United States Department of Agriculture
National Agricultural Statistics Service

Crop Land Data Layer & Acreage Estimates

Presented by Audra Zakzeski

United States Department of Agriculture
National Agricultural Statistics Service

Provide timely, accurate, and useful statistics in service to U.S. agriculture

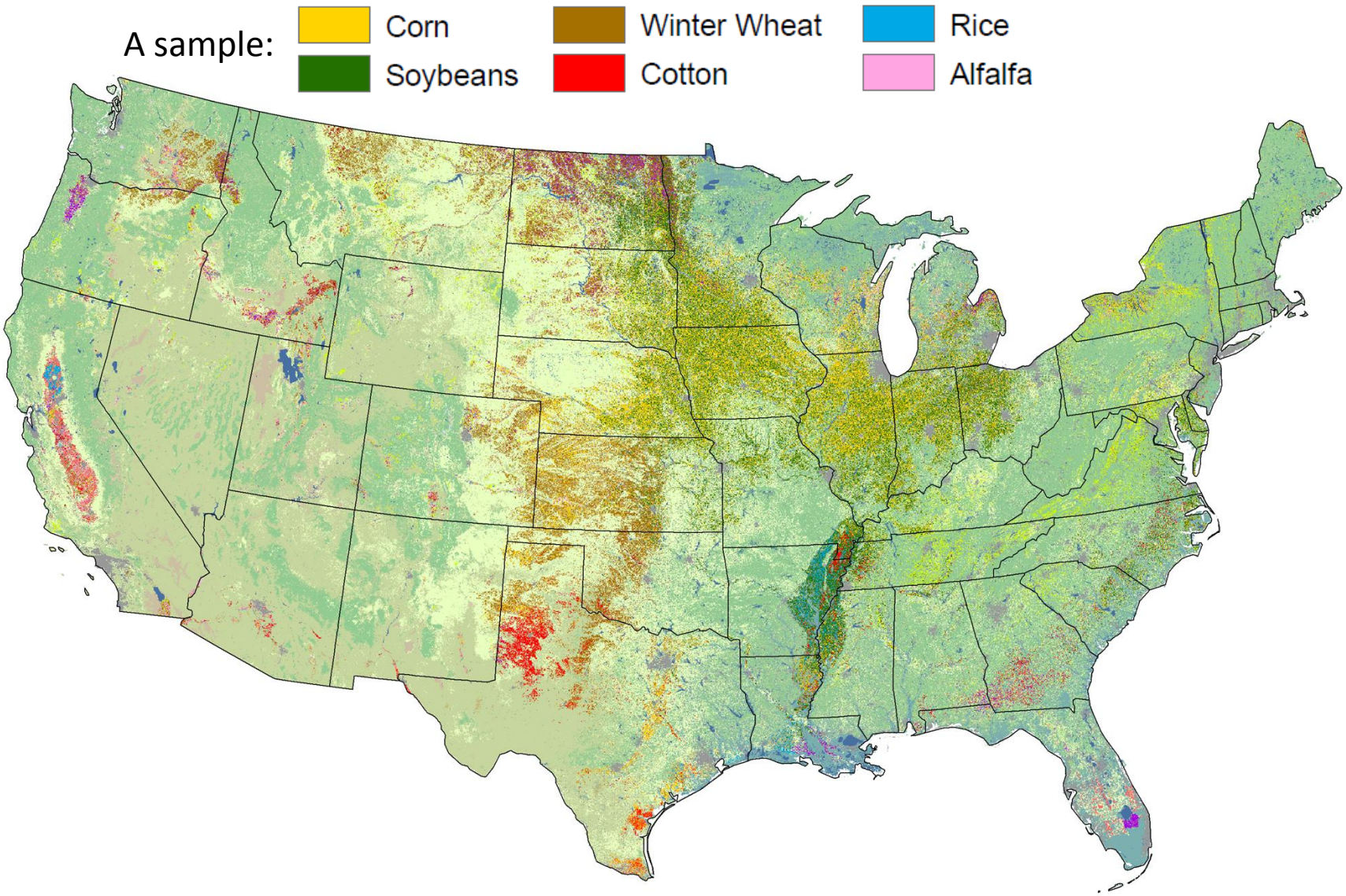
A sample of surveys and programs:

Census of Agriculture	**Crop Acreage**	Agricultural Yield
Crops / Stocks	Crop Progress & Condition	Farm Labor
June Area Survey	Agricultural Resource Management (ARMS)	Chemical Use
Cattle Inventory	Census of Horticulture	Bee & Honey

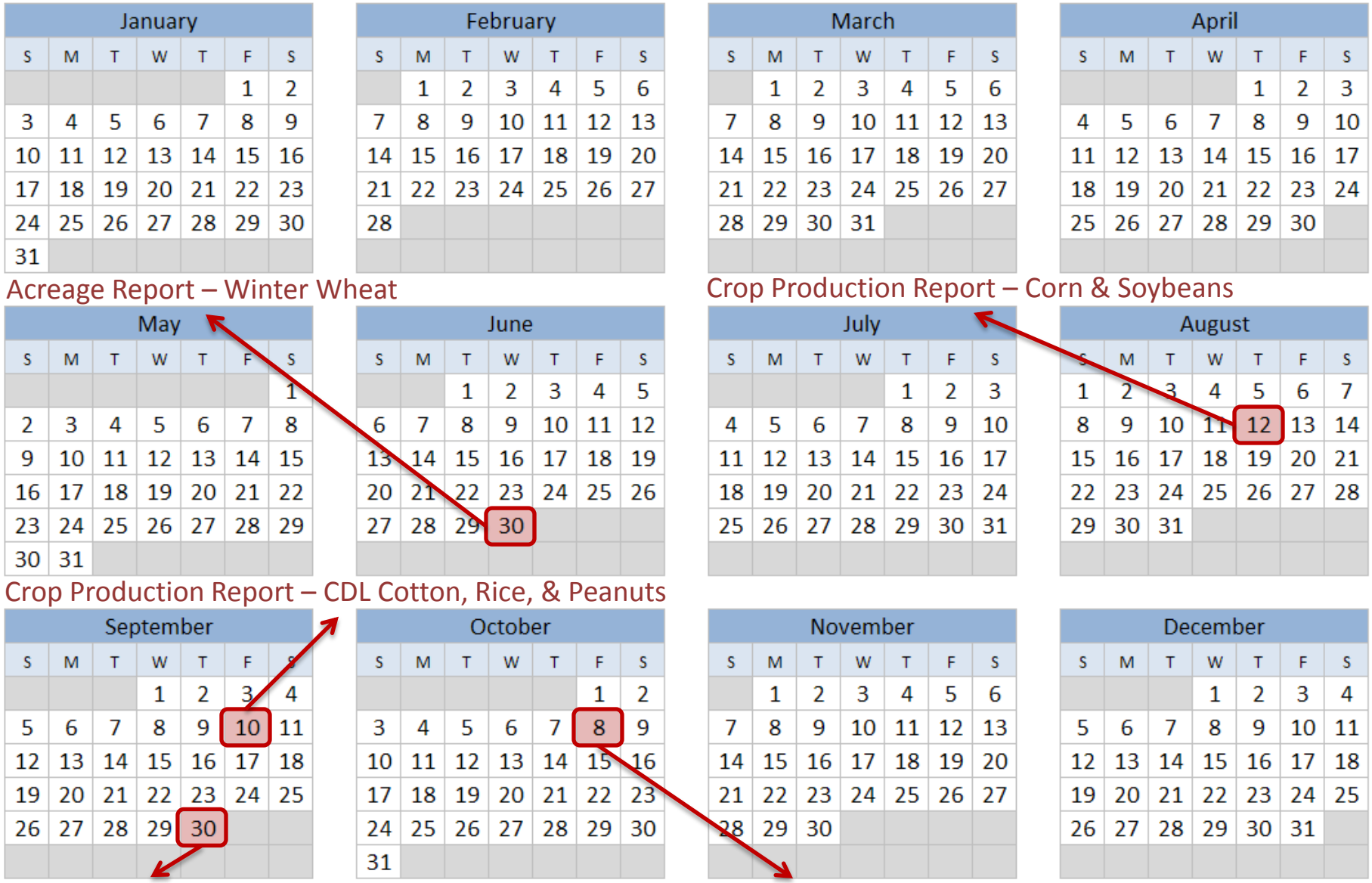
What is a Crop Land Data Layer (CDL)?

