

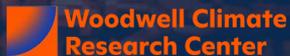


Creating Remote Imaging Pyramids for the Permafrost Discovery Gateway

Luigi Marini,

Anna Liljedahl, Lauren Walker, Robyn Thiessen-Bock, Chris Jones, Matt Jones, Anna Liljedahl, Kenton McHenry, Todd Nicholson, Chandi Witharana, Ingmar Nitze, Gala Wind, Rajitha Udawalpola, Ehsan Bhuiyan, Jason Cervenec, Bidhya Yadav, Amber Budden, Michael Brubaker, Guido Grosse, Ben Jones, Aiman Soliman

October 15th, 2021



**National Center for
Supercomputing Applications**

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

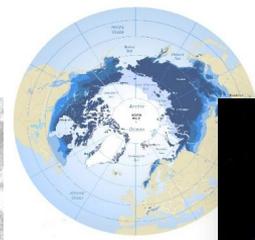


Human Impact





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



Coastal erosion



Thaw slumps



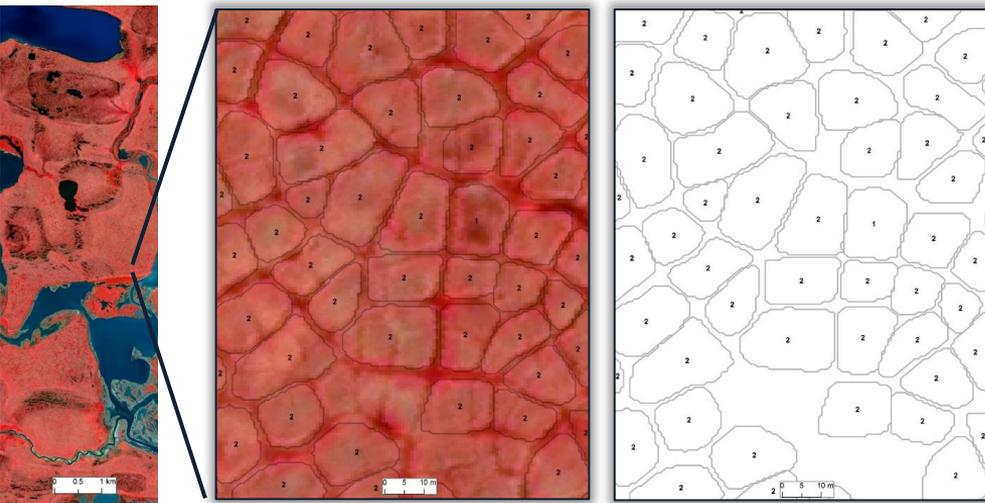
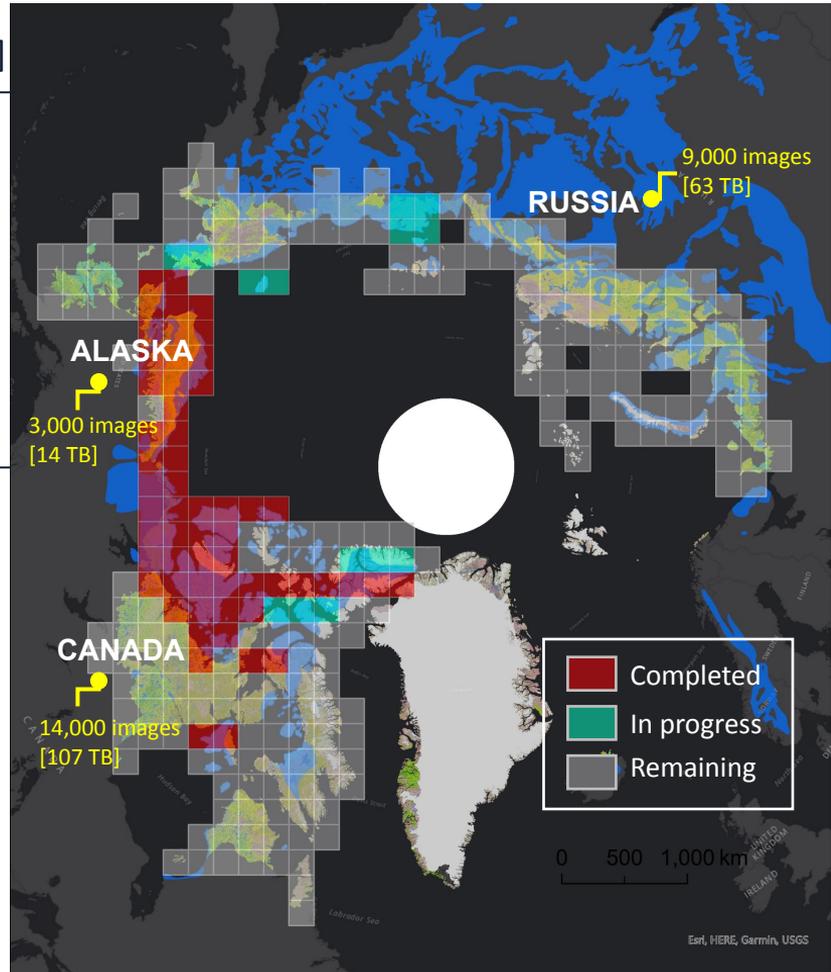
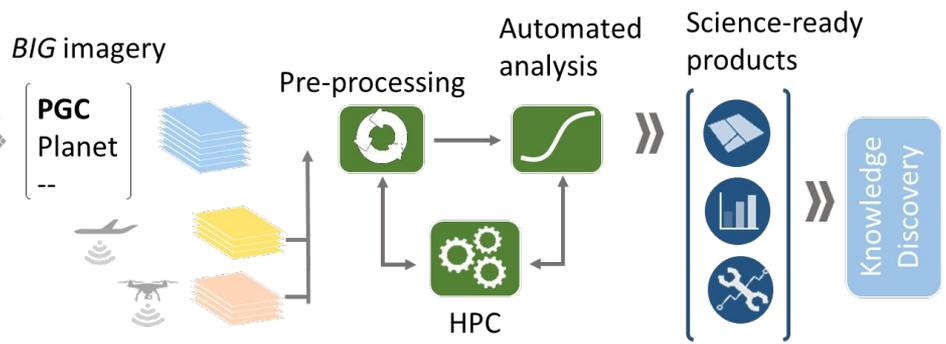
Compute



