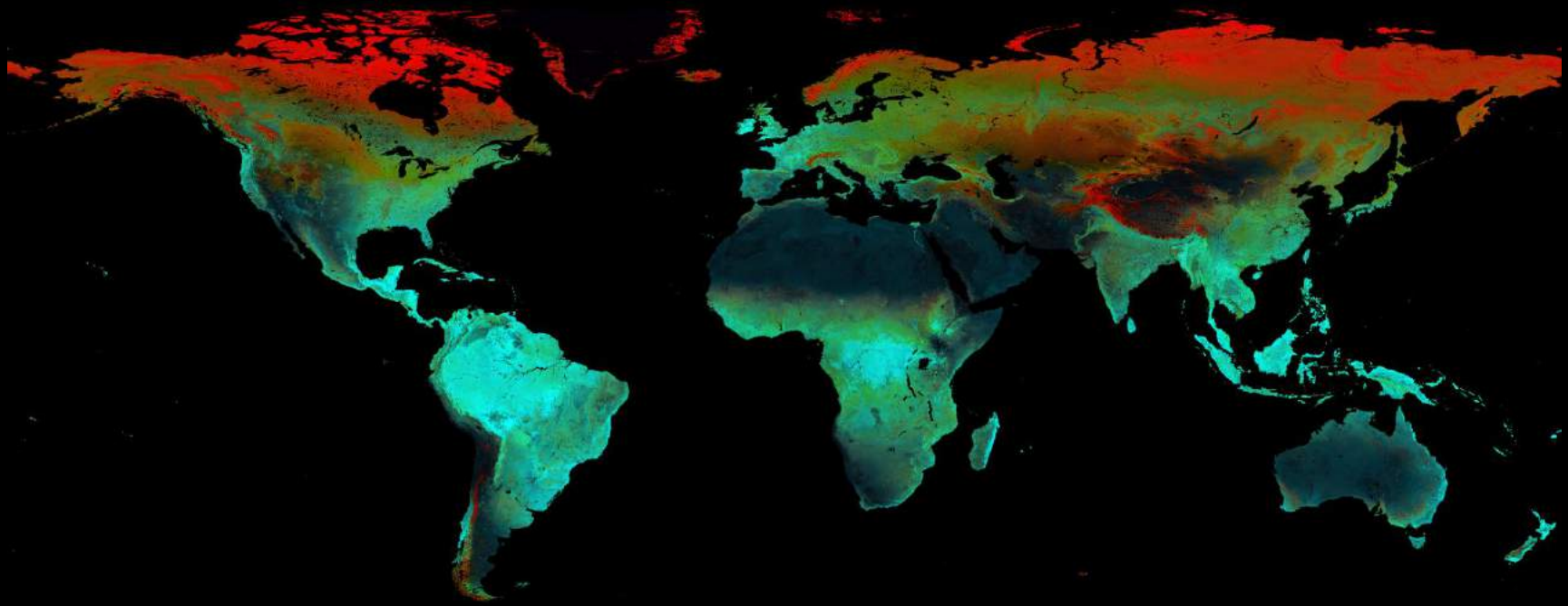
Developing and testing the Dynamic Habitat Indices from MODIS for biodiversity and conservation



V. C. Radeloff, L. Farwell, D. Gudex-Cross, D. Helmers, A. Ives, A. Pidgeon, E. Razenkova, L. Zhu
University of Wisconsin-Madison

N. Coops, UBC Vancouver; M. Oliver, U Delaware

NASA Biodiversity and Ecological Forecasting Science Team Meeting, 5/21/2019

Outline

I. The Dynamic Habitat Indices

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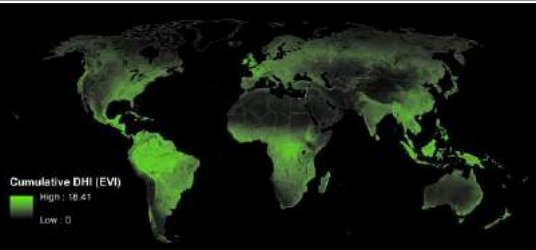
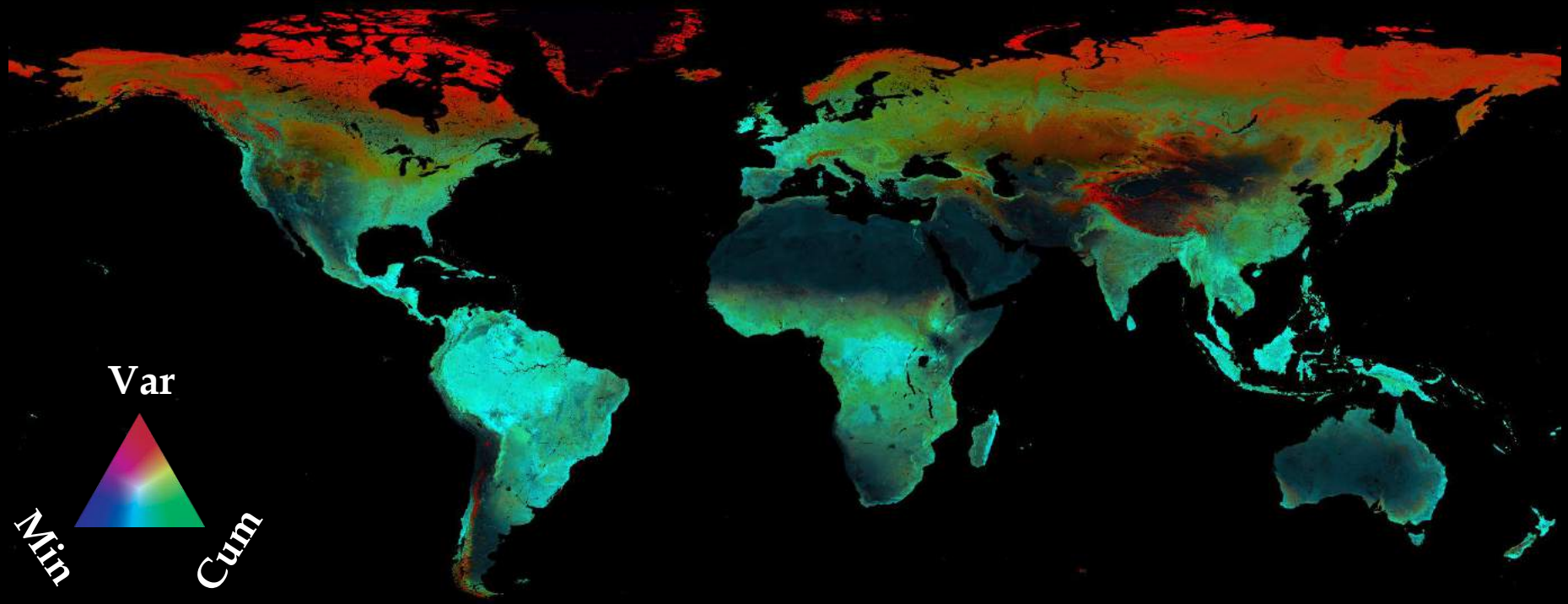
The Dynamic Habitat Indices

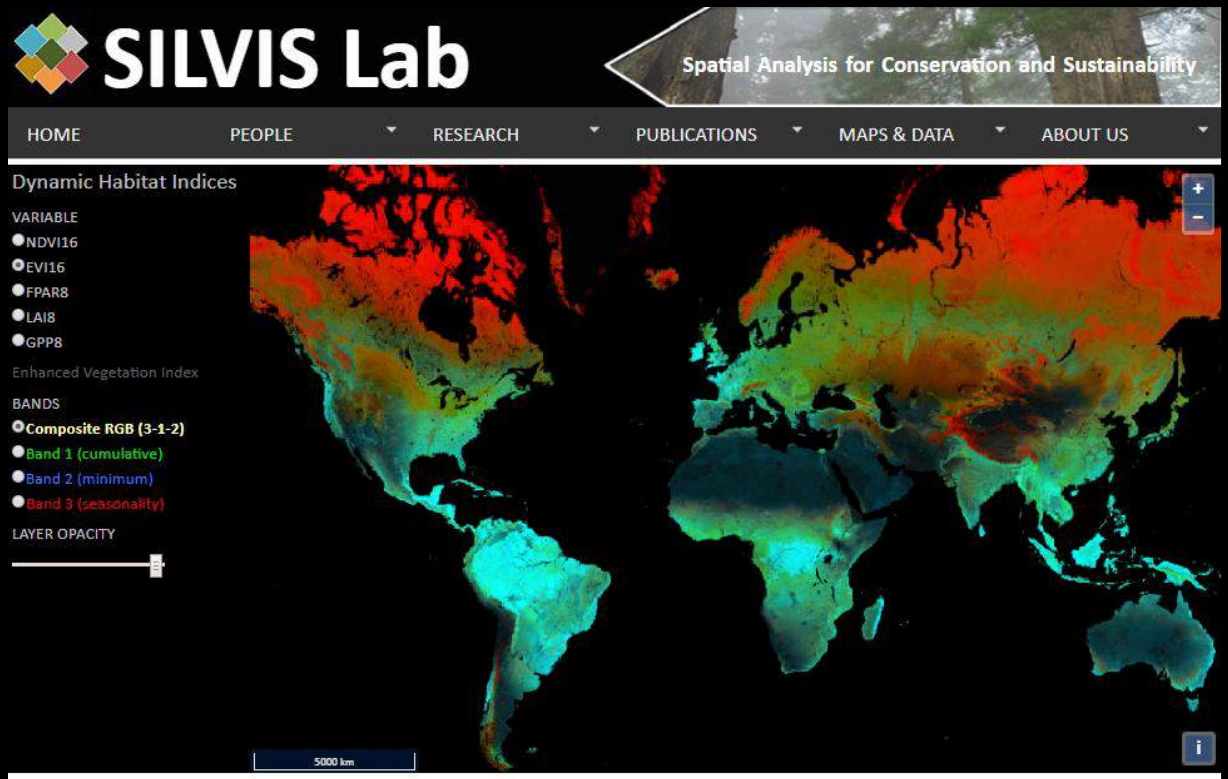
Ecology	DHIs
Available energy hypothesis	
Environmental stress hypothesis	
Environmental variability hypothesis	

The Dynamic Habitat Indices



Composite EVI DHIs (2003-'14)

