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Snow entrainment in applied avalanche modeling using SamosAT

J.-T. Fischer (1), M. Granig (2), P. Jörg (2,3)

(1) Federal Research Centre for Forests (BFW) - Departement Natural Hazards, Innsbruck, Austria, (2) Austrian Service for Torrent and Avalanche Control - Centre for Snow and Avalanches, Schwaz, Austria, (3) Institute of Mountain Risk Engineering (IAN), University of Natural Resources and Life Sciences, Vienna, Austria

SamosAT is a simulation toolbox for avalanches. It includes a model for dense flow avalanches which describes an avalanche as a shallow flow and can be used with various rheologies. Additionally a two phase air/ice particle mixture model is used to describe the motion of powder snow avalanches. The fundamental laws of mass and momentum conservation are the basis of the dynamic models.
The initial mass distribution is one of the main input variables when considering avalanche simulations. Release areas and release heights are defined with certain rules found in literature. Snow entrainment and erosion along the avalanche path are important processes influencing the avalanche dynamics. When taking entrainment processes into account, the model equations of mass and momentum balance gain extra terms and parameters. Additionally entrainment areas and heights have to be defined. To this date the implementation of these processes in applied avalanche models is still work in progress. The two model types of SamosAT incorporate different entrainment possibilities. For the dense flow model, frontal entrainment (ploughing) or a shear stress dependent erosion can be considered. The mass of the powder snow avalanche is determined by a shear stress dependent flux function. Here the mass can be entrained from the underlying dense flow avalanche or directly from the snow cover.
In this work the implementation of the different entrainment mechanisms in SamosAT is described. Furthermore a new 'mountain snow cover approach' is suggested in order to provide a standardized method to determine the initial mass distribution when considering significant amounts of entrainable snow. This approach is based on the well known methods used to determine release heights in applied avalanche modeling. Finally well documented avalanche events are compared to the simulation results considering the different snow entrainment mechanisms.