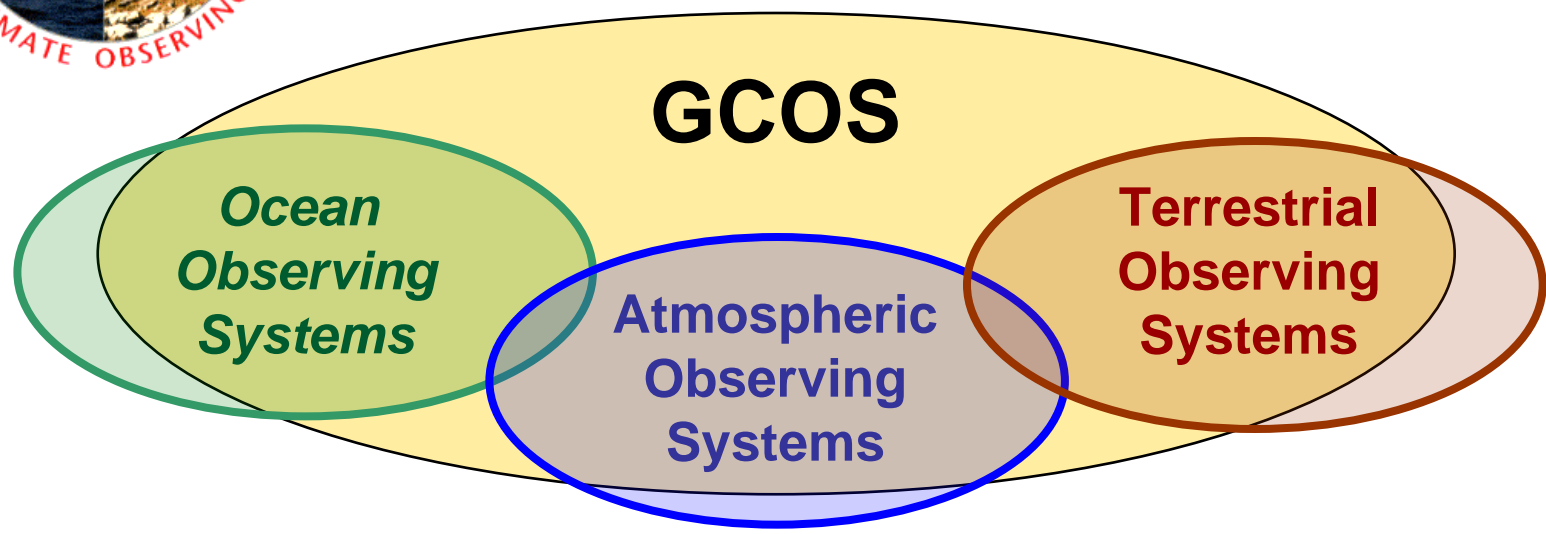
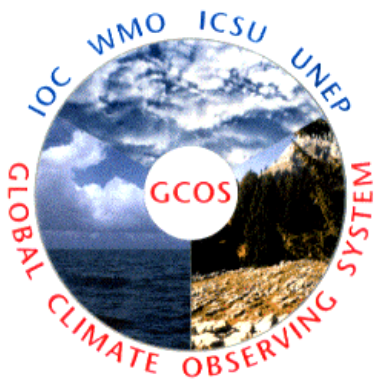




GTN-P

Global Terrestrial
Network for
Permafrost

*Continued Permafrost Warming
in Northern Alaska, 2008
Update*



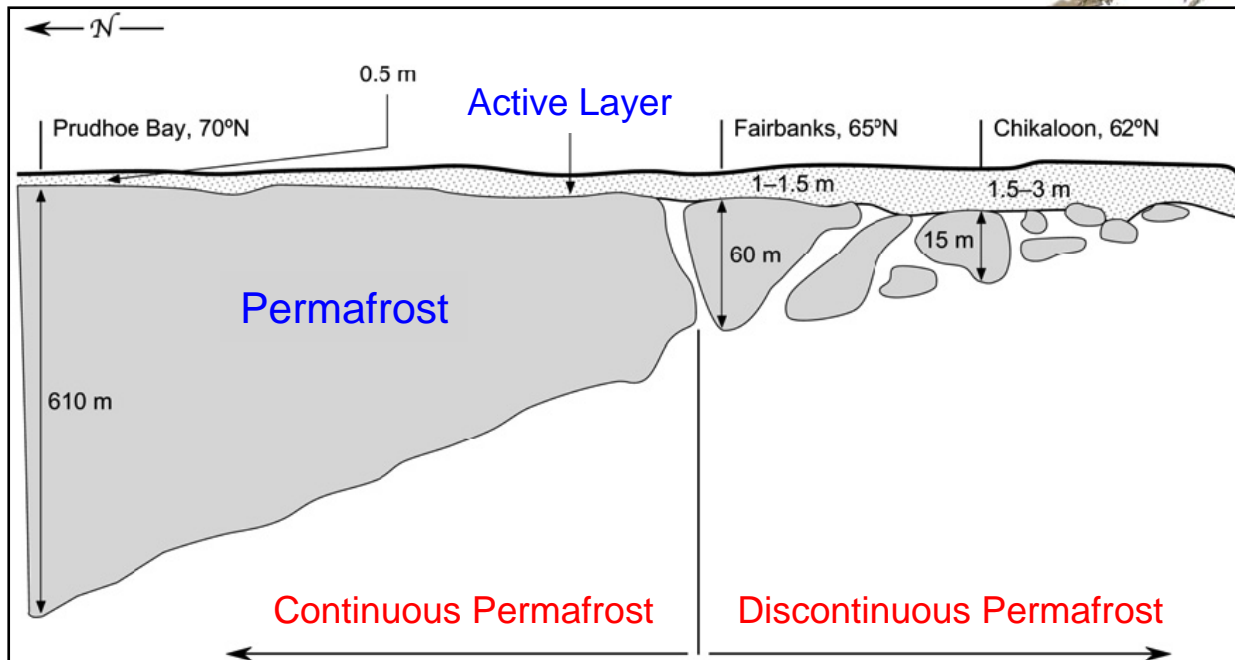
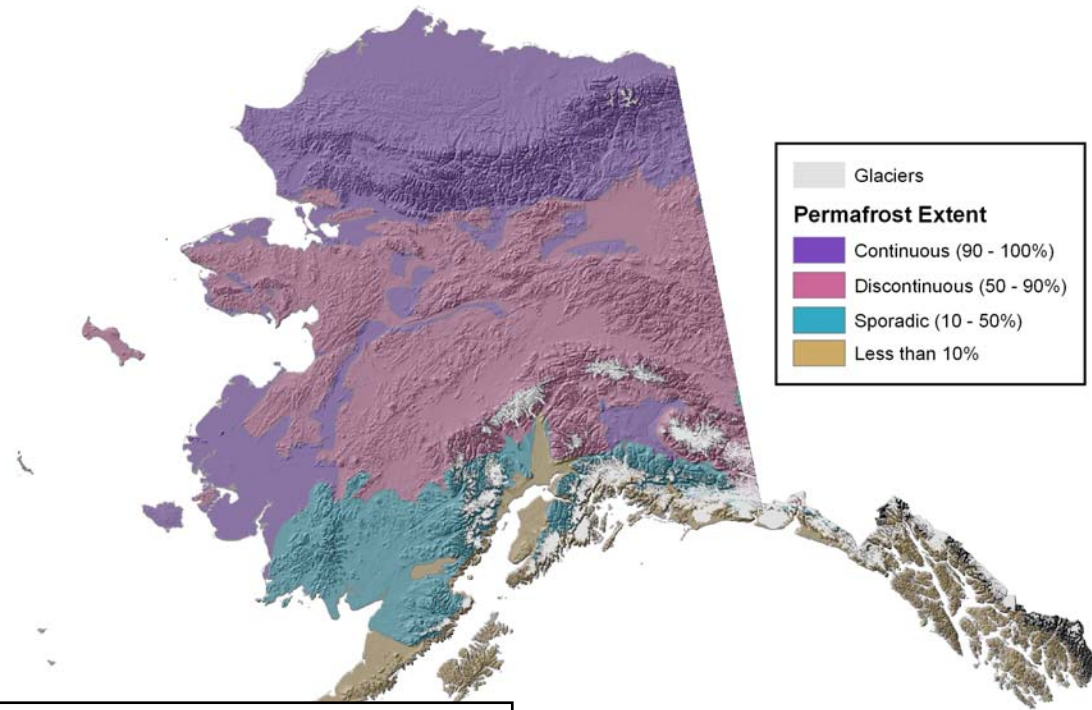
Essential Climate Variables:

....

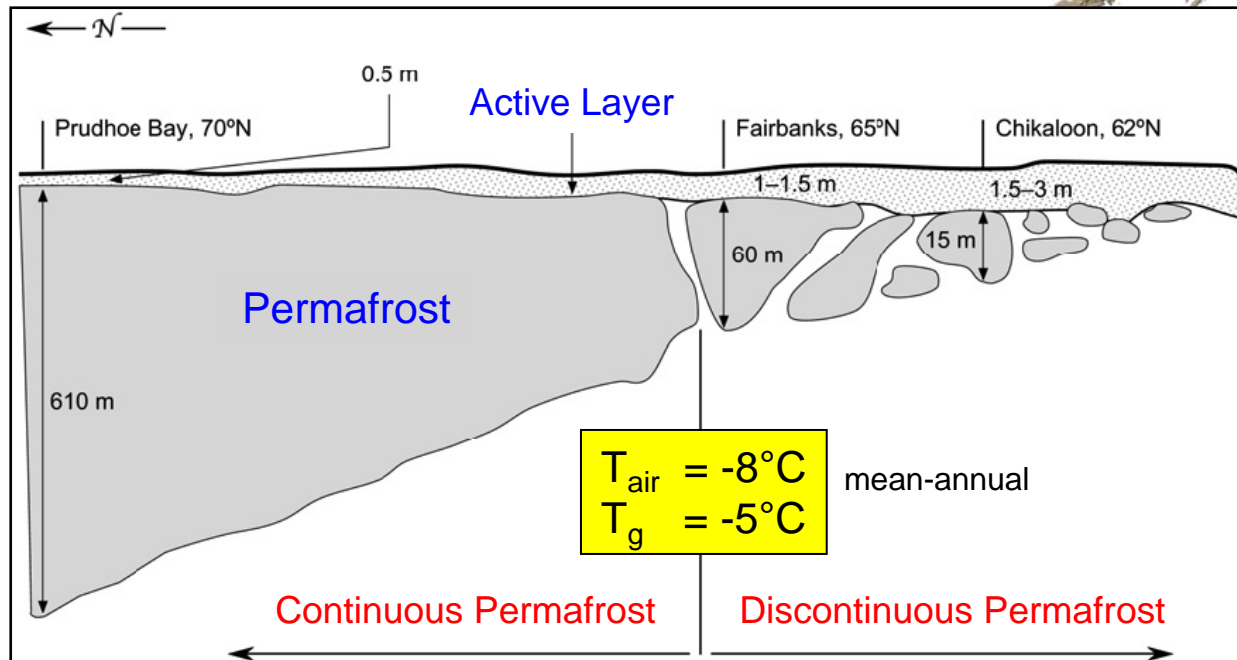
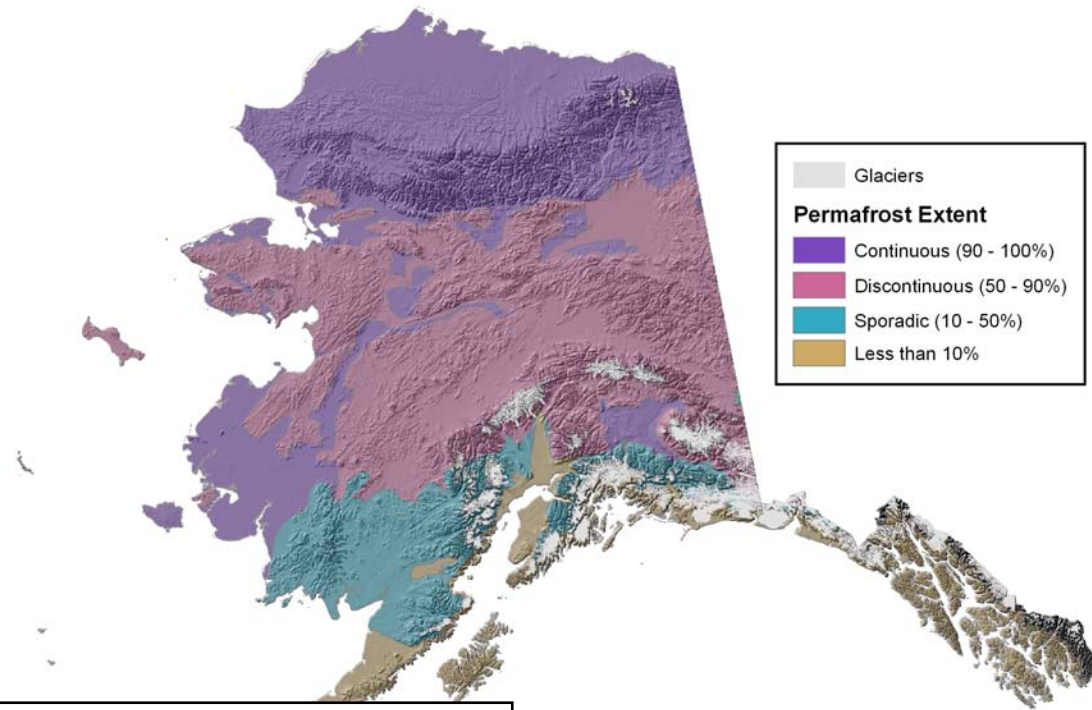
- permafrost - active layer thickness (GTN-P)
- permafrost - thermal state (GTN-P)

....

