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Modelling the activation of a confined debris slide in Northern Calabria: the 28 January 2009 slope movement at San Benedetto Ullano

G. Capparelli (1), P. Iaquinta (2), G. Iovine (2), O. Terranova (2), and P. Versace (1)

(2) CNR-IRPI, Via Cavour 6 - 87036 Rende (CS - Italia) (terranova@irpi.cnr.it; iovine@irpi.cnr.it; iaquinta@irpi.cnr.it), (1) UNICAL-Dip. Difesa del Suolo - Ponte P. Bucci, 87036 Arcavacata di Rende (CS - Italia) (kgiov@dds.unical.it; versace@dds.unical.it)

Southern Italy was severely stricken by abundant rains during Autumn-Winter 2008/2009, with widespread geomorphic effects such as slope movements and erosive processes, floods, inundations of cultivated fields and urbanised sectors, and coastal instabilities. A large number of superficial landslides were triggered in Calabria up to the middle of January, damaging life lines, roads, urbanised areas and lands, mainly in the NW sector of the region. Further persistent rainfalls were recorded until the end of March, and several deeper phenomena also activated along the slopes threatening villages and main lifelines.

More specifically, a large rainfall-induced debris slide started mobilizing on 28 January along the Eastern slope of the Coastal Chain, in the vicinity of San Benedetto Ullano (Cosenza province). The slope movement threatened the southern suburbs of the village, damaging the road to the cemetery and the provincial road to Marri. Thanks to a prompt detailed geomorphologic field survey (protracted for the entire period of activity), to recurrent hand-made measures of superficial displacements performed at a set of datum points by a team of volunteers, and a real-time control system of meteoric conditions and superficial displacements at a set of precision-extensometers, the evolution of the phenomenon was mapped up to the last days of April, when the movement practically stopped at the end of the rainy period.

Based on the results of the above-mentioned control activities, a basic empirical reference framework of procedures could be defined, which allowed the Authorities concerned to better manage the phases of geo-hydrological crisis, by adopting suitable emergency measures. The preliminary geological model of the landslide and of the affected slope, which had to be defined in the first stages of mobilization based on the few available data, was progressively refined thanks to the results of a couple of explorative drillings, driven down to 40 meters below the ground after the stopping of the slope movement. At first, a preliminary hydrological analysis was also carried out to evaluate the rainfall triggering mechanism of the landslide, by using the rainfall data and the timing of mobilization. At this purpose, the empirical FLaIR (Forecasting of Landslide Induced by Rainfall) model was applied to identify the mobility function, which describes the relationship between slope movements and rainfalls. Thanks to the availability of further geological and hydrological information, and on kinematic data collected at the datum points and at the extensometers cited above, the model could be calibrated by relating the mobility function to the movements recorded after the paroxysmal phase, thus obtaining a more refined depiction of the kinematics of the phenomenon.