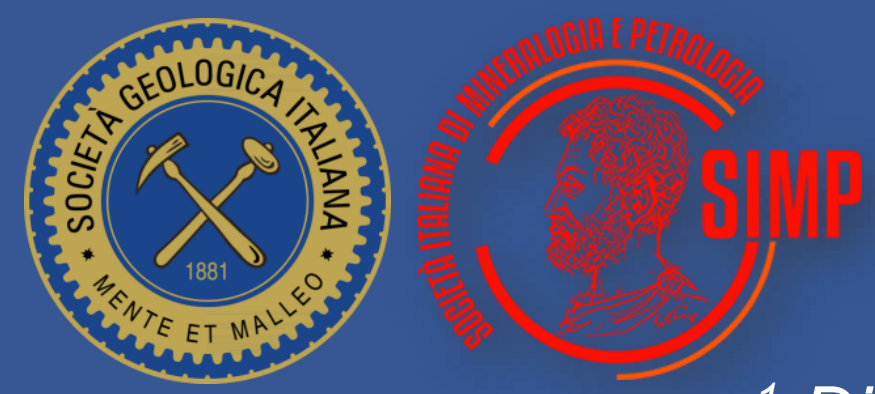


# Geosites recognition and geosystem services assessment in Alagna Valsesia (Monte Rosa, W-Alps, Italy): a sustainable development perspective for an Alpine Geopark

Khoso R.B.\*<sup>1</sup>, Guerini M.<sup>1</sup>, Gentilini S.<sup>1,2</sup>, Tognetto F.<sup>1</sup>, Viani C.<sup>1</sup> & Giardino M.<sup>1,3</sup>

<sup>1</sup> Dipartimento di Scienze della Terra, Università di Torino. <sup>2</sup> Magma Geopark, Egersund (Norway). <sup>3</sup> Geoparco Sesia-Val Grande UGGp, Varallo (VC).



## Introduction

For assessing the **geosystem services** of an area, it is crucial to identify sites of scientific interest that serve multiple purposes, such sites are defined as **geosites** [1,2]. The various geosystem services offered by the geosites that are essential for humans must be understood and managed in light of **environmental change** and **human resource exploitation**. Drawing measures to conserve the natural elements and processes that contribute to these geosystem services [3]. These elements and processes are part of the **geodiversity** and vast array of geosystem services that are actively influenced by geodiversity. Additionally, the provision and preservation of geosystem services involve both direct and indirect contributions from geodiversity [3]. So, the recognition of geosites and assessment of geosystem services helped in critical evaluation of the **benefits** offered by the geosites and the **vulnerability** caused by natural events to the man-made infrastructure development of the area.

## Study Area

**Alagna Valsesia** is a municipality and small village located high in the Valsesia alpine valley in the province of Vercelli, Piedmont region, northern Italy, and is part of **Sesia Val Grande UNESCO global geopark**. It is a tourist place for **mountaineering** and **winter sports**, and it is internationally renowned for its **freeride off-piste skiing**. It was originally settled by **Walsers** at the beginning of the 12th century. It is located at an elevation of 1,191 meters (3,907 ft) a.s.l just south of the **Monte Rosa**, elevation 4,638 meters (15,217 ft) a.s.l (the second highest peak in the Alps).

