



# A new tool for assessing landscape change and resilience

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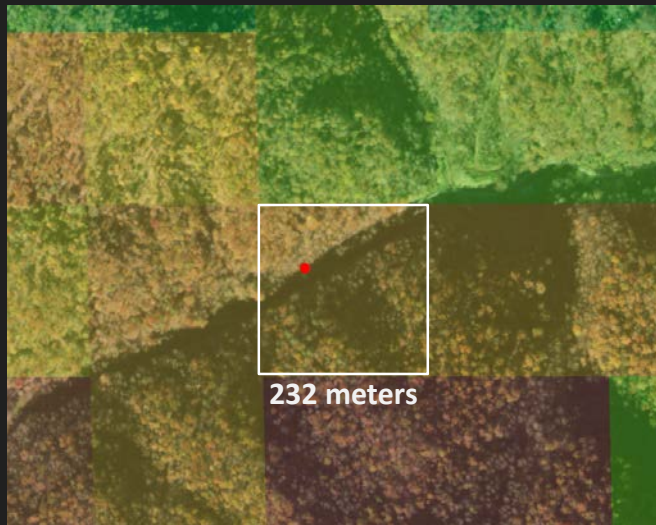
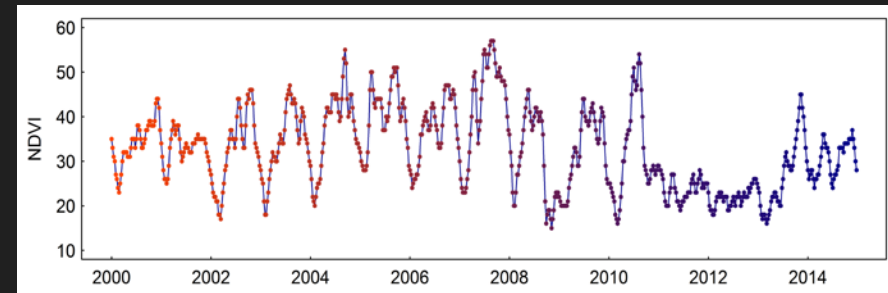
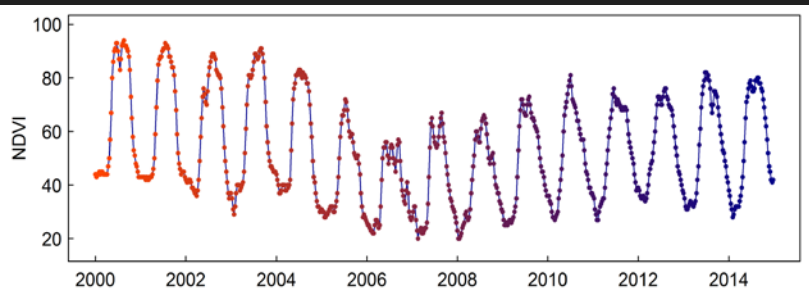
Eastern Forest Environmental Threat Assessment Center  
Southern Research Station  
USDA Forest Service  
Asheville, NC



