

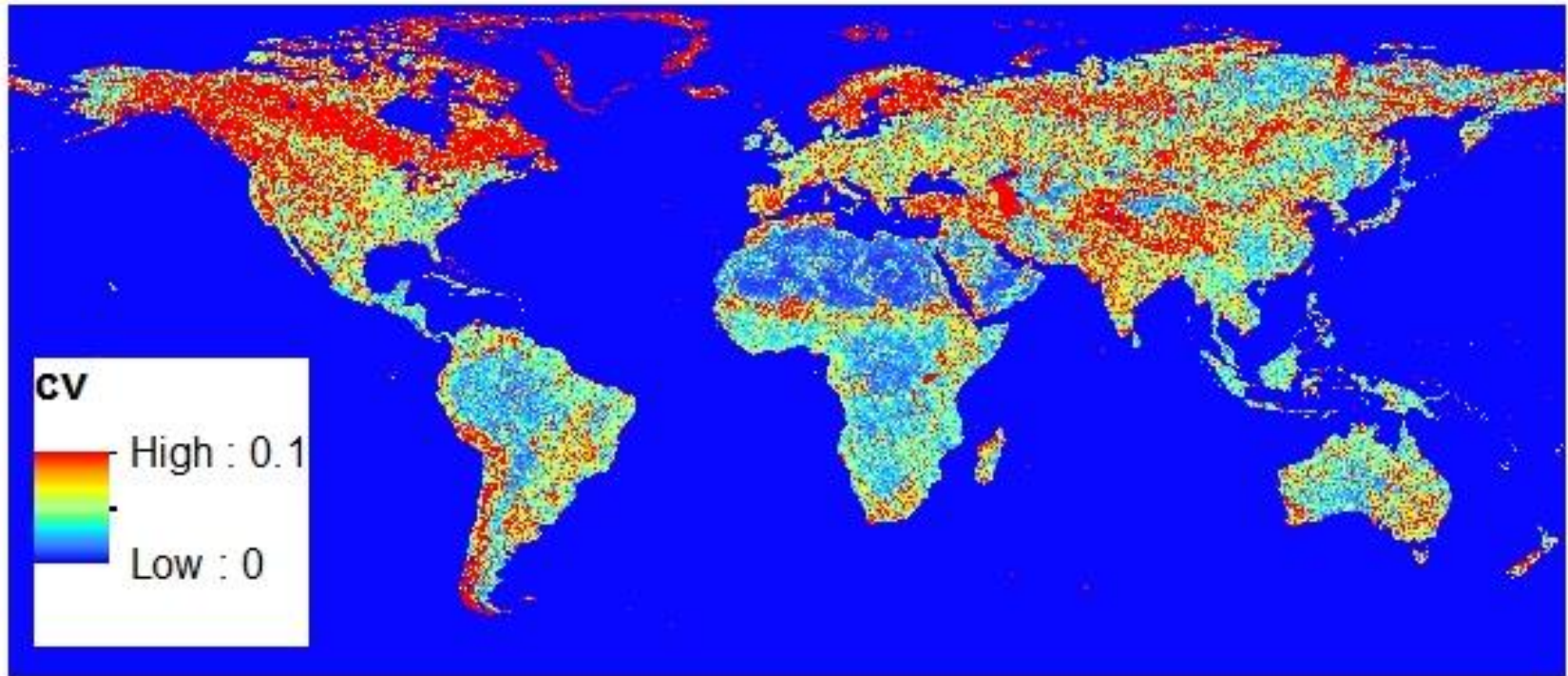
# Habitat Heterogeneity Metrics

7/30/2013

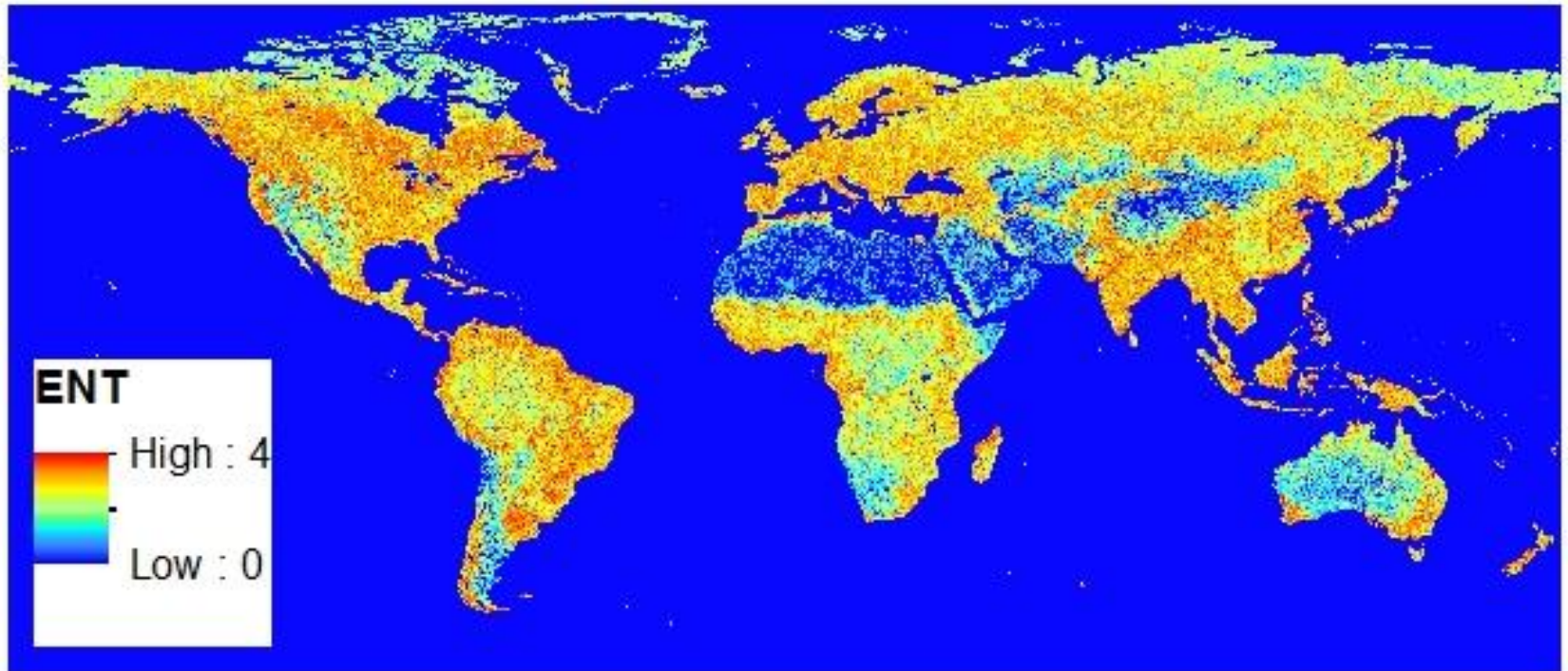
# Heterogeneity Metrics

- Texture measures derived from MODIS EVI
  - 250-m 16-day EVI (MOD13Q1) from 2001 to 2005
  - 95<sup>th</sup> percentile over the 5-year time series
  - First- and second-order texture measures at 30'' (~1km) resolution
    - Mean, max, min, range, std, cv, median, 95<sup>th</sup> percentile, 5<sup>th</sup> percentile, skewness
    - Angular second moment (ASM), Contrast (CON), Correlation (COR), Dissimilarity (DIS), Entropy (ENT), GLCM Maximum (GLCMMAX), GLCM Mean (GLCMMEAN), GLCM Variance (GLCMVAR), Homogeneity (HOM)

