



Mapping Drought Impacts on Land Following in California with Satellite Data

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Project Team:

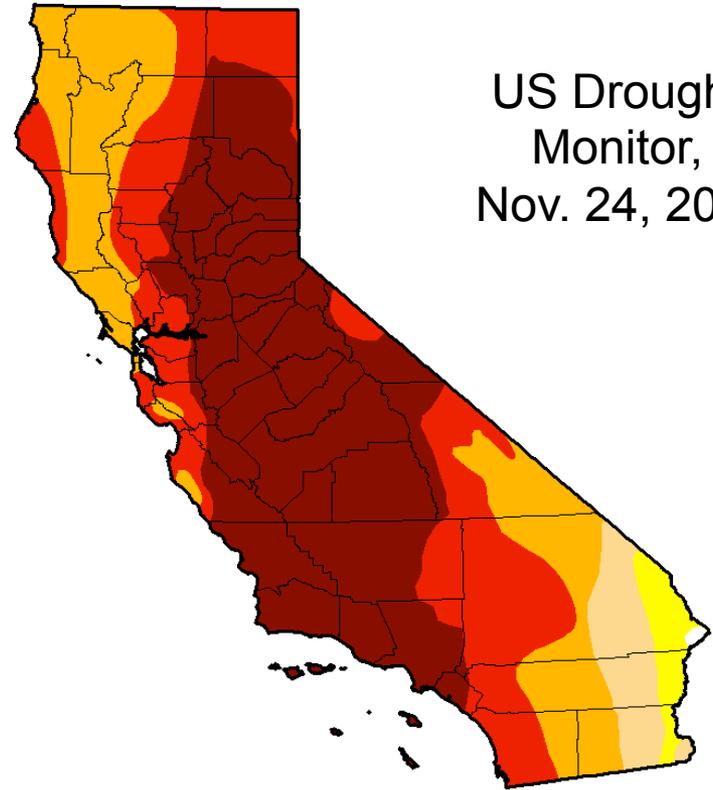
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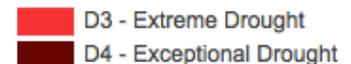
Drought Impacts on CA Agriculture

- ~44% of CA farms received surface water allocations of 0% in 2015
- ~75% of CA farms received <20% of full surface water allocation
- Reductions in surface water supplies offset through increased reliance on groundwater resources
- Estimated economic losses of \$2.7 billion for ag sector (UC Davis, 8/17/2015)

US Drought Monitor,
Nov. 24, 2015



Intensity:



Drought Impacts and Land Fallowing

- **Background:** Mapping of fallowed areas during drought identified as a priority by CA Department of Water Resources (CDWR)
- **Information needed:** Monthly estimates of idle and cropped acreage, with <2 week delay, field-scale resolution, accuracy of +/- 25% acceptable (similar to USDA Cropland Data Layer 'Idle' class)
- **Objective:** Apply satellite data to provide information that will allow CDWR and other stakeholders to identify extent of fallowed acreage during droughts



Drought Impacts on Land Following

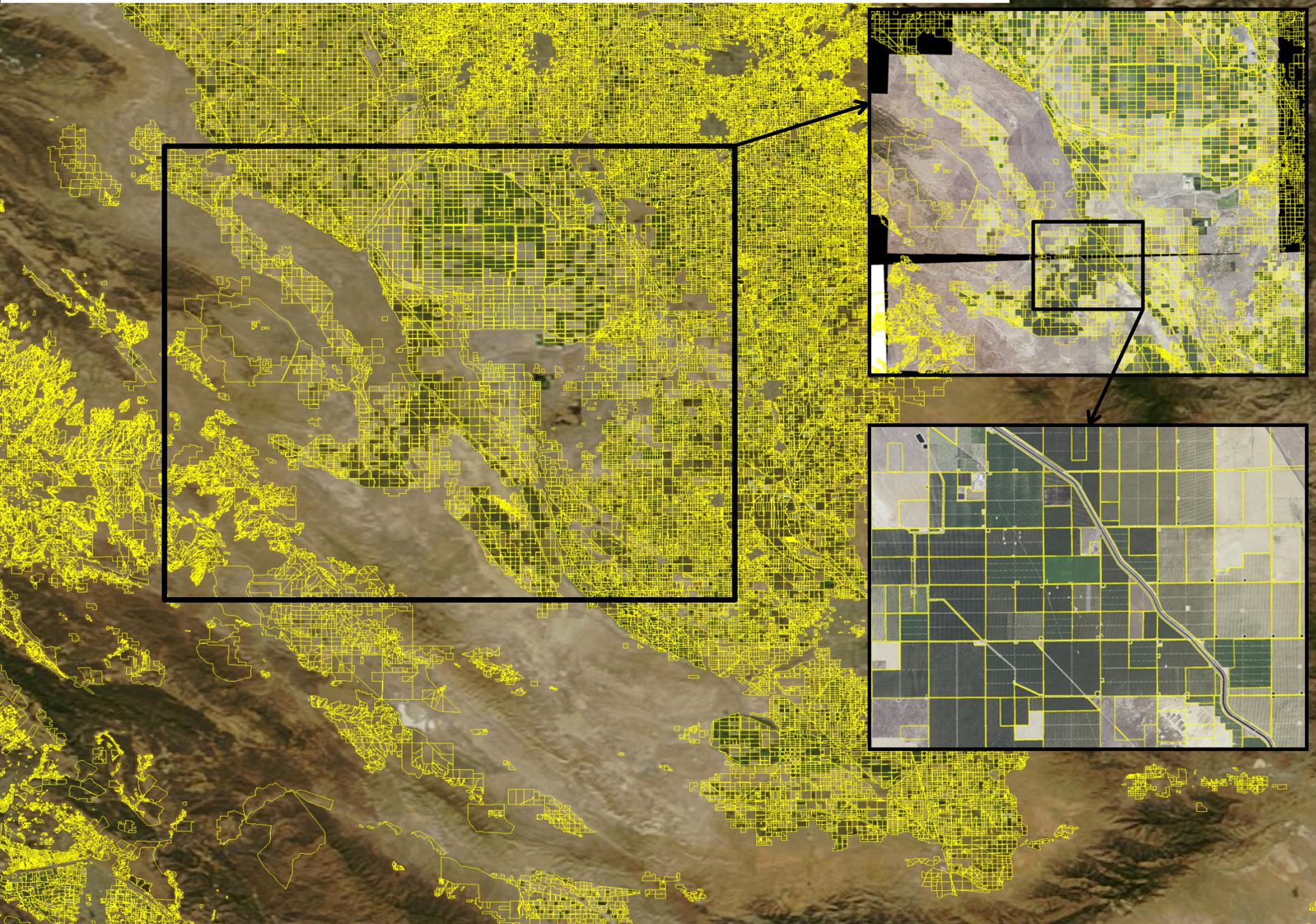
Limitations of previously available information:

- 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

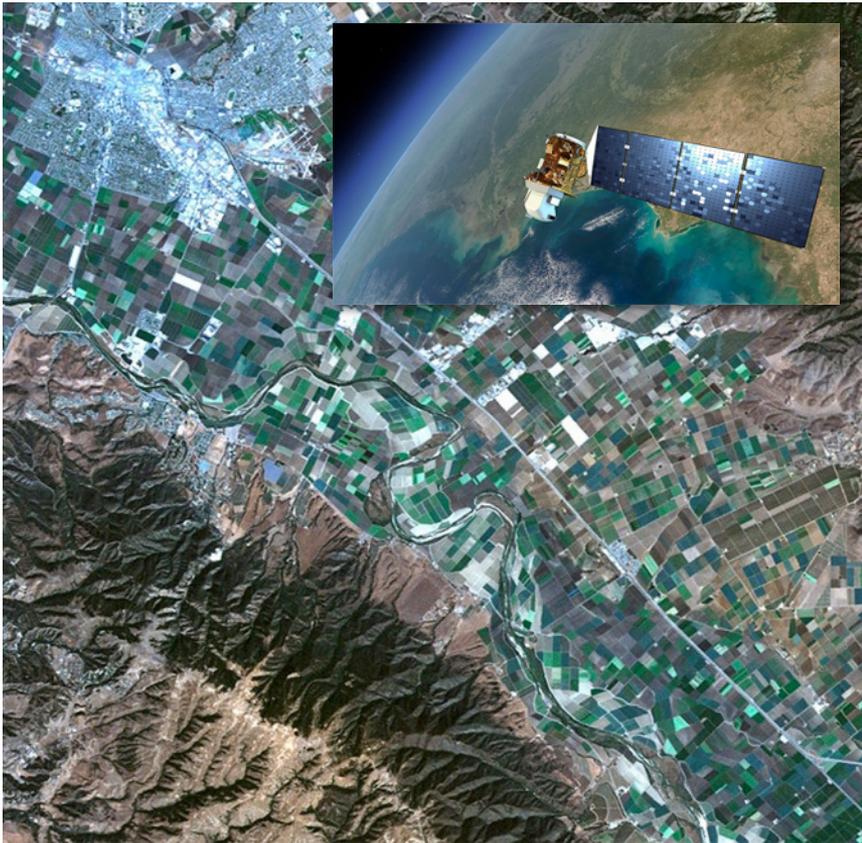
Actions supported:

- Assessment of extent and severity of drought impacts
- State proclamations of emergency pursuant to the California Emergency Services Act and allocation of drought relief funding
- State priorities for providing assistance to impacted counties
- Quantification of economic impacts of drought on agricultural sector

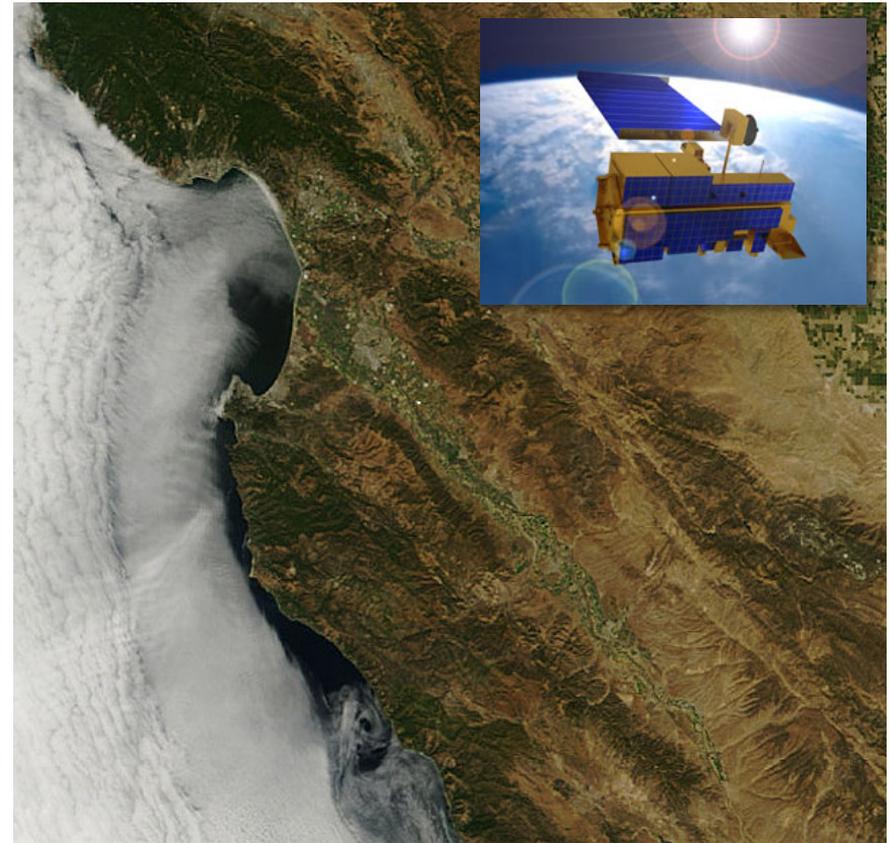
Southern San Joaquin Valley, CA, Field Boundary Polygons



