RFID tags and reader to measure physical parameters in glacial environment

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# RFID tags and reader to measure physical parameters in glacial environment

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## TAG DESIGN



Transmission apparatus

Printed Circuit Board (PCB):
- Control unit
- Sensors interfaces
- Power stages

Batteries

**20 cm x 3.5 cm**

## SYSTEM DESCIPTION



Capsule

Accelerometer

Magnetometer

Battery

Temperature sensor

Pressure sensor

**TAG**

Printed Circuit Board (PCB)

Antenna

Microcontroller

Flash memory
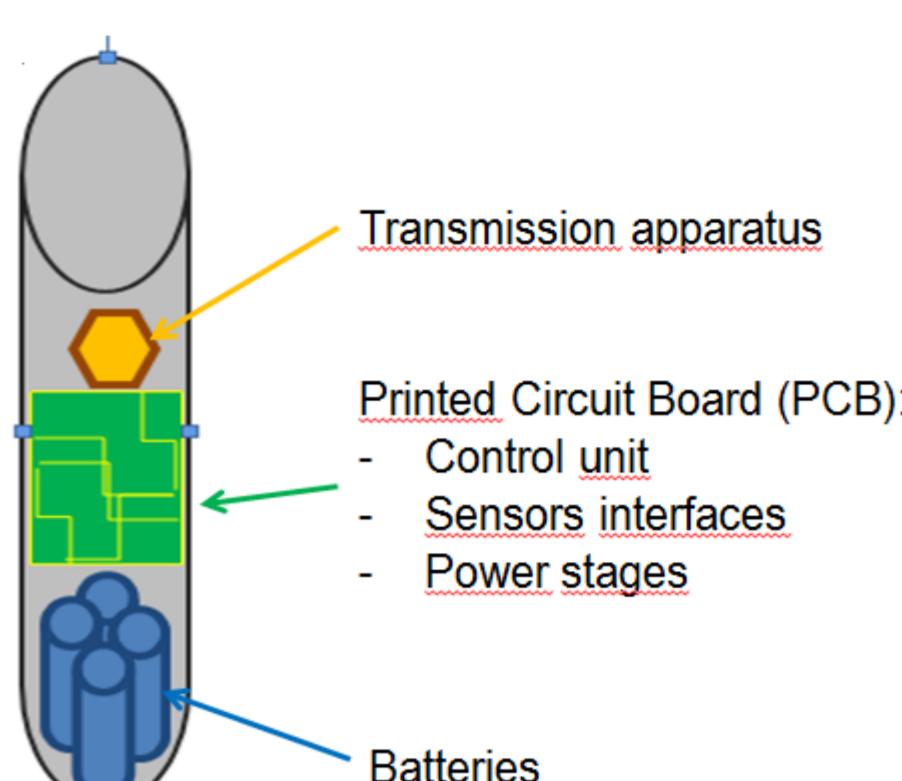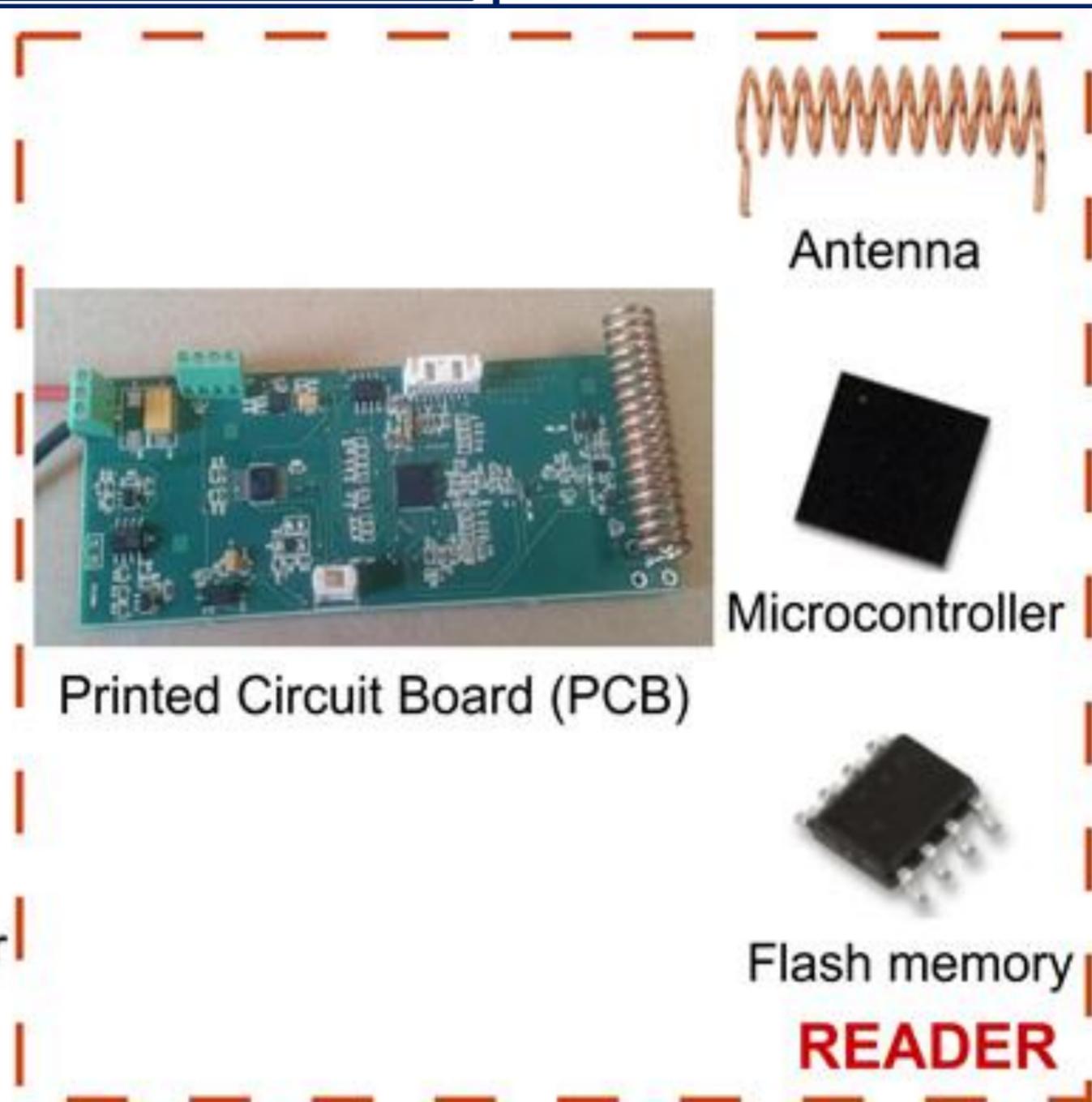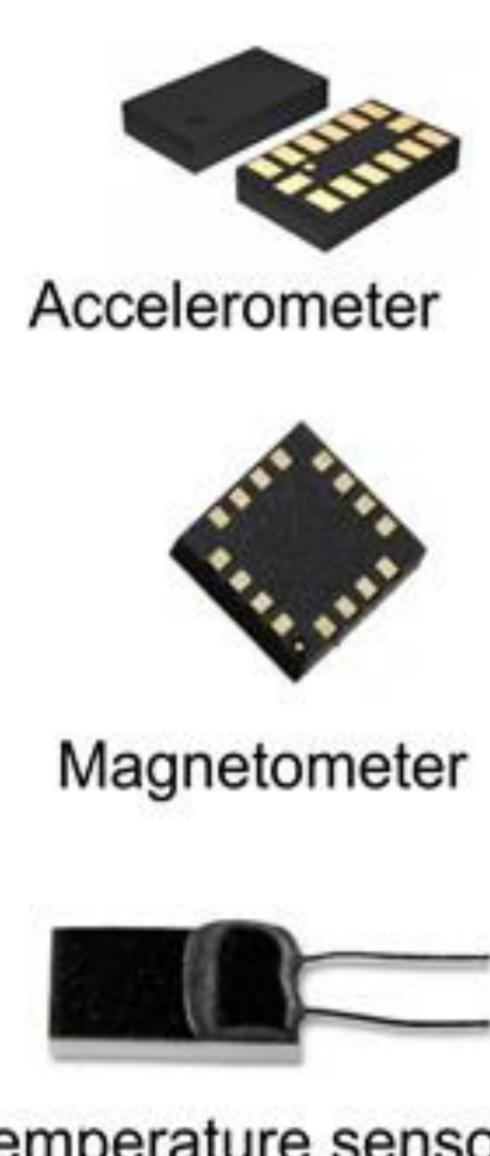
**READER**