Permafrost Zones Alaska

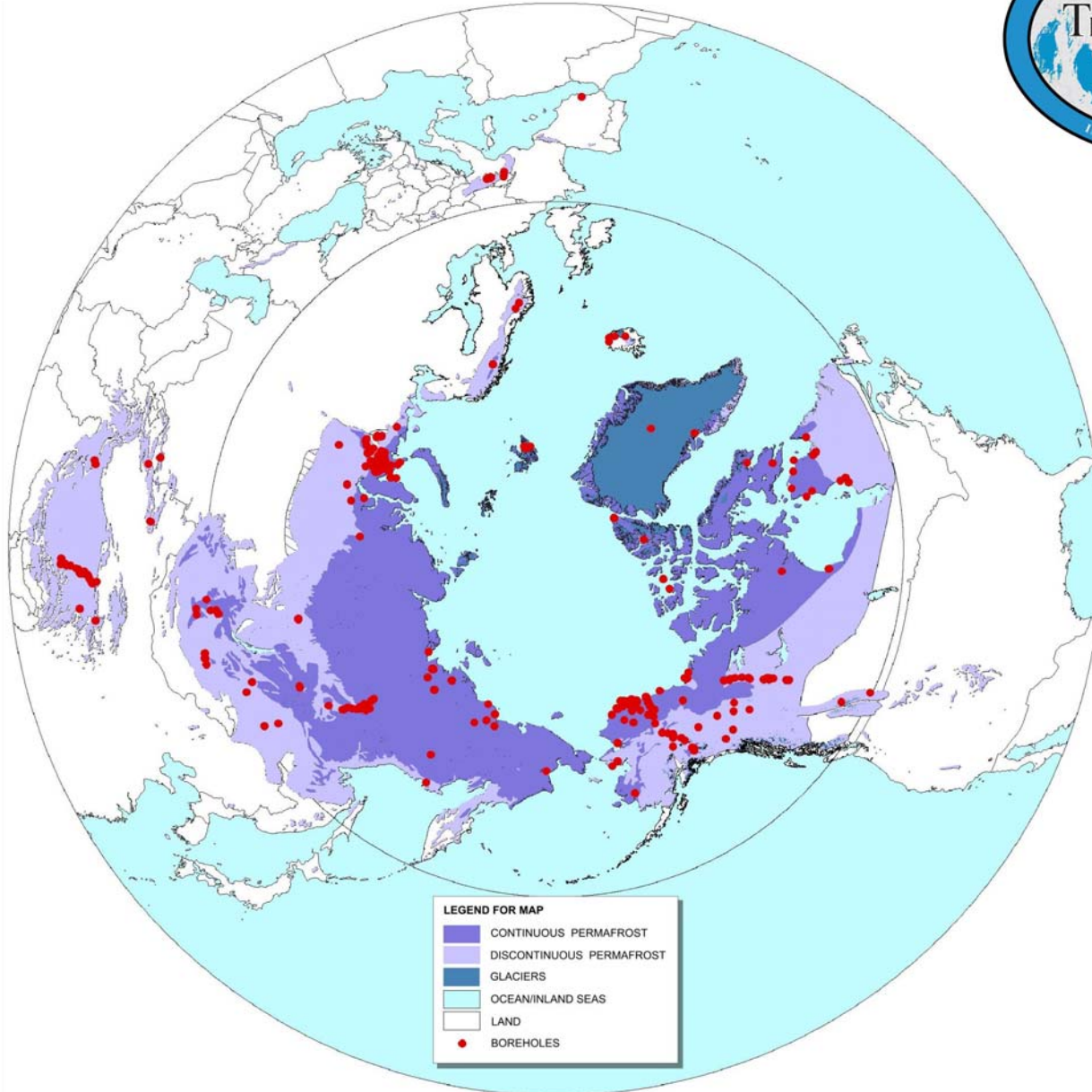


Permafrost Zones Alaska

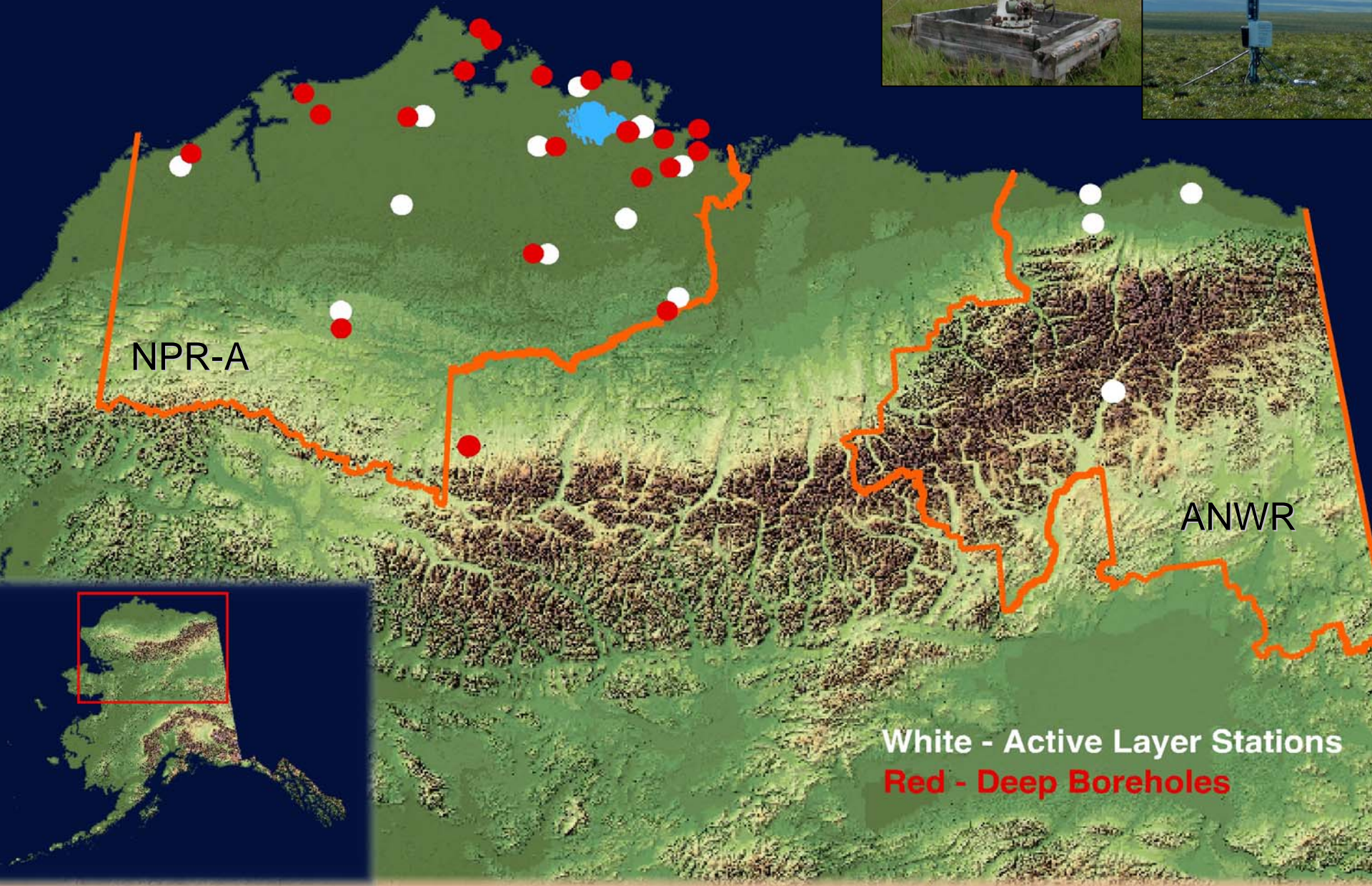




GTN-P: Thermal State of Permafrost



DOI / GTN-P



NPR-A

ANWR

White - Active Layer Stations
Red - Deep Boreholes

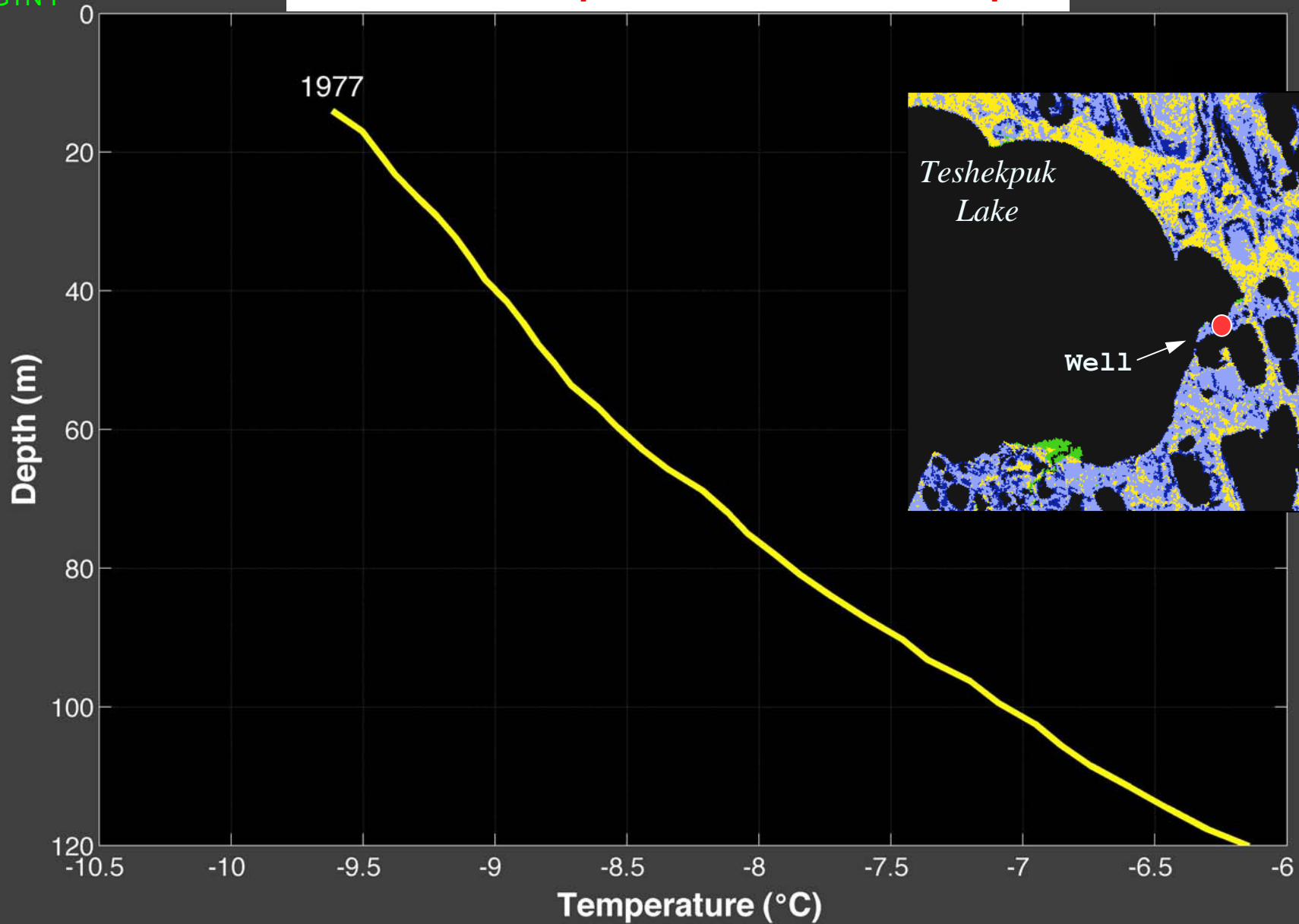


Arctic Ocean

measuring circuit
located in a
thermally controlled
Faraday cage

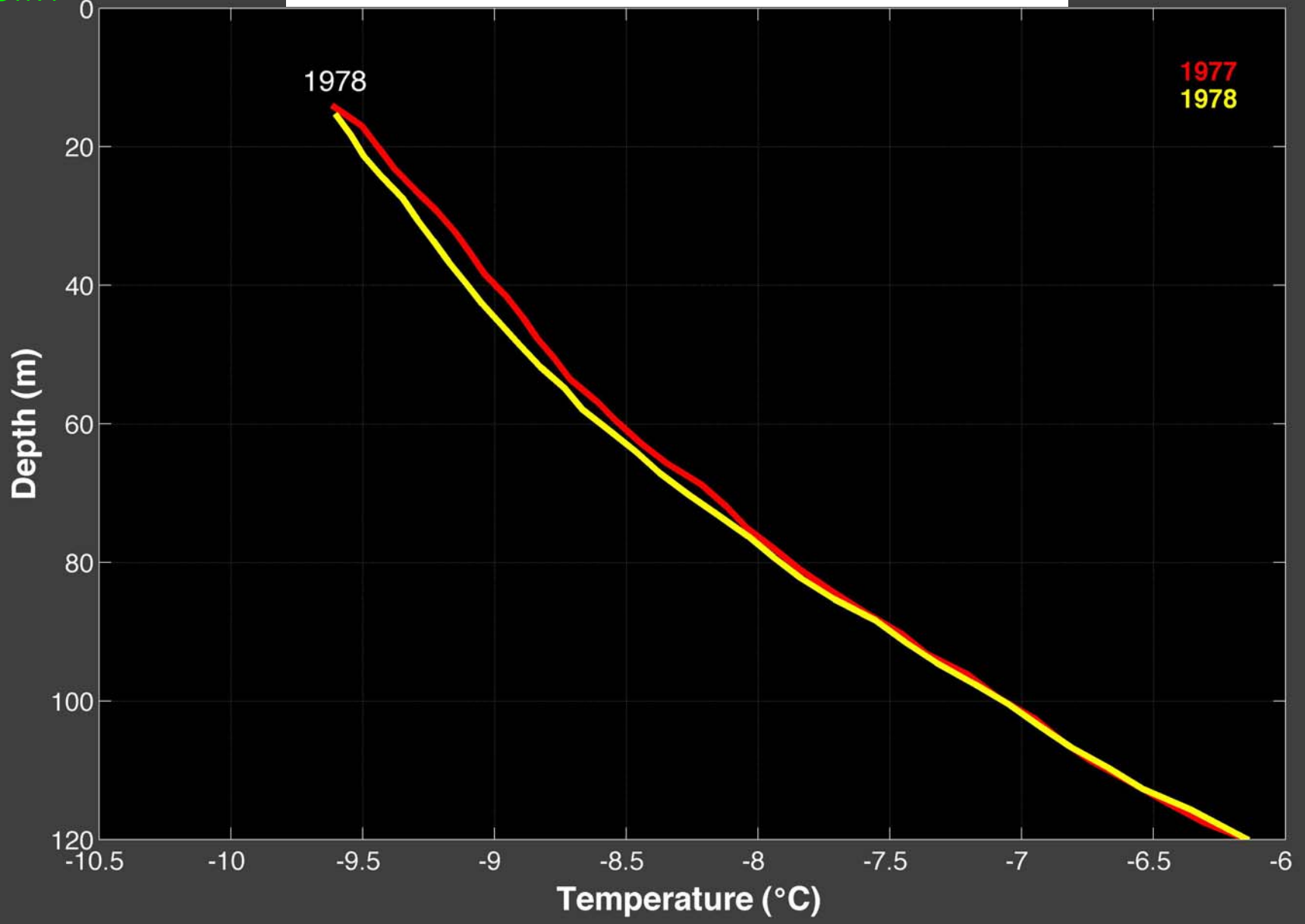
Temperatures are periodically remeasured in the DOI/GTN-P boreholes using the USGS's Polar Temperature Logging System. System sensitivity is ~ 0.2 mK, uncertainty = 3.3 mK.

Permafrost Temperatures: East Teshekpuk



Temperatures at East Teshekpuk about 1.6 years after borehole completion.

