The effects of climate variability on vegetation phenology across Great Smoky Mountains National Park

US Forest Service FFACCTs
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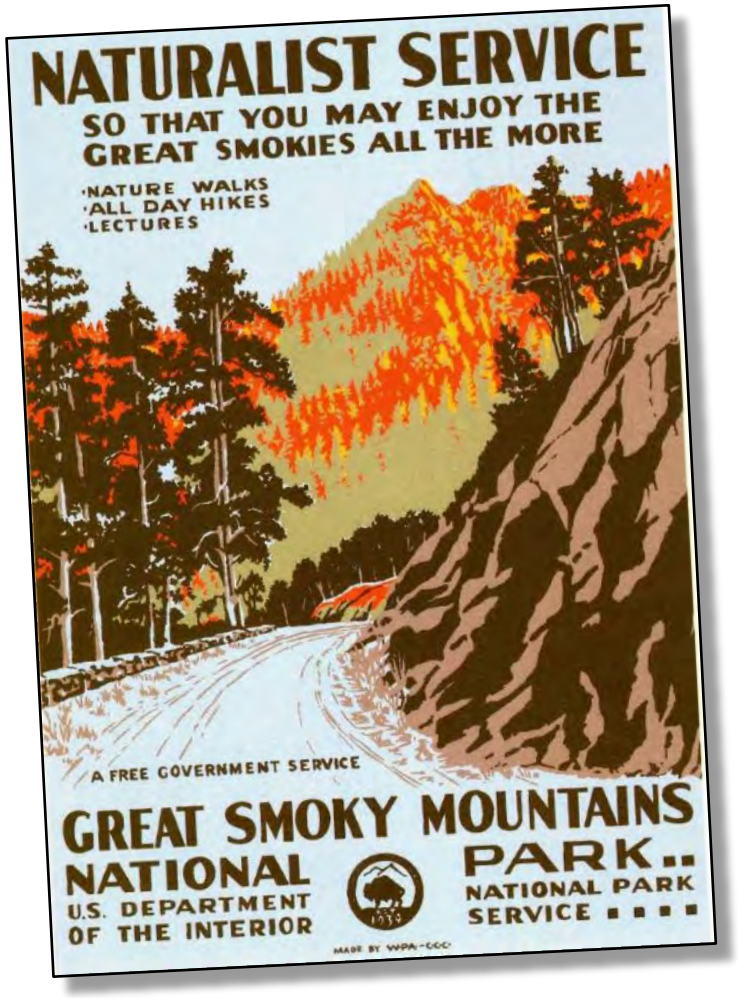
Why monitor vegetational phenology?



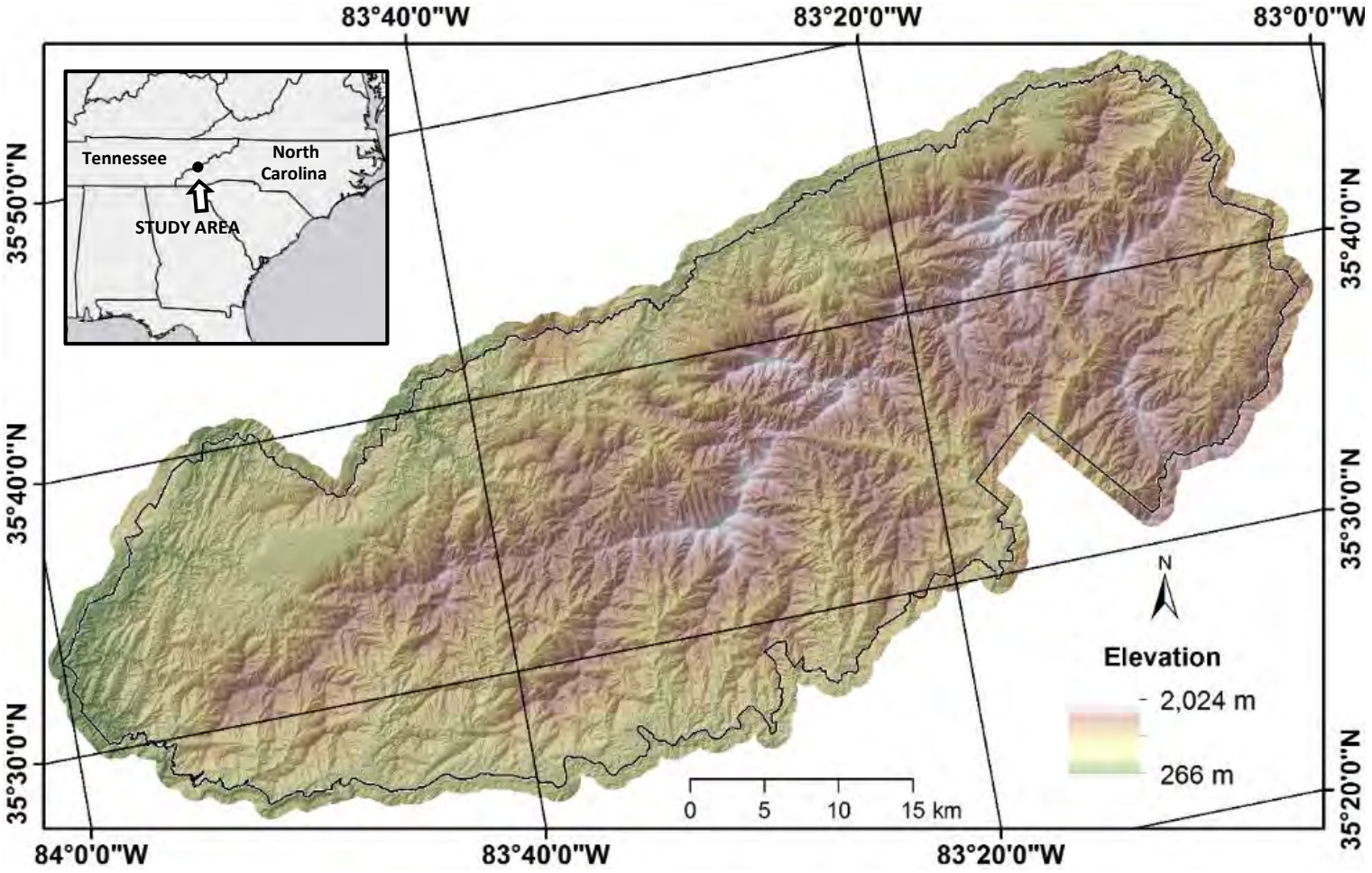
Phenological values include spring flowering, wildlife, and fall foliage: these are sensitive to seasonal climate variation.