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

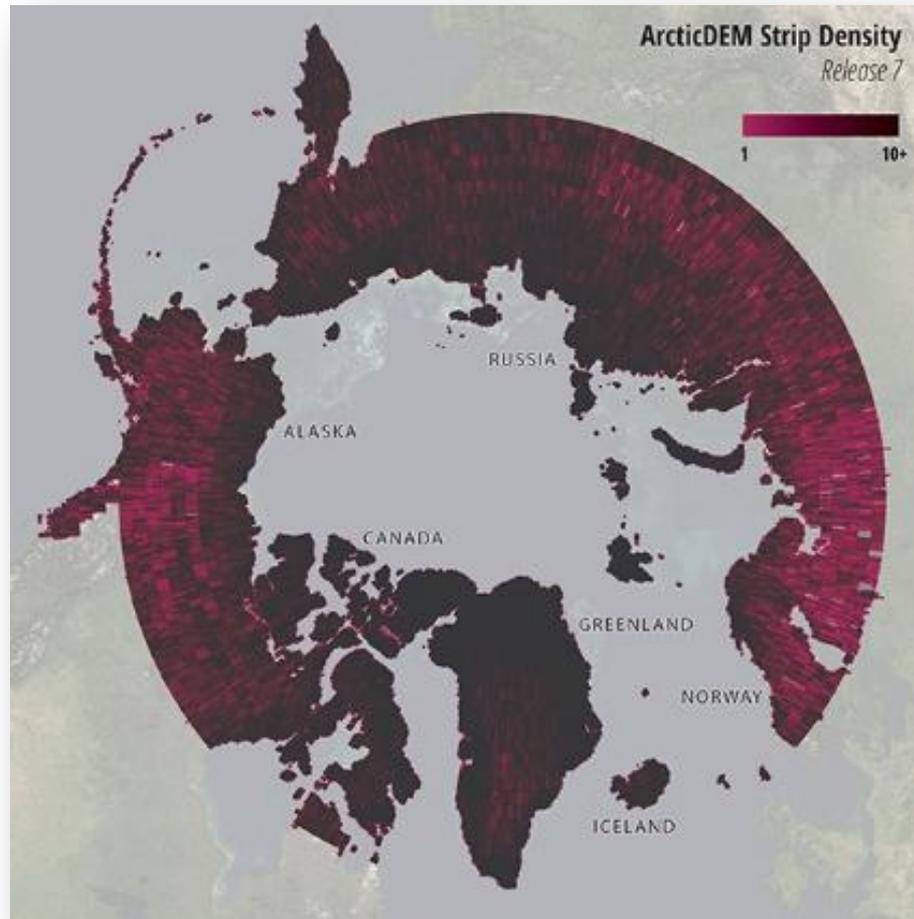
Tundra Vegetation map (CAVM 2019) and Ground ice probability map (high category) are shown in the background