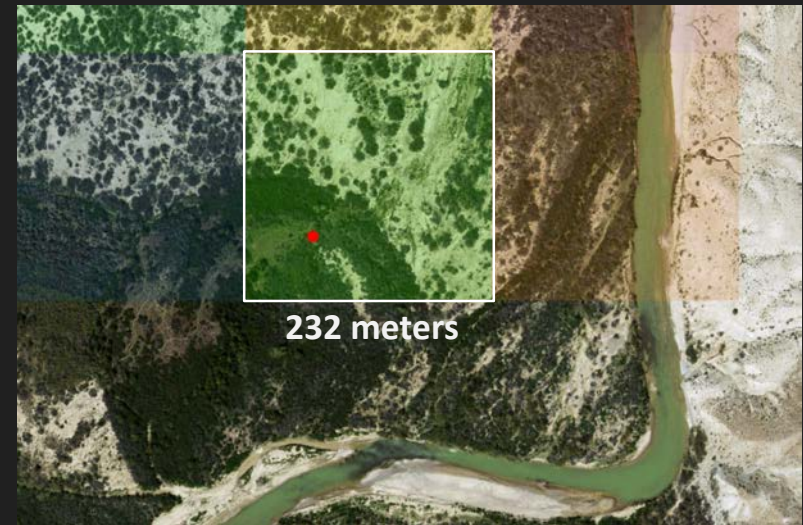
# LandAT data source

MODIS Normalized Difference Vegetation Index (NDVI), 2000 – 2015

Annual land surface phenology: timing of vegetation change



Appalachian forest pixel, WV



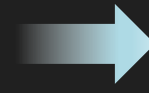
Desert riparian pixel, west Texas



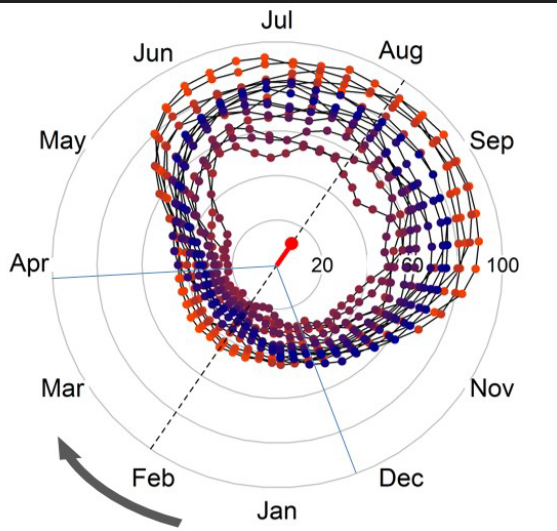
## NDVI Within-year variability



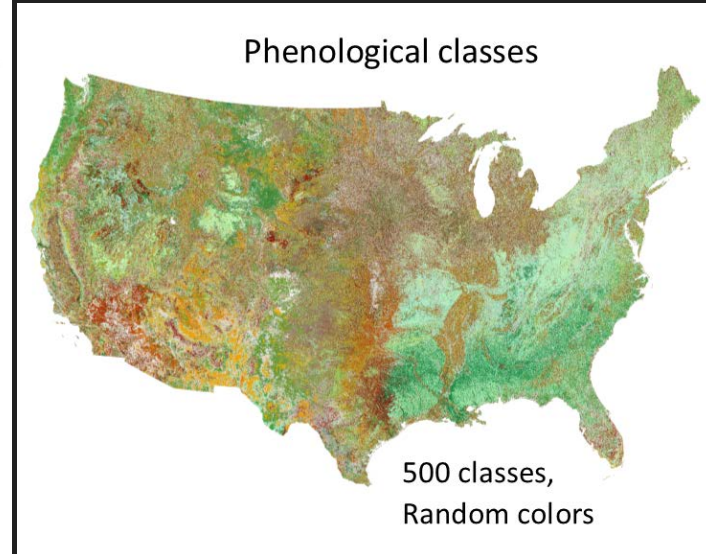
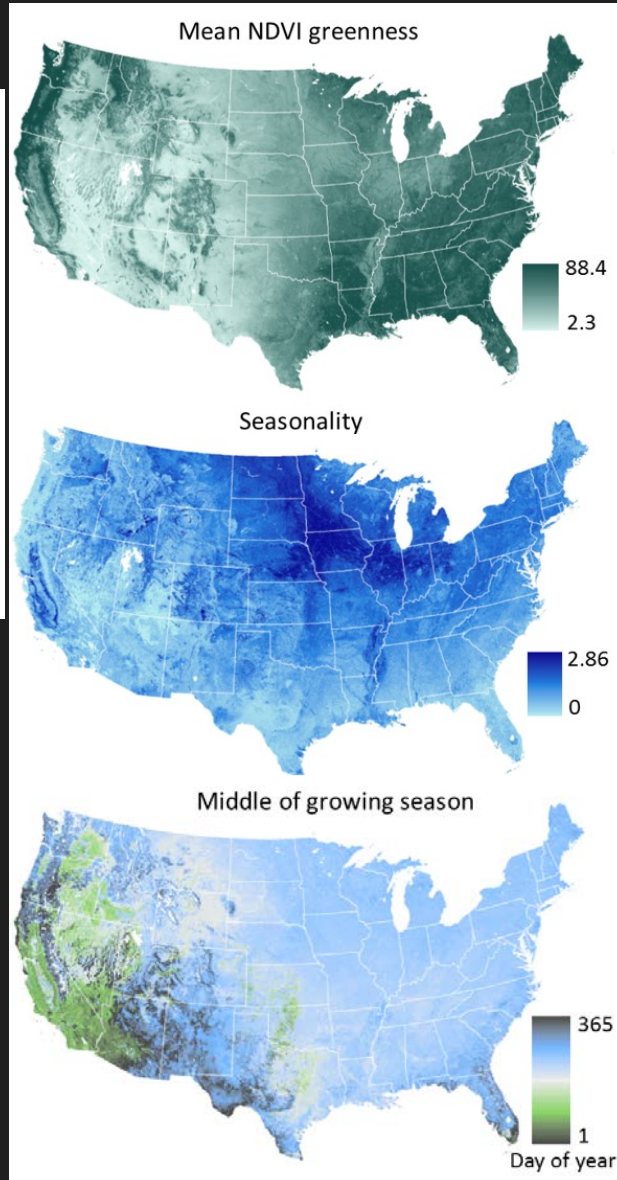
## Annual phenology metrics



