Evolving USDA Satellite Data Needs for Land and Agriculture Applications and Decision Making

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USDA/National Agricultural Statistics Service

5/20/2025

Agenda

- Who is NASS
  - Geospatial Data Products
    - Cropland Data Layer/Disasters/Crop Yield/Soil Moisture
- US Forest Service
  - Forest Wildfire and Health Protection
  - Event Response

National Agricultural Statistics Service

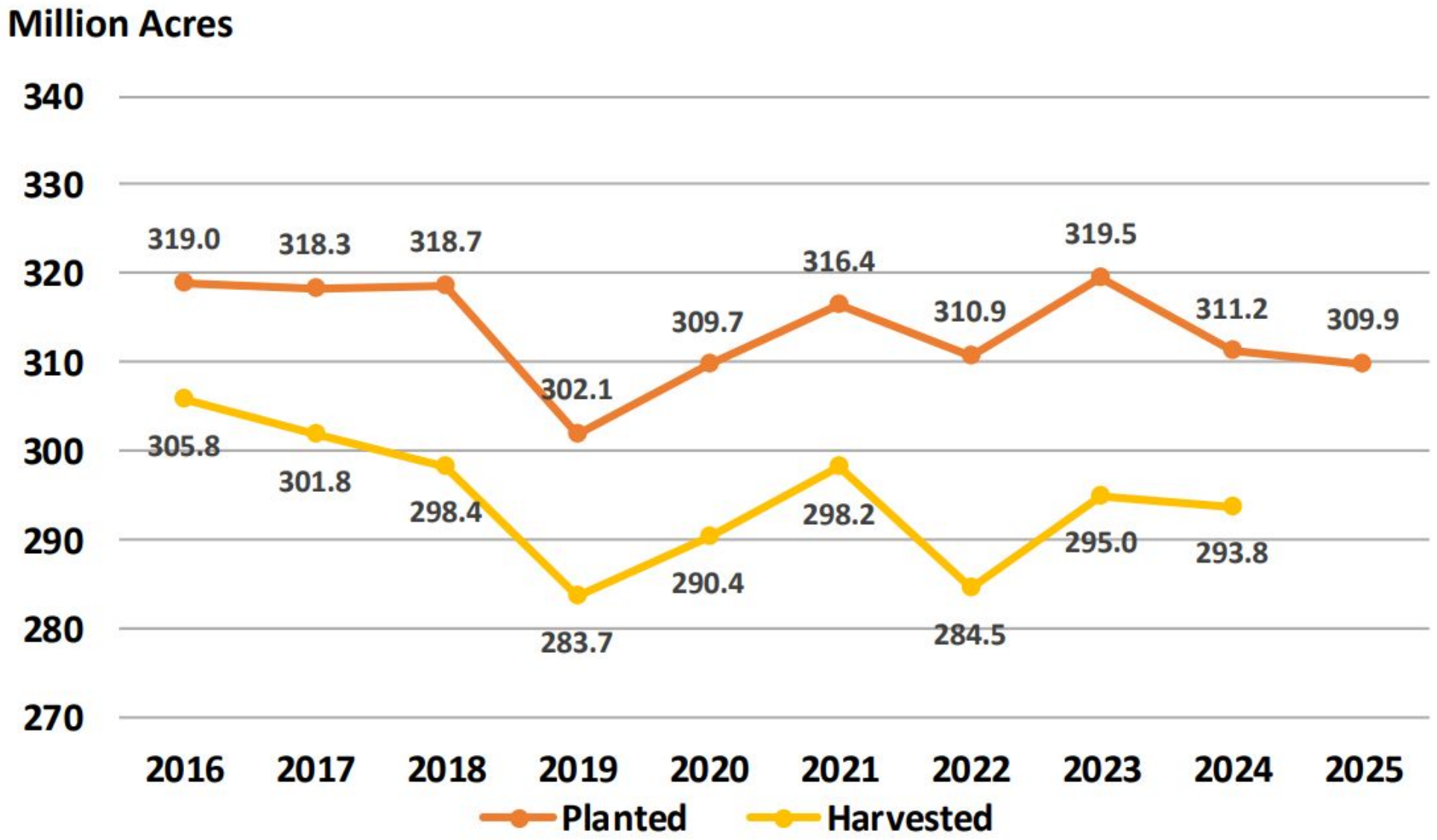
www.nass.usda.gov

What NASS Does

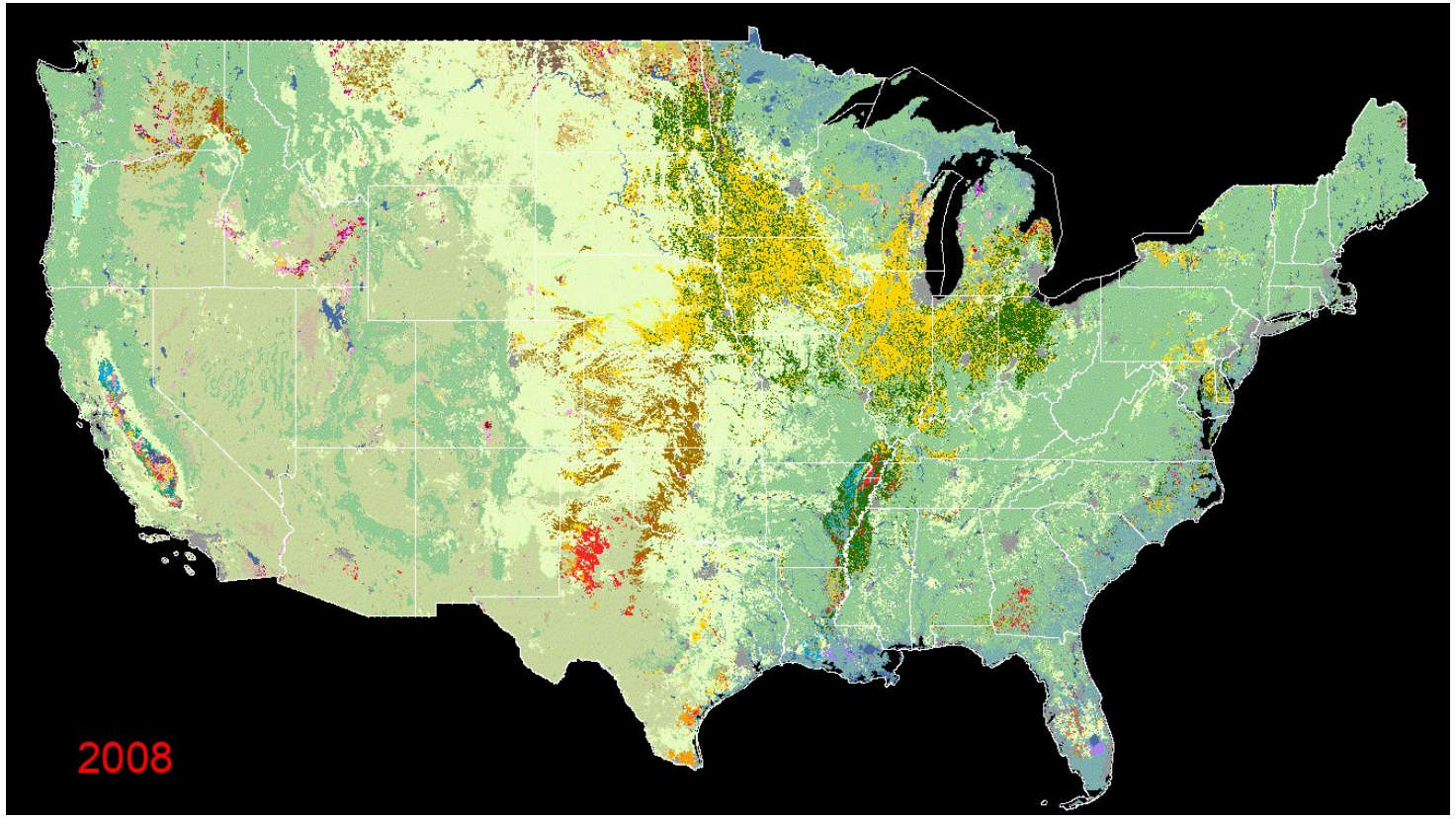
- Agricultural Estimates Program
  - Official U.S. statistics for production, inventory, value, demographics
  - 120 crop commodity reports produced annually
  - 45 livestock commodity reports produced annually
  - Over 450 reports published annually
- Coordinate Federal/State agricultural statistical needs

Farm Definition - Any place from which $1,000 of agricultural products were produced and sold, or normally, would have been sold. (Unchanged since 1974).

Principal Crop Acres



Large volume of Earth observation data for CONUS crop mapping – NASS Cropland Data Layer (CDL)



- Annually produced, georeferenced, **30m, crop-specific land cover** dataset
- Containing 110+ agricultural and 14 non-agricultural categories
- **Freely available** and open to the public
- CONUS mapping products since 2008 (2024 CDL released February 2025)

