Testing the Dynamic Habitat Indices from MODIS for biodiversity and conservation

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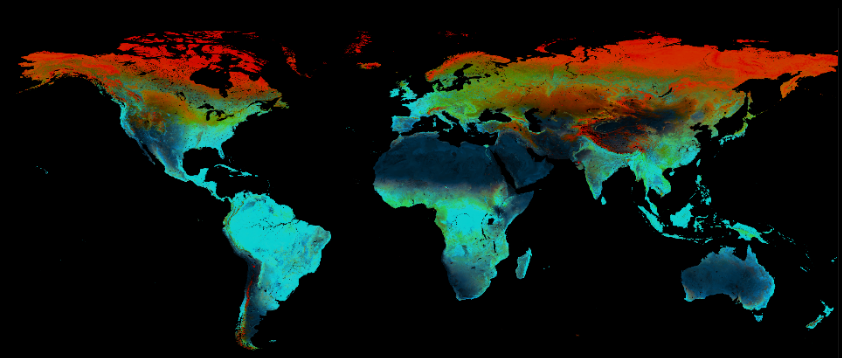
NASA Biodiversity and Ecological Forecasting
Science Team Meeting, 5/24/2017

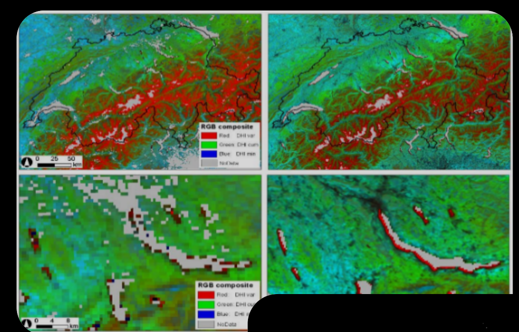
Outline

I. Background: the Dynamic Habitat Indices

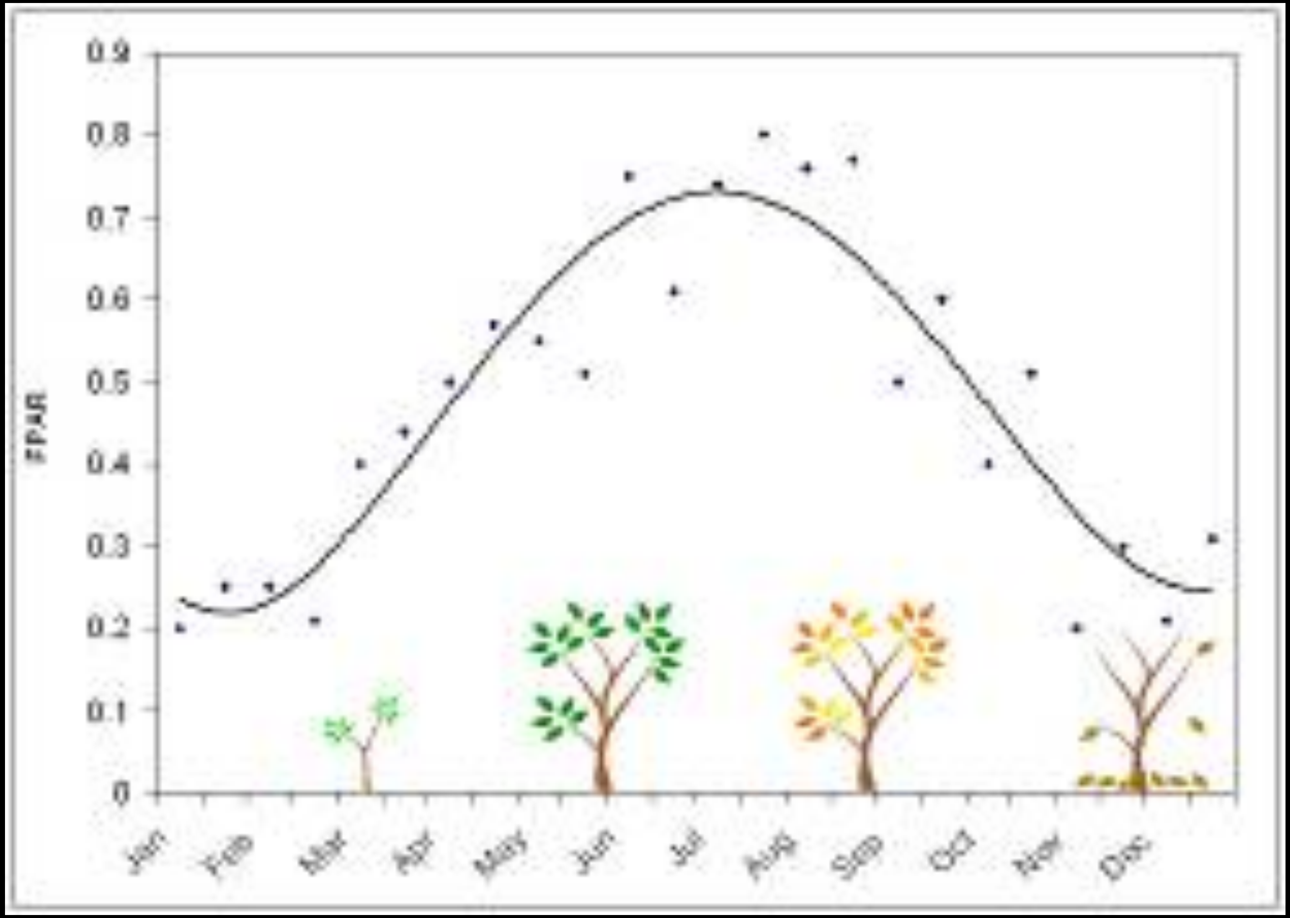
II. Datasets: Composite and annual DHIs

III. Proof of concept: DHIs and biodiversity





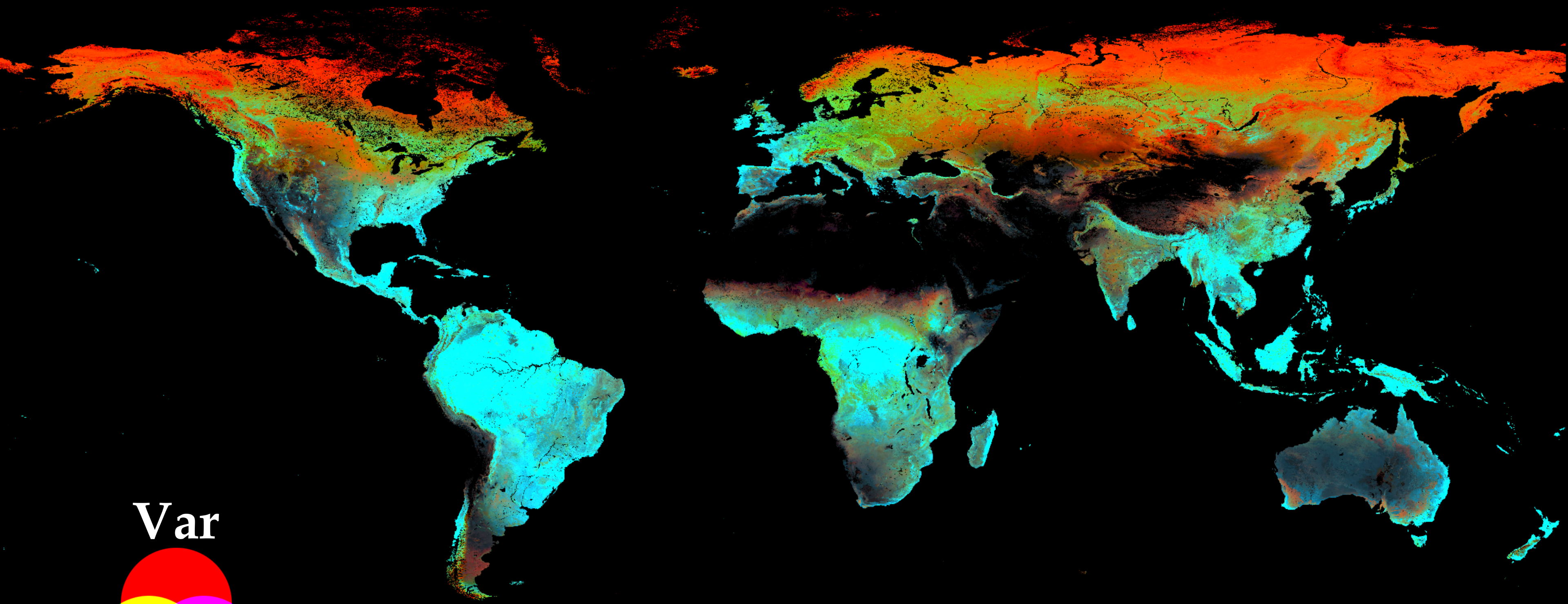
The Dynamic Habitat Indices

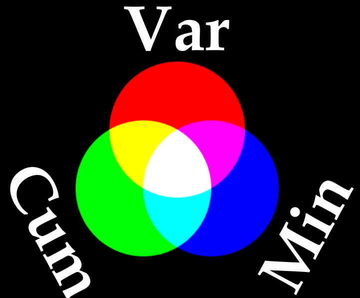


The Dynamic Habitat Indices

Ecology		DHIs
Available energy hypothesis	→	Cumulative productivity
Environmental stress hypothesis	→	Minimum productivity
Environmental variability hypothesis	→	Coefficient of variation

The Dynamic Habitat Indices





FPAR DHIs

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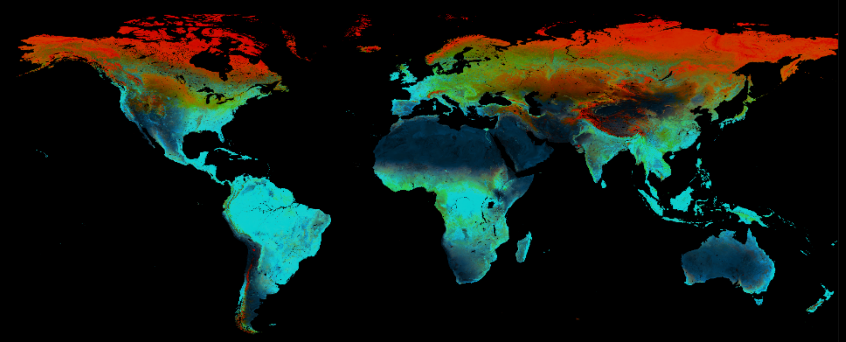

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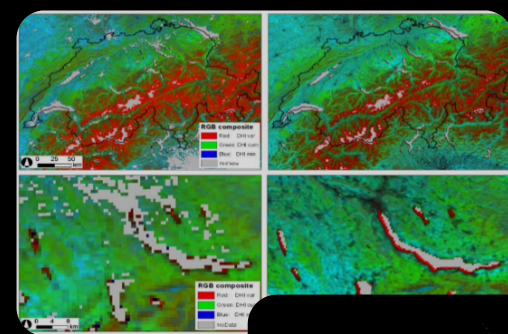

