

Linking (remotely sensed) optical diversity to genetic, phylogenetic and functional diversity to predict ecosystem processes

Dimensions of Biodiversity Team PIs



Gamon



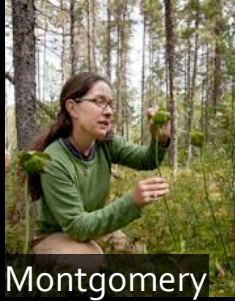
Hobbie



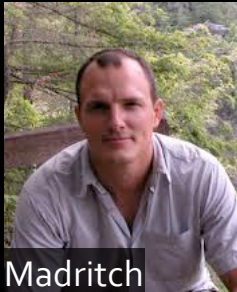
Cavender-Bares



Townsend



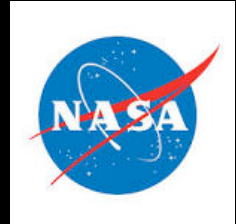
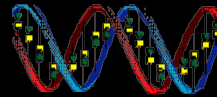
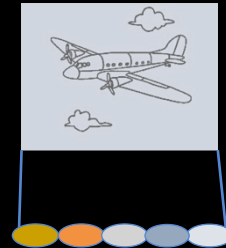
Montgomery



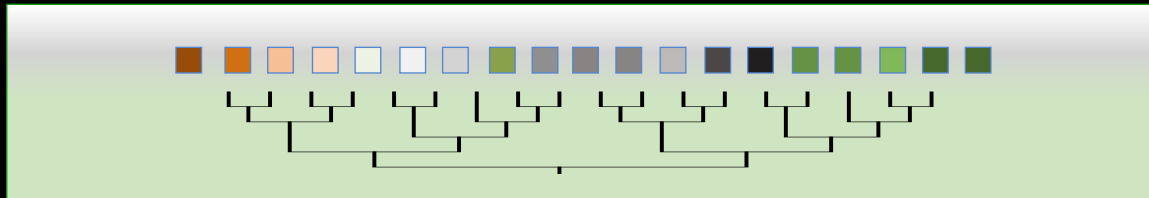
Madritch



Zygielbaum



DEB
1342872



Linking (remotely sensed) optical diversity to genetic, phylogenetic and functional diversity to predict ecosystem processes

Dimensions of Biodiversity Team Pls



Gamon



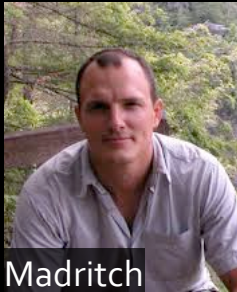
Hobbie



Townsend



Montgomery



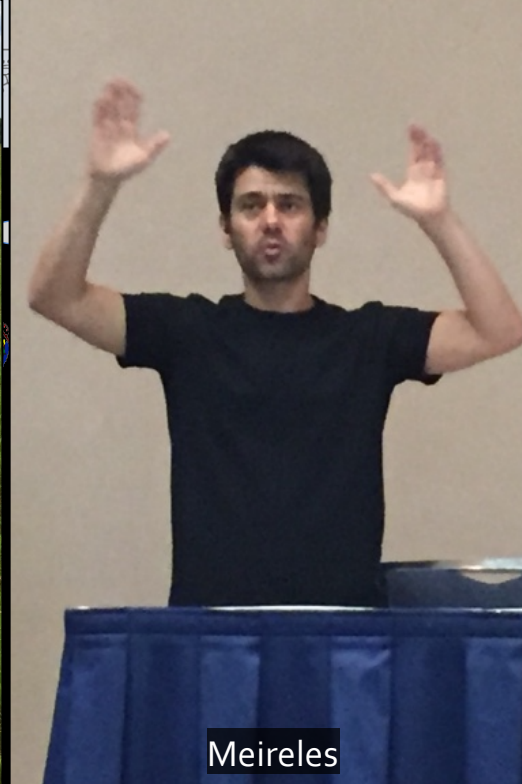
Madritch



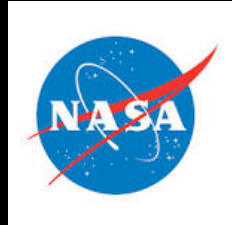
Zygielbaum



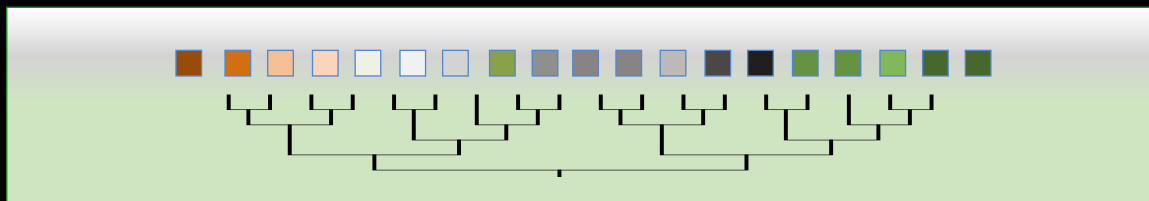
Schweiger

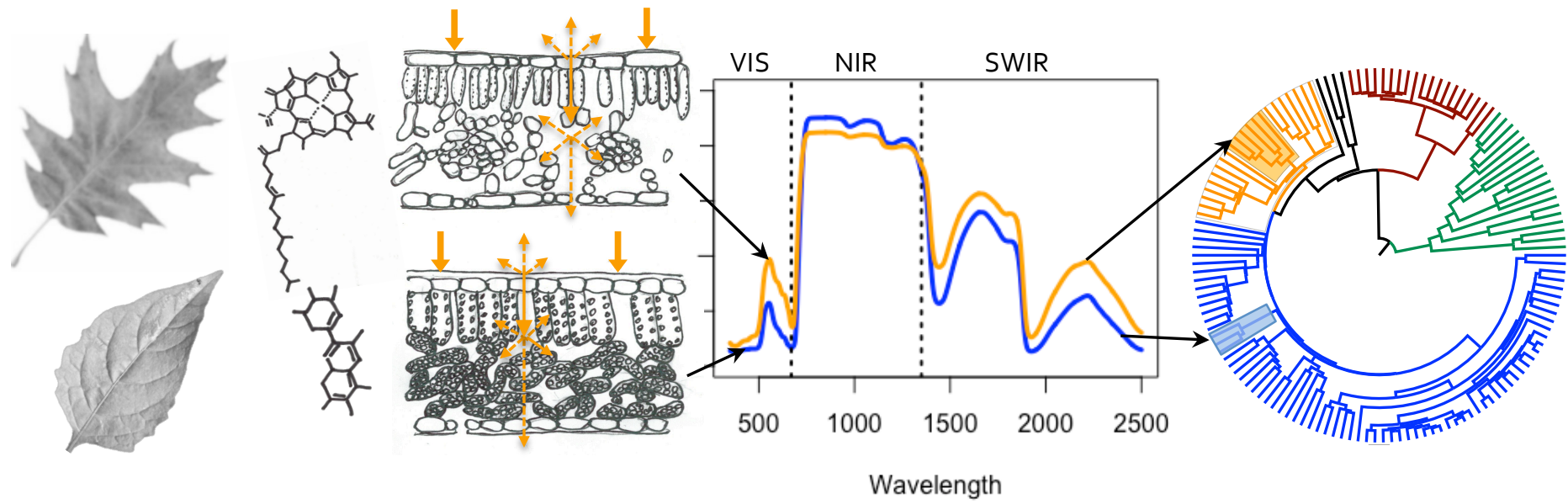


Meireles

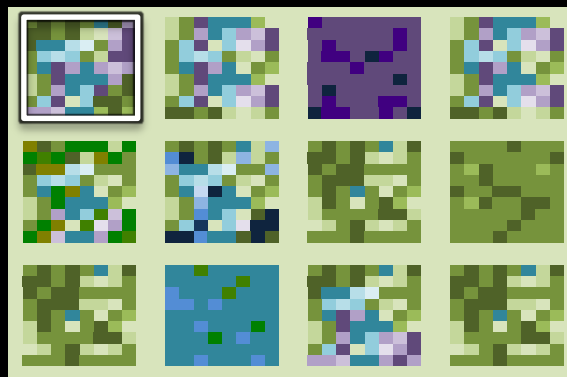
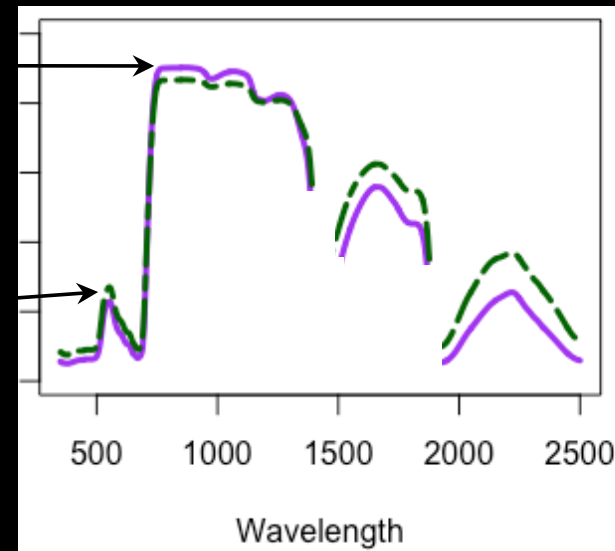
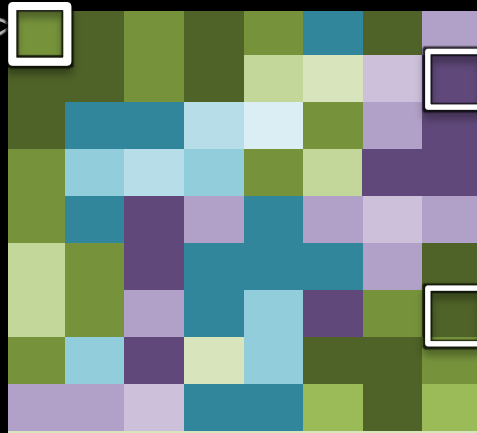


3
2872

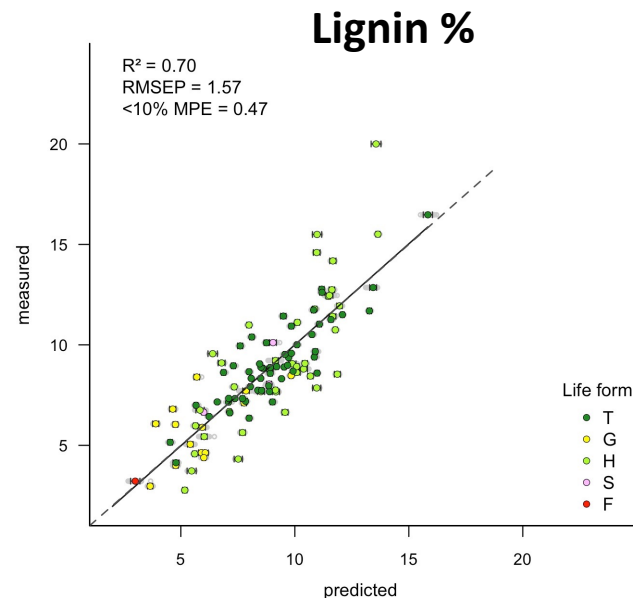
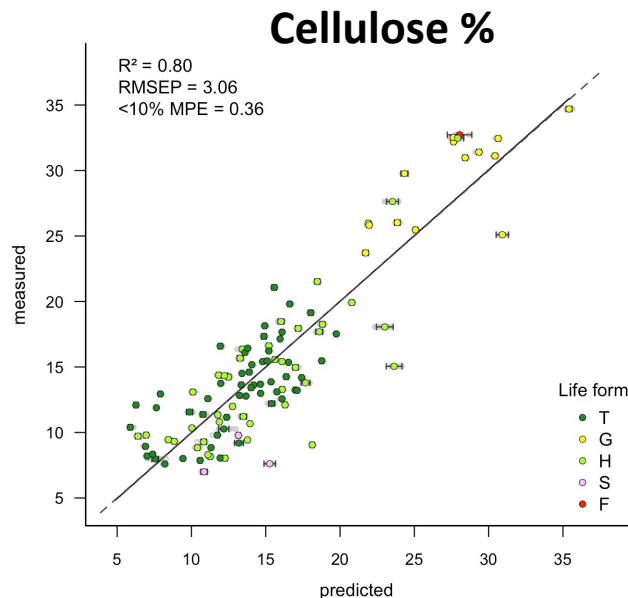
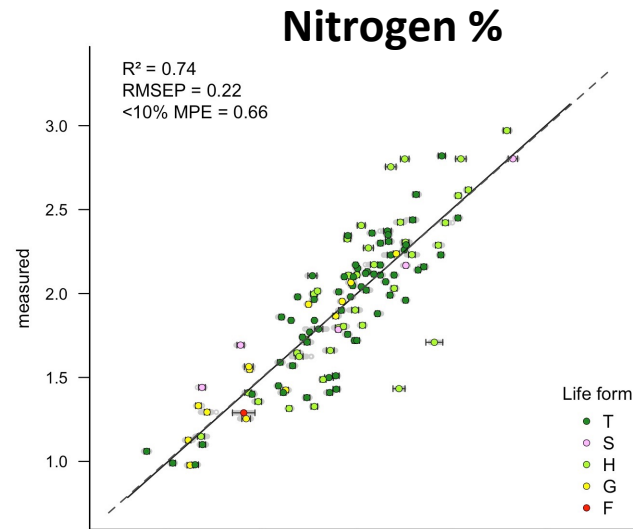
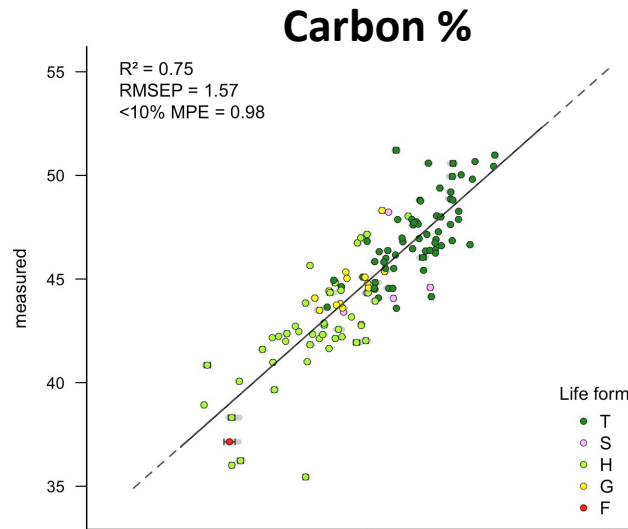




