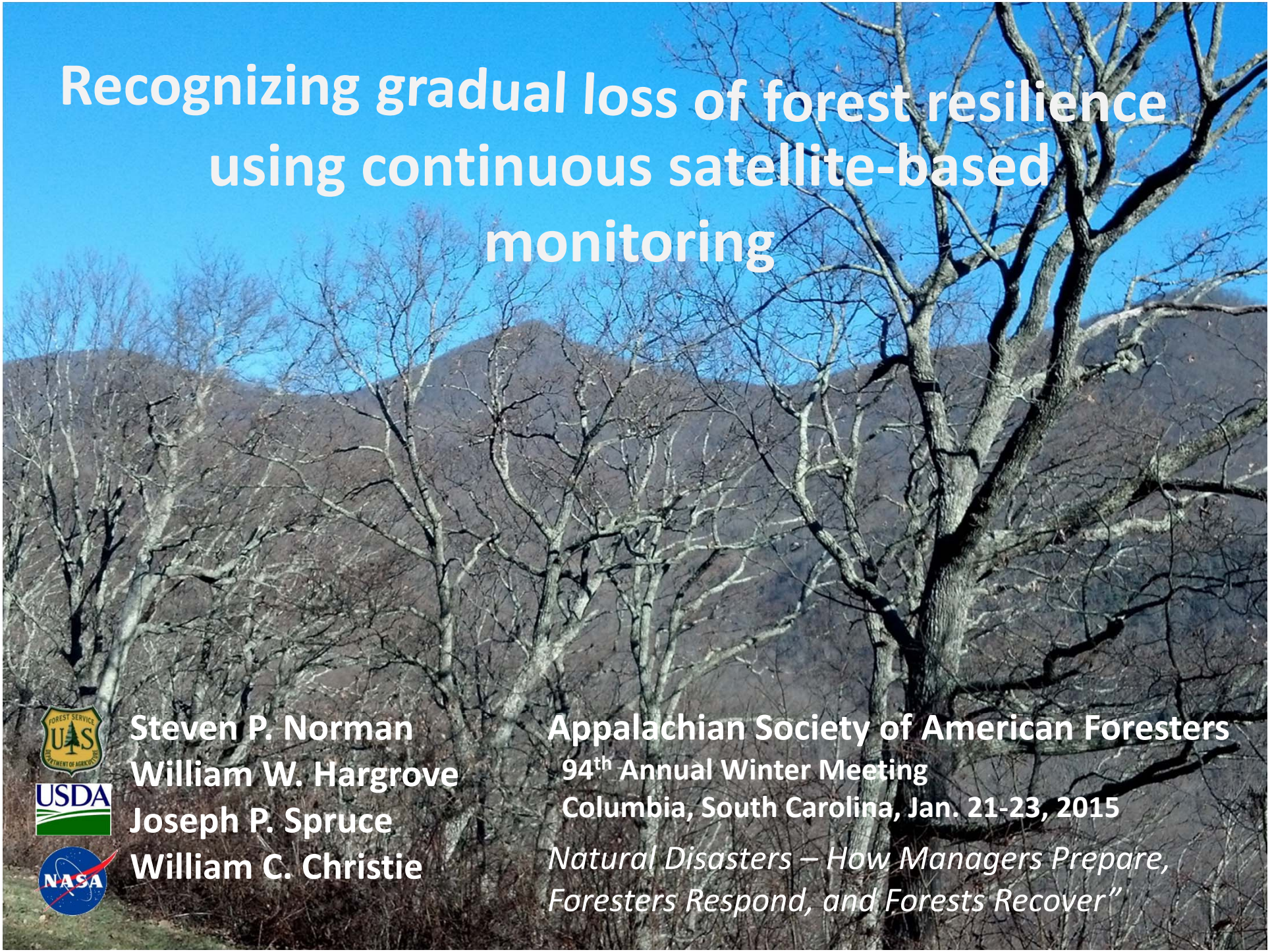
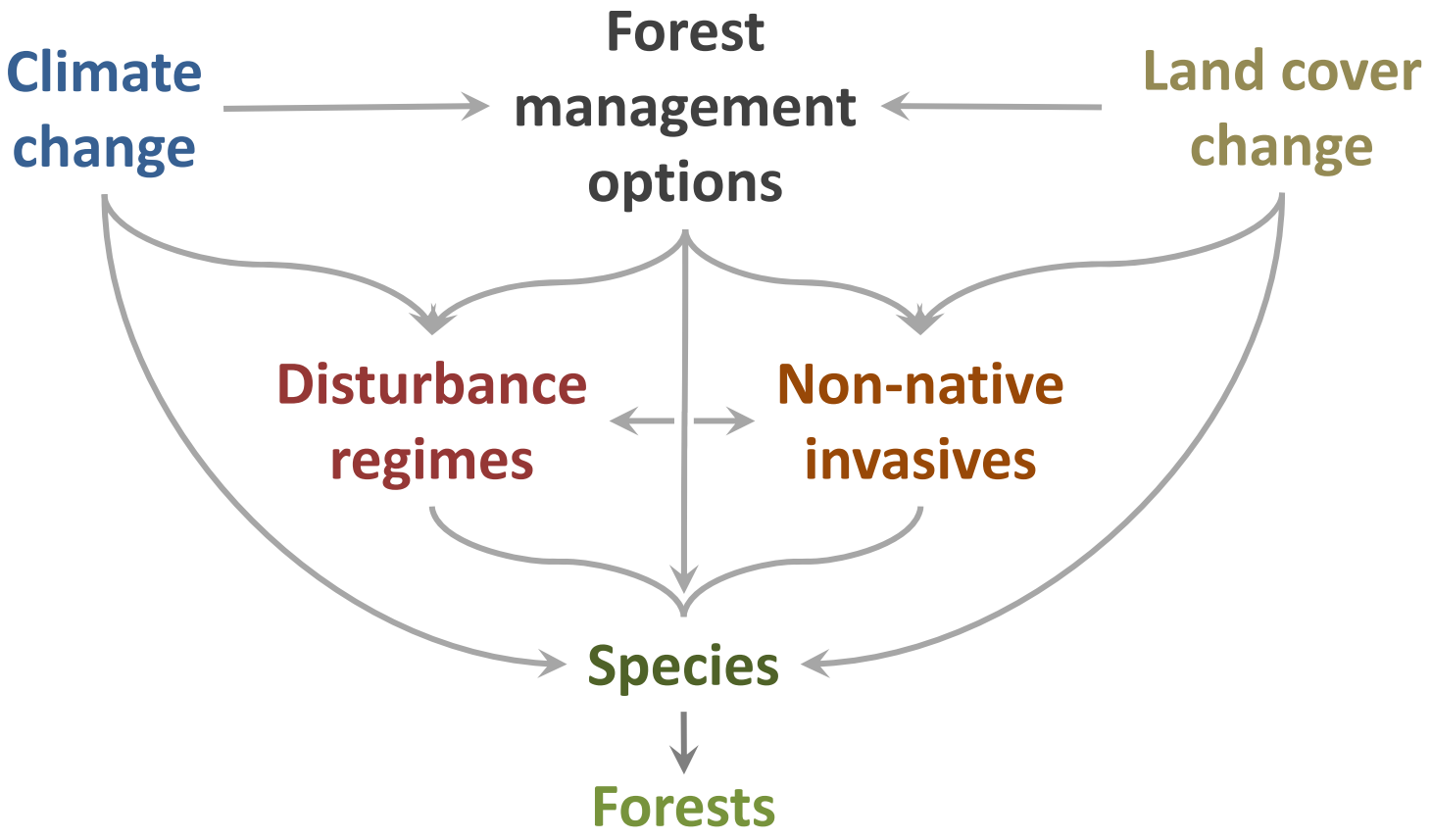
Recognizing gradual loss of forest resilience using continuous satellite-based monitoring



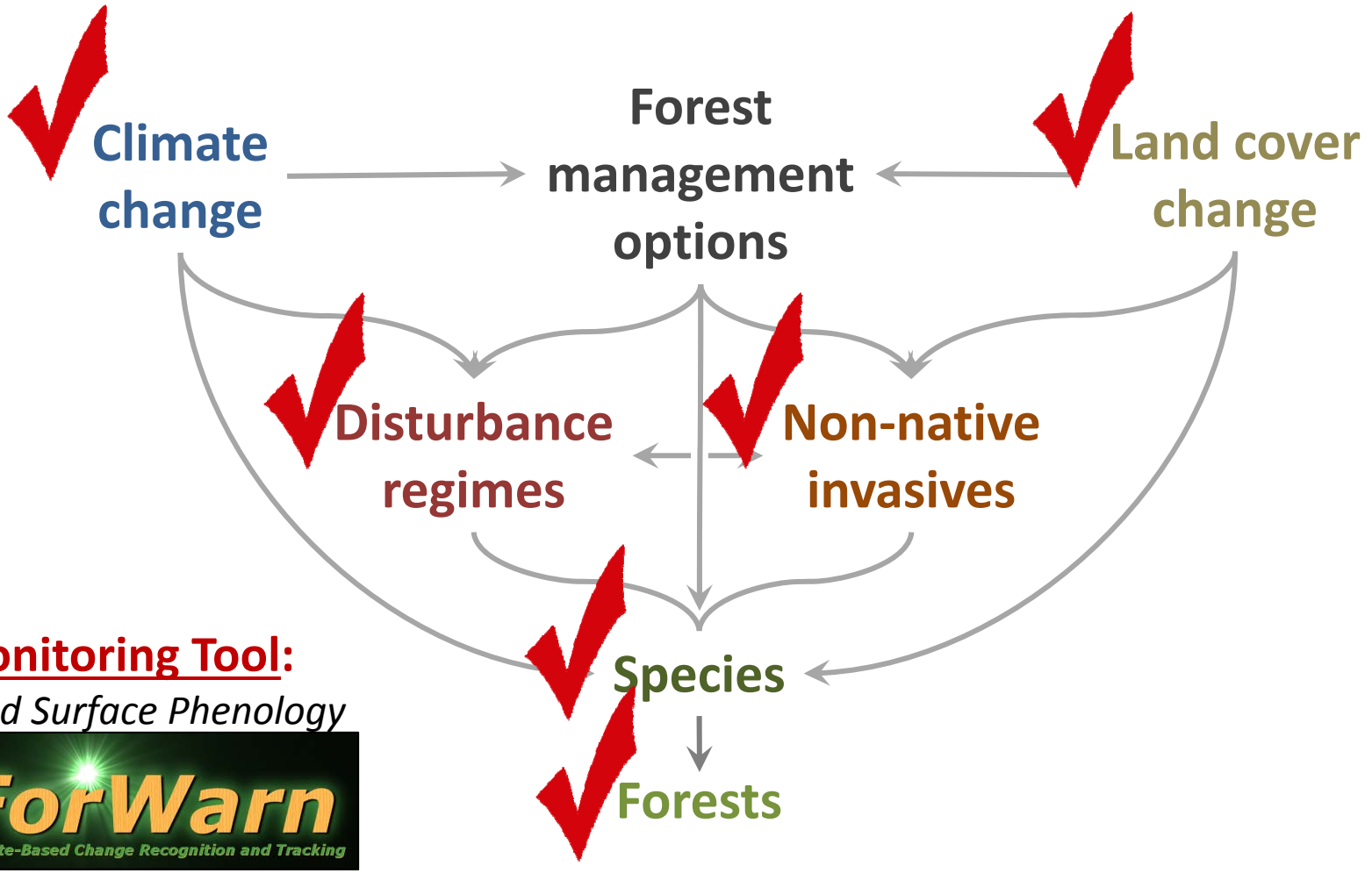
Steven P. Norman
William W. Hargrove
Joseph P. Spruce
William C. Christie

Appalachian Society of American Foresters
94th Annual Winter Meeting
Columbia, South Carolina, Jan. 21-23, 2015
Natural Disasters – How Managers Prepare, Foresters Respond, and Forests Recover"

Gradual change in these factors can erode landscape resilience



Gradual change in these factors can erode landscape resilience



Monitoring Tool:

