# Developing U.S. Phenoregions from Remote Sensing

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The Award-Winning *ForWarn* System

- Phenology is the study of periodic plant and animal life cycle events and how these are influenced by seasonal and interannual variations in climate.
- *ForWarn* is interested in deviations from the "normal" seasonal cycle of vegetation growth and senescence.
- The system produces a new forest disturbance map for the U.S. every 8 days through the Forest Change Assesent Viewer.
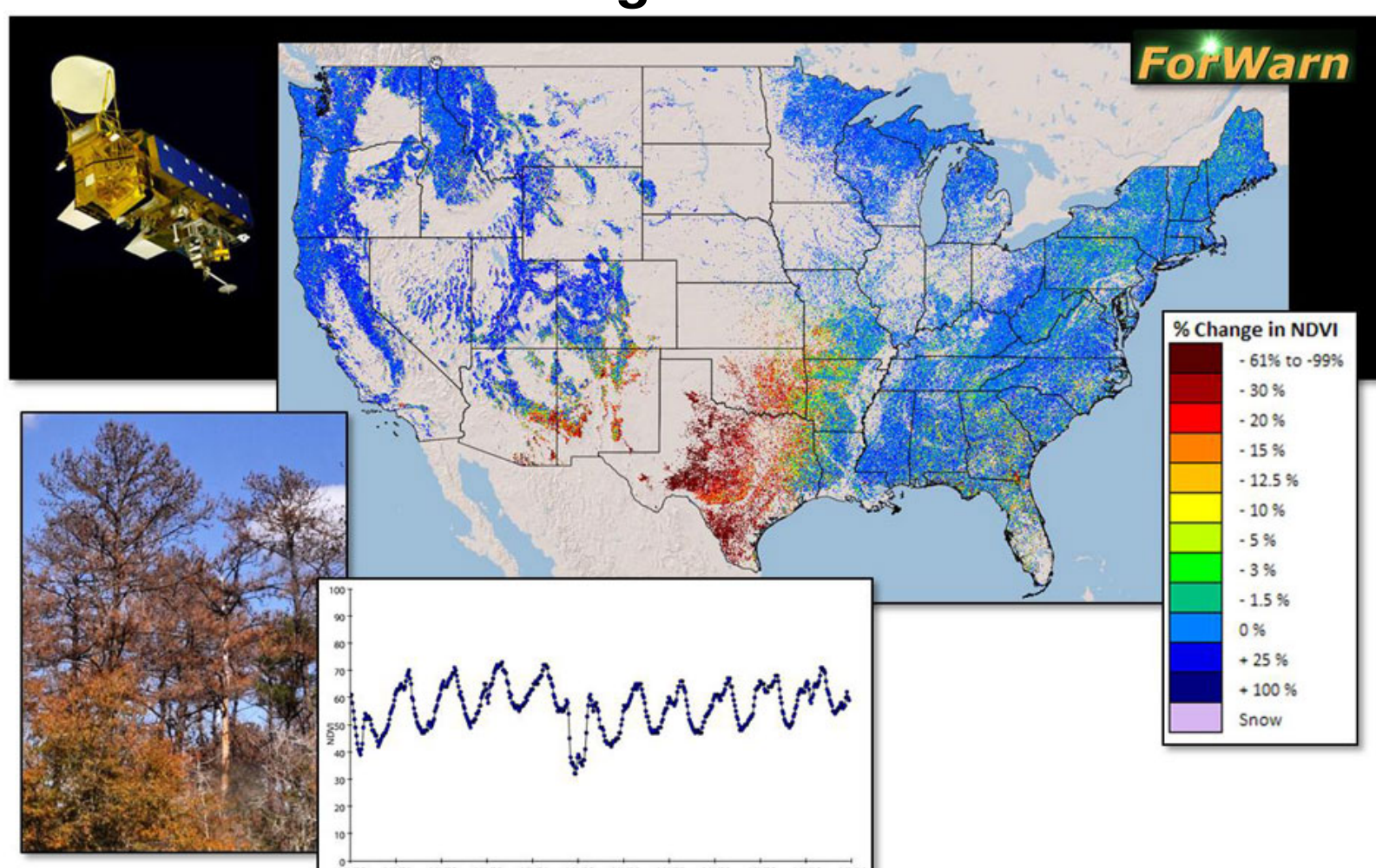
Annual Greenness Profile Through Time
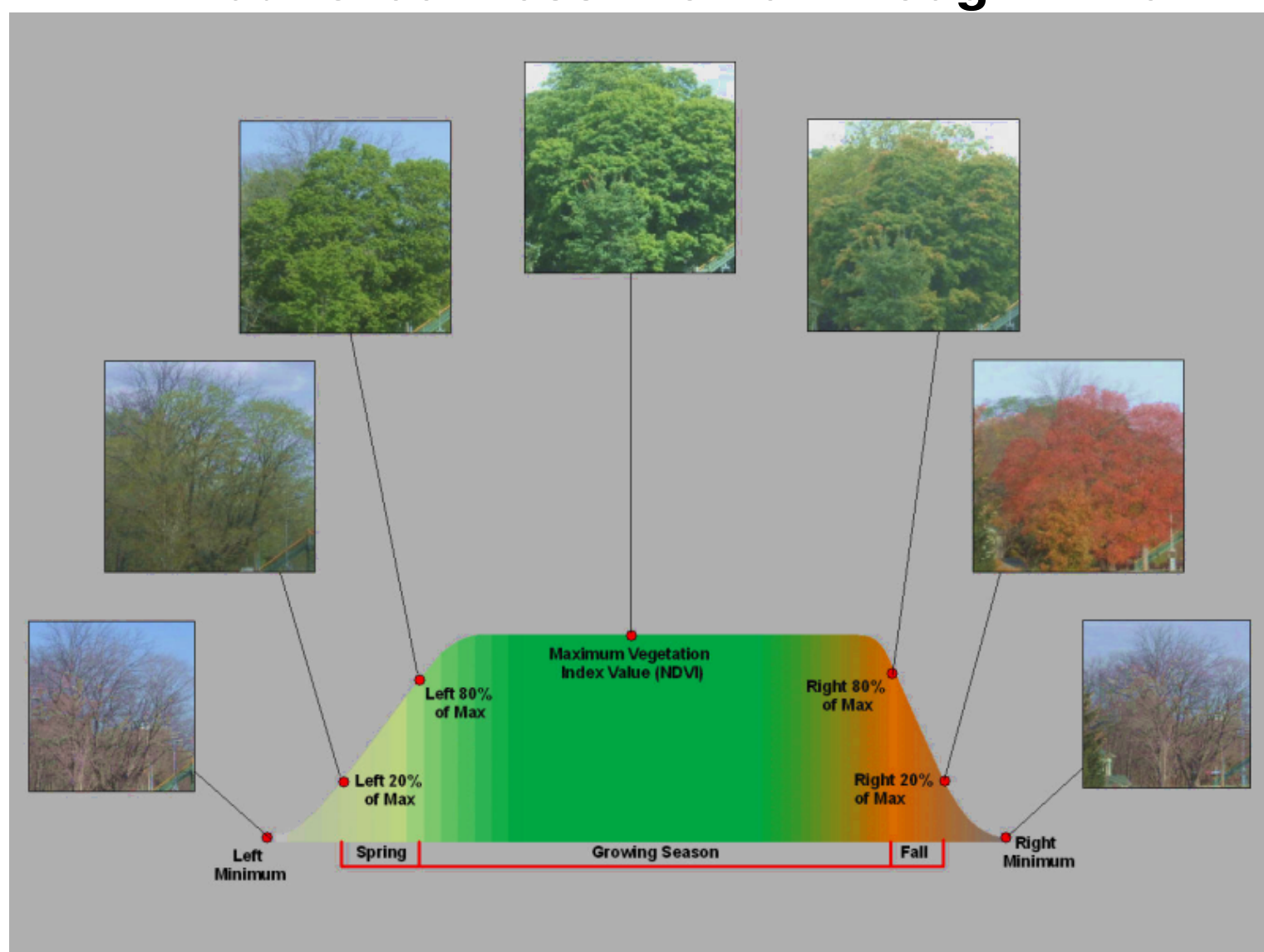
MODIS Snapshots by Season – Walker Branch
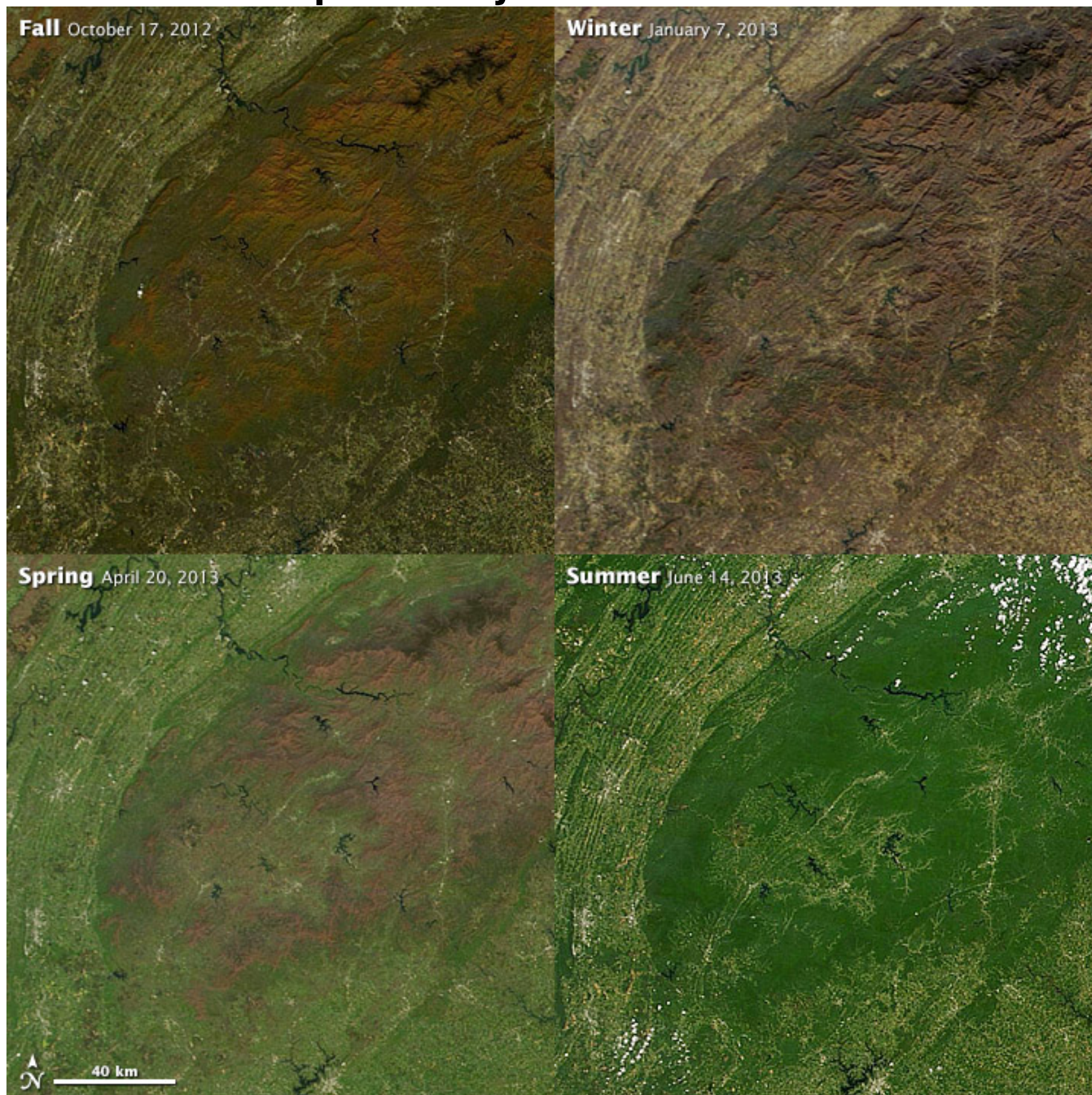
### The Forest Change Assessment Viewer

