

Near Real-Time Disaster Monitoring of Agriculture using Remote Sensing and Geospatial Data

Disaster Analysis Website:

https://www.nass.usda.gov/Research_and_Science/Disaster-Analysis/index.php



Courtesy: InsideClimate News



Courtesy: KDRV.com

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Agriculture Outlook Forum | February 21 - 22, 2019



Outline

- **Background**
 - Why monitor and assess agriculture during disasters?
 - Recent disasters impacting agriculture
- **Geospatial Data**
 - Copernicus Sentinel-1 Synthetic Aperture Radar (SAR)
 - NASA MODIS optical imagery
 - Fire location data
 - NASS Cropland Data Layer (CDL)
- **Process Flow**
- **Deliverables**
- **Summary**



Background

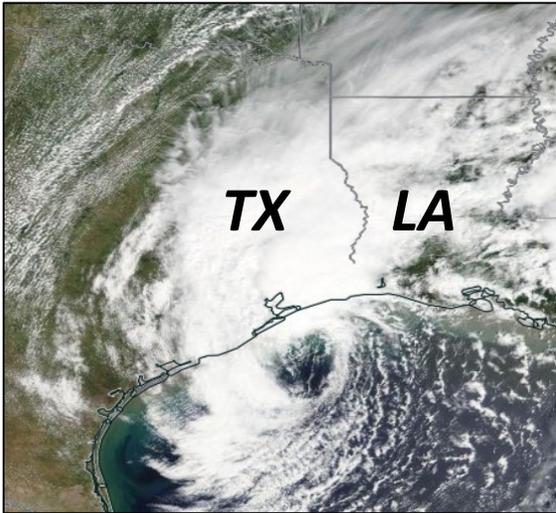
Disaster monitoring and assessment of agriculture are important for food security, disaster assistance, crop insurance, agricultural statistics and decision support.

NASS's mission is to provide timely, accurate and useful statistics in service to U.S. agriculture.

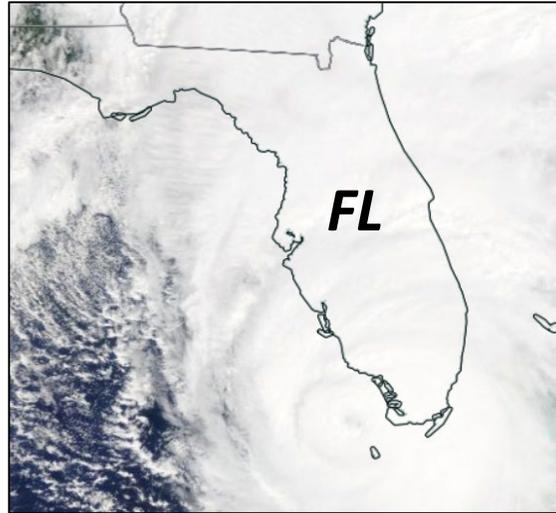
Freely available satellite imagery and geospatial techniques are currently used to monitor and assess cropland and pasture in *near real-time* during disaster events.



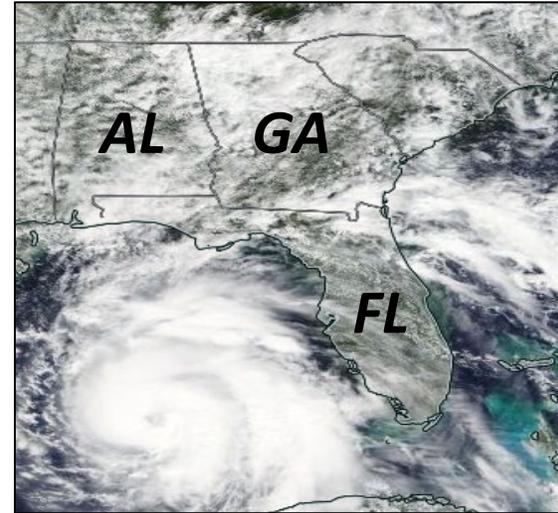
Recent Disasters – Hurricanes



Hurricane Harvey
August 2017



Hurricane Irma
September 2017



Hurricane Michael
October 2018



Hurricane Florence
September 2018

Recent Disasters – Fires



Wine Country Fires
October 2017



Oregon Substation Fire
July 2018

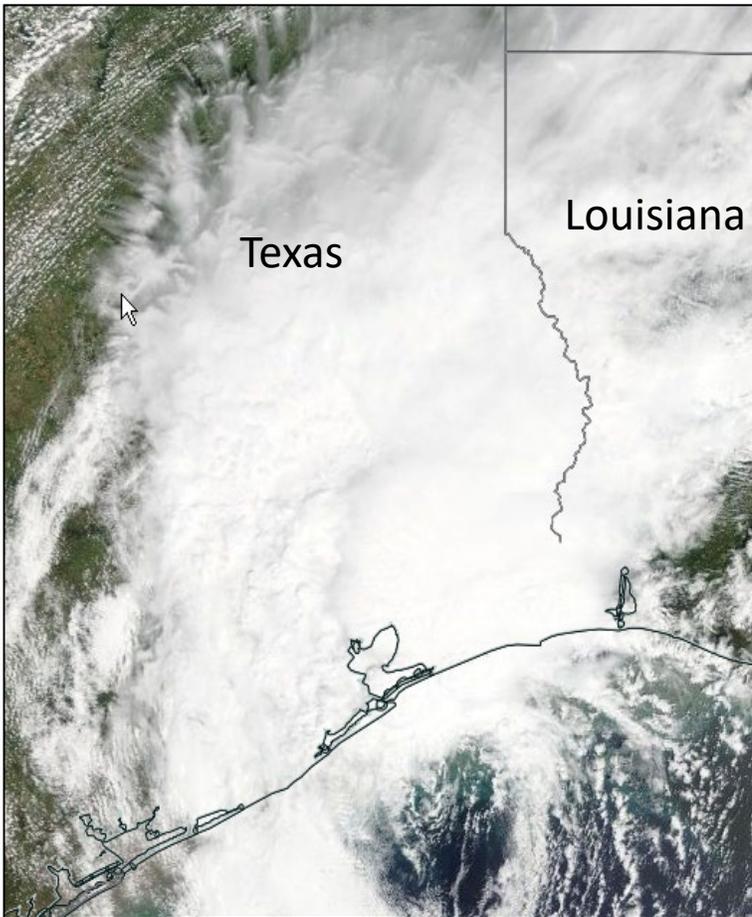


Geospatial Data

Synthetic Aperture Radar, Optical Imagery,
Fire Location Data and the Cropland Data Layer

Why Use Radar?

