# Identifying impacts of landscape changes on hydrology and carbon export in Old Crow Flats, YK


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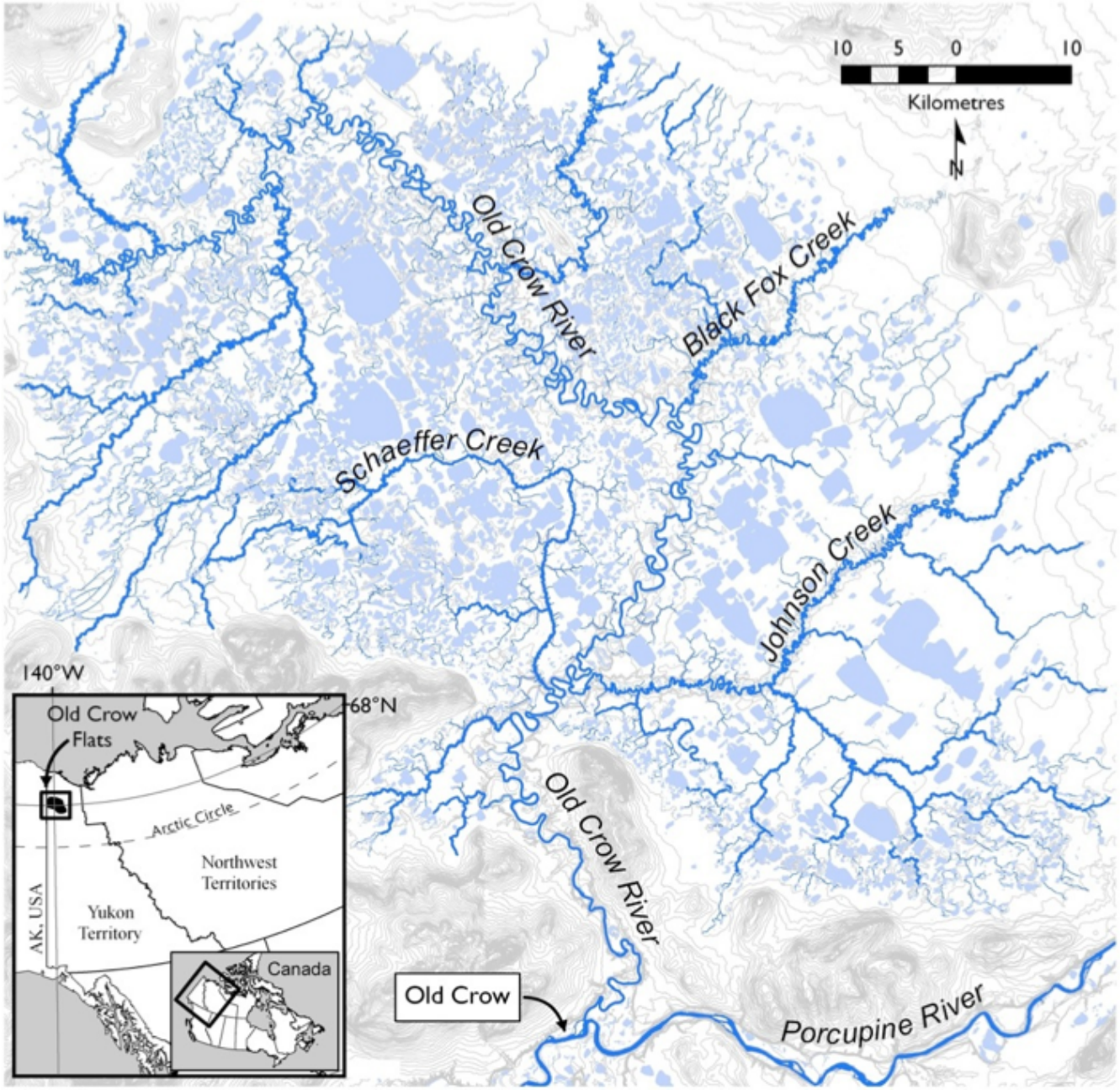
