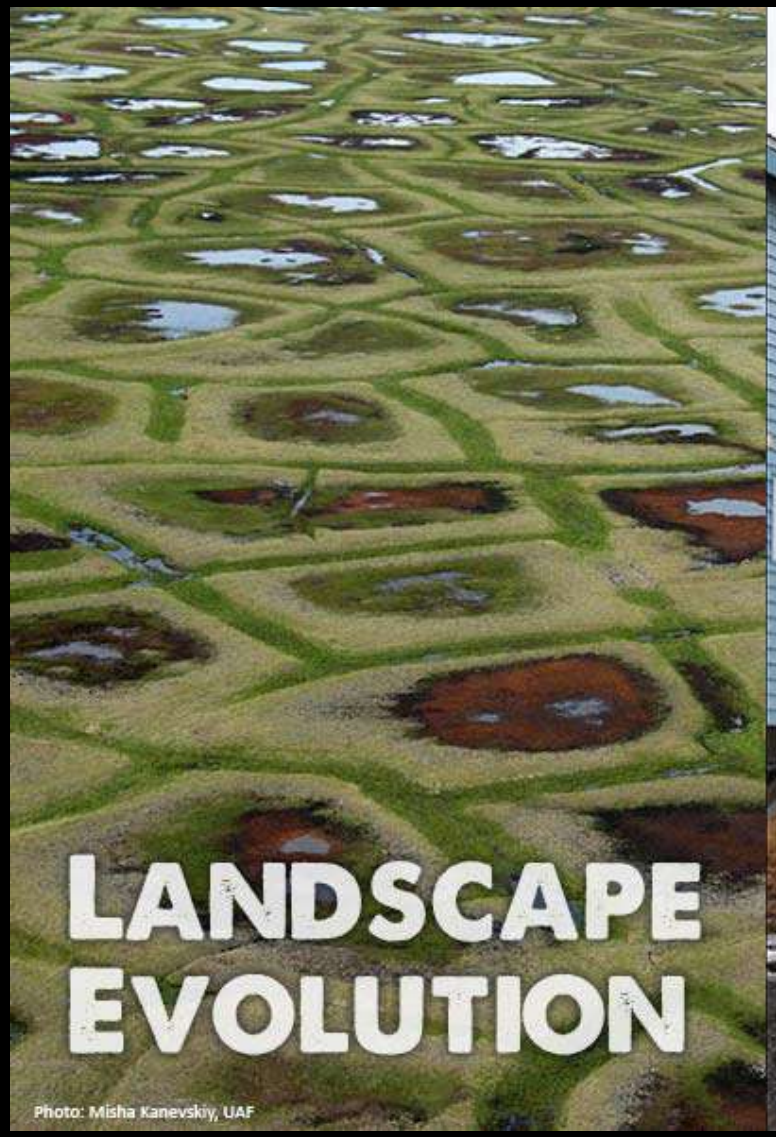
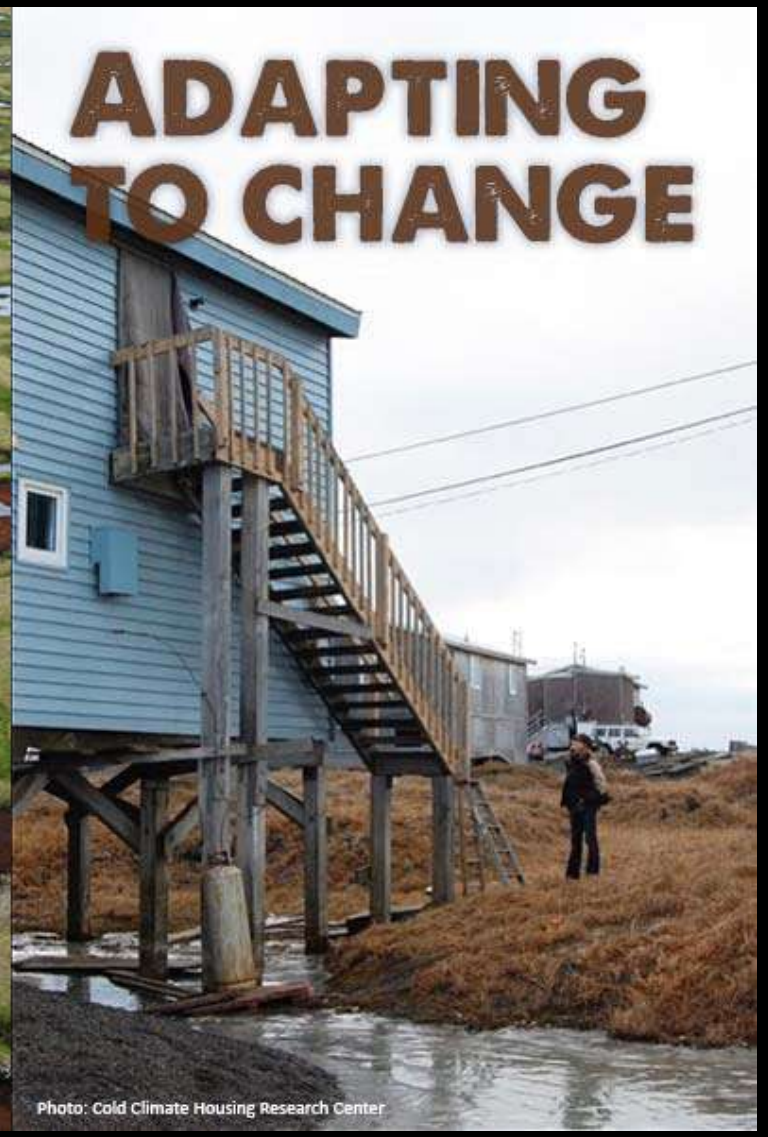
Navigating the New Arctic with a focus on ground ice

Landscape evolution and
adapting to change
in ice-rich permafrost systems
(NNA-IRPS)

