POLAR
POLAIRE

POLAR-ABoVE Activities

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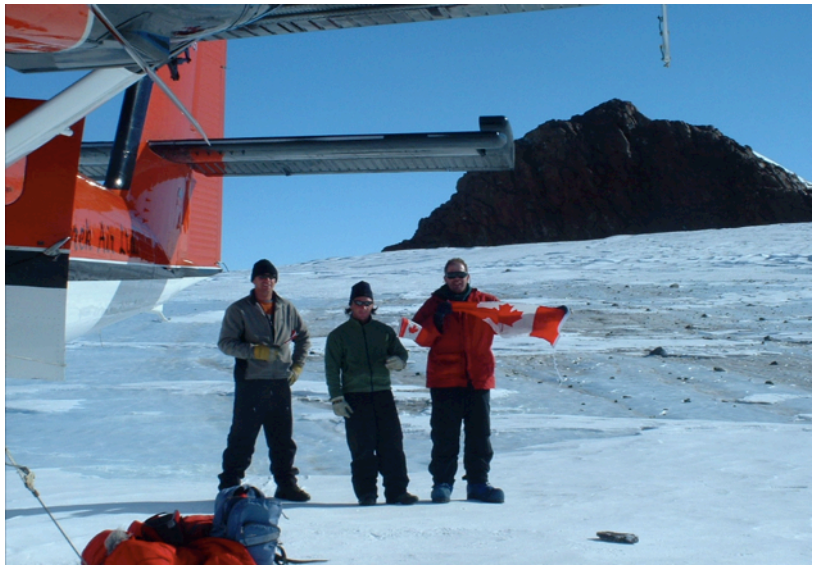
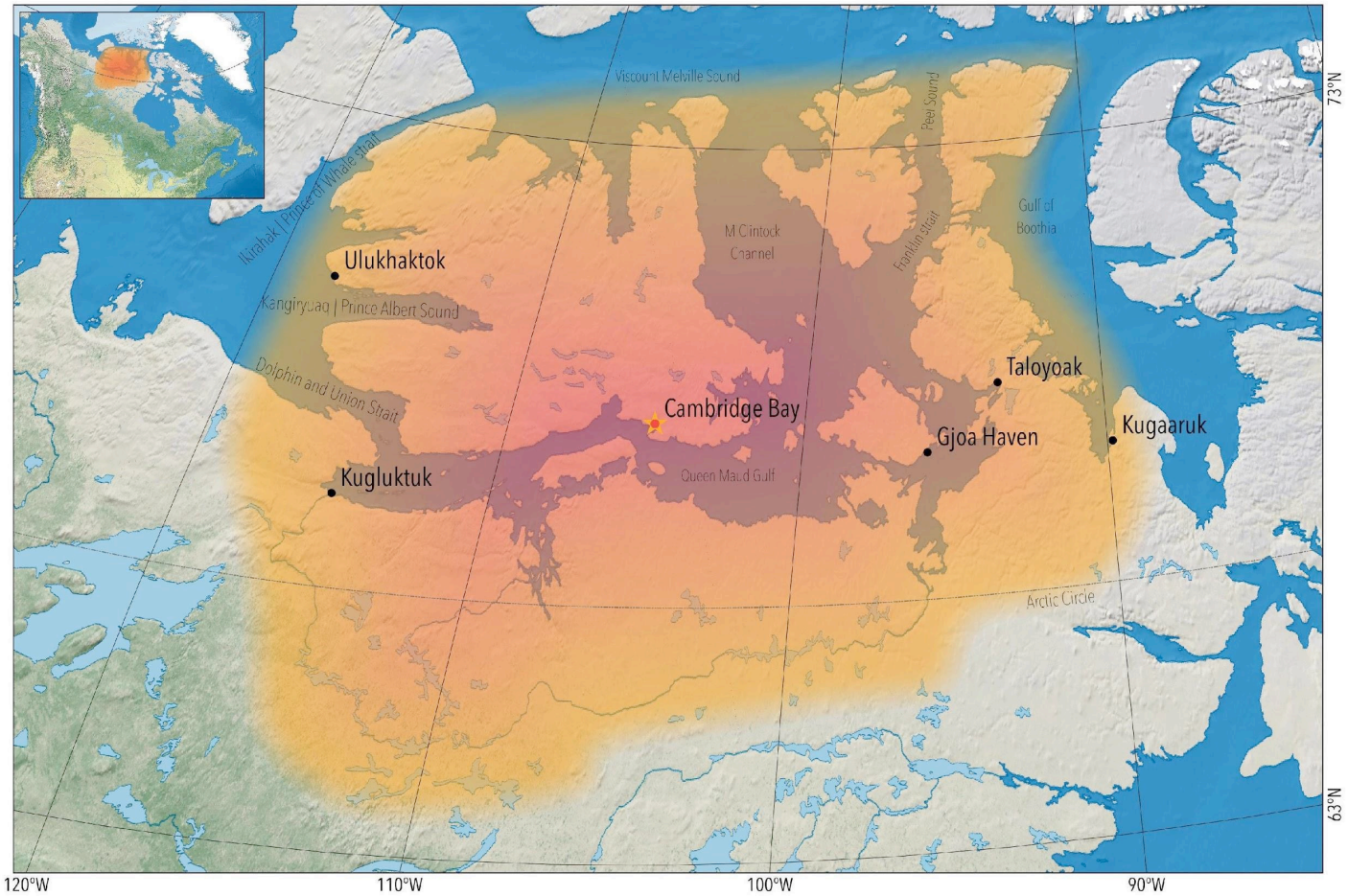
NASA ABoVE ASTM5, May 20-23, 2019

Polar Knowledge Canada's Mandate

- **Advance knowledge** of the Canadian North
- Promote the development and **dissemination of knowledge** of the other circumpolar regions, including the Antarctic
- Strengthen **Canada's leadership** on Northern issues
- Operate a hub for scientific research at the Canadian High Arctic Research Station (**CHARS**) campus in Cambridge Bay, NU



The CHARS and Environment & Research Area (ERA)



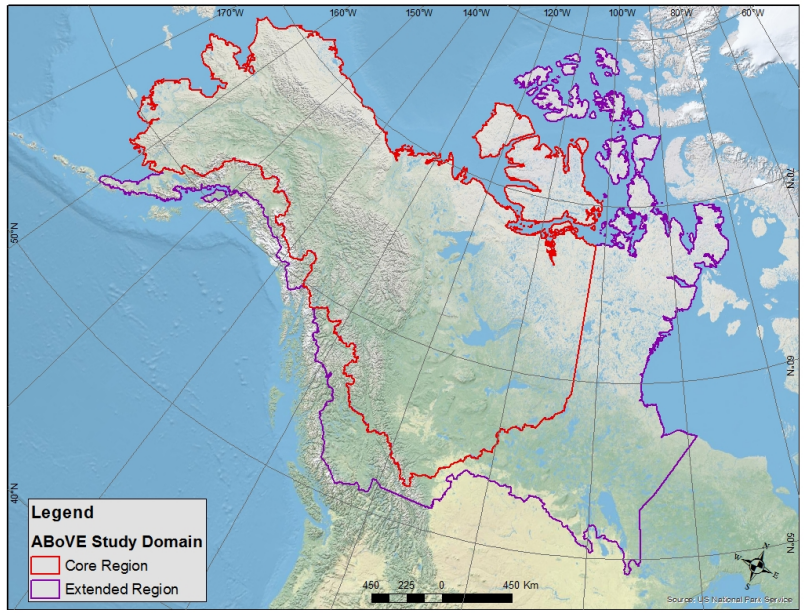
- The CHARS campus located in Cambridge Bay, Victoria Island, Nunavut, CAN @ 69°N
- POLAR's internal ABoVE-linked research is conducted throughout the ERA…
- ABoVE focus is on Arctic tundra ecosystem mapping