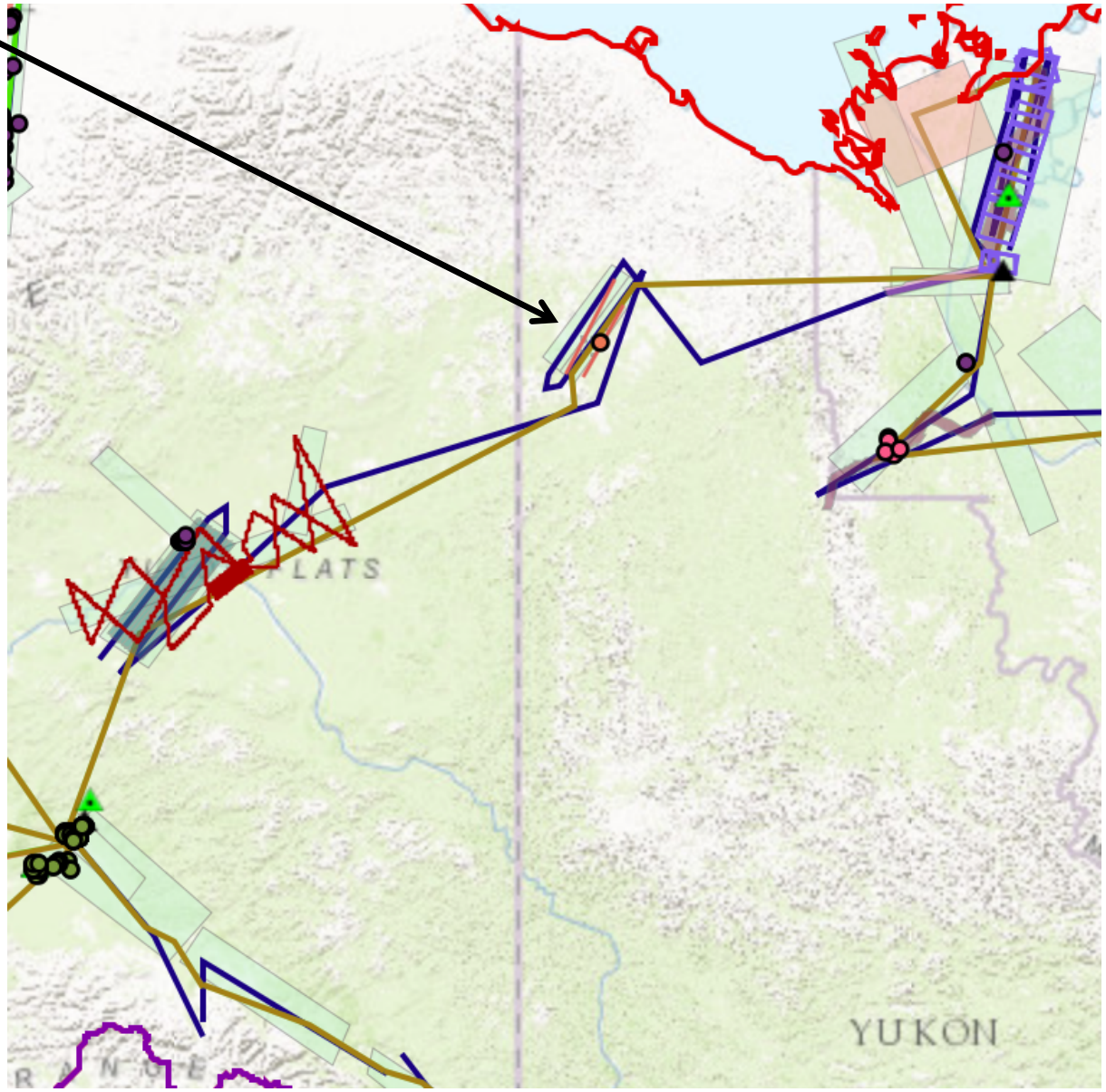
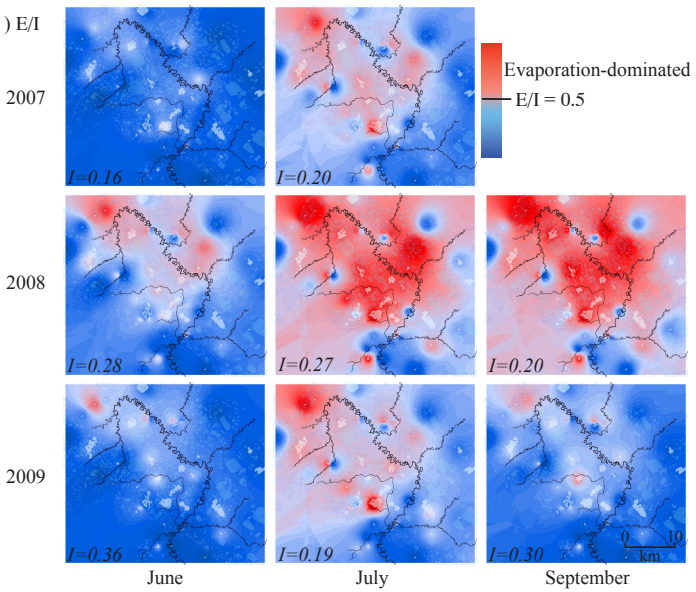
# Old Crow Flats: Traditional territory of the Vuntut Gwitchin First Nation

