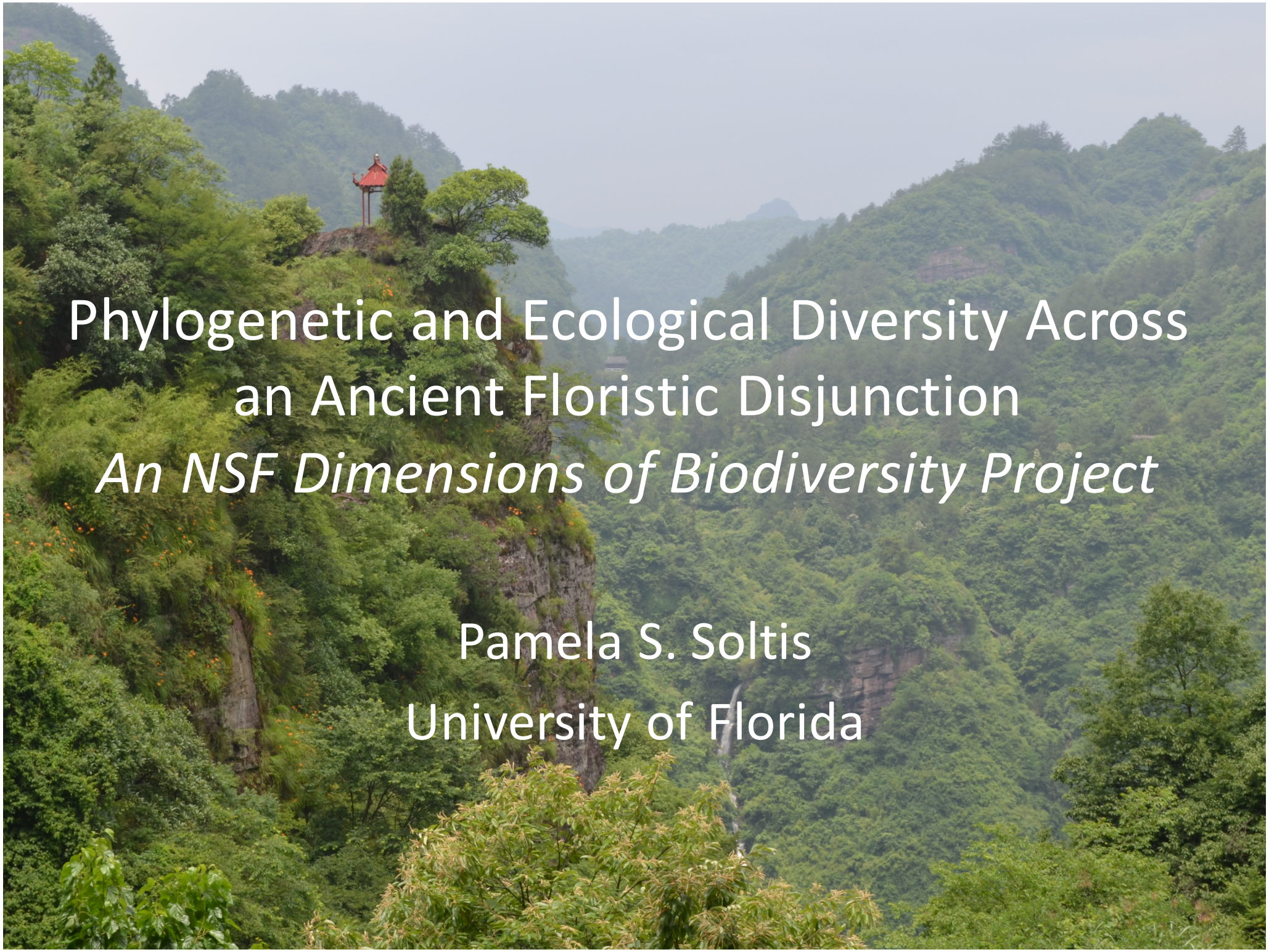

Phylogenetic and Ecological Diversity Across an Ancient Floristic Disjunction

An NSF Dimensions of Biodiversity Project

Pamela S. Soltis

University of Florida

US-China Collaboration: Team Members

- Pam Soltis
  - Phylogenetics
- Doug Soltis
  - Phylogenetics
- Jeremy Lichstein
  - Ecology, Modeling
- Eric Triplett
  - Nitrogen Fixation, Microbiology
- Matt Gitzendanner
  - Phylogenetics, Computational Biology
- Stephanie Bohlman
  - Ecology, Remote Sensing

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The Foundation for The Gator Nation

US-China Collaboration: Team Members

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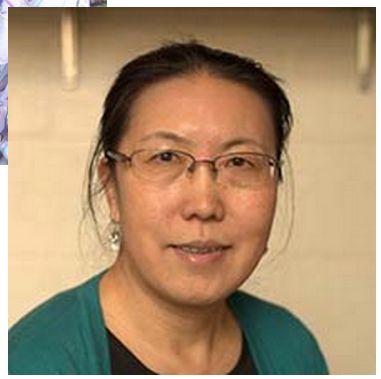
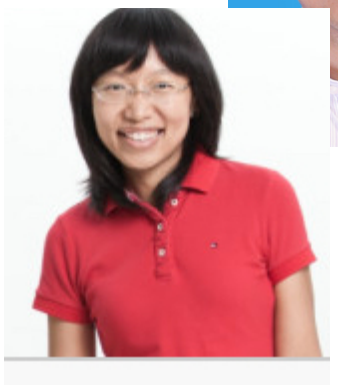
- Michelle Mack
  - Ecology, Northern Arizona University
- Jenny Xiang
  - Systematics, North Carolina State University
- Wei Shi
  - Soil Science & Ecology, North Carolina State University

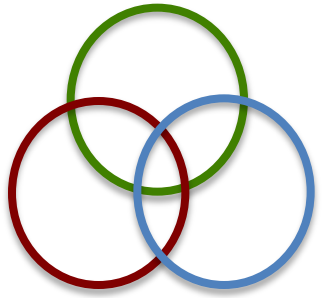


US-China Collaboration: Team Members

- Chengxin Fu
  - Zhejiang University
- Yunpeng Zhao
  - Zhejiang University
- Zhiduan Chen
  - Botany, CAS, Beijing
- Haiyan Chu
  - Soil Science, CAS, Nanjing
- Yuan Zeng
  - Remote Sensing & Digital Earth, CAS, Beijing



