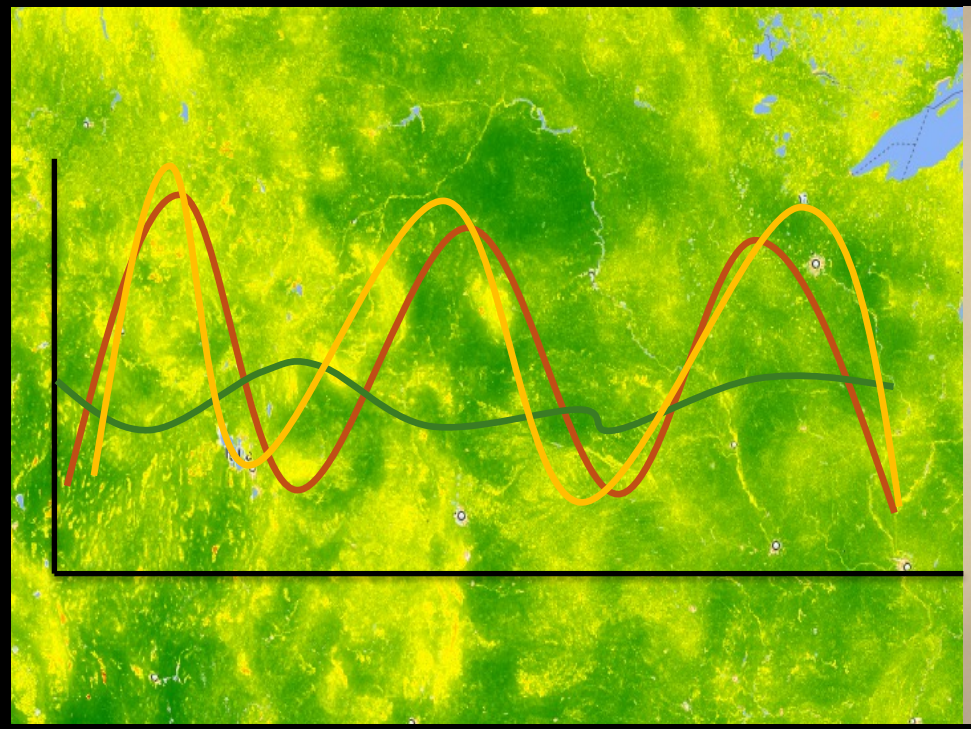
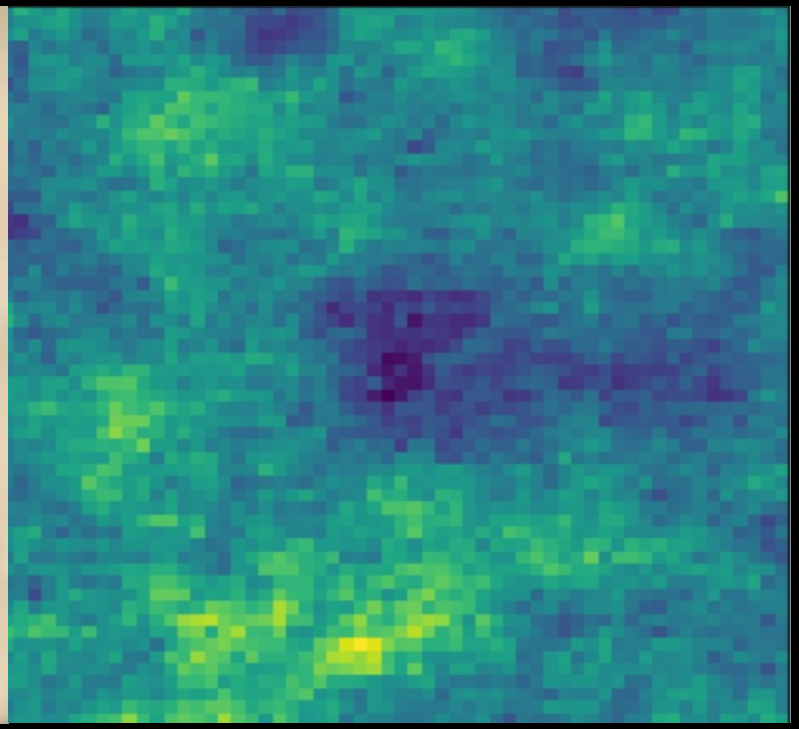
Multiple spatial scales, long-term trends, and synchrony of the dynamic habitat indices and bird populations

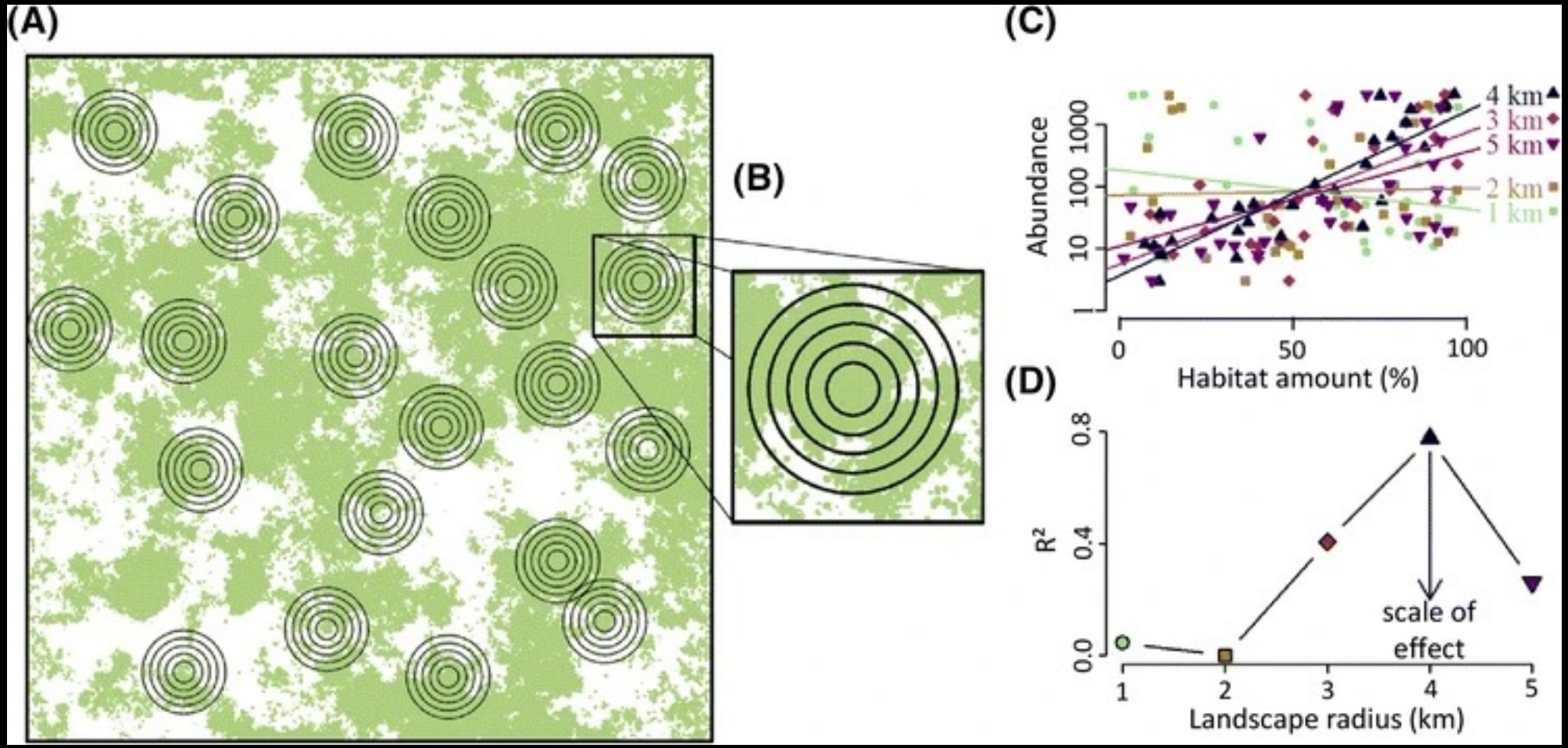




Volker C Radeloff, Akash Anand, Ryan Buron, University of Wisconsin-Madison

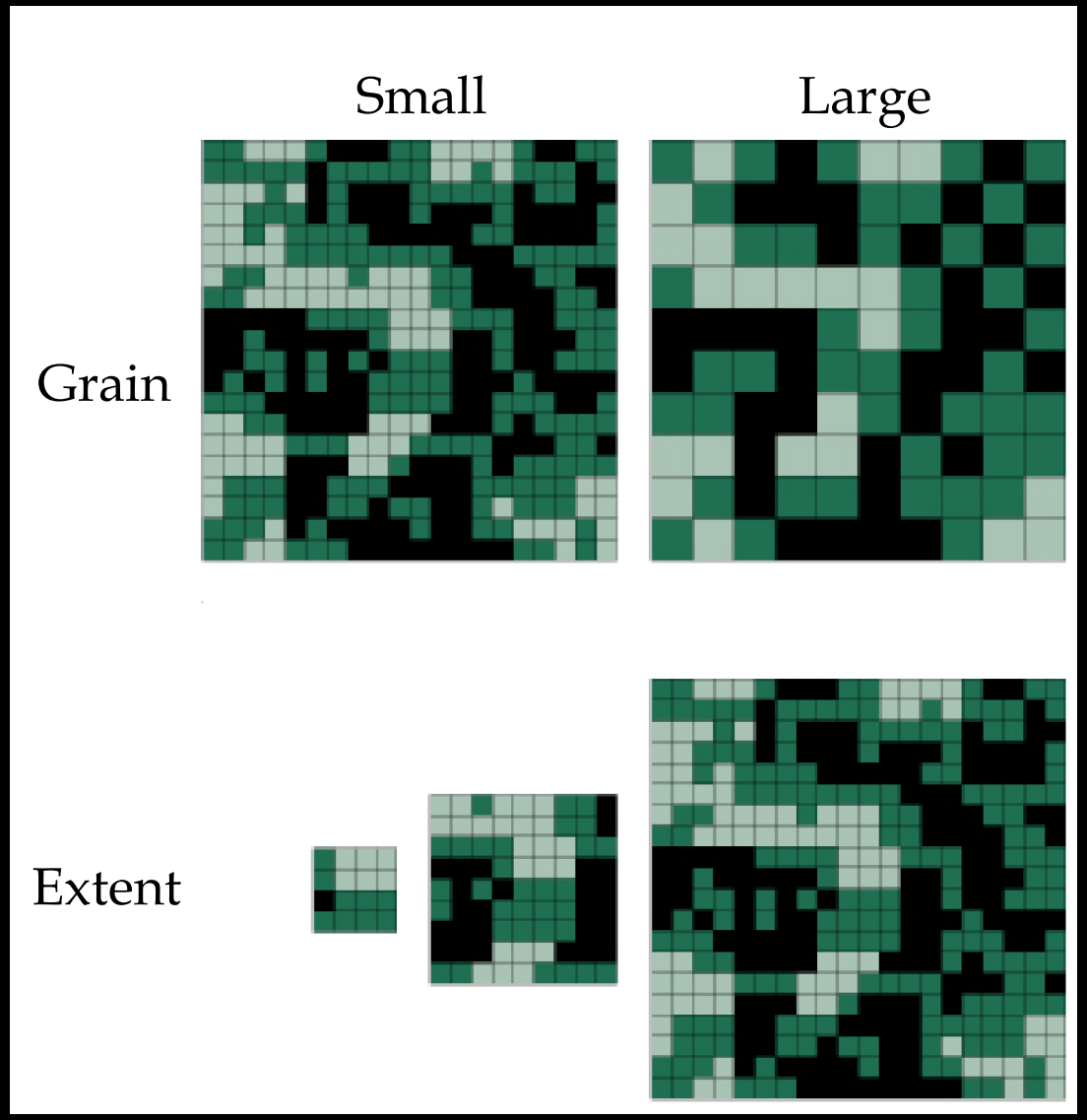
A. M. Pidgeon, B. Zuckerberg, E. Silveira, A. Ives, L. Farwell, A. Bar-Massada, N. Coops, and M. Hobi