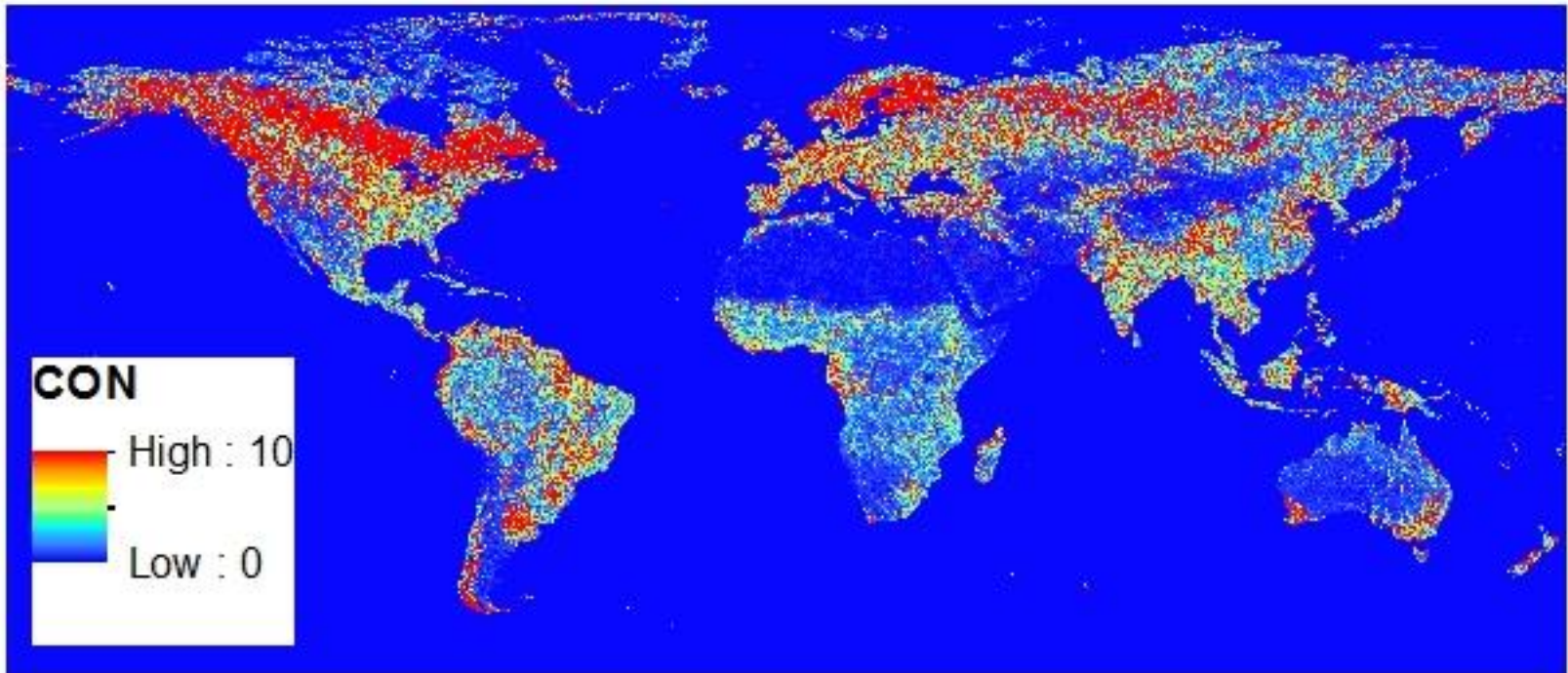
# Coefficient of Variation



# Entropy



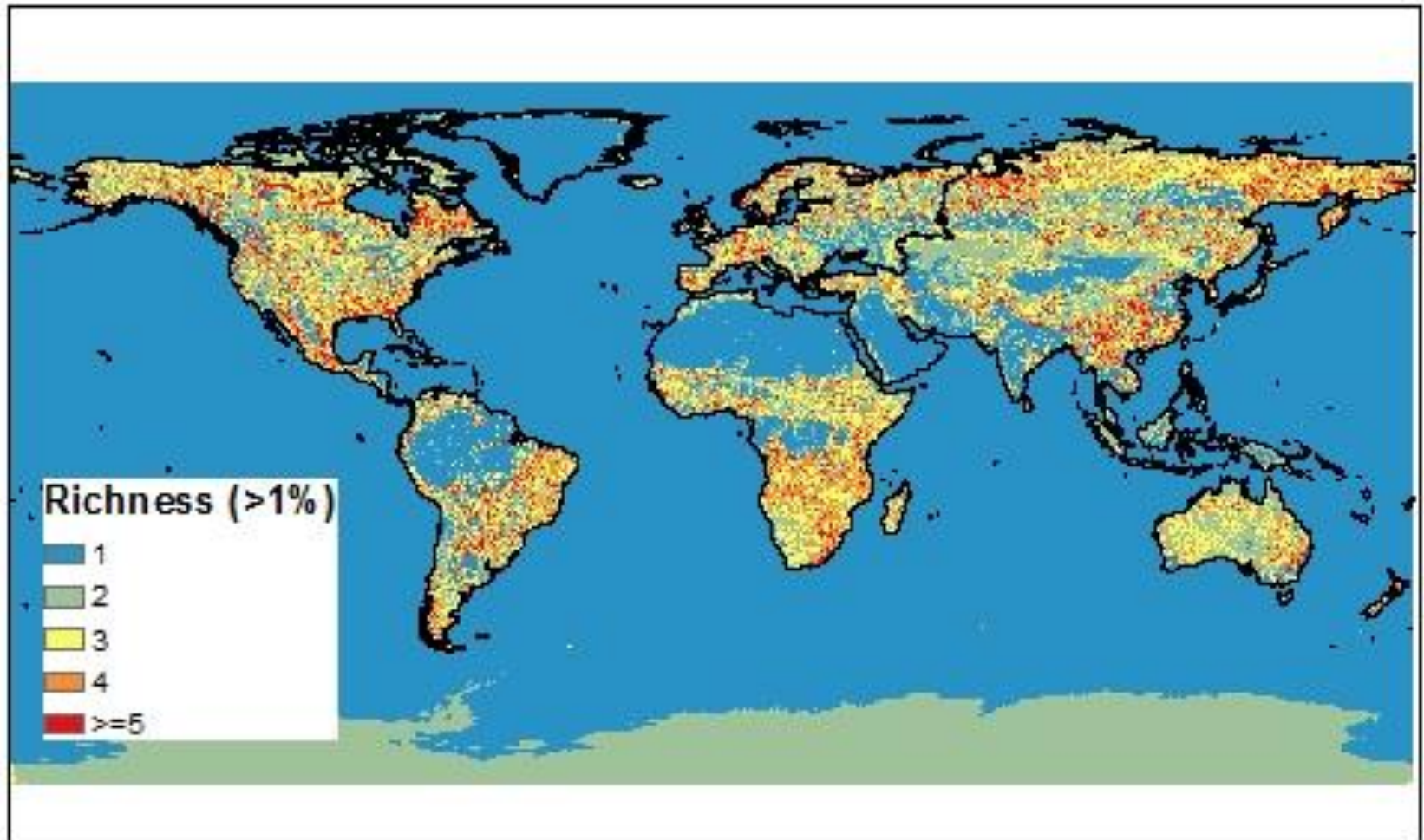
# Contrast



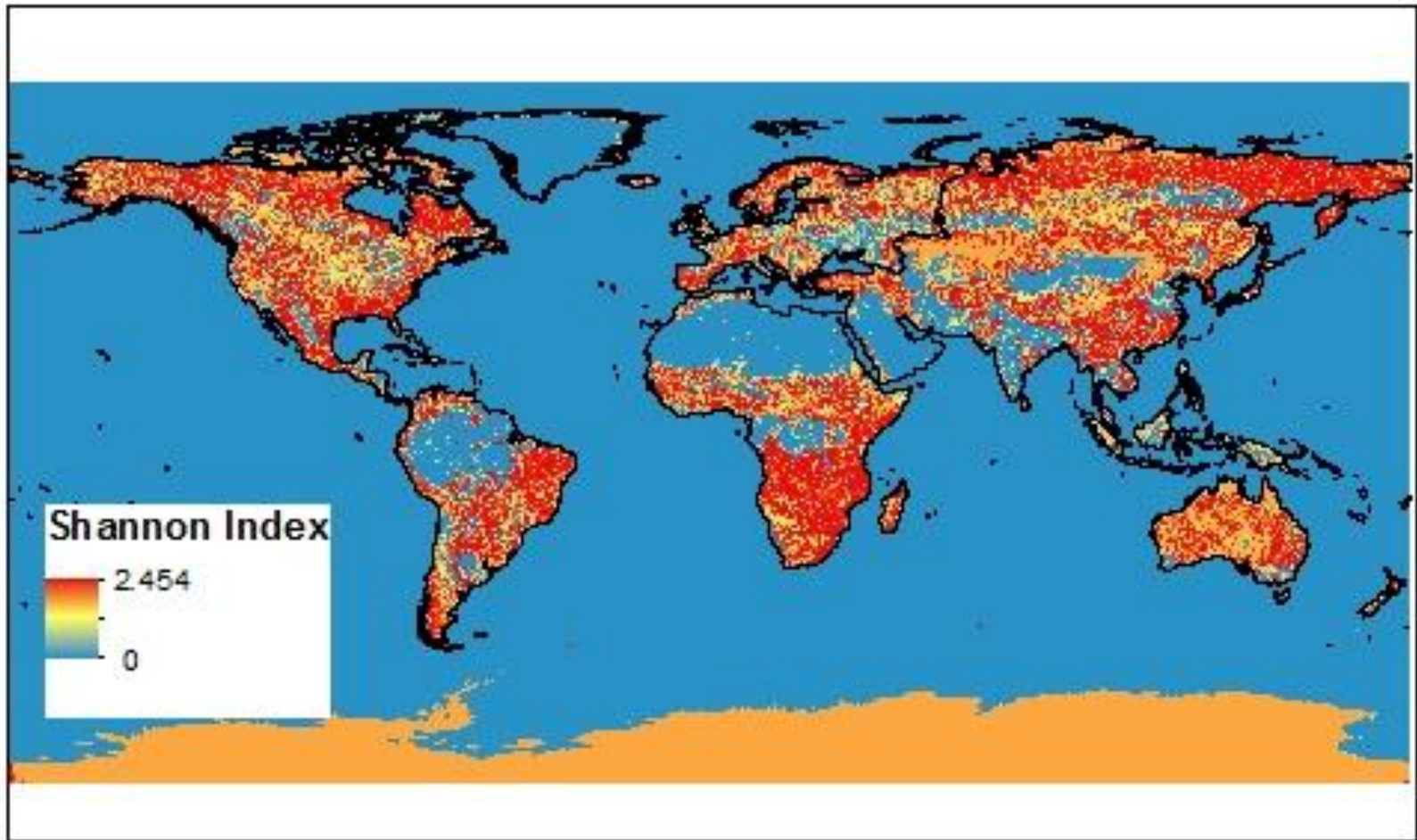
# Heterogeneity Metrics

- Metrics derived from land cover data
  - 3 datasets
    - Consensus land cover (12 classes, 1km)
    - GlobCover (22 classes, 300m)
    - MODIS (17 classes, 500m)
  - Heterogeneity metrics at 30" (~1km) resolution
    - Class richness
    - Shannon diversity index
    - Simpson diversity index
    - Pielou evenness index