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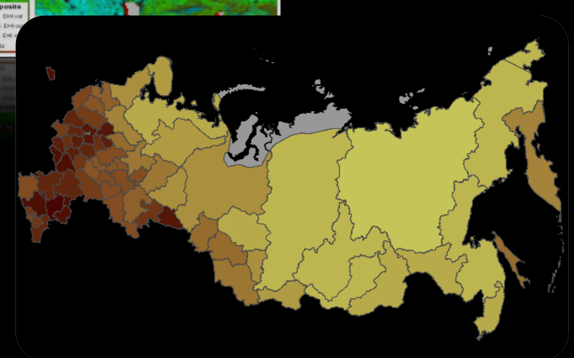
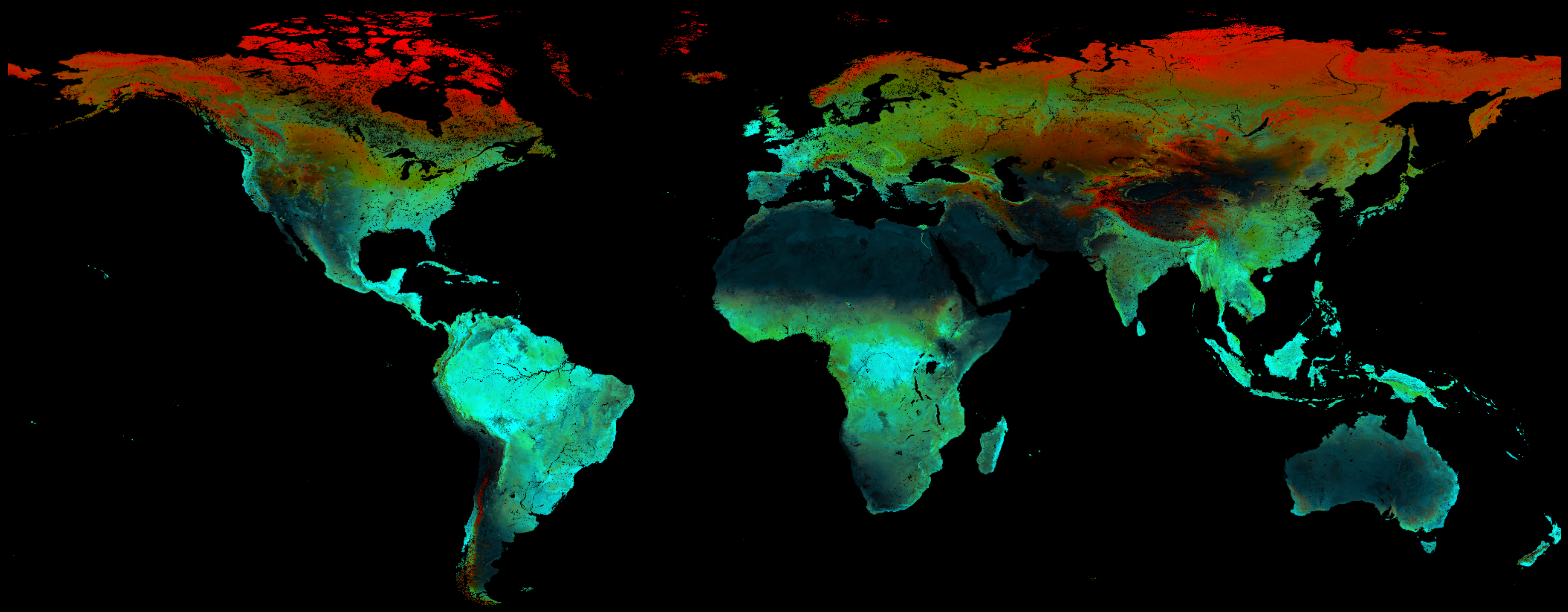


Datasets

- MODIS Composite DHIs for 2003-2014
  - Why: MODIS vegetation data have some noise and phenology varies among years
  - Why: Some biodiversity data, e.g., range maps, have no clear date
  - What it is: The median of all observations for a given date

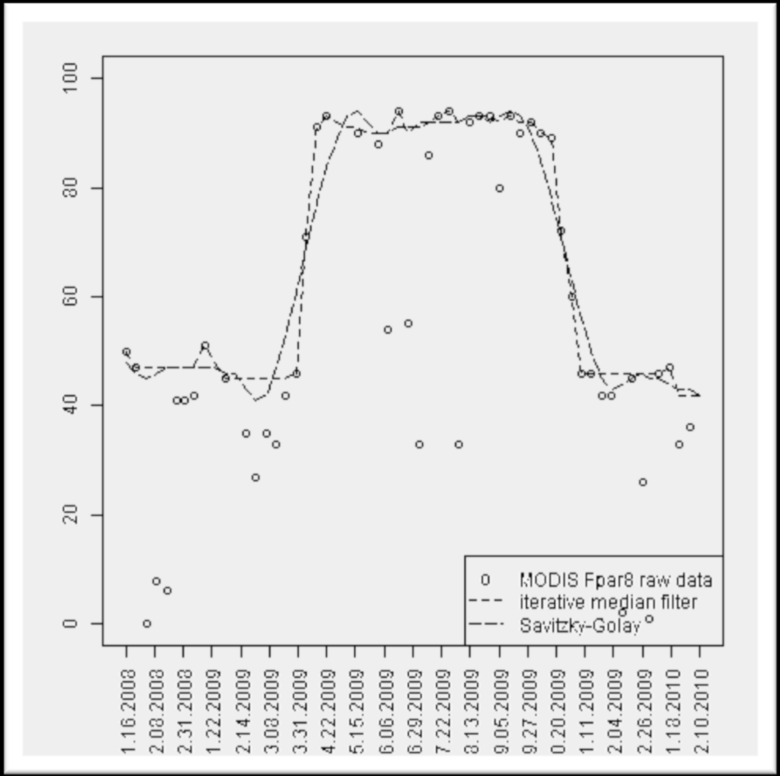
Datasets



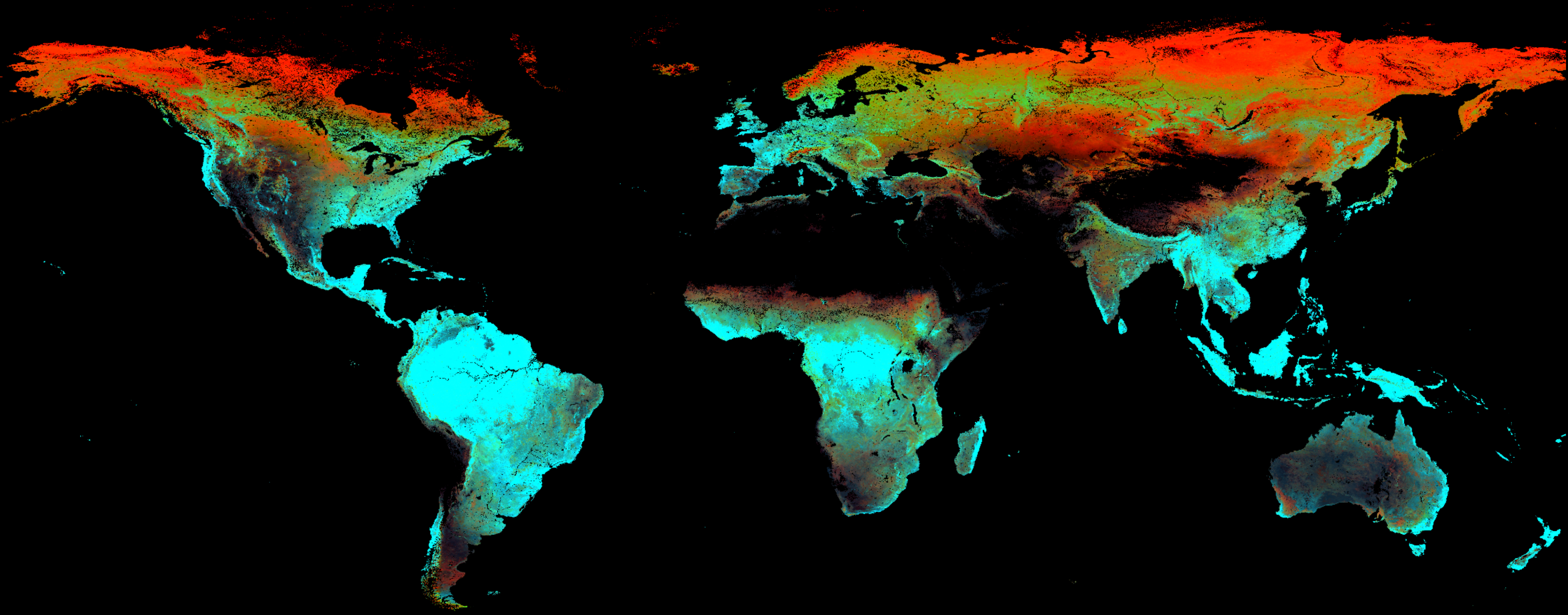
Composite 1-km EVI DHIs

Datasets

- Annual DHIs
  - Why: Interannual variability is important
  - Smoothing annual phenology
    - Iterative median
    - Savitzky-Golay



Datasets



FPAR DHIs 2012

silvis.forest.wisc.edu/data/DHIs

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Dynamic Habitat Indices

VARIABLE

- NDVI16
- EVI16
- FPAR8
- LAI8
- GPP8

Enhanced Vegetation Index

BANDS

- RGB composite (3-1-2)
- Band 1 (cumulative)
- Band 2 (minimum)
- Band 3 (seasonality)

DOWNLOADS

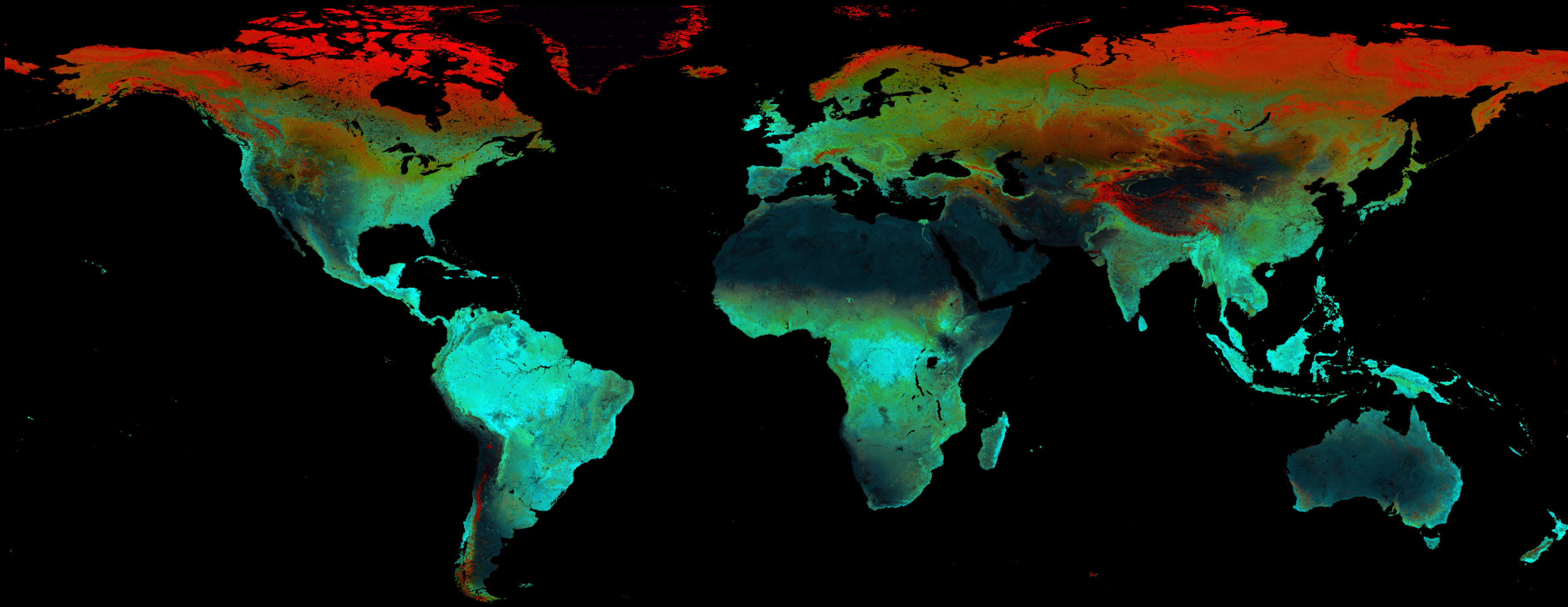
Vegetation Index	Composite DHIs from 2003 -2014 MODIS data	Smoothed annual DHIs												
NDVI16 Normalized Difference Vegetation Index	NDVI16 Composite DHIs	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
EVI16 Enhanced Vegetation Index	EVI16 Composite DHIs	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
FPAR8 Fraction absorbed Photosynthetically Active Radiation	FPAR8 Composite DHIs	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
LAI8 Leaf Area Index	LAI8 Composite DHIs	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
GPP8 Gross Primary Production	GPP8 Composite DHIs	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015

All DHIs datasets are single composite RGB images stored in GeoTIFF format at 1 kilometer spatial resolution. Map projection is WGS84 (EPSG:4326).