ForWarn is a forest change recognition and tracking system that uses high-frequency, moderate resolution satellite data to provide near real-time forest change maps for the continental United States that are updated every eight days.
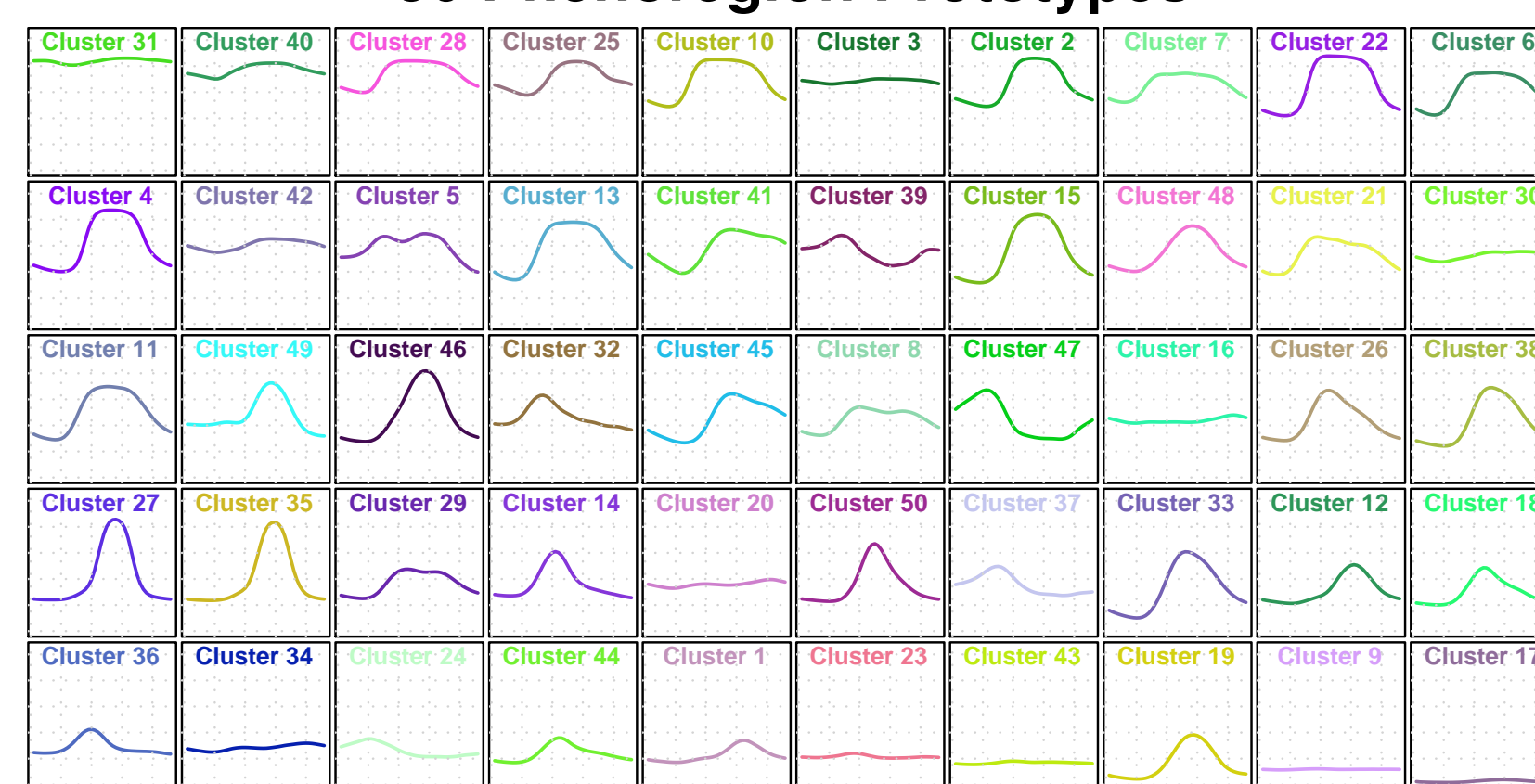
http://forwarn.forestthreats.org/fcav/

