A Simple Particle Saltation Model Using Computational Fluid Dynamics

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Introduction: This work presents a three-dimensional model of particle saltation using computational fluid dynamics. The importance of this investigation is to predict the environmental impact that could be generated during certain dust generation activities. Figure 1 shows a schematic representation of saltation and wind profile.

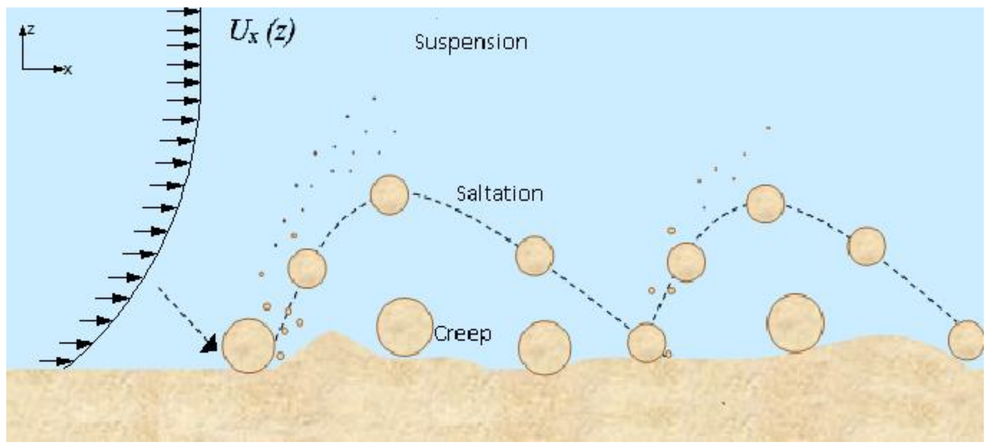

Figure 1. Schematic representation of saltation and wind profile

Computational Methods: Interaction of three processes: the behavior of the wind, the trajectory of the particles in saltation and the momentum transfer between the wind flow and suspended particles. It is a three-dimensional model that includes turbulent effects through the κ-ε equations, drag force, and gravity. To simulate this mechanism of transport, was used the Fluid Flow>Single-Phase Flow>Turbulent Flow κ-ε, and Fluid Flow>Particle traicing>Particle traicing for Fluid Flow physics.

The domains of study consist in two rectangular boxes (Figure 2). The second one has a random function applied in the base, to simulate an irregular terrain.

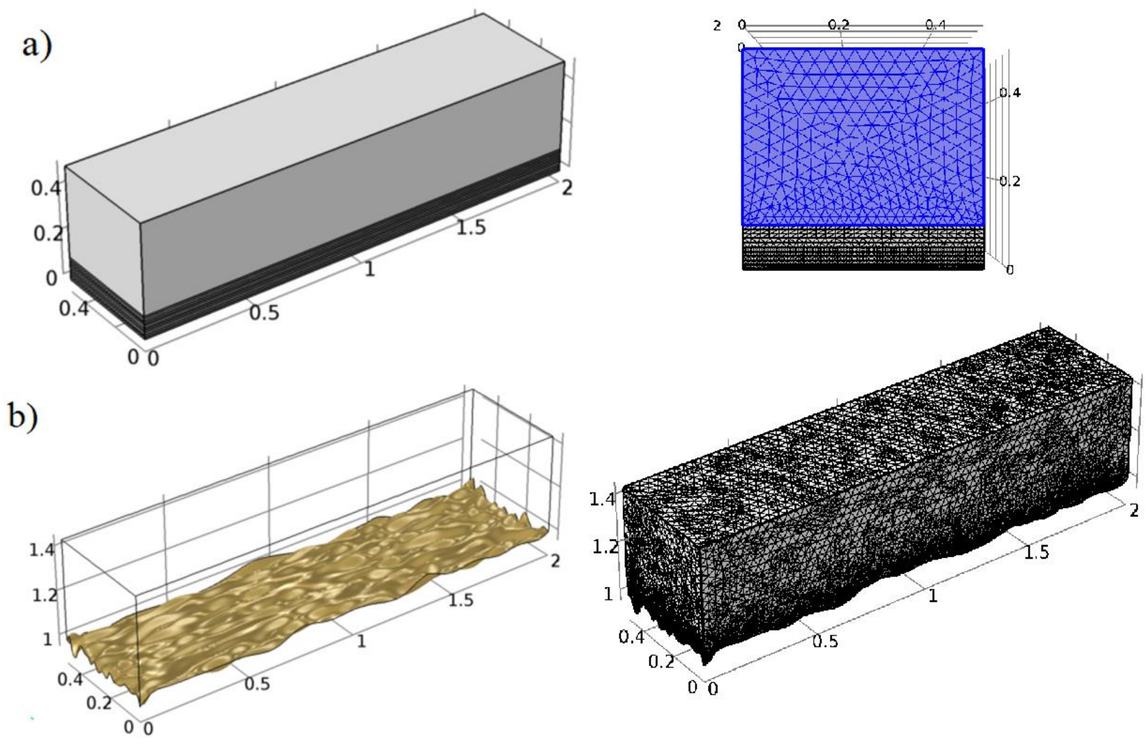

Figure 2. Geometry's Domain. a) Ideal terrain, b) Irregular terrain.