Radar Can Penetrate Through Clouds



MODIS Terra – Optical
August 29, 2017



Copernicus Sentinel-1 Synthetic Aperture Radar
August 29, 2017



Copernicus Sentinel-1 Synthetic Aperture Radar

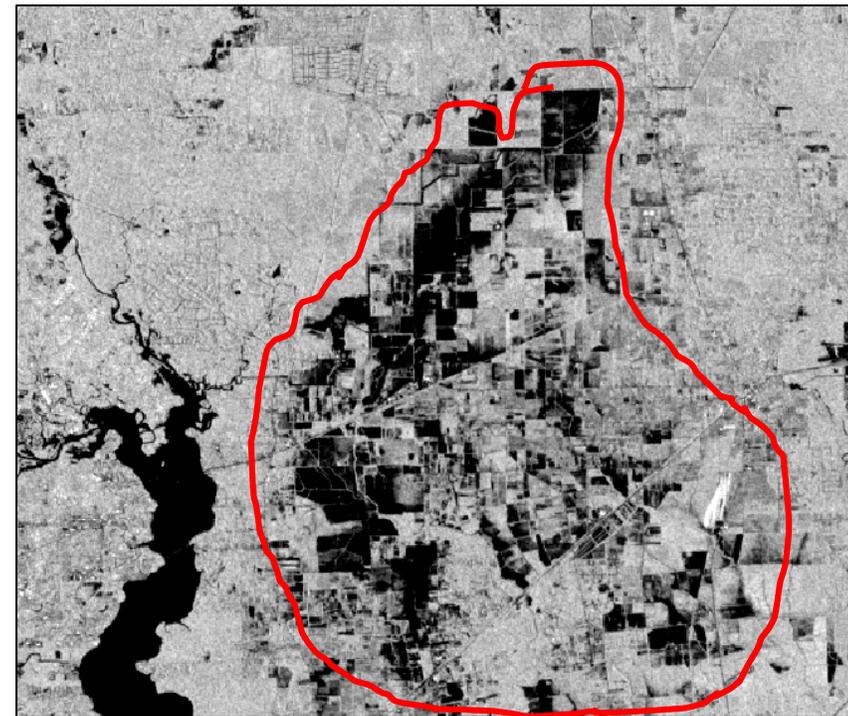
Launch

- Sentinel-1A: April 3, 2014
- Sentinel-1B: April 25, 2016

Revisit time: Six days (at the equator)
with two-satellite constellation



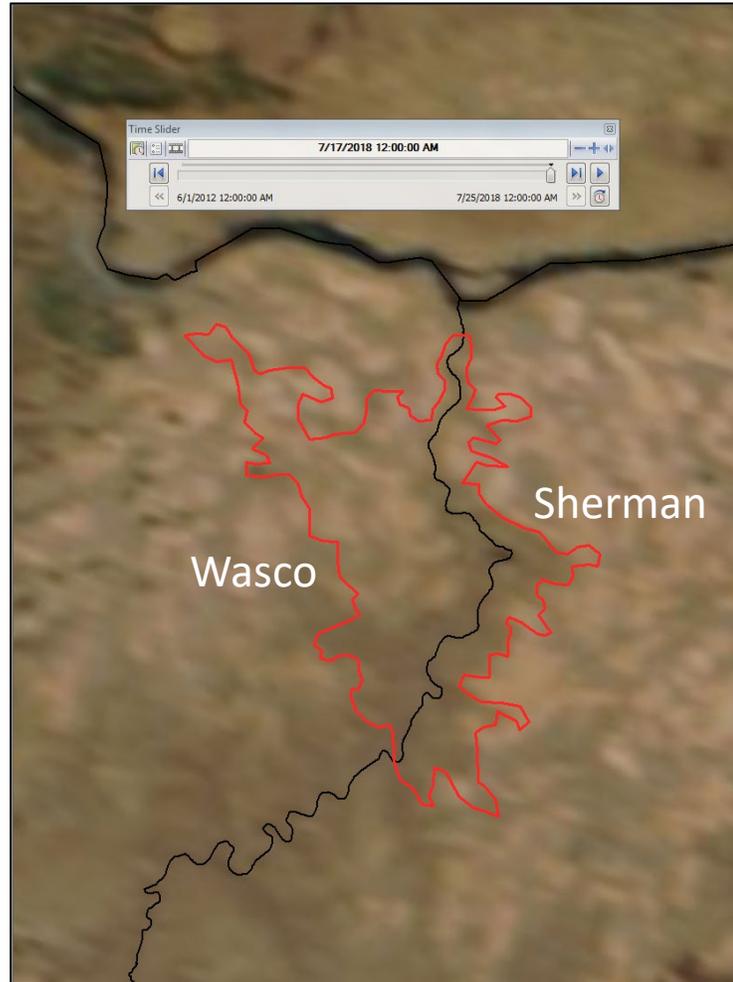
Flooding near Houston, Texas
(Harris and Liberty Counties)
August 29, 2017



