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Permafrost Discovery Gateway

Anna Liljedahl & team PDG



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Bringing you big geospatial information



Woodwell is collaborating with 7 organizations:



UConn
UNIVERSITY OF CONNECTICUT
Chandi Witharana



**ALASKA NATIVE
TRIBAL HEALTH
CONSORTIUM**



Michael Brubaker,
Sarah Yoder



NCSA
Kenton McHenry,
Luigi Marini



NSF
**ARCTIC
Data
Center**



Matt
Jones

ASU
Arizona State
University



Wenwen Li



UAF
UNIVERSITY OF
ALASKA
FAIRBANKS

Helene Genet, Ben Jones
& Jennifer Moss



**ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG**



Guido Grosse, Ingmar Nitze

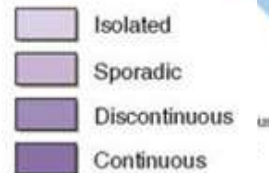
Google.org Fellows



Permafrost:
Ground that remains below 0°C
for at least two consecutive years

.....

Permafrost



Ice-rich permafrost

Up to 70% of the top 10ft of the ground can be ice.



Hay field on ice-rich permafrost

Disturbing the organic soil
cause permafrost to thaw.

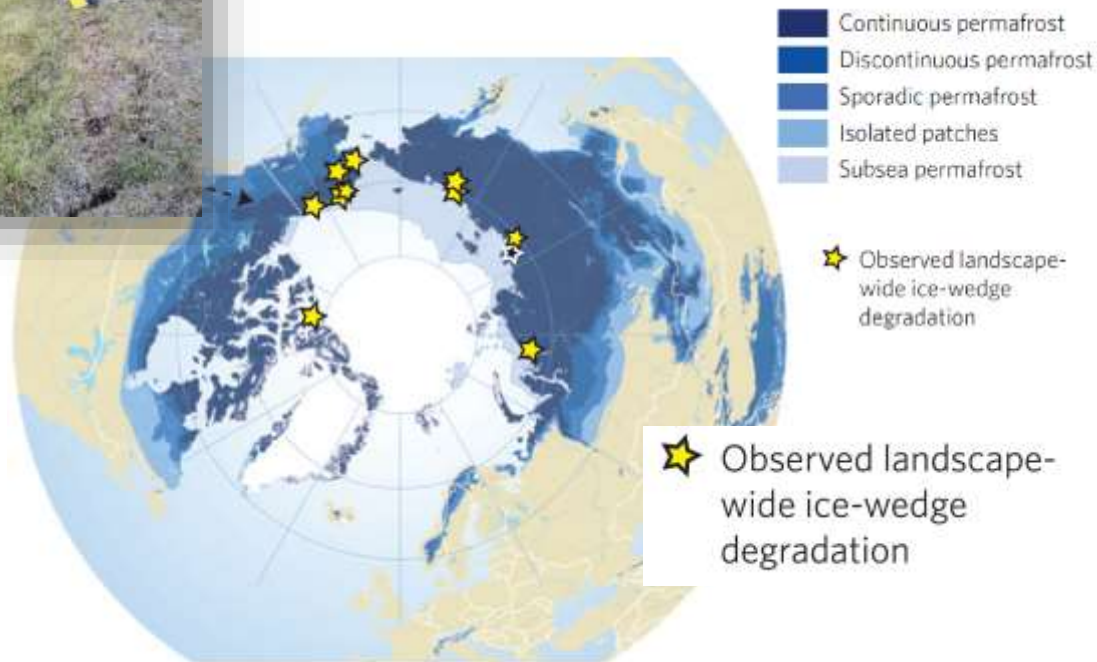






Ice-wedge degradation

Remote sensing analyses from several locations using satellite imagery show ground subsidence in undisturbed sites.



Across the Arctic, permafrost thaw is releasing carbon into the global climate system, causing problems to infrastructure, and disrupting ways of living.

5 million people

live on permafrost in the Arctic

50% of Arctic infrastructure

is at risk of permafrost thaw damage within the next 25 yrs

Hjort et al., 2022, Nature Reviews

PDG has the potential to help people by providing data and discovery tooling that can help communities and policymakers assess risk and opportunities.





