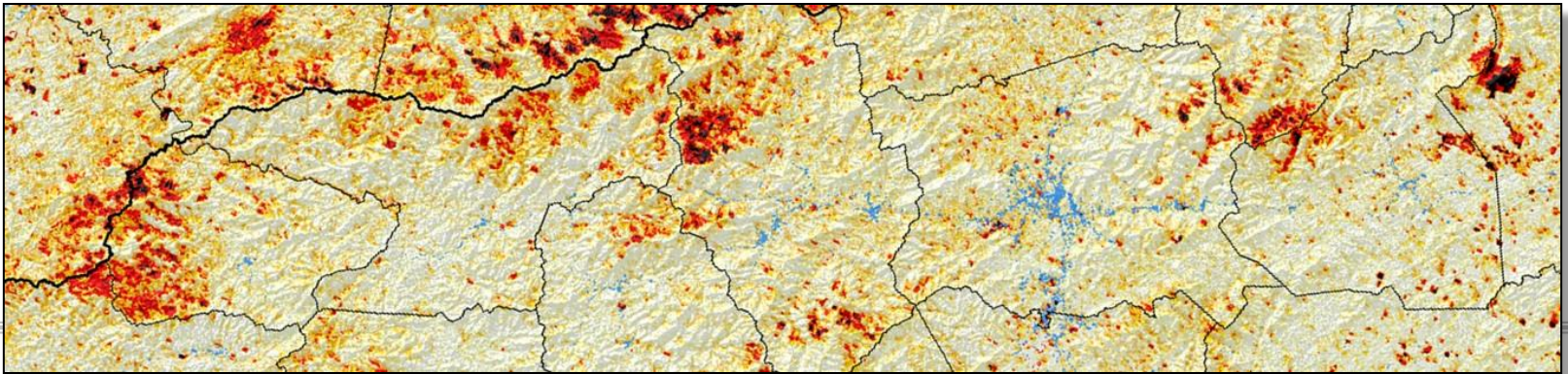




**The Forest Inventory and Analysis (FIA) program
and systematic remotely-sensed forest monitoring:
Do these provide parallel or interconnected insights?**



Steven P. Norman
William W. Hargrove

Southern Research Station
Eastern Threat Center

**Southern Group of State Foresters
FIA Coordinators Meeting**

Asheville Renaissance Hotel
March 12, 2015

Outline

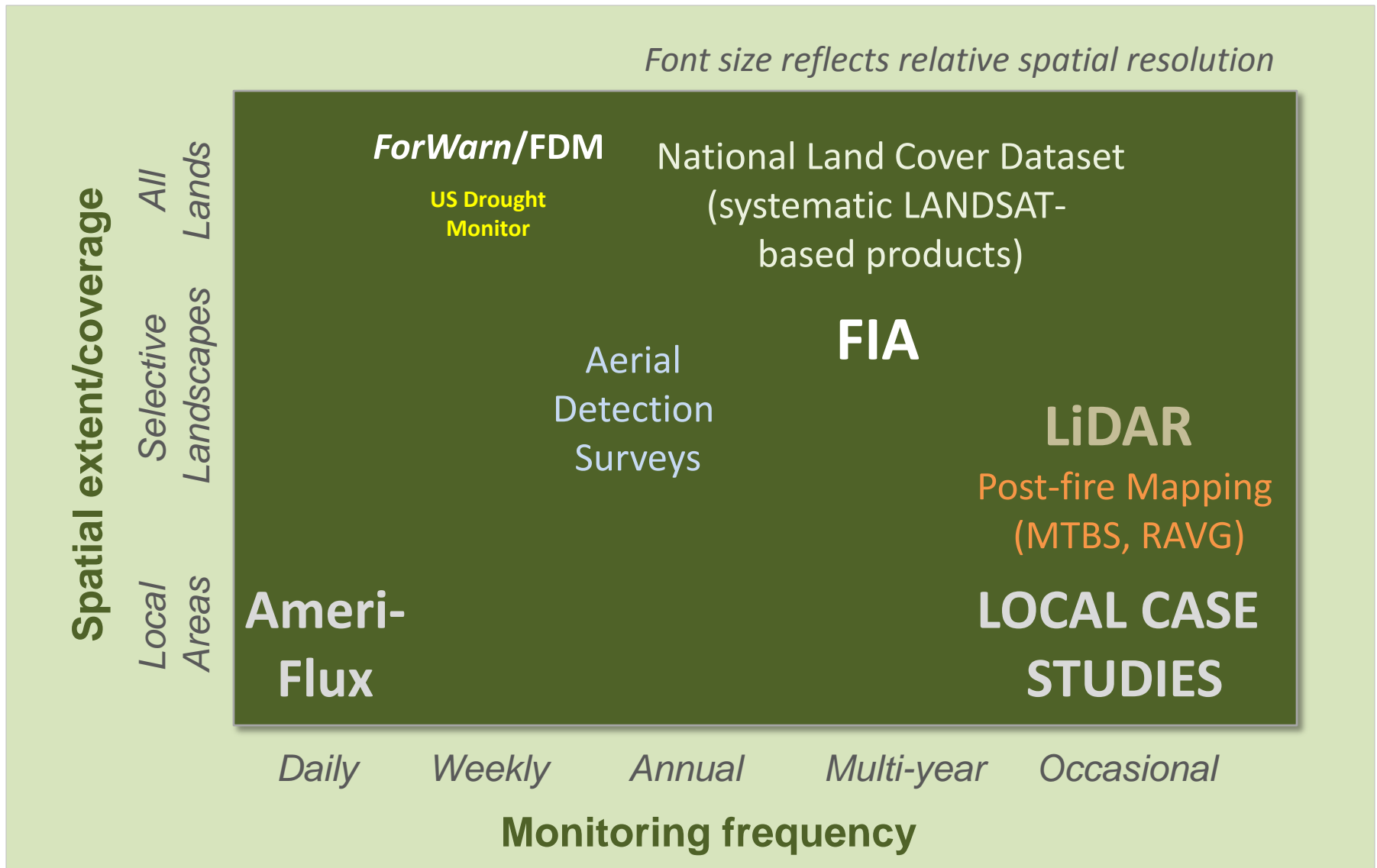


- **The *ForWarn* system**
- **Interconnections with FIA**
 - Land Surface Phenology-based vegetation types for representation
 - Near-real-time change detection for rapid response
 - Long-term monitoring for contextualizing time and landscapes



The *ForWarn* system

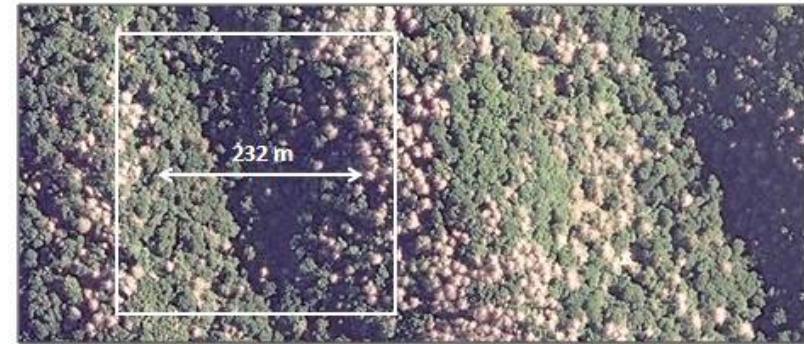
Approaches to US forest monitoring



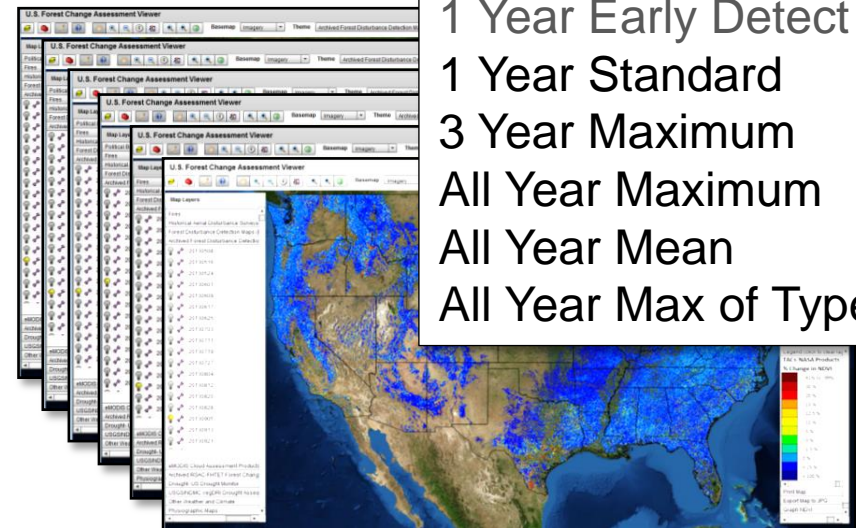
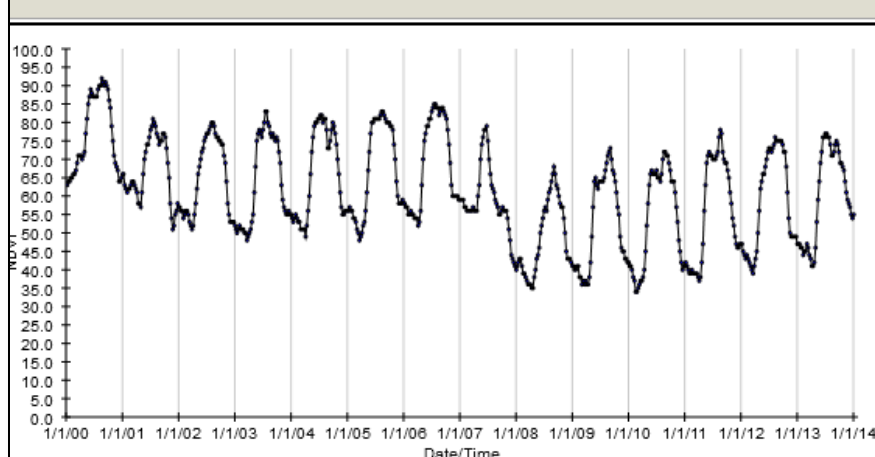
The *ForWarn* system



- Online at <http://forwarn.forestthreats.org>
- Measure is the Normalized Difference Vegetation Index (NDVI) from MODIS
- 232 meter resolution (5.4 ha/13 ac)
- 8-day frequency (46 periods/year from 2000)
- Since 2010, 276 near-real-time change maps /year using 6 seasonally-adjusted baselines
- Derived and long-term monitoring products



MODIS NDVI for Lat: 35.8397 Lon: -81.8732

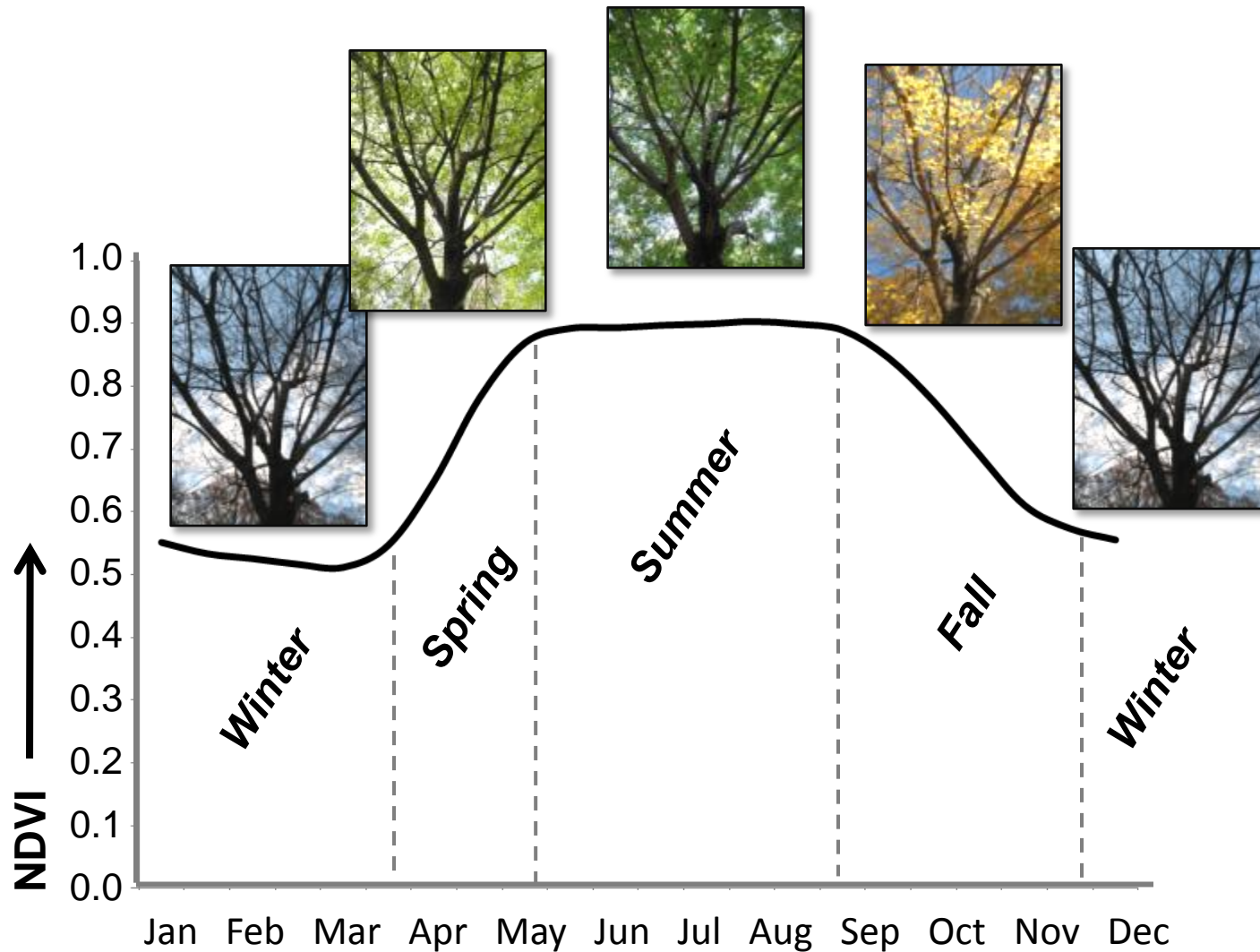


Baselines

- 1 Year Early Detect
- 1 Year Standard
- 3 Year Maximum
- All Year Maximum
- All Year Mean
- All Year Max of Type

