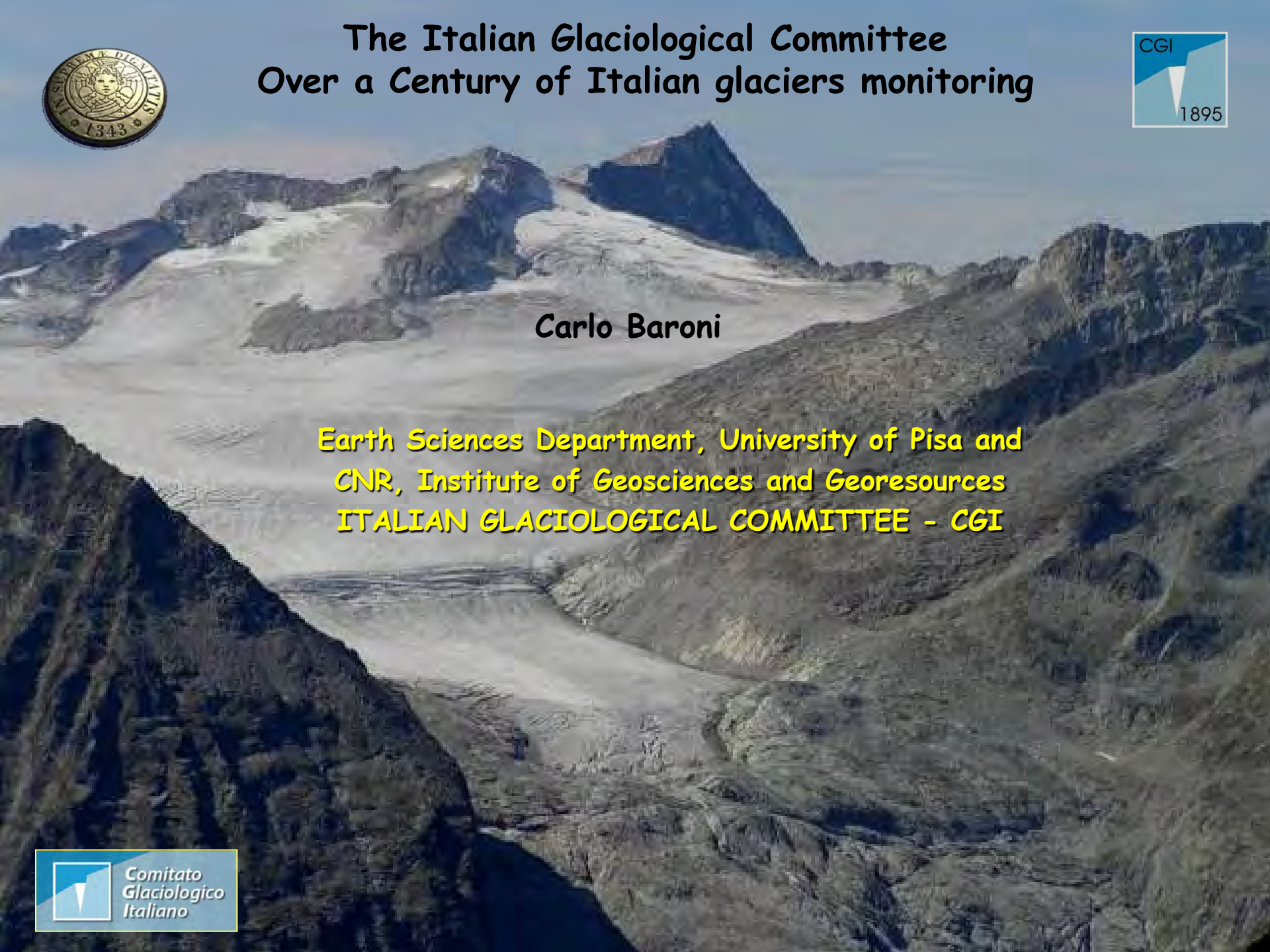
The Italian Glaciological Committee
Over a Century of Italian glaciers monitoring



Carlo Baroni

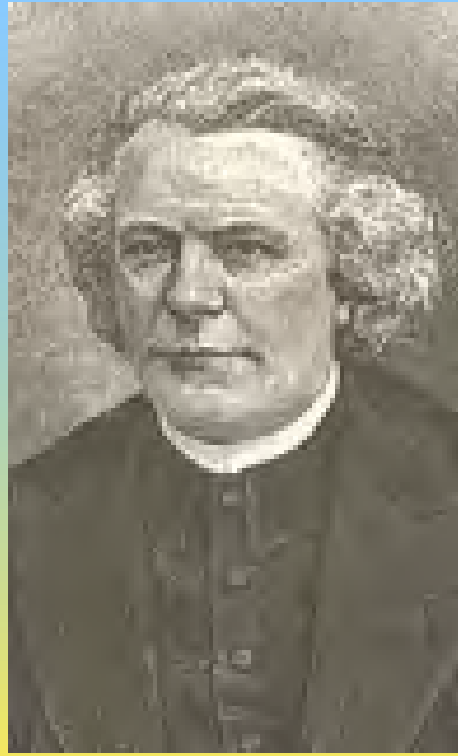
Earth Sciences Department, University of Pisa and
CNR, Institute of Geosciences and Georesources
ITALIAN GLACIOLOGICAL COMMITTEE - CGI

Comitato Glaciologico Italiano

DATAbase for reconstructing the spatial-temporal evolution of the Glacial Resource in the Italian ALPs over the last 100 years in the framework of the NextData Project (DATAGRALP)

CNR IRPI – Torino resp. Marta Chiarle
CGI – resp. Carlo Baroni

Antonio Stoppani (1824-1891)



In Stoppani's work we can find the first observations about Italian glaciers with peculiar informations about past and contemporary glacier dynamics.

Great observer and explorer, multi-disciplinary researcher, Stoppani is considered the 'Father' of Italian Geology which was superbly explained in his greater work on natural sciences "Il Bel Paese" (*The Beautiful Country*). (1876)

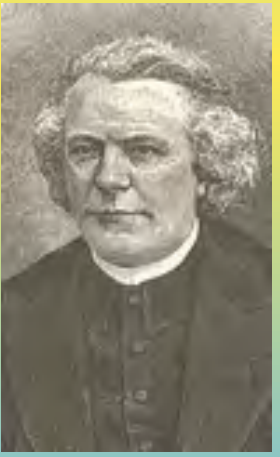
1876 - Ghiacciaio dei Forni
(A. Stoppani, Il Bel Paese)

1846 - Ghiacciaio dei Forni
(A. Stoppani, Il Bel Paese)

Stoppani made first observations about the spectacular outburst floods on two well studied italian glaciers:

Ghiacciaio dei Forni
(Ortles-Cevedale Group)

Ghiacciaio del Belvedere
(M. Rosa Group)



Ghiacciaio del Belvedere
(M. Rosa Group) 2009

The **Italian Glaciological Committee** (**CGI**) has been working in Italy since 1895, with the task of promoting and coordinating research in the field of glaciology.

In origin, the CGI was a **commission for the study of Italian glaciers** within the Italian Alpine Club (CAI);
Since 1914, it became independent organism with the support of the National Research Council (CNR) and of other organizations and agencies interested in glaciological research

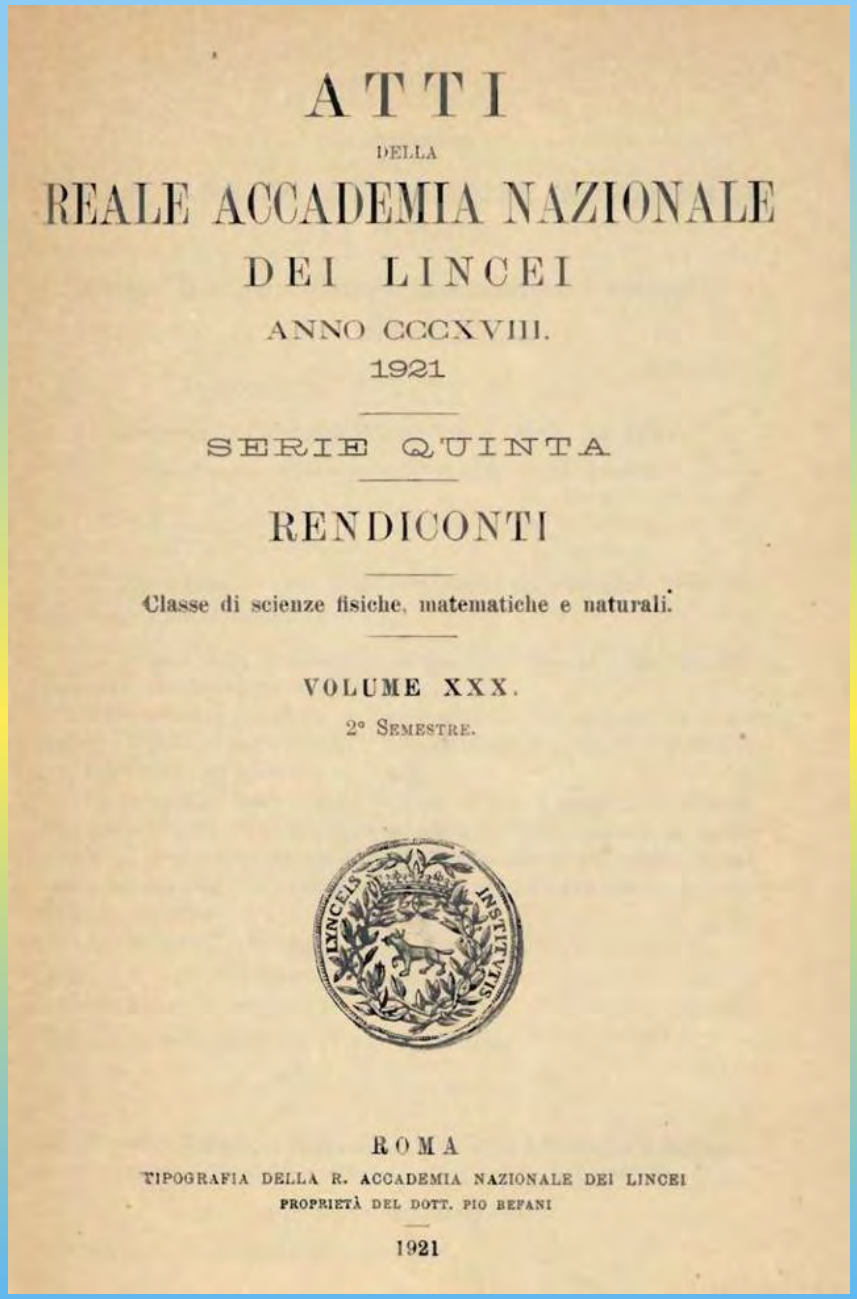
Carlo Somigliana (1860-1955)

First President of the Italian Glaciological Committee (1910-1953) after having been President of the **Italian Glaciological Commission**.

Great Physicist and Mathematician **Carlo Somigliana** was also an expert mountaineer.

His passion for the mountains and his understanding of the physics were greatly combined when he derived a simple relationship to obtain

ice-thickness estimates and bedrock morphologies from surface velocity data



ATTI

DELLA

REALE ACCADEMIA NAZIONALE

DEI LINCEI

ANNO CCCXVIII.

1921

SERIE QUINTA

RENDICONTI

Classe di scienze fisiche, matematiche e naturali.

VOLUME XXX.

2° Semestre.

ROMA

TIPOGRAFIA DELLA R. ACCADEMIA NAZIONALE DEI LINCEI

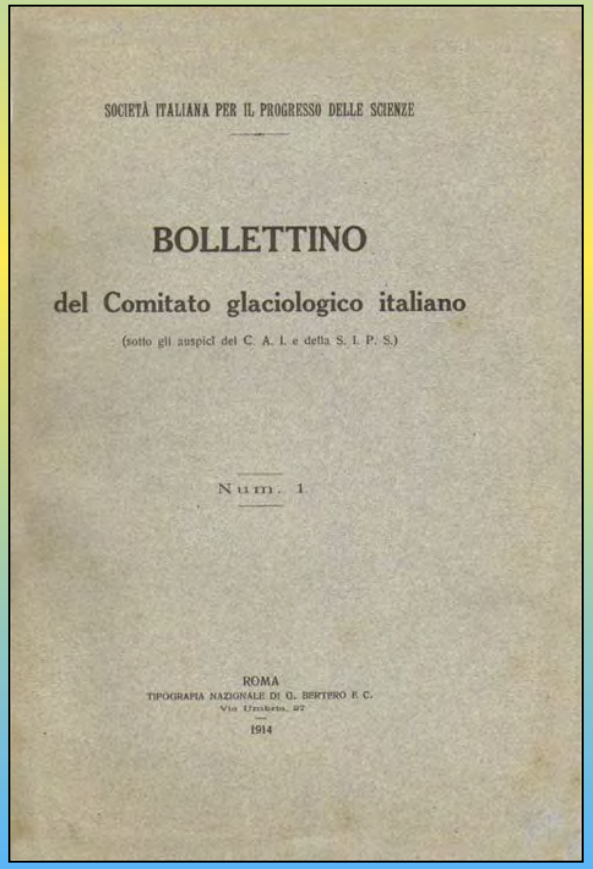
PROPRIETÀ DEL DOTT. PIO BEFANI

1921

Great leader of glaciological research in Italy, in 1914 Carlo Somigliana started the publication of the Bollettino del Comitato Glaciologico Italiano.

A simple and well defined program:

… "collect through scientific methodology the larger amount of observations about glacier physics, hydrology and morphology of our Alps."


SOCIETÀ ITALIANA PER IL PROGRESSO DELLE SCIENZE

BOLLETTINO

del Comitato glaciologico italiano

(sotto gli auspici del C. A. I. e della S. I. P. S.)

Num. 1

ROMA
TIPOGRAFIA NAZIONALE DI G. BERTERO E C.
Via Umbria, 27
1914


SOCIETÀ ITALIANA PER IL PROGRESSO DELLE SCIENZE

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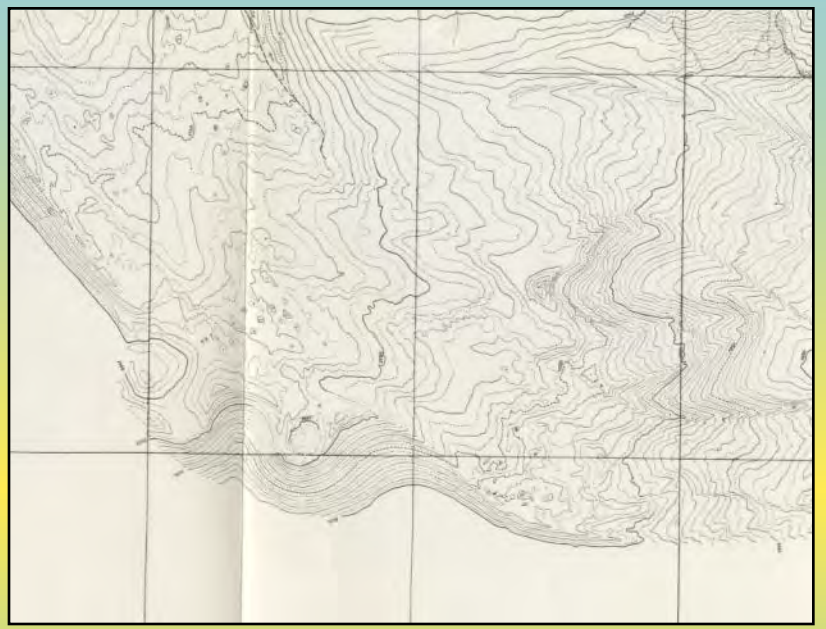
Num. 1

ROMA
TIPOGRAFIA NAZIONALE DI G. BERTERO E C
Via Umbria, 27
1914

…. Quantitative analysis

Station G - Base GH



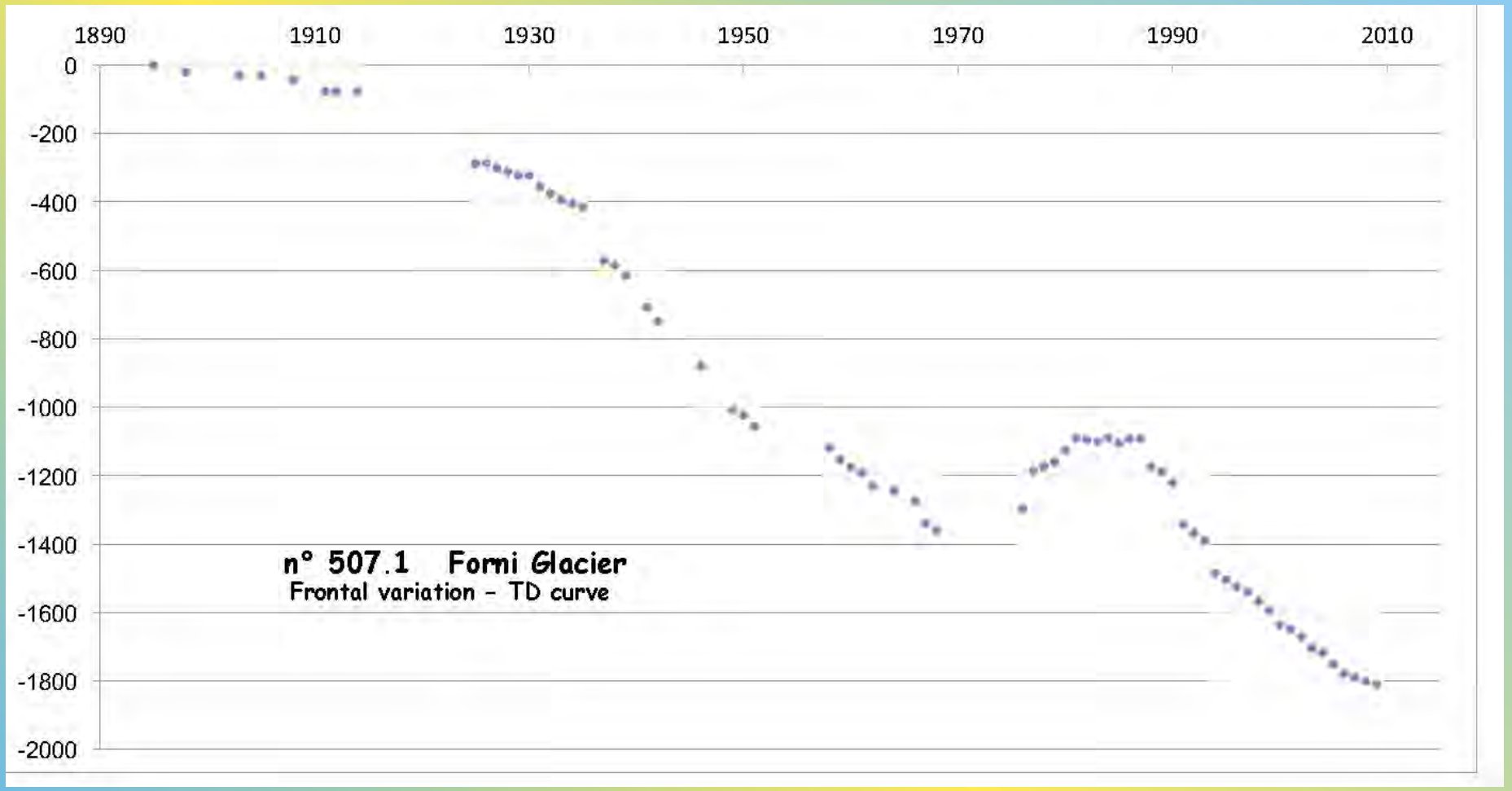
Mapping of Miage Glacier front

Miage Glacier, Mount Blanc area, survey 1913

stereogrammetric survey (Stereoautografo von Orel)

(Francesco Porro, Boll. CGI n. 1, 1914)

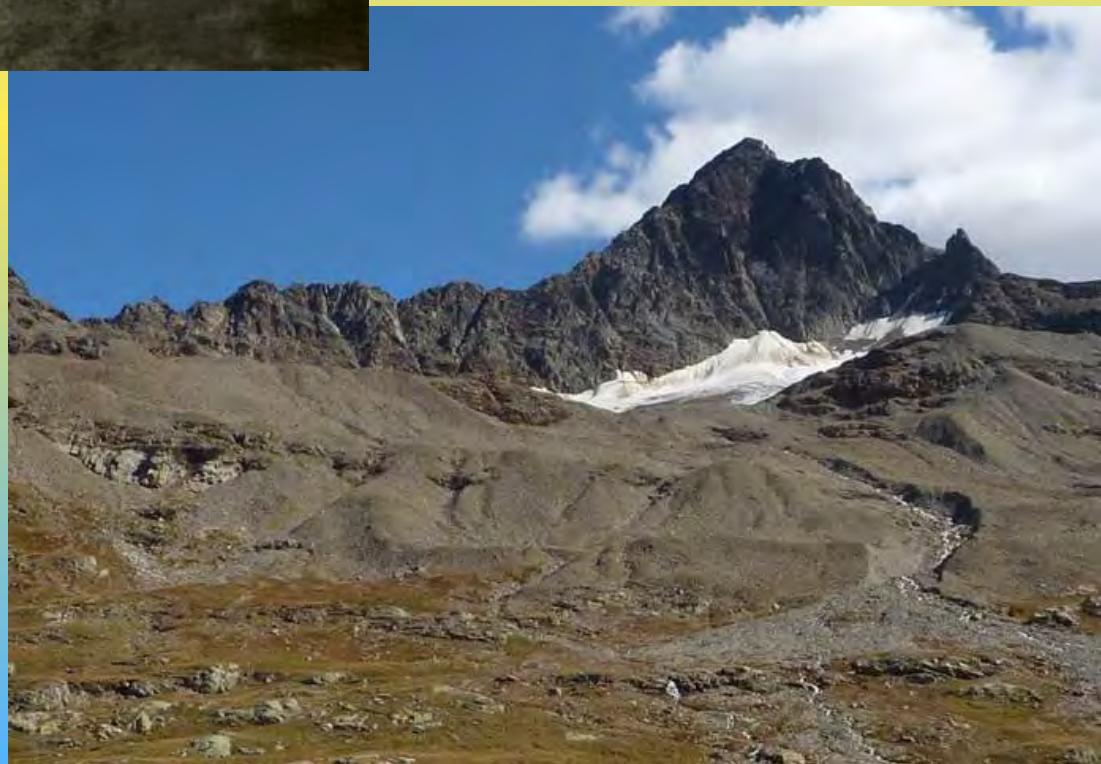
Since its origin, the CGI recognized the importance of systematic monitoring of Italian glaciers and, in particular, of measurement of frontal variations.



