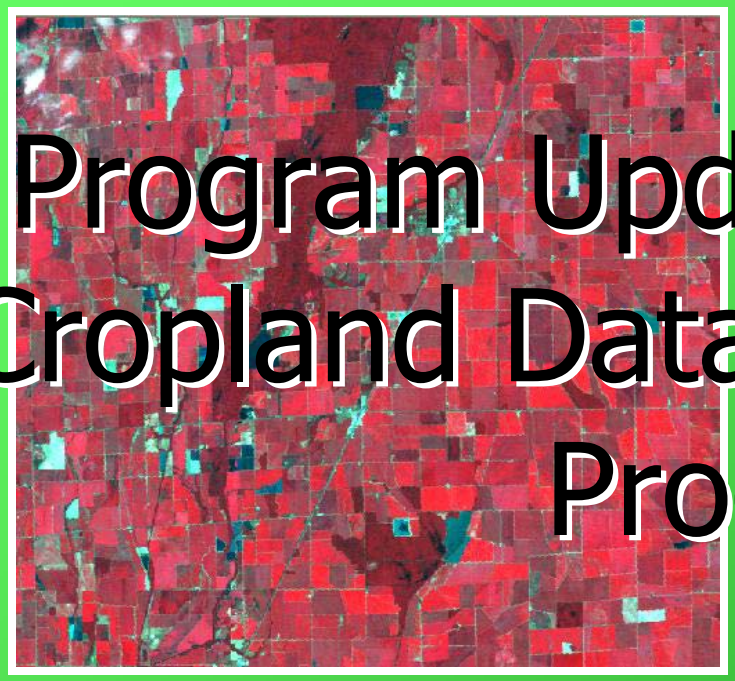
New Methods and Satellites:



A Program Update on the NASS Cropland Data Layer Acreage Program

Rick Mueller
Claire Boryan
Bob Seffrin

01/12/2006

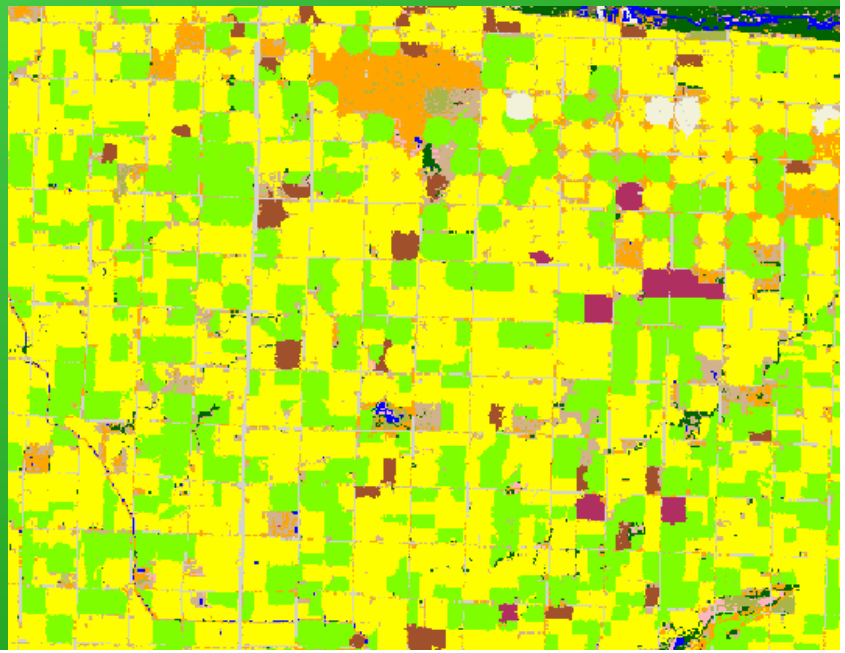
Agenda

- Acreage background
- Program scope/cooperators
- Program updates
- Results over Nebraska `05

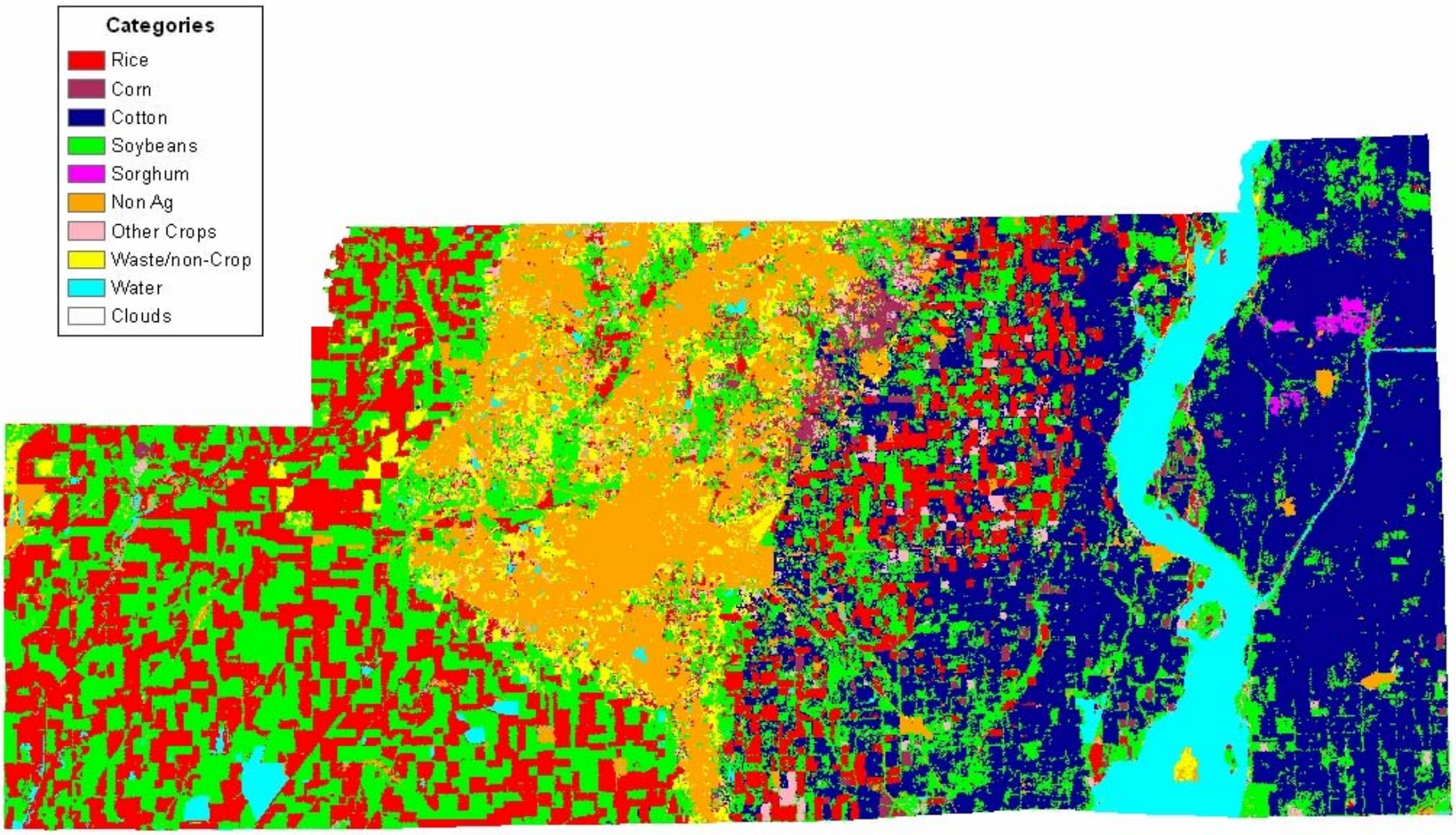
Cropland Data Layer

- Acreage Estimates
  - County and state level "major crops"
    - Unbiased statistical estimator

AL	Cherokee	1	20	19	15499199
AL	Cullman	1	20	43	15499199
AL	De Kalb	1	20	49	15499199
AL	Etowah	1	20	55	15499199
AL	Jackson	1	20	71	15499199
AL	Lauderdale	1	10	77	15499199
AL	Lawrence	1	10	79	15499199
AL	Limestone	1	10	83	15499199
AL	Madison	1	10	89	15499199
AL	Marshall	1	20	95	15499199
AL	Morgan	1	10	103	15499199
AL	Talladega	1	30	121	15499199
AL	D10 Comb	1	10	888	15499199
AL	D20 Comb	1	20	888	15499199
AL	D30 Comb	1	30	888	15499199
AL	D40 Comb	1	40	888	15499199
AL	D50 Comb	1	50	888	15499199
AL	D60 Comb	1	60	888	15499199
AL	D10 Northe	1	10	999	15499199
AL	D20 Mounl	1	20	999	15499199
AL	D30 Upper	1	30	999	15499199
AL	D40 Black	1	40	999	15499199
AL	D50 Coast	1	50	999	15499199
AL	D60 Wireg	1	60	999	15499199