Satellite Data



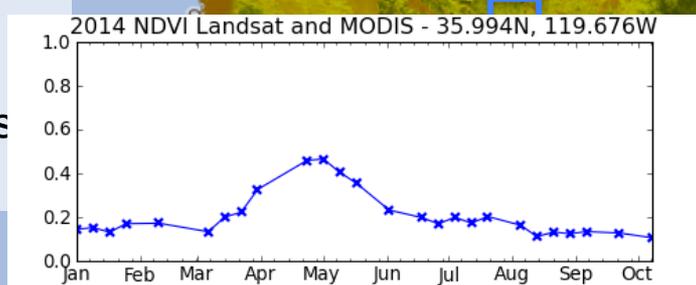
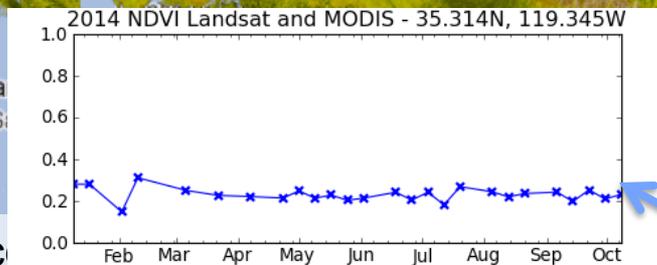
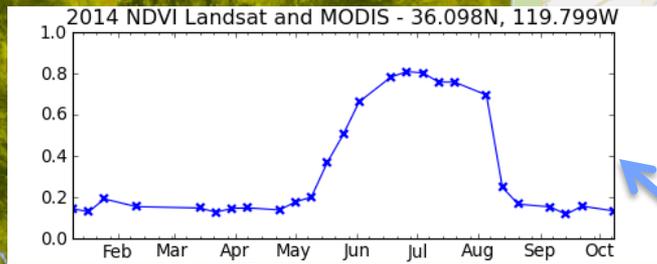
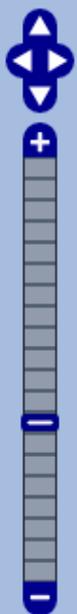
Landsat 5/7/8 (TM / ETM+ / OLI)
30m / 0.25 acres
Overpass every 8-16 days



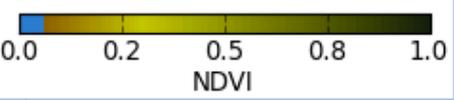
Terra / Aqua (MODIS)
250m / 15.5 acre
Daily overpass

Satellite Monitoring of Crop Development

Go to: Search [About](#) [Help](#) Select Date:



Normalized Difference Vegetation Index (NDVI); 8-day composite from Landsat and MODIS

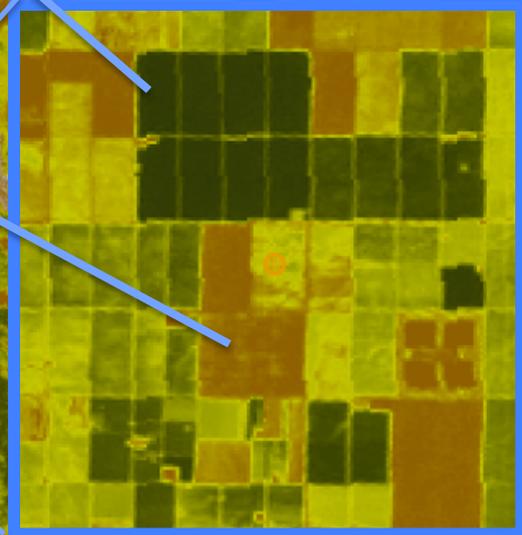


SIMS Data Layers

- ETcb
2011-07-07
- Crop coefficient (Kcb)
2011-07-04 to 2011-07-11
- Veg. Index (NDVI) gapfilled
2011-07-04 to 2011-07-11
- Veg. Index (NDVI)
2011-07-04 to 2011-07-11

