



Alabama Agriculture

Using NASA Earth Observations to
Assess the Feasibility of Monitoring
Water Retention in Cover and Winter
Crops

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Community Concerns

2024: **driest August since 1895** in Alabama

Negatively impacts **agricultural commodities**

Producers **fall behind** on growing and harvesting

Lower yields and quality of crops



Cover and Winter Crops



Corn



Cowpea



Sorghum-Sudangrass



Sunn Hemp



Winter Wheat



Corn

Growing Season
April – October

Winter Season
November – March

Growing Season
April – October

Project Partner

Alabama Drought Reach (ADR)

Partnership between **Auburn University Water Resources Center** and the **Office of the State Climatologist**



Image Credit: Adam Newby



Image Credit: Liz Junod

Mission: monitor agricultural impact of drought and improve drought communications with the agricultural community

Project Objectives

1

Classify and map cover and winter crop implementation

2

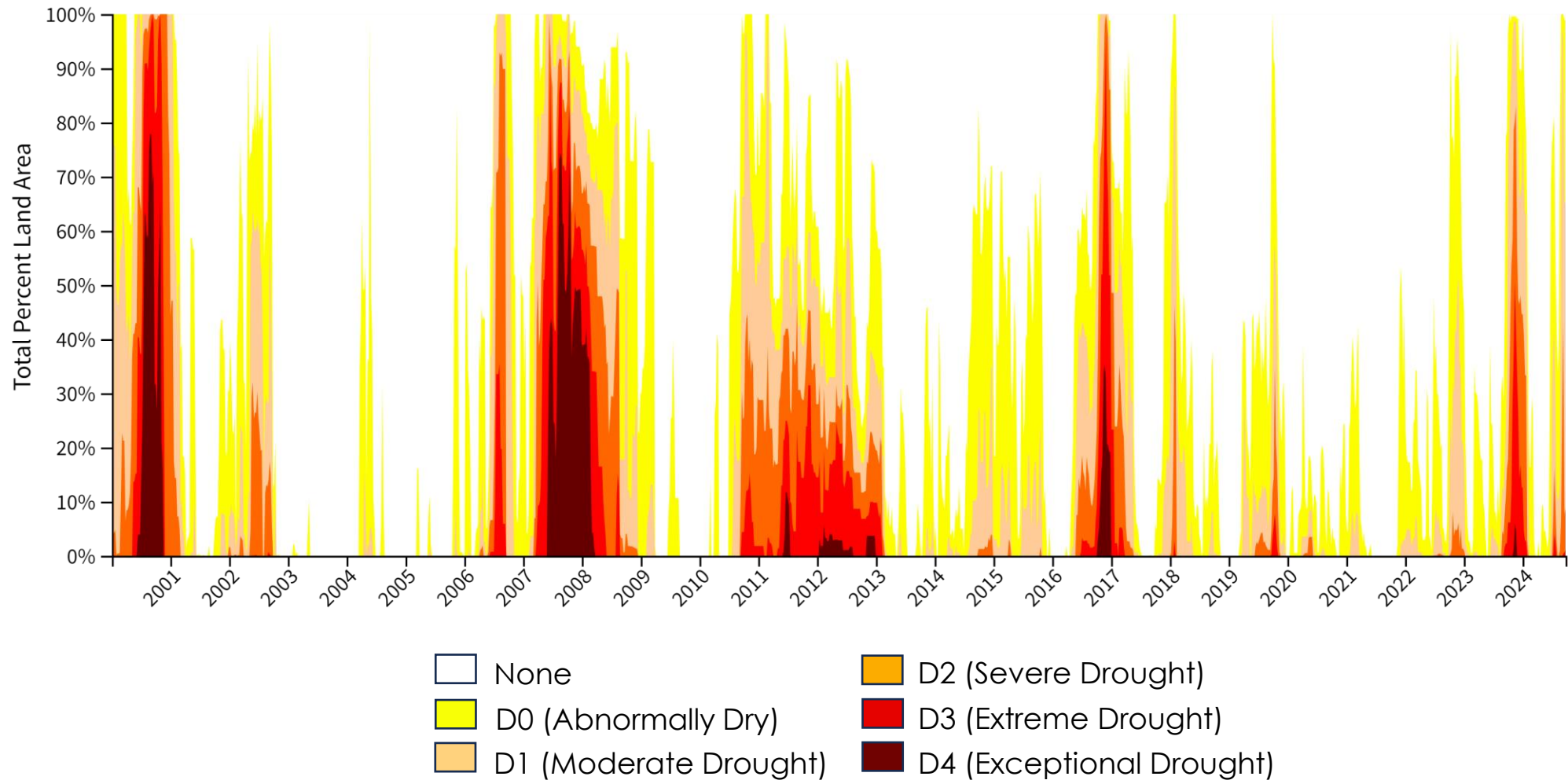
Quantify soil water retention

3

Compare soil water retention across soil groups and land cover types to estimate the impact of cover and winter crops