Data Mining for Detecting Threats to U.S. Forest Health

- USDA Forest Service, NASA, DOE ORNL, and USGS developed an early warning system for forest threats.
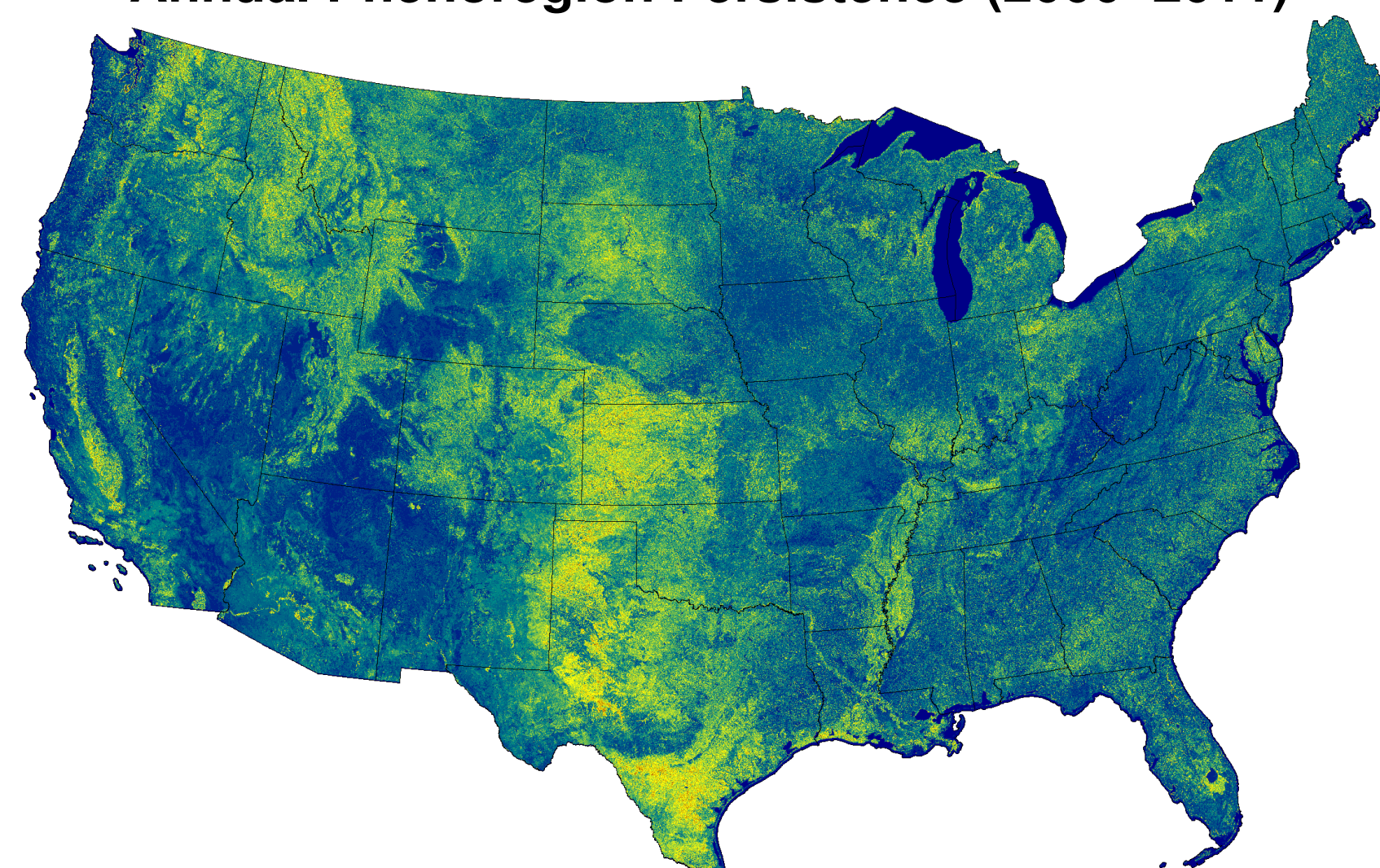- *ForWarn* system uses phenology derived from NDVI observations from MODIS every 8 days.

