Permafrost

Permafrost

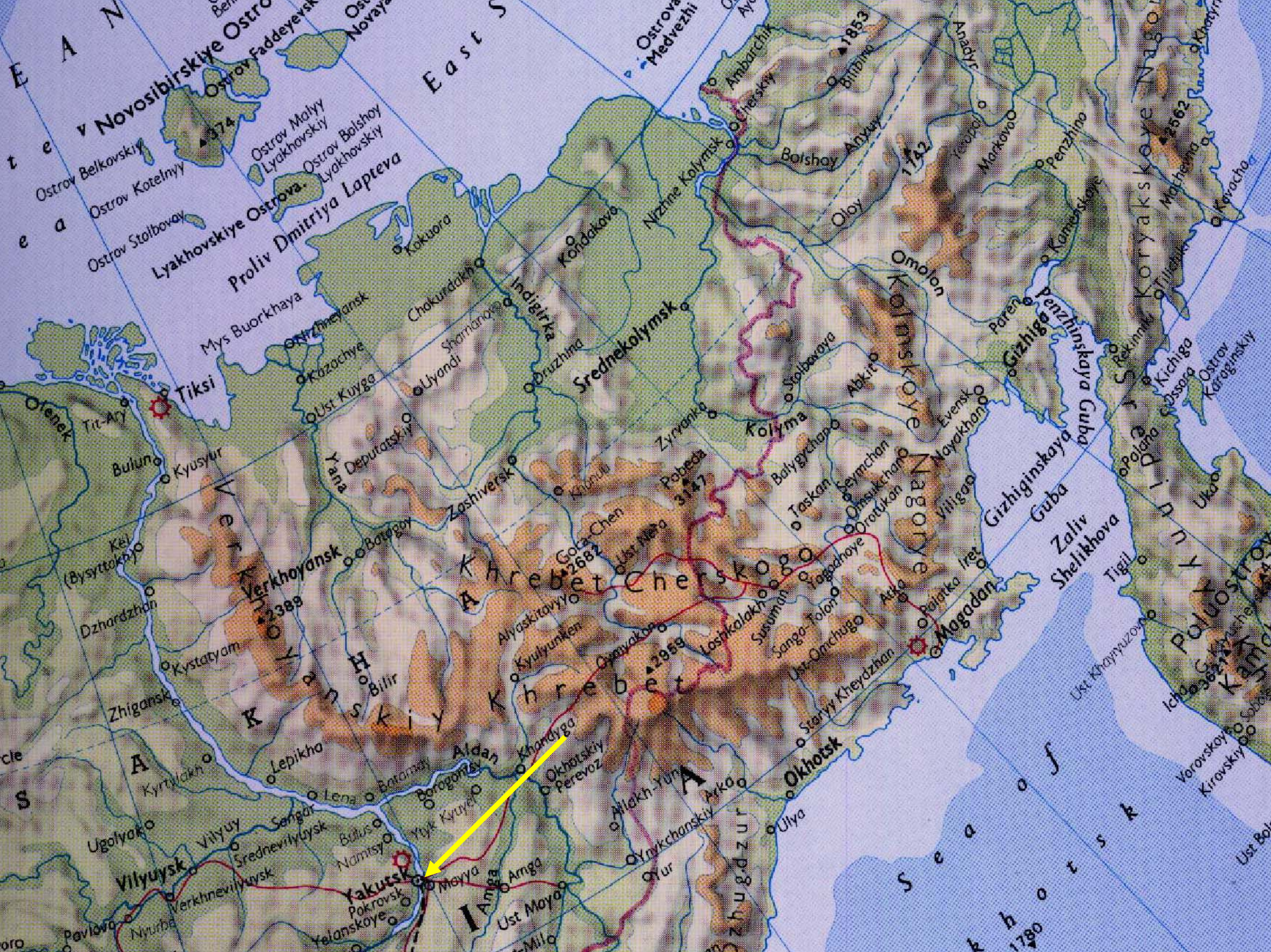
1: Permafrost research history

2: Permafrost definition

3: Permafrost distribution and thickness

- Present
- Past

4: Permafrost significance



Novosibirskiye Ostrova
Ostrov Faddeyevskiy
Ostrov Belkovskiy
Ostrov Kotelnyy
Ostrov Malyy Lyakhovskiy
Ostrov Bolshoy Lyakhovskiy
Ostrov Stolbovoy
Lyakhovskiye Ostrova
Proliv Dmitriya Lapteva
East S
Ostrova Medvezhi
Mys Buorkhaya
Kokuora
Chokurdakh
Indigirka
Kondakovo
Nizhne Kolymsk
Ambarchik
Cherskiy
Bilibino
Bolshoy Anyuy
Anadyr
Markovo
Penzhino
Koryakskoye Nagorye
Oloy
Omolon
Kolymskoye Nagorye
Kamenskoye
Tilichiki
Korf
Paren
Gizhiga
Penzhinskaya Guba
Srednekolymsk
Stolbovaya
Abkit
Evensk
Kolyma
Zyryanka
Tiksi
Olenek
Tit-Ary
Bulun
Kyusyur
Nizhneyansk
Kazachye
Ust Kuyga
Uyandi
Shamanovo
Druzhina
Deputatskiy
Yana
Zashiversk
Khonuu
Pobeda
3147
Balygychan
Seymchan
Taskan
Omsukchan
Orotukan
Nayakhan
Viliga
Gizhiginskaya Guba
Zaliv Shelikhova
Tigil
Sredinnyy Khrebet
Poluostrov Kamchatka
Kichiga
Ostrov Karaginskiy
Ossora
Palana
Verkhoyansk
Batagay
Kyusyur
Kei (Bysyttakh)
Dzhardzhan
Kystatyam
Zhigansk
Verkhoyanskiy Khrebet
2389
Khrebet Cherskogo
Goda-Chen
2682
Ust Nera
Yagodnoye
Susuman
Sango-Tolon
Ust-Omchug
Atka
Palatka
Magadan
Iret
Alyaskitovyy
Kyulyunken
Oymyakon
2959
Losinkalakh
Staryy Kheydzhan
Bilir
Khandyga
Aldan
Okhotskiy Perevoz
Allakh-Yun
Arka
Okhotsk
Ulya
Dzhugdzhur
Yrykchanskiy
Yur
Amga
Ust Maya
Lena
Batamay
Borogontsy
Lepikha
Kyrtylakh
Sangar
Bulus
Namtsy
Yakutsk
Mayya
Pokrovsk
Yelanskoye
Vilyuy
Vilyuysk
Srednevilyuysk
Verkhnevilyuysk
Ugolyakh
Nyurba
Pavlovo
Sea of Okhotsk
1780
Ust Khayryuzovo
Icha
Sobolevo
Vorovskoye
Kirovskiy
Ust Bol
Ust Kamchatsk

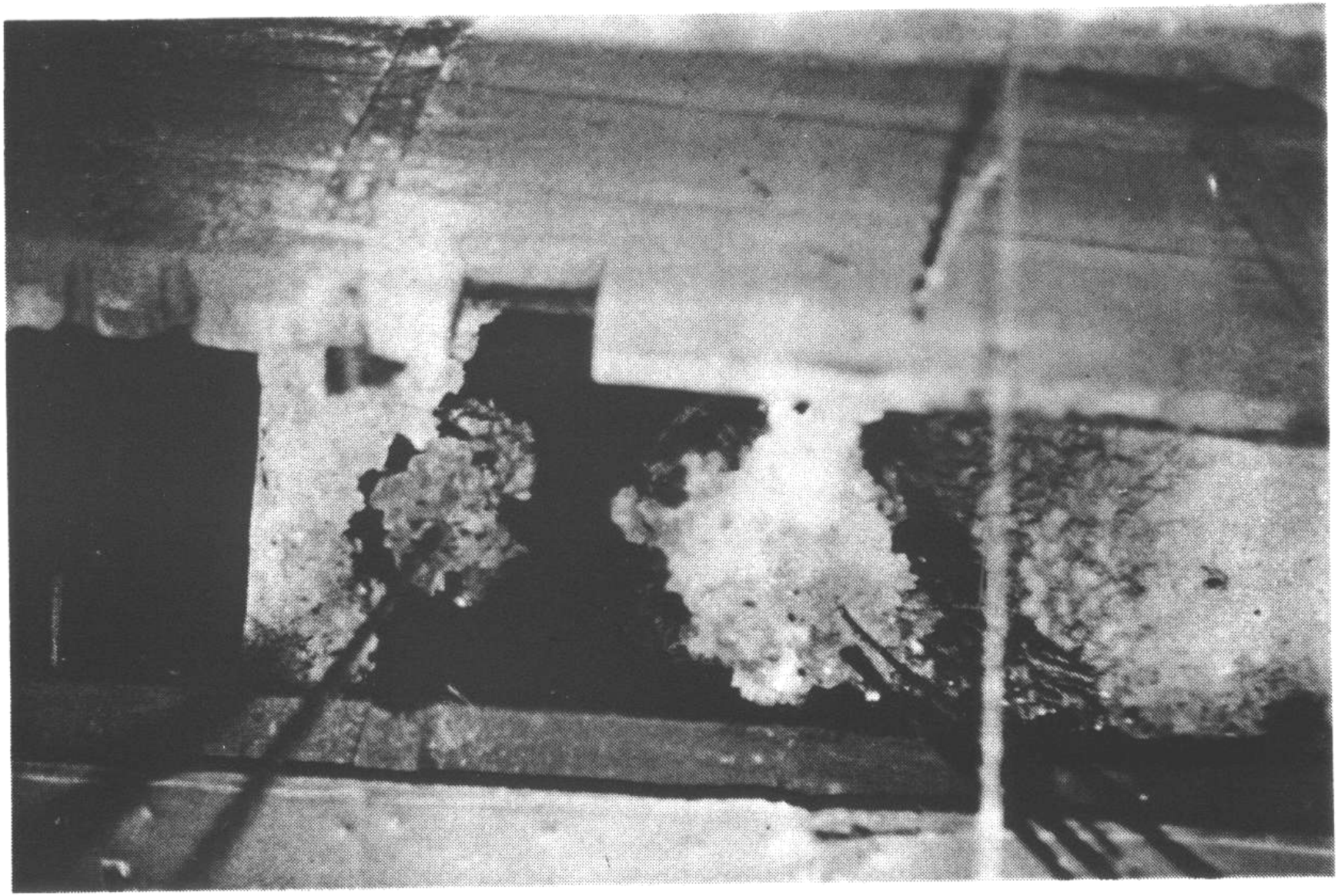


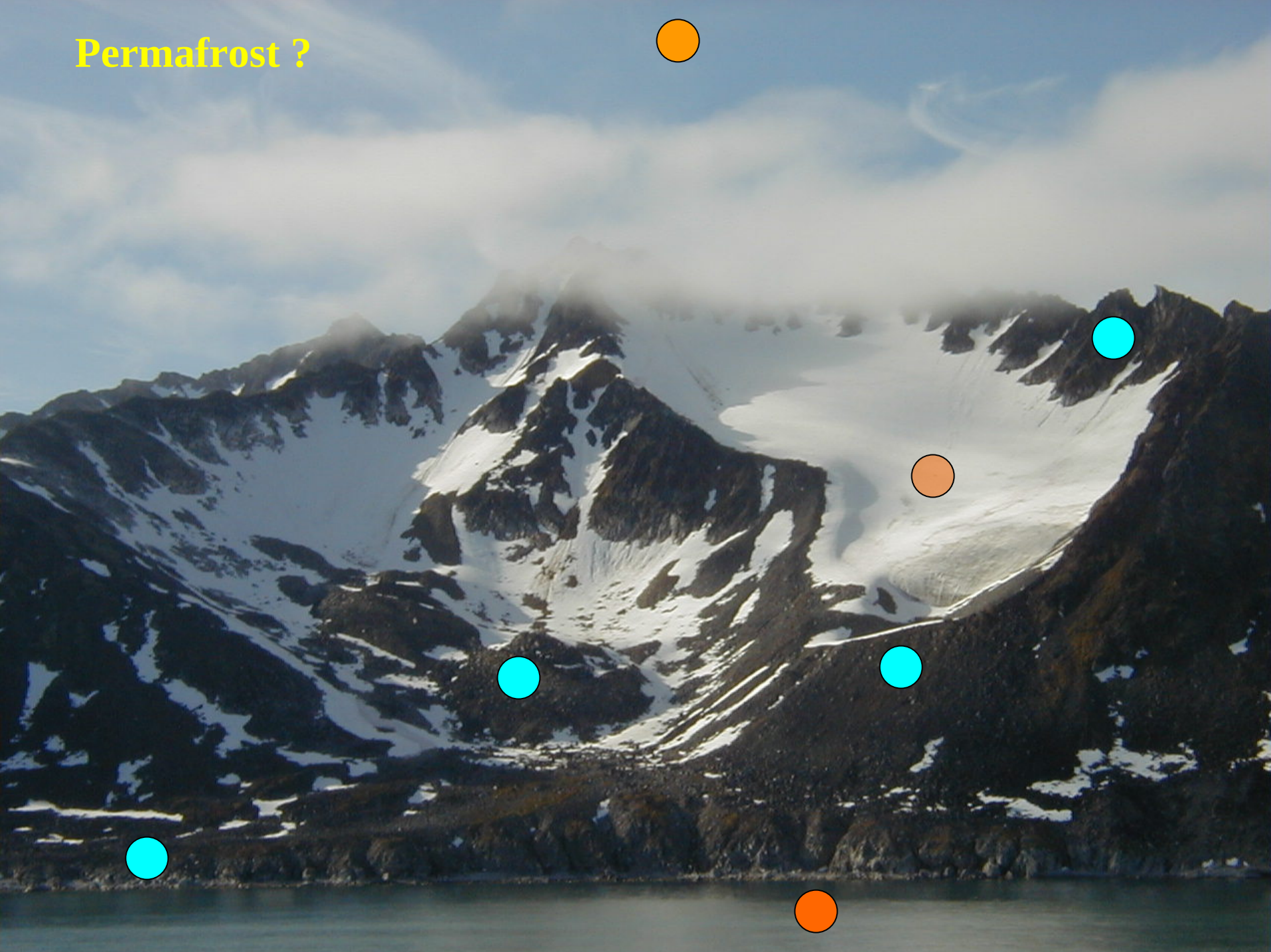
Plate I: View into the Shargin Well in Yakutsk, USSR, that was described by Academician A. F. Middendorf in 1848. The moisture condensed as ice on the walls is removed at regular intervals.

Plate II: Building Showing the Results of Thaw Settlement in Dawson City, Yukon Territory, Canada.

