Detecting nutrient limitation from the sky

Alex Young (SUNY-ESF), Marissa Gabriel (Drexel University), Ruth Yanai (SUNY-ESF)
alexyoung.116@gmail.com

Introduction

Although airborne remote sensing can collect information on every tree crown in a research plot, it is difficult to correctly match individual trees to their corresponding crown locations. Here we examine the spectral profiles of individual trees from three mature northern hardwood stands (C7, C8, C9) and assess our ability to predict tree species from hyperspectral imagery.

We also leverage a long-term nutrient manipulation study to ask if experimental additions of N and P impact canopy reflectance.

C7

C8

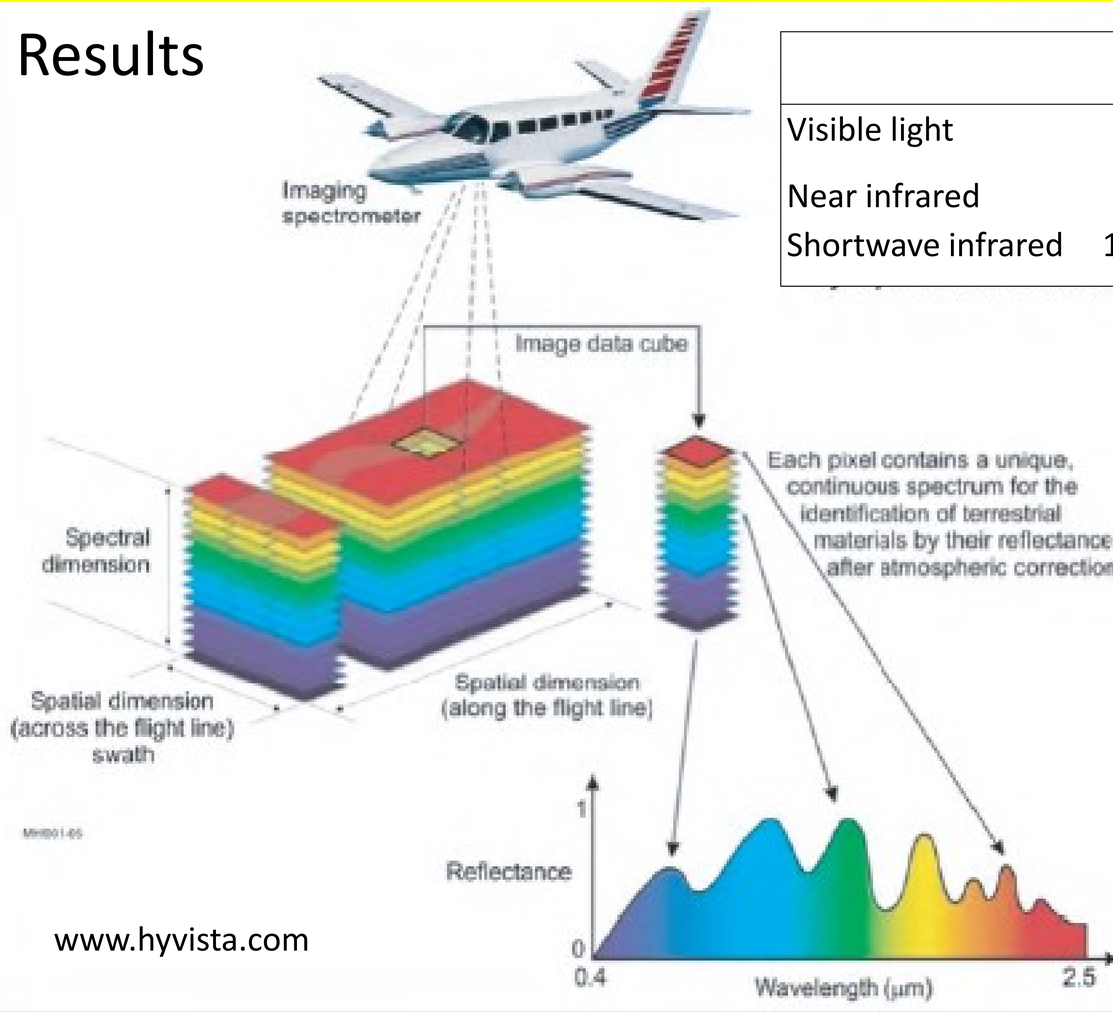
Hypothesis: Canopy reflectance will differ between nutrient addition treatments.