A tool to identify agriculture type and location

Each pixel represents a type of crop or land cover

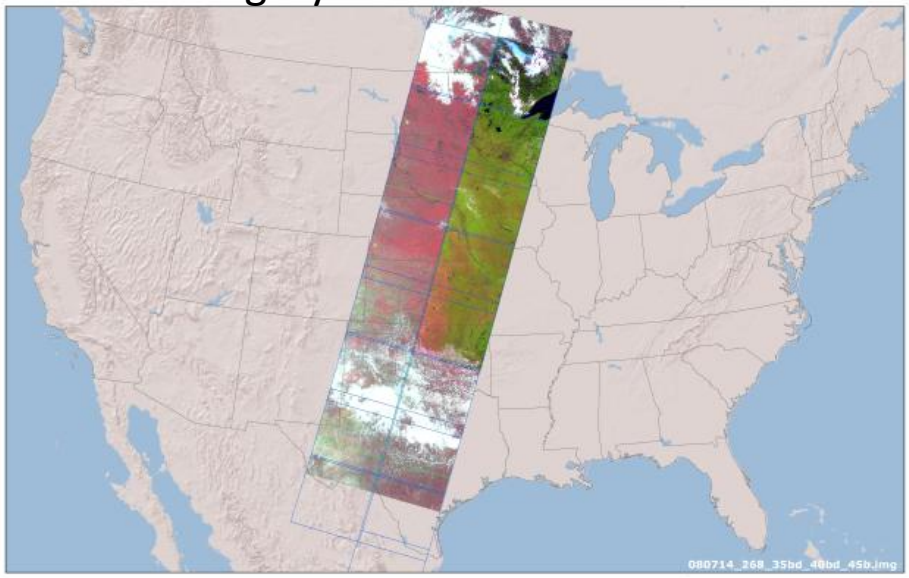


2010 CDL Production Schedule

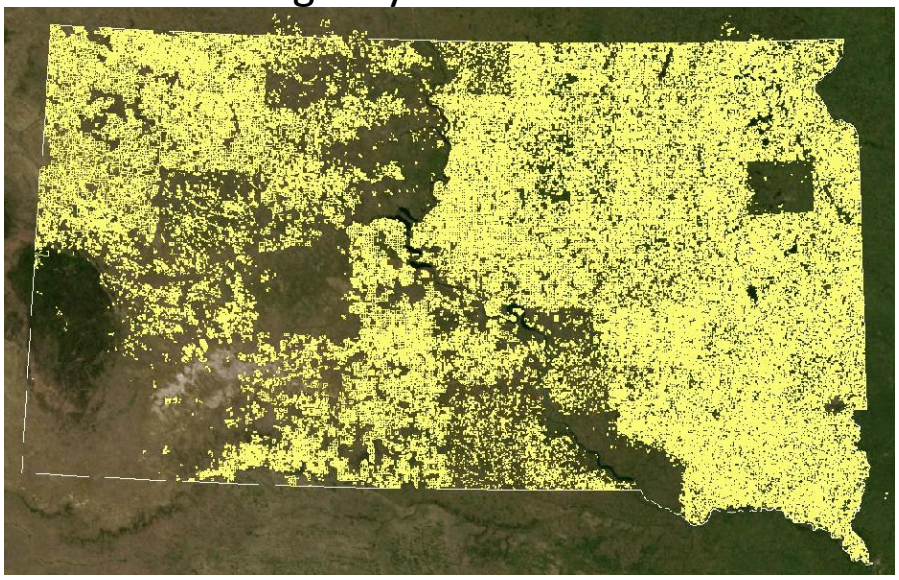


Inputs

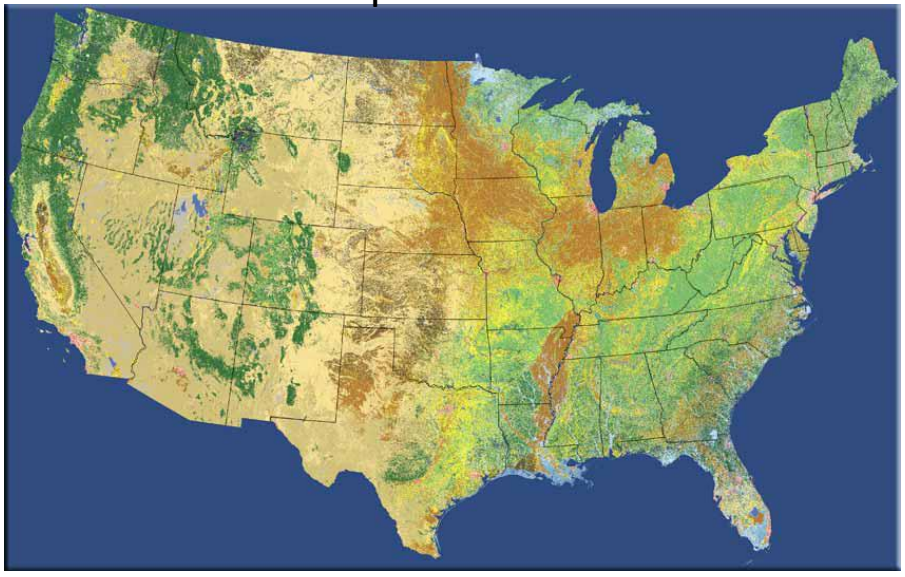
Satellite Imagery - AWiFS & Landsat TM



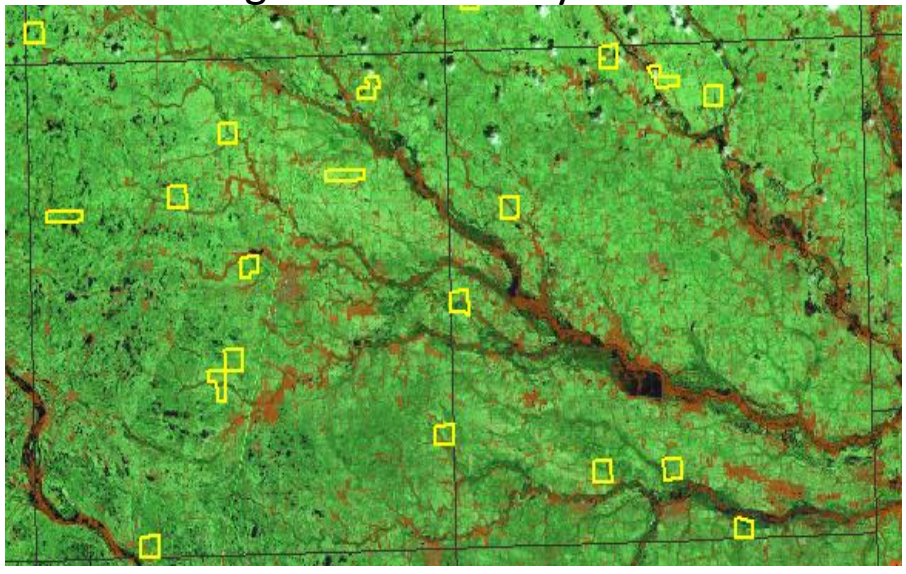
Farm Service Agency – Common Land Unit



NLCD & Derivative products



NASS June Agriculture Survey



Software Suite

Ground Truth Preparation
- ESRI ArcMap

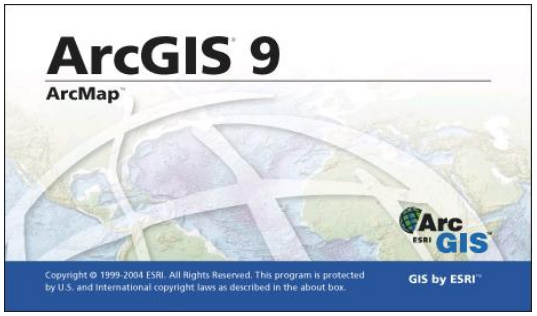
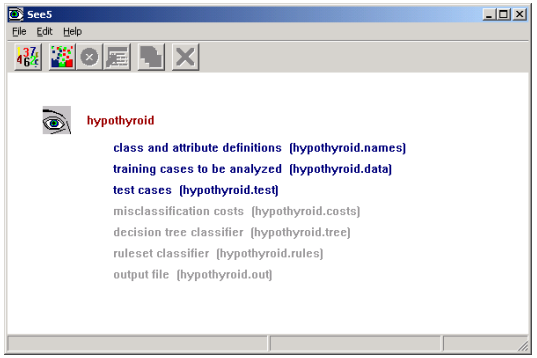


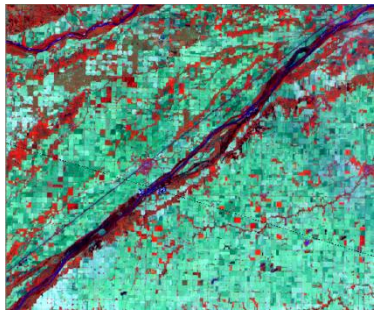
Image Preparation
- Leica Geosystems ERDAS Imagine 9.1

Image Classification
- See 5



Acreage Estimates
- SAS/IML Workshop

Satellite Images over time



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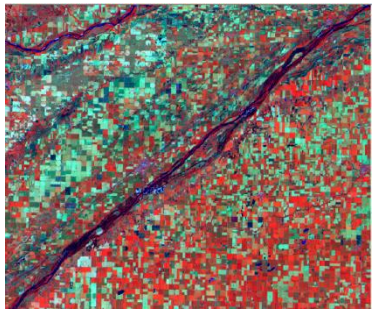
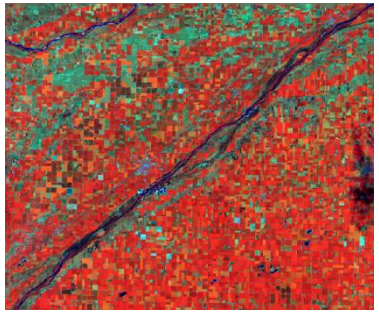
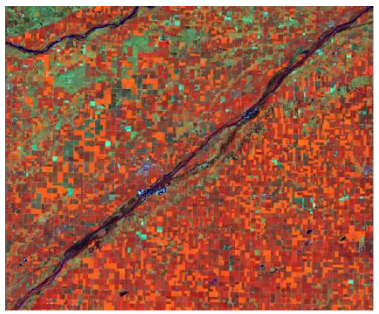