Climate-mediated phenology impacts disturbance dynamics and growing season productivity.

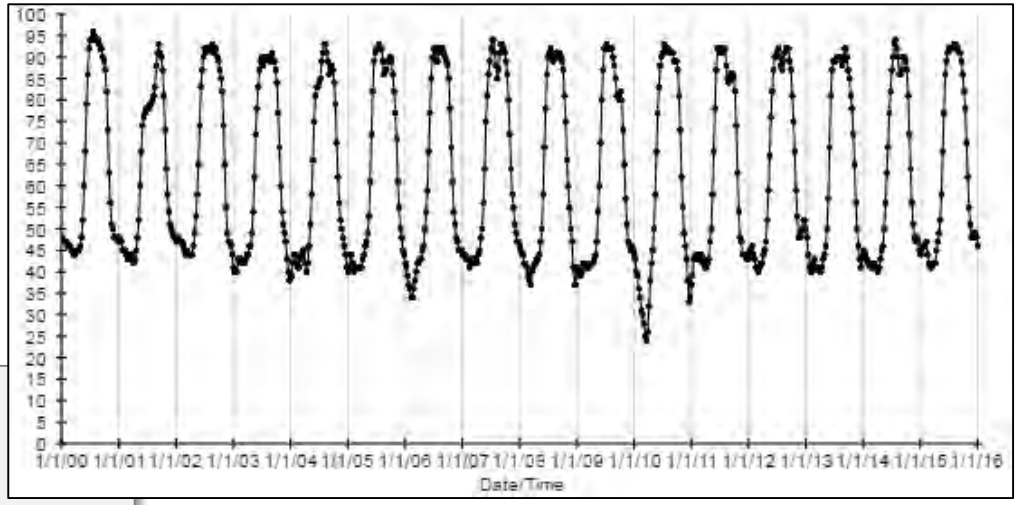
Research questions

- What is the fundamental nature of the Park's land surface phenology (LSP) gradients?
- How and why does spring and autumn LSP vary from year to year?
- What do observations tell us about our ability to monitor LSP and its response to climate change?

