Creating Remote Imaging Pyramids for the Permafrost Discovery Gateway

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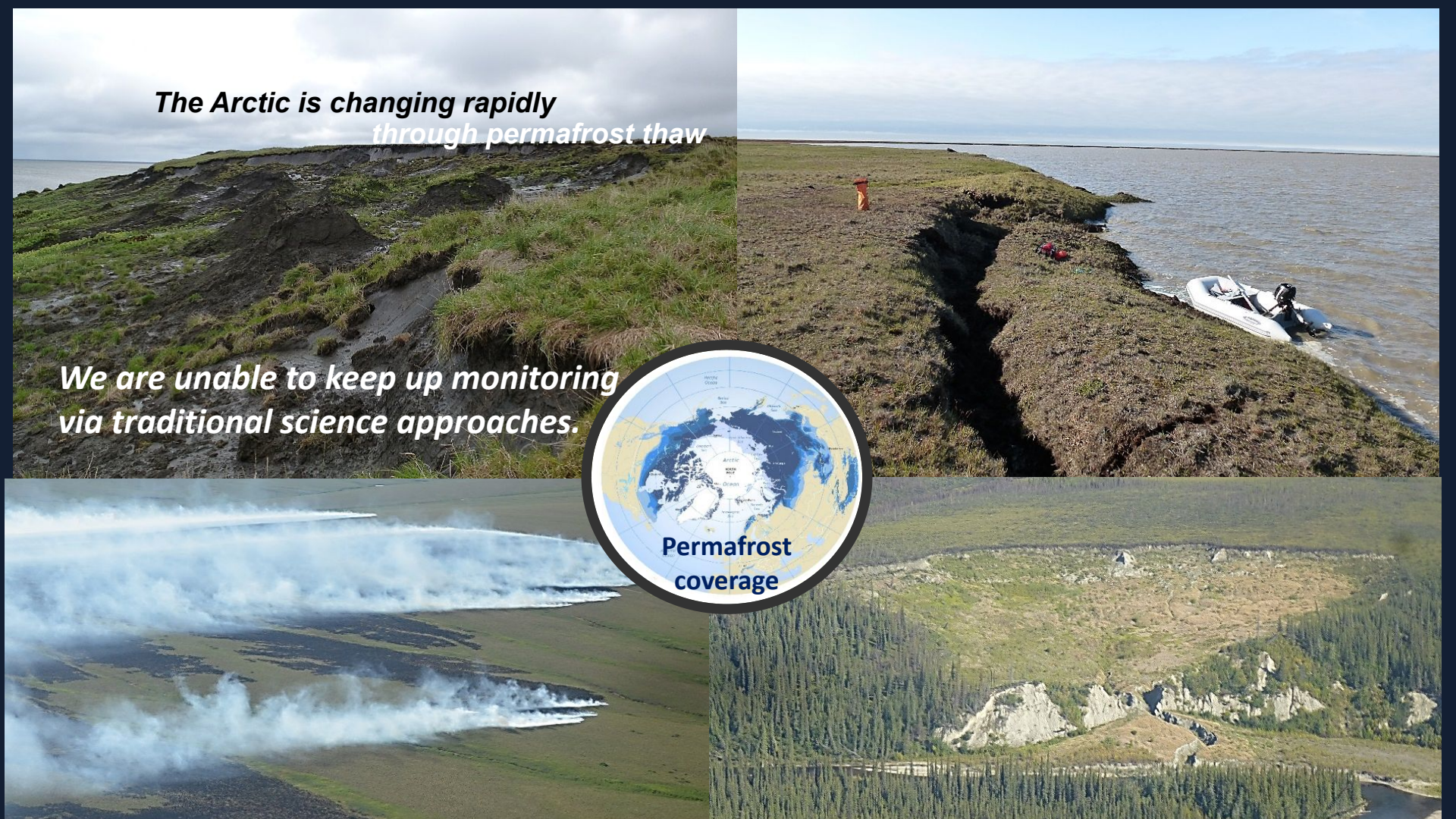
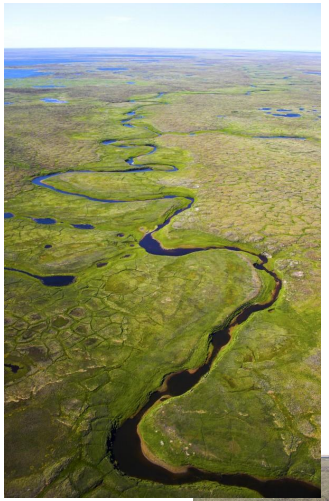
National Center for Supercomputing Applications
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Woodwell Climate Research Center