## Annual phenological classification

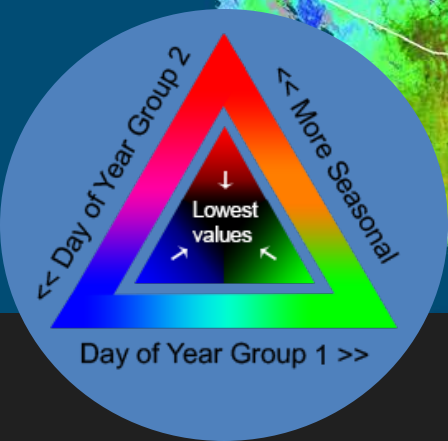
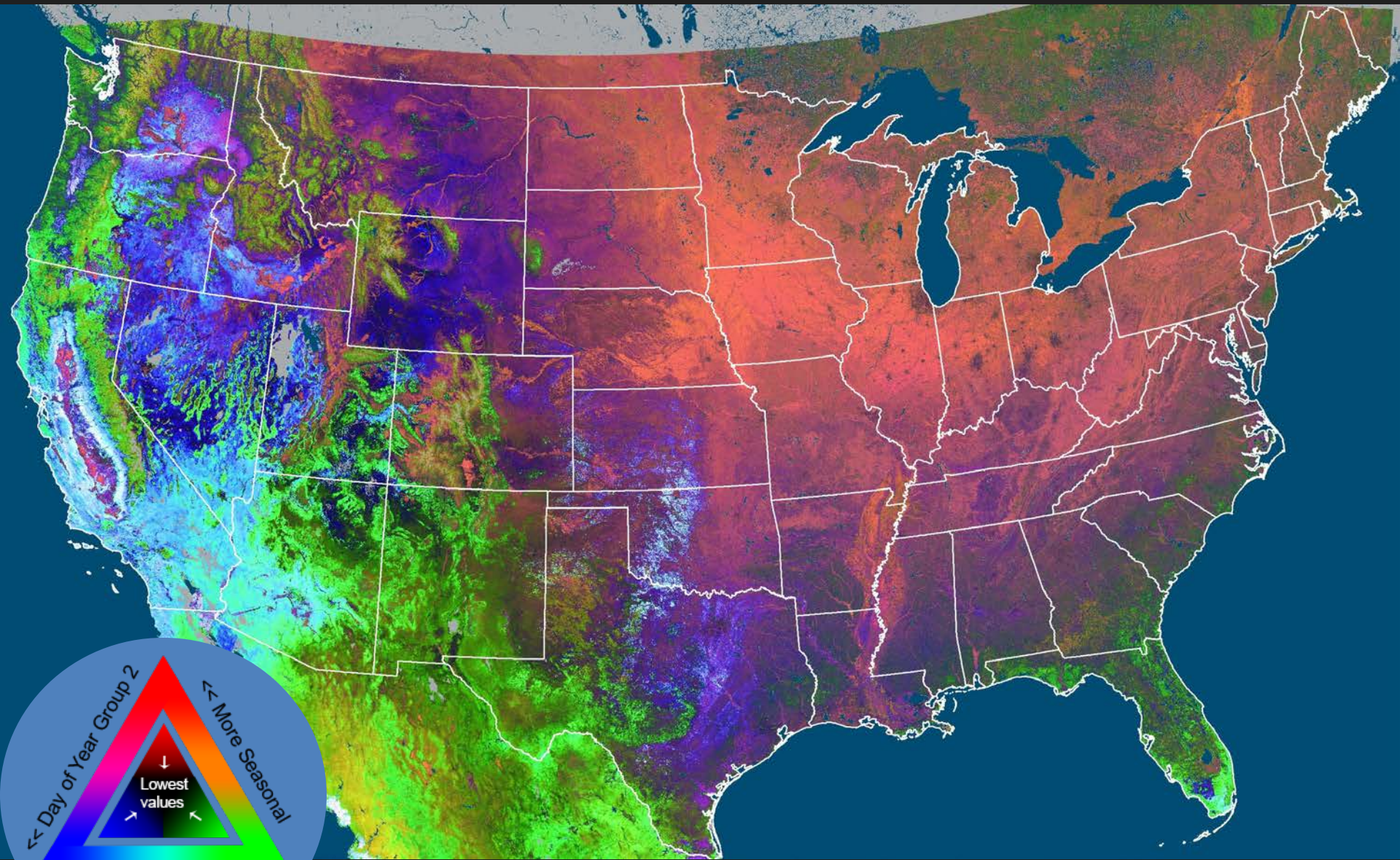