2023 Continental United States
Land Cover Categories (by decreasing acreage)

Agriculture

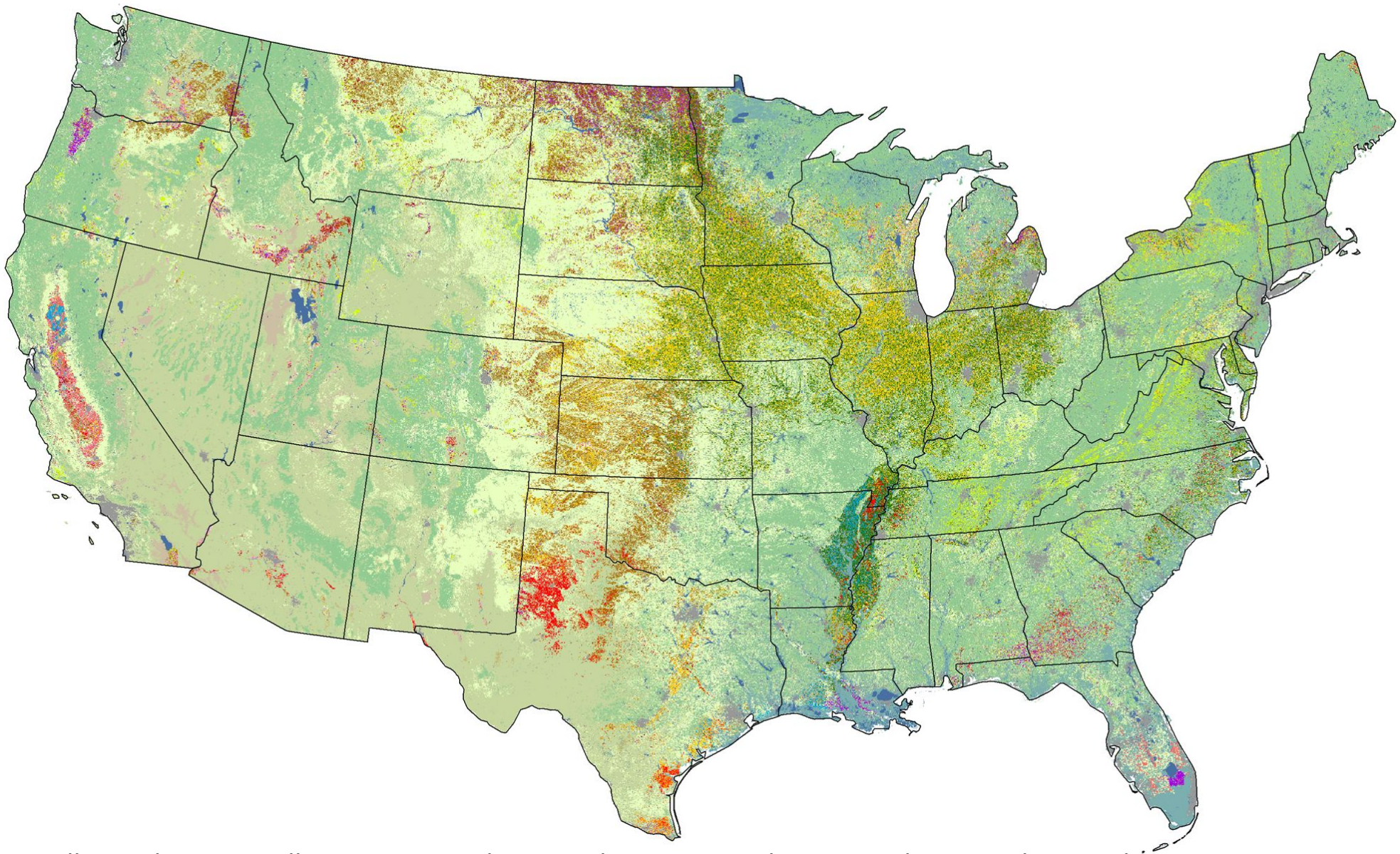
- Grassland/Pasture
- Corn
- Soybeans
- Winter Wheat
- Other Hay/Non Alfalfa
- Alfalfa
- Fallow/Idle Cropland
- Spring Wheat
- Cotton
- Sorghum
- Dbl Crop WinWht/Soybeans
- Rice
- Barley
- Canola
- Almonds
- Peanuts
- Oats
- Durum Wheat
- Dry Beans
- Sugarcane
- Sod/Grass Seed
- Sunflower
- Peas
- Sugarbeets
- Grapes
- Potatoes
- Millet
- Triticale
- Pistachios
- Rye
- Oranges
- Dbl Crop WinWht/Sorghum
- Lentils
- Aquaculture
- Walnuts
- Pecans
- Apples
- Citrus
- Chick Peas
- Tomatoes
- Dbl Crop WinWht/Corn
- Dbl Crop WinWht/Cotton
- Sweet Corn
- Cherries
- Dbl Crop Triticale/Corn
- Blueberries
- Mustard
- Other Tree Crops
- Pop or Orn Corn
- Prunes
- Safflower
- Clover/Wildflowers
- Flaxseed
- Onions
- Tobacco
- Sweet Potatoes
- Peaches
- Hops
- Christmas Trees
- Other Crops
- Herbs
- Olives
- Dbl Crop Oats/Corn
- Carrots
- Pears
- Mint
- Avocados
- Dbl Crop Barley/Soybeans
- Camelina
- Garlic
- Lettuce
- Cucumbers
- Watermelons
- Misc Vegs & Fruits
- Greens
- Pomegranates
- Pumpkins
- Apricots
- Dbl Crop Barley/Corn
- Cabbage
- Buckwheat
- Strawberries
- Plums
- Dbl Crop Soybeans/Oats
- Squash
- Broccoli
- Peppers
- Caneberries
- Cantaloupes
- Cranberries
- Dbl Crop Lettuce/Cotton
- Dbl Crop Lettuce/Cantaloupe
- Dbl Crop Lettuce/Barley
- Other Small Grains
- Switchgrass
- Turnips
- Dbl Crop Corn/Soybeans
- Speltz
- Radishes
- Honeydew Melons
- Nectarines
- Cauliflower
- Celery
- Rape Seed
- Vetch
- Asparagus
- Gourds
- Eggplants
- Dbl Crop Barley/Sorghum

Non-Agriculture

- Forest
- Shrubland
- Wetlands
- Developed
- Open Water
- Barren
- Perennial Ice/Snow

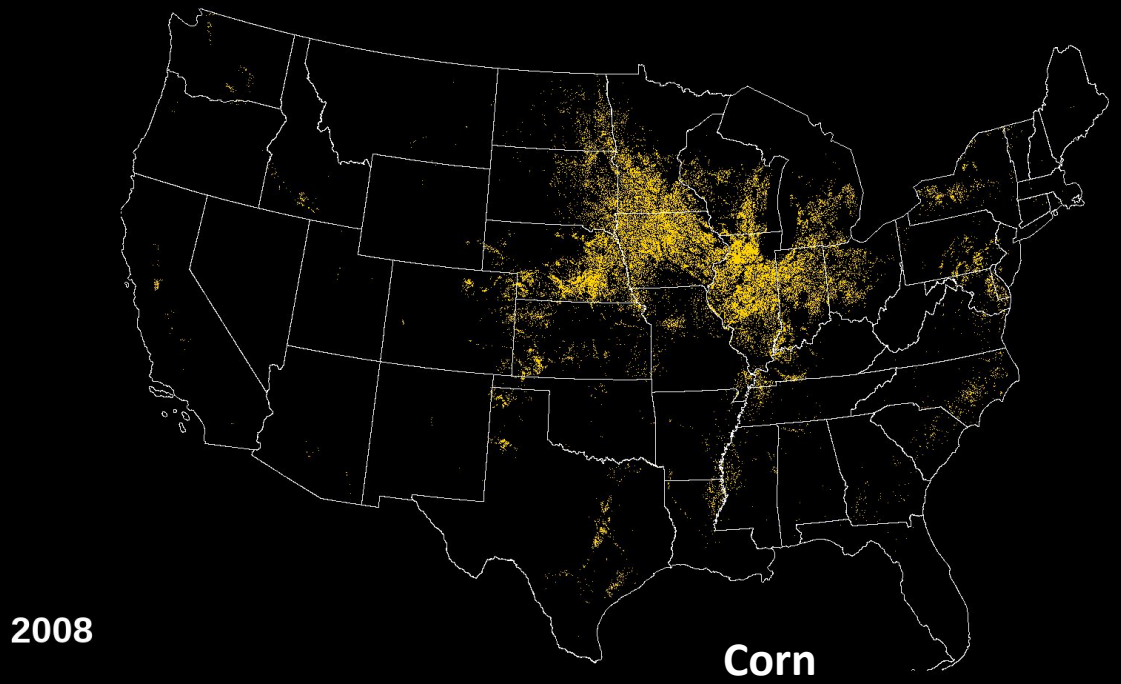
CropScape: https://nassgeodata.gmu.edu/CropScape/
CroplandCROS: https://croplandcros.scinet.usda.gov/
GEE CDL Viewer: https://www.nass.usda.gov/Research_and_Science/Cropland/Viewer/index.php