### Study Area Boundary

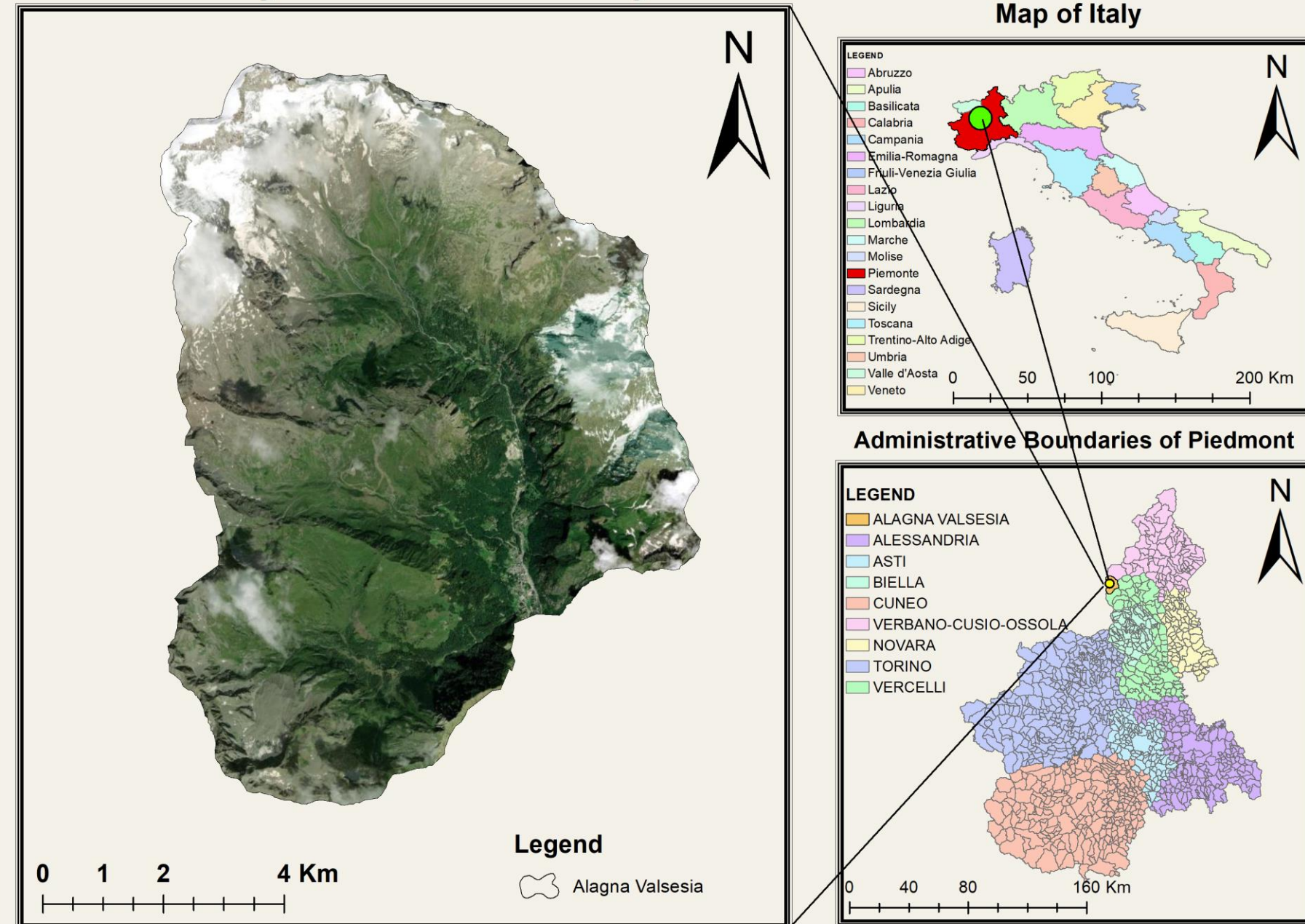


Figure 1: Location map of the study area

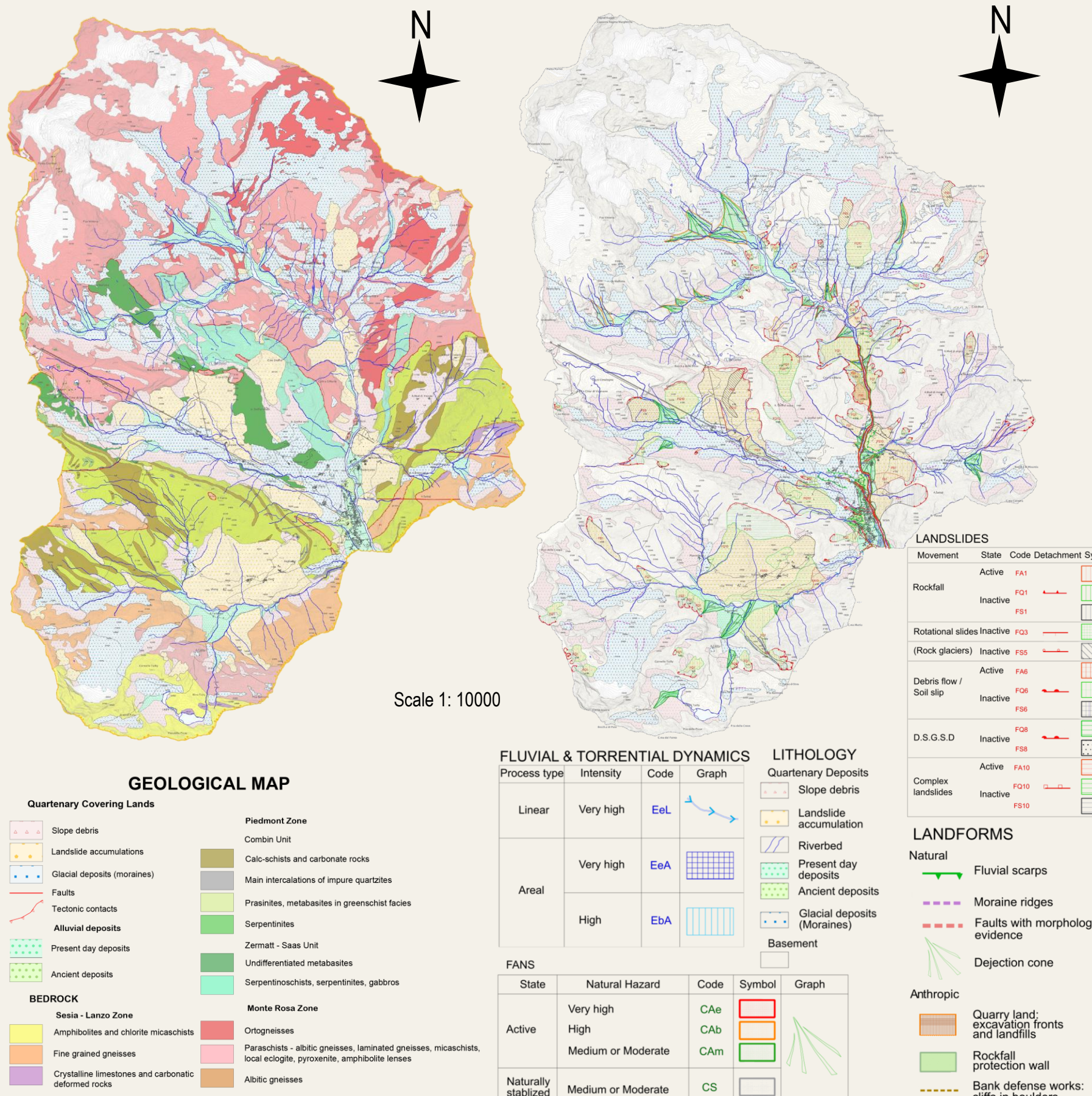


Figure 2: Geological Map [4] Figure 3: Geomorphological Map [4]

## Methodology

- We concentrated on the highest elevation area Alagna Valsesia within Sesia Val Grande UGGp.
- Data from literature and **geological / geomorphological** maps is analyzed to assess the geodiversity and recognize the geosites within the municipality of Alagna Valsesia.
- Then, assessed the role of those geosites in providing the various geosystem services.
- Geosystem services were identified with the help of framework developed by Murray Gray [5].
- The recognized geosystem services are classified in **5** different groups and each group has various types, in total there are **25 service types**.
- The data is processed and mapped in **QGIS**.