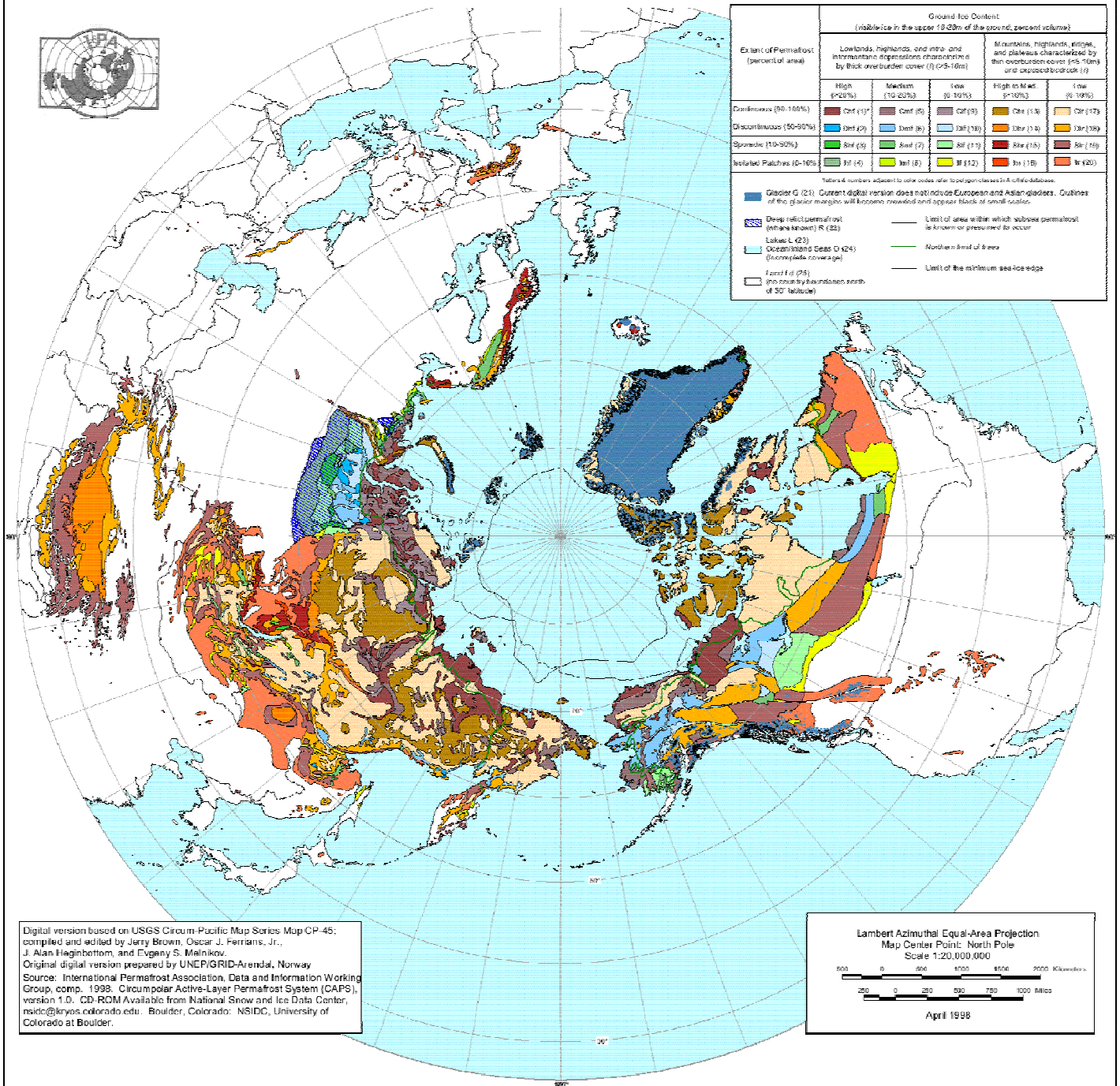
Original permafrost definition by S.W.Muller 1945:

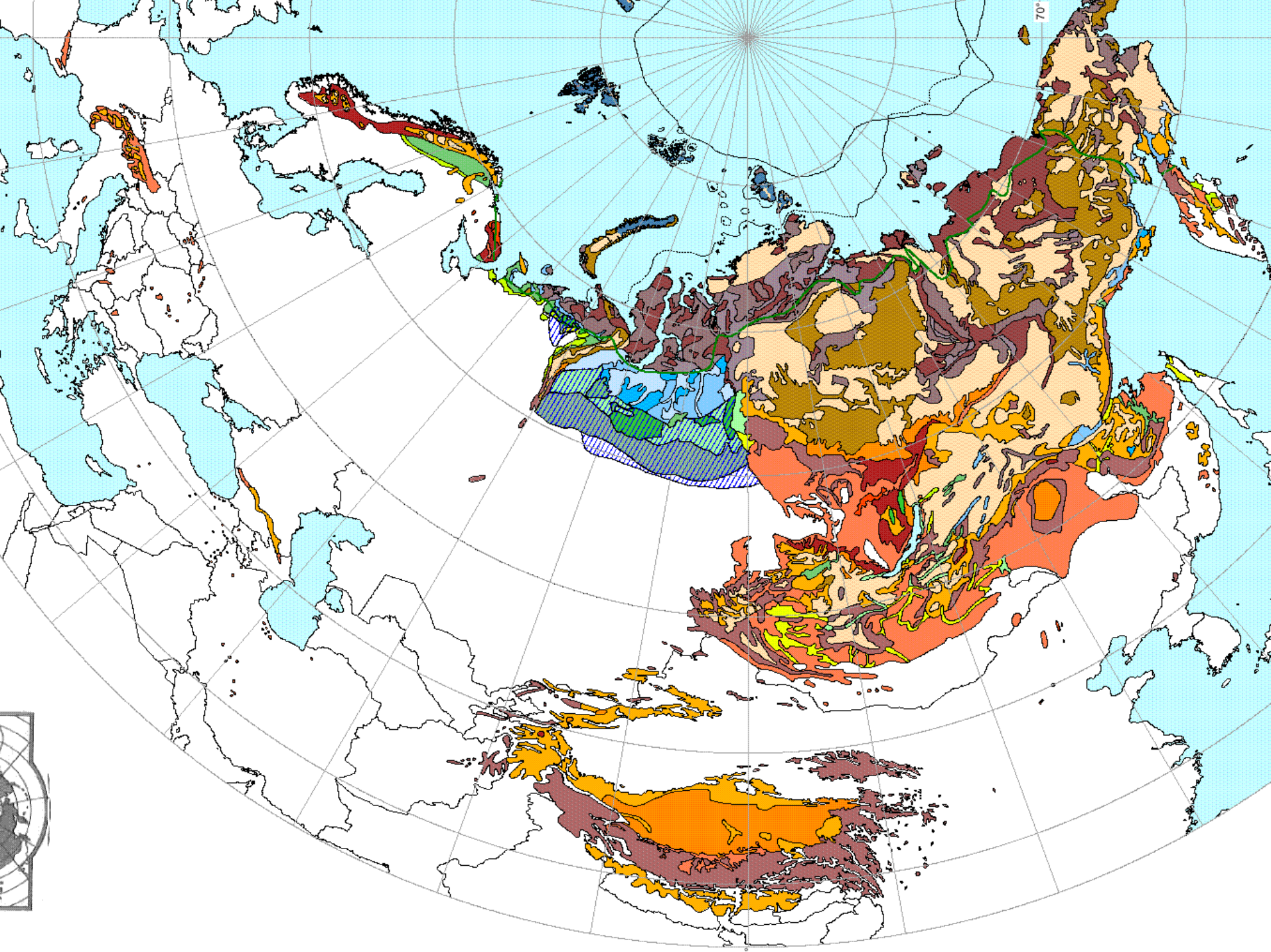
Permanently frozen ground or **permafrost** is defined as a thickness of soil or other superficial deposit, or even of bedrock, at a variable depth beneath the surface of the earth in which a temperature below freezing has existed continually for a long time (from two years to tens of thousands of years).

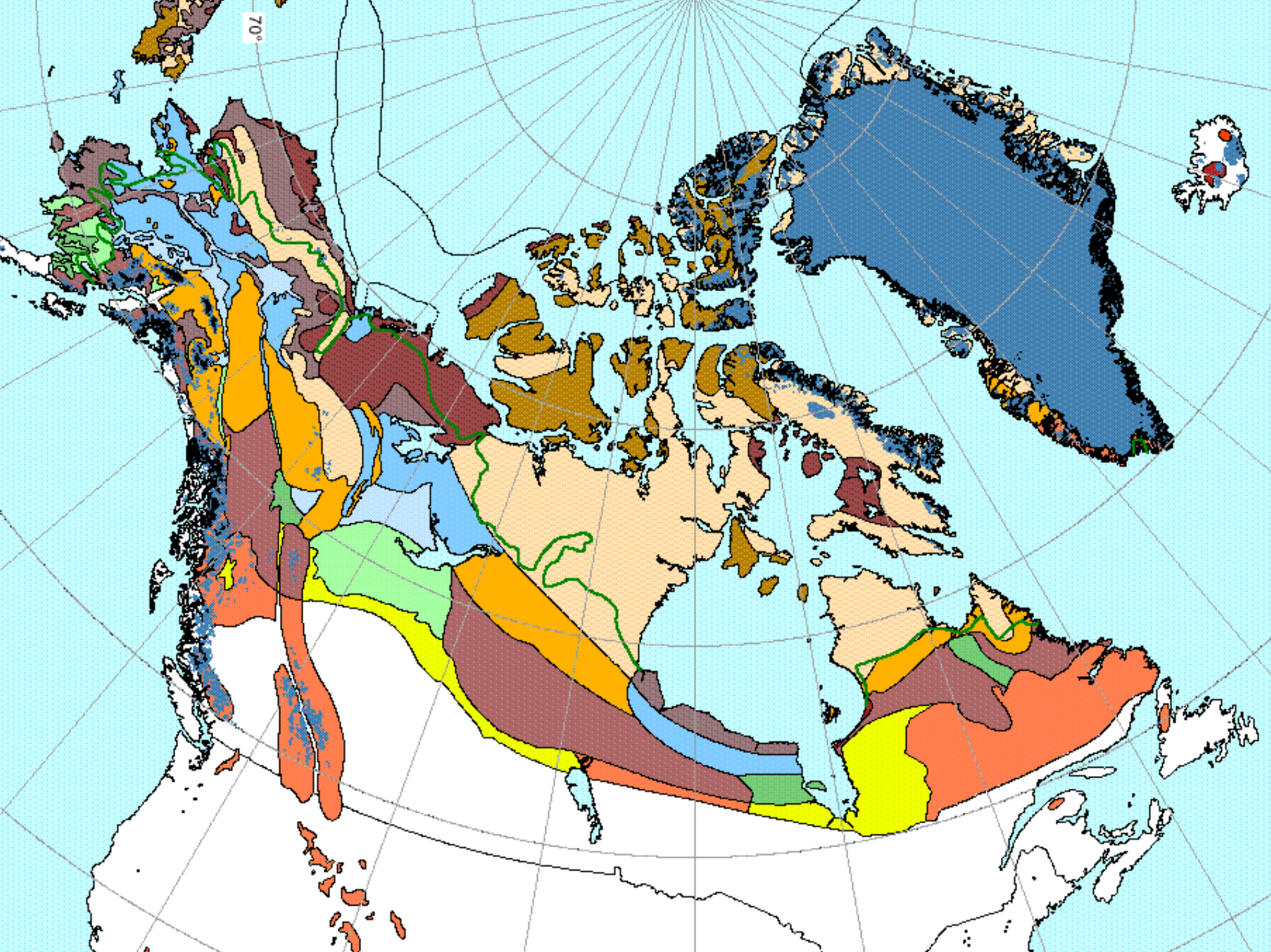
Permanently frozen ground is defined **exclusively** on the basis of temperature, irrespective of texture, degree of induration, water content, or lithologic character.

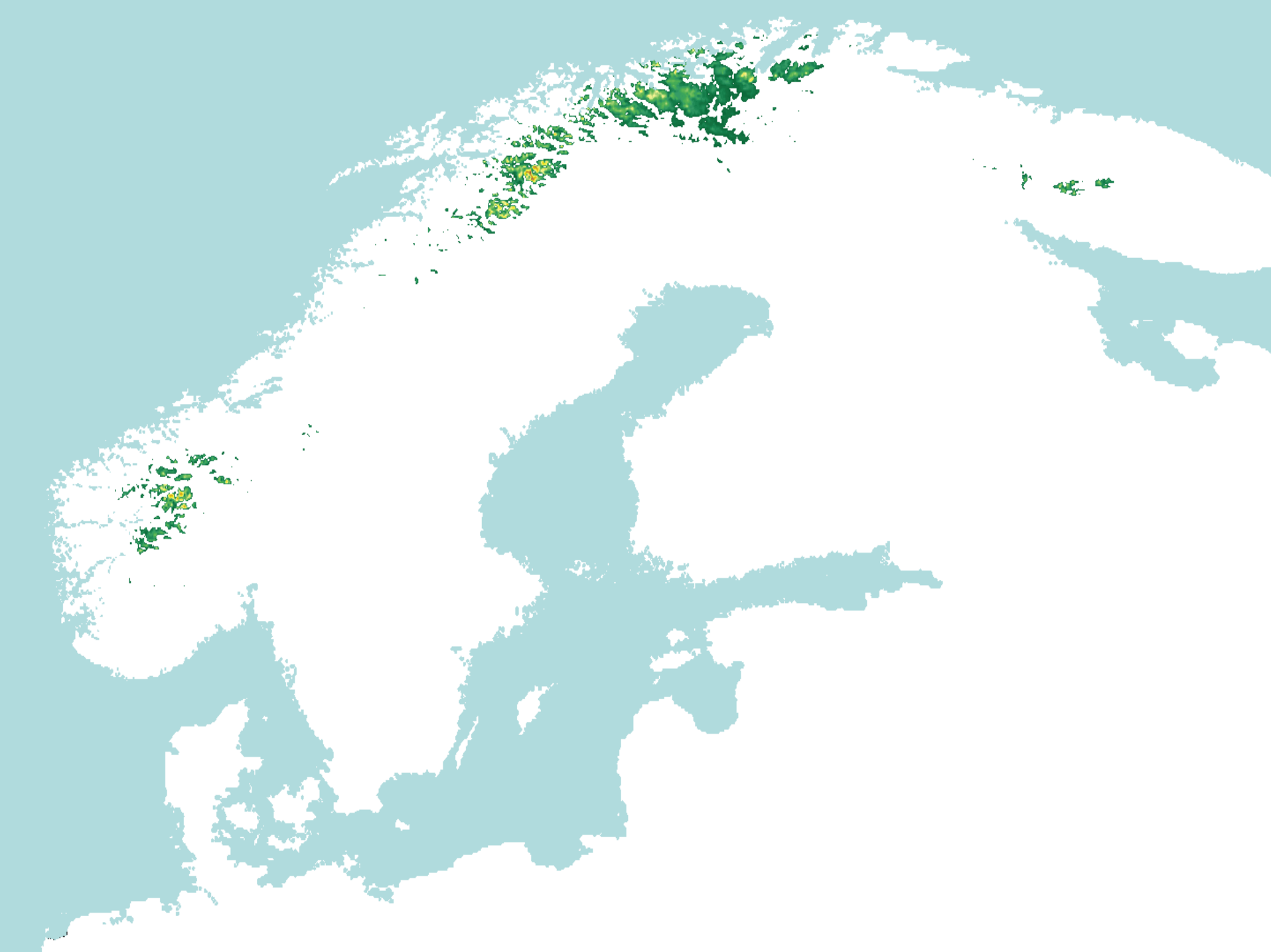

Permafrost ?