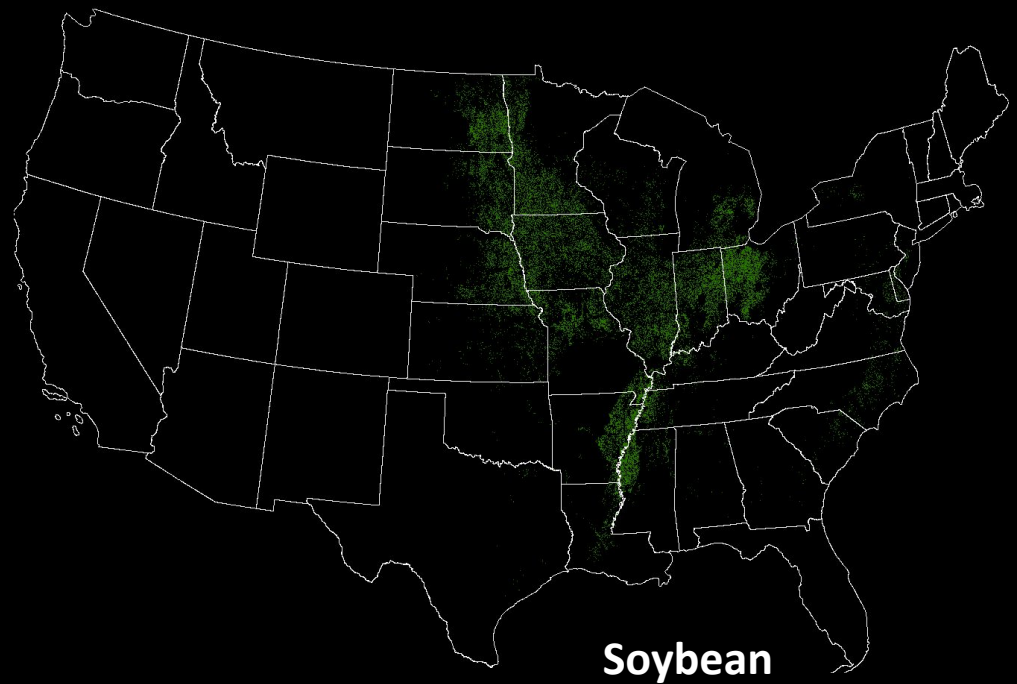
10 Meter Cropland Data Layer

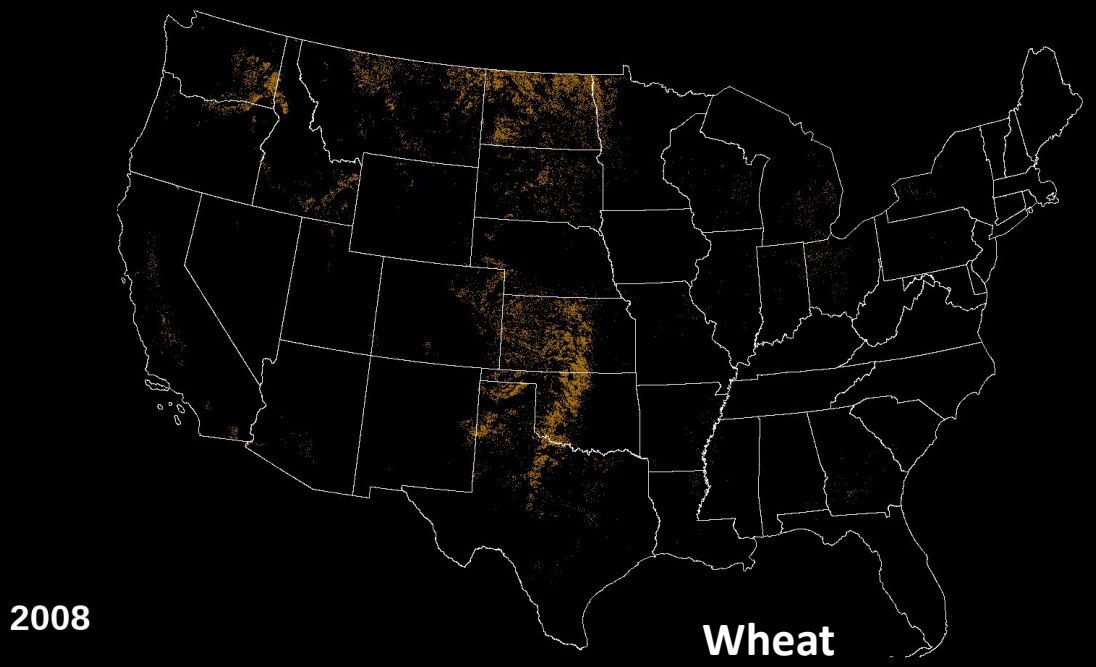


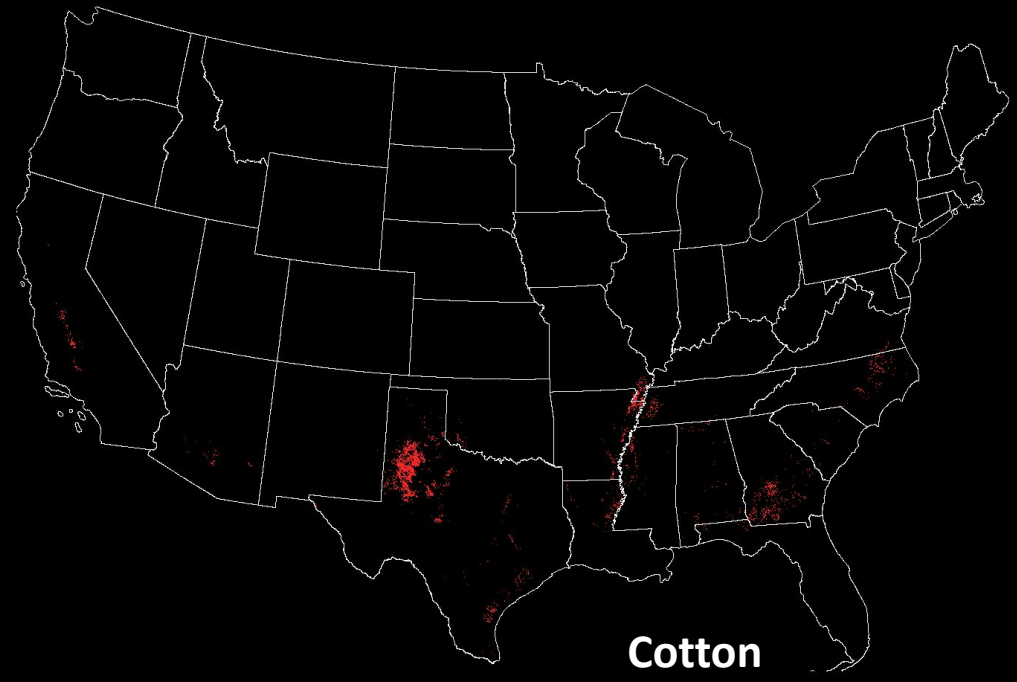
Annually combining satellite imagery and USDA administrative data to produce supplemental crop acreage estimates

https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php


2008
Corn


2008
Soybean

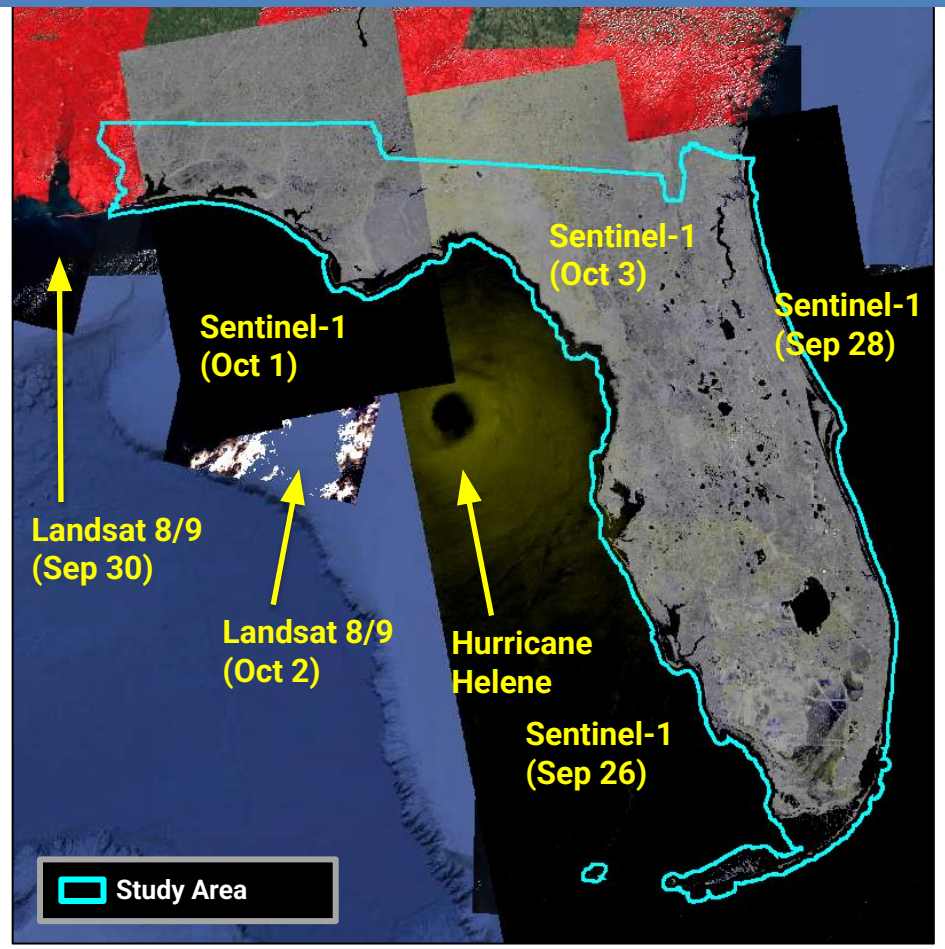

2008
Wheat


2008
Cotton

Assessments on Impacted Croplands from Extreme Weather Events

Photo: Damage to crop fields from flooding in Mountain Lake, MN in June 2024 *(Photo Credit: Mountain View Drones, Media Source: National Weather Service)*

Helene - Florida Assessment



Assessment Dates (after inundation): 9/26/24 to 10/5/24
Reference Dates (before inundation): 9/4/24 to 9/26/24

Percent of Crop Acres Inundated by Hurricane Helene

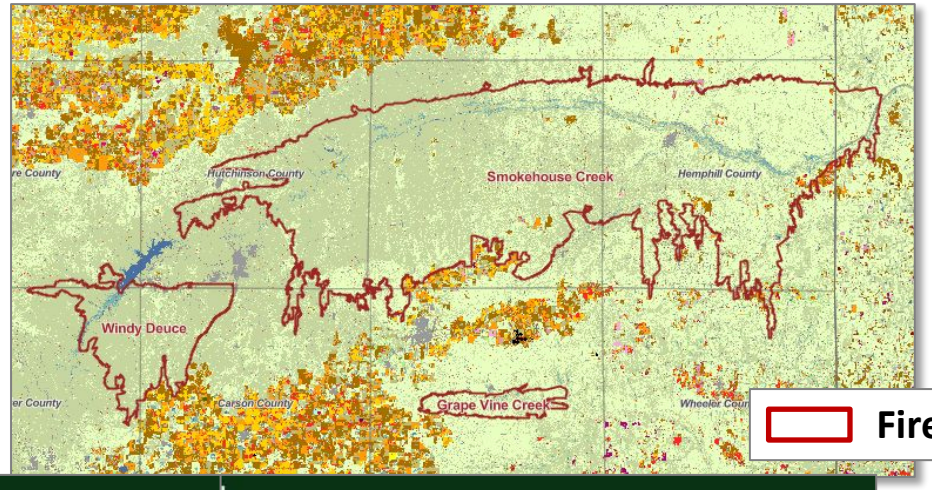
Crop Type	Total Statewide Acres	Minimal Percent Inundated†
Avocados***	3,900	4.19%
Citrus (not including Oranges)****	20,100	0.49%
Corn*	90,000	0.26%
Cotton*	89,000	0.24%
Oranges***	278,300	0.70%
Peanuts*	160,000	0.20%
Sugarcane**	407,600	0.18%
Total (selected commodities)	**1,048,900**	**0.42%**

*Acres Planted, NASS 2023
**Acres Harvested, NASS 2023
***Acres Bearing, NASS 2023
****Acres Bearing, not including oranges, NASS 2023

†Percent of acres impacted based on 1) all available post-event image acquisitions as of October 5, 2024, 2) raw pixel counts from the 2023 CDL which are not official NASS estimates, and 3) where flooded croplands were observed based on analysis of available imagery (which may not always equate to total yield loss). Therefore, the amount of cropland affected by storm inundation may be different than these estimates indicate.

