TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

POLAR TREC

Welcome to *PolarConnect*

Permafrost and Community

With PolarTREC Educator Allyson Woodard

& Team Researchers Dr. Alexander Kholodov, & Dr. Santosh Panda

February 28, 2019

Getting to Know Adobe Connect

Slides will be shown here

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List of all participants

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Find out more about the presentation

Chat here

Participant Introductions

In the Chat box, please introduce yourself by typing in your:

- ✓ Name
- ✓ School or Institution
- ✓ The number of students and adults participating with you in the same location

What is PolarTREC?

- Since 2004, the Arctic Research Consortium of the United States (ARCUS), a non-profit organization, has been administrating the PolarTREC Program.
- PolarTREC is professional development for K-12 teachers. They are paired with researchers for 2-6 week research experiences in the polar regions.
- Over 150 teachers from around the United States have joined scientists in the Arctic and Antarctica to learn about science, the polar regions, and to share what they have learned with their students and communities.

ARCUS
ARCTIC RESEARCH CONSORTIUM OF THE UNITED STATES

25 Years of Connecting Arctic Research
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Questions

During the Presentation:

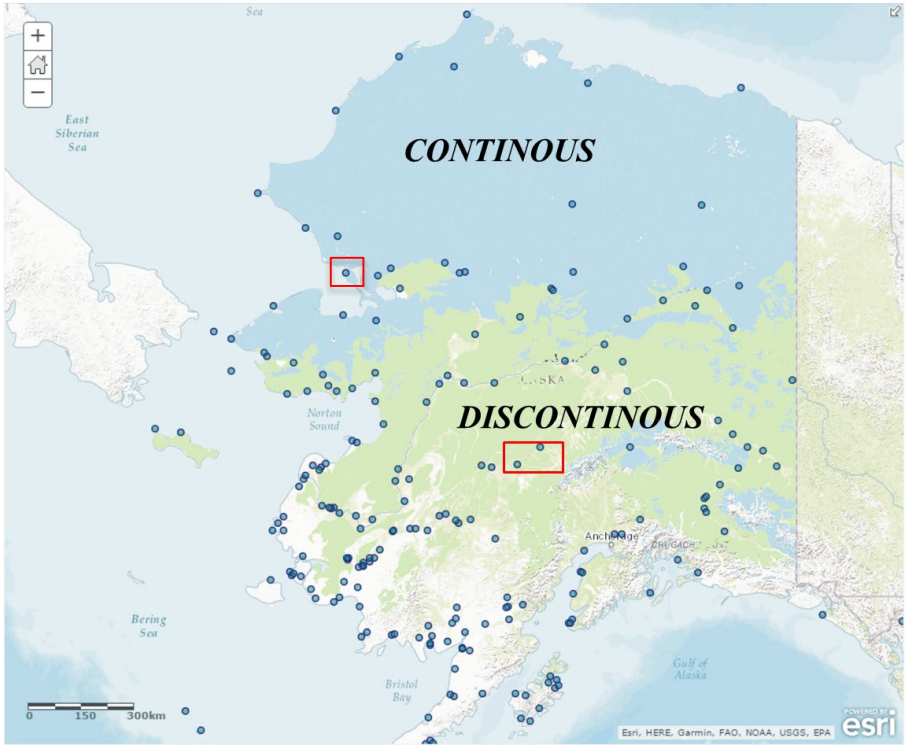
- Type your question in the text chat box

At the End of the Presentation, two options:

1. Type your question in the text chat box, or
2. Raise your hand with the "hand button".

- PolarTREC staff will call on you and activate your microphone.
- Speak loud and clear, directly into the computer microphone or the phone to ask your question.

PERMAFROST ON ALASKA



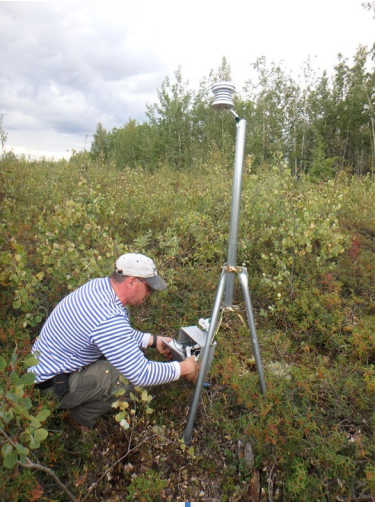
Permafrost underlies ~80% of Alaska (Jorgenson et al. 2008). Permafrost distribution can be classified as continuous (>90% of land area underlain by permafrost), discontinuous (90% – 50%),sporadic (50% – 10%), or isolated (<10%) (Ferrians 1965).

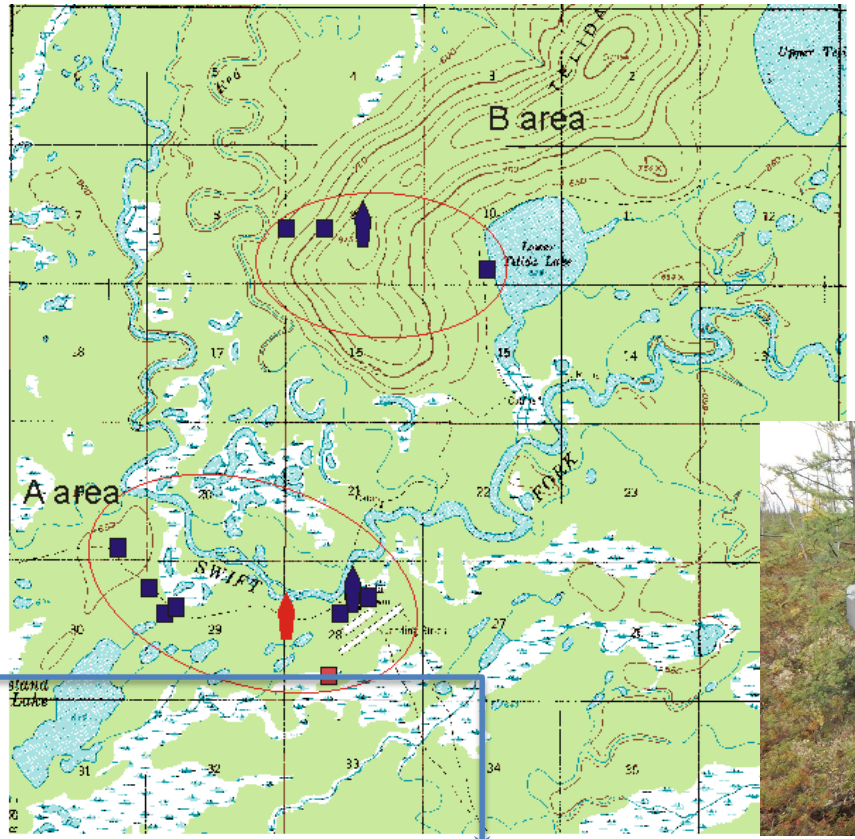
OBSERVATION SITES CHARACTERISATION

Totally the network includes 20 observation points. In 2016 we instrumented 12 sites and in 2017 – 8 more. Thirteen sites are located at Telida village and 7- at Nikolai. Eleven of them (6 at Telida and 5 at Nikolai) represent the permafrost area.