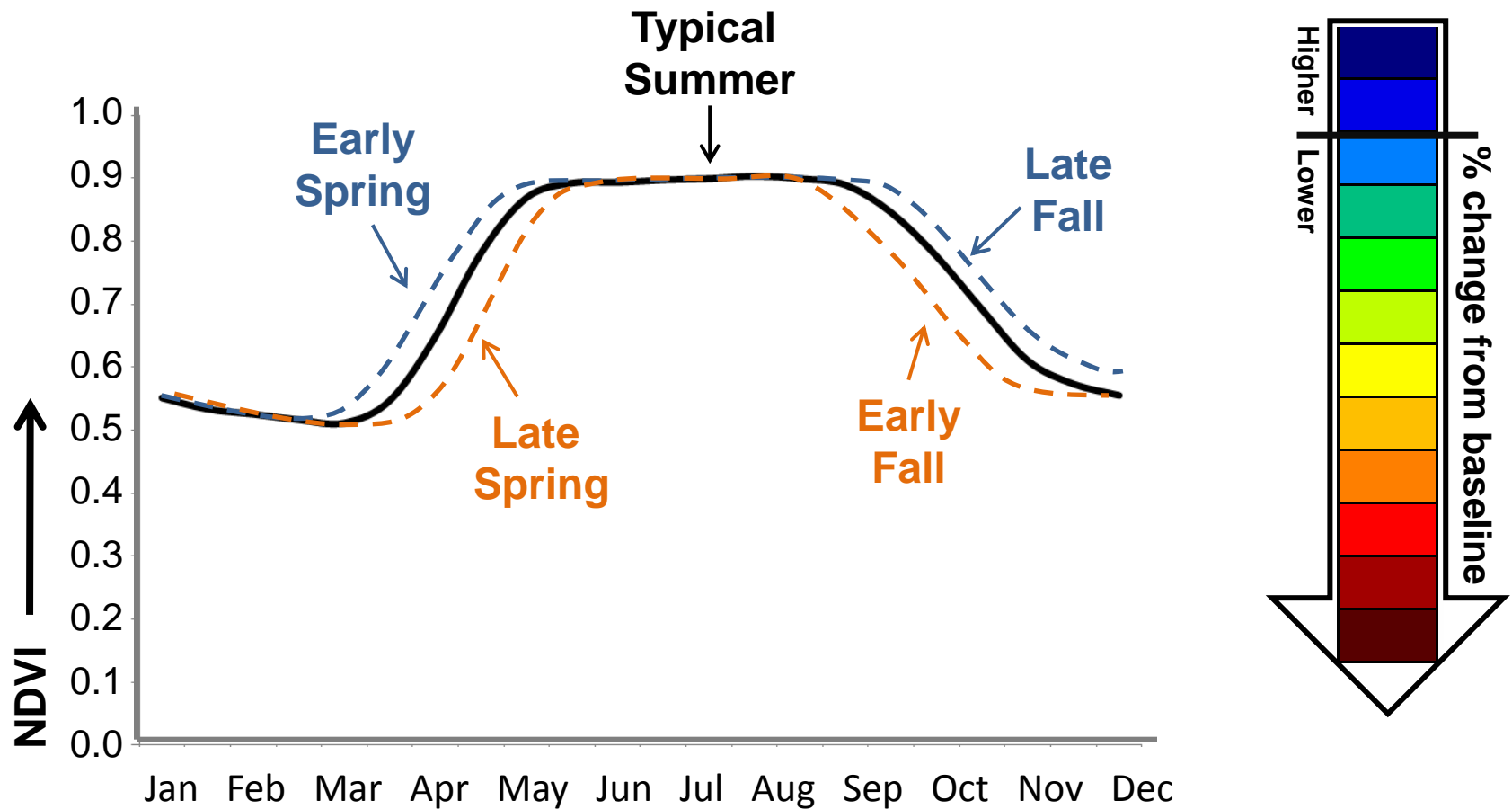
The *ForWarn* system

Seasonal change in NDVI reflects vegetational phenology



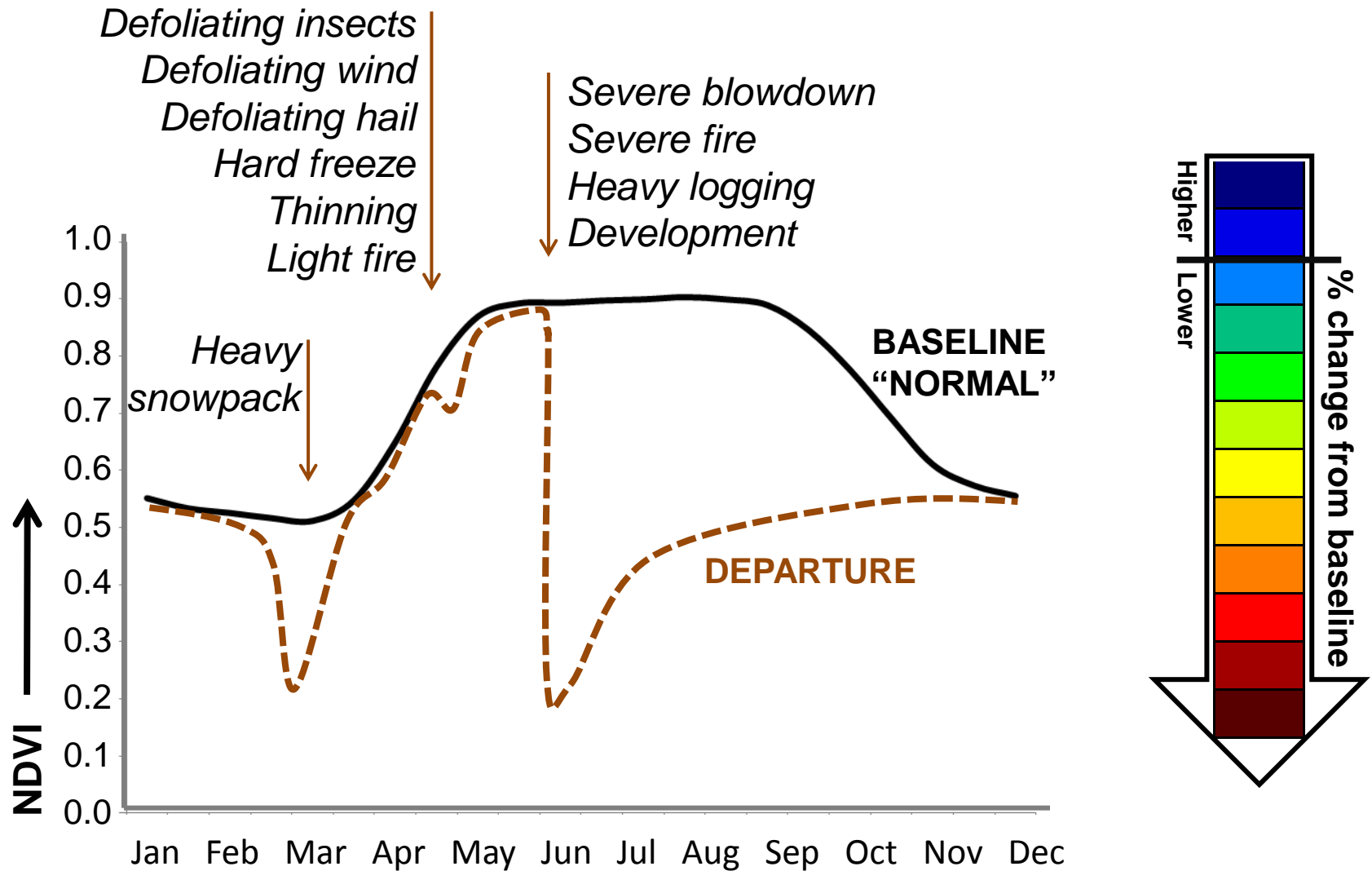
The *ForWarn* system

Baseline phenology compared to variation in Spring and Fall



The *ForWarn* system

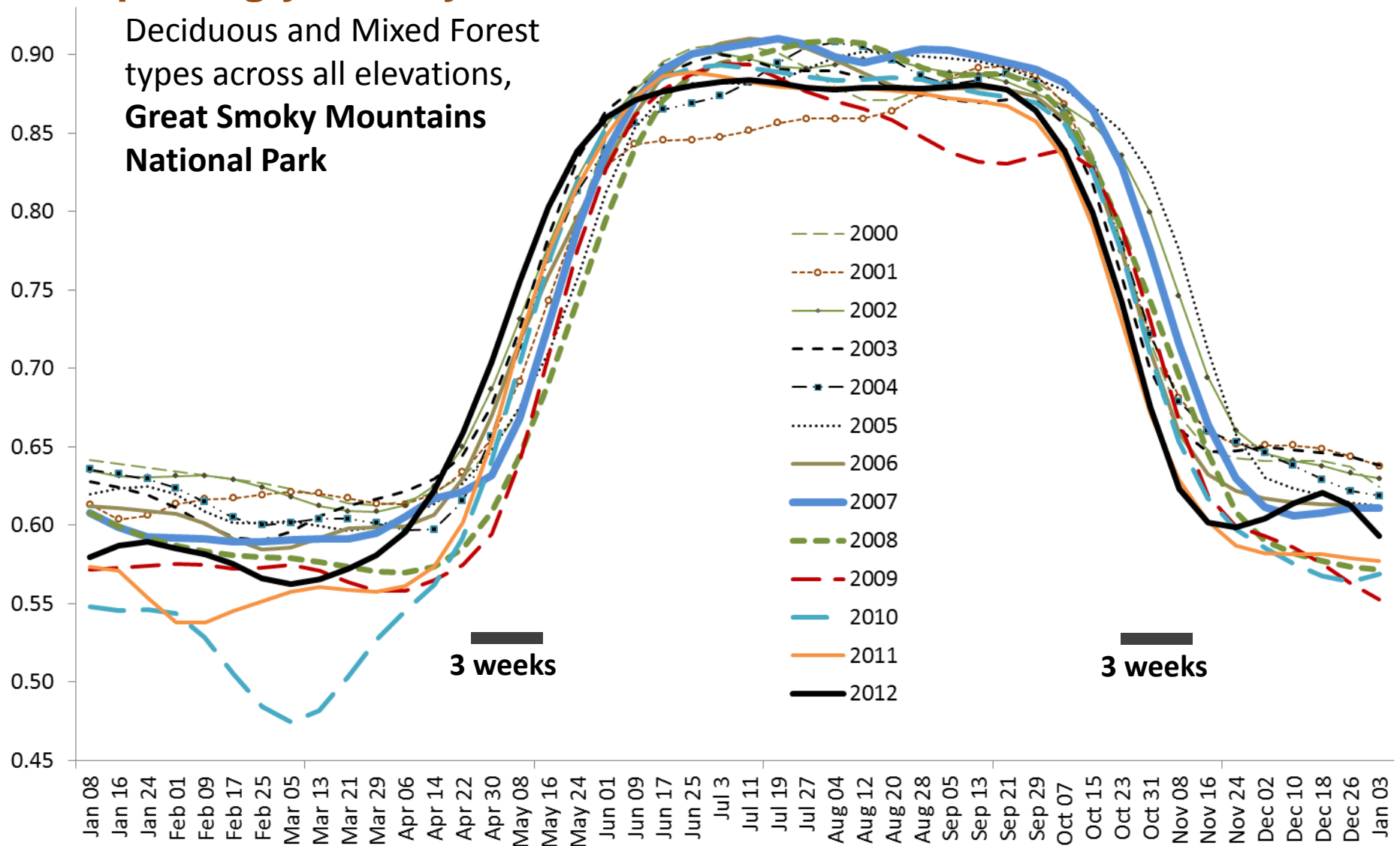
Baseline phenology compared to disturbance effects



The *ForWarn* system

Capturing year-to-year variation in NDVI

Deciduous and Mixed Forest types across all elevations,
**Great Smoky Mountains
National Park**



Forest Monitoring with FIA and *ForWarn*

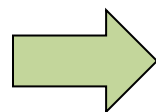
| | FIA | <i>ForWarn</i> |
|--|---|---|
| Purpose | Long-term monitoring through sampling | Near-real-time and long-term monitoring through mapping |
| Temporal resolution (frequency) | Every few years; varies by state | Near-real-time (8 day frequency) |
| Temporal coverage | Variable, but available for decades | 2000-present |
| Spatial resolution | Rigorous sample; plot to tree resolution | 232m (5.4 ha, 13 acres) |
| Spatial coverage | Forestlands, some woodlands; limited urban forest | All-lands coverage for CONUS |

Outline



- The *ForWarn* system

- Interconnections with FIA



- Land Surface Phenology-based vegetation types for representation
- Near-real-time change detection for rapid response
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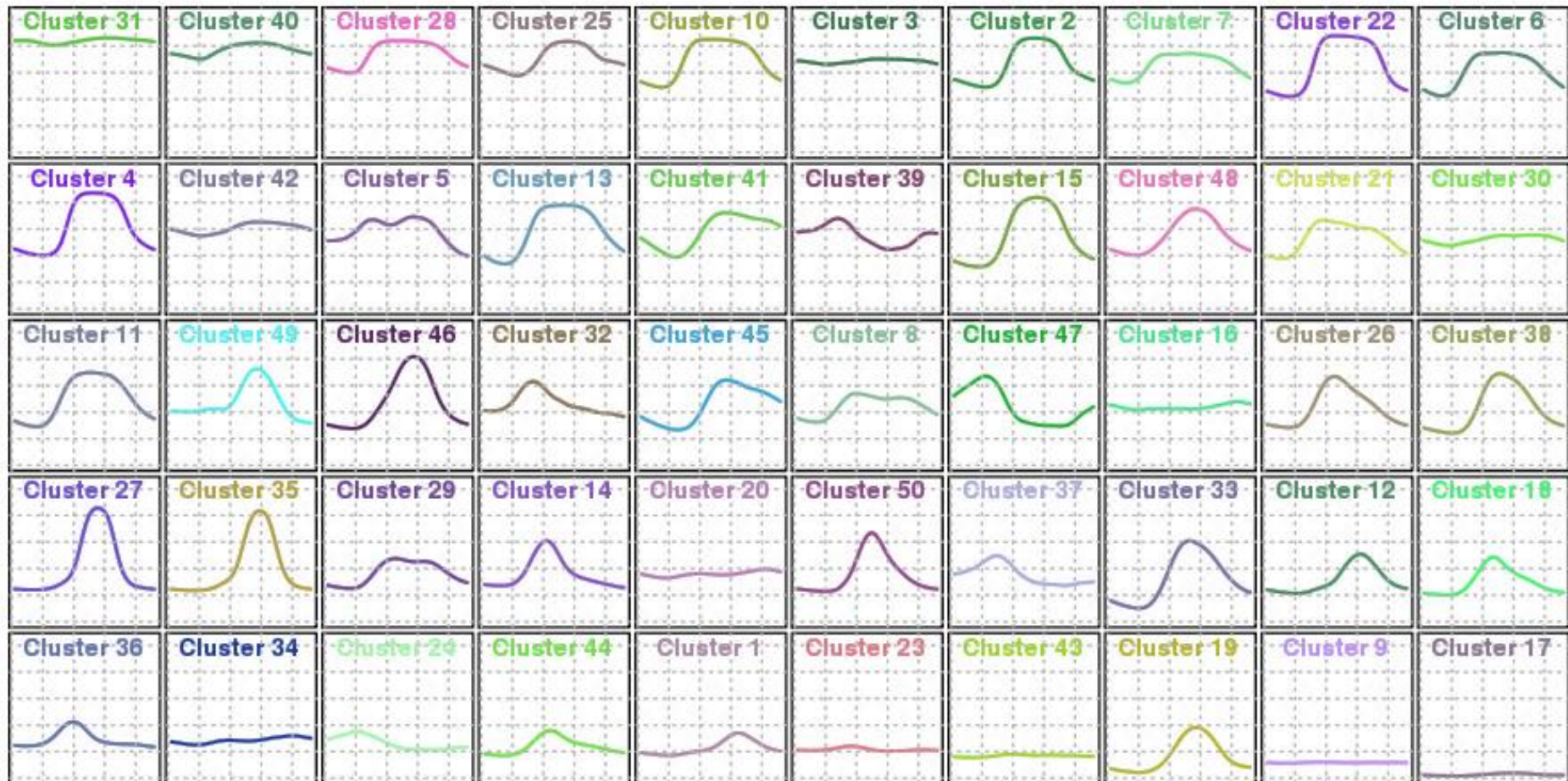