Website: <https://sentinels.copernicus.eu/web/sentinel/home>

NASA MODIS Optical Data

Before Fire: July 17, 2018



After Fire: July 24, 2018



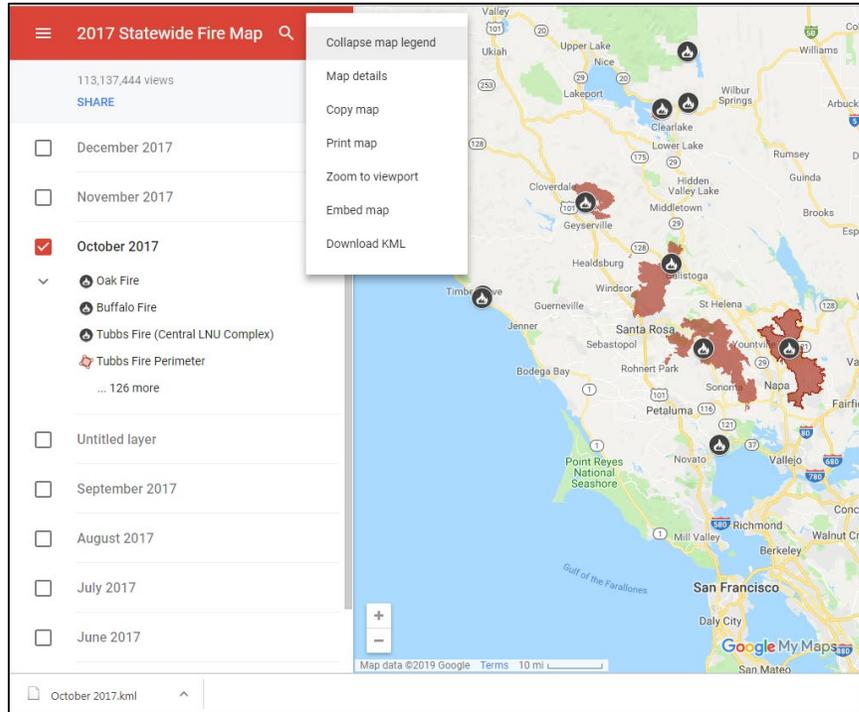
Daily MODIS Image Server: <http://modis.arcgis.com/arcgis/rest/services/MODIS/ImageServer>