This activity is regularly conducted since the end of the 19th Century, supplying therefore one of the longest observations series of glaciers frontal variations in the world.

Sforzellina Gl. (Ortles-Cevedale Group)
Desio, 1943

The annual glaciological surveys allowed acquiring a large amount of data and a precious photographic documentation.

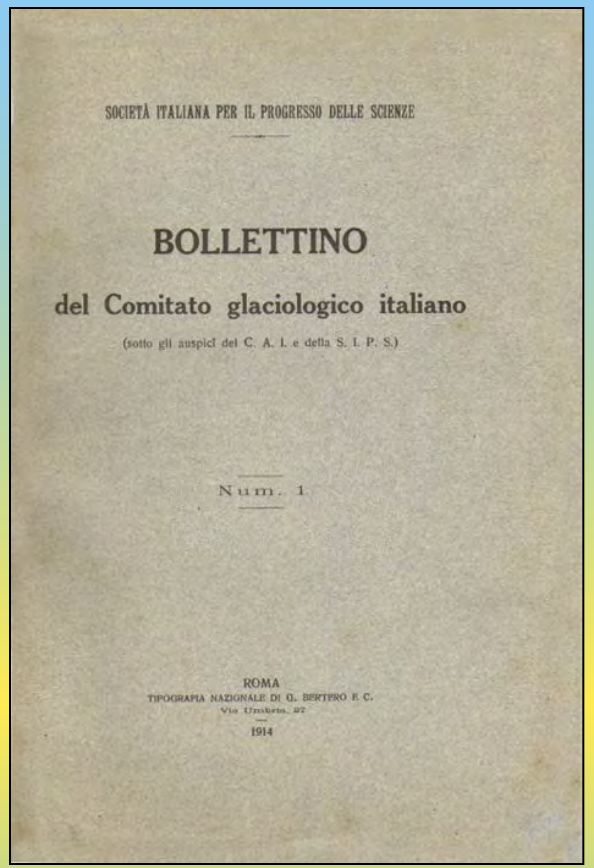


Sforzellina Gl. (Ortles-Cevedale Group)
C. Baroni, september 2011

Comitato Glaciologico Italiano

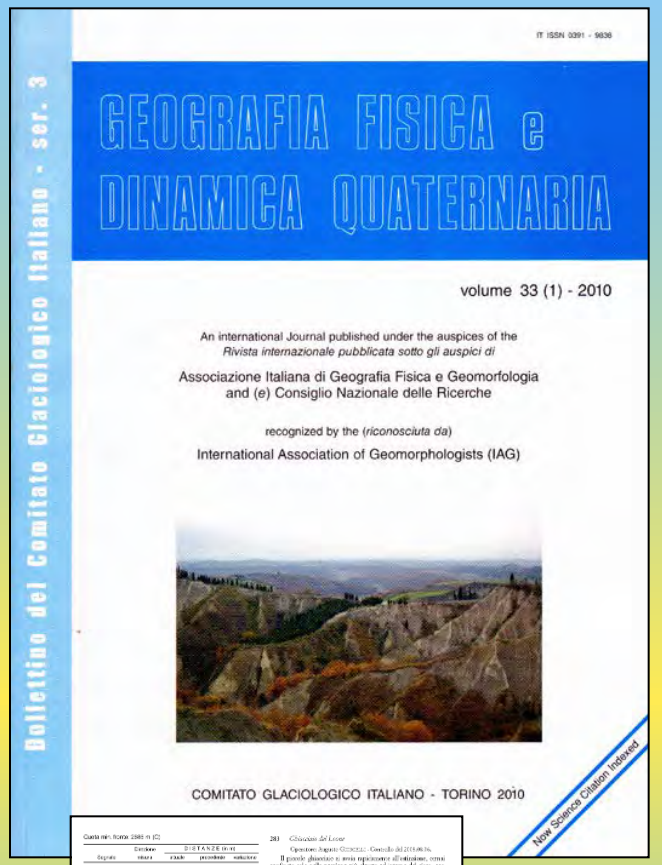
Ghiacciaio del Pizzo Varuna (Bernina)
record of its extintion (2012)

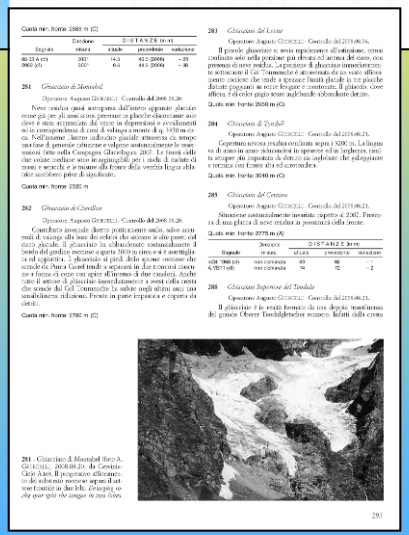
1914-1948



1950-1977

1977-2012 …

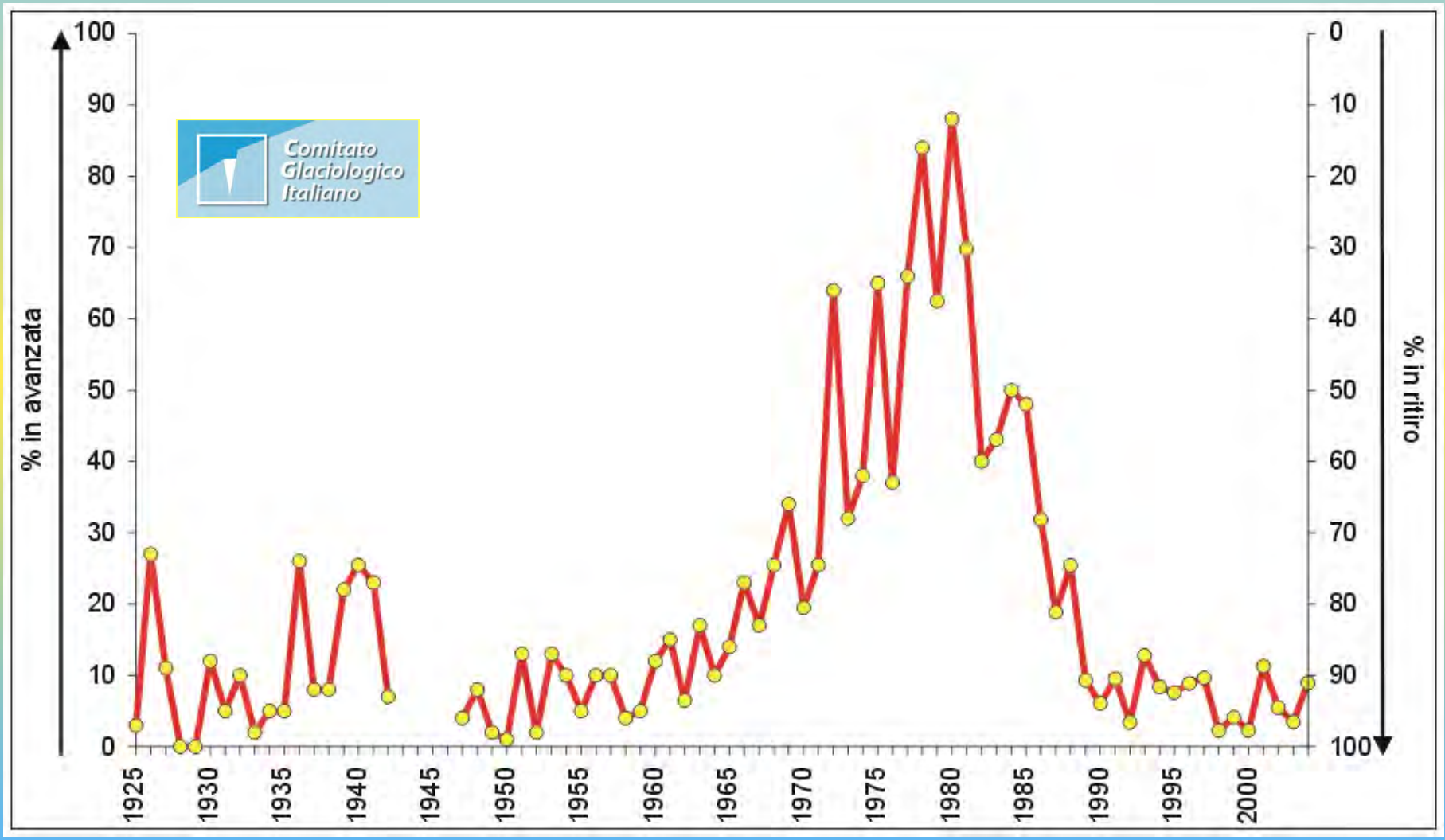




A section of the CGI Bulletin is dedicated, since 1927, to the results obtained in the framework of the annual glaciological survey (http://www.gfdq.glaciologia.it/).

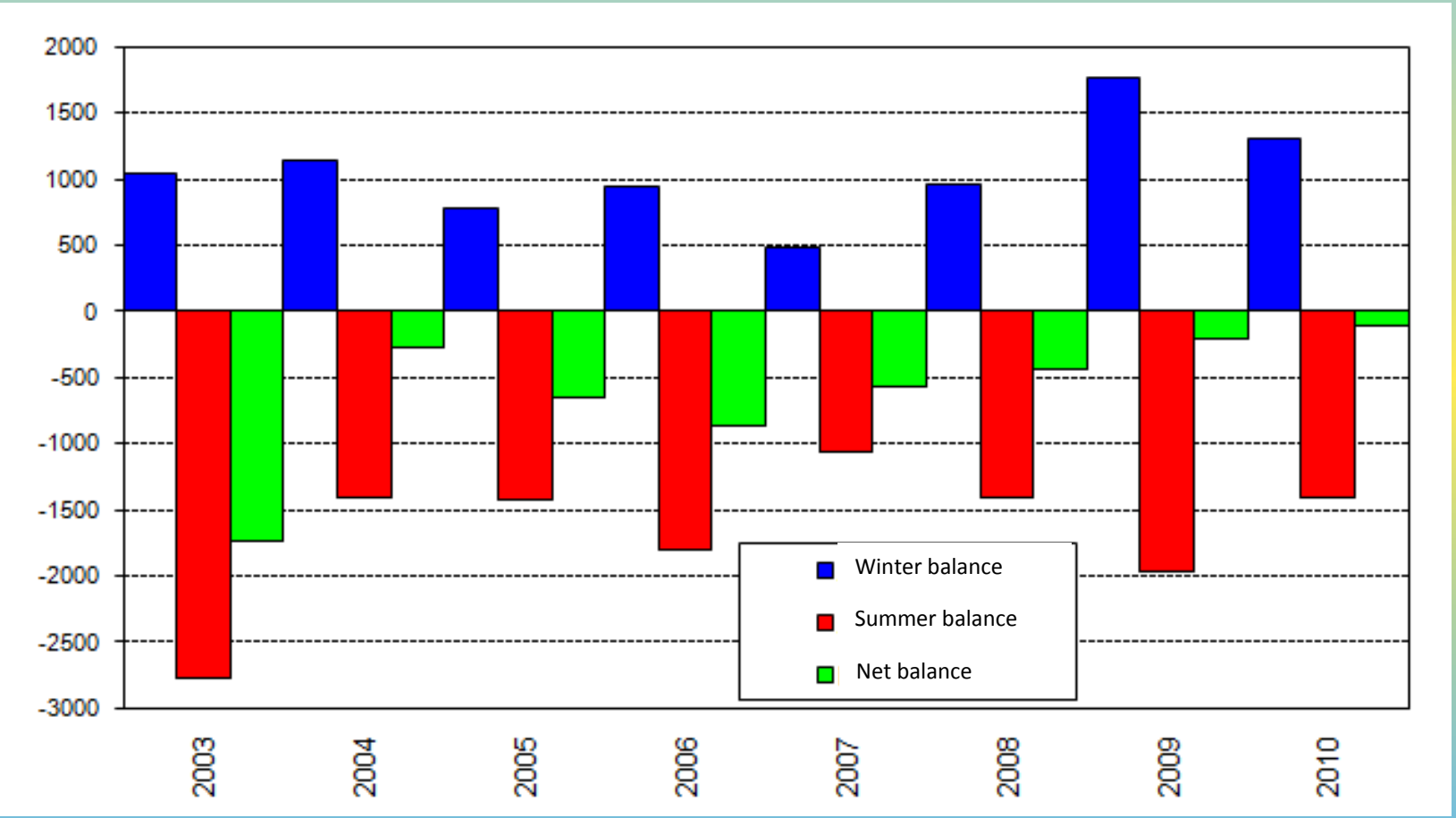
Comitato Glaciologico Italiano

At present, approximately 150 glaciers are monitored every year by voluntary surveyors, also linked to regional associations
http://www.glaciologia.it/i-ghiacciai-italiani/le-campagne-glaciologiche/?lang=en



Mass Balance - La Mare Glacier (Ortles Cevedale Group)

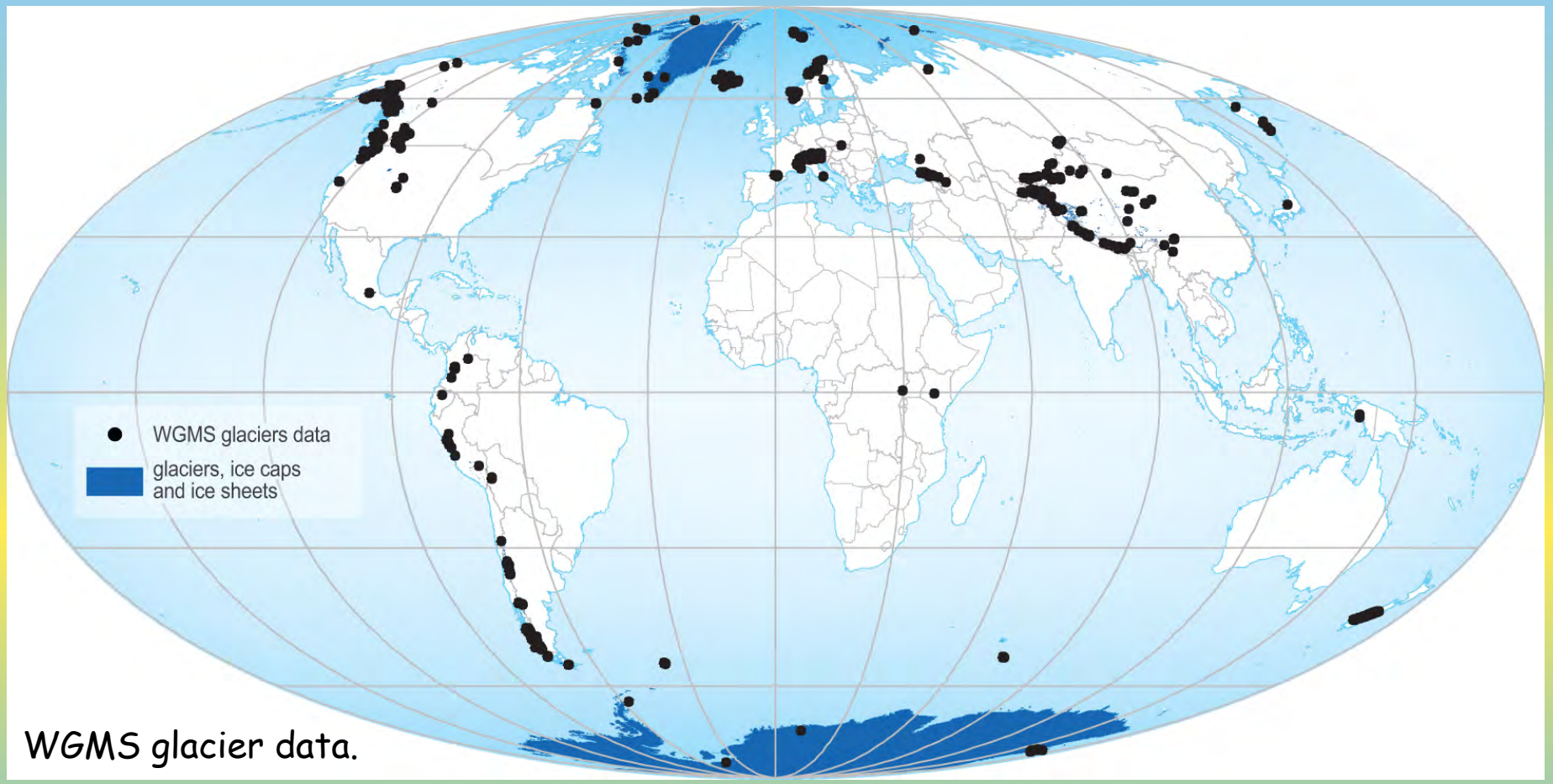
Mass balance of selected Italian glaciers is measured since 1967 (e.g. Careser Glacier). About a dozen of glaciers are presently monitored for measuring the glaciological mass balance.



Comitato Glaciologico Italiano

Data source: L. Carturan

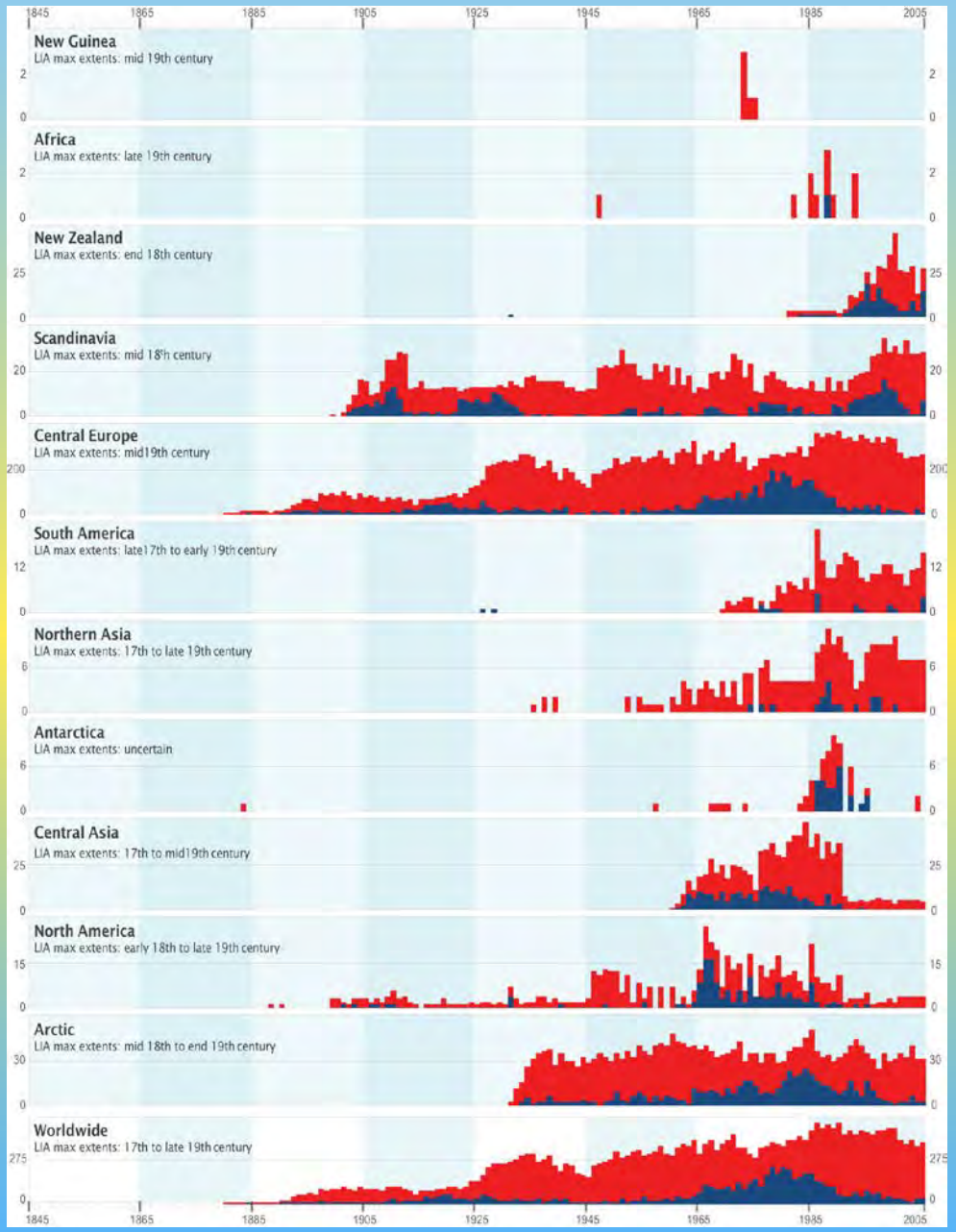
Global Glacier Changes: facts and figures



WGMS glacier data.

All the collected data related to the monitoring of frontal variations and annual mass balances measured in the Italian Alps contribute to the World Glacier Monitoring Service (WGSM) database (www.geo.uzh.ch/microsite/wgms/).

