

# **ABoVE Airborne Campaign 2017**

## **-- Yukon Interests --**

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Executive Council Office, Government of Yukon



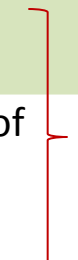
# Opportunities to leverage the ABoVE Airborne Campaign in Yukon

Process: led by Polar Knowledge Canada and Canadian Forest Service

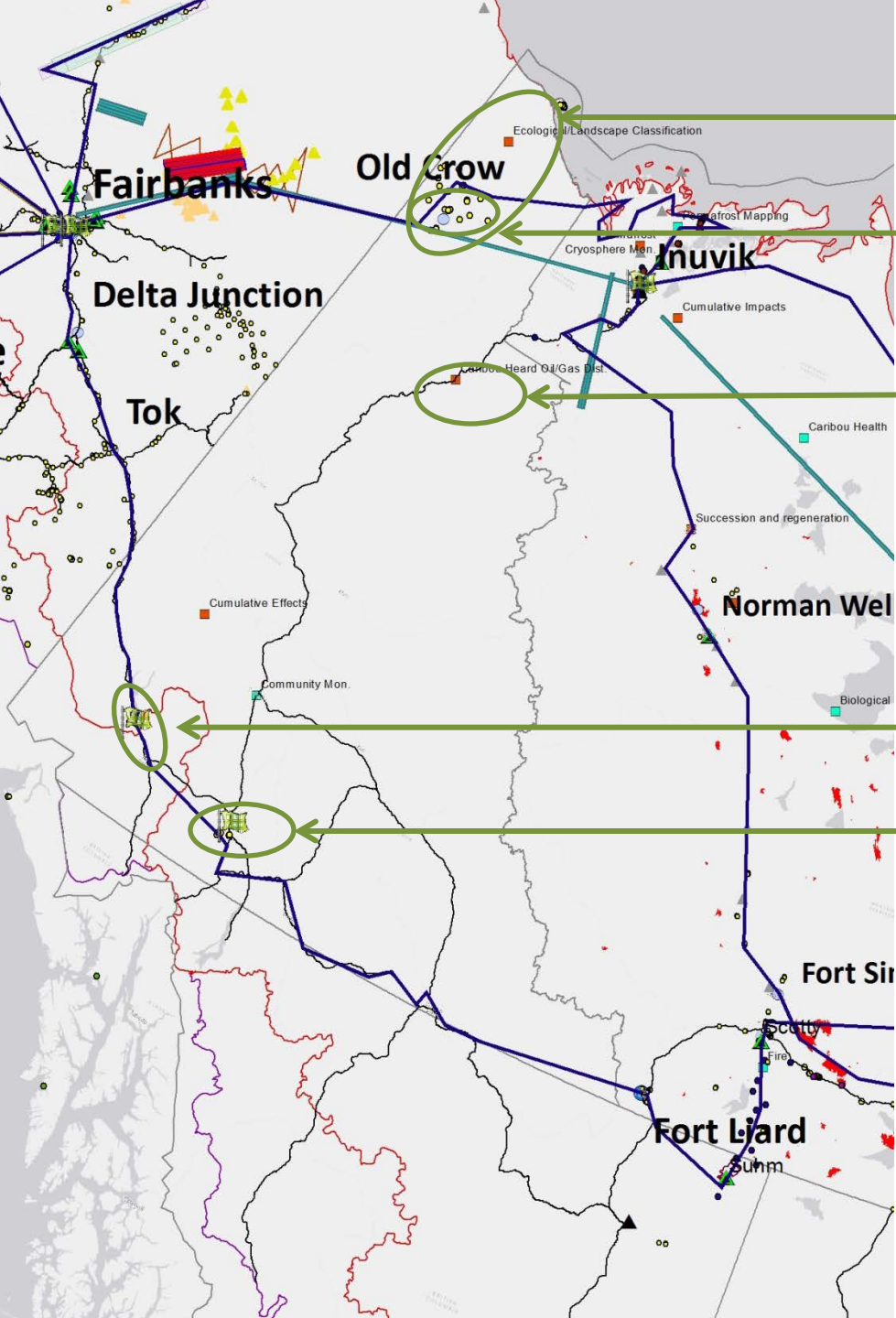
## Objectives:

1. Identify Yukon organizations and agencies that can both benefit from and contribute to (e.g. via ground calibration or other airborne activities)
2. Leverage current and planned Canadian research and monitoring efforts
3. Inform advanced discussions on funding or coordinating supplemental flight lines

Title	Principle Investigator
1. Monitor and map changes in permafrost, surface water drainage and forest cover to predict susceptibility to mass movements (landslides) in the community of Old Crow	Carolyn Relf, Yukon Geological Survey, Government of Yukon
2. Influence of climate-induced landscape changes on hydrological and carbon systems in Old Crow Flats	Kevin Turner, Brock University
3. Eco-hydrological processes at the Wolf Creek Research Basin	Sean Carey, MacMaster University; John Pomeroy, University of Saskatoon; Ric Janowicz, Department of Environment, GY
4. Mapping and analysis of forest-tundra treeline, Kluane	Ryan Danby, Queens University
5. Relationship between vegetation, snow cover and albedo, and how they are influenced by climate variability and change, Kluane	Scott Williamson and Dave Hik, University of Alberta
6. Porcupine caribou herd and the Animals on the Move project	Mike Sutor, Department of Environment, Government of Yukon
7. *Recovery modeling of historical oil and gas disturbances in the winter range of the porcupine caribou herd	Kirstie Simpson, Department of Energy Mines and Resources, Government of Yukon



