

# ***Talk #1: ABoVE Related Studies at Trail Valley & Havikpak Creeks, NWT***

**Philip Marsh, Wilfrid Laurier University, Waterloo, ON**

Oliver Sonnentag, Universite de Montreal

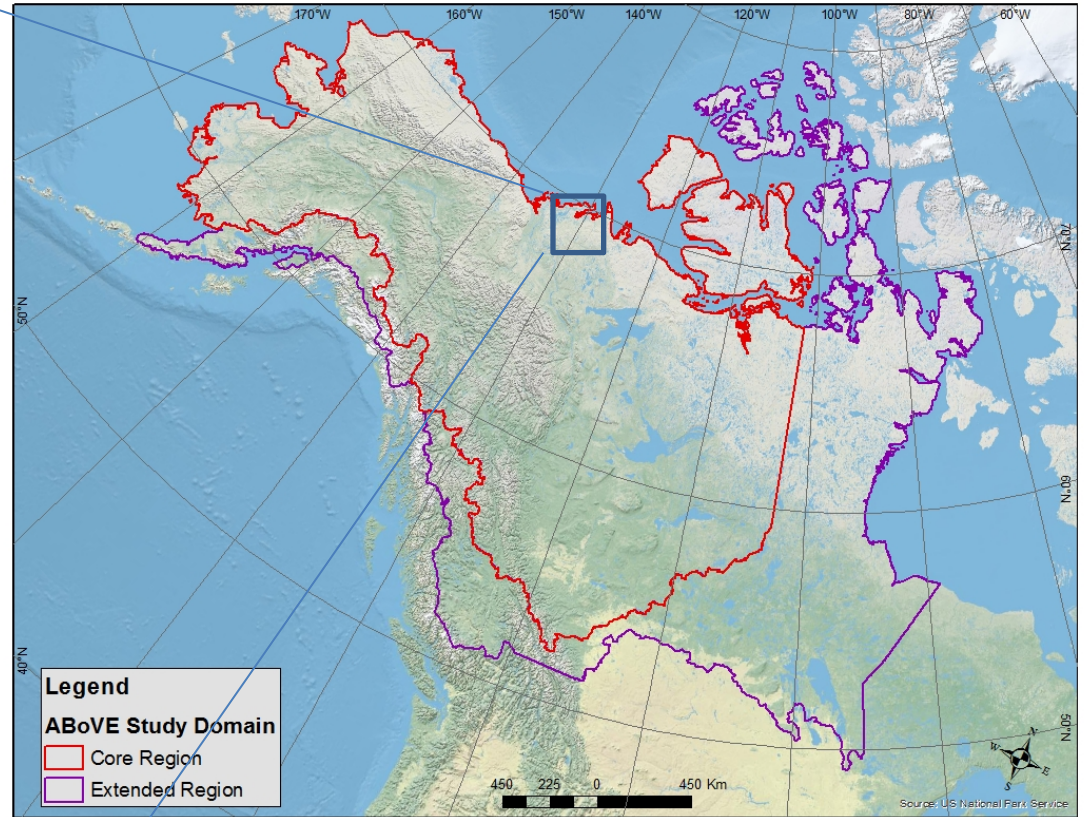
Aaron Berg, University of Guelph

Jennifer Baltzer, Wilfrid Laurier University

Chris Derksen, Environment and Climate Change Canada



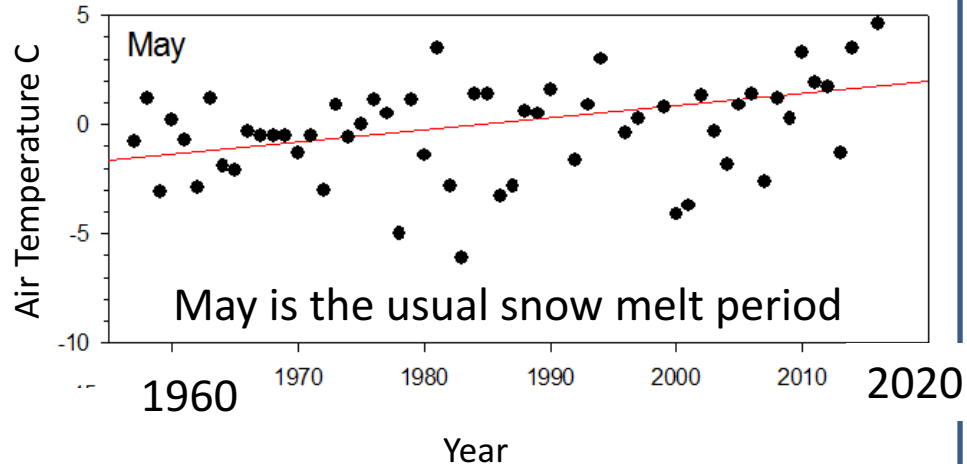
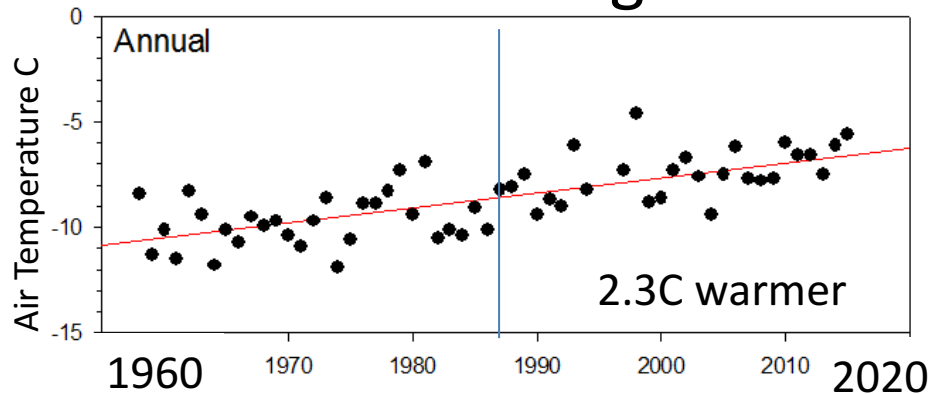
# Trail Valley and Havikpak Creeks



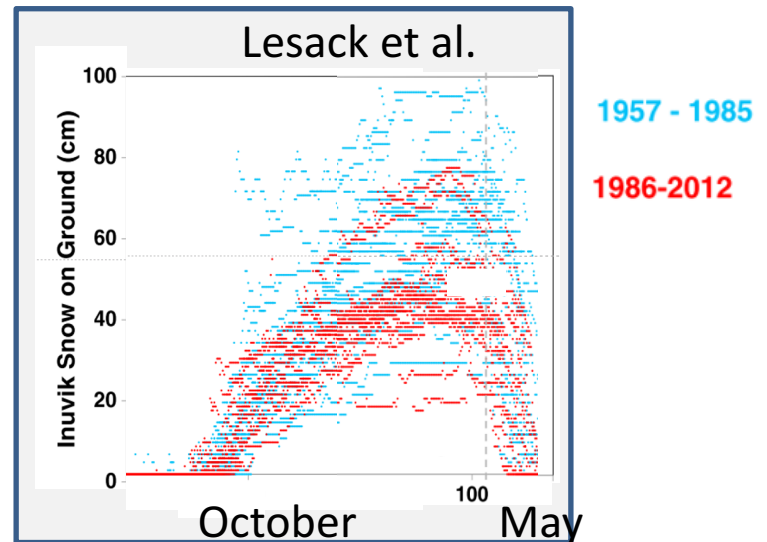
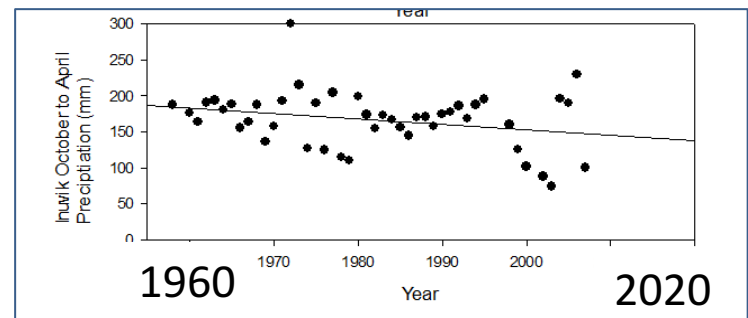