Temporal Components of Modern Biodiversity



- What is the role of history in shaping modern biodiversity?
- (i) plant and microbial codiversification
- (ii) geographic patterns of variation in community diversity, structure, and function
- (iii) the relative roles of historical constraints and local adaptation in shaping community and ecosystem species, genetic, and functional diversity

EA-ENA Floristic Disjunction

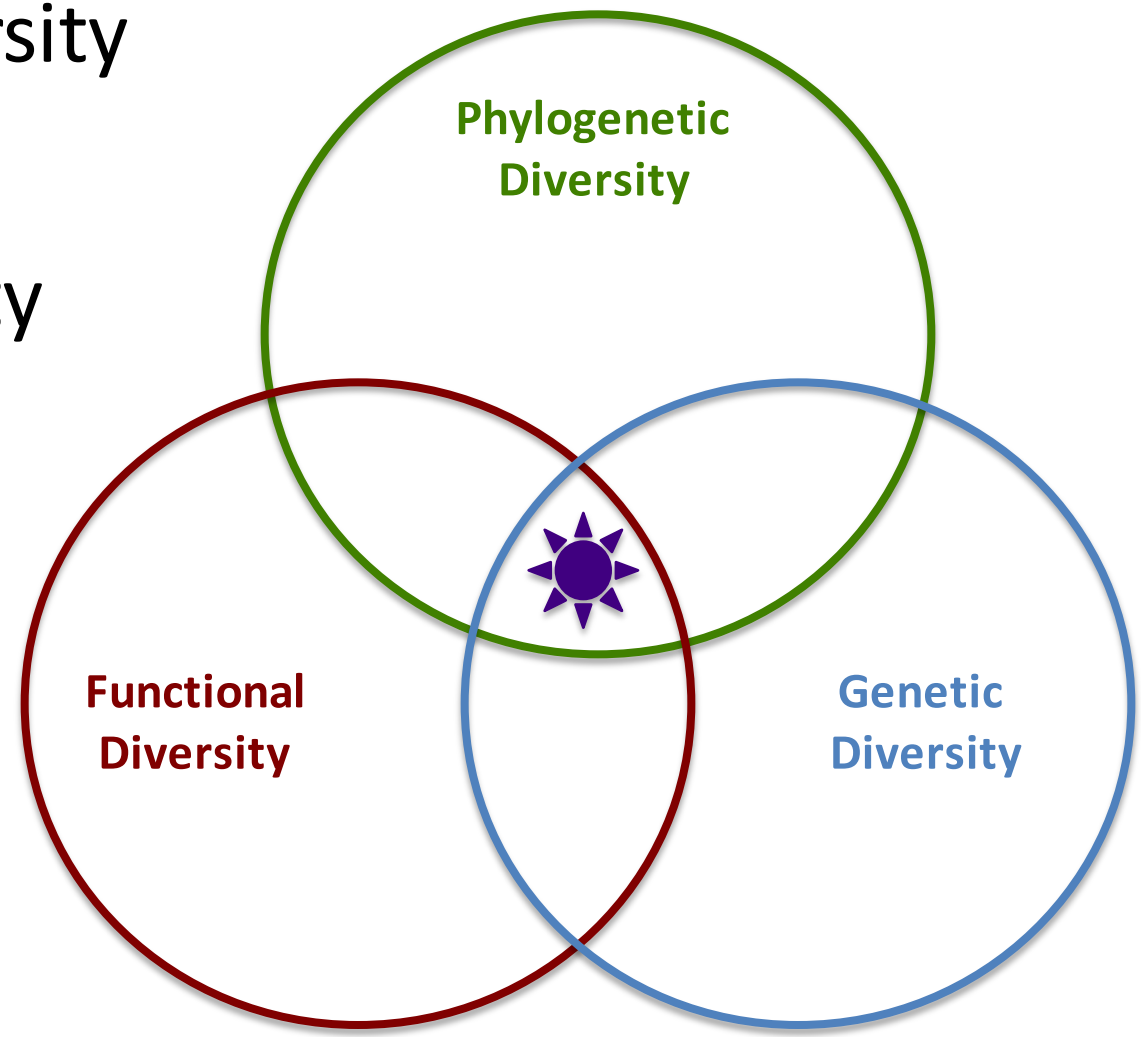
- EA-ENA forests provide an excellent system to examine the link between biodiversity and ecological function, within the context of a shared geographic and phylogenetic history.

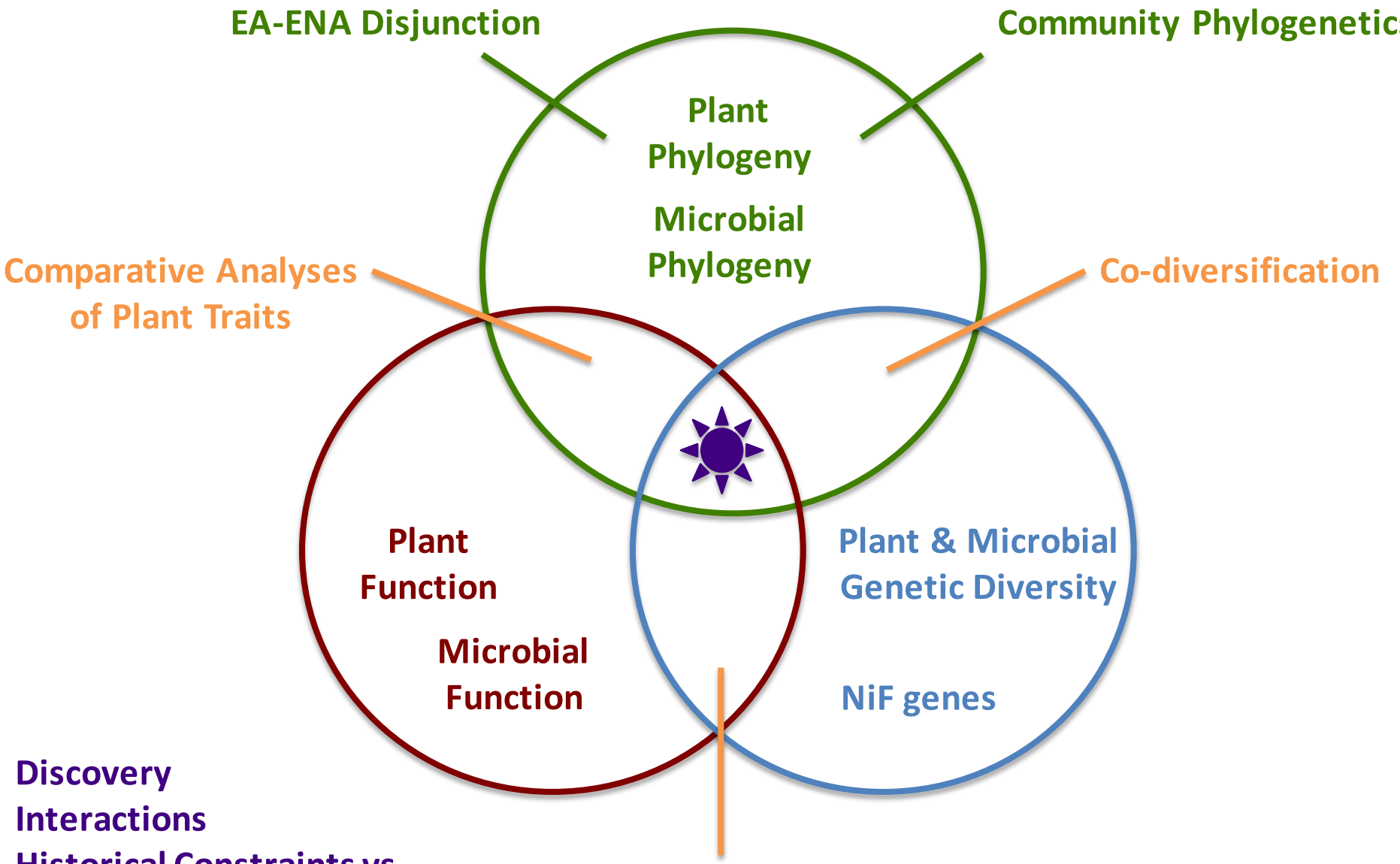
Fig. 1. Approximate geographic distribution of genus *Liriodendron*.