POLAR-ABoVE Overview

- Aid coordination of ABoVE activities throughout Canada's Northern regions

- POLAR-supported ABoVE partner projects
  - 2020-23 Competitive Funding Process
  - Ongoing inventory of POLAR-supported projects and data/products – linking Polar Data Catalogue and others with *ORNL DAAC*

- Joint review paper in *Polar Knowledge: Aqhaliat*

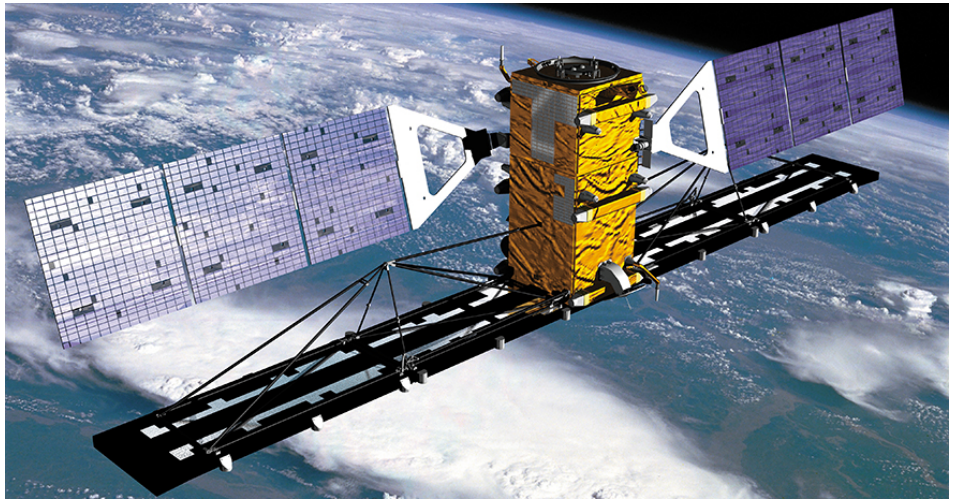


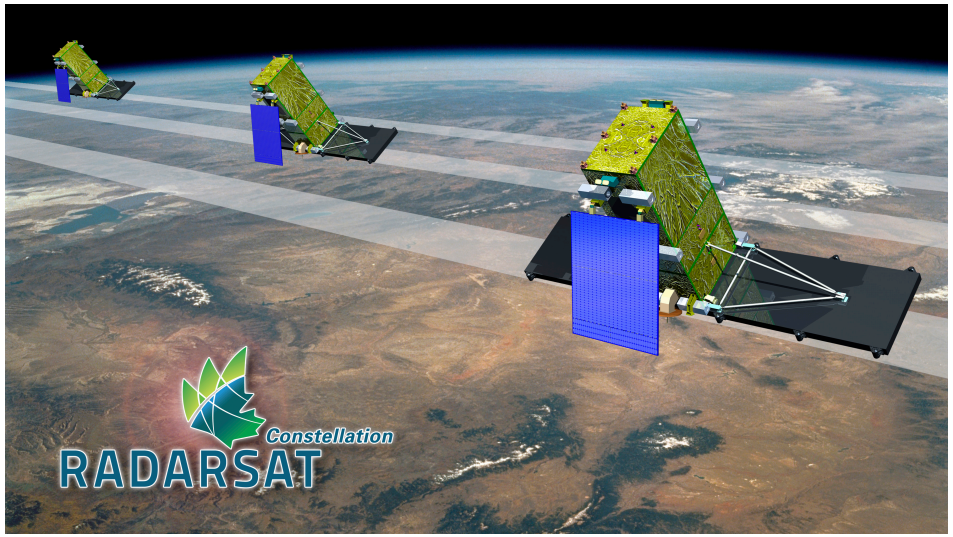
RADARSAT-2 Image Acquisitions

Join RADARSAT working group

RADARSAT-2 (C-band SAR)

- 2017-18: > $^{2}/_{3}$ of sites imaged each year
  - Requests processing at RADARSAT Orderdesk
- 2019: requests for field season
- 2019+: RADARSAT Constellation Mission launching June 11, 2019, from Vandenberg AFB, California
  - Summer 2019: commissioning
  - Fall 2019: regular operations
    - Access & process TBD





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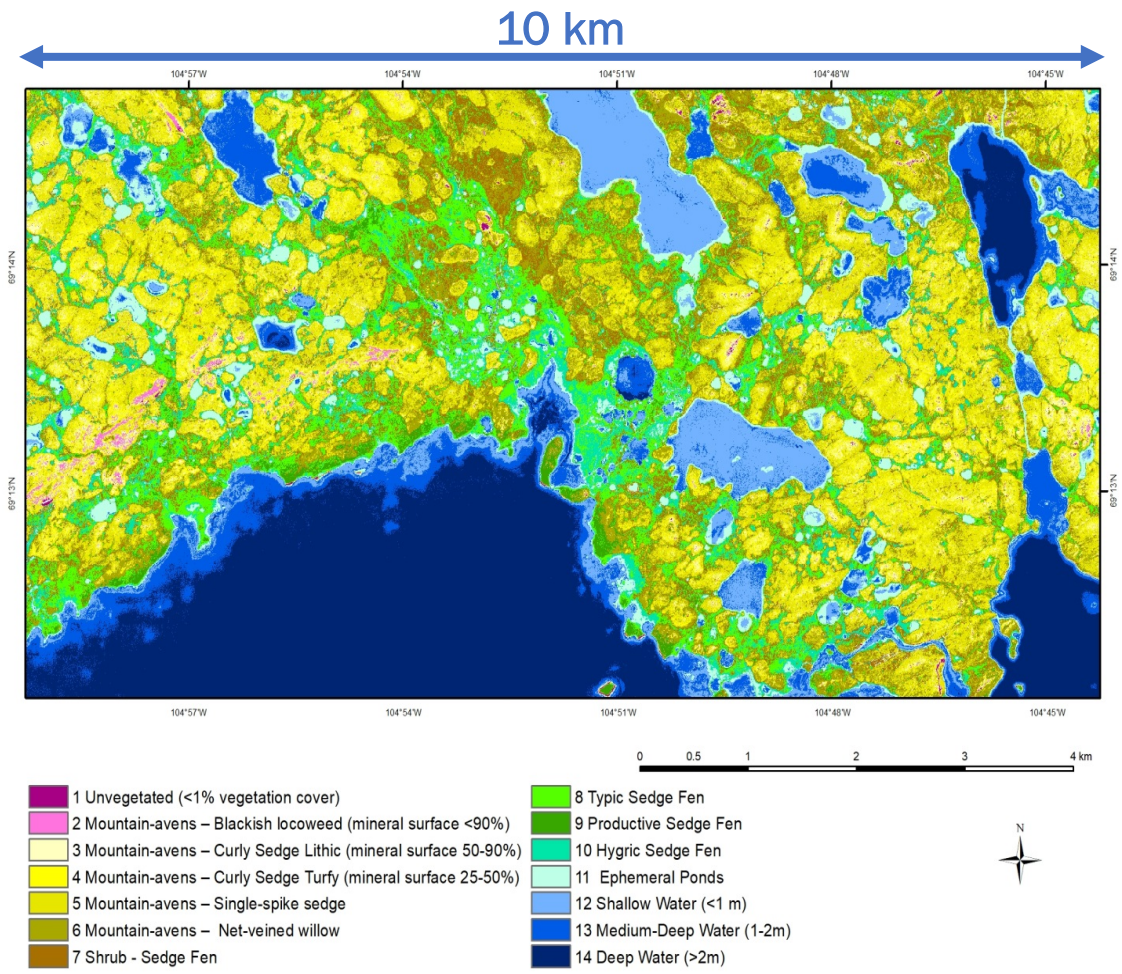
CHARS Intensive Monitoring Area (IMA)

