bed" that screens energy-rich grains (saltons) from hitting the ground. Solving the fluid motion with the Lattice Boltzmann Method the effect of particle-particle collisions on preferential concentration is also investigated. Another application is powder mixing in a channel due to turbulent fluctuations. Following A.M. Reynolds (2003), a stochastic differential equation is solved for the motion of fluid particles that are attached to real particles. The dependence of the observed diffusive behaviour on Reynolds and Stokes number is monitored. Finally, also spatial correlations in the velocity field are imposed by a Heisenberg-type Hamiltonian.

REFERENCES

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