Site ID	Ecotype	Organic layer		Canopy coverage	Active layer	
		Thickness, cm	Composition		Thickness, cm	Type
NS	Young low density black spruce forest	>40	Alive moss (2 cm), fibrous, peat	-	90	Thaw depth
TV1	Tall shrubs / young deciduous forest	17	Alive vegetation (2 cm), humus	-	>135	Freezing depth
TV2	Deciduous forest	4	Humus, **ash!**	17	>100	Freezing depth
TV3	Young low density black spruce and larches forest	>50	Alive moss (3-4 cm), fibrous, peat	-	60	Thaw depth
TV4	Medium density mixed boreal forest	25	Alive moss (4 cm), fibrous, **ash!**	48	>110	Freezing depth
TV5	Low density black spruce forest	~50	Alive moss (5 cm), peat	17	50	Thaw depth
TV6	Medium density black spruce forest	25	Alive moss (3 cm), fibrous, peat	40	80	Thaw depth
TV7	Mixed boreal forest	23	Alive moss (~5 cm), fibrous	28	>100	Freezing depth
TV8	Low density black spruce forest	>50	Alive moss (8 cm), peat	11	50	Thaw depth
TV9	Medium density deciduous forest	12	Humus, **ash!**	51	>100	Freezing depth
TV10	Low density black spruce forest	50	Alive moss (5 cm), fibrous, peat	26	70	Thaw depth
TV11	Low density black spruce forest	>30	Alive moss, fibrous, peat	4	80	Thaw depth