# One of our main themes is to explain and understand these changes

## Warming



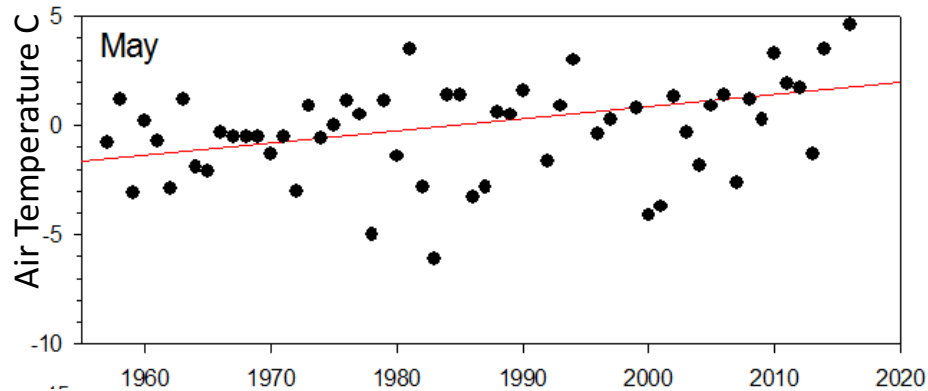
## Drying



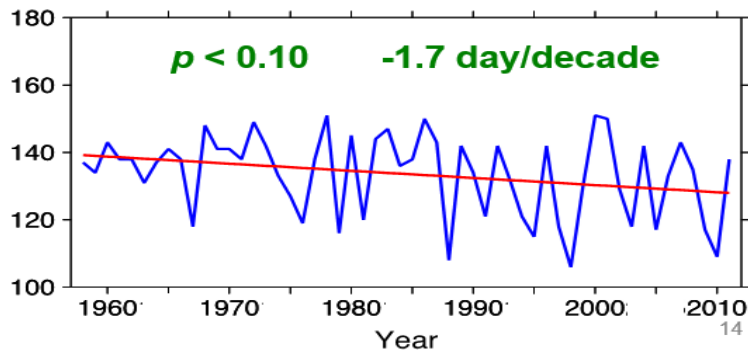


# a) Earlier spring melt - but later spring runoff

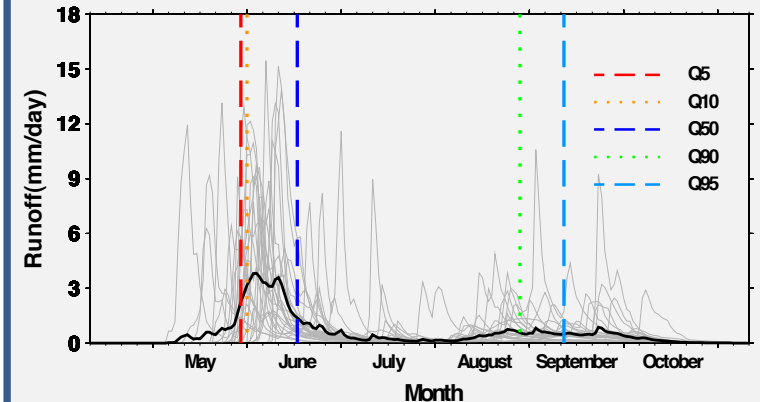
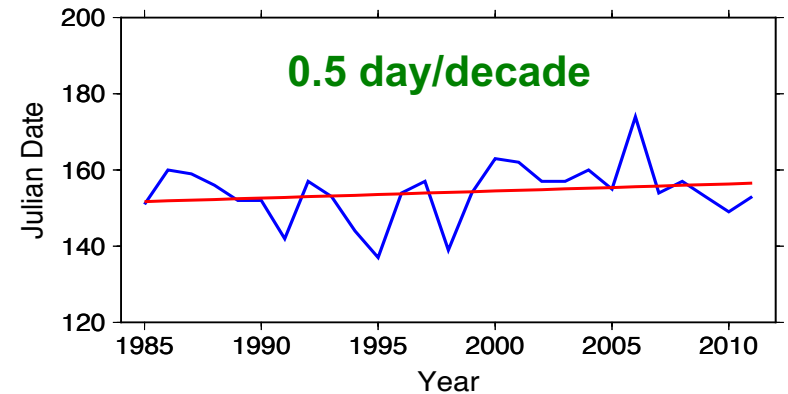
Much warmer air temperature during the melt period



Start of snowmelt



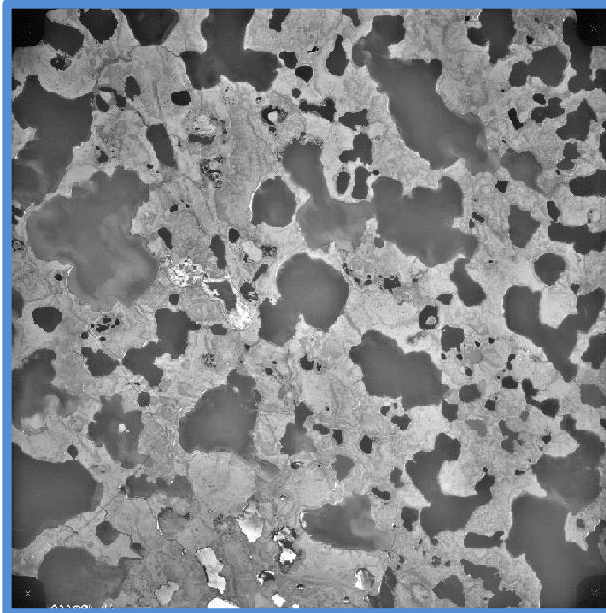
Date of Q50. i.e. 50% of runoff



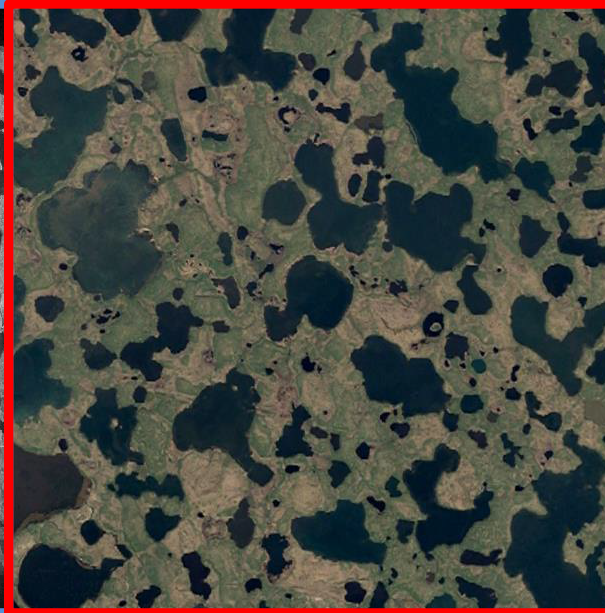


## b) Warming, drying and increased evap - but no sign of upland lake desiccation

1972



2016

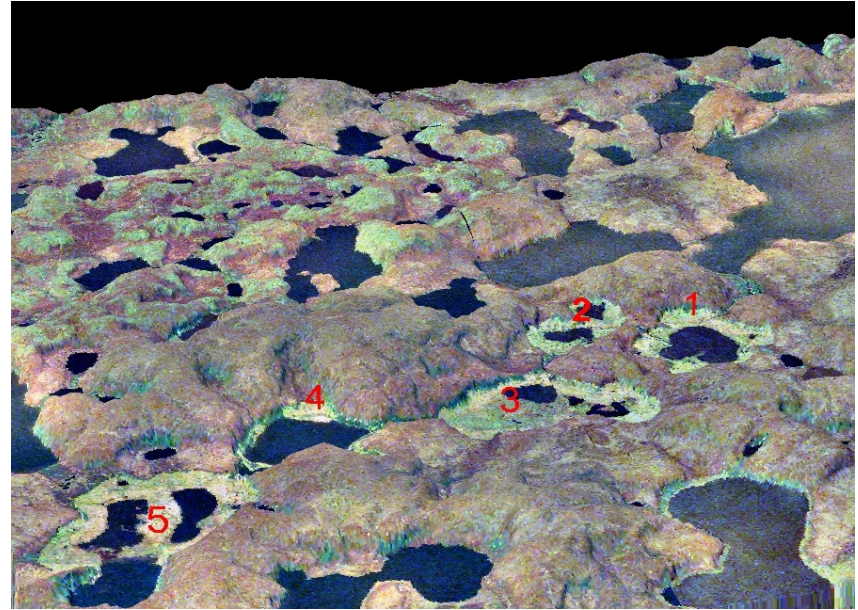


Trail Valley Creek region. 60 km north of Inuvik, NWT

- Warming would suggest longer ice free period and higher evaporation
- Previous studies in the 1980's showed that lake evaporation was close to annual precip.
- Would expect declining lake levels



# c) Melting of permafrost - but decreased rate of Catastrophic Lake Drainage



Year	# of drained lakes	# of drained lakes/yr
1950 – 1973	26	1.13
1974 – 1985	10	0.83
1986 – 2000	5	0.33



# The Future

How will the hydrology change over the next decades?