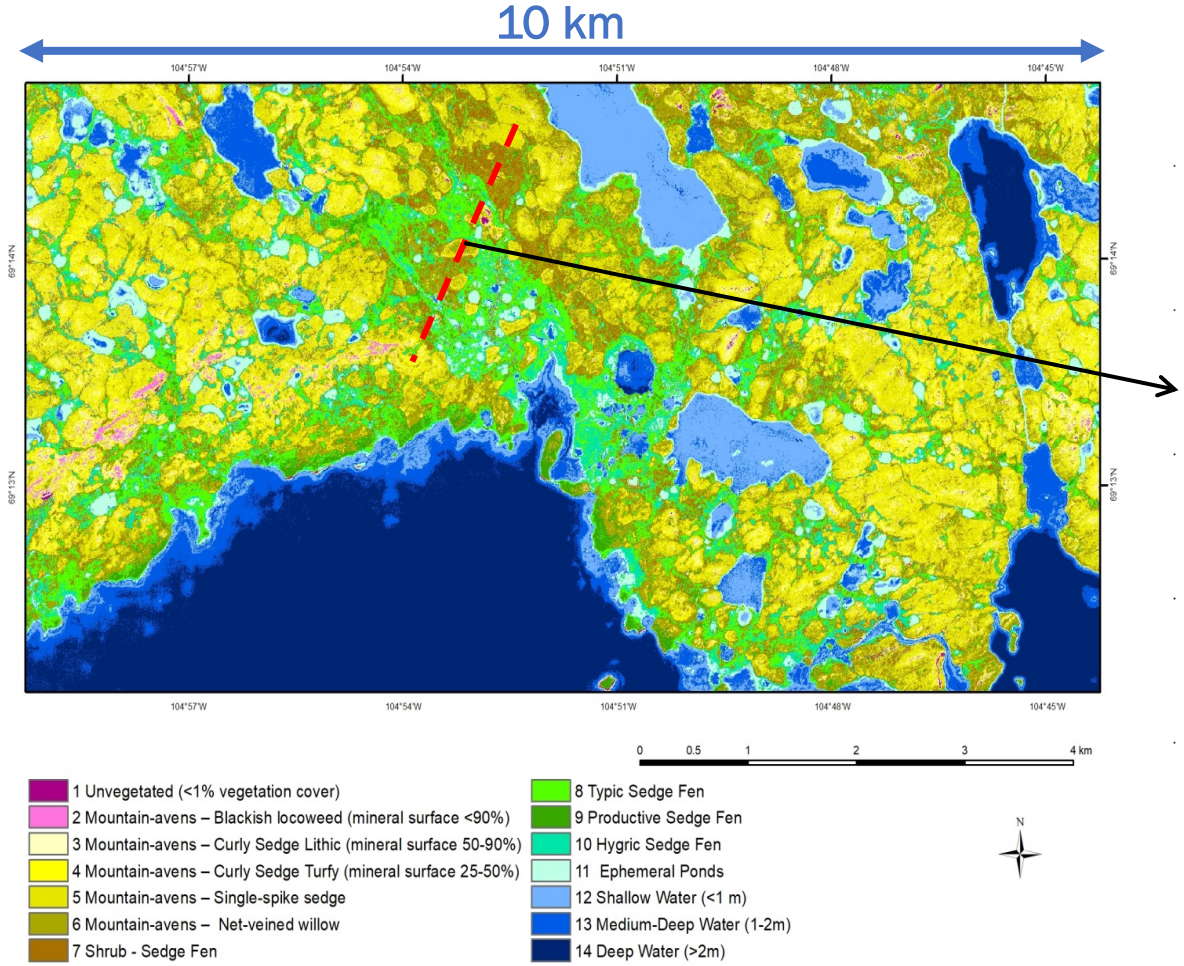


McLennan et al (in Review) High Resolution Mapping of Tundra Ecosystems on Victoria Island, Nunavut – Application of a Standardized Terrestrial Ecosystem Classification. CJRS

CHARS Terrestrial Ecosystem Classification and Mapping

- Description and classification of all terrestrial ecosystems in the CHARS ERA
- High resolution (50 cm – World View 2) terrestrial ecosystem map using a standardized ecosystem classification and mapping approach (CASBEC)
- A scalable, ecological template for designing and implementing research and monitoring
- Working to quantify attributes for mapped ecotypes - soil/foliar nutrients, mean snow depth, soil C, flooding duration, soil moisture, biomass
- Next step to develop this scale of mapping for the two paired watersheds (ca. 35 km^2)

CHARS Intensive Monitoring Area (IMA)



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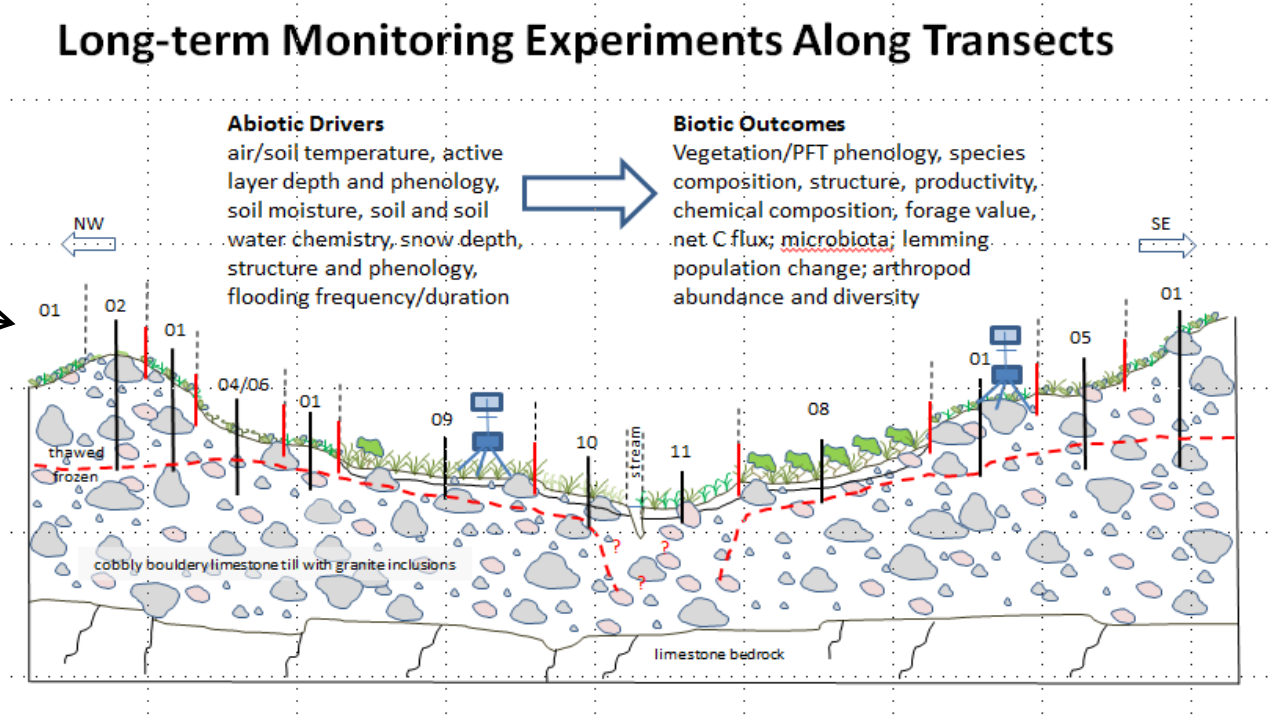