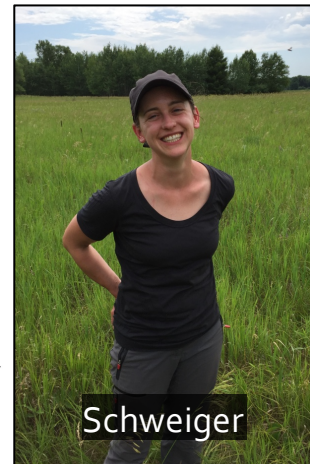
Detecting plant diversity in manipulated experiments

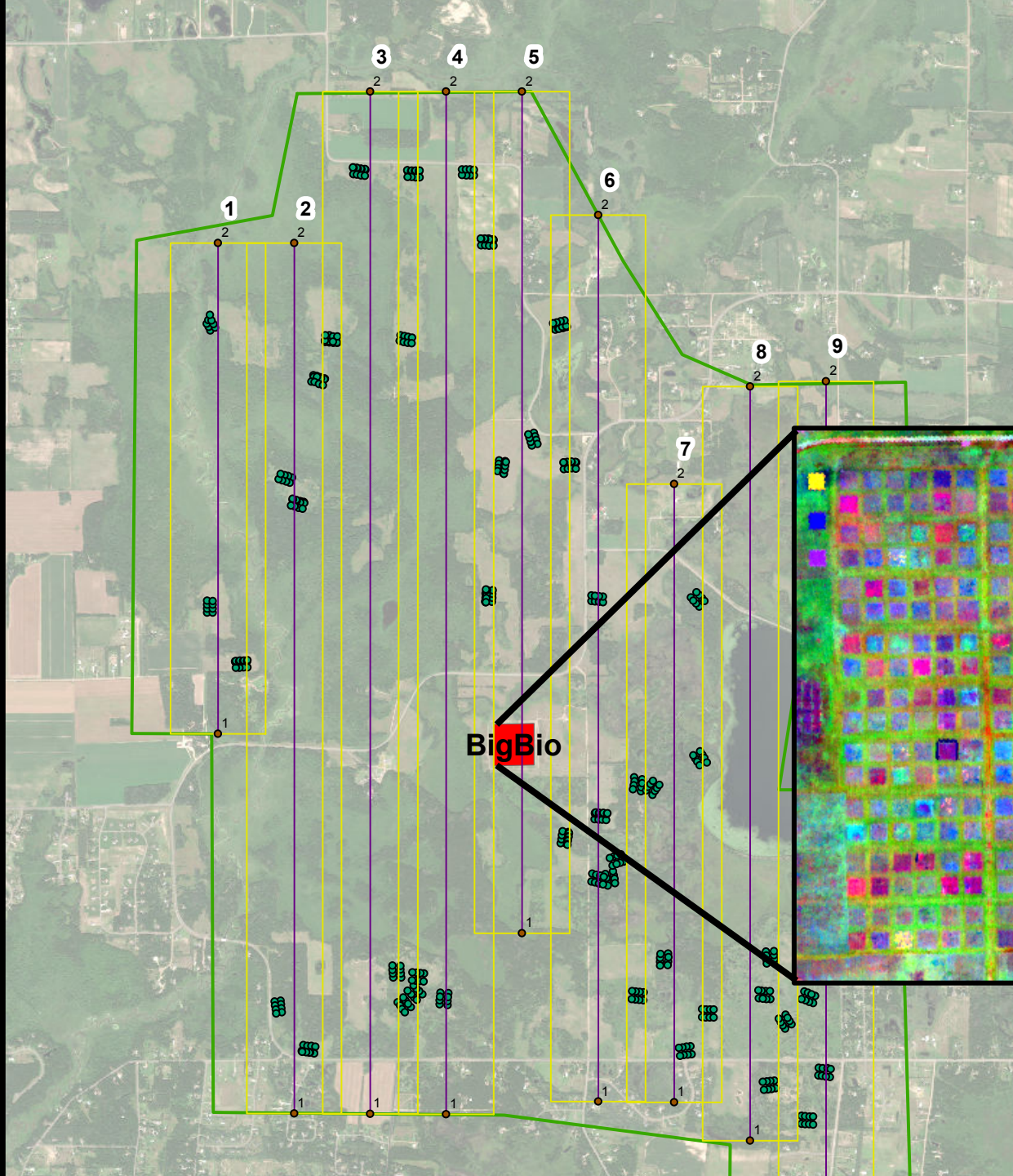


Spectra predict functional traits (PLSR models)

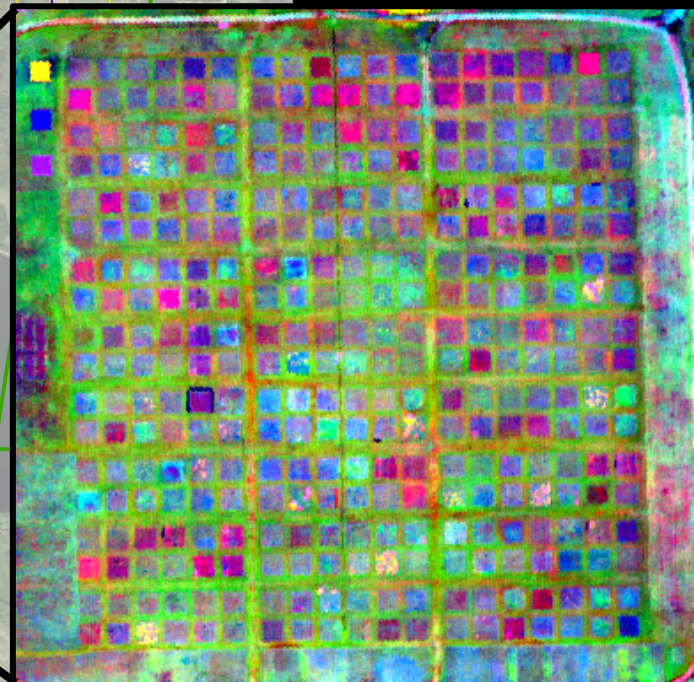


Chlorophyll A
Chlorophyll B
Lutein
Violaxanthin
Antherixanthin
Zeaxanthin
Beta Carotene
Anthocyanins
Solubles
Hemicellulose

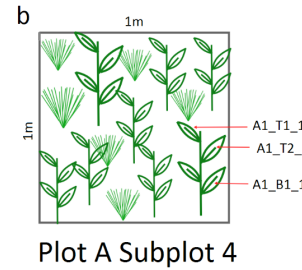
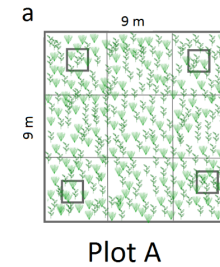
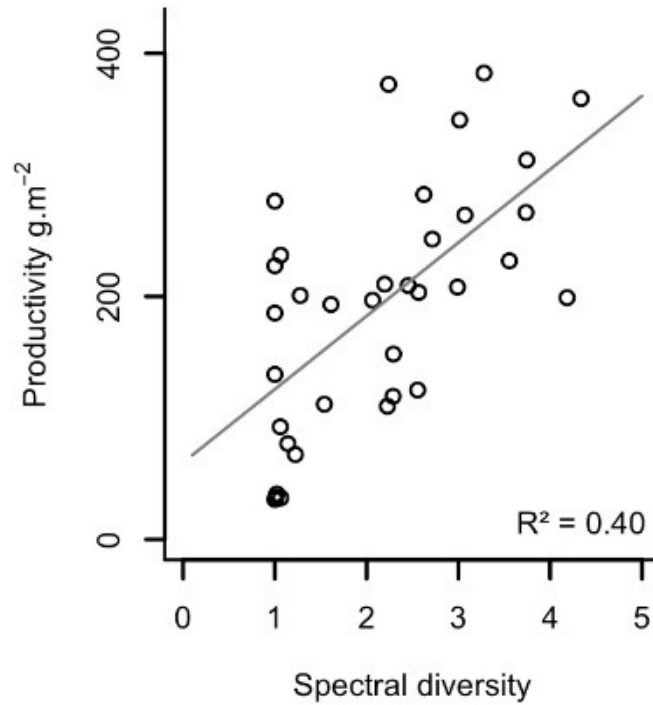




BigBio



At the leaf level,
spectral diversity
predicts productivity



c

$$\overline{\text{Plant}} = \frac{1}{n} \sum_{i=1}^n \text{Plant}_i$$

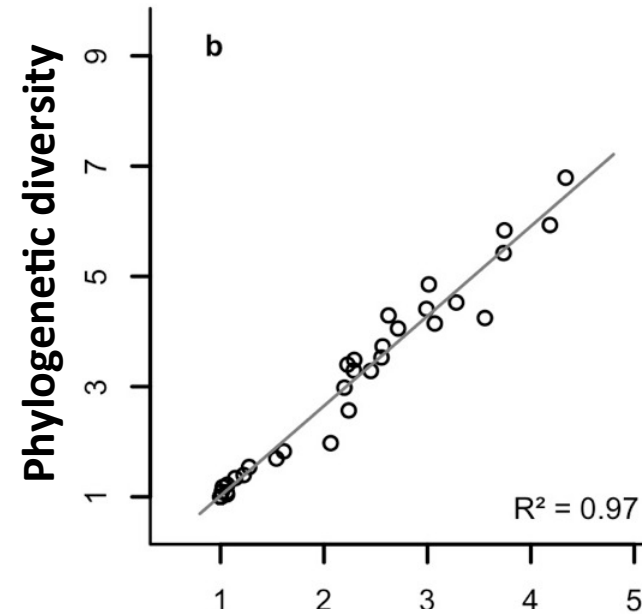
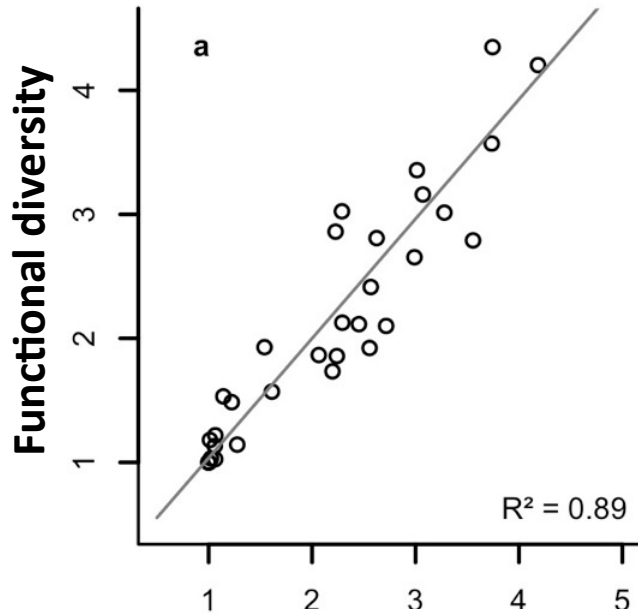
d