Geospatial Fire Data

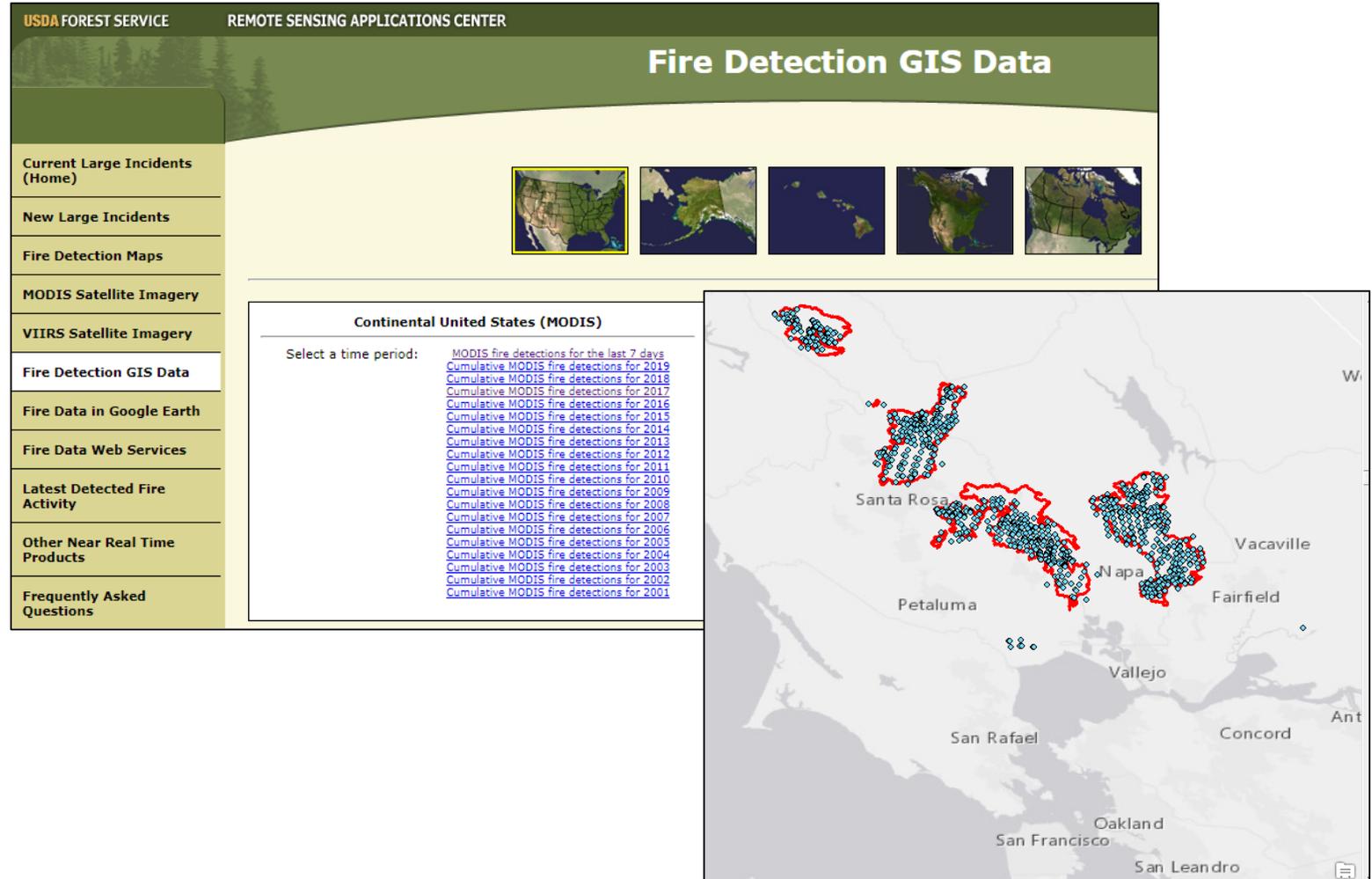
Cal Fire Perimeter Polygons

<http://www.fire.ca.gov/general/firemaps>

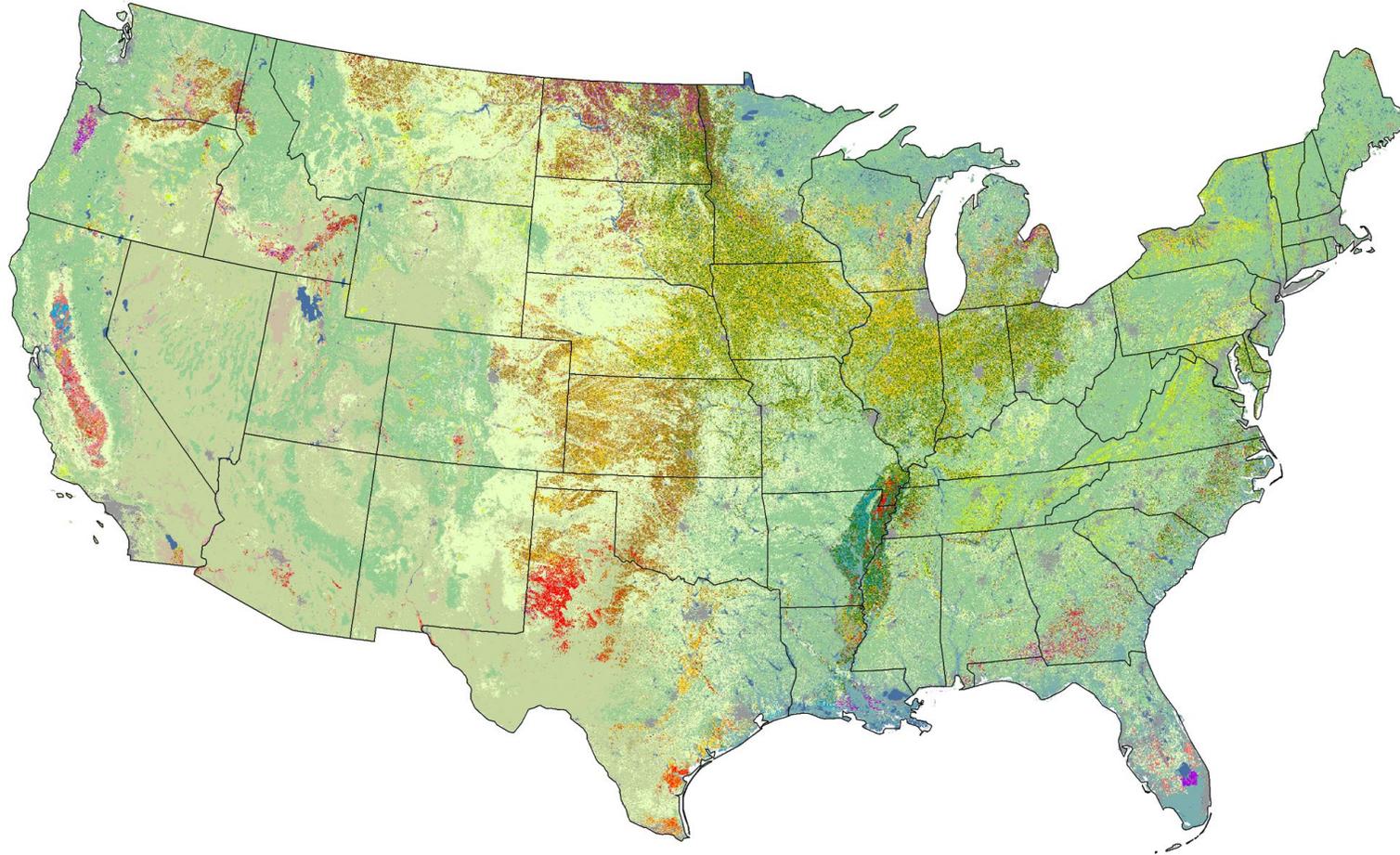


USDA Forest Service Continental Active Fire Detection Points

<https://fsapps.nwcg.gov/afm/gisdata.php>



NASS Cropland Data Layer (CDL)



- Annually released, geo-referenced, 30 meter, crop-specific land cover data set
- Produced with optical imagery, from multiple satellites, acquired across the summer growing season
- Multiple versions produced during the growing season to obtain independent acreage estimates
- National scale since 2008
- The 2018 CDL was released to the public on February 15, 2019



