iDigBio
Using museum collections data to improve biodiversity measures

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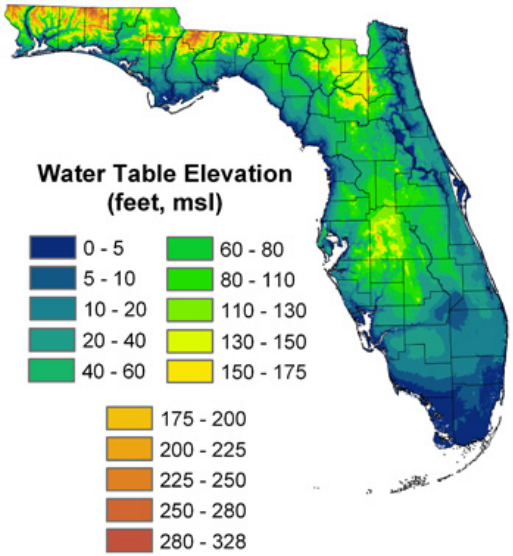
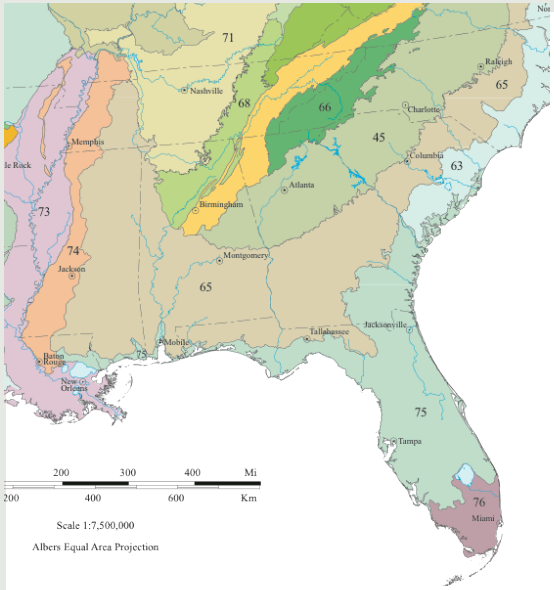
Capturing Biodiversity

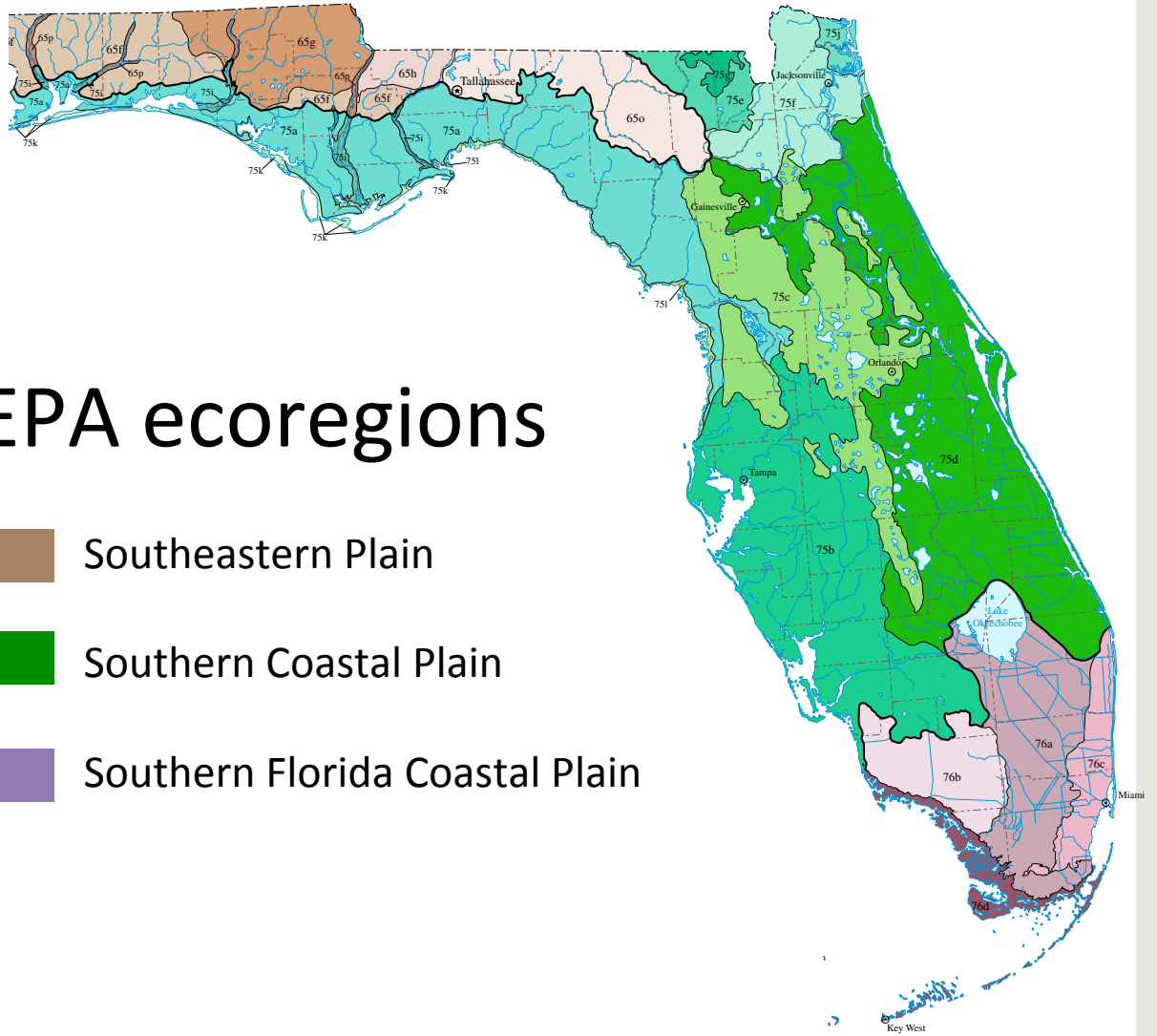
- Using biodiversity data – landscape level
  - Alpha diversity
  - Beta diversity
  - Species co-occurrence communities
- Evolutionary perspective on the landscape
  - Using fossils to date the evolutionary trees
  - Phylodiversity measures
- Climate change

Florida


Water Table Elevation
(feet, msl)
0 - 5
5 - 10
10 - 20
20 - 40
40 - 60
60 - 80
80 - 110
110 - 130
130 - 150
150 - 175
175 - 200
200 - 225
225 - 250
250 - 280
280 - 328

Florida





EPA ecoregions

- Southeastern Plain
- Southern Coastal Plain
- Southern Florida Coastal Plain

~ 4,100 plant species

Species Distribution Modeling

- Reconstructing species distributions
  - museum specimens
  - long-term monitoring data
  - *to generate ranges for use in biodiversity and PD analyses*
- Sampling in 3 EPA regions present in FL
- Taxonomic Name Resolution
- >30 points per species (10-20 for rare endemics)

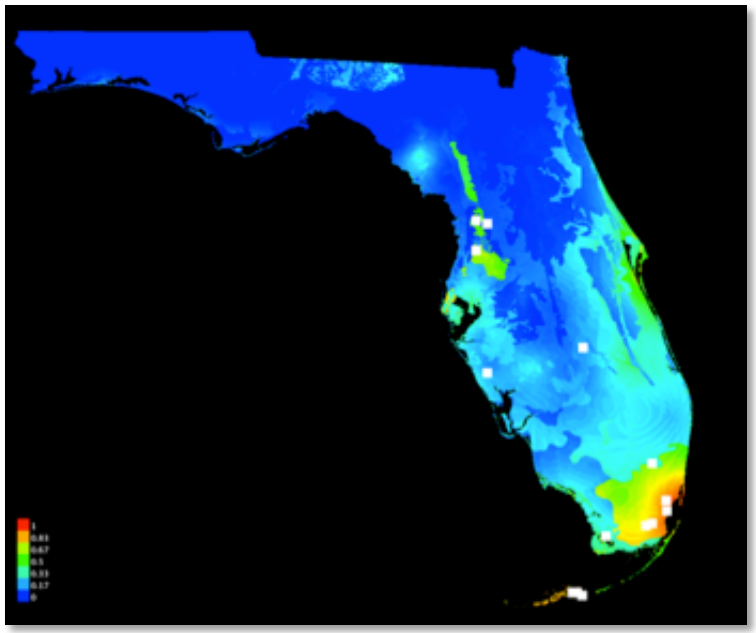
  372,241 unique points

1,548 species models (38%)

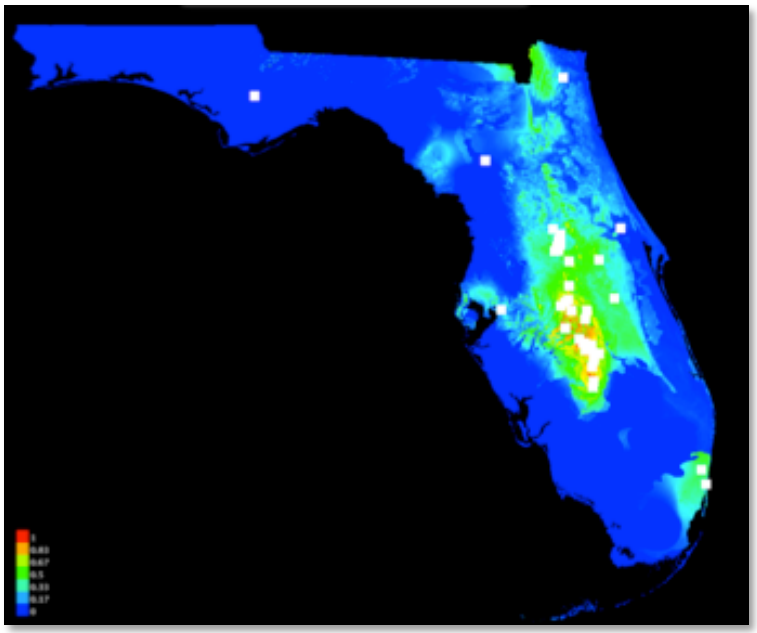
Modeling with historical data

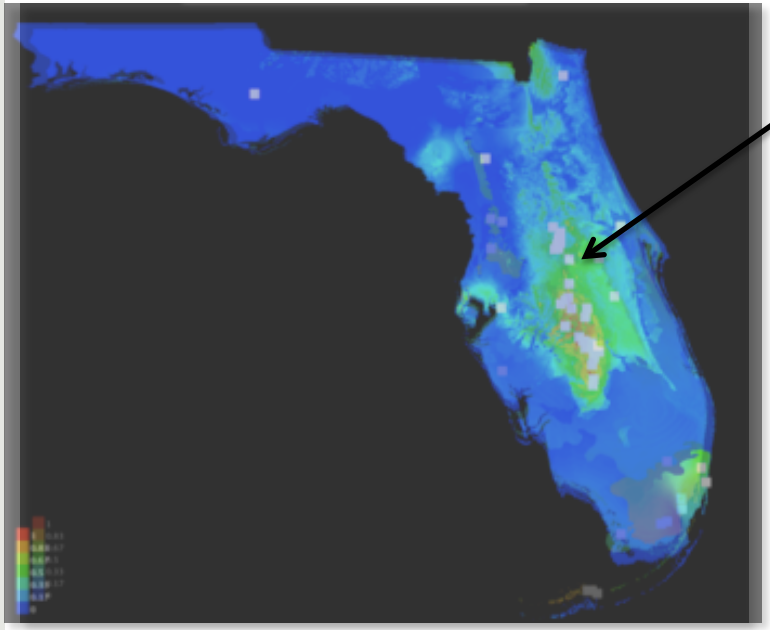
- Dated (year)
- Reflect distribution of plants through recent history
- Can use the climate conditions at the time of collection
- Use PRISM monthly data
  - Reconstruct Bioclim layers for each year of collection
    - ➢ Run MaxEnt model

