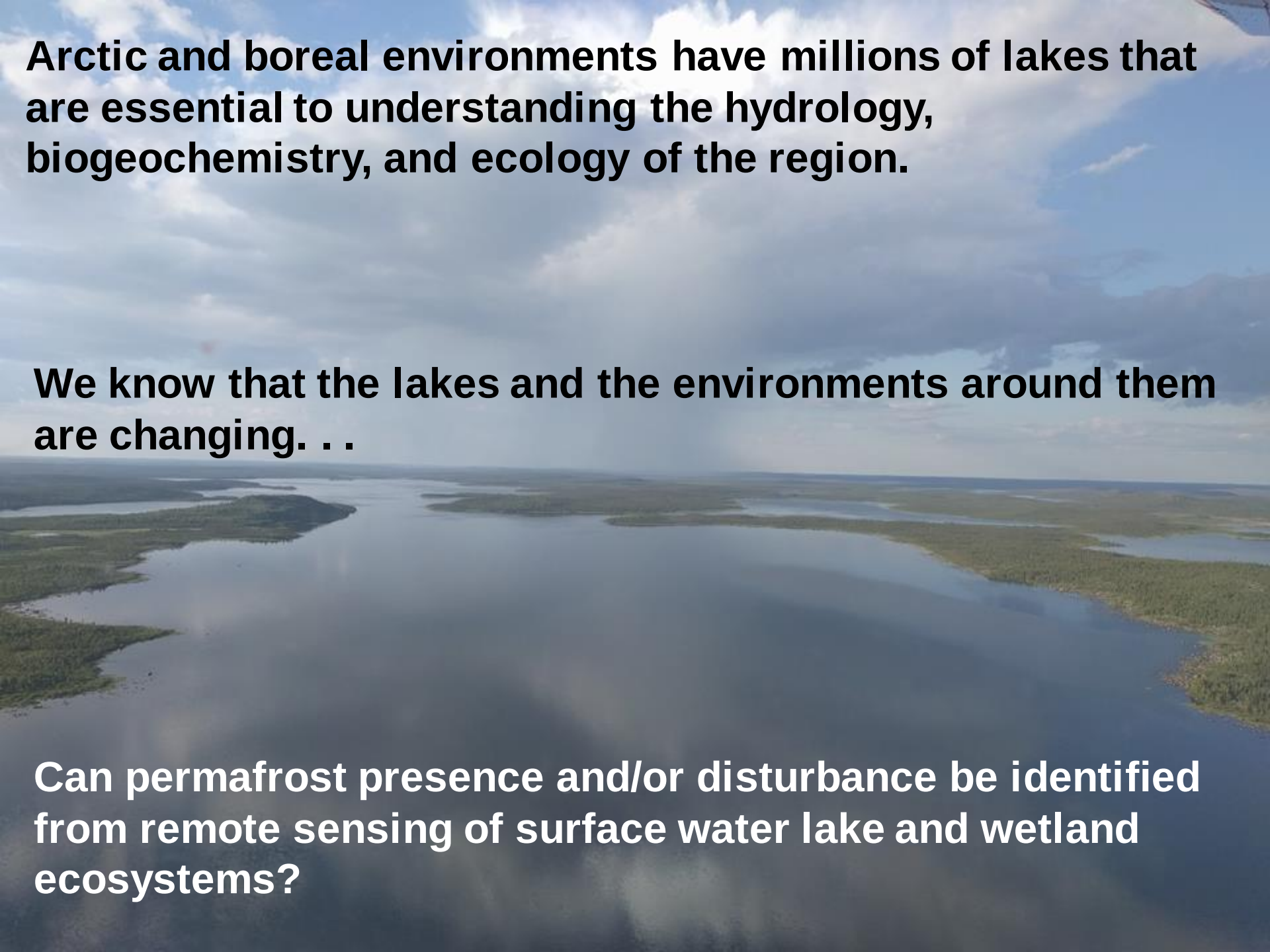
AirSWOT: Measuring the Sensitivity of Arctic-Boreal Surface Water to Permafrost Extent

Laurence C. Smith, UCLA, PI
Tamlin M. Pavelsky, UNC
Dennis P. Lettenmaier, UCLA

Gradate Students: Lincoln Pitcher, Sarah Cooley, Ethan Kyzivat, Simon Topp, Ted Langhorst, Merritt Harland

