Geophysical Research Abstracts
Vol. 18, EGU2016-9781-1, 2016
EGU General Assembly 2016

Continuum viscoplastic simulation of a granular column collapse on large slopes : $\mu(I)$ rheology and lateral wall effects

Nathan Martin (1), Anne Mangeney (1,2), Ioan Ionescu (3), and Francois Bouchut (4)

(1) University Paris Diderot, Institut de Physique du Globe de Paris, Sorbonne Paris Cité, France, (2) ANGE team, INRIA, CEREMA, Lab. J.-Louis Lions, Paris, France (mangeney@ipgp.fr), (3) LSPM, University Paris-Nord, Sorbonne-Paris-Cité, France, (4) Université Paris-Est, Laboratoire d'Analyse et de Mathématiques Appliquées (UMR 8050), CNRS, UPEMLV, UPEC, 77454 Marne-la-Vallée, France

The description of the mechanical behaviour of granular flows and in particular of the static/flowing transition is still an open and challenging issue with strong implication for hazard assessment [*Delannay et al.*, 2016]. In particular, *detailed quantitative* comparison between numerical models and observations is necessary to go further in this direction.

We simulate here dry granular flows resulting from the collapse of granular columns on an inclined channel (from horizontal to 22^o) and compare precisely the results with laboratory experiments performed by *Mangeney et al.* [2010] and *Farin et al.* [2014]. Incompressibility is assumed despite the dilatancy observed in the experiments (up to 10%). The 2-D model is based on the so-called $\mu(I)$ rheology that induces a Drucker-Prager yield stress and a variable viscosity. A nonlinear Coulomb friction term, representing the friction on the lateral walls of the channel is added to the model. We demonstrate that this term is crucial to accurately reproduce granular collapses on slopes higher than 10^o whereas it remains of little effect on horizontal slope [*Martin et al.*, 2016].

We show that the use of a variable or a constant viscosity does not change significantly the results provided that these viscosities are of the same order [*Ionescu et al.*, 2015]. However, only a fine tuning of the constant viscosity ($\eta = 1$ Pa.s) makes it possible to predict the slow propagation phase observed experimentally on large slopes. This was not possible when using, without tuning, the variable viscosity calculated from the $\mu(I)$ rheology with the parameters estimated from experiments. Finally, we discuss the well-posedness of the model with variable and constant viscosity based in particular on the development of shear bands observed in the numerical simulations.

References

Delannay, R., Valance, A., Mangeney, A., Roche, O., and Richard, P., 2016. Granular and particle-laden flows: from laboratory experiments to field observations, *J. Phys. D: Appl. Phys.*, submitted.

Farin, M., Mangeney, A., and Roche, O., 2014. Dynamics, deposit and erosion processes in granular collapse over sloping beds, *J. Geophys. Res. Earth Surf.*, **119(3)**, 504-532.

Ionescu, I., Mangeney, A., Bouchut, F., and Roche, O., 2015. Viscoplastic modelling of granular column collapse with pressure and rate dependent viscosity, *J. Non-Newtonian Fluid Mech.*, **219**, 1-18.

Mangeney, A., Roche, O., Hungr, O., Mangold, Faccanoni, G., and Lucas, A., 2010. Erosion and mobility in granular collapse over sloping beds, *J. Geophys. Res.-Earth Surf.*, **115**, F03040.

Martin, N., Ionescu, I. R., Mangeney, A., Bouchut, F. and Farin, M., Continuum viscoplastic simulation of a granular column collapse on large slopes: $\mu(I)$ rheology and lateral wall effects, submitted.