6th WORLD LANDSLIDE FORUM
2023 FLORENCE ITALY

14-17 NOVEMBER 2023

LANDSLIDE SCIENCE FOR SUSTAINABLE DEVELOPMENT

Proceedings of the 6th World Landslide Forum. Florence Italy, 14-17 November 2023
Abstract book

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SESSION 2.2

INTEGRATED APPLICATION OF DEFORMATION MONITORING TECHNIQUES AND PROCESS ANALYSES OF DEEP-SEATED LANDSLIDES (part I)

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MULTI-SOURCE DATA ANALYSIS TO ASSESS THE KINEMATICS OF THE PISCIOTTA DEEP-SEATED GRAVITATIONAL SLOPE DEFORMATION (SOUTHERN ITALY)

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Purpose: Although Deep-Seated Slope Deformations (DSGSD) are well-known in the literature, their evolution and kinematics are still poorly understood. Their behavior is often complex and characterized by small movements associated with steady-state creep, alternating with periods of stasis, or accelerating downslope movements that, in some cases, could result in sudden and catastrophic failure events. Therefore, a multidisciplinary approach is often required. This work shed light on the complex geometry and kinematics of the Pisciotta DSGSD, a deep-seated roto-translational sliding involving structurally complex turbiditic rock masses and interacting with man-made infrastructures. Located along the coast of the Tyrrhenian Sea in the south of Italy, the Pisciotta DSGSD has been known since the 1960s. Its movement towards the Fiumicello riverbed manifested from the second half of the eighties, with mean rates of approximately 1m/year. Significant movements affected the SS447 road, crossing the DSGSD mass at its middle height, which suffered continuous planimetric and altimetric distortions. The progressive sliding also affected the Salerno-Reggio Calabria railway tunnel, running on two distinct sediments and crossing the Fiumicello torrent (De Vita et al., 2013).

Methods: A multidisciplinary investigation was performed to reveal the geometrical features and the long- and short-term spatial and temporal behavior of the Pisciotta DSGSD. We collected structural data and Digital Surface Models (DSM) employing drone investigations. We then exploited high-resolution optical imagery and Synthetic Aperture Radar (SAR) satellite data from the Sentinel-1 satellite mission to assess the long- and short-term kinematics of the DSGSD body. The interpretation of such data has been assisted by ancillary information consisting of topographic maps at different scales, airborne Lidar data, and ground-based measurements such as rainfall data, boreholes, and inclinometric measurements. All these data were exploited by analytical and 3D numerical approaches to provide the best estimate of the DSGSD failure surface(s) and volume and assess its current kinematics.

Results and Conclusions: Typical DSGSD landforms were mapped employing in-situ surveys, aided by stereoscopic analysis of historical aerial images and high-resolution drone-based mapping. Structural data and ancillary ground-based surveys revealed the presence of a highly weathered and folded turbiditic sequence, with competent sandstone and calcarenite units alternated by weak tectonically disrupted argillite and mudrock layers. Remote sensing measurements from optical imagery and Synthetic Aperture Radar satellite data assessed the DSGSD's long- and short-term kinematics, allowing to distinguish a pre-failure period with accelerating displacement rates, a failure period with maximum displacement rates, and a current post-failure period with decelerating displacement rates. Analytical and numerical models confirmed the deep reach (up to 80 m) of the studied DSGSD, as verified by available boreholes and inclinometric measurements, and they allowed the estimation of its failure surface(s) and a volume of roughly 6.2x106 m3. Numerical modeling further revealed an apparent interference between the DSGSD and the odd railway tunnel, which intercepts the DSGSD toe for approximately 60-80 meters length.

References

1. De Vita P, Carratù,MT, La Barbera G, Santoro S. Kinematics and geological constraints of the slow-moving Pisciotta rock slide (Southern Italy). Geomorphology 2013; 201, 415–429. https://doi.org/10.1016/j.geomorph.2013.07.015

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