## Methodology Flowchart

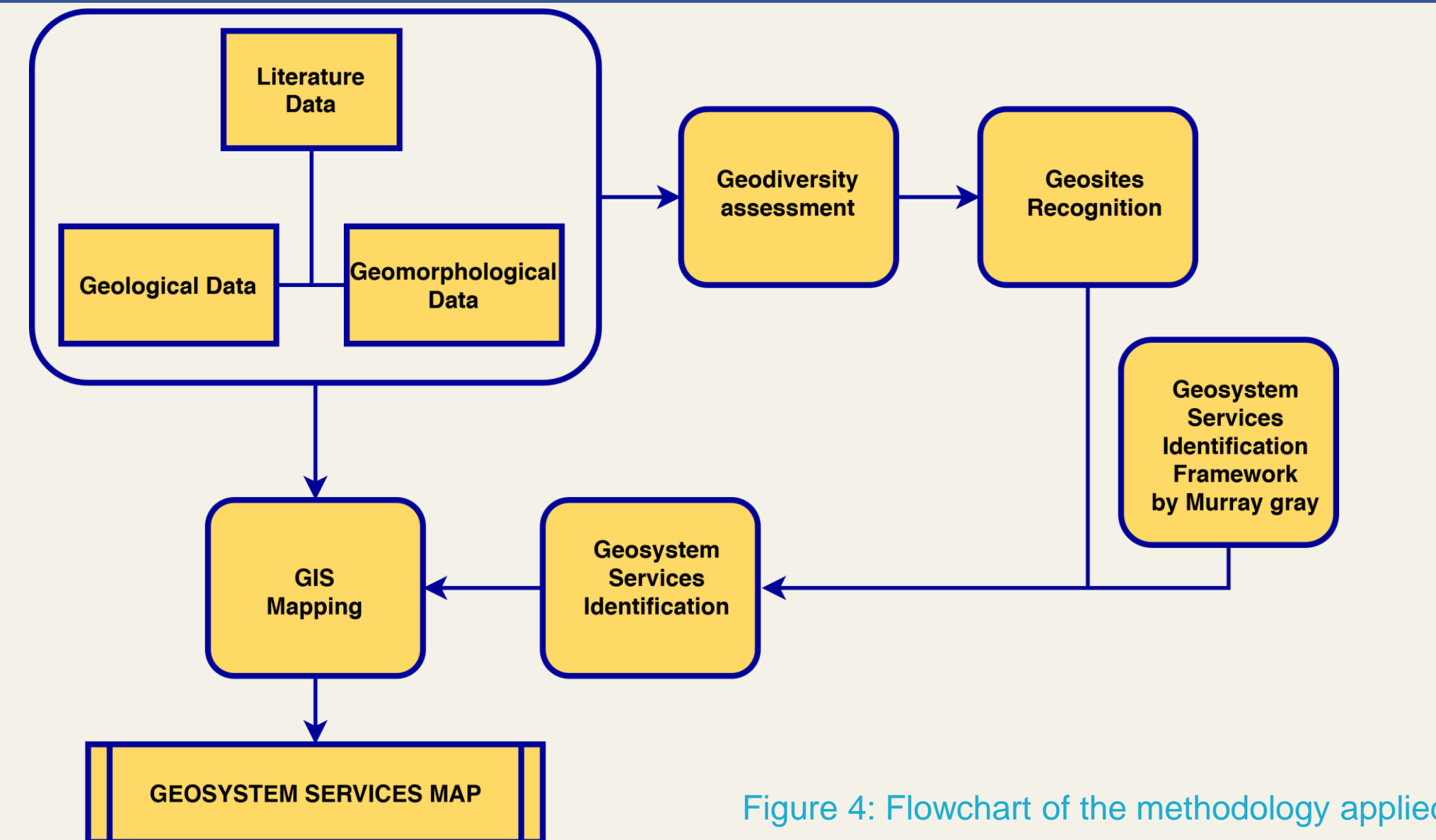


Figure 4: Flowchart of the methodology applied

## Geosites in Alagna Valsesia

Alagna Valsesia has total **8 geosites** in its vicinity. These geosites fall into local, regional and international importance.