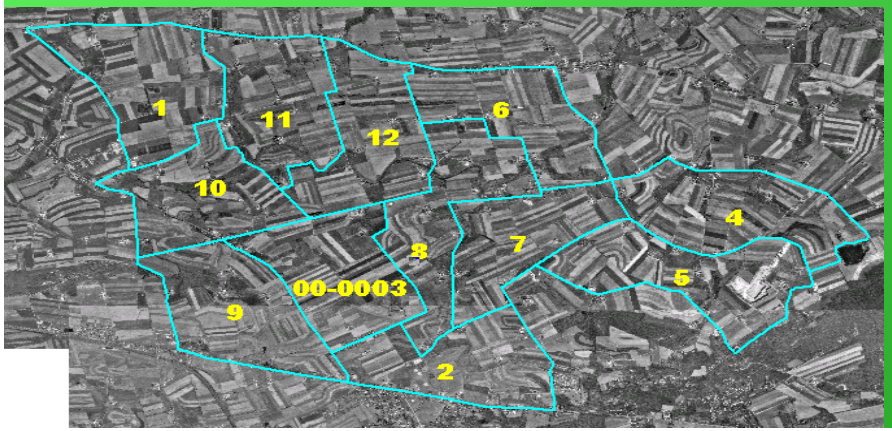
Craighead County, Arkansas 2005

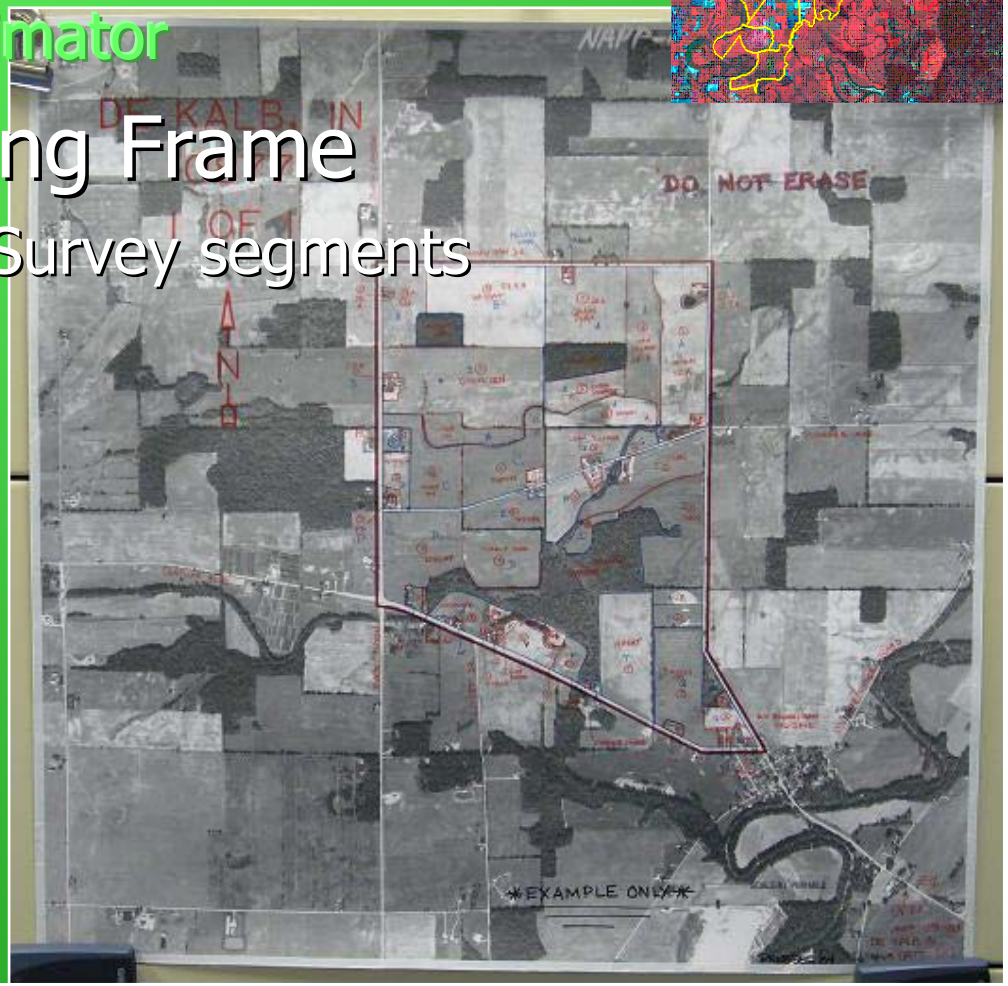


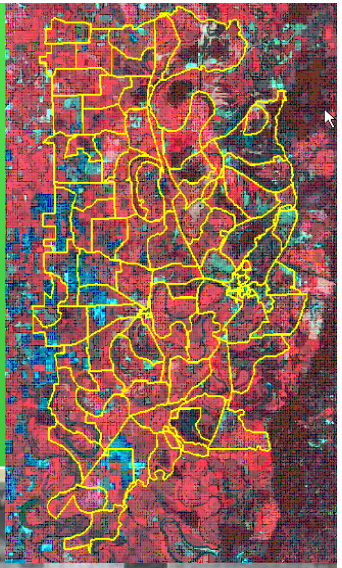
Cropland Data Layer

Cropland Data Layer

- Acreage Estimates
  - County and state level "major crops"
    - Unbiased statistical estimator
- Based on Area Sampling Frame
  - Uses June Agricultural Survey segments
    - Ground truth training

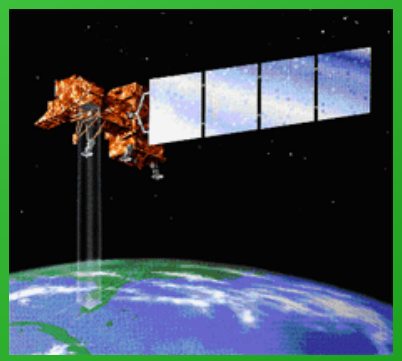






Cropland Data Layer

- Acreage Estimates
  - County and state level "major crops"
    - Unbiased statistical estimator
- Based on Area Sampling Frame
  - Uses June Agricultural Survey segments
    - Ground truth training
- Landsat TM/ETM+
  - Launched 1984/1999



The Landsat Data Gap

Landsat 7 ETM+

Landsat 5 TM

USGS
science for a changing world

News Release

November 30, 2005 Ron Beck

Landsat 5 Experiencing Technical Difficulties

On November 26, 2005, the back-up solar array drive on Landsat 5 began exhibiting unusual behavior. The solar array drive maintains the proper pointing angle between the solar array and the sun. The rotation of the solar array drive became sporadic and the solar array was not able to provide the power needed to charge the batteries. Maintaining power to the batteries is critical to sustain proper operation of the spacecraft. The primary solar array drive failed under similar circumstances last January. As a result of this current situation, imaging operations will be suspended for at least the next two weeks or until attempts to solve the problem have been resolved.

Source: USGS, Landsat Project:
http://landsat.usgs.gov/slc_enhancements/slc_off_level1_standard.php

Cropland Data Layer

- Acreage Estimates
  - County and state level "major crops"
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    - Uses June Agricultural Survey segments
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- Landsat TM/ETM+
    - Launched 1984/1999
- Peditor Software
  - Public domain
  - Cluster/Classify/Regression/Mosaic

Project Players

- **USDA/NASS Research Division**
  - Spatial Analysis Research Section
    - Remote sensing analysts
    - Software developers
- **USDA/Foreign Ag Service**
  - Production Estimates & Crop Assessment Division
    - PECAD
  - Cooperative imagery provider

Linking U.S. Agriculture FAS to the World

Production Estimates and Crop Assessment Division

Program Cooperators

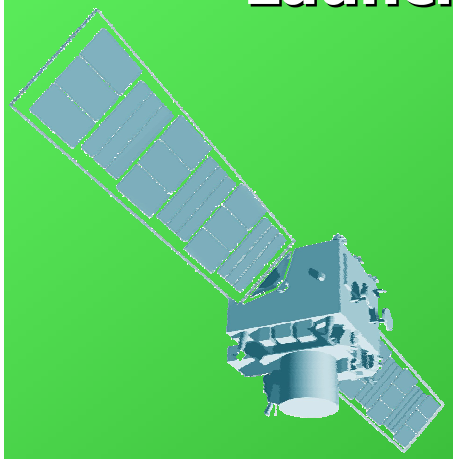
New Program Updates

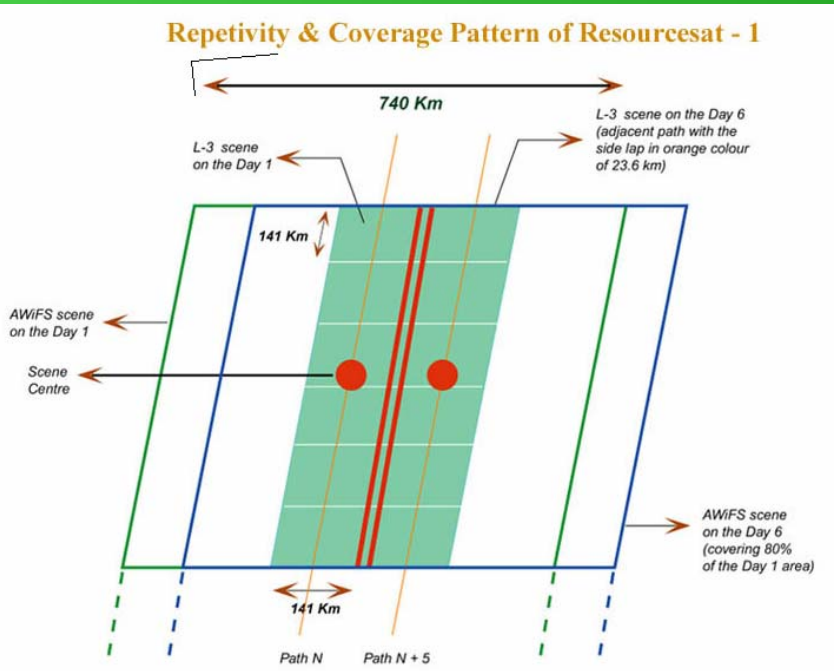
- Indian Space Research Organization
  - ResourceSat-1 AWiFS sensor