# Land Cover Class Richness (Consensus land cover)

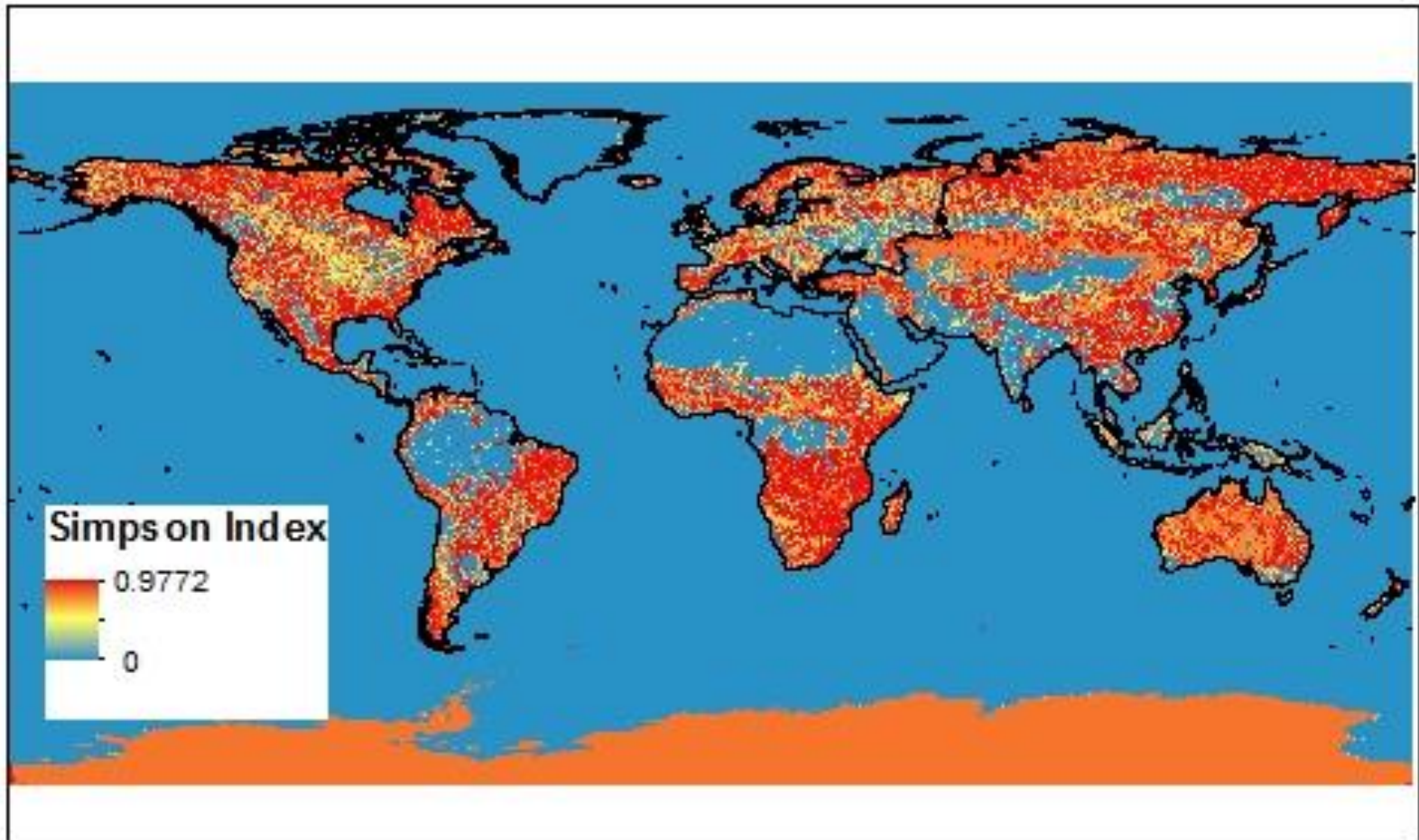


# Shannon Diversity Index (Consensus land cover)

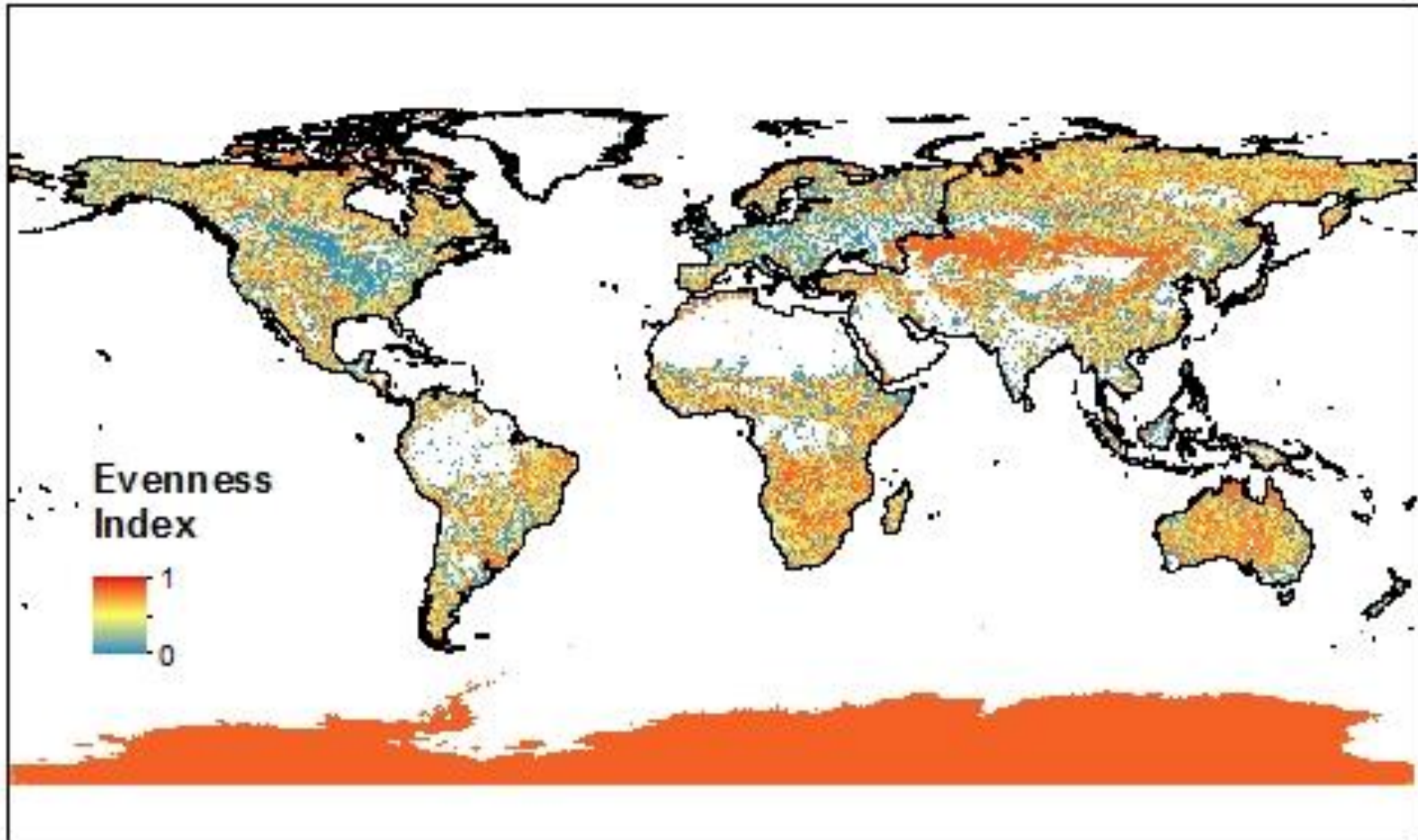




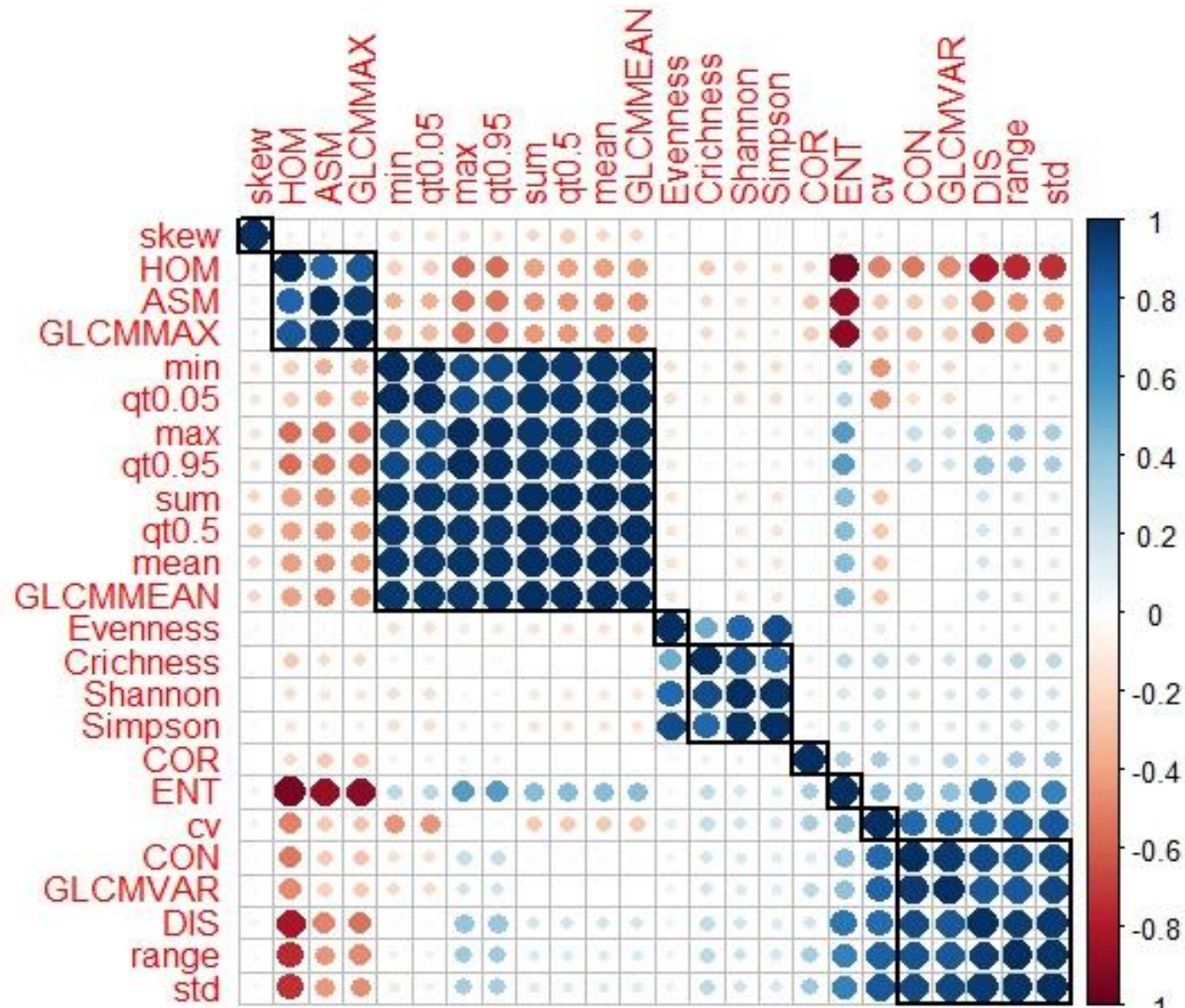
# Simpson Diversity Index (Consensus land cover)



