Geophysical Research Abstracts
Vol. 18, EGU2016-2732-2, 2016
EGU General Assembly 2016

Maximum speeds and alpha angles of flowing avalanches

David McClung (1) and Peter Gauer (2)

(1) University of British Columbia, Geography, Vancouver, B.C., Canada (mcclung@geog.ubc.ca), (2) Norwegian Geotechnical Institute, Oslo, Norway (Peter.Gauer@ngi.no)

A flowing avalanche is one which initiates as a slab and, if consisting of dry snow, will be enveloped in a turbulent snow dust cloud once the speed reaches about 10 m/s. A flowing avalanche has a dense core of flowing material which dominates the dynamics by serving as the driving force for downslope motion. The flow thickness typically on the order of 1 -10 m which is on the order of about 1% of the length of the flowing mass. We have collected estimates of maximum frontal speed u_m (m/s) from 118 avalanche events. The analysis is given here with the aim of using the maximum speed scaled with some measure of the terrain scale over which the avalanches ran. We have chosen two measures for scaling, from McClung (1990), McClung and Schaerer (2006) and Gauer (2012). The two measures are the $\sqrt{H_0}$; $\sqrt{S_0}$ (total vertical drop; total path length traversed). Our data consist of 118 avalanches with H_0 (m)estimated and 106 with S_0 (m)estimated. Of these, we have 29 values with H_0 (m),S_0 (m)and u_m (m/s)estimated accurately with the avalanche speeds measured all or nearly all along the path. The remainder of the data set includes approximate estimates of u_m (m/s)from timing the avalanche motion over a known section of the path where approximate maximum speed is expected and with either H_0or S_0or both estimated.

Our analysis consists of fitting the values of $u_m/\sqrt{H_0}$; $u_m/\sqrt{S_0}$ to probability density functions (pdf) to estimate the exceedance probability for the scaled ratios. In general, we found the best fits for the larger data sets to fit a beta pdf and for the subset of 29, we found a shifted log-logistic (s l-l) pdf was best. Our determinations were as a result of fitting the values to 60 different pdfs considering five goodness-of-fit criteria: three goodness-of-fit statistics :K-S (Kolmogorov-Smirnov); A-D (Anderson-Darling) and C-S (Chi-squared) plus probability plots (P-P) and quantile plots (Q-Q). For less than 10% probability of exceedance the results show that $u_m/\sqrt{H_0}$; $u_m/\sqrt{S_0}$ are greater than 2.0 and 1.3 respectively.

In addition, to: $u_m/\sqrt{H_0}$; $u_m/\sqrt{S_0}$, we collected 105 companion values of the αangle for runout positions defined by $\tan\alpha = H_0/X_0$where $X_0$is horizontal reach calculated from start position to stop position of the tip of the avalanches. The αangle is a very simple measure of runout introduced by Scheidegger (1973) for rock avalanches. McClung and Mears (1991) collected αangles from more than 500 paths with maximum runout estimated for return periods on the order of 100 years and the range of values was: $18^o - 42^o$which is close to that here: $(20^o - 45^o)$. The results showed that runout increases(α decreases) with maximum speed but there is considerable scatter in the relationship. The Spearman rank correlation is -0.54 (p $<$ 0.005).Rank correlations of α vs. $u_m/\sqrt{S_0}$; $u_m/\sqrt{H_0}$ are - 0.44;.- 0.56 (both with p $<$ 0.005