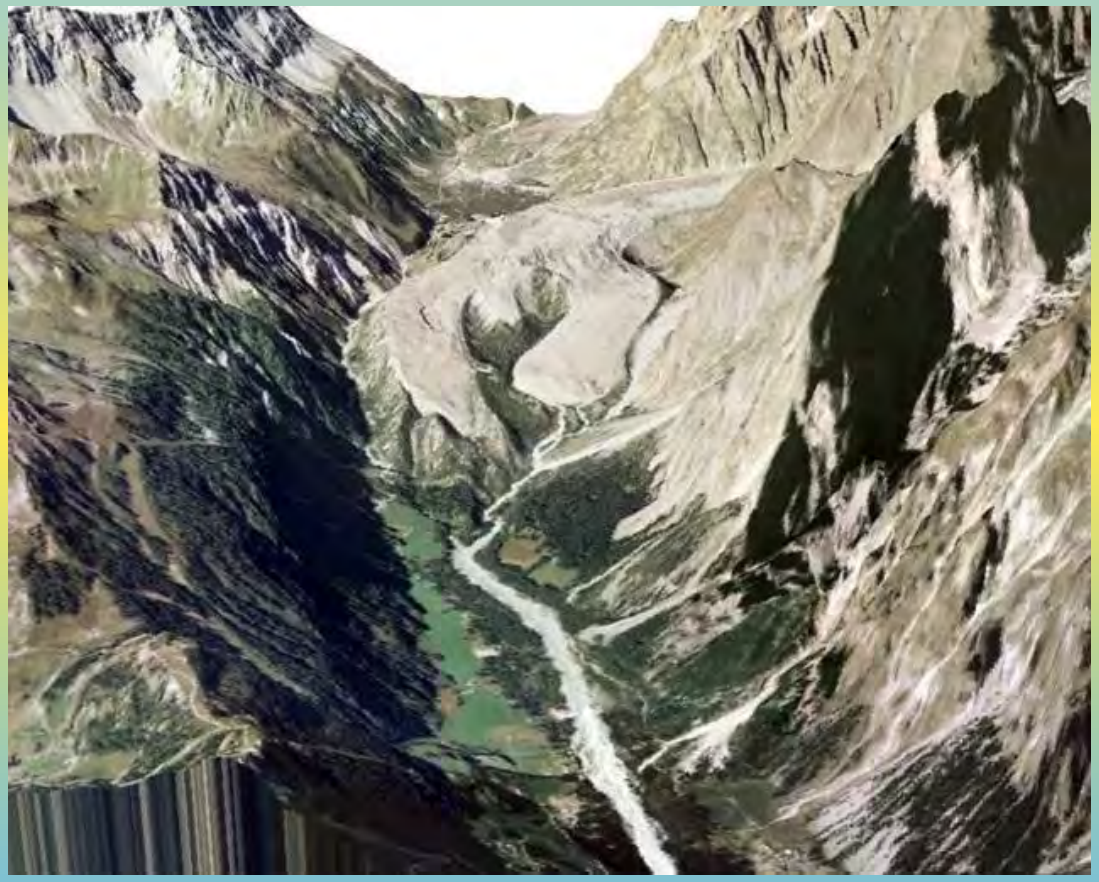
Global Glacier Changes: facts and figures



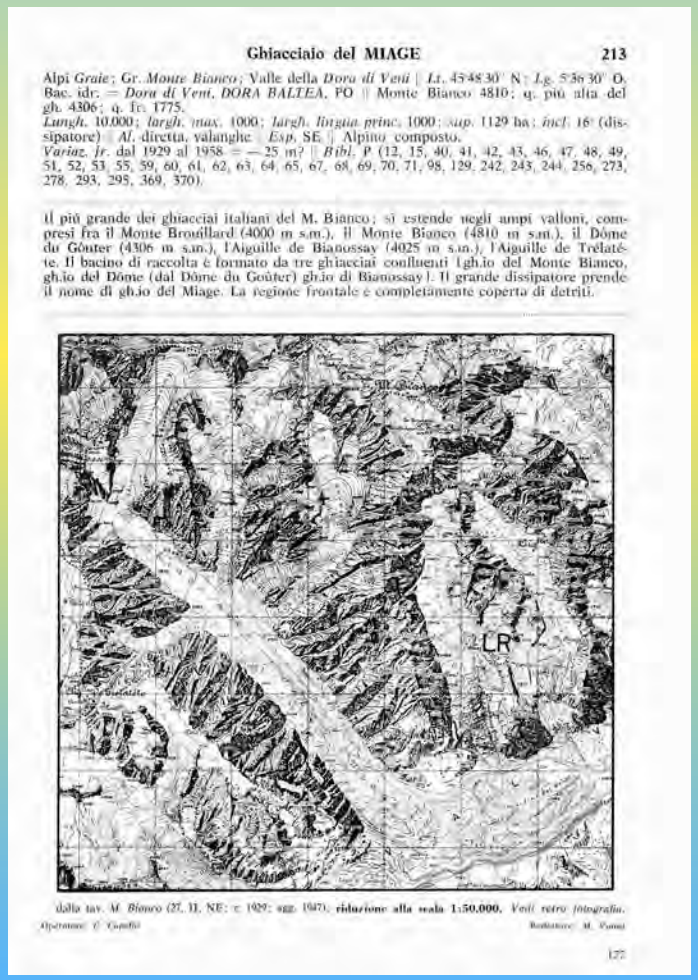
Glacier lenght changes; advancing (blue) and retreating (red) glaciers.

Glacier Inventories

Glacier inventories represent important tools, which allow the quantification of glaciers extension and volume … and their evolution



Miage Glacier (Mt. Blanc)



Ghiacciaio del MIAGE 213

Alpi *Graie*; Gr. *Monte Bianco*; Valle della *Dora di Veni* || *Lt.* 45°48'30" N; *Lg.* 5°36'30" O. Bac. idr. = *Dora di Veni, DORA BALTEA*, PO || Monte Bianco 4810; q. più alta del gh. 4306; q. fr. 1775.
Lungh. 10.000; *largh. max.* 1000; *largh. lingua princ.* 1000; *sup.* 1129 ha; *incl.* 16° (dissipatore) || *Al.* diretta, valanghe || *Esp.* SE. || Alpino composto.
Variaz. fr. dal 1929 al 1958 = — 25 m? || *Bibl.* P (12, 15, 40, 41, 42, 43, 46, 47, 48, 49, 51, 52, 53, 55, 59, 60, 61, 62, 63, 64, 65, 67, 68, 69, 70, 71, 98, 129, 242, 243, 244, 256, 273, 278, 293, 295, 369, 370).

Il più grande dei ghiacciai italiani del M. Bianco; si estende negli ampi valloni, compresi fra il Monte Brouillard (4000 m s.m.), il Monte Bianco (4810 m s.m.), il Dôme du Gôuter (4306 m s.m.), l'Aiguille de Bianossay (4025 m s.m.), l'Aiguille de Trélaté-te. Il bacino di raccolta è formato da tre ghiacciai confluenti (gh.io del Monte Bianco, gh.io del Dôme (dal Dôme du Goûter) gh.io di Bianossay). Il grande dissipatore prende il nome di gh.io del Miage. La regione frontale è completamente coperta di detriti.

dalla tav. *M. Bianco* (27, II, NE; e 1929; agg. 1947), **riduzione alla scala 1:50.000.** *Vedi retro fotografia.*

Rilevatore: M. Pansa

127

COMITATO GLACIOLOGICO ITALIANO

GENERALE CARLO PORRO E INGEGNERE PIETRO LABUS

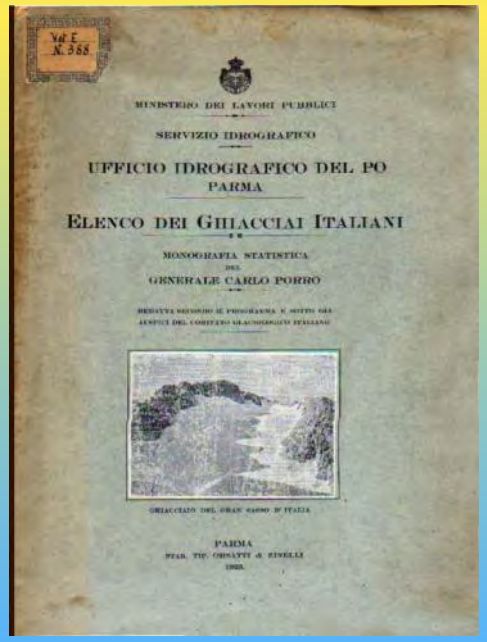
ATLANTE
DEI
GHIACCIAI ITALIANI

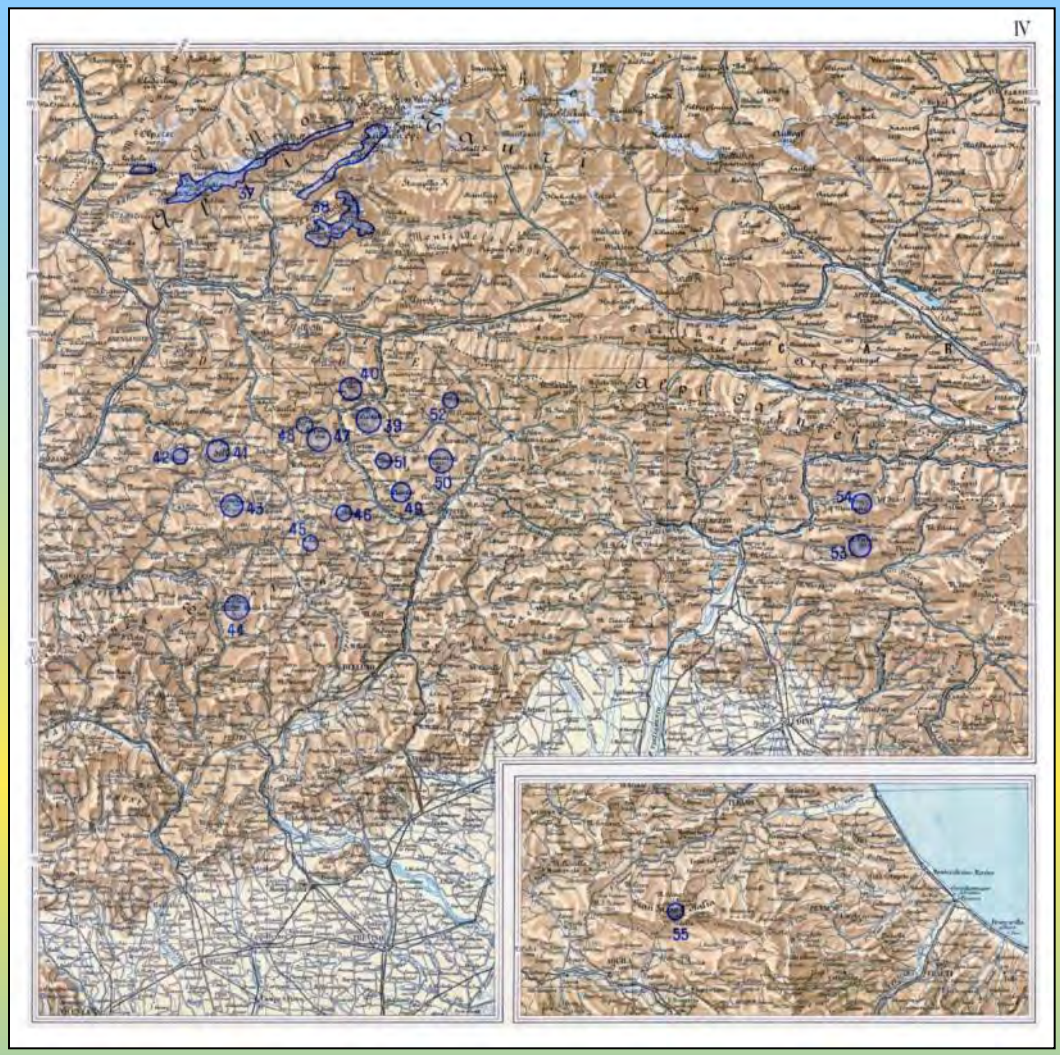
PARTE PRIMA

CARTA COROGRAFICA

SCALA 1:500.000

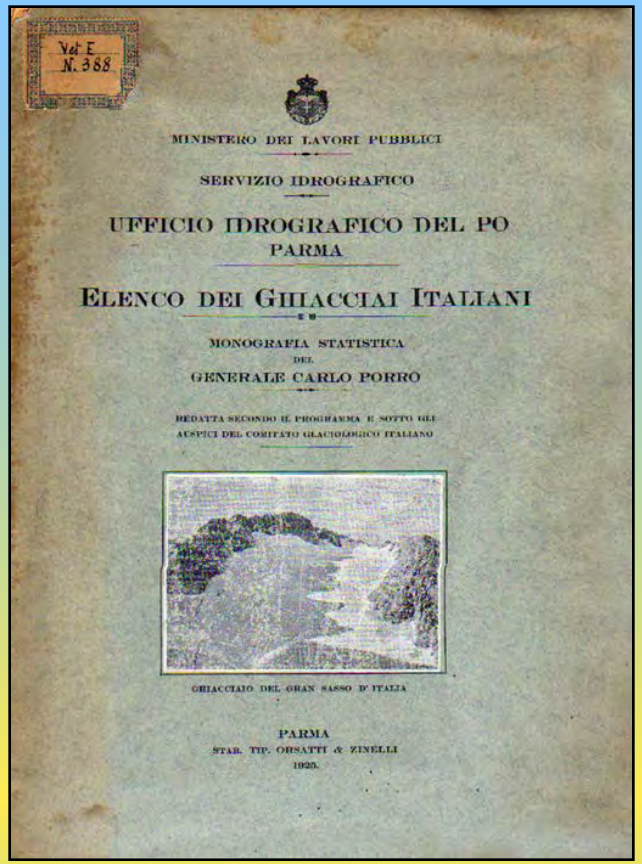
Istituto Geografico Militare -1927- Anno V.





"Porro" Inventory 1925-1927

Comitato Glaciologico Italiano

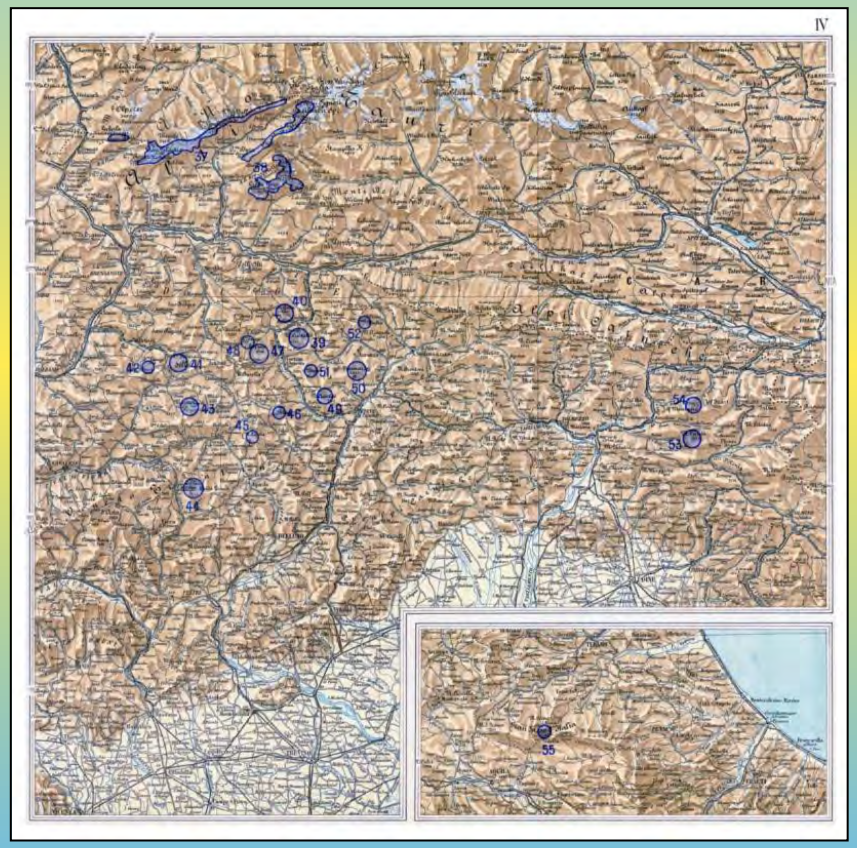


1925

"Porro" Inventory 1925-1927

774 glaciers
in 4 sheets at the scale of 1:500.000

773 Glaciers on the Alps
1 Glacier on the Apennines (Calderone)



1927

Comitato Glaciologico Italiano

Atlas of the Italian Glaciers; Porro and Labus, 1927
http://www.glaciologia.it/pubblicazioni/?lang=en

I.G.M.I

Ghiacciaio di Cresta Bianca

Gruppo — Alpi Dolomitiche

Carte topografiche d'Italiane della zona: Car. Carta Rossa

Lunghezza massima (secondo il pendio):

Larghezza massima (trasversalmente al pendio):

Area (in proiezione topografica orizzontale): ettari 10

Inclinazione media della superfice

Quota { del punto più alto m. 2900 / " " " basso m. 2700

Esposizione

Torrente di scarico

Portata di detto torrente (in litri al 1")

Data dell'osservazione 20 Settembre 1924

Y.G. W. Y

Merciai G

Ghiacciaio Adamé

Gruppo Adamello — Alpi Retiche

Carte topografiche d'Italiane della zona: I.G.M.I F. 20 III NO. M. Adamello 1:25000

Lunghezza massima (secondo il pendio): m. 1500

Larghezza massima (trasversalmente al pendio): m. 750

Area (in proiezione topografica orizzontale): ettari 120

Inclinazione media della superfice 24°

Quota { del punto più alto m. 3200 / " " " basso m. 2300

Esposizione Sud

Torrente di scarico Roia di Adamé

Portata di detto torrente (in litri al 1")

Data dell'osservazione 7 Agosto 1919 - 18 Luglio 1920

Dott. Prof. G. Merciai

On the occasion of the **International Geophysical Year in 1957-1958**, CGI surveyed a new inventory, published in four volumes (CGI-CNR, 1959; 1962). The CGI-CNR inventory includes
- 838 glaciers, which existed at the end of the 1950s;
- 190 glaciers that disappeared from the previous inventory are also reported.

In total 1028 glaciated units were documented (http://www.glaciologia.it/ghiacciai.html).

CGI-CNR 1959-1962, *Catasto dei Ghiacciai Italiani.* Comitato Glaciologico Italiano, Torino, v. 1-4


CONSIGLIO NAZIONALE DELLE RICERCHE
COMITATO GLACIOLOGICO ITALIANO

CATASTO DEI GHIACCIAI ITALIANI

ANNO GEOFISICO 1957 - 1958

VOLUME II°

GHIACCIAI DEL PIEMONTE

(con carta schematica dei ghiacciai delle Alpi Piemontesi)

TORINO
COMITATO GLACIOLOGICO ITALIANO
Palazzo Carignano
1961

1959-1962

838 Glacial bodies
at the end of the '50s of the 19th Century

745 Glaciers
93 Glacierets

+ **190** extint glaciers (in the previous 50 yrs)

Comitato Glaciologico Italiano

CGI-CNR 1959-1962, *Catasto dei Ghiacciai Italiani.* Comitato Glaciologico Italiano, Torino, v. 1-4

1959-1962

838 Glacial bodies at the end of the '50s of the 19° Century

745 Glaciers

93 Glacierets

\+ **190** extint glaciers (in the previous 50 yrs)

(for a total of 1028 entries)

covering a total extension of **494 km²**

In the volumes, glaciers of the Italian Alps are grouped in three main sectors:

- 322 glaciers are hosted in the Western Alps (Piemonte)
- 185 glaciers in Central Alps (Lombardia)
- 330 glaciers in the Eastern Alps (Tre Venezie)

Comitato Glaciologico Italiano

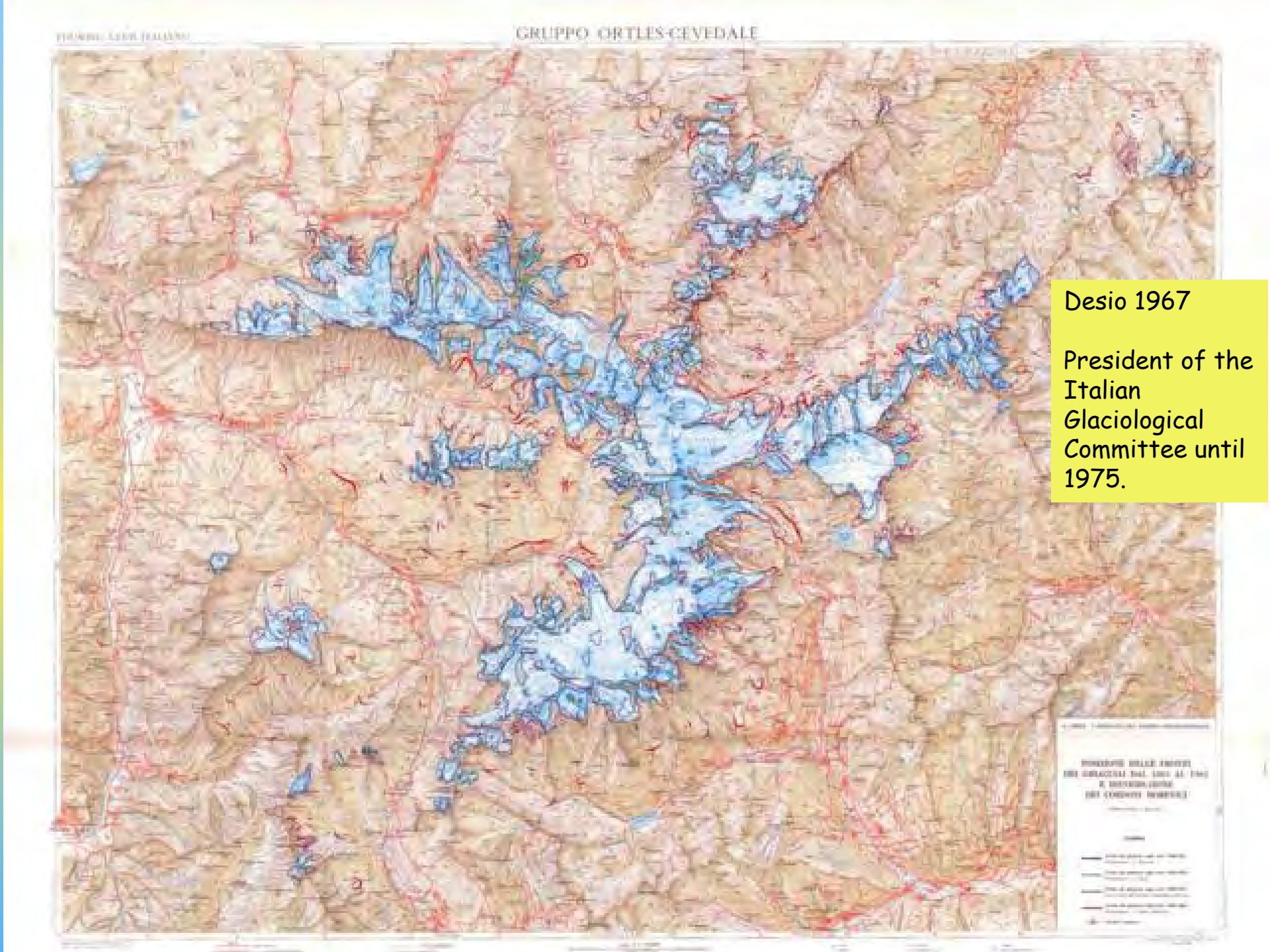

Comitato Glaciologico Italiano
Ubicazione dei ghiacciai italiani
dati tratti dal Catasto dei ghiacciai italiani CGI-CNR, 1959-1962
Location map of the italian glaciers
data from the Inventory of Italian Glaciers, CGI-CNR, 1959-1962
Mappa
Satellite
http://www.glaciologia.it/ghiacciai.html
Google
Immagini ©2011 TerraMetrics - Termini e condizioni d'uso


Comitato Glaciologico Italiano
Ubicazione dei ghiacciai italiani
dati tratti dal Catasto dei ghiacciai italiani CGI-CNR, 1959-1962
Location map of the italian glaciers
data from the Inventory of
Italian Glaciers, CGI-CNR, 1959-1962
Mappa
Satellite
Comitato Glaciologico Italiano
Occidentale del Canin
Alpi: Giulie
Gruppo: Montasio - Canin
Valle: Del Ferro
Ubicato a quota (m): 2587
Lunghezza (m): 300
Superficie (ha): 9
Consulta scheda
http://www.glaciologia.it/ghiacciai.html
Google
Immagini ©2011 TerraMetrics - Termini e condizioni d'uso

The meltwater generating from italian glaciers was also summarized:

- 534 glaciers contributed to the hydrological regime of Po River
- 255 glaciers to the Adige River and the remaining
- 48 glaciers belonged to other hydrological basins.

