Can mycorrhizal association be detected remotely with hyperspectral measurements?

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Abstract

Recently, Fisher et al. (2016) found that tree-mycorrhizal associations can be detected remotely using spaceborne multi-spectral measurements of canopy spectral and phenological signals. However, hyper-spectral data have enormous potential to refine this detection, and possibly connect mycorrhizal association directly to canopy nutrient concentrations. Here, we evaluate airborne AVIRIS data flown over mycorrhizal gradients in the US to detect mycorrhizal association. As spaceborne spectroscopic instruments are imminent, and the impact of mycorrhizae on global biogeochemical cycling and CO2 fertilization responses continue to emerge, we may soon have the ability to produce global coverage of fine scale mycorrhizal detection.

National Aeronautics and Space Administration

Detecting Mycorrhizal Associations with Spectroscopic Imagery

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Abstract

Recently, Fisher et al. (2016) found that tree mycorrhizal associations can be detected remotely using spaceborne multi-spectral measurements of canopy spectral and phenological signals. However, spectroscopic data have enormous potential to refine this detection, and possibly connect mycorrhizal association directly to canopy nutrient concentrations. Here, we evaluate airborne AVIRIS data flown over mycorrhizal gradients in the US to detect mycorrhizal association. As spaceborne spectroscopic instruments are imminent, and the impact of mycorrhizae on global biogeochemical cycling and CO^2 fertilization responses continue to emerge, we may soon have the ability to produce global coverage of fine scale mycorrhizal detection.

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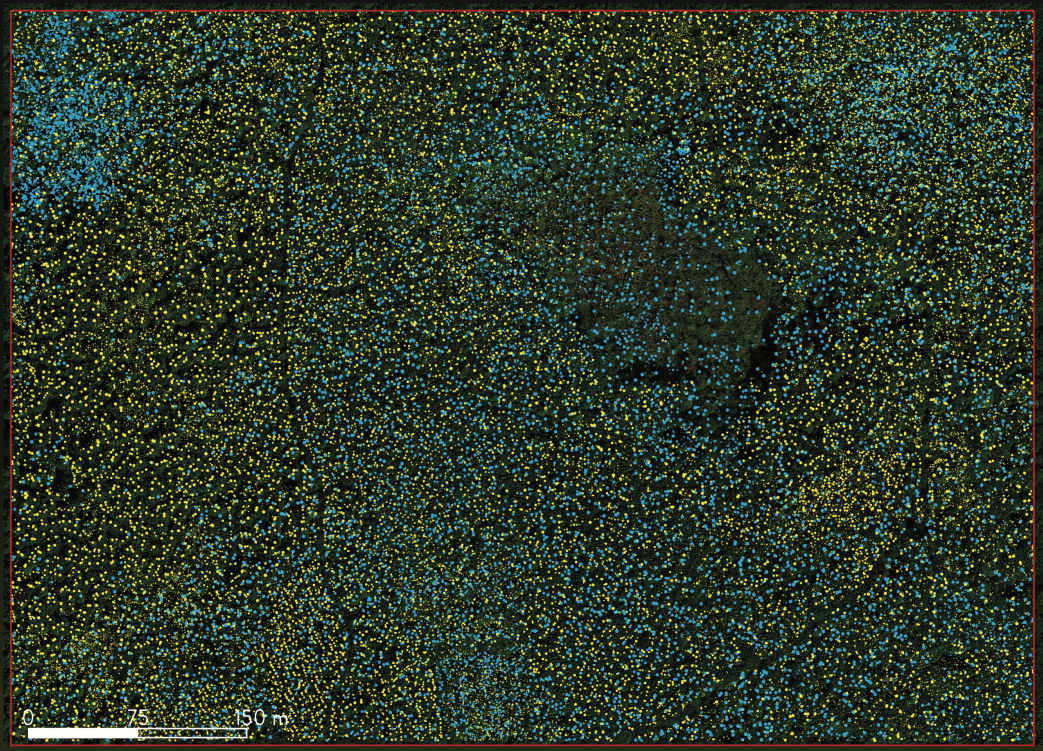
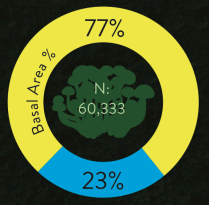