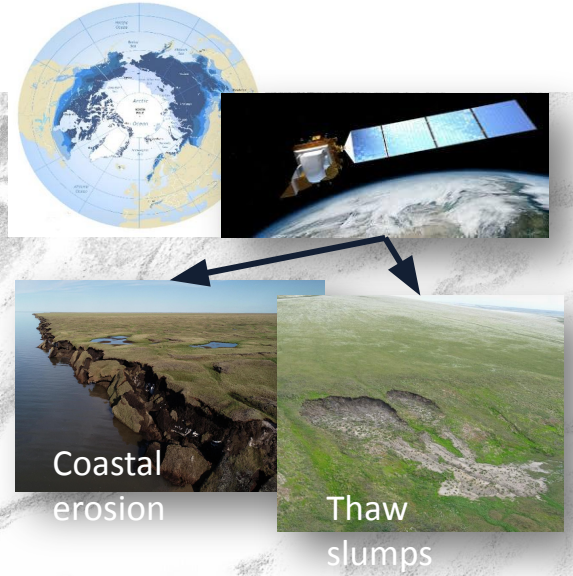

The Arctic is changing rapidly
through permafrost thaw
We are unable to keep up monitoring
via traditional science approaches.
Permafrost
coverage

Human Impact



Permafrost Discovery Gateway

Developing permafrost big imagery products & making them discoverable for knowledge-generation

