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Torrential susceptibility at a regional scale, Southern Alps (France)

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Torrents of the Southern French Alps are prone to dramatic debris-flows and flash floods. These extreme events may cause significant economic damage and human death. In order to minimize these consequences, it is necessary to improve our ability to predict the spatial and temporal occurrence of these phenomena. For this purpose we need to integrate the spatial and temporal variability of geomorphic sensitivity in the chain of risk prediction. Therefore a regional approach is chosen to characterize torrent responses within a GIS.

The identification of torrents prone to debris-flow using GIS-derived morphometric measures has been studied with discriminant analysis and logistic regression (Jackson et al., 1987; Marchi et al., 1993; Sorriso-Valvo et al., 1998; Bovis et al., 1999; Marchi and Brochot, 2000; De Scally et al., 2001; De Scally et al., 2004; Glade, 2005; Rowbotham et al., 2005). Fans slope and Melton's ruggedness index are considered as the best parameters to discriminate fans dominated by fluvial and debris-flow processes, so that we define a discriminating threshold compiling the values of this two parameters from 297 basins known in the literature.

As a part of the Paramount project, the sensitivity of the road and railway infrastructures to these geomorphic hazards is evaluated. Here we present the discrimination of torrential responses (fluvial vs. debris-flow dominated catchments) using a linear discriminant analysis of the morphometric variables (channel slope and Melton's ruggedness index) that we can easily extract from a large scale DEM (25m). The basins were delineated by a hydrological analysis of the DEM. Outlets were defined as intersection of the streamlines and the transport infrastructures (BD Topo, IGN®). The studies of the previously cited authors are based on maps discrediting the alluvial fans from debris-flow ones and show the morphometric controls occurring on each fan. We will consider that the channel slope can be used rather than the fan slope, because it can be extracted automatically from DEM without knowing the exact location and shape of the fans. We applied the thresholds of slope and Melton index derived from our database and validated the results on a random sample of basins.

Automatic object-oriented classification protocols are developed to map erosional patches in catchments from 50 cm resolution orthophotographs. Given the slope and the curvature, the geomorphic connectivity between hillslopes and channels is assessed. This approach provides an opportunity to improve the morphometric discrimination of torrent catchments by characterizing their potential sediment availability.