The southernmost Italian glacier, the Ghiacciaio del Calderone was still the only glacier in the Apennines (Gran Sasso Massif), located at the southernmost glacierization limit of Europe.



Desio 1967

President of the Italian Glaciological Committee until 1975.

World Glacier Inventory (WGI 1981-84)

Data collected by the CGI also contributed to the World Glacier Inventory (WGI 1981-84), in which are reported:

1397 glaciers of the Italian Alps, covering a total extension of **608 km²**

- 531 in Western Alps (322 in 1959-62)
- 305 in Central Alps (185 in 1959-62)
- 560 in Eastern Alps (330 in 1959-62)

world glacier monitoring service
World Glacier Inventory (WGI 1981-84) –
http://map.ngdc.noaa.gov/website/nsidc/glacier/viewer.htm

Comitato Glaciologico Italiano

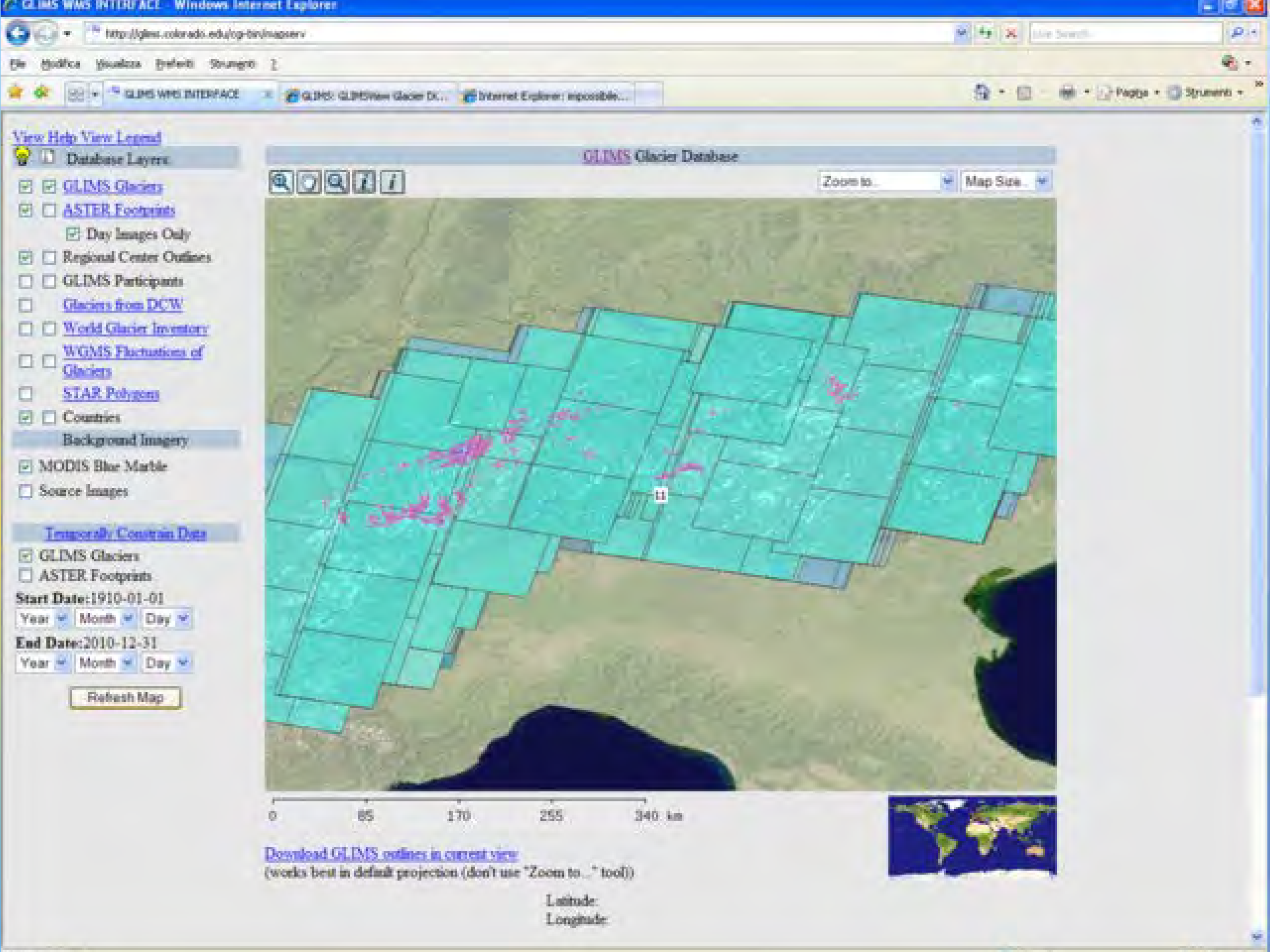
1988-1989 Glacier Inventory

The more recent updating of the Italian glaciers inventory refers to 1988-'89. Based on an aerial photogrammetrical survey conducted across the entire Italian Alps, the inventory was supported by the Italian Minister of the Environment.
This inventory considers 787 glaciers with dimensions greater than 0.05 km^2, which covered a total area of 474 km^2 (about 20% of the total extension of the glaciers in the Alps).

The comparison between the two CGI inventories evidences a reduction of the glacierized areas in the Italian Alps from 1959 and 1988-89.

The Gran Sasso Massif hosts the remnant of the last Apennine glacier, the Calderone Glacier, now reduced to little more than a debris covered glacieret.

Comitato Glaciologico Italiano

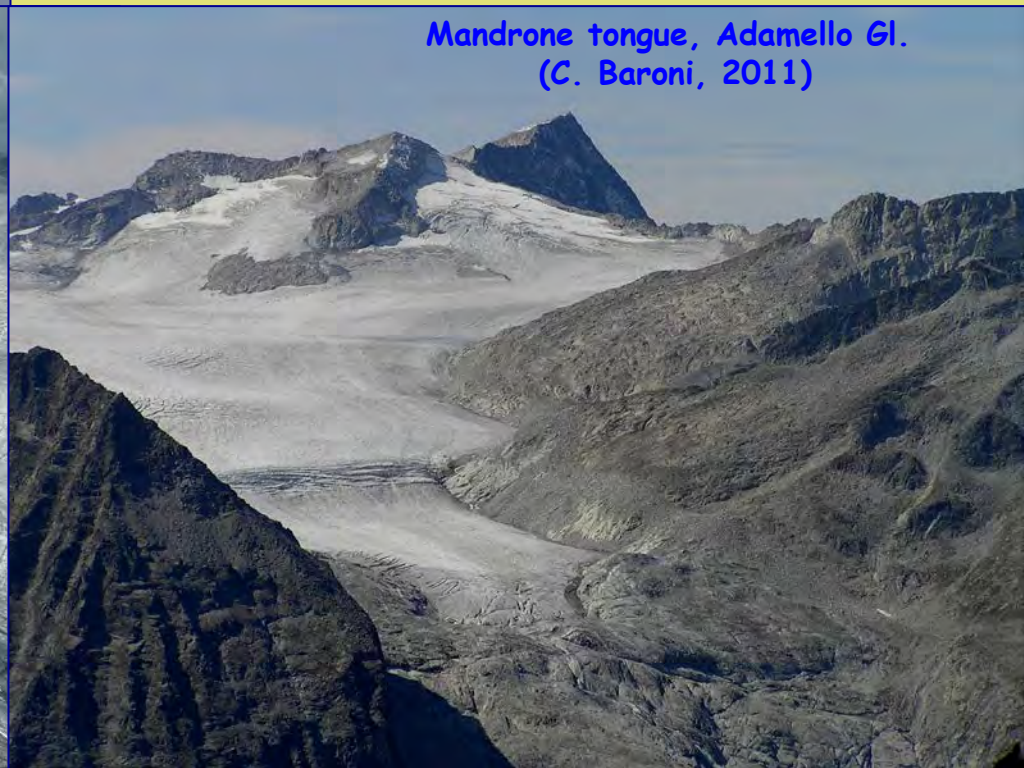

GLIMS WMS INTERFACE - Windows Internet Explorer
View Help View Legend
Database Layers
GLIMS Glaciers
ASTER Footprints
Day Images Only
Regional Center Outlines
GLIMS Participants
Glaciers from DCW
World Glacier Inventory
WGMS Fluctuations of Glaciers
STAR Polygons
Countries
Background Imagery
MODIS Blue Marble
Source Images
Temporally Constrain Data
GLIMS Glaciers
ASTER Footprints
Start Date:1910-01-01
Year Month Day
End Date:2010-12-31
Year Month Day
Refresh Map
GLIMS Glacier Database
Zoom to...
Map Size...
0 85 170 255 340 km
Download GLIMS outlines in current view
(works best in default projection (don't use "Zoom to..." tool))
Latitude:
Longitude:


(P. PAGLIARDI, SGL 08.09.2007)

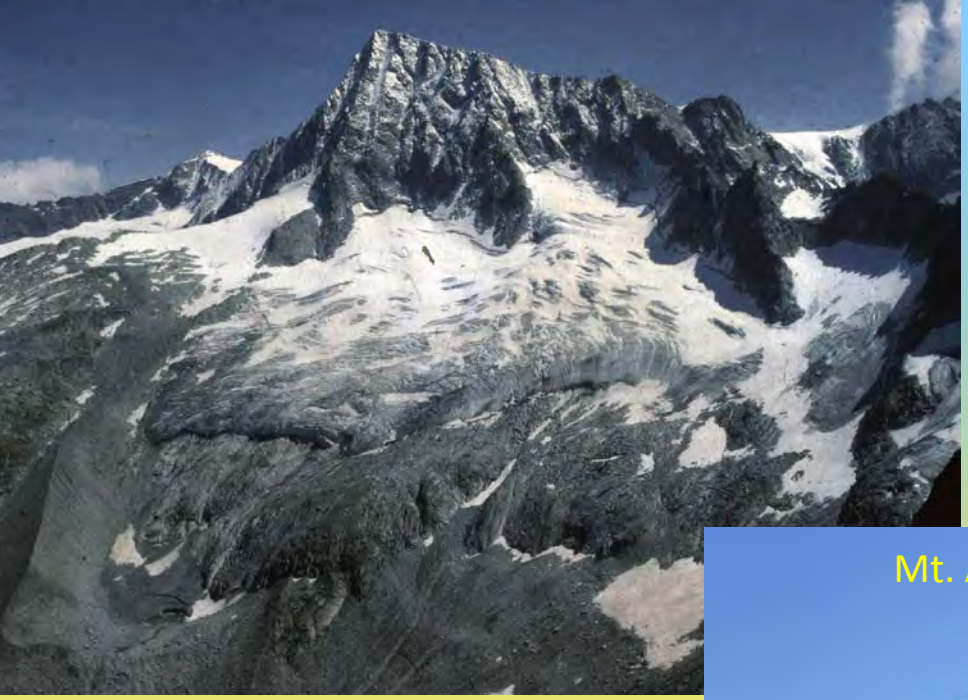
The largest glacial complex of the Italian Alps is the
Adamello Glacier
a composite summit glacier

about
18 km^2 in 1991,
16 km^2 in 2007


Pian di Neve, Adamello 1990


Mandrone tongue, Adamello Gl.
(C. Baroni, 2011)

while the larger valley glacier is the Forni Glacier in the Ortles-Cevedale Group



Avio Glacier (Adamello Group)
(August 1984)

Over 80% of the Italian glaciers, however, consists of glaciers very small in size.

Mt. Adamello (3539 m)

Comitato Glaciologico Italiano

Avio Glacier (Adamello Group)
(Bessi, SGL, 06.09.2006)

Little Ice Age (15th -19th Cent. Max ~1850)

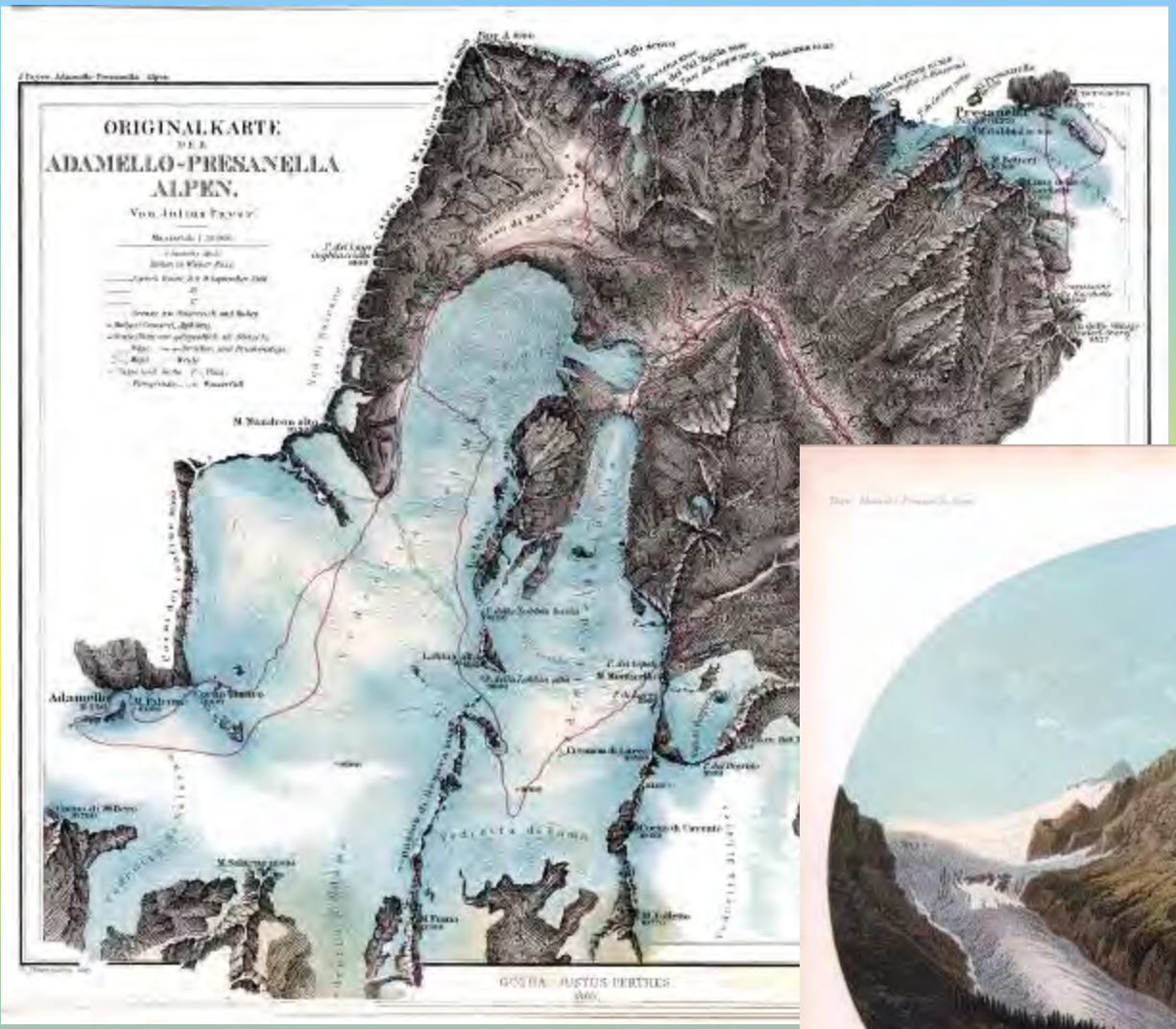
Long and bitter winters
Vigorous glacier advances

Abraham Hondius, 1684

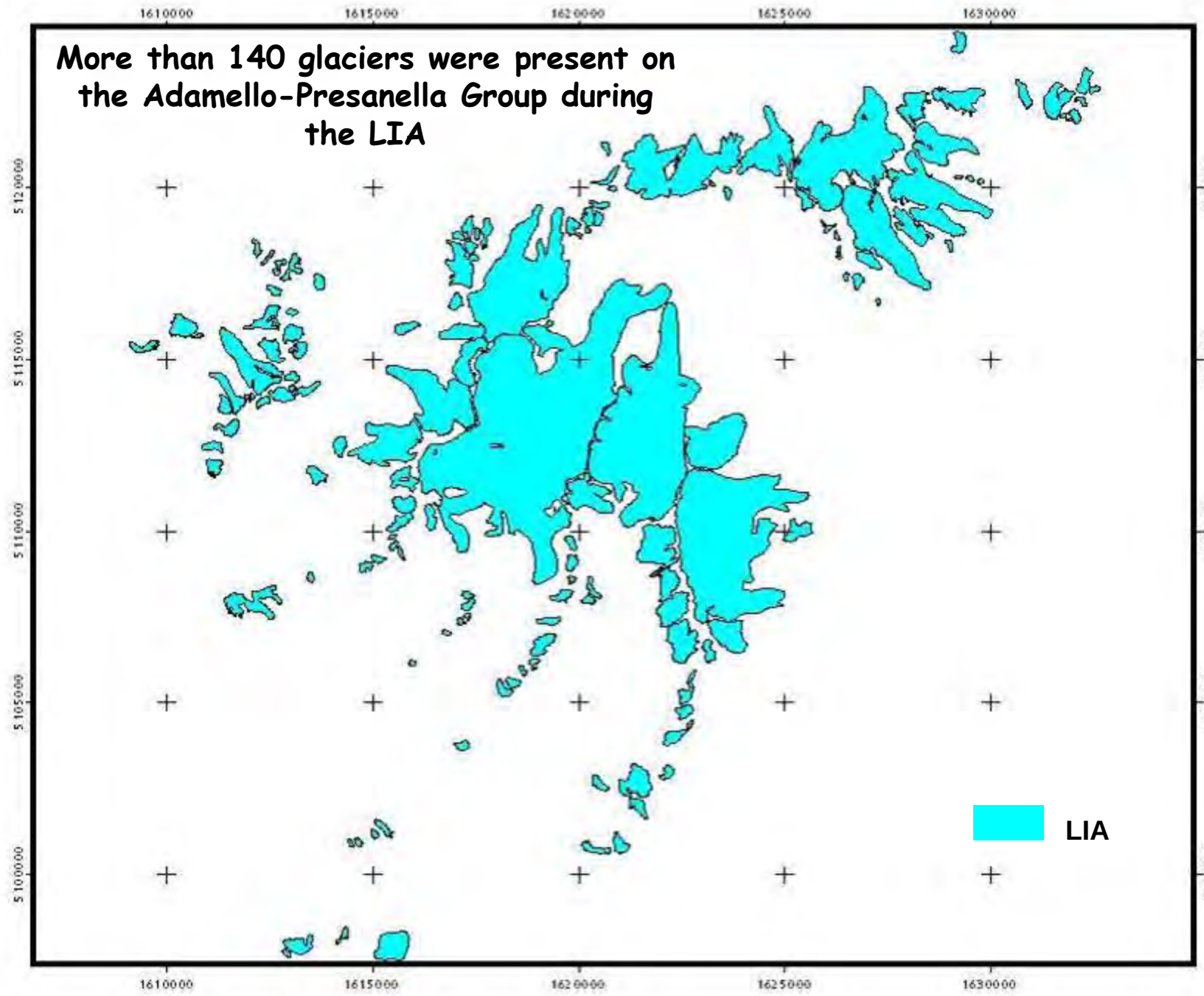
Thames at Temple Stairs (1684)

