



Hydrology, Hydropower, and Remote Sensing in Alaska

Jessica Cherry, Katrina Bennett, and Molly Tedesche
High Latitude Proving Ground

Outline

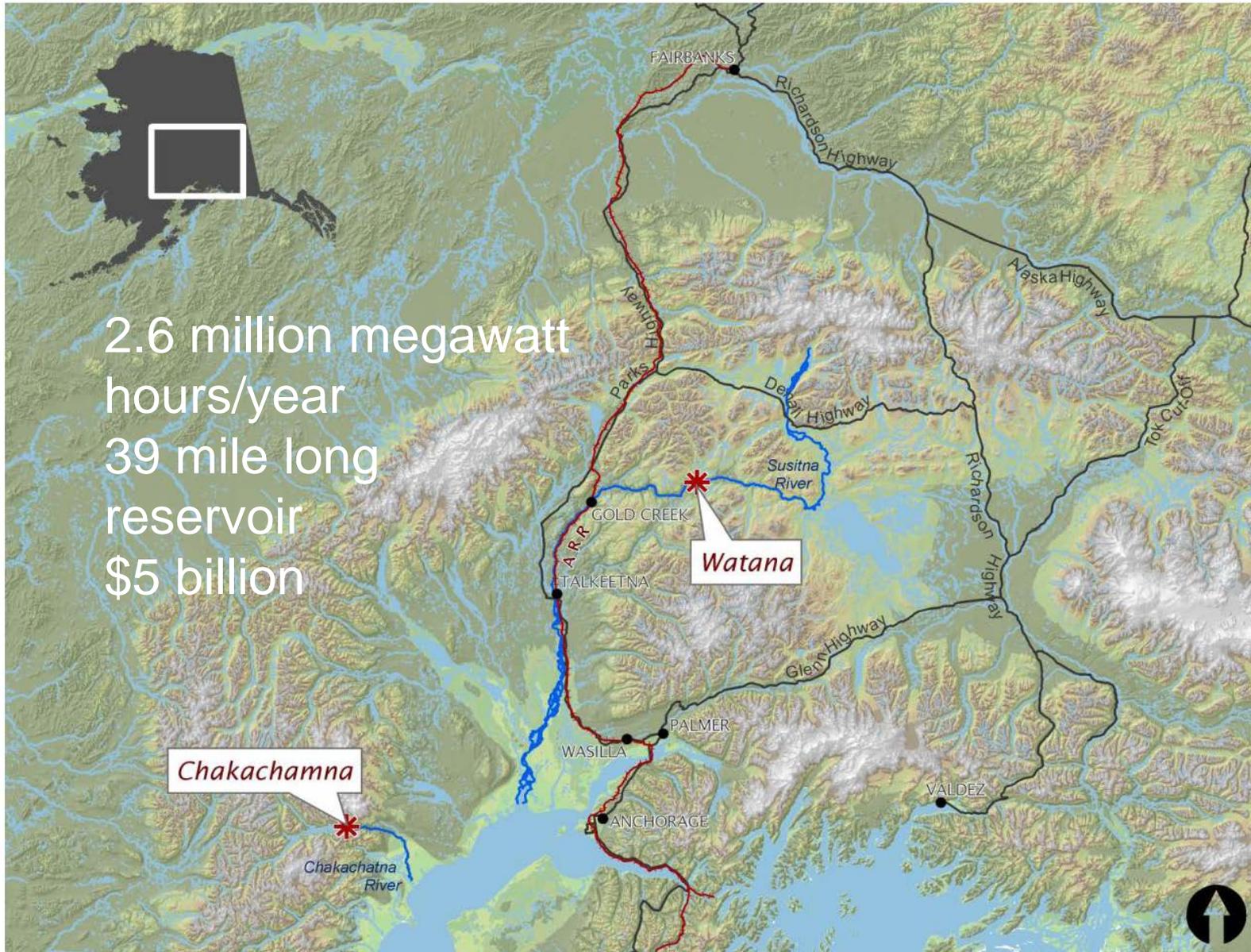
- Motivation: Communities and Physical Infrastructure
- High Latitude Proving Ground Snow Hydrology related activities
- Other Tools in our Toolbox/Ongoing activities related to imagery-based hydrology

Another Flood Season in AK



NWS photo

Susitna Proposal



Bradley Lake: Railbelt Power



**The FOUR DAM POOL
Power Agency**

**HYDROELECTRIC PROJECTS
in Alaska**



Terror Lake

Communities Served:
Kodiak and Port Lions
Provider:
Kodiak Electric Association
Facilities:
Two-unit 22.5 MW plant.
1-17.4 mile 138 kV line
1-14 mile 14.4/24.9 kV line
2,200 foot tailrace
discharges into Kizhuyak River



Solomon Gulch

Communities Served:
Glennallen & Valdez
Provider:
Copper Valley Electric Assoc.
Facilities:
Two-unit 12MW plant
106 mile transmission line



Tyee Lake

Communities Served:
Wrangell and Petersburg
Provider:
Thomas Bay Power Authority
Facilities:
Two-unit 22.5MW plant.
83 mile transmission line



Swan Lake

Communities Served:
Ketchikan Area
Provider:
Ketchikan Public Utilities
Facilities:
Two-unit 22.5MW plant.
30 mile transmission line



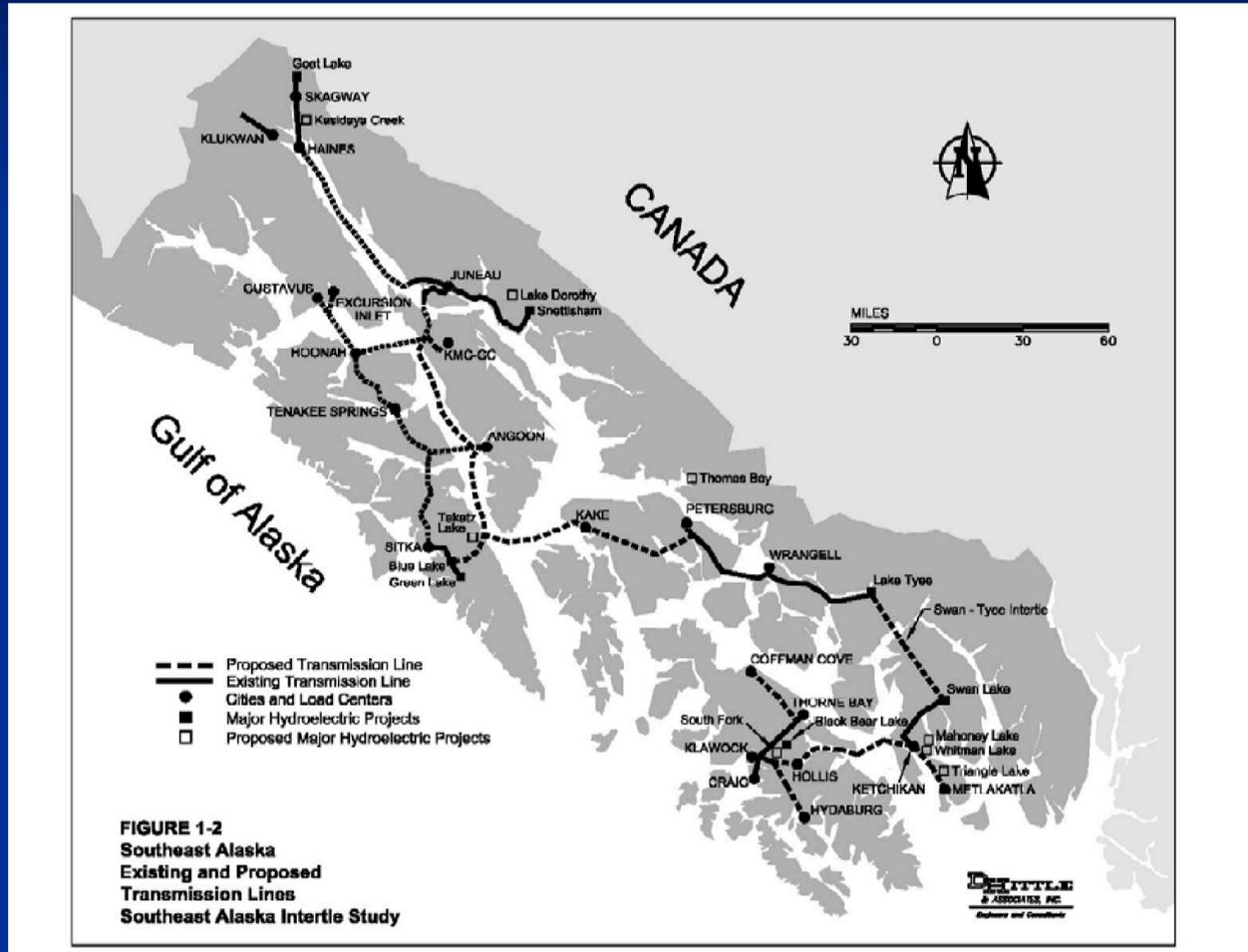
Planned Swan-Tyee Intertie

Communities To Be Served:
Wrangell, Petersburg, Ketchikan
with excess 80,000,000 kWh unutilized capacity