2000  2015





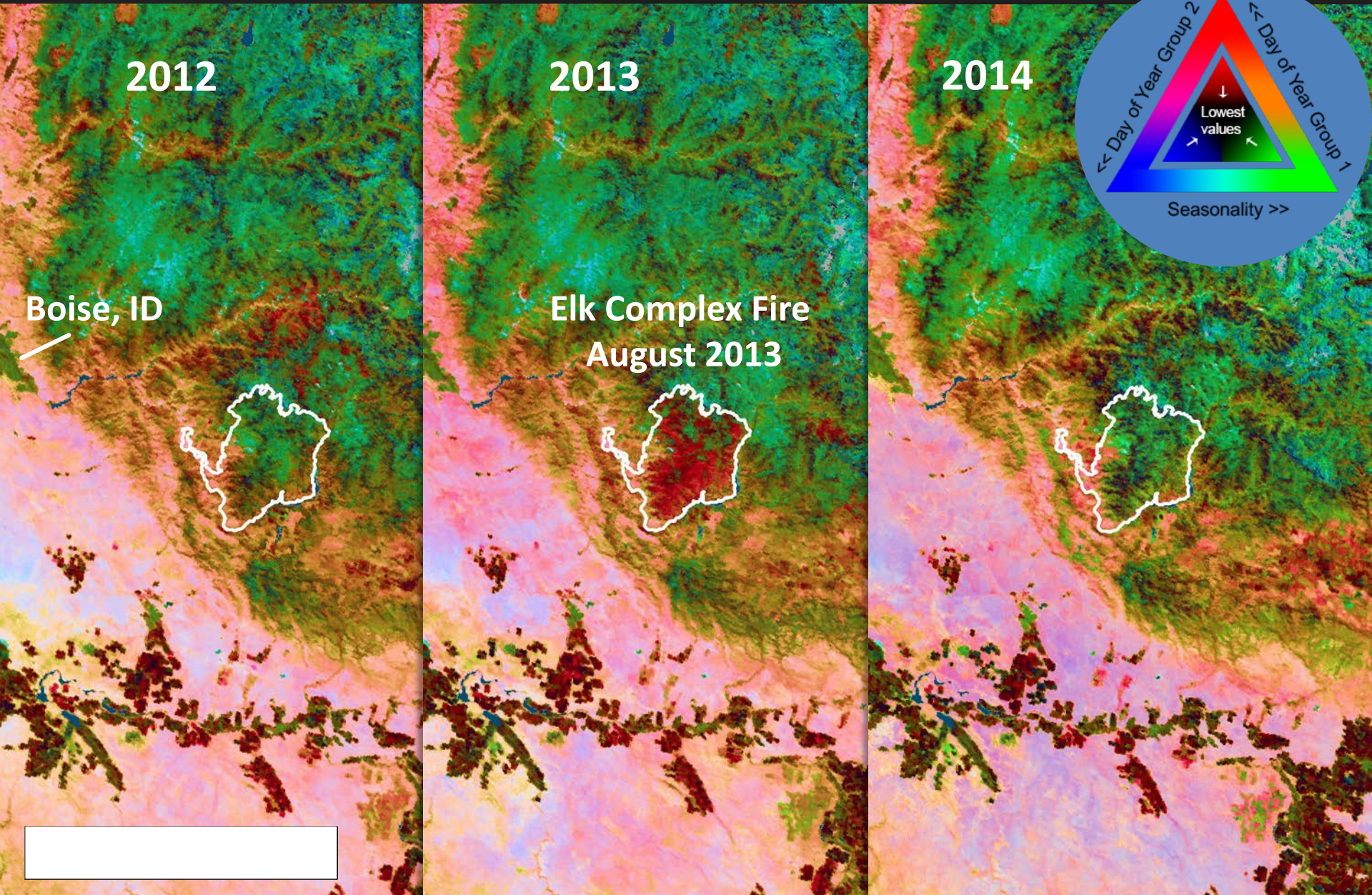
# Phenoclasses: phenological similarity shown by color similarity