## EXAMPLE OF APPLICATION

⌧ Sensore



$t_0$

$t_0+\Delta t$

Tag
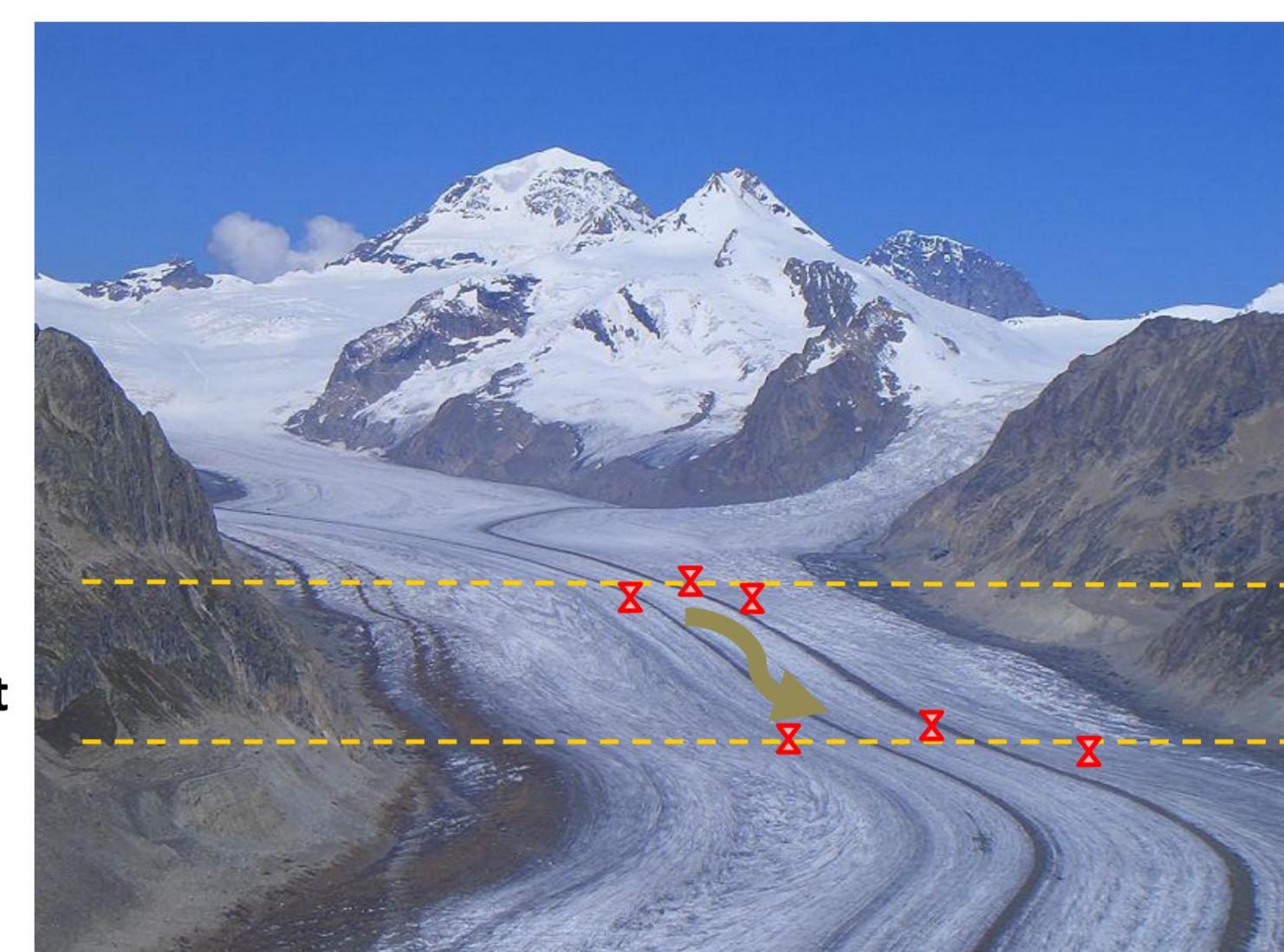
Reader with USB for laptop connection