# ***ABoVE Related Studies in the western Canadian Arctic - Trail Valley & Havikpak Creeks, NWT***

**Objectives:** The overarching objective is to improve our understanding of the controlling processes, interactions and changes to flora, permafrost, snow and hydrology through the use of field observations, remote sensing, and modelling at sites at the Arctic treeline.

- O1)** Quantify the links between vegetation and snow cover across the arctic treeline,
- O2)** Determine how interactions between vegetation, snow, soil moisture and energy exchange mediate permafrost vulnerability and resilience to climate change, and
- O3)** Understand how vegetation through direct controls on snow cover and evapotranspiration, controls runoff and lake levels

ArcticNet

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Polar Knowledge  
Canada

Savoir polaire  
Canada



AURORA RESEARCH INSTITUTE  
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Canada Research  
Chairs





# Trail Valley Creek

TVC Main Met

Meteorological Service Canada

Siksik Creek

Water Survey Canada

TVC Forest Spruce (TFS)

TVC Upper Plateau (TUP)

TVC Tall Shrub (TTS)

Inuvik – Tuktoyaktak Highway





# Havikpak Creek

Meteorological  
Service Canada

Flux  
tower

Water Survey  
Canada

Dempster Highway

Inuvik Airport





# Flux and energy balance, snow, and runoff

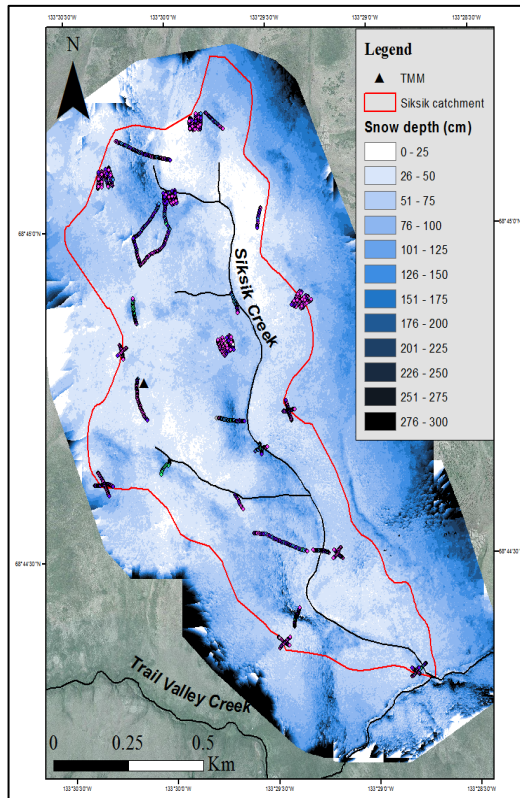




# Theme 1: Snow measurements (Phil Marsh)

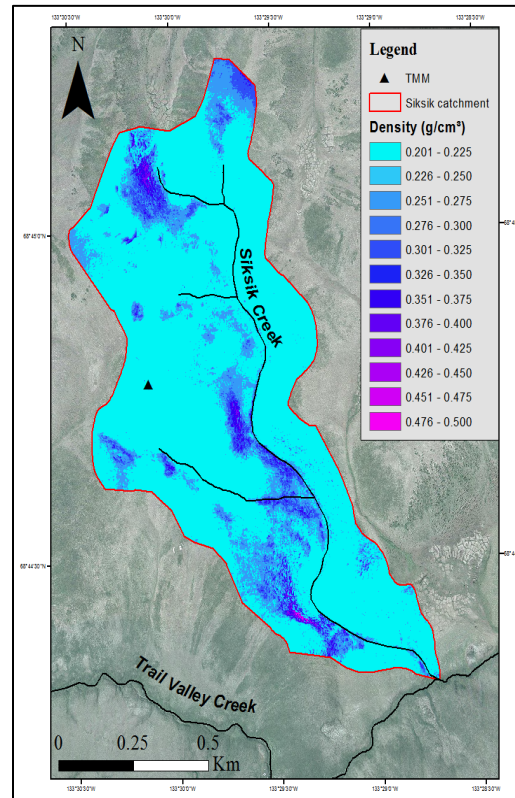


## 1. Snow Depth (cm)



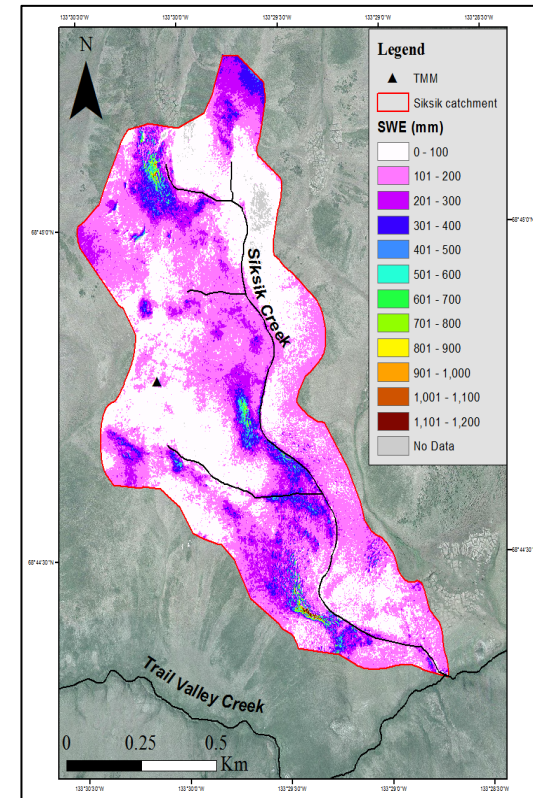
Aerial photos analyzed using Structure-from-Motion software