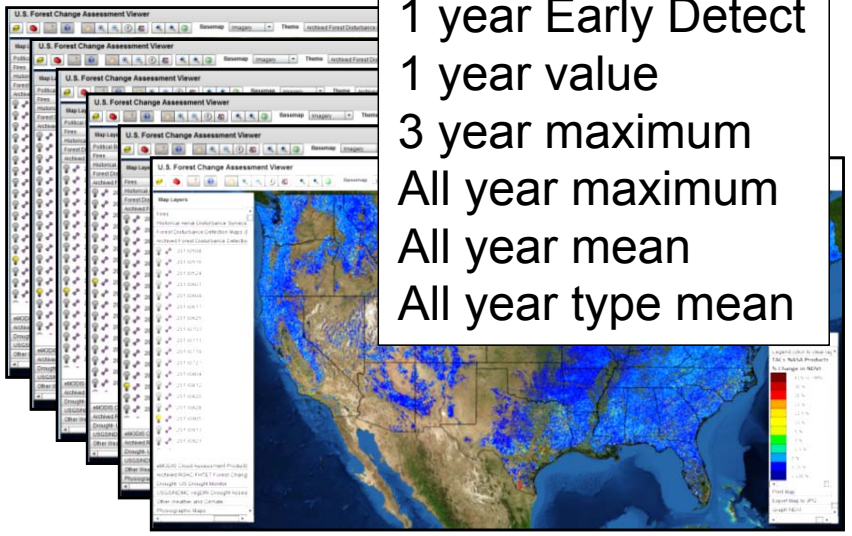
Land Surface Phenology

ForWarn

Satellite-Based Change Recognition and Tracking

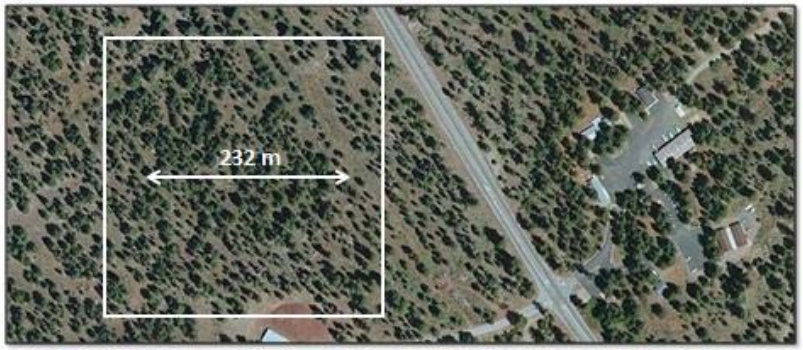
The *ForWarn* system

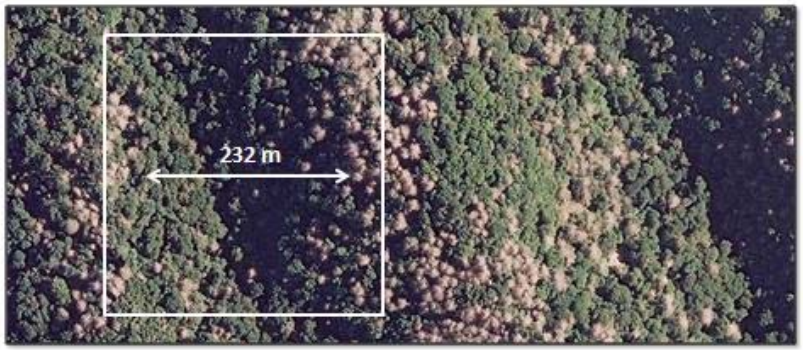
- Normalized Difference Vegetation Index (NDVI) from daily eMODIS and MODIS
- 232 meter resolution
- 46 periods per year (8-day intervals)
- Max value of 24-day moving window
- 2000 to present historical database
- Includes NDVI time series and change maps
- Online: http://forwarn.forestthreats.org

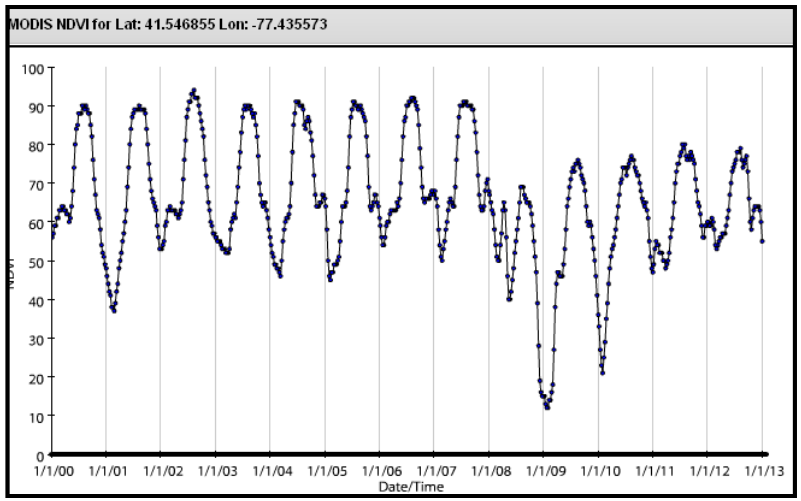


Baselines

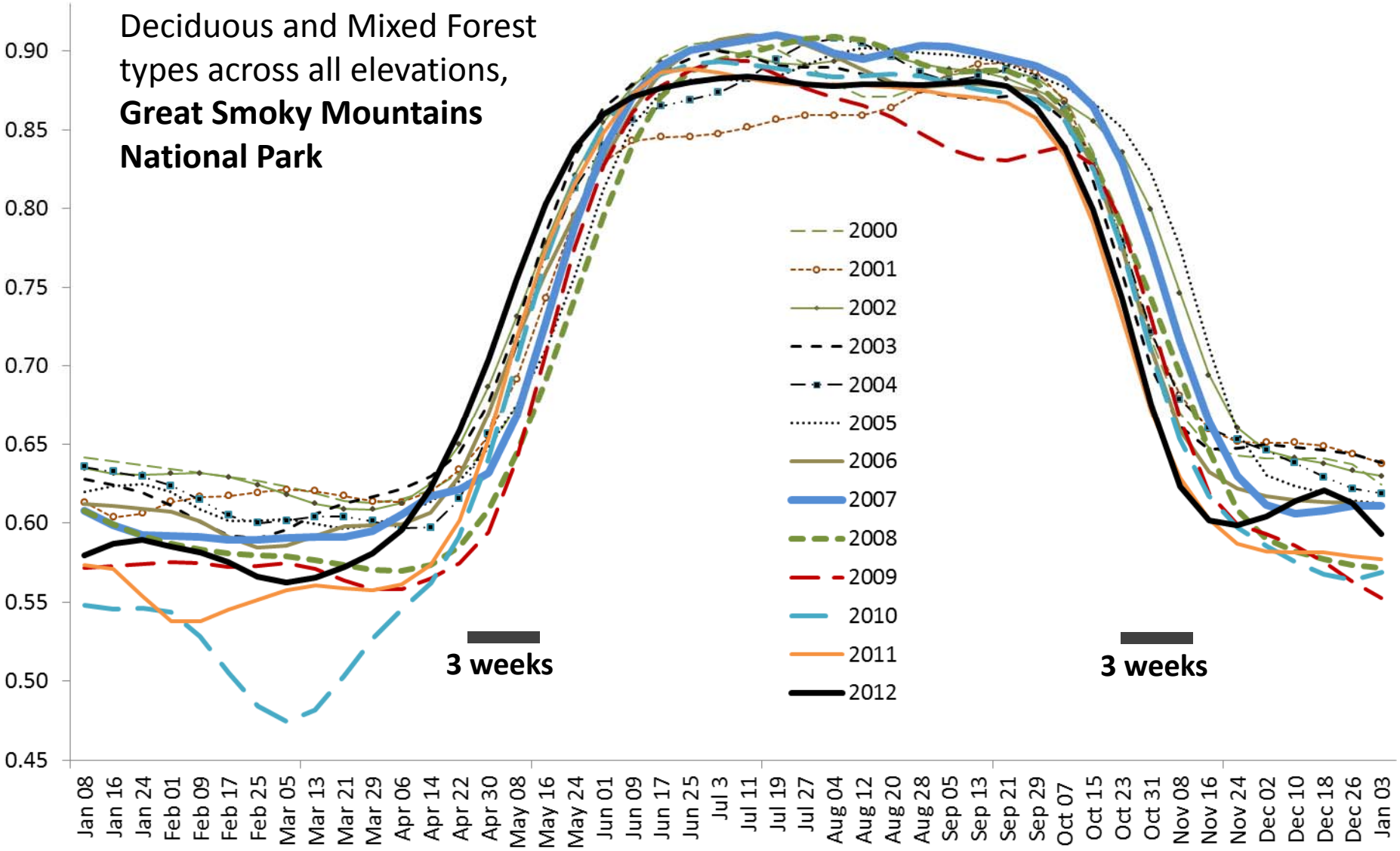
1 year Early Detect
1 year value
3 year maximum
All year maximum
All year mean
All year type mean



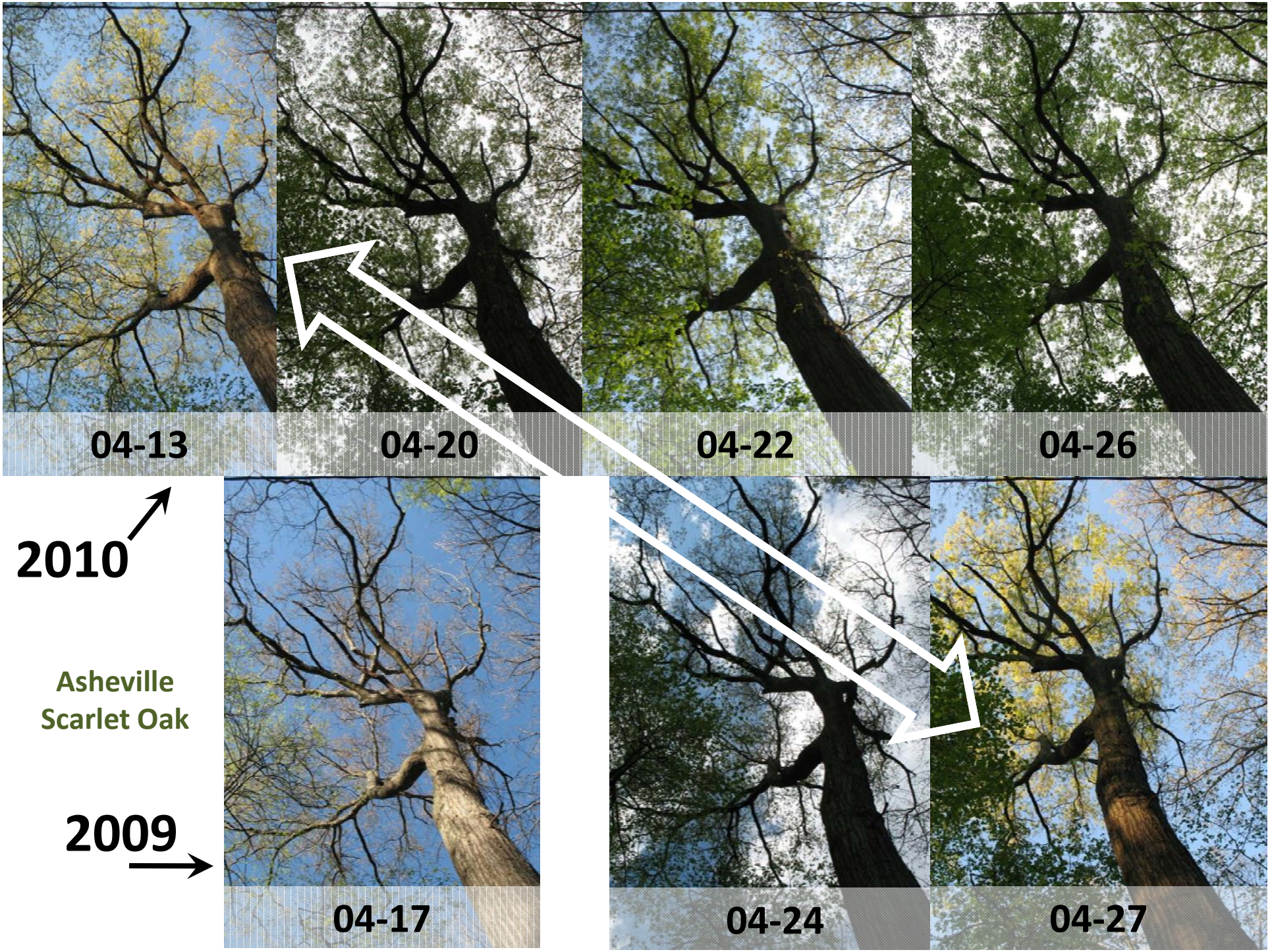




Monitoring within-season to inter-year variation in weather- and climate-sensitive vegetational phenology



Mean of 38,318 MODIS cells


04-13
04-20
04-22
04-26
2010
Asheville
Scarlet Oak
2009
04-17
04-24
04-27

Effects of a warm March and April Frost along the Snowball Trail (4,950ft.), Pisgah National Forest, NC