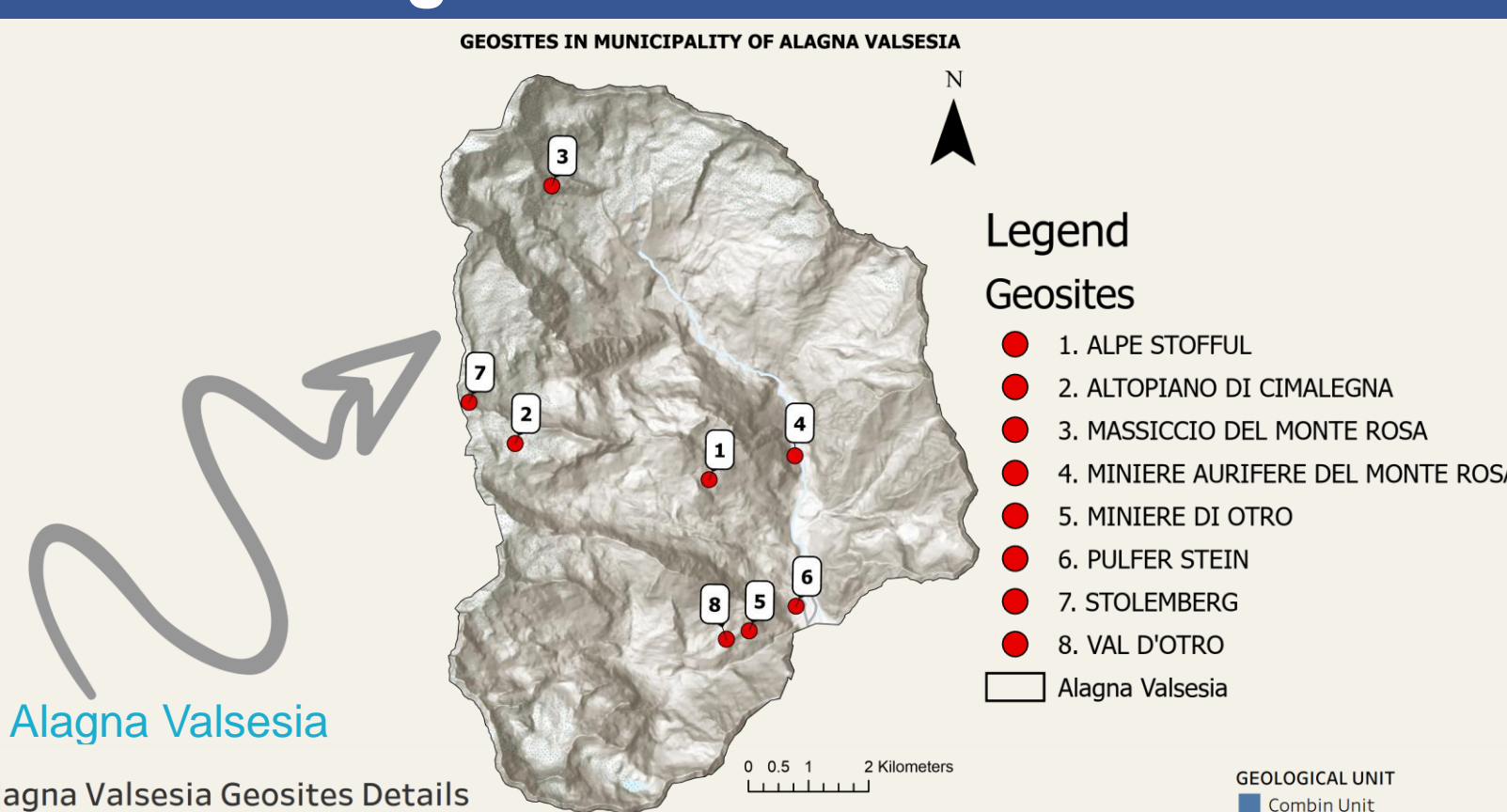


Figure 5: Location map of geosites in Alagna Valsesia

