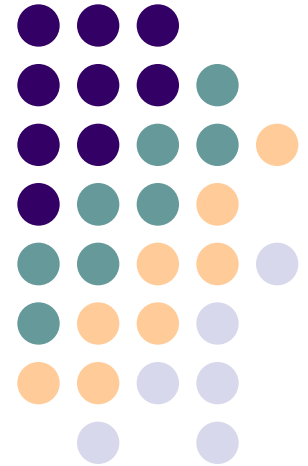


Geographic Information Systems & Boreas

Creating spatial databases for arctic environments

Professor Ezra Zubrow
Dustin Keeler, Christina Spielman, & Eva Hulse
State University of New York at Buffalo, U.S.A.



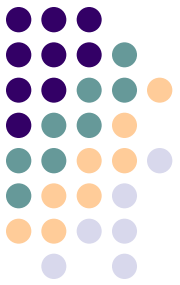
Example of a spatial or geodatabase

<http://gcmd.gsfc.nasa.gov>

The screenshot shows the Global Change Master Directory website. The browser address bar displays <http://gcmd.gsfc.nasa.gov/>. The page header includes the NASA logo and the text "GODDARD SPACE FLIGHT CENTER". Below this is a banner for "Global Change Master Directory" with the tagline "Discover Earth science data and services". A navigation menu contains links for Home, Data Sets, Data Services, Collaborations, Add to GCMD, What's New, Participate, Conferences, and Links. The main content area is titled "Find Data" and features a grid of data categories, each with a representative image and a brief description:

- Agriculture**: forest science, soils ...
- Atmosphere**: precipitation, air quality ...
- Biosphere**: ecosystems, vegetation...
- Biological Classification**: animals/invertebrates, plants...
- Climate Indicators**: air temperature, drought ...
- Cryosphere**: frozen ground, sea ice ...
- Human Dimensions**: land use, population ...
- Data Centers**: Projects, Platforms / Sources
- Instruments**: Projects, Platforms / Sources
- Land Surface**: erosion, topography ...
- Oceans**: ocean temperature, salinity ...
- Paleoclimate**: ice cores, land records ...
- Solid Earth**: geochemistry, seismology ...
- Spectral / Engineering**: radar, visible imagery ...
- Sun-Earth Interactions**: auroras, solar activity ...
- Terrestrial Hydrosphere**: ground water, water quality ...

At the bottom of the "Find Data" section, there is a "Data Set Text Search" input field and a "Search tips" link. To the right, a "Find Data Services" section lists various services such as "Data Analysis and Visualization", "Data Management / Data Handling", "Education / Outreach", "Environmental Advisories", "Hazards Management", "Metadata Handling", "Models", "Reference and Information Services", and "Data Services Text Search". The CEOS logo and "CEOS International Directory Network" are visible at the bottom right. The browser's status bar at the very bottom shows "Internet" and "100%".



GIS & Boreas

- **HHH:** Home, Hearth, and Household in the Circumpolar North
- **MOVE:** Moved by the State: Perspectives on Relocation and Resettlement in the Circumpolar North
- **SCENOP:** Social Change and the Environment in Nordic Prehistory: Evidence from Finland and Northern Canada

HHH

Home, Hearth, and Household in the Circumpolar North



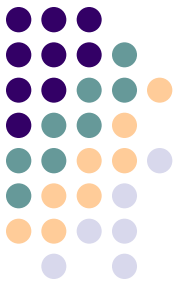
- **Hearths and Homes in Canada and Siberia: Reimagining Traditional Skills**
- ***The Study of Space in Inuvialuit Dwellings***

This activity explores the design, engineering and use of spaces in semi-permanent winter dwellings of the Inuvialuit (the Inuit of the Western Canadian Arctic) in the pre-1900 period through the use of archaeological and ethnographic data and virtual reality modeling. This research will involve excavations at archaeological sites at the mouth of the Mackenzie River, ethnographic and oral history research, and the use of virtual reality models to explore the engineering involved in constructing these dwellings.

<http://www.sami.uit.no/boreas/canada.html>

MOVE

Moved by the State: Perspectives on Relocation and Resettlement in the Circumpolar North

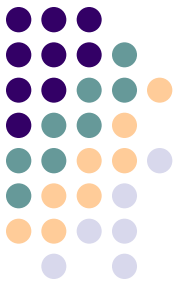


- **A Comparative Study of Development and Settlement in the Circumpolar North**
- Using the tools of economic geography and population geography, the aim of this project will be to document and analyze changes in the spatial distribution of economic activity and settlements patterns across the circumpolar North.
- A major component upon which the analysis will be based will be a geodatabase of economic activity and population distribution across the North. Other geodatabases or GIS (geographic information systems) have been compiled on the Arctic or the North that emphasize changes in physical characteristics of northern regions, many emphasizing the impact of climatic change on these regions. The proposed geodatabase would emphasize the economic and human aspects of the circumpolar North and changes in these attributes.

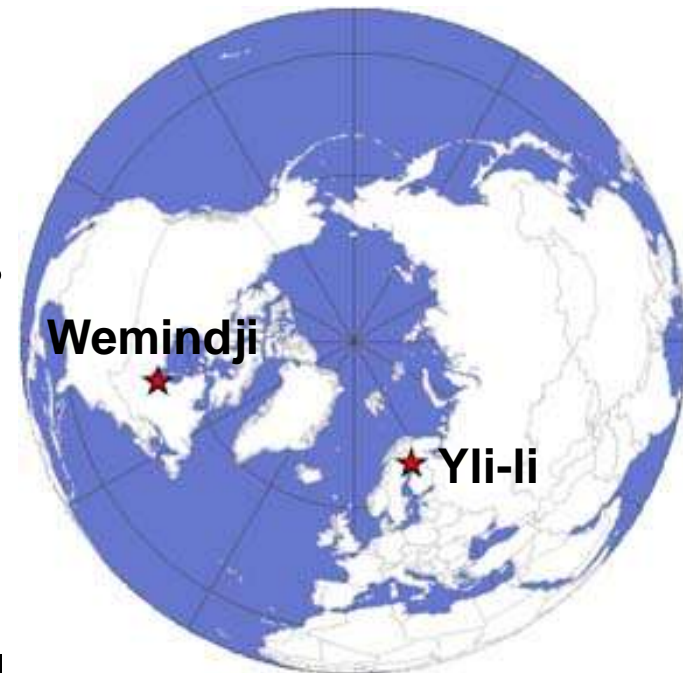
<http://www.alaska.edu/boreas/move/cn/>

SCENOP

Social Change and the Environment in Nordic Prehistory: Evidence from Finland and Northern Canada

