Research to Operational: A Paradigm Shift for the Cropland Data Layer Program

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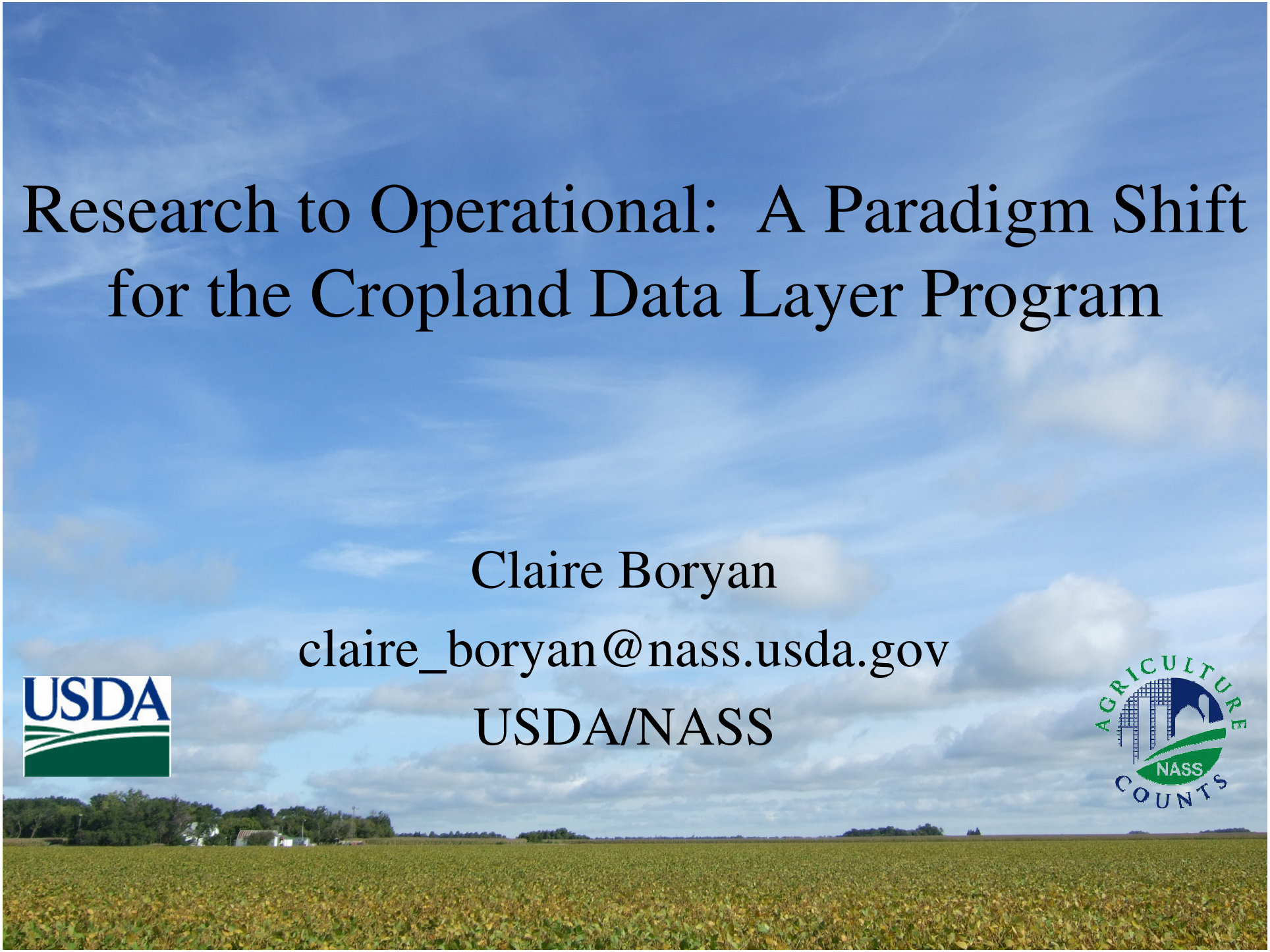
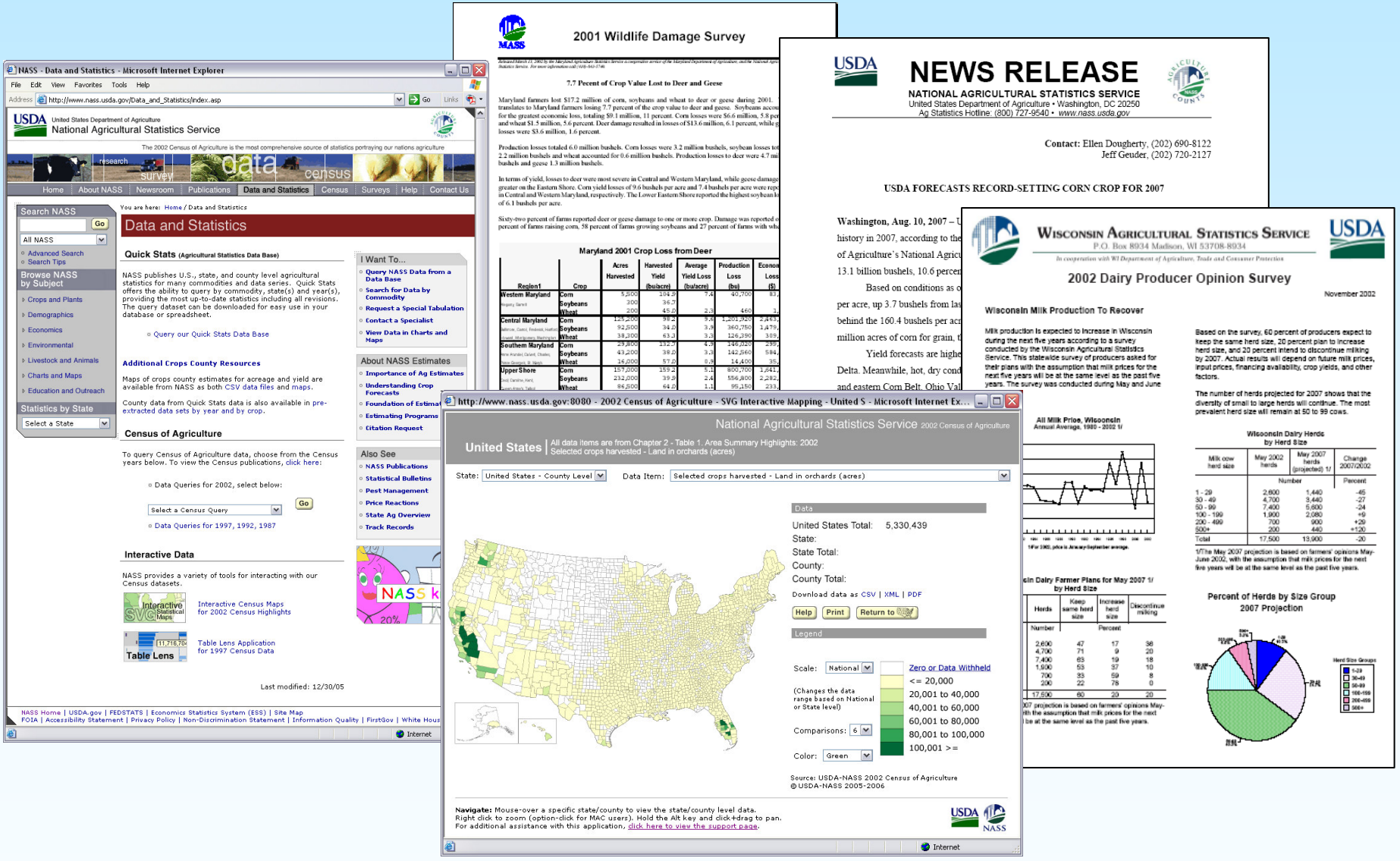
USDA/NASS



