



Satellite Derived Deciduous Understory Heat Maps of Post- Thin Stands

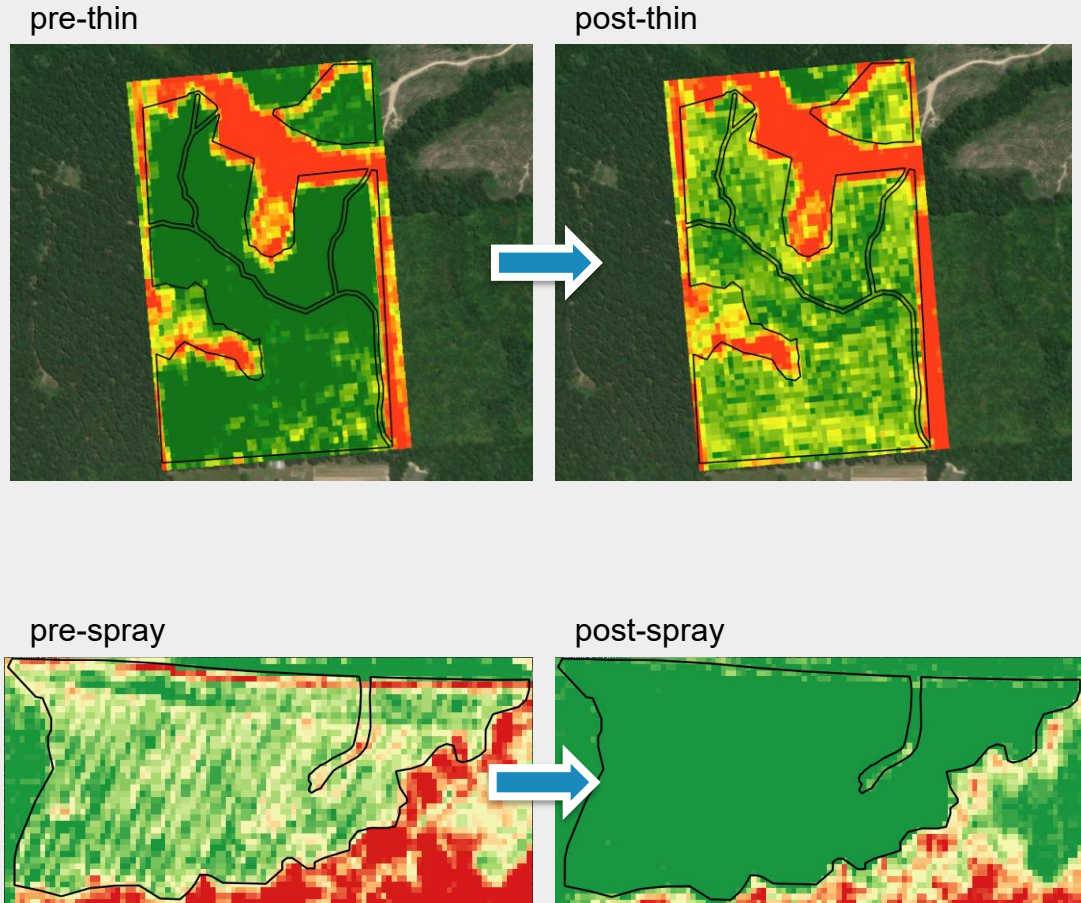
William Skinner – Forest Planning Analyst

Heat Map Creation

Process

- Google Earth Engine's Python API + ESA Sentinel-2 imagery
- Deciduous vegetation leaves flush in the early spring
- Spike in leaf area can be compared to the more stable evergreen LAI
- Comparison ("leaf-on/leaf-off") is used to produce a raster layer of deciduous understory
- Assist in mid-rotation spraying, & evaluate treatment + contractor QA/QC

Examples



Credit's Due

Forest Productivity Coop:

- Dr. Andrew Trlica (NC State)
- Dr. Matthew Sumnall (VT)
- Methods from 2012 paper:
 - Christine E. Blinn
 - Timothy J. Albaugh
 - Thomas R. Fox
 - Randolph H. Wynne
 - Jose L. Stape
 - Rafael A. Rubilar
 - H. Lee Allen

FOREST PRODUCTIVITY COOPERATIVE



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JOURNAL ARTICLE

A Method for Estimating Deciduous Competition in Pine Stands Using Landsat

Get access >

Christine E. Blinn, Timothy J. Albaugh, Thomas R. Fox, Randolph H. Wynne, Jose L. Stape, Rafael A. Rubilar, H. Lee Allen