Collaborators from: Environment and Climate Change Canada (ECCC); Government of the N.W.T., Canada (GNWT); Colorado University (CU); US Geological Survey (USGS); University of Massachusetts, Amherst (UMass-Amherst); U.S. Army Cold Regions Research and Engineering Laboratory (CRREL); Brock University (Brock U.); Wilfrid Laurier University (Laurier); Laboratoire d'Etudes en Géophysique et Océanographie Spatiales, France (LEGOS); Companhia de Pesquisa de Recursos Minerais, Geological Survey of Brasil (CPRM)

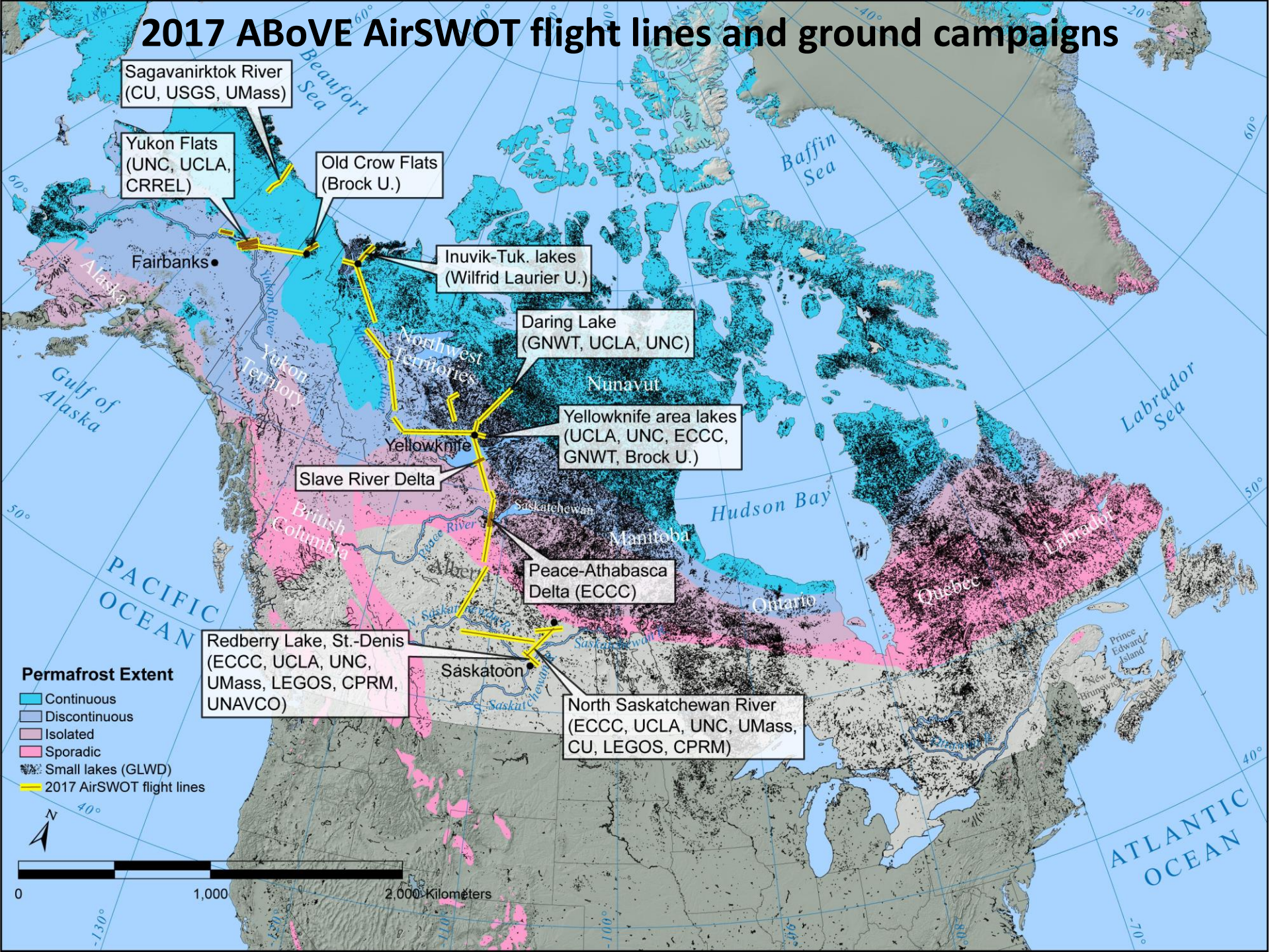


Arctic and boreal environments have millions of lakes that are essential to understanding the hydrology, biogeochemistry, and ecology of the region.