Base Layer

- Google Satellite



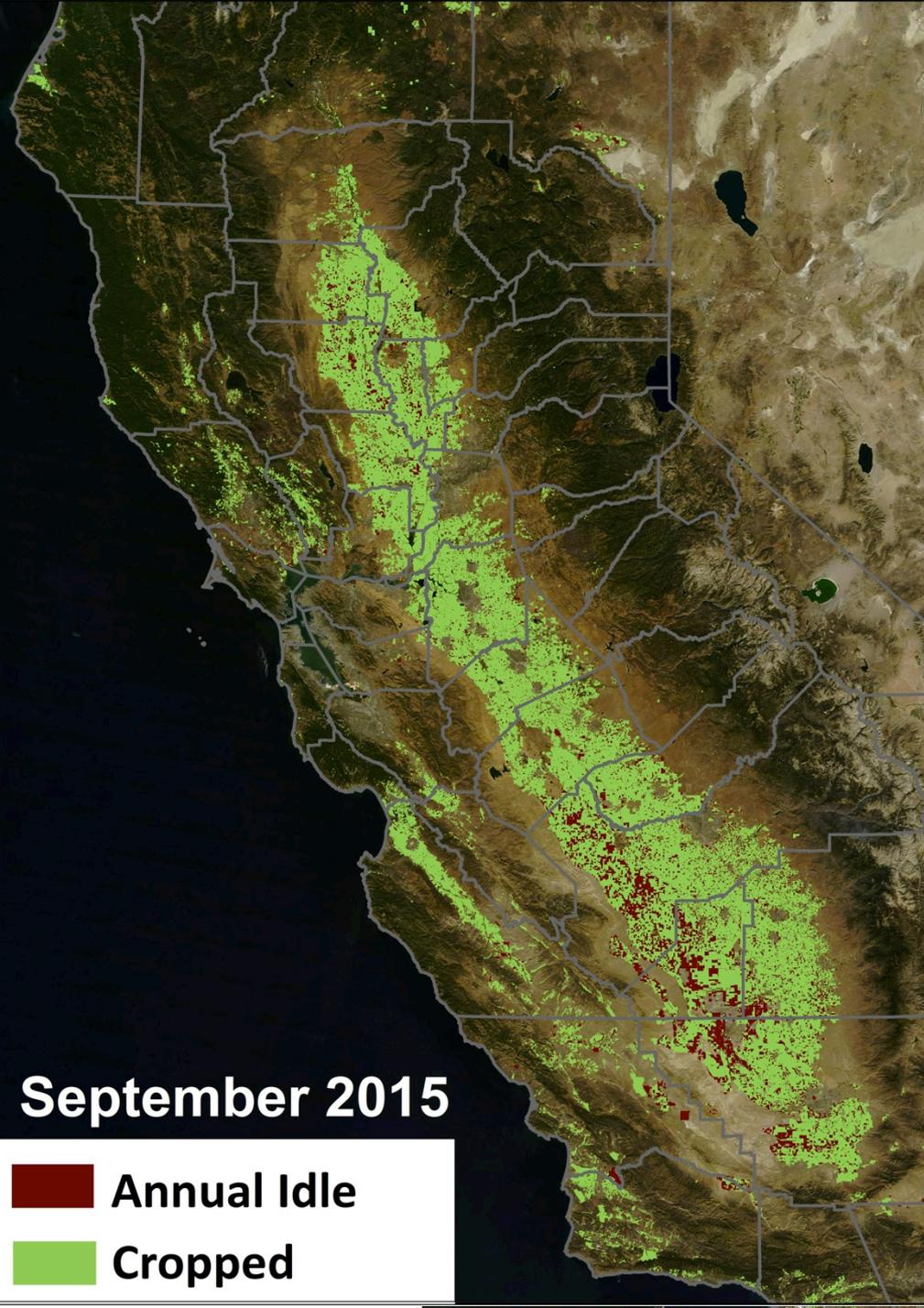
35.39402 N, -119.85320 W

Disclaimer: This data is for research and evaluation purposes only.

NASA Official: [Ramakrishna R.Nemani](#)