Goal:

- Establish 2 or more transects to track relationships between abiotic drivers, ecosystem processes and biotic outcomes.
  - 2019: locate 1 transect and establish 8 soil temperature arrays, Eddy Covariance towers, weather station, and other instruments, and initiate measures of abiotic drivers.

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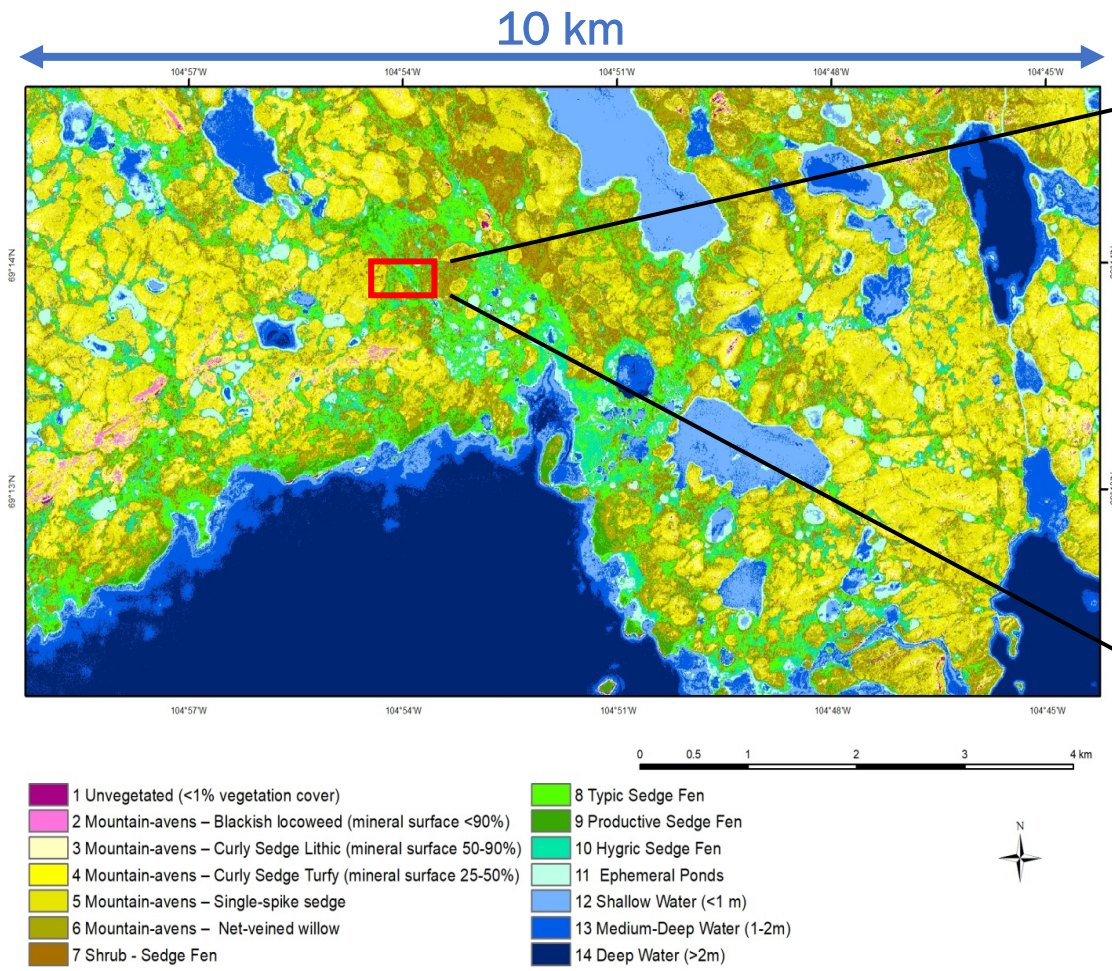
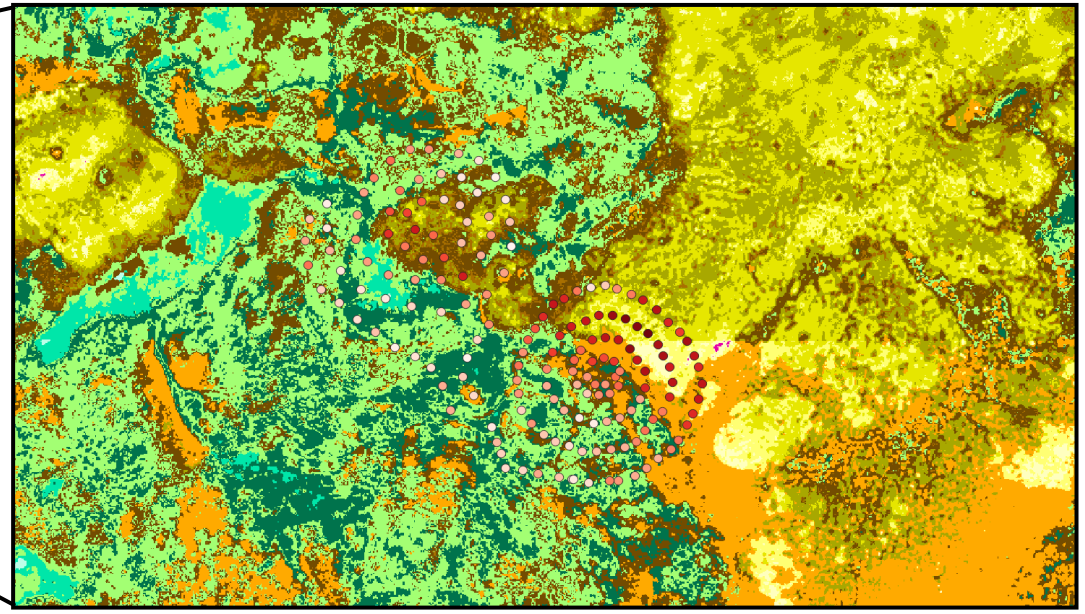


Applications for Snow Modelling



- <u>Snow depth sampling over Ecotype map boundary</u>
  - Strong correlations with ecosite units
    - Alex Langlois Team, U Sherbrooke, Spring 2019