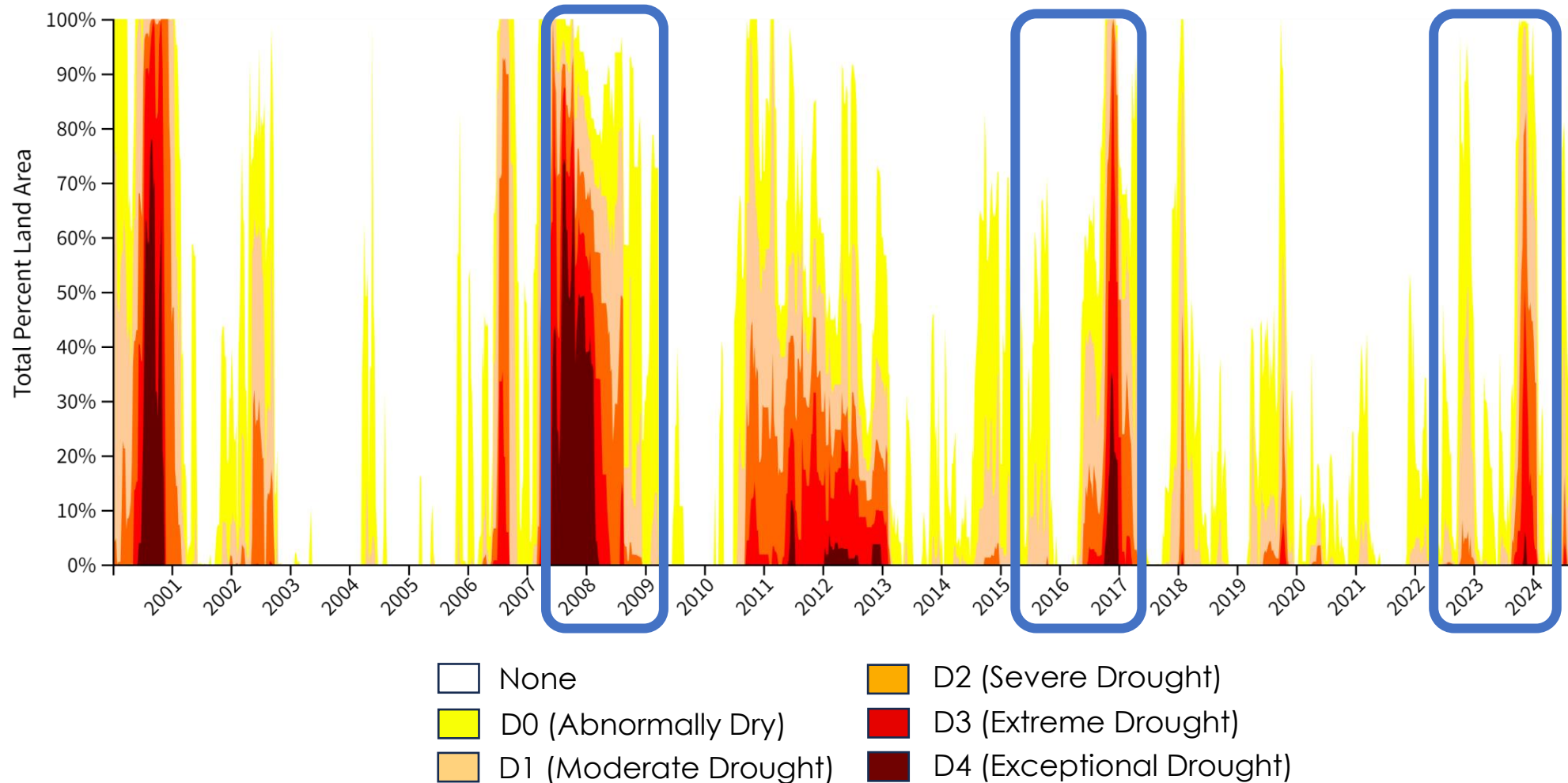
Study Period

Alabama Percent Area in U.S. Drought Monitor Categories

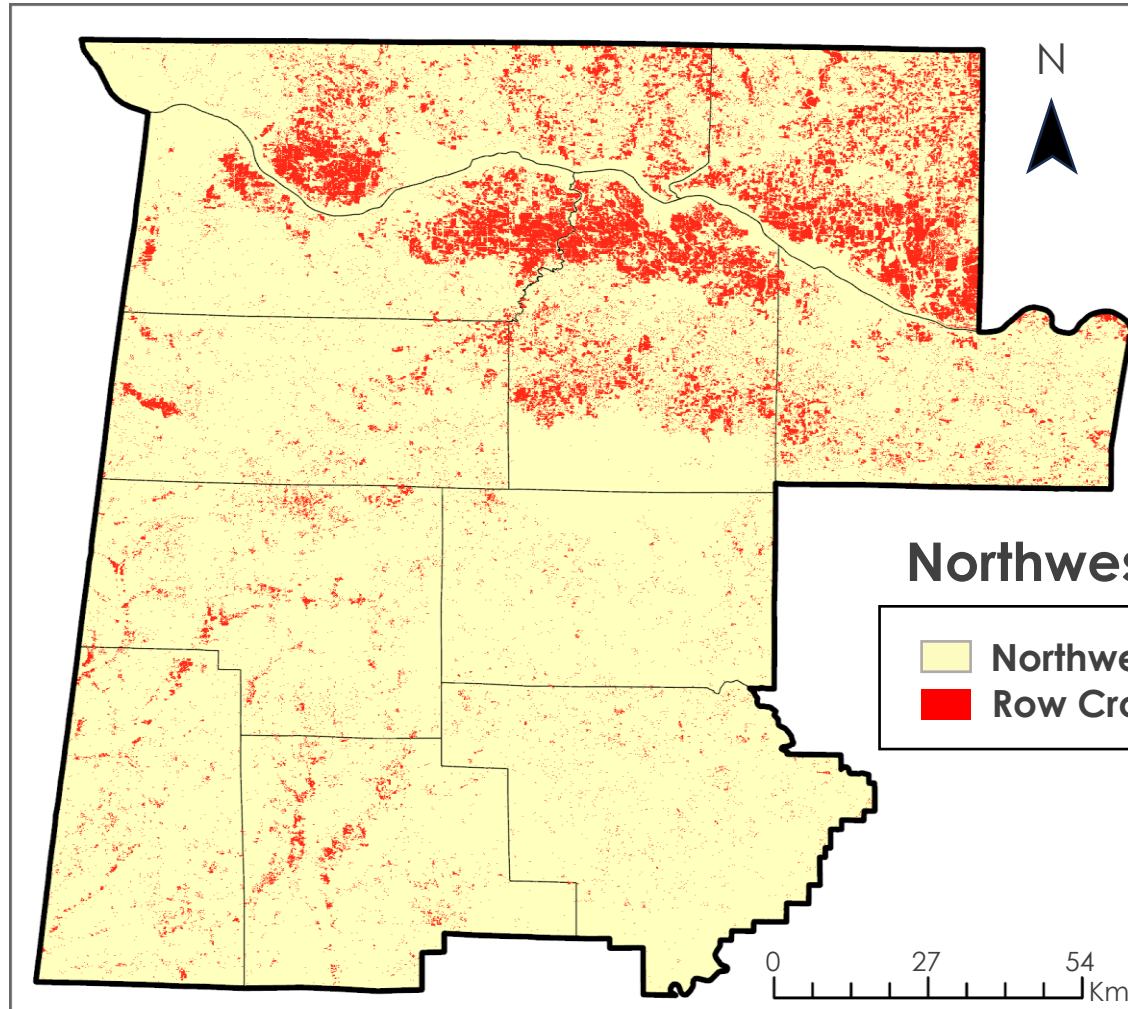


Study Period

Alabama Percent Area in U.S. Drought Monitor Categories



Study Area



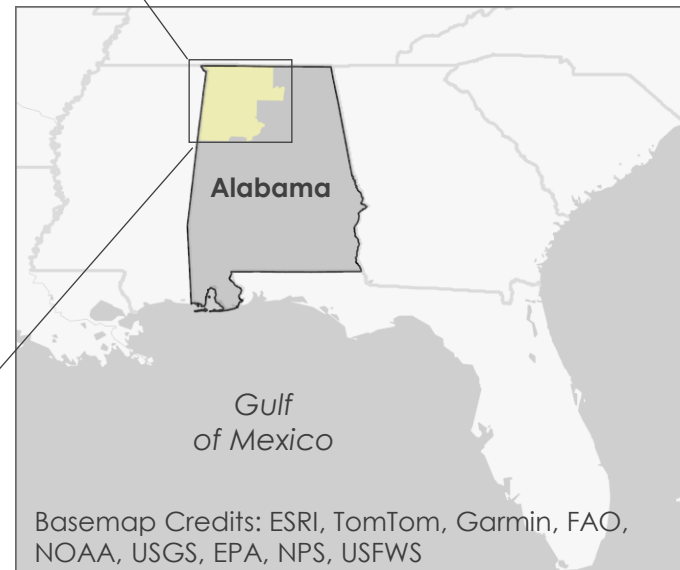
Northwest SET



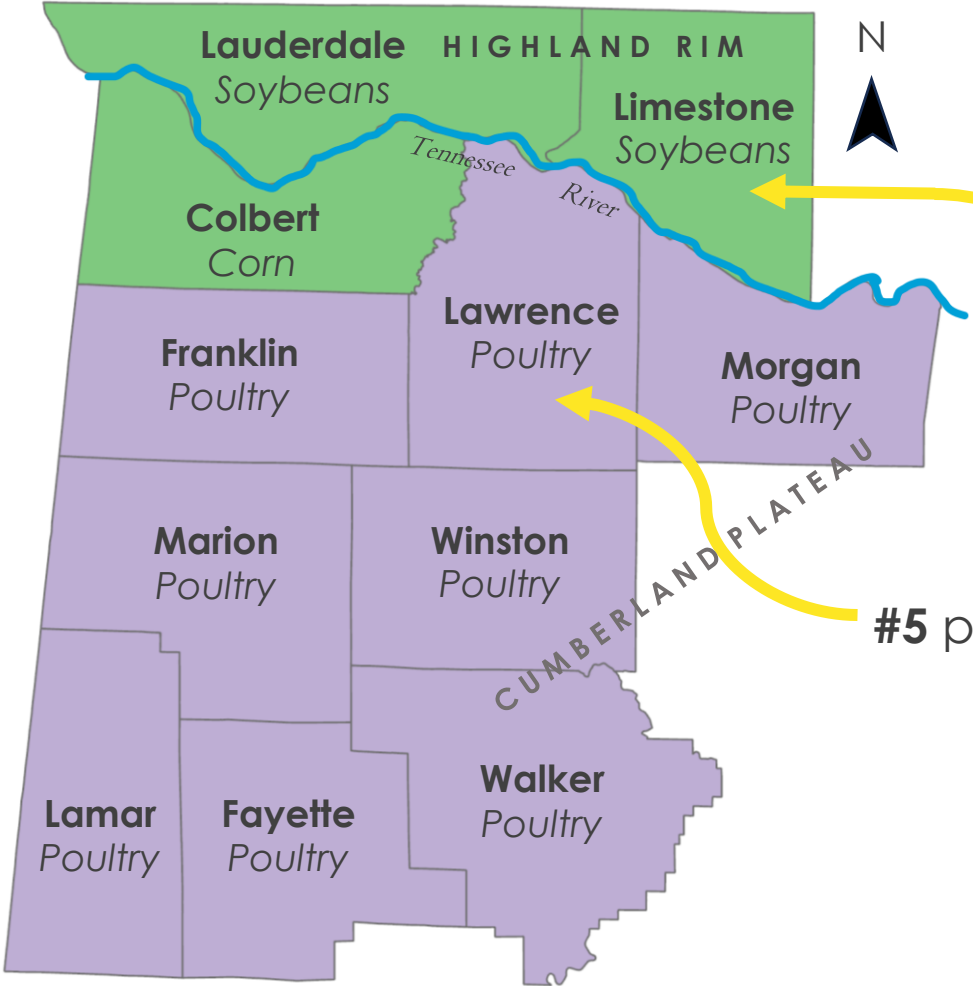
Northwest Strategic Extension Team (SET) Alabama, USA



11 counties



Study Area



Top Agricultural Commodities in Sales by County

Census of Agriculture (2022)

#1 producer of oilseeds, dry beans, dry peas
#3 producer of cotton in AL

#5 producer of all crops in AL

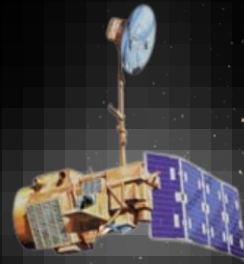
Majority Share of Sales

- Row crops
- Livestock, poultry and products

Northwest SET

Earth Observations

Landsat 5 TM
Thematic Mapper

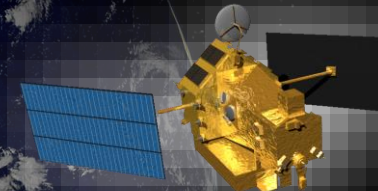


GPM-IMERG
Global Precipitation
Measurement



TRMM

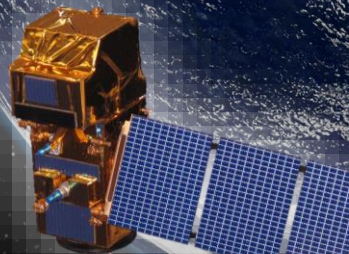
Tropical Rainfall
Measuring System



Landsat 8 OLI
Operational Land Imager



Sentinel-2 MSI
MultiSpectral Instrument



Landsat 9 OLI-2
Operational Land Imager-2



Methods Overview

Winter & Cover Crop Mask

Utilizing Harmonized Landsat Sentinel-2
& Landsat 5 TM

ArcGIS Pro
Extract
Crop Mask

ArcGIS Pro
Apply NDVI
Threshold

Jupyter Hub
Normalized
Difference
Vegetation
Index (NDVI)

