

Fallowed Area Mapping for Drought Impact Reporting and Decision Making

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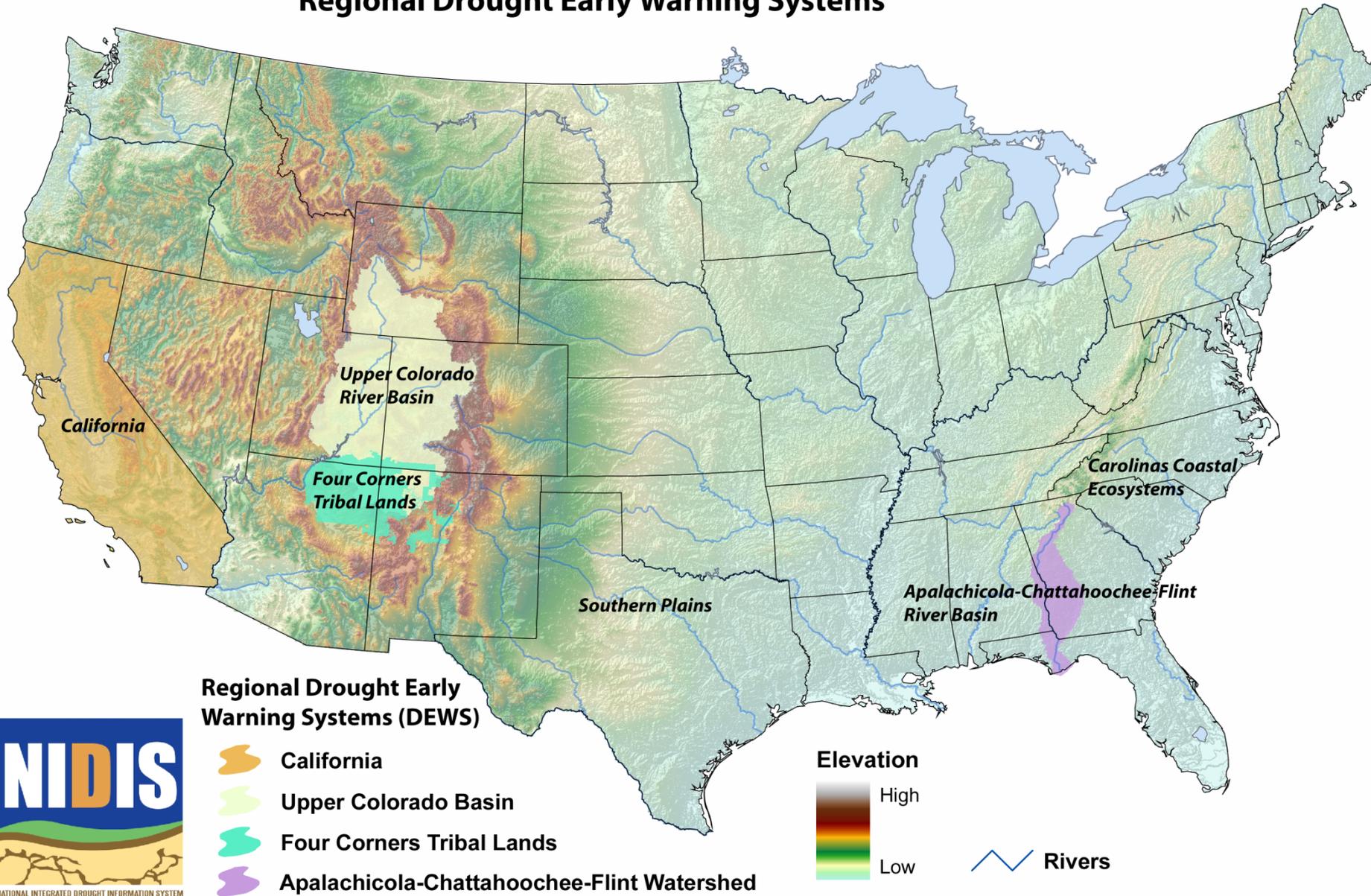
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Remote Sensing for Drought Monitoring and Response Workshop
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National Integrated Drought Information System (NIDIS) Regional Drought Early Warning Systems



Drought Impacts on Land Following

- **Background:** Mapping of fallowed areas during drought identified as a research priority for NIDIS by CA Department of Water Resources (CDWR)
- **Information needed:** Product similar to 'idle lands' class in USDA NASS Cropland Data Layer for California, but on a monthly basis during growing season
- **Project objective:** Apply satellite data to provide information that will allow CDWR and other stakeholders to identify extent of, or change from historical conditions in, fallowed acreage due to water shortage



Drought Impacts on Land Following

- **Decisions supported:**
 - State concurrence in county-level requests for USDA drought disaster designations
 - State proclamations of emergency pursuant to the California Emergency Services Act
 - State priorities for providing assistance with and processing of local water transfer requests
- **Limitations of previously available information:**
 - USDA NASS Cropland data layer (CDL) considered confidential and market sensitive during the growing season
 - Fallowed acreage reports from other sources do not follow standard definitions or data collection methods → often generate conflicting estimates



Stakeholder requirements

- **Monthly tabular acreage summaries by county for April - September**
- **Latency of no more than two weeks**
- **Historical figures required for context**



Project Status

- **Within-season estimates of fallowed acreage for June, August, September, October from USDA National Agricultural Statistics Service using Cropland Data Layer infrastructure**
 - USDA Farm Service Agency (FSA) data used in training decision tree algorithms for each year
- **Early-season estimates for March – May developed by NASA Ames Research Center / California State University Monterey Bay**
 - Decision tree algorithms applied to time-series of satellite vegetation index data
- **Project team will begin producing fallowed area data and maps for California to support CDWR in April 2014**



