National Aeronautics and Space Administration

Detecting Mycorrhizal Associations with Spectroscopic Imagery

Fernando E. Romero Galvan[1], Joshua B. Fisher[1], Ryan P. Pavlick[1], Edward R. Brzostek[3], Kaitlin M. Gold[4], Richard P. Phillips[2]

[1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA; [2]Indiana University, Bloomington, IN; [3]West Virginia University, Morgantown, WV; [4]Cornell University, Ithaca, NY

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.

Acknowledgements

Funding was provided by the US Department of Energy Office of Biological and Environmental Research Terrestrial Ecosystem Science Program, and by NASA's IDS program. The authors would further like to give thanks to the contribution and support of the Dave Orwig from Harvard Forest Laboratory, NASA-JPL AVIRIS team, Gregory H. Halverson[1], and Matt B. Dohlen[1].

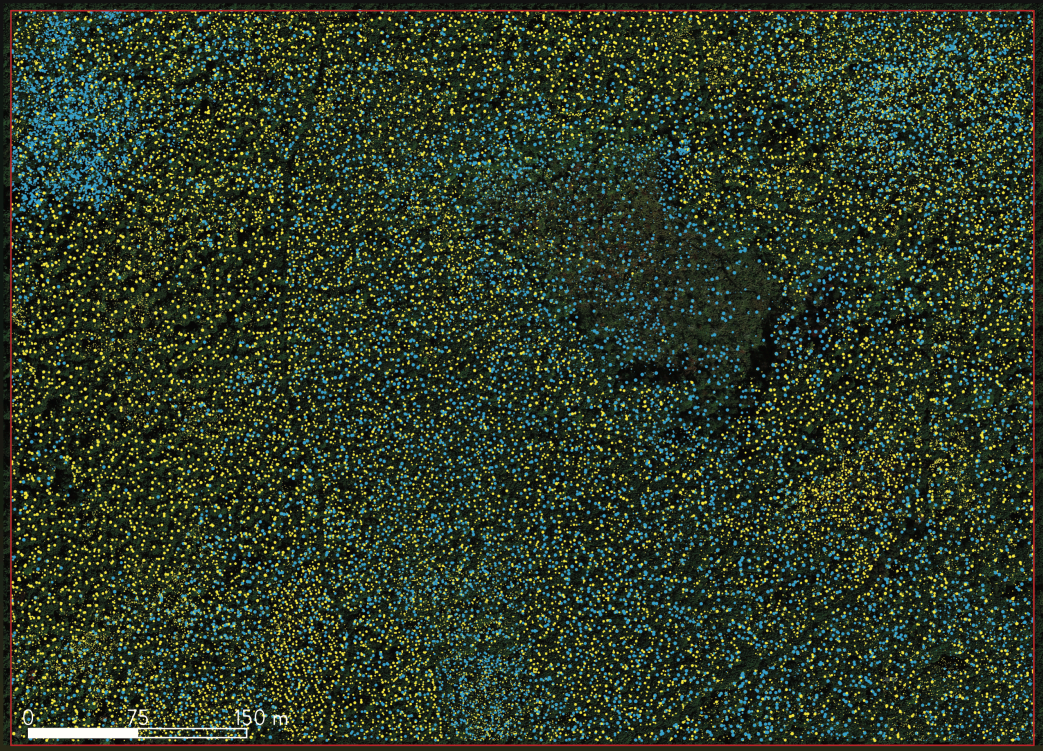
References

- Fisher, Joshua B., Sean Sweeney, Edward R. Brzostek, Tom P. Evans, Daniel J. Johnson, Jonathan A. Myers, Norman A. Bourg, Amy T. Wolf, Robert W. Howe, and Richard P. Phillips. "Tree-Mycorrhizal Associations Detected Remotely From Canopy Spectral Properties." Global Change Biology 22, no. 7 (2016): 2596–2607. https://doi.org/10.1111/gcb.13264.
- Orwig D, Foster D, Ellison A. 2015. Harvard Forest CTFS-ForestGEO Mapped Forest Plot since 2014. Harvard Forest Data Archive: HF253.

National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

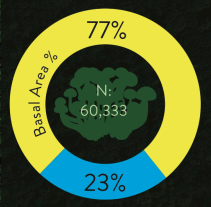


Harvard Forest

Tree Species & Mycorrhizae Associations

Tree-Sizes:

Ectomycorrhizal

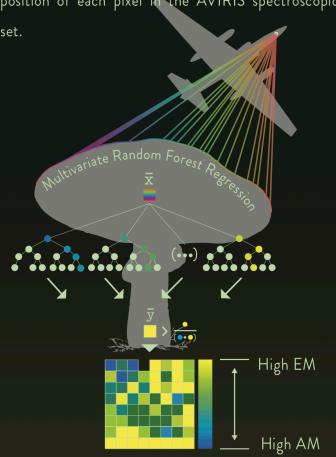


Arbuscular Mycorrhizal

Study Area

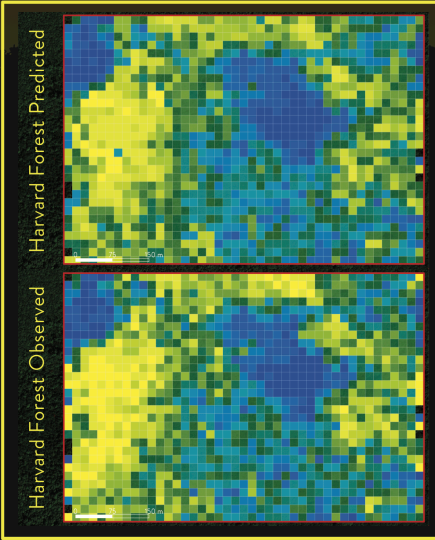
Methods

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.



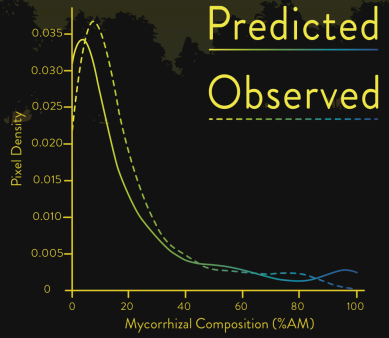
For the purposes of first-pass analysis random forest regression model was trained with the full set to measure how well it could predict mycorrhizae composition.

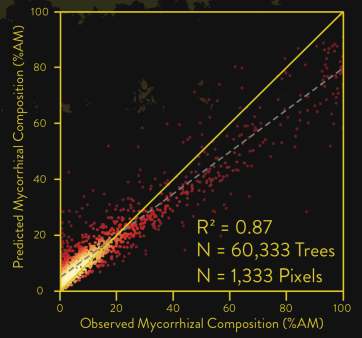
Results



Predicted

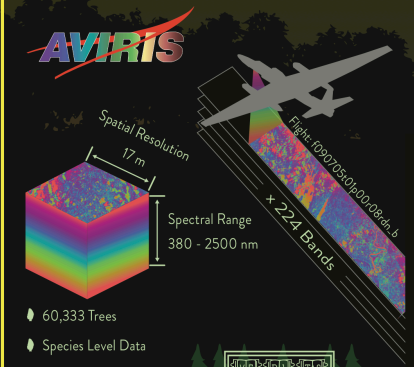
Observed





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