

# Acreage Estimate Production Throughout the Growing Season: An Update on the Cropland Data Layer

Rick Mueller

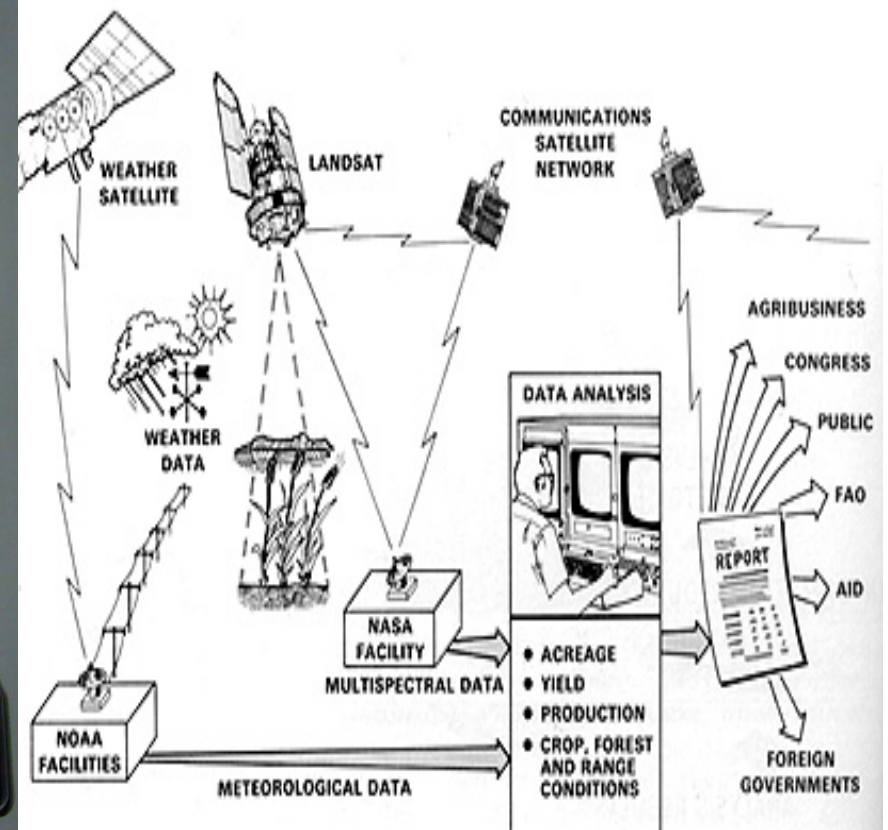
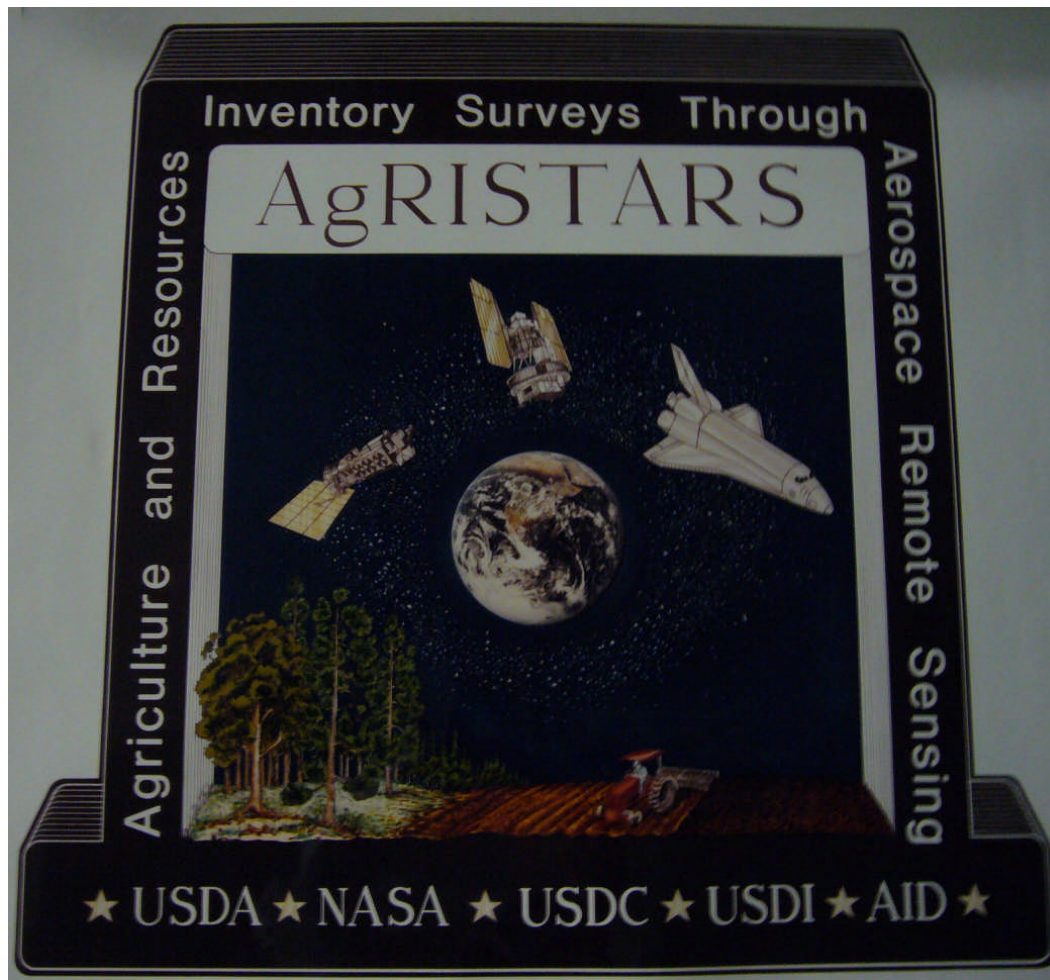
Head, Spatial Analysis Research

October 20, 2008



# Cropland Data Layer (CDL) Discussion

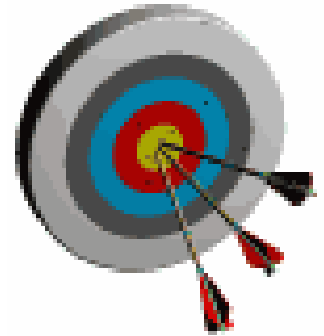
- Legacy program
  - Issues: Budget/Satellites/Agency Support/Technology





# CDL Program Objectives

- **“Census by Satellite”**
  - Annually cover major producing corn and soybean regions
  - Indications reflect actual location of the crops
    - Not address on record via survey
- **Provide timely, accurate, useful indications**
  - Measurable error
  - Unbiased/independent estimator
  - State, county, district (ASD)
- **Operationalize indications delivery**
  - For June, August, and October
    - Ag Statistics Board
  - Update planted area
- **Output crop specific CDL**
  - Distribute to public at the cost of reproduction
    - [NRCS Geospatial Data Gateway](#)