Questions to be Addressed:

Evolution of landscape diversity and function in the disjunct forests of EA & ENA

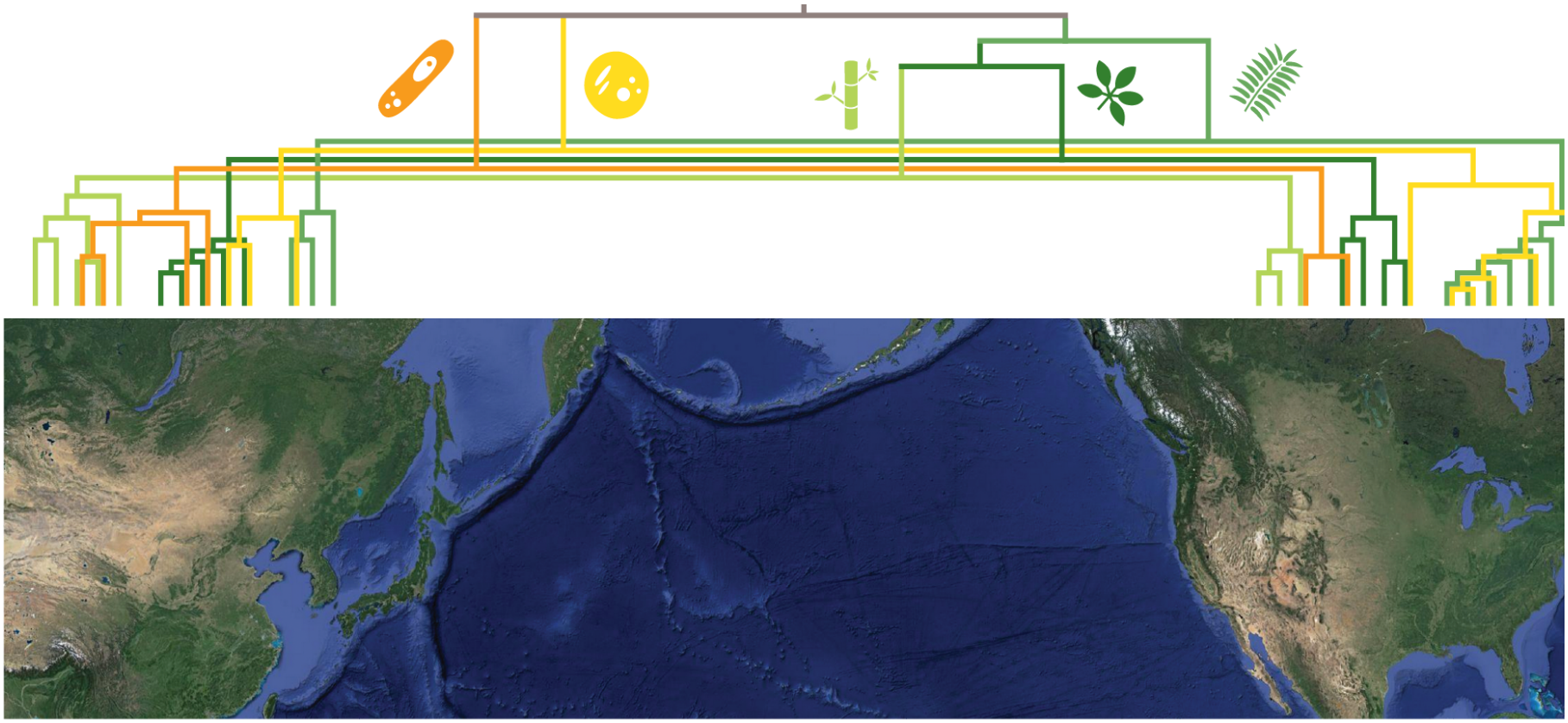
- Phylogenetic Diversity
- Genetic Diversity
- Functional Diversity
- Climate Change
- Integration