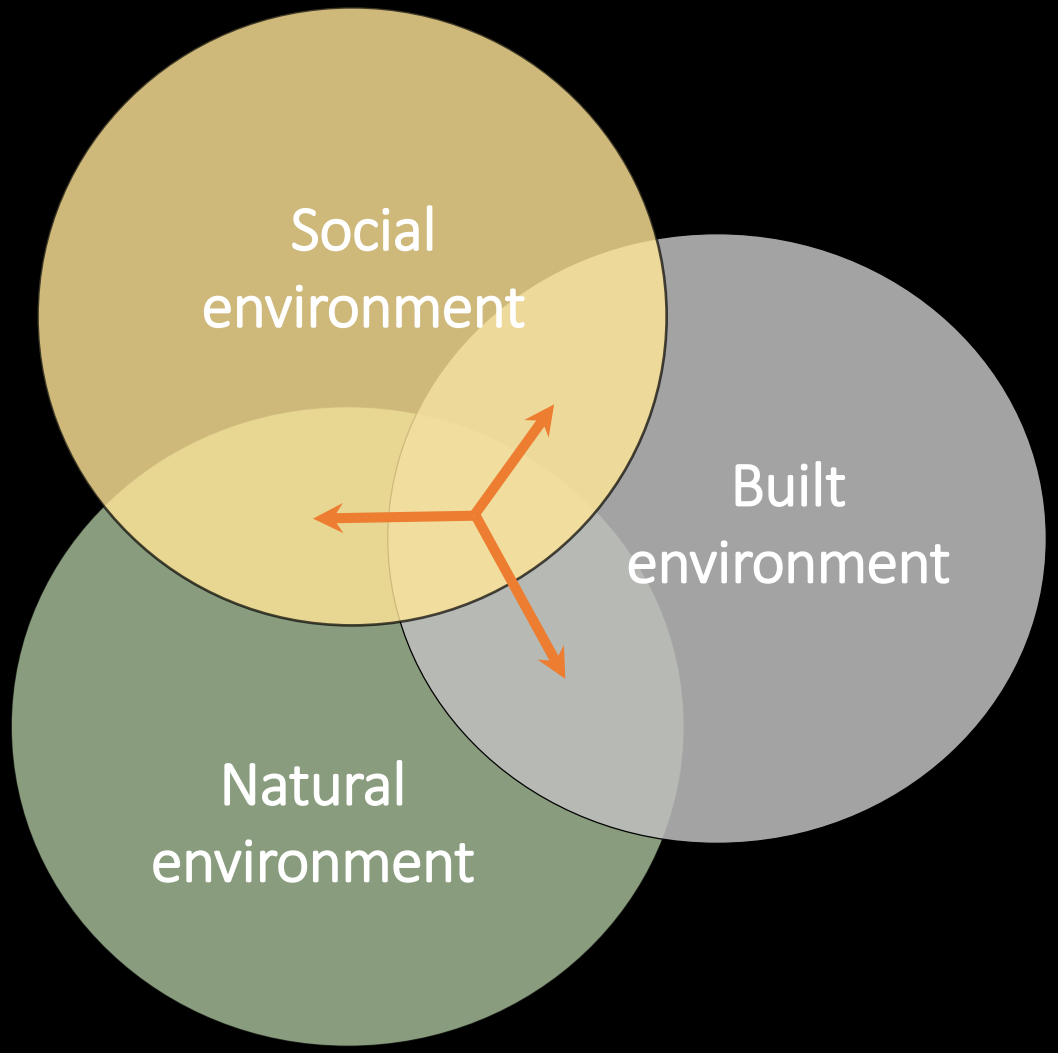




D. A. “Skip” Walker and Jana Peirce

Institute of Arctic Biology, University
of Alaska Fairbanks (UAF)

RATIC/T-MOSAiC meeting at ASSW 2021, 21 March,
15:30-18:30 GMT



Navigating the New Arctic (NNA) framework

Overview

- Some background: Ice-rich permafrost systems (IRPS)
- Some successes (best practices)

❖ Coordination, Collaboration, and Co-development (Jana)

Ice-rich permafrost system

Overarching theme

Ground Ice

- Literally, the glue that holds the system together
- Any reduction or major modification of ground ice affects the whole system

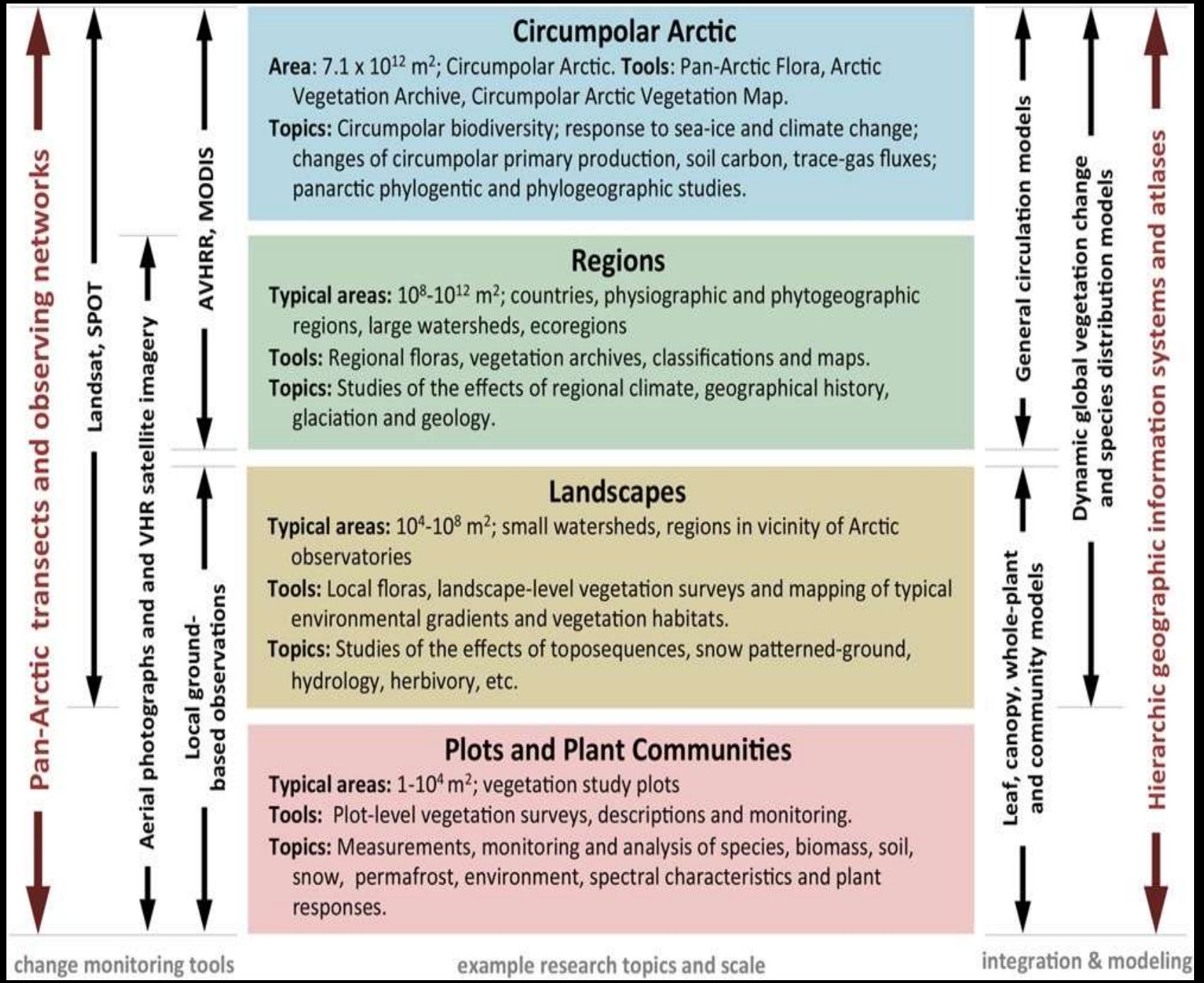
Ice wedge, Misha Kanevskiy

Coastal erosion of Ice wedges, USGS

Low-centered and high-centered ice-wedge polygon, Misha Kanevskiy

Primary questions

- Where, why, and how is ground ice accumulated in IRPS?
- How do IRPSs evolve and how are they currently changing?
- How can people and their infrastructure adapt to IRPS changes?