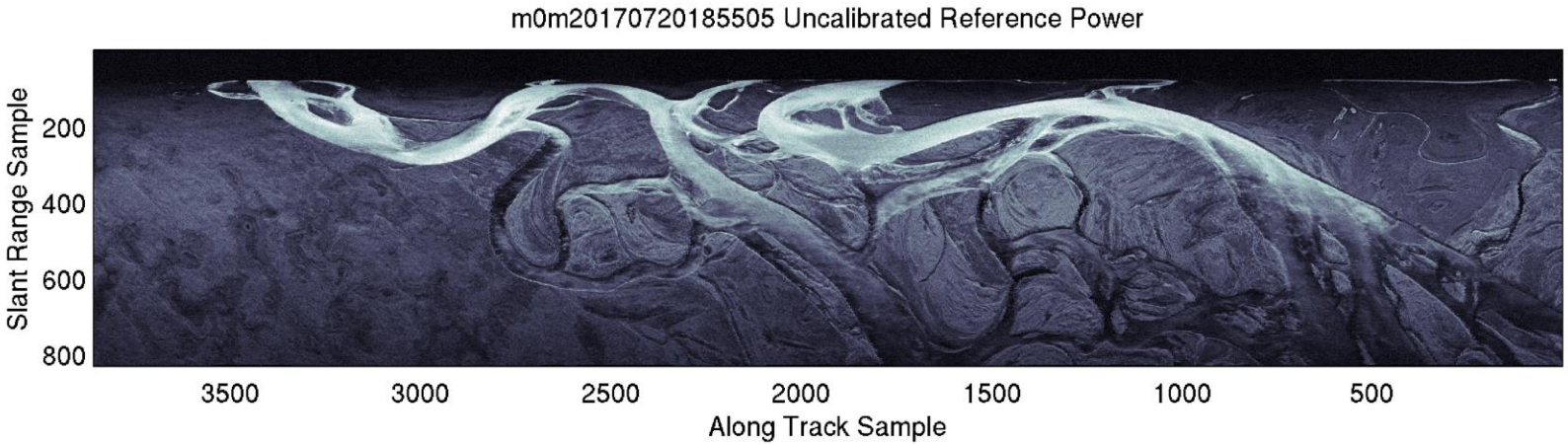
We know that the lakes and the environments around them are changing. . .

Can permafrost presence and/or disturbance be identified from remote sensing of surface water lake and wetland ecosystems?

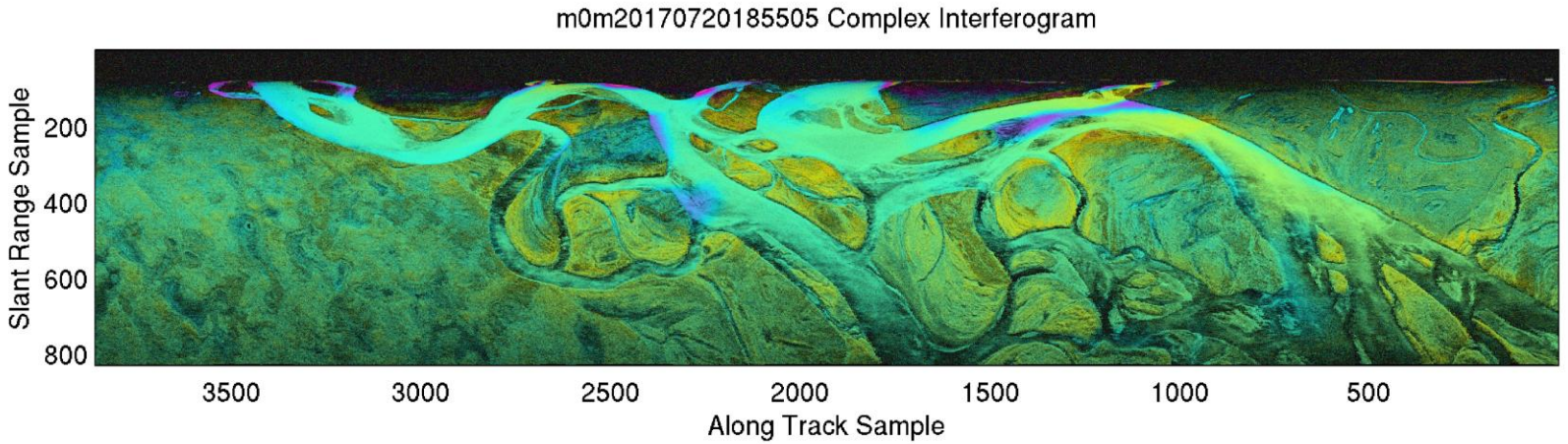
2017 ABoVE AirSWOT flight lines and ground campaigns