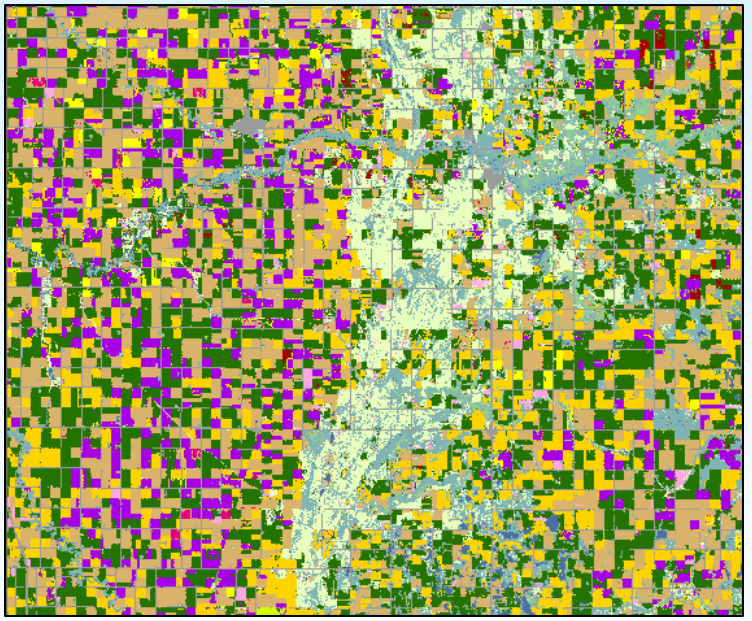
NASS Overview

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



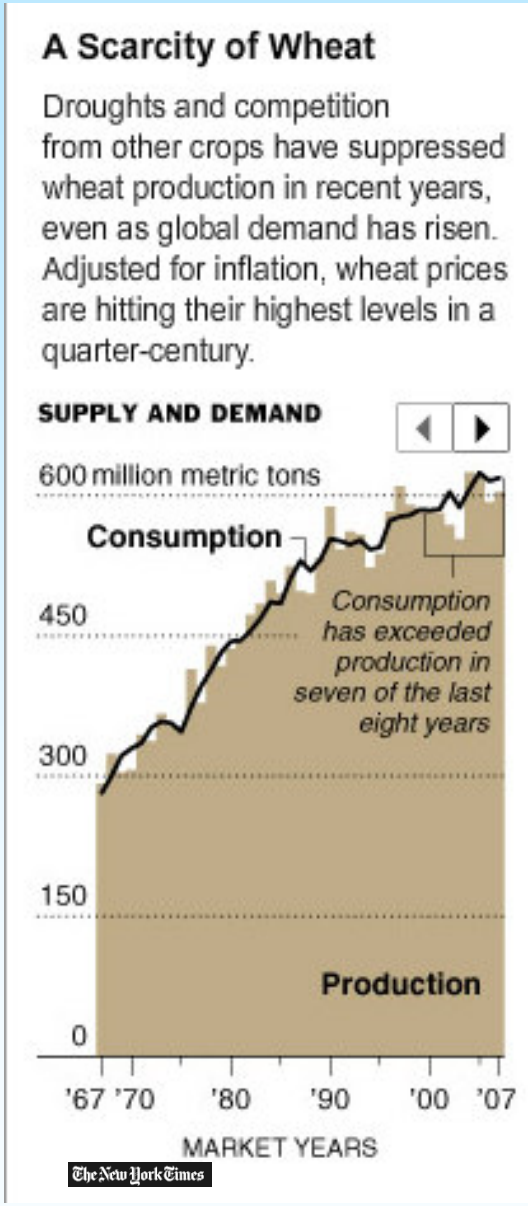
Cropland Data Layer Program Objectives

- "Census by Satellite"
  - Without area duplication
  - Major corn and soybean regions
- Provide timely, accurate, useful independent estimates
  - Measurable error
  - County and state level
- Deliver estimates months earlier
  - October estimates (Operational) to meet Agricultural Statistics Board deadline
  - December estimates (Research)



Acreage estimates are essential for…….

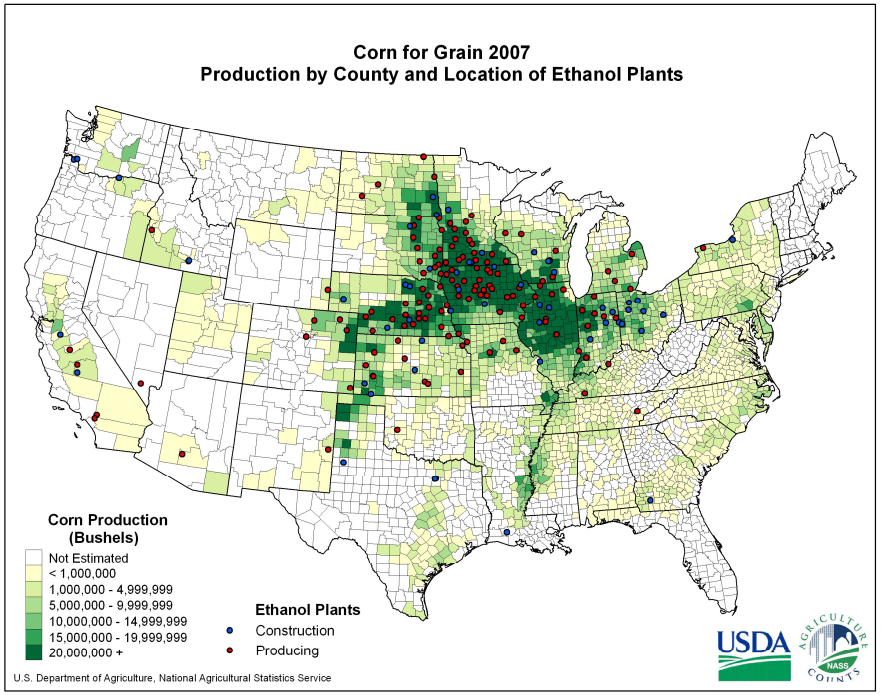
- the smooth operation of Federal farm programs.
- farmers who rely on them in making production and marketing decisions.



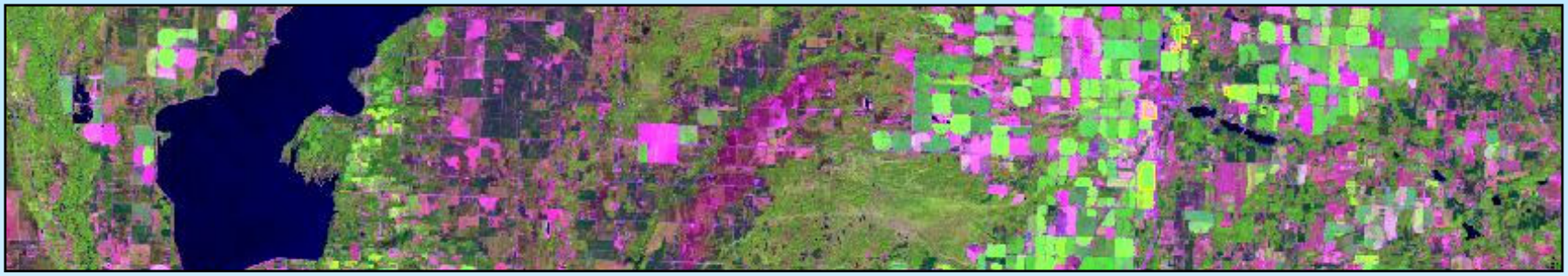
Acreage estimates are essential for…….

- planning and administering Federal and State programs in areas such as conservation, environmental quality, trade and food safety.

- agribusiness including: the transportation sector, storage companies, banks and other lending institutions, commodity traders and food processors.