\*Note: Project not covered by the foundational flightlines as currently proposed



Project 6 (Suitor)

Projects 1 (Relf) and \*2 (Turner)

Project 7 (Simpson)

\*Projects 4 (Danby) and \*5 (Hik and Williamson)

\*Project 3 (Carey, Pomeroy and Janowicz)

\*Notes: Projects are interested in securing supplemental flightlines; discussions underway through POLAR

# Predicting susceptibility to mass movements (landslides) in the community of Old Crow

## PI: Relf (YGS)

### Project objectives:

- Map surface water drainage to identify slopes at risk for mass wasting
- Monitor changes in active layer depths to identify slopes where large volumes of material can be mobilized downslope;
- Improve existing landscape hazard map

### Intended use of airborne data:

Vegetation, moisture and permafrost classification



## PI: Relf (YGS)

### Existing information:

*(that can be used to calibrate/validate the airborne data)*

1. Considerable information currently exists for the community including detailed geological mapping, hydrological and vegetation data.
2. LiDAR was flown in 2015 for a portion of the study area.
3. Numerous boreholes in the community are instrumented to record ground temperature data.
4. Have completed detailed (1:10K) mapping around the community and identified geo-hazards; anticipate doing more follow-up work, which could be guided in part by new high resolution imagery





# Influence of climate-induced landscape changes on hydrological and carbon systems in Old Crow Flats

**PI: Turner (Brock)**

## Project objectives:

To provide insight on how climate-induced landscape changes are influencing hydrological and carbon systems across an important lake-rich permafrost landscape.

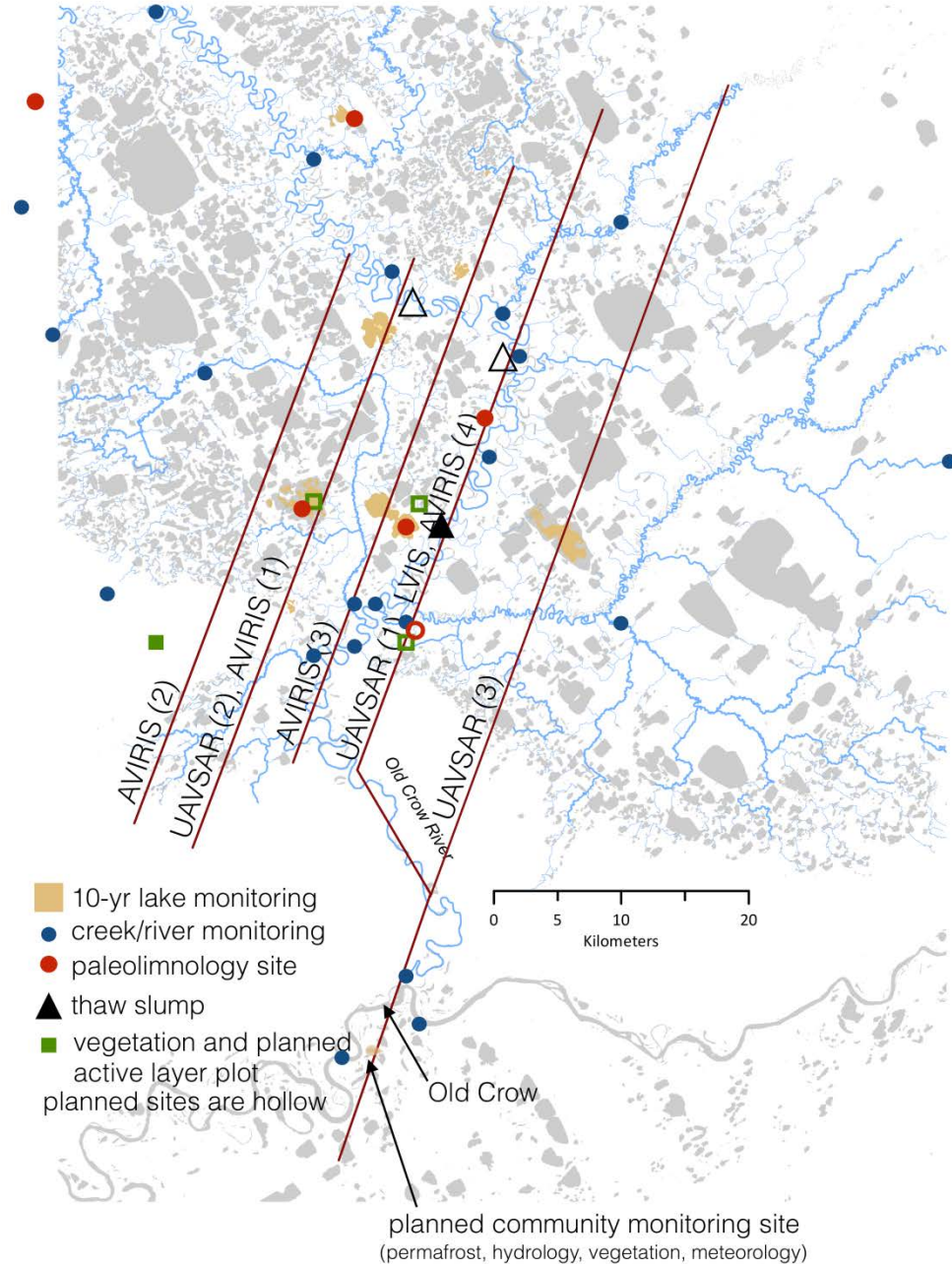
## Intended use of airborne data:

- UAVSAR:
  - Incorporate active layer properties in assessment of drivers of lake/river hydrology
  - With LVIS, identify lake inflow/outflow (surface and subsurface) for water balance studies
  - identify locations along the Old Crow River sensitive to retrogressive thaw slumps
- LVIS:
  - Map hydrological features (water tracks, fens, creeks) in monitored lakes/ivers
  - Inventory amount of material exported to river from slumps
  - Identify past slumps and their age/frequency (in conjunction with AVIRIS and dendrochronology work)
- AVIRIS
  - Evaluate correspondence with vegetation measurements (height, age, species, biomass, UAV-derived NDVI maps).
  - Refine land cover assessments in monitoring lake catchments
  - Potentially model hydrological conditions of other lakes based on relations with catchment land cover and ground conditions
  - Identify biomass in former slumps

# Influence of climate-induced landscape changes on hydrology and carbon export in Old Crow Flats



Prioritized lines for ABoVE Airborne Campaign based on past and planned field monitoring sites:



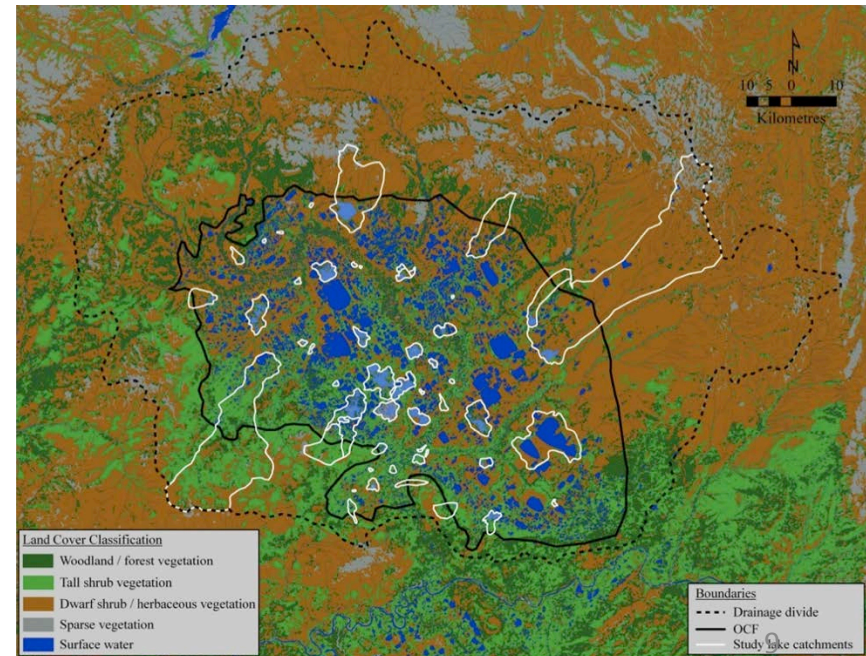
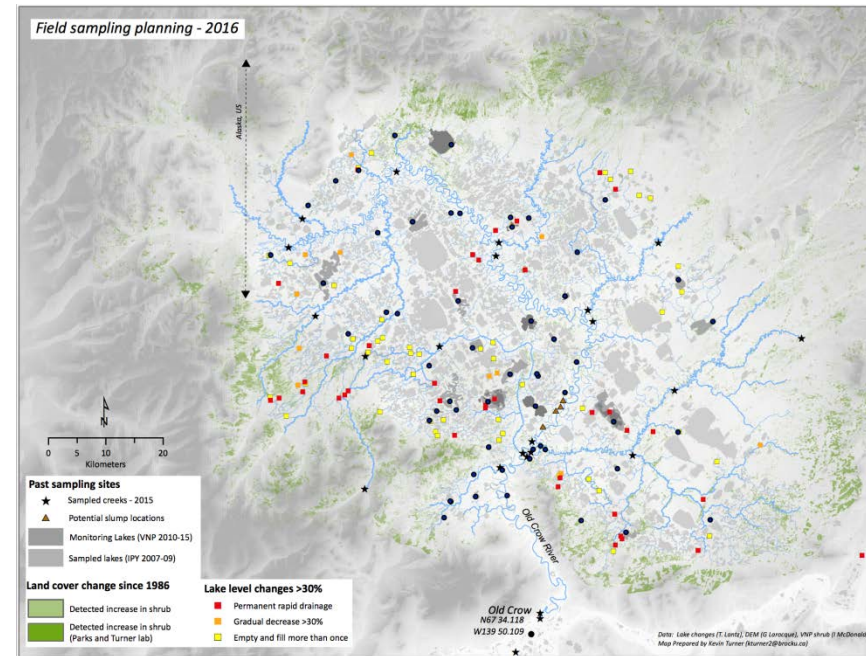