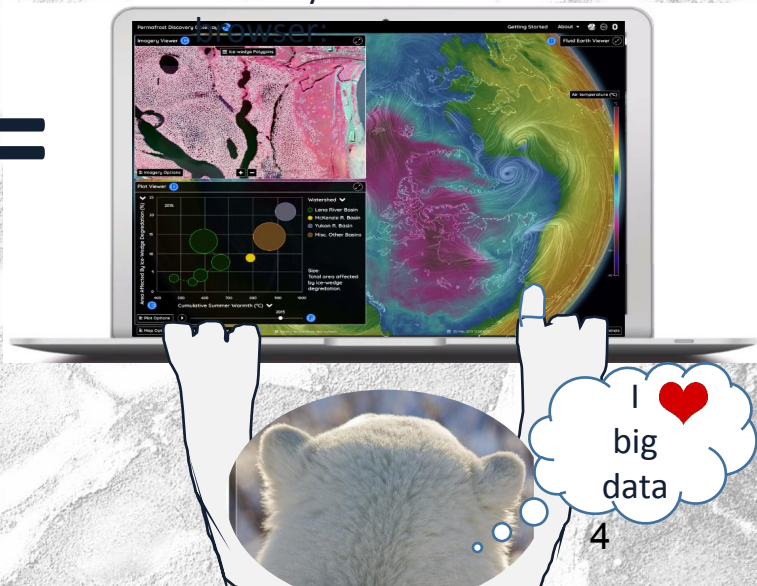


+

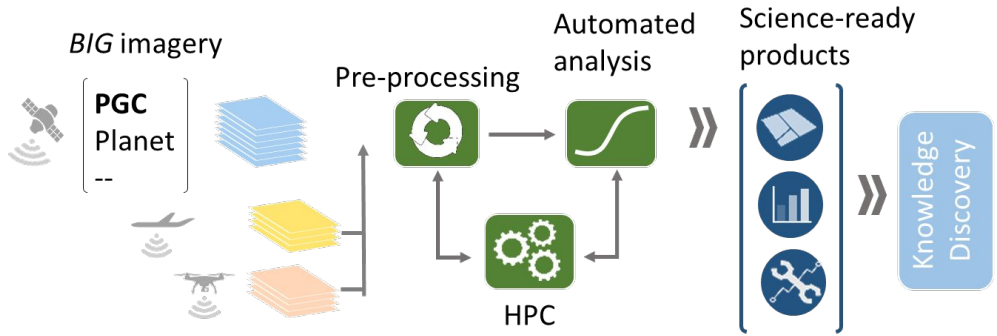
Compute

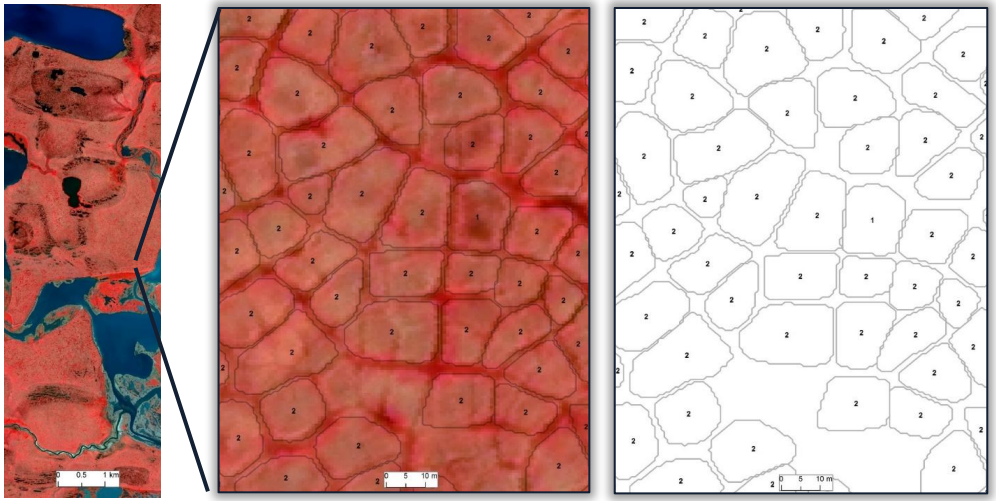
=

You on your web

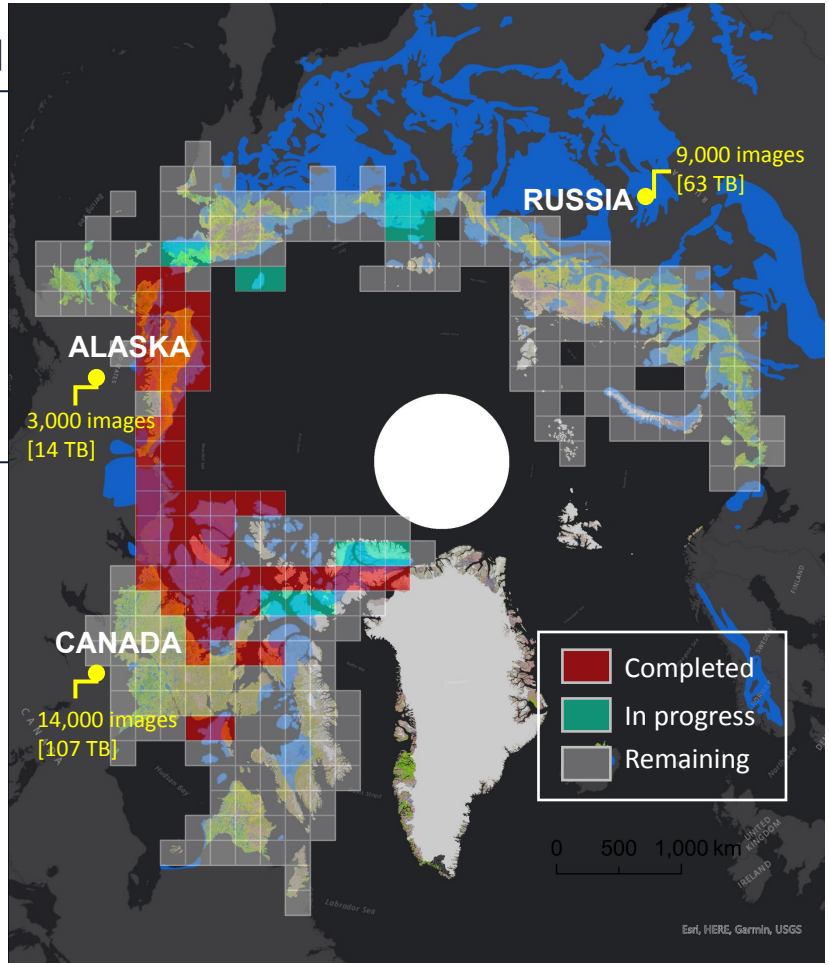


Mapping Application for Arctic Permafrost Land Environment [MAPLE]





AI-based automated ice-wedge polygon detection from sub-meter resolution satellite imagery



Tundra Vegetation map (CAVM 2019) and Ground ice probability map (high category) are shown in the background

[Witharana et al. 2020, Bhuiyan et al 2020, Udawalpola et al 2021, Hasan et al . 2021]

‘Big’ imagery

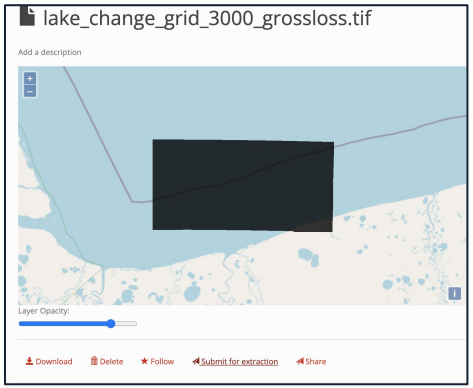
- Entire Arctic (above 60°N) has been imaged by DigitalGlobe Inc. commercial satellites in 0.5m resolution four times in the last 6 years.
- > 4 petabytes of imagery
  (> 1 million image scenes)
- Image data is available at the Polar Geospatial Center (PGC), University of Minnesota