[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

Input



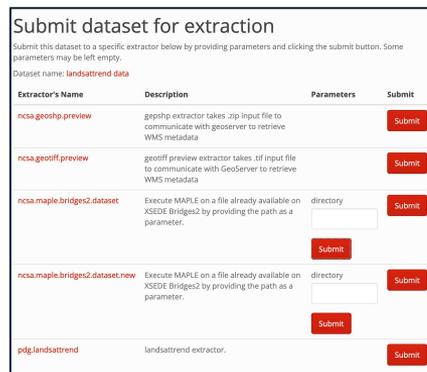
lake_change_grid_3000_grossloss.tif

Add a description

Layer Opacity:

[Download](#) [Delete](#) [Follow](#) [Submit for extraction](#) [Share](#)

Submit



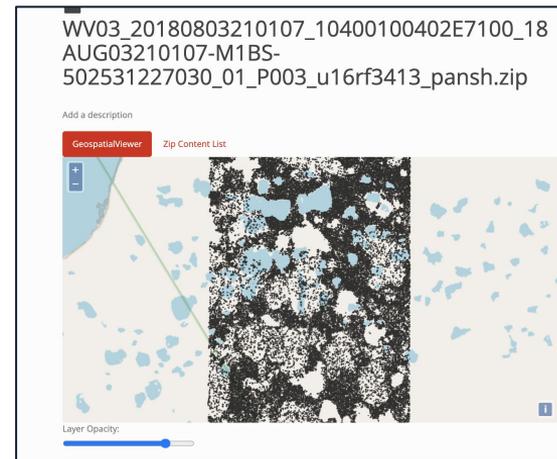
Submit dataset for extraction

Submit this dataset to a specific extractor below by providing parameters and clicking the submit button. Some parameters may be left empty.

Dataset name: landsattrend data

Extractor's Name	Description	Parameters	Submit
nca.geohp.preview	geohp extractor takes .zip input file to communicate with geoserver to retrieve WMS metadata		Submit
nca.geotiff.preview	geotiff preview extractor takes .tif input file to communicate with GeoServer to retrieve WMS metadata		Submit
nca.maple.bridges2.dataset	Execute MAPLE on a file already available on XSEDE Bridges2 by providing the path as a parameter.	directory <input type="text"/>	Submit
nca.maple.bridges2.dataset.new	Execute MAPLE on a file already available on XSEDE Bridges2 by providing the path as a parameter.	directory <input type="text"/>	Submit
pdg.landsattrend	landsattrend extractor.		Submit