Flatspike Sedge

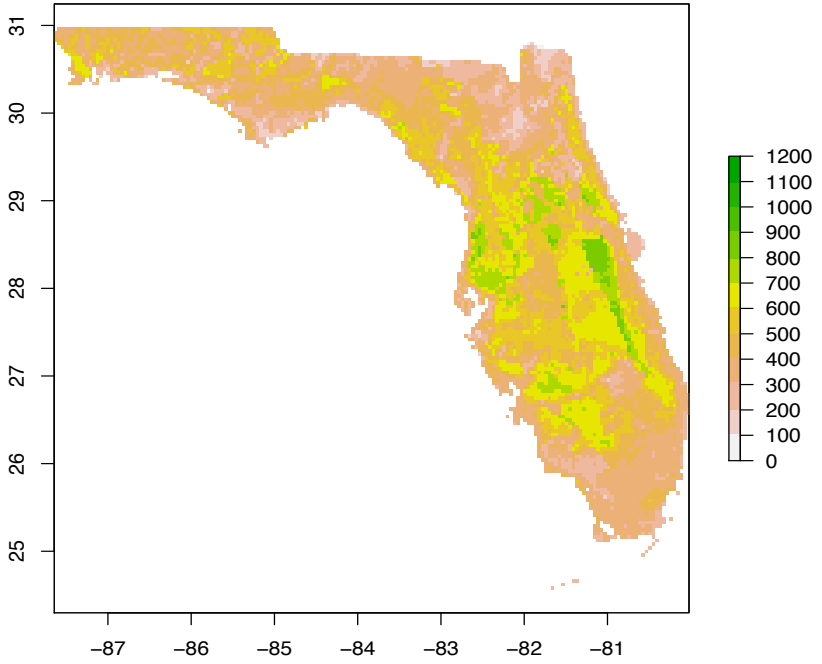


Scrub Plum



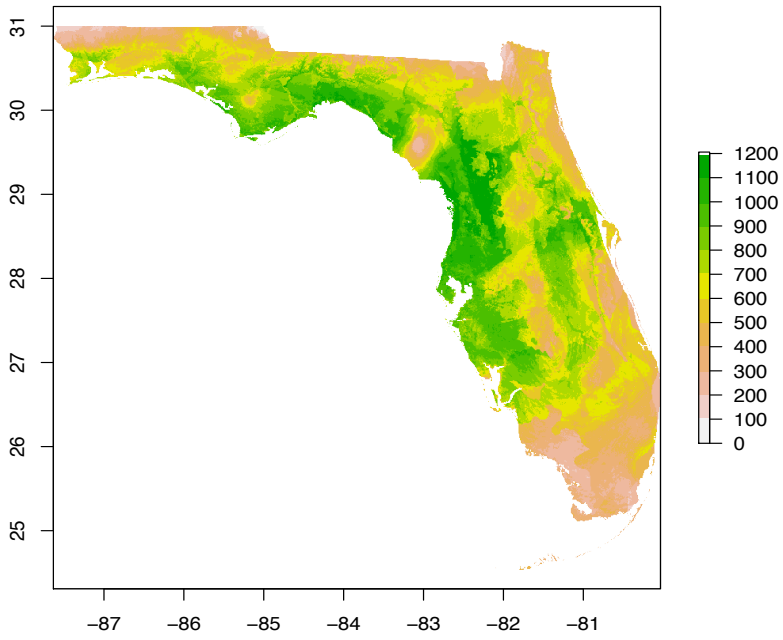


What species are predicted to reside in this point?