Facilities:
Planned 57-mile intertie
connecting Swan Lake & Lake Tyee projects

Bradley Lake
Two unit 45 MW plant

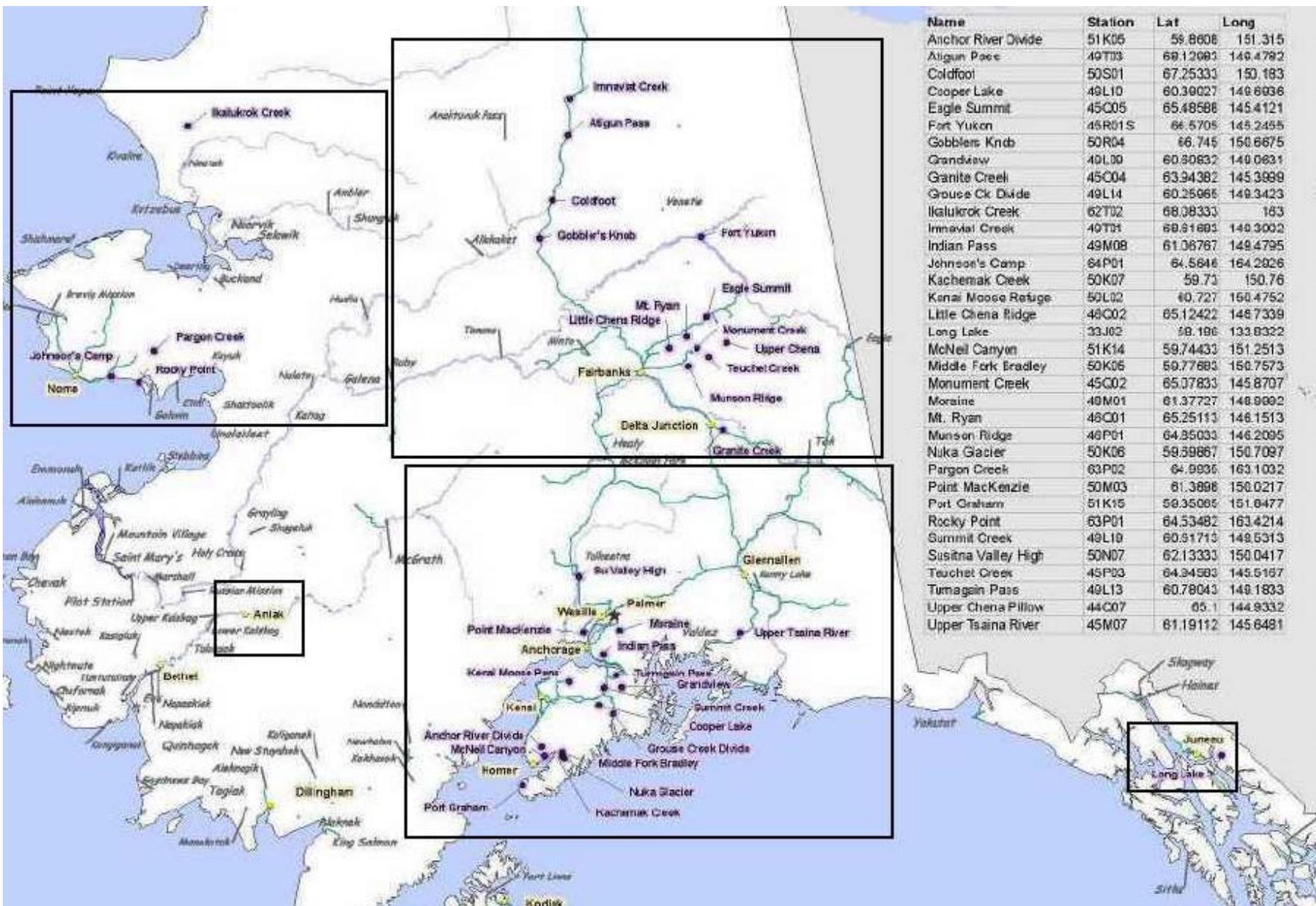
SE Grid – Existing and Proposed



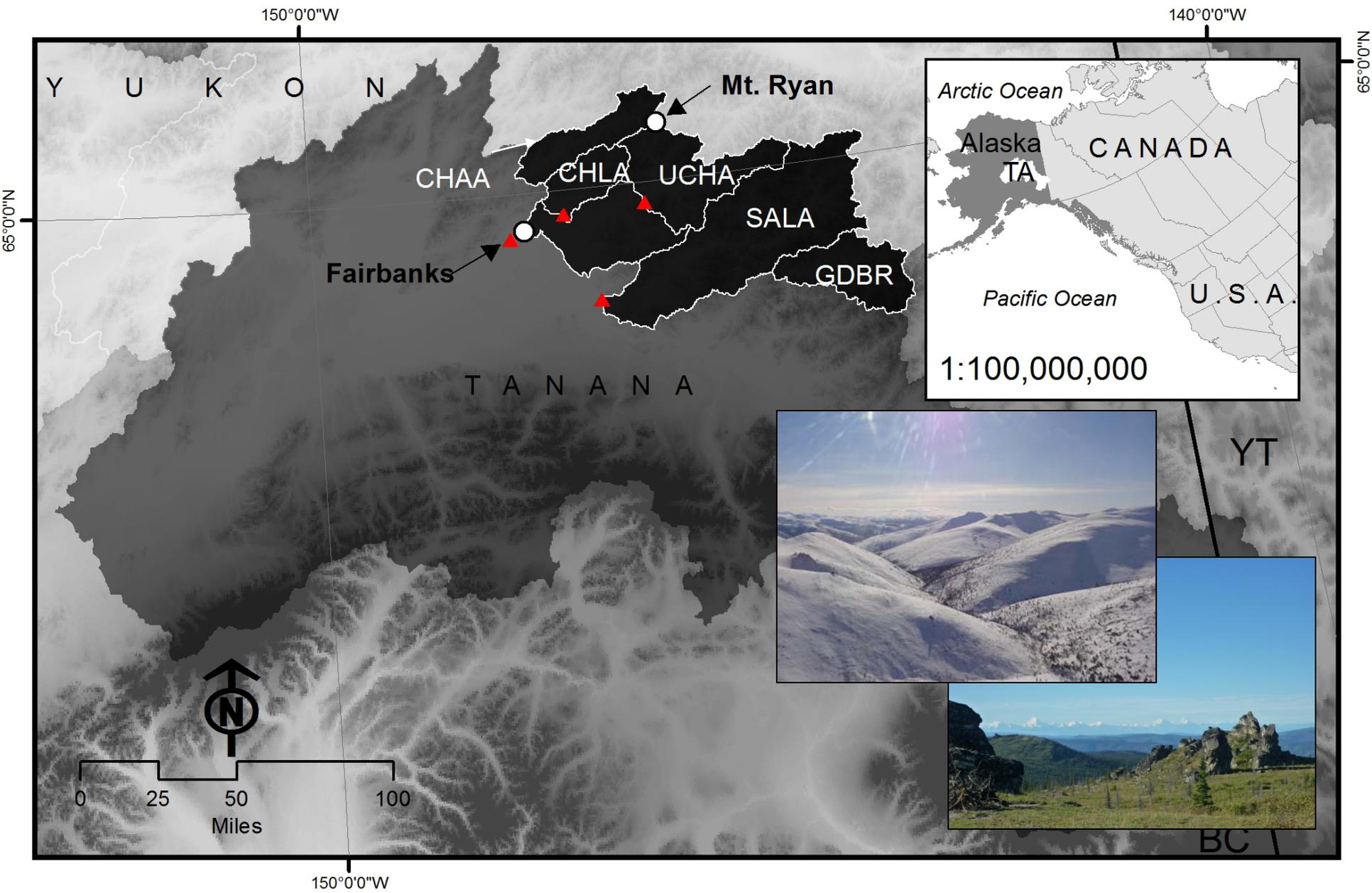
The FOUR DAM POOL

Power Agency

Snotel Network in AK



High Latitude Proving
Ground Snow Products:
collaboration with AK River
Forecast Center