MAP OF THE RESEARCH AREA AND OBSERVATION POINTS LOCATION



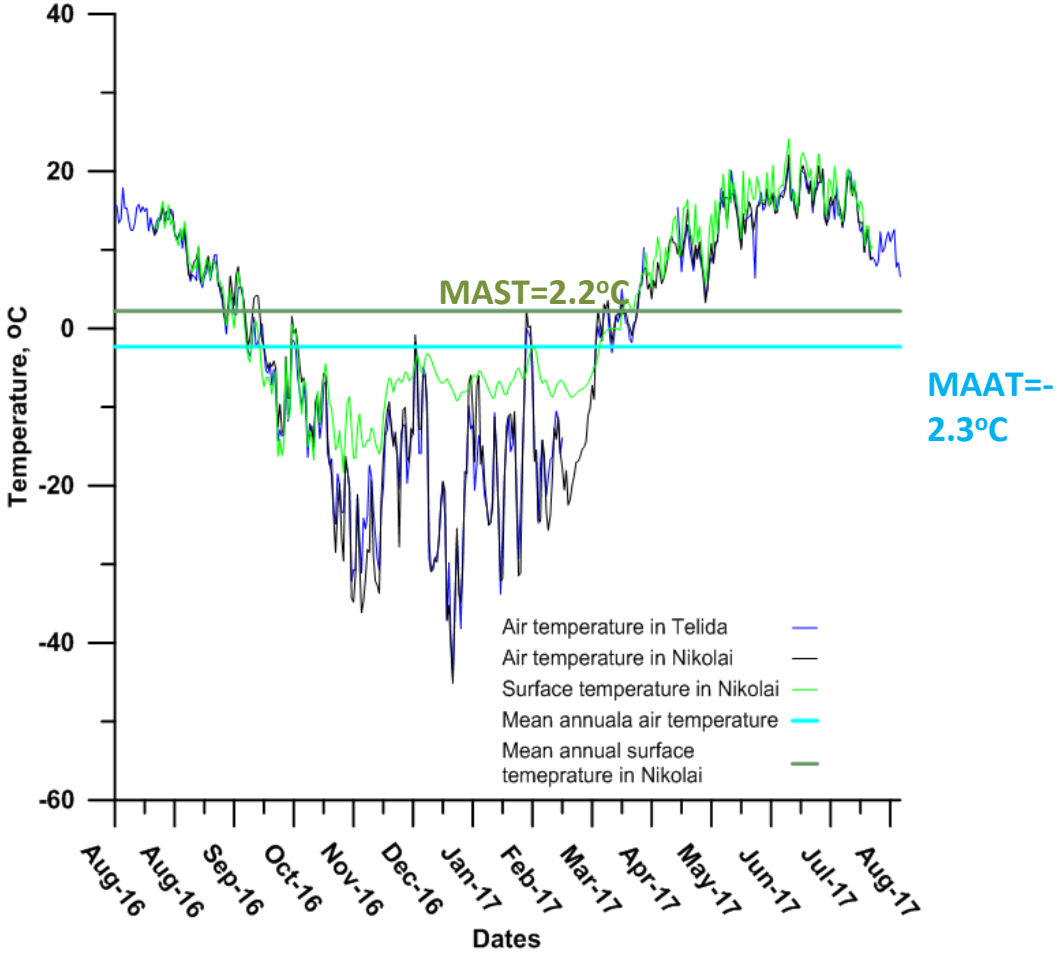


Intensive research area

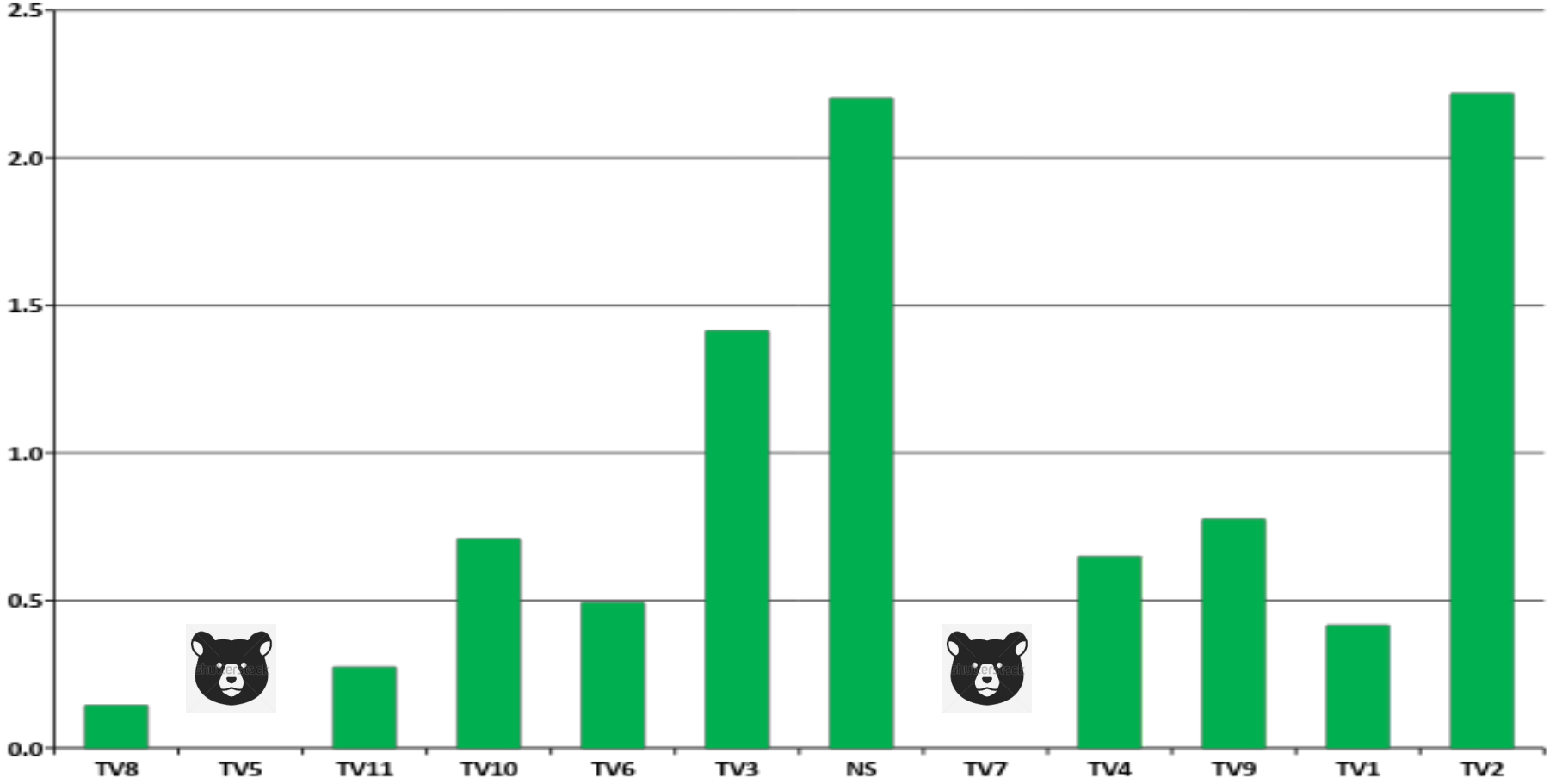
Tripods equipped with air temperature/relative humidity sensor, 2 soil moisture and 4 temperature sensors. Blue - installed in 2016, red - 2017.

4-channel data logger with temperature sensors. Blue - installed in 2016, red - 2017.

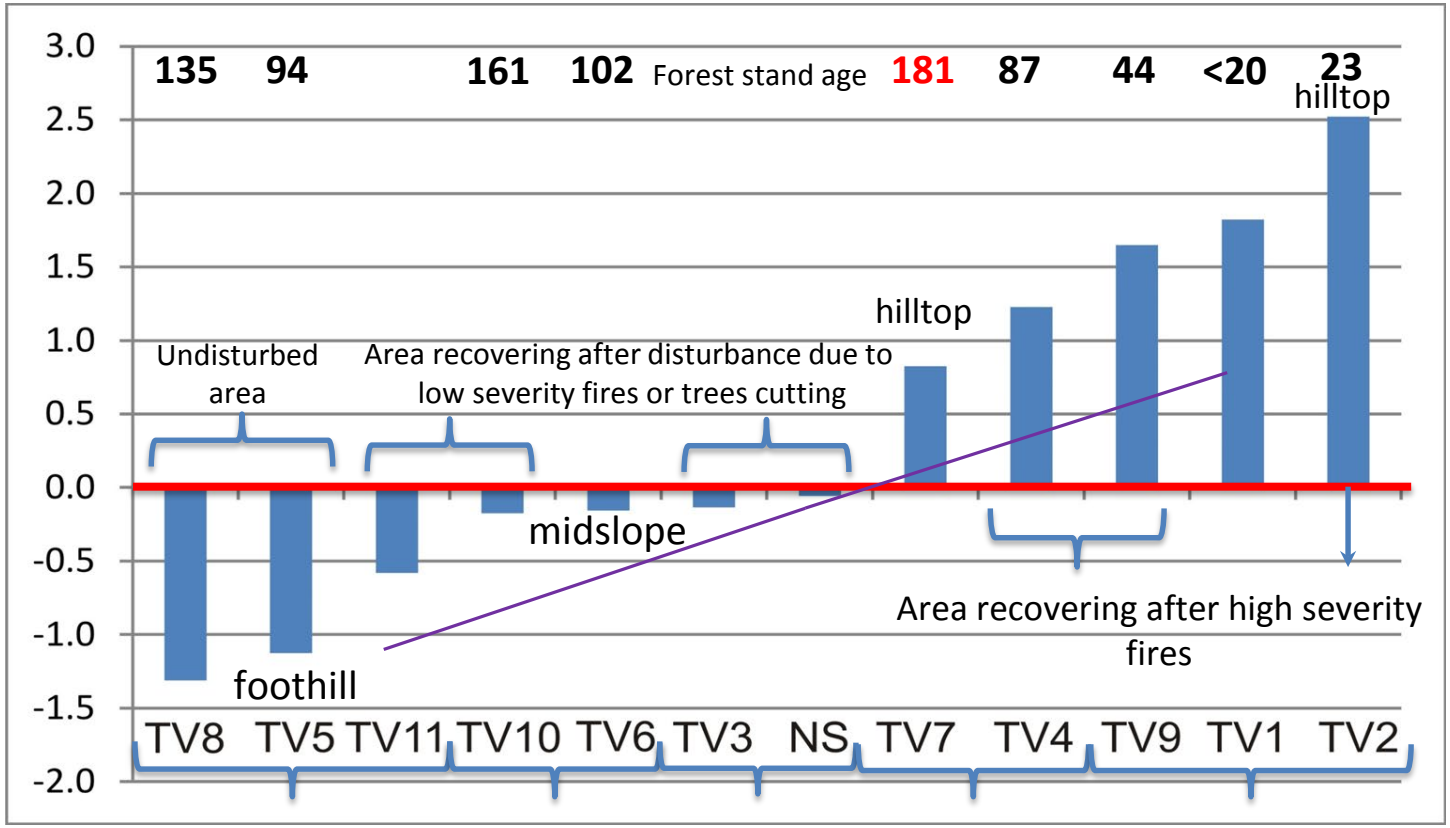
AIR AND SURFACE TEMPERATURE DYNAMICS IN 2016-17



