

Data Partnership Synergy

The Cropland Data Layer

Rick Mueller

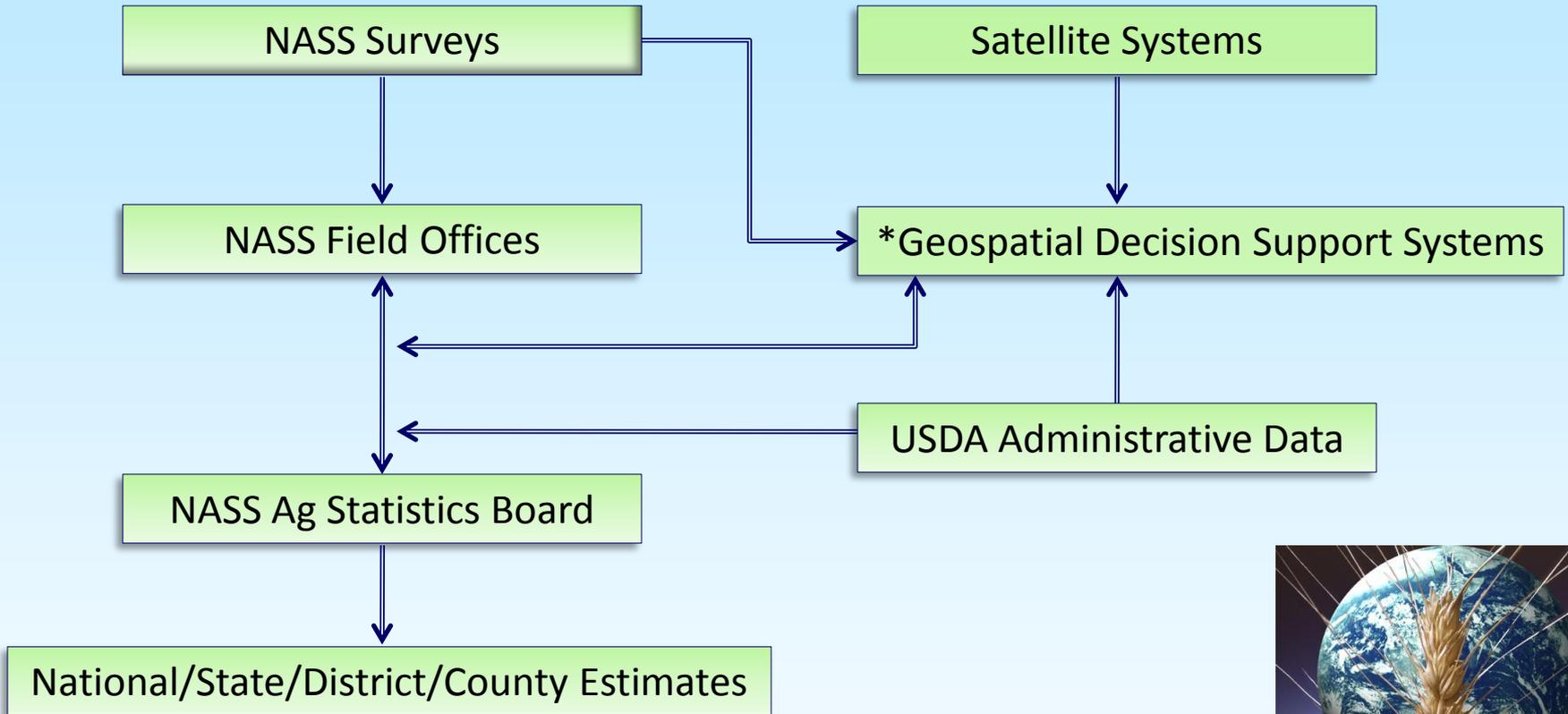
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USDA/NASS

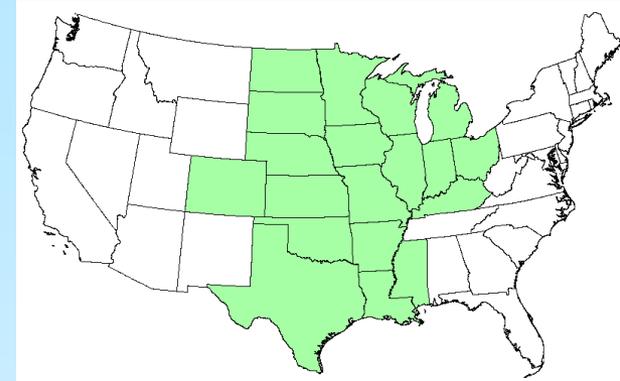


NASS Estimation Systems



*NASS uses Geospatial Decision Support Systems to provide updated information to the Ag Statistics Board and data users.

Cropland Data Layer Objectives



■ “Census by Satellite”

- *Annually* cover major program crops
- Ag intensive states/regions

■ Provide timely, accurate, useful indications

- Measurable error
- Unbiased/independent estimator
- State, County, Agricultural Statistics Districts