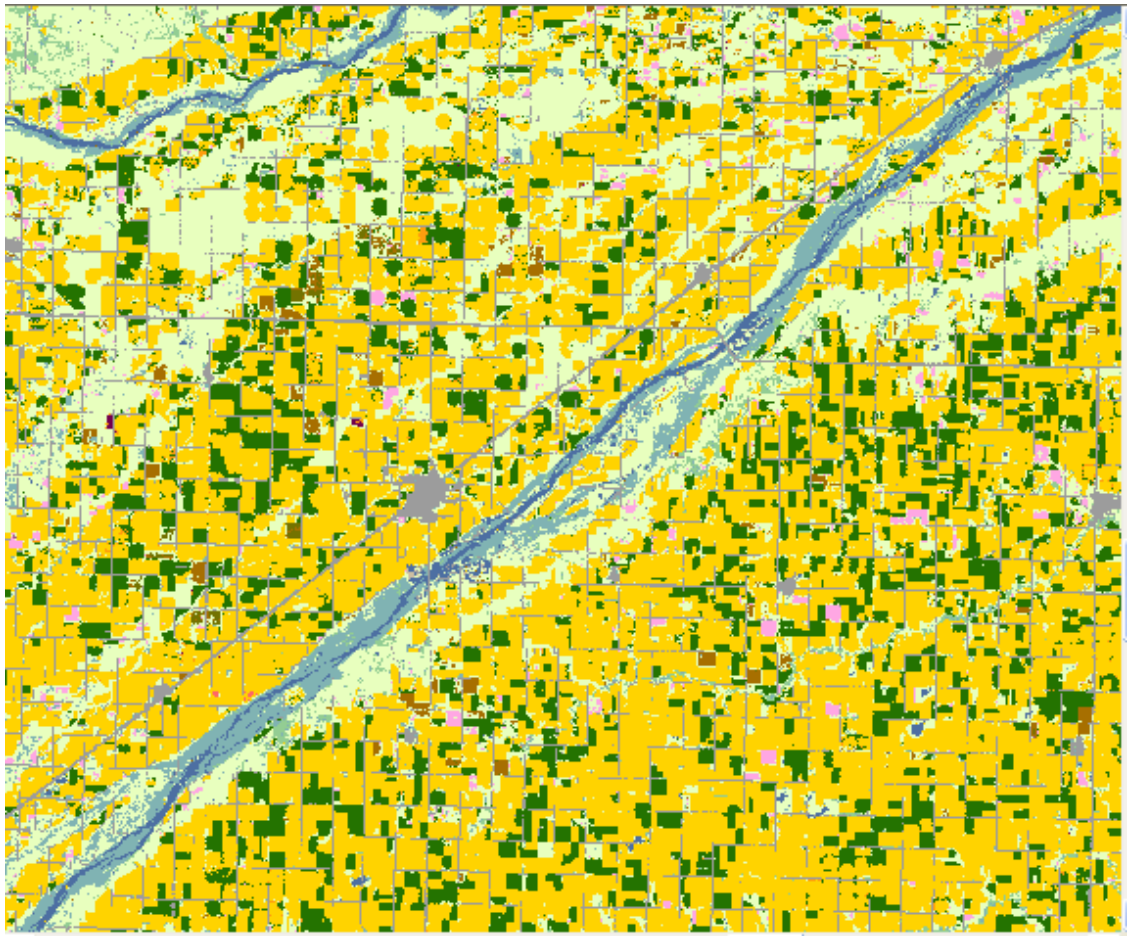
June 21



July 15



Aug 27



Ground Truth – Land Cover

Agriculture Ground Truth

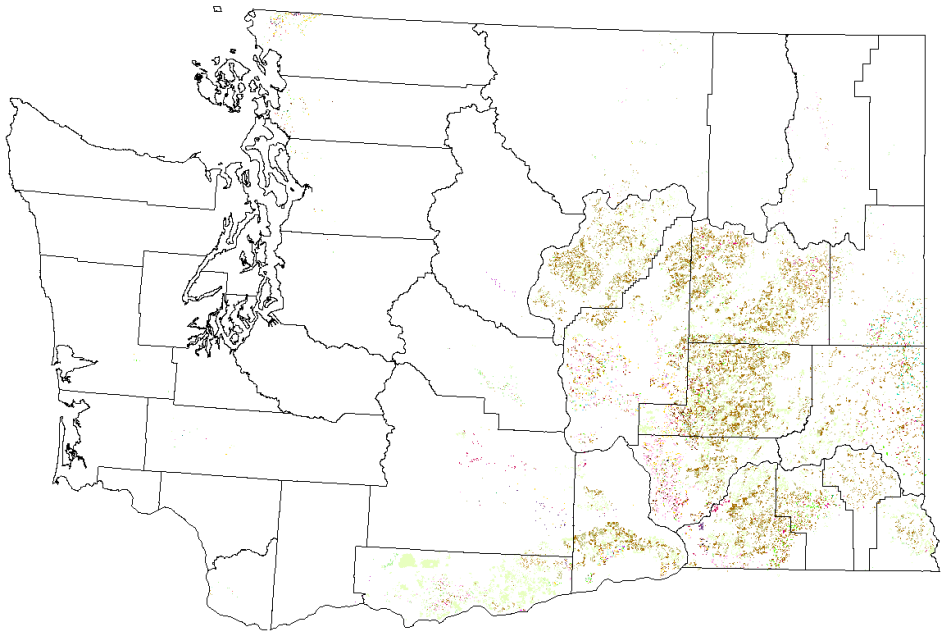
Provided by Farm Service Agency

Identifies known fields and crops

Divide known fields into 2 sets

½ used for training software

½ used for validating results

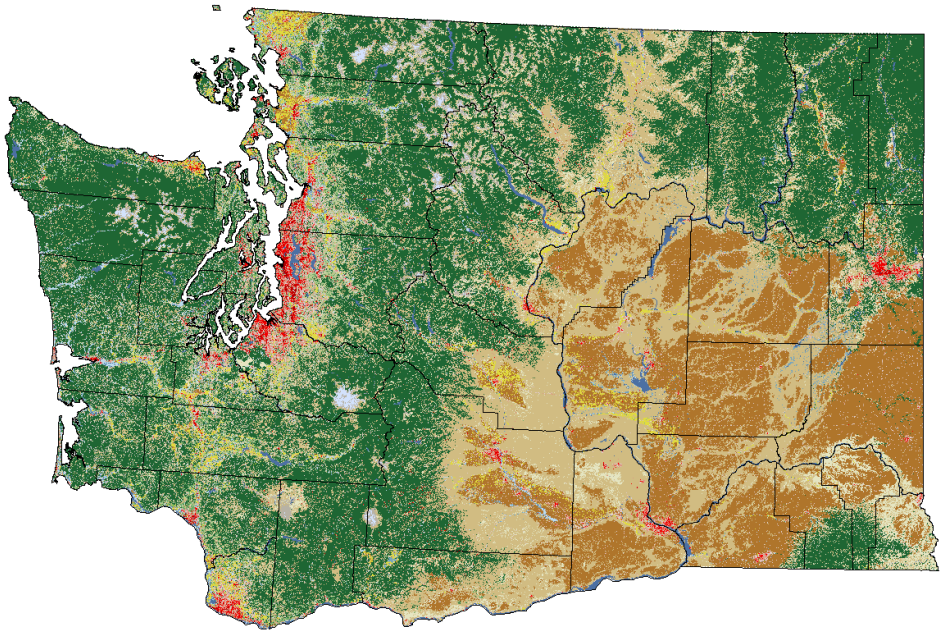


Non-Agriculture Ground Truth

USGS National Land Cover Dataset

Identifies urban infrastructure and non-agriculture land cover

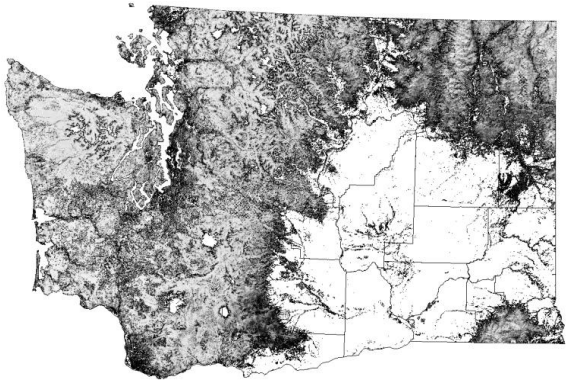
Forest, grass, water, cities



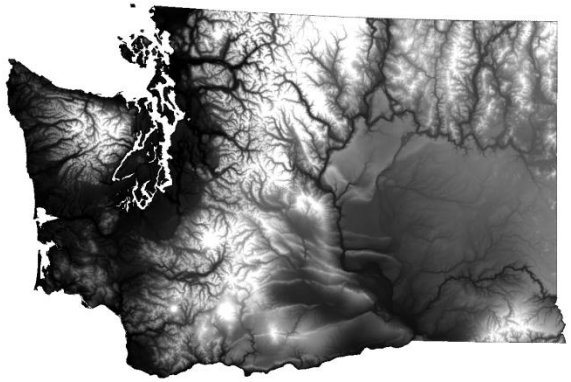
Ground Truth – Ancillary

US Geological Survey

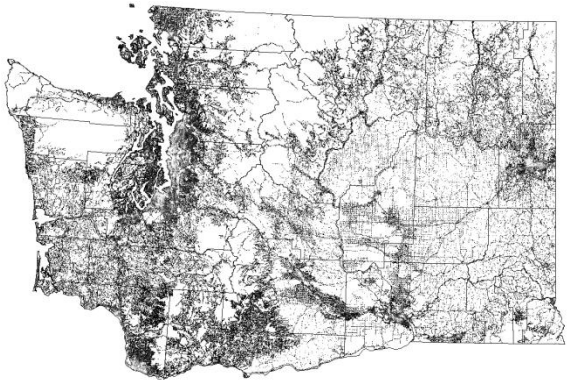
Forest Canopy



Elevation

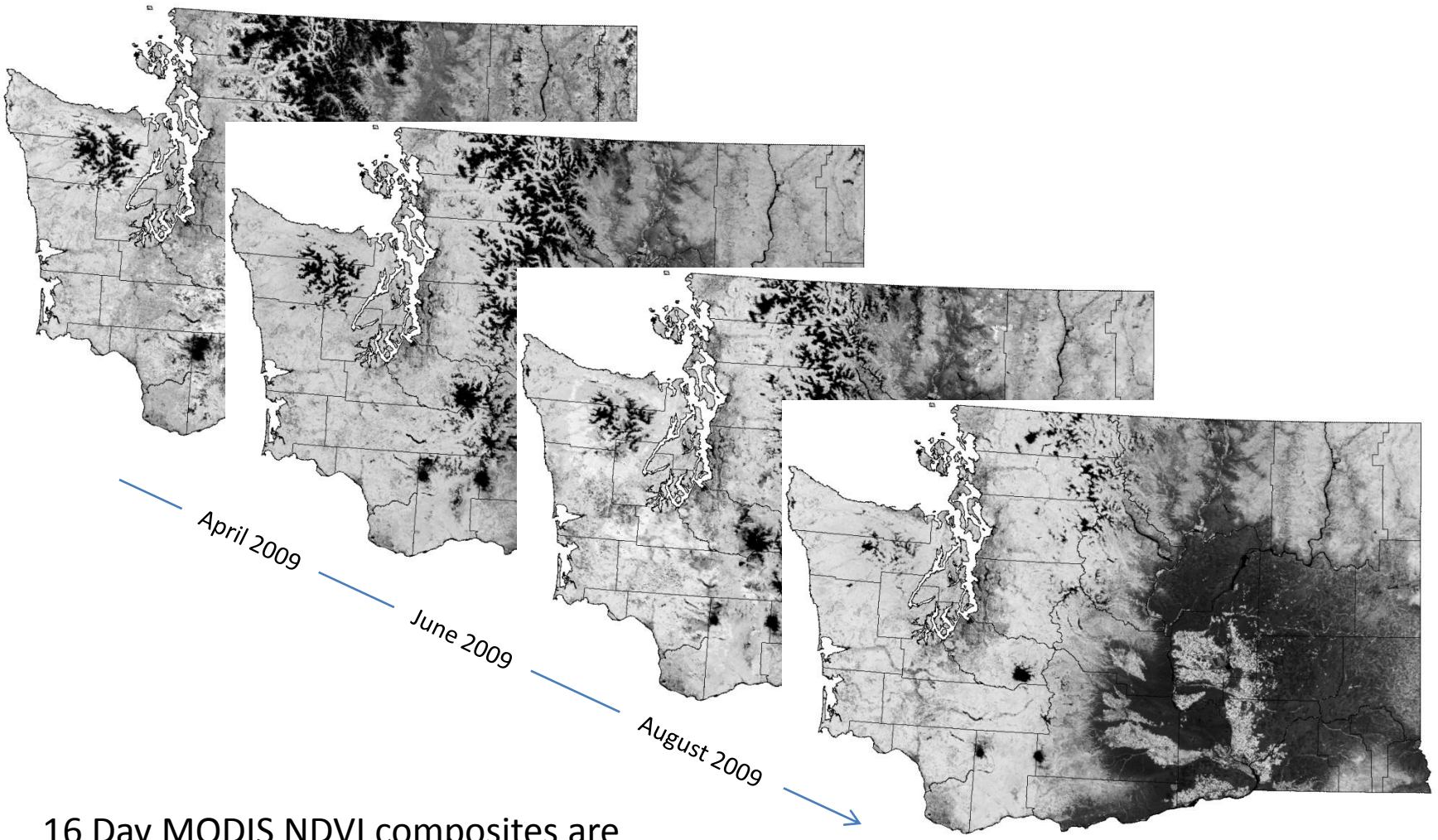


Impervious Surfaces



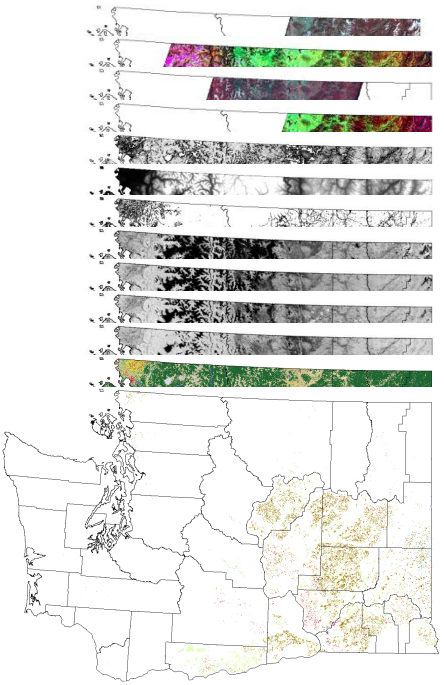
Ancillary datasets help separate the agricultural landscape; determining agricultural potential

MODIS



16 Day MODIS NDVI composites are used to identify winter wheat fields or to fill in gaps were there is little satellite coverage.

