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A multi-disciplinary approach to study coastal complex landslides: the case of Torino di Sangro (Central Italy)

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This work illustrates the studies carried out on a complex landslide phenomenon between the Sangro and Osento River's mouths, near Torino di Sangro village in Southern Abruzzo Region (Italy). Historical activity of this landslide is well-documented since 1916; the activation/reactivation of the movements caused several interruptions of a national railway and the damage of few houses. The Torino di Sangro case study can be regarded as representative of many large landslides distributed along the central Adriatic coast (e.g., Ancona, Ortona, Vasto and Petacciato Landslides) that affect densely populated urban areas with a large amount of man-made infrastructure. The main controlling factors of these large and deep-seated landslides are still debated.
From the geological and geomorphological viewpoint, the central Adriatic coast is characterized by a low-relief landscape (mesa) carved on clay-sandstone-conglomerate bedrock belonging to the Upper Pliocene – Lower Pleistocene marine deposits and locally to the Middle Pleistocene marine to continental transitional deposits. This high coast is widely affected by slope instability (rock falls, rotational, complex and shallow landslides) on both active and inactive sea cliffs, the first being mainly affected by wave-cut erosion and the latter influenced by heavy rainfall and changes of pore pressure. The main landslide has the typical characteristics of a deep-seated gravitation deformation.
The landslide study was based on a multidisciplinary approach including: 1) definition and GIS mapping of geology and geomorphology factors (slope, aspect, topographic curvature, bedrock lithology, near-surface deposits, deposit thickness and land use), by means of DTM processing, multi-temporal analysis, and large-scale geomorphological field survey; 2) monitoring system in the landslide; 3) application of empiric models for the analysis of unstable sandstone-conglomerate escarpments; 4) slope stability analysis performed using a stress–strain numerical modeling solved by a Finite Difference Method (FLAC 2D).
This study suggests that rock falls and shallow landslide are hazardous phenomenal that involve the near-surface cover of a bigger and more complex landslide. The distinction between secondary processes, which appear to be the most hazardous in the short-term, and deep-seated one, demonstrated that accurate multi-approach analysis provide important information that can be supportive for local administration and decision makers, and for the comprehension of the factors controlling large and deep-seated landslide affecting the Adriatic coastal slopes.