Progress Report

Multi-regional evaluation of new machine learning algorithms for mapping tree species distribution and abundance

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Kasey Legaard[1], Aaron Weiskittel[1], Ken Bundy[1], Erin Simons-Legaard[1,2]

[1] University of Maine, Center for Research on Sustainable Forests
[2] University of Maine, School of Forest Resources

Presenter: Kasey Legaard

Overview

Goal:

Development and testing of remote sensing and machine learning methods with the intention of improving forest maps derived from low-cost data

Objectives:

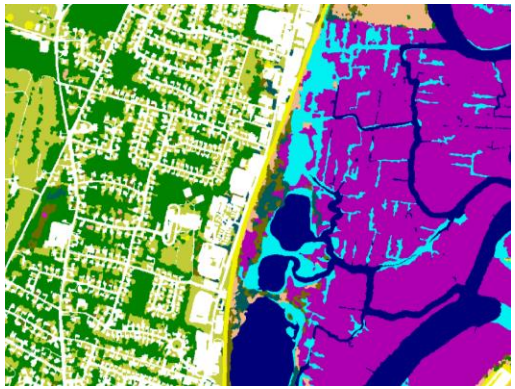
- 10-meter species relative abundance, biomass, forest type, disturbance
- Multi-objective machine learning to reduce systematic prediction error
- Algorithms, workflows integrated into high-volume production software
- Algorithm testing and map validation in multiple regions

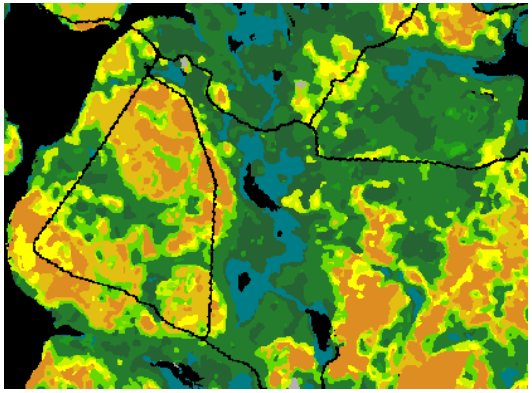
Overview

State of Maine High Resolution Land Cover Project

Statewide 1-meter land cover map

- Very high-resolution land cover produced by the NOAA Coastal-Change Analysis Program (C-CAP)
- 17 land cover categories, including impervious surfaces, natural vegetation, agriculture, and wetlands
- Regular updates every 4-6 years at reduced cost



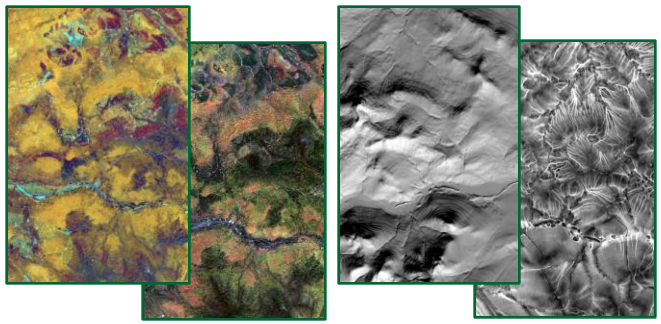


Statewide 10-meter forest type and land cover map

- High-resolution forest type data produced by UMaine, embedded with NOAA C-CAP land cover data
- 15 forest type classes plus recent forest disturbance (12 upland and 3 lowland classes)
- Regular updates every 4-6 years at reduced cost

