PARCS

Meeting ARCSS goals into the 21st Century

A summary of research and organizational strategies

Prepared for the 2002 ARCSS All Hands Meeting


Outline
1. Development of PARCS
2. The contribution of PARCS research to ARCSS
3. PARCS accomplishments
4. New PARCS science initiatives
5. PARCS organizational strategy

PARCS = PALE + GISP (1999)

Terrestrial + Lacustrine + Marine + Ice Core Records

- paleoecology
- paleohydrology
- paleochemistry
- paleoceanography
- paleoclimate

PARCS

Brings together the diverse and specialized arctic paleo community and develops synergy through facilitating:

- Communication within community and with ARCSS
- Identification key science priorities and opportunities
- Development of specific research programs through meetings and workshops
- Sharing technical resources and logistics
- Developing international contacts
- Data archiving, atlas synthesis and access provision
- Dissemination of results to ARCSS, wider scientific community, policy makers and general public

•http://www.ngdc.noaa.gov/paleo/parcs/

PARCS data contribute to ARCSS foci

- Arctic climate 2100
- Natural and Human System sustainability
- Biogeochemical Cycles and Feedbacks
- Detection of change

Where PARCS data contribute

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ARCSS

Analogues from the past →
- future climate

Baselines for assessment →
- detecting change, context of change

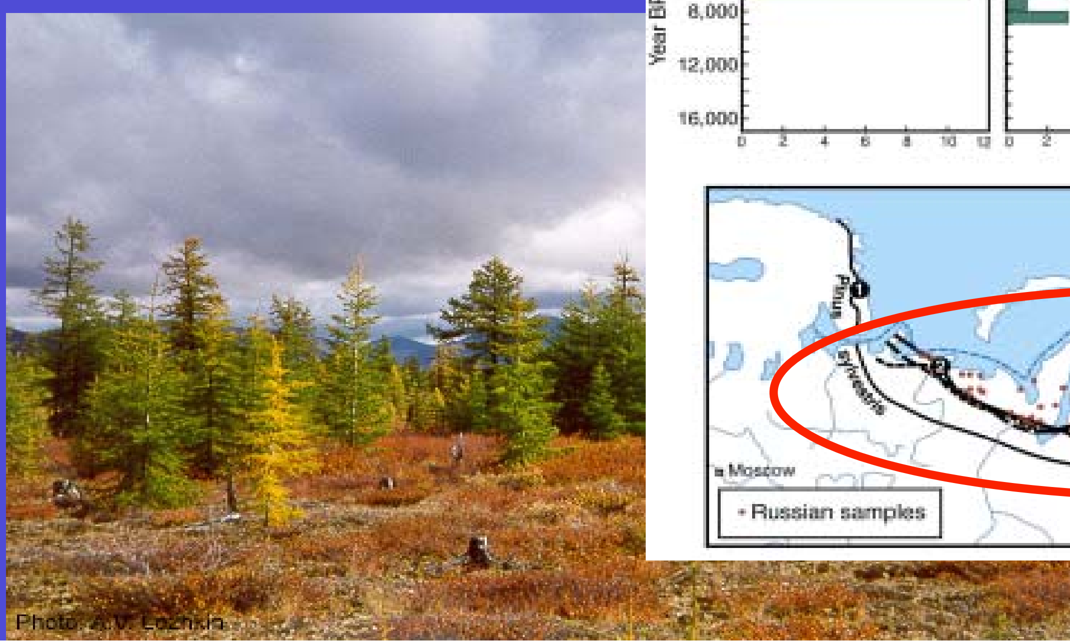
Natural experiments in system responses/ feedbacks coupled with models →
- Mechanisms of climate change
- Biogeochem feedbacks
- Ecosystems/human systems sustainability