$$\overline{A1} = \frac{1}{n} \sum_{i=1}^n A1_i$$

Individual 1



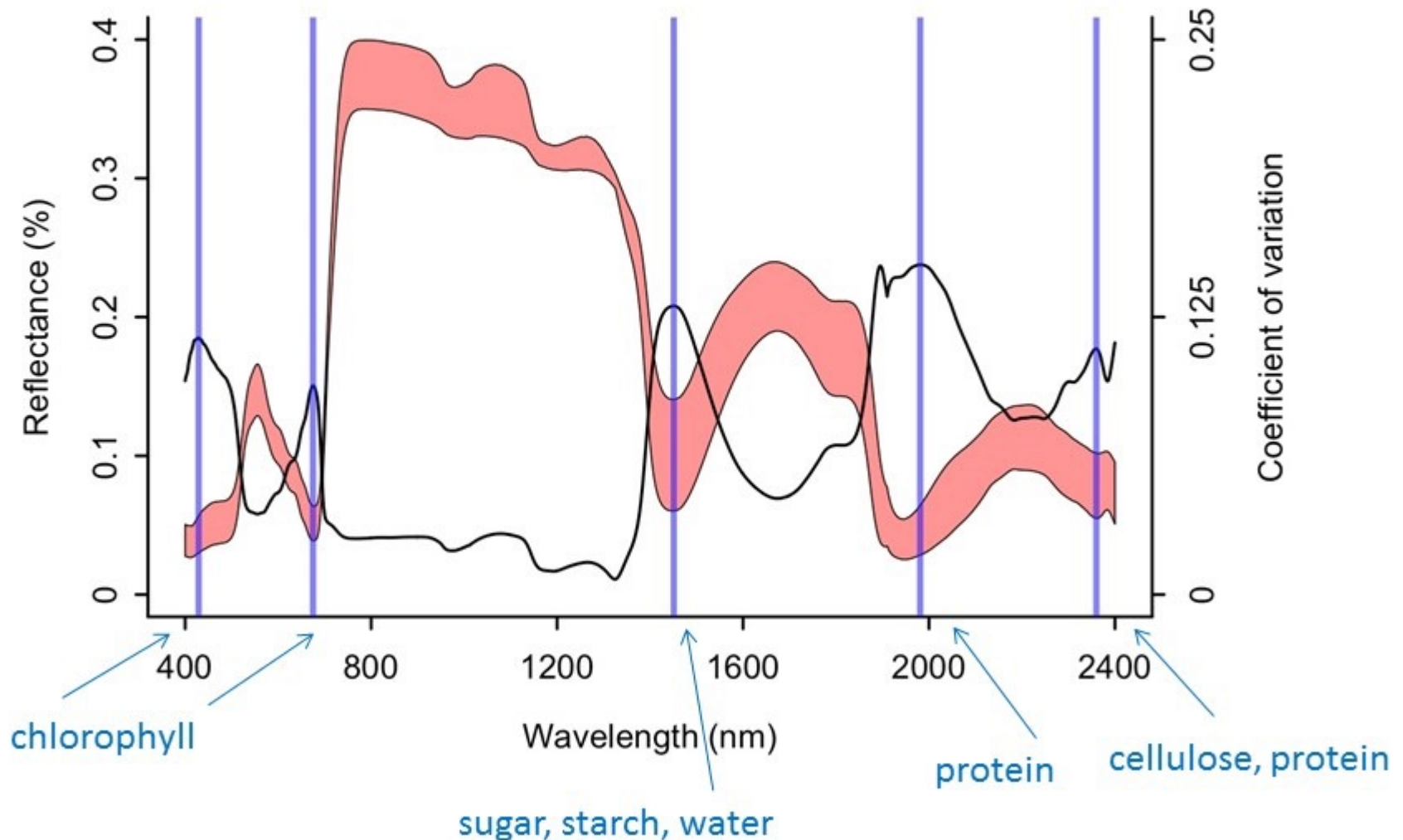
Spectral diversity is tightly coupled to functional diversity (LES traits) and phylogenetic diversity



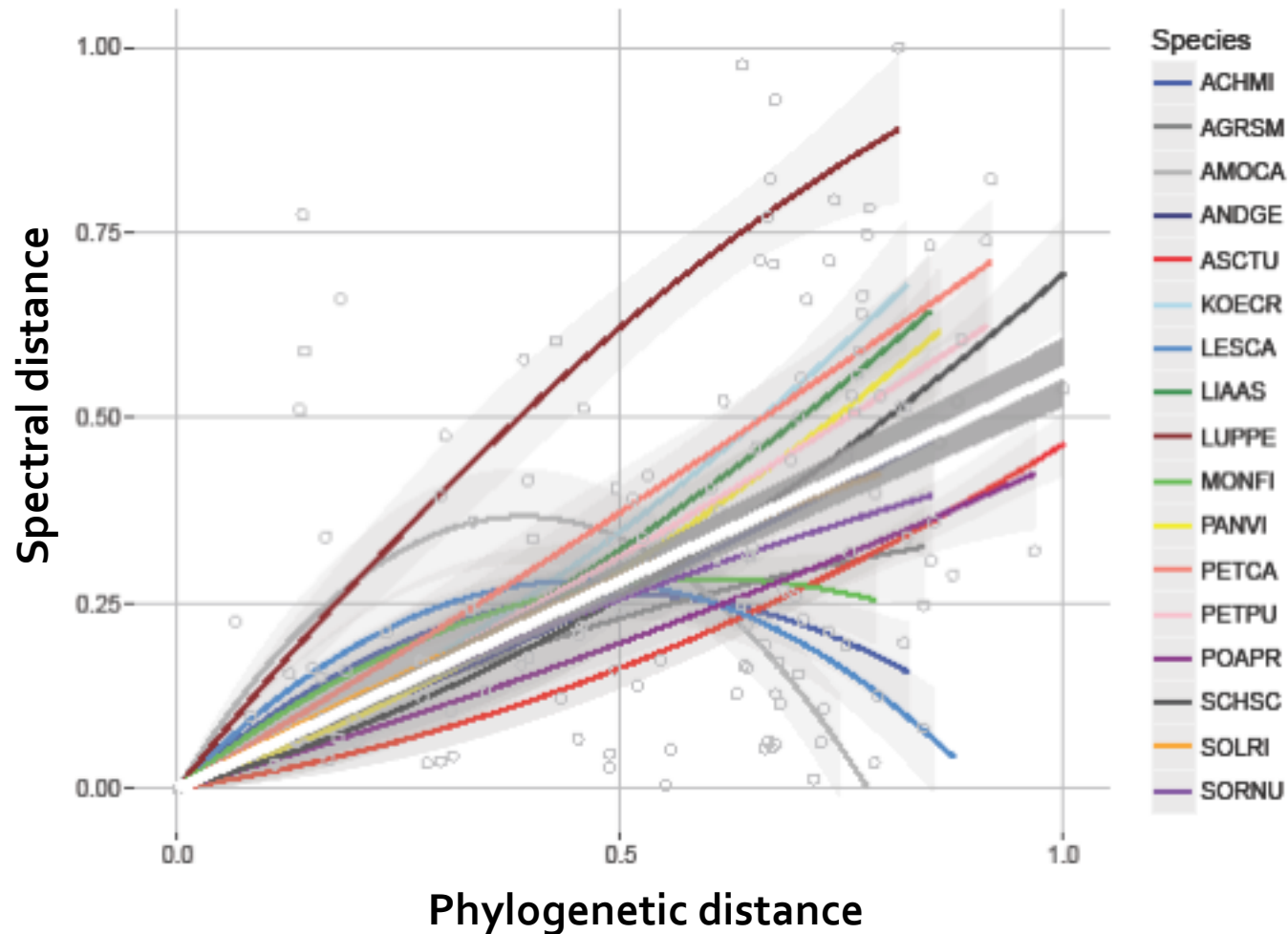
Spectral diversity



Spectral profiles, coefficient of variation, and local maxima of the coefficient of variation



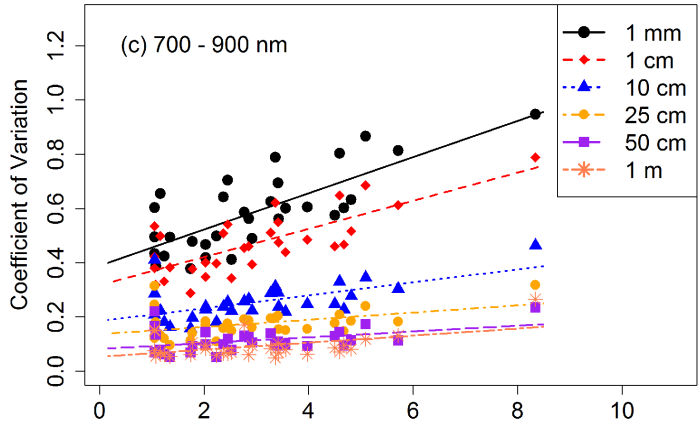
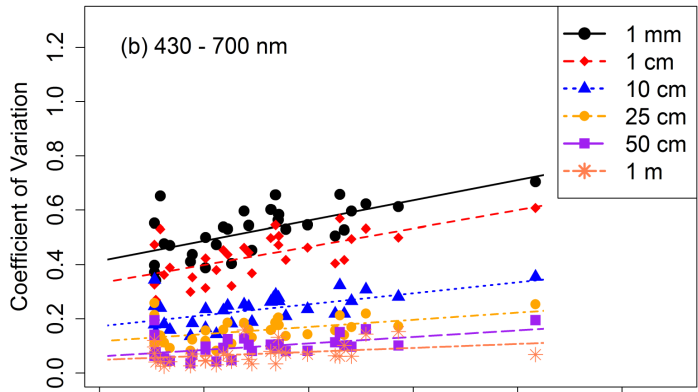
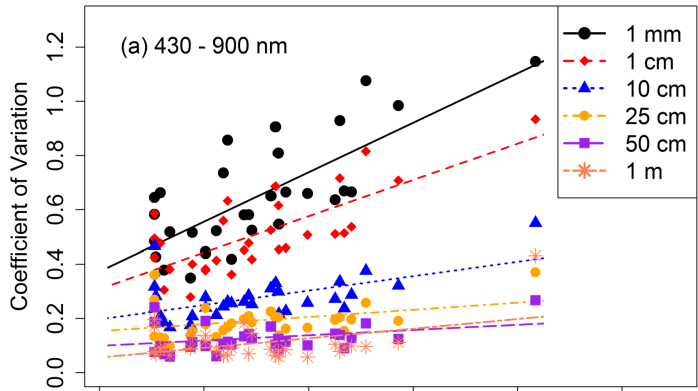
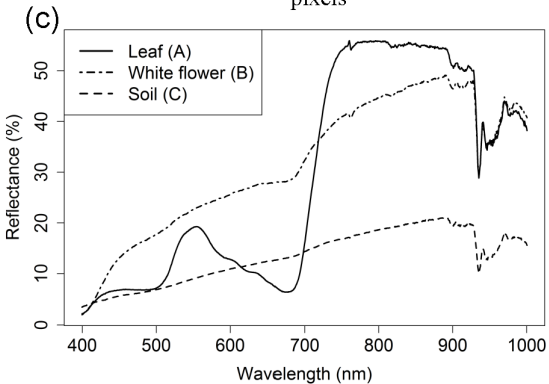
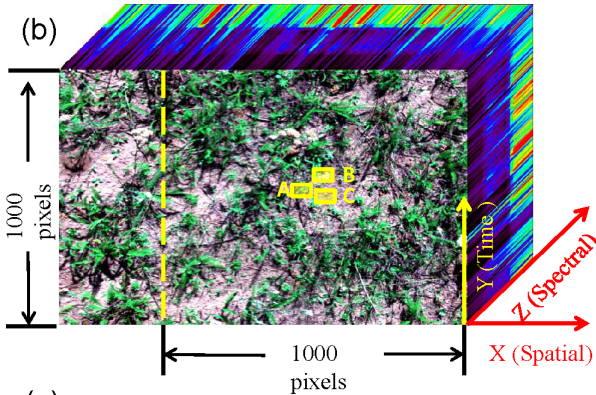
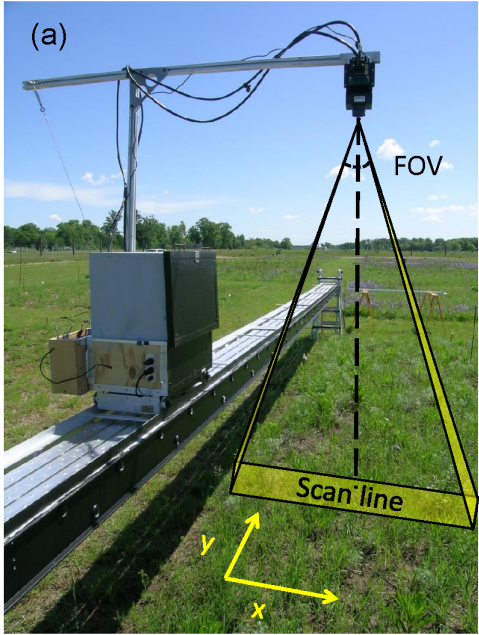
Spectral distances between each prairie species and all other species correlate with phylogenetic distances (for most species)