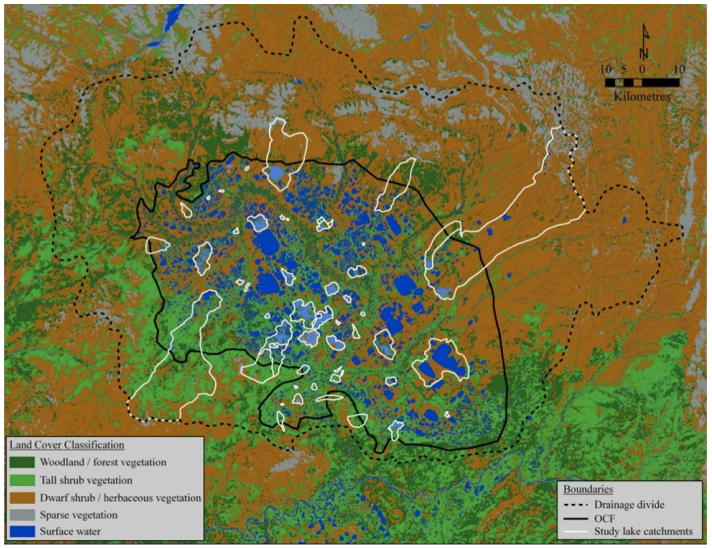


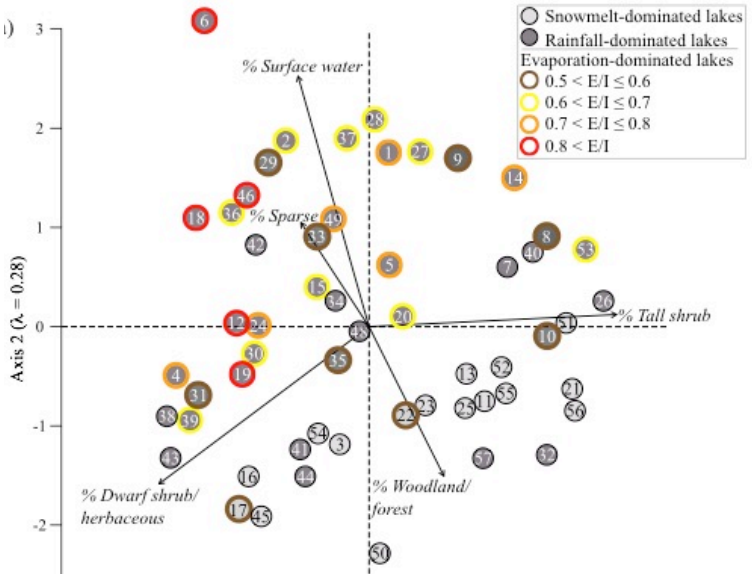
Old Crow Flats, nicely positioned between Fairbanks,AK and Inuvik,NT



- *Background of hydrology research in Old Crow Flats*
  - *Identify lakes sensitive to evaporation*
  - *Determine general landscape drivers of hydrological variability (in lakes and rivers)*