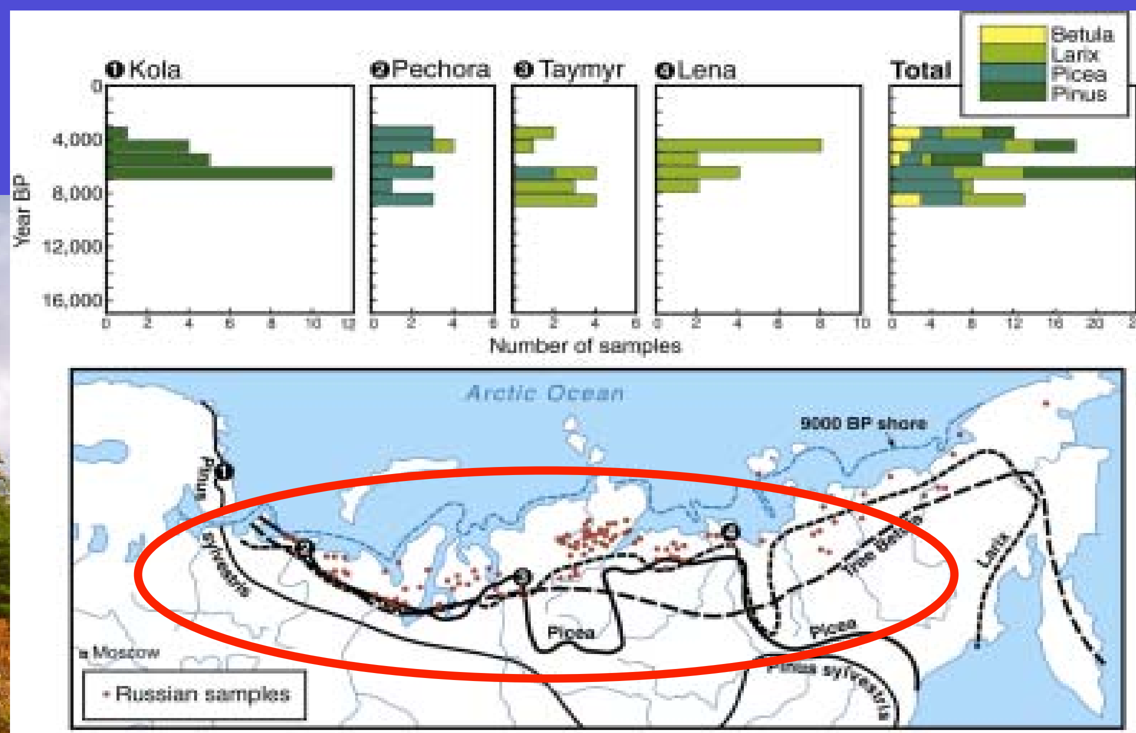
Provide analogues and scenarios

•Indicate what we can expect from the biophysical system as climate changes (we may have been there before).

-- *properties of future systems; scenarios for modeling natural and human response; anticipate surprises.*

