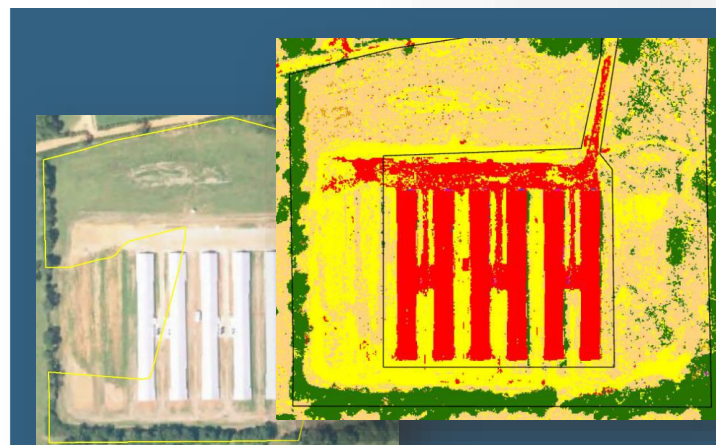
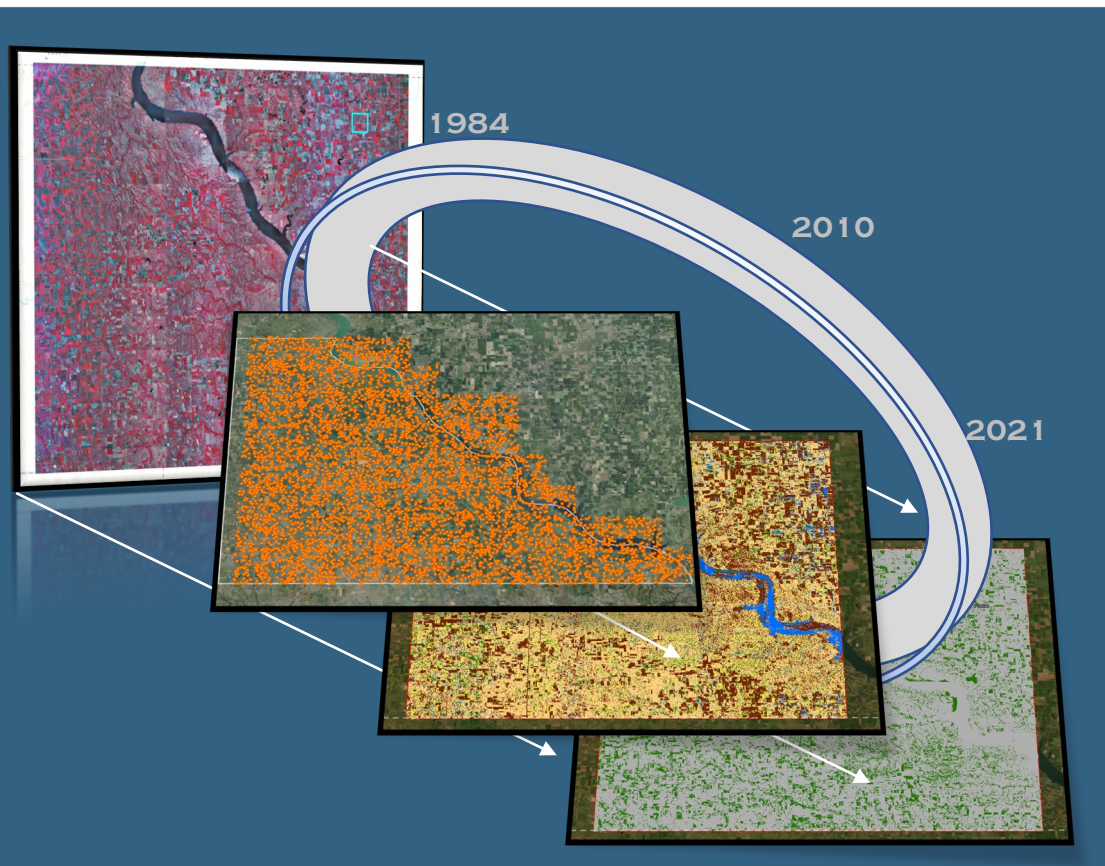




United States Department of Agriculture



# Land Change Analysis Tool (LCAT)

FARM PRODUCTION AND CONSERVATION  
FSA | NRCS | RMA | Business Center

# Background

## Pilot Project:

Agriculture Improvement Act of 2018 (2018 Farm Bill)

- Improve program accountability and integrity through targeted and coordinated efforts
- Data mining to identify changes

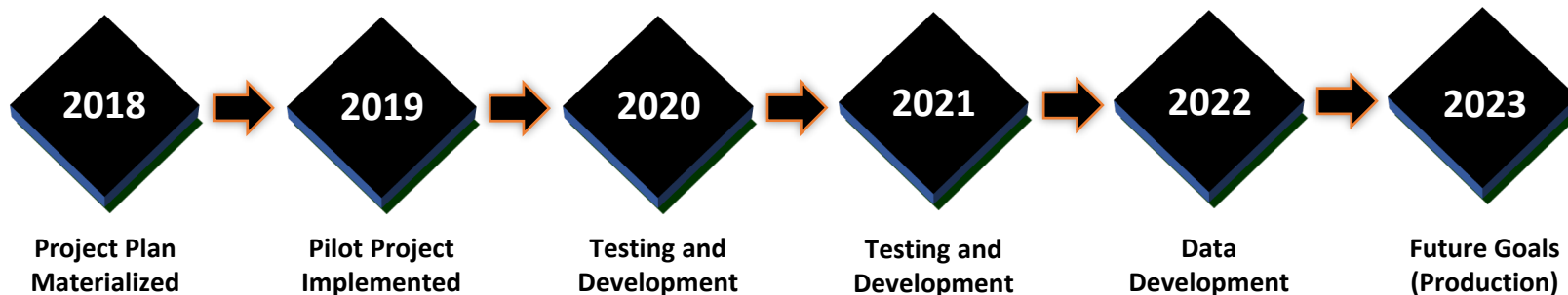
CLU Database Guidelines (*10-CM Par. 33C*)

- Capture cropland, pasture, and rangeland areas
- Tracts should not include:  
Public roads, Barns, Houses, or other structures

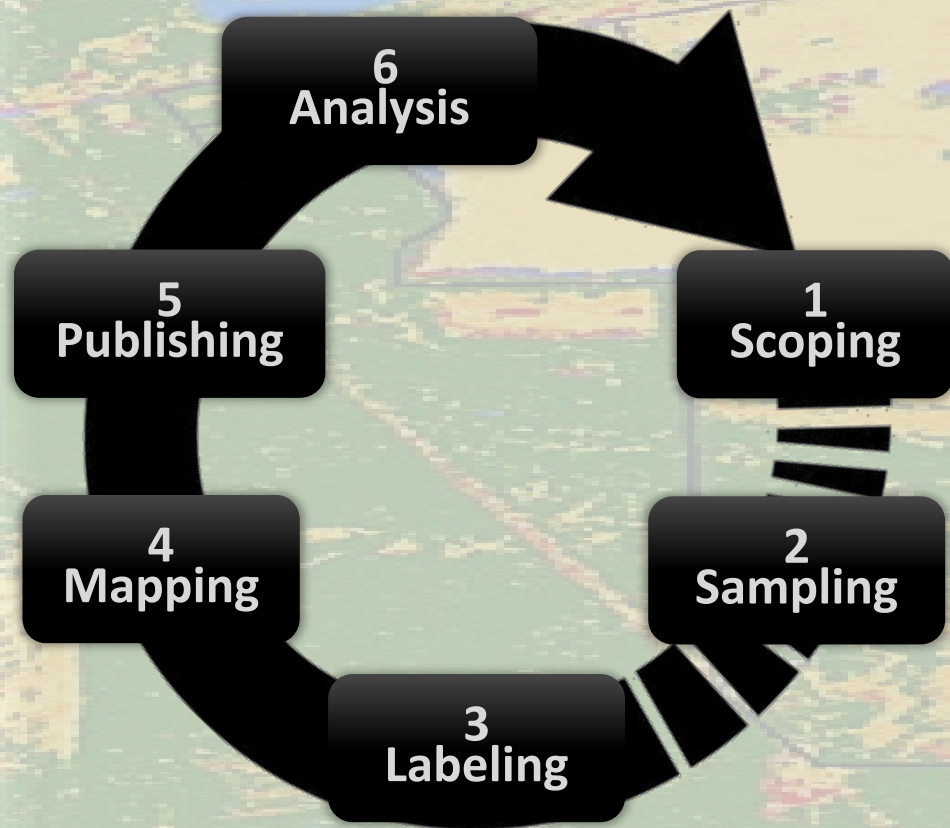


## LCAT- Land Change Analysis Technique

Utilizes NAIP imagery and machine learning to develop a high resolution land cover map that flags records for review.



