



Spatial distribution and hydrological threshold of the October 1954 high magnitude debris flow event occurred in the Amalfi coast (southern Italy)

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The extreme cloudburst that hit the Amalfi coast and the cities of Salerno and Vietri sul Mare during the night between the 25th and the 26th of October 1954 represents the most damaging hydrologic-induced disaster occurred in Campania region (southern Italy) and one of the principal known at national scale. It caused the loss of 318 lives and 5.500 homeless besides the destruction of a great number of public and private buildings. Damages were recorded in a restricted mountainous area extended less than 50 km² in which the rainfall reached the maximum intensity. Precipitation started approximately at 1:00 PM of the 25th October 1954 with a moderate intensity that increased during the evening and night up to extreme values (150 mm/h), thus resulting in the exceptional rainfall of 504 mm recorded at the Salerno rain gauge in less than 24 hours. For such a precipitation, which corresponds to about 1/3 of the average annual value, a return period greater than 1000 years was estimated. The extreme hydrological event induced exceptional runoff and erosional processes along slopes and valleys causing hundreds of debris flows that involved ash-fall pyroclastic deposits covering mountain slopes, mainly derived from the 79 A.D. Plinian eruption of the Somma-Vesuvius volcano. The huge mass of debris flowed from slopes into the hydrographic network, forming unique debris floods at the valley bottom that reached the coast line and produced ephemeral fan deltas at the mouths of the Regina Major and the Bonea torrents. The most important damages occurred along valley streams and in correspondence of restrictions of the hydraulic cross section due to man-made structures.

The October 1954 event is well known in the scientific community even if its extreme nature attracted researchers more for the hydrological aspect than for analysis of effects on slope stability, thus this phenomenon is still known as the 1954 Salerno's flood.

The purpose of this research is to advance the comprehension of the effects of the October 1954 extreme hydrologic event on slope stability by means of quantitative analysis of the aerial photos taken few days after the disaster, from which a complete landslide inventory and cartography as well as analysis of spatial distribution were carried out. This acquisition permitted to widen the case histories regarding the higher magnitude debris flow events involving ash-fall pyroclastic deposits beyond the similar and better-known event occurred between the 5th and the 6th of May 1998 in the Sarno Mountains (Campania region) that caused the loss of 152 lives.

The landslide recognition allowed to identify more than 1200 initial shallow landslides (soil slips) that evolved in debris avalanches and debris flows. Based on such data, an analysis of the morphological conditions predisposing to slope instability, in comparison with the same already obtained for the Sarno Mountains case history, was carried out. According with this scope, landslide inventory was analysed with spatial analysis techniques in relationship with Digital Elevation Model data. Moreover, the spatial occurrence of landslides was correlated to the rainfall distribution, thus achieving the estimation of an empirical hydrological threshold leading to triggering, coupled with the magnitude of the induced debris flows.

The results obtained from the re-examination of the October 1954 hydrologic and mass-movement events can be considered a new fragment in the issue of the instability of ash-fall pyroclastic deposits affecting the densely inhabited footslopes of mountainous areas surrounding the Somma-Vesuvius volcano.