Land Surface Phenology-based urban vegetation

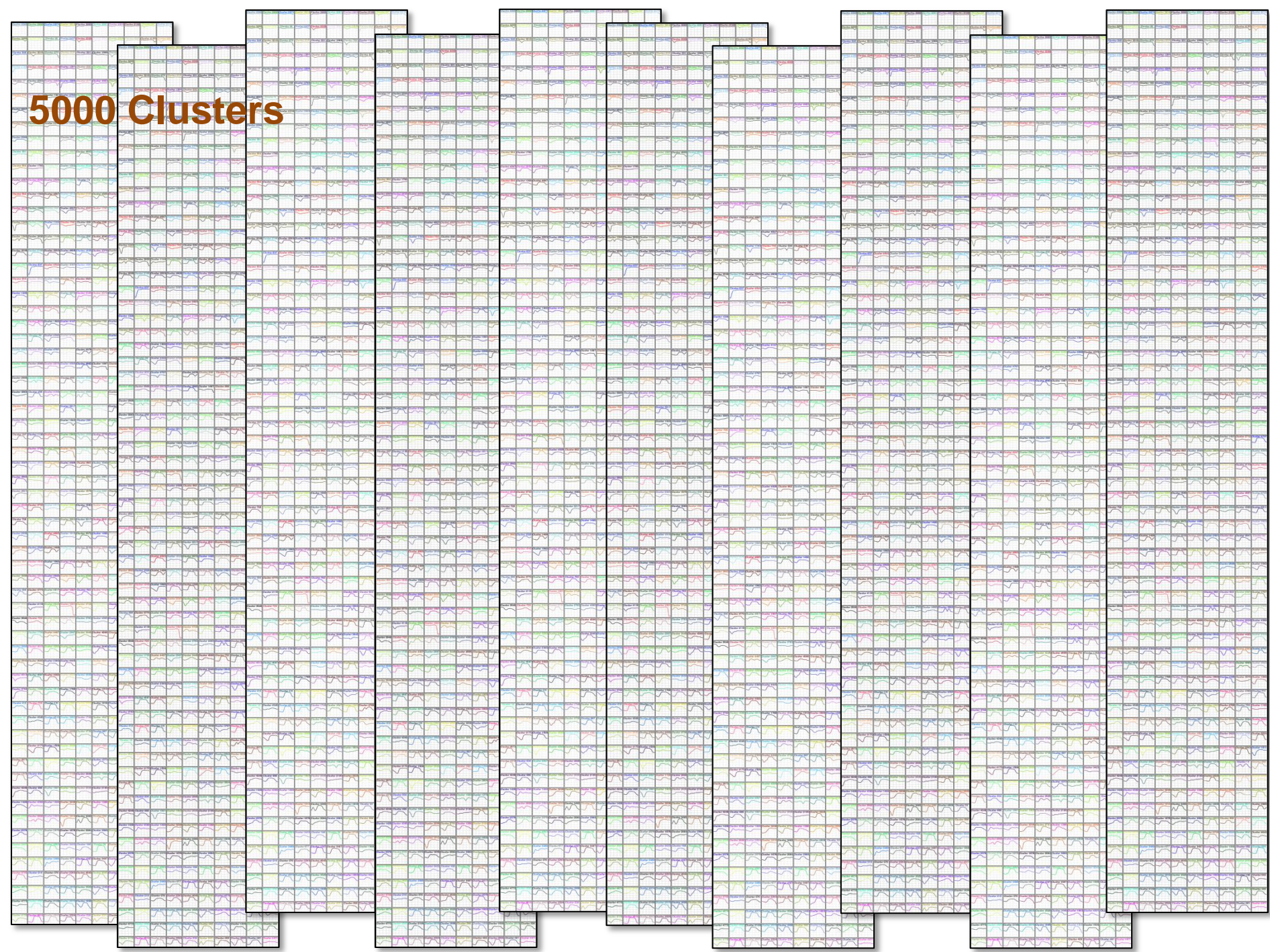
50 Clusters

2000-2012
Max Mode
Phenoregions

Note the variety of evergreen, deciduous and non-vegetative forms

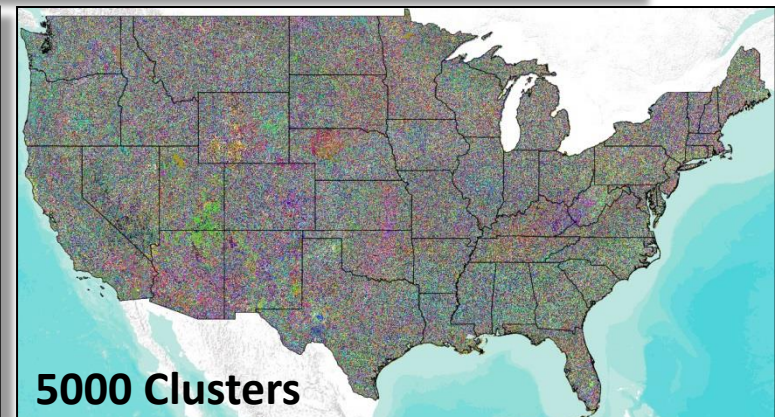
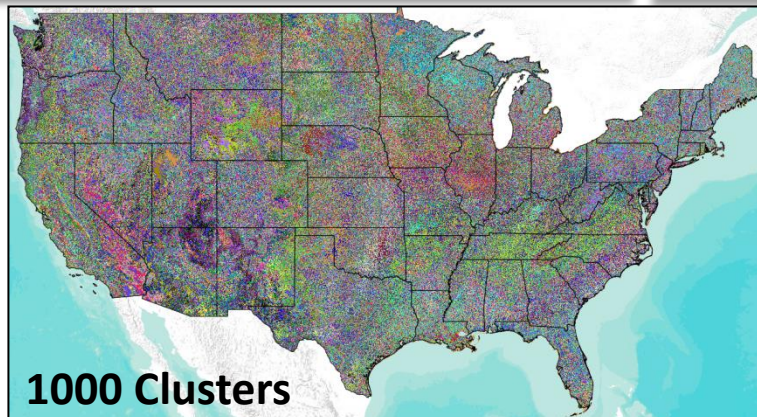
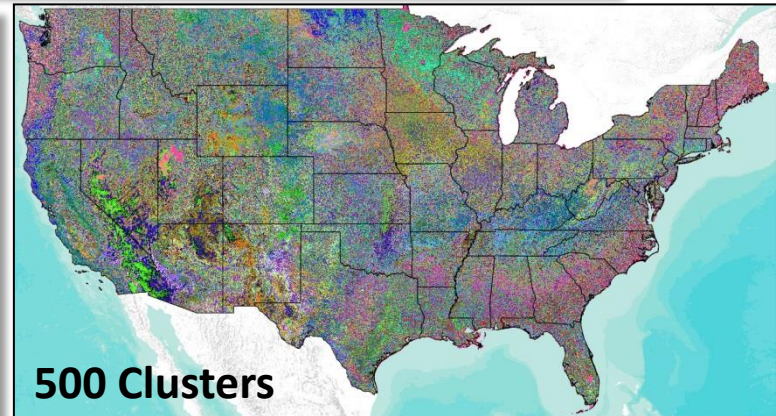
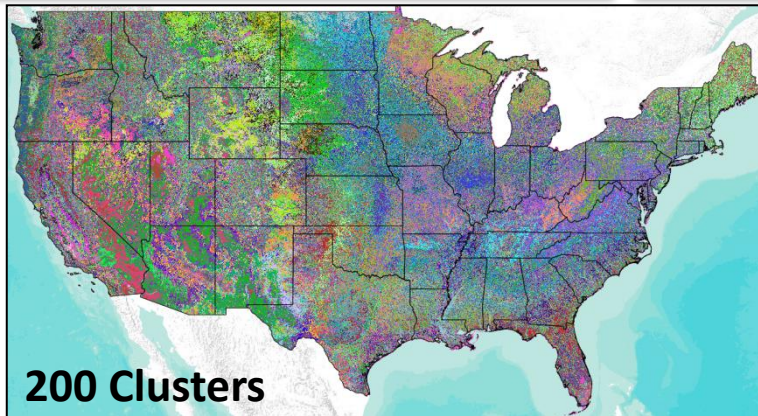
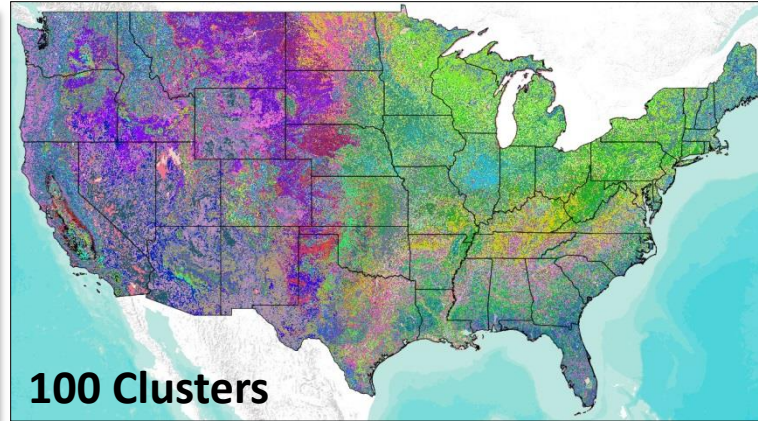
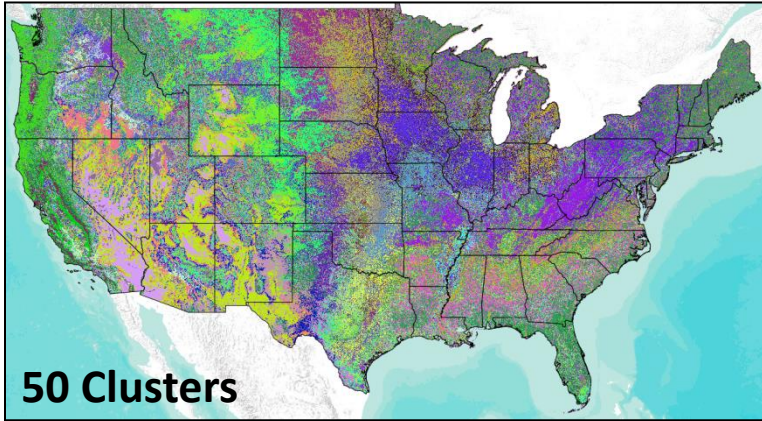


5000 Clusters



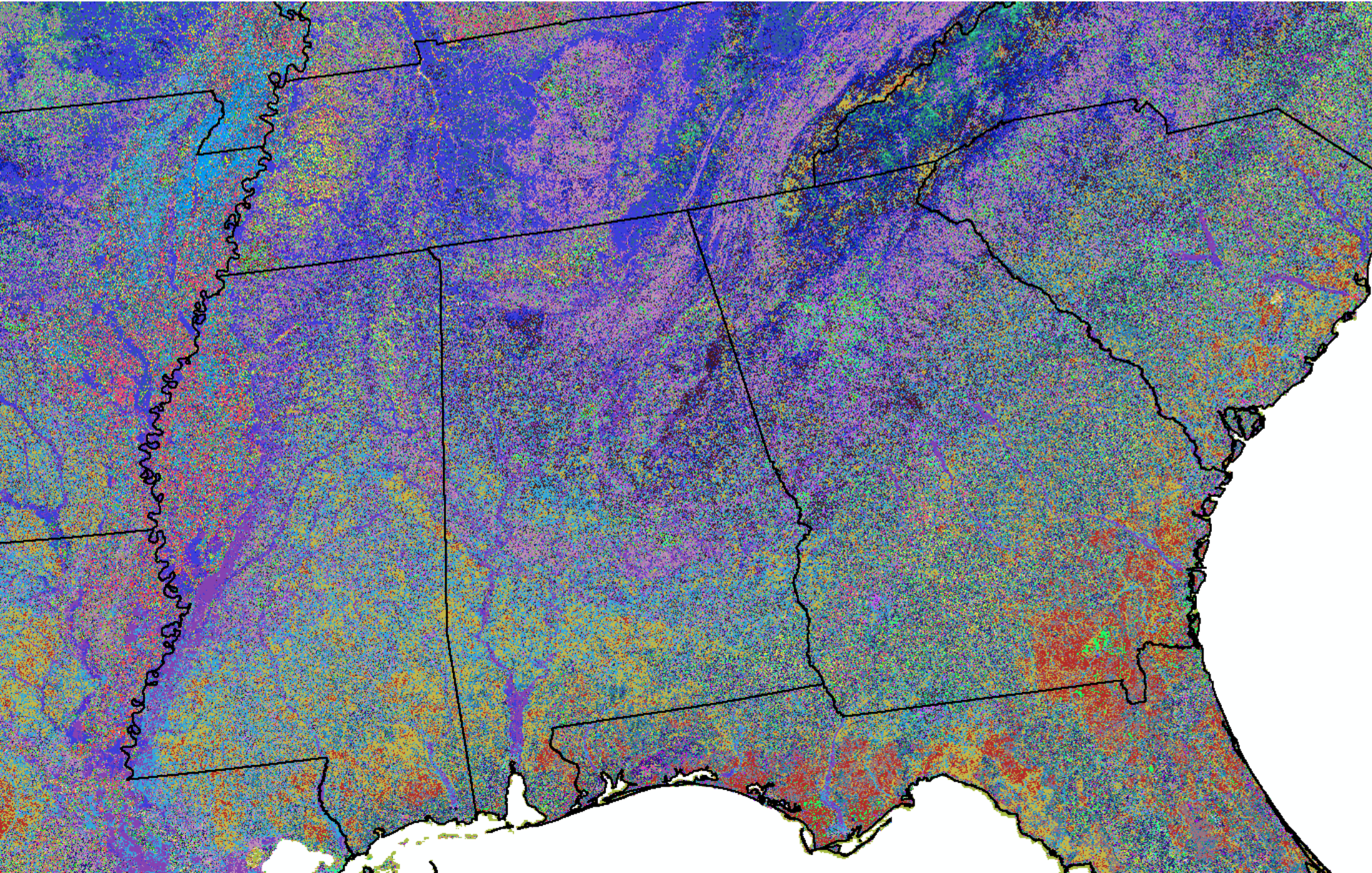
Land Surface Phenology-based vegetation types

