Capability of the Monte Carlo method to simulate resuspension phenomena

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A model for the resuspension of a monolayer of particles deposited on a flat surface is developed based on a Monte Carlo (MC) simulation. Particles are attached through an adhesion force. A turbulent flow is assumed to be responsible for the resuspension of particles. The stochastic process used for resuspension is based on the evaluation of probabilities depending on the ratio between adhesion and aerodynamic forces and using a Metropolis function. Although simple, our model accounts for the main features of the resuspension flux observed experimentally and by other models. Figure 1 shows the three typical behaviors for the resuspension flux obtained through MC simulations. The model is able to clearly show the role that force distribution parameters (both for adhesion and turbulent) have on the short- and long-term resuspension flux.

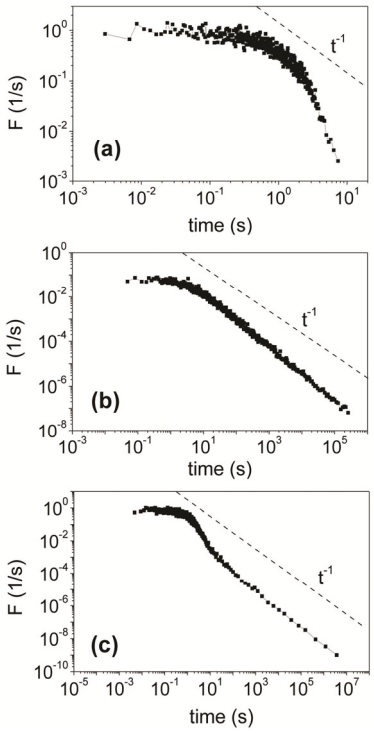

Figure 1. Flux of resuspended particles vs. time: (a) short-term resuspension, (b) long-term resuspension and (c) long-term resuspension with a shoulder.

Although results obtained with our model based on a force ratio are satisfactory, the version of the model is not appropriate to reproduce experimental data for resuspension fraction vs. the fluid velocity. Thus, a second version of our MC model is developed, wherein the resuspension probabilities are evaluated from a balance between the adhesion and the hydrodynamics moments acting on each particle. As seen in Figure 2, the model can reproduce various experimental scenarios.

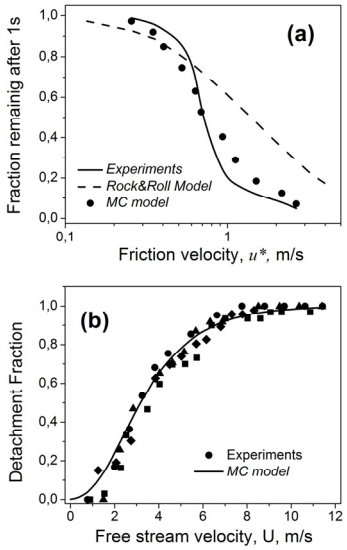

Figure 2. Comparison between the moment balance MC model results and experimental results from: (a) Reeks *et al* (2001) and (b) Ibrahim *et al* (2003).

Our model adequately spans all the possible features for particle resuspension and allows us to build a state diagram useful to determine the future behavior of a system, given some physical parameters (Benito, 2014). We prove that a model based on a moment balance successfully reproduces a wide range of experimental data. The MC model adds the stochastic nature of adhesion and interaction forces appearing in resuspension, complementing previous models.

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Reeks, M., Hall, D. (2001) *Journal of Aerosol Science* **32**, 1-32.

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