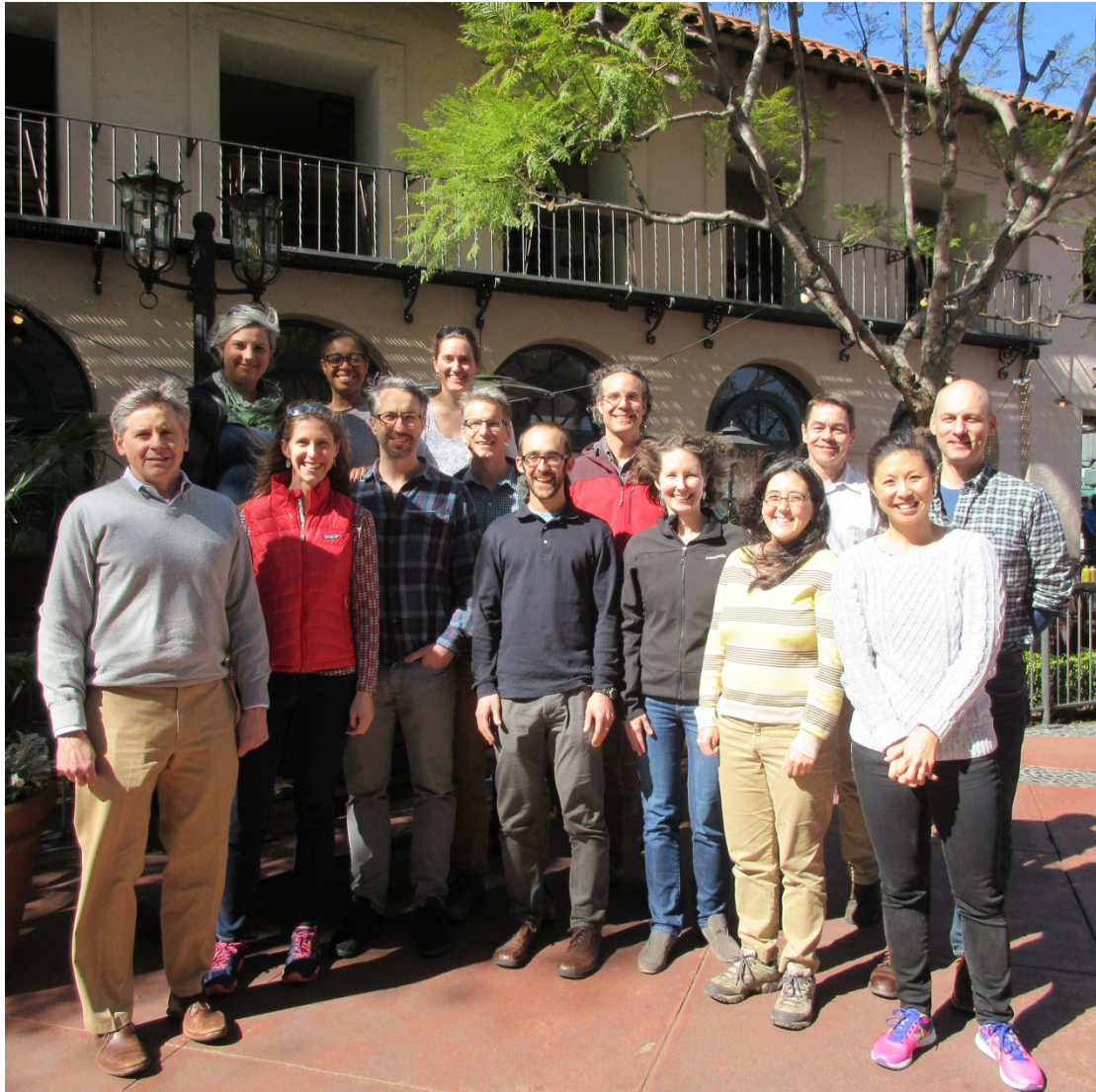




Connecting biodiversity, geodiversity, and remote sensing across scales

Sydne Record (Bryn Mawr), Phoebe
Zarnetske (MSU), Kyla Dahlin (MSU) and
the NASA BIOxGEO working group

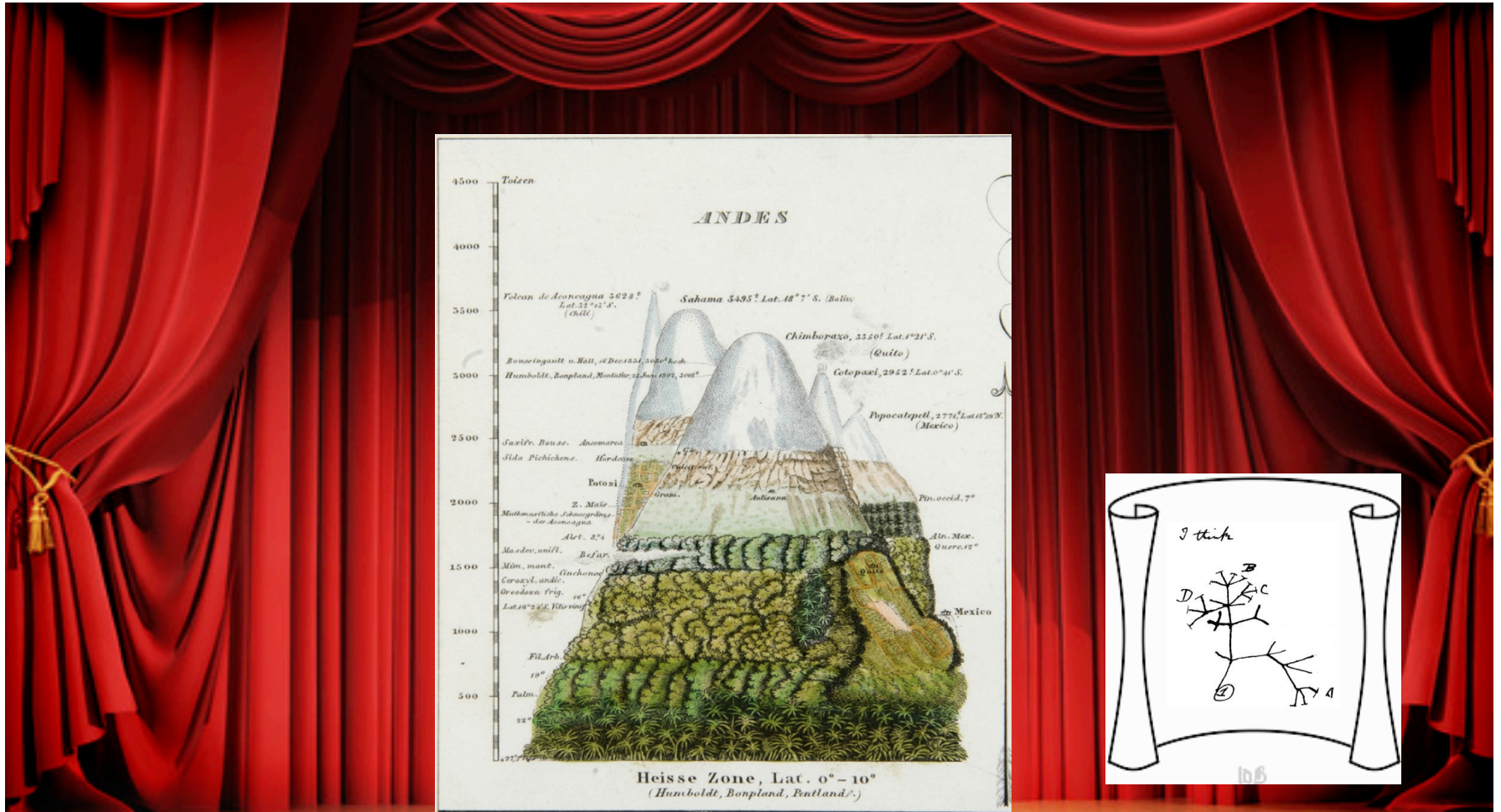
The NASA BIOxGEO Group



Phoebe Zarnetske (MSU)
Kyla Dahlin (MSU)
Sydne Record (Bryn Mawr)
Jennifer Costanza (NCSU)
Andrew Finley (MSU)
Keith Gaddis (AAAS/NASA)
John Grady (Bryn Mawr)
Martina Hobi (UW Madison)
Andrew Latimer (UC Davis)
Sparkle Malone (UFSF)
Scott Ollinger (UNH)
Stephanie Pau (FSU)
Quentin Read (MSU)
Woody Turner (NASA)
Adam Wilson (U Buffalo)