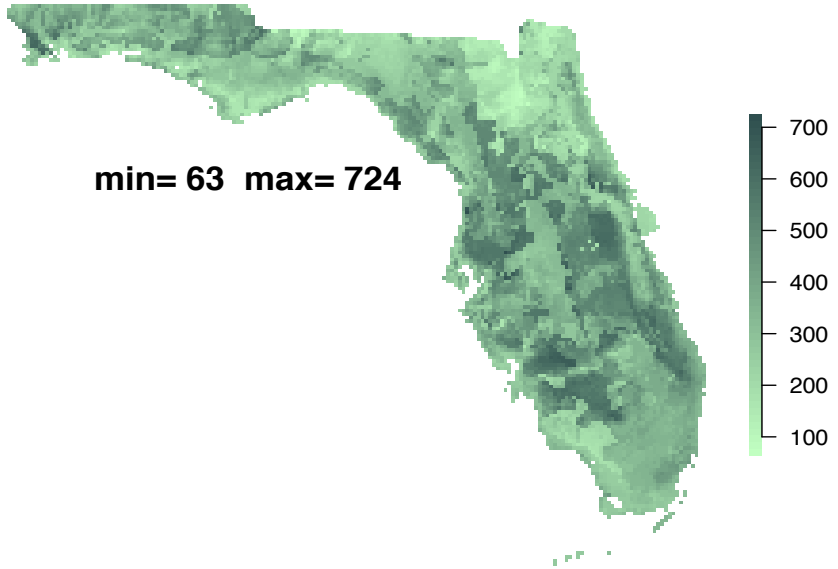
Alpha diversity

Averaged Bioclim climate data



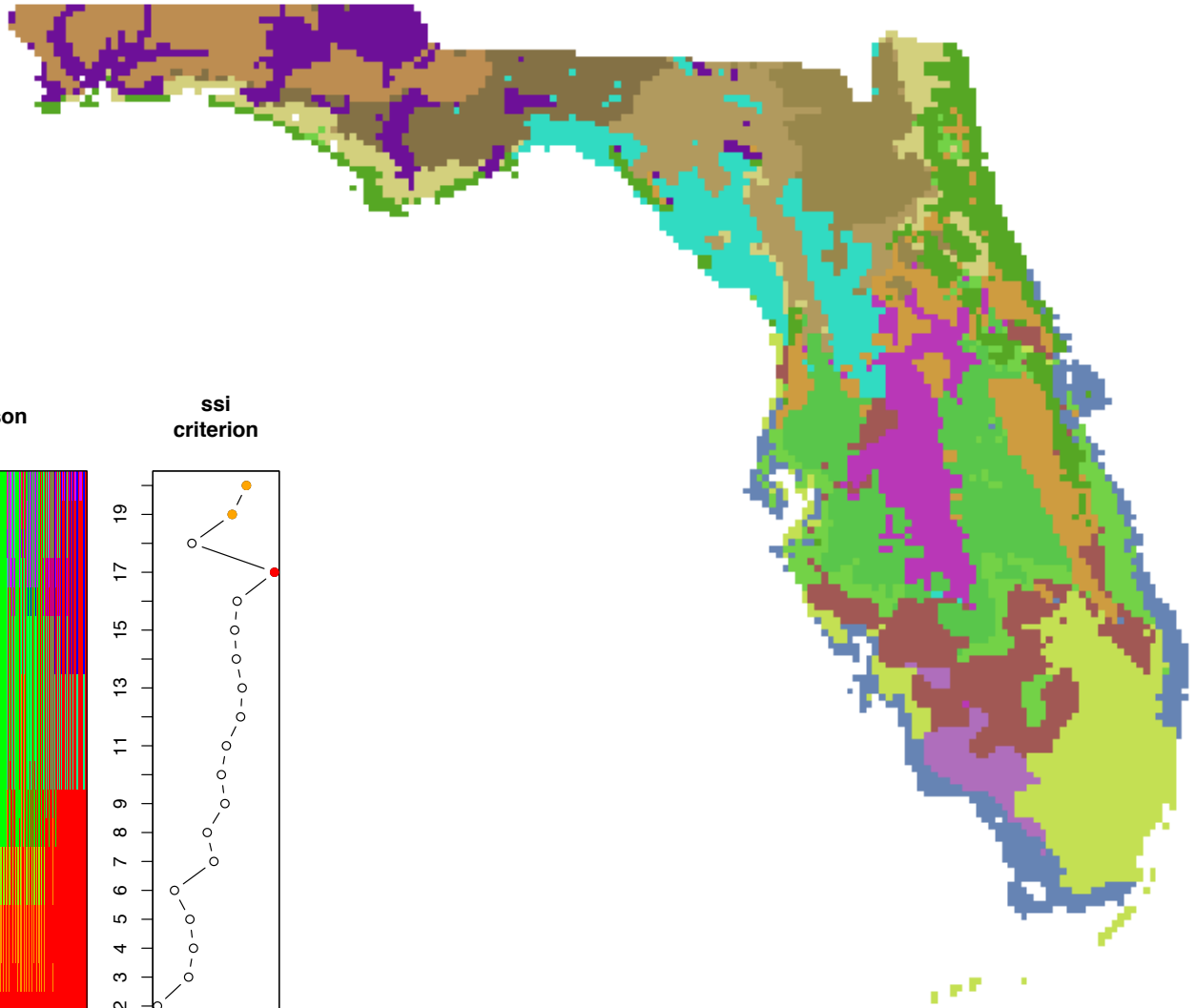
Max=1,192

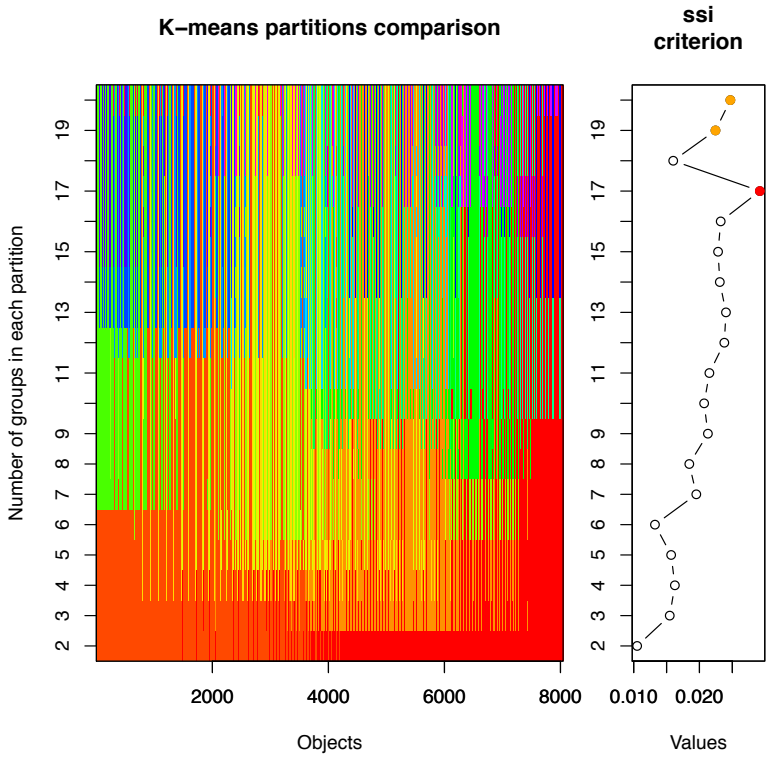
Yearly climate data

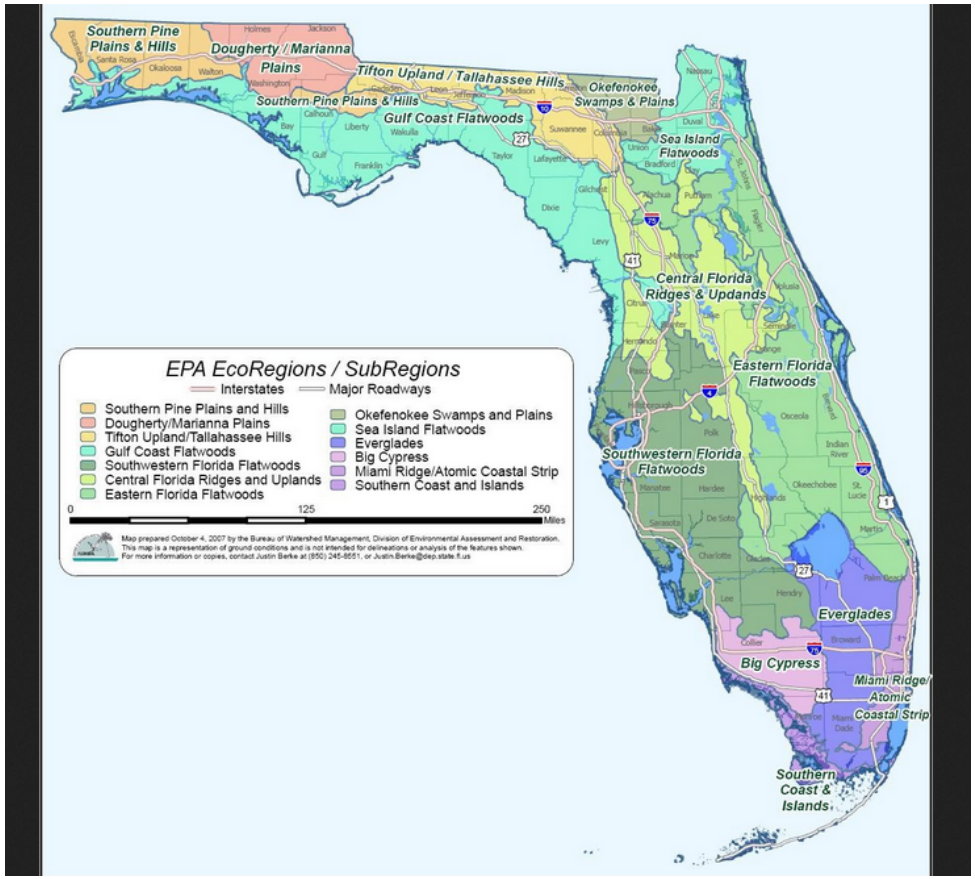


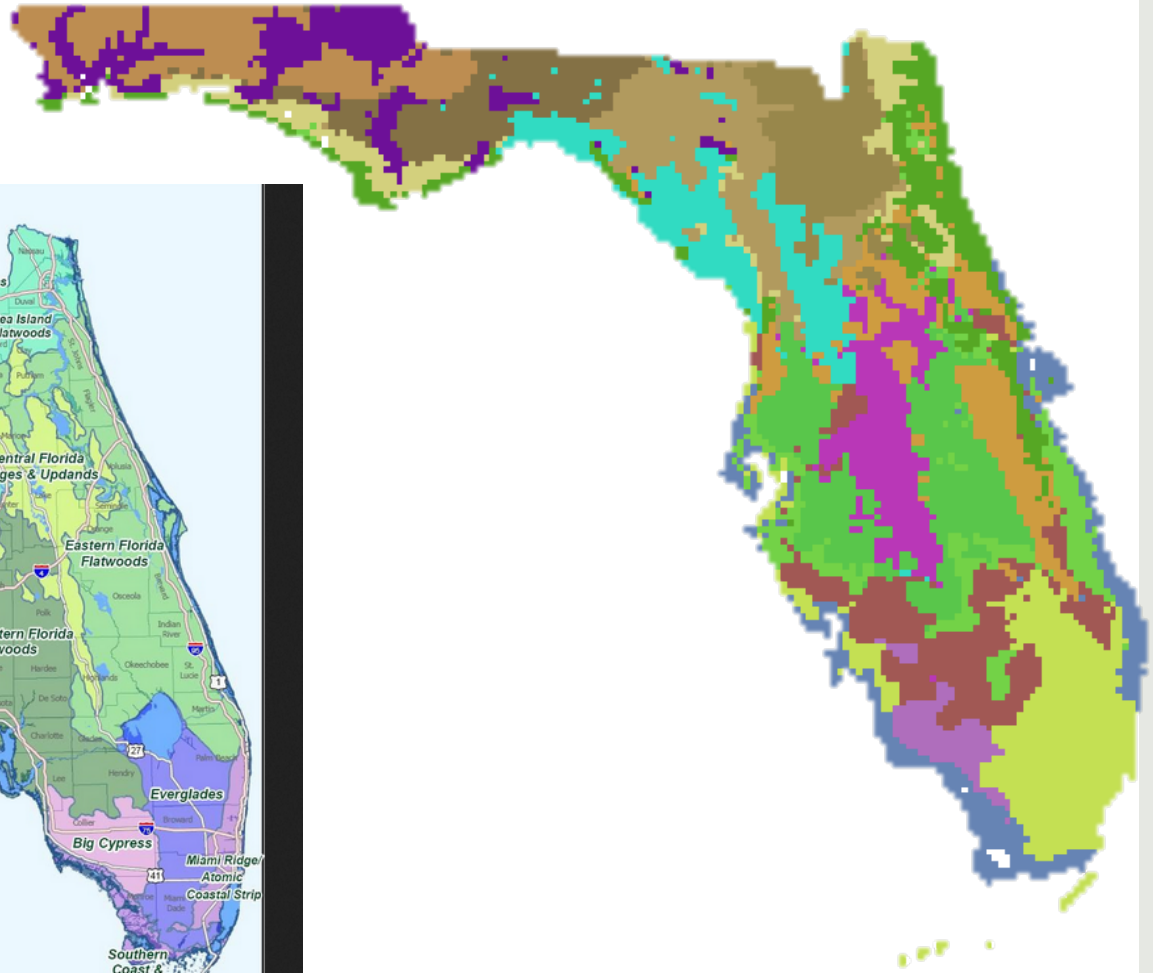
Max=724

Florida communities from models



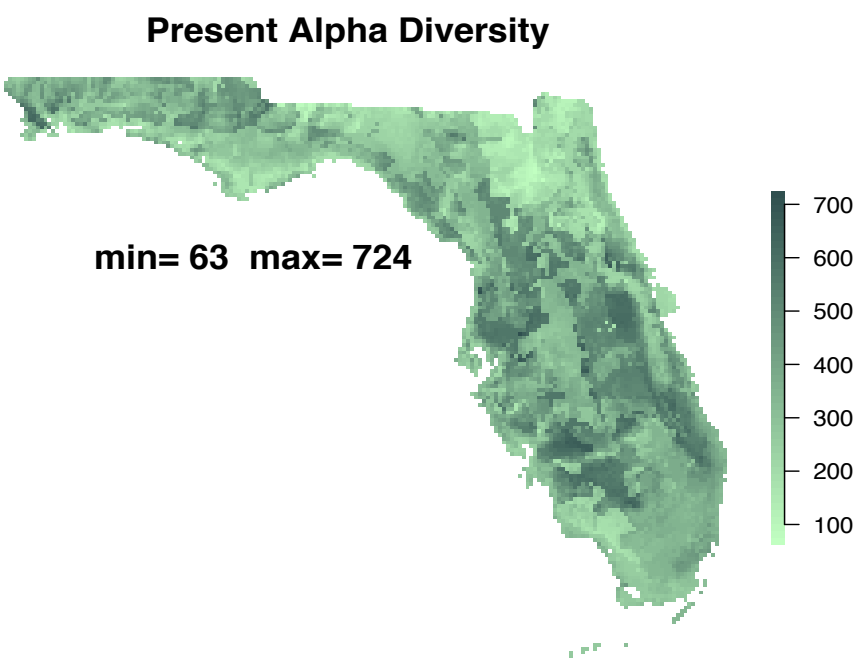


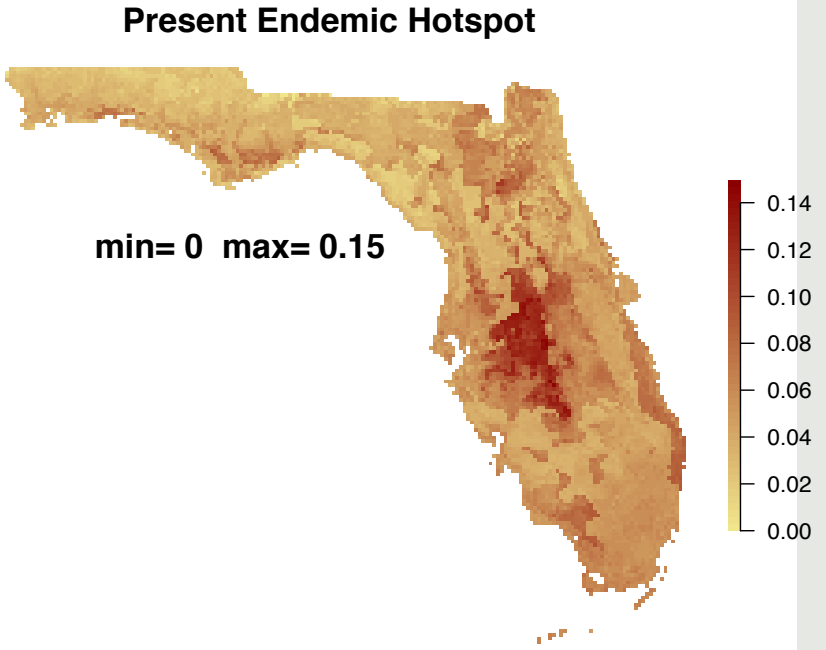

Southern Pine Plains & Hills
Dougherty / Marianna Plains
Tifton Upland / Tallahassee Hills
Okefenokee Swamps & Plains
Southern Pine Plains & Hills
Gulf Coast Flatwoods
Sea Island Flatwoods
Central Florida Ridges & Updands
Eastern Florida Flatwoods
Southwestern Florida Flatwoods
Everglades
Big Cypress
Miami Ridge/ Atomic Coastal Strip
Southern Coast & Islands
EPA EcoRegions / SubRegions
Interstates
Major Roadways
Southern Pine Plains and Hills
Dougherty/Marianna Plains
Tifton Upland/Tallahassee Hills
Gulf Coast Flatwoods
Southwestern Florida Flatwoods
Central Florida Ridges and Uplands
Eastern Florida Flatwoods
Okefenokee Swamps and Plains
Sea Island Flatwoods
Everglades
Big Cypress
Miami Ridge/Atomic Coastal Strip
Southern Coast and Islands
0
125
250
Miles