Treeline advance



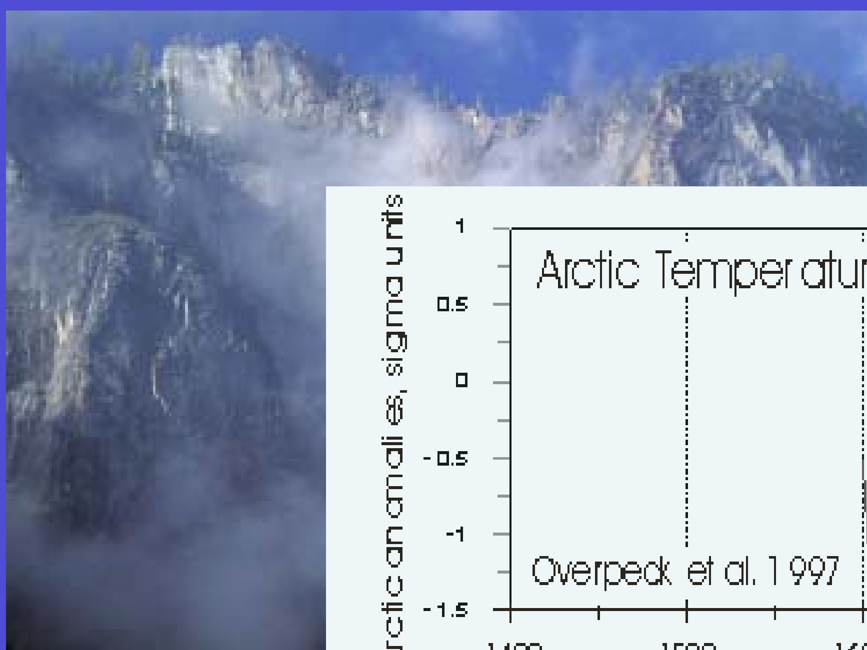


MacDonald et al. 2000

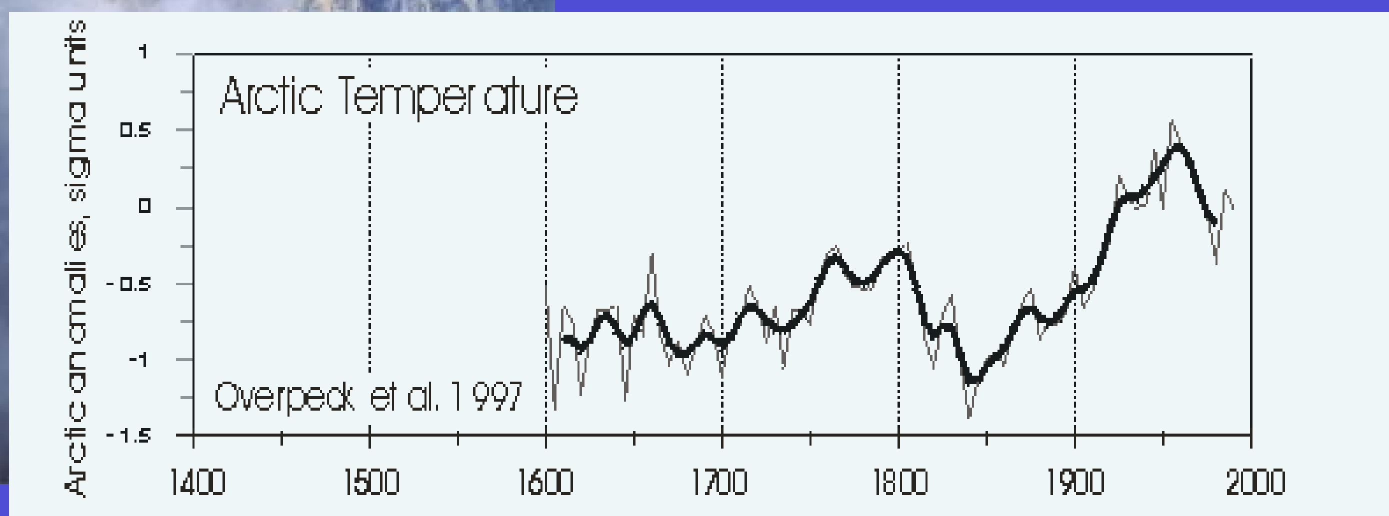
Providing baselines and context:

•Range of possible magnitudes of change
•Characterization of climate cycles
•Assessment of future projections

-- *detecting and assessing observed changes*

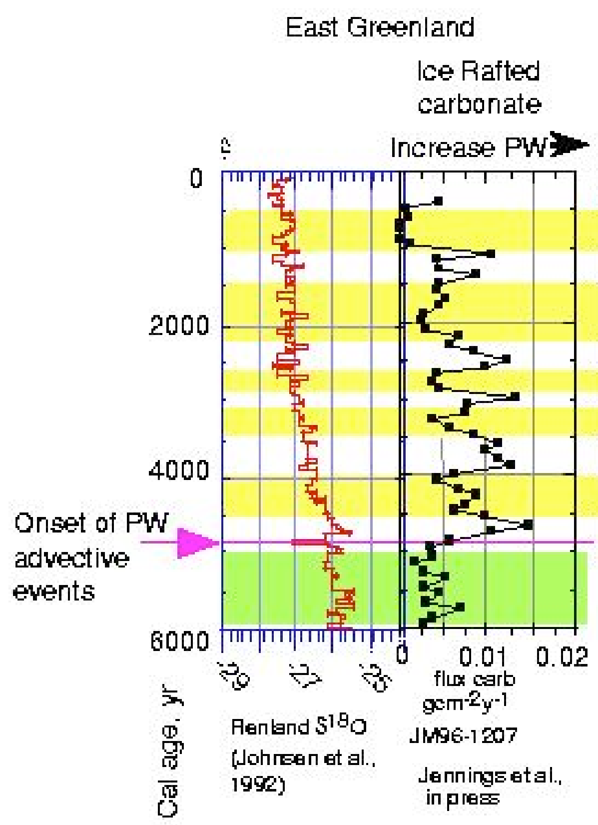


Arctic-wide temperature



North Atlantic sea ice

Holocene variability,east Greenland and Iceland Shelves



- Severe arctic ice events began ca 5000 years ago (carbonate proxy)
- Polar water and ice export via the East Greenland current
- Possible link between large-scale forcing and onset of higher-frequency oscillations in the climate system
- correlate with deep-sea cooling events?
- LIA-MWP type cycle?