CropScape: <https://nassgeodata.gmu.edu/CropScape/>



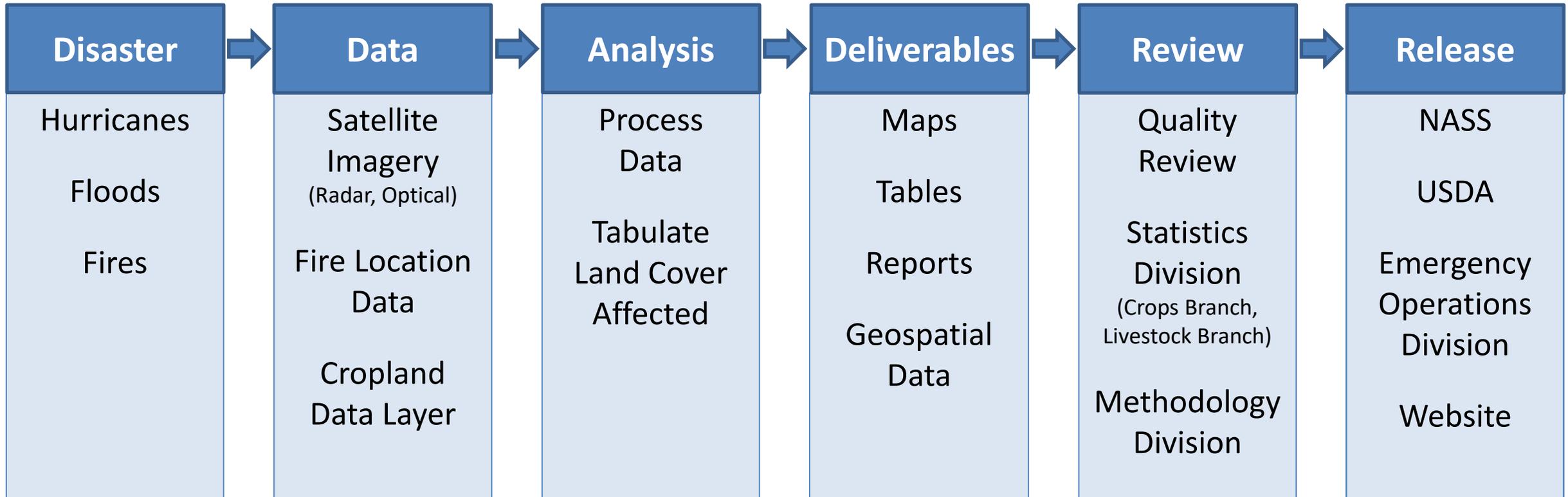
NASS Cropland Data Layer

1	Corn	41	Sugarbeets	73	Other Tree Fruits	227	Lettuce
2	Cotton	42	Dry Beans	74	Pecans	228	Cucumbers
3	Rice	43	Potatoes	75	Almonds	229	Pumpkins
4	Sorghum	44	Other Crops	76	Walnuts	230	Lettuce/Durum Wht
5	Soybeans	45	Sugarcane	77	Pears	231	Lettuce/Cantaloupe
6	Sunflower	46	Sweet Potatoes	80	Other Non-Tree Fruit	232	Lettuce/Upland Cotton
10	Peanuts	47	Misc. Vegs. & Fruits	92	Aquaculture	233	Lettuce/Barley
11	Tobacco	48	Watermelons	204	Pistachios	234	Durum Wht/Sorghum
12	Sweet Corn	49	Onions	205	Triticale	235	Barley/Sorghum
13	Pop. or Orn. Corn	50	Pickles	206	Carrots	236	WinWht/Sorghum
14	Mint	51	Chick Peas	207	Asparagus	237	Barley/Corn
21	Barley	52	Lentils	208	Garlic	238	WinWht/Cotton
22	Durum Wheat	53	Peas	209	Cantaloupes	239	Soybeans/Cotton
23	Spring Wheat	54	Tomatoes	210	Prunes	240	Soybeans/Oats
24	Winter Wheat	55	Caneberries	211	Olives	241	Corn/Soybeans
25	Other Small Grains	56	Hops	212	Oranges	242	Blueberries
26	Dbl. Crop WinWht/Soy	57	Herbs	213	Honeydew Melons	243	Cabbage
27	Rye	58	Clover/Wildflowers	214	Broccoli	244	Cauliflower
28	Oats	59	Sod/Grass Seed	216	Peppers	245	Celery
29	Millet	60	Switchgrass	217	Pomegranates	246	Radishes
30	Speltz	61	Fallow/Idle Cropland	218	Nectarines	247	Turnips
31	Canola	62	Pasture/Grass	219	Greens	248	Eggplants
32	Flaxseed	66	Cherries	220	Plums	249	Gourds
33	Safflower	67	Peaches	221	Strawberries	250	Cranberries
34	Rape Seed	68	Apples	222	Squash	251	Corn - Non-Irrigated
35	Mustard	69	Grapes	223	Apricots	252	Soybean - Non-Irrigated
36	Alfalfa	70	Christmas Trees	224	Vetch	253	WinWheat - Non-Irrigated
37	Other Hay	71	Other Tree Nuts	225	WinWht/Corn		
38	Camelina	72	Citrus	226	Oats/Corn		

