

Pan-Arctic permafrost thermal conditions: Where does the Yamal Peninsula fit?

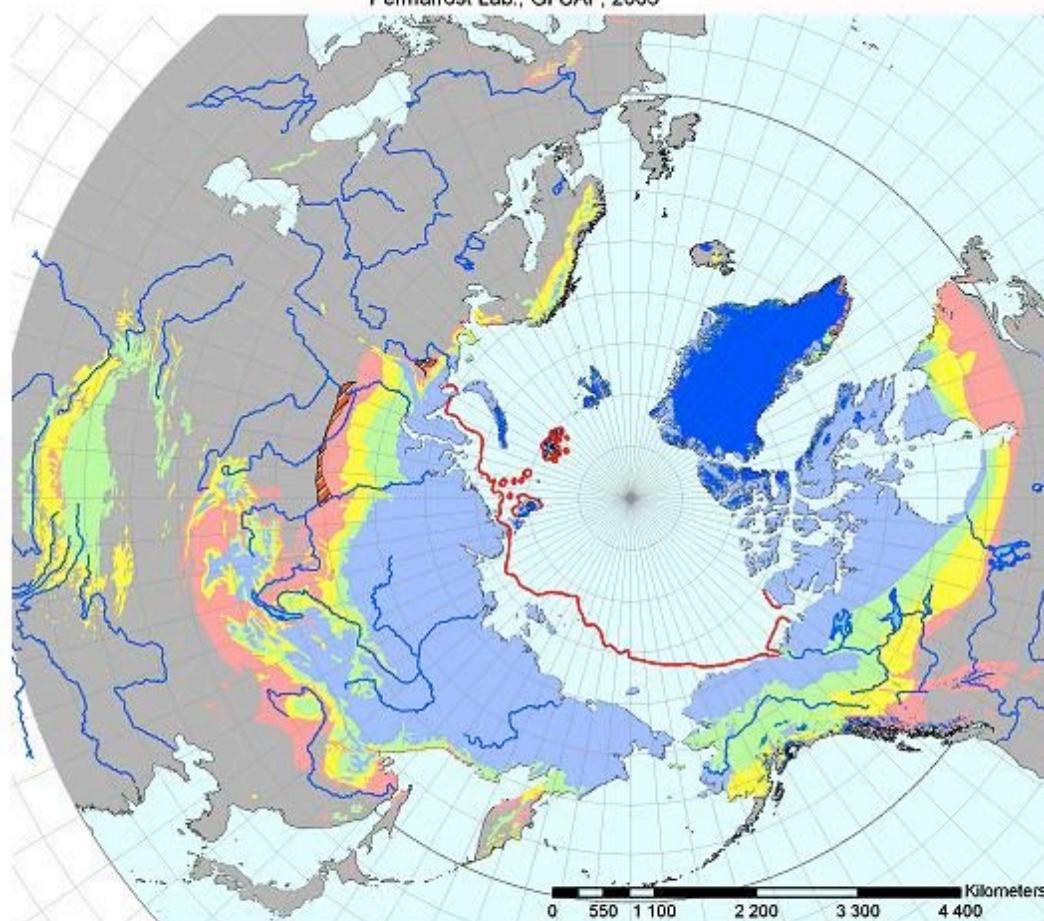


V. Romanovsky, A. Kholodov and S. Marchenko
University of Alaska Fairbanks



Circumpolar permafrost extent

Permafrost Lab., GI UAF, 2003



Legend

Permafrost extent

- Continuous (90-100% of area)
- Discontinuous (50-90% of area)
- Sporadic (10-50% of area)
- Isolated (0-10% of area)

Subsea cryosphere

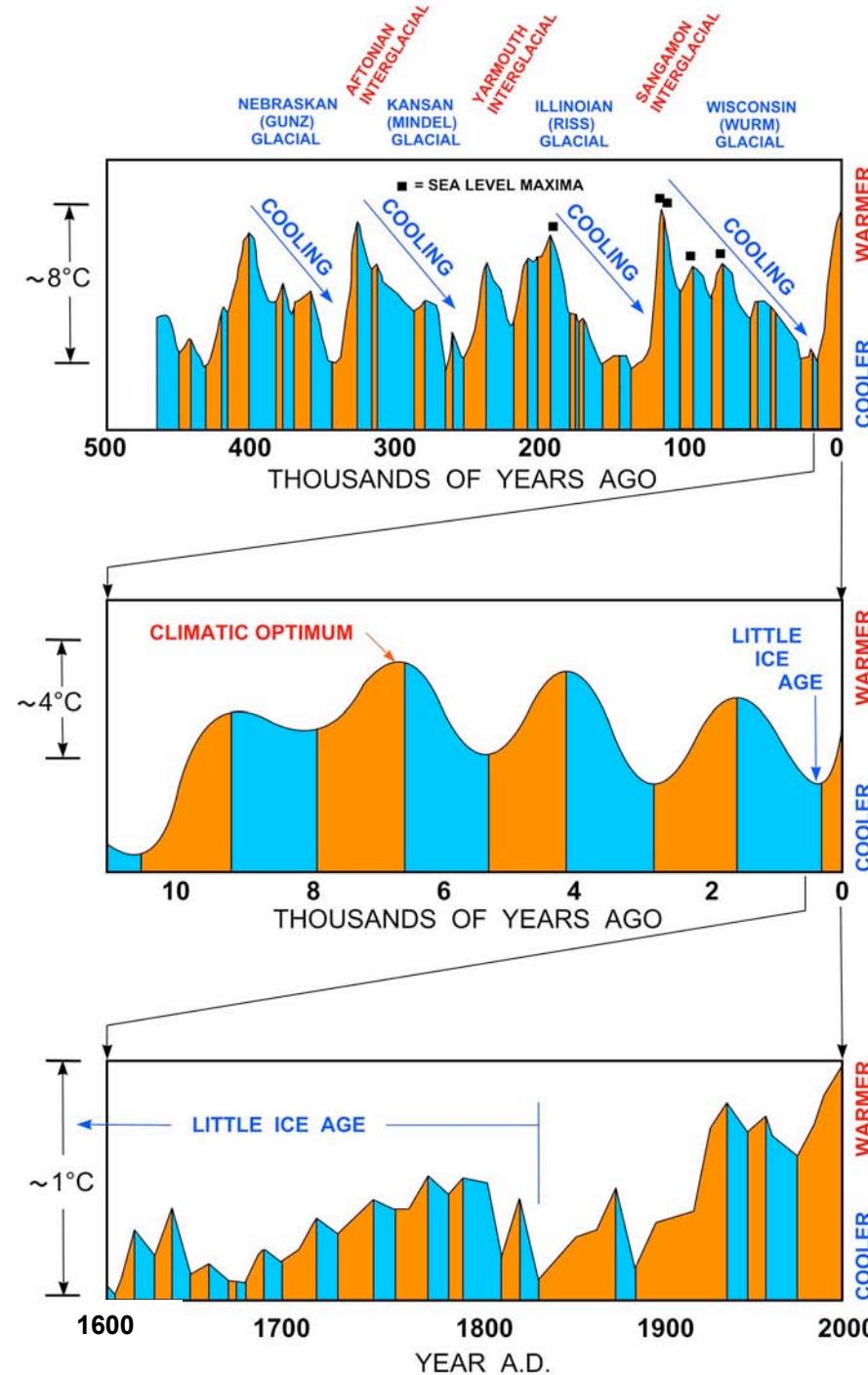
- Subsea permafrost limit

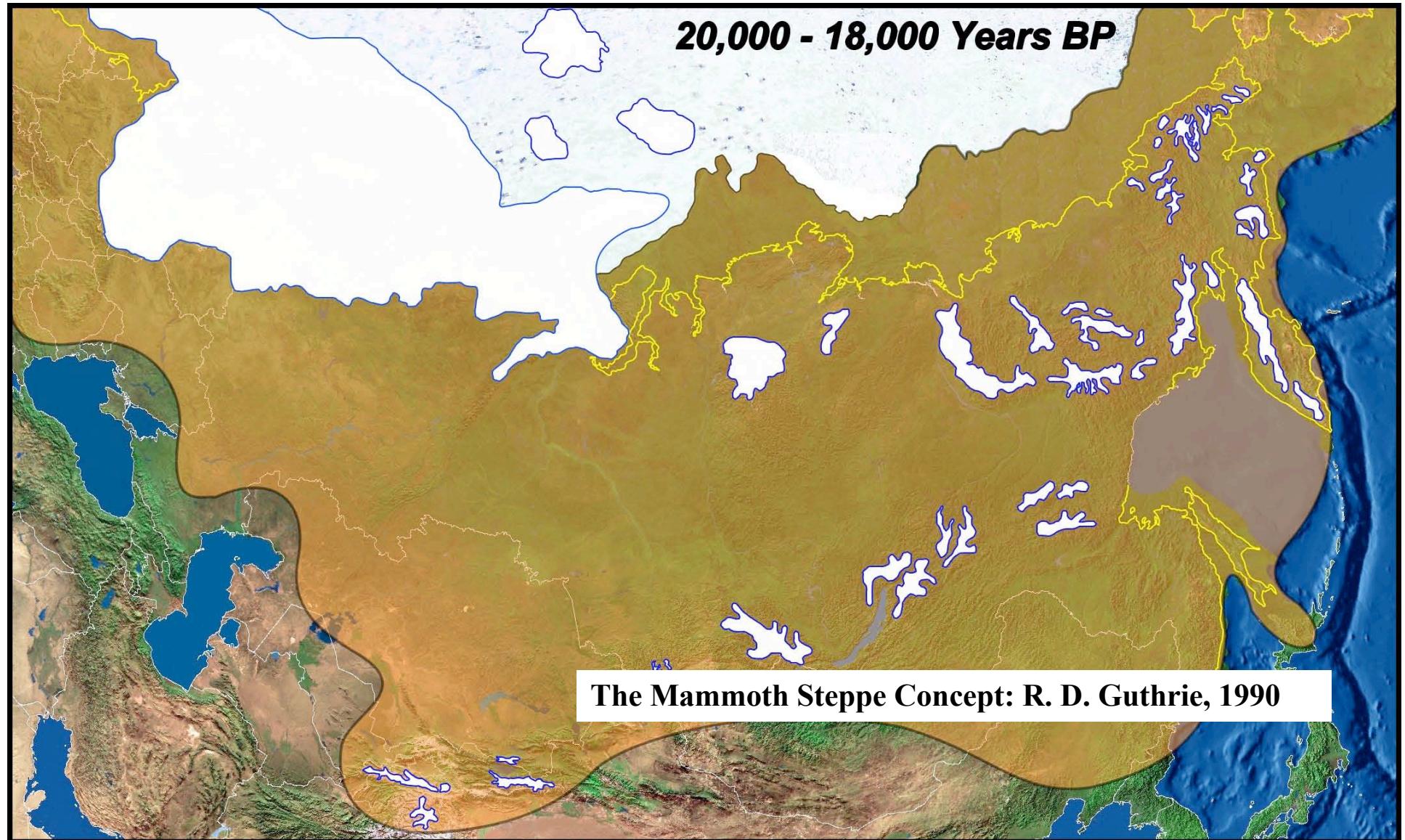
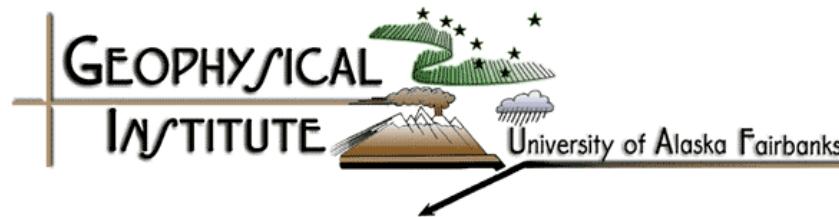
Geographic objects

- Glaciers
- Lakes
- Ocean and Seas
- Land
- Rivers
- 10 x 10 Degree Graticule

This map was prepared by using an electronic version of the "Circum-Arctic Map of Permafrost and Ground-Ice Condition", J. Brown, O.J. Ferrians, Jr., J.A. Heginbottom, & E.S. Melnikov, 1997, U.S. Geological Survey, ISBN 0-607-88745-1.







The Mammoth Steppe Concept: R. D. Guthrie, 1990



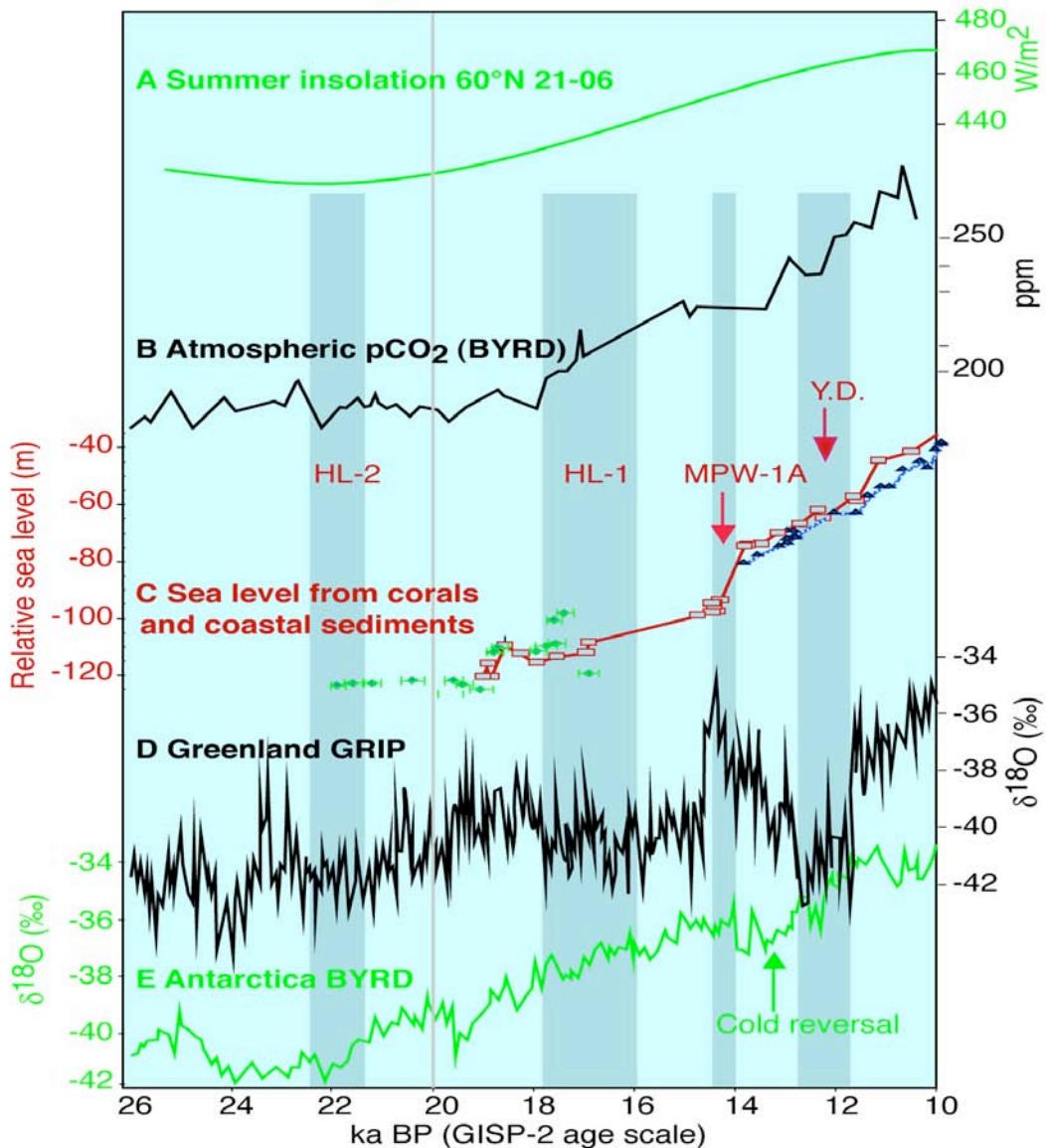


Photo by M. Grigoriev



Photo by M. Grigoriev

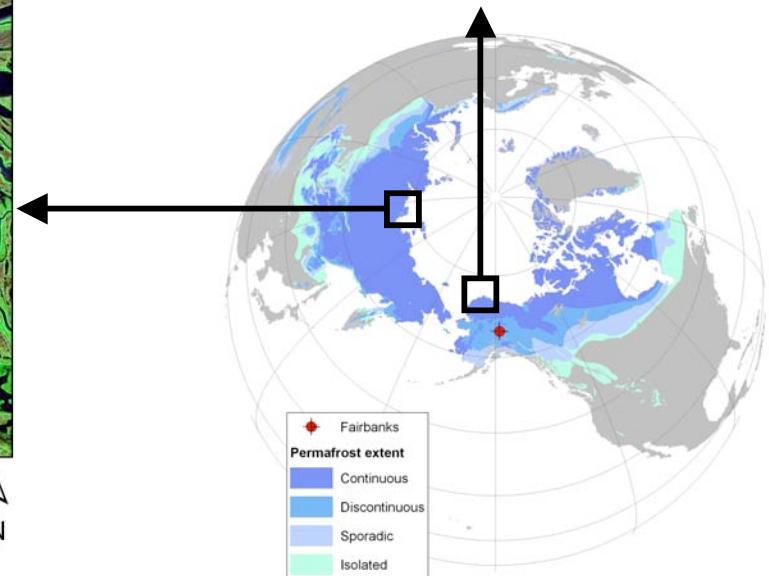
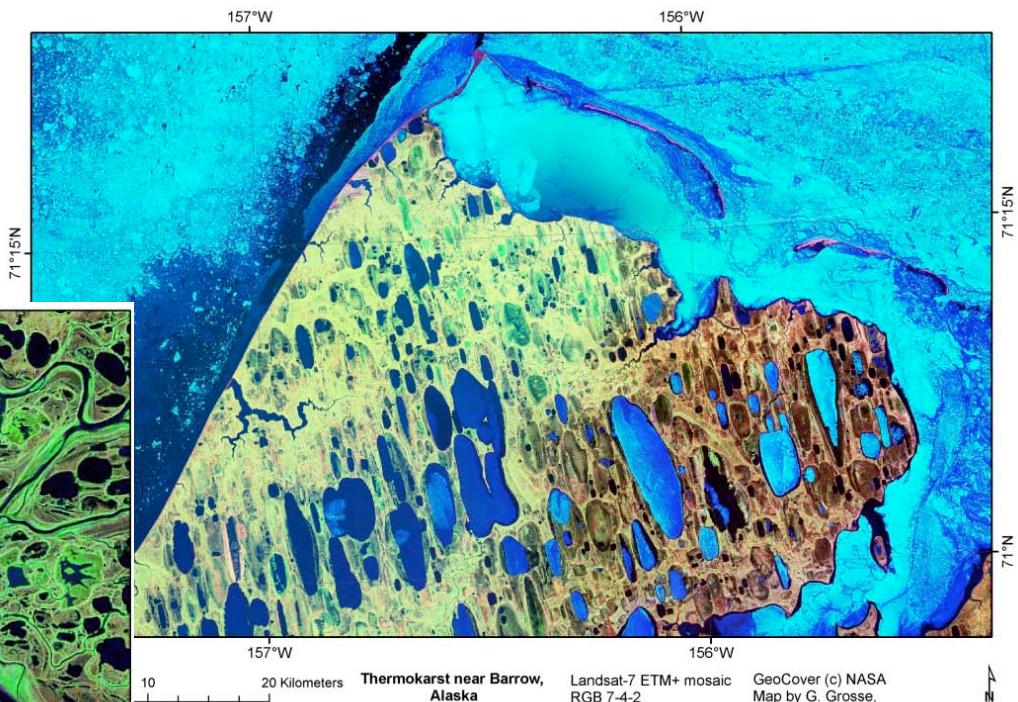
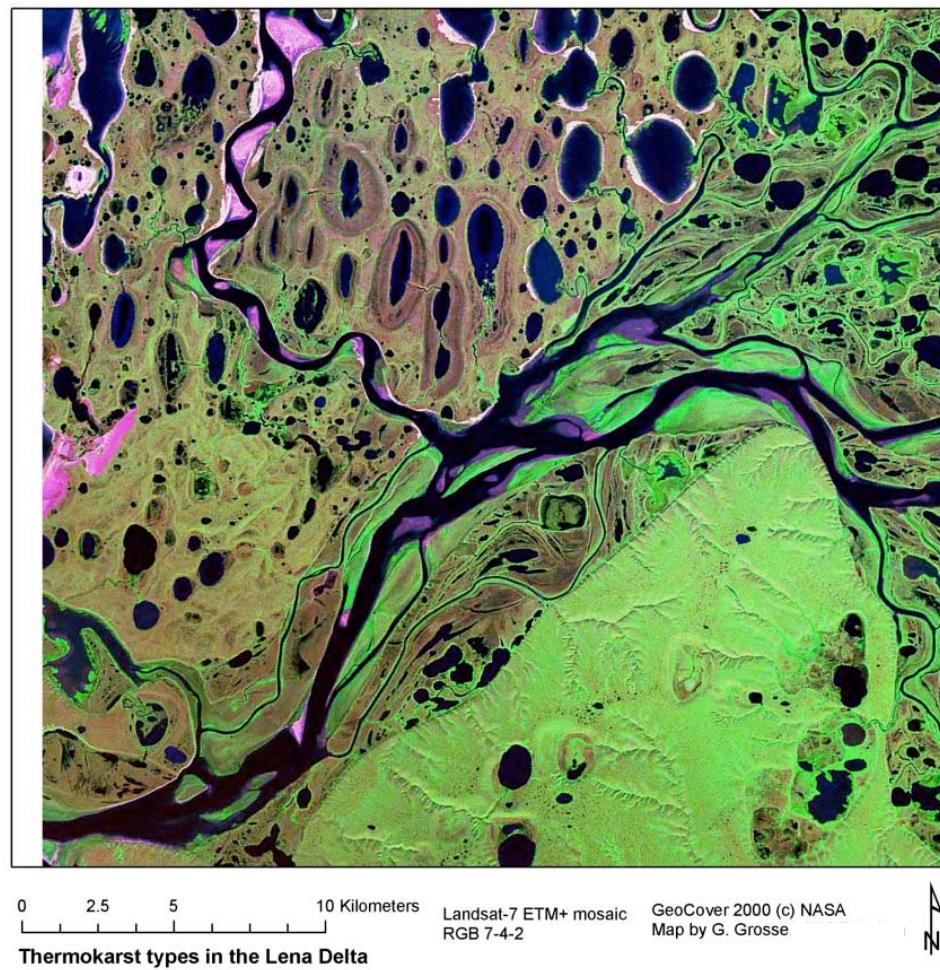
Last Deglaciation (25-10 ka BP) Through Various Proxies