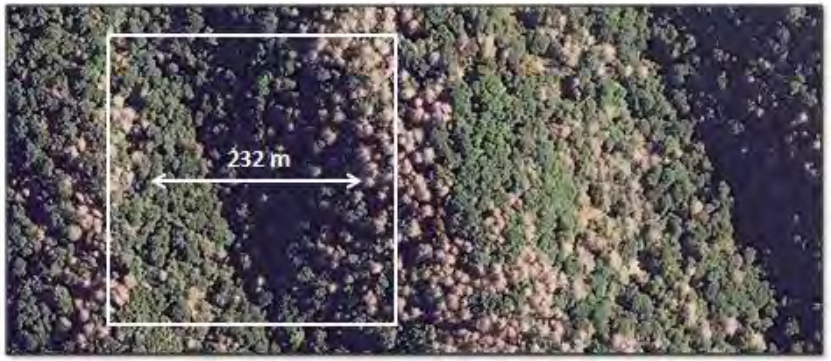
Great Smoky Mountains National Park



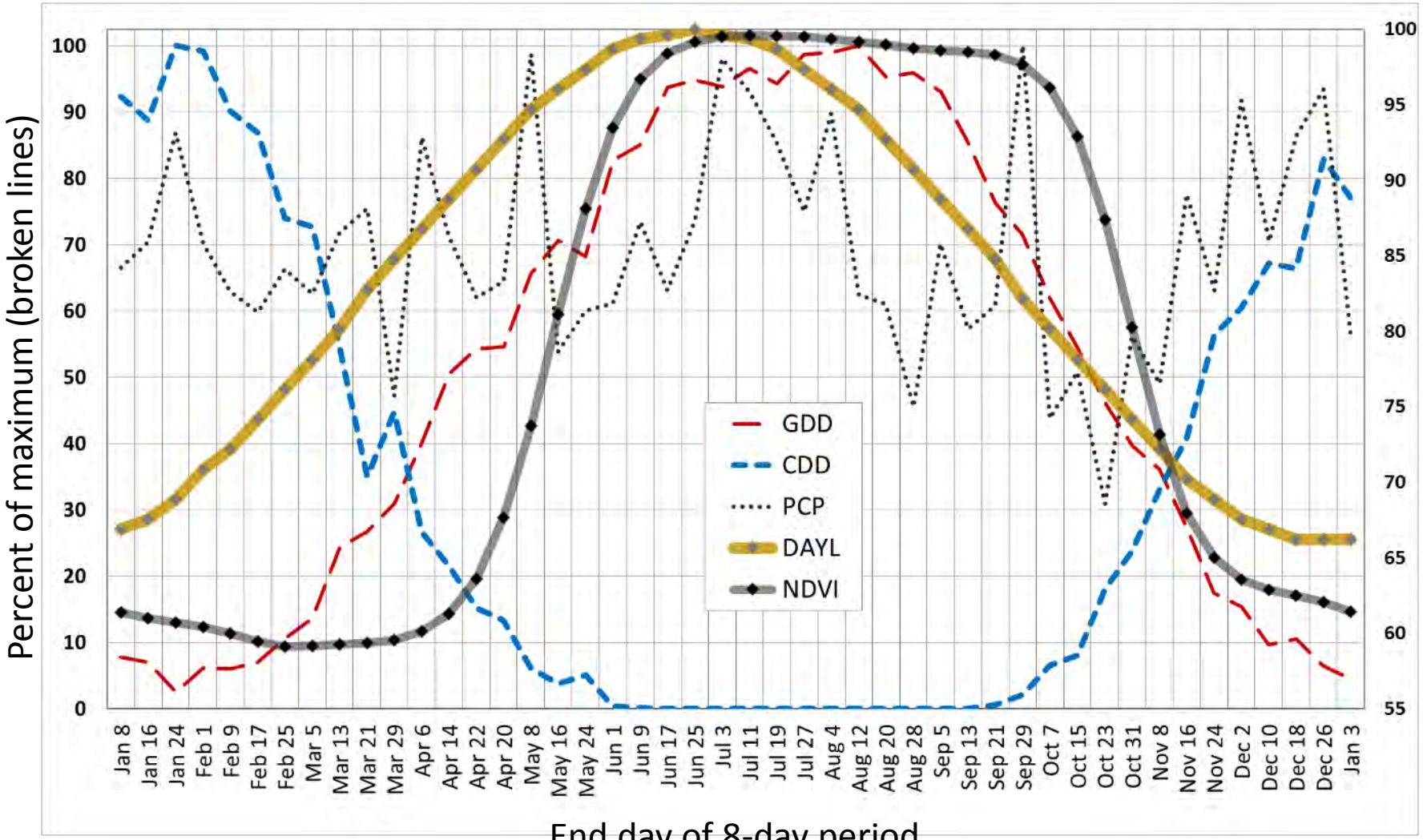
The *ForWarn* dataset



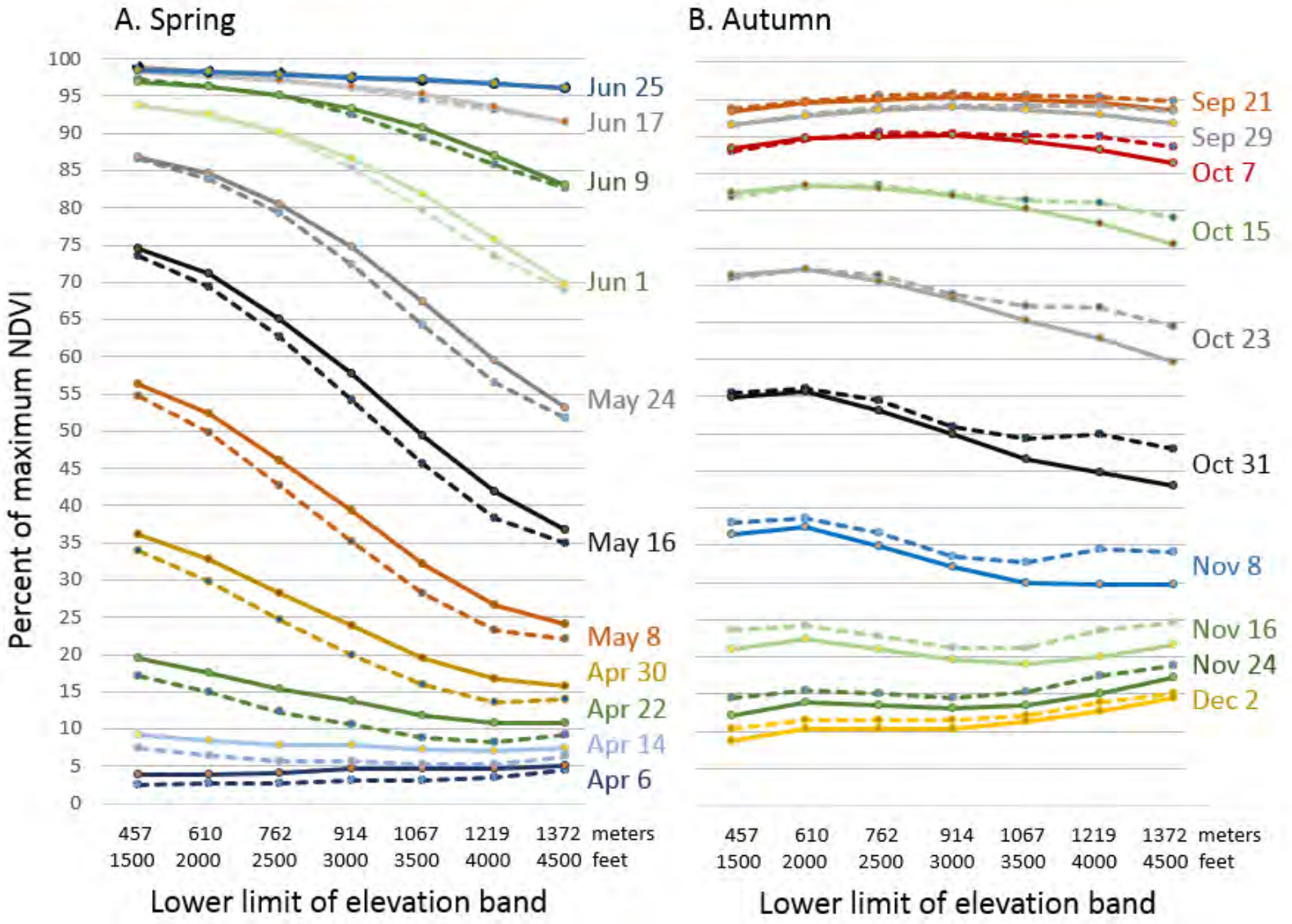
- Uses NDVI (the Normalized Difference Vegetation Index)
- From daily MODIS satellite streams (Terra and Aqua satellites)
- Pixels are 232 m resolution (13.4 ac.)
- Calculated at 8-day time steps (46 periods per year)
- Highly processed to remove clouds and other image quality issues
- Starts in 2000; through a year ago
- Near-real-time change products are online at: http://forwarn.forestthreats.org



The context of phenology with respect to daylength, temperature, precipitation within Great Smoky Mountains NP

