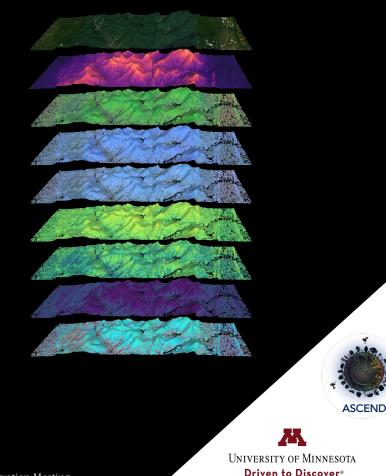
### Mapping changes in forest diversity and disease in North American temperate forests

**J. Antonio Guzmán Q.**, Jeannine Cavender-Bares (PI), Philip A. Townsend, Jesús N. Pinto-Ledezma, Gerard Sapés, Jennifer Juzwik, Jonathan Knott.

guzman@umn.edu University of Minnesota



### Project goals (summary):

1. Model species distributions using remote sensing data as input variables.

- 2. Scale forest diversity detection to map communities using satellite imagery.
- 3. Identify and differentiate threats to oaks species.



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Philip A. Townsend



Jesús N. Pinto-Ledezma



Gerard Sapés



Jennifer Juzwik



Jonathan Knott

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Pinto-Ledezma and Cavender-Bares (2021) Scientific Reports

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#### Article | Open access | Published: 12 August 2021

Predicting species distributions and community composition using satellite remote sensing predictors

#### Jesús N. Pinto-Ledezma 🖾 & Jeannine Cavender-Bares

Scientific Reports 11, Article number: 16448 (2021) | Cite this article



Remote Sensing of Environment Volume 273, May 2022, 112961

Canopy spectral reflectance detects oak wilt at the landscape scale using phylogenetic discrimination

 Gerard Sapes<sup>a</sup> A ≅, Cathleen Lapadat<sup>a</sup>, Anna K. Schweiger<sup>ab c</sup>, Jennifer Juzwik<sup>d</sup>,

 Rebecca Montgomery<sup>e</sup>, Hamed Gholizadeh<sup>f</sup>, Philip A. Townsend<sup>g</sup>, John A. Gamon<sup>h</sup>i,

 Jeannine Cavender-Bares<sup>a</sup> A ≅



Remote Sensing of Environment Volume 298, 1 December 2023, 113794



Mapping oak wilt disease from space using land surface phenology

]<u>. Antonio Guzmán Q.</u> <sup>a</sup> <sup>O</sup> <sup>O</sup> <sup>O</sup> <sub>i</sub> <u>Psús N. Pinto-Ledezma</u> <sup>a</sup> <sup>O</sup> <sub>i</sub> <u>David Frantz</u> <sup>b</sup> <sup>O</sup> <sub>i</sub> <u>Philip A. Townsend</u> <sup>c</sup> <sup>O</sup> <sub>i</sub> <u>Jennifer Juzwik</u> <sup>d</sup> <sup>O</sup> <sub>i</sub> <u>Jeannine Cavender-Bares</u> <sup>a</sup> <sup>O</sup>

#### RESEARCH ARTICLE | ENVIRONMENTAL SCIENCES

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Mechanistic links between physiology and spectral reflectance enable previsual detection of oak wilt and drought stress

Gerard Sapes 📀 🖾 , Lucy Schroeder 🧐 , Allison Scott, 🔫 , and Jeannine Cavender-Bares 🥯 🖾 Authors Info & -Affiliations

 Edited by James Ehleringer, The University of Utah, Salt Lake City, UT; received September 17, 2023; accepted December 11, 2023