Satellite image footprints *(above 60°N)*

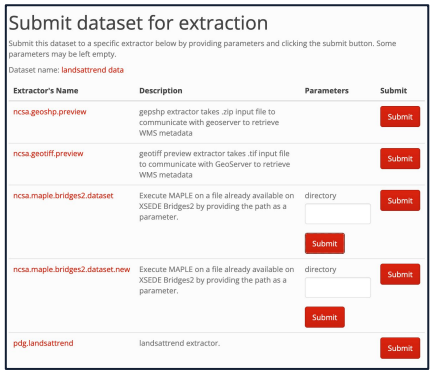
MAPLE Clowder Extractor

https://clowderframework.org/

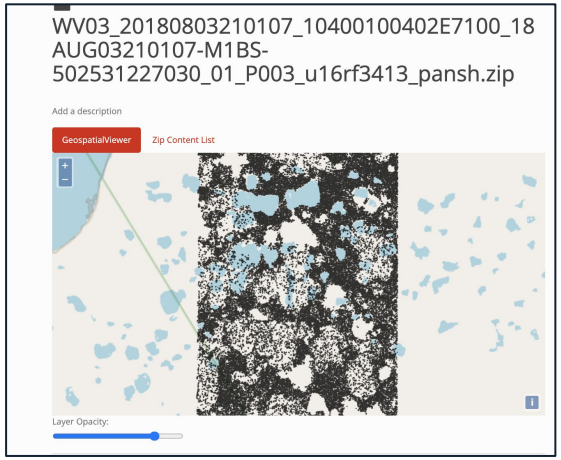
Input

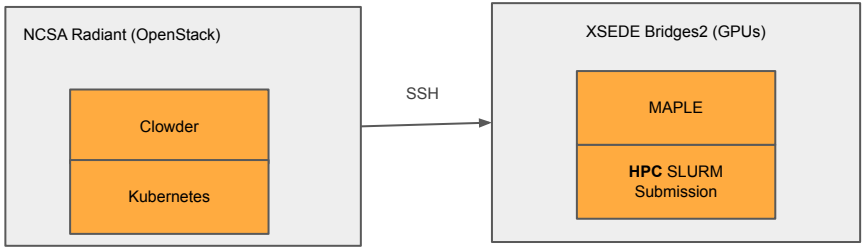


Submit



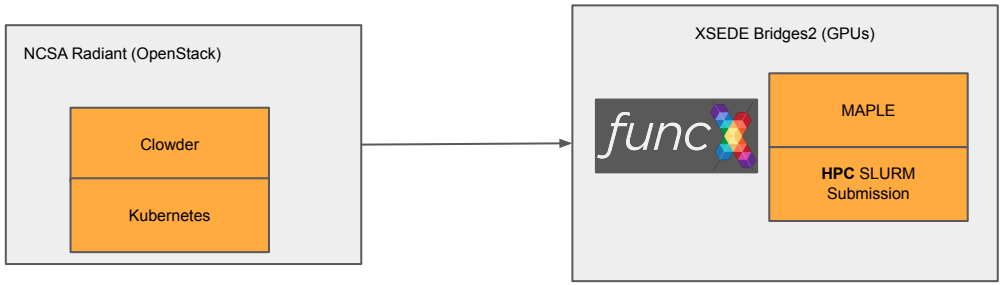
Output

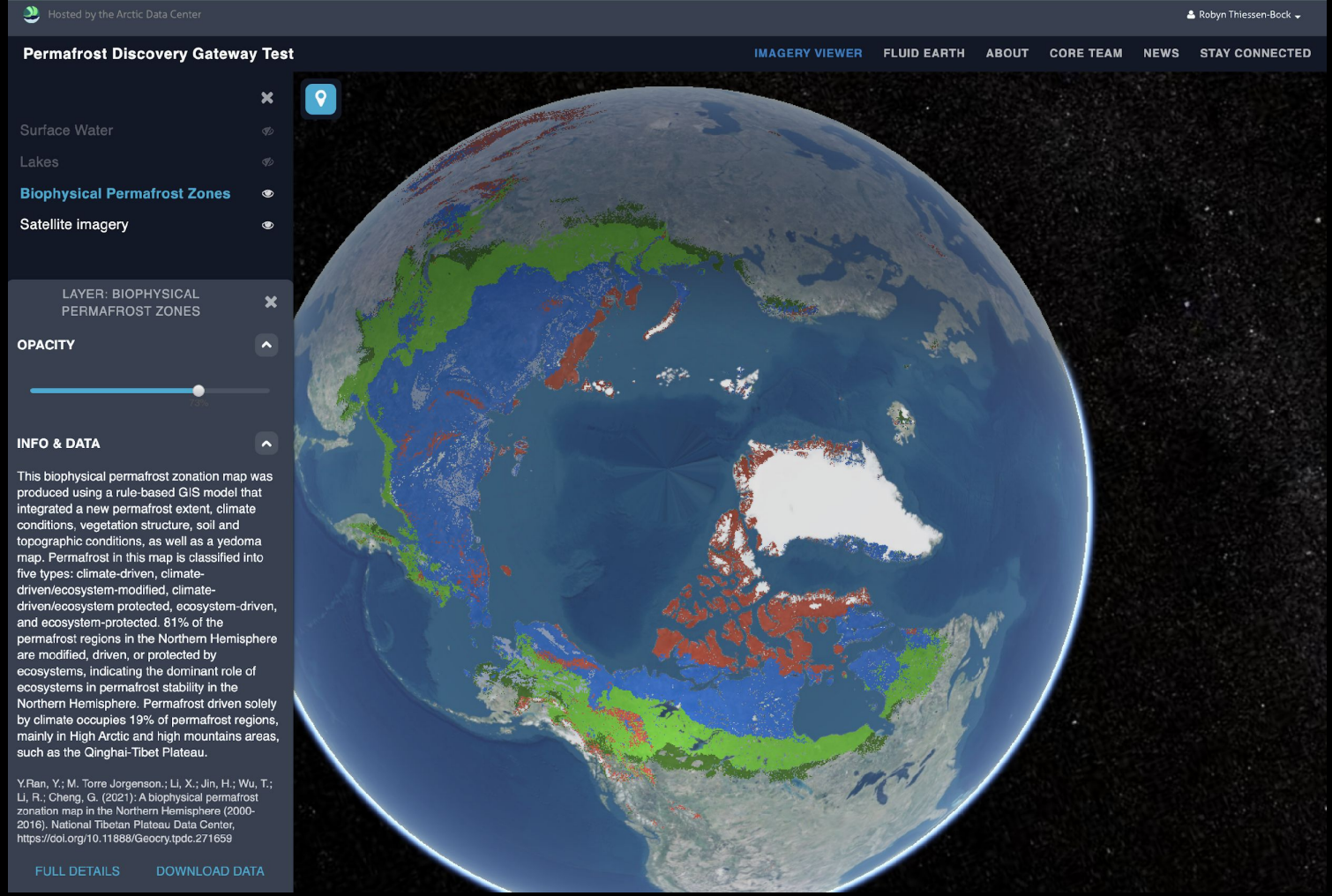




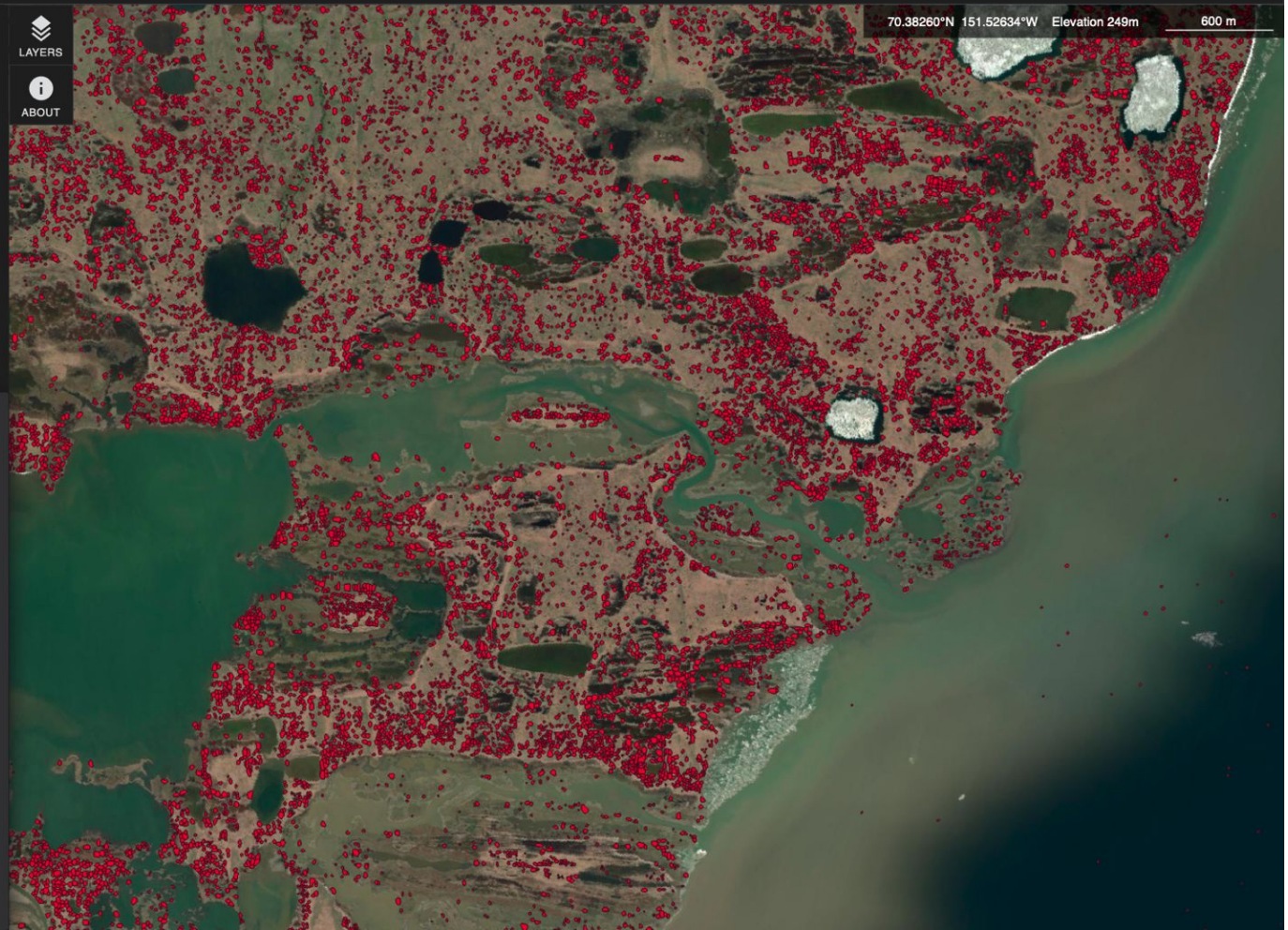
FuncX for Submission to XSEDE Bridges2

- Use funcX to achieve better portability beyond Bridges2