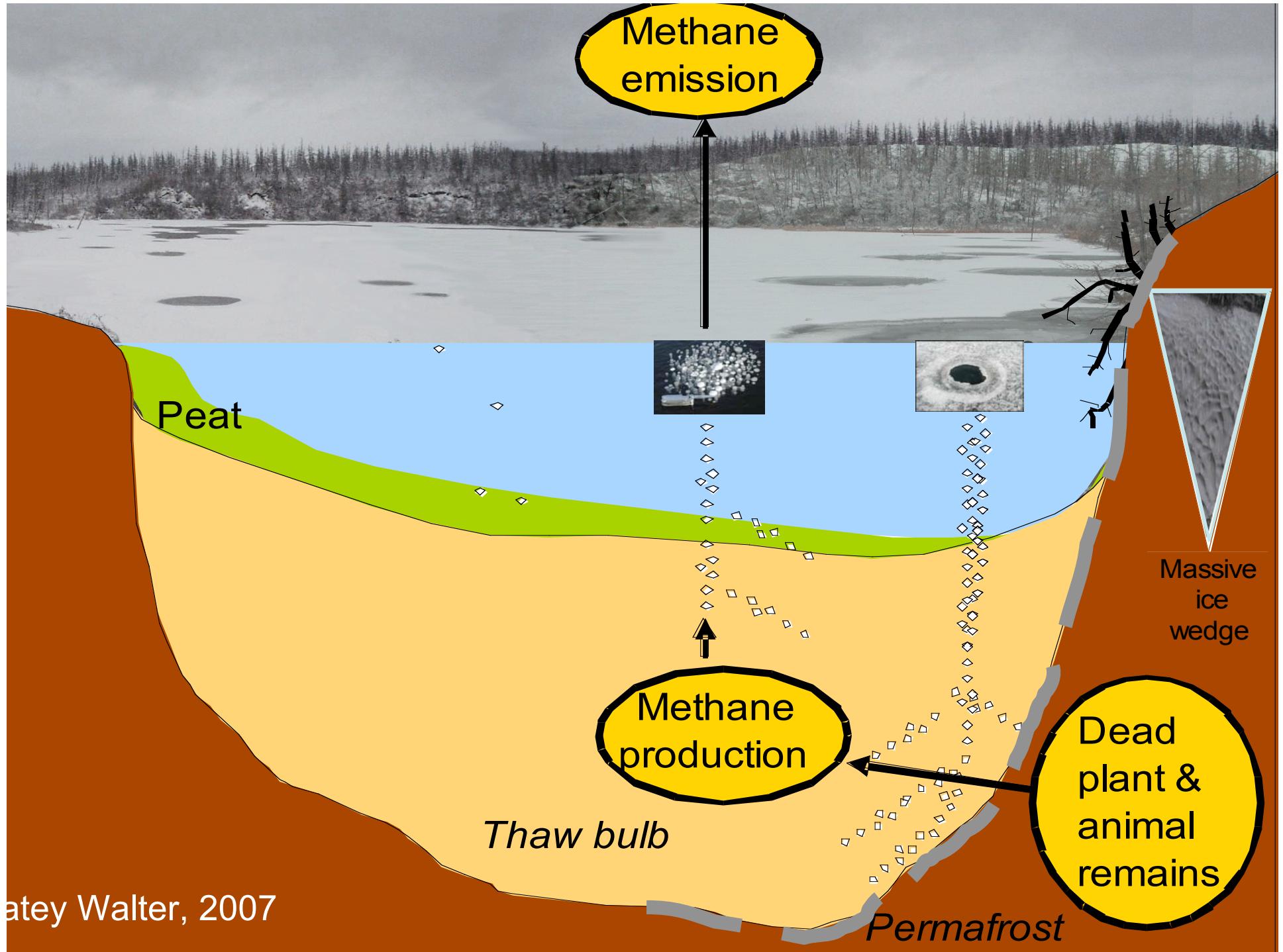




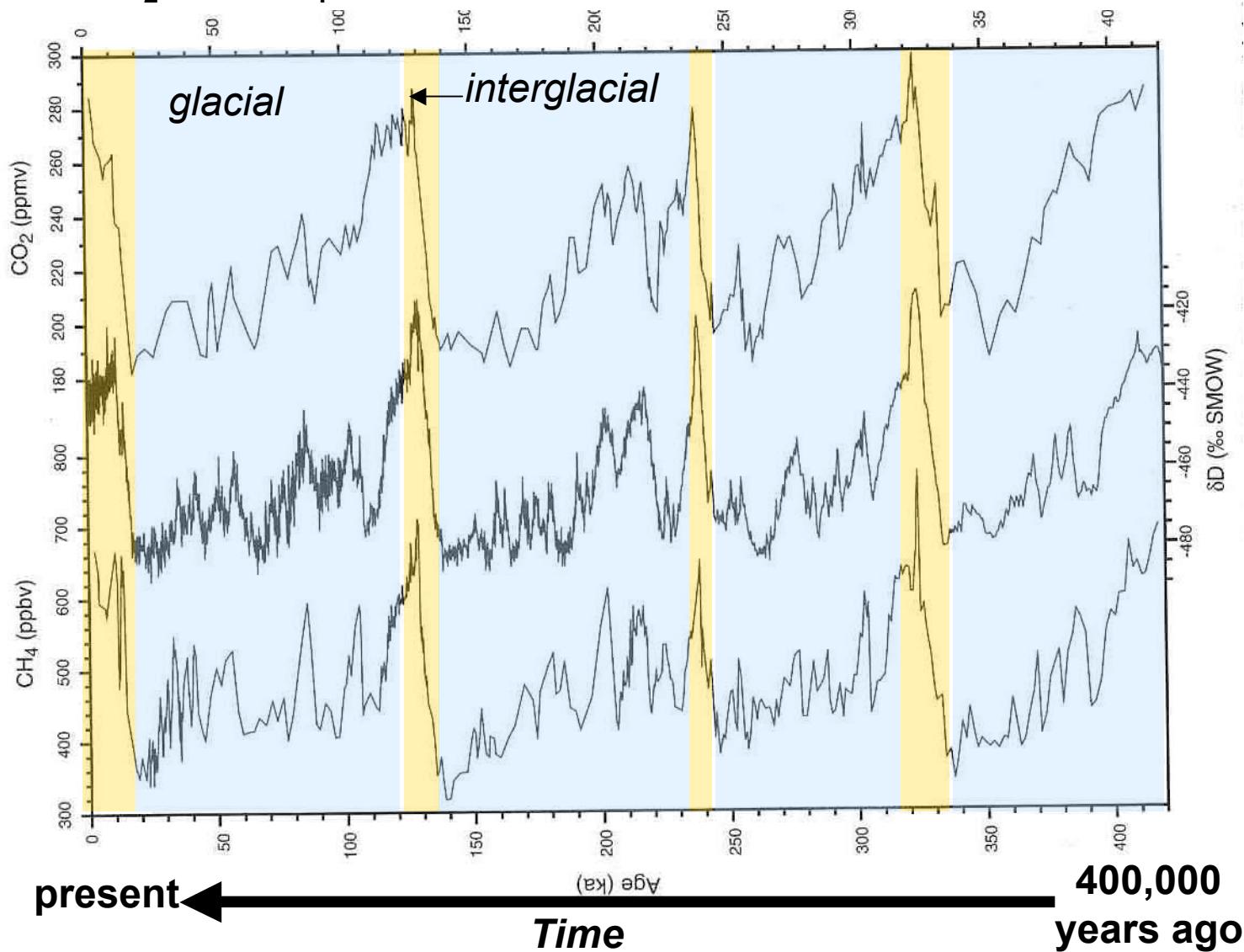
9,000 - 5,000 Years BP

Examples for Arctic landscapes affected by massive permafrost degradation (thermokarst)

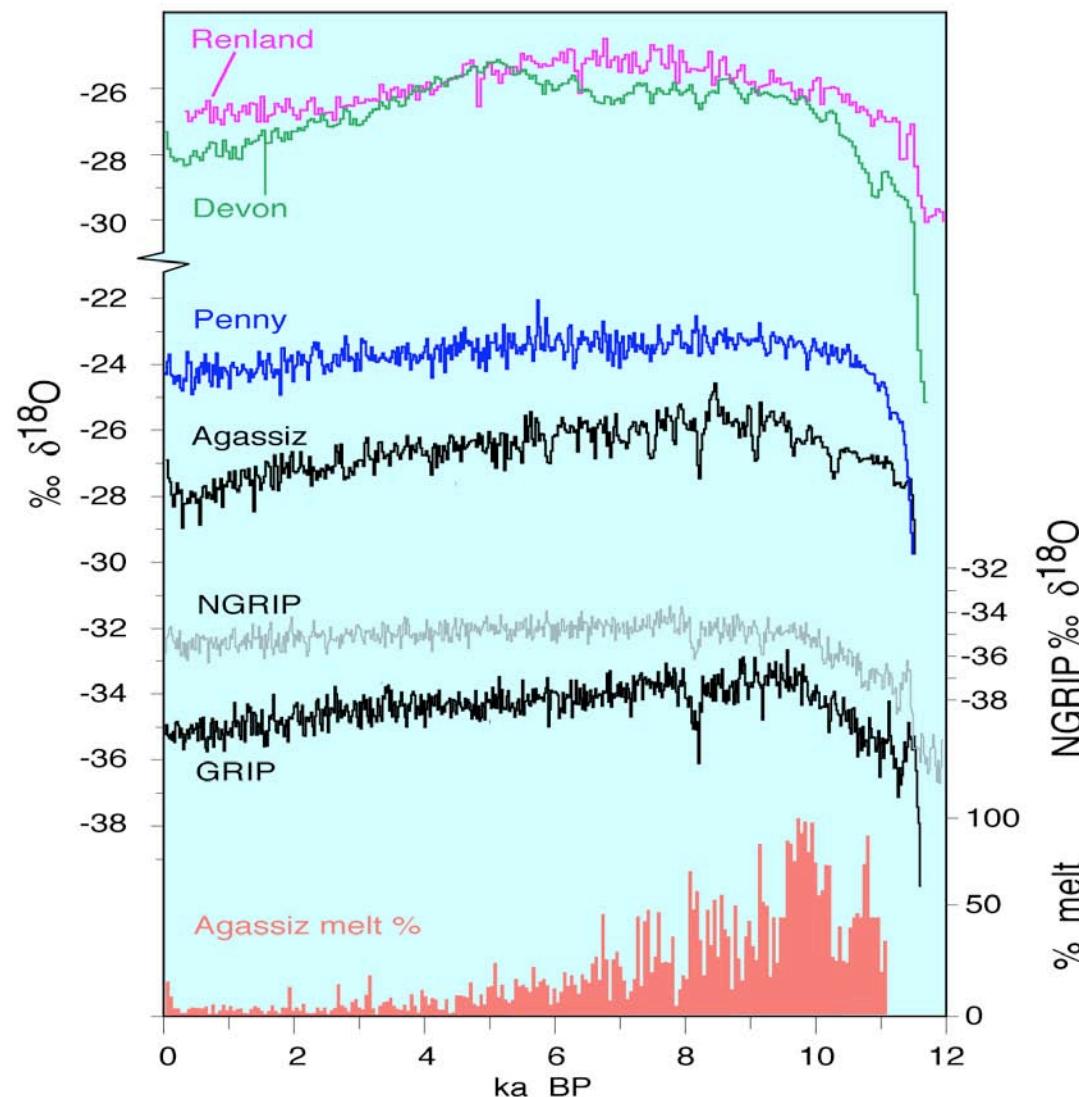




CO_2 and CH_4 in ice cores from Greenland and Antarctica

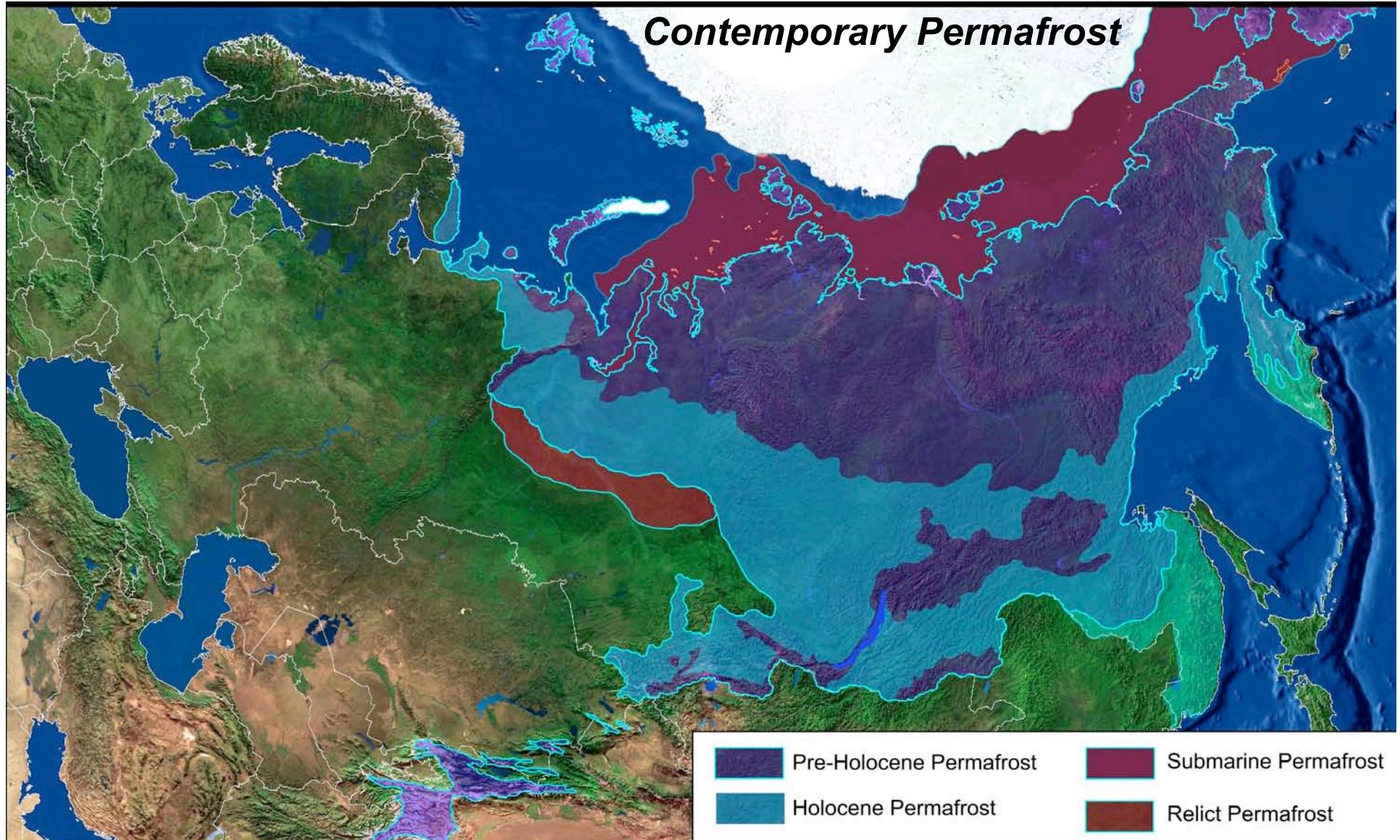


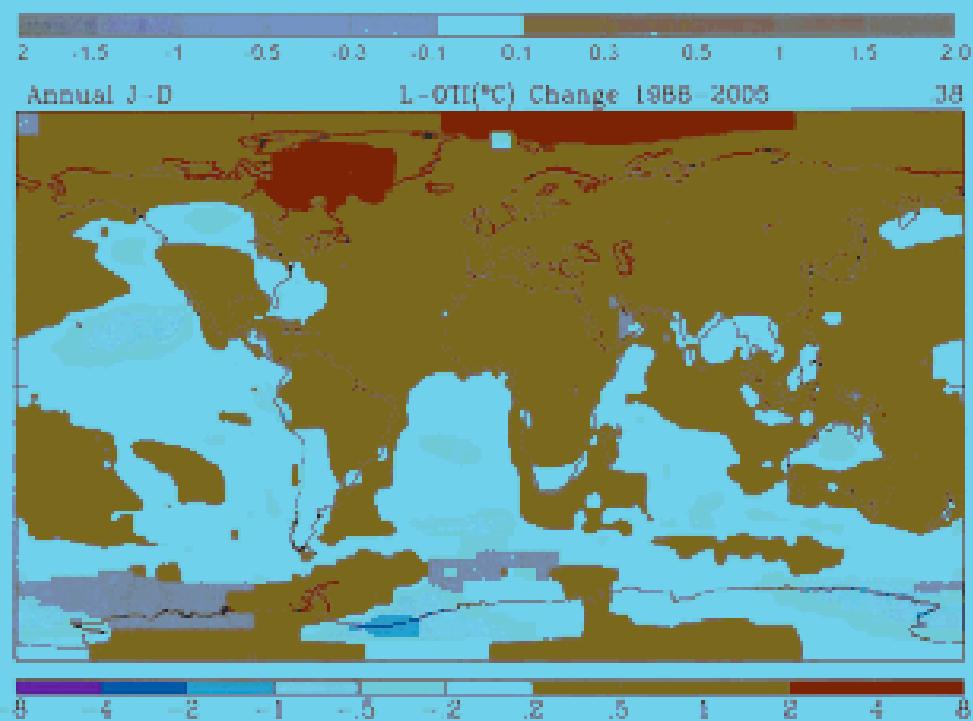
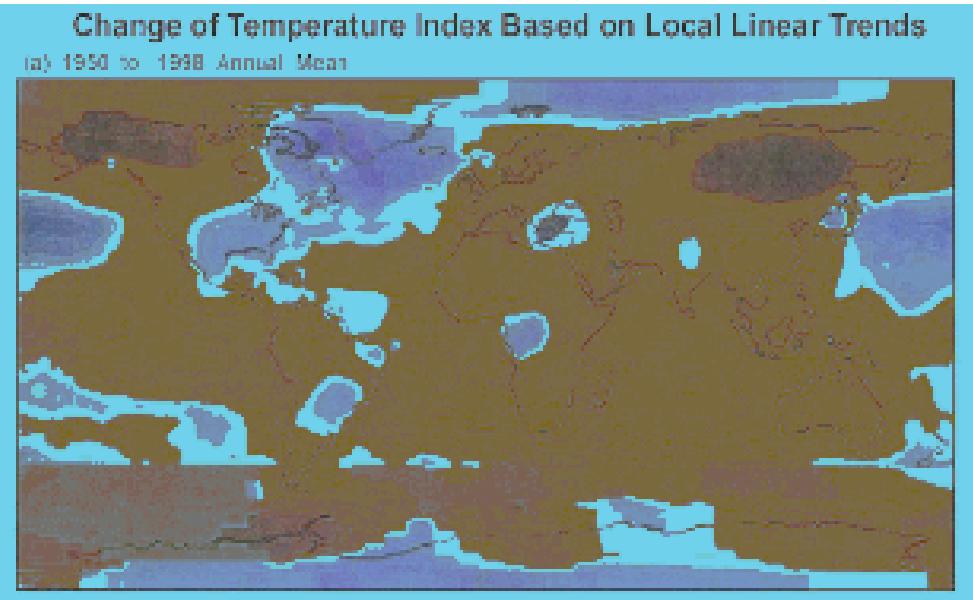
Holocene $\delta^{18}\text{O}$ Records from Greenland and Canadian Arctic Ice Caps





Contemporary Permafrost





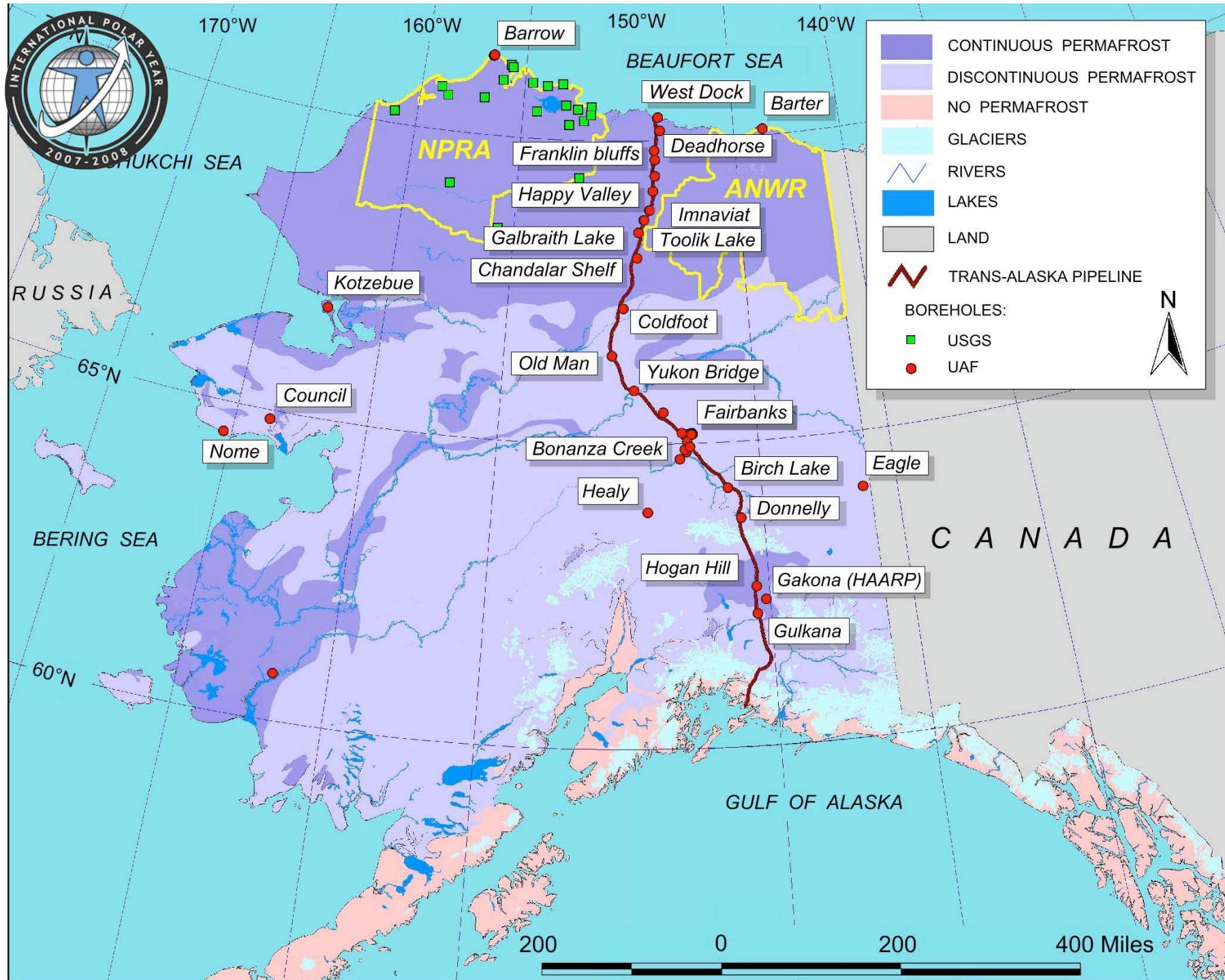
(J. Hansen)

