

# Active layer and borehole temperatures from La Foppa rock glaciers, Val Vallaccia, Central Italian Alps, Version 1

---

## USER GUIDE

### How to Cite These Data

As a condition of using these data, you must include a citation:

Please contact the data provider for the correct Data Citation for this data set.

FOR QUESTIONS ABOUT THESE DATA, CONTACT [NSIDC@NSIDC.ORG](mailto:NSIDC@NSIDC.ORG)

FOR CURRENT INFORMATION, VISIT <https://nsidc.org/data/GGD294>



National Snow and Ice Data Center

## TABLE OF CONTENTS

1	DATA DESCRIPTION.....	2
1.1	Site Visit Description and Other Information .....	2
1.2	Borehole Characteristics .....	2
1.3	Characteristics of Data Storage System .....	3
1.4	Sample File.....	3
1.5	GGD Site Data Value.....	3
1.5.1	General Characteristics of La Foppa Site.....	3
1.5.2	Characteristics of La Foppa 1 Borehole .....	4
1.6	Characteristics of La Foppa 2 Borehole.....	6
1.7	Characteristics of La Foppa 3 Borehole.....	7
2	REFERENCES .....	8
3	DOCUMENT INFORMATION.....	9
3.1	Please cite these data from the CAPS Version 1.0 CD-ROM as follows: .....	9
3.2	Publication Date.....	10
3.3	Date Last Updated .....	10

# 1 DATA DESCRIPTION

## 1.1 Site Visit Description and Other Information

---

The La Foppa site is a glacial cirque located in the upper part of the Val Vallaccia, near Livigno, in the Italian Central Alps. The La Foppa cirque is characterized by five rock glaciers, of which four are active and one is of uncertain activity or is inactive. These rock glaciers, especially the two largest, named La Foppa I and La Foppa II, have been the subject of geophysical investigations (Lozej and Guglielmin, 1992; Guglielmin et al., 1994; Guglielmin 1997) including BTS measurements (bottom temperature of snow; more than 70 measurements between 1990 and 1993) and STG measurements (shallow temperature of ground in summer) (Calderoni et al. 1993; Guglielmin and Tellini 1992, 1994; Guglielmin 1997). The distribution of BTS and STG measurements indicate that above 2800 a.s.l. the permafrost is continuous whereas below this elevation it is constrained inside the rock glaciers, where it is not continuous.

Three boreholes have been established. One is in the frontal part of La Foppa I where the BTS values are always lower than -3 degrees C, and where the active layer detected with V.E.S. (vertical electrical soundings) ranges from 0.8 to 2.7 meters. The second borehole is in the central part of La Foppa I, where the BTS values range between -0.5 and -2.1 degrees C, and the V.E.S. indicate an active layer of 3 - 5.5 meters thick. The third borehole is located on the moraine ridge (of Late Glacial age) at 10 meters of the lateral slope of La Foppa I that overlaps the moraine ridge. Here the BTS values and V.E.S. point out the absence of permafrost. Near the third borehole there is a meteorological station that measures air temperature at 4 meters above the ground, snow cover, snow temperature every 20 cm up to 420 cm, precipitation, wind speed and direction, atmospheric pressure, relative humidity, and soil temperature at 2 and 30 cm depth. Borehole data are recorded on data loggers. A sample of the data is presented on the CAPS Version 1.0 CD-ROM; in this file, data values must be divided by 10 to obtain the correct value.

## 1.2 Borehole Characteristics

---

All three boreholes were drilled in the summer of 1993 (July) and have been equipped with the same thermistors chain (made by CAE, Bologna) with 5 thermistors located at depths of 2, 30, 50, 150, and 300 cm.

The thermistors (model TM01S) used have an operating temperature range of -30 to +80 degrees C and have an accuracy of 0.4 degree C and a resolution of 0.02 degree C. The sensors are connected to a data logger (model SP200, made by CAE, Bologna) with a nonvolatile EPROM memory of 128 Kbyte. The measurements are recorded every 30' at the depth of 2 cm, every hour at 30 and 50 cm and every 3 hours at 150 and 300 cm. In the location of borehole 2 there is also

an albedometer and a net radiometer that records the values (measured in w/m<sup>2</sup>) every 10 minutes. All sensors started to measure on 1 October 1993.

## 1.3 Characteristics of Data Storage System

---

The data measured in each borehole are recorded through the data loggers (model SP200 made by CAE of Villanova di Castenaso, Bologna) on EPROM memory of a capacity of 128 Kb with a method "Read and Write". Every 3 months specialized operators take out the data with a suitable PC. The data are transferred in a binary format. After this the data are read through a software named "MARTE" (made by CAE), in a graphic form and corrected, and then they are stored in .SMF format that is readable by more widely-used databases.

The calibration and validation of the data carried out by Pedrini Marco and Berbenni Flavio of Centro Nivometereologico of Lombardia Regione.