- Do you need special permissions to run FuncX on head node?
  - Long running process?





Lauren Walker, Chris Jones, Robyn Thiessen-Bock, Matt Jones, Amber Budden



- LEO Network news
- Ice wedge polygons
- Lakes
- Percent cover ice wedges
- Satellite imagery

ICE WEDGE POLYGONS LAYER DETAILS

OPACITY

25%

INFORMATION & DATA

Created by: Chandi Witharana

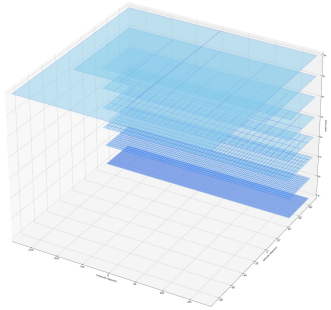
The first pan-Arctic map of ice-wedge polygons. An ice wedge is a crack in the ground formed by a narrow or thin piece of ice that measures 3 to 4 meters in length at ground level and extends downwards into the ground up to several meters. Ice wedges are degrading with climate change, affecting watershed hydrology, and amplifying the loss of permafrost.

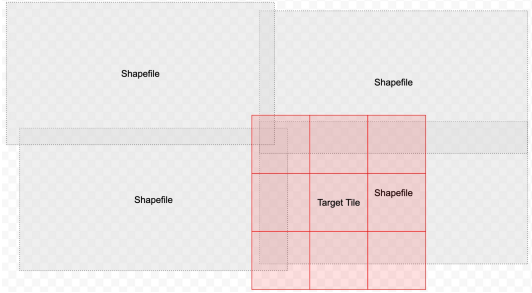
Chandi Witharana. Ice wedge polygons. 2021. File last modified on 2 Jun. 2021. 3D tiles. Retrieved from https://permafrost.arcticdata.io on 3 Jun. 2021.