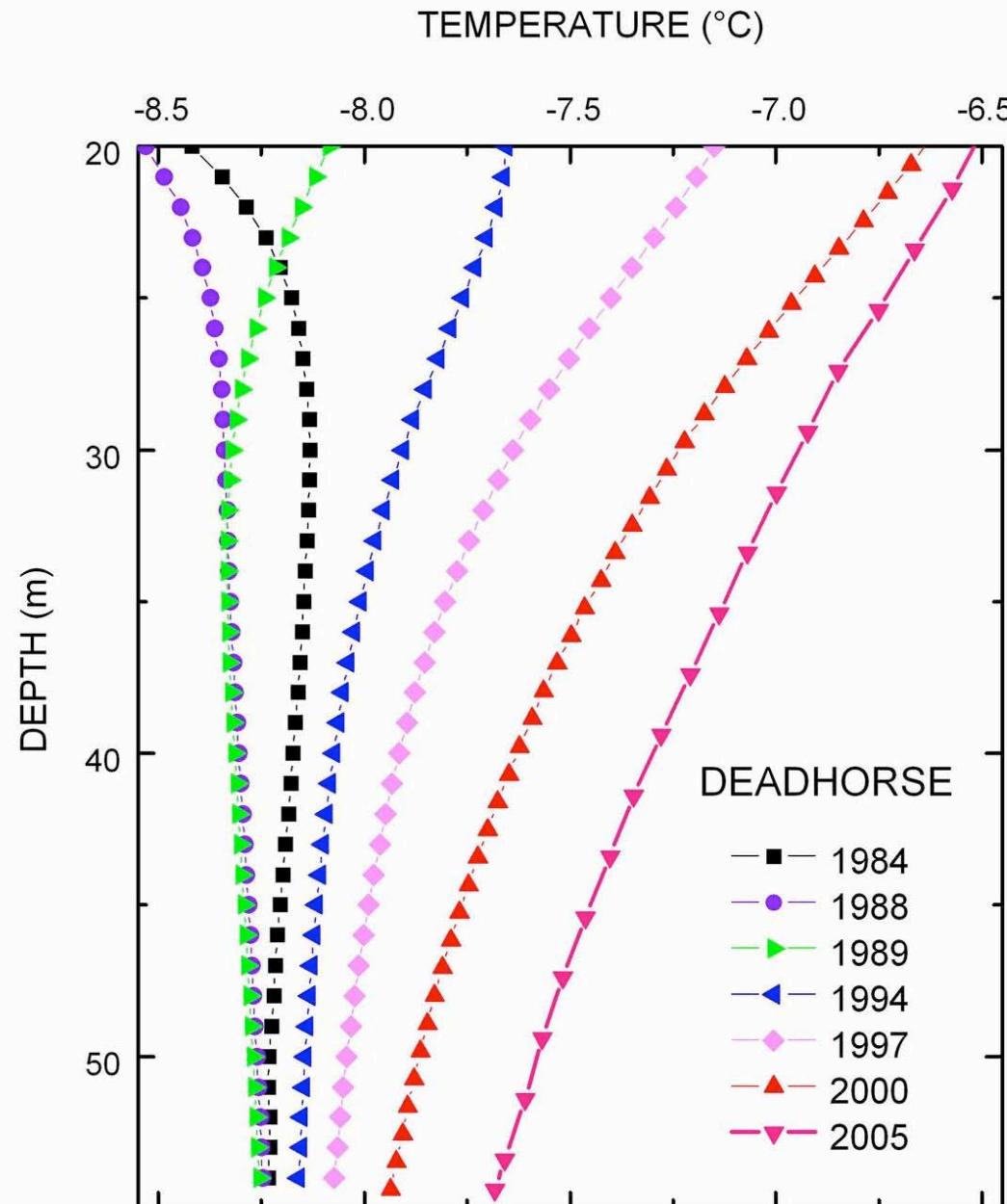
The changes in mean annual air temperature from 1950 to 1998

The changes in mean annual air temperature from 1986 to 2006

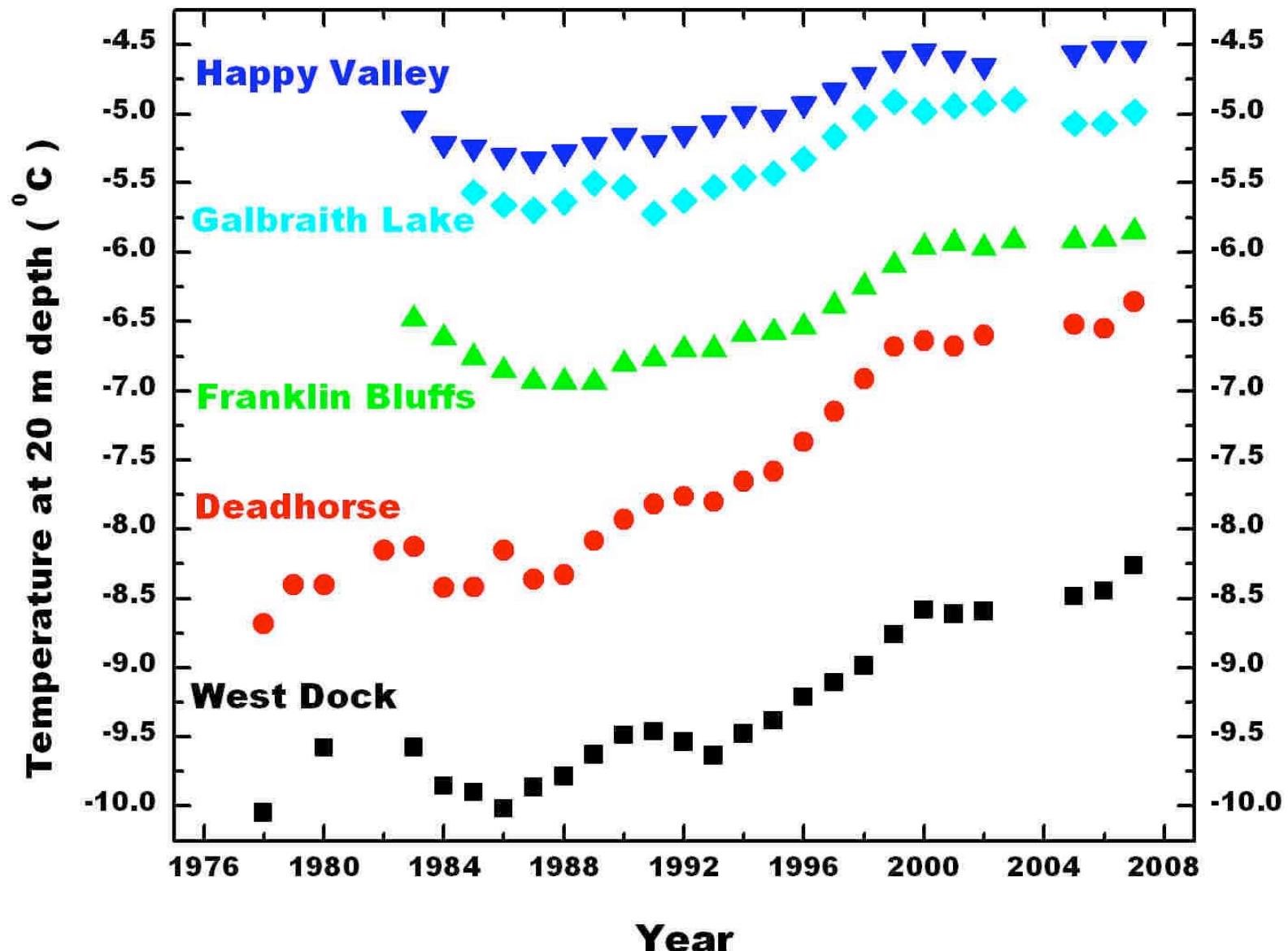
Topics to be covered:

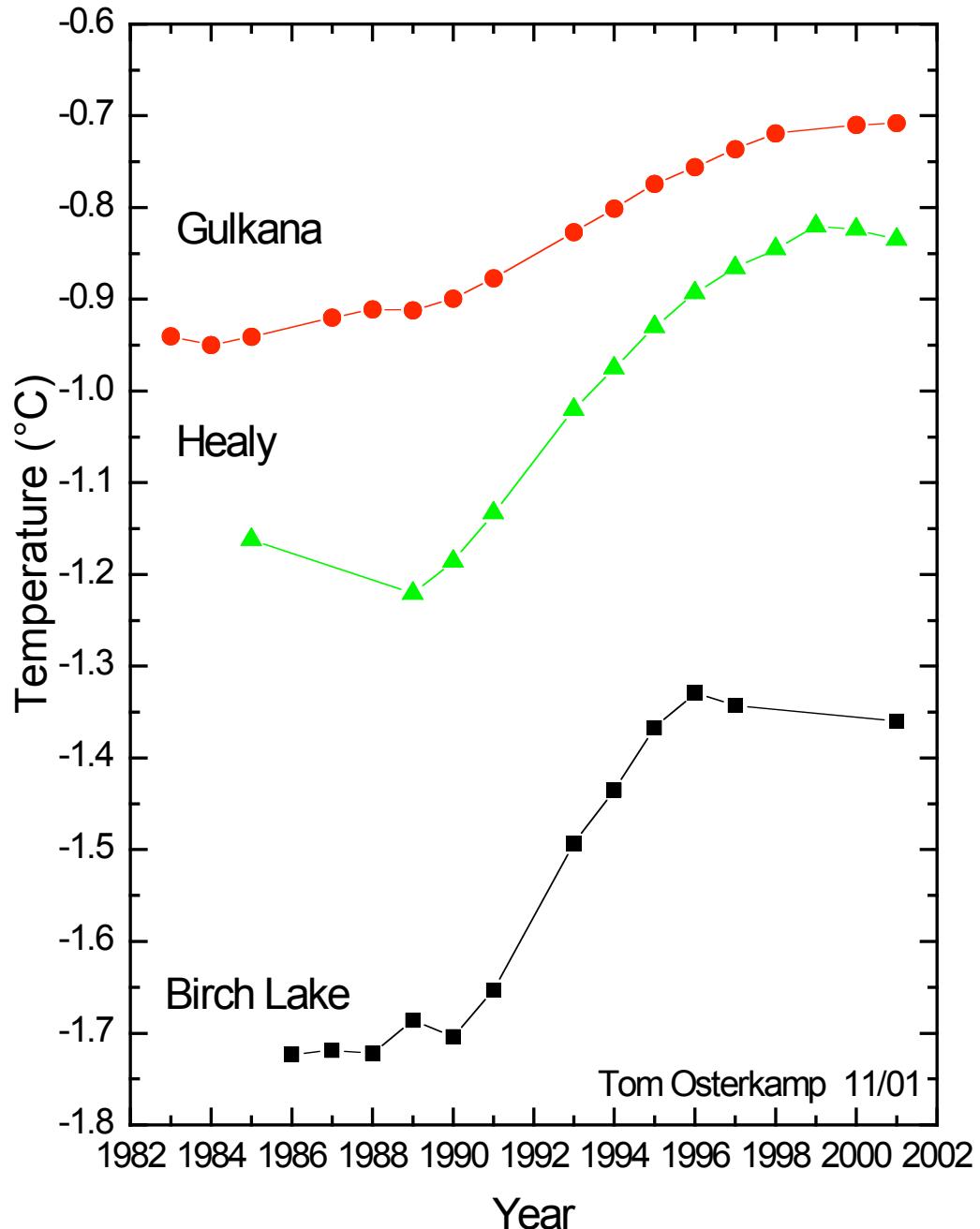
- **Measuring Permafrost Thermal Regime**
- **Modeling Permafrost Thermal Regime**
- **Permafrost in Climate Models**



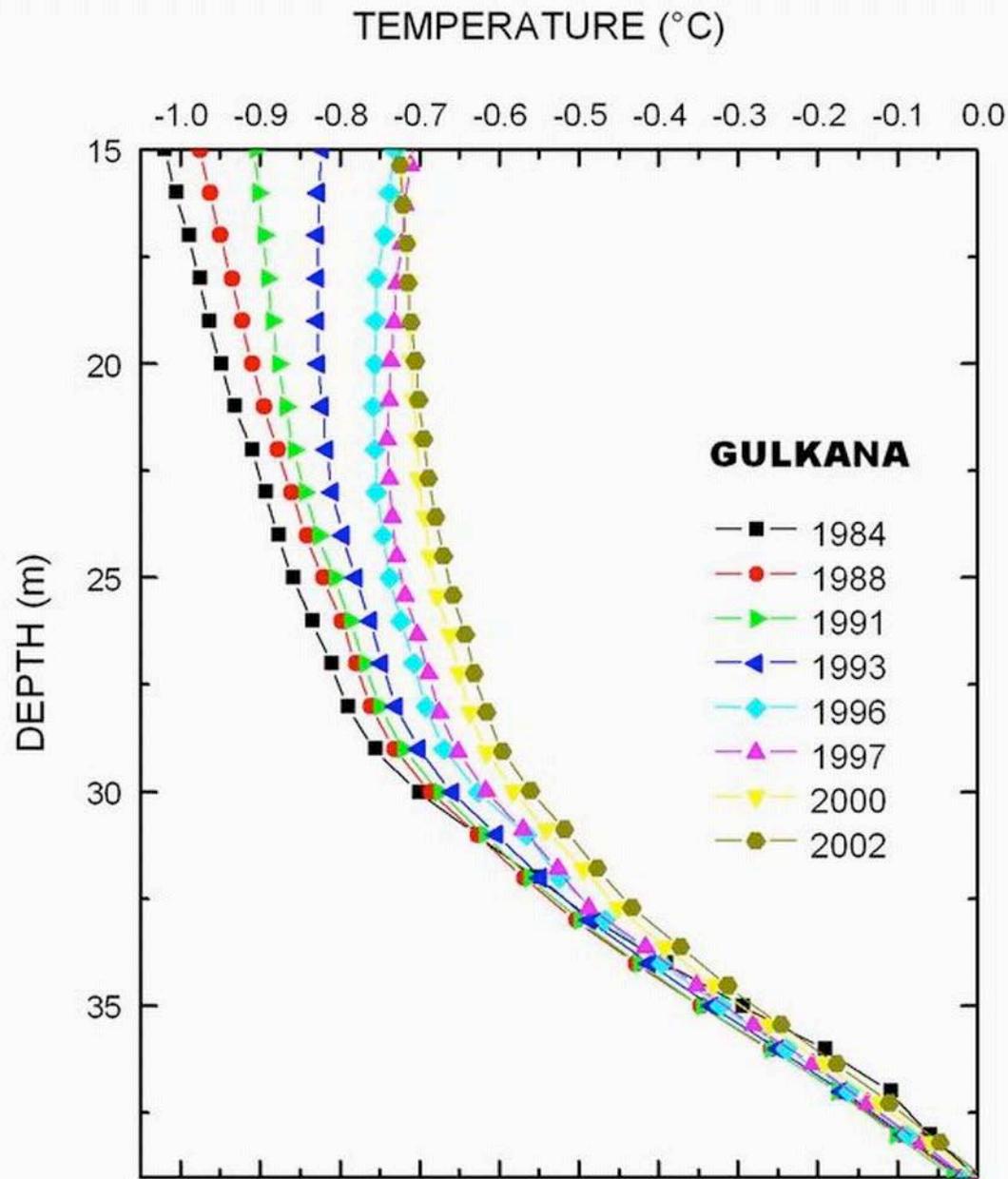


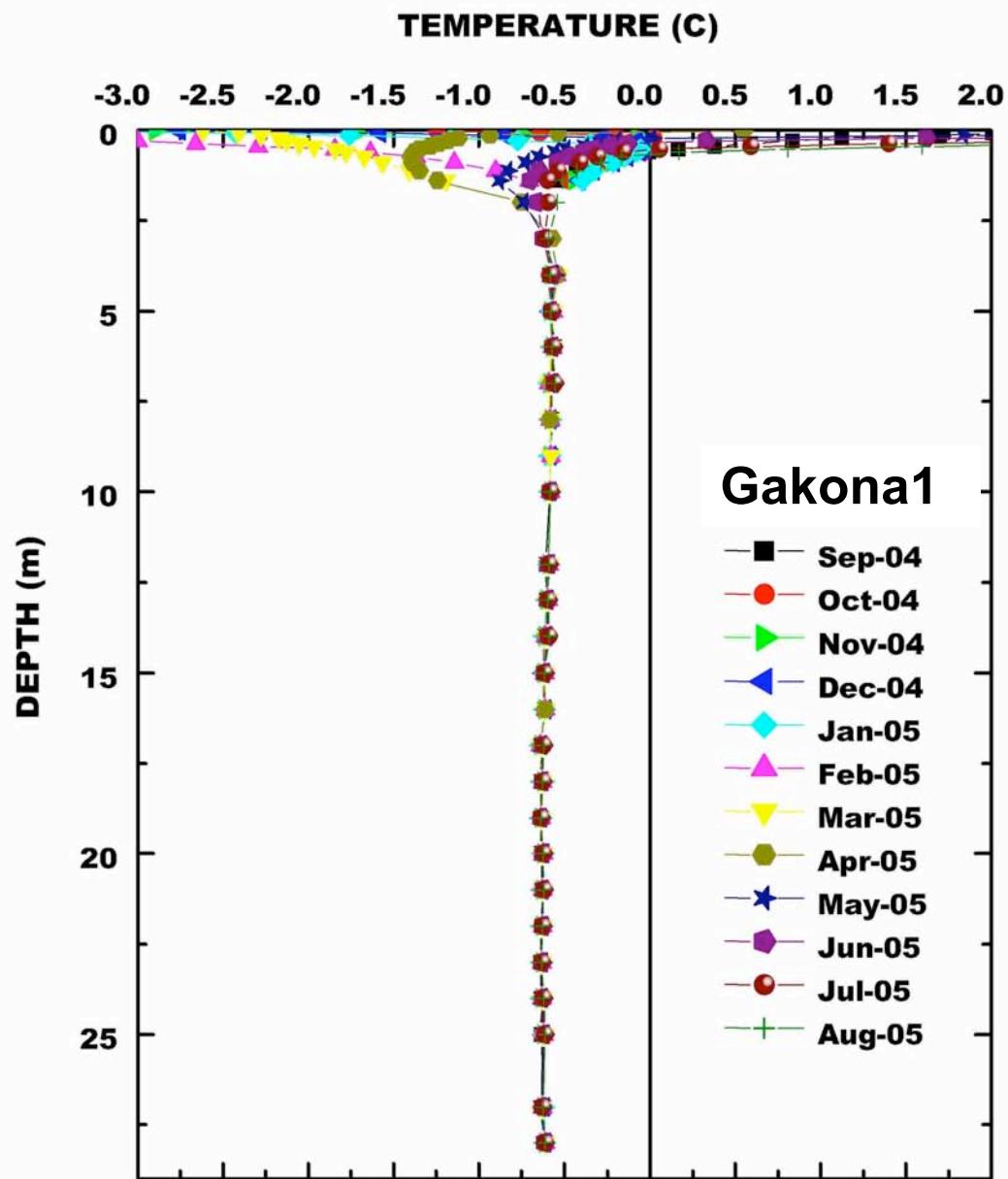
"TSP" Time Series - Northern Alaska
(Osterkamp and Romanovsky)