## 2. Snow Density (cm)



Snow density estimated from a depth – density relationship

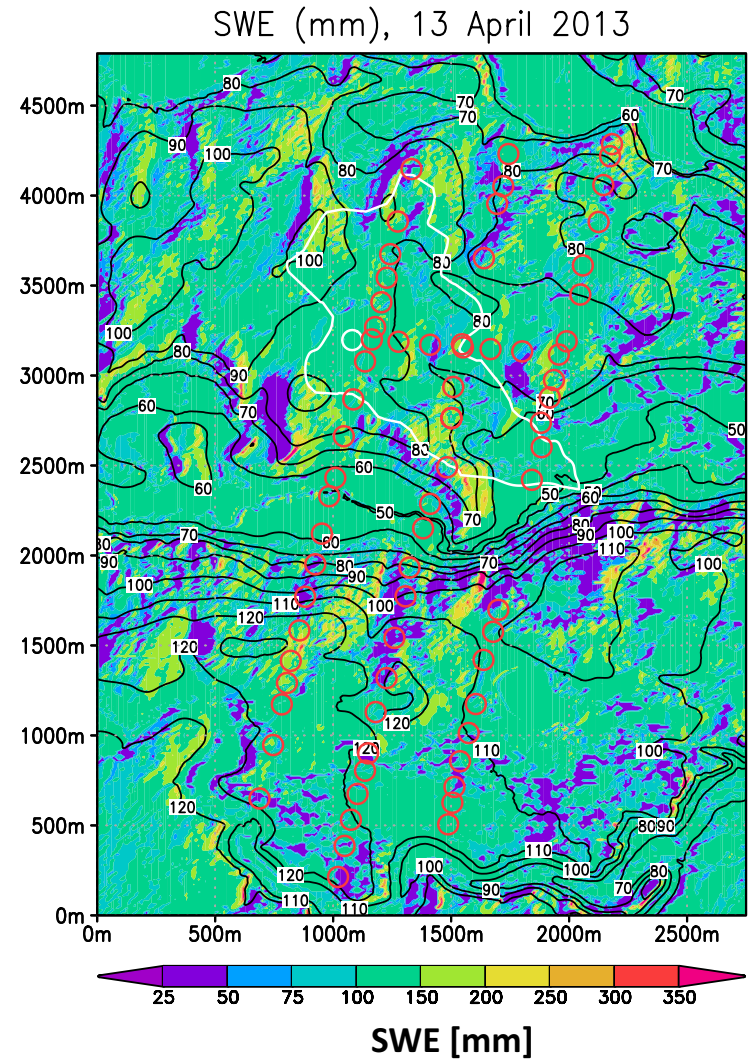
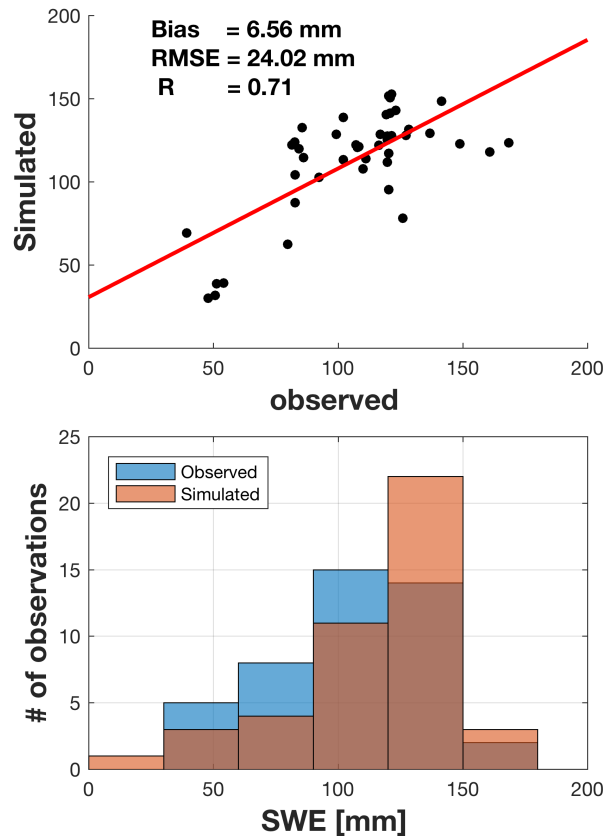
## 3. Snow Water Equivalent (cm)



SWE from #1 and #2

# Theme 1: Snow modelling (Phil Marsh)

*Ally Toure and Glen Liston - SnowModel*

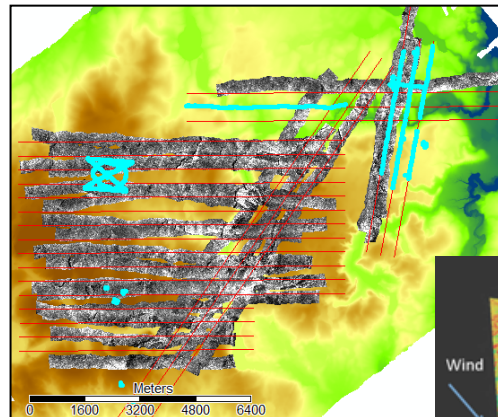




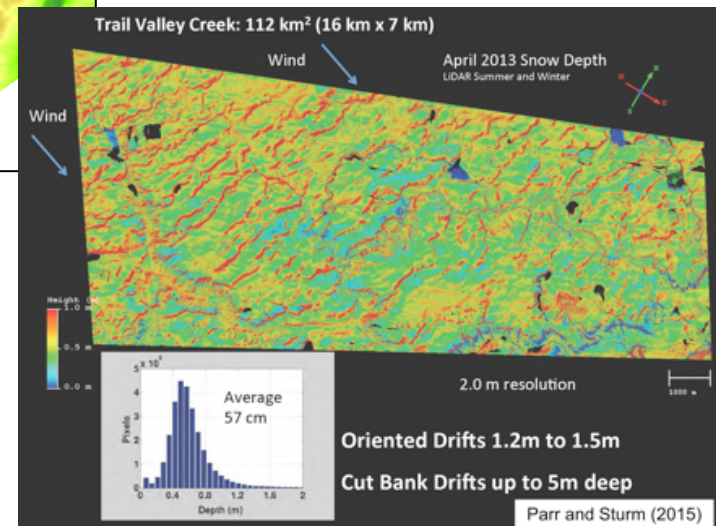
# Theme 1: Snow upscaling through remote sensing (Chris Derksen)

- Airborne radar measurements and comprehensive in situ snow measurements acquired during 2012/13 winter
- In partnership with the Canadian Space Agency, these datasets are being utilized to develop new radar algorithms for the retrieval of snow water equivalent
- Future airborne campaigns will support snow mass satellite mission concept studies ongoing at CSA and ESA

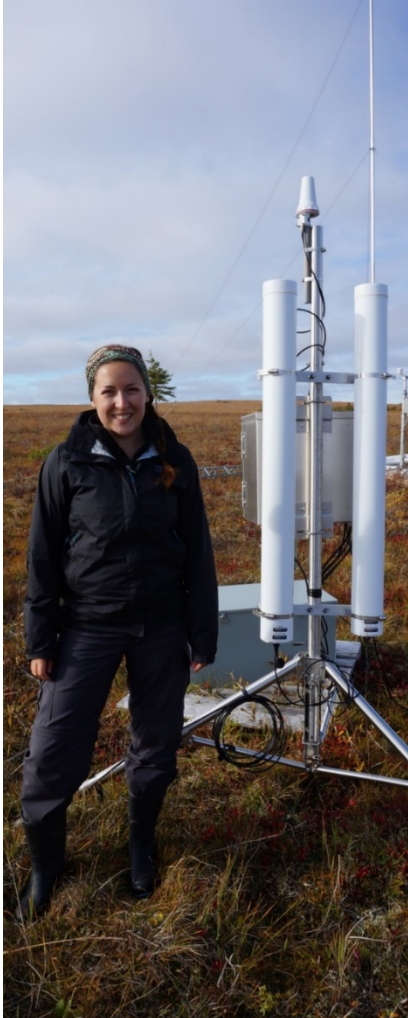
SAR



Lidar



# Theme 2: Soil Moisture measurements and remote sensing (Aaron Berg)



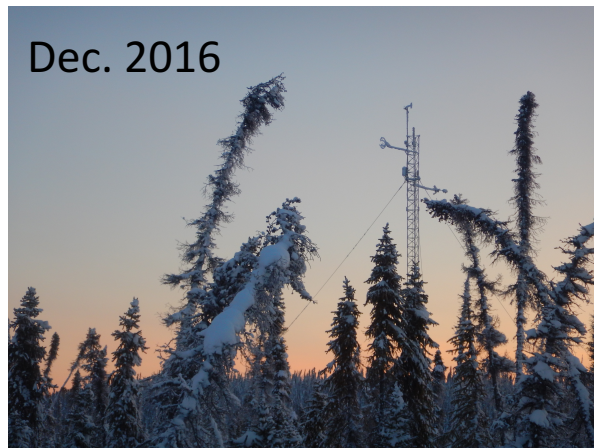
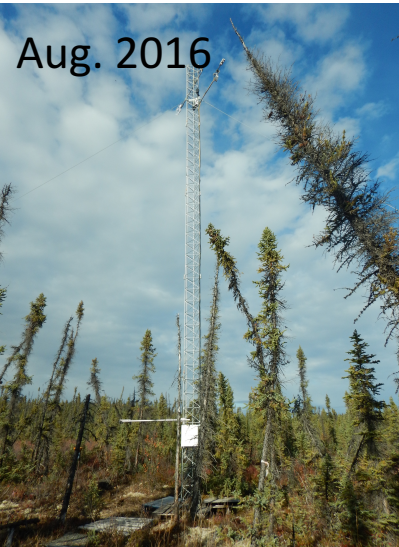
Soil moisture measurements using:

- Cosmic Ray Sensors
- Networks of point sensors such as TDR
- Remote Sensing



# Theme 3: Flux towers (Oliver Sonnentag)

Havikpak Creek



Trail Valley Creek





# Theme 4: Shrubs and forest (Jenn Baltzer)

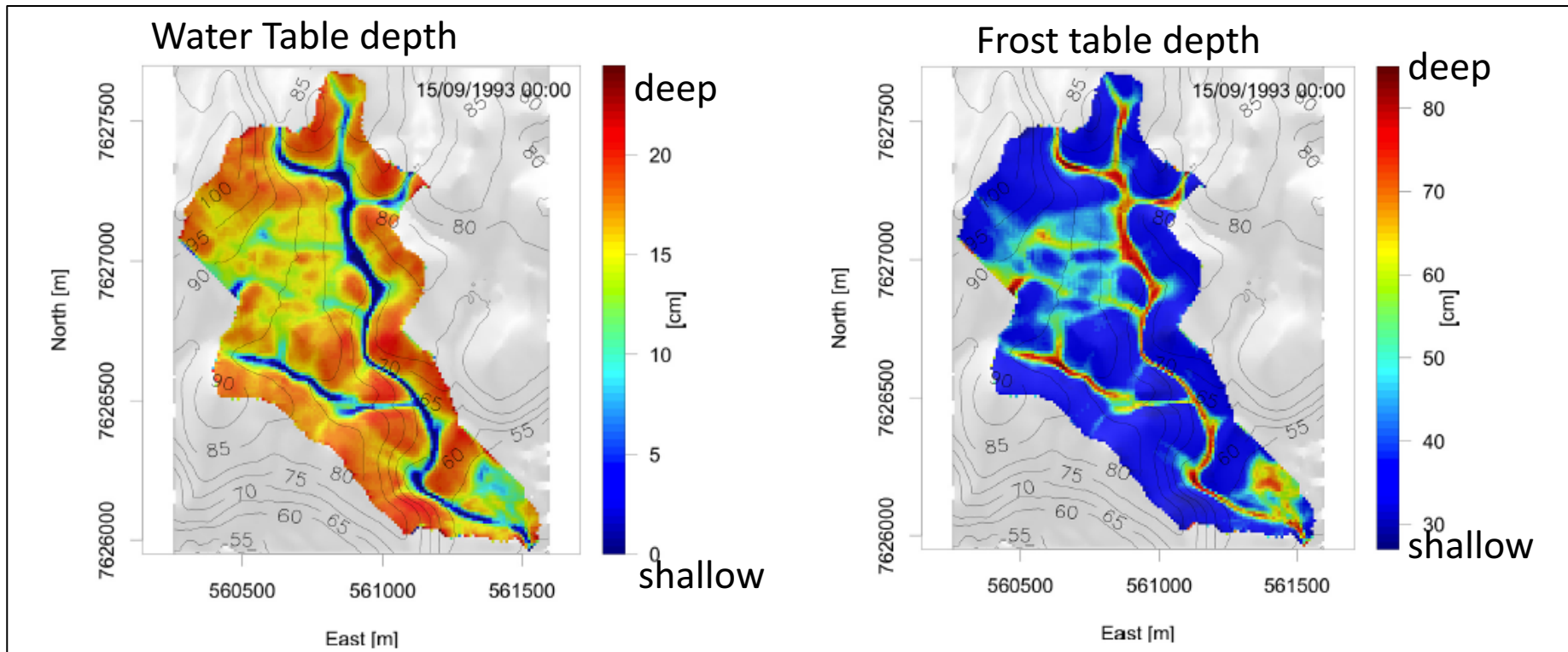




# Theme 5: Thaw depth measurements and modelling (Phil Marsh)

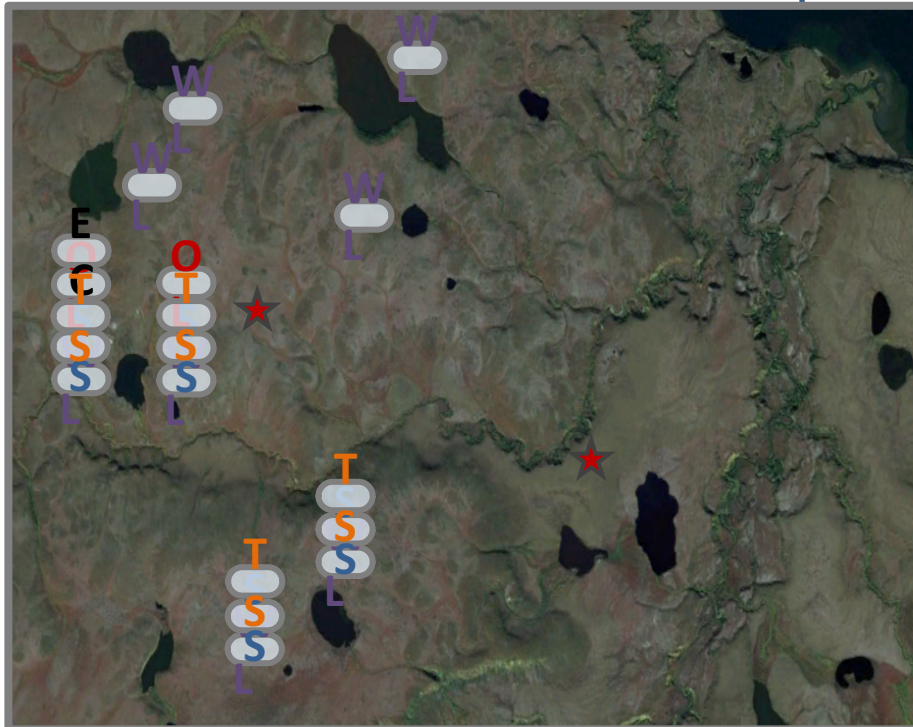
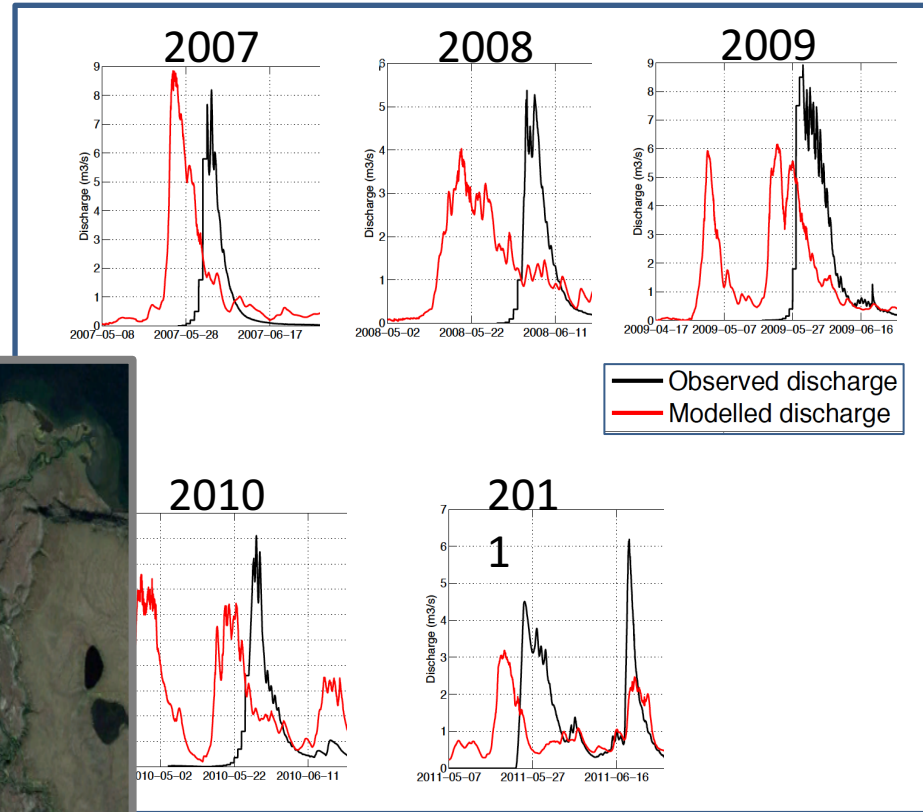
## Thaw depth modelling with GEOtop