150°0'0"W

140°0'0"W

Y U K O N

Mt. Ryan

CHAA

CHLA

UCHA

SALA

GDBR

Fairbanks

T A N A N A



150°0'0"W

N.0'0"N

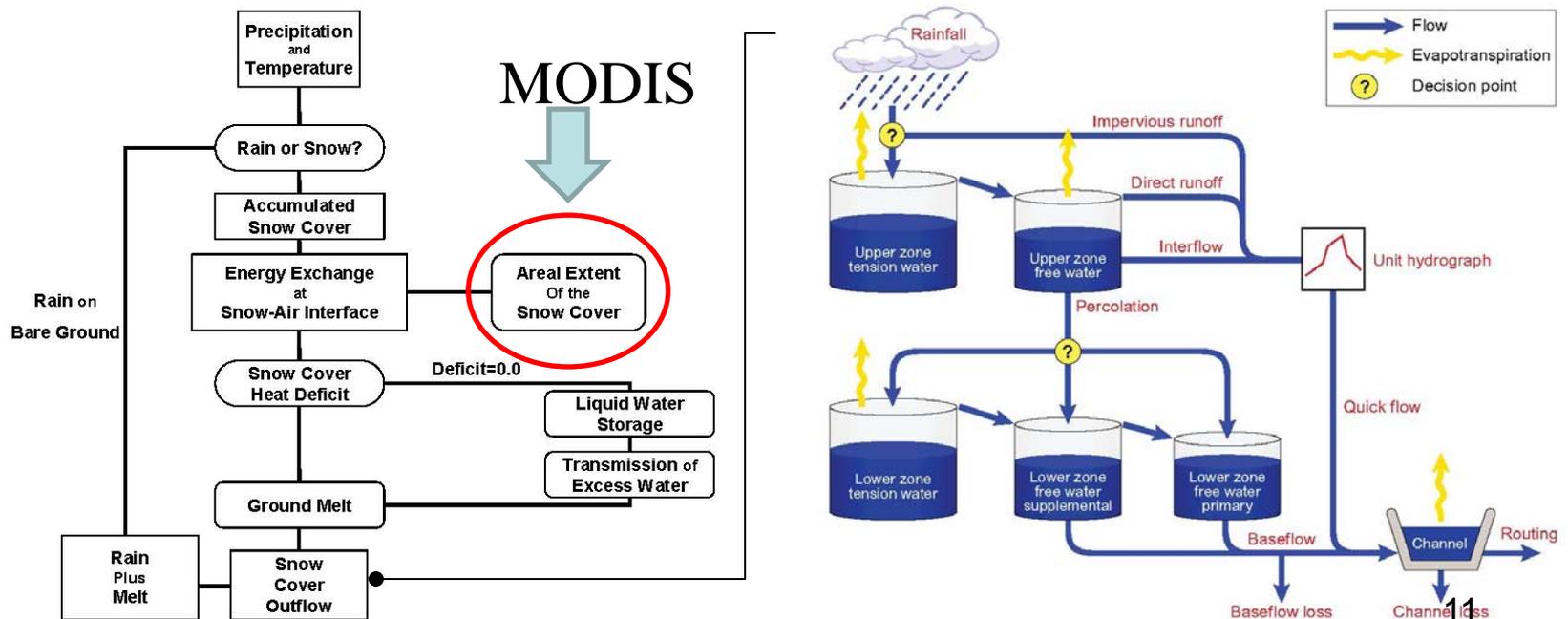
65°0'0"N

YT

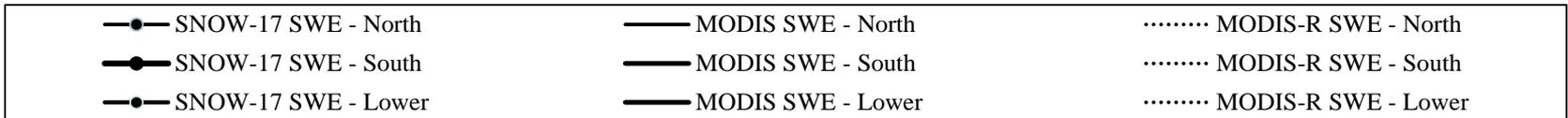
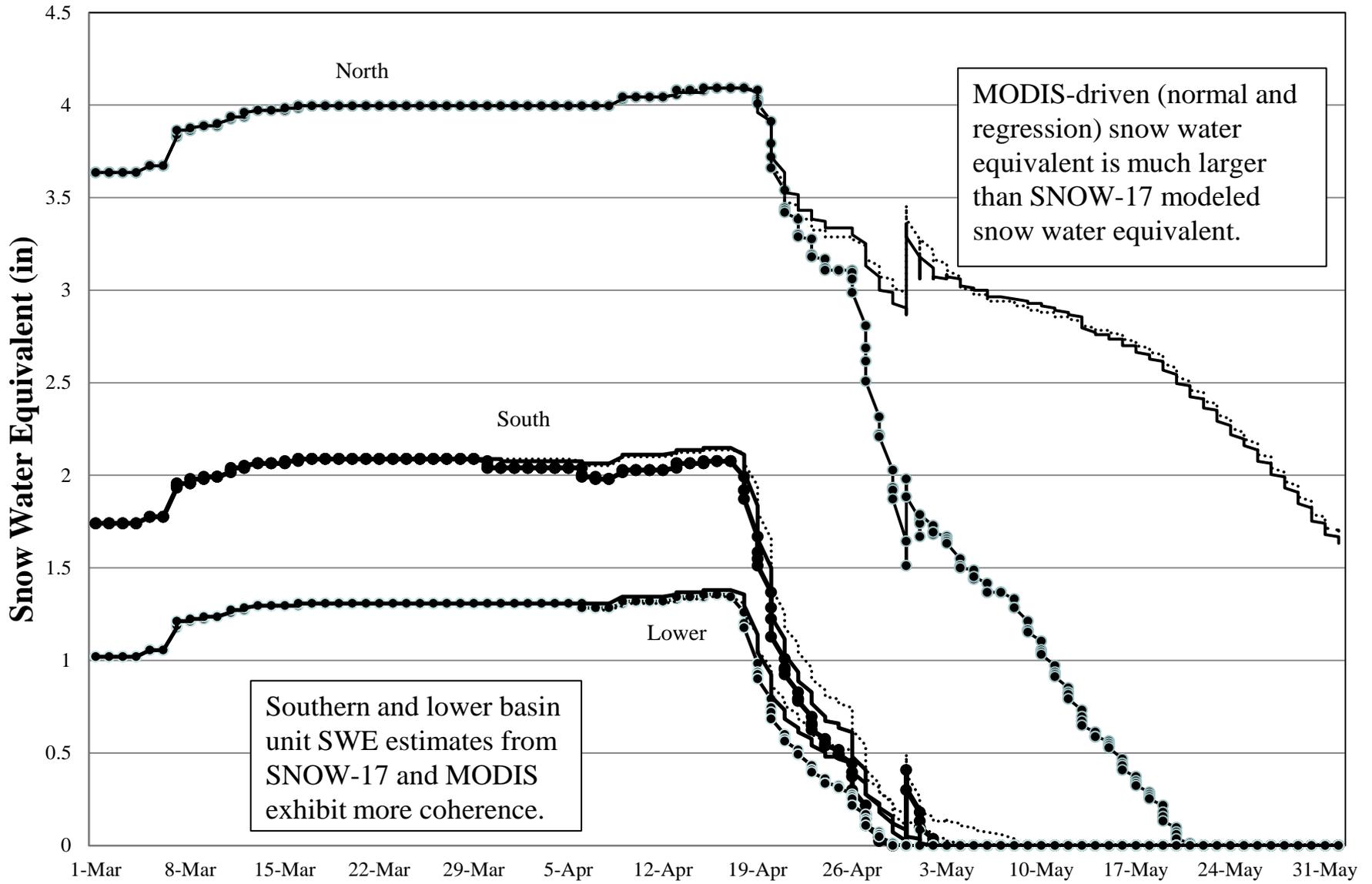
BC

SNOW-17/ SAC-SMA

- **SNOW-17**, snow air temperature index model
- **SACramento Soil Moisture Accounting** model, conceptual water balance model and a frozen ground iteration (Dec 2010), run in lumped mode



Upper Chena River Basin - MODIS vs SNOW-17 Model Snow



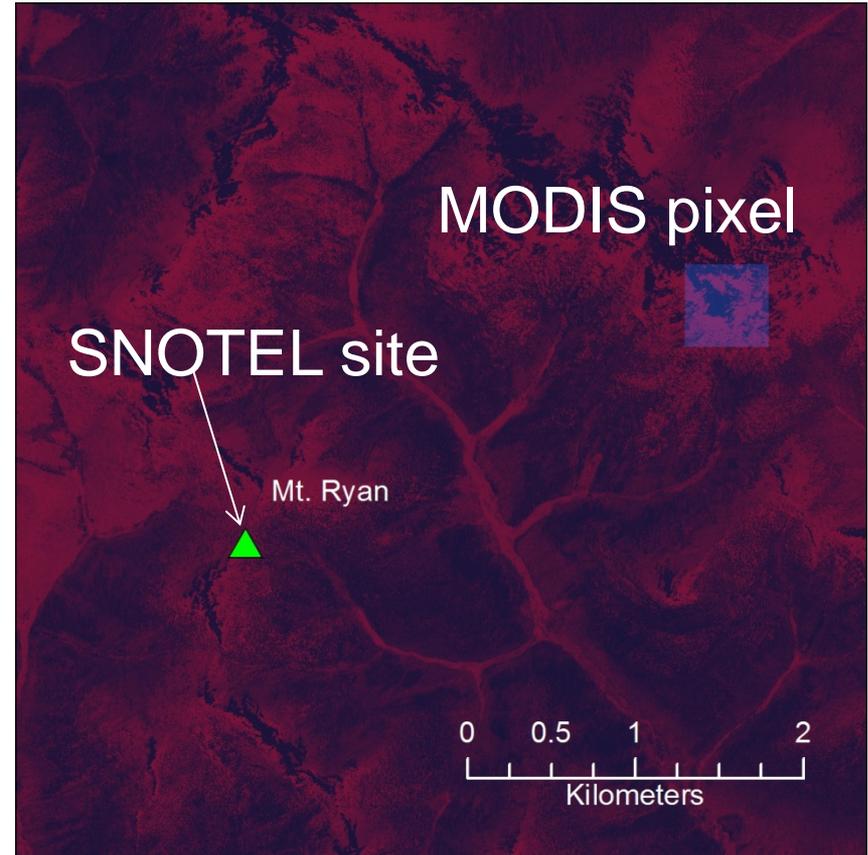
Field Work Spring Snowmelt 2013

- MODIS needs to be verified at the broad scale for quantification of error in snow cover extent through the melt season
- For example, an important question is how does the MODIS data perform in boreal forested regions in comparison to open vegetated sites?
- These questions can not be addressed without a detailed field campaign