Satellite Data



Landsat (TM / ETM+ / OLI),
SPOT, DMC

20-30m / 0.1 - 0.25 acres
Overpass every 8-16 days



Terra / Aqua (MODIS)

250m / 15.5 acres
Daily overpass

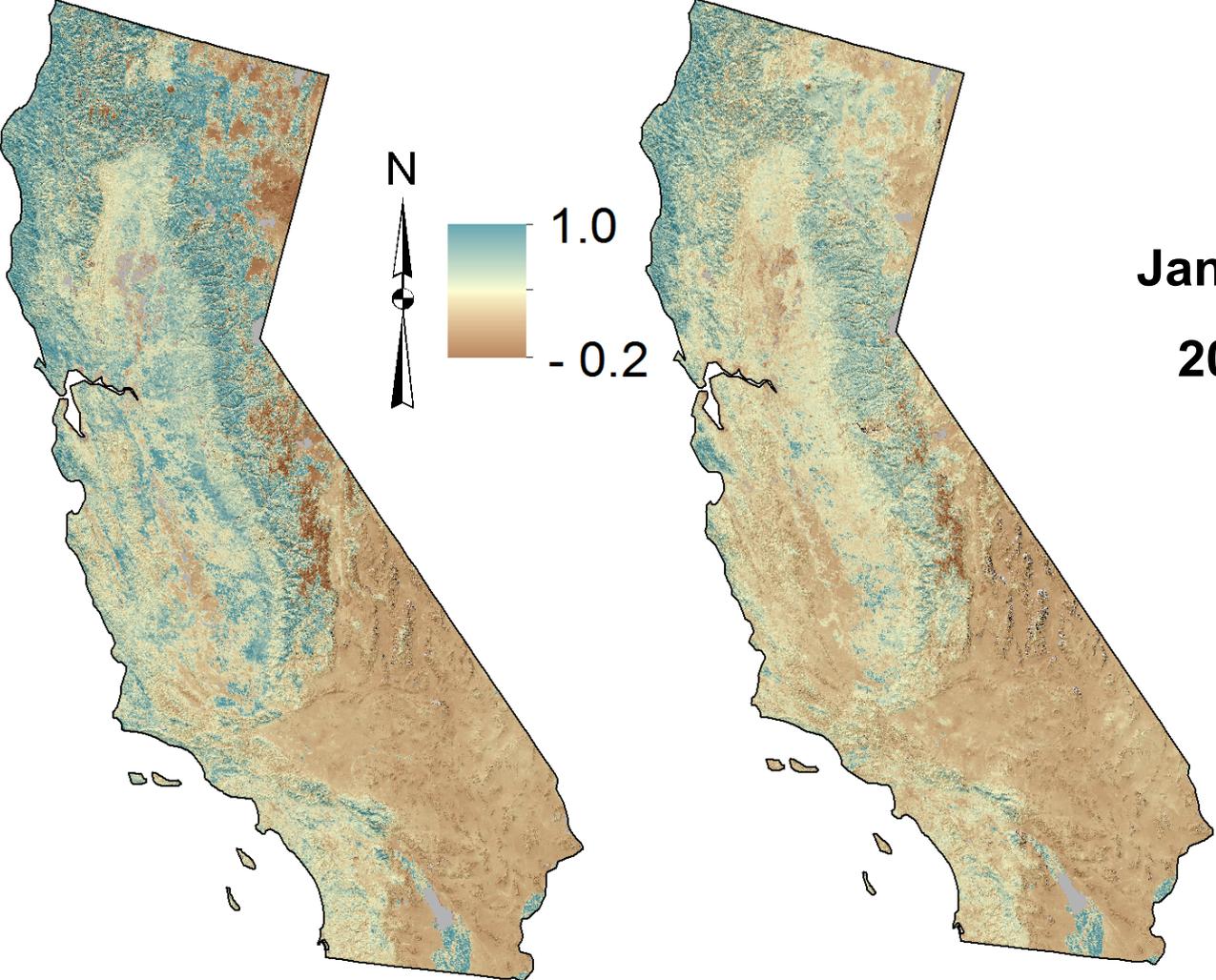
Statewide Vegetation Condition

2013

2014

January
2013

January
2014

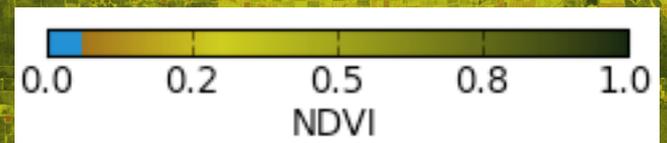


ENHANCED VEGETATION INDEX