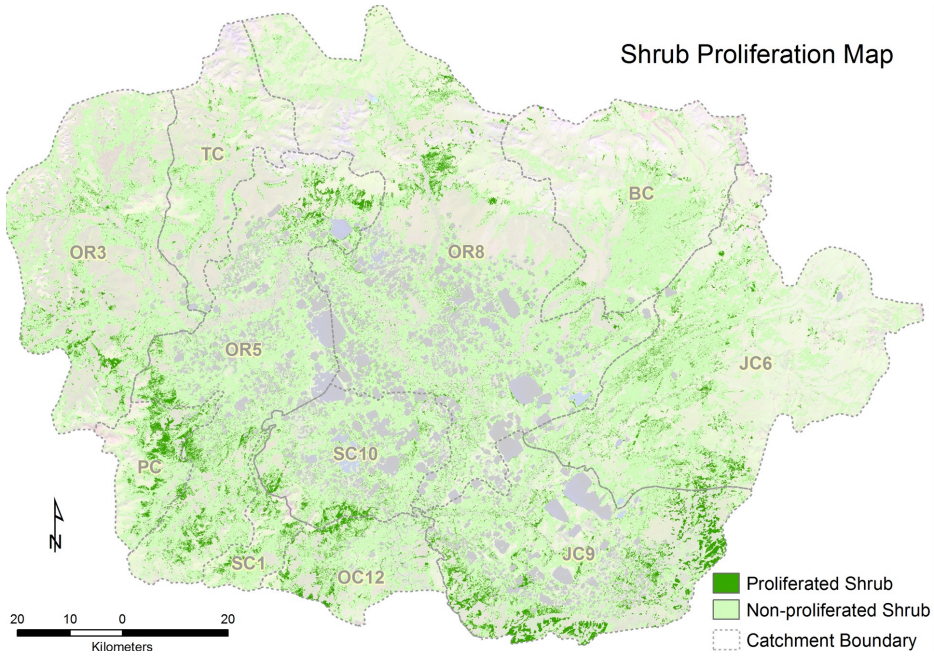



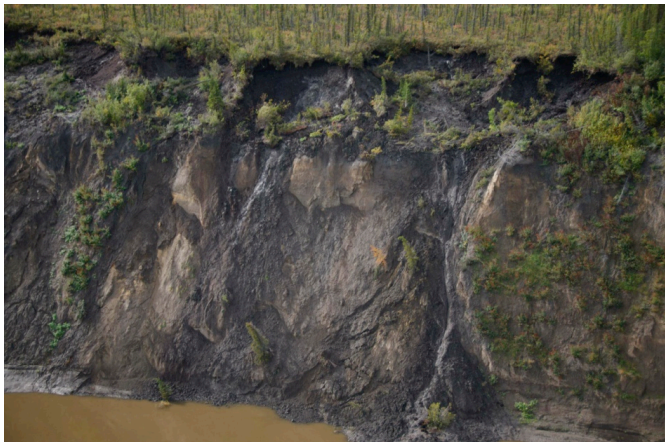

*Turner et al, 2014, GCB*
*Turner et al., 2014, PPP*

# Old Crow Flats: Landscape changes affecting lakes and rivers

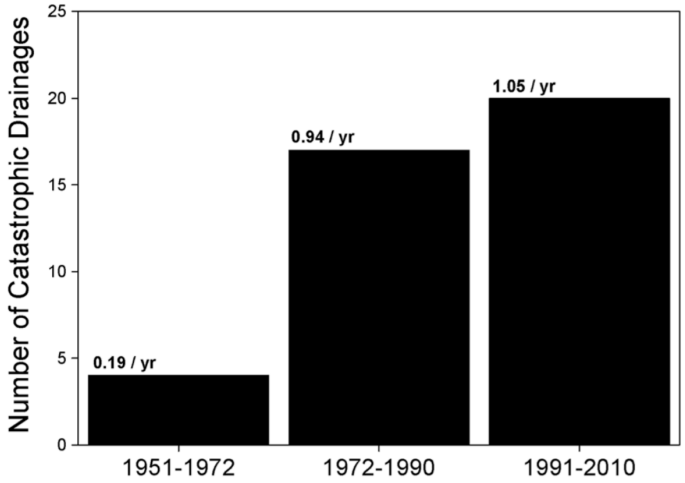
## 1) Shrub vegetation proliferation




## 2) Retrogressive thaw slumping

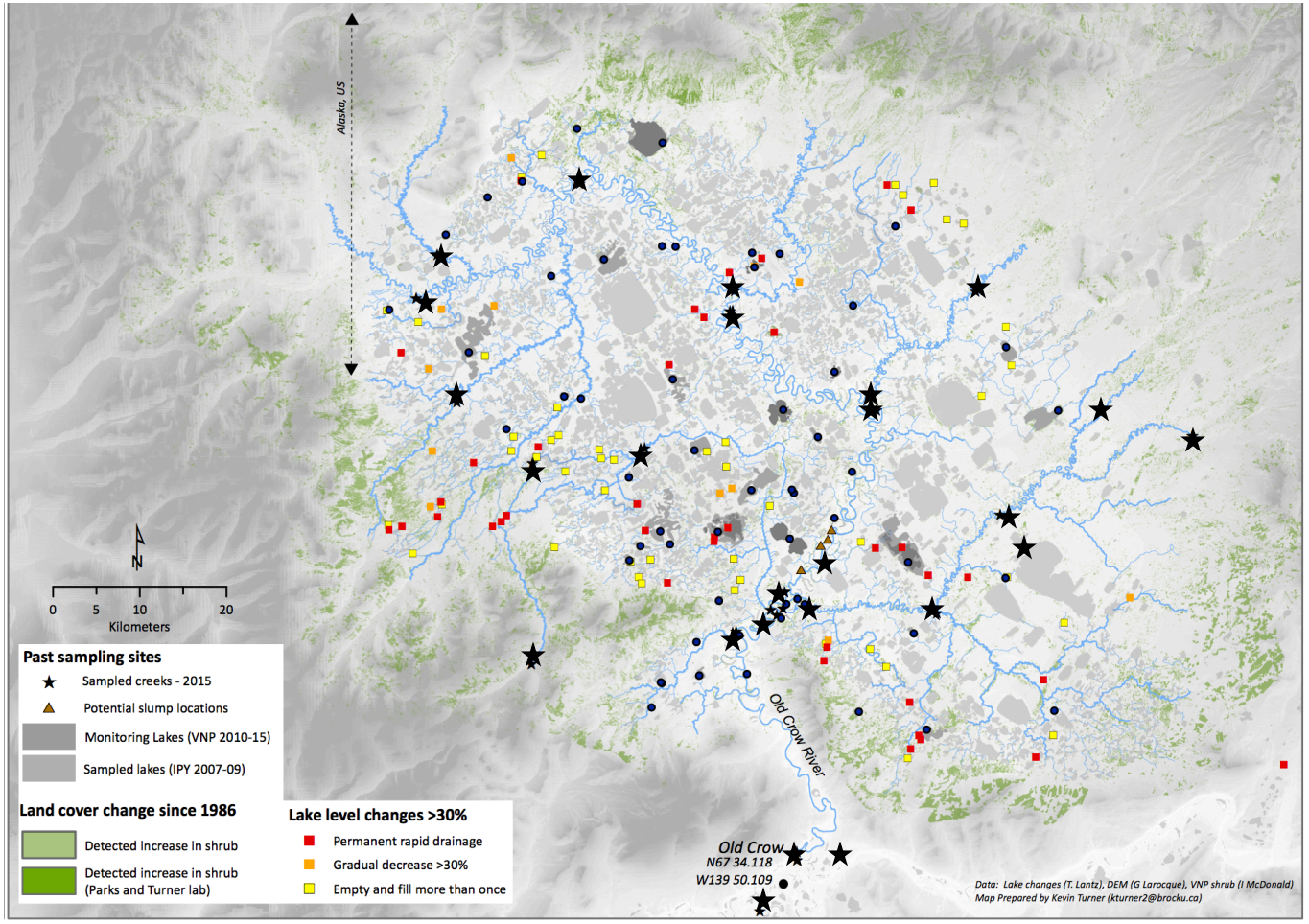


## 3) Lake drainage




*From Lantz and Turner, 2015, JGR*

- *Ongoing research questions*
  - *What landscape changes have occurred and where?*
  - *How are changes in the landscape (shrub proliferation, permafrost slumps) affecting water and carbon balances?*
    - *e.g., what does increasing shrub do to active layer and hydrological flow pathways?*





- NSERC-supported research 2016-20

  Identifying:
  - spatial variability in land cover change
  - spatial association among land cover, active layer, hydrology, water chemistry
  - runoff generation processes and carbon export from OCF sub-catchments
  - impacts of retrogressive thaw slumps on river hydrology/chemistry (e.g., carbon export)
  - Past lake hydrological responses to climate and landscape changes (paleolimnology)


Distance along the Old Crow River

# Planned 2017 field campaign:

## Lakes and rivers

- Water sampling
- Water level monitoring
  - –useful data for Larry Smith and **AirSWOT**
- Lake sediment coring

## Vegetation

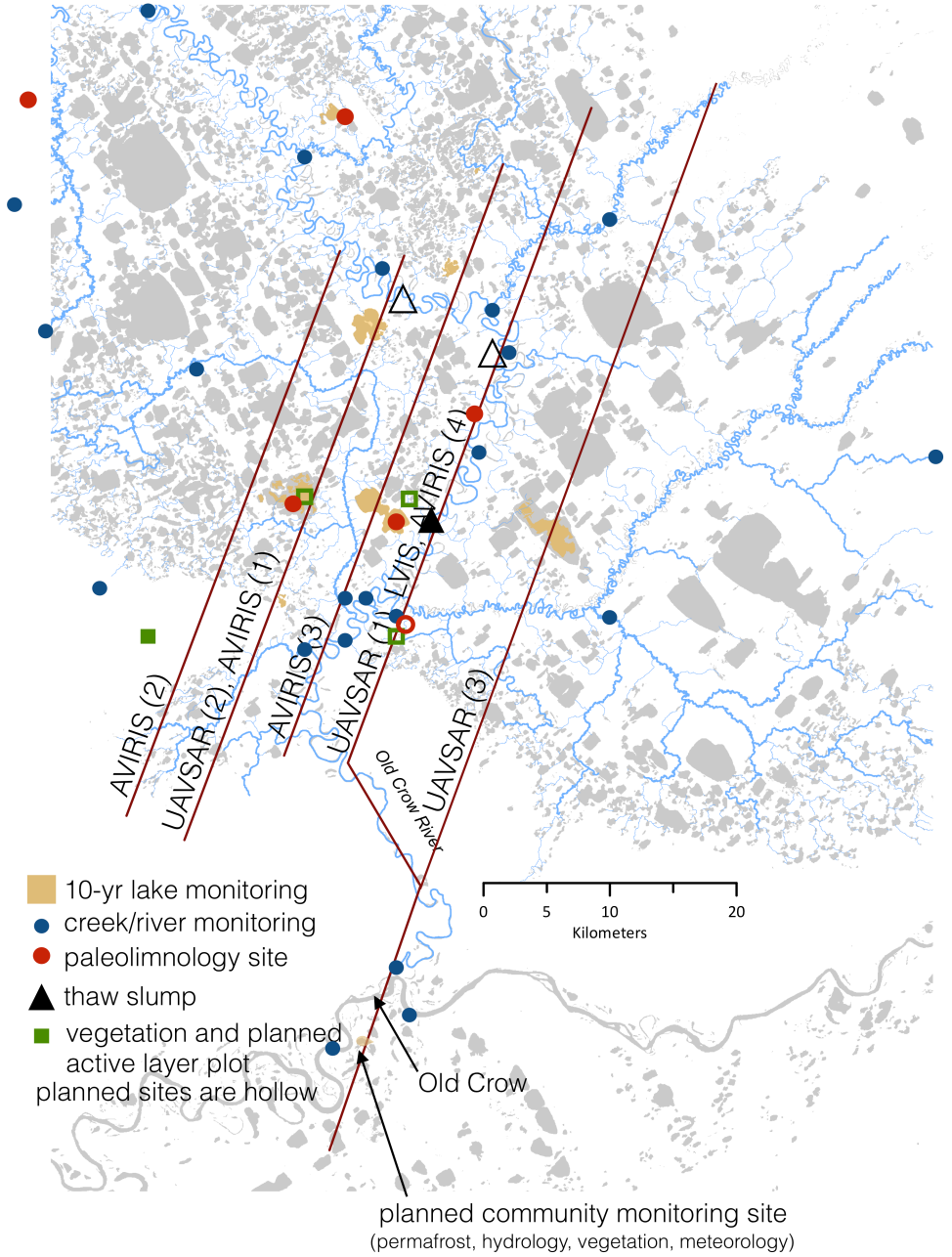
- Vegetation survey plot (age, height, species, UAV NDVI)
  - –access dependent
  - –Useful for **AVIRIS**
- Deploy continuous Chl-a sensors (CFI pending)