## 1.4 Sample File

---

This sample file is referred to the temperature of 2 cm depth of the month of May 1996 in the borehole 1.1. The first column is the day; the second is the hour (every 30'); the third is the temperature that is recorded in degrees C x 10. So it is necessary to divide each value by 10 to obtain the exact value.

## 1.5 GGD Site Data Value

---

### 1.5.1 General Characteristics of La Foppa Site

Site no.: 1

Source of data:

The data loggers in the Boreholes are the property of: Regione Lombardia, Centro Nivometereologico Bormio, Servizio Enti Locali.

The researcher is: Guglielmin Mauro

Private Researcher at the moment works at the Servizio Geologico, Regione Lombardia, Via F.Filzi, 22, 20124 Milano; Home address Via Matteotti 22, 20035 Lissone, MI, Italy, e-mail (home) [cannone.guglielmin@galactica.it](mailto:cannone.guglielmin@galactica.it)

Data type:

Temperature log

## Site visit description

Other : Geophysical, BTS measurements and geomorphological analyses

### Location:

Latitude: 46 deg. 28 min. 36 sec. N

Longitude: 10 deg. 11min. 20 sec. E

### Elevation a.s.l.:

(m): 2670-2800 m a.s.l.

### Aspect (slope orientation):

North

### Slope angle (degree):

ranges from 2 to 42 degrees

### Landform:

Other: The site is complex from geomorphological point of view but the main data are recorded on rock glaciers (active and of uncertain activity) and morainic ridge.

### Material:

Morainal (till) partially reworked by frost action and mixed with debris.

### Texture of material:

Diamicton

### Drainage:

probably well drained on the rock glaciers and imperfectly drained on the cirque bottom

### Vegetation type:

Grassland on the moraine; tundra, alpine and un-vegetated surface on the rock glaciers

### Vegetation cover (%):

90% on the moraine and 5 % on the rock glacier

### Anthropogenically disturbed site:

No

Fire history: no fire historically recorded in this area

## 1.5.2 Characteristics of La Foppa 1 Borehole

Site no.: 1.1

Source of data:

The data loggers in the boreholes and the data are the property of: Regione Lombardia, Centro Nivometereologico Bormio, Servizio Enti Locali.. The researcher is: Guglielmin Mauro, a Private Researcher at the moment working at the Servizio Geologico, Regione Lombardia, Via F.Filzi, 22, 20124 Milano; Home address Via Matteotti 22, 20035 Lissone, MI, Italy e-mail (home) [cannone.guglielmin@galactica.it](mailto:cannone.guglielmin@galactica.it)

Data type:

Temperature log

Site visit description

Other: Geophysical, BTS measurements and geomorphological analyses

Location:

Longitude: 10 deg. 11'18"E

Latitude: 46 deg. 28'42"

Elevation a.s.l.:

(m): 2690 m a.s.l.

Aspect (slope orientation):

North

Slope angle (degree):

15 deg.

Landform:

Other: active rock glaciers.

Material:

Morainal (till) mixed with debris.

Texture of material:

Diamicton

Drainage:

Well drained

Vegetation type:

Tundra, alpine

Vegetation cover (%):

5 %

Anthropogenically disturbed site:

No

Fire history:

no fire historically recorded in this area

## 1.6 Characteristics of La Foppa 2 Borehole

---

Site no.: 1.2

Source of data:

The data loggers in the boreholes, and the resulting data, are the property of: Regione Lombardia, Centro Nivometereologico Bormio, Servizio Enti Locali. The researcher is: Guglielmin Mauro, a Private Researcher at the moment working at the Servizio Geologico, Regione Lombardia, Via F.Filzi, 22, 20124 Milano; Home address Via Matteotti 22, 20035 Lissone, MI, Italy e-mail (home) [cannone.guglielmin@galactica.it](mailto:cannone.guglielmin@galactica.it)

Data type:

Temperature log

Site visit description

Other: Geophysical, BTS measurements and geomorphological analyses

Location:

Longitude: 10 deg. 11'20"E

Latitude: 46 deg. 28'36"

Elevation a.s.l.:

(m): 2725 m a.s.l.

Aspect (slope orientation):

North

Slope angle (degree):

10 deg.

Landform:

Other: active rock glaciers.

Material:

Morainal (till) mixed with debris.

Texture of material:

Diamicton

Drainage:

Well drained

Vegetation type:

Tundra, alpine

Vegetation cover (%):

5 %

Anthropogenically disturbed site:

No

Fire history:

no fire historically recorded in this area

## 1.7 Characteristics of La Foppa 3 Borehole

---

Site no.: 1.3

Source of data:

The data loggers in the Boreholes are the property of: Regione Lombardia, Centro Nivometereologico Bormio, Servizio Enti Locali.