Vegetation Condition, San Joaquin Valley, Jan., 2011

• Hanford

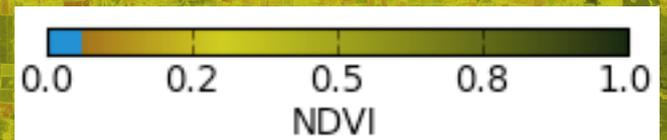
• Visalia



Vegetation Condition, San Joaquin Valley, Jan., 2013

● Hanford

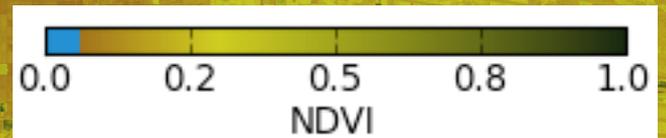
● Visalia



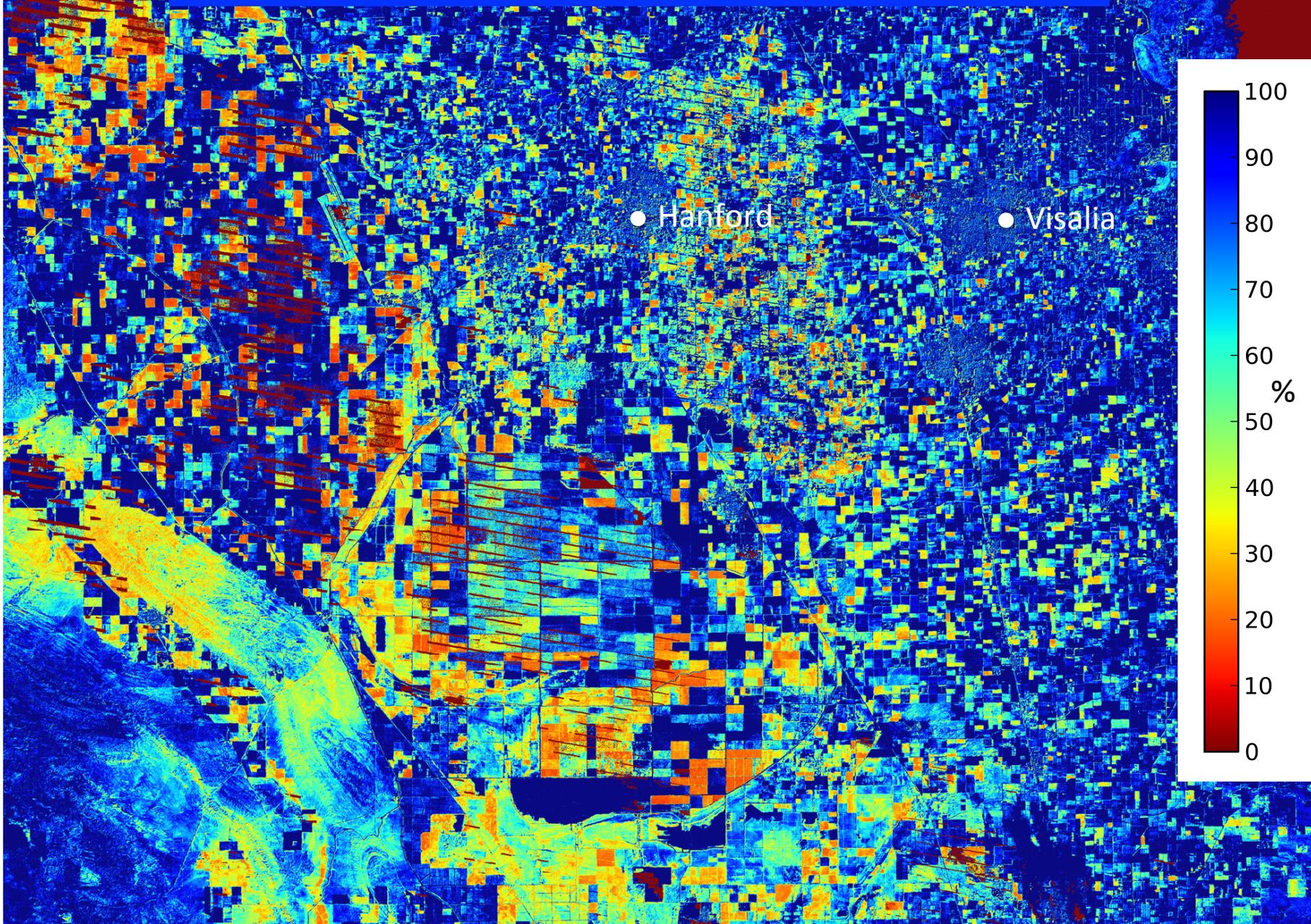
Vegetation Condition, San Joaquin Valley, Jan., 2014