11

Present Diversity

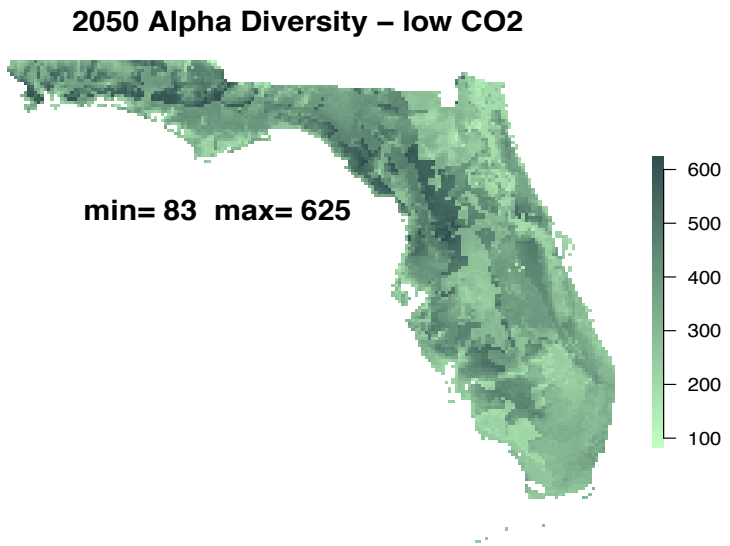




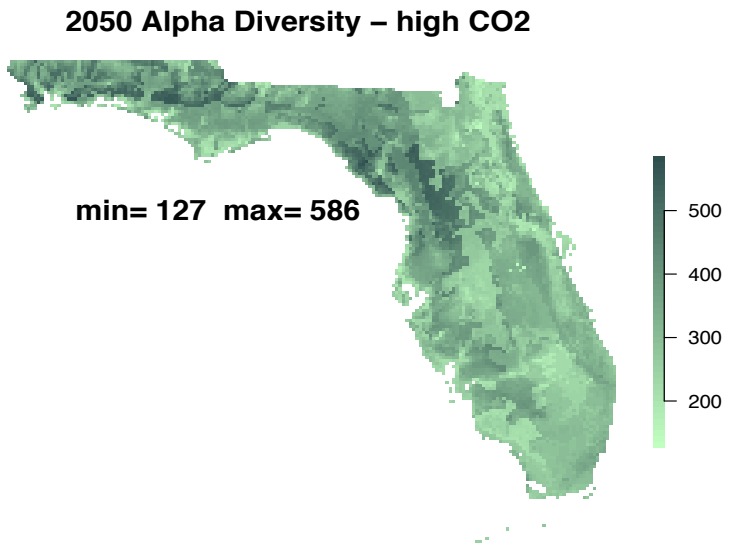
Endemic species/total species

Future Diversity: 2050

Low CO2

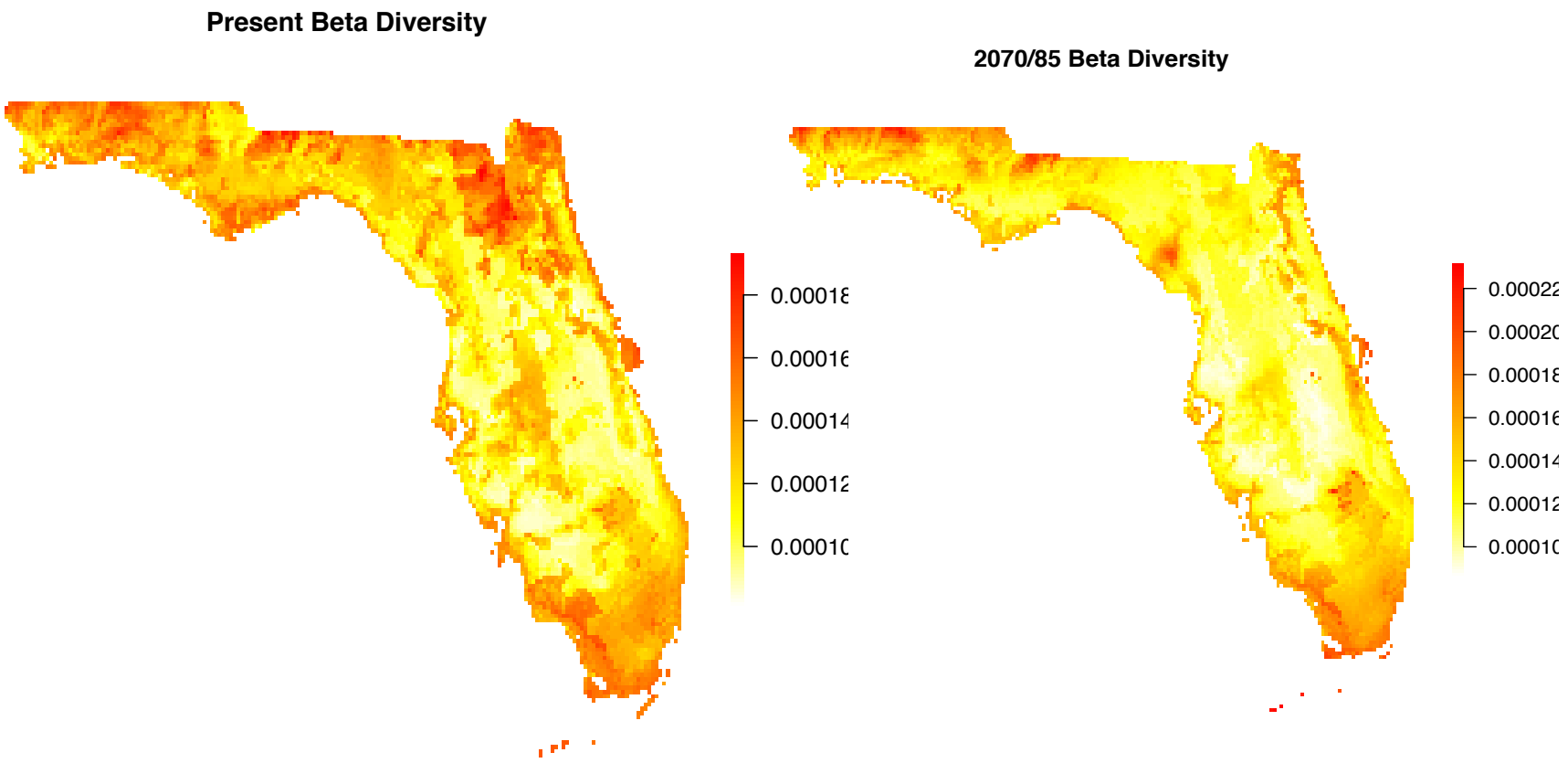


High CO2



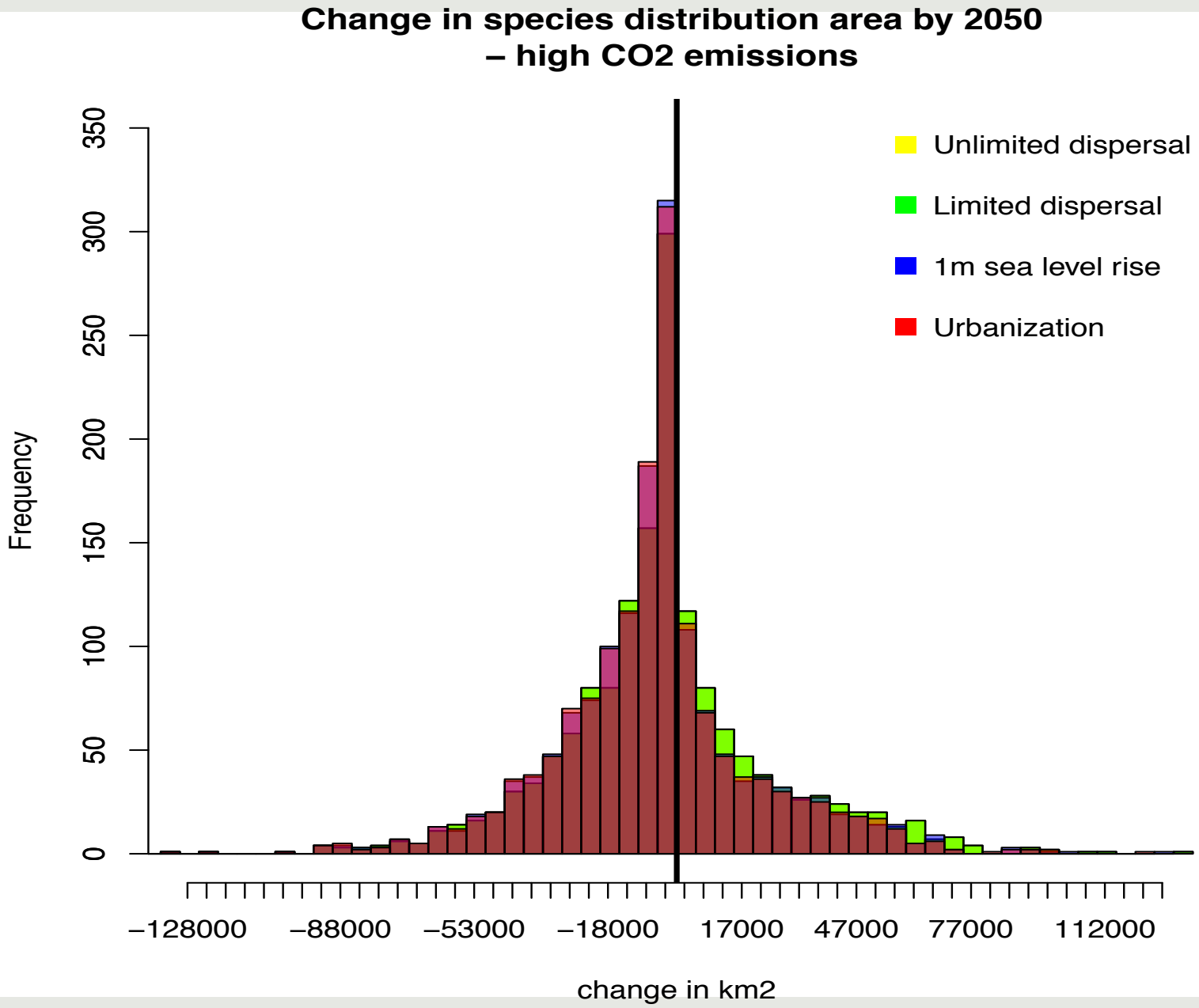
Hypothesis: homogenization of landscape

Beta Diversity

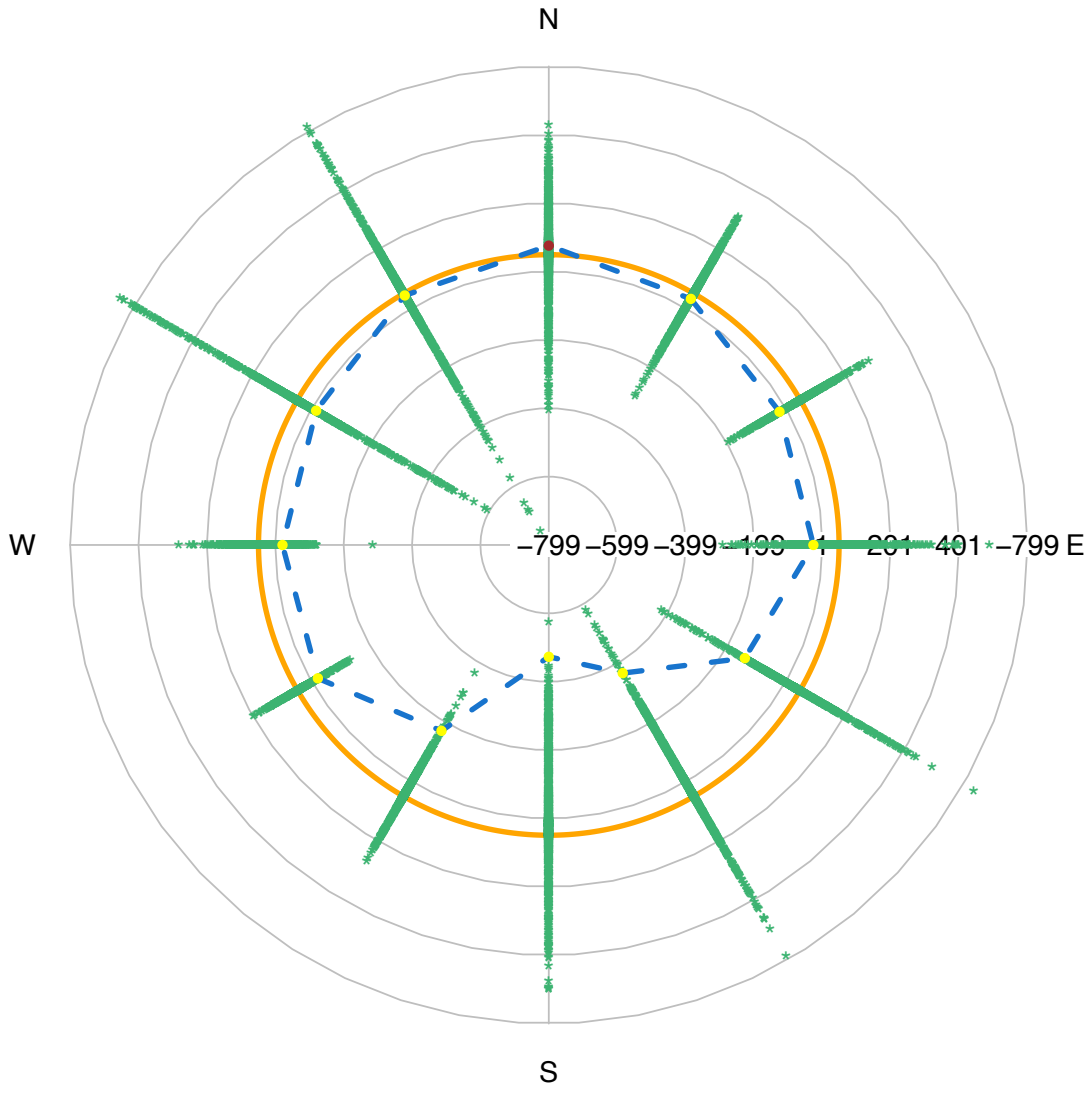


Species Extinction risk : 2070

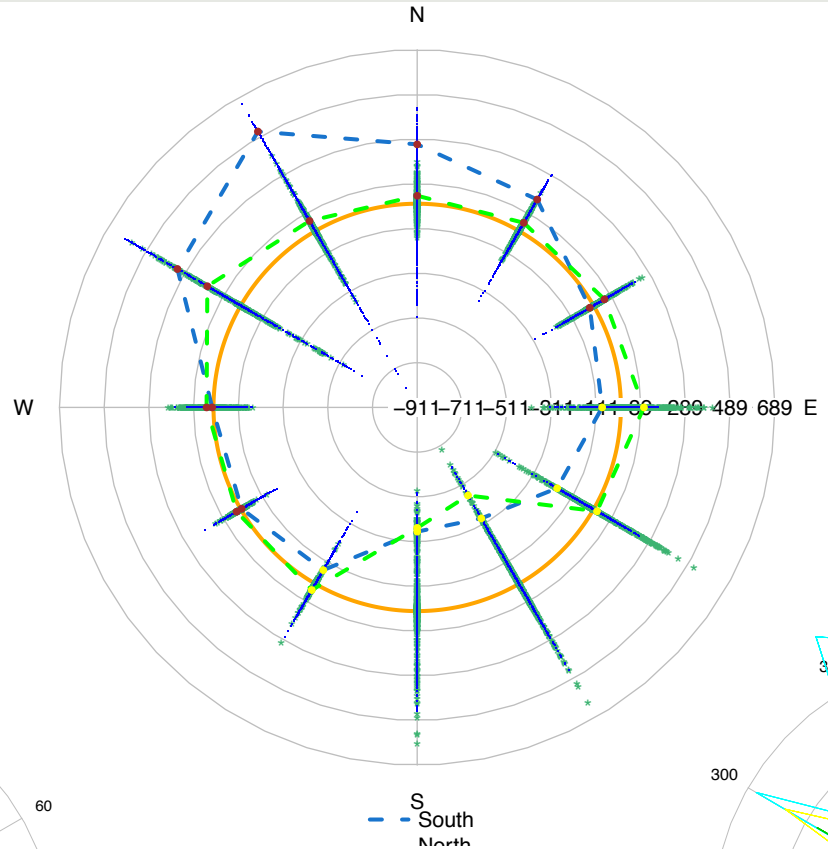
Projection conditions	Low CO2 emissions	High CO2 emissions
Unlimited disp., No SLR, No urb.	**115**	**314**
Endemics	11	25
Limited disp., No SLR, No urb.	**144**	**333**
Endemics	11	26
Limited disp., 1m SLR, No urb.	**146**	**340**
Endemics	11	26
Limited disp., 1m SLR, Urb. Best scenario	**146**	**340**
Endemics	11	26
Limited disp., 1mSLR, Urb. Worst scenario	**146**	**340**
Endemics	11	26

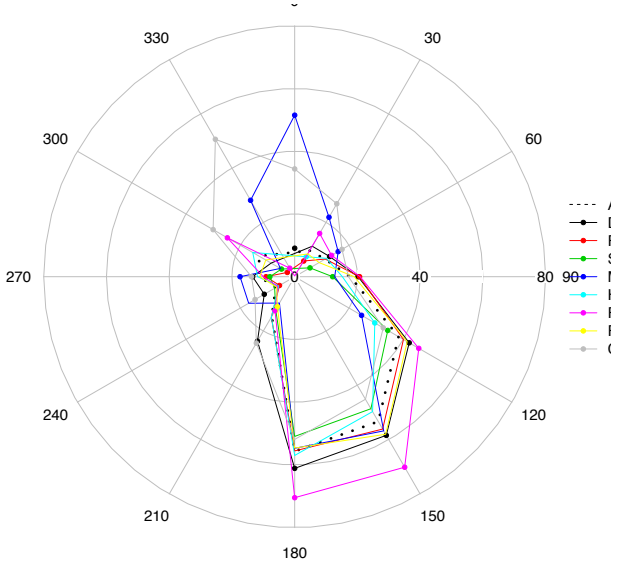