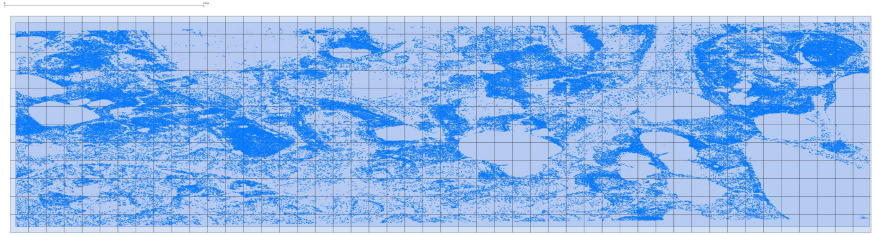
FULL DETAILS CITE DOWNLOAD DATA

Tile Job Dispatcher

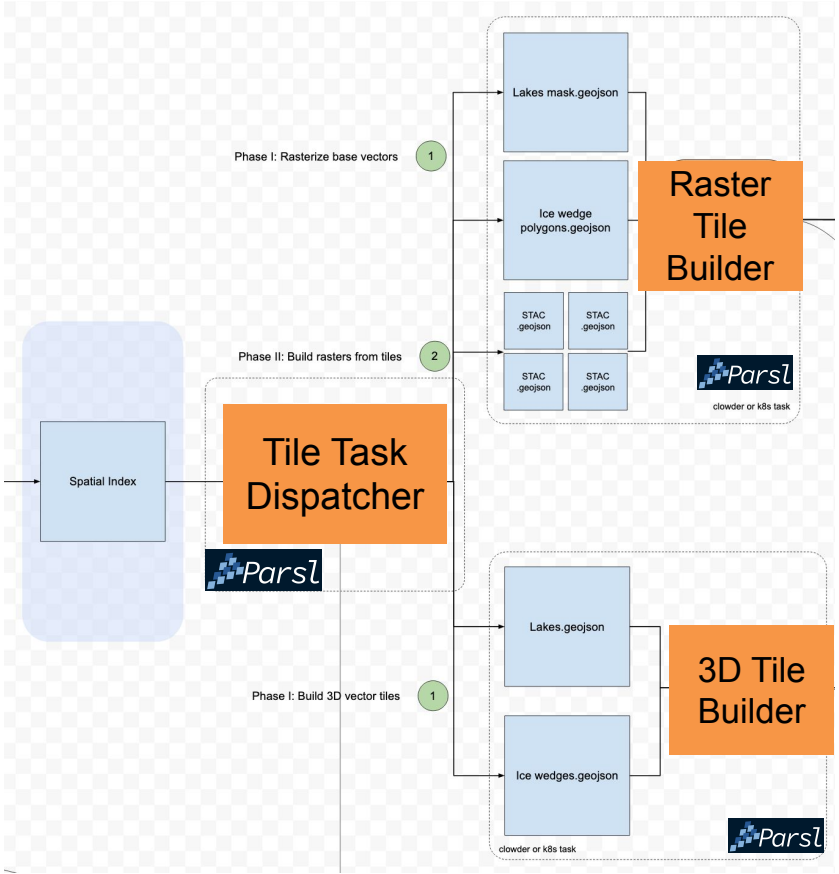
- Graph we are trying to build is not aligned with the tile structure
- Ideal: launch jobs as enough tiles stream in
- Realistic: Wait for all files to become available
- Parsl **pattern** for triggering jobs based on requirements?







Creating Raster and 3D Tiles at Scale



CESIUM

Clowder Parsl Extractor

- Prototyped a Clowder extractor to Launch Parsl jobs on local Kubernetes cluster
- Plan to generalize to make it easier to create Clowder extractors leveraging Parsl (Simple Clowder Extractors)
- Improvement: Ability to load incluster config in **parsl.providers.kubernetes.kube.py:107**:
  - **config.load_kube_config()** vs **config.load_incluster_config()**

Thank you!

https://permafrost.arcticdata.io

Permafrost Discovery Gateway

Navigating the New Arctic
Awards # 1927872, 1927723, 1927729, 1927720, 1927920, & 2052107

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