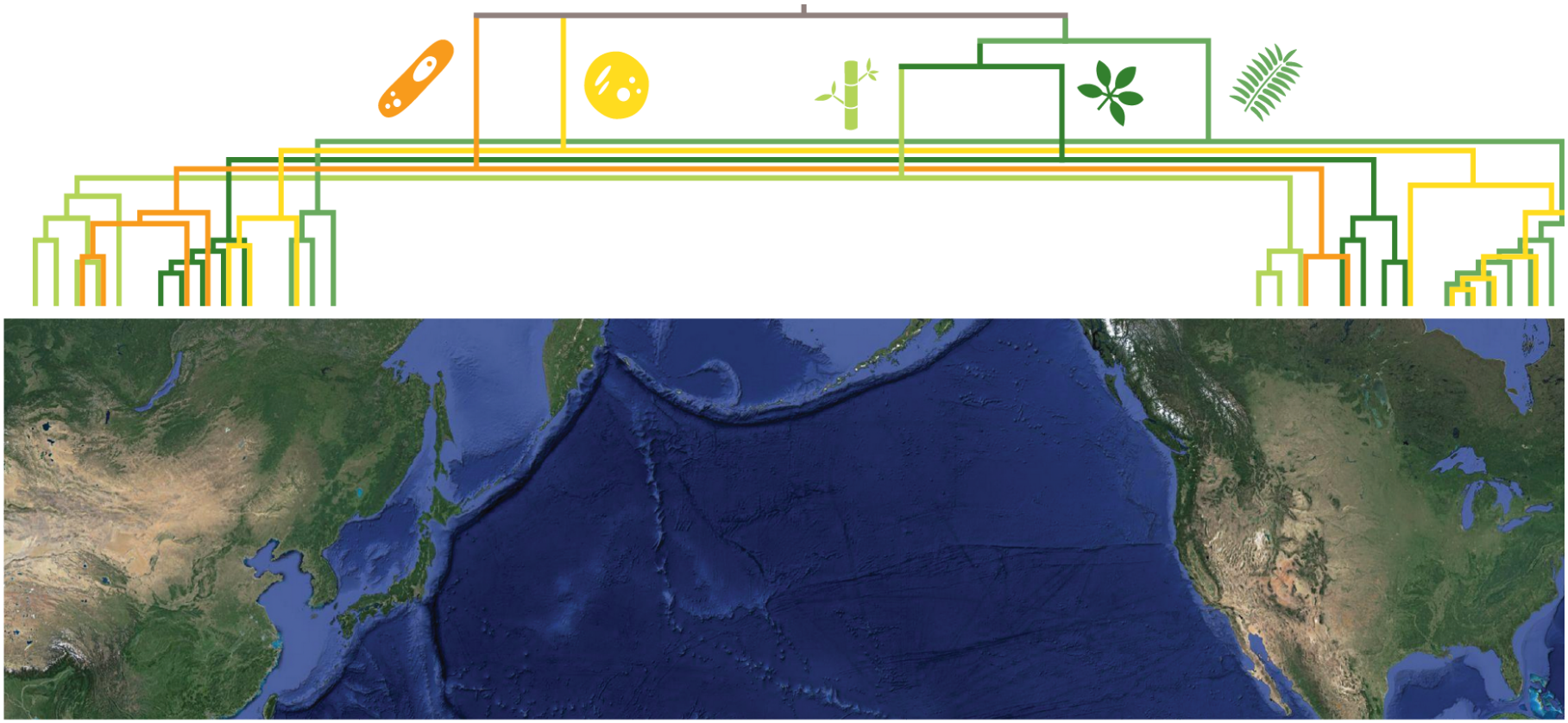
- Discovery
- Interactions
- Historical Constraints vs. Local Adaptation
- Variance for Enhancing Climate Models