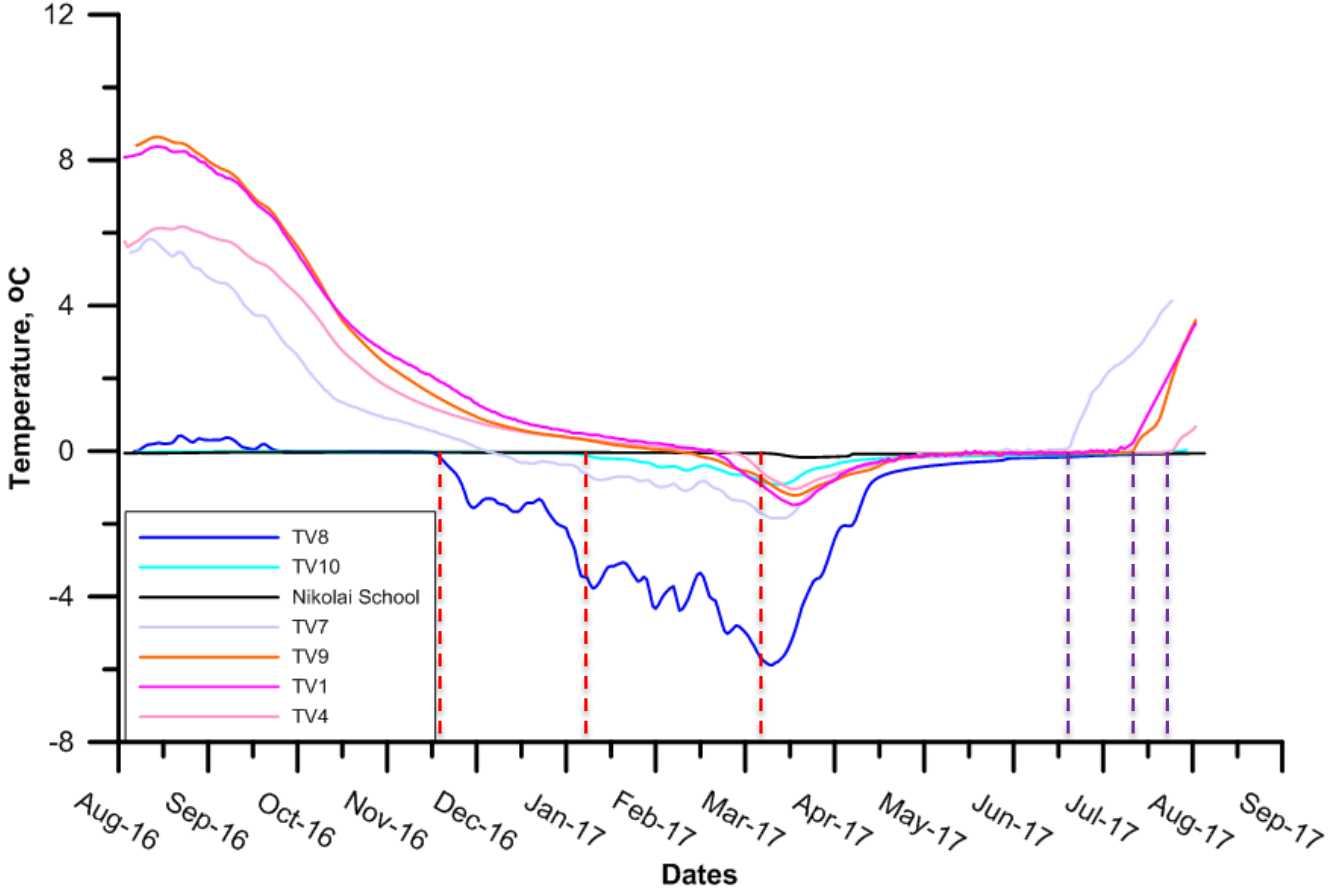
MEAN ANNUAL TEMPERATURE AT THE GROUND/MOSS SURFACE WITHIN DIFFERENT ECOTYPES IN 2016-2017



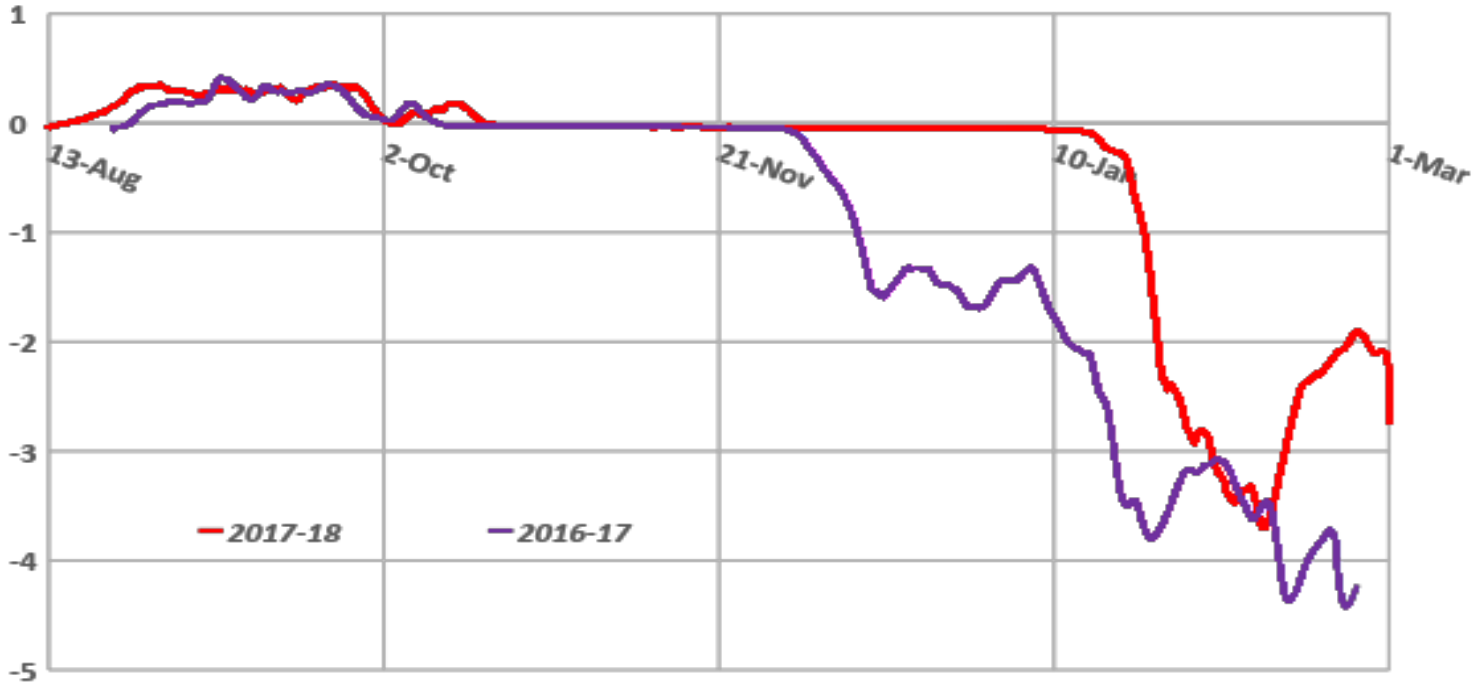
MEAN ANNUAL TEMPERATURE AT THE BOTTOM OF ACTIVE LAYER WITHIN DIFFERENT ECOTYPES IN 2016-2017



