Geophysical Research Abstracts
Vol. 21, EGU2019-18022-1, 2019
EGU General Assembly 2019

Validating and improving the parameterization for the critical crack length in the snow cover model SNOWPACK

Bettina Richter (1), Alec van Herwijnen (1), Mathias Rotach (2), and Jürg Schweizer (1)

(1) WSL Institute for Snow and Avalanche Research, (2) Institute of Atmospheric and Cryospheric Sciences, ACINN, Innsbruck, Austria

When assessing the avalanche danger in the context of avalanche forecasting, data on current snowpack and meteorological conditions are evaluated. The temporal and spatial resolution of snowpack data, mainly consisting of snow profiles and stability tests, is generally very limited. Detailed snow cover models can help fill this gap, in particular if they also provide snow instability data. Snow instability information should indicate how easily a failure can be initiated and whether it will propagate. For the latter process, crack propagation, a new parametrization for the critical crack length was recently suggested and implemented in the snow cover model SNOWPACK. The implementation allows for an unambiguous comparison to field experiments, as the critical crack length can also be measured in the field. We hence assessed how well SNOWPACK can forecast the critical crack length. We used data from three winter seasons 2014-2015 to 2016-2017 at two field sites above Davos, Switzerland. Both sites are equipped with an automatic weather station. Comparing the critical crack length from modeled snow properties to results of in-situ propagation saw tests revealed significant discrepancies. To improve the predictions we developed a new parameterization. The new formulation eliminates ambiguous and poorly defined parameters of the original parametrization and instead accounts for the microstructure of snow. The temporal evolution of the observed critical crack length was very well represented and the normalized root mean square error was reduced from 1.77 to 0.28 compared to the original formulation. A simple local minimum threshold approach allows to automatically detect weak layers within vertical profiles of the critical crack length provided by SNOWPACK. The new formulation increased the probability of detection of critical weaknesses from 0.26 to 0.91 and reduced the false alarm ratio from 0.89 to 0.47 compared to the original formulation. We show that the critical crack length can be predicted from simulated snow stratigraphy solely driven with meteorological data. With the automatic weak layer detection a crucial step has been taken towards the operational use of spatially distributed snow instability data for numerical avalanche forecasting.