Indian Remote Sensing Satellite: ResourceSat-1

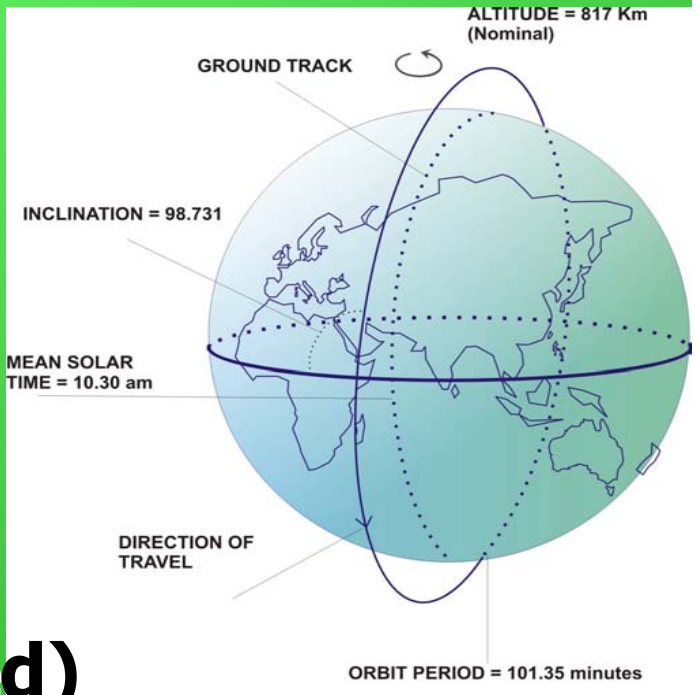
Advanced Wide Field Sensor (AWiFS)

- 370 km swath per quad
- 740 km combined
- 56 m resolution at nadir
- 70 m resolution at scene edges
- Launched 2003





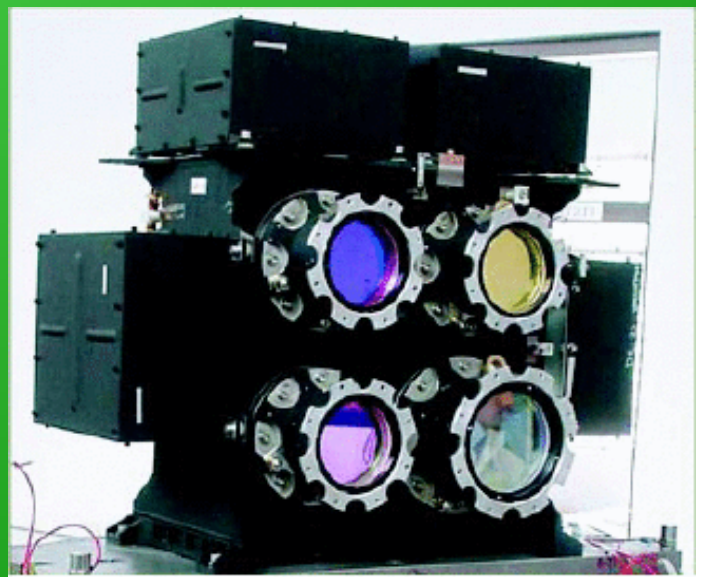
Advanced Wide Field Sensor (AWiFS)

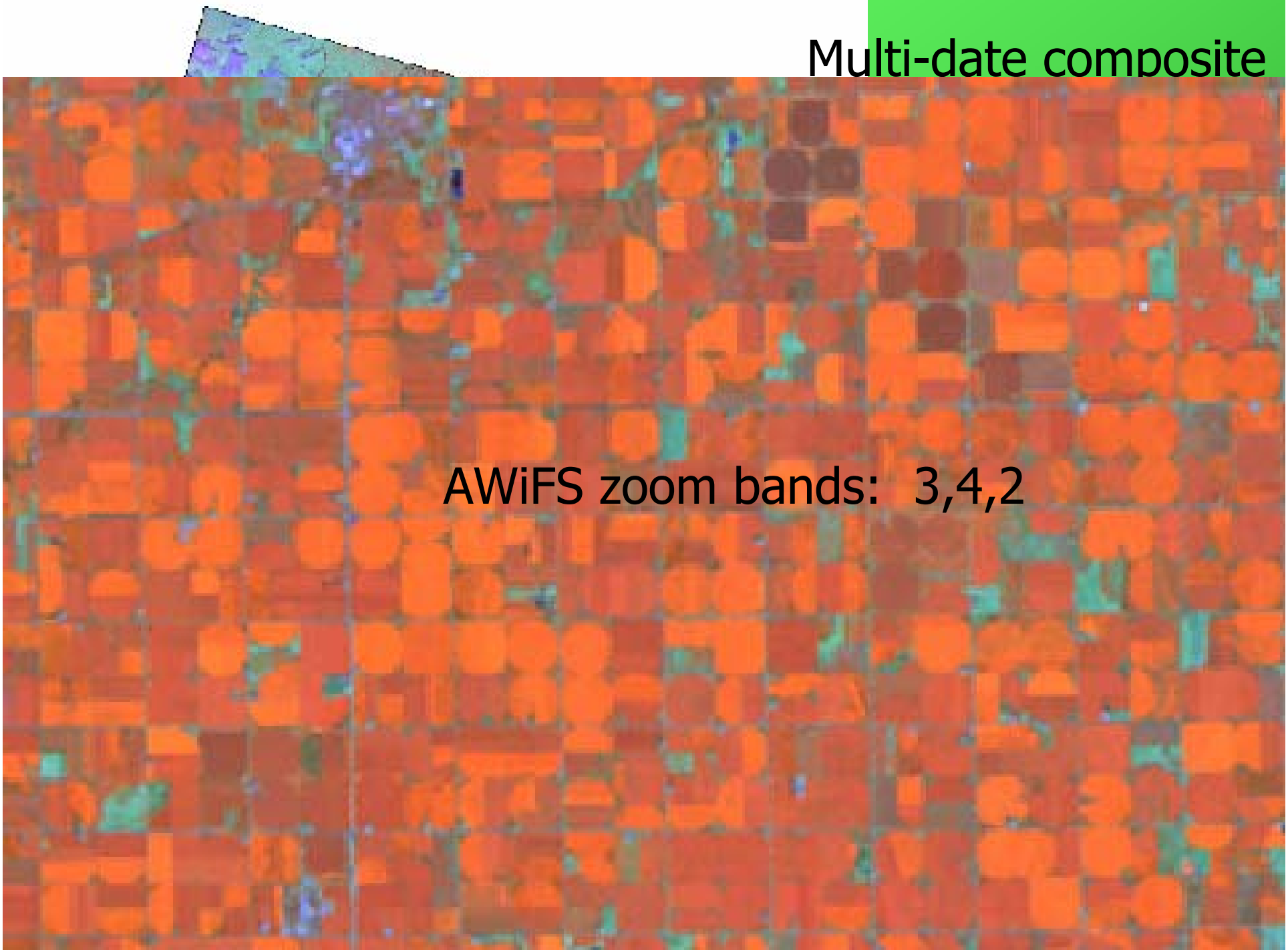


Spectral Bands:

- B2: 0.52-0.59 (Visible Green)
- B3: 0.62-0.68 (Visible Red)
- B4: 0.77-0.86 (Near Infrared
- B5: 1.55-1.70 (Middle infrared)

