Geophysical Research Abstracts
Vol. 21, EGU2019-4328, 2019
EGU General Assembly 2019


# A quasi three-phase one-dimensional model for rock-ice avalanches

Stefania Sansone, Giorgio Rosatti, and Daniel Zugliani
University of Trento, Department of Civil, Environmental and Mechanical Engineering, Italy (stefania.sansone@unitn.it)

In glacial environments, the increase in temperature related to climate changes yields the possible development of the so-called rock-ice avalanches, free-surface granular flows involving a mixture of earth materials, like rocks, ice and water. The peculiar process, occurring during the motion downslope of these masses and that distinguishes this phenomenon from a classical debris flow, is the transition of water from the solid phase (ice) to the liquid one. The ice melting process is responsible for a progressive reduction of the volumetric concentration of the overall solid phase (ice plus rock) and an increase of the water content.
The main purpose of this work consists in developing a mathematical model able to distinguish the different behaviour of ice compared to rock inside the solid phase of the mixture. Thus, a quasi three-phase model is derived starting from a complete three-phase approach and assuming an isokinetic condition between the two solid phases. The resulting system is composed of five equations, three of them corresponding to the mass balance laws written for each component of the mixture and the remaining two equations, corresponding to the momentum conservation equations referred to the solid and liquid phases. The comparison of this mathematical model with the ones present in the literature (biphasic and monophasic) permits us to highlight some innovative aspects of the proposed approach.
In addition, a detailed analysis of the eigenstructure of the model is presented. One of the peculiar aspects coming out from this work is the loss of hyperbolicity of the system, connected not only to the difference of speed between the solid and liquid phases, feature observed also in other biphasic models, but especially to the ice content of the mixture. The performed analysis suggests that the loss of hyperbolicity could be an indication of an inadequate mathematical description of the physical behaviour of the ice inside the mixture in case of high concentration of this component.