# LCAT Process



## 1. Scoping

Sample Plan

## 2. Sampling

Point selection

## 3. Labeling

Training data for modeling

## 4. Mapping

8 class land cover map

## 5. Publishing

Review maps and publish  
image service

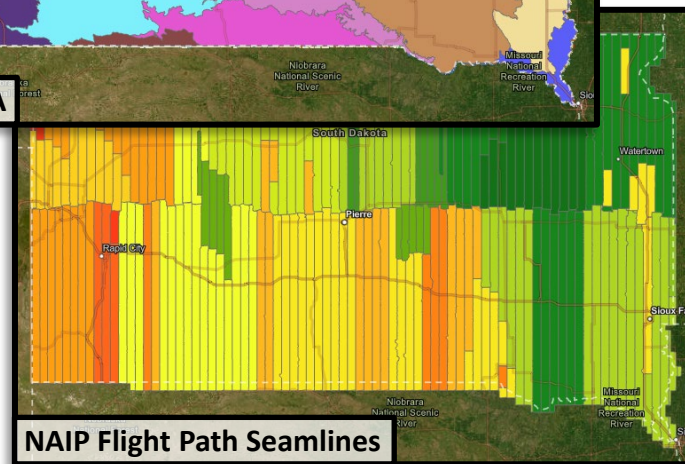
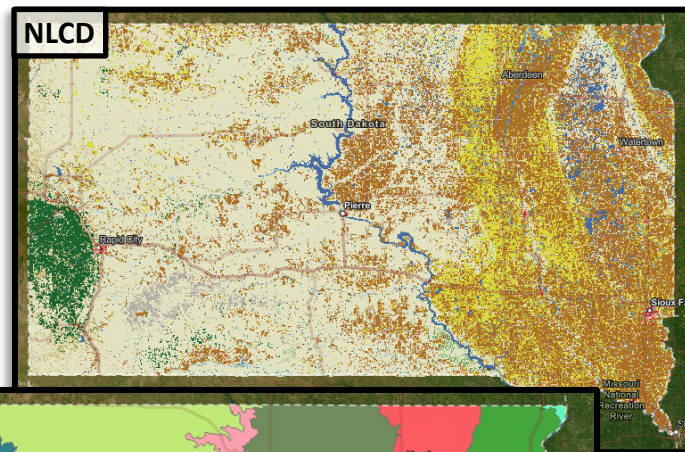
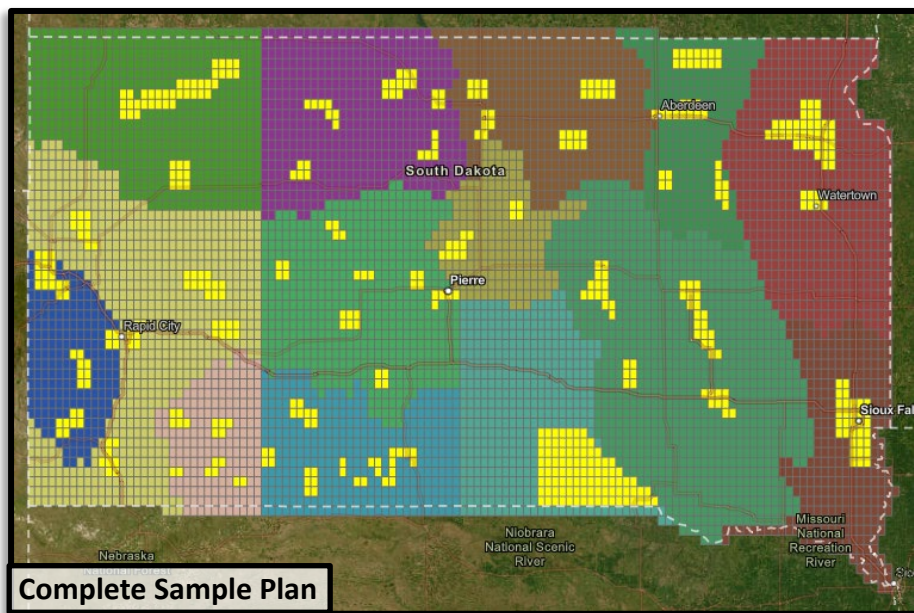
## 6. Analysis

Develop derivative products  
and data



# 1. Scoping

- Sample Plan Development
- Consultation with local field staff



## Input Data

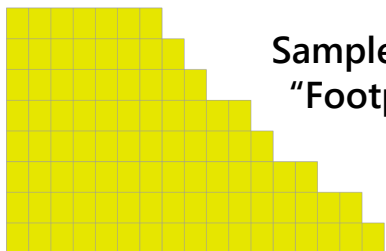
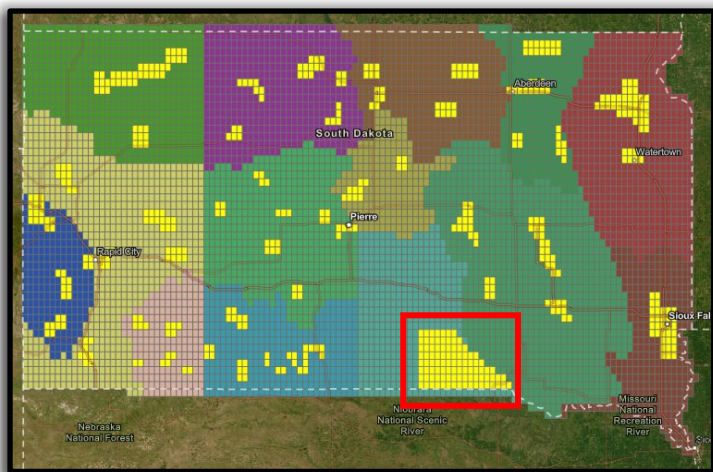
- NAIP Imagery
- NLCD / MLRA maps
- Image Acquisition Seamlines



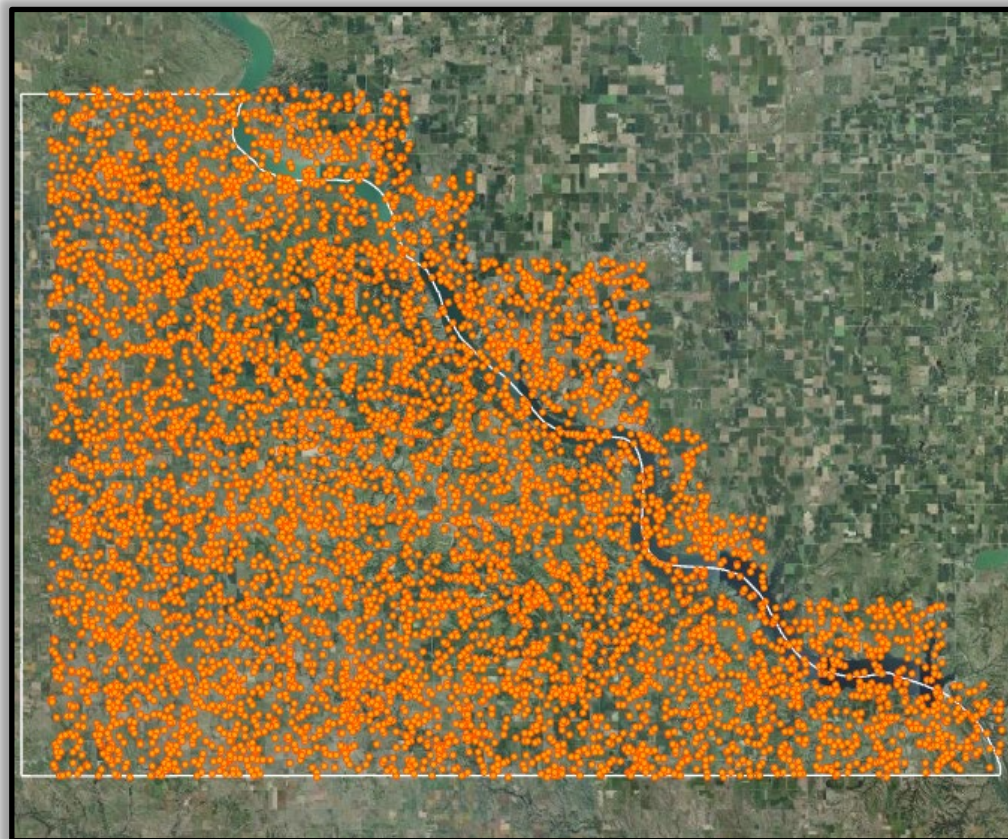
# 2. Sampling

## Generate sample points from NAIP Imagery

- 75 – 100 points per image
- Total points are dependent on state or project size