## Slump

- UAV and DGPS survey of retrogressive thaw slump
  - –useful for DEM working group **and LVIS**

## Active Layer

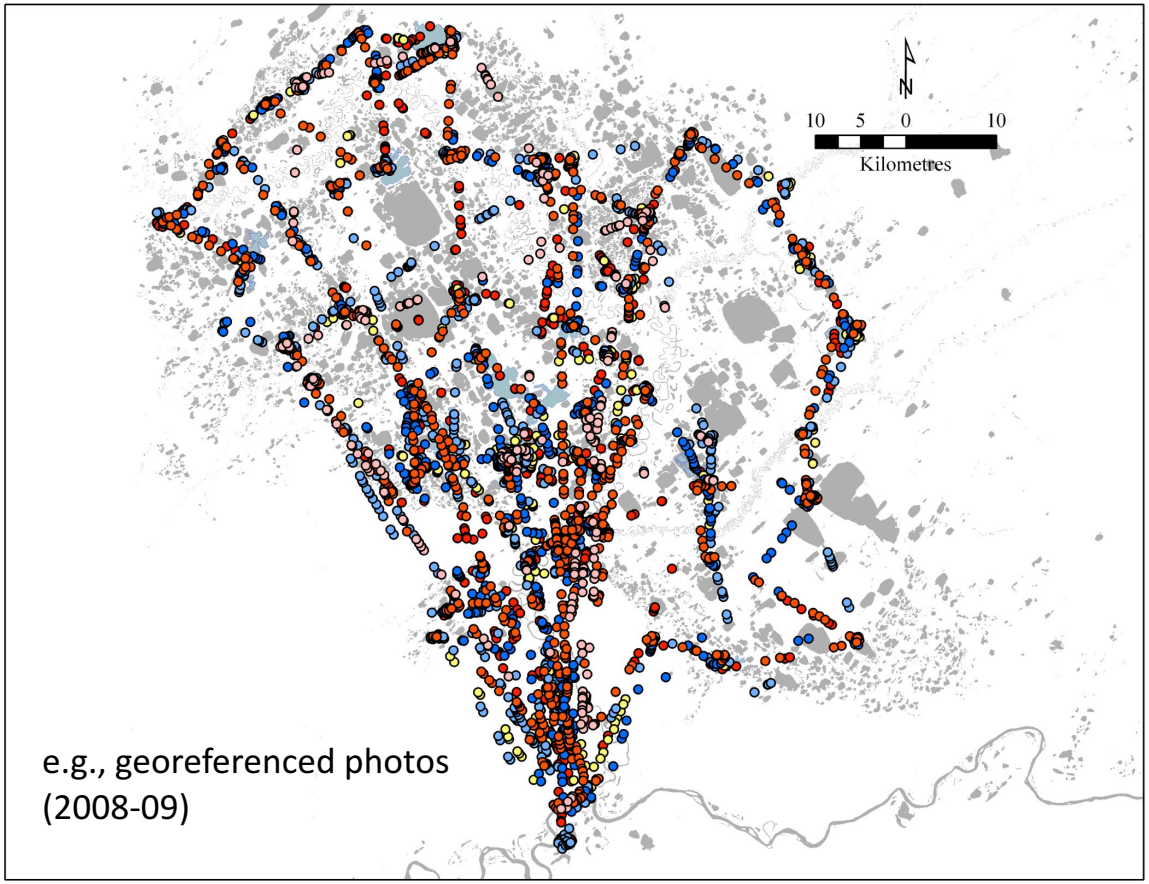
- Active layer (probe) surveys during late Aug
  - –useful for K Schaefer and **UAVSAR**
- Deploy continuous moisture/temperature sensors (CFI pending)




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

# Existing information:

Georeferenced oblique aerial photographs could be another source of information relevant to ABoVE-related work




Indicator for:

- Land cover properties
- Water level/inundation
- Pre-slump conditions

:

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I personally have logged >200 hrs flying over and photographing this landscape (2007-16)