CropScape: <https://nassgeodata.gmu.edu/CropScape/>



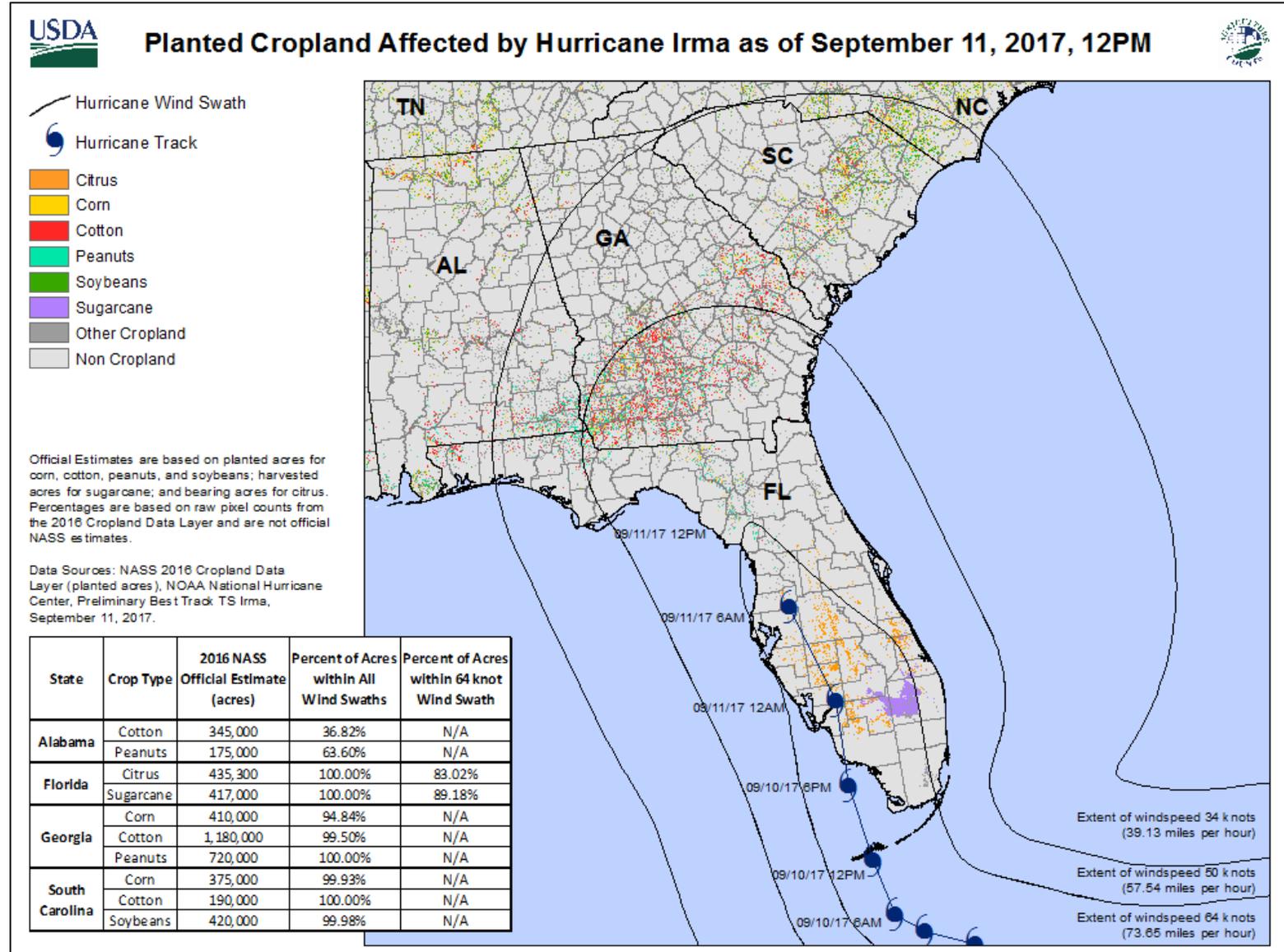
Process Flow



Deliverables

Maps, Tables, Reports, Geospatial Data
and Disaster Analysis Website

Hurricane Wind Swath Maps

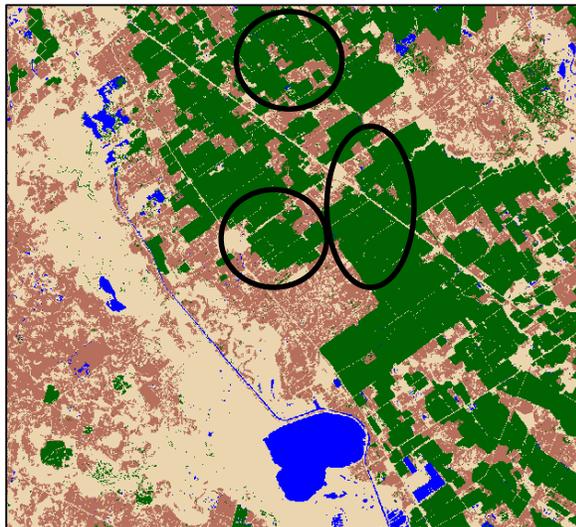


NOAA Hurricane GIS Data:
<https://www.nhc.noaa.gov/gis/>



Crop Inundation Raster Layers

08/22/2017 (Pre-flood)

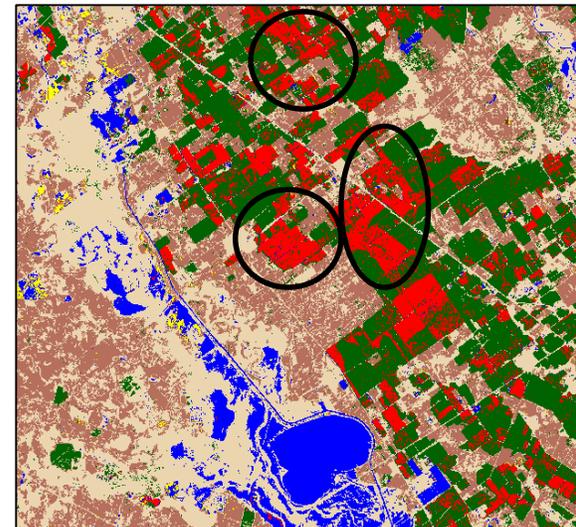


Hurricane Harvey
Calhoun County, Texas

Copernicus
Sentinel-1A
Synthetic Aperture
Radar (SAR)



09/03/2017 (Post-flood)



