

# Verification of snow-pillow measures through snow stratigraphy profiles for the determination of the Snow Water Equivalent in Valgrosina (northern Italy)

## Authors

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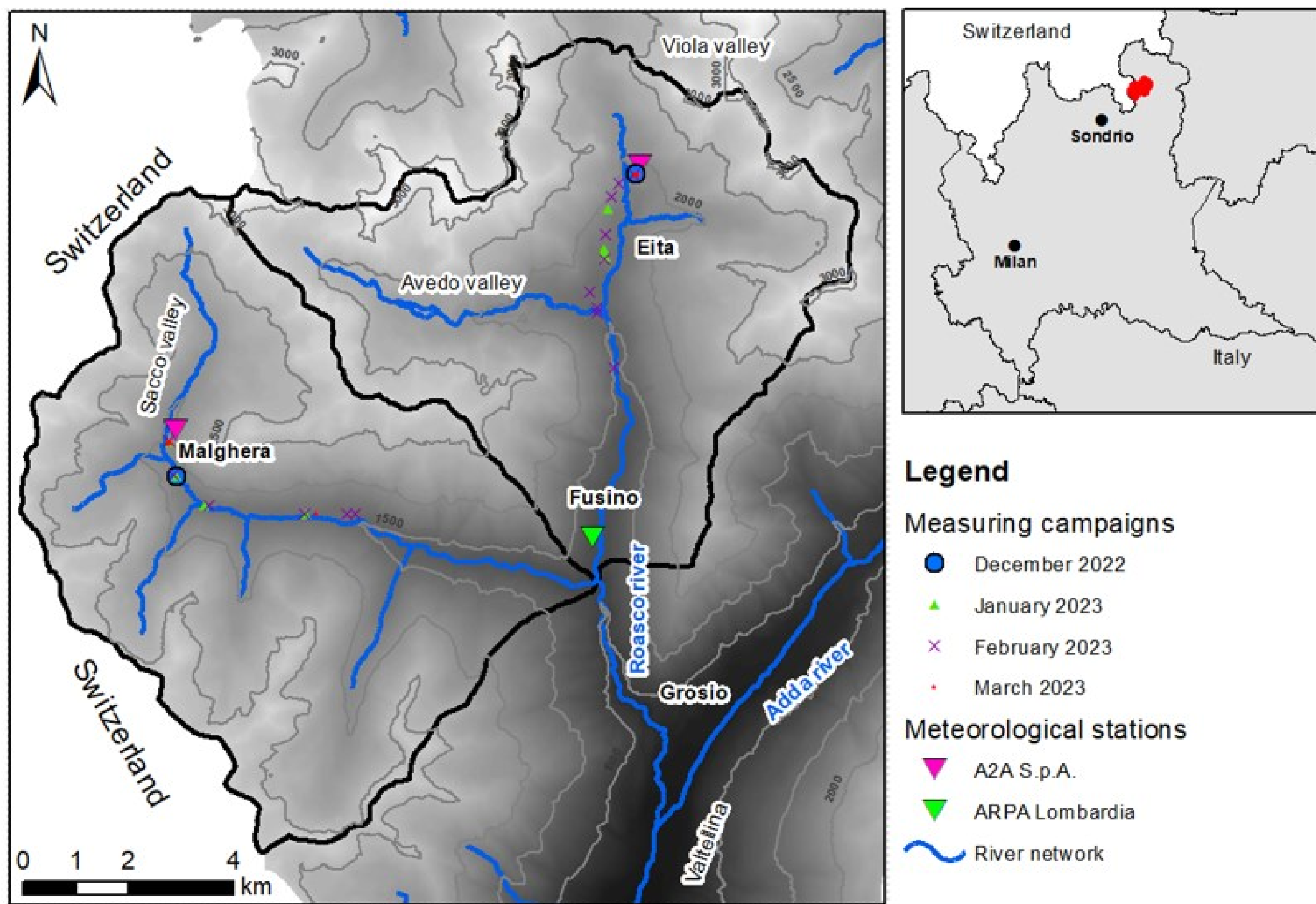
## SPECIFIC OBJECTIVES

- the verification of snow density measures at two meteorological stations equipped with snow-pillow.
- the correlation of snow density and snow height manual, discontinuous, point measures with morphological characteristics and continuous data.
- the development of a procedure to derive spatial maps of SWE.