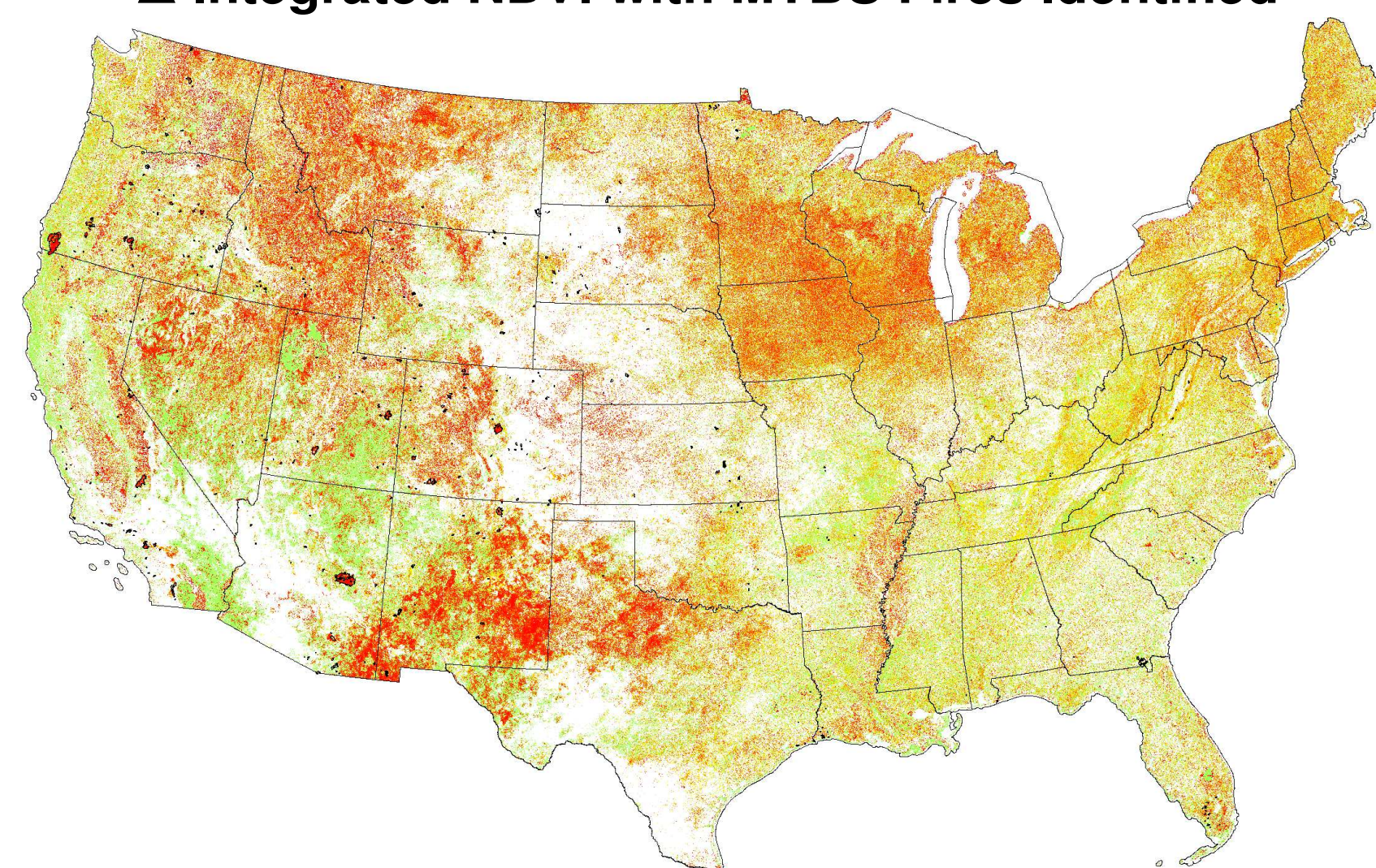### Phenological Mode for 50 Phenoregions (2000–2011)
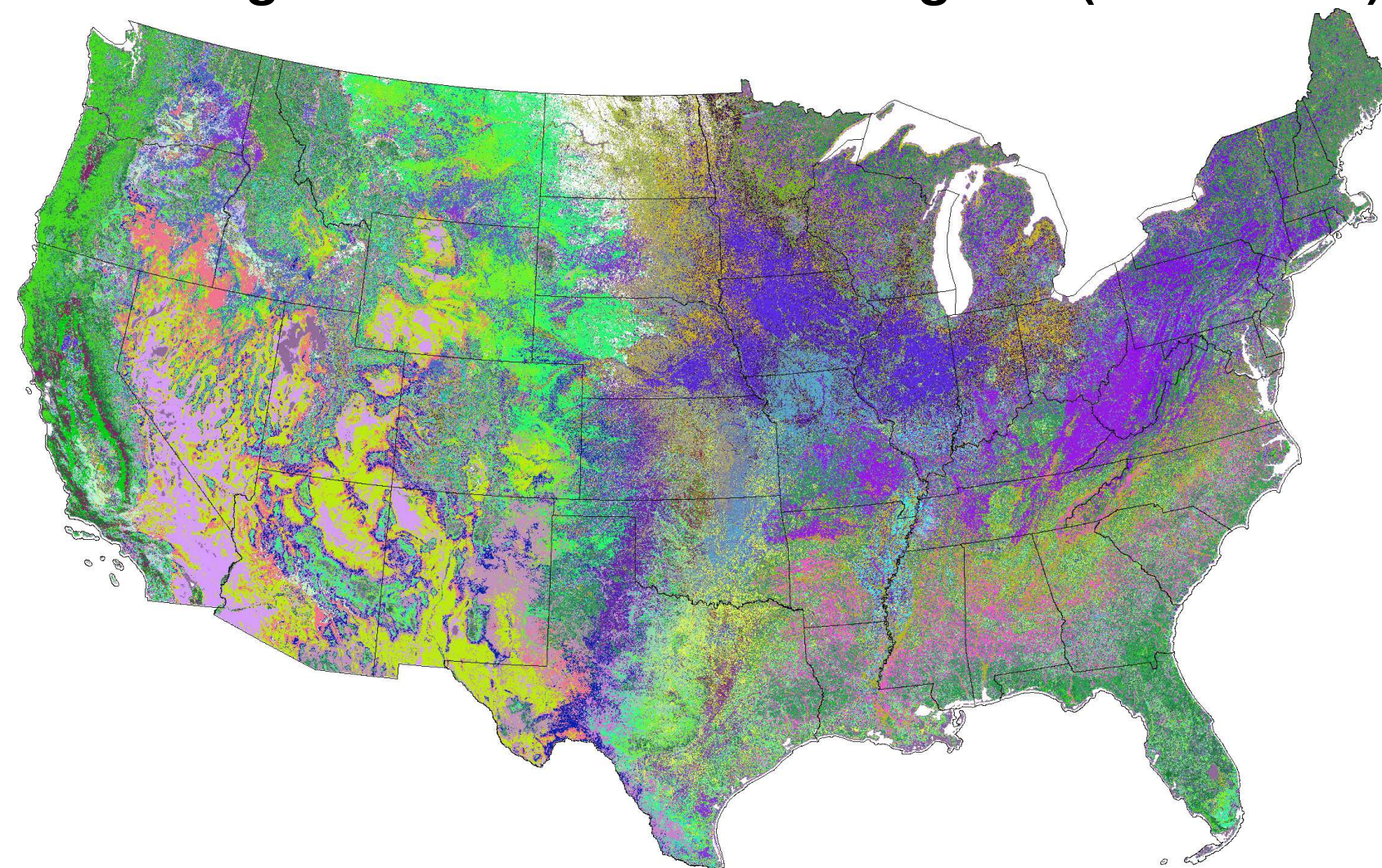
50 Phenoregion Prototypes