Conserving nature's stage

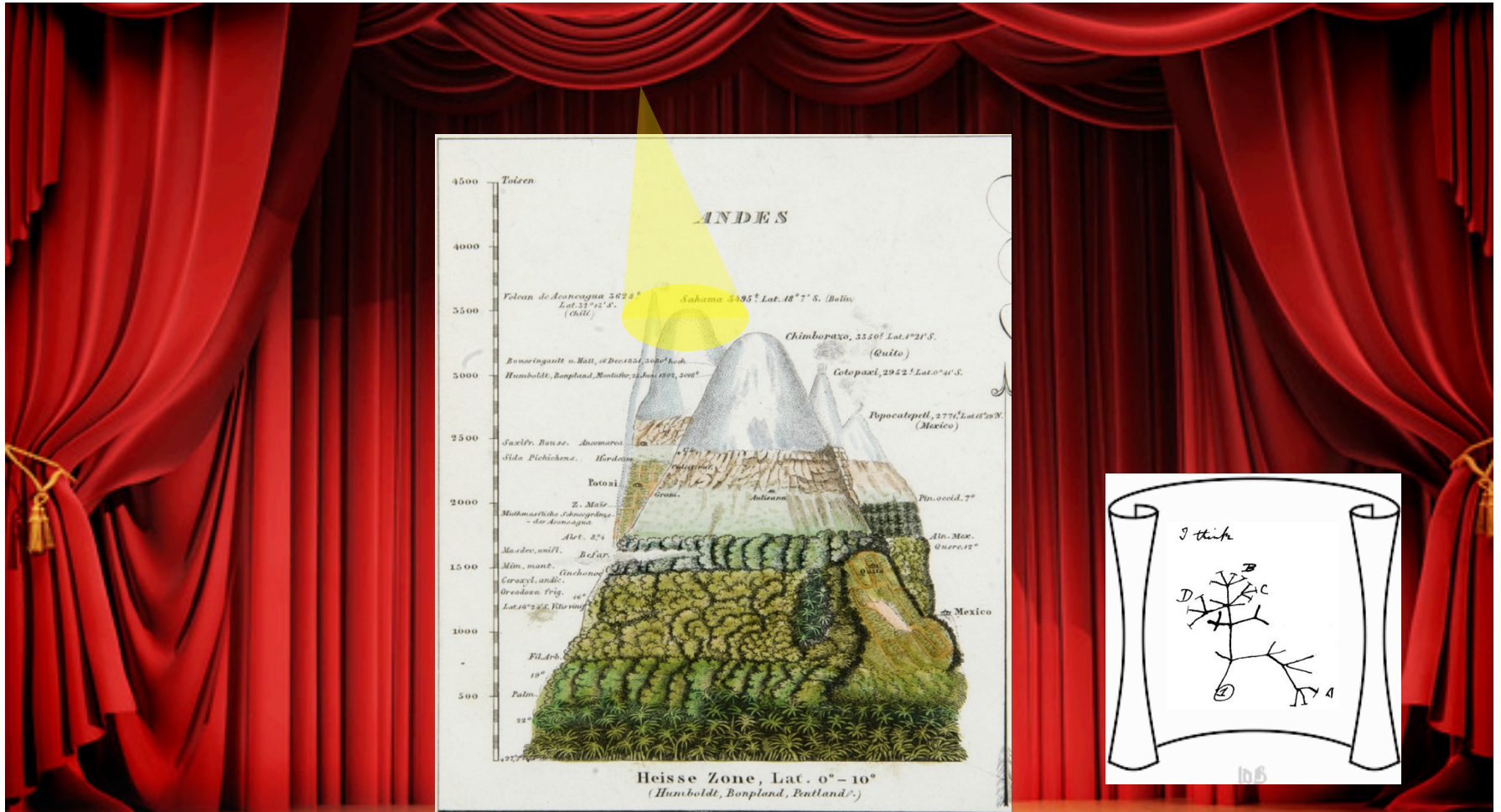
Hutchinson's ecological theatre and evolutionary play



Hutchinson (1965); Beier et al. (2015)

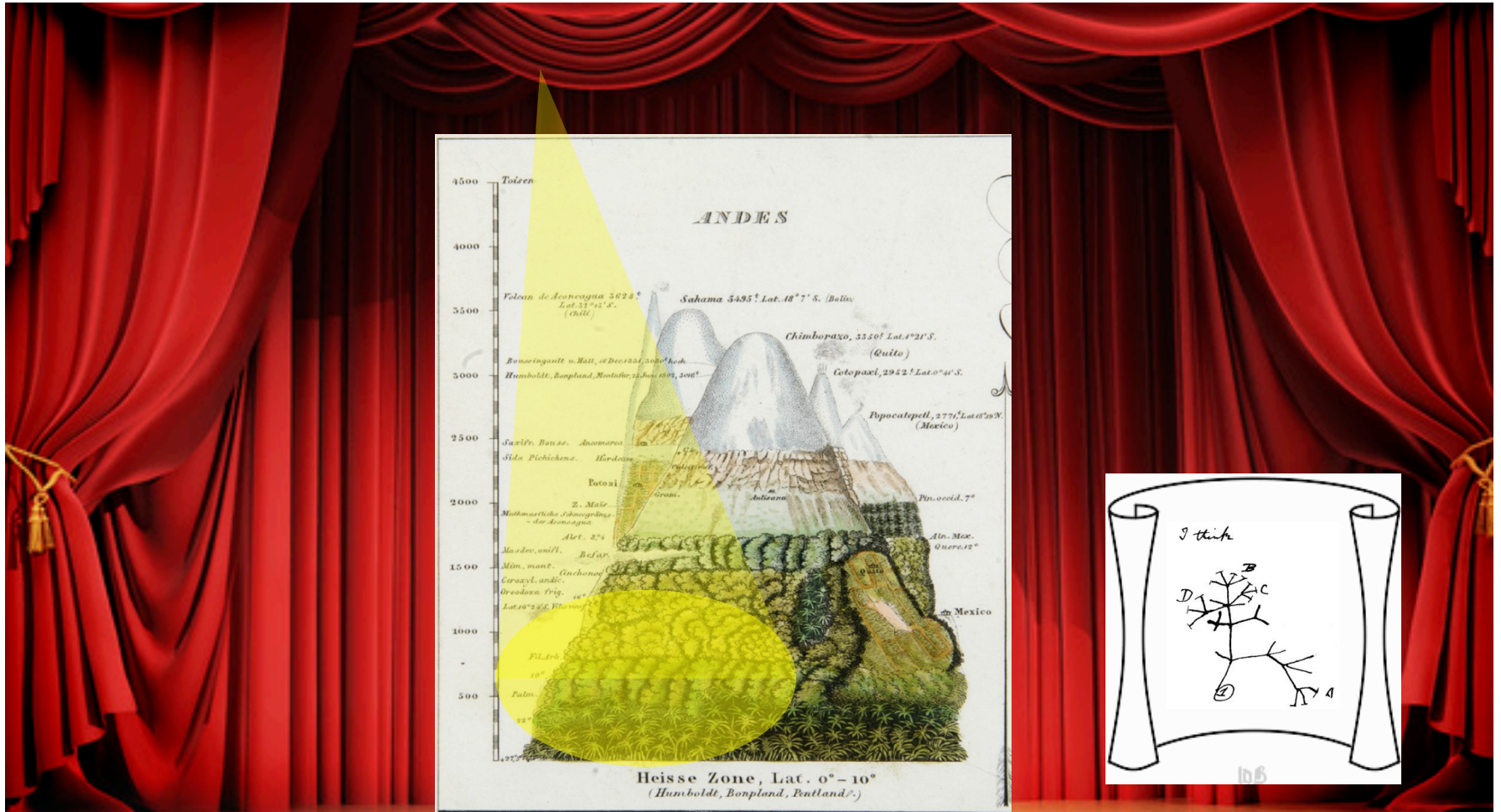
Conserving nature's stage

Hutchinson's ecological theatre and evolutionary play



Conserving nature's stage

Hutchinson's ecological theatre and evolutionary play



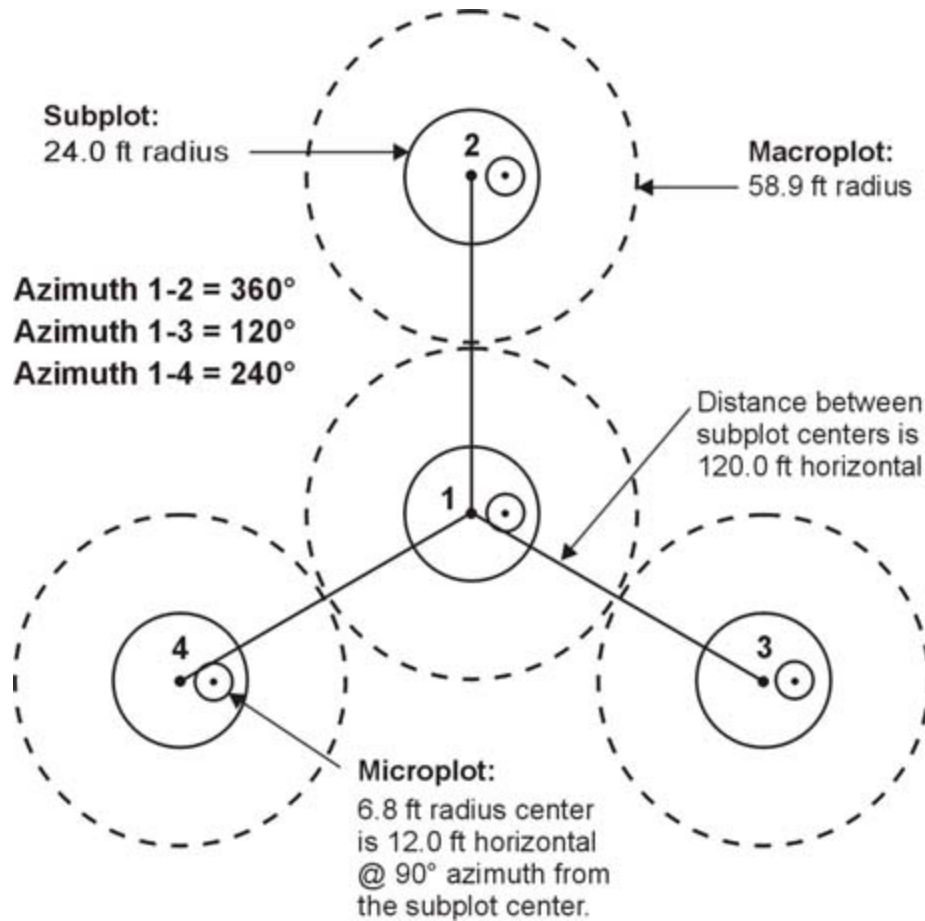
Proposed Questions

- How does the relationship between biodiversity* and geodiversity change across spatial scales?