The Dynamic Habitat Indices



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

The Dynamic Habitat Indices

silvis.forest.wisc.edu/data/DHIs

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
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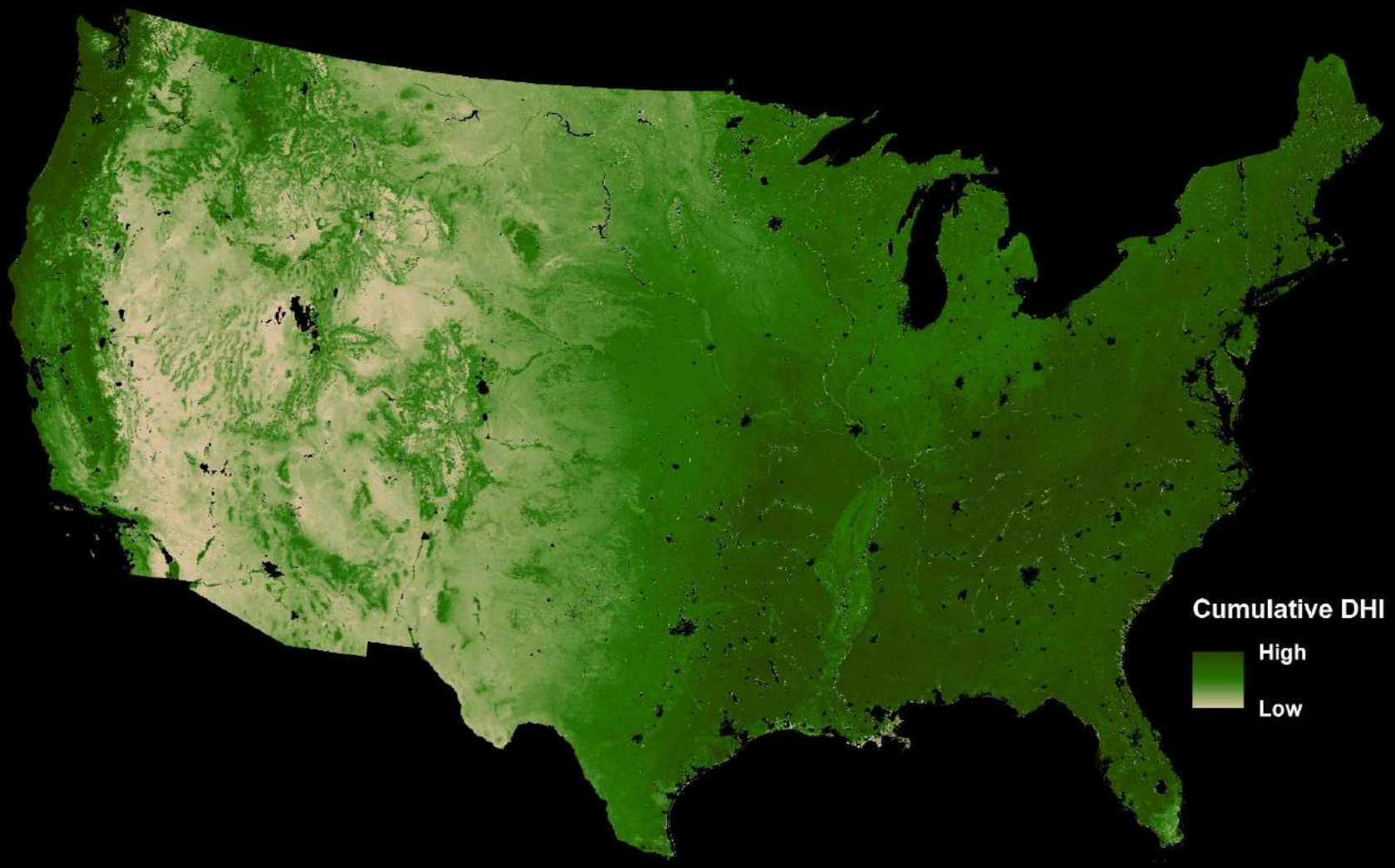
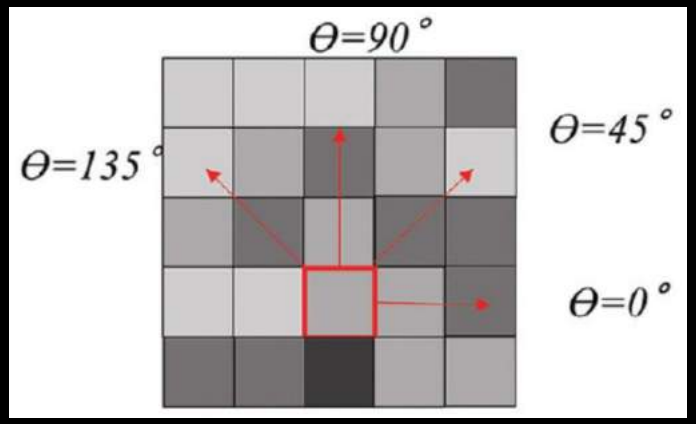
Texture of DHIs



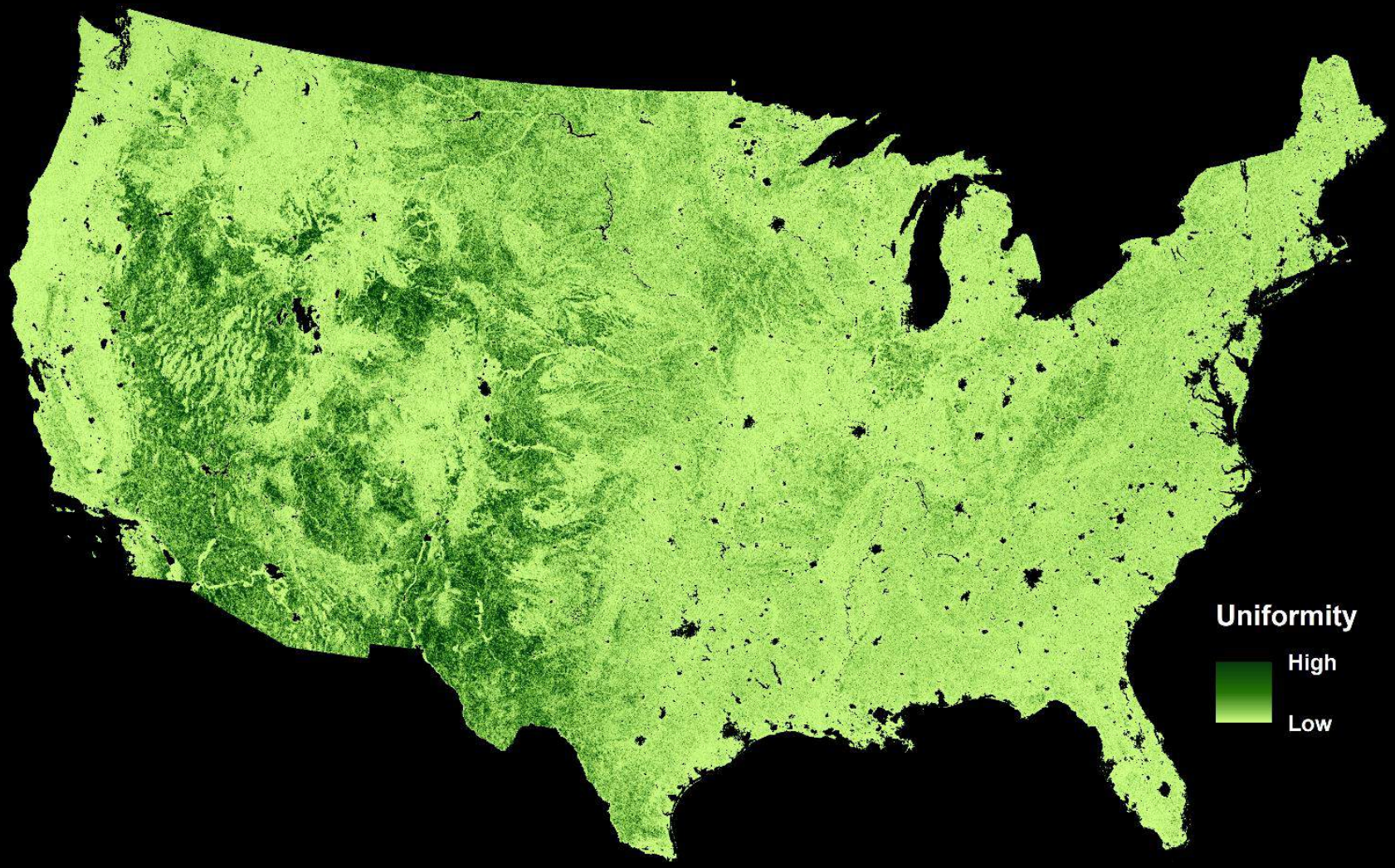
Texture of DHIs

- 3x3 pixel moving window = 3 km^2
- 1st-order: Standard deviation
- 2nd-order:
  - Entropy, Uniformity, Homogeneity
  - Contrast, Dissimilarity
  - Correlation



Gray-level Co-occurrence Matrix (Haralick 1973)

Texture of DHIs



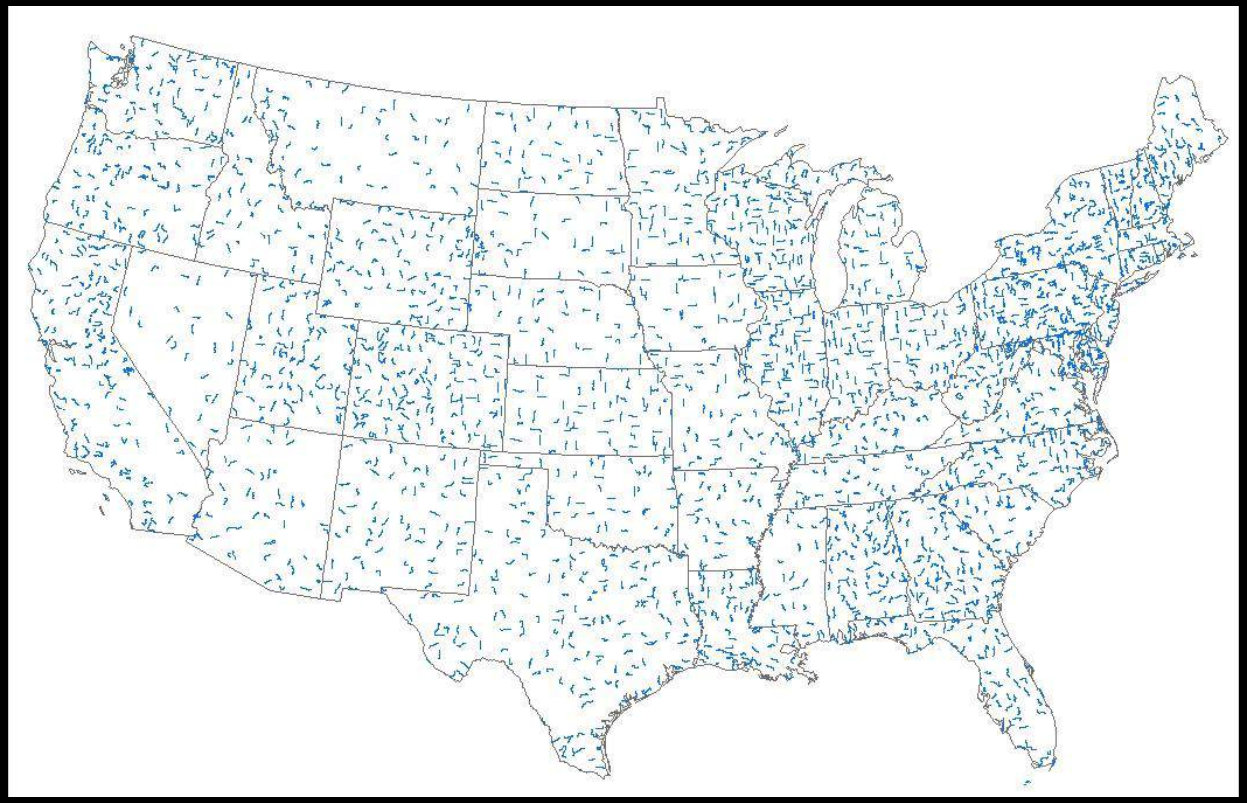
Texture of DHIs

Texture of DHIs

Breeding Bird Survey:

- 2013-2017
- 2,749 routes
- 329 species

  - 73% Forest
  - 55% Shrubland
  - 23% Grassland



Texture of DHIs

Predictor	Est.	*P*	adj. R^2
Cumulative DHI	7.75	<0.001	0.28
Uniformity	-6.67	<0.001	0.20
Entropy	6.13	<0.001	0.17
Correlation	-5.65	<0.001	0.15
Homogeneity	-5.15	<0.001	0.12
Std Dev	2.05	<0.001	0.02
Dissimilarity	1.60	<0.001	0.01
Contrast	0.15	ns	-

