Geophysical Research Abstracts
Vol. 17, EGU2015-11092, 2015
EGU General Assembly 2015

A simple analytical model to assess the critical length for crack propagation in weak snowpack layers derived from discrete element simulations

Johan Gaume (1), Alec van Herwijnen (1), Guillaume Chambon (2), and Jürg Schweizer (1)

(1) WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland (johan.gaume@gmail.com), (2) IRSTEA, UR ETGR, Grenoble, France

Dry-snow slab avalanches are generally caused by a sequence of fracture processes including (1) failure initiation in a weak snow layer underlying a cohesive slab, (2) crack propagation within the weak layer and (3) slab tensile failure leading to its detachment. During the past decades, theoretical and experimental work has gradually led to a better understanding of the fracture process in snow involving the collapse of the structure in the weak layer during fracture. This now allows us to better model failure initiation and the onset of crack propagation, i.e. to estimate the critical length required for crack propagation. However, the most complete model to date, namely the anticrack model, is based on fracture mechanics and is therefore not applicable to avalanche forecasting procedures which assess snowpack stability in terms of stresses and strength. Furthermore, the anticrack model requires the knowledge of the specific fracture energy of the weak layer which is very difficult to evaluate in practice and very sensitive to the experimental method used.
To overcome this limitation, a new and simple analytical model was developed to evaluate the critical length as a function of the mechanical properties of the slab, the strength of the weak layer as well as the collapse height. This model was inferred from discrete element simulations of the propagation saw test (PST) allowing to reproduce the high porosity, and thus the collapse, of weak snow layers. The analytical model showed a very good agreement with PST field data, and could thus be used in practice to refine stability indices.