Change in species distribution area by 2050
– high CO2 emissions
Unlimited dispersal
Limited dispersal
1m sea level rise
Urbanization
Frequency
0
50
100
150
200
250
300
350
−128000
−88000
−53000
−18000
17000
47000
77000
112000
change in km2

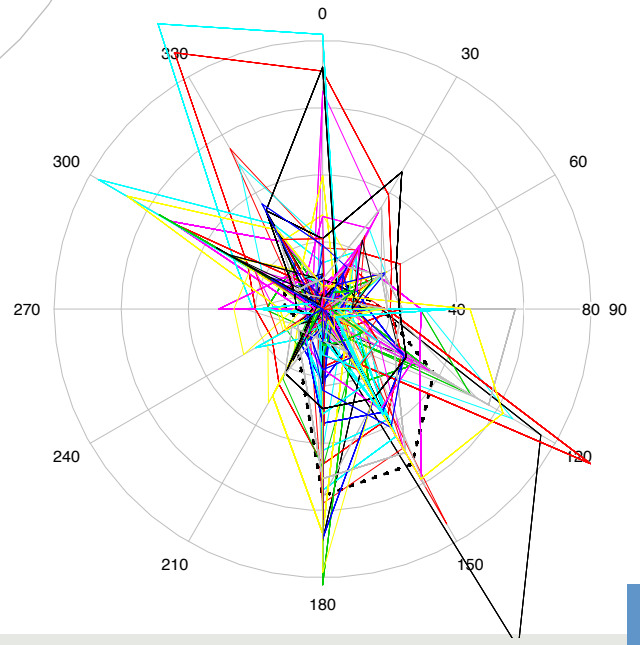
Shift in the edge of the distribution – 2050, high CO2 + 1m SLR



Breaking down the dataset – work in progress…



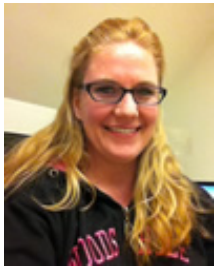


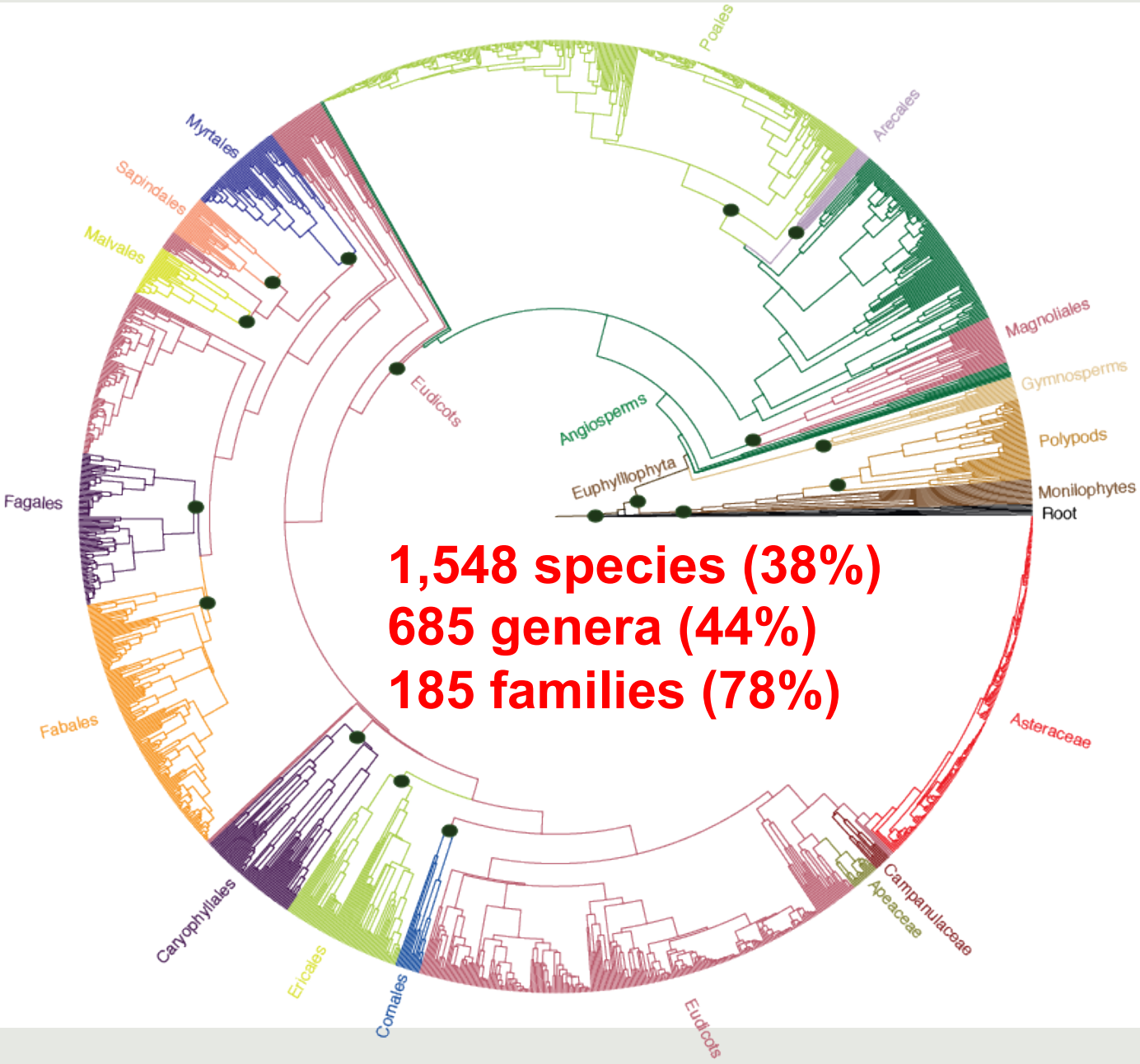


Linking to Phylogeny: the Tree

- *rbcL*, *matK*
  - 718 *matK*, 684 *rbcL* from GenBank

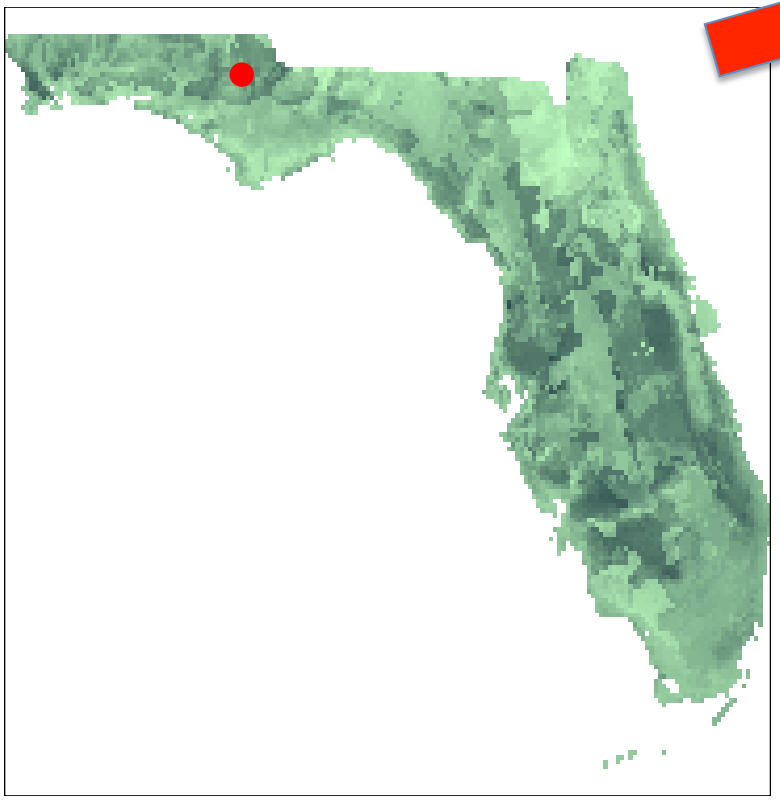
    722 *matK*, 756 *rbcL* sequenced
- 3 outgroups (Funariaceae, Pottiaceae, Mastigophoraceae)
- RAxML on partitioned dataset
- Dating with 17 calibration points (Bell et al., 2010, and Soltis et al., 2002 for the root)