All years, 2001 - 2015



# Phenoclasses: phenological similarity shown by color similarity

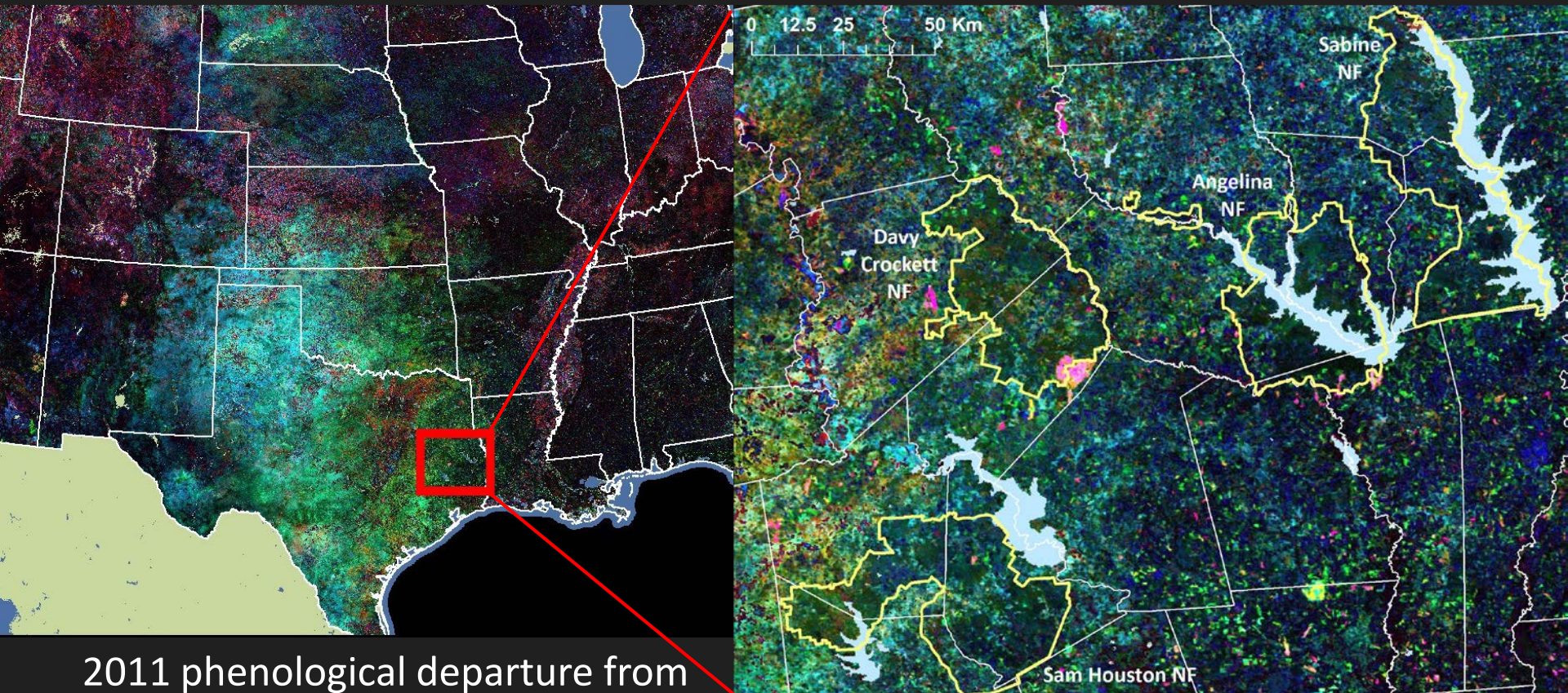




# Land surface phenology: annual anomalies

2011 drought-related departure from baseline

Brighter color = greater departure



2011 phenological departure from  
2000-2009 baseline

East Texas National Forests



# Using information theory to characterize landscape organization and dynamics

Phenological class in 2000, 2001, etc.