**Winter & Cover
Crops**

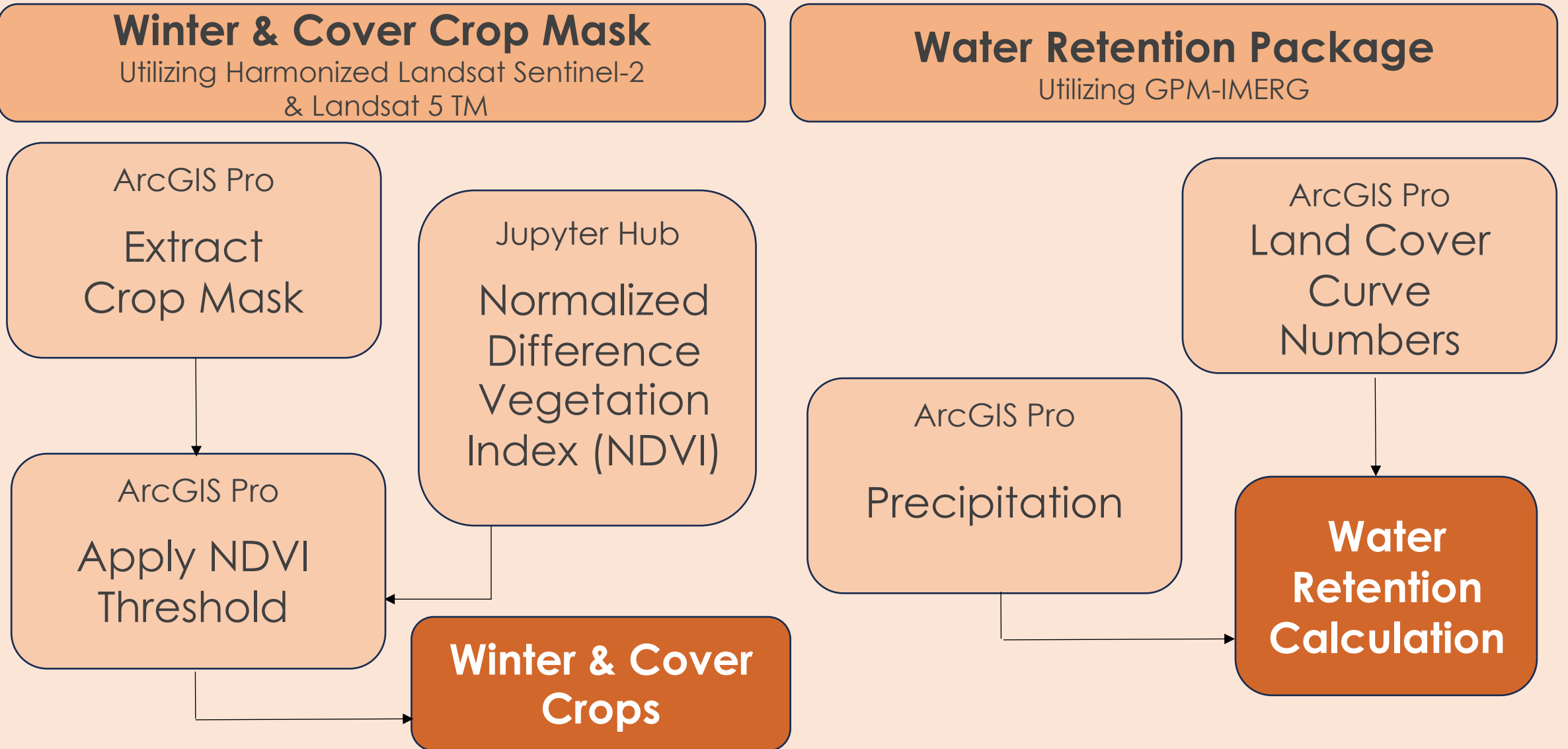
Water Retention Package

Utilizing GPM-IMERG

ArcGIS Pro
Land Cover
Curve
Numbers

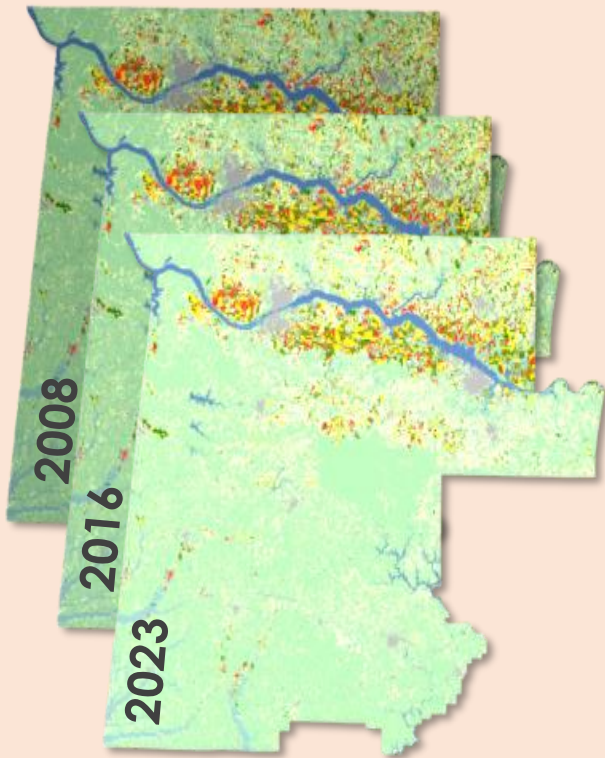
ArcGIS Pro
Precipitation

**Water
Retention
Calculation**



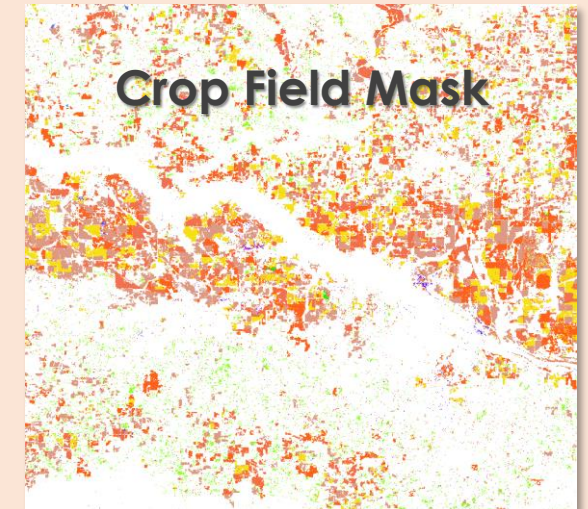
Methods: Winter & Cover Crop Map

USDA Cropland Data Layer

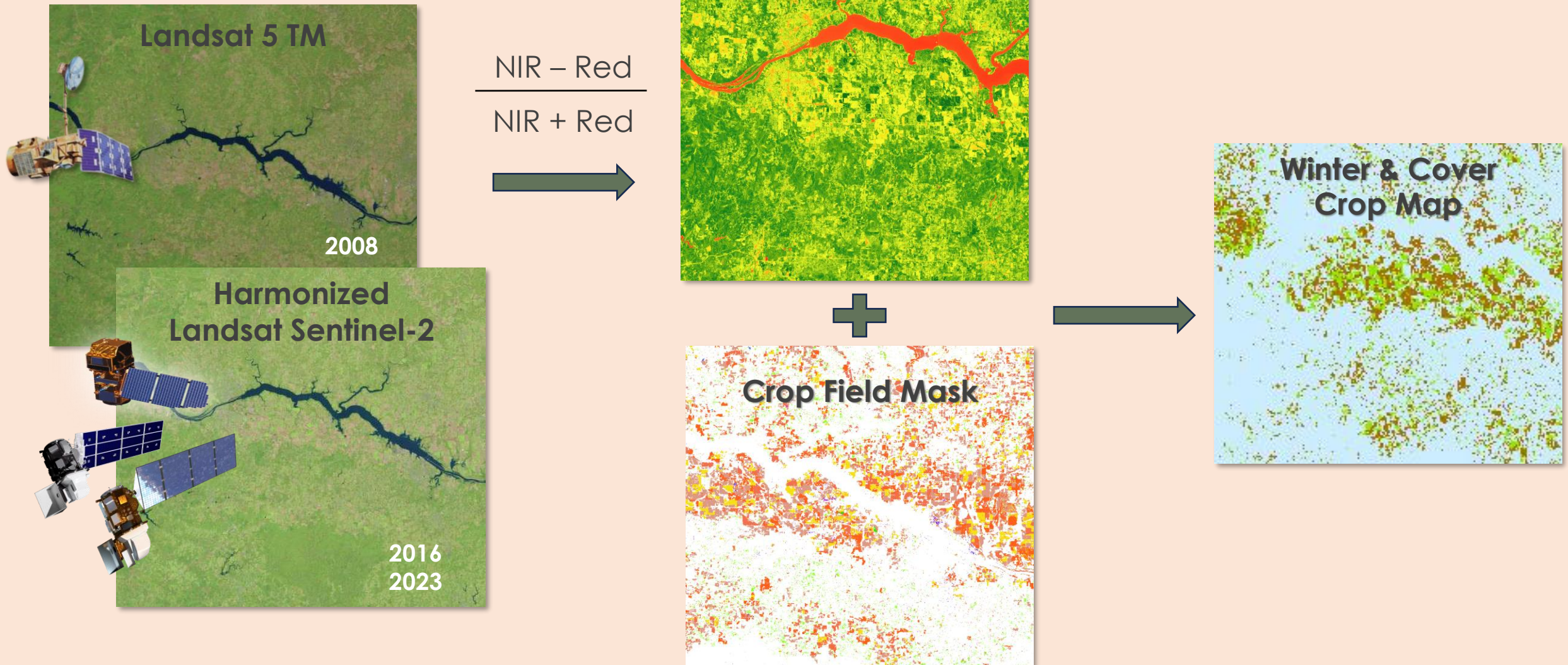


Code	Crop
62	Pasture / Grass
63	Forest
64	Shrubland
65	Barren
68	Apples
71	Other Tree Crops
72	Citrus
77	Pears
83	Water
92	Aquaculture