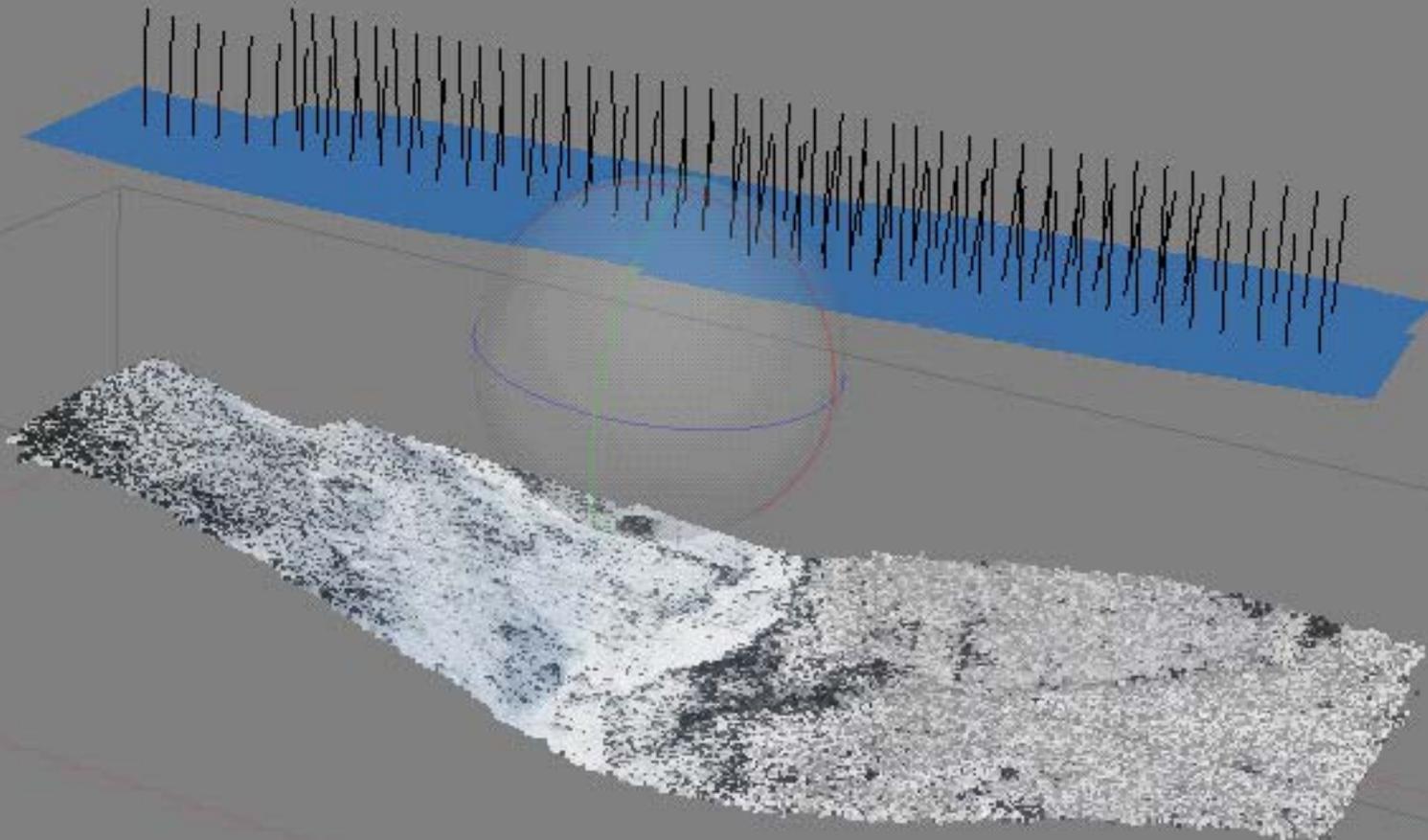
Field Work Spring Snowmelt 2013

Capture melt using different types of remote sensors

- Fish eye approach
- Time-lapse photos
- Airborne low level RGB photography (Navion L17, 4 person fixed-wing, 1500 feet AGL)
- Manual sampling through sites in the basin
- Aim to capture a range of forested, tundra and shrub sites for validation of MODIS snow cover extent and melt



CPCRW Snow Surveys



New Collaboration: NOHRSC

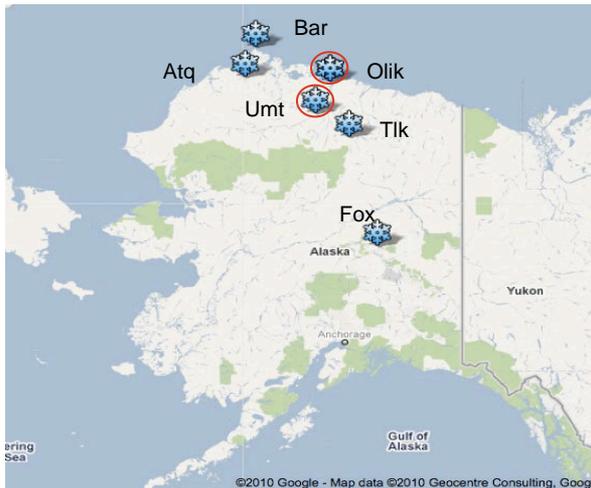
- Goals: making more snow and other hydrology products available in Alaska on operational time scales
- Short term: frequent telecons
 - Experimental model evaluation by UAF grad students
 - Get MODSCAG (GOES-R SCA) product flowing to Alaska
- Long term: expand airborne observation program
 - Test and evaluate physically based hydrology models
 - Utilize and improve data assimilation
 - Using NASA LIS and SNODAS in Alaska

Other tools in our Toolbox

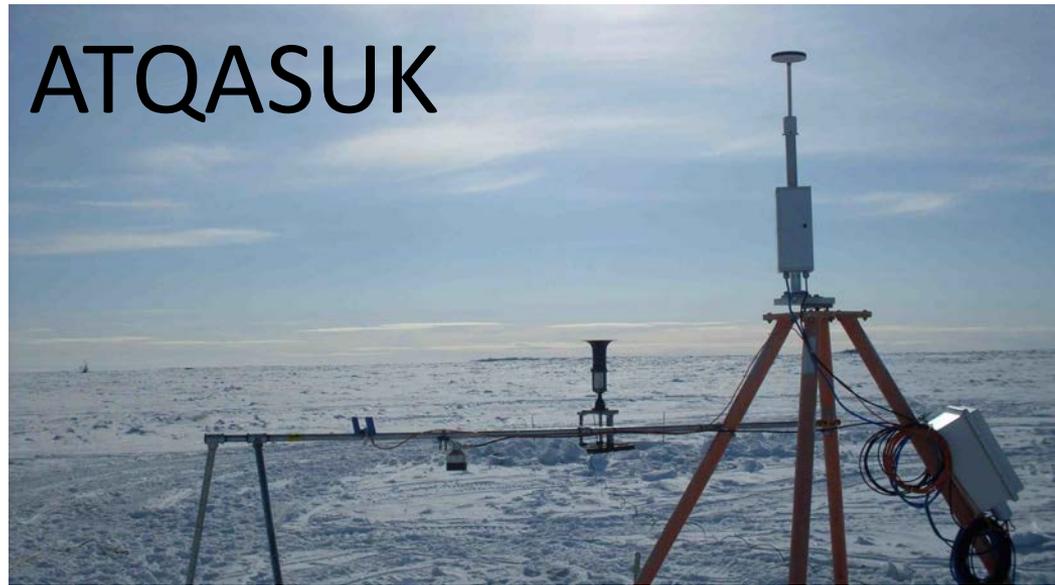


In Situ Station Networks

Arctic Transportation Networks: improved monitoring and prediction of blowing snow

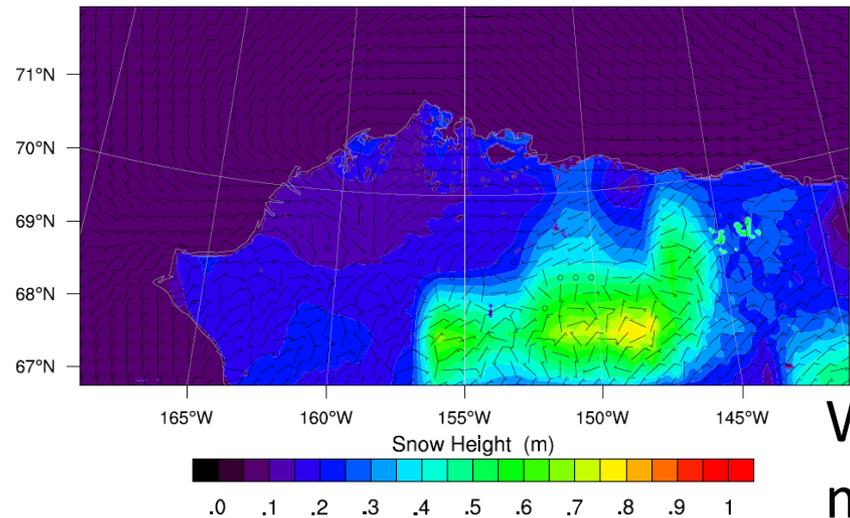


 = deploying in summer 2013



J. Cherry

Used for in situ studies and validation of models



Example: Seward Peninsula

<http://ine.uaf.edu/werc/projects/seward/>



Photo: R. Busey, J. Cherry



International Arctic Research Center and Water and Environmental Research Center UAF INE WERC Home Sitemap SP Diagnostics Bering Strait Research Consortium

Seward Peninsula Hydrometeorology Network

Home About Us Sites Past Projects Project Team Current Data

Seward Peninsula Weather Stations

Welcome to our near-real time and historical data portal for our weather and hydrology sites in the Bering Strait region.

