

Using Earth Observations To Identify Areas of Oak Decline in Illinois and Investigate Contributing Risk Factors

Project Synopsis

In recent decades, a syndrome known as Rapid White Oak Mortality (RWOM) has led to a pronounced decline in the health and stand density of White oak woodlands (*Quercus alba*) across the Midwestern United States. The limited studies available on RWOM point to a complex of drivers, but the dynamics of decline remain elusive. Researchers at the Morton Arboretum have ongoing projects to determine decline factors and plan conservation measures for White oak woodlands in the Shawnee National Forest and Kaskaskia River Basin. In our study, we utilized NASA Earth observations, GIS technologies, and programming to detect changes in vegetation health and assess its correlations to climatic and topographic variables.

Objectives

DETECT

vegetation health changes

DERIVE

decline variables

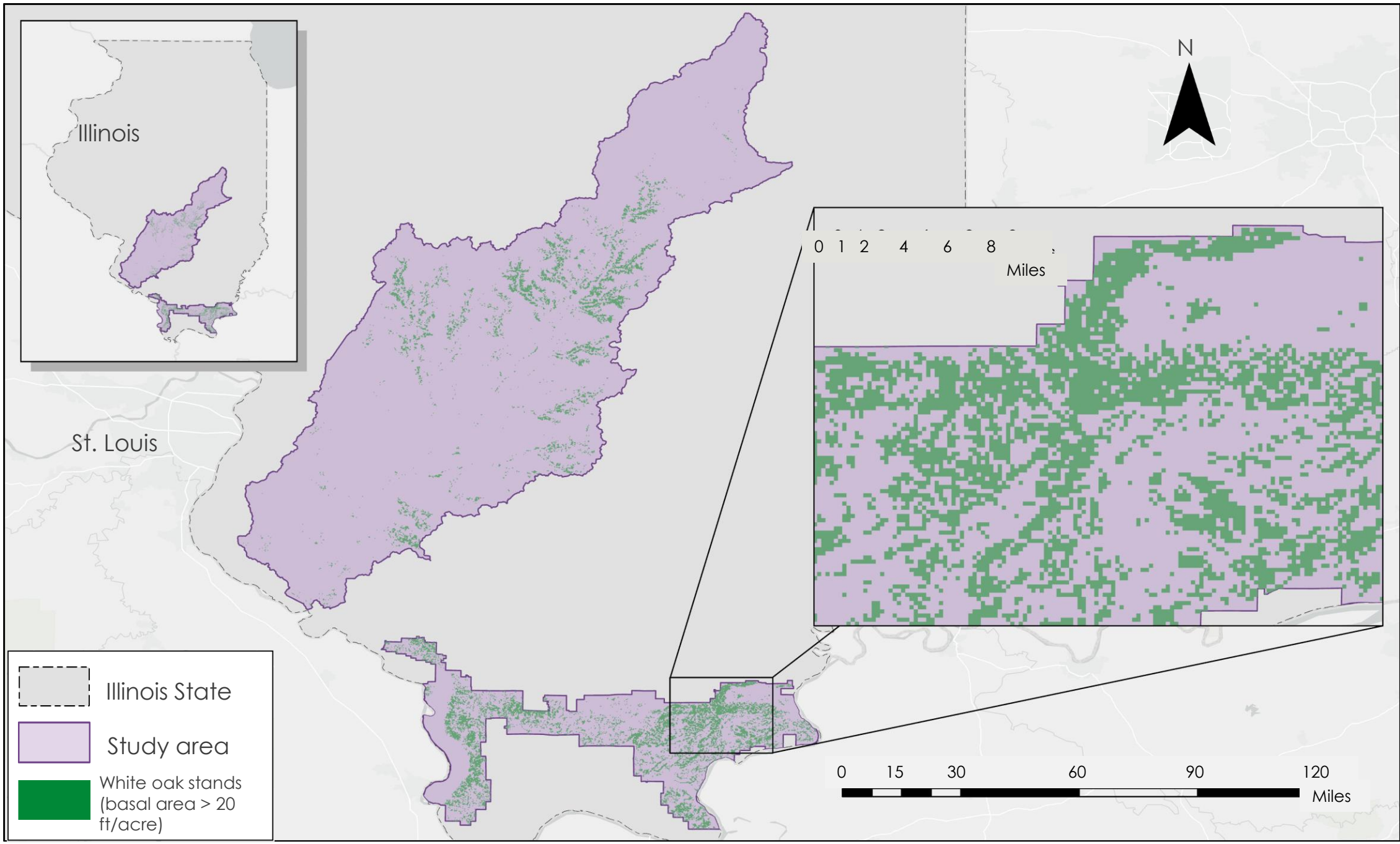
ASSESS

vegetation health & potential risk variable relationships

CREATE

a present-day risk map

Study Area



Methodology

Topographic Variables

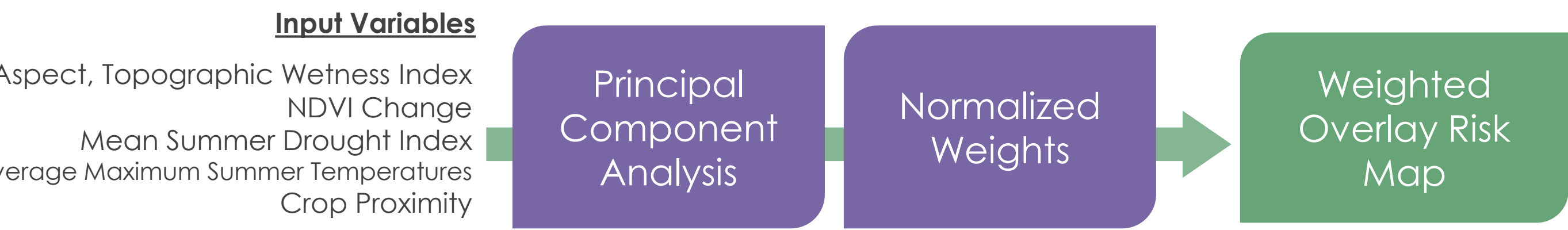
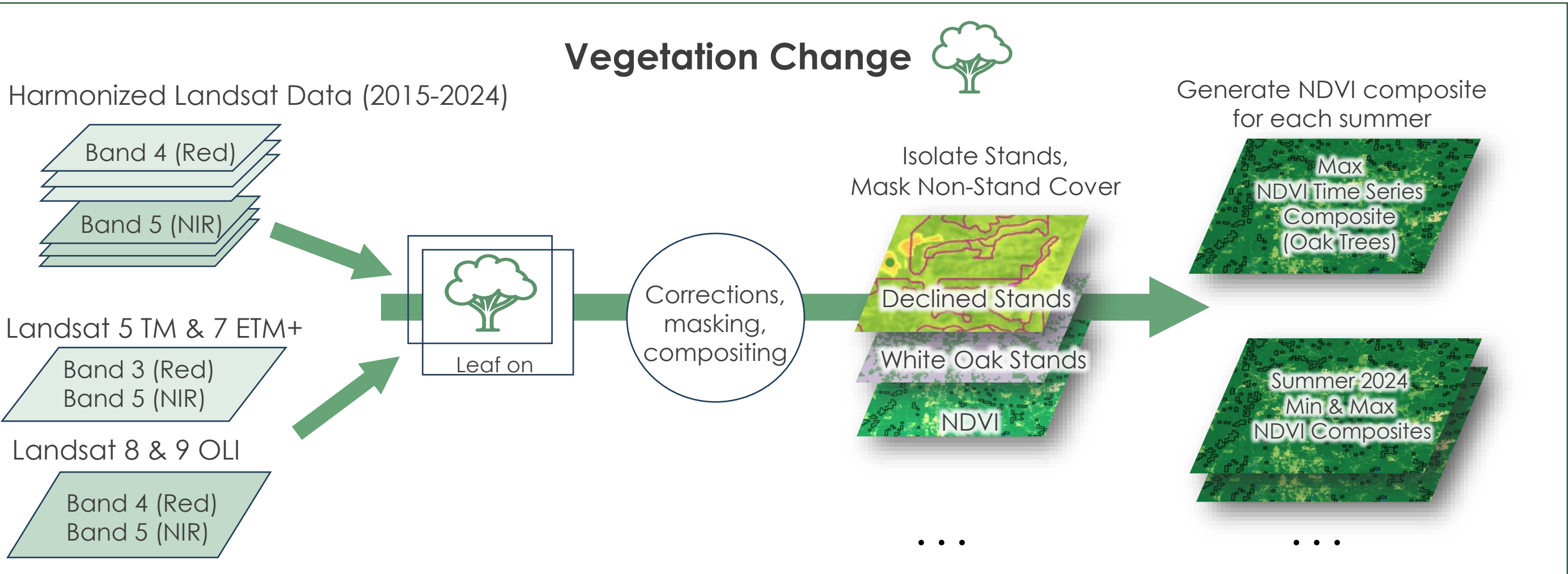
Aspect, Slope, Topographic Wetness Index Maps