C9

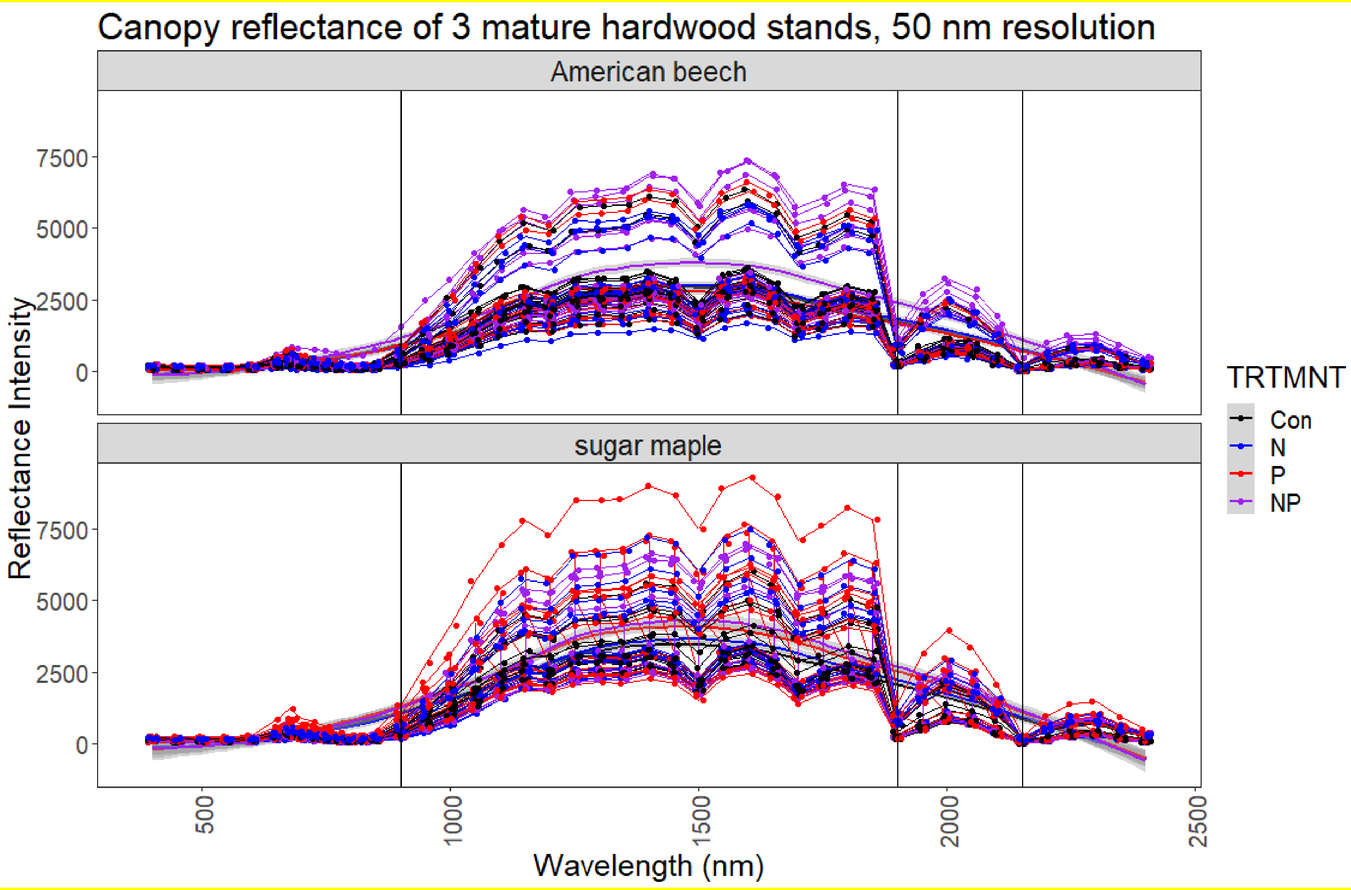
Methods

Since 2011, the multiple element limitation in northern hardwood ecosystems study (MELNHE) has added 30 kg/ha/yr of N as NH_4NO_3 and 10 kg/ha/yr P as NaH_2PO_4 to the forest floor. In 2017, the NEON airborne observation platform flew over Bartlett Experimental Forest and collected ortho-rectified imagery and lidar. We matched tree crown locations to individual trees in the field and extracted reflectance values from 50 wavelengths per pixel. These points were then used as a training dataset for random forest tree species classification.