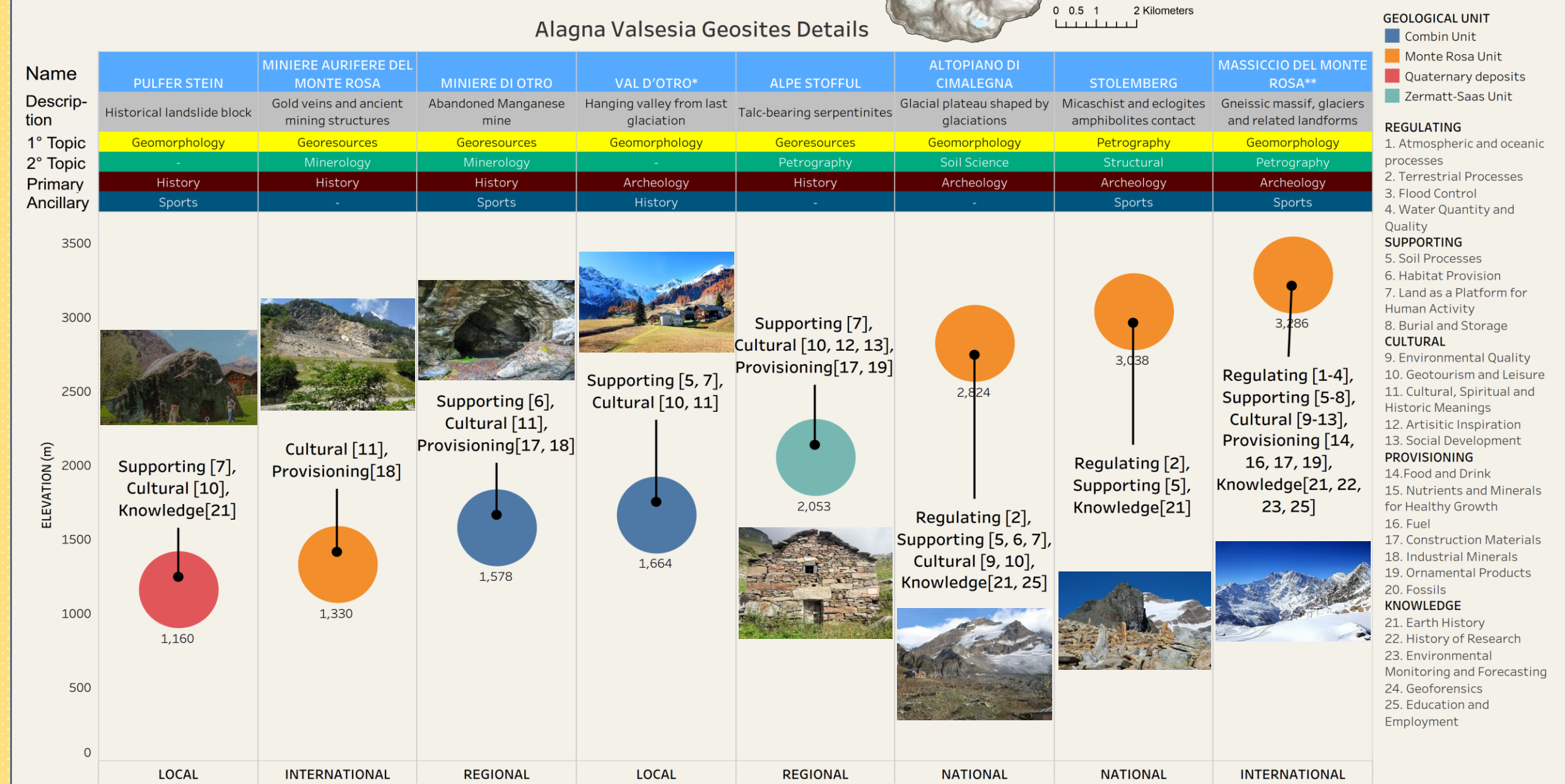


Figure 6: Geosites inventory in Alagna Valsesia [6]

