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A HIGH-RESOLUTION DELINEATION OF THE CIRCUMPOLAR TAIGA-TUNDRA ECOTONE

Ranson-01 - Carbon Cycle Science, LCLUC

Co-investigators:

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Mark Chopping (Montclair State U.)



Institutional Collaborations

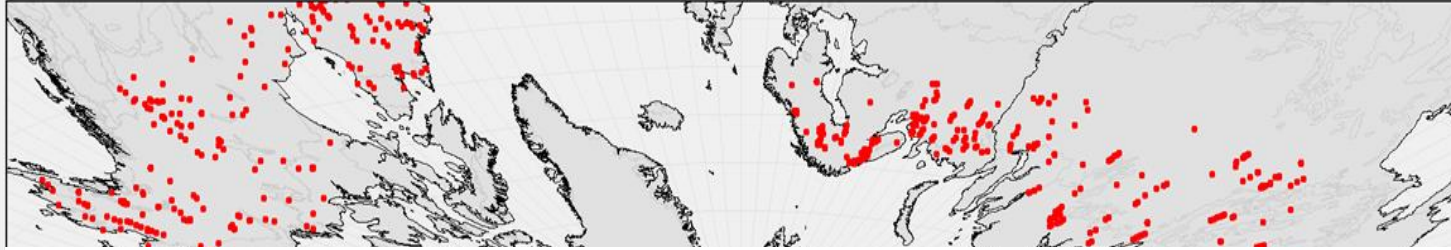
- University of Maryland
- Montclair State University
- Sukachev Institute of Forests
- NASA AMES Stereo Pipeline
- NASA GSFC High Performance Computing Group (NCCS/ADAPT)

And... but... therefore

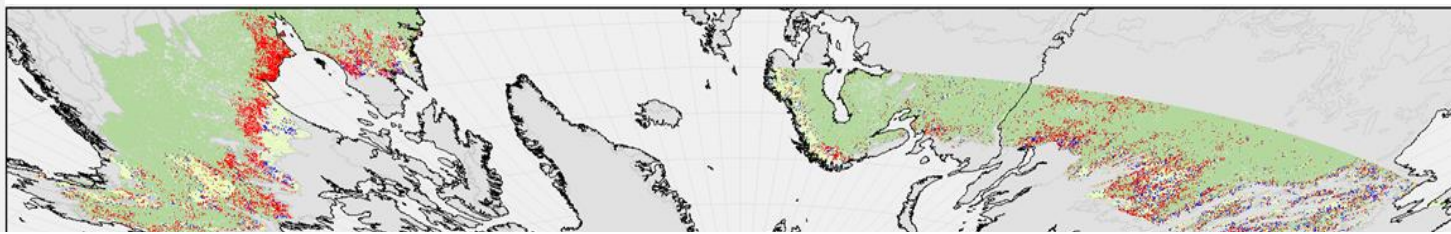
- The circumpolar TTE is subject to accelerated warming and location and structure are changing, but we need to do careful higher resolution analysis to understand impacts of these changes, therefore this project uses airborne and high resolution satellite imagery (HRSI) to evaluate and extend a Landsat 7 vegetation continuous fields (VCF) product.

Previous TTE Work

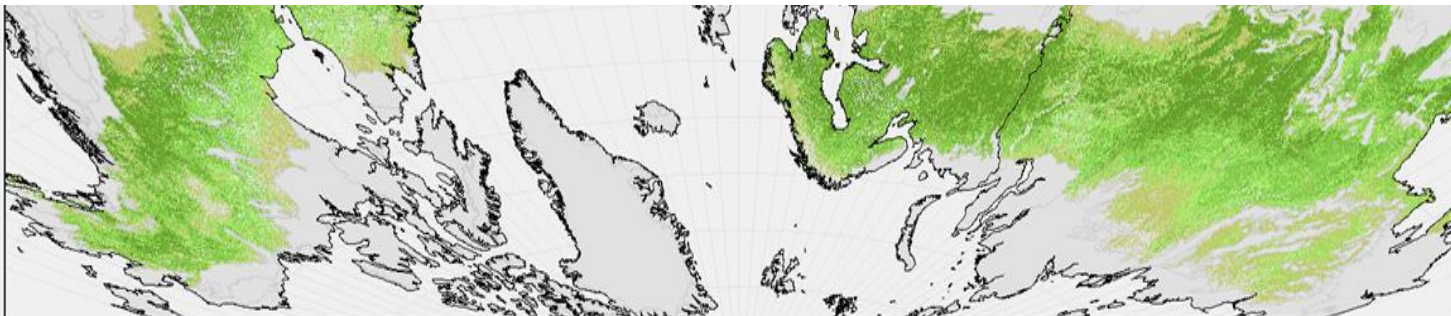
MODIS VCF Validation (Montesano et al. 2009)



