Mary Lindsey
Graduate Research Assistant

University of Maryland
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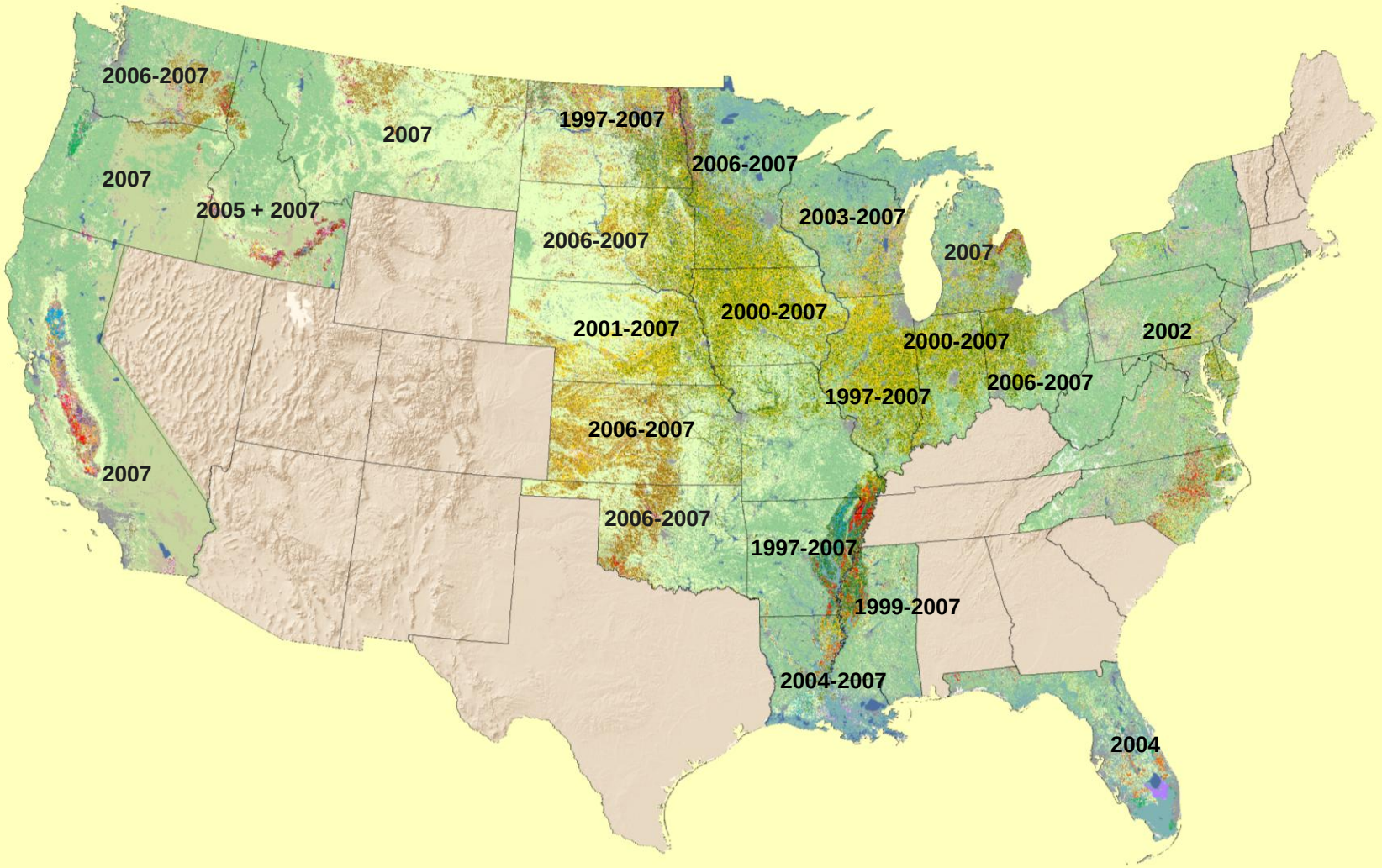
Rick M. Mueller
Section Head

United States Department of Agriculture (USDA)
National Agricultural Statistics Service (NASS)
Research and Development Division (RDD)
Spatial Analysis Research Section (SARS)

Agricultural Land-Use Classification for California Using AWiFS and MODIS Data

Cropland Data Layers
1997 - 2007



Cropland Data Layer and Acreage Estimation Processing Flow

Input Vector Data

NASS JAS segments

FSA CLU

USGS NLCD

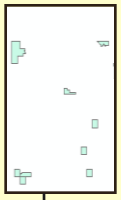
Input Raster Data

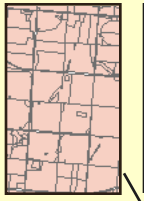
IRS Resourcesat-1 raw AWiFS summer time series

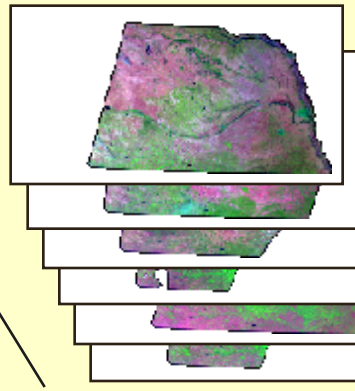
NASA Terra MODIS 16-day NDVI prior fall and summer time series

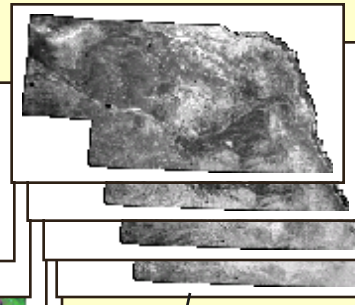
USGS NLCD 2001 Impervious & Canopy

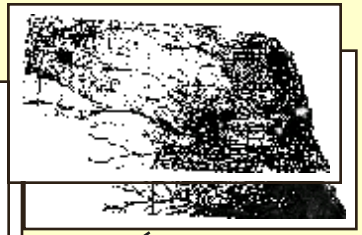
USGS NED Elevation







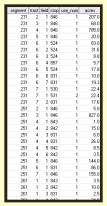


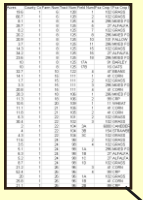


Tabular Data

JAS eData

FSA 578





Non-agricultural Ground truth

ESRI ArcGIS

Link and assess data sets

Agricultural Ground truth

ERDAS IMAGINE®

Rulequest See5.0

Derives decision tree-based classification rules

Generated rule set

Manages and visualizes datasets

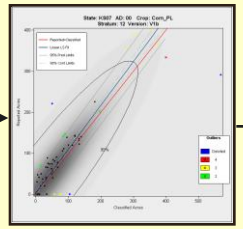
ESRI ArcGIS

Extract JAS intersecting pixels

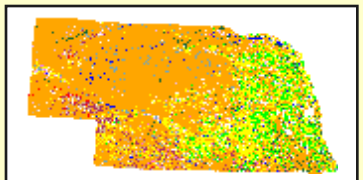
Estimation

sas

Customized for acreage estimation



Pixel count vs. reported acreage

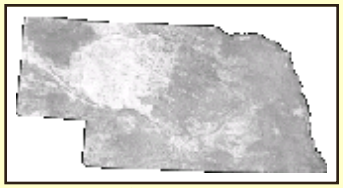


-- Cropland Data Layer --

State and county crop acreage statistics

NASS Internal Only

Output



Confidence Layer

Accuracy Assessment

Diagnostics

Cropland Data Layer and Acreage Estimation Processing Flow

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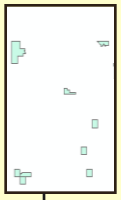