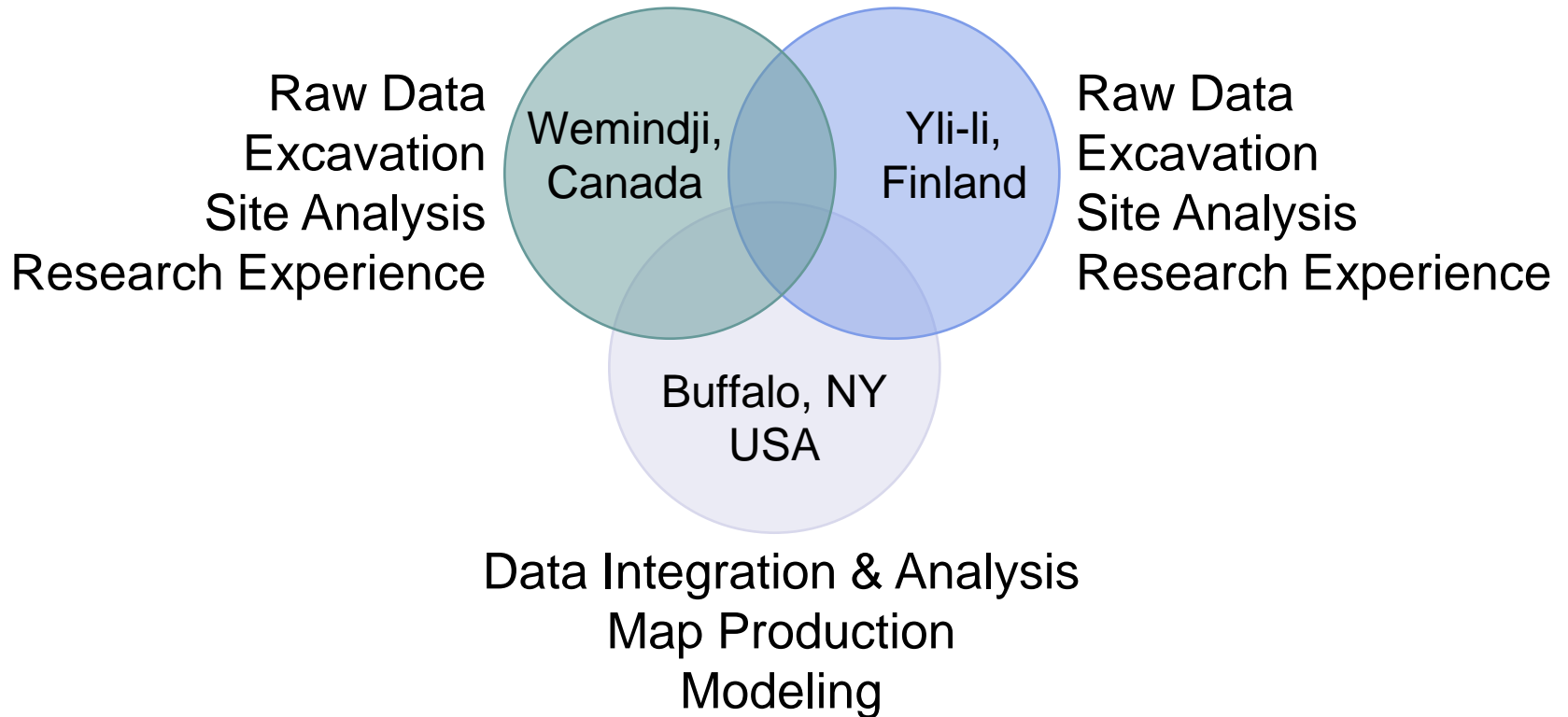


- Isostatic uplift creates dynamic coastal environments.
- The Gulf of Bothnia, Finland and James Bay, Canada have similar uplift patterns as well as a record of prehistoric human occupation going back to the melting of the ice sheets.
- We can compare cultural responses to environmental change in both places.
- With a GIS, we can integrate and organize spatial data from multiple sources, and model data for how things would have been in the past.