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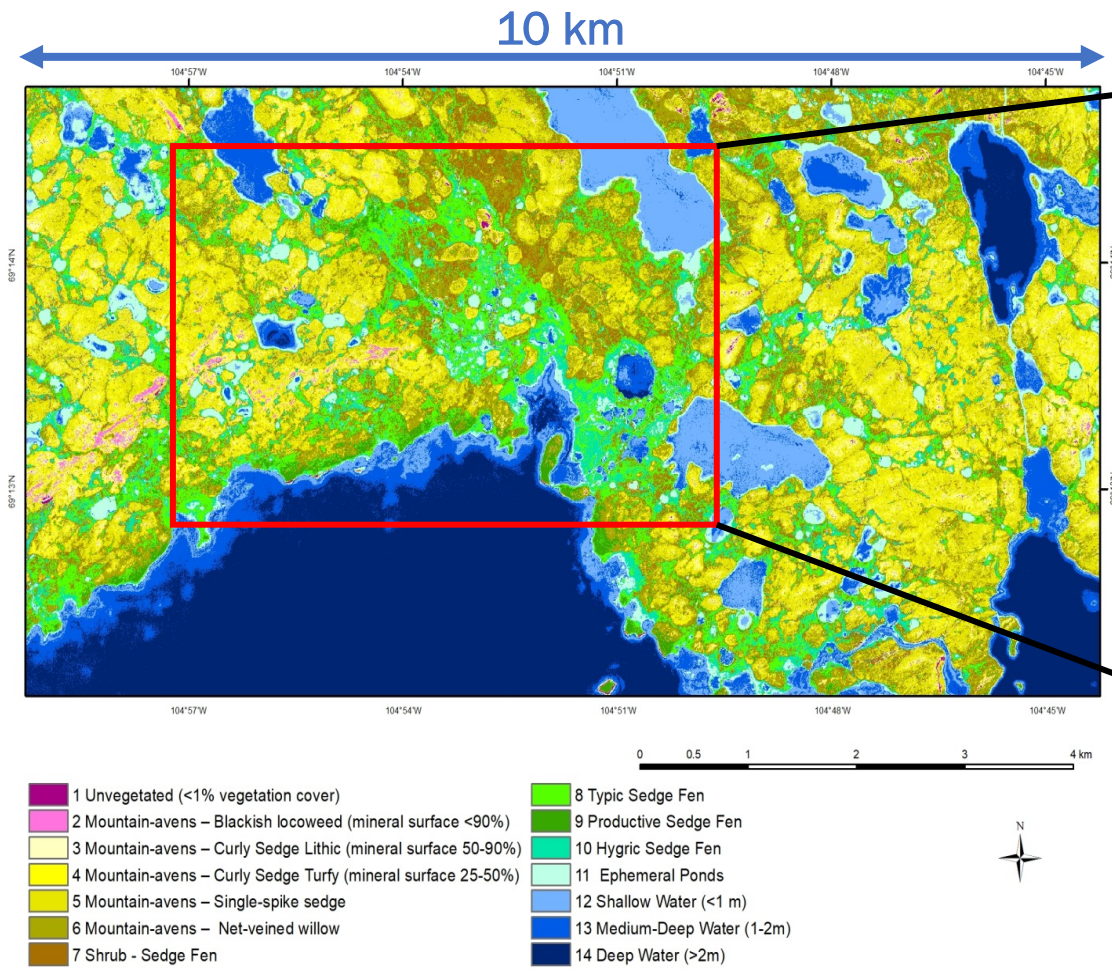
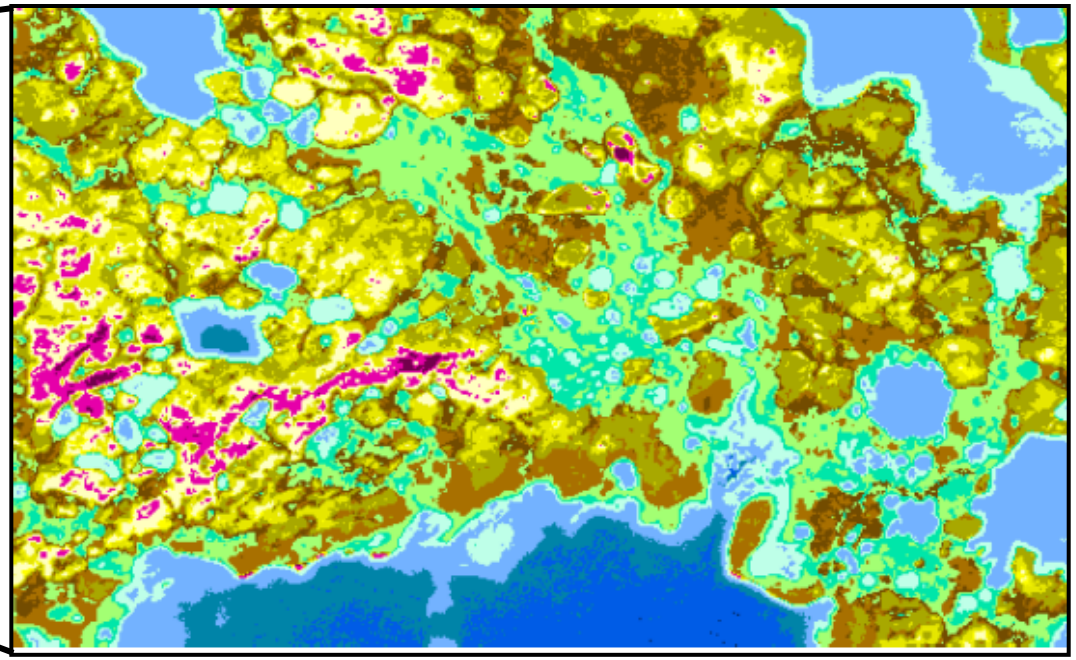


Scaling Up



Need to scale up high resolution to medium resolution ecosystem mapping – image shows Intensively Monitored Area (IMA) high resolution mapping scaled up to 10 m Sentinel-2, 10 m scale.

