Polar Knowledge Canada (POLAR)

Establishing CHARS as an Arctic Flagship Research and Monitoring Site

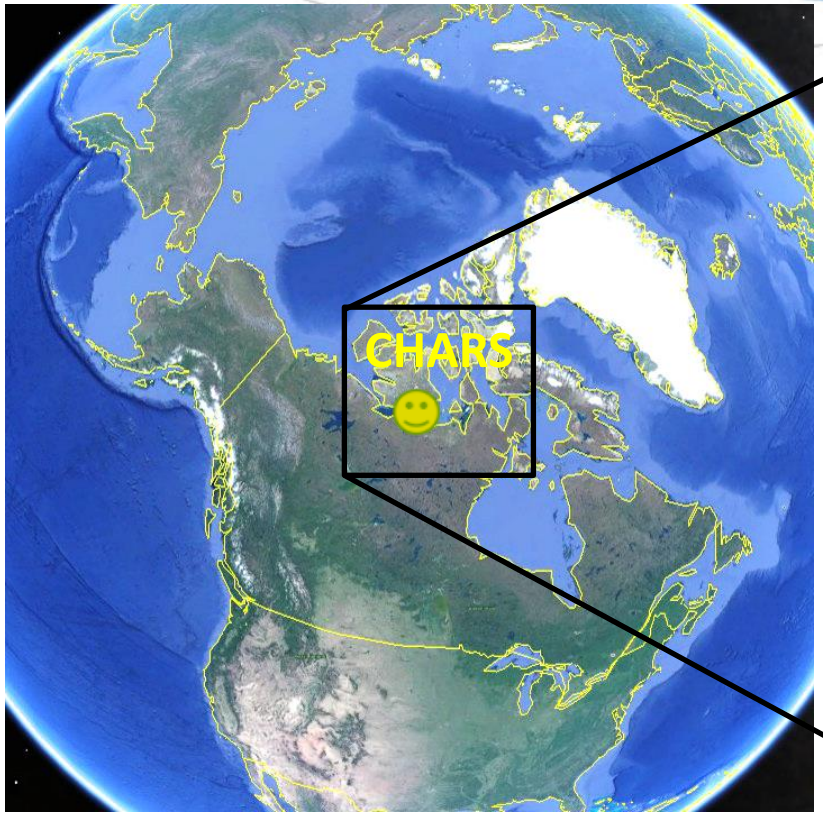
Houben, A.J., D. S. McLennan, J. Wagner, C. Arko, C., S. Coulombe, I. Hogg, J-F Lamarre, and O. Schimnowski

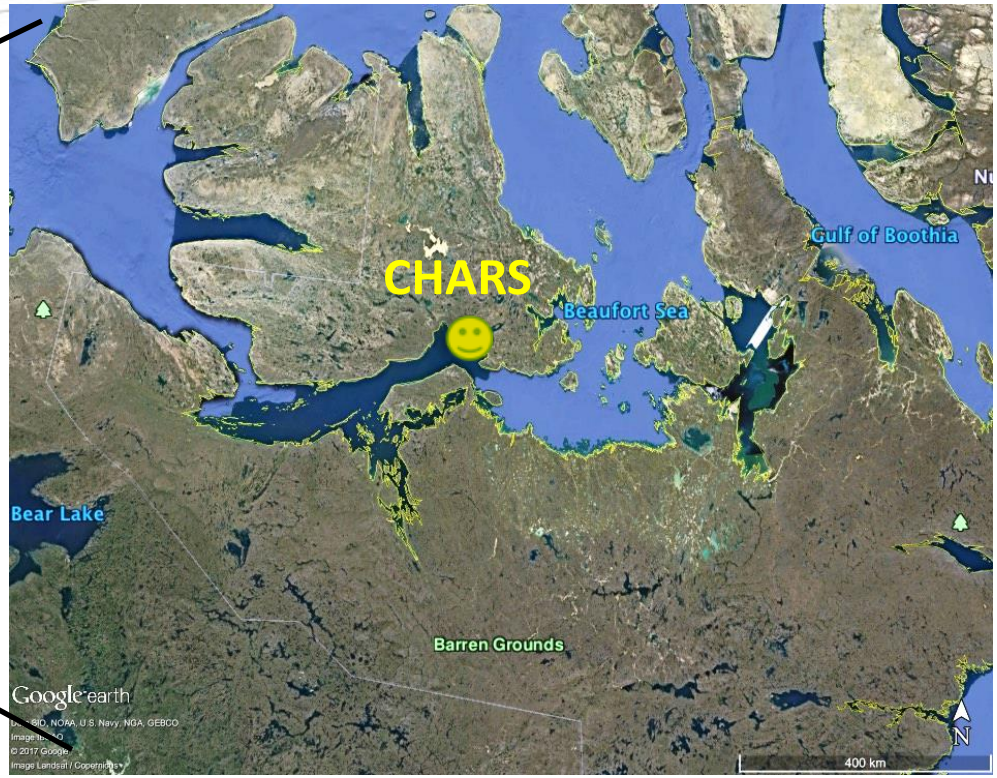
NASA ABoVE Science Team Meeting, January 23-26, 2018

CHARS: Canadian High Arctic Research Station

POLAR HQ at CHARS

Cambridge Bay, Nunavut, Canada





Polar Knowledge Canada | Savoir polaire Canada

Canada

The CHARS Campus

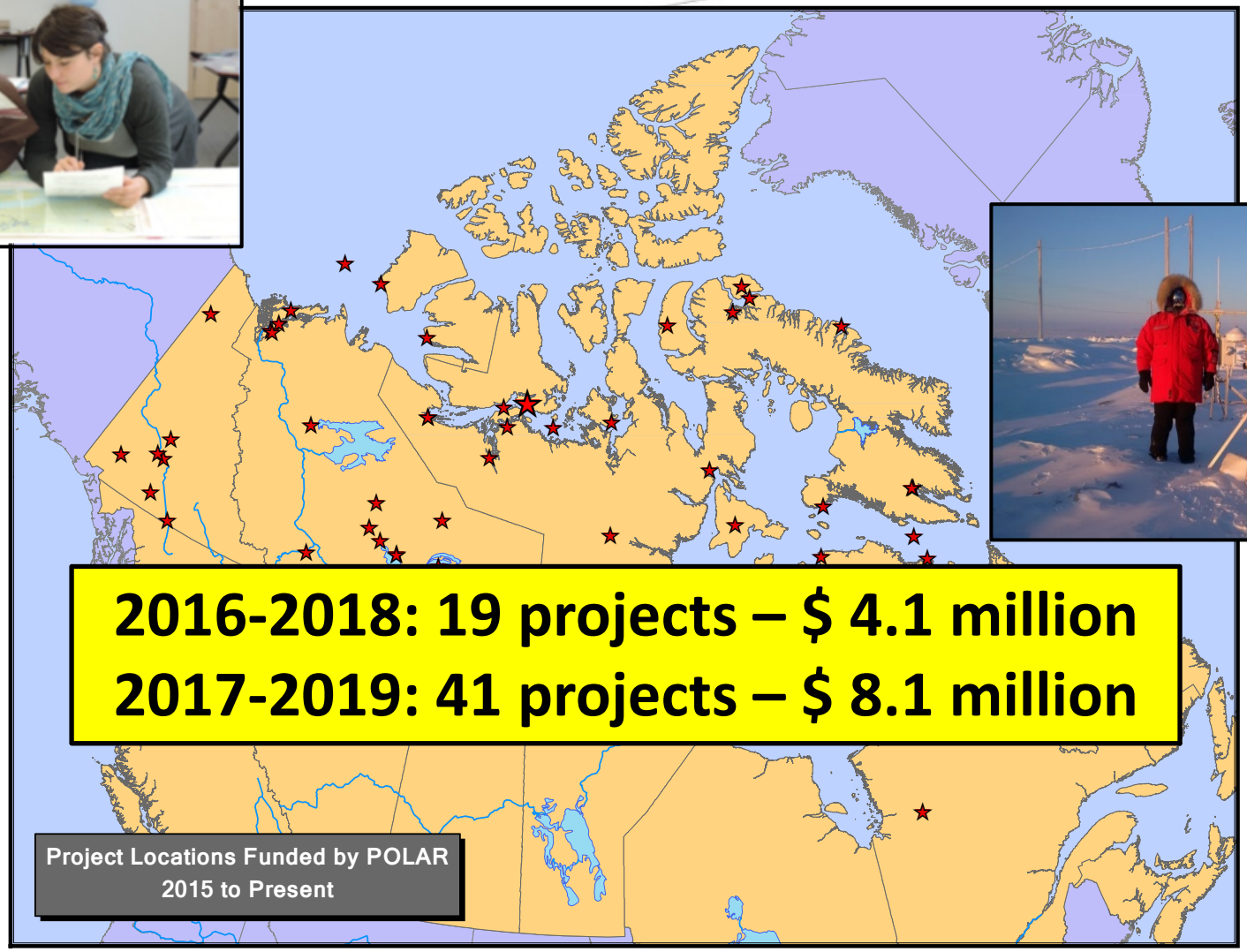
- Free to use! Accommodates 48
- Field equipment and lab facilities
- Digital: e.g. DEM (BAS), AVIRIS (2017)
- Data stored at Polar Data Catalogue
  - https://www.polardata.ca
- In-house expertise…