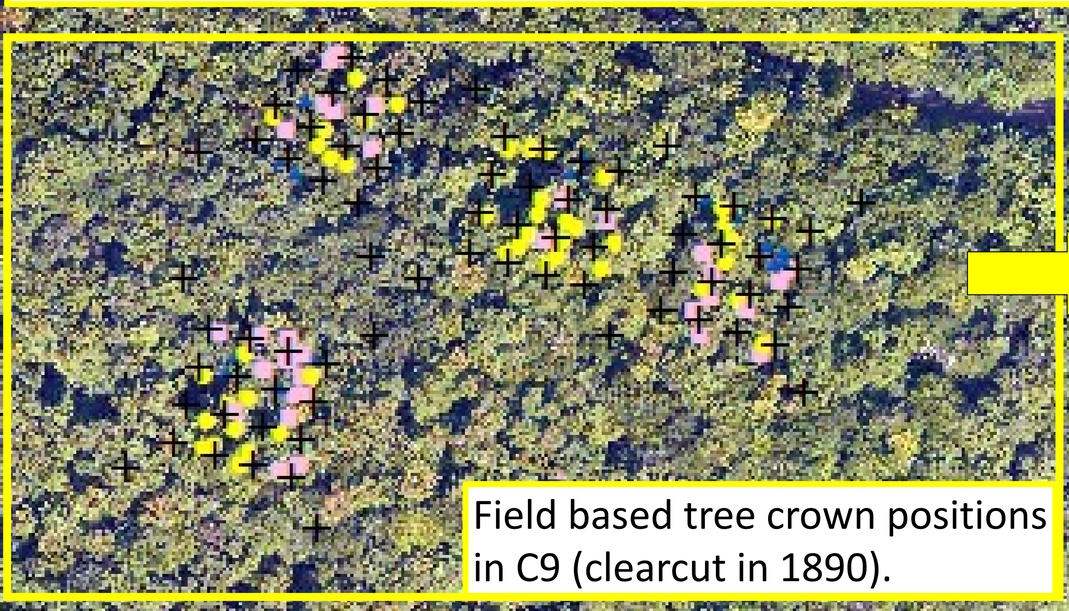
Results



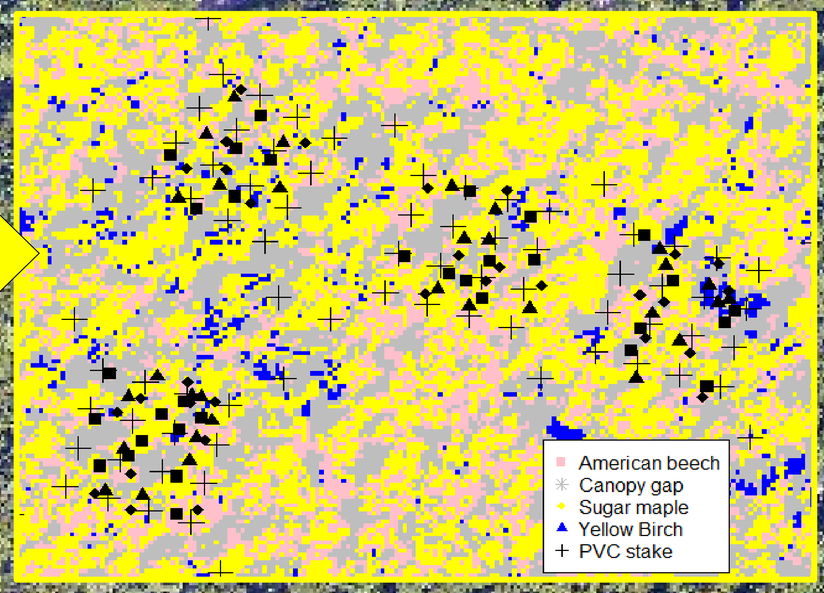
	Wavelength
Visible light	400–700 nm
Near infrared	700–1300 nm
Shortwave infrared	1300–3000 nm



Species classification and prediction: 42% error rate (4 species)



Field based tree crown positions in C9 (clearcut in 1890).



Discussion

- Hyperspectral profiles may inform forest health monitoring.
- It is difficult to match trees to crowns.
- Drones may offer similar results with higher spatial and temporal resolution.
-Link reflectance to foliar chemistry and the leaf economic spectrum.

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