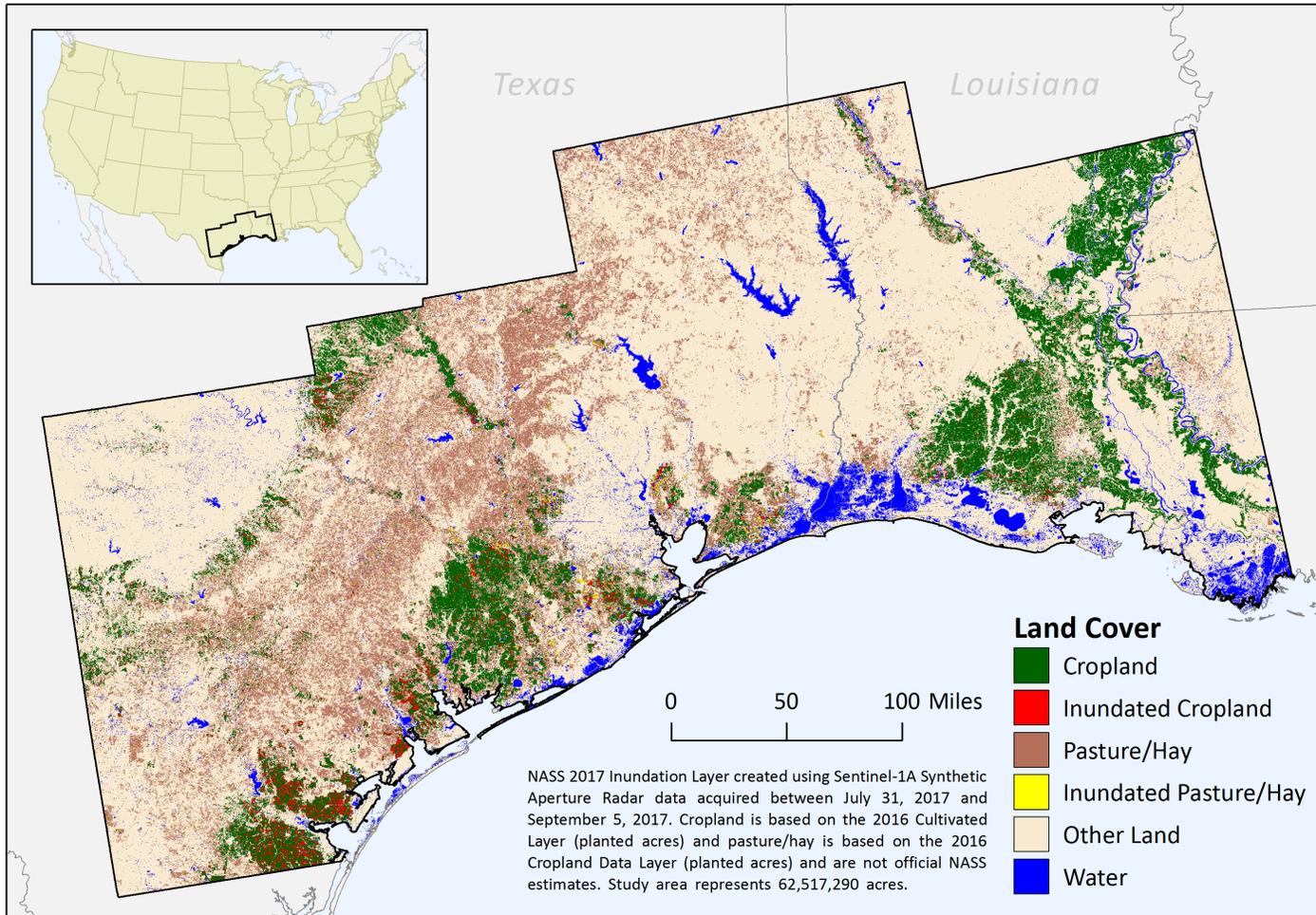
Inundation Layer

- | | |
|---|---|
|  Water |  Inundated Cropland |
|  Cropland |  Inundated Pasture/Hay |
|  Pasture Hay | |
|  Other | |

Inundation Analysis and Maps



Hurricane Harvey: Inundated Cropland and Pasture/Hay



Crop Type	Percent Inundated
Corn	14.54%
Cotton	14.53%
Fallow/Idle Cropland	9.47%
Oats	10.39%
Rice	7.43%
Sorghum	25.72%
Winter Wheat	11.45%
Total Cropland	10.16%
Pasture/Hay	3.68%

Total Area Analyzed

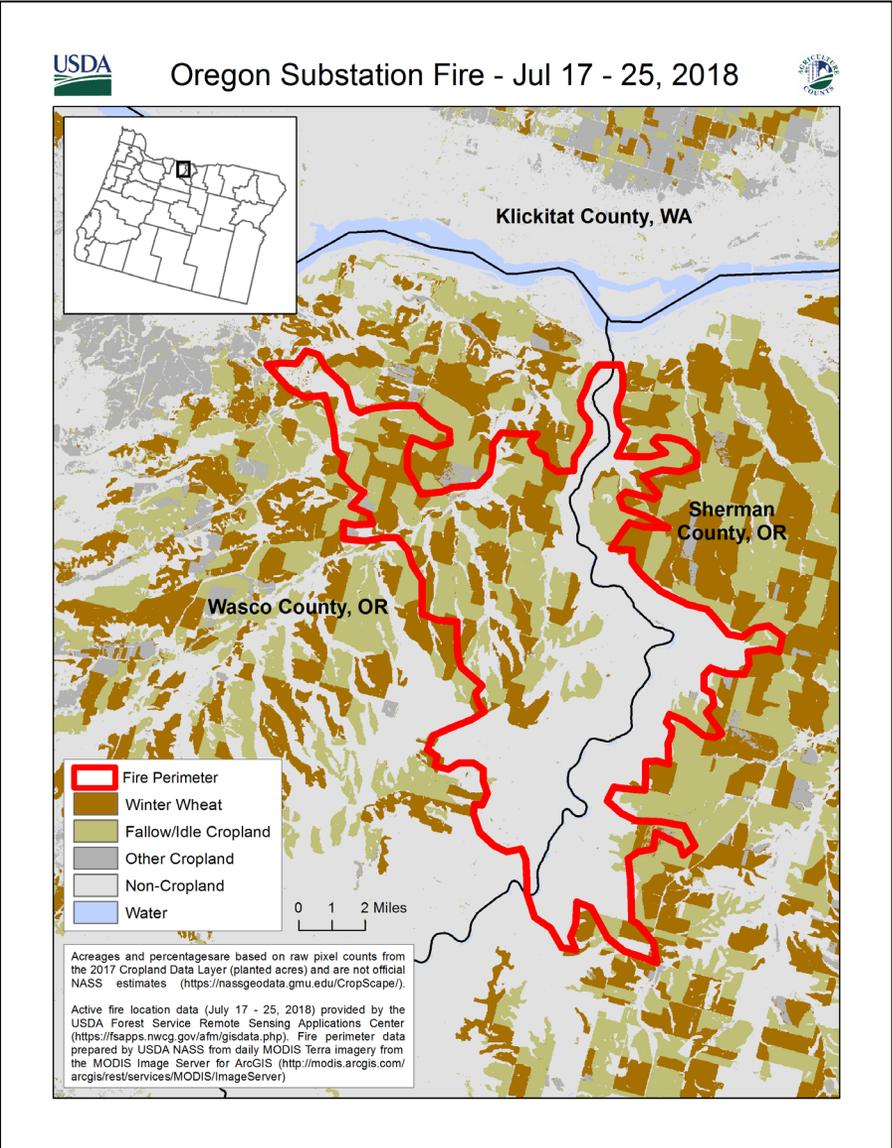
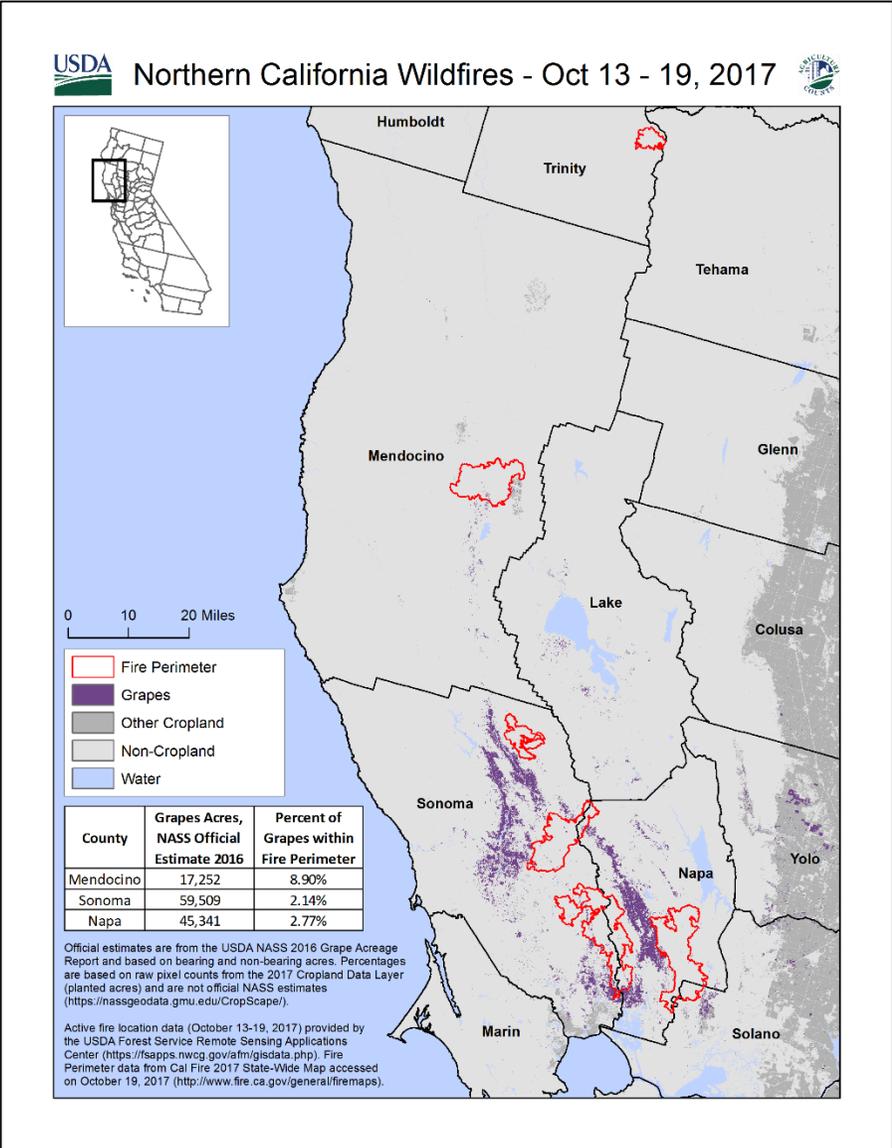
Total: 62,517,290 acres