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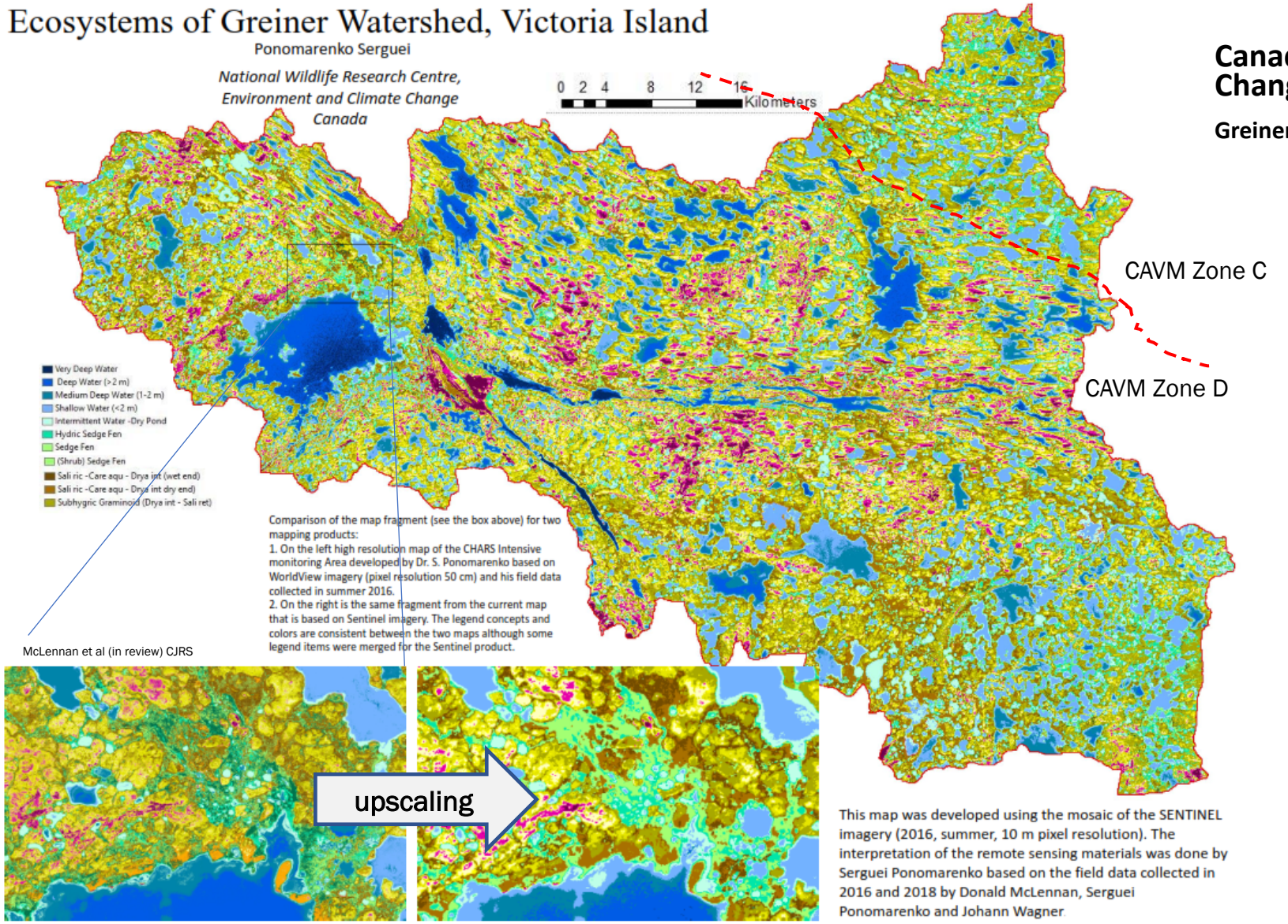
Other ABoVE-linked Research and Products



Canadian Space Agency, Environment and Climate Change Canada & POLAR partnership

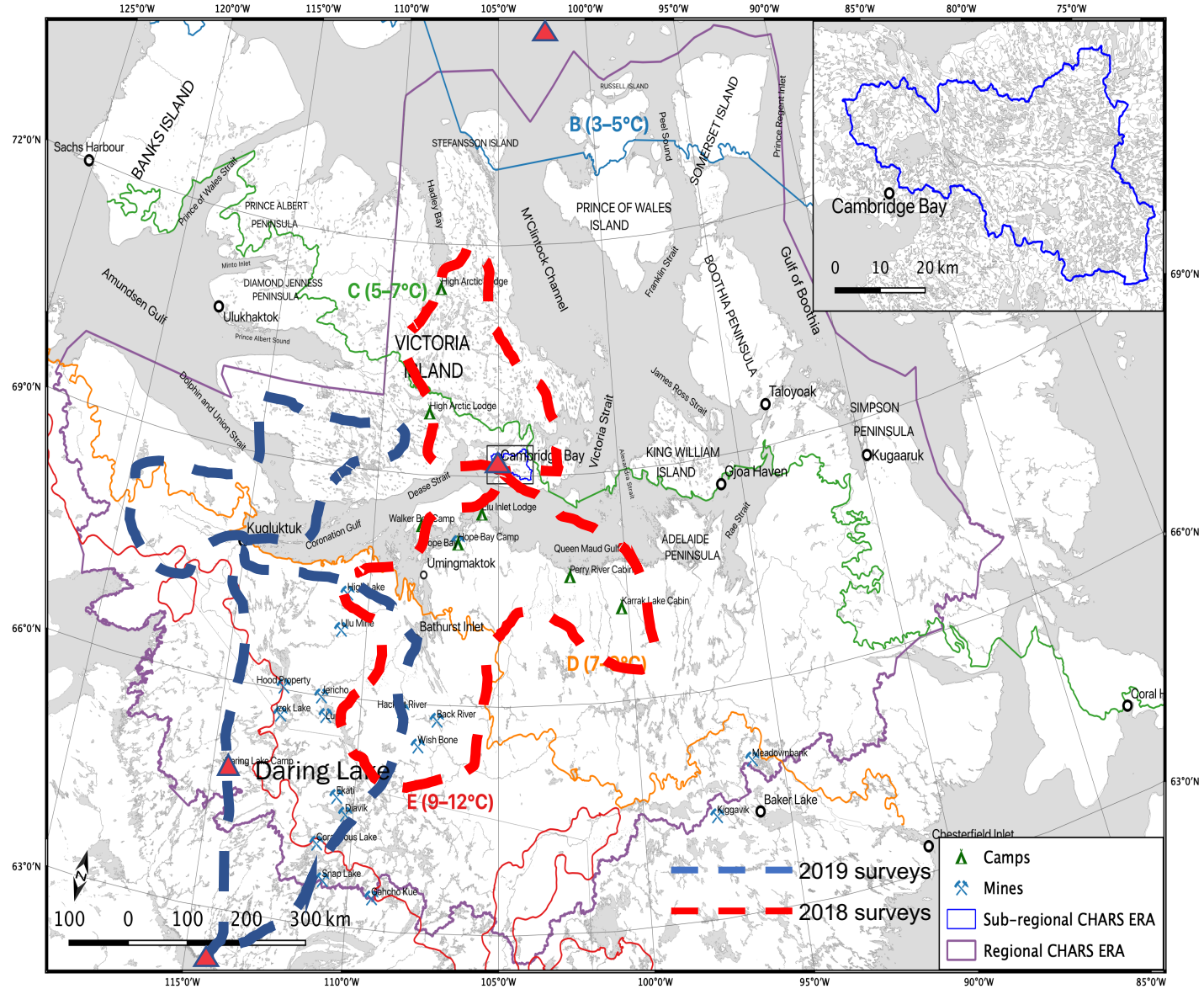
Greiner watershed:

- Access to ABoVE Cloud
- Remote Sensing and GIS support – ECCC Carleton University
- Arctic DEM + (BAS LiDAR)
- Greiner watershed sub-drainages
- Hi-res (50 cm WV2) eco-mapping – IMA
- Med res (10m Sentinel 2) eco mapping – Greiner
- Snow studies – Alex Langlois U Sherbrooke
- Land to lake linkages – Milla Rautio UQAC
- Land to ocean linkages – Brent Else U Calgary, Kristina Brown Woods Hole/DFO

ABoVE-POLAR partnerships

- AVIRIS-ng flights 2017, 2019
- Phil Townsend U.Wisc Team 2019
- Scott Goetz UNA Team 2020

CHARS ERA ABoVE Regional Activities



Regional ERA

- Steep climatic gradient across 4 of 5 Circumpolar Arctic Vegetation Map (CAVM) Team (2003) Subzones
- Many issues – communities, tundra vegetation change, caribou, mining, etc.
- ▲ Daring Lake to CHARS to Queen's University station on Melville Island to Yellowknife for experimental work along gradient