- Jennings et al. (in press)

Data from past ‘natural experiments’ of systems response coupled with modeling

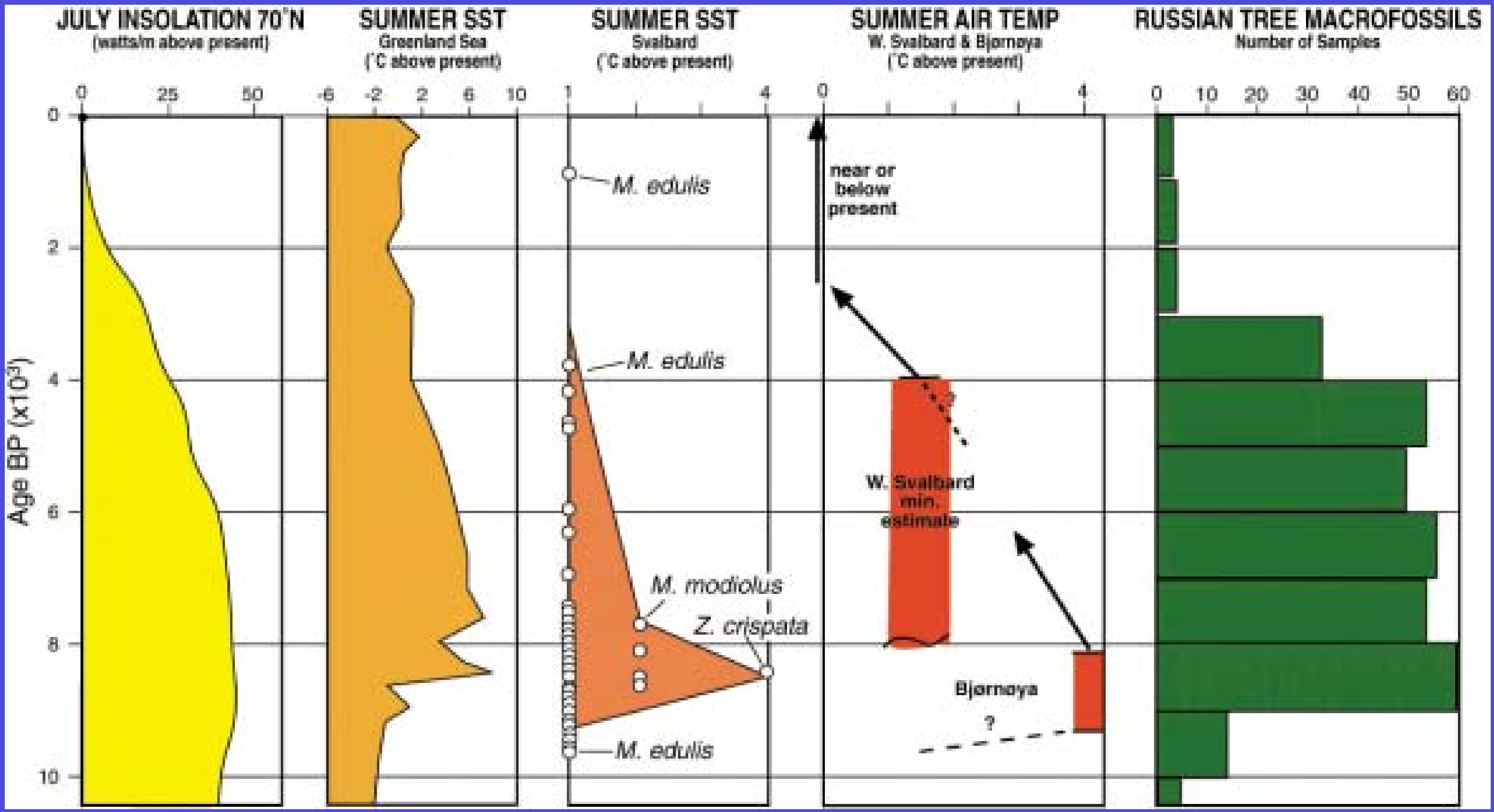
- *lead to understanding of*:

- mechanisms of change
- how the system responded to various types of forcing and feedbacks in the past
- impact of alteration of biogeochemical cycles
- sustainability under altered conditions
- uncertainties in models

- example...