Remotely sensed
spectral diversity
predicts plant diversity
at fine spatial resolution
better than at course
spatial resolution

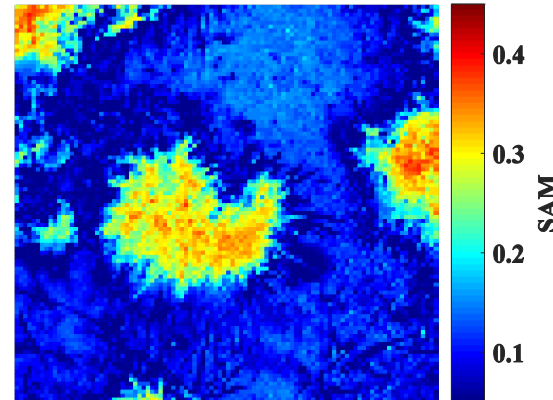
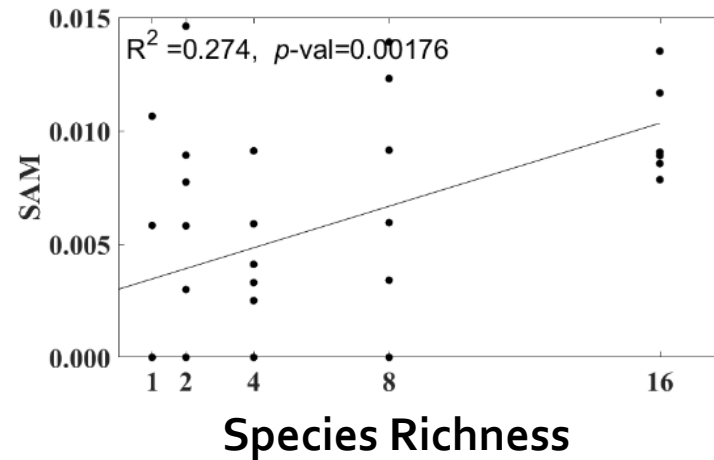
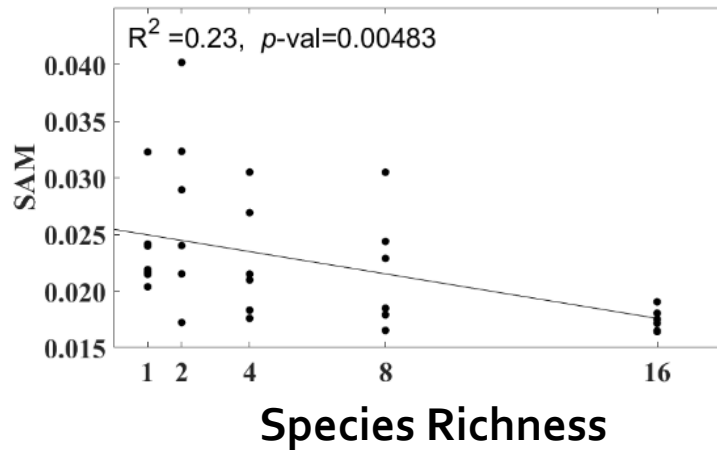


R. Wang



Plant diversity - Simpsons Index

Soil removal methods allow detection of plant diversity in cases where plant density is low



Remote Detection



Vegetation chemistry

Diversity (SR, PE, FE)
Composition

Productivity

aboveground

Plant community structure and function

belowground

Root Chemistry

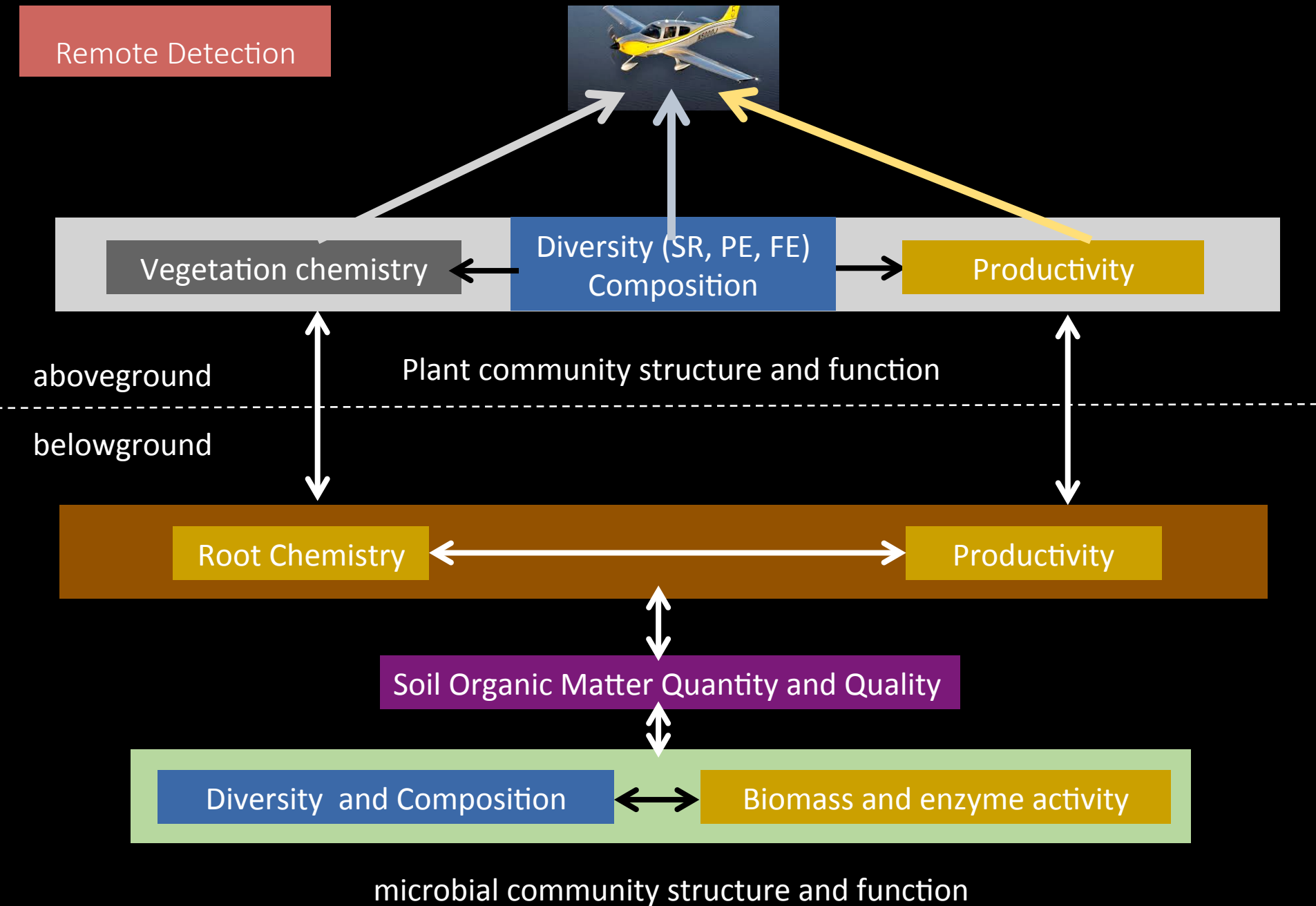
Productivity

Soil Organic Matter Quantity and Quality

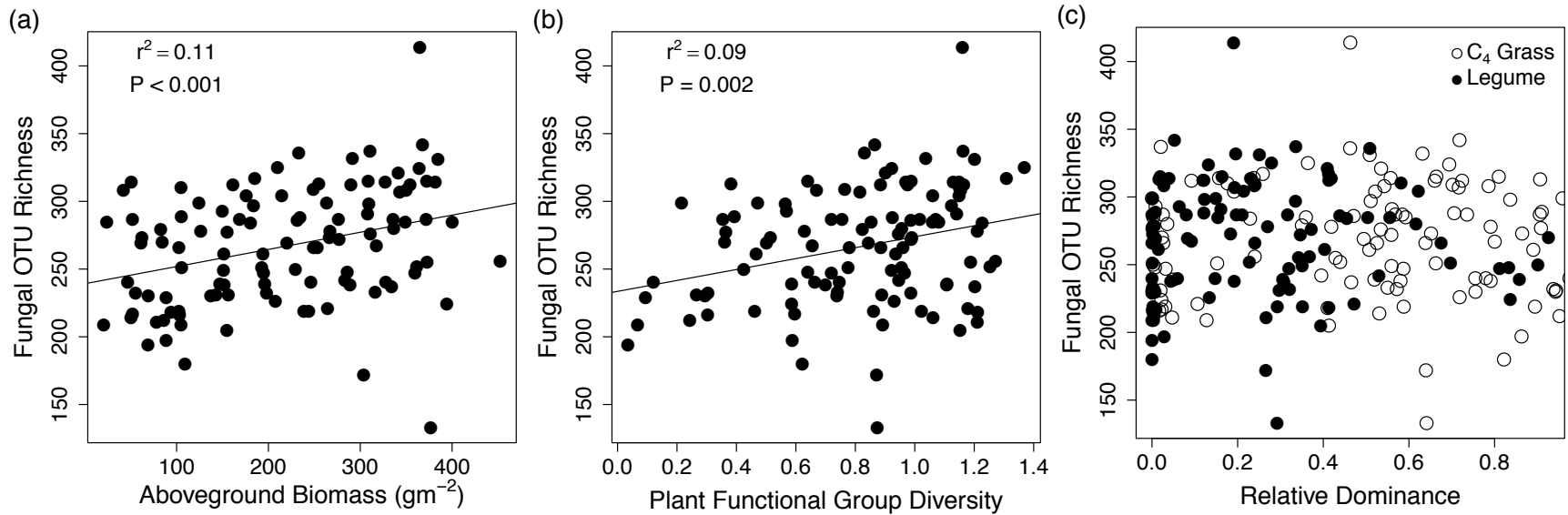
Diversity and Composition

Biomass and enzyme activity

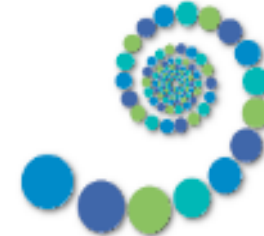
microbial community structure and function