Crop Field **Exclusion** Sample

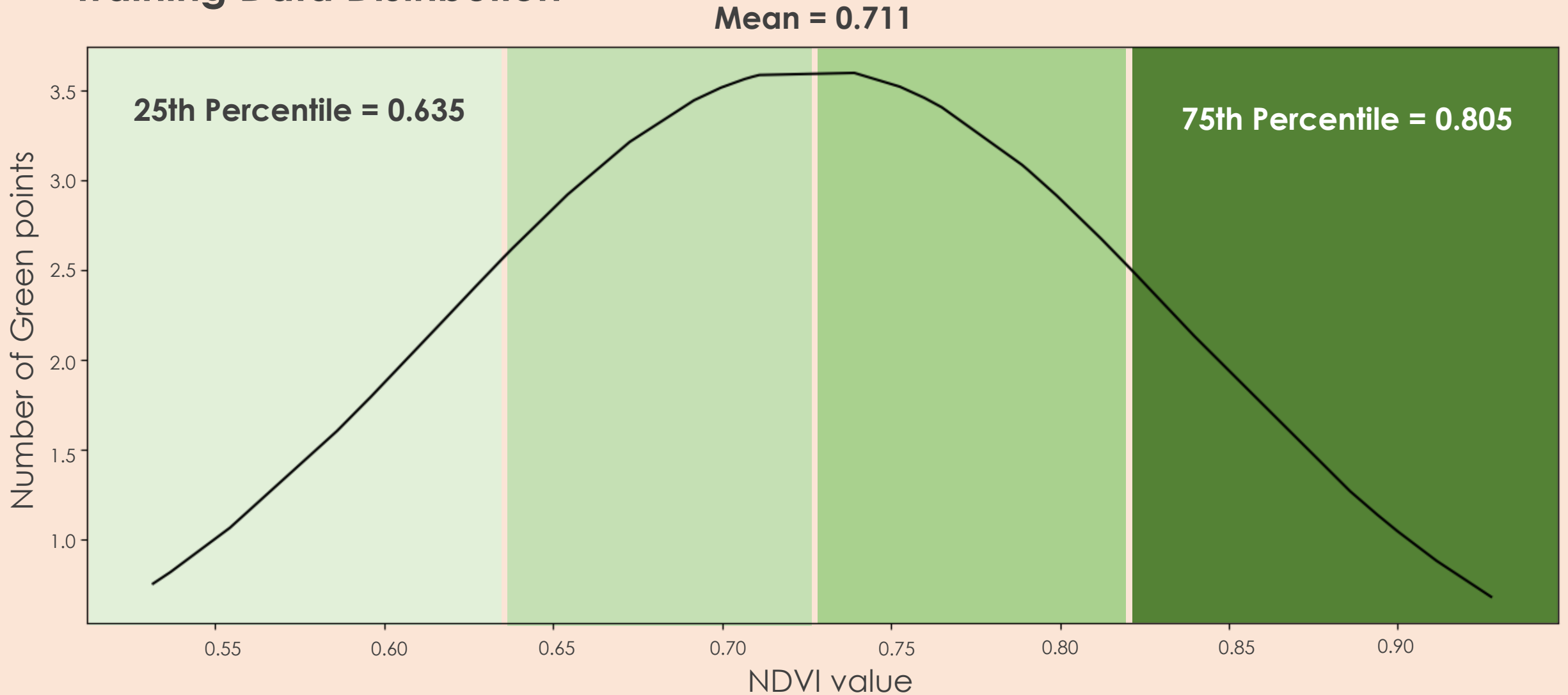


Methods: Winter & Cover Crop Map



Methods: Calculating NDVI Threshold

Training Data Distribution



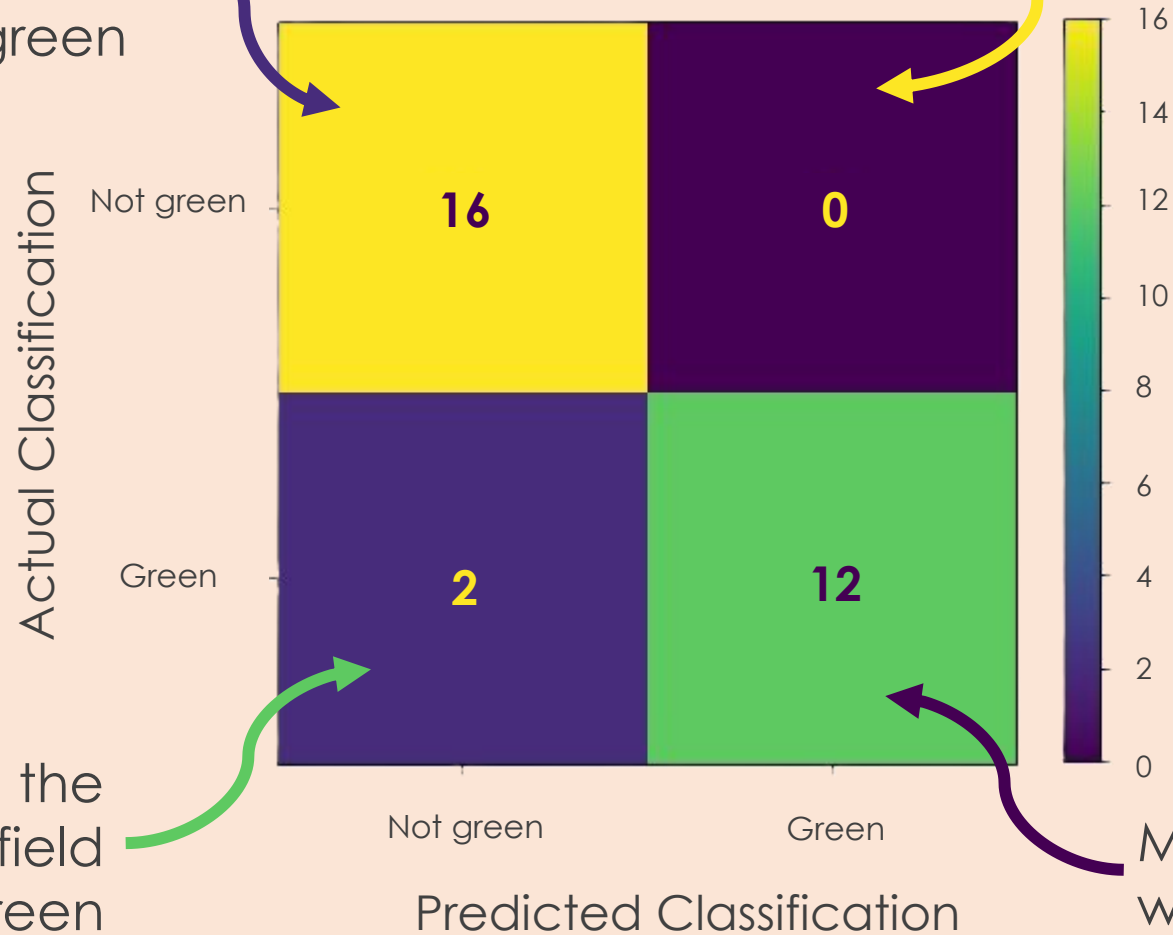
Methods: Testing Our NDVI Threshold

Model predicted the field was not green, field **was not** green

Confusion Matrix

Model predicted the field was green, field **was not** green