Discovery tools

permafrost.arcticdata.io

Permafrost Discovery Gateway

Brevig Mission, AK



This community in the Norton Sound region of

Ice-Wedge Polygons

Zoom

Download (2.2 GB)

Opacity

80%

Ice-wedge polygons are ubiquitous ground features in landscapes underlain by ice-rich permafrost. Ice-wedge polygons are bounded by wedges of ice, which develop from millennia of repeated frost-cracking during cold winters and snowmelt water infiltrating the cracks in spring.

Relevance

Ice wedges are quite susceptible to thaw and thus can be an early warning of permafrost loss. Ice-wedge thaw also creates new ponds and pathways that can cause rapid lake drainage.

Methodology

High resolution satellite imagery combined with

Legend

Local Stories

LED Network content

Ice-Wedge Polygons

Ice-Wedge Polygons

Permafrost Extent

Isolated patches

Sporadic

Discontinuous

Continuous

Surface Water Index Trend 2000-2021 (July Trend in Aug)

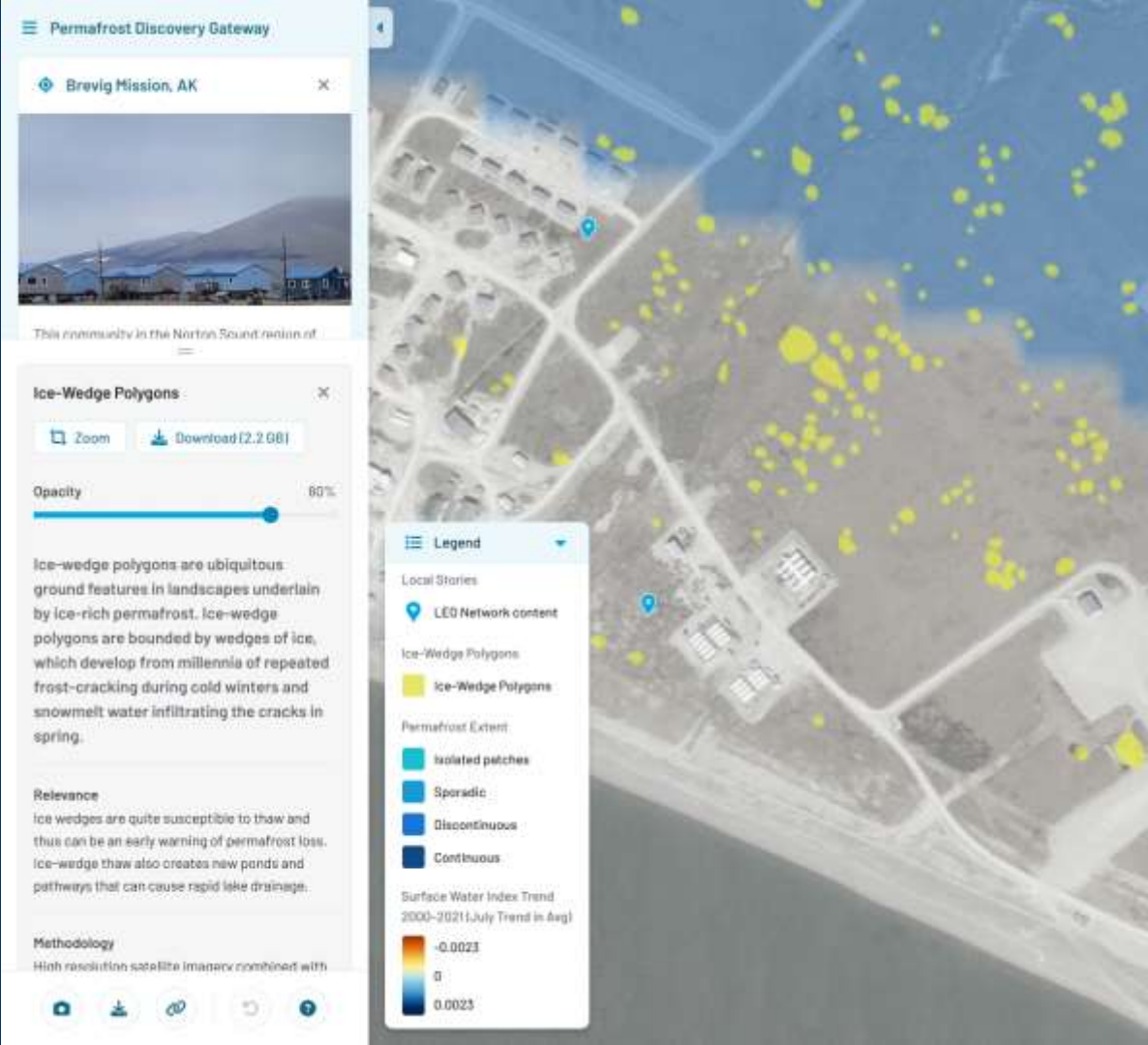
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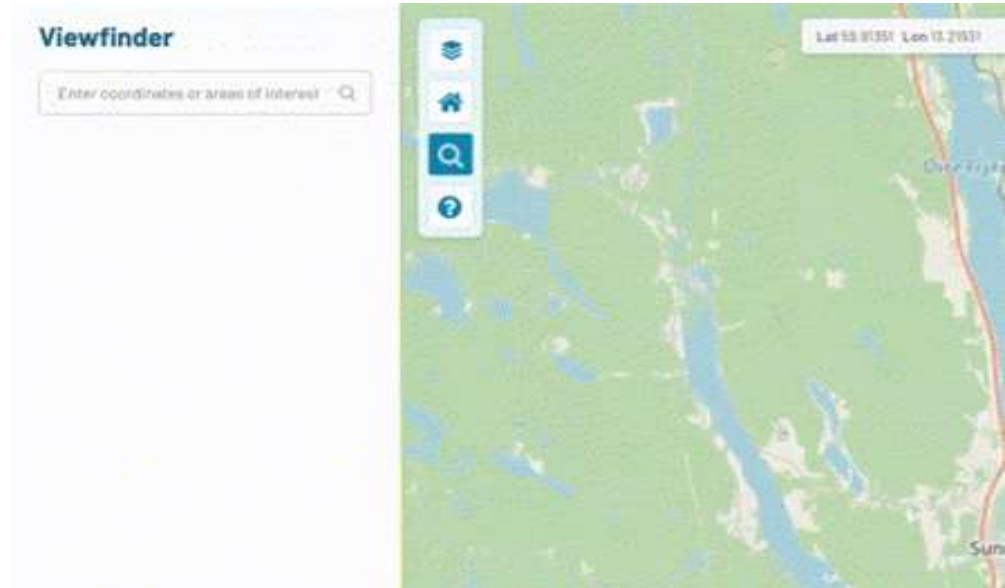
Discovery tools for big geospatial data