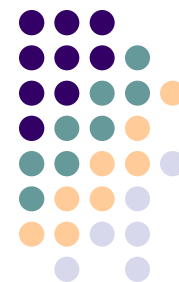


<http://scenop.googlepages.com/home>

SCENOP Organization

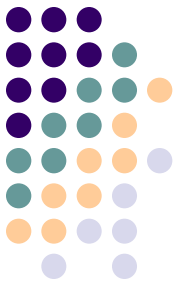


Data needed from Wemindji & Yli-li



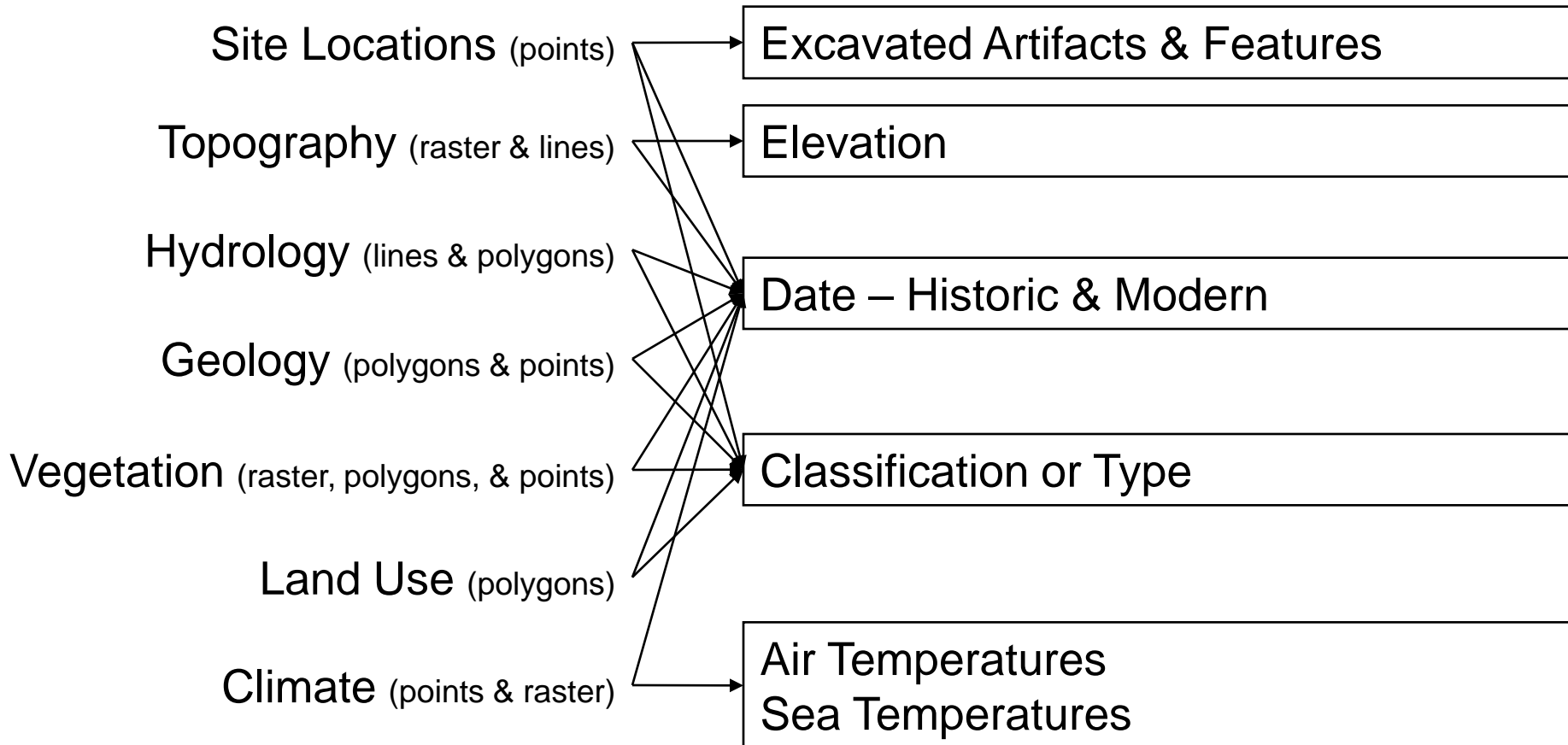
- Site Information
 - Locations
 - Date of Occupation
 - Excavated Artifacts
 - Excavated Features
- Topography
 - DEM
- Hydrology
 - Shorelines
 - Lakes & Rivers
- Vegetation – Modern & Historic
- Geology
 - Soil Chemistry
 - Site Stratigraphy
- Climate – Modern & Historic
 - Air Temperature
 - Sea Temperature
- Land Use - Modern & Historic

Data Needed for Wemindji & Yli-li



Geographic Data Layers

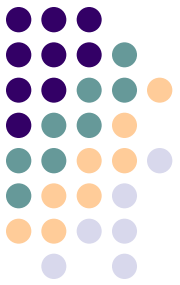
Qualitative Information for Geographic Data





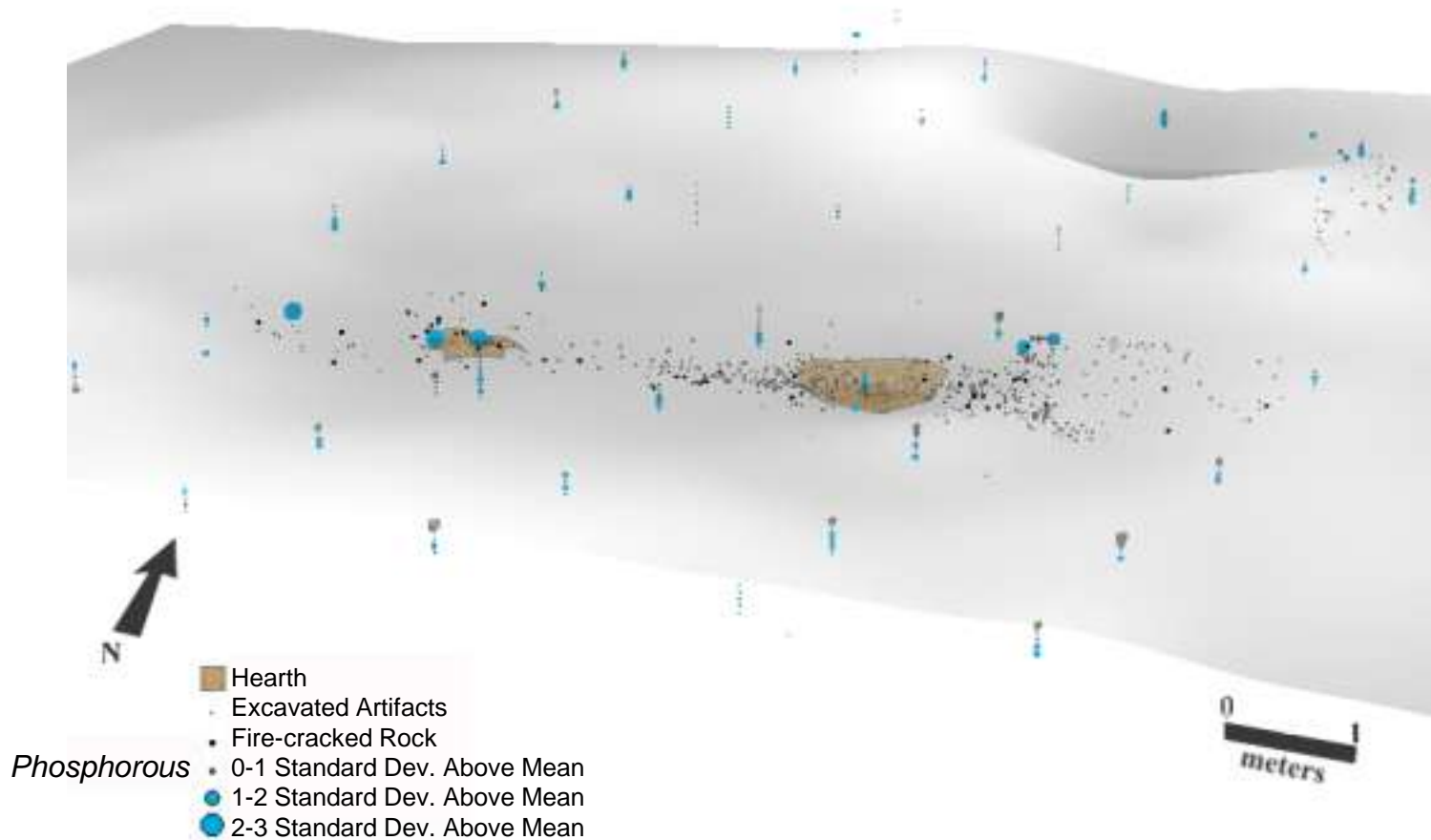
Site Information (points)