● Hanford

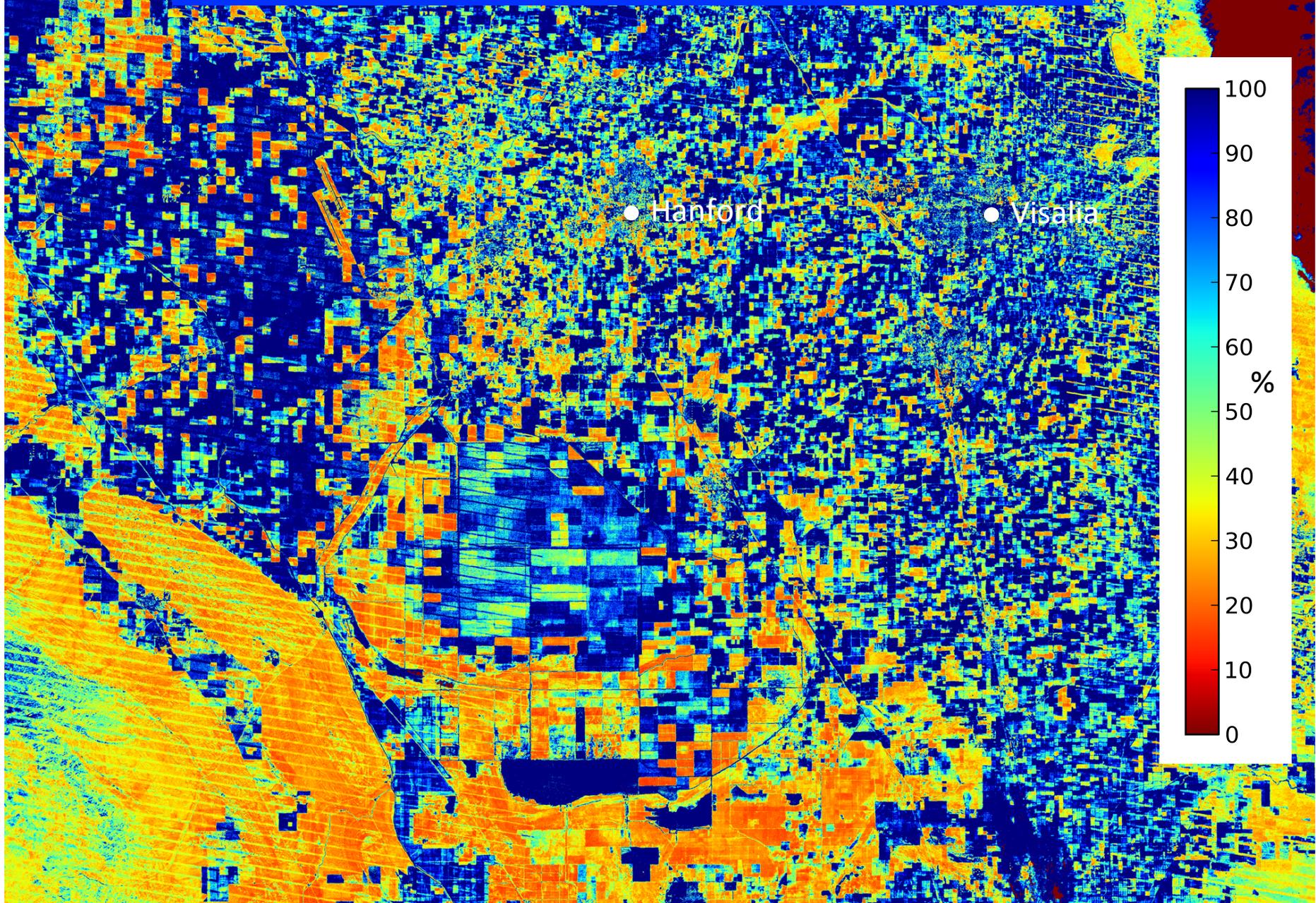
● Visalia



January 2011 vs January 2013

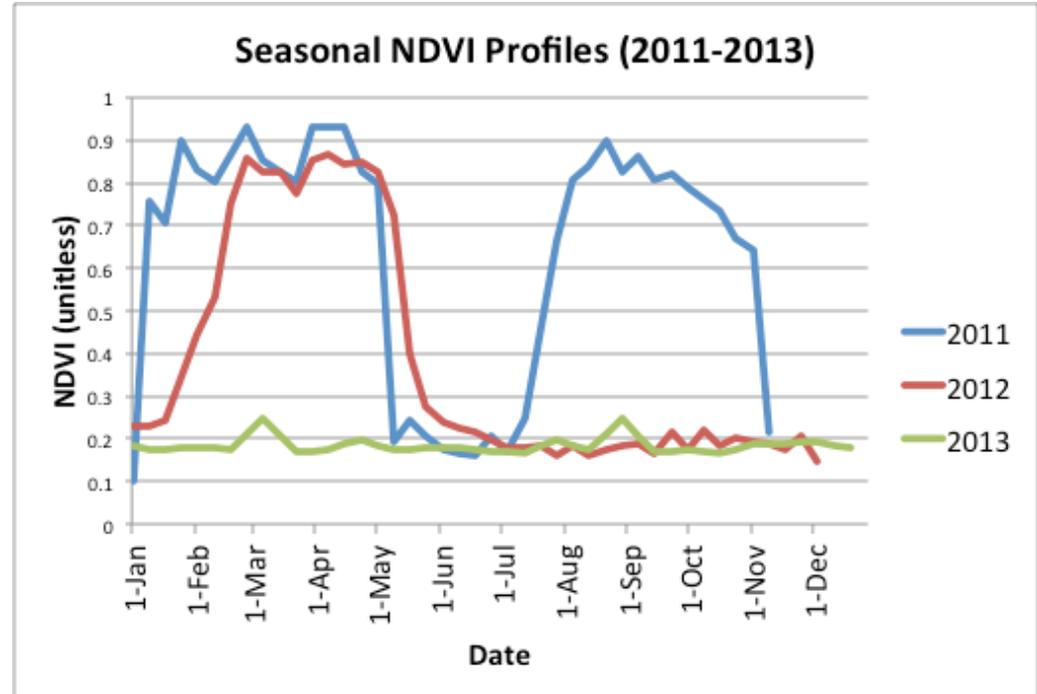


January 2011 vs January 2014



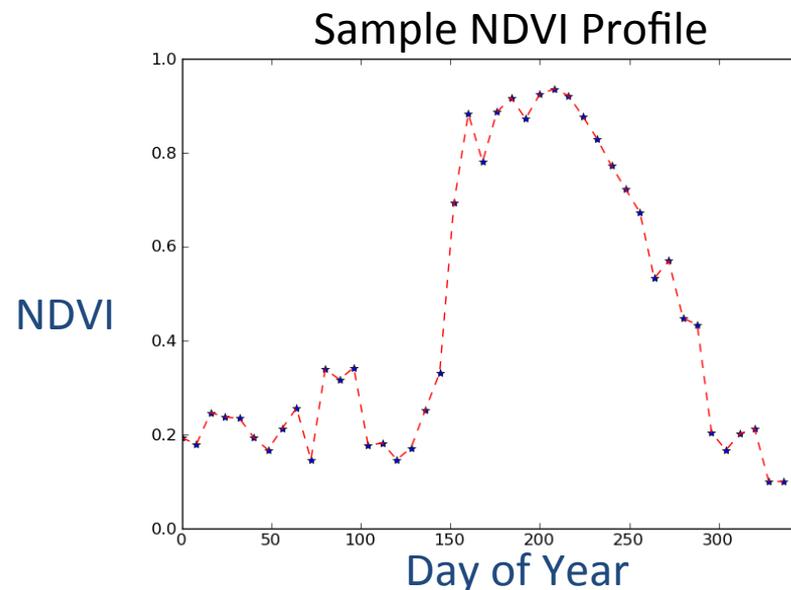
Early Season Mapping of Fallowed Area (March – June)