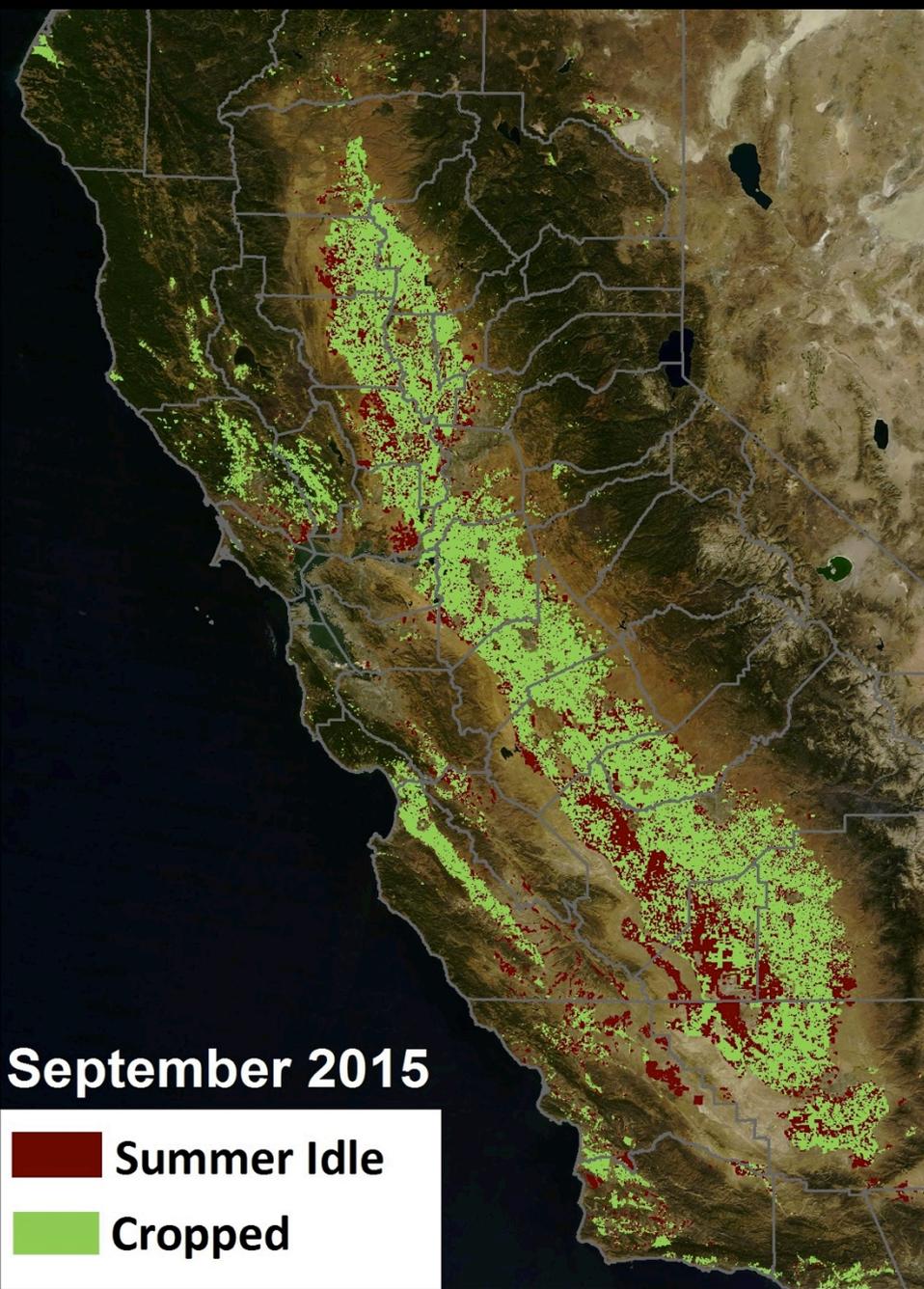
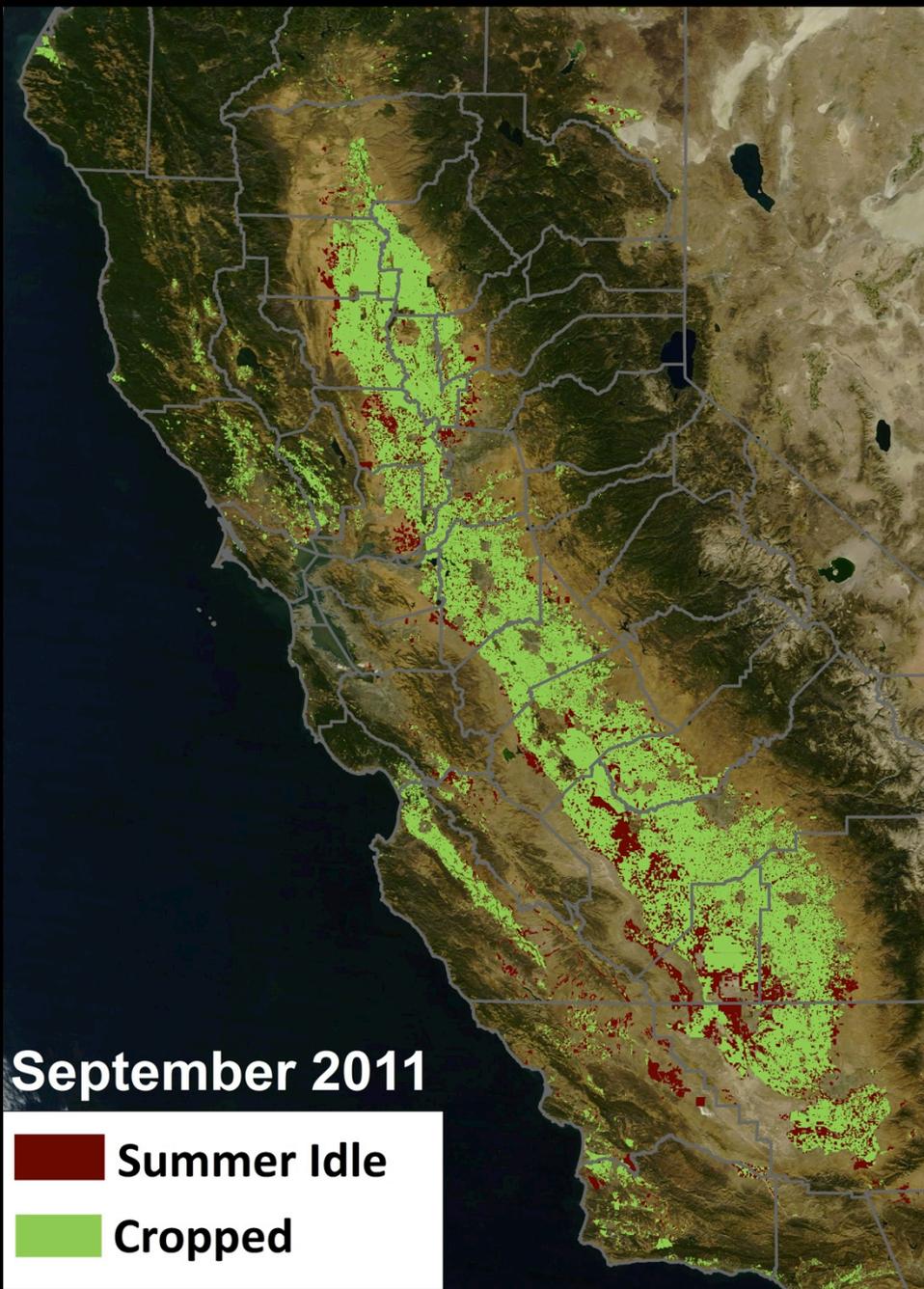
Curator: [Forrest Melton](#)