Annual Phenoregion Persistence (2000–2011)

### △ Integrated NDVI with MTBS Fires Identified

Changes in phenoregion classification suggest where vegetation may be susceptible to interannual variability of climate or where large scale forest disturbances have occurred.
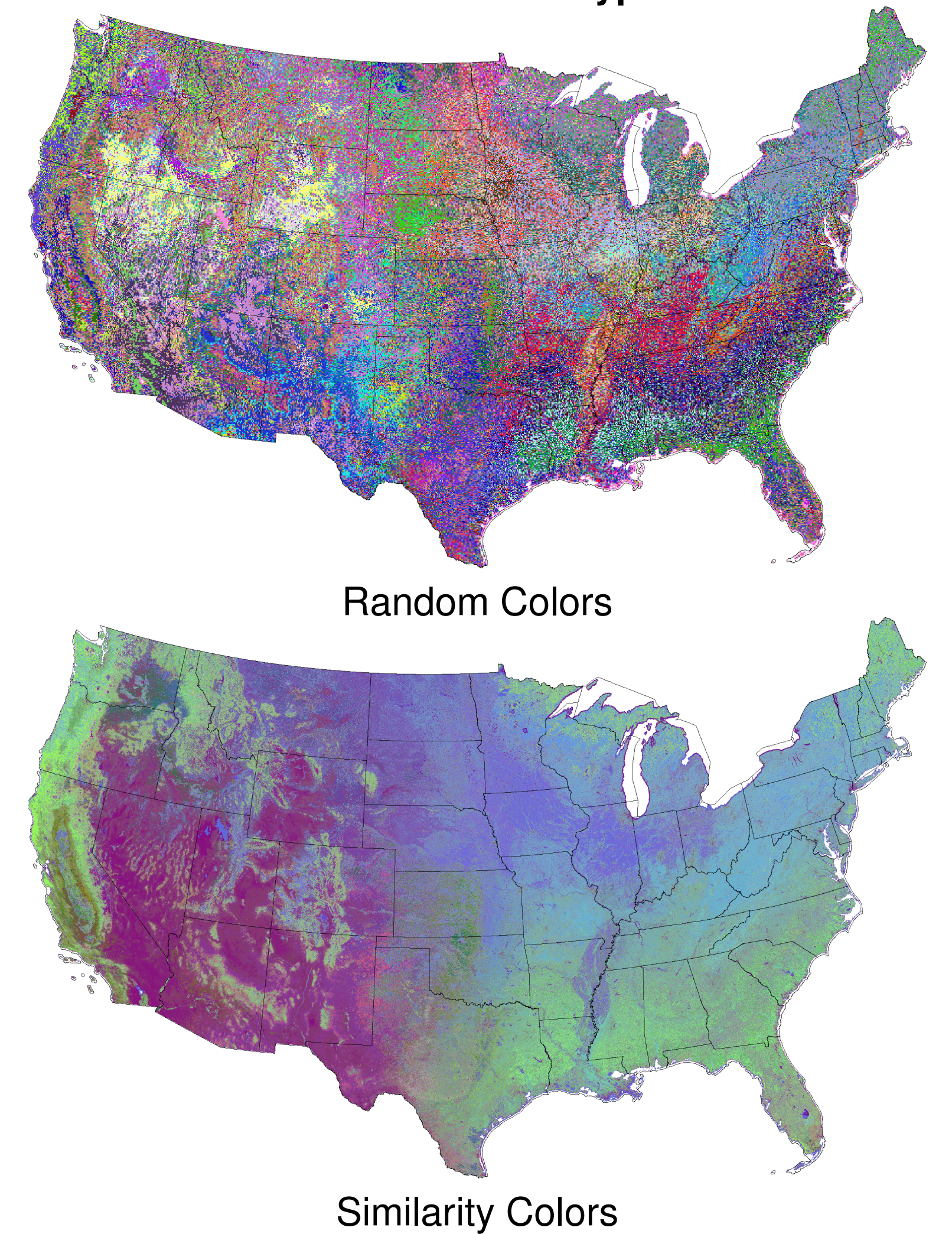
Stealing Labels from Expert Maps to Identify Phenoregions

- The Mapcurves method for comparing categorical maps enables us to "steal" labels from expert-derived land cover maps.
- Mapcurves provides a Goodness of Fit (GOF) metric for spatial overlap between our phenoregions and polygons from all other expert maps.
- The label for the best-fitting expert polygon is then associated with the phenoregion in question.