- Idling of land results in detectable change in seasonal NDVI profiles



Early Season Mapping of Fallowed Area (March – June): *Approach*

- Normalized Difference Vegetation Index (NDVI) composites for California generated from timeseries of 8-day composites from Landsat 5/7/8 (30m) + MODIS (250m)
- Using field boundary shapefiles from County Ag Commissioner offices, extracted NDVI profiles (field averages) for every field in the Central Valley
- Timeseries of satellite data used to classify fields as crop or non-crop
- Rapid development and testing utilizes Landsat and MODIS repositories on NASA Earth Exchange



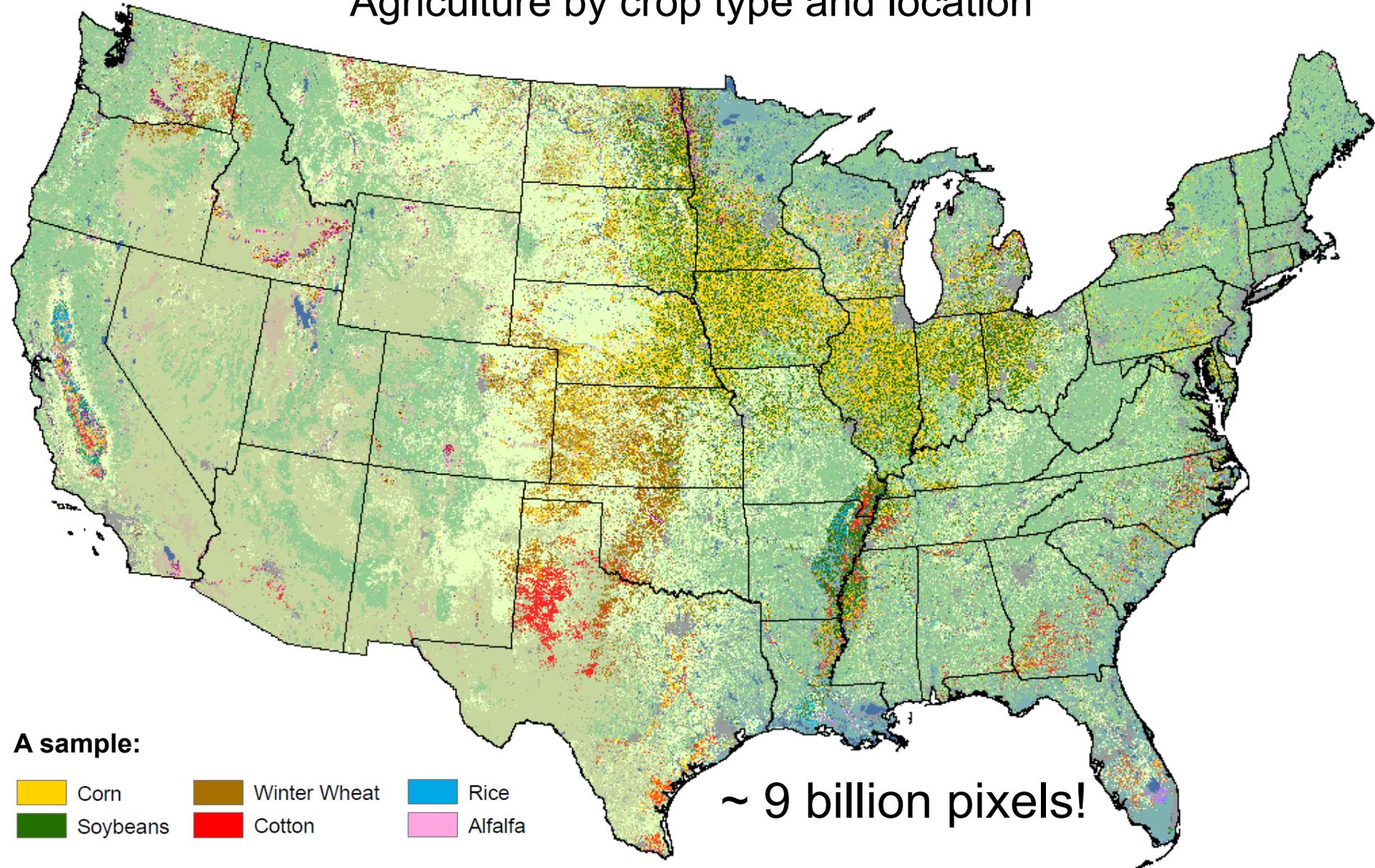
Early Season Accuracy Assessment

ACCURACY TABLE (excluding perennials)	FAM March 2013 (n = 99)		FAM April 2013 (n = 99)		FAM May 2013 (n = 99)	
	<i>Crop</i>	<i>Non-Crop</i>	<i>Crop</i>	<i>Non-Crop</i>	<i>Crop</i>	<i>Non-Crop</i>
Producers Accuracy	60%	84%	50%	100%	33%	100%
Users Accuracy	30%	95%	100%	96%	100%	94%
Overall	82% correct		96% correct		94% correct	

- Accuracy statistics derived from comparisons against field survey data collected in 2013. Initial results for 2013 highly encouraging.
- Statistics focus on crop/non-crop classification.
- Initial estimates for 2014 beginning in April of this year to assess impact of drought on winter following.