# Community Involvement

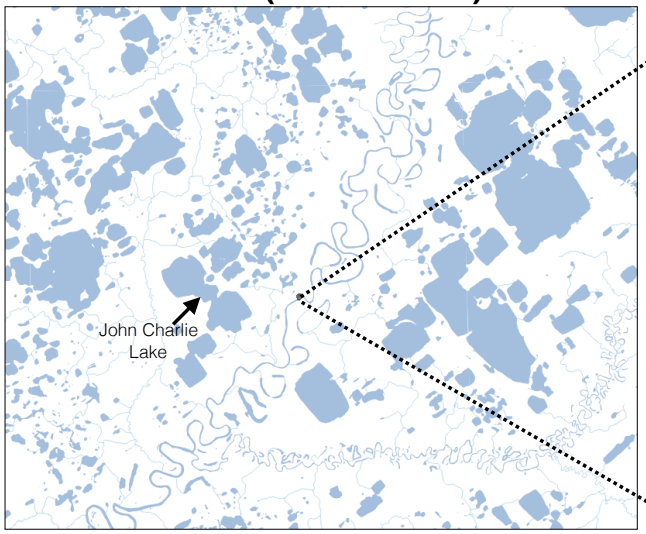
- Important to learn of how ABoVE-related research can be useful to community.
- Have participated in many community meetings, school workshops, and other events in Old Crow during IPY
  - Will be doing more community engagement moving forward
- Collaborating on a POLAR proposal that includes development of a community monitoring site

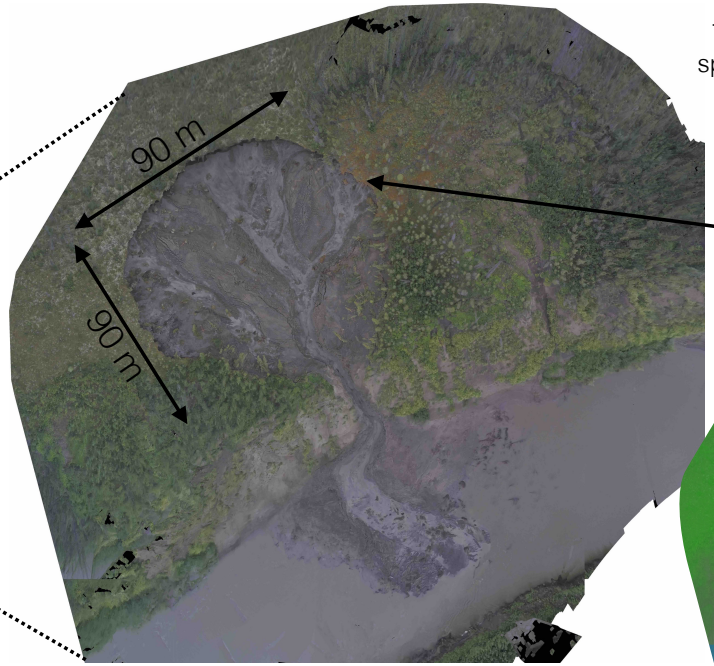
Community Involvement: example product posted in Old Crow

# Preliminary Assessment of a New Permafrost Slump Along the Old Crow River

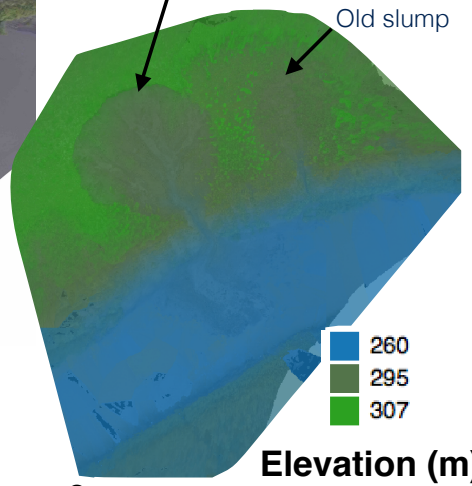
Kevin Turner, Brock University, St. Catharines, Ontario

## Old Crow Flats (central area)



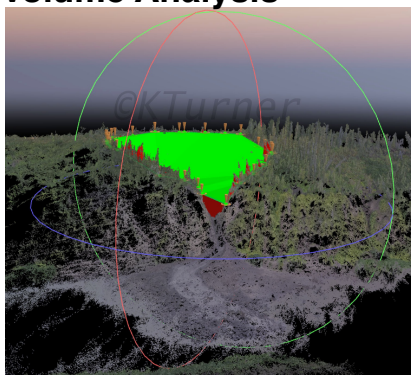




There is evidence of slumps at many spots along the Old Crow River and in other northern landscapes (NWT). This new one can be monitored to understand how it changes and affects the river water.