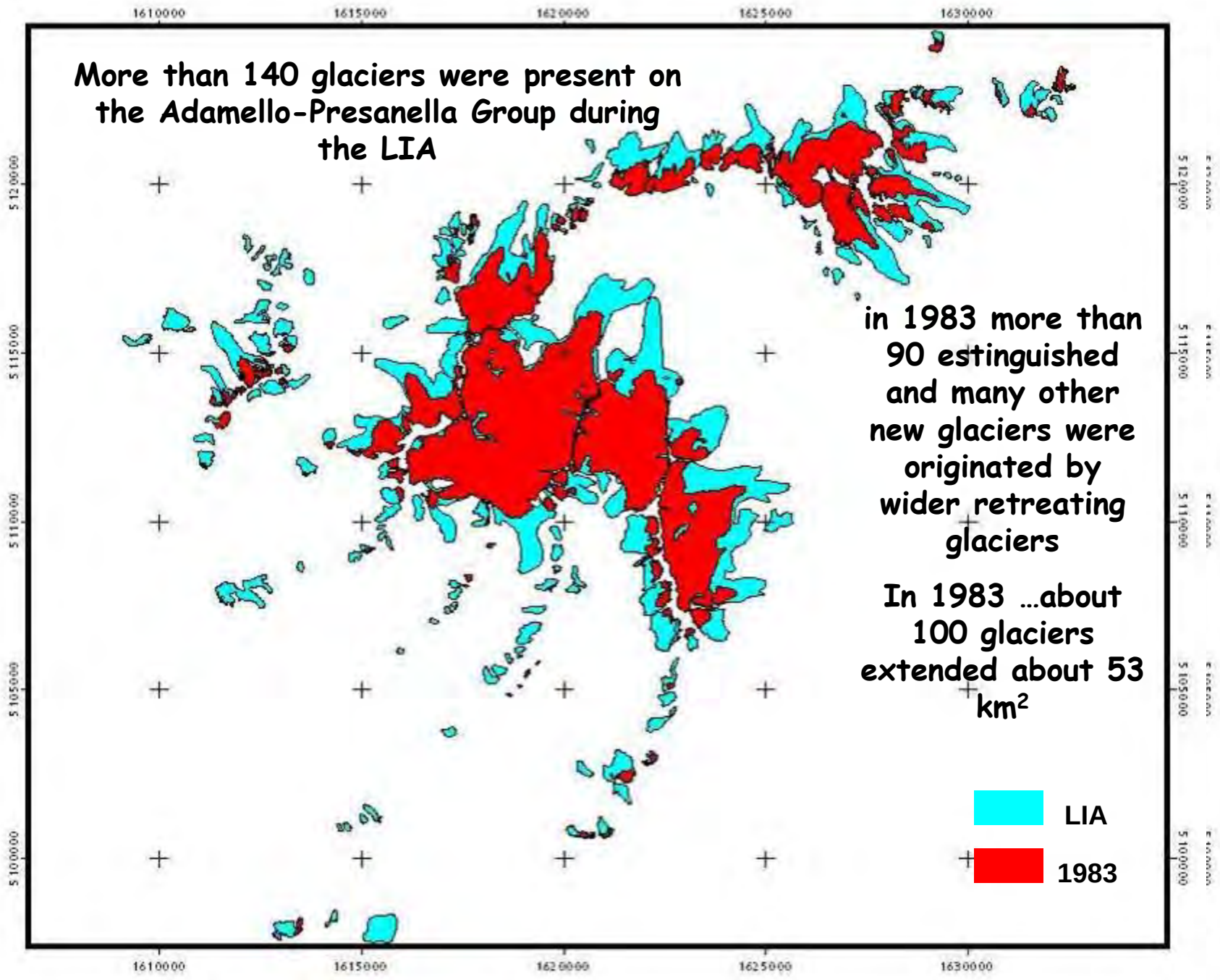
Mandrone and Lobbia Glaciers
Adamello Group (Central Alps)

Originalkarte der Adamello
Presanella Alpen (Payer J. 1865)

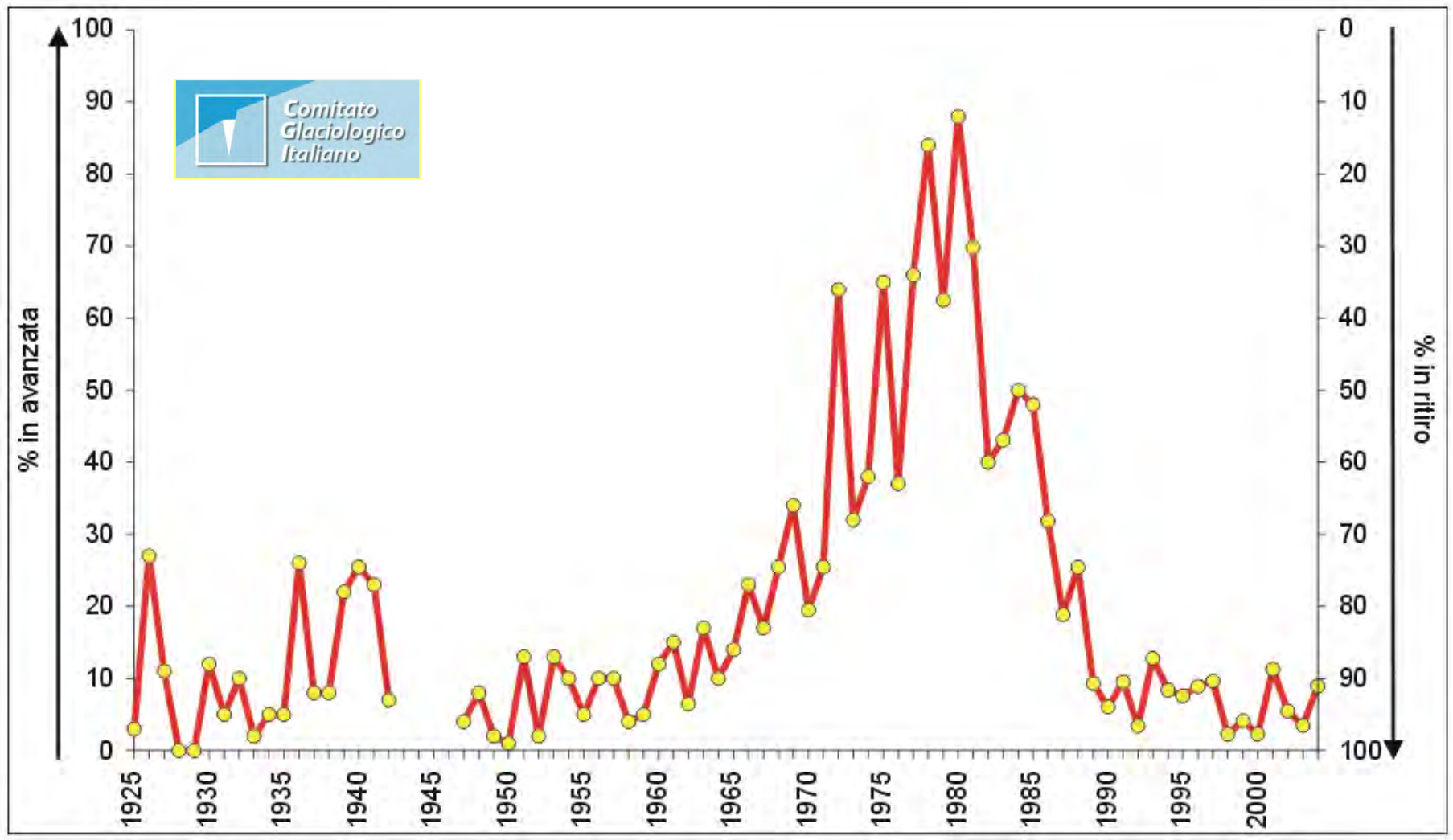


Comitato Glaciologico Italiano


More than 140 glaciers were present on the Adamello-Presanella Group during the LIA
1610000
1615000
1620000
1625000
1630000
5120000
5115000
5110000
5105000
5100000
LIA


More than 140 glaciers were present on the Adamello-Presanella Group during the LIA
in 1983 more than 90 estinguished and many other new glaciers were originated by wider retreating glaciers
In 1983 …about 100 glaciers extended about 53 km²
LIA
1983
1610000
1615000
1620000
1625000
1630000
5120000
5115000
5110000
5105000
5100000

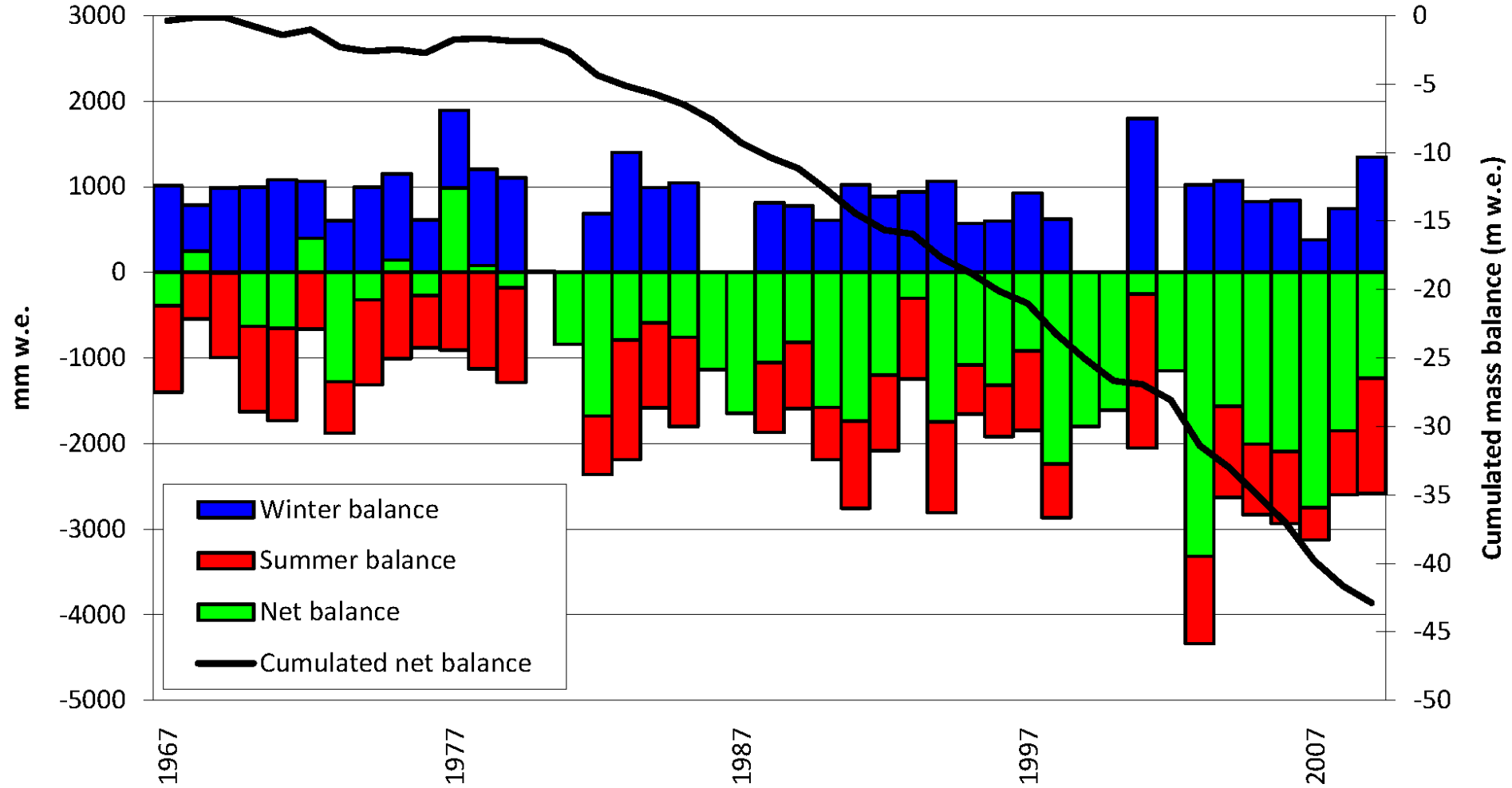
The Italian glaciers, since the end of the maximum Holocene advance (LIA) have experienced a phase of generalized retreat, accentuated in the 50s of the 20th Century, which was followed by a slight advancing stage culminated in the late '70s and early '80s. Since the '90s there was a general withdrawal of almost all the Italian glaciers.



Since the second half of the 19th Century the Italian glaciers lost more than 40% of their areal extension. The mean annual snow line rose about 100 m, as a mean.

Many of the wider glaciers subdivided originating minor glacial bodies. Several small glaciers disappeared or are presently reduced to glacierets, while many others are almost completely debris-covered.

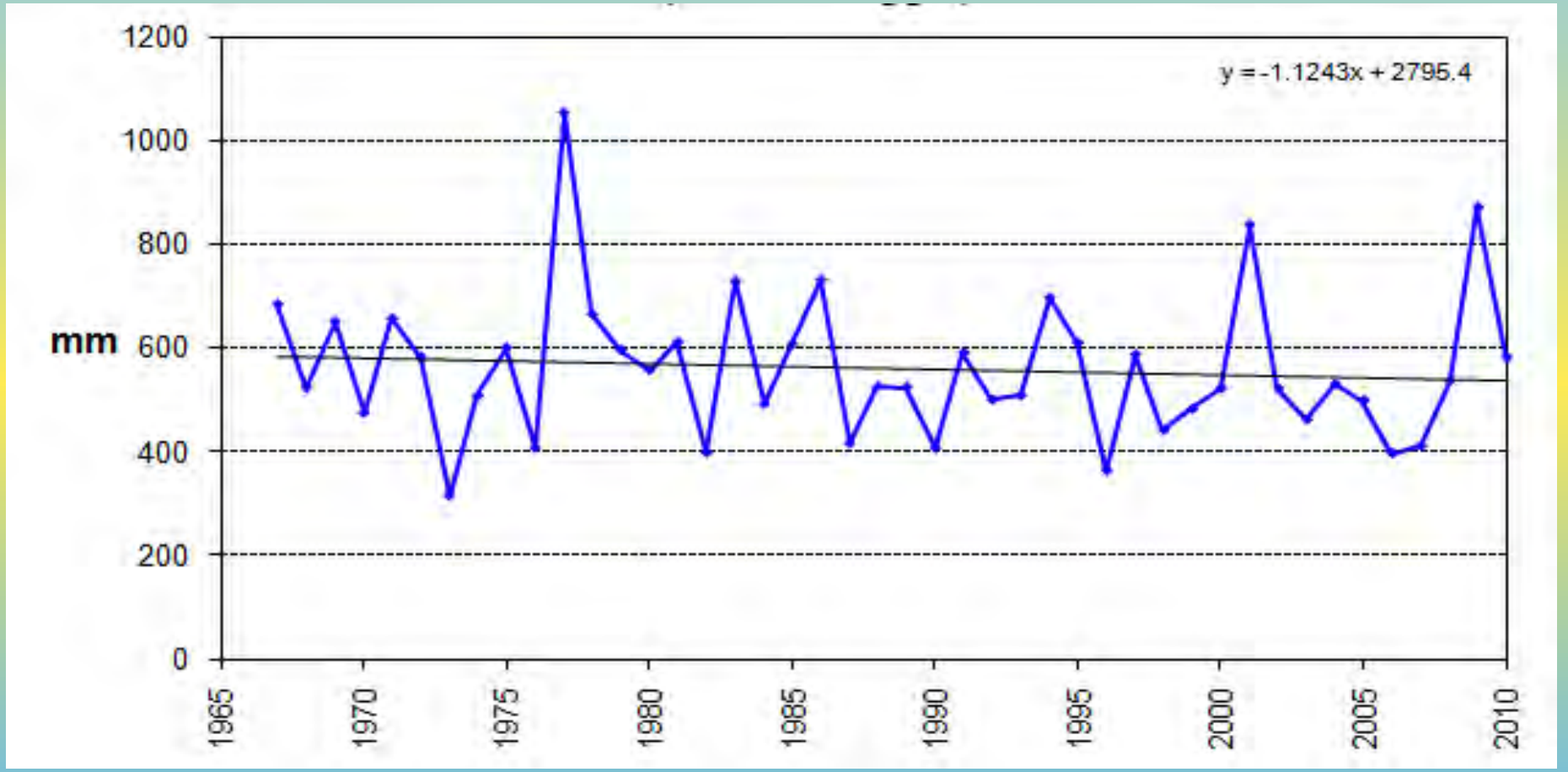
Careser Glacier – Mass Balance 1967 - 2009



Comitato Glaciologico Italiano

Data source: L. Carturan

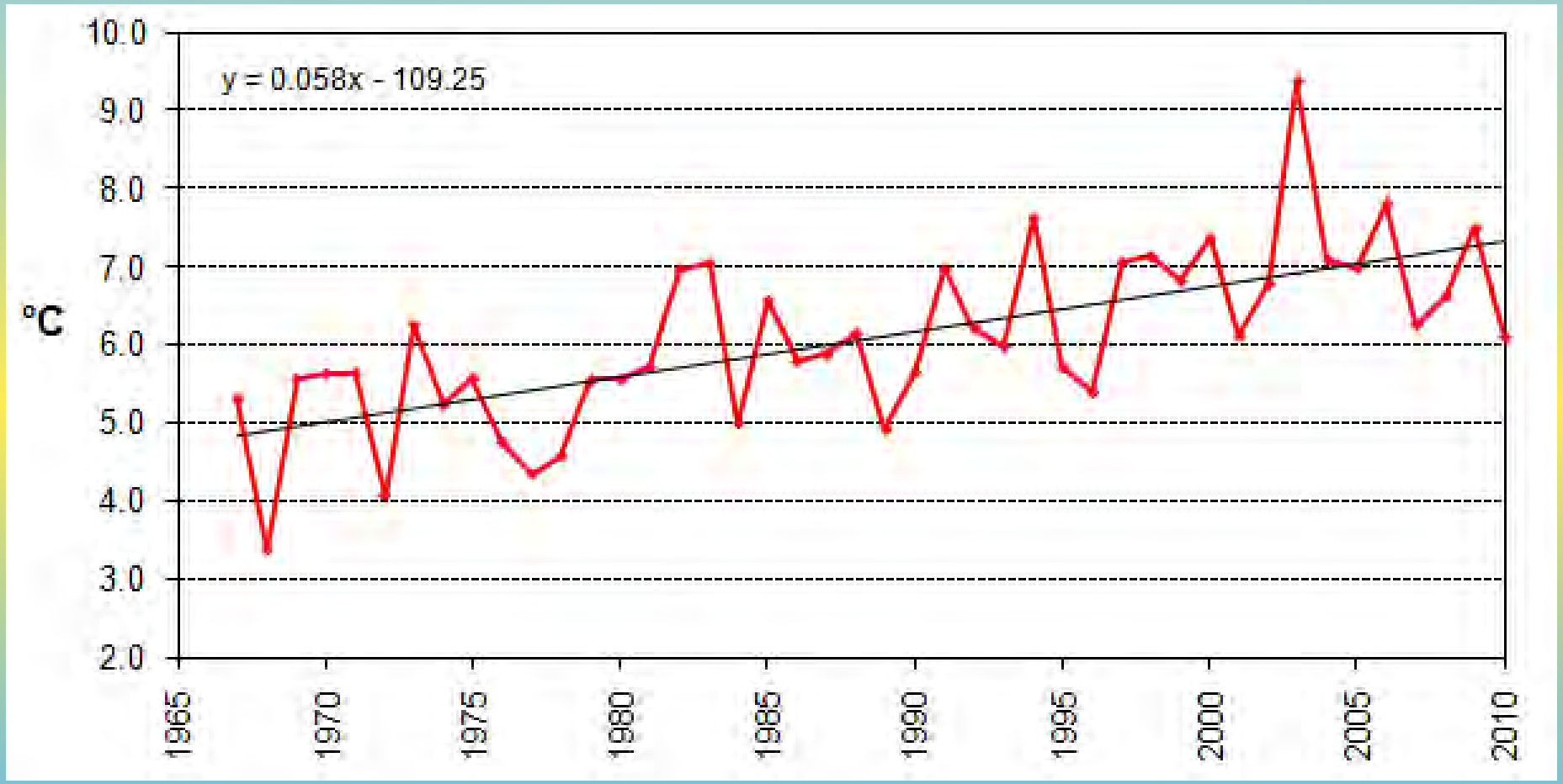
Climatic variation at the Careser dam
cumulated winter precipitation (October-May)



Comitato Glaciologico Italiano

Data source: L. Carturan

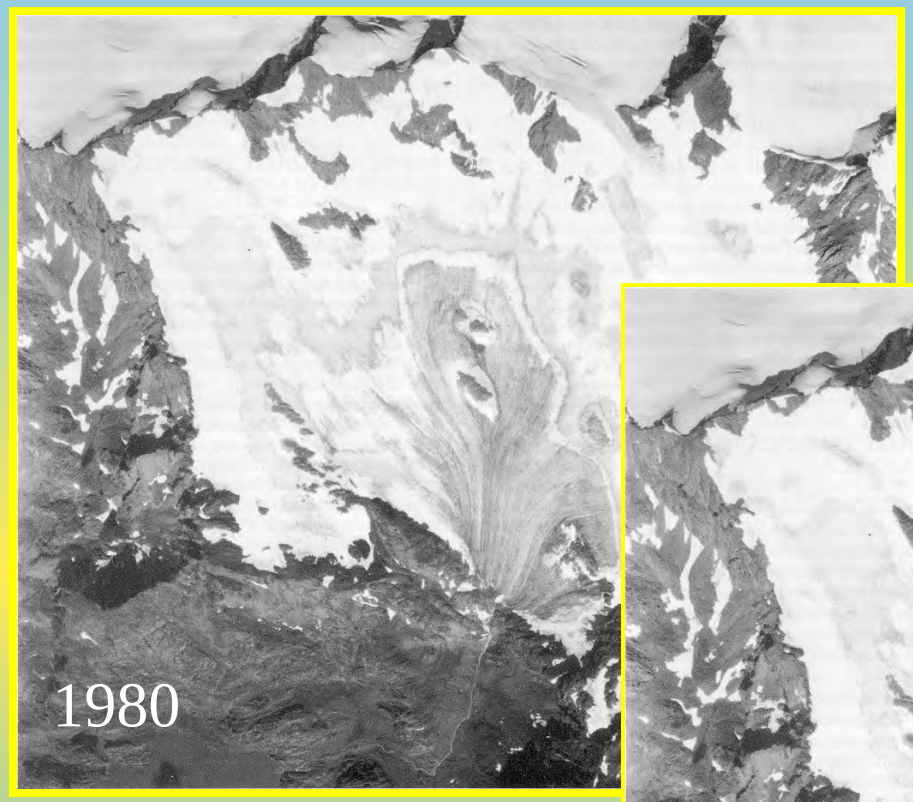
Climatic variation at the Careser dam
Mean Temperature of the ablation season (JJAS)