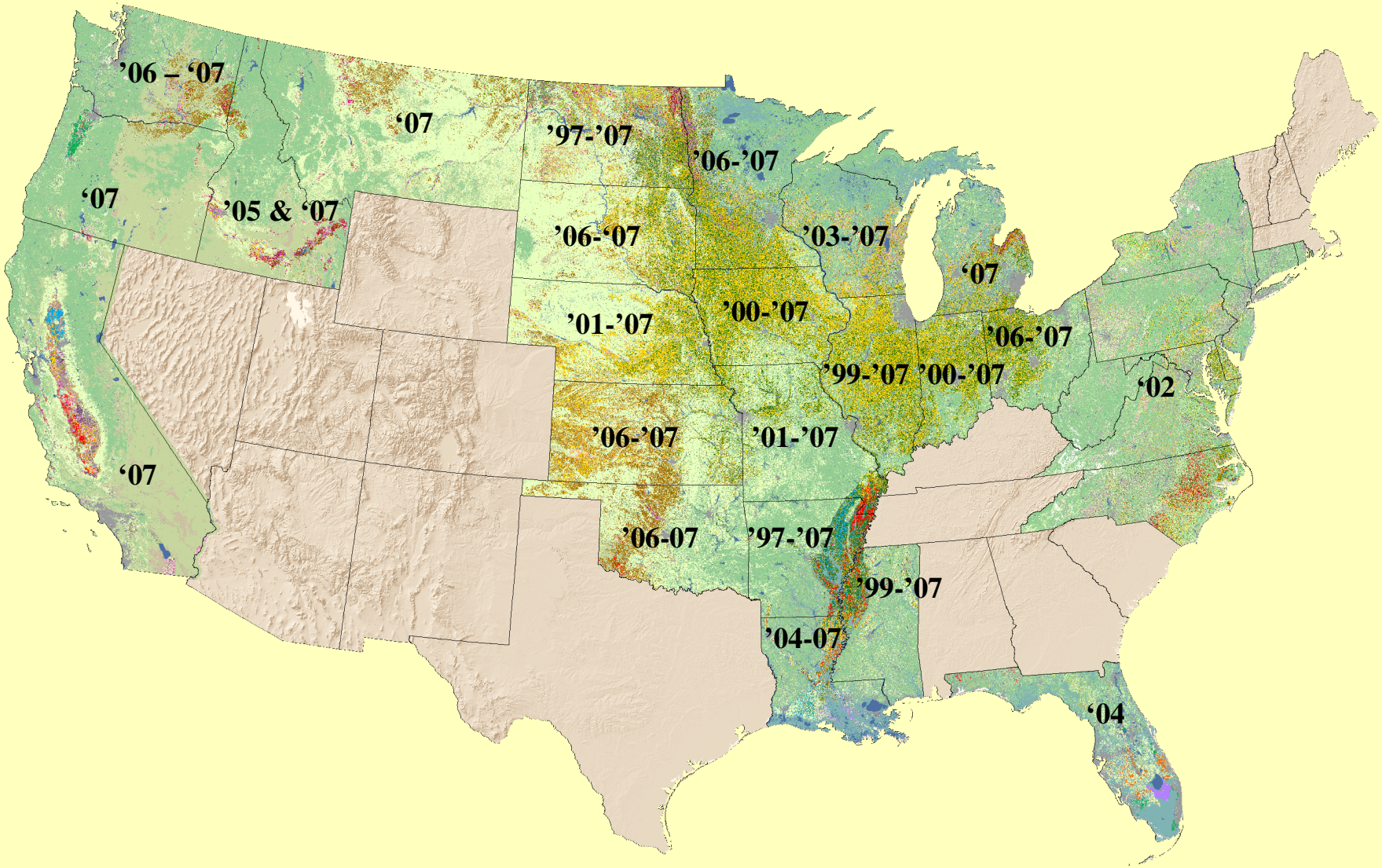


Agenda

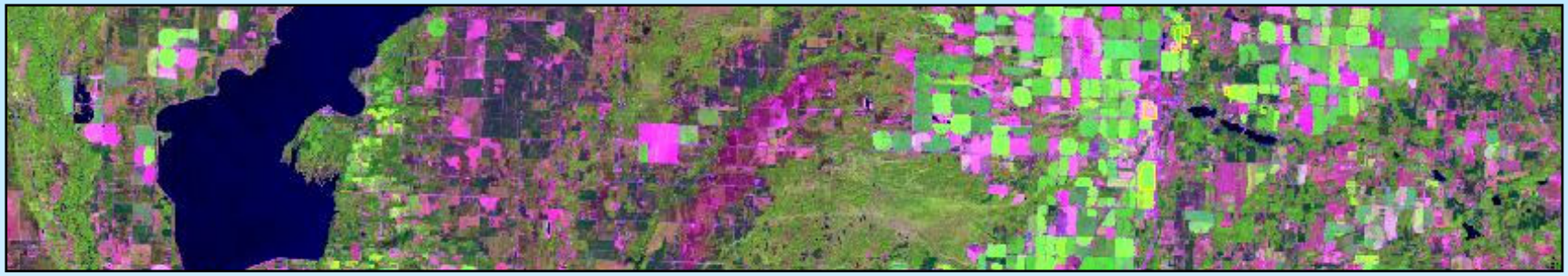


- Acreage Program Updates
  - Advanced Wide Field Sensor (AWiFS)
  - Ground truth: FSA/CLU + 578 & NLCD
  - Ancillary data sets
  - Commercial software suite
- What's next

Cropland Data Layers
1997 - 2007



Cropland Data Layer Components



- AWiFS sensor

IRS Resourcesat-1 AWiFS Imagery

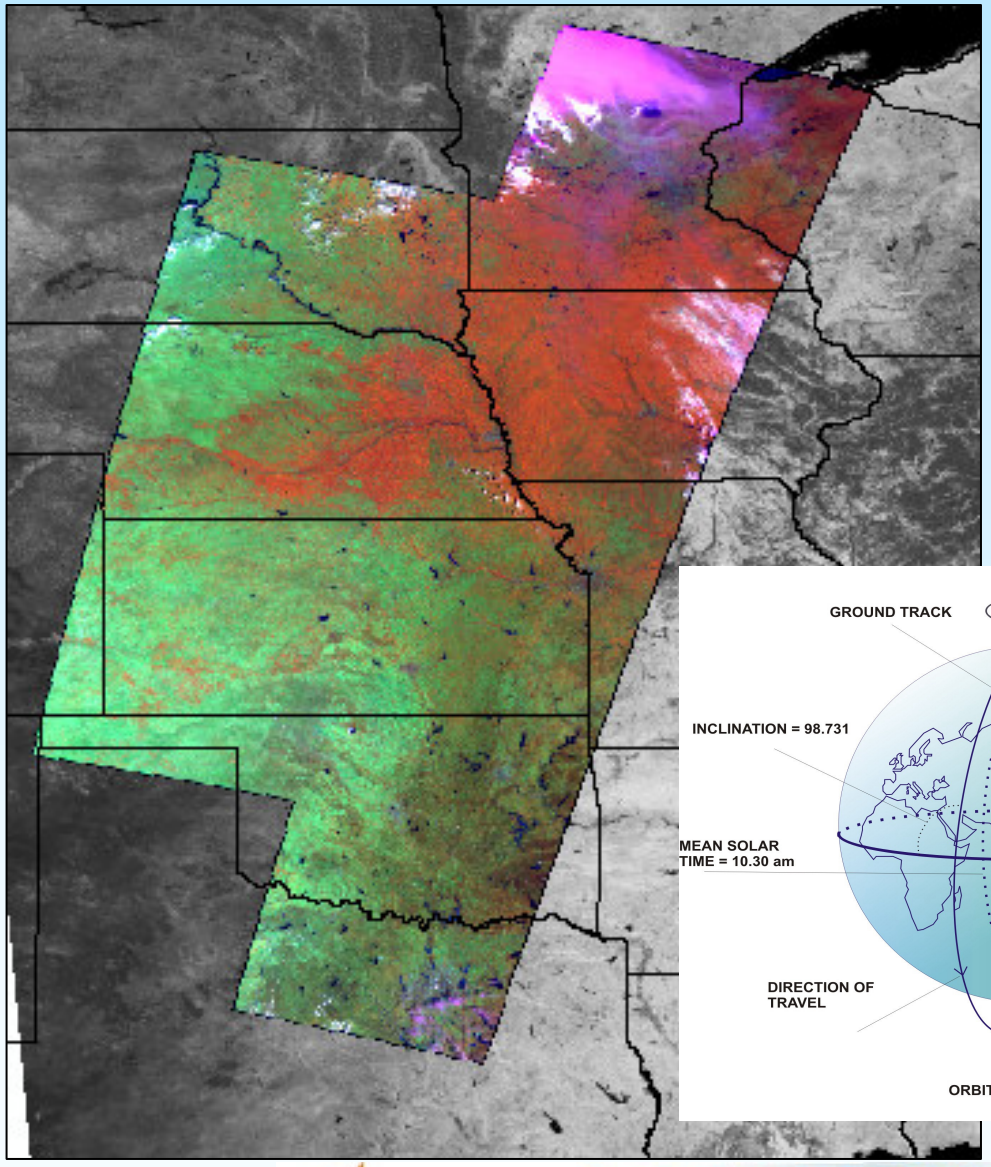
340 km swath per head
740 km combined

5-day revisit

4 spectral bands
- B2: 0.52 - 0.59
- B3: 0.62 - 0.68
- B4: 0.76 – 0.86
- B5: 1.55 – 1.7

56 m nadir/70 m field edges

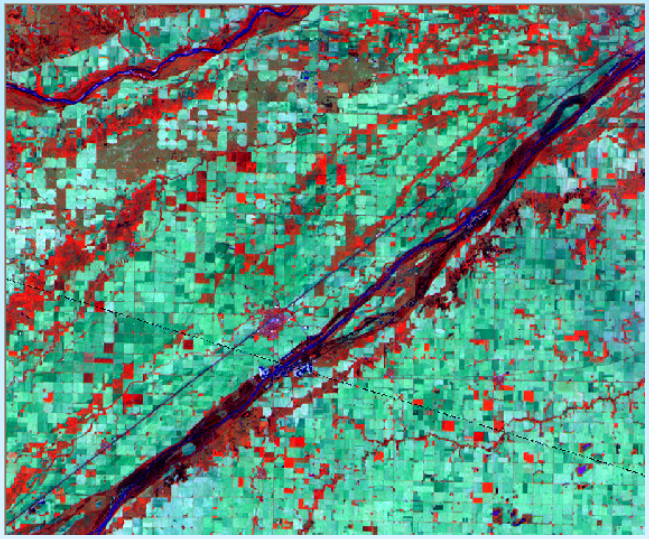
Data provided by Arctic Slope Regional Corporation



