Rapid, dense grain flows: assessment of current models in regards of experimental data

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ABSTRACT

First, we review some striking features displayed by rapid dense flows of grain collections. For free-surface gravity flows on moderate slopes, dense grain flows are characterised by a localisation of the strain over a typical thickness of ten or twenty grain sizes. The velocity profile displays remarkably a *nonzero* shear rate at the vicinity of the free surface, and an (approximate) exponential decrease from the free surface to the substrate at-rest. We then review the various theoretical modelings currently aimed at describing rapid dense-packed grain flows. The first category postulates both a state equation - relating shear pressure, shear rate and density - and a rheological behaviour, i.e. a constitutive relation which relates stress and strain rate. These starting assumptions rely mainly on phenomenological considerations. The second category concerns models primarily inspired from the classical kinetic theory of atomic gas, and altered in order to account for the inelasticity of collision and the absence of thermal motion. At last we recall the foundations of the Non-Smooth Mechanics, and the results obtained within the frame of the Contact Mechanics algorithms. We assess the relevance of these models in regard of some peculiar experimental features.