6 ka Arctic

At 6 ka (~ 6000 BP) summer insolation in arctic is still higher than present, Laurentide and Fennoscandian ice are gone, North Atlantic summer SSTs cooling, but still warm



MacDonald et al. 2000

An Arctic environment warmer than present

Edwards and MacDonald, unpublishable

An Arctic environment warmer than present

Edwards and MacDonald, unpublishable

Paleo vegetation records and models suggest 6-ka warming on land (PAIN project)

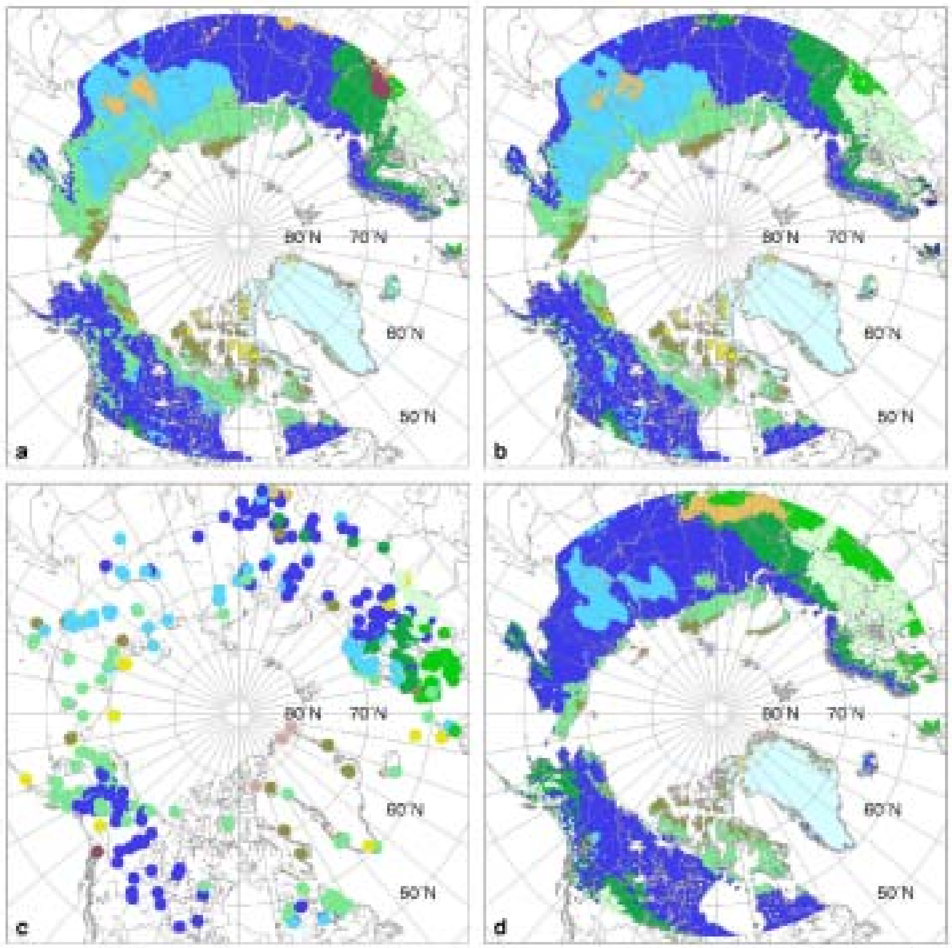


Figure 4 .Simulated vegetation at the mid-Holocene with a the IPSL-CM1 AOGCM and with b the HADCM2 AOGCM.Observed vegetation at the mid-Holocene c from pollen data.Simulated potential vegetation for 2090-2100 with the HADCM2-SUL GCM using the IS92a greenhouse-gas scenario.