Overview

Species and Forest Type Mapping

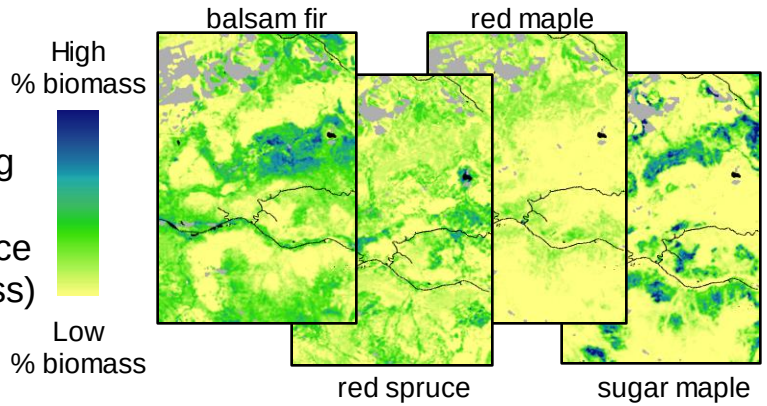


Multispectral, multi-temporal satellite imagery and terrain attribute data

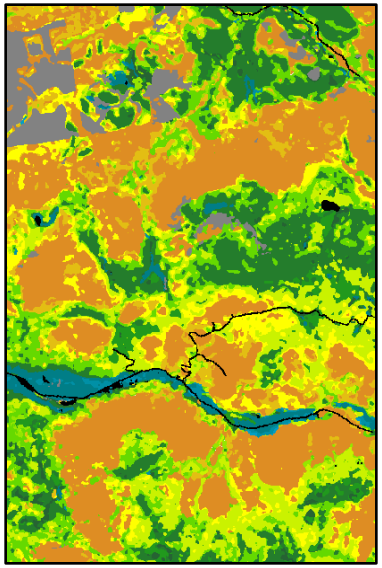
+

USFS field data*

Machine learning predictions of species abundance (% of total biomass)



Forest type classification derived from individual species models



*Confidential plot location data provided by the USDA Forest Service FIA Program (public location data shown)

Progress

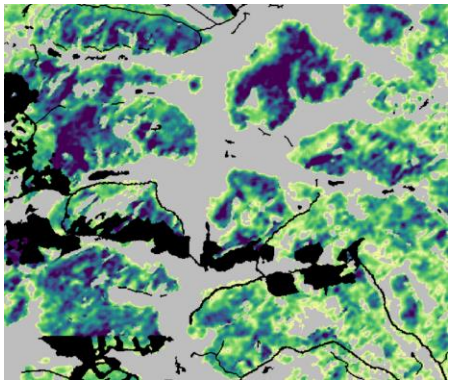
Species and Forest Type Mapping

Species and forest type mapping workflows tested and finalized across approx. 5 million acres

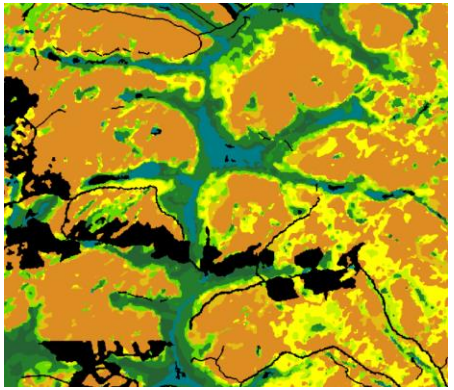
Currently processing data for statewide coverage

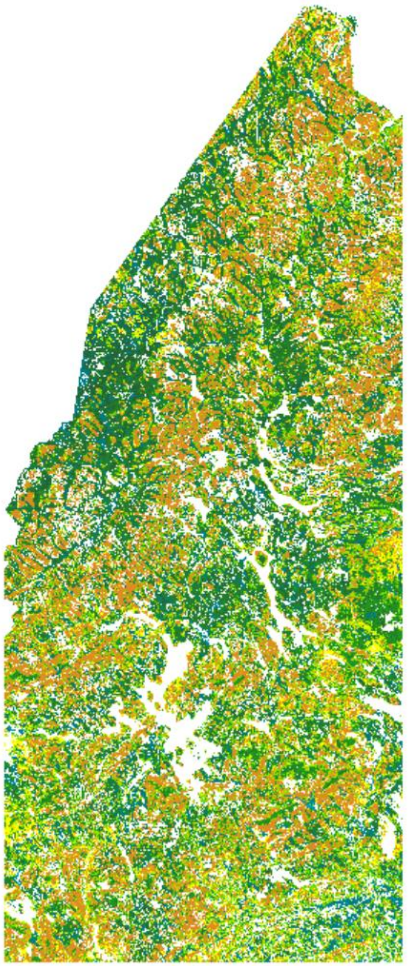
Plan to integrate with NOAA C-CAP data this winter, and deliver final land cover products next spring