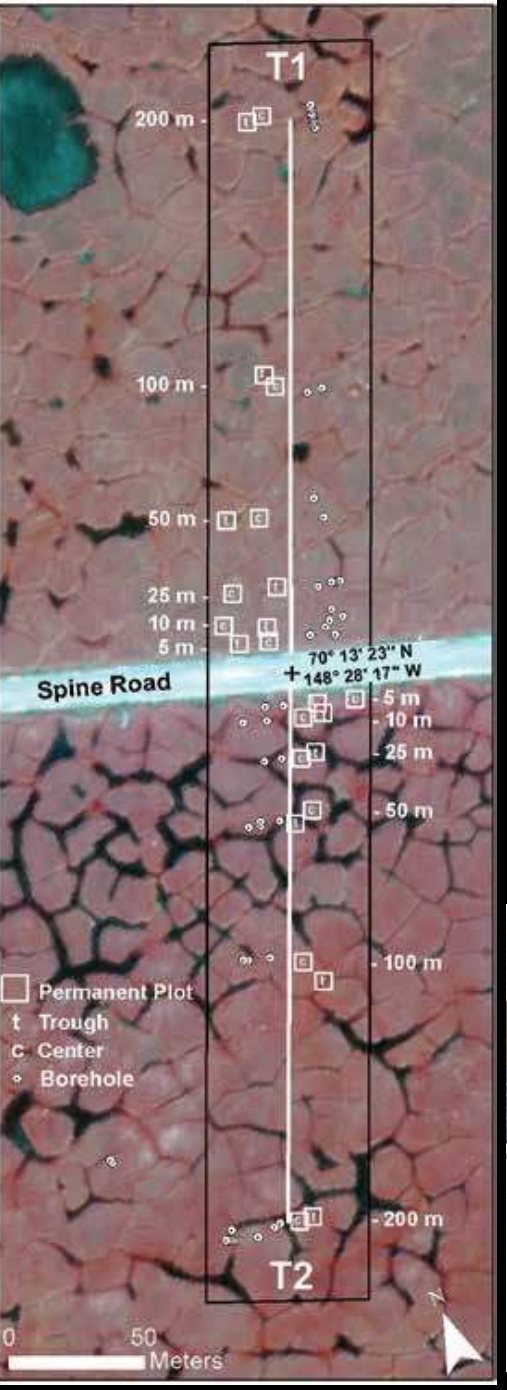
Hierarchical approach to study IRPSs

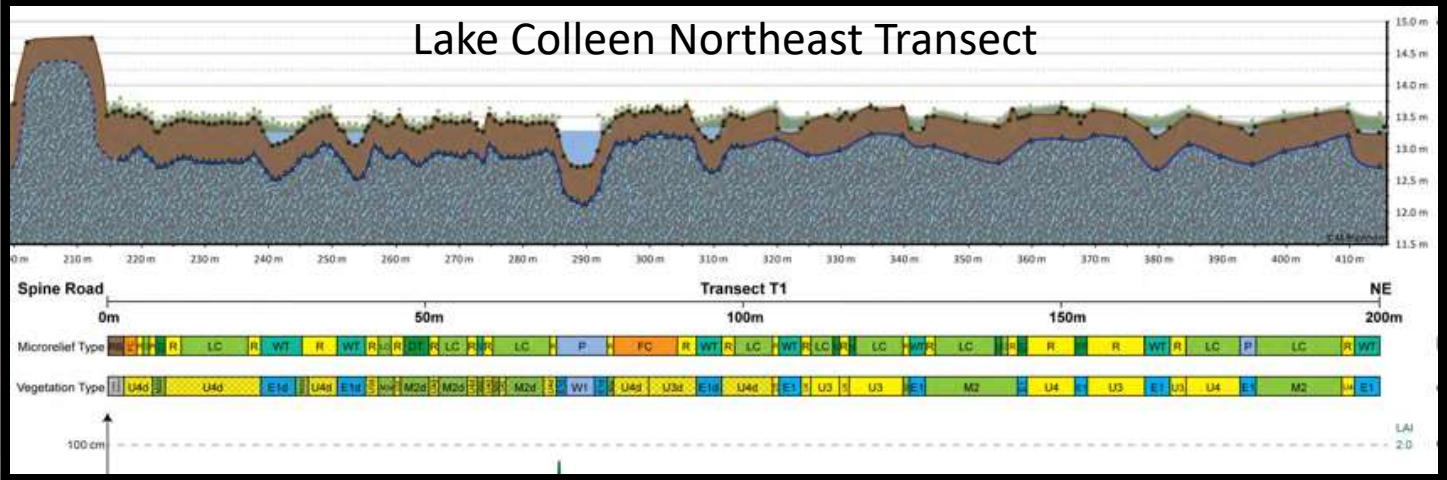
Walker, D. A., et al. 2016. *Environmental Research Letters*, *11*(5), 1–16. http://doi.org/10.1088/1748-9326/11/5/055005

IRPS observatories

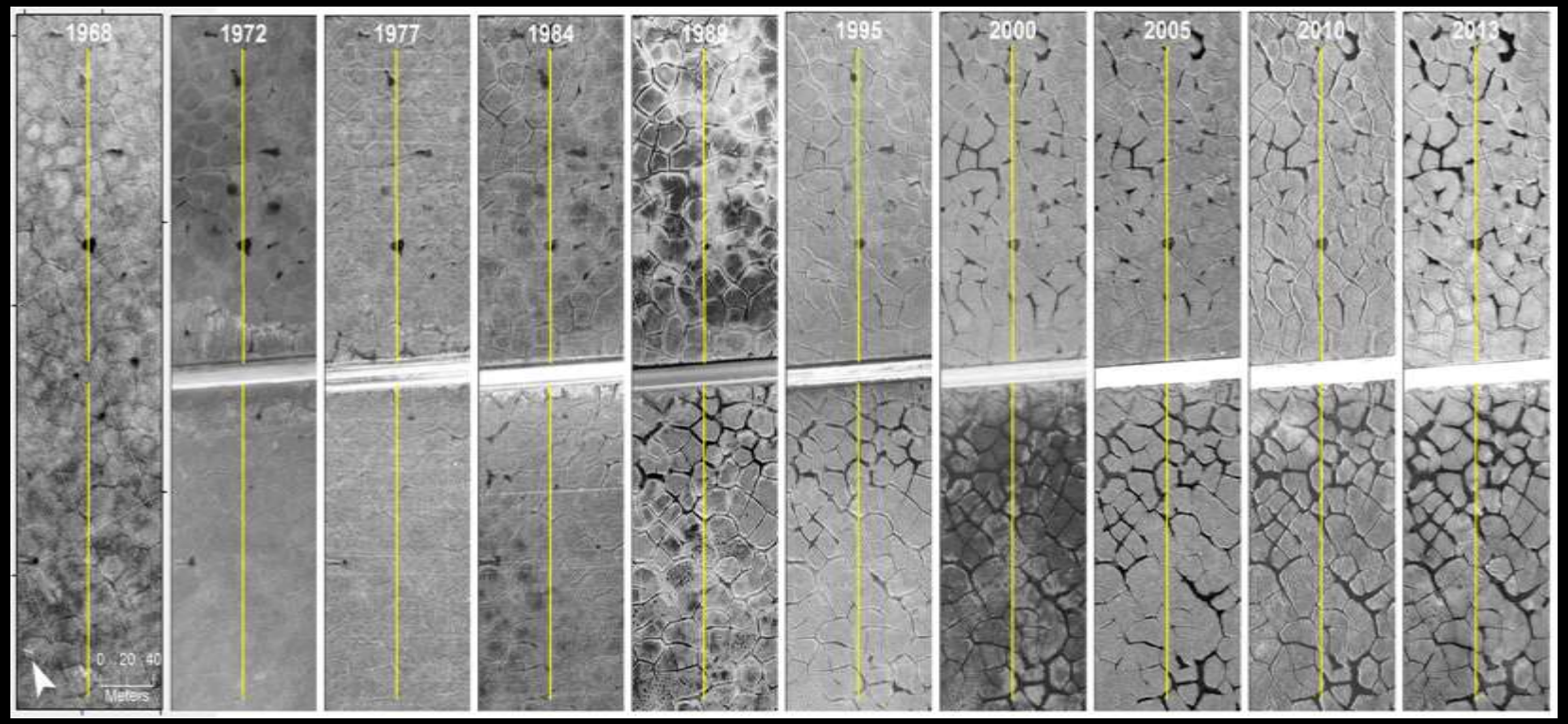
Plot-level observations and monitoring:

- Aerial photo time series
- Climate stations
- Permafrost boreholes
- Plot and transect surveys and mapping
  - Micro-topography
  - Active layer
  - Vegetation
  - Soil
  - Snow
  - Dust
  - Flooding





Thermokarst ponds: Linkages to T-MOSAiC Freshwater theme



1. Thermokarst pond plot-level studies: Emily Watson-Cook, Misha Kanevskiy, et al.

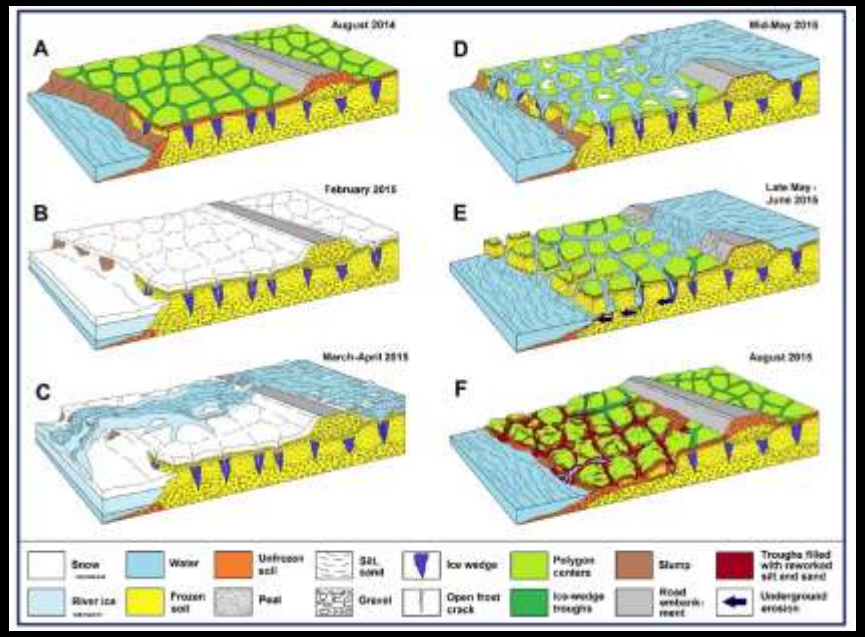
2. Remote sensing mapping and time series analyses: Ben Jones et al.

3. Strong hydrology and modeling component: Anna Liljedahl, et al. Permafrost Discovery Gateway

Permafrost Discovery Gateway

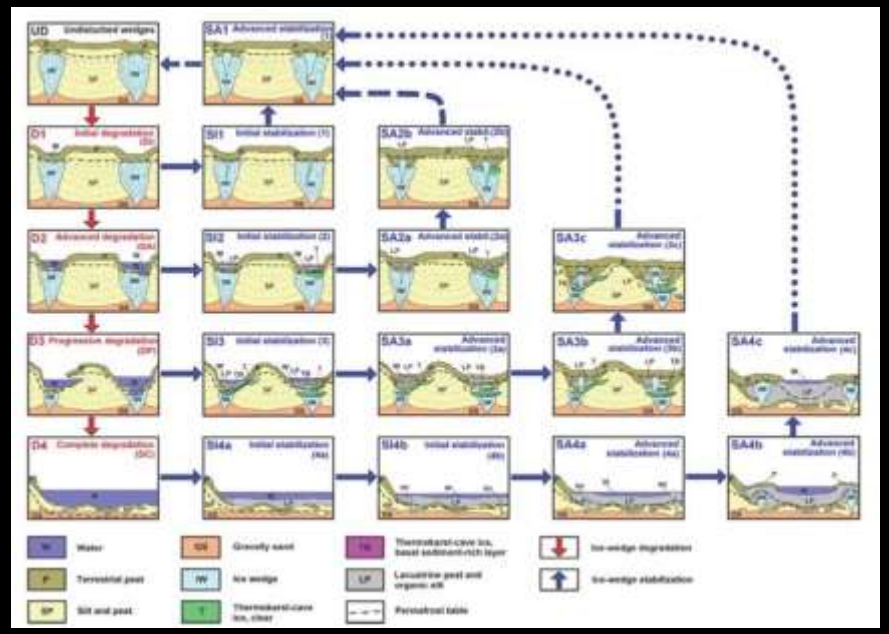
Conceptual diagrams for scenarios analyses