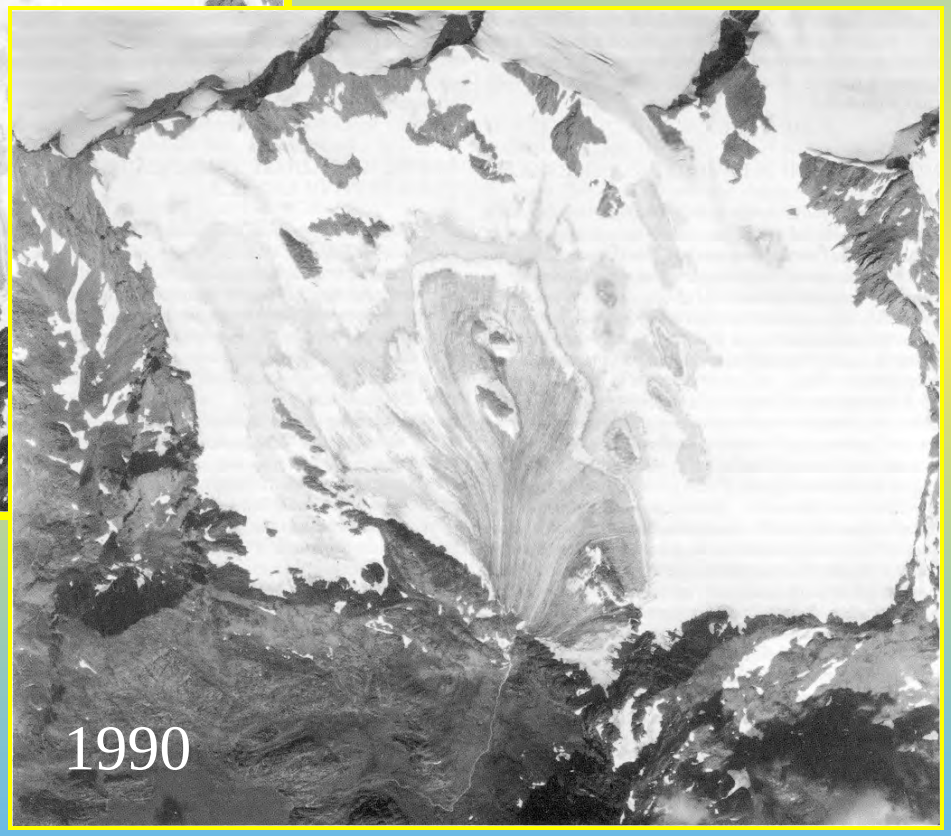
Comitato Glaciologico Italiano

Data source: L. Carturan

Mass Balance: indirect methods
Photogrammetry



Ghiacciaio del Caresèr



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Giada e Zanon (1992)

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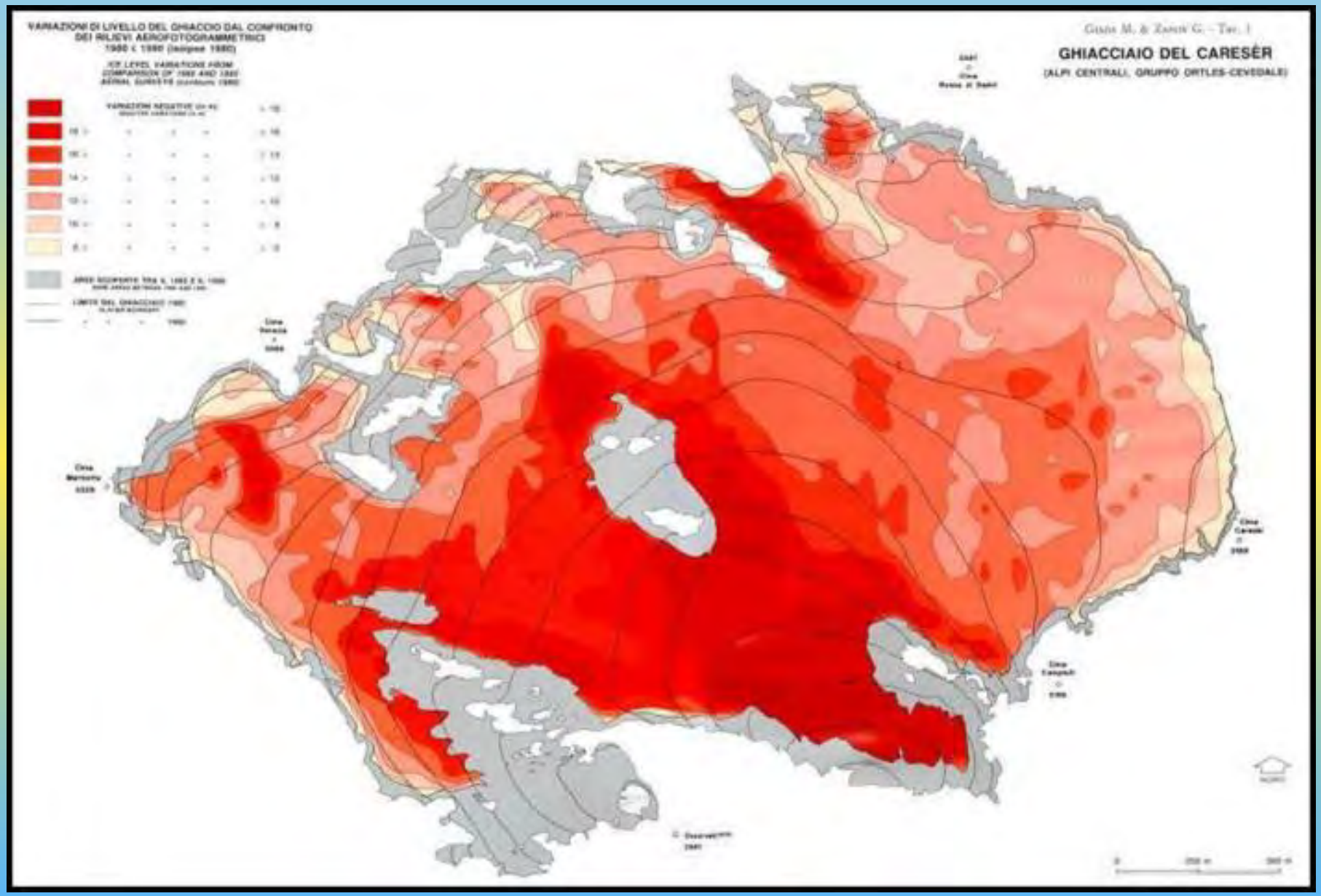
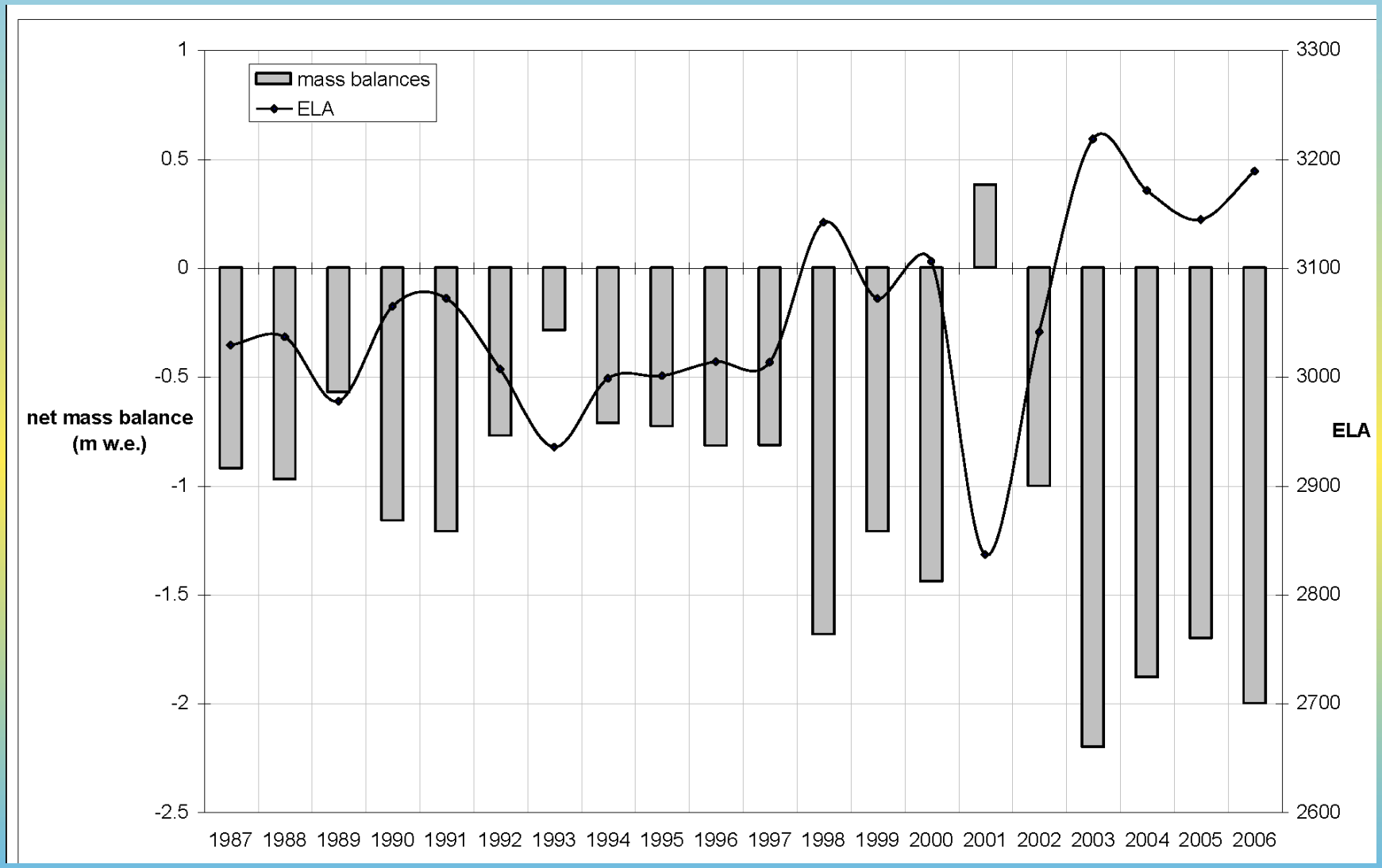


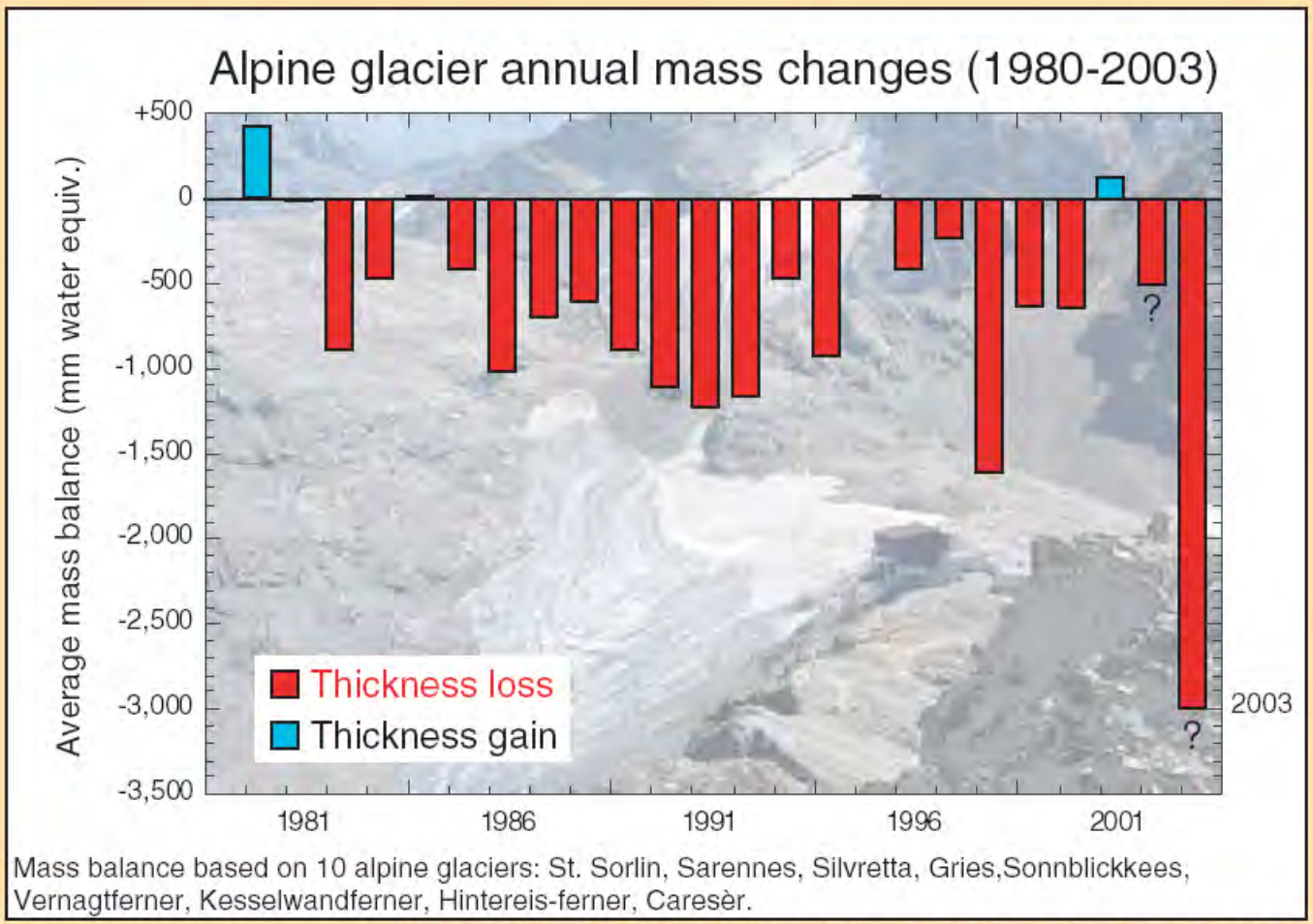
Mass Balance and ELA rise – Sforzellina Glacier

(Ortles – Cevedale)



Cannone et al., 2008 (Mass Balance by C. Smiraglia et. Al)

2003: most negative mass balance of Alpine glaciers



Courtesy: Regula Frauenfelder (World Glacier Monitoring Service, Zürich)

Isotherm 0° C above 4000 m for several days, longest ablation season endured 93 days (mean of the last 20 yrs = 45 days)

1985
G. Potenza

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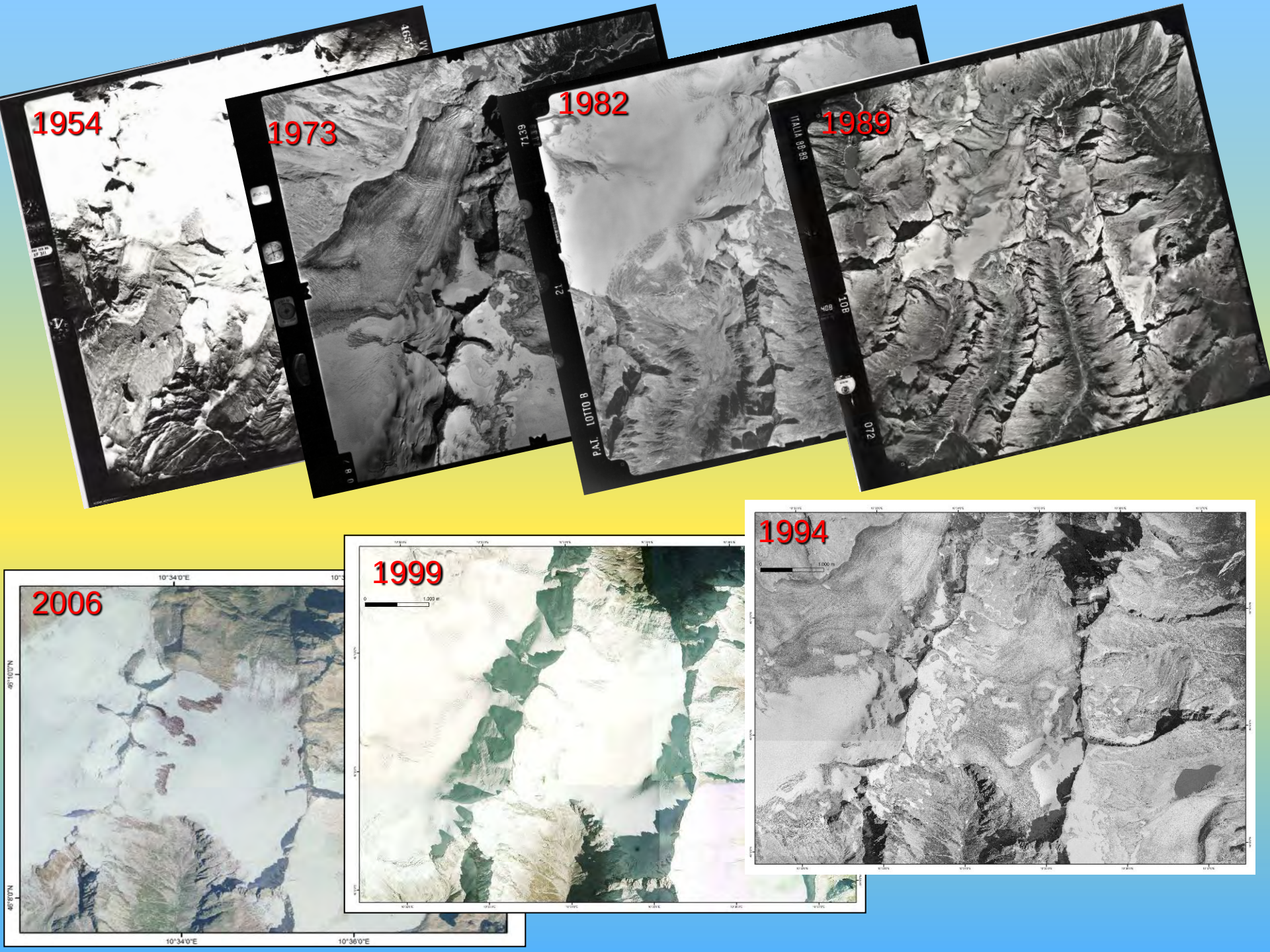
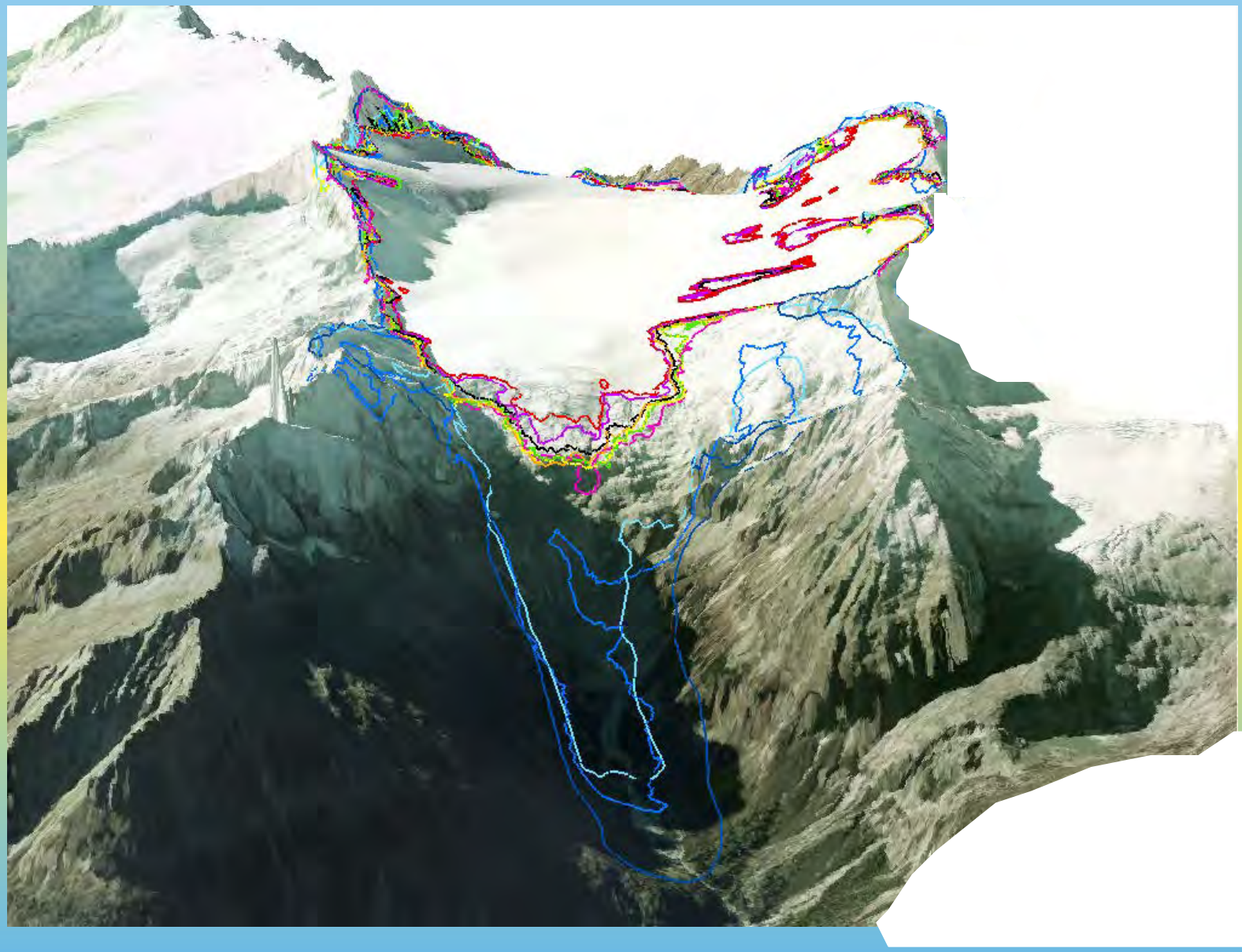
In recent years, almost 100% of the Italian glaciers are retreating;
numerous alpine glaciers have repeatedly found entirely below the snowline, recording significant frontal retreat, contractions of the accumulation basins, thinning of glacial bodies and tongues.

