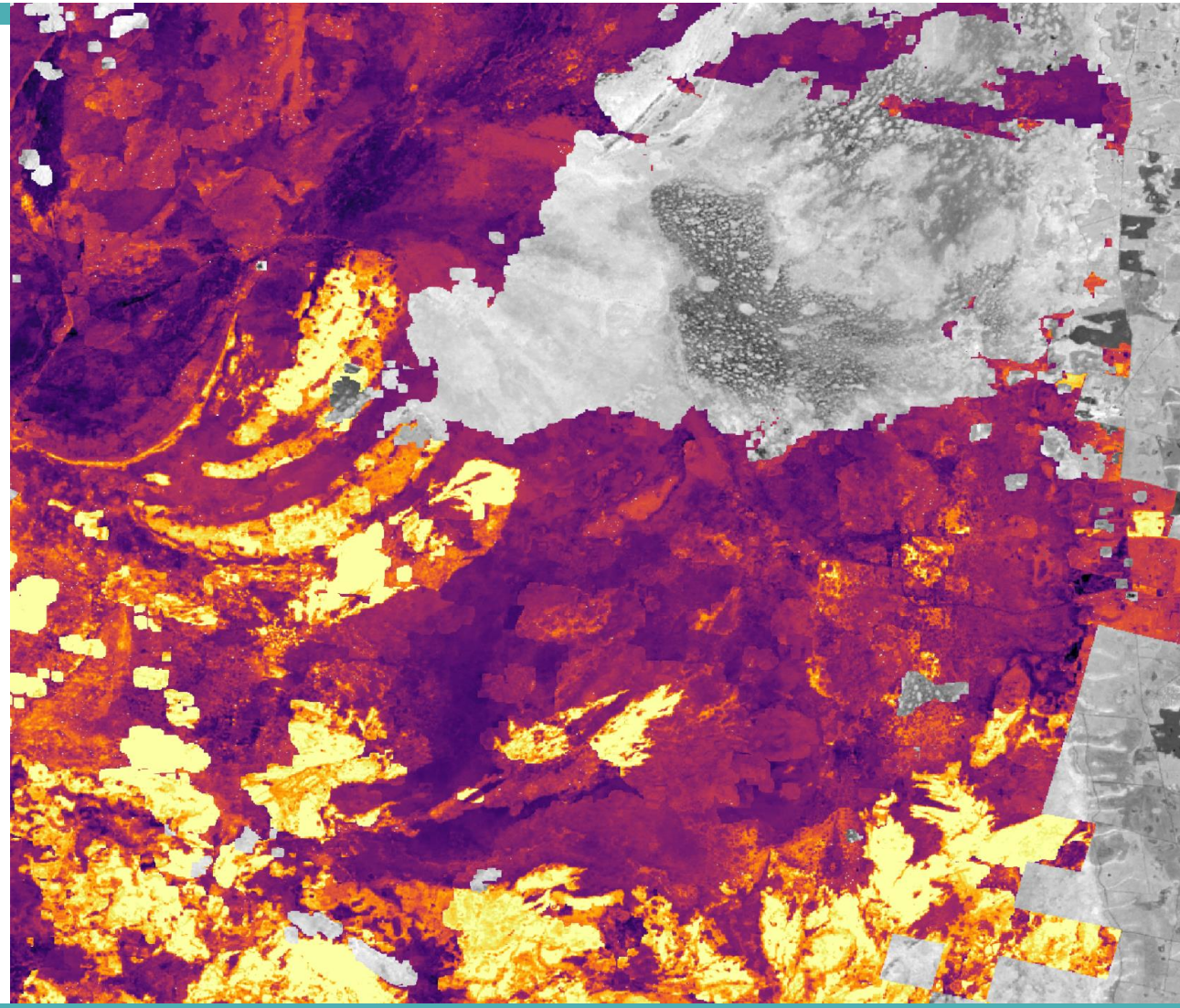
National Aeronautics and Space Administration

Okefenokee
Water Resources

Using Earth Observations to Assess Hydrologic Changes and Wildfire Risk in the Okefenokee Swamp



Brianne Kendall
Kyle Steen
Hailey Schmidt
Laramie Plott

Overview

- BACKGROUND
- OBJECTIVES
- METHODOLOGY
- RESULTS
- CONCLUSION

Image Credit: Okefenokee National Wildlife Refuge

Team

Brianne Kendall

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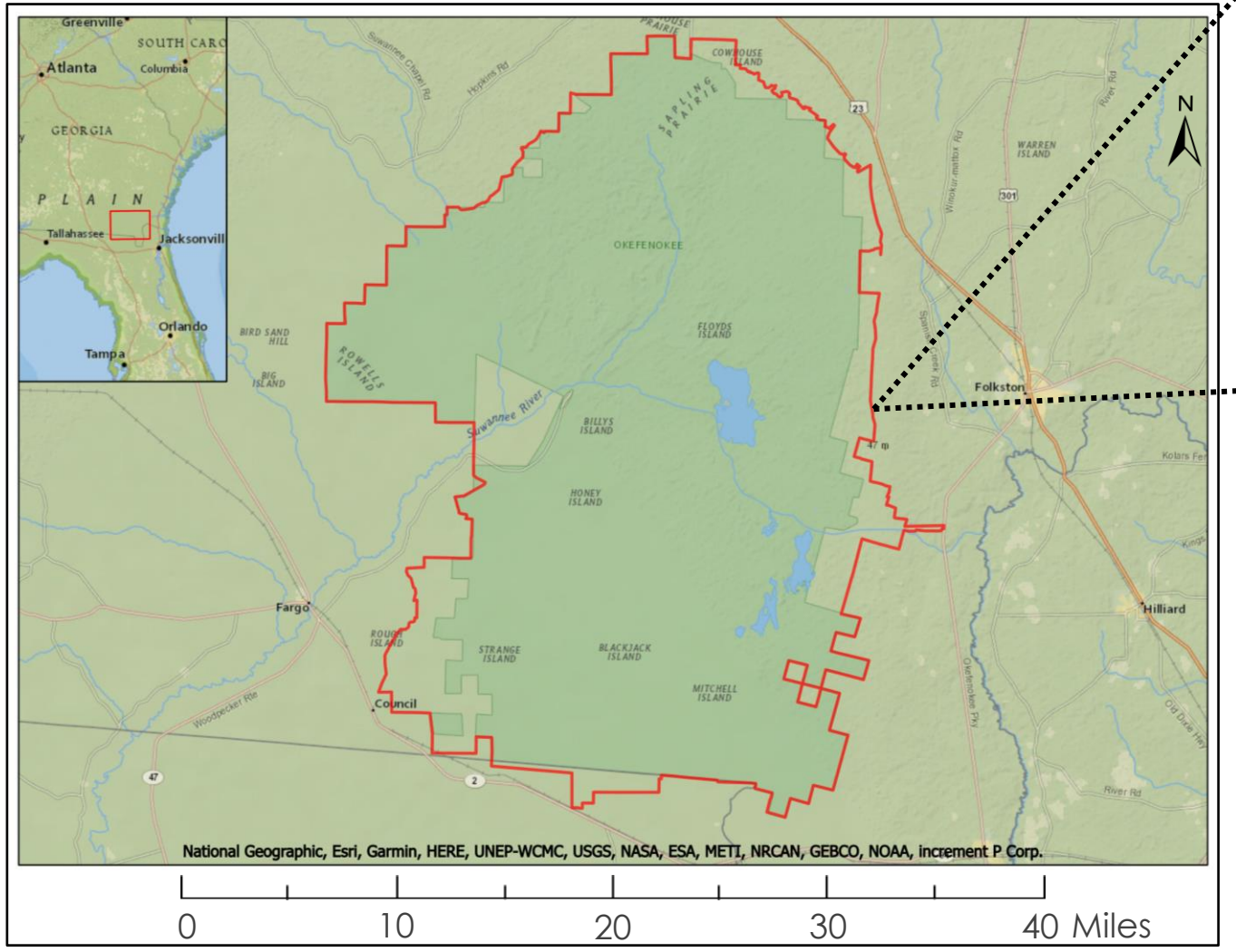
Partners and Study Area