Climate Variables Time Series

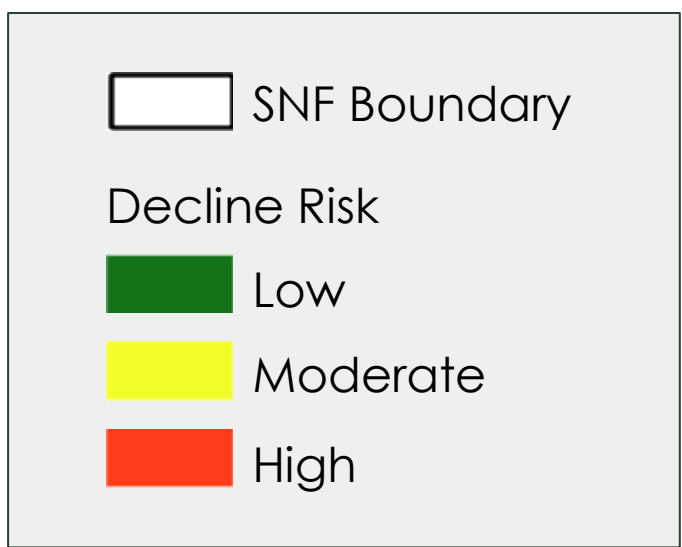
Standardized Precipitation Index, Max Summer Temperatures Time Series Maps

Cropland Proximity

Oak Stand Distances to Commercial Cropland Maps



Results



- Principal Components**
- 1) Topographic Moisture Gradient:** Steep, dry slopes contrast with flat, wet areas – pointing to moisture as a key factor in oak health
 - 2) Temperature-vegetation relationship**
Areas of high summer temperatures show notable vegetation changes and reduced precipitation
 - 3) Agricultural Interface**
Commercial crop proximity emerges as a distinct pattern, representing areas where agricultural land use interfaces with oak habitat