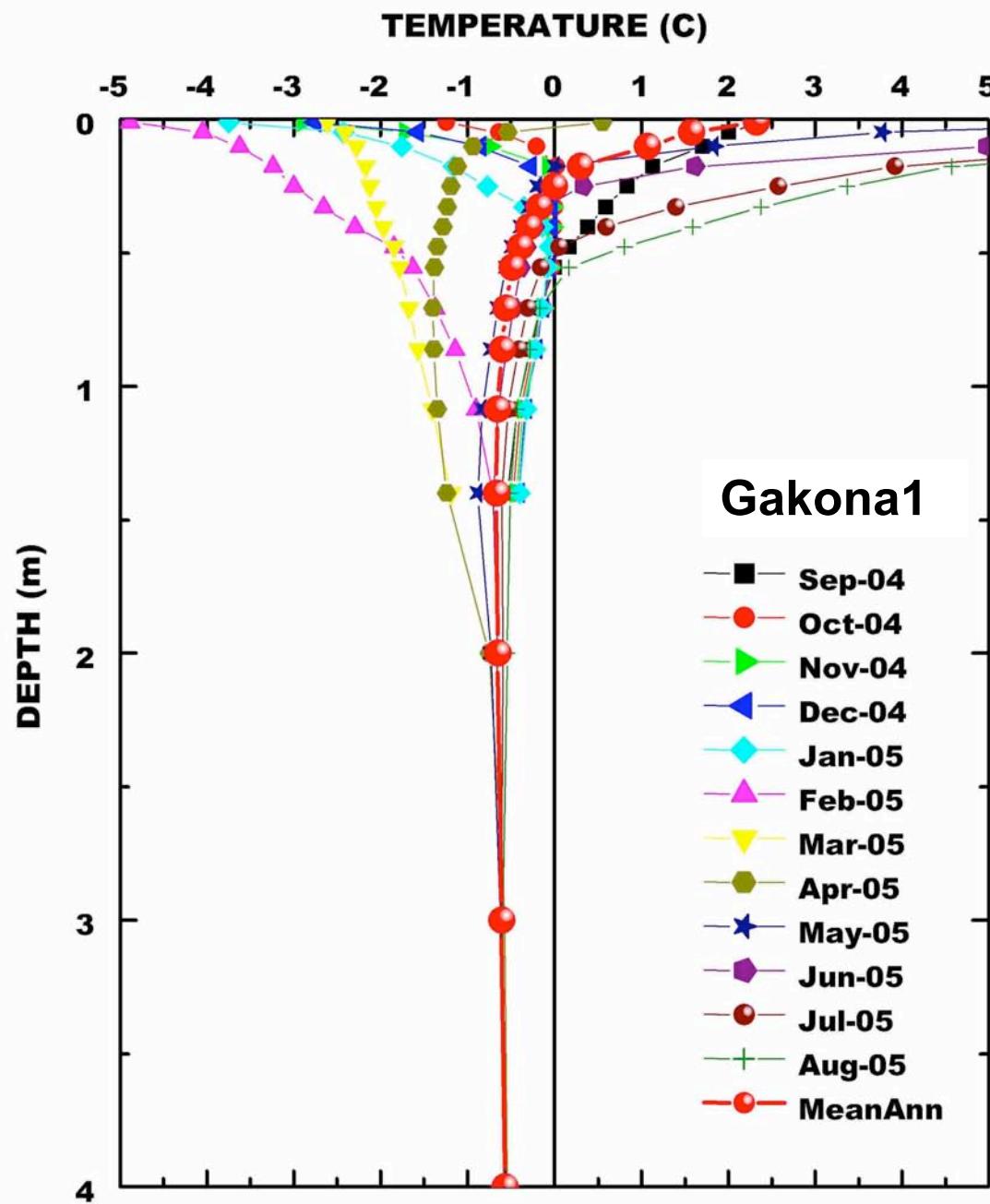




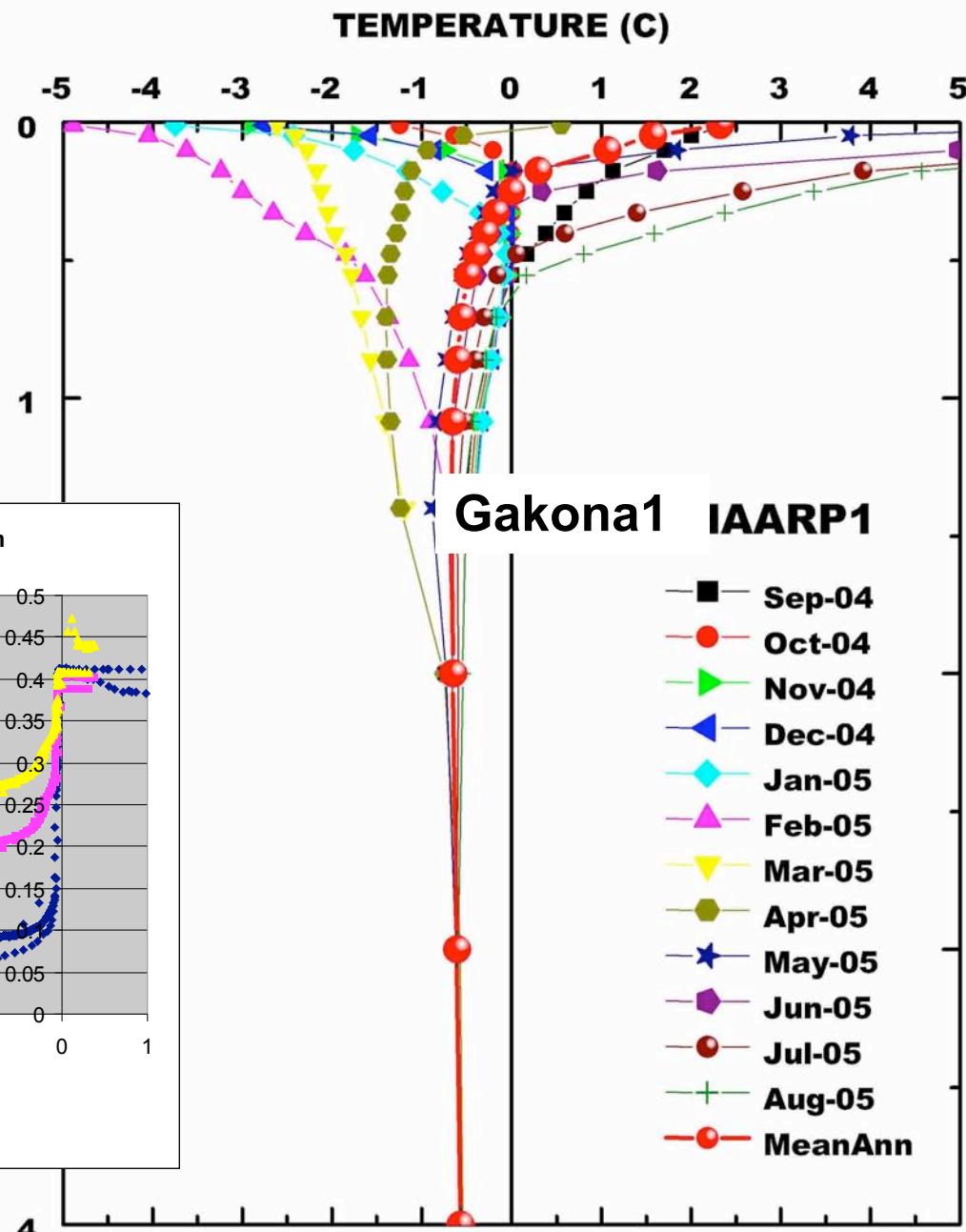
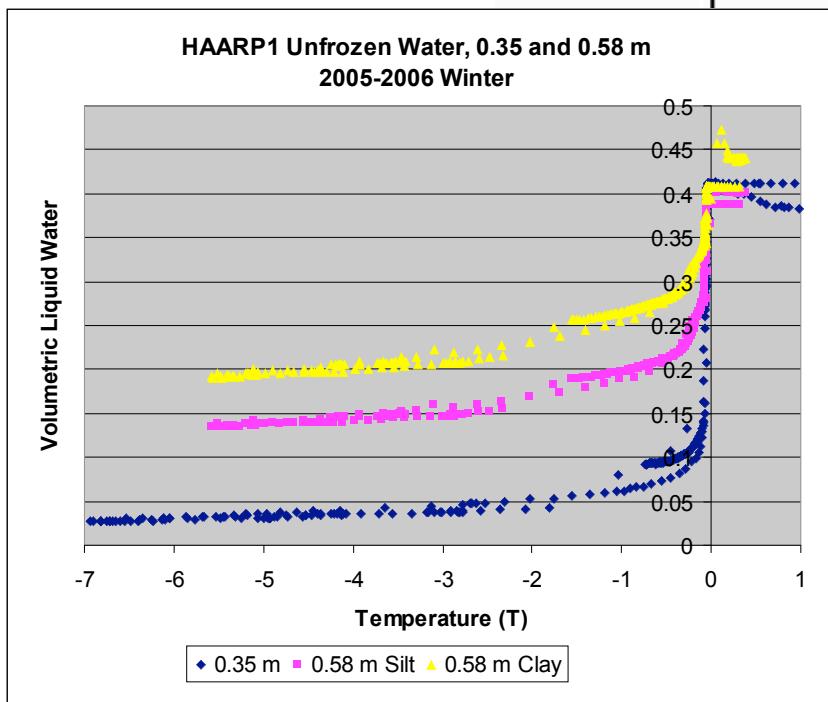
Temperatures at the 20 m depth in discontinuous permafrost in Interior Alaska.

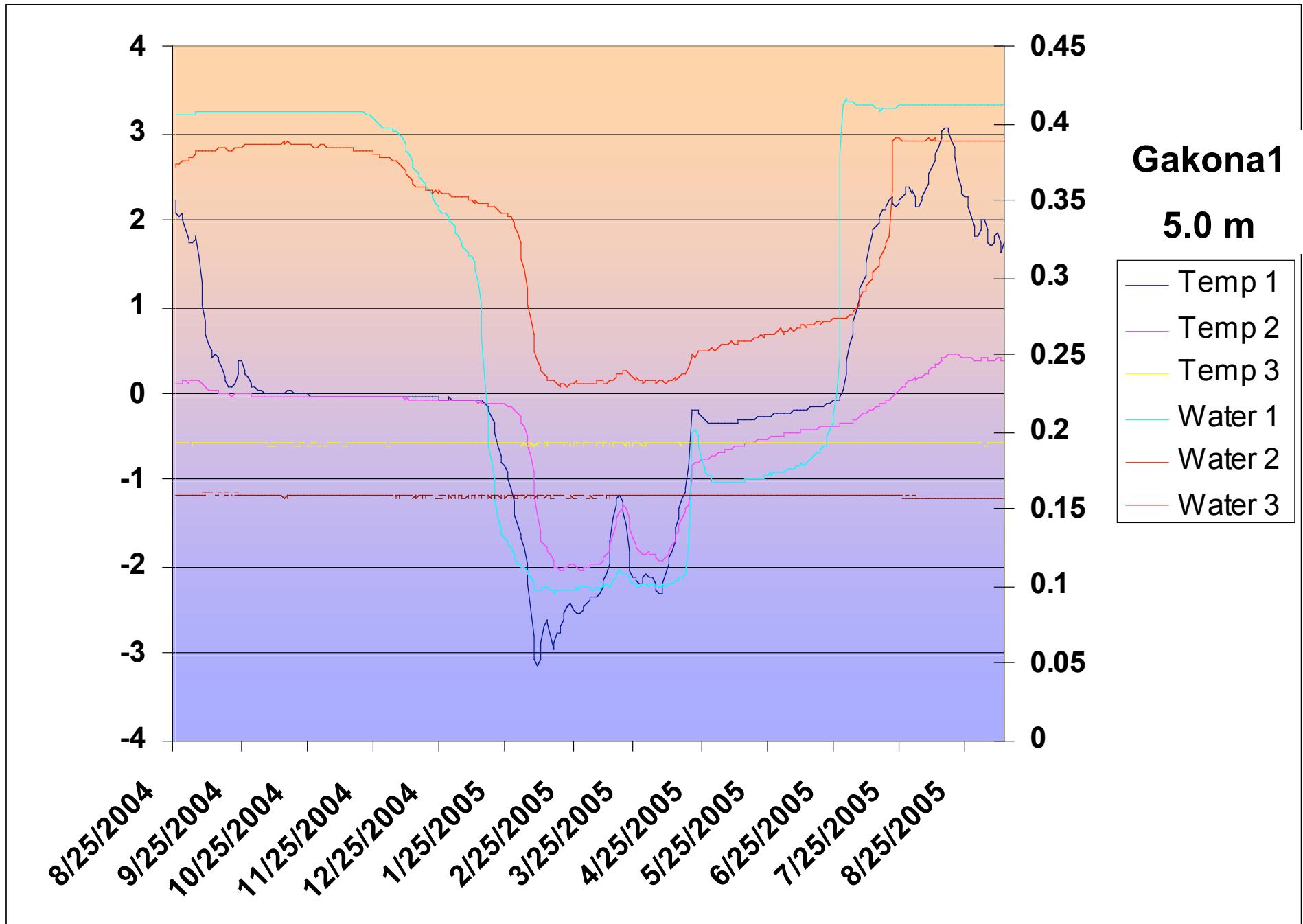


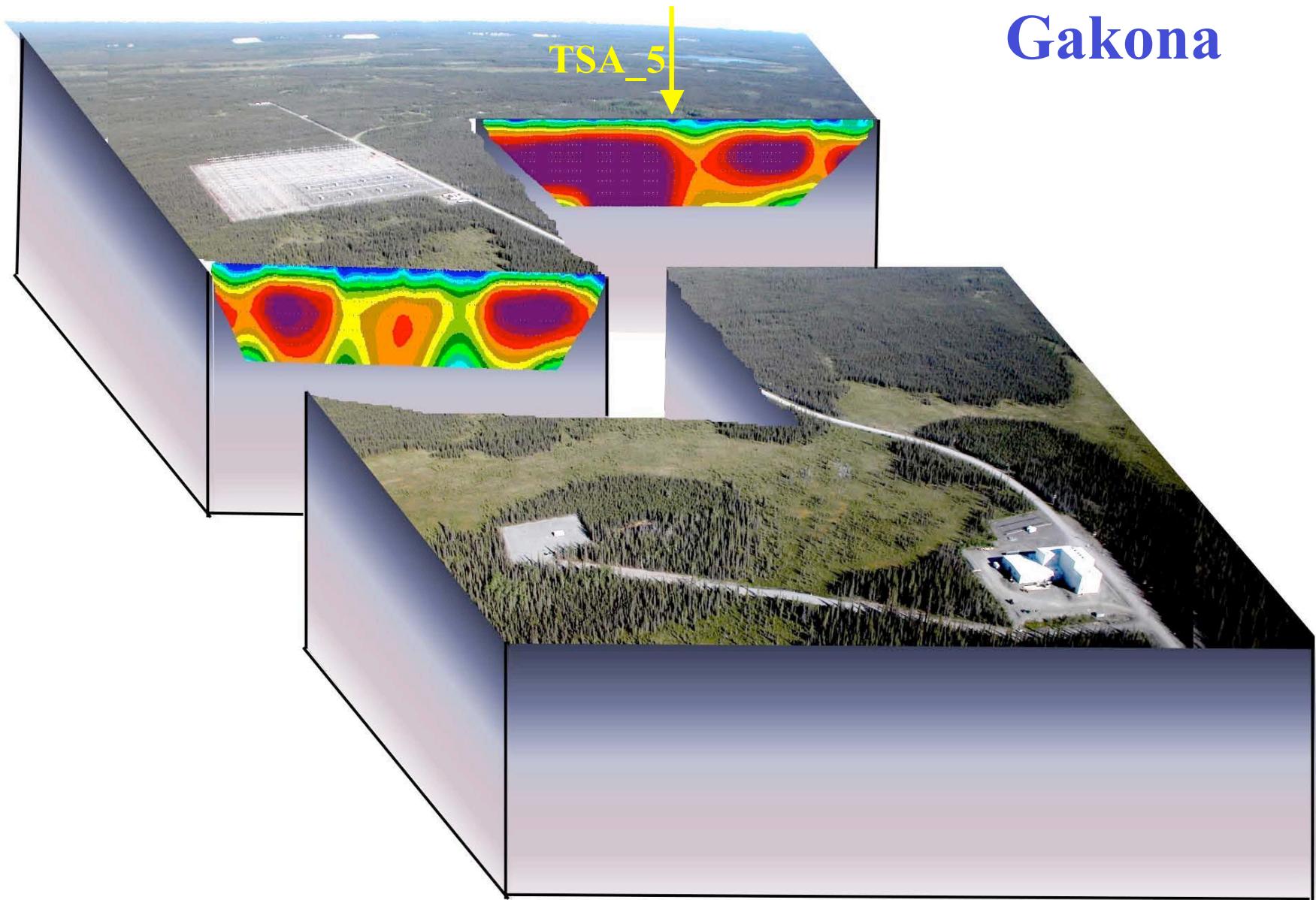




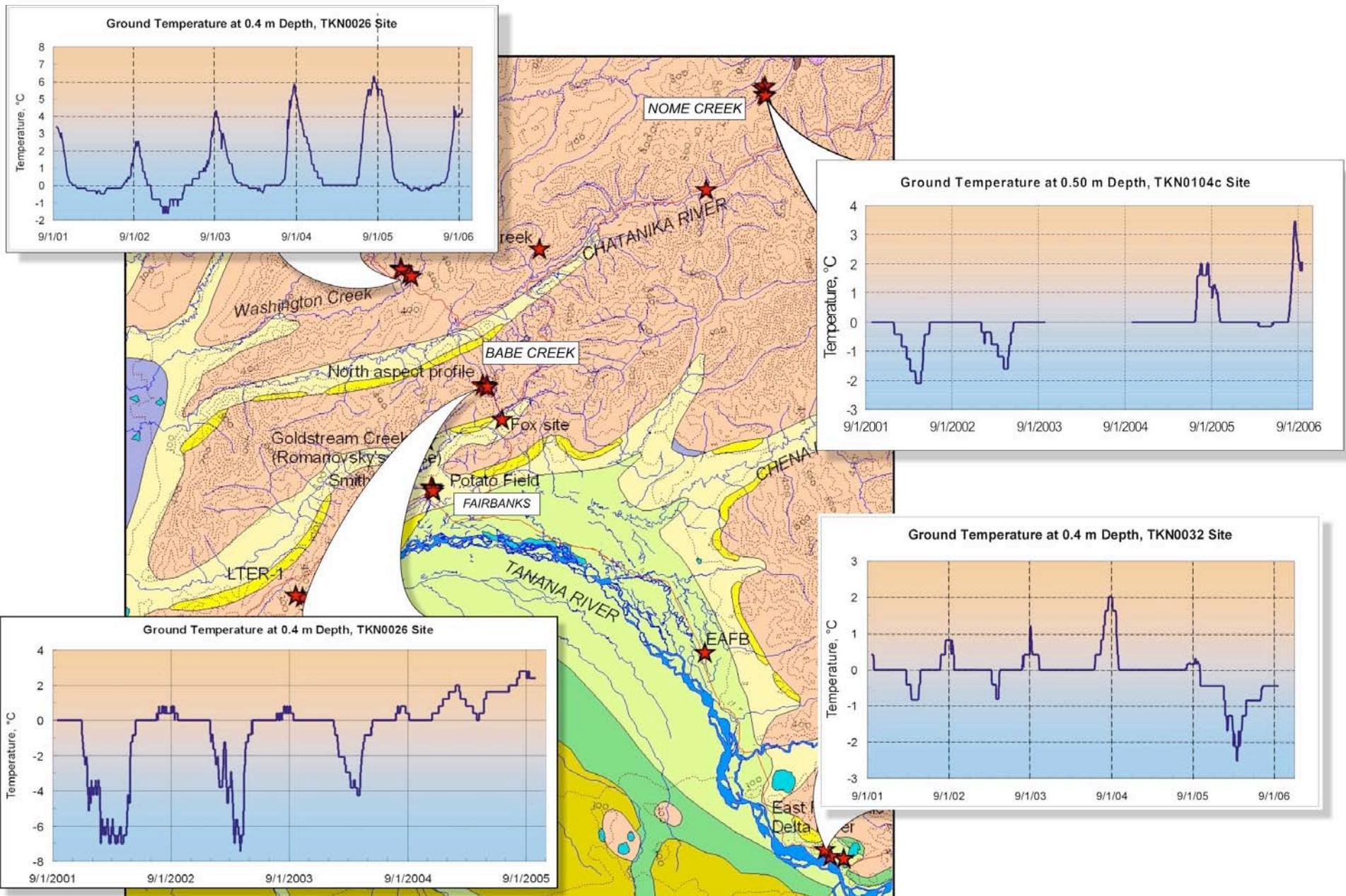
High unfrozen water content

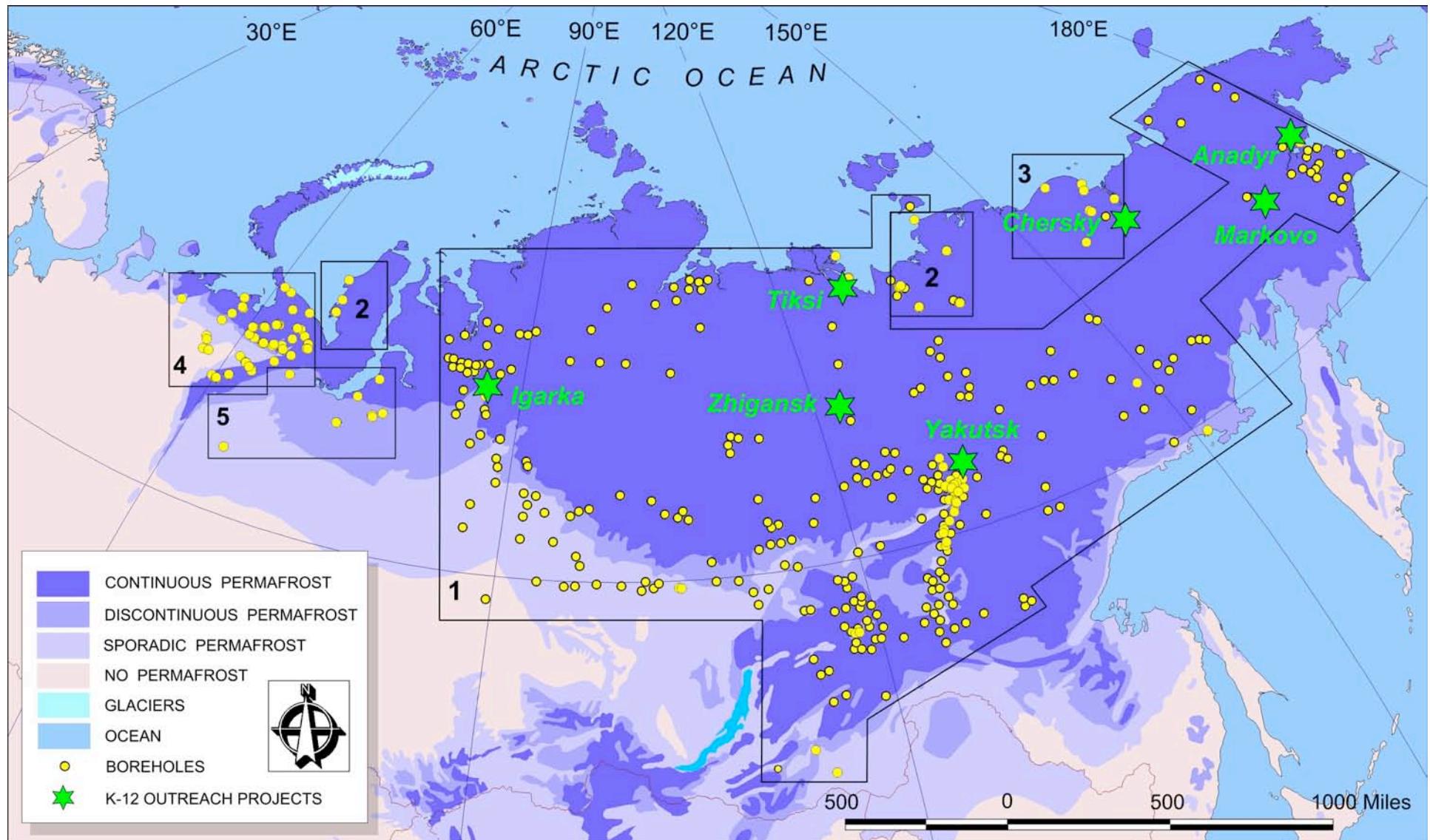
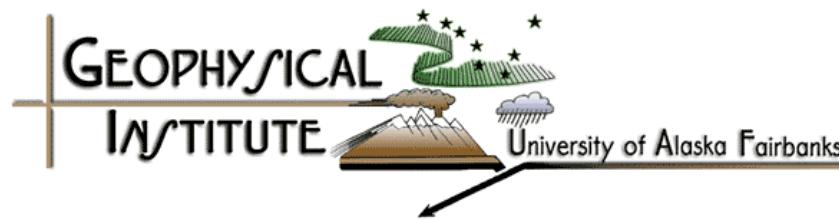