5 day repeat cycle




Multi-date composite
AWiFS zoom bands: 3,4,2

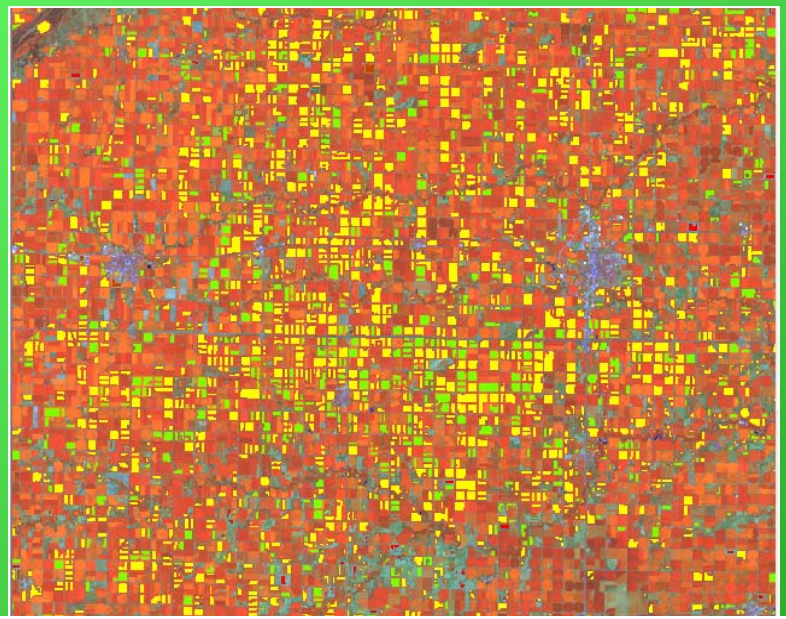
New Program Updates

- Indian Space Research Organization
  - ResourceSat-1 AWiFS sensor

- USDA/Farm Service Agency
  - GeoSpatial Common Land Unit
  - Administrative 578 data

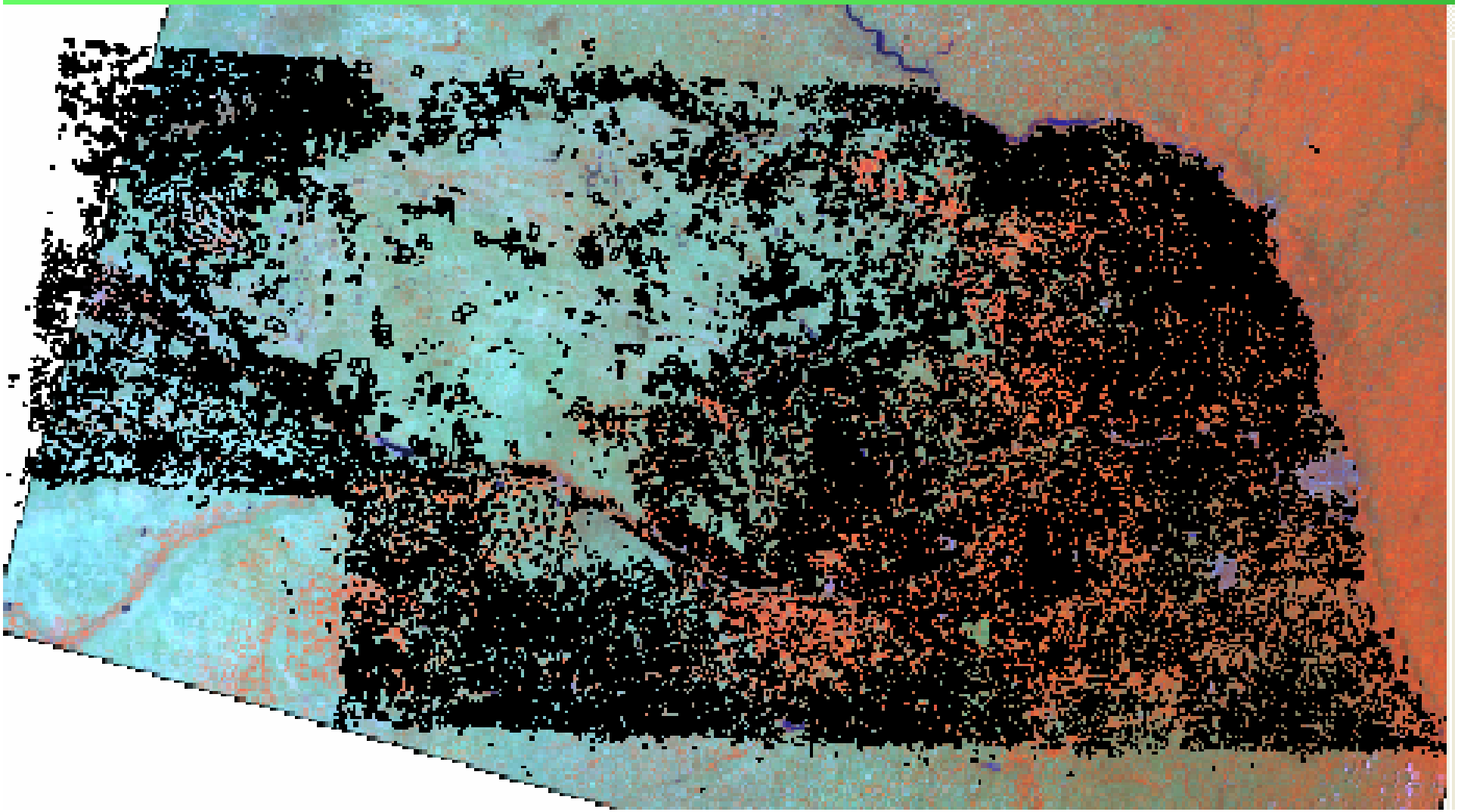
USDA/Farm Service Agency

- Common Land Unit (CLU) GeoDataset
- National in scope (Enterprise GIS)
  - Measures crop type & acreage
- Pare down data for training/testing
  - Polygon based ground truth



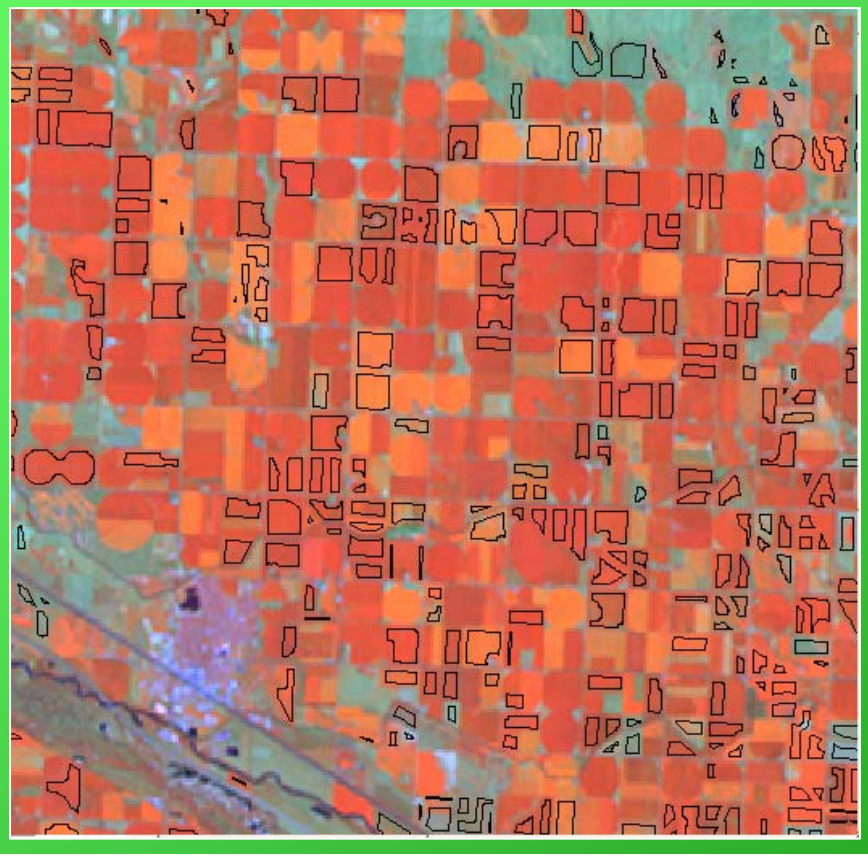
OID	STATE_CODE	ACRES	COUNTY	FARM	TRACT	FIELDNO	FSA_CROP	CROP_TYPE	IRRIGATED	USE
0	31	5.7	1	3	294	6	0041	YEL	2	Grain
1	31	38.9	1	3	294	1A	0081	COM	1	Grain
2	31	5	1	3	294	1B	0041	YEL	2	Grain
3	31	18.9	1	3	294	1C	0041	YEL	2	Grain
4	31	112.1	1	3	294	1D	0041	YEL	1	Grain
5	31	5	1	3	294	1E	0041	YEL	1	Grain
6	31	155.7	1	5	87	1	0081	COM	1	Grain
7	31	79.1	1	5	88	1	0041	YEL	1	Grain
8	31	94.3	1	6	7390	1	0041	YEL	1	Grain
9	31	10.9	1	6	7390	5	0099	N/A	2	Establi
10	31	139.9	1	6	7391	1A	0041	YEL	1	Grain
11	31	5	1	6	7391	1B	0041	YEL	2	Grain
12	31	5.2	1	8	203	1A	0011	HRW	2	Grain
13	31	3.6	1	8	203	1B	0011	HRW	2	Grain
14	31	55.9	1	8	203	1C	0081	COM	1	Grain
15	31	6	1	8	203	1D	0101	N/A	2	Blank
16	31	38.5	1	8	203	1E	0041	YEL	1	Grain
17	31	5.6	1	8	203	1F	0041	YEL	2	Grain
18	31	4.2	1	8	203	2A	0011	HRW	2	Grain
19	31	21.5	1	8	203	2B	0041	YEL	1	Grain
20	31	45	1	8	203	2C	0011	HRW	2	Grain
21	31	141.2	1	10	204	1A	0041	YEL	1	Grain
22	31	6	1	10	204	1B	0041	YEL	2	Grain
23	31	6	1	10	204	1C	0041	YEL	2	Grain
24	31	67.8	1	11	1455	1A	0081	COM	2	Grain
25	31	67.9	1	11	1455	1B	0041	YEL	2	Grain
26	31	20.3	1	12	401	1A	0041	YEL	1	Grain
27	31	28.6	1	12	401	1B	0041	YEL	2	Grain
28	31	2.9	1	12	401	1C	0101	N/A	2	Blank
29	31	4.4	1	12	401	2A	0041	YEL	2	Grain
30	31	1.5	1	12	401	2B	0041	YEL	2	Grain