Texture of DHIs

Predictor	Est.	*P*	adj. R^2
Cumulative DHI	7.75	<0.001	0.28
Uniformity	-6.67	<0.001	0.20
Entropy	6.13	<0.001	0.17
Correlation	-5.65	<0.001	0.15
Homogeneity	-5.15	<0.001	0.12
Std Dev	2.05	<0.001	0.02
Dissimilarity	1.60	<0.001	0.01
Contrast	0.15	ns	-

Multivariate Model	adj. R^2
Cumulative DHI + Uniformity + Contrast + Correlation	0.37

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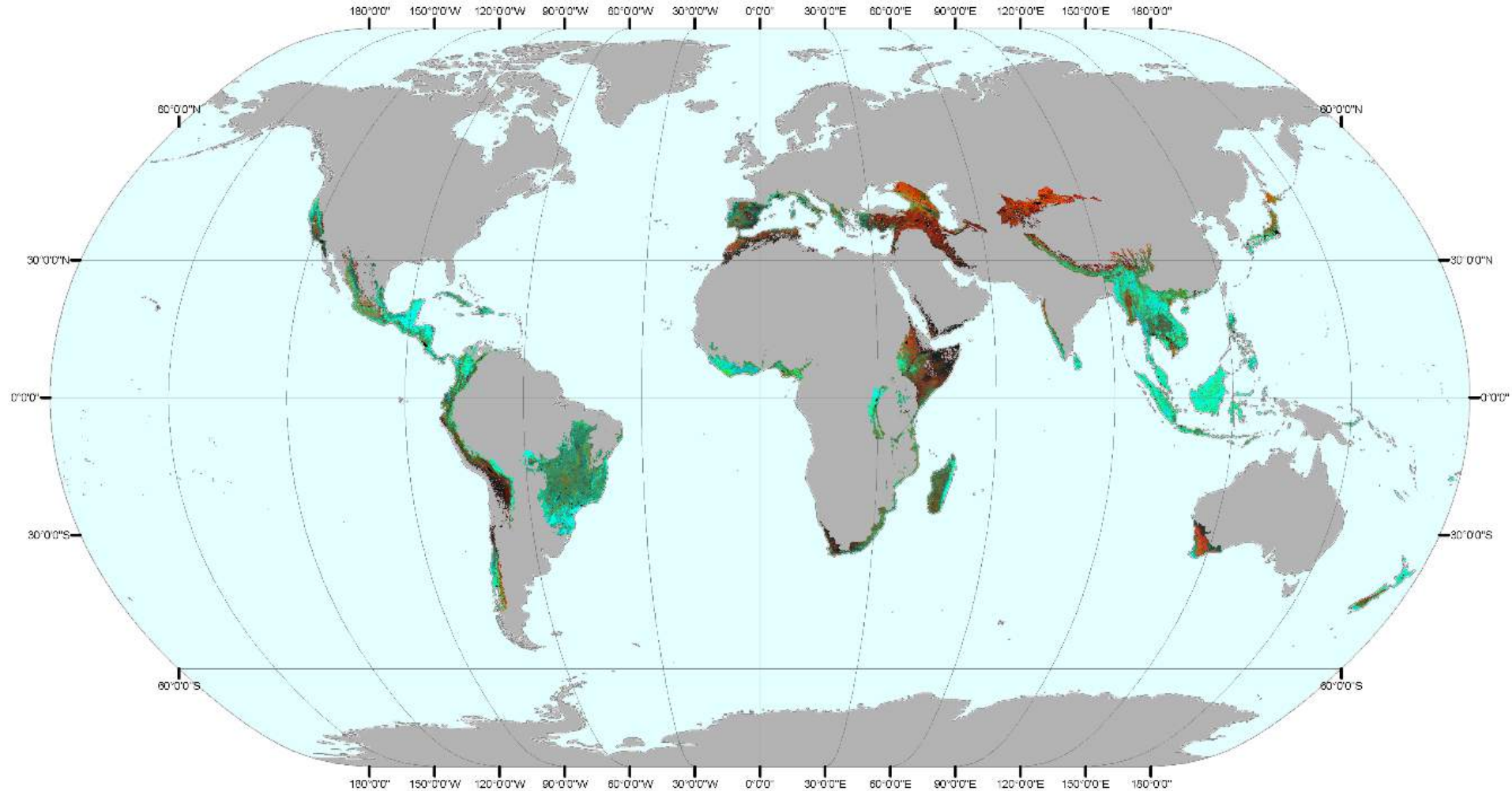
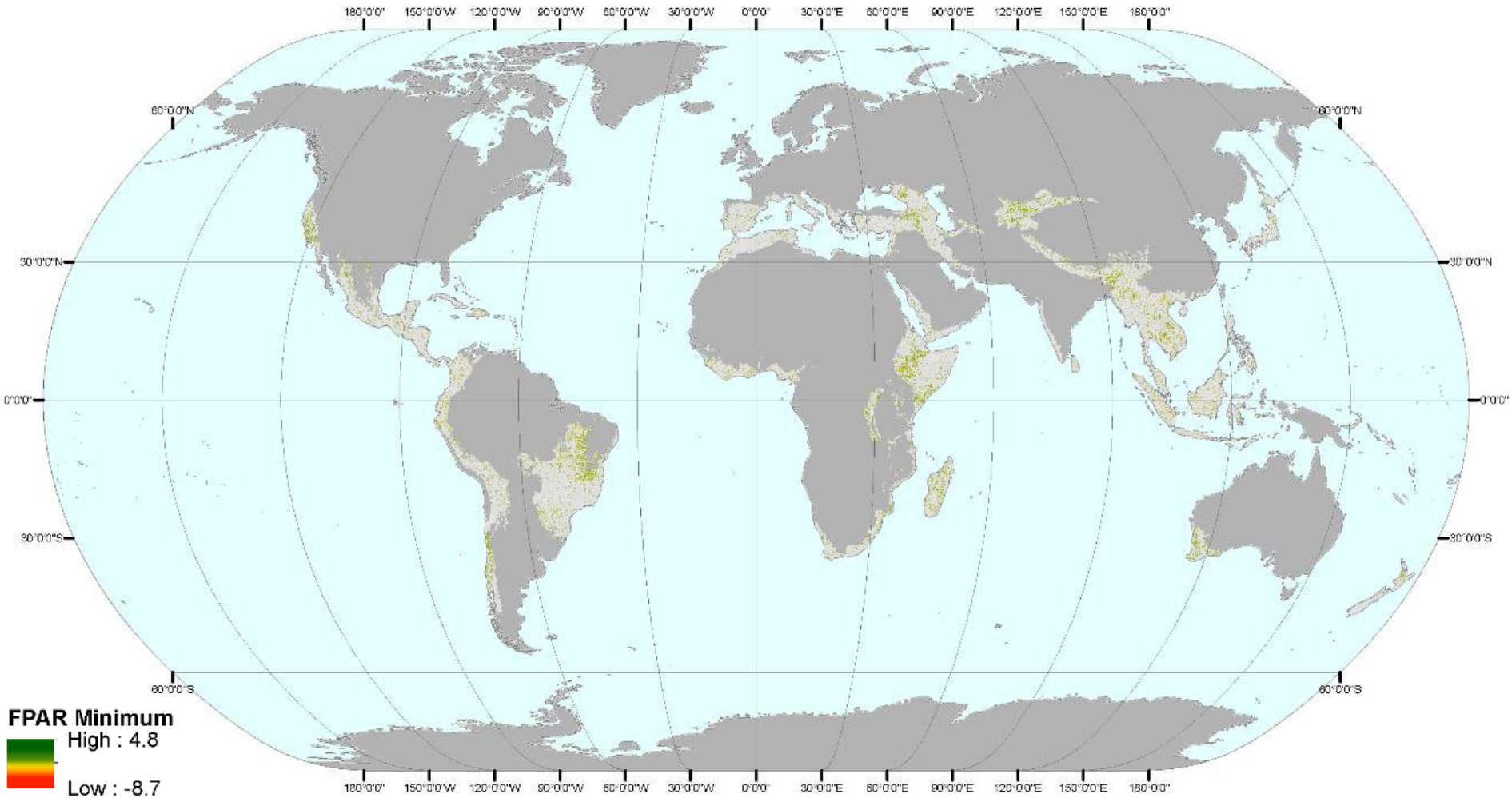
Trends in DHIs



Coops et al.

Trends in DHIs



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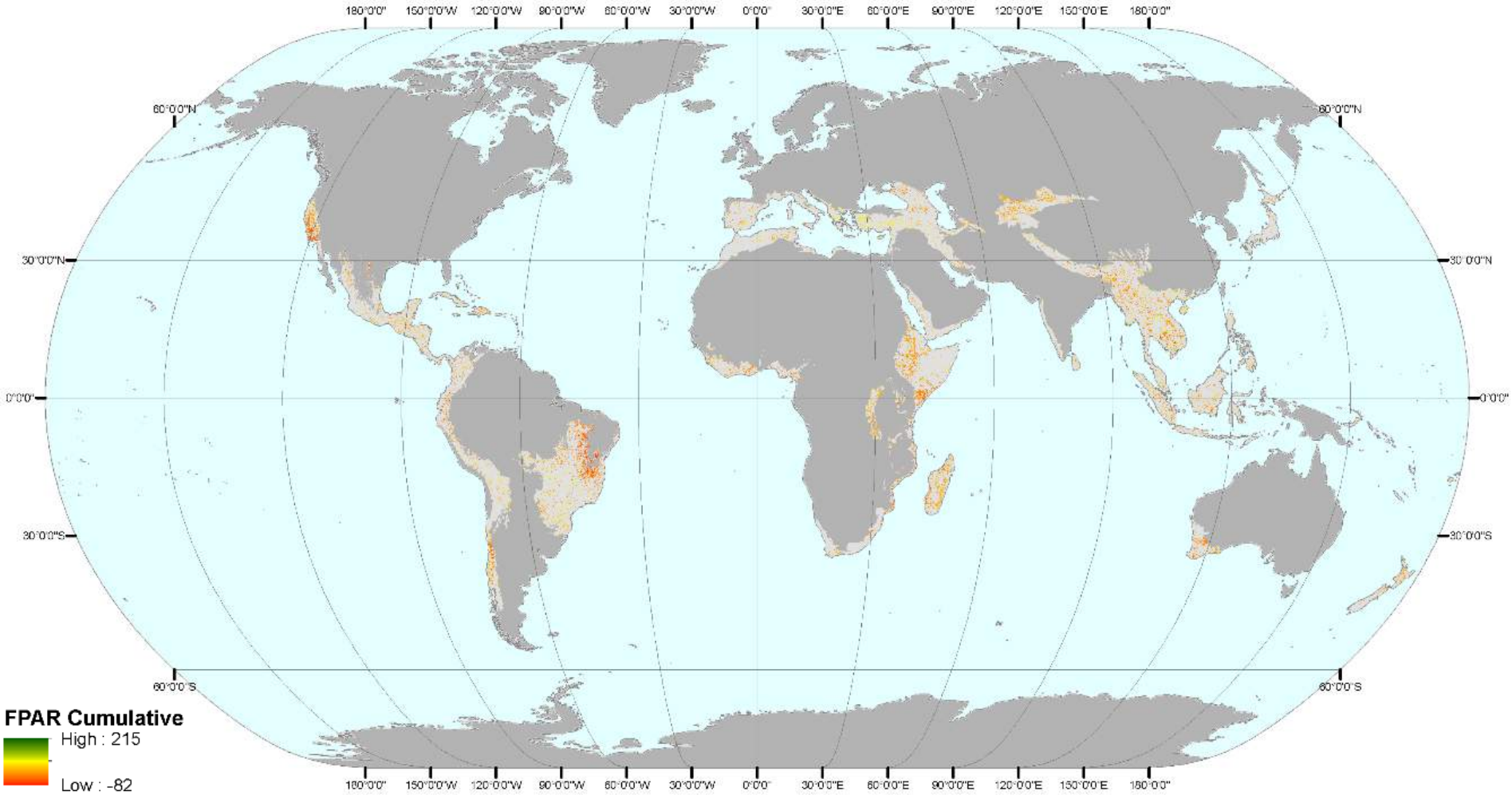