■ Operationalize indications delivery

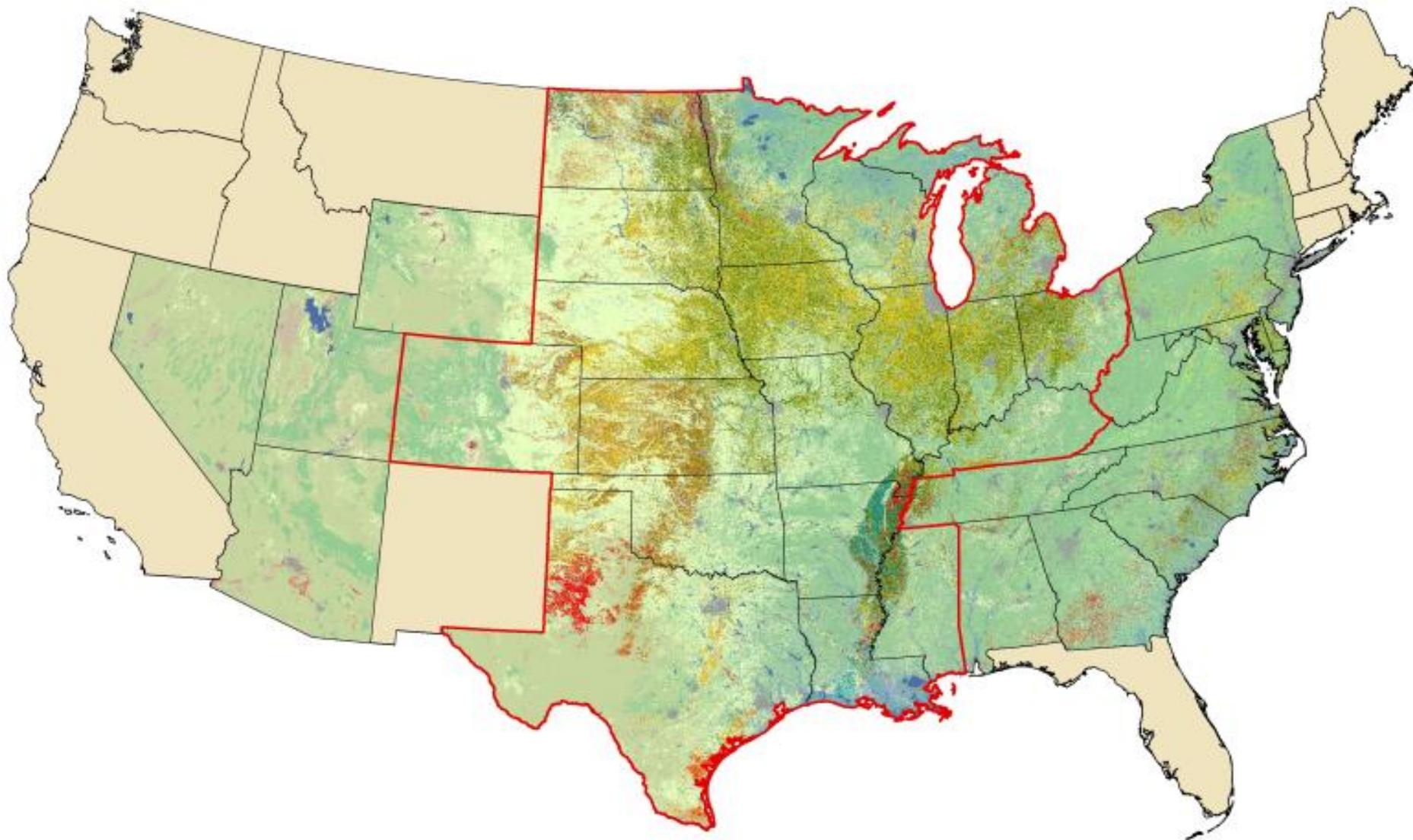
- For June, July, August, September and October
 - Agricultural Statistics Board
 - Field Offices
- Update planted area

■ Output crop specific CDL

- Distribute to public at the cost of reproduction
 - [NRCS Geospatial Data Gateway](#)



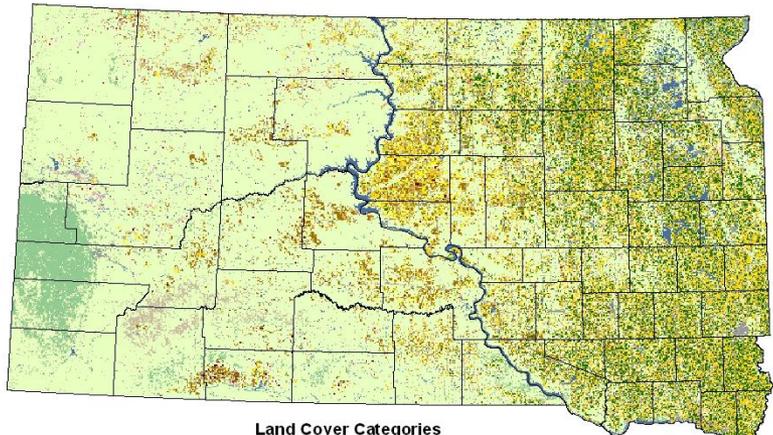
2008 Cropland Data Layer Production



*states outlined in red were processed during the growing season to produce NASS estimates



South Dakota 2008 Cropland Data Layer

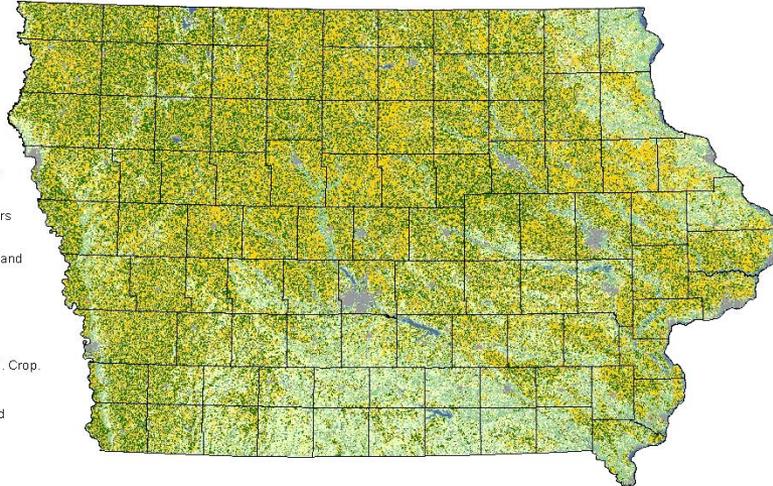


Land Cover Categories
(Ordered by Decreasing Acreage)

- | | | | |
|--------------------|----------------------|------------------------|-----------------|
| Agriculture | | Non-Agriculture | |
| Pasture/Grass | Fallow/Idle Cropland | Woodland | Urban/Developed |
| Corn | Millet | Water | Wetlands |
| Soybeans | Sorghum | Other Small Grains | Barren |
| Winter Wheat | Oats | Rye | Shrubland |
| Spring Wheat | Barley | Flaxseed | |
| Alfalfa | Peas | | |
| Sunflowers | Safflower | | |