Underground thermokarst erosion during 2015 Sag R. flood



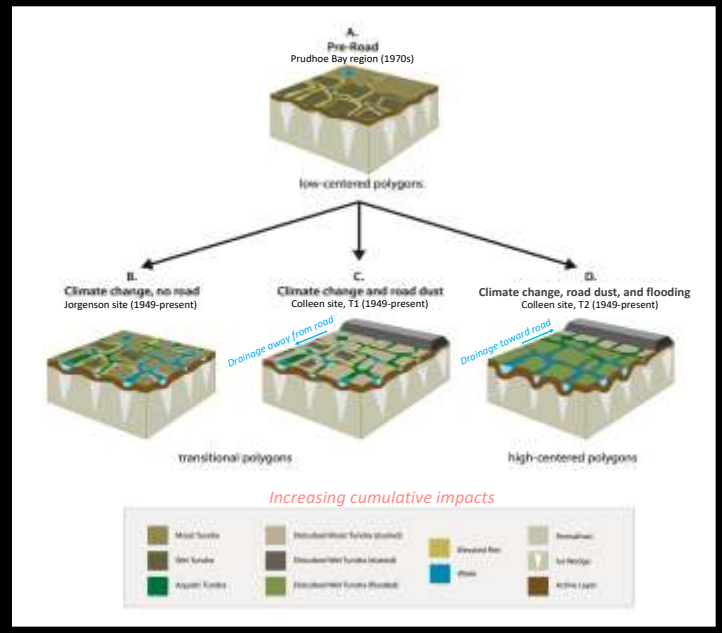
Shur et al. 2016. *EICOP.*

Stages of ice-wedge degradation and stabilization



Kanevskiy et al. 2017. *Geomorphology.*

Cumulative impacts of roads and climate change



Walker et al. 2021 in prep. *Arctic Science.*

Infrastructure scenarios

Node and network: Prudhoe Bay Oilfield

subhankarbanerjee.org

Corridor: Dalton Highway

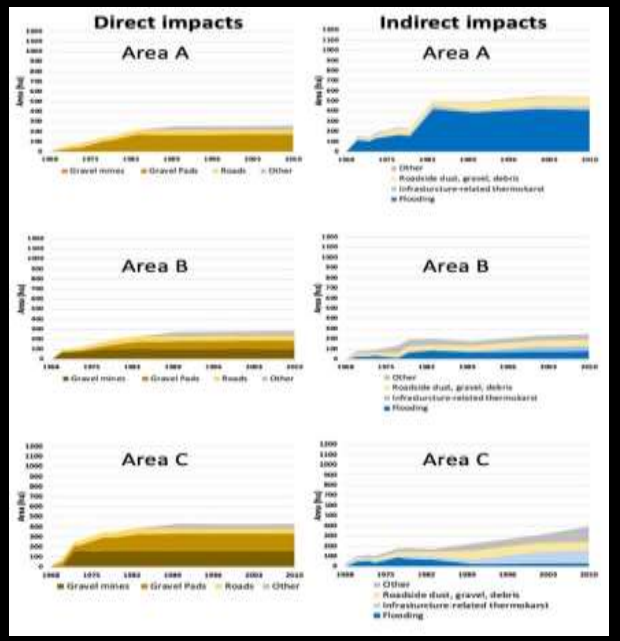
motorcycle-usa.com

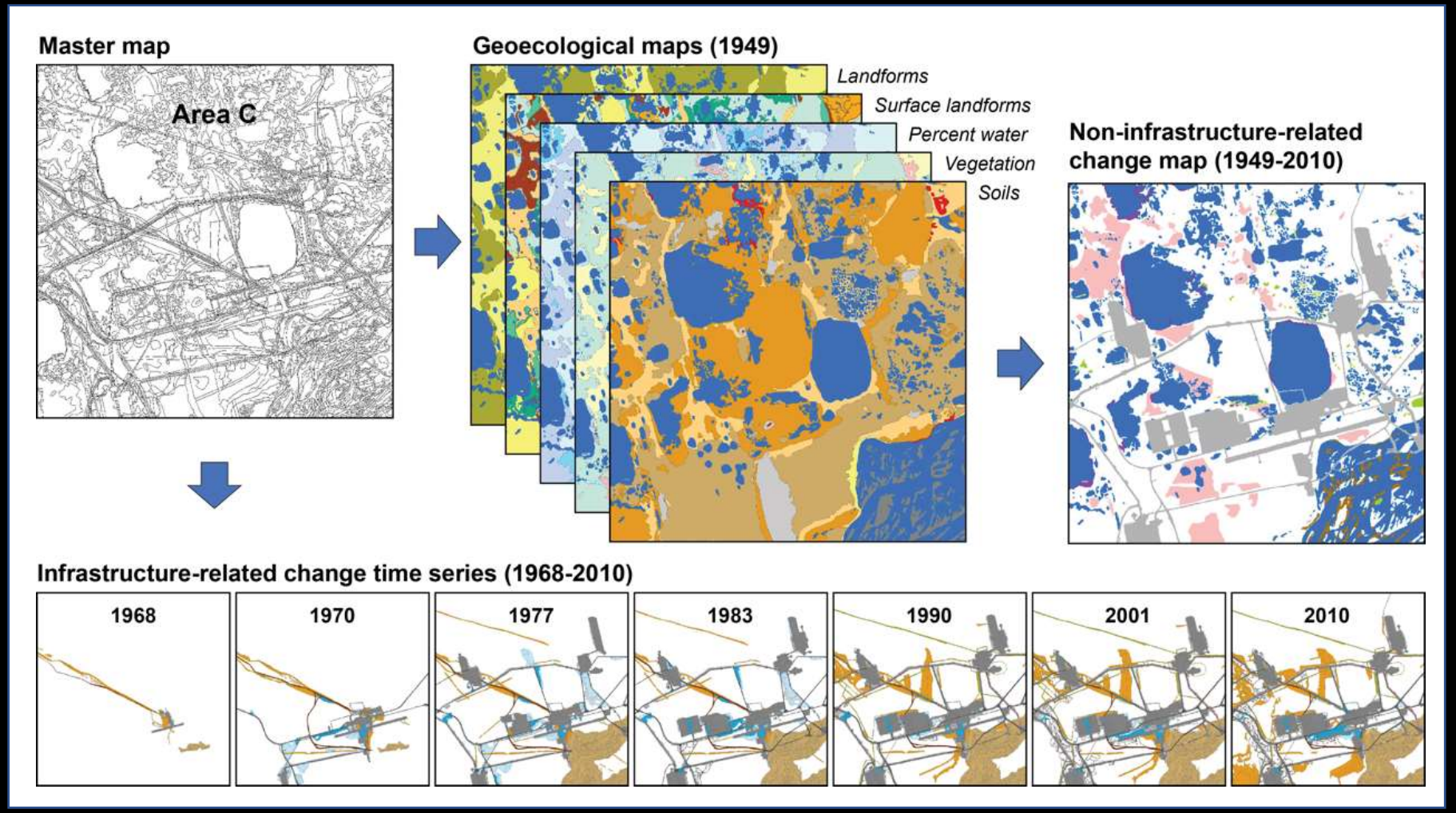
Village: Point Lay

AlaskaTeenMedia

Landscape scale:

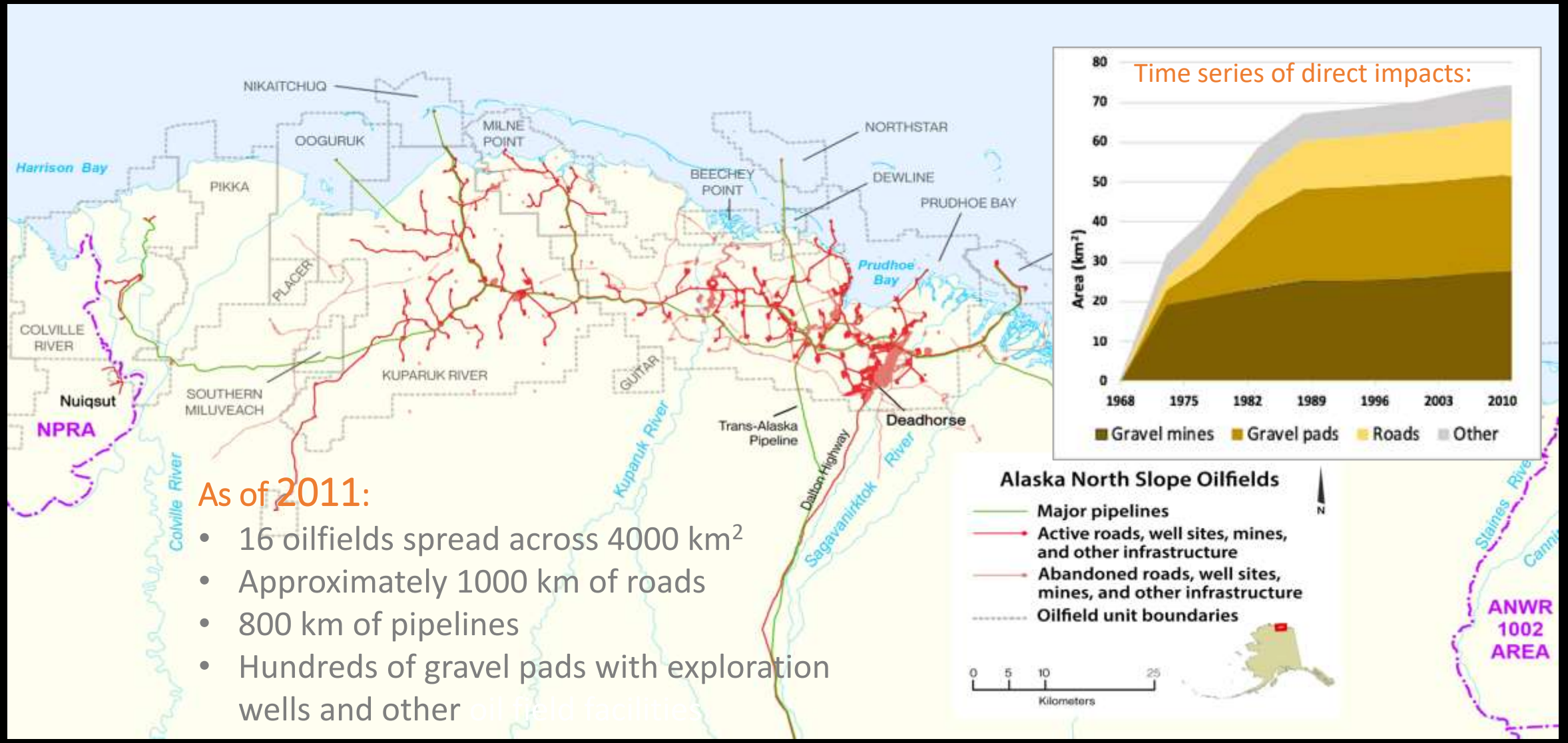
Integrated geoecological and historical-change mapping