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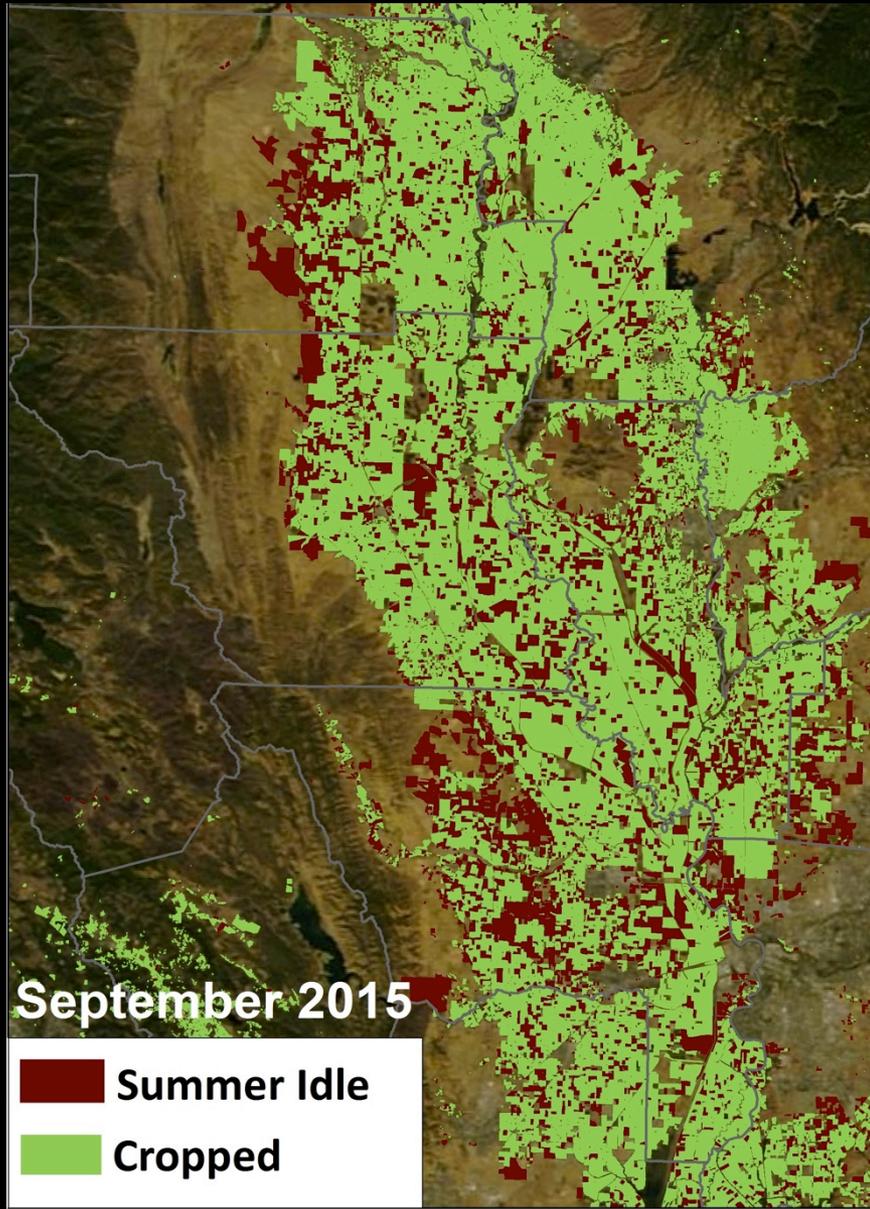