$P$  = Transition probability

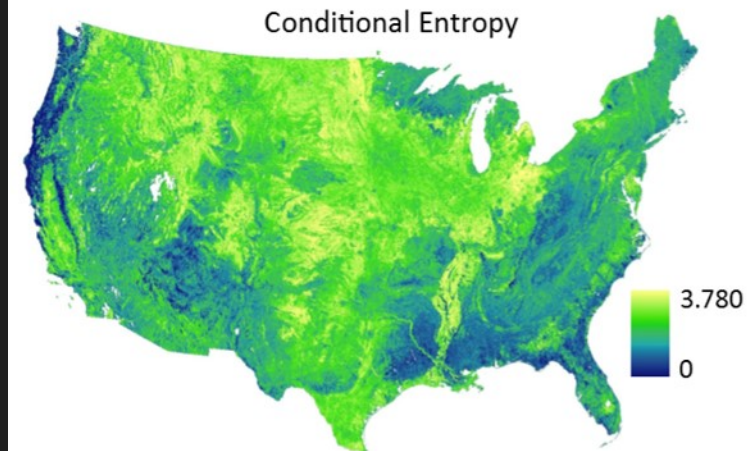
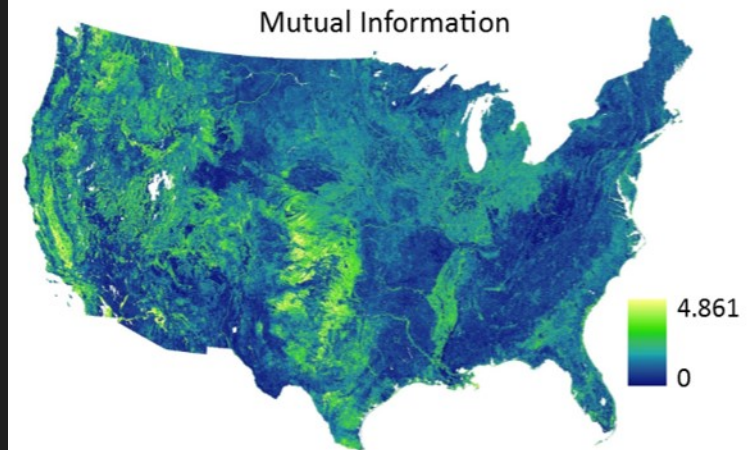
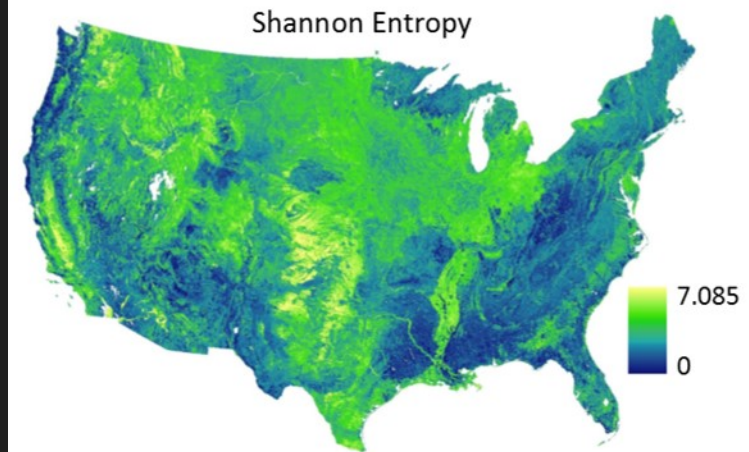
$H$  = Shannon Entropy

$$H = - \sum_i (P_i \cdot \log_2(P_i))$$

$MI$  = Mutual Information

$$MI = \sum_i \sum_j \left( P_{i,j} \cdot \log_2 \left( \frac{P_{i,j}}{P_{\cdot i} \cdot P_{\cdot j}} \right) \right)$$

