Geophysical Research Abstracts
Vol. 13, EGU2011-8448, 2011
EGU General Assembly 2011

Two-dimensional modeling of snow avalanches in Iceland - applications for hazard mapping and avalanche forecasting

Magni Hreinn Jónsson, Eiríkur Gíslason, Harpa Grímsdóttir, and Tómas Jóhannesson
Icelandic Meteorological Office, Iceland (magni@vedur.is)

As a part of the development of snow avalanche hazard zoning in Iceland, a one-dimensional PCM-based snow avalanche model was used to define a quantitative measure of run-out which is termed run-out index. The run-out index may be interpreted as the run-out distance of an avalanche measured in hectometers if it were to fall in a certain, parabolically shaped, standard path which is representative for Icelandic avalanche paths. Run-out indices can also be assigned to certain locations in avalanche paths and then they represent the run-out length of avalanches which stop at the respective locations. Statistical analysis of 196 historical avalanches in 81 paths is used as basis for snow avalanche hazard zoning at the Icelandic Meteorological Office (IMO).

Two-dimensional avalanche models have been used at IMO since the year 2000 for various applications and the models have been calibrated for Icelandic conditions. Two dimensional models have been under constant development during recent years and they have gradually become better at simulating avalanches. Therefore, it is important to have a method to use those models systematically in avalanche hazard zoning. In order to develop such a method, the concepts of the standard path and run-out indices have been adopted to two dimensions using the samosAT model. The model was used to calculate run-out indices for the paths in the data-set. A 2D run-out index was then assigned to each avalanche in the data set and also to avalanches at four well documented avalanche sites in Iceland. A statistical run-out distribution was derived based on the two-dimensional indices and compared to the earlier distribution based on the one-dimensional PCM model. The two-dimensional model takes into account various geometrical features of the path that one-dimensional avalanche models do not represent. Thus, the lateral geometry results in tongues of long run-out below gullies opposed to the PCM model which would have required larger run-out indices to show the same geographical run-out lengths. Consequently, the results of the 2D model show a distinct difference in relative run-out lengths compared with the PCM model. Geometrical features of an avalanche path can therefore be used to partly explain difference in return periods of avalanches of similar geographical run-out length between paths.

The revised distribution of the two-dimensional run-out indices has the potential to make the hazard zoning procedure more objective. The run-out indices also provide quantitative arguments for the shape of tongues in hazard zones. The previous methodology is dependent on subjective judgment of avalanche experts in the hazard zoning process to add topographic effects to the PCM model results. With the two-dimensional modeling this need of subjective adjustments of model results is reduced.

Since the run-out index enables "transfer of avalanches" between paths, a straight forward method to compare avalanches at different locations is provided. That is also important for avalanche forecasting, and is used at IMO by the aid of maps of known hazard zones showing run-out indices that may be considered iso-run-out-lines. When avalanches start to fall during critical periods, near real-time estimate of run-out lengths of each observed avalanche may be obtained. It is, then, possible to determine where a given avalanche would have stopped if it had fallen at a site of interest (most often a populated area).

In short, 2D run-out indices along with a statistical analysis of avalanche run-out data provide a way to use 2D avalanche models in hazard mapping in a systematic way. Furthermore, run-out indices may be useful for avalanche forecasting during avalanche cycles.