# PI: Turner (Brock)

## Existing information:

*(that can be used to calibrate/validate the airborne data)*

- the Isotopes and chemistry of 57 lakes (IPY 2007-2009). Fourteen have been monitored since with collaborations with Vuntut National Park
- General landscape drivers of lake water balances have been determined using land cover analysis derived from Landsat data.
- Runoff generation processes from six years of river water chemistry and isotope tracers.
- River/creek analysis increased to 22 sites during 2015 for water chemistry and isotope tracers ( $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$ ,  $\delta^{13}\text{C}$ )
- Lake sediment paleolimnological records from several lakes within suggested swaths.
- Vegetation survey plot (2016)
- UAV survey of retrogressive thaw slump and identified influence on Old Crow River (quantity of material, water chemistry, isotopes)
- Seasonal water level measurements of selected lakes



# Eco-hydrological processes at the Wolf Creek Research Basin

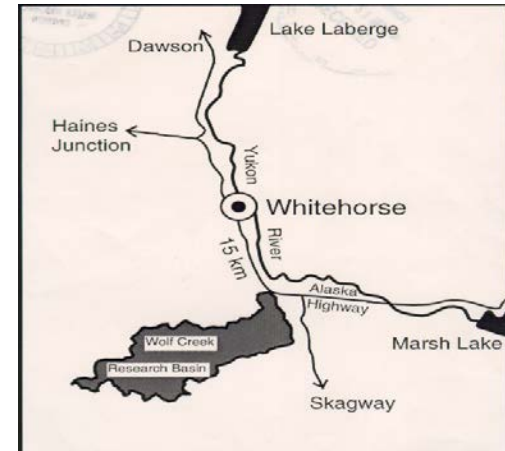
**PI: Carey (McMaster), Pomeroy (USask), Janowicz (GY)**

## Project objectives:

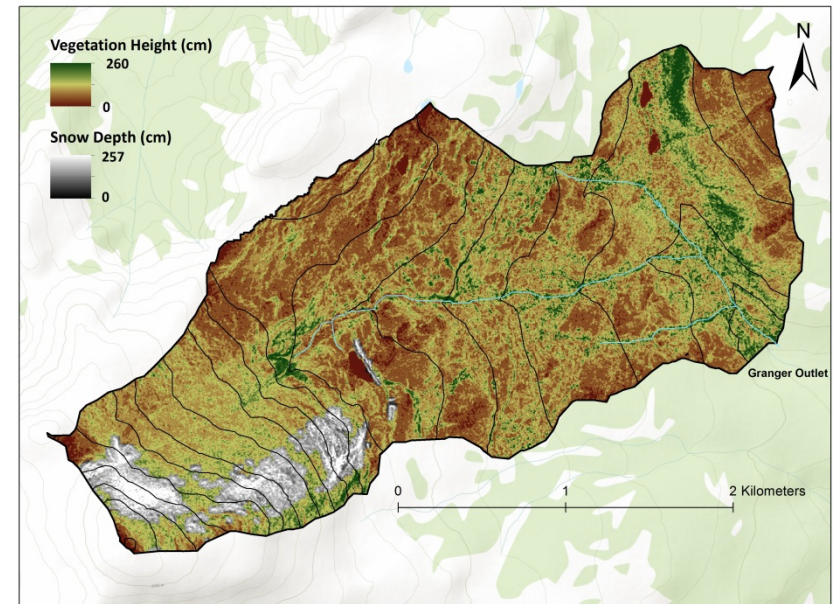
1. To advance knowledge of eco-hydrological processes. Particularly water-plant interactions across biomes.
2. To predict the influence of climate change on the hydrology of Yukon and other cold regions.

## Intended use of airborne data:

- Fundamental and applied research to improve our understanding of coupled hydrological, energy and biogeochemical cycling and their sensitivity to change (climate and cryosphere).
- Improved soil moisture, active layer and vegetation characterization



Location just south of Whitehorse



LiDAR derived shrub height map from 2007 for a sub-watershed

**PI: Carey (McMaster), Pomeroy (USask), Janowicz (GY)**

**Existing information:**

*(that can be used to calibrate/validate the airborne data)*

- 23 years of continuous high quality hydrometeorological data (3 met, 4 hydrometric stations including eddy covariance instrumentation)
- 6 soil temperature and moisture arrays
- Historical imagery and LiDAR
- Approximately 100 peer-reviewed scientific articles have been published from research undertaken in WCRB
- Part of Changing Cold Regions Network Research Program
- Part of (new) Global Water Futures project