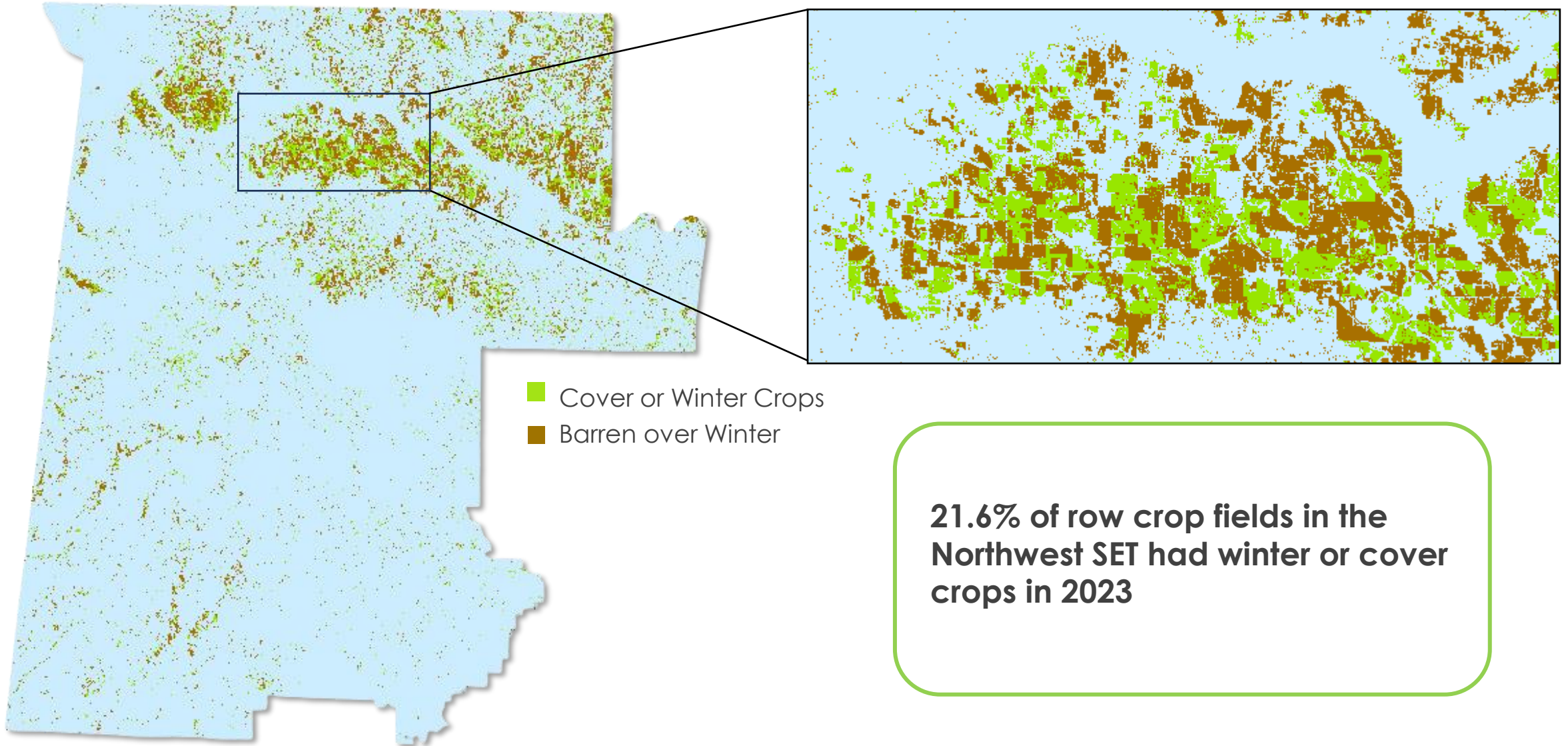
93% accuracy
(28/30)



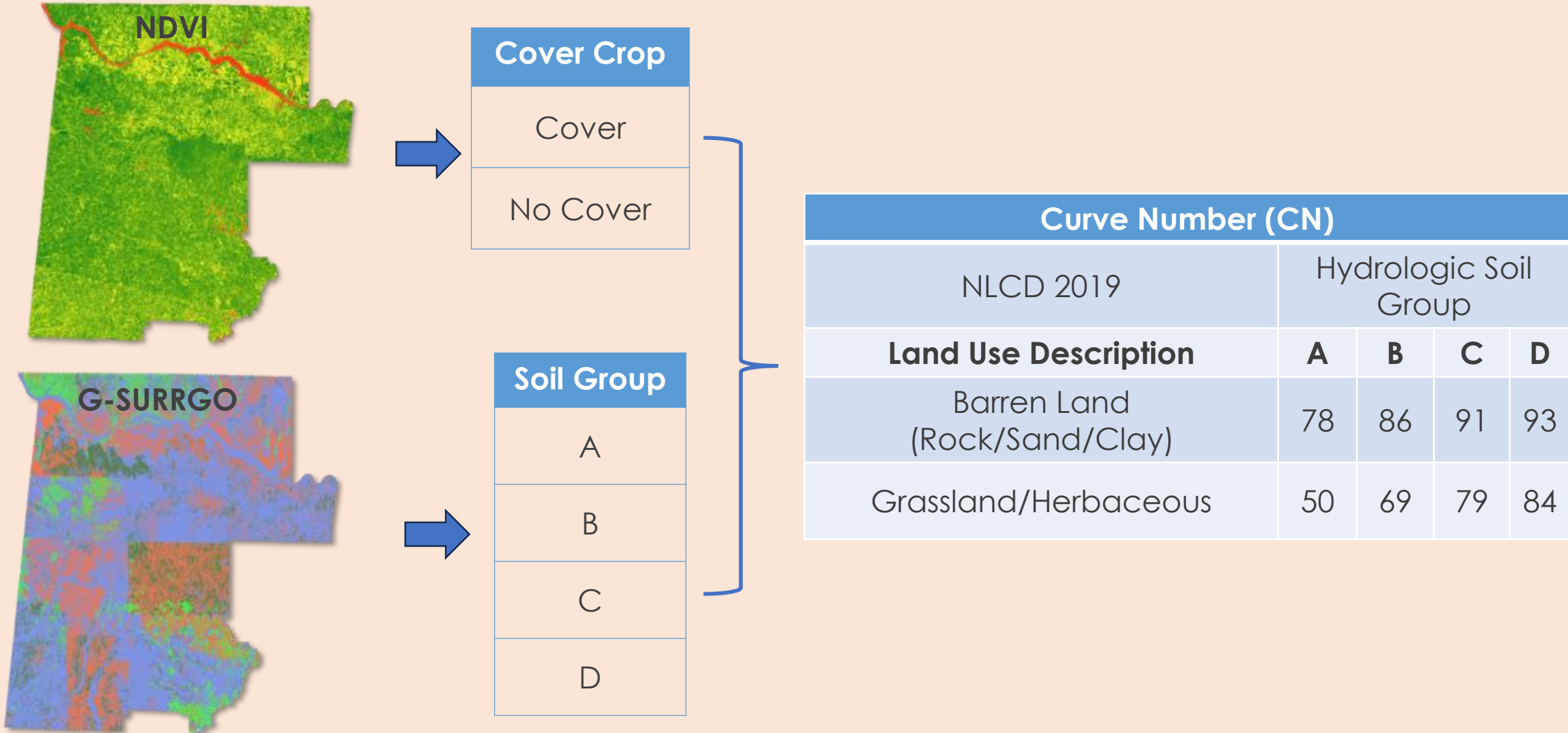
Model predicted the field was not green, field **was** green

Model predicted the field was green, field **was** green

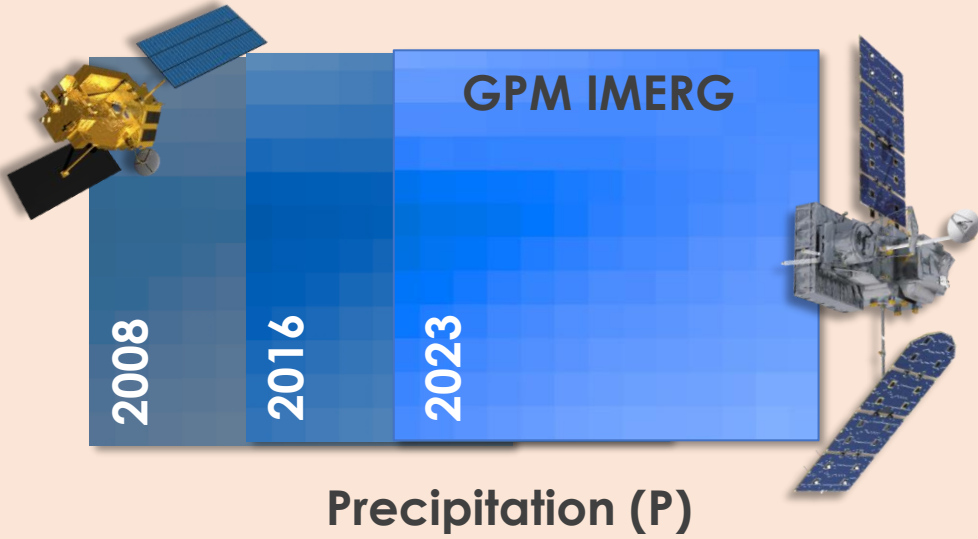
Results: Winter and Cover Crop Map



Methods: Water Retention Analysis



Methods: Water Retention Analysis



Curve Number (CN)

