

## Investigations on the Application of Avalanche Simulations: A Survey Conducted among Avalanche Experts

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**Abstract :** This study focuses on the evaluation of snow avalanche simulations, based on a survey that has been carried out among avalanche experts. In the last decades, the application of avalanche simulation tools has gained recognition within the realm of hazard management. Traditionally, avalanche runout models were used to predict extreme avalanche runout and prepare avalanche maps. This has changed rather dramatically with the application of numerical models. For safety regulations such as road safety simulation tools are now being coupled with real-time meteorological measurements to predict frequent avalanche hazard. That places new demands on model accuracy and requires the simulation of physical processes that previously could be ignored. These simulation tools are based on a deterministic description of the avalanche movement allowing to predict certain quantities (e.g. pressure, velocities, flow heights, runout lengths etc.) of the avalanche flow. Because of the highly variable regimes of the flowing snow, no uniform rheological law describing the motion of an avalanche is known. Therefore, analogies to fluid dynamical laws of other materials are stated. To transfer these constitutional laws to snow flows, certain assumptions and adjustments have to be imposed. Besides these limitations, there exist high uncertainties regarding the initial and boundary conditions. Further challenges arise when implementing the underlying flow model equations into an algorithm executable by a computer. This implementation is constrained by the choice of adequate numerical methods and their computational feasibility. Hence, the model development is compelled to introduce further simplifications and the related uncertainties. In the light of these issues many questions arise on avalanche simulations, on their assets and drawbacks, on potentials for improvements as well as their application in practice. To address these questions a survey among experts in the field of avalanche science (e.g. researchers, practitioners, engineers) from various countries has been conducted. In the questionnaire, special attention is drawn on the expert's opinion regarding the influence of certain variables on the simulation result, their uncertainty and the reliability of the results. Furthermore, it was tested to which degree a simulation result influences the decision making for a hazard assessment. A discrepancy could be found between a large uncertainty of the simulation input parameters as compared to a relatively high reliability of the results. This contradiction can be explained taking into account how the experts employ the simulations. The credibility of the simulations is the result of a rather thoroughly simulation study, where different assumptions are tested, comparing the results of different flow models along with the use of supplemental data such as chronicles, field observation, silent witnesses i.a. which are regarded as essential for the hazard assessment and for sanctioning simulation results. As the importance of avalanche simulations grows within the hazard management along with their further development studies focusing on the modeling fashion could contribute to a better understanding how knowledge of the avalanche process can be gained by running simulations.

**Keywords :** expert interview, hazard management, modeling, simulation, snow avalanche

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