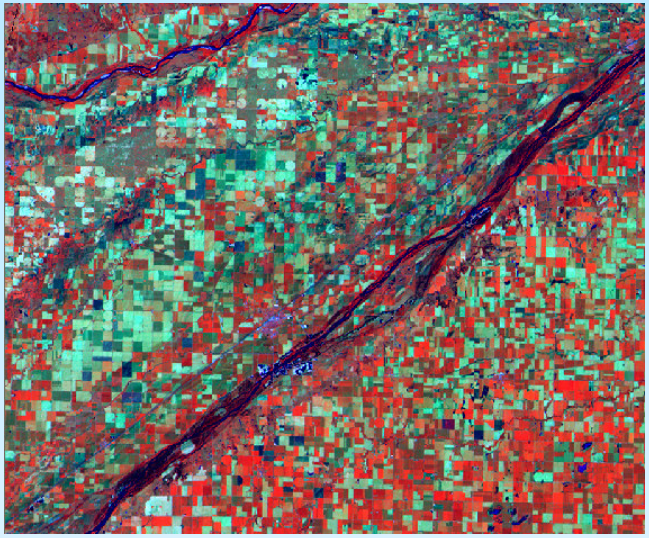
13 Aug 2007

Department of Space
Indian Space Research Organisation

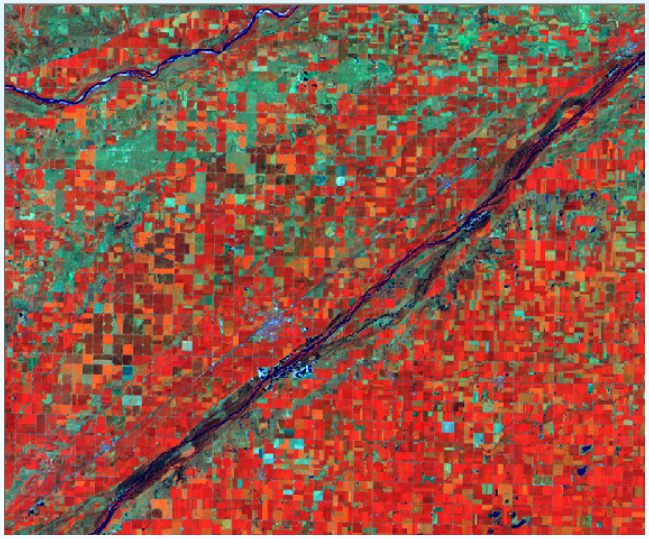
AWiFS Imagery Time Series



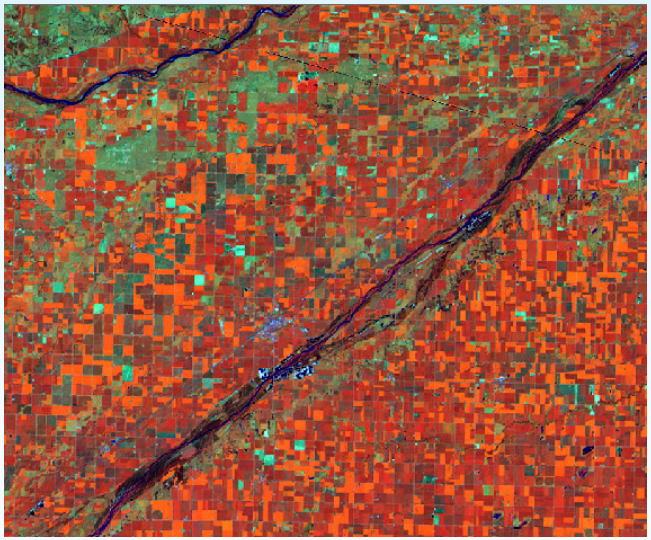
May 18



June 21

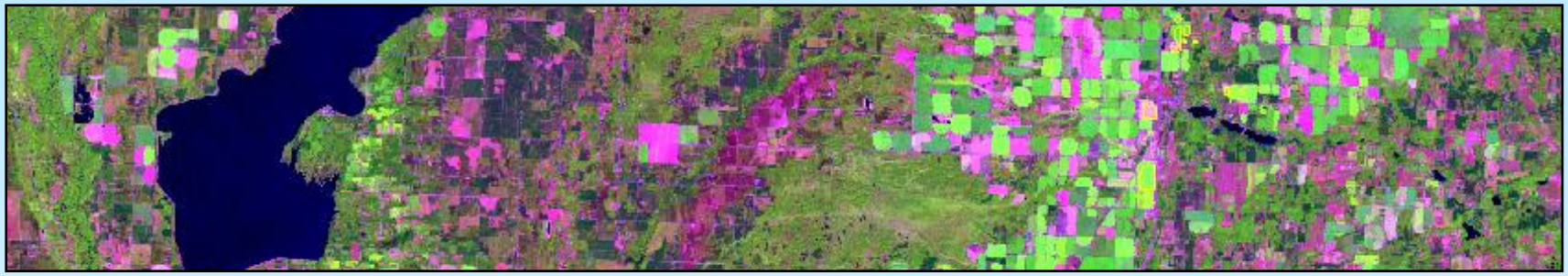


July 15



August 27

Cropland Data Layer Components



- AWiFS sensor
- Common Land Unit/578 Admin Data
  - USDA/Farm Service Agency
    - Training/testing datasets
  - NLCD 2001 (non agriculture)
  - Ancillary datasets
    - MODIS, NED, NLCD Canopy, NLCD Impervious

Ground Truth - Agriculture

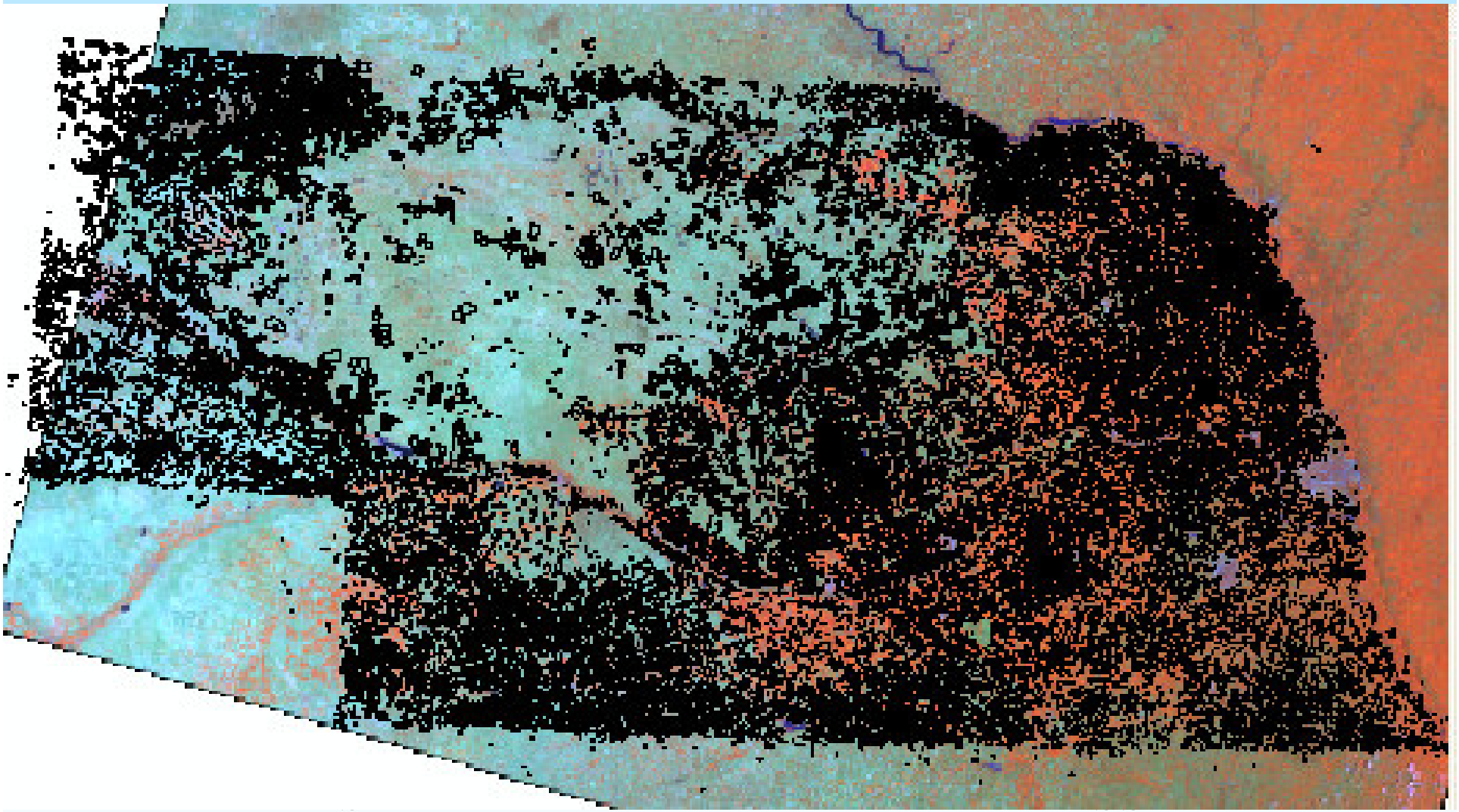
- Farm Service Agency (FSA)
  - Common Land Unit (CLU)
  - 578 reporting data