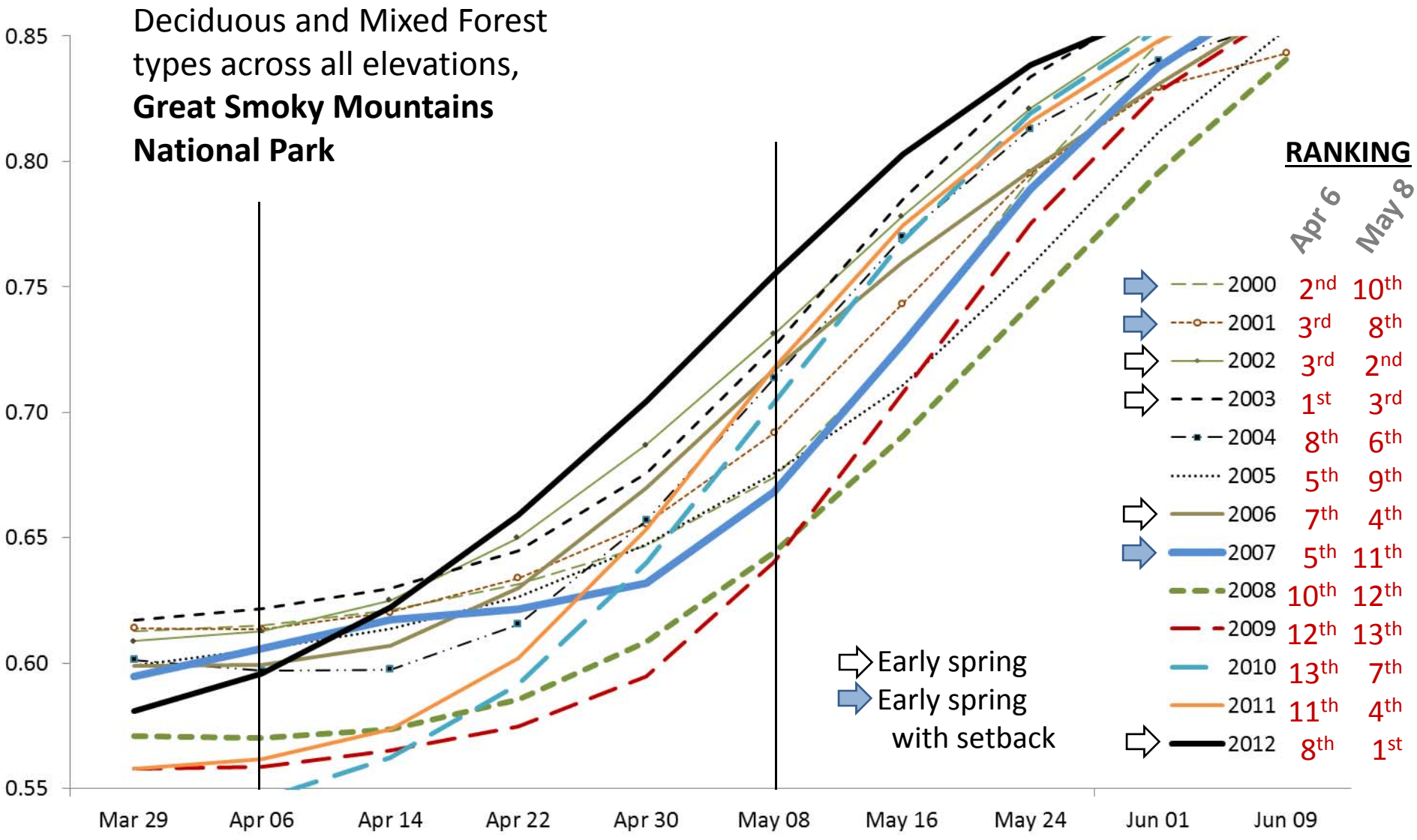
(photos taken 4/27/2012 by SPN)

Hobblebush Viburnum

Turk's Cap Lily

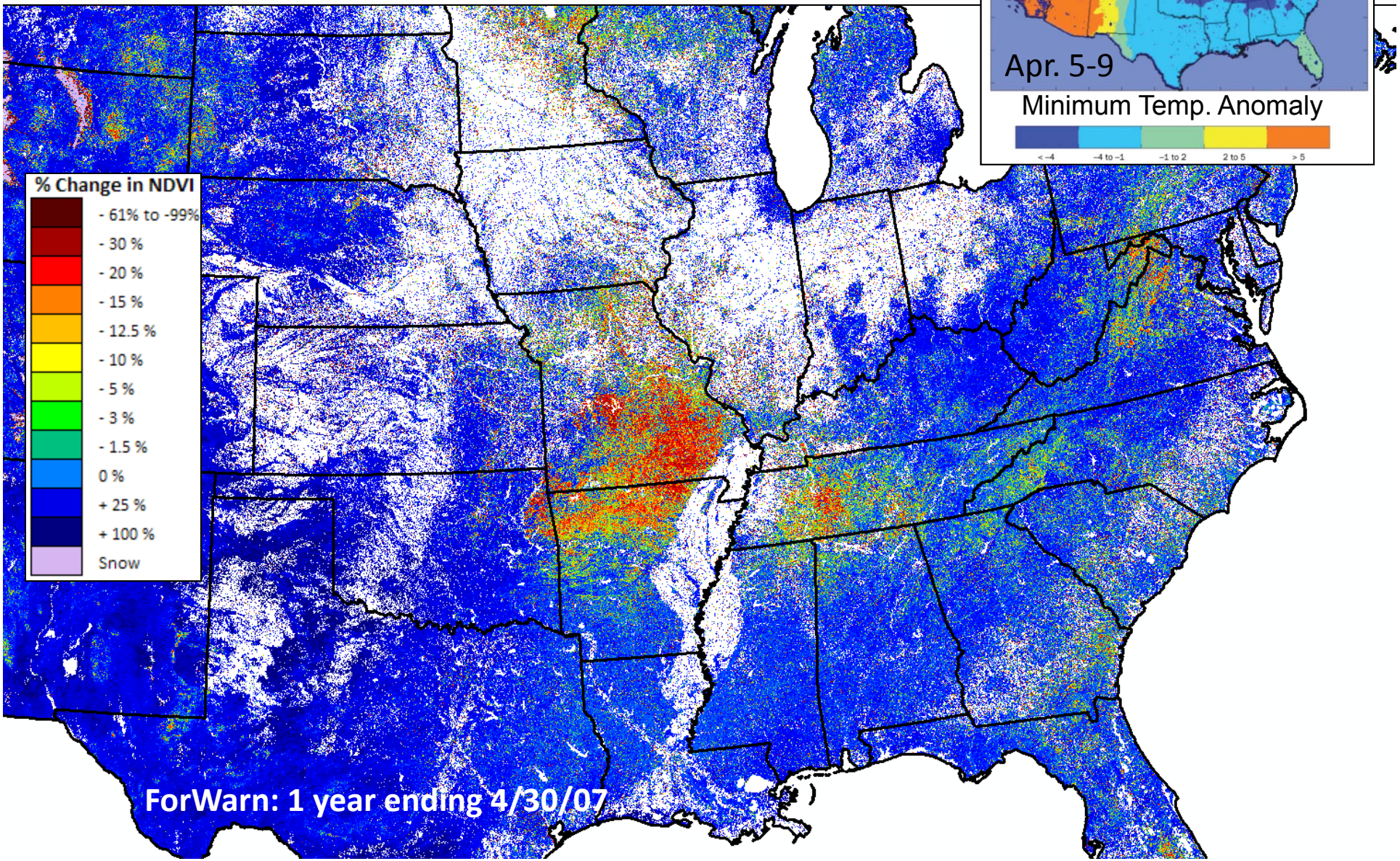
Yellow Buckeye

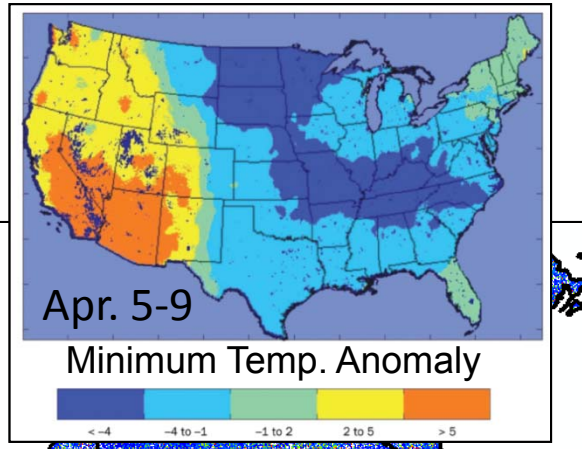
Monitoring within-season to inter-year variation in weather- and climate-sensitive vegetational phenology



Mean of 38,318 MODIS cells

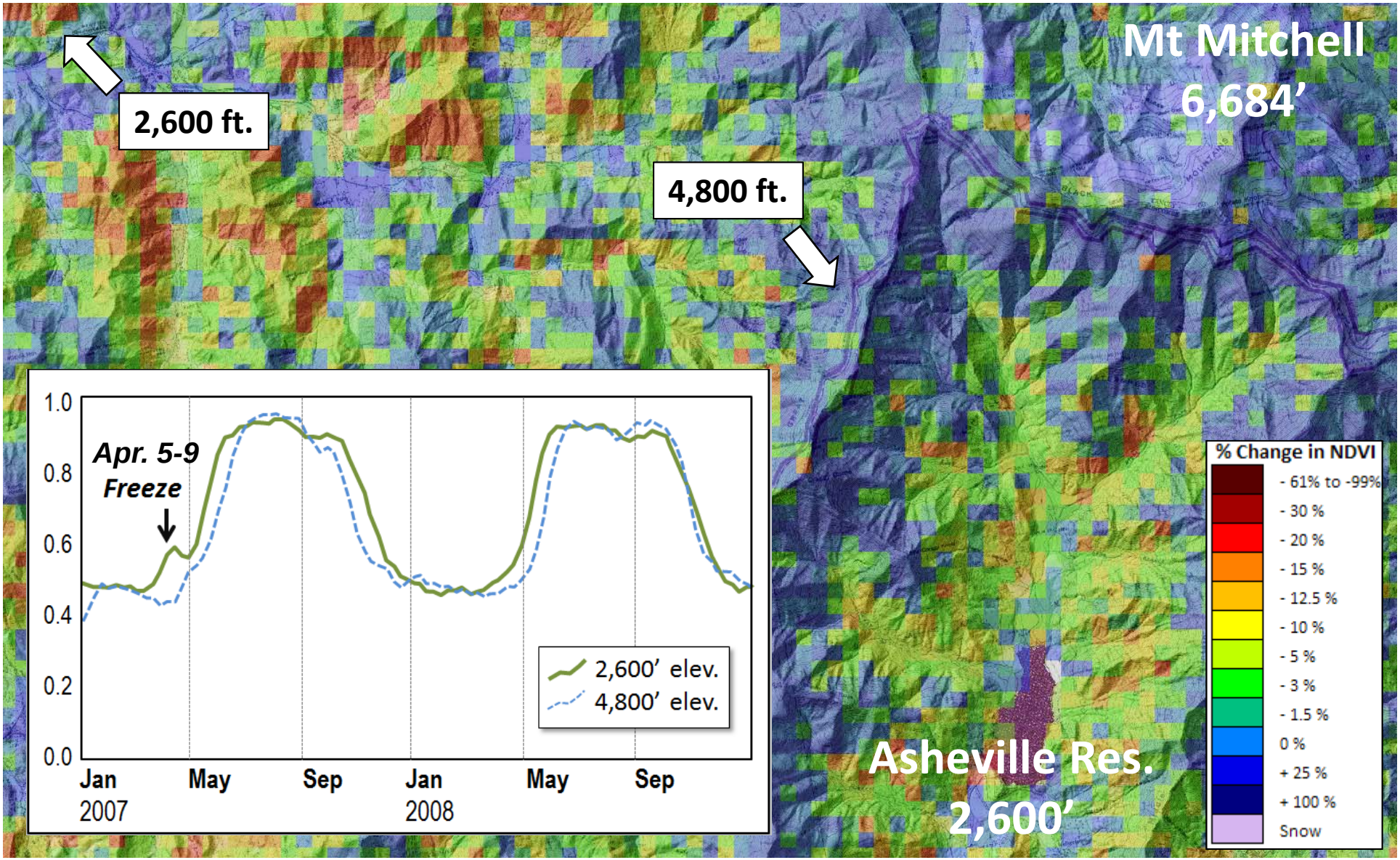
Monitoring disturbances linked to gradual change: The 2007 “Big Freeze”