Historical change analysis: Raynolds et al. (2014) *Global Change Biology,* 20: 1211–1224

Regional scale time series of infrastructure:
North Slope, Alaska, infrastructure since 1968



As of 2011:

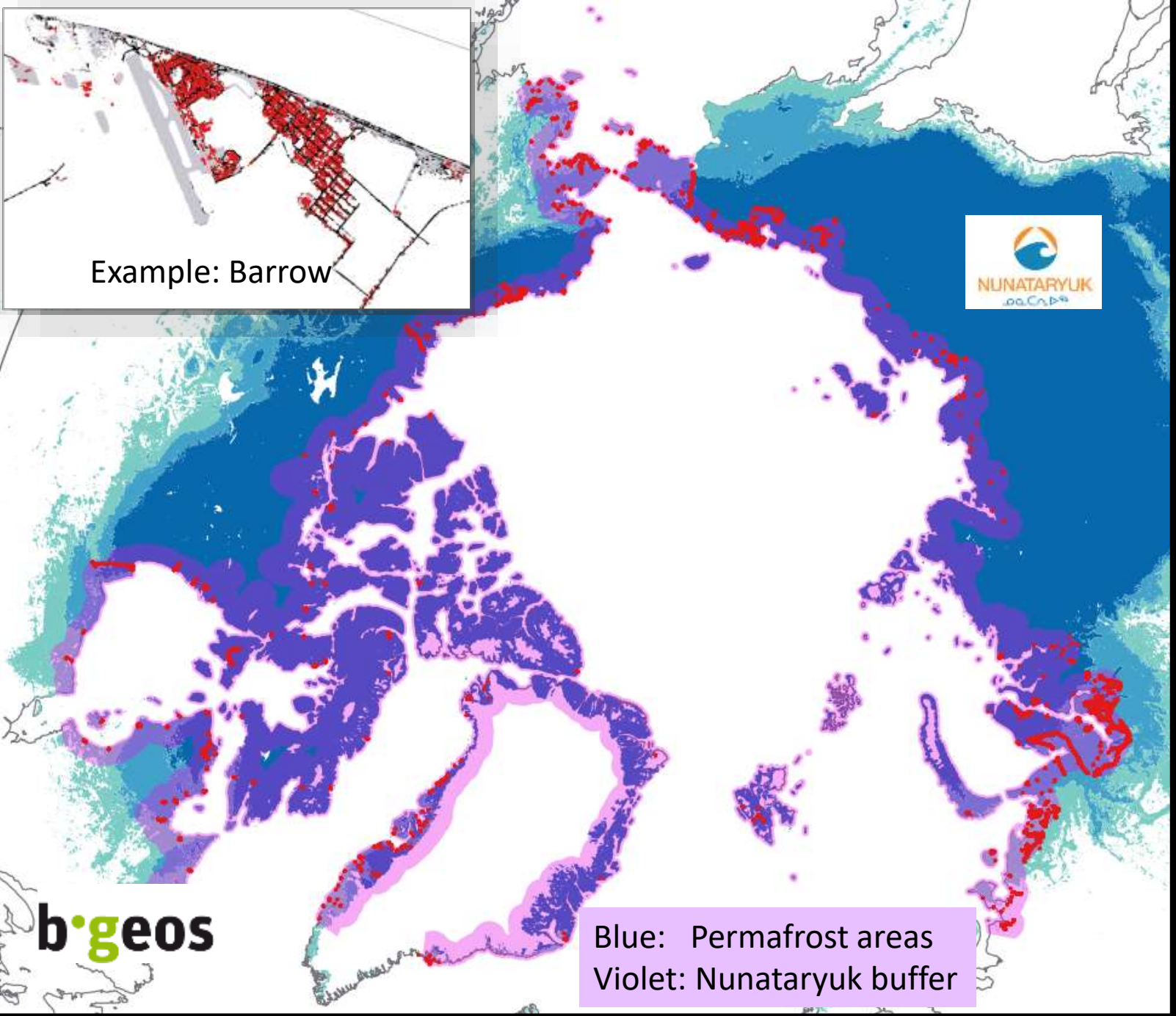
- 16 oilfields spread across 4000 km^2
- Approximately 1000 km of roads
- 800 km of pipelines
- Hundreds of gravel pads with exploration wells and other oil field facilities

Time series of direct impacts 1969-2011: Raynolds et al. 2014. *Global Change Biology,* 20: 1211–1224.

Map courtesy of BP Exploration (Alaska)

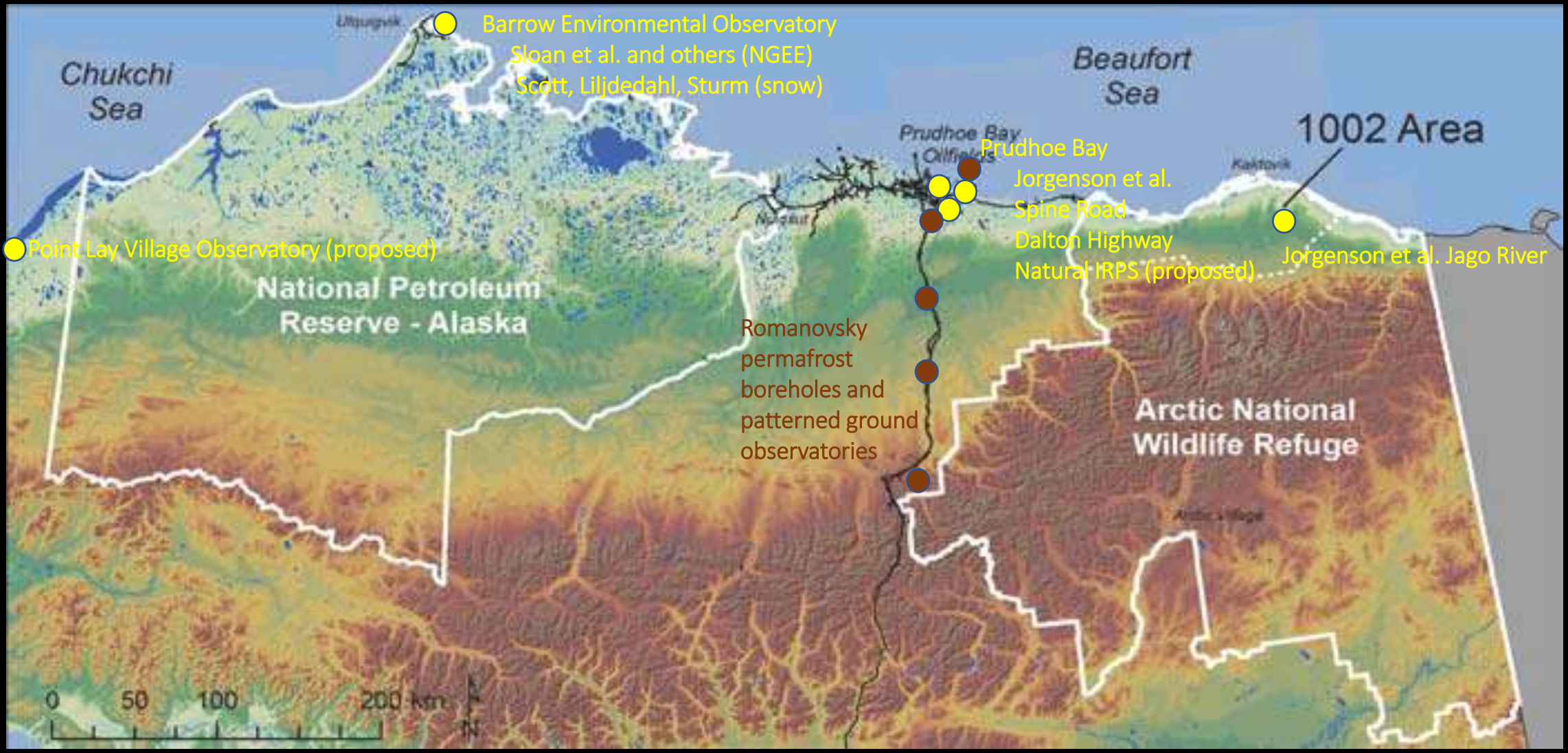
Circumpolar infrastructure
Classification and mapping