POLAR Pan-Northern S&T Program

Priority Areas, 2014-2019:

1. **Baseline information to prepare for northern sustainability**
2. **Predicting the impacts of changing ice, permafrost and snow on shipping, infrastructure and communities**
3. Alternative and renewable energy for the North
4. Catalyzing improved design, construction and maintenance of northern built infrastructure

POLAR-funded projects



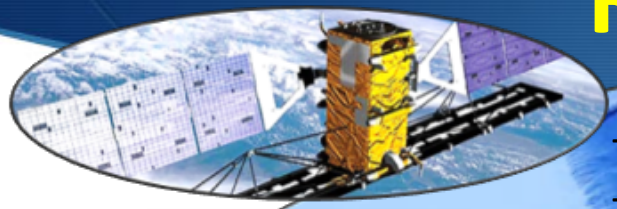
2016-2018: 19 projects – $ 4.1 million

2017-2019: 41 projects – $ 8.1 million

POLAR ABoVE Projects 2017-19

- Asselin et al. @ UQ Abitibi-Temiscamingue. Impacts of climate change on wildfire risk in boreal forests in the Northwest Territories. Communities across NWT.
- Calmels et al. @ Yukon College. Mapping permafrost vulnerability in Vuntut Gwitchin Traditional Territory: Climate change impacts on landscapes and hydrology. Old Crow, Yukon Territory.
- Humphreys et al. @ Carleton University. Improving Canada's climate change projections by incorporating Arctic shrub feedbacks. Dareing Lake Tundra Ecosystem Research Station (TERS), NWT.
- Langlois et al. Universite u Quebec de Sherbrooke. Development of a multi-scale cryosphere monitoring network for the Kitikmeot region and Northwest Territories using modeling and remote sensing. Nunavut (Cambridge Bay, Gjoa Haven, Kugluktuk, Kitikmeot region)
- Marshall et al. @ University of Calgary. Cryosphere-Climate Monitoring. Kluane Lake Research Station, Yukon Territory.
- Quinton et al. @ Wilfrid Laurier University. Consortium for Permafrost Ecosystems in Transition (CPET). Scotty Creek & Suhm Creek. NWT.
- Sharam et al. @ Environmental Resource Management. What mechanisms drive habitat choice by caribou? - A resource selection function approach using Traditonal Knowledge, remote sensing and field surveys. Nunavut, NWT (Hope Bay, Back River, Ekati, Courageous Lake)

Radarsat-2 (CSA)



- **June 12 to Nov. 30, 2017**
- **24 day cycle**

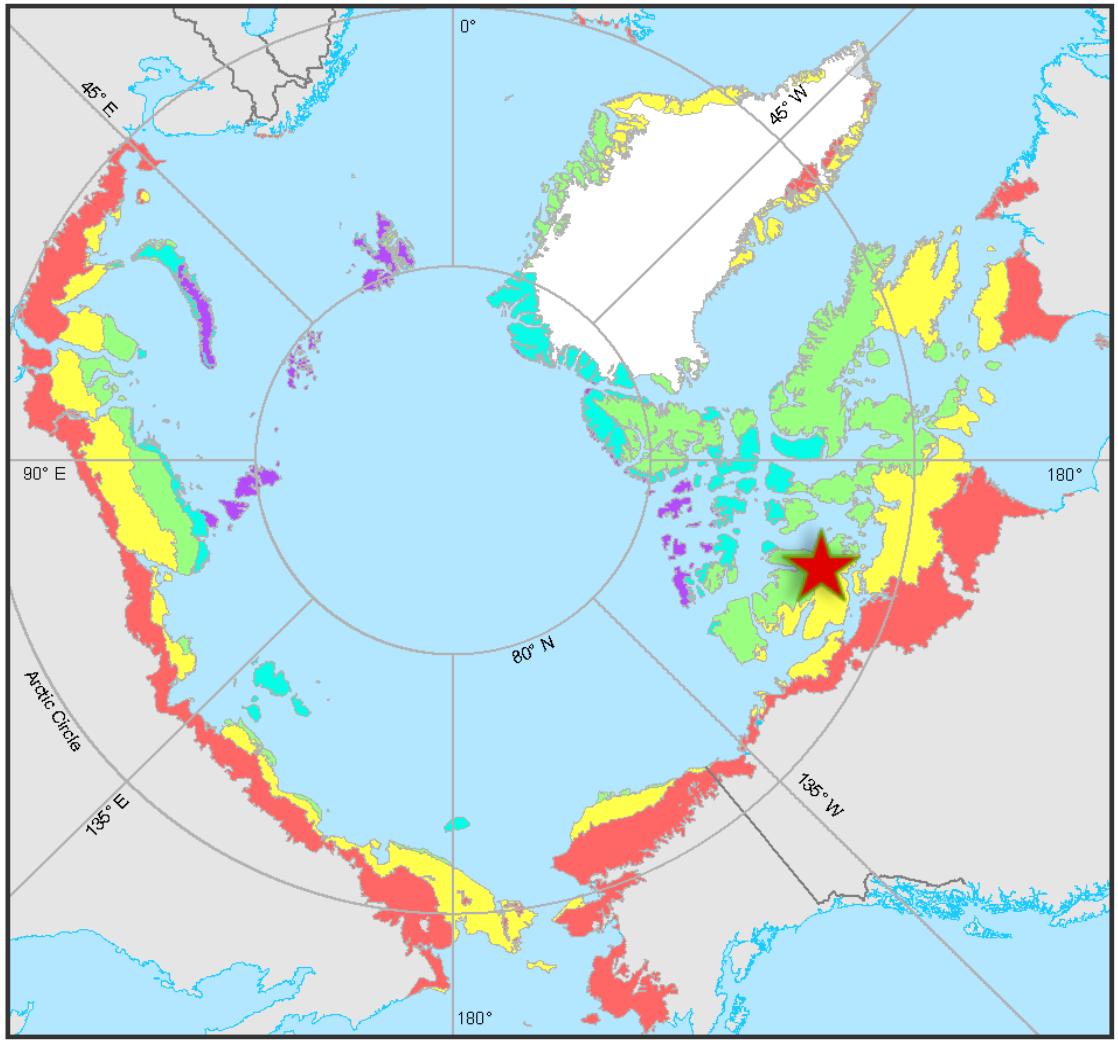
2017 Collections:

- 500 swaths surveyed
- 66% success of researcher requests
- All data on CCMEO NEODF catalogue

2018 Preparations:

- Your research needs; who needs access
- MURF (Multi-User Request Forms)

