Geophysical Research Abstracts
Vol. 21, EGU2019-7037, 2019
EGU General Assembly 2019

How avalanche velocity and cohesion influence impact pressure build-up on structures

Michael Kyburz (1,2), Betty Sovilla (1), Johan Gaume (1,3), and Christophe Ancey (2)

(1) WSL Institute for Snow and Avalanche Research SLF , Davos Dorf, Switzerland (michael.kyburz@slf.ch), (2) Environmental Hydraulics Laboratory, Swiss Federal Institute of Technology, Lausanne, Switzerland, (3) Snow and Avalanche Simulation Laboratory SLAB, Swiss Federal Institute of Technology, Lausanne, Switzerland

Fast dense avalanches have long been considered to be critical for the design load of avalanche mitigation structures. A recent analysis of over 50 full-scale avalanches at the Vallée de la Sionne (VdlS) test site suggests that warm gravitational avalanches may lead to even higher bending moments on mast-like structures. Moreover, as shown by several studies the gravitational pressure contribution is significantly underestimated. To date, it is often assumed that snow cohesion leads to higher pressure levels in low-velocity avalanches.

To better understand how snow cohesion affects pressure build-up on structures, we simulate the avalanche-obstacle interaction with a newly developed model based on the Discrete Element Method. With this setup, we are able to systematically vary flow velocity and cohesion, and study the resulting impact pressure on a structure. To test the model we compare the simulations to full-scale pressure measurements from VdlS.

In our analysis, we are able to decouple pressure contributions due to inertial and cohesive forces. Our results show that pressure amplifications observed in gravitational flows arise from force chains forming around the obstacle. The increase in cohesion crucially enhances the strength and the persistence of the force chains. Interestingly, altering cohesion does not lead to significant changes in the size and shape of the mobilised domain in the flow, which interacts with the structure. The amplification of contact forces within the mobilised domain alone leads to a doubling of the pressure compared to the case without cohesion.