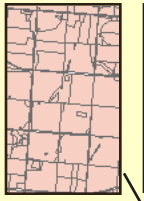

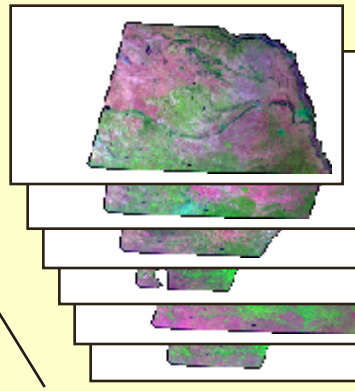

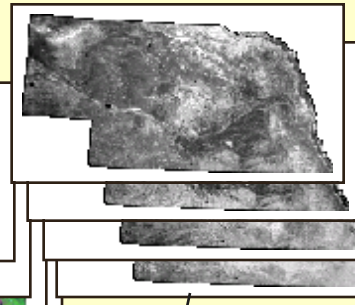

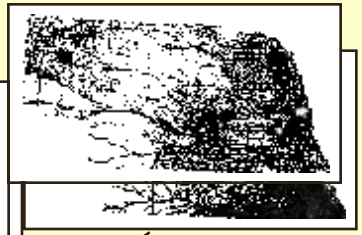

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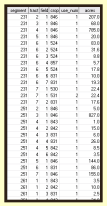

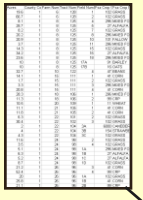

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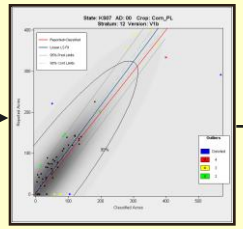

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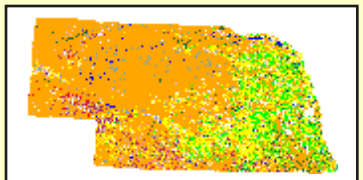

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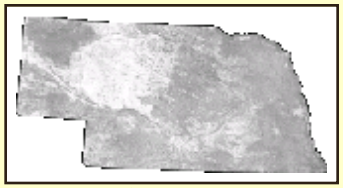

Confidence Layer

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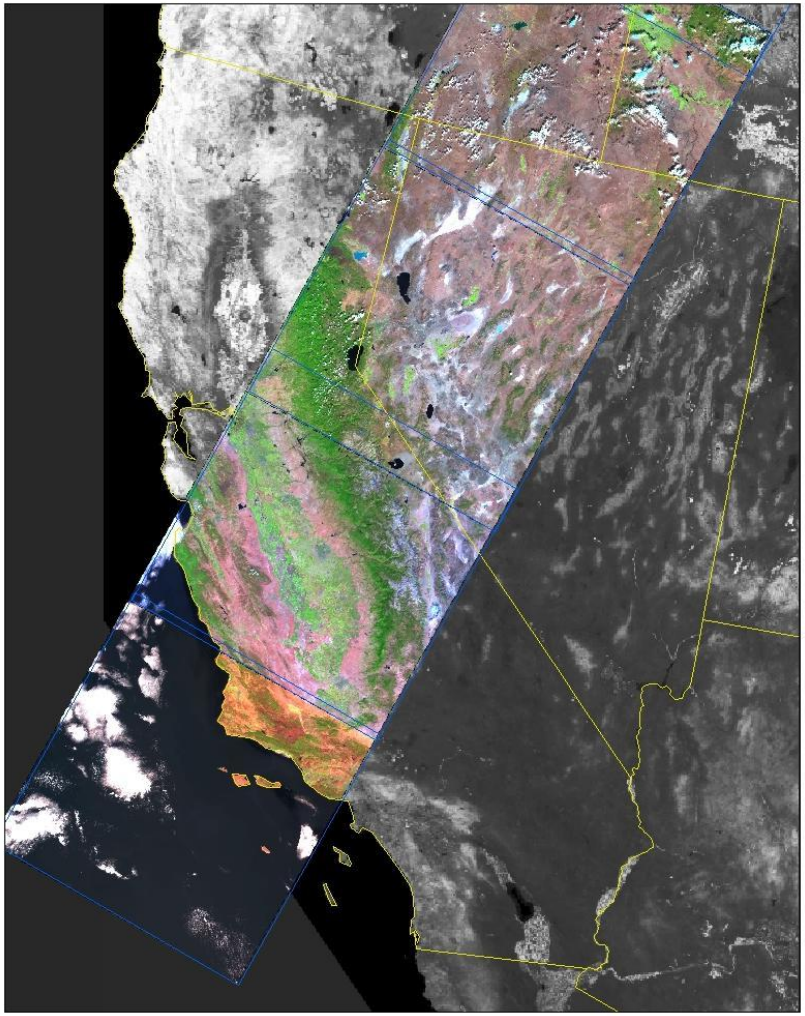
Diagnostics

Imagery - AWiFS Specifications

Key Characteristics	
Swath width	737 km
Spectral bands	Green: 0.52 – 0.59 Red: 0.62 – 0.68 Near IR: 0.77 – 0.86 Mid IR: 1.55 – 1.70
Repeat Time	Every 5 days
Pixel size	56 x 56 m
Scene size	370 x 370 km
Radiometric Resolution	8 or 10 bits



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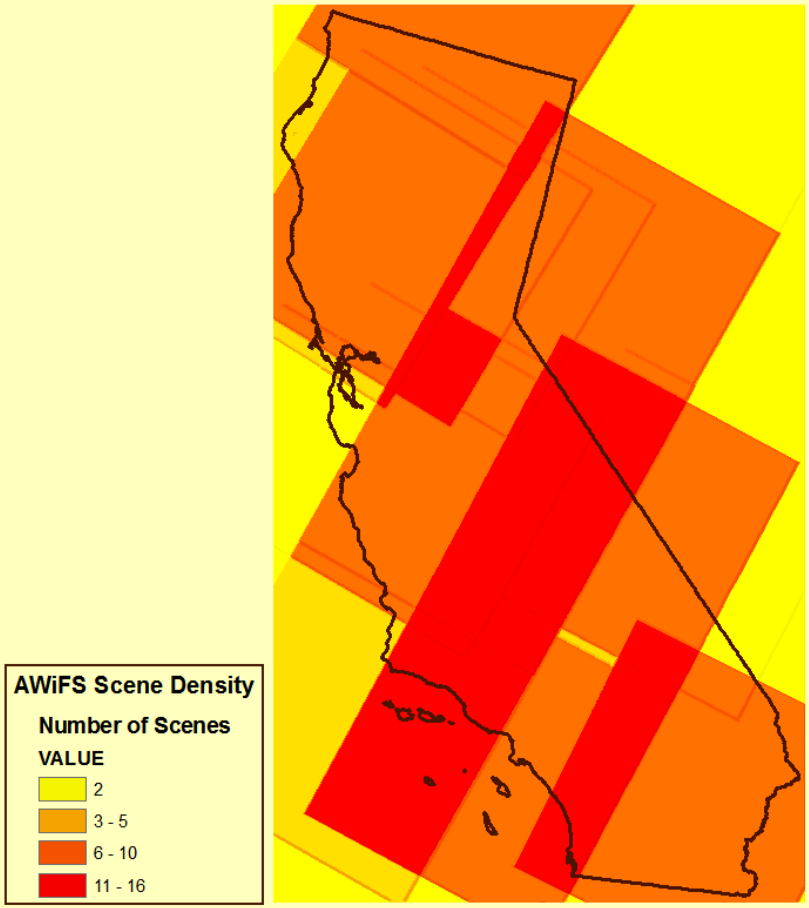
Imagery - AWiFS Scene Selection



- Chosen to meet minimum scene depth
- Goal of one scene per month per “analysis district”
- Scenes span from April 1 to September 26
- Mosaics created of scenes from same date and path
- Final result: 33 out of 49 scenes selected