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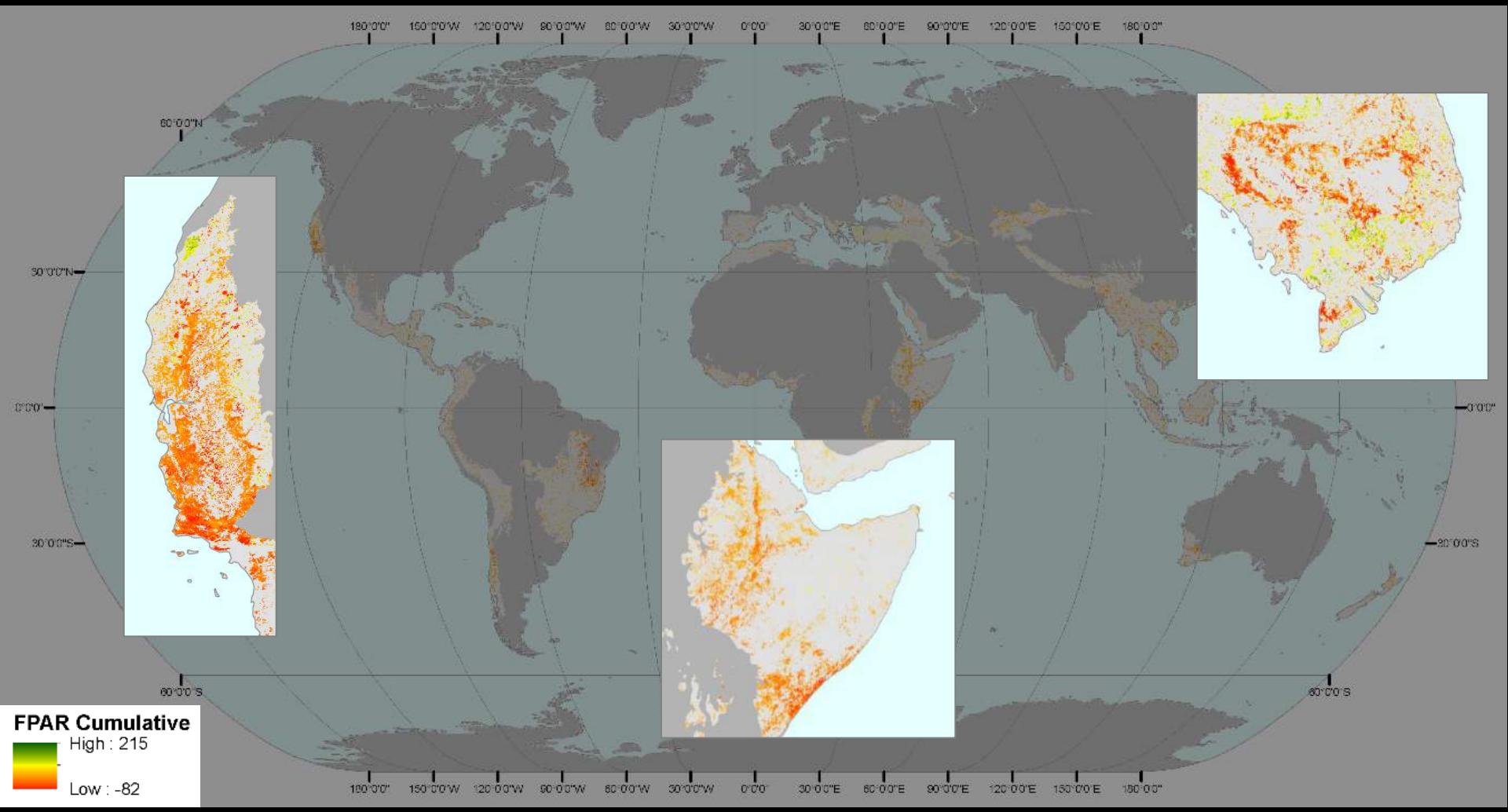

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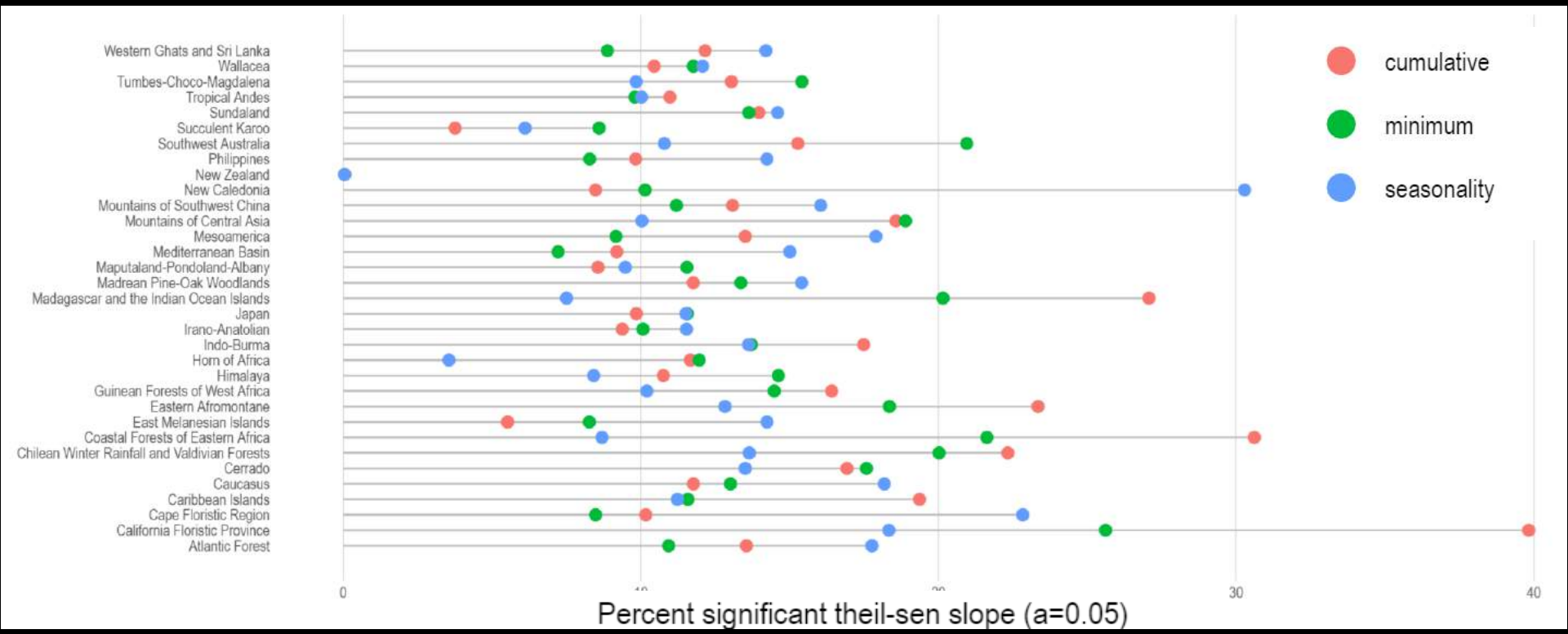
Trends in DHIs



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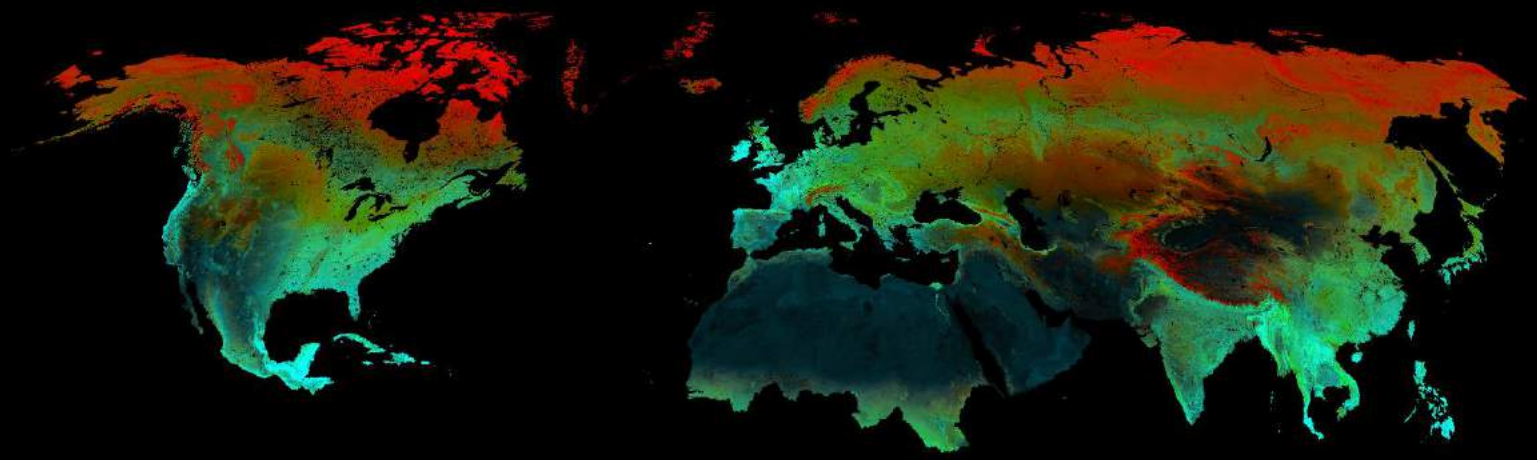
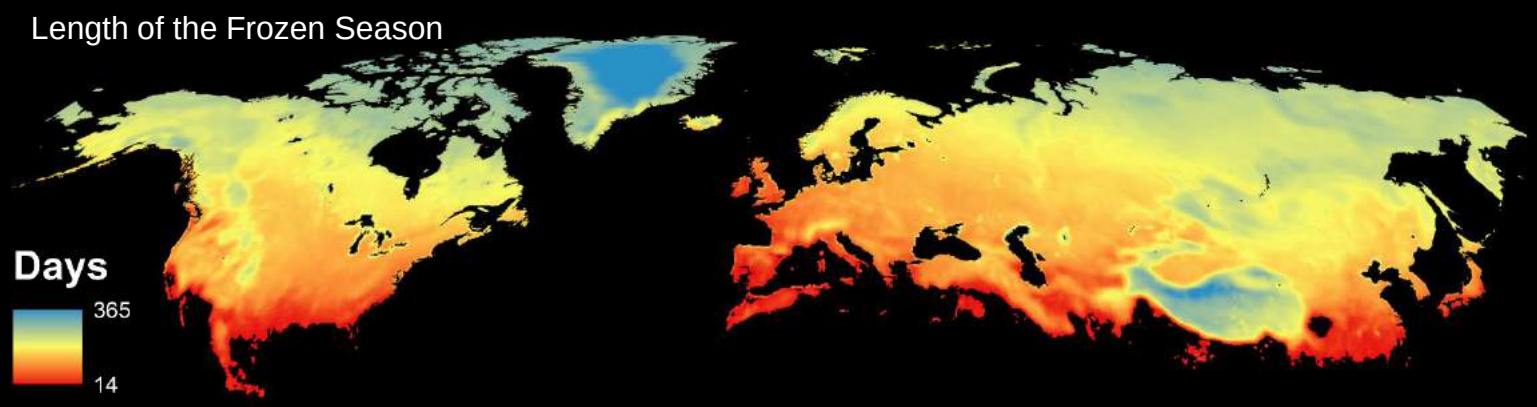
DHIs vs. Snow and Ice