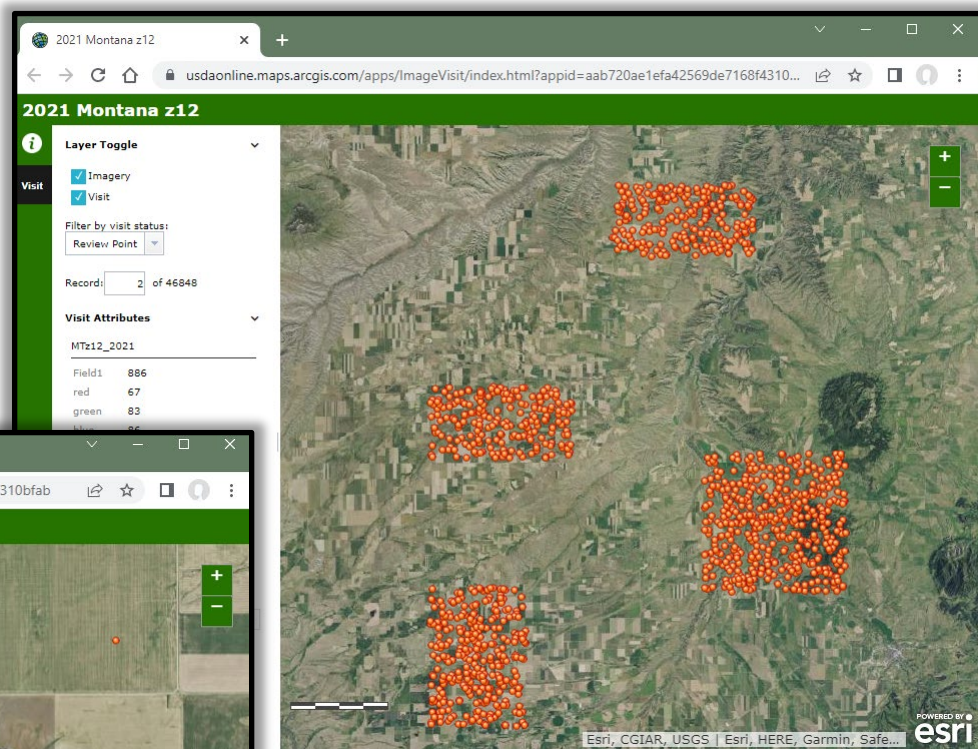
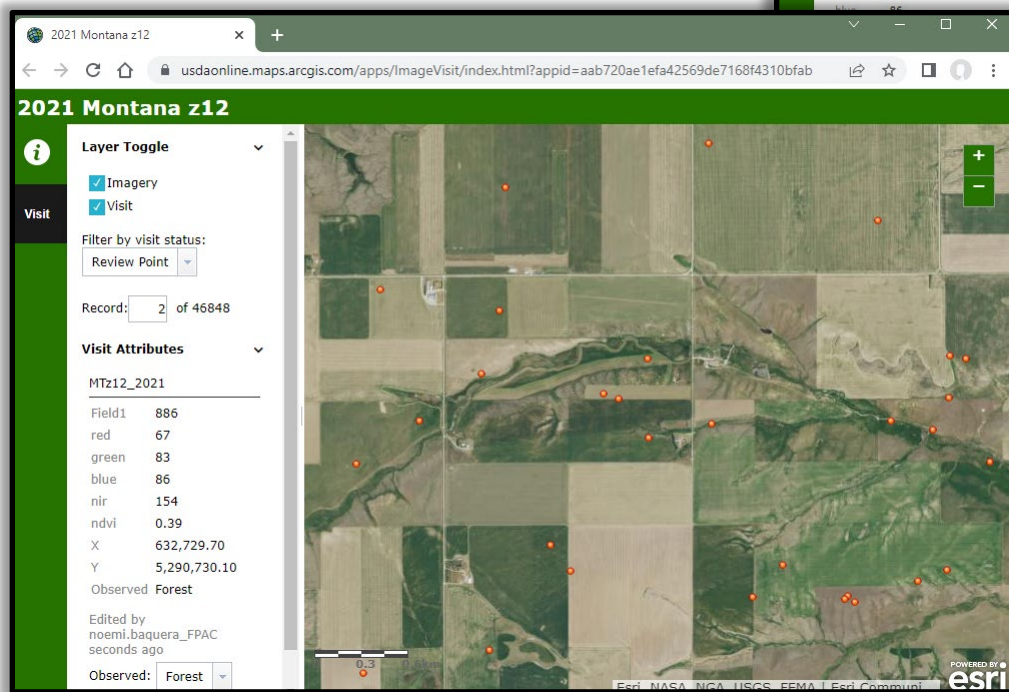
Sample Image  
"Footprints"



# 3. Labeling

## LCAT Labeling Web Application

- ESRI's ArcGIS Online Platform
- Crowd-Sourcing of point labeling for AI Model Training



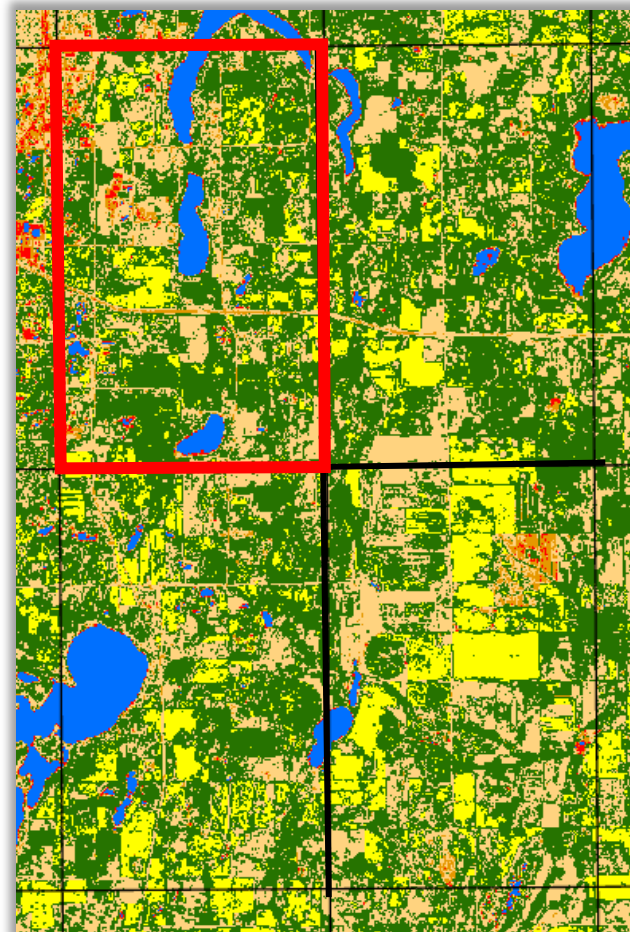
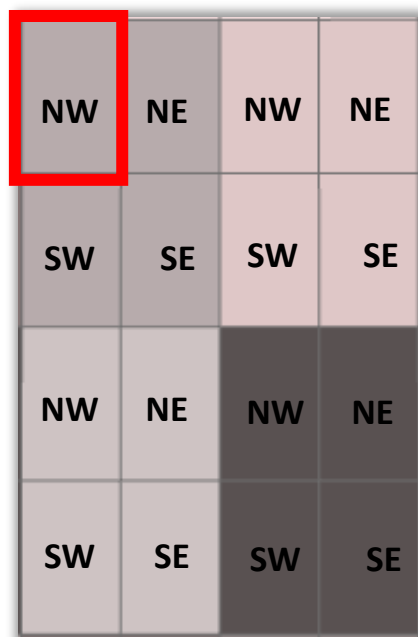
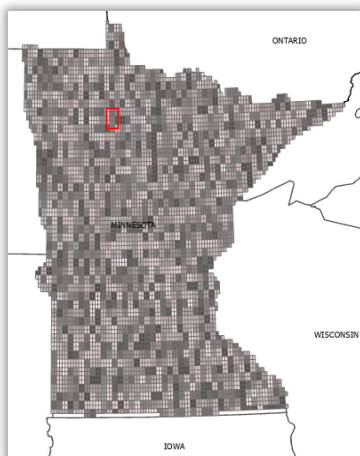
- ~10,000 points per week
- Allows partnerships with outside organizations, universities, etc.