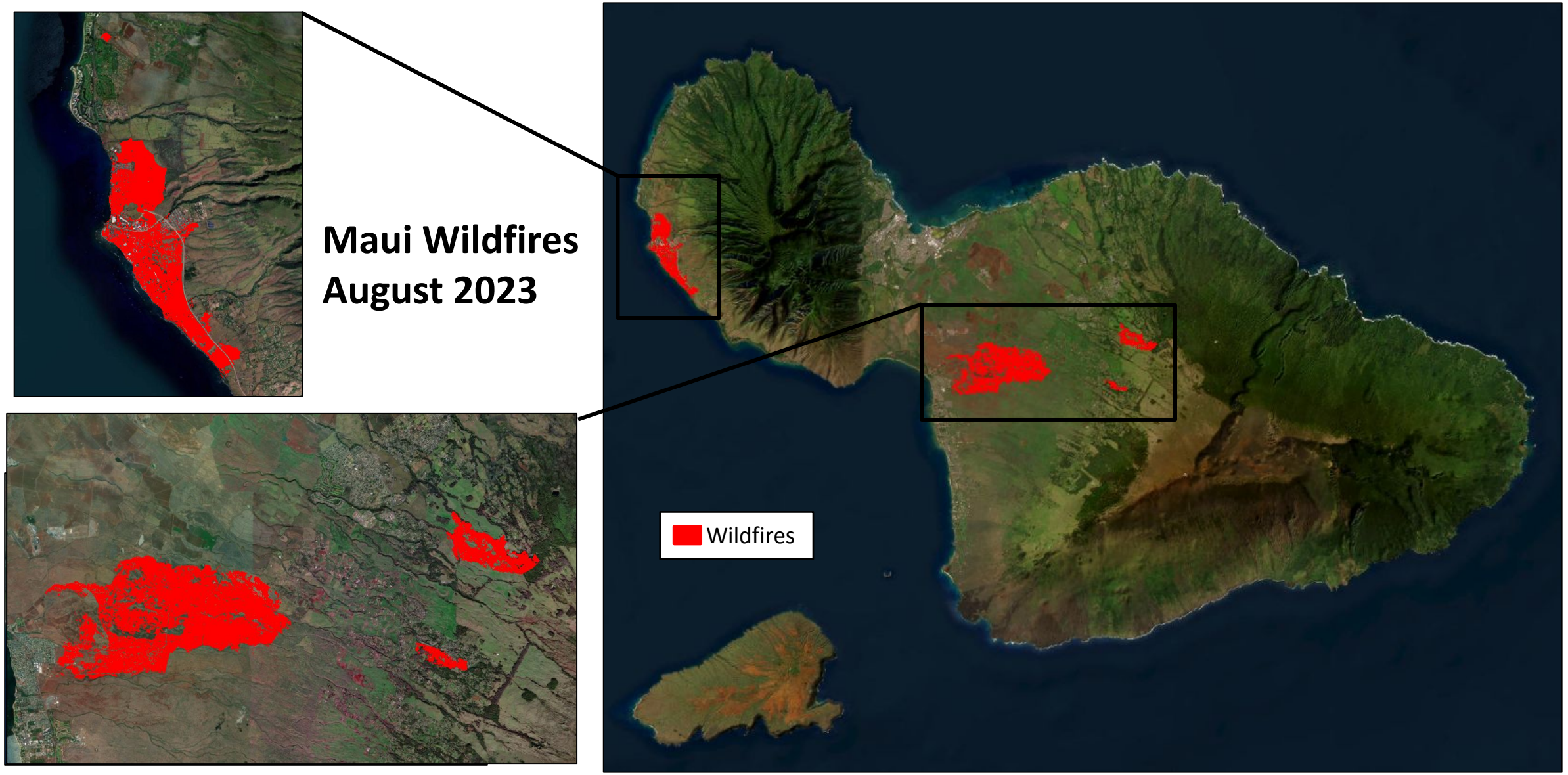
Cropland Acreage in TX Wildfire Extents

- The largest potential impact inside the wildfire extents was to Grassland / Pasture areas, followed by Winter Wheat, Sorghum, Other Crops, Cotton, and Corn.
- Grassland / Pasture areas experienced the greatest potential impact within the wildfire extents, representing < 1% of all surveyed Grassland / Pasture areas across Texas.



Crop Class	Acres Impacted	Total Acres Across State*	Percent of Total Acres Impacted
Grassland / Pasture	447,944	88,472,861	0.51%
Winter Wheat	8,624	6,400,000	0.26%
Sorghum	5,175	2,000,000	0.13%
Other Crops	2,113	11,424,626	0.04%
Cotton	1,978	5,579,000	0.03%
Corn	803	2,500,000	0.02%

"Total Acres Across State" values obtained from official NASS estimates: 2022 Census of Agriculture and 2023 Surveys. “Percent of Total Acres Impacted” by “Crop Class” calculated based on how acreage by crop type inside wildfire perimeters compared to Official NASS Estimates (2022 Census of Agriculture, 2023 NASS Surveys) of total acres surveyed across the state for each crop type.



Maui, HI - Fire extents derived from Sentinel-2 Normalized Burn Ratio (NBR), August 8-18, 2023.

https://www.nass.usda.gov/Research_and_Science/Disaster-Analysis/2023/index.php#Hawaii%20Wildfires

Hawaii Wildfires: Cropland Impact Assessment

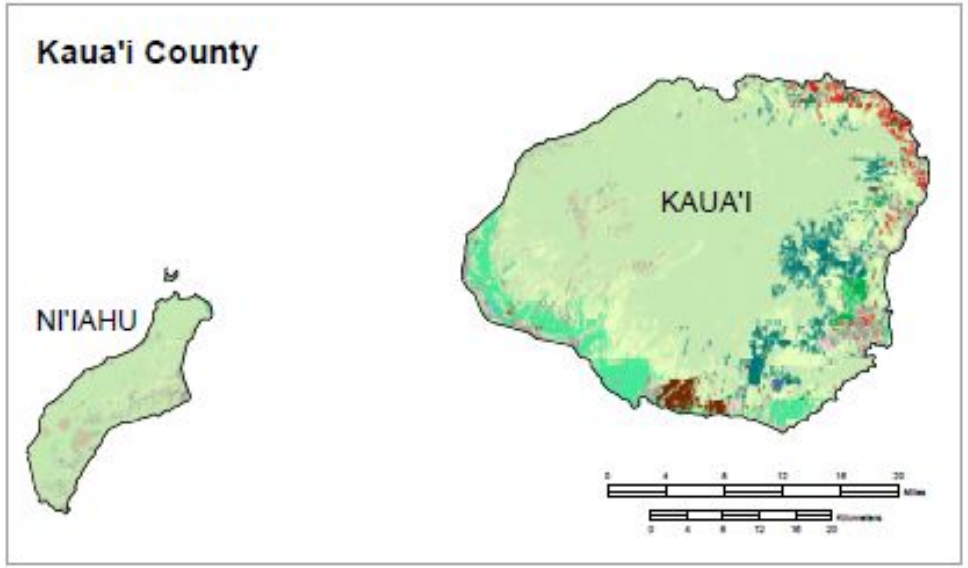
- Majority of crop landcover types within the fire extents was Pasture and Rangeland, followed by Diversified Crops.
- This project demonstrated a need for current crop cover to enable rapid disaster response and crop damage assessments.
  - Led to development of 10-m-resolution Hawaii Cropland Data Layers (HCDL) for 2023 and 2024.
  - Funded by USDA NIFA's Applied Science Program, AgriWatch is a collaborative effort between NASS, the University of Hawaii at Manoa, NOAA, and Colorado State University.

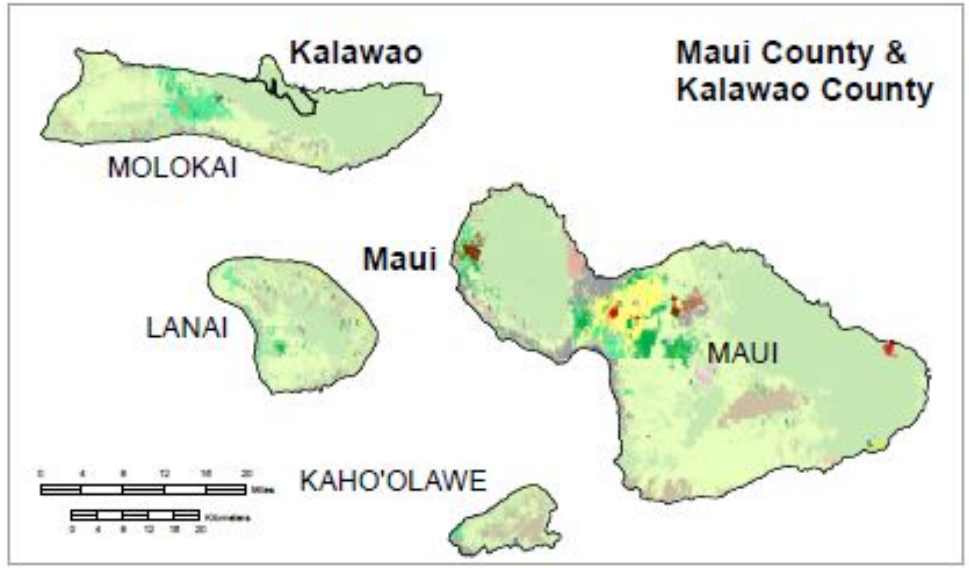
Land Cover Impacted by Wildfires Identified from Sentinel-2 MSI Normalized Burn Ratio (NBR) between August 8-13, 2023

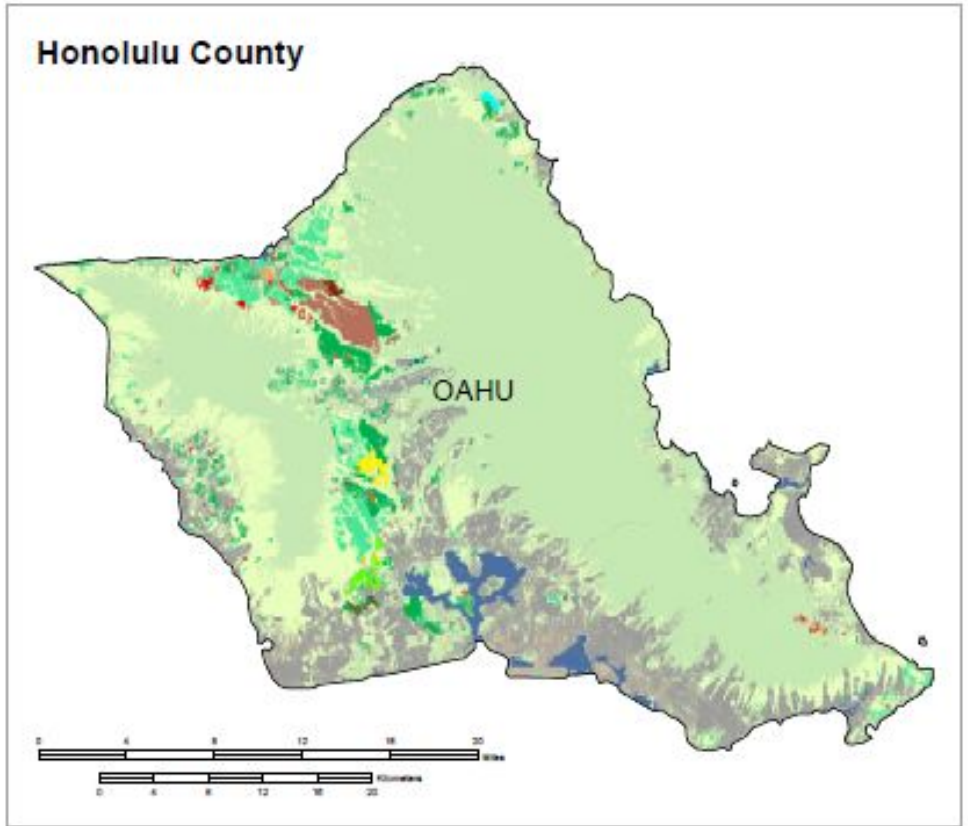
Crops	Acres Impacted	Acres State Total*	%
Rangeland	3720.31	1267150	0.28
Pasture	3160.89	764286	0.34
Diversified Crop	155.53	65179.9	0.23