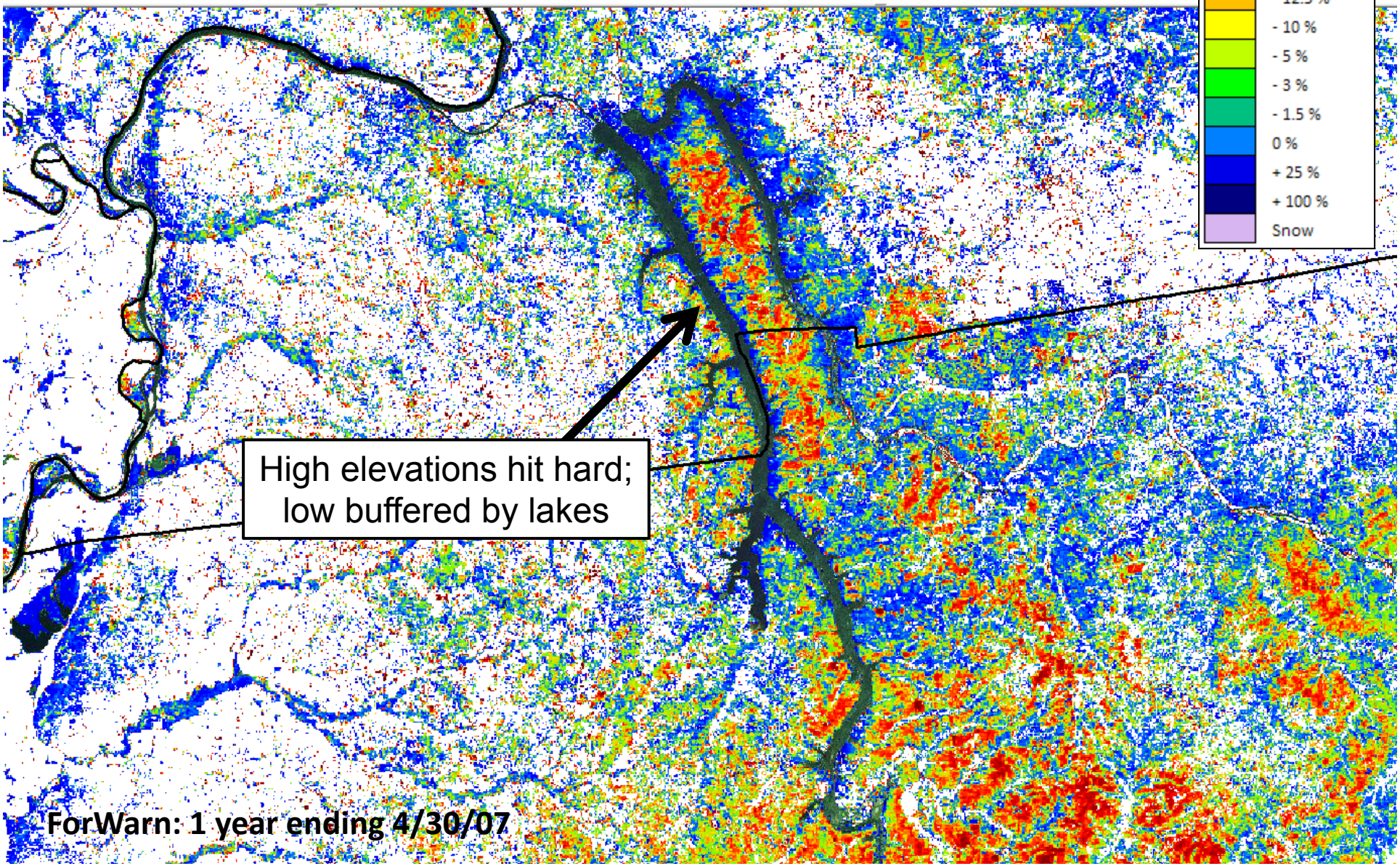


Monitoring disturbances linked to gradual change: The 2007 "Big Freeze"—Topographic nuances

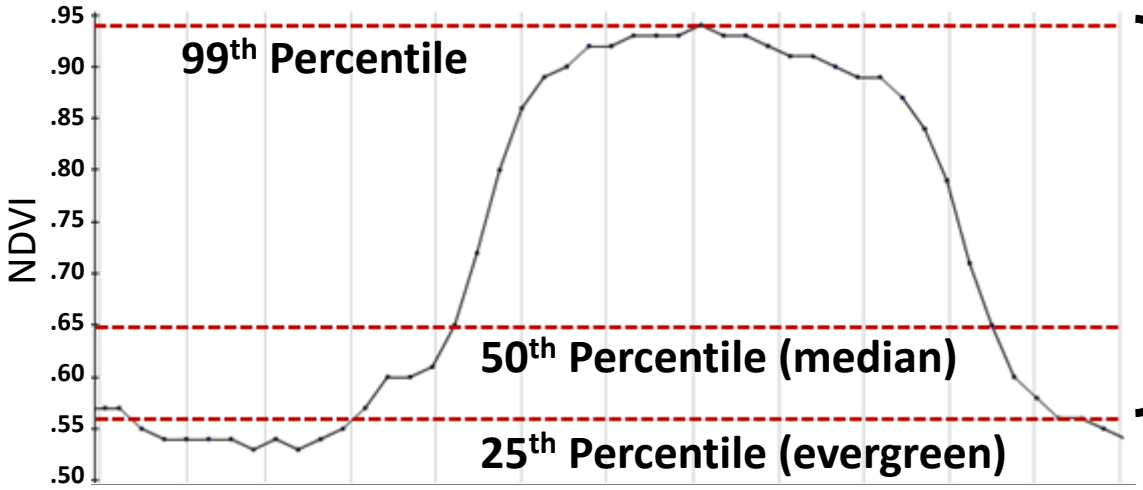
ForWarn: 1 year ending 4/30/07



Monitoring disturbances linked to gradual change: The 2007 “Big Freeze”



Monitoring change in vegetational type using insights from high frequency MODIS time series

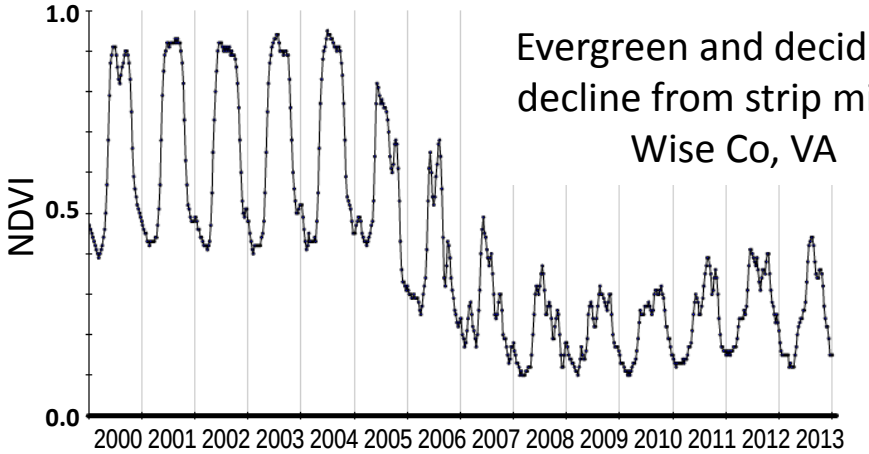


DECIDUOUS FRACTION

Low winter NDVI; high inter-seasonal amplitude

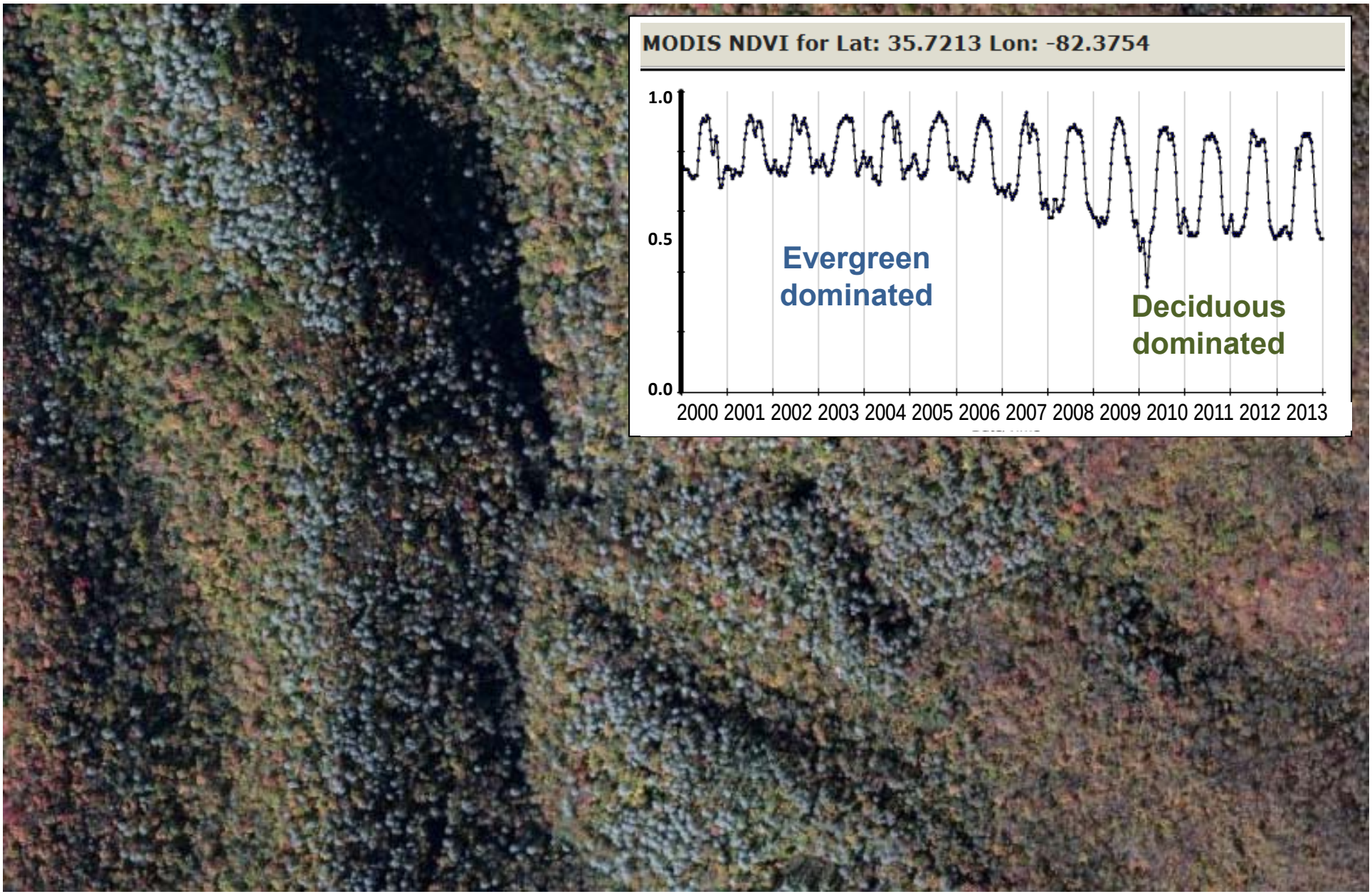
EVERGREEN FRACTION

High winter NDVI; low inter-seasonal amplitude



Evergreen and deciduous decline from strip mining Wise Co, VA

Monitoring gradual loss of evergreen (hemlock)