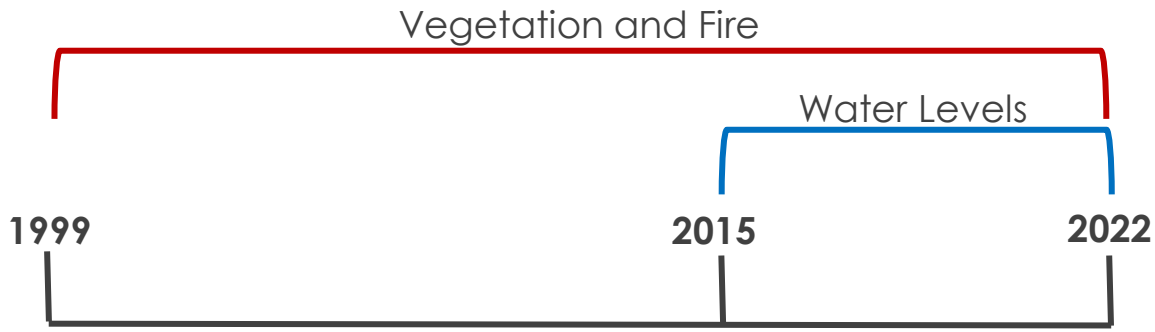


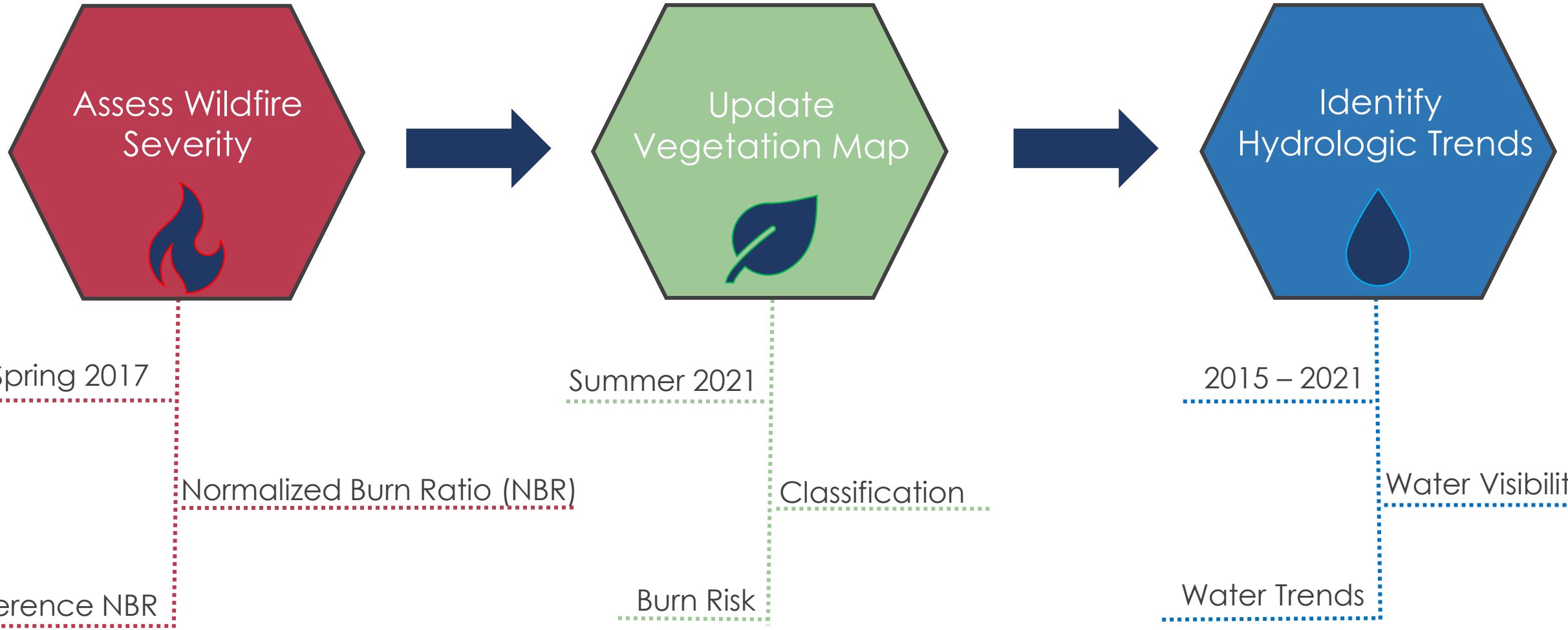
Image Credit: Okefenokee National Wildlife Refuge

Community Concerns

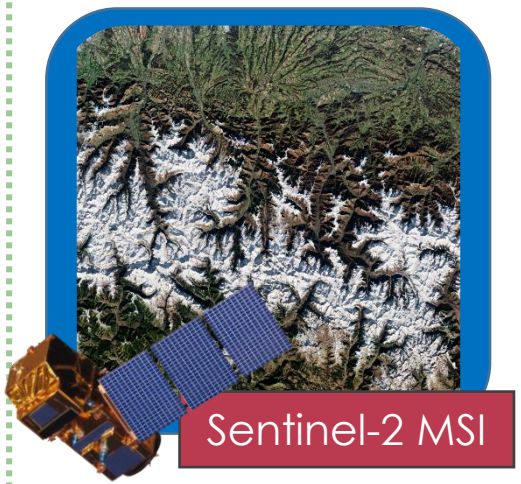
- Biodiversity
- Recreation
- Economy
- Health & Air Quality

Image Credit: Okefenokee National Wildlife Refuge

Objectives


Assess Wildfire Severity
Update Vegetation Map
Identify Hydrologic Trends
Spring 2017
Normalized Burn Ratio (NBR)
Difference NBR
Summer 2021
Classification
Burn Risk
2015 – 2021
Water Visibility
Water Trends