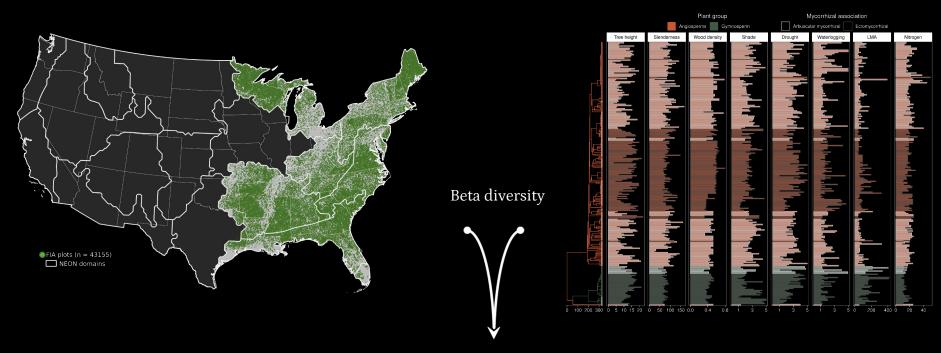
 February 5, 2024
 121 (7) e2316164121

 https://doi.org/10.1073/onas.2316164121

## Mapping multiple dimensions of forest diversity

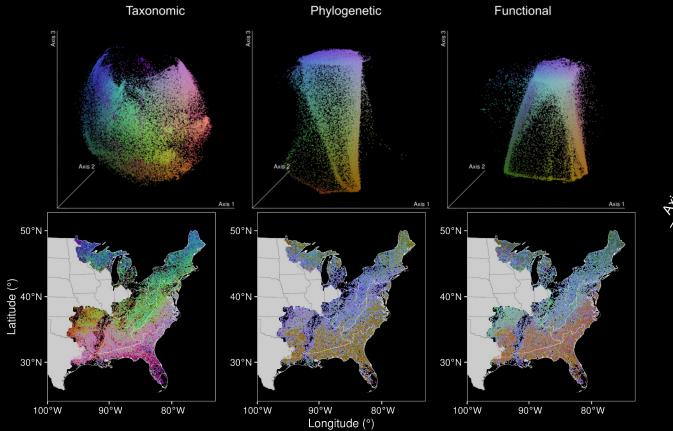
#### FIA inventories

# Taxonomic, phylogenetic, and functional information



Ordination of communities using Non-metric Multidimensional Scaling (NMDS)

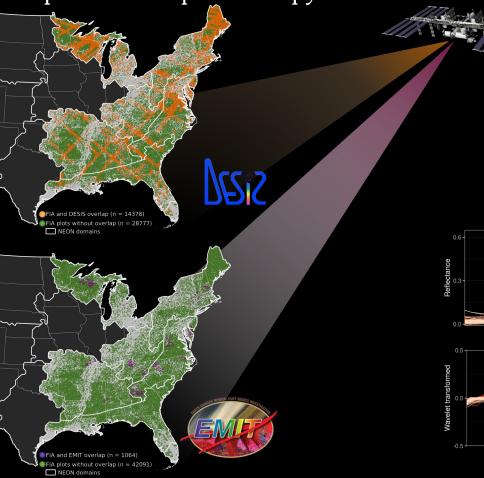
### Ordination of plant communities



Axis 2

NMDS of multiple dimensions of beta diversity and its spatial pattern

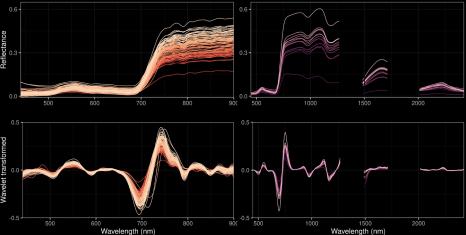
### Spaceborne spectroscopy data



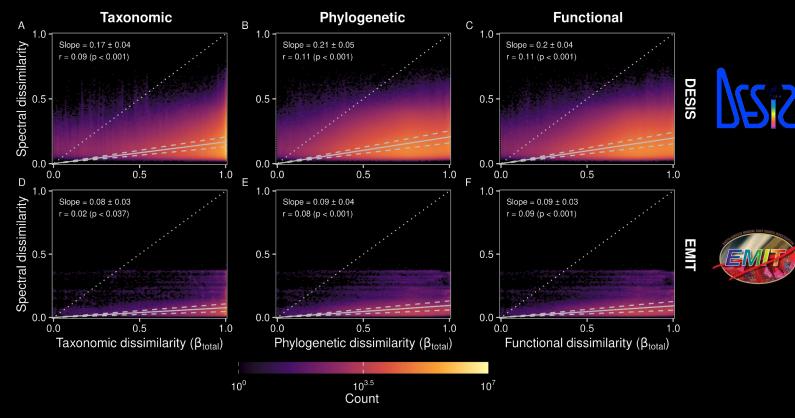
#### Our application

- To test the correspondence between spectral and community dissimilarity
- To develop models (PLSR) to predict community ordinations (beta diversity)