**January**

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

8:● 15:○ 22:○ 30:○

**February**

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	

6:● 13:○ 20:○ 28:○

**March**

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

7:● 14:○ 21:○ 29:○

**April**

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

5:● 12:○ 20:○ 28:○

**May**

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

5:● 11:○ 19:○ 27:○

**June**

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24				
29	30					
3	10	18	26			

3:● 10:○ 18:○ 26:○

Crop Acreage Report

**July**

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
27	28	29	30	31		

2:● 10:○ 18:○ 25:○

Crop Production Report

**August**

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
		4	5	6	7	8
11	12	13	14	15	16	17
18	19	20	21	22	23	24
24	25	26	27	28	29	30
31						

1:● 8:○ 16:○ 23:○ 30:○

**September**

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				
7						

7:○

Small Grains Annual Summary

**October**

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	
		8	9	10	11	
		15	16	17	18	
19	20	21	22	23	24	25
26	27	28	29	30	31	

7:○ 14:○ 21:○ 28:○

Crop Production Report

**November**

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

5:○ 13:○ 19:○ 27:○

**December**

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
		8	9	10	11	12
		15	16	17	18	19
		21	22	23	24	25
		28	29	30	31	
5	12	19	27			

# CDL States and Commodities

State	Corn	Soybeans	Winter Wheat	Cotton	Spring Wheat	Rice	Sorghum	Sugar-beets	Sugar-cane	Durum Wheat	Dry Beans	Sunflower	Canola
Arkansas	F, RS	F,O, RS	F, RS	S,O, RS		F, RS	F						
Colorado	F, RS		S,O, RS		A		F				F	F, P	
Illinois	S,O, RS	S,O, RS	S,O, RS				F					U	
Indiana	S,O, RS	S,O, RS	F, RS										
Iowa	S,O, RS	S,O, RS	A										
Kansas	F, RS	S,O, RS	S,O, RS	A			F, RS				F	F, P	
Louisiana	F, RS	F, RS	A, RS	S,O, RS		F, RS	F		F, RS				
Michigan	F, RS	F, RS	F, RS								F	U	U
Minnesota	S,O, RS	S,O, RS	A		S,O, RS			F, RS			F	F, P	F, P
Mississippi <sup>1</sup>	F, RS	F, RS	F, RS	S,O, RS		F, RS	A, RS						
Missouri	F, RS	S,O, RS	S,O, RS	F, RS		F, RS	F					U	
Nebraska	S,O, RS	S,O, RS	S,O, RS				F				F	F, P	
North Dakota	F, RS	F,O, RS	A		S,O, RS			F, RS		F, O, RS	F, RS	F, P, RS	F, P, RS
Ohio	S,O, RS	S,O, RS	S,O, RS										
Oklahoma	F	F	S,O, RS	F			F					U	U
South Dakota	F, RS	F,O, RS	F, RS		F, RS					A	F	F, P	
Texas	F, RS	F, RS	S,O, RS	S,O, RS		F	F				F	F, P	
Wisconsin	S, O, RS	F, RS	F		A						L	U	

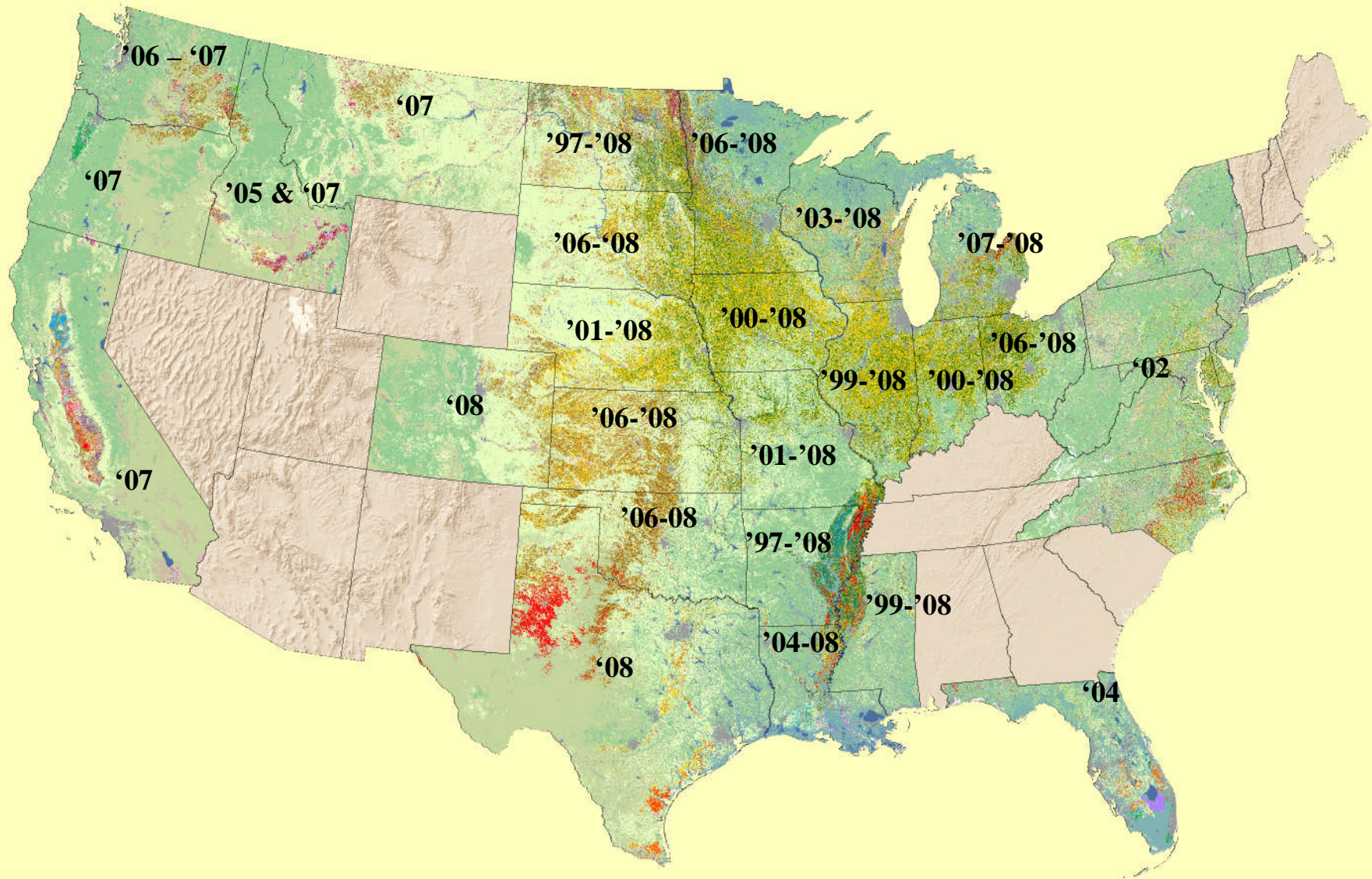


	Green shading indicates states new to program in 2008.
<sup>1</sup>	Unable to complete the MS 2008 Aug. RS estimation due to flooding & unusually late FSA signup
<b>Program Definitions:</b>	
S	Speculative State
F	Full Program State
A	Annual State
P	Estimates published
U	Estimates submitted, published in other states
L	Limited forecast state (none in Oct.)
RS	Remote Sensing
O	Objective Yield State