Integrating Plant and Microbial Phylogenetics

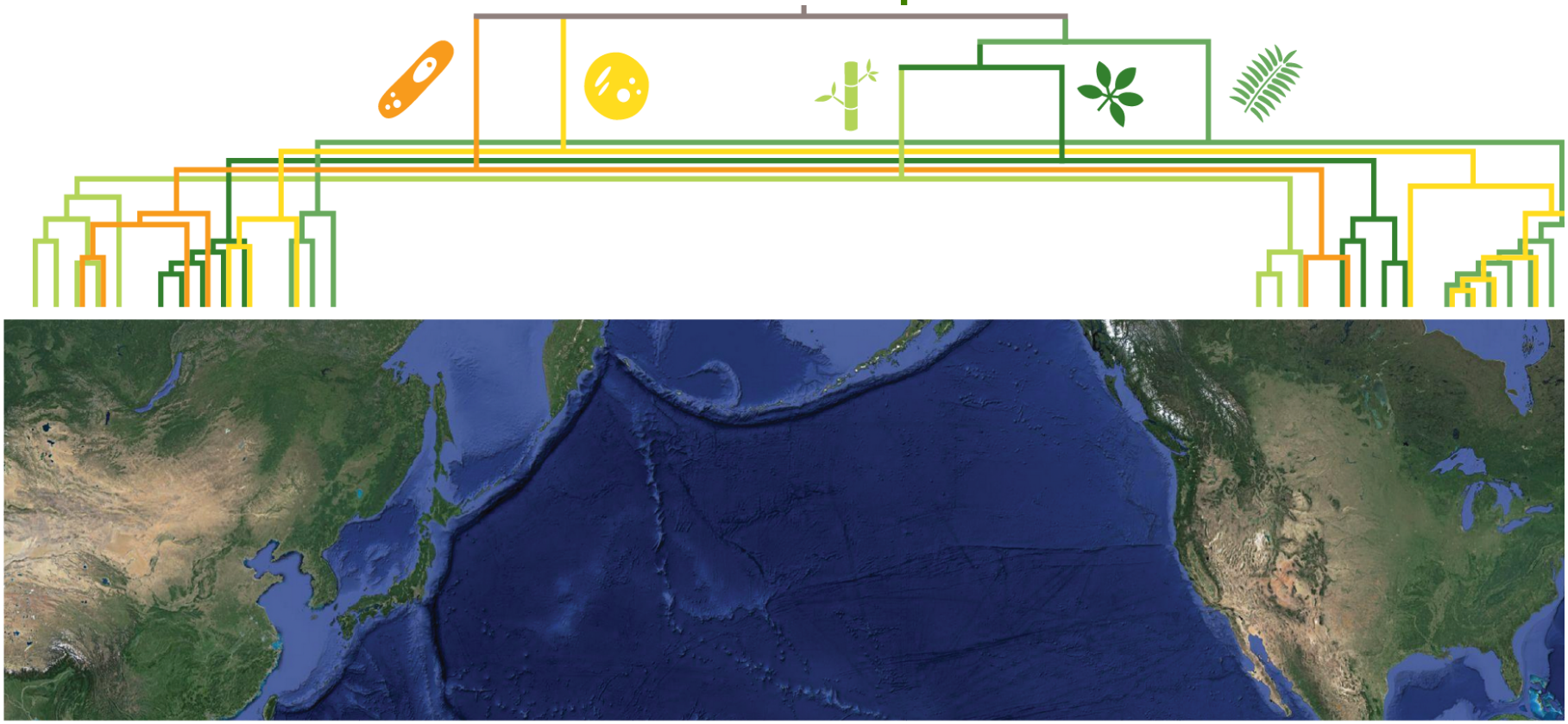


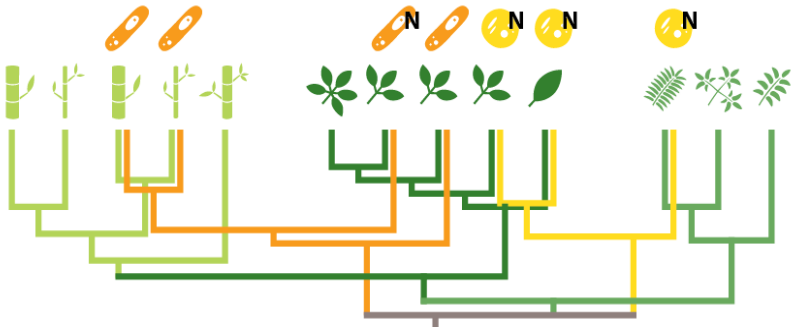
Are phylogenetic patterns congruent?

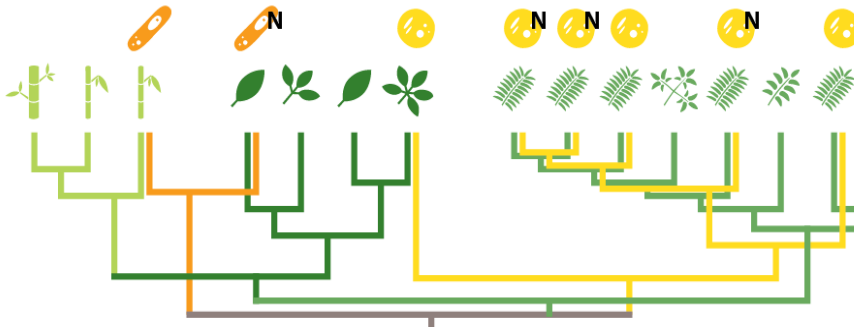
Integrating Phylogenetics and Plant Trait Data