# 4. Mapping

## NAIP Imagery

- Quarter Quad (QQ)
- 125M pixels per image (QQ)
- 2 years cycle for each state



## LCAT Process

- AI (Artificial Intelligence) machine learning algorithm
- Docker allows for large scale processing

**Significant improvement in production capacity with Docker**



# Satellite vs Aerial Image Classification

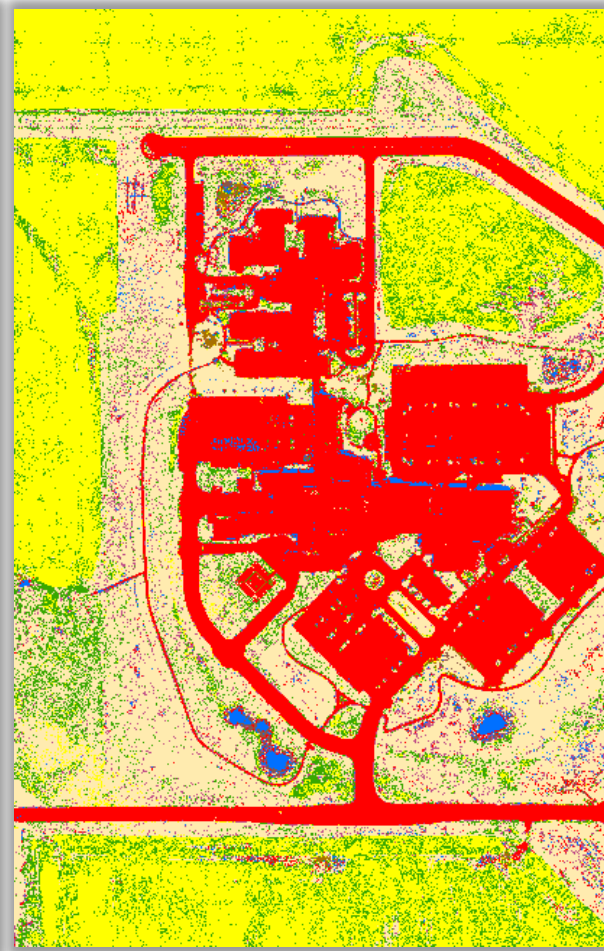
**NLCD**  
(satellite)



**NAIP 2021**

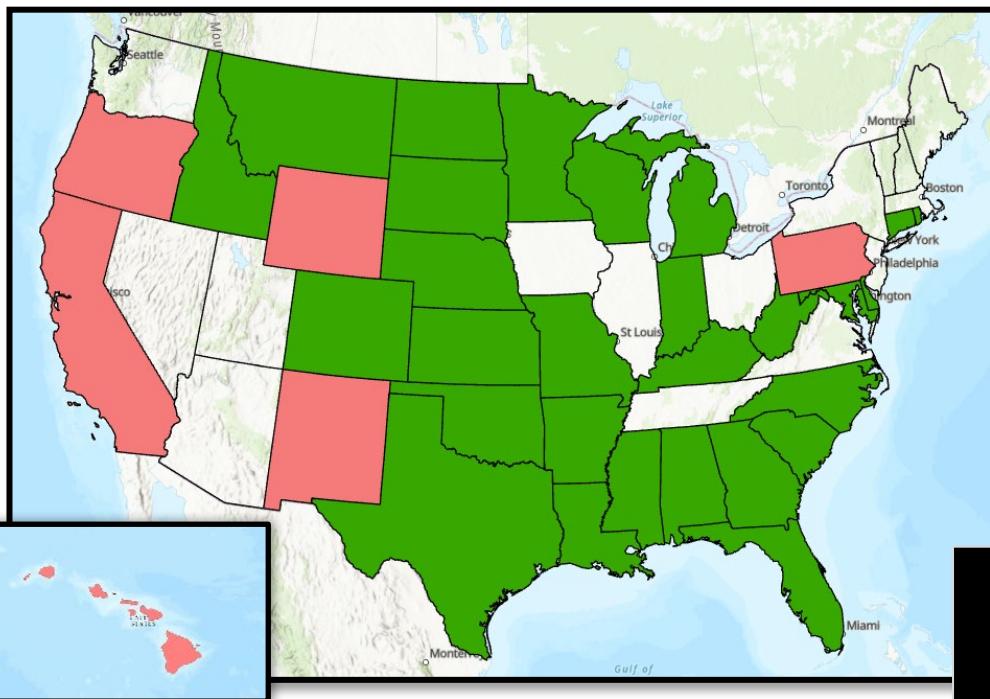


**LCAT**





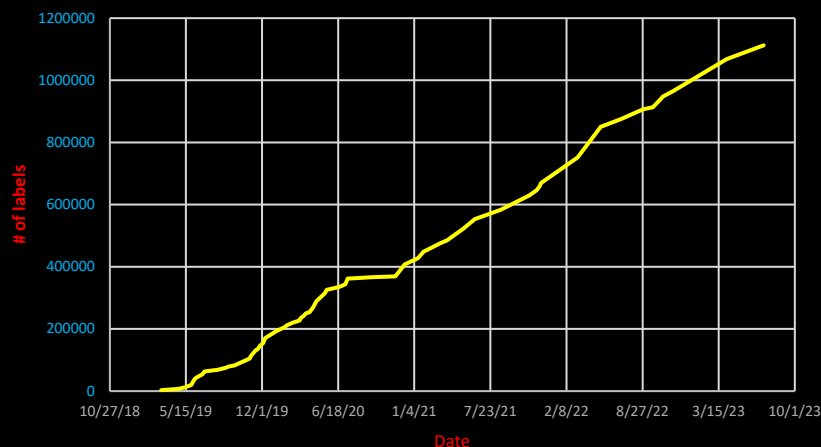
# LCAT Status 2023



**Over 1.2 billion acres mapped**  
**Over 1.2 million points labeled**

2022 - NE, MO, NM, CA, PA	60cm
2021 - SD, RI, DE, MN, OK, MT*, CO*	60cm
2020 - MS, WI, KY, NC, WV, TX, ND, HI*, OR	60cm
2019 - SC, GA, AL, LA, AR	60cm
2018 - CT, MI, IN, MD, DE	1m
2017 - AL, GA, FL, ID	1m
2016 - CT	

**Volume of Training Data (as of July 11, 2023)**

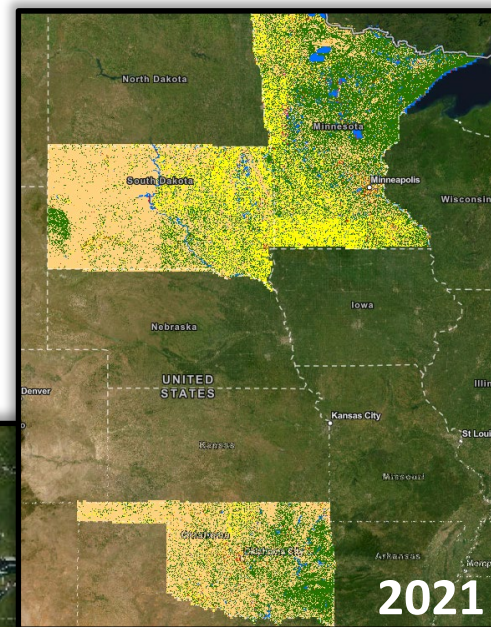
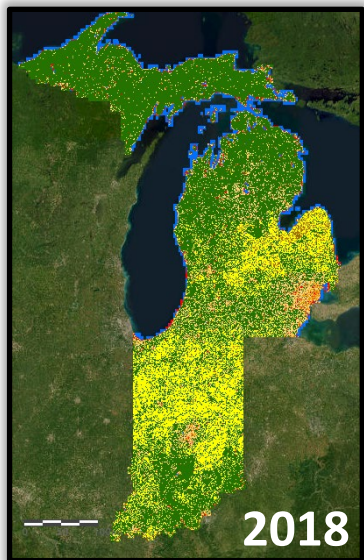




