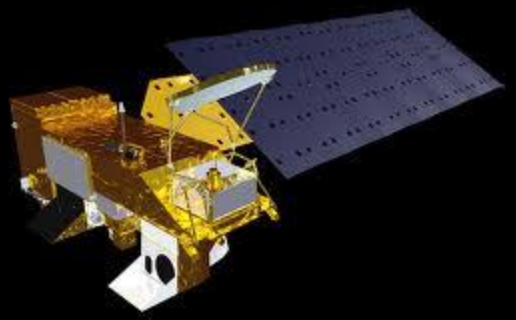
Satellite-based monitoring of seasonal, successional and event fuels for fire planning



Steve Norman
William Christie
Bjorn J Brooks
William Hargrove

USDA Forest Service, Southern Research Station, Eastern Threat Center, 200 WT Weaver Blvd, Asheville, NC 28804

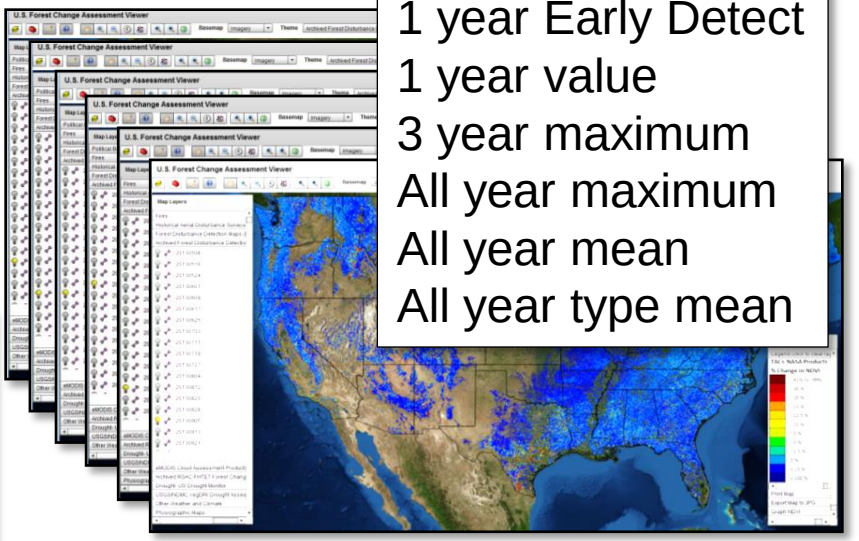
Southern Blue Ridge Fire Learning Network Workshop
Morganton, NC
May 12-14, 2015

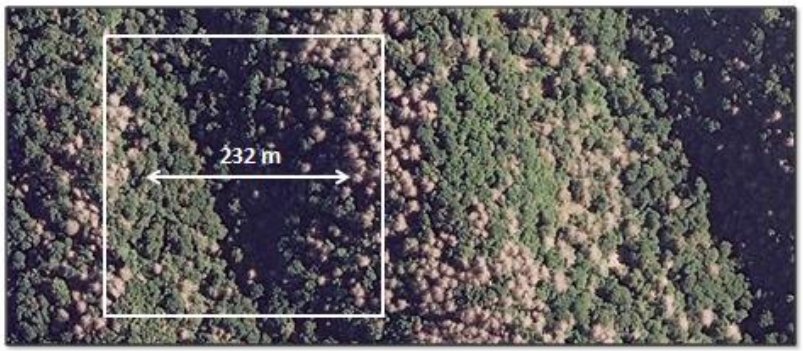
The *ForWarn* system

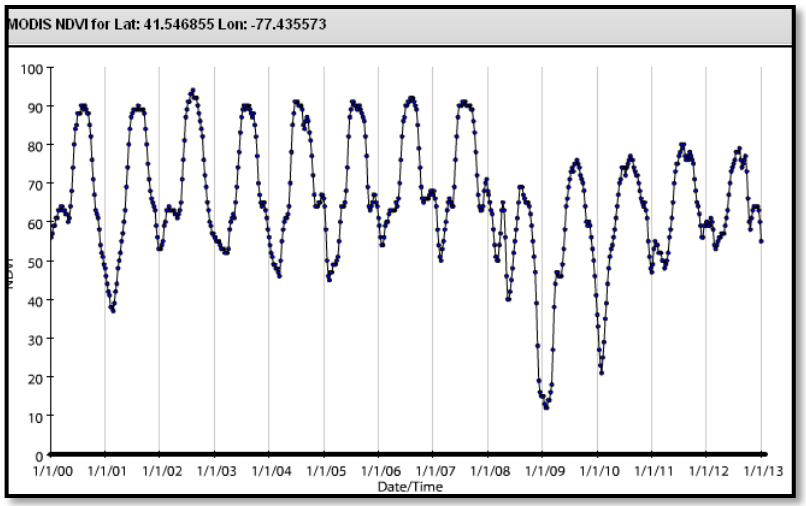
- Normalized Difference Vegetation Index (NDVI) from daily eMODIS and MODIS
- 232 meter resolution
- 46 periods per year (8-day intervals)
- Max value of 24-day moving window
- 2000 to present historical database
- Includes NDVI time series and change maps
- Online: http://forwarn.forestthreats.org

Baselines

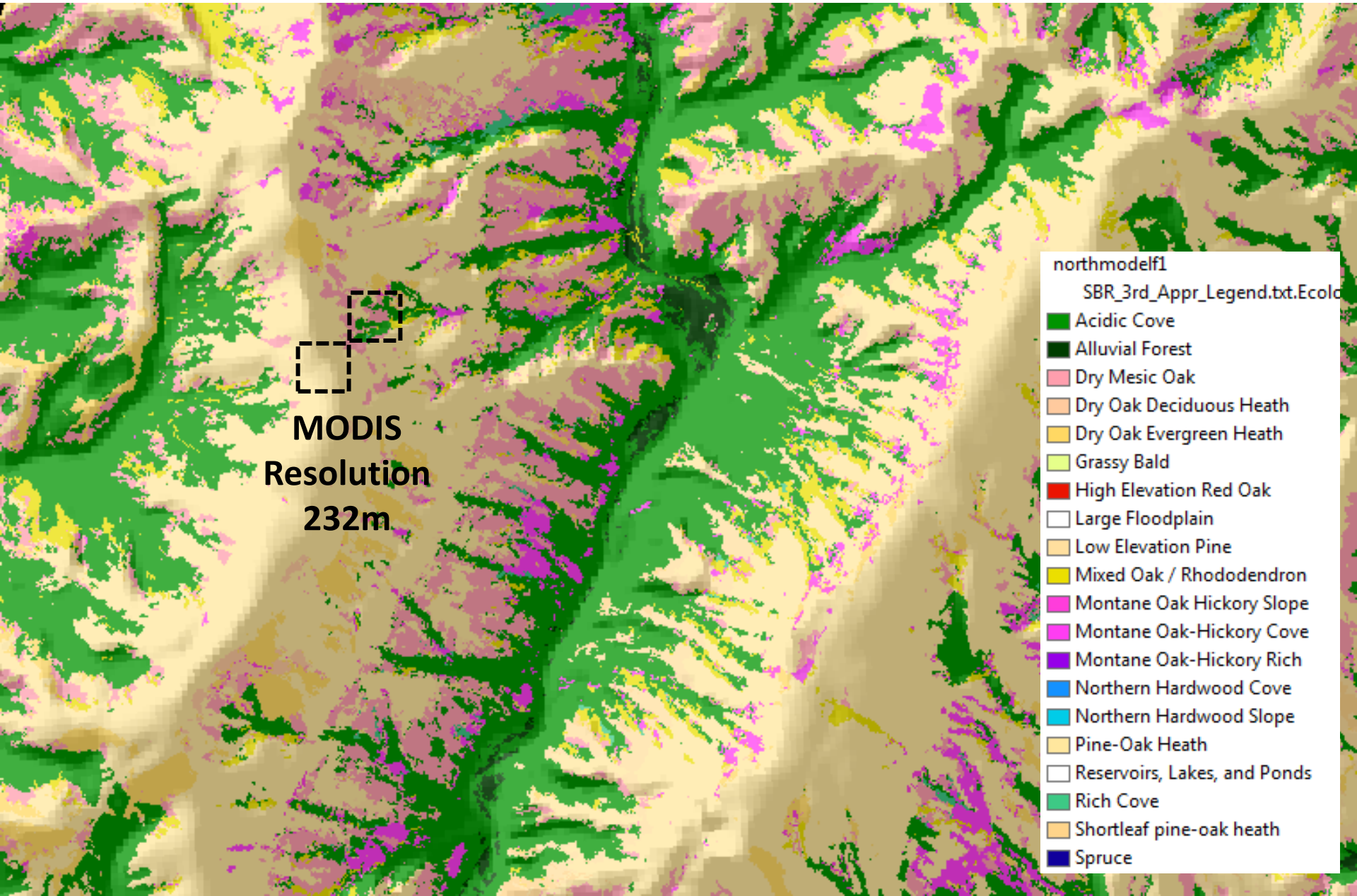
1 year Early Detect
1 year value
3 year maximum
All year maximum
All year mean
All year type mean







Potential vegetation types of Linville Gorge vs MODIS resolution



Fuel dynamics of the Blue Ridge Region

1. **Seasonal Fuels** – Fuels that vary across seasons from annual growth, senescence or decomposition (*e.g.,* annual leaf litter, deciduous foliage, senesced grass).

2. **Event Fuels** – Fuels that increase relatively suddenly due to specific (often chance) events such as wind or ice storms, fires, logging or insect/disease mortality. (*e.g.,* blowdowns)

3. **Successional Fuels** – Fuels that gradually accumulate or evolve over a period of years due to successional changes in vegetation, especially after disturbance (*e.g.,* post-fire or post-logging transitions from herbaceous, grassy or shrub fuels to understory litter; progressive fuel shifts from novel invasive species).

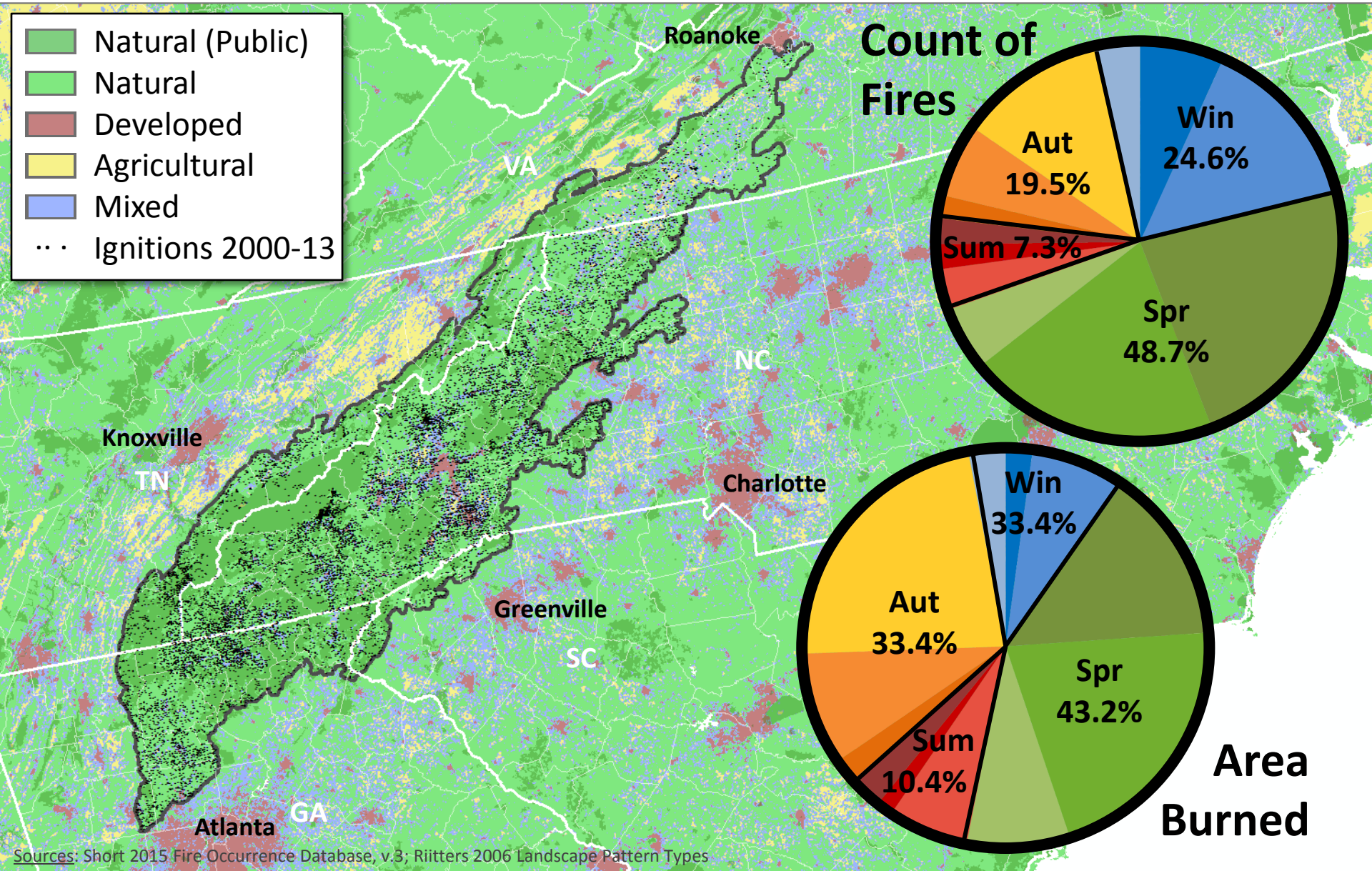
1. Monitoring seasonal fuels and fire conditions