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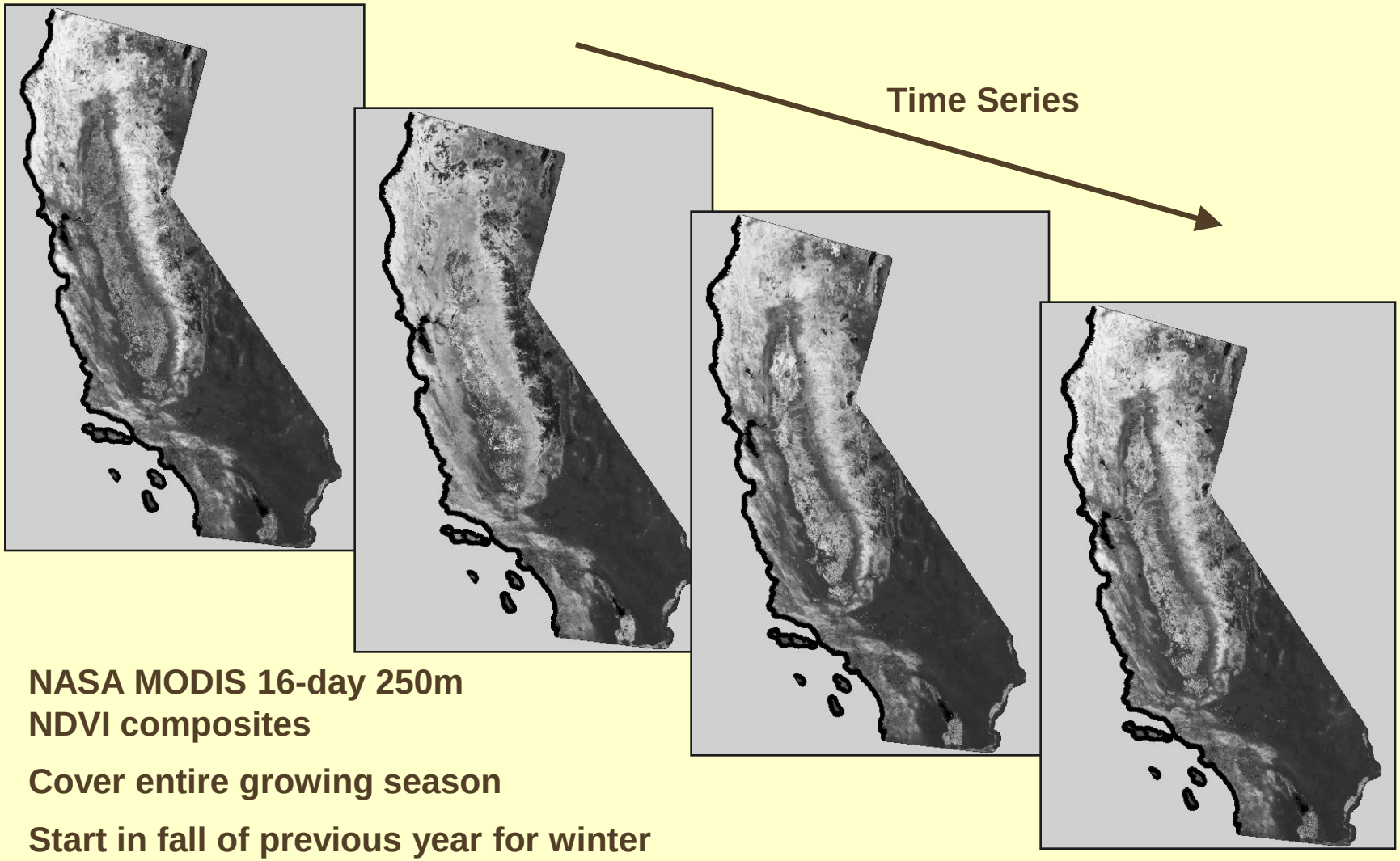
Ancillary - MODIS



- NASA MODIS 16-day 250m NDVI composites
- Cover entire growing season
- Start in fall of previous year for winter wheat

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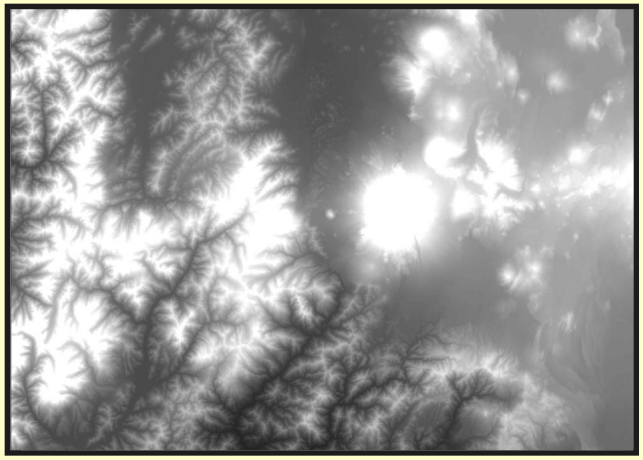
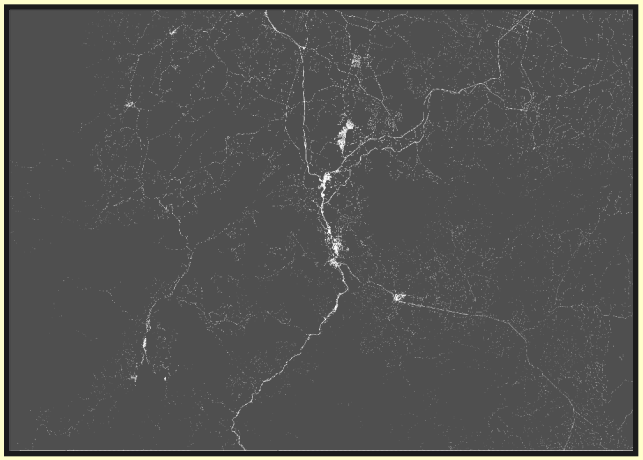
Ancillary – USGS Products



Elevation

Canopy



Impervious

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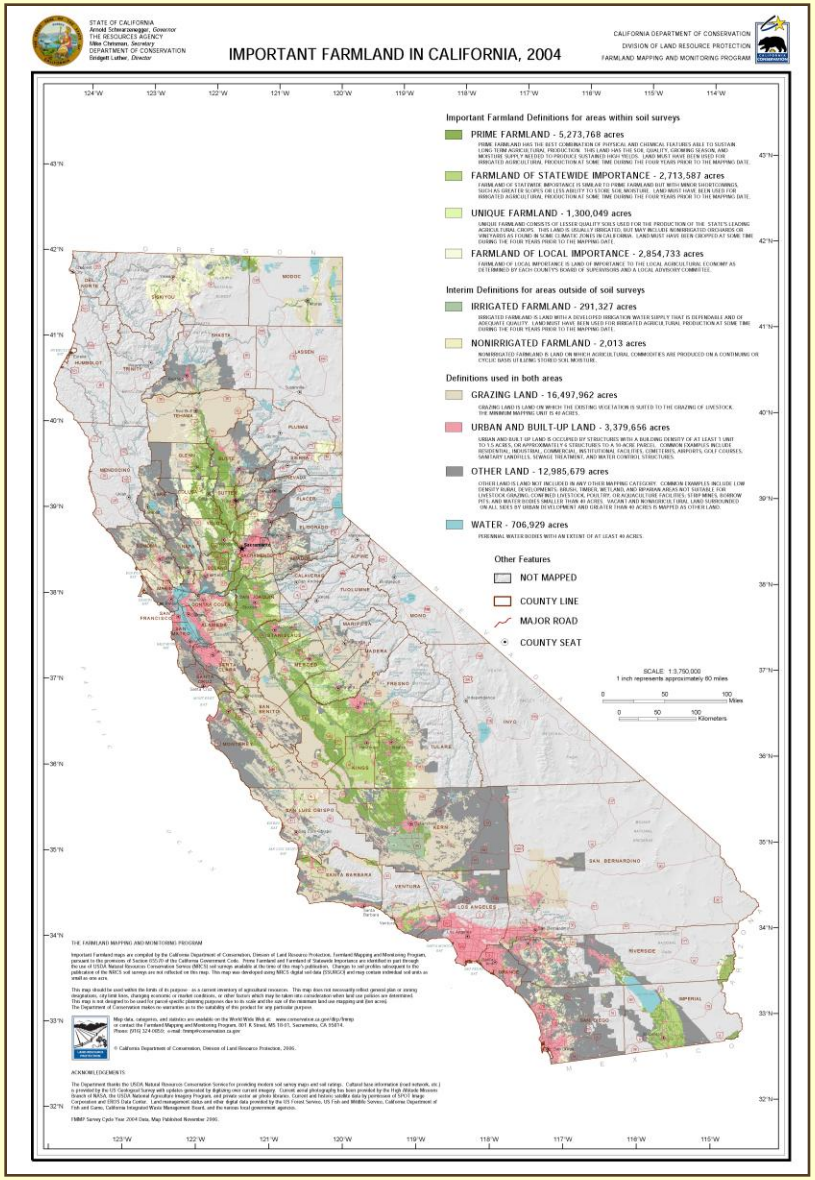
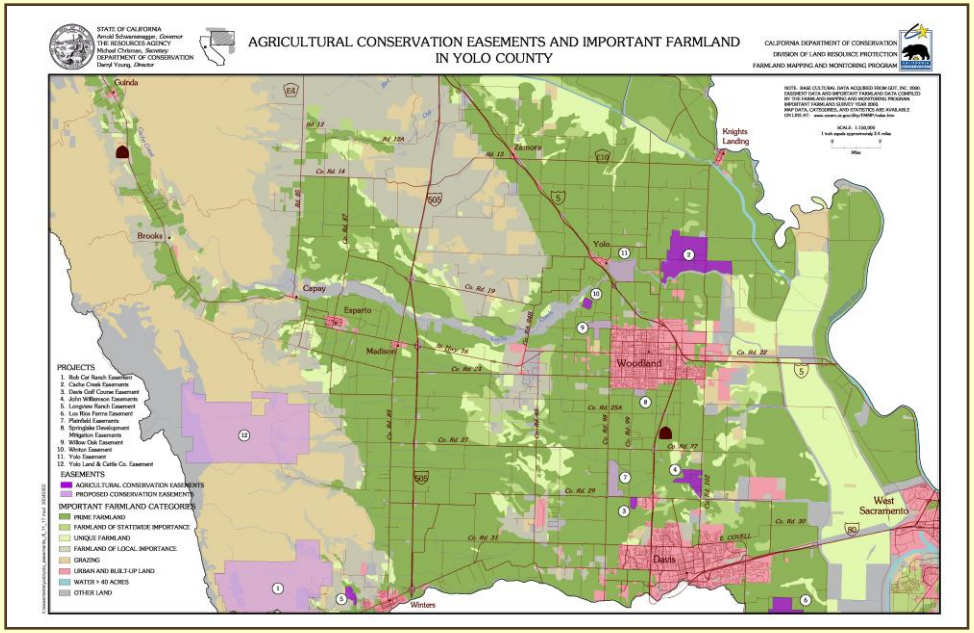
California Farmland Mapping and Monitoring Program