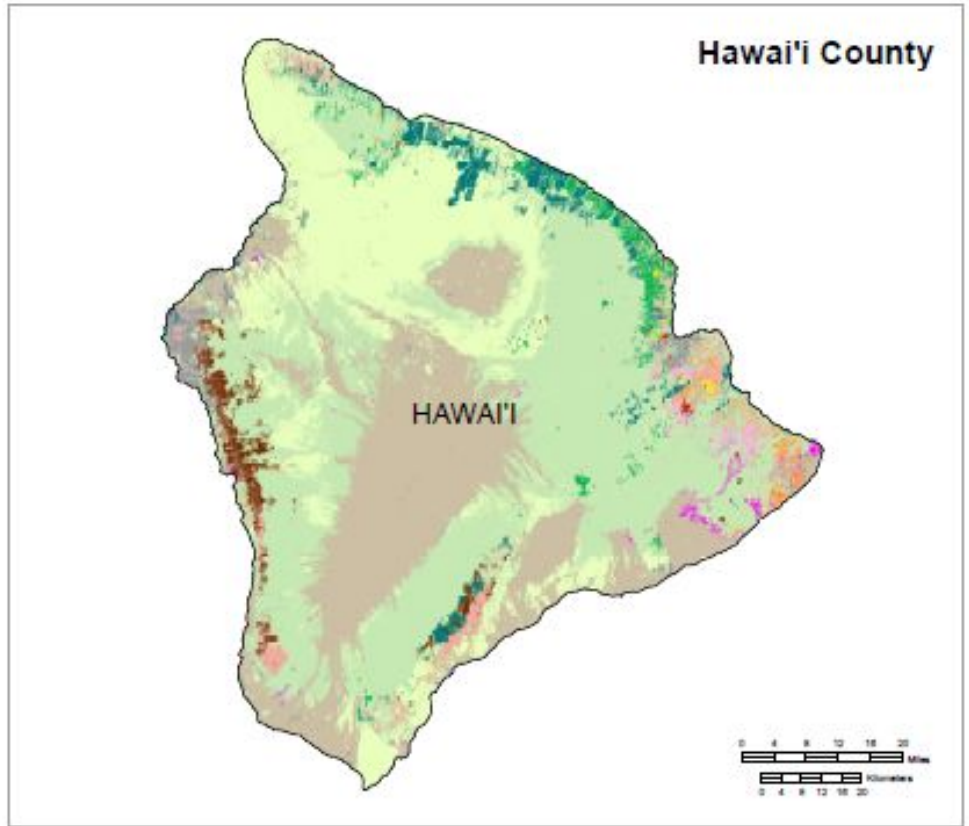
*Acres State Total calculated from land cover data products used in analysis (Acres are not official NASS estimates).

2024 Hawaiian Cropland Data Layer









Land Cover Categories (by decreasing acreage)

Agriculture

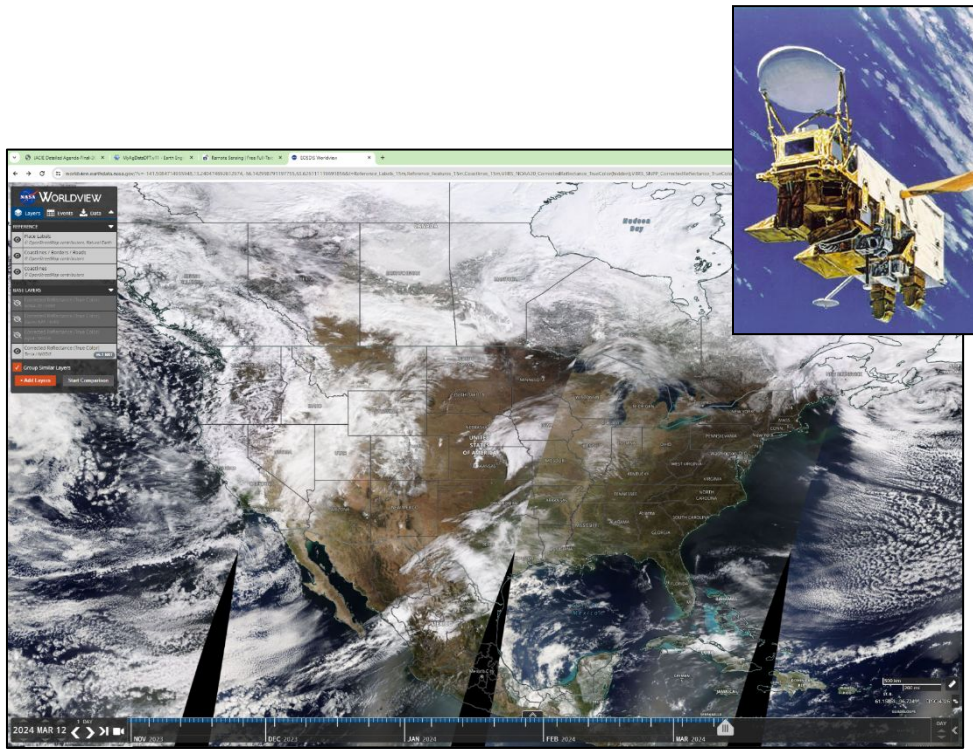
- Grassland/Pasture/Rangeland
- Diversified Crops
- Macadamia
- Commercial Forestry
- Seed Crops
- Coffee
- Tropical Fruits
- Flower
- Citrus
- Flower (greenhouse)
- Papaya
- Pineapple
- Misc Vegs
- Banana
- Sugarcane
- Aquaculture
- Corn
- Sweet Basil