TEMPERATURE DYNAMICS AT THE BOTTOM OF ACTIVE LAYER

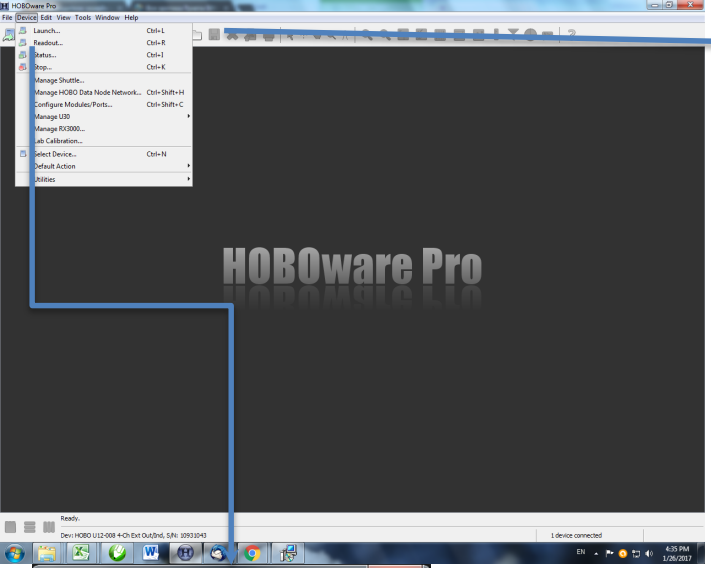


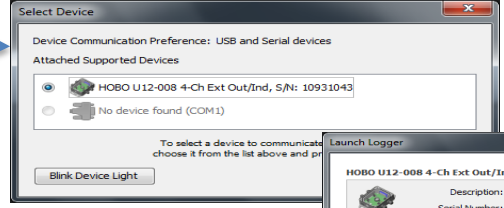
Temperature dynamics at the bottom of active layer at the "coldest" site.

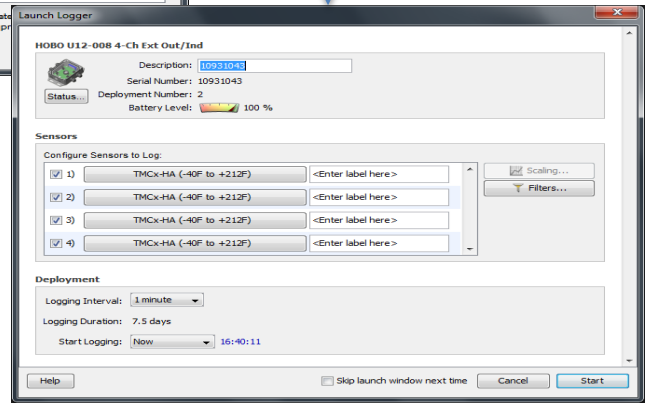


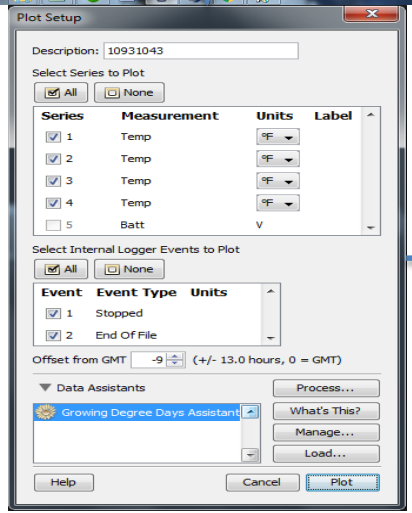
EQUIPMENT

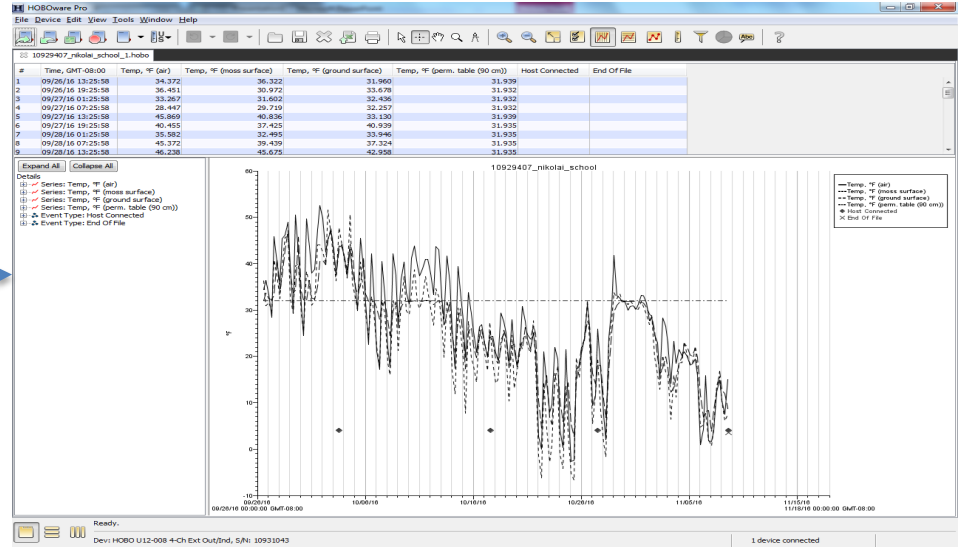

U-12
UX-120
H-21
Temperature/
relative
humidity
sensor
Temperature
sensors
Soil
moisture
sensors


HOBOware Pro


Select Device
Device Communication Preference: USB and Serial devices
Attached Supported Devices
HOBO U12-008 4-Ch Ext Out/Ind, S/N: 10931043
No device found (COM1)
Blink Device Light


