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The temporal and spatial occurrences of the shallow landslides and debris flows in the Sannio area (Southern Italy)

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Specific hydrological analysis and application of the *Leaky Barrel Model* and *SHALSTAB* have been carried out to define temporal and spatial occurrences of the shallow landslides and debris flow source zones in the Sannio area, Southern Italy.

During the storms of January 2003 and March 2005 this area was hit by thousands of landslides, developed along steep slopes underlain by argillaceous sequences of flysch and foredeep deposits of the Apennine chain. Most of the landslides are characterised by shallow movements, involving the colluvium cover, and stopped after some meters; however, many instabilities evolved to debris flows.

During the storm of January 2003, deep seated landslides also occurred, and were characterised by reactivations of previous instabilities. Flood phenomena occurred in many places, mainly along high-order drainage lines. All these phenomena caused significant damage, mainly to agricultural works and to road and railway networks.

The area is characterised by a Mediterranean climate, with a dry and hot season between July and August; November and December are the wettest months. The storms of January 2003 and March 2005 occurred late in the wet season, after an amount of antecedent rainfall higher than the historical mean. These conditions caused the reaching of field capacity of the soil.

The distribution of the rainfall within each storm has been evaluated by frequency analysis for different time interval. Up to 12 hours, the cumulative rainfall totals were not exceptional, indicating a well distributed rainfall. Return time reached its maximum for 24 hours÷2 days cumulative rainfall.

All these characteristics have allowed the application of the *Leaky Barrel Model*, which simulates the amount of the "water retained", Z, in the cover in relation to rainfall hourly data distribution. Knowing the time of the landslides activity, the critical amount of "water retained", Z_t, was fixed, and the hydrological triggering threshold in this area was defined.

Spatial occurrences of the instabilities were estimated from the application of *SHALSTAB*. This study is based on detailed surveys in a test area of 40 km^2, where more than 130 shallow instabilities occurred during the storms of January 2003 and March 2005, and reported on a 1:5000-scale topographic base map. Specific geotechnical laboratory and in situ tests were carried out, in order to characterise colluvium material. Some factors have supported the application of *SHALSTAB* in this area: geological and morphological conditions, the high number of instabilities occurred, and the good quality of the hydrological data. In particular, the density of the instability zones in the test area drawn by *SHALSTAB* has been calibrated by the *Leaky Barrel Model*, which allows to consider the power of the storms in term of difference Z_{max} and Z_t and to the time during which Z is higher than Z_t.

1 Main references

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