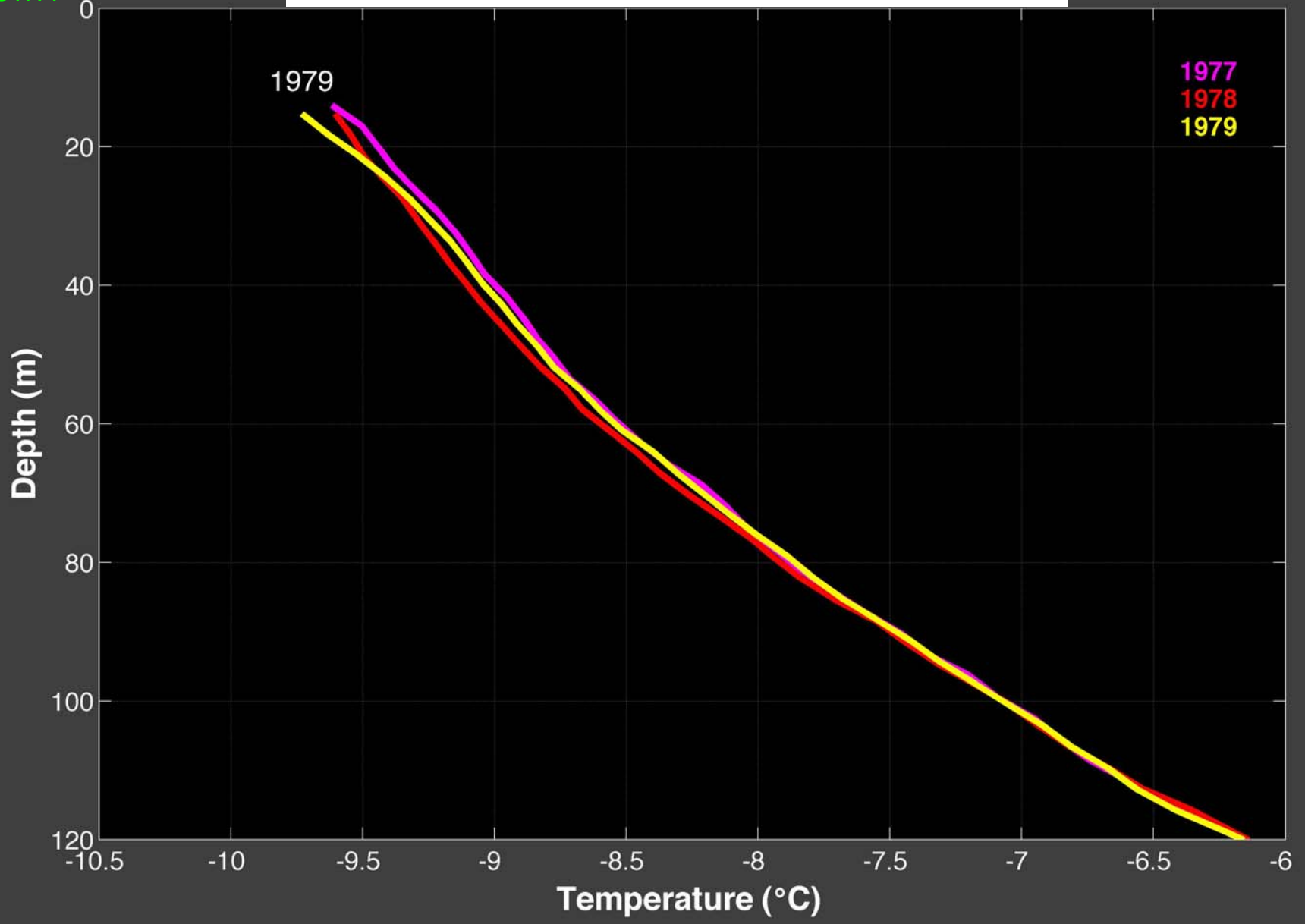
Permafrost Temperatures: East Teshekpuk



1977
1978

1978

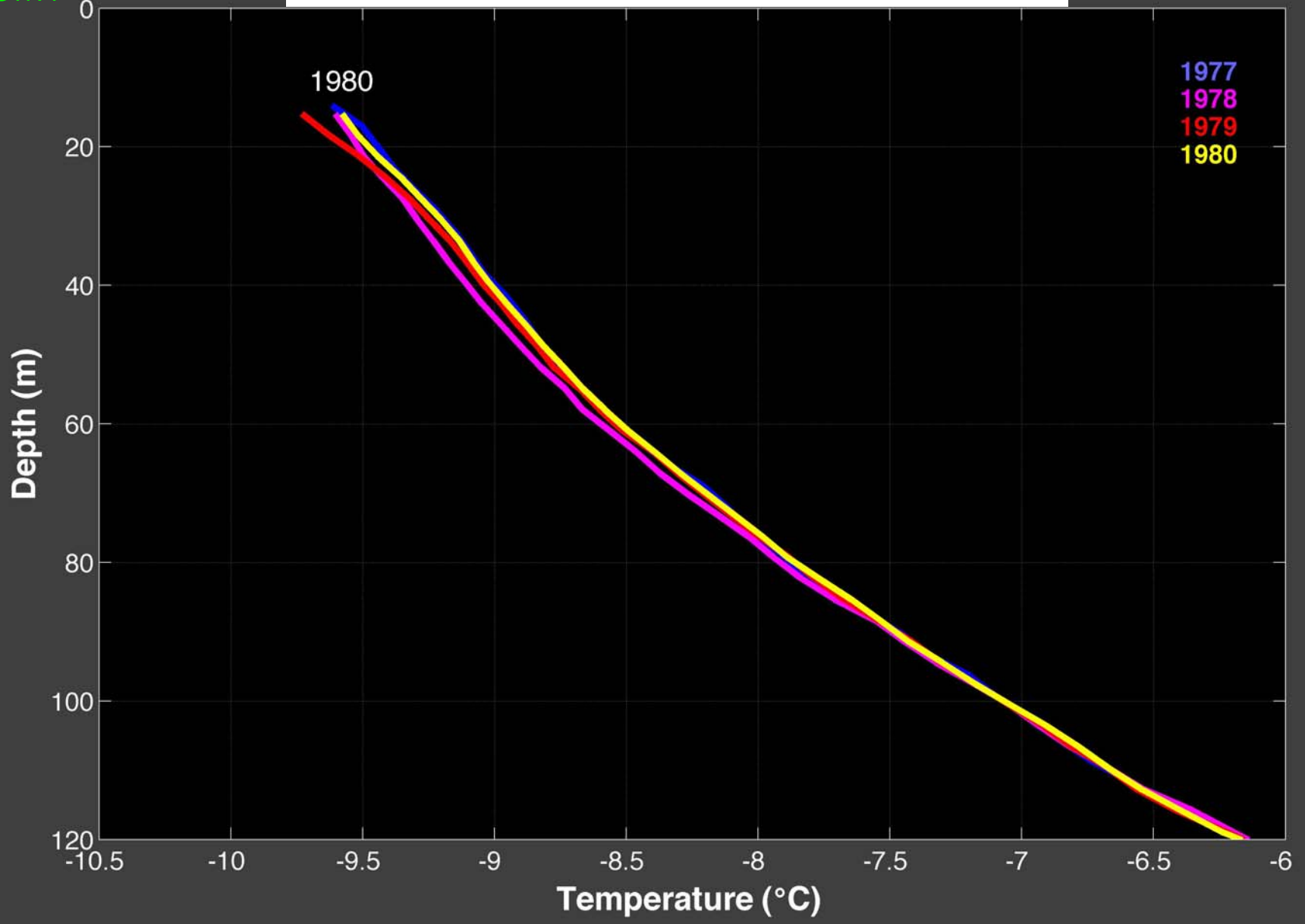
Permafrost Temperatures: East Teshekpuk



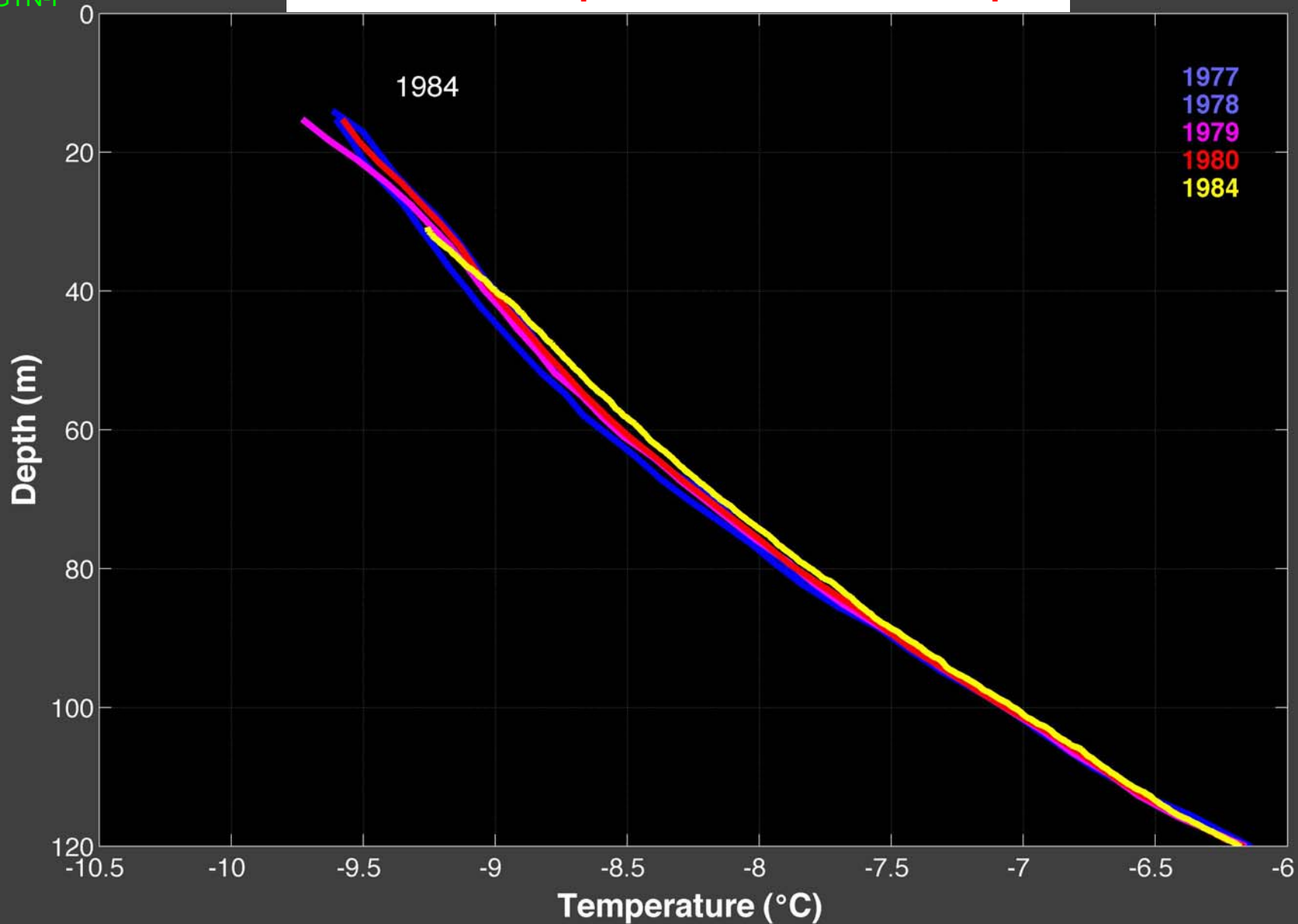
1977
1978
1979

1979

Permafrost Temperatures: East Teshekpuk

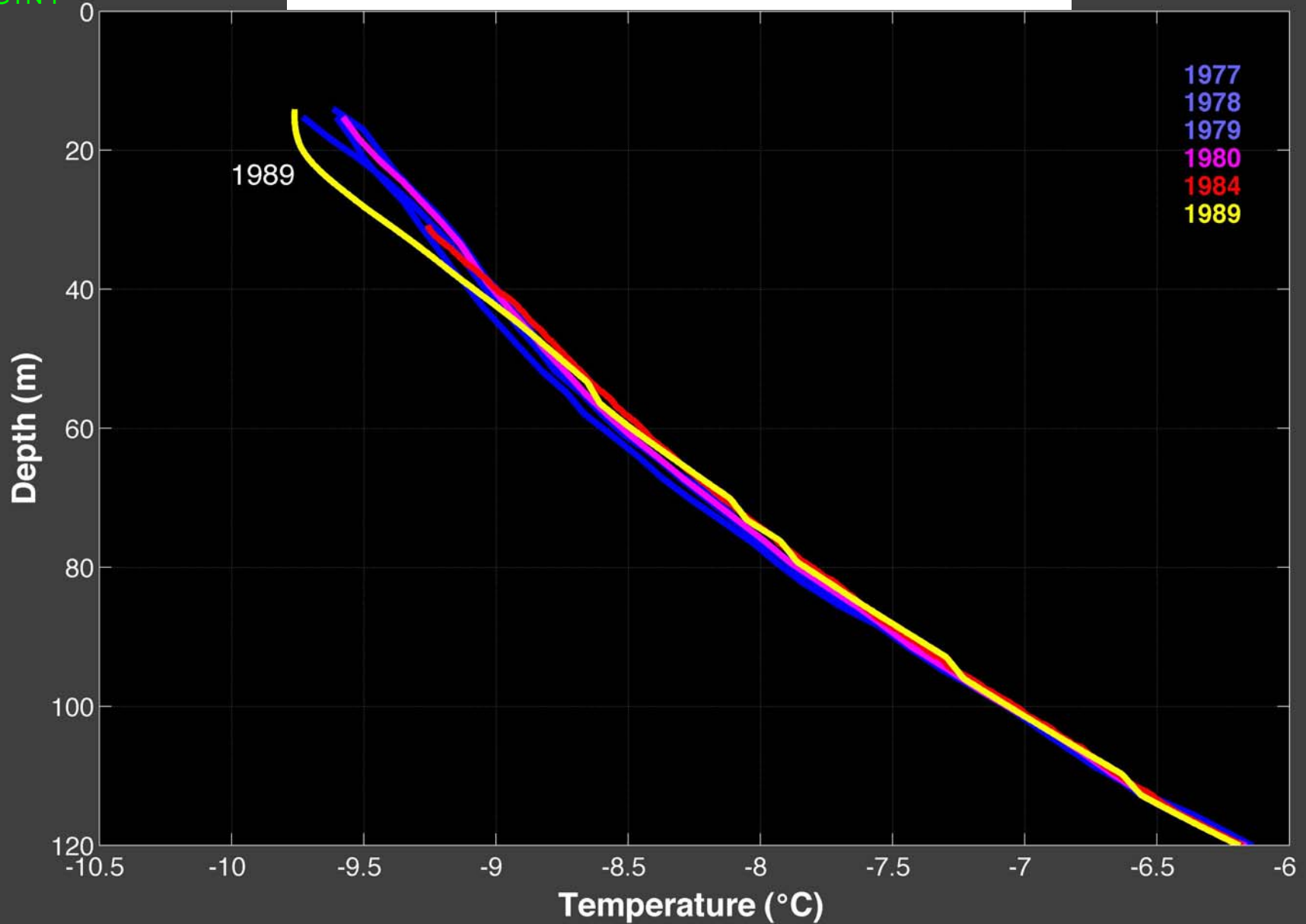


Permafrost Temperatures: East Teshekpuk



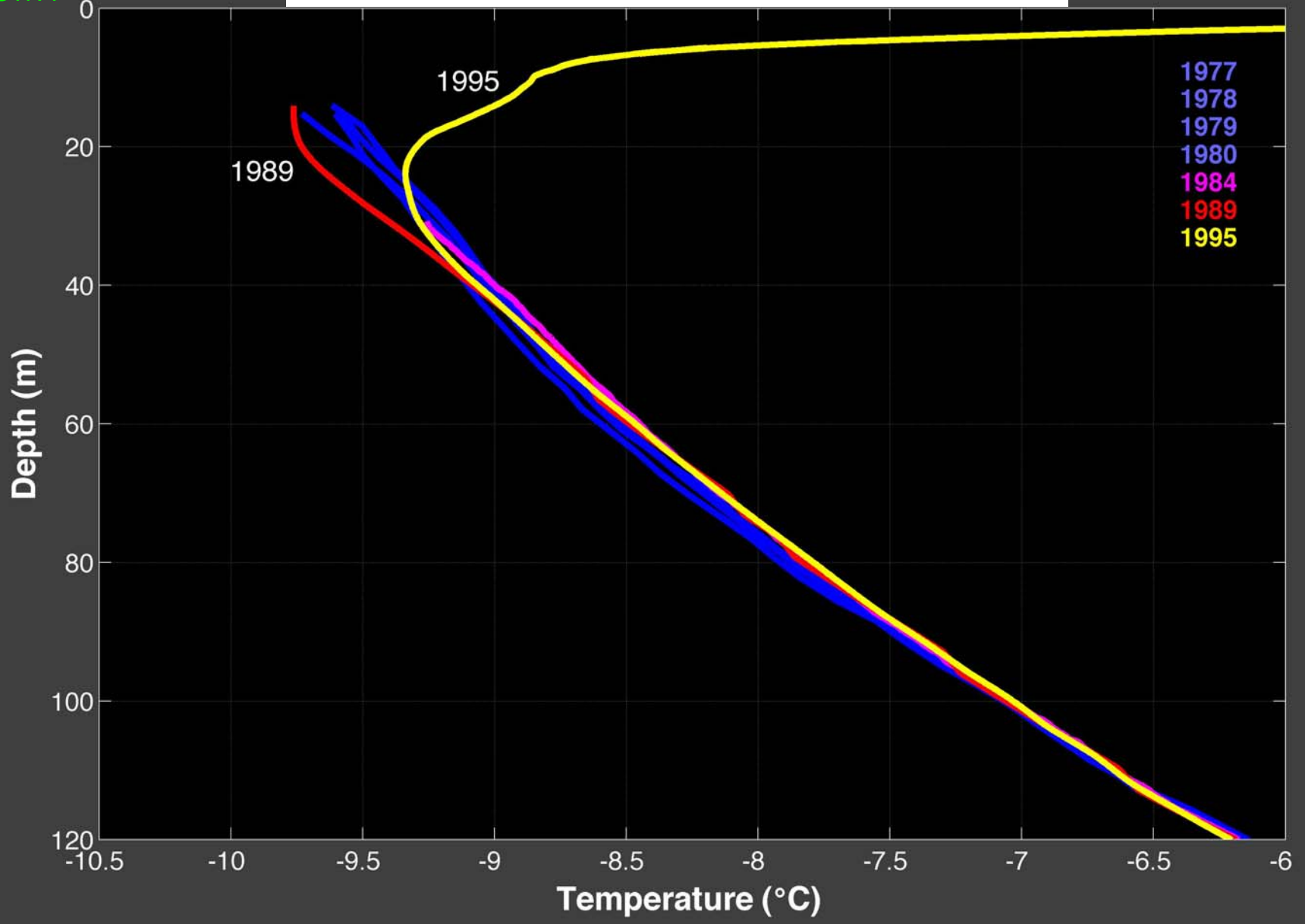
Northern Alaska experienced a mild cooling during 1983-84. Just a hint of that cooling is visible in the 1984 East Teshekpuk log (it's much more apparent at other sites).