Processing a CDL



Satellite Imagery

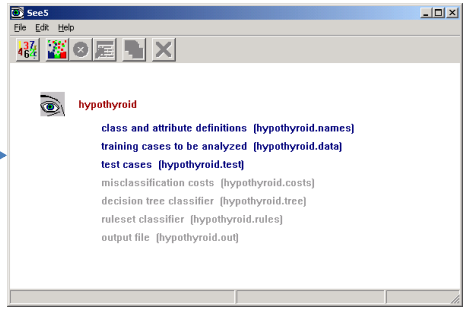
Ancillary Data

MODIS Data

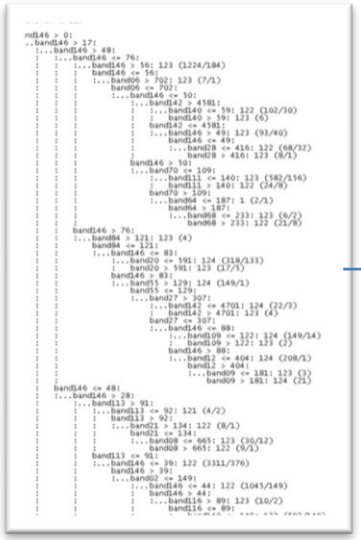
Ground Truth

Sampling

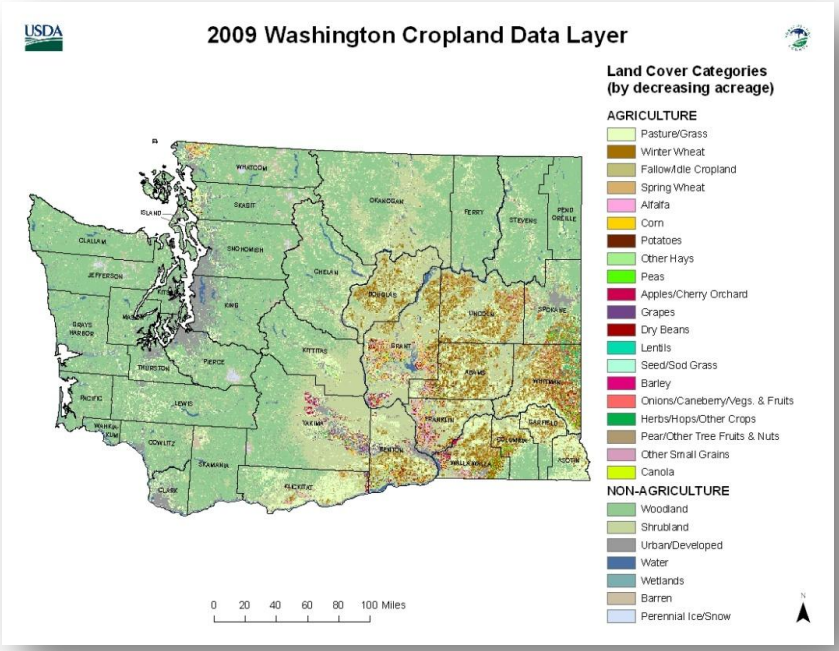
See5



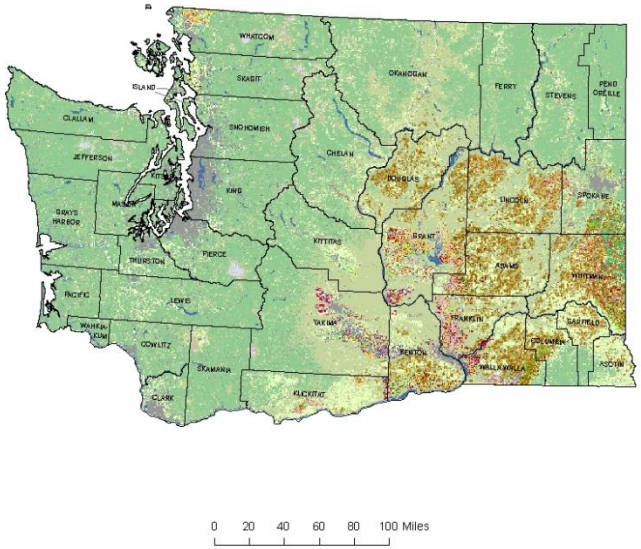
Decision Tree



Classification



2009 Washington Cropland Data Layer

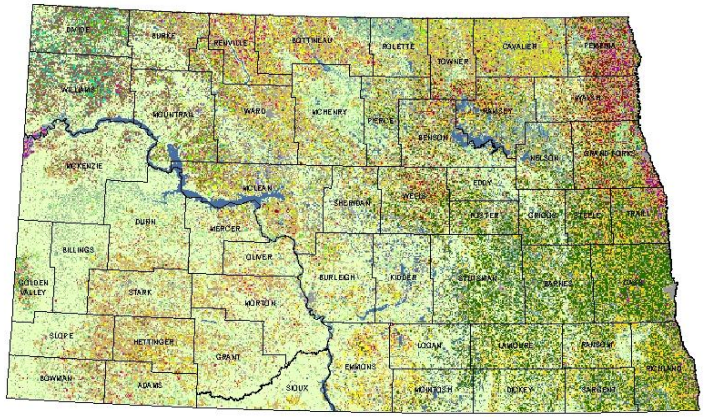


Land Cover Categories (by decreasing acreage)

AGRICULTURE
- Pasture/Grass
- Winter Wheat
- Fallow/Idle Cropland
- Spring Wheat
- Alfalfa
- Corn
- Potatoes
- Other Hays
- Peas
- Apples/Cherry Orchard
- Grapes
- Dry Beans
- Lentils
- Seed/Sod Grass
- Barley
- Onions/Caneberry/Vegs. & Fruits
- Herbs/Hops/Other Crops
- Pear/Other Tree Fruits & Nuts
- Other Small Grains
- Canola

NON-AGRICULTURE
- Woodland
- Shrubland
- Urban/Developed
- Water
- Wetlands
- Barren
- Perennial Ice/Snow

2009 North Dakota Cropland Data Layer

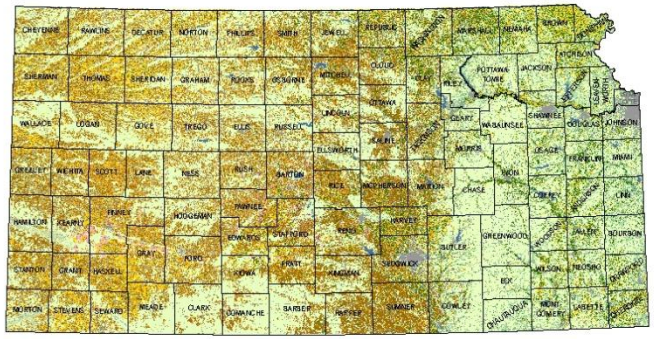


Land Cover Categories (by decreasing acreage)