Phenoregions Reclassed Using Land Cover Types

(a) IGBP Land Cover (c) Olson's Global Ecoregions

(b) 50 Phenoregions Reclassed (d) 50 Phenoregions Reclassed
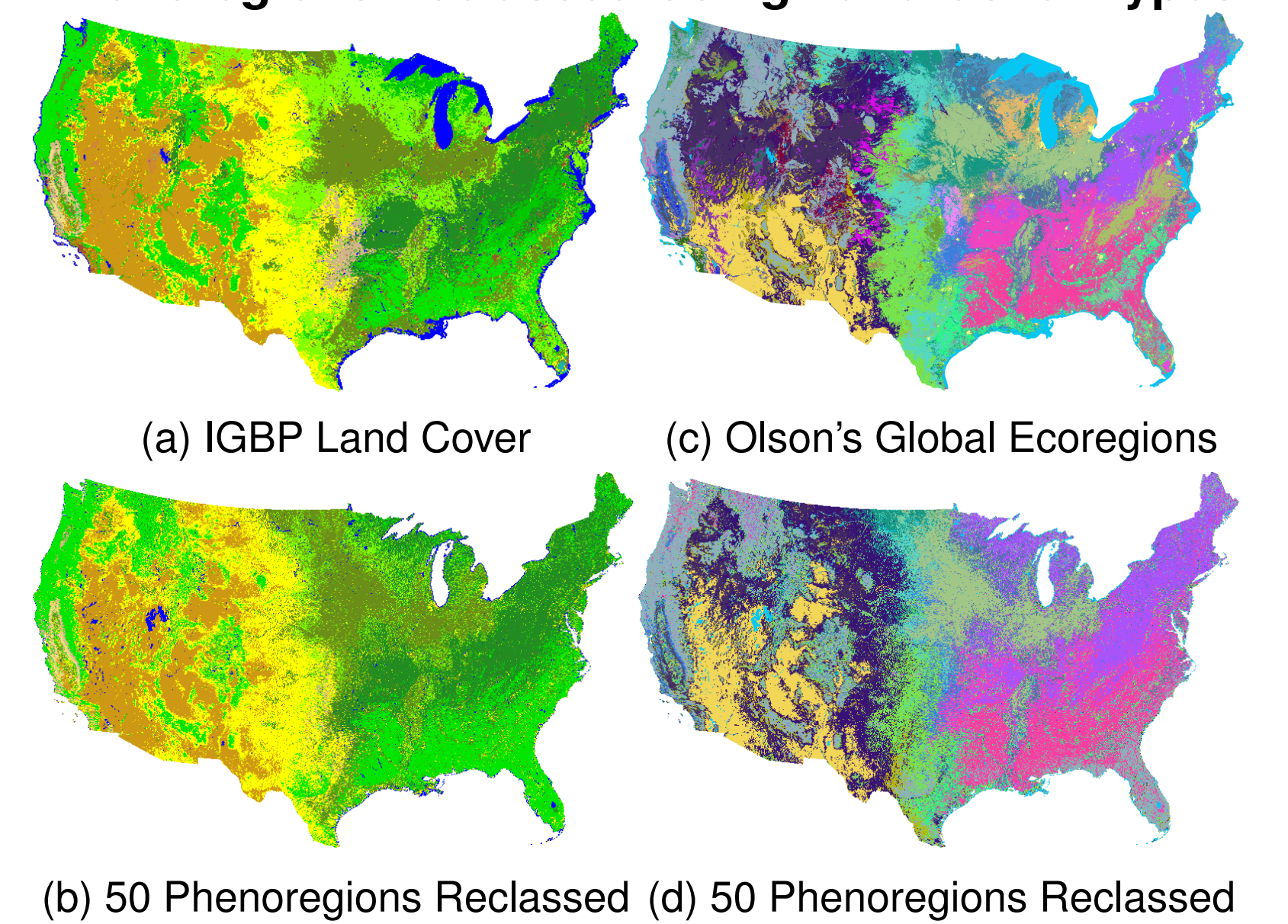
1000 Phenoregions Reclassed into 235 Land Cover Types

Random Colors

Similarity Colors

Composition of the 235 Land Cover Types Map

Map	Cats	WCats	WClusts	%Area
10. Seasonal Land Cover Regions	194	43	160	19.45
9. Olson Global Ecoregions	49	12	96	12.36
3. Fedorova, Volkova, and Varlyguin World Vegetation Cover	31	4	93	10.69
17. Landfire Vegetation Types	443	27	85	9.09
6. Küchler Types	117	34	81	7.87
14. Major Land Resource Areas	197	42	107	7.18
12. Leemans-Holdridge Life Zones	26	8	54	5.27
11. USGS Land Cover	24	7	21	4.85
4. GAP National Land Cover	578	19	124	4.48
5. Holdridge Life Zones	25	9	38	4.15
2. Foley Land Cover	14	7	48	3.86
16. National Land Cover Database 2006	16	8	47	3.24
13. Matthews Vegetation Types	19	5	18	2.49
15. Wilson, Henderson, & Sellers Primary Vegetation Types	23	2	9	1.46
7. BATS Land Cover	17	4	10	1.23
8. IGBP Land Cover	16	3	4	0.80
1. DeFries UMd Vegetation	12	2	5	0.25
TOTAL		235	1000	100%