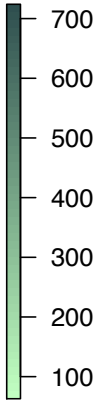


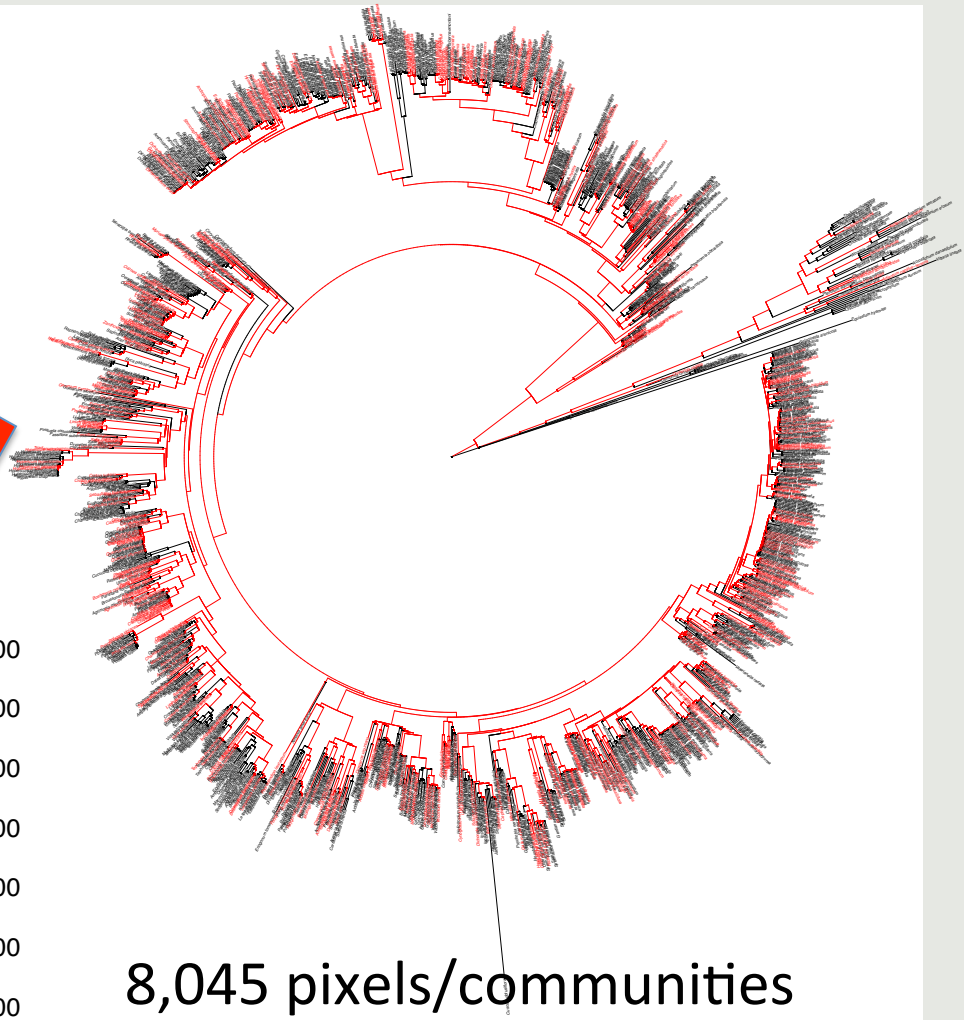

Poales
Arecales
Myrtales
Sapindales
Malvales
Magnoliales
Gymnosperms
Eudicots
Angiosperms
Polypods
Euphyllophyta
Monilophytes
Root
Fagales
1,548 species (38%)
685 genera (44%)
185 families (78%)
Asteraceae
Fabales
Campanulaceae
Apeaceae
Caryophyllales
Ericales
Comales
Eudicots

Phylogenetic Diversity

Species list at each pixel



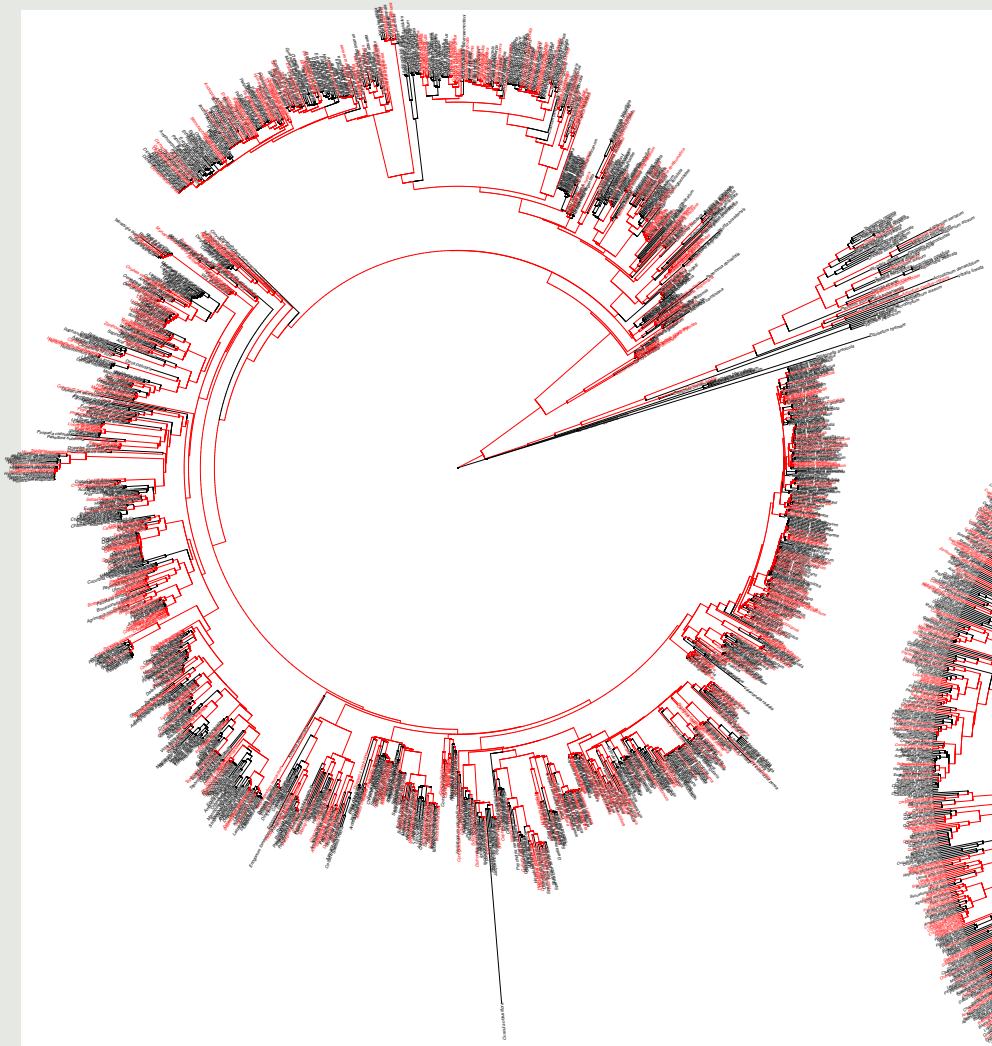


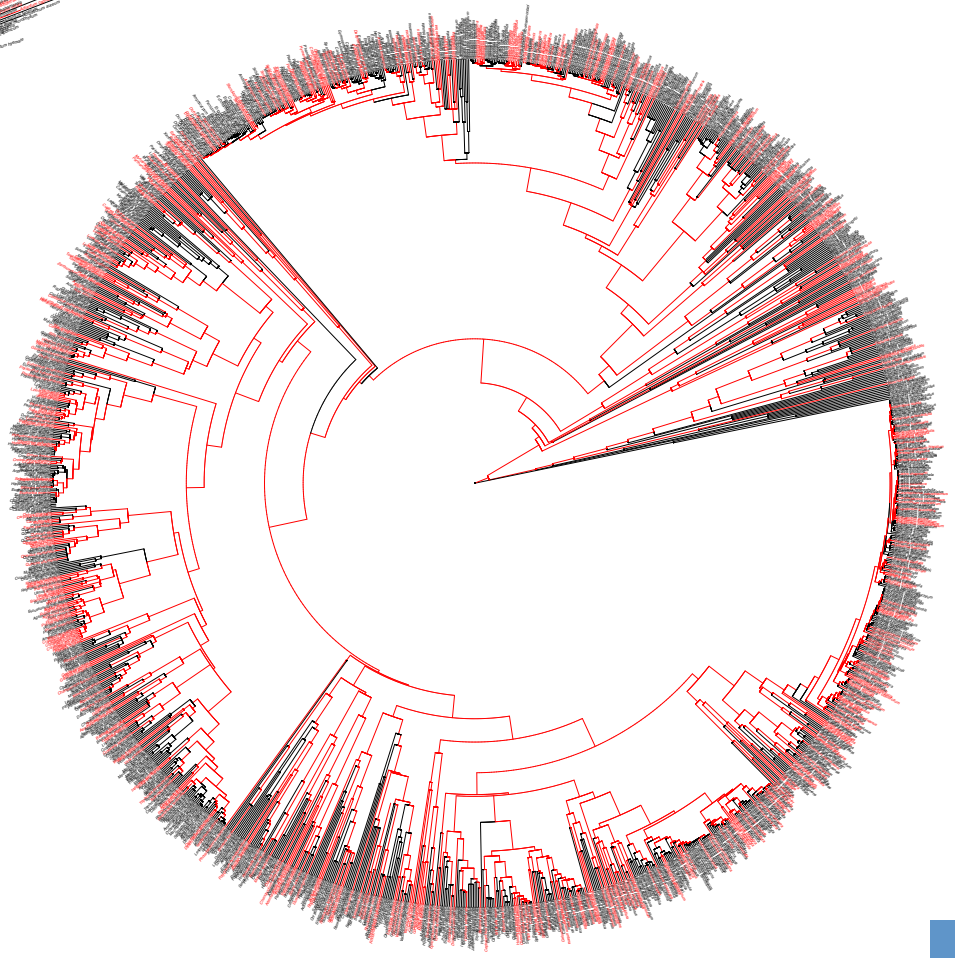


8,045 pixels/communities

16km^2 per pixel

Phylogram vs. ultrametic tree | 1.c.

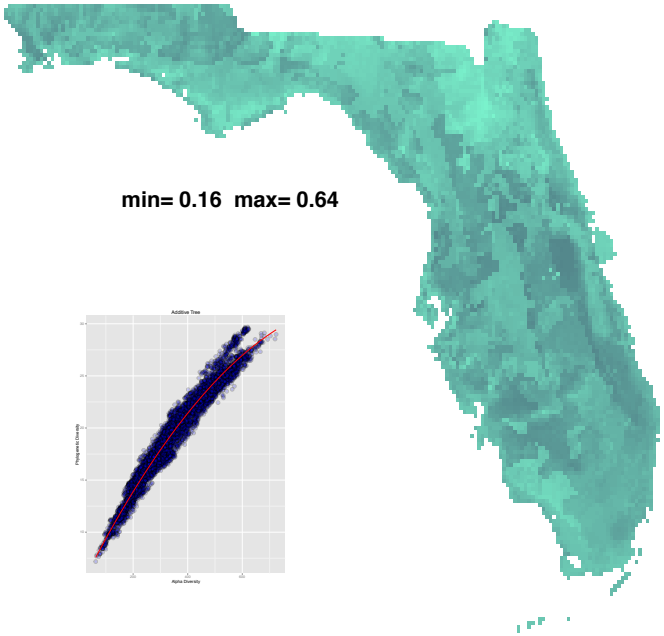


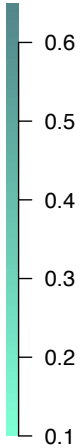


Phylogram vs. ultrametic tree | 1.c.