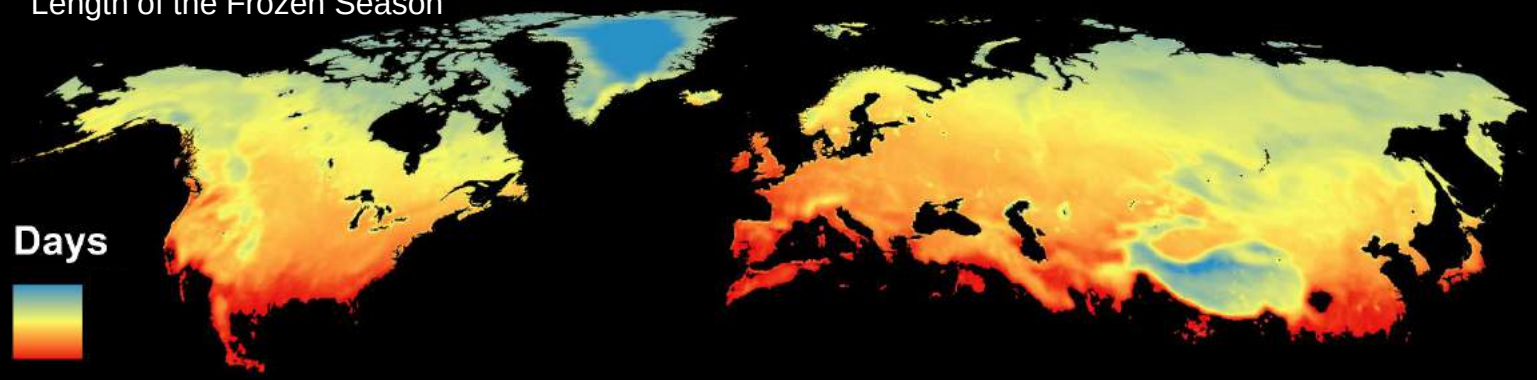


DHIs vs. Snow and Ice



DHIs vs. Snow and Ice

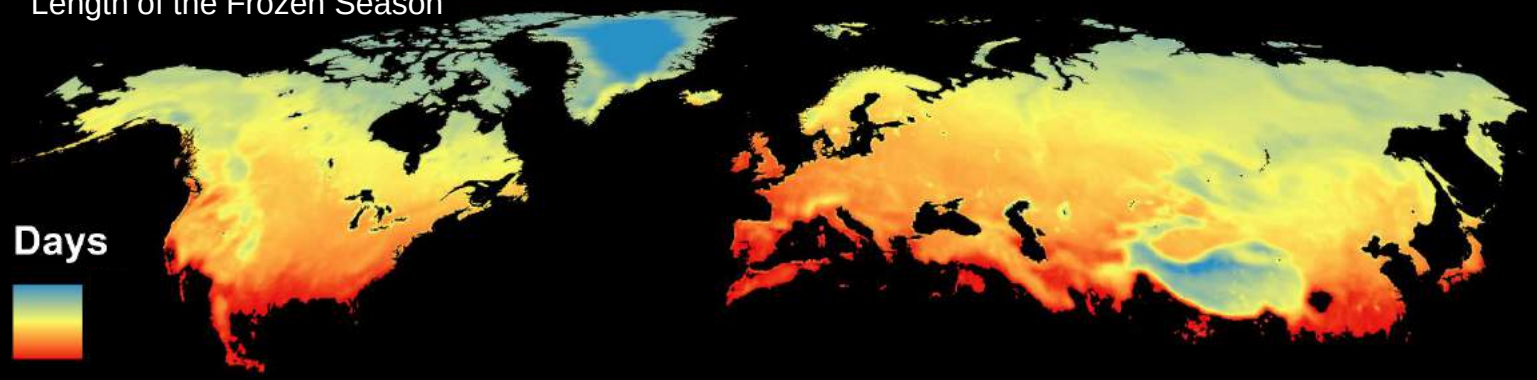
Length of the Frozen Season



Length of the Frozen Season with Snow Cover

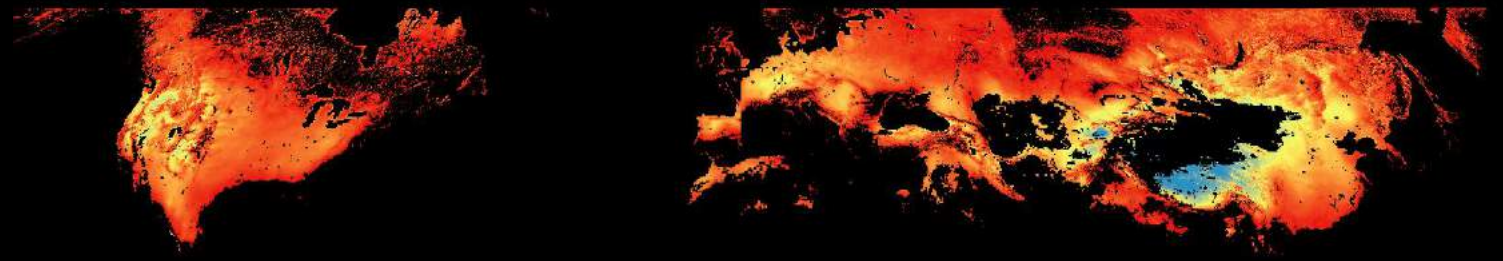
DHIs vs. Snow and Ice

Length of the Frozen Season

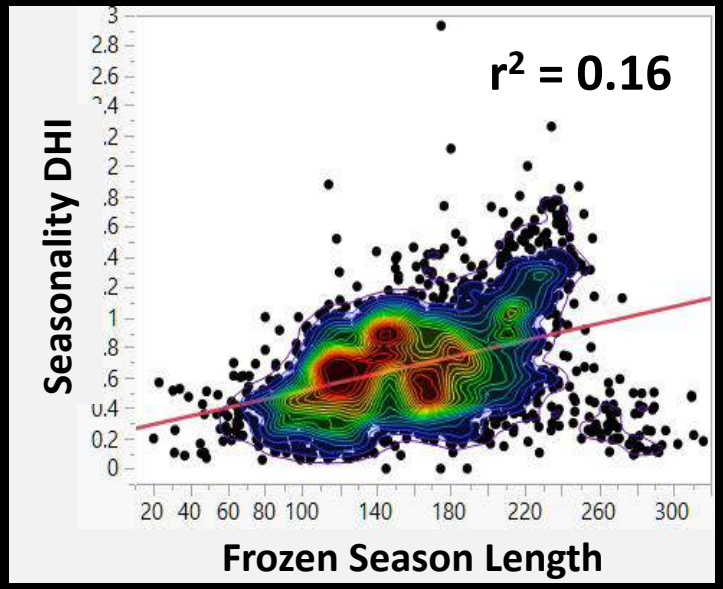


Length of the Frozen Season with Snow Cover

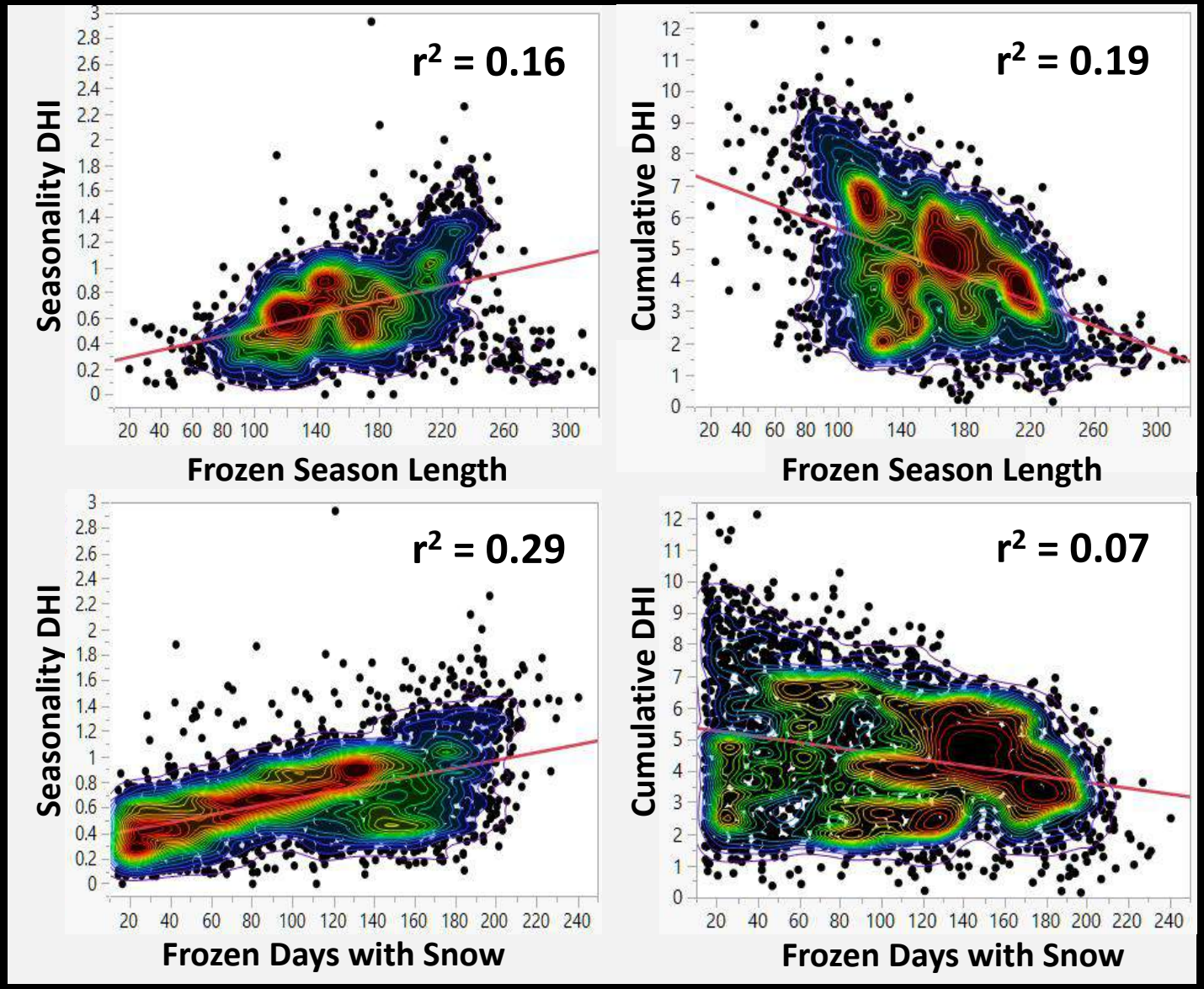
Length of the Frozen Season without Snow Cover