Results

Ideal Results

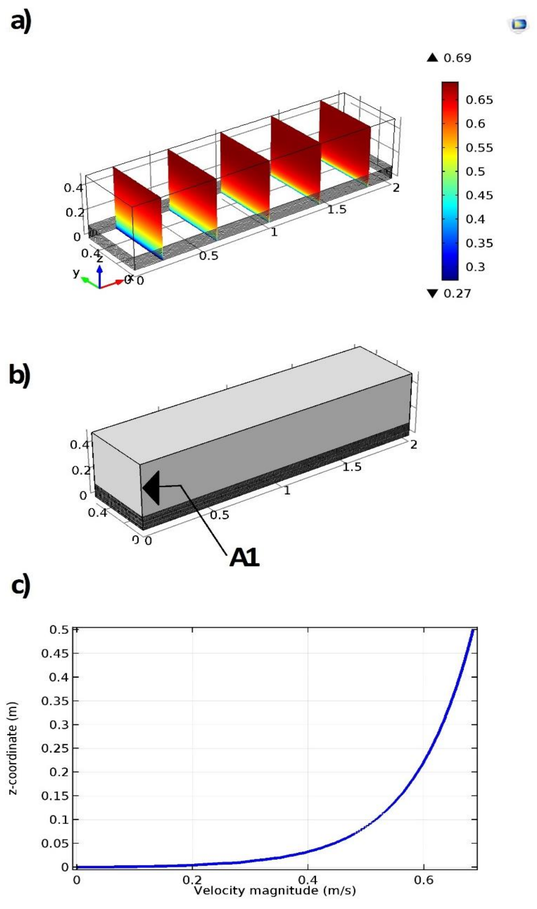

Figure 3. Velocity magnitude profiles for a 1 m/s wind speed at 10 m. a) Velocity magnitude contours, b) example of selected rake.

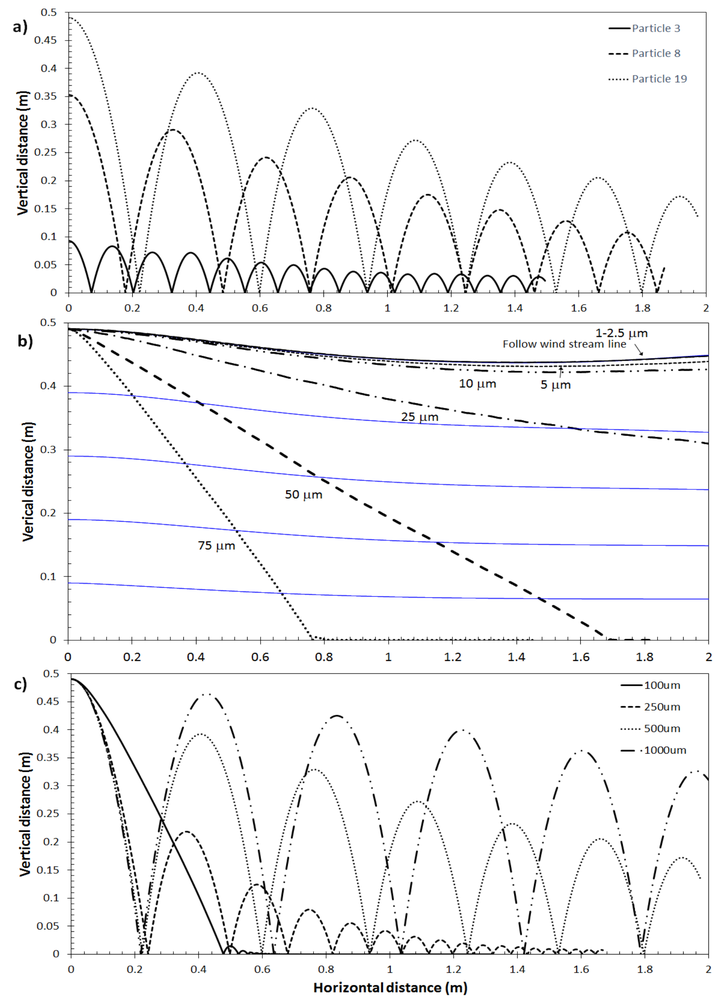

Figure 4. Particle trajectories. a) 500 μm particles were released from different heights, b) 1-75 μm, c) 50-1000 μm particles trajectories dropped at 0.49 m on the Y-axis.