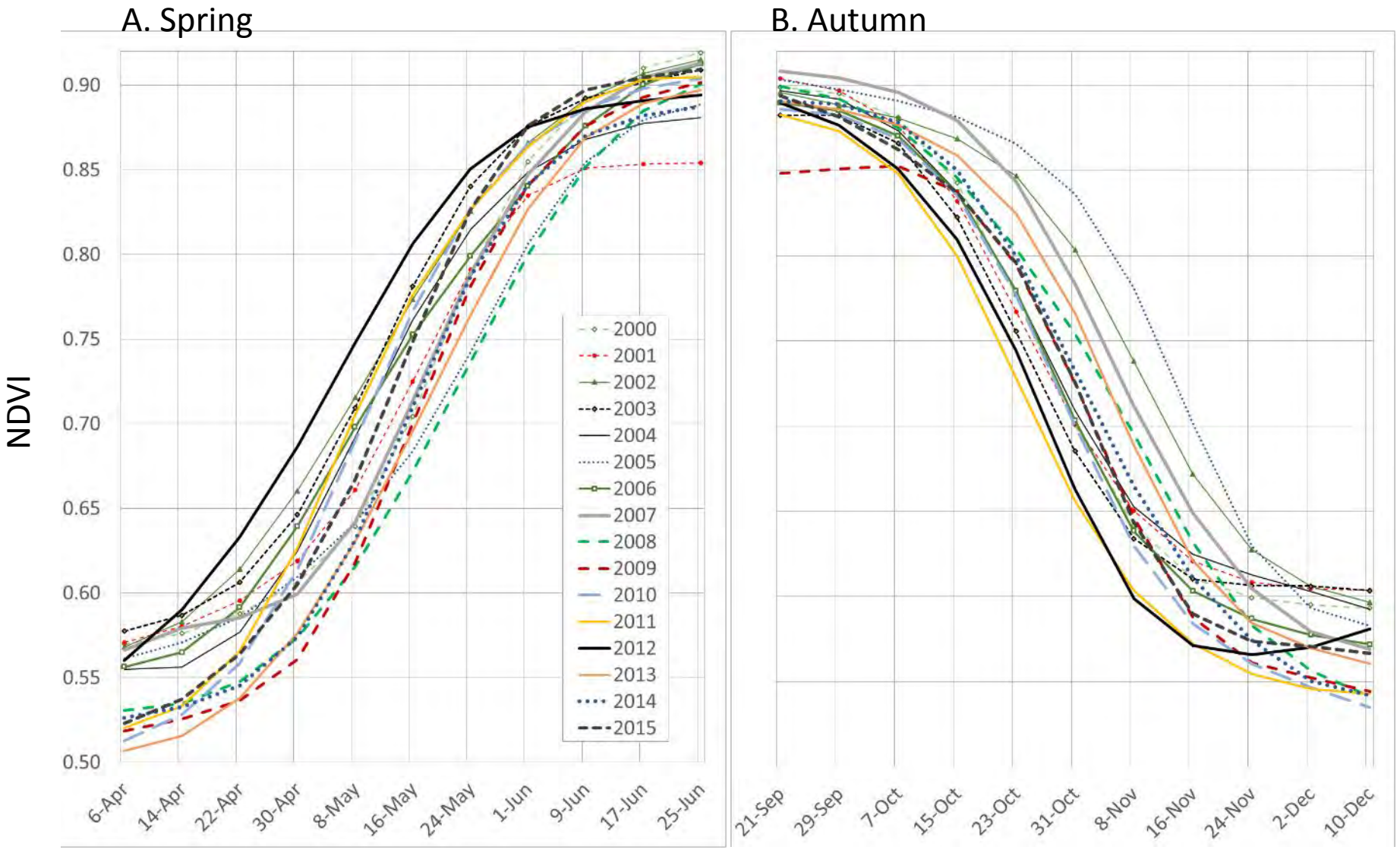


Long-term mean phenological behavior across the Park by elevation and solar radiation



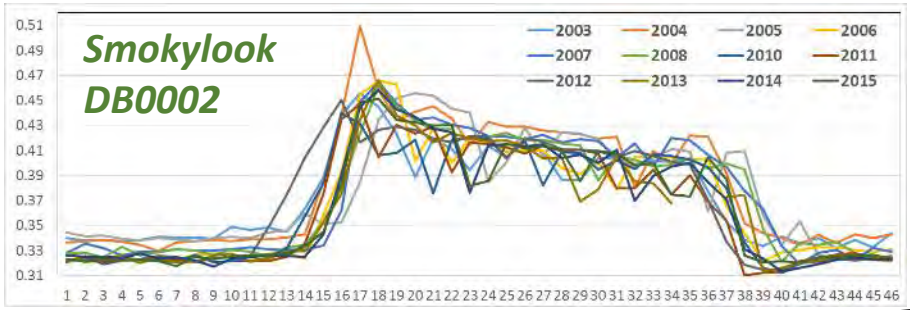

April 20, 2015
Tulip poplar
White oak

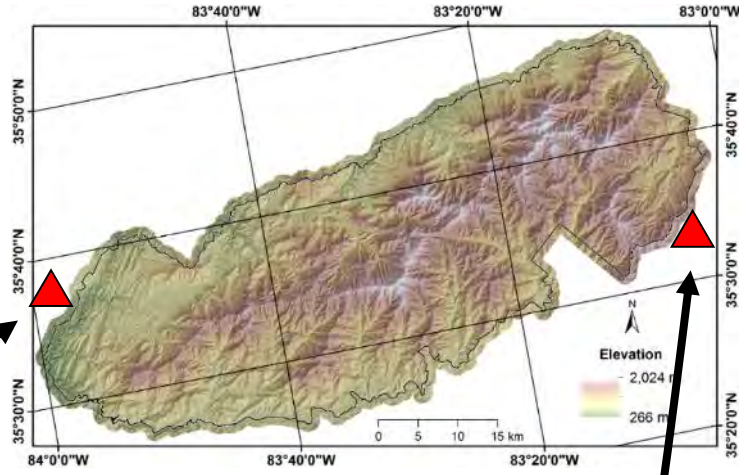
Timing of spring and autumn from MODIS NDVI, 2000-2015



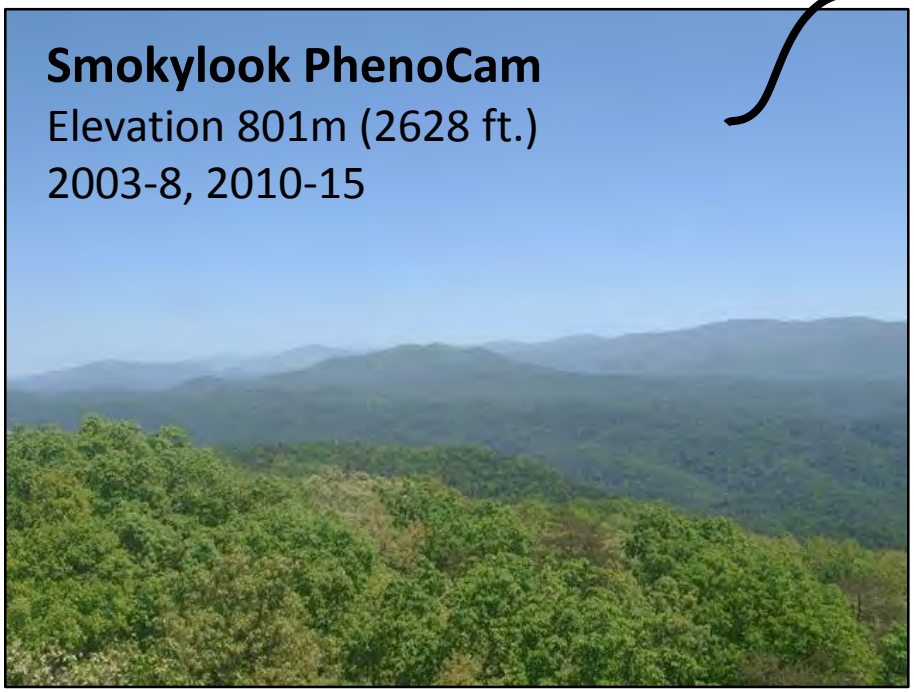
Comparison of MODIS NDVI with other data: The PhenoCam Network's green chromatic coordinate (gcc)