ca. 1950s

1. Monitoring seasonal fuels and fire conditions

Wildfire ignitions in the Blue Ridge Region, 2000-2013

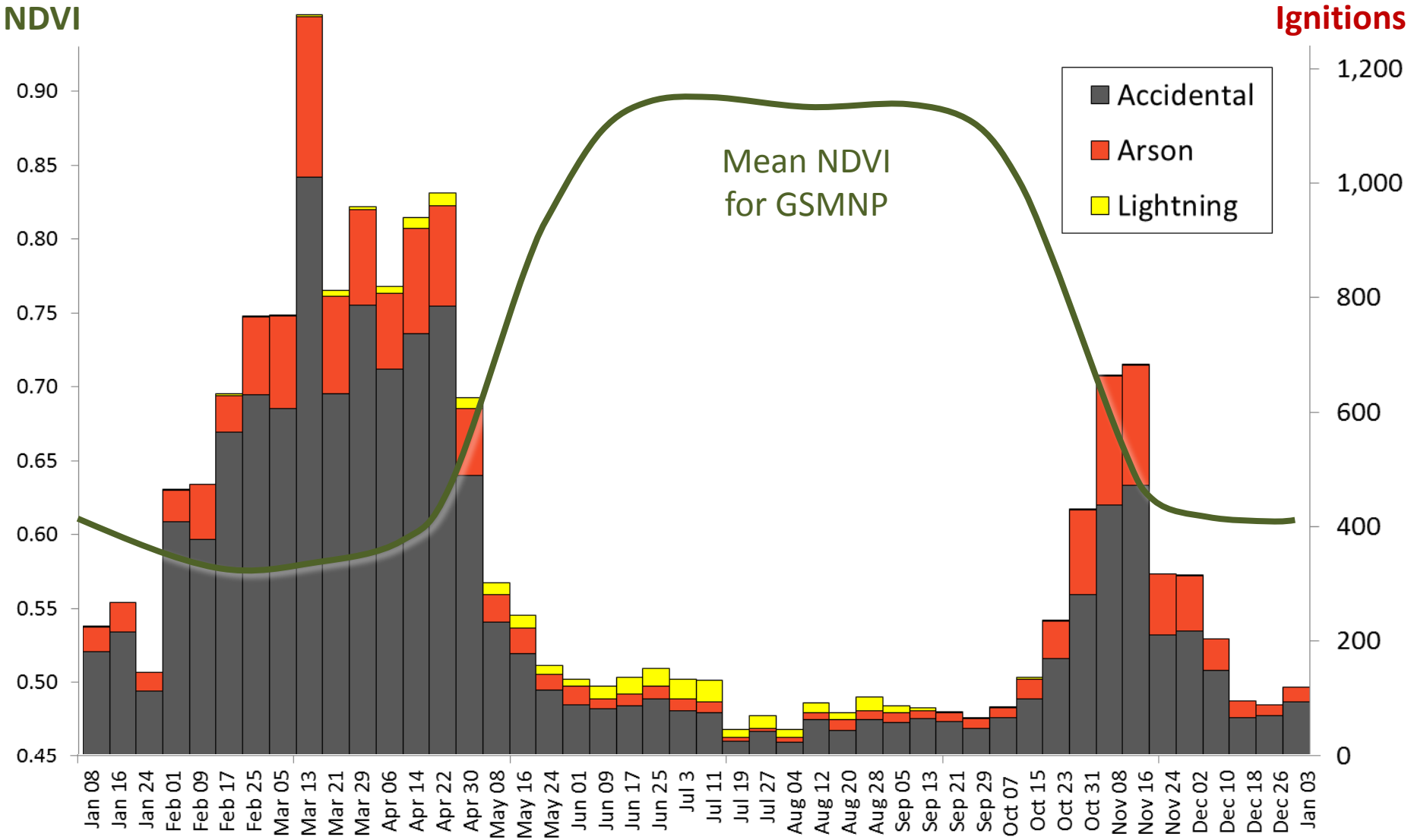
N=15,804 fires



Sources: Short 2015 Fire Occurrence Database, v.3; Riitters 2006 Landscape Pattern Types

1. Monitoring seasonal fuels and fire conditions

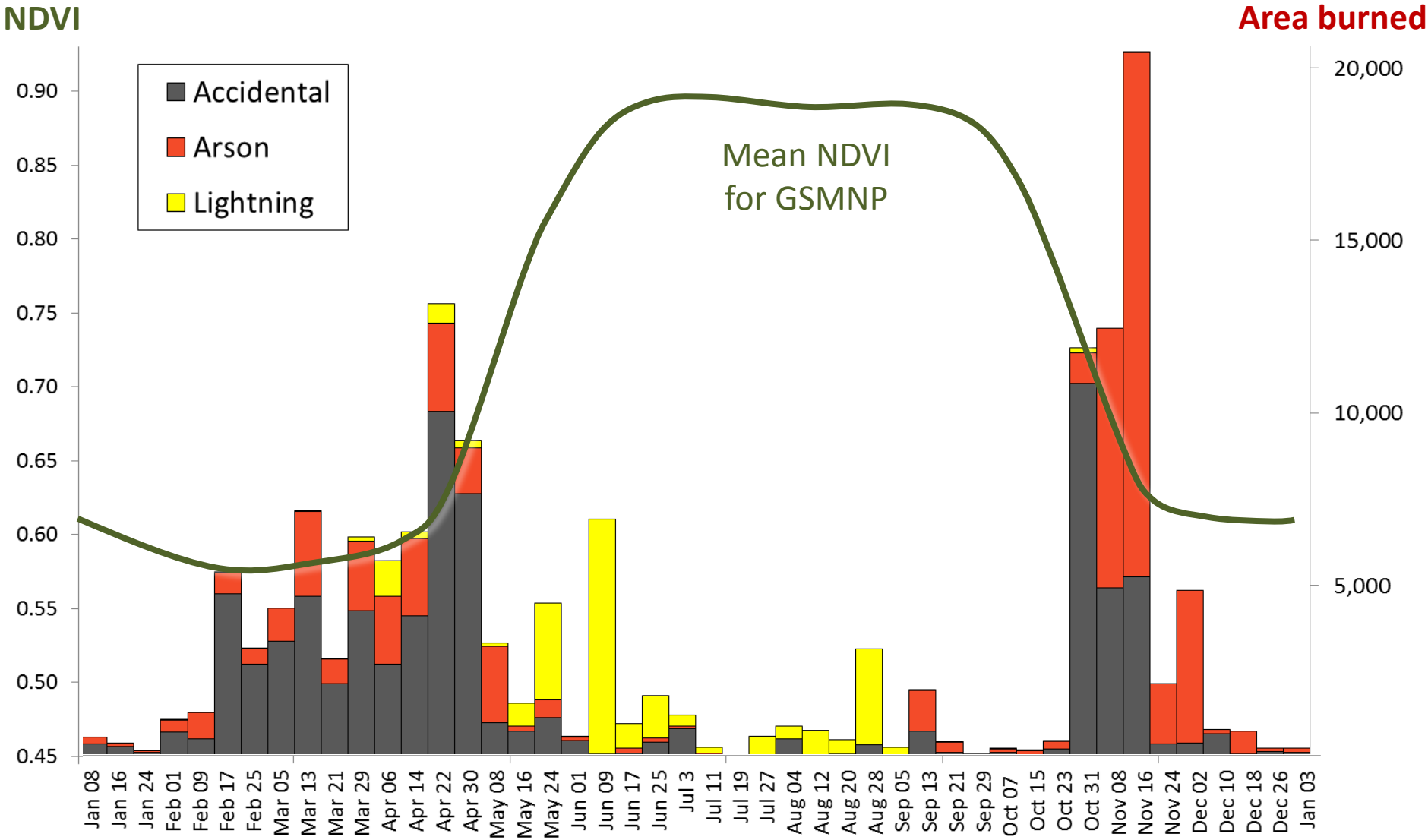
Count of wildfire ignitions in the Blue Ridge Region, 2000-2013 compared to the mean *ForWarn* NDVI for deciduous forests of Great Smoky Mountains NP



Sources: Short 2015 Fire Occurrence Database, v.3; ForWarn NDVI data, 2000-2012

1. Monitoring seasonal fuels and fire conditions

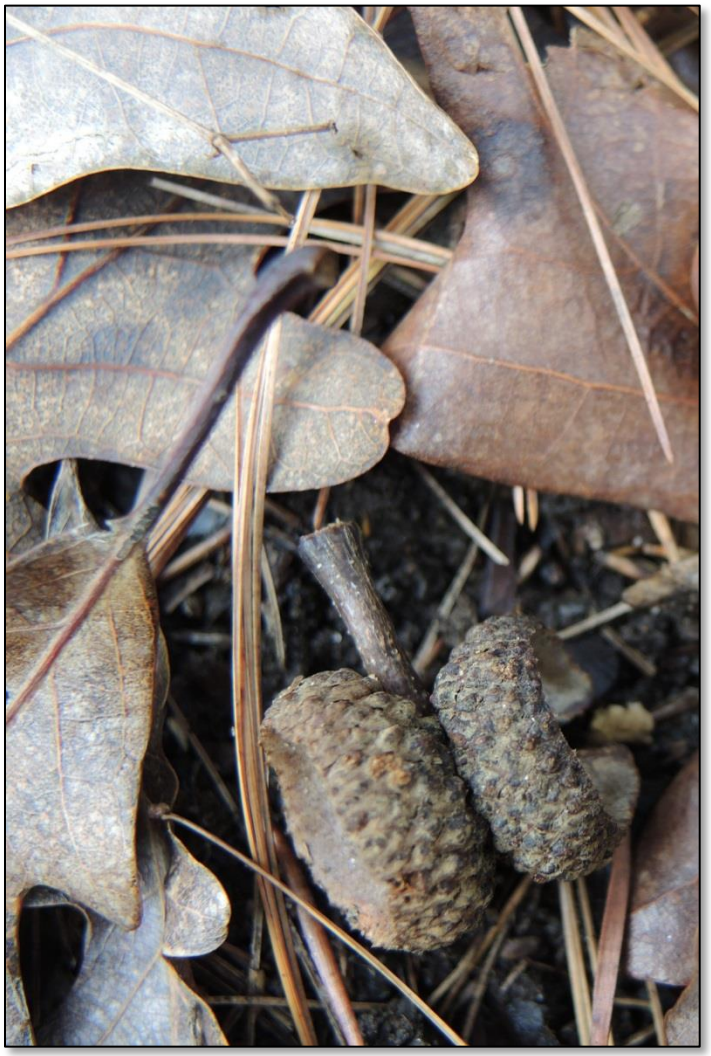
Area burned by wildfire in the Blue Ridge Region, 2000-2013 compared to the mean *ForWarn* NDVI for deciduous forests of Great Smoky Mountains NP



Sources: Short 2015 Fire Occurrence Database, v.3; ForWarn NDVI data, 2000-2012

1. Monitoring seasonal fuels and fire conditions

Offered explanations for the Blue Ridge's "seasonal fire niches"



Seasonality of macro-climate

- Regional temperature flux (heat)
- Seasonal winds drive fire spread
- Humidity and air masses

Seasonality of micro-climate

- Overstory shading cools surface temperatures and raises humidity
- Local transpiration increases RH.
- Leafed canopy reduces surface wind