AGRICULTURE
- Pasture/Grass
- Spring Wheat
- Soybeans
- Other Hays
- Corn
- Durum Wheat
- Canola
- Sunflowers
- Dry Beans
- Barley
- Winter Wheat
- Peas
- Alfalfa
- Fallow/Idle Cropland
- Flaxseed
- Sugarbeets
- Lentils
- Oats
- Potatoes
- Other Crops/Vegs./Fruits
- Millet
- Safflower
- Sorghum
- Rye
- Seed/Sod Grass

NON-AGRICULTURE
- Urban/Developed
- Wetlands
- Water
- Woodland
- Shrubland

2009 Kansas Cropland Data Layer



Land Cover Categories (by decreasing acreage)

AGRICULTURE
- Pasture/Grass
- Winter Wheat
- Corn
- Fallow/Idle Cropland
- Soybeans
- Sorghum
- Alfalfa
- W. Wht./Soy. Dbl. Crop
- Sunflowers
- Rye
- Cotton
- Other Crops/Vegs./Tree Nuts
- Other Small Grains
- Oats

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

0 20 40 60 80 100 Miles

2009 Arkansas Cropland Data Layer

Land Cover Categories (by decreasing acreage)

AGRICULTURE
- Pasture/Grass
- Soybeans
- Rice
- Cotton
- Fallow/Idle Cropland
- Corn
- W. Wht./Soy. Dbl. Crop
- Winter Wheat
- Sorghum
- Aquaculture
- Other Crops/Vegs. & Fruits
- Other Tree Nuts

NON-AGRICULTURE
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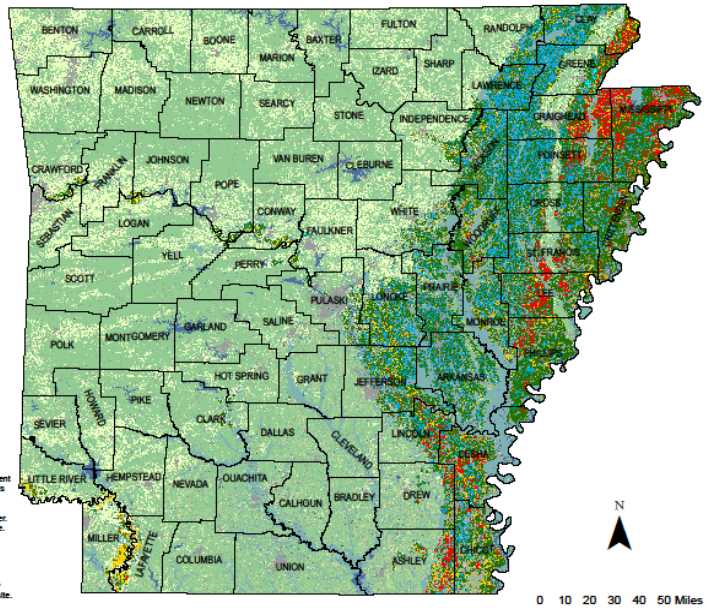
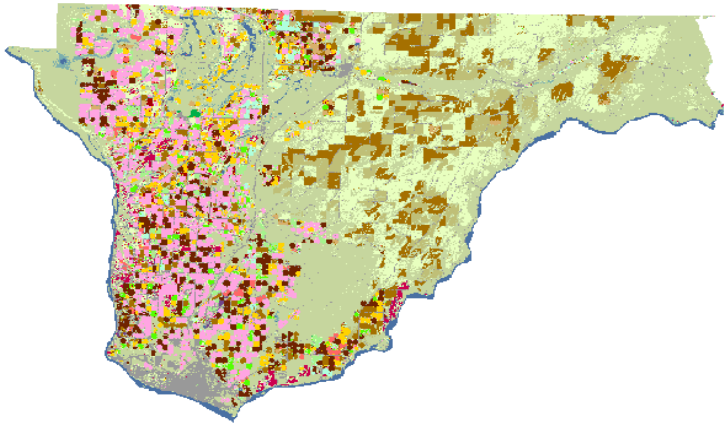
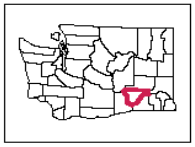
- Wetlands
- Urban/Developed
- Shrubland
- Water
- Barren



Produced by: U. S. Department of Agriculture, National Agricultural Statistics Service, Research and Development Division, Geospatial Information Branch, Spatial Analysis Research Section.
Data Source: Resourcesat-1 AWIFS courtesy of USDA Foreign Agricultural Service, Landsat 5 Thematic Mapper.
Image Processing: Ruiequest See5 and ERDAS Imagine.
Ground Truth: The Farm Service Agency Common Land Unit for crops classes, and 2001 National Land Cover Dataset (NLCD) for non-agricultural classes.
Ancillary Data: NLCD Impervious Surface, NLCD Forest Canopy, National Elevation Dataset, and Moderate Resolution Imagery Spectroradiometer (MODIS) 16 day Normalized Difference Vegetation Index (NDVI) composite.
Projection: UTM zone 15, WGS84 datum.
Map Production: ESRI ArcGIS 9.3.1.

2009 Franklin County, Washington





Land Cover Categories

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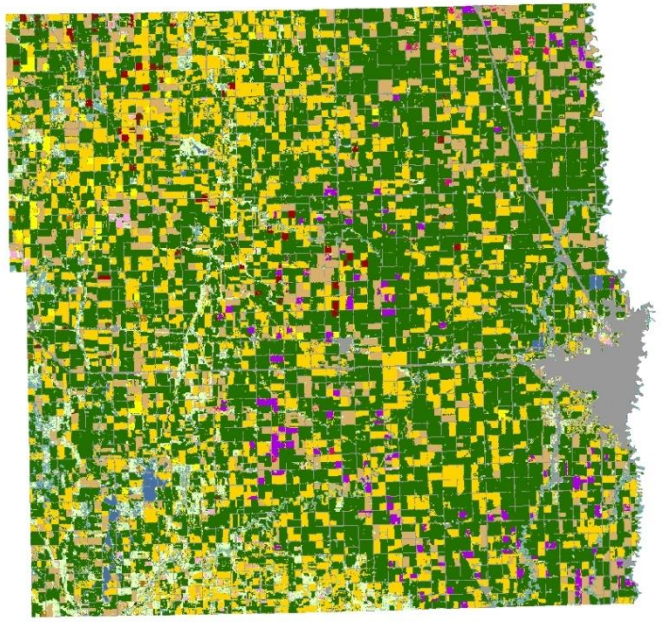
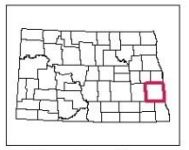
- Grapes
- Dry Beans
- Lentils
- Seed/Sod Grass
- Barley
- Onions/Caneberry/Vegs. & Fruits
- Herbs/Hops/Other Crops
- Pear/Other Tree Fruits & Nuts
- Other Small Grains
- Canola

NON-AGRICULTURE
- Woodland
- Shrubland
- Urban/Developed
- Water
- Wetlands
- Barren
- Perennial Ice/Snow

N

2009 Cass County, North Dakota





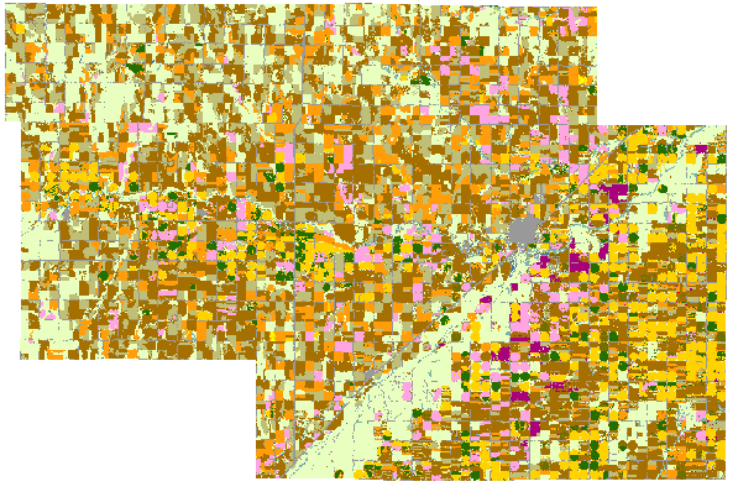
Land Cover Categories

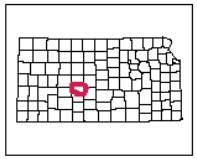
AGRICULTURE
- Pasture/Grass
- Spring Wheat
- Soybeans
- Other Hays
- Corn
- Durum Wheat
- Canola
- Sunflowers
- Dry Beans
- Barley
- Winter Wheat
- Peas
- Alfalfa
- Fallow/Idle Cropland
- Flaxseed
- Sugarbeets
- Lentils
- Oats
- Potatoes
- Other Crops/Vegs./Fruits
- Millet
- Safflower
- Sorghum
- Rye
- Seed/Sod Grass

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

N

2009 Pawnee County, Kansas





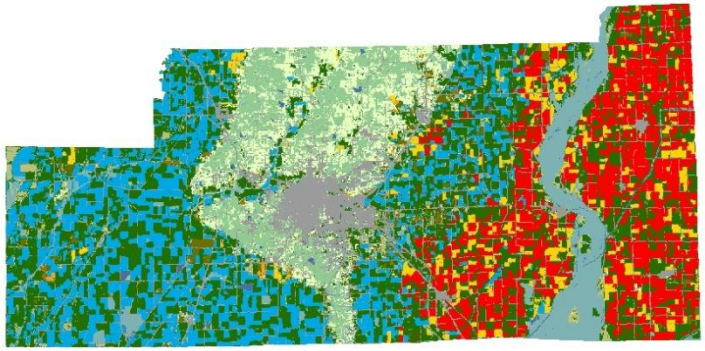
Land Cover Categories

AGRICULTURE
- Pasture/Grass
- Winter Wheat
- Corn
- Fallow/Idle Cropland
- Soybeans
- Sorghum
- Alfalfa
- W. Wht./Soy. Dbl. Crop
- Sunflowers
- Rye
- Cotton
- Other Crops/Vegs./Tree Nuts
- Other Small Grains
- Oats