* *Functional, phylogenetic, taxonomic*



The Nation's Forest Census



Forest Inventory and Analysis Taxonomic Data – 5 km radius

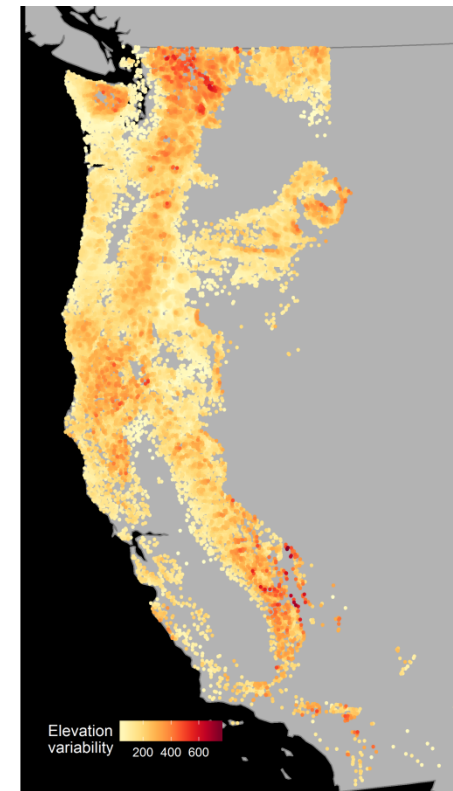
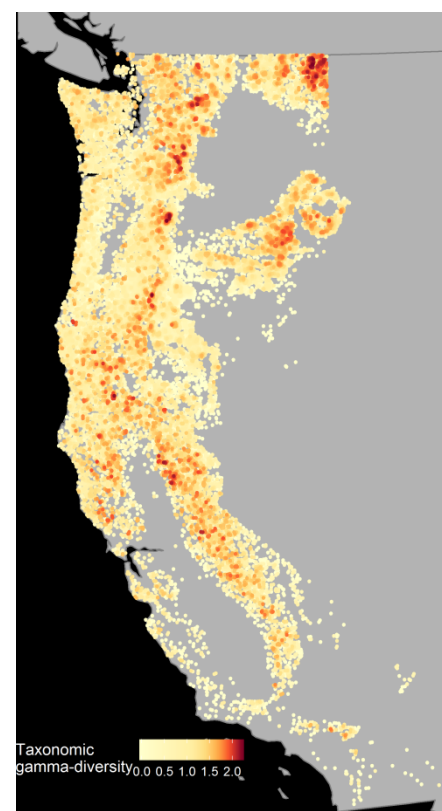
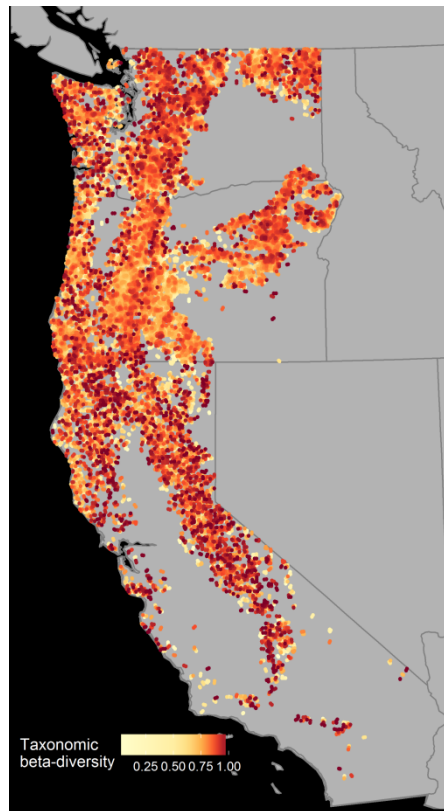
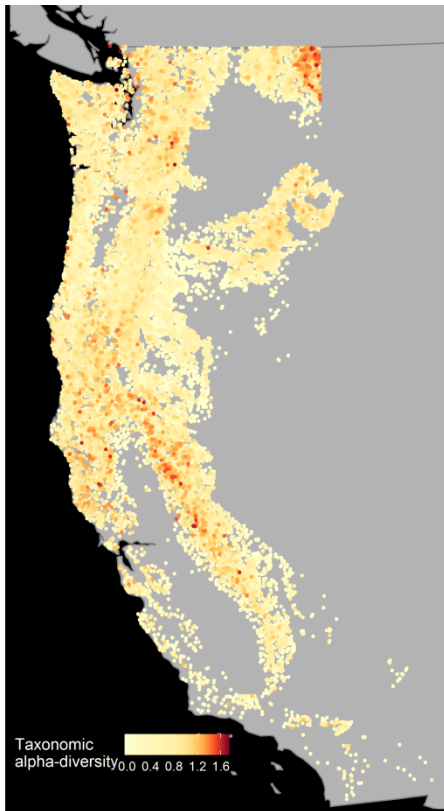


Alpha diversity

Beta diversity

Gamma diversity

Geodiversity



*Geodiversity = elevation variability

Forest Inventory and Analysis Taxonomic Data – 100 km radius

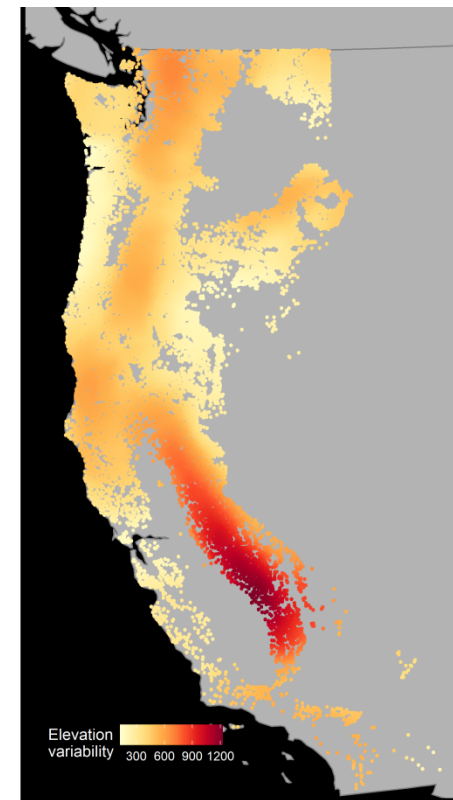
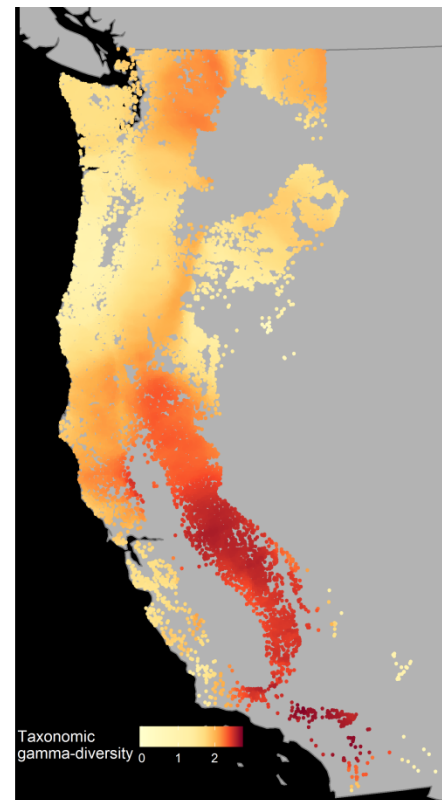
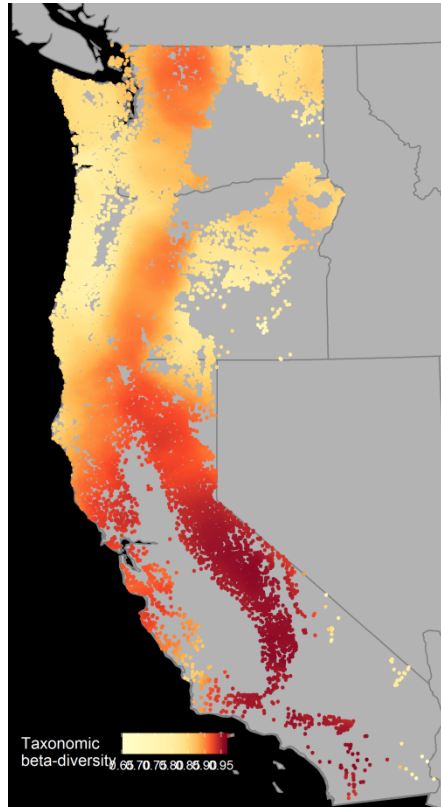
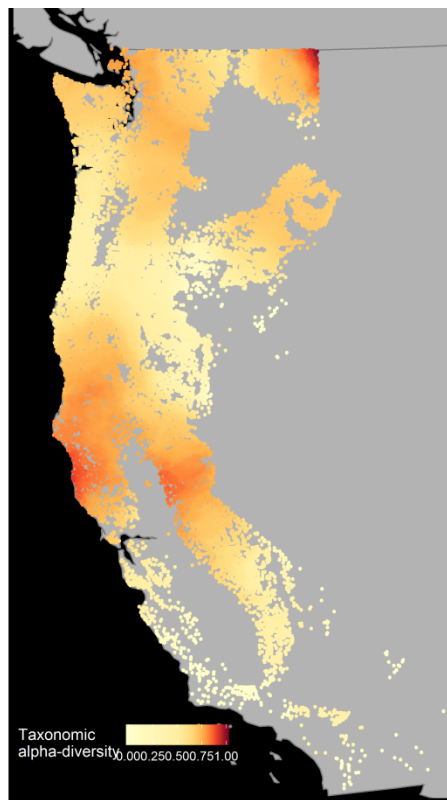