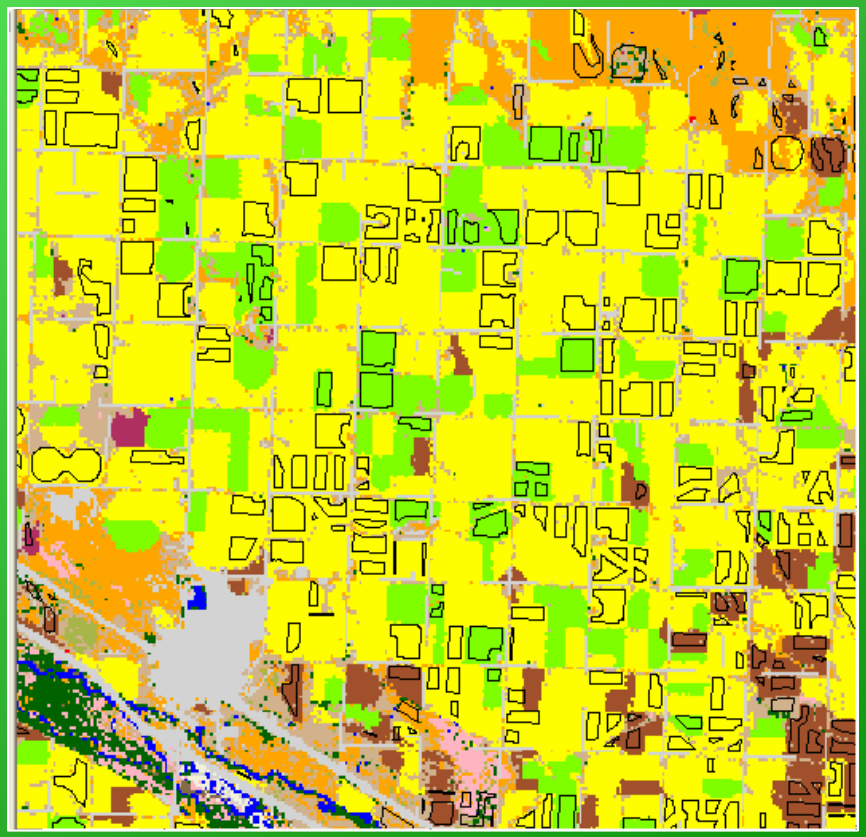
CLU Sample Population in Nebraska



Edit CLU's with ArcGIS

- Select fields with 1-1 relationship
  - Separate for training/testing
  - Misses specialty/small acreage crops



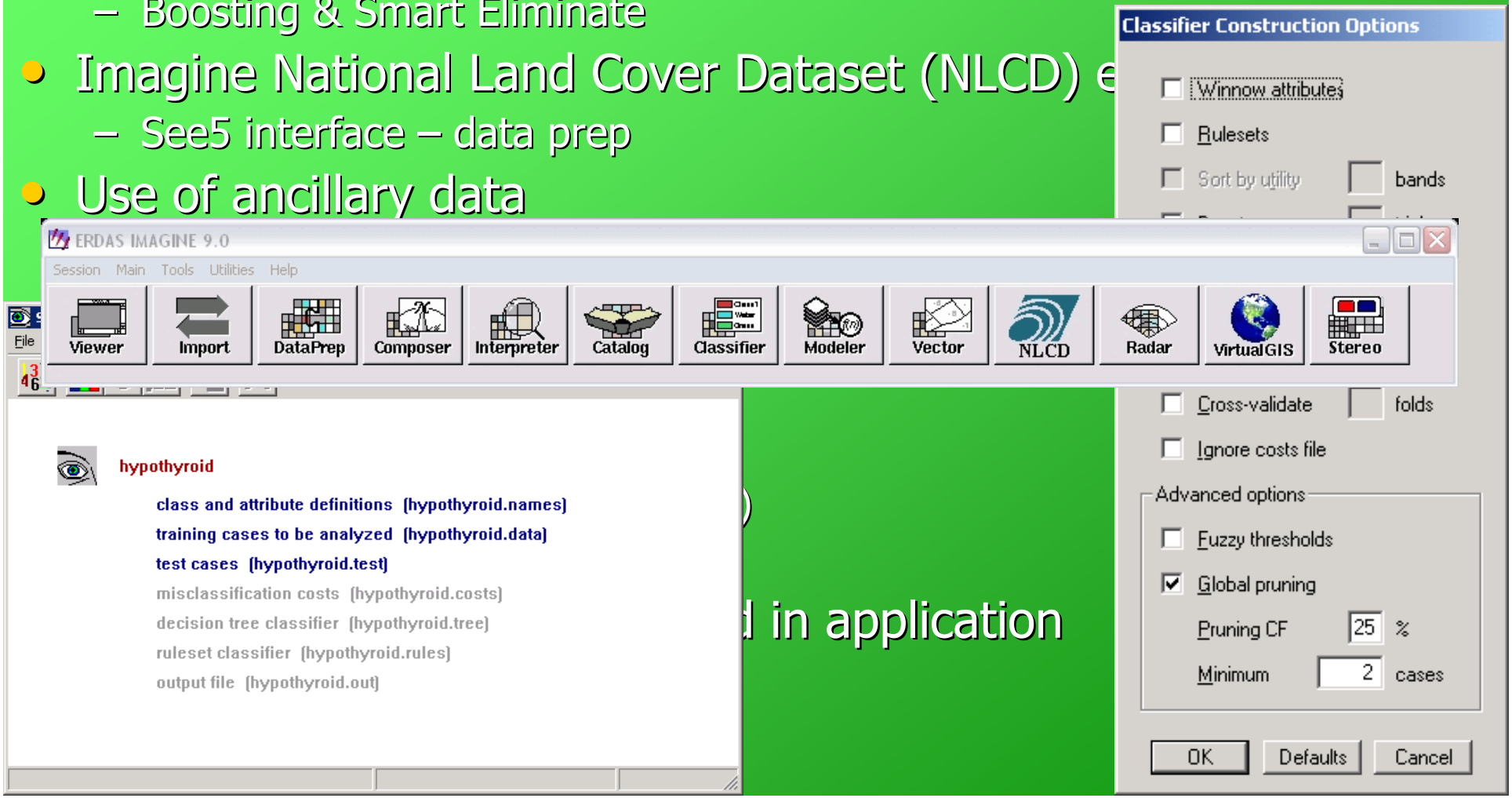


New Program Updates

- Indian Space Research Organization
  - ResourceSat-1 AWiFS sensor
- USDA/Farm Service Agency
  - GeoSpatial Common Land Unit
  - Administrative 578 data
- See5
  - CART software
  - www.rulequest.com

See5 Methodology Summary

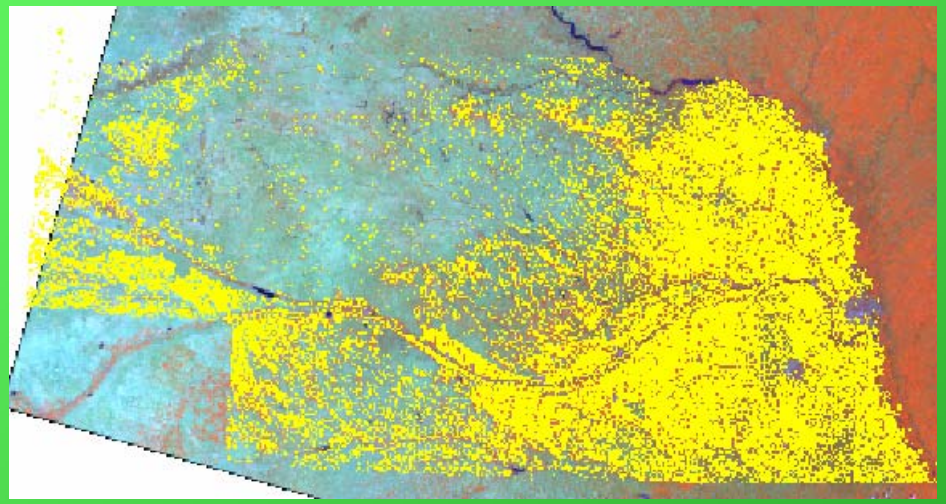
- See5 for derivation of decision tree classification rules
  - Boosting & Smart Eliminate
- Imagine National Land Cover Dataset (NLCD) e
  - See5 interface – data prep
- Use of ancillary data