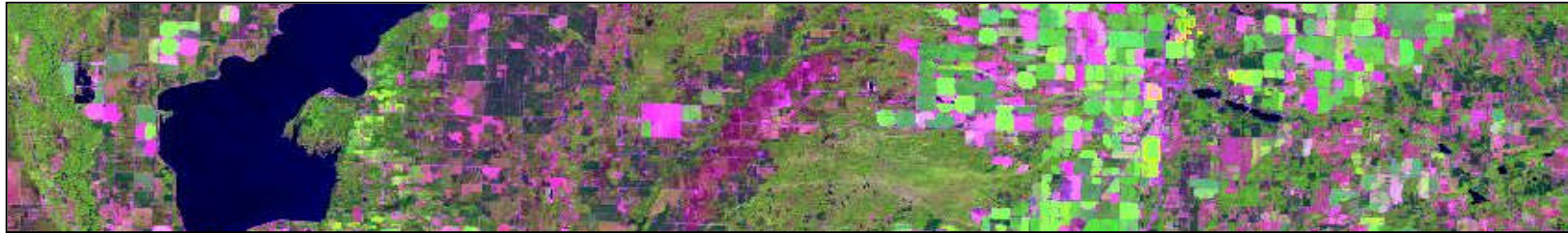




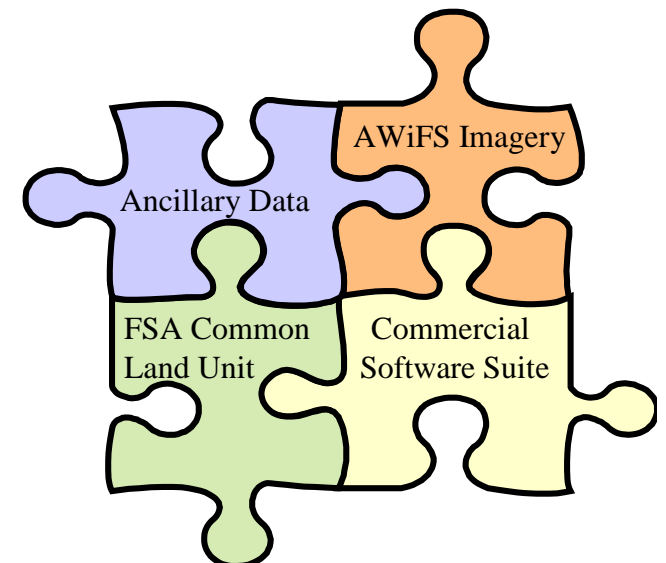
# Cropland Data Layers 1997 - 2008



# CDL Program



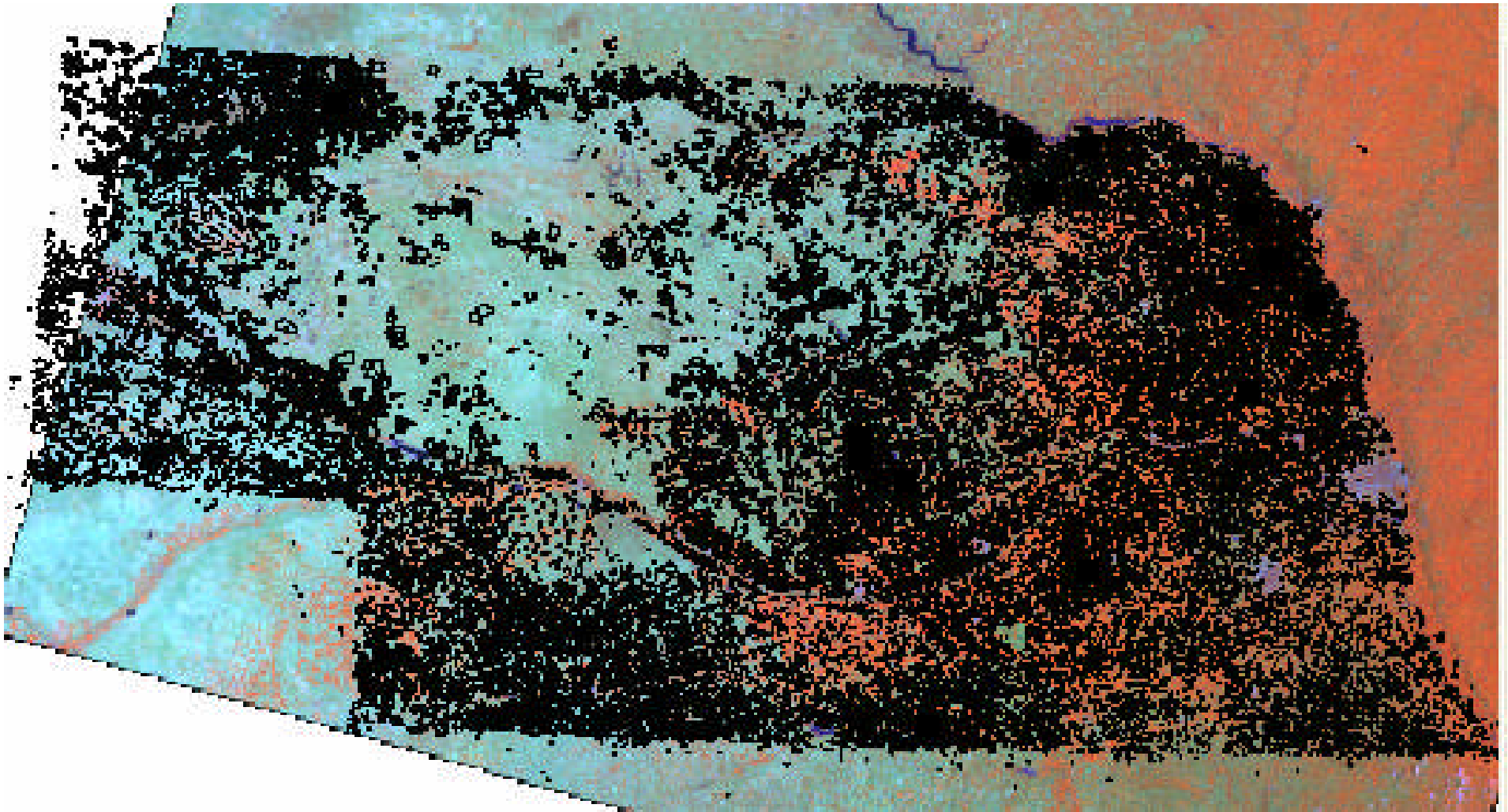
- Inputs
  - Resourcesat-1 AWiFS imagery
  - Farm Service Agency – Common Land Unit
  - Ancillary data
  - Commercial software suite
- Outputs
  - Acreage Estimates
  - Cropland Data Layer