RELATED PUBLICATIONS

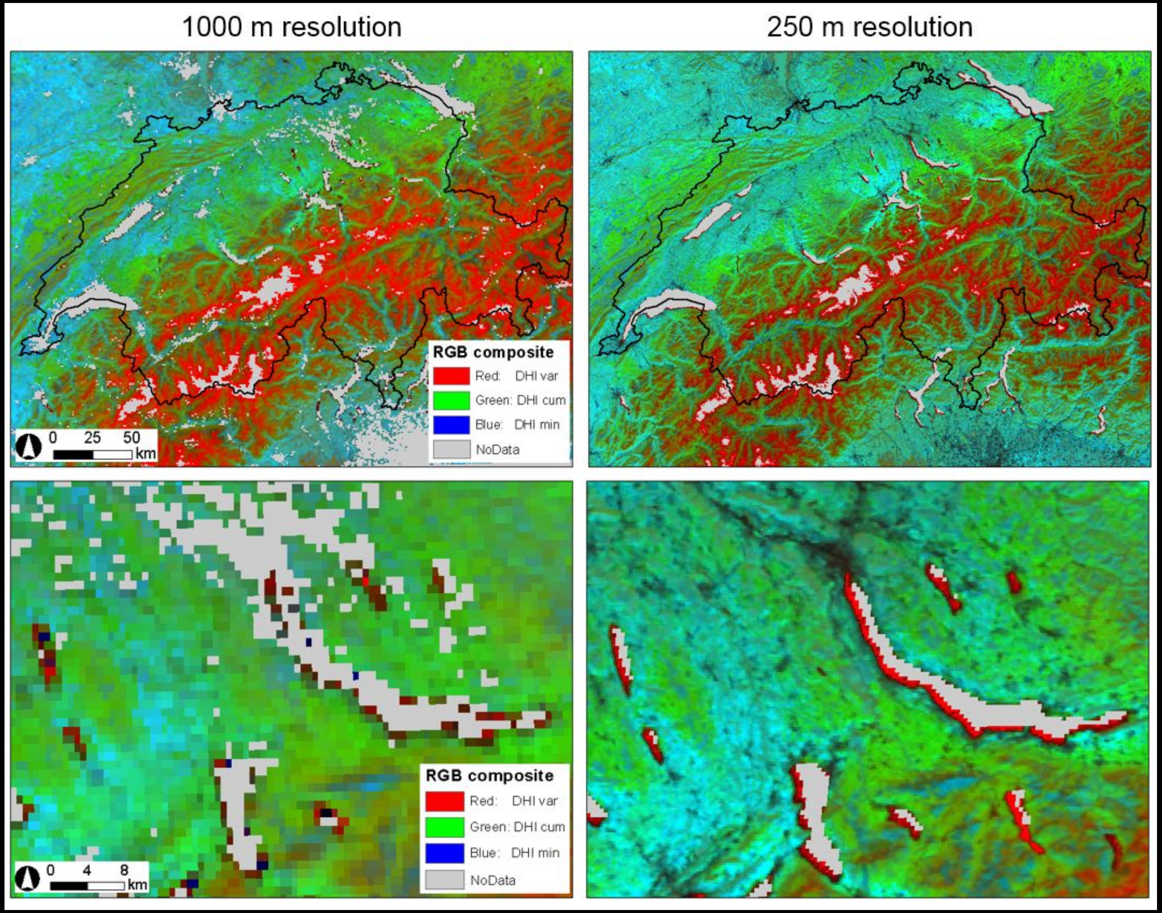
Hobi, M.L., Dubinin, M., Graham, C.H., Coops, N.C., Clayton, M.K., Pidgeon, A.M., & Radeloff, V.C. (2017). A comparison of Dynamic Habitat Indices derived from different MODIS products as predictors of avian species richness. Remote Sensing of Environment, 195, 142-152.	PDF

Datasets



Composite 250-m EVI DHIs

Datasets



1-km vs. 250-m EVI DHIs

Outline

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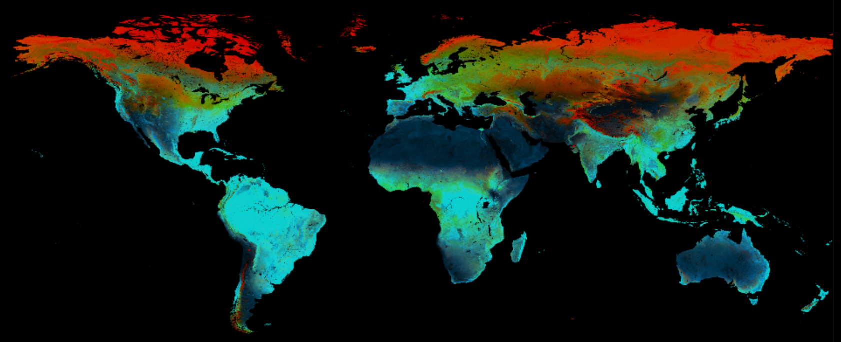
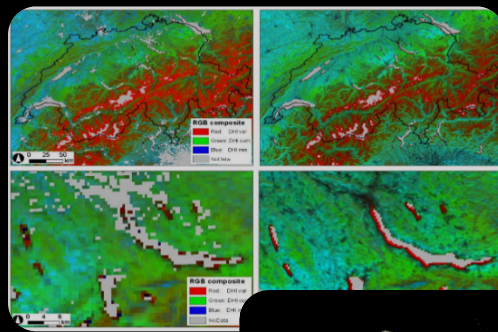
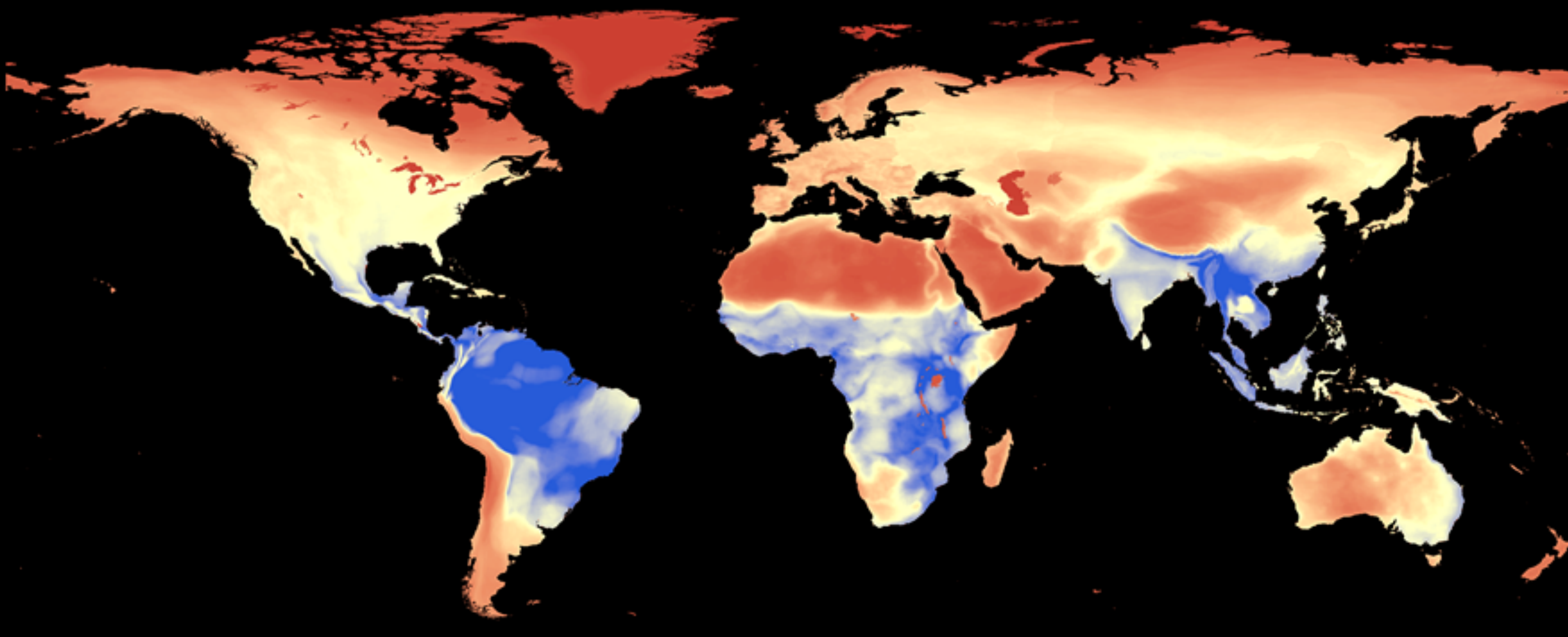