https://phenocam.sr.unh.edu/webcam/



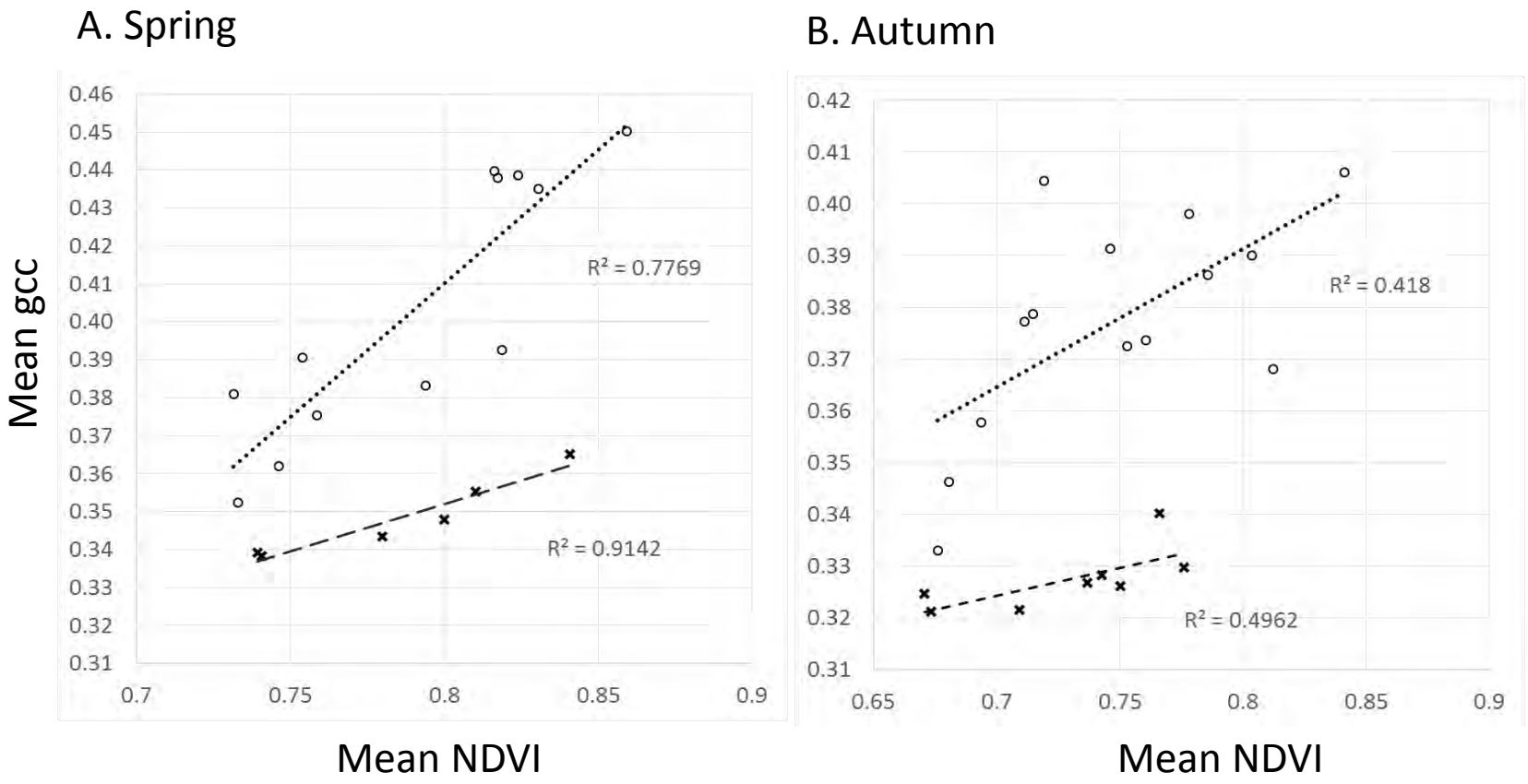


Smokylook PhenoCam
Elevation 801m (2628 ft.)
2003-8, 2010-15

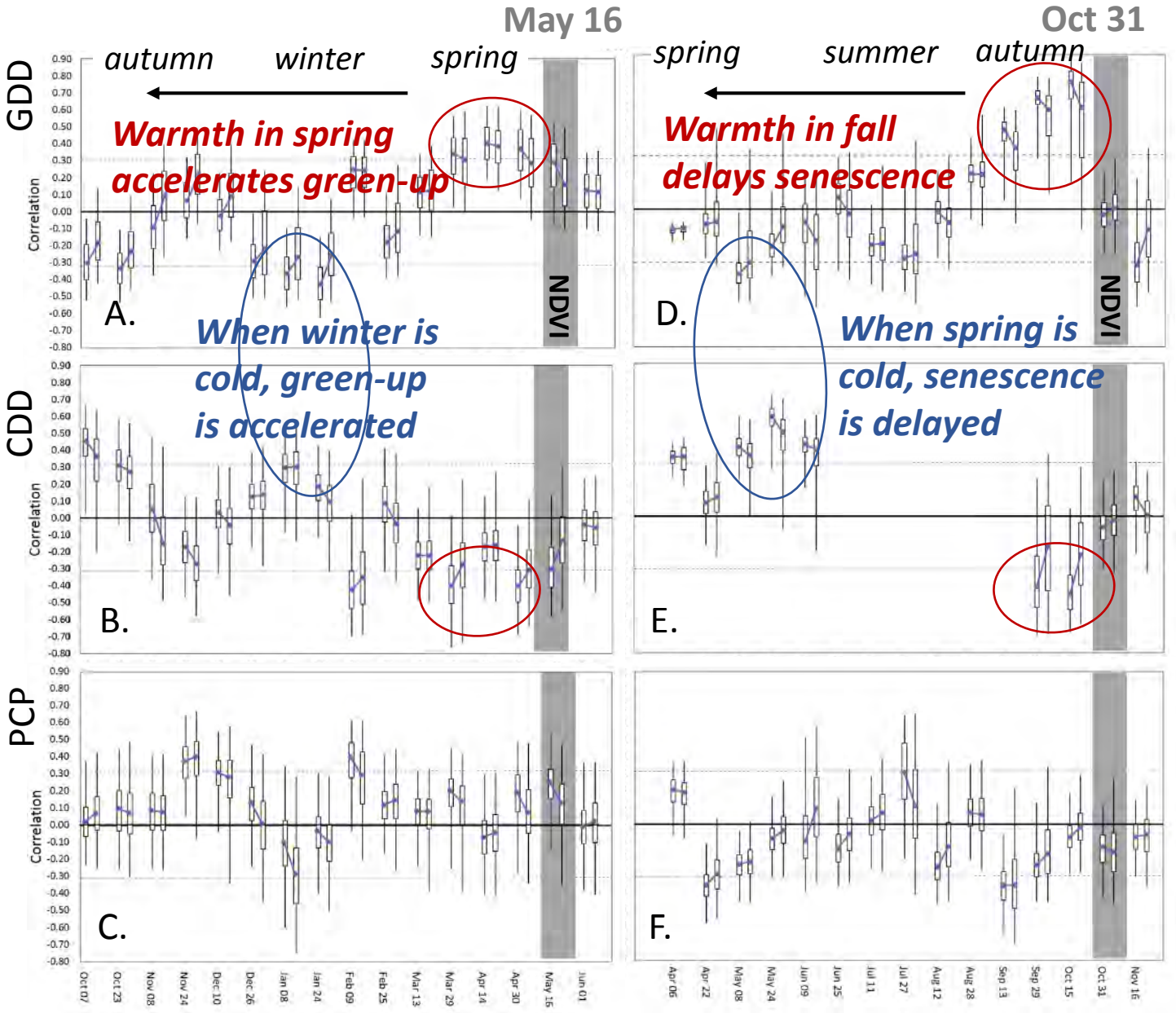


Smokypurchase PhenoCam
Elevation 1550m (5085 ft.)
2008-2015

Comparison of MODIS-NDVI with PhenoCam green chromatic coordinate (gcc)