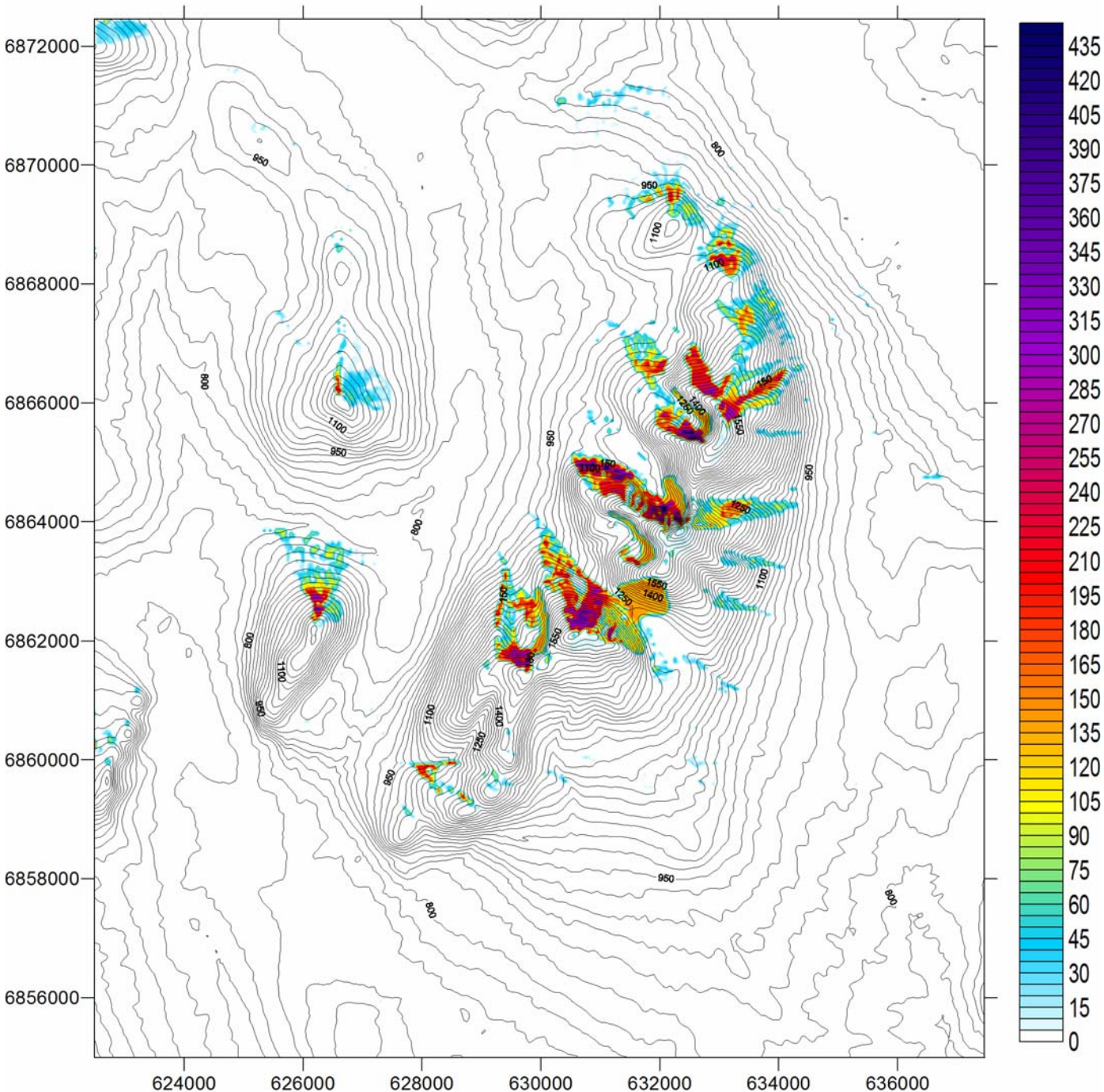
CIRCUM-ARCTIC MAP OF PERMAFROST AND GROUND-ICE CONDITIONS




70°


70°




Sølen permafrost (m) 20010901-20020831
6872000
6870000
6868000
6866000
6864000
6862000
6860000
6858000
6856000
624000
626000
628000
630000
632000
634000
636000
435
420
405
390
375
360
345
330
315
300
285
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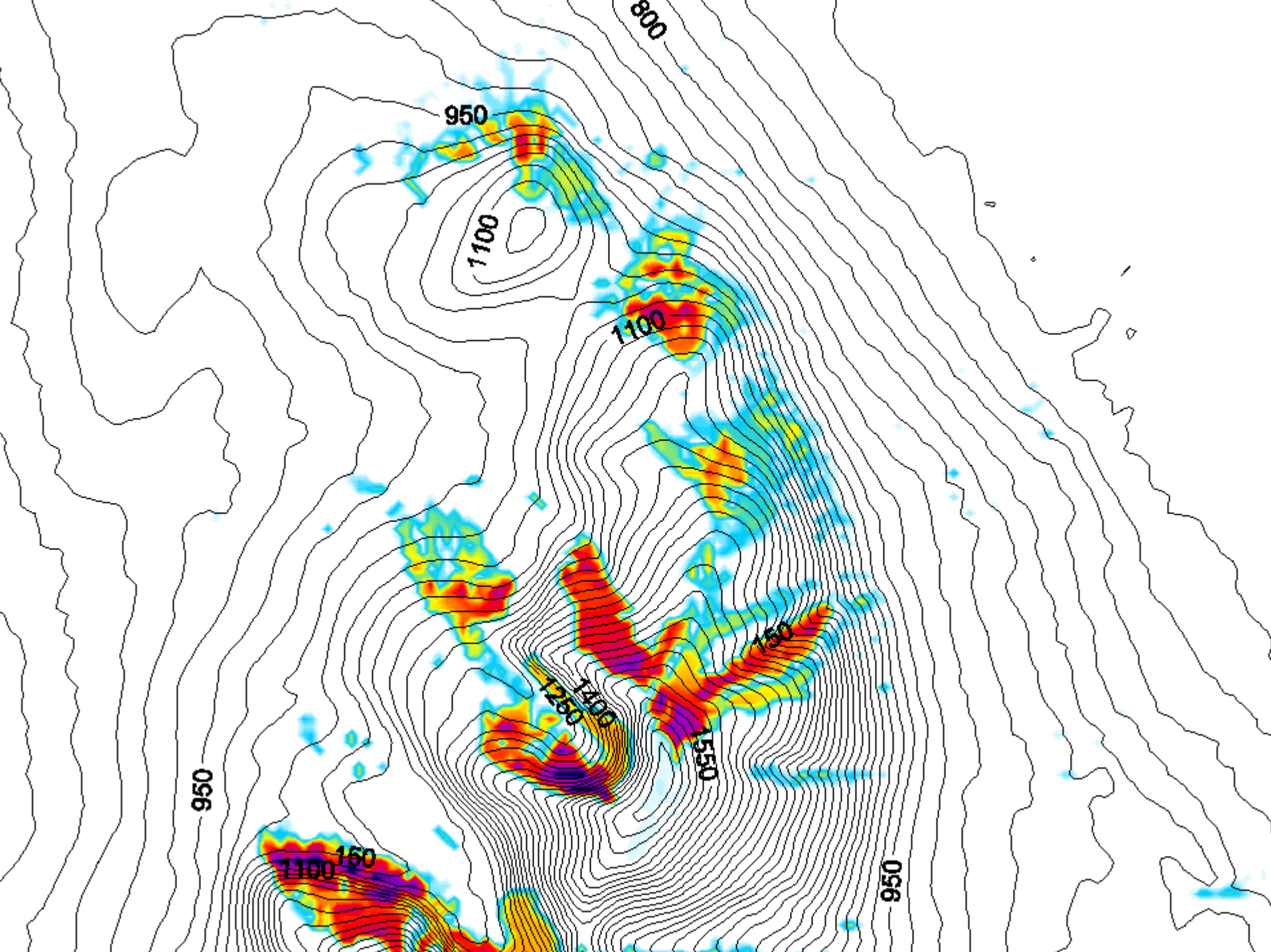
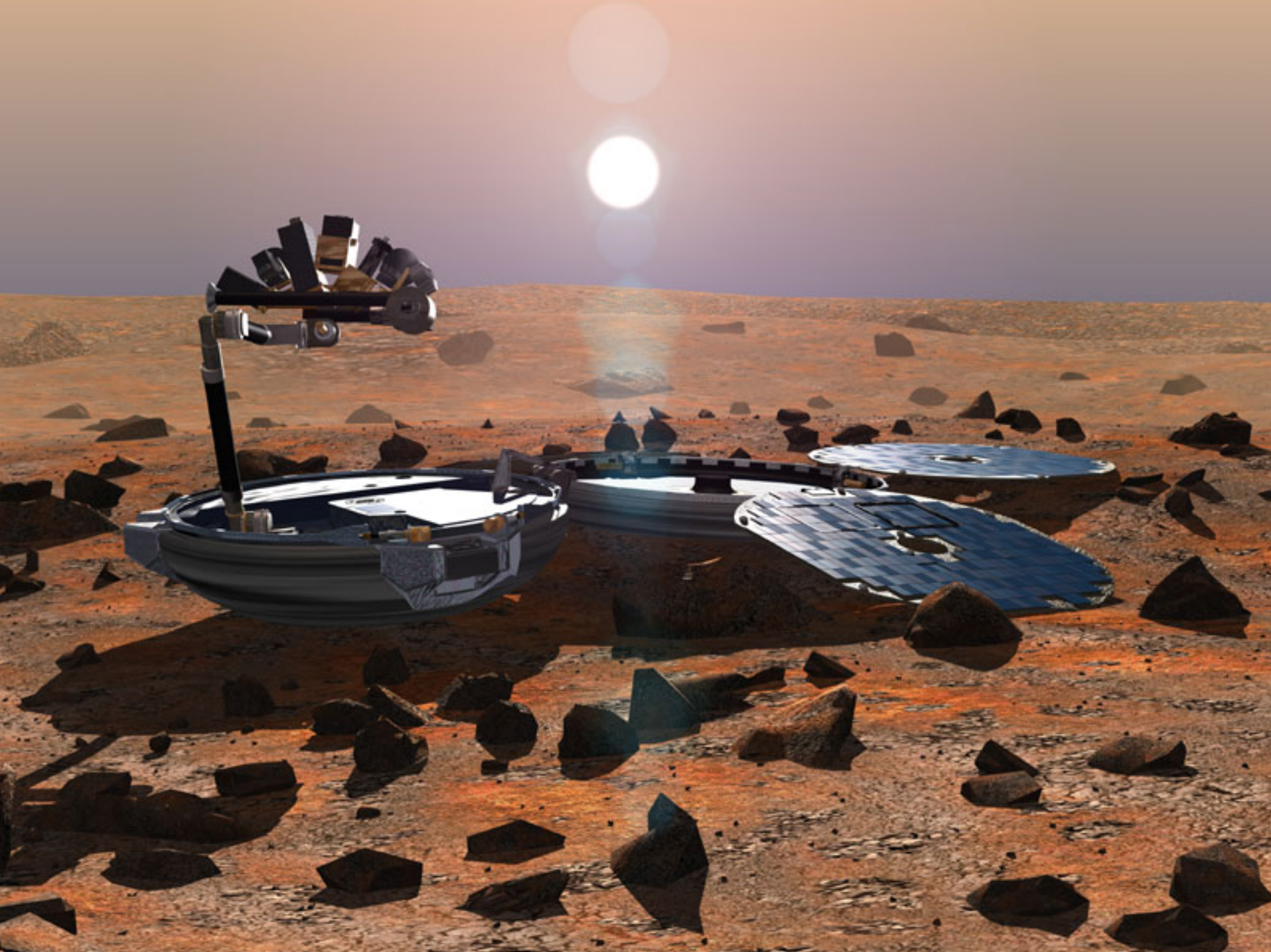
210
195
180
165
150
135
120
105
90
75
60
45
30
15
0