# 5. Publishing – LCAT Image Service

[https://nrcsgeoservices.sc.egov.usda.gov/arcgis/rest/services/land\\_use\\_land\\_cover](https://nrcsgeoservices.sc.egov.usda.gov/arcgis/rest/services/land_use_land_cover)

- LCAT is published internally and to the public
- Over 19 States from 2018-2021 are available
- More states are ready for publication (2017-2021)
- Best available service



## 6. Analysis

- Customer request and requirements
- Develop derivative products and data according to project specifications

### Current partnerships:



United States Department of Agriculture

Animal and Plant Health Inspection Service  
Wildlife Services



COLLEGE OF  
AGRICULTURE &  
NATURAL RESOURCES





# Alabama & Georgia FSA - Pilot Project

- LCAT maps were used to update the CLU database and helped streamline the review process
- Easily customized to evaluate different land use types:  
Barren, crop, forest, grassland, shrub, urban, water, wetland

“Cropland” CLU Polygon

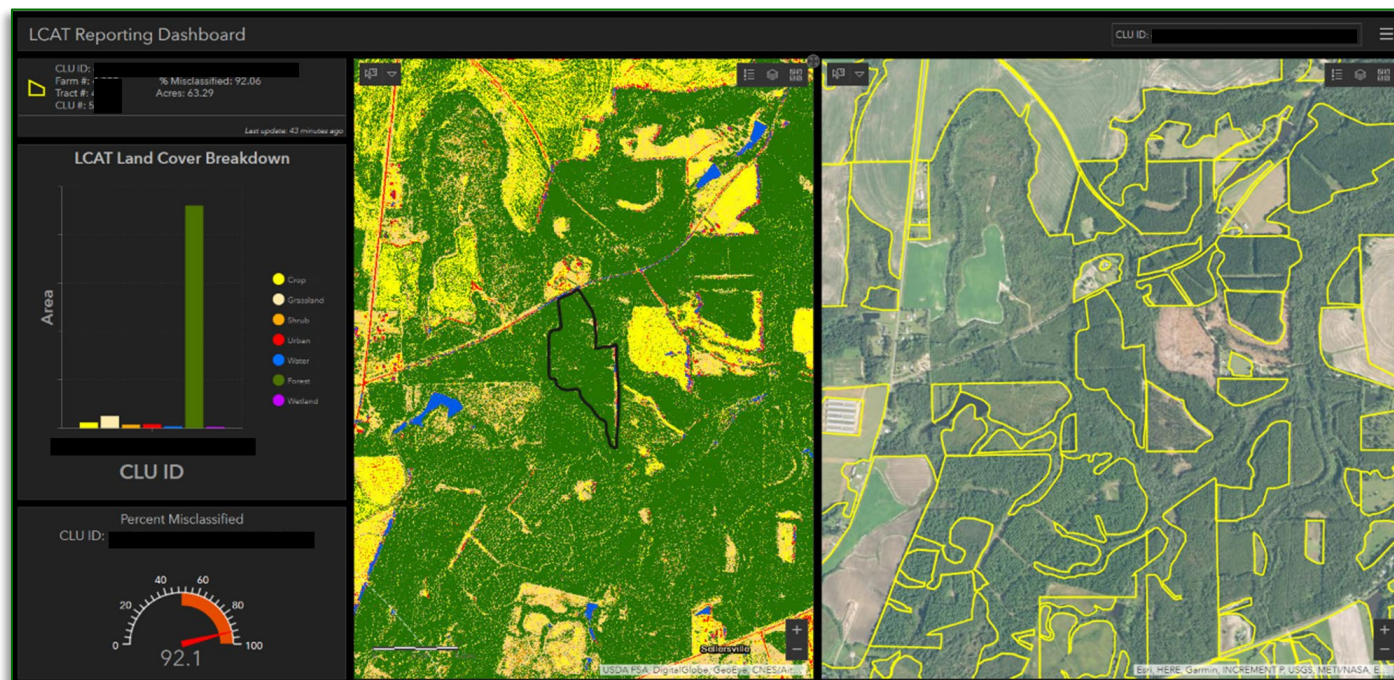
C	C	C	C
C	C	C	C
C	C	C	C
C	C	C	C

LCAT Image

W	W	C	C
C	C	C	C
C	C	F	F
C	C	F	F

Flagged for Review

!	!		
		!	!
		!	!



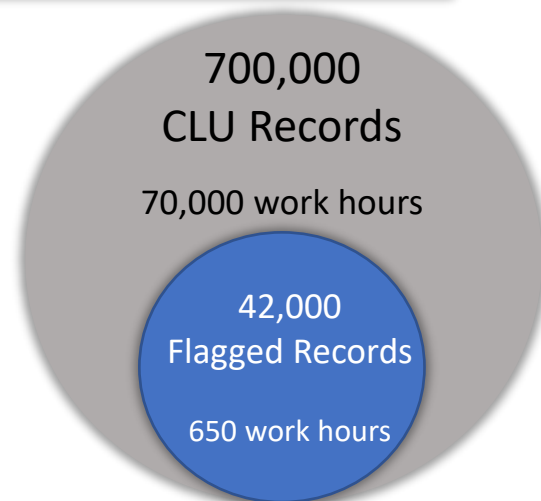


# Georgia FSA Case Study



**Technology assistance for better data-driven decision making and improved efficiency.**

- CLU Records: ~ 700,000 records
- Flagged Records: 42,000 records
- Reduced Work Hours: 70,000 → 650 hours



# Eastern Redcedar Monitoring in South Dakota

## FPAC-GEO and NRCS SD collaboration

Native species encroaching on natural grassland

- Reduces grazing land
- Increases soil erosion
- Reduces wildlife habitat
- Expensive to remove/maintain extents



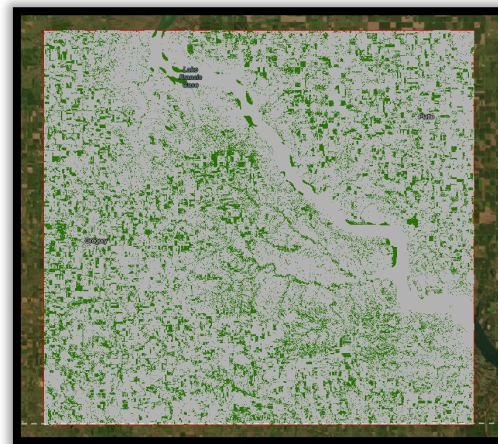
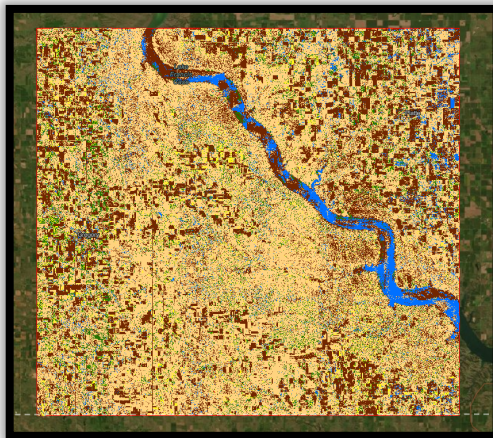
Historical Imagery  
1984 - 2021