## Geomorphology & Geosystem Services

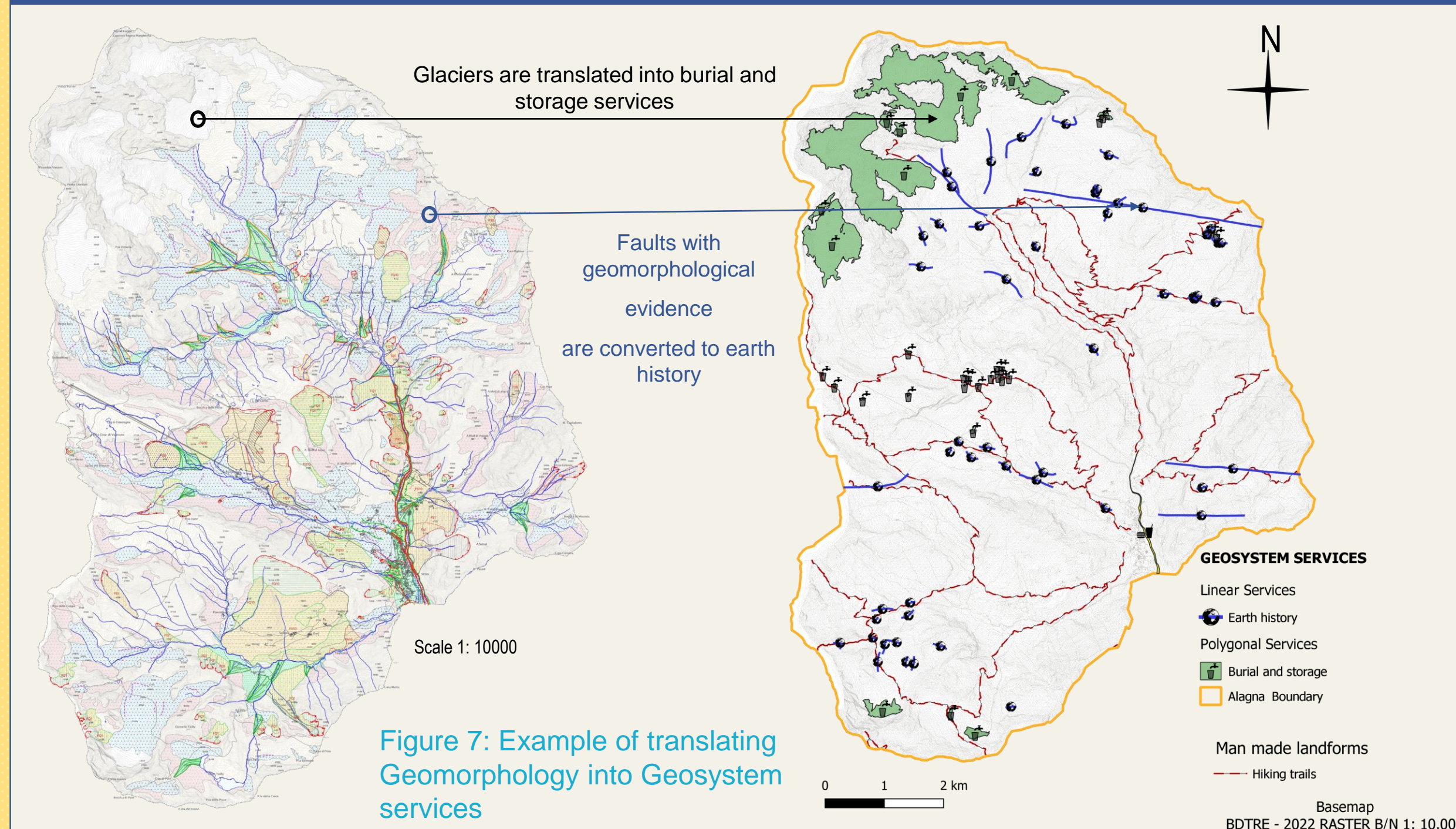


Figure 7: Example of translating Geomorphology into Geosystem services

## Geosystem Services Map

Alagna Valsesia offers wide variety of geosystem services including **regulating, provisioning, cultural, supporting and knowledge services**.