Cold EG-NL
Cold deciduous
Cool EG
Shrub tundra
Graminoid tundra
Temp. grassland

At 6 ka there was

✓A small to moderate *asymmetric* extension of treeline and shrub tundra northward in most sectors (compared with today)

Future scenario:

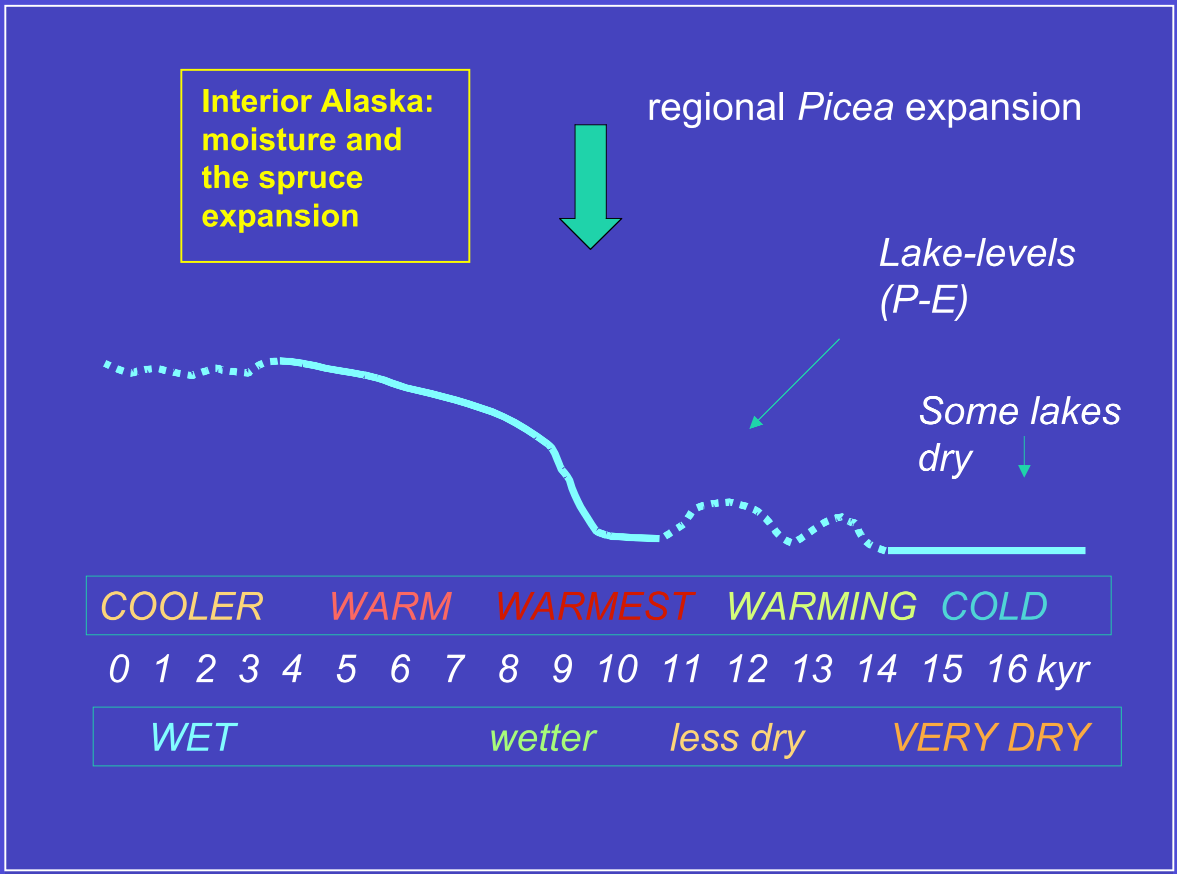
➢Substantial increase in forest over tundra

➢Reduction in cold deciduous forest in Siberia

➢**But**
models misrepresent forest in Labrador, Siberia

Kaplan (2001), Kaplan et al. (in prep).

Temperature not the only important variable



In the western Arctic, a warm, dry period in the early Holocene demonstrates the strong role of P-E in driving vegetation cover.

Figure shows time (R to L) and a general temperature trend derived from proxy data. The lake-level curve is a composite, based on 9 records (arbitrary scale). The spruce response is from AMS-dated pollen data.

Edwards and Finney (in prep)

Accomplishments to date

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General accomplishments to date:

• Greenland ice-core legacy (**GISP I, GISP II)**
• Greatly increased spatial array proxy data from NA and Eurasian Arctic – land and ocean (Beringian Atlas, Overpeck et al, 1997, CAPE 2001…)
•Process studies to improve proxy-data interpretation and develop new proxies (Eastern Arctic, Beringia)
•In-house data archive, synthesis and management (PARCS Electronic Data Atlas)
•Initiation of data-model comparisons and sensitivity experiments (Beringia, Circumarctic)
•Development of an international outreach element and several international data syntheses (CAPE)

New PARCS science initiatives

1. Understand the causes and consequences of very warm arctic climates.

What will be the extent, rapidity, and spatial pattern of warming, and what will be its environmental impact?