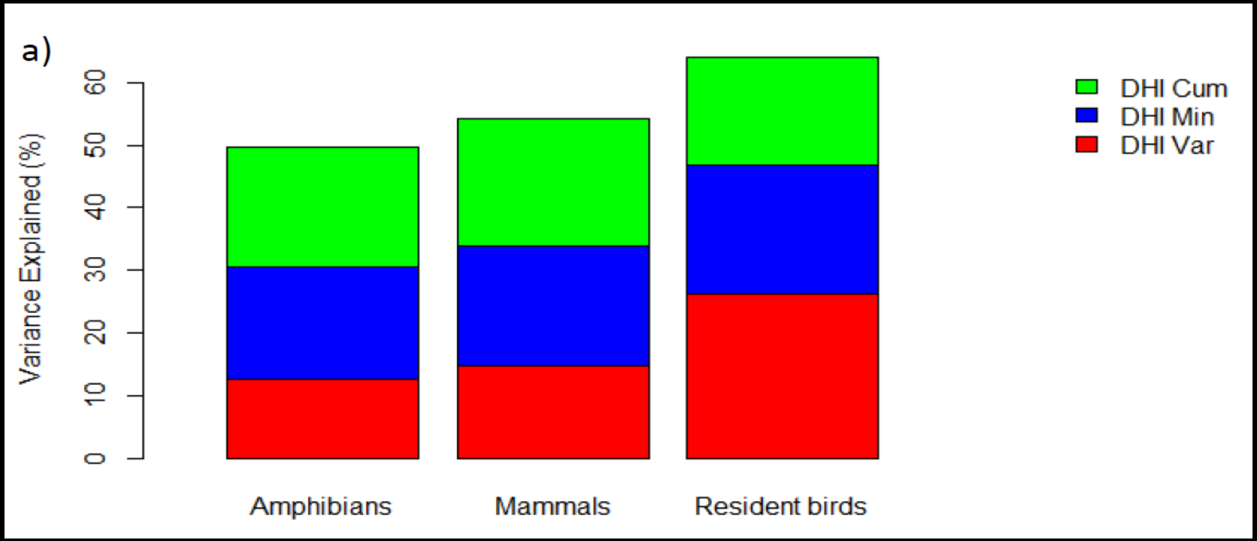


DHIs and global biodiversity

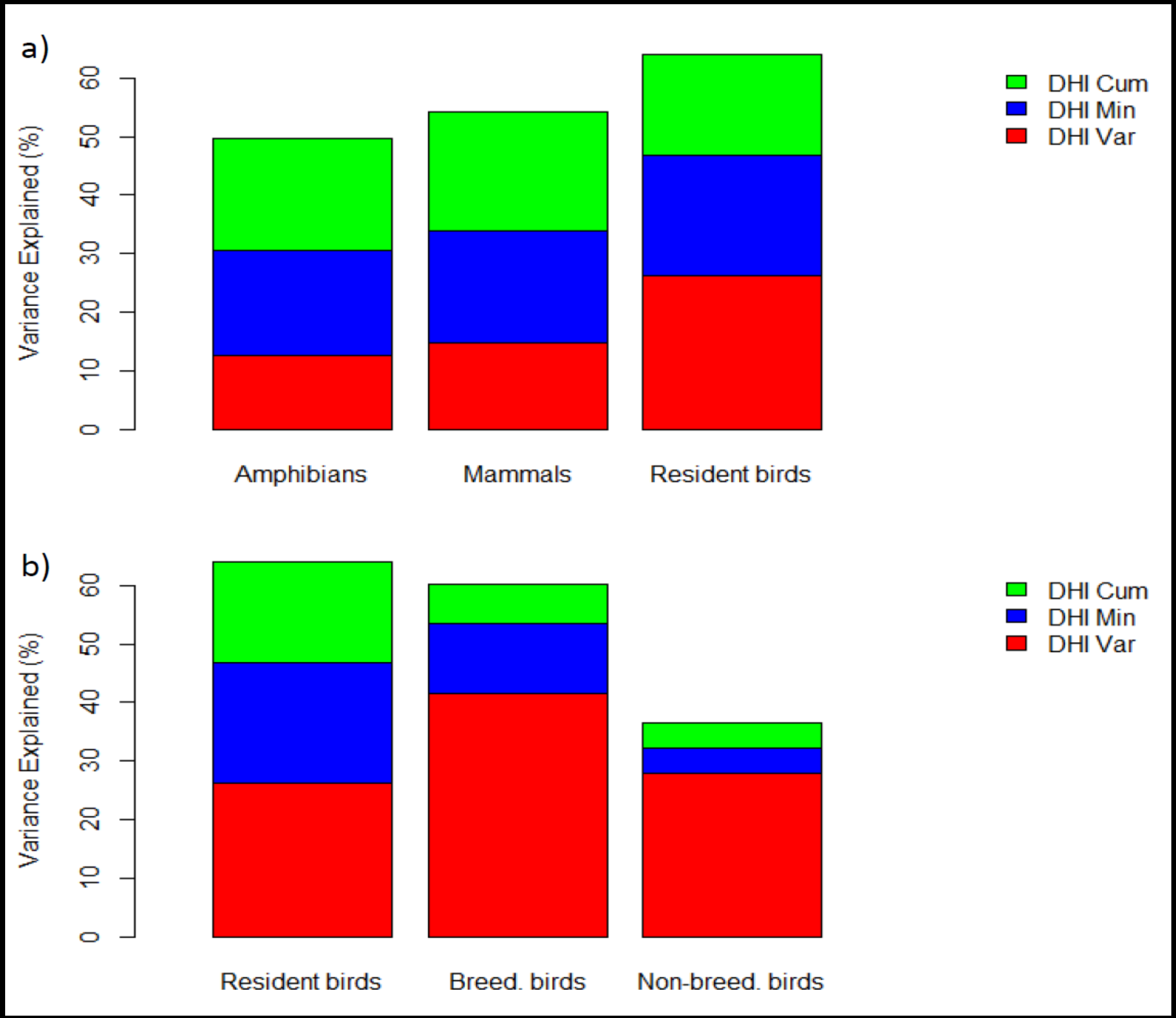


Birds

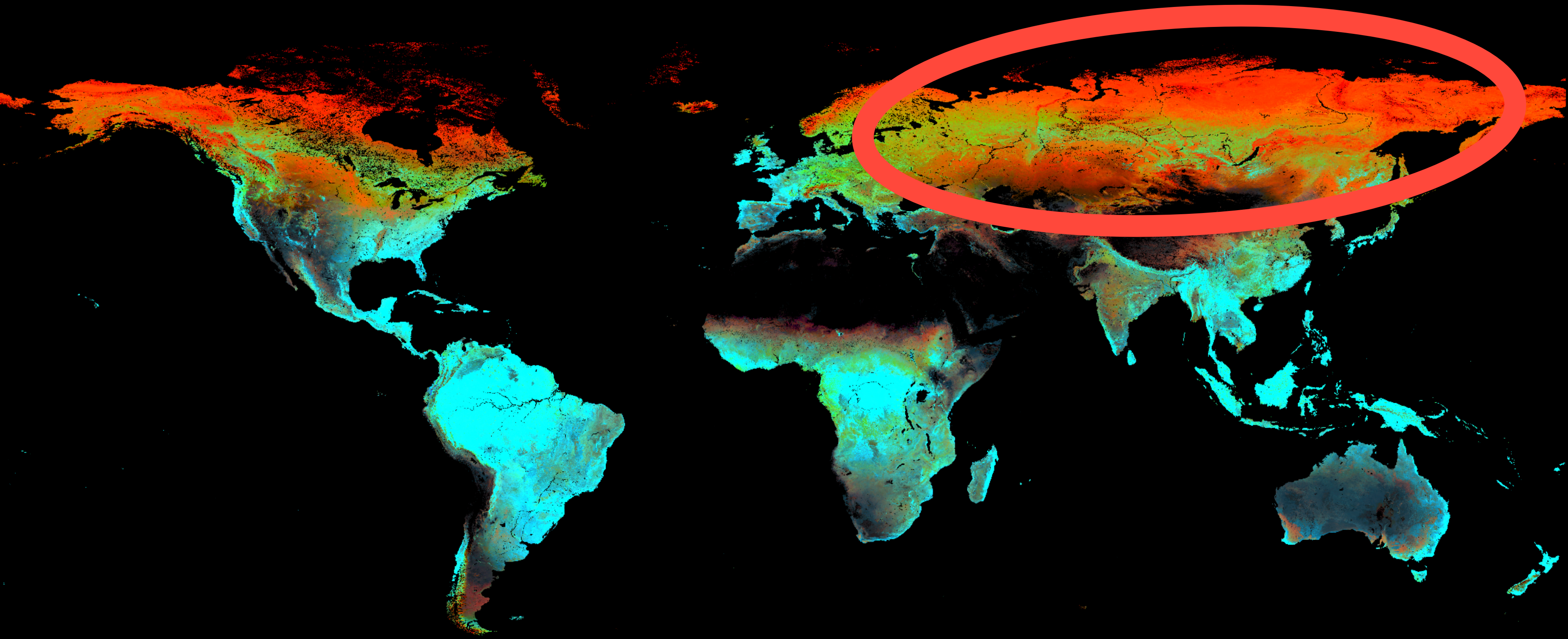
DHIs and global biodiversity



DHIs and global biodiversity



DHIs and abundances

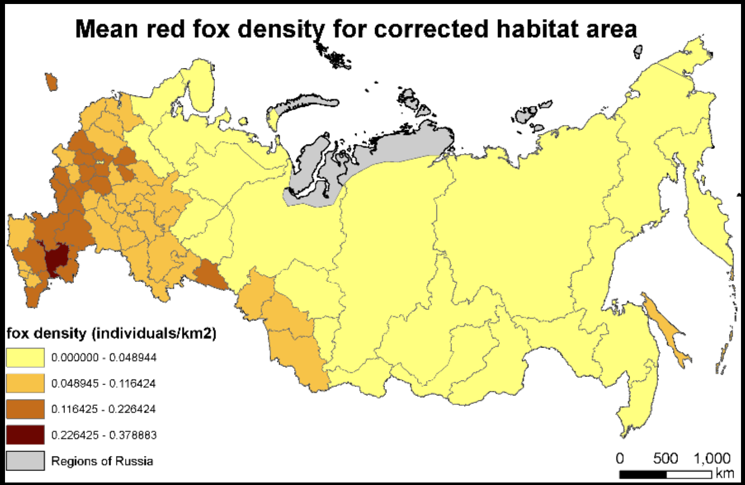


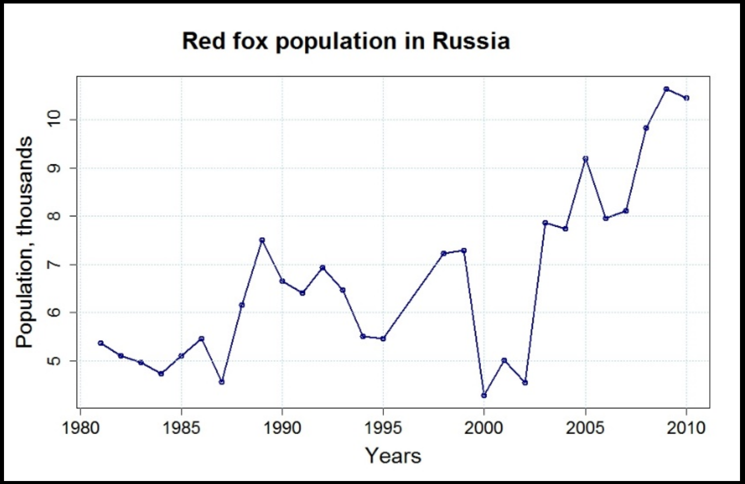
Composite FPAR DHIs

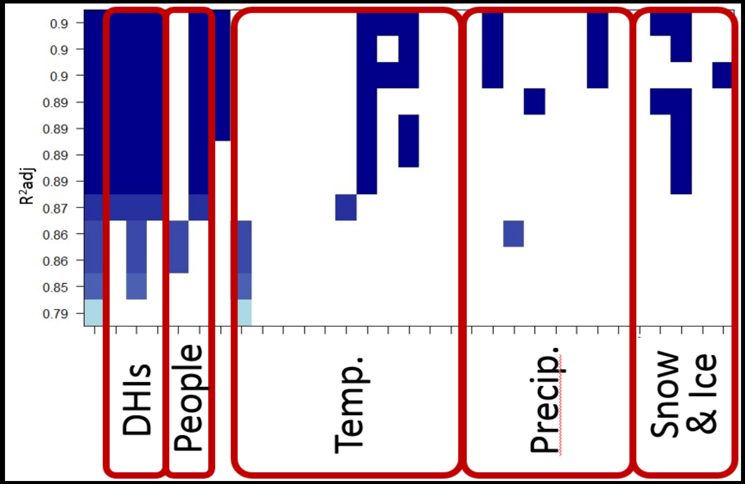
DHIs and abundances

- Russian Winter Track Counts
  - 50,000 transects
  - 10-km long
  - Start in 1966