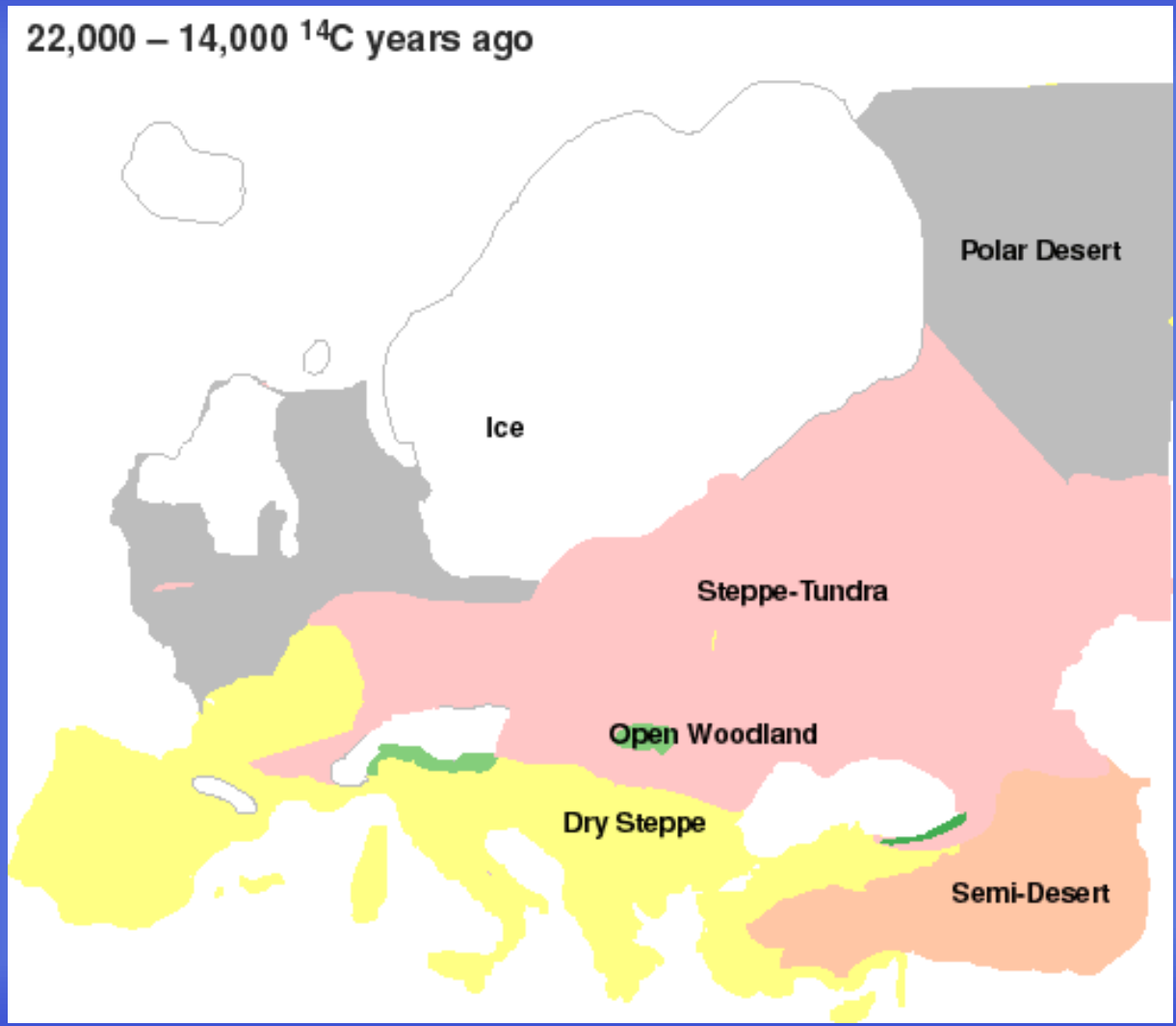

800
950
1100
1100
150
1250
1400
1550
950
1100
150
950

Permafrost on other planets ?

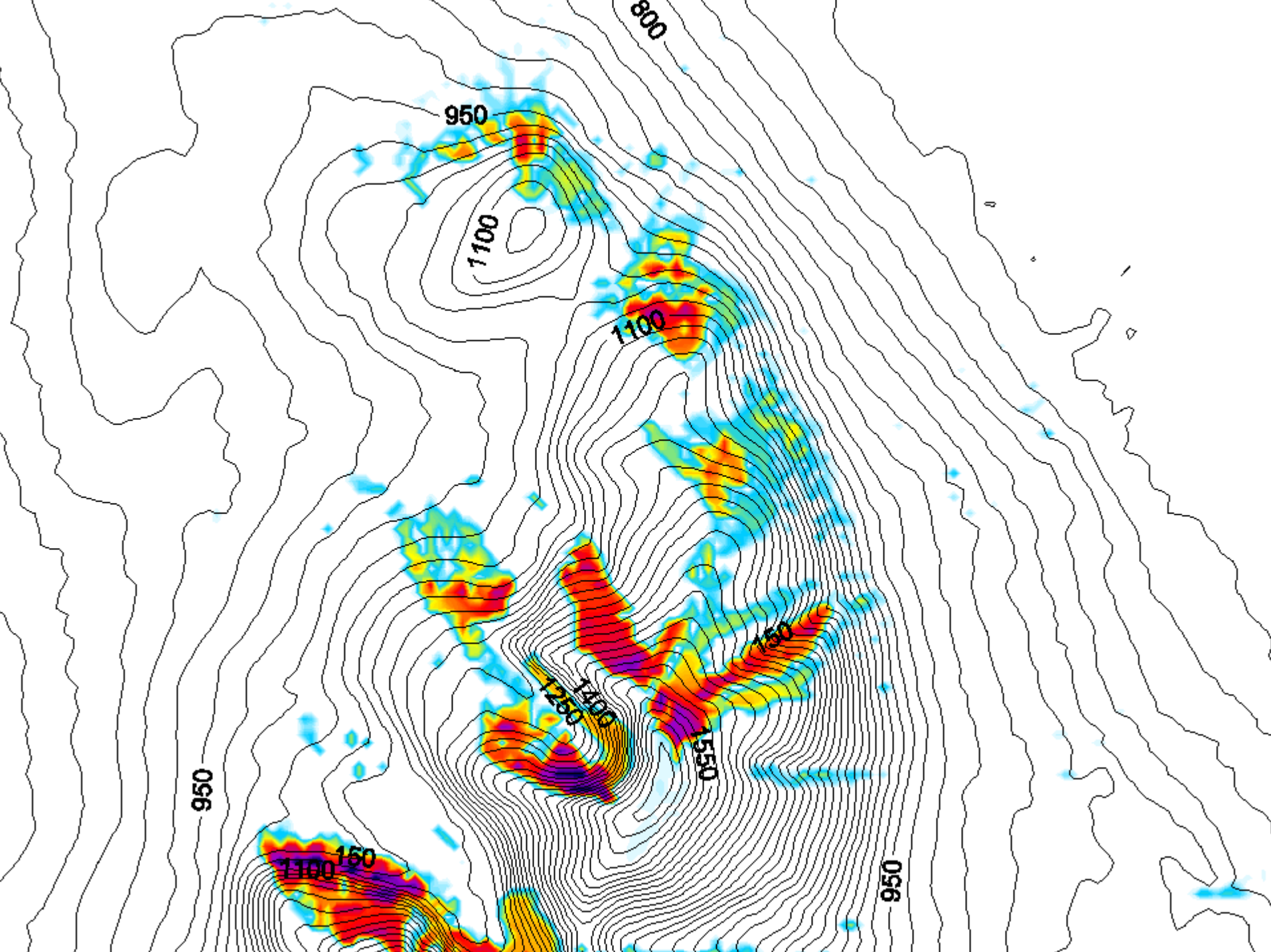



400 m
437 yards

Permafrost in Europe since last glaciation



During the last glacial period, permafrost covered about 50% of the land surface on planet Earth