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

N

2009 Craighead County, Arkansas



Land Cover Categories

AGRICULTURE
- Pasture/Grass
- Soybeans
- Rice
- Cotton
- Fallow/Idle Cropland
- Corn
- W. Wht./Soy. Dbl. Crop
- Winter Wheat
- Sorghum
- Aquaculture
- Other Crops/Vegs. & Fruits
- Other Tree Nuts

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

N

Validating CDLs

We measure the accuracy of each CDL

Compare

Classified pixels from CDL

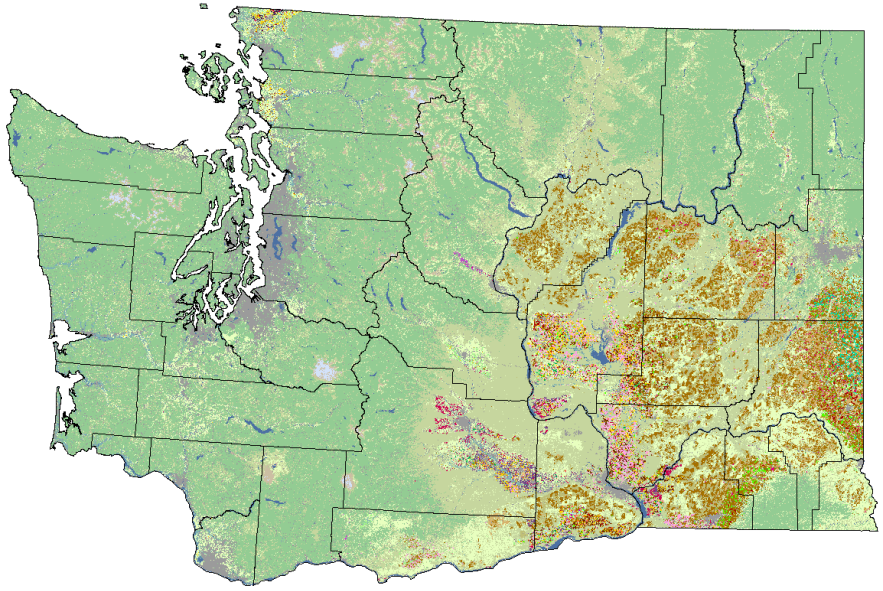
Known pixels, not used for classifying imagery, from FSA

Track

Producer Accuracy & Errors of Omission - % of pixels from category missing

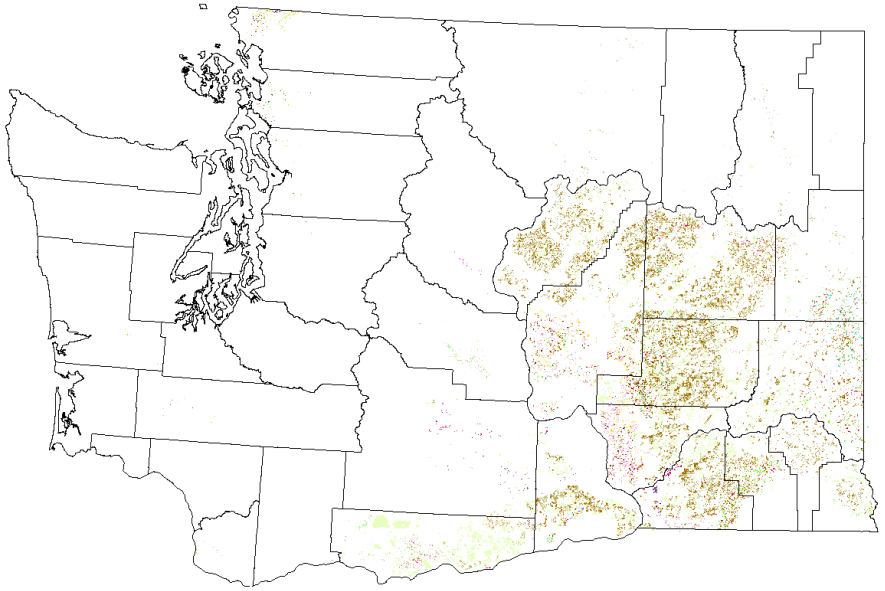
User Accuracy & Errors of Commission - % of pixels from category that are over classified

Cropland Data Layer



versus

Groundtruth – ½ saved for validation



Accuracy Assessments

STATEWIDE AGRICULTURAL ACCURACY REPORT

Crop-specific covers only	*Correct	Accuracy	Error	Kappa
OVERALL ACCURACY**	645164	90.05%	9.95%	0.8663

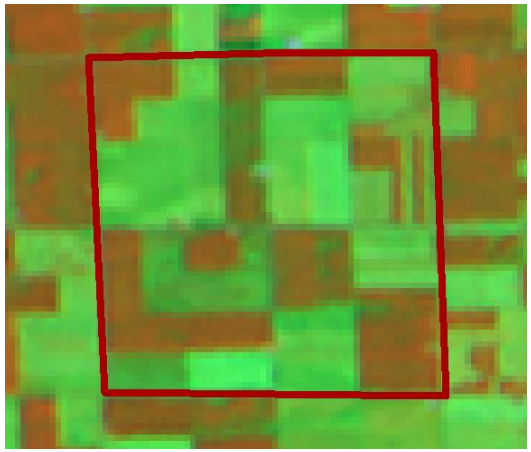
Cover Type	Attribute Code	*Correct Pixels	Producer's Accuracy	Omission Error	Kappa	User's Accuracy	Commission Error	Cond'l Kappa
Corn	1	13258	84.61%	15.39%	0.8438	90.54%	9.46%	0.9039
Sorghum	4	0	0.00%	100.00%	0.0000	n/a	n/a	n/a
Soybeans	5	0	0.00%	100.00%	0.0000	0.00%	100.00%	0.0000
Sweet Corn	12	5671	74.53%	25.47%	0.7436	87.17%	12.83%	0.8707
Mint	14	475	69.55%	30.45%	0.6953	81.76%	18.24%	0.8174
Barley	21	3229	52.89%	47.11%	0.5269	77.49%	22.51%	0.7735
Spring Wheat	23	58526	85.00%	15.00%	0.8393	87.80%	12.20%	0.8690
Winter Wheat	24	254045	95.94%	4.06%	0.9446	95.30%	4.70%	0.9361
Other Small Grains	25	85	9.00%	91.00%	0.0898	30.36%	69.64%	0.3029
Rye	27	0	n/a	n/a	n/a	0.00%	100.00%	0.0000
Oats	28	3	0.53%	99.47%	0.0052	6.25%	93.75%	0.0620
Speltz	30	0	0.00%	100.00%	0.0000	n/a	n/a	n/a
Canola	31	269	38.21%	61.79%	0.3819	66.92%	33.08%	0.6689
Safflower	33	0	n/a	n/a	n/a	0.00%	100.00%	0.0000
Rape Seed	34	0	n/a	n/a	n/a	0.00%	100.00%	0.0000
Mustard	35	494	61.83%	38.17%	0.6180	75.30%	24.70%	0.7529
Alfalfa	36	27815	85.17%	14.83%	0.8471	91.30%	8.70%	0.9100
Other Hays	37	8786	42.27%	57.73%	0.4165	83.41%	16.59%	0.8305
Camelina	38	0	0.00%	100.00%	0.0000	n/a	n/a	n/a
Sugarbeets	41	286	83.87%	16.13%	0.8387	99.65%	0.35%	0.9965
Dry Beans	42	4822	77.36%	22.64%	0.7722	77.05%	22.95%	0.7691
Potatoes	43	16223	90.74%	9.26%	0.9058	96.82%	3.18%	0.9676
Other Crops	44	9	4.35%	95.65%	0.0435	39.13%	60.87%	0.3912
Misc. Vegs. & Fruits	47	513	38.69%	61.31%	0.3865	87.10%	12.90%	0.8708
Watermelon	48	0	0.00%	100.00%	0.0000	n/a	n/a	n/a
Onions	49	2937	91.38%	8.62%	0.9135	95.08%	4.92%	0.9506
Lentils	52	4083	75.86%	24.14%	0.7574	80.41%	19.59%	0.8030
Peas	53	9554	76.09%	23.91%	0.7581	82.74%	17.26%	0.8252

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

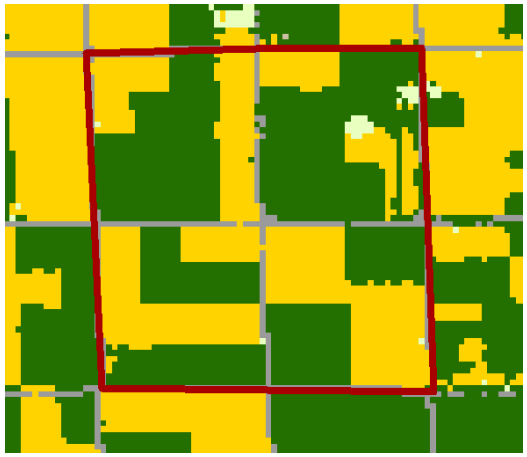
Regression-based Acreage Estimator

Acreage not just about counting pixels

The Goal: Identify areas with defined acreage totals to compare CDL pixel counts
Current Solution: June Agriculture Survey Segments



Vs.