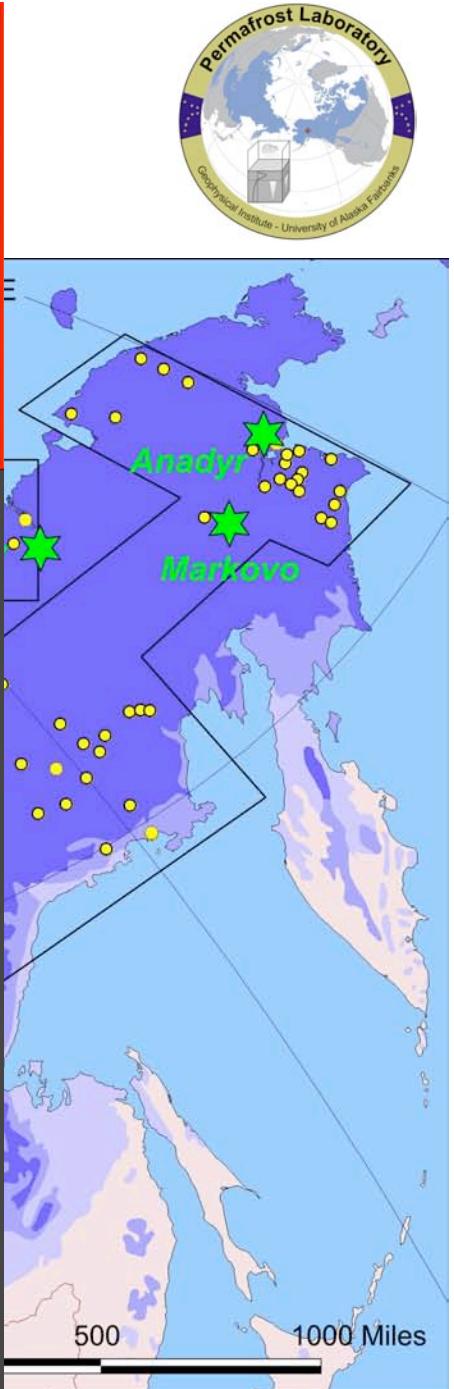
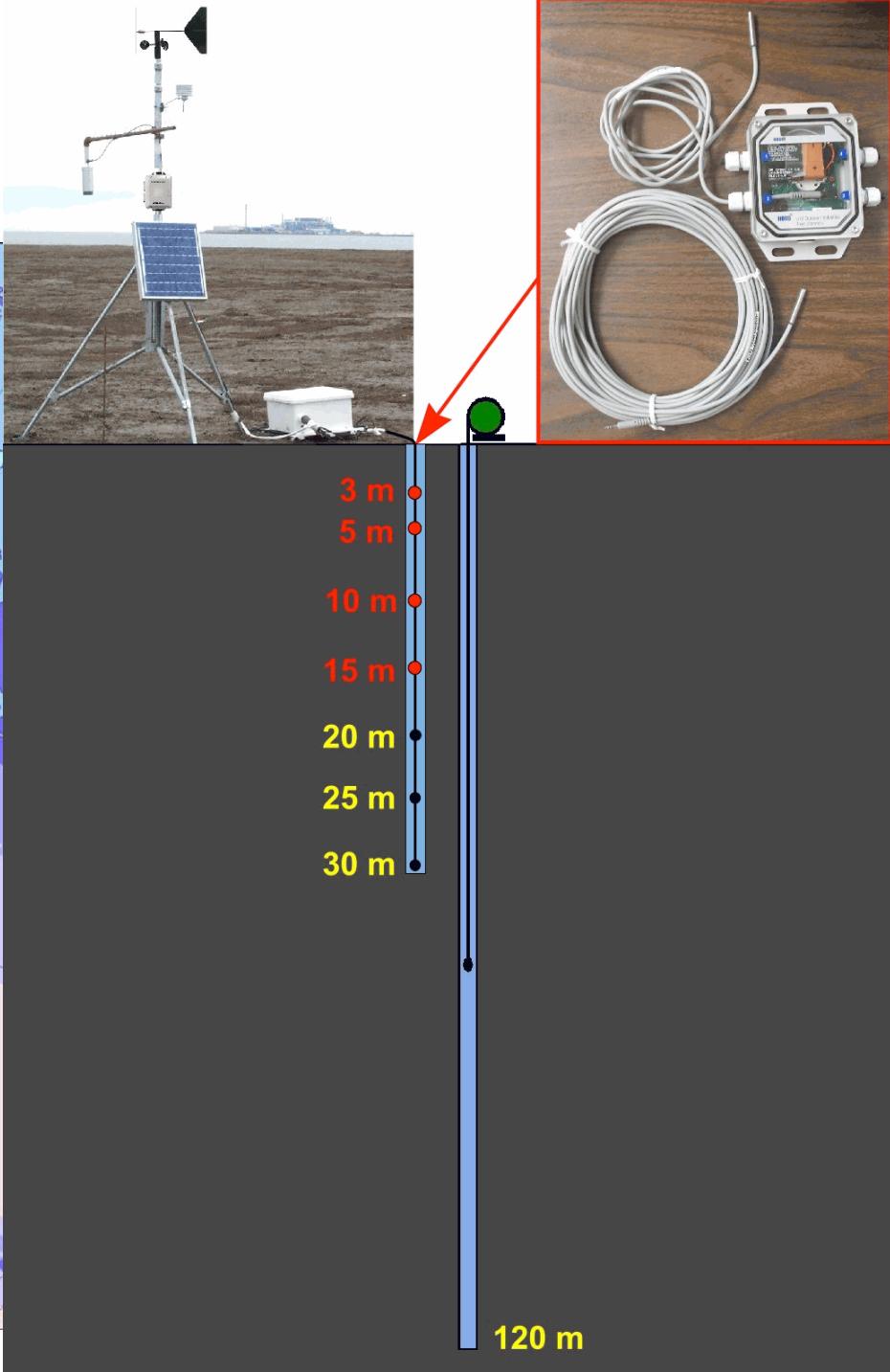
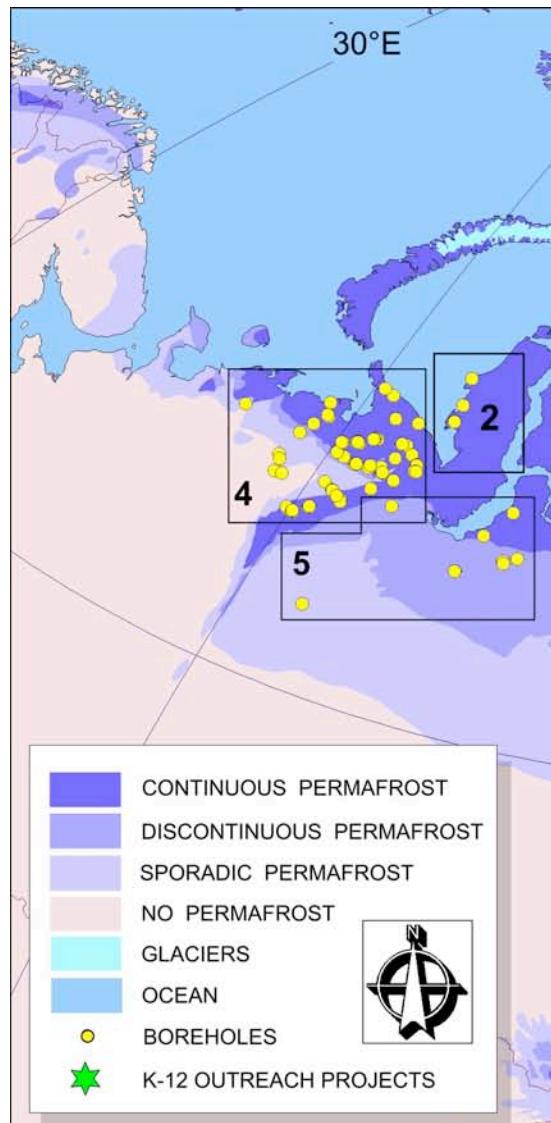


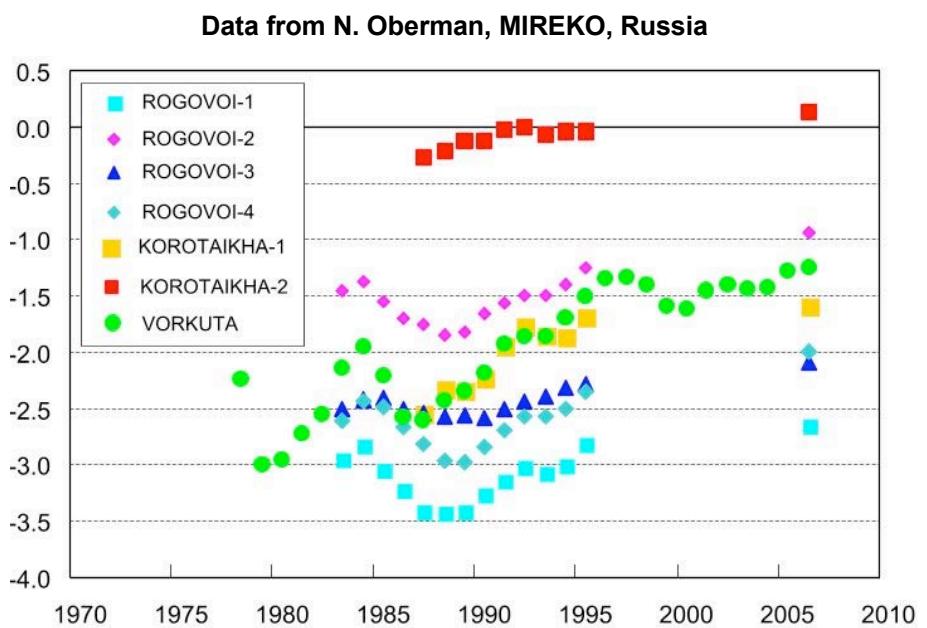
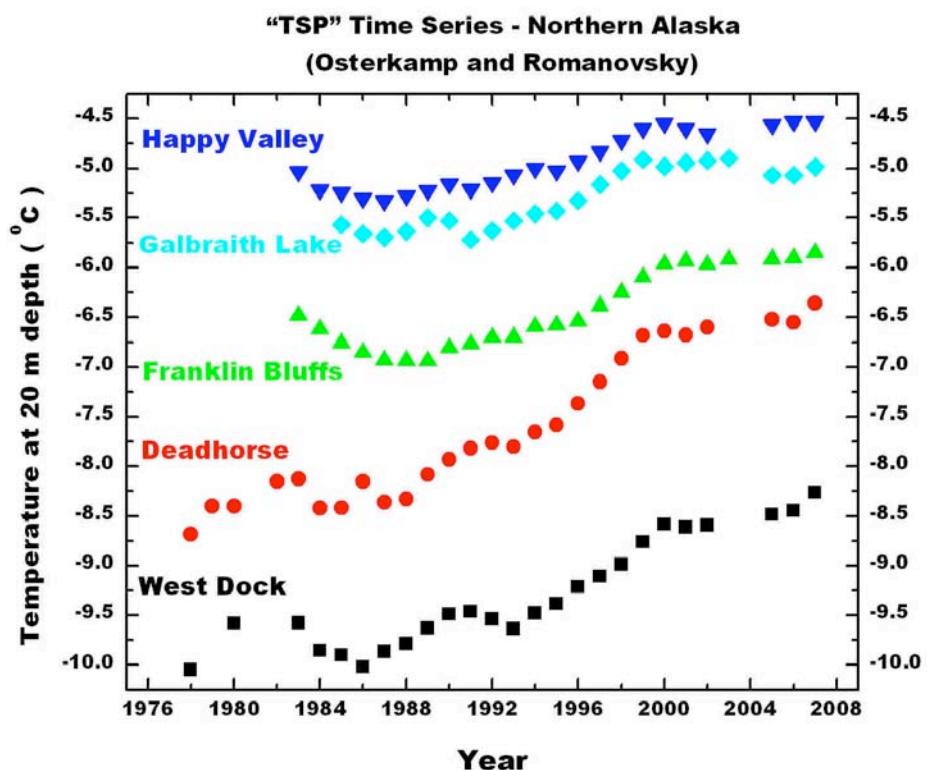
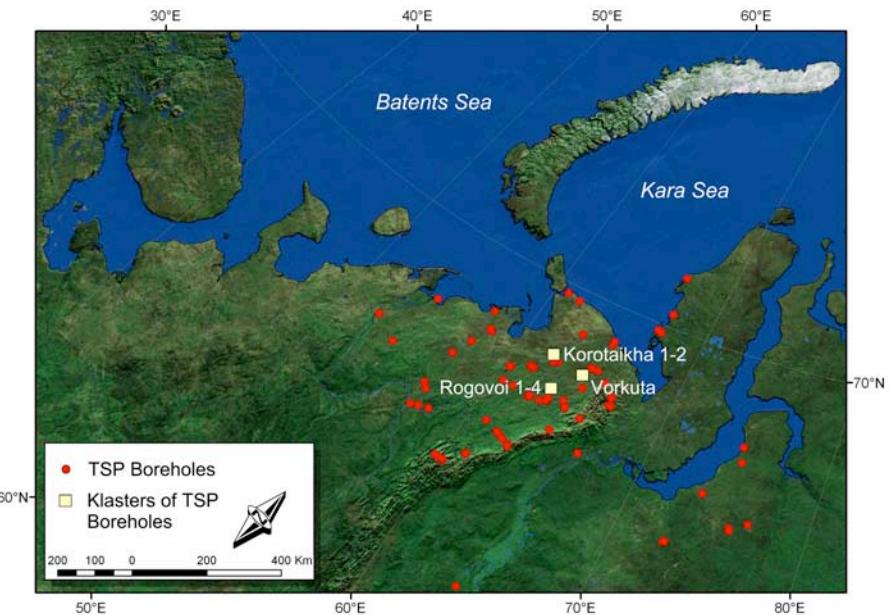
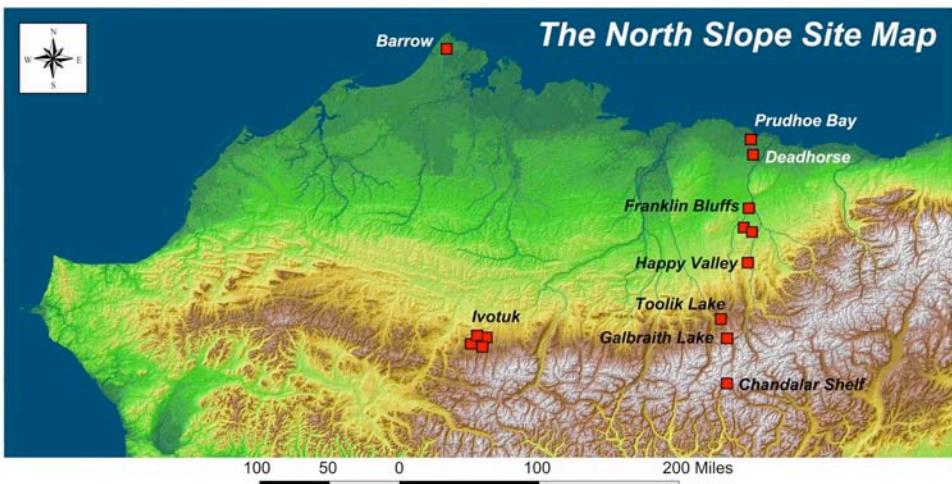