# Pielou Evenness Index (Consensus land cover)

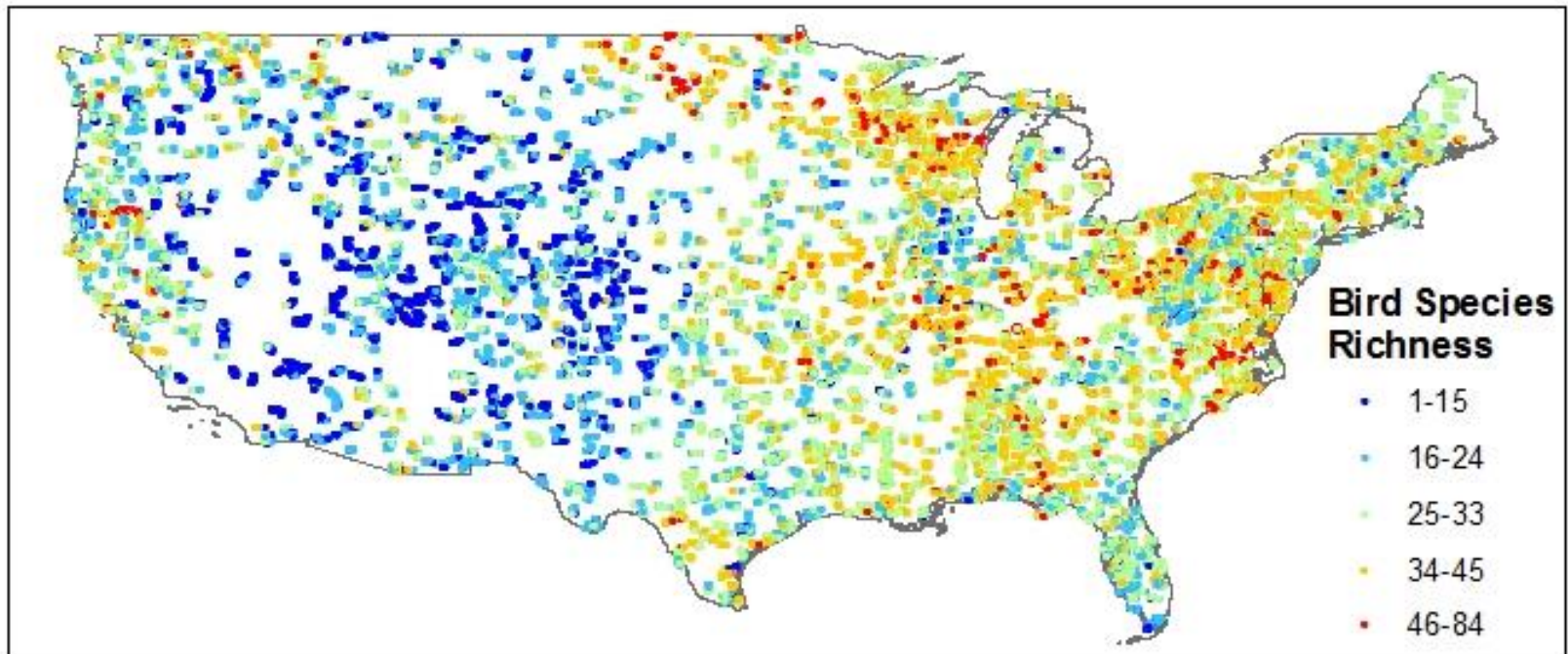


# Correlations between Metrics (Conterminous US)



# Bird Species Richness

- BBS stop-level data from 1997 to 2011
- 115,300 stops (2,306 routes) were surveyed at least 10 times during the period



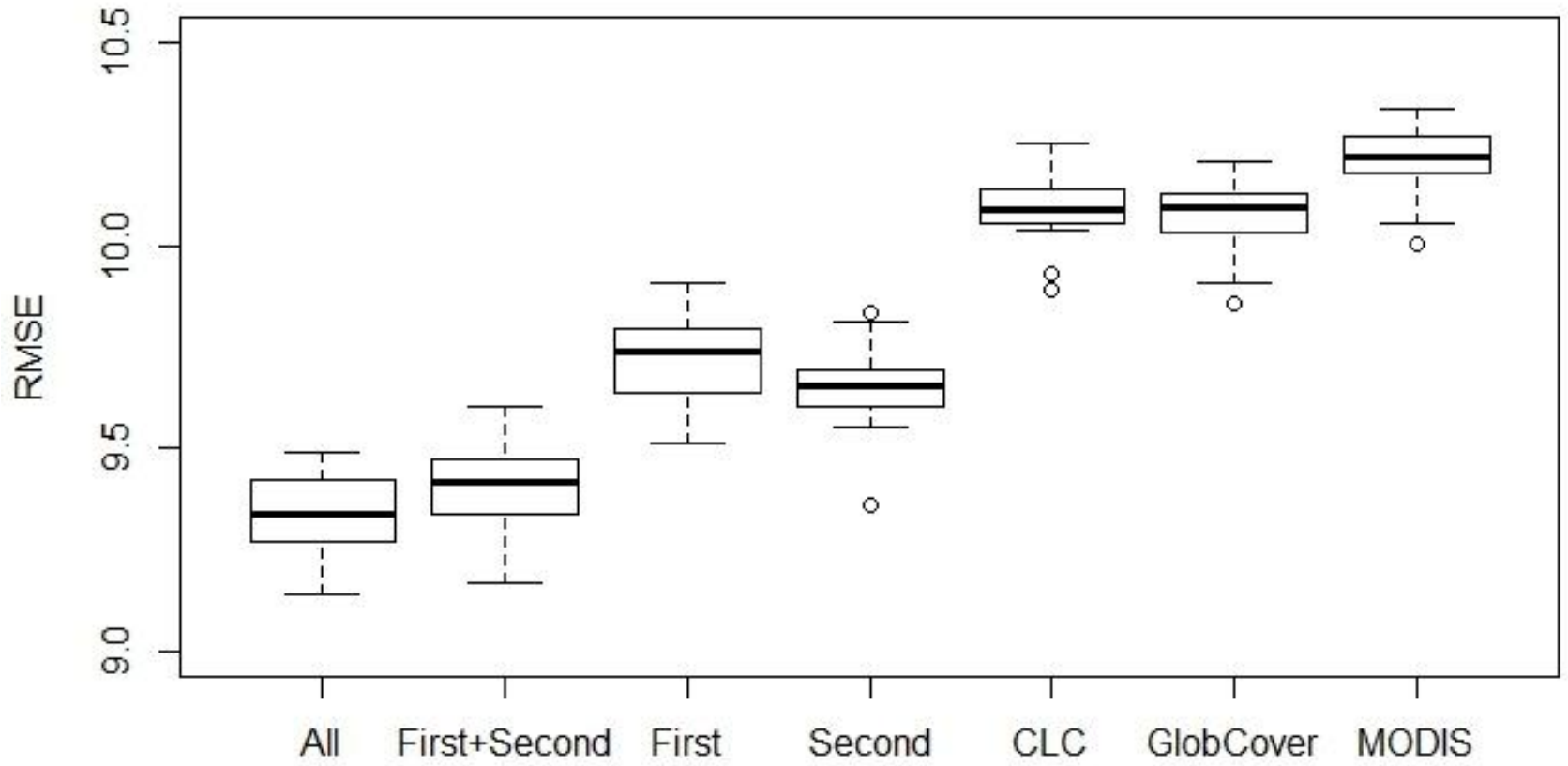
# Correlations with Bird Species Richness

Metrics	r	Metrics	r	Metrics	r
<b>Group 1</b>		<b>Group 3</b>		<b>Group 5</b>	
skew	<b>-0.081</b>	max	0.494	Richness	<b>0.146</b>
<b>Group 2</b>		mean	<b>0.496</b>	Shannon	0.072
HOM	<b>-0.301</b>	min	0.470	Simpson	0.050
ASM	<b>-0.330</b>	5 <sup>th</sup>	0.472		
GLCMMAX	<b>-0.315</b>	median	0.495	<b>Group 8</b>	
ENT	0.315	95 <sup>th</sup>	0.495	CON	0.016
<b>Group 4</b>		GLCMMEAN	0.495	GLCMVAR	0.008
Evenness	<b>0.055</b>			DIS	<b>0.133</b>
<b>Group 6</b>		<b>Group 7</b>		range	0.119
COR	<b>0.036</b>	cv	<b>-0.075</b>	std	0.105