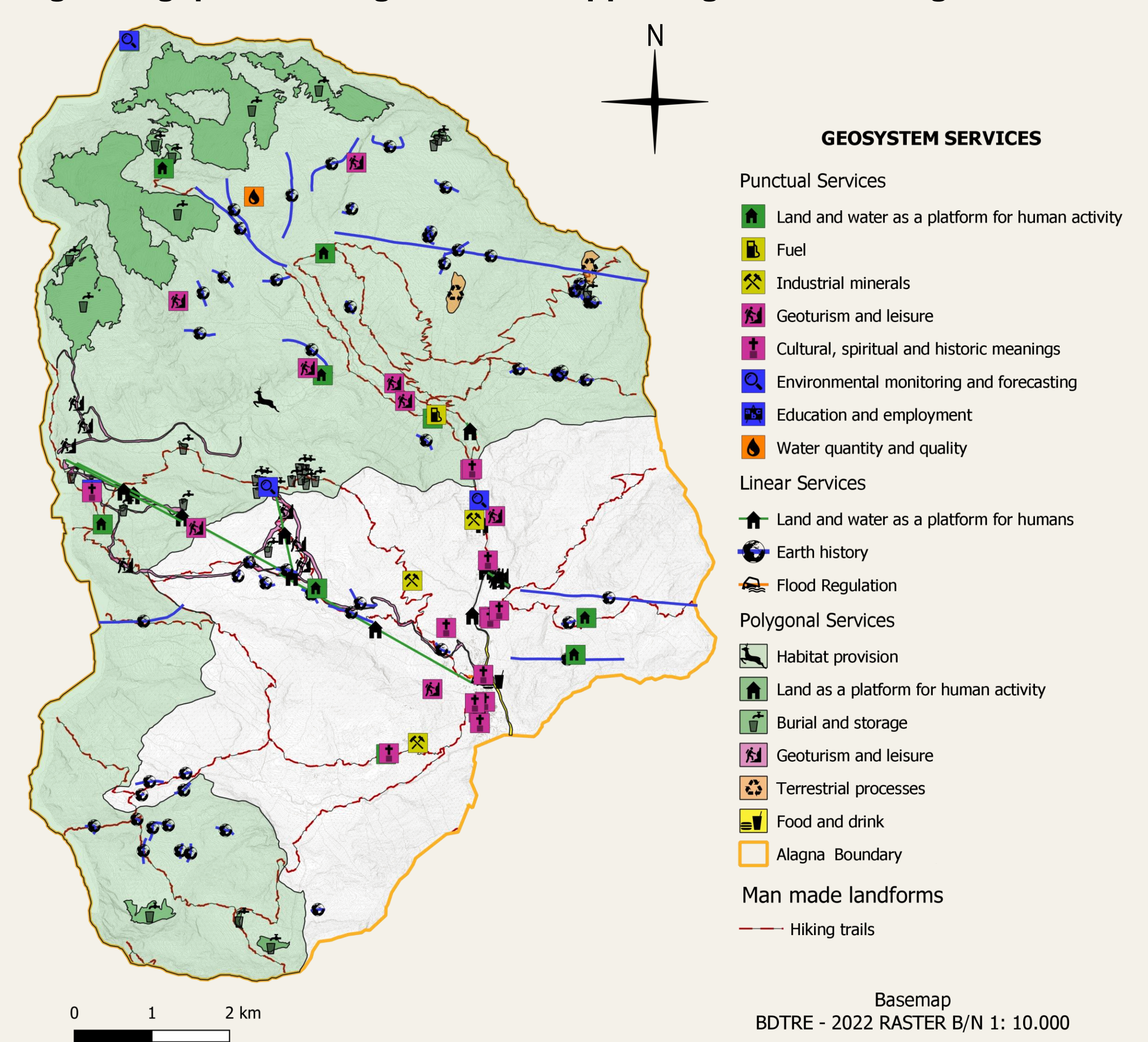


Figure 8: Geosystem services map of Alagna Valsesia

## Results & Discussion

In this study **8 geosites** in Alagna Valsesia were identified and the elevation range of the geosites varies from about **1160 m a.s.l** to **3286 m a.s.l**. These geosites have local, regional and international importance. Each geosite offers at least two geosystem services and these services are benefited by the local people of the area. Furthermore, due to the various **scientific** and **aesthetic value**, these sites have the potential for long term **sustainability**.

After recognizing the geosites the geosystem services assessment of Alagna Valsesia have been carried out to generate a map highlighting all the services offered to humans. But overexploitation of these services by humans can destroy the geodiversity of the Sesia Val Grande UGGp.

In this study, the recognition of geosites and geosystem services assessment provides the extensive viewpoint for the sustainable development of the area given the benefits offered to humans. This **human-nature** interaction should be balanced by proper sustainable **strategies** to avoid depletion of the important sites and loss of **geodiversity** and **geoheritage**.

## Conclusion

In light of the current **climate change** situation it is important to identify and make proper inventories of the geosites to understand the broad perspective of sustainable development of geodiversity. In reality, the continuous changes are having a significant negative impact on vital **abiotic ecosystem services** for **human activities**.

The geosites identification provides a complete picture of scientific and aesthetic value which is crucial for drawing measures. The identification is also important for highlighting the abiotic ecosystem services offered by an area. This creates a bridge and provides an opportunity for application of integrative frameworks, multidisciplinary models to achieve the abiotic ecosystem service management for an area in sustainable manner.

Thus, this study provides the basis for future studies and showcases the sustainable development perspective for the mountain regions.

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## Contact Information | Event

**Rasool Bux KHOSO**  
PhD student

✉ rasoolbux.khoso@unito.it  
Geositlab, Department of Earth Sciences, University of Torino, Via Valperga Caluso 35, 10125, Italy



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