# Agricultural Ground Truth



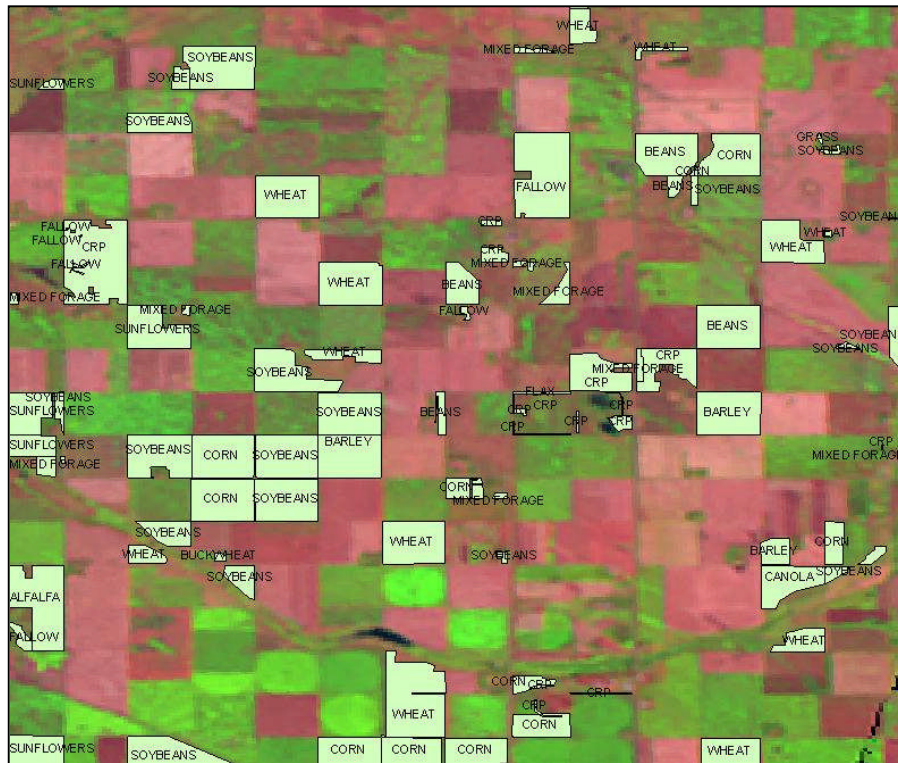
- Farm Service Agency (FSA)
  - Common Land Unit (CLU)
  - 578 attributed reporting data



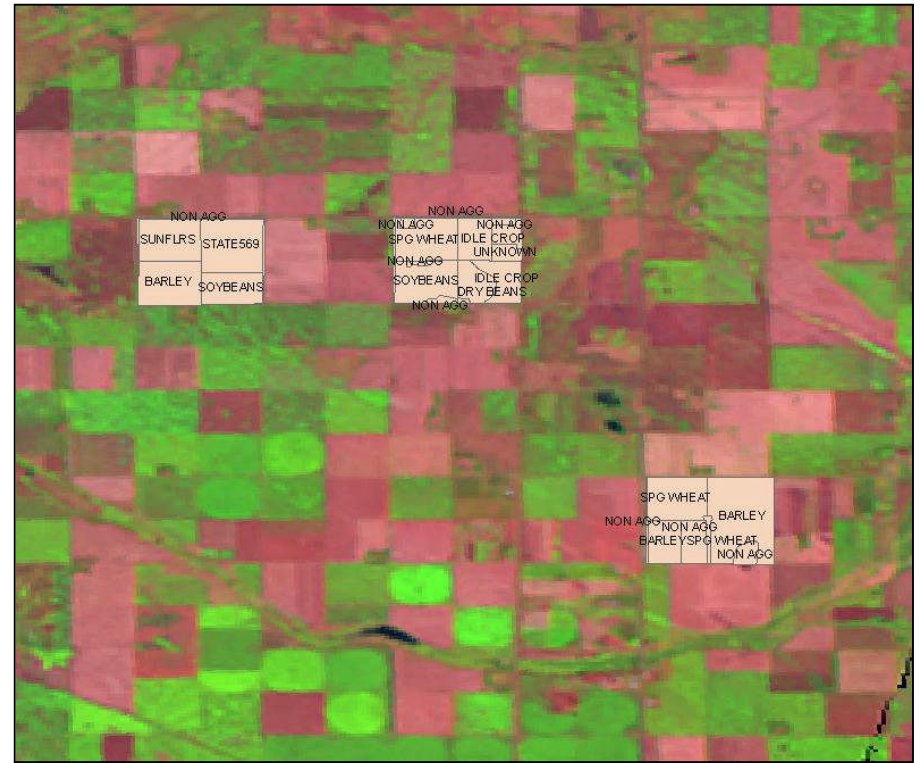


# Agricultural Ground Truth

- Farm Service Agency (FSA)
  - Common Land Unit (CLU)
  - 578 attributed reporting data