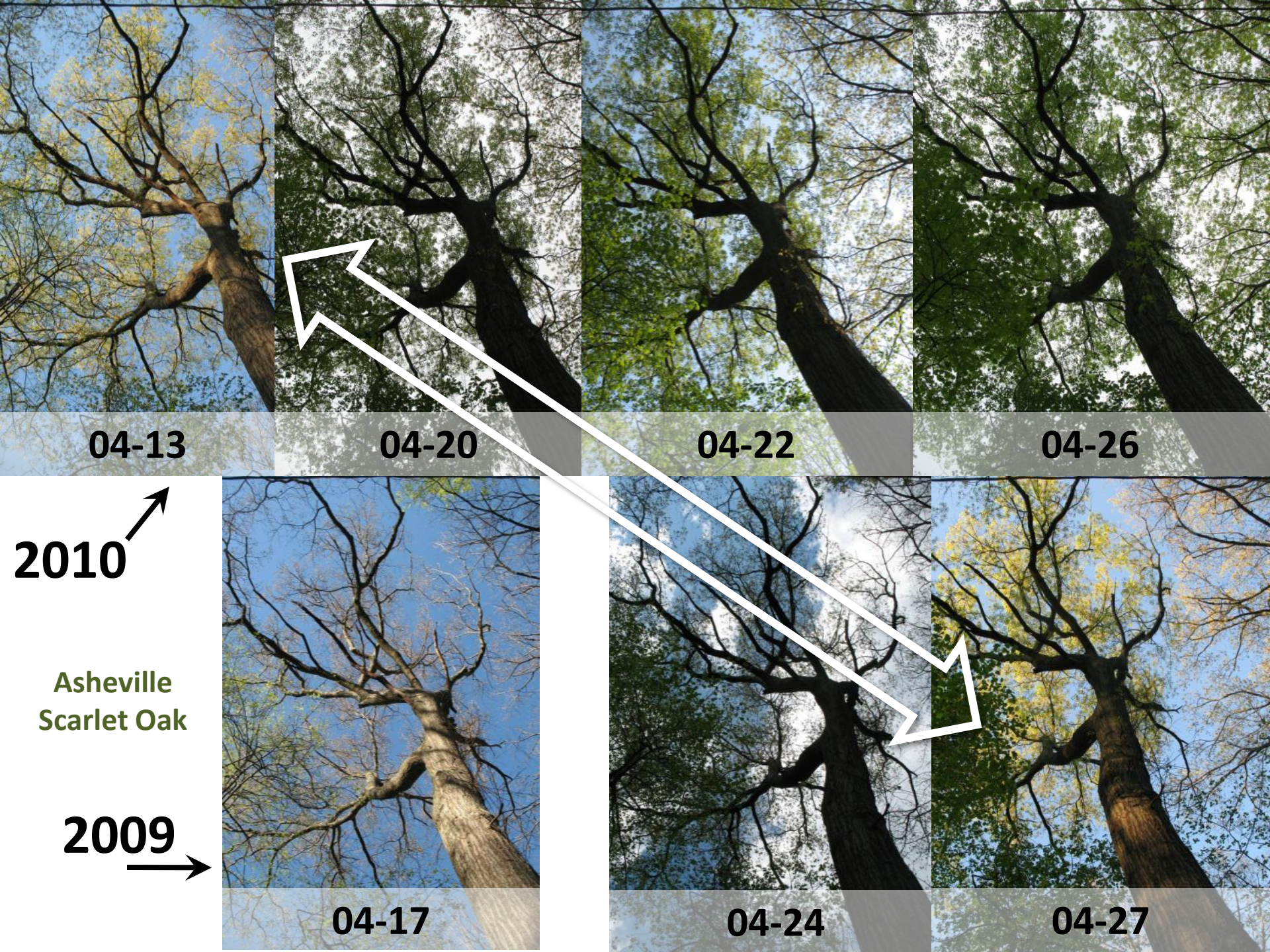
Seasonality of fuel availability

- The timing of litter fall
- The biology of species senescence
- Decomposition

Seasonality of human behavior

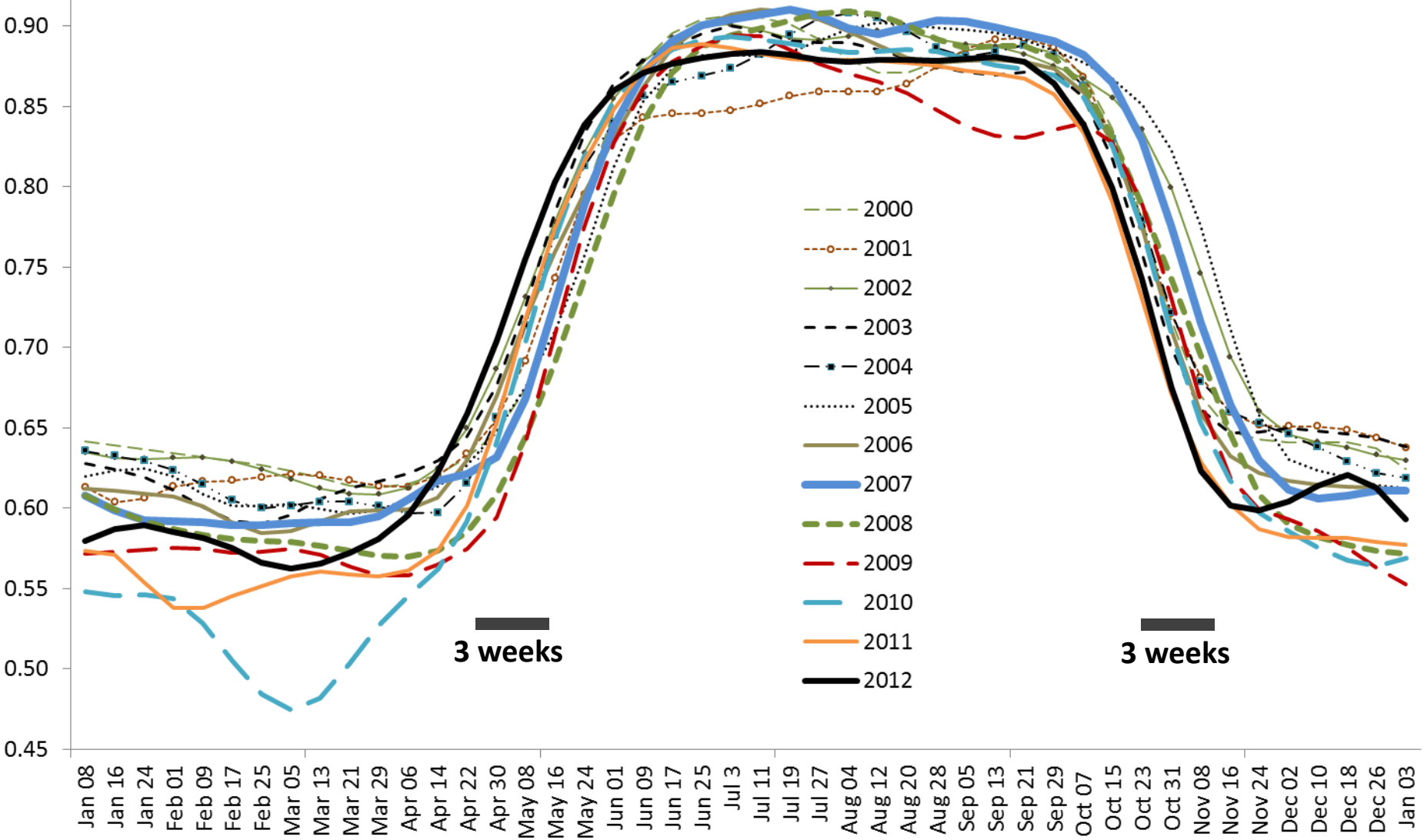
- Increased outdoor activity
- Post-winter refuse burning

Land Surface Phenology


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

1. Monitoring seasonal fuels and fire conditions

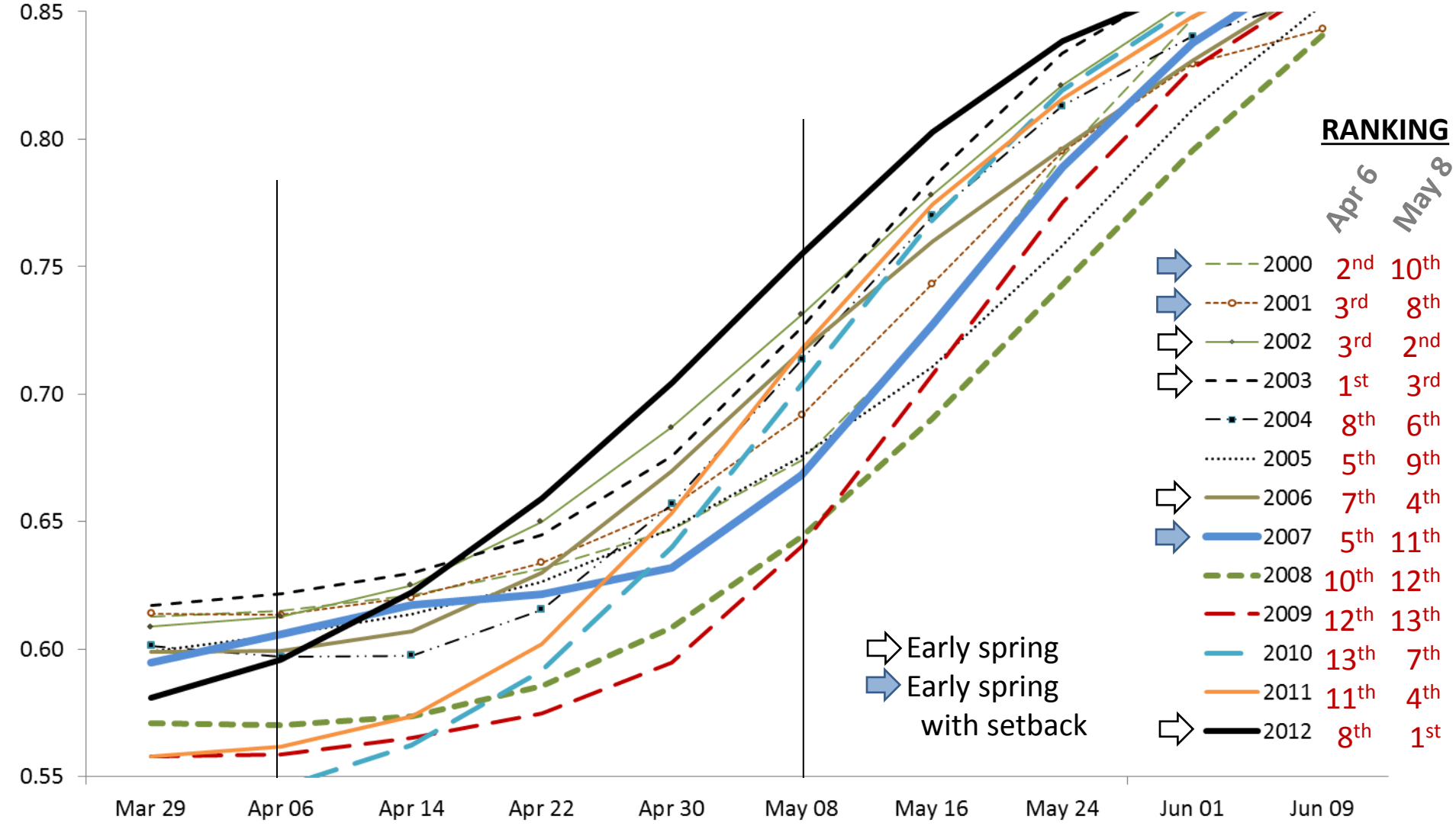
ForWarn's NDVI for Deciduous and Mixed Forests of the Great Smoky Mountains National Park, 2000-2012



N=38,318 MODIS cells

1. Monitoring seasonal fuels and fire conditions

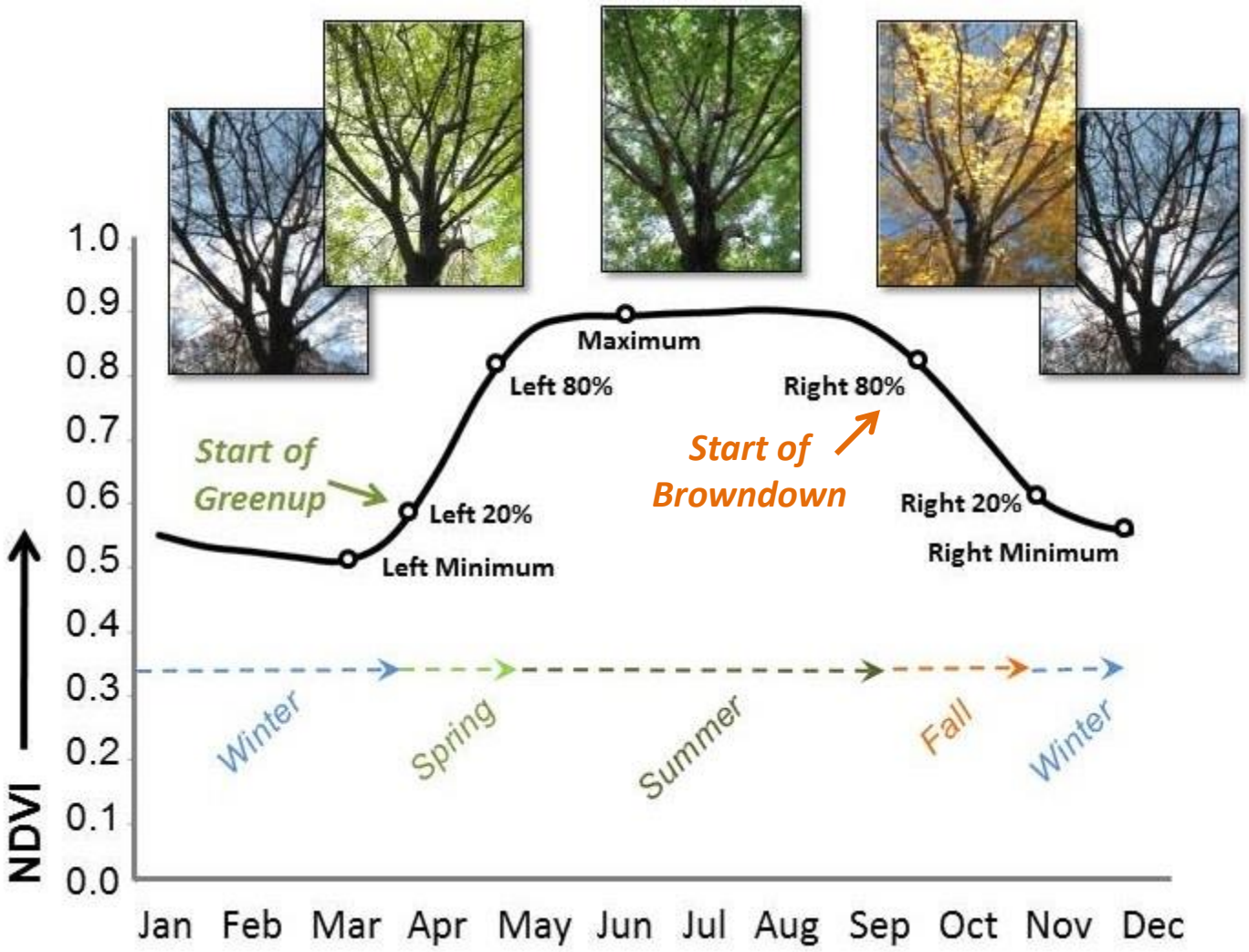
ForWarn's NDVI for Deciduous and Mixed Forests of the Great Smoky Mountains National Park, 2000-2012



N=38,318 MODIS cells

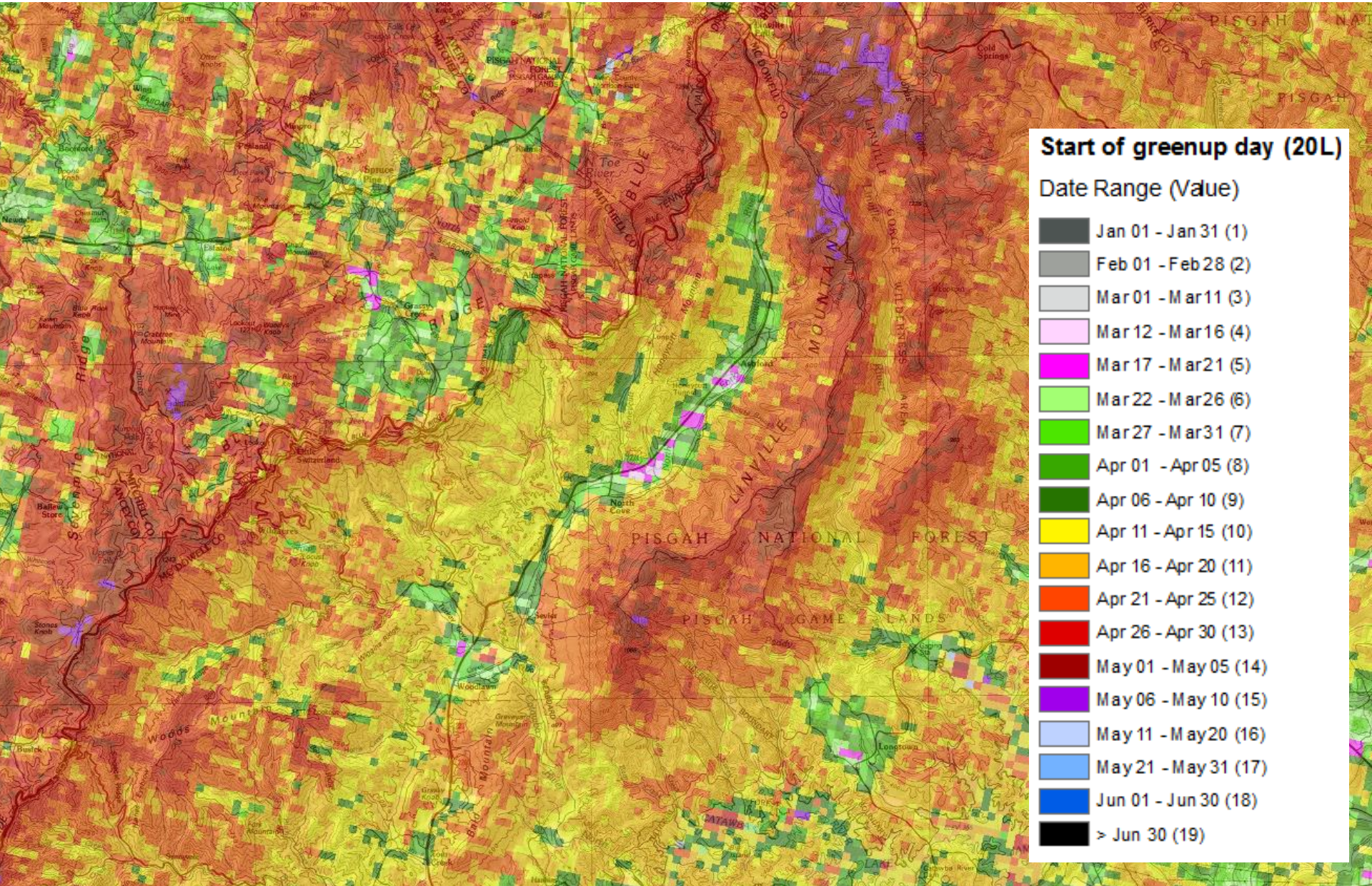
1. Monitoring seasonal fuels and fire conditions