Permafrost Temperatures: East Teshekpuk

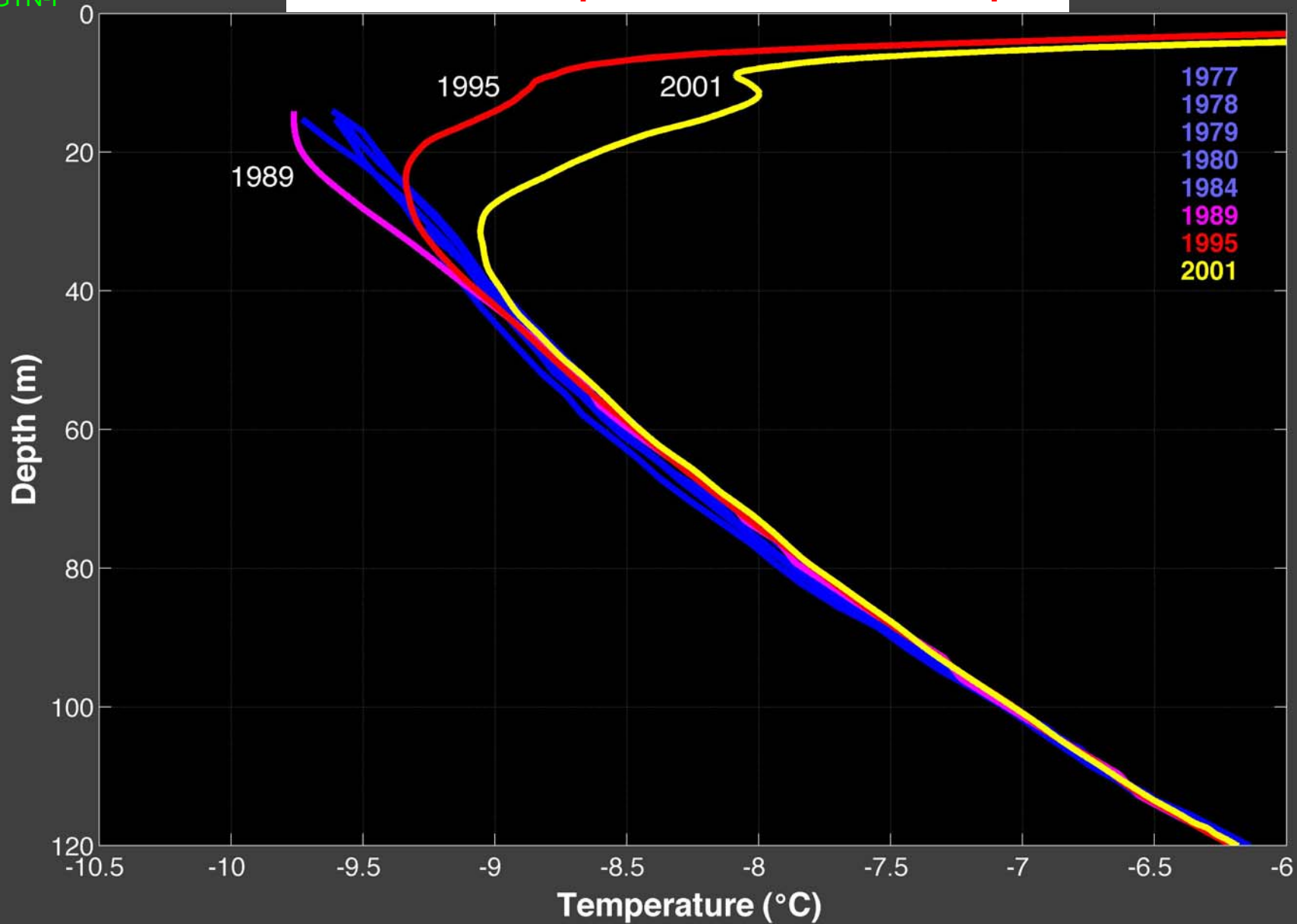


Temperature logs acquired during 1989 began to show a recovery from the mid-1980's cooling.

Permafrost Temperatures: East Teshekpuk

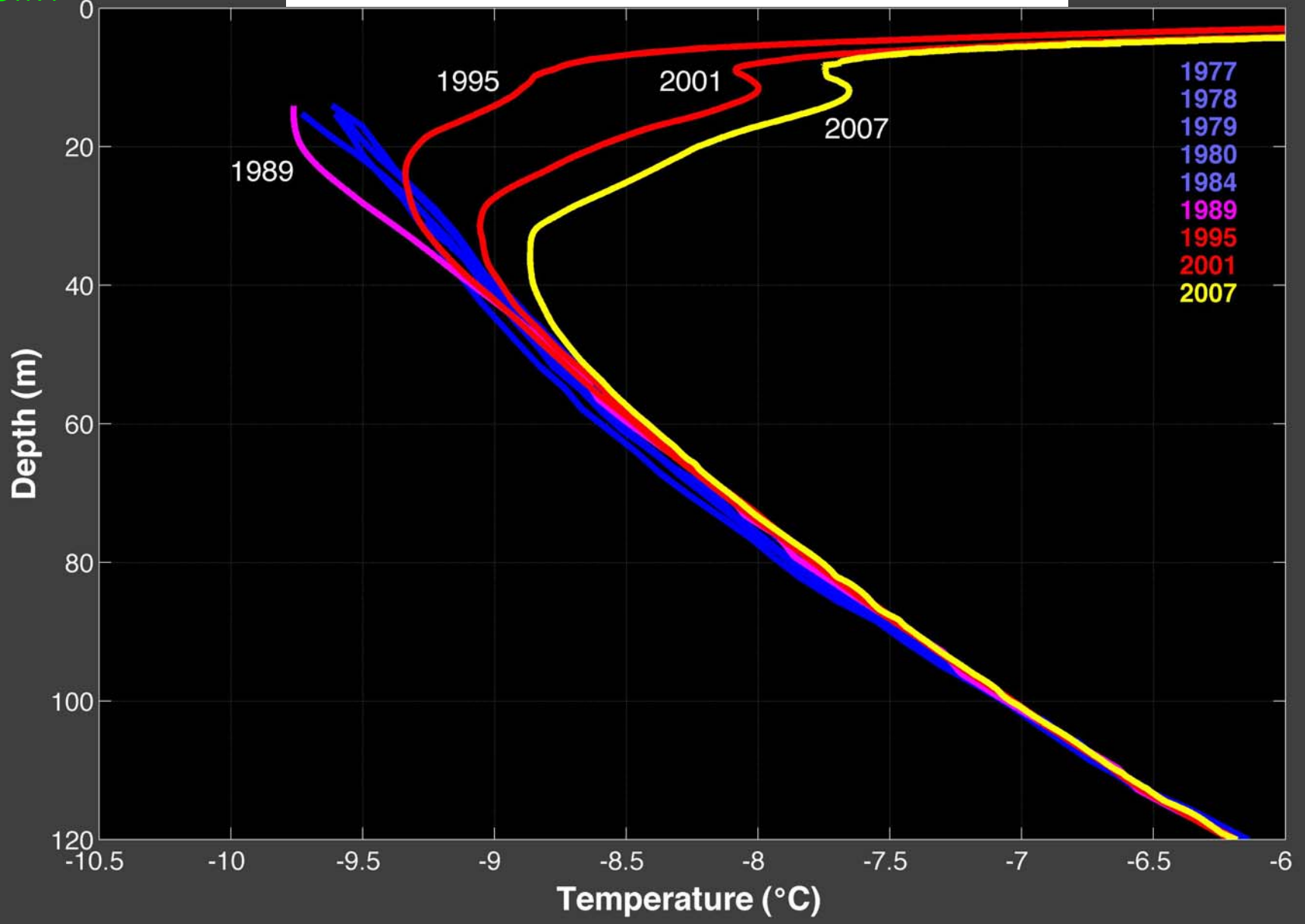


Permafrost Temperatures: East Teshekpuk

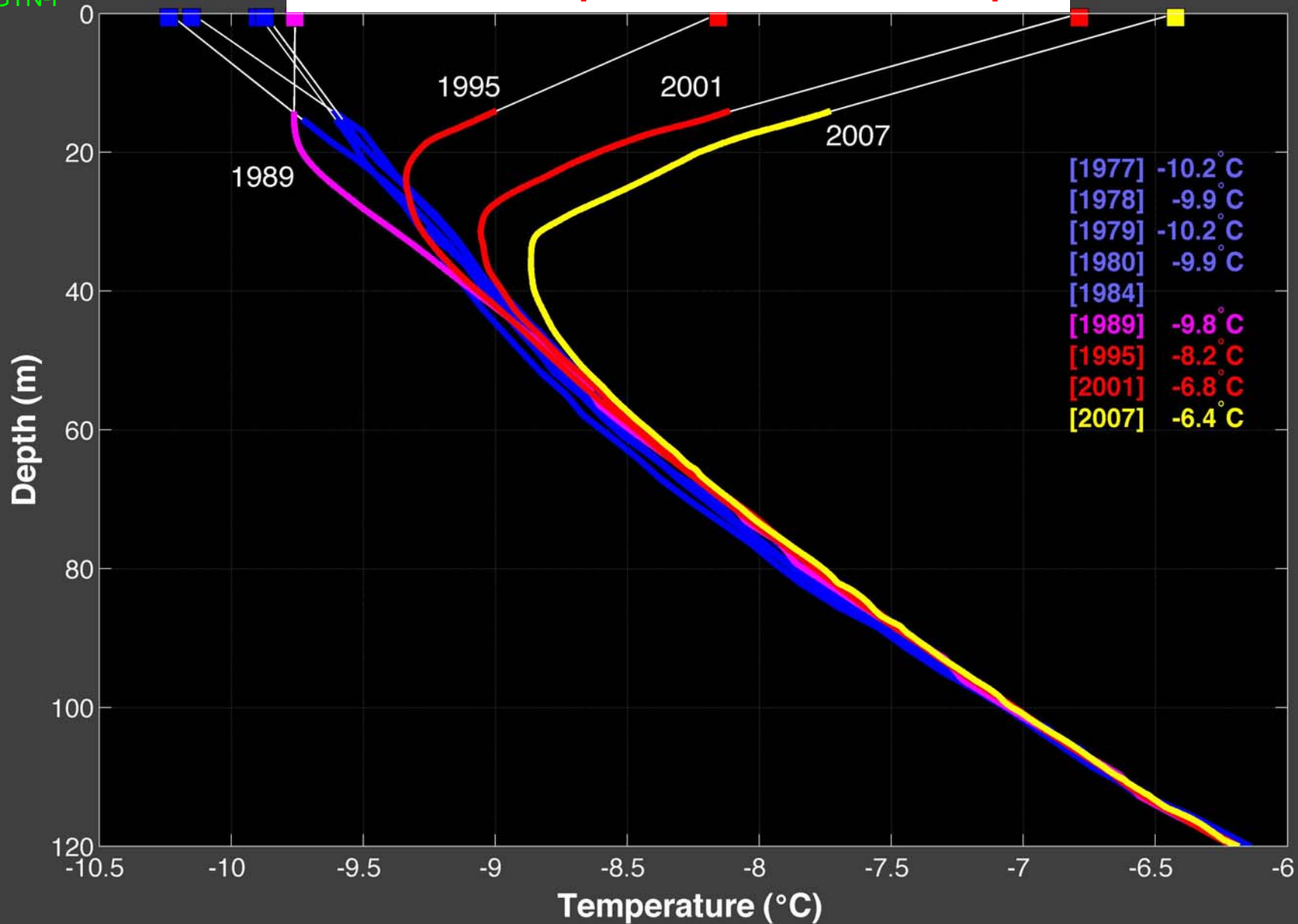


The climate record during the 1990's was clearly different from that during the 80's and late 70's.