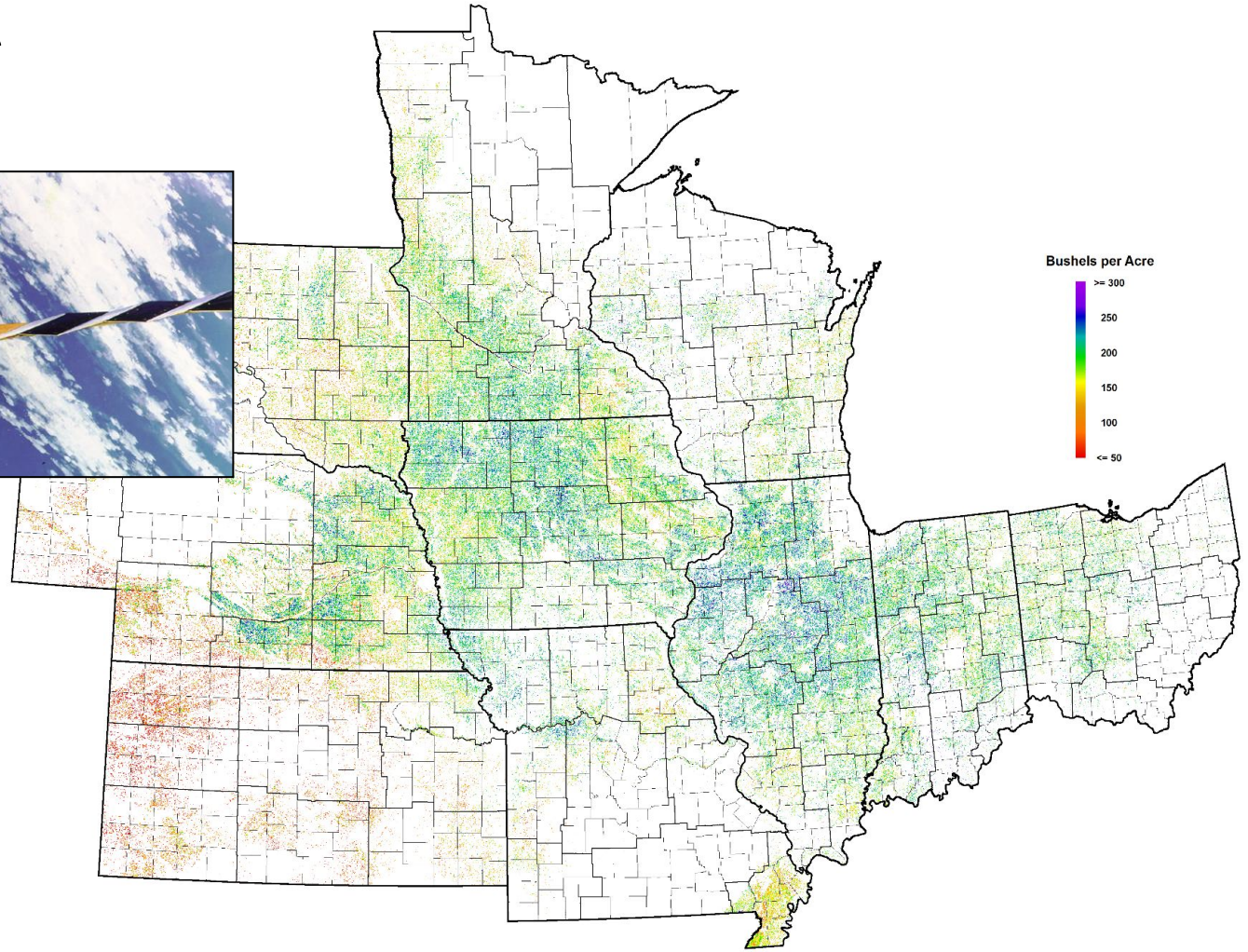
Non-Agriculture

- Water
- Trees
- Barren
- Developed
- Shrubland

MODIS-based Corn Yield Estimation

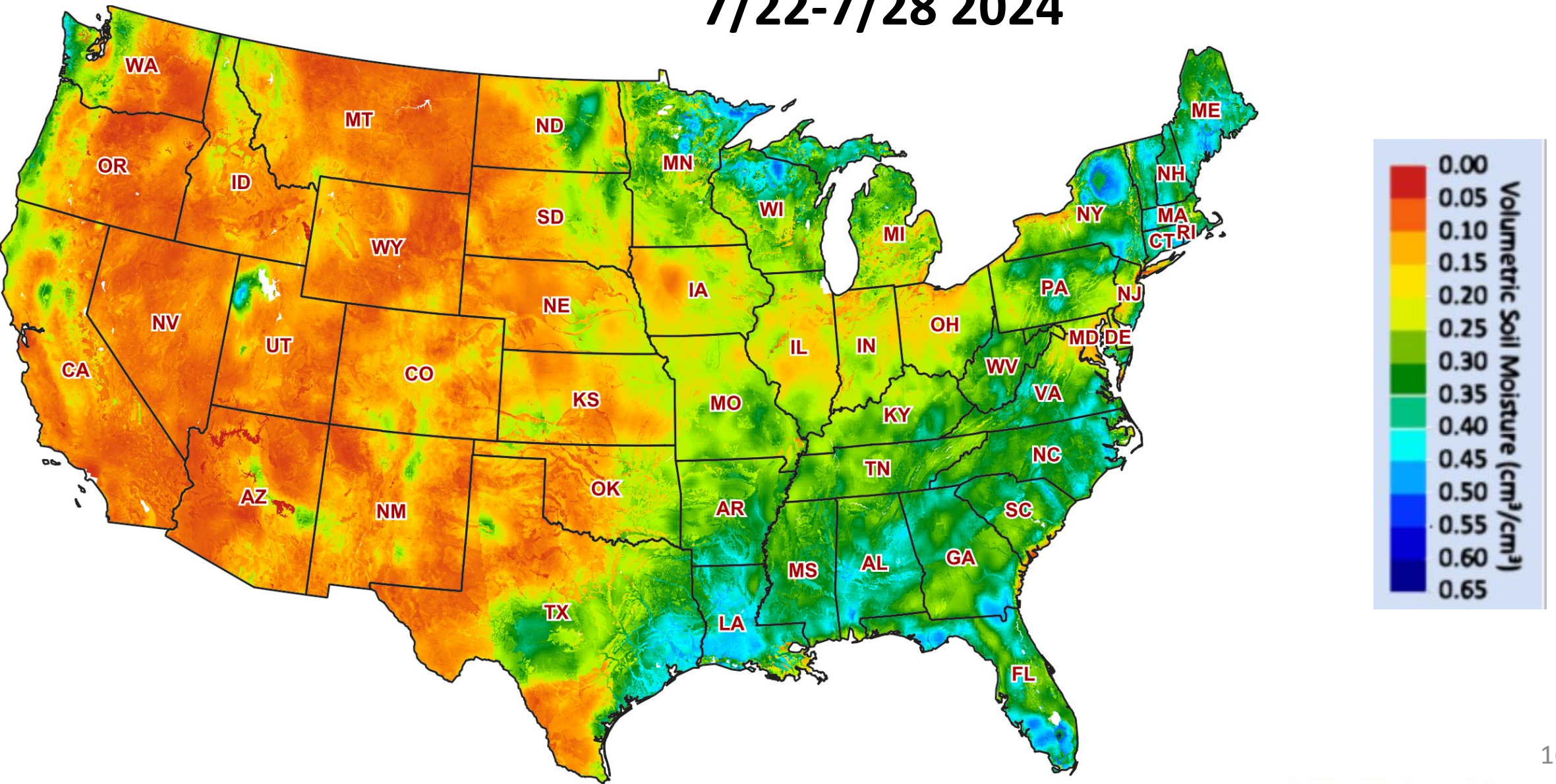
Corn yield estimation using high spatial and temporal coverage with NASA MODIS satellite imagery





CropCASMA (Crop Condition and Soil Moisture Analytics)

7/22-7/28 2024



SMAP Soil Moisture for NASS Crop Weather Reporting

United States Department of Agriculture
National Agricultural Statistics Service

Arkansas Crop Progress and Condition

Delta Region - Arkansas Field Office
10800 Financial Centre Parkway, Suite 110 Little Rock, Arkansas 72211
(501) 228-9926 · FAX (855) 270-2705 · www.nass.usda.gov
Cooperating with the Arkansas Department of Agriculture

This report contains the results from the **Crop Progress and Condition** weekly survey. The survey is completed by county extension agents' visual observations and contact with producers in their county. These data are also posted on our web site at *https://www.nass.usda.gov/ar* and in a more detailed report at *https://www.nass.usda.gov*. Thanks to all of the county extension agents who responded to this survey.

Week Ending: August 4, 2024

Released: August 5, 2024

According to the National Agricultural Statistics Service in Arkansas, there were 6.9 days suitable for fieldwork for the **week ending Sunday, August 4, 2024**. Topsoil moisture supplies were 10 percent very short, 37 percent short, 49 percent adequate, and 4 percent surplus. Subsoil moisture supplies were 8 percent very short, 31 percent short, 55 percent adequate, and 6 percent surplus.

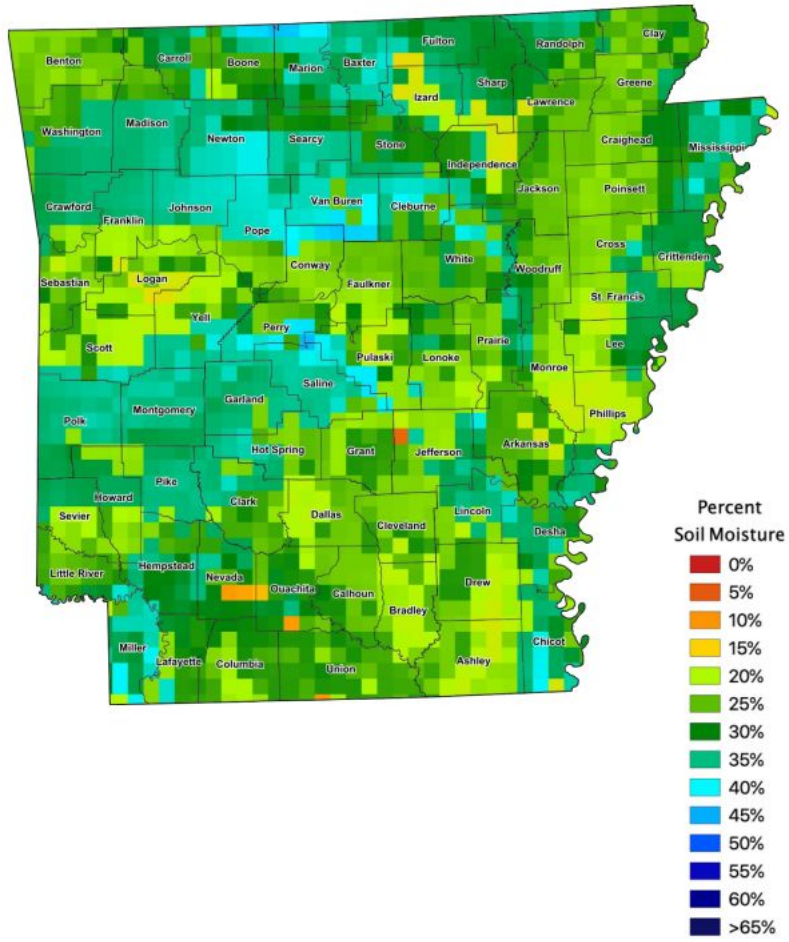
Crop Progress for Week Ending August 4, 2024

Crop	This week	Last week	Last year	5-year average
	(percent)	(percent)	(percent)	(percent)
Corn dough	92	87	88	87
Corn dented	79	68	72	67
Corn mature	38	17	29	22
Cotton squaring	99	96	99	99
Cotton setting bolls	91	83	86	91
Cotton bolls opening	13	7	2	3
Hay second cutting	69	55	71	(NA)
Peanuts pegging	98	92	100	98
Rice headed	86	75	70	57
Rice mature	13	3	8	4
Soybeans blooming	99	97	96	93
Soybeans setting pods	88	84	86	79
Soybeans coloring	12	5	8	3

(NA) Not available.

Crop Condition for Week Ending August 4, 2024

Item	Very poor	Poor	Fair	Good	Excellent
	(percent)	(percent)	(percent)	(percent)	(percent)
Corn	2	3	19	52	24
Cotton	1	6	19	48	26
Hay, all	0	7	35	45	13
Livestock	0	5	26	53	16
Pasture	2	13	26	49	10
Peanuts	2	2	9	47	40
Rice	1	2	18	55	24
Soybeans	1	5	21	57	16
Vegetables	2	3	46	40	9

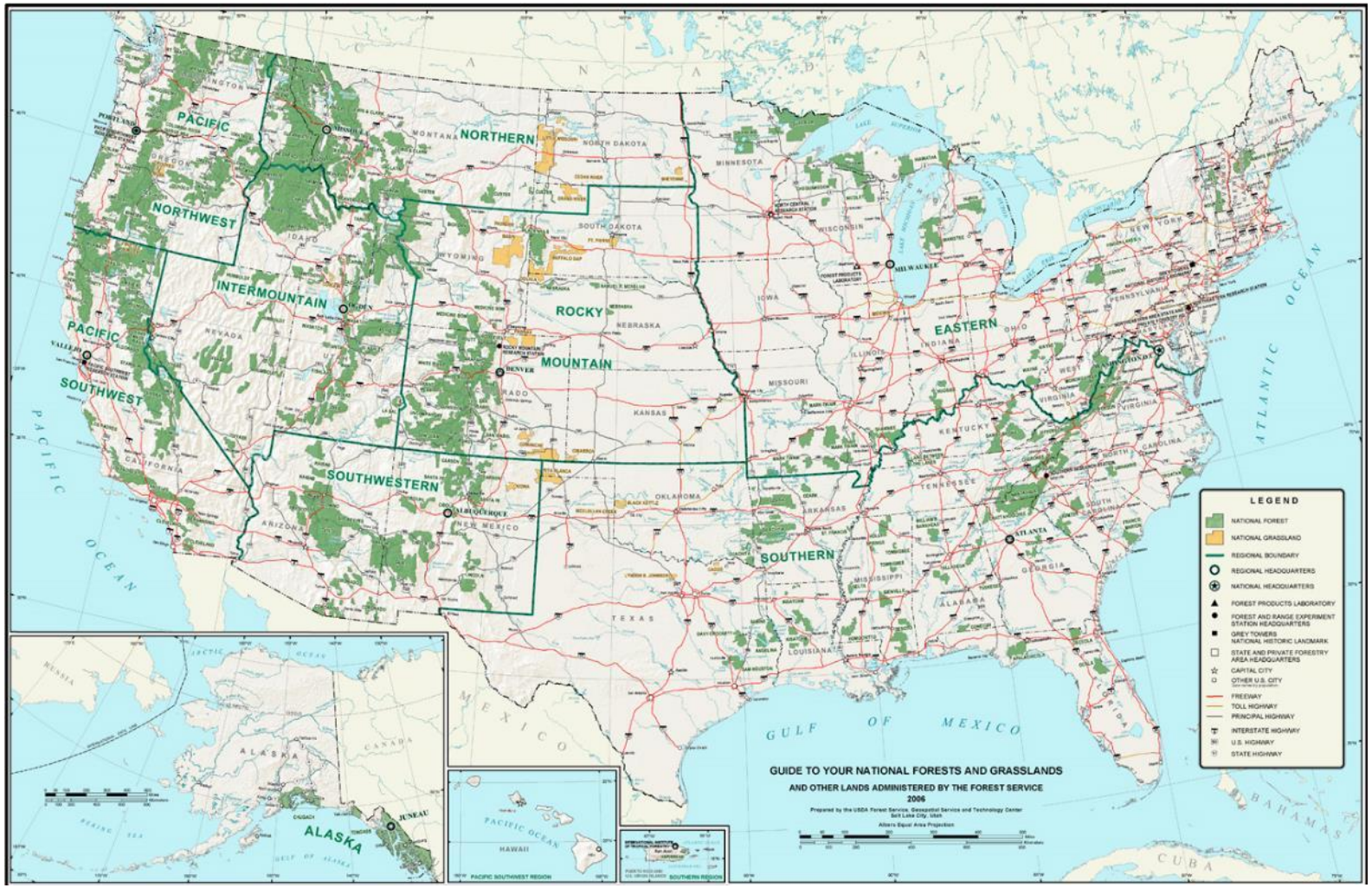


Arkansas Subsoil Moisture Map for the week of July 22 – July 28, 2024

The Soil Moisture Active Passive (SMAP) provides measurements of soil moisture in the root zone as a weekly average, represented by pixels. Each pixel represents 9 by 9 kilometer plot or about 20,000 acres. The SMAP data measures soil moisture in cubic centimeters of water/cubic centimeters of soil. The scale represents the percent of water in a given volume of soil. More information and additional mapping is available at https://nassgeo.csiss.gmu.edu/CropCASMA/.