Ecosystem Mapping and Research

- Develop Sentinel-2 (10 m) terrestrial ecosystem map (TEM)
- Use TEM as baseline to support RS studies using Landsat stacks
  - greening/shrubification
  - caribou calving/summering habitat
  - permafrost and active layer change
- Wetland inventories/studies, land-atmosphere feedbacks, tree line, lakes

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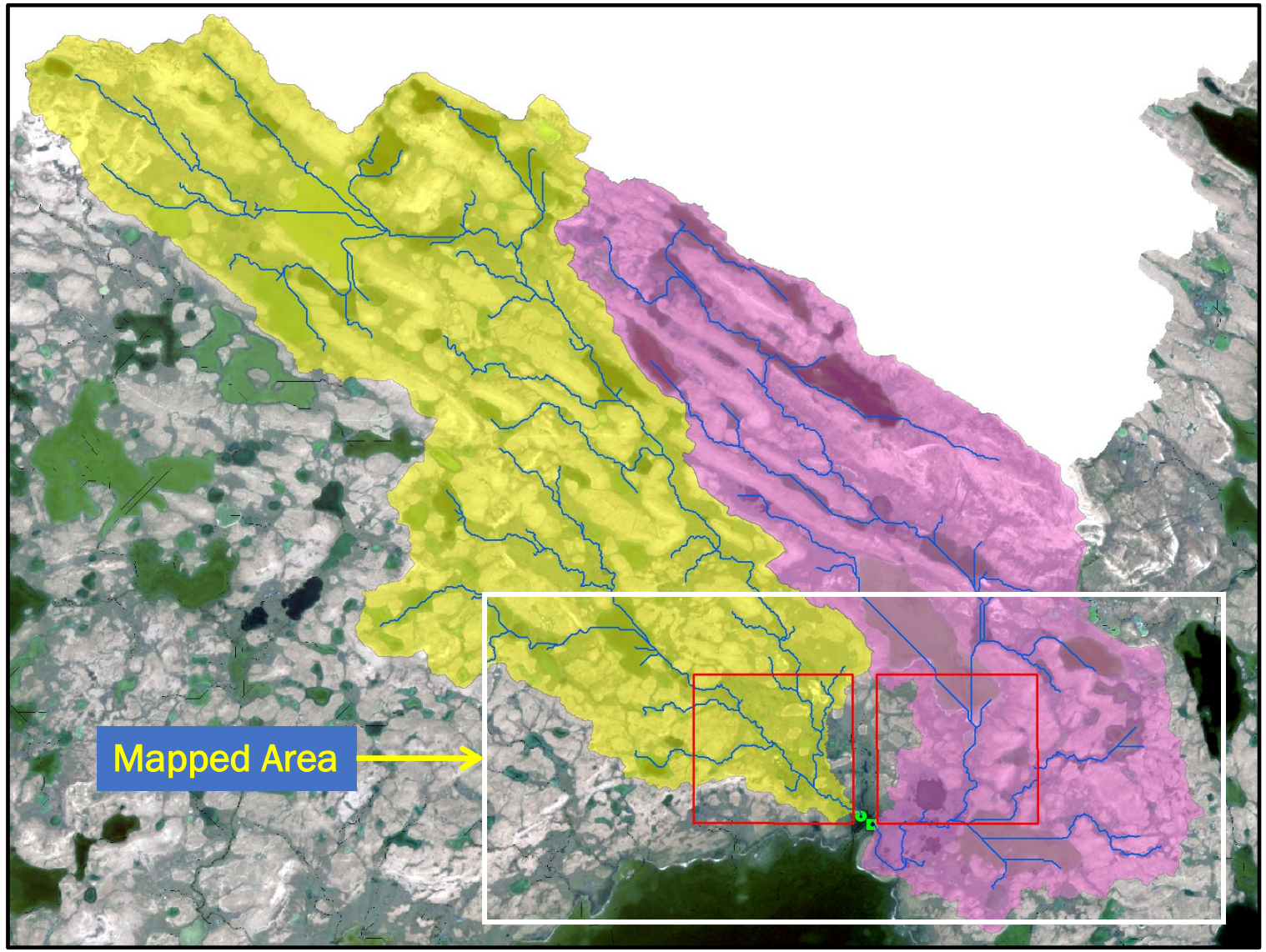
- Extra discussion slides follow

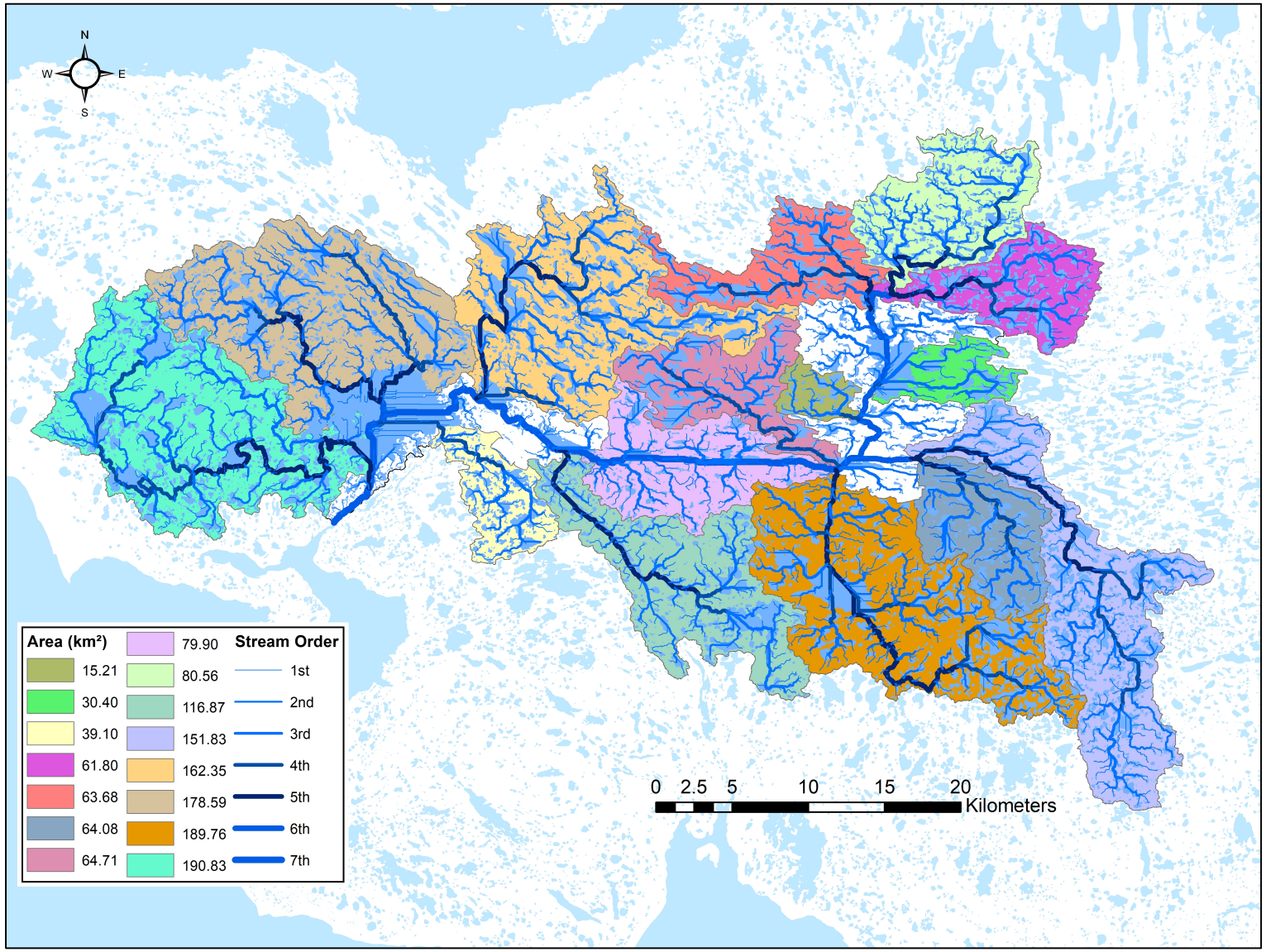
Paired Watersheds – CHARS IMA



Paired Watersheds

- IMA design uses a classic paired watershed approach
- High resolution mapping will be completed soon for both watersheds
- LiDAR to create DSM to be completed within 2 years