- Four field campaigns were organized for measuring snow properties between December 2022 and March 2023
- During each campaign, a snow stratigraphy profile was executed close to each of the two meteorological stations equipped with snow-pillow.
- For each profile snow height, temperature at 5-cm intervals, snow penetration resistance, snow density and number of layers were measured.
- Each layer was described in terms of humidity, average grain size and form, and hardness (hand test).
- Comparisons between continuous station data and profiles were made to verify the similarity of density measures and relate possible inconsistencies to specific layer properties.
- Snow depth and snow density manual measures were performed at other locations in the valley, characterized by different elevation, slope and aspect in comparison to the stations and the complete profiles.

METHODOLOGY

STUDY AREA



Valgrosina is a tributary valley of Valtellina, which is exploited for hydropower production by A2A S.p.A. Given the crucial role of snow in determining the seasonal availability of water in the alpine environment, A2A installed in the two branches of the valley (Malghera and Eita) two weather stations equipped with snow-pillow.



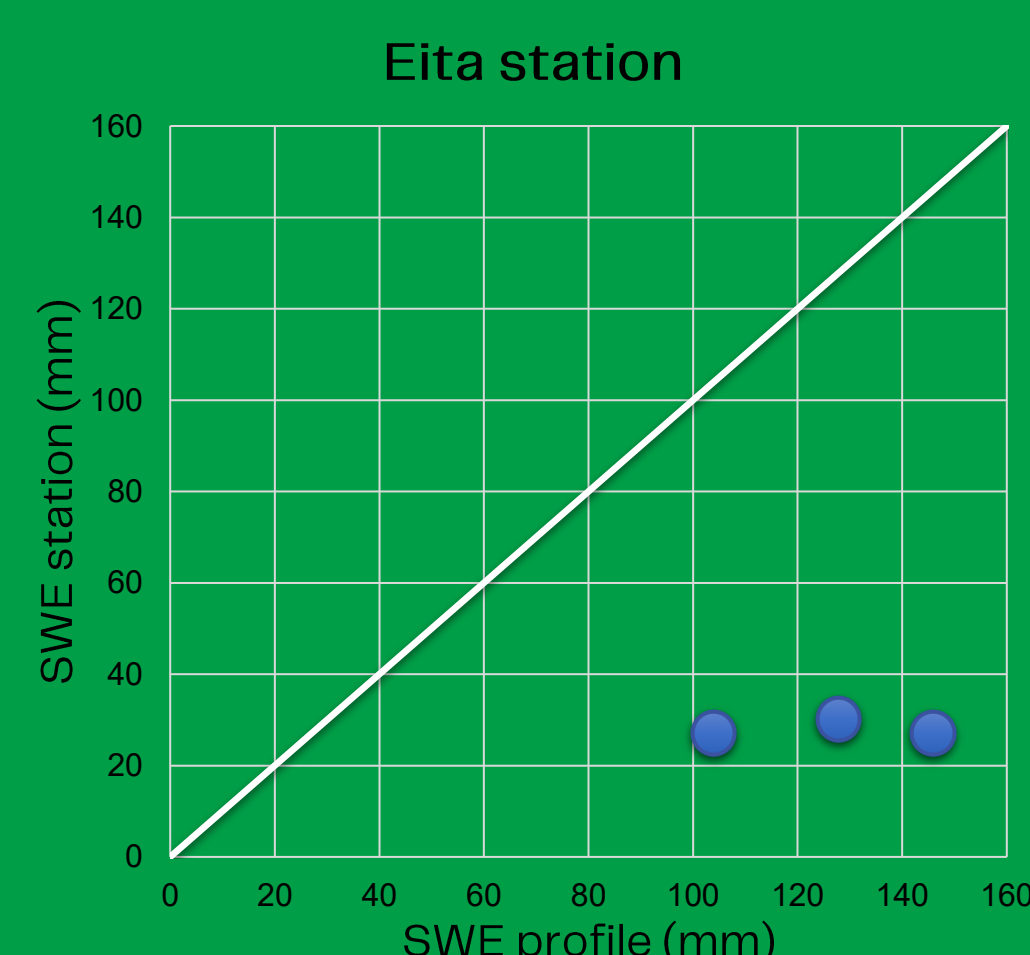
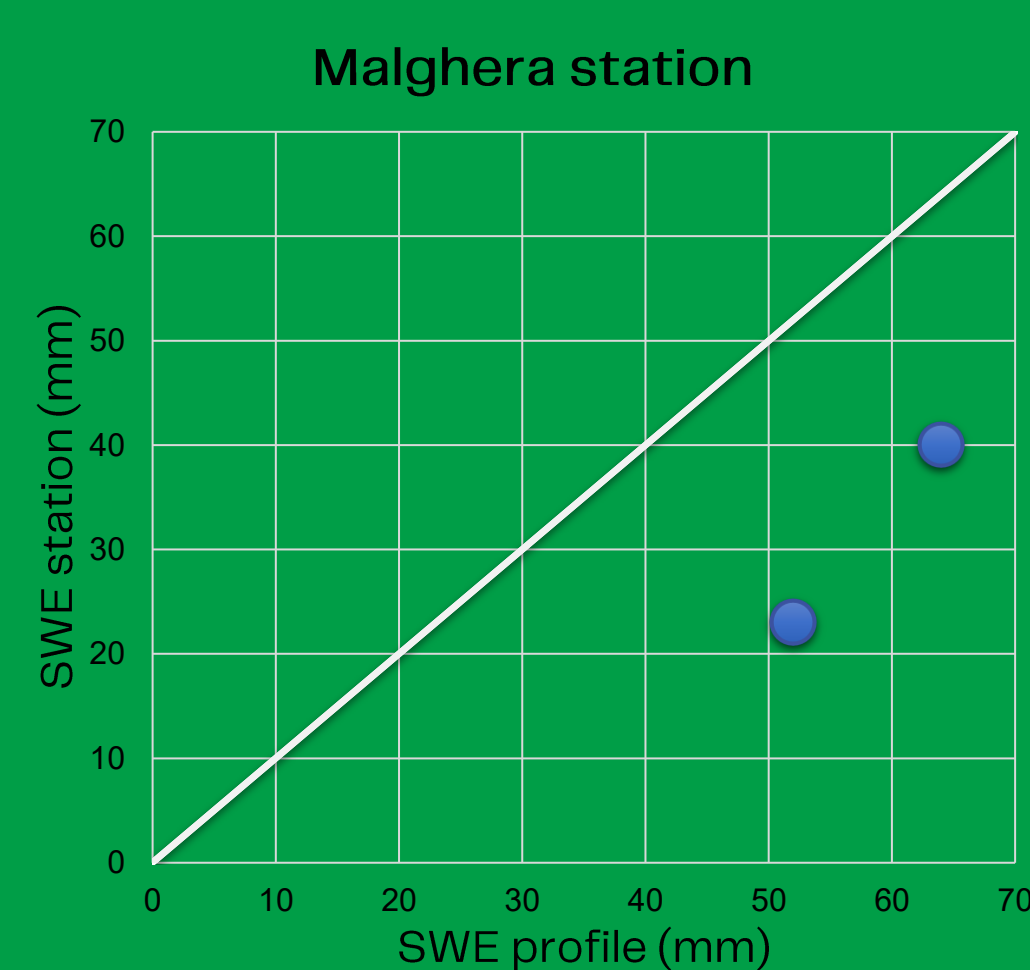
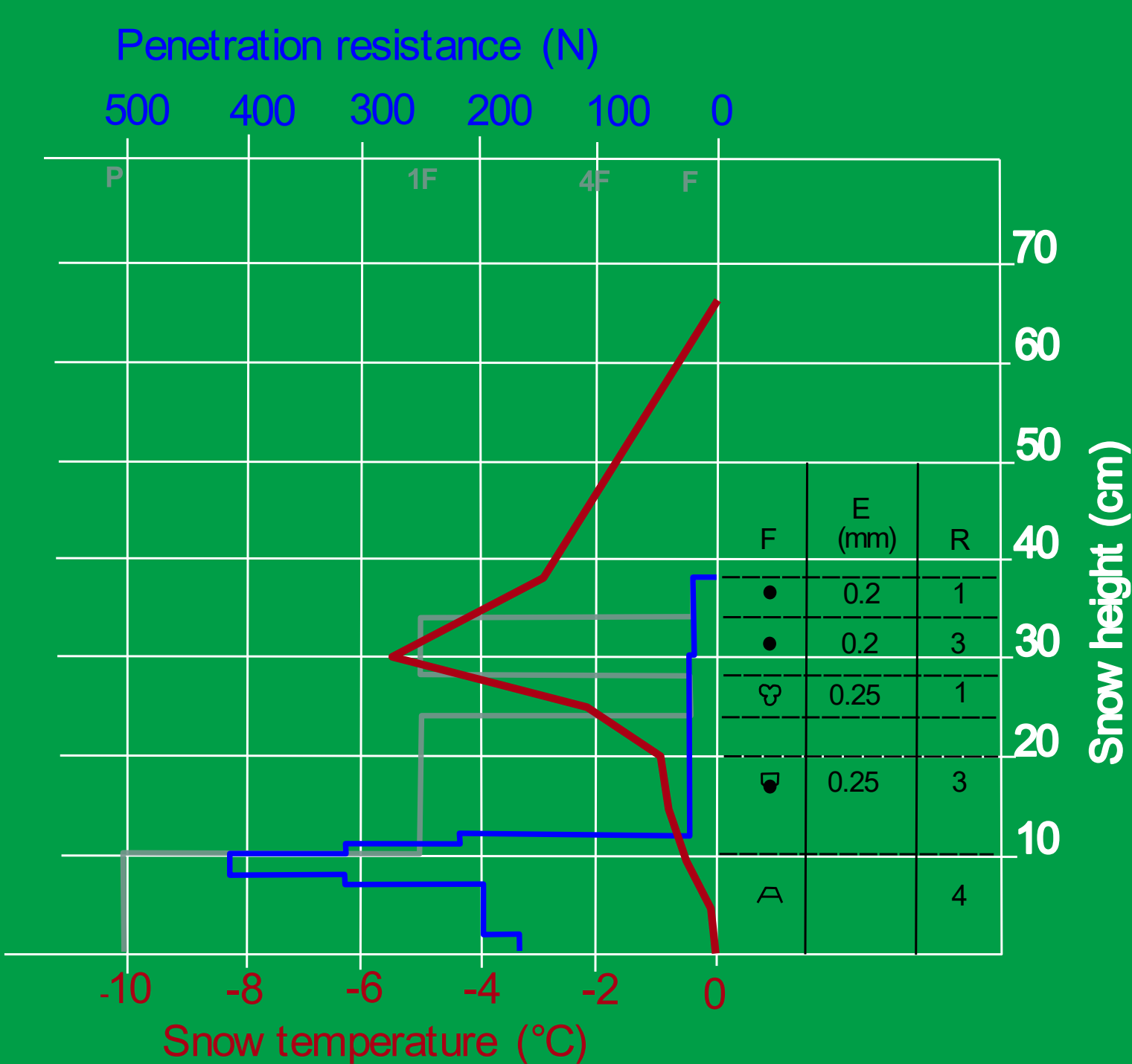
Malghera weather station