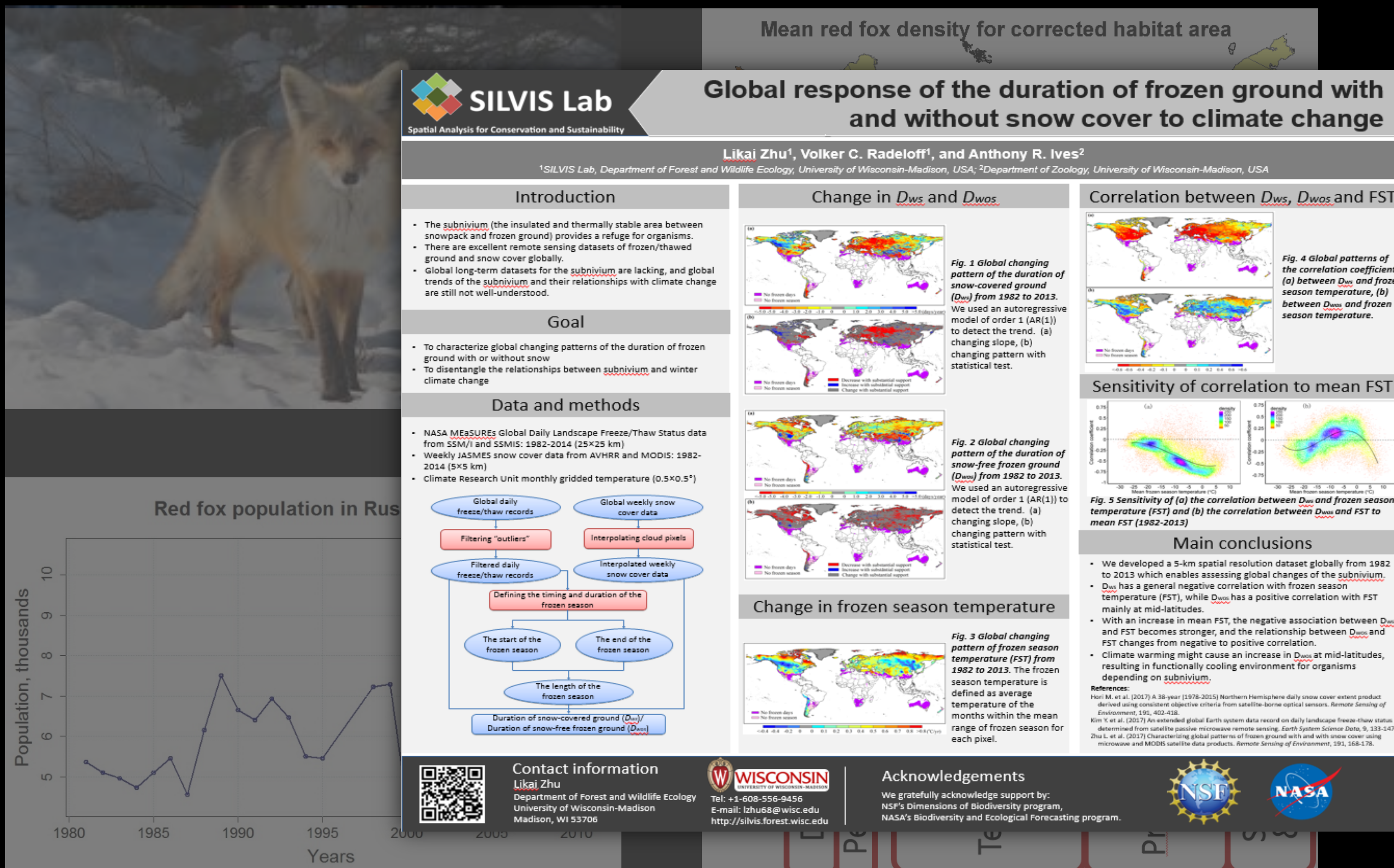
DHIs and abundances







DHIs and abundances



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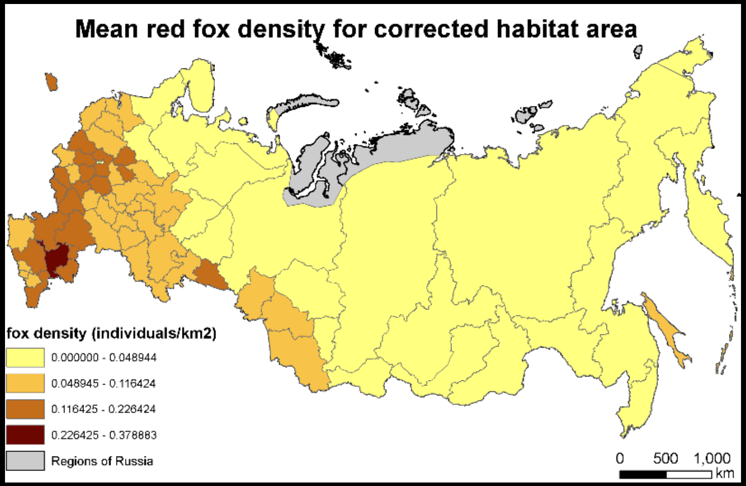

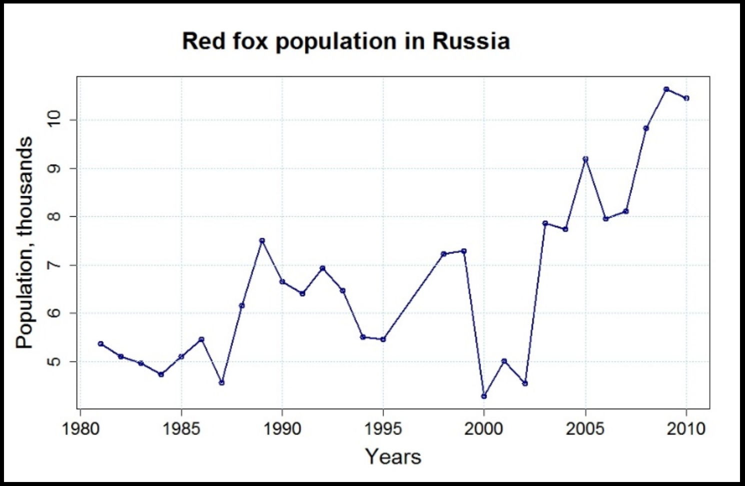

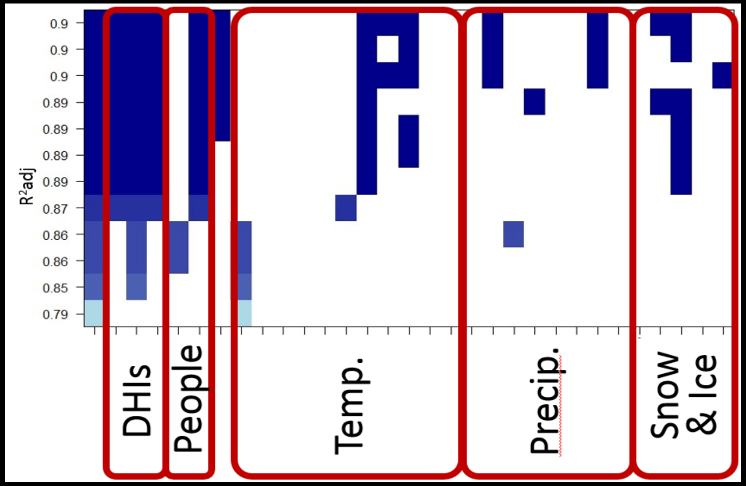

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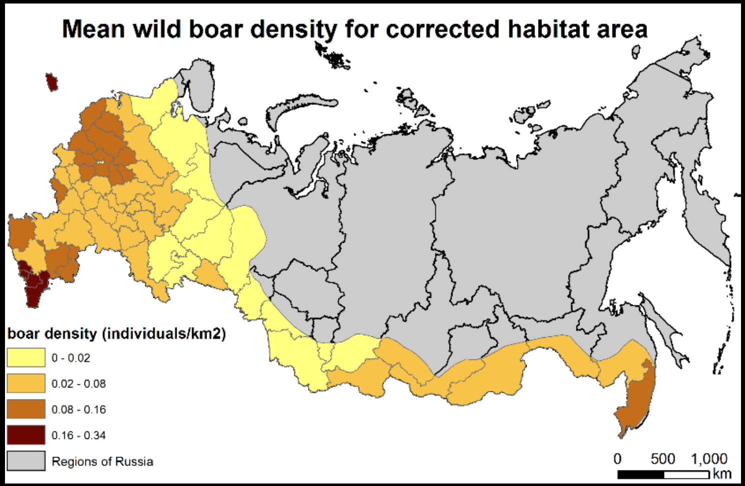

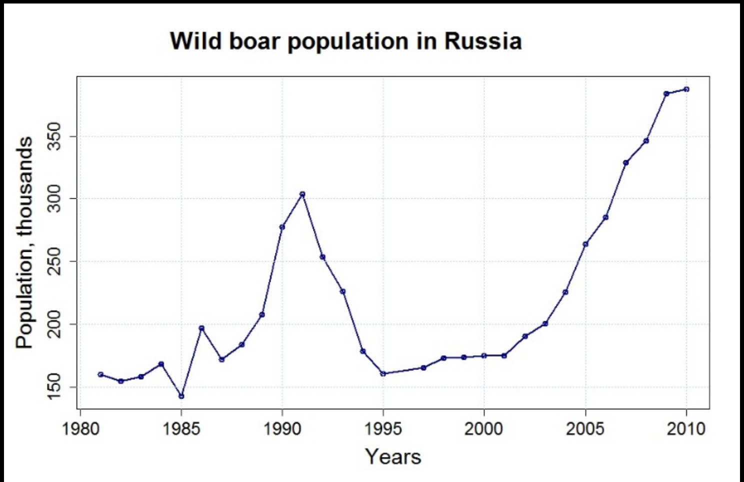

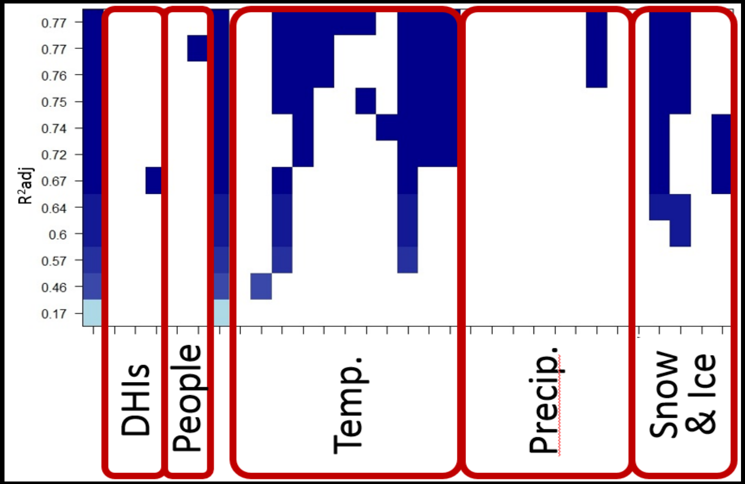

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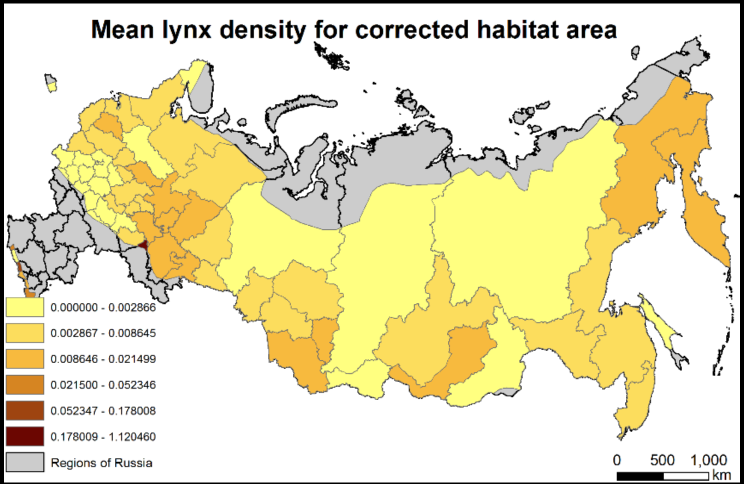