2000-2012
Max Mode
Phenoregions

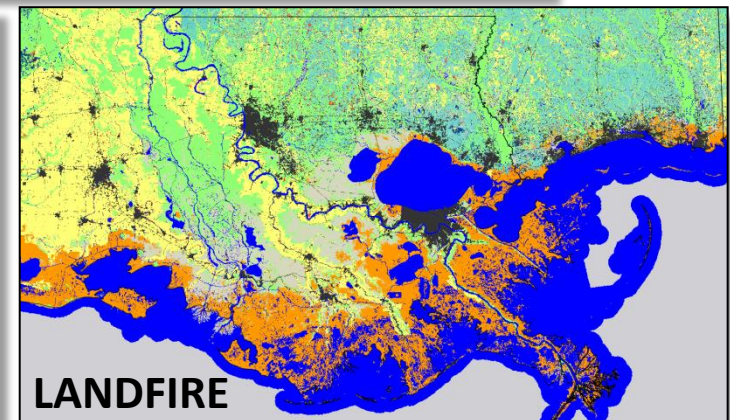
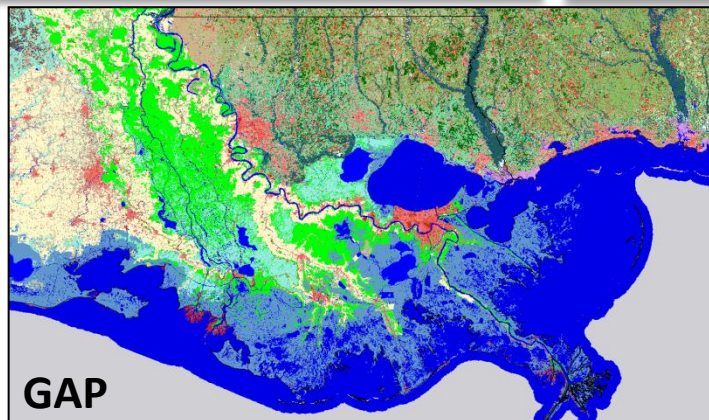
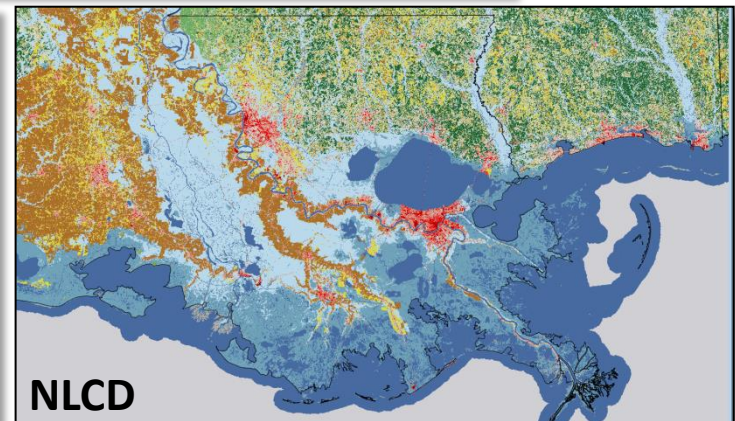
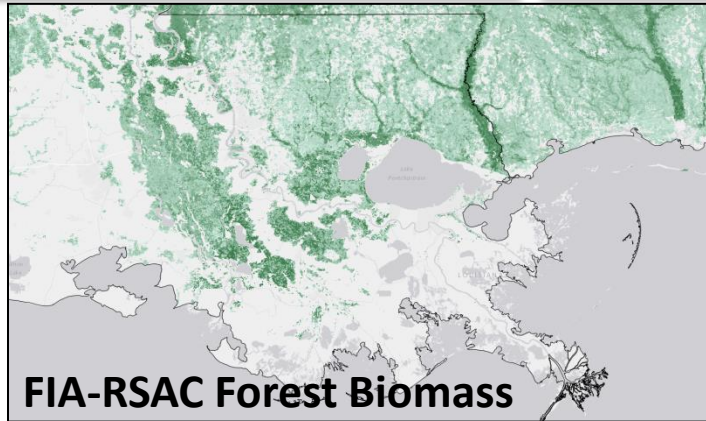
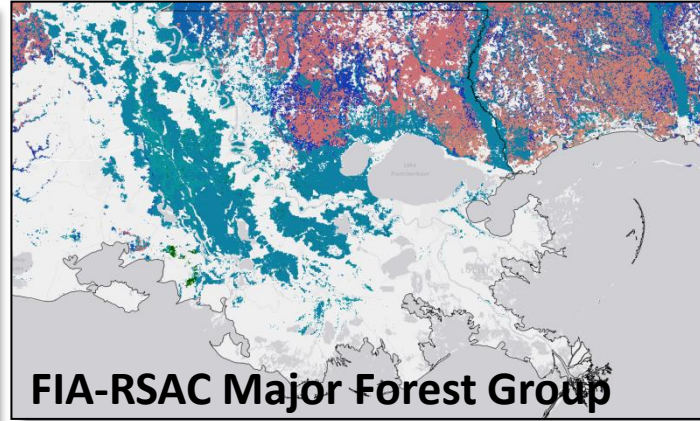
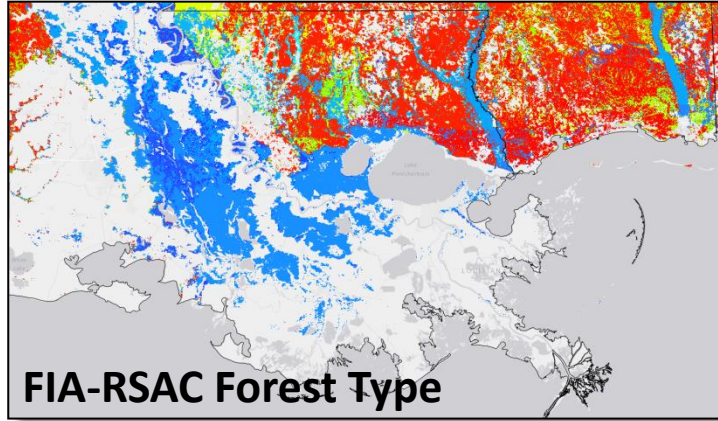


Land Surface Phenology-based vegetation types

200 “Max-Under” phenoregions (random colors)

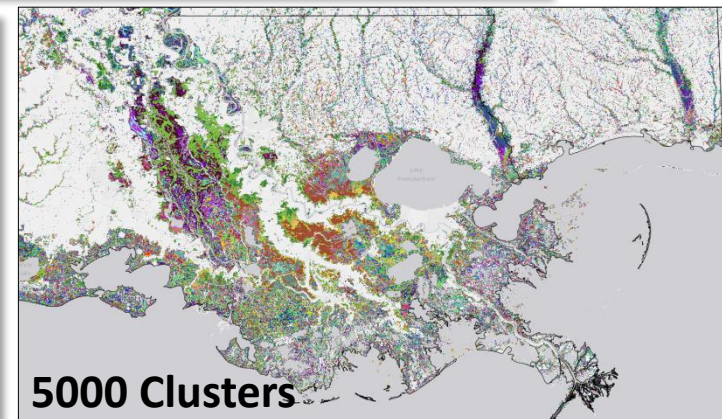
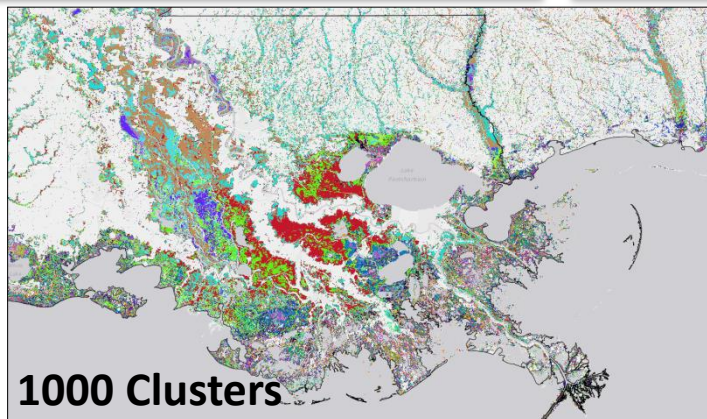
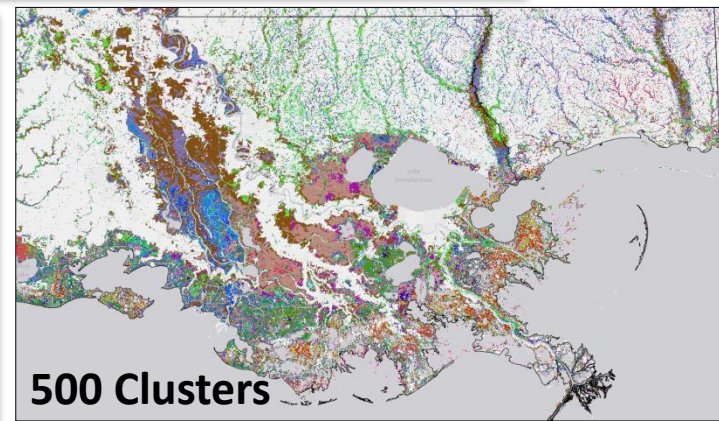
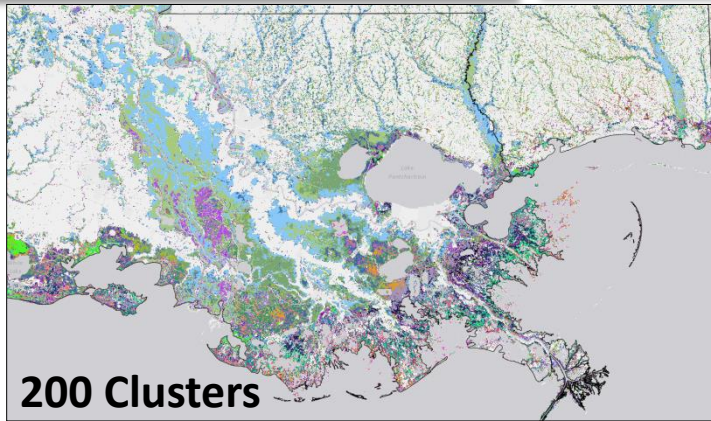
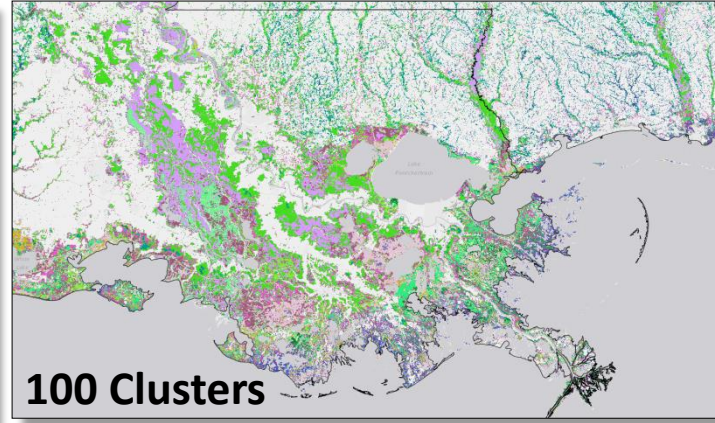
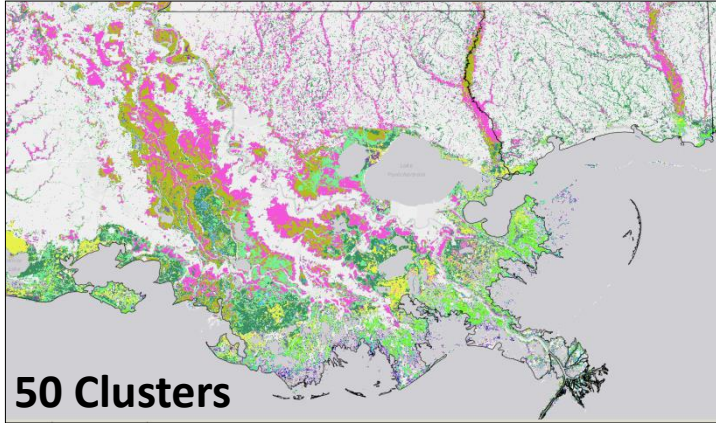


Existing vegetation types for Louisiana



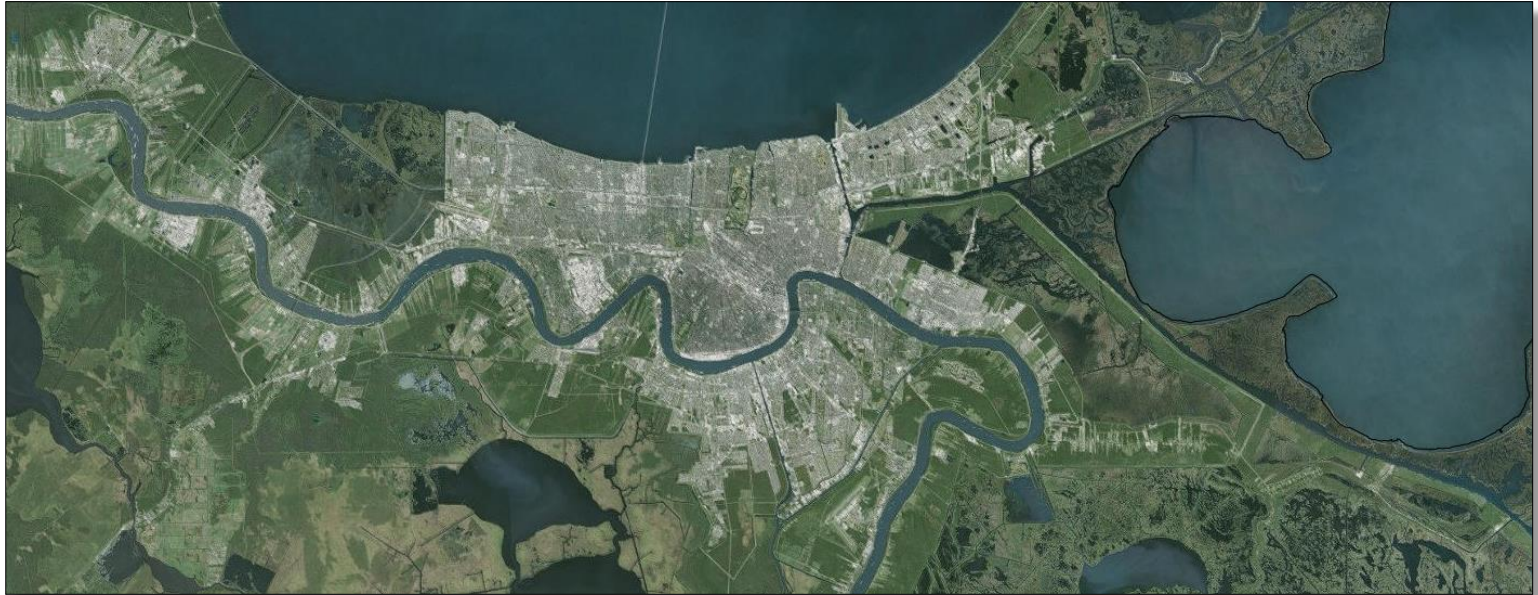
Land Surface Phenology-based wetland types