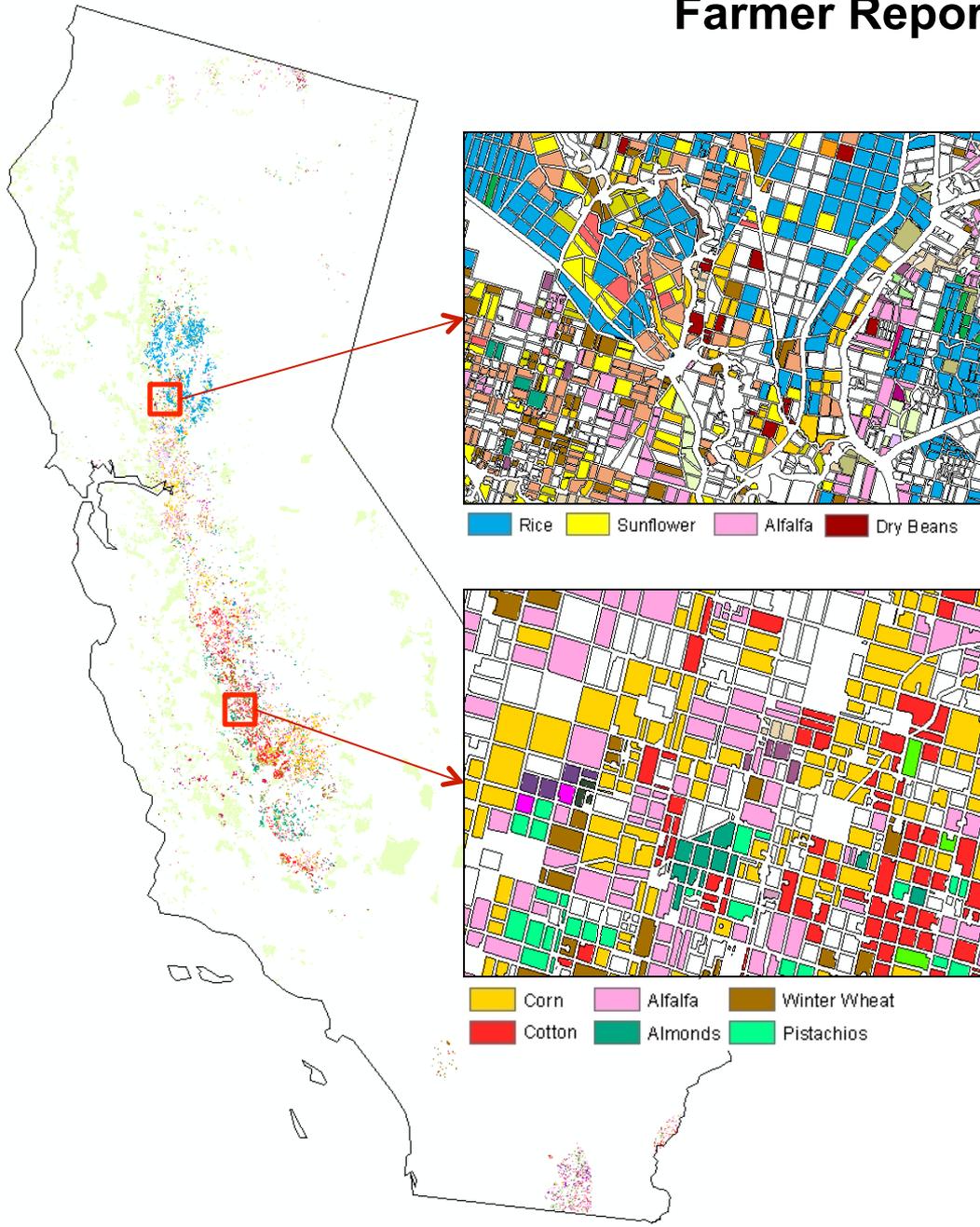
USDA NASS Cropland Data Layer

Agriculture by crop type and location



Groundtruth – Farm Service Agency 578 Data

Farmer Reported Data



FSA 578 & Common Land Unit

Common Land Unit

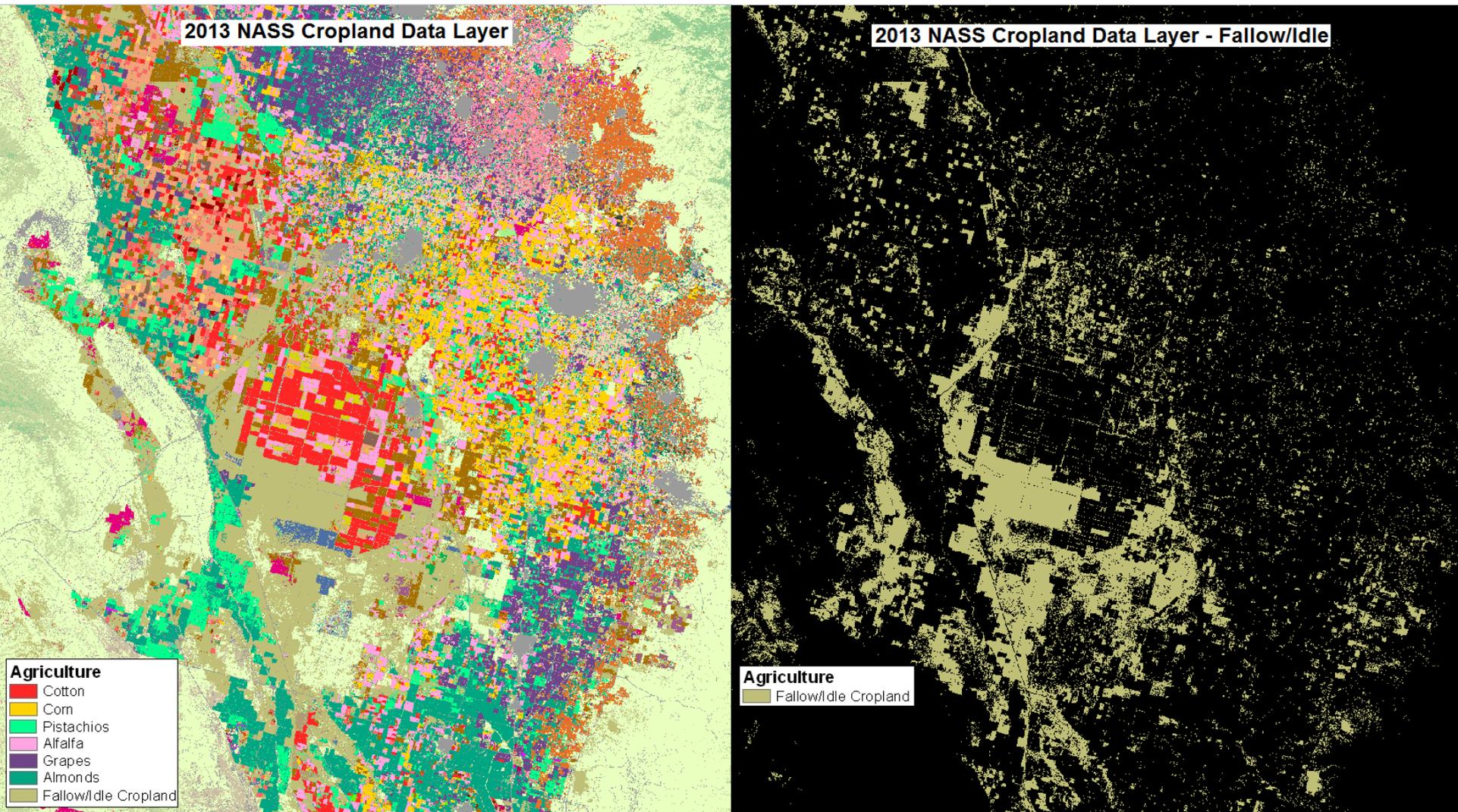