Annett Bartsch et al.



- **Input:** Sentinel-1 SAR and Sentinel-2 multispectral data
- **Method:** Fusion of two AI method results (gradient booting and deep learning)
- Three final classes:
  - Buildings and other constructions (bridges etc)
  - Roads and rail tracks
  - Other human impacted area (gravel pads, air strips open pit mines etc)

Sharing of information with other NNA and RATIC projects through Zoom meetings



Oral Talk Session ID19

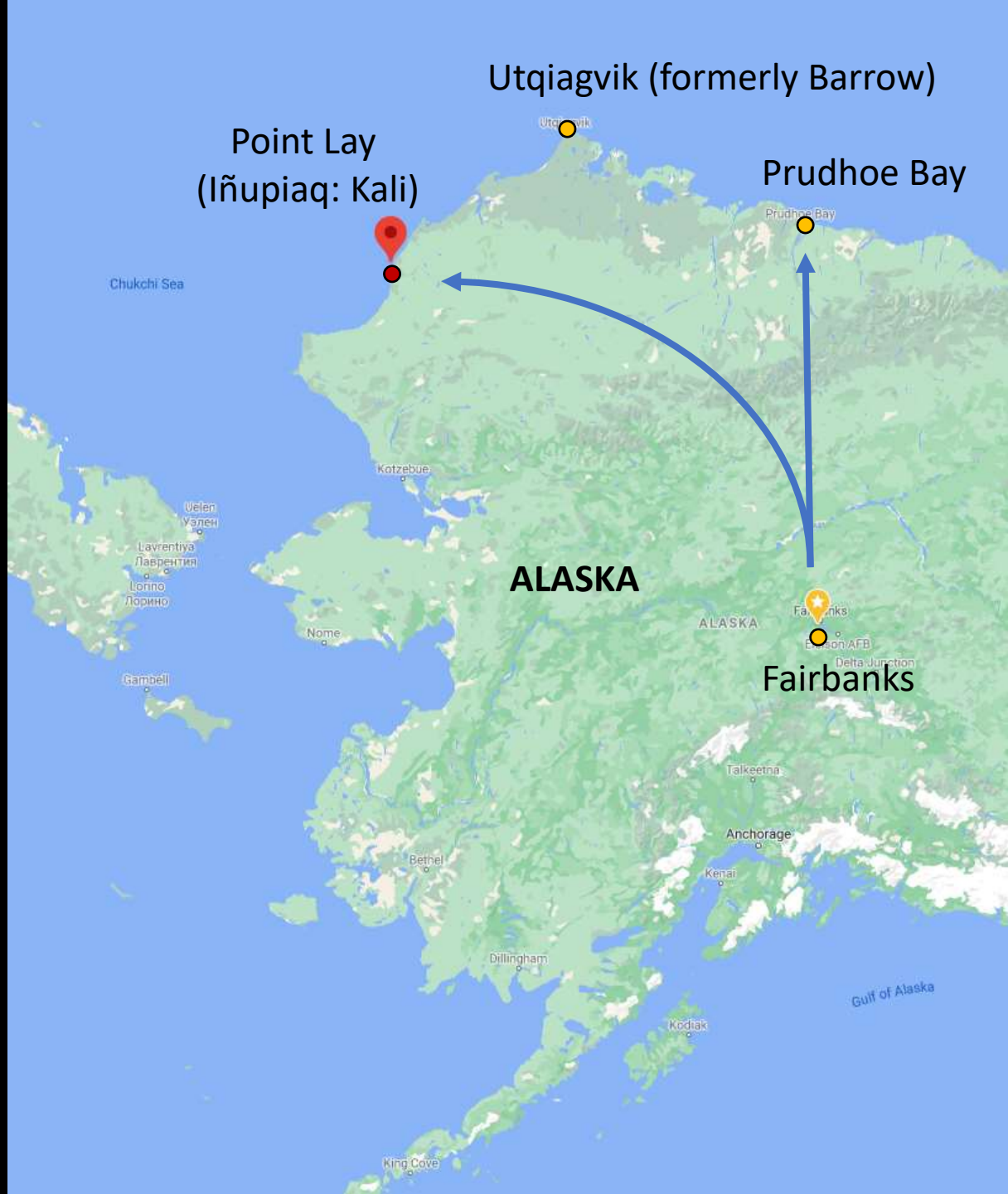
ASSW 2021,
Session ID19, Northern Roads and Railways: Social and Environmental Effects of Transport Infrastructure
Thu 8 AM GMT

Cumulative impacts of a gravel road and climate change in an ice-wedge polygon landscape

Donald A. Walker, Martha K. Raynolds, Mikhail Z. Kanevskiy, Yuri Shur, Vladimir E. Romanovsky, Benjamin M. Jones, Marcel Buchhorn, M. Torre Jorgenson, Jozef Šibík, Amy L. Breen, Emily Watson-Cook, Helena Bergstedt, Anna Liljedahl, Ronnie Daanen, Jana L. Peirce

Adapting to Change in Point Lay, Alaska (Kali)

- 230 people (~90% Iñupiat)
- Median age is 22! (over 100 students)
- Already relocated twice
- “Ground Zero for climate change on the North Slope”



Primary Research Question:

What are the best solutions for housing foundations in Point Lay where thaw subsidence is extreme?

- What has been tried?
- What has worked well? What hasn't?
- What can we learn from other places in the Arctic with ice-rich permafrost?

Research Partner:

Cold Climate Housing Research Center (CCHRC), National Renewable Energy Laboratory (NREL)

Photos: CCHRC

Coordination, Collaboration, Co-development

Jana Peirce
Project Coordinator

October 2019 reception in Fairbanks with project partners in town for the Alaska Federation of Natives (AFN)

3-minute video to introduce ourselves to community (CCHRC)

Community Partners

Research

Cold Climate Housing Research Center (CCHRC)

UAF Institute of Northern Engineering (INE)

Outreach

Ukpeaġvik Iñupiat Corporation Science (UIC Science)

Village

Tribal Government
- Tribal President**
- Village Liaison
- Steering Committee
- Tribal Council
- Residents

Kali School
- NSB School District
- School Principal**
- Teachers
- Students

Cully Corporation
- President/CEO*
- Consultant

Regional

Tagiugmiullu Nunamiullu Housing Authority (TNHA)
- Executive Director**
- TNHA Staff

North Slope Borough
- Dept. of Planning & Community Services Director**
- Capital Improvement Projects
- Public Works, Water and Sewer Dept.

