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Susceptibility analysis of large rock instabilities

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Large rockfall instabilities can be a major threat to human activities. Some large rock avalanches or landslides have been monitored a few days or a few months before the catastrophic failure, but very few have been monitored for a long time interval. How can we assess their hazard ? A detailed analysis of all the slopes in mountainous areas around the world it is impossible to be carried out. Therefore, a fast assessment method must be developed, in order to be able to perform a first regional screening to prioritize more detailed site investigations.
We propose a susceptibility assessment approach for large rock slope failures based on the analysis of two criteria:
1. The existence of a deformed zone (or volume)
2. Evidences of present or past activity (e.g. rockfalls,displacements)
The goal of criterion (1) is to characterize the deformation state of a slope by considering feasible destabilizing mechanism (controlled by discontinuities, intact rock mass failure or both). The analysis of the distribution of the deformation in comparison to the location of the activity (2) permits to evaluate if the deformed zone is close to failure or if a continuous quasi-stable deformation is occurring.
The rate of deformation (v) can be computed by various sources of information relative to the time interval (dt), and occurred displacement (dl(t)), such as dating of past events and direct/indirect or remote displacement measurements, using:

$$v = dl(t)/dt$$

Past events must be analysed in their more general context (e.g. deglaciation, water impoundment, meteo-climatic conditions, landuse). Coupled with the analysis of the state of activity, this permits to characterize the state of deformation as well as the failure mechanisms.

The efficiency of this semi-empirical approach is demonstrated by several examples, such as the present instability at Randa (Switzerland), the old instability of the Kilchenstock (Switzerland), several rock slopes in Norway and other past instabilities.