Correlation distributions of spring and autumn NDVI with lagged antecedent 24-day weather by cover type

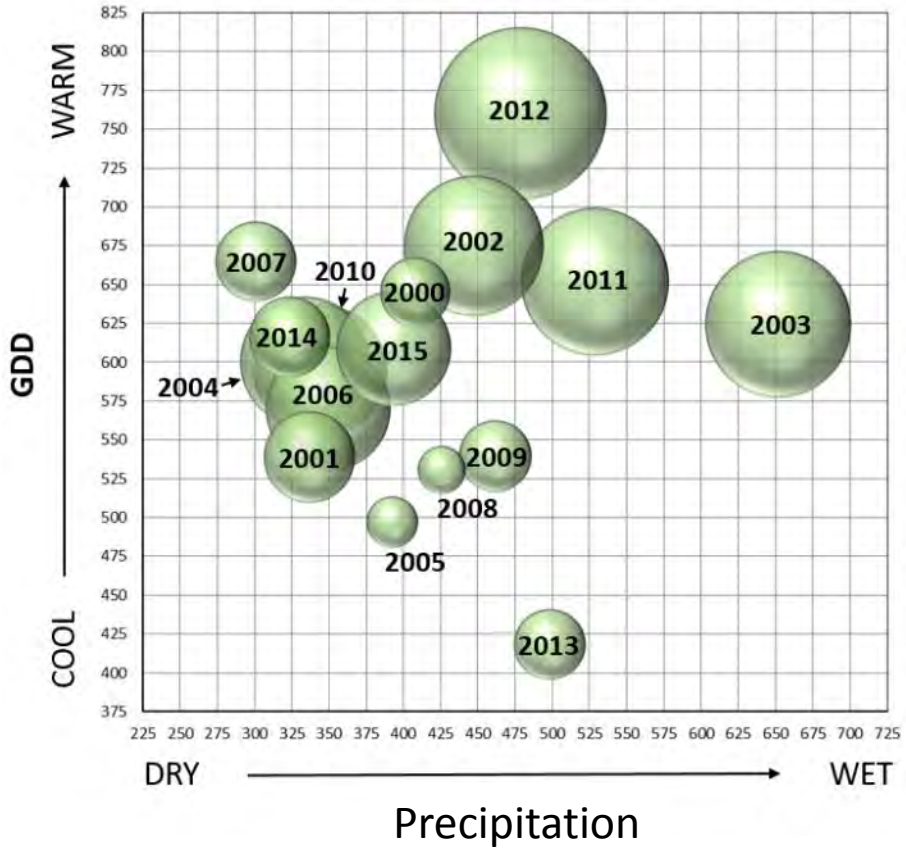


Deciduous distribution (left)
Conifer/Mixed distribution (right)

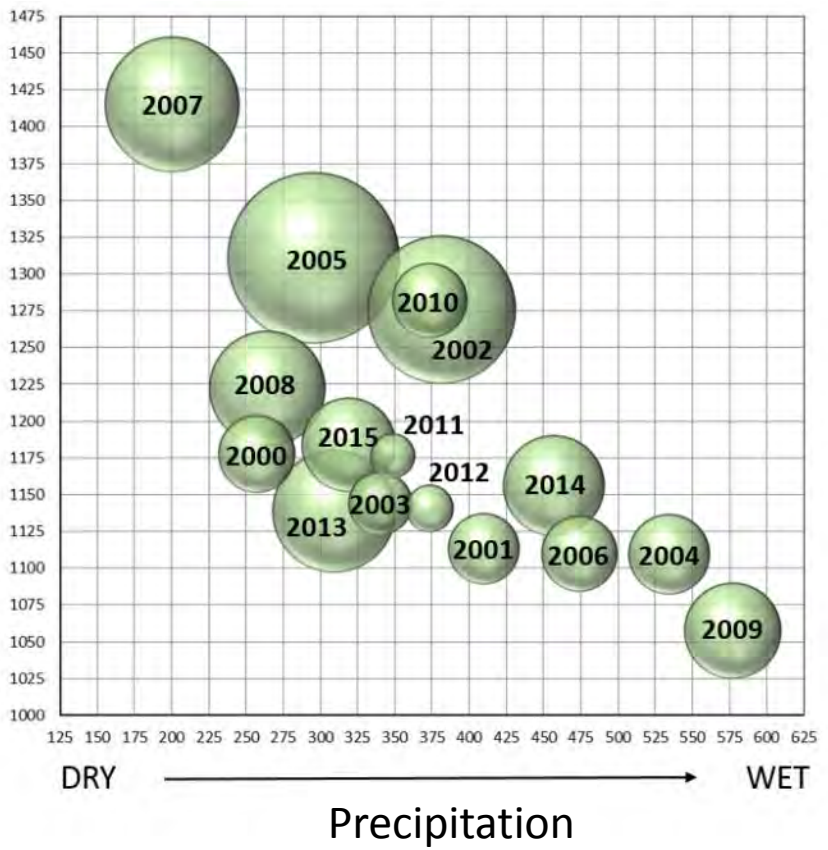
The 1st, 25th, 50th, 75th and 99th percentiles are shown by each box plot