September 2015

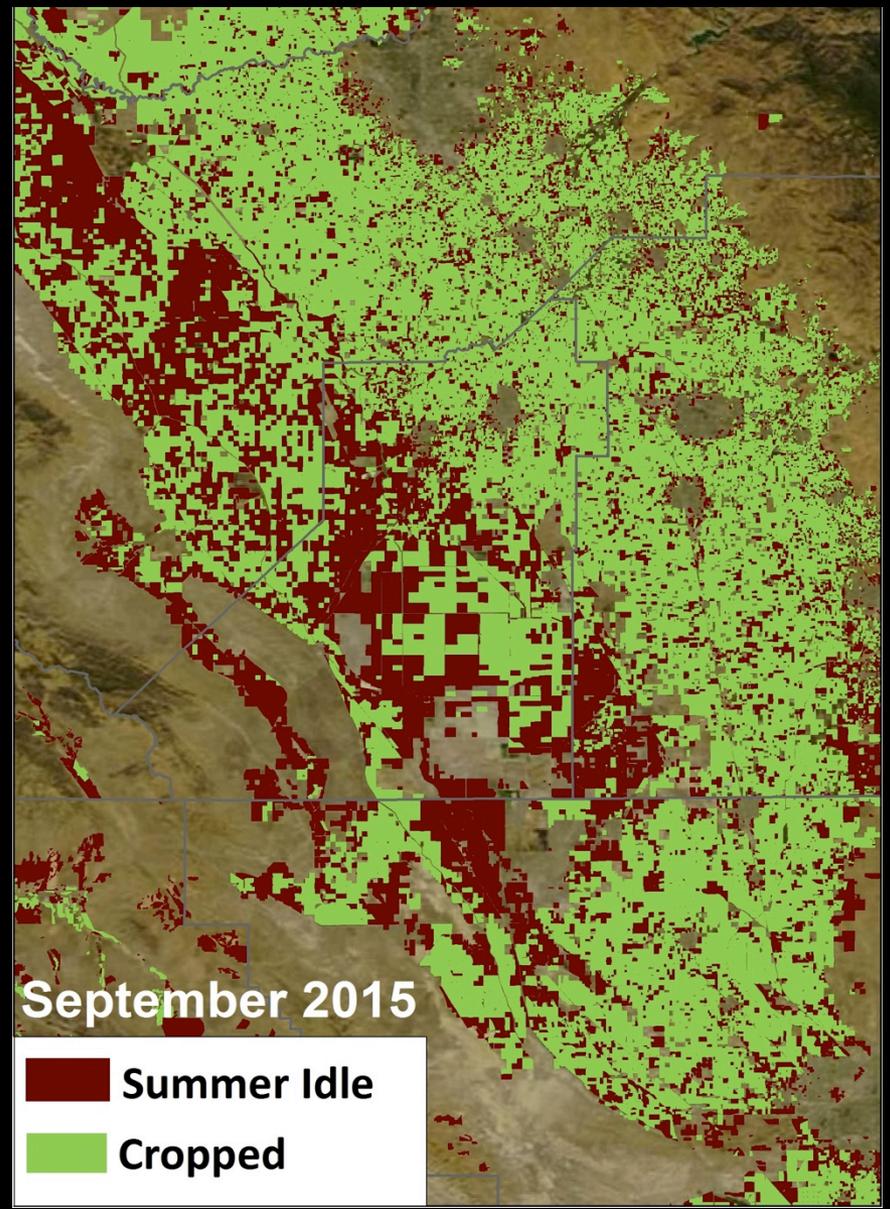
-  Annual Idle
-  Cropped



Sacramento Valley Summer Conditions



San Joaquin Valley Summer Conditions

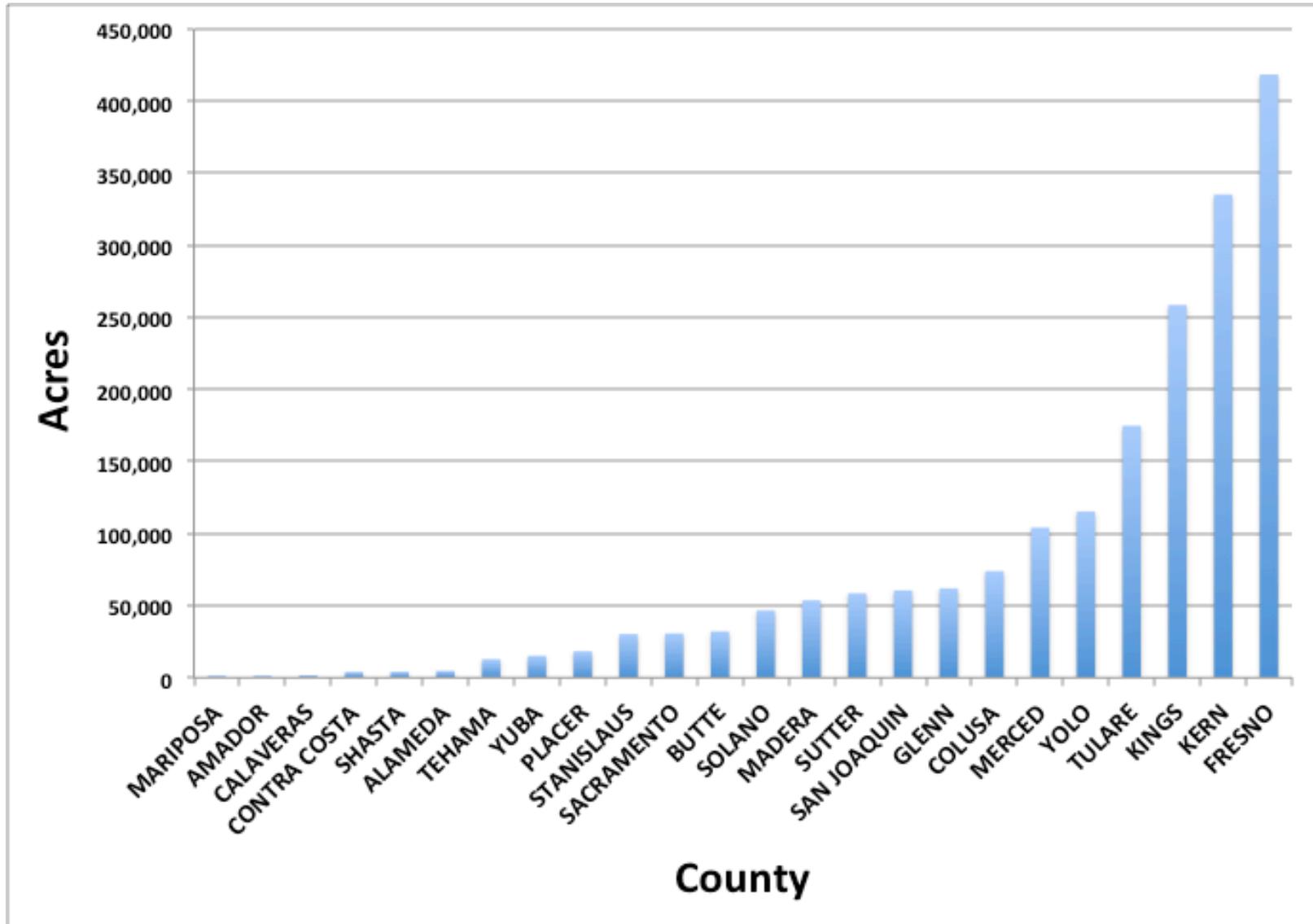


Fallowed Acreage Summary

Central Valley, Total Fallow Acreage During the Drought (Sept. 30, 2015)		
Year	Summer Fallow (idle since June 1)	Annual Fallow (idle since January 1)
2015	1,917,100	1,032,500
2014	1,893,700	1,310,100
2013	1,446,800	680,600
2011	1,394,900	406,000
2015 - 2011	522,200	626,500