Alpha diversity

Beta diversity

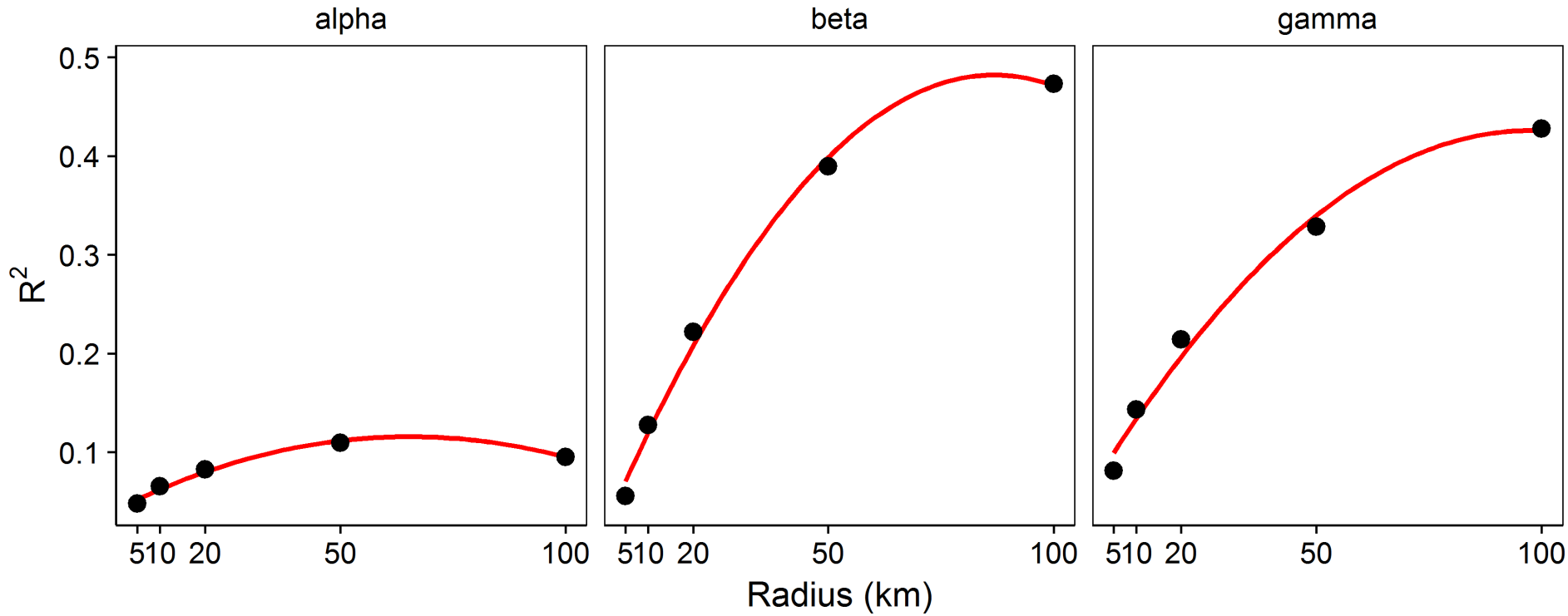
Gamma diversity

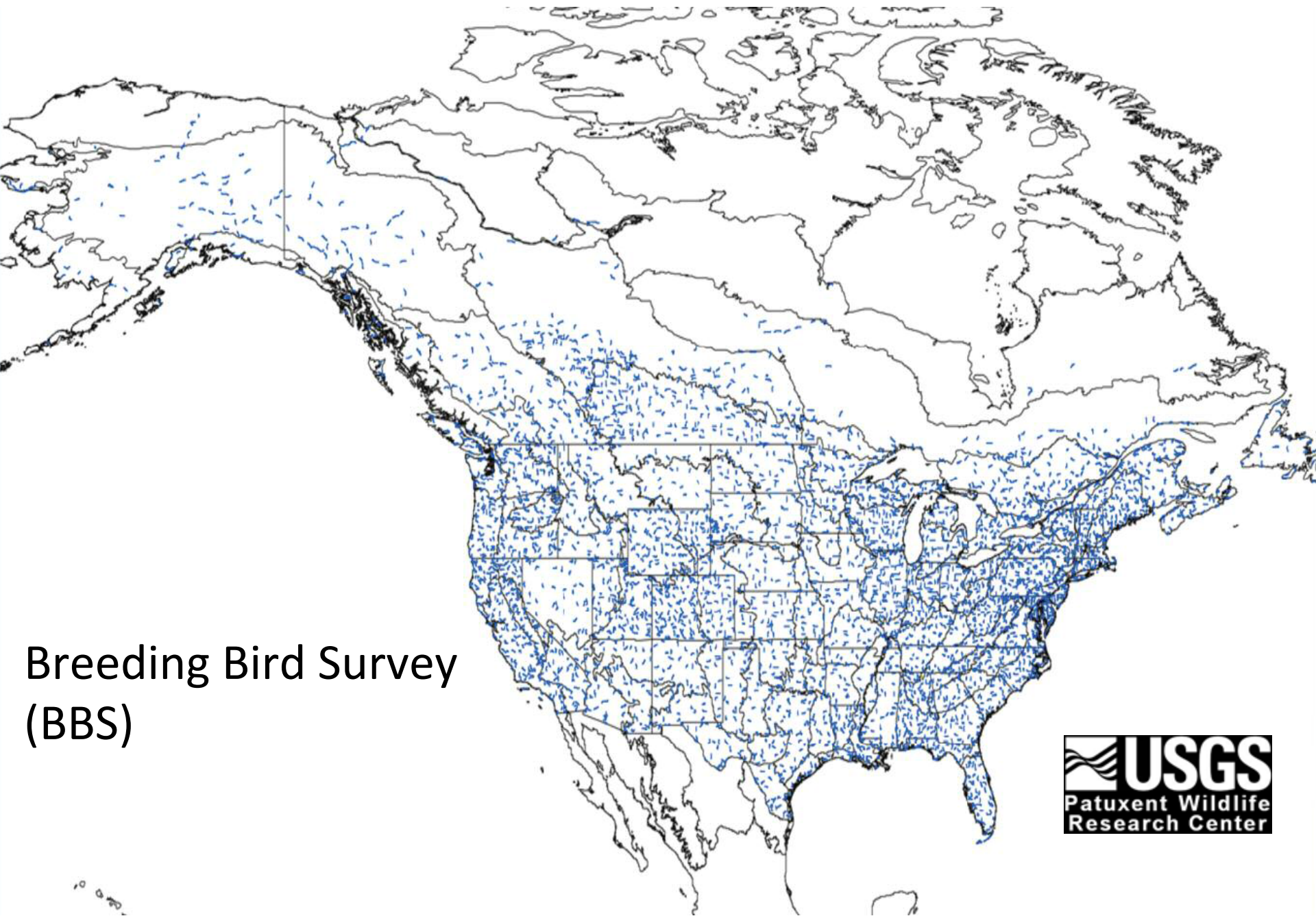
Geodiversity



*Geodiversity = elevation variability

FIA: GAM fits by radius





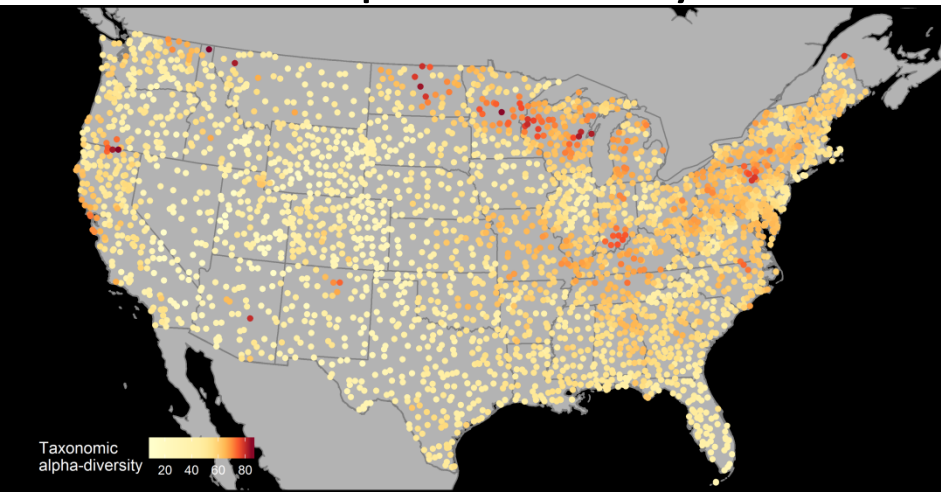
Breeding Bird Survey (BBS)