Launch Logger
HOBO U12-008 4-Ch Ext Out/Ind
Description: 10931043
Serial Number: 10931043
Status...
Deployment Number: 2
Battery Level: 100 %
Sensors
Configure Sensors to Log:
1) TMCx-HA (-40F to +212F) <Enter label here>
2) TMCx-HA (-40F to +212F) <Enter label here>
3) TMCx-HA (-40F to +212F) <Enter label here>
4) TMCx-HA (-40F to +212F) <Enter label here>
Scaling...
Filters...
Deployment
Logging Interval: 1 minute
Logging Duration: 7.5 days
Start Logging: Now 16:40:11
Help
Skip launch window next time
Cancel
Start


Plot Setup
Description: 10931043
Select Series to Plot
All
None
Series Measurement Units Label
1 Temp °F
2 Temp °F
3 Temp °F
4 Temp °F
5 Batt V
Select Internal Logger Events to Plot
All
None
Event Event Type Units
1 Stopped
2 End Of File
Offset from GMT -9 (+/- 13.0 hours, 0 = GMT)
Data Assistants
Growing Degree Days Assistant
Process...
What's This?
Manage...
Load...
Help
Cancel
Plot


HOBOware Pro
File Device Edit View Tools Window Help
10929407_nikolai_school_1.hobo
Time, GMT-08:00
Temp, °F (air)
Temp, °F (moss surface)
Temp, °F (ground surface)
Temp, °F (perm. table (90 cm))
Host Connected
End Of File
Expand All
Collapse All
Details
Series: Temp, °F (air)
Series: Temp, °F (moss surface)
Series: Temp, °F (ground surface)
Series: Temp, °F (perm. table (90 cm))
Event Type: Host Connected
Event Type: End Of File
10929407_nikolai_school
Ready.
Dev: HOBO U12-008 4-Ch Ext Out/Ind, S/N: 10931043
1 device connected

Summary

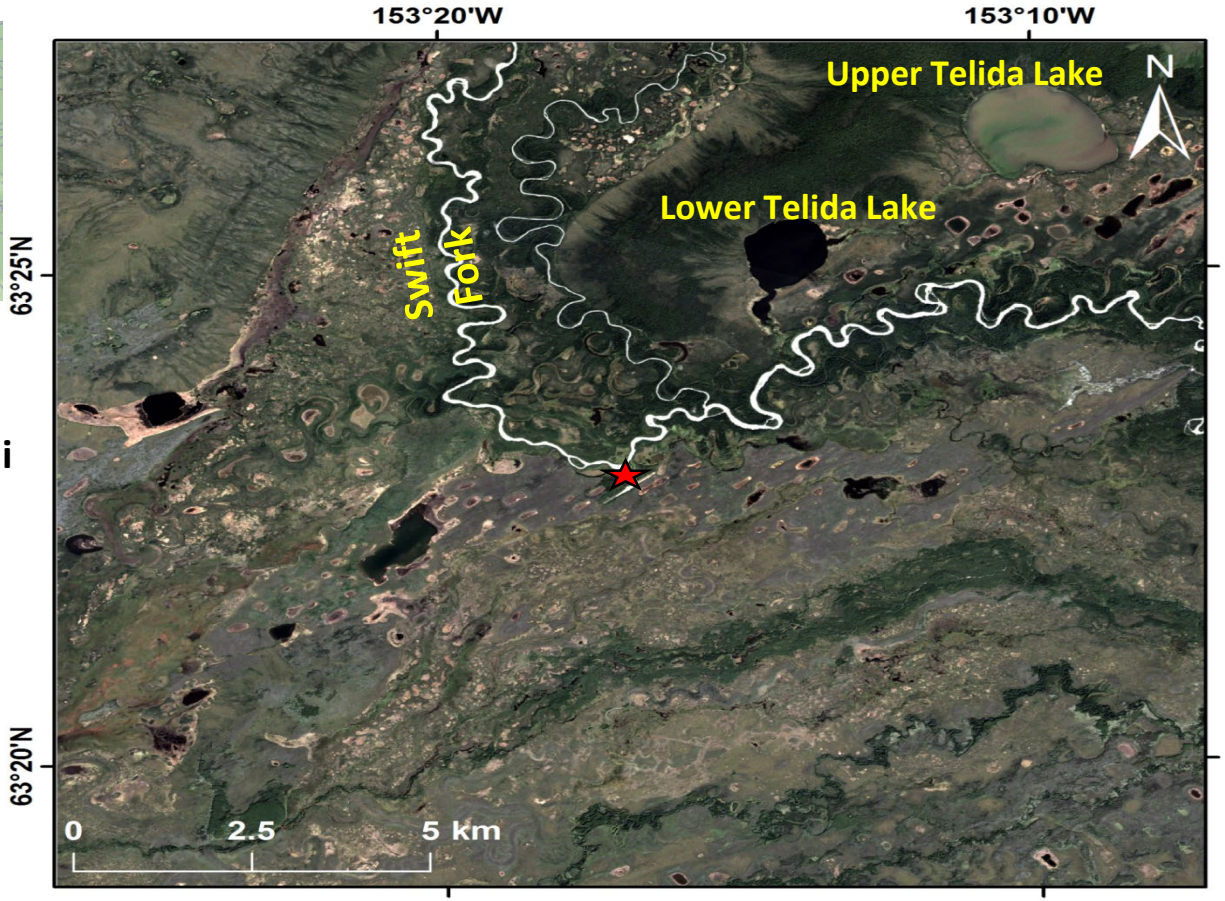
- ***Sustainable monitoring is not an ultimate solution of the adaptation to the environmental changes, but true coproduction of knowledge through a trusted and equal partnership between indigenous communities and scientist is a powerful tool can help make rural communities more resilient.***
- ***Mechanisms of bringing scientific results back to communities are still underdeveloped. It is a greatest problem of community-based observations***

Study Area: Telida Village, Alaska

Telida village is located on the Swift Fork, 25 miles west of Denali National Park