Aboveground biomass and plant diversity (but not FGs) predict fungal diversity



NIMBioS Working Group: Remotely Sensing Biodiversity



NIMBioS

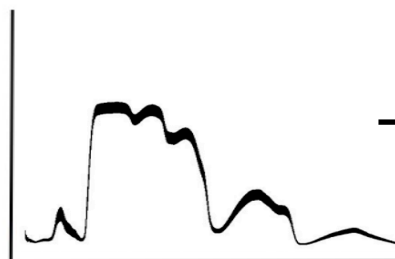


Raw spectra

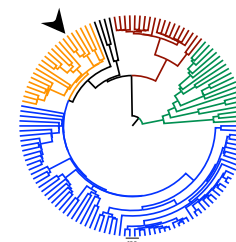
spectrolab

EcoSIS

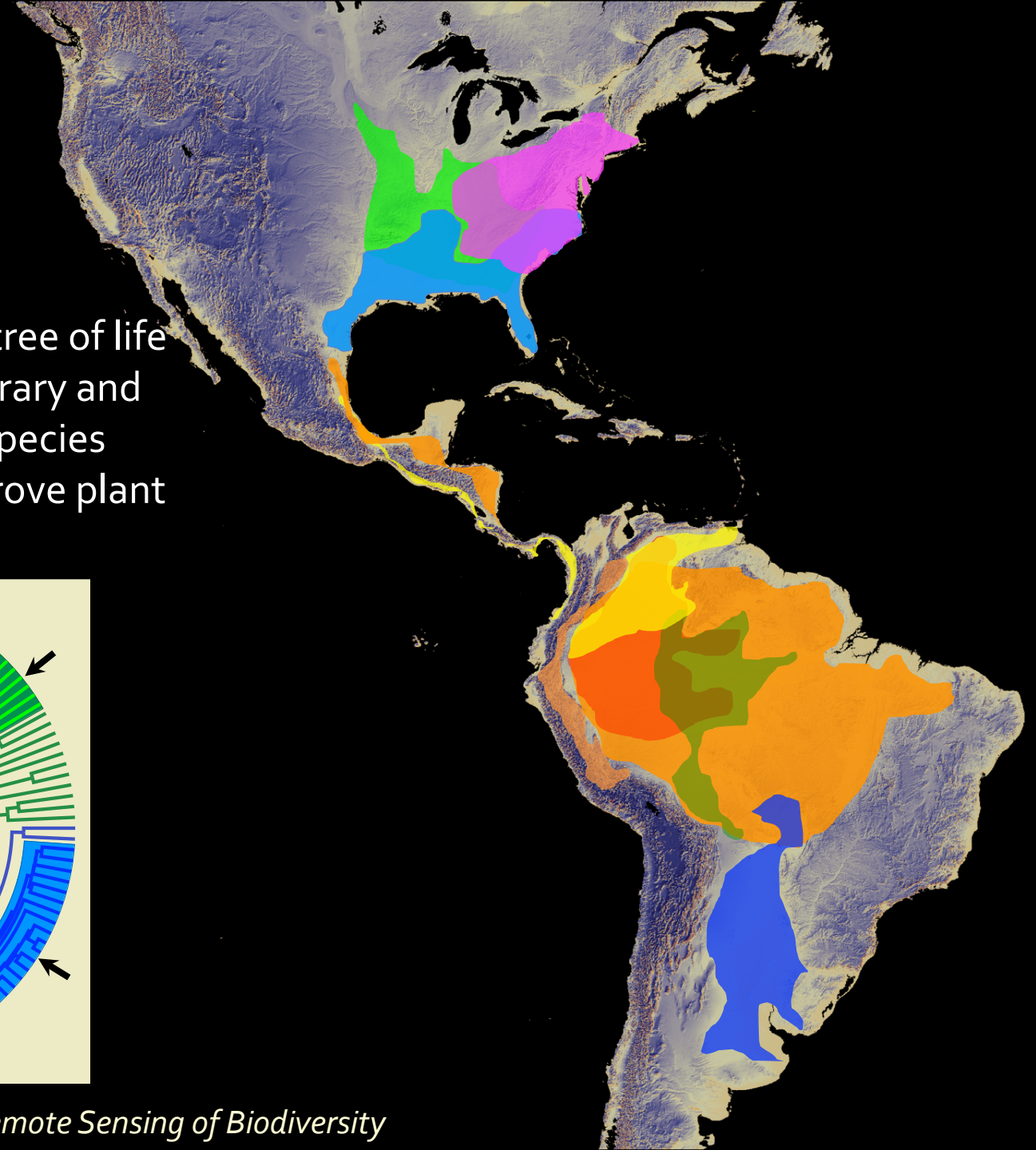
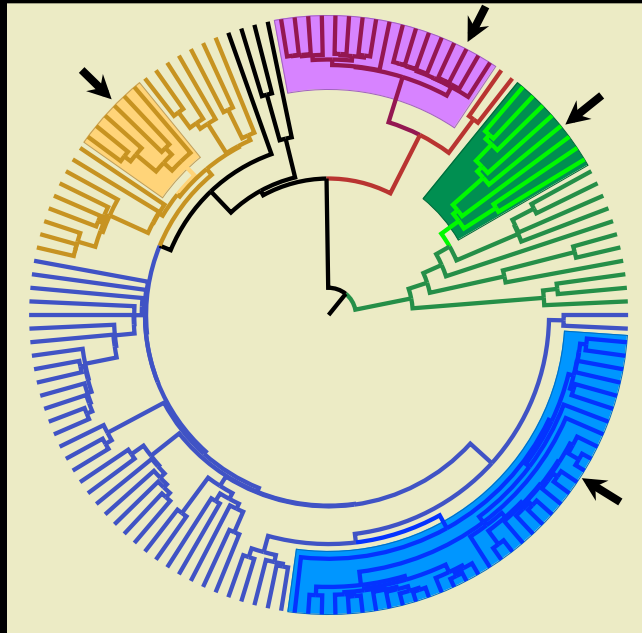
reconcile



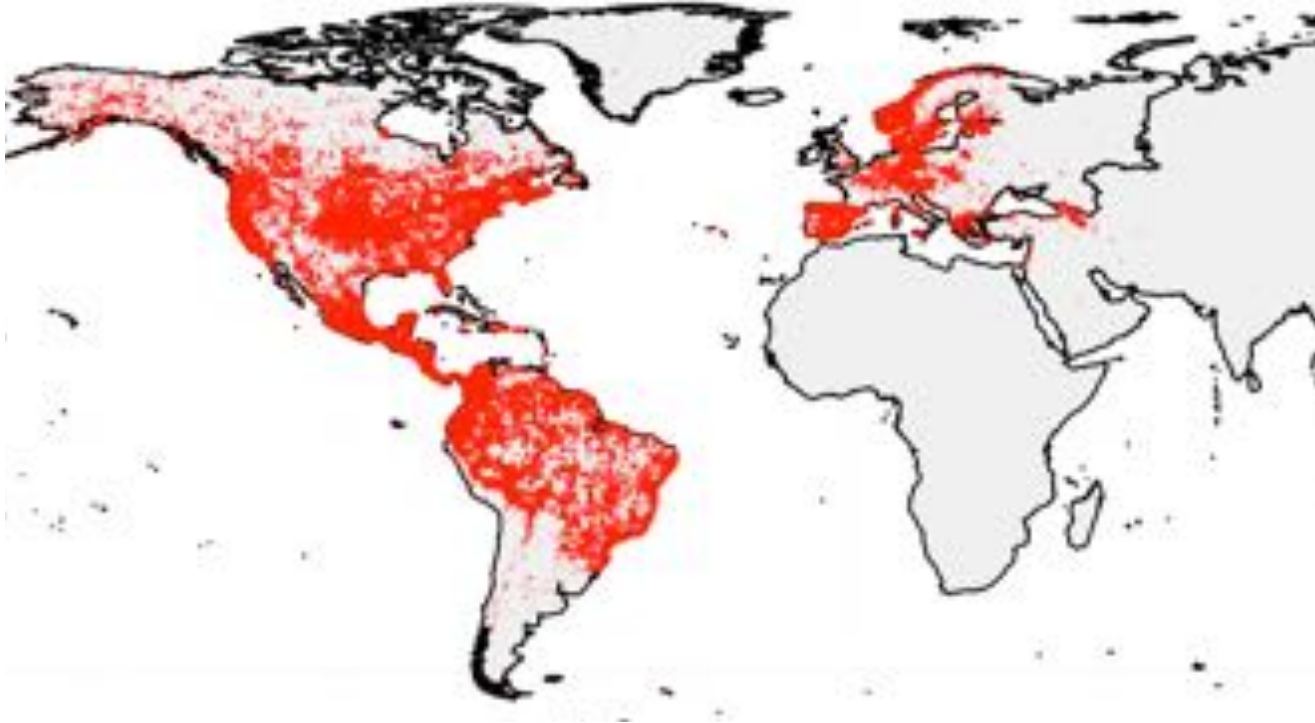
phylo
model



Spectral location in the tree of life will require a spectral library and can be integrated with species distribution data to improve plant diversity monitoring



Leaf level - high lability in spectral regions associated with pigments

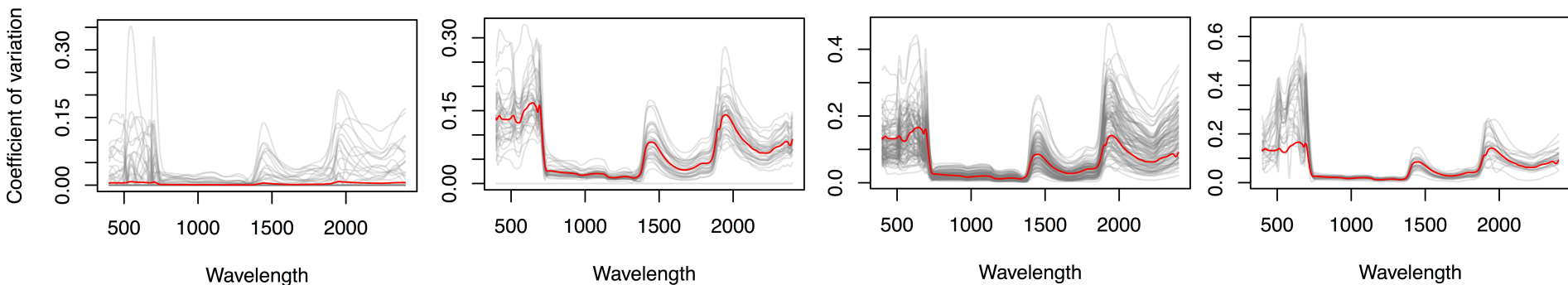


Peru

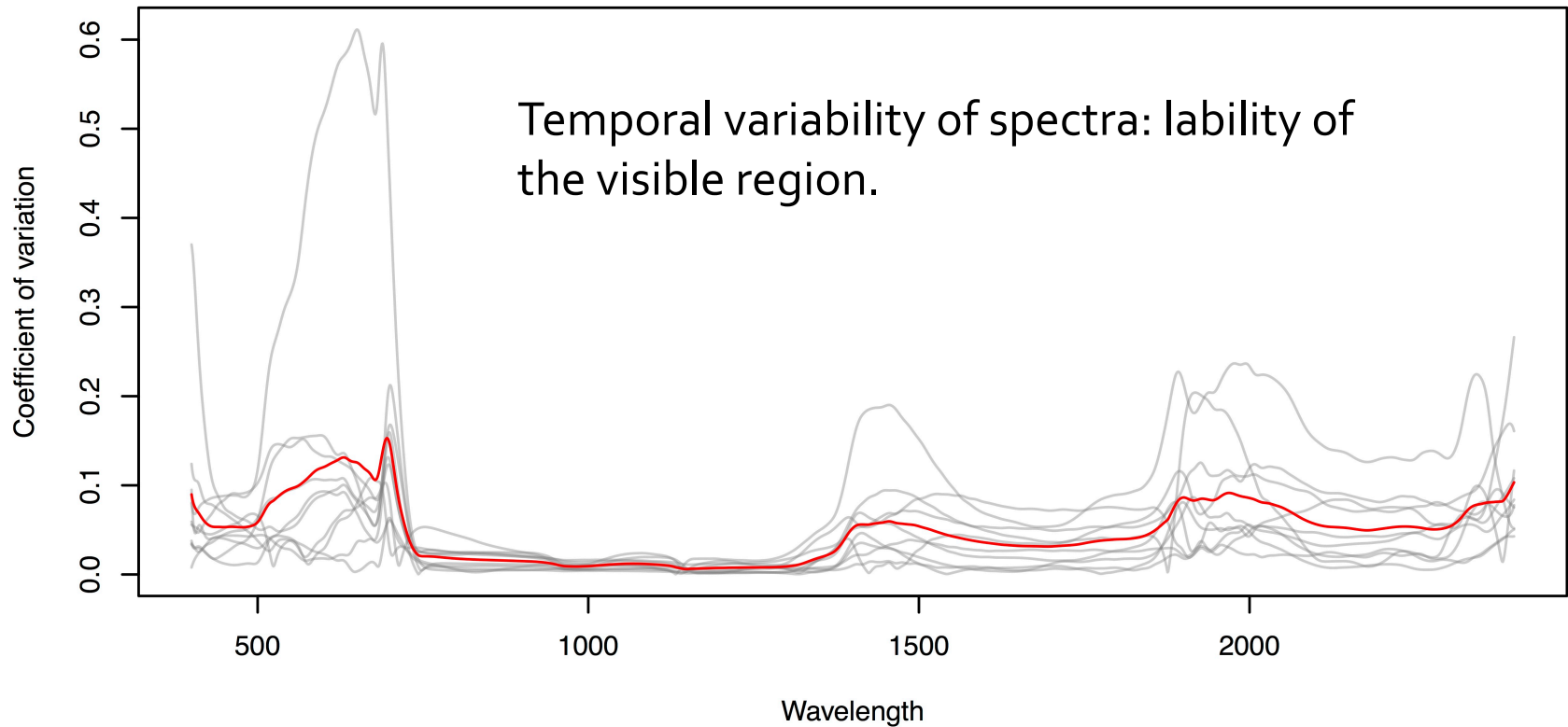
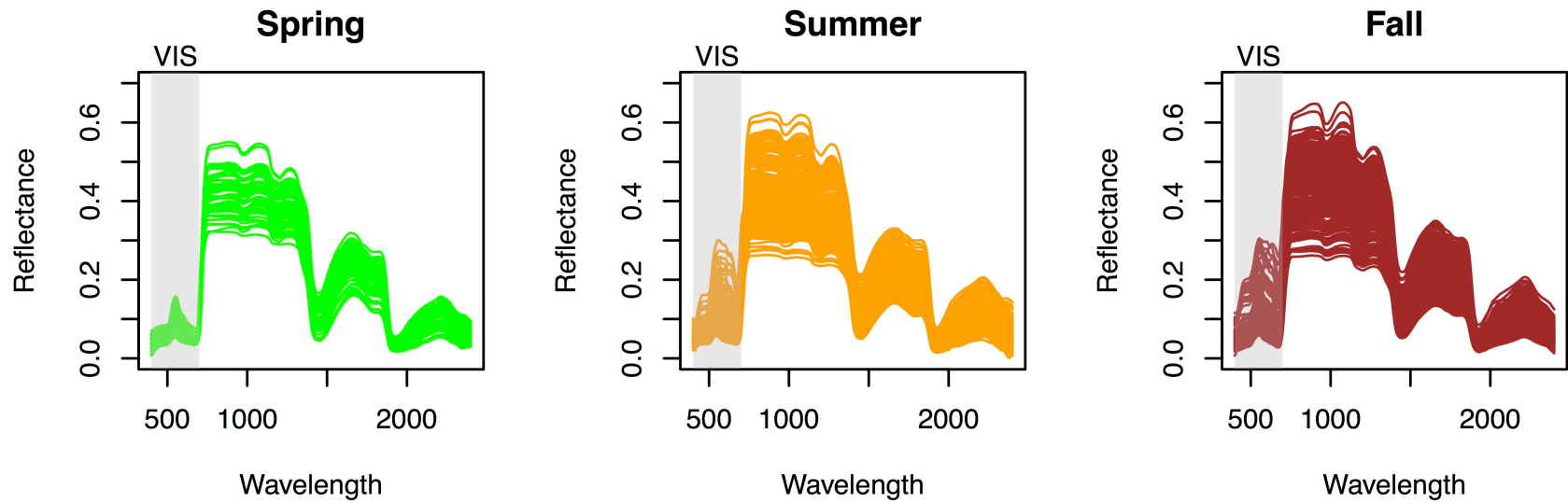
Cedar Creek