Sugar maple



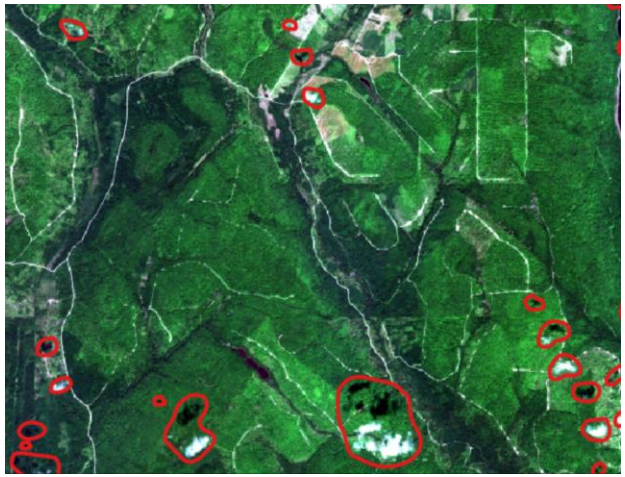
Forest type

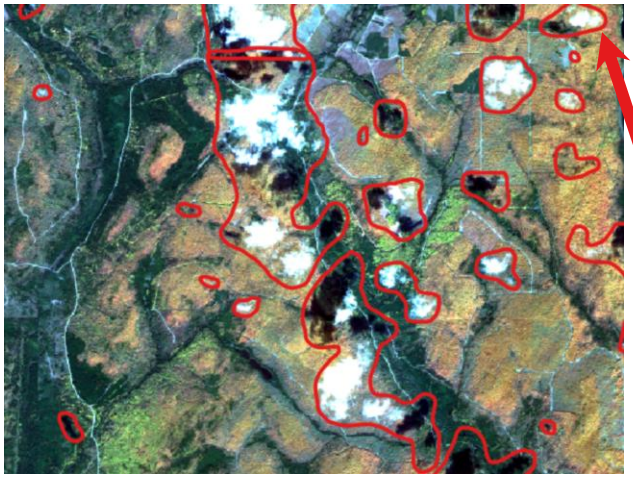




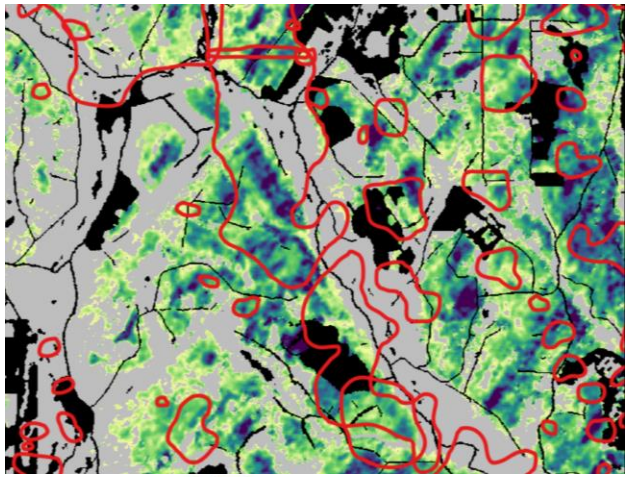
Progress

Cloud cover represents most significant barrier to project completion

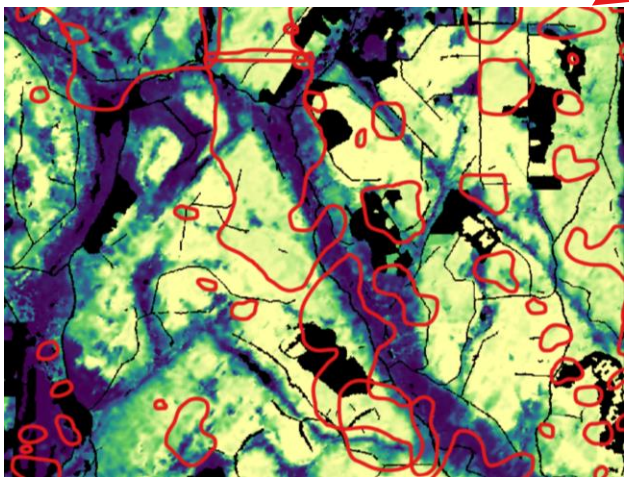




Predicted % sugar maple



Predicted % softwood



We can make good predictions despite cloud cover, but clouds and shadows must be accurately delineated to prevent map error