Introduction



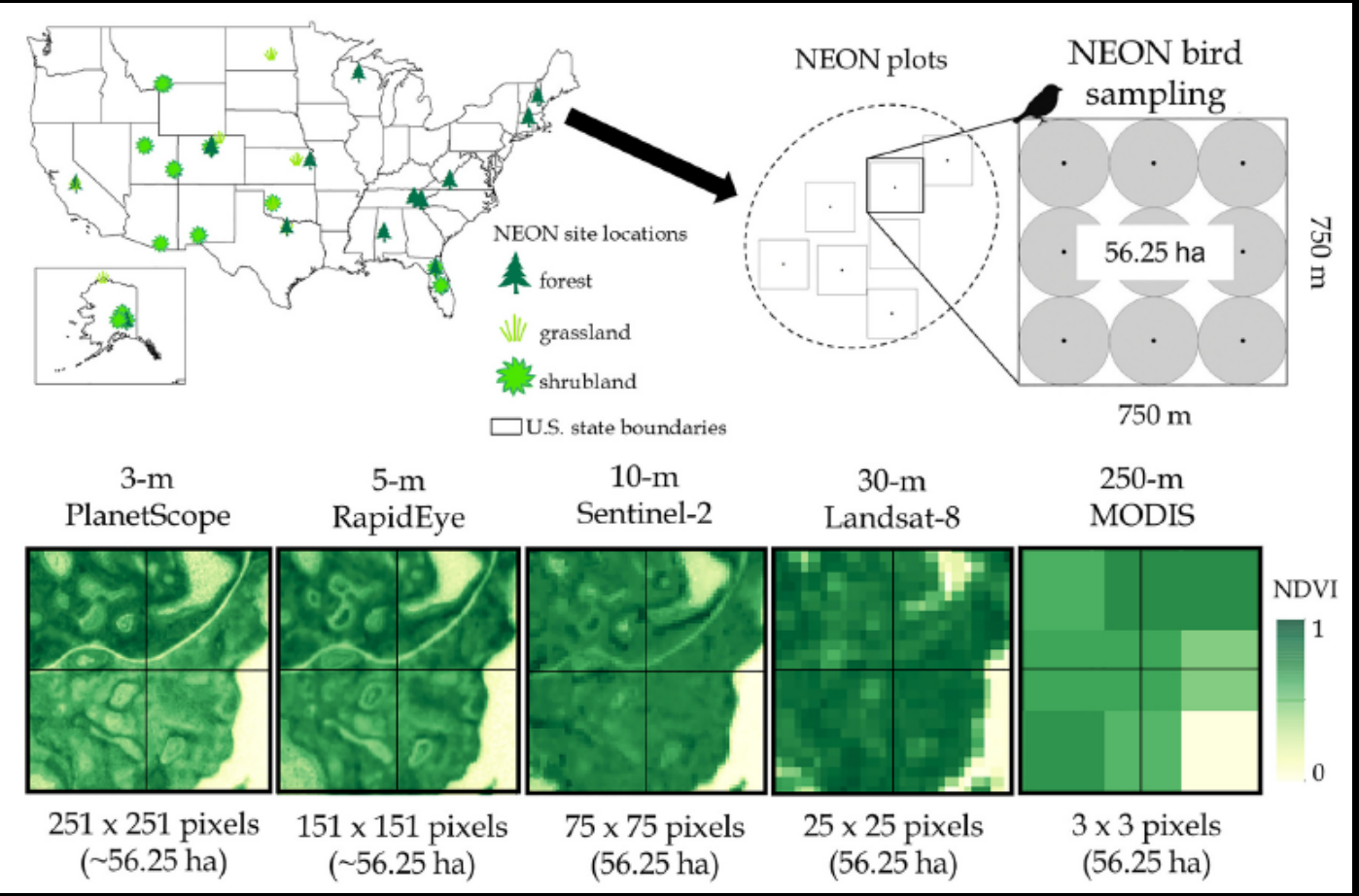
Miguet et al., 2015, Landscape Ecology, 31:1177-94

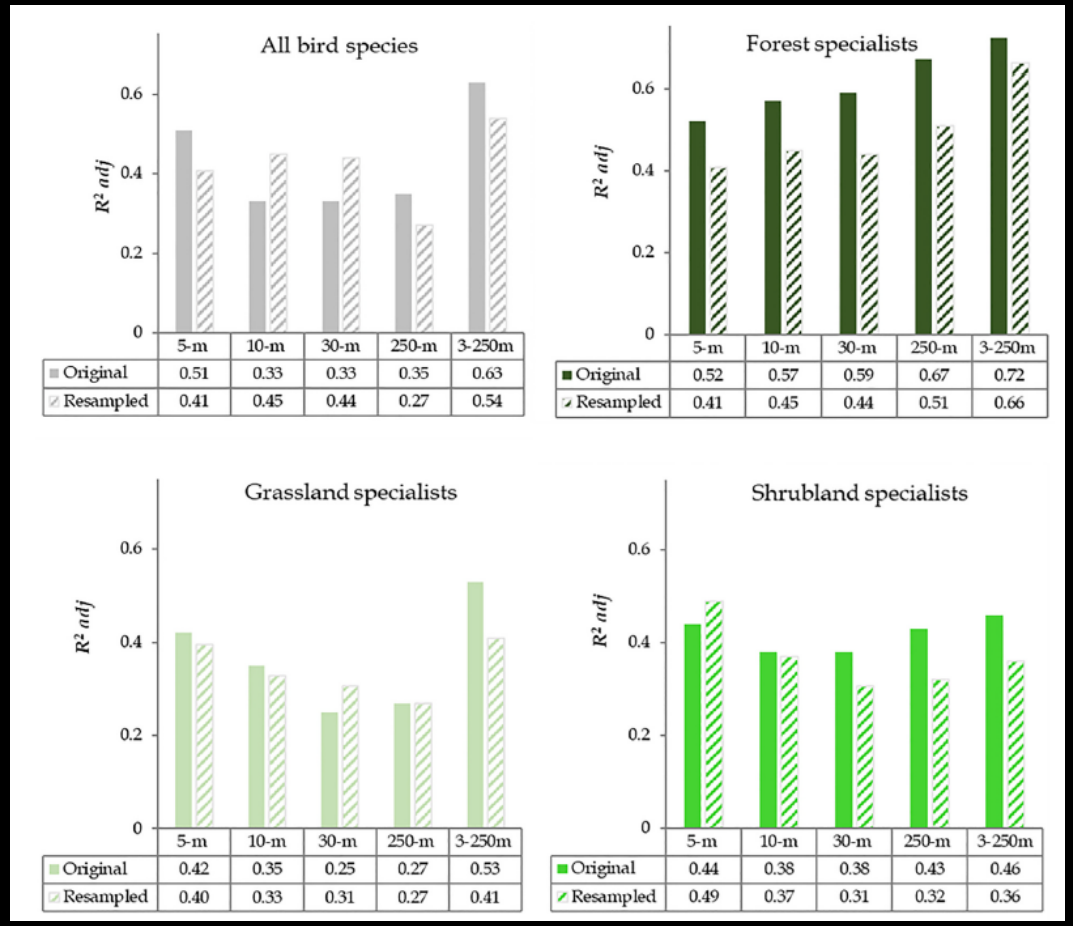
Introduction



A. Hansen, MSU

Introduction





All bird species	5-m	10-m	30-m	250-m	3-250m
Original	0.51	0.33	0.33	0.35	0.63
Resampled	0.41	0.45	0.44	0.27	0.54

Forest specialists	5-m	10-m	30-m	250-m	3-250m
Original	0.52	0.57	0.59	0.67	0.72
Resampled	0.41	0.45	0.44	0.51	0.66

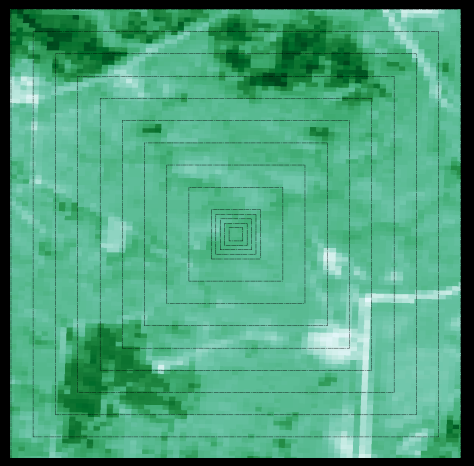
Grassland specialists	5-m	10-m	30-m	250-m	3-250m
Original	0.42	0.35	0.25	0.27	0.53
Resampled	0.40	0.33	0.31	0.27	0.41

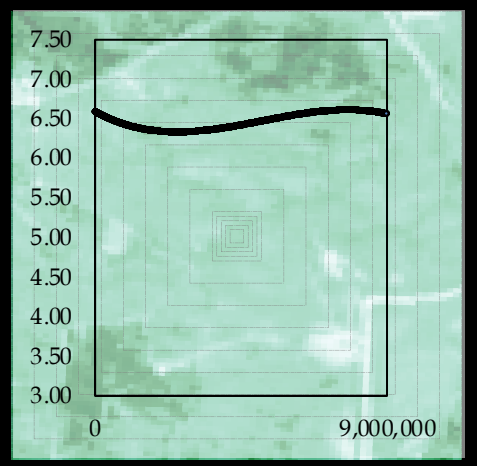
Shrubland specialists	5-m	10-m	30-m	250-m	3-250m
Original	0.44	0.38	0.38	0.43	0.46
Resampled	0.49	0.37	0.31	0.32	0.36

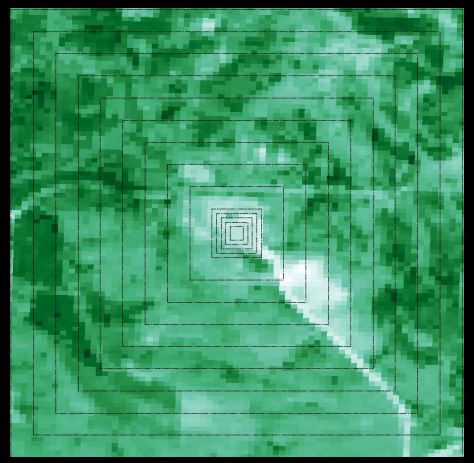
Silveira et al., 2023, *Remote Sensing of Environment*, 295:113661

