XL cycle - Academic Year 2024/2025

PhD course in "**Models and Methods for Material and Environmental Sciences**"

"**Landslide Processes and Multiscale Risks Analyses**"

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Abstract

The project aims to conduct a multiscale analysis of landslide processes, integrating basin-scale investigations for non-structural mitigation strategies and site-scale analyses to support structural mitigation efforts. At the basin scale, satellite-based technologies such as InSAR interferometric data, will be used adopting two techniques: Permanent Scatterers (PS) and Interferogram Stacking. These data will enable the detection and monitoring of ground deformations with millimetric precision over extensive areas. These tools provide critical insights into the temporal and spatial evolution of landslides, facilitating large-scale multitemporal analysis and the identification of potentially hazardous zones for updated land-use planning. At the site scale, detailed studies will be conducted on complex landslides, mainly in the Piacenza Apennines. These analyses will integrate different monitoring techniques. High-resolution DEMs from UAV-LiDAR surveys and orthophotos, will be used to perform a multitemporal analysis, combined with field surveys and subsurface data, in order to perform the characterization of landslide morphology and dynamics, delineating landslide boundaries, mapping sliding surfaces, and understanding the interactions between geological structures and active processes. Slope stability assessments will quantify variations in safety factors under changing geotechnical and hydrological conditions, while rainfall-event correlations will provide insights into triggering mechanisms. The susceptibility of the territory to various types of landslide initiation will be assessed at a large scale using both geostatistical and machine learning techniques. These methods will help estimate the likelihood of landslide occurrence and generate susceptibility maps. The accuracy of these maps will be validated through Receiver Operating Characteristic (ROC) and Success Rate Curves. This approach is a potential decision-making tool for both structural and non-structural mitigation. By combining satellite data with in-situ observations, the project provide a comprehensive framework for understanding and managing landslide risks. The combined outcomes will support periodic updates of susceptibility maps, taking into account environmental factors and supporting land-use planning and landslides risks reduction.