Map Markers

- Anvil Mt
- Anvil City Science Academy
- C1-Grid
- C2-Blueberry
- Kigluaiks
- K1-Burn
- K2-Met
- K3-Mauze
- Skookum

icing conditions are the typical cause of data communication problems.

Please bear with us and check back later.

A satellite map of the Seward Peninsula with several weather station locations marked with blue pins and labels: K3-Mauze (N/A), K1-Burn (N/A), K2-Met (N/A), Kigluaiks (N/A), C2-Blueberry (N/A), C1-Grid (N/A), Skookum (-22° C / -7° F), Anvil Mt (5° C / 40° F), and Anvil City Science Academy (-1° C / 31° F). The Google logo and copyright information are visible at the bottom of the map.

Stations

- Council
 - C1-Grid
 - C2-Blueberry
- Kougarok
 - K1-Burn
 - K2-Met
 - K3-Mauze
- Anvil Mountain
 - Anvil City Science Academy
- Skookum Pass
- Kigluaiks

Data Codes

| Code | Data Type |
|------|--------------------------|
| AT | Air Temperature |
| RH | Relative Humidity |
| WS | Wind Speed |
| WD | Wind Direction |
| P | Precipitation |
| SD | Snow Depth |
| SM | Soil Moisture |
| STP | Soil Temperature Profile |
| SST | Soil Surface Temperature |
| BV | Battery Voltage |
| PT | Panel Temperature |

Real Time Data pulled over a network of radios and repeaters

Uploaded to Internet at Nome; web services

Archived at UAF

Partnerships: Northwest Campus of UAF in Nome, Anvil City Science Academy (Jr. High), Kawerak Native Corp, National Park Service

Data Management

ArcticLCC Data Rescue and Inventory
of Hydrology-Related Data in Arctic Alaska

Home Project Description Project Documents Contributors Contacts

Now Available: ArcticLCC Final Report

Imiq Database

Welcome to the ArcticLCC Data Rescue and Inventory of Hydrology-Related data in Arctic Alaska.

Map Search Results

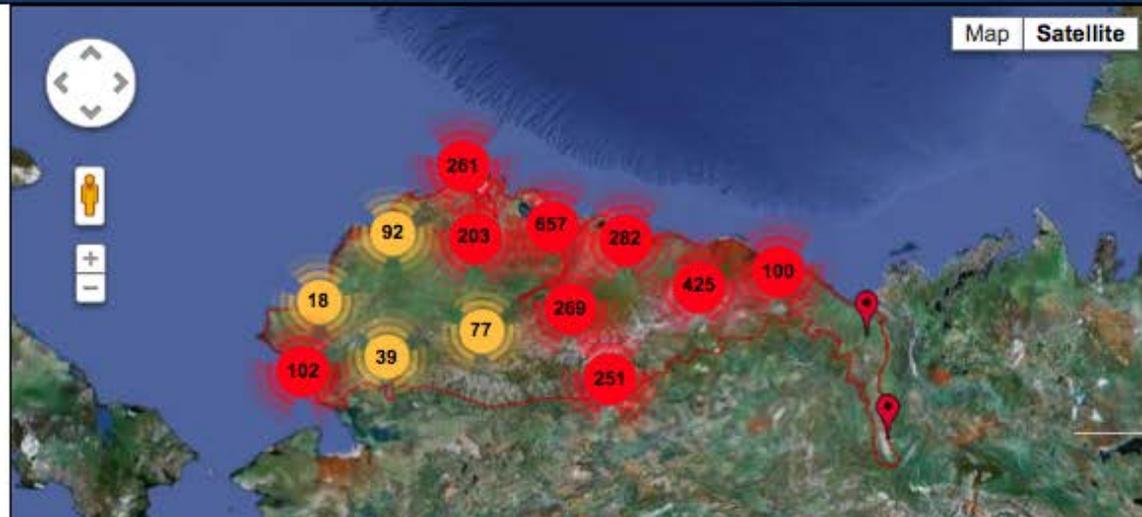
Clear Map Show All Markers Reset

Map Satellite

Imiq Database

Sites are grouped to clusters to show markers which are close together or overlap.

Click on clusters to zoom in.





National Weather Service Alaska - Pacific River Forecast Center

HOME

NWS Site Map

National News

Organization

Rivers

River Forecasts

Observed Precipitation

Forecast Precipitation

All Locations



River Observations



River Forecasts

Reset View

Map

Satellite



Create zoom box



Airborne Observation and Cal/Val

Platforms: Conventional



Photo: Chas Jones



Photo: Pat Harman



Photo: Bob Busey



Photo: Jessica Cherry

Platforms: UAS & Balloons



*Photo: Jessica
Cherry*



Photo: NASA



Photo: Pat Harman

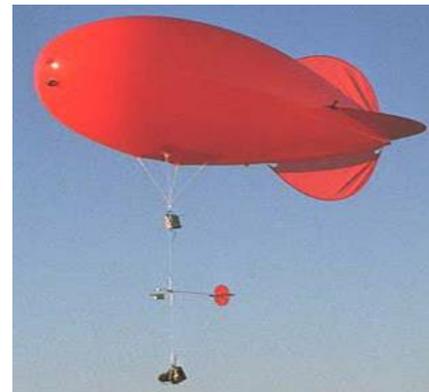


Photo: Vaisala

Payloads

Integrated Sensor System ('Tinman')
developed by our group at UAF includes:

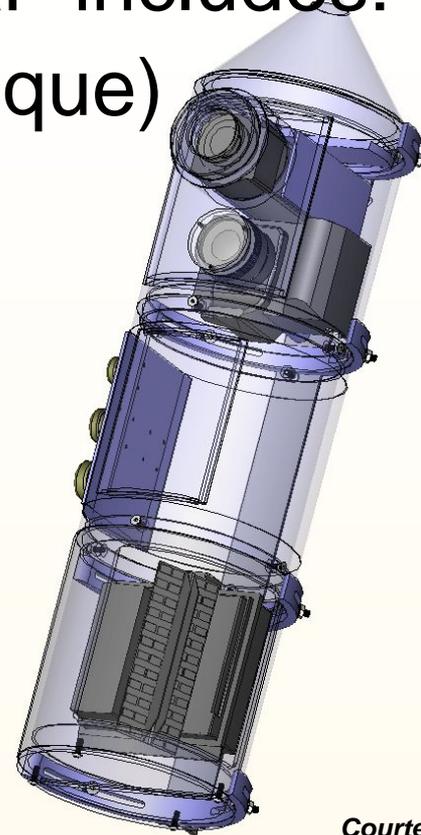
RGB cameras (Nadir and Oblique)

FLIR cameras

X-band SAR

Hyperspectral camera

Multispectral cameras



Payloads

A meteorological package (T, RH, P)

