LVIS lidar Evaluation of Sentinel1 SAR for Enhanced Canopy Height Mapping in Boreal Forests

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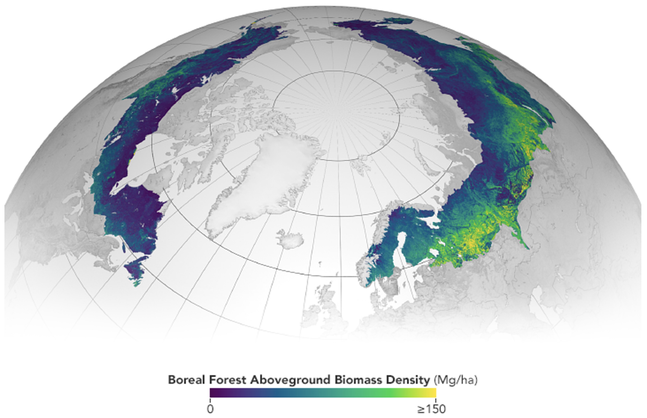
Background



In phase 2 ABoVE Project:

Open source and operational workflow to map Above Ground Biomass Density (AGBD) and Vegetation Height in Circumpolar boreal forests at 30-meter resolution.

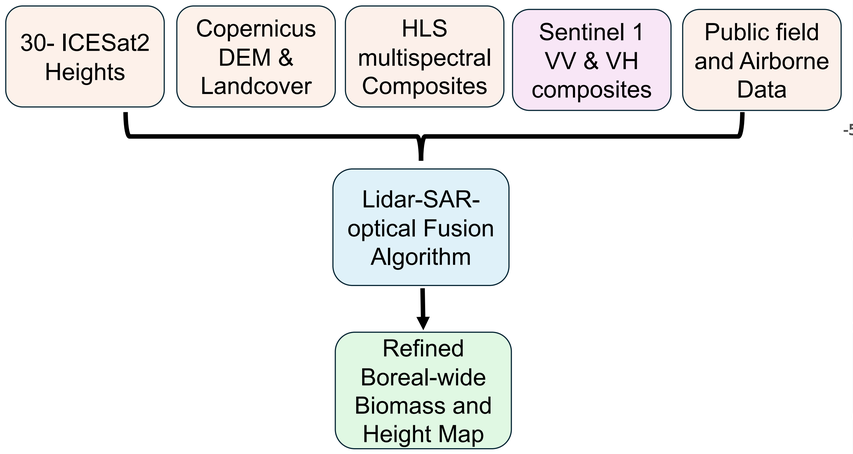
- ORNL DACC Dataset [1]
- Code [2]
- NASA MAAP Platform [3]

Phase 3:
Examine AGB dynamics across environmental gradients in circumpolar Boreal forests, including AGB change, Rate of change, Hotspots of rapid, and slow growth, and link these to warming trends.

Objectives

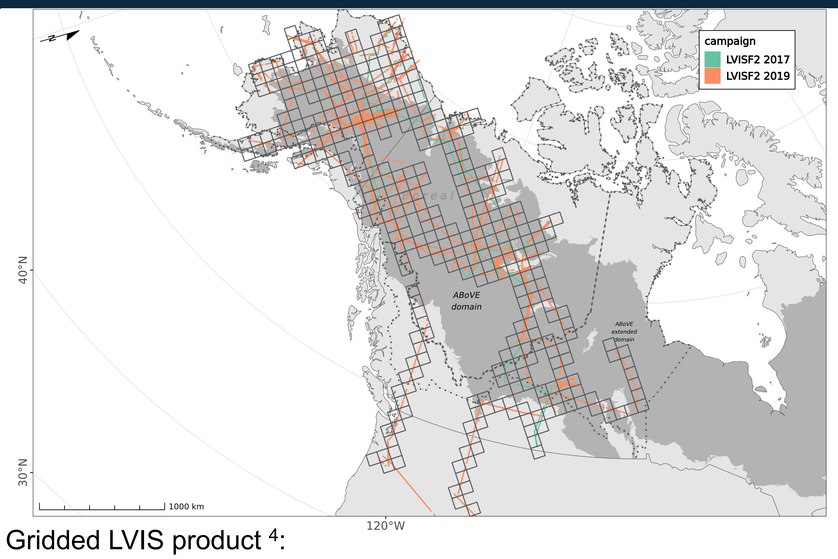
1- To validate the boreal height map product using LVIS Lidar dataset at large scale as an independent validation set.