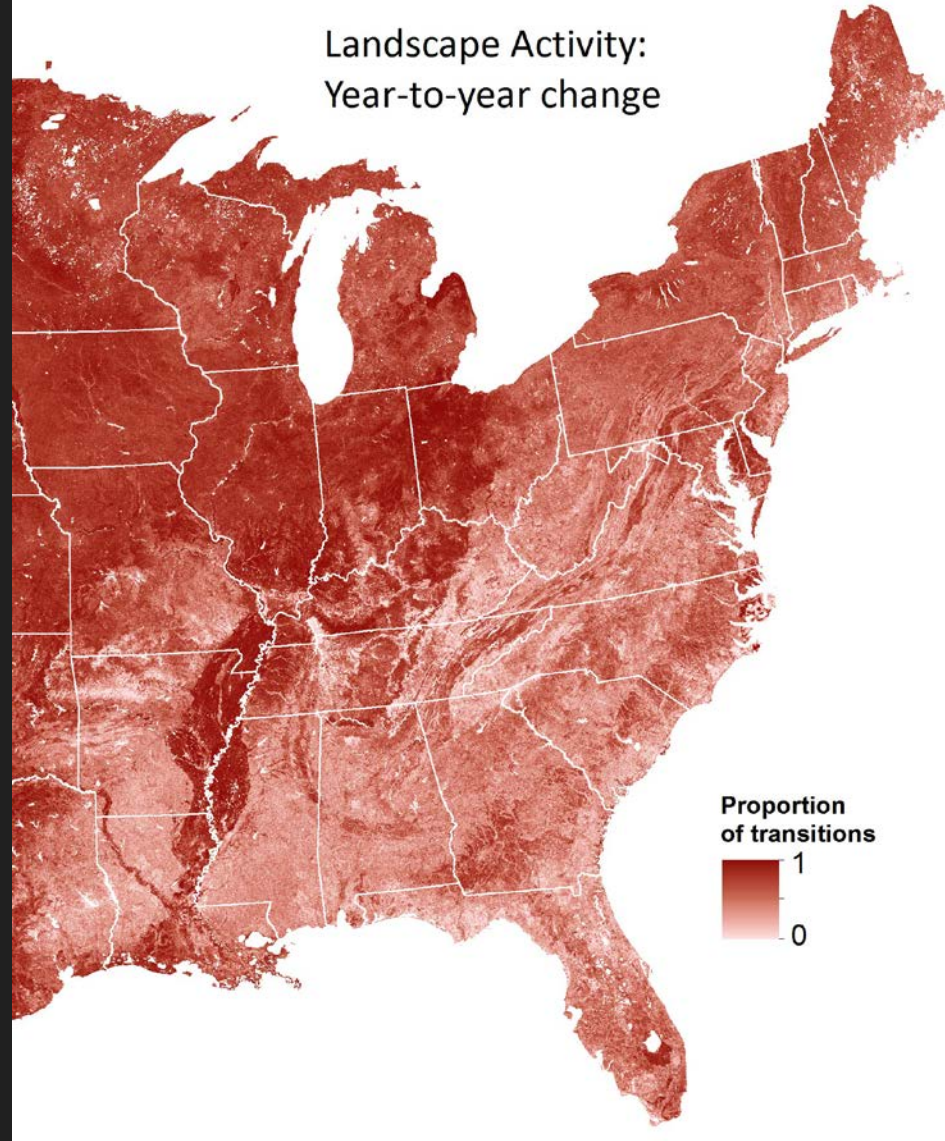
Conditional Entropy = mean  $H$  -  $MI$