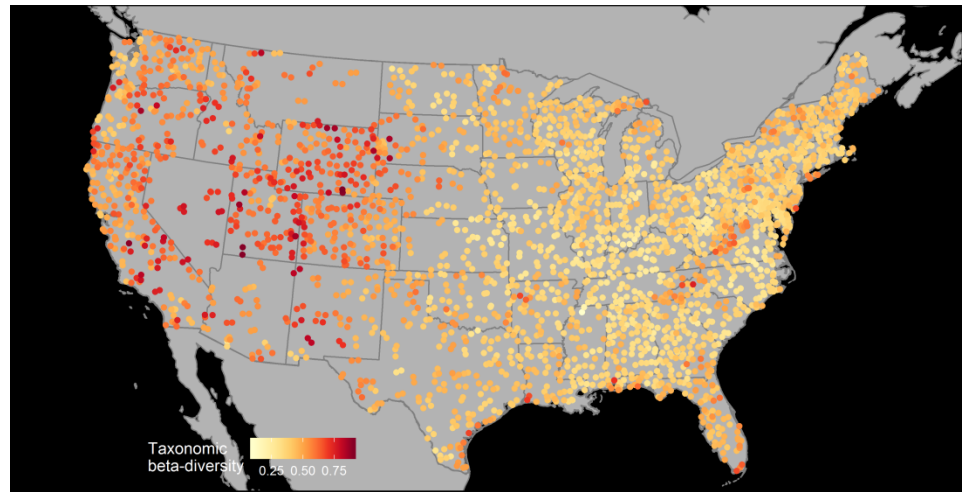
Breeding Bird Survey Taxonomic Data – 50 km radius



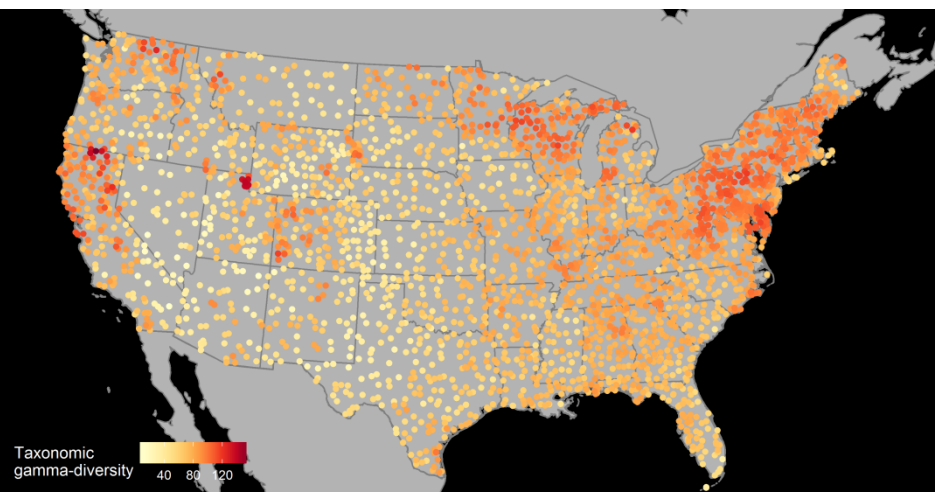
Alpha Diversity



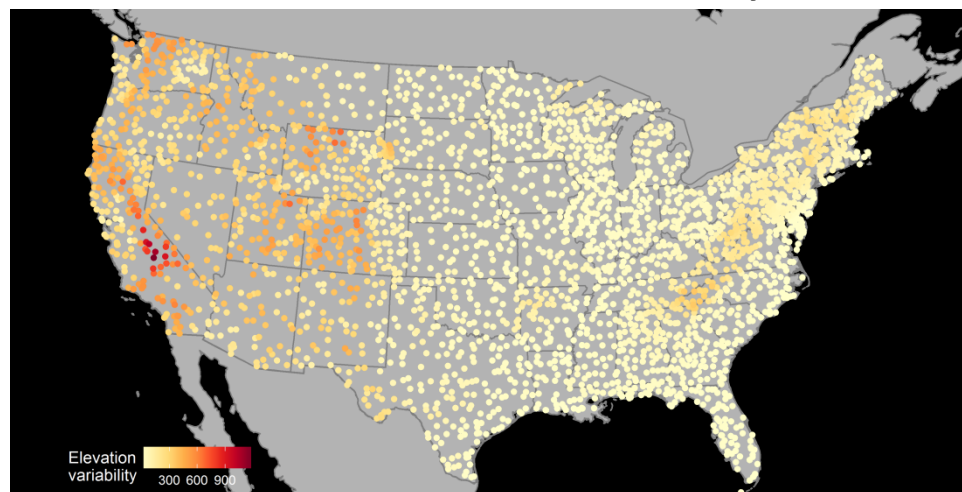
Beta Diversity



Gamma Diversity



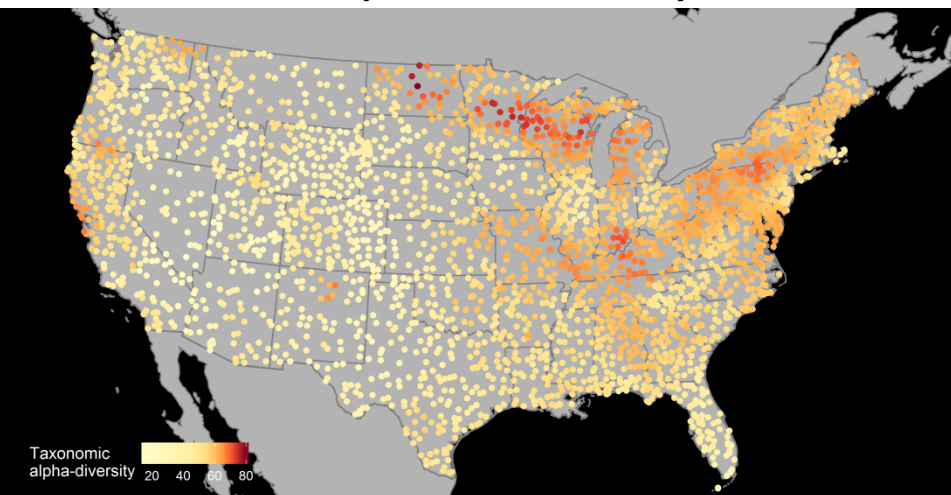
Elevation variability



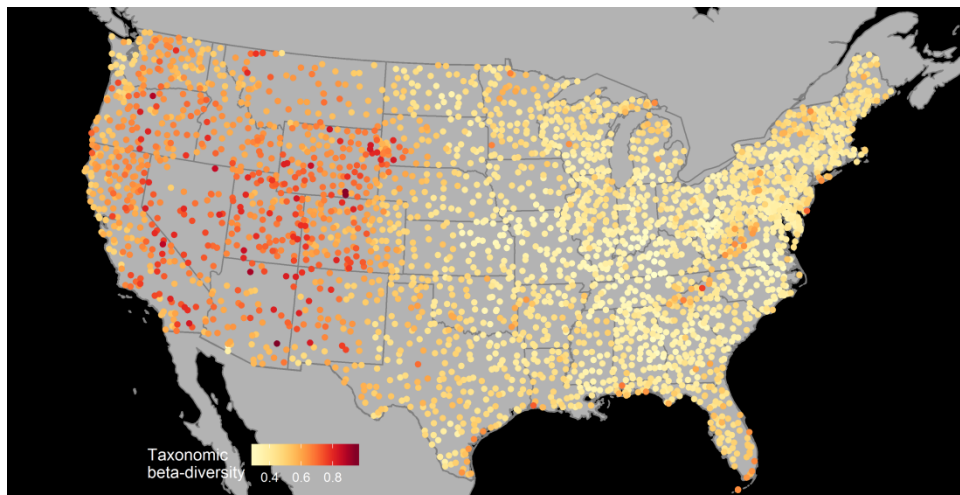
Breeding Bird Survey Taxonomic Data – 100 km radius