Soil Conservation Service Curve Number Method

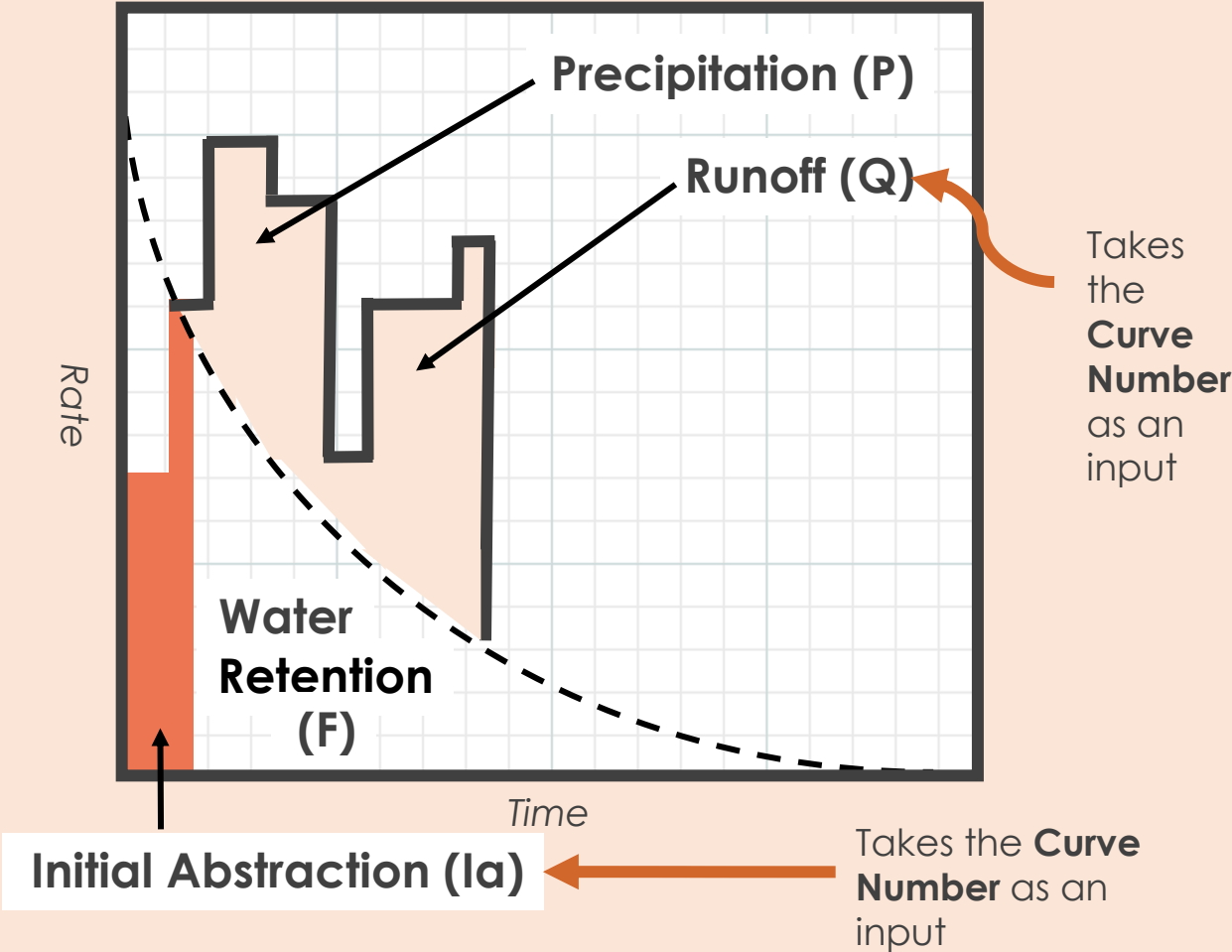
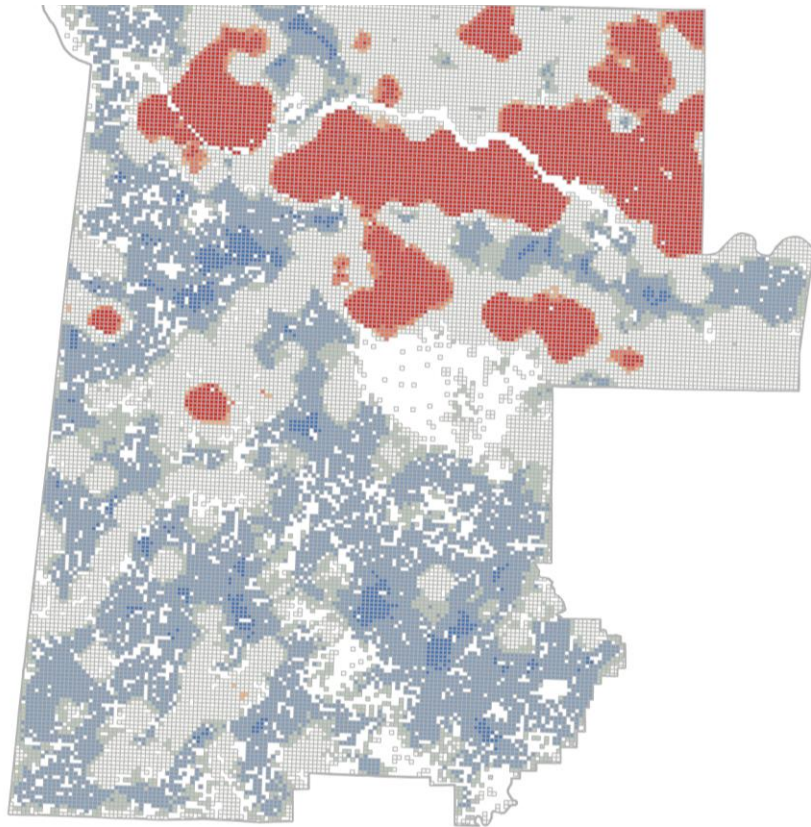


Image Credit: NASA

Results: Hot Spot Analysis (2023)

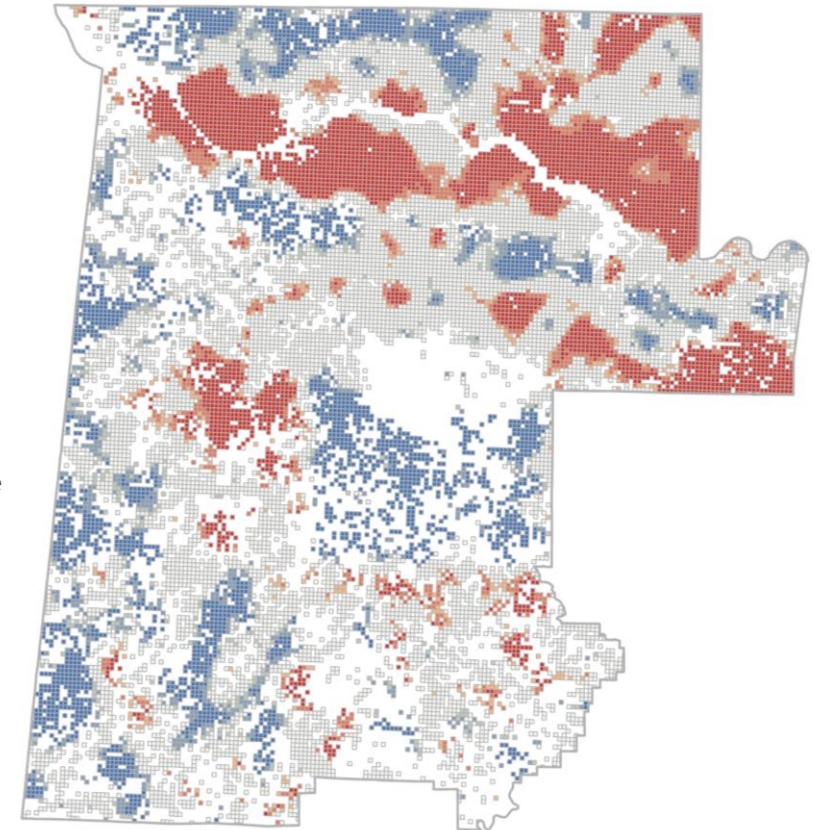
Cover & Winter Crop Hot Spots (Area, m)