Satellites and Sensors Used



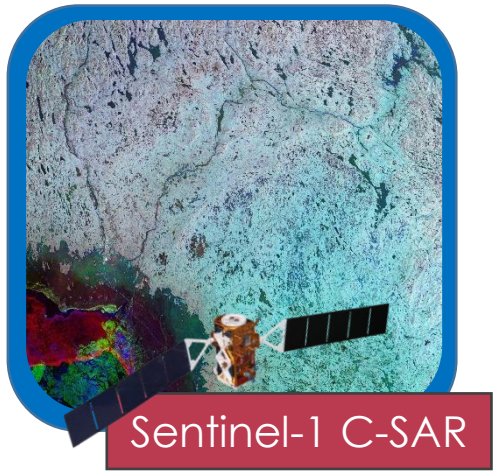


Image Credit: NASA, ESA

Methodology – Wildfire Severity

Data Acquisition

- Landsat 8 OLI Surface Reflectance

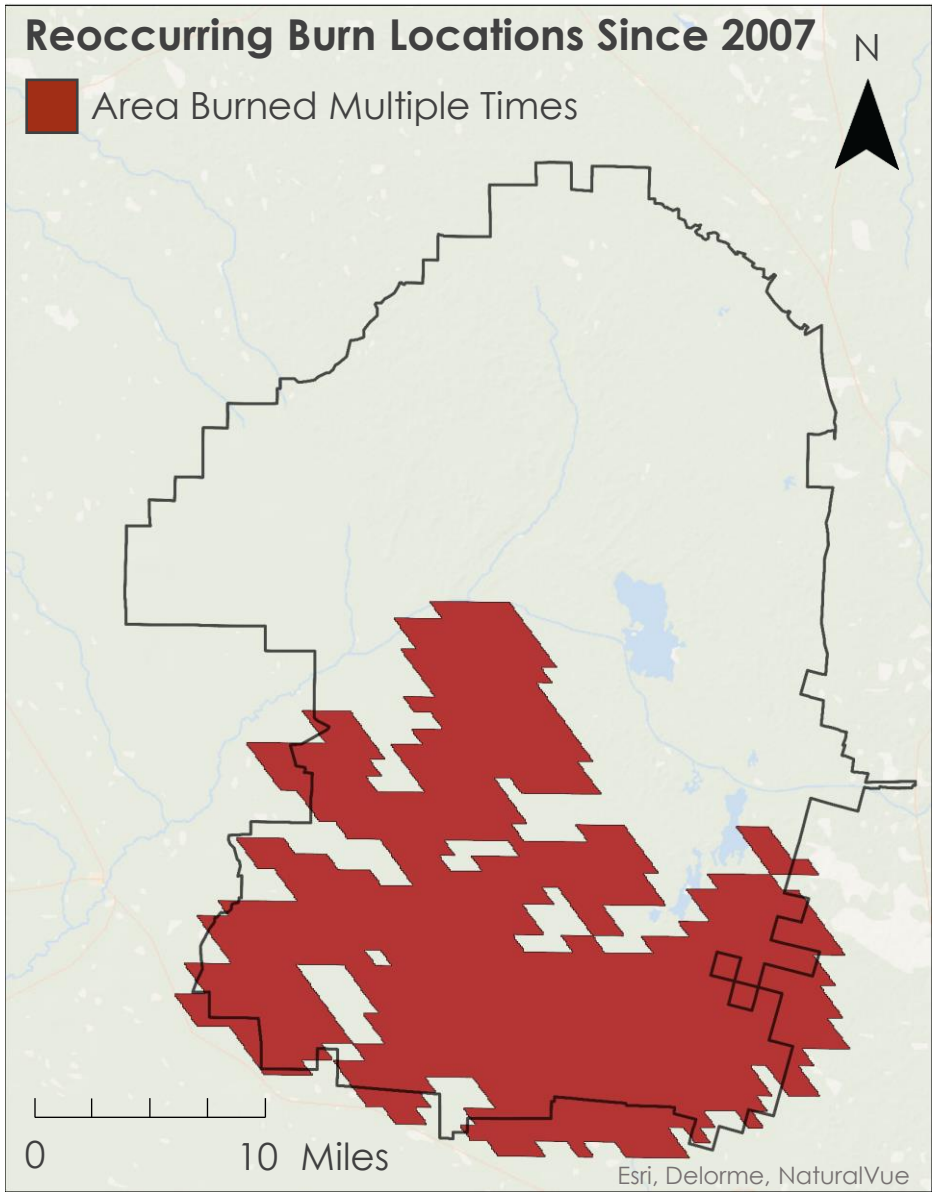
Data Processing

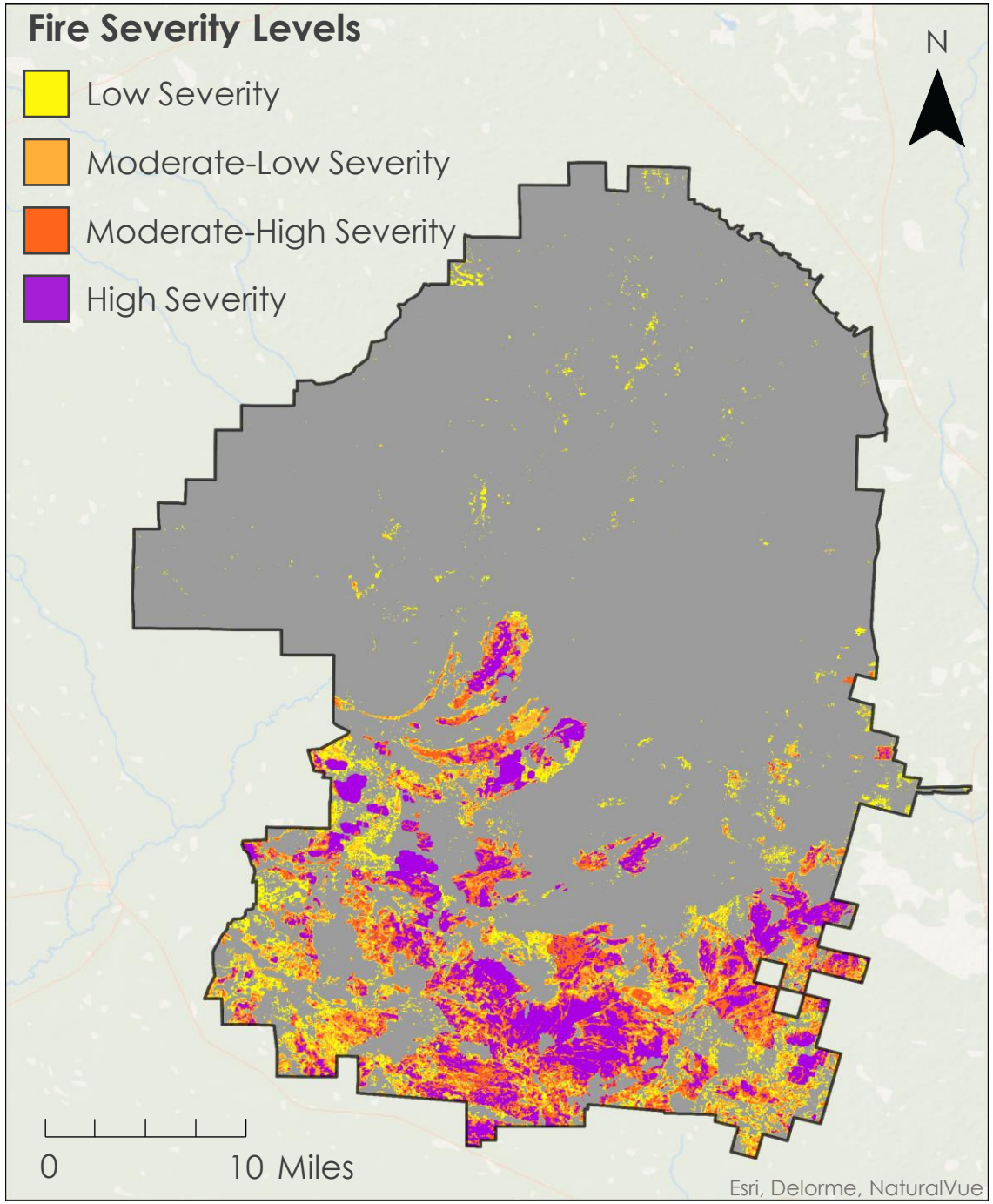
- Google Earth Engine
- NBR = (NIR-SWIR2)/(NIR+SWIR2)
- dNBR = PreFireNBR - PostFireNBR

Data Analysis

- Geographic Information Systems Mapping
- Lower dNBR values = Low Severity
- Higher dNBR = High Severity