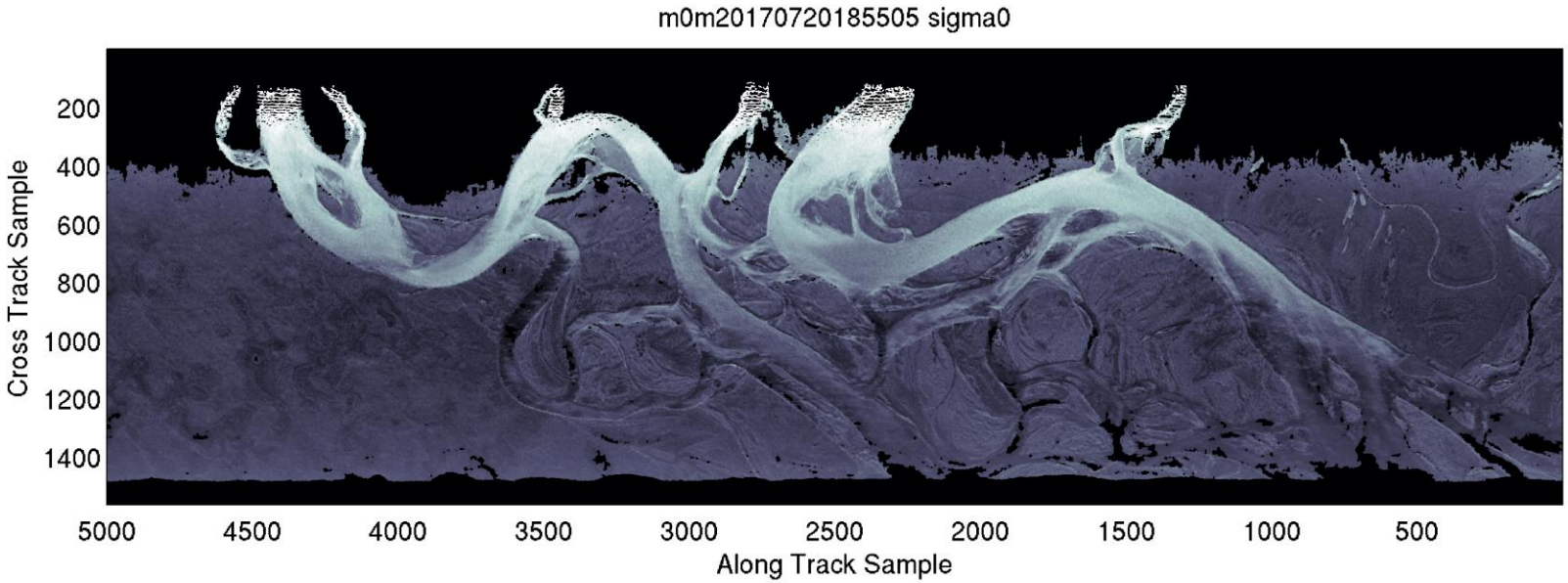
Uncalibrated Reference Channel Power



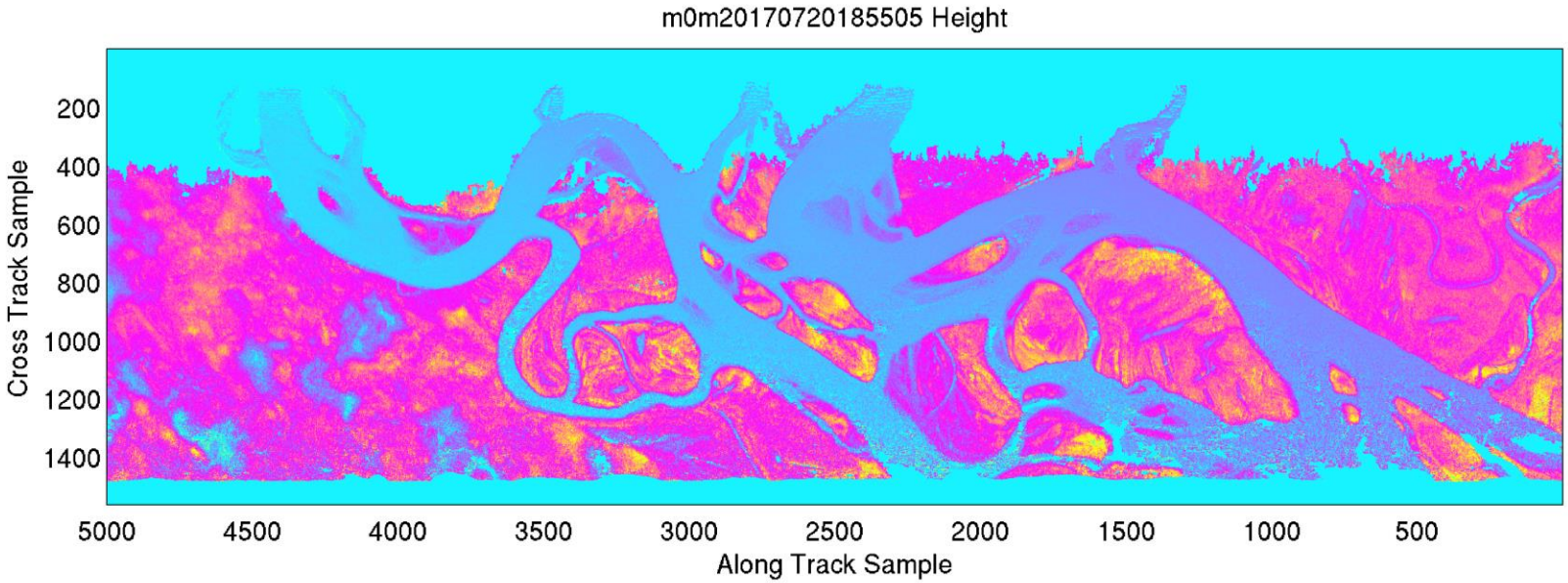
Complex Interferogram
brightness = interferometric coherence
color = wrapped phase flattened with reference DEM