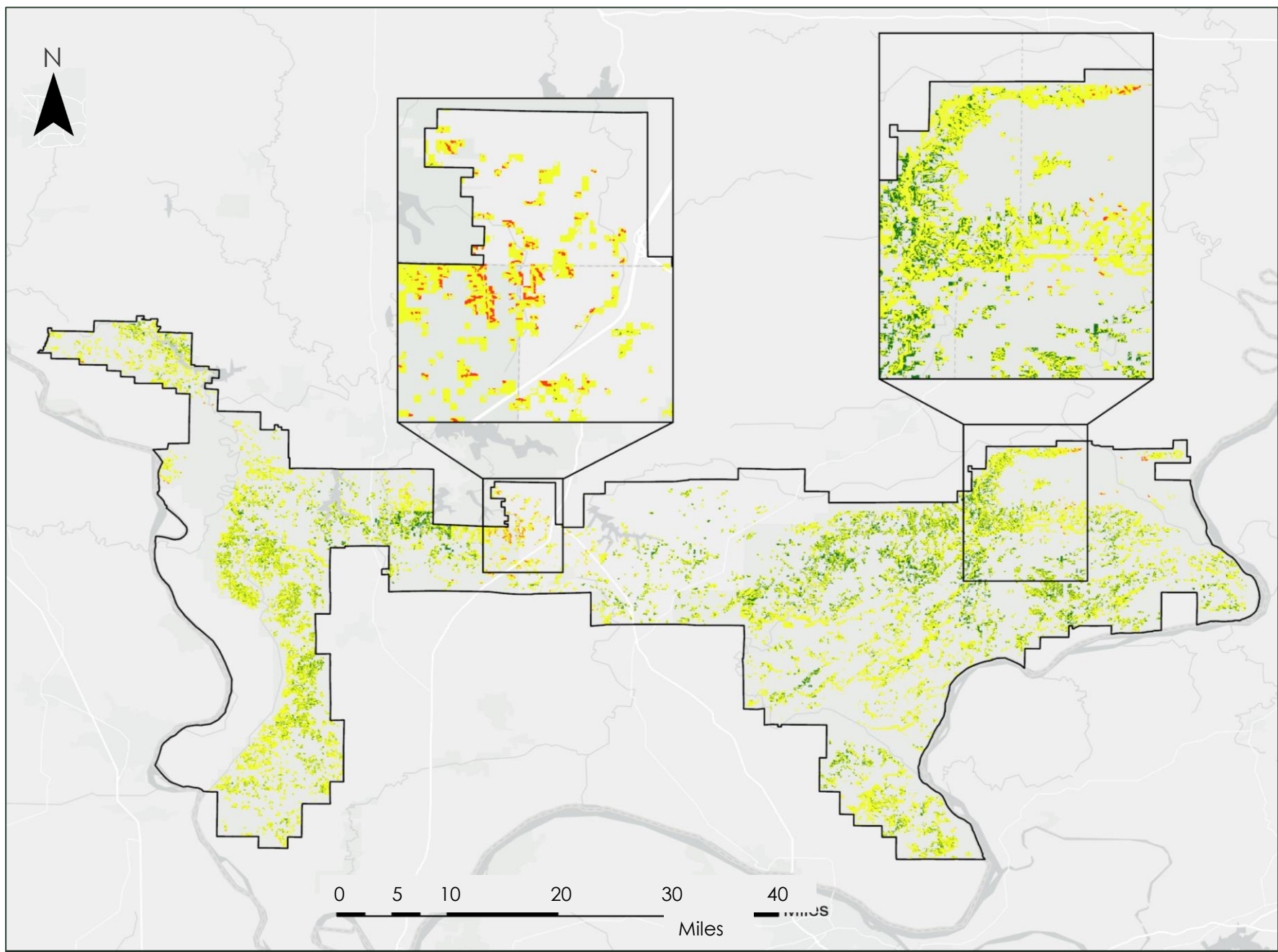


Figure Caption: This oak mortality risk map shows the level of decline risk for White oak stands across the Shawnee National Forest. Green correlates to low risk, yellow to moderate, and red to high. Pockets of high-risk oak stands are highlighted in the western and northeastern regions of the study region.