FSA

NASS

NASS June Agricultural Survey (JAS) data still used for acreage estimation

Ground Truth - Agriculture

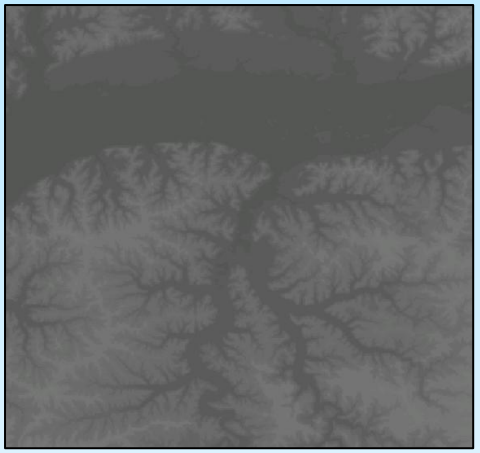


NASS June Agricultural Survey (JAS) data still
used for acreage estimation

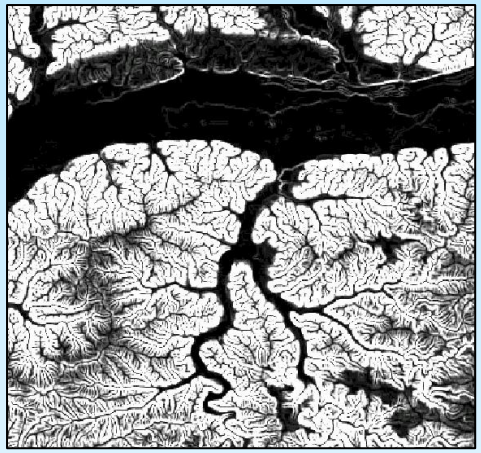
Ground Truth – Non Agricultural

- Proportional sampling
- Use categorized 2001 National Land Cover Dataset from USGS