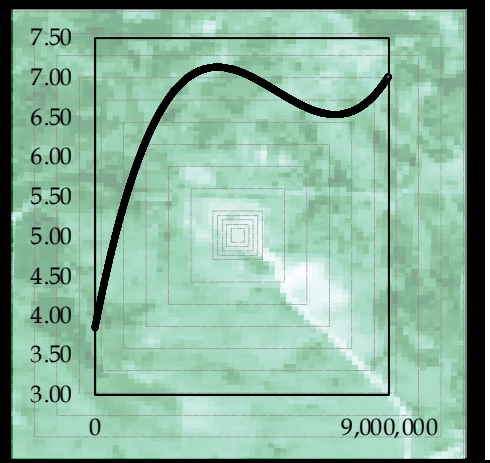
Introduction

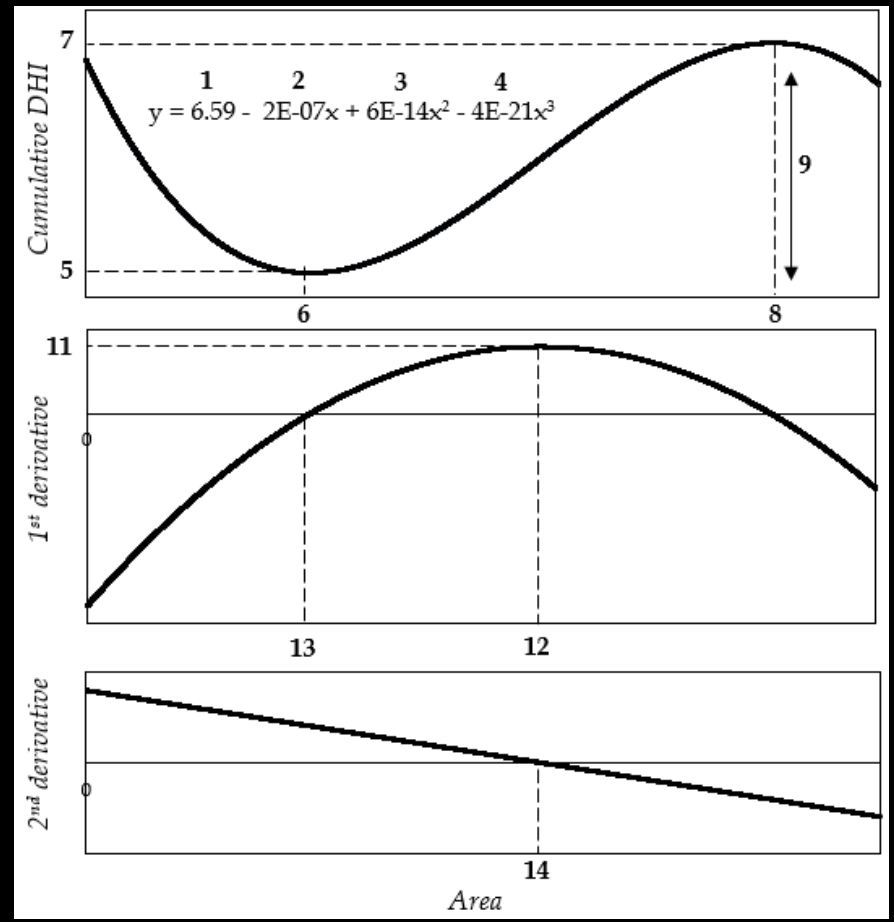
Scalograms











https://github.com/anand97aakash/scalogram

Silveira et al., *Ecography*, in review

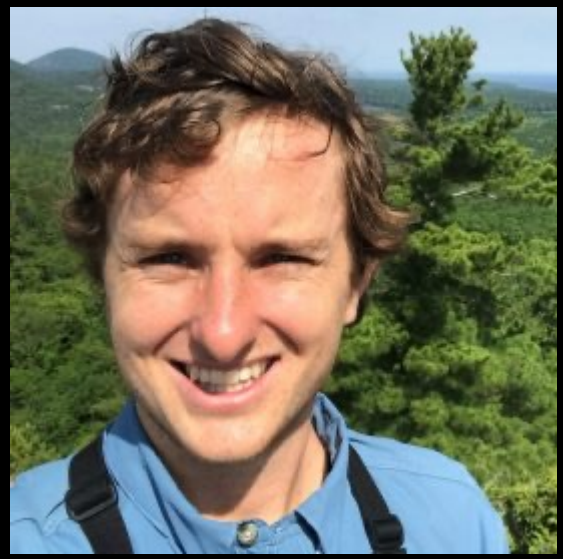
Questions

1. But what about space vs. time?

2. Can CNNs do multiscale?

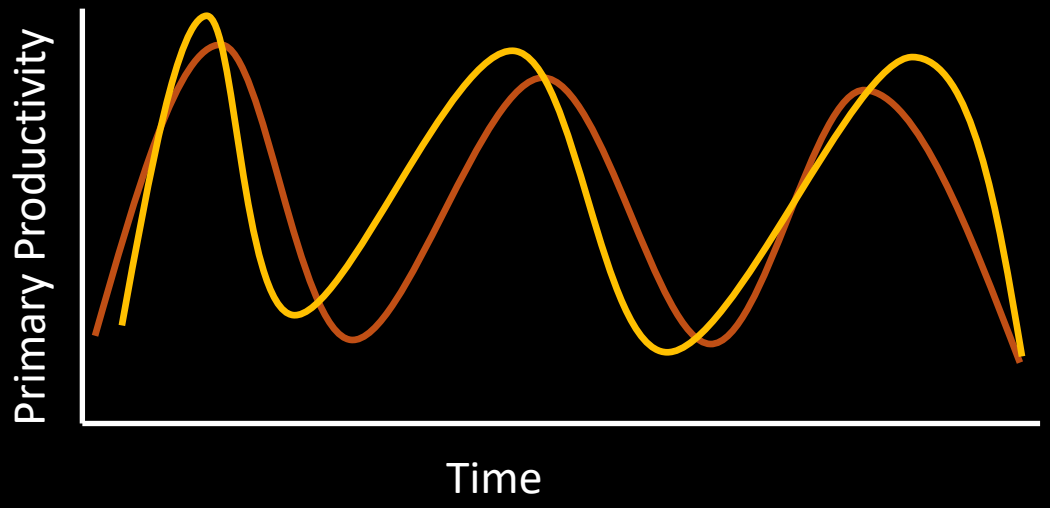
Questions

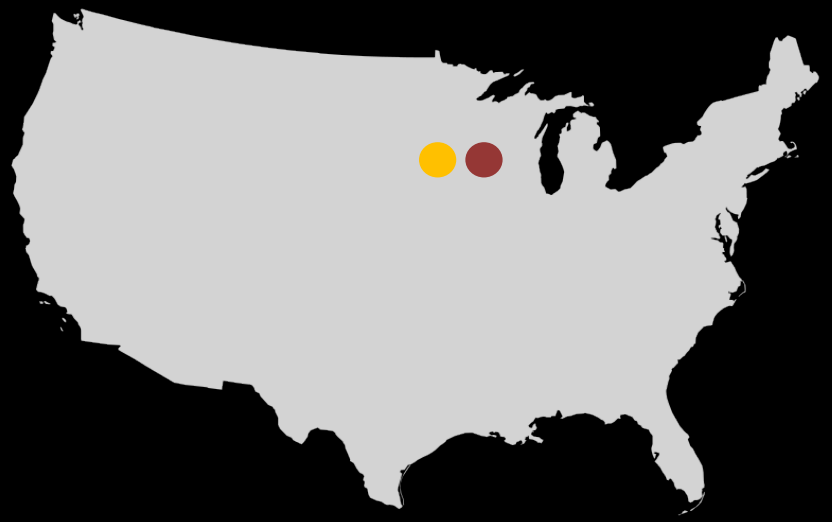
1. But what about space vs. time?



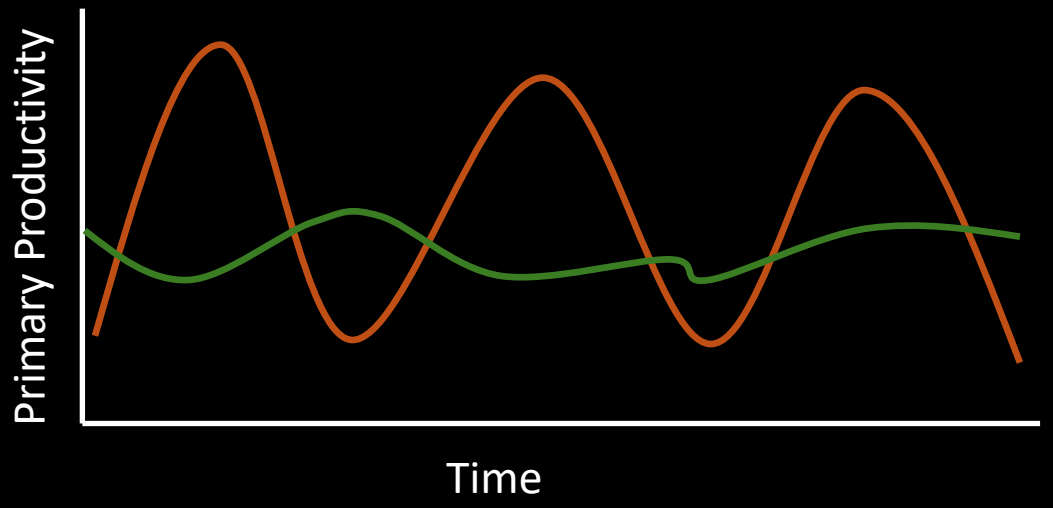
2. Can CNNs do multiscale?