PARCS research focus:

- Proxy climate records, ecosystem indicators, status of key biogeochemical and other feedback variables from very warm periods
- Records of ‘climate surprises’ – rapid and/or nonlinear changes associated with reorganizations of the system
- Use of these ‘natural experiments’ in data-model comparisons to assess sensitivity to forcing and address mechanisms of climate change

2. High-frequency arctic climate variability

Internal oscillations of the climate system (AO,NAO,ENSO) are important contributors to observed climate variability.

- Long-term behavior
- Response to changes in global/hemispheric forcing
- Range of temporal and spatial variability experienced

PARCS research will address temporal and spatial variability in the arctic system at annual to decadal resolution. The focus will be on :

- ➢ the last two thousand years (recent records within the range of current climate boundary conditions)
- ➢complete/partial records from earlier in the present interglaciation
- ➢ comparisons with transient model simulations

PARCS organizational structure

Co-chairs and science steering committee

DMO - SMO

Research working group 1
Warm Arctic

Research working group 2
High Frequency variability

PARCS synthesis working groups

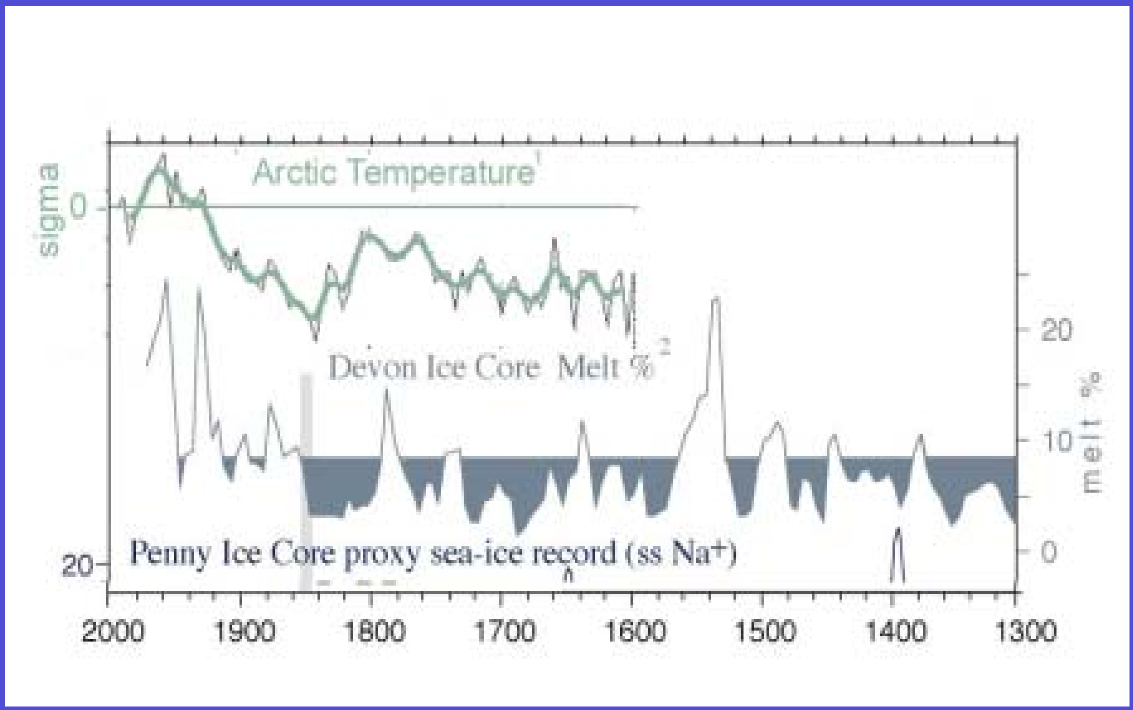
ARCSS-wide synthesis working groups

PARCS 2002

Locations of forest beyond modern treeline in Eurasia during the mid-Holocene

MacDonald et al (2000)