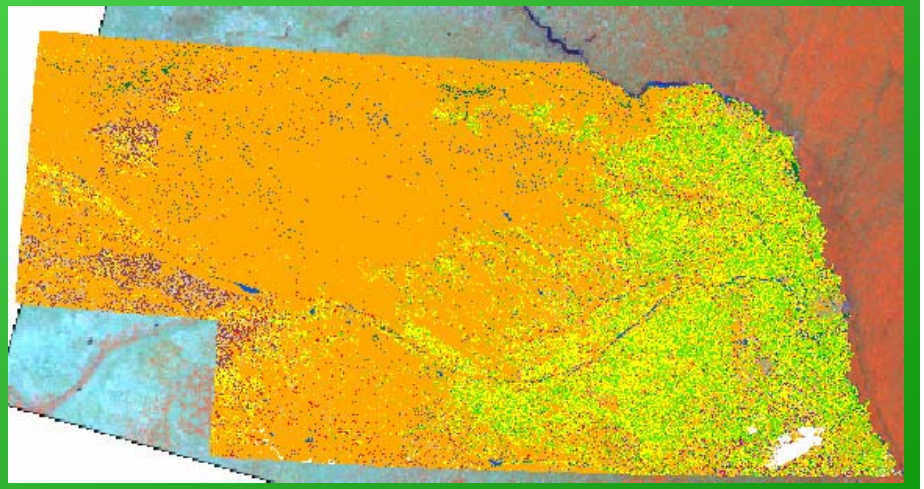
d in application

Ancillary Data sets

- Past Cropland Data Layers (multi-year)
- Agricultural mask created from past CDLs
- National Land Cover Data set 2001

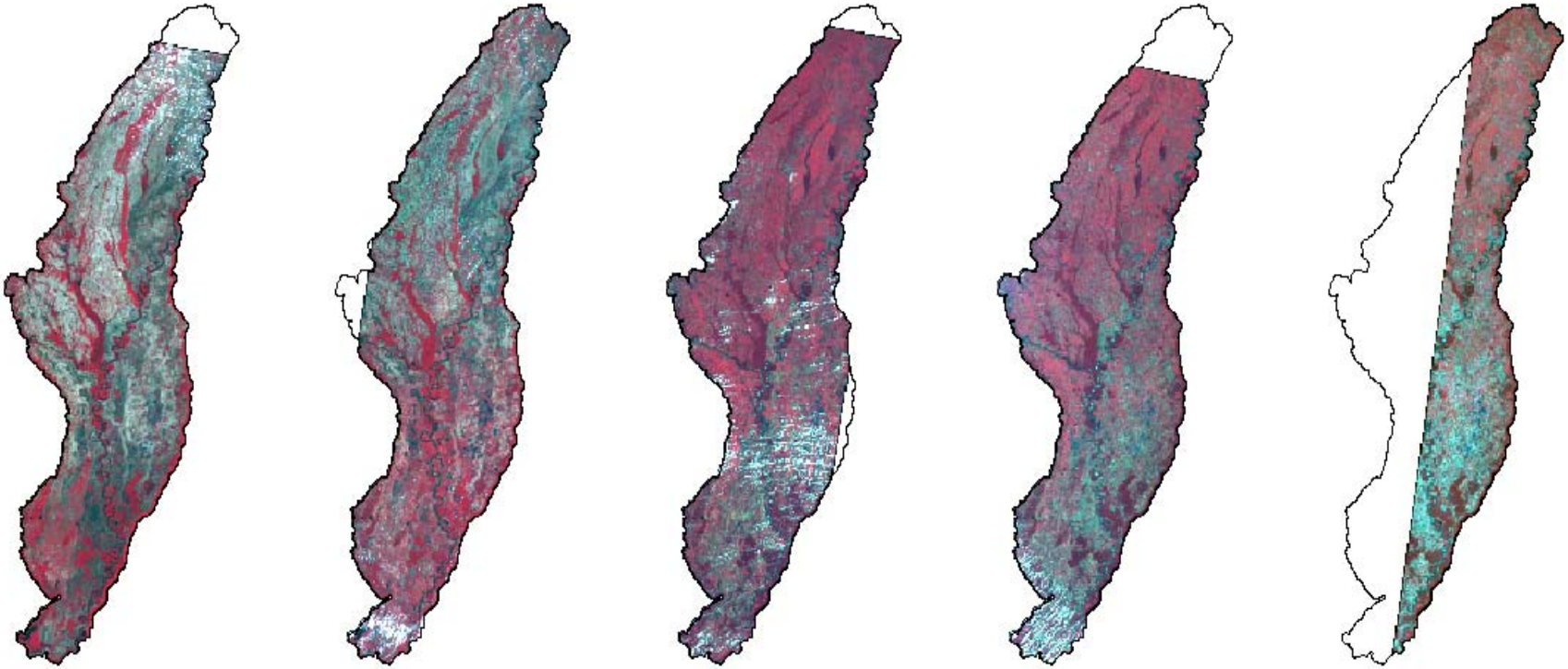


- Agricultural Mask



- Previous CDLs

AWiFS Time Series 2005



April 27 June 19 August 20 September 3 September 4

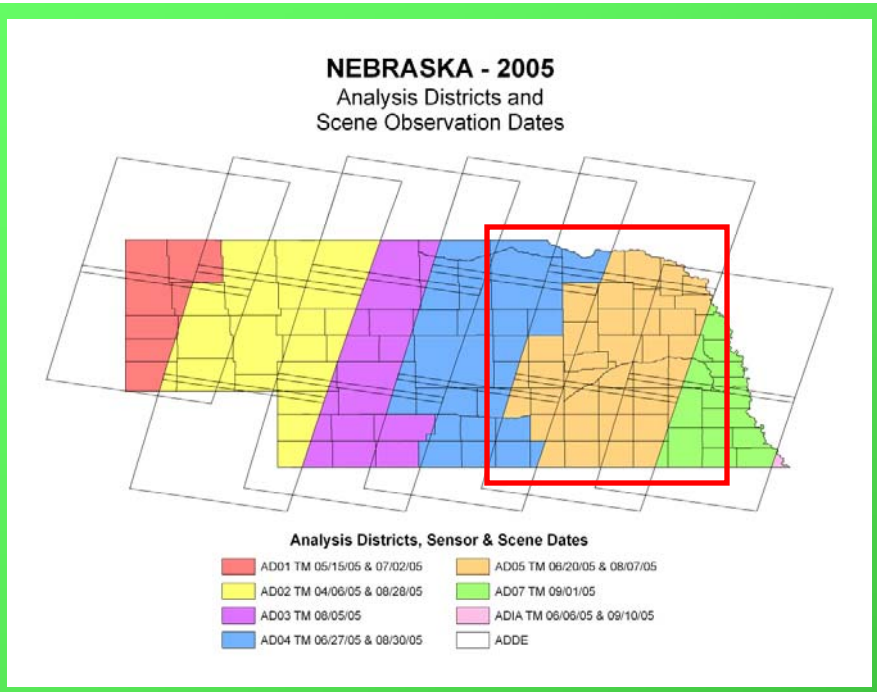
Decision Tree Issues

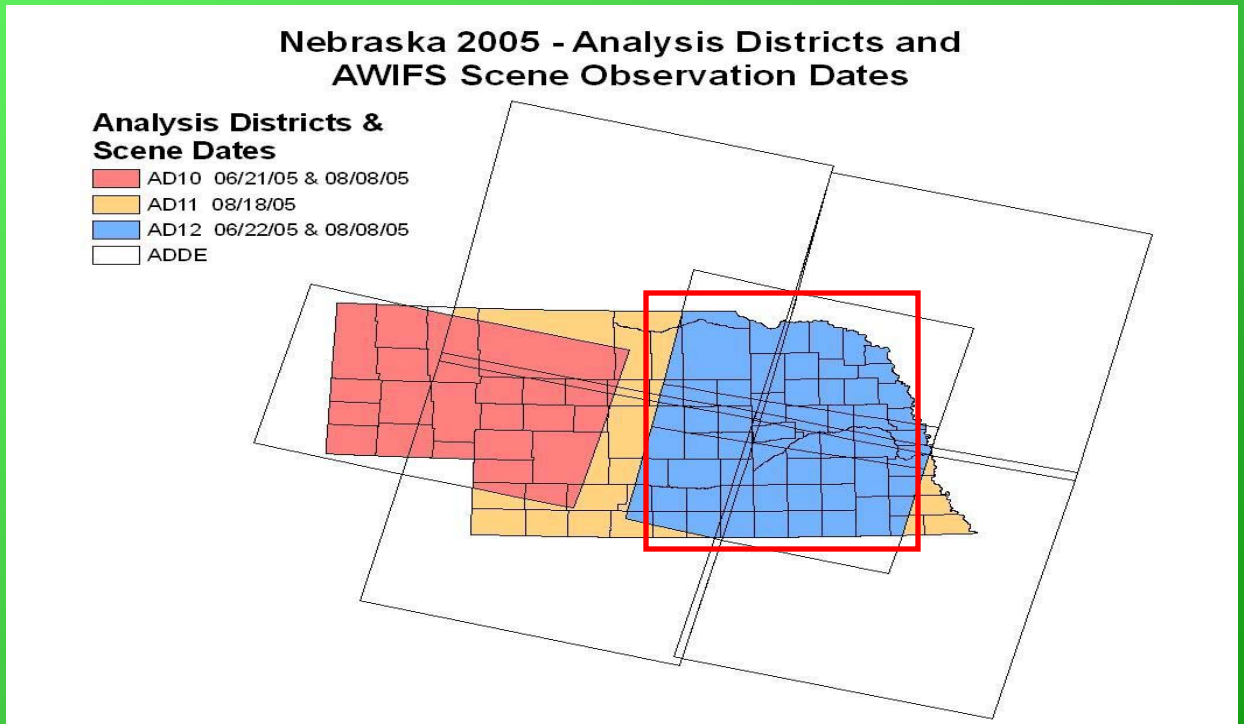
- ✓ Pros
- ✓ Non parametric
  - ✓ Continuous & thematic layers
- ✓ Large data volumes
- ✓ Data masking
- ✓ Repeatable/efficient
- ✓ Tolerant of outliers
- ✓ Literature
- ✓ Inexpensive