Iowa 2008 Cropland Data Layer

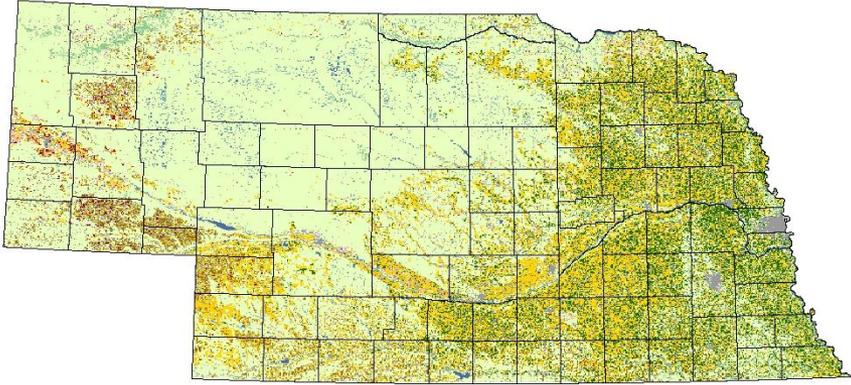


Land Cover Categories
(Ordered by Decreasing Acreage)

- | | | | |
|--------------------|-------------------------|------------------------|-----------|
| Agriculture | | Non-Agriculture | |
| Corn | Soybeans | Urban/Developed | Woodland |
| Pasture/Grass | Alfalfa | Water | Wetlands |
| Oats | Winter Wheat | Other Crops | Barren |
| Spring Wheat | Seed/Sod Grass | Fallow/Idle Cropland | Shrubland |
| Barley | Clover/Wildflowers | Durum Wheat | |
| Other Crops | W. Wht./Soy. Dbl. Crop. | Sorghum | |
| Rye | | Dry Beans | |
| | | Urban/Developed | |



Nebraska 2008 Cropland Data Layer

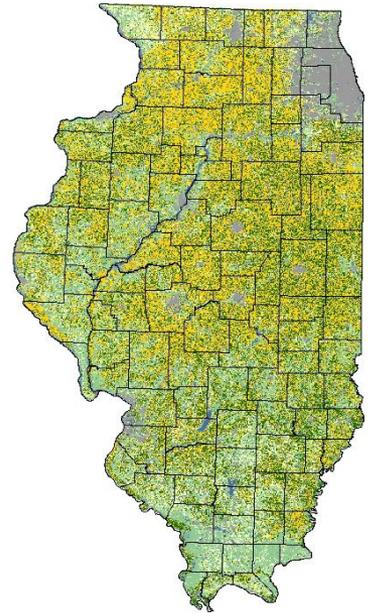


Land Cover Categories
(Ordered by Decreasing Acreage)

- | | | | |
|----------------------|------------|------------------------|-----------|
| Agriculture | | Non-Agriculture | |
| Pasture/Grass | Millet | Urban/Developed | Woodland |
| Corn | Dry Beans | Water | Wetlands |
| Soybeans | Oats | Barren | Shrubland |
| Winter Wheat | Sunflowers | | |
| Fallow/Idle Cropland | Sugarbeets | | |
| Alfalfa | Potatoes | | |
| Sorghum | Rye | | |



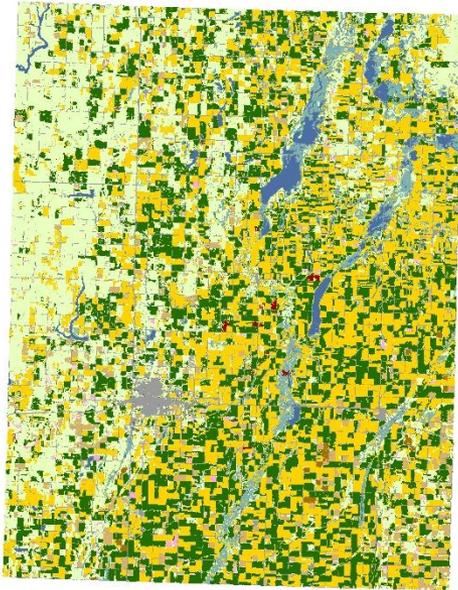
2008 Illinois Cropland Data Layer



Land Cover Categories
(Ordered by Decreasing Acreage)

- | | | | |
|---------------------|-------------------------|------------------------|-----------------|
| Agriculture | | Non-Agriculture | |
| Corn | Soybeans | Woodland | Urban/Developed |
| Pasture/Grass | W. Wht./Soy. Dbl. Crop. | Water | Wetlands |
| Winter Wheat | Fallow/Idle Cropland | Barren | Shrubland |
| Alfalfa | Sorghum | | |
| Misc. Vgs. & Fruits | Dry Beans | | |
| Seed/Sod Grass | Other Crops | | |
| Oats | Clover/Wildflowers | | |

Brown County, South Dakota 2008 Cropland Data Layer



Land Cover Categories (Ordered by Decreasing Acreage)

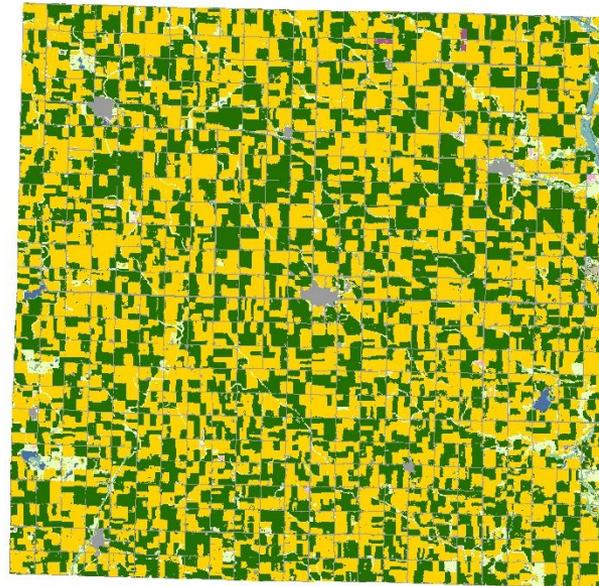
Agriculture

- Corn
- Soybeans
- Spring Wheat
- Alfalfa
- Winter Wheat
- Dry Beans
- Sunflowers
- Oats
- Millet
- Sorghum
- Barley
- Rye
- Other Crops

Non-Agriculture

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

Pocahontas County, Iowa 2008 Cropland Data Layer



Land Cover Categories (Ordered by Decreasing Acreage)