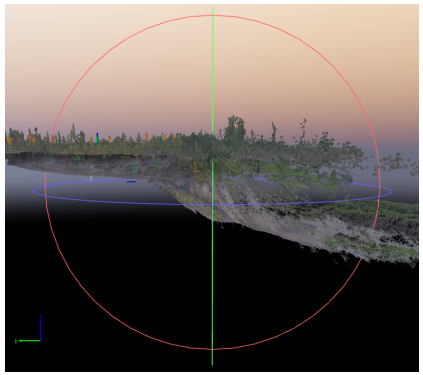



**Elevation (m)**

## Volume Analysis




## Side View



Preliminary analysis suggests that the slump moved about 37654 $m^3$ (~49000 cubic yards or over 3000 dump trucks worth) of material toward the river.

## Next Questions

Local interest:

How do slumps affect the river water?

Are slumps happening more?

Global interest:

How much carbon has been exported to the river?

- permafrost samples were collected from the slump for analysis
- water samples collected at slump and downstream for water chemistry and carbon analyses

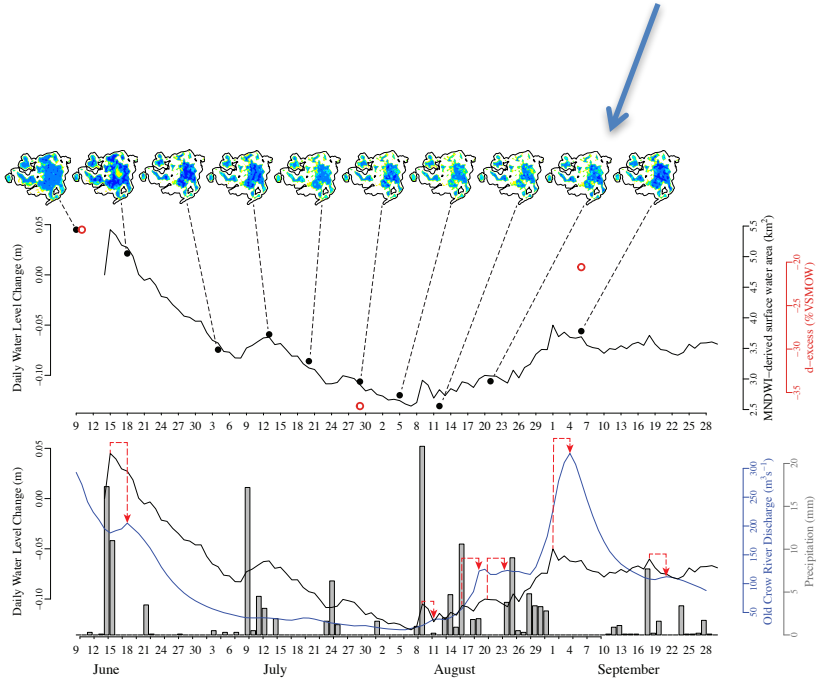
Funding for my research has been provided until 2020. I hope to present and discuss more of these findings with you during my visits. Please don't hesitate to contact me if you have questions (email: kturner2@brocku.ca, phone: 905-688-5550 ext. 5399)

# Existing/Planned data products:

## Lakes and rivers

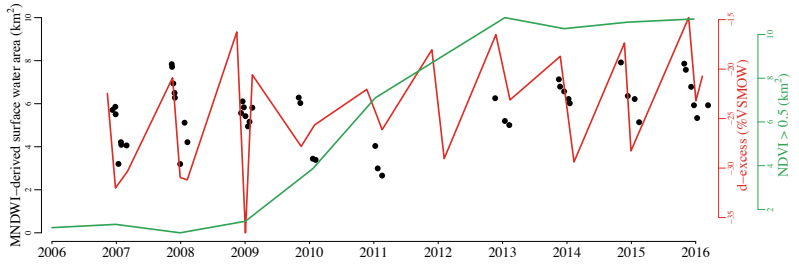
- Isotopes ($\delta^{18}O$, $\delta^{2}H$, $\delta^{13}C$) and chemistry
  - –57 lakes (IPY 2007-2009).
  - –14 lakes 2007-2016 (collaboration with Parks Canada)
  - –River/creek monitoring sites (detecting influence of lake drainage and slumps on hydrology and carbon export
- Landsat findings
  - –general land cover drivers of lake water balances
  - –Lake drainage frequency (Lantz and Turner 2015)
  - –Lake level/veg change detection in drained lake
- Water level data for many lakes
- Lake sediment paleolimnological records from several lakes within suggested swaths.

Check out my poster for a look at the new stuff




## Vegetation

- Vegetation survey plot 2016 (age, height, species, UAV NDVI)




## Slump

- UAV survey of retrogressive thaw slump and identified influence on Old Crow River (quantity of material, water chemistry, isotopes)

## Active Layer

- Planned active layer surveys during late Aug 2017

Active Layer

## Project objectives:

To utilize multiple data sets to identify the hydrological responses to changing climate over multiple spatial and temporal scales.

## 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/rivers
  - 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
- AirSWOT
  - Evaluate utility for evaluating seasonal lake level changes

Note – it is really important to establish standardized processing steps