DHIs vs. Snow and Ice



DHIs vs. Snow and Ice



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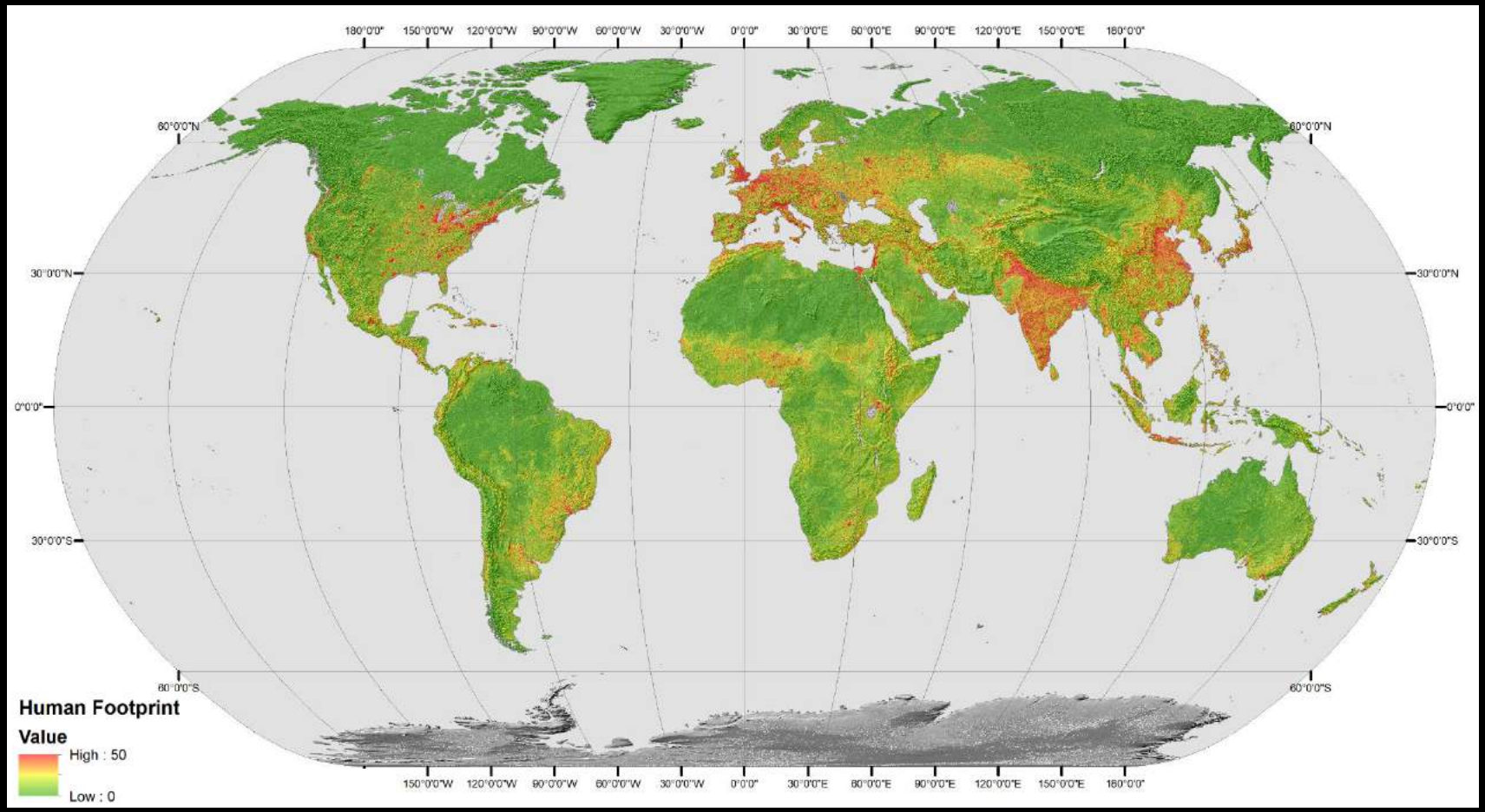
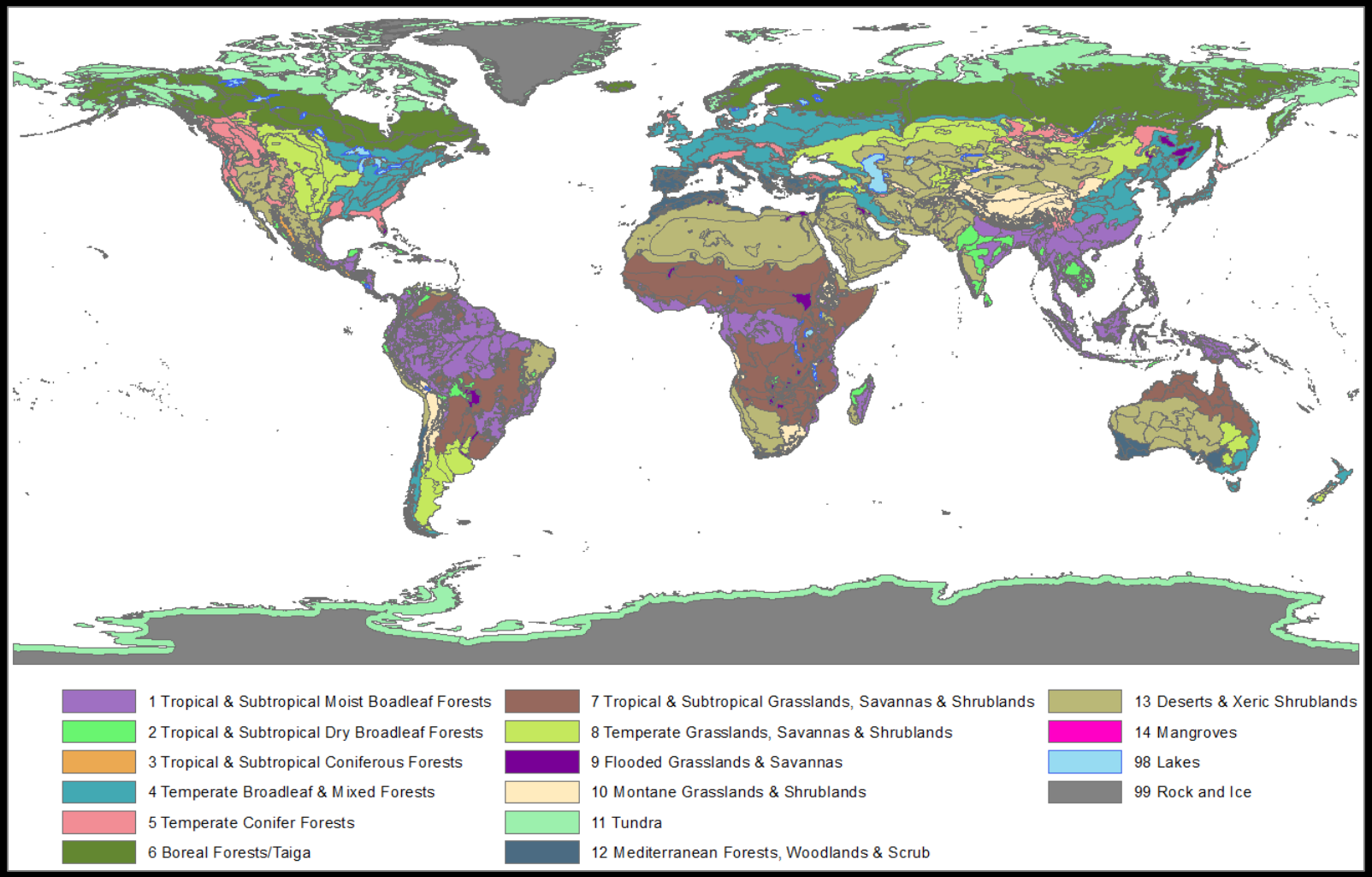


Coops et al.

DHIs vs. Human Footprint



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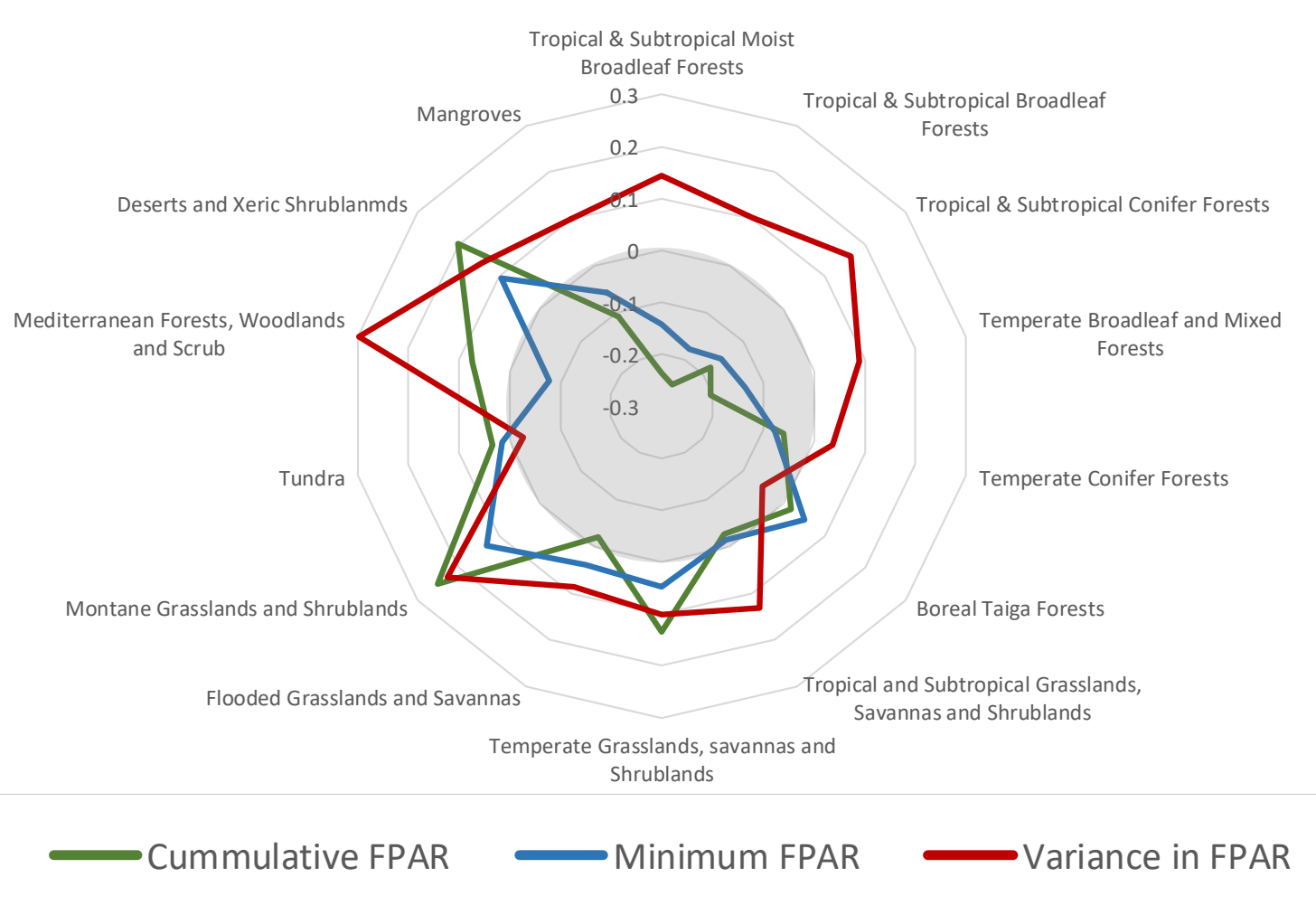

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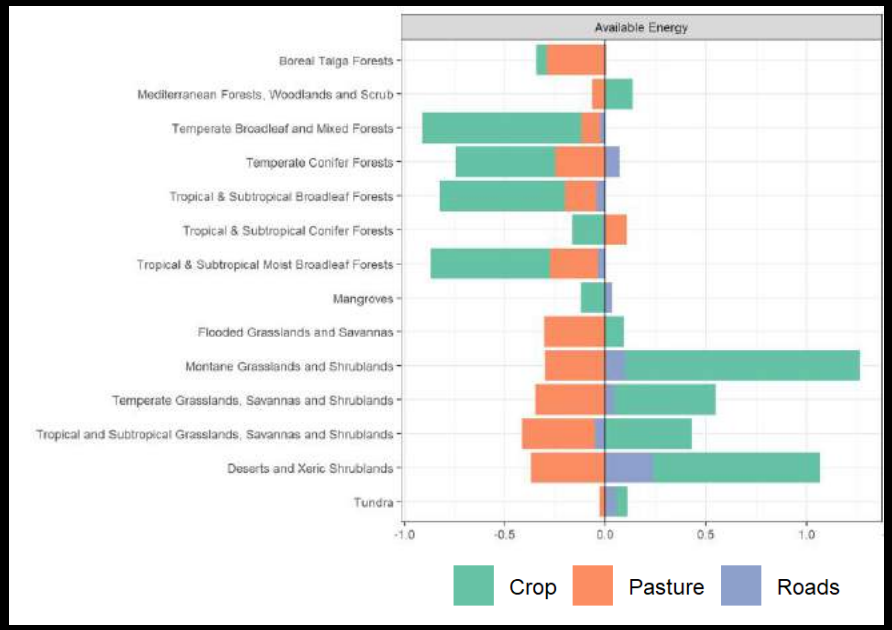

Coops et al.