# Mapping and analysis of forest-tundra treeline, Kluane

## PI: Danby (Queens)

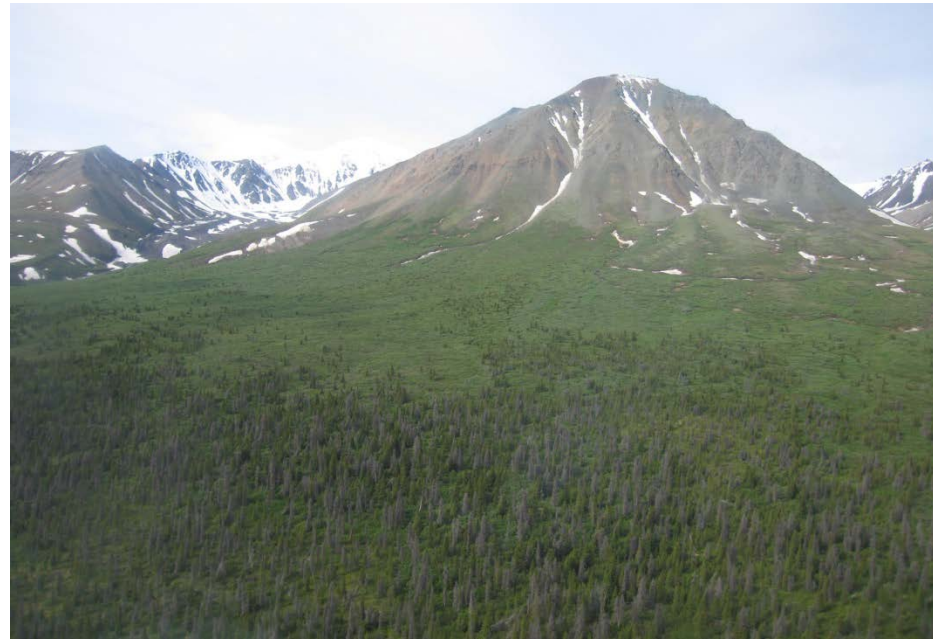
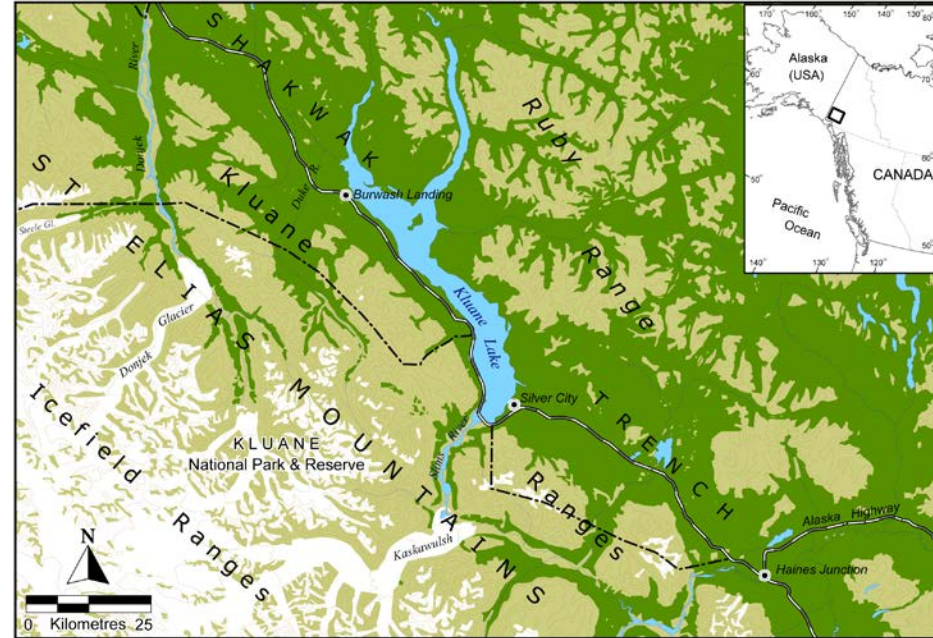
### Project objectives:

Better understand how multiple physical and biological variables interact to influence treeline dynamics for the purpose of improving forecasts of future change

### Intended use of airborne data:

LVIS and AVIRIS data will be used to generate high-resolution maps and DEMs of the treeline ecotone for:

- i. spatial pattern analysis
- ii. species distribution / niche modelling
- iii. analysis of successional trajectories of different stands following spruce bark beetle disturbance