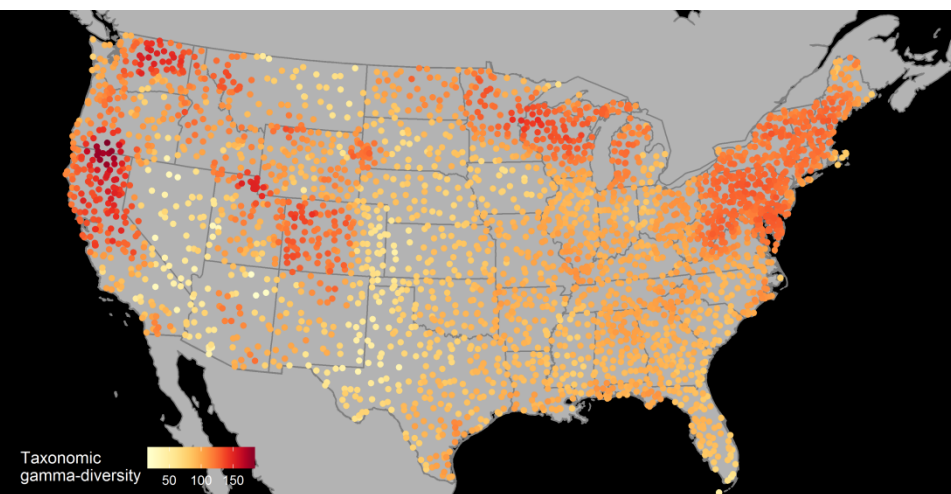
Alpha Diversity



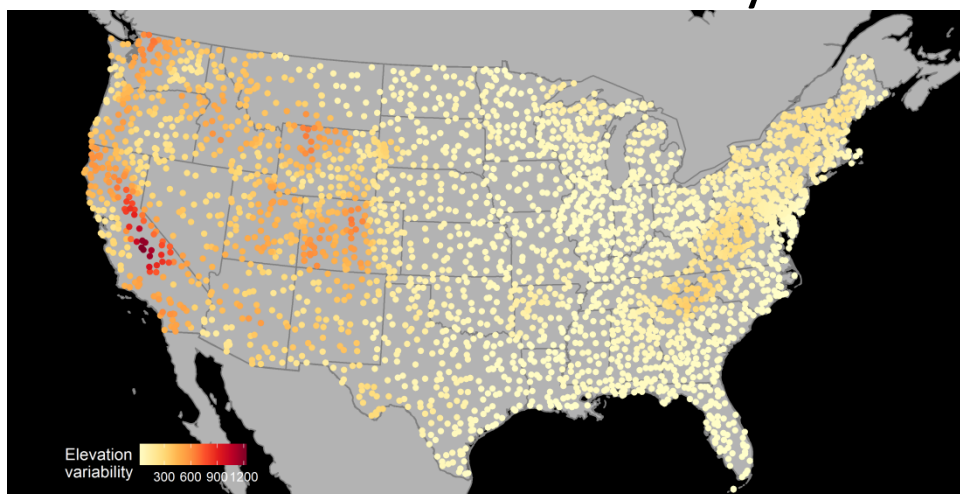
Beta Diversity



Gamma Diversity

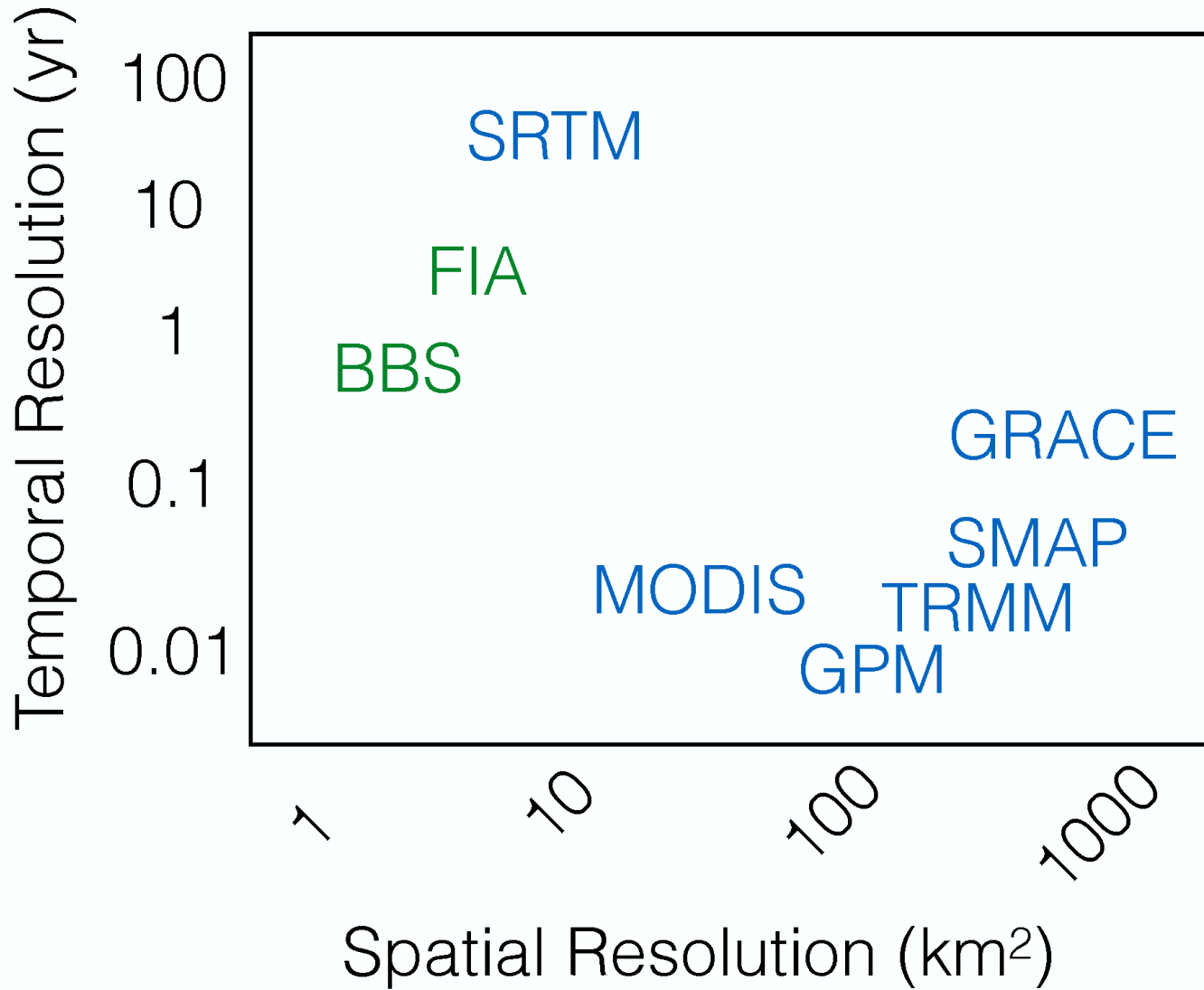


Elevation variability



Proposed Questions

- How does the relationship between biodiversity* and geodiversity change across spatial scales?
- What derived NASA products at particular spatial or temporal scales would transform the use of geophysical data by biodiversity scientists?



NASA Products
Ecological Data



What extent should a geo-variable be calculated to explain the maximum variability in a given biodiversity measurement. We define extent (or area) over which to calculate the geo-variable based on a circle of radius r .

Zone of influence models

Global zone of influence (assume single geo-variable for now):

$$y(s) = f[\beta, r; s, x] + e(s)$$

- ▶ $y(s)$ is a biodiversity measurement at location s
- ▶ β is a vector of length 2 holding an intercept and slope coefficient (β_0, β_1)
- ▶ r is the radius of a circle over which the geo-variable is calculated. r has uniform support e.g., $U(0, 10km)$
- ▶ x geo-variable over the entire domain
- ▶ $e(s)$ white-noise residual process $N(0, \tau^2)$

$$f[\beta, r; x] = \beta_0 + v(s)^\top \beta_1$$

- ▶ $v(s) = g(x, r, s)$, where $g(\cdot)$ is a function that calculates location s specific geo-variable over a circle of radius r

Zone of influence models

Space-varying zone of influence (assume single geo-variable for now):

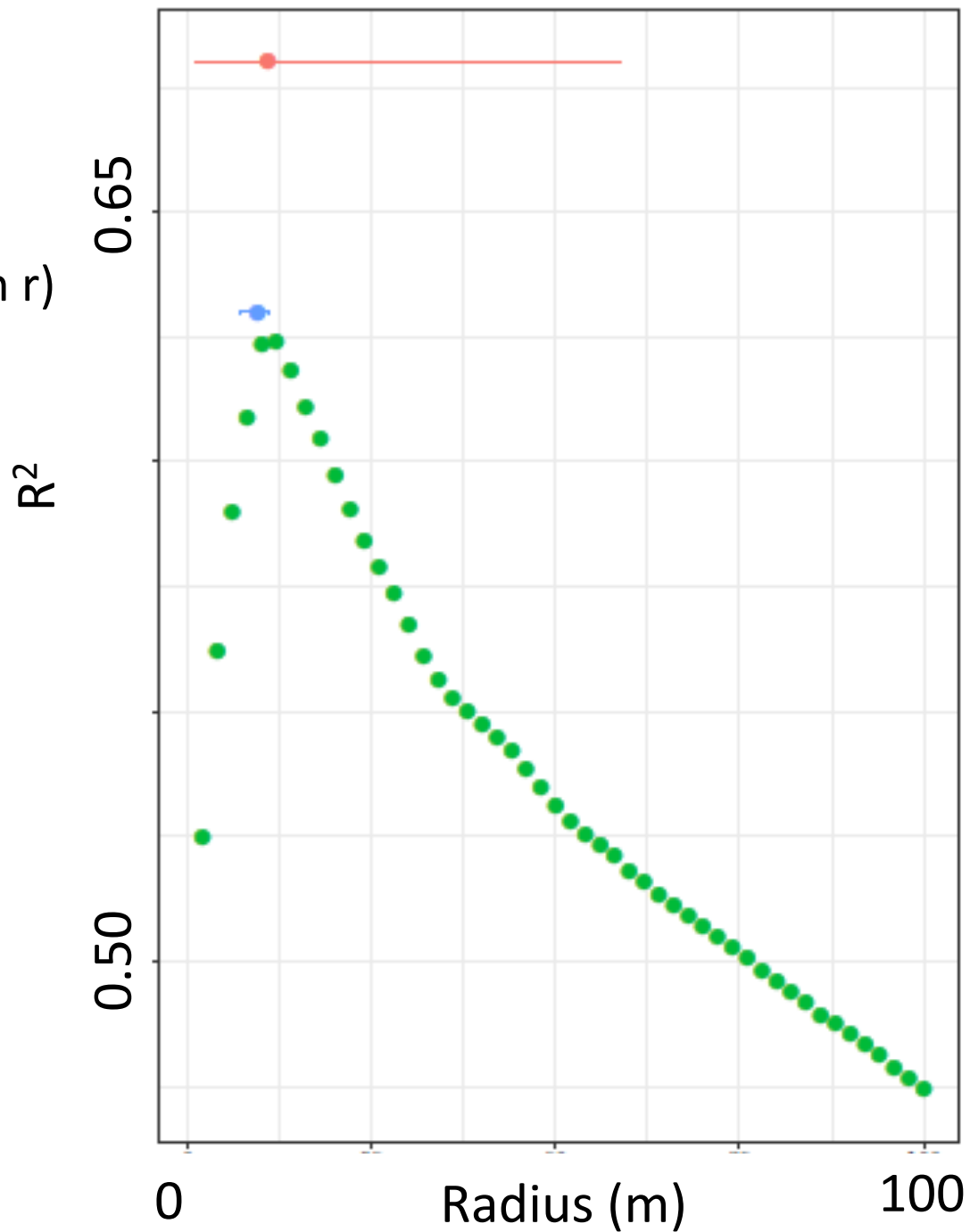
$$y(s) = f[\beta, r; s, x] + e(s)$$

- ▶ $r(s)$ is a **location specific** radius of a circle over which the geo-variable is calculated. r follows a GP transformed to uniform support e.g., $U(0, 10km)$

All other model elements were previously defined.