sigma0

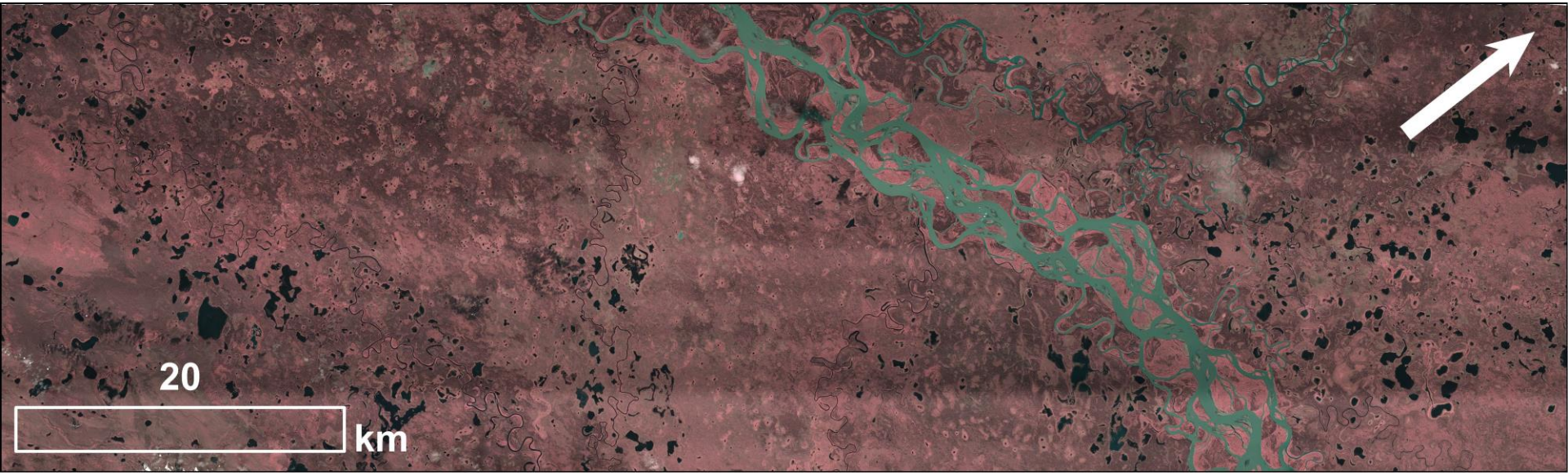

m0m20170720185505 sigma0
Cross Track Sample
200
400
600
800
1000
1200
1400
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
Along Track Sample

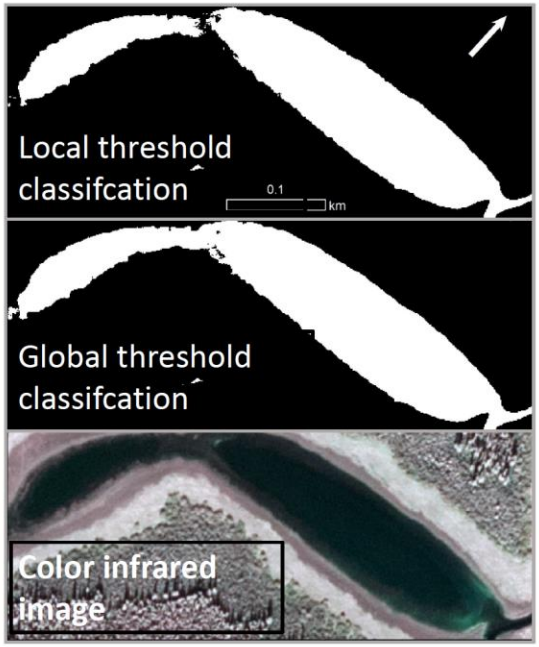
Reconstructed Height



AirSWOT DCIS Lake Classification

Poster: Ethan Kyzivat et al., Thursday, #99





Results from the AirSWOT DCIS color infrared camera show that it can be used to successfully classify lake areas with high accuracy.

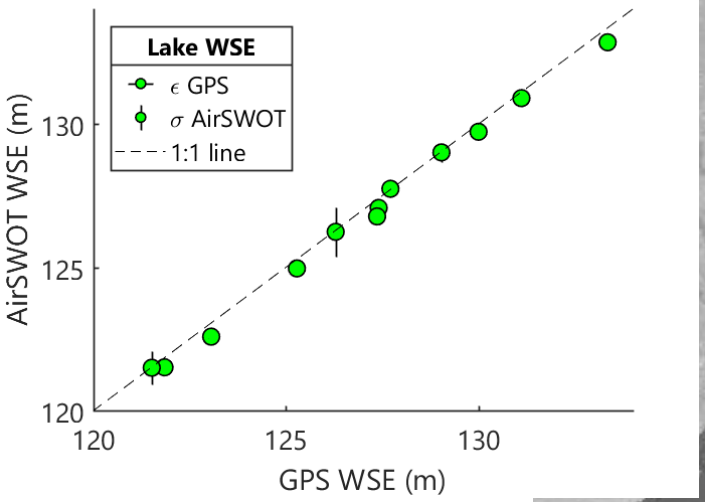
This data will be critical for calculating lake height and lake water storage variations from AirSWOT radar data.