Circumpolar MODIS-derived TTE (Ranson et al. 2011)

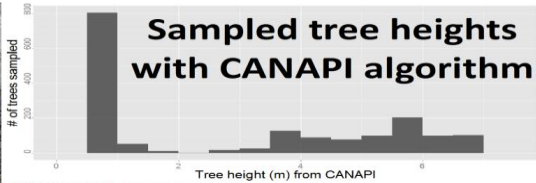
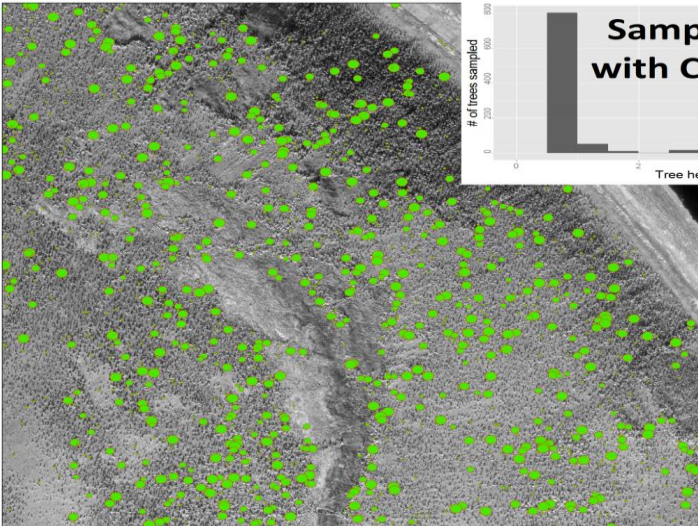


Global Landsat VCF(Sexton et al. 2013)

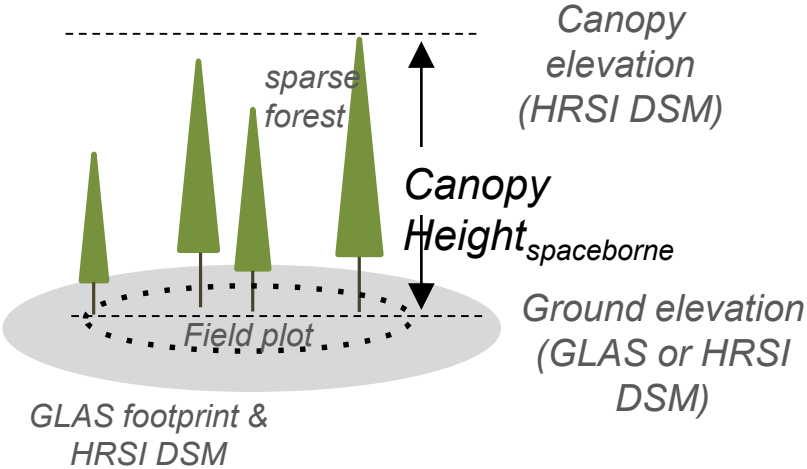


Previous TTE Work (continued)

HRSI Canopy Height (Chopping et al. 2011; Montesano et al. 2014)



Worldview-1 image in a northern Siberian Larch forest



Science Questions

- Tier 2 Science Questions addressed
 - How is the circumpolar boreal forest changing?
 - What are the impacts on this vulnerable ecotone in the face of accelerated warming?
 - How is ecosystem structure changing?