Example of inventories with a single species



# Spectral vs community dissimilarity

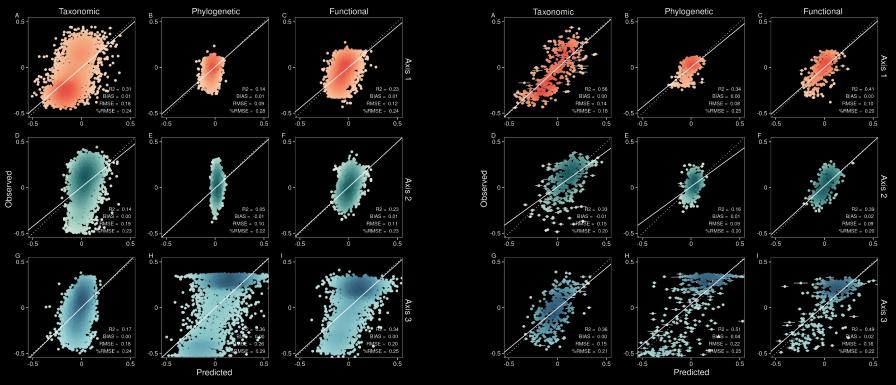


Comparisons between community and spectral dissimilarity

# PLSR model performance

DESIS

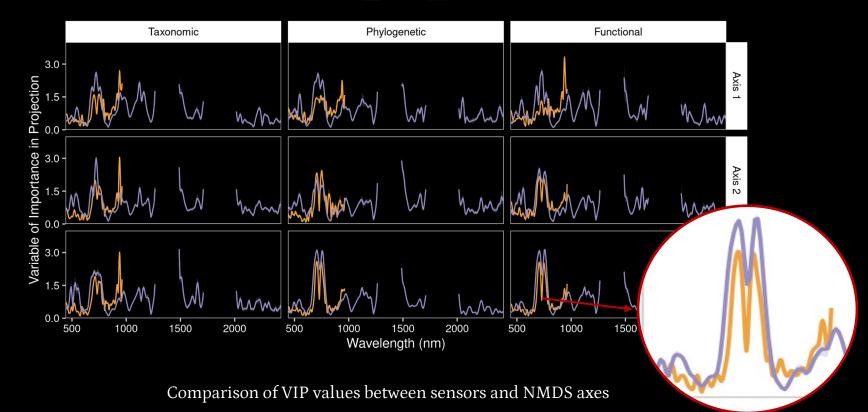
EMIT



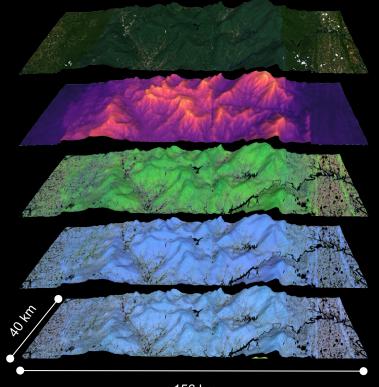
Observed and predicted relationships of models to predict NMDS axes on validation datasets