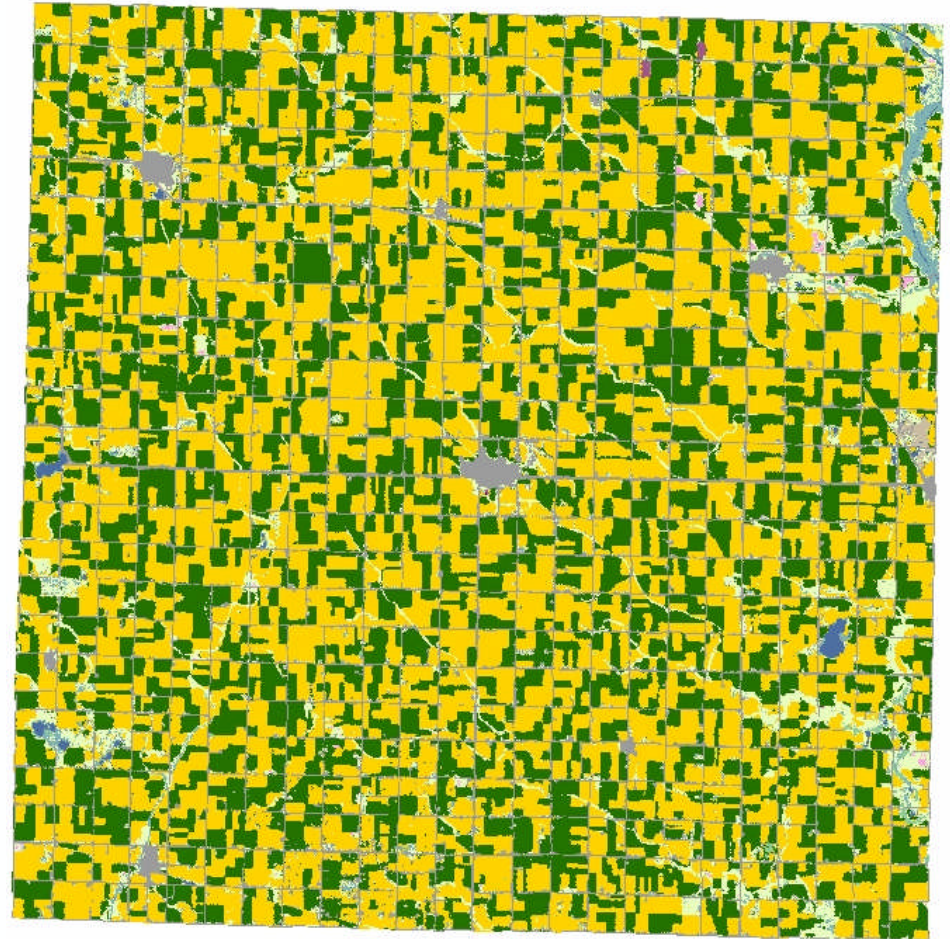


FSA



NASS





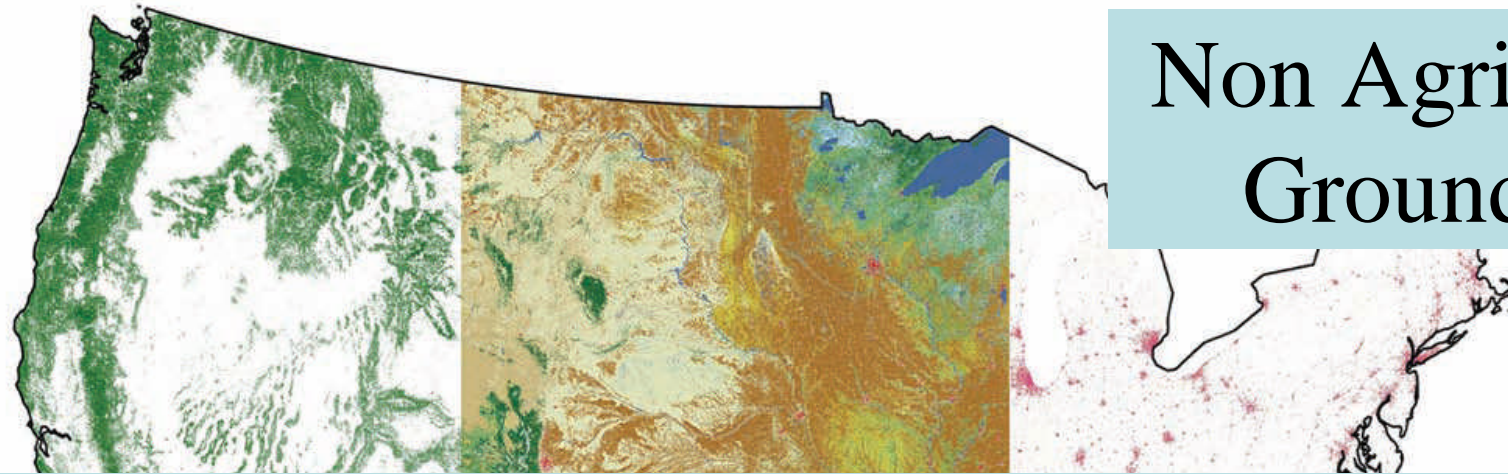
Matching CLU's used for sampling

CDL Classification

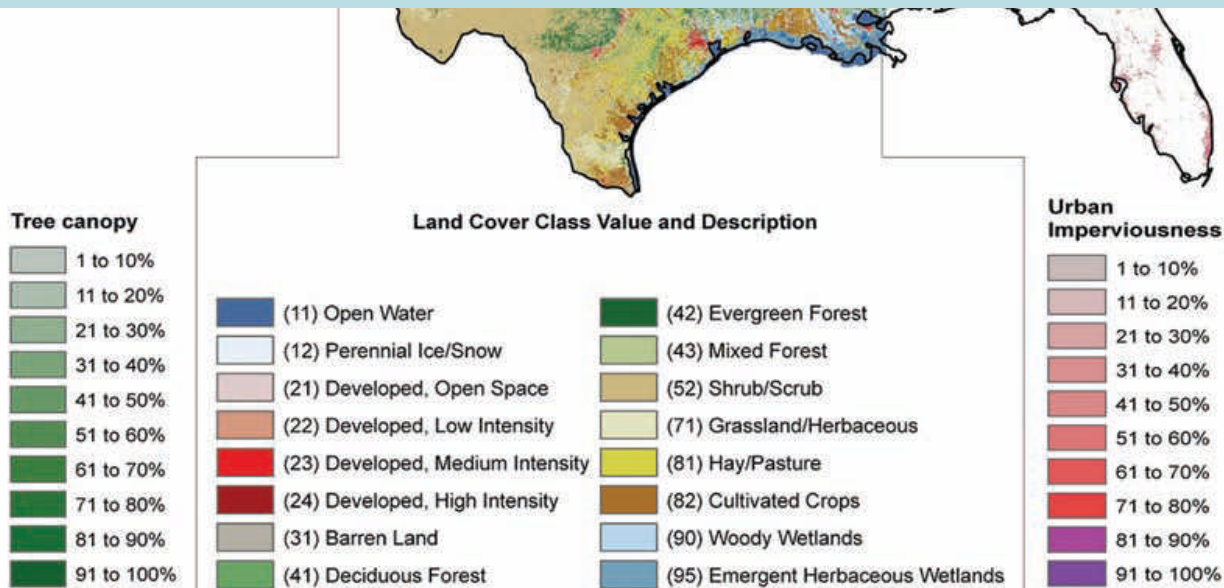
$\frac{1}{2}$  sample for training &  $\frac{1}{2}$  sample for testing  
Filter multi-field CLU/high acreage variance  
Comprehensive **program crop coverage**