- Produces maps and statistical data used for analyzing impacts on California's agricultural resources
- Land is rated according to soil quality and irrigation status
- Maps are updated every two years with the use of aerial photographs, computer mapping, public review, and field work

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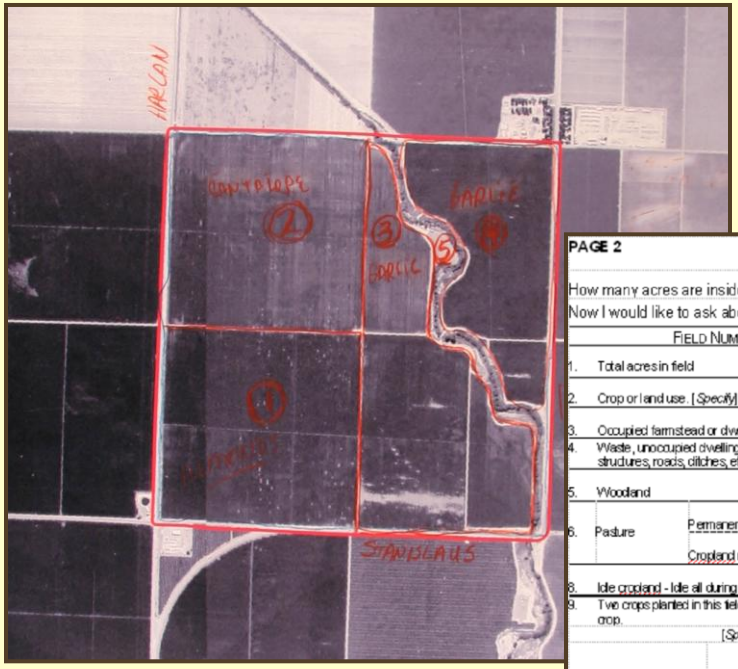
Ground Truth - June Area Survey (JAS) Data

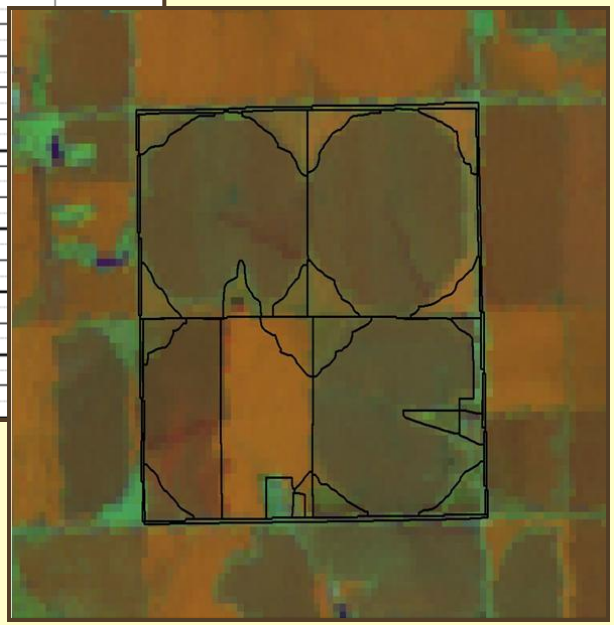


PAGE 2 **SECTION D - CROPS AND LAND USE ON TRACT** 17

How many acres are inside this blue tract boundary drawn on the photo (map)? .

Now I would like to ask about each field inside this blue tract boundary and its use during 2000.

	Field Number	01	02	03	04	05
1.	Total acres in field	828	828	828	828	828
2.	Crop or land use. [Specify]					
3.	Occupied farmstead or dwelling	843				
4.	Waste, unoccupied dwellings, buildings and structures, roads, ditches, etc.					
5.	Woodland	831	831	831	831	
6.	Pasture — Permanent (not in crop rotation)	842	842	842	842	
	Pasture — Cropland (used only for pasture)	856	856	856	856	
8.	Idle cropland - Idle all during 2000	857	857	857	857	
9.	Two crops planted in this field or two uses of the same crop.	☐Yes ☐No	☐Yes ☐No	☐Yes ☐No	☐Yes	
	[Specify second crop or use]					
	Acres	844	844	844	844	
10.	Acres left to be planted	610	610	610	610	
11.	Acres irrigated and to be irrigated [If double cropped, include acreage of each crop irrigated]	620	620	620	620	
16.	**Winter Wheat** (Include cover crop) — Planted	540	540	540	540	
17.	**Winter Wheat** (Include cover crop) — For grain or seed	541	541	541	541	
18.	**Rye** (Include cover crop) [Exclude ryegrass] — Planted	547	547	547	547	
19.	**Rye** (Include cover crop) [Exclude ryegrass] — For grain or seed	548	548	548	548	