CHARS – in the 'REAL' Arctic



Circumpolar Arctic Region
Bioclimate Subzones

- Zone A
- Zone B
- Zone C
- Zone D
- Zone E
- Non Arctic
- Glaciers

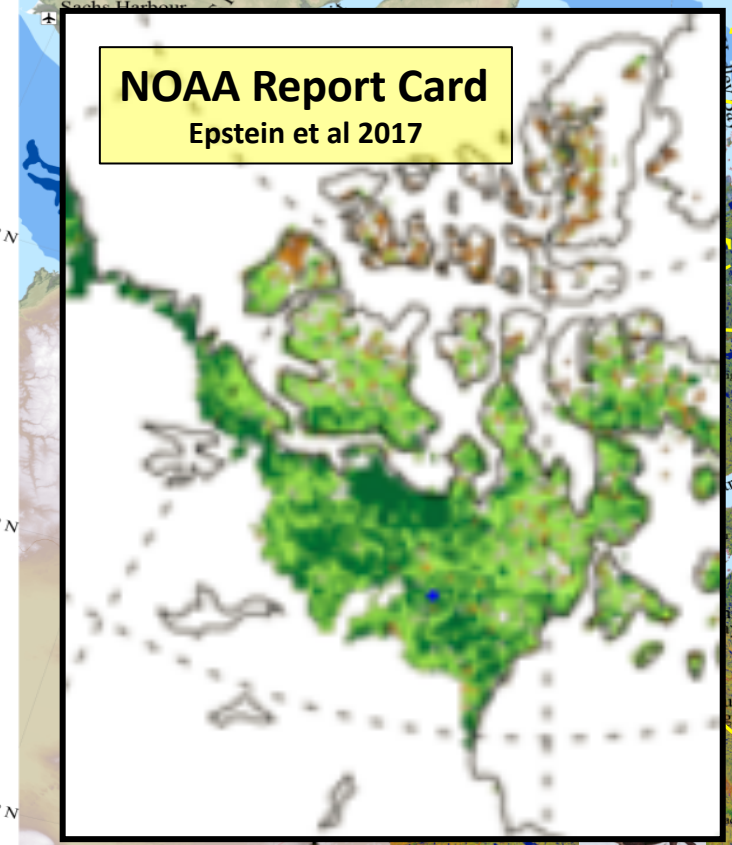
0 250 500 750 1000
Kilometers

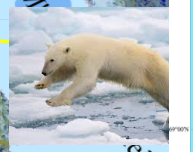
Lambert Azimuthal Equal Area Projection
Longitude of origin: -180°, Latitude of origin: 90°

Derived from: CAVM Team. 2003. Circumpolar Arctic Vegetation Map. (1:7,500,000 scale), Conservation of Arctic Flora and Fauna (CAFF) Map No. 1. U.S. Fish and Wildlife Service, Anchorage, Alaska.

http://www.ArcticAtlas.org/

CHARS Regional ERA





-5 Cº)

D-(7-9 Cº)

STEFANSSON ISLAND

KING WILLIAM ISLAND

SIMPSON PENINSULA

Queen Maud Gulf

Beverly

Nanisivik

Kugaaruk (Pelly Bay)

Baker Lake (Qamani'tuaq)

Rae Strait

Alexandra Strait

Cambridge Bay (Iqaluktuuttiaq)

Elu Inlet Lodge

Hope Bay Camp

Perry River Cabin

Meadowbank

Kiggavik

Corageous Lake

Snap Lake

Gahcho Kue

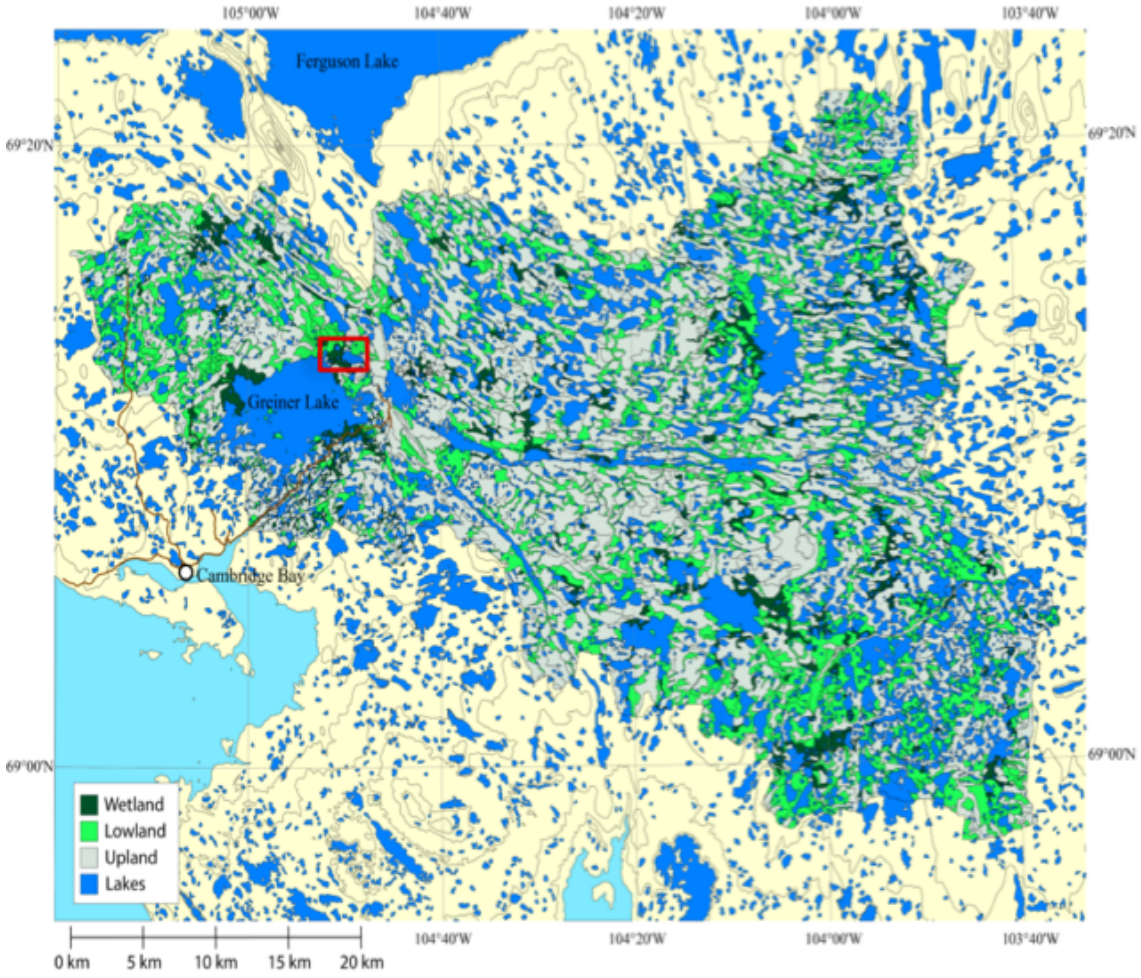
TERS - Daring Lake

0 km 100 km 200 km 300 km 400 km

- Hamlets
- Mines
- Camps
- Izok Project Port Site
- Watersheds
- Treeline
- Izok Corridor Project Road

CHARS Sub-regional ERA

Greiner (Ikalktutiak) Lake Watershed



- Circumpolar Flagship Monitoring Site
- instrumented ,Intensive Long Term Monitoring Area (IMA)
- safe, accessible, inventoried research area for visiting researchers
- social-ecological systems model frame
- community-based monitoring and Indigenous Knowledge

Geology and Landforms

- Carbonate bedrock overlain by 1-3 m of till of mixed lithology
- Post-glacial marine transgression – lowland fine textured marine deposits
- Soils mostly Turbic and Organic Cryosols (CSSC1998); active layers 30 cm to > 2m