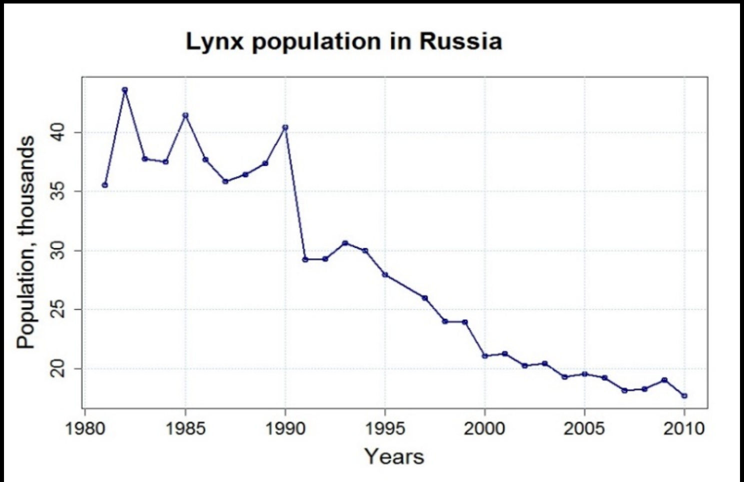

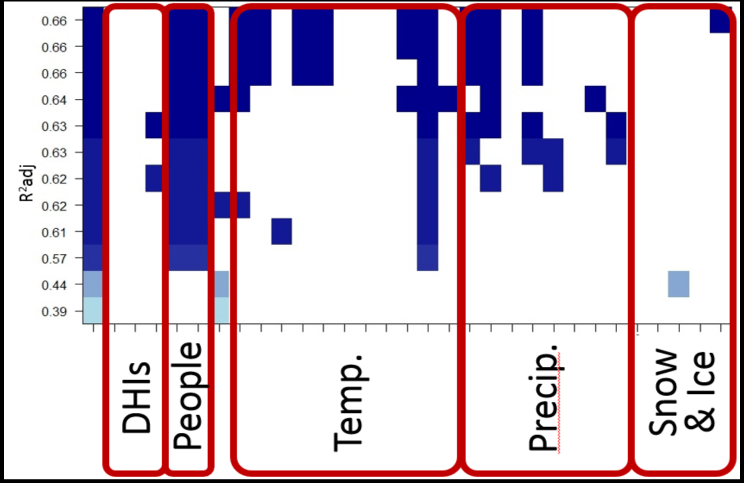

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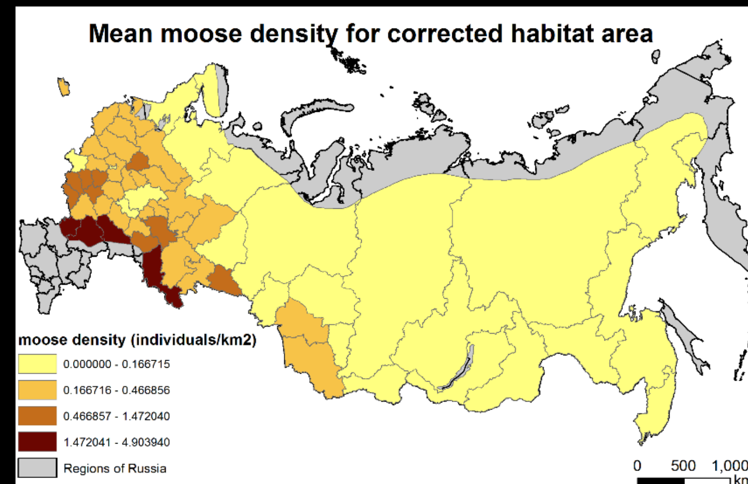

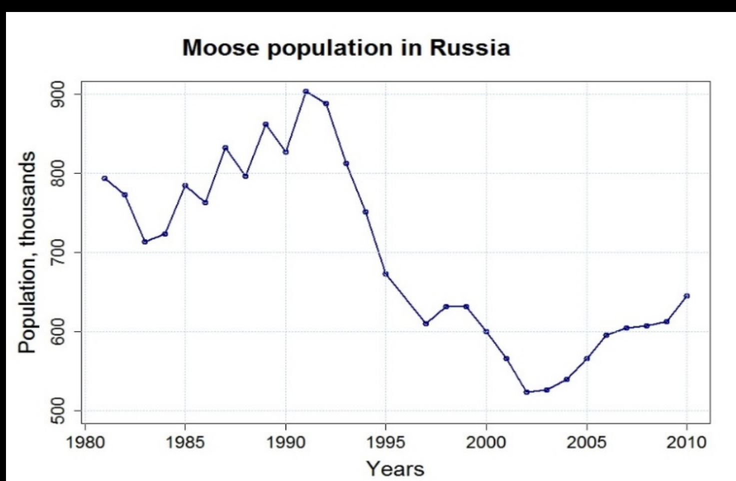

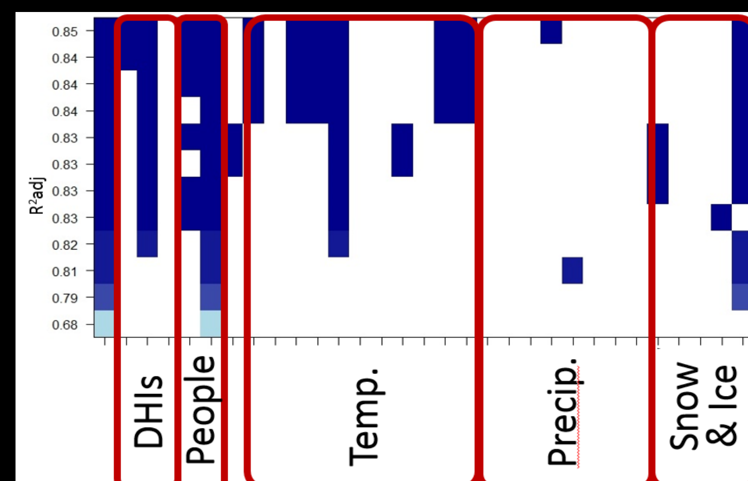

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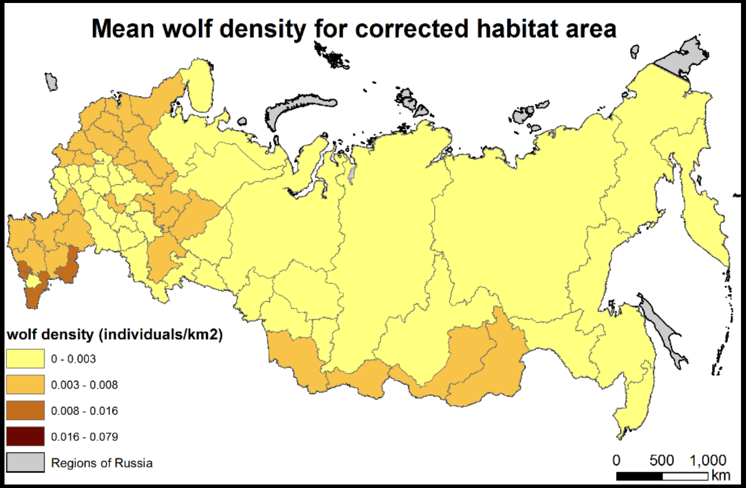