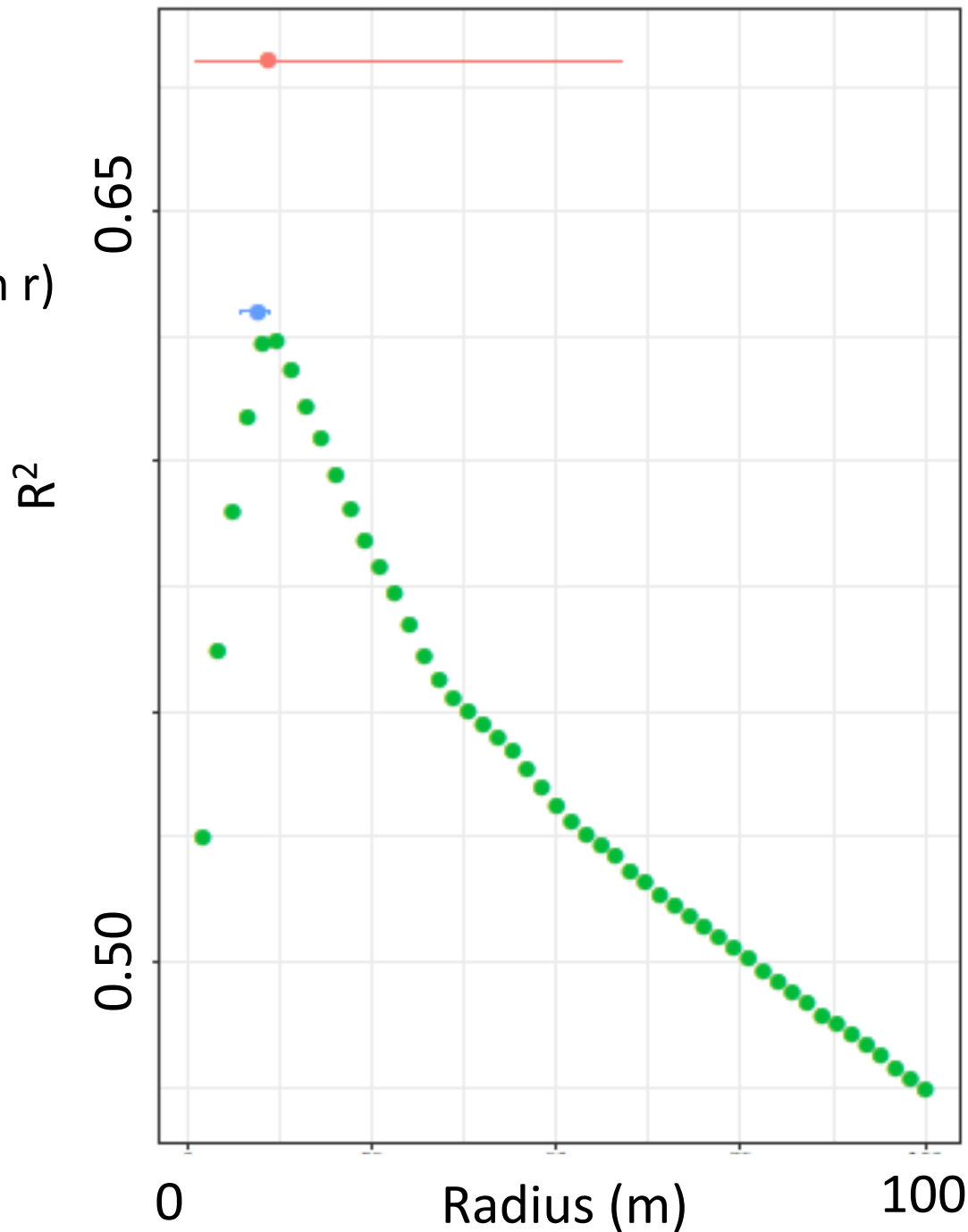
Models

- Discrete
- Global (r)
- Spatial (GP on r)



Models

- Discrete
- Global (r)
- Spatial (GP on r)



* Eventually extensions to multivariate response



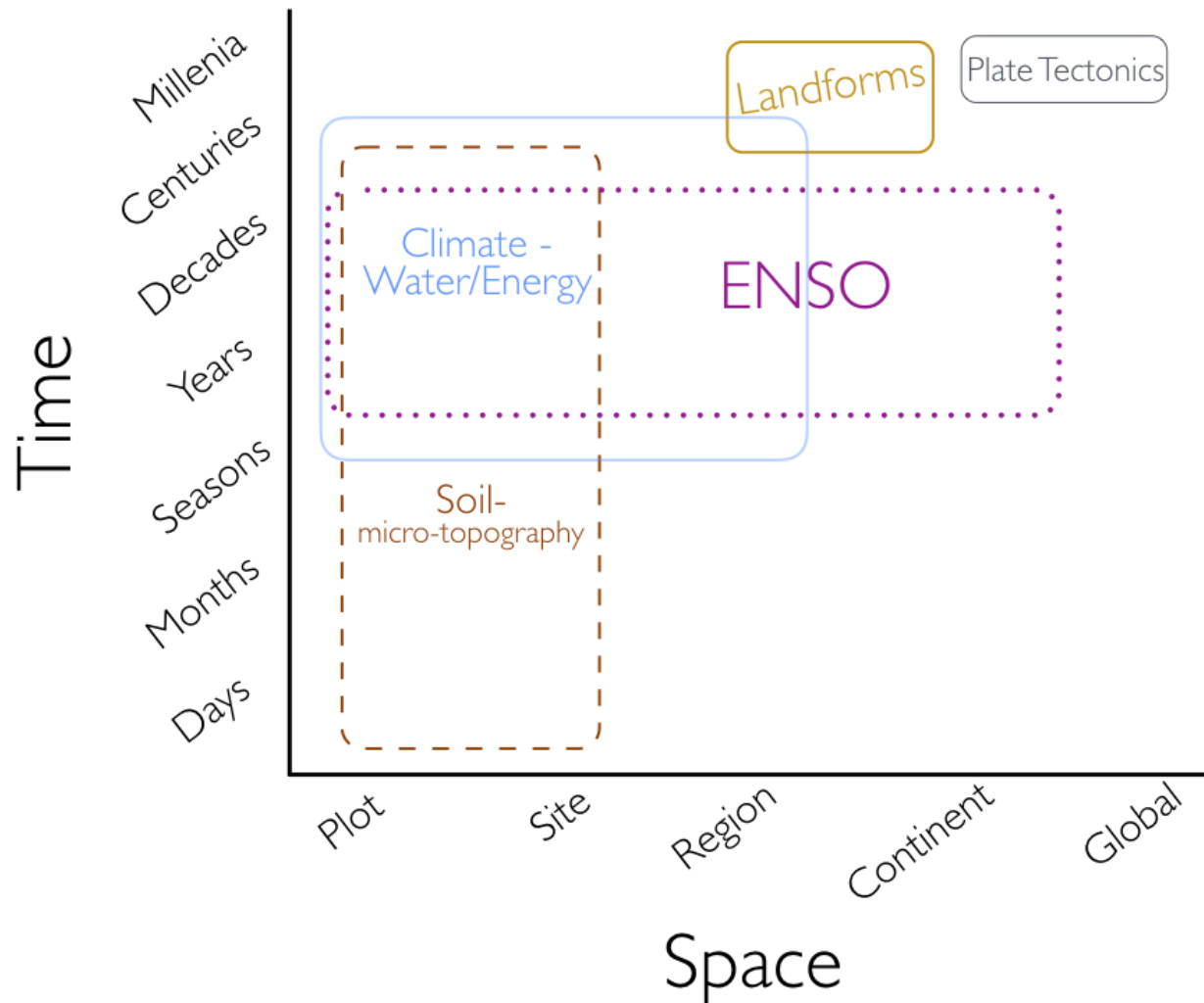
August 2017, Portland, OR

- Ignite session “Connecting remote sensing to biodiversity science in the Anthropocene” on Wednesday morning
- Special evening session “How can current and future satellite missions advance biodiversity science?: A discussion of current tools and future ideas” on Wednesday evening

Thank you!