1km<sup>2</sup> sub-basin of TVC, 10 m regular grid



# Theme 6: stream flow and lake observations and modelling

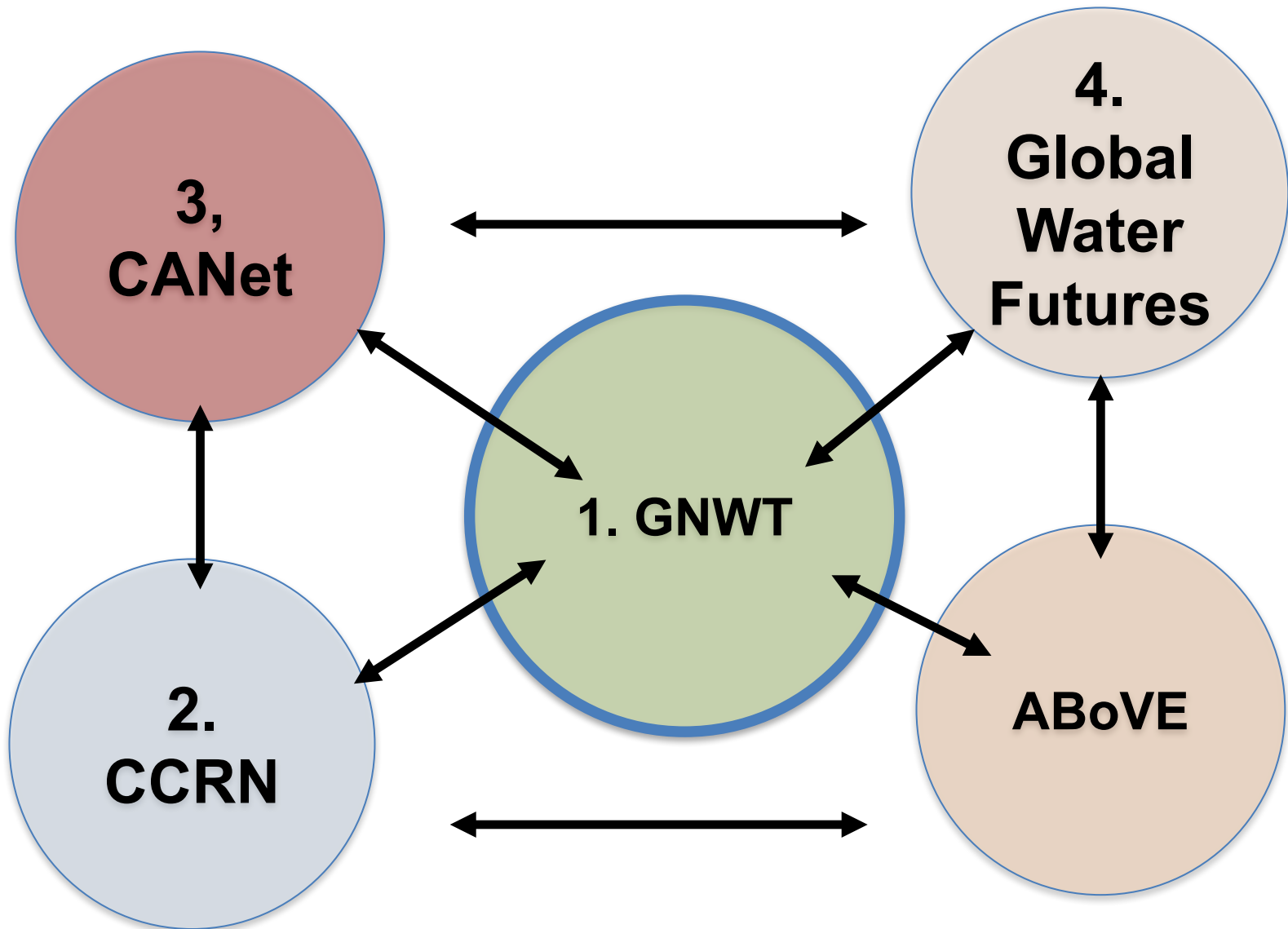
GEOtop hydrological model runs to Trail Valley Creek







# Talk # 2: How does research at Trail Valley, Havikpak and Scotty Creek, fit into our larger research program, and contribute to ABoVE





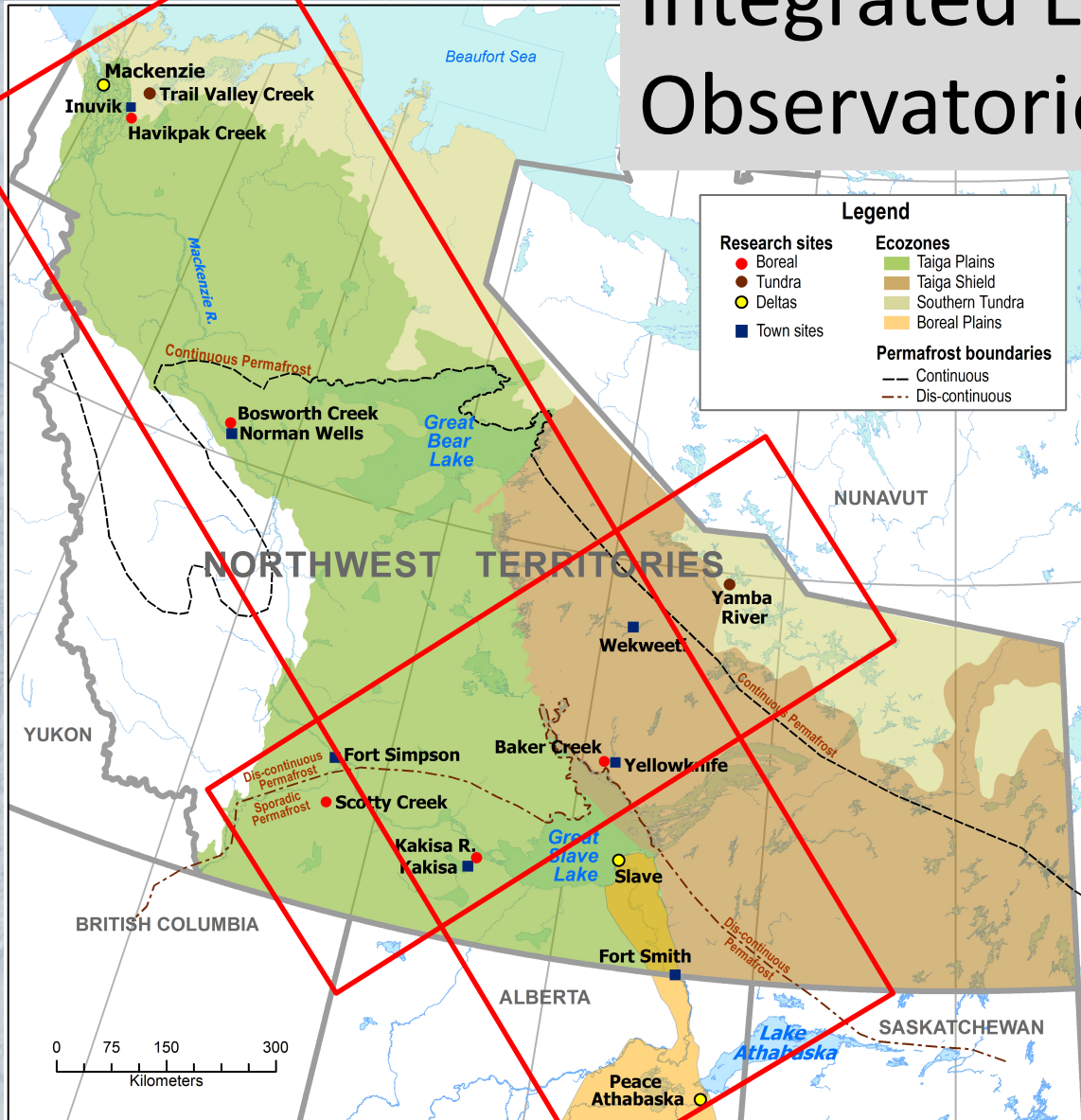
# 1. GNWT – WLU Partnership

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1. 10 year partnership: 2010 to 2020
2. Goal: to expand the Territories' capacity to conduct environmental research and monitoring, and to train the new expertise needed to manage its natural resources for future generations
3. The purpose is to provide new infrastructure and expertise to the GNWT for environmental research and education in order to expand the Territories' capacity to conduct environmental research and monitoring, and to train the new expertise needed to manage its natural resources for future generations in face of emerging challenges from climate change and the impacts of growth and development.