Integrating Phylogenetic, Genetic, and Functional Data over Space and Time



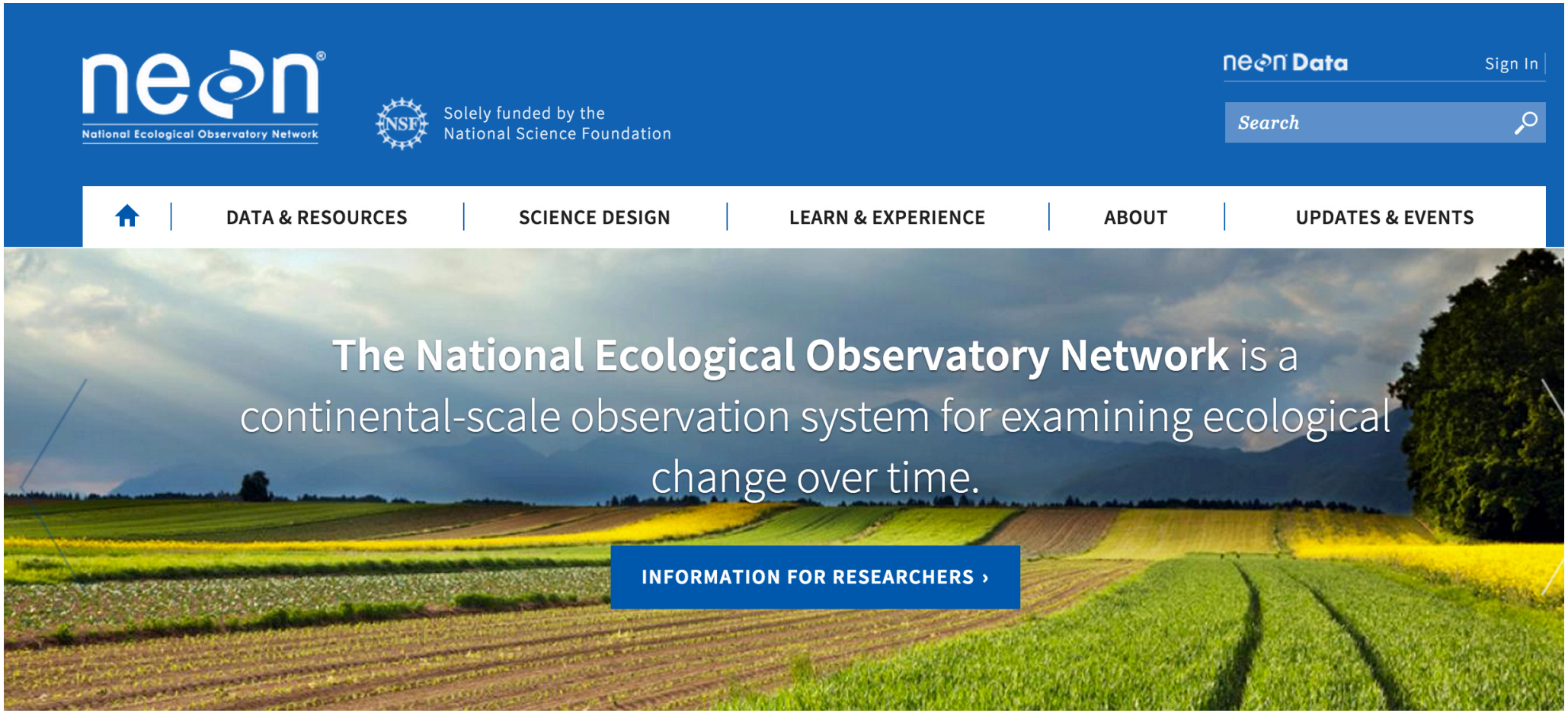




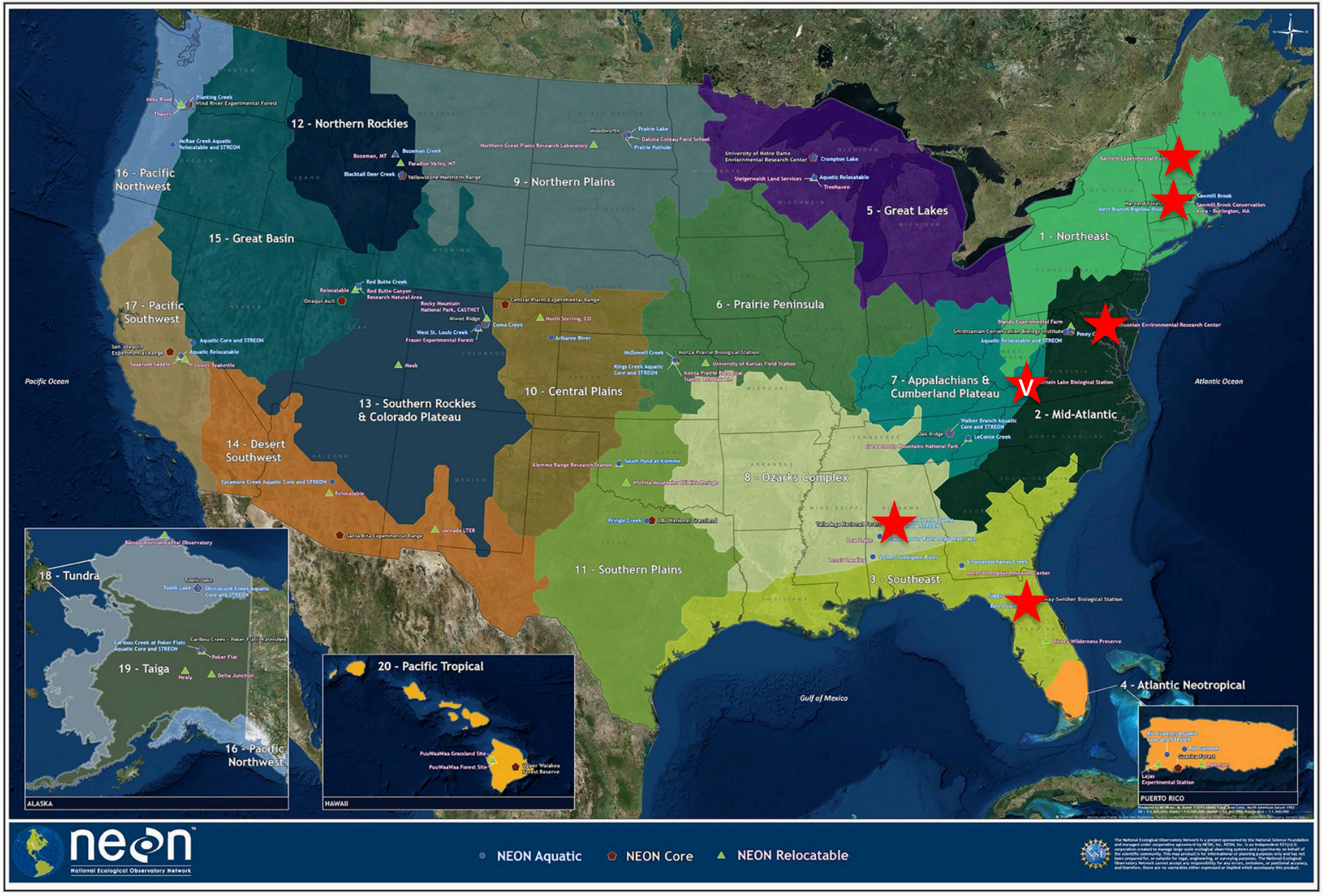
Sampling Design

- 6 sites in eastern US, 4 sites in China
- At each site:
  - Plant traits for 20 species of disjuncts (5 individuals) (mostly canopy trees)
  - Subset of traits for 100 additional species
  - 20-30 species for phylogenetics of disjuncts
  - Up to 300 species for community phylogenetics
  - Microbial sampling: 4 soil cores + leaves for same individuals scored for plant traits
  - Mapping of canopy trees via Remote Sensing