A cavity-ringdown laser spectrometer for water isotopes

SDSU Water Vapor, Carbon, Methane Flux



Photo: Vaisala

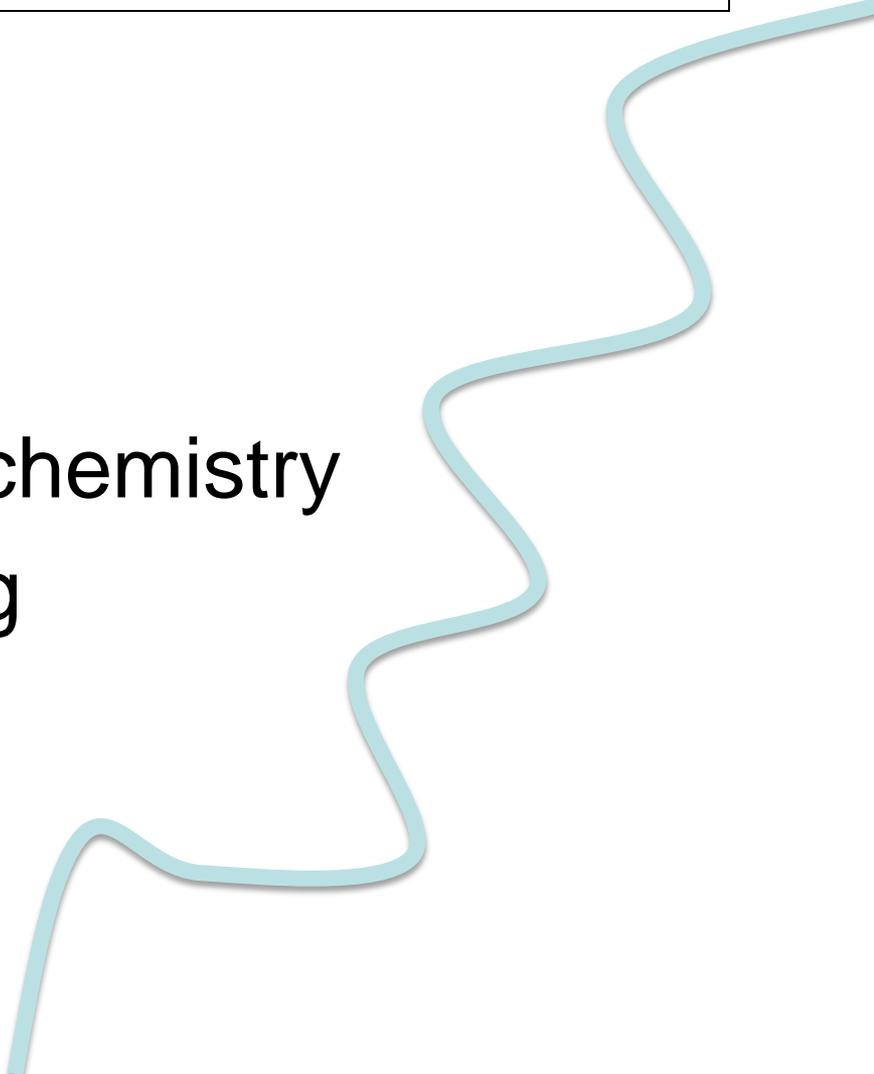


Photo: Phil Yoon

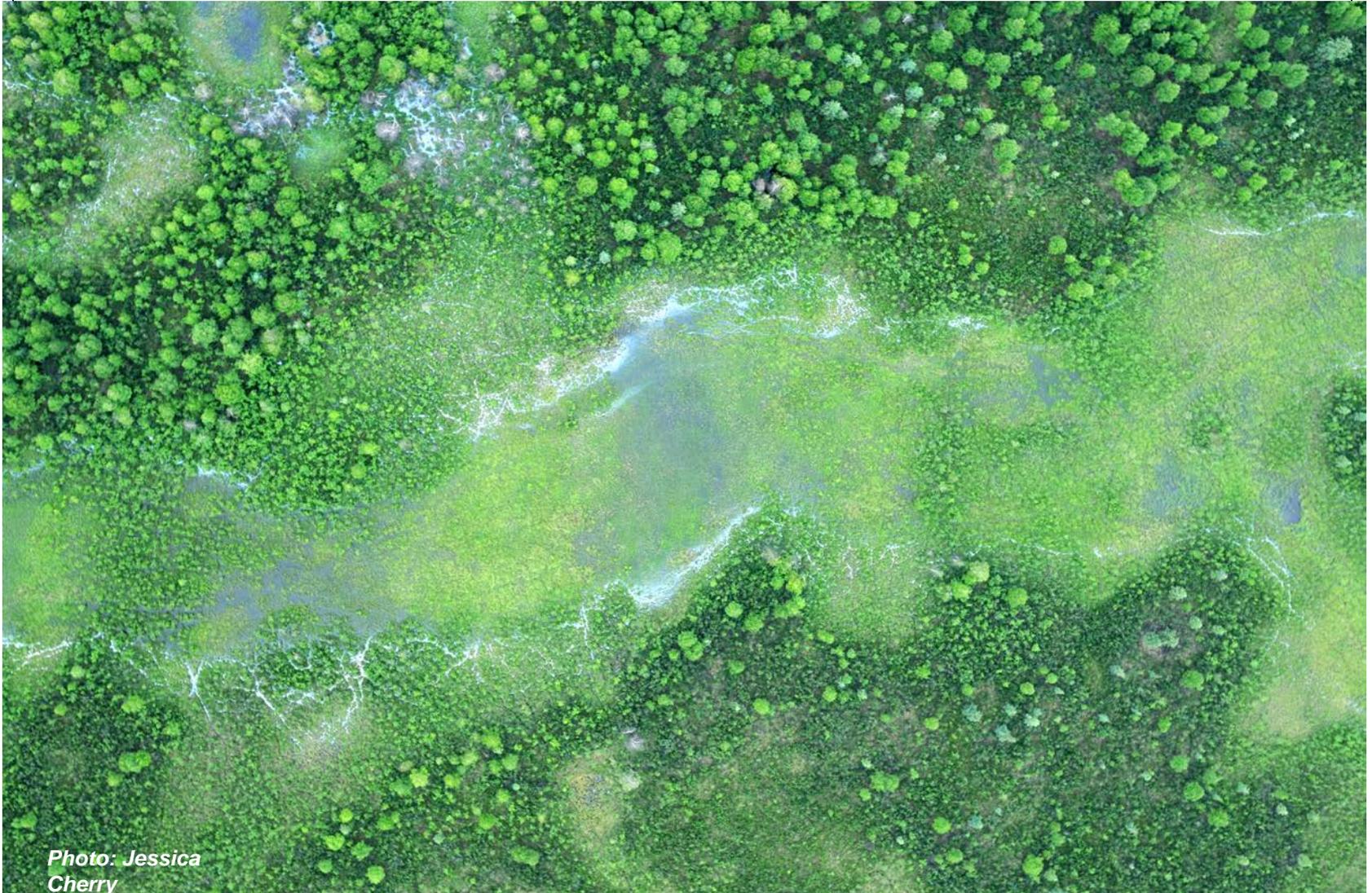


Photo: Picarro

Hydrologic Applications

- Surface Water
 - Ground Water
 - Water Vapor
 - Hydrology and Biogeochemistry
 - Snow and Ice Modeling
- 

Surface Waters: Wetlands

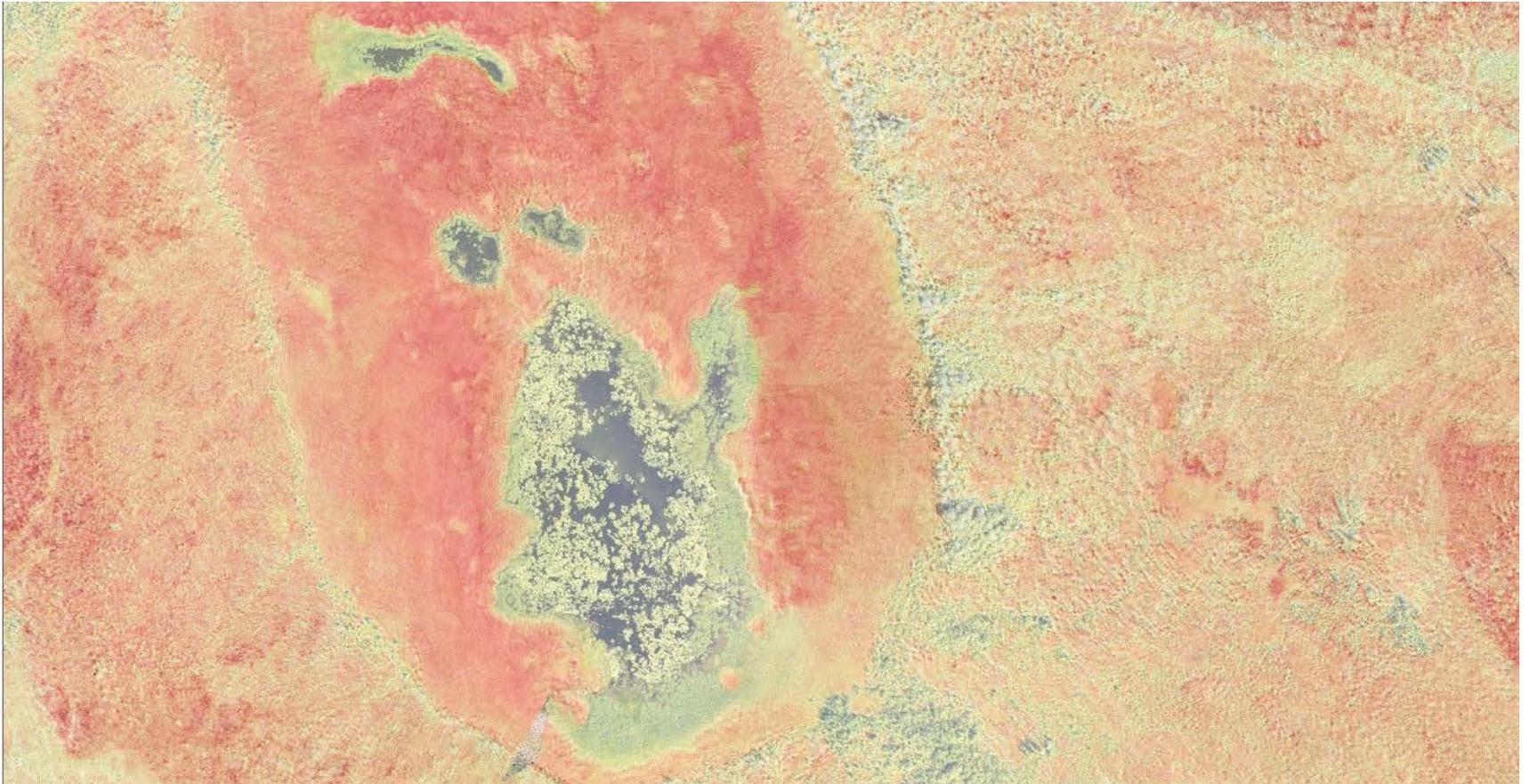


*Photo: Jessica
Cherry*

Micro-climatology



Micro-climatology (Thermal IR)