ENA Trees

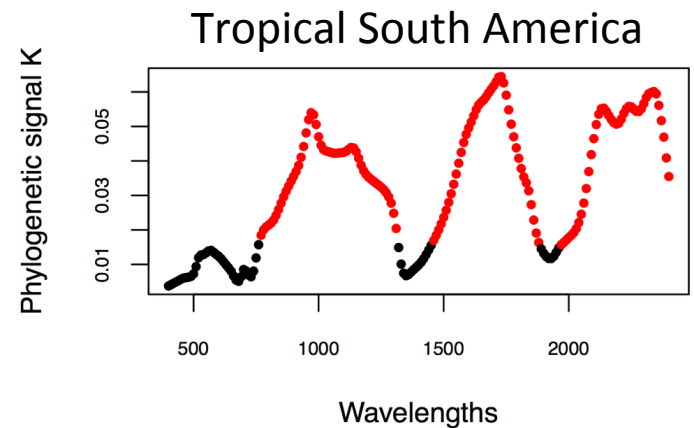
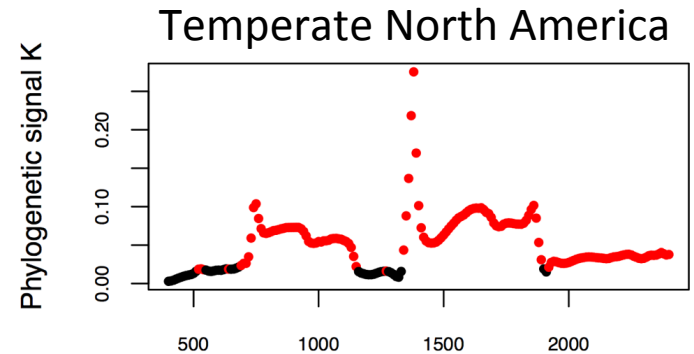
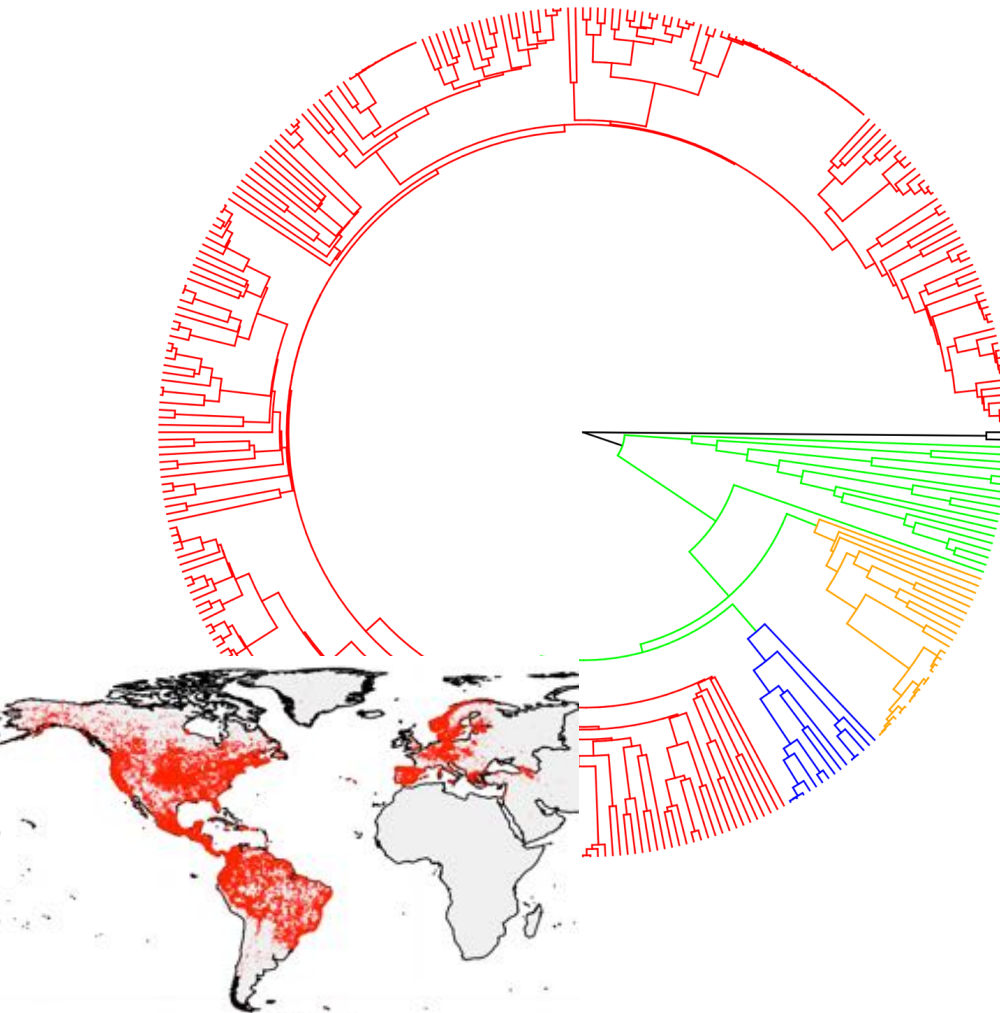
Oaks North America



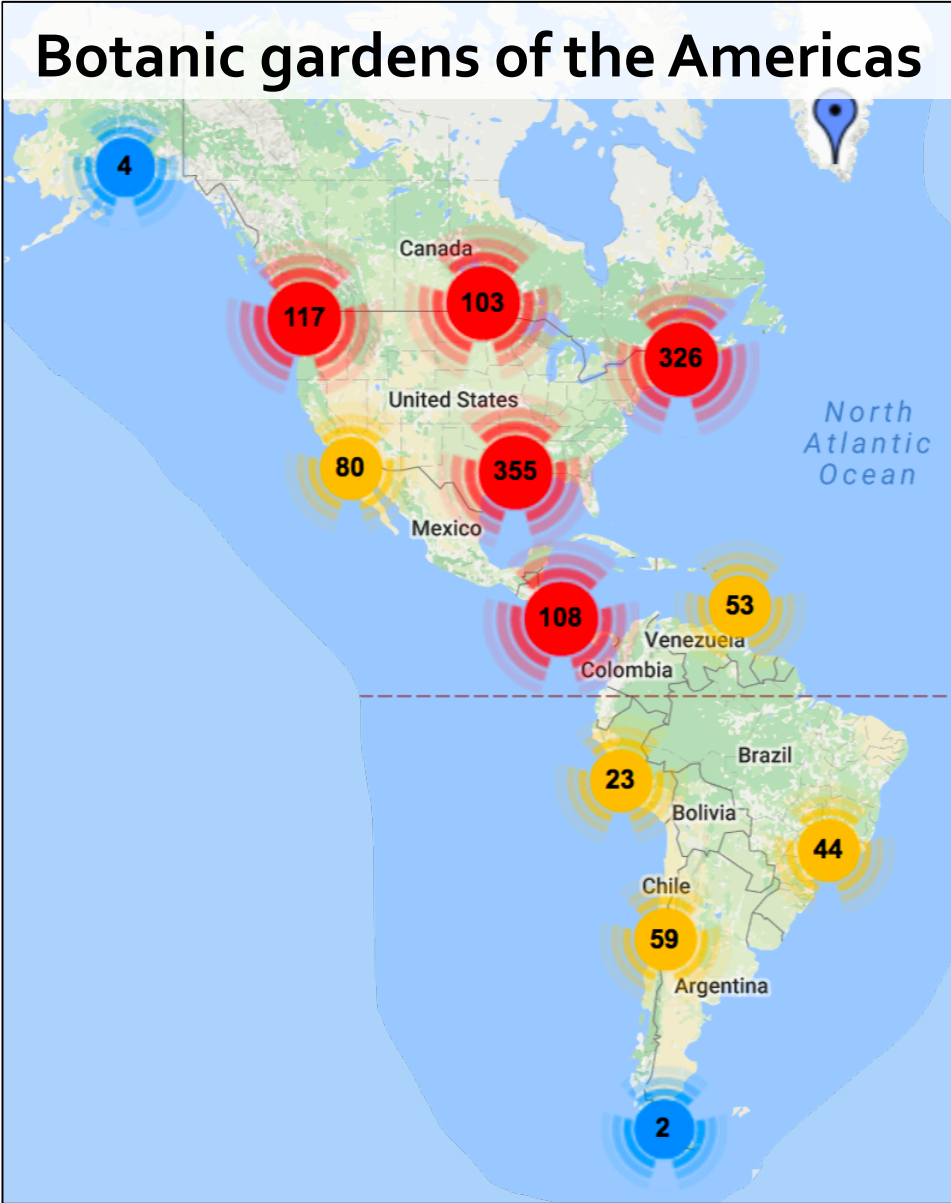
Vatiation across seasons in California



Spectra are phylogenetically conserved EXCEPT in the *visible* range associated with pigments for light harvesting and photoprotection



How to generate canopy spectral profiles for the plant tree of life...