Effects of cumulative growing degree days and precipitation (over 88 days) on spring and autumn NDVI

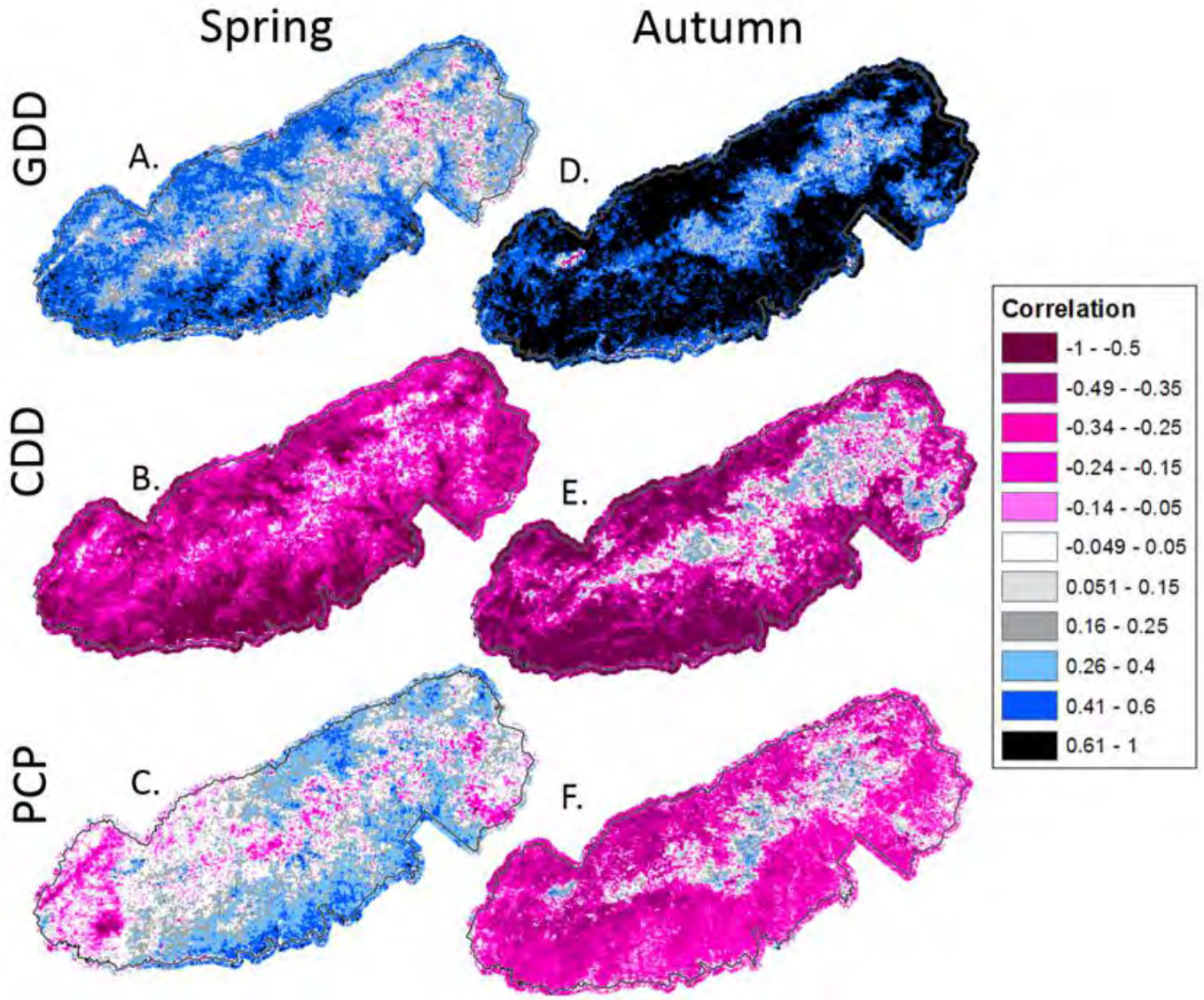
A. Spring (May 16 period)



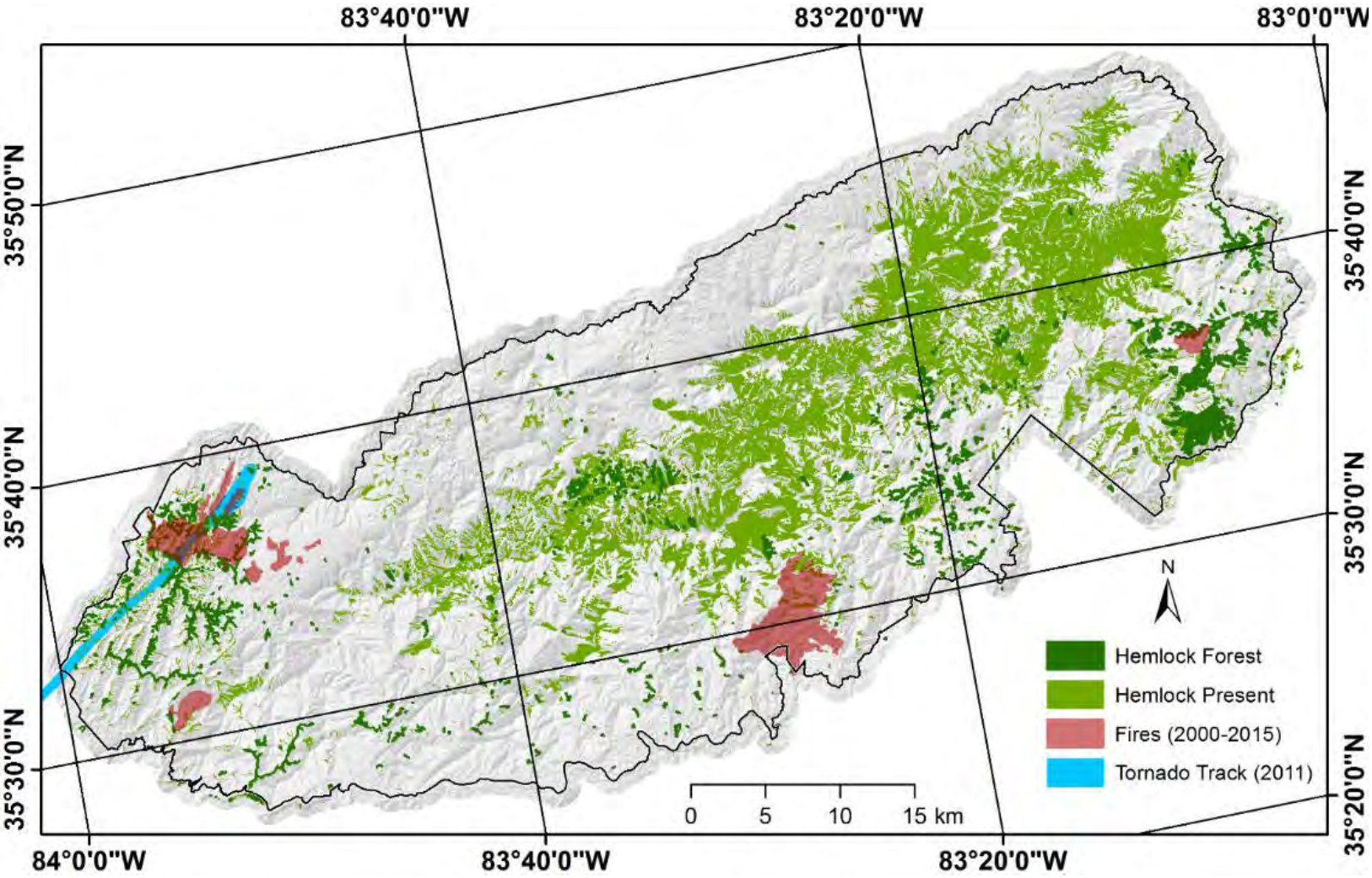
B. Autumn (Oct. 31 period)