- Increase data access
 - Remove technical & \$\$\$\$\$\$ barriers
- Increase “freshness” of information
 - Shorten & automate the pipeline
- Make science more inclusive
 - Connect information & knowledge
- Make science useful!



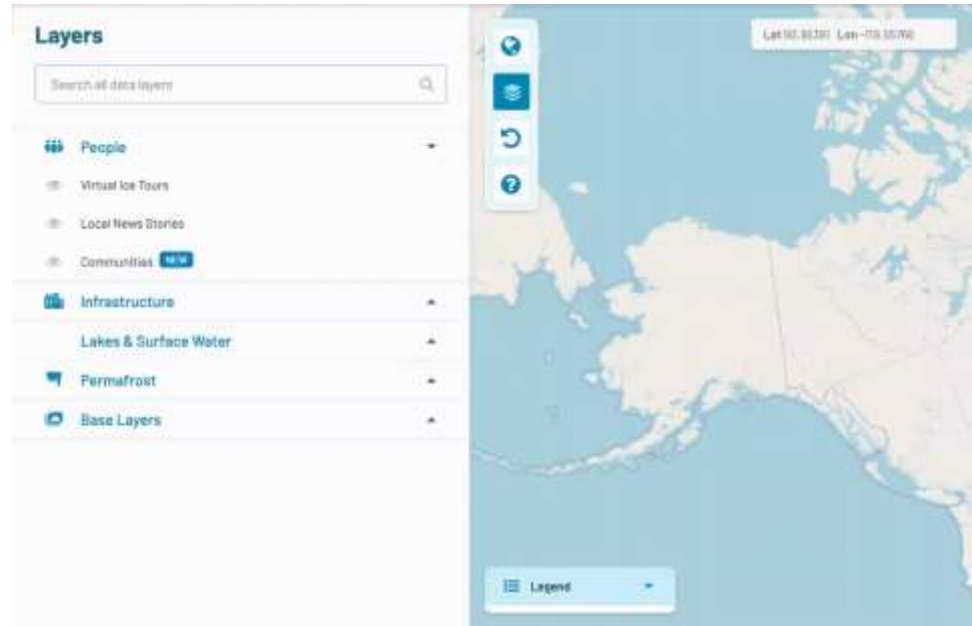
Location Search

We've introduced place name, area of interest, and lat/long coordinate-based search functionality.



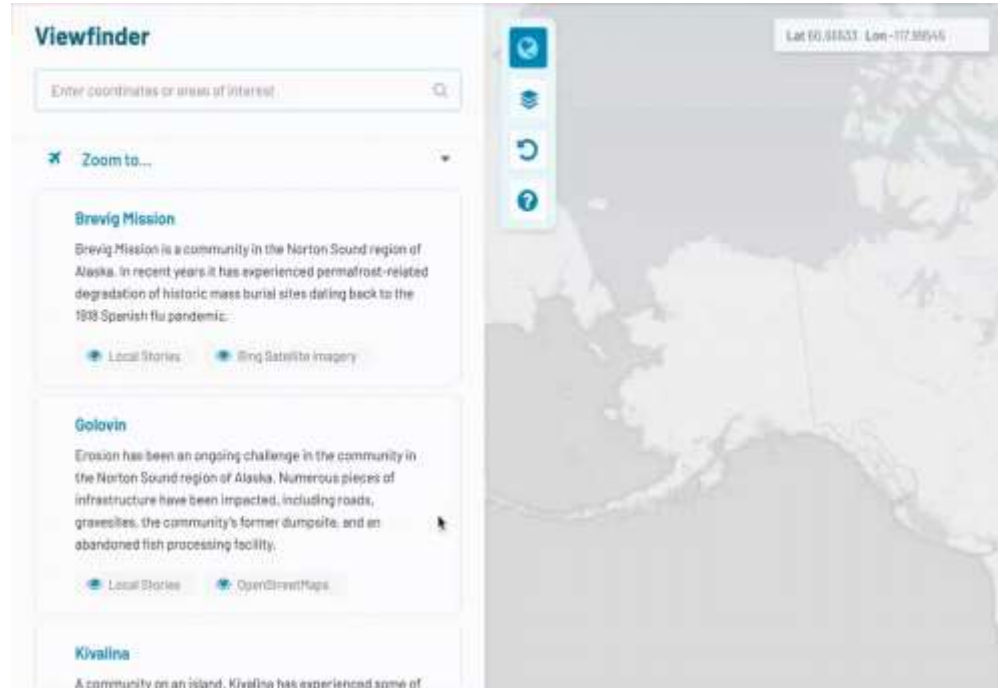
Legend Design

Legends are inside the map, including palette info of all visible layers.



