Geophysical Research Abstracts,
Vol. 11, EGU2009-3365, 2009
EGU General Assembly 2009
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Analysis of debris flow characteristics with a simple model incorporating entrainment processes.

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Entrainment of channel path material, and material deposition during run-out are key features of many rapid landslides like debris flows. Such mechanisms are able to change significantly the mobility of the flow, through rapid changes of the flow volume and of its rheology. Models using both a constant rheology and a constant volume cannot yield accurate forecast of debris-flows characteristics (velocity, discharge, flow height, spreading area), especially for debris flows occurring in heterogeneous torrential watersheds characterized by various geological settings and surficial deposits.
The objective of this paper is to present and test a simple 1D debris-flow model with a material entrainment concept based on limit equilibrium considerations and the generation of excess pore water pressure through undrained loading of the in situ material. The debris flow model propagation is based on a one dimensional finite difference solution of a depth–averaged form of the Navier-Stokes equations of fluid motions. The flows are treated as a one phase material, which behaviour is controlled by different rheological characteristics depending on the liquid/solid ratio. In this model, users are able to implement a change in rheology at the onset of entrainment
The model is tested on a debris flow event that occurred in 2003 in the Faucon torrent, and for which a detailed database on the sediment budget per reaches is available.