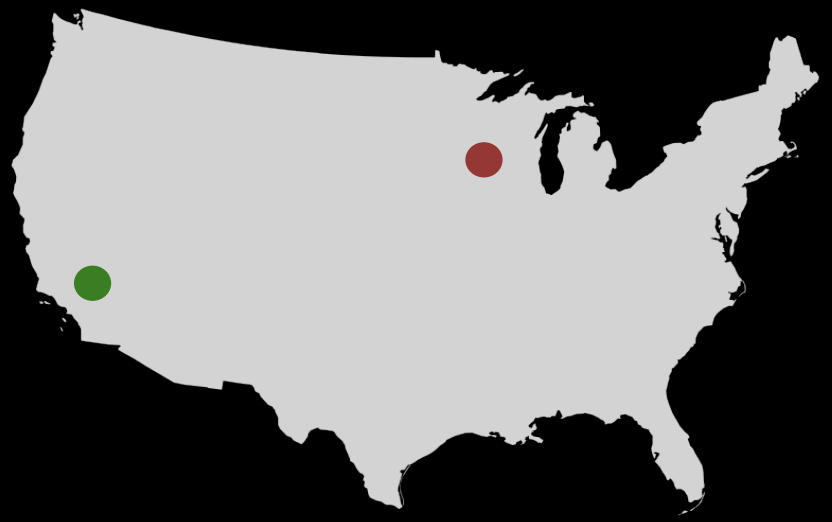
Synchrony in DHIs and birds



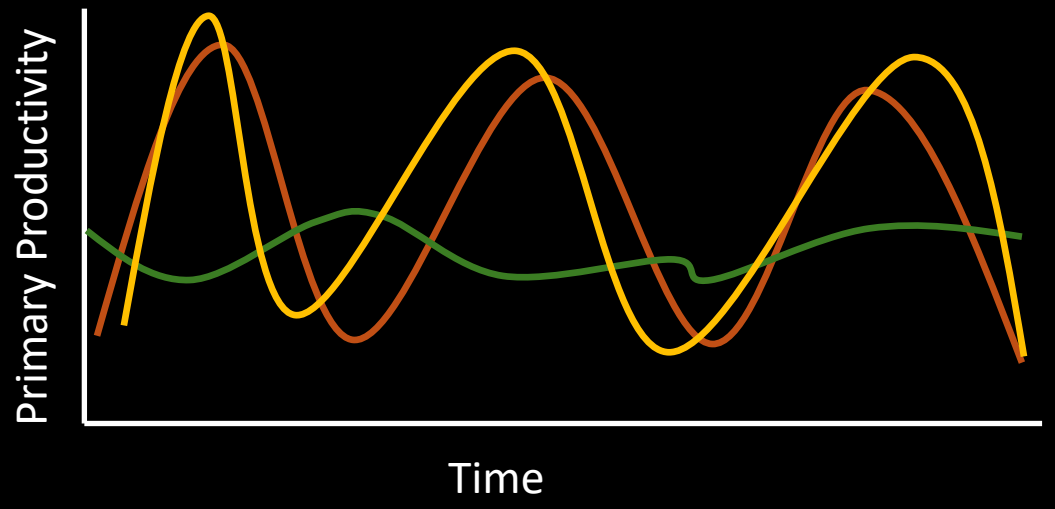


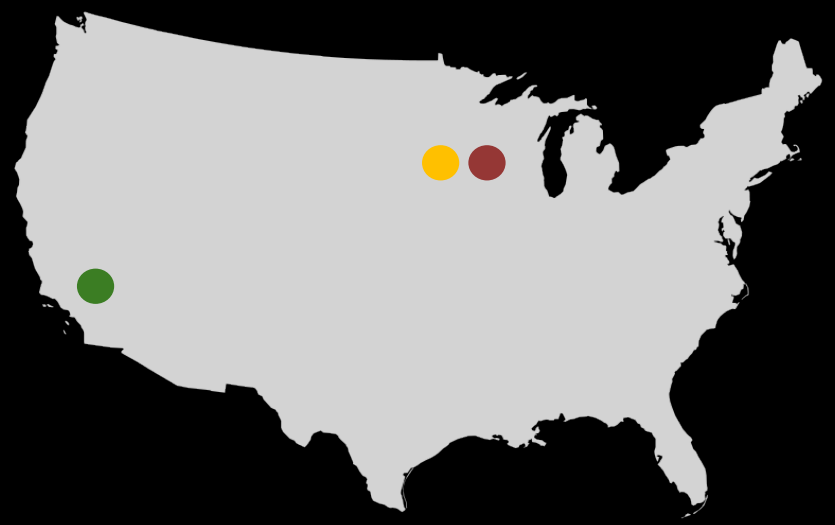
Synchrony in DHIs and birds

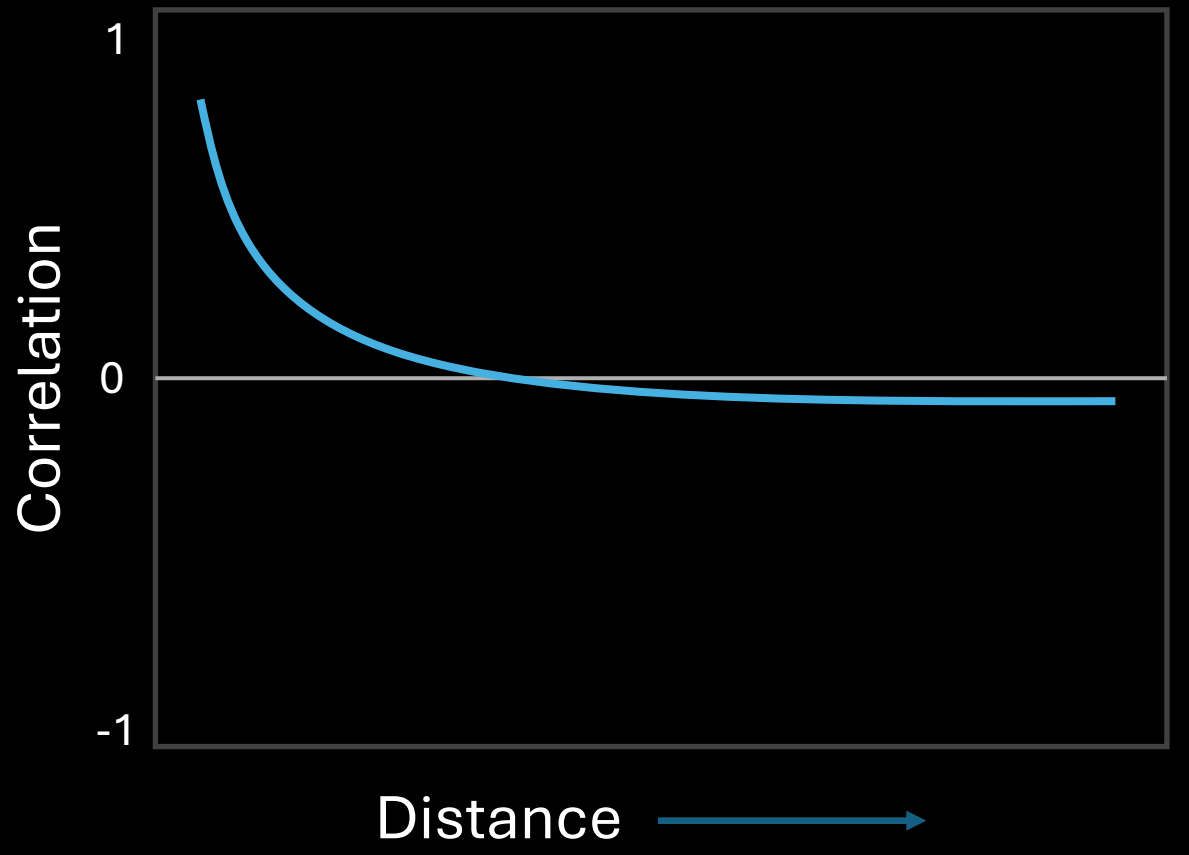




Synchrony in DHIs and birds

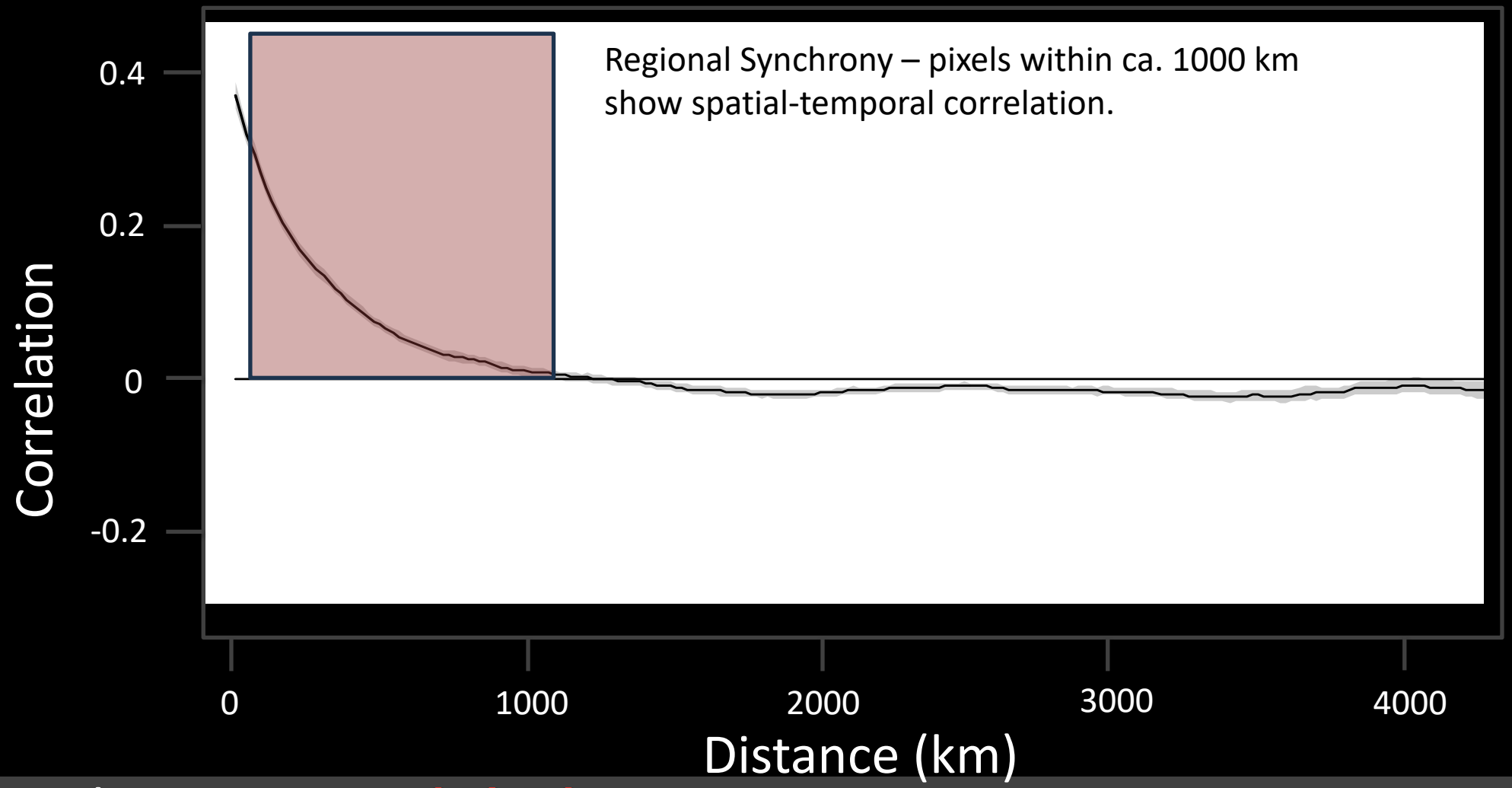




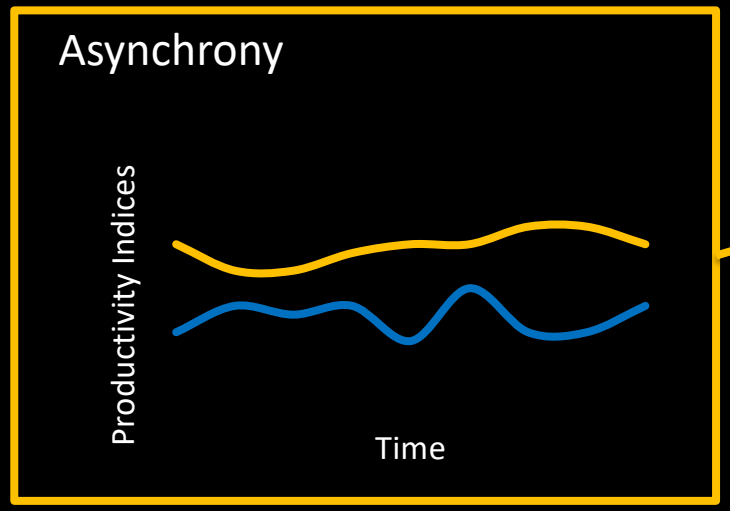


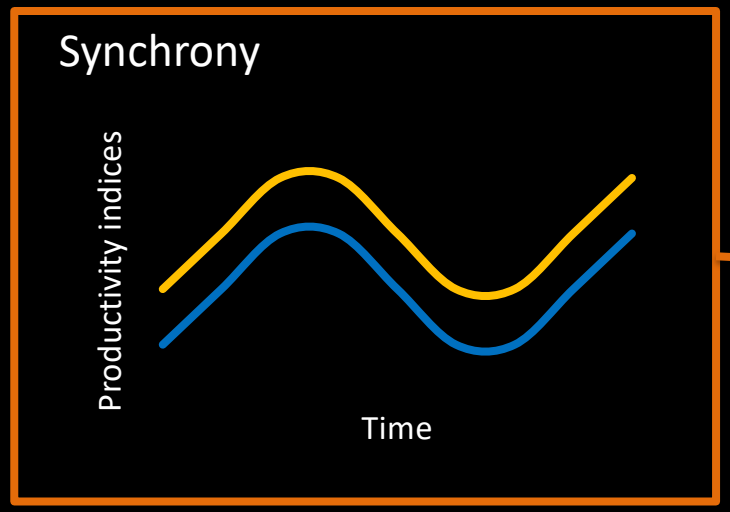
Synchrony in DHIs and birds

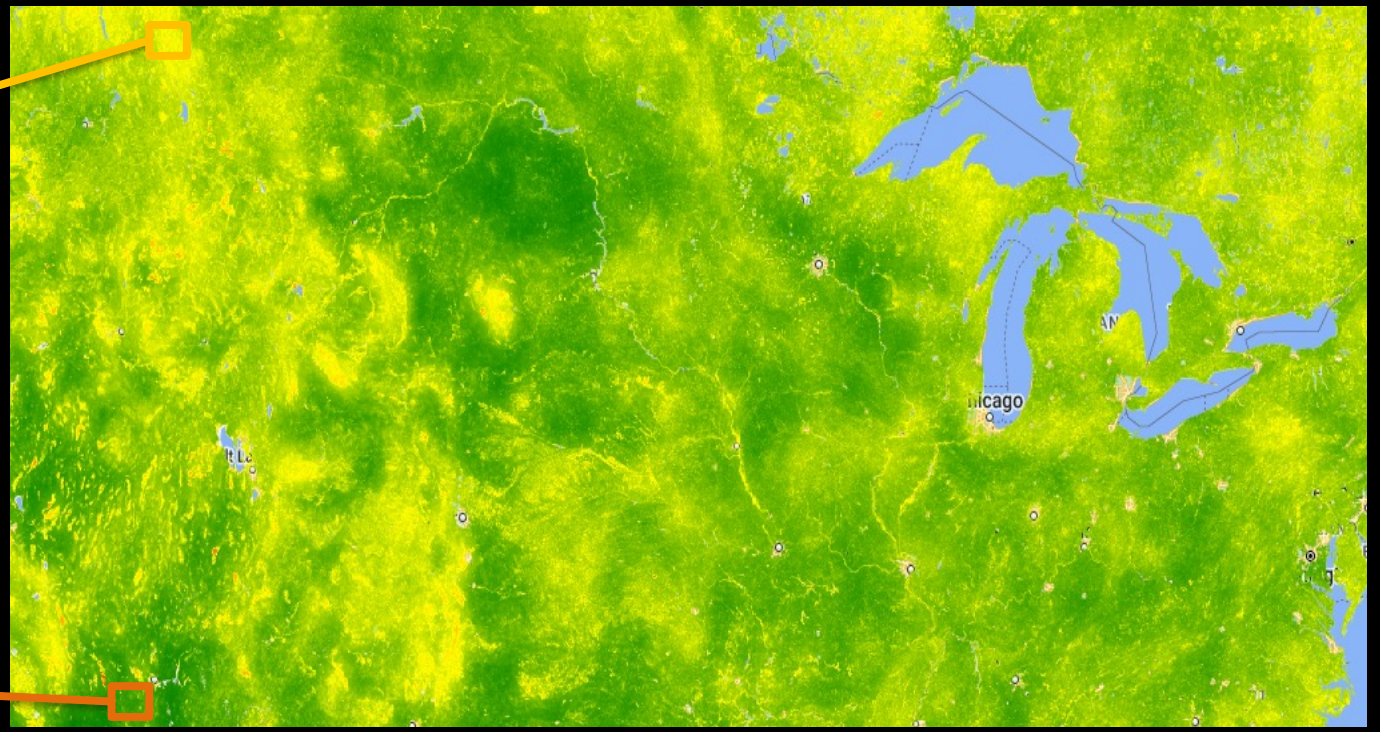
cumDHI Correlogram 2003 - 2015



Synchrony in DHIs and birds



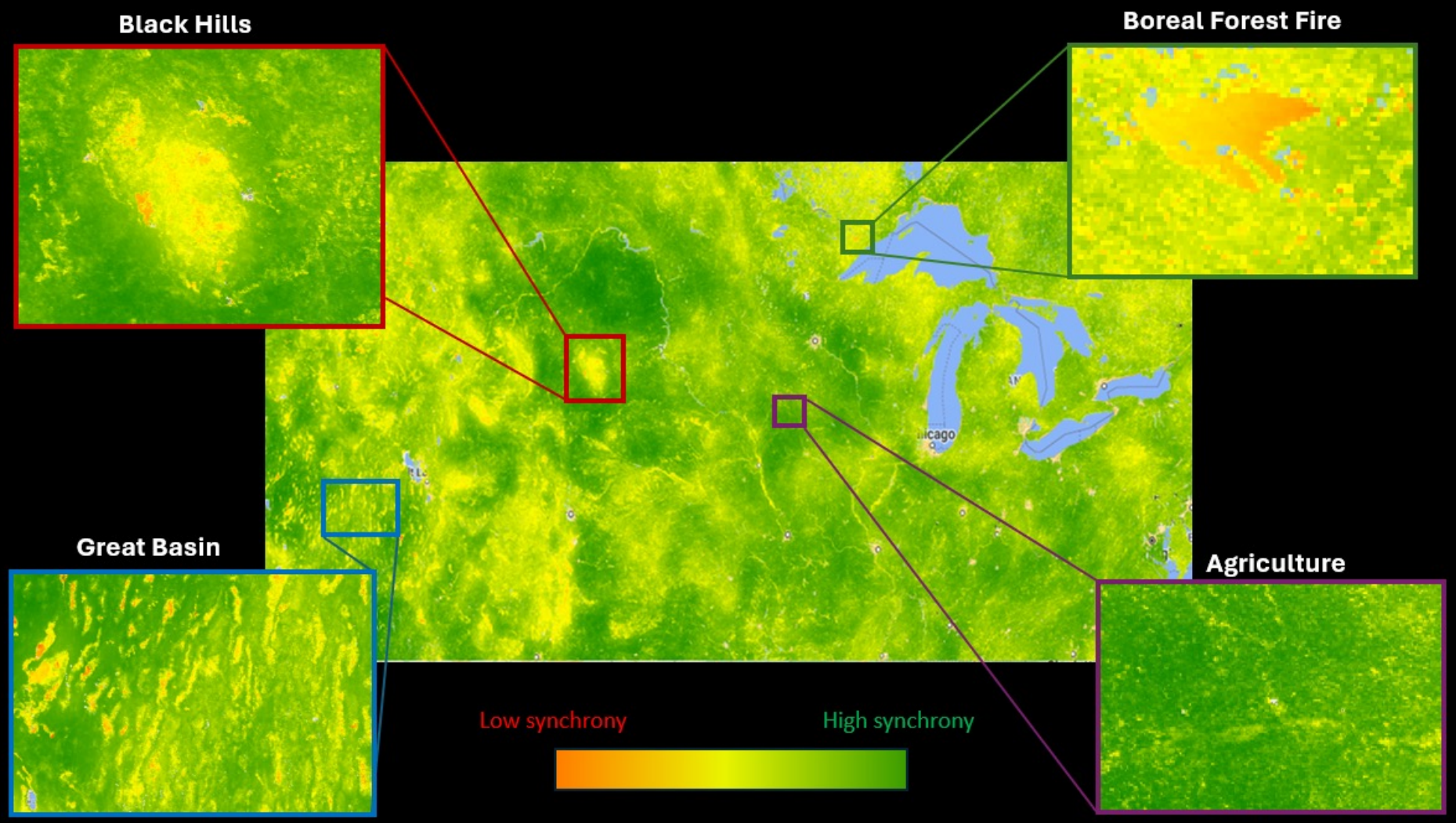