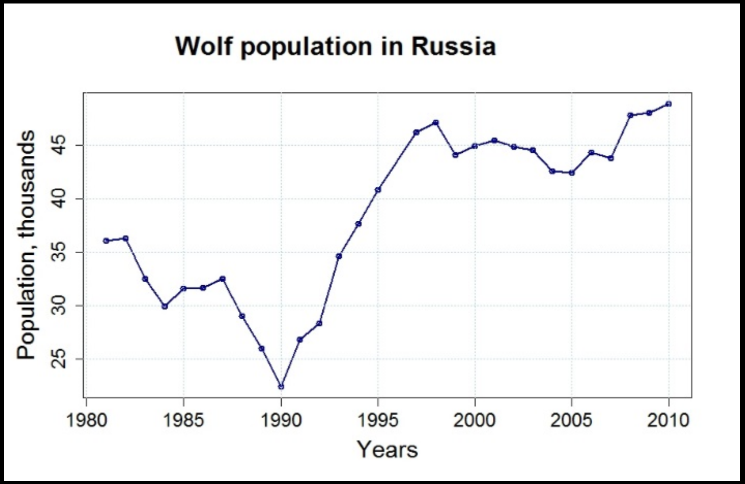

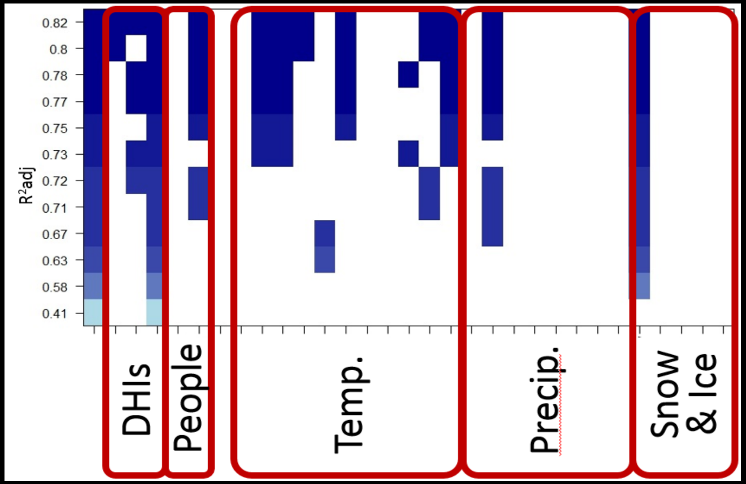

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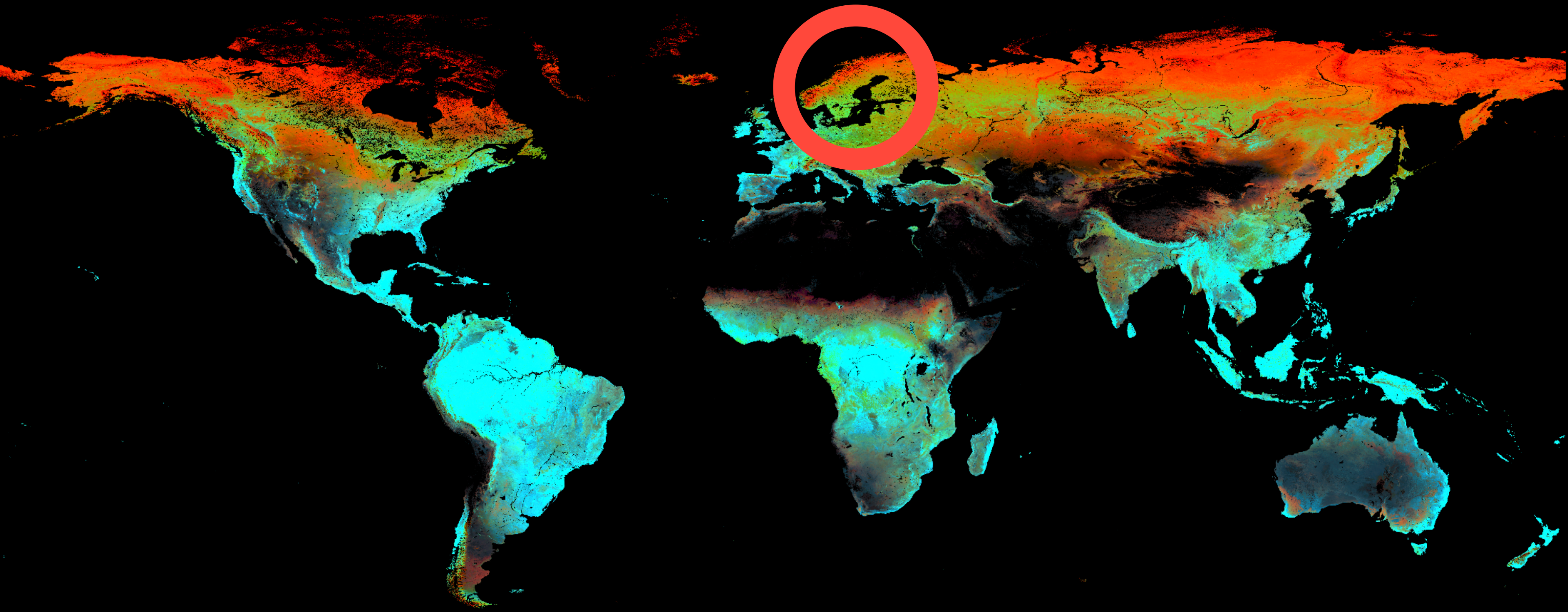
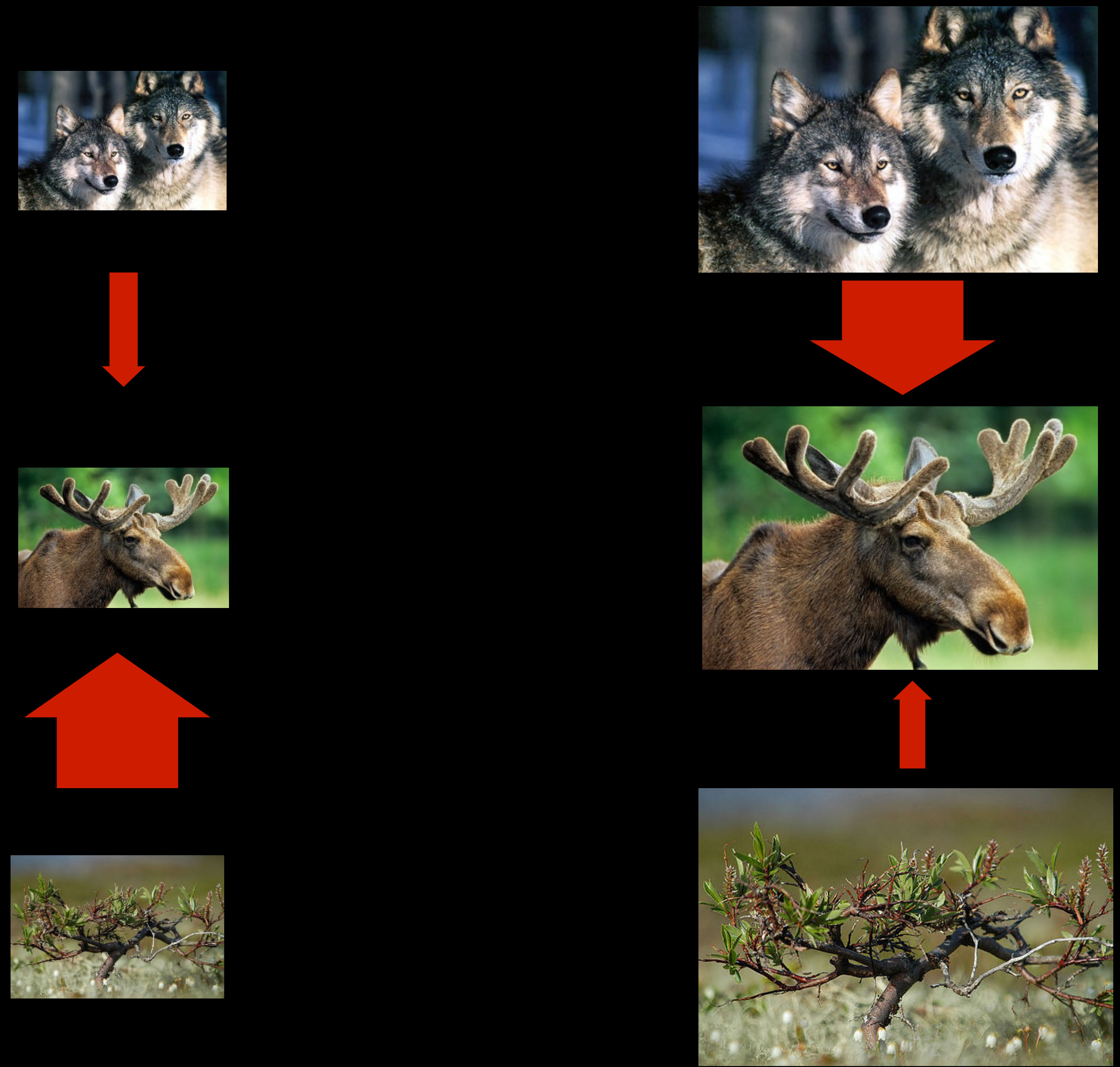


Composite FPAR DHIs

DHIs and abundances

DHIs and abundances



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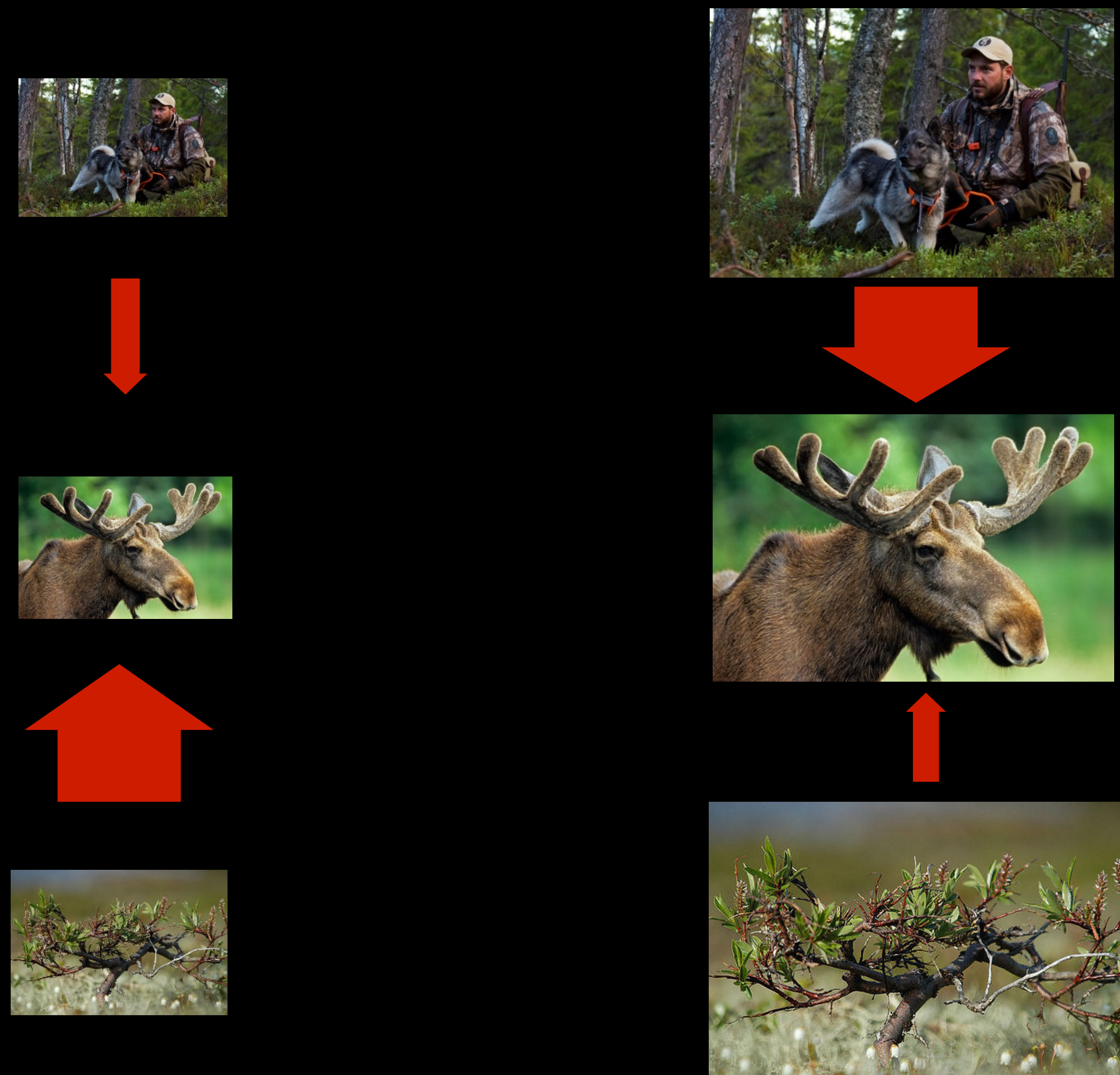
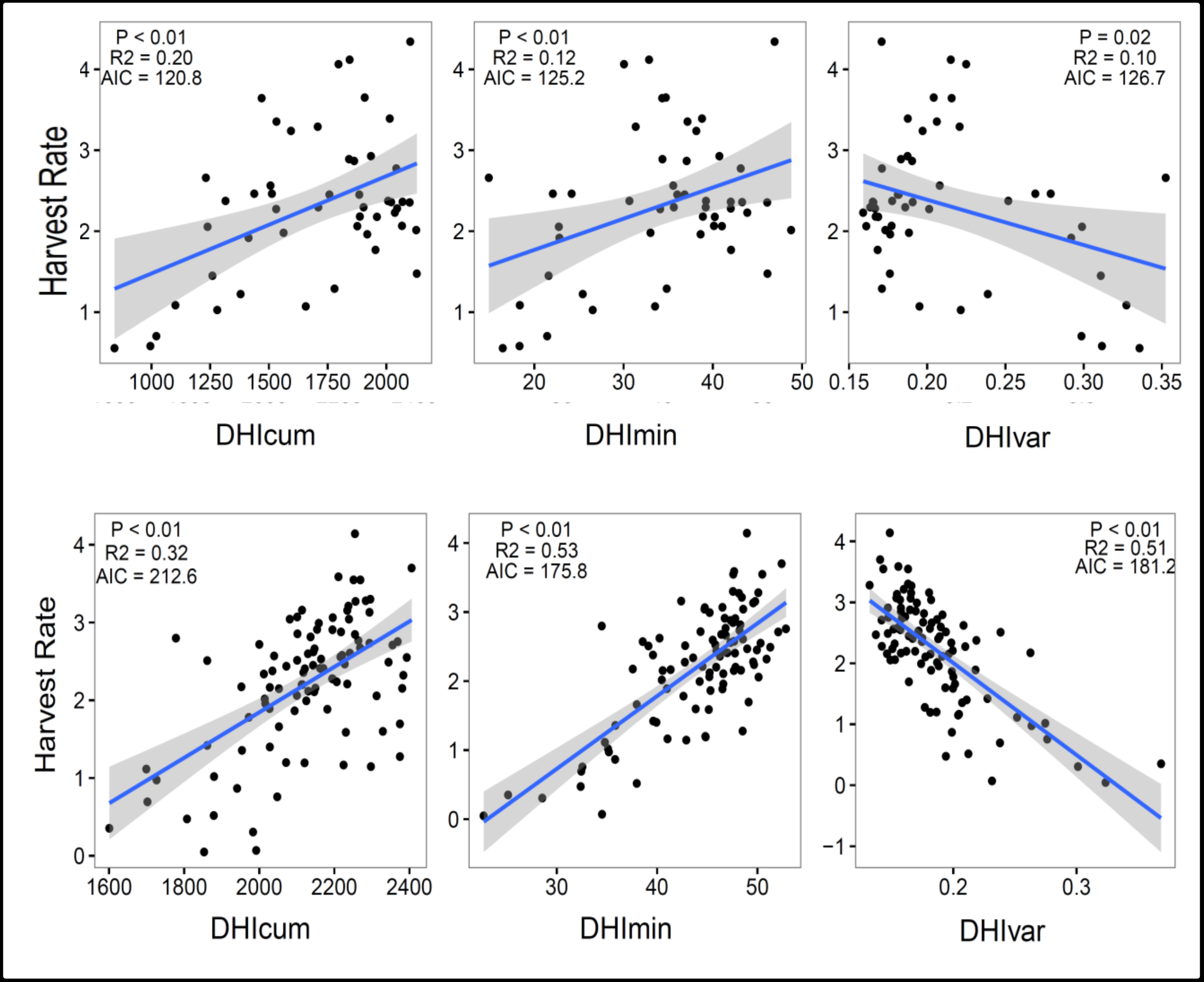


