Détection par SIG des zones rocheuses à fortes susceptibilités d'éboulement

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One of the lessons learned from the 1991 Randa rockfall is that rock instability failures have rarely a single cause. These failures are the result of the combined action of various instability factors acting on the long term stability of the rock mass. These instability factors can be divided into two categories: intrinsic parameters (i.e. parameters inherent to the rock mass) and external factors, that act on the latter, creating an instability or changing its state.
The current work proposes both a modular (i.e. that can be adapted to the specific needs of the study) and evolutive (i.e. that can be upgraded with the development of new tools and new documents) GIS-based approach to take rock instabilities into account on a regional scale, in order to prioritize detailed field investigations.
Various tools to compute instability factors have been developed and tested: (1) dip direction analysis makes it possible to simulate the sensitivity to freeze and thaw cycles; (2) the use of the critical slope points at parts of the territory that are steeper than an homogeneous terrain; (3) three-dimensional morpho-structural analysis enables to determine the large scale discontinuities by means of a DTM; (4) kinematic tests point at areas with unfavorable structural features; (5) the volumes prone to erosion can be determined by subtracting the present topography and a smoothed one; (6) the hydraulic head index shows the total amount of water flowing through each points of the DTM; (7) an activity index makes it possible to relate the scree deposits to the cliff degrading processes.
Five case studies enable to test various ways to combine these instability factors, in order to furnish rockfall susceptibility maps. By means of this cartographic algebra, it is possible to answer to each specific problem: the susceptibility can be assessed either along a linear object at risk (road joining Aproz to Fey or Quebec City Promontory), or on a surfacic one (Fionnay, Lourtier or Mattertal). If an event database is available, the susceptibility can be replaced by a probability of failure (Quebec City Promontory). The results thus obtained show a good correlation either with the existing landslides databases (Quebec City Promontory) or with detailed field surveys (road joining Aproz to Fey, Fionnay, Lourtier or Mattertal).
In order to complete the approach, trajectory analysis should be performed starting from zones with high susceptibilities (or probabilities). Zones with high susceptibilities that threaten infrastructures should be the subject of complementary investigations, including analysis of further numerical documents or detailed field surveys.