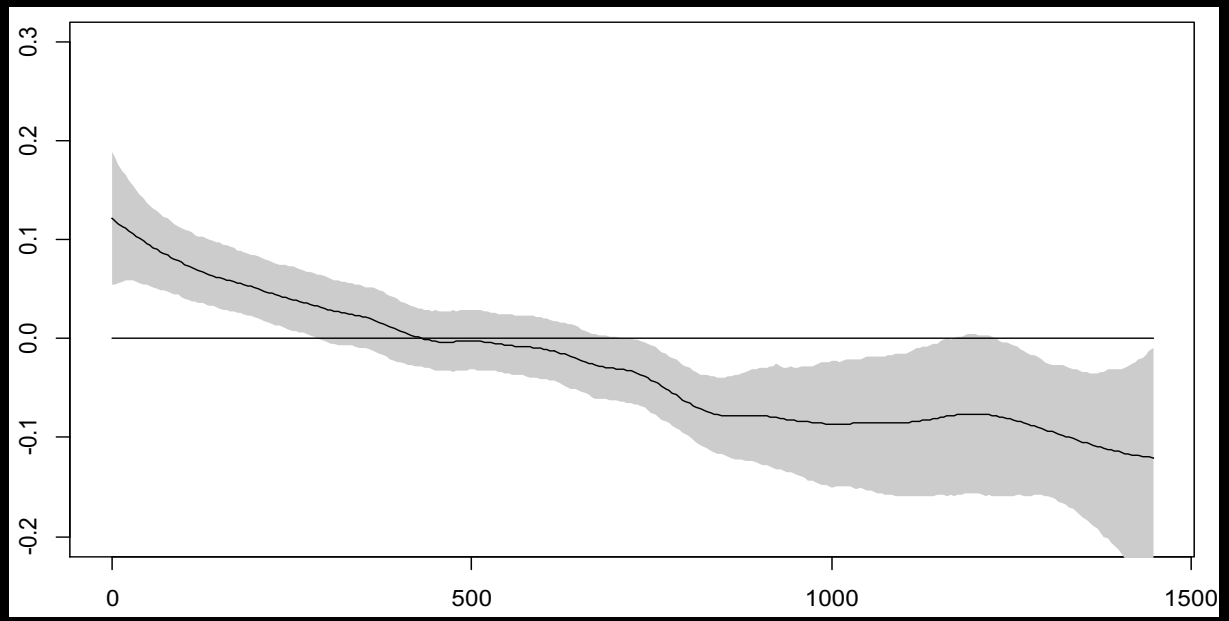
Low synchrony

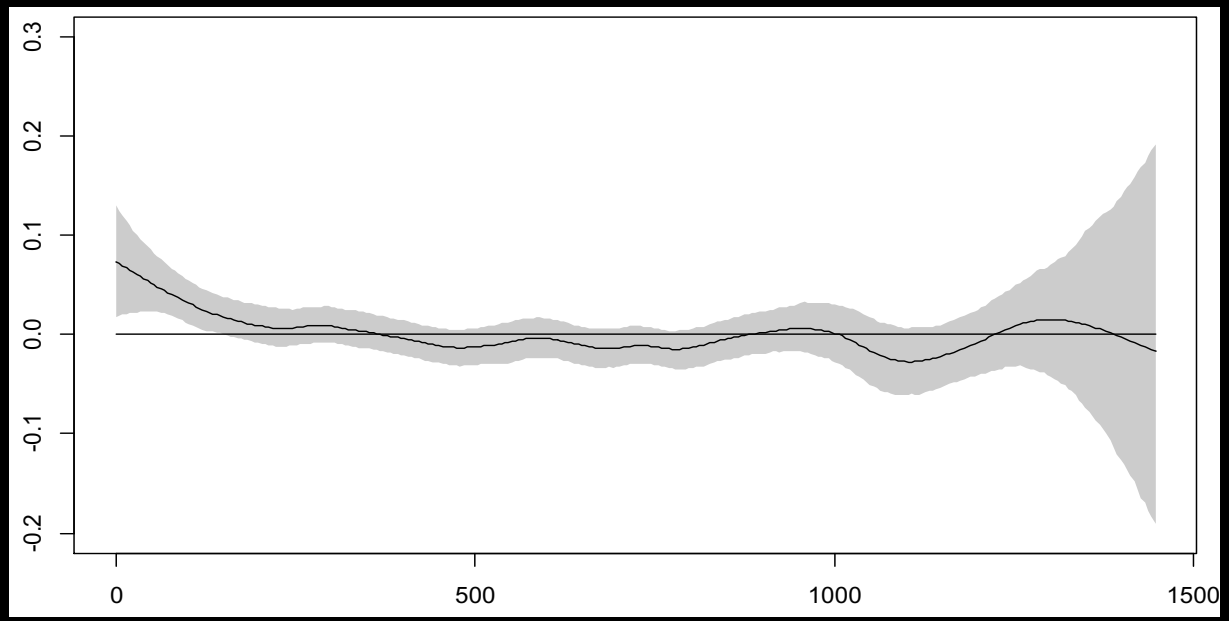
High synchrony

Synchrony in DHIs and birds

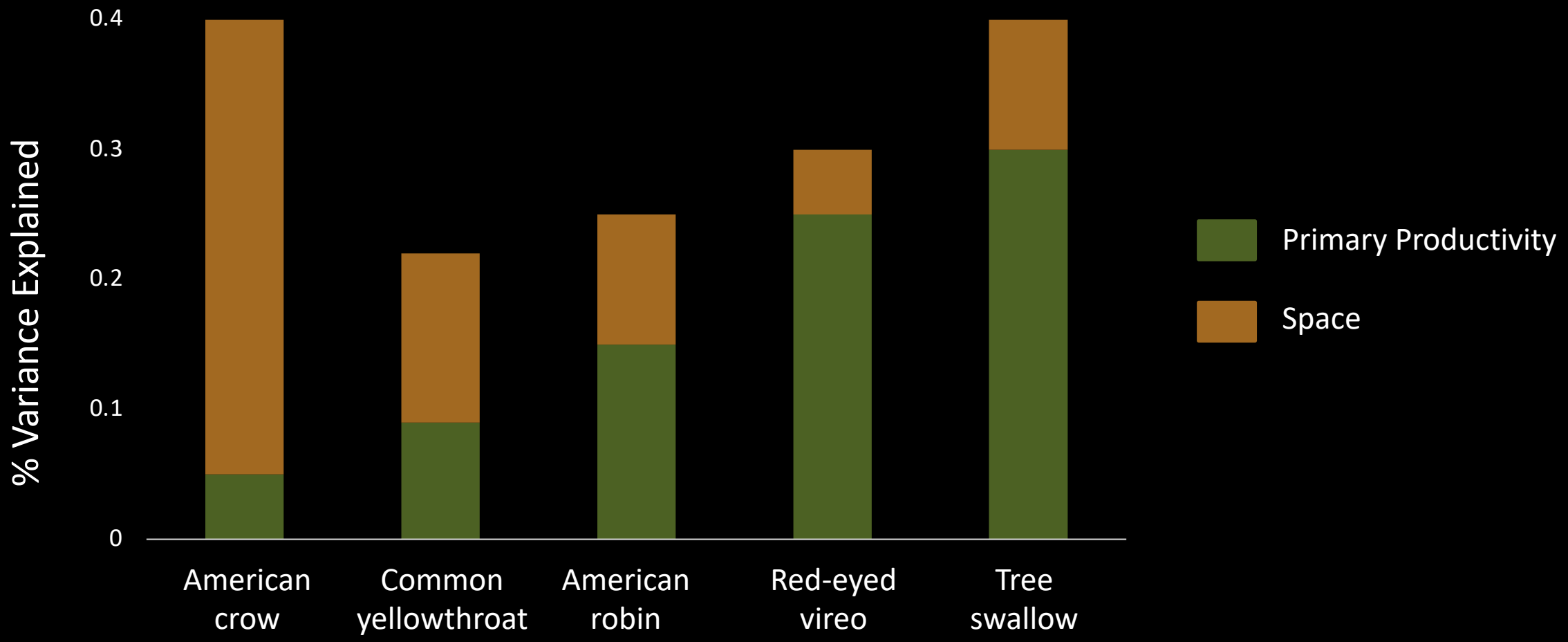


Synchrony in DHIs and birds





Distance (km)

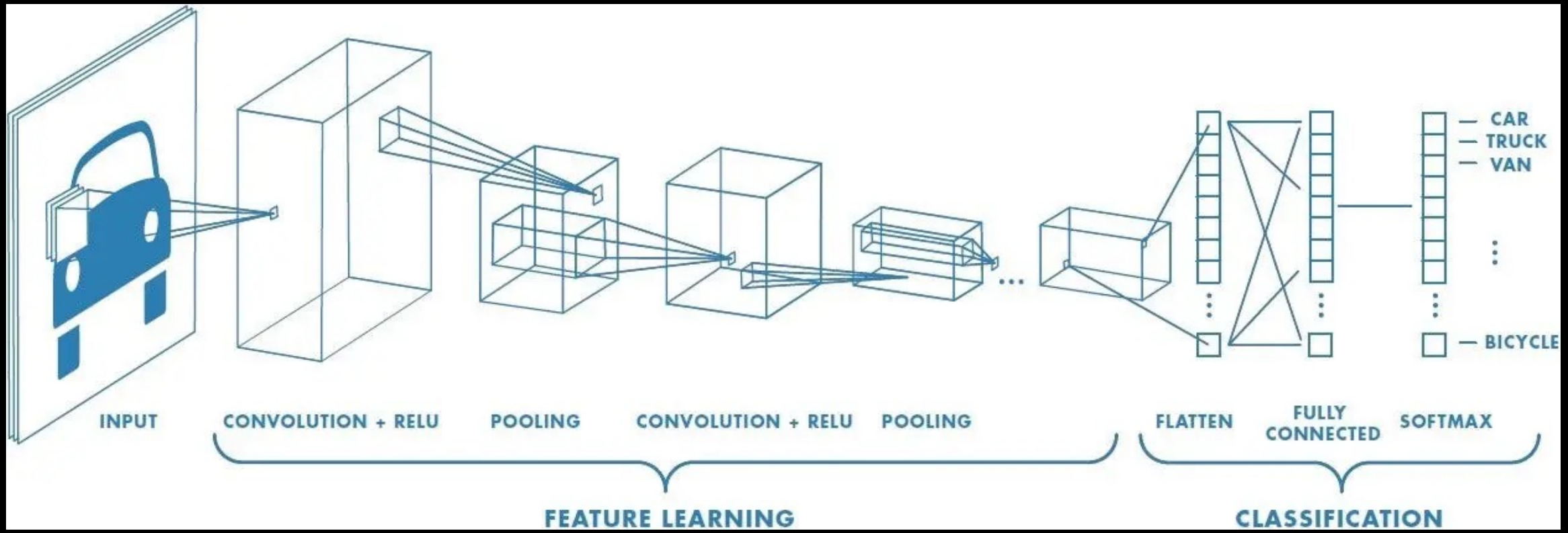

% Variance Explained
0.4
0.3
0.2
0.1
0
American crow
Common yellowthroat
American robin
Red-eyed vireo
Tree swallow
Primary Productivity
Space

Questions

1. But what about space vs. time?

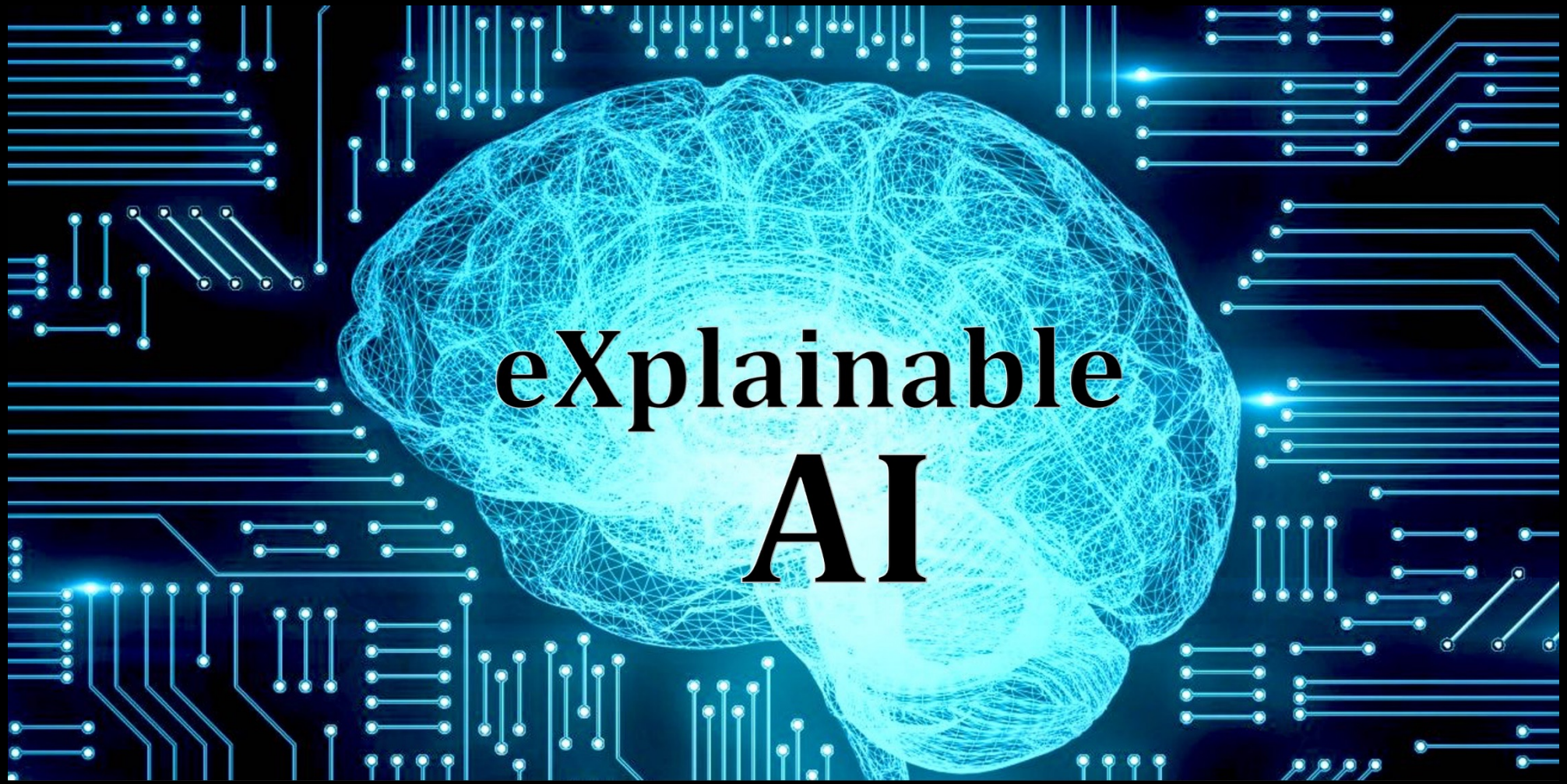
2. Can CNNs do multiscale?