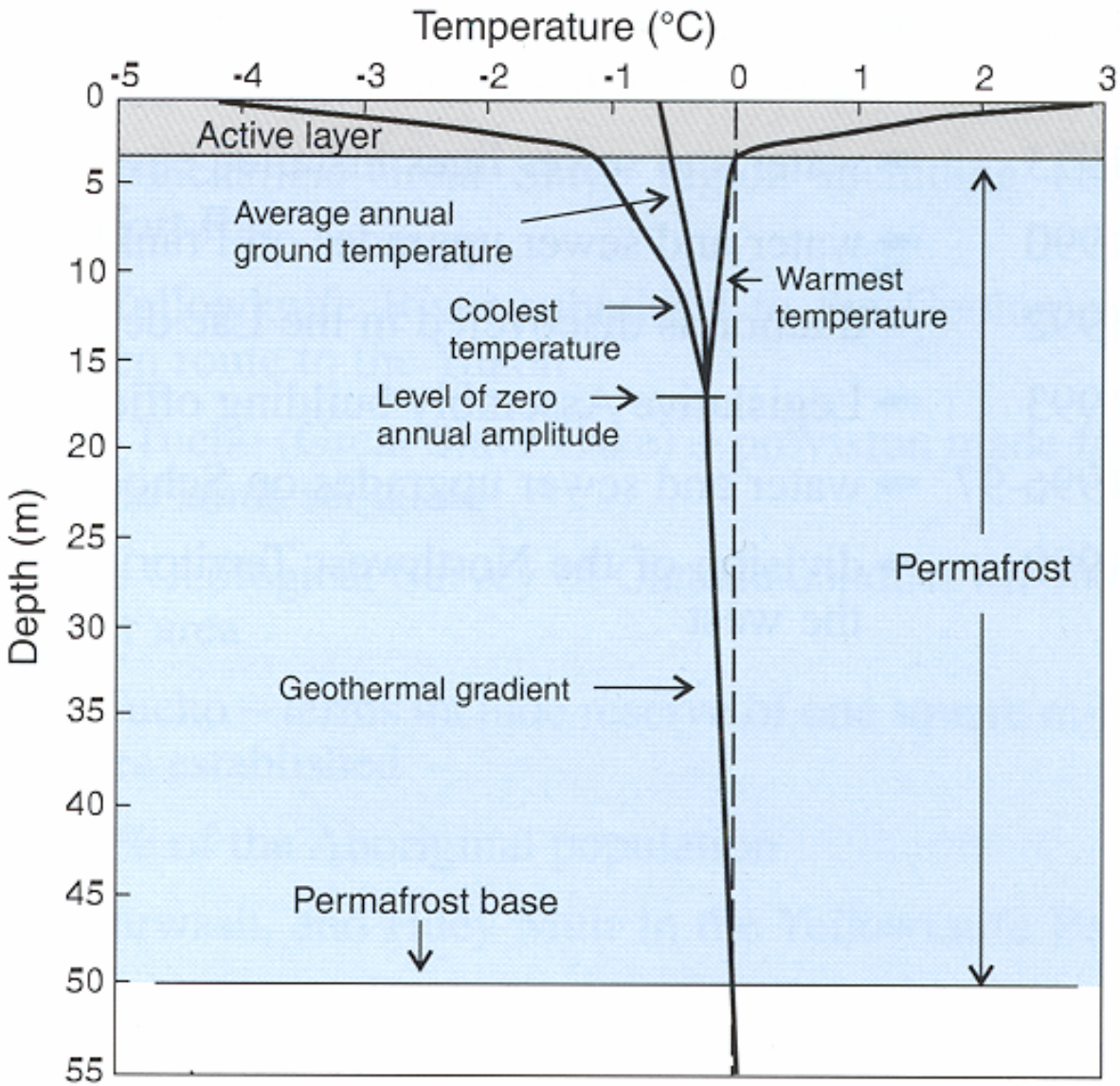

800
950
1100
1100
150
1250
1400
1550
950
1100
150
950

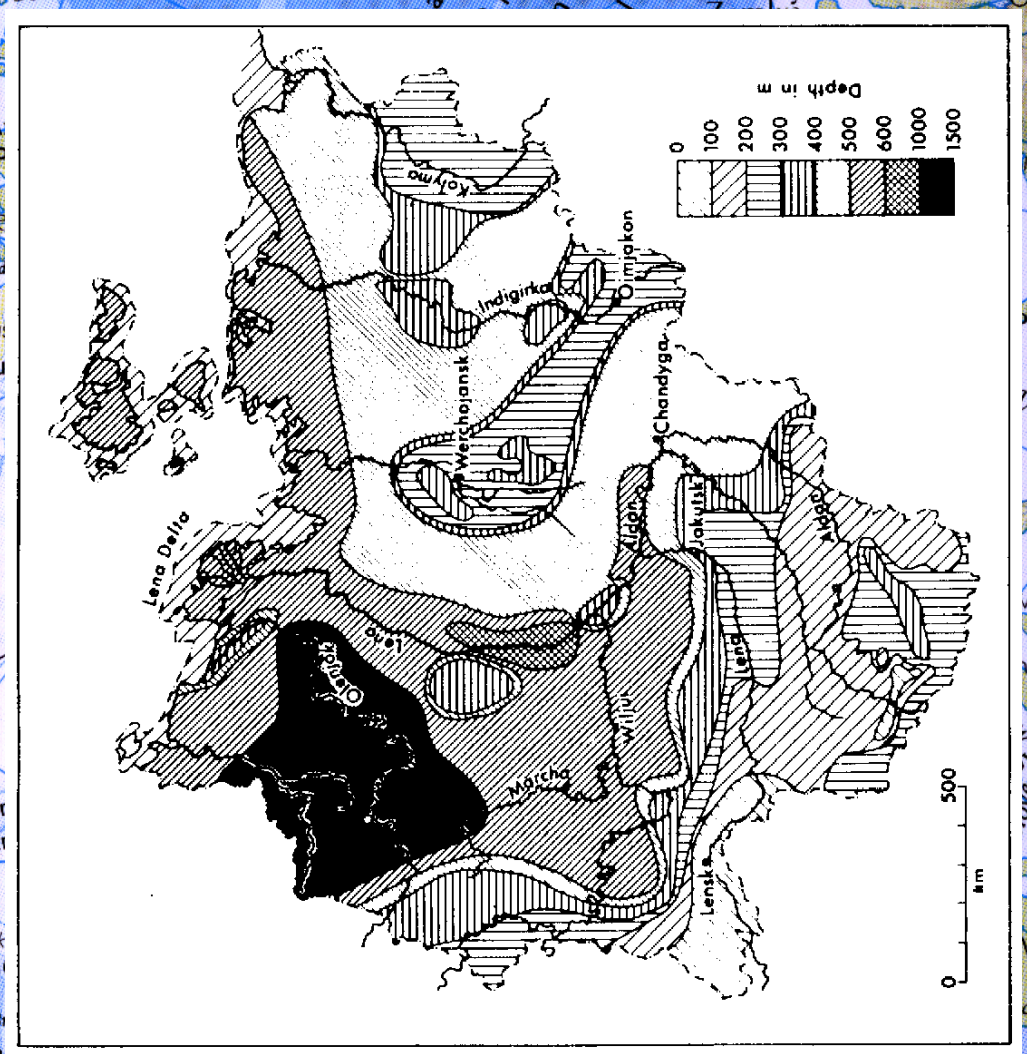
Permafrost depends on climate (MAAT),

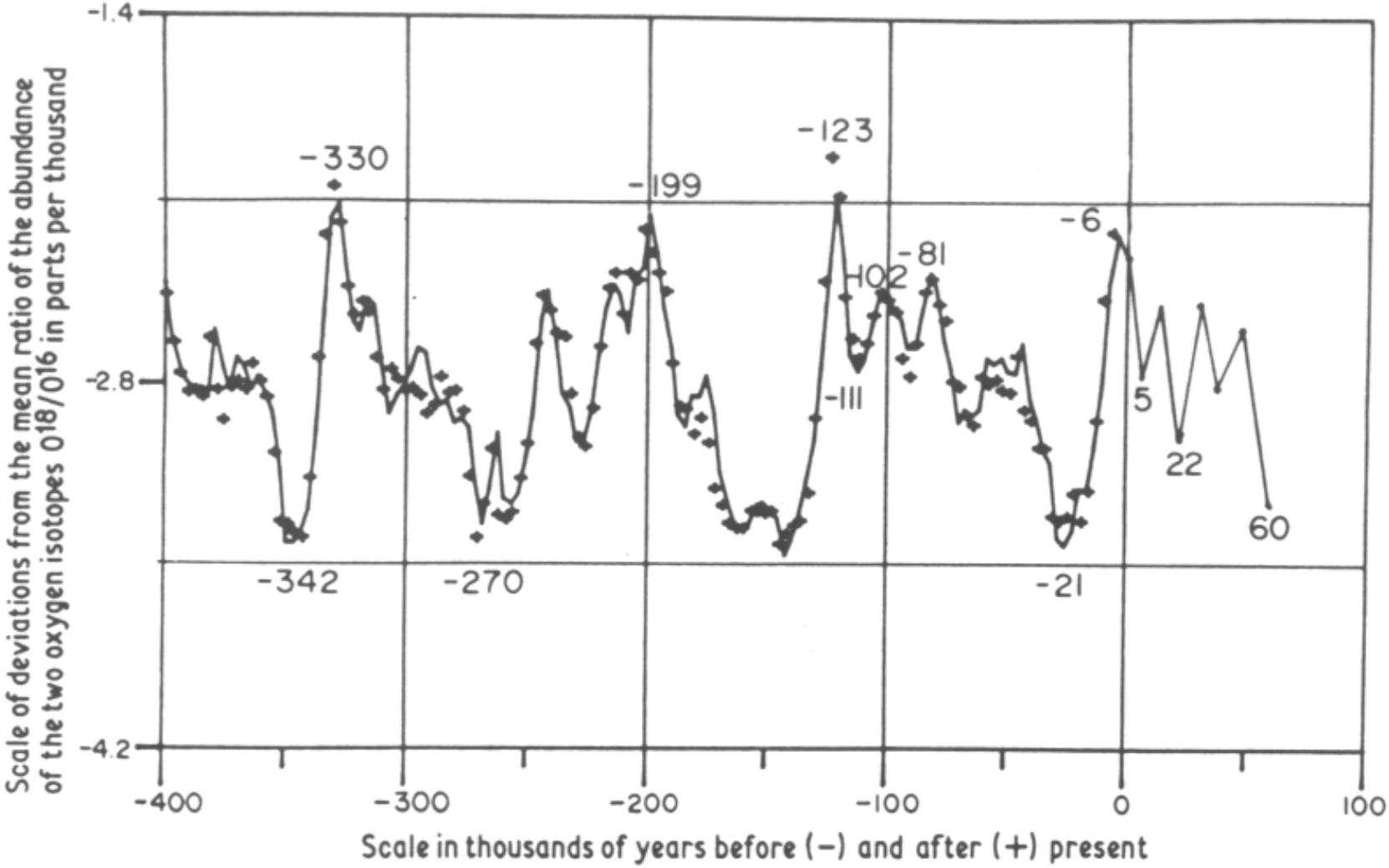
but also on local parameters such as:

- **vegetation**
- **snow cover thickness**
- **snow cover duration**
- **wind**
- **aspect**
- **albedo**
- **lithology**

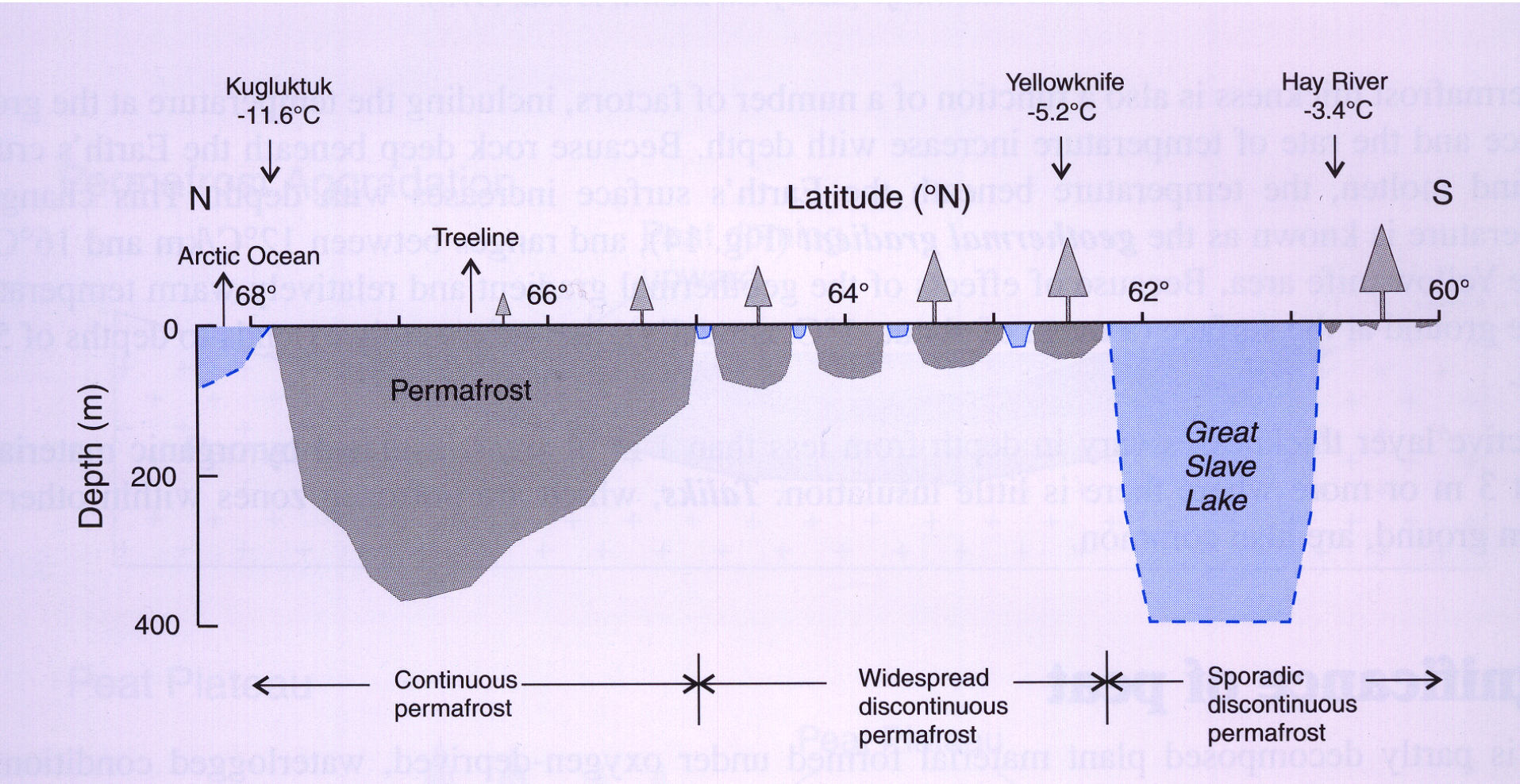
Thickness of permafrost ?




Depth in m
0
100
200
300
400
500
600
1000
1500
Kolyma
Indigirka
Omakon
Chandyga
Werchojansk
Aldan
Jakutsk
Aldan
Lena Delta
Lena
Yana
Wilui
Marcha
Lensk
500
km
0


-1.4
-2.8
-4.2
-330
-199
-123
-102
-81
-6
-111
5
22
60
-342
-270
-21
-400
-300
-200
-100
0
100
Scale of deviations from the mean ratio of the abundance of the two oxygen isotopes 018/016 in parts per thousand
Scale in thousands of years before (-) and after (+) present

Permafrost transect north-south in Canada



-6°C -2°C 0°C

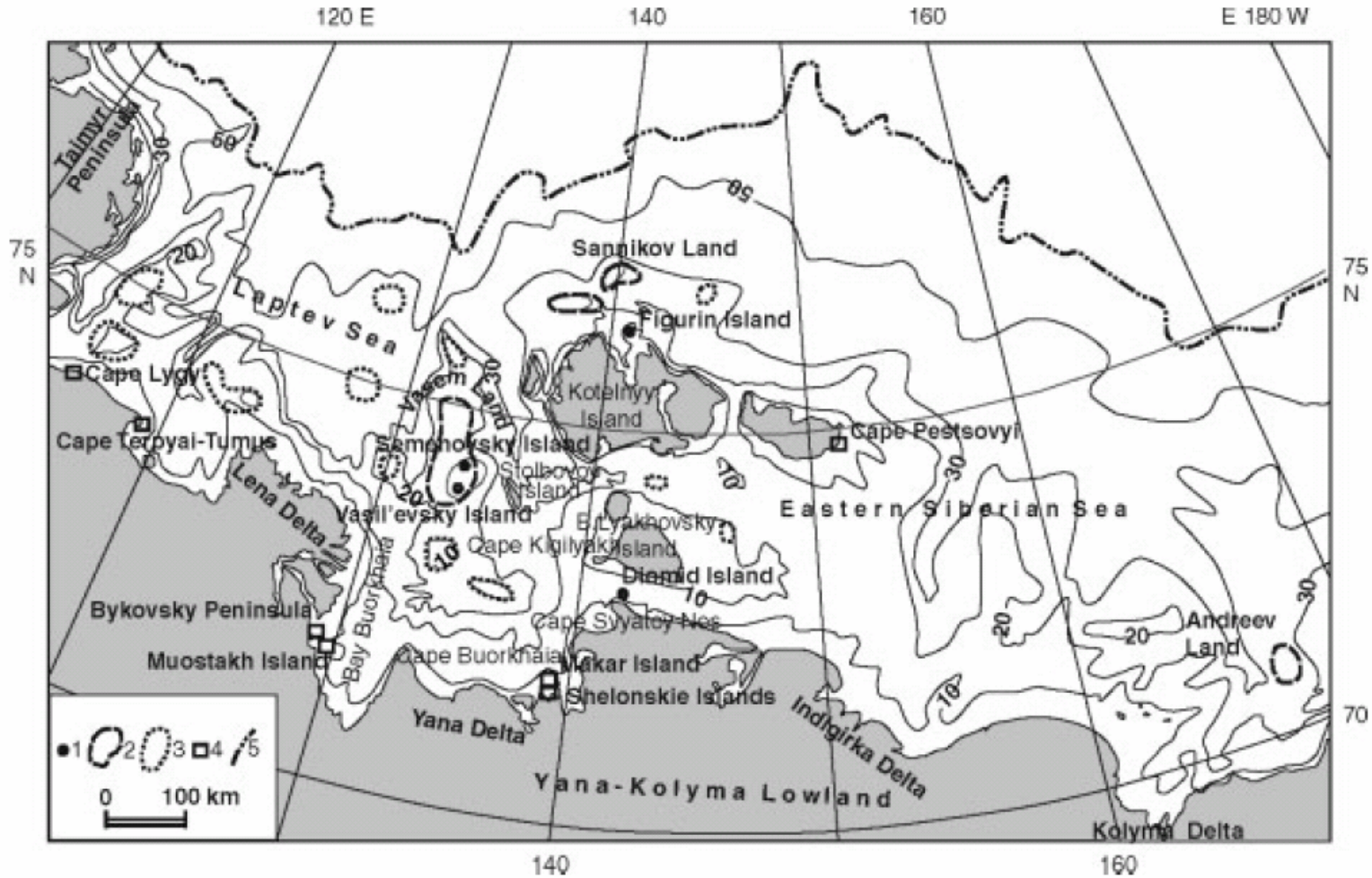
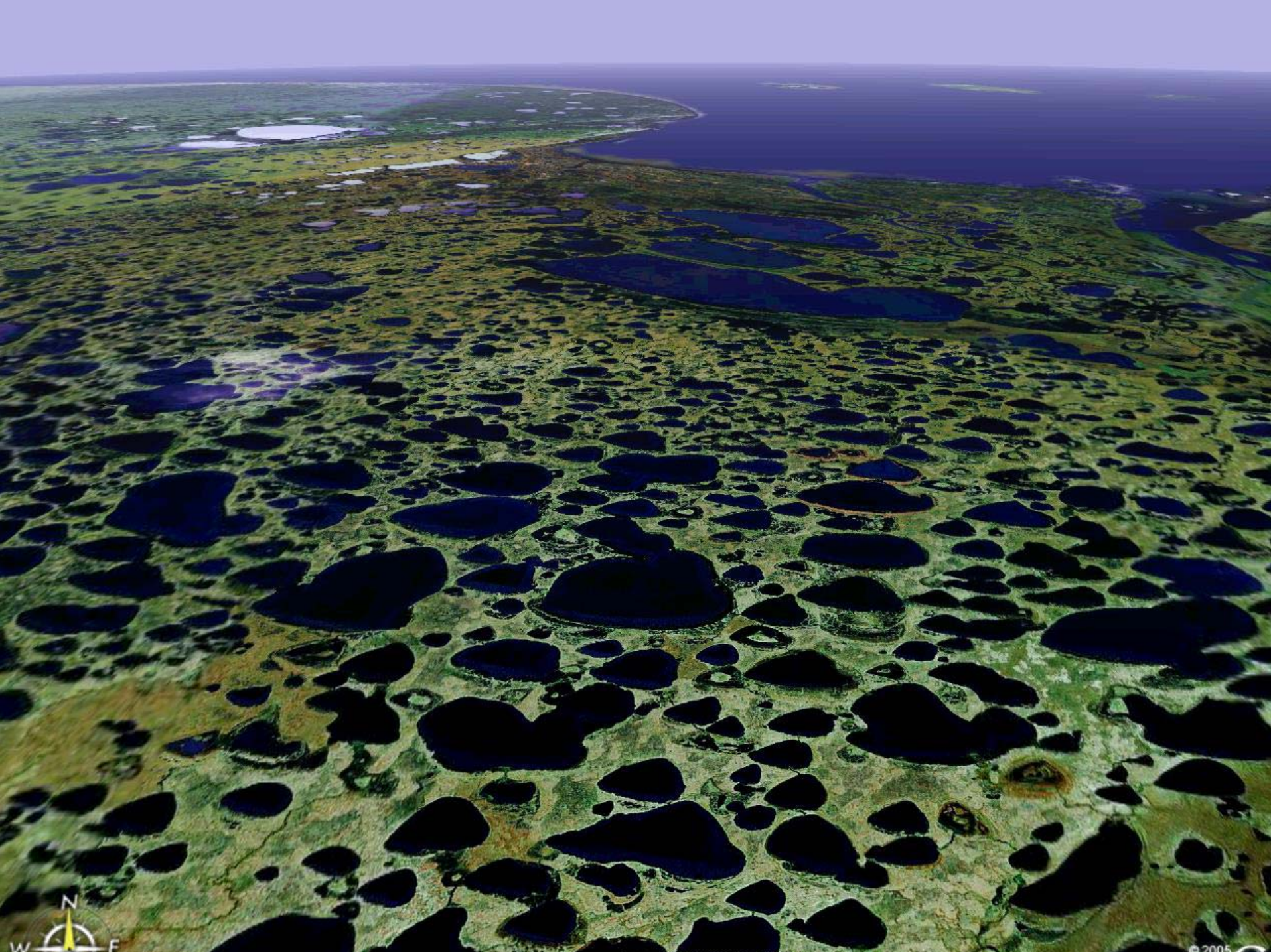


Figure 3 Schematic map of IC islands: (1) IC islands that disappeared according to historical documents in the 18th–20th centuries; (2) IC islands presumably existed (according to historical documents) 100–250 years ago; (3) IC islands, the location of which was reconstructed in this studies based on geocryological data (destroyed by thermal abrasion 300–800 years ago); (4) IC islands, and other islands and peninsulas being eroded by thermal abrasion at the present time; (5) shelf edge.