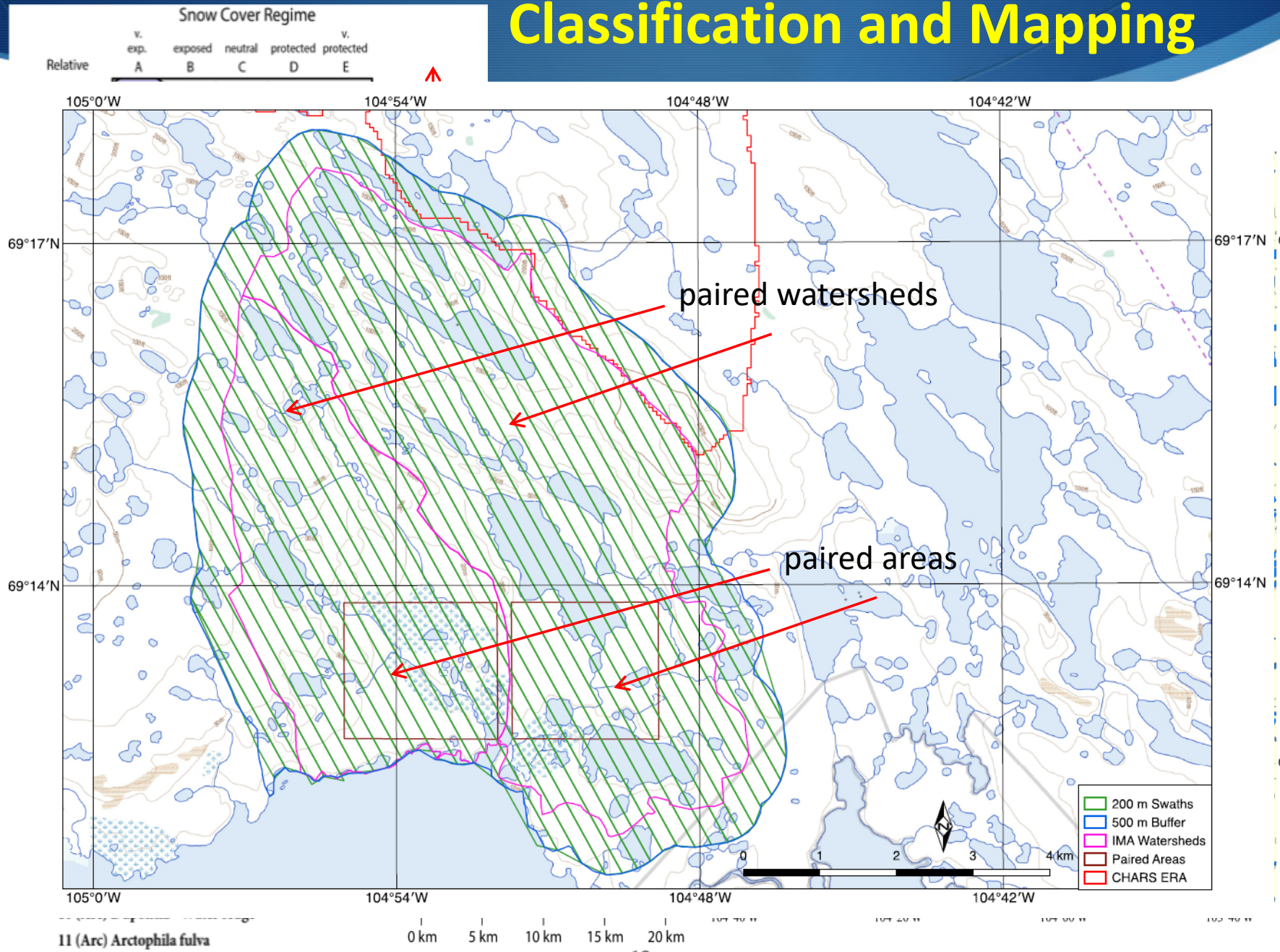
Freshwater Ecosystems

- Hundreds of water bodies that range from large connected basins (to ca 10m) to shallow (<1m) seasonally connected ponds
- Few large rivers – small streams and seasonal drainages
- Highly alkaline systems – pH > 8.0
- Supports very productive char and lake trout populations

Tundra Ecosystems

- Erect Dwarf Shrub Tundra Biome (Zone D – CAVM)
- Snow a key driver of terrestrial ecosystem mosaic and processes (spring inundation, winter protection)
- Supports diverse Arctic biota directly in the path of climate change effects