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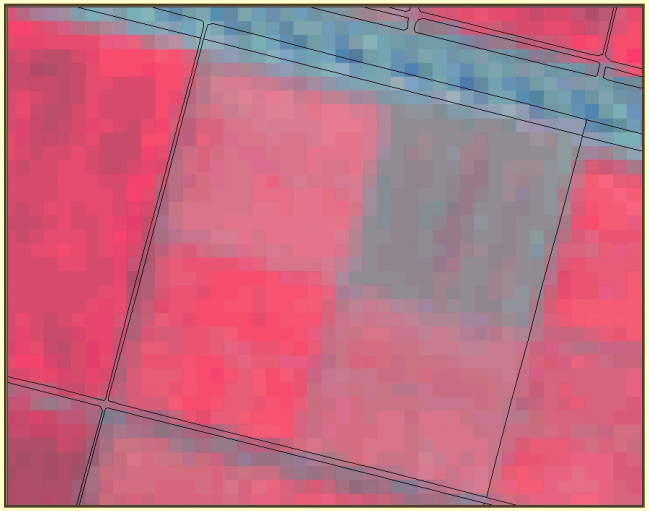
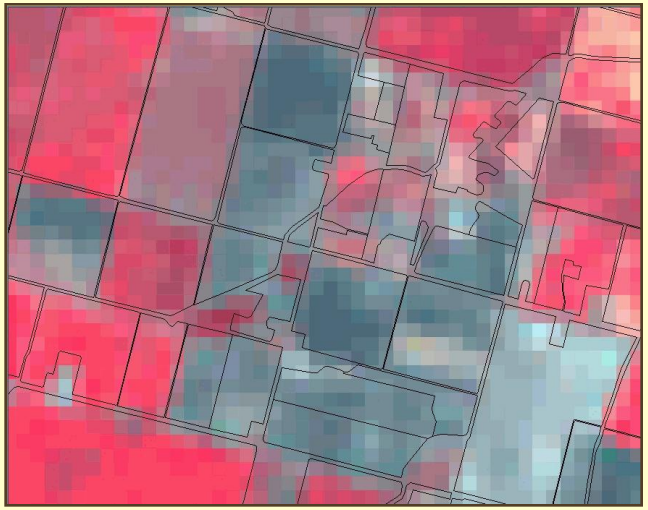
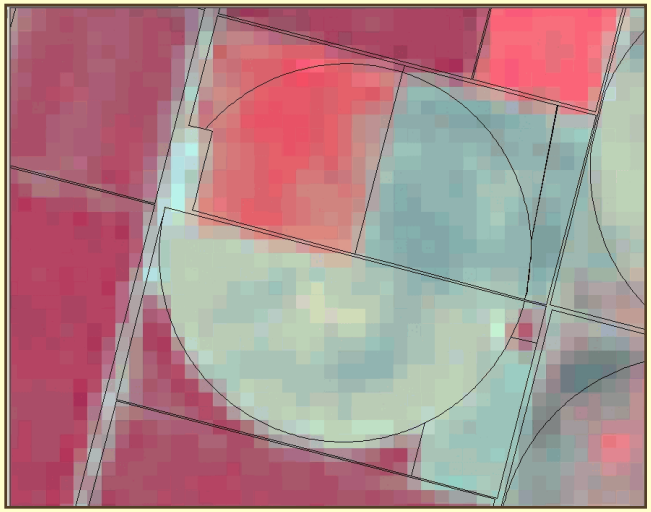
Ground Truth - FSA CLU/578 Data





- Covers more area
- Less labor intensive
- ½ used for training
- ½ used for validation



- Fewer crop types
- Multiple crop types (in the same field)
- Not a proportional sample

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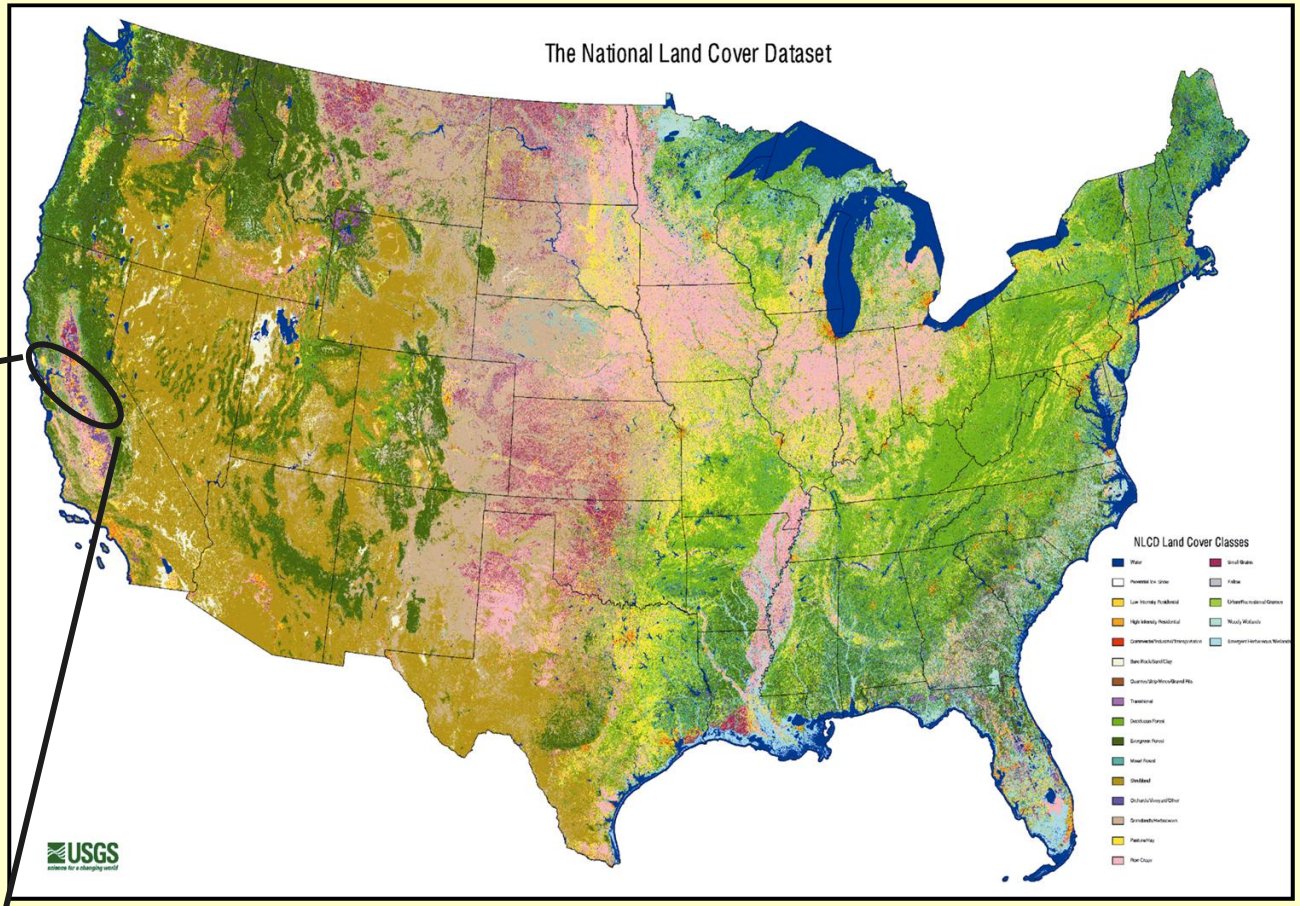
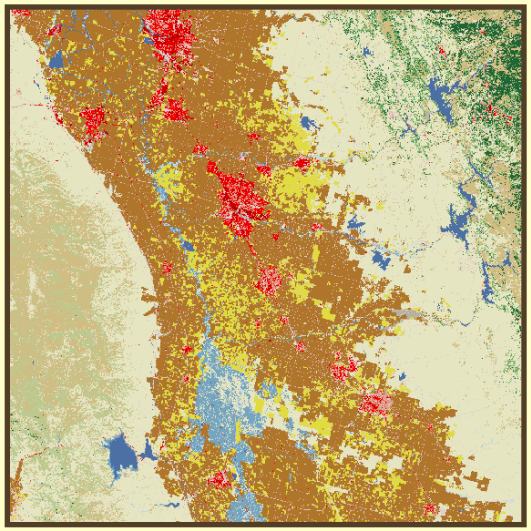
Ground Truth – National Land Cover Dataset





- Proportional sampling approach
- Pasture/hay and cultivated categories ignored

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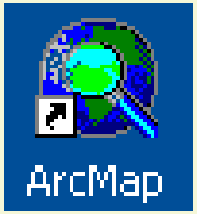
Classification – Software

Commercial Software Suite

- Imagery Preparation:
  - Leica Geosystems ERDAS Imagine 9.1
- Ground Truth Preparation:
  - ESRI ArcGIS
- Image Classification:
  - Decision-tree software
    - Rulequest See 5.0
- Acreage Estimation:
  - SAS