# Non Agricultural - Ground Truth

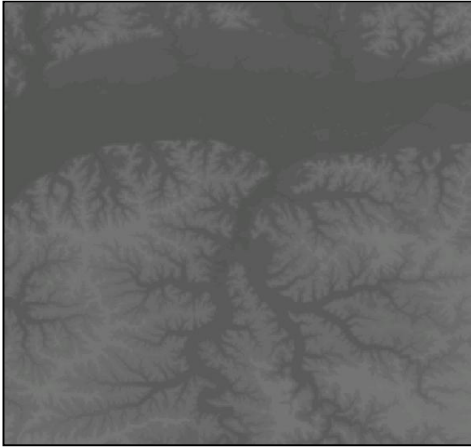


- Proportional sampling
- 2001 National Land Cover Dataset from USGS
- Improve CDL coverage of non-ag classes

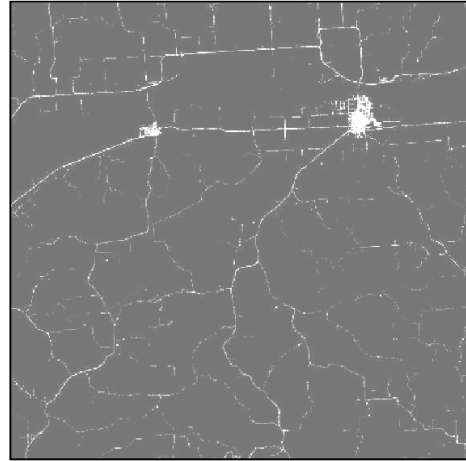




# Ancillary Data – USGS/NASA Products



Elevation

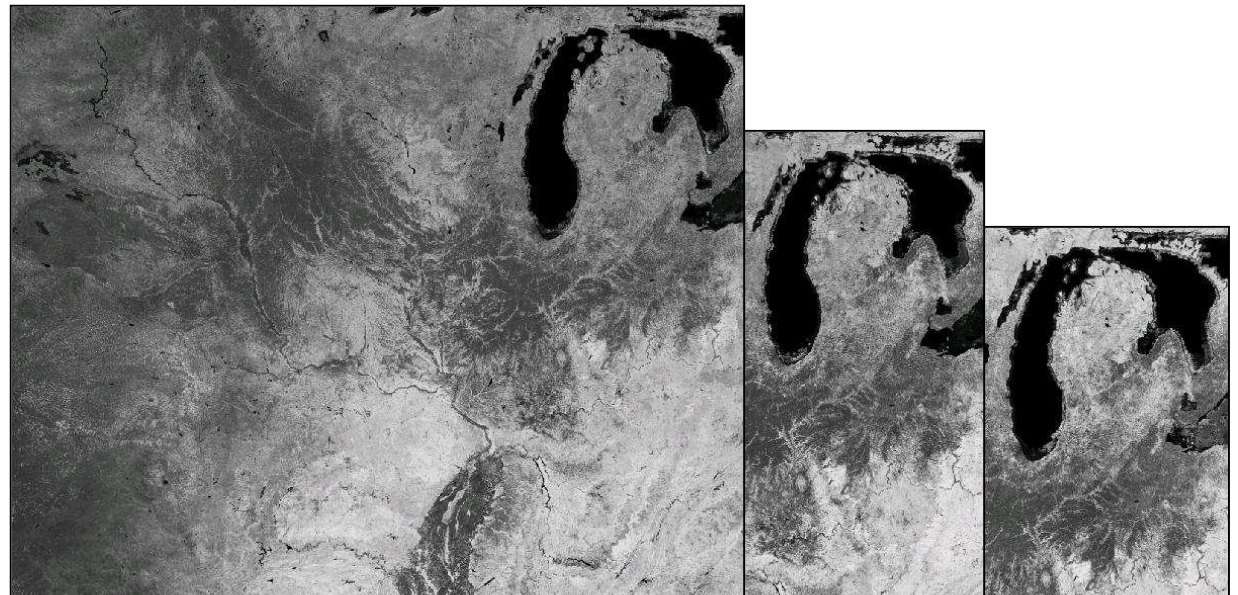


Imperviousness



Forest Canopy

NASA MODIS Terra  
(16-day NDVI composite)



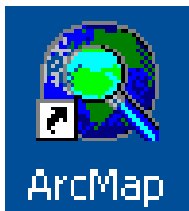
# Commercial Software Suite



- Imagery Preparation
  - ERDAS Imagine



- Image classification
  - Decision tree software
    - See5.0 [www.rulequest.com](http://www.rulequest.com)



- Ground Truth Preparation
  - ESRI ArcGIS



- Acreage Estimation
  - SAS/IML workshop

# Classification – See5 Decision Tree

The screenshot displays the See5 [network version] application window. The main window shows a project named 'combined\_samples\_2000000' with various files and settings listed. Overlaid on this are two dialog boxes: the 'NLCD Mapping Tool' and the 'Classifier Construction Options'.

**NLCD Mapping Tool** dialog box options:

- Percent Calculation ...
- NLCD Sampling Tool ...
- Cubist Classifier...
- See5 Classifier...
- Accuracy Assessment...
- Smart Eliminate...
- Cubist Info
- See5 Info
- Close

**Classifier Construction Options** dialog box options:

- Winnow attributes
- Rulesets
- Sort by utility  bands
- Boost  trials
- Subsets of values
- Use sample of  %
- Lock sample
- Cross-validate  folds
- Ignore costs file
- Advanced options:
  - Fuzzy thresholds
  - Global pruning
  - Pruning CF  %
  - Minimum  cases
- OK
- Defaults
- Cancel

- 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 See5



# Accuracy Statistics

Crop-specific covers only	*Correct	Accuracy	Error	Kappa
OVERALL ACCURACY	740009	93.56%	6.44%	0.8488