National Forest System Lands

- National Forest System lands include:
  - 193 million acres
  - 155 National Forests
  - 20 National Grasslands
- NFS Lands cover 8.5% of the US land area ~ Texas
- Maintain and improve the health, diversity, and productivity of the nation's forests and grasslands



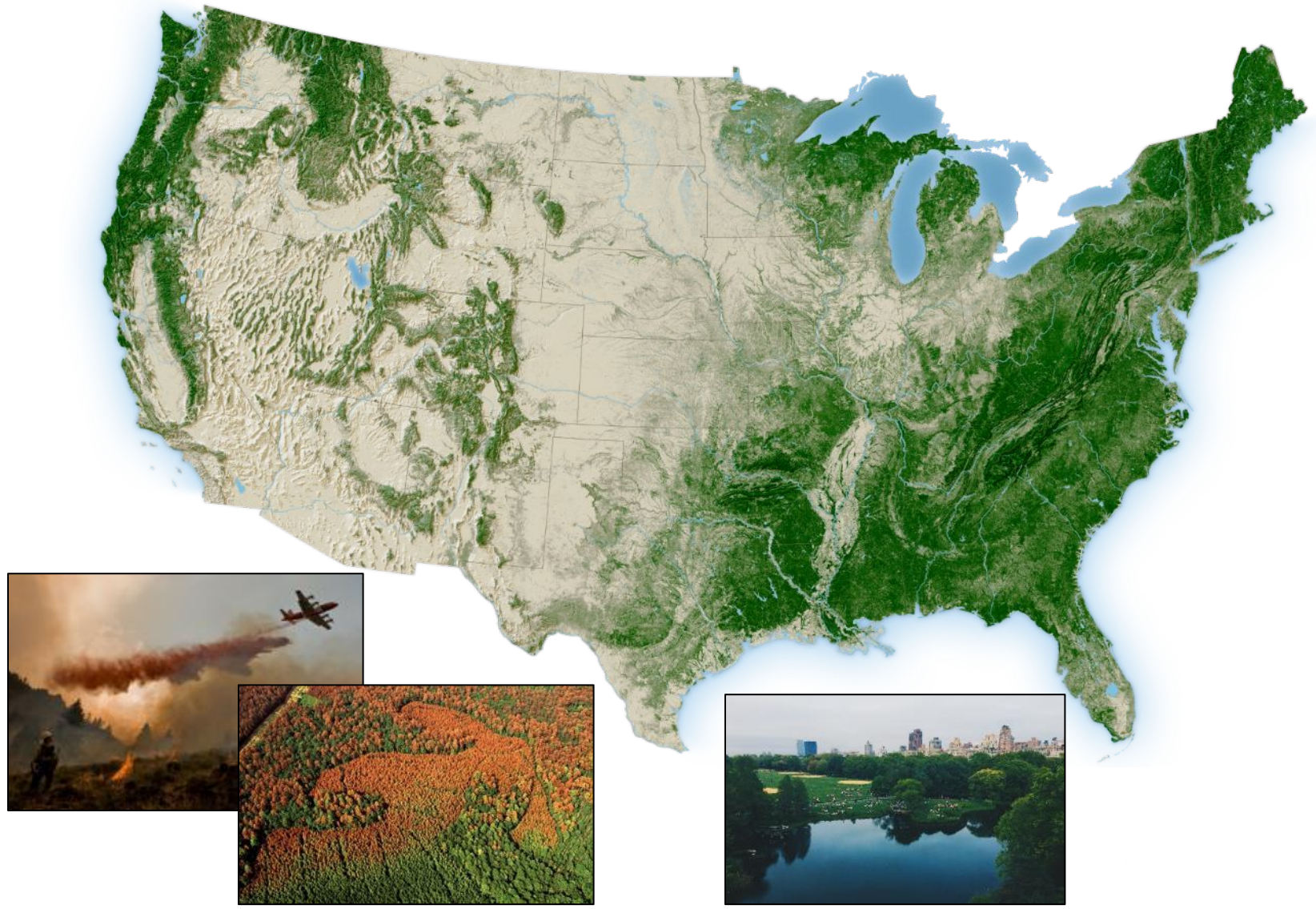
https://www.fs.usda.gov/sites/default/files/GuideMap-2020.pdf

https://www.fs.usda.gov/managing-land/national-forests-grasslands

State, Private, and Tribal Forest Lands

Remote Sensing Mission

- Provide technical and financial assistance to sustain the nation's forests & grasslands
- Protect and restore forest lands and protect communities – 766 million forested acres
- Major program activities include:
  - Wildfire management
  - Forest health protection
  - Cooperative forestry
  - Conservation education



https://www.fs.usda.gov/about-agency/state-private-forestry

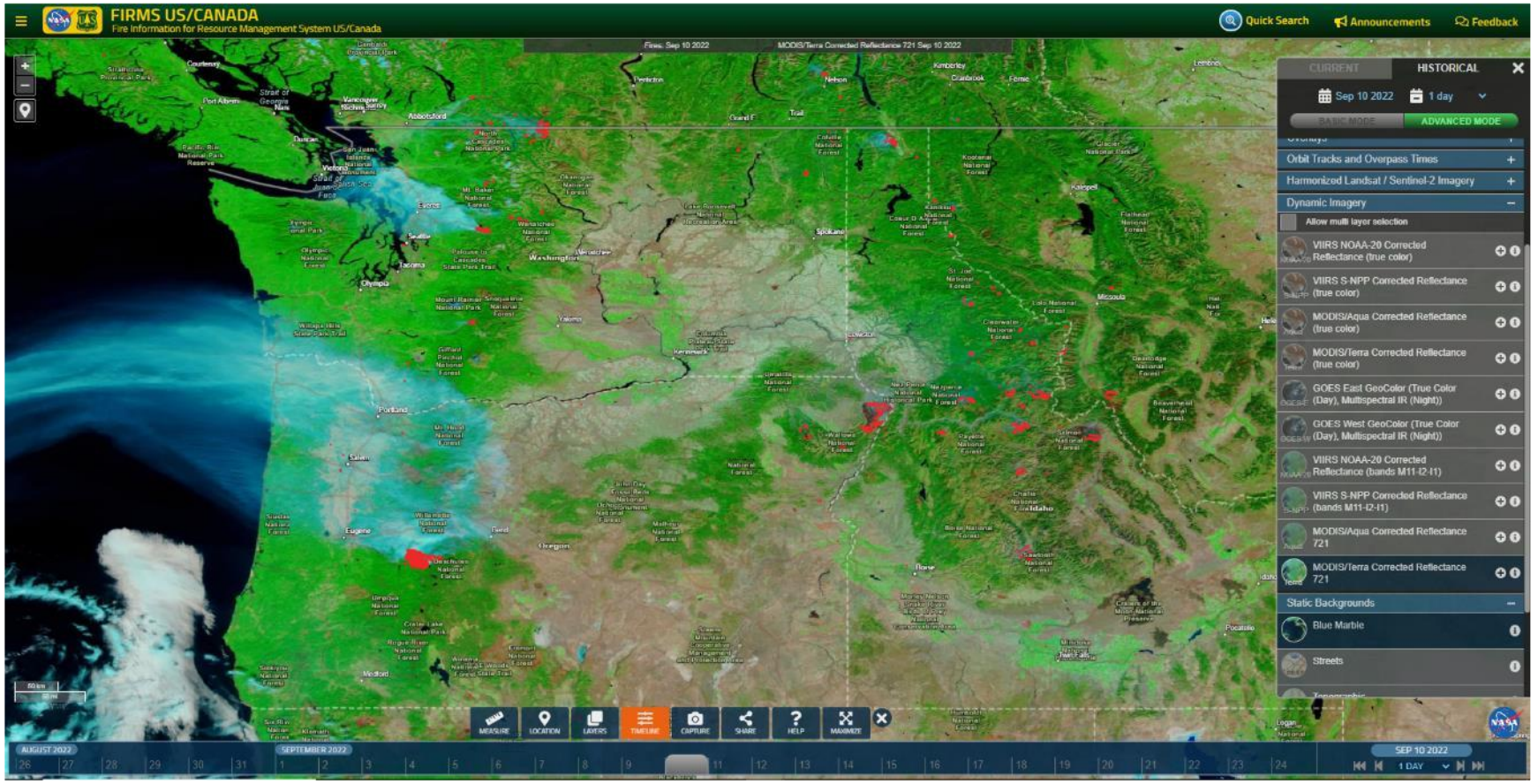
Wildland Fire Management

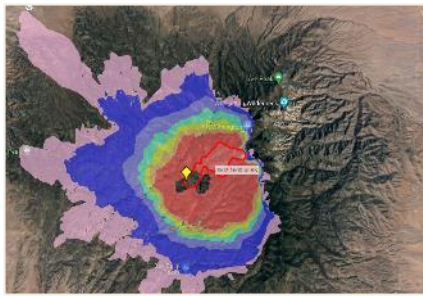
Objectives:

- Comprehensive fire detection and monitoring for US and Canada

Outcomes:

- Increase situational awareness
- Inform strategic planning and response
- Focus tactical scale mapping assets
- Key input data for fire Decision Support Services & applications