Permafrost Temperatures: East Teshekpuk

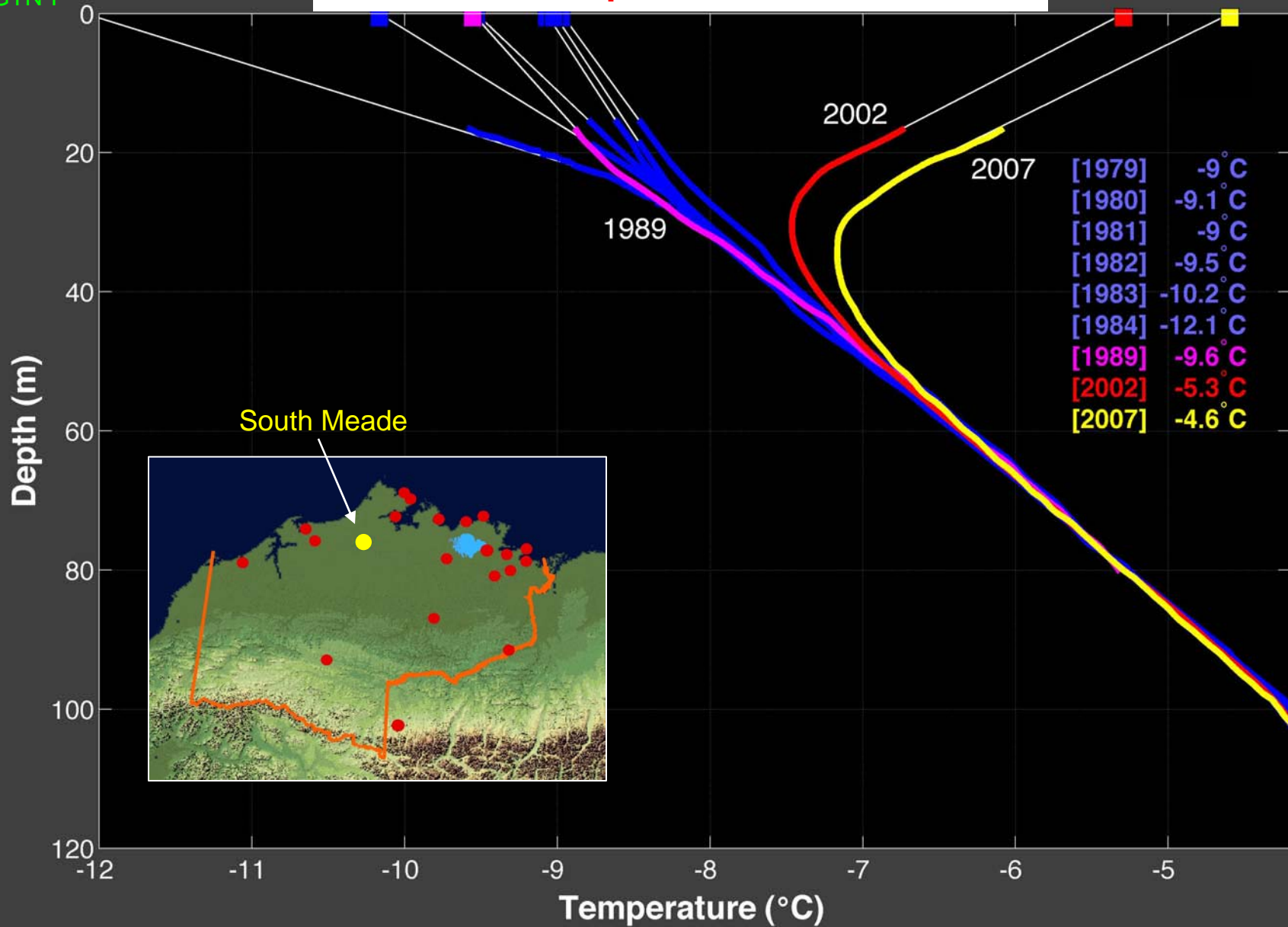


Permafrost Temperatures: East Teshekpuk



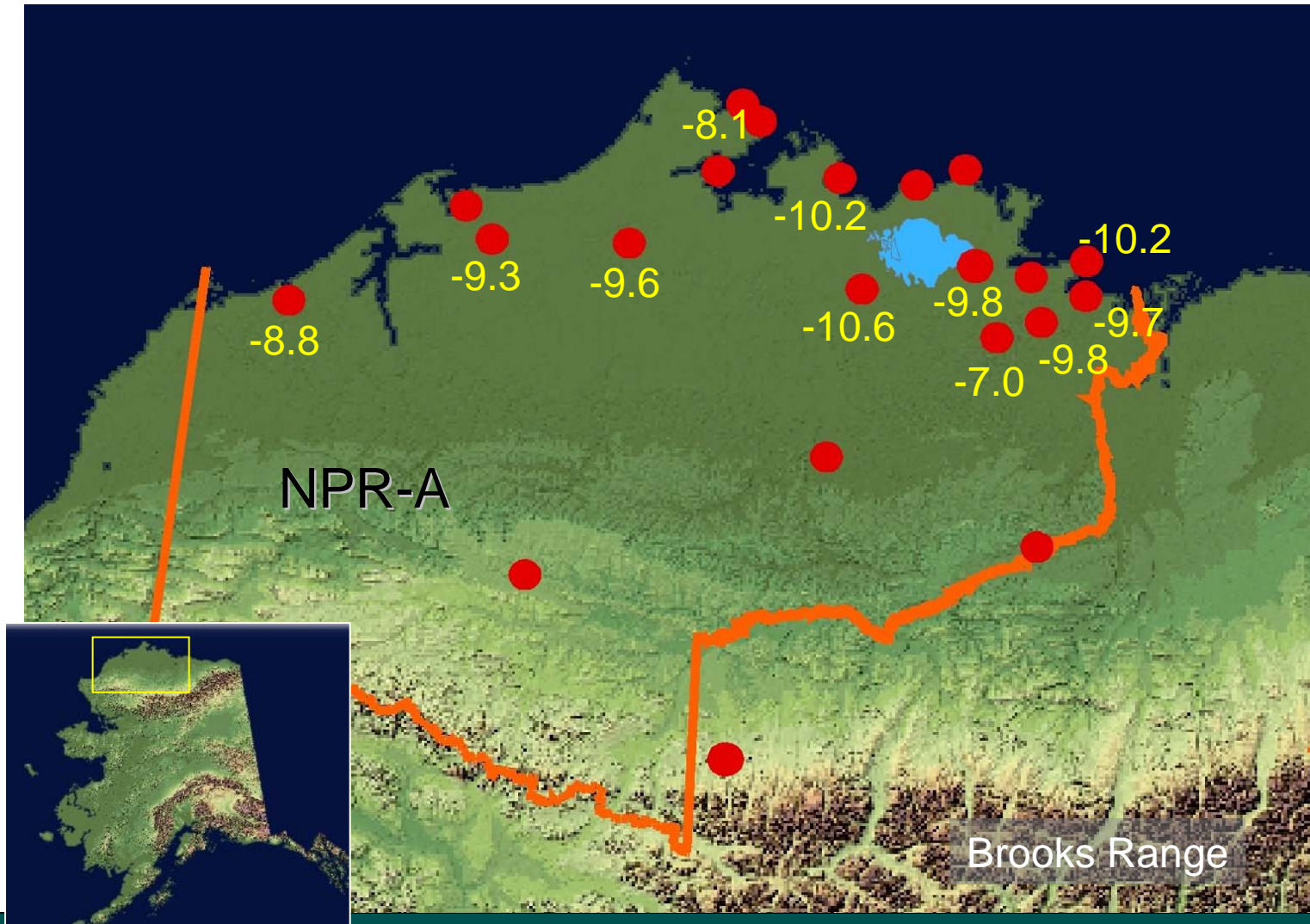
Measured temperature profiles with preliminary extrapolated surface temperatures. Surface temperatures were ~ **3.6°C warmer** during 2007 than during the late-70's, early-80's.

Permafrost Temperatures: South Meade



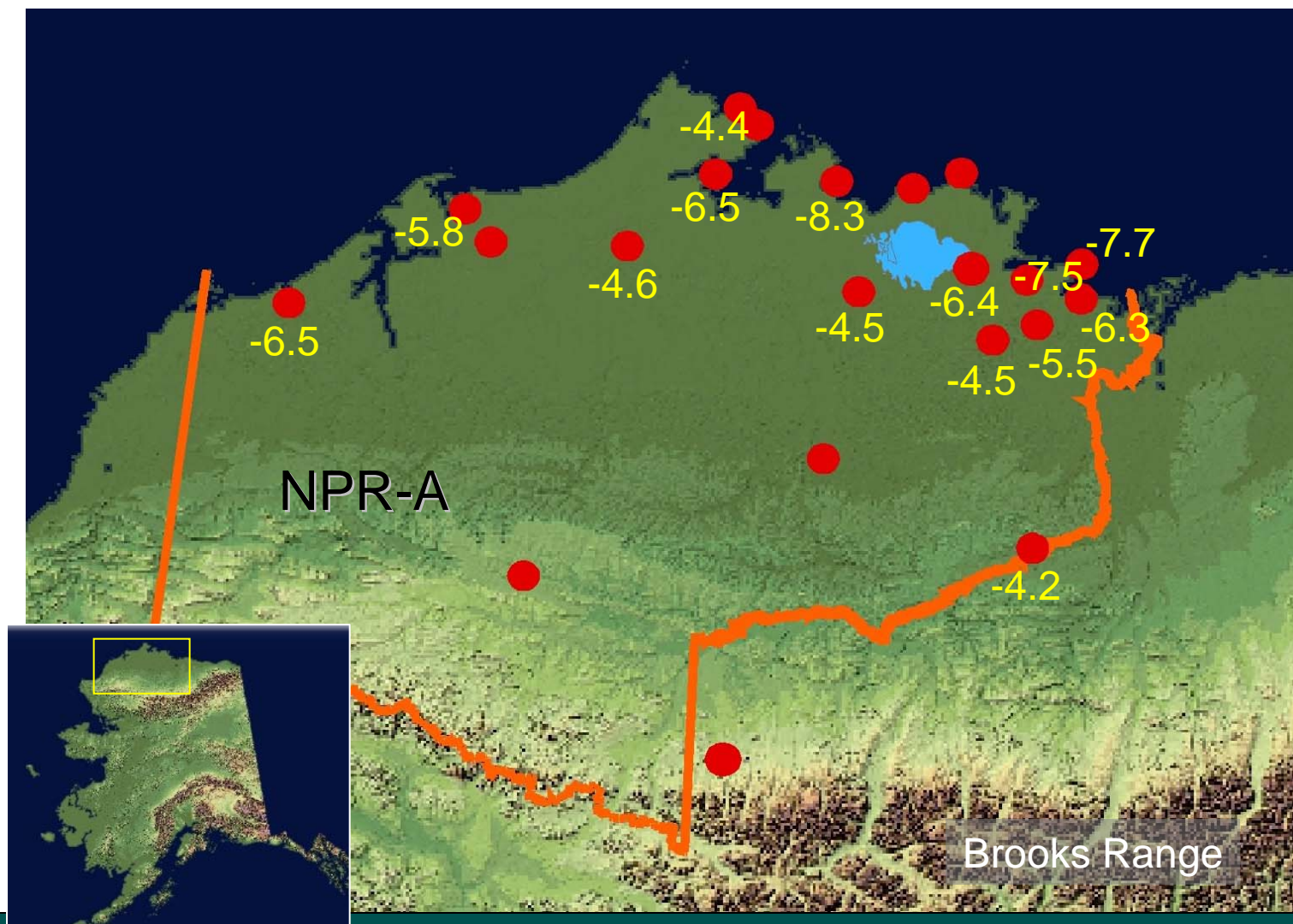
Surface temperatures were ~ **4.6°C warmer** at South Meade during 2007 than during the late-70's, early-80's.

Mean-Annual Surface Temperatures (°C), 1989



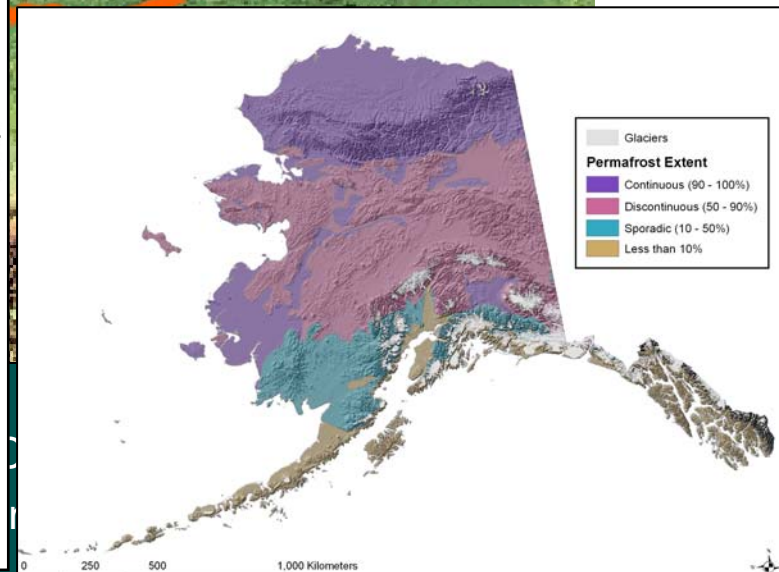
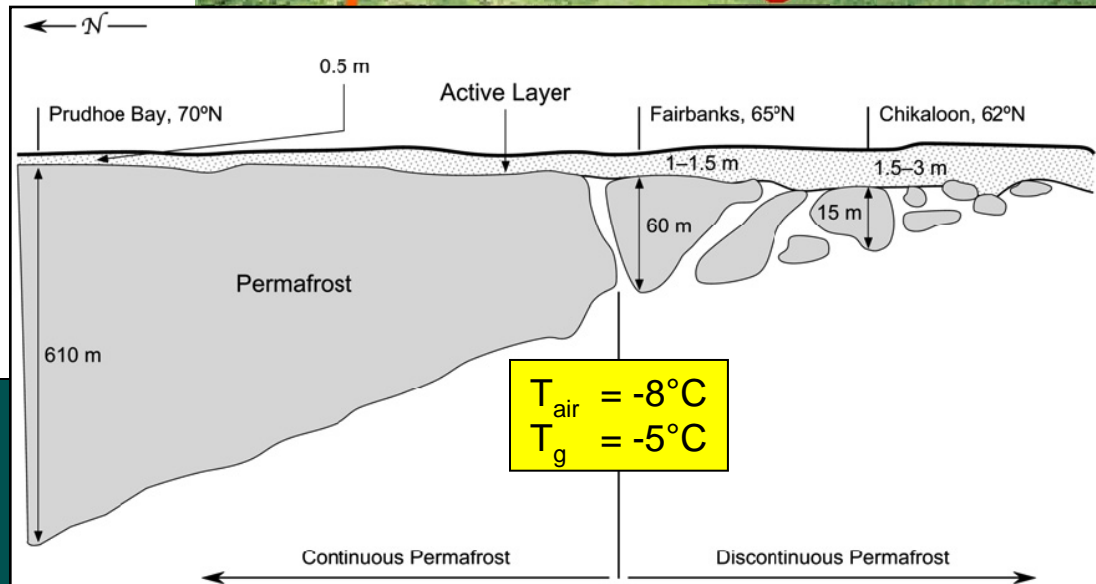
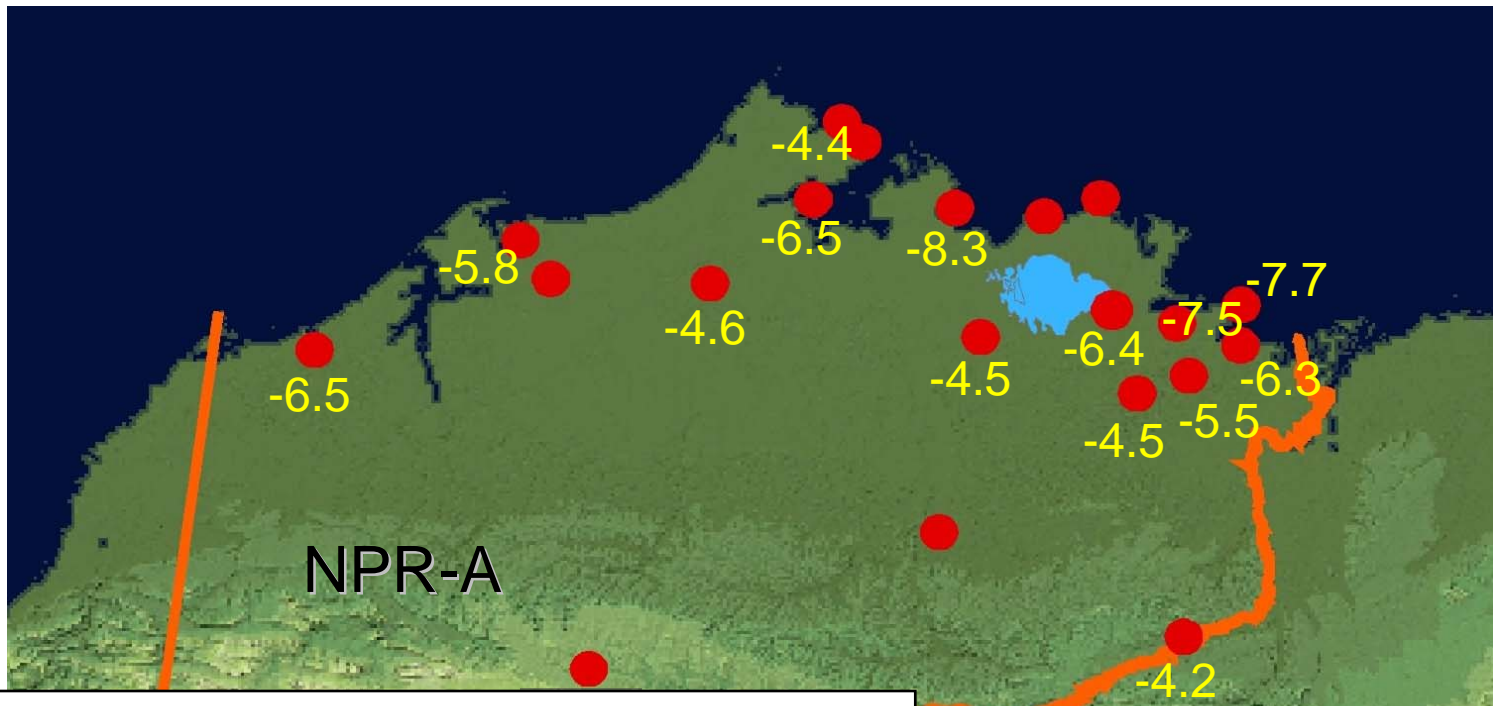
Arctic Coastal Plain (ACP) was well within the Continuous Permafrost Zone in 1989 ($T_g < -5^\circ\text{C}$).