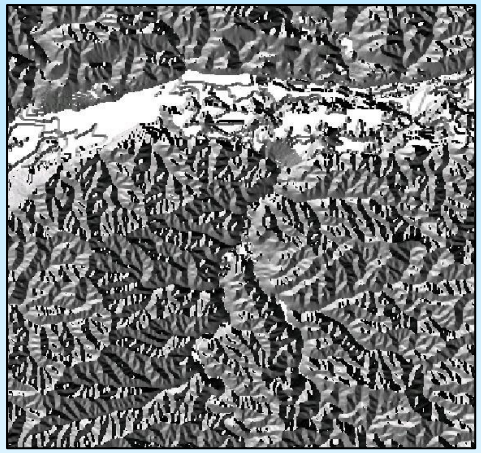
Ancillary Data – USGS Products



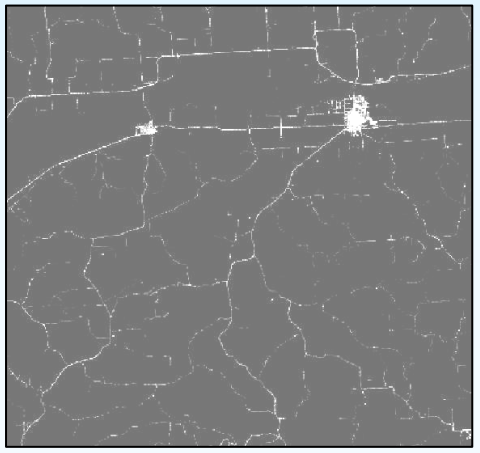
Elevation



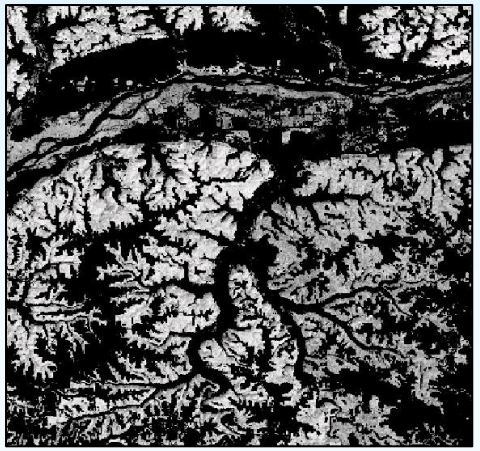
Slope



Aspect

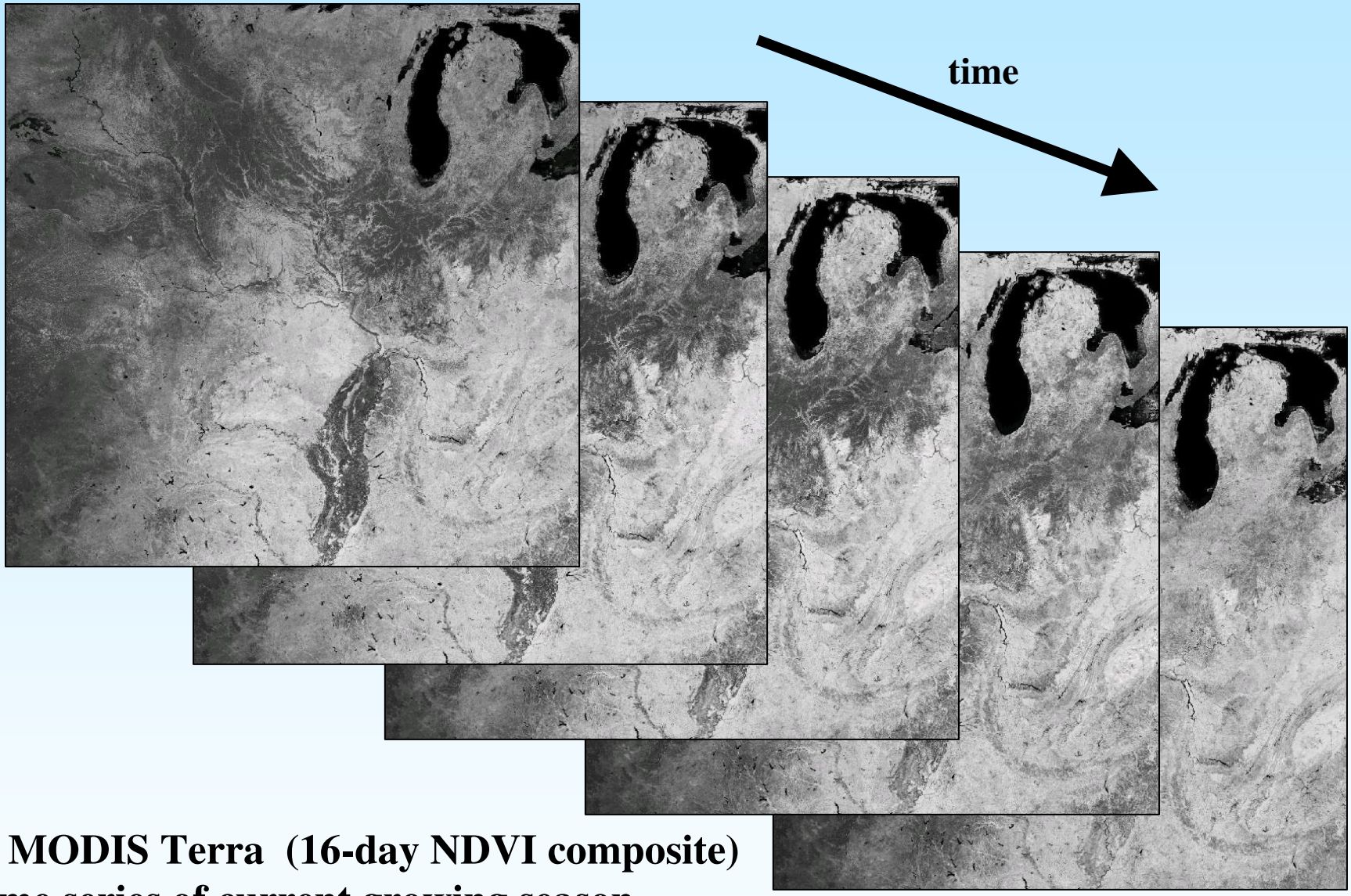


Impervious



Canopy

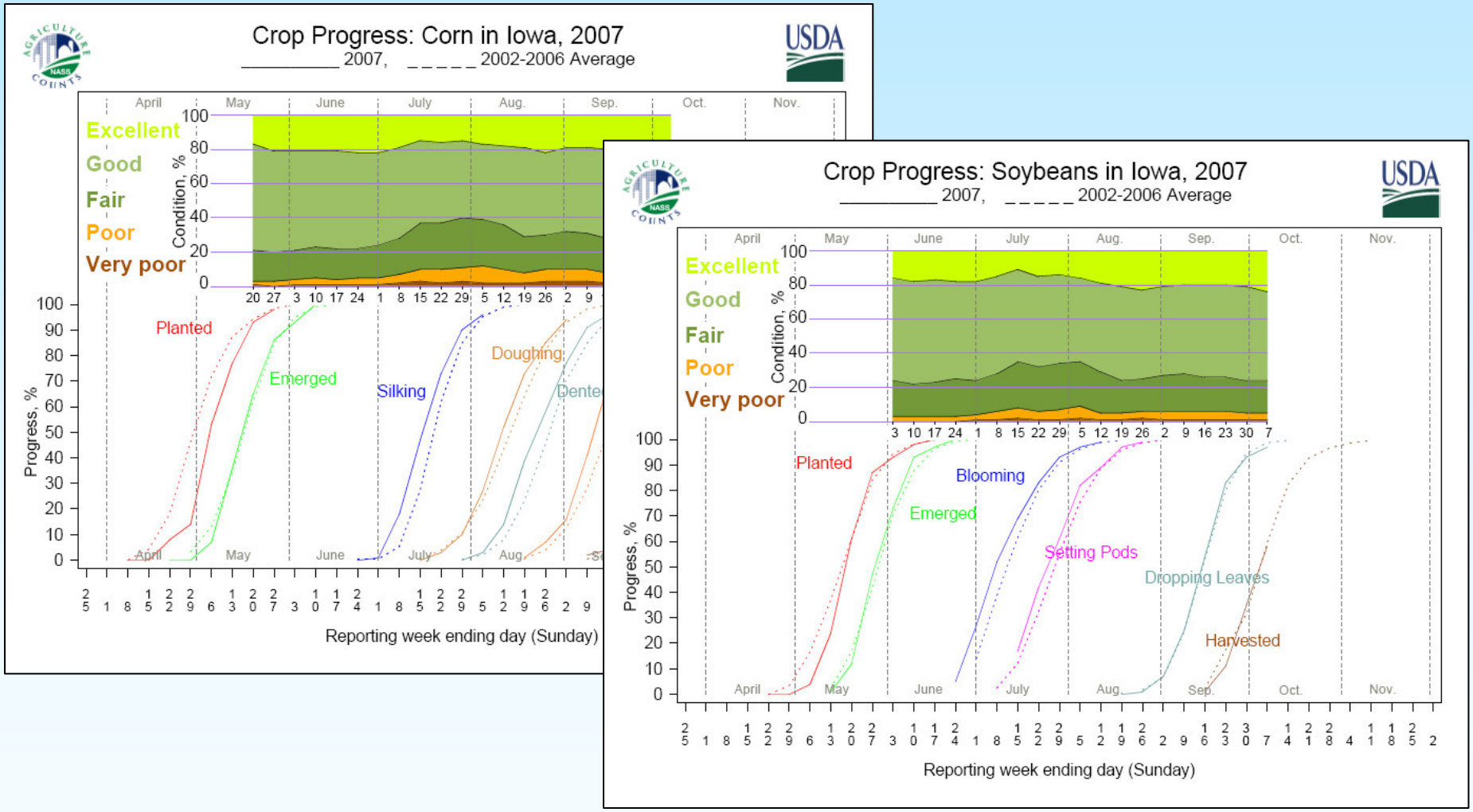
MODIS NDVI Imagery



NASA MODIS Terra (16-day NDVI composite)

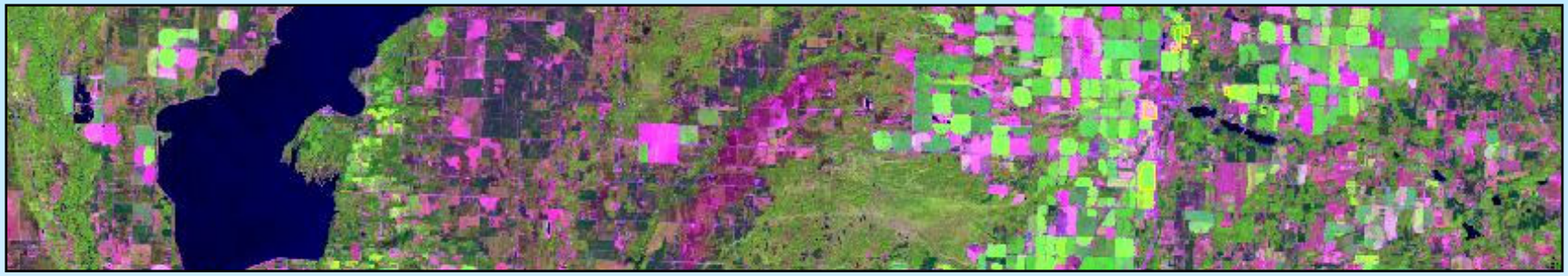
- **Time series of current growing season**
- **Fall scenes from previous year**

Image Timing



http://www.nass.usda.gov/Charts_and_Maps/Crop_Progress_&_Condition/

Cropland Data Layer Components



- AWiFS sensor
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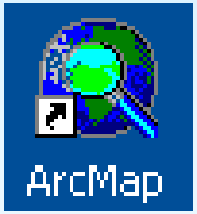
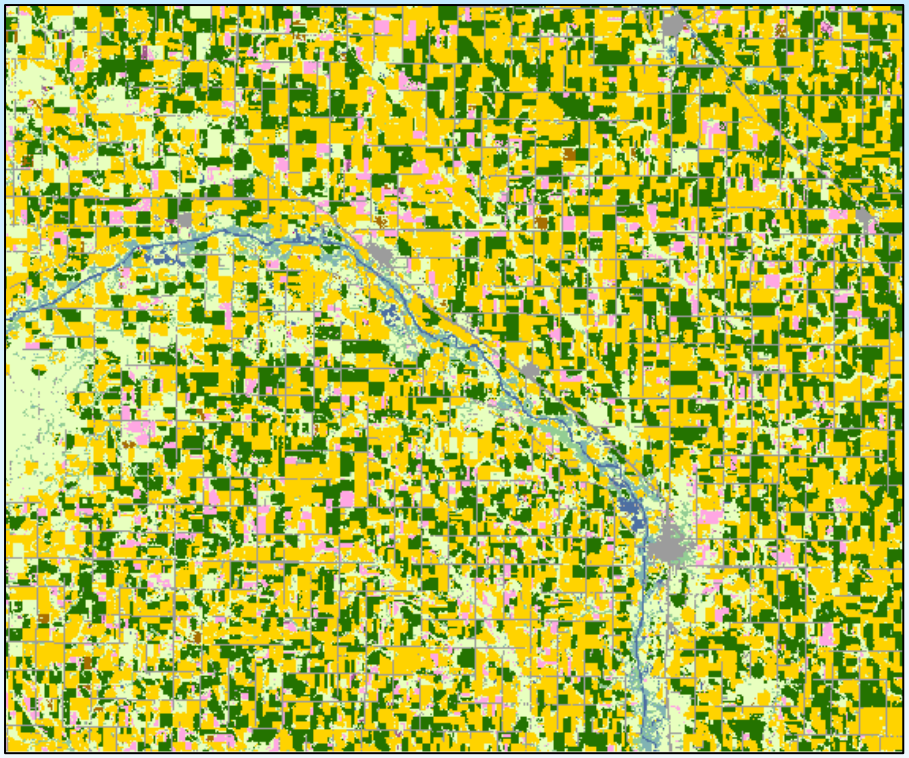
  - USDA/Farm Service Agency
- Ancillary data sets
- Commercial software suite

Commercial Software Suite

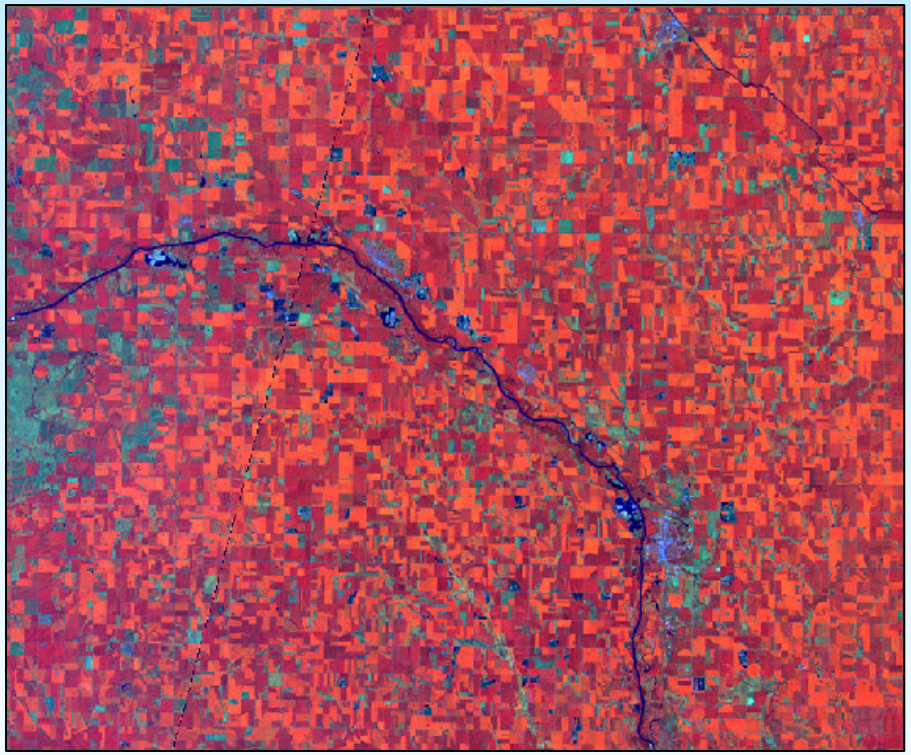
- Imagery Preparation
  - Leica Geosystems ERDAS Imagine
- Image classification
  - Decision tree software
    - See5.0 www.rulequest.com
- Ground Truth Preparation
  - ESRI ArcGIS
- Acreage Estimation
  - SAS/IML workshop



