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Preliminary assessment of rockfall hazard based on GIS data

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The increasing availability of geographic information system (GIS) data, such as digital elevation model DTM, vectorised topographic map, etc. makes the analysis of potential rockfalls easier on large areas using simple models.

Assuming that potential rock instabilities are located in rockfaces or steep slopes, for instance slopes ≥40°, potential rock instabilities areas may be deduced from the 1:25’000 topographic vector map and the slope computed from DTM. Using grid format under GIS (ArcView for example), both documents are merged into one instability grid file in Boolean format, using 0 for no instability and 1 for instability.

Each point of the instability grid is considered as a potential rockfalls source, which is located in the DTM grid. The points of the DTM that are lower in altitude and included in a cone centred on a source point define the potential propagation area associated geometrically with that grid point. The aperture angle of the cone is fixed at around 57°. The contouring of the contribution of all points leads to global potential zones of propagation. The results obtained for the propagation grid points are either Boolean values or the values of the number contributing source points. The latter is a crude image of the most probable rockfalls paths. By using the difference of altitude between the cone and a point in the propagation zone, an estimation of the speed of rock can be deduced, but those results must be interpreted with caution. The cone method is computed using the software CONEFALL.

This simple model has two main limitations. The first is the lateral extension, which is exaggerated. The second is that vertical rockfaces with a flat relief at its bottom, lead to an overestimated propagation zone. To take into account the limitation of the method and field observations, the propagation area may be subdivided in four sub-zones; (1) the proved propagation zone (where blocks are observed); (2) the suspected zone of propagation (no observed blocks but rockfalls can easily propagate further than (1)); (3) unproved propagation zone (where blocks may not propagate but it is difficult to prove it); (4) highly unlikely propagation zone (high reverse slope, artefacts of the method). This zoning has the advantage to keep in a document the systematic results arising from the cone method.

This simple method is a quick tool that gives information on the potential propagation rockfalls area on large region. For instance in Switzerland 3500 km^2 were covered using the cone method in a preliminary study (CADANAV). Applied to smaller areas a rapid zoning may be established based on a quick field investigation. Furthermore a freeware is available on the web.