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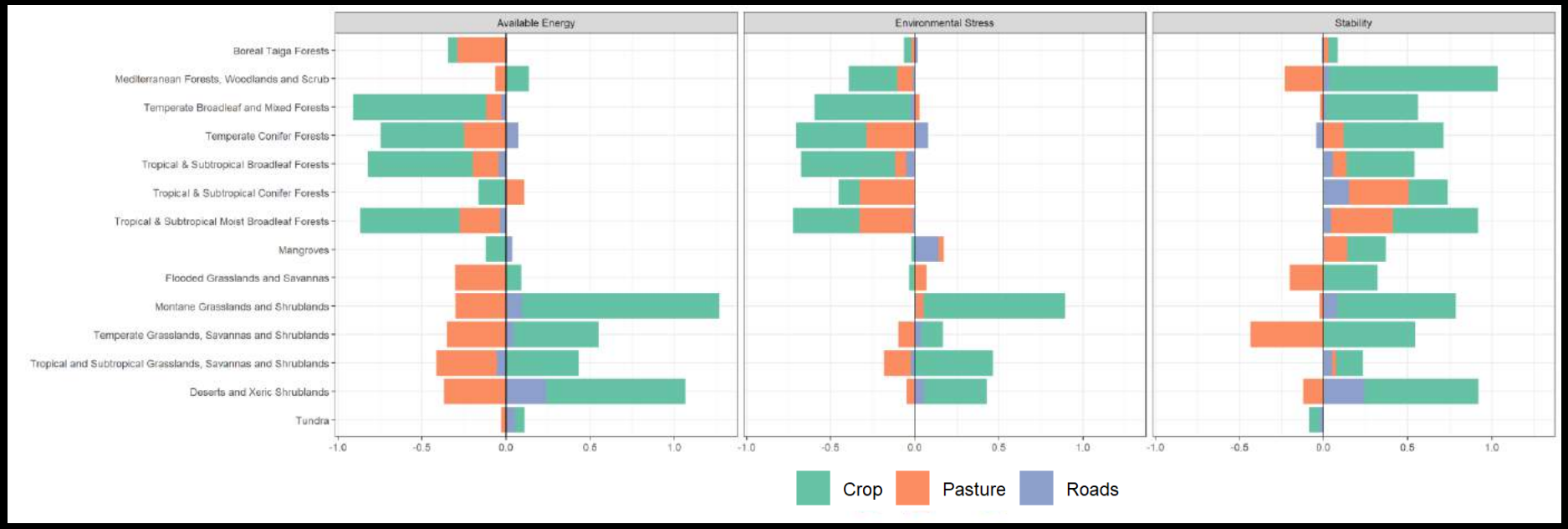
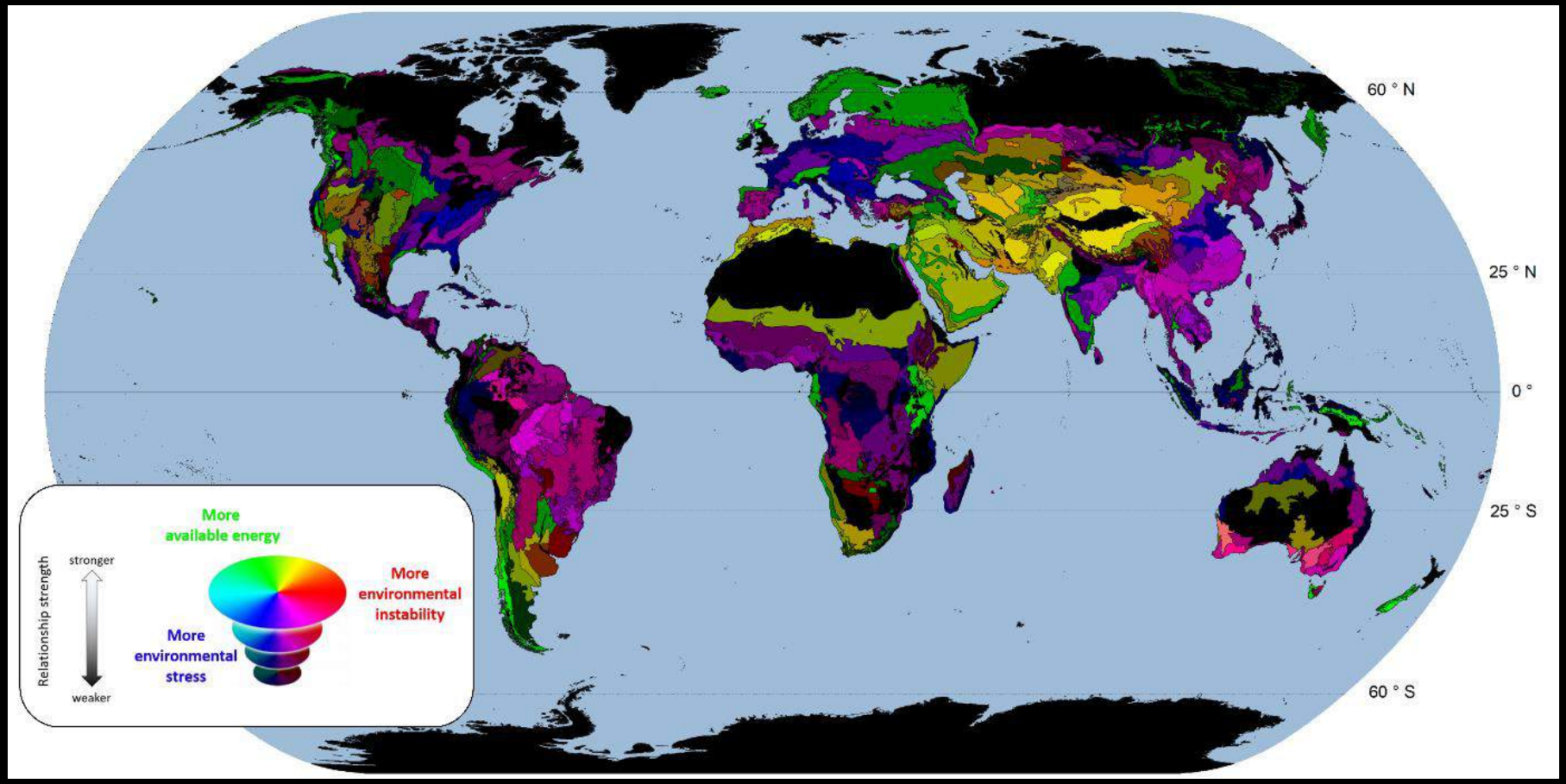


Coops et al.

