



Spreading dynamics of a granular mass: material properties, initial condition and consequences for continuous modelling

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Numerous natural flows involving rocks and various debris can be considered granular as soon as the interstitial fluid plays no or little role in the overall dynamics. However, the understanding of the behaviour of a dense collection of grain is still very partial, resulting essentially in the absence of reliable predictive models. Studying the rheology of simple granular systems is thus a essential step towards the elaboration of efficient modelling of real flows. In this perspective, idealized experiments of the collapse and the spreading of a granular mass have shown a surprisingly rich phenomenology which still wants explanation (Lube et al 2004, Lajeunesse et al 2004, Balmforth and Kerswell 2005). The experiment consists of allowing an initially confined column of granular material to collapse and spread onto an horizontal plane, until it stops forming a deposit which defines the runout distance of the flow. Using discrete numerical simulations, we recover the experimental results (Staron & Hinch 2005). We study the details of the collapse and spreading dynamics, and we show the leading role of the initial condition and of the vertical acceleration it induces. Varying the properties of the grains, we show that the latter change the effective friction properties of the mass, but do not affect the shape of the scaling law satisfied by the runout distance. Finally, modifying a shallow-water model in order to take into account the initial vertical acceleration without violating shallow-water assumptions, we are able to recover the experimental results in spite of the over-simplified structure of the flow. These results suggest that the overall dynamics is primarily dictated by the existence of an initial acceleration, while the structure of the flow is related to the effective friction. This stresses the importance of the triggering mechanisms of natural flows.