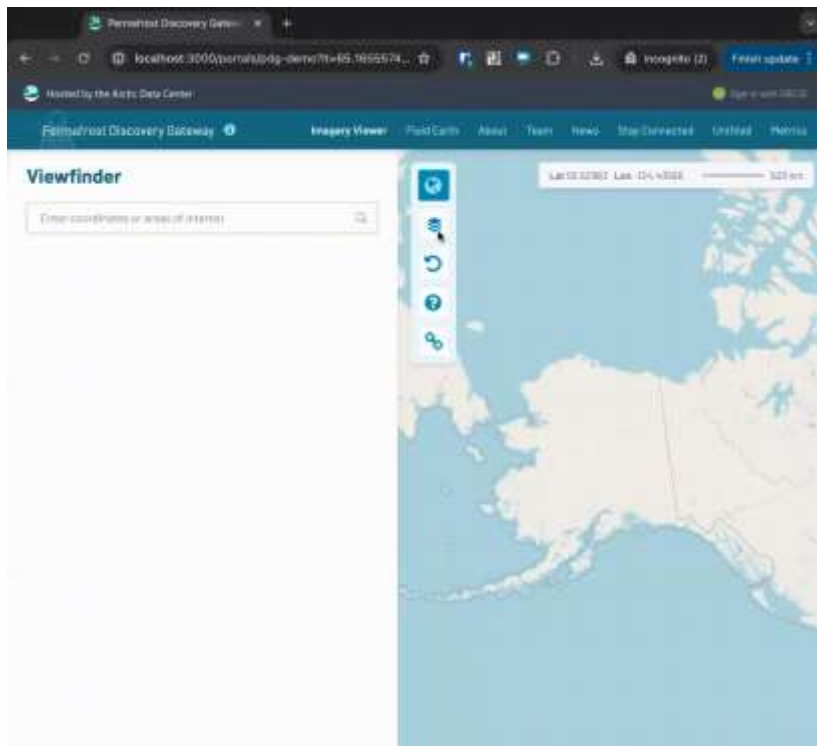
Zoom to & Storytelling

With the zoom to feature, we've incorporated a storytelling element in the user interface that showcases and zooms in on communities, making it easier to discover, explore, and derive meaning from the data.



Shareable URL

Users can now share a url that saves the current location and data layer configuration. The PDG map resets any time the browser window is closed, but with the new share url feature users can easily return to a previous configuration.



Gathering Feedback

After prototyping the functionality in the previous slides and candidates for subsequent releases, we spoke with target users to get feedback, see where the design is working, and where we might reconsider our approach.

“

I have the option to download them all [layers], deselect some of them perhaps, and then download just the ones I want. **That would be really useful to me.** It's exactly what I described.

“

This is what I like about what you guys are doing, because **you're moving away from standardized software which often is expensive for small communities.**

“

The time series would be a neat visualization for a city planner to say: **What's happening in our community?** Are we seeing expansion? Are we seeing contraction?