Land Cover  
Mapping

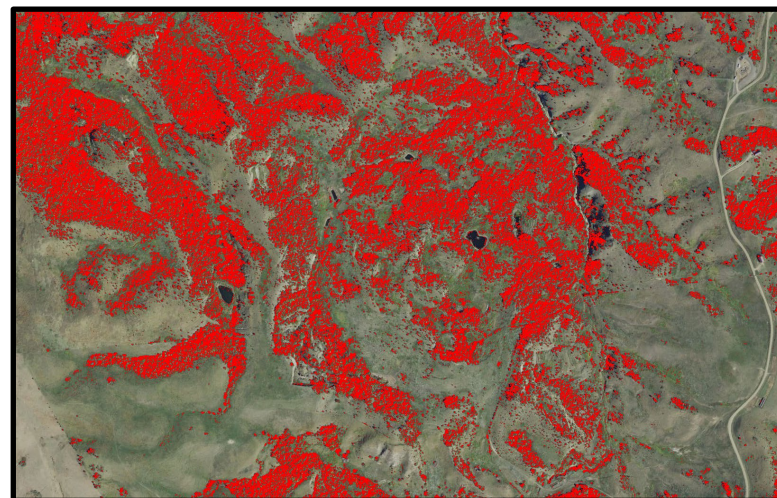
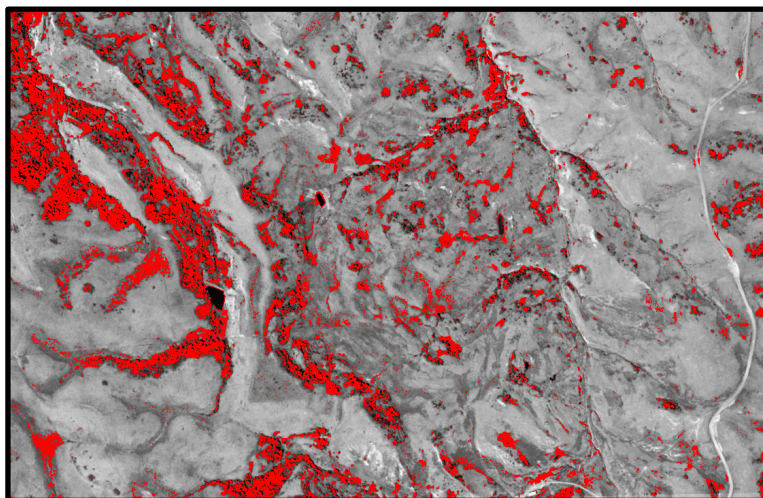
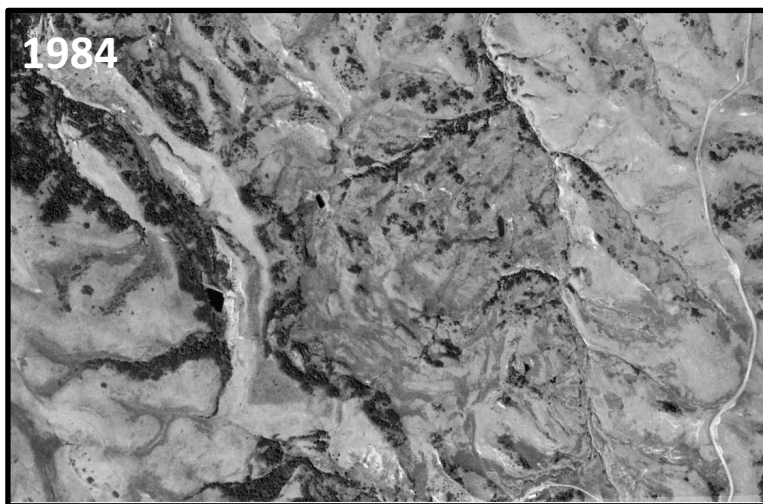


Land Cover  
Derivative





# Land Change Analysis (1984 - 2021)

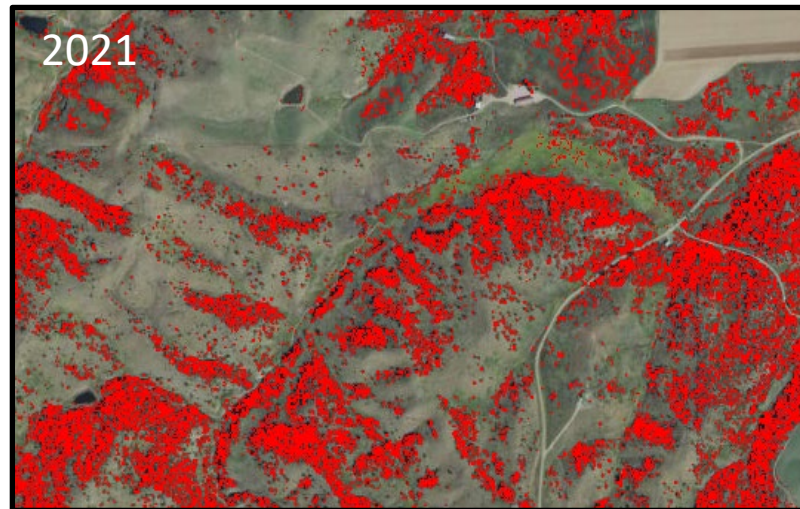
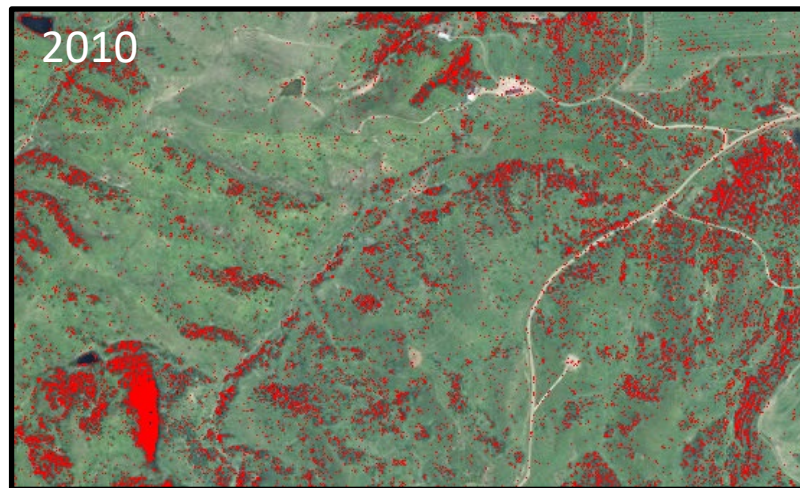
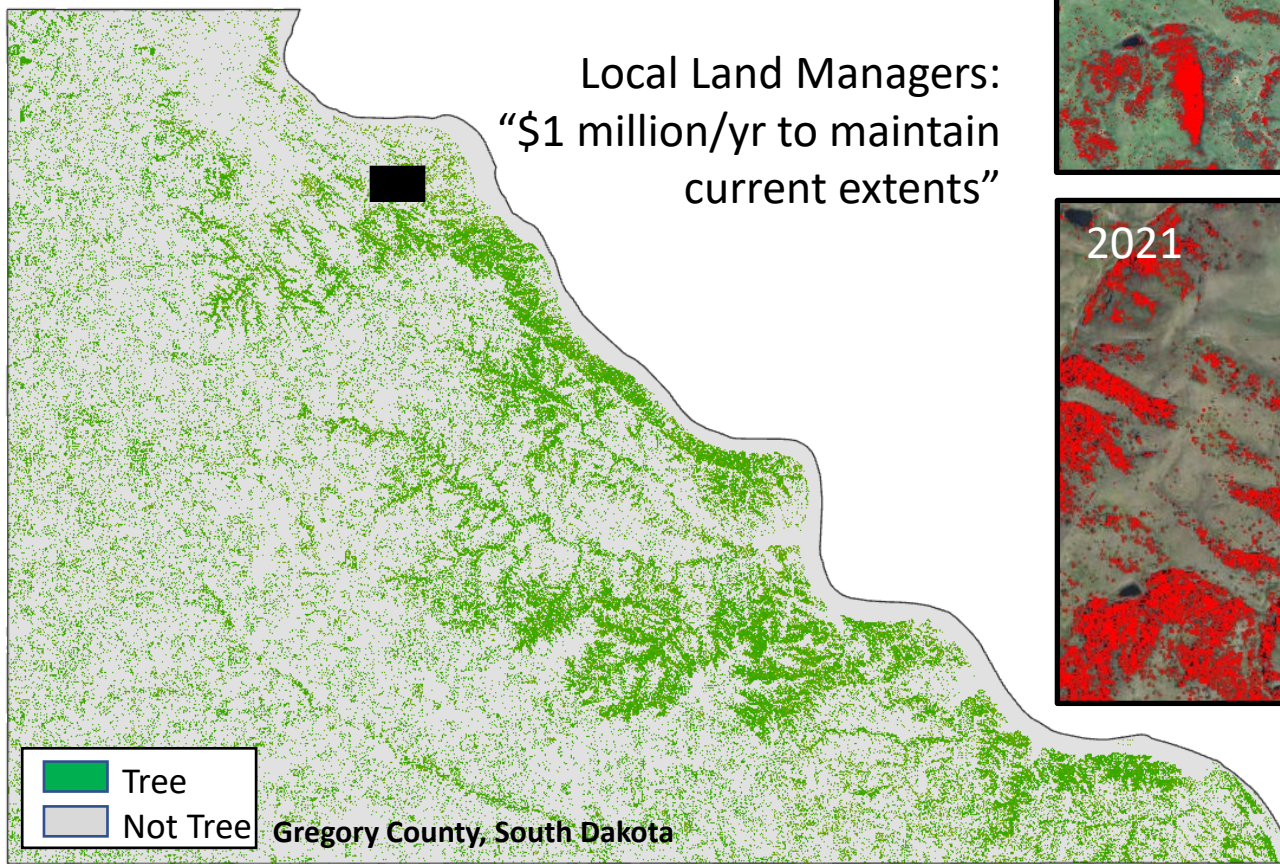