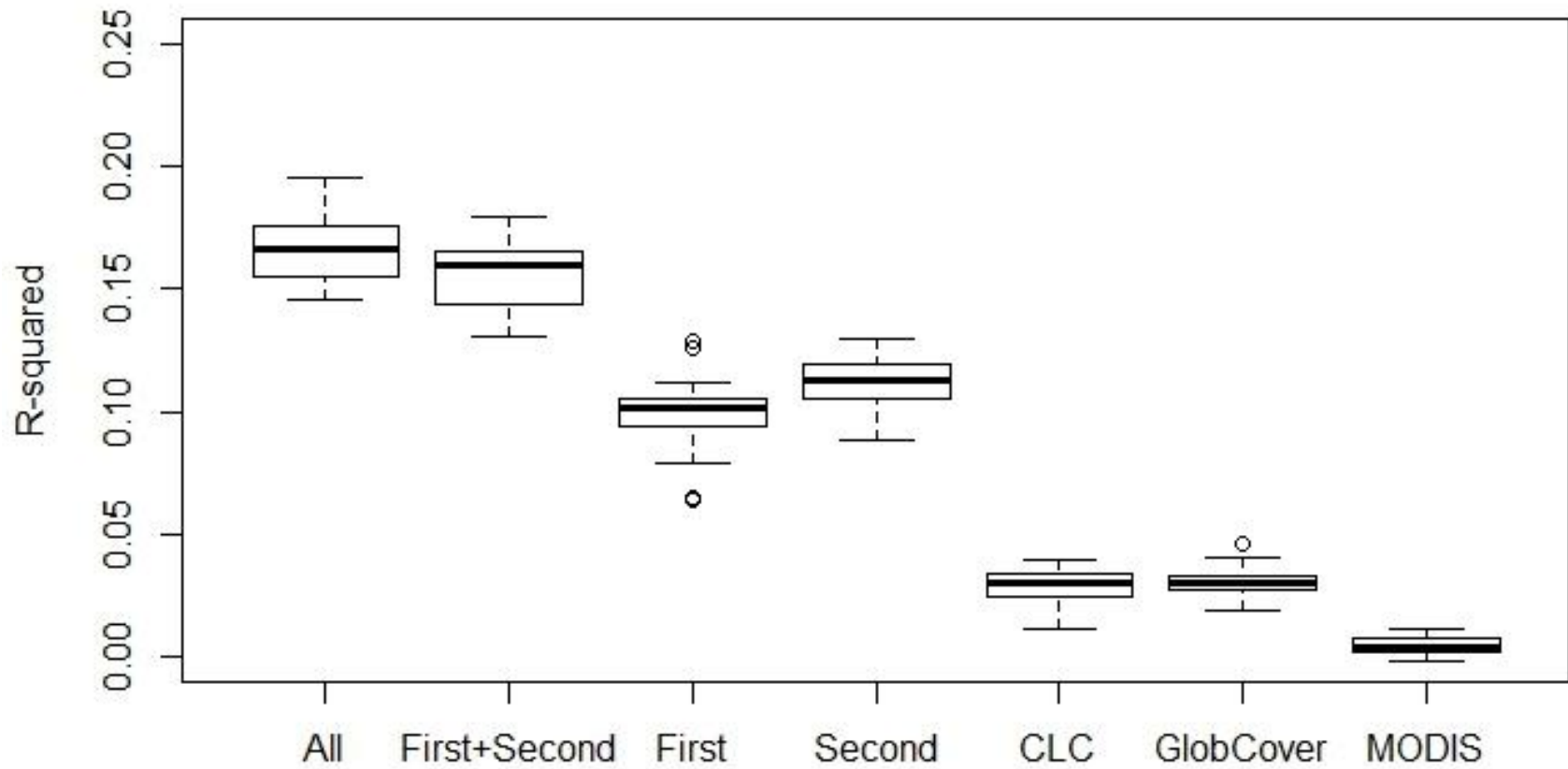
# Modeling Bird Species Richness

- Multiple linear regression
- 20 sets of randomly selected stops (one for each route) for building the models
- Another 20 sets of stops for testing
- Seven models
  - All:  $\text{richness} \sim \text{skew} + \text{cv} + \text{ASM} + \text{COR} + \text{DIS} + \text{Evenness} + \text{Crichness}$
  - First+Second:  $\text{richness} \sim \text{skew} + \text{cv} + \text{ASM} + \text{COR} + \text{DIS}$
  - First:  $\text{richness} \sim \text{skew} + \text{cv} + \text{range}$
  - Second:  $\text{richness} \sim \text{ASM} + \text{COR} + \text{DIS}$
  - CLC/GlobCover/MODIS:  
 $\text{richness} \sim \text{Evenness} + \text{Crichness} + \text{Simpson}$