2000-2012
Max Mode
Phenoregions

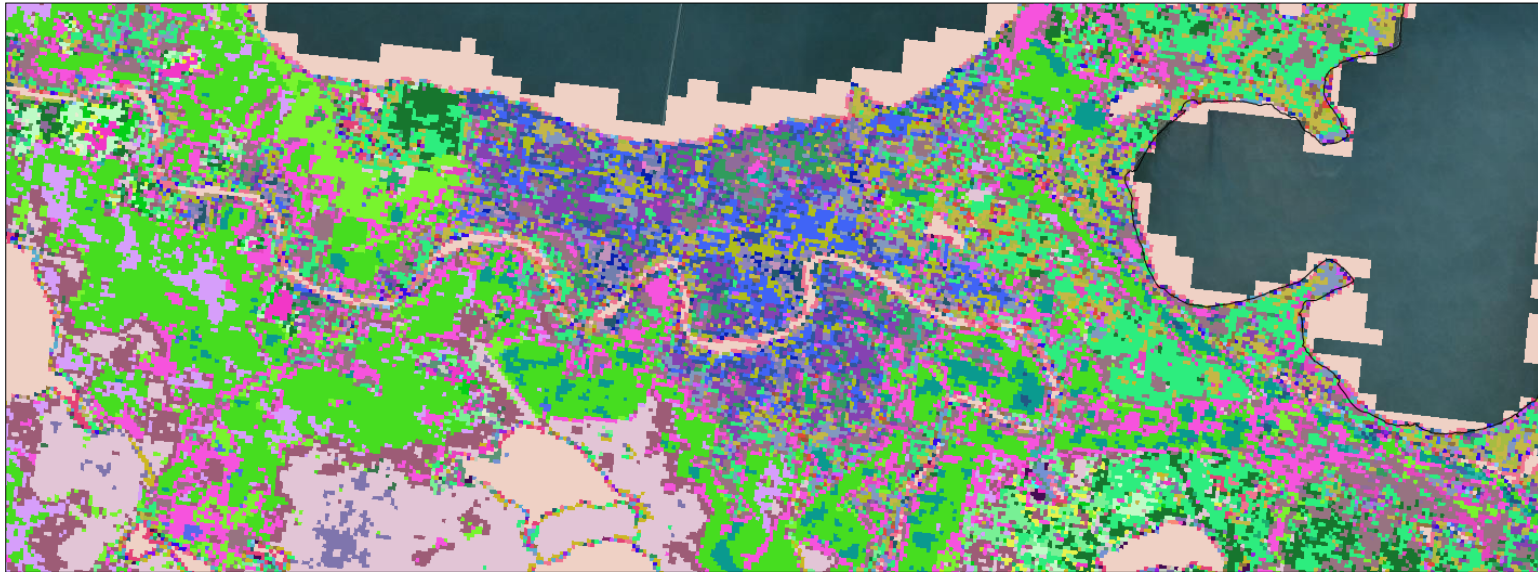


Land Surface Phenology-based urban vegetation

**New Orleans
Louisiana**

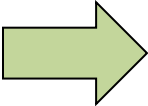


**2000-2012
Max Mode
Phenoregions
50 Clusters**



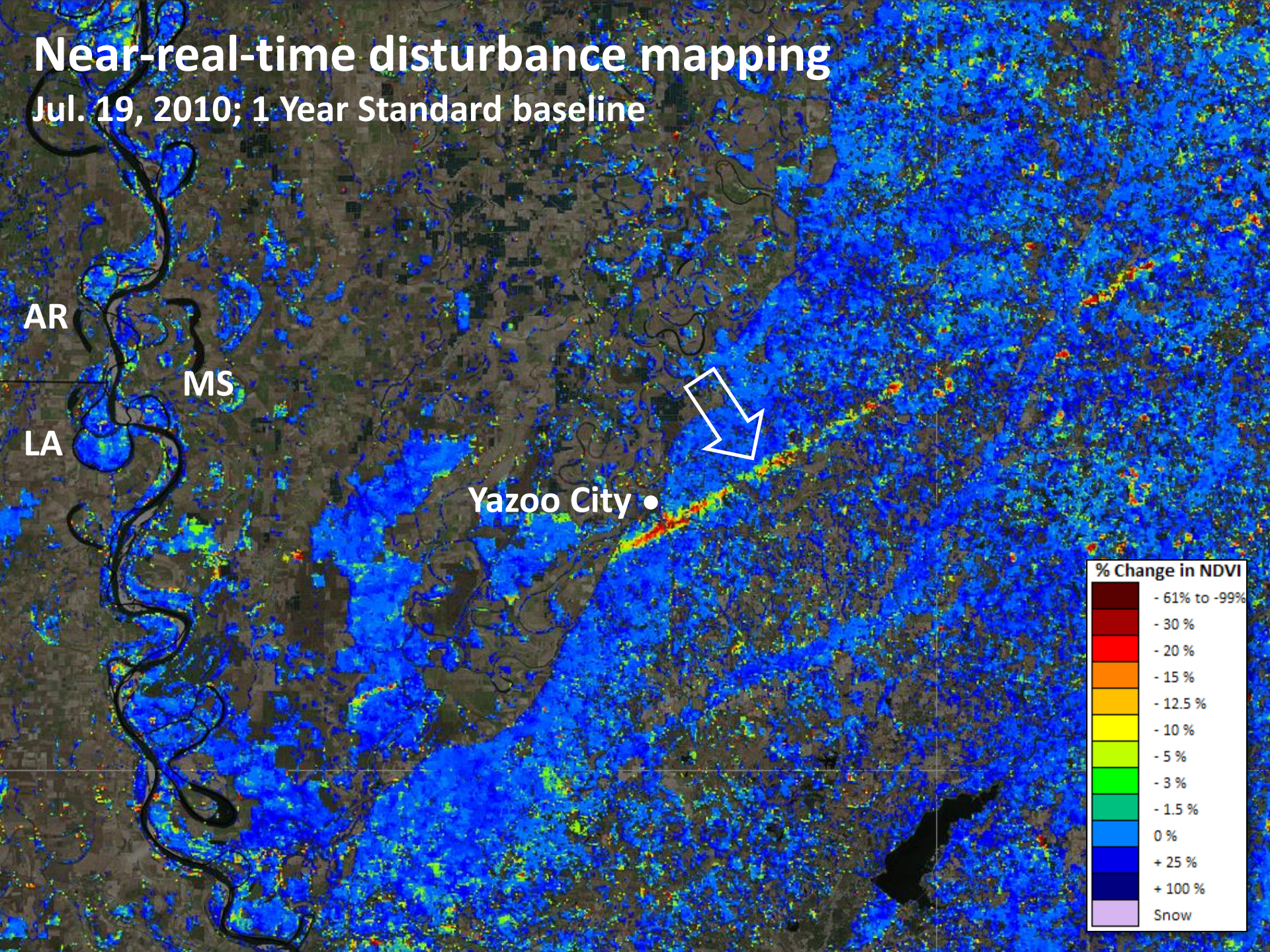
Outline



- The *ForWarn* system
 - Interconnections with FIA
 - Land Surface Phenology-based vegetation types for representation
- 
- Near-real-time change detection for rapid response
 - Long-term monitoring for contextualizing time and landscapes

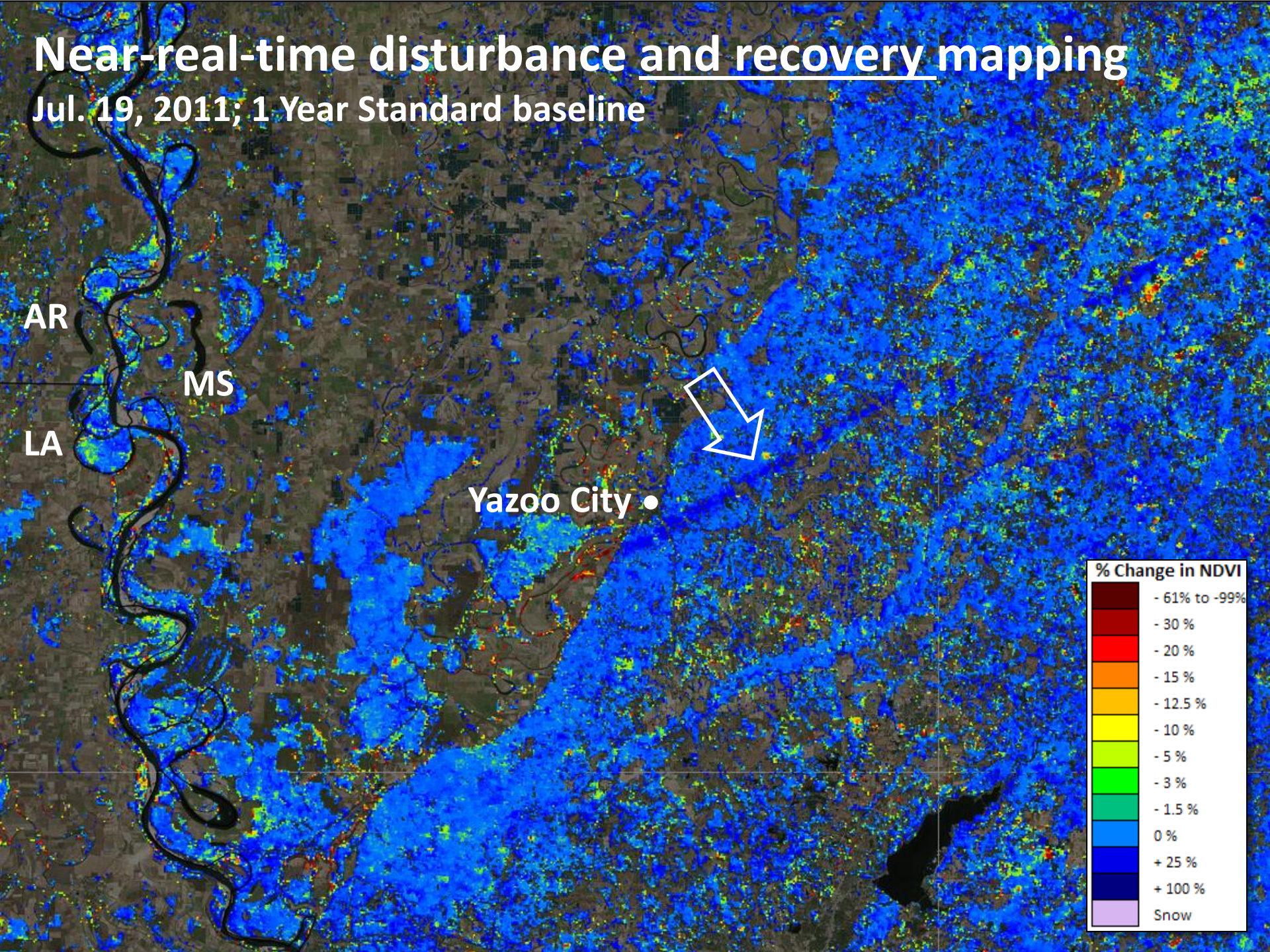
Near-real-time disturbance mapping

Jul. 19, 2010; 1 Year Standard baseline



Near-real-time disturbance and recovery mapping

Jul. 19, 2011; 1 Year Standard baseline



Near-real-time disturbance mapping

Chattahoochee National Forest tornado, Apr. 27, 2011

Lake Burton



Near-real-time Chattahoochee NF tornado severity

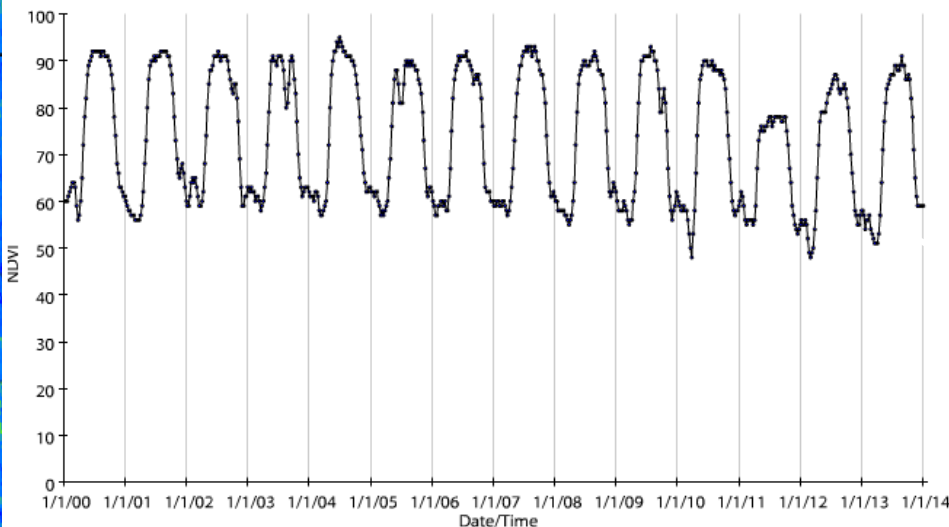
NC

Jul 3, 2011: Change from 2010

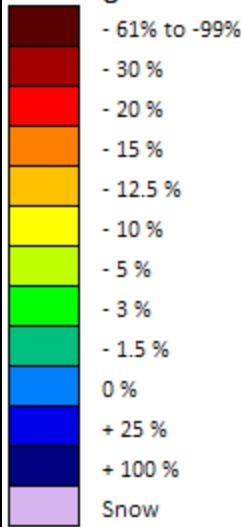
GA

SC

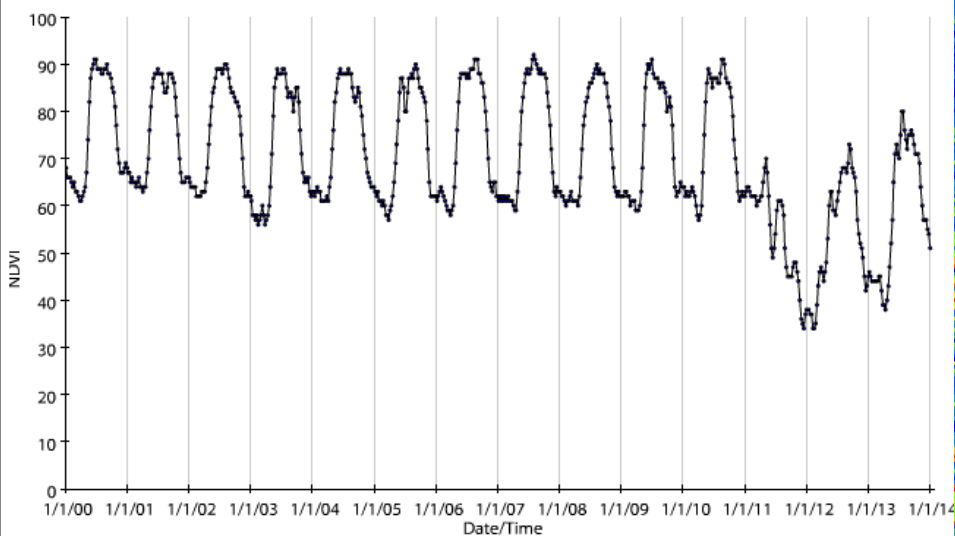
MODIS NDVI for Lat: 34.752127 Lon: -83.750170



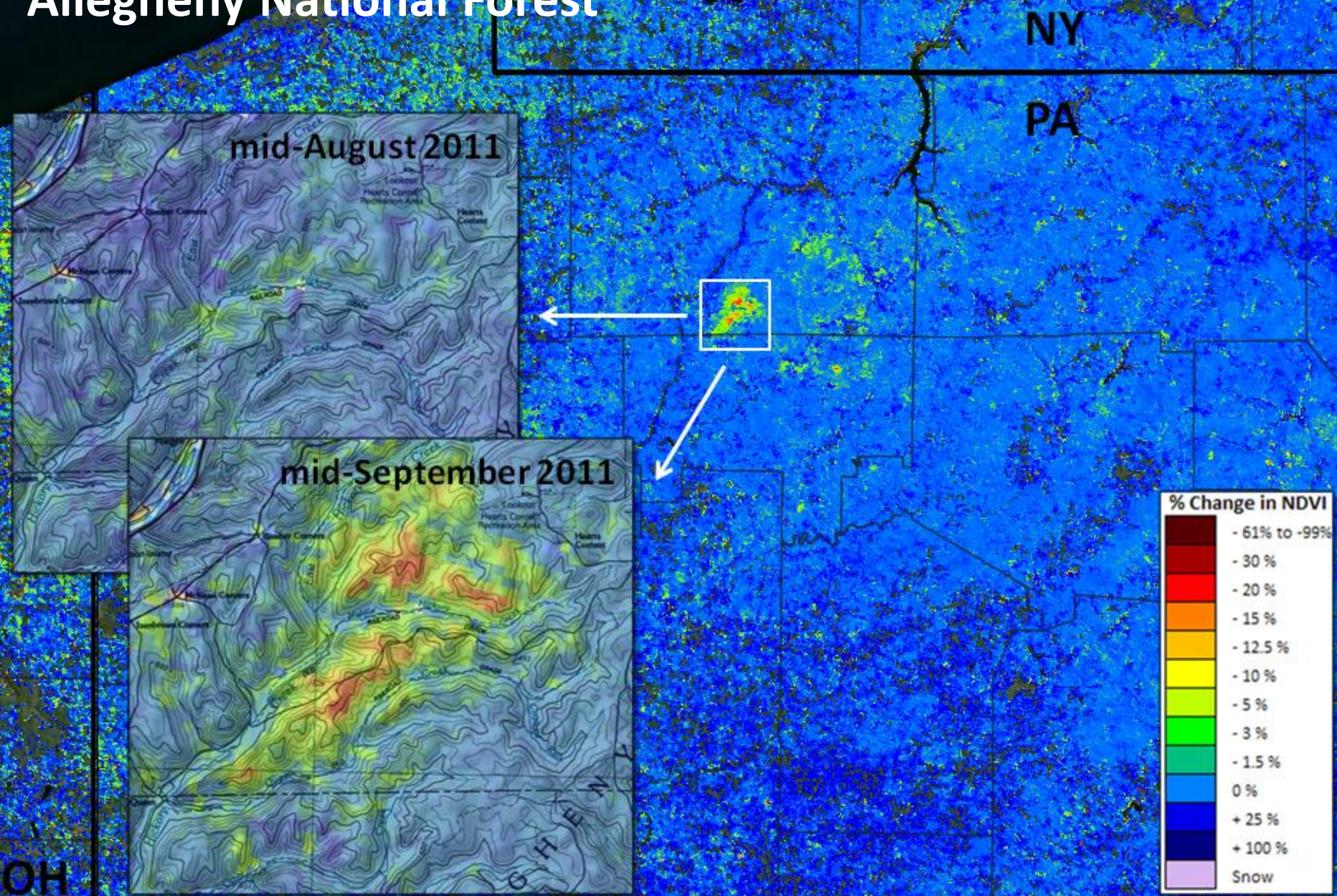
% Change in NDVI



MODIS NDVI for Lat: 34.837853 Lon: -83.575622



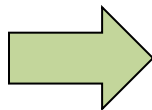
Near-real-time late season Fall Webworm defoliation Allegheny National Forest