ForWarn's Land Surface Phenology seasonal parameters



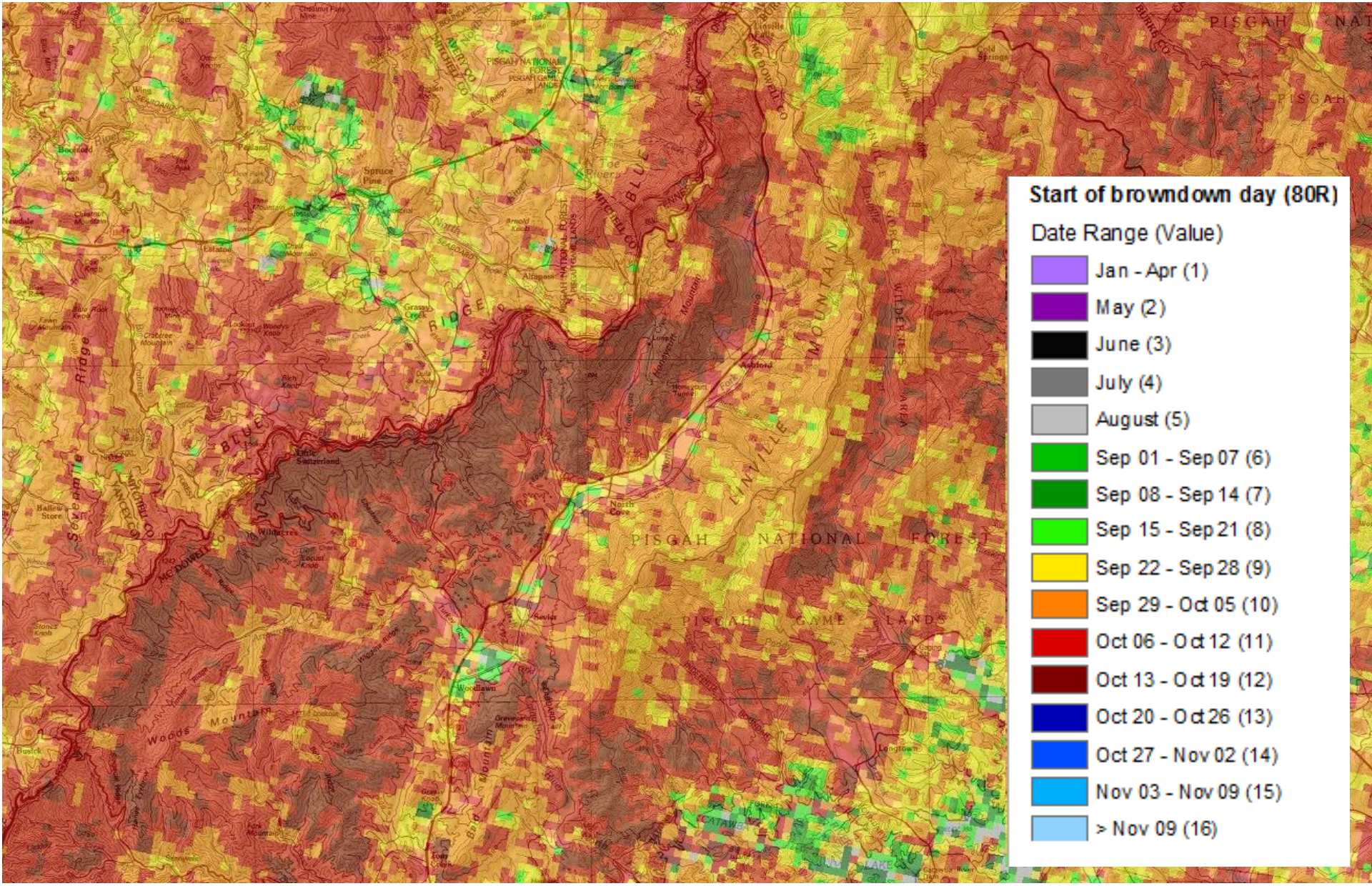
1. Monitoring seasonal fuels and fire conditions

ForWarn's mean start of Spring greenup

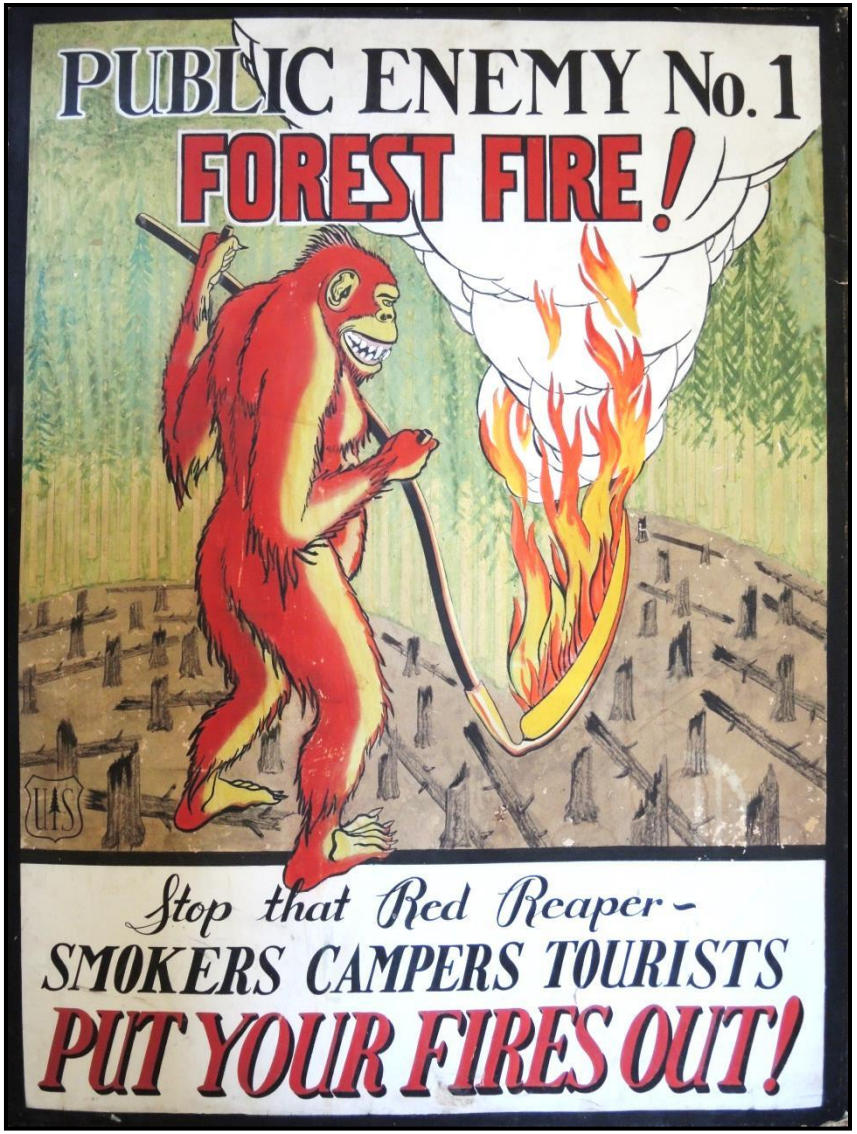


1. Monitoring seasonal fuels and fire conditions

ForWarn's mean Start of Fall browndown



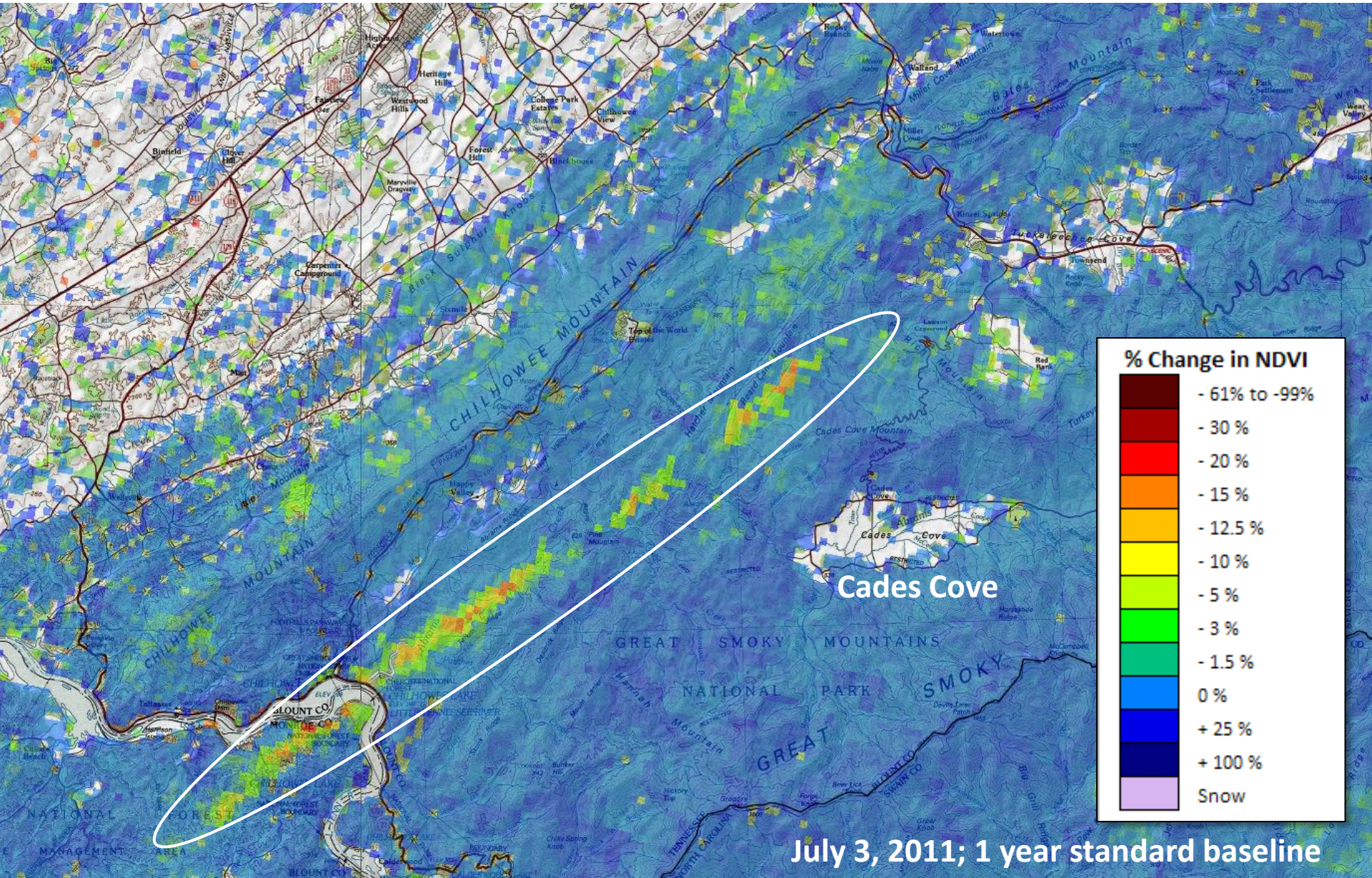
2. Monitoring events that alter fuels



ca. 1930s

2. Monitoring events that alter fuels

2011 Great Smoky Mountains National Park Tornado, TN



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2011 Great Smoky Mountains National Park Tornado

National Park Service
http://www.nps.gov/grsm/learn/nature/dff11-tornado.htm

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Great Smoky Mountains | National Park NC,TN

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A A A

Tornadoes and Fire

Dispatches from the Field > **Tornadoes & Fire**

A flight over the park revealed the wide swath of downed forest after the tornado.
NPS photo.