<https://nwtwlu.com/>

# GNWT – Laurier Partnership Integrated Environmental Observatories





# 1. CCRN Research Program (Howard Wheeler)

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- 5 year, multimillion dollar research program
- Focused on western and northern Canada, carries out research at the GNWT-Laurier Research sites
- Strongly linked to GEWEX, CliC, GEO, NCAR, NASA, WMO and more

## Research Themes

**Theme A:** Observed Earth System Change in Cold Regions - Inventory and Statistical Evaluation

**Theme B:** Improved Understanding and Diagnosis of Local Scale Change

**Theme C:** Upscaling for Improved Atmospheric Modelling and River Basin Scale Prediction

**Theme D:** Analysis and Prediction of Regional and Large Scale Variability and Change

**Theme E:** User Community Outreach and Engagement

# 1. Water, Ecosystem, Cryosphere, and Climate (WECC) Observatories

## Sub-Arctic Tundra

#11: Trail Valley Creek, NT



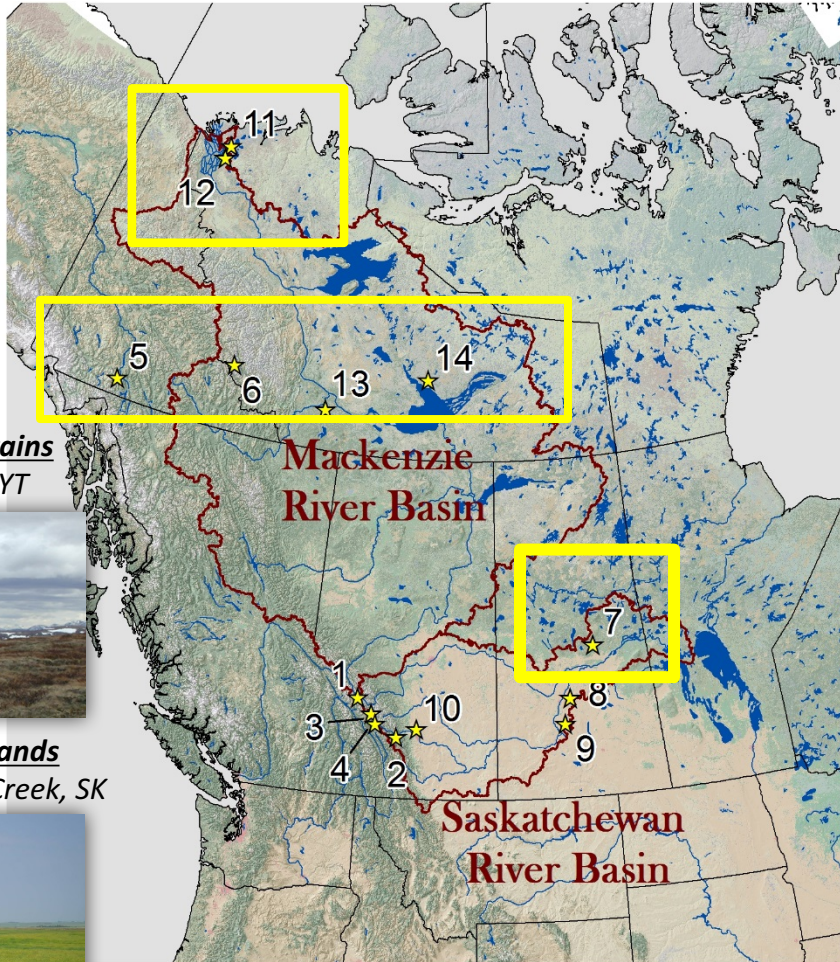
## Sub-Arctic Mountains

#5: Wolf Creek, YT



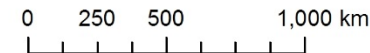
## Mixed Grasslands

#9: Brightwater Creek, SK



Water, Ecosystem, Cryosphere, and Climate (WECC) Observatories

1. Columbia Icefield, AB
2. Marmot Creek, AB
3. Peyto Glacier, AB
4. Lake O'Hara, BC
5. Wolf Creek, YT
6. Brintnell Glacier, NT
7. BERMS, SK
8. St. Denis, SK
9. Brightwater Creek, SK
10. West Nose Creek, AB
11. Trail Valley Creek, NT
12. Havikpak Creek, NT
13. Scotty Creek, NT
14. Baker Creek, NT



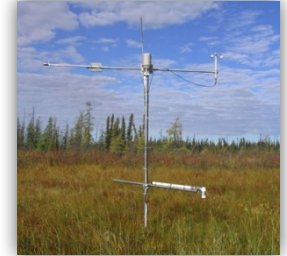
## Taiga Shield

#14: Baker Creek, NT



## Taiga Plains

#13: Scotty Creek, NT



## Boreal Forest

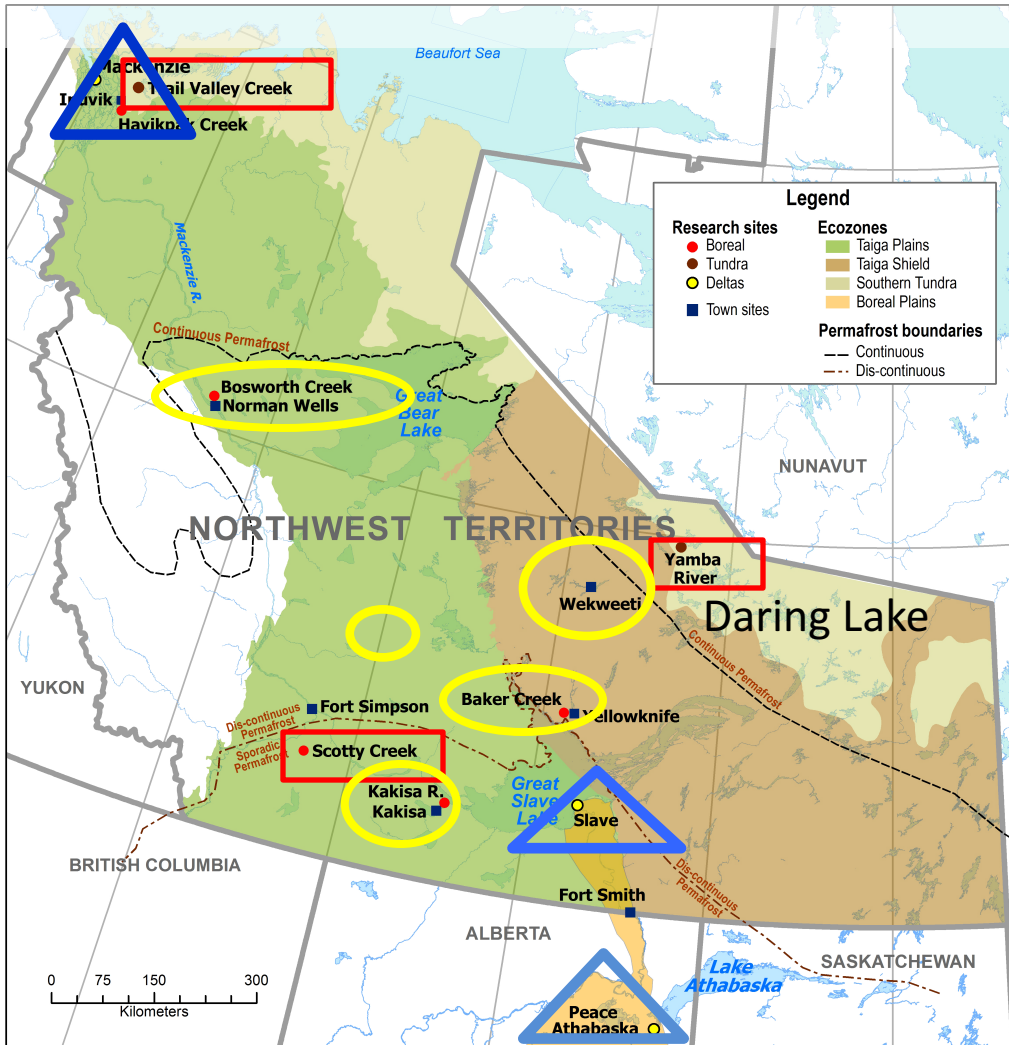
#7: BERMS, SK—  
Black Spruce





# 2. CFI - Changing Arctic Network (CANet)

## Integrated Environmental Observatories



### Remote Field Camps (red boxes)

- Trail Valley Creek (Tundra)
- Scotty Creek (Taiga)
- Tundra Ecosystem Research Station