Outline

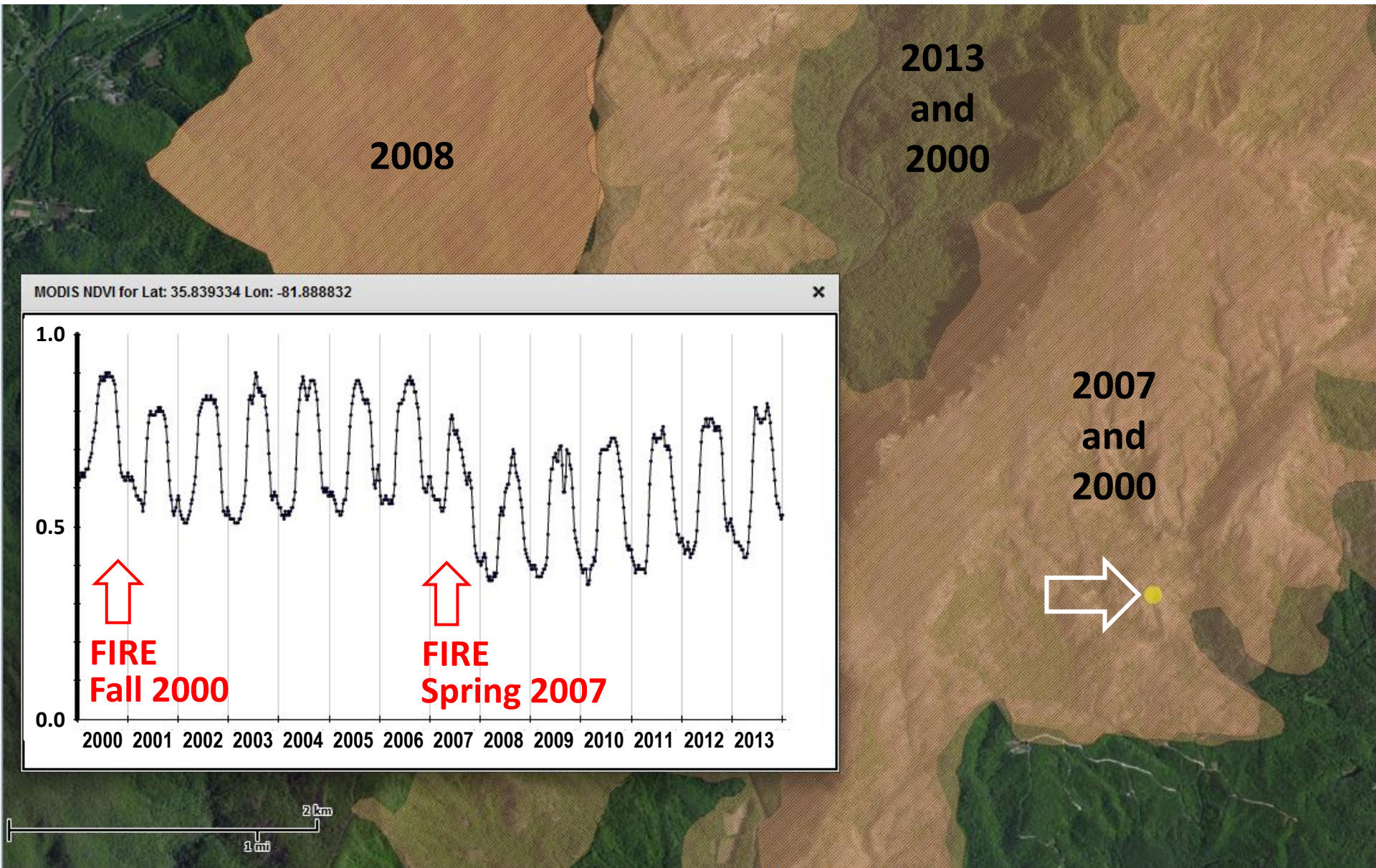


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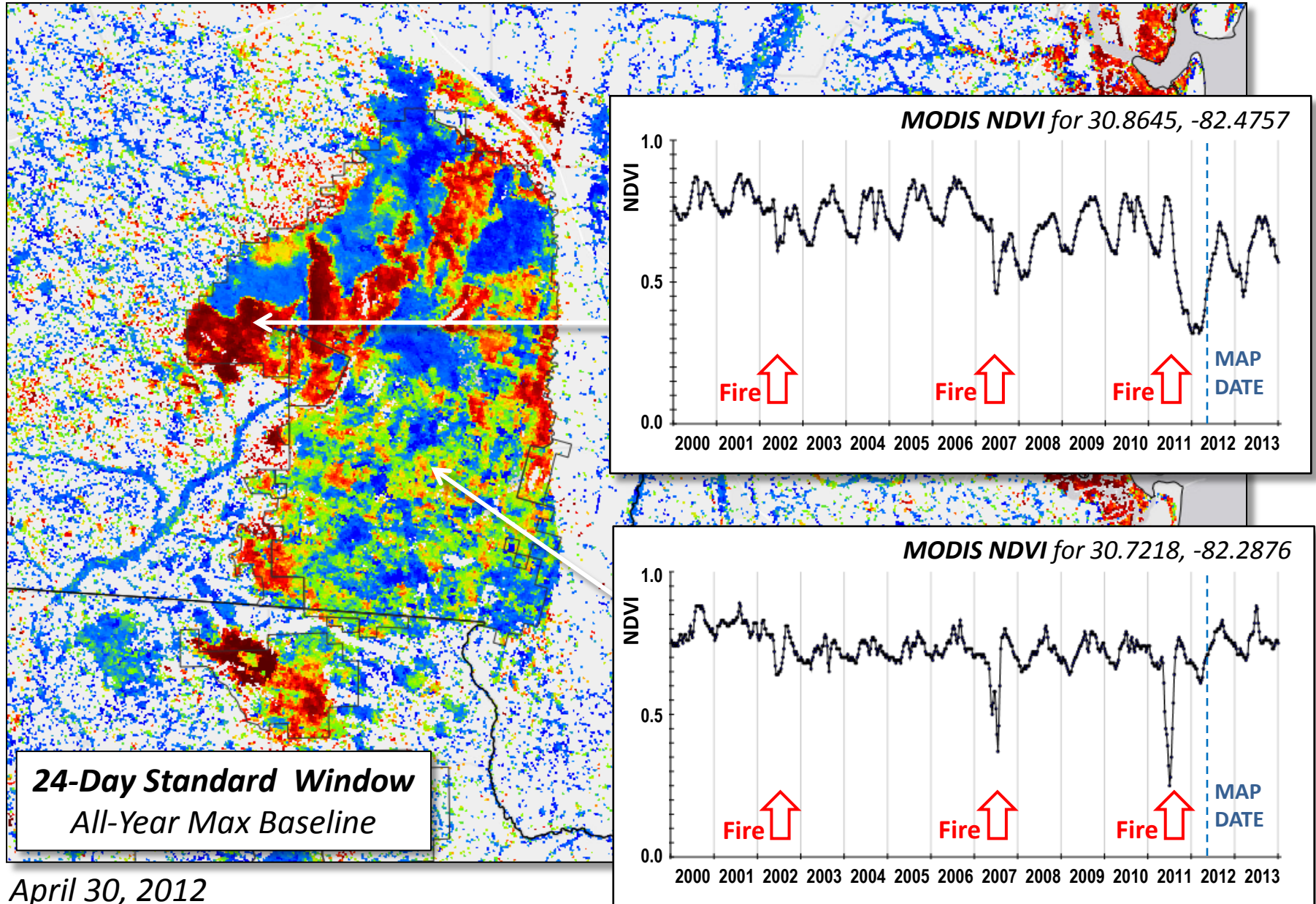
Monitoring fire regime responses and NDVI recovery

Linville Gorge, NC



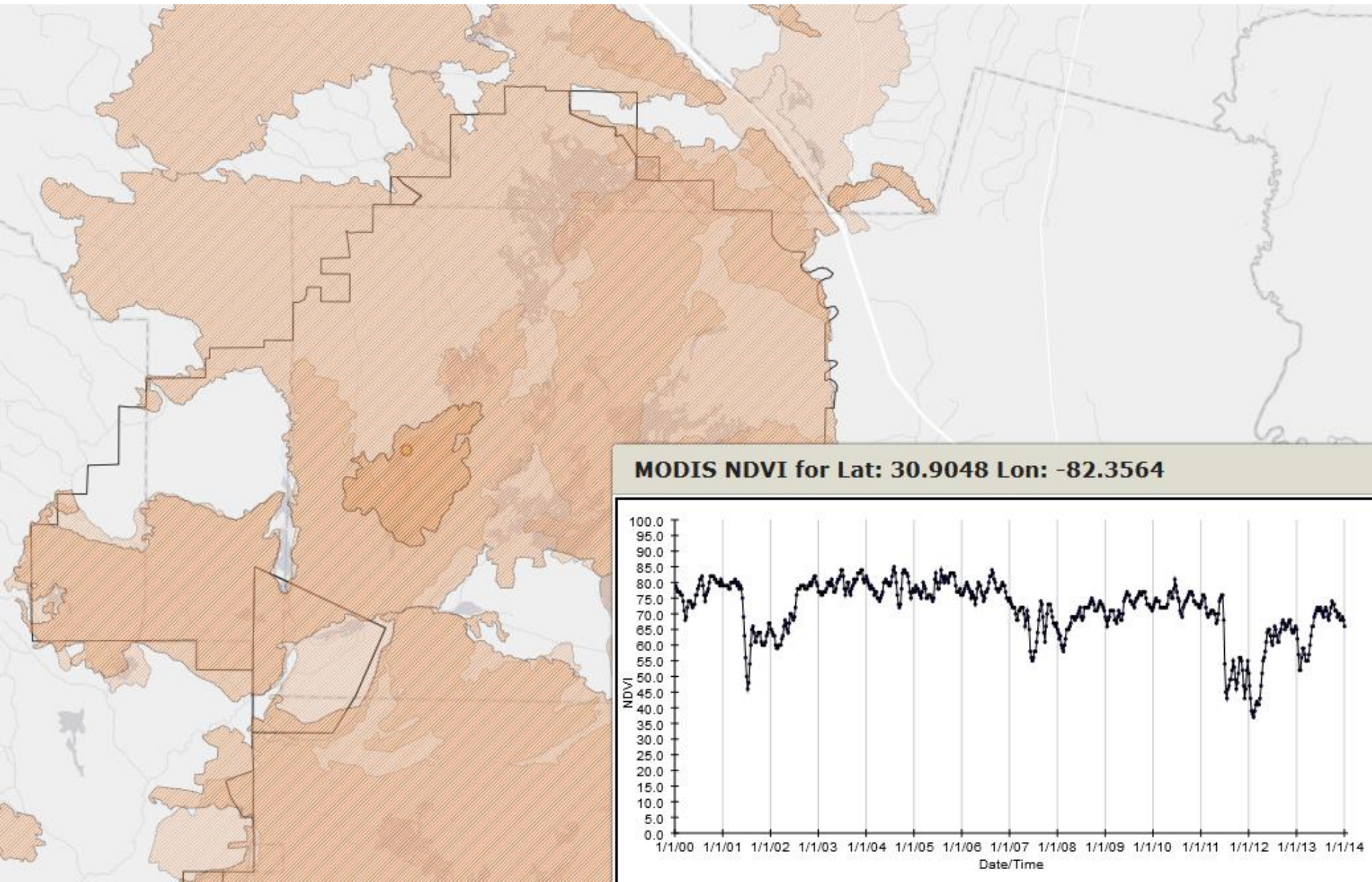
Response to fire regime change, Okefenokee wetlands

Gradual erosion of resilience?



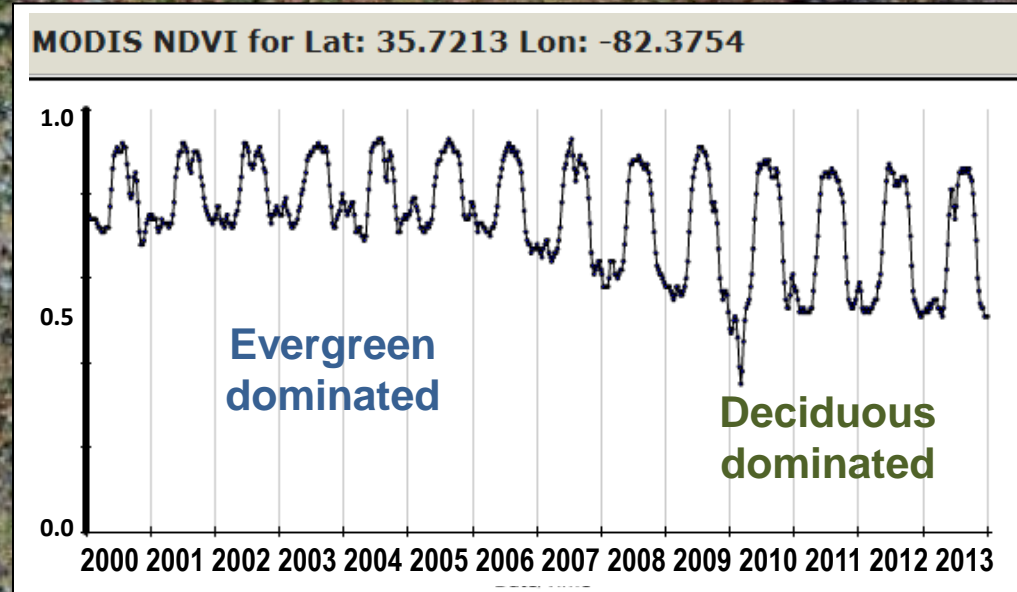
Response to fire regime change, Okefenokee wetlands

Gradual erosion of resilience?



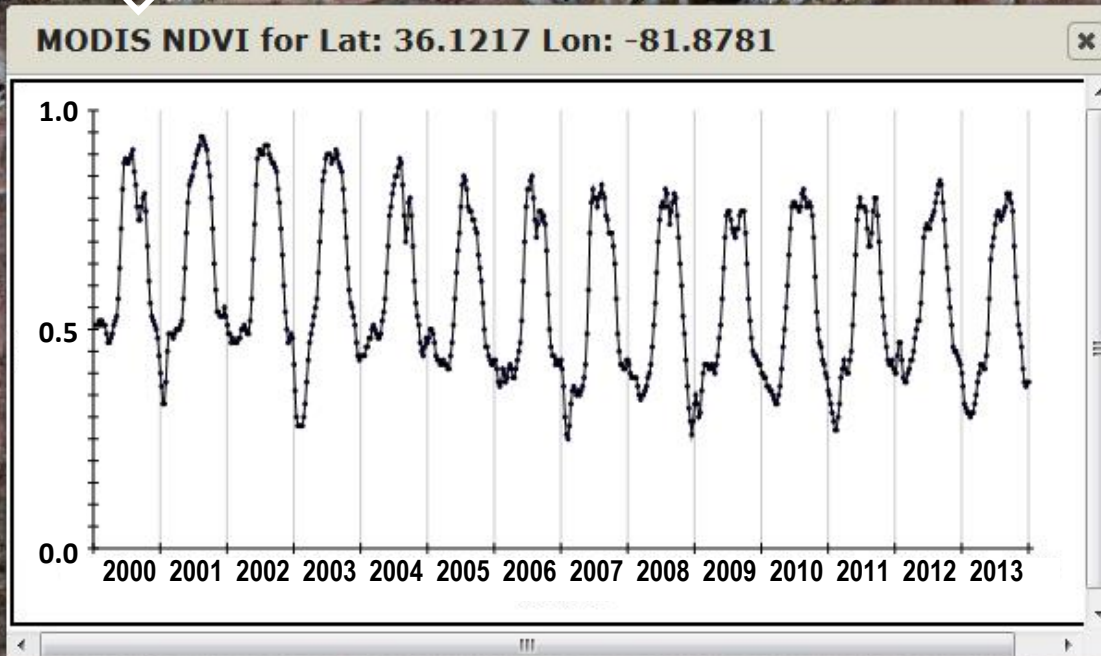
Monitoring gradual loss of evergreen (hemlock)