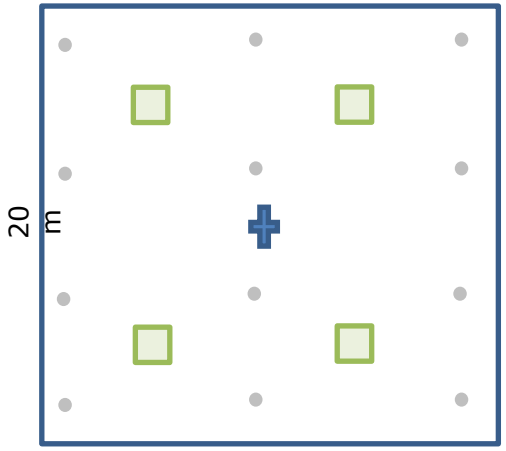
Classification and Mapping



Paired Areas Design

IMA - Detailed Monitoring Plots/Transects

Monitoring Plot

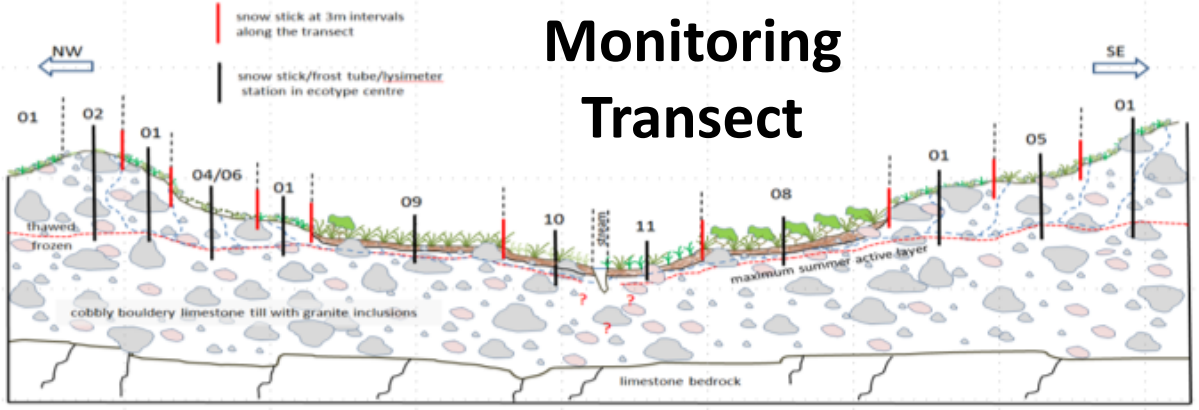


ITEX vegetation plot

digital camera, soil moisture meter, soil thermistors, soil solution lysimeters

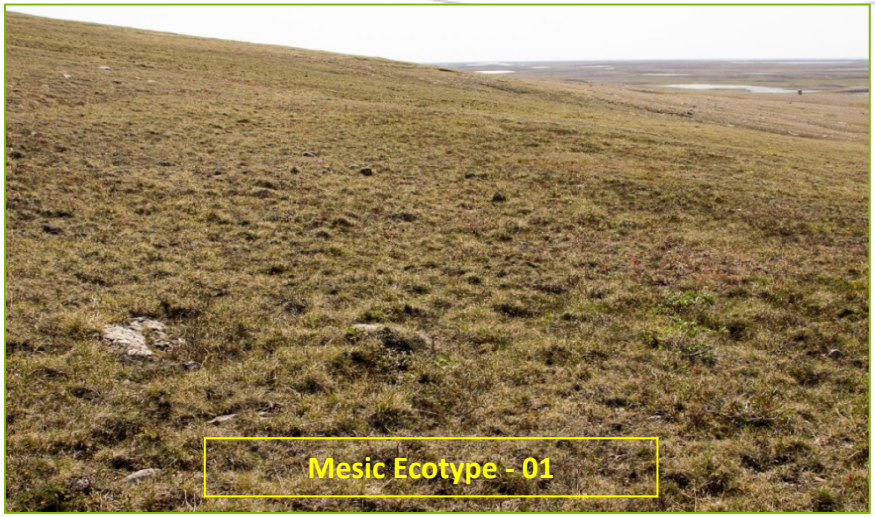
snow stick

Monitoring Transect

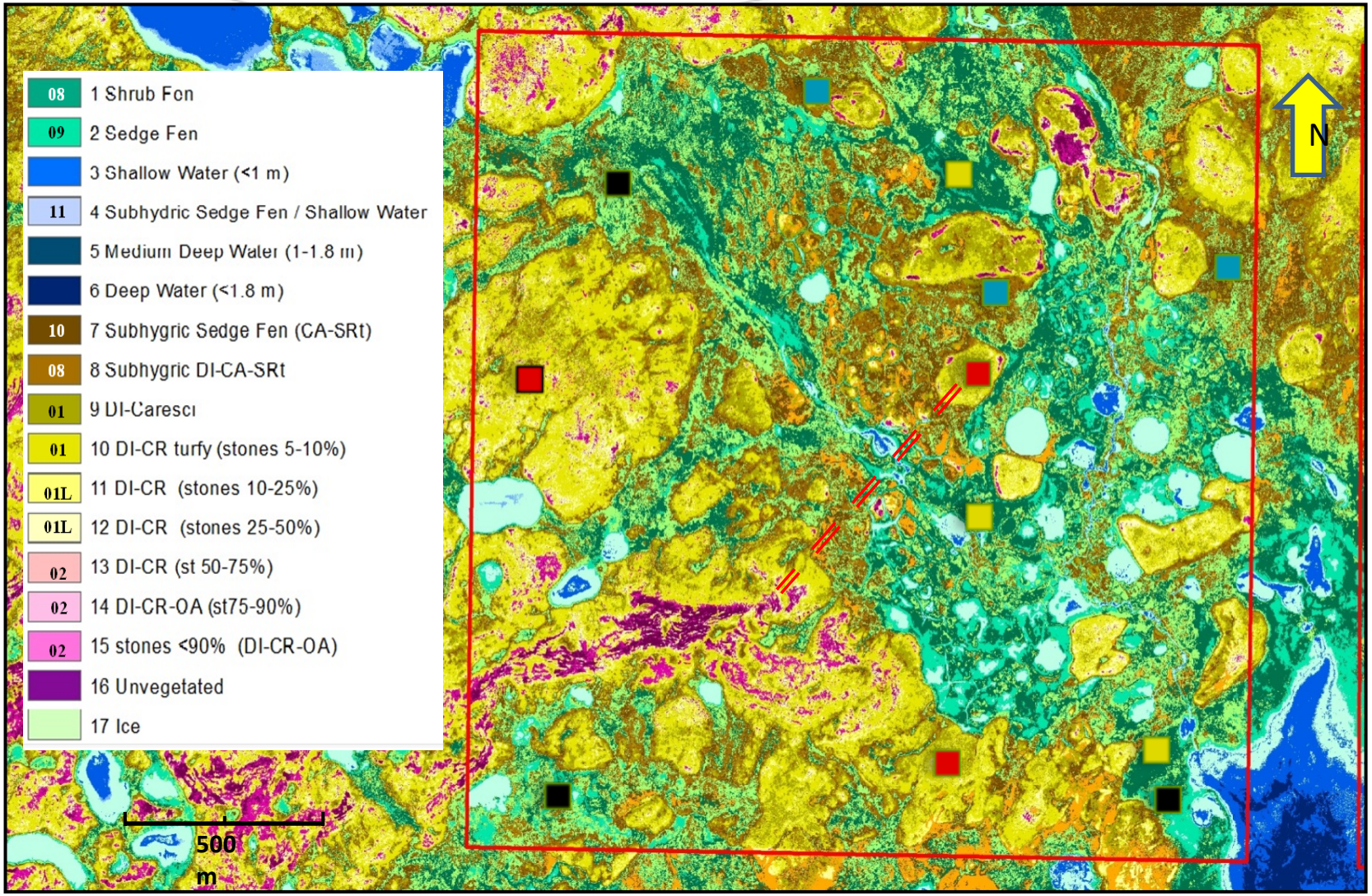


- gradient studies across ecotones
- energy/materials exchange terrestrial – freshwater
- processes/abiotic drivers of productivity (snow, inundation, soil texture, OM, active layer)
- rationale for regional ecosystem extrapolations (e.g., ‘greening - browning’, C storage, vegetation/shrub change, habitat quality)

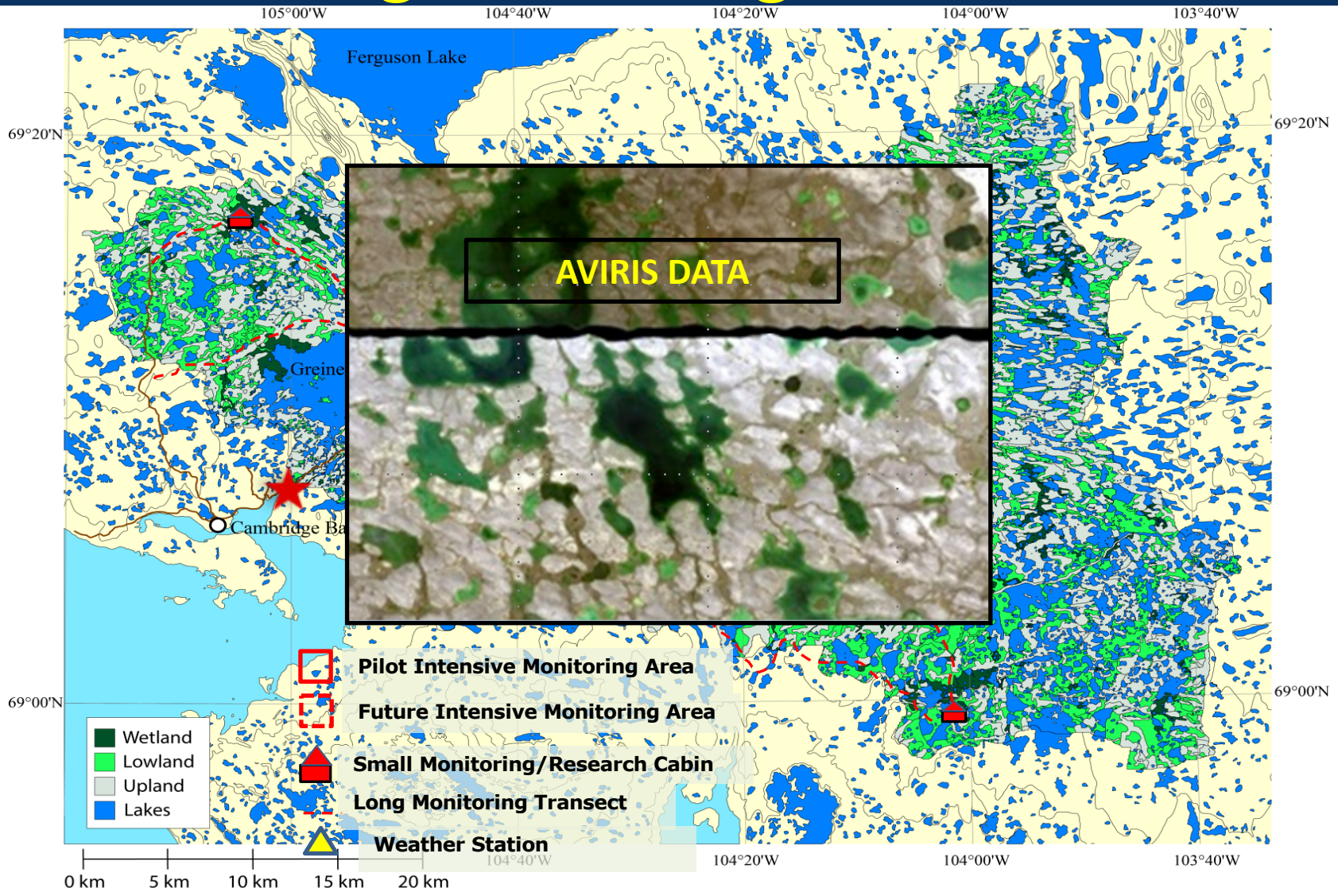
Targeted Ecotypes
Long-term Experimental Monitoring