Forest Health Protection

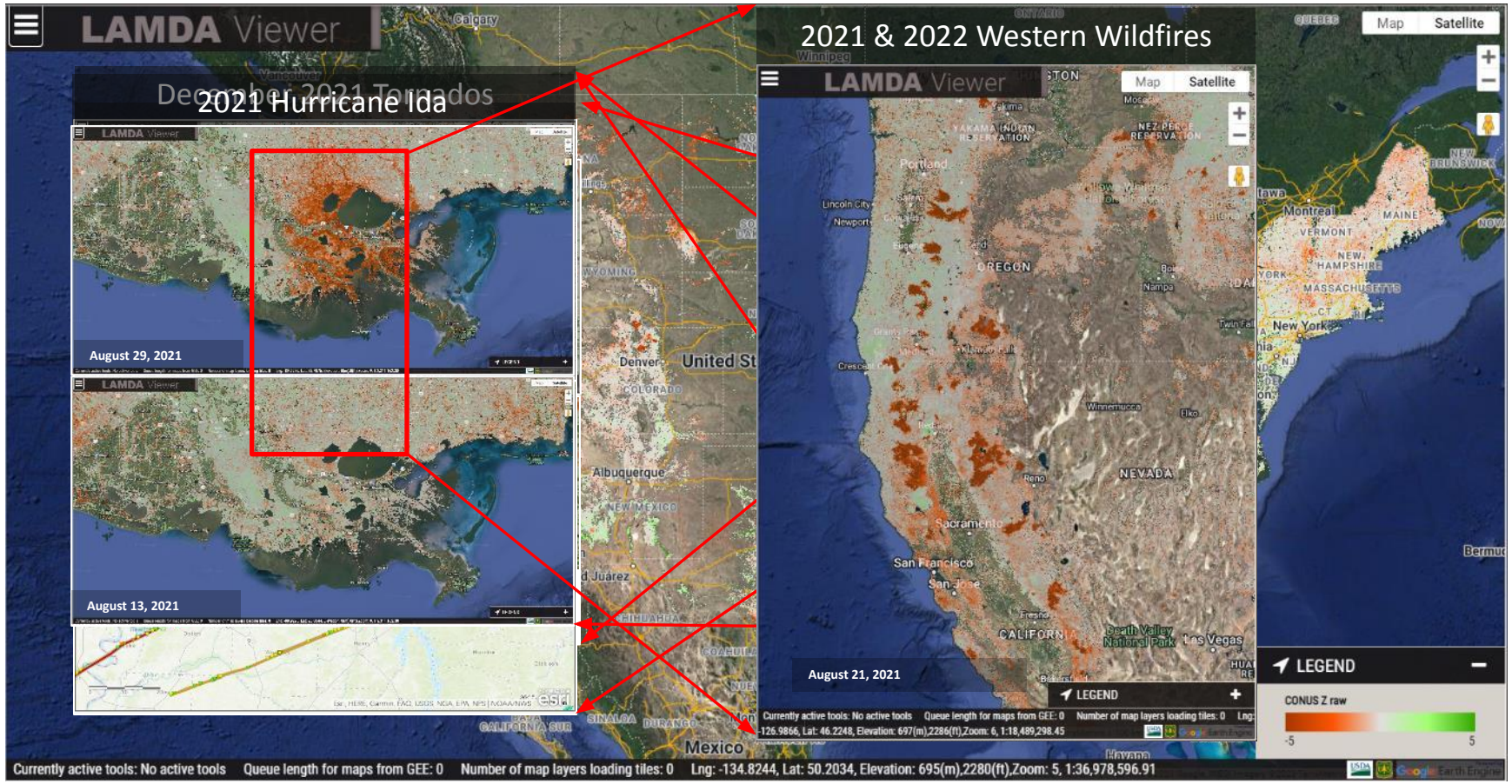
Objectives:

- Detect forest disturbance and mortality events throughout the US
  - Biotic and abiotic events
- Monitor throughout the growing season

Outcomes:

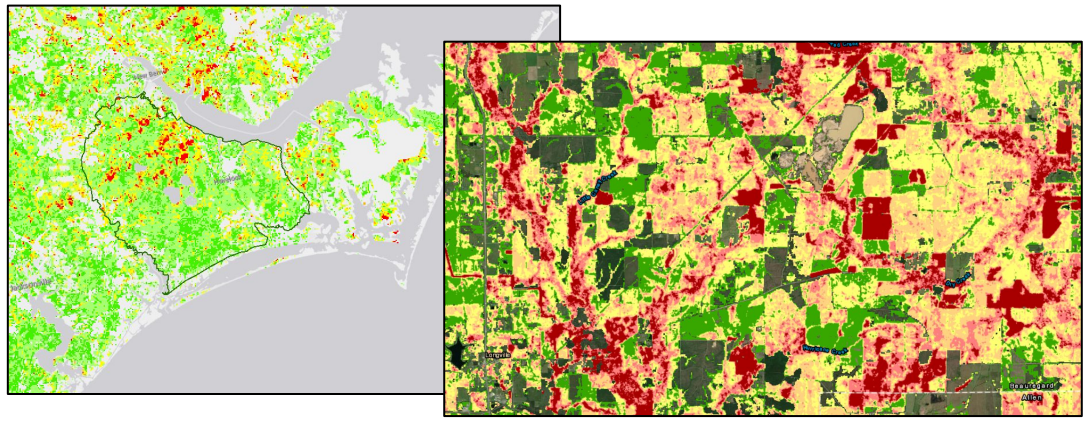
- Inform timing and location of aerial surveys
- Increase safety of FS staff
- Inform strategic planning and response to catastrophic events

- LAMDA Product Downloads (rcr-usfs.github.io)

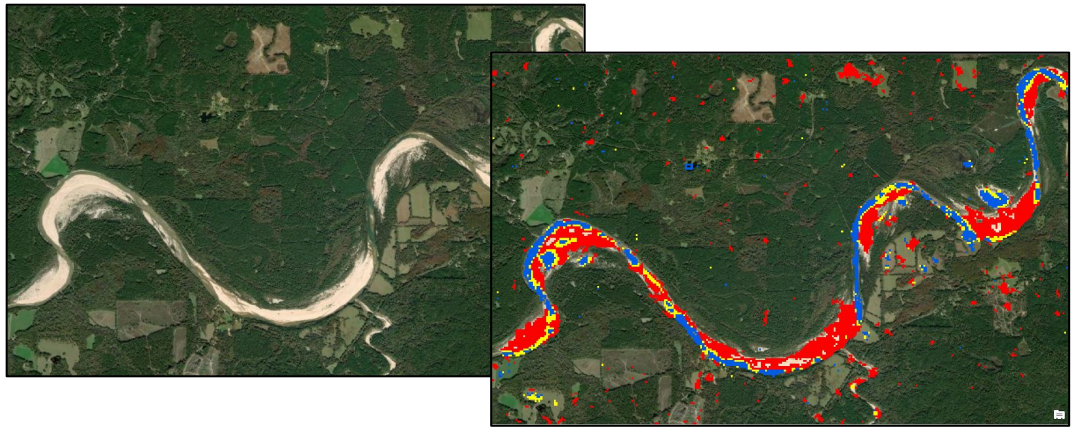


Event Response Geospatial Products

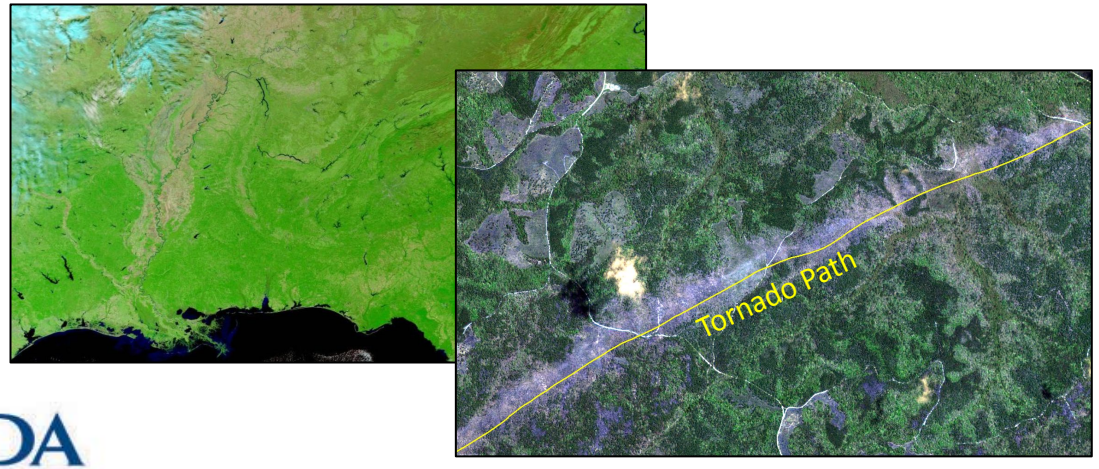
Forest Damage Assessments



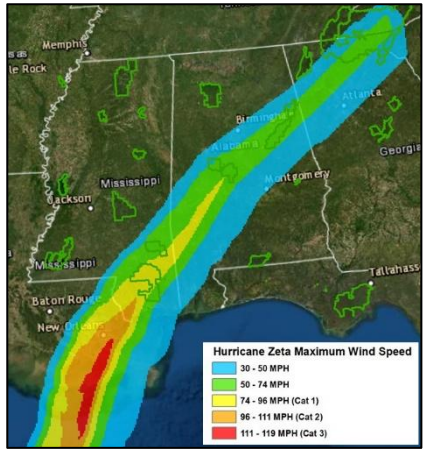
Detection

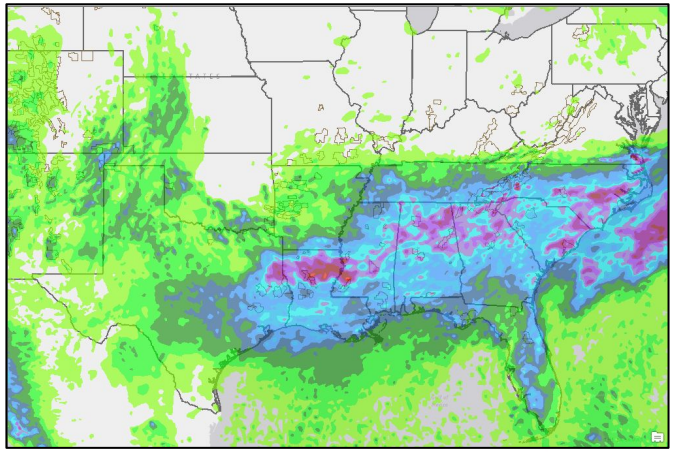


Satellite and Airborne Imagery & Web Services



Observations





Future NASS Data Products and Services

- Evolving need for more EO data
  - Increased temporal and spatial resolutions
  - Support USDA mission needs
- Growing need for AI and ML methods and tools
  - Essential components of data processing chains
  - Innovation to improve ag statistics
- CDL CONUS US + Hawaii + territories
  - 10m initiative
- Deep learning crop yield and soil moisture modeling
  - Provide in-season crop yield predictions (bi-weekly, monthly)

Summary

Thank you

Rick.Mueller@usda.gov

CDL Visualization:
CropScape: https://nassgeodata.gmu.edu/CropScape/
CroplandCROS: https://croplandcros.scinet.usda.gov/
GEE CDL Viewer: https://www.nass.usda.gov/Research_and_Science/Cropland/Viewer/index.php

CDL: https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php

Disasters: https://www.nass.usda.gov/Research_and_Science/Disaster-Analysis
CropCASMA: https://nassgeo.csiss.gmu.edu/CropCASMA/

Ag Statistics: https://quickstats.nass.usda.gov/