Eastern Canadian Arctic Climate Variability over the last 700 years

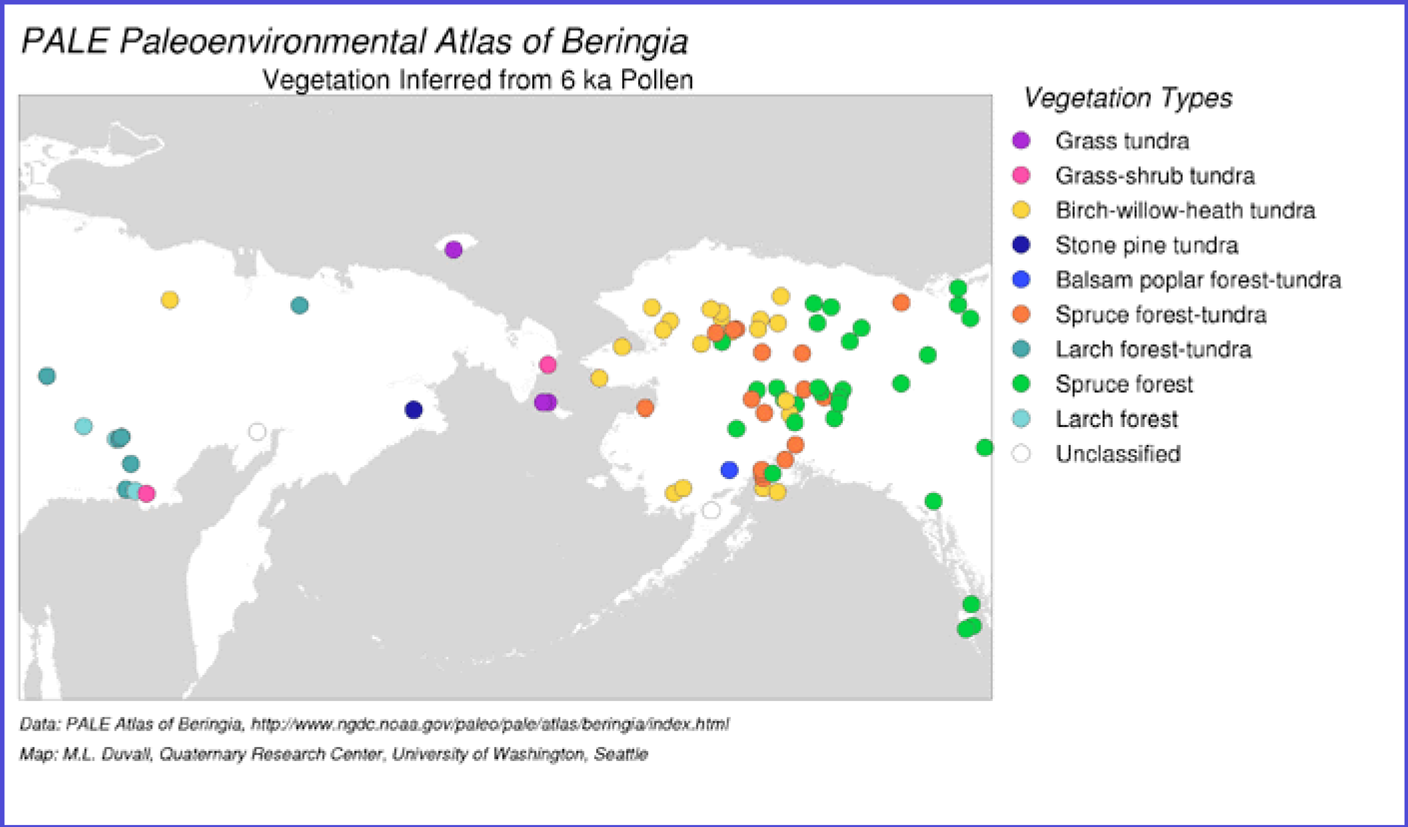


Wake et al., 2001

Sea Ice in Baffin Bay (from Na proxy in ice core):

- High-resolution sea-ice record
- Severe LIA
- Milder early 20th C
- Return to severe sea-ice past few decades
- Corresponds to cooling in eastern Canadian Arctic

Current research


PALE Paleoenvironmental Atlas of Beringia
Vegetation Inferred from 6 ka Pollen
Vegetation Types
Grass tundra
Grass-shrub tundra
Birch-willow-heath tundra
Stone pine tundra
Balsam poplar forest-tundra
Spruce forest-tundra
Larch forest-tundra
Spruce forest
Larch forest
Unclassified
Data: PALE Atlas of Beringia, http://www.ngdc.noaa.gov/paleo/pale/atlas/beringia/index.html
Map: M.L. Duvall, Quaternary Research Center, University of Washington, Seattle