Mean-Annual Surface Temperatures (°C), 2007

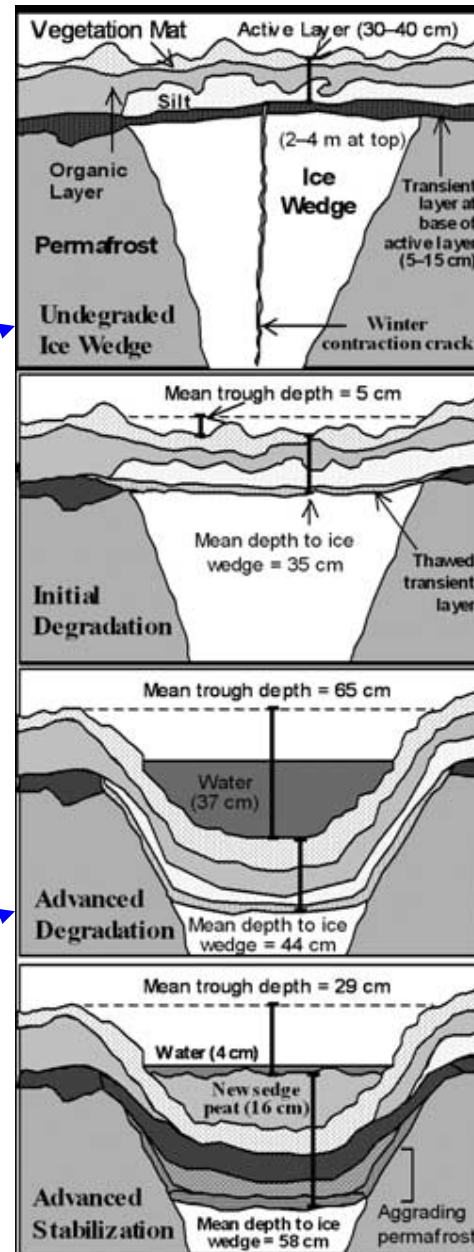


By 2007, surface conditions at some locations on the ACP were approaching those that occur at the Continuous / Discontinuous permafrost boundary ($T_g = -5^\circ\text{C}$). [$\Delta T = 3.5^\circ\text{C}$]

Mean-Annual Surface Temperatures (°C), 2007



Ice-Wedge Degradation Arctic Coastal Plain

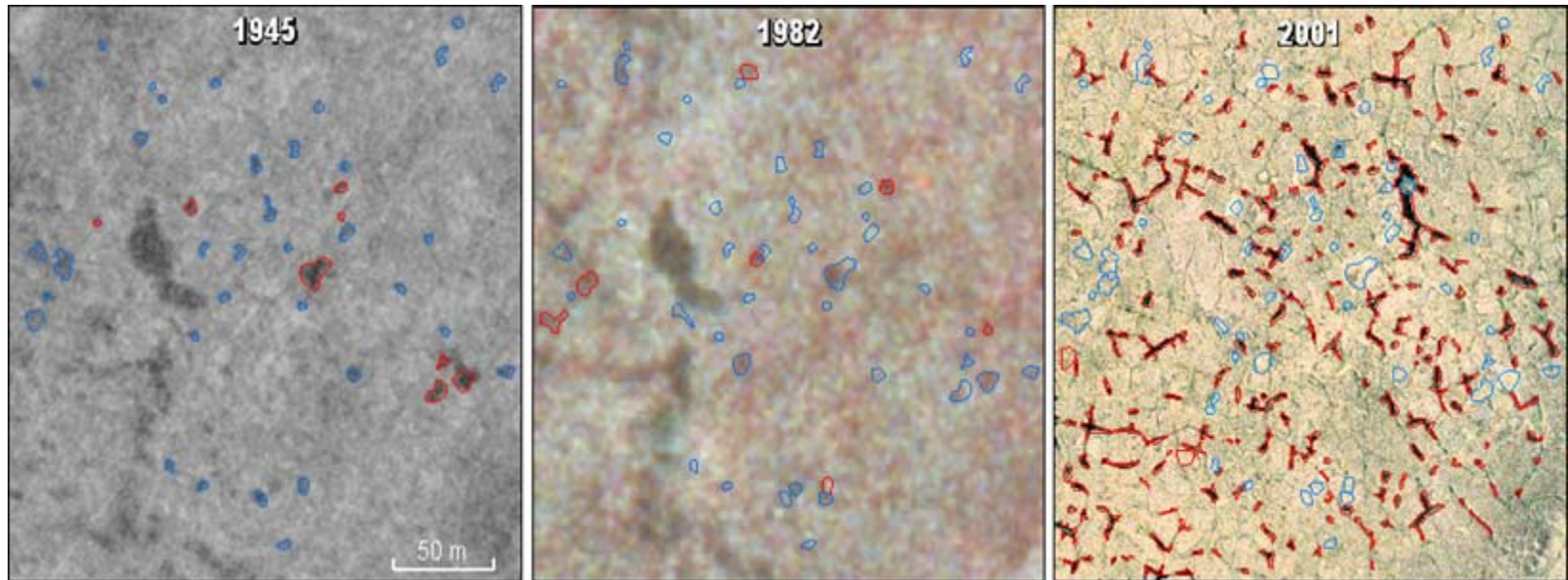


Ice Wedges

- Take 1000s of years to form.
- Have been stable on the ACP for > 3000 years

Ice-Wedge Degradation Arctic Coastal Plain

Jorgenson et al., GRL, 2006



area of thermokarst pits = 0.5%
density of pits = 88/km²

0.6%
128/km²

4.4%
1336/km²

- Area/density of thermokarst pits abruptly increased an order of magnitude after 1982; an event of similar magnitude probably hasn't occurred in the past 3,000 years.
- Enhanced degradation was due to warmer summer temperatures during 1989-1998.
- Degradation of ice wedges has caused a substantial redistribution of surface water from the adjacent tundra into the degraded trough network.
- If the trend continues, 10-30% of the terrestrial landscape may be directly effected.