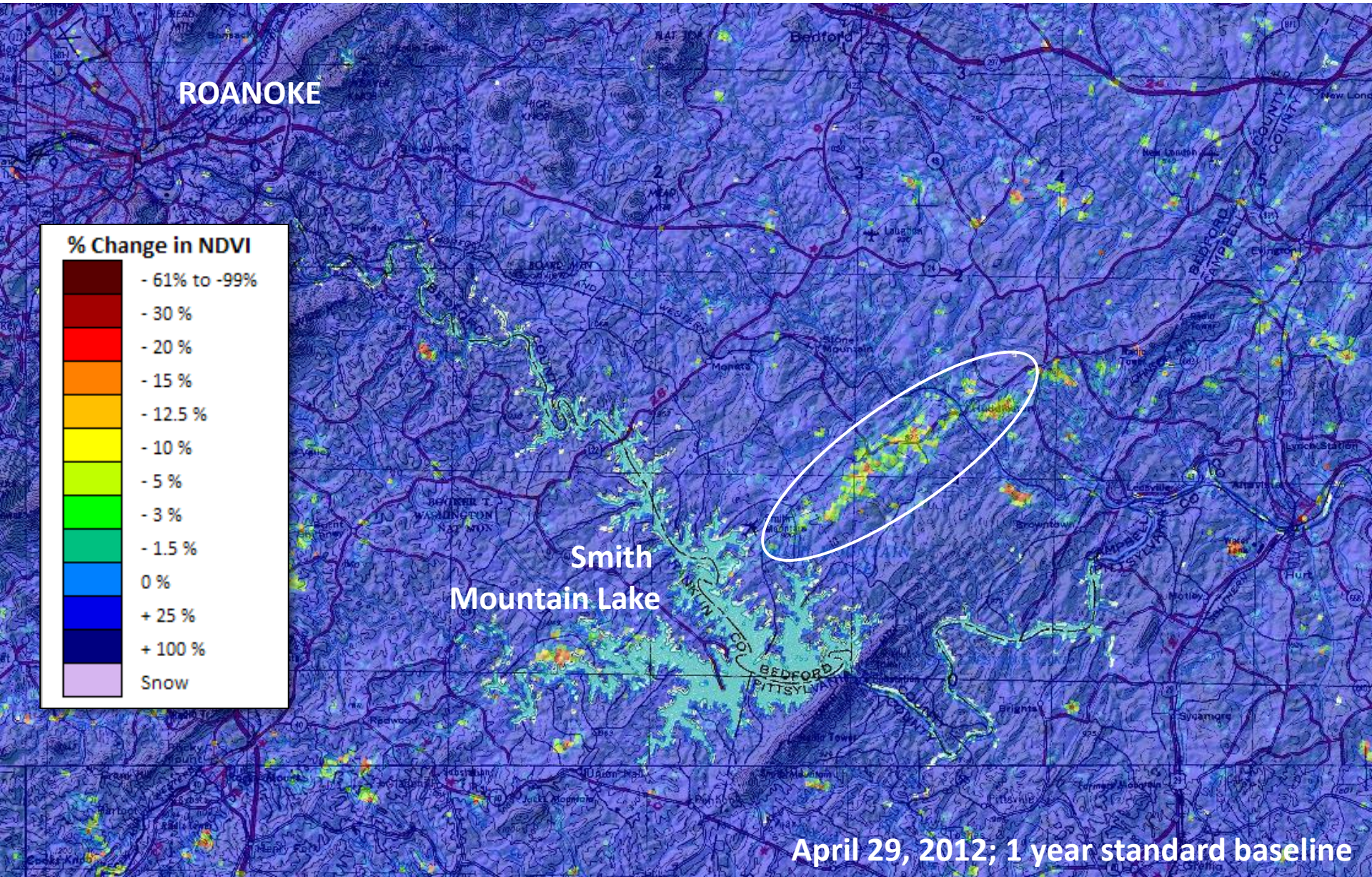
Tall trees uprooted, tossed, and broken in half like twigs. Main park trails piled head-high with a tangle of debris, mile upon mile. And an entire forest changed: these are the widespread impacts that resource managers at Great Smoky Mountains National Park discovered following a tornado and violent storms that ripped across the park this spring.

The tornado—a Category 4, packing winds from 166 to 200 mph—has shut off recreational access to large areas of the park's northwest corner for perhaps months. But the storm's changes to park forests may last for decades or even centuries to come. If you've ever been to the western side of the Smokies, you would recognize the drier soils and towering, fluffy-crowned pines of its higher, sunny ridges. This is a forest type that thrives with regular fire: its yellow pines and chestnut oaks, among other species, have thick gnarled bark to withstand regular scorching, and its trees grow best in an uncrowded, fire-cleared understory.

Following decades of fire exclusion in National Parks and Forests, these xeric, or dry habitat, pine-oak forests have been disappearing. To restore them, fire managers began using controlled burns, and over the past decade have planned and set low-intensity, controlled

2. Monitoring events that alter fuels

Pre-leaf-out ice storm damage near Smith Mountain Lake, VA, Mar. 24, 2012



2. Monitoring events that alter fuels

Pre-leaf-out ice storm damage near Smith Mountain Lake, VA, Mar. 24, 2012

Lake area still recovering from hail storm

Story

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Posted: Tuesday, July 31, 2012 4:08 pm

By JASON DUNOVANT Smith Mountain Eagle

Smith Mountain Lake residents may remember 2012 as the year of wild weather. Since the beginning of the year, the area has experienced vicious storms, stifling heat, a powerful windstorm called a derecho and a hailstorm that many Lake residents are still trying to clean up after several months later.

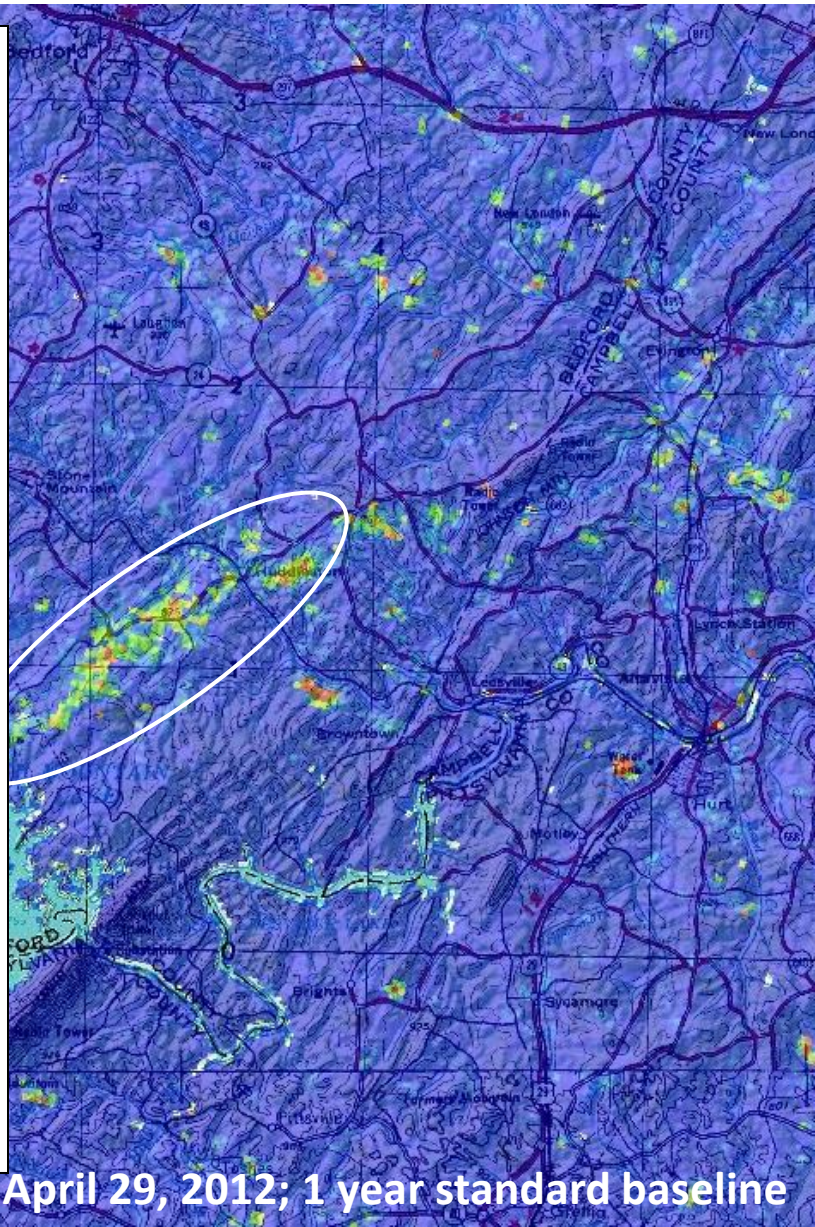
The hailstorm that hit the Smith Mountain Lake area on March 24 caused thousands of, if not millions of dollars, in damage to several homes and businesses. Hail the size of golf balls destroyed the roofs, gutters and siding as the storm made its way through Wirtz and Smith Mountain Lake. Insurance companies and construction crews have been working overtime since the storm hit to fix the damage.

"We were averaging around 150 calls per day after the storm," Nancy Schmidt with Bob Riddick Roofing said.

The business, like many others like it in the area, was bombarded with work in the weeks following the storm. While the calls have slowed in recent weeks as more homes have been repaired, Schmidt said that they are still booked up many months into the future.

Schmidt said most of the calls have come from the Wirtz area and in Moneta off Scruggs Road. Several homes in the Boardwalk and Park Place subdivisions and on Dudley Amos Road were heavily damaged during the storm.

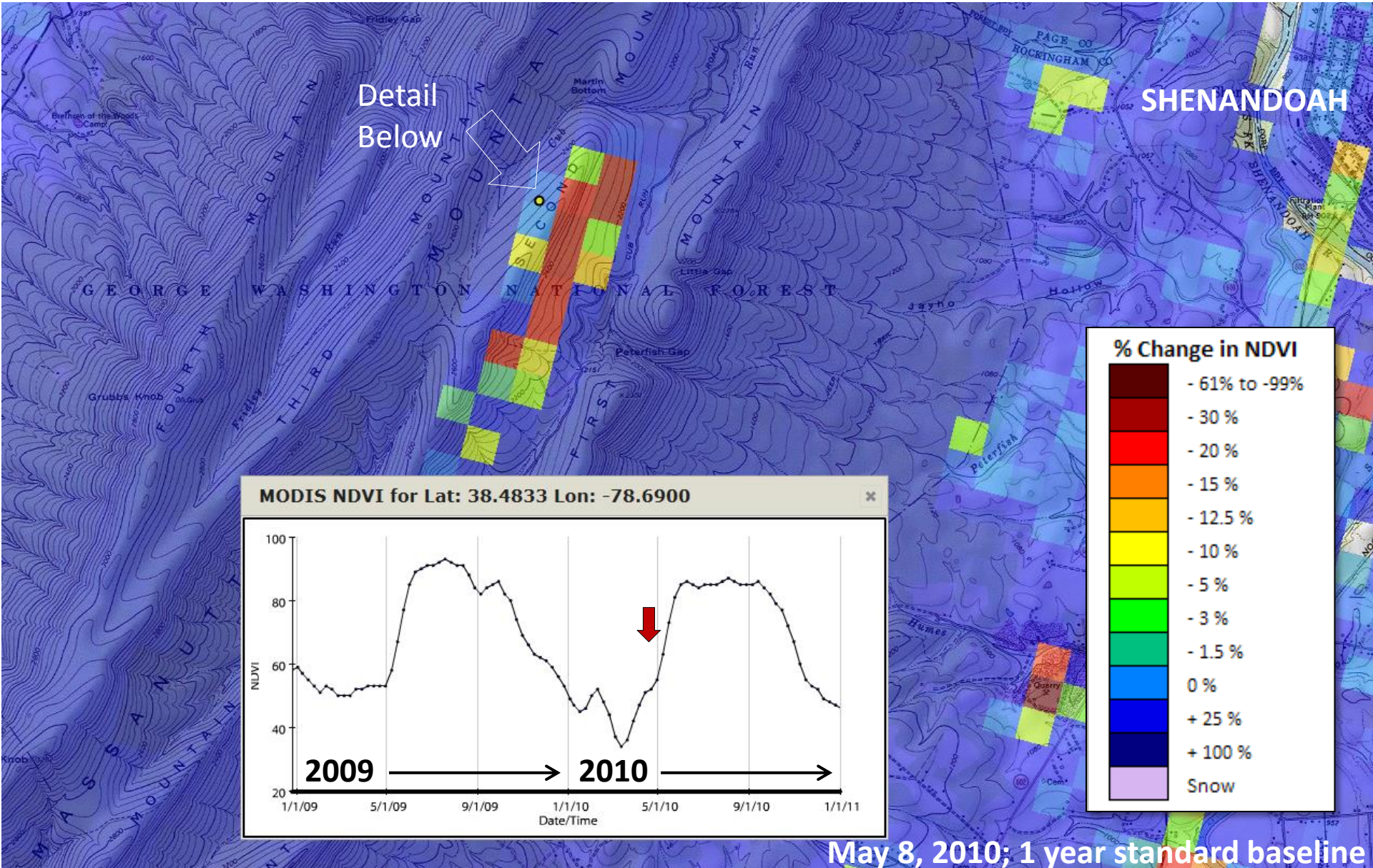
www.smithmountaineagle.com
July 31, 2012