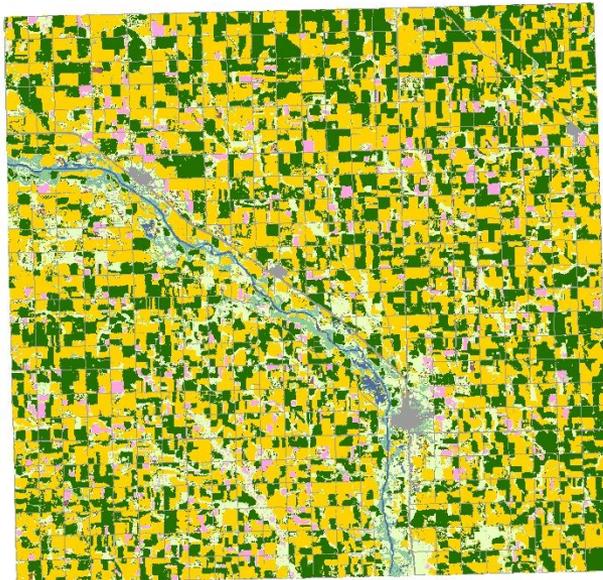
Agriculture

- Corn
- Soybeans
- Pasture/Grass
- Alfalfa
- Oats
- Winter Wheat
- Spring Wheat
- Clover/Wildflowers

Non-Agriculture

- Urban/Developed
- Wetlands
- Woodland
- Water
- Barren

Cuming County, Nebraska 2008 Cropland Data Layer



Land Cover Categories (Ordered By Decreasing Acreage)

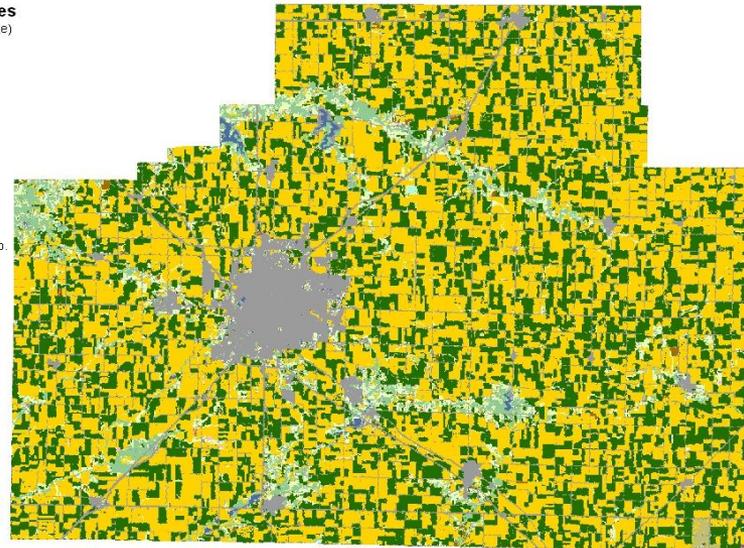
Agriculture

- Corn
- Soybeans
- Pasture/Grass
- Alfalfa
- Oats
- Winter Wheat
- Fallow/Idle Cropland
- Sorghum
- Rye
- W. Wht./Soy. Dbl. Crop.
- Seed/Sod Grass

Non-Agriculture

- Urban/Developed
- Woodland
- Wetlands
- Water
- Barren
- Shrubland

McLean County, Illinois 2008 Cropland Data Layer



Land Cover Categories (Ordered by Decreasing Acreage)

Agriculture

- Corn
- Soybeans
- Pasture/Grass
- Winter Wheat
- Fallow/Idle Cropland
- Alfalfa
- Misc. Veggies. & Fruits
- Seed/Sod Grass
- W. Wht./Soy. Dbl. Crop.
- Oats
- Dry Beans
- Sorghum
- Clover/Wildflowers
- Sunflowers
- Rye
- Other Crops
- Peas

Non-Agriculture

- Urban/Developed
- Woodland
- Wetlands
- Water
- Barren
- Shrubland

Data Partnerships

■ Foreign Ag Service

■ Satellite Image Archive

■ Resourcesat-1 AWiFS

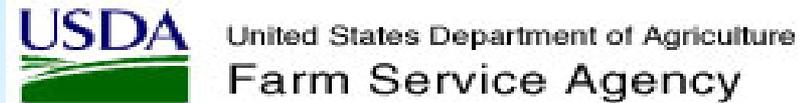
- 5 day repeat/56 meter resolution/740 KM swath



■ Farm Service Agency

■ Common Land Unit

- Agricultural specific ground truth



■ US Geological Survey

■ National Land Cover Dataset

- Non-agricultural specific ground truth



CDL Program

Inputs

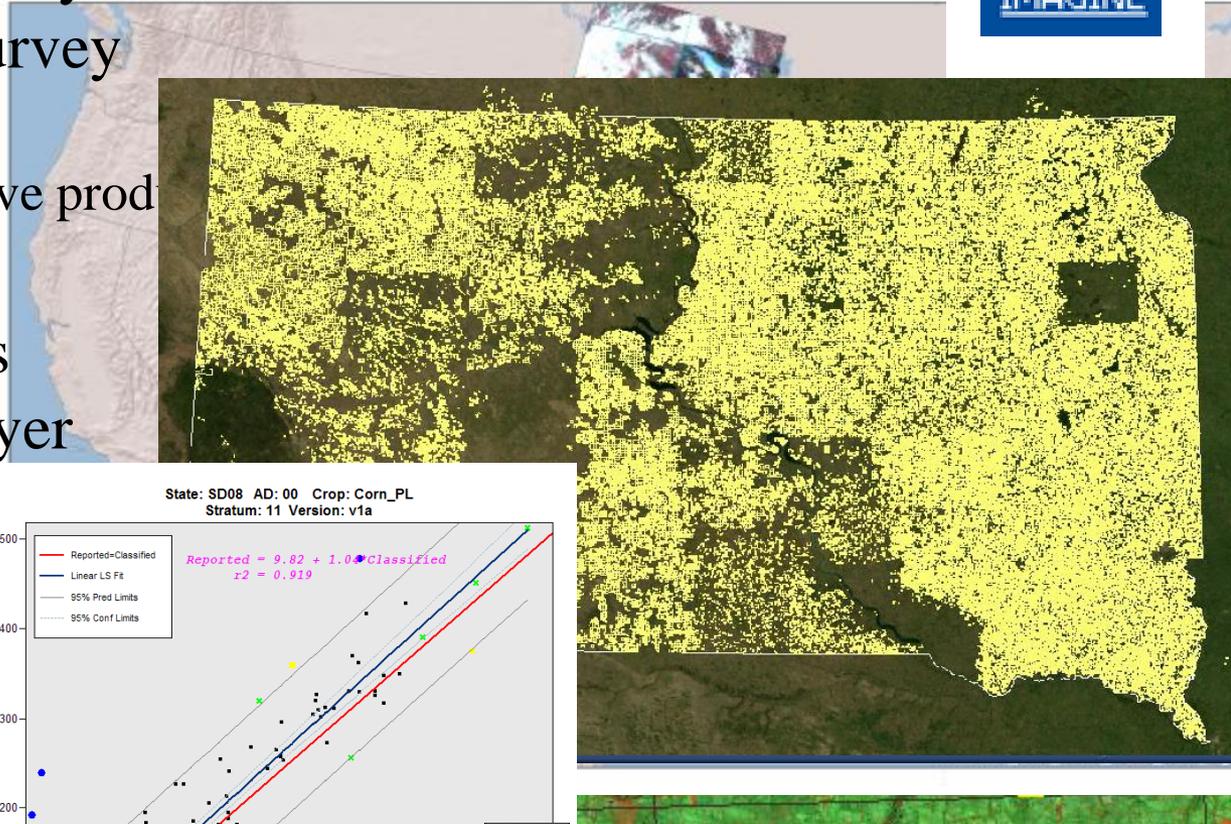
- Resourcesat-1 AWiFS imagery
- Farm Service Agency – Common Land Unit
- NASS June Ag Survey
- Ancillary data
 - NLCD & derivative prod