Proportional Phylogenetic Diversity

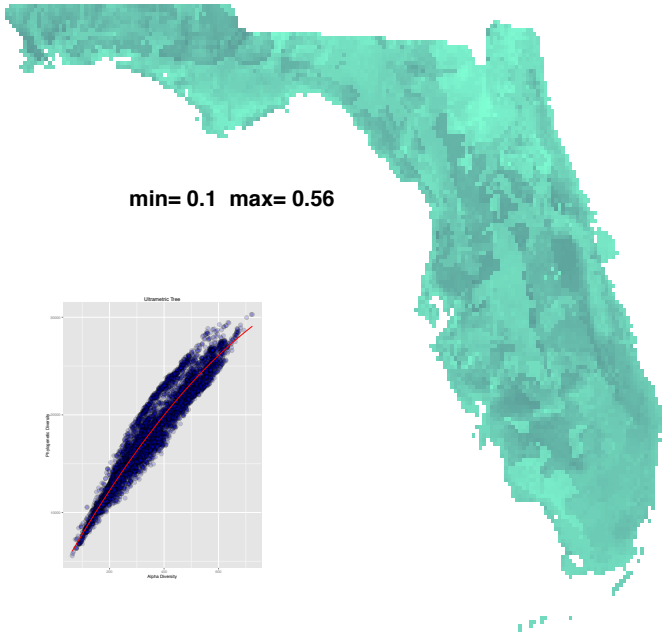
Phylogram





Proportional Phylogenetic Diversity

Ultrametric tree

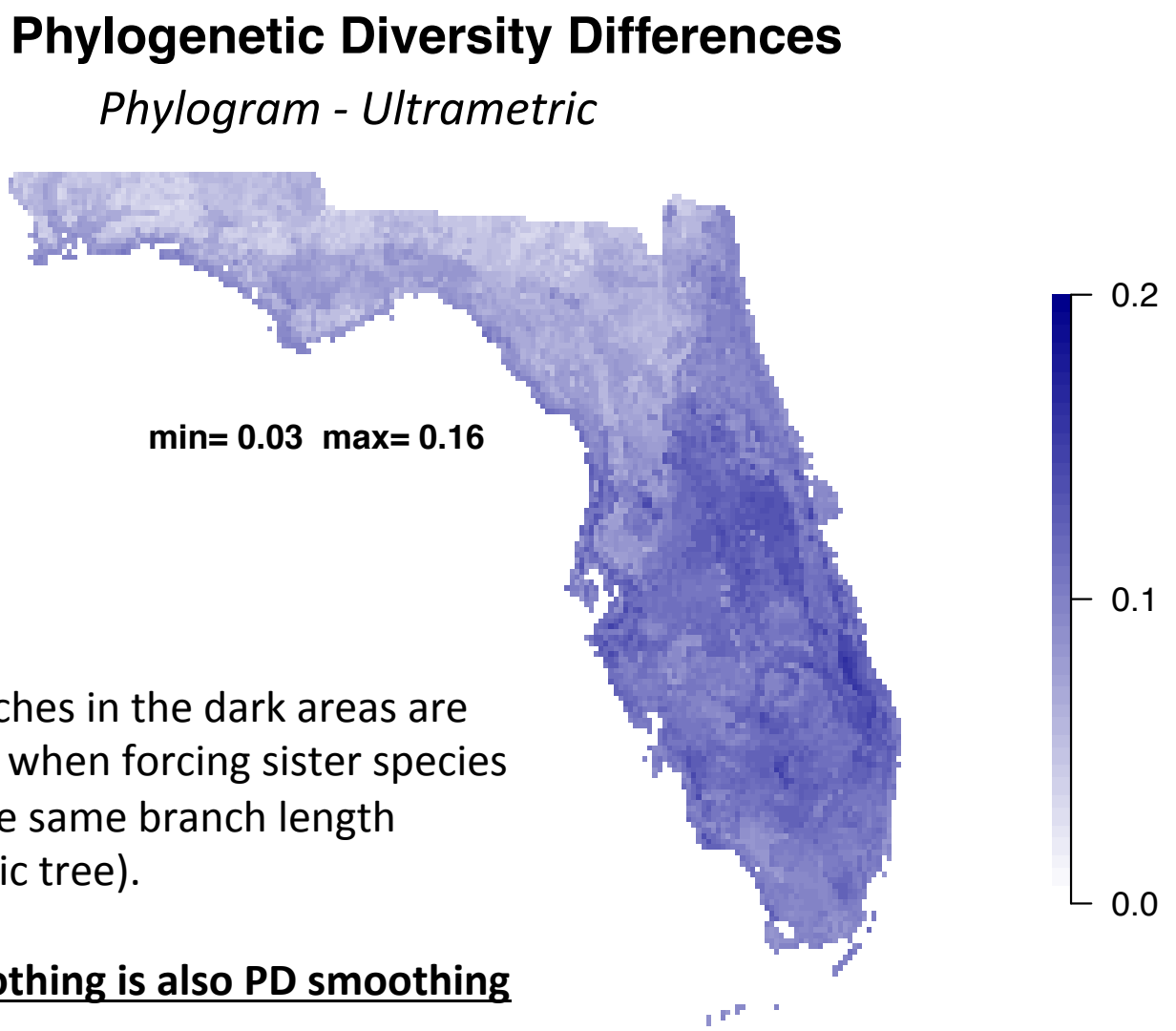


- Genetic diversity
- Accumulation of evolutionary change

- Time diversity
- Amount of evolutionary history

- More easily comparable to other methods/studies

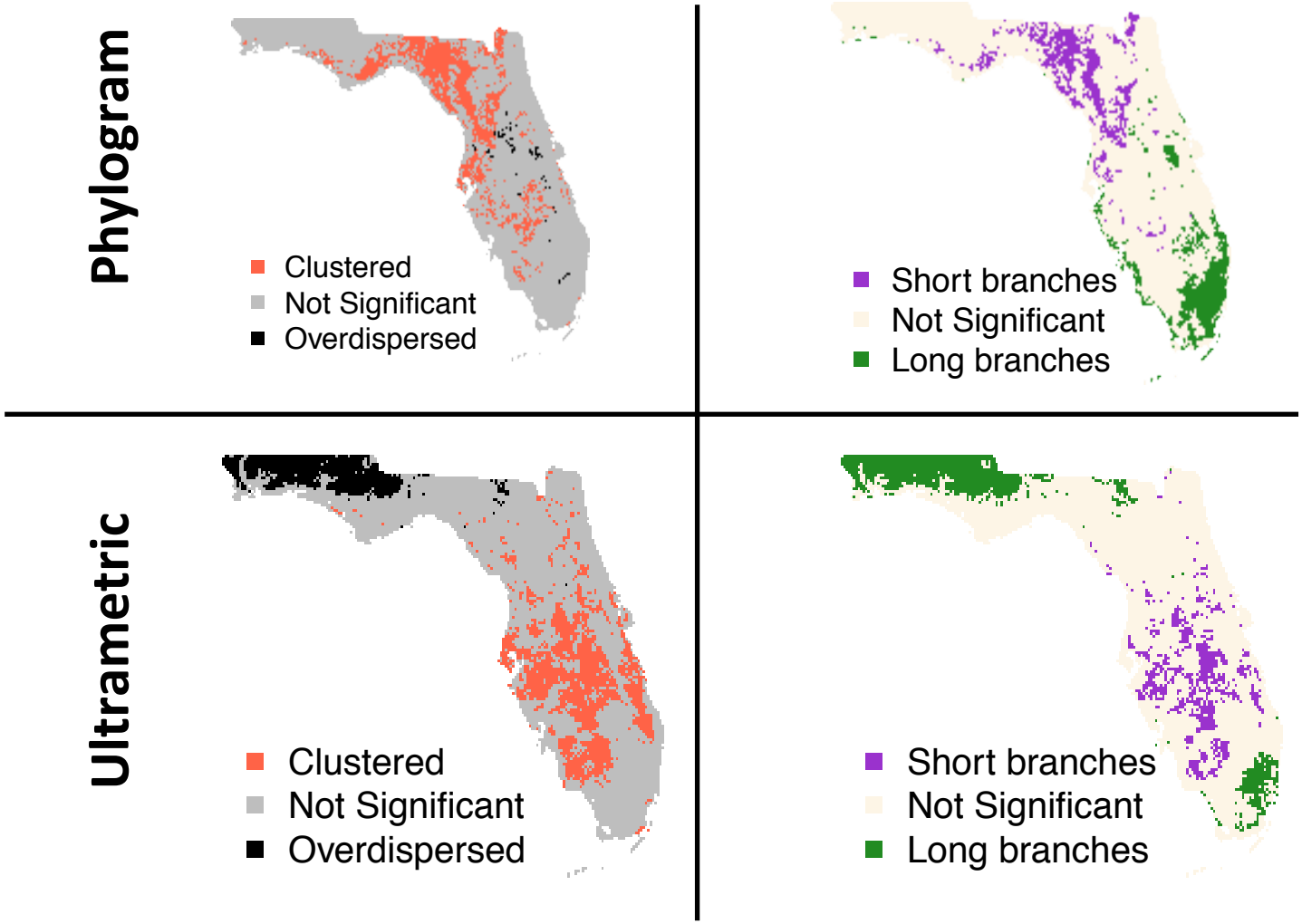
Phylogram vs. ultrametic tree | 1.c.

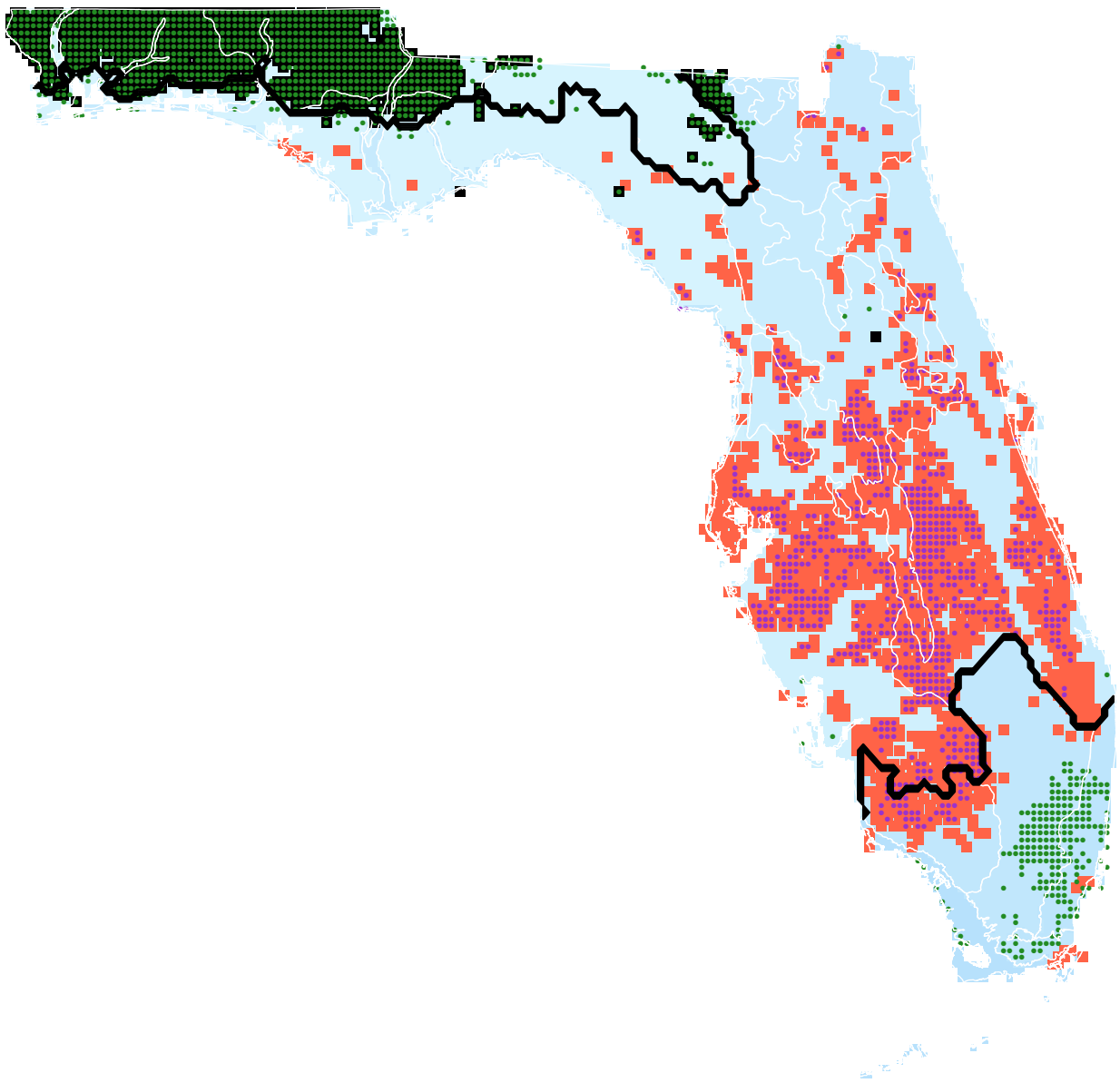


Long branches in the dark areas are shortened when forcing sister species to have the same branch length (ultrametric tree).