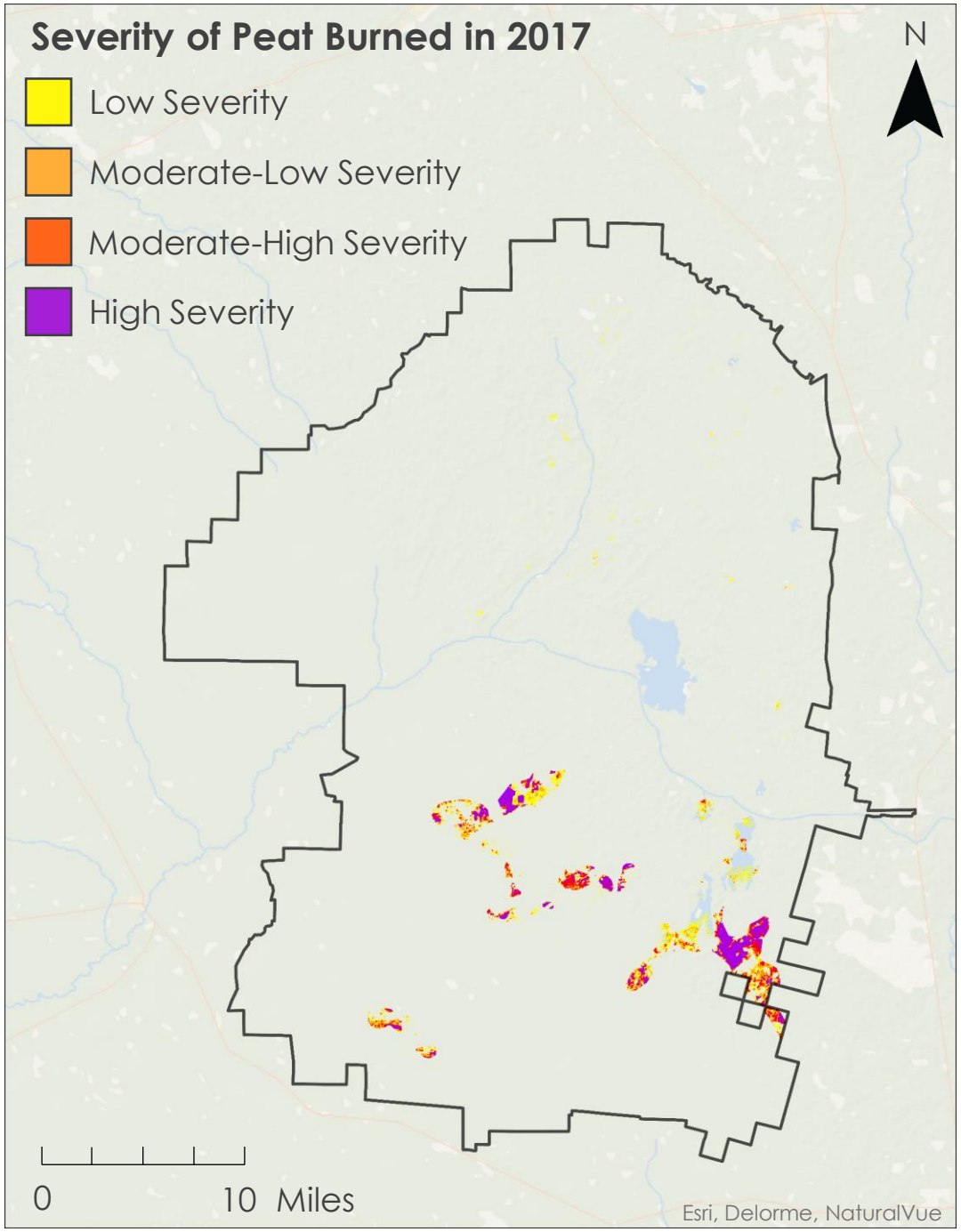
Results – Wildfire Severity



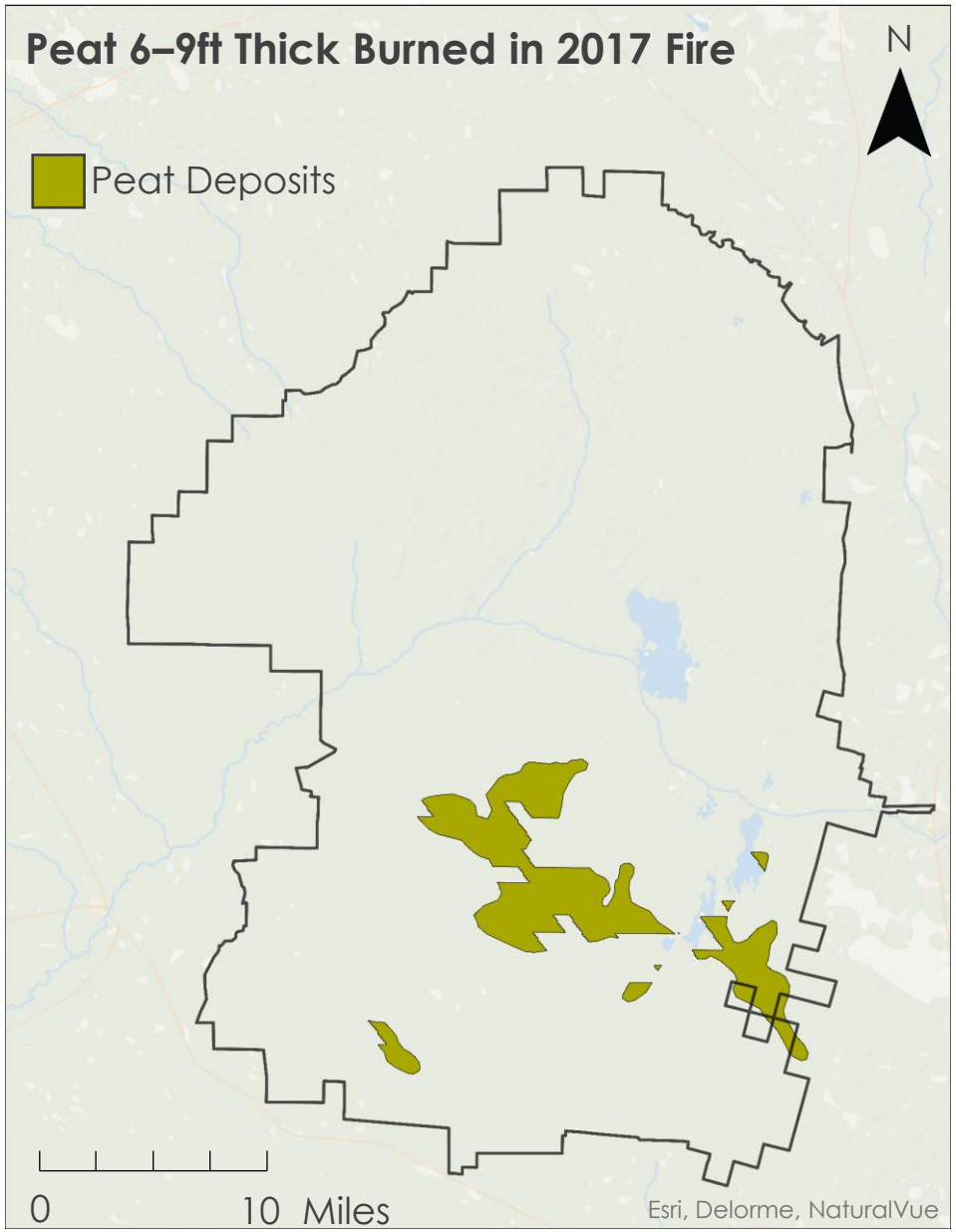


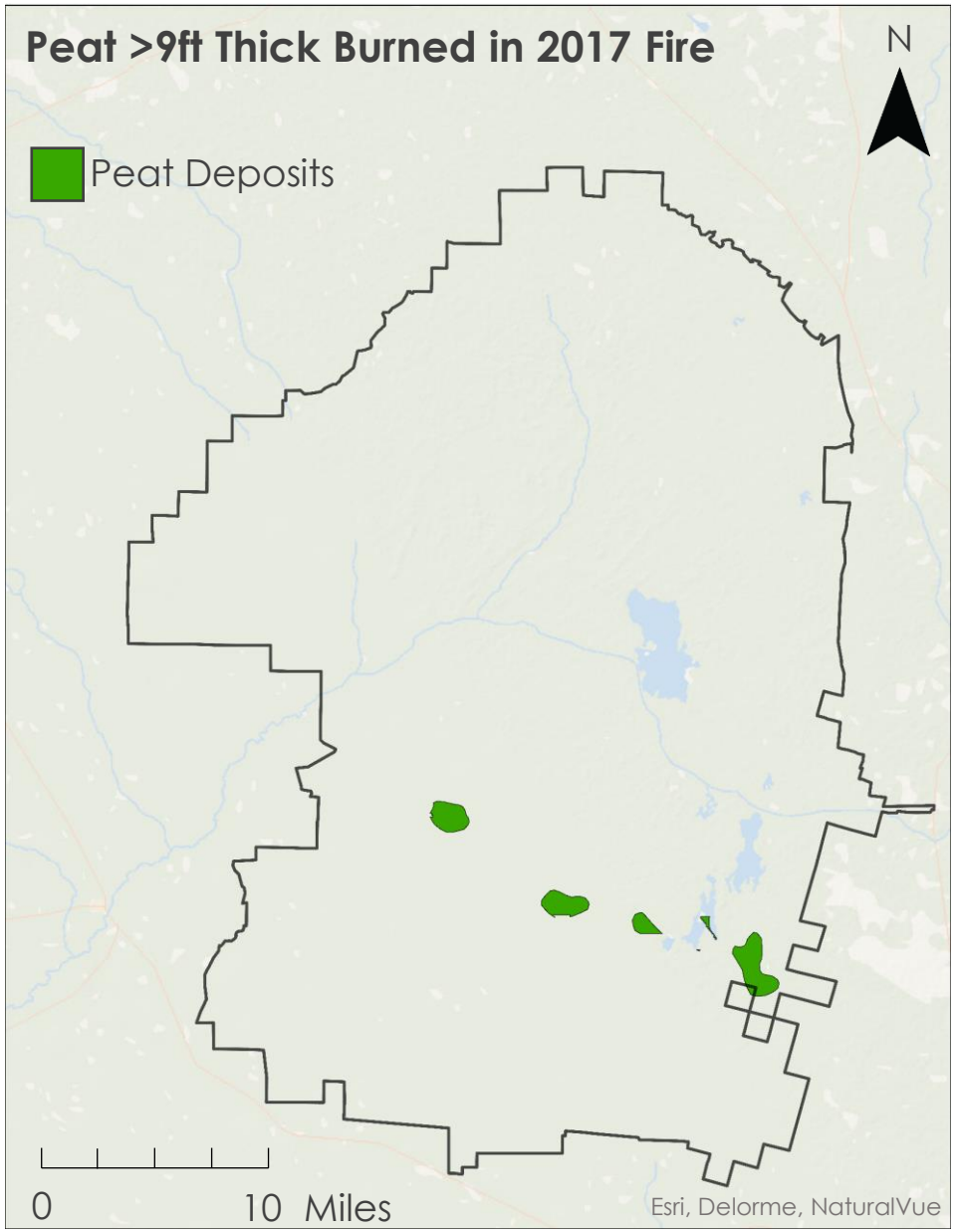
Results – Wildfire & Peat

- Peat locations interpolated from Dr. Art Cohen's Research
- Peat locations overlaid with the 2017 West Mims Fire burn severity map



Results – Wildfire & Peat





Methodology – Vegetation Map

Data Acquisition

- Sentinel-2 MSI: Multispectral Instrument, Level-2A

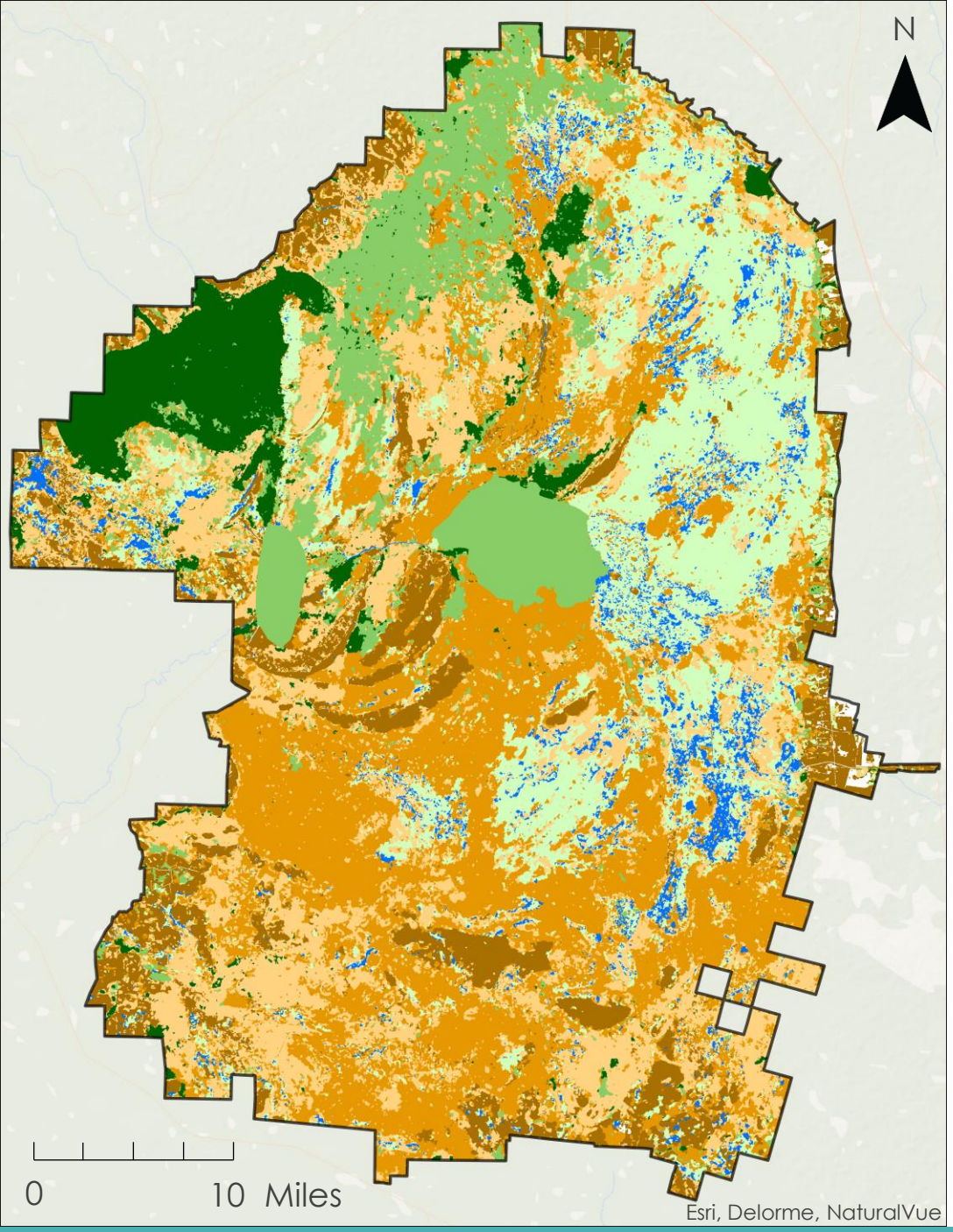
Data Processing

- Google Earth Engine
- True color and false color composite

Data Analysis

- Updated Vegetation Map
- 10m x 10m resolution
- Classification Scheme
- Forested vs aqueous areas

Results – Vegetation Map



Landcover – 2021

- Mature Forest
- Diffuse Hardwood / Cypress / Pine
- Pine / Sparse Pine
- Shrubs
- Shrubs / Herbaceous With Sparse Trees
- Mixed Aquatic / Herbaceous Prairie
- Bare Ground
- Open Water

Methodology – Water Visibility

Data Acquisition

- Sentinel-1 SAR GRD C-Band data (2015–2021)
- Interferometric Wide
- VV + VH Polarization

