Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06255, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06255
EGU General Assembly 2008
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Laboratory experiments on the characterization of avalanche deposits of a bi-disperse granular material

F. Moro (1), T. Faug (2), H. Bellot (2), F. Ousset (2)

(1) Dipartimento di Geoscienze, Università degli Studi di Padova, Italy, (2) Cemagref, Grenoble Regional Centre, Saint-Martin d'Hères, France

Rapid mass movements such as snow avalanches are often modeled thanks to small-scale laboratory experiments using mono-disperse dry granular materials flowing down an inclined plane. Recent detailed measurements on in situ flows of dense and dry snow in a large scale channel showed that the flow of dense snow is characterized by a very viscous upper thick layer, made of large aggregates, over a much less viscous thin layer, made of single snow grains. Therefore, flows of bi-disperse granular materials may be good candidates to model avalanches of dense and dry snow. We carried out small-scale laboratory tests on bi-disperse granular avalanches. The tests consisted in releasing a mass of glass beads from a reservoir that first flowed down an inclined channel and finally spread out on an inclined unconfined run-out zone. The mass ratio between fine grains (150-250 μm) and large grains (1 mm) in the initial released mass was systematically changed and we quantified its influence (i) on the incoming flow depth and the front velocity in the channel using a laser line shifted by the flow, and (ii) on the deposit shape using an accurate fringe analysis technique. Our study showed that the main characteristics of the deposit are strongly influenced by the ratio between fine and large particles; the deposit was uniform or characterized by typical waves depending on the initial mass ratio and the curve giving the deposit length in the run-out zone versus the initial mass ratio displayed a maximum value.