June Ag Segment

Farmers within segment report 220 acres of corn

Crop Land Data Layer

Pixel Counting estimates 180 acres of corn

Regression-based Acreage Estimator

Acreage not just about counting pixels

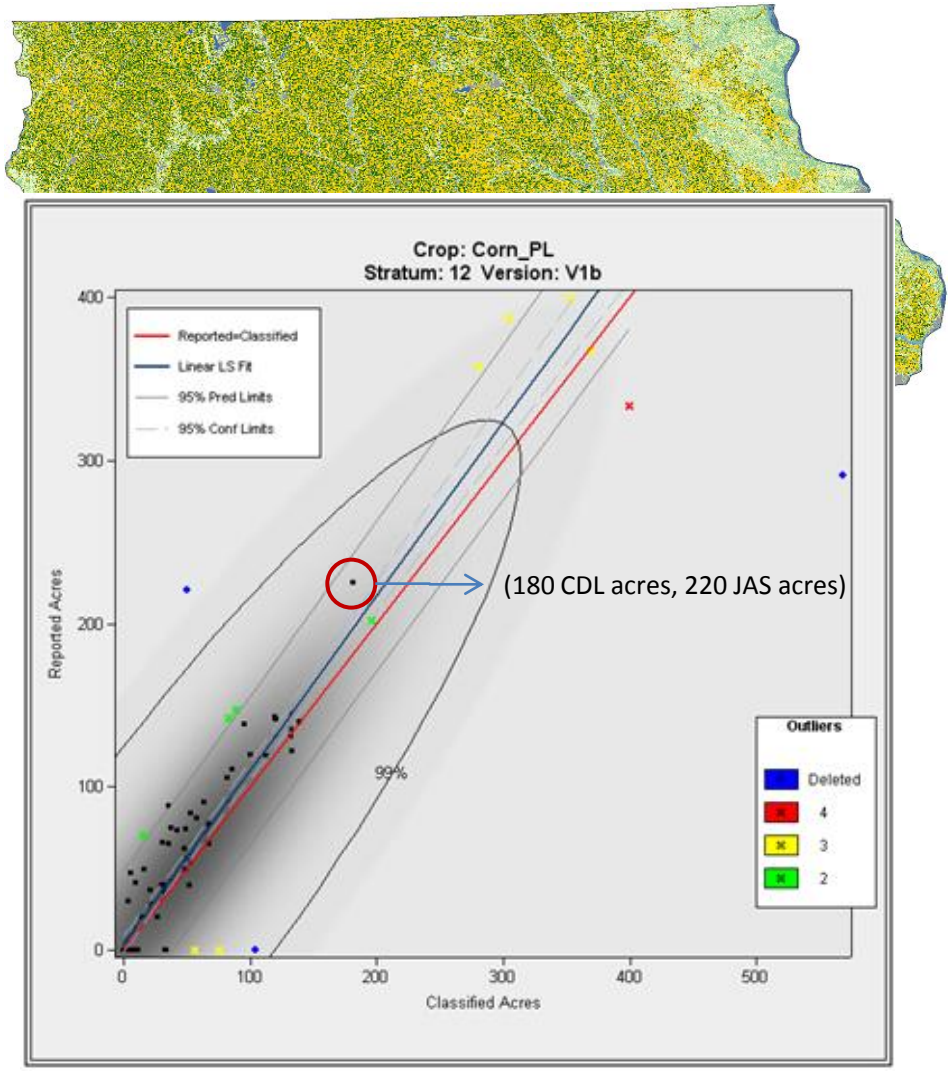
Simple Linear Regression

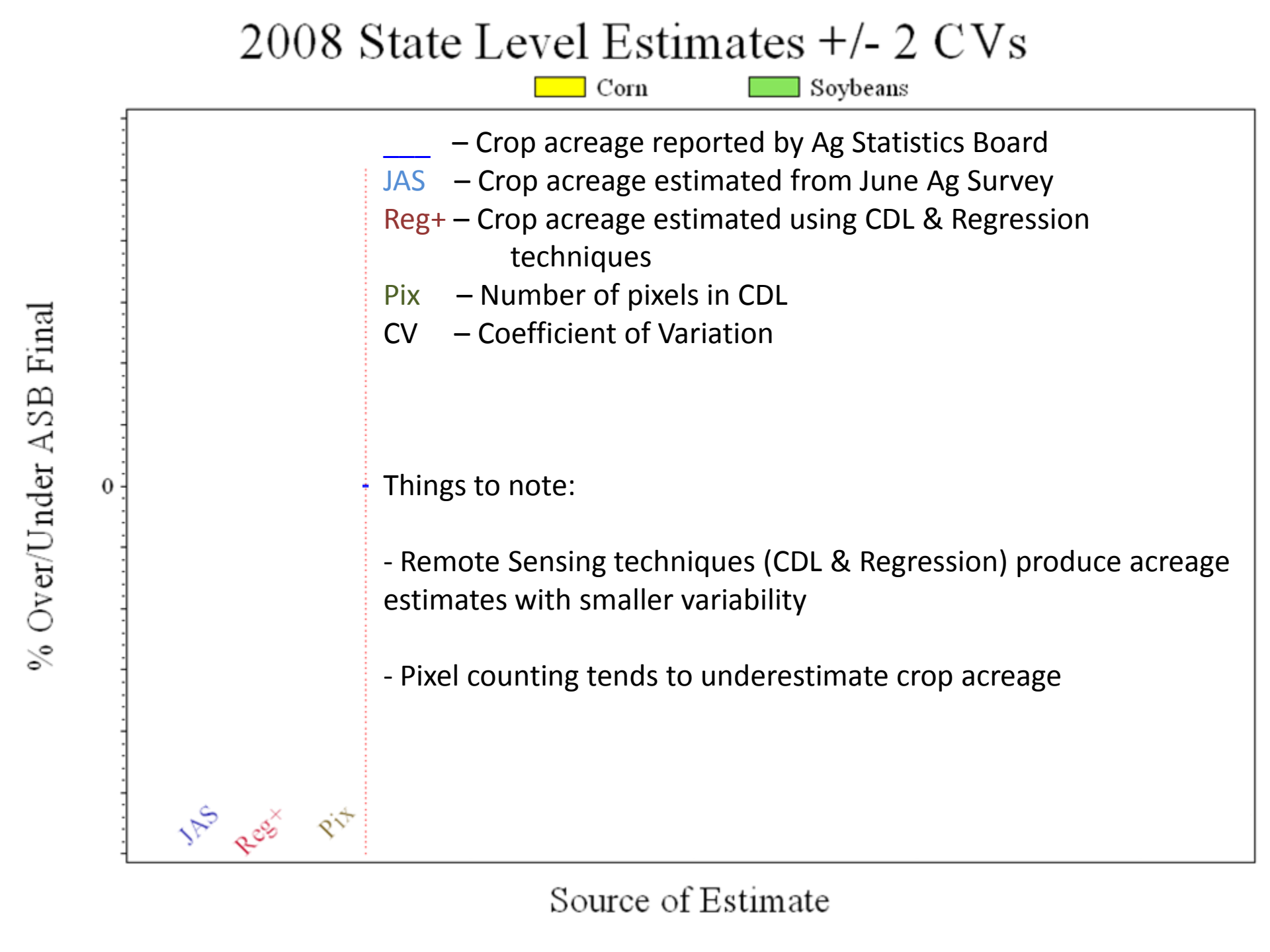
Regression used to relate categorized pixel counts to the ground reference data

- **(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




2008 State Level Estimates +/- 2 CVs
Corn
Soybeans
___ – Crop acreage reported by Ag Statistics Board
JAS – Crop acreage estimated from June Ag Survey
Reg+ – Crop acreage estimated using CDL & Regression techniques
Pix – Number of pixels in CDL
CV – Coefficient of Variation
Things to note:
- Remote Sensing techniques (CDL & Regression) produce acreage estimates with smaller variability
- Pixel counting tends to underestimate crop acreage
% Over/Under ASB Final
0
JAS
Reg+
Pix
Source of Estimate