Output

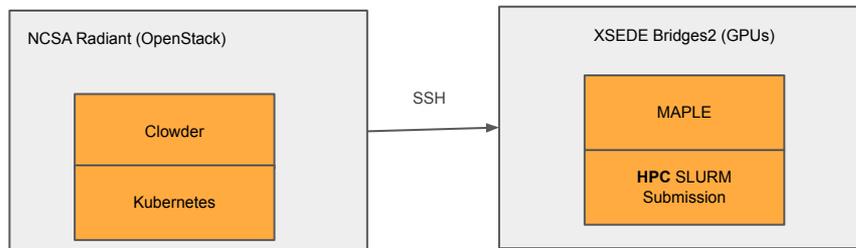


WV03_20180803210107_10400100402E7100_18
AUG03210107-M1BS-
502531227030_01_P003_u16rf3413_pansh.zip

Add a description

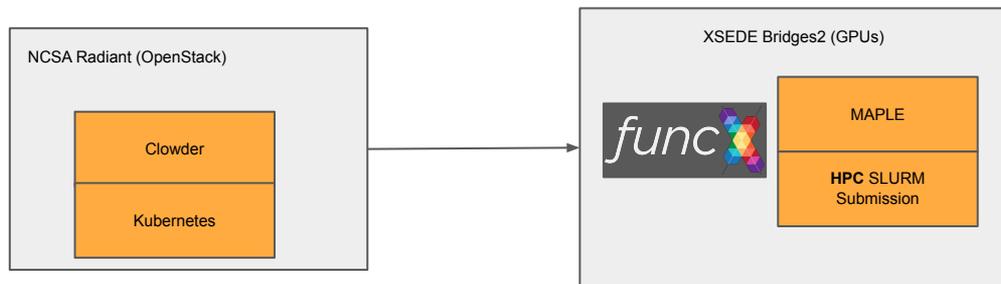
[GeospatialViewer](#) [Zip Content List](#)

Layer Opacity:



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?



Permafrost Discovery Gateway Test

[IMAGERY VIEWER](#) [FLUID EARTH](#) [ABOUT](#) [CORE TEAM](#) [NEWS](#) [STAY CONNECTED](#)

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LAYER: BIOPHYSICAL PERMAFROST ZONES ×

OPACITY ⬆️

INFO & DATA ⬆️

This biophysical permafrost zonation map was produced using a rule-based GIS model that integrated a new permafrost extent, climate conditions, vegetation structure, soil and topographic conditions, as well as a yedoma map. Permafrost in this map is classified into five types: climate-driven, climate-driven/ecosystem-modified, climate-driven/ecosystem-protected, ecosystem-driven, and ecosystem-protected. 81% of the permafrost regions in the Northern Hemisphere are modified, driven, or protected by ecosystems, indicating the dominant role of ecosystems in permafrost stability in the Northern Hemisphere. Permafrost driven solely by climate occupies 19% of permafrost regions, mainly in High Arctic and high mountains areas, such as the Qinghai-Tibet Plateau.

Y.Pan, Y.; M. Torre Jorgenson.; Li, X.; Jin, H.; Wu, T.; Li, R.; Cheng, G. (2021): A biophysical permafrost zonation map in the Northern Hemisphere (2000-2016). National Tibetan Plateau Data Center, <https://doi.org/10.11888/Geocrytpdc.271659>

[FULL DETAILS](#) [DOWNLOAD DATA](#)