Irregular Terrain Results

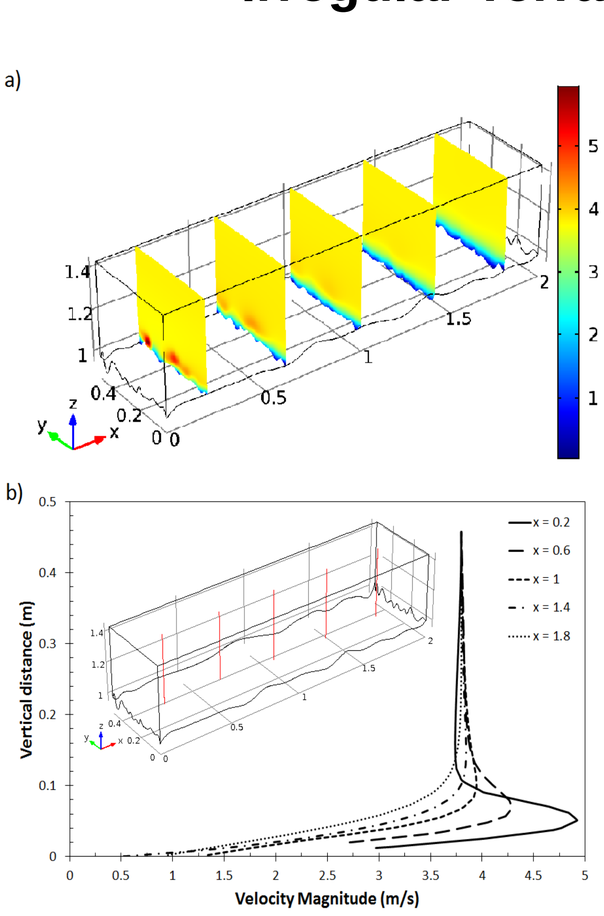

Figure 5. Velocity magnitude and profiles along the X-axis. a) contours, b) profiles

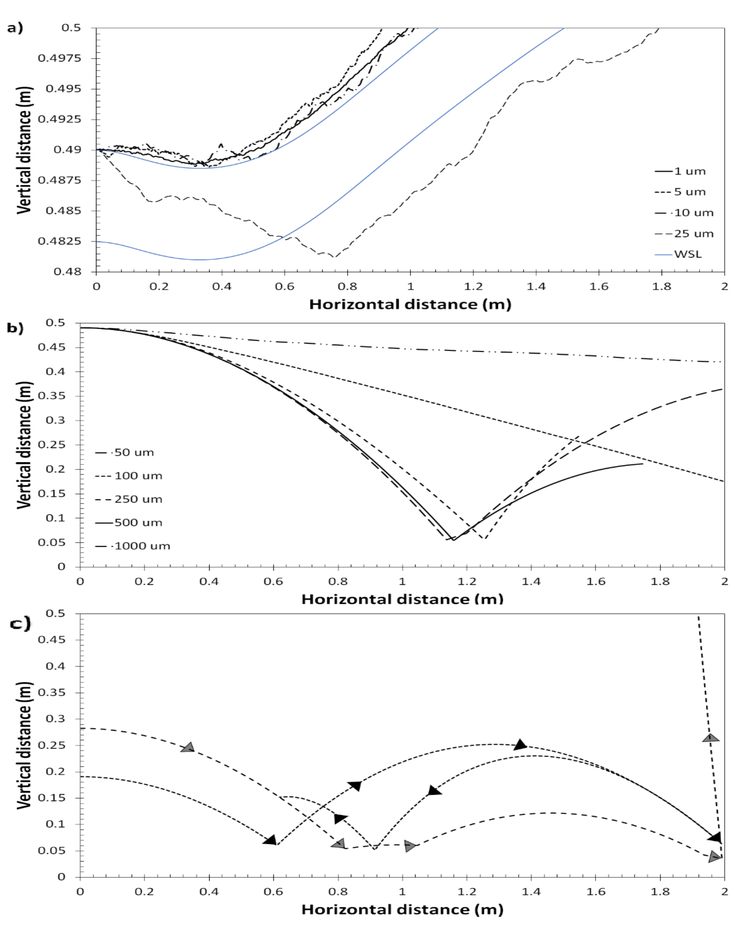

Figure 6. Particle trajectories at 5 m/s wind speed. a)1-25 μm Particles dropped at 0.49 m on the Y-axis. b) 50-1000 μm particles dropped at 0.49 m on the Y-axis. c) 500-μm particles trajectories.

References:

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