Southern Appalachians



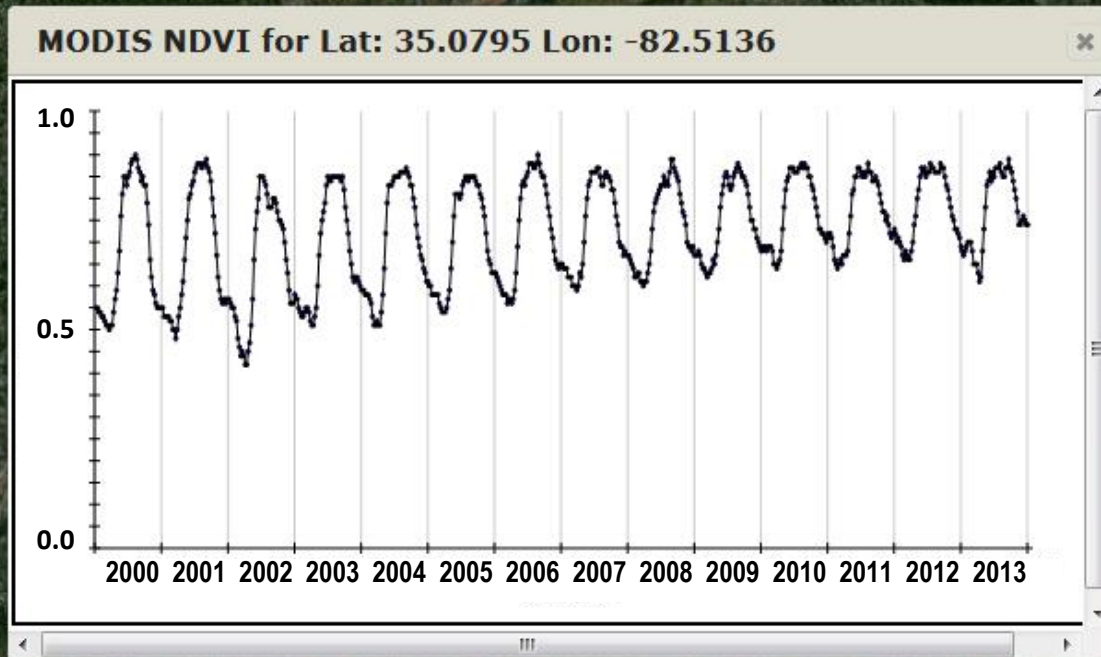
Monitoring Land Cover Change

Mountaintop development near Grandfather Mtn., NC



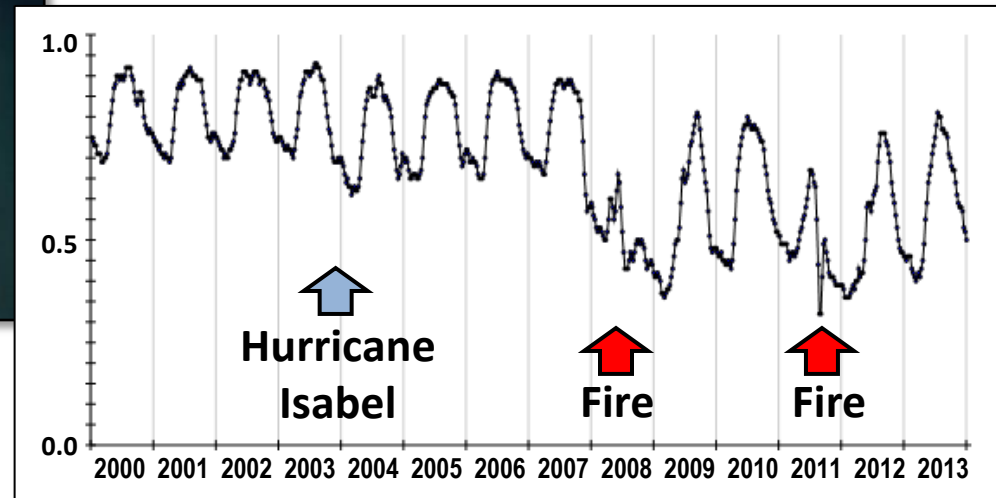
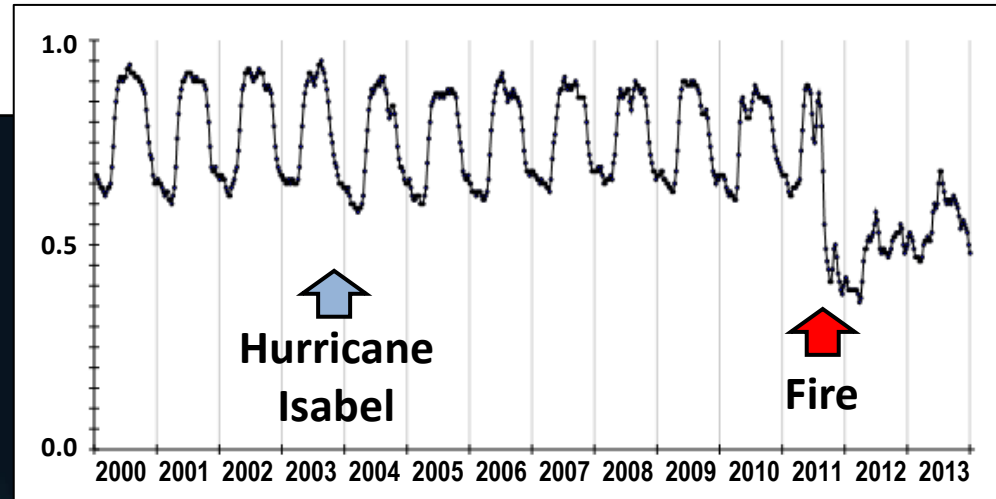
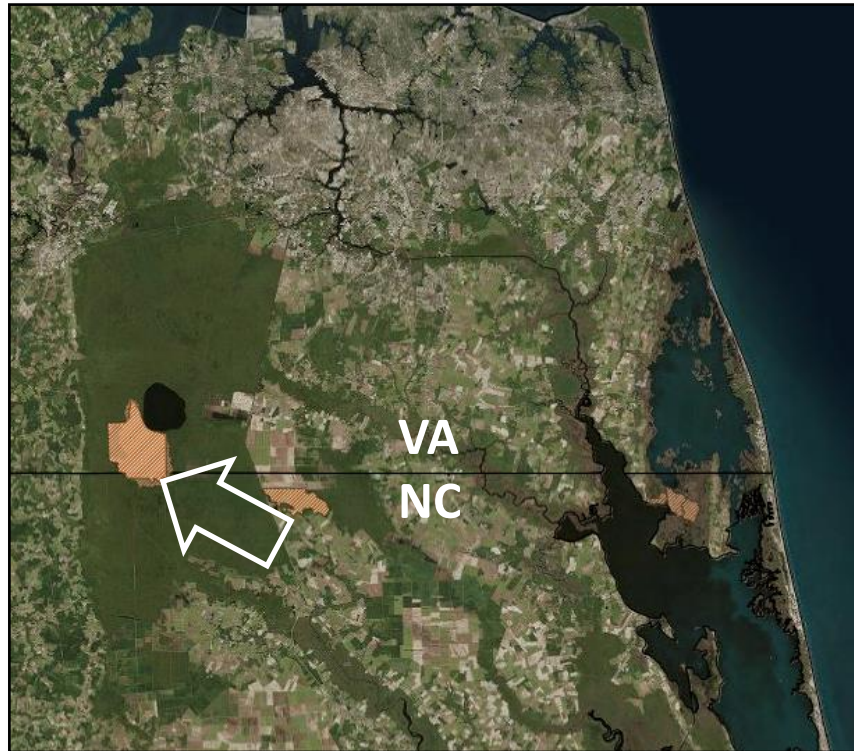
Monitoring logging recovery

Greenville County SC



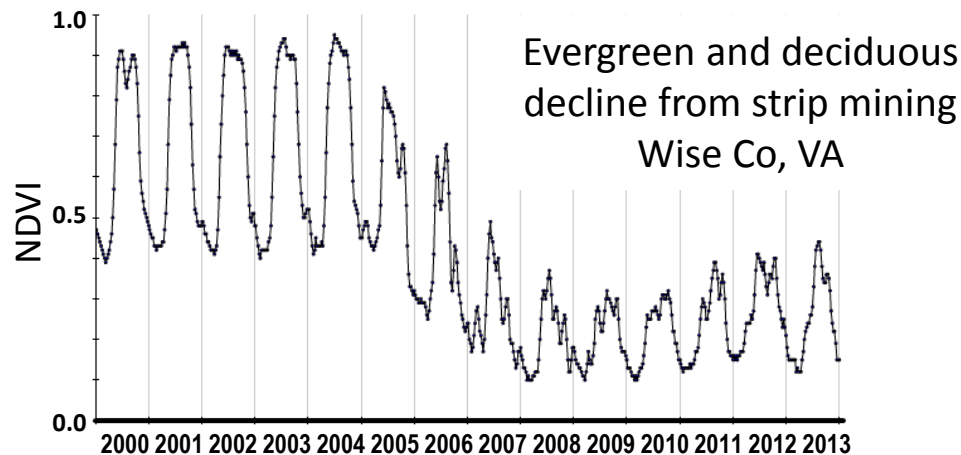
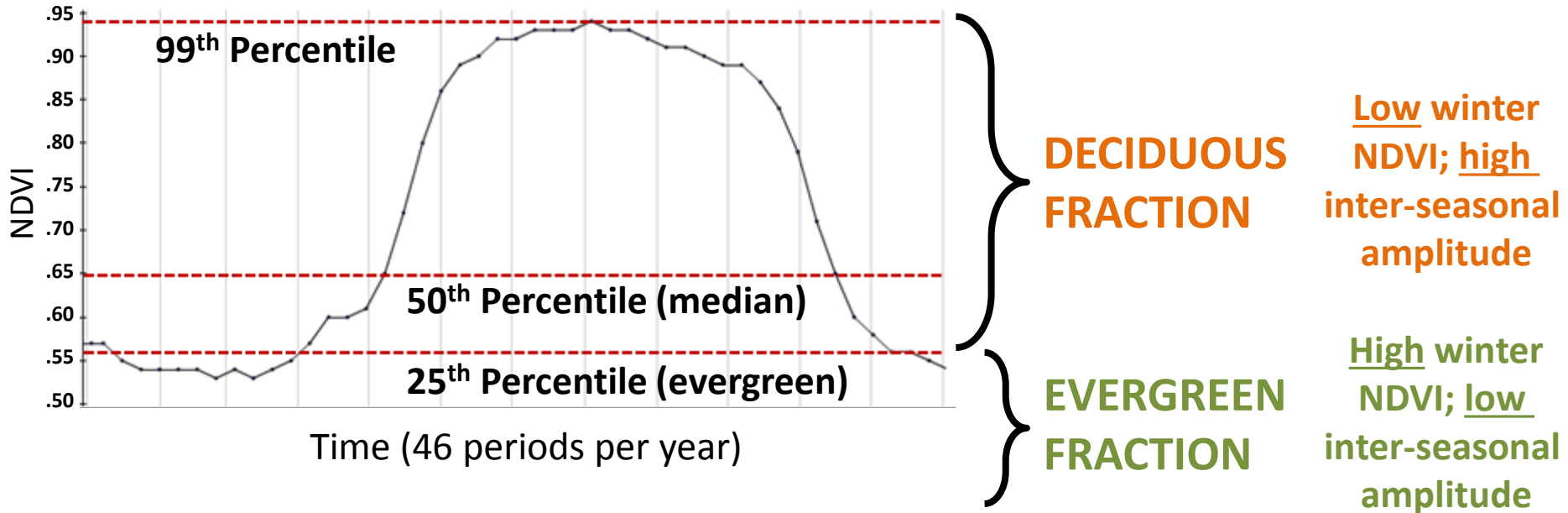
Monitoring the impacts from multiple disturbances

