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3D Numerical Simulation of Particle-Particle Collisions in Saltation Mode near Stream Beds

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Abstract

The importance of particle-particle collisions in sediment saltation in the bed-load layer is analyzed herein by means of numerical simulation. The particle saltation theoretical/numerical model follows a Lagrangian approach, and addresses the motion of sediment particles in an open channel flow described by a logarithmic velocity profile. The model is validated with experimental data obtained from the literature. In order to evaluate the importance of the phenomenon, simulations with and without particle-particle collisions were carried out. Results for two different sediment concentrations are presented, namely 0.13% and 2.33%. For each concentration of particles, three different flow intensities were considered, and trajectories of two different particle sizes, within the sand range were computed. Changes in particle rotation, particle velocity, and angle of trajectory before and after particle-particle collisions appear to be relatively important at lower shear stresses, whereas they decrease in significance with increasing flow intensities. Analyses of the evolution in time of the second order moment of particle location suggest that inter-particle collisions introduce transverse diffusion in saltating particles in the span-wise direction.

Key words: particle-particle collision, inter-particle collision, saltation, bed-load transport, two-phase flow model, Lagrangian model.