Surface Waters: Lake Freeze Up

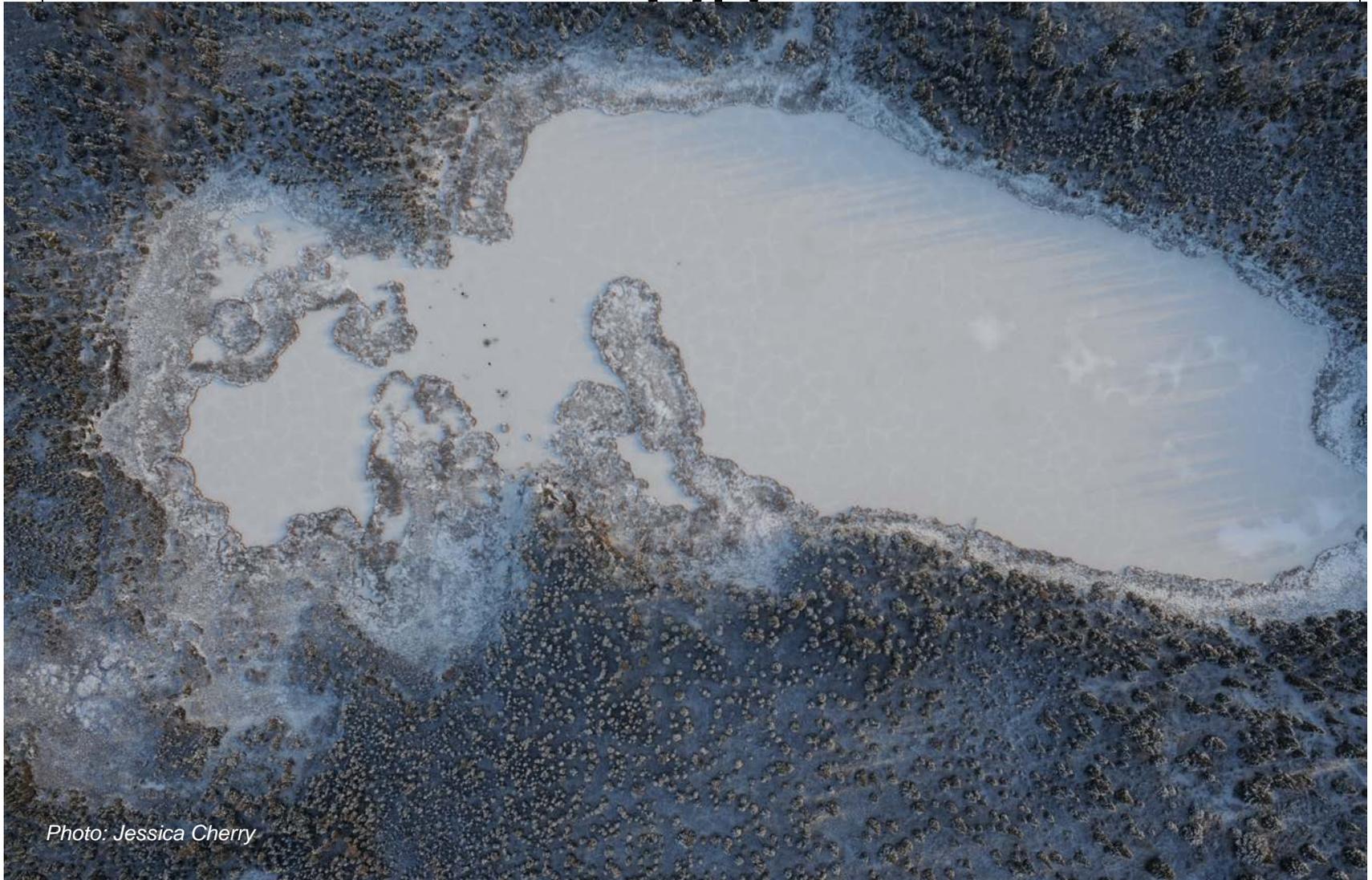
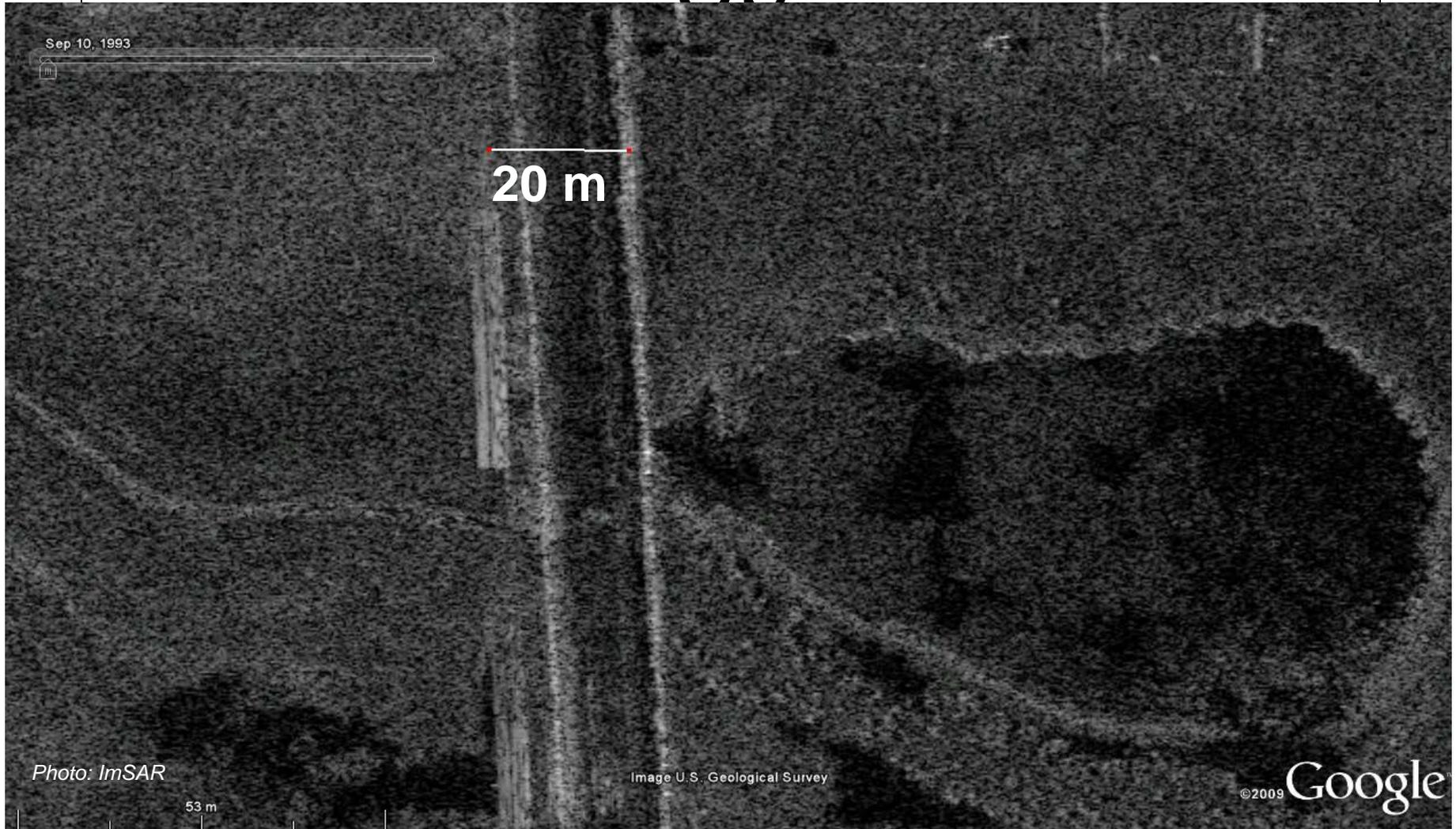
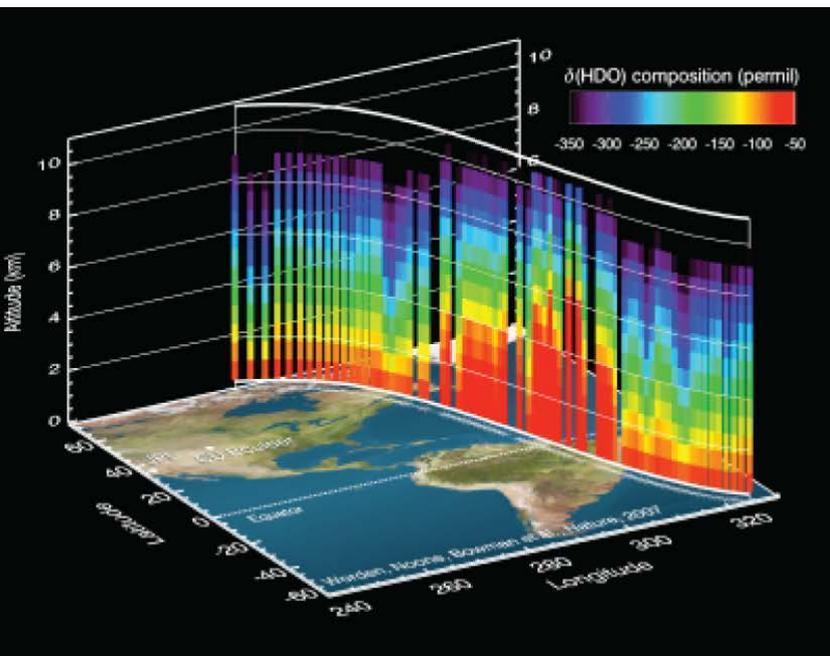