CRP

Climate

Ecosystem

Soil Utilization

Water Use

Transportation

Pest Control

Land Cover

Epidemiology

Agribusiness

Wildlife Habitat

Irrigation

Forest

Ethanol

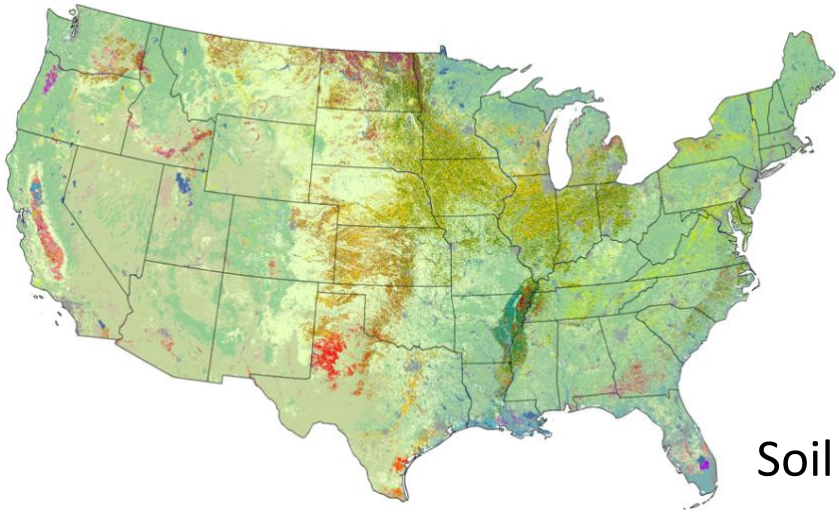
Biodiesel

Research

Pesticides

Erosion

Carbon



Crop Rotation

Crop Production

Education

Yield

Crop Intensity

Fertilizer Usage

Condition Assessment

Modeling

Soil and Water

Planning

Watersheds

Urban Growth

Commodity

Acreage Estimates

Change Detection

Environmental Risk

Land Use

Land Management

Mapping

Water Quality

Data Mining

Biofuel

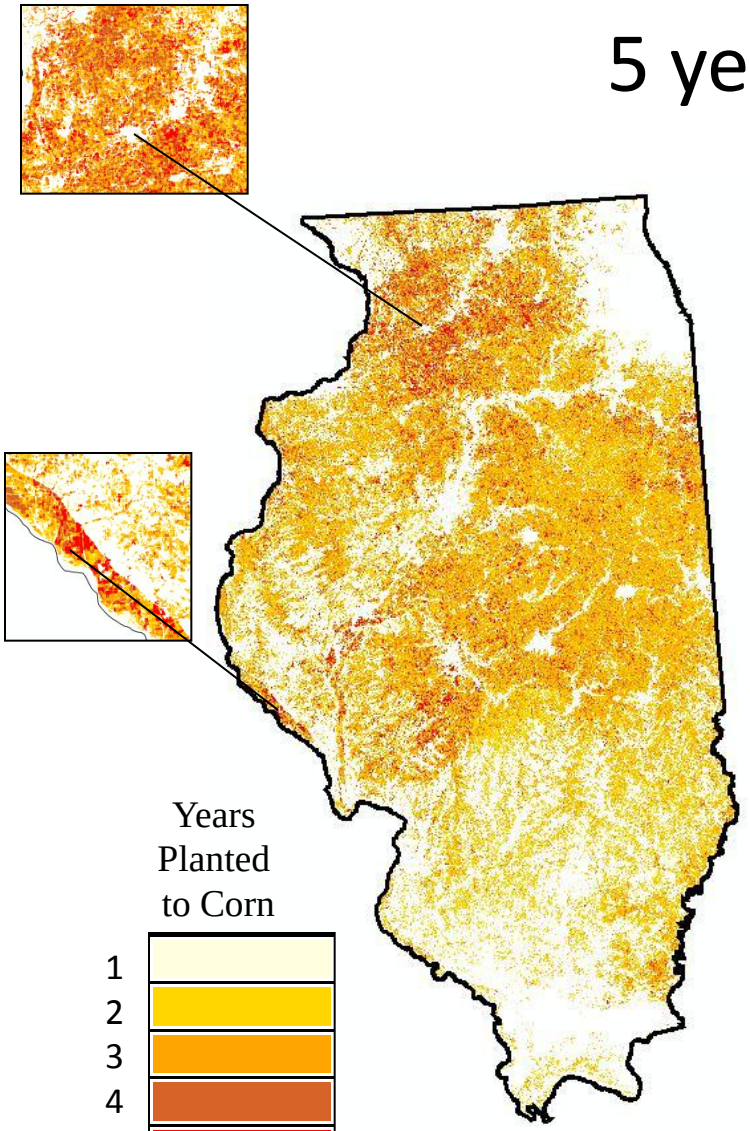
Crop Protection

Disaster Assessment

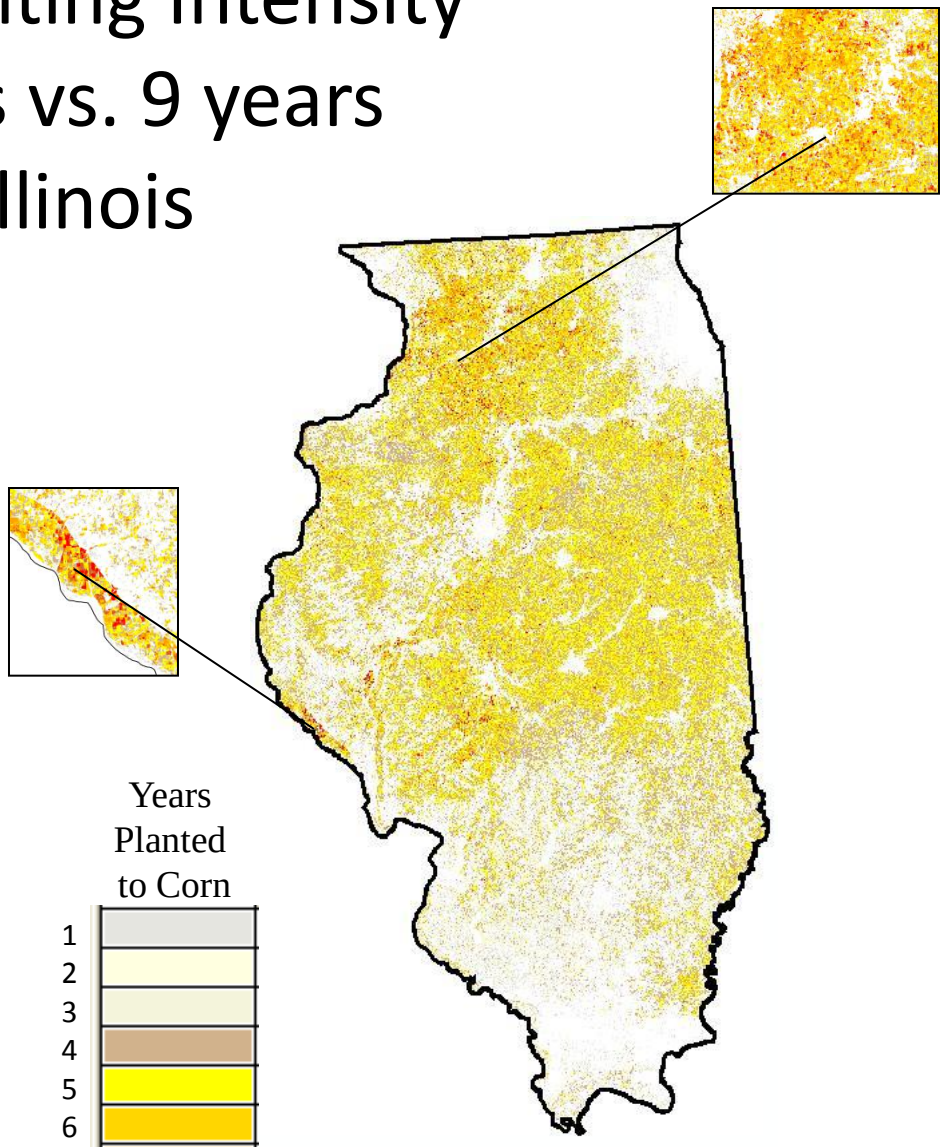
Fertilizer

Ecology

Corn Planting Intensity
5 years vs. 9 years
Illinois

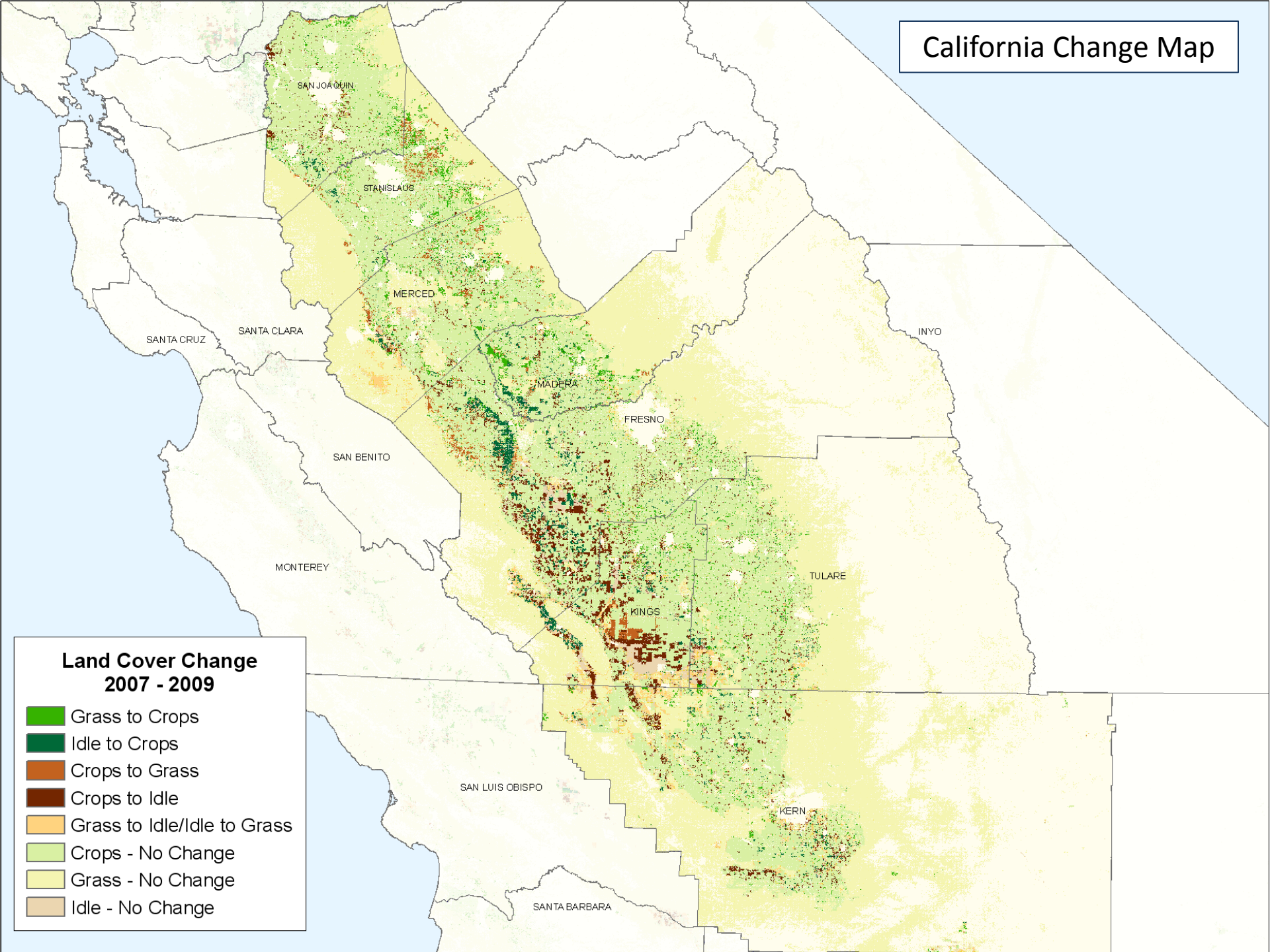


2003-2007



1999-2007

California Change Map



Thank You
Any Questions?

Hosted @ NRCS Geospatial Data Gateway &
http://www.nass.usda.gov/research/Cropland/SARS1a.htm