## CHARACTERIZATION TESTS

1. Test of capsule impermeability, mechanical strength, transparency to electromagnetic waves
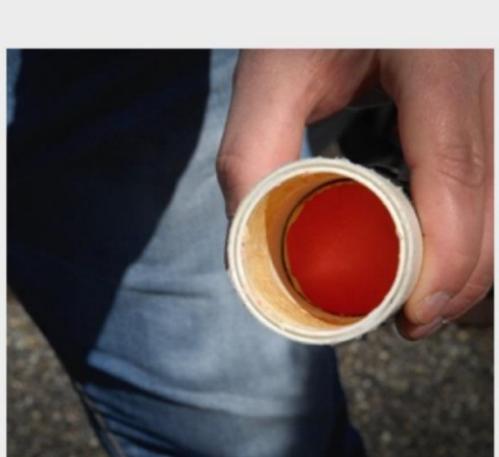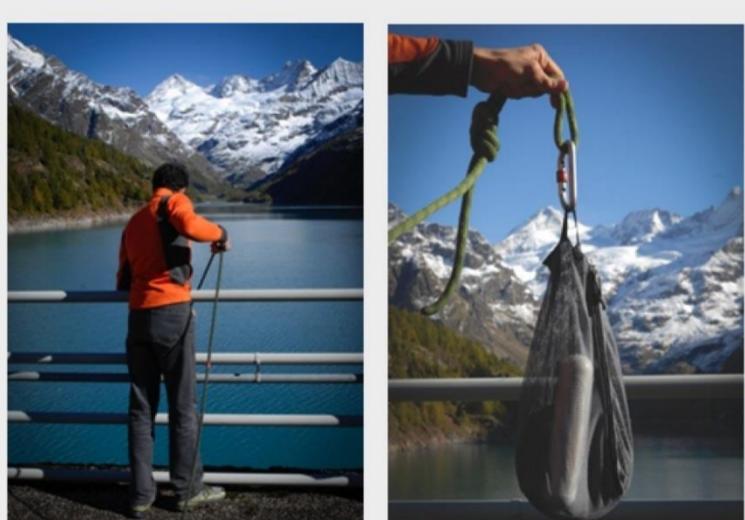


2. Signal straight measurement in free space

Received signal at different antenna polarisation and distance



Estimated error at 15 m distance in free space condition

| | Delta Gain [dB] | Errore d MAX [m] |
|---|---|---|
| Azimuth POL V | 4.28 | 1.6 |
| Elevazione POL V | 8.81 | 2.8 |
| Azimuth POL O | 3.06 | 1.4 |
| Elevazione POL O | 12.89 | 4.4 |