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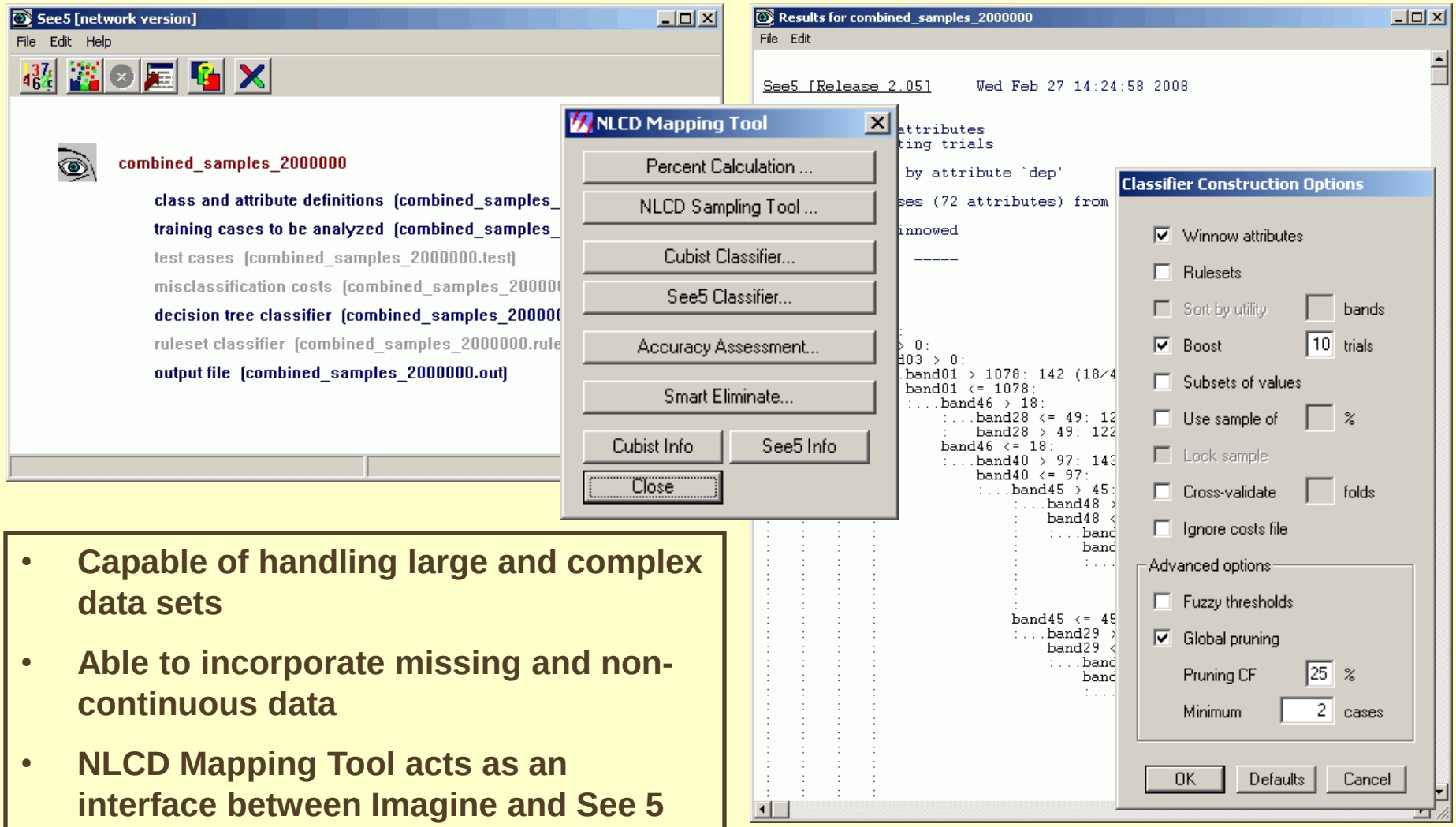
Classification – See 5 Decision Tree



- Capable of handling large and complex data sets
- Able to incorporate missing and non-continuous data
- NLCD Mapping Tool acts as an interface between Imagine and See 5

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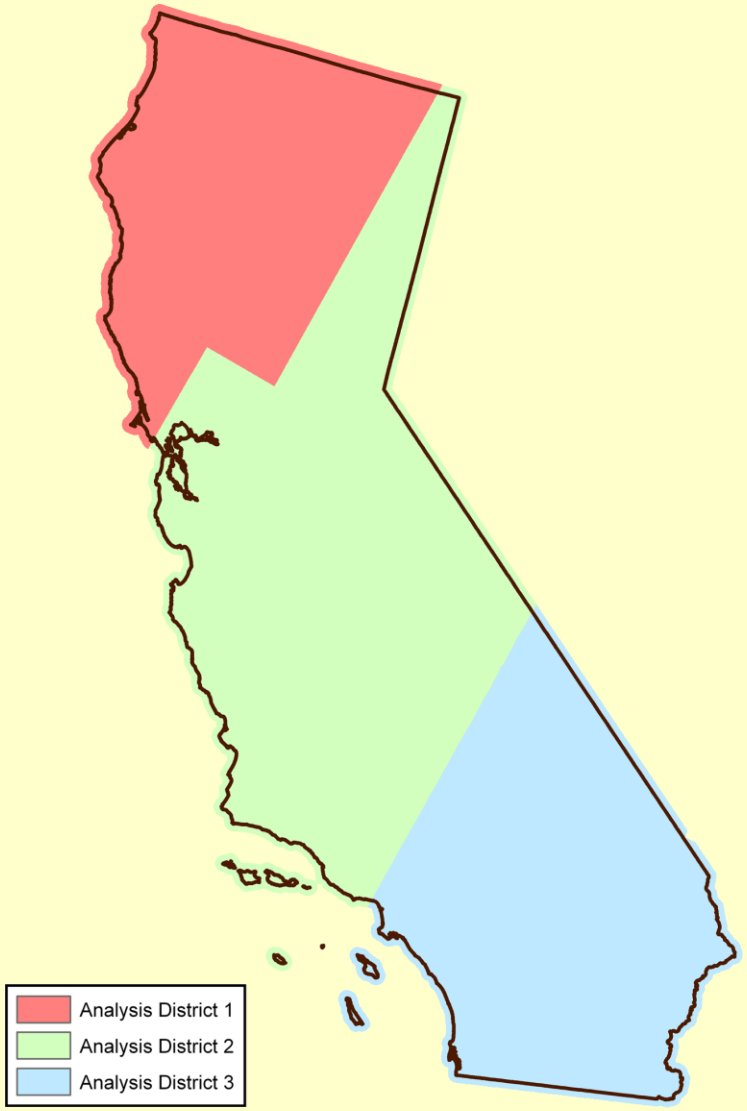
Classification – Three Approaches

- **Analysis District 1:**
  - 11 AWiFS scenes
  - 2 million sample points
  - Smart Eliminate MMU = 5
- **Analysis District 2:**
  - 9 AWiFS scenes
  - 2 million sample points
  - Smart Eliminate MMU = 5
- **Analysis District 3:**
  - 14 AWiFS scenes
  - 924,872 sample points
  - Smart Eliminate MMU = 5