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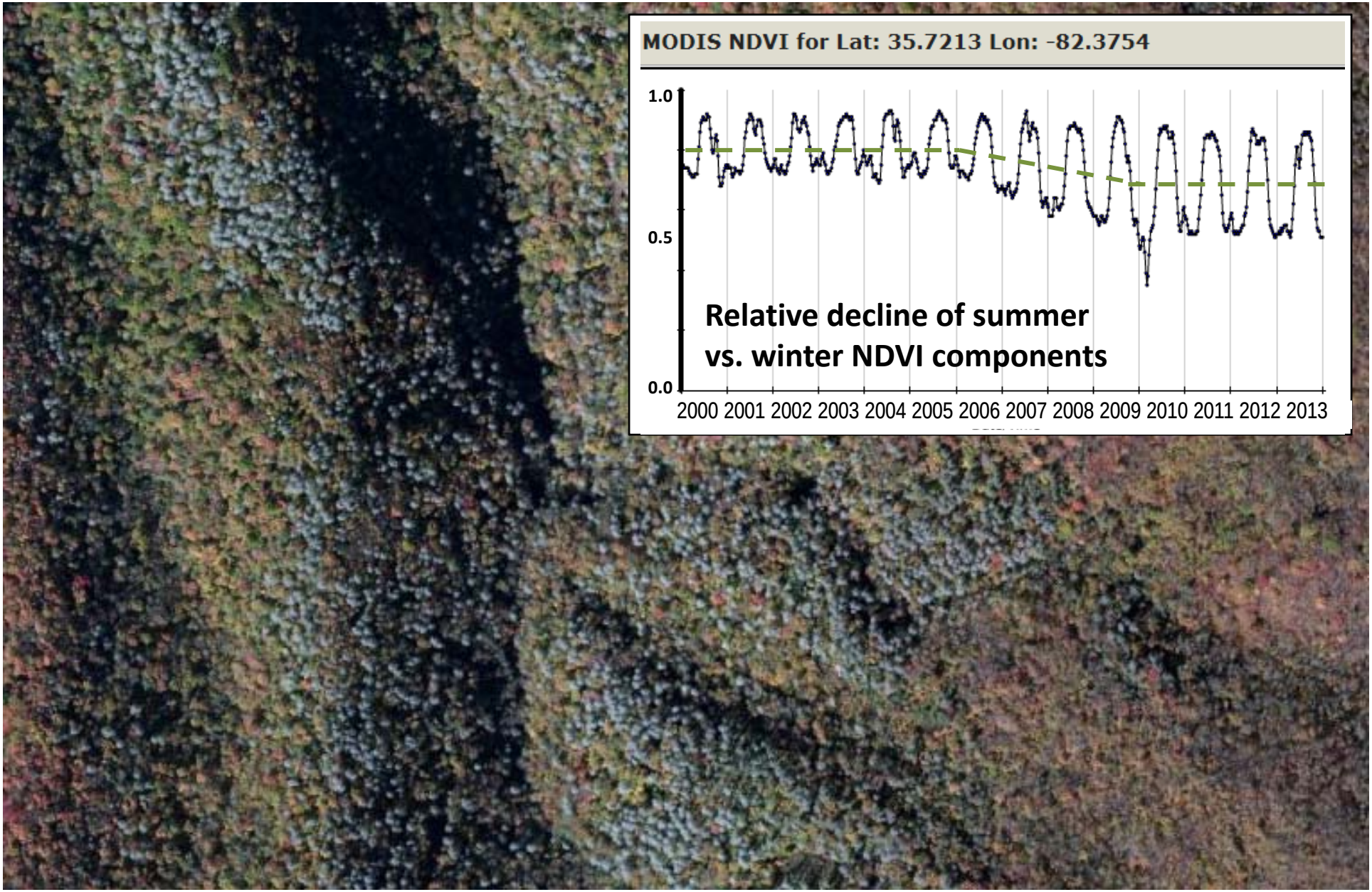
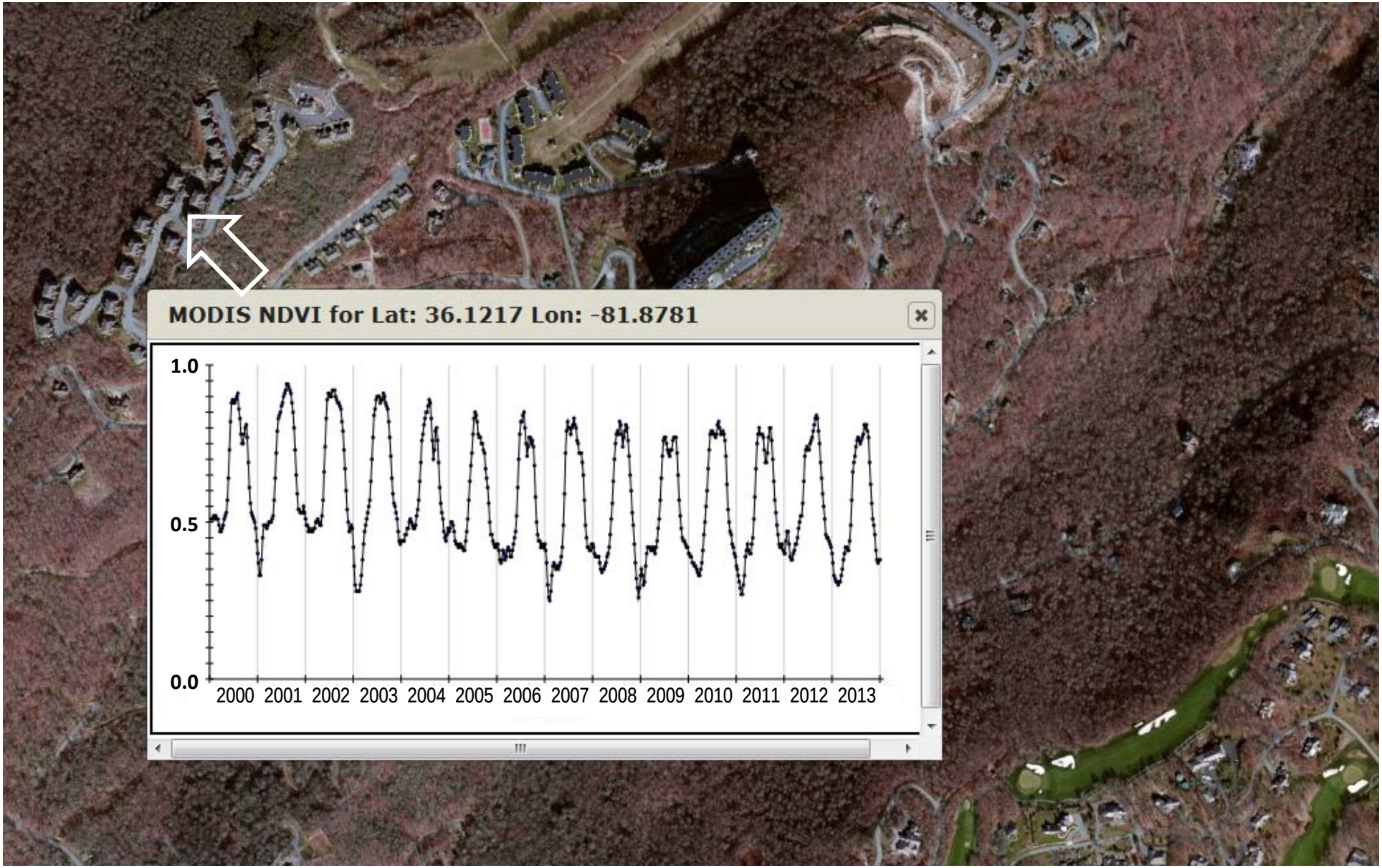


Monitoring Land Cover Change
Mountaintop development near Grandfather Mtn., NC



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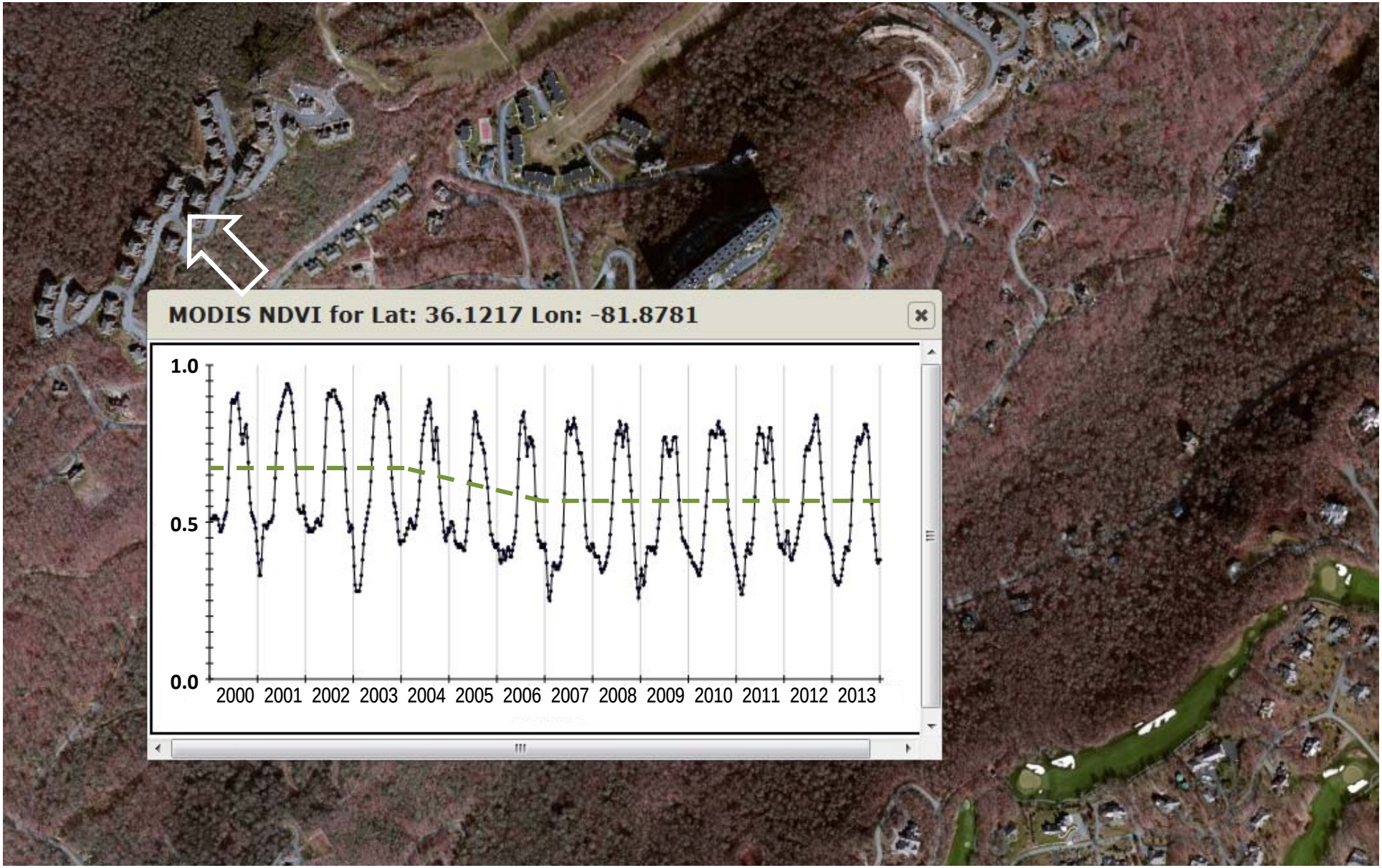
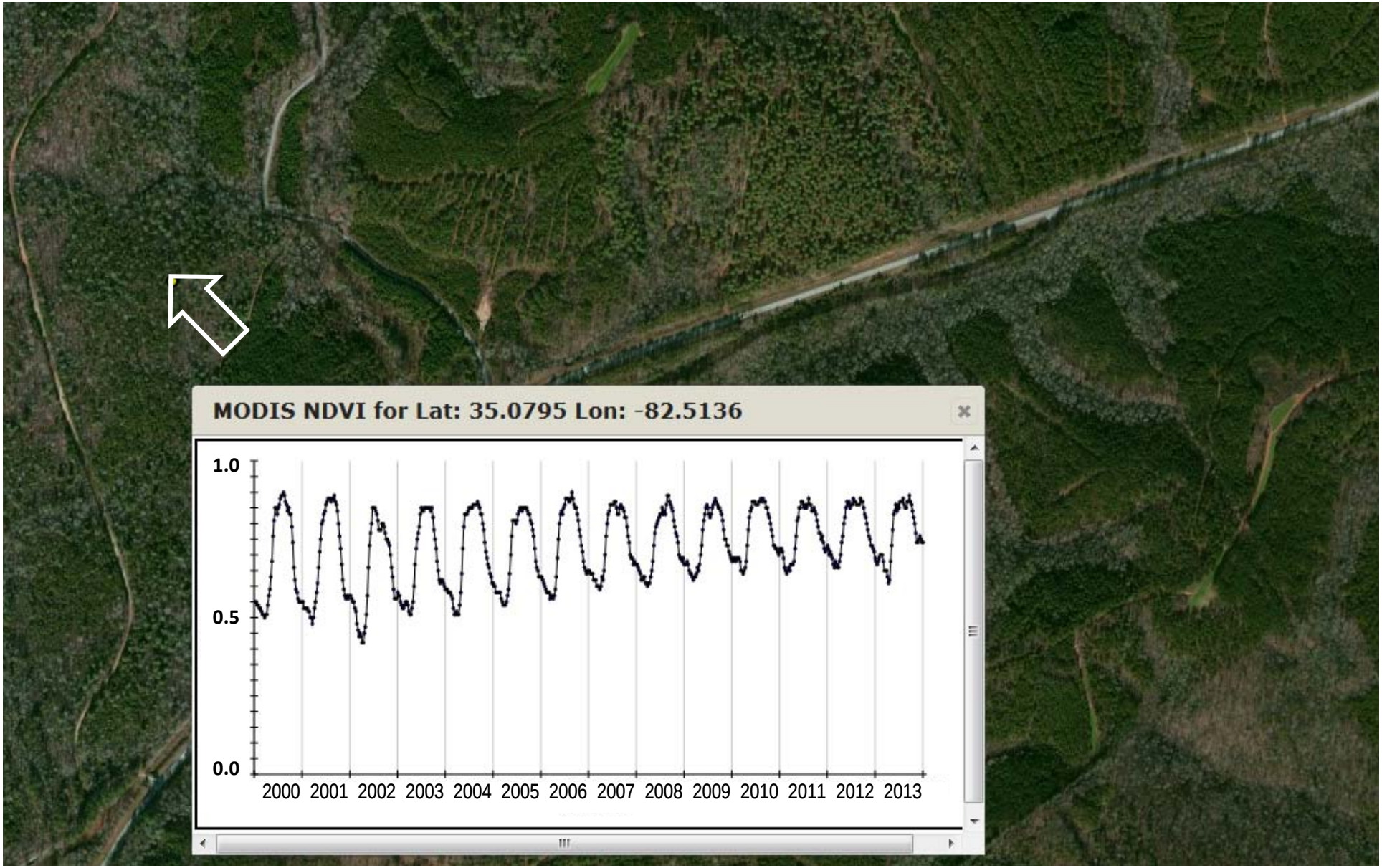