Outputs

- Acreage Estimates
- Cropland Data Layer

Process

- Commercial soft



Sensor Specifications Compared

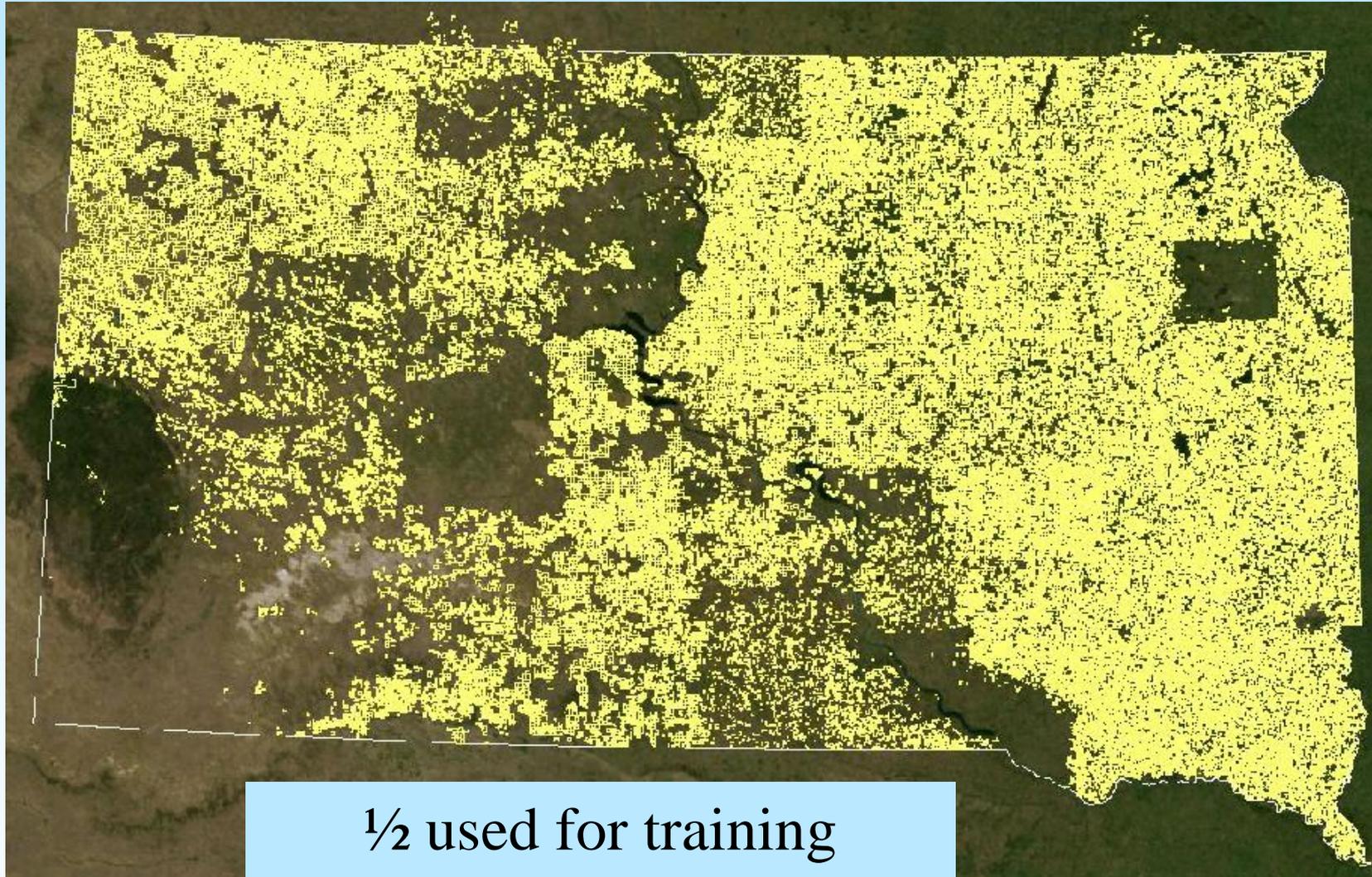
	<u>TM</u>	<u>AWiFS</u>
Altitude	705 km	817 km
Equatorial crossing time	9:45 ± 15 minutes	10:30 ± 5 minutes
Temporal Resolution	16 days	5 days
Spatial Resolution	30 x 30 m (reflective) 120 x 120 m (thermal)	56 x 56 m
Radiometric Resolution	8 bit (256)	10 bit (1024)
Spectral Resolution	6 (B, G, R, NIR, SWIR, MIR) + Thermal IR	4 (G, R, NIR, SWIR)
Swath wide	185 km	737 km
Scene size	184 x 152 km	370 x 370 km