3. Radio frequency measurements through the detection of the RSSI (Received Signal Strength Indicator) in air, snow, ice
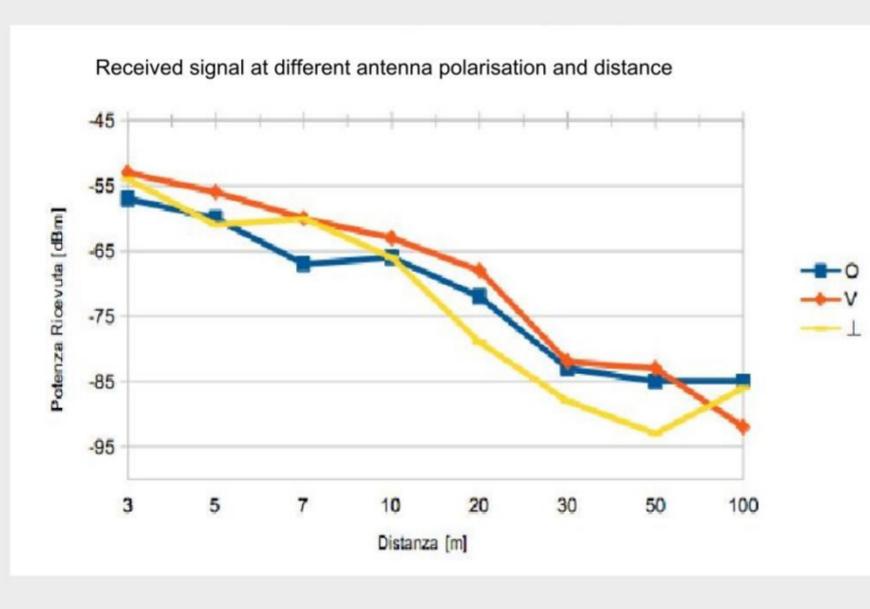
4. Power link estimation over free air

5. Characterization of temperature sensor in environmental chamber

## FIELD TEST

Installation: capsule with tag+sensors at ground surface
Measured parameters
temperature (bottom of snowpack), pressure - hourly;
RSSI - daily.
Control measures (manually executed): temperature (air, bottom of snowpack) - daily; snow depth - daily; snow density - weekly.
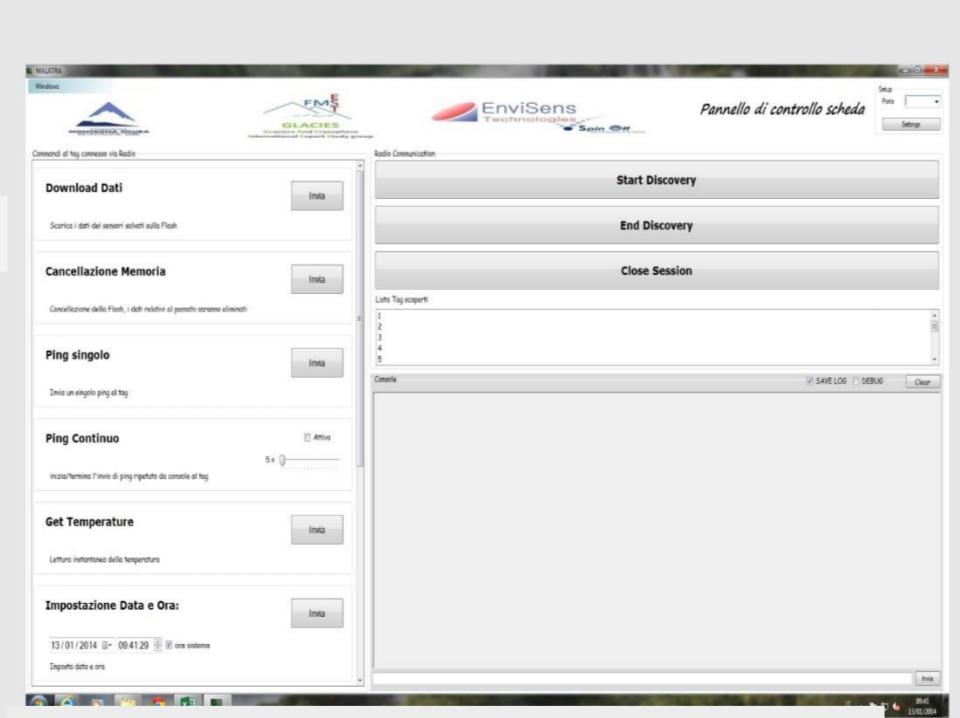
graphic interface that allows communication between reader and tag