IPBES Americas Regional Assessment



Arnold Arboretum



Rebecca Montgomery



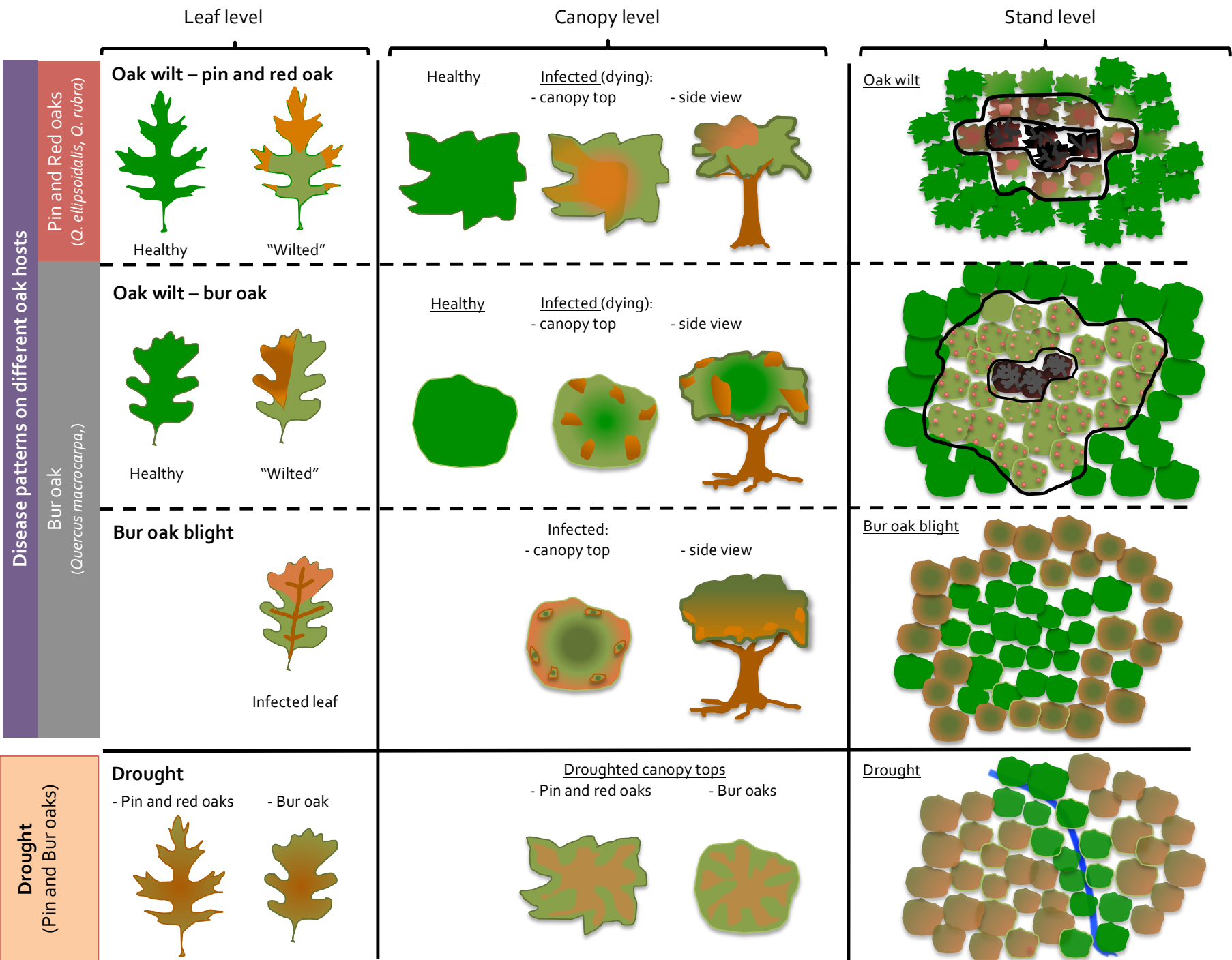
Jennifer Juzwik

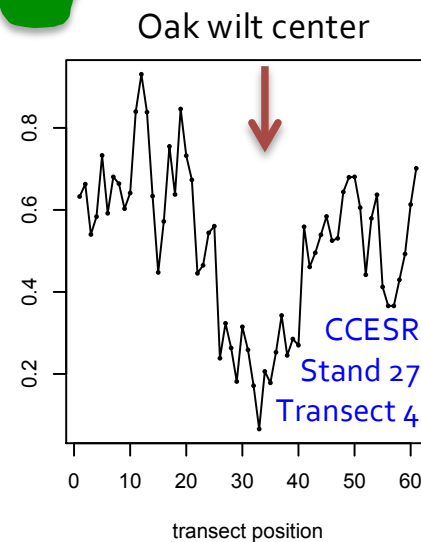
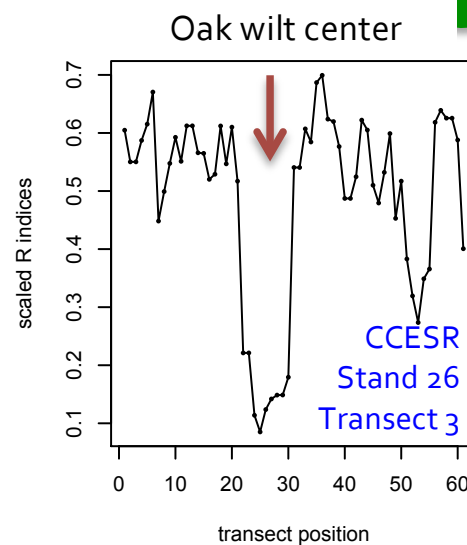
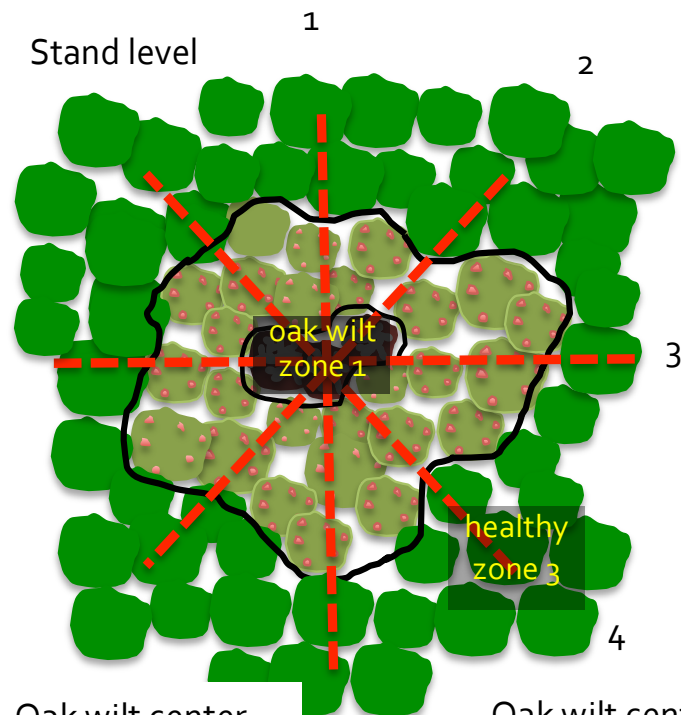
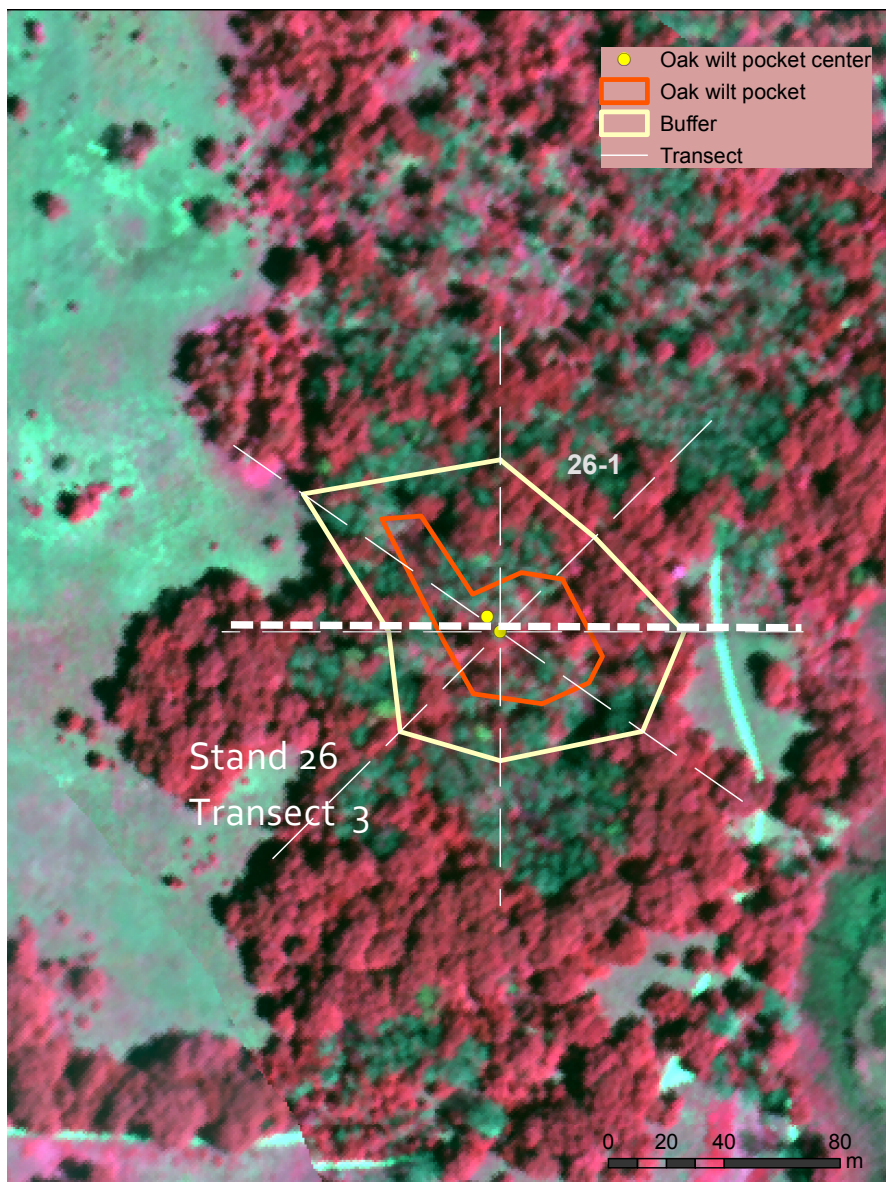


Phil Townsend

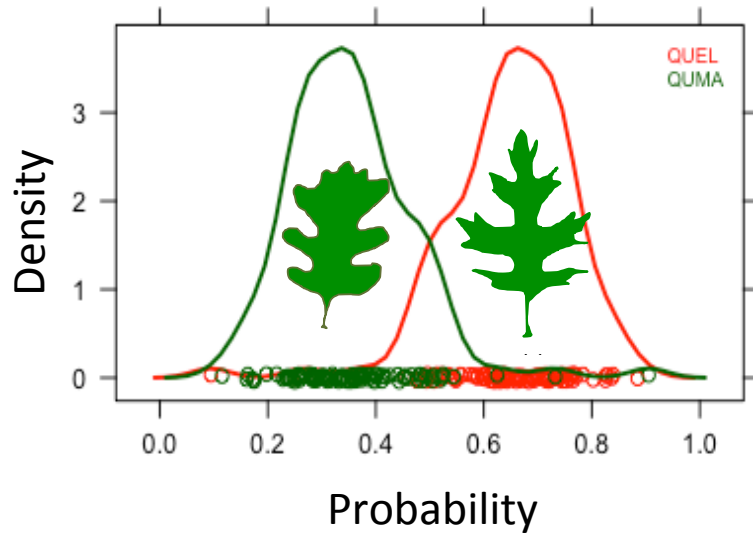
and many others

Accurate detection of tree threats –
Oak wilt

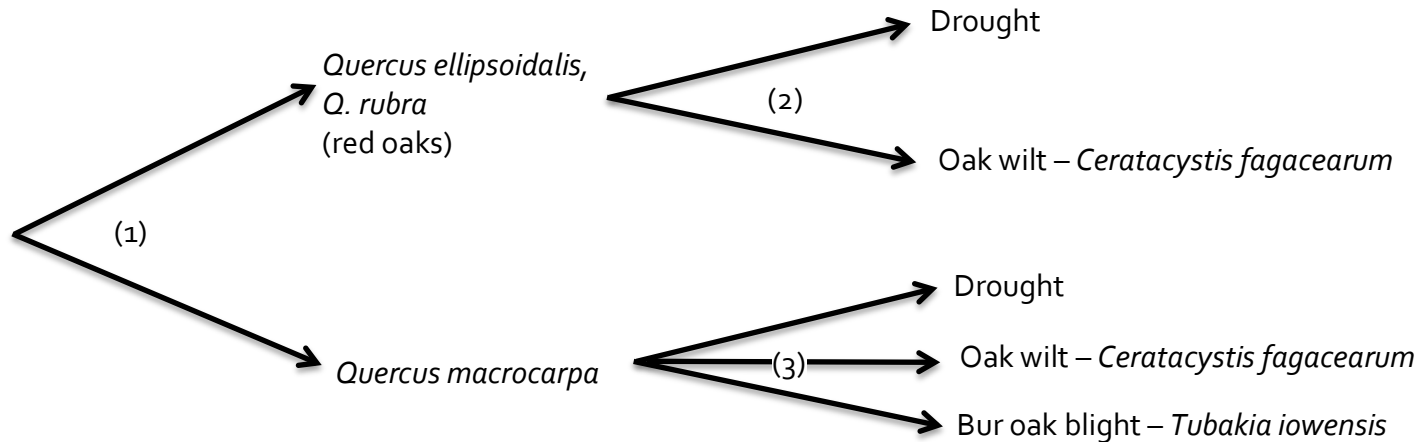
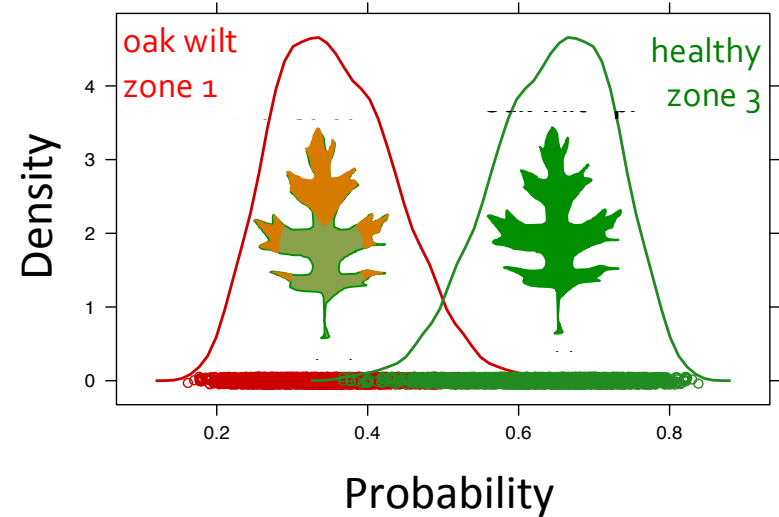