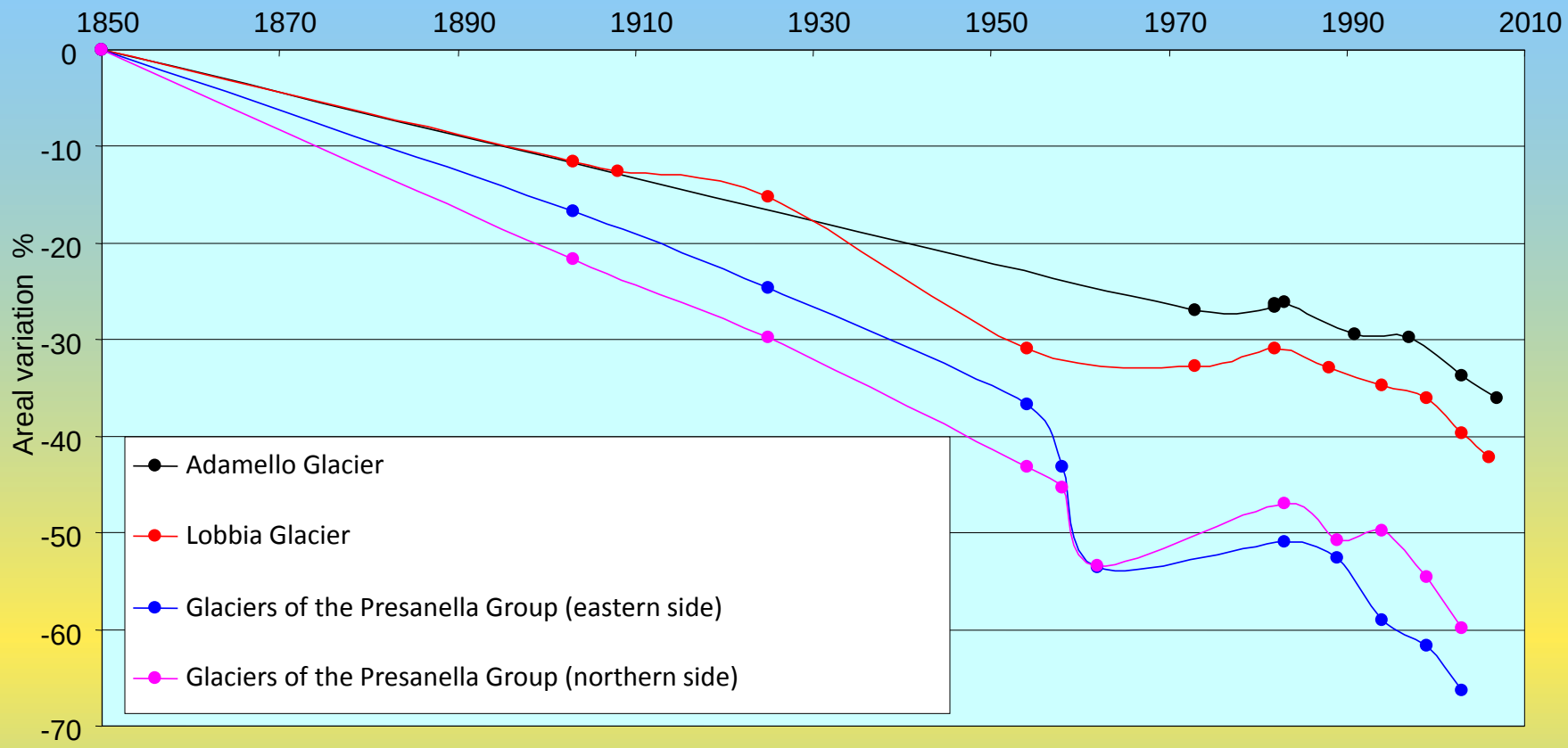
1916 – Foto di archivio CAI - Brescia

1929 – Foto di archivio Cai - Brescia


1954
1973
1982
1989
1994
1999
2006
10°34'0"E
10°36'0"E

PEG
1885
1903
1954
1973
1982
1988
1994
1999
2003





From 1850 AD to 2006 the Lobbia Glacier reduced by 42% while

- the Adamello Gl. reduced by 36% (2007)
- Glaciers of the northern side of Presanella group reduced by 60% (2003)
- Glaciers of the eastern side of Presanella group reduced by 66% (2003)

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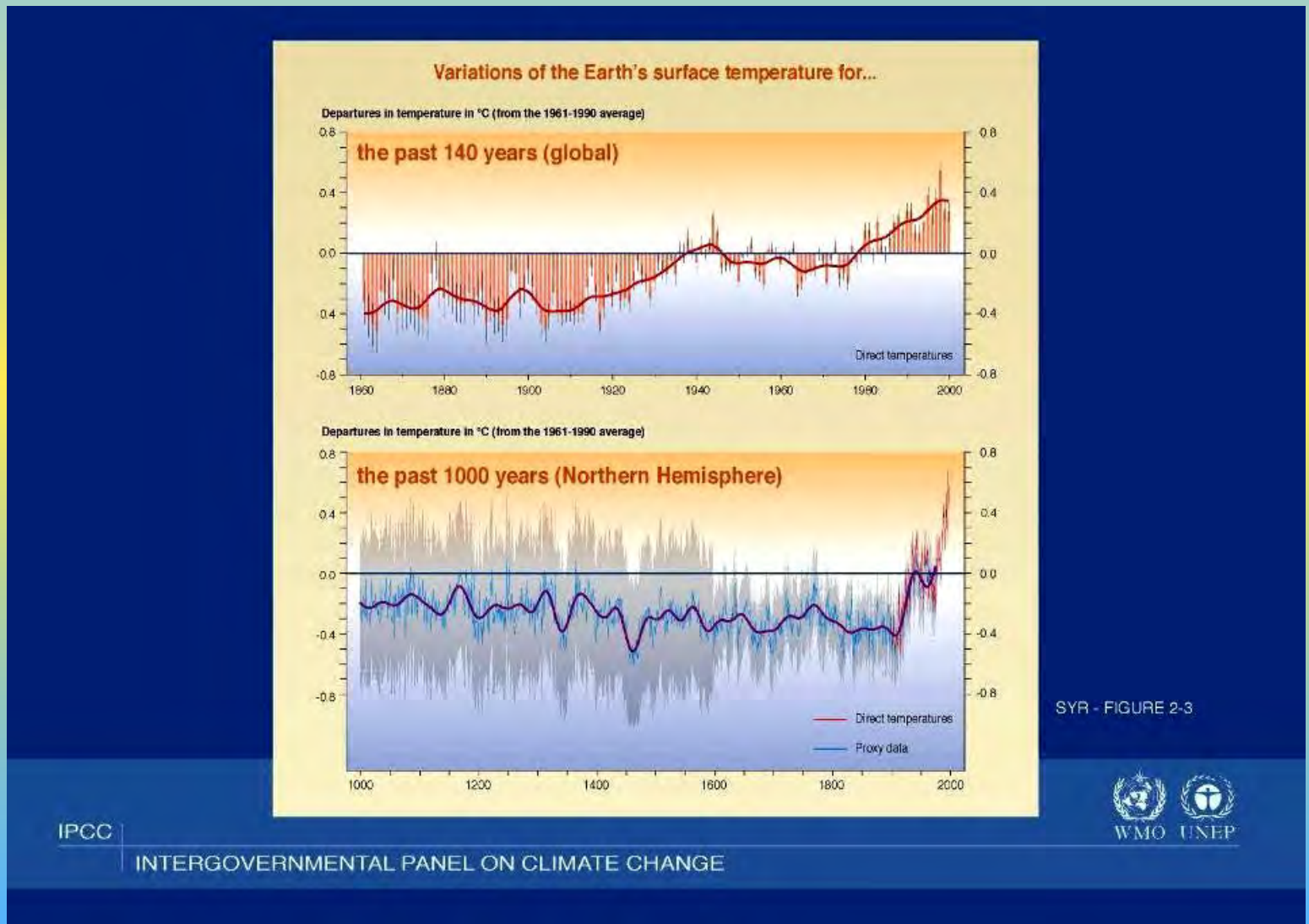
Only the inertia of the ice has allowed glaciers to overcome these critical steps: the strong imbalance that seems to characterize the glaciers compared to current climatic conditions suggests that if this situation will last, further dramatic areal and volume reductions must be expected.



White – War (First World War)
The site of Punta Linke (Ortles-Cevedale)

Credits:
Soprintendenza per i beni librari archivistici e archeologici della Provincia autonoma di Trento, Museo di Peio, Comune di Peio e Provincia Autonoma di Trento

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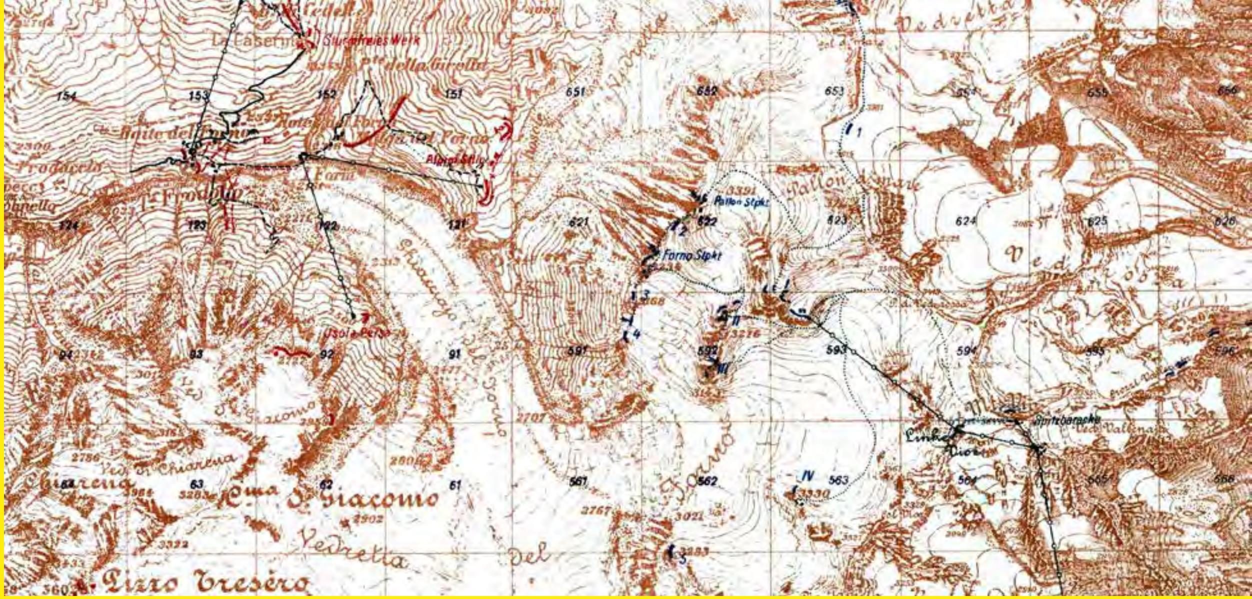
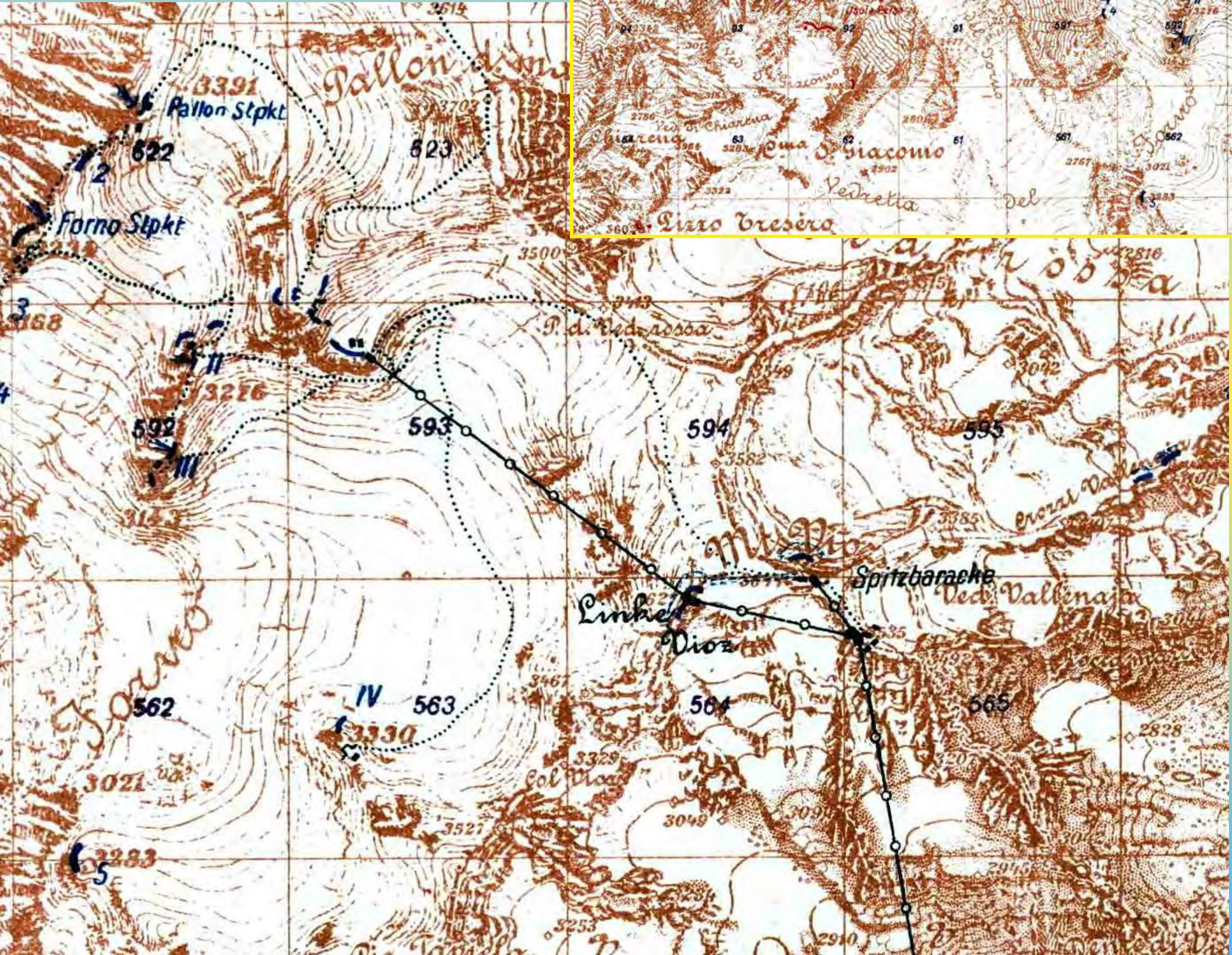
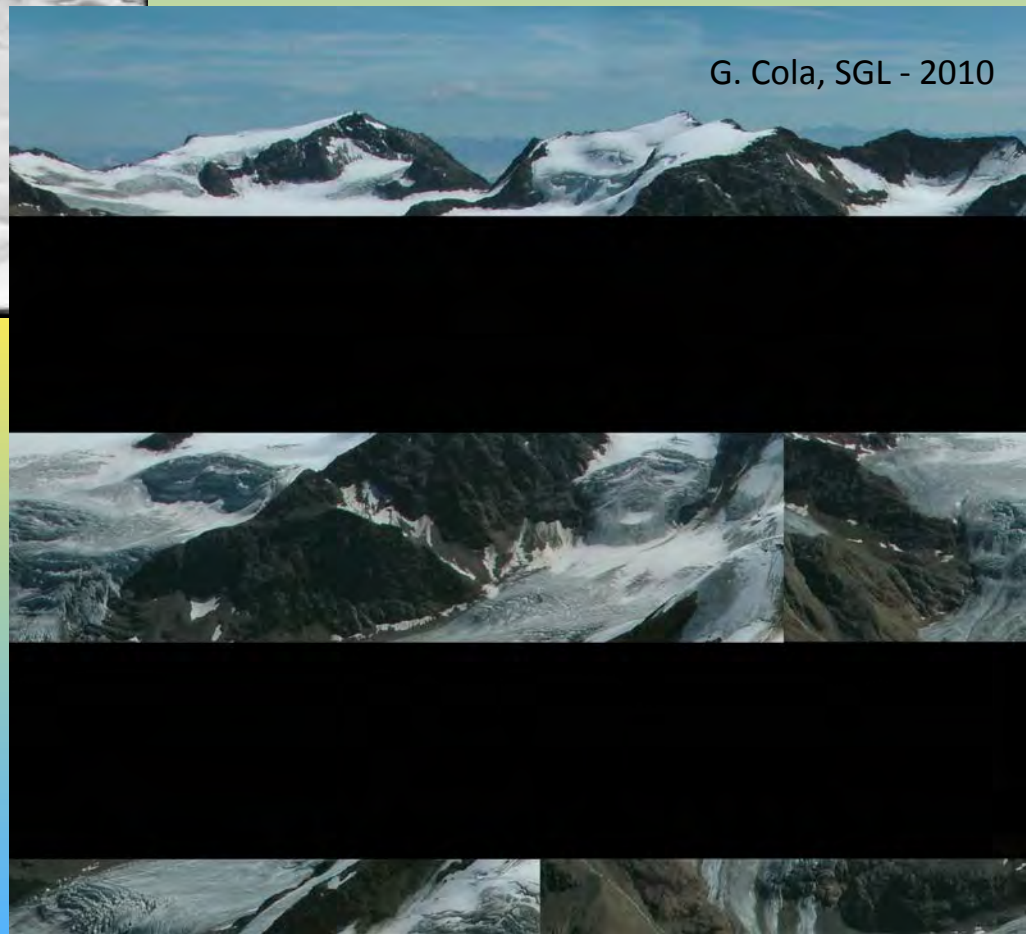

Cma. S. Giacomo
Vedretta
Pizzo Tresero
Pallon Stpkt
Forno Stpkt
Linke
Vioz
Spitzbaracke


Pallon Stpkt
3391
522
Forno Stpkt
523
3216
592
593
594
595
Spitzbaracke
Linke
Vioz
IV
562
563
564
565
3330
3021
Forno
Col Vioz
P. d. Vedrossa

Forni Glacier
Ortles-Cevedale Group
about
13 km^2 in 1991,
12 km^2 in 2003

IGM, 1917 – From P.zo Tresero



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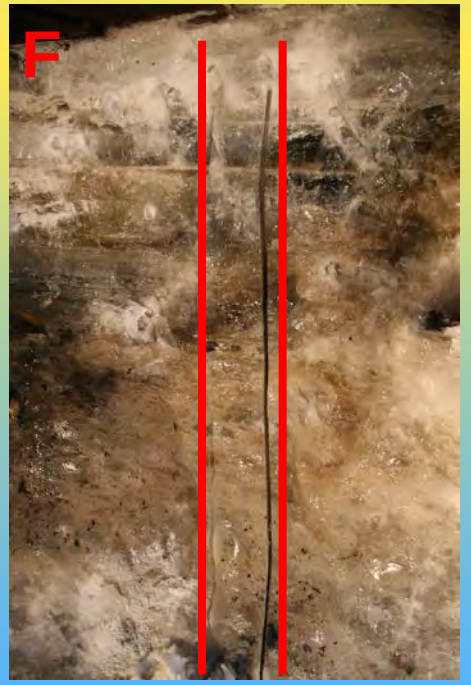
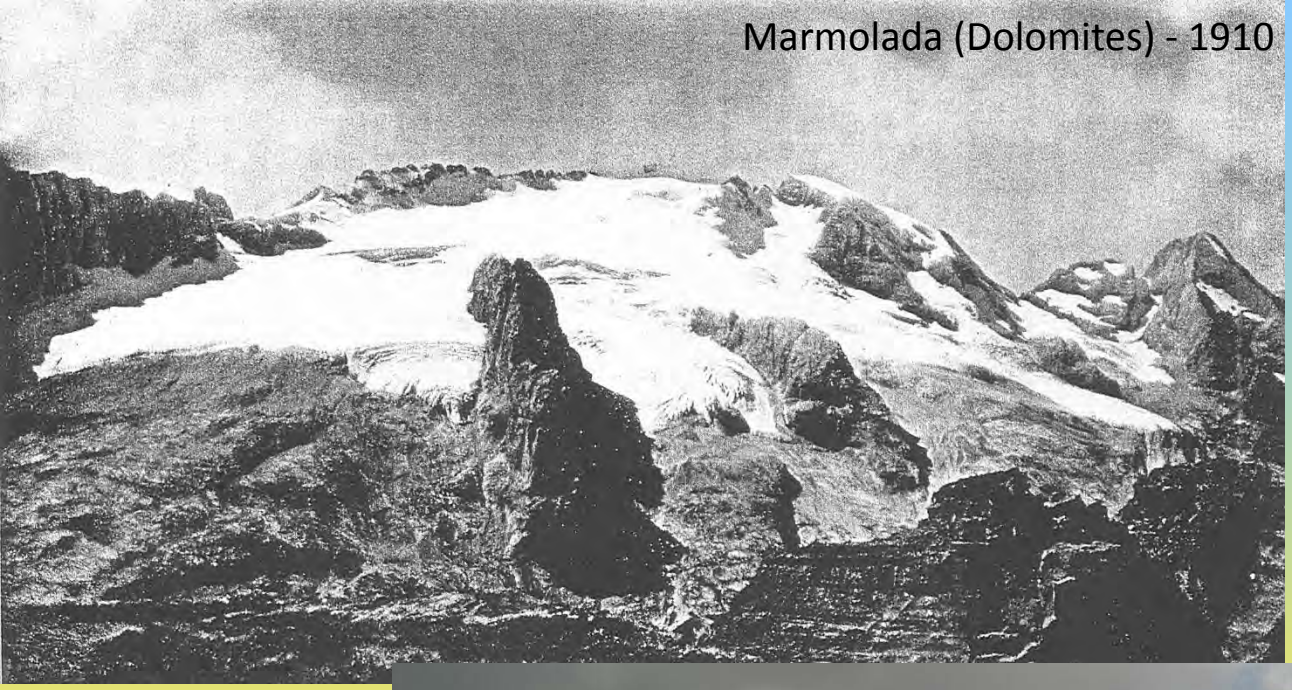
A) Taglio di un pilastrino;
B e C) pilastrino A1;
D e E) pilastrino A2;
F) pilastrino A3.
Le linee rosse identificano la dimensione del taglio effettuato.