- Source: surveyed locations
 - Regional or settlement: based on historic & recent reports on archeological sites
 - Site-specific or hearth: based on mapping of structural remains such as artifacts, hearths, & pits
- Attribute information:
 - Date of occupation & type of site
 - Excavated artifacts & features found
 - Soil sample & land surface
- Issues:
 - Scale – integrating regional & site-specific information
 - Coordinate systems
 - Establishing site chronology & making sure calibrated & uncalibrated 14-C dates aren't used interchangeably.



Detailed Site Reconstruction

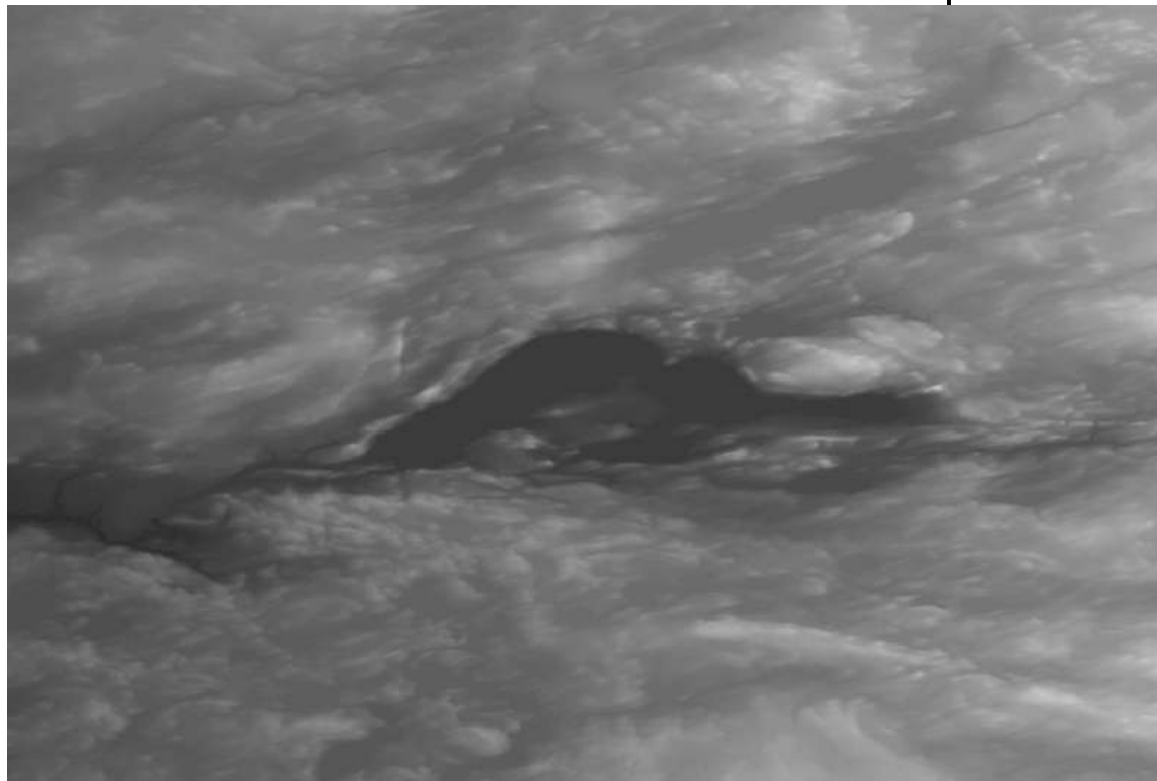
One specific site at Nocuso, Yli-li, Finland surveyed in 2005



Regional Topography (raster & lines)

- Source:

- Digital Elevation Models (DEM)
- Contours from public maps
- Surface elevations surveyed during fieldwork



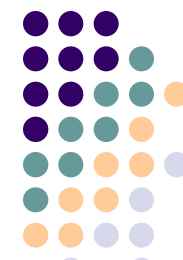
Regional DEM: Old Factory Lake, Wemindji, Canada

- Attribute information:

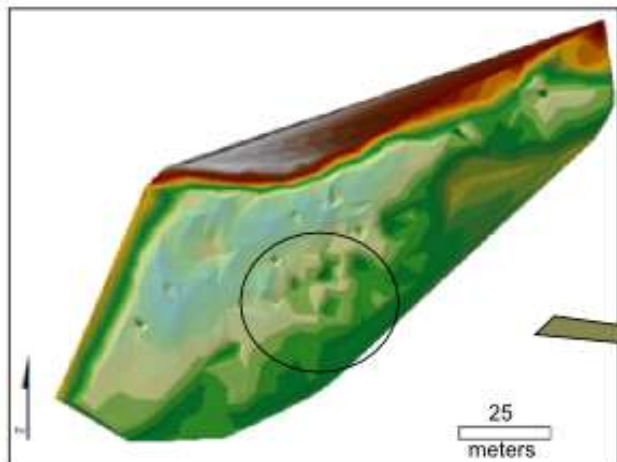
- Elevation

- Issues:

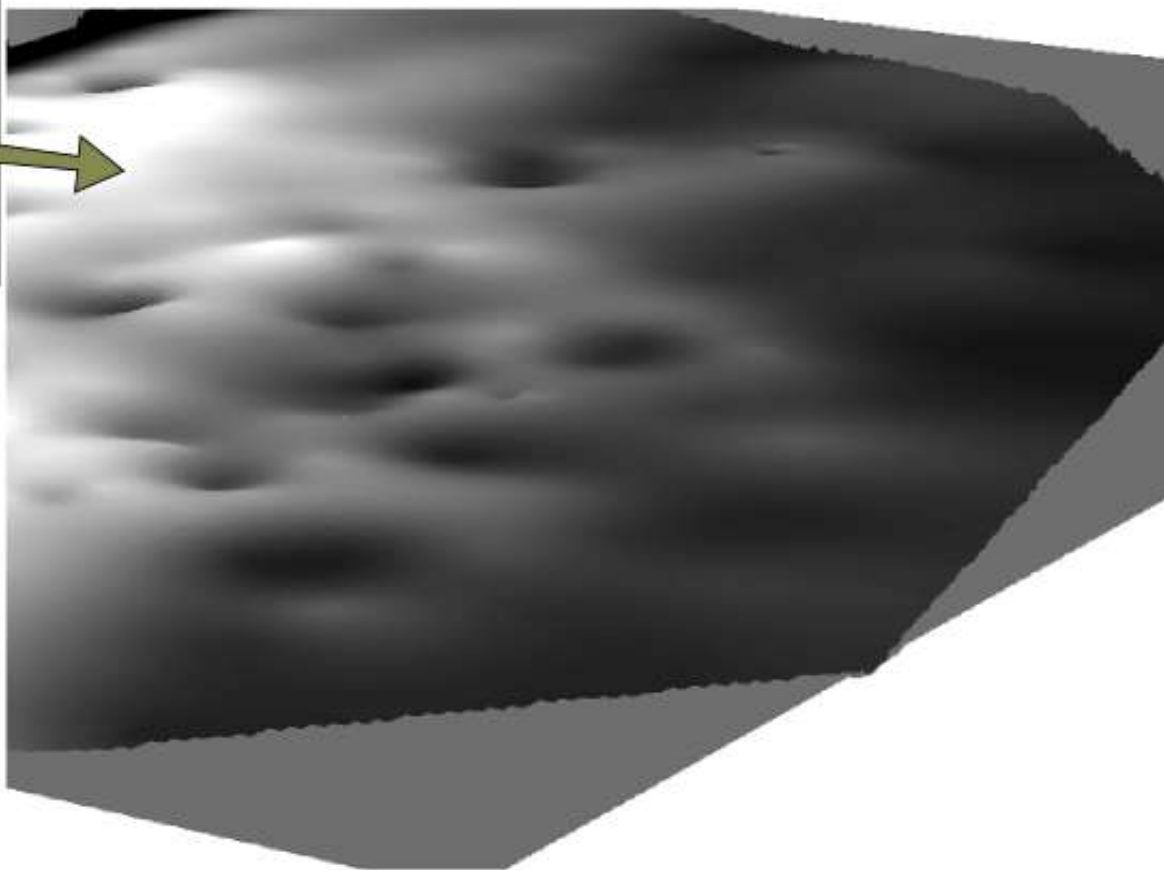
- Collected at multiple scales and/or elevation intervals for varying degrees of detail
- Historic data must be modeled using other data types and sources

