A depth-integrated model for granular flows on the transition of different bed conditions

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The different basal boundary conditions profoundly affected the flow behavior of debris flow. However, it is hard to have a general and straightforward model to describe the flow profile switching from different bed conditions. In this study, we purpose a new depth-averaged model to simulate the dense granular flow transition between the rigid and mobile bed. The model is based on mass conservation, momentum conservation, and kinetic energy conservation. We apply the linearized mu(I) rheology to describe granular deformation and assume Coulomb friction along the sidewalls. By incorporating the basal shear rate term into the equations, the theory can balance the extra force from rigid bed friction force. To check the model approach, we conducted an equilibrium and non-equilibrium heap flow experiments using the narrow see-saw channel, which can be tilted to different angles between runs or during flows. To compare the experimental results with the theory, the flow fields are monitored using high-speed video and particle-tracking velocimetry.

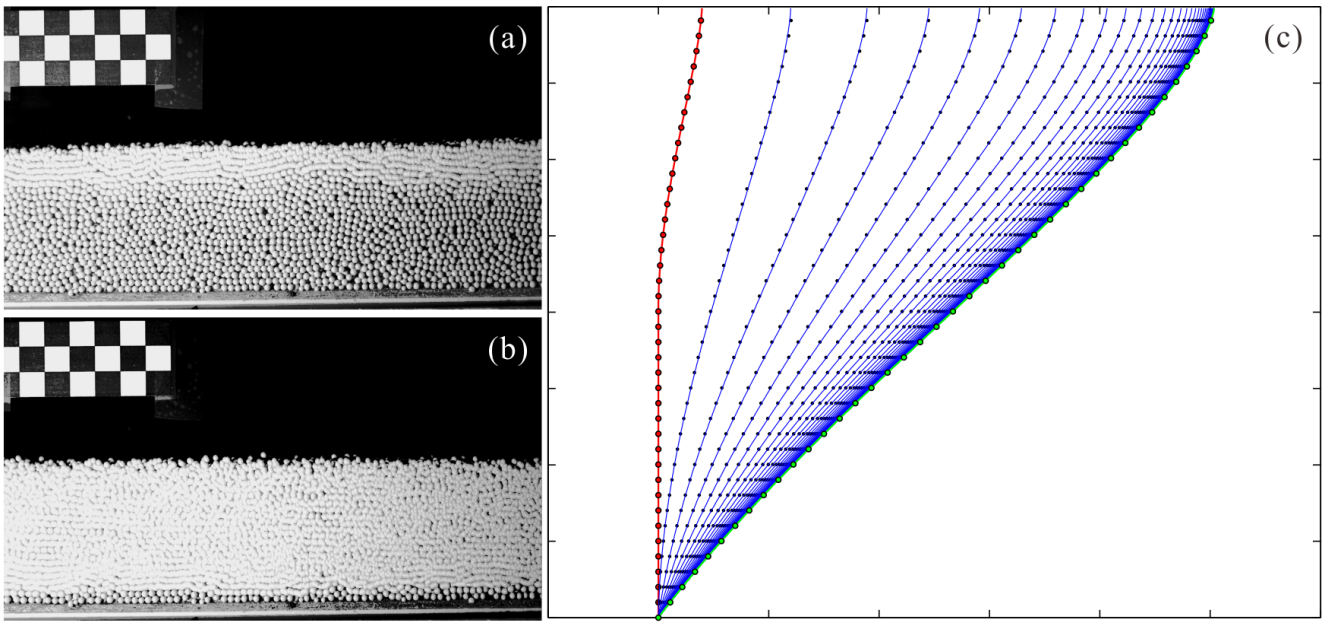

Fig.1 Experimental longexpousre image (a) over deposition bed; (b) over rigid bed; and (c) the transition velocity profile of theory prediction.