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



IMAGERY VIEWER

LEO Network news



Ice wedge polygons



Lakes



Percent cover ice wedges



Satellite imagery



LAYERS



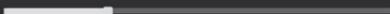
ABOUT

70.38260°N 151.52634°W Elevation 249m 600 m

ICE WEDGE POLYGONS LAYER DETAILS



OPACITY



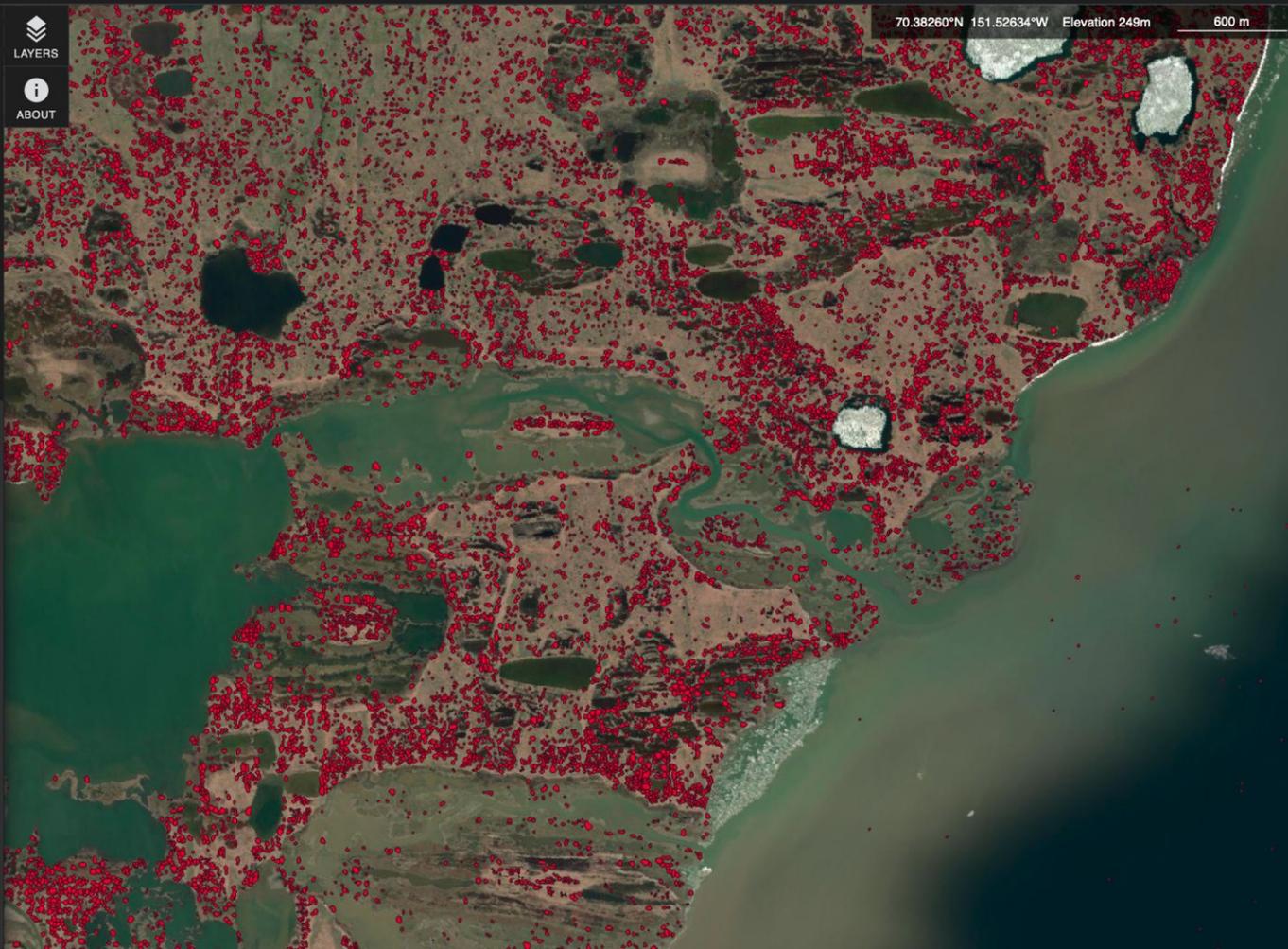
25%

INFORMATION & DATA

Created by: Chandi Witharana

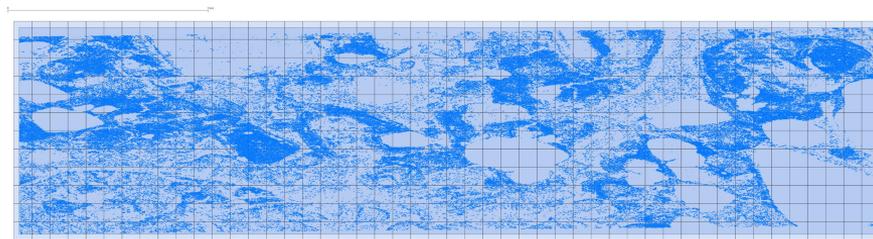
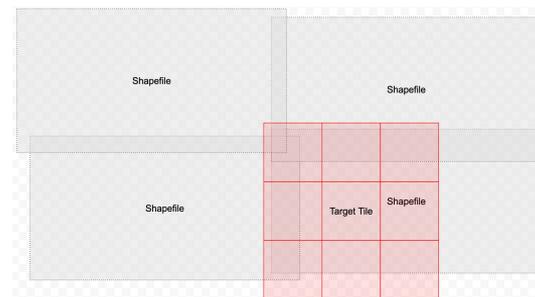
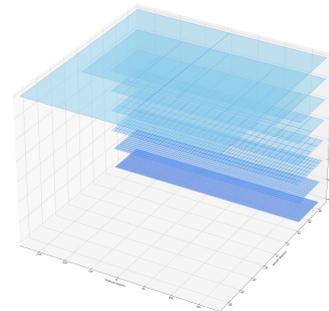