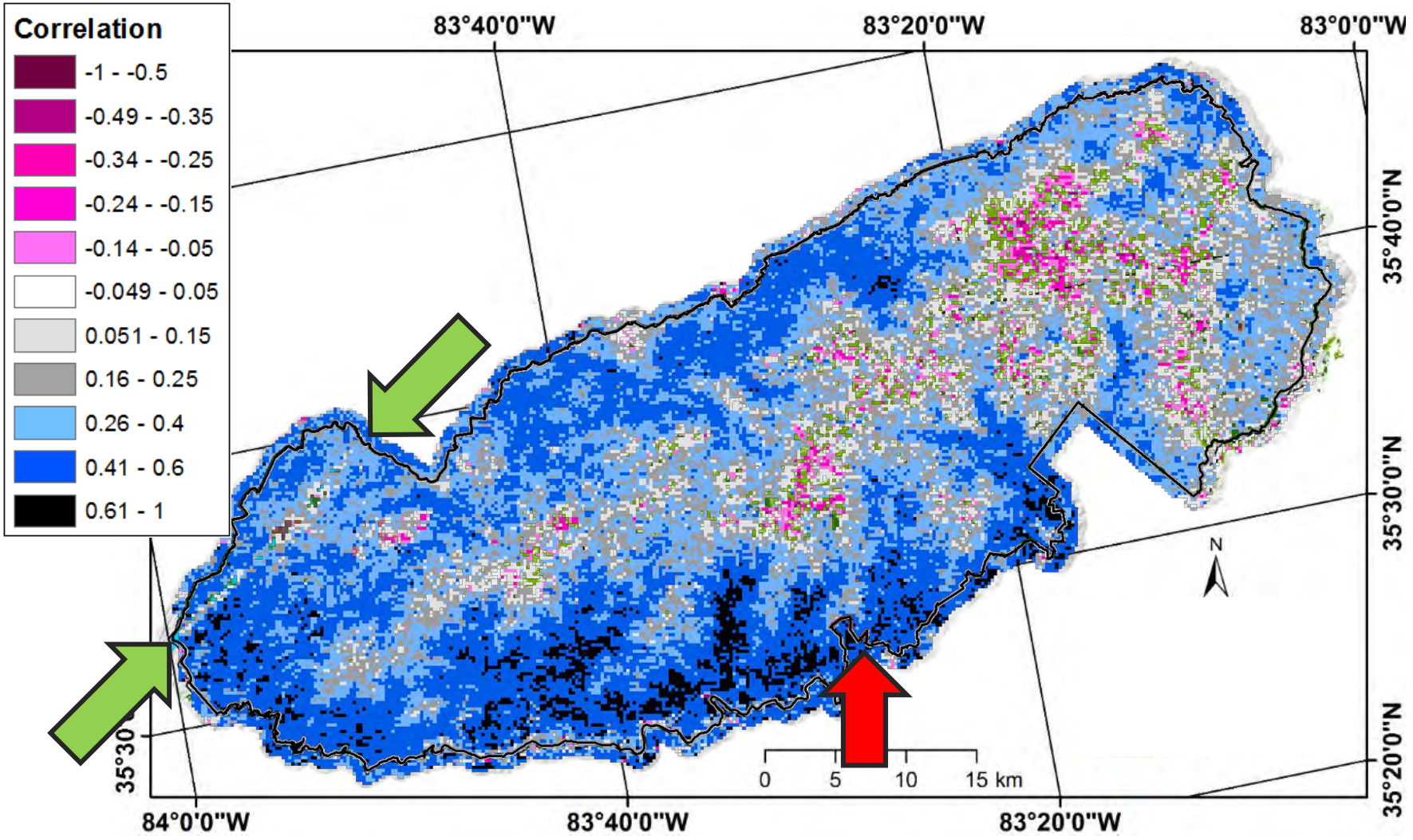
Mapped correlations of spring and autumn NDVI with lagged weather



Areas of disturbance within Great Smoky Mountains National Park, 2000-2015



Mapped correlations of spring NDVI with antecedent growing degree days, 2000-2015



Summary of results

- Elevation is the primary driver of Land Surface Phenology (LSP) for the Park, with a secondary, though important influence of aspect and vegetation type.
- Satellite-based measures of LSP capture how spring timing can vary as it progresses, and that green-up and brown-down have varied by about 2.5 weeks over these 16 years.
- Warm-wet spring weather accelerates green-up, while warm-dry or average fall weather delays senescence, with potential cross seasonal lags in both seasons.
- Disturbances can confound our ability to monitor LSP, but we can deal with this problem through aggressive use of ancillary data filtering.