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Kinematics and geological constraints of the constant slow moving Pisciotta earth slide (southern Italy)

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The Pisciotta landslide is a slow moving deep-seated earth slide occurring in Campania region (southern Italy) that since the last decades have constantly damaged a provincial road (SS 447) and currently represents a very hazardous condition for a national railway crossing its foot. The landslide involves flysch deposits belonging to the North-Calabrian tectonic unit, which are constituted by intercalated calcarenites, marls and argillaceous rocks, with a complexly folded structure.
The analysis of morphological evolution of the unstable slope, the quantitative analysis of ground deformations and the reconstruction of an engineering-geological model consistent with spatial features of the landslide were the principal objectives and scope of the investigations.
The morphological evolution of the unstable slope and the outcropping landslide structures were assessed through the examination of all available aerial photos (1943, 1955, 1971, 1982, 1991, 1995, 2003 and 2006). Quantitative kinematic analyses of ground deformations were executed both considering the progressive displacement of the road derived from topographic maps and ortophotos (1955-2006) and through a weekly topographic monitoring of 50 targets distributed in the landslide body (September 2006 - March 2008). The engineering-geological model of the landslide was reconstructed by means of stratigraphic data derived from boreholes, inclinometers monitoring, as well as geological and geophysical surveys.
The analysis of aerial photographs demonstrated the existence of an early stage of deformation since 1943 that has progressively expanded in the following years. Besides the main scarp and the landslide flanks, other significant landslide structures as longitudinal and transversal cracks as well as positive or negative morphologies were clearly observed and mapped in the following years. They indicated a progressive depletion of the upper part of the slope and a bulging of the foot.
The quantitative kinematic analysis based on the progressive displacement of the road and the topographic targets allowed the measurement of ground deformations since 1955 until 2008, with a total maximum displacement of about 55 m and an average velocity of about 1 m/year. The long-term analysis (53 years) showed a progressive and constant deformation, with a little increase of velocity in recent years. In addition, the assessment of deformations in the short period, carried out by means of weekly topographic surveys (18 months), showed a progressive and quite constant rate of displacement. Average velocity of about 0.4 cm/day, maximum values up to 1.3 cm/day, after prolonged rainfalls, and minimum velocity of about 0.1 cm/day, at the end of the dry season, were measured. The monitoring of ground deformations also permitted to assess a composite kinematics of the landslide body that resulted with differential displacements, velocities and accelerations. The engineering-geological and geometric model of the landslide was found to be conditioned by specific stratigraphic and structural constraints. The landslide involves a stratigraphic interval of the Saraceno Formation with a prevalent marly-argillaceous composition. The structural setting of the Formation is intensely folded and faulted but with a globally monocline attitude downstream dipping. The left flank of the landslide is set on a normal fault.
Based on the reconstructed model and considering the variability of the depth of the rupture surfaces, assessed from 30 to 50 m, the depleted mass and the accumulation volume were estimated in the range $3 \div 5 \times 106$ m3.