Monitoring logging recovery, Greenville County SC



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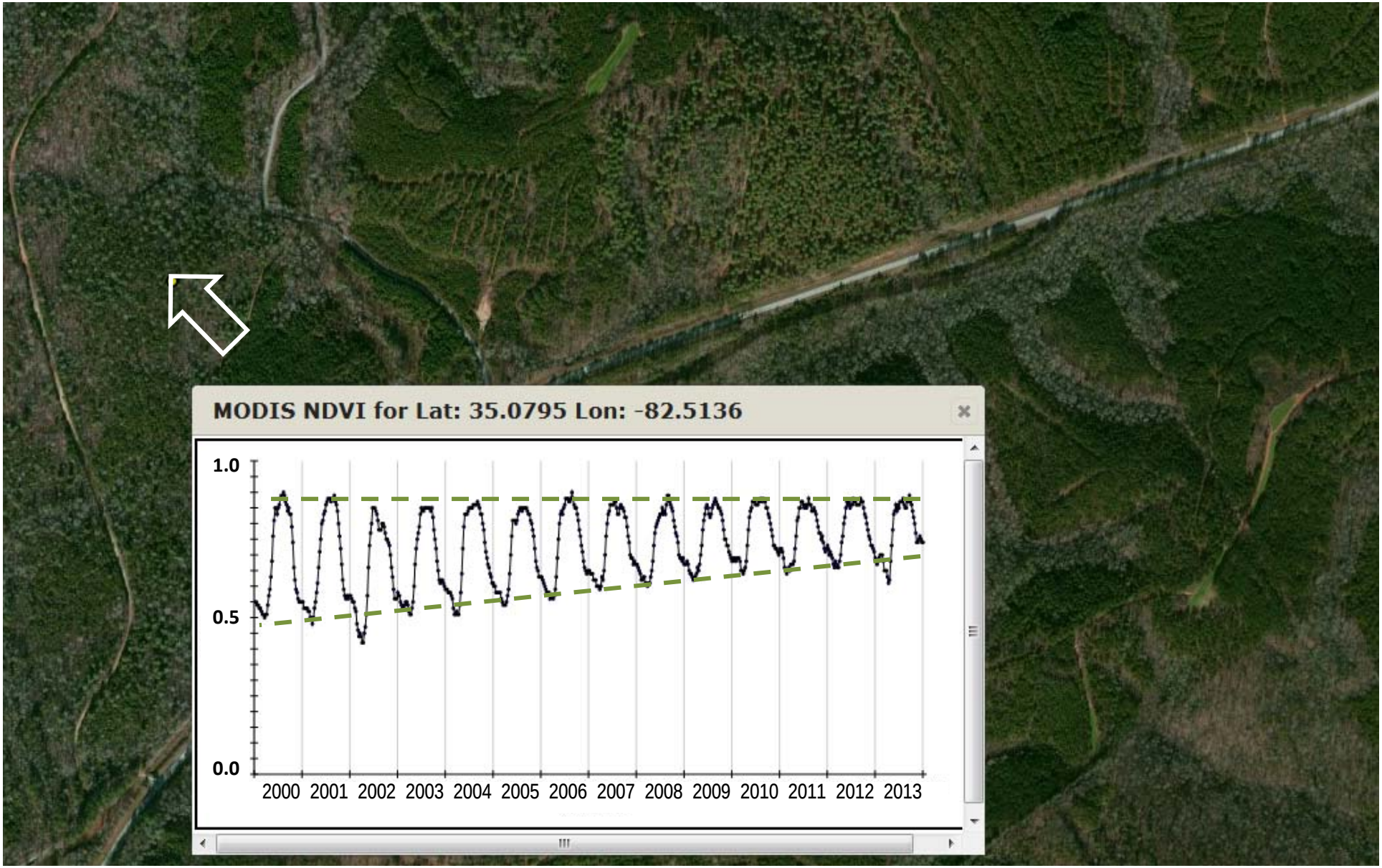
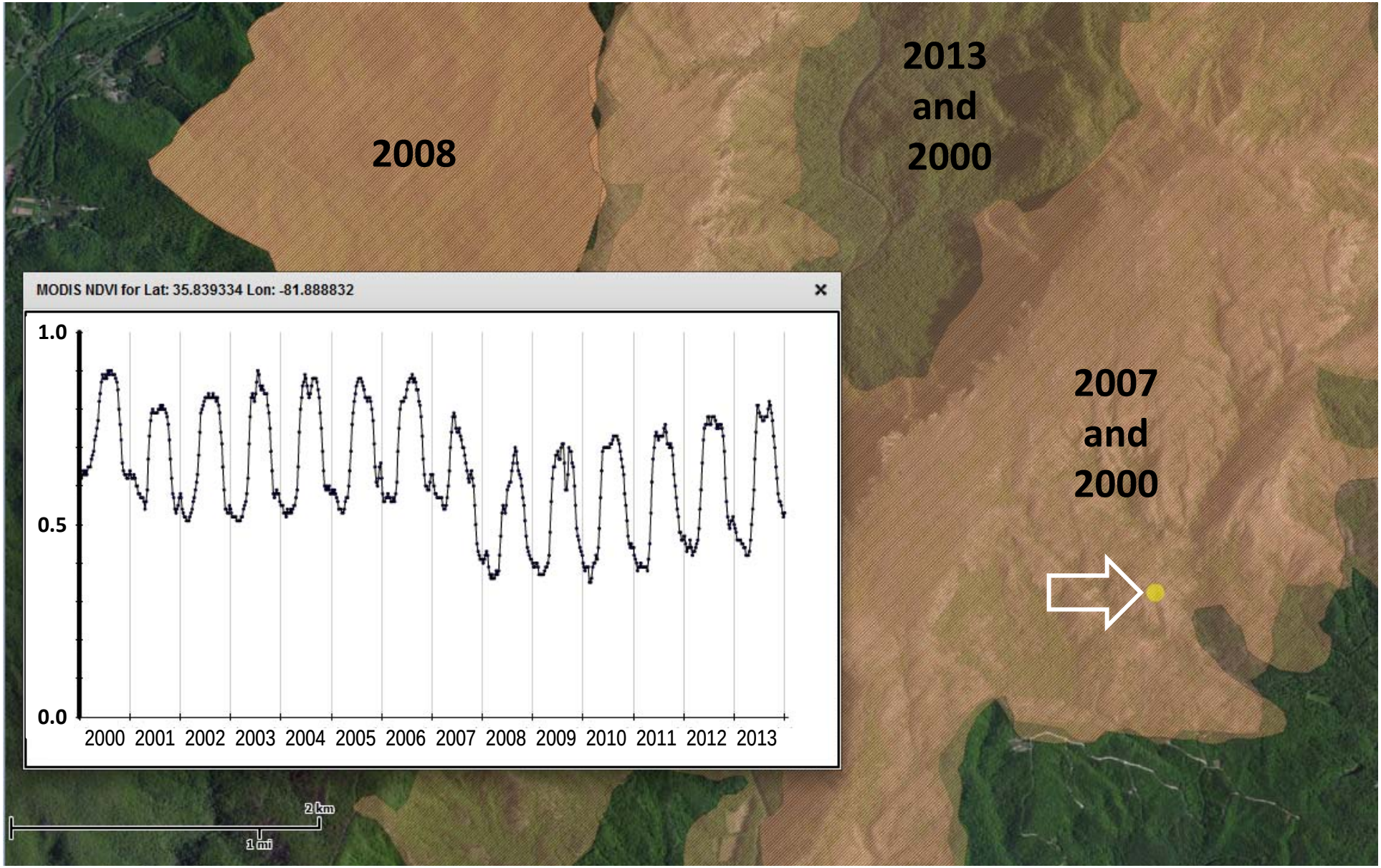
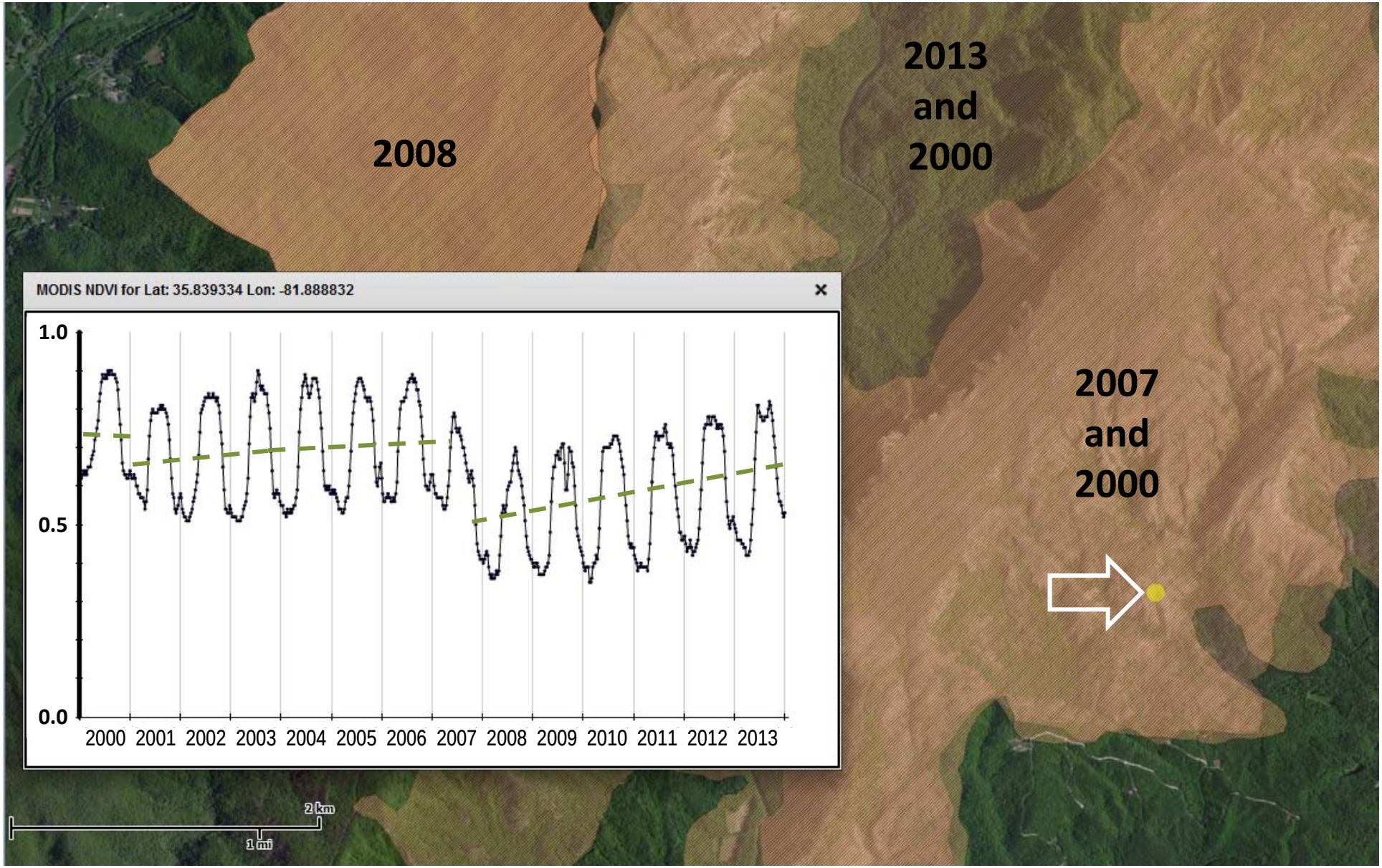