UIC Science
- Outreach & Engagement Manager**

Inupiat Community of the Arctic Slope (ICAS)
- Executive Director
- Environmental/Natural Resources Director**

Orange = more active collaboration

** = Advisory Group member

Framework for Collaboration

- *Seek to build trust and mutual respect in our relationships by working to increase equity.*
- *Recognize that no one person's information or knowledge is more important than others.*

- **Village Liaison**: Main point of contact for project. Will receive an annual stipend equivalent to about 2 weeks work. Selected by the Tribal Council.
- **Local Steering Committee**: Identify best methods for working with community members and ways residents can participate in research. Four members selected by the Tribe, paid per meeting.
- **Advisory Group**: Meets several times a year by Zoom to help guide overall direction of the project (unpaid):
  - Review progress and work plans
  - Prioritize questions local & regional leaders/planners need answers to
  - Identify collaborative and educational opportunities
  - Advise on work products to ensure they meet the local/regional needs
  - Evaluate project at conclusion on its success in producing actionable science.
- **Project Coordination Agreement or MOA**: Developed with Village Liaison, approved by the Tribal Council. Includes agreed on compensation rates.
- **Subcontract with Tribe**: Identify roles and services the Tribe has the interest and capacity to provide and budget for it.

Factors for Success

*People are happy to work with the "**Permafrost People.**"*

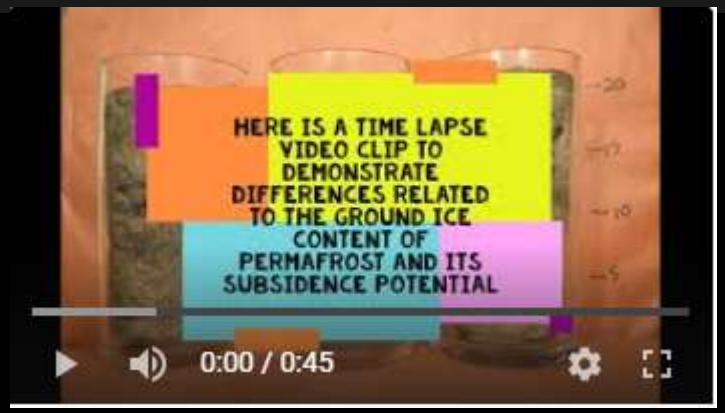
– Pearl Neakok, 1st Village Liaison

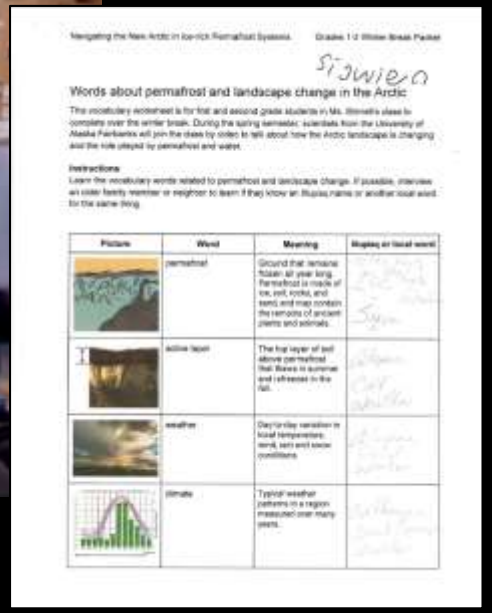
- **Start with a research question that is driven by local needs and priorities.** The community has expressed strong support for partnering on this project because it addresses urgent health and safety challenges related to permafrost thaw.
- **Icebreakers first!** Before you do anything, introduce yourselves to the community. People will respond more quickly to a person than a project.
- **Project Coordination Agreement.** It encourages realistic and ethical framework for collaboration and puts it in writing. Especially good if the community has not adopted its own guidelines for researchers working on their land!
- **Pay your local partner(s)**: It's more equitable if everyone is getting paid for their contributions (not just scientists).
- **Regional helpers**: UIC Science has helped us make connections.
- **Advisory Group**: The best thing we've done to understand local issues and perspectives during COVID. Four other research projects working in Point Lay have joined in the calls so we all benefit.

K-12 Outreach

Icebreaker: Classroom visit by Zoom

Scientists introduced themselves and shared “one cool thing.”





Navigating the New Arctic in Ice-rich Permafrost Systems. Grades 1-2 Winter Break Packet

Siowiea

Words about permafrost and landscape change in the Arctic

This vocabulary worksheet is for first and second grade students in Ms. Winnett's class to complete over the winter break. During the spring semester, scientists from the University of Alaska Fairbanks will join the class by video to talk about how the Arctic landscape is changing and the role played by permafrost and water.

Instructions

Learn the vocabulary words related to permafrost and landscape change. If possible, interview an older family member or neighbor to learn if they know an Iñupiaq name or another local word for the same thing.

Picture	Word	Meaning	Iñupiaq or local word
	permafrost	Ground that remains frozen all year long. Permafrost is made of ice, soil, rocks, and sand, and may contain the remains of ancient plants and animals.	
	active layer	The top layer of soil above permafrost that thaws in summer and refreezes in the fall.	
	weather	Day-to-day variation in local temperature, wind, rain and snow conditions.	
	climate	Typical weather patterns in a region measured over many years.	

Grades 1-2

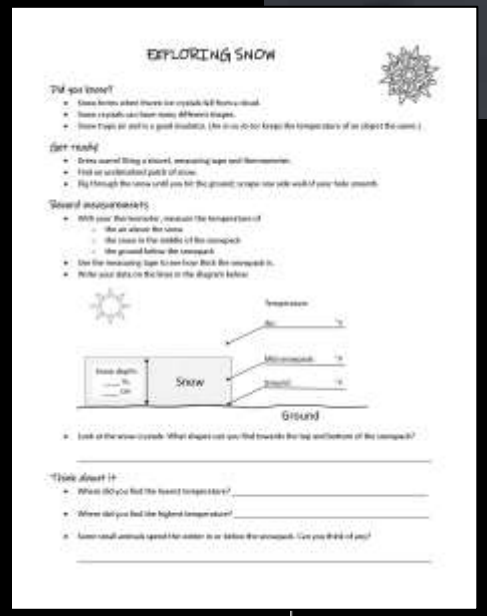
Permafrost vocabulary

Name JAYLA

Ground that remains frozen all year long.

PERMAFROST is made of ice, soil, rocks, and sand, and may contain the remains of ancient plants and animals.

Middle &
High School



1st & 2nd
Graders

Permafrost-related Activities

in collaboration with Kali teachers & principal

1st & 2nd Grade Bulletin Board

Sharing Back Data & Findings

www.gida-global.org/care

From our Project Collaboration Agreement:

- Guided by CARE Principles for Indigenous Data Governance for handling, ownership, reporting, and archiving of all data collected in Point Lay.
- Data collected in Point Lay will be organized and delivered back to the community in a format the Tribal Council believes will be useful.
- The Tribal Council can share and use the data however they would like.
- To meet funding requirements and contribute to the advancement of scientific knowledge, researchers will publish papers, present research findings to the public, and archive data in open science data repositories.