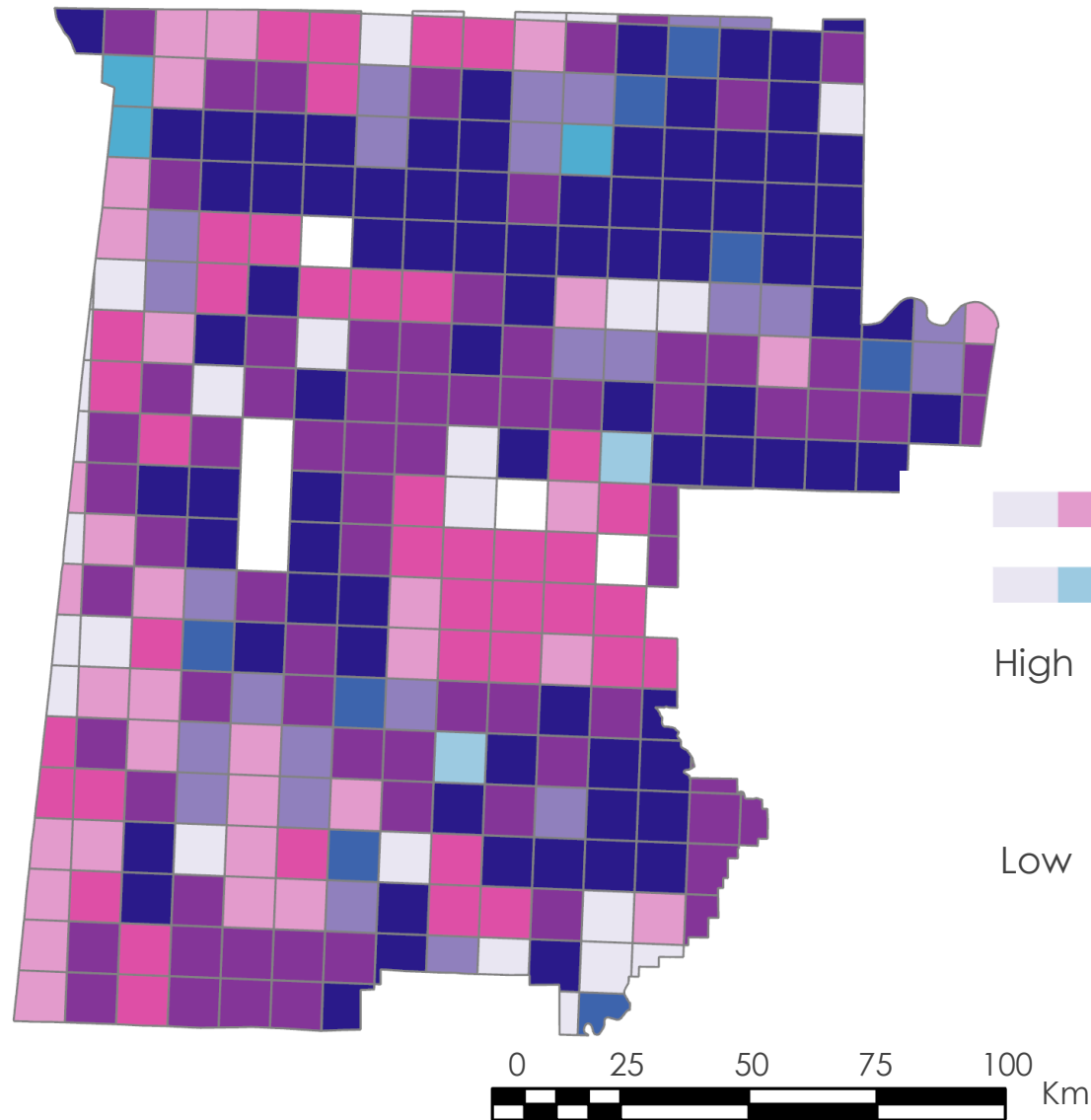
- Hot Spot with 99% Confidence
- Hot Spot with 95% Confidence
- Hot Spot with 90% Confidence
- Not Significant
- Cold Spot with 90% Confidence
- Cold Spot with 95% Confidence
- Cold Spot with 99% Confidence



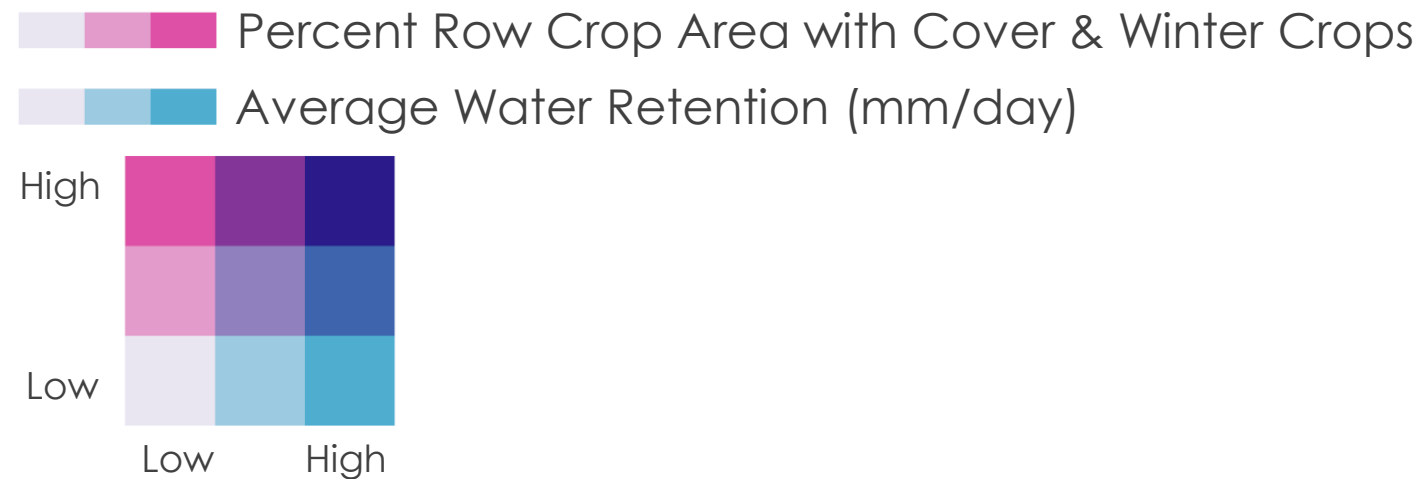
Water Retention Hot Spots (Avg., mm/day)



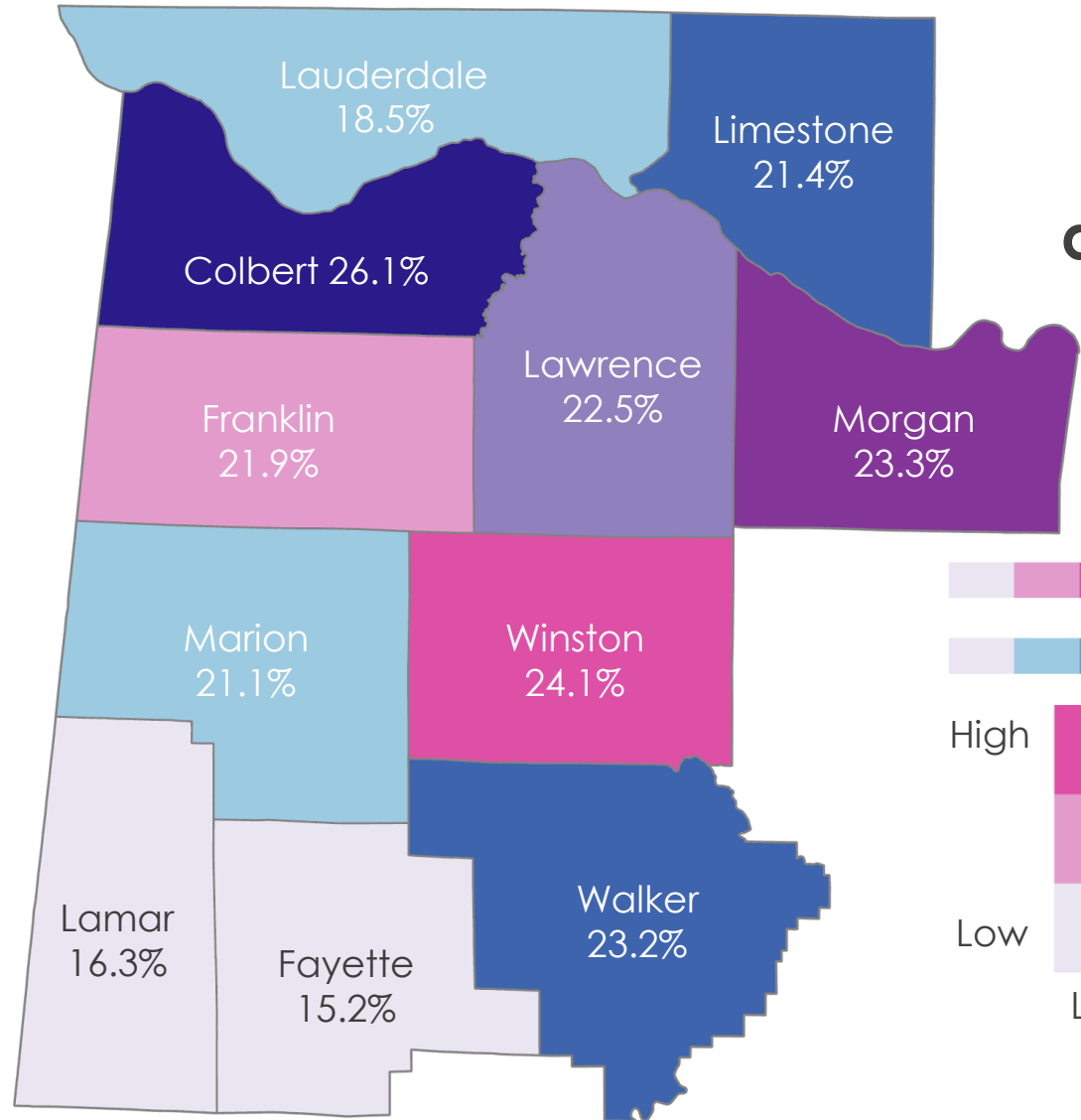
Results: 10km-level Analysis (2023)