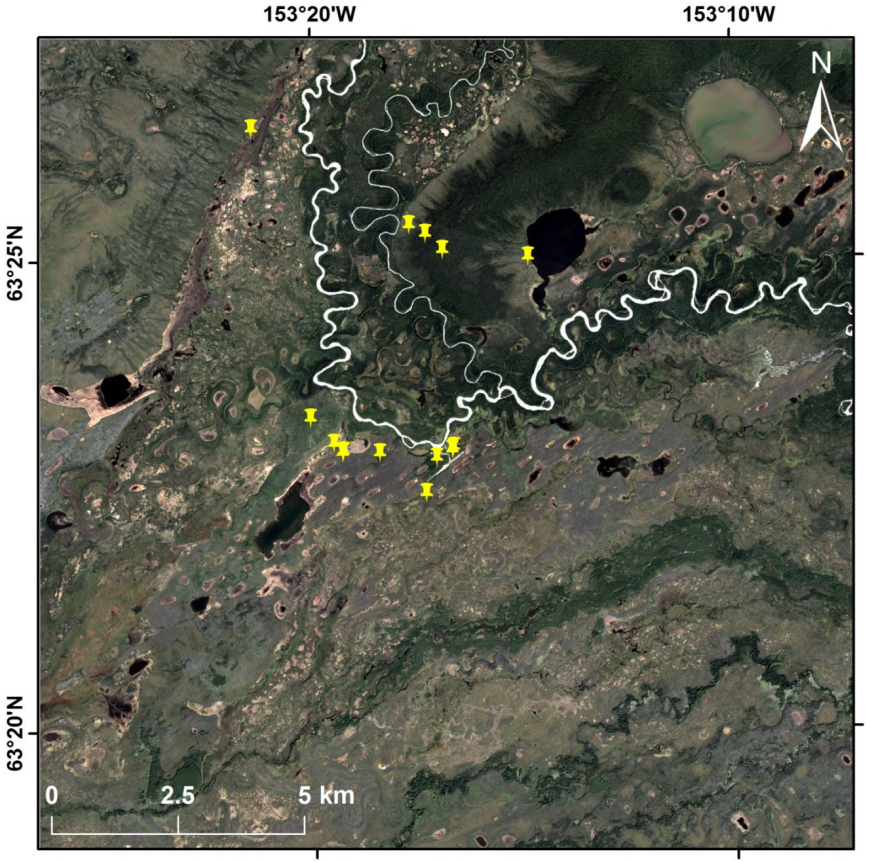
Area: 100^2 Miles
Elevation: 174 – 375 m asl

Climate: Continental
Summer Temperature: 5 – 32 °C
Winter Temperature: -48 – -18 °C



Integrating field observation, remote sensing, and temperature modeling

Temperature Monitoring Stations



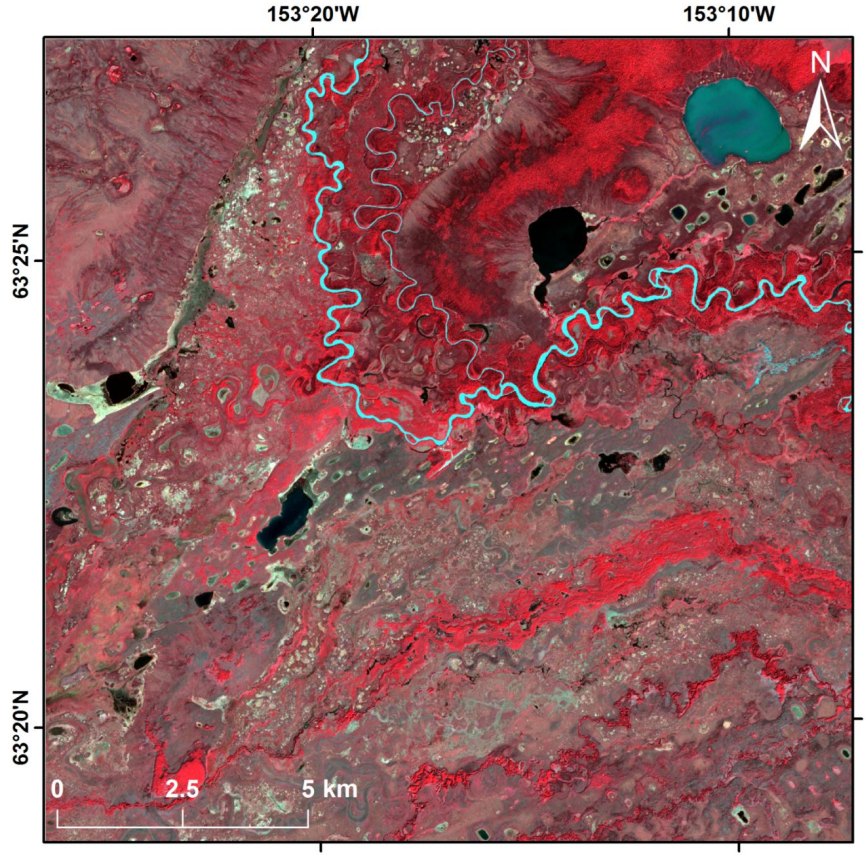
Field Observations

Land Cover	% Cover	Thaw Depth [cm] Aug. 10-13, 2017	+Avg. temp [C] 08/2016 – 08/2017	Snow Depth [cm]	Snow density [g/cm^3]
Closed Spruce	21.6	44.4±6.0	+1.2 -0.2	50±6	0.16
Open Spruce	37.6	40.3±6.4	-0.6	51±4	0.14
Mixed Forest	14.8	45.3±4.0	+1.6	48±6	0.18
Deciduous and Tall Shrub	24.5	41.6±4.3	+1.8	56±5	0.20
Ericaceous Shrub	1.4	52.0±7.0	-0.13	48±6	0.19

+Average mineral soil temperature

*Near-surface permafrost

Remote Sensing

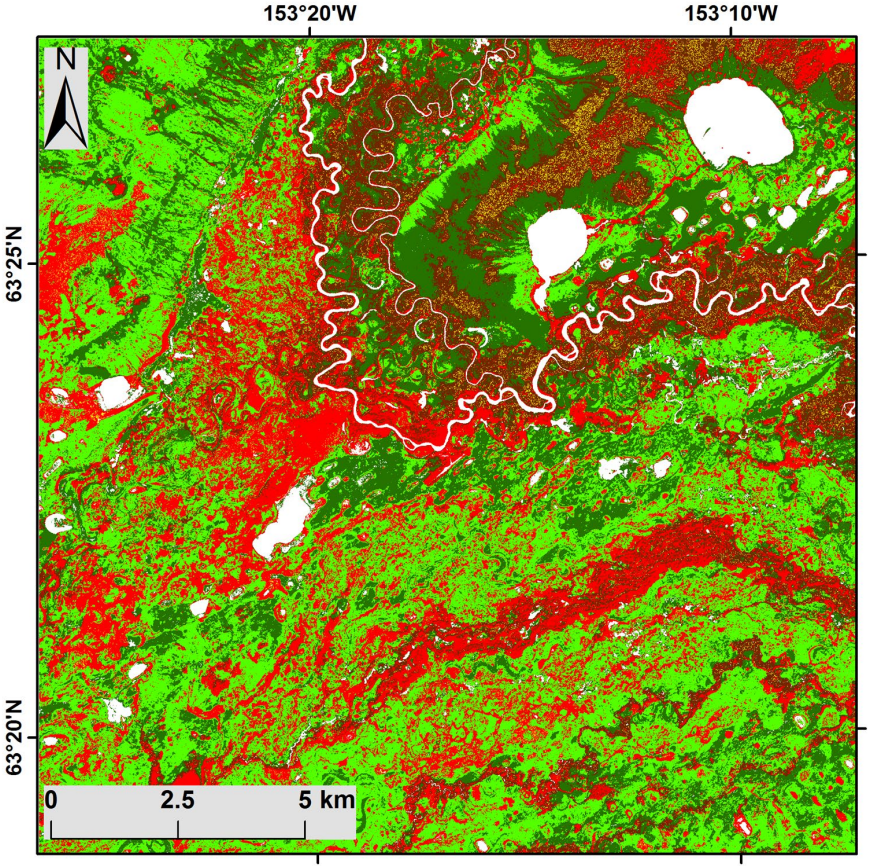


PlanetScope Image:

Four bands: Blue, Green, Red, and Near IR
Spatial Resolution: 4 m
Acquisition: 6 Aug. 2017

Source: Planet.com

Landcover Mapping



- Dark Object Subtraction
- Masked out water bodies using NDVI thresholding
- Created a data composite: 4 image bands
  NDVI layer,
  NIR mean
  NIR variance
- Mapped landcover using Maximum Likelihood supervised classification
- Overall Accuracy: 86%

Open Spruce
Closed Spruce
Mixed Forest
Deciduous Forest and Tall Shrub
Ericaceous Shrub

Ground Temperature Modeling

Geophysical Institute Permafrost Laboratory (GIPL) 1.0

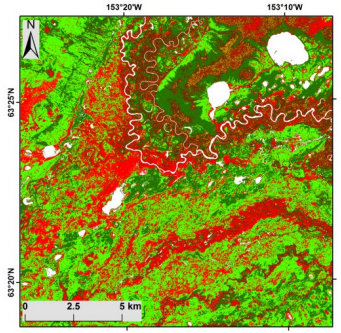
Model Input Data

Climate input:

mean monthly air temperature and monthly total precipitation

- ❑ **5-GCM composite RCP 8.5 Scenario (2016-2017) [Source: SNAP]**
- ❑ **Future Decades 2030, 2040, and 2050**

Ecosystem input:



Landcover Class

Organic layer thickness
Thermal diffusivity

Soil Class

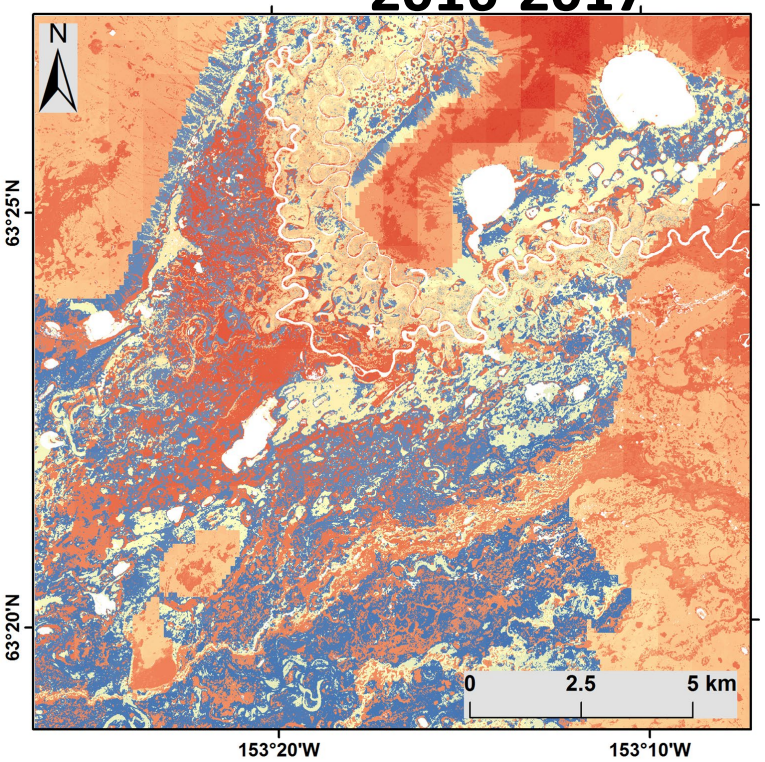
Heat capacity
Thermal conductivity
Water content

Snow Class

Fresh snow density
Maximum snow density

Modeled ground temperature at the bottom seasonal freeze-thaw layer

2016-2017

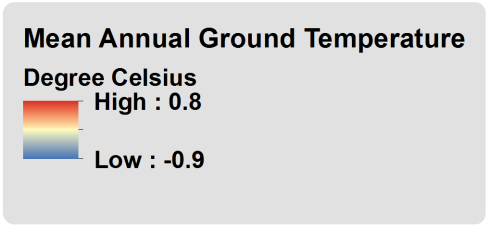


Near-surface Permafrost:

Present under 39% of the Study Area

Permafrost Temperature: 0 to -0.9 °C

Active Layer Thickness: <= 1.6 m



Summary

- ***Permafrost distribution around Telida village is sporadic (permafrost underlies ~ 39% of the study area)***

- ***Permafrost surface temperature is -1 °C or warmer***

- ***Permafrost is generally present under Open Spruce, and Ericaceous Shurb landcover, and patchy under Closed Spruce landcover.***

About me: Allyson

Exhibit developer at Oregon Museum of Science and Industry (OMSI) in Portland, OR

Under the Arctic: Digging into permafrost


THE
NORTH
FACE


Skittles

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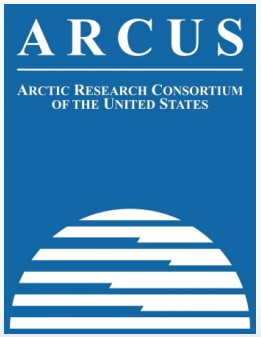
Thank You!

An archive of the event will be available shortly.

http://www.polartrec.com/polar-connect/archive



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Comparison of observed ground temperature with modeled ground temperature

Station	Days	Sensor Depth [m]	Modeled *SFTL [m]	Average Temp. [°C]	Modeled Temp. [°C]
TV1	332	1.35	1.86	1.85	0.67
TV2	357	0.80	1.84	2.57	0.72
TV3	357	0.75	0.98	-0.13	-0.16
TV4	360	1.10	0.95	1.23	0.36
TV5	255	0.55	0.56	-1.12	-0.66
TV6	354	0.90	1.02	-0.16	0.34
TV7	350	0.90	1.00	0.83	0.42
TV8	353	0.58	0.56	-1.31	-0.82
TV9	356	1.00	1.30	1.65	0.12
TV10	353	0.75	0.57	-0.17	-0.71
TV11	353	0.80	0.57	-0.58	-0.71

***SFTL: Seasonal freeze-thaw layer thickness**