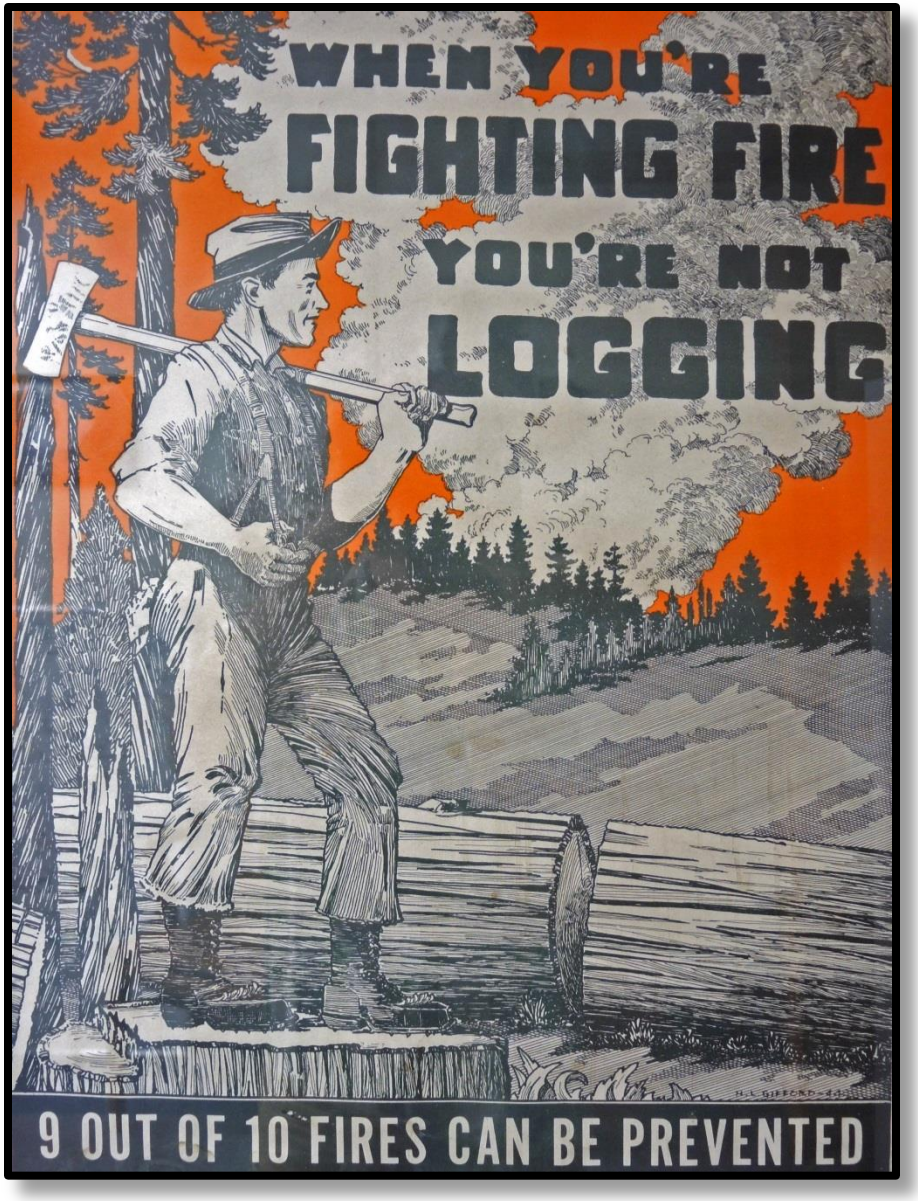
April 29, 2012; 1 year standard baseline

2. Monitoring events that alter fuels

"Second Mountain" Rx Fire, April 15, 2010. George Washington NF



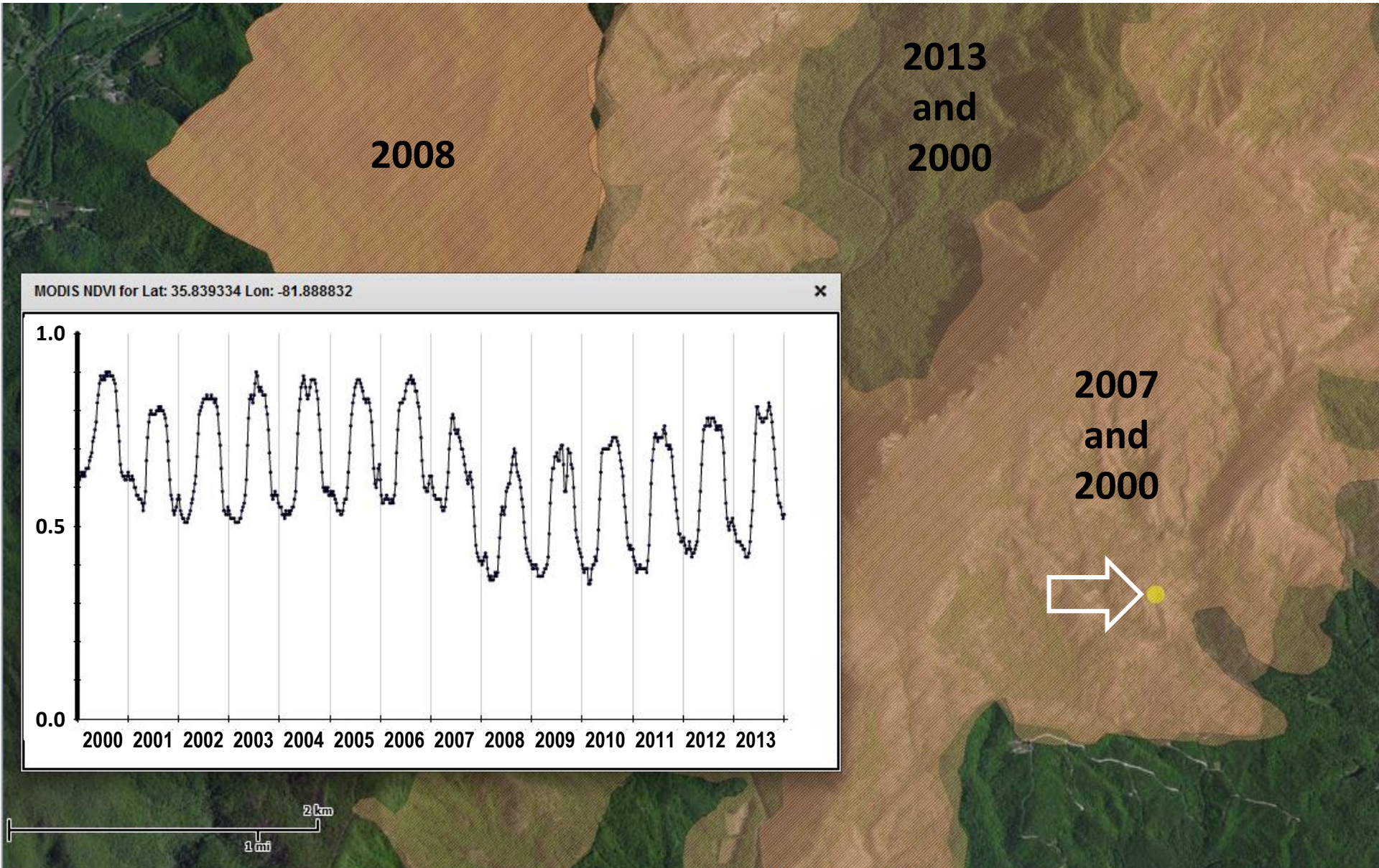
3. Monitoring successional fuels and vegetation



1945

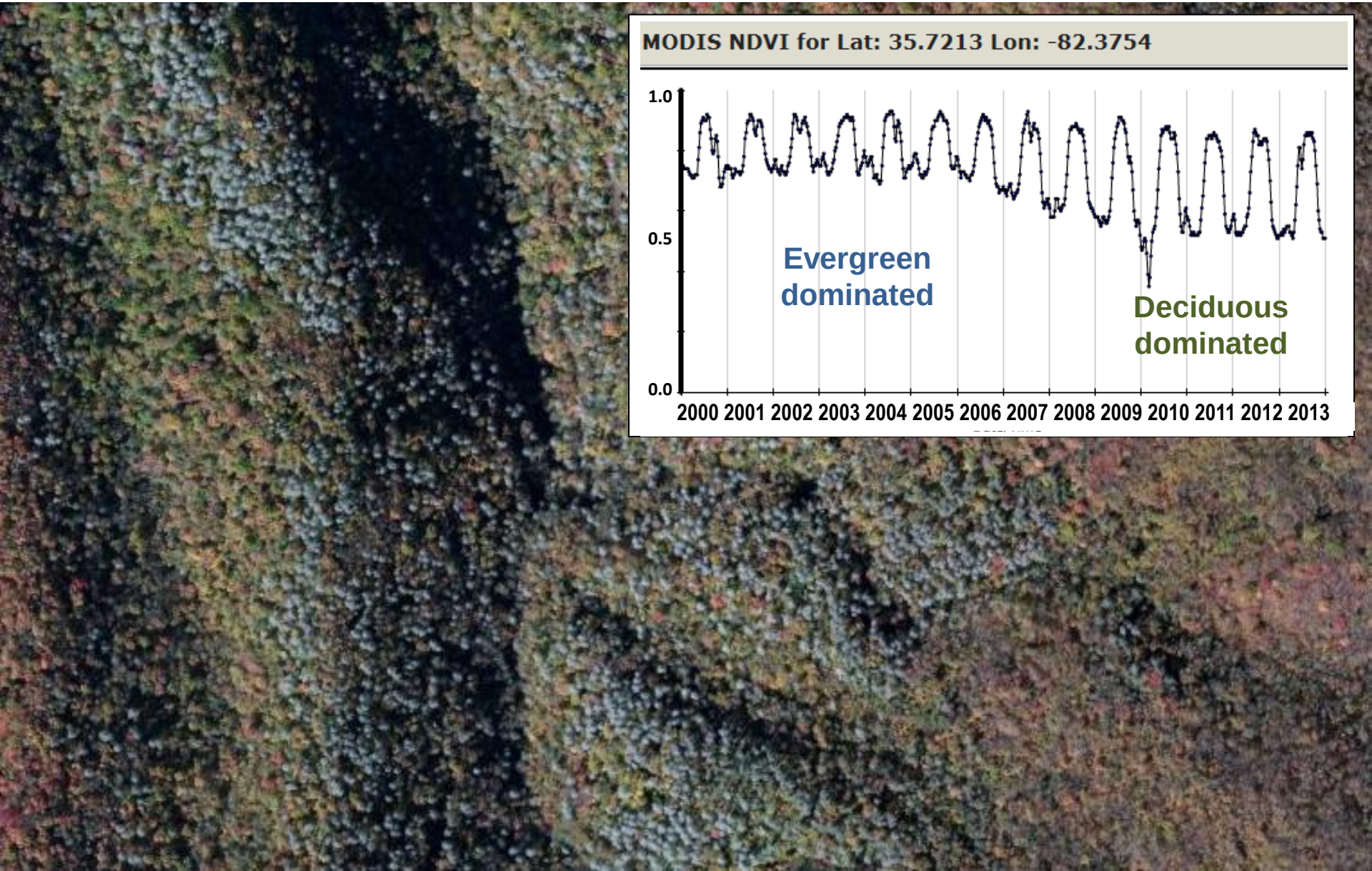
3. Monitoring successional fuels and vegetation

Wildfires, Linville Gorge, NC



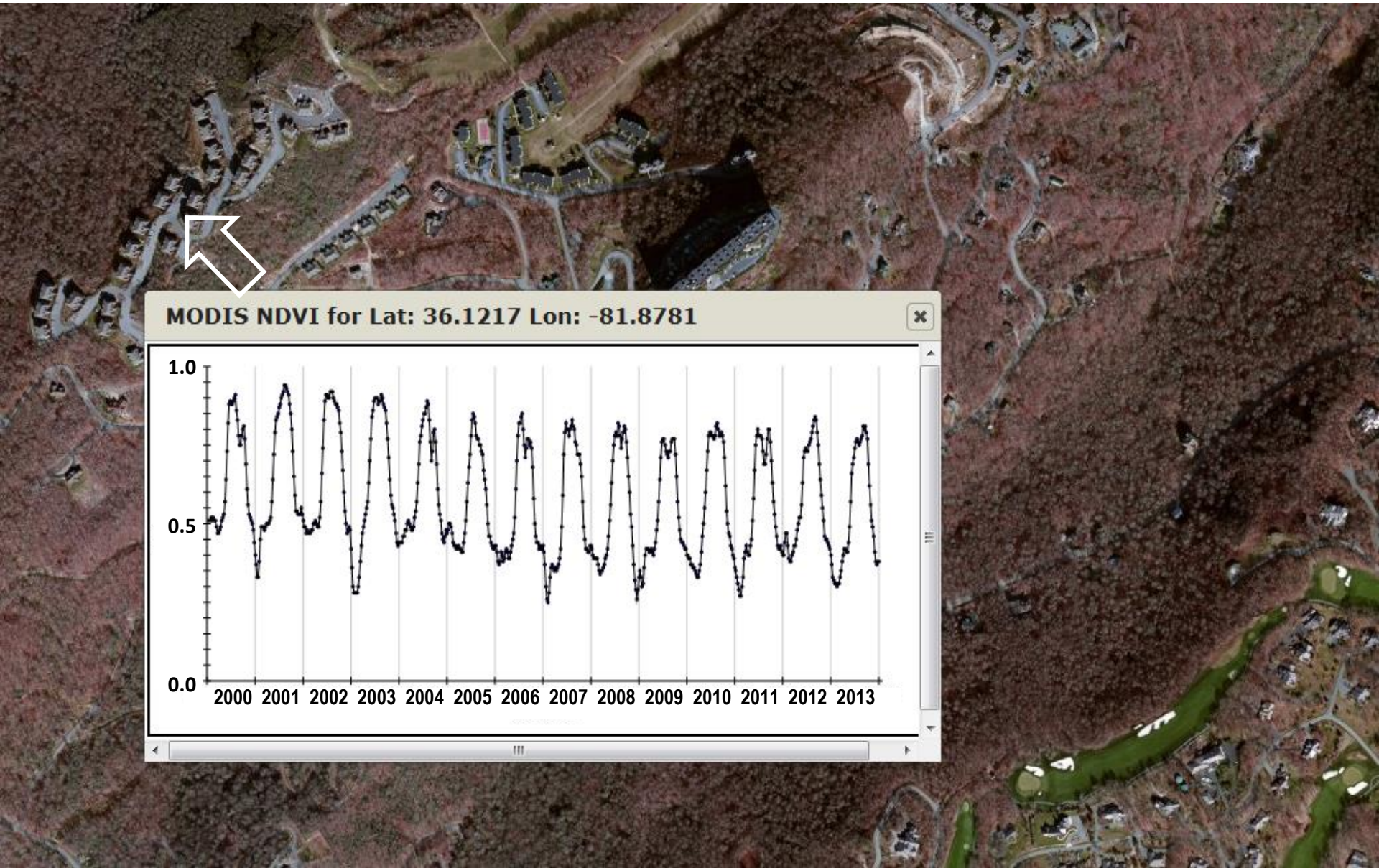
3. Monitoring successional fuels and vegetation

Gradual loss of evergreen (hemlock)