Rate smoothing is also PD smoothing

Phylodiversity





THANK YOU !!!!

Atlas of Florida Vascular Plants

Alabama Plant Atlas
Alabama Herbarium Consortium
& The University of West Alabama

GLOBAL BIODIVERSITY INFORMATION FACILITY

Université de Montréal

UNSW AUSTRALIA

ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

FLORIDA STATE UNIVERSITY
VIRES ARTES MORES
1851

STATE

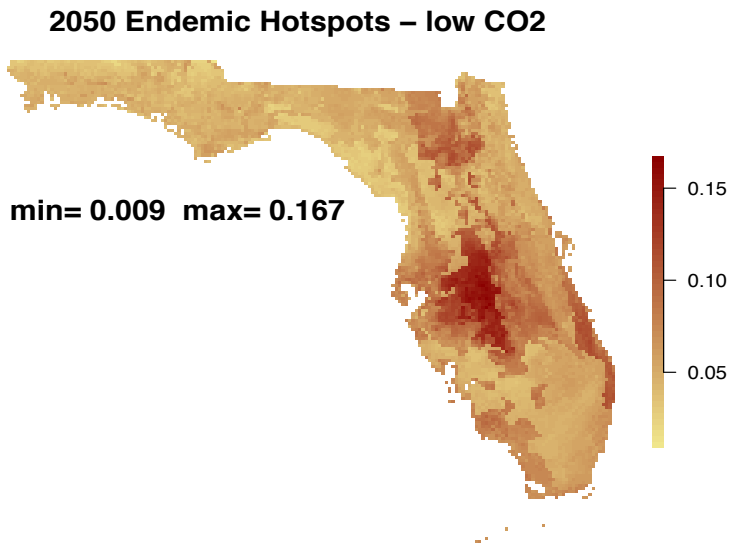
FLORIDA MUSEUM OF NATURAL HISTORY

FLORIDA Natural Areas INVENTORY

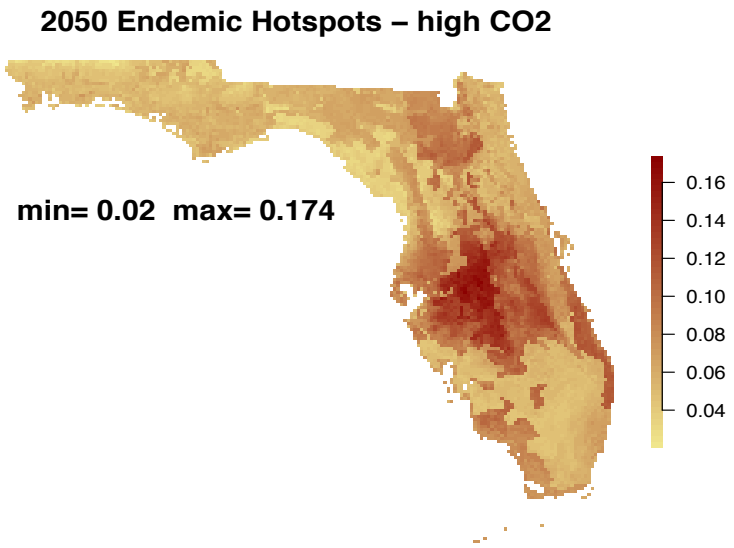
LSU

Future Endemism: 2050

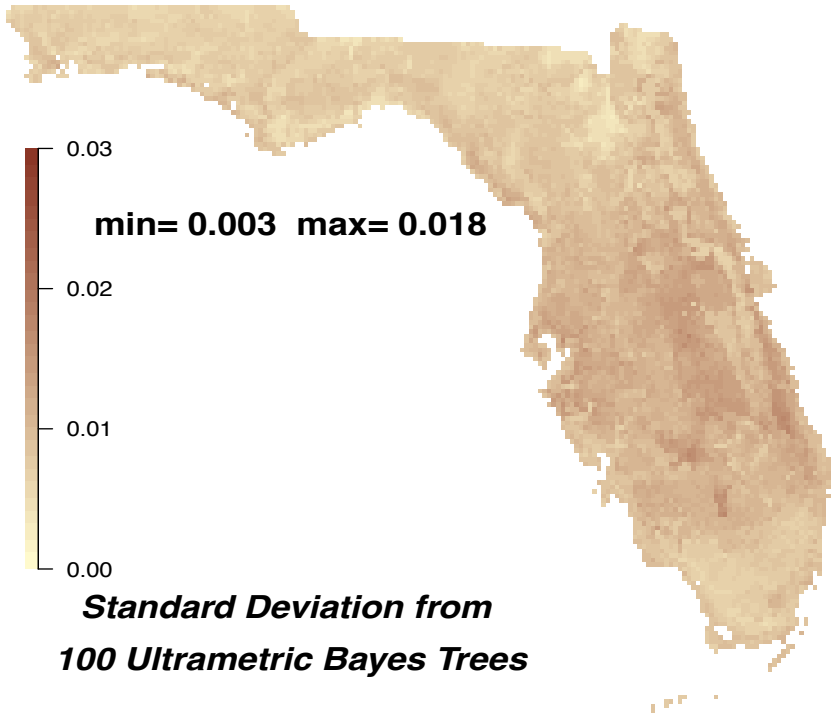
Low CO2

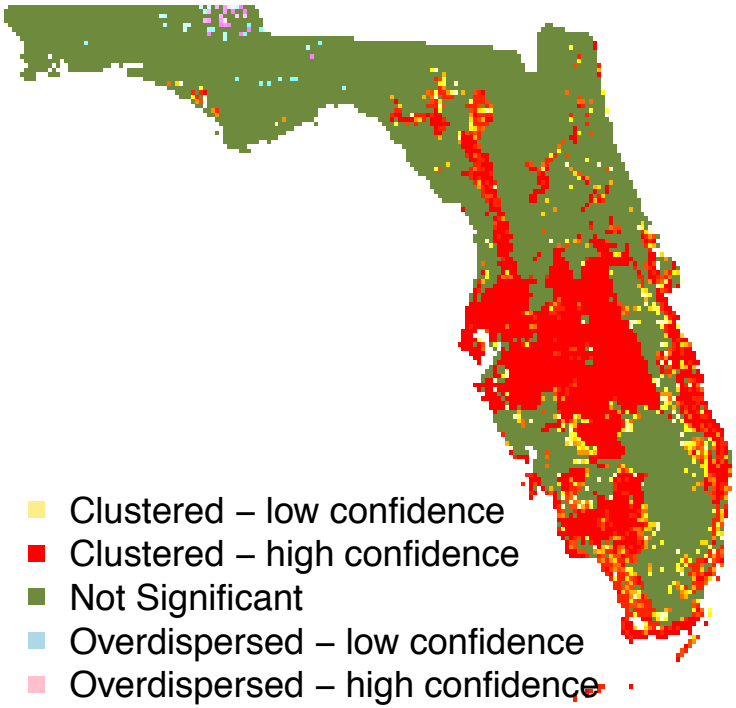


High CO2



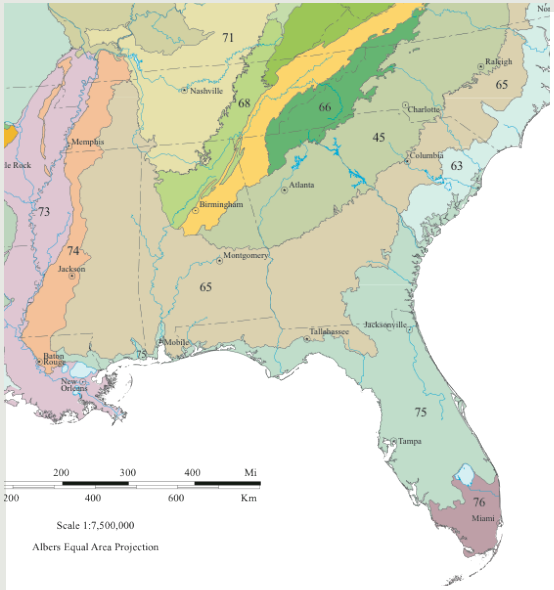
Uncertainty

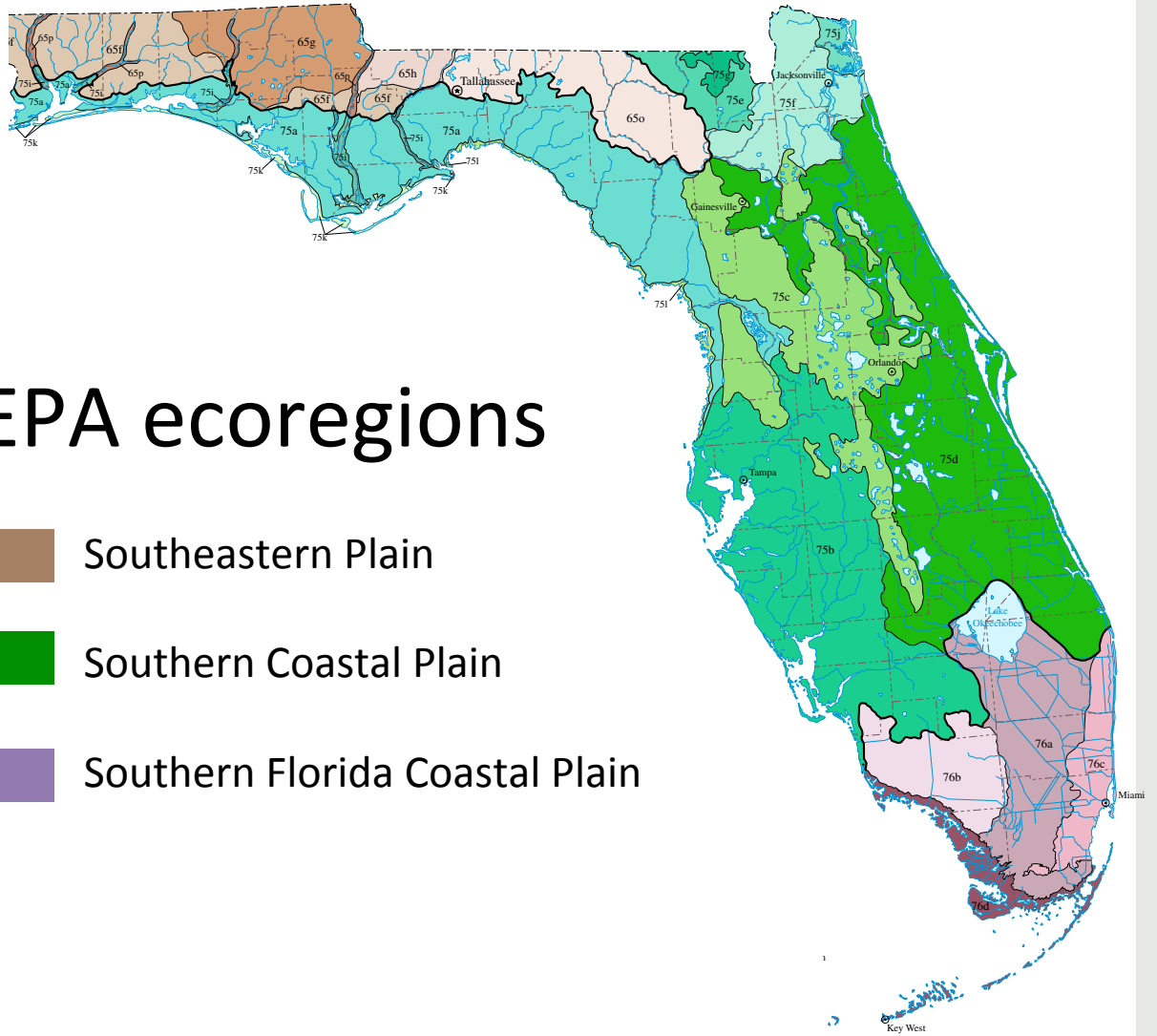




- Estimating uncertainty is essential
- Does it affect patterns of significance ?

Florida





EPA ecoregions

- Southeastern Plain
- Southern Coastal Plain
- Southern Florida Coastal Plain

~ 4,100 plant species