Detailed Terrestrial Ecosystem Mapping
Experimental Design



Extensive Monitoring Grids
Long Monitoring Transects



Ground Support for ABoVE Projects

- **cryosphere:** permafrost/active layer; thermokarst; lake ice; snow (depth, structure, season; SWE, RoS)
- **hydrology:** flows; groundwater/stream chemistry; inundation; lake bathymetry/classification
- **soils:** nutrients; microbes; C storage and distribution; C flux (tower and chamber); contaminants
- **vegetation:** biomass; phenology/fruiting; communities; local to surface-climate feedback
- **fauna:** shorebirds; songbirds; waterfowl; raptors; carnivores; ungulates; lemmings

Communities of Practice

CHARS Long-term Monitoring Experiments

CoP Proposal:

- for each major area of study assemble a coalition of the willing to collaborate on development of best practices for long term monitoring experiments
- e.g., soils, hydrology, vegetation; fauna; landscape
- apply the best practices in the CHARS ERA/IMA
- amend with ongoing research developments
- potential POLAR/other support (grad students etc)

More Information

Ecosystem Monitoring in the CHARS Experimental and Reference Area

Terrestrial Ecosystem Monitoring Plan

PILOT PHASE (2017-2019)

August 2017

Towards the Development of the Canadian High Arctic Research Station (CHARS) as a Centre for Science and Technology in Canada and the Circumpolar North

Regional Social and Ecological Context, Baseline Studies, and Monitoring Pilots

June 2015

Thank You!

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Savoir polaire Canada (FR)

Website: http://www.canada.ca/en/polar-knowledge/ (English)
http://www.canada.ca/fr/savoir-polaire/index.html (Français)

Planned Work – 2018-2019

CHARS ERA

- finish high resolution ecosystem classification and mapping; high resolution DEM
- initiate extensive monitoring grid network (e.g., snow depth, active layer, soil temperatures, songbirds/shorebirds, lemming)
- initiate long monitoring transects (e.g., all birds, lemming nests, active layer, fauna, vegetation phenology)

Planned Work – 2018-2019

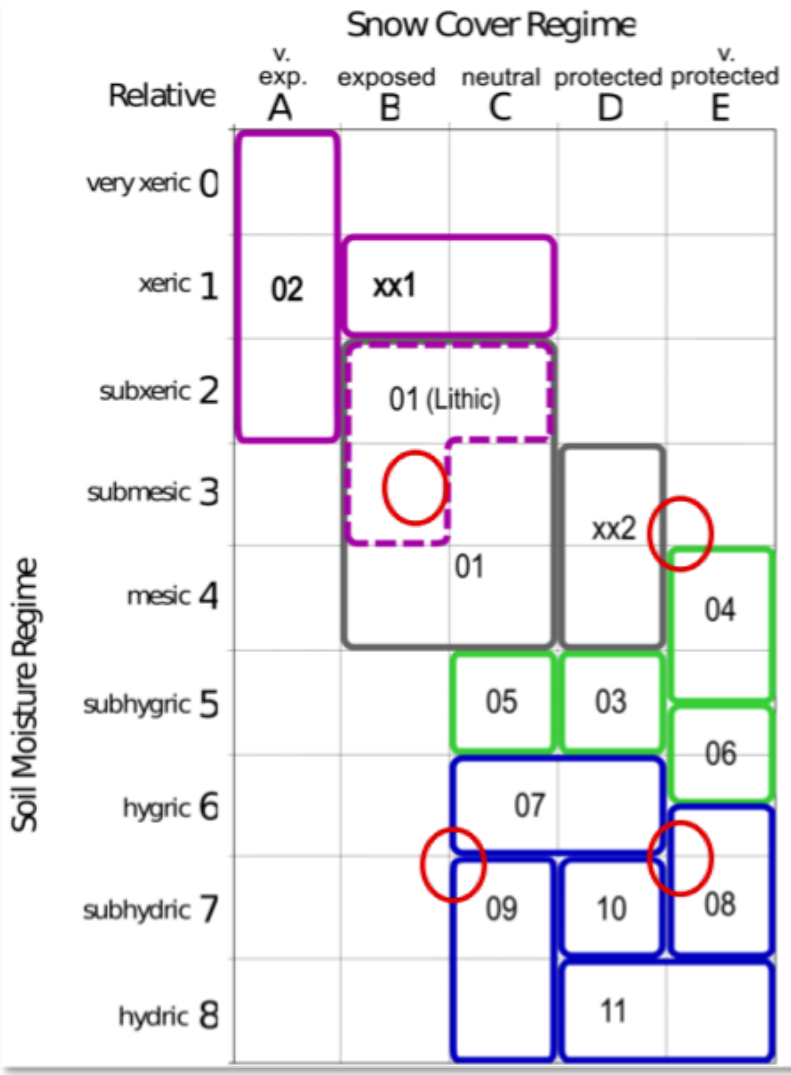
CHARS IMA

- finish high resolution ecosystem classification and mapping
- re-install IMA instrumentation (flux towers, 3 m tower, stream gauging; weather stations)
- establish long-term hypothesis-based monitoring plots and stream gauging in Paired Area 1
- establish arthropod monitoring (pitfall, ponds, streams, nets)
- initiate long term shorebird/songbird monitoring

Planned Work – 2018-2019
CHARS Science Staff

- Jean-Francois Lamarre: Trends in Arctic-nesting migratory birds breeding ecology; tracking migration path of migratory species; Arctic-wide biodiversity mapping app
- Stephanie Coulomb: Monitor retrogressive thaw slumps on Victoria Island; river erosion in Kugluk Territorial Park; establish PF monitoring transect
- Johann Wagner: CO_2/CH_4 flux; establish long term vegetation plots; plant floristics/genetics
- Ian Hogg: DNA reference library of arctic life forms; Barcode of Life Data Systems (BOLD); Global Spore Sampling Project

Terrestrial Ecosystems
Classification and Process



Classification of terrestrial ecosystems (ecosite types) in the CHARS ERA

01 (Arc041)— Dryas integrifolia – Saxifraga oppositifolia; Carex rupestris
02 (Arc) — Saxifraga tricuspidata – Oxytropis arctobia
xx1(Arc) — Salix arctica || xx2 — Dryas integrifolia – Oxytropis
03 (Arc) — Dryas integrifolia – Salix reticulata
04 (Arc027) — Cassiope tetragona – Dryas integrifolia – Salix reticulata
05 (Arc) — Dryas integrifolia – Carex aquatilis – Salix arctica
06 (Arc) — xxDryas integrifolia – Equisetum arvense – Arctous alpina || Salix polaris – Moss
07 (Arc) — Salix arctica – Carex aquatilis – Scorpidium
08 (Arc) — Salix richardsonii – Carex aquatilis
09 (Arc) — Carex aquatilis
10 (Arc) — Dupontia f sheri – Carex aquatilis
11 (Arc) — Arctophila fulva