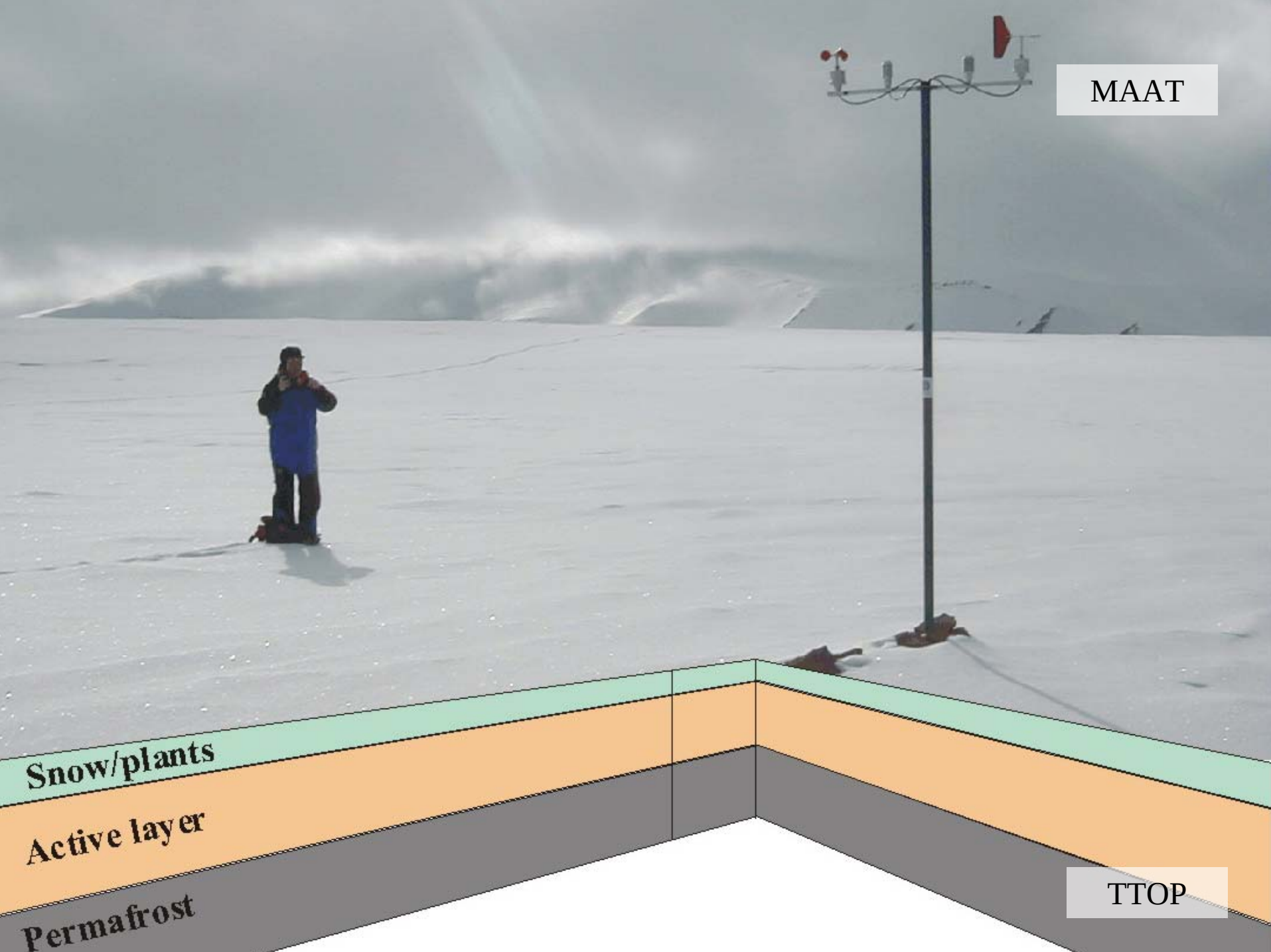
Ice complex, Lena Delta (Foto A. Sher)

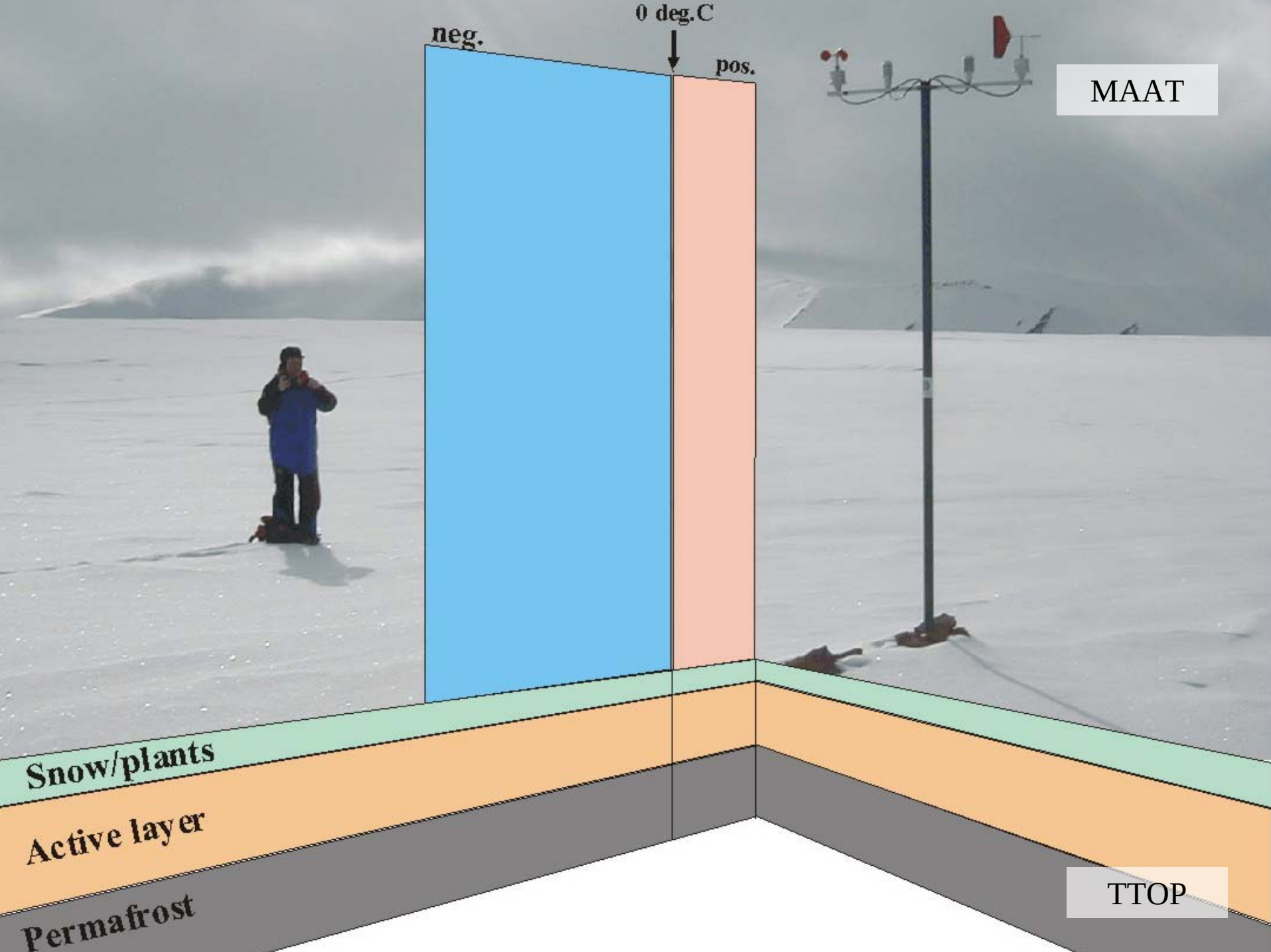

N

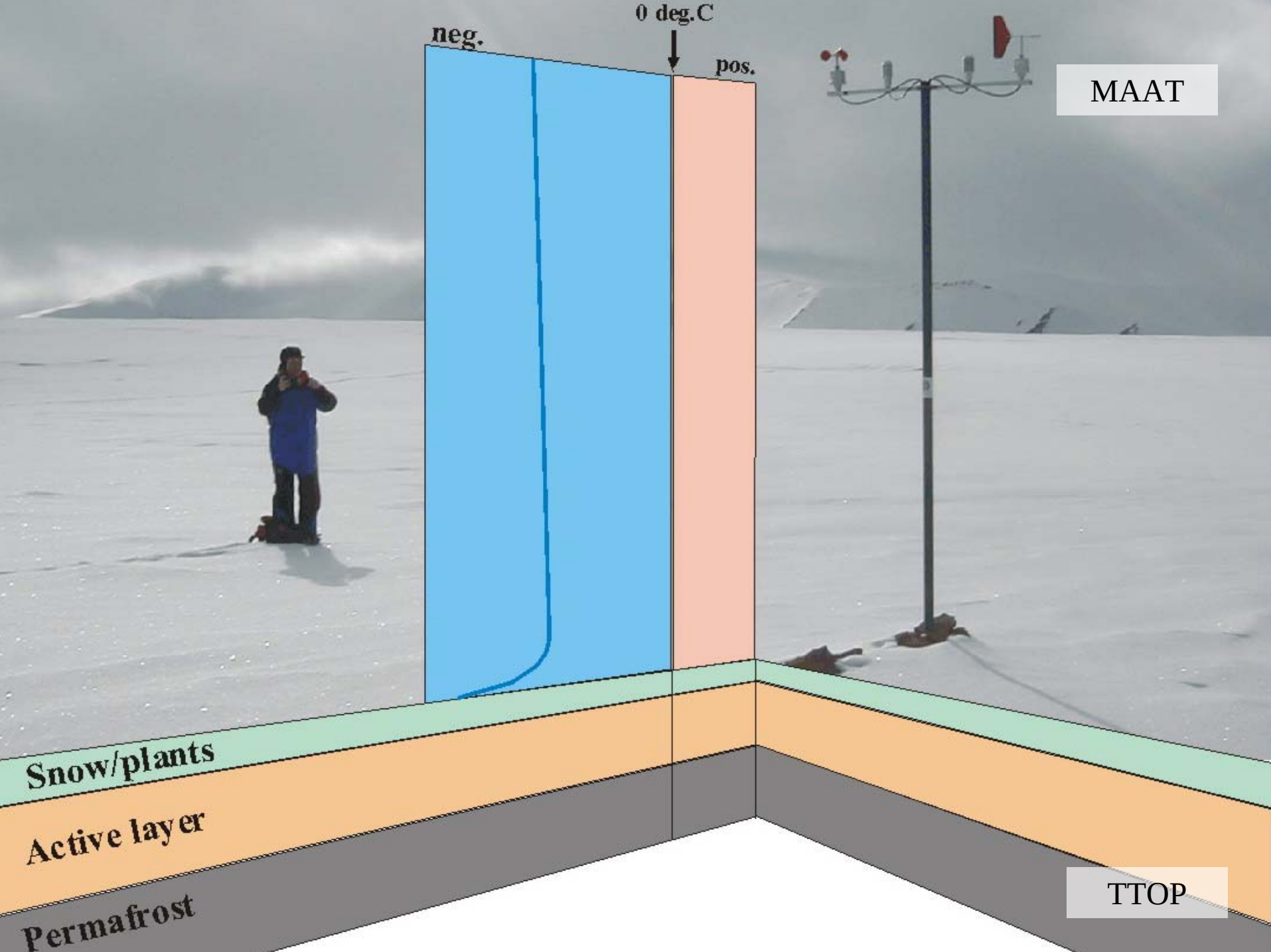

N
W
E

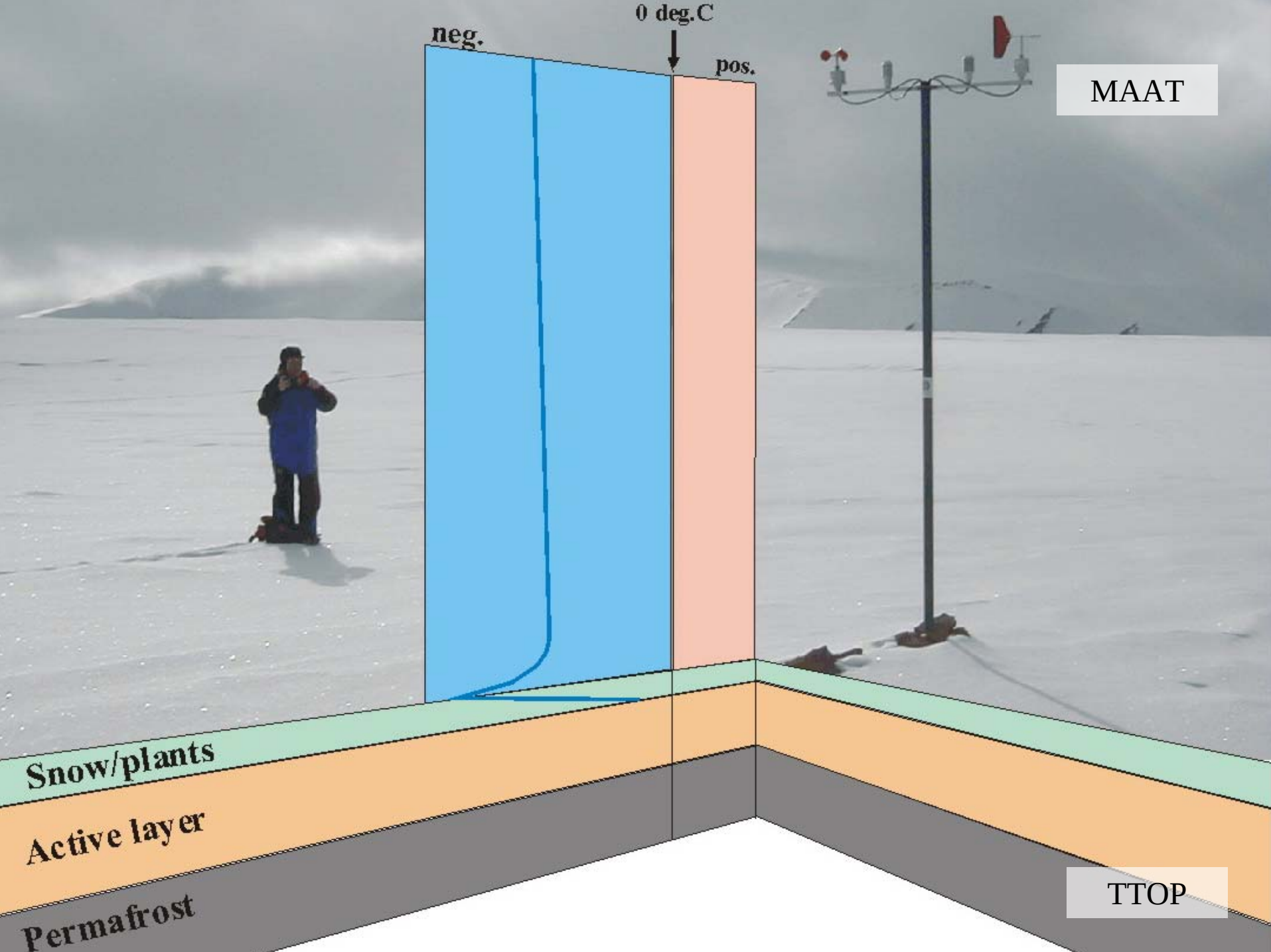
Gruvefjellet meteorological station, central Spitsbergen, Svalbard, 18th May 2002