# RMSE



# Adjusted R2





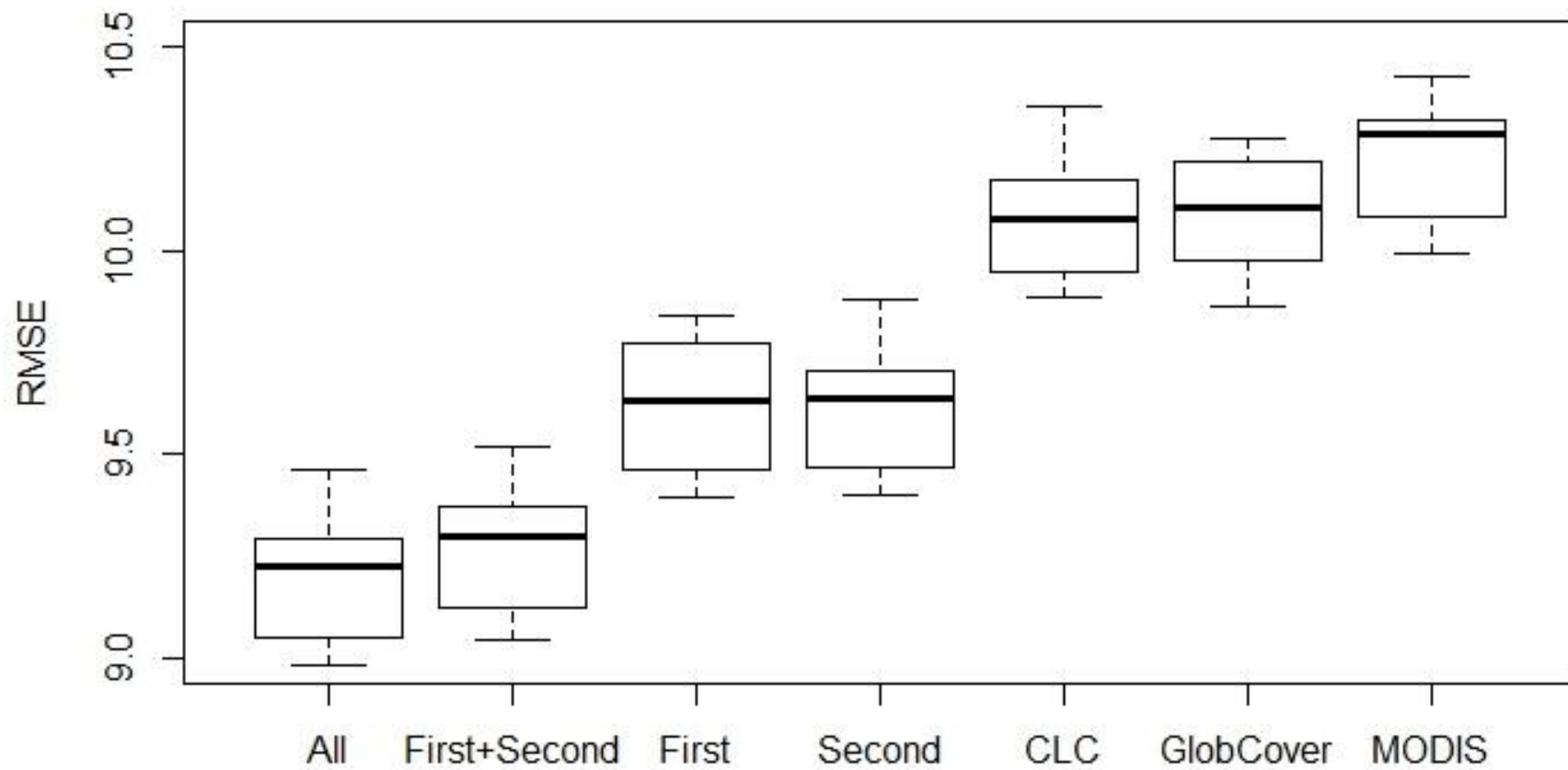
# Significant Variables

- Bird Species Richness ↑
  - cv ↓
  - range ↑
  - ASM ↓ (less orderly)
  - DIS ↑ (higher dissimilarity)
  - Land Cover Class Richness ↑

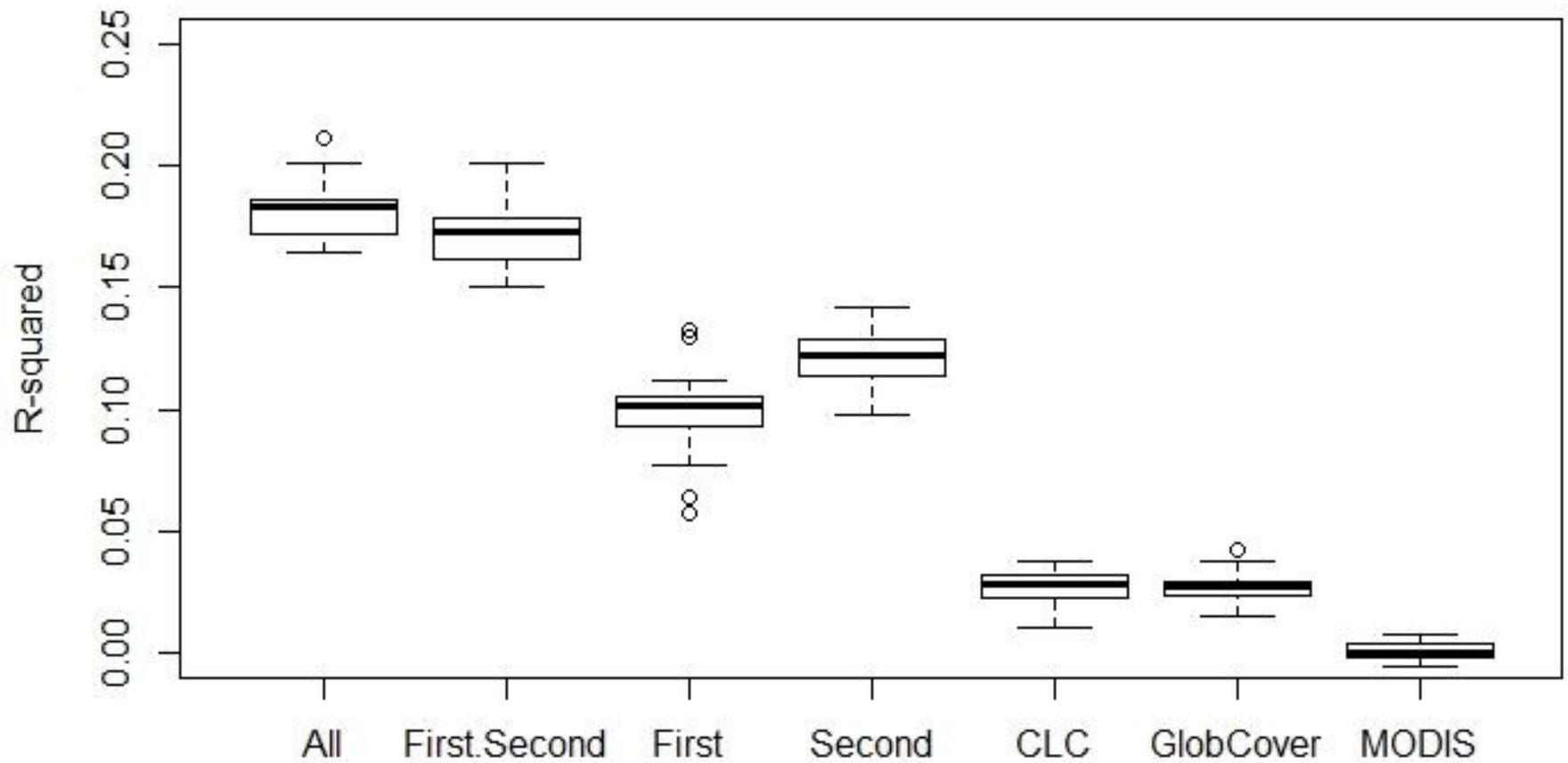
# Modeling Bird Species Richness

- Multiple linear regression with PCA
- Seven models (with PCs account for >99% variation)
  - All: richness  $\sim$  First 10 PCs
  - First+Second: richness  $\sim$  First 8 PCs