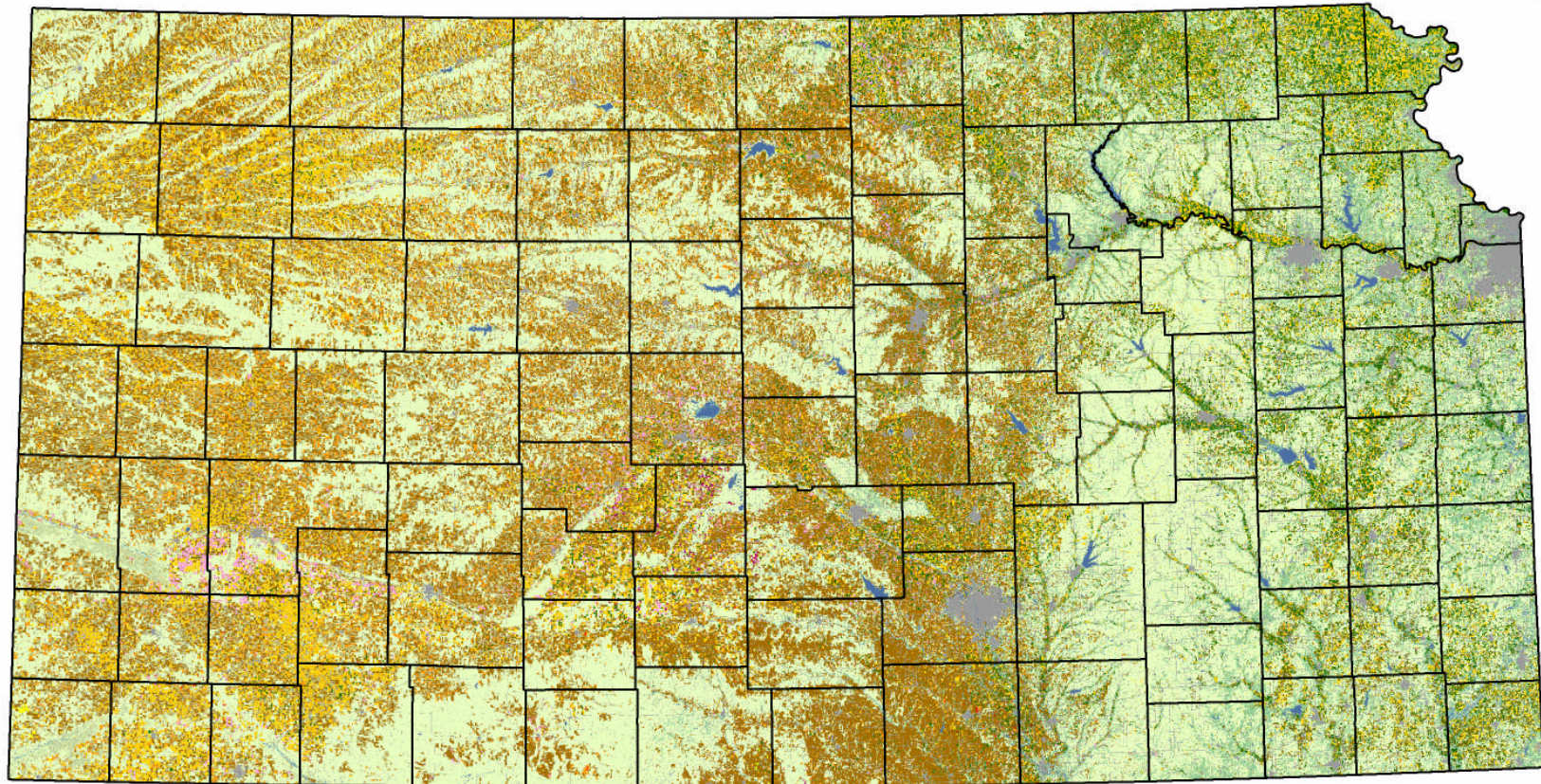
Cover Type	Attribute Code	*Correct Pixels	Producer's Accuracy	Omission Error	Kappa	User's Accuracy	Commission Error	Cond'1 Kappa
Corn	1	28358	95.36%	4.64%	0.9528	93.08%	6.92%	0.9297
Cotton	2	11757	95.08%	4.92%	0.9505	94.59%	5.41%	0.9456
Rice	3	2	28.57%	71.43%	0.2857	66.67%	33.33%	0.6667
Sorghum	4	21251	89.85%	10.15%	0.8972	92.46%	7.54%	0.9236
Soybeans	5	12885	86.15%	13.85%	0.8604	88.61%	11.39%	0.8851
Sunflowers	6	102	89.47%	10.53%	0.8947	99.03%	0.97%	0.9903
Peanuts	10	512	90.14%	9.86%	0.9014	92.09%	7.91%	0.9208
Barley	21	785	71.95%	28.05%	0.7194	97.39%	2.61%	0.9739
Durum Wheat	22	48	42.86%	57.14%	0.4286	100.00%	0.00%	1.0000
Spring Wheat	23	205	56.47%	43.53%	0.5647	99.03%	0.97%	0.9903
Winter Wheat	24	580437	97.54%	2.46%	0.9631	94.00%	6.00%	0.9117
Other Small Grains	25	1120	56.97%	43.03%	0.5694	93.57%	6.43%	0.9356
Win Wht /Soyb Dbl Crop	26	14758	79.51%	20.49%	0.7932	90.06%	9.94%	0.8996
Rye	27	13249	66.90%	33.10%	0.6664	91.39%	8.61%	0.9129
Oats	28	2941	64.85%	35.15%	0.6479	95.18%	4.82%	0.9517
Millet	29	439	77.02%	22.98%	0.7701	96.48%	3.52%	0.9648
Canola	31	337	75.90%	24.10%	0.7590	98.83%	1.17%	0.9883
Alfalfa	36	19653	88.21%	11.79%	0.8807	91.78%	8.22%	0.9168
Dry Beans	42	115	88.46%	11.54%	0.8846	93.50%	6.50%	0.9350
Potatoes	43	49	96.08%	3.92%	0.9608	100.00%	0.00%	1.0000
Other Crops	44	50	45.87%	54.13%	0.4587	80.65%	19.35%	0.8064
Misc Veggies & Fruits	47	33	54.10%	45.90%	0.5410	86.84%	13.16%	0.8684
Watermelon	48	24	77.42%	22.58%	0.7742	85.71%	14.29%	0.8571
Peas	53	188	72.59%	27.41%	0.7258	96.91%	3.09%	0.9691
Clover/Wildflowers	58	21	36.21%	63.79%	0.3621	75.00%	25.00%	0.7500
Fallow/Idle Cropland	61	30612	69.78%	30.22%	0.6922	90.48%	9.52%	0.9025
Peaches	67	9	36.00%	64.00%	0.3600	100.00%	0.00%	1.0000
Other Tree Nuts & Fruit	71	69	33.82%	66.18%	0.3382	83.13%	16.87%	0.8313

\*Correct Pixels represents the total number of independent validation pixels correctly identified in the error matrix.





