

## PREFACE

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We are pleased to present a themed issue of *AUC Geographica* 2/2024, which is dedicated to our multifaceted research conducted in the Alpine environment. This research and education activities were conducted within the framework of the 4EU+ cooperation initiative. The three universities participating in this project have collaborated in both research and education since 2021 and include Charles University (Czechia), University of Milan (Italy) and Heidelberg University (Germany) (Fig. 1). We are pleased to present the results of the first three-year collaboration in the combined study of the Belvedere Glacier (Italian Alps), an iconic debris-covered glacier, situated in the Monte Rosa Massif, the second-highest mountain of the European Alps. The site is well-known not only as

a popular tourist destination, but also because of natural hazards related to glacial and geomorphological processes, which are locally affecting hamlets and the tourist trail network.

The principal aim of this international collaboration has been to establish a research foundation for education, with a particular focus on PhD students, and to create an appropriate context for integrated research topics in physical geography, geomorphology and remote sensing. By employing modern methodologies, we seek to collect new data and develop new strategies for the research of glacier-related changes and its hazards during the global climate change. The collaboration started with the provision of university mini-grants, which facilitated the



**Fig. 1** Our research group in the field in 2021.

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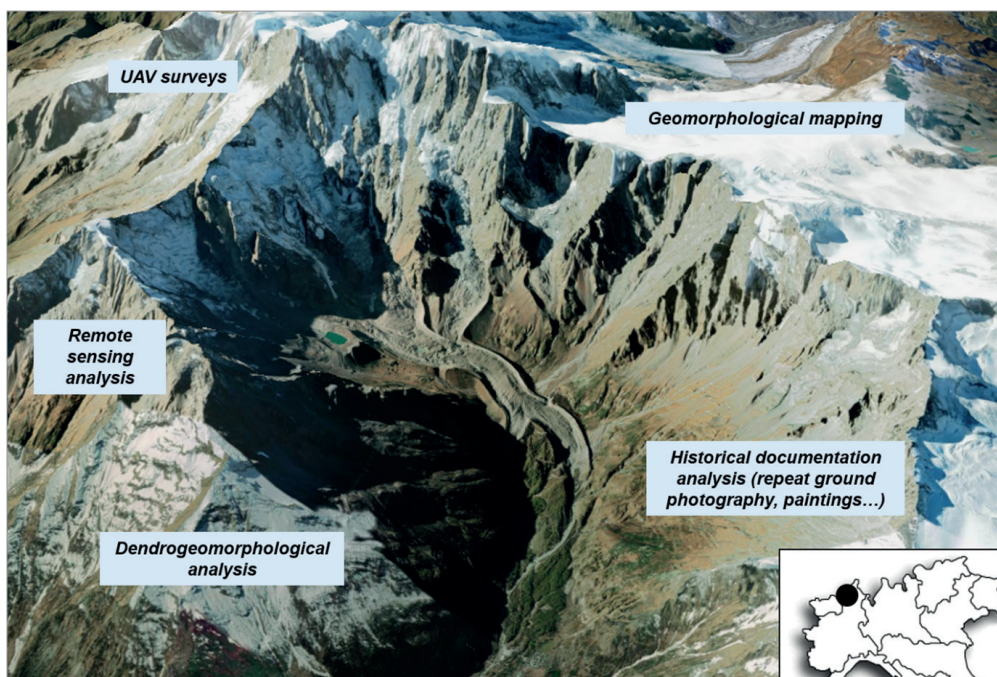


**Fig. 2** Devastating flash flood from 2024 (Rio Tambach in the Staffa Village, part of Macugnaga), according Beba Schranz on [www.nimbus.it](http://www.nimbus.it).

organisation of several seminars, research exchanges, and fieldwork aimed at data collection and training for early career scientists and students. This has led to the preparation of several Master and PhD theses and their presentation during scientific congresses for young researchers in 2022 and 2023. Moreover, we have produced none research papers and intend to further develop our database for future fieldwork-based research on glacier changes and associated geo-hazards. The most recent natural hazards, such as a debris flow, which occurred on 27 August 2023, and the 29–30 June 2024 flash flood (Fig. 2), justify our continuing research in this area. These events have significantly impacted several locations in the Western Italian Alps and the Southern Swiss Alps, especially the Macugnaga watershed.

The Belvedere Glacier, a prominent feature of the Alps, has undergone notable changes in recent decades that have been affected by climatic fluctuations.

This debris covered glacier exhibits highly distinctive response patterns within the Alpine region. This special issue of the AUC Geographica (<https://karolinum.cz/en/journal/auc-geographica>) presents the research on the Belvedere Glacier (see Table of Content), with a particular focus on its dynamic responses to environmental changes. The articles included in this special issue employ a range of methodological approaches, including remote sensing and *in-situ* field observations, absolute and relative datings, monitoring and mapping. They provide a more comprehensive understanding of the glacier's current state since 1951 in comparison to long-term historical records (Fig. 3). The first article reviews previous research in this area by various Swiss and Italian researchers. The remaining articles analyse the current dynamics of glacier retreat and down-wasting through the application of innovative techniques, which yield new findings in glaciology and associated geo-environmental studies.



**Fig. 3** The head of the Anzasca Valley, the valley of the Belvedere Glacier where we are currently used to work with our students for educational and research purposes.