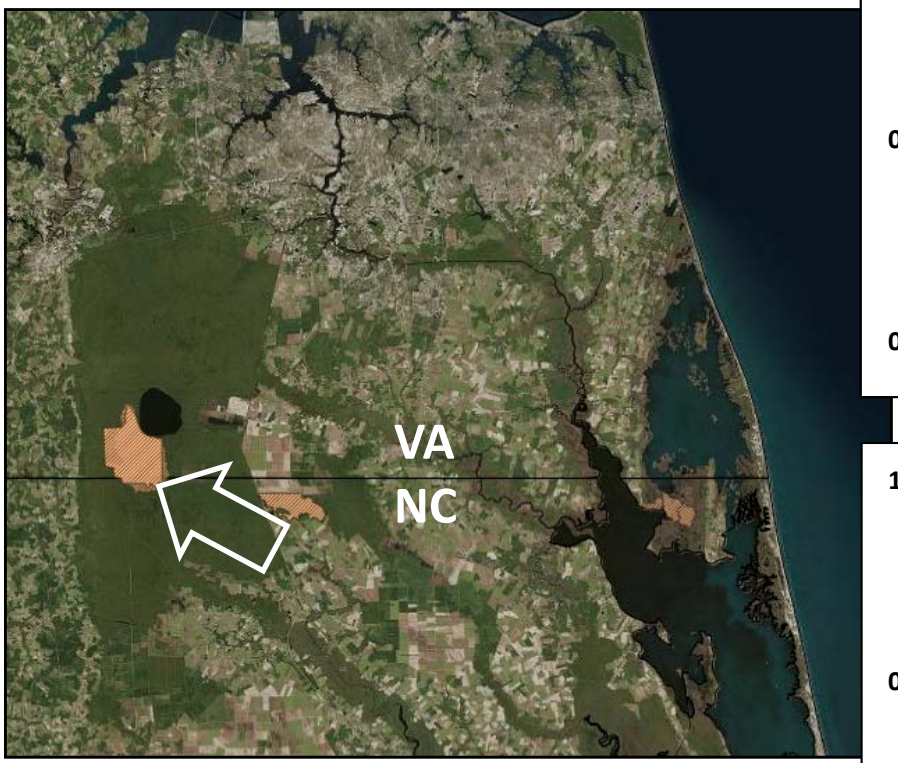
Monitoring multiple fire responses and recovery, Linville Gorge, NC

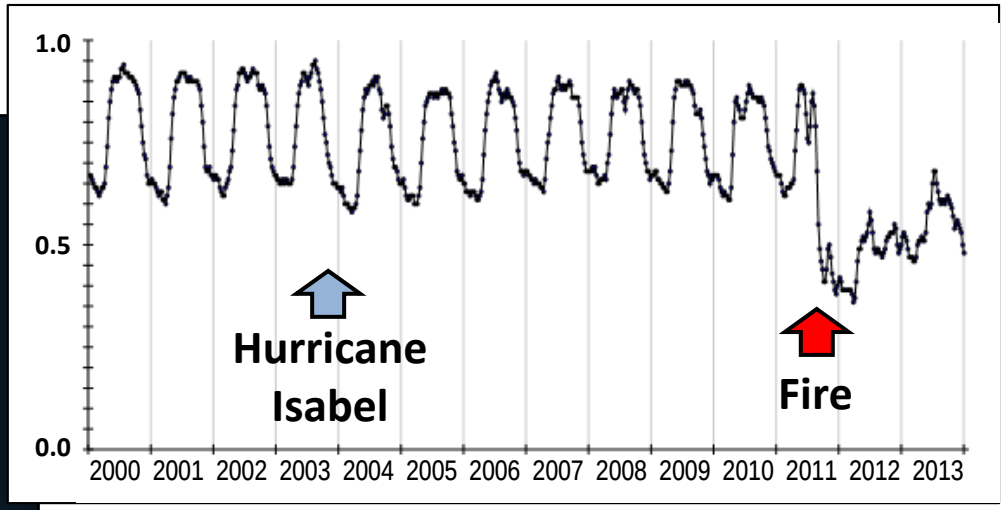


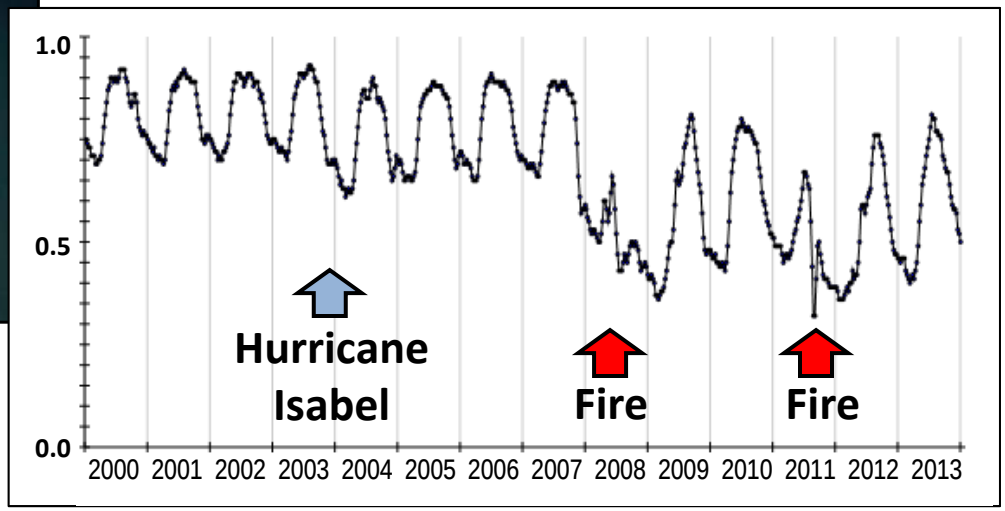
Monitoring multiple fire responses and recovery, Linville Gorge, NC



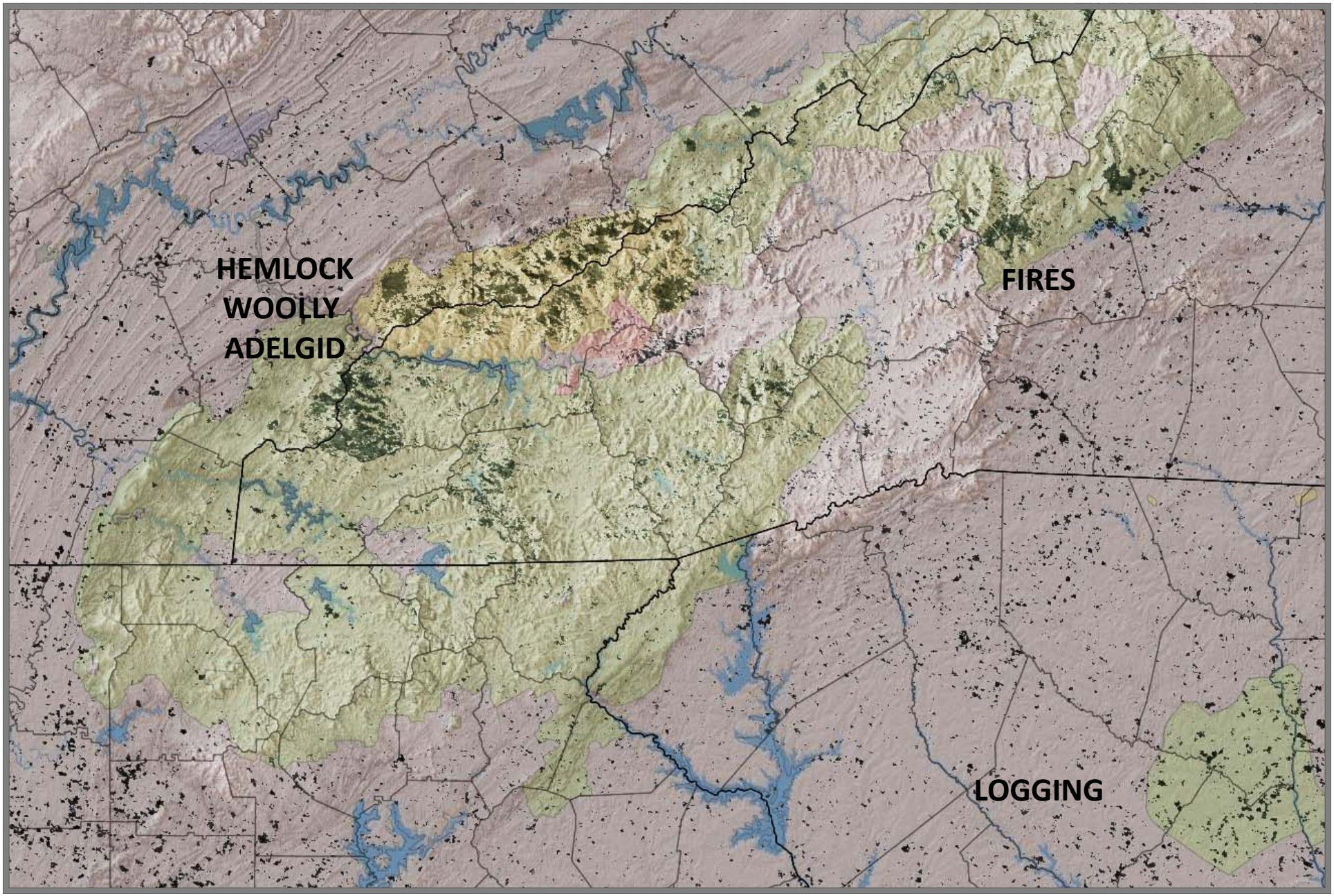
Monitoring the impacts from multiple disturbances in forest wetlands of the Great Dismal Swamp, VA