Marmolada (Dolomites) - 1910



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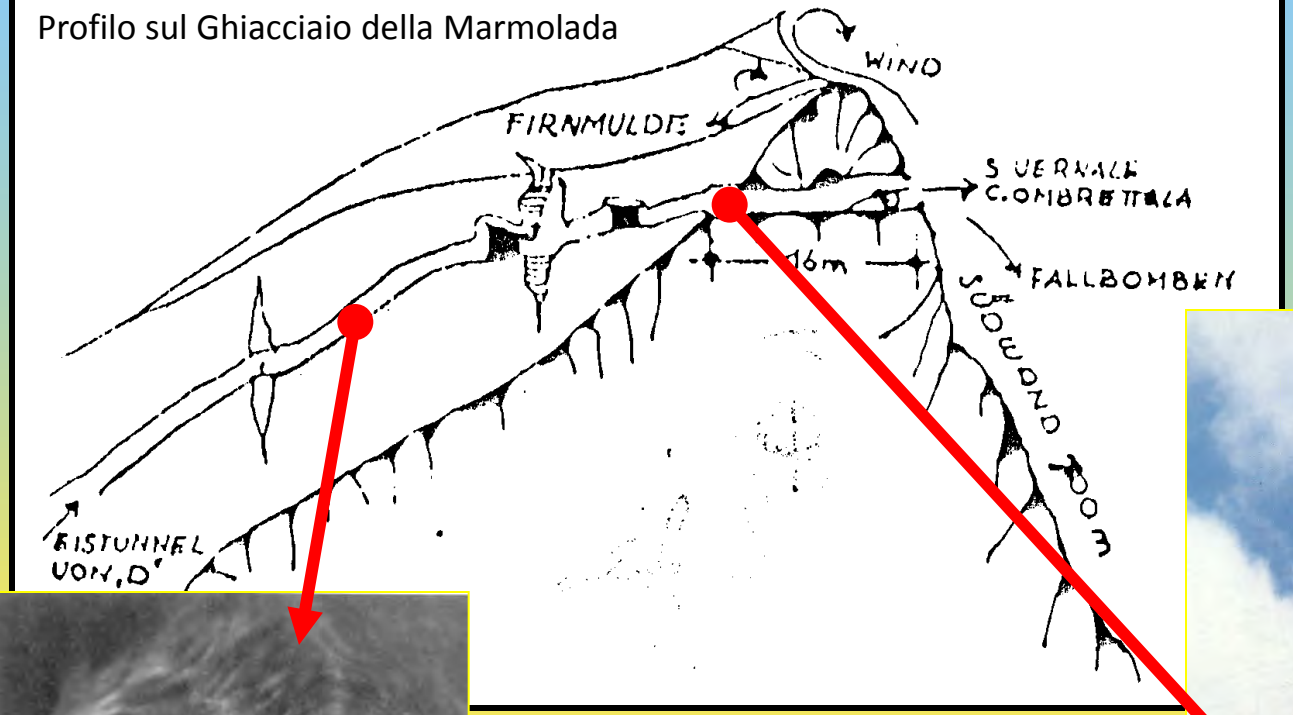
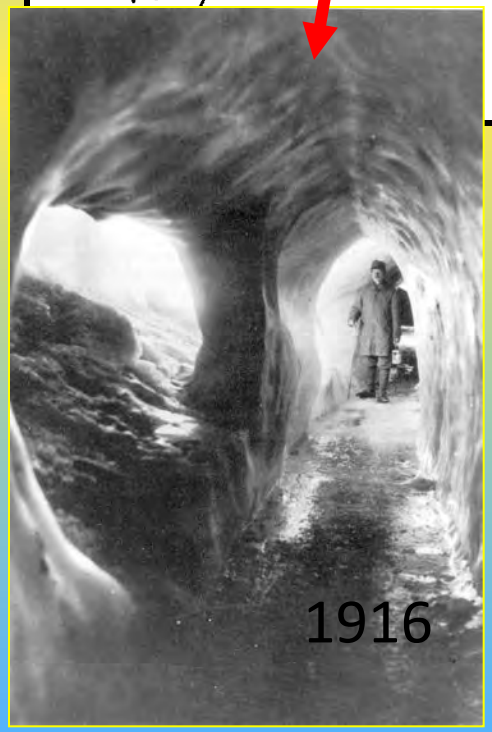
Marmolada (Dolomites) - 2008

Profilo sul Ghiacciaio della Marmolada





Bartoli et al. (1992) - *La Città di Ghiaccio*

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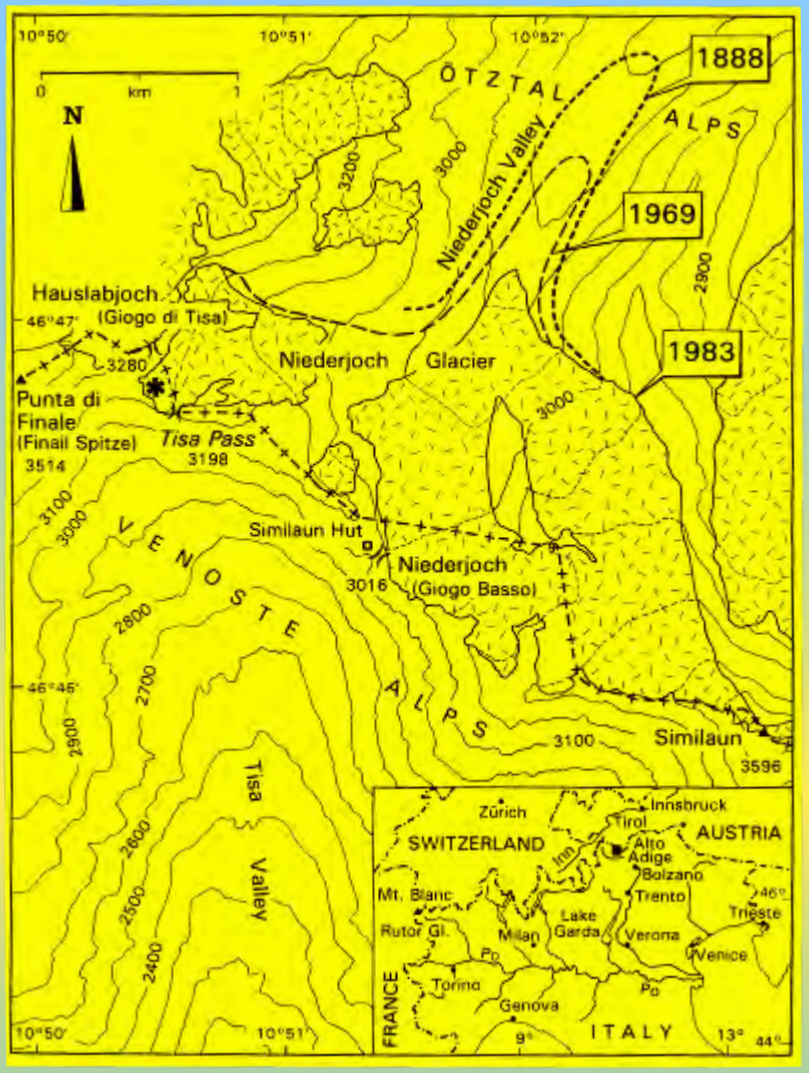
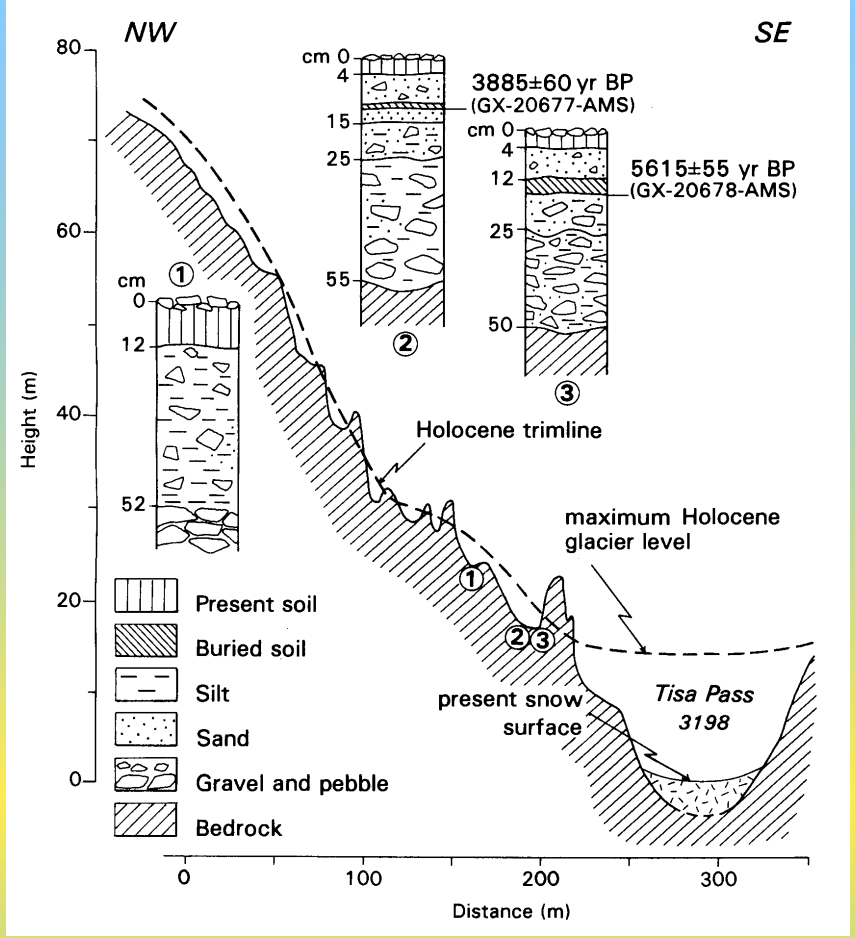
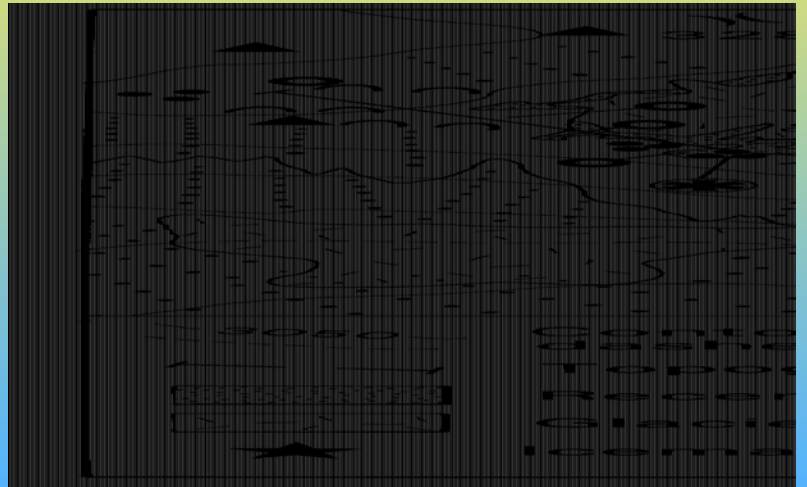
The Iceman

5300-5050 anni cal BP







Baroni and Orombelli, 1996
Quaternary Research

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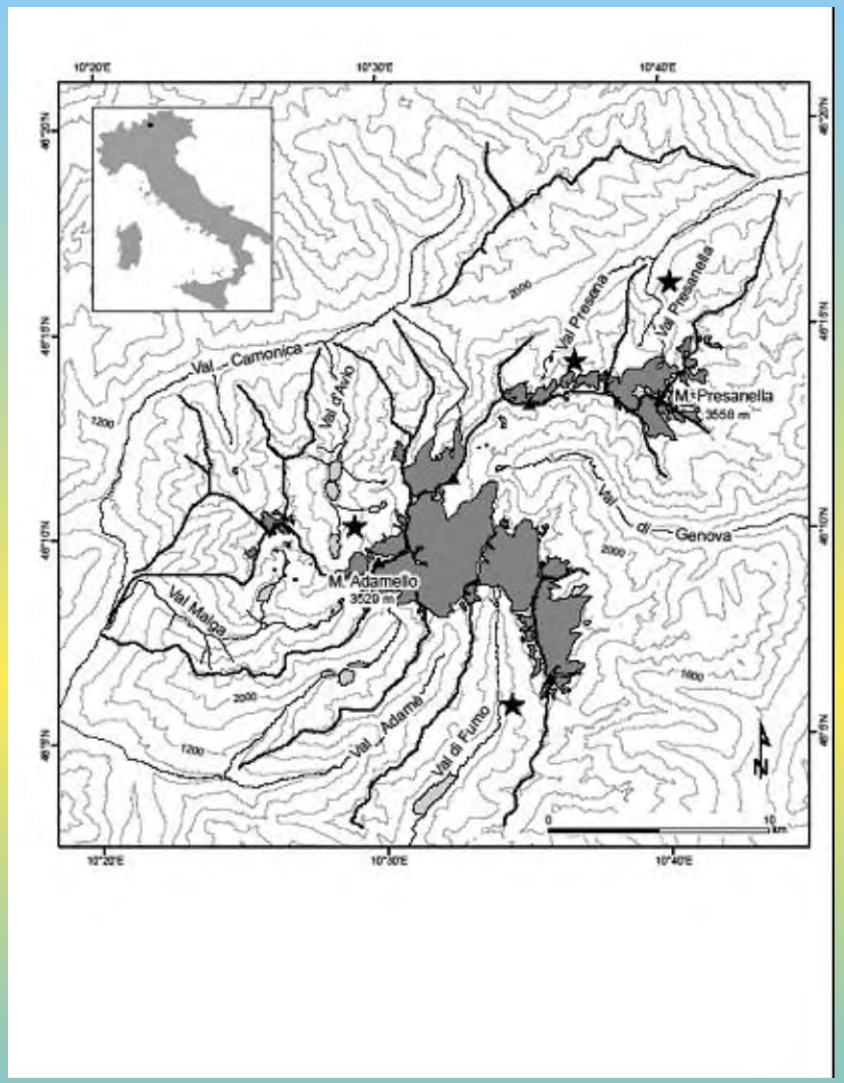

10°20'E
10°30'E
10°40'E
46°20'N
46°15'N
46°10'N
46°5'N
Val Presena
Val Presanella
Val Camonica
Val d'Avio
M.te Presanella
3558 m
Val di Genova
M. Adamello
3539 m
Val Malga
Val Adama
Val di Fumo
2000
1200
1600
N
0
10
km

Figure 7. Actual and reconstructed June-July mean temperature over their entire overlapping period (1760-2004) (r=0.53).

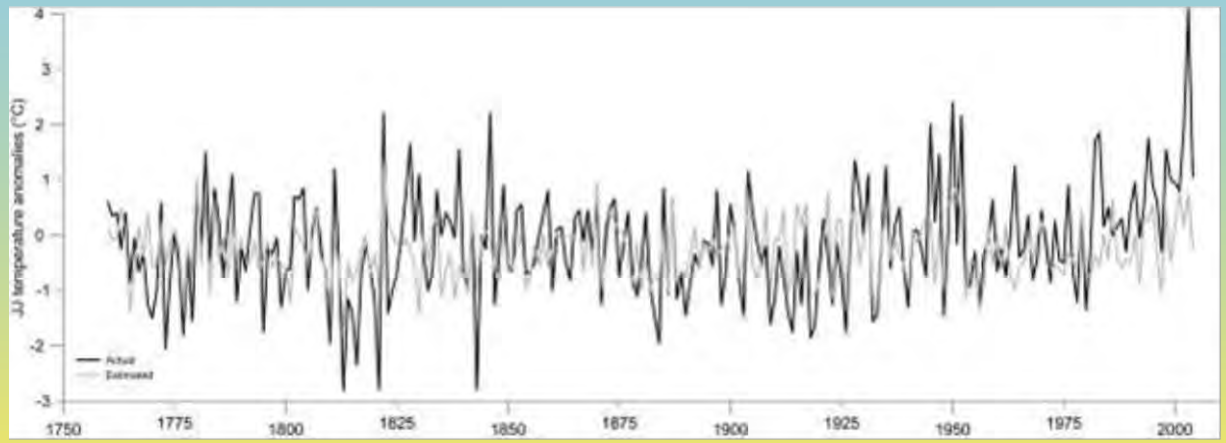
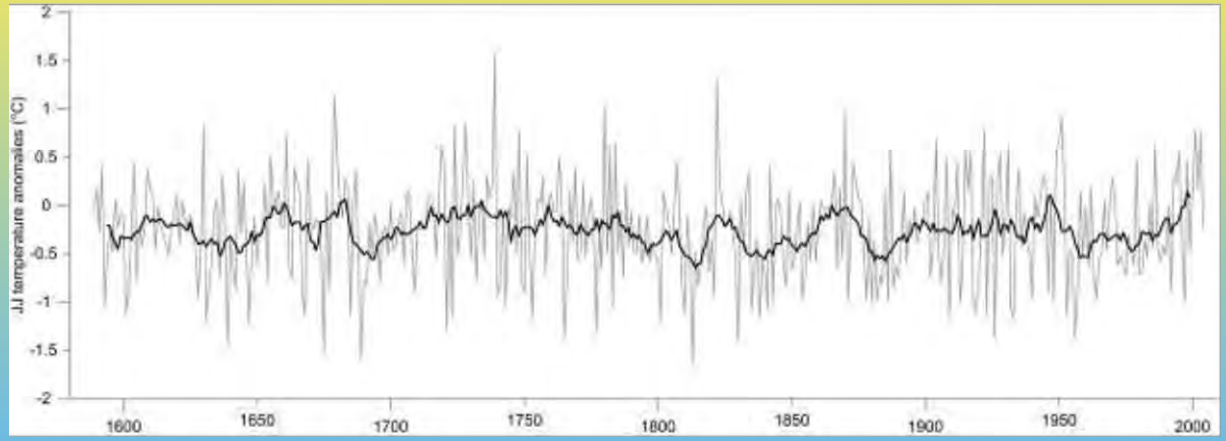
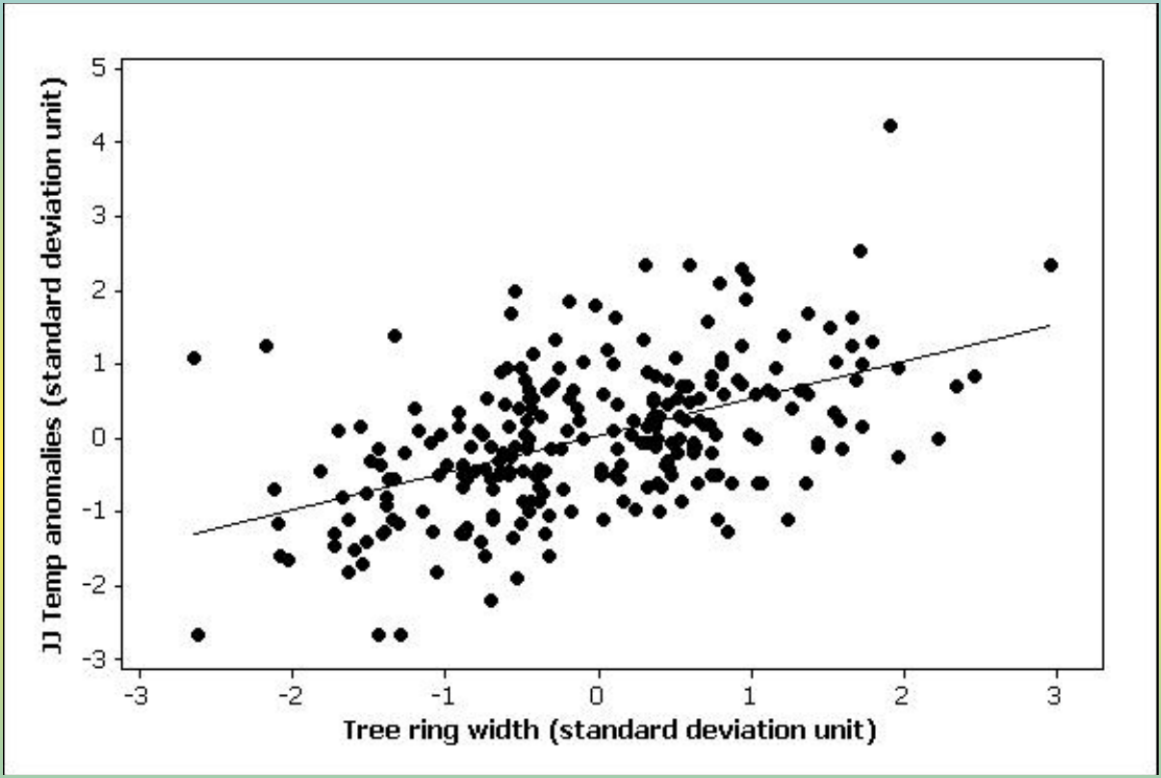


Figure 8. Reconstructed June–July mean temperature. The thick line is the 11-year moving average.




JJ Temp anomalies (standard deviation unit)
5
4
3
2
1
0
-1
-2
-3
-3
-2
-1
0
1
2
3
Tree ring width (standard deviation unit)

Ghiacciaio Orientale di Fellaria
(photograph by G. Kappenberger, 5th Sept. 2006)