CIVIL AND ENVIRONMENTAL ENGINEERING

AMMIN/DIATI - Definition of regional-scale hazard scenarios to rockfall phenomena through territorial and climatic variables

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Supervisor	VAGNON FEDERICO - federico.vagnon@polito.it
Contact	VAGNON FEDERICO - federico.vagnon@polito.it TIRANTI DAVIDE - davide.tiranti@arpa.piemonte.it
Context of the research activity	Rockfalls are frequent and hazardous in the Alps, influenced by geology and climate. This study develops a regional method to assess rockfall hazard in Piemonte's high-altitude areas, integrating terrain, geological, climatic factors, and historical events. It produces a susceptibility map and identifies climatic trigger thresholds. IPCC climate projections are included, supporting risk assessments for exposed elements.
Objectives	Rockfalls are among the most frequent and hazardous landslides in Alpine regions, strongly influenced by both geological conditions and climate variability. This study proposes a regional-scale methodology to assess rockfall hazard scenarios across the high-elevation Alpine sector of Piemonte, using a combination of territorial and climatic factors. The analysis integrates morphometric, geological, and climate-related factors with a database of historical events to produce a regional-scale susceptibility map and to obtain the identification of triggering threshold values related to climatic variables. In addition to current terrain data, the methodology includes projections based on IPCC climate scenarios, considering the strong correlation between rockfall occurrence and air temperature variations. The resulting hazard scenarios could also support preliminary risk assessments of vulnerable targets exposed to this risk across the region. The main objective of the research would be: - Enhancement of susceptibility assessment using territorial and climatic data in order to develop an integrated model that combines geological, morphometric, altimetric, and climatic variables to improve regional-scale rockfall susceptibility assessment. - Replace or integrate the traditional GSI with a more dynamic approach that considers not only the static mechanical properties of rocks but also the evolving geotechnical conditions due to climatic factors such as global warming and precipitation variability. - Integration of artificial intelligence (AI) for predictive analysis through machine learning (ML) techniques to analyze large volumes of spatial and

	temporal data, improving the ability to predict rockfall events based on environmental and historical variables. - Integrate climate historical data and future projections based on IPCC scenarios to simulate future changes in occurrence behavior of rockfalls. Consider temperature increases and rainfall variability over the long term to predict how regional susceptibility will evolve.

Skills and competencies for the development of the activity	Candidates should have a degree in civil and environmental engineering, geosciences, nature and environmental sciences. Basic knowledge in applied geology, geoengineering/environmental engineering, climate change monitoring, and adaptation is required. Proficiency in GIS, data processing, and basic coding skills (e.g., Matlab, R or Python) are necessary for the development of the activities.