DHIs vs. Human Footprint



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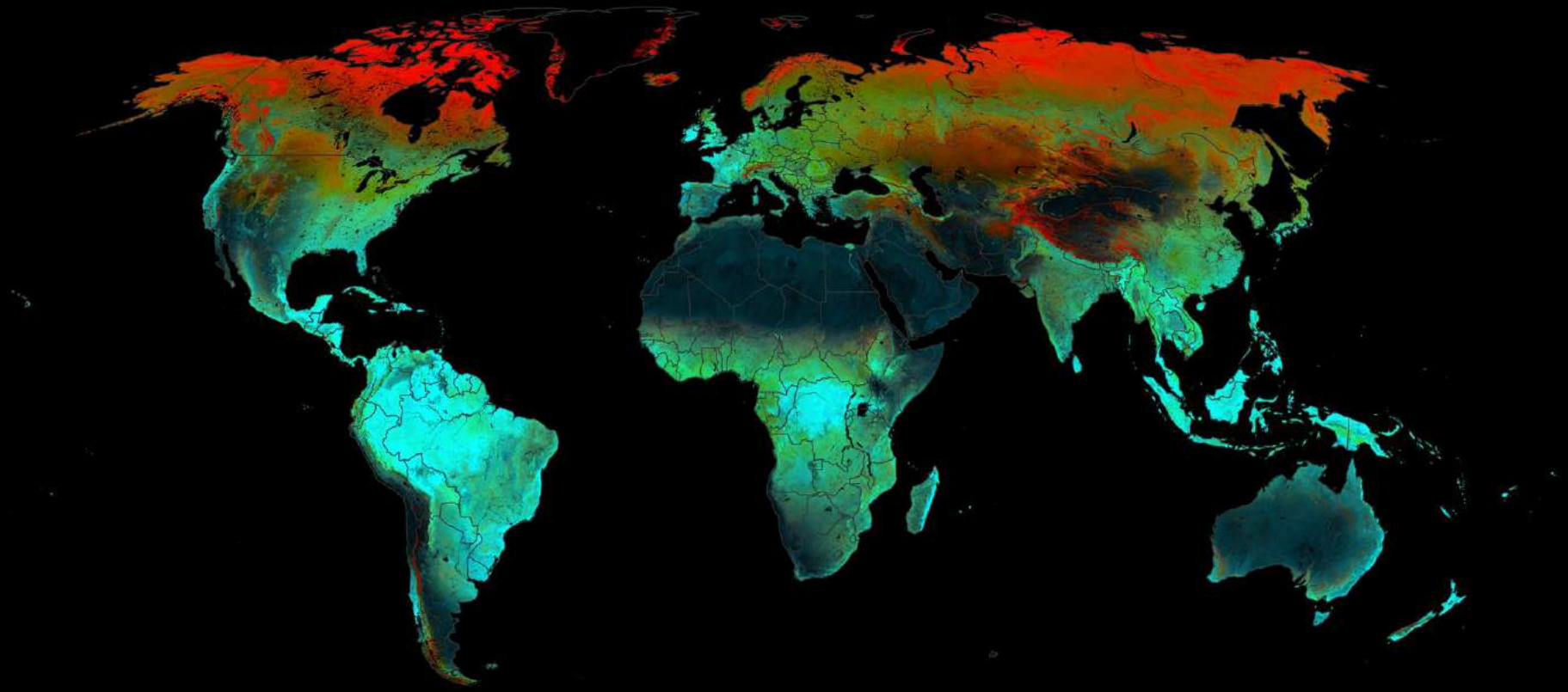
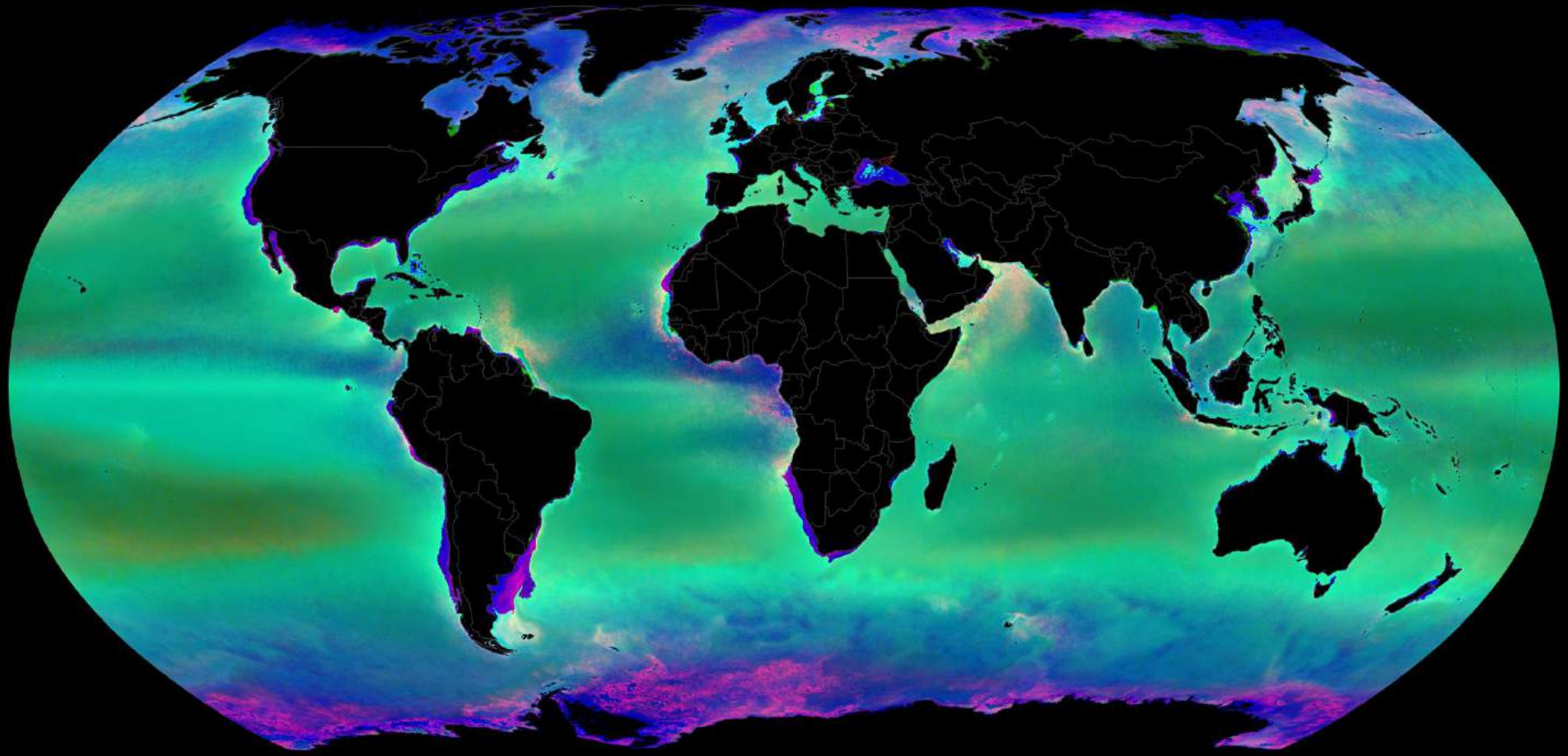
Our map

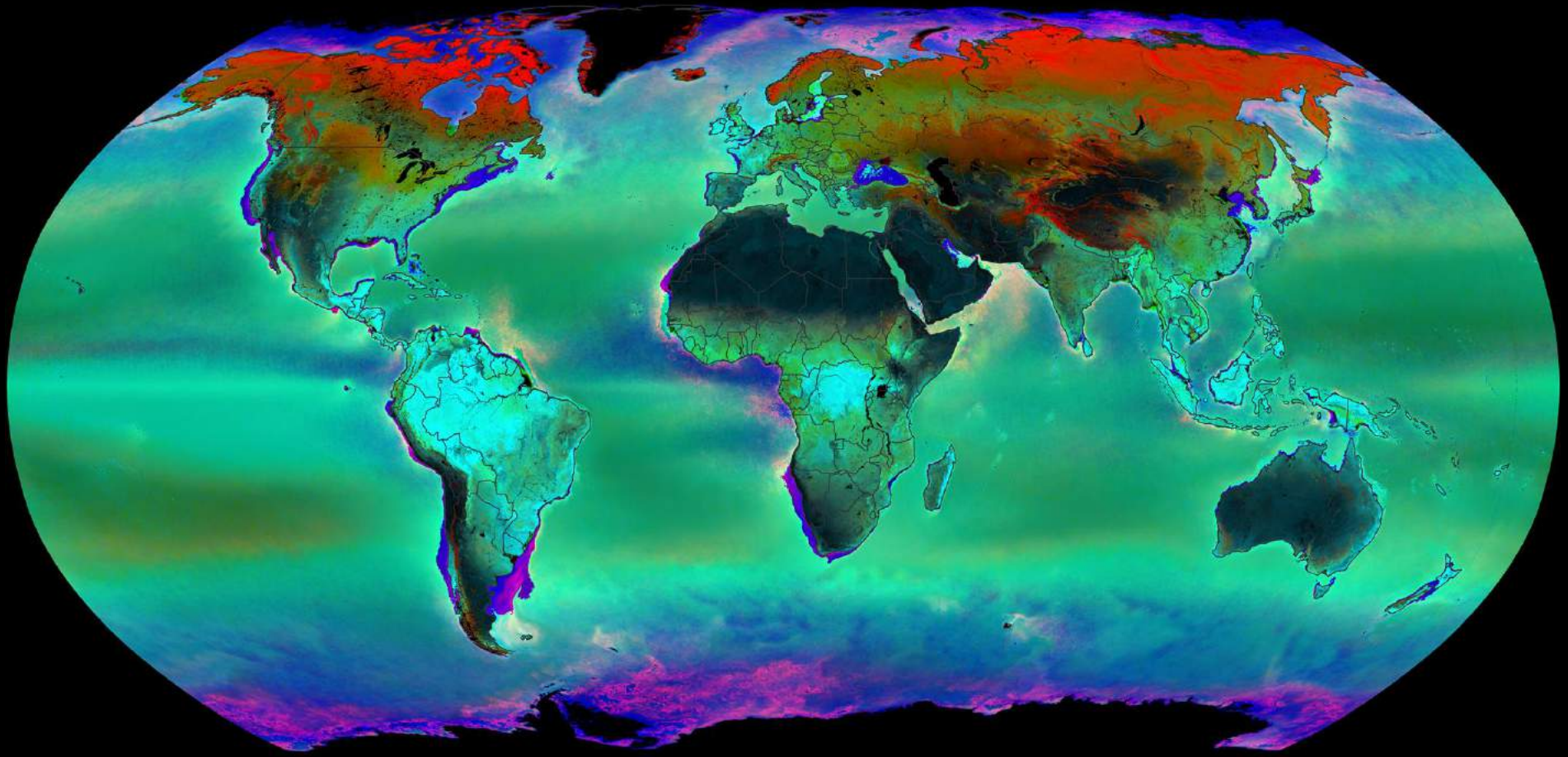


Matt's map



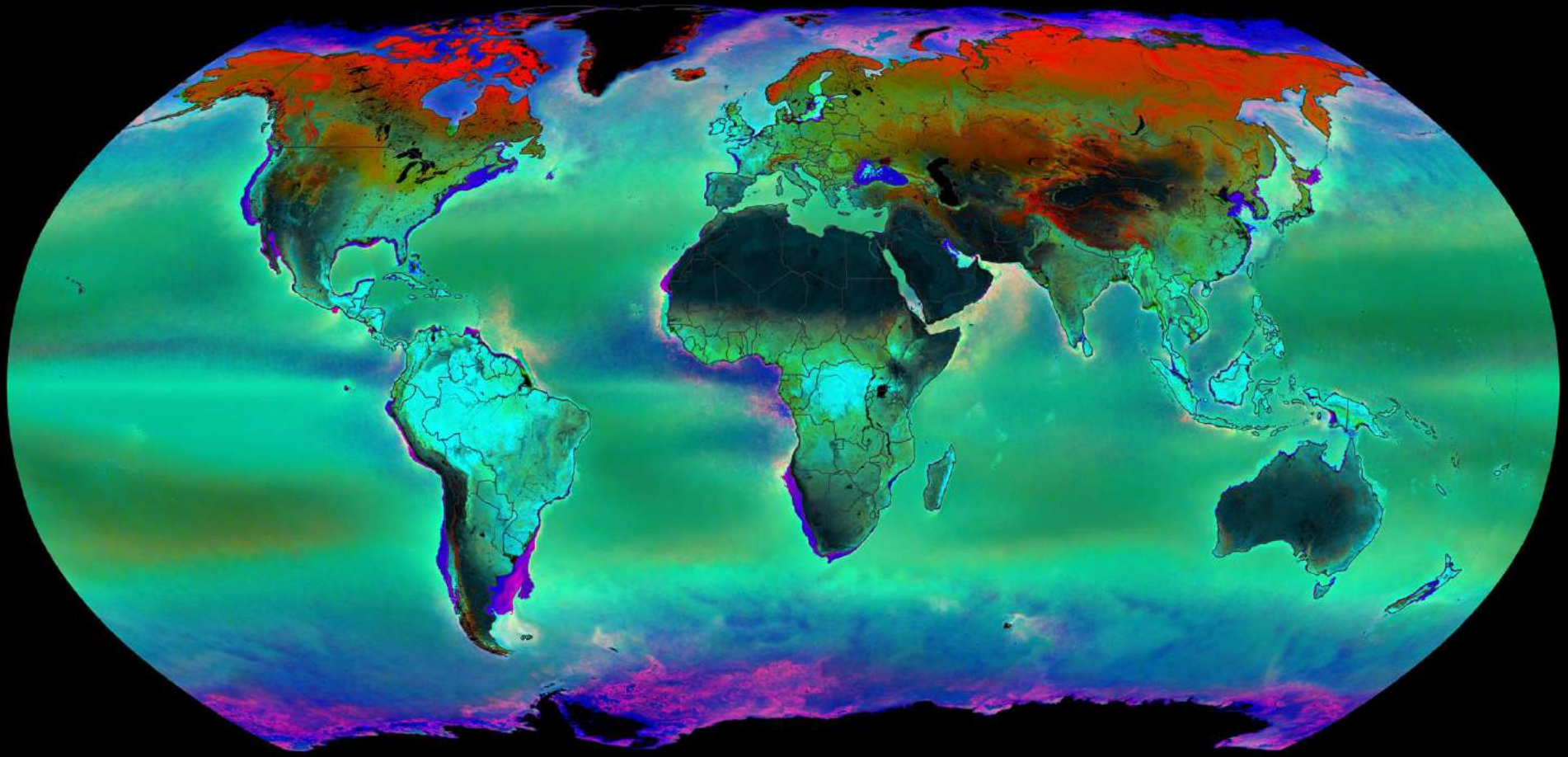
Oliver, M.

Frank's map



Oliver, M.

THE END



Oliver, M.