NEON Sites: 6 sites in ENA



NEON Sampling Locations

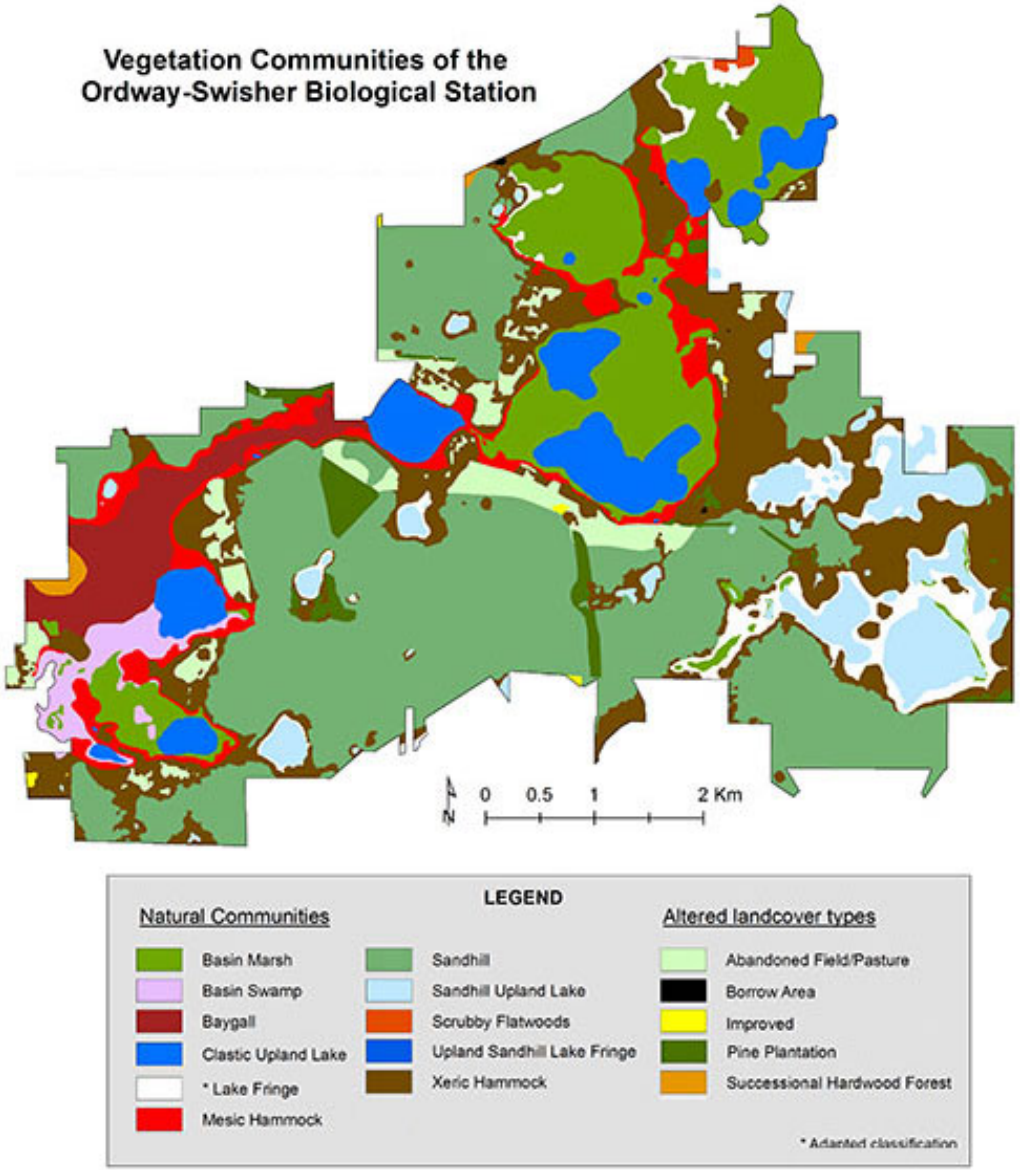


Functional Diversity: Plants

- Plant Functional Traits: physiological, morphological, chemical, and ecological characteristics of plants
  - primary determinants of C and nutrient cycling and of fluxes of energy and matter between terrestrial ecosystems and the atmosphere
- Leaf mass per area (LMA); seed size; maximum height; wood density; concentrations of C, N, P, and lignin in live and senesced leaves
- Linkages between plant phylogenetic and functional diversity, microbial diversity, and ecosystem function
- Functional consequences of the EA-ENA disjunction

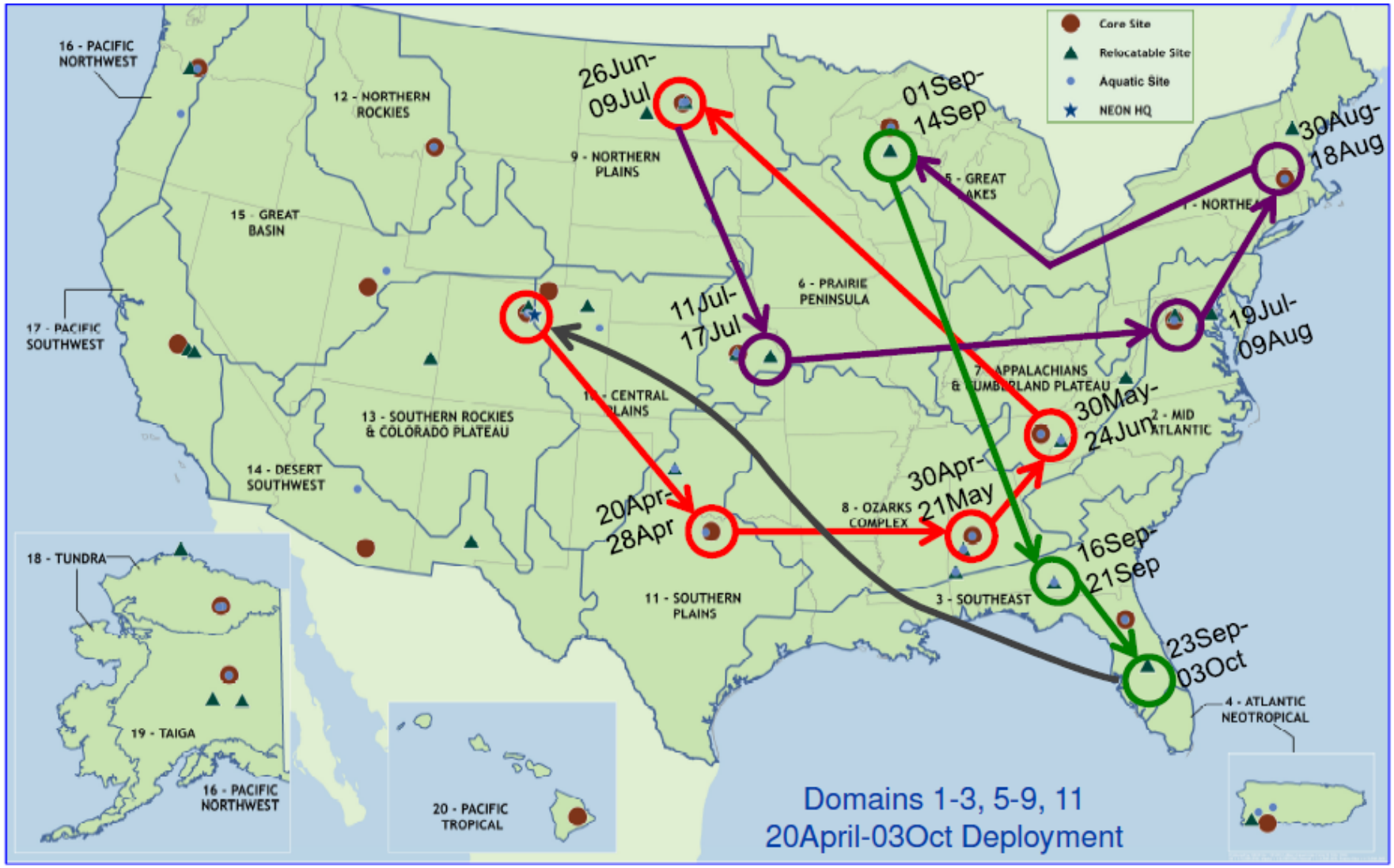
Community Phylogenetics

- Analyses of community structure and phylogenetic diversity at multiple scales
  - Random samples of 300 species
  - Vegetation communities