Harvard Forest

Tree Species & Mycorrhizae Associations

Tree-Sizes:

Ectomycorrhizal

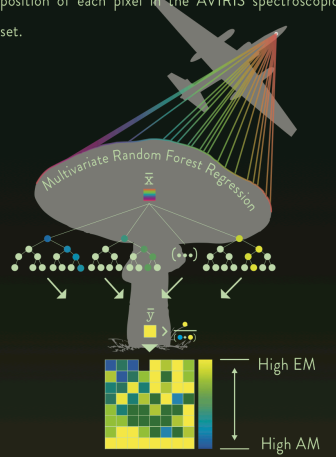


Arbuscular Mycorrhizal

Study Area

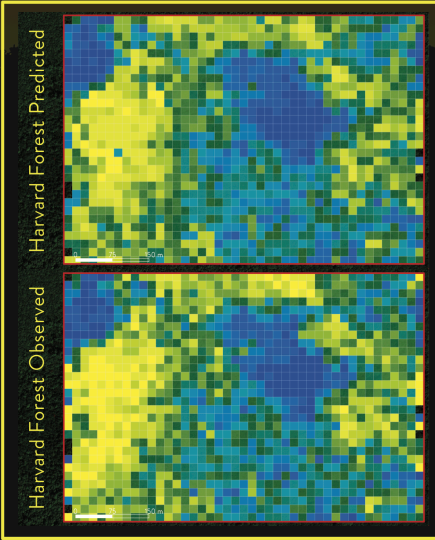
Methods

Multivariate random forest regression model was used to estimate the basal-area weighted AM/EM percentage composition of each pixel in the AVIRIS spectroscopic dataset.



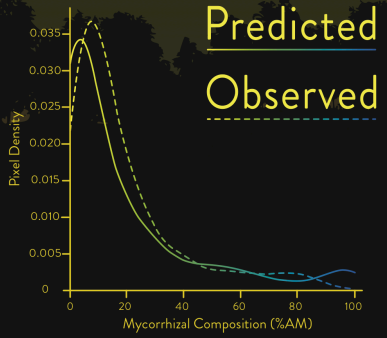
For the purposes of first-pass analysis random forest regression model was trained with the full set to measure how well it could predict mycorrhizae composition.

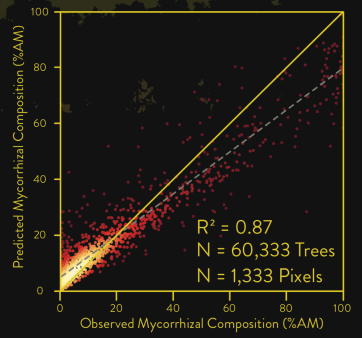
Results



Predicted

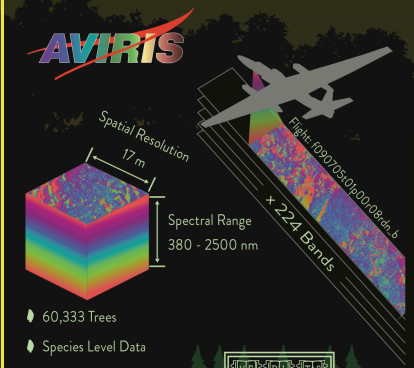
Observed





Predicted AM-percentage vs. observed AM-percentage mycorrhizal associations across 60,333 trees aggregated to 17 by 17 meter resolution derived from AVIRIS pixel resolution. The variability explained by random forest regression for AM percentage composition at AVIRIS dataset's resolution was measured at (0.87).

Data Sources



- 60,333 Trees
- Species Level Data
- Basal Area for Each Tree