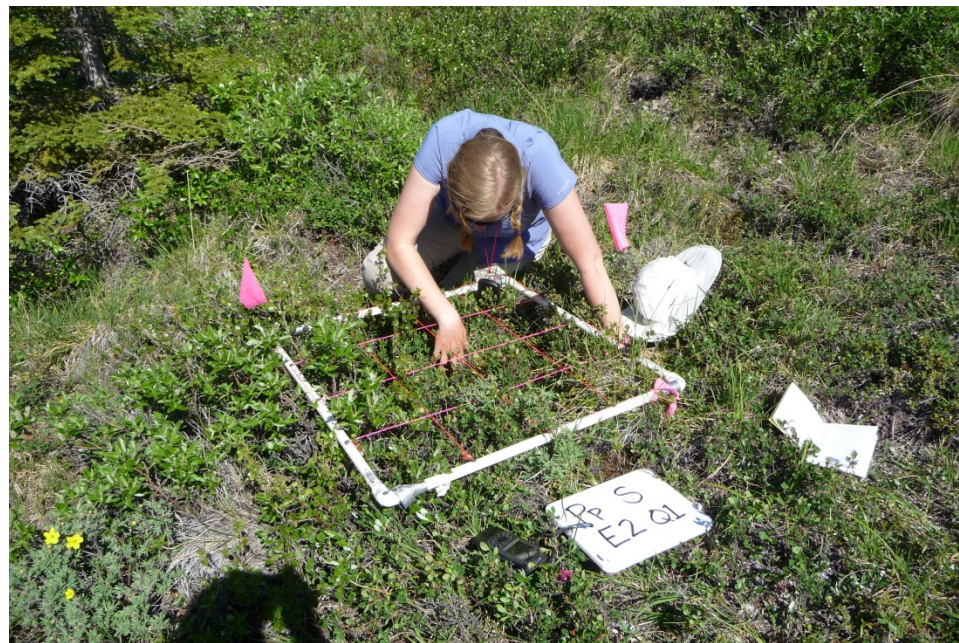
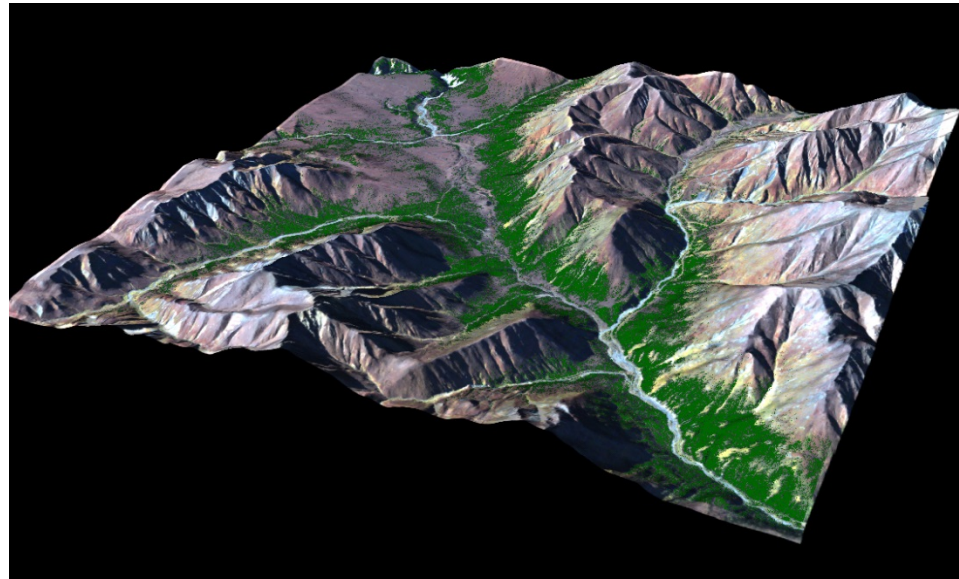


## PI: Danby (Queens)

### Existing information:

*(that can be used to calibrate/validate the airborne data)*

1. Variety of space-borne imagery has acquired over the last 15 years, including four Quickbird images and two Hyperion swaths. Useful as a baseline for change detection, particularly in light of a recent extensive spruce-bark beetle infestation in the region that has extended to treeline.
2. Several long-term vegetation inventory and monitoring plots throughout the region that can be used for ground validation





# Relationship between vegetation, snow cover and albedo, and how they are influenced by climate variability and change, Kluane

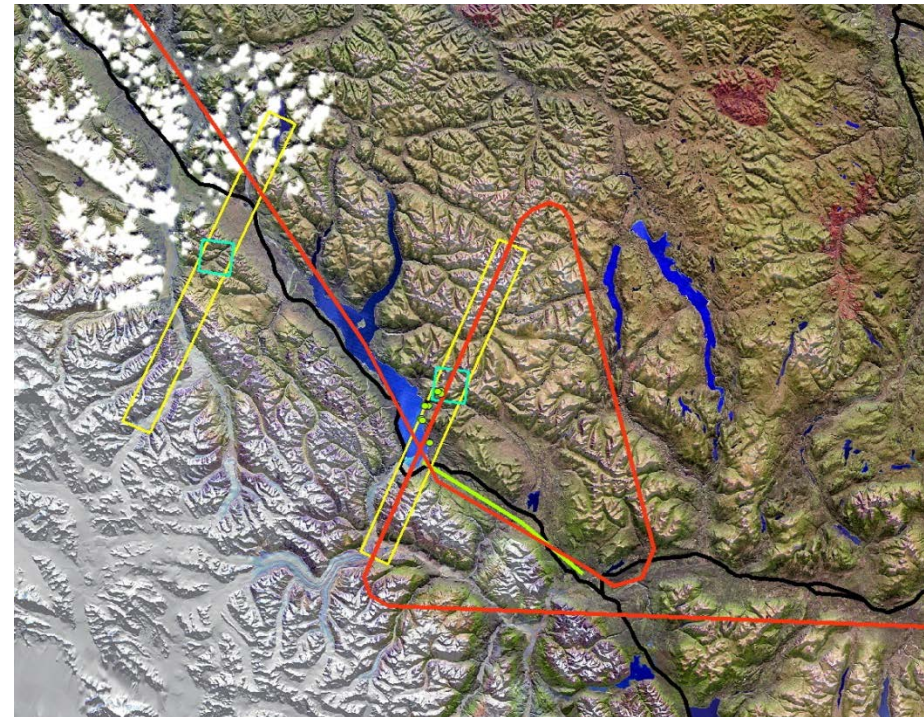
**PI: Williamsonm McKnight and Hik (UAlberta)**