2- To reduce vegetation height and AGBD uncertainties by incorporating Sentinel-1 SAR



1- https://doi.org/10.3334/ORNLDAAC/2186 (Latest version with major updates available soon)
2- https://github.com/aliz237/icesat2_boreal
3- https://www.earthdata.nasa.gov/about/maap
4- https://doi.org/10.3334/ORNLDAAC/1923

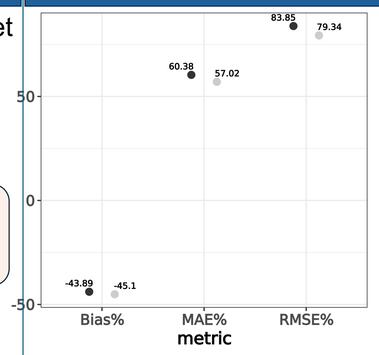
Methods

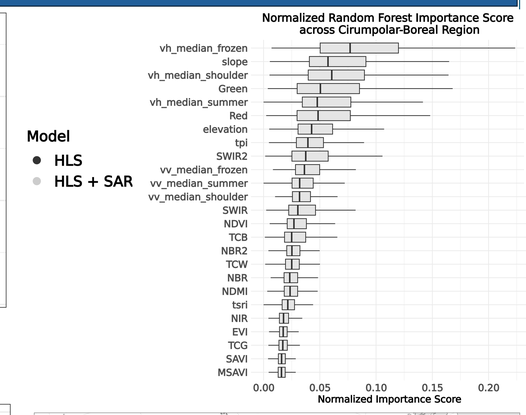


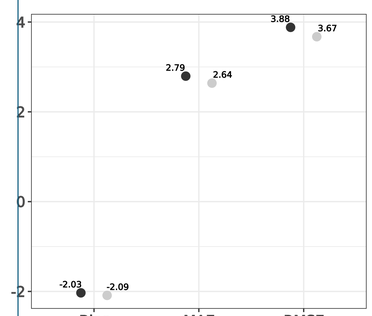
Gridded LVIS product [4]:
- 30 m^2 raster products including Relative Height (RH) and Canopy Cover (CC) metrics at different height thresholds
- Collected from NASA's LVIS facility instrument for each flightline from 2017 and 2019
- Intersected 372 vegetation height tiles (square boundaries above) Approximately 85 million 30 m^2 independent validation pixels

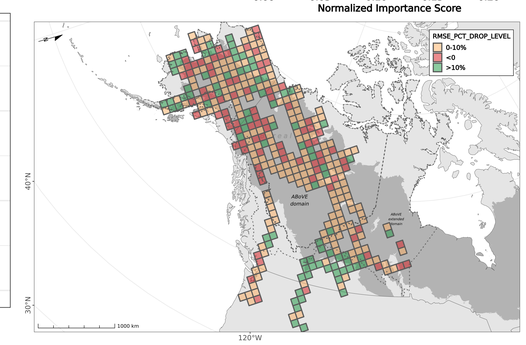
Vegetation Height Validation and SAR enhancement analysis by
- First creating vegetation height maps with and without SAR
- Aligning and comparing these maps with gridded LVIS dataset