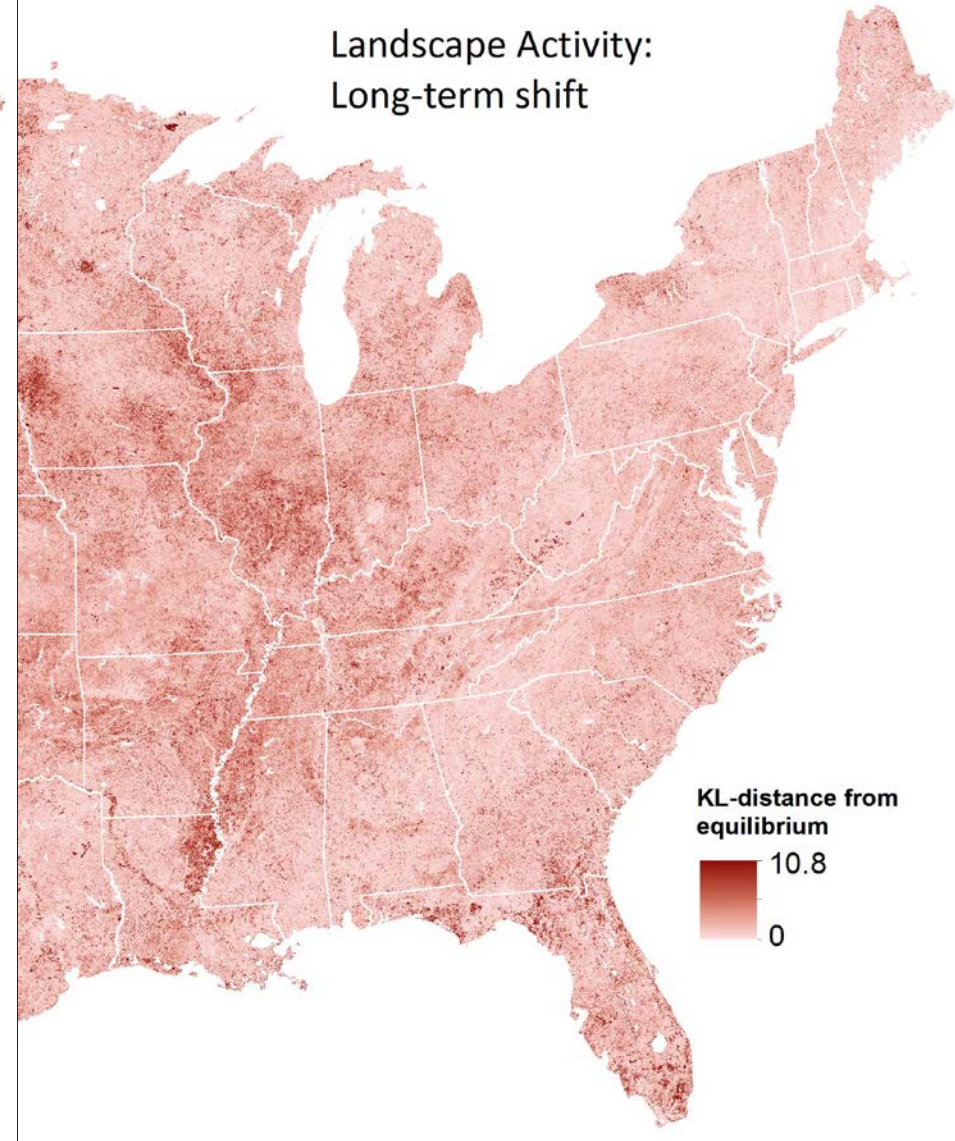


# How 'dynamic' are landscapes?

Landscape Activity:  
Year-to-year change



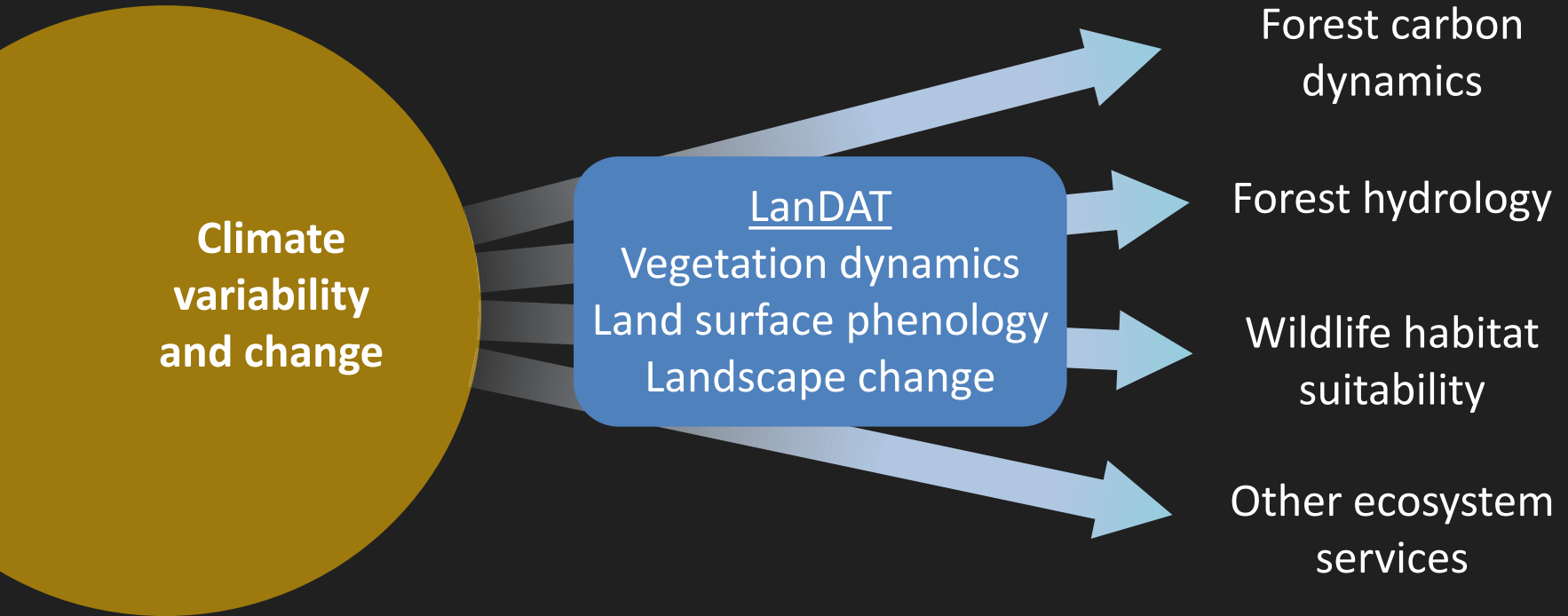
Landscape Activity:  
Long-term shift



Distance between current phenoclass distribution and projected equilibrium distribution: Kullback-Leibler distance



# Vegetation dynamics mediate many climate-resource relationships





Eastern Threat Center  
Bjørn–Gustaf Brooks, William Hargrove, Stephanie  
Worley–Firley, Steve Norman, William Christie

National Environmental Modeling and Analysis Center  
University of North Carolina – Asheville

Appalachian Landscape Conservation Cooperative



Thank You!

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