  - First: richness  $\sim$  First 3 PCs
  - Second: richness  $\sim$  First 5 PCs
  - CLC/GlobCover/MODIS: richness  $\sim$  First 3 PCs

# RMSE



# Adjusted R2



# Significant Variables

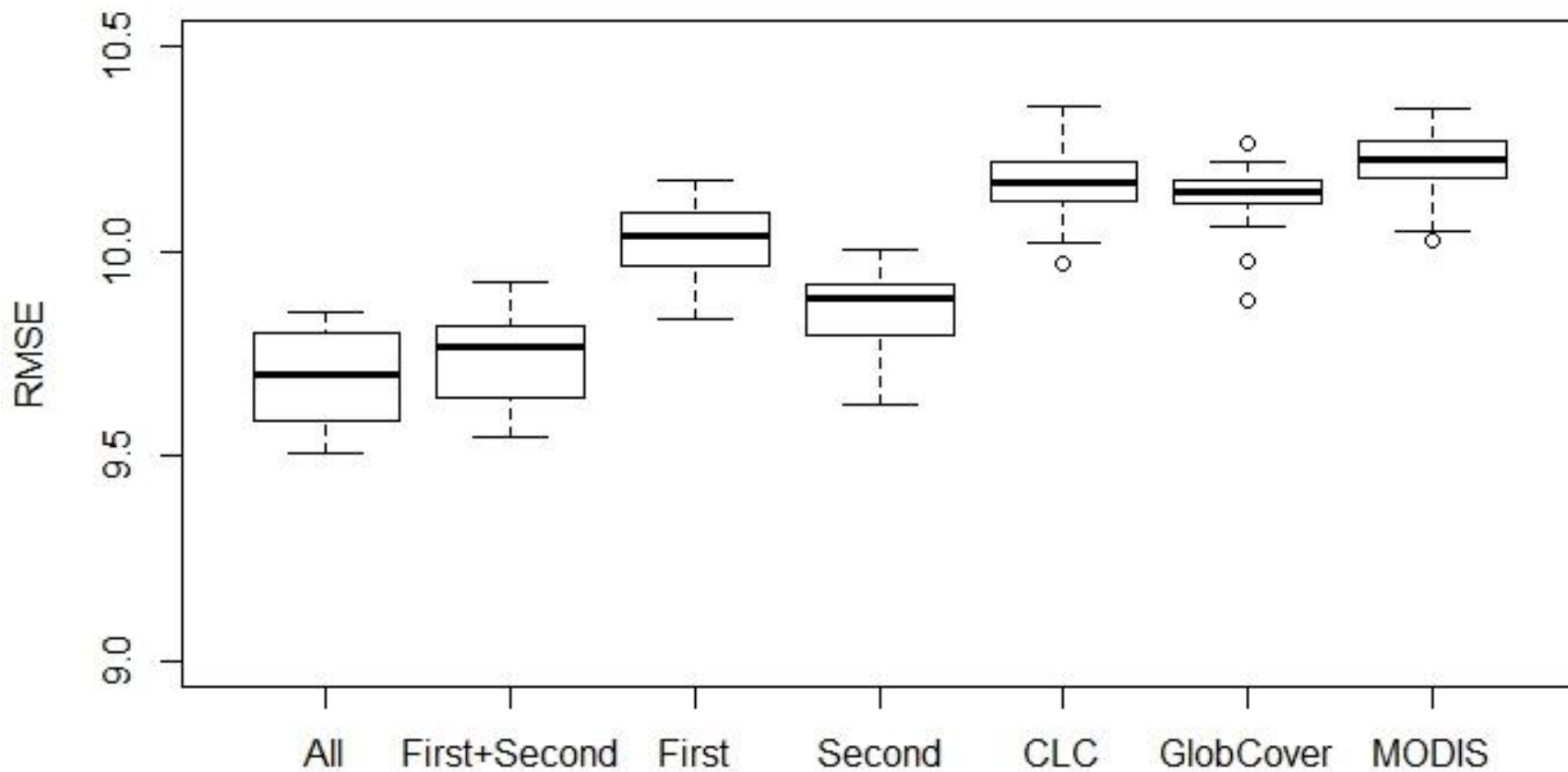
- Most important variables:
  - PC3 (+), PC8 (+) , PC9 (+)
- Richness ↑
  - cv ↓
  - range ↑
  - ASM ↓ (less orderly)
  - CON ↓ (less contrast)
  - ENT ↑ (more disorderly)
  - GLCMMAX ↓ (less dominant)
  - GLCMVAR ↓ (higher variance)