Greiner Watershed – Conceptual Model

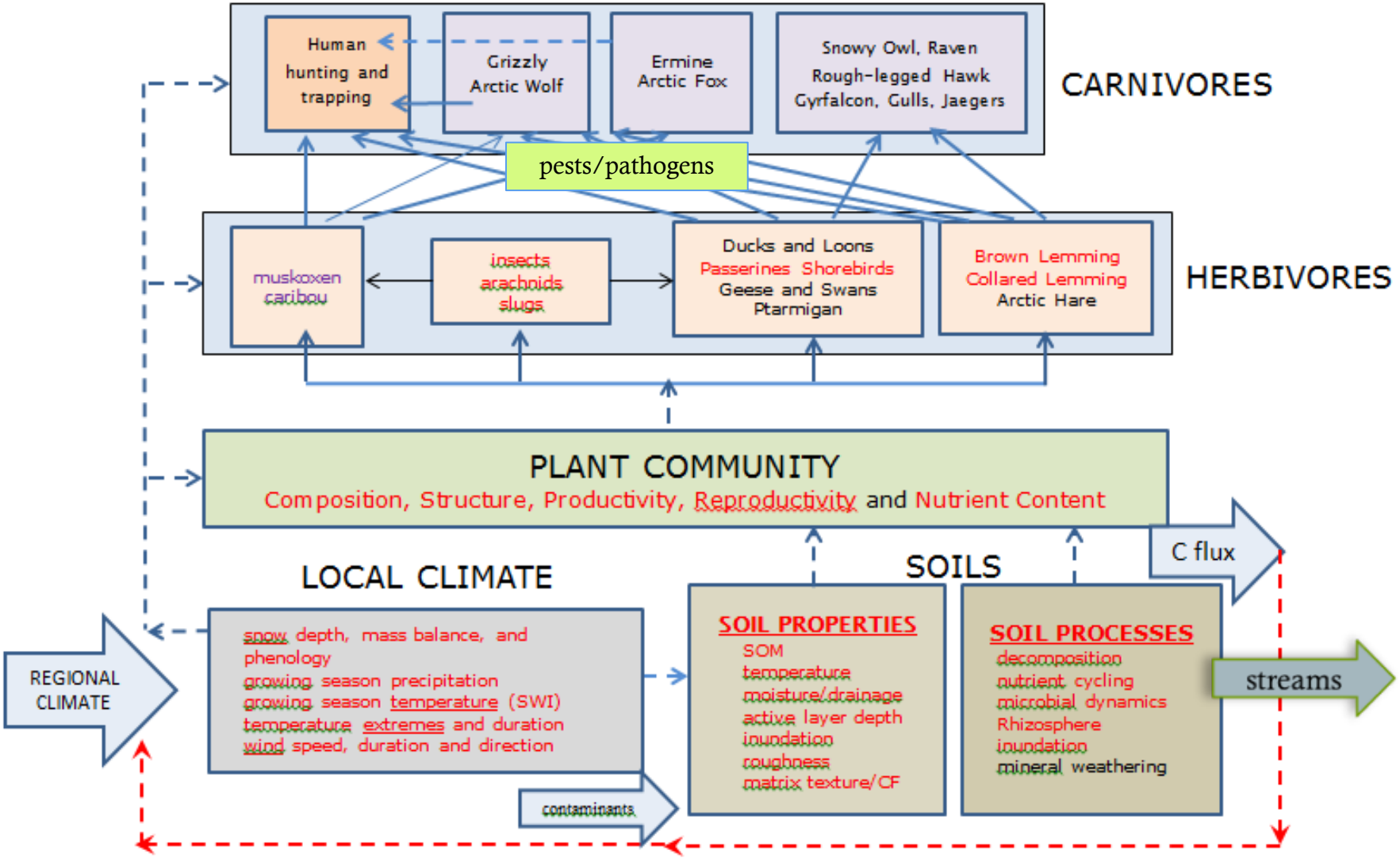


Figure 7: Conceptual model of the CHARS terrestrial ecosystem area showing abiotic drivers, vegetation, herbivores and carnivores and high level linkages among components.

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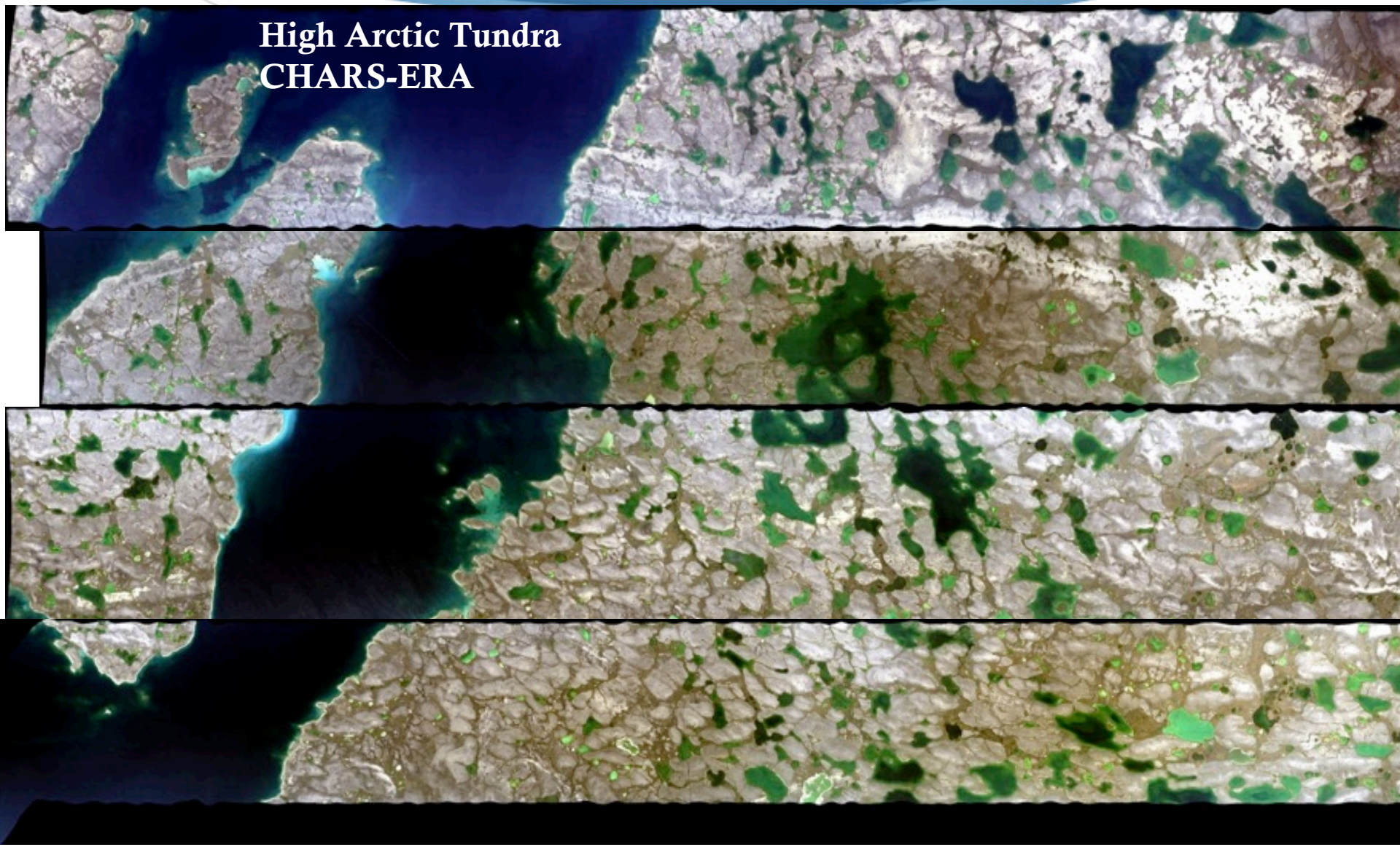
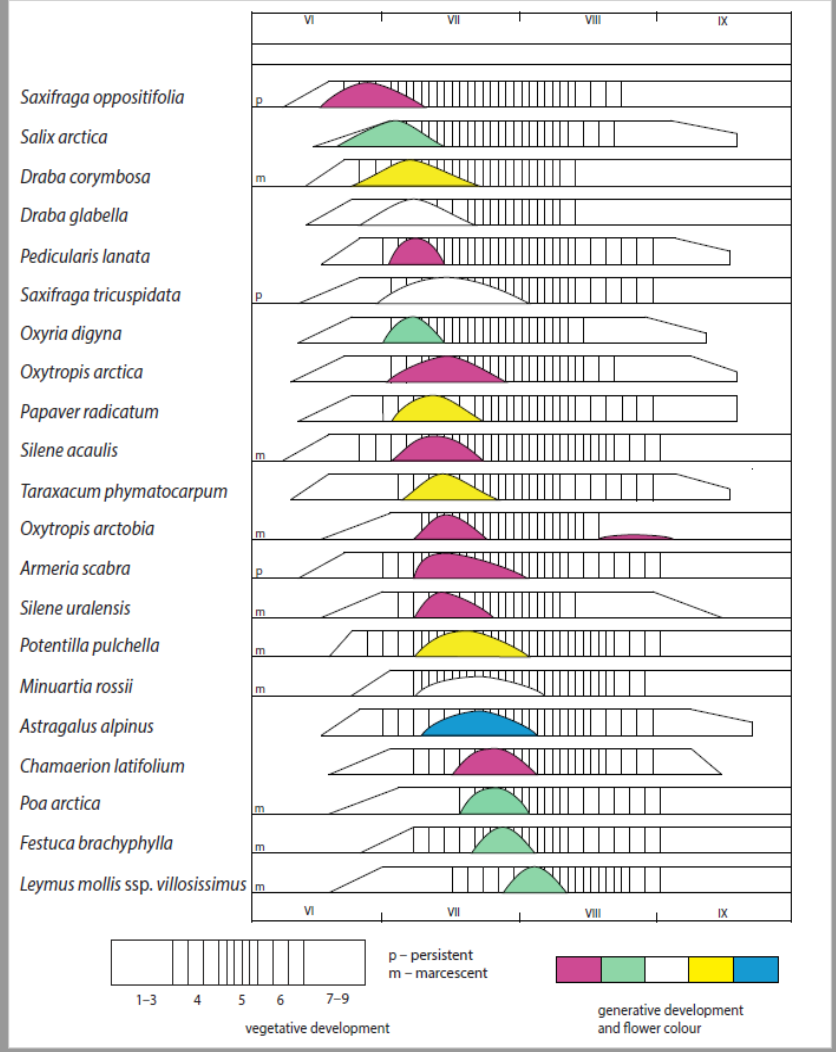


