Evaluation of the rockfall susceptibility of the Solà D'Andorra using the Matterock methodology

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The rockfall susceptibility of a slope is directly linked to the topographical relief and the presence of favorable discontinuities for the detachment of rock volumes from the slope face. In order to rank the rockfall susceptibility throughout a slope so as to localize the zones which are the most probable to produce rockfalls, these parameters have to be taken into consideration. In this context, the objective of this work was the identification of susceptible areas on the Solà de Andorra, in Andorra. The susceptibility is evaluated implementing a GIS platform and the Matterock methodology (Rouiller et al., 1998) by superposition of four criteria that are related to the topographical relief and the presence of discontinuities. The used parameters and the related analyses to obtain them are the following and they are briefly described in the continue:

1. Comparison of the slope angle with the threshold value defined by slope angle analysis.

2. Average number of unfavorable discontinuities per surface unit.

3. Number of kinematically permitted plane or wedge failures.

4. Value in cubic meters of the potentially instable volumes using the Slope Local Base Level, SLBL, method.

The slope angle analysis is used for the determination of an angle value above which rockfalls are very probable. It is based on the decomposition of the histogram of the present slope angles to different families, using a Gaussian distribution. The families represent the existing geo-morphological structures. The threshold value is determined by the angle characterizing the steepest family.

The unfavorable discontinuities are detected using the Matterock software. The input data is the DEM and the principal discontinuity sets. The output is the average number of discontinuities counted in every topographic facet.

The kinematic tests are also performed using the Matterock software. For each unfavorable discontinuity set, the number of potential plane or wedge failures is calculated.

The volumes above a base level that is determined by the topographical relief are calculated using the SLBL method, also on a GIS platform.

For the application at a local scale to the Solà de Andorra, the four analyses are performed and their outputs are ranked using appropriate rating. The susceptibility index that is used is equal to the sum of the ranked outputs and it is expressed on an increasing scale from 0 to 8. Historical rockfall events are superimposed on the topographic map to check the consistency of the results. It is indicated that areas characterized by high values of the susceptibility index coincide with past events, thus may be considered prone to also produce rockfalls in the future.

References

Rouiller, J.-D., Jaboyedoff, M., Marro, C., Phlippossian, F. and Mamin, M. (1998): Pentes instables dans le Pennique valaisan. Rapport final PNR31. VDF, Zürich.