# Land Change Analysis (2010-2021)

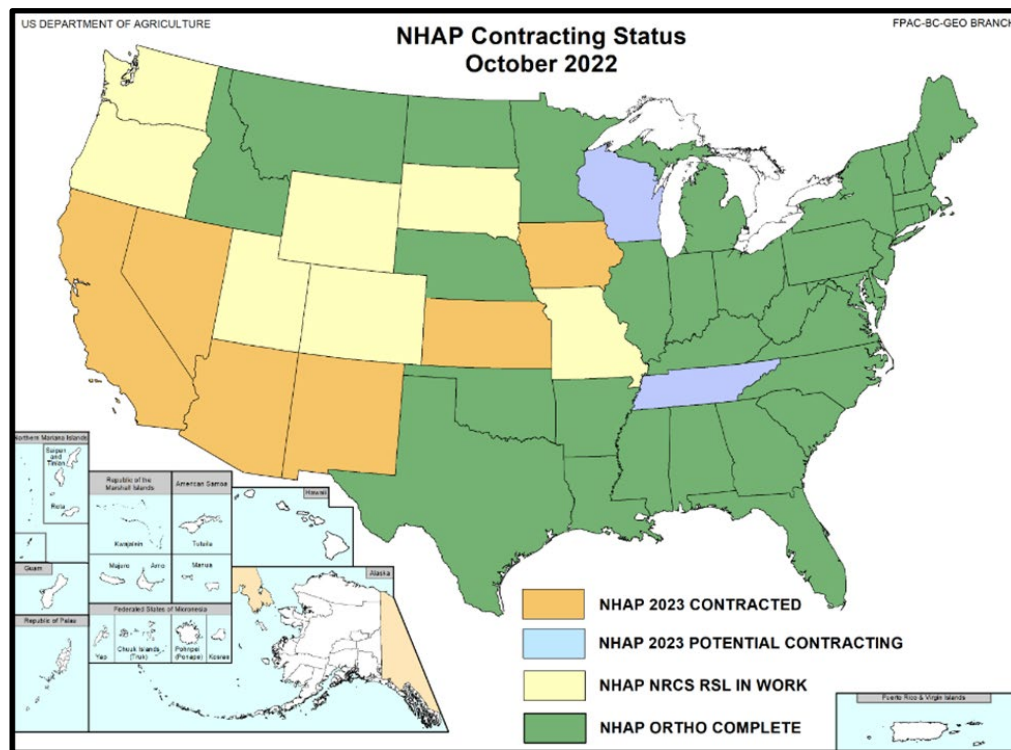
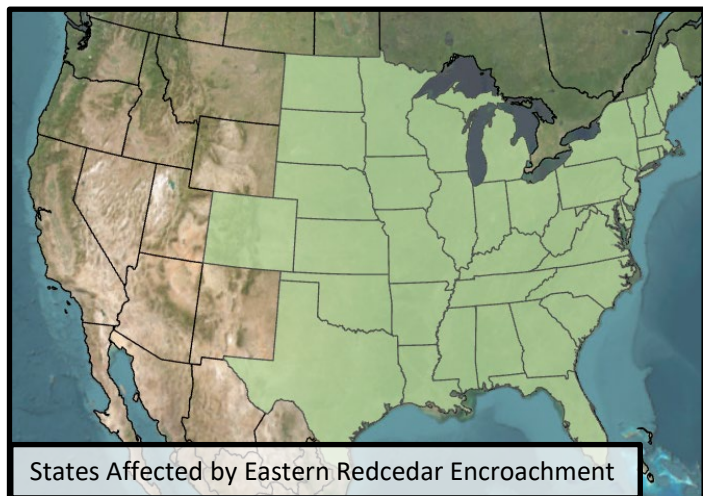
10% increase of Redcedar in Gregory County  
= (920 ac/yr)

Local Land Managers:  
"\$1 million/yr to maintain  
current extents"



# Eastern Redcedar Encroachment: Future Monitoring

Track species encroachment  
throughout the Great Plains  
and beyond



LCAT, NAIP, and NHAP coverage is expanding



# UMD / APHIS Collaboration

938%

Return On Investment

ESRI/APHIS Economic Analysis

## Airport Wildlife Habitat Management

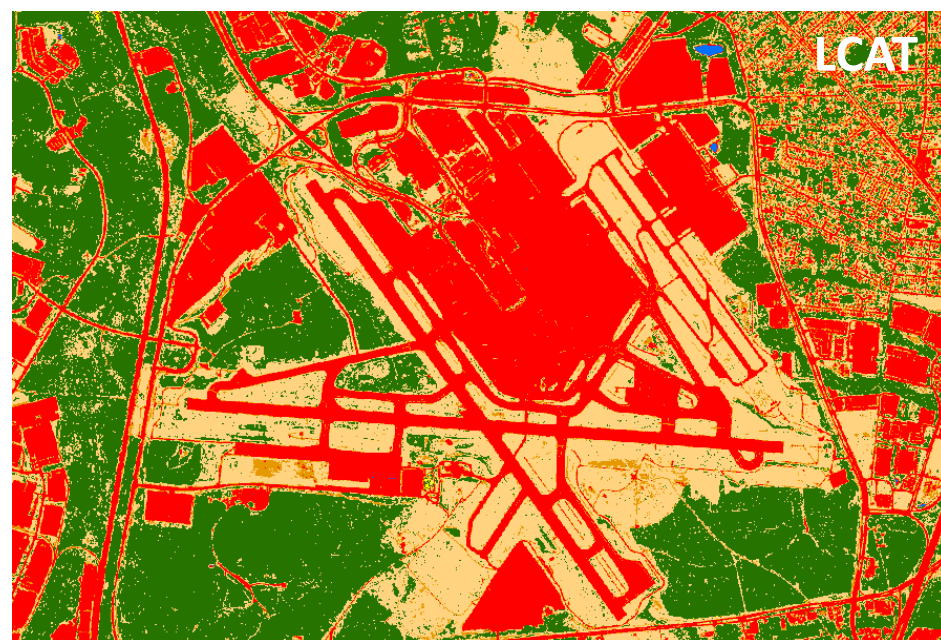
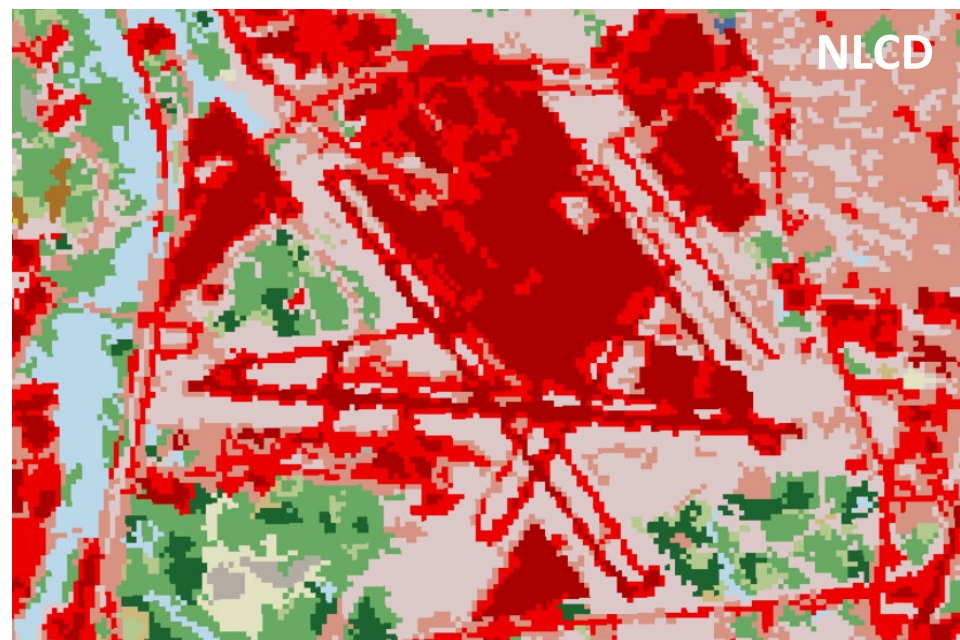
### Capstone Projects 2020/2021/2022