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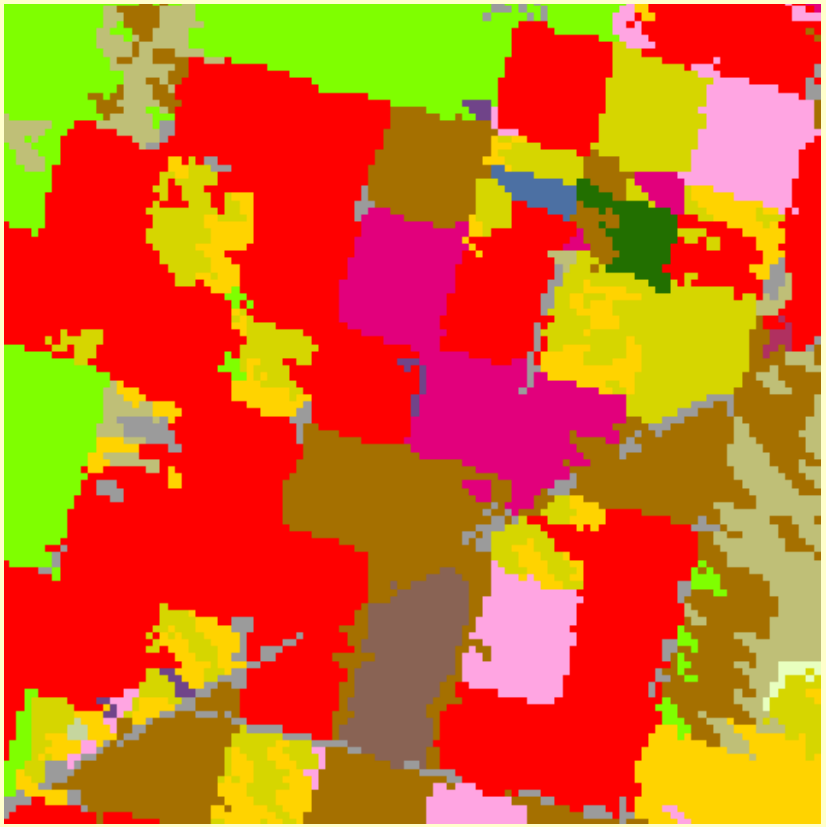
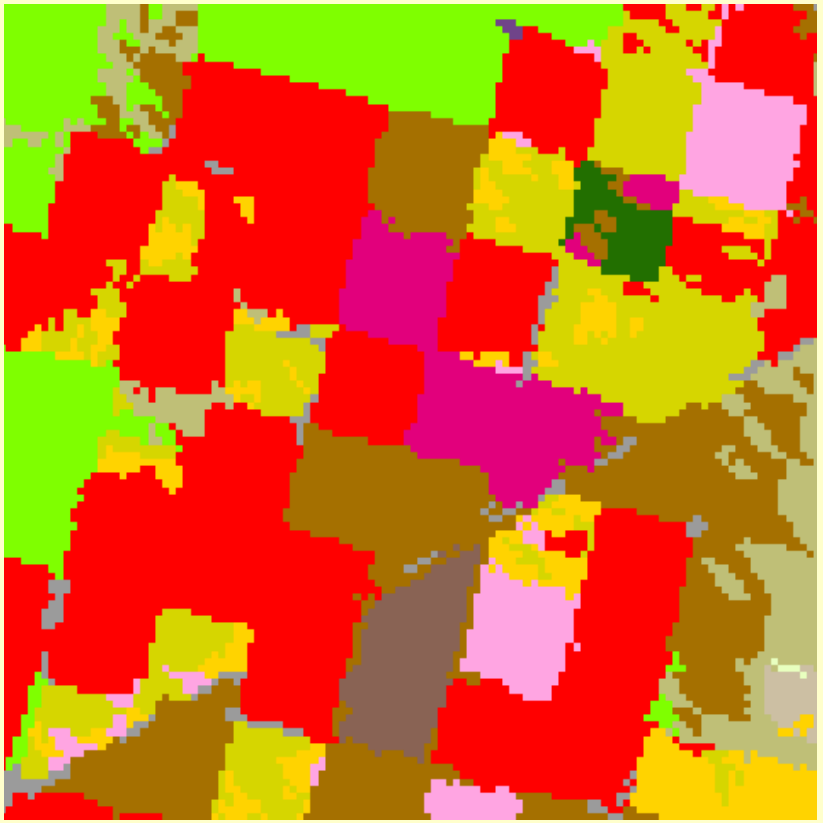
Classification – Visual Assessment

Hybrid Approach – Smart Eliminate 5 MMU



Standard Approach – Smart Eliminate 5 MMU



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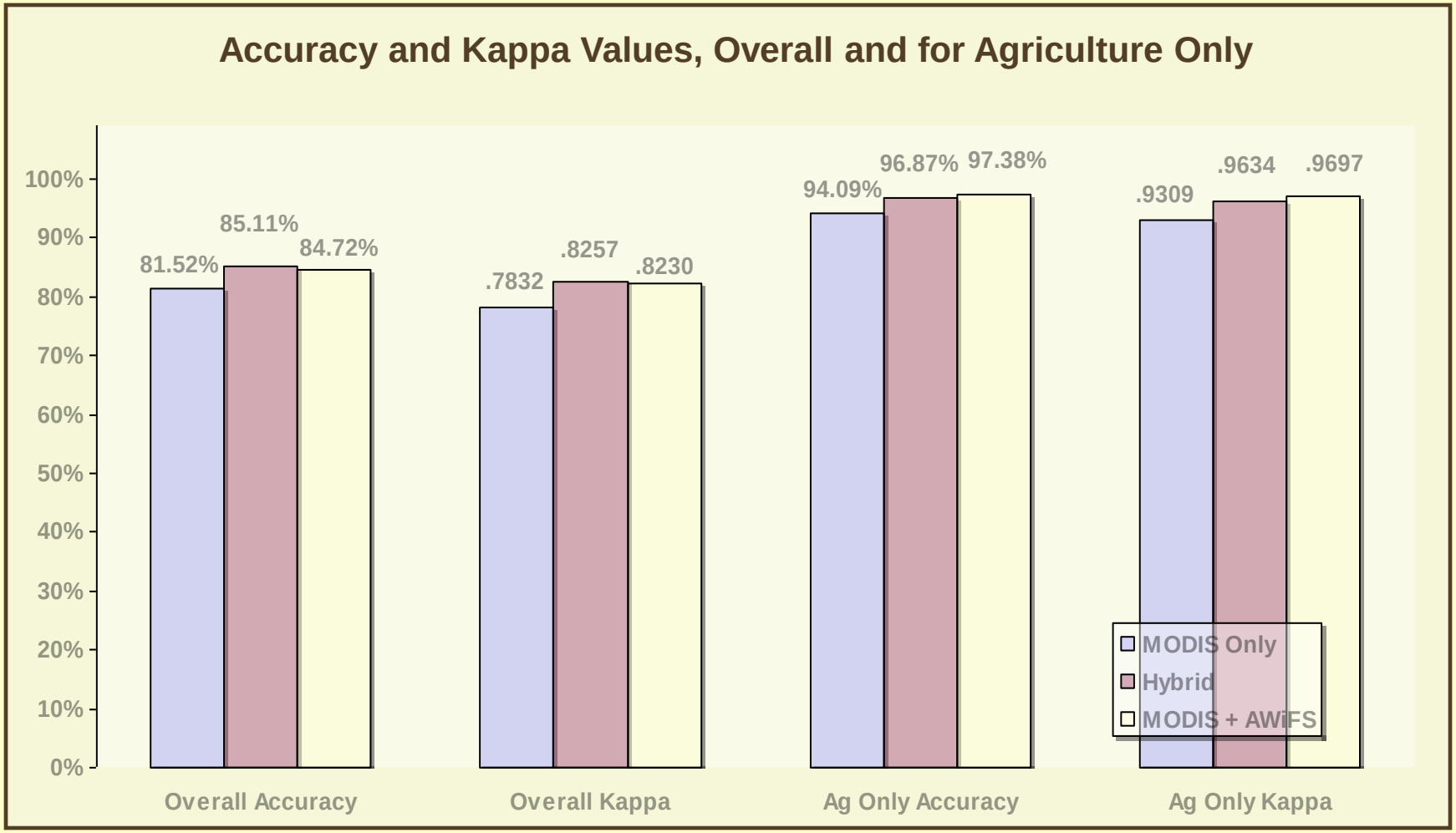
Classification – Quantitative Assessment