CNNs for multi-scale habitat modeling



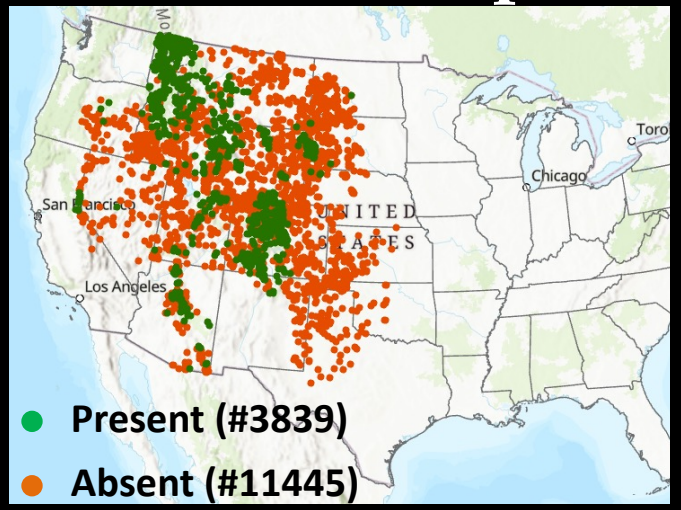
CNNs for multi-scale habitat modeling

CNNs for multi-scale habitat modeling

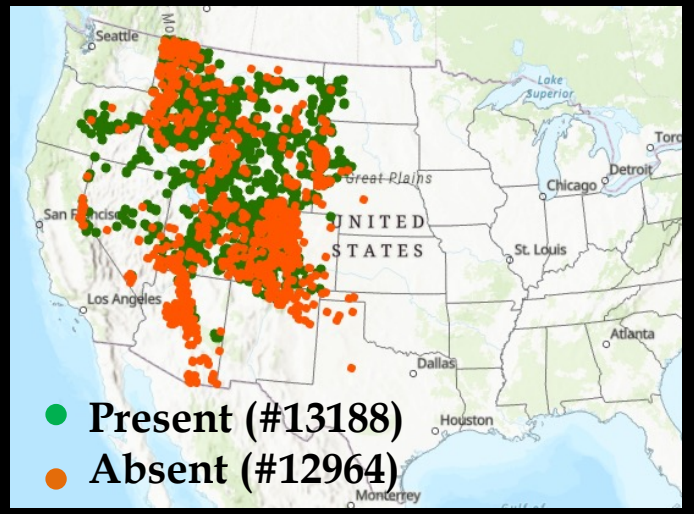


CNNs for multi-scale habitat modeling

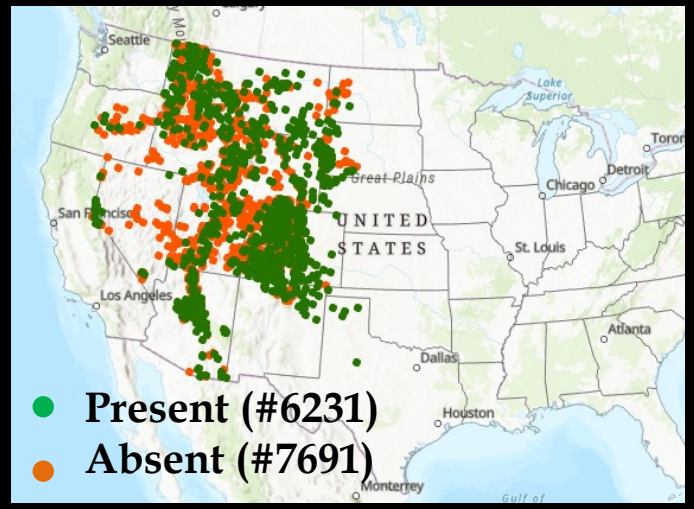
Brown Creeper



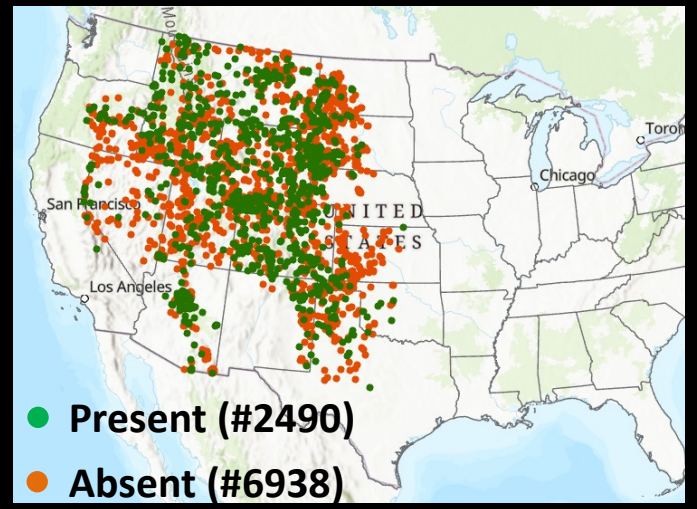
Mountain Bluebird



Western Wood-Pewee

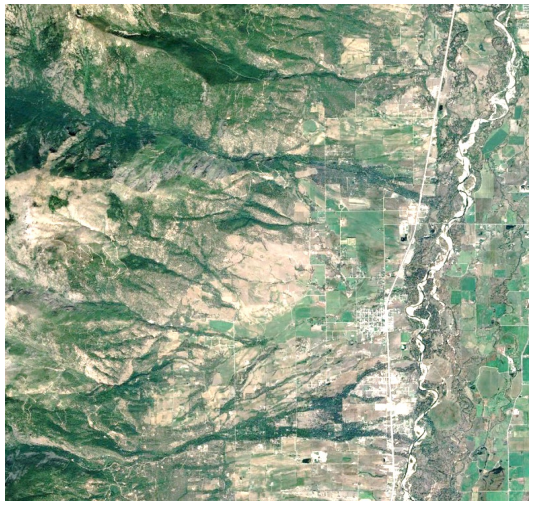


American Kestrel

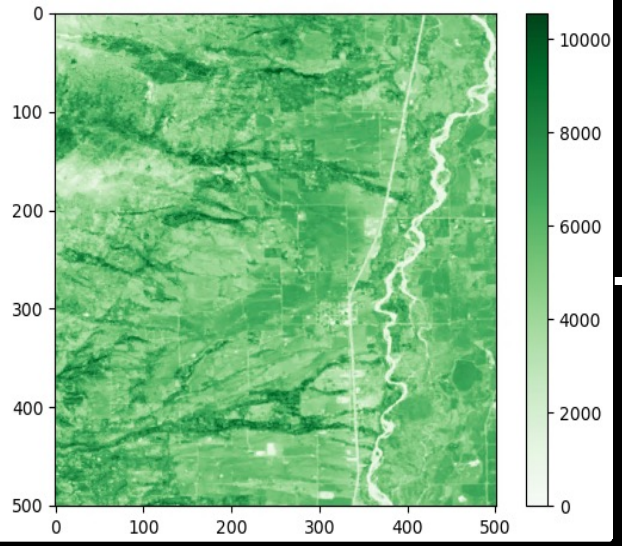


CNNs for multi-scale habitat modeling

Google Earth Image

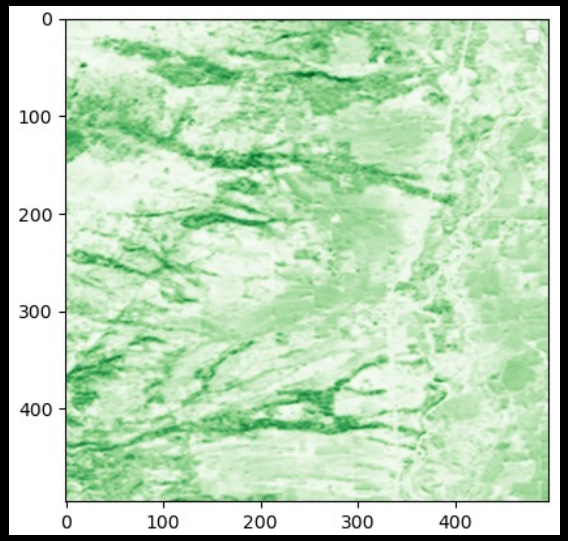


Input (CumDHI)

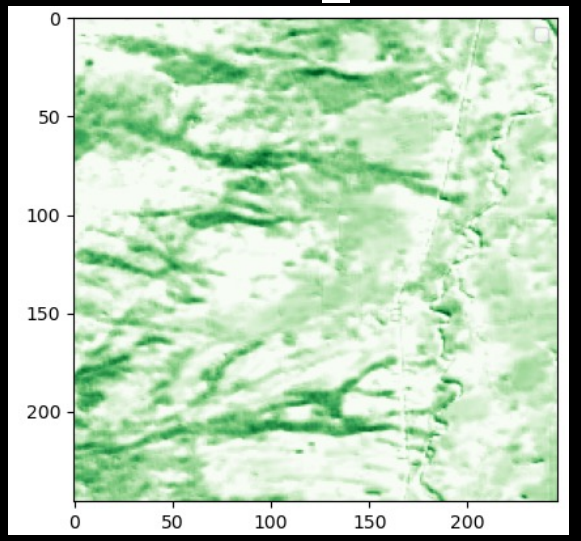


CNN

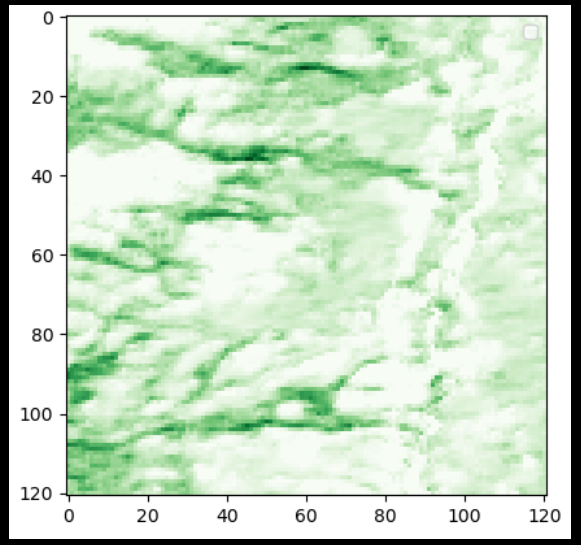
Conv_1



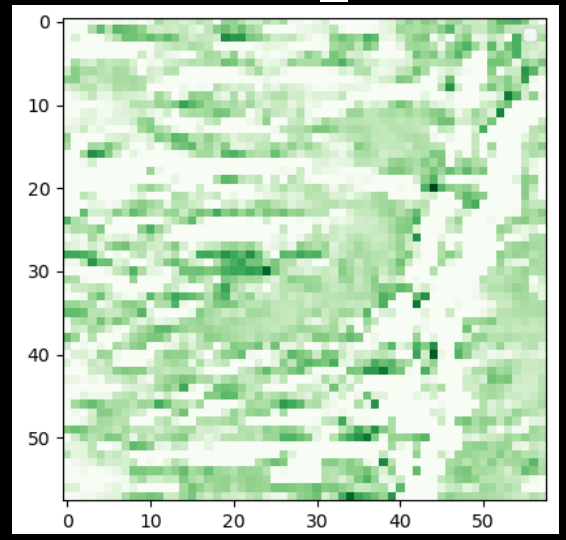
Conv_2



Conv_3

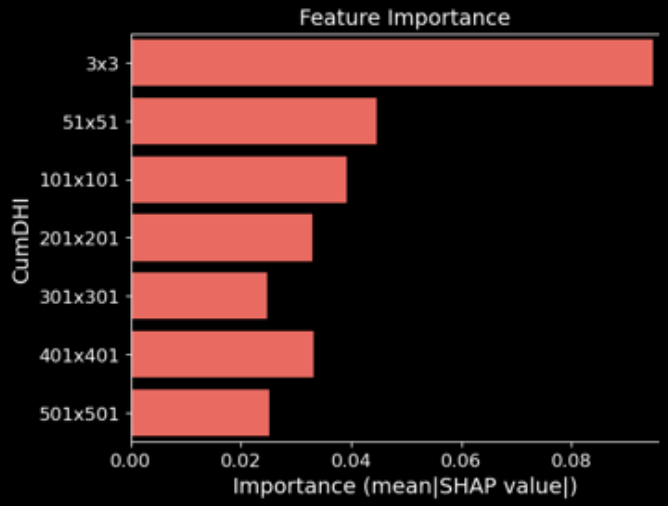


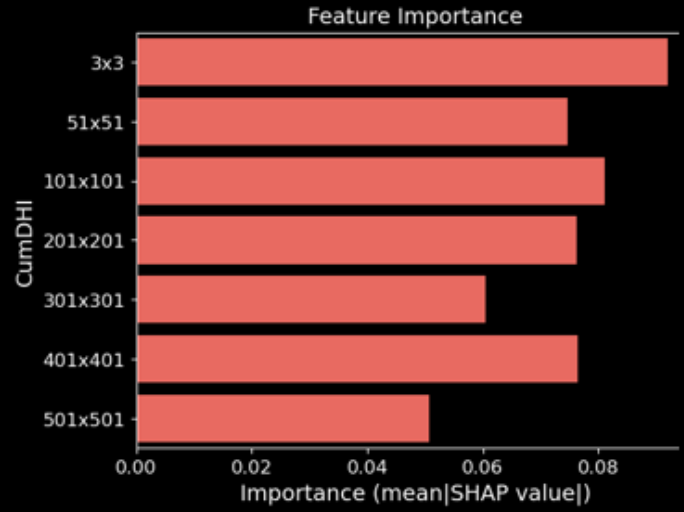
Conv_4

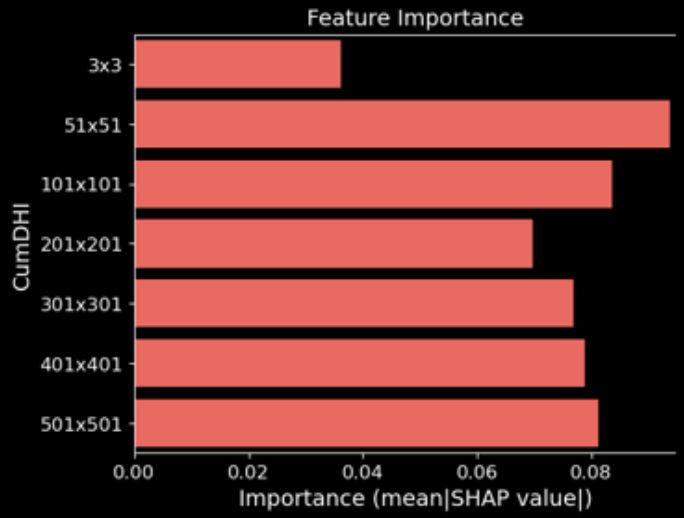


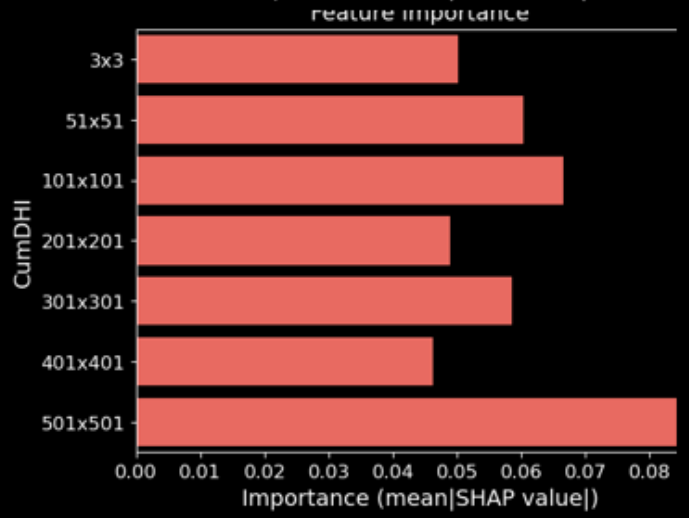
CNNs for multi-scale habitat modeling

SHapley Additive exPlanations (SHAP)