Loadings	PC3	PC8	PC9
cv	-0.28	<b>-0.88</b>	-0.16
range	-0.15	0.06	<b>0.69</b>
skew	-0.08	0.14	0.01
std	-0.18	0.07	0.25
ASM	<b>-0.47</b>	0.12	<b>-0.41</b>
CON	<b>-0.32</b>	0.27	-0.17
COR	0.04	0.19	-0.11
DIS	-0.11	0.16	-0.12
ENT	<b>0.35</b>	0.07	-0.24
GLCMMAX	<b>-0.46</b>	0.07	0.12
GLCMVAR	<b>-0.34</b>	0.19	-0.21
HOM	-0.27	-0.06	0.31
Richness	0.04	0.03	0.02
Evenness	-0.01	0.03	0.05
Shannon	0.01	-0.01	-0.04
Simpson	0.01	-0.00	-0.03

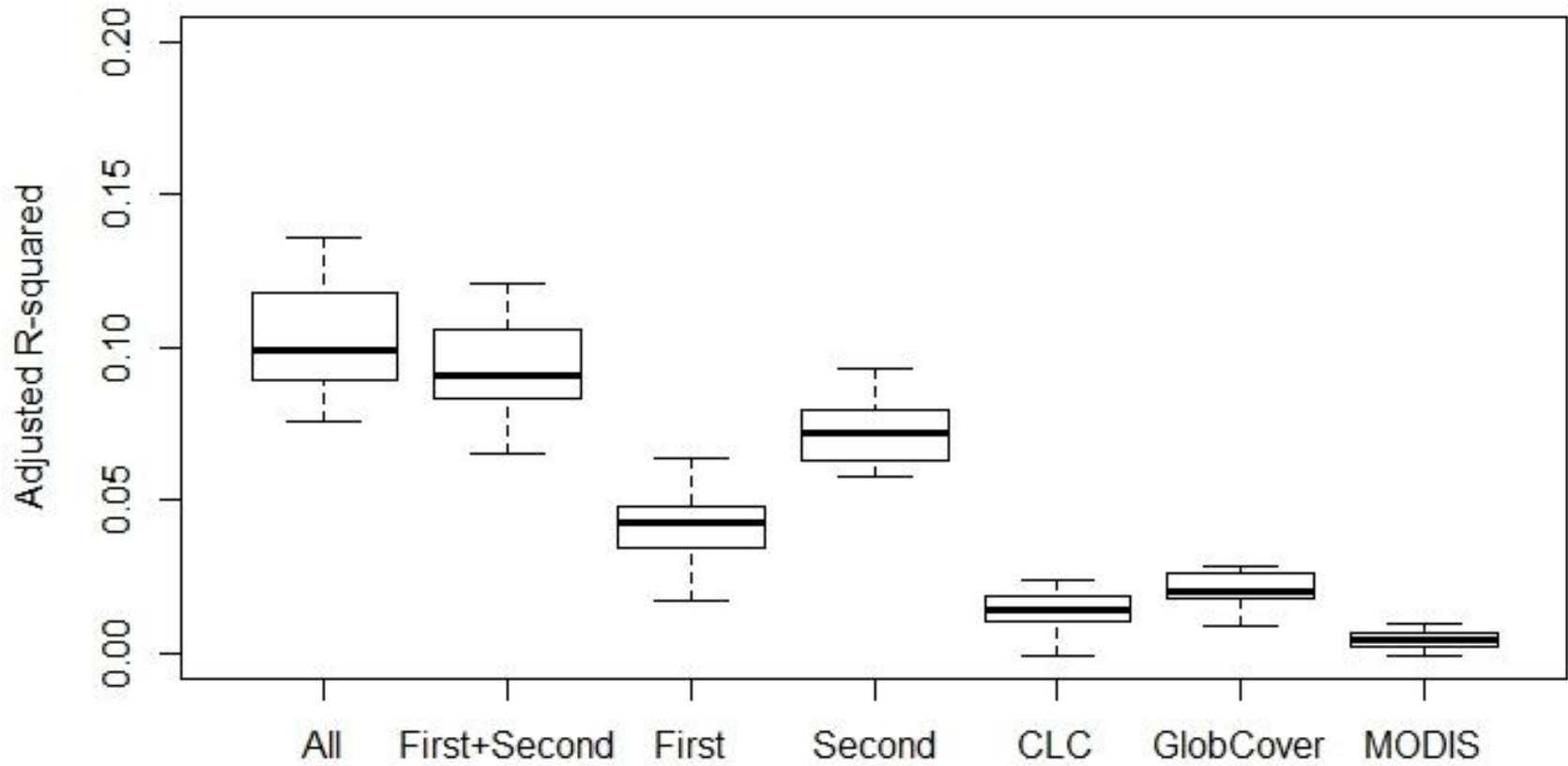
# Modeling Bird Species Richness

- Spatial autoregressive error model
- 20 sets of randomly selected stops (one for each route)
- Seven models
  - All:  $\text{richness} \sim \text{skew} + \text{cv} + \text{ASM} + \text{COR} + \text{DIS} + \text{Evenness} + \text{Crichness}$
  - First+Second:  $\text{richness} \sim \text{skew} + \text{cv} + \text{ASM} + \text{COR} + \text{DIS}$
  - First:  $\text{richness} \sim \text{skew} + \text{cv} + \text{range}$
  - Second:  $\text{richness} \sim \text{ASM} + \text{COR} + \text{DIS}$
  - CLC/GlobCover/MODIS:  
 $\text{richness} \sim \text{Evenness} + \text{Crichness} + \text{Simpson}$

# RMSE



# Adjusted pseudo-R2





# Significant Variables

- Bird Species Richness ↑
  - ASM ↓ (less orderly)
  - Land Cover Class Richness ↑

# Next Step

- Functional diversity of avian community