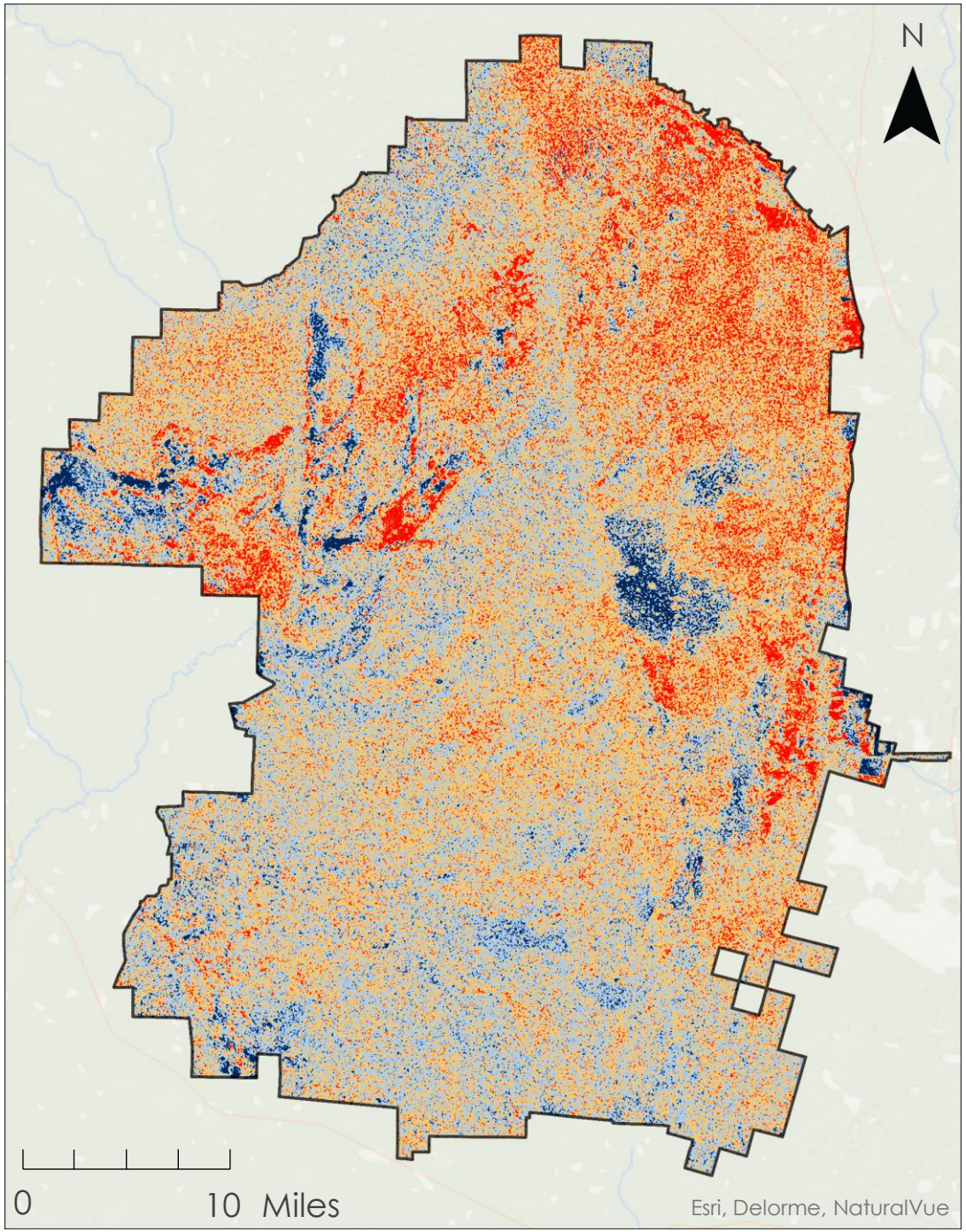
Data Processing

- Median function to assess annual image collections
- Filtered to one image per year

Data Analysis

- Water Detection Timeseries
- Change Detection Maps
- Absolute Difference
- Median Statistics Fill Method