Permafrost Degradation Arctic Alaska

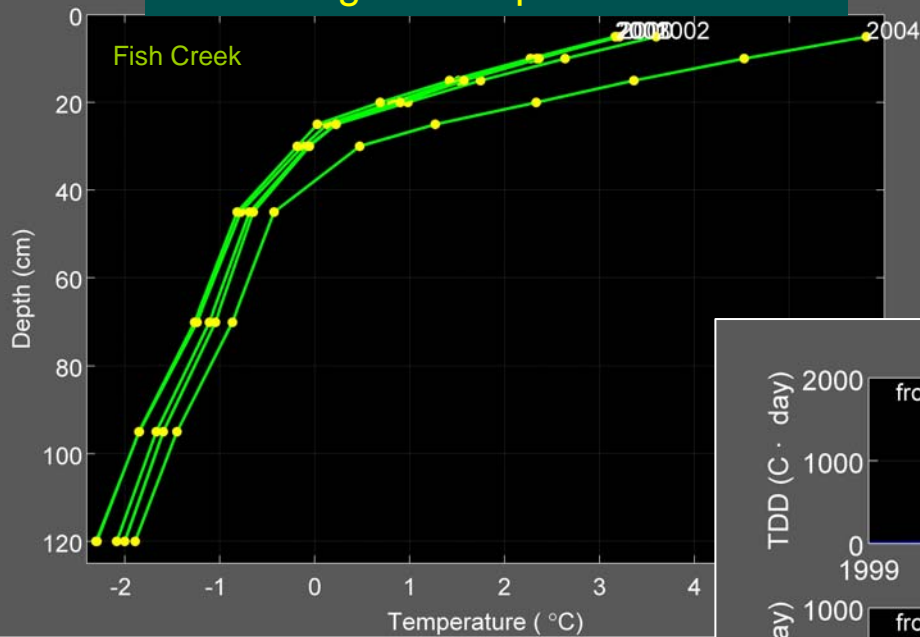
thaw slump

August, 2004



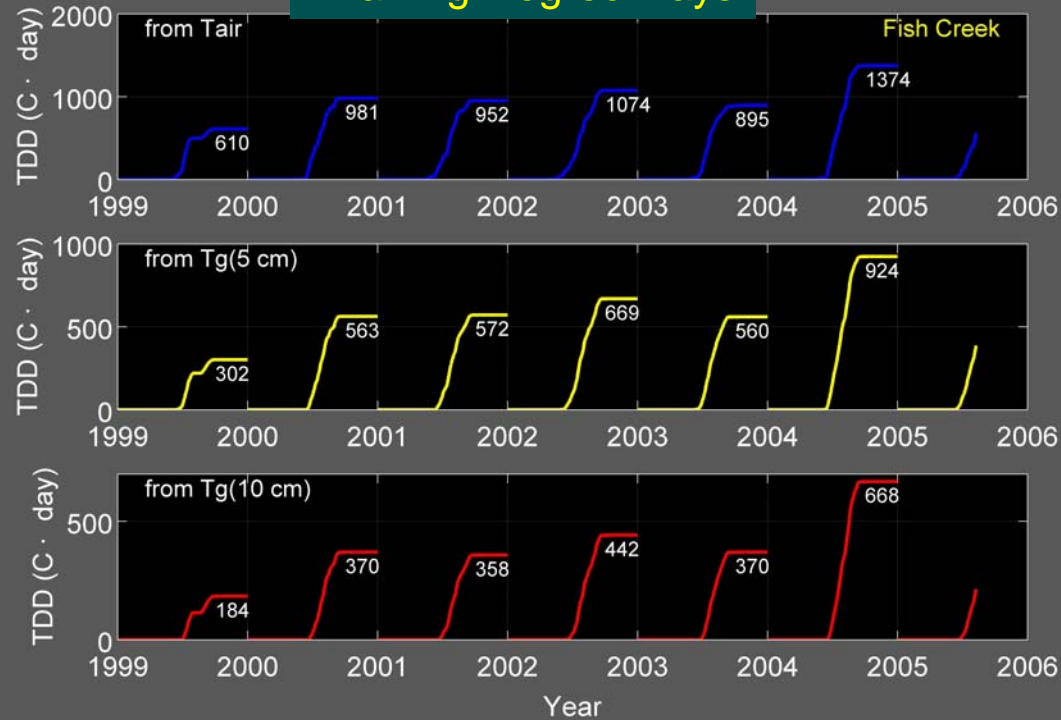
changing shoreline environment

Mean-August Temperature Profiles

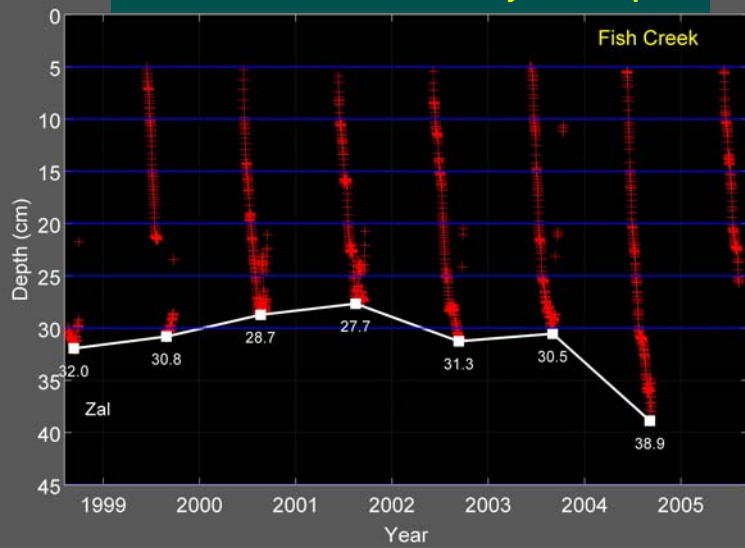


2004: a particularly warm summer

Thawing-Degree-Days



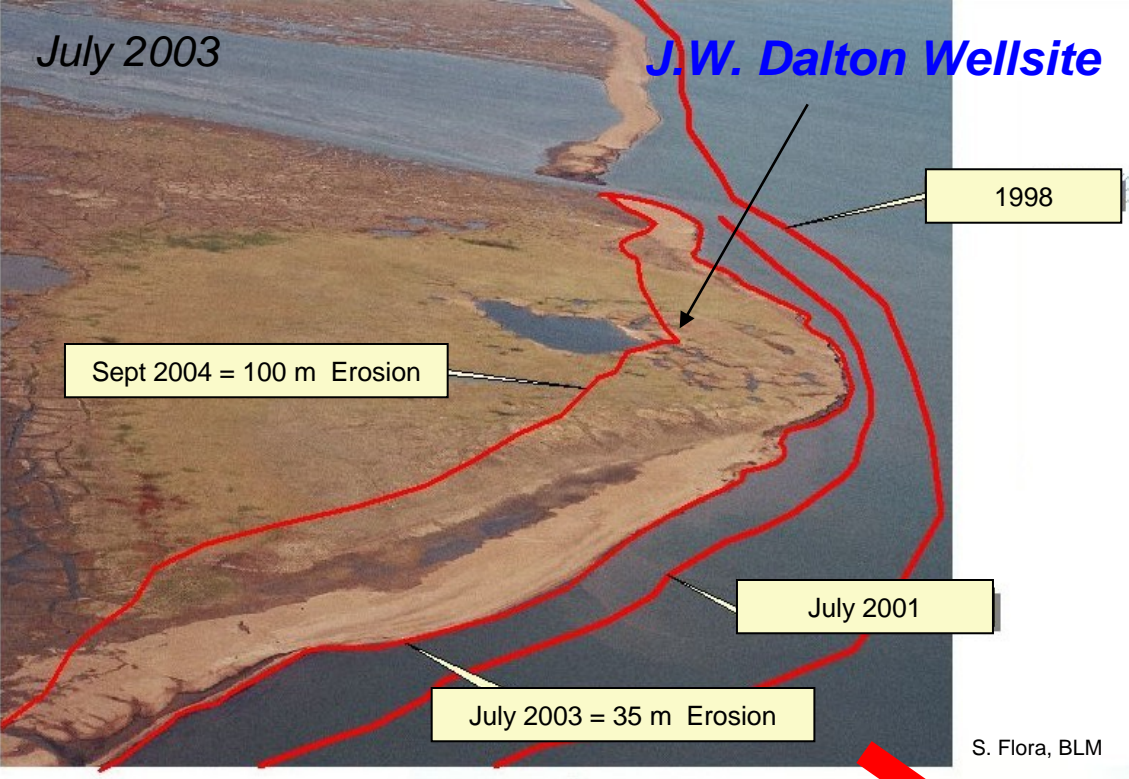
Maximum Active-Layer Depth



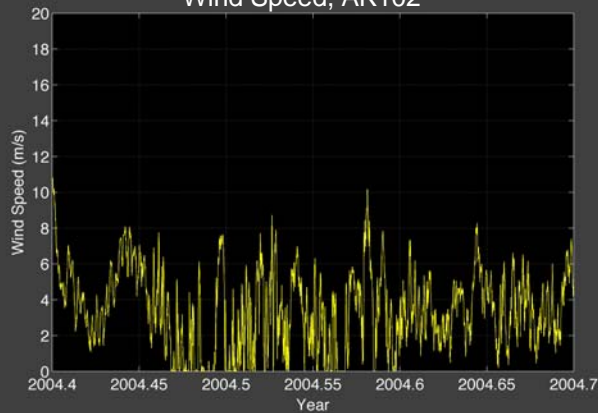
July 2003

J.W. Dalton Wellsite

Coastal Erosion Arctic Alaska



Wind Speed, AK102



Coastal Erosion - Drew Point, Arctic Coast



Permafrost Degradation - Arctic Alaska

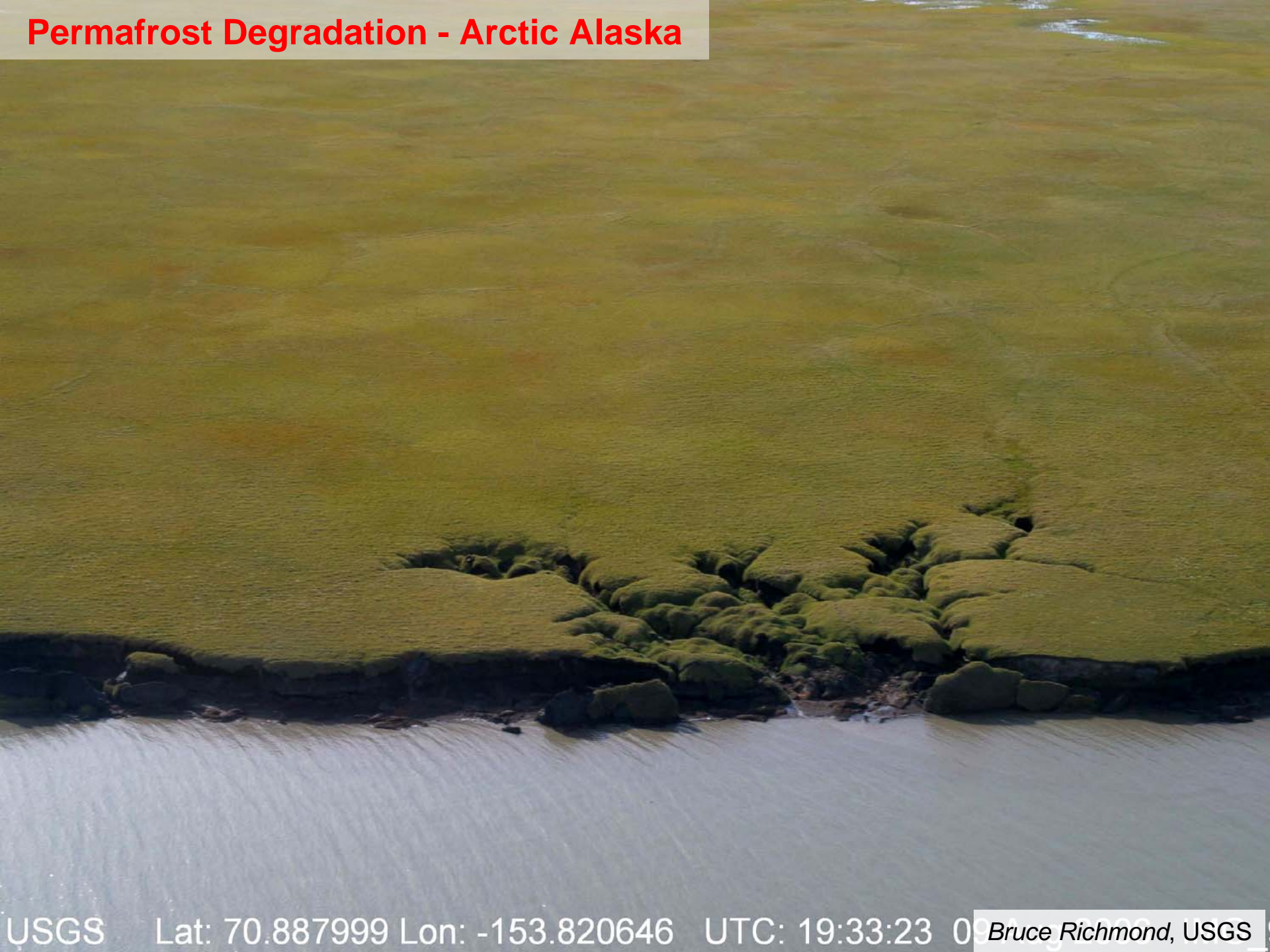
*ice wedges,
advanced degradation*

Permafrost Degradation - Arctic Alaska



*thermokarst
gully*

Permafrost Degradation - Arctic Alaska

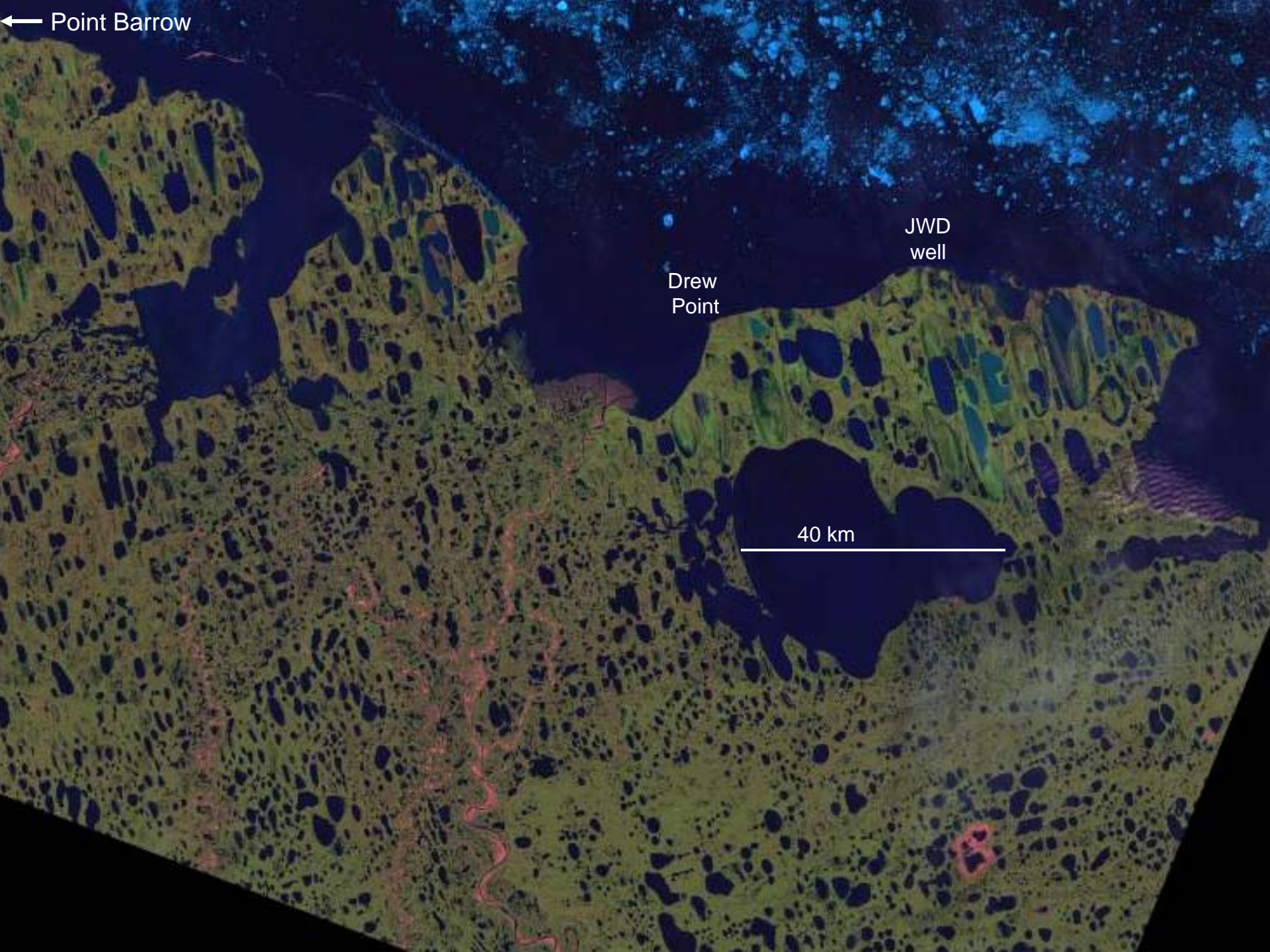


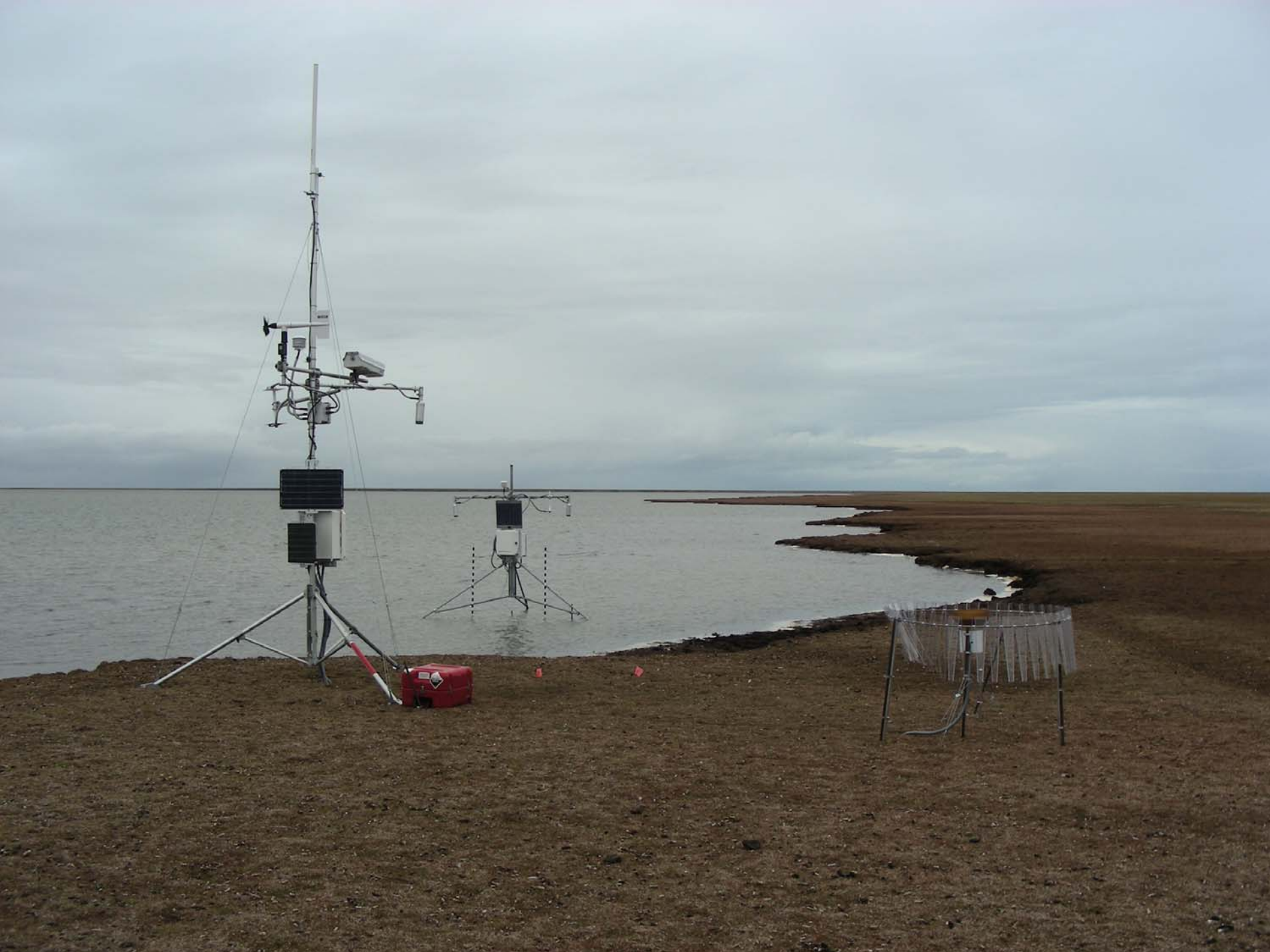
Permafrost Degradation - Arctic Alaska