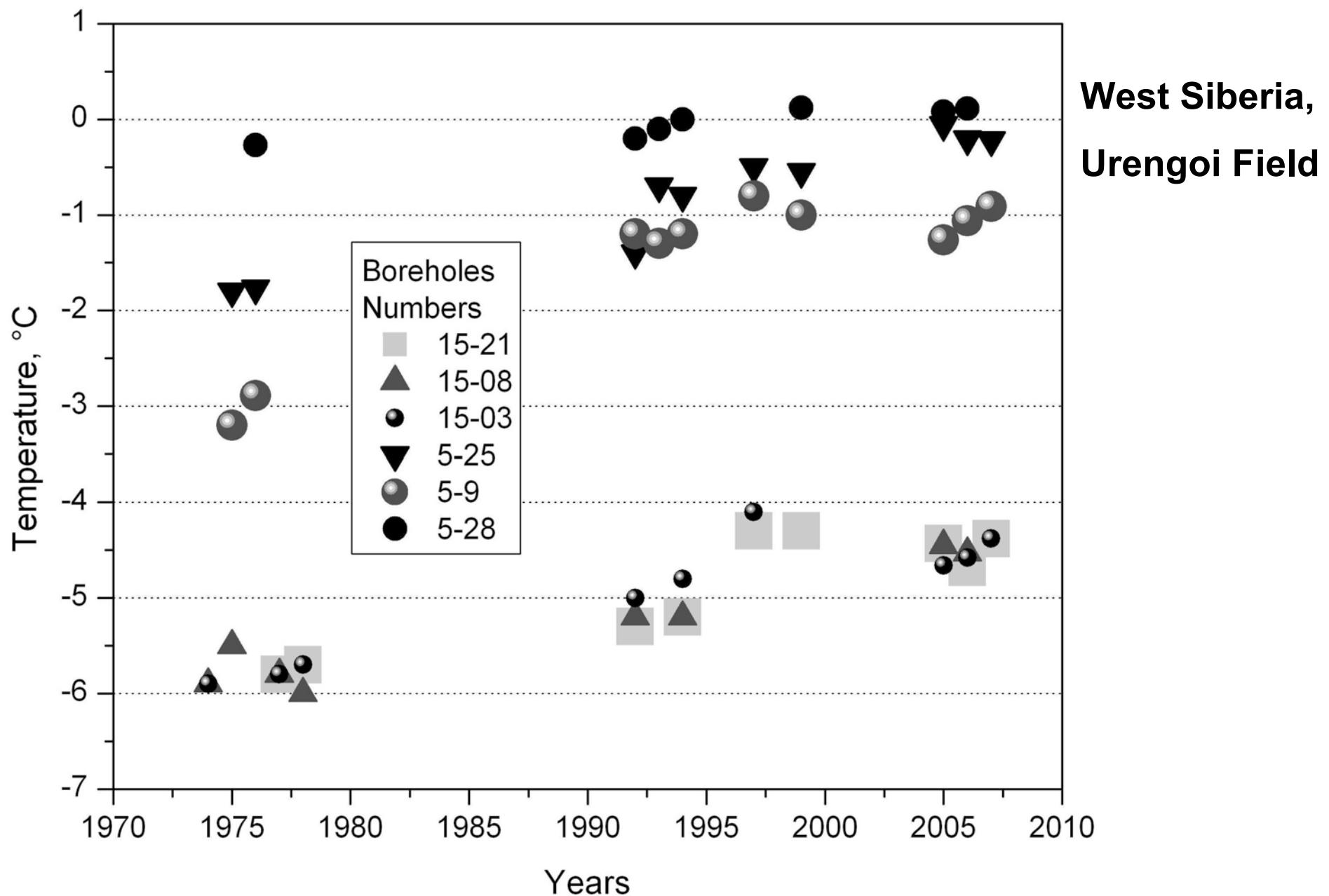
Gakona

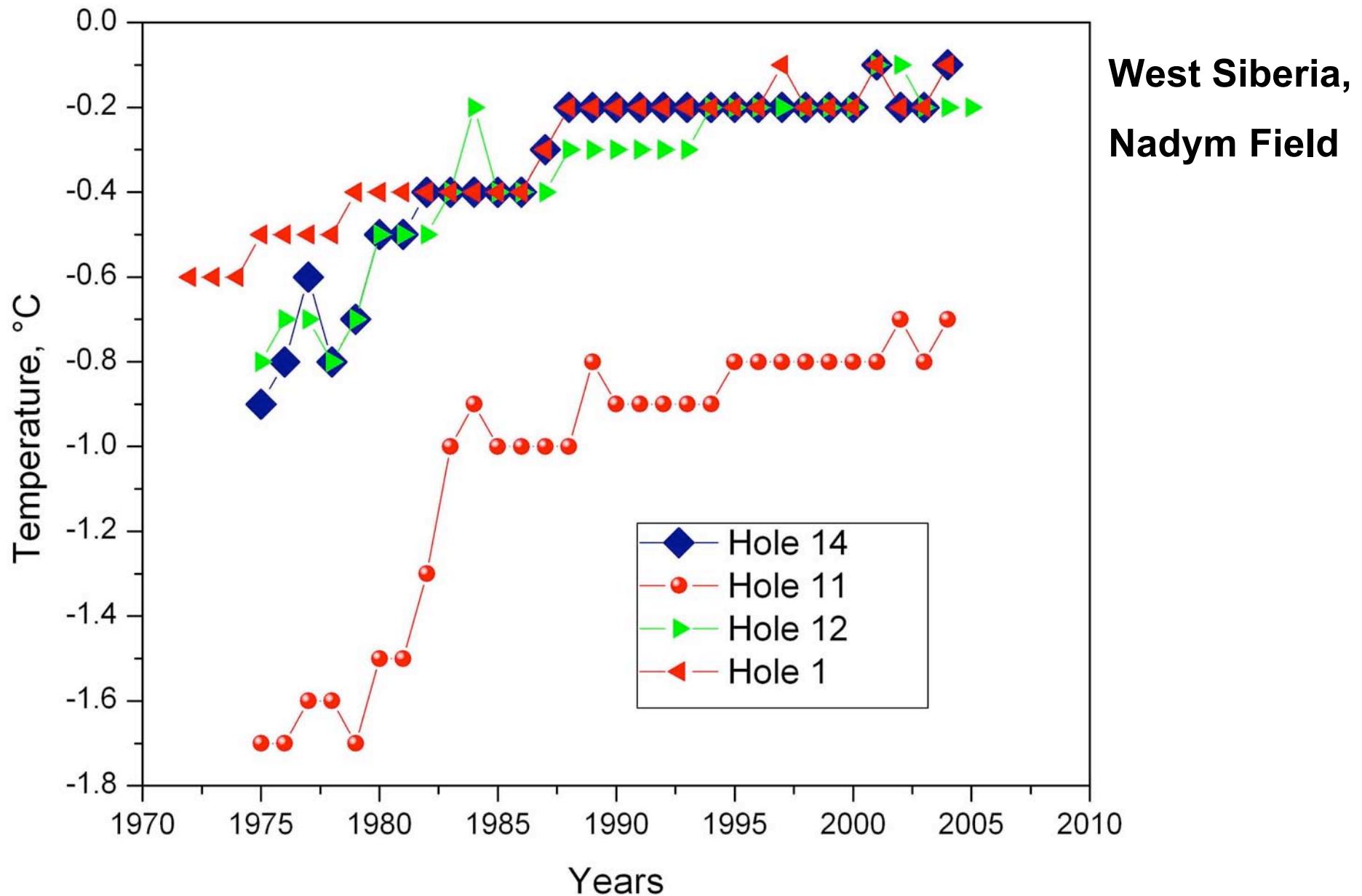




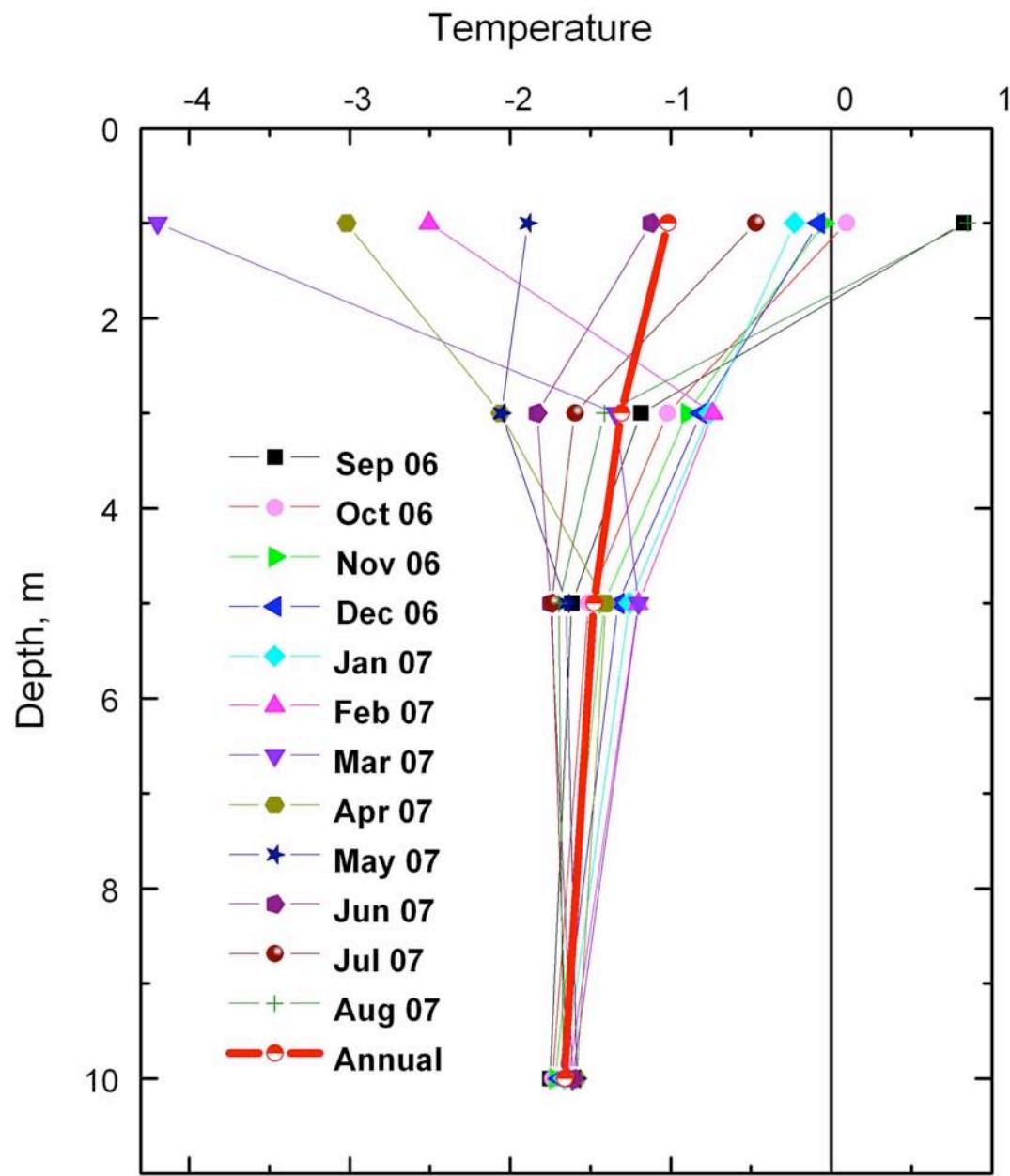




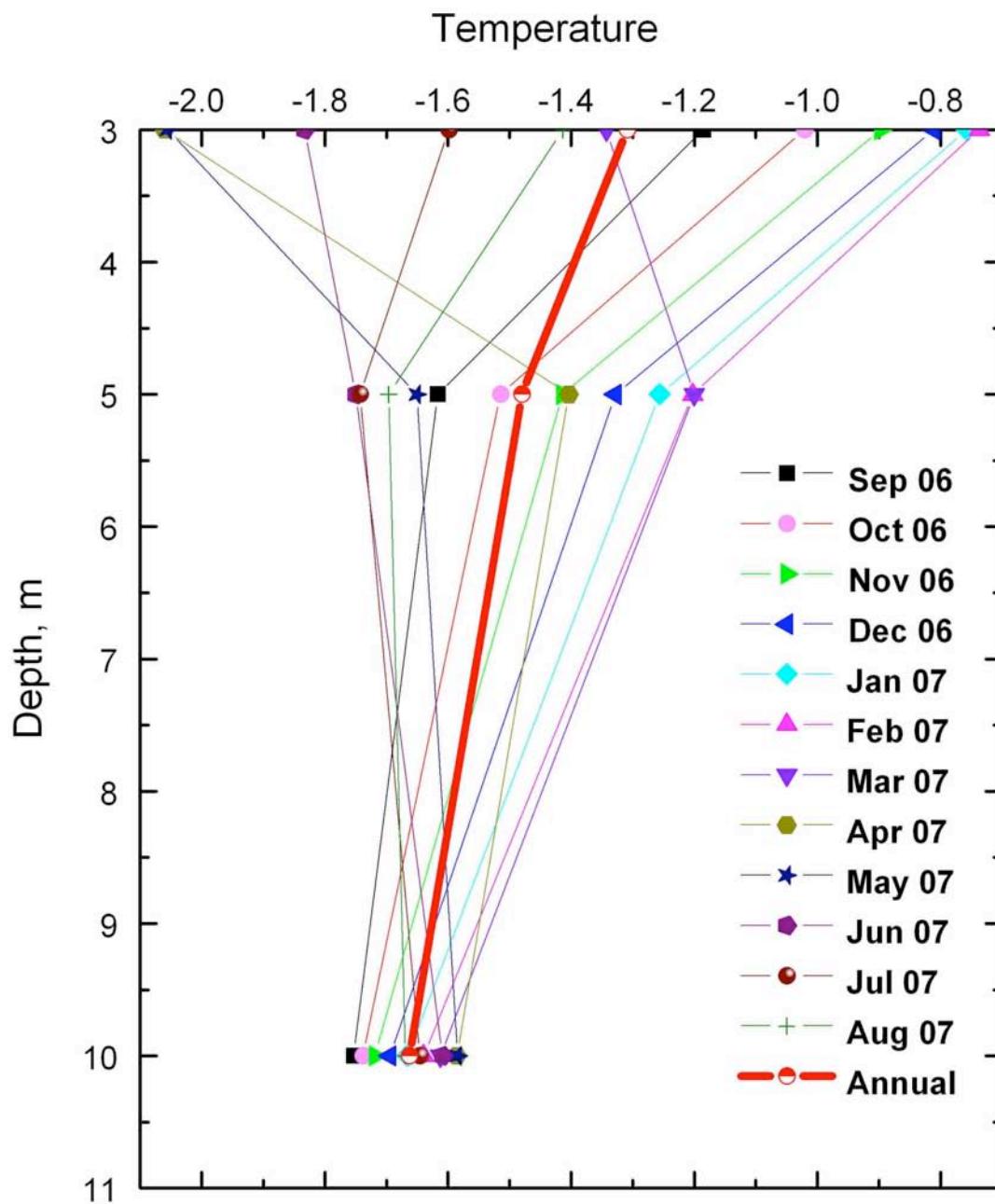




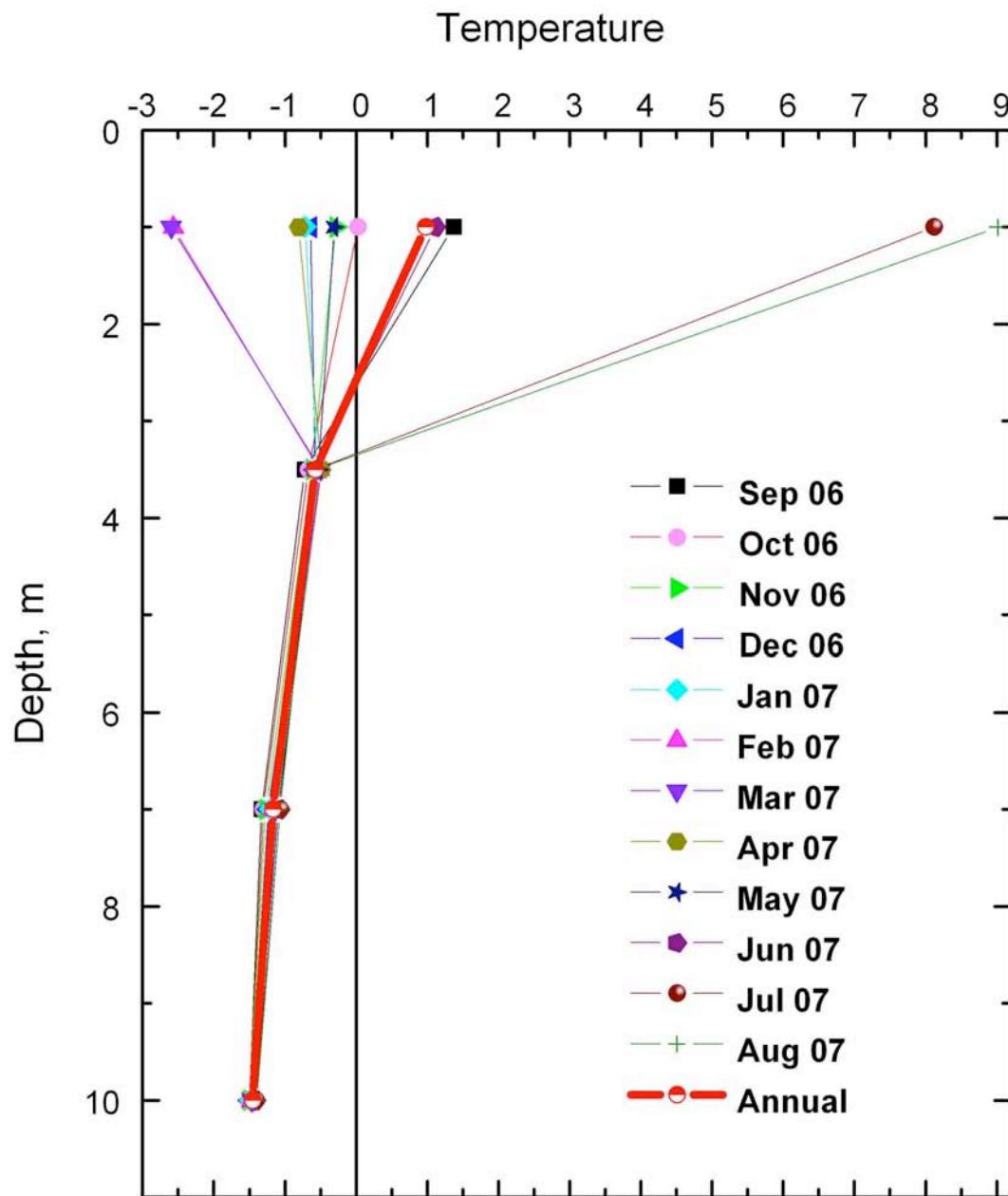
**European Russia,
Cape Bolvansky
2006 - 2007**



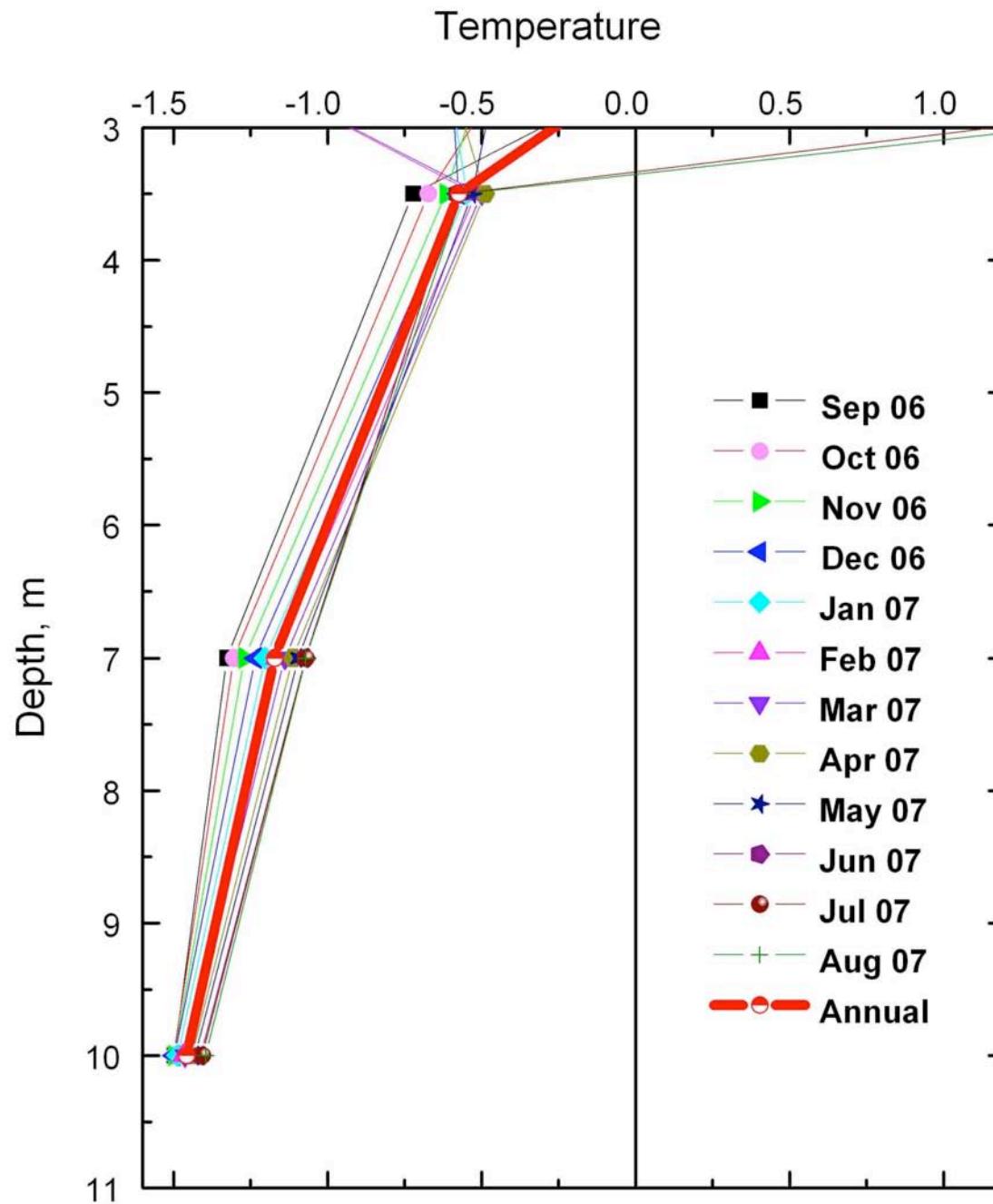
**European Russia,
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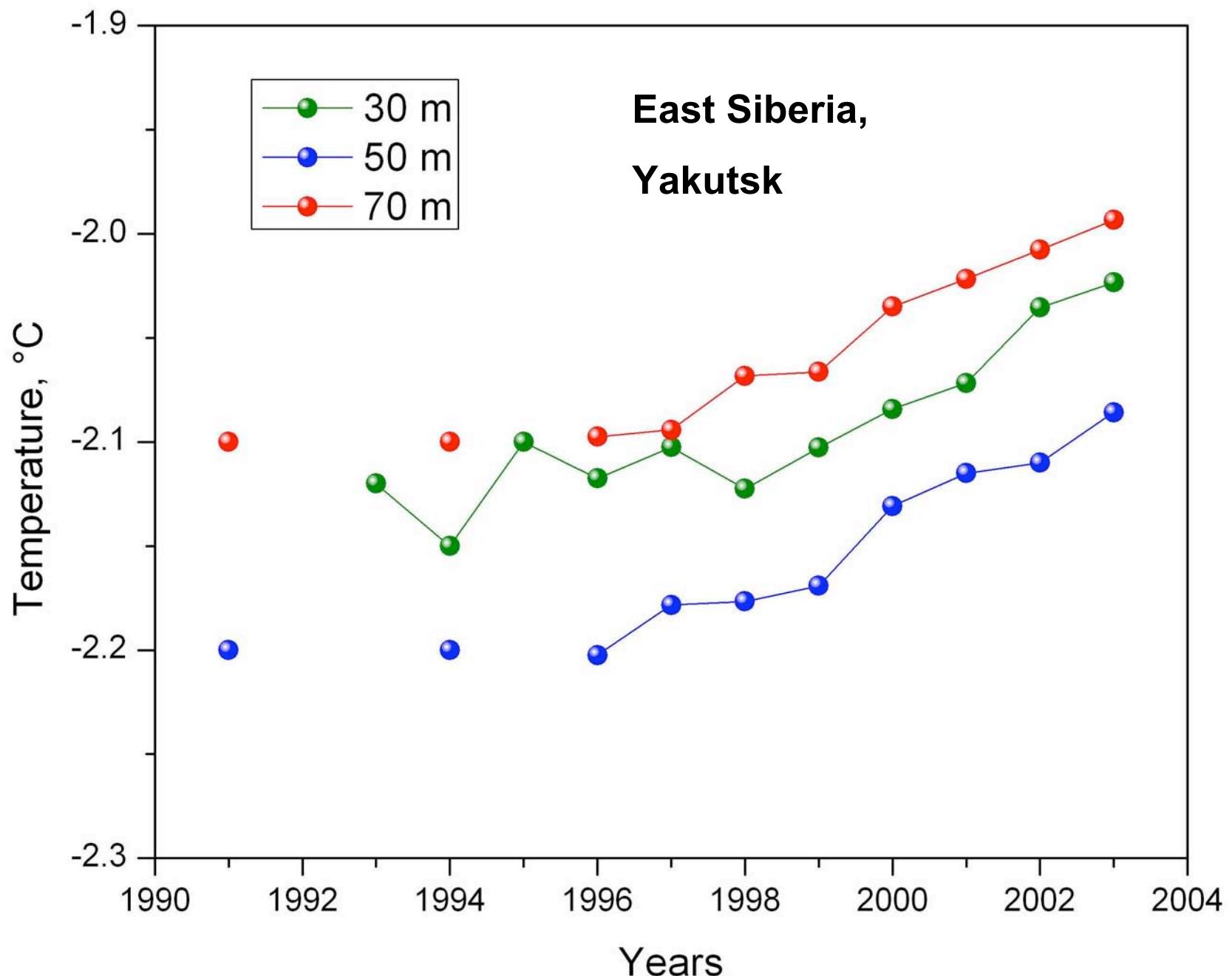


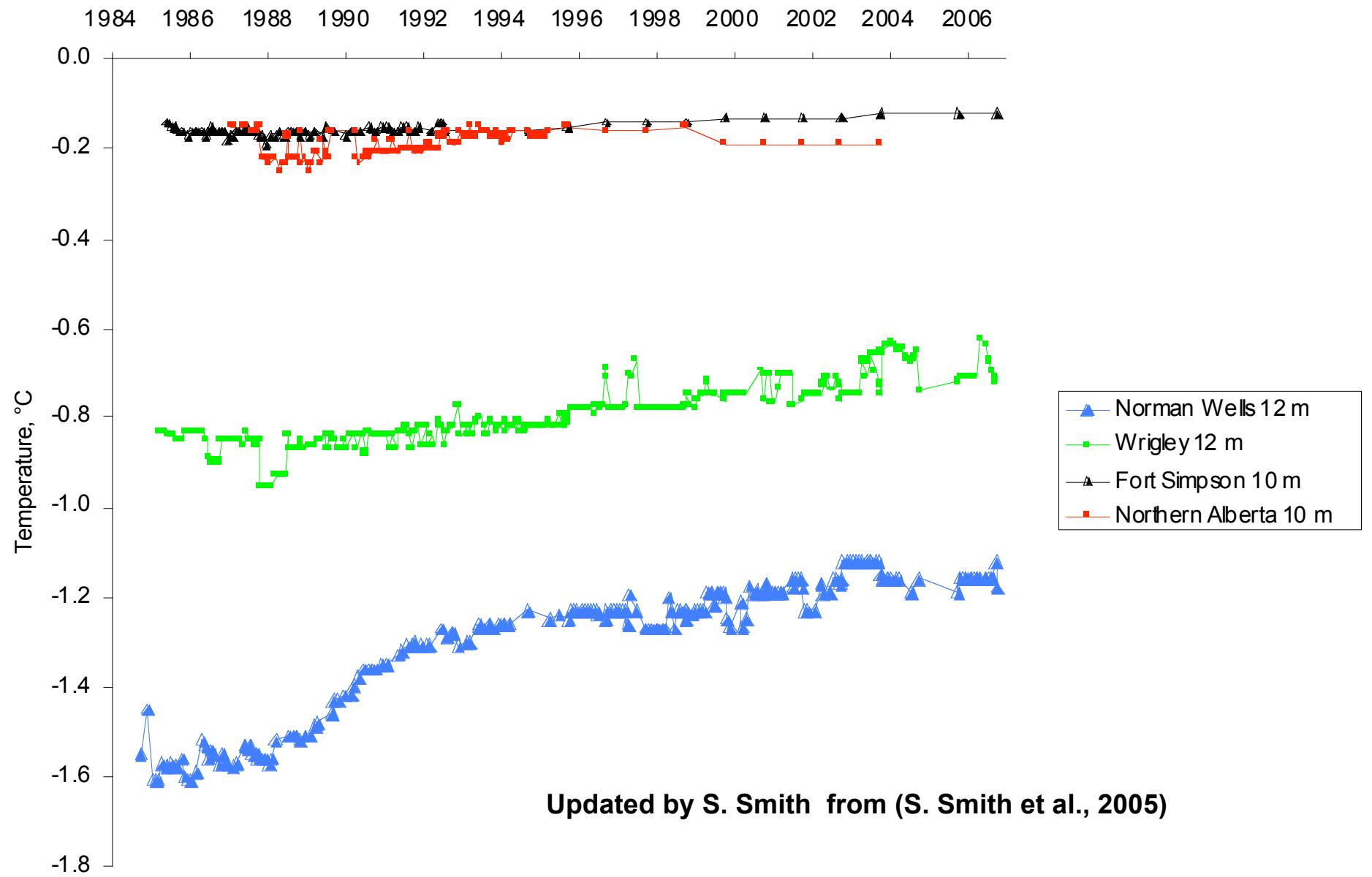
**West Siberia,
Urengoi Field
2006 - 2007**

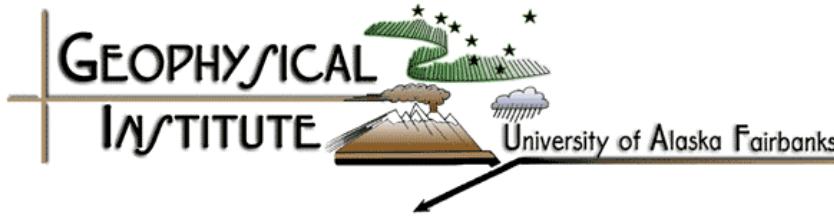


**West Siberia,
Urengoi Field
2006 - 2007**









Two Approaches in Permafrost Dynamics Modeling :