- Digitized polygon field data managed in the state office

FSA 578 Data

- Farmer reported data specifying crop type and location
- Includes “fallow/idle” land cover

The Fallow/Idle Mask created from CDL

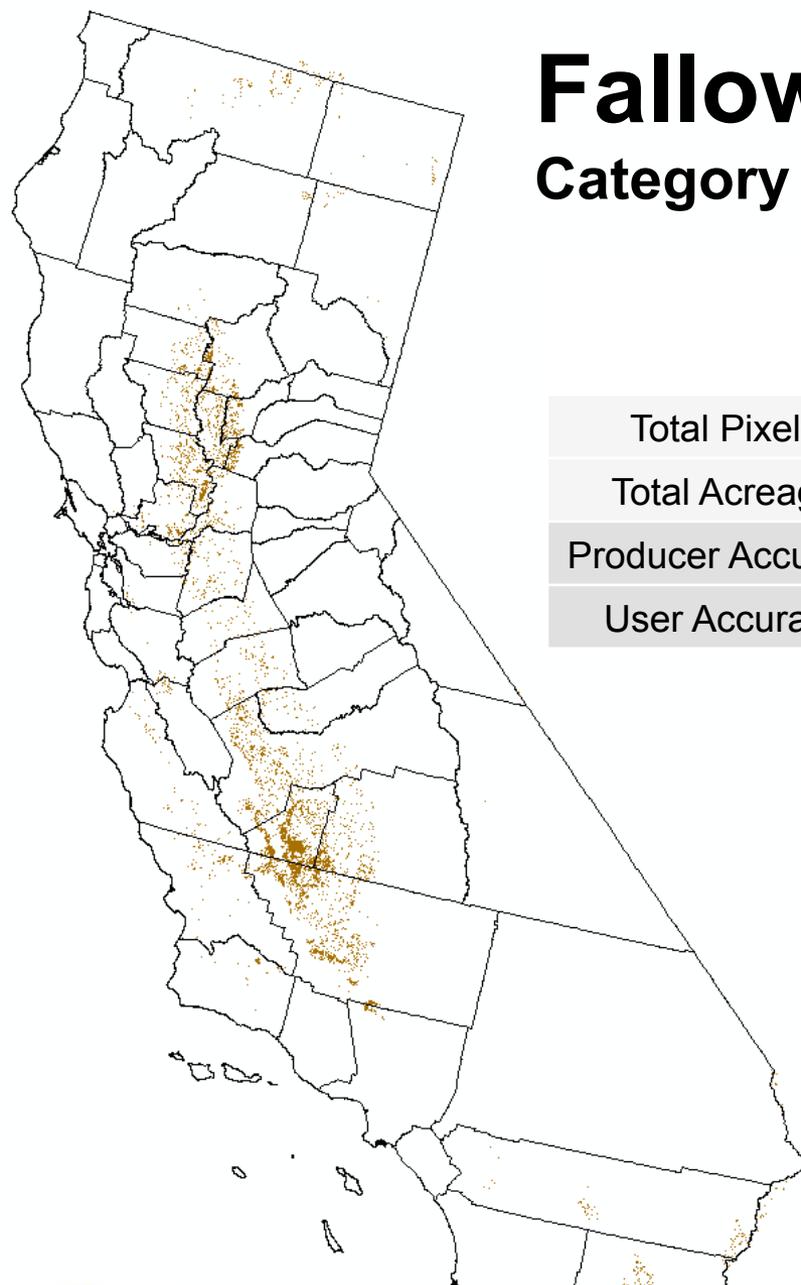
Binary mask of Fallow/Idle classified pixels



