

#### National Aeronautics and Space Administration



#### SOUTHERN INDIANA ECOLOGICAL CONSERVATION

Assessing Canopy Cover Dynamics and Forest Type Groupings in Indiana to Inform Restoration Activities

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# **Study Area**

- Southern Indiana: 30 counties, 9,114.6 square miles
- Includes the Hoosier National Forest (HNL)
- Historically oak-hickory
  - Forest undergoing mesophication due to long periods of fire exclusion
- Study period: 1984 2023



Image Credit: Carly Jane Casper



### Partners

- Let the Sun Shine In Indiana
- USDA, US Forest Service, Hoosier National Forest
- Sentinel Landscape Partnership, Southern Indiana
- Indiana Department of Natural Resources,
  Division of Fish & Wildlife and Division of Forestry
- Purdue University



### **Community Concerns**

- Prescribed burning is controversial
- Optics of management practices can cause negative public opinions of the Forest Service
- Cost of management



Image Credit: USDA Forest Service

Image Credit: Ylvers

### Objective



Conduct a feasibility study applying NASA Earth observations to create tools for oak-hickory restoration in Southern Indiana by identifying:

- Sites with 80% + canopy cover
- Sites suitable for oak-hickory growth
- Sites undergoing mesophication due to persistence of beech-maple stands



Image Credit: NatureServe

### Earth Observations & Study Period (1984–2023)



Image Credit: NASA GSFC

### Methods: Data Acquisition

#### **Ancillary Datasets**

- National Land Cover Database (NLCD)
- USGS 3DEP 1 Arc Second
- Hoosier National Forest Common Stand Exam (CSE)



# Methods: Green Vegetation Fraction

#### Process

- Filtered Landsat imagery to the growing season (May August)
- Calculated Normalized Difference Vegetation Index (NDVI) for each image within the growing season
- Created annual greenest pixel mosaic from NDVI to display the maximum vegetation value for each year



# Methods: Green Vegetation Fraction



## Methods: Green Vegetation Fraction



- Calculate Green Vegetation Fraction (GVF) for each 3-year composite
- Compute difference of vegetation across time

# Methods: Restoration Suitability Map

#### Process



- Map for entire study
- Map for subset of study area Hoosier National Forest
- Beech Maple Stand Presence/Absence available for HNL only

# Methods: Restoration Suitability Map

### 2 Reclassify



- Assign Boolean values to each input layer
- 1 = suitable for restoration
- 0 = unsuitable for restoration

### Methods: Restoration Suitability Map

Calculate the Exclusive Suitability

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Suitability for Hoosier = Slope \* Landform \* Aspect \* Tree Canopy Cover \* Beech Maple

Suitability for Entire Study Area = Slope \* Landform \* Aspect \* Tree Canopy Cover

### **Results: Green Vegetation Fraction Map**



### **Results: Restoration Suitability Map**



Suitable Regions

### **Errors/Uncertainties**

- National Land Cover Database Level 2 is approximately 77.5% accurate (Wickham et al., 2023)
- Lack of canopy structure data
- Soil drainage classes are not specific to oak-hickory or beechmaple
- Suitability inputs with the Boolean function weighs all inputs the same
- Constraints on time computational power made it difficult to do a more comprehensive analysis and differentiate between tree species

## Feasibility & Partner Implementation

- Remote sensing and GIS analysis of forests undergoing mesophication is possible
- In situ data of tree species of interest is necessary for restoration suitability analysis
- Unable to differentiate between tree species with spectral data within time constraints
- Using lidar for canopy height data to derive a canopy cover assessment could increase accuracy of mesophication assessments



### Conclusions

- It is feasible to use NASA Earth observations, along with ancillary datasets, to select sites for oak-hickory restoration.
- However, a canopy structure analysis and field observations of tree species are critical to assess mesophication.
- Our study effectively identified sites where our partners should dedicate efforts to oakhickory restoration.



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