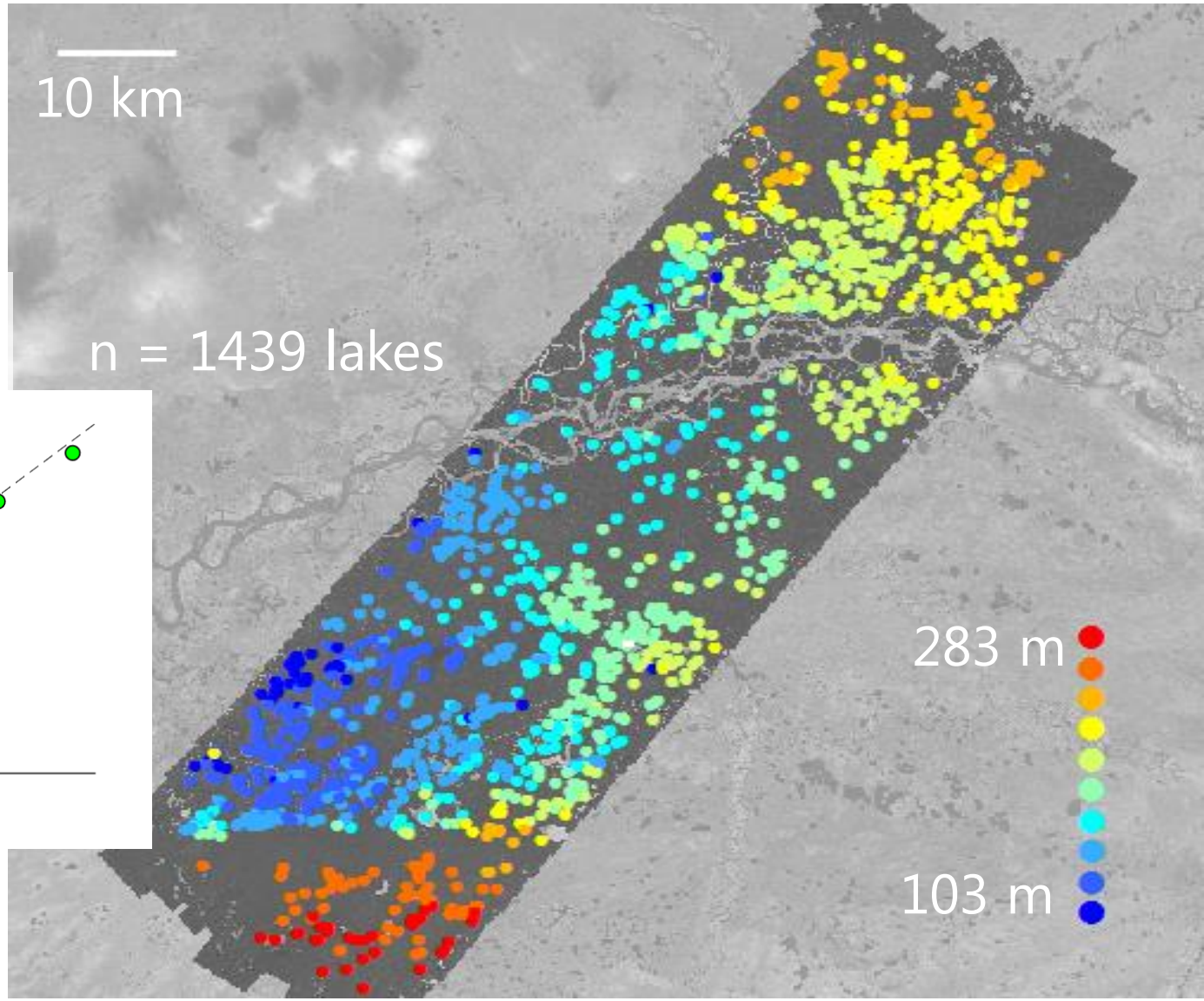
Capabilities of AirSWOT Radar in the Yukon Flats

Poster: Lincoln Pitcher et al., Thursday, #87

AirSWOT Can resolve heights in >1400 lakes in the Yukon Flats. Results from 2015 data suggest that lakes heights in areas with high permafrost likelihood are more variable.