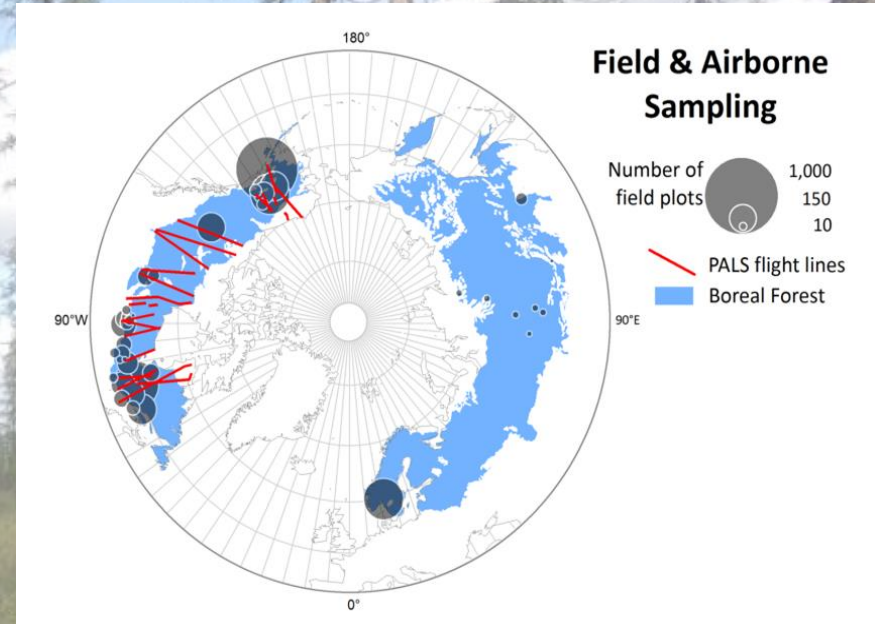
Science Objectives

- Tier 2 Science Objectives
 - Ecosystem Dynamics
 - improve our prior circumpolar arctic-boreal transition assessment to understand current and expected changes in ecotone structure
 - characterize the spatial patterns of the tree-tundra mosaic across the boundary
 - Ecosystem Service
 - Estimate forest cover and biomass change in intensive study site transects : useful for assessing impacts on wildlife habitat and human subsistence.

Approach

- Use HRSI data to quantify forest structure across transects in the TTE
- Utilize ABoVE cloud computing capabilities.
- Produce benchmark circumpolar maps of TTE tree cover at 30-m resolution.
- Use airborne lidar & field measurements as sources of training & validation.

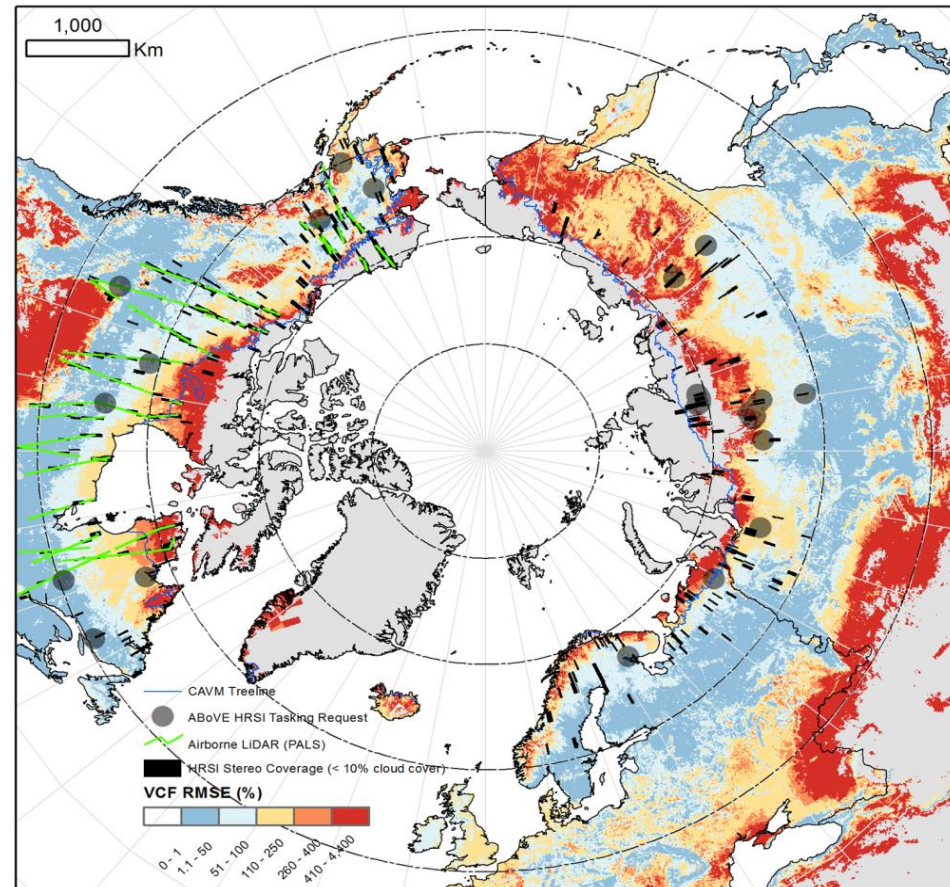
Field Studies



- **Basic Forest plot measurements are acquired**
 - e.g. species, DBH, height, crown diameter, diameter bore or cookies, ground cover.
- **Planning / timing of field efforts**
 - Siberia 2016, northern US 2016, no funds for AK or Canada field work

Spaceborne Remote Sensing

- Satellite sensing assets to be used
 - Landsat/Sentinel 2
 - WorldView-1, WorldView-2, and Quickbird-2.
 - ASTER GDEM (v1,v2)



Airborne Remote Sensing

- Existing airborne remote assets to be used
 - GLiHT over Tanana Valley, AK acquired in 2015 and beyond
- Potential uses for new airborne data
 - Waveform Lidar (e.g. LVIS) over TTE in AK and Western Canada
 - Role for AIRMOSS, ECOSAR, UAVSAR?