- – Cons
- – The trees created can be complex and difficult to interpret
- – Somewhat a “black box” in operation
- – Reliant on other software for data preparation and finishing

Acreage Program Results

- Nebraska 2005
  - TM vs. AWiFS


NEBRASKA - 2005
Analysis Districts and
Scene Observation Dates
Analysis Districts, Sensor & Scene Dates
AD01 TM 05/15/05 & 07/02/05
AD02 TM 04/06/05 & 08/28/05
AD03 TM 08/05/05
AD04 TM 06/27/05 & 08/30/05
AD05 TM 06/20/05 & 08/07/05
AD07 TM 09/01/05
ADIA TM 06/06/05 & 09/10/05
ADDE

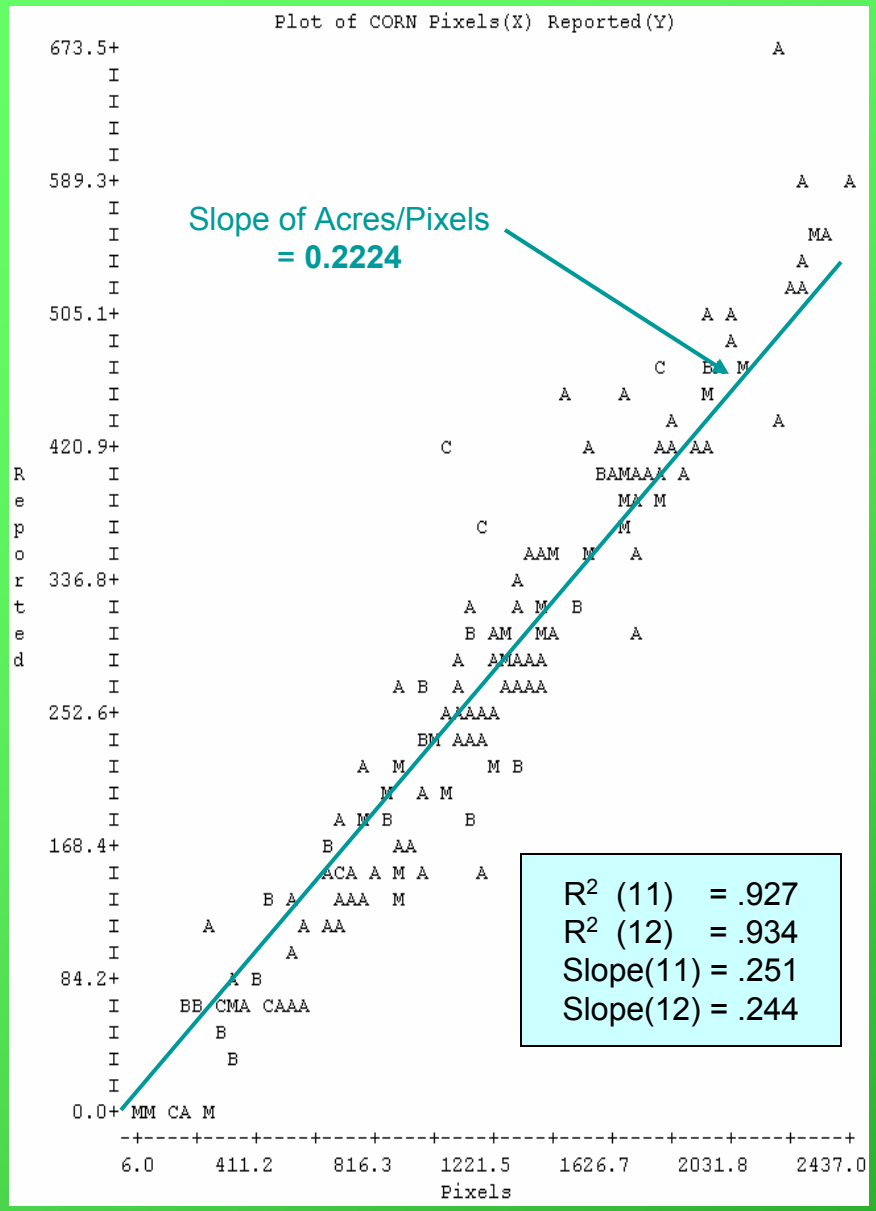

Nebraska 2005 - Analysis Districts and
AWIFS Scene Observation Dates
Analysis Districts &
Scene Dates
AD10 06/21/05 & 08/08/05
AD11 08/18/05
AD12 06/22/05 & 08/08/05
ADDE

Kappa Statistics and Pixel Counts for Nebraska 2005 Classifier Accuracy

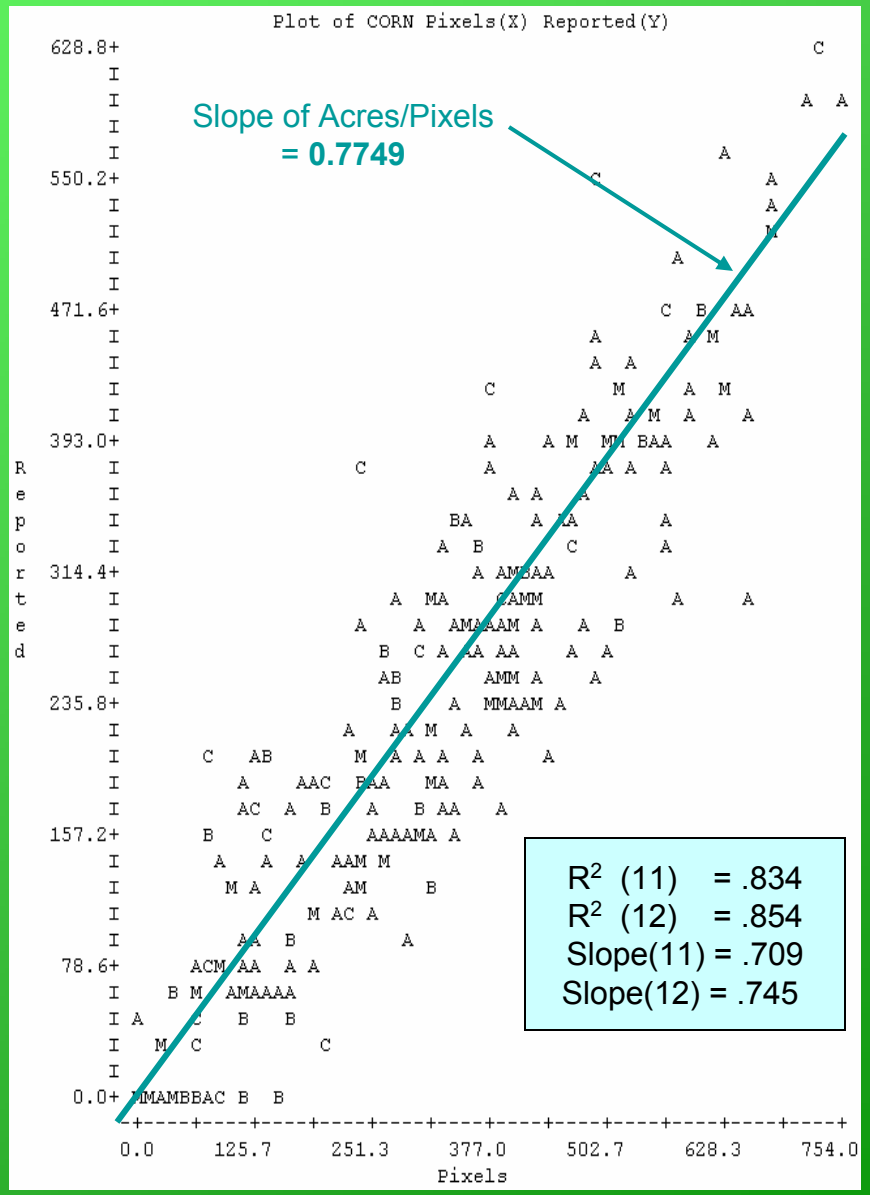
	Kappa		Training Pixels	
	Corn	Soybeans	Corn	Soybeans
District	TM	TM	TM	TM
AD01	97.5	.	2,014	.
AD02	89.7	99.9	9,635	888
AD03	75.7	81.4	18,440	2,814
AD04	88.5	95.7	39,219	19,693
AD05	92.3	90.4	81,409	50,103
AD07	70.3	91.1	30,181	20,769
District	AWiFS	AWiFS	AWiFS	AWiFS
AD10	95.3	98.3	3,510	347
AD11	65.1	66.2	106,721	61,581
AD12	65.6	64.1	81,273	51,978