Permafrost
Discovery Gateway



Big map data

Monitor permafrost thaw across the Arctic

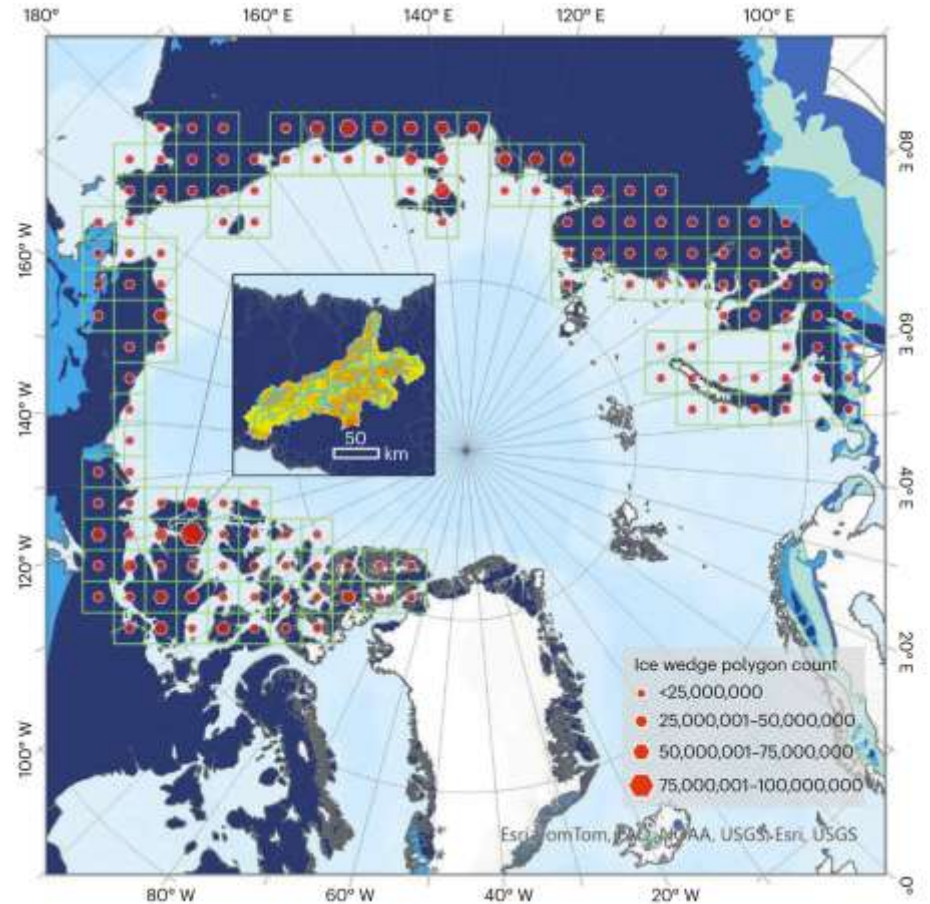
Ice-wedge polygons

Mapping where we have ice-wedge polygons and therefore, ice-rich permafrost, across the Arctic



Ice-wedge polygon map

We have over 1.8 billion ice-wedge polygons mapped from 0.5 m resolution Maxar imagery.



Retrogressive Thaw Slumps

RTS can release large amounts of sediment into rivers.



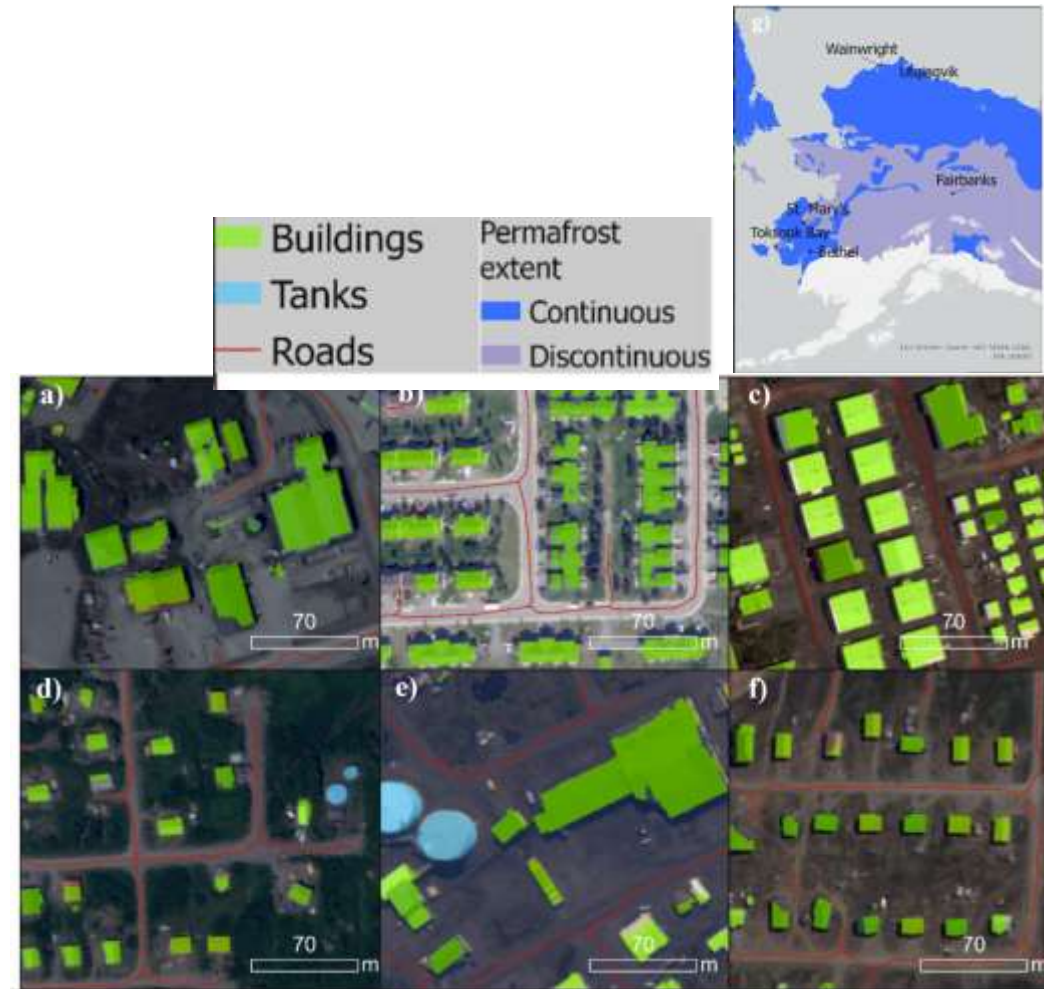
Retrogressive Thaw Slump map

Effort ongoing on mapping individual RTS using Planet imagery (~3m) and how each RTS evolve over time.