- 2020 - Analysis of all IAD/BWI/DCA airports
- 2021 - BWI history 2011/2015/2018
- 2022 - Analysis of NAS PAX and Kahului Airport

### Student Internships 2020/2021

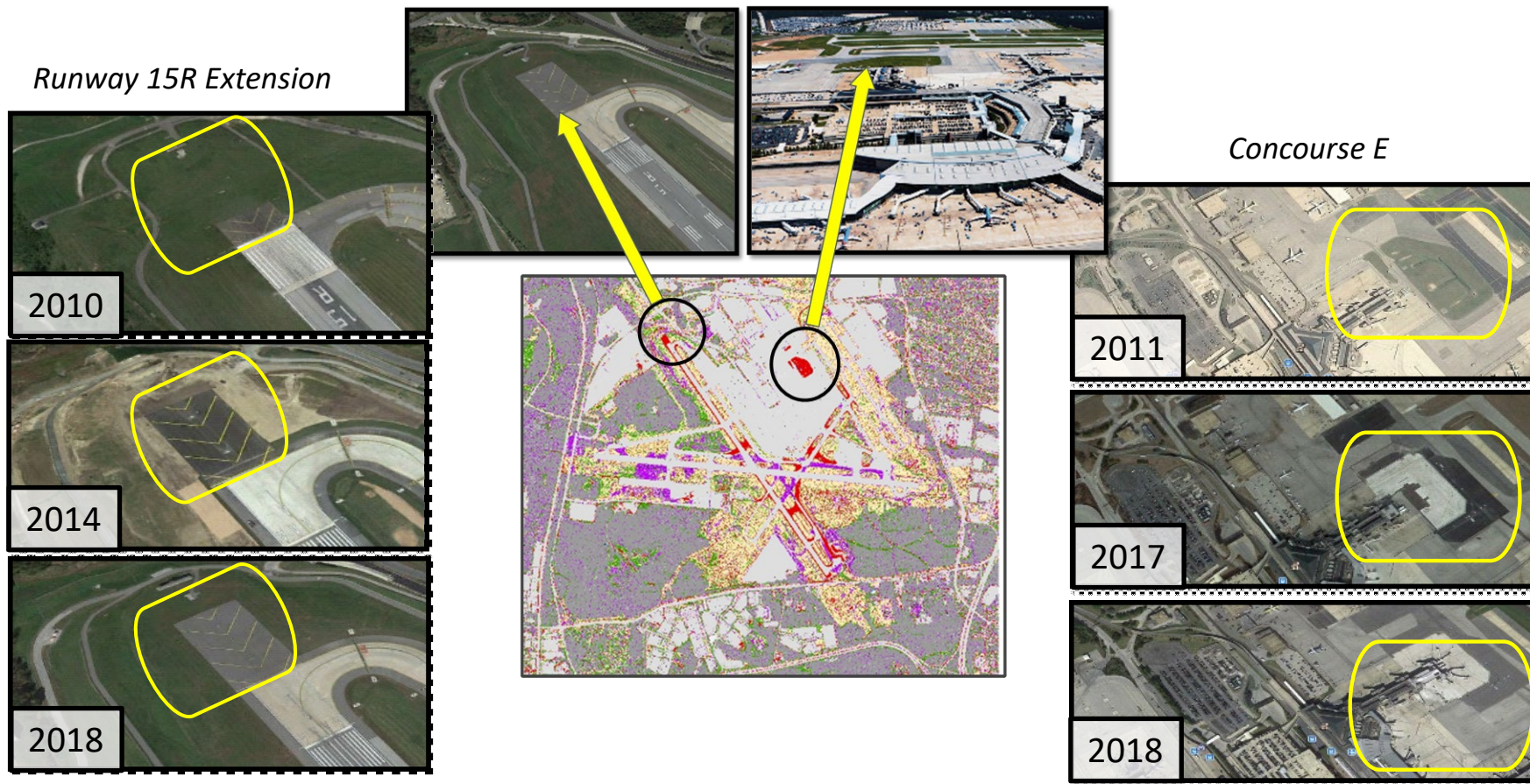
- 2020 - IAD analysis using 2016 NAIP imagery
- 2021 - PAX River history 2011/2015

### Fall GIS Class 2021 - Image Classification



# UMD Analysis: BWI Results

## Conversion of grasslands at BWI Airport



Real-world experience for students and pipeline for talent



# BWI Example: Safer travel for everyone





..... future goals  
and objectives

### ***USDA is a customer service agency***

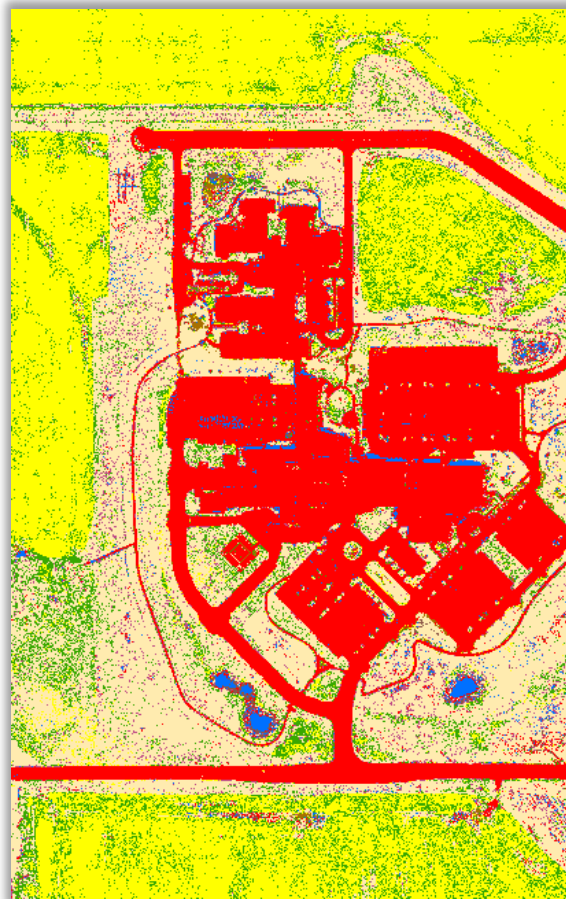
- Explore business applications that were not possible before
- The continuation and development of partnerships
- Process refinement and exploration of innovative machine learning environments
- National LCAT map and refresh state maps as NAIP is acquired

### **GEO Mission Statement**

*"Deliver best-in-class, innovative, customer-focused, geospatial information and solutions that are accessible, current, and authoritative."*



# Questions?



[https://nrcsgeoservices.sc.egov.usda.gov/arcgis/rest/services/land\\_use\\_land\\_cover](https://nrcsgeoservices.sc.egov.usda.gov/arcgis/rest/services/land_use_land_cover)