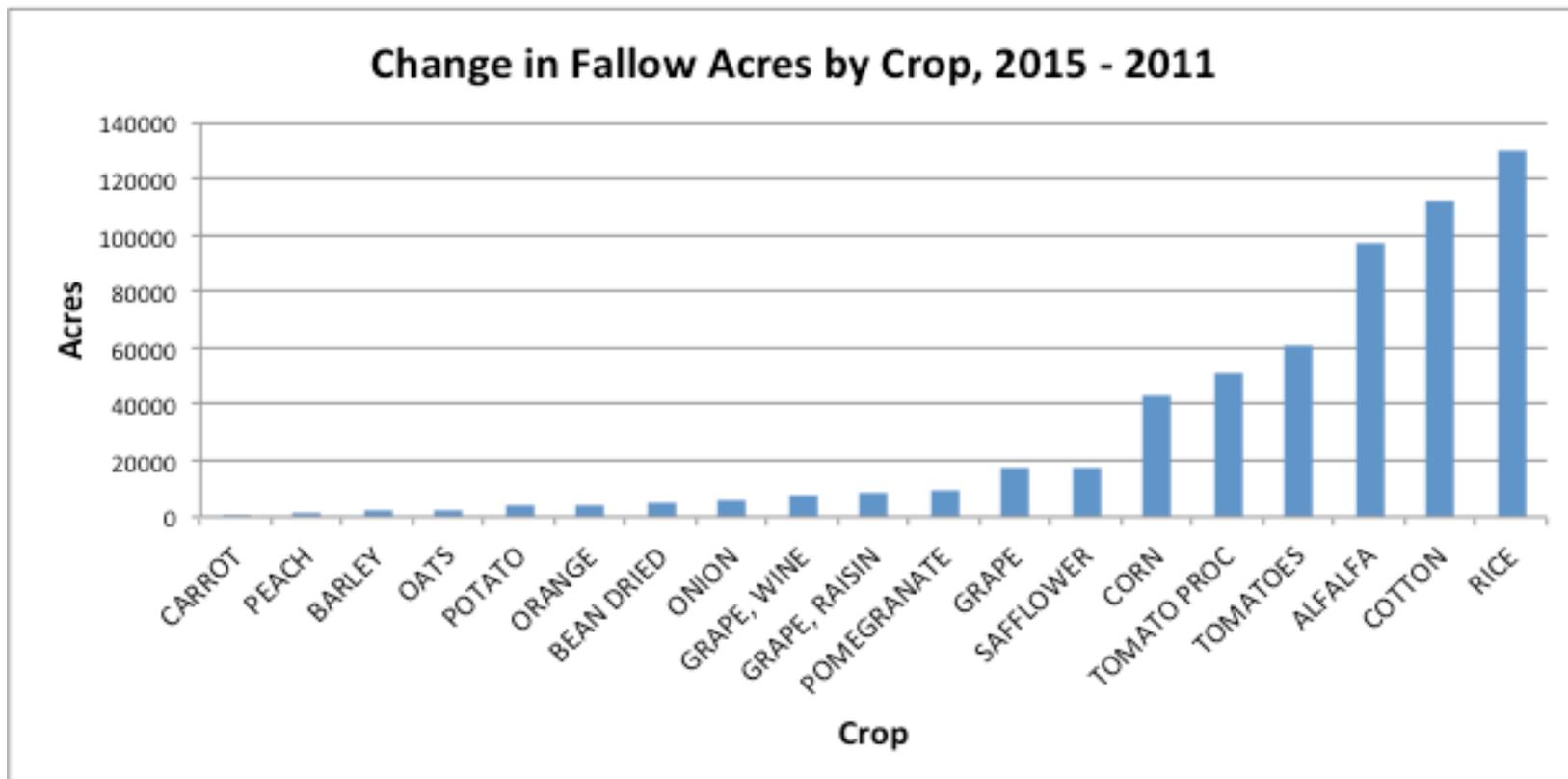
<https://nex.nasa.gov/nex/projects/1372/>

2015 Central Valley Summer Following by County



<https://nex.nasa.gov/nex/projects/1372/>

Change in Fallow Acreage by Crop Type Central Valley, CA



<https://nex.nasa.gov/nex/projects/1372/>

Accuracy Assessment

Field Survey Transects

California Central Valley



Survey transects, from April-May and
May-June 2012. ~1000 fields total.

March – Sept, 2014/2015, 670 fields surveyed monthly

2015 Accuracy Assessment

Season	Overall, % correct	Cropped, % correct	Fallow, % correct	Cropped, producer's accuracy	Cropped, user's accuracy	Fallow, producer's accuracy	Fallow, user's accuracy
Winter	95%	97%	88%	97%	97%	88%	88%
Summer	96%	96%	95%	99%	96%	95%	88%

- Accuracy statistics derived from comparisons against field survey data collected in 2014 and 2015 at ~670 field sites
- Statistics focus on crop/non-crop classification
- Majority of discrepancies explained by issues with young perennials (vineyards, orchards) and transitional fields

Next Steps

- Currently working to implement algorithms on cloud computing resource and transition capability to CA DWR for sustained operation
 - Earth Engine is most promising option but CA DWR approval pending
- Testing strategies in California to improve detection of young perennials and separation of marginal winter grains from weeds and volunteer wheat
- Developing plans to extend coverage to other regions → not possible without partnerships
- Beginning work on mapping of crop classes in California with CA DWR

Summary

- Remote sensing provides a low-cost, consistent approach for tracking crop development, and mapping drought impacts and land fallowing
- Collaborative, interagency effort between USGS, NASA, USDA, and CA DWR to develop an operational monitoring capability for land fallowing in the California Central Valley
- Successfully demonstrated capability for within season mapping of fallow acreage (advanced delivery of information >10 months).



Questions?



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<https://nex.nasa.gov/nex/projects/1372/>
<http://c3.nasa.gov/water>