Modeling Approaches

- Data products useful for ecosystem and carbon models.
- Digital terrain and canopy height models produced from Stereo processing.
- Linear models to relate hi-res analysis to Landsat VCF

Geospatial Data Products

- Types of products to be created:
 - Accuracy assessments of VCF products
 - Processed stereo image data to produce local DEM and canopy height maps
 - Circumpolar Tundra-Taiga Ecotone VCF maps
- Circumpolar 30m VCF and local area very high resolution
- Temporal range
 - L7VCF (2000-2010), HRSI products (2007 – 2015)

Geospatial Data Products (cont)

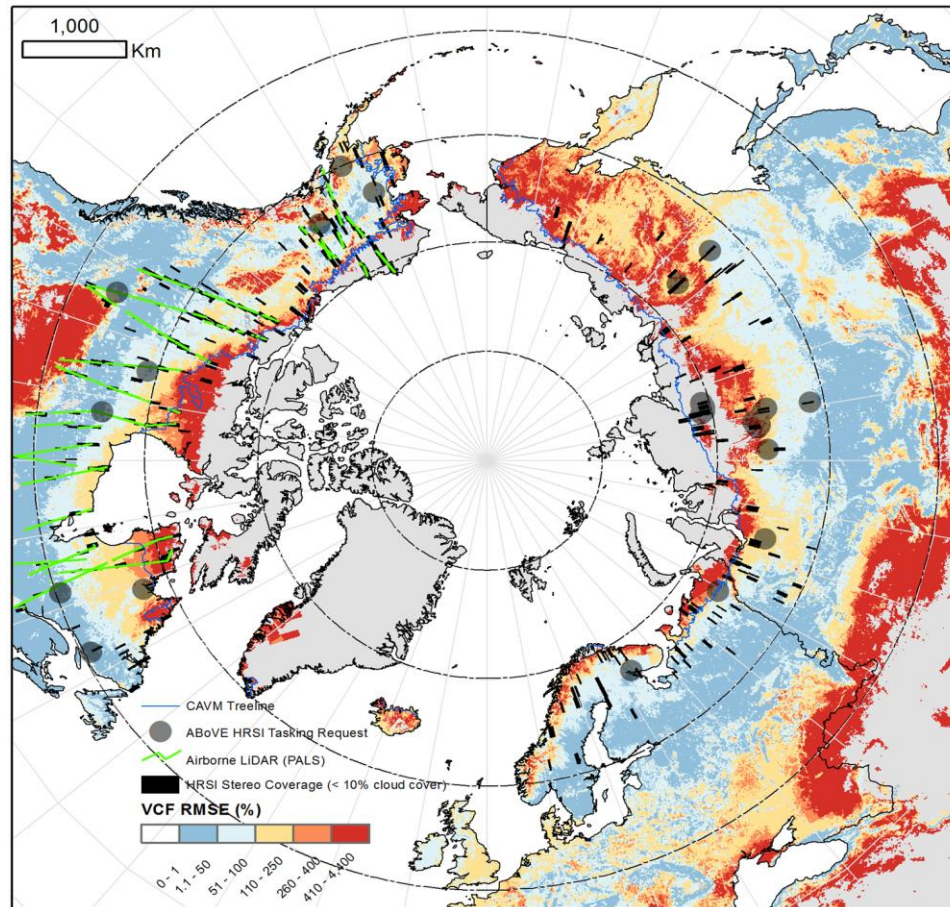
- Data formats, grids, and projections
 - GIS-ready rasters (GeoTiffs; UTM WGS84)
- Google Earth KMZ
- Stakeholder / user base
 - Users of hi-resolution spatial data
 - Boreal ecosystem and carbon cycle scientists, hi-res data useful for state, local and tribal activities.

Other expected products / outcomes

- Provide NASA with updated taiga-tundra ecotone status maps.
- Provide assessment of confidence level of 30 m resolution VCF in the boreal zone.
- Process significant number of High-resolution stereo image pairs in ABoVE region that can be used for topography and forest height analysis

A scenic landscape featuring a dense forest of tall evergreen trees in the background. In the middle ground, a calm body of water, possibly a lake or a wide river, reflects the sky. A small, dark log or piece of driftwood floats in the water. The foreground consists of a rocky shoreline with patches of green grass and small plants. The overall atmosphere is peaceful and natural.

Thank you



A preliminary year 2000 estimate of percent tree cover uncertainty derived from the Landsat VCF tree cover product (Sexton et al. 2013). Black polygons represent archived HRSI stereo data we are currently acquiring. Grey circles indicate areas that we are tasking new data collects. Green lines represent existing airborne LiDAR (PALS) transects across the forest-tundra.