Example Classification Subset

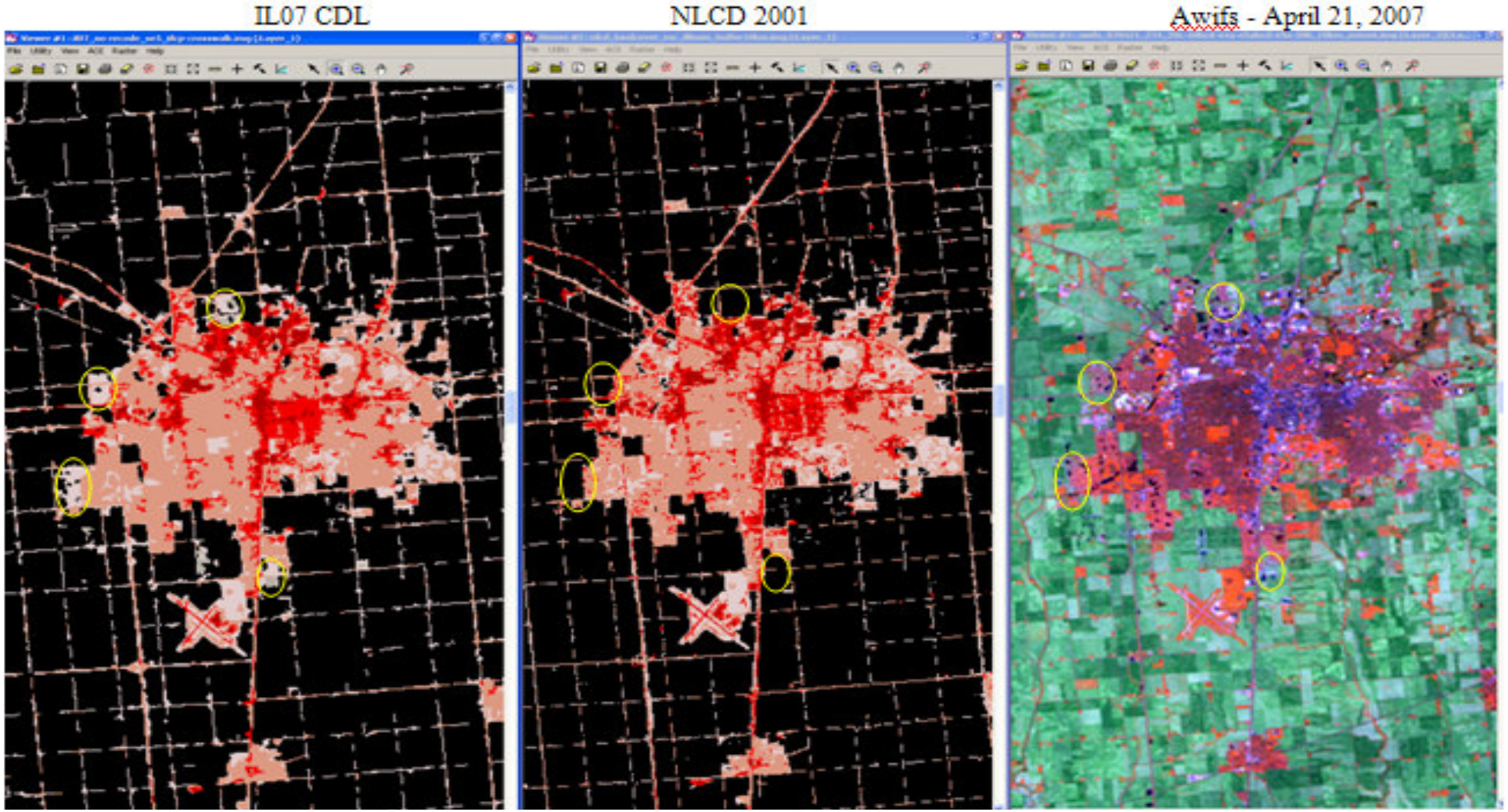


CDL Classification



Resourcesat-1 AWiFS, 13 Aug 2007

Non Ag NLCD Updates (urban sprawl)

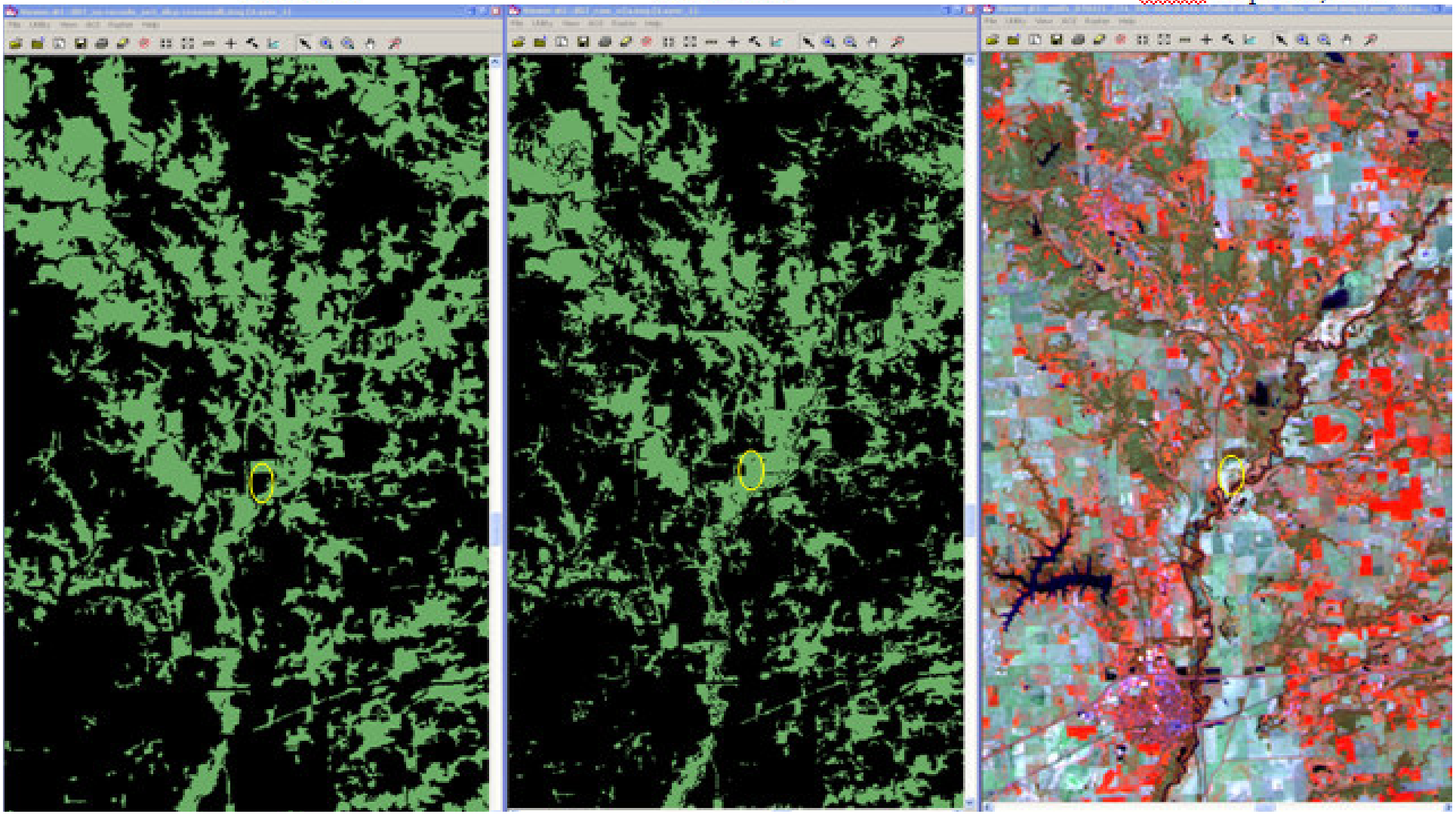


Non Ag NLCD Updates (forest clearing)

IL07 CDL

NLCD 2001

Awifs - April 21, 2007



Accuracy Assessment

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'l 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 Vegs & 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 identifed in the error matrix.