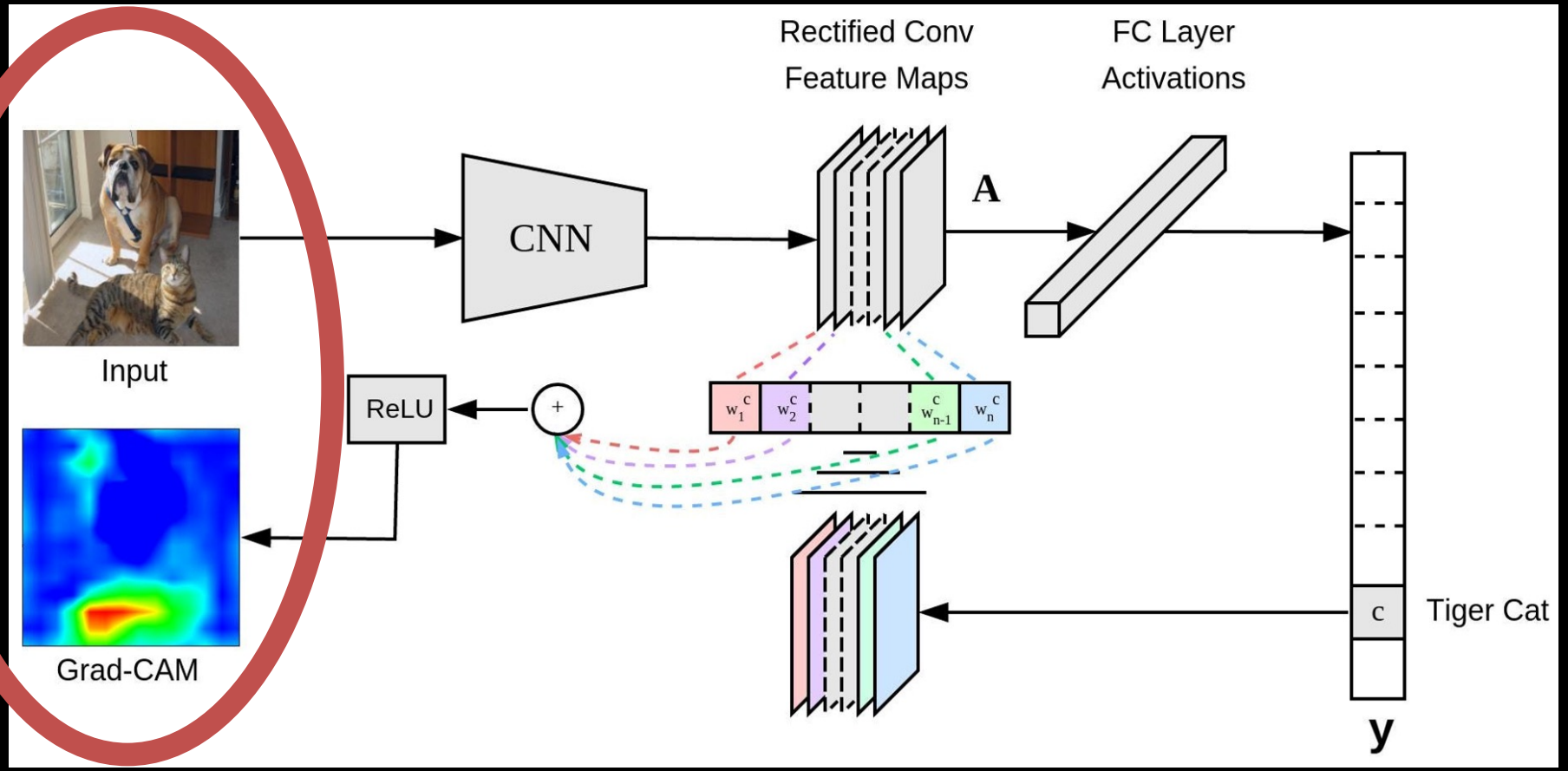






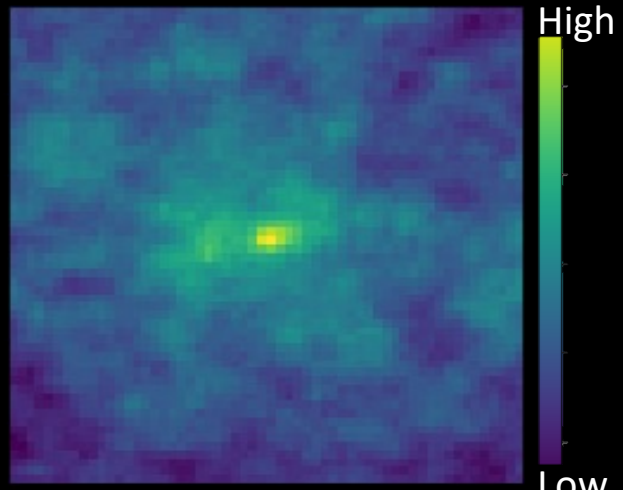
CNNs for multi-scale habitat modeling

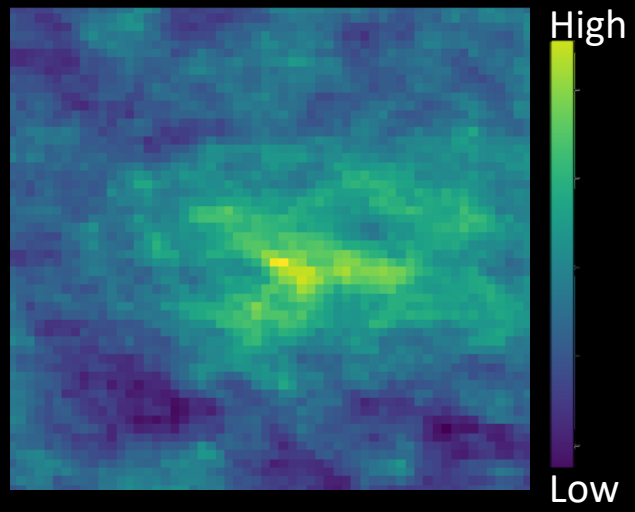
Gradient Weighted Class Activation Mapping