## RESULTS AND CONCLUSIONS

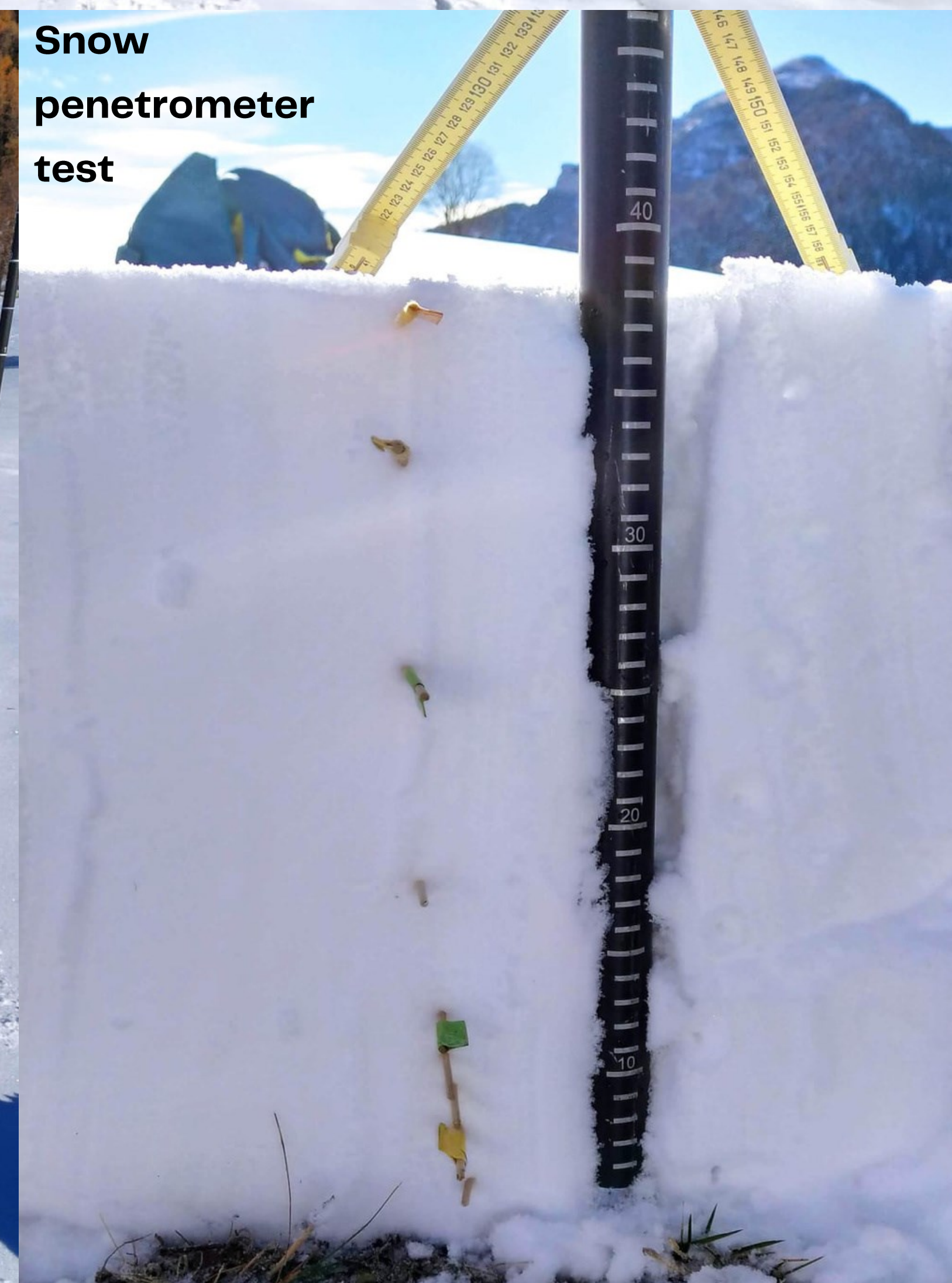
Preliminary results show a high spatial variability of snow height and a tendency of snow-pillow to underestimate snow density and SWE:

- for Malghera station between 37% and 55% in comparison to profiles.
- for Eita station between 74% and 81% in comparison to profiles. In addition, showing a snow density always below 0.1 g/cm<sup>3</sup> thus physically incorrect.

Example of snow profile performed on 2023-01-23 (12.45 pm) close to the Eita weather station. Snow height: 38 cm. Air temperature: 1.3°C.



Eita weather station



Snow penetrometer test

In Malghera, the measures are two because in December the station timeseries presented missing values and in March the snow height was zero. In Eita, the measures are three because, due to the atmospheric conditions, it was not possible to reach the station and perform the tests.

Given the limitation of the snow-pillow measures, reliable correlations with manual measures and morphometric variables could not be derived. A recalibration of the instruments was suggested to A2A. After the instrument maintenance, a second group of campaigns will be carried out next winter, selecting measuring points a-priori based on morphometric characteristics. Also, the possibility to introduce indirect spatial measures through geophysical instrumentation will be explored.



Photo of a snow-pillow



Snow-pillow image created by AI

AI image