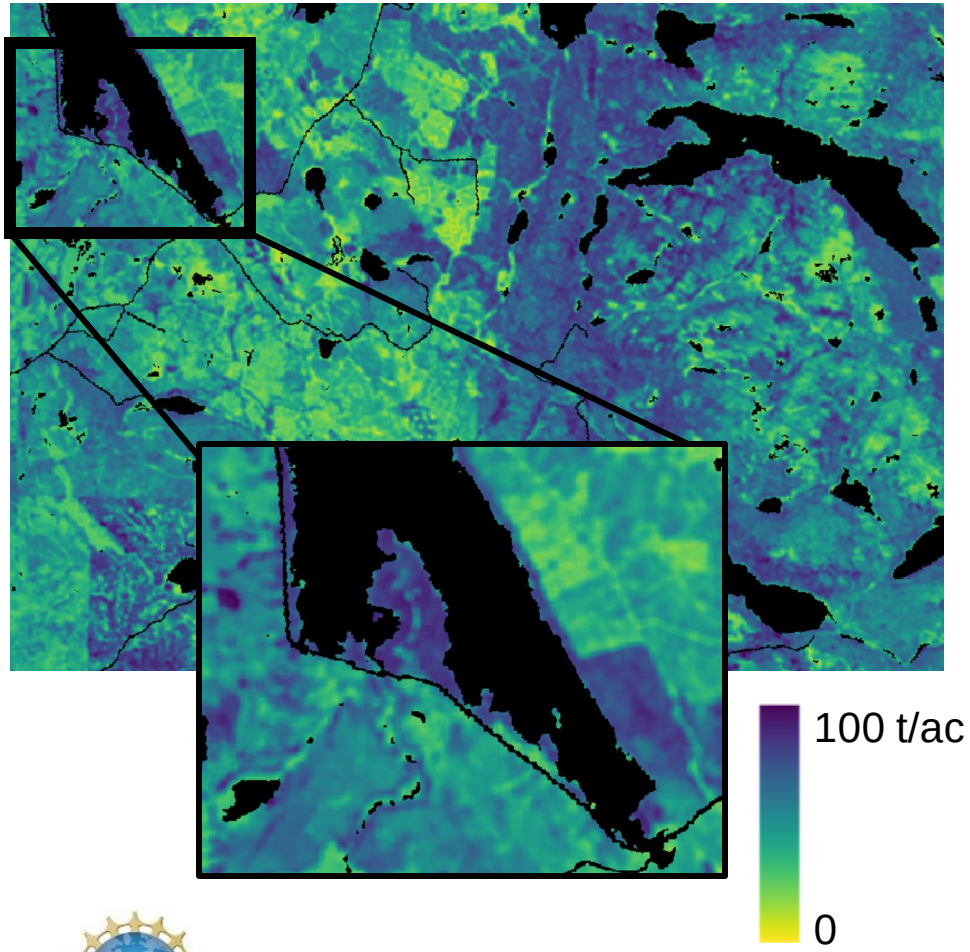
We are using a ML-assisted hand-digitizing process

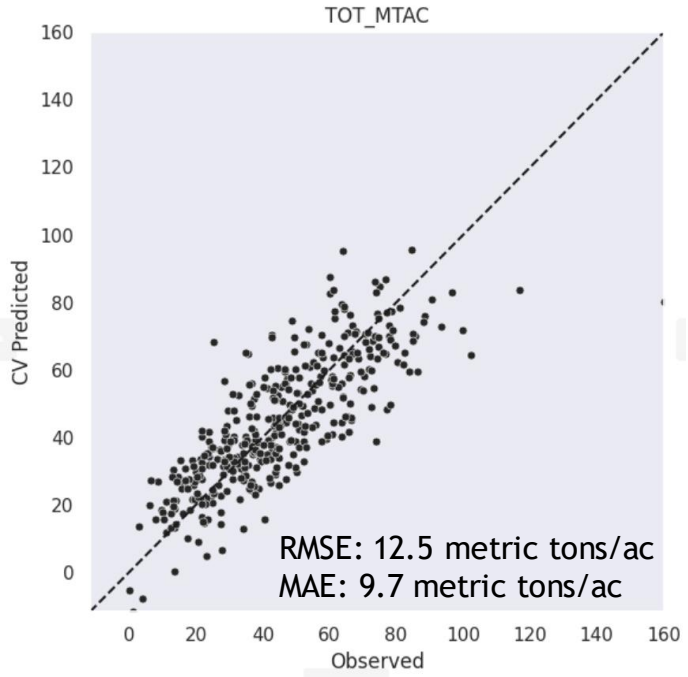
Currently revising our cloud and shadow detection algorithms to improve the machine assist and accelerate the hand editing

Progress

State of Maine Biomass Mapping

Preliminary aboveground live biomass from NAIP point cloud metrics and Sentinel-2 bands, northwest Maine





Processing 2021 NAIP point cloud statewide, at 10-meter resolution, using software developed in-house

Very fast computation of gridded metrics, easily scaled for large-area processing

Summary

Recent progress:

- Finalized algorithms and workflows used for statewide species and forest type mapping; progressing on statewide coverage
- Shared species data with a couple forest products companies, with good reviews against internal data
- Made various improvements to cloud/shadow detection including a QGIS plugin developed with students from Monroe Community College, but require further improvement to reduce hand correction
- Fast, scalable software for computation of point cloud metrics over large areas; continued progress on statewide NAIP-based biomass mapping
- Finishing an NSF REU project to implement a cloud-hosted geospatial database application to facilitate integration of disparate spatial data (Charlie Brush, Cornell)