Southern Journal of Applied Forestry, Volume 36, Issue 2, May 2012, Pages 71–78,

<https://doi.org/10.5849/sjaf.10-034>

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Methodology

Equations

- Simple ratio vegetation index (SR) = $p4/p3$
 - where p4 is the top of atmosphere (TOA) reflectance of the near-infrared band (Landsat Thematic Mapper (TM) band 4) and p3 is the TOA reflectance of the red band (TM band 3)
- Flores et al. (2006)* LAI equation:
 $LAI = 0.56(SR) - 0.83$
- Competing veg. LAI (CVLAI) equation:
 $CVLAI = \text{Spring LAI} - \text{Winter LAI}$
 - spring LAI is measured in early spring between late April and May, and winter LAI is measured in the winter between late December and February

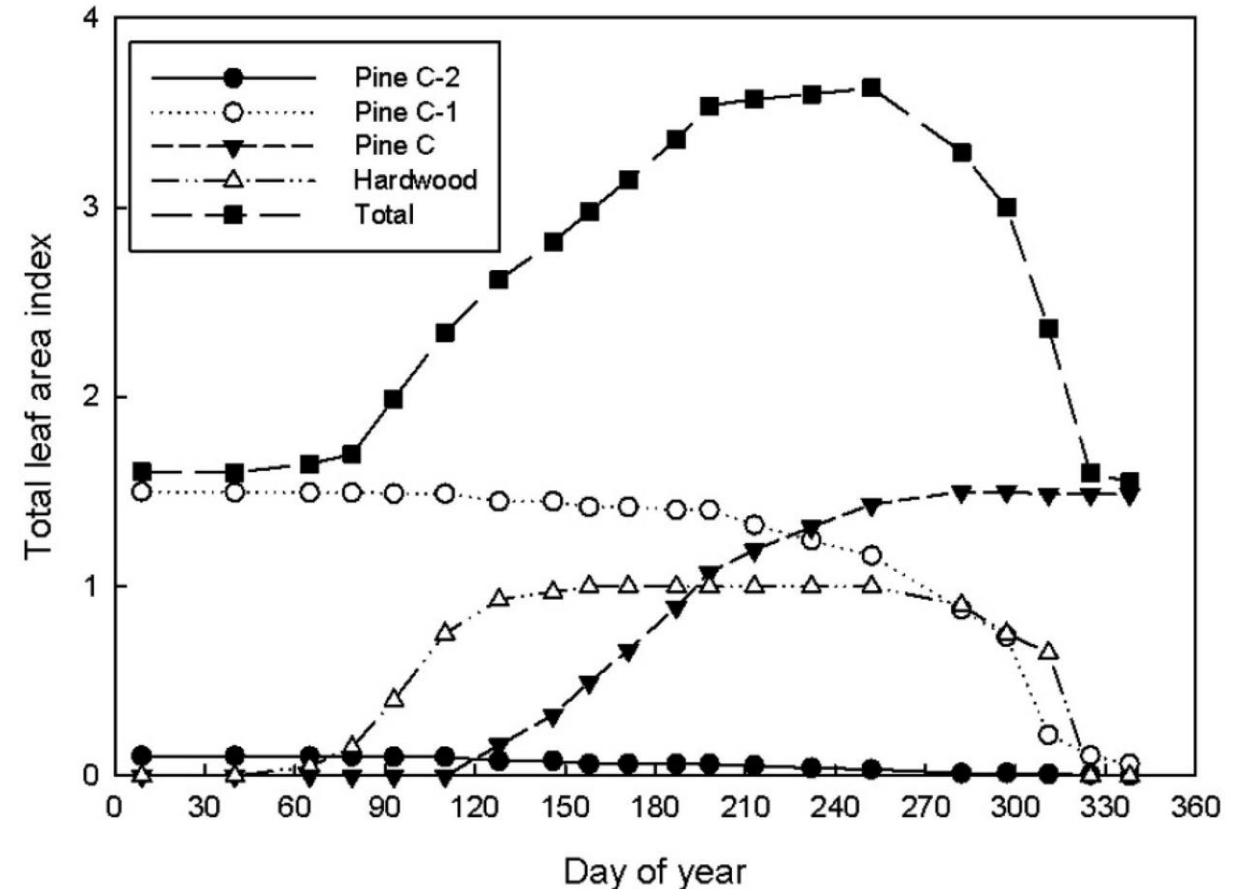


Figure 1. Seasonal dynamics of leaf area in a loblolly pine plantation. Pine C-2 is the 2-year-old needle cohort, pine C-1 is the 1-year-old needle cohort, pine C is the current year needle cohort, hardwood denotes the hardwood foliage, and total is the total leaf area for the entire stand (Blinn et al., 2012).

*FLORES, F.J., H.L. ALLEN, H.M. CHESHIRE, J.M. DAVIS, M. FUENTES, AND D. KELTING. 2006. Using multispectral satellite imagery to estimate leaf area and response to silvicultural treatments in loblolly pine stands. *Can. J. For. Res.* 36(6):1587-1596.