Results

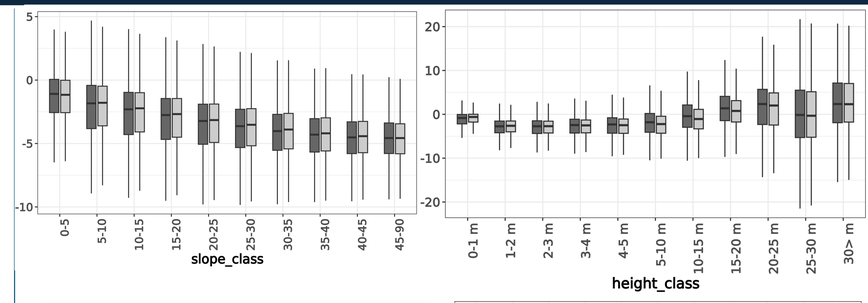


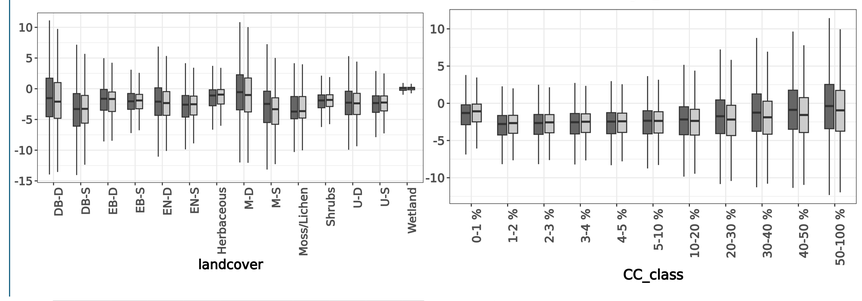


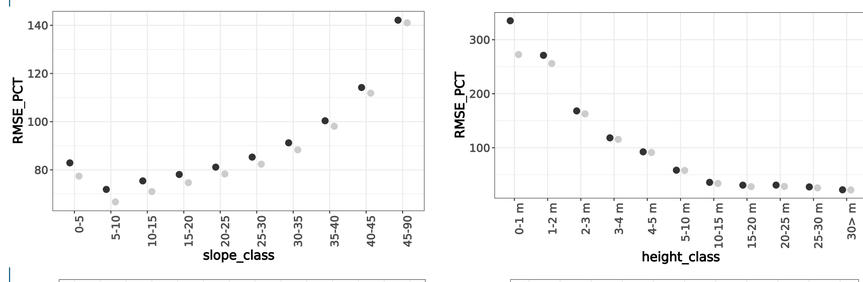


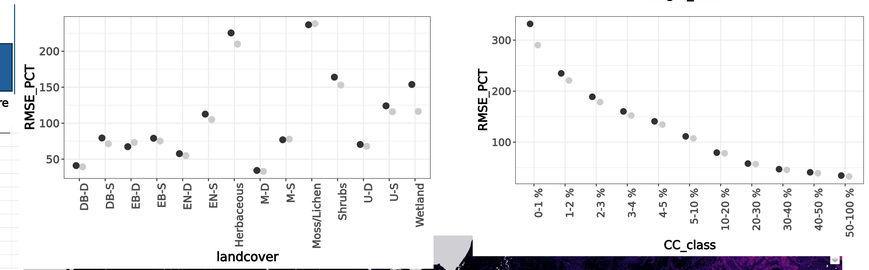


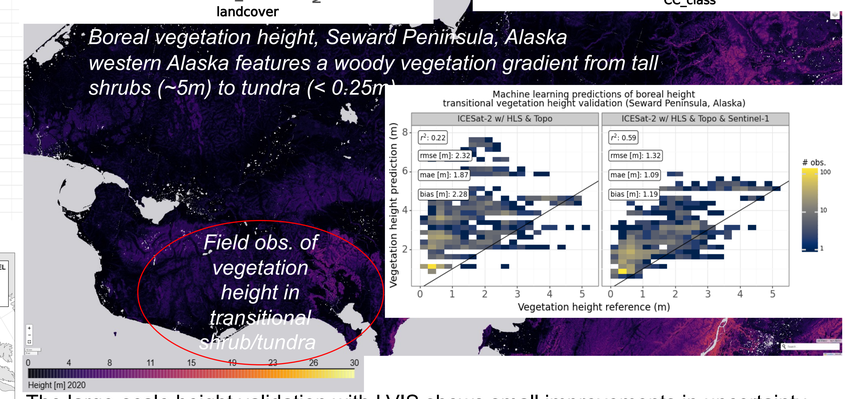
Results











The large-scale height validation with LVIS shows small improvements in uncertainty from the SAR-enhanced version of across the full boreal vegetation height gradient, with most significant reduction in errors in the shortest-stature vegetation.

A targeted, local-scale validation in the short-stature shrublands of the Seward Peninsula suggests a more significant reduction in uncertainty across this portion of the vegetation structure gradient using reference height from field observations.