The University of Alaska Fairbanks: A member of an Arctic GIS community

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University of Alaska Fairbanks
The Arctic

Bundy Fiord, Axel Heiberg Island
Diversity of geospatial data
Many pieces to the global puzzle
GIS: A means to bring the pieces together
The University of Alaska Fairbanks:

A treasure house of arctic geospatial information
An Arctic GIS Network

- A mechanism to help us integrate our diverse data, organizations, users and technological capabilities and share this among the arctic science and world communities.

- Such a network would promote collaboration and wide participation in discovering and sharing data and analysis capabilities, as well as finding other required services and new opportunities.
Three UAF subnodes interacting through geospatial information

Northern Ecosystem Analysis and Mapping Laboratory (NEAML)
A proposed Arctic Geobotanical Atlas

AMAP Terrestrial and Freshwater Thematic Data Center
SynCon project

Institute of Arctic Biology
Caribou project
A web-based Circumpolar Arctic Geobotanical Atlas

- Collection of geobotanical maps and supporting documentation for the Arctic phytogeographic region.

- Fusion of three ongoing GIS efforts:
  - Circumpolar Arctic Vegetation Mapping project,
  - Kuparuk River basin geobotanical atlas,
  - Prudhoe Bay geobotanical atlas and cumulative impact studies.
The 4-Dimensional Framework of the Circumpolar Arctic Geobotanical Atlas
The horizontal dimension: Location
Vertical dimension: scale of maps

Macroscale Megascale
Macregion

Mesoscale
Microregion Mesoregion

Microscale... Mesosite Macrosite

...Microscale Microsite

Linking Elements

Circumpolar Arctic (10,000,000 sq km)
- Extension of Flux Study findings to the circumpolar Arctic
- Global flux estimates for trace gases, water and energy

Regions (10 - 10,000 sq km)
- Regional patterns of vegetation, NDVI, and fluxes related to climate and large-scale geologic features
- Regional measures of CO₂ flux (aircraft)
- Hydrology of major rivers

Landscapes (0.1 to 10 sq km)
- Landscape controls on vegetation, NDVI, soil carbon, and active layer
- Tower measurements of CO₂, ET, and soil heat flux
- Linkages between terrestrial and freshwater systems

Plots (0.1 - 100 sq m)
- Influence of site factors on species, vegetation communities, NDVI, and soils
- Spatial and temporal variation of trace-gas (CO₂, CH₄) energy and H₂O flux

Integration, Modeling

Arctic Land-Atmosphere Model (GLAM)
Hierarchical GIS
Regional prammem Model
Canopy light Model

(Delcourt and Delcourt, 1988) (Walker and Walker, 1991)
Processes of change operate across many scales

- Processes of change operate across a broad range of spatial and temporal scales.
- Require a broad range of map scales.
Kuparuk River basin: hierarchy of map scales

• Up to 8 scales of data available in the Kuparuk River region

• Plot to global scales

• Part of the Toolik Lake LTER and ARCSS ATLAS projects
Hierarchy of Databases for the Kuparuk River basin
Depth dimension: Map themes or attributes

Toolik Lake Grid
Regional maps: Canada

- AHVRR false CIR image
- Parent material pH
- Elevation
- Vegetation

Gould and Raynolds, in prep.

- Component of the Circumpolar Arctic Vegetation Map
- 1:4.5M scale
West Siberia and the Taimyr Peninsula, Russia

- Bedrock geology
- Lake cover
- Vegetation zones
- Soils
- Geomorphology
- Vegetation types

N. Moskalenko et al., in progress
Derived maps: Northern Alaska

- Maps based derived from look-up tables
- Maps derived from models
Time dimension: Historic changes

- 1:6000-scale mapping of the Prudhoe Bay Oil Field
- Cumulative impacts of oil field development

Predevelopment vegetation

History of area covered by four disturbance types

History of disturbance
GIS is key tool for answering scientific and societal questions

For example:

- Is there a relationship between vegetation, water cover, topography and caribou calving success?

- Is the distribution of atmospherically-transported contaminants controlled by the Arctic Front? And are levels of contaminants related to phytogeographic subzones?

- Is there any danger from contaminants in eating caribou hunted during the migration of the Central Arctic Herd?
Some key issues for an Arctic GIS Network

• Participation
  – How to involve the community in the process?
  – What defines a valuable member?
  – What technology is required to be a useful participant?

• Resources
  – Resources for research and education.
  – Resources for operations: data system development and infrastructure.
  – Long-term commitment and support.

• Data issues
  – Distributed vs. centralized data holdings.
  – Catalogs and/or measurements.
  – User services.
  – Security and access.
  – Publishing and sharing.
  – Effectiveness metrics.