1. Site-specific permafrost temperature reanalysis
2. Specially-distributed permafrost modeling

Permafrost Temperature Reanalysis

A numerical model calibration for a specific site using data on soils temperature and physical properties and the data from the closest meteorological station

Check the quality of calibration using soil temperature data not involved in calibration

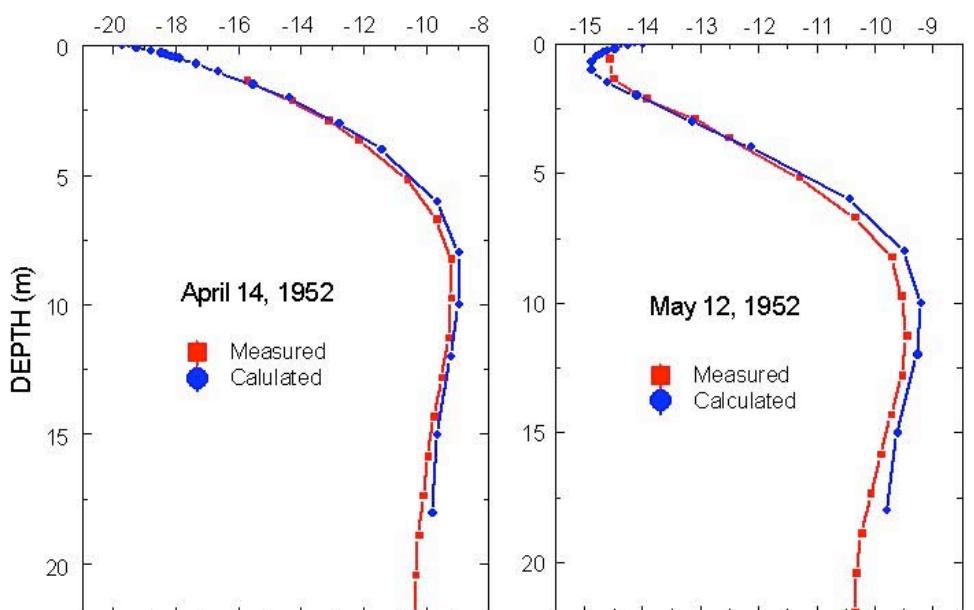
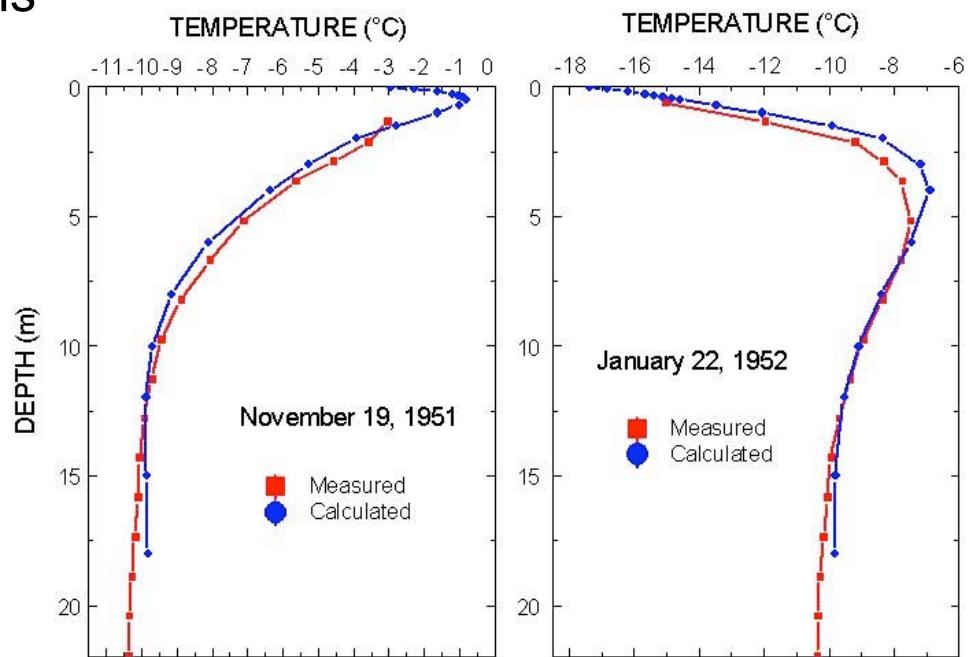
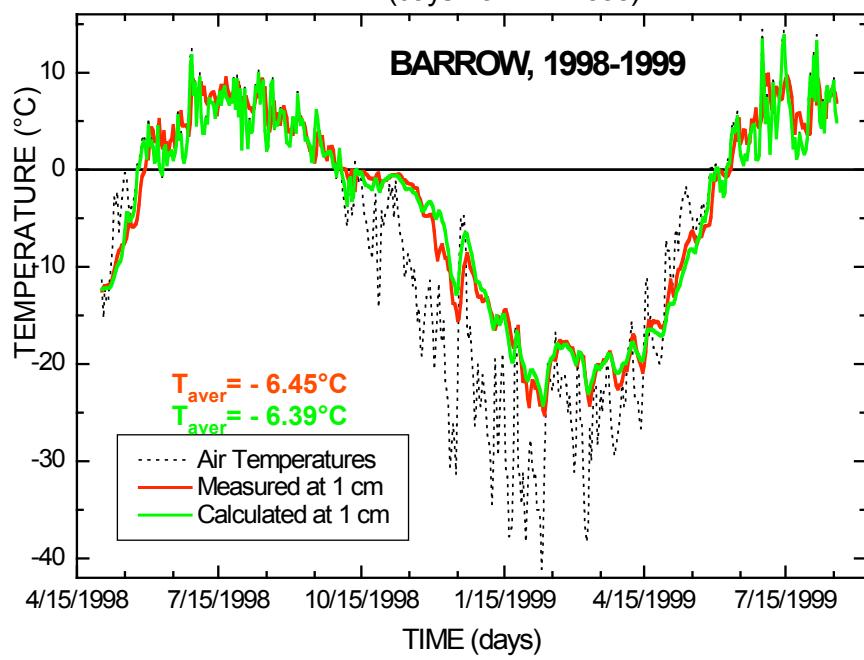
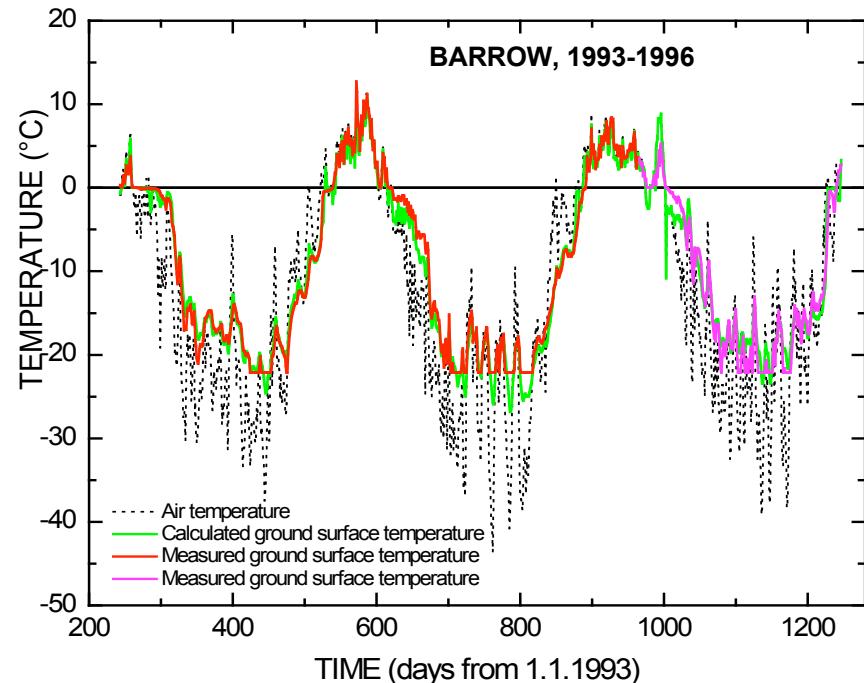
Methodology:

Long-term meteorological and other input data preparation, choosing scenarios of the past and future climatic changes

Numerical simulations of the geothermal field dynamics

Analysis of results and their geophysical and ecological interpretation

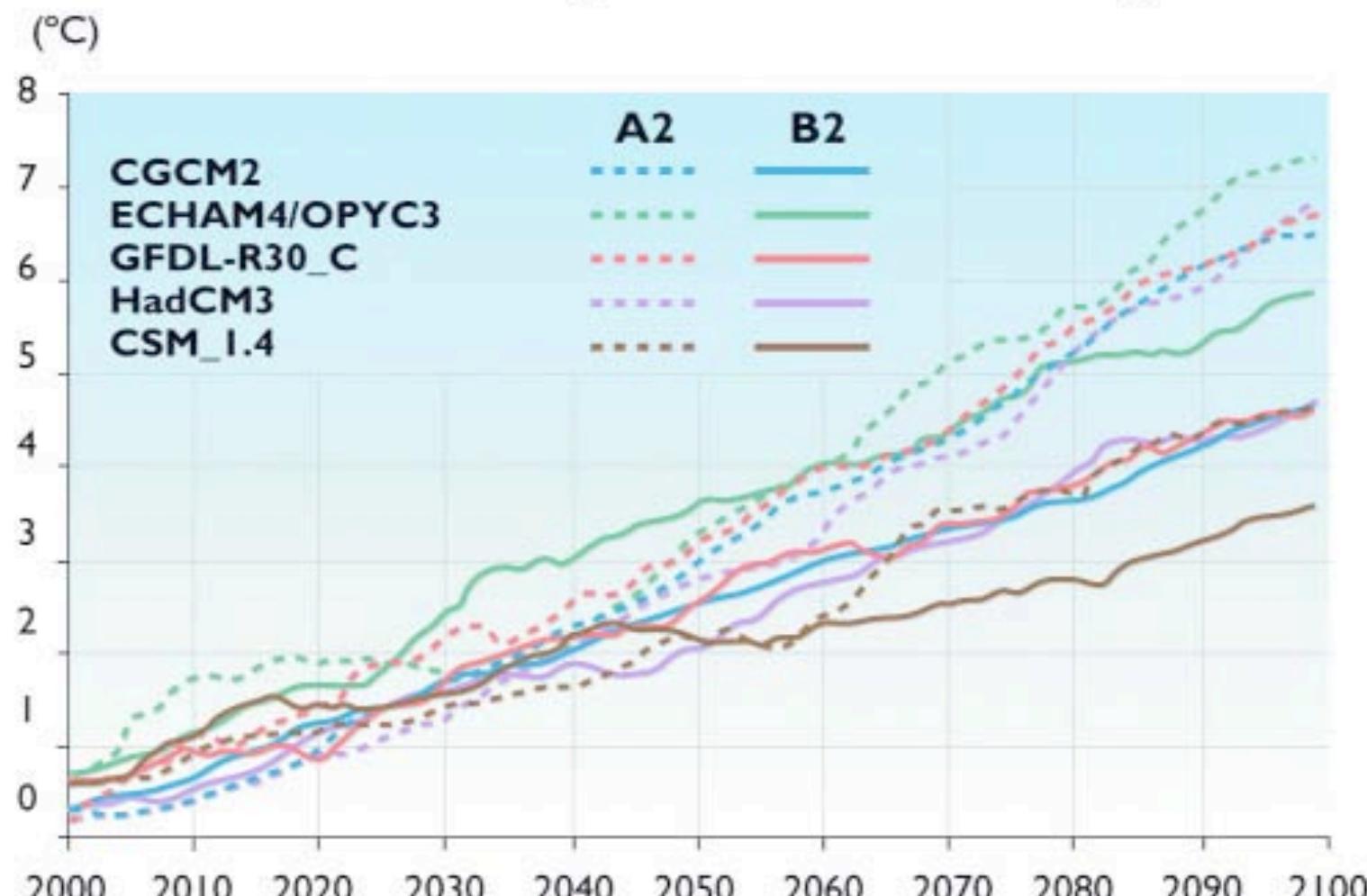
Permafrost Temperature Reanalysis



Future Changes in Climate and Permafrost

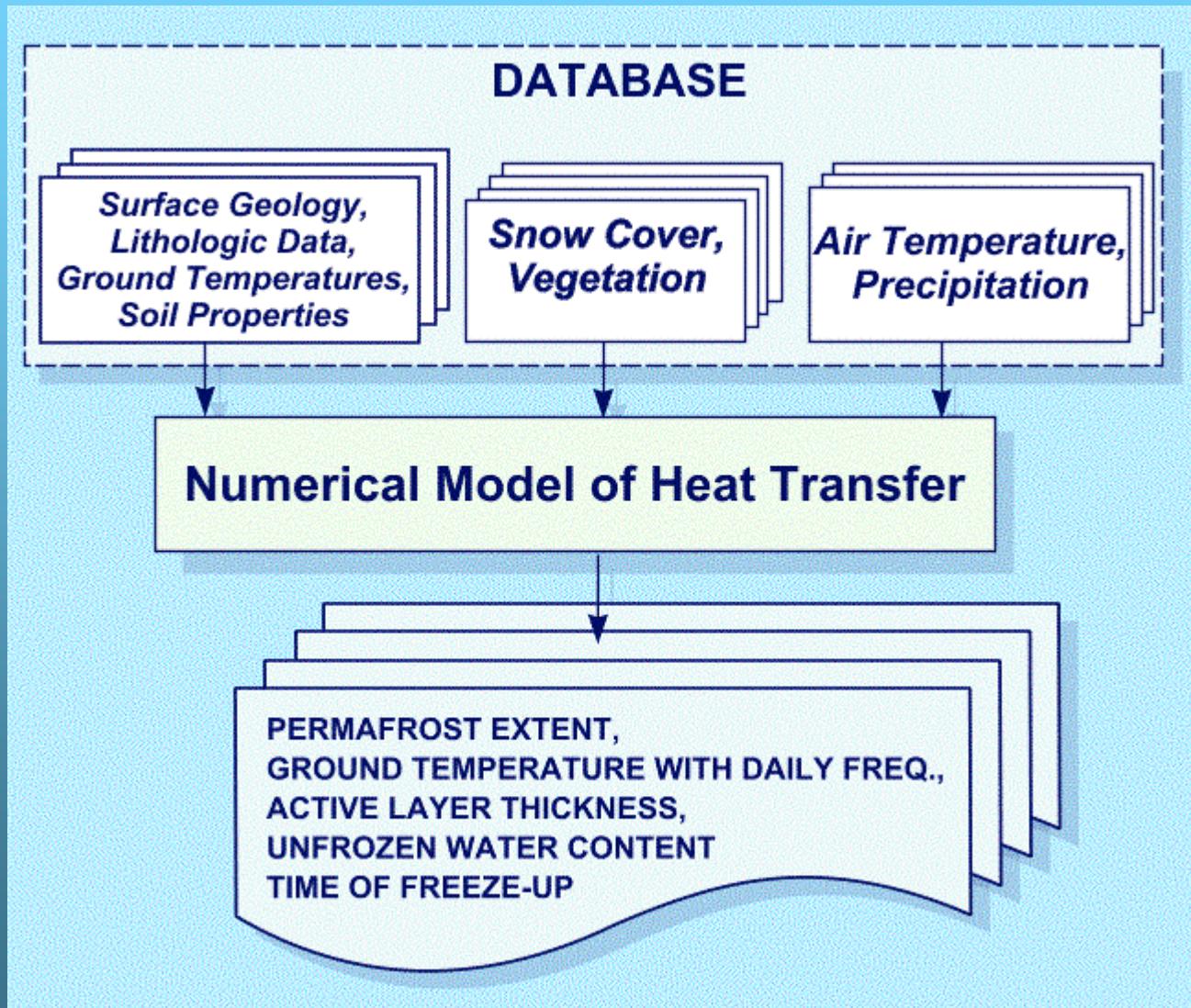
Projected Arctic Surface Air Temperatures 2000-2100

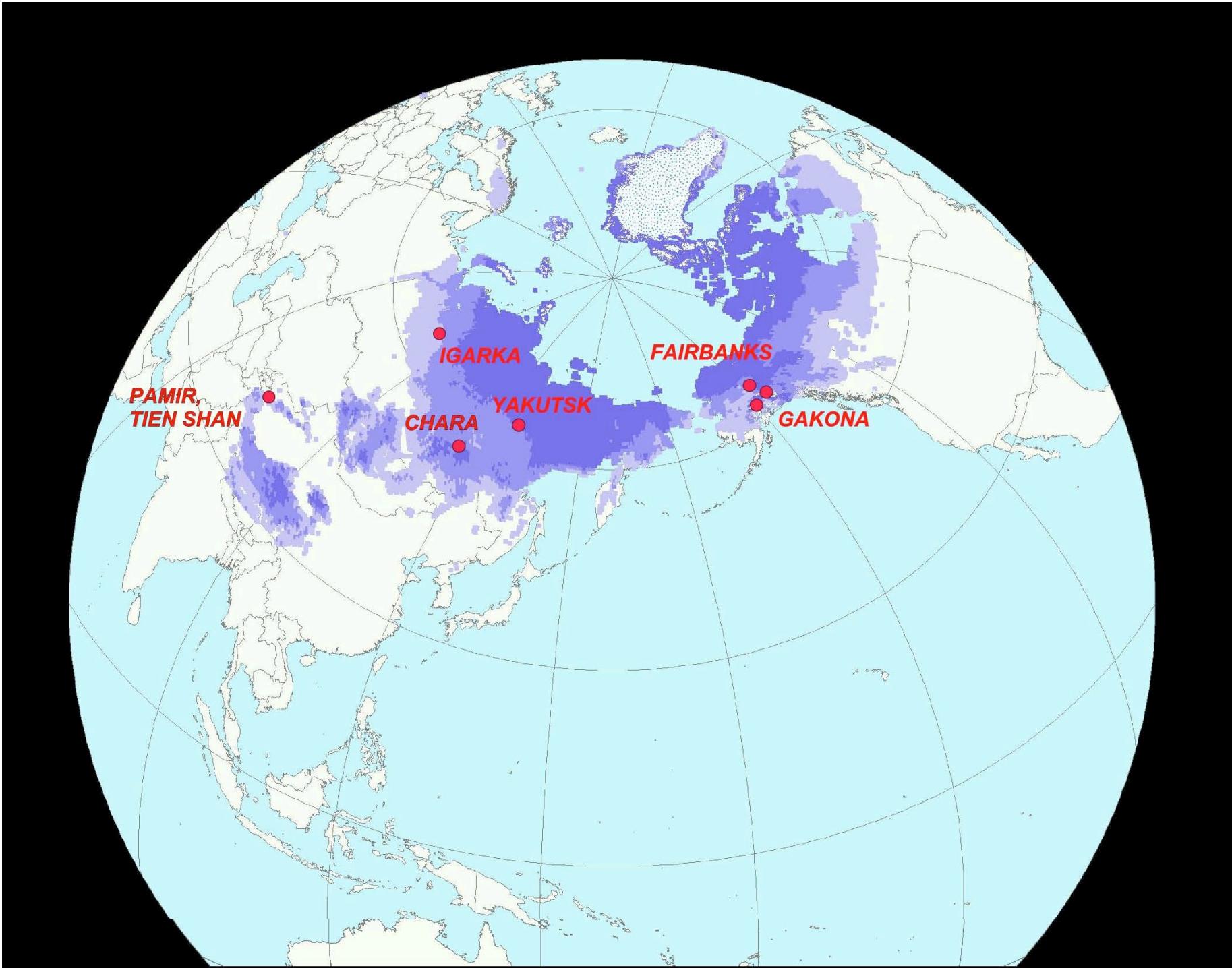
60°N – Pole: Change from 1981–2000 average