Geodiversity's influence on biodiversity in space and time



Median Shannon Taxonomic Alpha Diversity

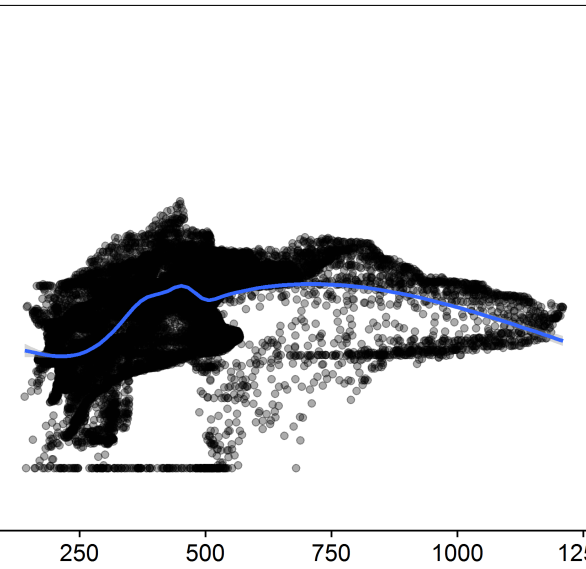
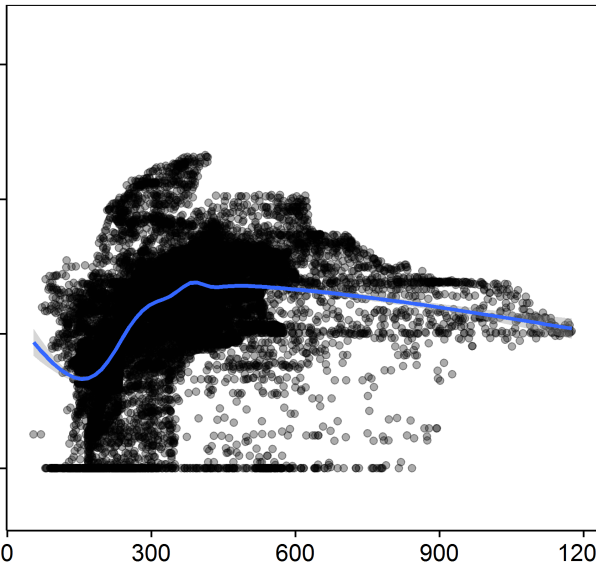
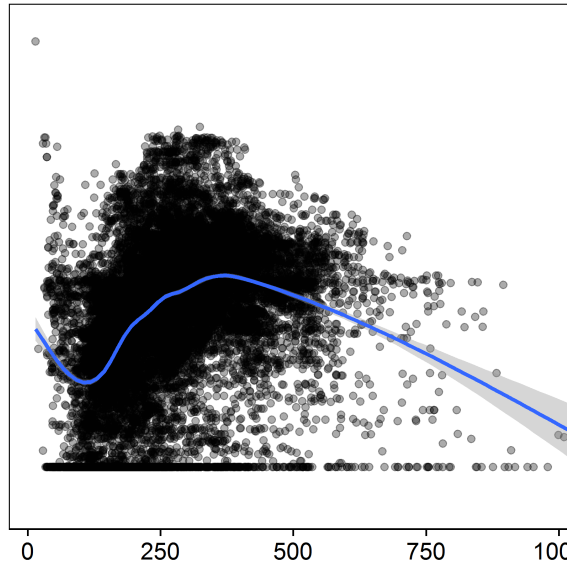
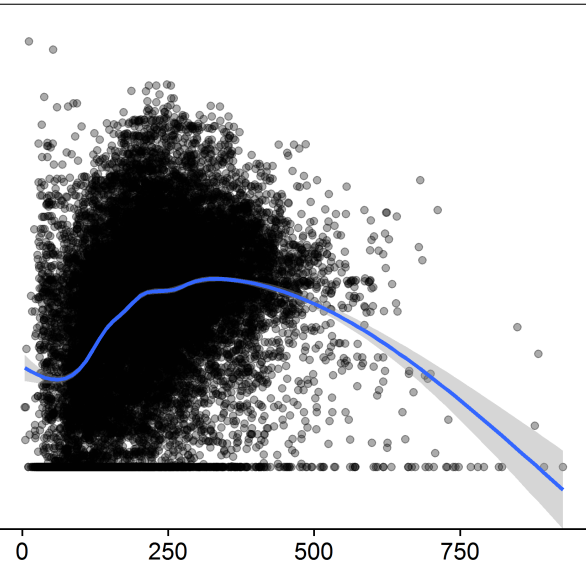
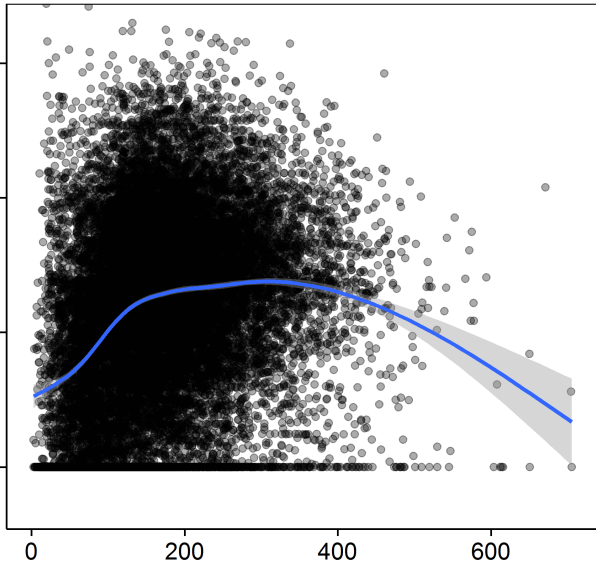
5 km

10 km

20 km

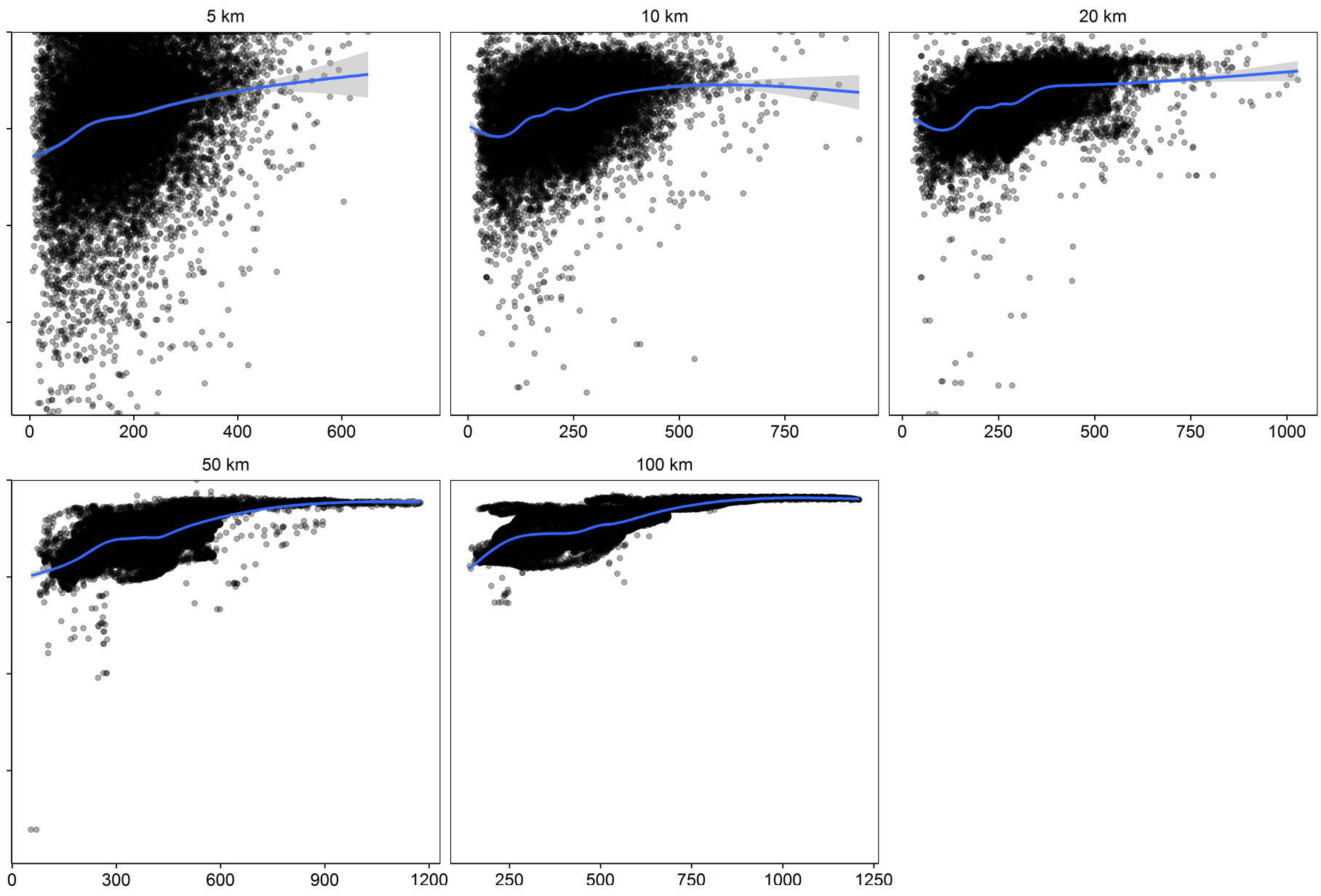
50 km

100 km



Standard deviation of elevation

Median Shannon Taxonomic Beta Diversity



Standard deviation of elevation

BBS: GAM fits by radius