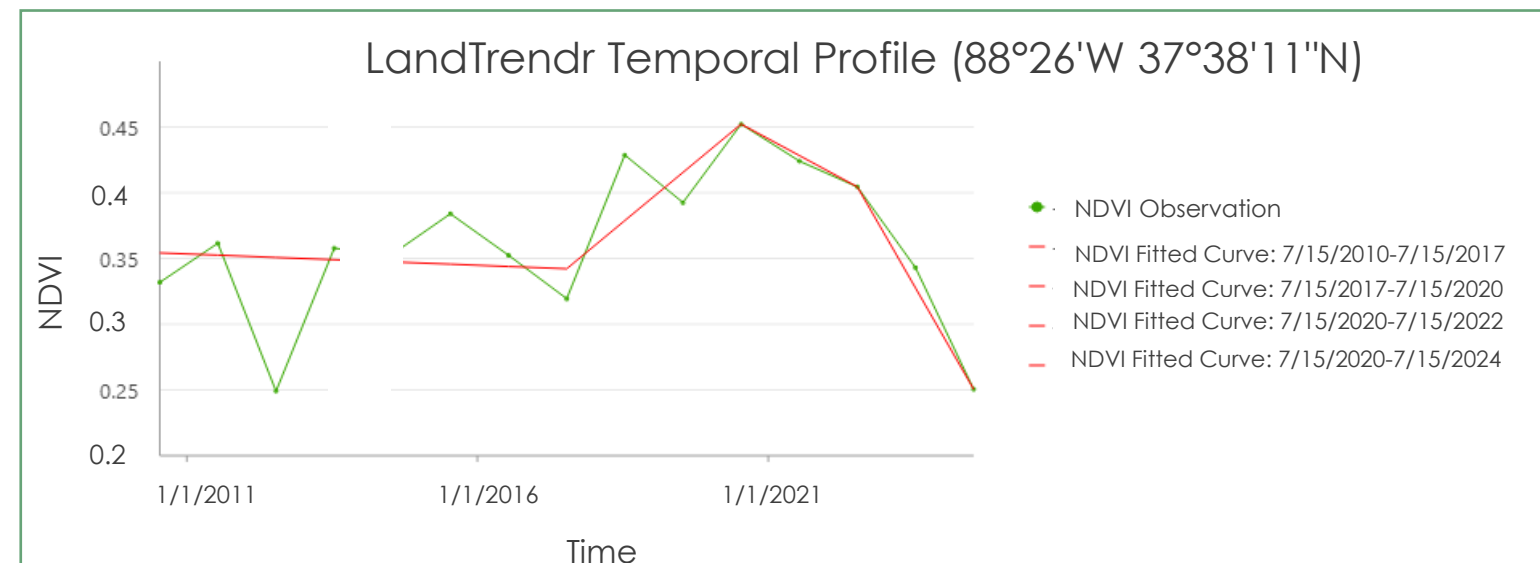
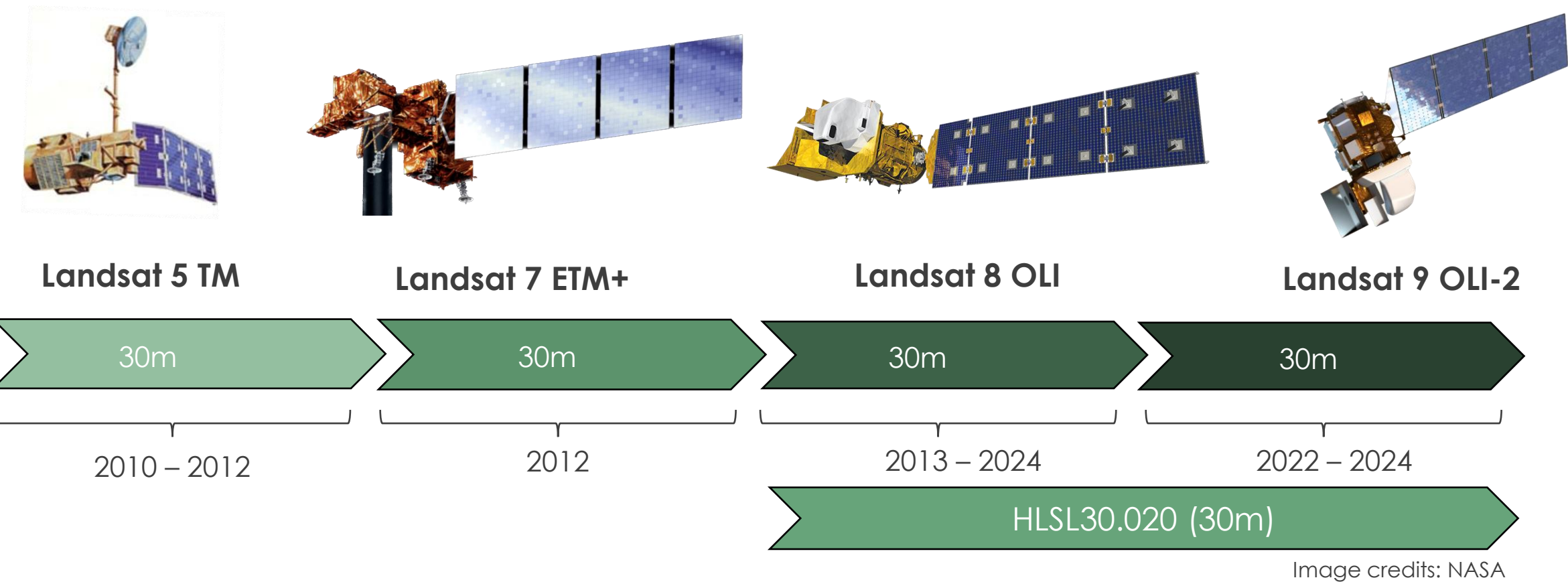


Figure Caption: NDVI temporal profile for a single pixel in the Shawnee National Forest between 2010 and 2024 (green). LandTrendr linear models (red) show a negative change at the end of the study period indicating possible oak mortality.

Earth Observations



Team Members

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Conclusions

- Inter-seasonal oak health changes could be feasibly derived within pre-identified oak stands at the pixel level (30m).
- Explored the strength of relationships between potential decline risk variables and White oak health.
- Created a map that estimates current decline risk for White oak stands.
- In situ data are needed to validate satellite-derived oak mortality risk results, including species-specific inventories and geolocated White oak mortality occurrences.

Project Partner

Dr. Fredric Miller, Senior Entomologist Researcher at the Morton Arboretum

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Center Lead Advisors

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