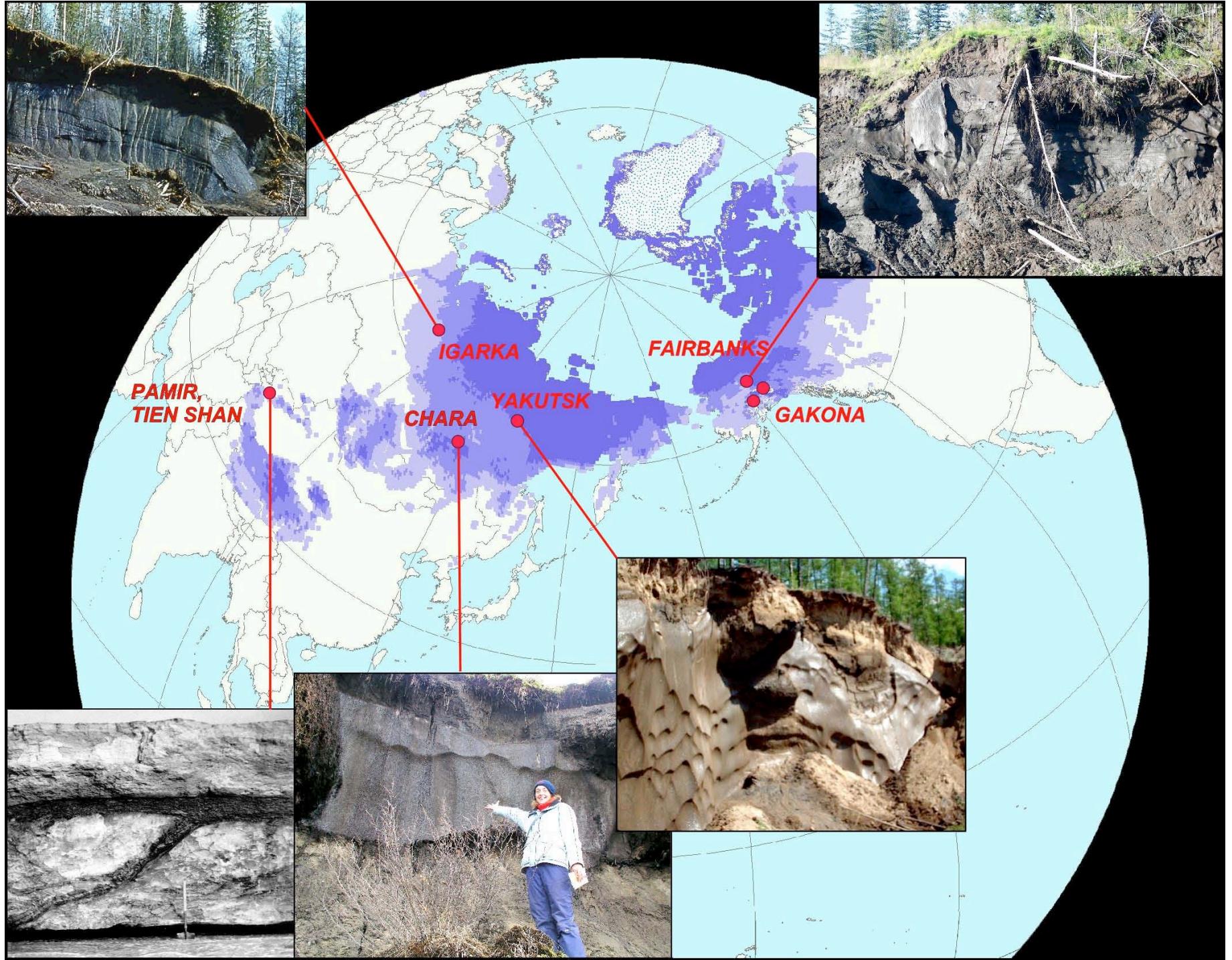


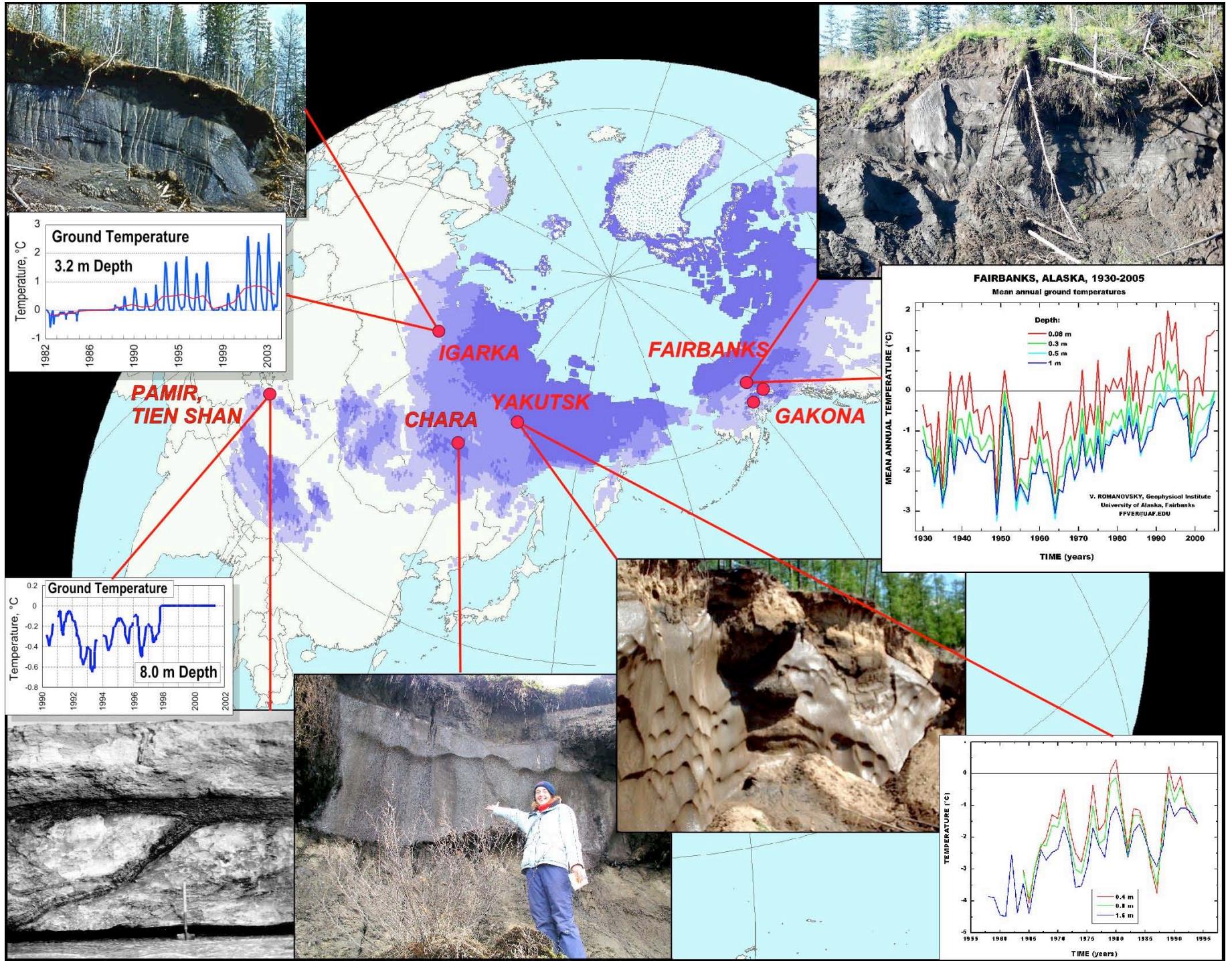
©2004, ACIA

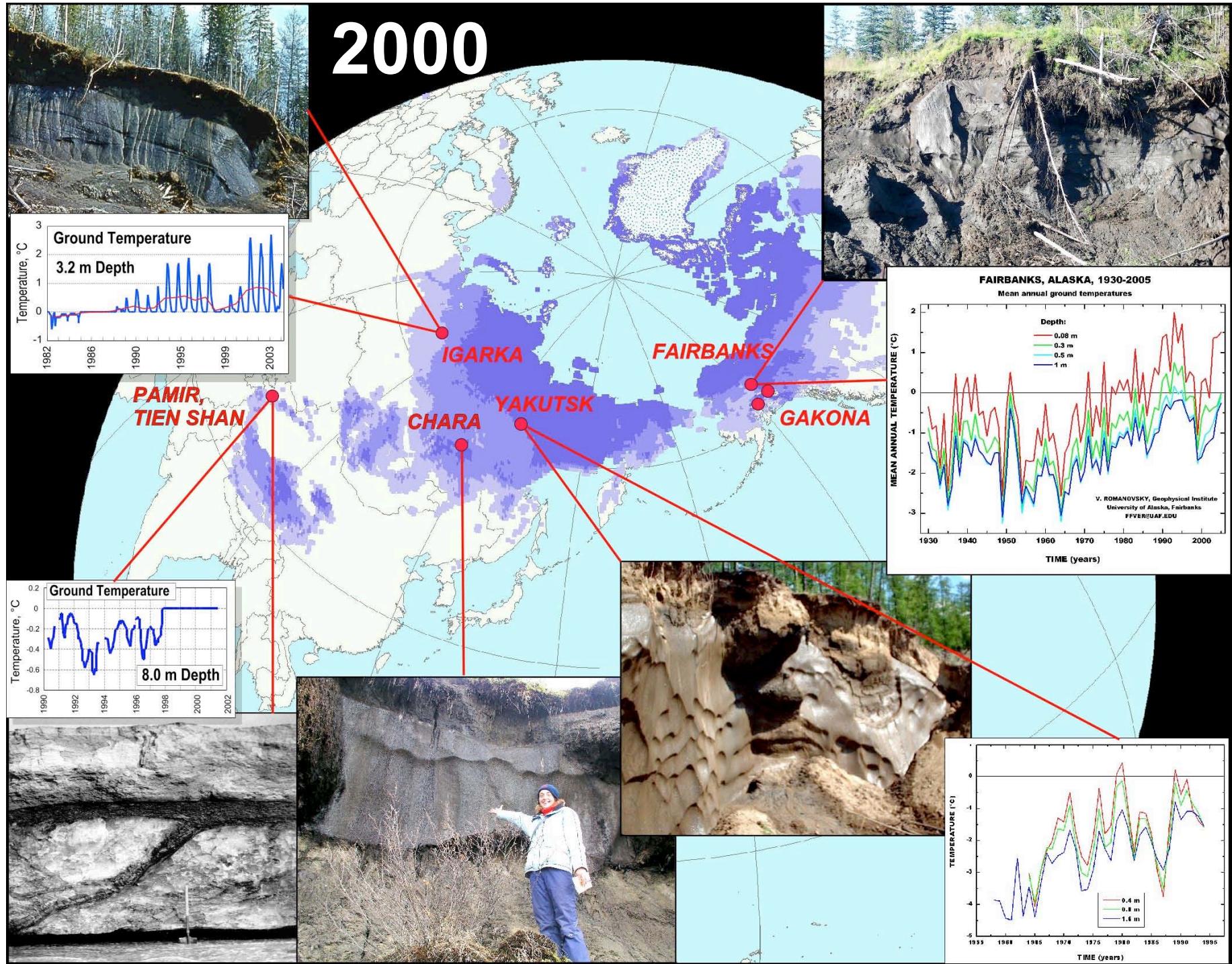
GIPL-2.0

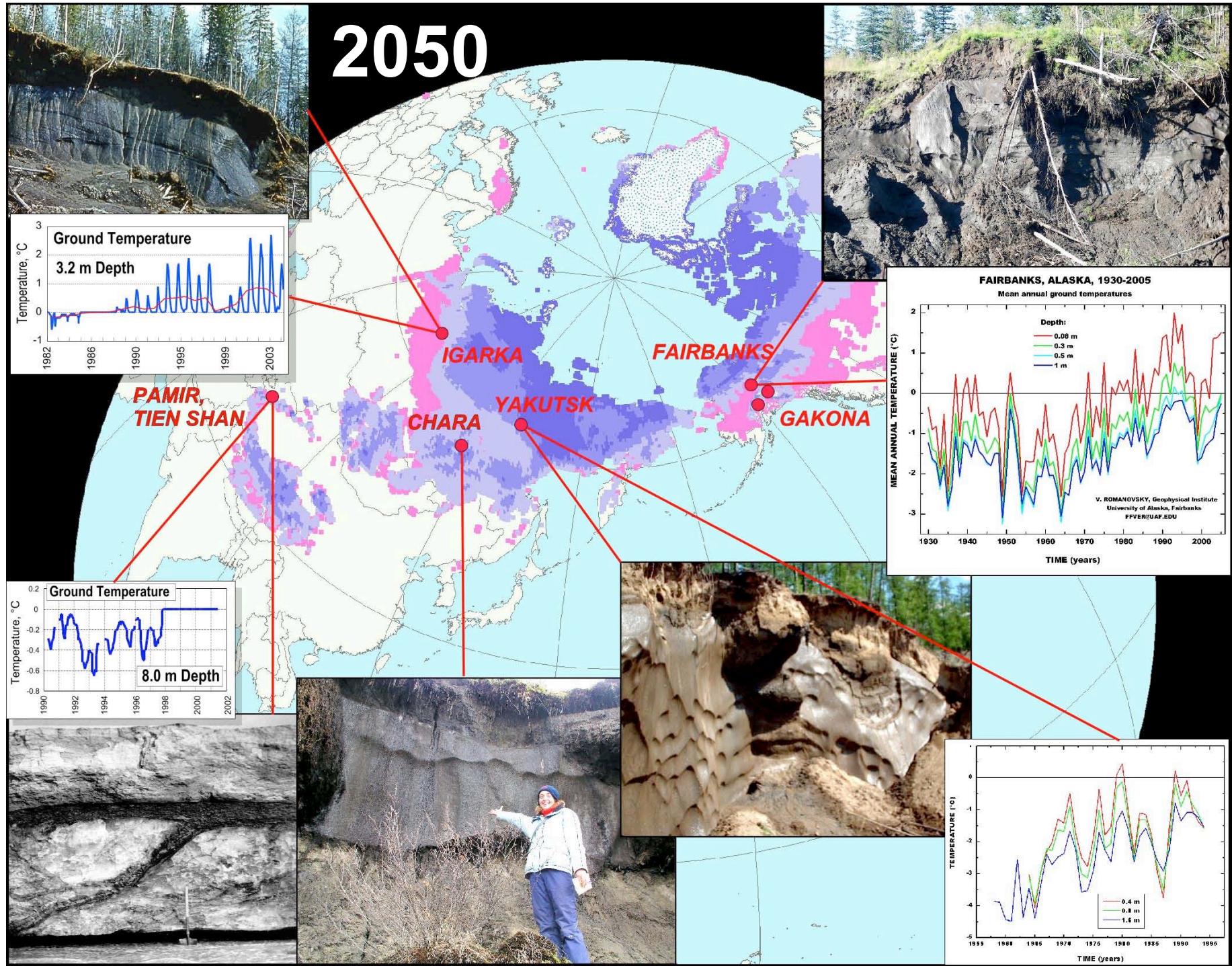


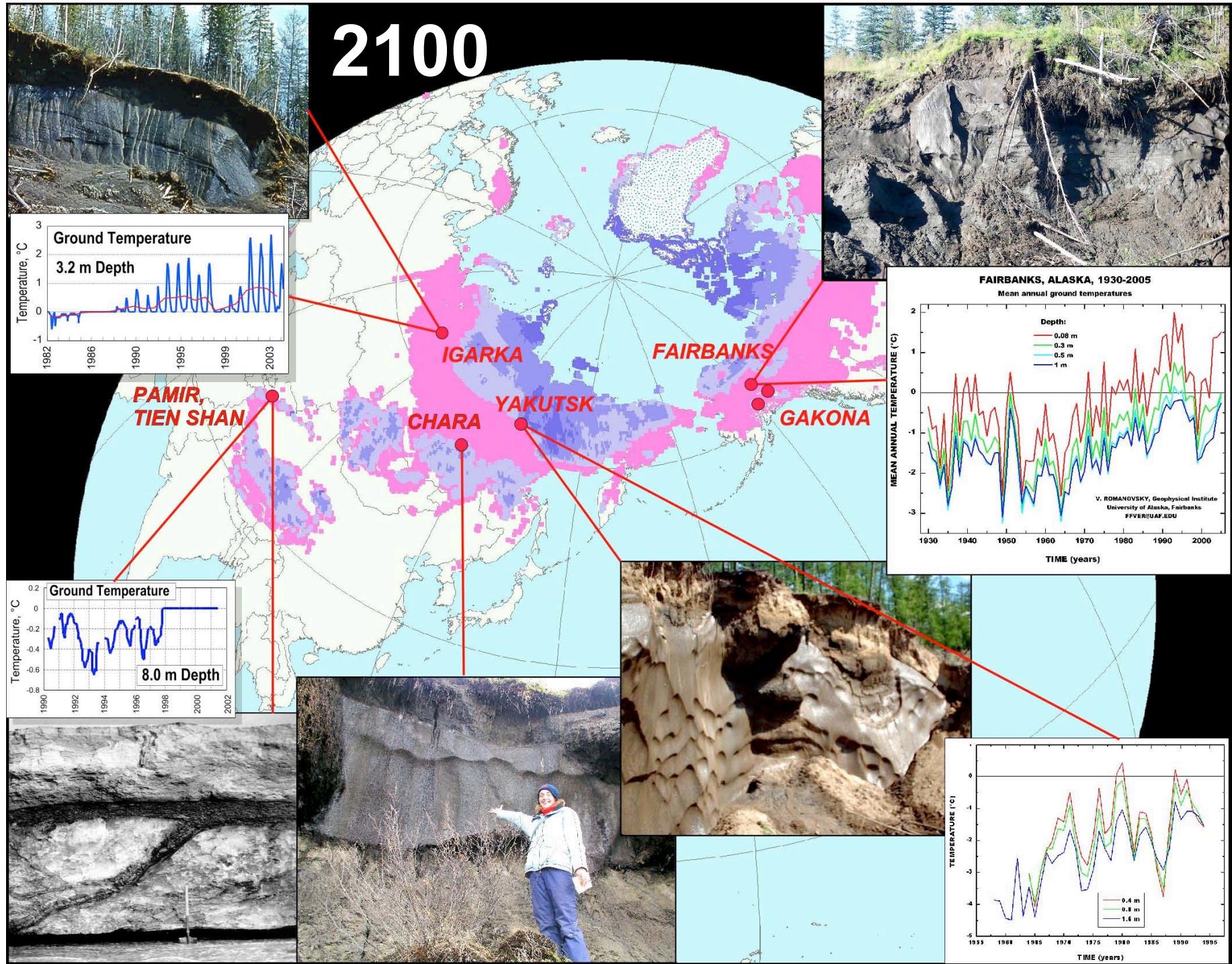












ACCO-Net



Circum-Arctic Coastal Key Sites

<http://www.awi-potsdam.de/www-pot/geo/acd.html>

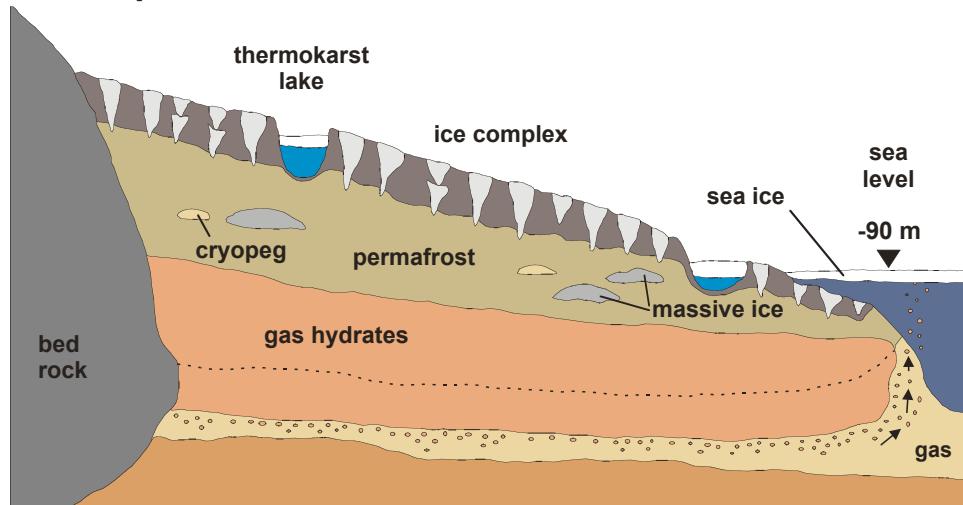


Jerry Brown, Volker Rachold
and the ACD Group



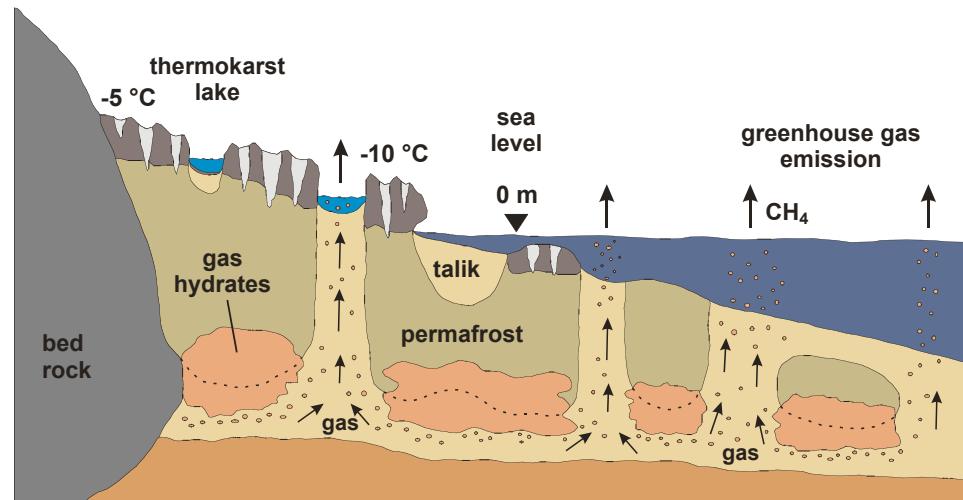
Arctic Science Summit Week
Reykjavik, Iceland
April 2004

**12500 years
before present**



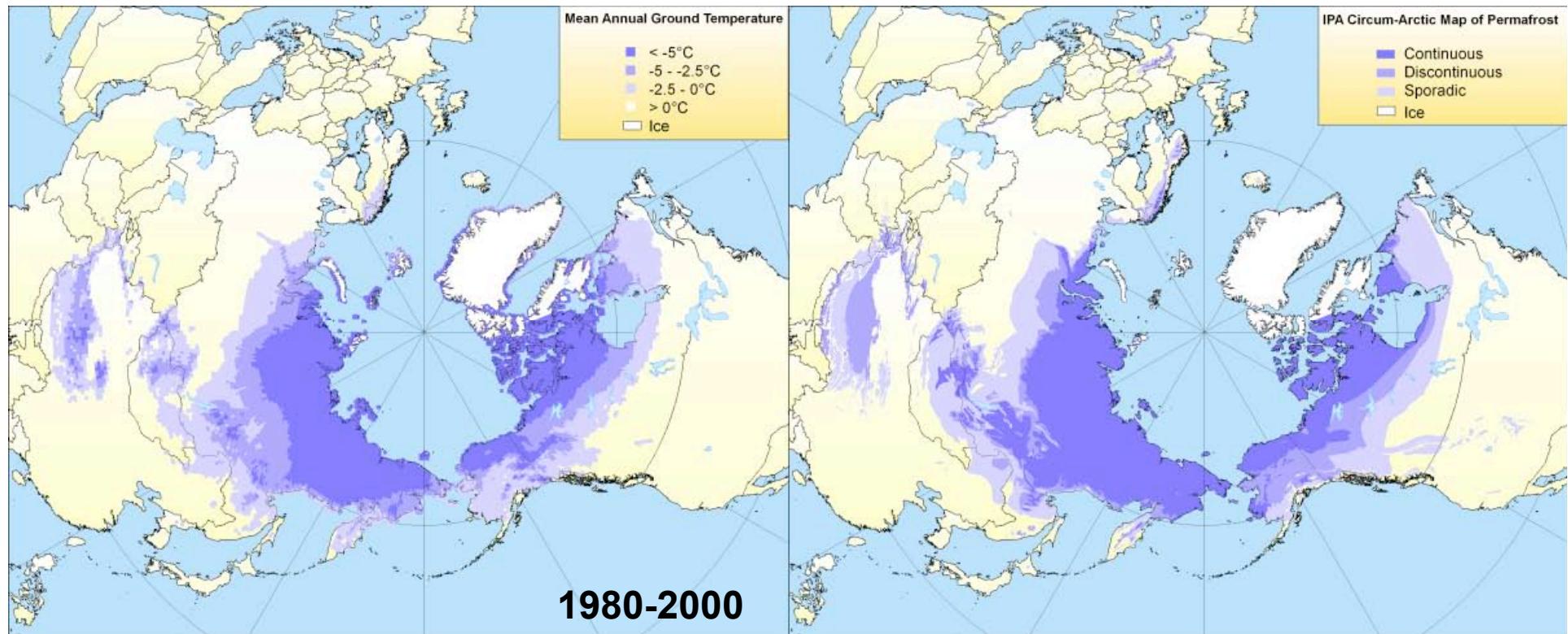
Schematic models of Coastal and Submarine Permafrost under different climatic conditions (after N. Romanovskii)

PRESENT



Thank you very much !





Conclusions

- Permafrost temperature needs to be continuously monitored
- Permafrost modeling is an important tool in Global Change research
- Present-day Global and Regional Climate Models not adequately represent permafrost dynamics
- A proper permafrost representation in these models is especially important at the time of permafrost degradation