CIVIL AND ENVIRONMENTAL ENGINEERING

Ateneo - Study & modeling of the interactions between infiltration water, temperatures, & induced deformations in the karst system of the Bossea Caves

Funded By	Politecnico di TORINO [P.iva/CF:00518460019]
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Context of the research activity	The project aims to explore the air-rock-water temperature interaction in the Cave of Bossea through a combination of field monitoring, advanced instrumentation, and numerical modeling, with the main objective to understand and to predict how climate changes may affect the "stability" of the Bossea karst system. The Bossea Caves offer a unique environment to study the complex interactions between infiltration water, its temperature and chemistry, and thermal variations within the rock mass, as well as any induced deformations.
Objectives	The Bossea Caves is characterised by a complex interactions between the infiltration water, its temperature and chemistry, and thermal variations within the rock mass, as well as any induced deformations. In the frame of the current climate transition and the changing precipitation patterns, this doctoral project aims to explore these phenomena through a combination of field monitoring, advanced instrumentation, and numerical modeling. The objective is to understand and predict how climate changes may affect the stability of the Bossea karst system. Moreover, this PhD project will contribute to the advancement of research related to “air-rock-water temperature monitorinig in the Cave of Bossea” conducted by the CC-PALEO-LAB, one of the multisite laboratories within the “Department of Excellence” and ct_@polito project. The expected objectives of the research are: 1. Monitoring of hydrogeological conditions: analysis of historical data on flow rate, chemistry, and temperature of the water in the Bossea Caves, as well as temperature sensor data at various depths within the rock mass. This will be correlated with rainfall patterns, snowmelt, and external temperatures in the study area. 2. Evaluation of induced deformations: use of borehole extensometers or alternatives like fiber optics (in collaboration with the interdepartmental center PhotoNext) to monitor rock mass deformations in response to temperature variations and the hydraulic load induced by infiltration water. 3. Experimentation on analog models: conducting experiments on small-scale analog models in the laboratory to validate numerical simulation results

	and gain a deeper understanding of the physical mechanisms involved. 4. Numerical modeling: utilizing advanced numerical models to simulate water flow, thermal distribution, and deformations in the rock mass of the Bossea Caves, to better understand the relationships between these processes. The expected outcomes at the end of the doctoral research are: 1. A better understanding of the interactions between water infiltration, temperatures, and deformations in the Bossea karst caves. 2. Development and validation of numerical models to predict the hydro-thermal-deformative behavior of the karst environment. 3. Collection of long-term monitoring data to understand the evolutionary dynamics of the Bossea Caves. 4. Potential applications in environmental protection, sustainable water resource management, and mitigation of geological risks.

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