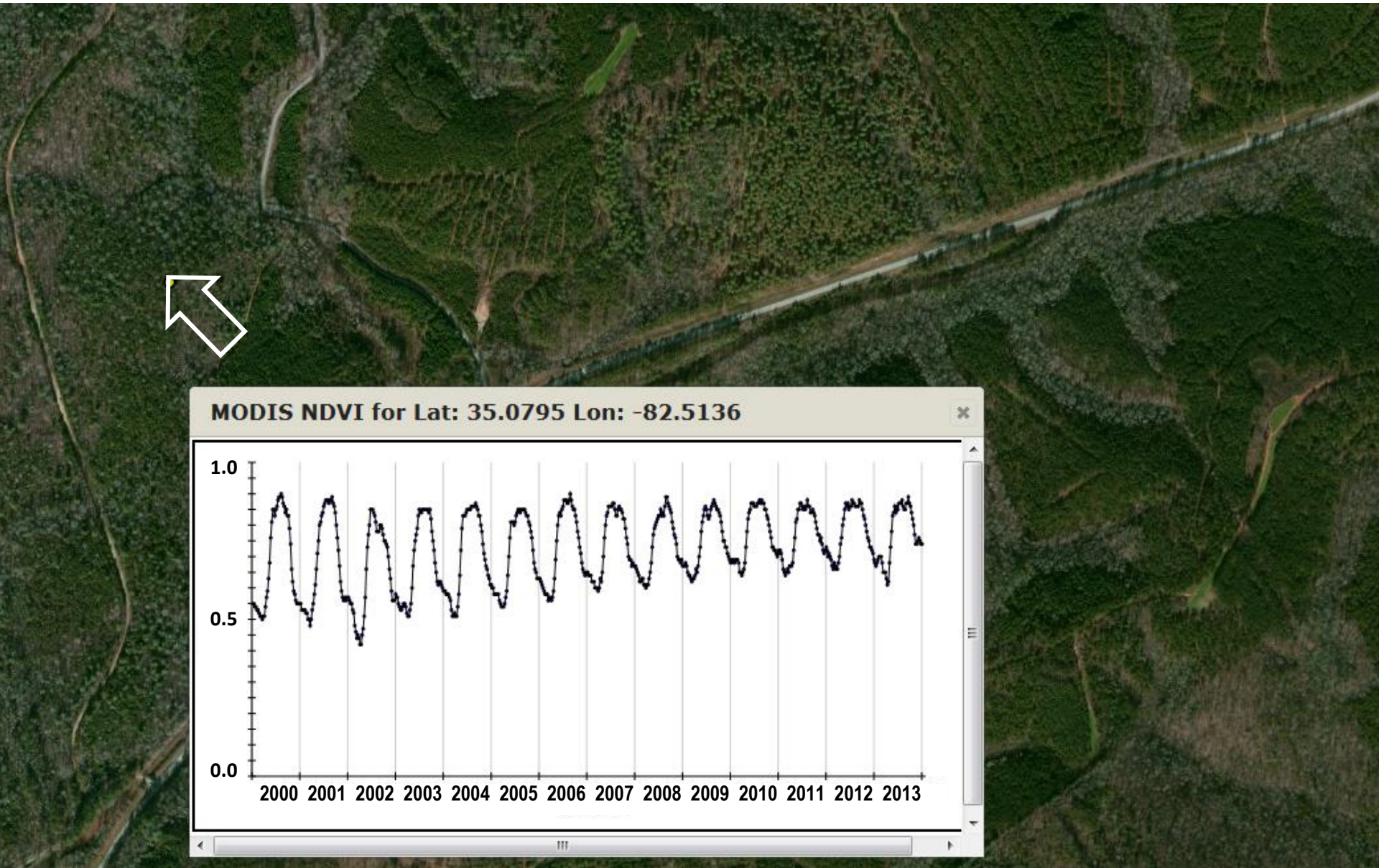
3. Monitoring successional fuels and vegetation

Mountaintop development near Grandfather Mtn., NC



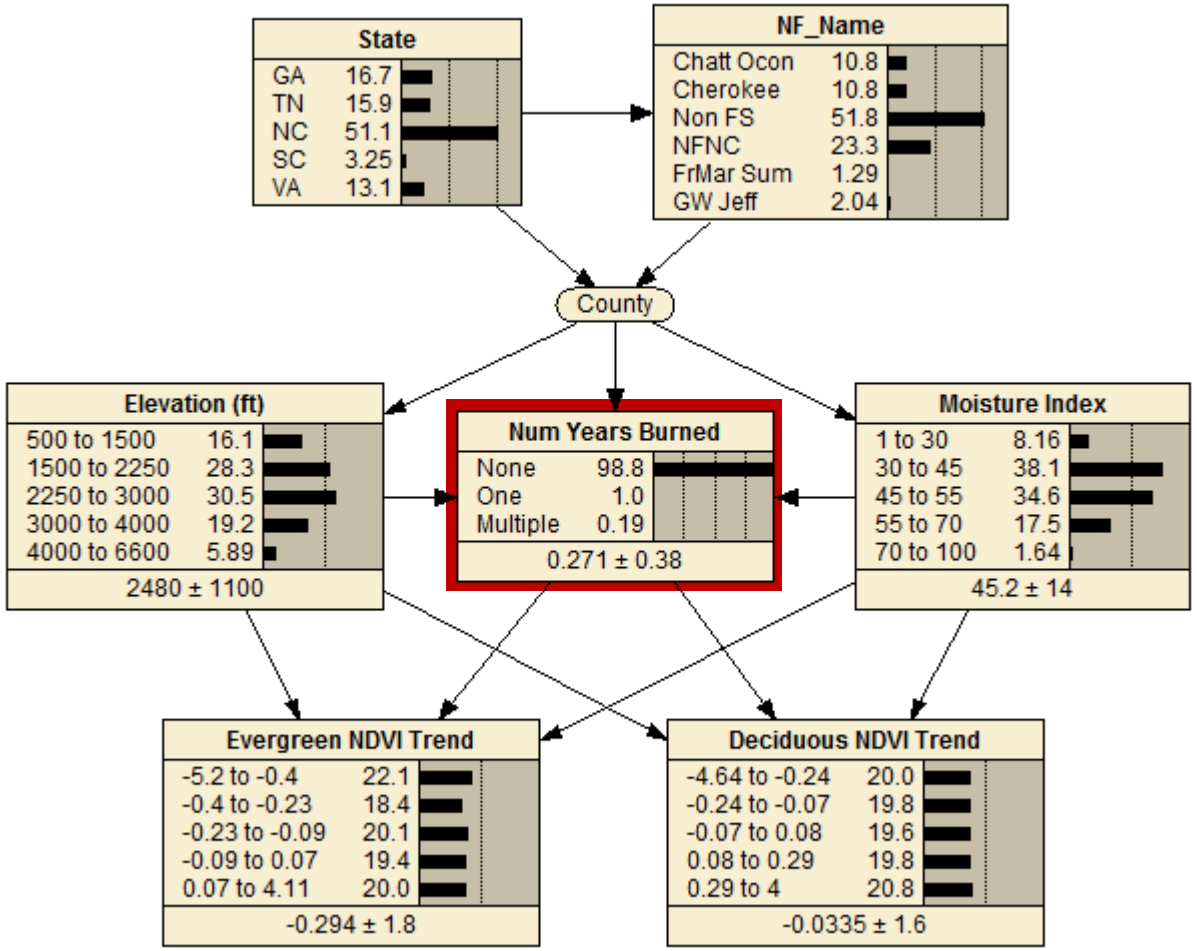
3. Monitoring successional fuels and vegetation

Logging recovery, Greenville County SC



3. Monitoring successional fuels and vegetation

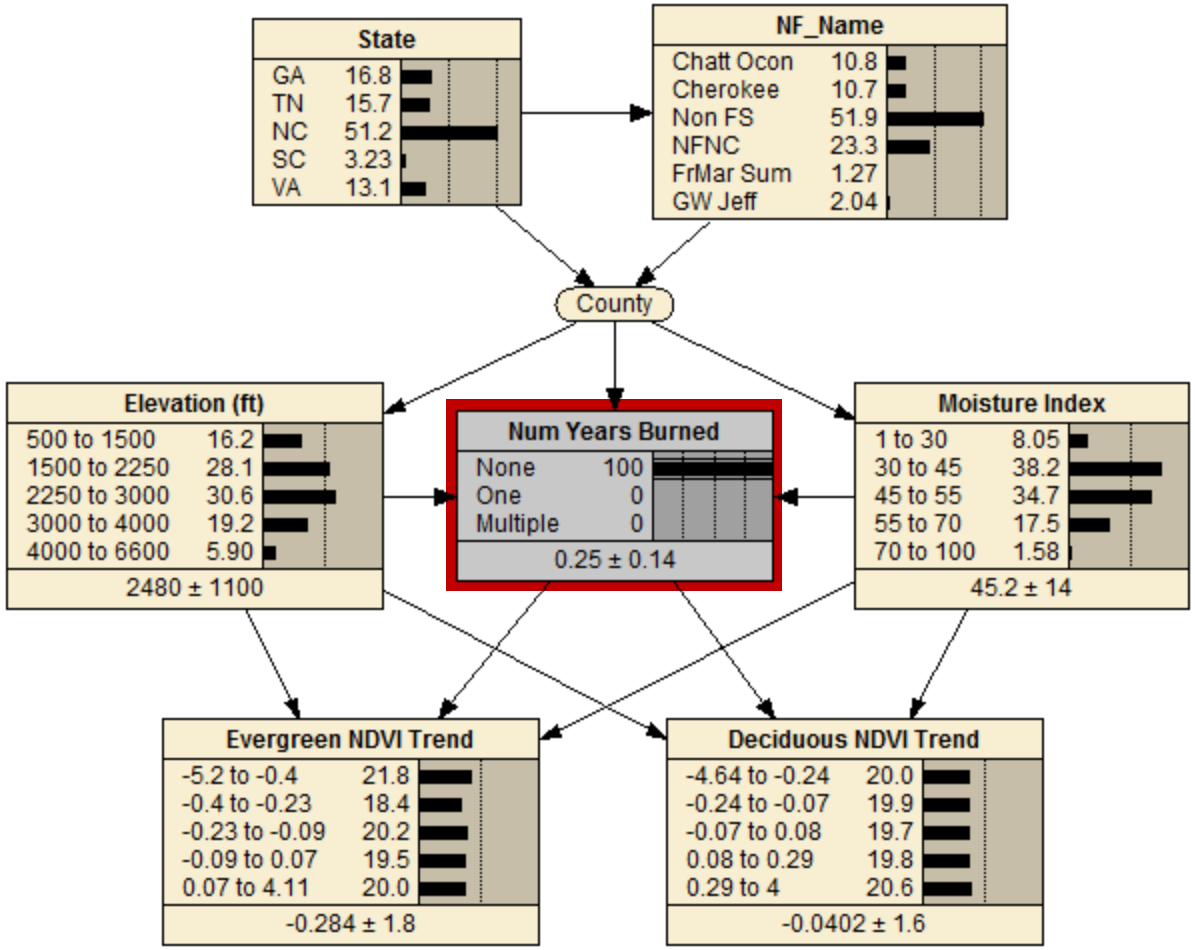
Not just cell-by-cell insights, but of landscape pattern: Modeling the probability of greenness trends across the Blue Ridge Region



N = 803,000 MODIS cells

3. Monitoring successional fuels and vegetation

Not just cell-by-cell insights, but of landscape pattern: Modeling the probability of greenness trends across the Blue Ridge Region



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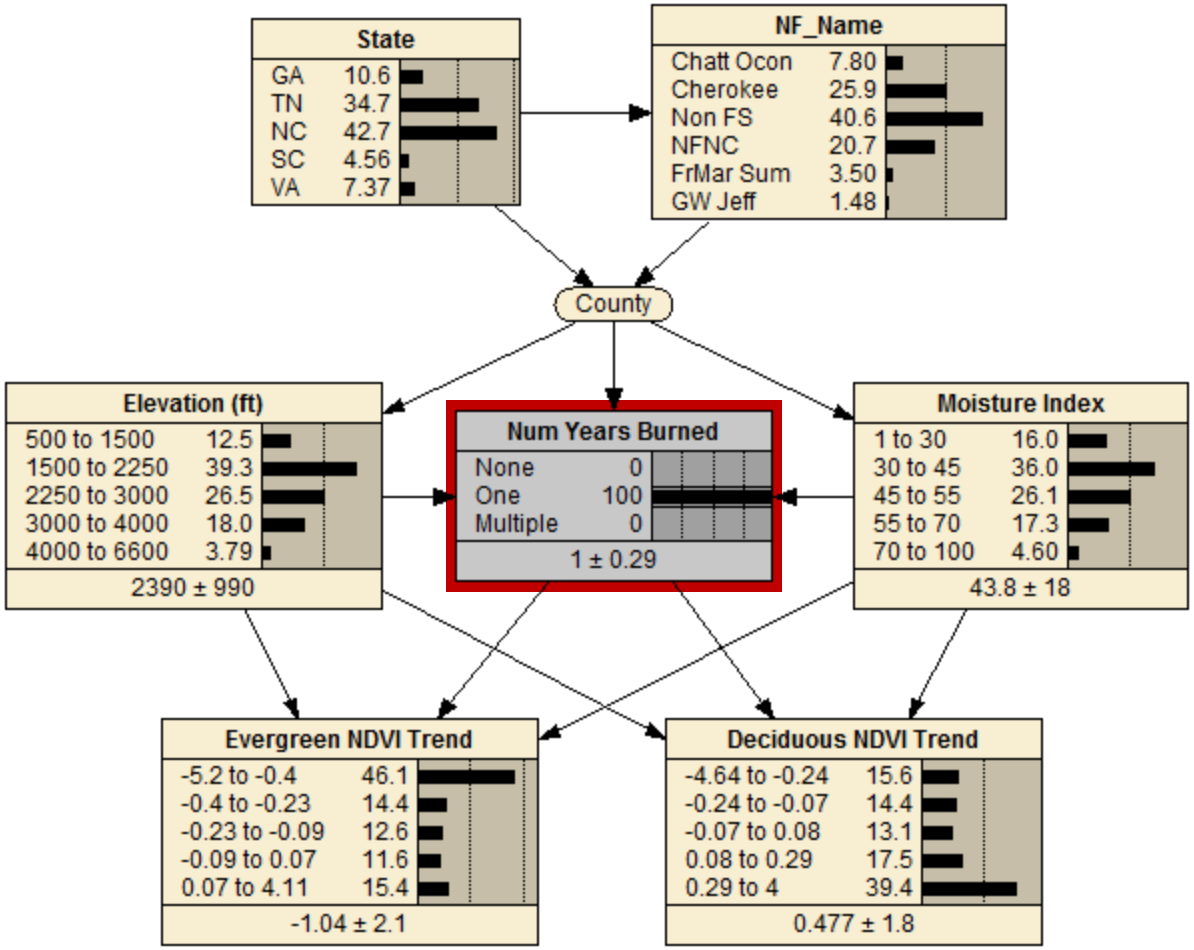