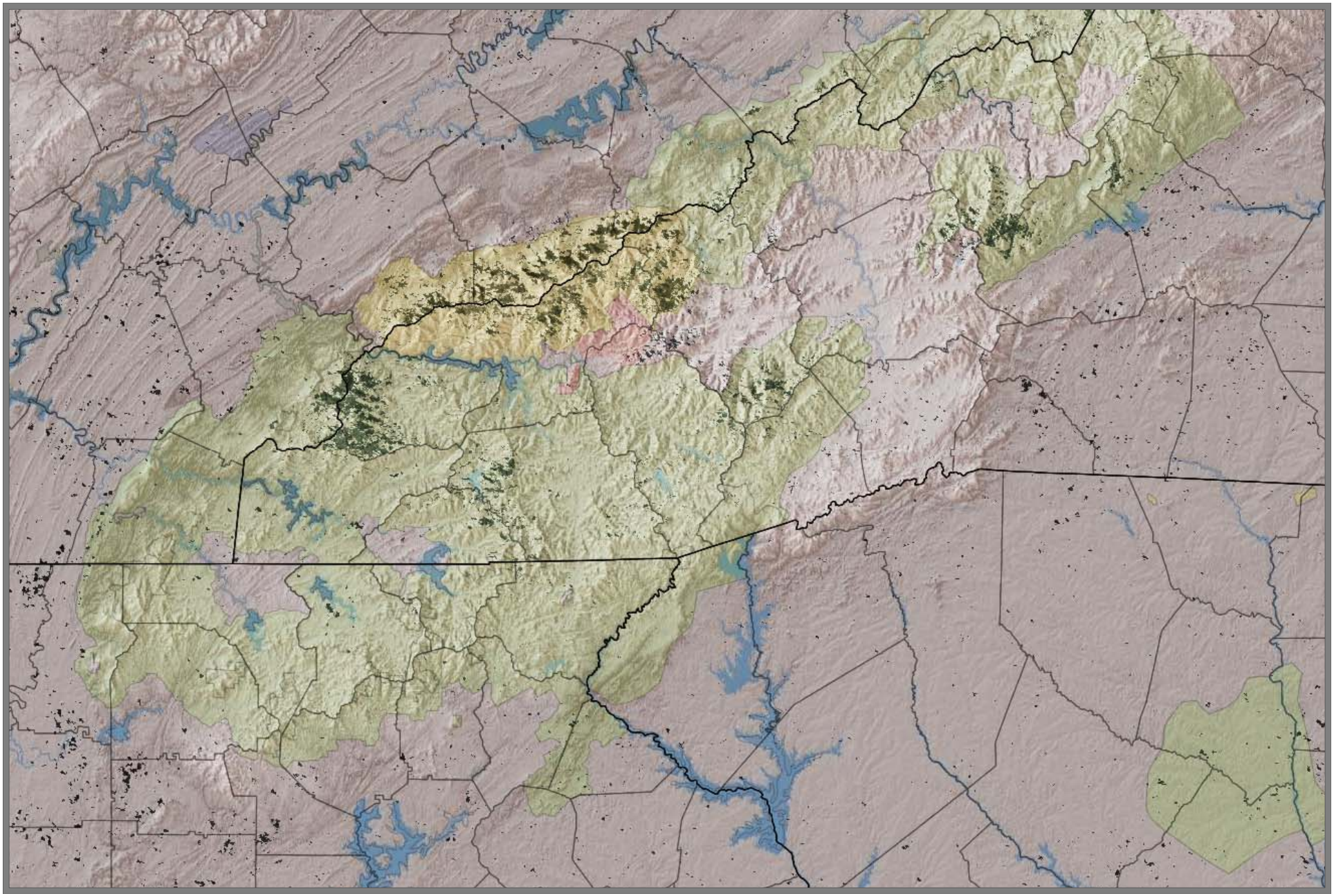




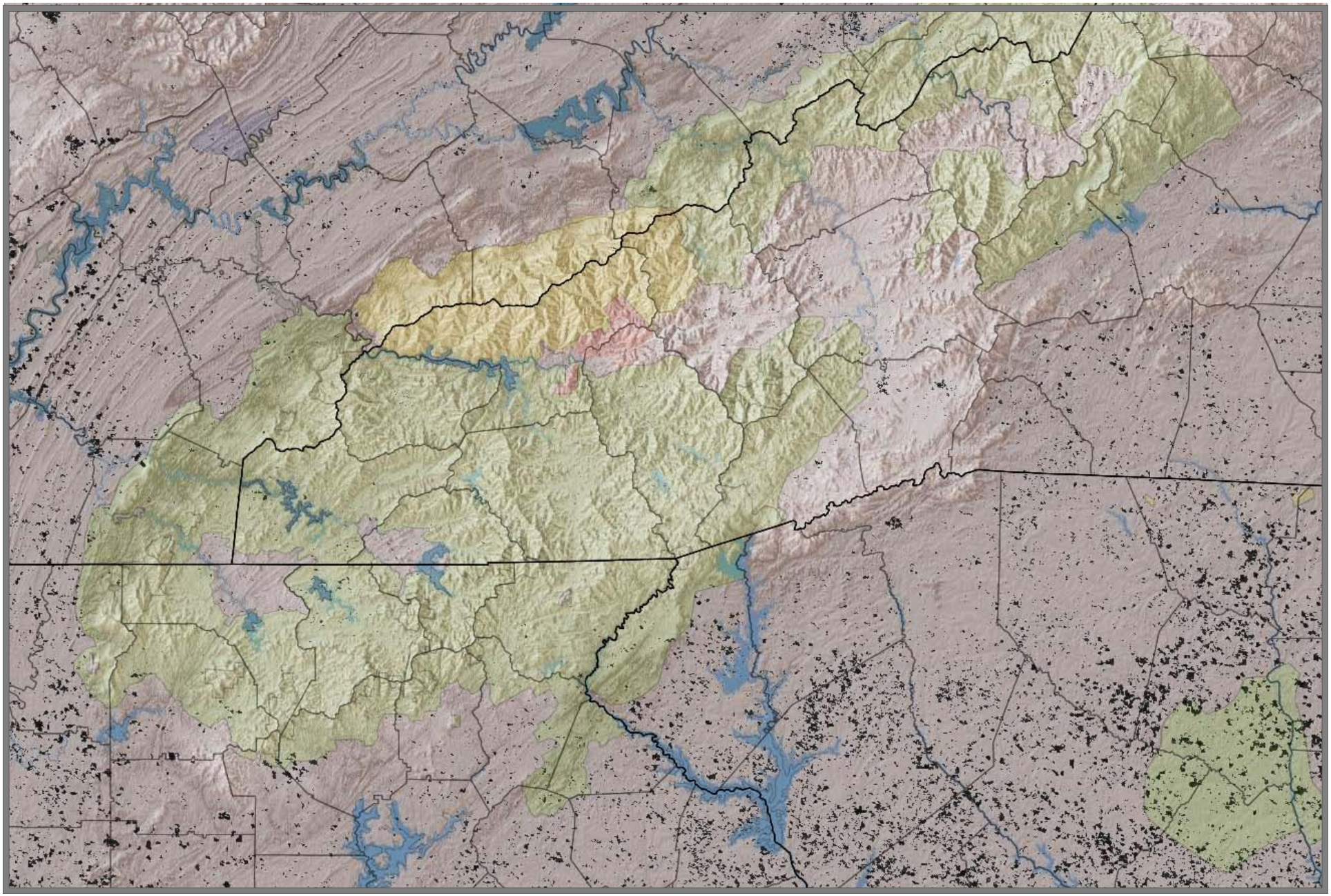
Tracking Evergreen Decline of Landscapes, 2000-2010



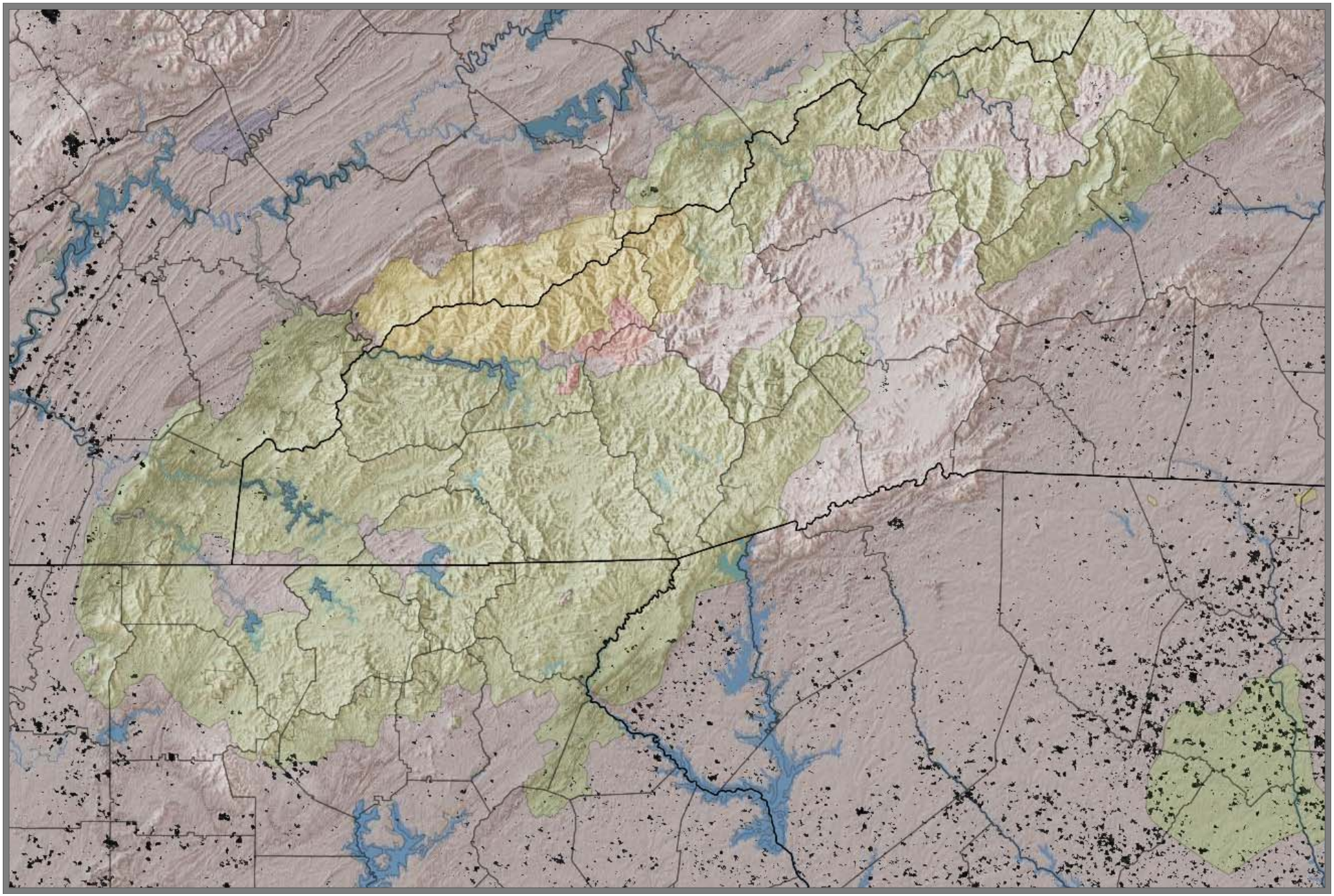
Tracking Deciduous Increase of Landscapes, 2000-2010



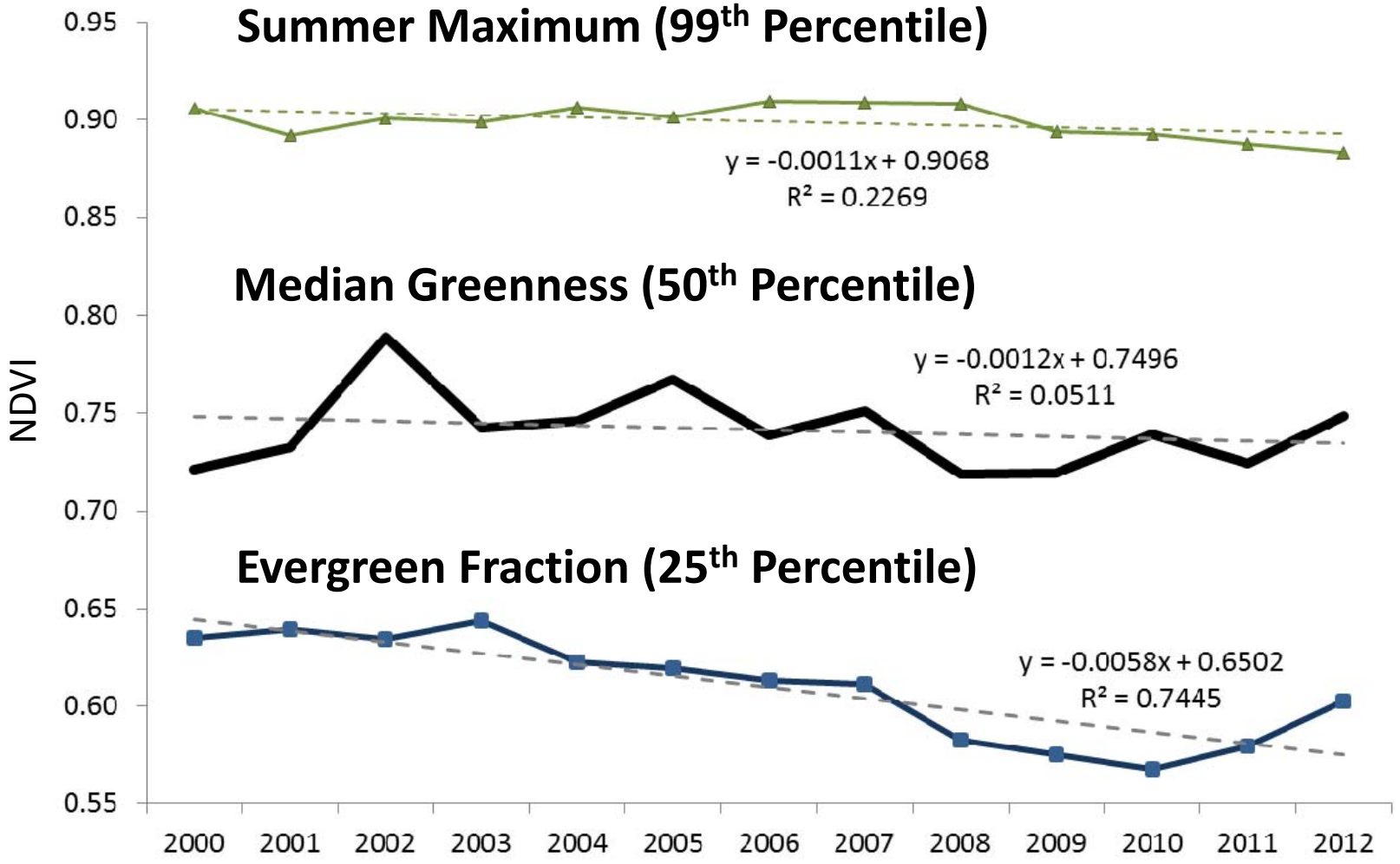
Tracking Deciduous Decline of Landscapes, 2000-2010



Tracking Evergreen Increase of Landscapes, 2000-2010



Monitoring trends in deciduous and mixed forests across all of Great Smoky Mountains National Park



Summary

- High-frequency monitoring of canopy greenness provides a broad suite of measures for monitoring both sudden and gradual forest change.

- For local areas, disturbance and recovery can be monitored directly: this relates to local resilience.

- More broadly, net change relates to landscape resilience which can be mapped for contextualizing threats, identifying specific forests at risk and for prioritizing active management solutions.