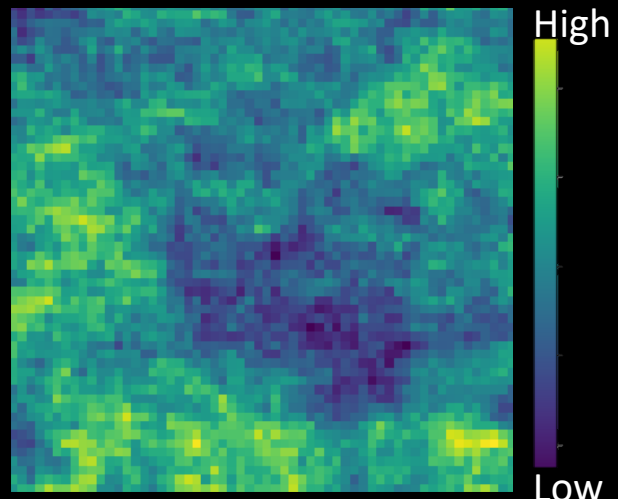


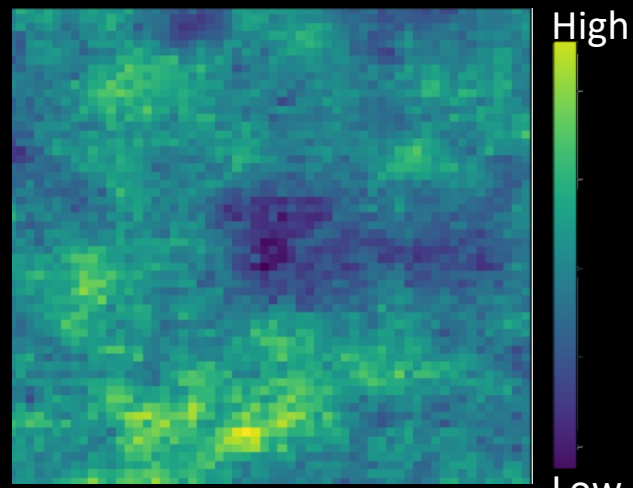
CNNs for multi-scale habitat modeling

Grad-CAM



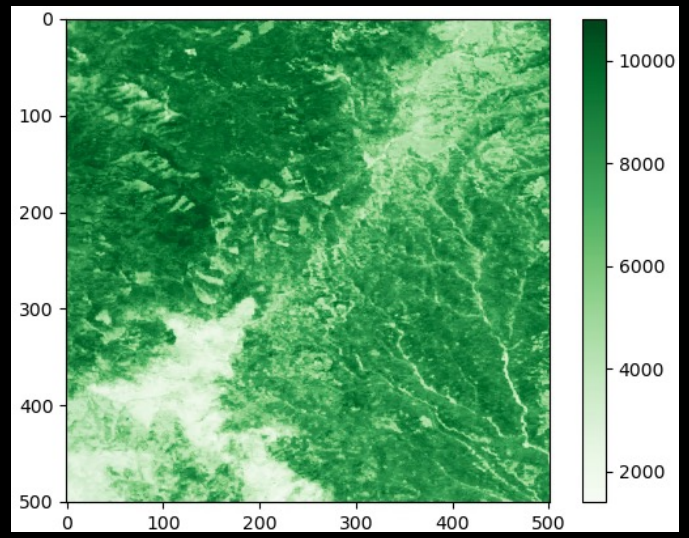




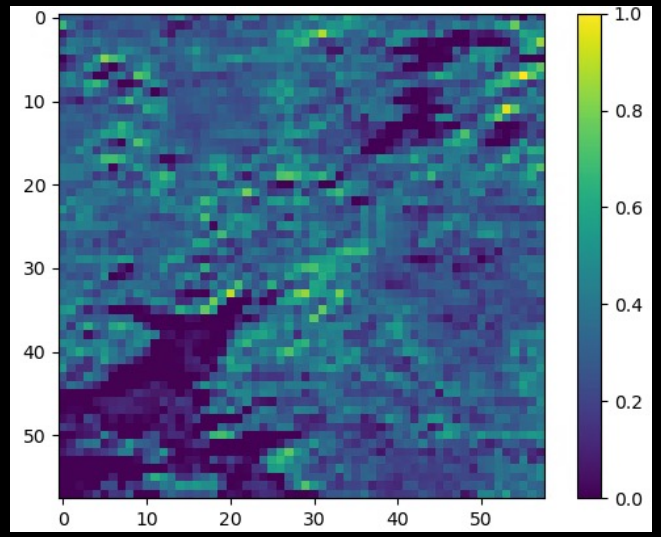


CNNs for multi-scale habitat modeling

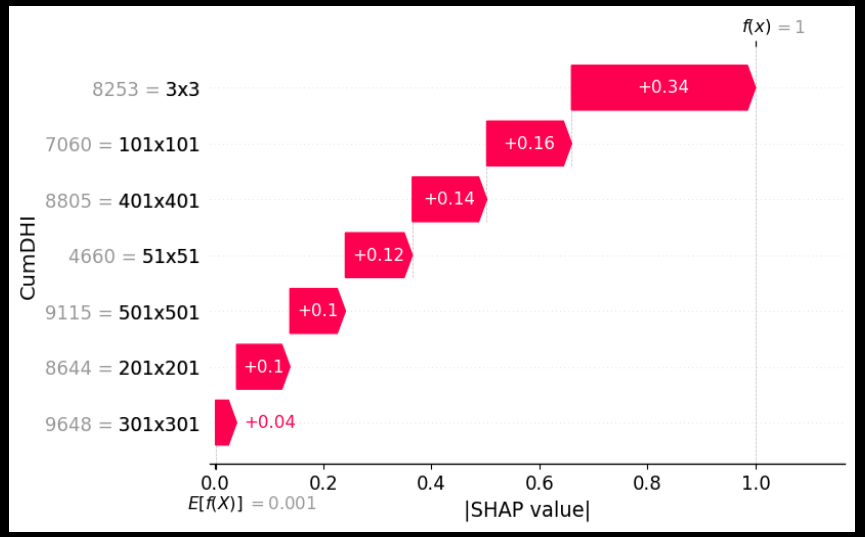
CumDHI



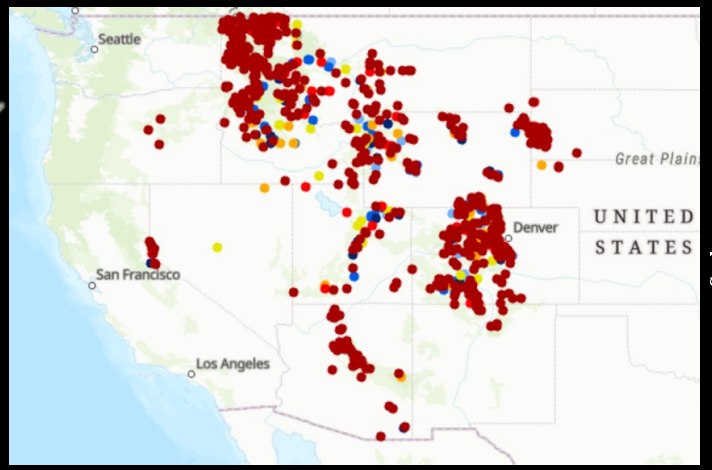
GradCAM

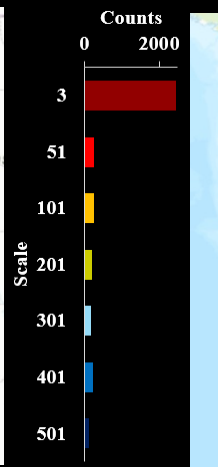


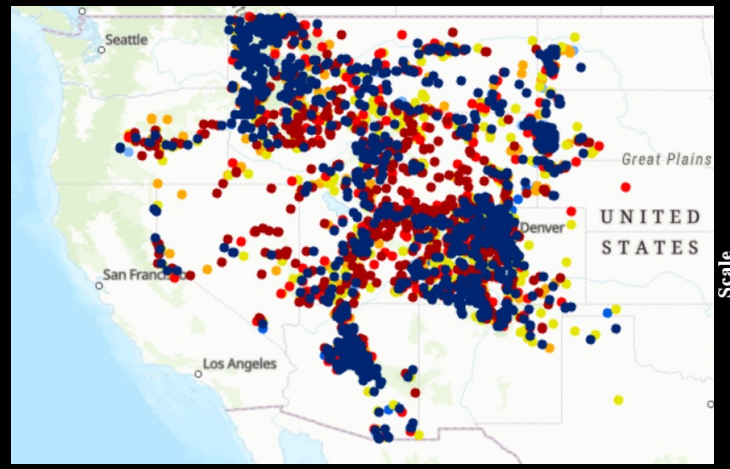
SHAP

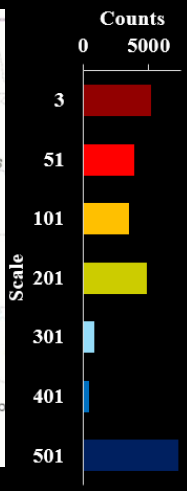


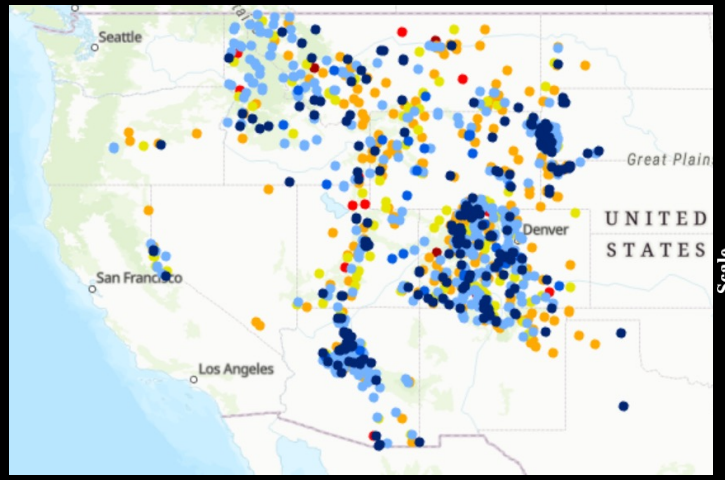
CNNs for multi-scale habitat modeling

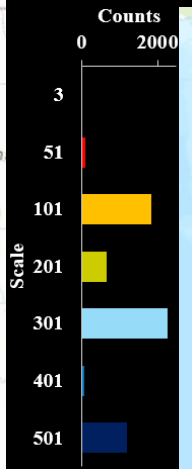


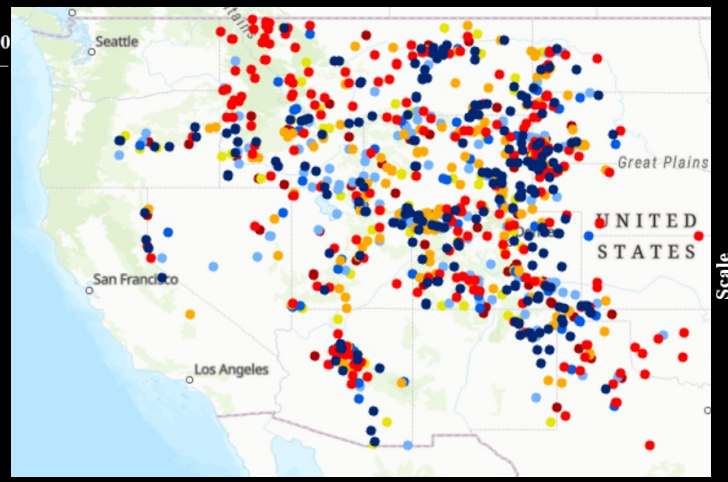


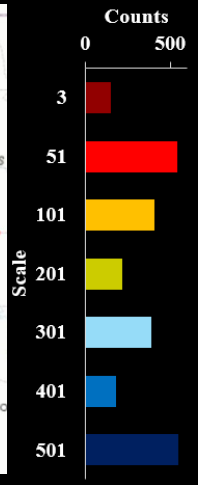




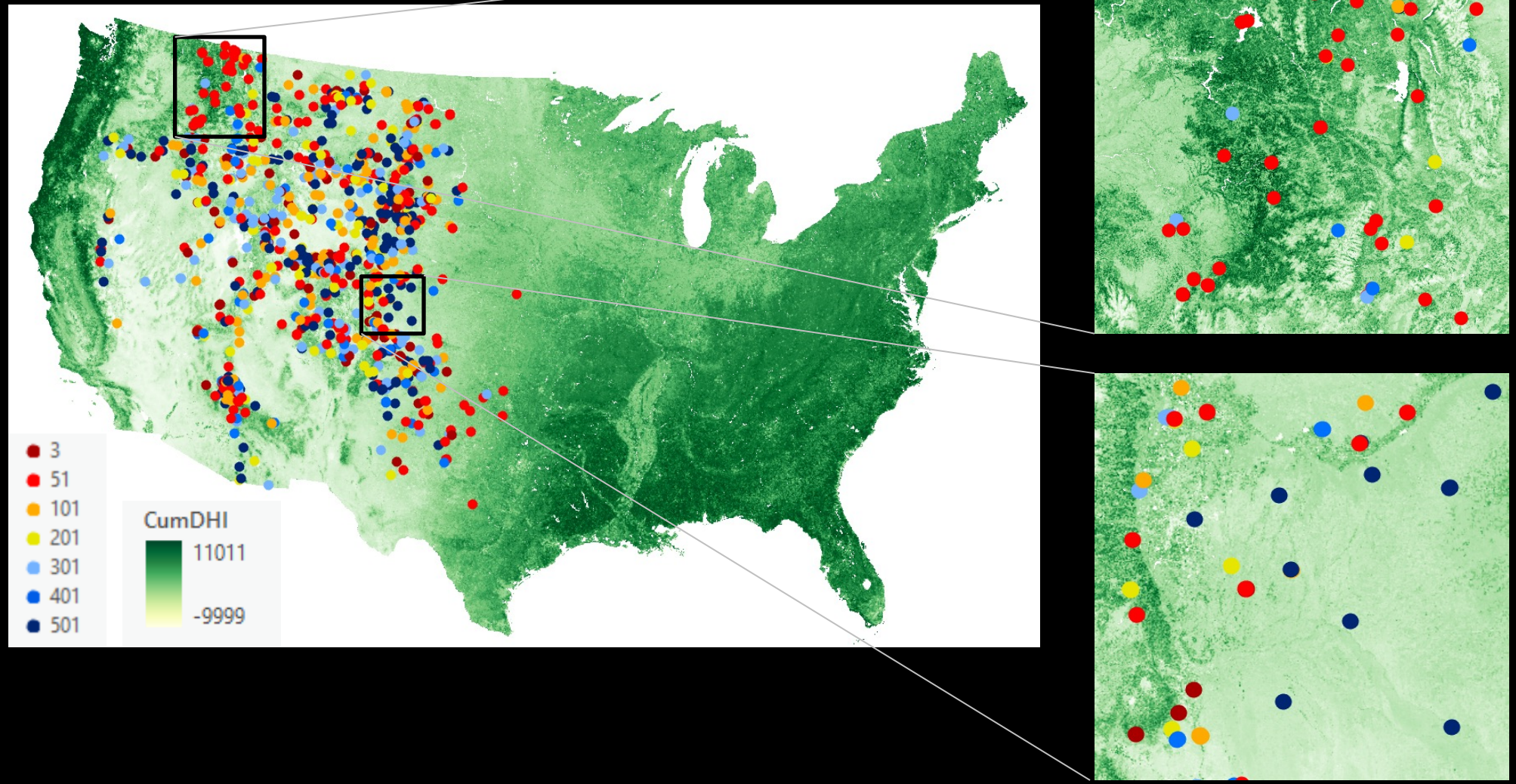


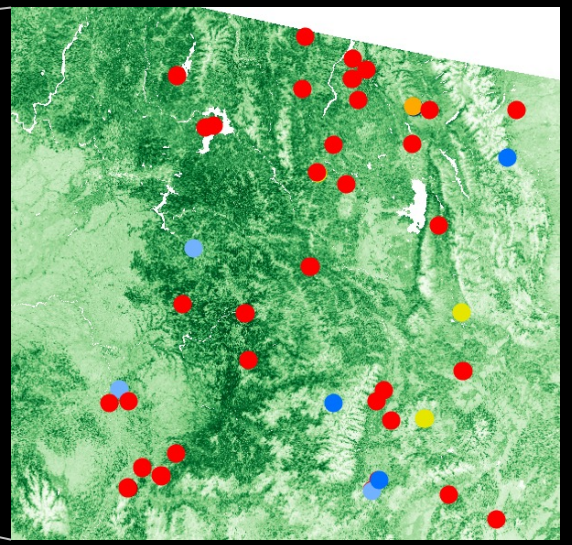






CNNs for multi-scale habitat modeling





Conclusions

Habitat selection is:

- Hierarchical
- Multi-scale *in space and time*
- Variable among species

Conclusions

Habitat selection is:

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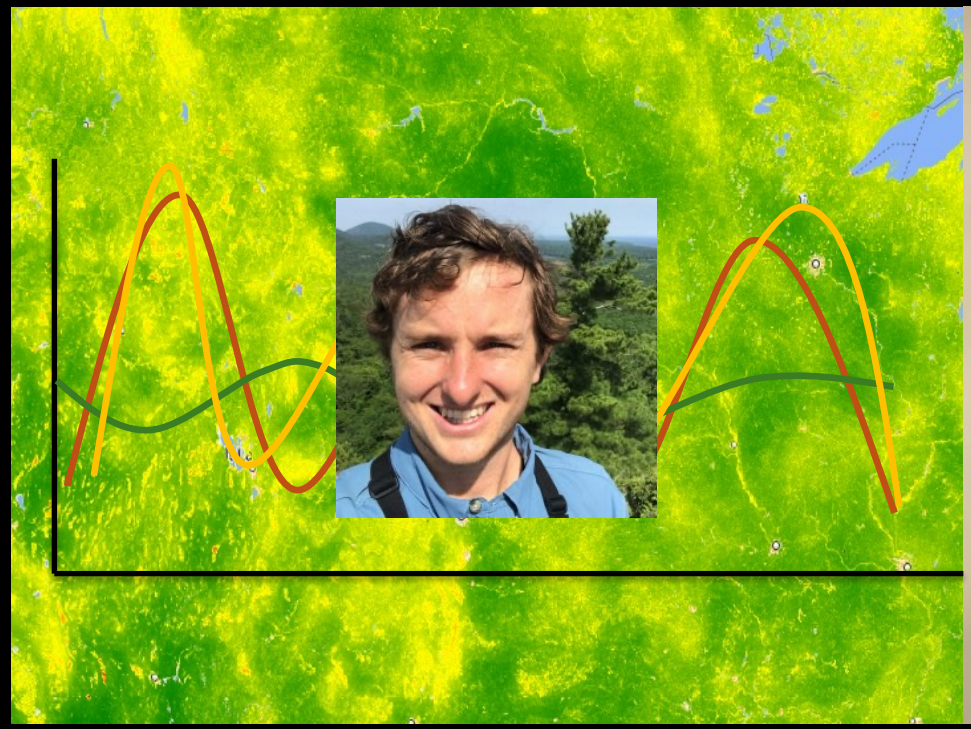
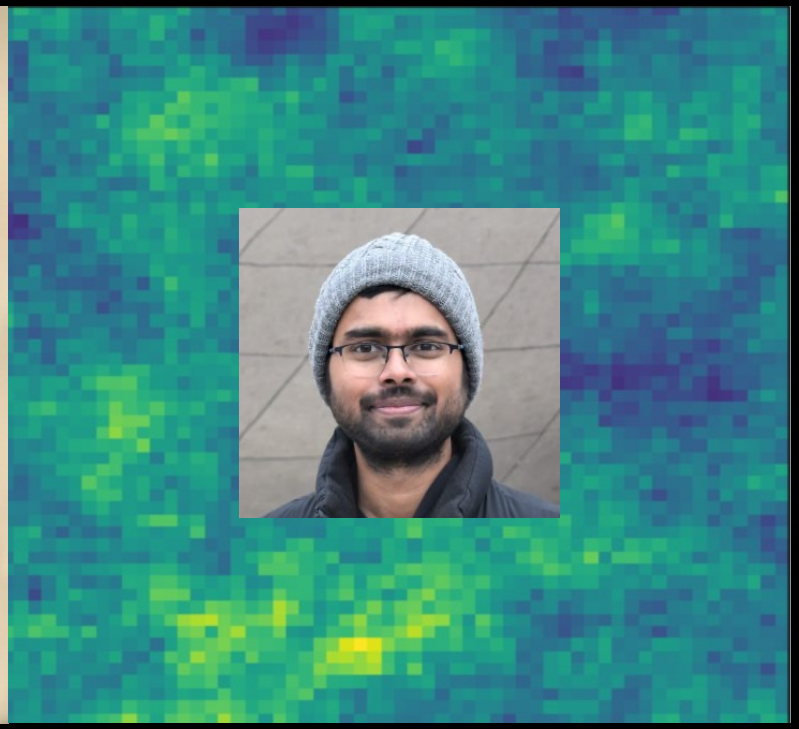
Habitat models can and should be too

- Multi-grain with different sensors
- Multi-extent with scalograms
- Spatio-temporal with synchrony analysis
- Multi-scale with CNNs

THANK YOU!!!





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