Great Dismal Swamp, VA



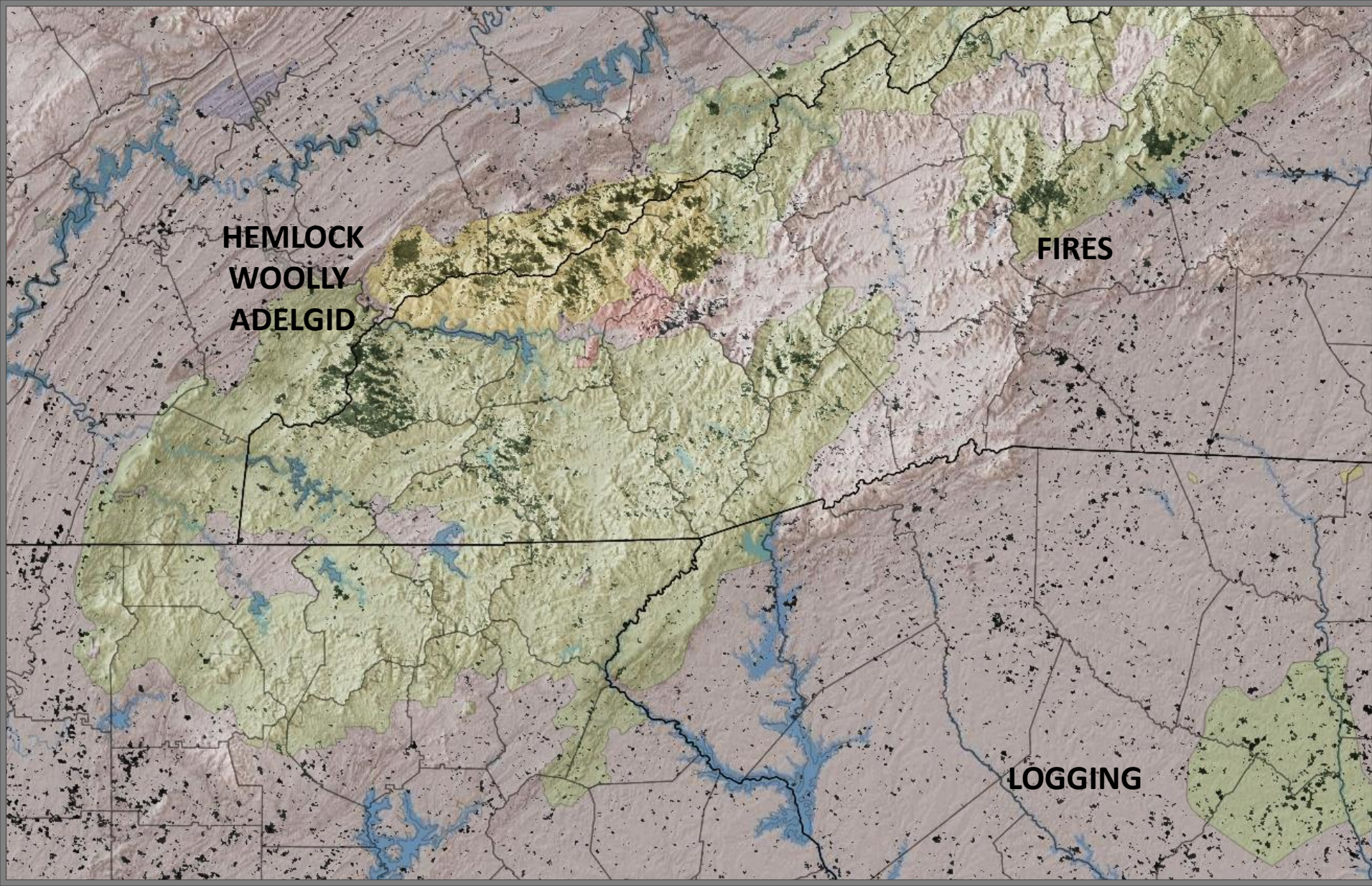
Synthesis products

ForWarn's high precision from high frequency observations



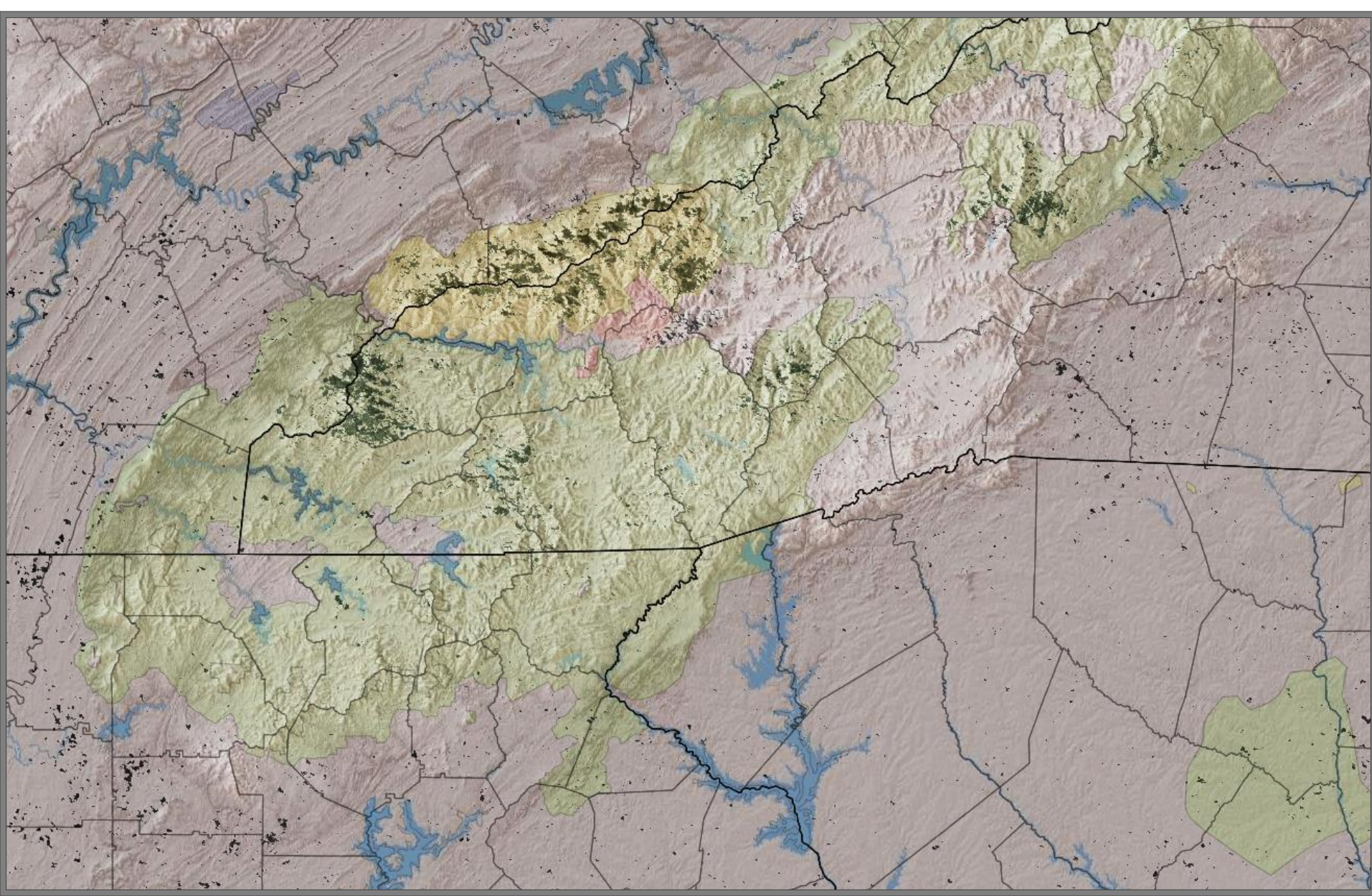
Synthesis products

Tracking Evergreen Decline of Landscapes, 2000-2010



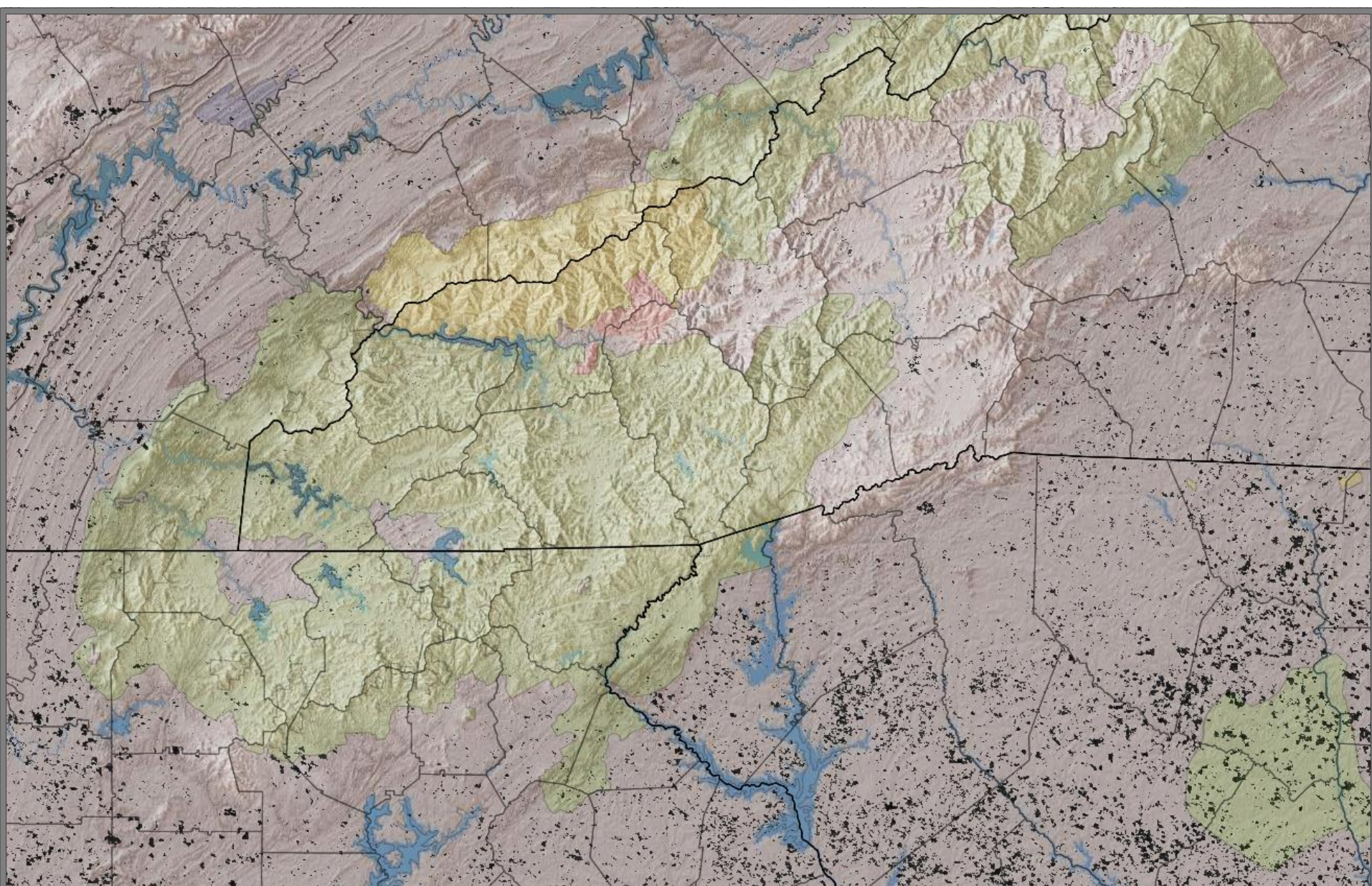
Synthesis products

Tracking Deciduous Increase of Landscapes, 2000-2010



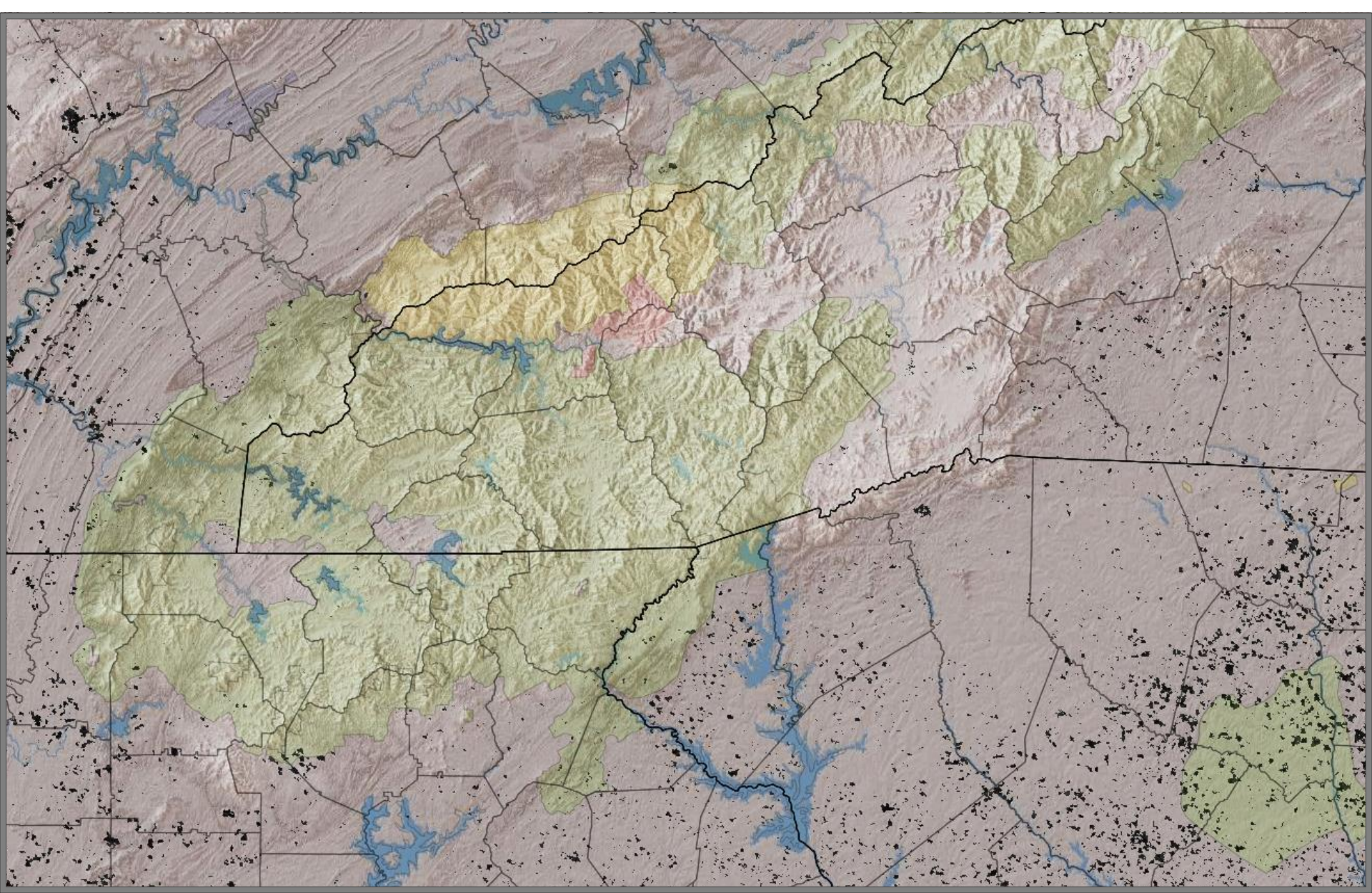
Synthesis products

Tracking Deciduous Decline of Landscapes, 2000-2010



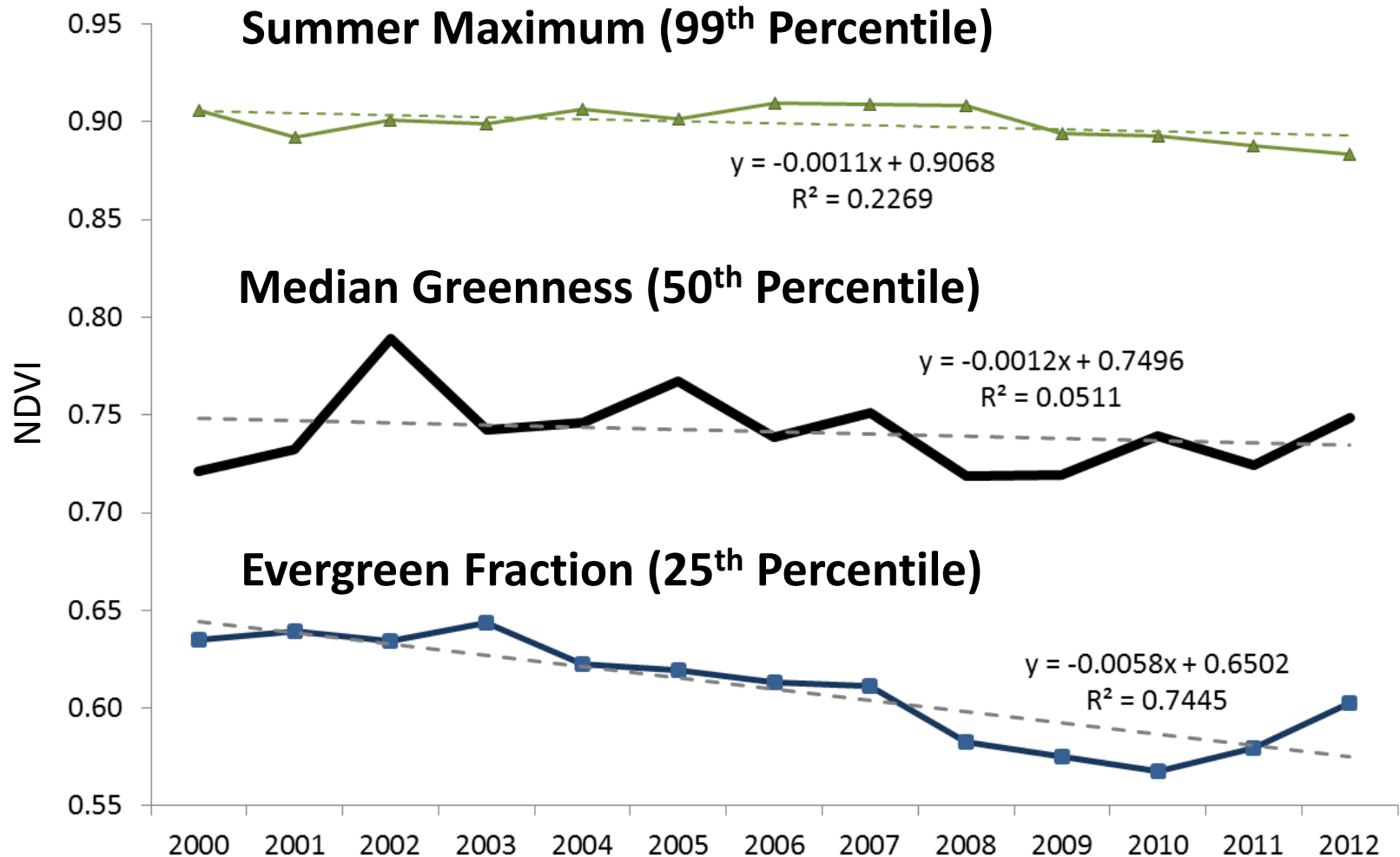
Synthesis products

Tracking Evergreen Increase of Landscapes, 2000-2010



Synthesis products

Trends in seasonal NDVI across Great Smoky Mountains National Park





Summary

Cross program applications and opportunities

- *ForWarn's* phenology-based vegetation maps can provide a unique perspective on FIA plot representativeness, particularly in those areas with otherwise poor vegetation maps.
- *ForWarn's* near-real-time maps of large severe disturbances can help tackle special FIA surveys more efficiently.
- *ForWarn's* NDVI history and ancillary disturbance products can help resolve the causes of compositional or structural change in FIA plots over time.
- Despite differences in spatial resolution, FIA plots can help verify the compositional contributors of different phenological profiles, such as deciduous/evergreen cover, canopy density or xerophytic/mesophytic composition.