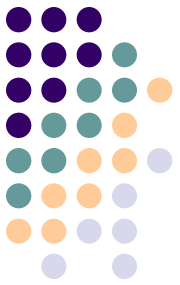


Site-specific Topography



Site-specific DEM: Nocuso, Yli-Ii, Finland in 2006 & 2007

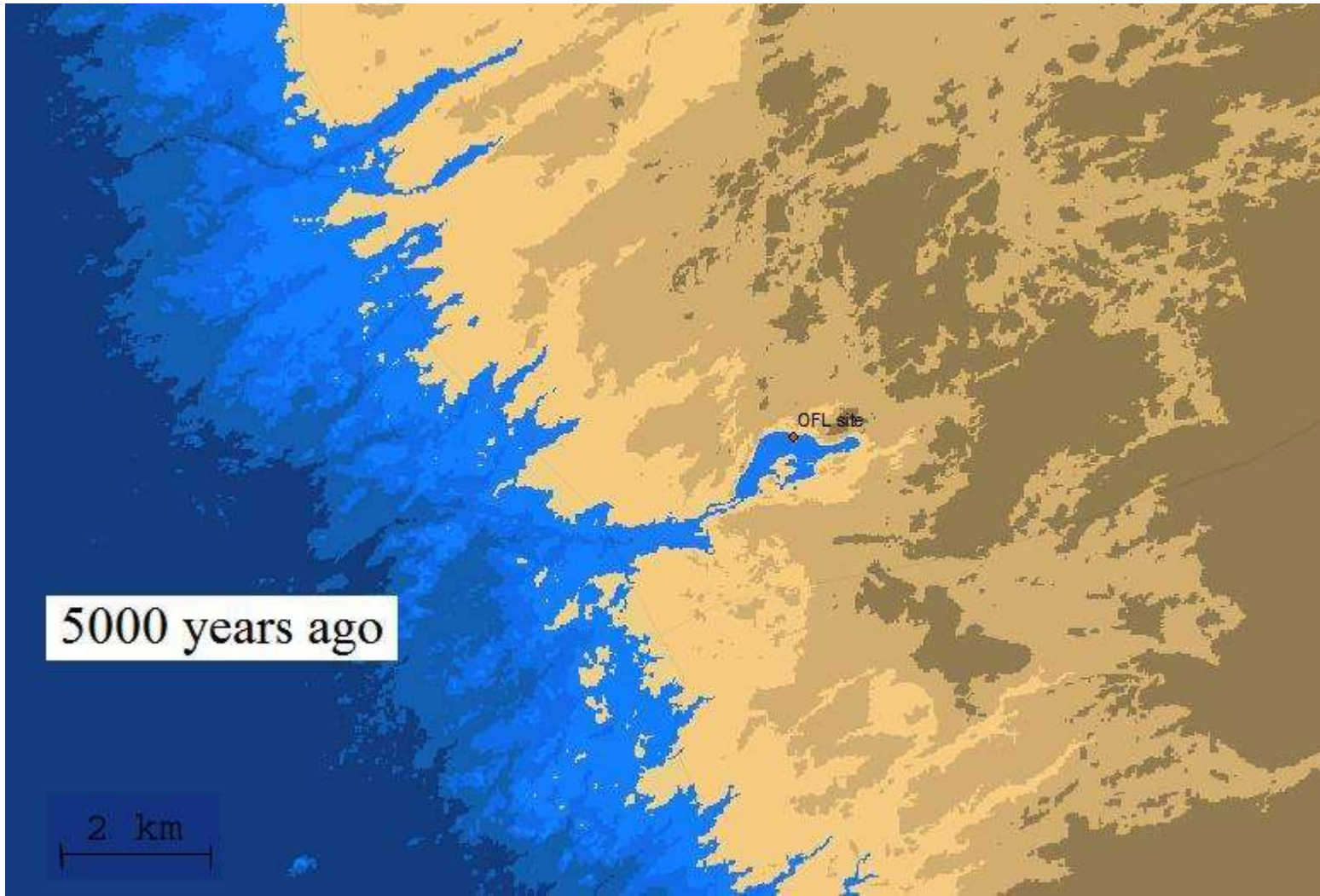




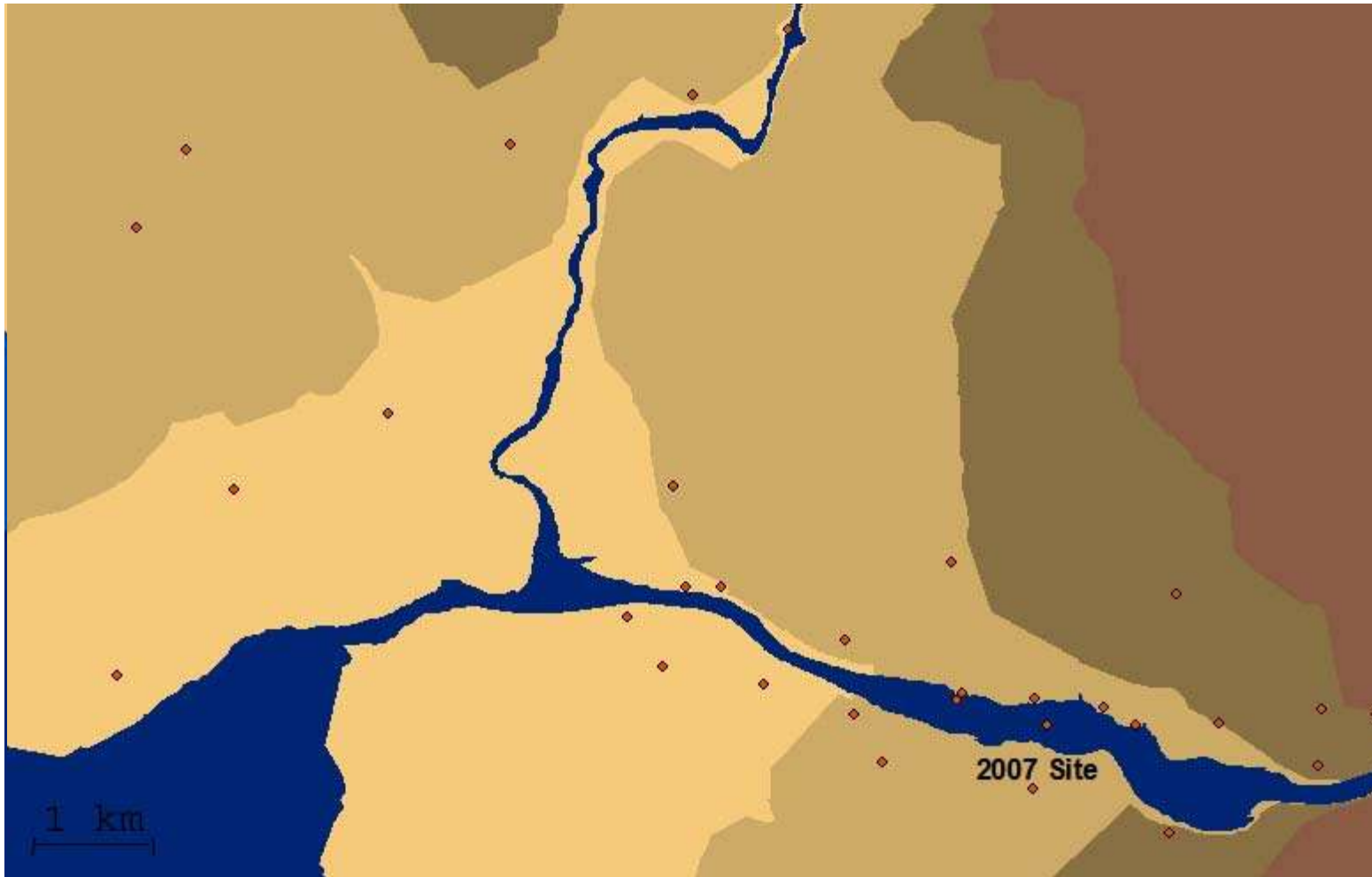
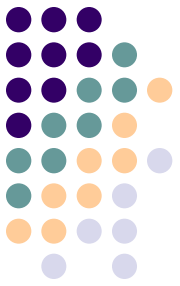
Hydrology (lines & polygons)

- Source:
 - Isostatic uplift curves
 - DEM
 - Surveyed data
- Attribute information:
 - Sea level
 - River course
 - Date
- Issues:
 - Historic information is difficult to model because modern data does not account for erosion or deposition processes.
 - Accuracy of sea level is dependent on quality of palaeoenvironmental research.