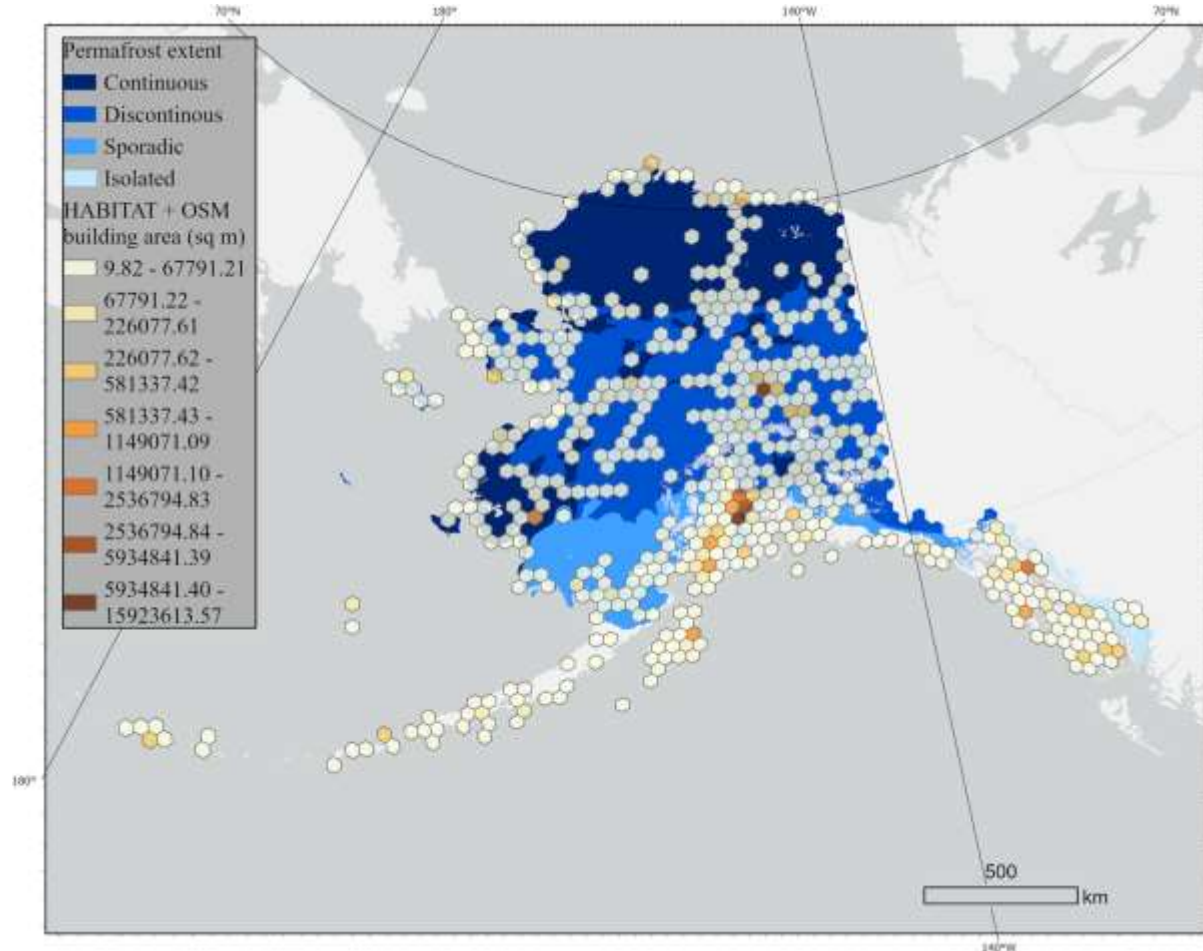
Infrastructure

We have developed a new infrastructure map of buildings, tanks, roads... from 0.5 m Maxar imagery.