Idle mask recreated during summer/fall growing season
June – August – September – October

Fallow/Idle Land Mask

Category 61 in CDL



In Season CDL Iterations

	June	August	September	October
Total Pixels	573,585	639,383	677,913	714,388
Total Acreage	127,562	142,195	150,764	158,875
Producer Accuracy	75.0%	79.4%	82.7%	78.2%
User Accuracy	66.6%	69.9%	71.1%	67.6%

Pixels – 30 meter pixels = 0.2223 acres

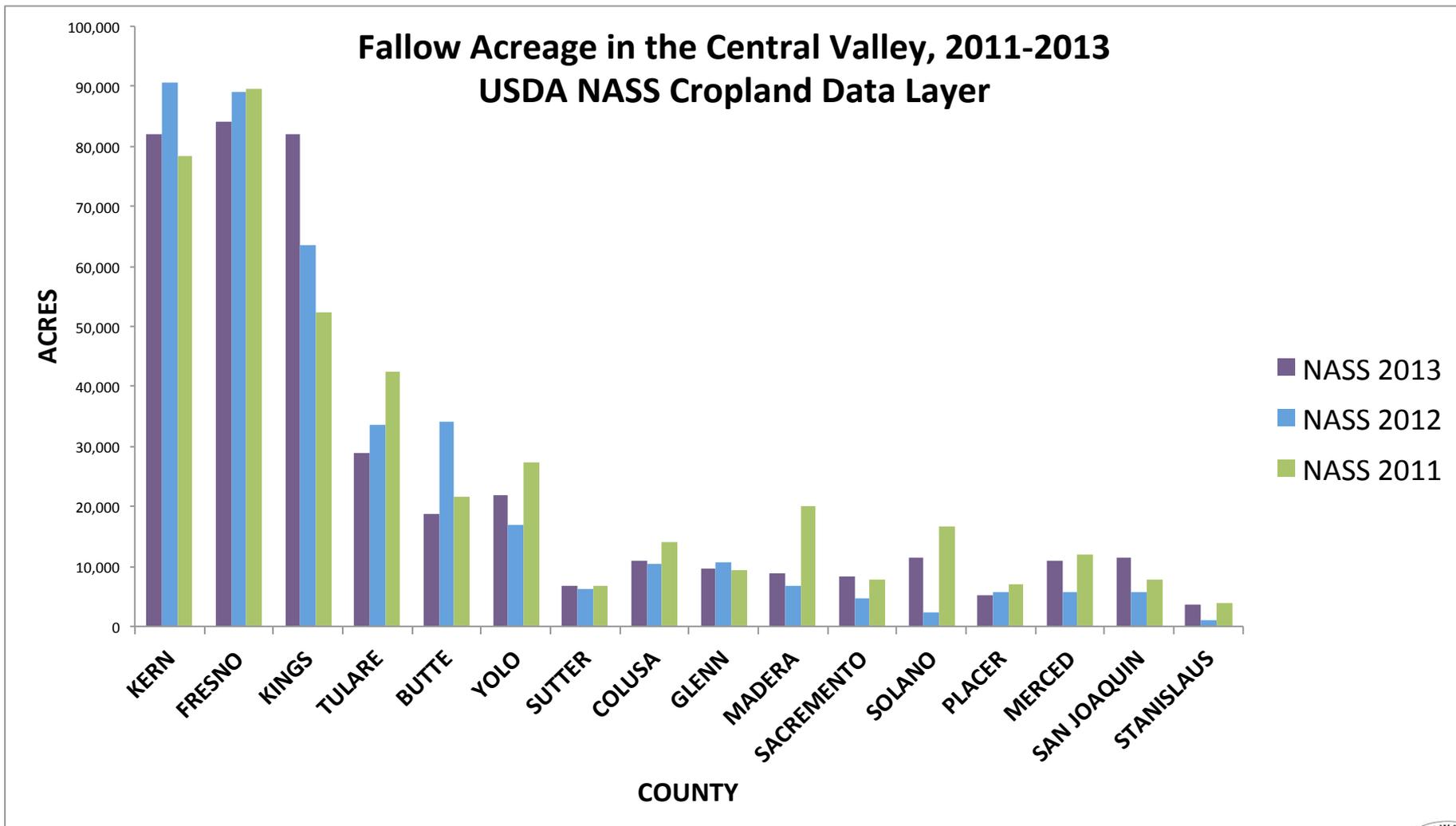
Producer Accuracy/Omission – relates to the probability that a ground truth pixel will be correctly mapped; occurs when a pixel is excluded from the correct category.

User Accuracy/Commission – indicates the probability a pixel from the classification matches the ground truth data; occurs when a pixel is included in an incorrect category

Definition of “Fallow/Idle” up to farmers



Idle Acres for 2011-2013



Questions?