Agricultural Ground Truth

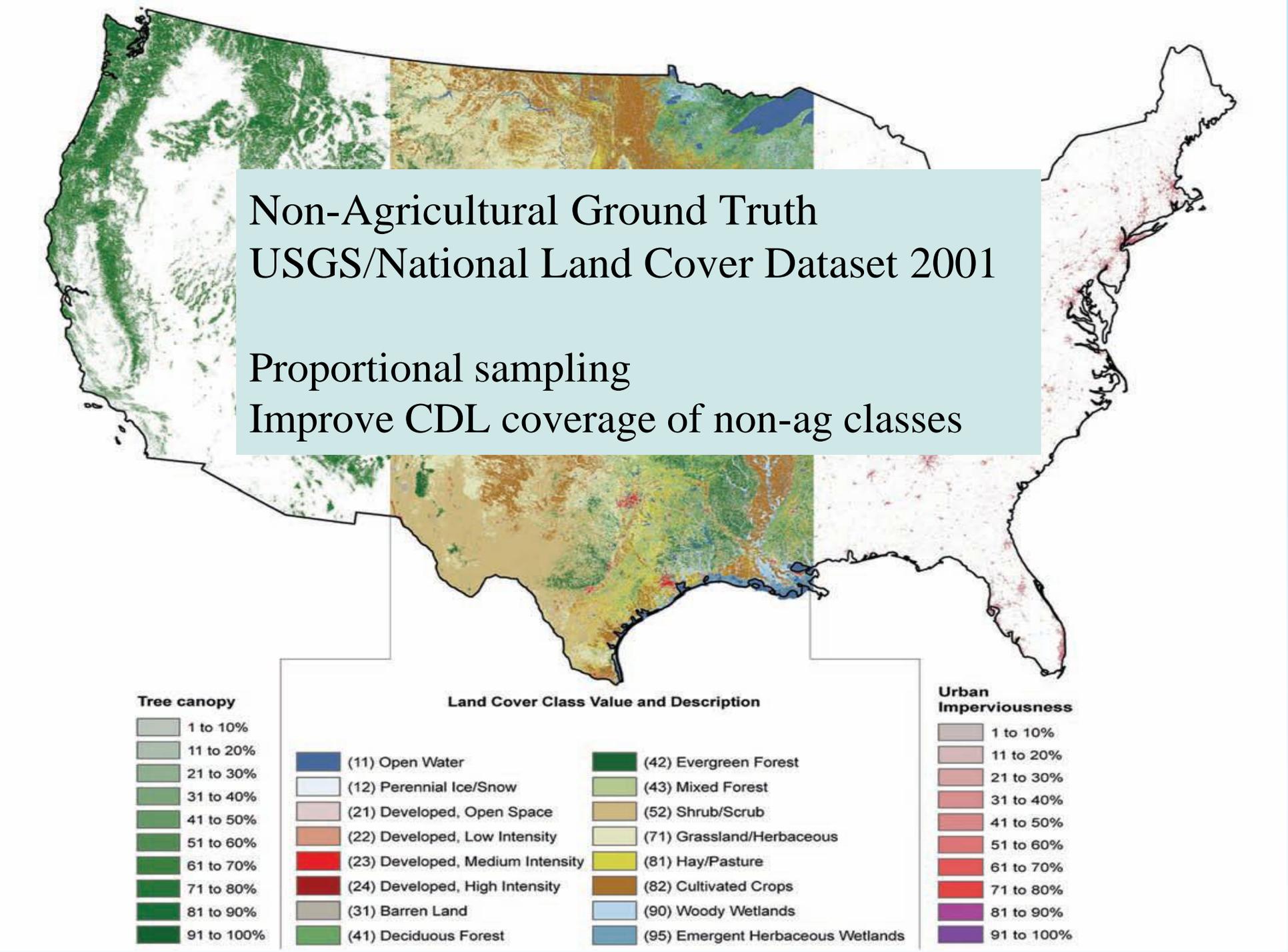
FSA Common Land Unit



United States Department of Agriculture
Farm Service Agency



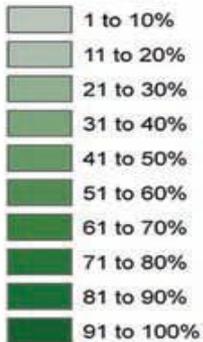
$\frac{1}{2}$ used for training
 $\frac{1}{2}$ used for validation



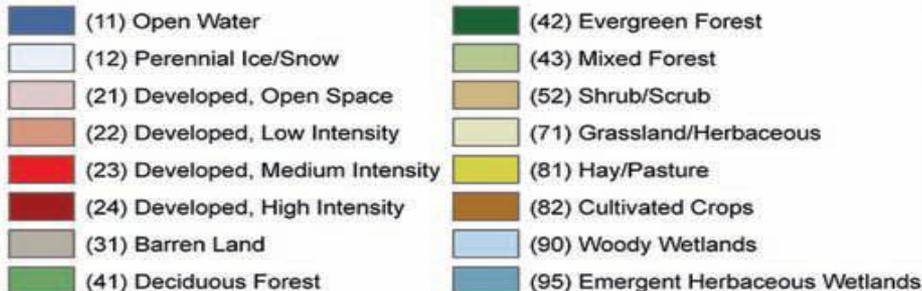
Non-Agricultural Ground Truth USGS/National Land Cover Dataset 2001

