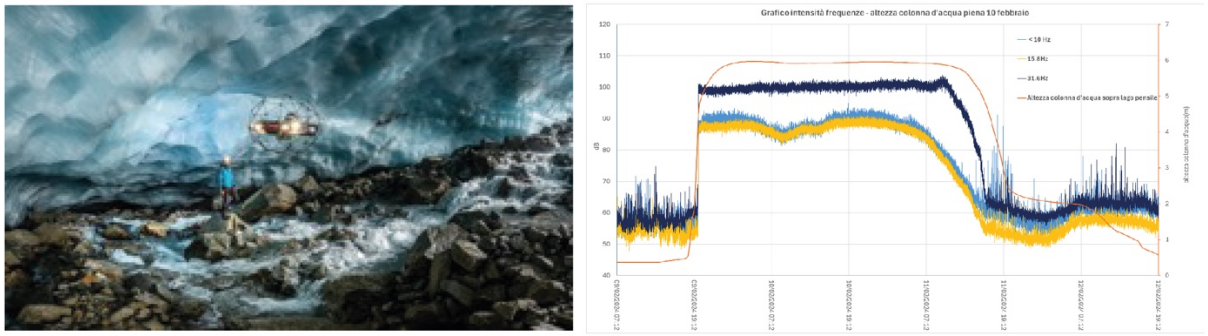
Monitoring and analyzing extreme floods in karstic and englacial conduits with innovative technologies

(Proposer: Dr. Francesco Sauro)

Project Summary: This PhD research project aims to implement and test new innovative systems for monitor and study flow dynamics and extreme floods in karstic and englacial conduits in two case scenarios: the Venetian Alps (karst) and Valais Alps (glaciers). While the hydrology of karst systems has been studied for decades, the impact of climate change in englacial drainage networks is still poorly investigated. Understanding drainage mechanisms and flood precursors is becoming very important, especially now with glaciers being subject of accelerated melting rates and relevant subsurface heat transfers due to global warming. Techniques commonly used to monitor karstic conduits could be used to assess and predict flood events in englacial/subglacial systems, but also new techniques could mutually improve the understanding of these two scenarios. Specifically, the project will apply the new promising methodology - only recently used in karst hydrology studies - of continuous hyperspectral sound monitoring paired with flow and energy transfer measurements using multiparametric probes. The project will also perform photogrammetry and laser scanner surveys of the karstic and englacial conduits through the use of the Elios Flyability drone (in human inaccessible areas) and Leica BLK2GO laser scanner, to better constrain their dimensions and morphology in relationship to extreme discharge events.



On the left, an englacial drainage conduit at the substrate contact of Gorner Glacier mapped with a LiDAR equipped collision-tolerant drone, On the right, an example of hyperspectral sound monitoring of an extreme flood in karstic conduits.

The data collected will allow not only to better understand karstic and englacial extreme floods, but also to develop continuous monitoring for alert systems for flash floods in both scenarios. Also, for the englacial case, the process of cryo-hydraulic amplification, where energy flows are released from the melt water into the interior of the glacier as it flows at its base, thus triggering an accelerated collapse, will be documented and described through numerical modelling.
Glaciospeleology, i.e. the study of karst-like phenomena that develop within a glacier, can provide significant input into research on the relative dynamics of melting and evolution. A further aim of the project is to quantify the impact that contact caves have on the mass balance of glaciers. The possibility of analysing data from past glacial epochs, preserved in karstic cavities in neighbouring areas, to investigate and predict future glacier behavior is also highlighted.

Study areas
The project will study alpine glaciers, such as the Aletsch and Gorner-Grenz, the first and second largest glaciers in the Alps. Karst networks in the Adige Valley and Asiago Mountains will be used as a test-grounds for the extreme floods monitoring technologies.

Scientific collaborations and support

The PhD project will be performed under the supervision of Dr. Francesco Sauro, in collaboration with Prof. Daniele Farinotti from the ETH of Zurich for the Swiss glacier monitoring and with Prof. Michelle André, expert in acoustic monitoring, Director of the LAB institute at the Technical University of Catalonia, BarcelonaTech.

Funding sources

A minimum of 10.000 euro of funds for field activities and instrumentation will be provided by La Venta Geographic Exploration Association (https://www.laventa.it/en/), through the "Inside the Glacier" project.