Infrastructure map of Alaska

We have developed a new infrastructure map of Alaska and, in the coming years, for the Arctic.



Near Real Time Monitoring of Lake Drainage

Problem

Currently, most permafrost knowledge is in the form of one-time decadal-scale snapshots of past thaw across the Arctic.



Solution

- *PDG users will be able to see which lakes have drained in the past month*



AI tools for access



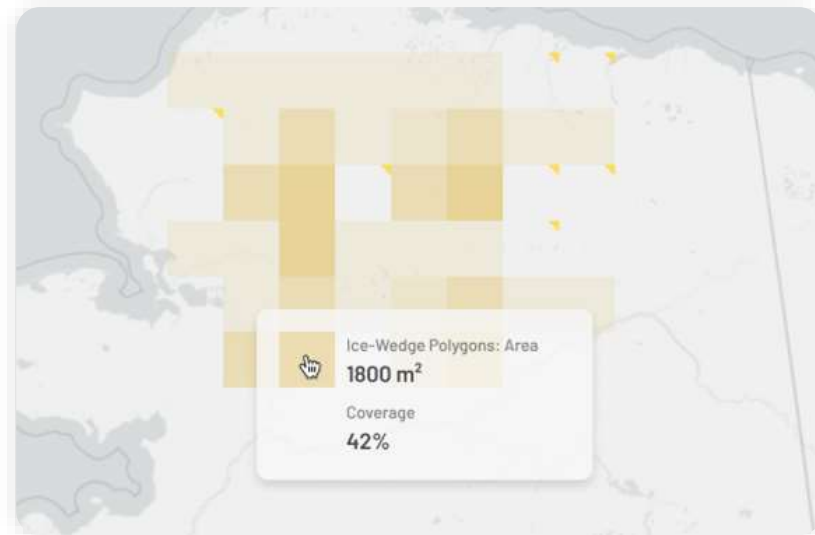
Problem

The scale of large geospatial datasets makes them difficult to understand at the global level.



Solution

We are creating a summary layer to make the data easier to understand at any zoom level.



Connect big data to the real world



Integrating local environmental observations and remote sensing to better understand the life cycle of a thermokarst lake in Arctic Alaska

Benjamin M. Jones, Susan Schaeffer Tessier, Tim Tessier, Michael Brubaker, Mike Brook, Jackie Schaeffer, Melissa K. Ward Jones, Guido Grosse, Ingmar Nitze, Tabea Rettelbach, Sebastian Zavoico, Jason A. Clark & Ken D. Tape



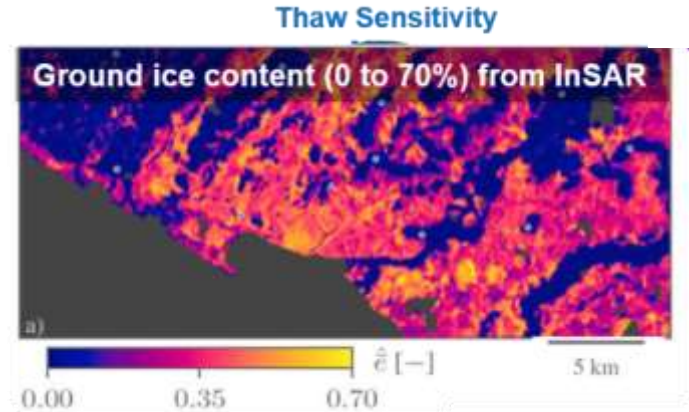
RAPID.
LOCAL.
CO-CREATED.
IMPACTFUL.

CIVIC
INNOVATION
CHALLENGE

New planning project:

Building resilient Arctic communities to permafrost thaw hazards

- Ground subsidence rates
 - New datasets
 - New access tools
- PDG webinar series, one-on-one online user interviews
- ***Looking for a pilot-study community partner!***



Simon Zwieback, UAF
Gary Greenberg, Alaska Mapping Company
Christopher Stevens, Northern Permafrost Consulting
Doug Hungarter, Google.org
...and the others in the PDG dev. team!

Thank you

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permafrost.arcticdata.io