# Kansas 2008 Cropland Data Layer



## Land Cover Categories

(Ordered by Decreasing Acreage)

### Agricultural

- Winter Wheat
- Corn
- Sorghum
- Soybeans
- Alfalfa
- W. Wht./Soy. Dbl. Crop.
- Sunflowers
- Rye

- Cotton
- Other Small Grains
- Clover/Wildflowers
- Oats
- Potatoes
- Seed/Sod Grass
- Canola
- Millet

- Other Crops
- Barley
- Other Tree Nuts
- Peas
- Apples
- Misc. Veggies. & Fruits

### Non-Agricultural

- Grass/Pasture/Non-Ag
- Urban/Developed
- Woodland
- Fallow/Idle Cropland
- Water
- Wetlands
- Shrubland
- Barren




















# Brown County, Kansas 2008 Cropland Data Layer











## Land Cover Categories (Ordered by Decreasing Acreage)

### Agricultural

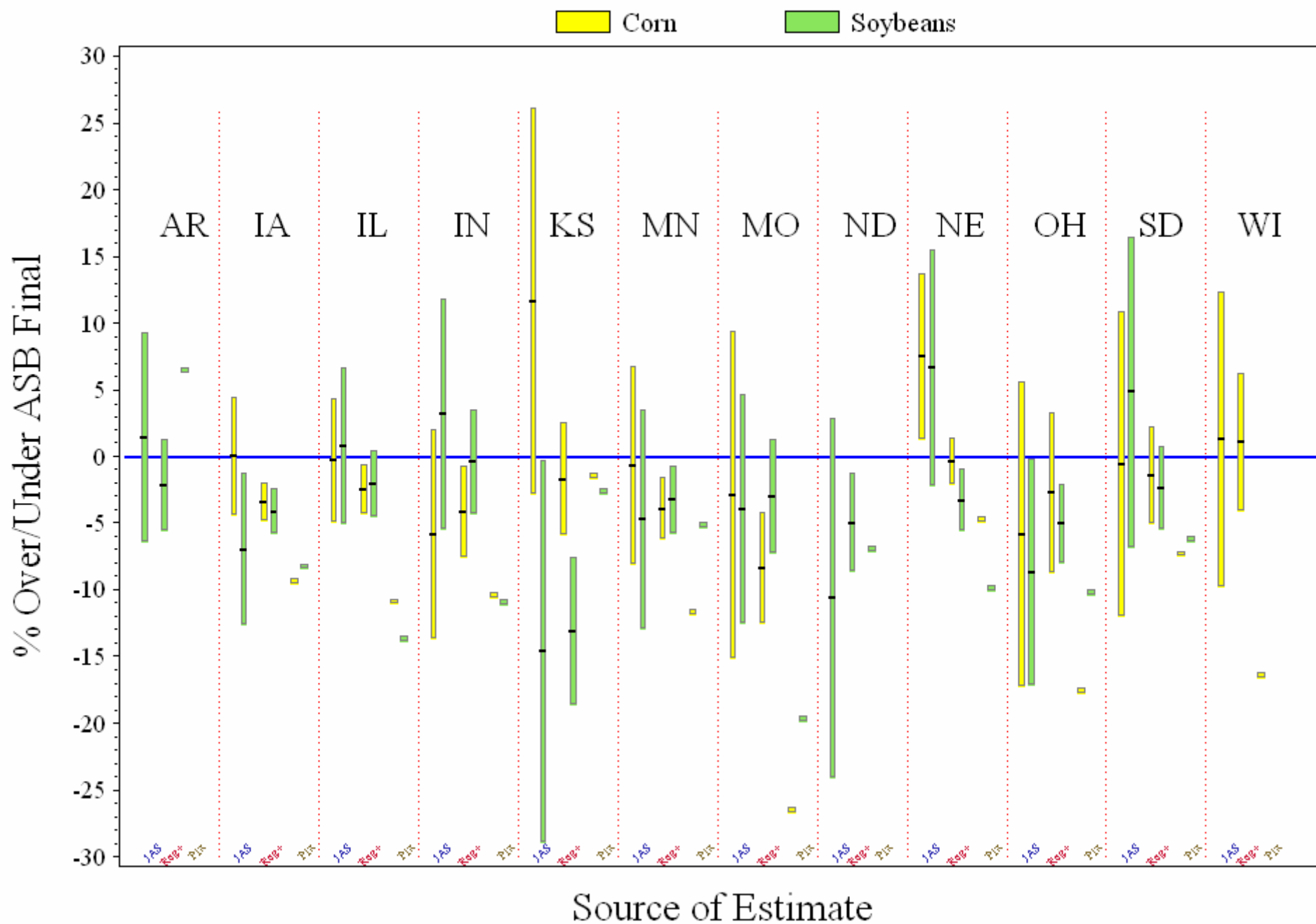
-  Soybeans
-  Corn/Sweet Corn
-  Winter Wheat
-  Alfalfa
-  Win. Wht./Soyb. Dbl. Cropped
-  Sorghum
-  Clover/Wildflowers
-  Other Crops/Grass Seed/Sod
-  Other Small Grains
-  Sunflowers
-  Oats
-  Cotton
-  Barley
-  Seed/Sod Grass
-  Other Tree Nuts

### Non-Agricultural

-  Grass/Pasture/Non-Ag
-  Woodland
-  Urban/Developed
-  Water
-  Wetlands
-  Barren
-  Fallow/Idle Cropland
-  Shrubland



# 2008 State Level Estimates +/- 2% CVs

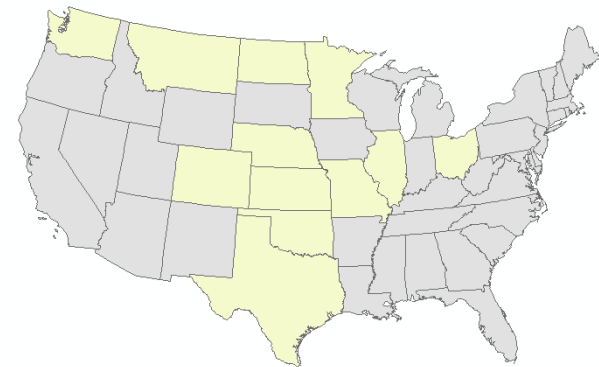




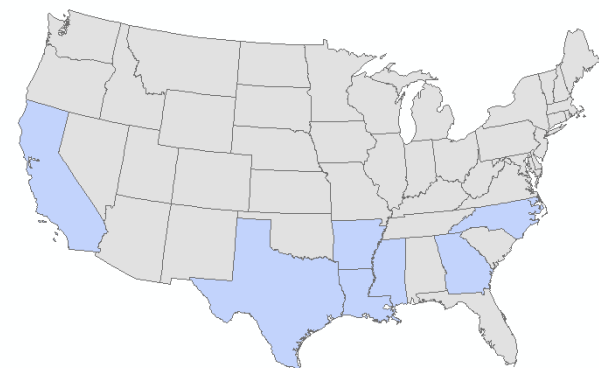


# Cropland Data Layer Future

- Improve acreage timing
  - Sept. Small Grain Summary
  - August district level estimates
- Expand geographic scope
  - Cotton, Winter, Durum and Spring Wheats
- Derivatives
  - Change detection
  - Crop rotations
- National program
  - Leverage resource partnerships



Primary Wheat States



Primary Cotton States