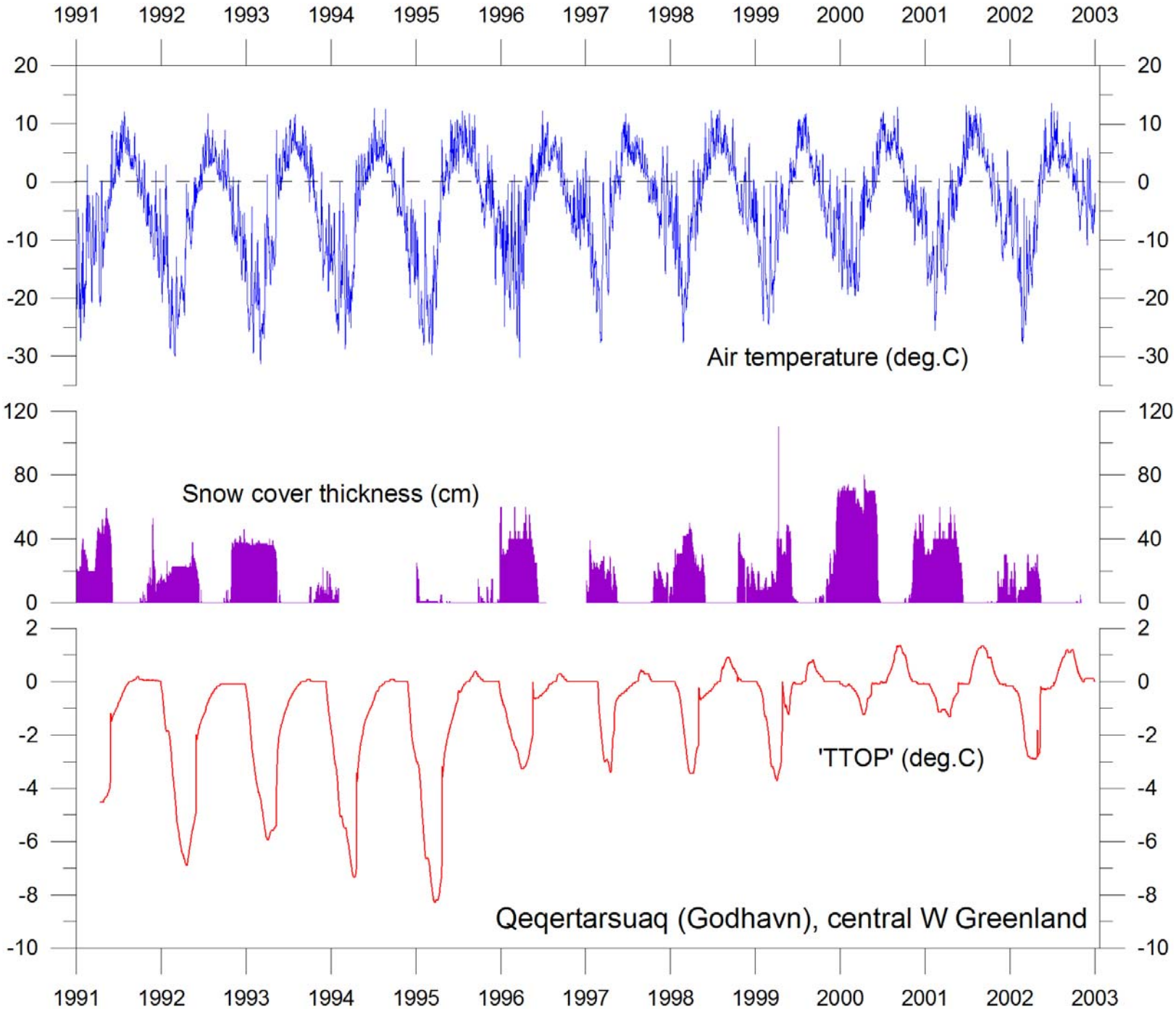
Controls on permafrost temperatures

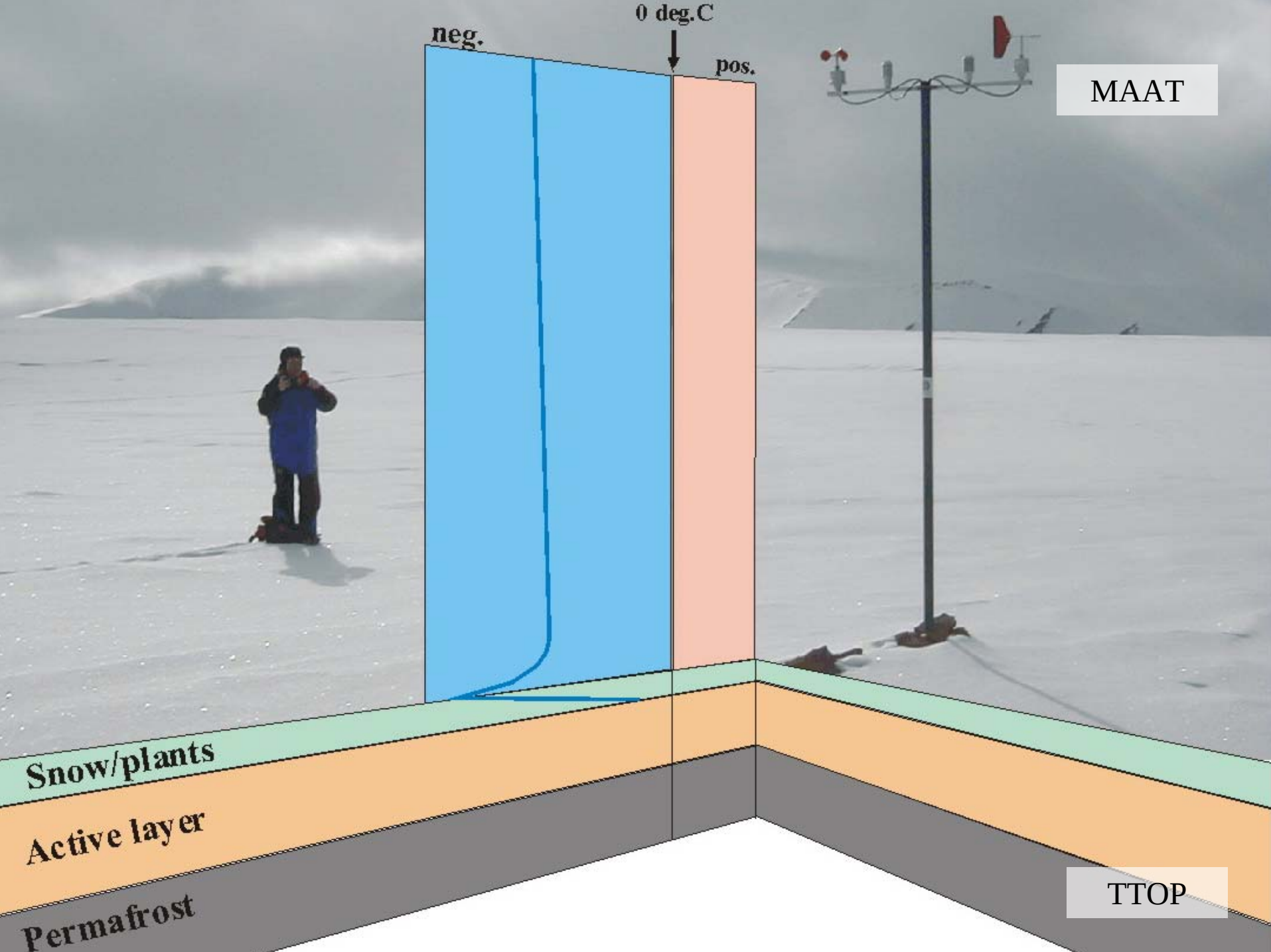

MAAT
Snow/plants
Active layer
Permafrost
TTOP

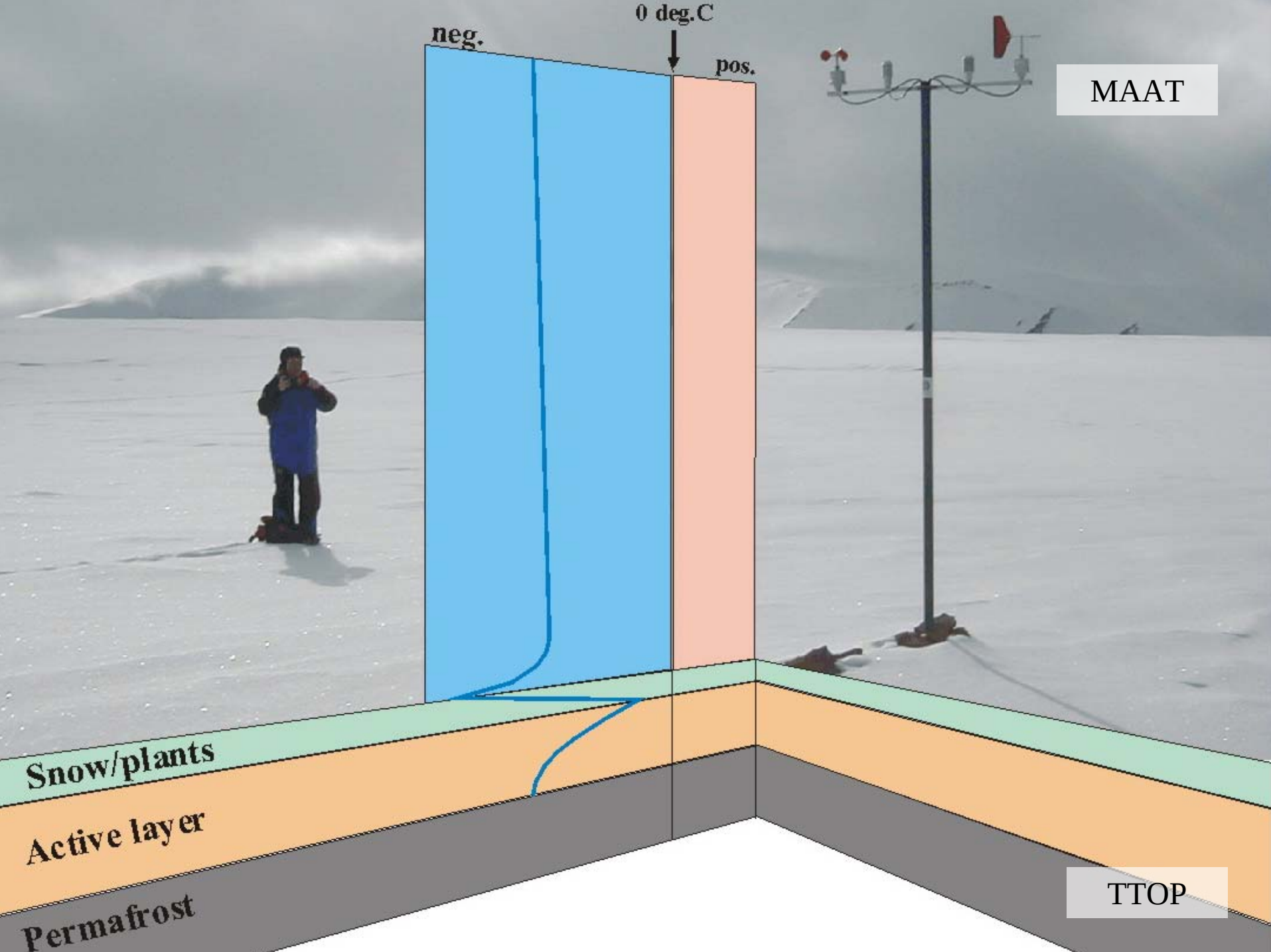

0 deg.C
neg.
pos.
MAAT
Snow/plants
Active layer
Permafrost
TTOP

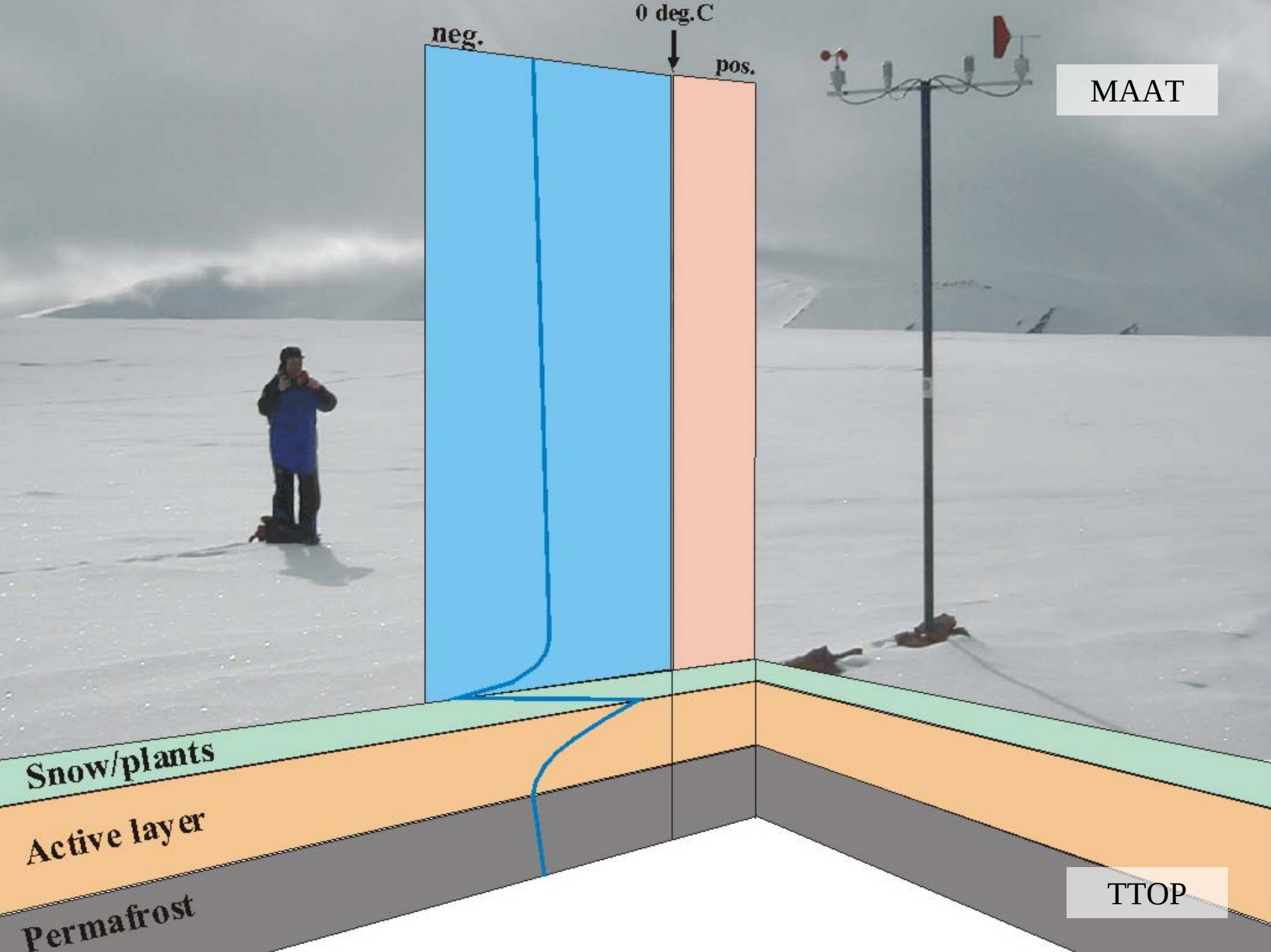

0 deg.C
neg.
pos.
MAAT
Snow/plants
Active layer
Permafrost
TTOP


0 deg.C
neg.
pos.
MAAT
Snow/plants
Active layer
Permafrost
TTOP


1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
20
10
0
-10
-20
-30
Air temperature (deg.C)
120
80
40
0
Snow cover thickness (cm)
2
0
-2
-4
-6
-8
-10
'TTOP' (deg.C)