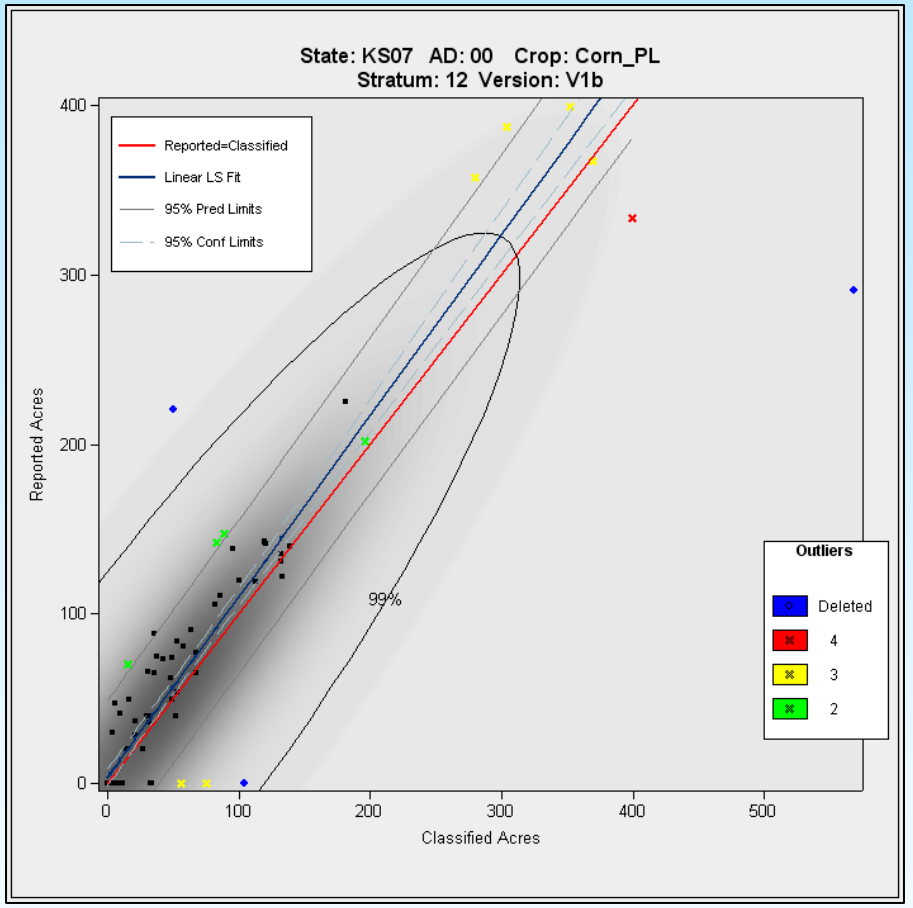
Regression-based Acreage Estimator

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

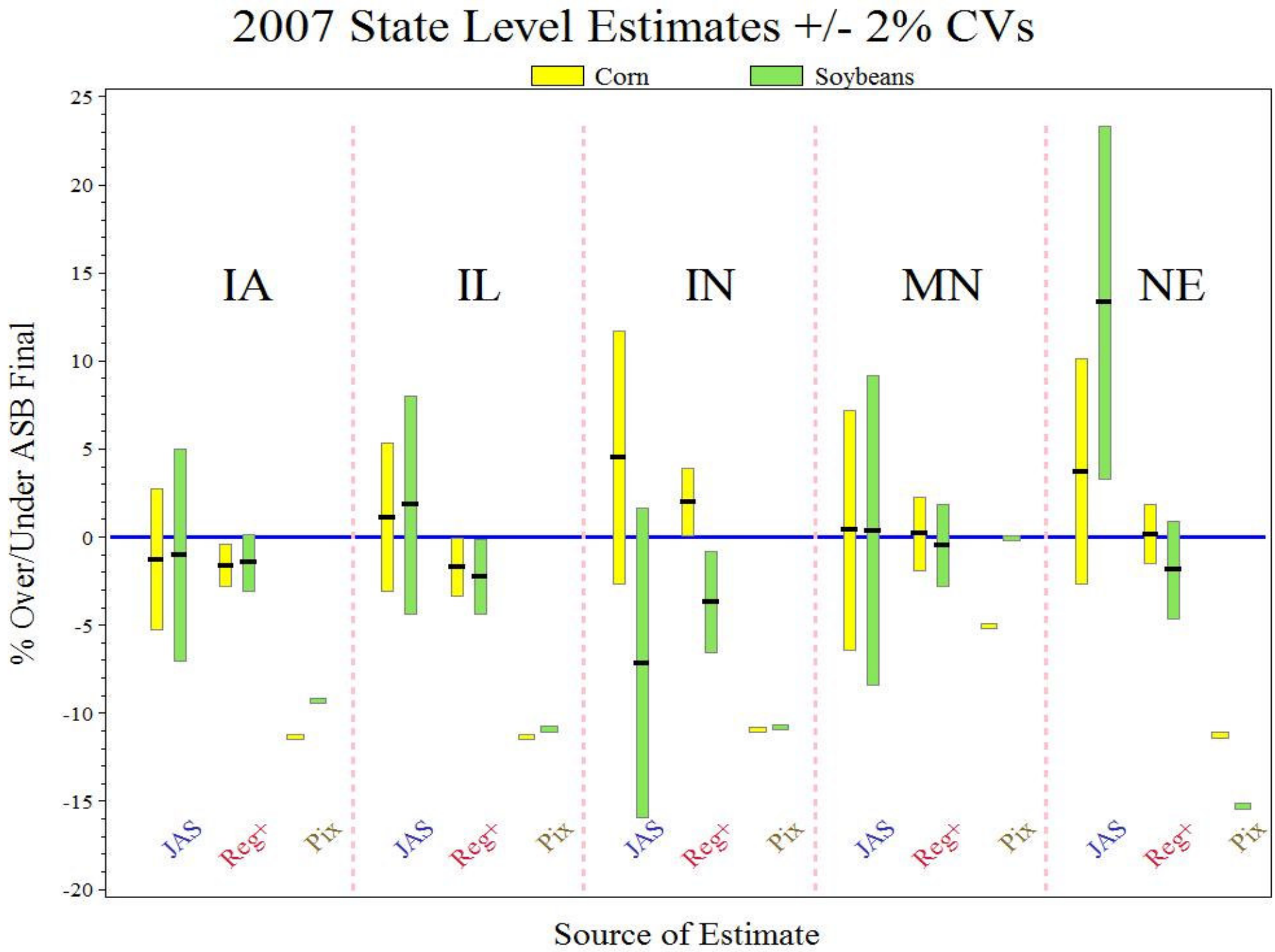
- **(X) – Cropland Data Layer (CDL) classified acres**
- **(Y) – June Agricultural Survey (JAS) reported acres**

Using both CDL and JAS acreage results in estimates with reduced error rates over JAS alone

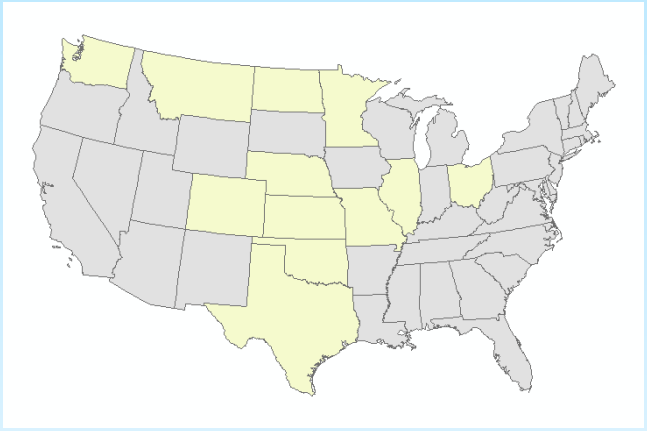
Outlier segment detection - correction or removal from regression analysis



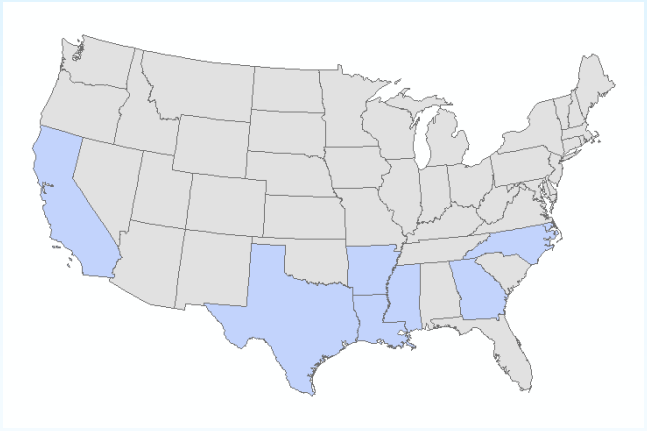
Acreage not just about counting pixels


2007 State Level Estimates +/- 2% CVs
Corn
Soybeans
% Over/Under ASB Final
25
20
15
10
5
0
-5
-10
-15
-20
IA
IL
IN
MN
NE
JAS
Reg+
Pix
Source of Estimate

CDL 2008 Status



Primary Wheat States



Primary Cotton States

- Operational Program
  - Early delivery of estimates
    - Winter Wheat - June
    - Corn and Soybeans - mid-August & mid-October
- Expand geographic scope?
  - Wheat states next priority
  - Cotton, Durum and Spring Wheat
- Derivatives?
  - Change detection
  - Crop rotation patterns

Thank You

Claire Boryan, Rick Mueller, Mike Craig, Dave Johnson, Bob Seffrin, Patrick Willis, Larry Beard, Zhengwei Yang and Lee Ebinger

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