Results – Visible Water Level

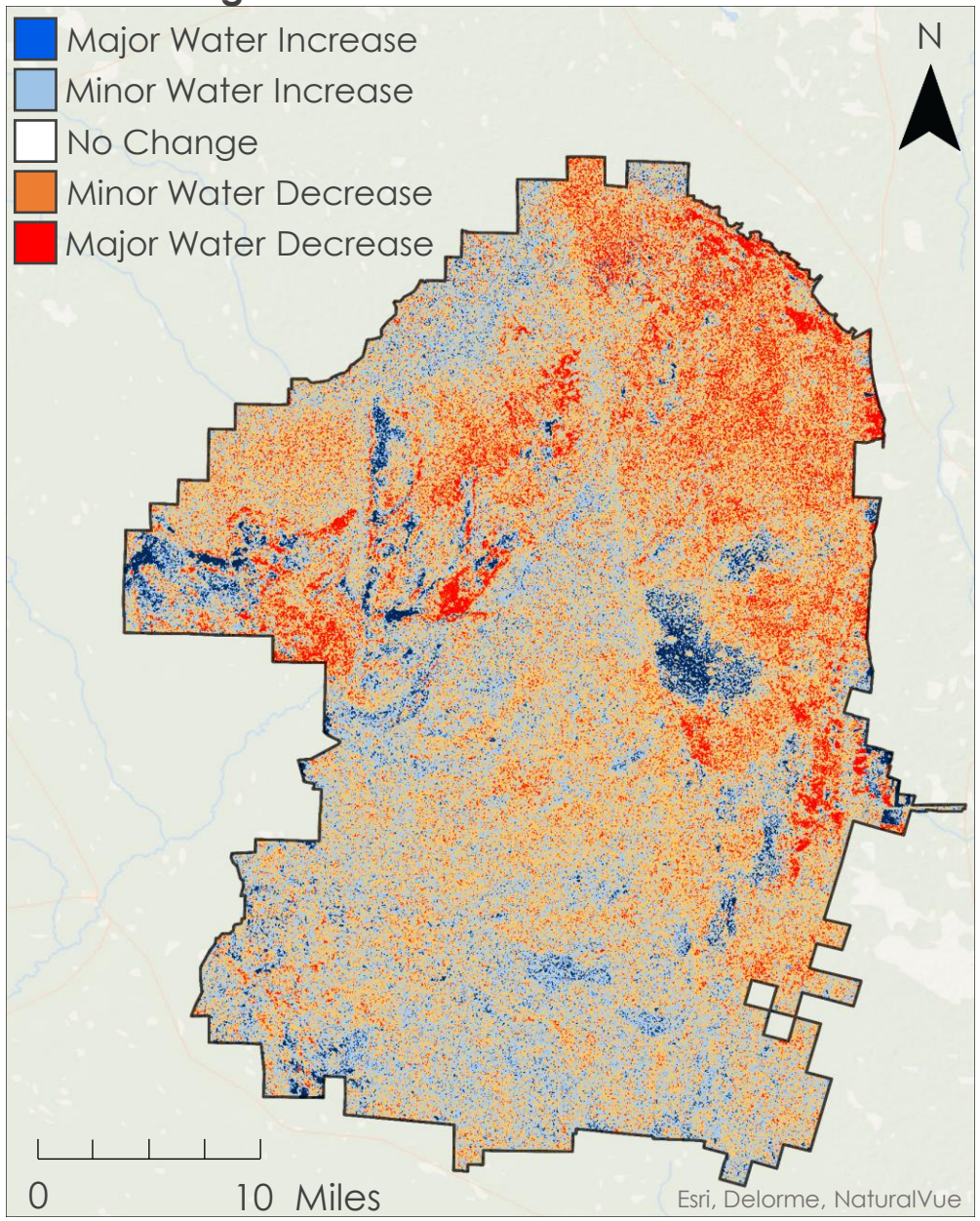


Water Visibility Changes 2015 – 2021

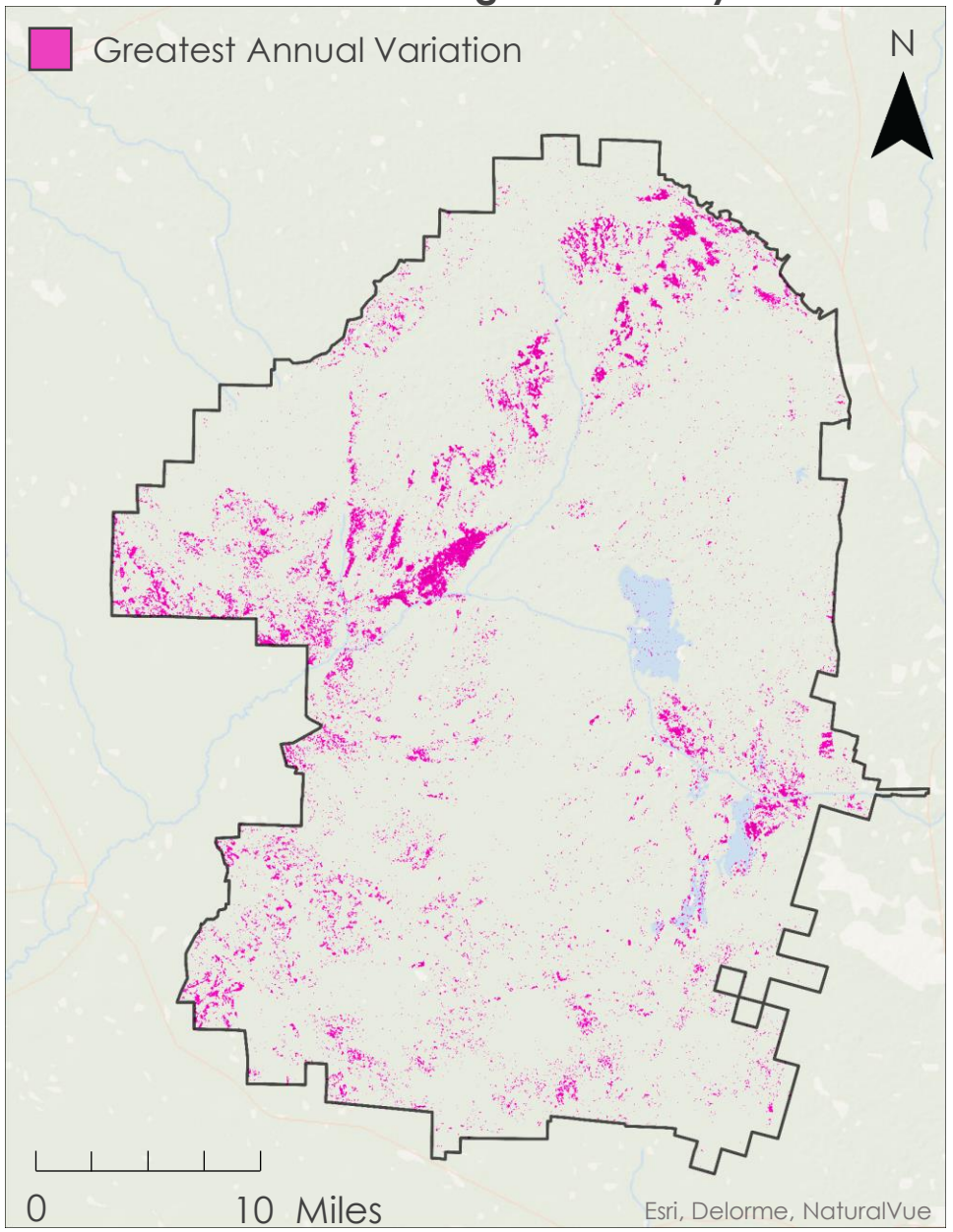
- Major Water Increase
- Minor Water Increase
- No Change
- Minor Water Decrease
- Major Water Decrease

Results – Water Visibility

Water Change Level 2015 – 2021



Weighted Overlay 2015 – 2021



Methodology – Soil Moisture & Fire Correlation

Data Acquisition

- SMAP Soil Moisture, from USDA's Crop Condition and Soil Moisture Analytics tool (2015 – 2021)

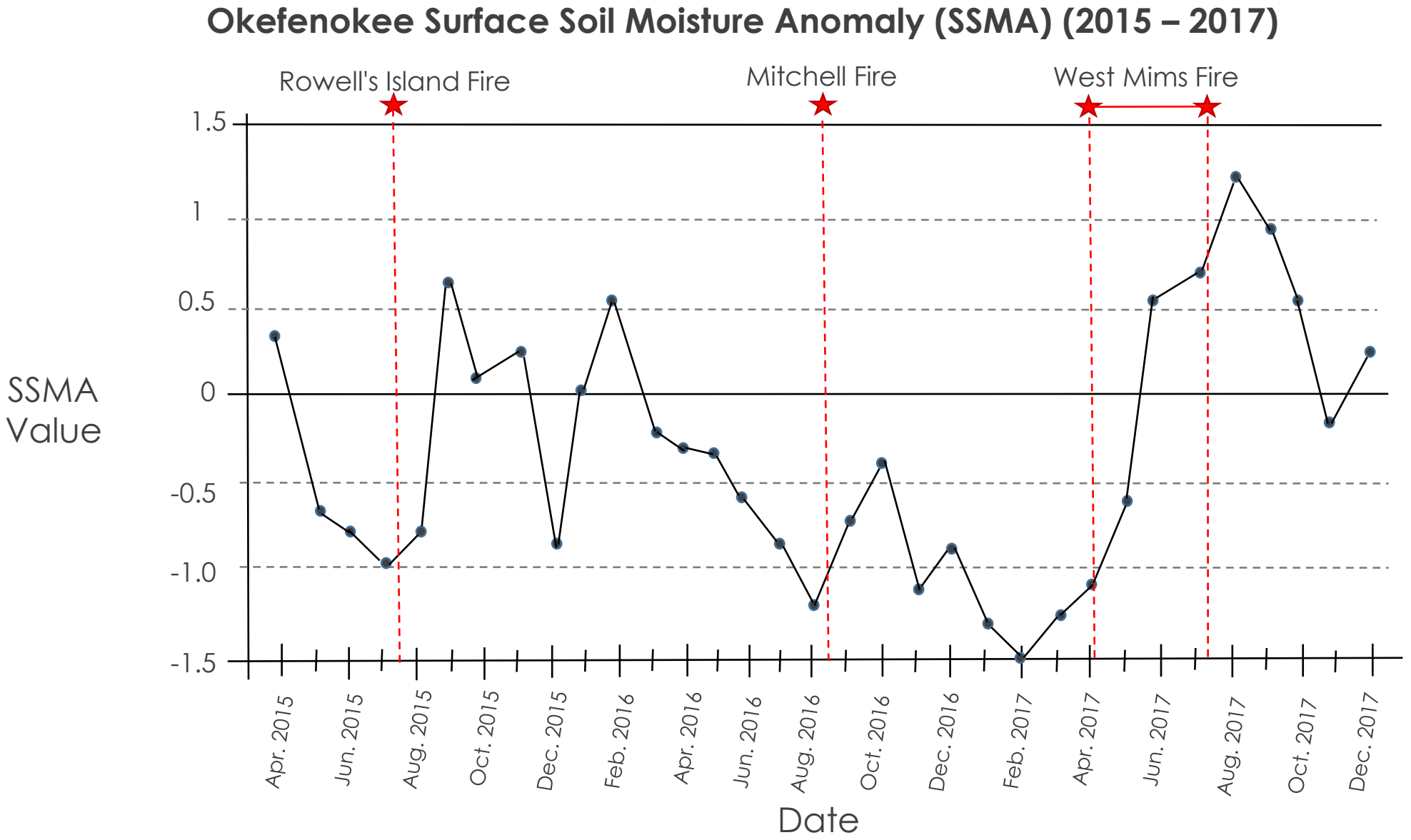
Data Processing

- All Pixels (23) averaged to make one refuge sized pixel
- Charts made & statistics calculated

