elevations of the runout zone. These critical values should be considered as a first guess and always be adapted to the actual situation. Finally, we discuss whether the calculated avalanche scenarios really help local avalanche services whether or not to close a road – and whether a fully automated procedure by coupling snow cover simulations and avalanche dynamics calculations makes sense.

P8.15

A SUCCESSFUL ATTEMPT TO INTRODUCE THE PROTECTIVE DAMS INTO SNOW AVALANCHES SIMULATIONS BY RAMMS IN THE KHIBINI MOUNTAINS, RUSSIA

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Snow avalanches are among the most significant natural hazards in the Khibini Mountains (despite the altitude to be less than 1200 m a.s.l.) located inside the Arctic circle in the Northwest of Russia. Well-documented avalanche events recorded in the town of Kirovsk were used to test the capabilities of avalanche dynamics program RAMMS to back-calculate snow avalanches in the Khibini Mountains. RAMMS is initially calibrated for the large-scale avalanches in Switzerland. However, it produced realistic results for more than 70 avalanches in the Khibini Mountains after modification of the friction values for these different environmental conditions. High level of correspondence of observed and simulated events was found for avalanches with medium and large volumes. At this study the back-calculations of avalanches in the original avalanche tracks using the 5-m resolution "historical" DEM (Mt. Ukspor) and in the same tracks after construction of two catching dams were performed. RAMMS was applied to back-calculate two artificially triggered (released together) and well-documented powder avalanches (18th February 2016) from the Mt. Ukspor that have unexpectedly overshoot the two lying perpendicular catching dams and resulted in 3 victims. We performed the simulations with the 5-m DEM (terrestrial laser scanning, summer 2015) which incorporated the dams, designed to protect the railway line, the road and the inhabited 5-floor houses situated behind them. As input we specified the observed release zones as well as the observed fracture heights. The fracture heights of two released avalanches were 0.8 m and 0,5 m corresponded to the release volumes of 167,000 m3 and 40,000 m3. The avalanches return period was assumed to be 100 years based on the complete historical avalanche data since the end of 1930th. While it is not recommended to apply RAMMS for simulating the effect of a dam lying perpendicular to the avalanche flow direction (RAMMS User Manual, 2017), in this case the RAMMS reproduced the observed avalanches behavior and runout distance. No information is available concerning the flow velocity. However, the obtained values agree in general to the values measured in these avalanche tracks before. Moreover, we assessed the avalanche risk in the area taking the presence of the catching dams into the account, discuss the technical procedure and the obtained results. Full social risk values were calculated separately for three different zones depending on the type of land use and characterized by different density of people as well as the duration a person stays in an avalanche-prone zone during the day. The estimated full social risk value equaled 4.4 people per year for the analyzed area. The obtained avalanche risk assessment results clearly demonstrate the necessity of the avalanche mitigation system reconstruction to prevent the loss of human lives in future.

P8.16

DAN3D MODEL PARAMETERS FOR SNOW AVALANCHE CASE STUDIES IN WESTERN CANADA

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Dynamic models are an important aspect of a snow avalanche hazard assessment for planning purposes. Models are often used to predict the impact area and velocities of snow avalanches. In this research, we analyzed the ability of a three-dimensional model, Dan3D, to back-analyse avalanche case studies. Dan3D is a depth-averaged model that calculates flow-like motion over three dimensional topography and was originally developed for extremely rapid, flow-like landslides. Fifteen snow avalanche case studies were analyzed, often obtained from highway operations (i.e., British Columbia Ministry of Transportation and Infrastructure, Parks Canada, and Alberta Parks). Most of the cases were from western Canada (i.e., British Columbia and Alberta) but other locations included the state of Washington and Norway. Each avalanche case study had an extreme runout, with an average return period of approximately 100 years, i.e., between 30- and 300-year return periods. For each case study, the Voellmy rheology was used and the two parameters, including turbulence and friction coefficients, were calibrated to determine values that best simulated the observations, such as runout length, lateral extent, and deposit thickness. Turbulence coefficients varied from 1000 to 4000 m/s². Friction coefficients varied from 0.15 to 0.40. Dan3D is capable of entraining material from the path during flow. Models were run both with and without entrainment to assess variations in model parameters to best simulate the case studies. Most case studies could be modelled with reasonable runout lengths, lateral extents, and debris thicknesses.