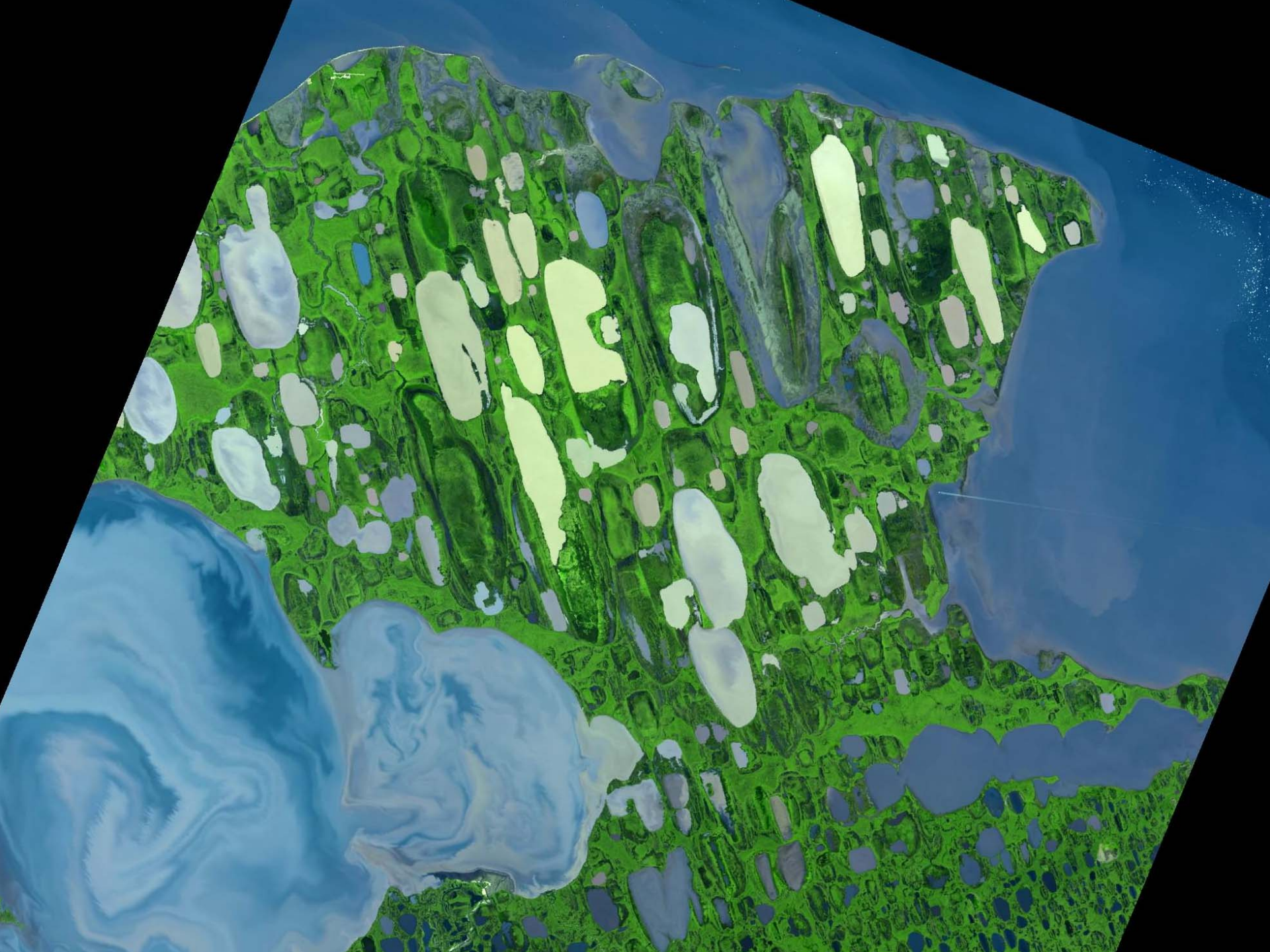
thaw slump

*increased sediment flux
from melting permafrost*

← Point Barrow



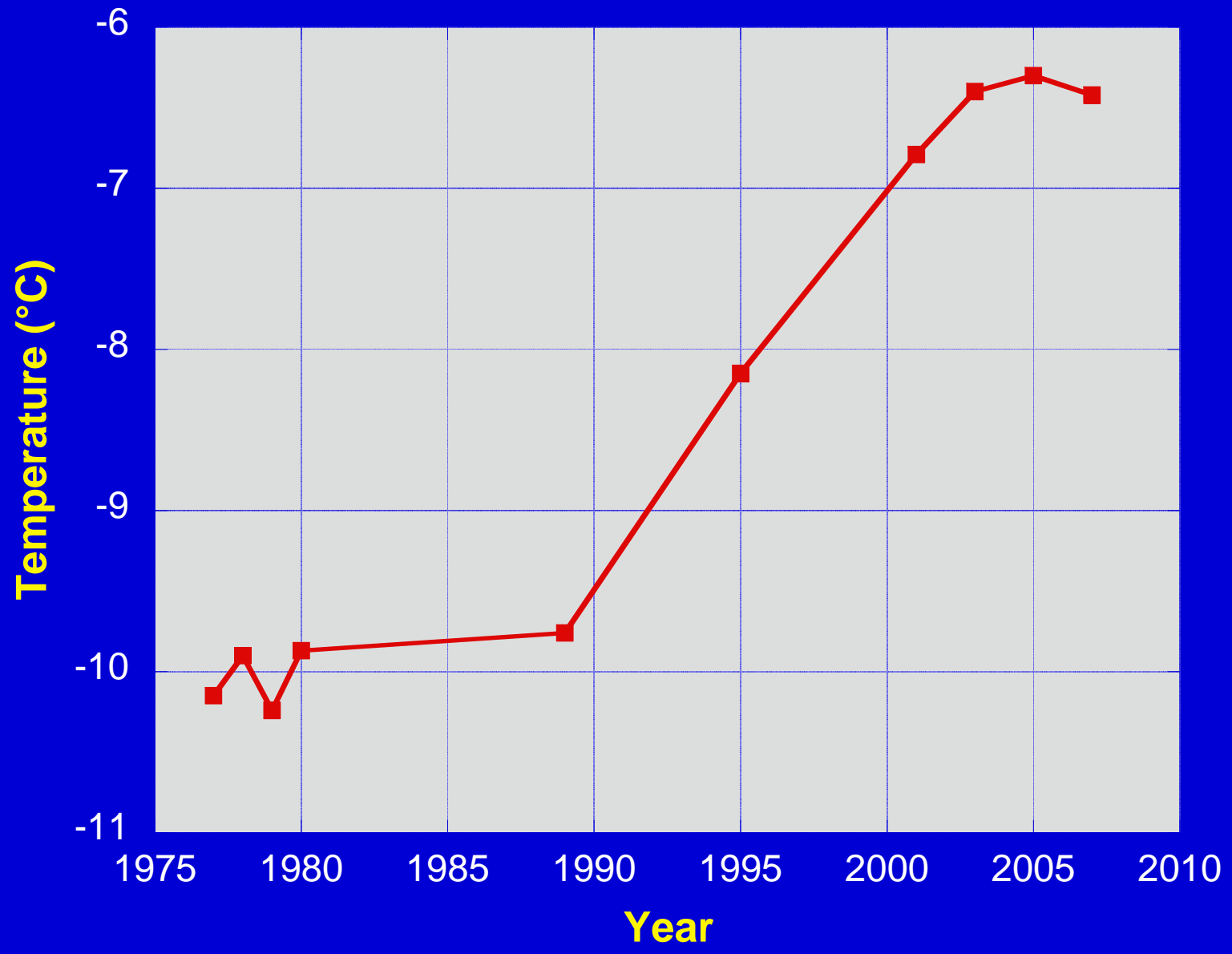




Thank you!



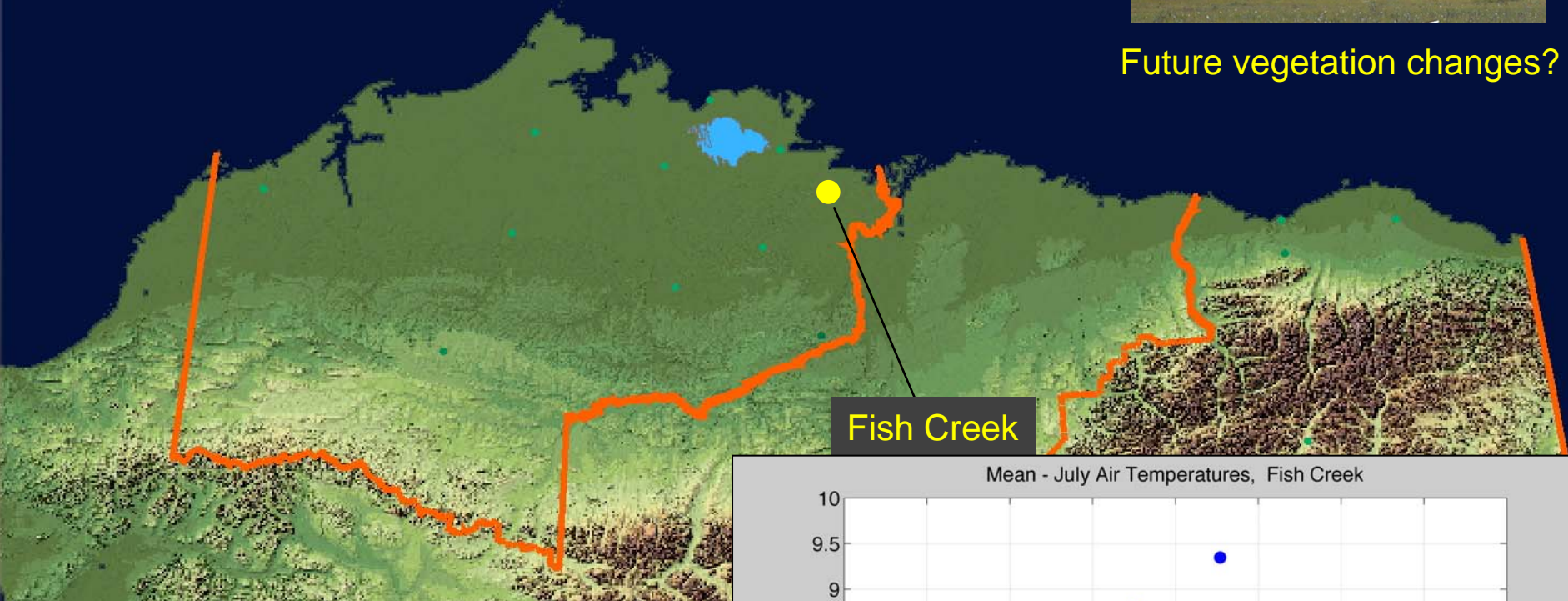
Near-Surface Temperatures at East Teshekpuk, NPRA



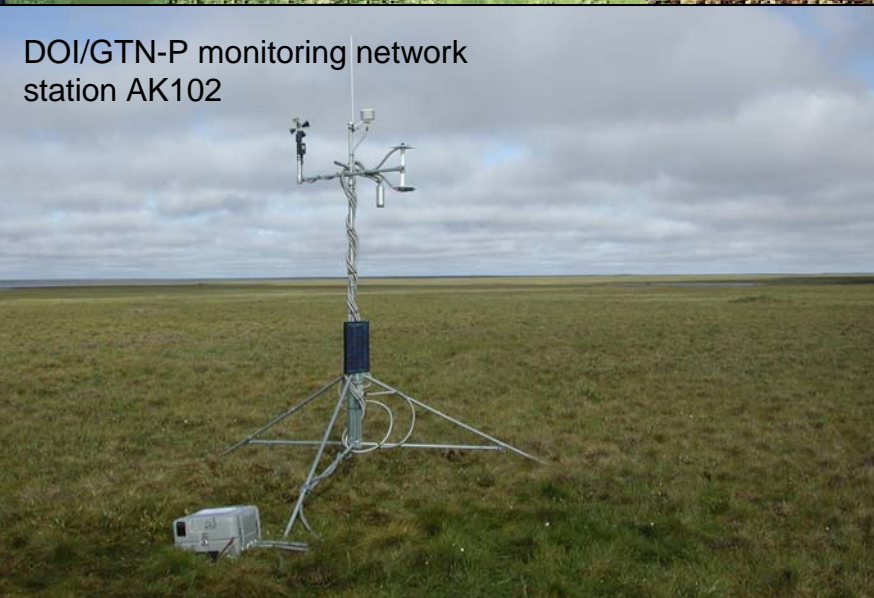
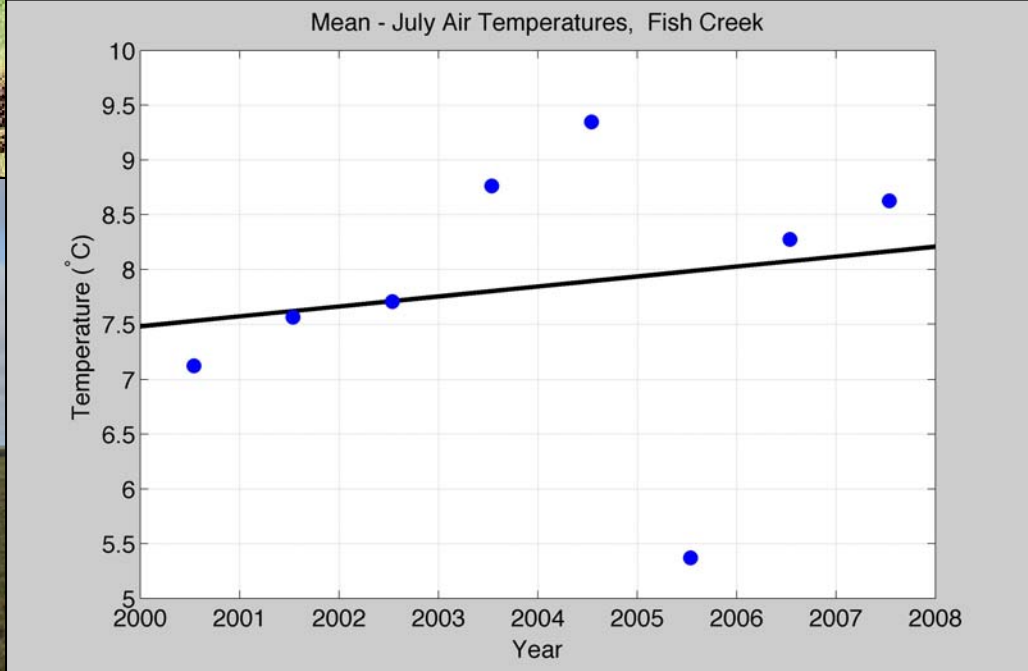
Mean-July Air Temperature (°C)



Future vegetation changes?



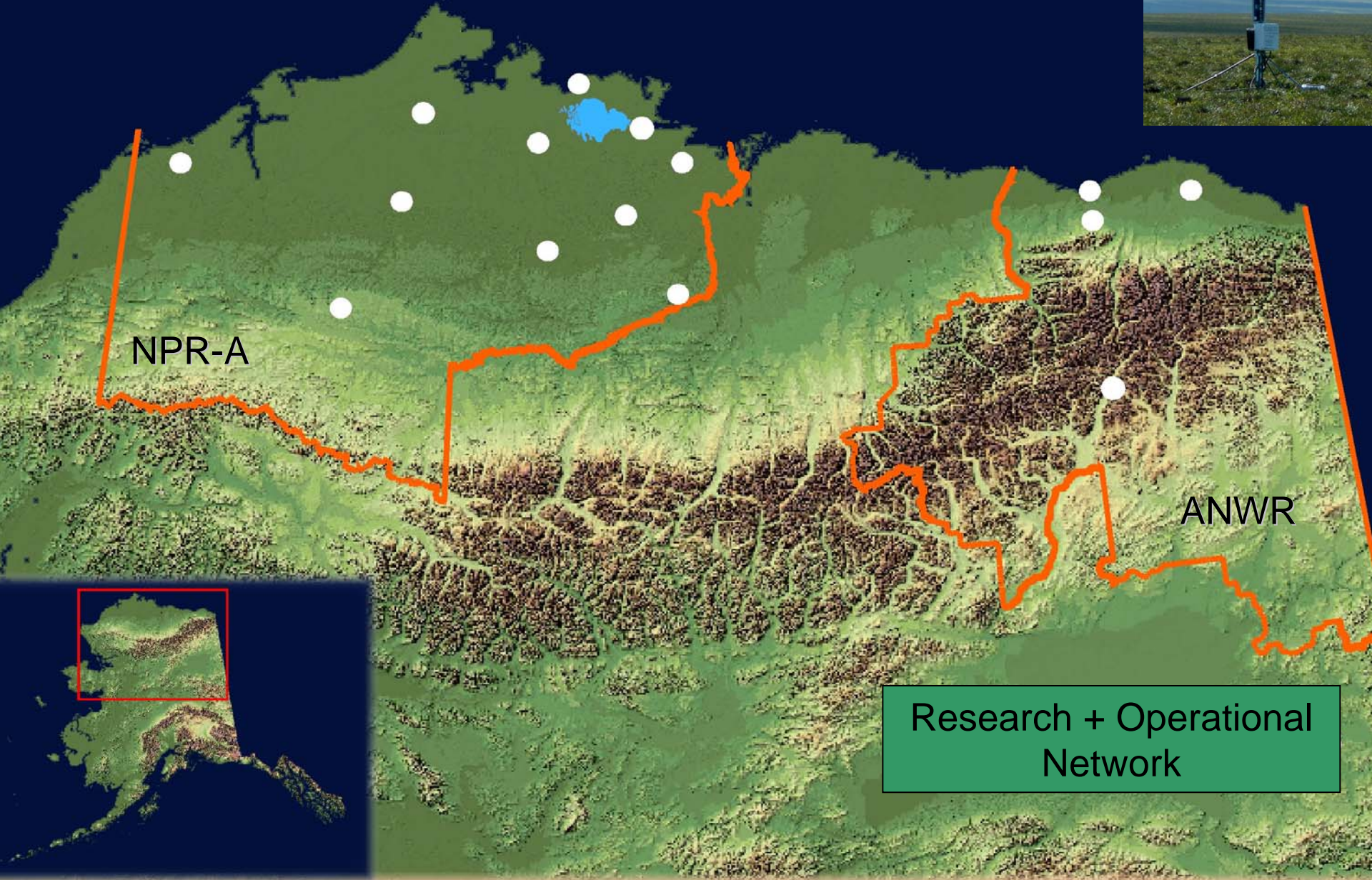
Fish Creek



DOI/GTN-P monitoring network station AK102

DOI / GTN-P Active-Layer Network

1) Automated Permafrost / Climate-Monitoring Stations



Research + Operational
Network

GCOS/GTOS/GTN-P Station U31

Marsh Creek, ANWR

- ground temperature (10 depths)
- soil moisture
- air temperature
- pressure*
- wind speed & direction
- rain*
- snow depth
- up- and downwelling shortwave radiation
- albedo



ANNUAL, WINTER, SUMMER Averages