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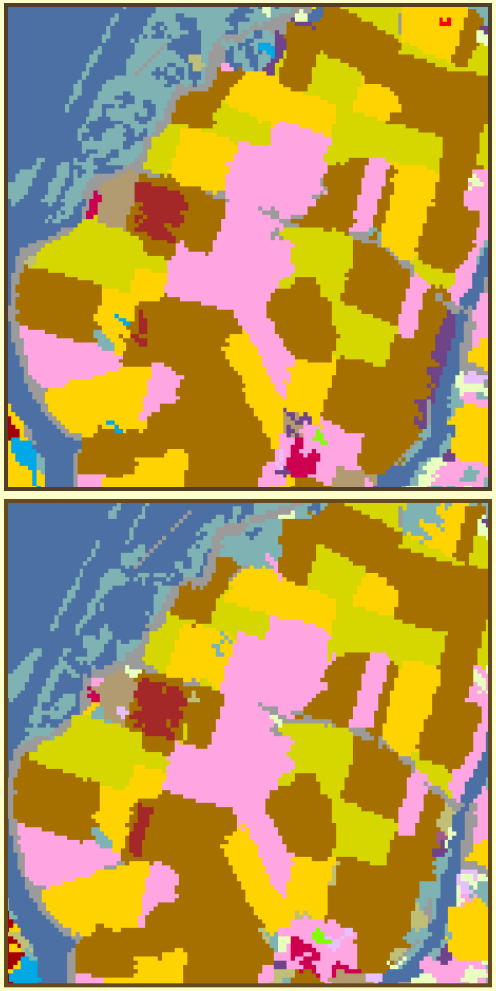
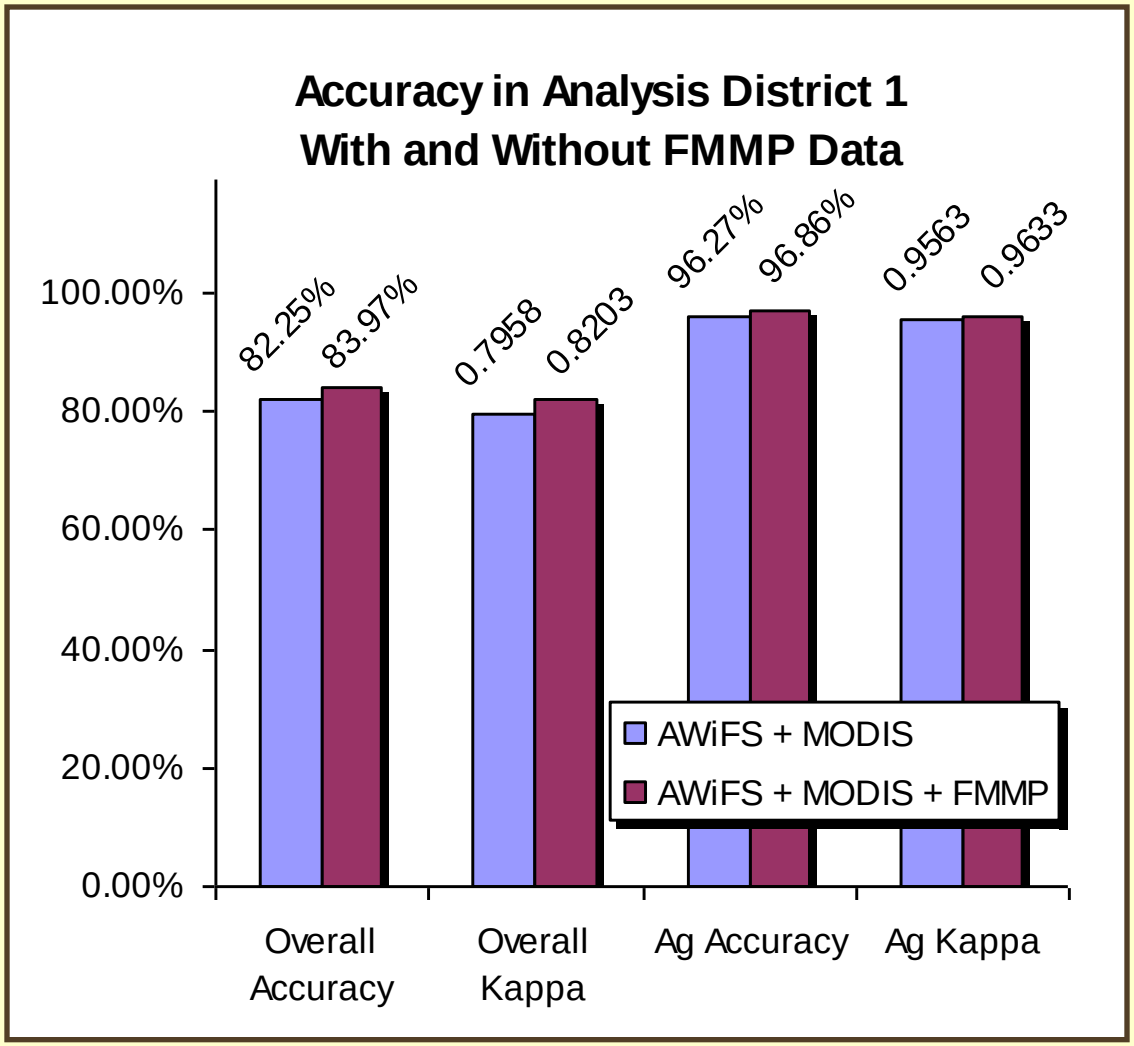
Classification – FMMP Assessment

With FMMP Data



Without FMMP Data



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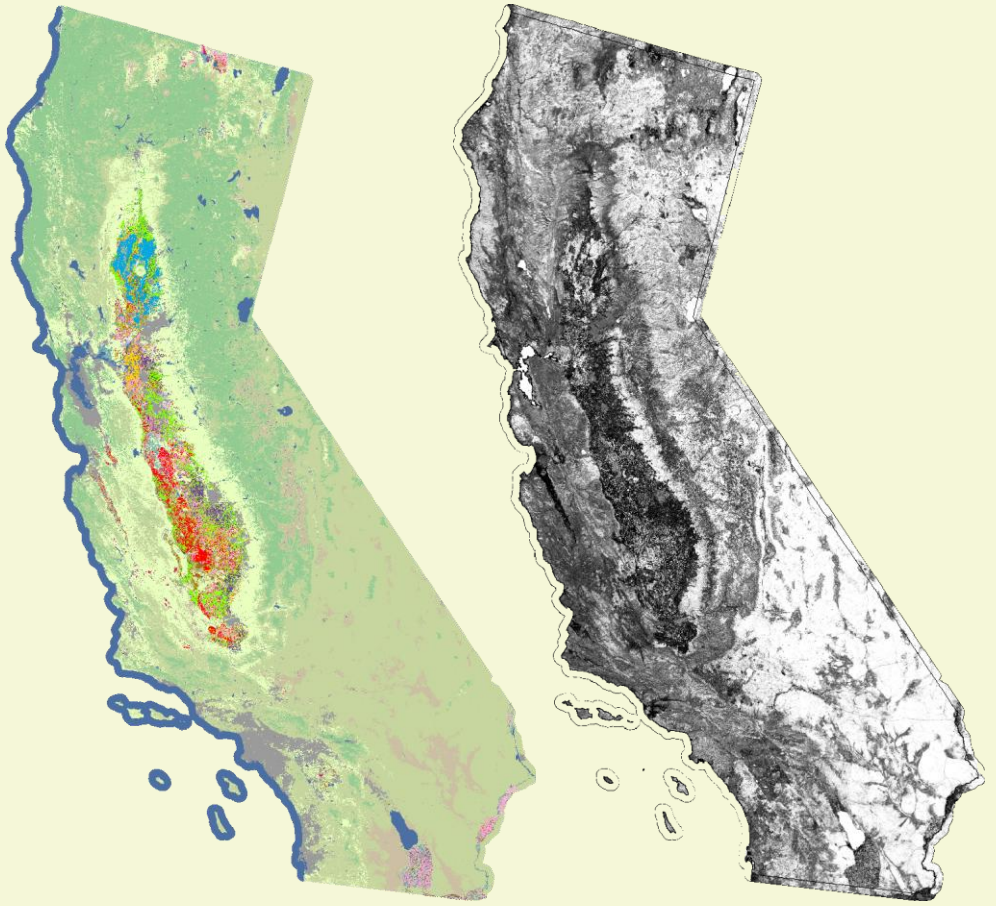
California Cropland Data Layer

- Available July 2008
- Downloadable at USDA Geospatial Data Gateway
- Includes:
  - Cropland data layer
  - Confidence image
  - 30m resolution version



United States Department of Agriculture
National Agricultural Statistics Service
Research and Development Division
Spatial Analysis Research Section

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Conclusions

- Abundance of ground truth probably largest contributor to accuracy
- Improving overall accuracy should address improving the accuracy of non-ag classes
- Accuracy boost using FMMP data indicates soil data should be considered as an input layer in other classifications

Future Research

- Investigate other MMU combinations for crops and non-crops
- Use of minimum sample size in the stratified sampling approach for smaller acreage crops
- Identify areas of change in the NLCD to exclude from sampling

Acknowledgments

- Thanks to Rick Mueller, Claire Boryan, Patrick Willis, Dave Johnson, and Lee Ebinger at USDA for their invaluable help and advice!
- Thanks also to Chris Justice, Jessica McCarty, and Katie Martini at the University of Maryland
- Closing photo by Josh Jackson, used under the Creative Commons license.
- And thanks to you!

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