# Variable of Importance in Projection (VIP)

Sensor — DESIS — EMIT

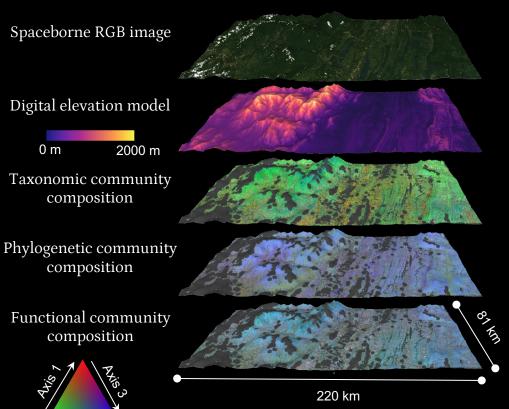


# Mapping multiple dimensions of beta diversity DESIS



156 km

#### EMIT

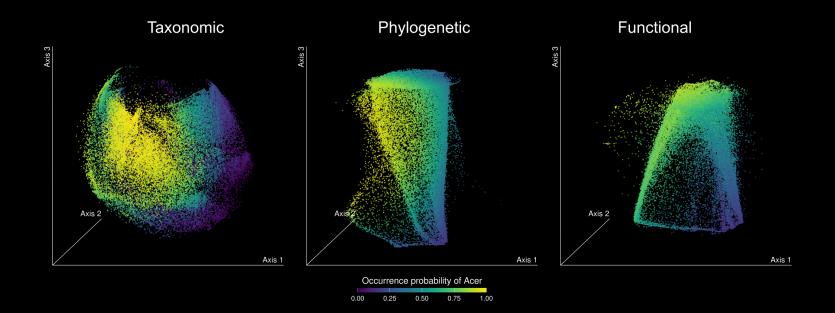


Appalachian mountains, Tennessee

Axis 2

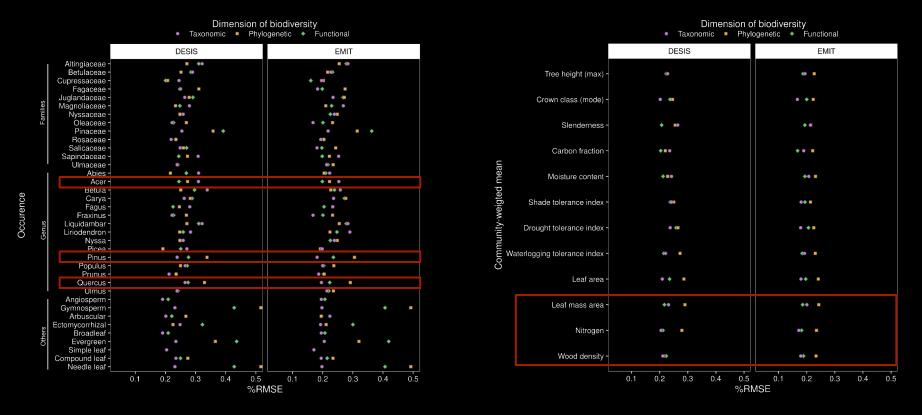
0 m

Beyond beta diversity: predicting plant occurrence and traits



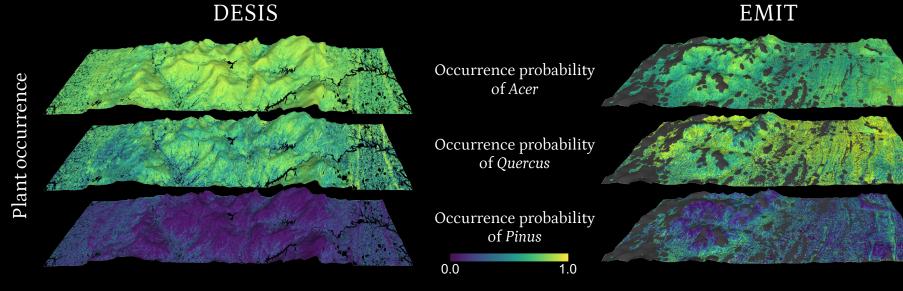
Probability of occurrence of plant lineages and community weighted mean of plant traits.

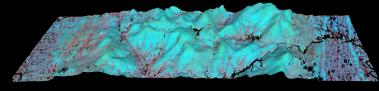
#### Models to map occurrence or CWM within communities



Performance of models for predicting occurrence and community traits on validation datasets

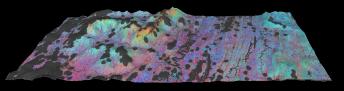
# Mapping occurrence of plant lineages and CWM





Community-weighted mean





Appalachian mountains, Tennessee

# Thank you!



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NASA Biodiversity Program (80NSSC21K1349) Jeannine Cavender-Bares (PI)