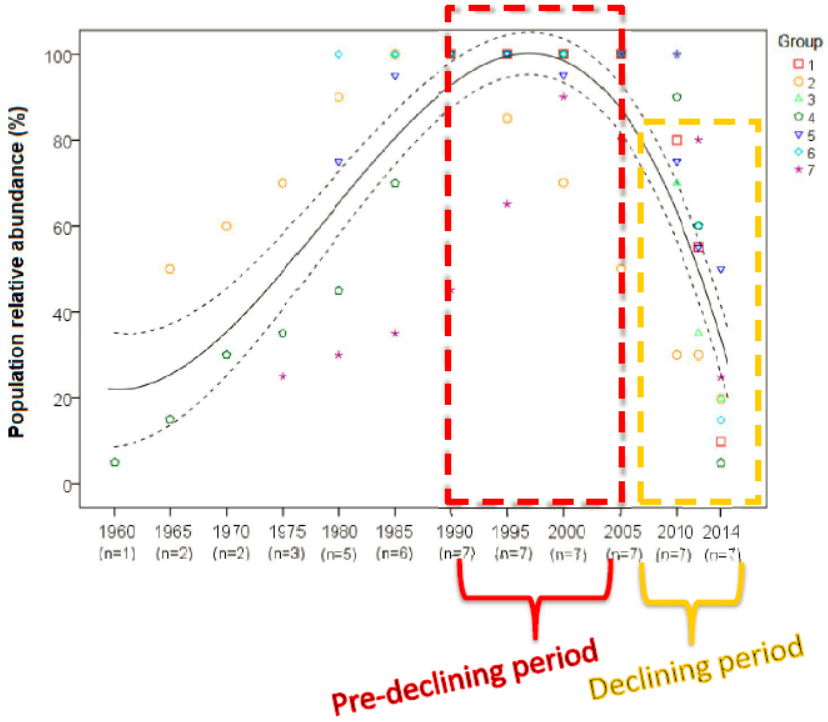
Vascular Plant Phenology



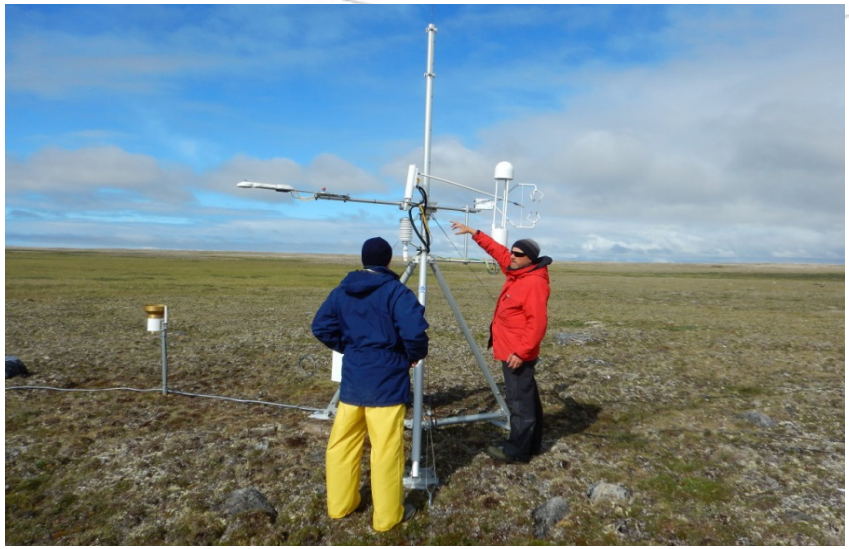
Traditional Knowledge

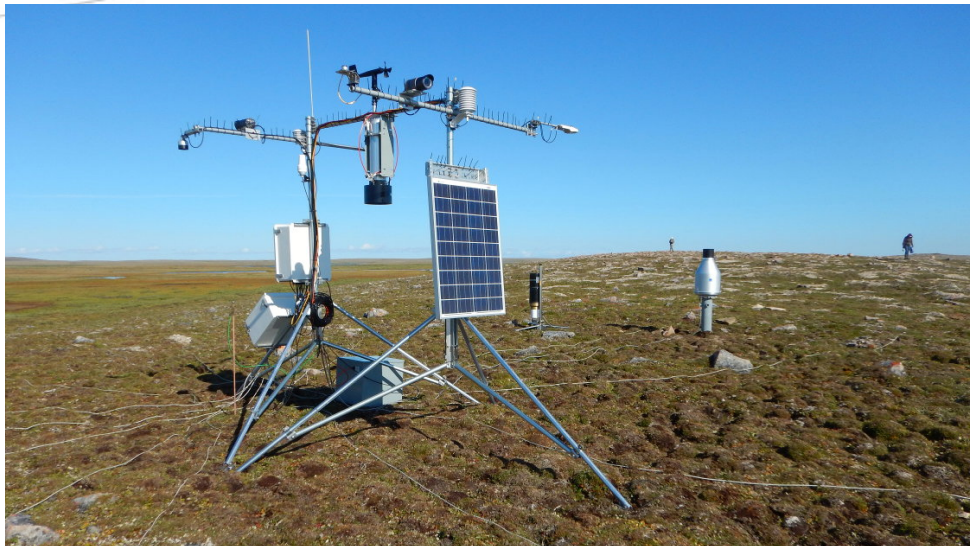
UNIVERSITY OF CALGARY

Caribou population trend



IMA - Instrumented Watershed





- 2 CH_4/CO_2 eddy diffusion towers
- 2 soil gas flux installations
- in-stream thingy
- 2 complete weather stations
- Snow thingy
- Soil thermistor arrays
- 3 m tower (cell link, radiometer, CH_4/CO_2 flux)