Workflow

Identify Stands of Interest

- Obtain stands from foresters or query list
- Get zipped shapefiles (w/o .sbx & .shp.xml...)
- Use Geeadd (python package) to load shapes as assets in Google Earth Engine

Generate Raster Layers

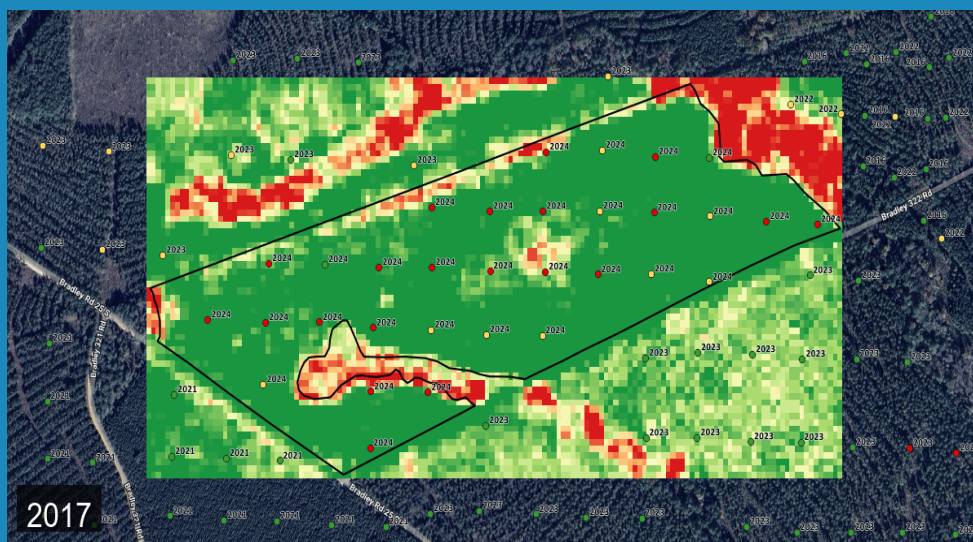
- Filter:
 - cloud cover
 - cloud shadows
 - snow
 - smoke
- Required to obtain two images per year of interest ("leaf-on/leaf-off")

Rerun? → Distribute maps

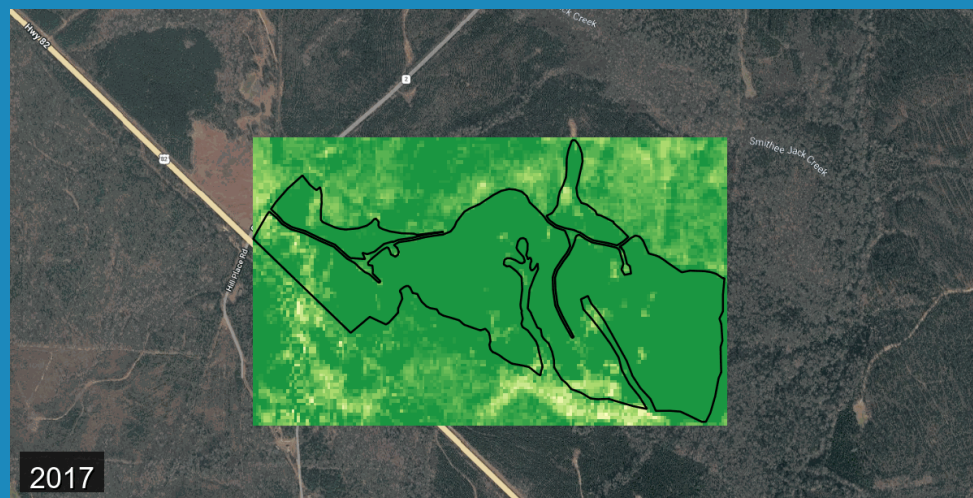
- Filtering may be too stringent, loosen:
 - cloud filter allowance
 - cloud probability threshold
 - seasonal date ranges
- Loosening only used for high elevation stands
- Add image dates for context

Geemap is another 'required' Python package. Geemap + Geeadd are a must to allow for automation of GEE tasks.

Stand was thinned in 2020 *not sprayed but crowns responded



Stand was thinned in 2022 & sprayed in 2024 *t-series



Limitations & Future Work

- Only for mid-rotation stands
 - satellite resolution
- Seasonality
 - “leaf-on/leaf-off”
- Cloud cover
 - high elevations
- Only deciduous understory
 - yaupon and waxy enemies
- Crop tree density and canopy cover
 - light thins or old thins
- Unexpected use: make sure SMZs don’t show up green post-spray

Thank you.
Questions?