Greiner Watershed Sub-Drainages



Sub-basins within the Greiner watershed, delineated from ArcticDEM. Catchments were calculated from fifth (but occassionally fourth) order streams emptying into higher order waterways.

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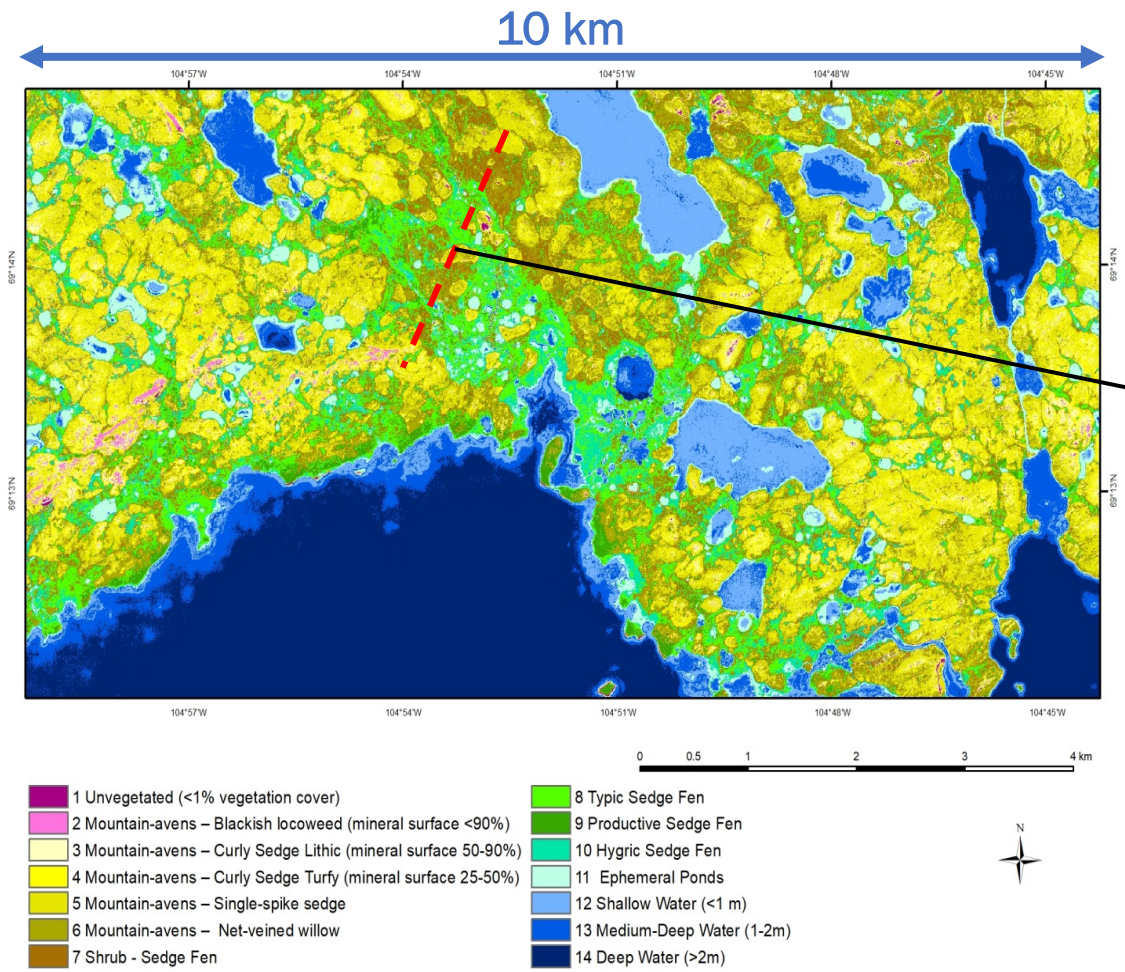

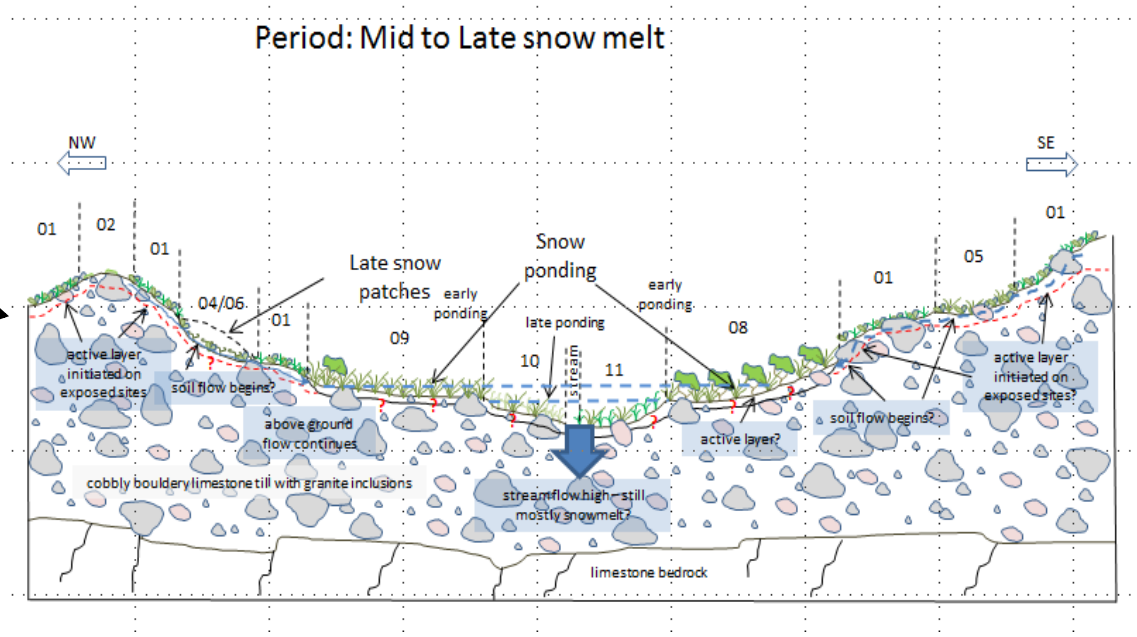

Schematic profile showing mid- to late snowmelt stage to <u>correlate changes in the terrestrial environment with water chemistry sampling at the watershed outlet</u>

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