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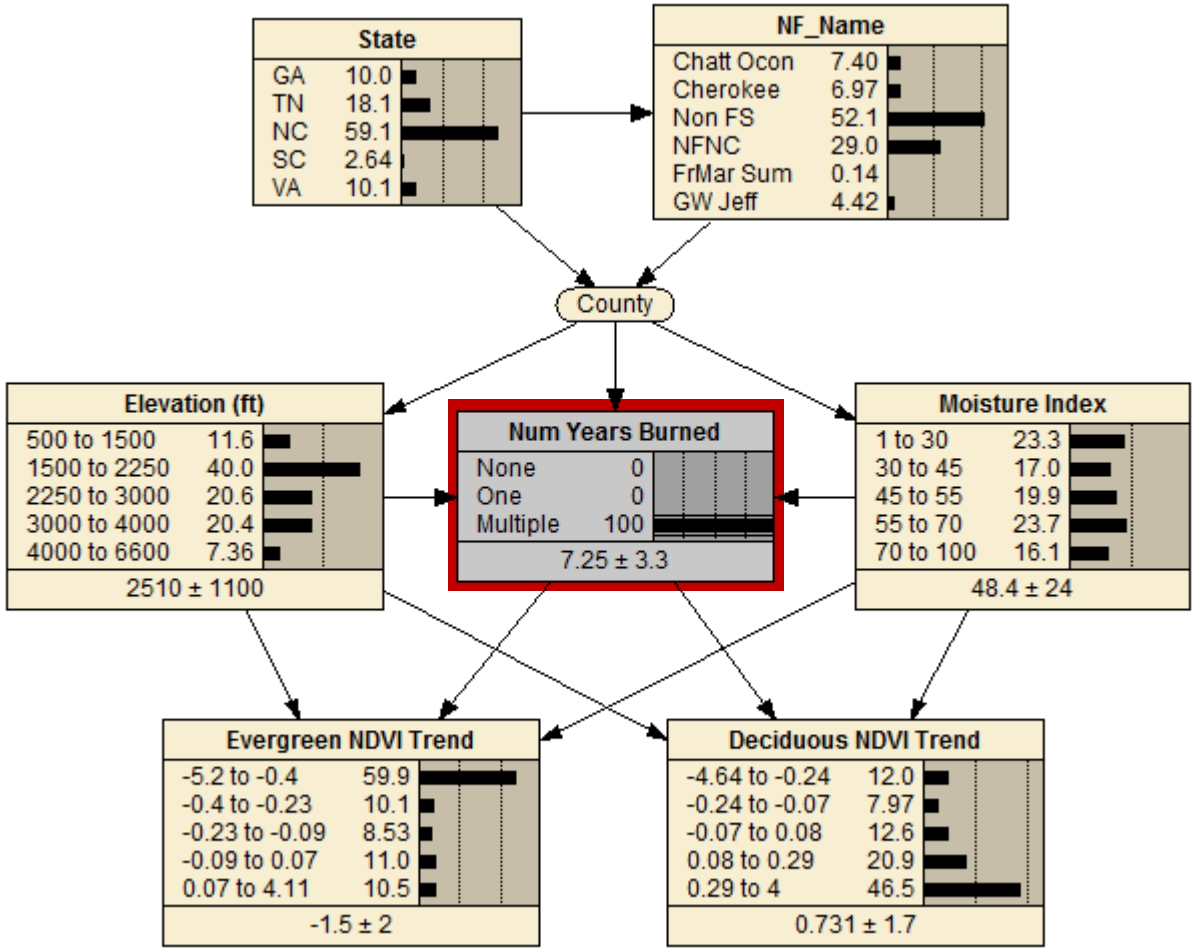
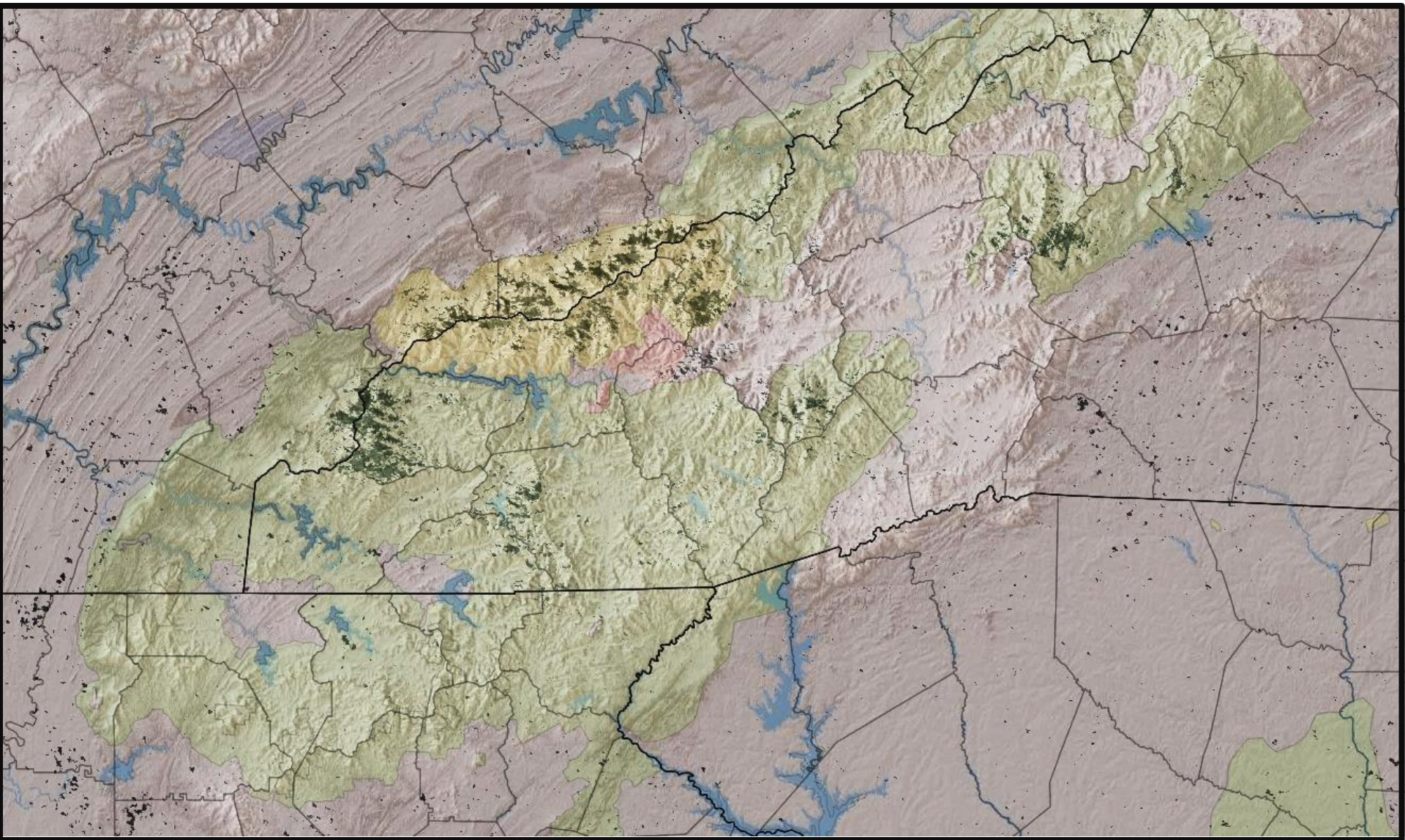


N = 803,000 MODIS cells

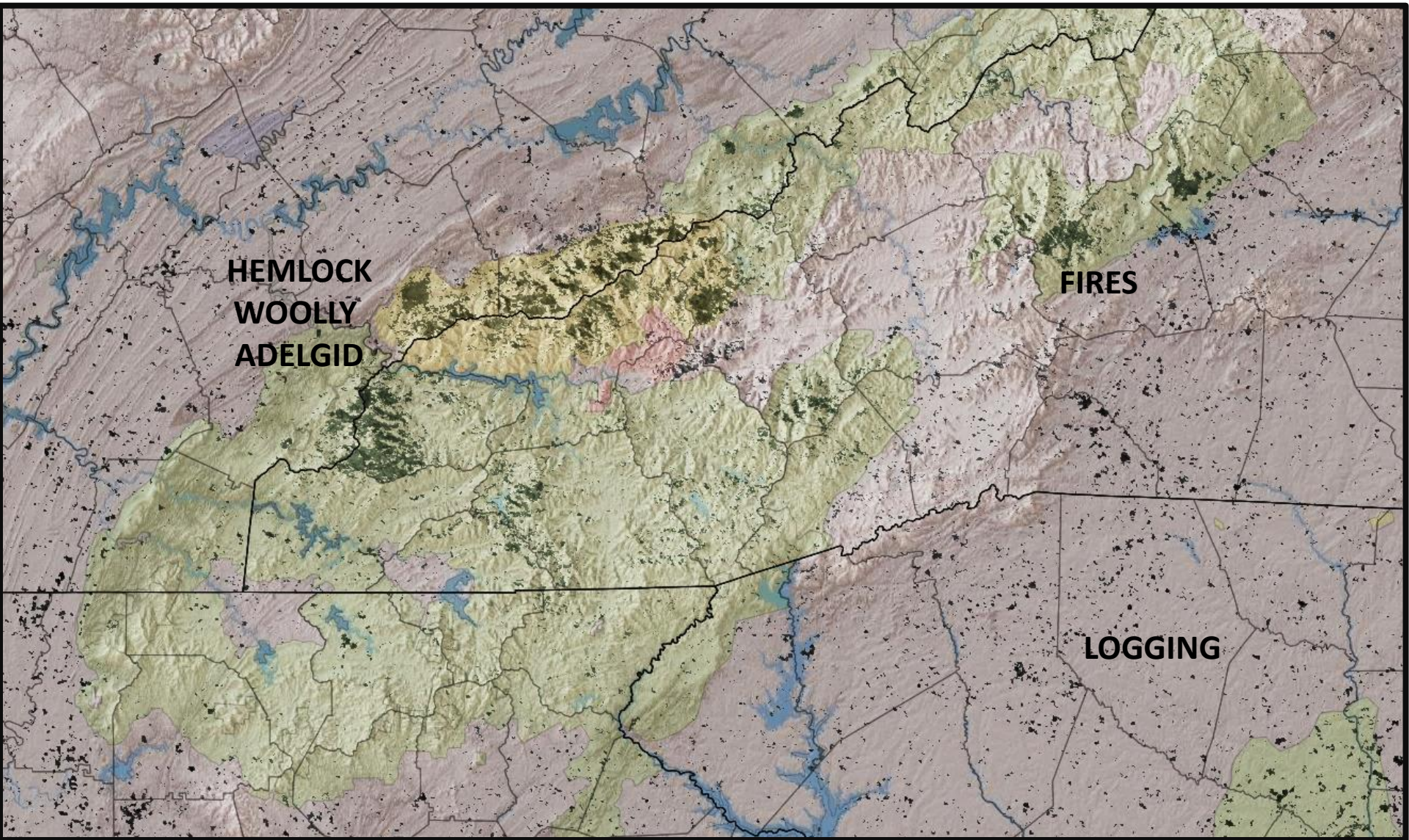
3. Monitoring successional fuels and vegetation

Modeling deciduous increase, 2000-2010

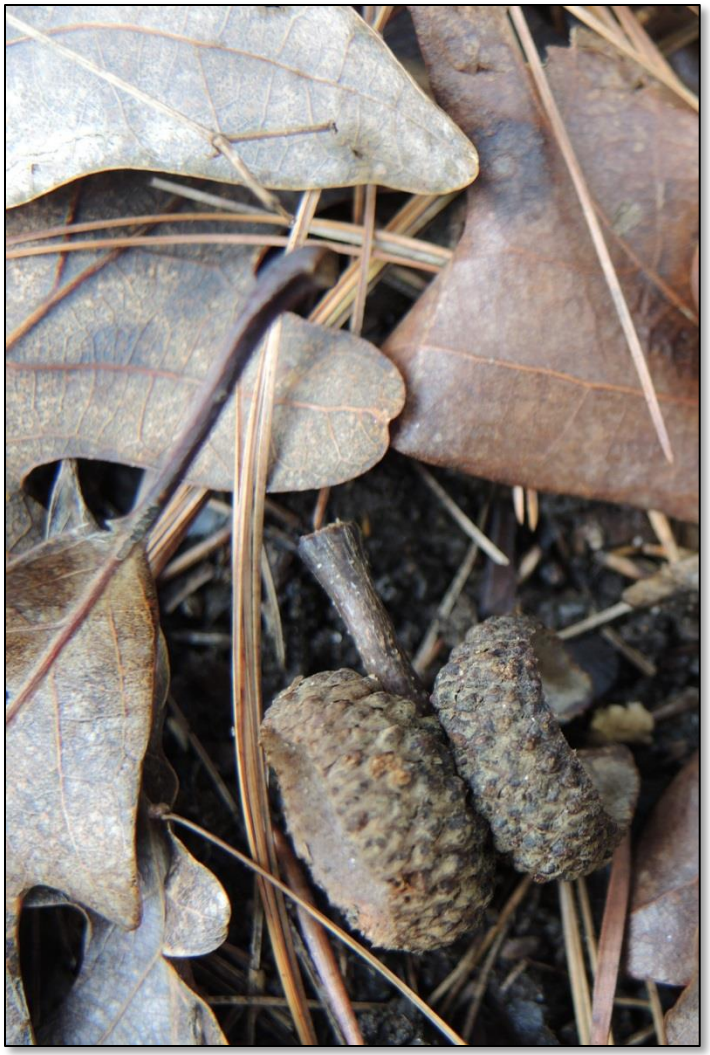


3. Monitoring successional fuels and vegetation

Modeling evergreen decline, 2000-2010



Summation



ForWarn's NDVI data provides both near-real - time and retrospective monitoring insights into seasonal, event and successional fuel dynamics.

The data convey annualized fire effects that can be broken out seasonally to discern easily confounded evergreen and deciduous trends. These conditions can be coarsely associated with desired conditions across broad landscapes.

For more, contact:
stevenorman@fs.fed.us
USDA Forest Service
Eastern Threat Assessment Center, Asheville, NC