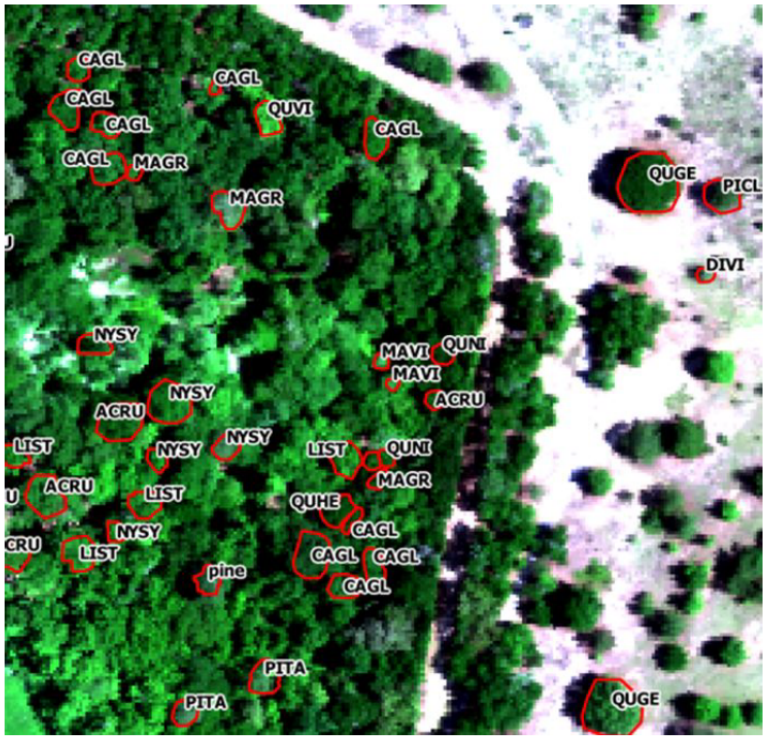


2016 NEON Flying Schedule

Boulder -> Wichita Falls -> Birmingham -> Knoxville -> Bismarck -> Topeka ->
Manassas -> Nashua -> Rhinelander -> Albany -> Kissimmee -> Boulder

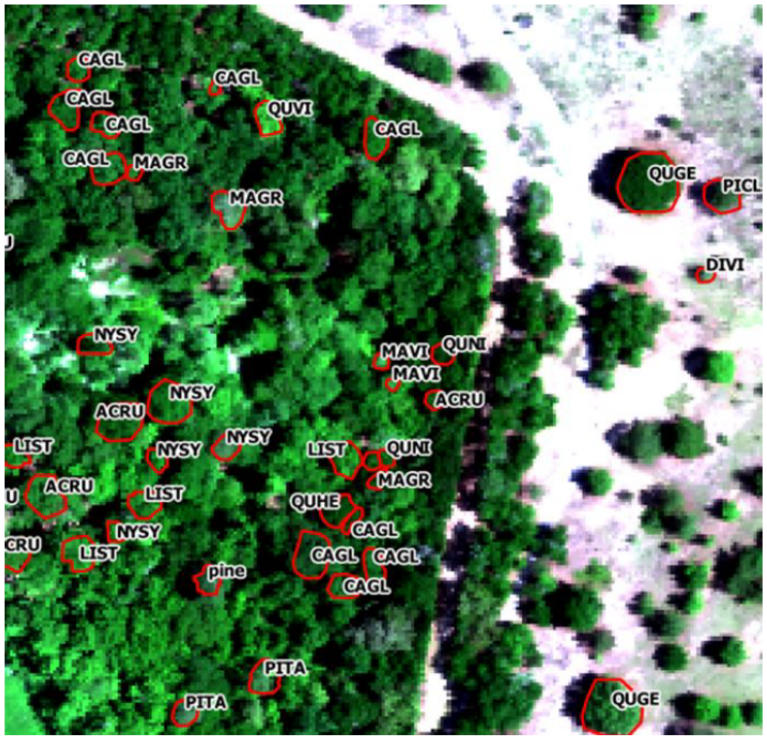


Using NEON Remote Sensing Data



Mapping crowns at OSBS (FL)

Using NEON Remote Sensing Data



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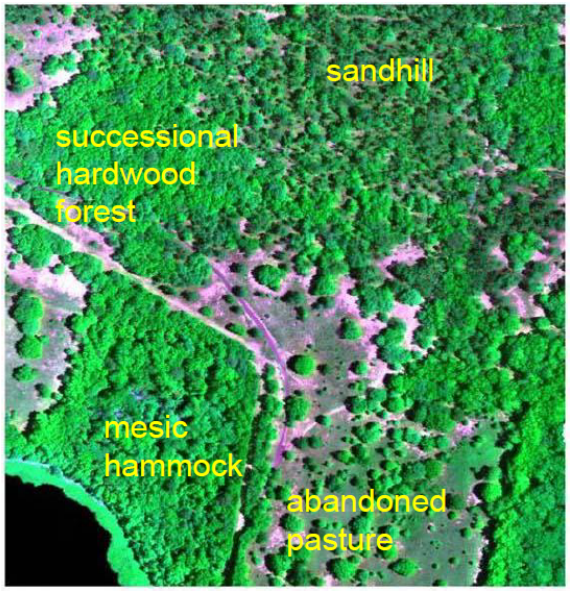

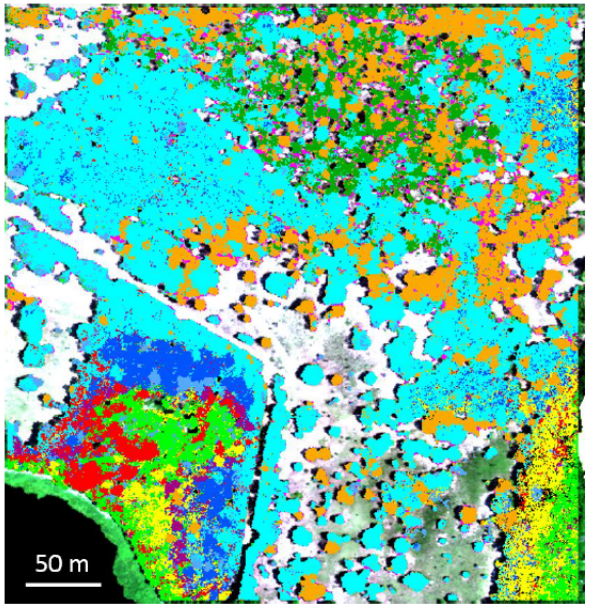

Chinese Ecosystem Research Network

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Mt. Dongling
Institute of Botany, CAS
Institute of Soil Sci., CAS
Mt.Tianmu
Zhejiang University
Mt.. Shennongjia
Mt. Gutian
Participant Institutes
Selected Sites
Sites with some data

Connecting Specimens, Trees, Tools