Tag measured temperature trend
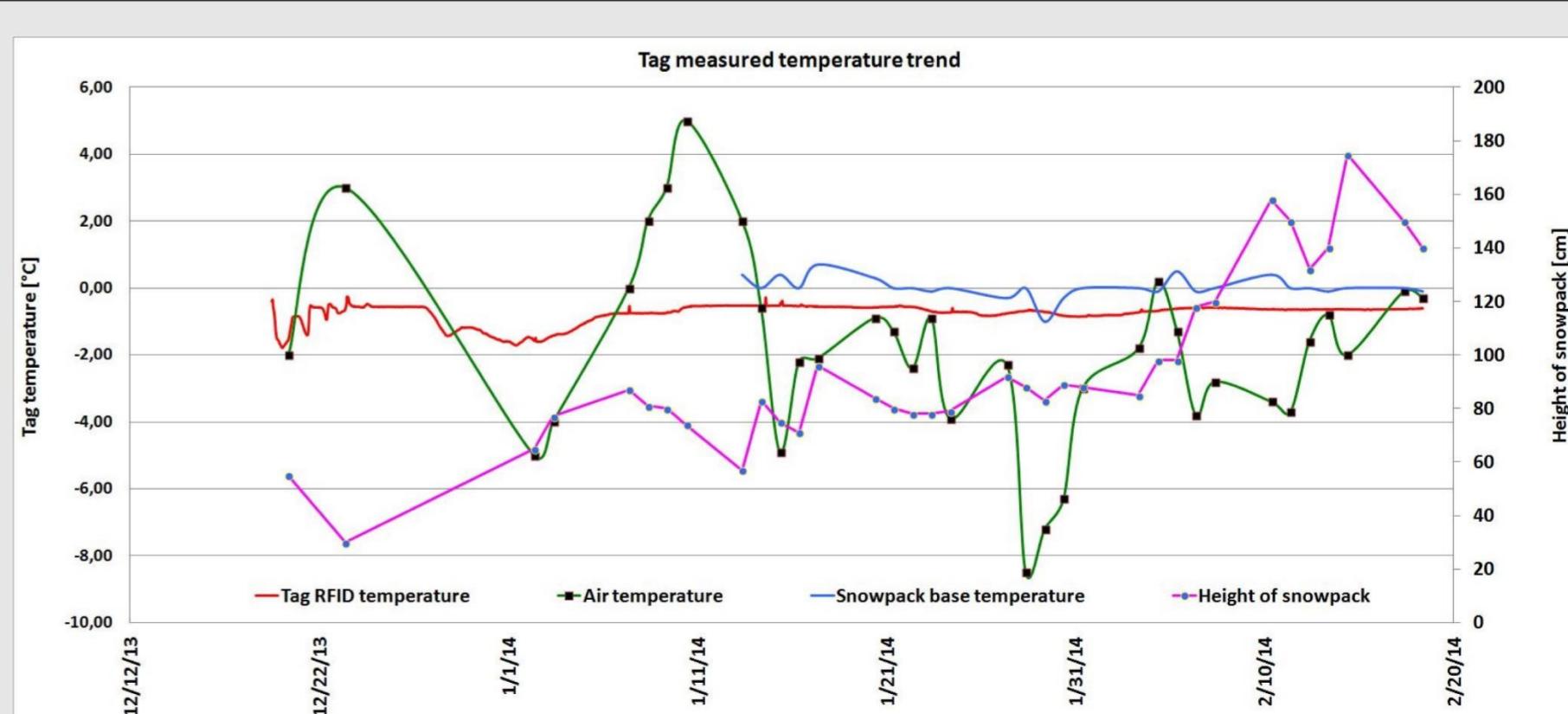


Temperature at the base of snowpack has a trend similar to air temperature until the thickness of snowpack is lower than 60 cm. When the cover increase, the temperature is stable and equal to about 0,6°C, according to manual measurements.

REF N. 1: O. Rorato et. al. , *An ad-hoc RFID tag for glaciers monitoring*, IEEE APWC 2014, Palm Beach, Aruba, 3 – 9 August 2014, pp. 864-867
REF N. 2: C. Lucianaz et. al., *RFID technology applied to glacial environment: MALATRA electronic system design and experimental data*, International Symposium on Contribution of Glaciers and Ice Sheets to Sea Level Change, Chamonix (FRA), 26-30 May 2014