Qeqertarsuaq (Godhavn), central W Greenland

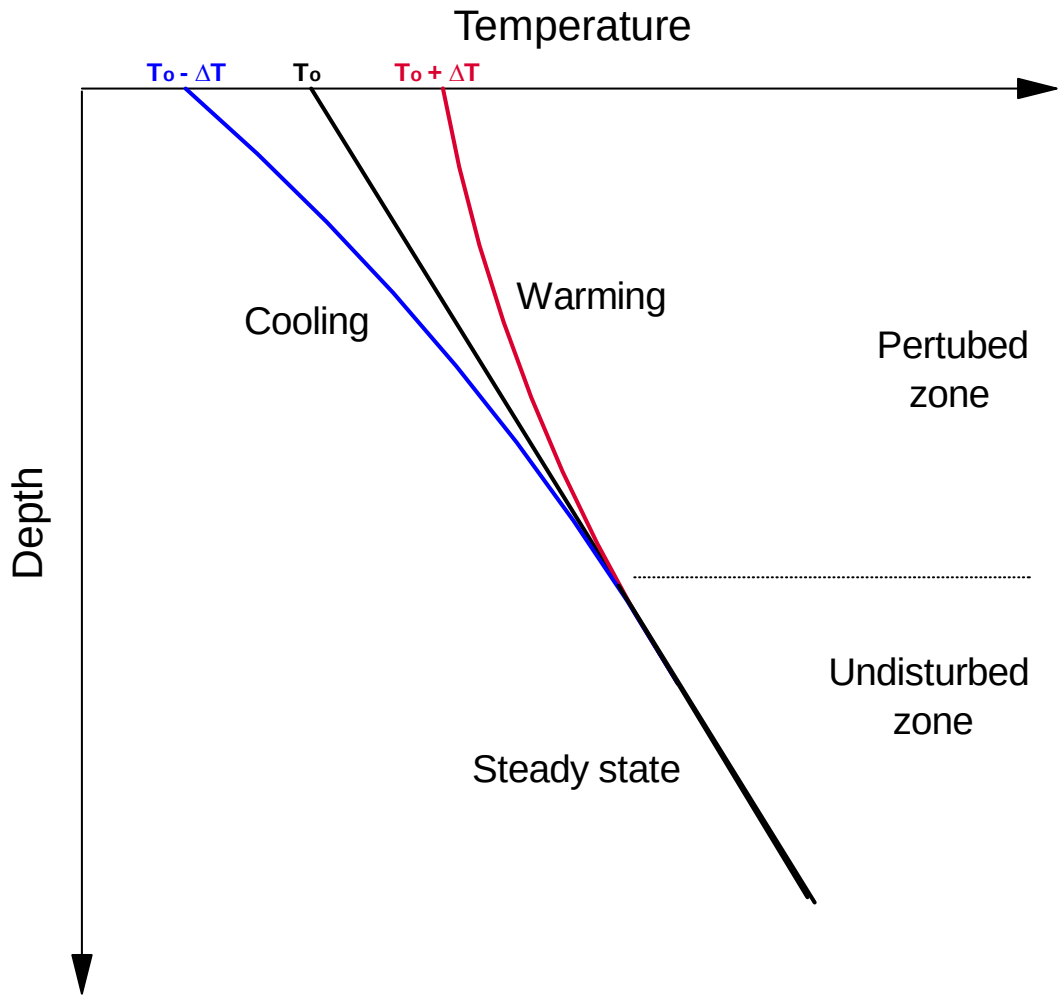

0 deg.C
neg.
pos.
MAAT
Snow/plants
Active layer
Permafrost
TTOP


0 deg.C
neg.
pos.
MAAT
Snow/plants
Active layer
Permafrost
TTOP

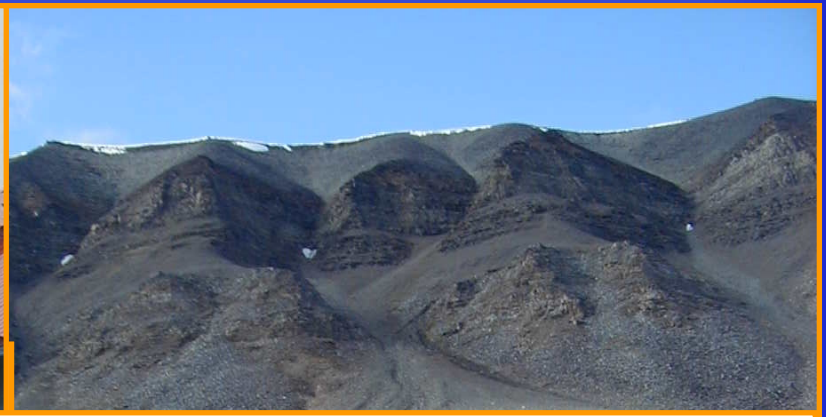

0 deg.C
neg.
pos.
MAAT
Snow/plants
Active layer
Permafrost
TTOP

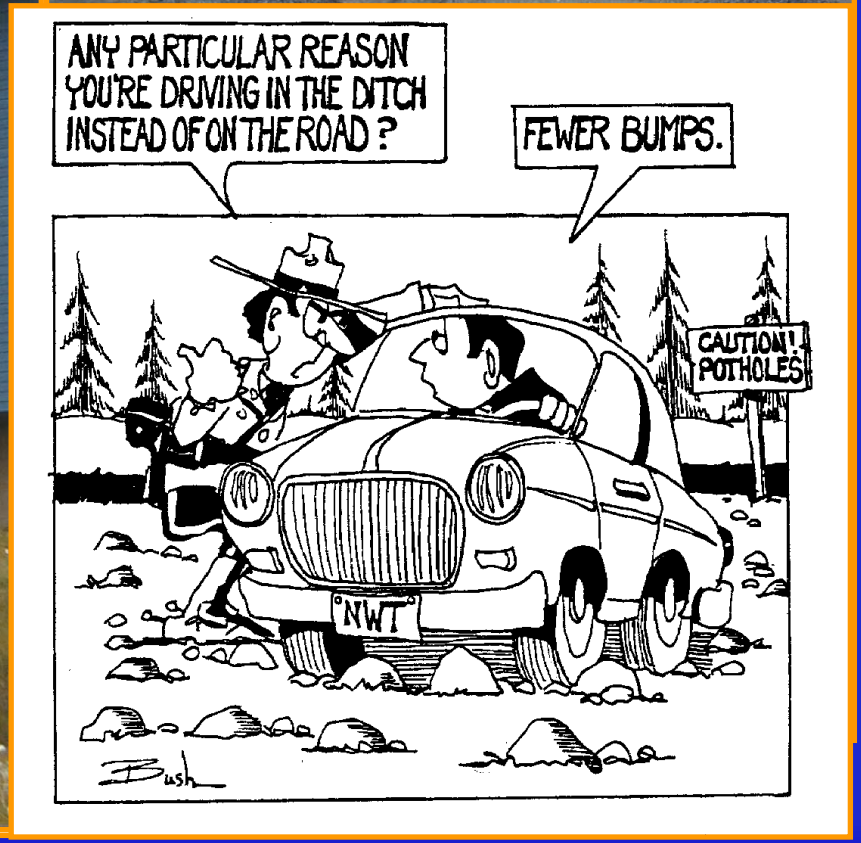
Permafrost and climate

- Geothermic response to changes in temperature (TTOP)



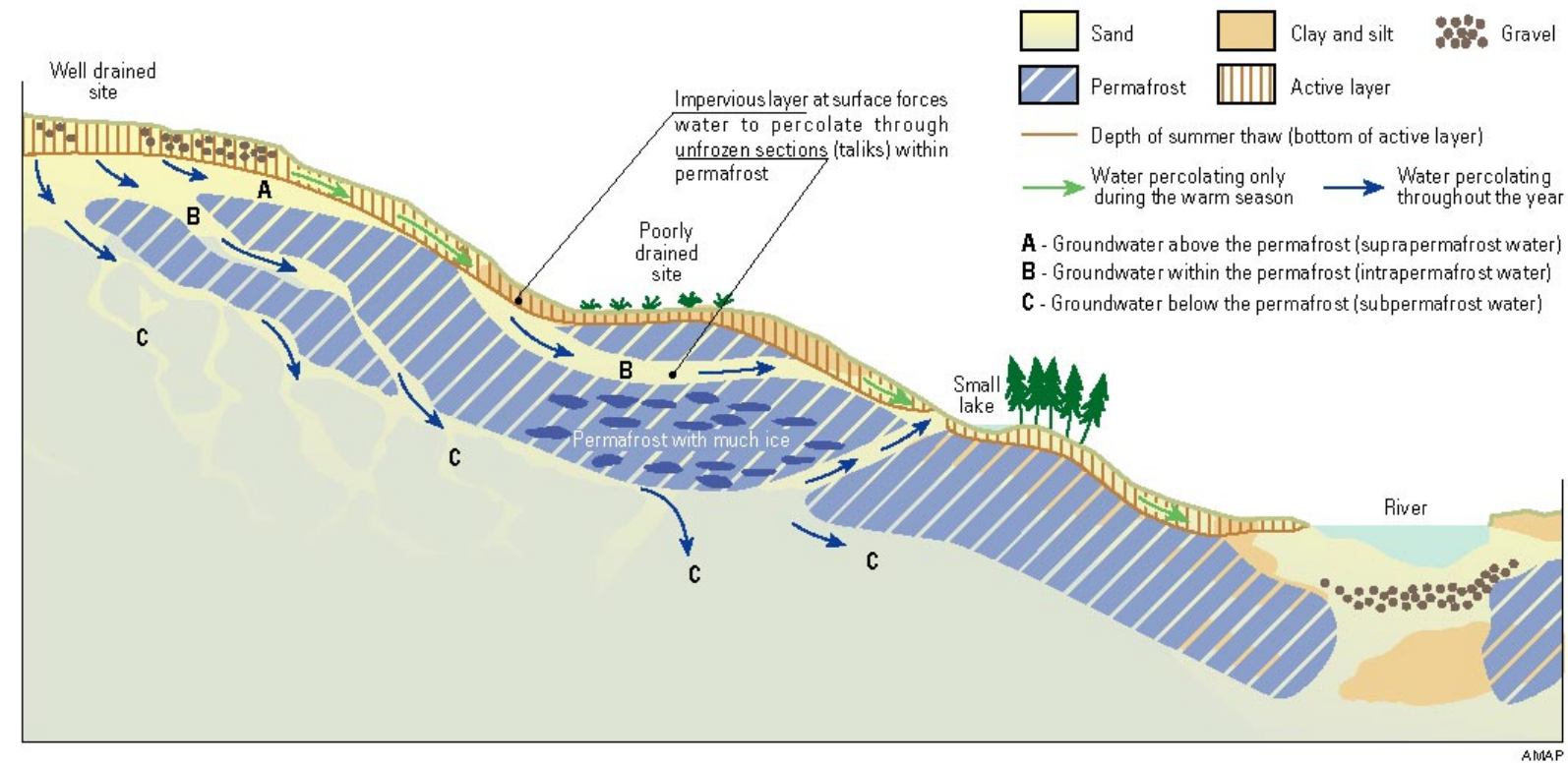
Permafrost significance





Arctic Monitoring and Assessment Programme

AMAP Assessment Report: Arctic Pollution Issues, Figure 2·10



Hydrosphere hydrology