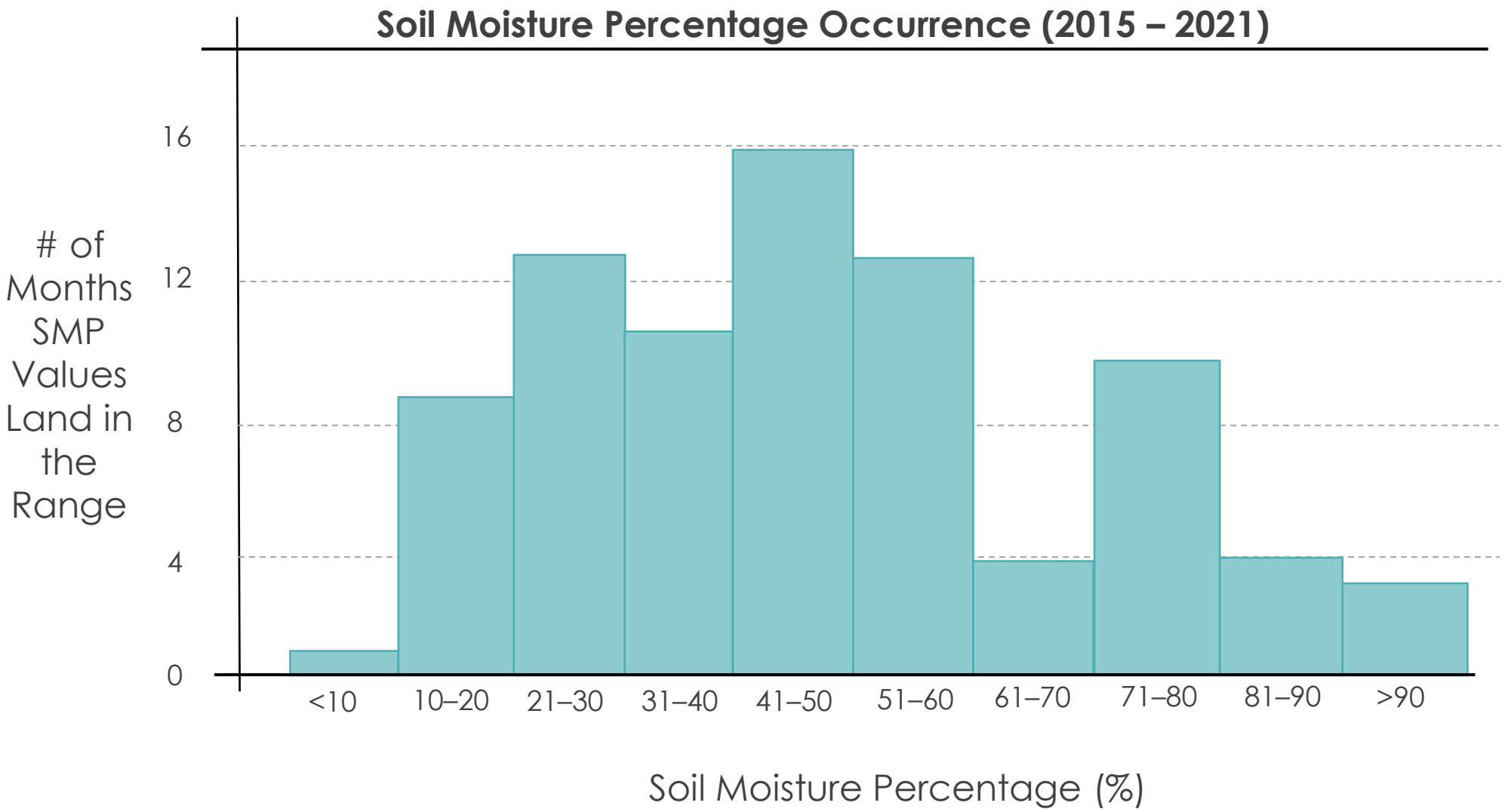
Data Analysis

- Surface Soil Anomalies
- Soil Moisture Profile

Results – Soil Moisture & Fire Correlation

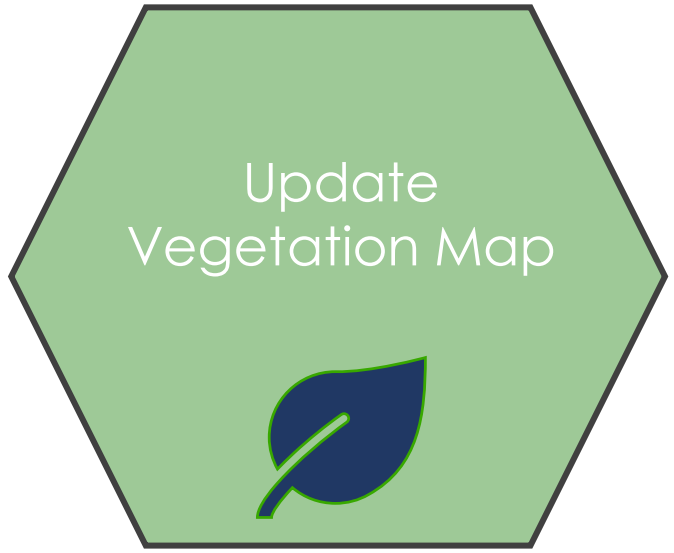


Results – Soil Moisture & Fire Correlation



Conclusions

- **Fire severity**
  - Southern portion of ONWR has been burned multiple times since 2007, including all three major fires (2007, 2011, 2017)
  - The 2017 dNBR compares pre- and post- fire conditions
    - 43% low levels of severity
    - 57% high levels of severity
- **Vegetation maps**
  - Increase in Mixed Aquatic / Herbaceous Prairie & Herbaceous / Shrubs with Sparse Trees
  - Mature forests are still present nearly a decade later



Conclusions

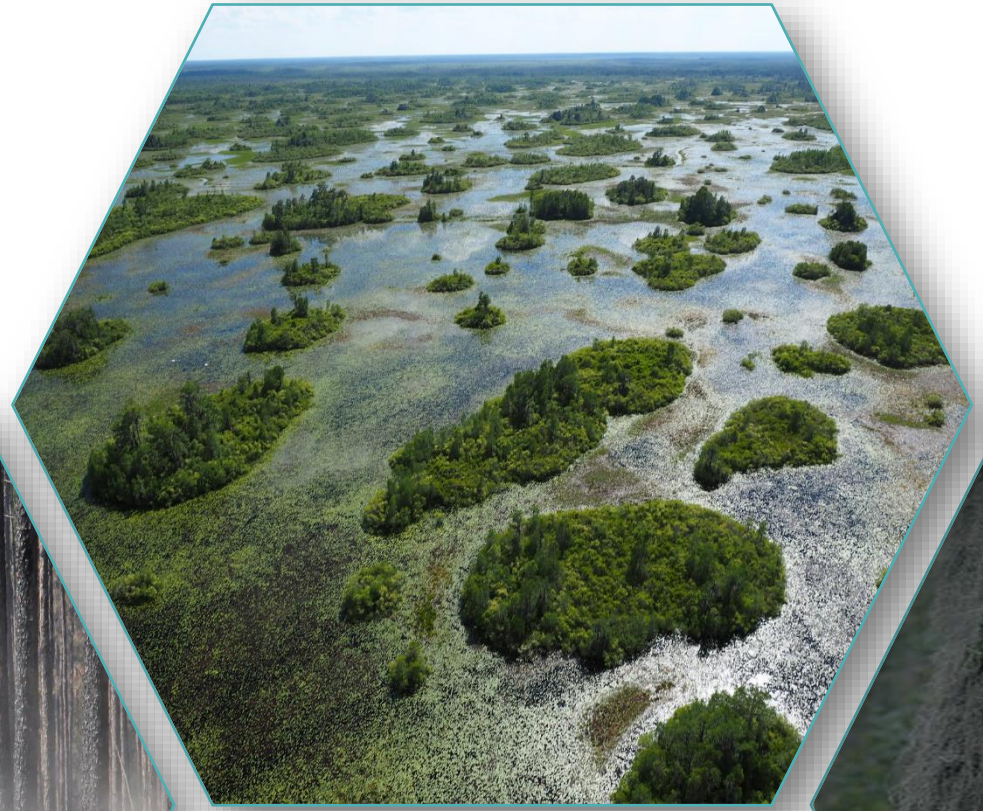
- **Water levels**
  - Drastic water change occurs along the Sill on the western side of ONWR
  - Southern portions of the swamp have a more stable water level
- **SMAP**
  - Surface soil moisture anomaly indicates where a fire could happen, but does not necessarily predict fire occurrence
    - Especially true when SSMA drops below zero
  - Monthly soil moisture profile distribution is normal
    - Mean: 47%

Errors & Uncertainties

- Large sensor overlap in 2017 water visibility map
- Water visibility data showed islands as open water
- We assumed that underground peat fires are atypical and do not affect our data
- Incorporate more climate and weather data with our SMAP analysis

Image Credit: Okefenokee National Wildlife Refuge

Future Work



Peat Research

Mining Risk

Cypress Tree Location

Image Credit: Okefenokee National Wildlife Refuge

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Questions?