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MONTE GENEROSO ROCKFALL FIELD TEST (SWITZERLAND): Comparison between real rockfall volumes measurements and production calculations

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The Monte Generoso rockfall testing area is a mountainside located in the canton of Ticino (southern Switzerland) above an important highway that links Italy to Northern Europe. The slope is steep and consists of two high fractured limestone cliffs situated one above the other and divided by a sparse forest. The highway is potentially affected by rockfall hazard leading to the installation of several protective dams. The upper series of dams, collecting the blocks issued from the higher cliff, were emptied in May 2011. This gave the unique opportunity to assess the volumes of blocks produced in a known period of time in the different sections of the upper cliff.
The cliff is formed by six catchments zones and the dams are therefore divided in six groups leading to the calculation of six volumes respectively. Based on geological and structural field data, a susceptibility assessment of the six portions of the cliff was performed and the results were compared to the six volume measured before emptying the dams. The aim is to spatially determine the main parameters influencing the rock fall production in the different portions of the cliff and to validate these results according to the material accumulated behind the protective dams.

Structural analyses based on high resolution DEM and field investigation was performed to define the orientation and the geometrical characteristics of the discontinuity sets. The bedding plus five joint sets are present in the cliff and display a very small spacing. Multiples wedge structures affect the stability of the cliff and a surface parallel discontinuity set promotes the formation of flake instabilities. Based on a 1m cell-size DEM, the Matterocking method was applied in order to calculate the number of potential failure mechanisms (wedge and planar sliding) for each cell of the DEM. This allowed us to establish a first susceptibility rating for the six portions of the cliff. This rating was then refined by taking into account only the steepest parts of the cliffs.
The direction of maximum discontinuity frequency is also calculated and corresponds to the azimuth direction in which the maximum number of discontinuities is crossed.
The comparison between the measured volumes of blocks in the dams and the Matterocking rating shows a good correlation. However, the correlation with the direction of maximum discontinuity frequency is poor, suggesting that this is not an implicit parameter for susceptibility rating. Therefore, the rockfall production of the cliff is much more depending on the structures rather than on the maximum fracturing direction.
Eventually, the hypothesis that the theoretically most rockfall-prone portions of the cliff correspond to those with the larger volumes of blocks measured in the protective dams is confirmed.