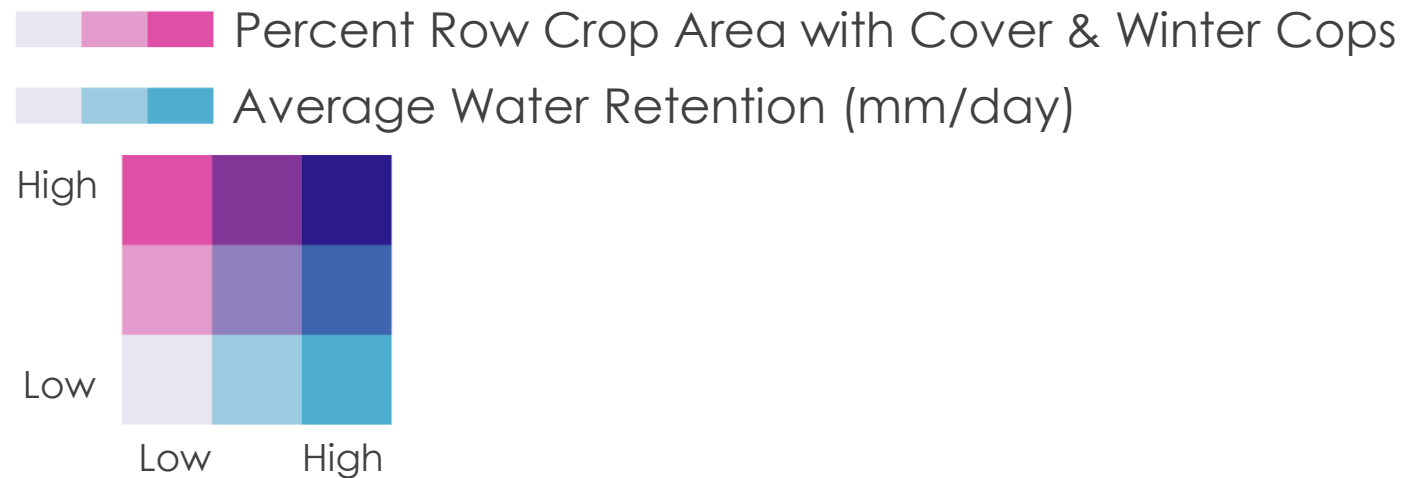
Cover & Winter Crop Adoption Rate (%) and Average Water Retention (mm/day)



Results: County-level Analysis (2023)

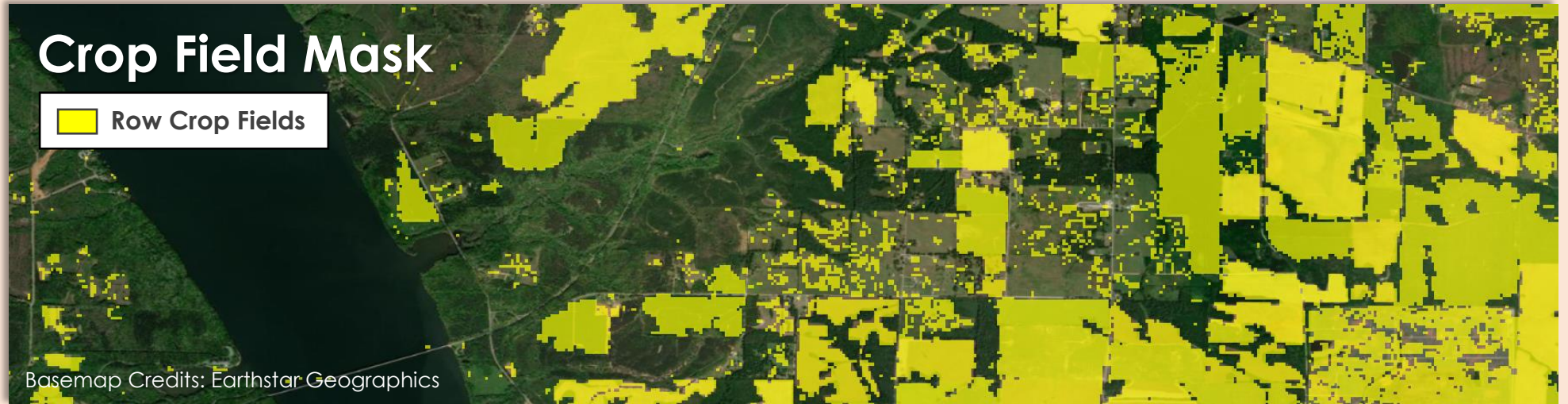


**Cover & Winter Crop Adoption Rate (%)
and Average Water Retention (mm/day)
by County**



Errors and Uncertainties

CDL
Accuracy
(80%)



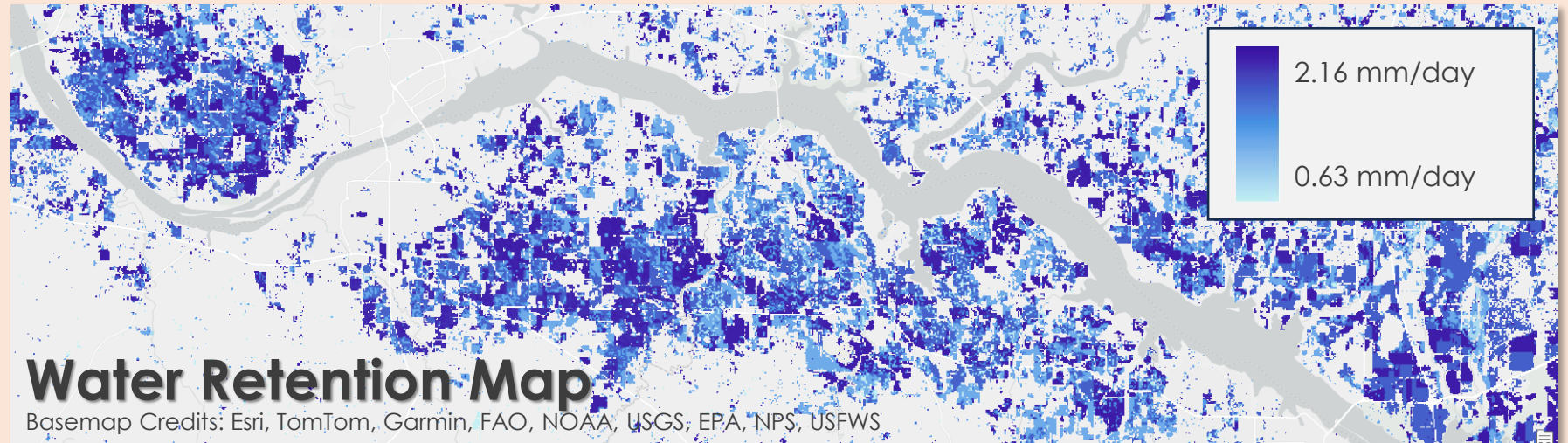
False Positives: Weeds

Errors and Uncertainties



Human Error:
Visual
Identification

Curve
Number
Inefficiencies



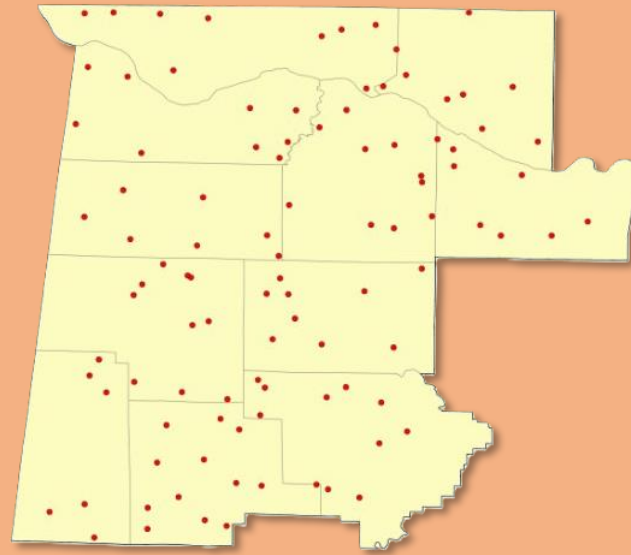
Limitations



Basemap Credits: Planet Labs

Ground-truth data for validation

Spatial extent



Precipitation

Soil type

Water retention calculation parameters

Future Considerations

Future work should focus on

- Investigating other SET regions in Alabama
- Attaining ground-truth points
- Assessing the impact of increased water retention
- Communicating water retention benefits

Alabama Drought Reach

Further studies should consider

- Time series approach to differentiate between winter and cover crops
- More robust water infiltration equations and parameters
- Machine learning classification

DEVELOP

Conclusions

- Utilizing NASA Earth observation data provided a **feasible and scalable** approach for monitoring cover and winter crop **implementation and effectiveness**
- Cover and winter crops were **significantly adopted** across row crop fields in our study area, with some counties showing **higher adoption rates** such as **Colbert County**
- Fields with cover and winter crops showed **improved water retention**
- Soil health and water retention can be enhanced by cover and winter crops, providing a **strategy for drought mitigation**

Acknowledgments

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