## Project objectives:

To investigate the relationship between vegetation, snow cover and albedo, and how they are influenced by climate variability and change

## Intended use of airborne data:

Determine: **(i)** how vegetation composition and productivity have changed along elevational transects from boreal forest to high alpine, and how changes in vegetation modify climate and hydrology; **(ii)** if sub-basin level variability in Kluane Lake hydrological and biophysical conditions can be quantified using ABoVE sensors; **(iii)** whether high resolution thermal imagery of alpine tundra can identify errors in coarse resolution MODIS LST time series; and **(iv)** if permafrost thaw depths can be determined for alpine tundra.

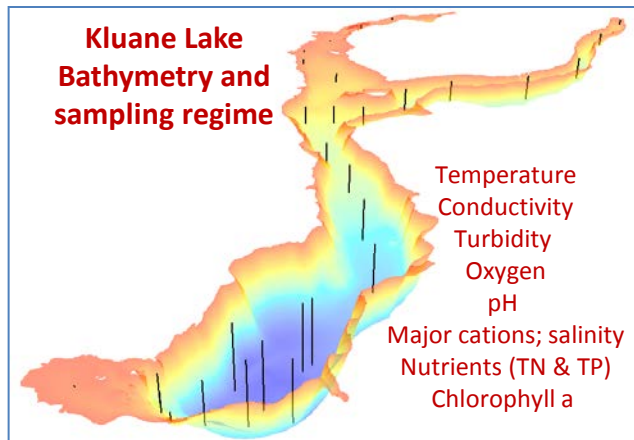


## PI: Williamson, McKnight and Hik (UAlberta)

### Existing information:

*(that can be used to calibrate/validate the airborne data)*

1. Hyperion, Quickbird, and Worldview images (since 2003) and extensive MODIS, NARR, SNAP data validation, integration and modeling.
2. Seven meteorological stations (1,200 m to 2,000 m elevation) since 2007, measuring air, soil, ground temperature, RH, rain/snow, wind, barometric pressure, net radiation, incoming solar radiation.
3. Extensive mapping of alpine and treeline vegetation composition, productivity, spectral properties, soil moisture, etc
4. In Kluane Lake, sampling full water column in the entire lake during the ice-free and winter seasons, and winter ice cover. Five permanent moorings to be deployed in spring 2017



# Porcupine caribou herd and the Animals on the Move project

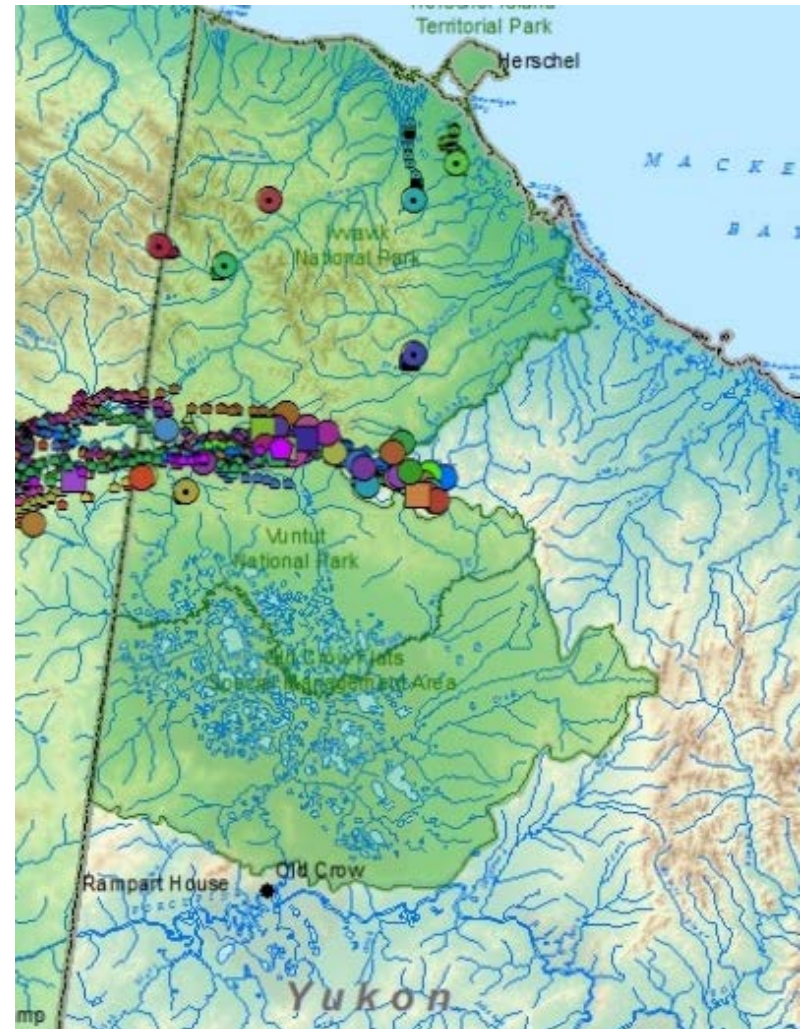
**PI: Suitor (ENV), Hebblewhite and Palm (U of Montana), Vierling (Idaho)**