The researcher is: Guglielmin Mauro

Private Researcher at the moment work at the Servizio Geologico, Regione Lombardia, Via F.Filzi, 22, 20124 Milano; Home address Via Matteotti 22, 20035 Lissone, MI, Italy e-mail (home) [cannone.guglielmin@galactica.it](mailto:cannone.guglielmin@galactica.it)

Data type: Temperature log

Site visit description

Other: Geophysical, BTS measurements and geomorphological analyses

Location:

Longitude: 10 deg. 11'15"E

Latitude: 46 deg. 28'40"N

Elevation a.s.l.:

(m): 2685 m a.s.l.



Aspect (slope orientation):

North

Slope angle (degree):

18 deg.

Landform:

Other: morainic ridge.

Material:

Morainal (till).

Texture of material:

Diamicton

Drainage:

Moderately well drained

Vegetation type:

Grassland

Vegetation cover (%):

90 %

Anthropogenically disturbed site:

No

Fire history:

no fire historically recorded in this area

## 2 REFERENCES

Cannone, N., Guglielmi, M., Smiraglia, C. (1995): Rapporti tra vegetazione e permafrost discontinuo in ambiente alpino. Val Vallaccia (Livigno, Sondrio). *Rivista Geografica Italiana*, 102, 91-111.

Guglielmi, M. (1989b): I rock glacier del Passo del Foscagno (Alta Valtellina, Sondrio). *Natura Bresciana*, 26, 35-47.

Guglielmi, M. con contributi di A. Notarpietro (1997) *Il Permafrost Alpino. Concetti, morfologia e metodi di individuazione (con tre indagini esemplificative in Alta Valtellina)*. Quaderni di Geodinamica alpina e Quaternaria, CNR, 5, 117 pp.

Guglielmin, M., Lozej, A., Tellini, C. (1994): Permafrost Distribution and Rock Glaciers in the Livigno Area (Northern Italy). *Permafrost and Periglacial Processes*, 5, 1-12.

Guglielmin, M., Tellini, C. (1992): Contributo alla conoscenza dei rock glaciers delle Alpi Italiane. I rock glaciers del Livignasco. (Alta Valtellina, Sondrio). *Riv. Geogr. It.*, 99, 395-414.

Guglielmin, M. & Tellini, C. (1993): First example of permafrost mapping with BTS in the Italian Alps (Livigno, Sondrio, Italy). *Acta Naturalia*, 29, 1/2, 39-46.

Guglielmin, M. & Tellini, C. (1994): Rilevamento del permafrost con il metodo BTS (Bottom Temperature of the Winter Snow Cover) nell'alta Valtellina (Sondrio, ITALIA).- *Geogr. Fis. Din. Quat.*, 17, 47-54

Guglielmin, M. & Tellini, C. (1995) Relazioni tra permafrost alpino e copertura nevosa: risultati preliminari (area del Foscagno, Sondrio, Italia). *Geogr. Fis. Dinam. Quat.* 18, 25-29.

Lozej, A. & Guglielmin, M. (1992): Prospezioni geoelettriche sul rock glacier de "La Foppa", Livigno, Sondrio (ITALIA), *GEAM-Boll. Ass. Min. Subalp*, XXIV, 4, dicembre, pp.373-382.

Guglielmin, M. (1997) : Periglacial Phenomena, permafrost distribution and glacial evolution in Foscagno area, Livigno (SO), Italy, In IV Intern. Conference on Geomorphology, Italy, 1997 -Guide for the excursion- Mountain permafrost and slope stability in the periglacial belt of the Alps", *Suppl. Geogr. Fis. Dinam. Quat.* 193, 195-199.

Guglielmin, M., Rossettin G. & Tellini, C. (1997) Pergélisol alpin et variations climatiques dans les Alpes Centrales (valtellina, Italie), IV Intern. Conf. On Geomorphology, Abstract, *Suppl. Geogr. Fis. Din. Quat.*, III, 1, 192, Submitted to Arctic and Alpine Research.

Guglielmin, M., Smiraglia, C. & Cannone, N. (1997) The rock glaciers of the Lombardy Alps (Italy) as indicators of mountain permafrost, IV Intern. Conf. On Geomorphology, Abstract, *Suppl. Geogr. Fis. Din. Quat.*, III, 1, 193, Submitted to Geomorphology.

### 3 DOCUMENT INFORMATION

#### 3.1 Please cite these data from the CAPS Version 1.0 CD-ROM as follows:

---

Guglielmin, M. 1998. Active layer and borehole temperatures from La Foppa rock glaciers, Val Vallaccia, Central Italian Alps. In: International Permafrost Association, Data and Information Working Group, comp. Circumpolar Active-Layer Permafrost System (CAPS), version 1.0. CD-ROM available from National Snow and Ice Data Center, [nsidc@kryos.colorado.edu](mailto:nsidc@kryos.colorado.edu). Boulder, Colorado: NSIDC, University of Colorado at Boulder.

## 3.2 Publication Date

---

January 1998

## 3.3 Date Last Updated

---

January 2021