Geophysical Research Abstracts
Vol. 21, EGU2019-13698, 2019
EGU General Assembly 2019

Thermal equilibrium in snow flows – A natural compensation of frictional energy dissipation

Jan-Thomas Fischer (1), Roland Kaitna (2), Kilian Heil (2), and Ingrid Reiweger (2)

(1) Austrian Research Centre for Forests - BFW, Department of Natural Hazards, Innsbruck, Austria (jt.fischer@uibk.ac.at), (2) Department of Civil Engineering and Natural Hazards, BOKU University of Natural Resources and Life Sciences, Vienna, Austria

Snow avalanches produce heat and subsequently encounter different flow regimes as they flow down the mountain. They may transition from cold, powder snow avalanches to warm, dense-flow avalanches, depending on snow properties such as temperature. For snow temperatures above approximately > -1 °C, the formation of larger snow granules is expected. Recently, laboratory investigations in a rotating drum revealed more details of the mechanisms driving the temperature evolution in moving snow. Alongside measuring the detailed, temporal evolution of temperature, the performed drum experiments allowed to reproduce possible flow regime transitions. Opposing the known and expected transitions it was possible to discover a new phenomenon for flowing snow, namely, the thermal equilibrium in gravitational mass flows. At this steady flow state at sufficiently low ambient temperatures, ambient cooling seems to compensate frictional heating and thus prevents possible flow regime transitions. Furthermore, it turns out that the thermal energy balance of the flowing mixture can be described by a simple analytical model, only taking into account frictional energy dissipation and heat exchange with the ambient medium. The model accurately captures the measured temperature evolution and predicts the observed thermal equilibrium. It furthermore allows to determine the heat transfer coefficient and total shear stress of the flowing material based on measured temperatures. This research could be an important piece in the puzzle to develop methods to predict the destructive potential of snow avalanches, especially with respect to the influence of the temperature evolution on the flow regime evolution and therefore the resulting mobility and run out.