Cropland: 7,061,403 acres

Pasture/Hay: 9,448,350 acres



Fire Analysis and Results



Disaster Analysis Website

Website: https://www.nass.usda.gov/Research_and_Science/Disaster-Analysis/index.php

Files Available for Download

- Maps
- Assessment reports
- Geospatial data
- Metadata
- Methodology paper

The screenshot shows the USDA National Agricultural Statistics Service (NASS) website. The header includes the USDA logo, the text 'United States Department of Agriculture National Agricultural Statistics Service', and social media icons for Twitter, YouTube, RSS, Facebook, and LinkedIn. A search bar is located in the top right corner. The main navigation menu includes 'Data & Statistics', 'Publications', 'Newsroom', 'Surveys', 'Census', 'About NASS', 'Contact Us', and 'Help'. The breadcrumb trail indicates the current location: 'Home / Research and Science / Disaster-Analysis'. The 'Related Topics' sidebar lists 'Research Fellow and Associate Program' and 'Seasonal Summary of Crop Progress and Condition'. The main content area is titled 'Research and Science' and features a 'Disaster Analysis' section. This section contains a paragraph explaining that NASS can now monitor agricultural disasters in near real-time and provide quantitative assessments using remotely sensed data and geospatial techniques. It lists three links: 'Hurricane Michael', 'Hurricane Florence', and 'Oregon Substation Fire'. Below this, there is a section for 'Hurricane Michael (October 2018)' with a detailed paragraph about the impact of the hurricane on agricultural land in Florida, Georgia, Alabama, South Carolina, and North Carolina. It mentions that the NASS responded to inquiries regarding the extent of flooding from Hurricane Michael over agricultural land in near real-time. The text states that a recently developed flood mapping procedure, based on Copernicus Sentinel-1 Synthetic Aperture Radar data and the NASS Cropland Data Layer, was implemented in response to the flood event. The data, maps, and reports below identify the extent of inundation over cropland and pasture based on this analysis. The crop inundation layers are publicly available for download. A list of files available for download includes: 'Assessment Report', 'Methodology Paper', 'Raster Data Zipfile', 'Metadata', and 'Wind Swath Maps Zipfile'. At the bottom of the page, there is a map titled 'Hurricane Michael: Inundated Cropland and Pasture/Hay'. The map shows the Southeastern United States, with labels for North Carolina, South Carolina, Georgia, and Alabama. A legend indicates that green represents 'Cropland' and red represents 'Inundated Cropland'. The map shows significant areas of inundated cropland in the coastal and inland regions of the Southeast.



Summary

- NASS monitors agricultural disasters in *near real-time* and provides quantitative assessments using satellite data and geospatial analysis to support crop estimation and emergency response.
- This capacity is possible due to *free* satellite imagery and geospatial data, which are posted with short latency, and geospatial analysis.
- Disaster maps, reports, and geospatial data are delivered to stake holders within NASS, at the department level, and to the USDA Emergency Operations Division.
- Data are made available to the general public on the NASS Disaster Analysis website.



Thank You

21

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Disaster Analysis Website:
[https://www.nass.usda.gov/Research and Science/Disaster-Analysis/index.php](https://www.nass.usda.gov/Research_and_Science/Disaster-Analysis/index.php)

Photo Courtesy: Dorothy Edwards, Naples (Fla.) Daily News