Probability of distinguishing
Northern Pin and Bur Oak



Probability of distinguishing:
Healthy and infected trees



PRODUCTS:

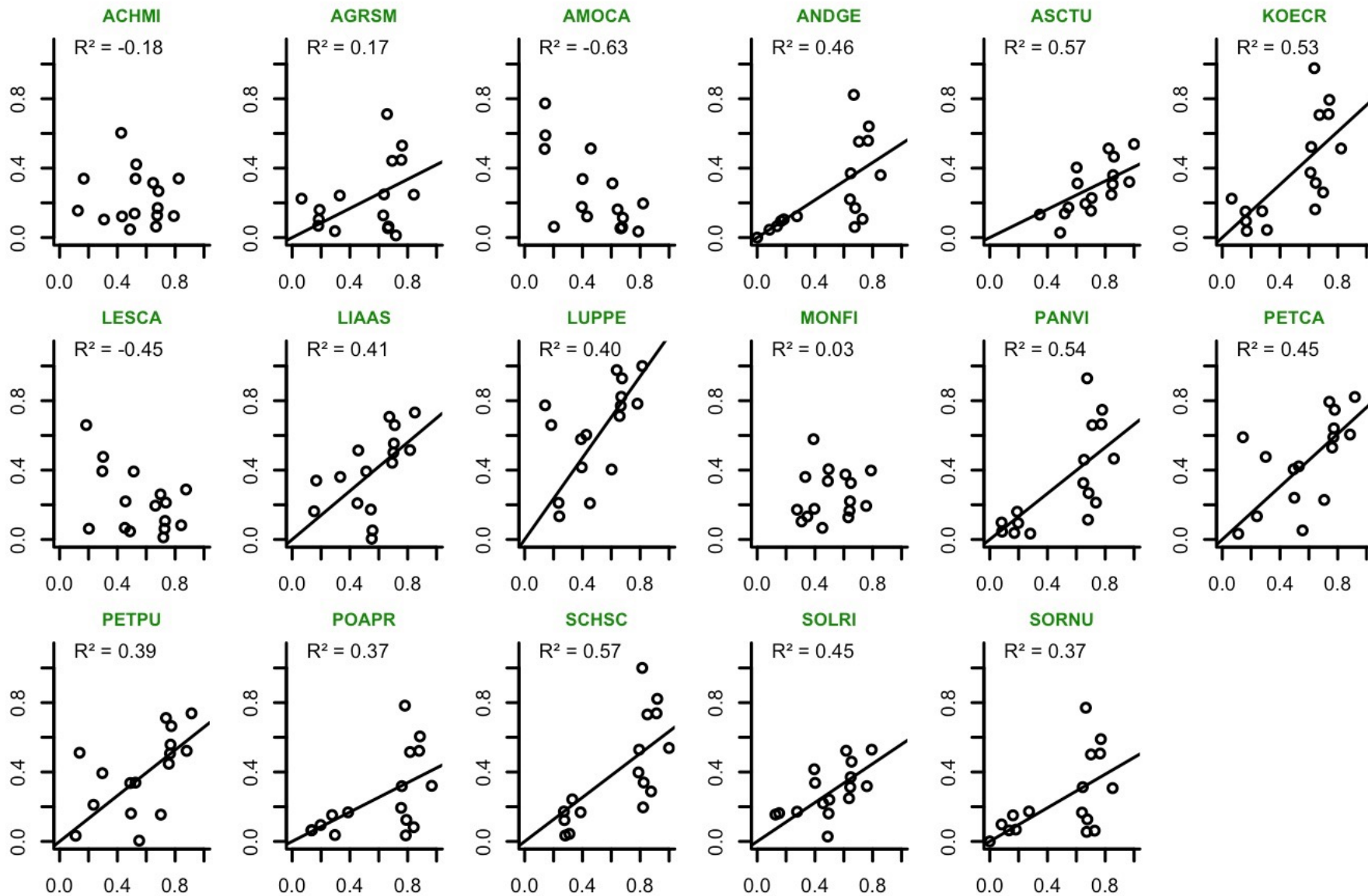
Open source R packages:

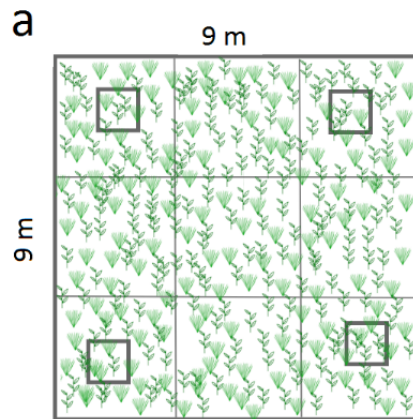
- **Spectrolab:** General package for spectroscopy in R. Implements functions for reading spectra from different field spectrometers, processing spectra (e.g. smoothing and vector normalization), and visualization.

<https://github.com/meireles/spectrolab>

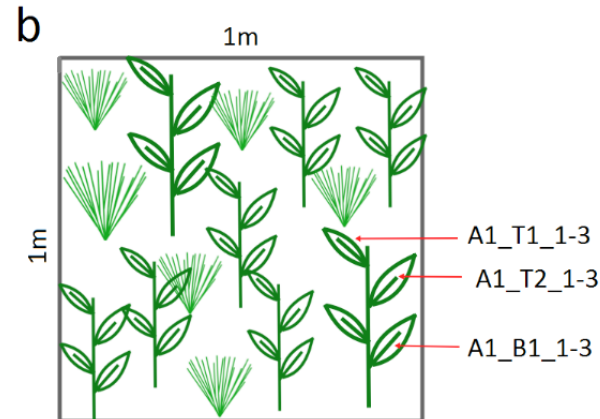
- **Reconcile:** Implements PLSR and Bayesian Model Averaging methods to convert spectra taken with different instruments.

<https://github.com/meireles/reconcile>.





Plot A



Plot A Subplot 4

c

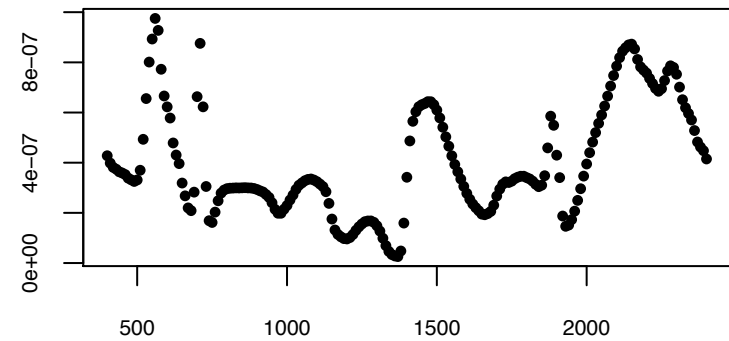
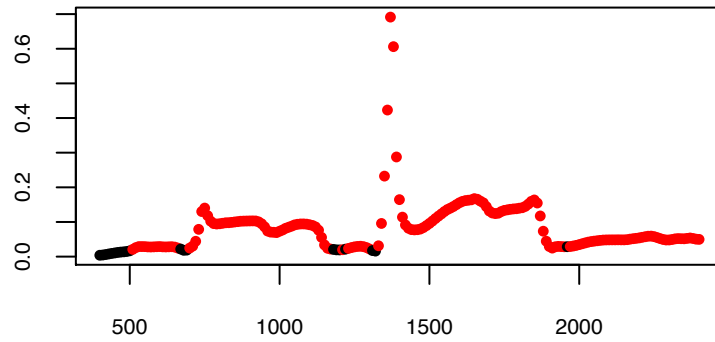
$$\overline{\text{plant}} = \frac{1}{n} \sum_{i=1}^n \text{plant}_i$$

d

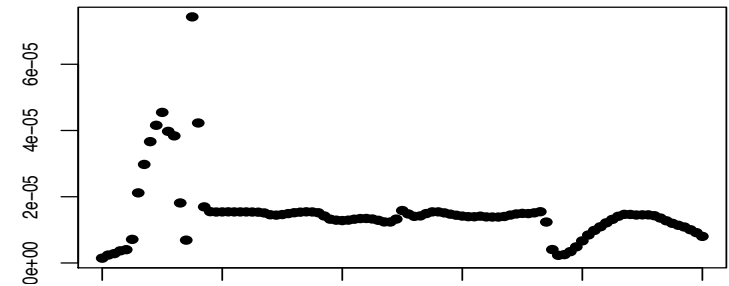
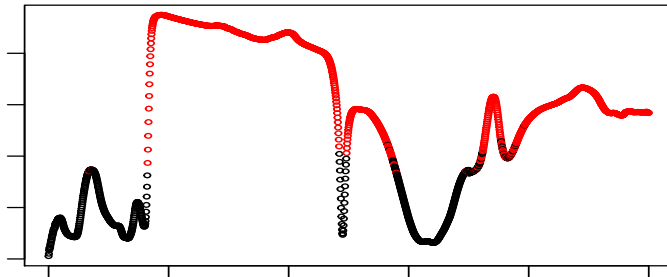
$$\overline{A1} = \frac{1}{n} \sum_{i=1}^n A1_i$$

Individual 1

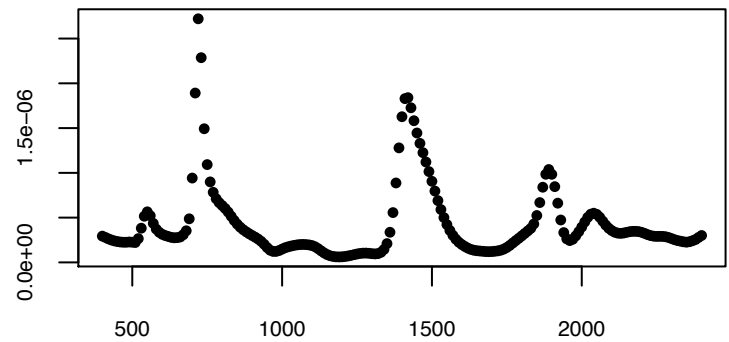
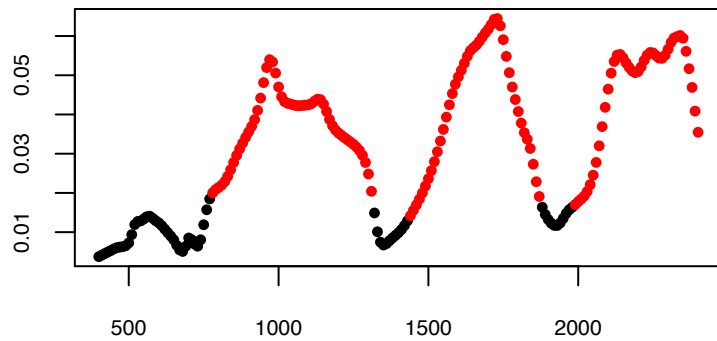
Eastern North America



Oaks of North America



Peru



Wavelengths

wavelengths