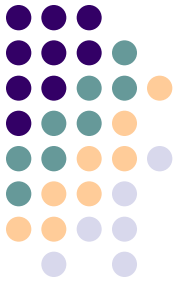
Wemindji Changing Coastlines



Yli-li Changing Coastlines



Geology (polygons & points)



- Source:
 - Regional geological maps
 - Soil chemistry & stratigraphic mapping of individual sites
- Attribute information:
 - Soil chemistry & characteristics
- Issues:
 - Scale – regional maps are measured in kilometers while individual site data has sub-centimeter accuracy.



Vegetation (raster, polygons, & points)

- Source:
 - Palaeoenvironmental/Paleoecological research
 - Pollen & stratigraphic surveys & analysis
- Attribute information:
 - Generalized type of vegetative cover
 - Date
- Issues:
 - Palaeo data based on analysis of pollen in deep sediment cores which is high resolution data that can be interpolated into a regional raster that may be low resolution.
 - Modern vegetation data is based on satellite imagery of the ground surface as well as point observations on the ground and is typically higher resolution than palaeo data.

Land Use (polygons)

- Source:

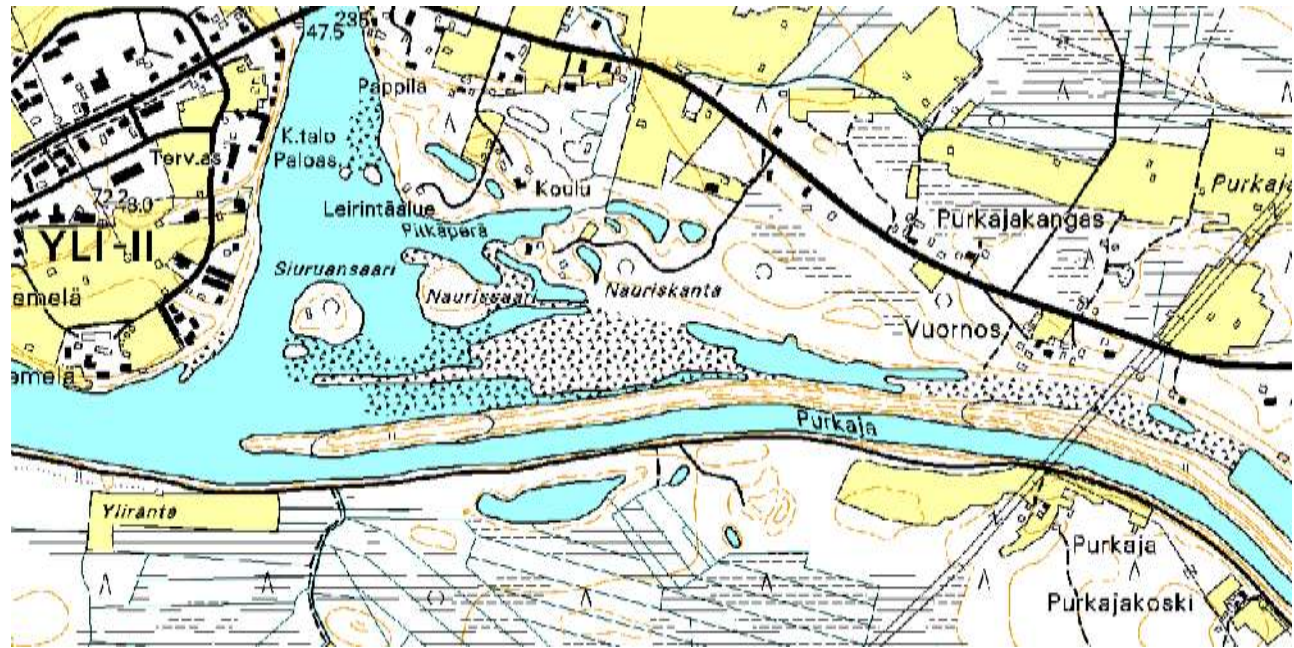
- Historical & Modern maps

- Attribute information:

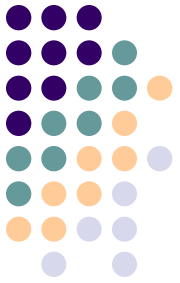
- Type of use
- Date

- Issues:

- Not in digital format
- Drawn at different scales

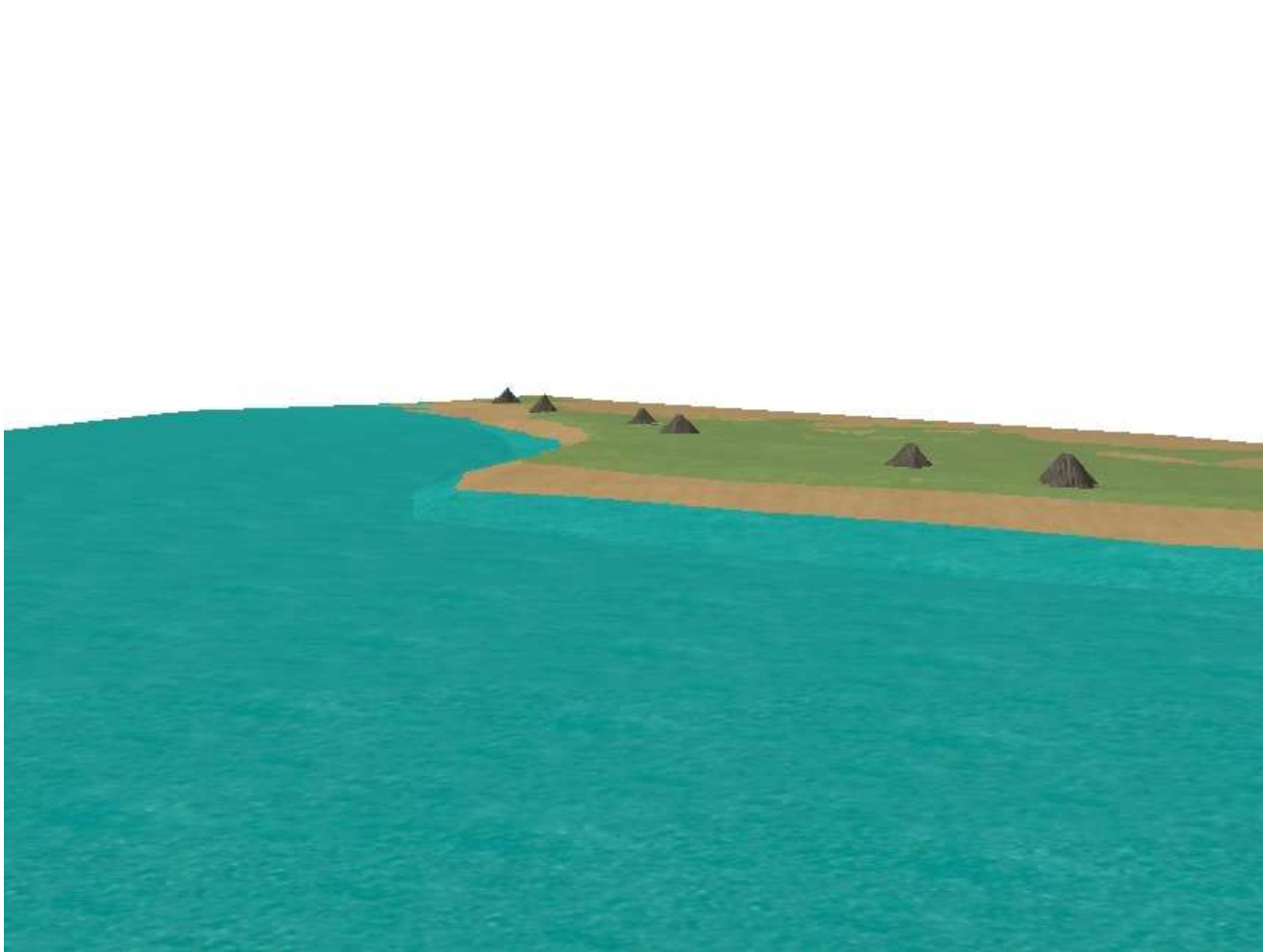


Climate (points & raster)



- Source:
 - Pollen isotopes for historic data
 - Weather stations for modern data
- Attribute information:
 - Dates
 - Air temperature
 - Sea temperature
- Issues:
 - Scale – point data from pollen cores is high accuracy but does not give accurate picture of region while modeled regional data is low resolution.

3-D Visualization – Modeled Data



Sharing Data & Products

Social change and the environment in Nordic prehistory - Microsoft Internet Explorer provided by Uni

https://www.cas.buffalo.edu/boreas/

File Edit View Favorites Tools Help

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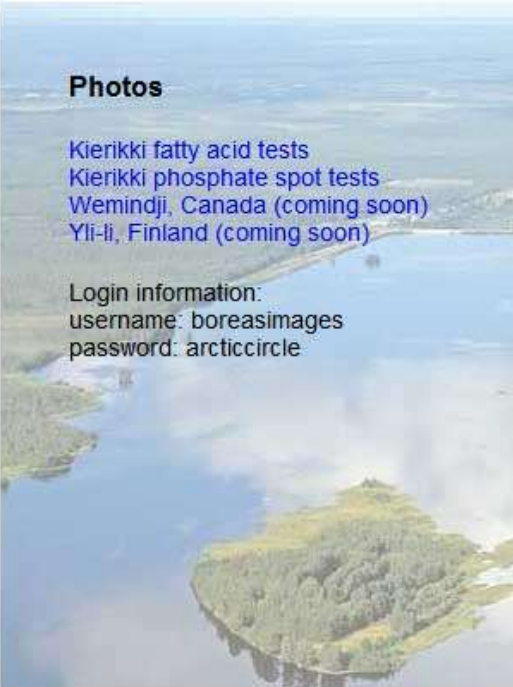
Social Change & the Environment in Nordic Prehistory

Evidence from Finland & Northern Canada

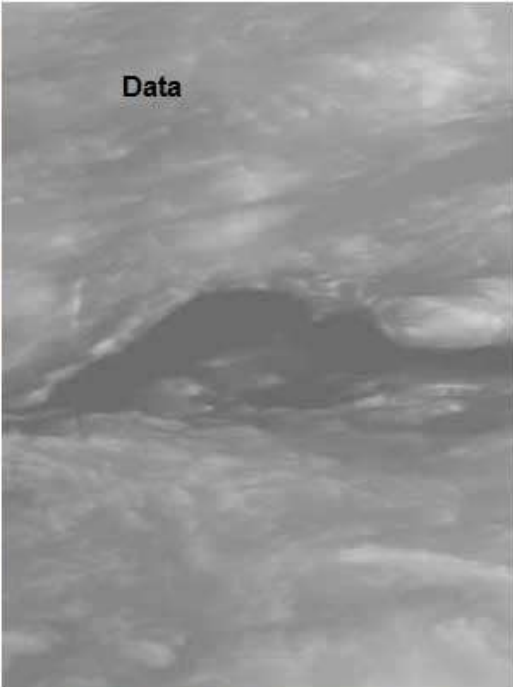
Photos

[Kierikki fatty acid tests](#)
[Kierikki phosphate spot tests](#)
[Wemindji, Canada \(coming soon\)](#)
[Yli-li, Finland \(coming soon\)](#)

Login information:
username: boreasimages
password: arcticcircle



Data



SCENOP Organization

Presentations & Documents

Nov. 2007 Spain


Yli-li, Finland

Raw Data, Excavation, Site Analysis, Research Experience

Raw Data, Excavation, Site Analysis, Research Experience

Buffalo, NY USA

Data Integration & Analysis, Map Production, Modeling



Maps