Proportional sampling
Improve CDL coverage of non-ag classes

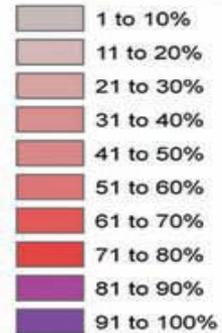
Tree canopy



Land Cover Class Value and Description

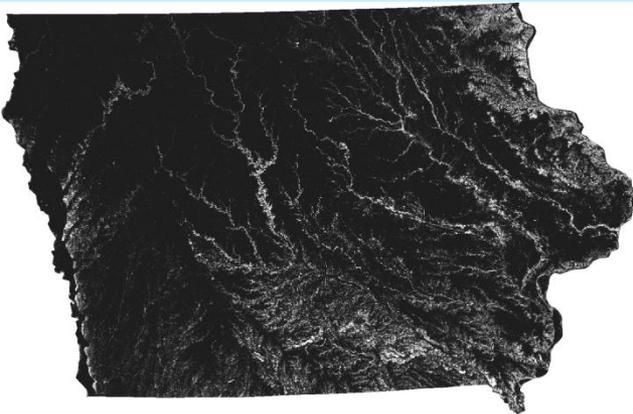


Urban Imperviousness



Ground Truth – Ancillary

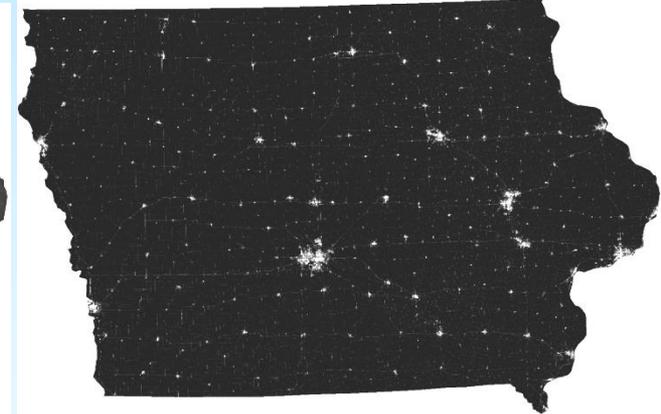
Forest Canopy



Elevation



Impervious



Ancillary datasets help separate the agricultural landscape; determining agricultural potential

```

5dates.out - WordPad
File Edit View Insert Format Help

See5 [Release 2.03] Tue Dec 26 09:20:26 2006
-----

Options:
  10 boosting trials

Class specified by attribute `dep'

Read 62526 cases (23 attributes) from 5dates.data
----- Trial 0: -----

```

```

Decision tree:

band15 > 59:
...band14 <= 34:
:   ...band01 > 33:
:   :   ...band04 > 113: 8 (76)
:   :   :   band04 <= 113:
:   :   :   :   ...band07 > 105:
:   :   :   :   :   ...band05 <= 21: 3 (5/
:   :   :   :   :   :   band05 > 21:
:   :   :   :   :   :   :   ...band18 > 25: 1
:   :   :   :   :   :   :   band18 <= 25:
:   :   :   :   :   :   :   :   ...band08 > 66
:   :   :   :   :   :   :   :   band08 <= 6
:   :   :   :   :   :   :   :   :   ...band08
:   :   :   :   :   :   :   :   :   band08
:   :   :   :   :   :   :   :   :   band07 <= 105:
:   :   :   :   :   :   :   :   :   :   ...band14 > 27:
:   :   :   :   :   :   :   :   :   :   :   ...band06 <= 21: 3
:   :   :   :   :   :   :   :   :   :   :   :   band06 > 21:

```

Classifier Construction 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

See5

File Edit Help

 **hypothyroid**

[class and attribute definitions \(hypothyroid.names\)](#)

[training cases to be analyzed \(hypothyroid.data\)](#)

[test cases \(hypothyroid.test\)](#)

[misclassification costs \(hypothyroid.costs\)](#)

[decision tree classifier \(hypothyroid.tree\)](#)

[ruleset classifier \(hypothyroid.rules\)](#)

[output file \(hypothyroid.out\)](#)

See5 Decision Tree Classifier

- Efficient and robust image classifier
- Incorporates a powerful ensemble method known as “boosting”
- Allows hundreds of layers of data
- The “NLCD Mapping Tool” was integrated into ERDAS Imagine
 - Provided gratis by USGS



NLCD Mapping Tool

Percent Calculation ...

NLCD Sampling Tool ...

Cubist Classifier...

See5 Classifier...

Accuracy Assessment...

Smart Eliminate...

Cubist Info See5 Info

Close

Accuracy Assessments

IA

Cover Type	Attribute Code	*Correct Pixels	Producer's Accuracy	Omission Error	Kappa	User's Accuracy	Commission Error	Cond'1 Kappa
Corn	1	2197719	96.58%	3.42%	0.9226	97.86%	2.14%	0.9509
Soybeans	5	1471094	96.24%	3.76%	0.9392	95.78%	4.22%	0.9320

IL

Corn	1	2258219	98.06%	1.94%	0.9527	98.58%	1.42%	0.9650
Soybeans	5	1339089	96.36%	3.64%	0.9438	97.96%	2.04%	0.9681

NE

Corn	1	1856422	97.29%	2.71%	0.9605	97.32%	2.68%	0.9608
Soybeans	5	849249	95.83%	4.17%	0.9513	96.95%	3.05%	0.9643

SD

Corn	1	803251	94.29%	5.71%	0.9342	95.78%	4.22%	0.9513
Soybeans	5	707383	95.03%	4.97%	0.9439	97.72%	2.28%	0.9741

IA

Crop-specific covers only	*Correct	Accuracy	Error	Kappa
OVERALL ACCURACY	3688803	95.74%	4.26%	0.9145

IL

OVERALL ACCURACY	3730093	97.05%	2.95%	0.9426
------------------	---------	--------	-------	--------

NE

OVERALL ACCURACY	3071960	94.05%	5.95%	0.8981
------------------	---------	--------	-------	--------

SD

OVERALL ACCURACY	2306428	87.51%	12.49%	0.8416
------------------	---------	--------	--------	--------

State level accuracies are very high

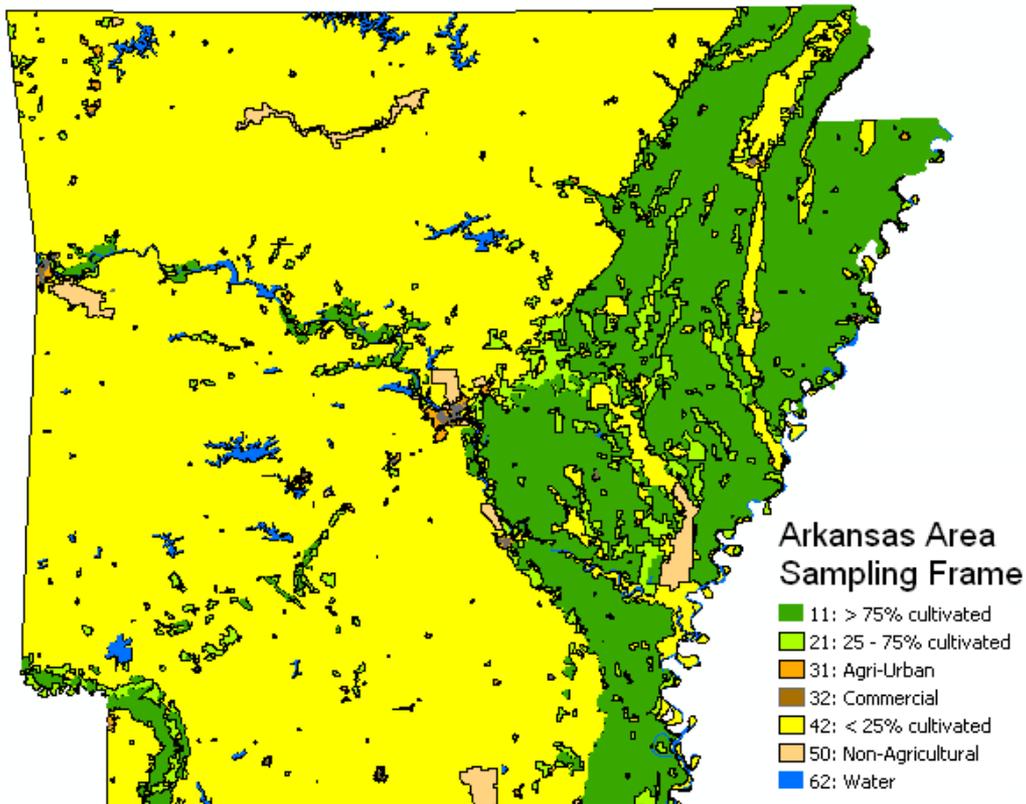
Producer's Accuracy: relates to the probability that a ground truth pixel will be correctly mapped and measures errors of omission.