## Project objectives:

- To develop and apply methodologies that can detect, map, and extrapolate predictions of caribou pathways over broad scales.
- To understand the key needs of caribou during migration, identification of key features used by the herd, and a regional map of migration pathways that can be directly used for land use management

## Intended use of airborne data:

Data will be used to identify and map migration pathways for the Porcupine caribou herd that can then be scaled up to the landscape level using satellite using satellite GPS data collar data currently being collected





## PI: Suitor (ENV)

### Existing information:

*(that can be used to calibrate/validate the airborne data)*

1. Significant international research collaboration occurred in the 2000's on the Old Crow Flats.
2. We continue to collect high resolution satellite GPS data for caribou and muskox in this region and will continue to do so for the foreseeable future.
3. Ivvavik and Vuntut National Parks, along with a regional east of Ivvavik in Yukon have recently completed detailed Ecological Landcover Classifications in addition to other regular monitoring completed



# Recovery modeling of historical oil and gas disturbances in the winter range of the porcupine caribou herd

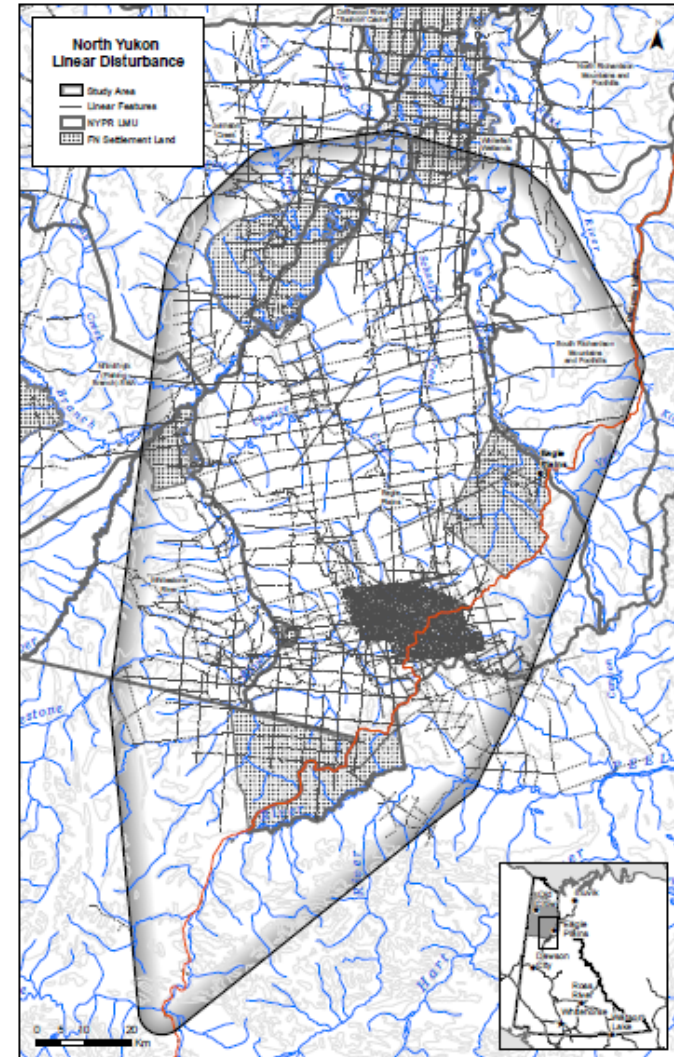
## PI: Simpson (EMR)

### Project objectives:

1. To establish an inventory of historical oil and gas disturbance
2. To monitor and track change over time as it relates to anthropogenic and natural disturbance in this region
3. To understand when a historical disturbance can be considered to be recovered

### Intended use of airborne data:

Modelling disturbance and recovery variables in the region



## PI: Simpson (EMR)

### Existing information:

*(that can be used to calibrate/validate the airborne data)*

1. 120 ground based research plots
  - ecological and landscape classification and position, vegetation composition and abundance, forest stand age and structure, active layer depth, full soil profiles including soil moisture and depth of organics, successional stage analyses and disturbance variables
2. 100 wildlife camera traps
3. LiDAR data for a portion of the study area and both SPOT-6 and Pleiades high resolution satellite imagery exist for most of the region along with some air photos
4. Satellite collars deployed on bull caribou who utilize this area as part of their winter range provide additional data on movement patterns.