### Other Sites (yellow ovals)

- Norman Wells (Boswell Ck)
- Kakisa (Kakisa R)
- Wekweeti
- Yellowknife (Baker Ck)
- Wrigley

### Deltas (blue triangles)

- Peace-Athabasca
- Slave
- Mackenzie

### GNWT – ENR Labs

- Yellowknife
- Ft. Simpson
- Inuvik

# Changing Arctic Network (CANet)

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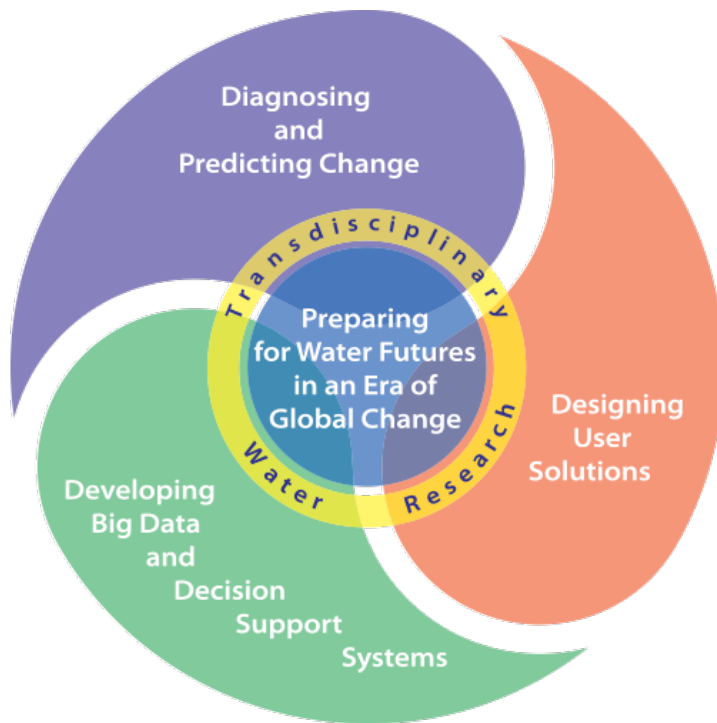
## Primary Infrastructure Categories:

- Unit 1: Resilience Unit
- Unit 2: Forest Response Unit
- Unit 3: Permafrost Unit
- Unit 4: Phenology Unit
- Unit 5: Carbon Unit
- Unit 6: Water Quantity Unit
- Unit 7: Water Quality Unit
- Unit 8: Biomonitoring Unit
- Unit 9: Northern Community Unit
- Unit 10: Laboratory Unit
- Unit 11: Support Unit
- Unit 12: Camp Infrastructure Unit
- Unit 13: NWT Laboratory Unit



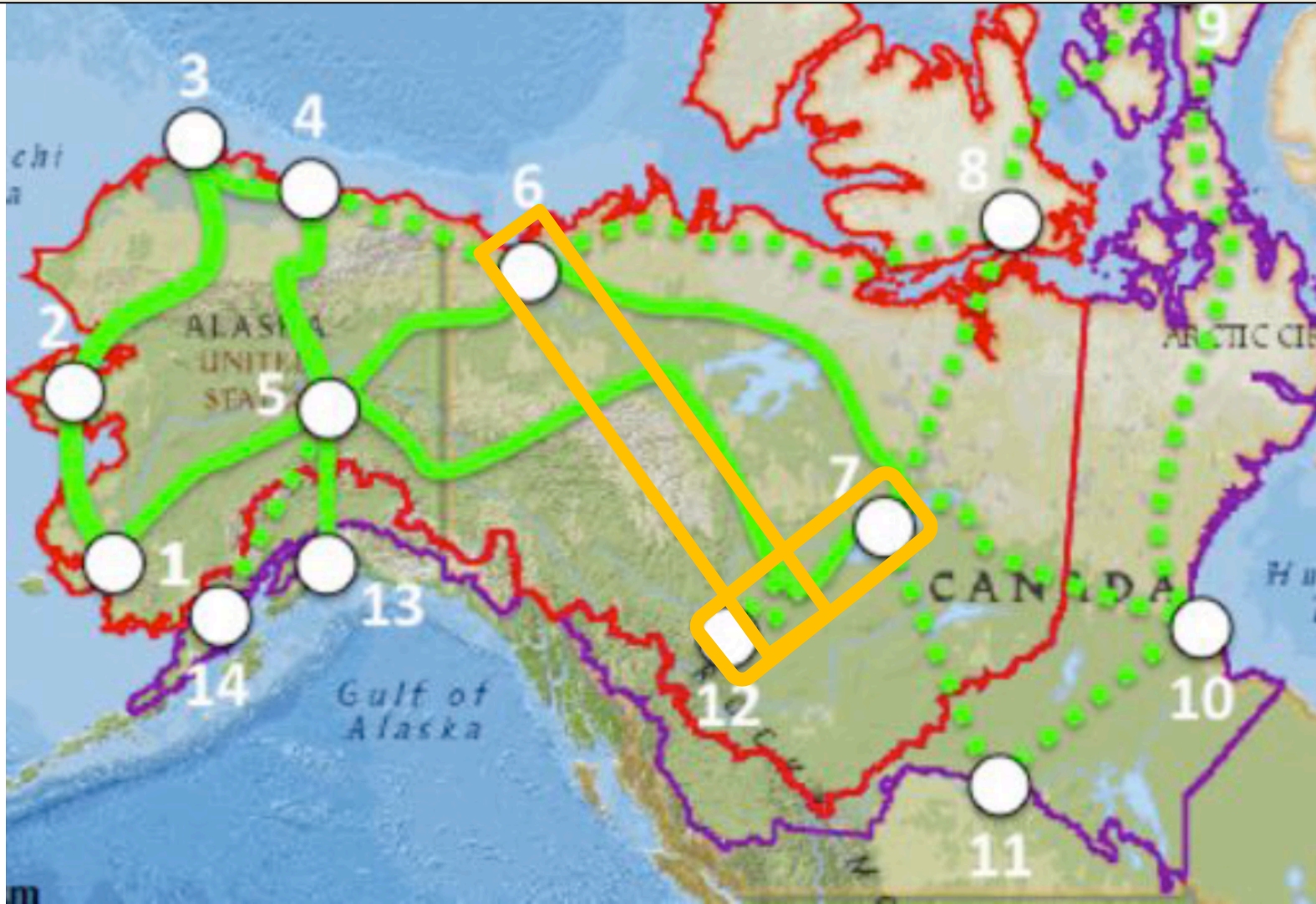
# 3. Global Water Futures

- Approximately \$80 million, 7 year program
- University of Saskatchewan is the lead university
- Partner Universities - Wilfrid Laurier University, University of Waterloo and McMaster University



"Global Water Futures: Solutions to Water Threats in an Era of Global Change" is a University of Saskatchewan-led research program that is funded in part by a \$77.8-million grant from the Canada First Excellence Research Fund. The aim is to transform the way communities, governments and industries in Canada and other cold regions of the world prepare for and manage these increasing water-related threats.

**Challenge** – to ensure that the wide range of science under the GNWT – WLU Partnership (components of CCRN, CANet, GWF) contribute fully to ABoVE





# Questions?