Errors of Omission: occur when a pixel is excluded from the correct category.

User's Accuracy: indicates the probability that a pixel from the classification actually matches the ground truth data and measures errors of commission.

Errors of Commission: occur when a pixel is included in an incorrect category.

Kappa Coefficient: A statistics measure of agreement, beyond chance, between two maps.



SECTION D - CROPS AND LAND USE ON TRACT

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	
1.	Total acres in field	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
6.	Pasture	Permanent (not in crop rotation)	842	842
			856	856

**Estimation Components:
Area Sampling Frame+
June Ag Survey+
Questionnaire**

Regression-based Acreage Estimator

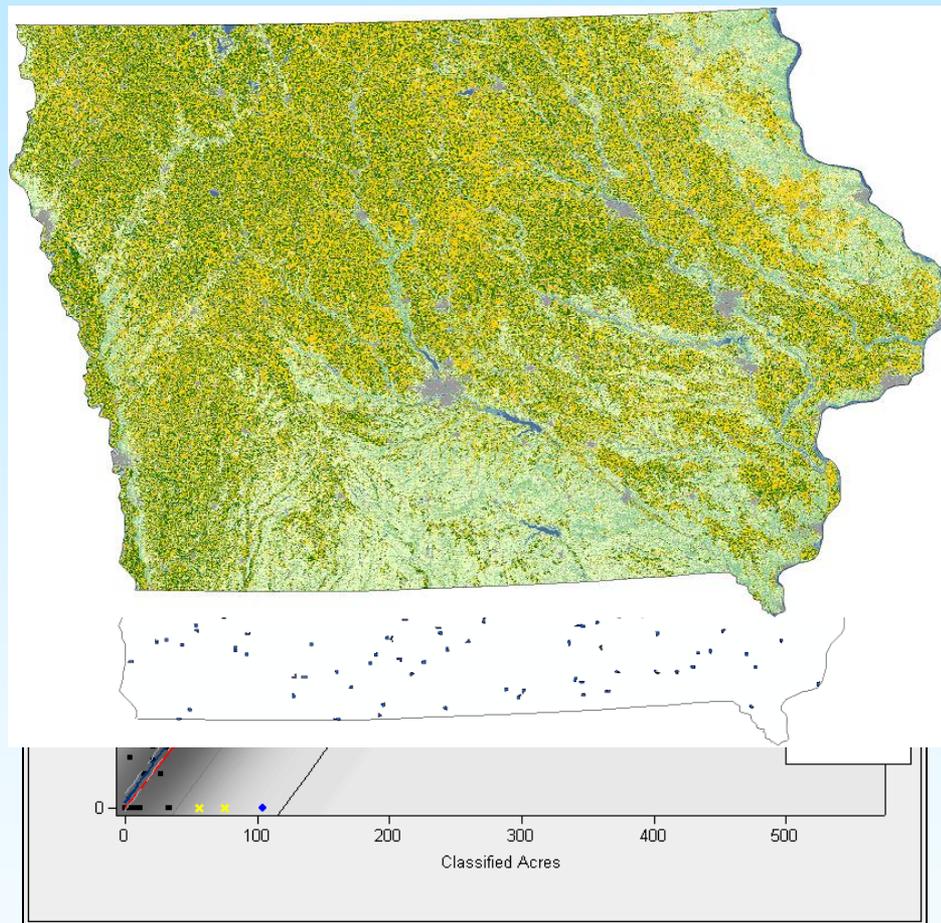
Simple Linear Regression

Regression used to relate categorized pixel counts to the ground reference data

- **(X) – Cropland Data Layer (CDL) classified acres**
- **(Y) – June Agricultural Survey (JAS) reported acres**

Outlier segment detection - removal from regression analysis

Using regression results in estimates reduces error rates over using JAS alone



Acreage not just about counting pixels

January						
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5

February						
Su	Mo	Tu	We	Th	Fr	Sa
				1	2	

March						
Su	Mo	Tu	We	Th	Fr	Sa
						1

CDL Production Schedule

8:●	15:○	22:○	30:○
-----	------	------	------

6:●	13:○	20:○	28:○
-----	------	------	------

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			

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

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	25	26	27	28
29	30					

Acreage Report
CDL winter wheat

July						
Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5

August						
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

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				

Crop Production Report
CDL cotton/rice/peanuts

Crop Production Report
CDL corn/soybeans

2:●	10:○	18:○	25:○
-----	------	------	------

1:●	8:○	16:○	23:○	30:○
-----	-----	------	------	------

7:○						
-----	--	--	--	--	--	--

Small Grains Annual Summary
CDL small grains

October						
Su	Mo	Tu	We	Th	Fr	Sa

November						
Su	Mo	Tu	We	Th	Fr	Sa

December						
Su	Mo	Tu	We	Th	Fr	Sa

Crop Production Report
CDL all crops

Historical:
Crop Production Annual Summary
CDL all crops/county estimates

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:○	28:○
-----	------	------	------

5:○	13:○	19:○	27:○
-----	------	------	------

5:○	12:○	19:○	27:○
-----	------	------	------