Photo: Jessica Cherry

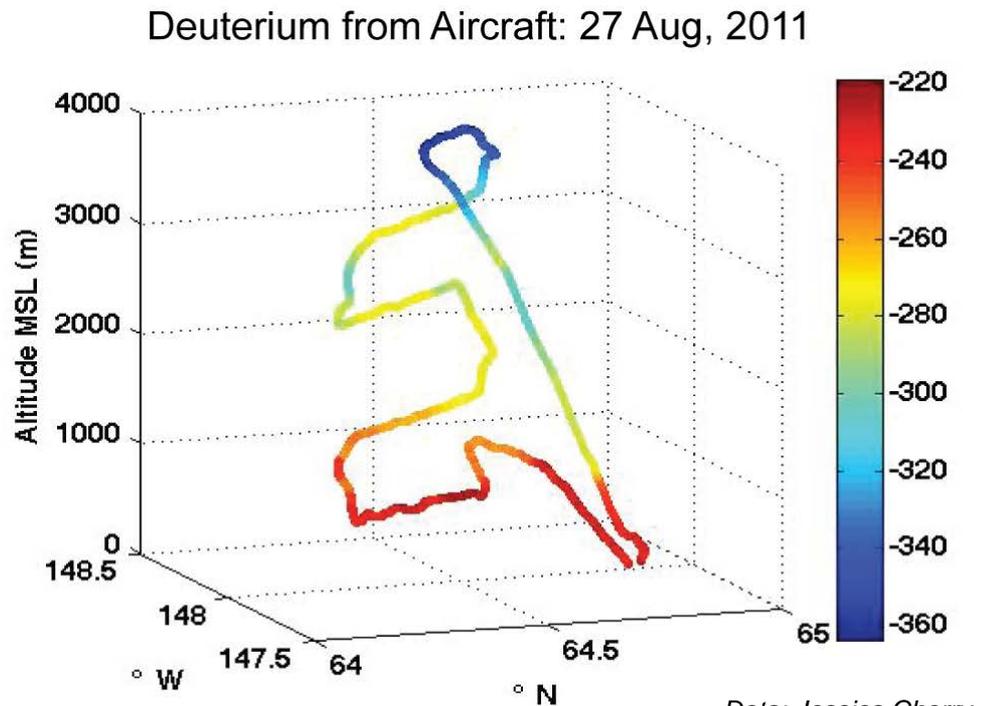
Surface Waters: Lake Freeze Up



Water Vapor: Isotopes



Courtesy David Noone



Data: Jessica Cherry

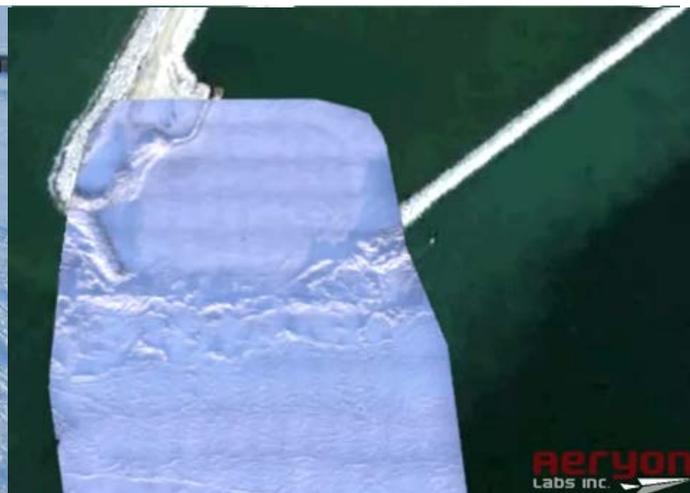
Hydrology: Snow & Ice Mapping



Photo: Chas Jones



Photo: AKDEC

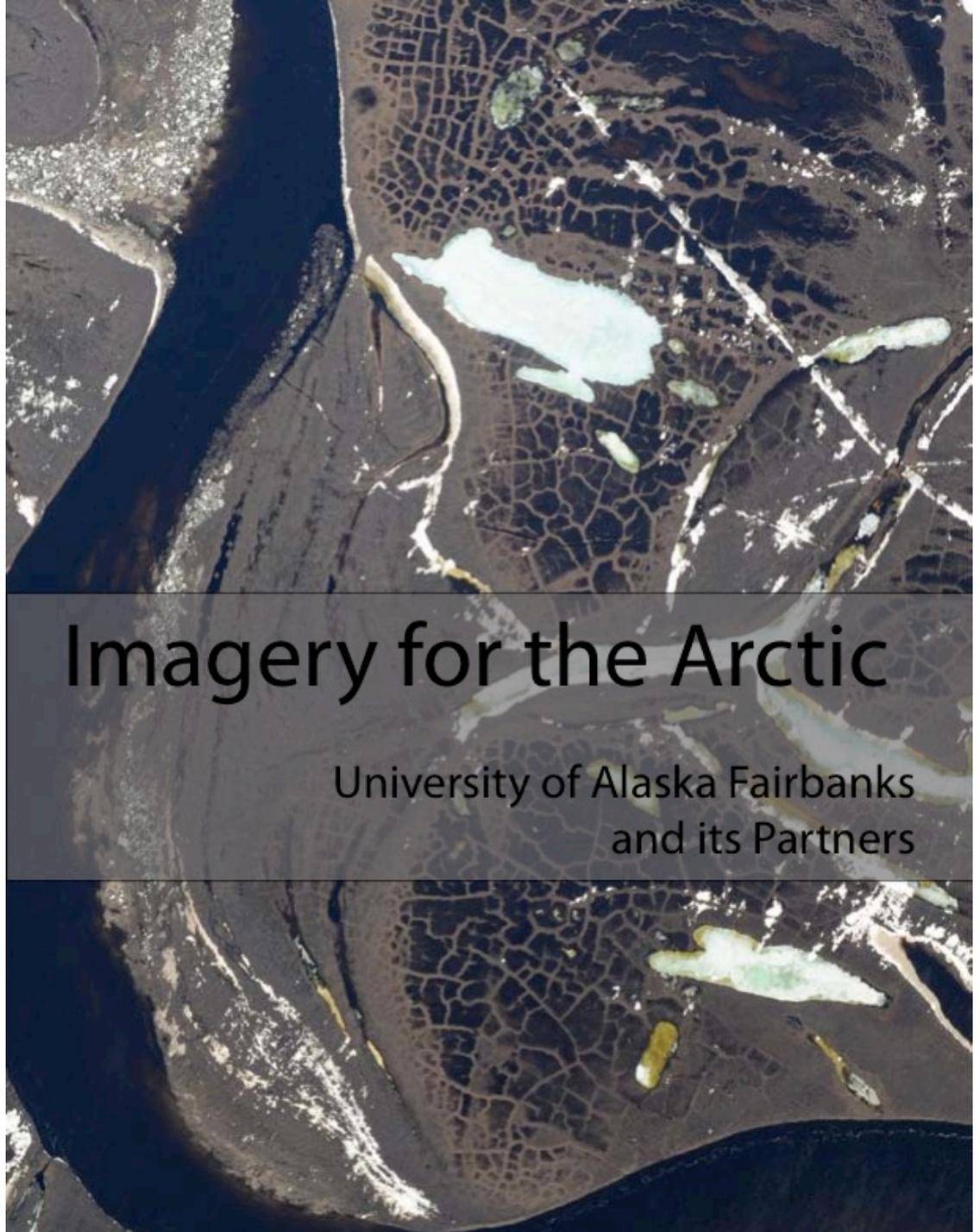


Future Directions

- Continued Snow Depletion mapping technique development
- Image and hydrology model integration
- Lake and river bathymetry, river velocity
- Migration to more physically-based hydrology models and improved data assimilation
- Develop new products and data integration modules for water resource management tools

Brochure:
educating
stakeholders on
how to use
remote sensing
imagery and
where to get it

Your contributions
are welcome!



Imagery for the Arctic

University of Alaska Fairbanks
and its Partners

Questions?



Contact: jcherry@iarc.uaf.edu