The first pan-Arctic map of ice-wedge polygons. An ice wedge is a crack in the ground formed by a narrow or thin piece of ice that measures 3 to 4 meters in length at ground level and extends downwards into the ground up to several meters. Ice wedges are degrading with climate change, affecting watershed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

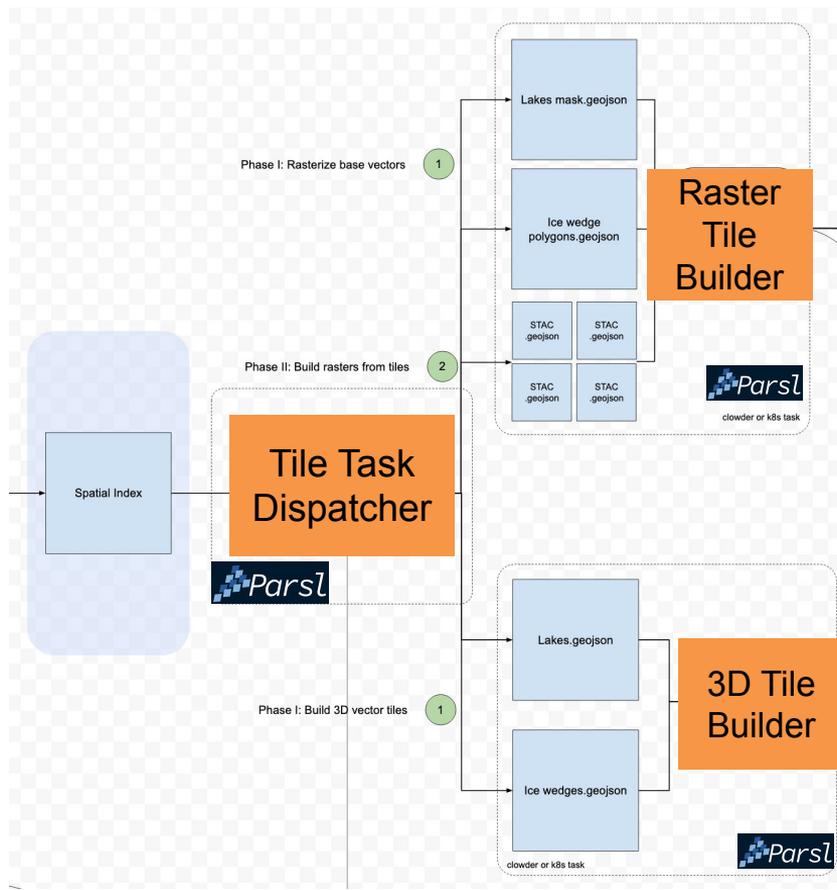
Tile Job Dispatcher

- 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



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



NCSA | NATIONAL CENTER FOR SUPERCOMPUTING APPLICATIONS