DHIs and abundances

Northern Sweden: Low productivity

Southern Sweden: High productivity



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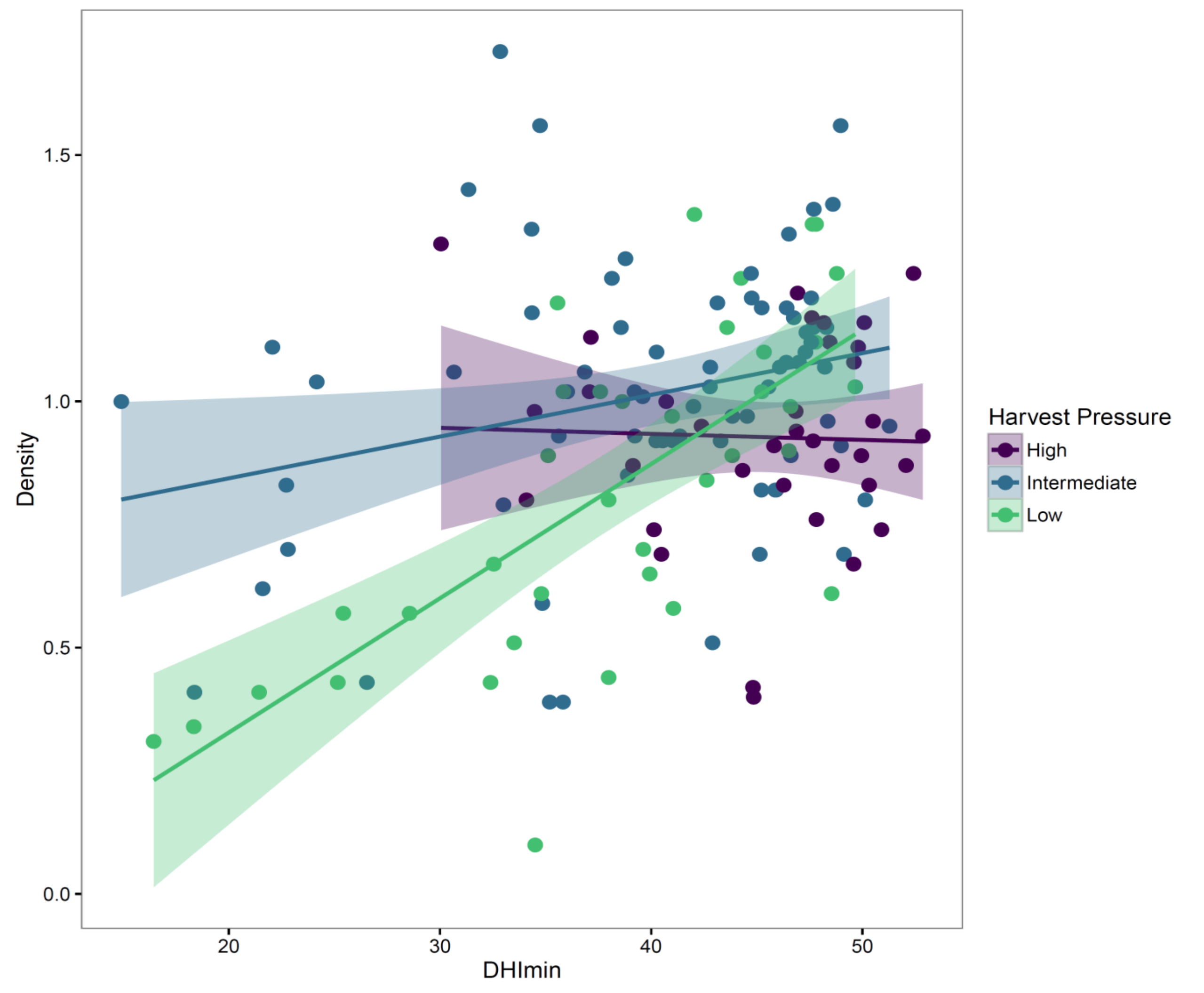

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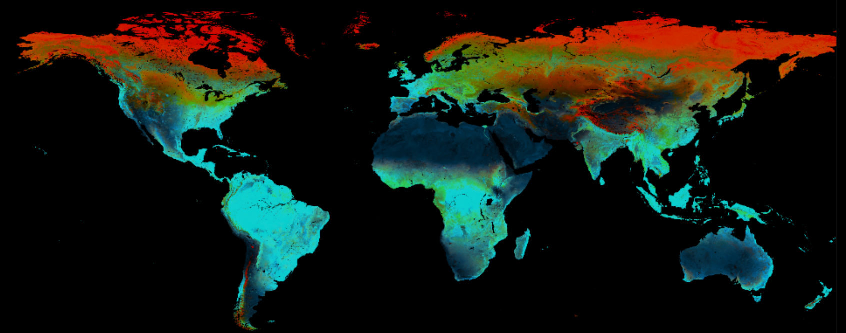

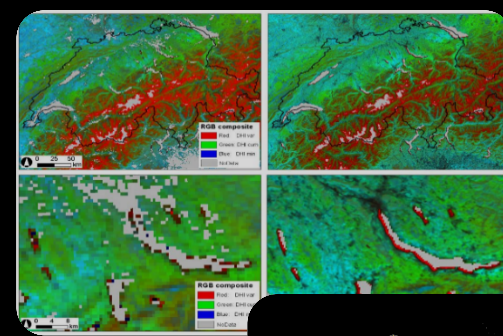

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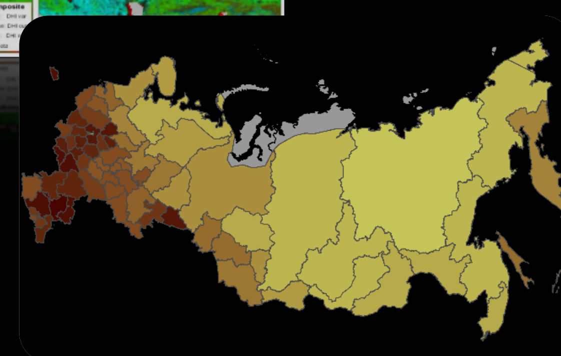


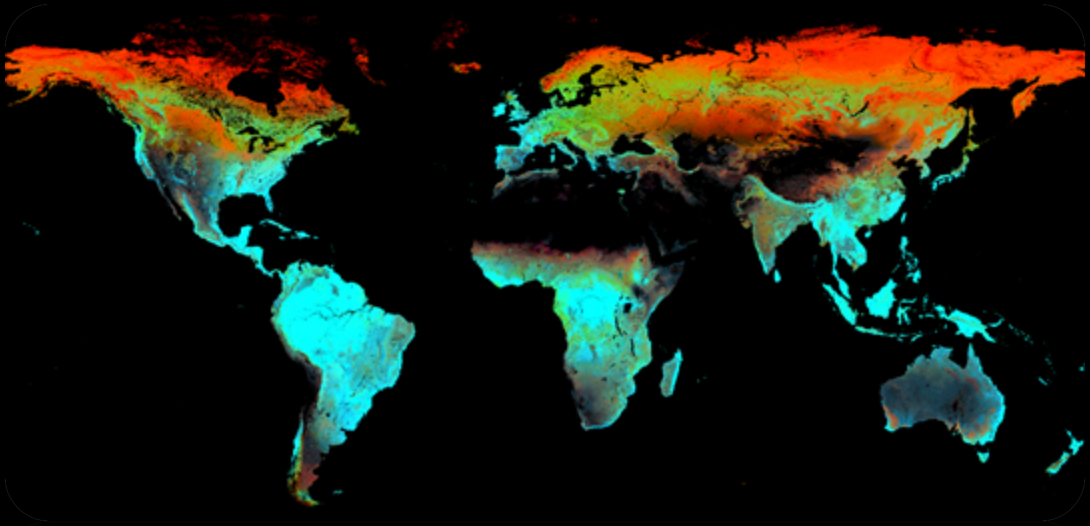
III. Proof of concept: DHIs and biodiversity

Conclusions

I. Background

– The DHIs are based on biodiversity theory

– Three indices of productivity that are key for biodiversity



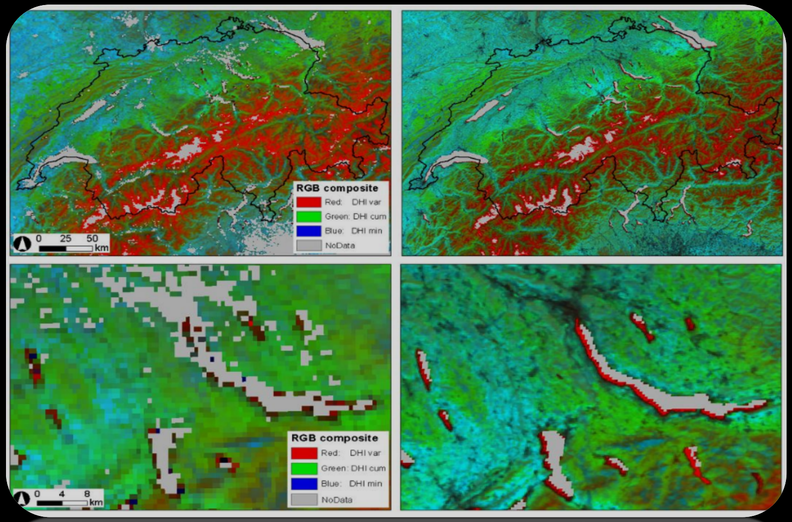
Conclusions

II. Datasets: completed

– Composite DHIs

– Annual DHIs

– Available for you!



Conclusions

III. DHIs and biodiversity

- Well correlated with global species richness
  - All three DHIs matter
- Well correlated with wildlife abundances
  - DHIs contribute to multivariate models
- Well correlated with predation rates
  - In highly productive areas, as they should

silvis.forest.wisc.edu/data/DHIs

radeloff@wisc.edu

Thanks!

DHIs and abundances

	Cum DHI	Min DHI	Var DHI	Human	Elevation	Temp.	Precip.	Snow/ Ice	R^2_{adj}
Brown bear					+	+	+	+	0.77
Hare		+		+		+	+	+	0.94
Lynx				+	+	+	+		0.67
Red fox	+	+	+	+	+	+		+	0.90
Wild boar				+	+	+	+	+	0.79
Roe deer				+		+	+	+	0.66
Moose	+	+		+		+	+	+	0.85
Wolf	+	+	+	+		+	+	+	0.82