Regression Analysis from Sample Estimation

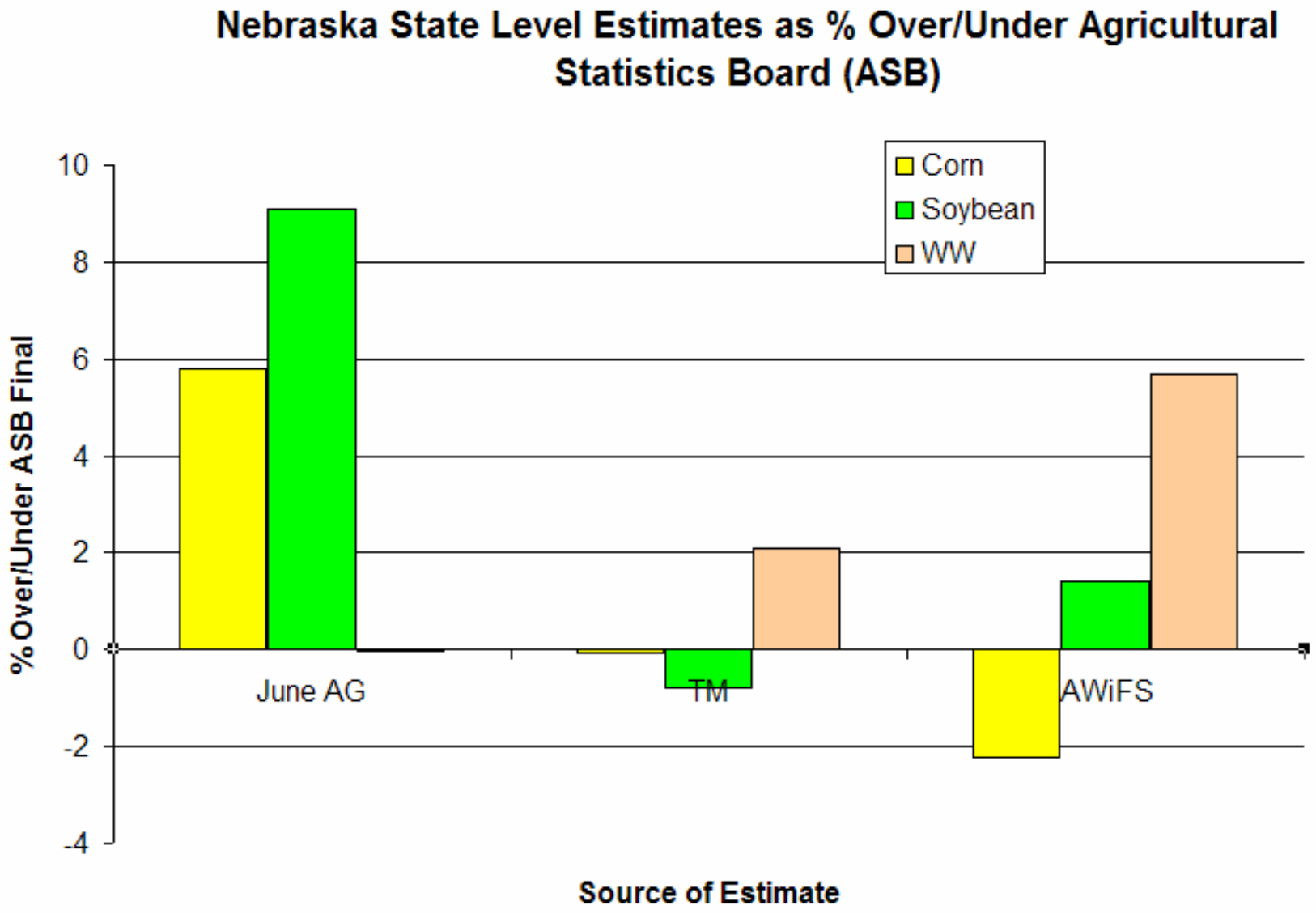
Landsat TM Corn



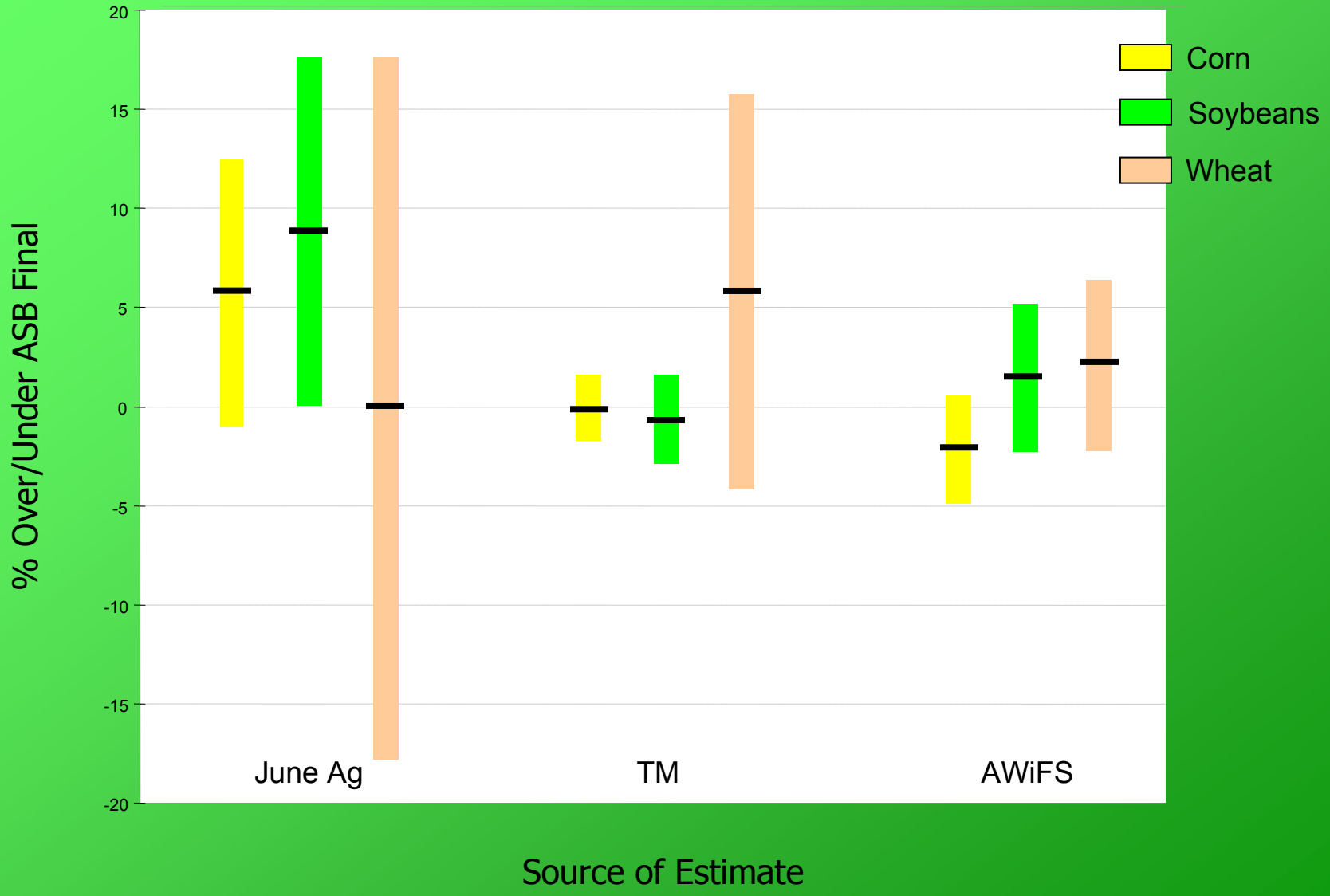
AWiFS Corn



Nebraska 2005 State Level Estimates as % Over/Under Agricultural Statistics Board (ASB)



Nebraska 2005 State Level Estimates +/- 2% CVs (Coefficient of Variation)



Program Summary

- **AWiFS**
  - TM outperforms
    - Only marginally for cropland cover types
  - State level assessments
    - AWiFS has larger CV's AWiFS lower Kappa
    - Useful for the NASS estimation program
  - More frequent cloud-free coverage
  - Very efficient to manage and process

- **FSA Common Land Unit**
  - Adequate alternative to JAS for training/testing
  - JAS segments necessary for estimation

- **See5**
  - Classification accuracy
  - Handling of large datasets
  - Repeatability
  - Speed

  - Need other commercial applications to process datasets