AirSWOT resolves lake levels with RMSE 21 cm

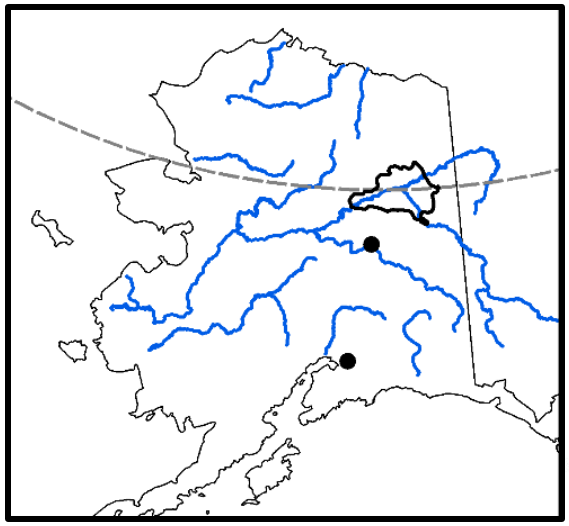




Seasonal Variability of Surface Water Extent

Poster: Sarah Cooley et al., Thursday, #83

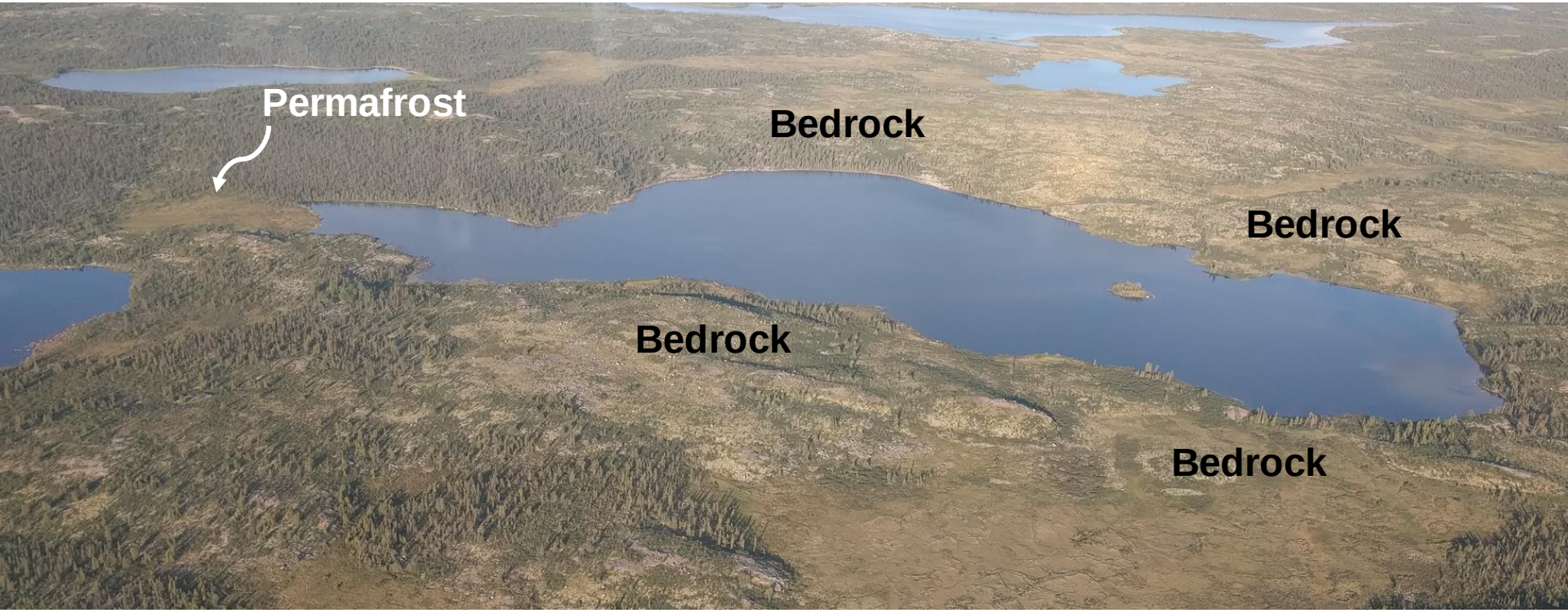
Daily optical imagery from Planet shows that patterns of seasonal lake area variations are partly controlled by permafrost.



50 km

Building for the Future

The Canadian Shield has hundreds of thousands of lakes that make up a substantial fraction of its surface area. A common assumption is that these lakes are primarily bedrock-controlled. . .



Science Questions:

1. What portion of Canadian Shield lakes are controlled by permafrost?
2. Do permafrost-controlled lakes behave differently from bedrock-controlled lakes?
3. How vulnerable are permafrost-controlled lakes to permafrost degradation?