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Geographer

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National Agricultural Statistics Service  
Research and Development Division  
Spatial Analysis Research Section**

# **An Evaluation of Resourcesat-1 LISS-III vs AWiFS Imagery for Mapping Croplands**



# NASS Overview

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

NASS - Data and Statistics - Microsoft Internet Explorer

Address: http://www.nass.usda.gov/Data\_and\_Statistics/index.asp

USDA National Agricultural Statistics Service

The 2002 Census of Agriculture is the most comprehensive source of statistics portraying our nation's agriculture

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**Data and Statistics**

Quick Stats (Agricultural Statistics Data Base)

NASS publishes U.S., state, and county level agricultural statistics for many commodities and data series. Quick Stats offers the ability to query by commodity, state(s) and year(s), providing the most up-to-date statistics including all revisions. The query dataset can be downloaded for easy use in your database or spreadsheet.

I Want To...

- Query NASS Data from a Data Base
- Search for Data by Commodity
- Request a Special Tabulation
- Contact a Specialist
- View Data in Charts and Maps

About NASS Estimates

- Importance of Ag Estimates
- Understanding Crop Forecasts
- Foundation of Estimates
- Estimating Programs
- Citation Request

Also See

- NASS Publications
- Statistical Bulletins
- Pest Management
- Price Reactions
- State Ag Overview
- Track Records

Additional Crops County Resources

Maps of crops county estimates for acreage and yield are available from NASS as both CSV data files and maps.

County data from Quick Stats data is also available in pre-extracted data sets by year and by crop.

Census of Agriculture

To query Census of Agriculture data, choose from the Census years below. To view the Census publications, click here:

- Data Queries for 2002, select below:

Select a Census Query

Data Queries for 1997, 1992, 1987

Interactive Data

NASS provides a variety of tools for interacting with our Census datasets.

Interactive Statistical Maps

Interactive Census Maps for 2002 Census Highlights

Table Lens

Table Lens Application for 1997 Census Data

Last modified: 12/30/05

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2001 Wildlife Damage Survey

7.7 Percent of Crop Value Lost to Deer and Geese

Maryland farmers lost \$17.2 million of corn, soybeans and wheat to deer or geese during 2001, translates to Maryland farmers losing 7.7 percent of the crop value to deer and geese. Soybeans account for the greatest economic loss, totaling \$9.1 million, 11 percent. Corn losses were \$6.6 million, 5.8 percent and wheat \$1.5 million, 5.6 percent. Deer damage resulted in losses of \$13.6 million, 6.1 percent, while geese losses were \$3.6 million, 1.6 percent.

Production losses totaled 6.0 million bushels. Corn losses were 3.2 million bushels, soybean losses are 2.2 million bushels and wheat accounted for 0.6 million bushels. Production losses to deer were 4.7 million bushels and geese 1.3 million bushels.

In terms of yield, losses to deer were most severe in Central and Western Maryland, while geese damage greater on the Eastern Shore. Corn yield losses of 9.6 bushels per acre and 7.4 bushels per acre were reported in Central and Western Maryland, respectively. The Lower Eastern Shore reported the highest soybean loss of 6.1 bushels per acre.

Sixty-two percent of farms reported deer or geese damage to one or more crops. Damage was reported on 27 percent of farms raising corn, 58 percent of farms growing soybeans and 27 percent of farms with wheat.

Maryland 2001 Crop Loss from Deer

Region	Crop	Acres Harvested	Harvested Yield (bushels)	Average Yield Loss (bushels)	Production Loss (bu)	Economic Loss (\$)
Western Maryland	Corn	15,500	124,493	7.4	40,100	83
	Soybeans	300	16.7	9.9	1,202,250	2,473
	Wheat	200	45.2	2.0	460	1
Central Maryland	Corn	114,200	924	3.9	360,750	1,479
	Soybeans	92,800	34.2	3.3	126,250	319
	Wheat	38,300	63.3	3.3	126,250	319
Southern Maryland	Corn	25,800	132.9	4.9	146,200	299
	Soybeans	43,200	39.0	3.3	142,250	319
	Wheat	16,900	57.0	0.9	14,400	16
Upper Shore	Corn	157,200	119.2	5.1	800,700	1,241
	Soybeans	232,000	39.8	2.4	186,400	2,232
	Wheat	84,800	64.0	1.1	99,150	213

USDA NEWS RELEASE

NATIONAL AGRICULTURAL STATISTICS SERVICE  
United States Department of Agriculture - Washington, DC 20250  
Ag Statistics Hotline: (800) 727-9540 • www.nass.usda.gov

Contact: Ellen Dougherty, (202) 690-8122  
Jeff Geuder, (202) 720-2127

## USDA FORECASTS RECORD-SETTING CORN CROP FOR 2007

Washington, Aug. 10, 2007 – U.S. corn production is expected to reach a record 13.1 billion bushels, 10.6 percent above the 2006 record of 11.8 billion bushels, according to the Agriculture's National Agricultural Statistics Service.

Based on conditions as of August 10, 2007, the average yield per acre is expected to be 131.1 bushels, up from 126.4 bushels per acre in 2006. The average yield per acre is expected to be 131.1 bushels per acre, up from 126.4 bushels per acre in 2006. The average yield per acre is expected to be 131.1 bushels per acre, up from 126.4 bushels per acre in 2006.

Yield forecasts are high for the Delta. Meanwhile, hot, dry conditions in the Southeast and eastern Corn Belt, Ohio Valley and the Great Plains are expected to reduce yields in those areas.

WISCONSIN AGRICULTURAL STATISTICS SERVICE

P.O. Box 8034 Madison, WI 53708-8034

In cooperation with WI Department of Agriculture, Trade and Consumer Protection

2002 Dairy Producer Opinion Survey

November 2002

Wisconsin Milk Production to Recover

Milk production is expected to increase in Wisconsin during the next few years according to a survey conducted by the Wisconsin Agriculture Statistics Service. This statewide survey of producers asked for their plans with the assumption that milk prices for the next five years will be at the same level as the past five years. The survey was conducted during May and June 2002.

Based on the survey, 60 percent of producers expect to keep the same herd size, 20 percent plan to increase herd size, and 20 percent intend to discontinue milking by 2007. Actual results will depend on future milk prices, input prices, financing availability, crop yields, and other factors.

The number of herds projected for 2007 shows that the diversity of small to large herds will continue. The most prevalent herd size will remain at 50 to 99 cows.

http://www.nass.usda.gov:8080 - 2002 Census of Agriculture - SVG Interactive Mapping - United States - Microsoft Internet Explorer

National Agricultural Statistics Service 2002 Census of Agriculture

United States | All data items are from Chapter 2 - Table 1. Area Summary Highlights: 2002 Selected crops harvested - Land in orchards (acres)

State: United States - County Level | Data Item: Selected crops harvested - Land in orchards (acres)

United States Total: 5,330,439

State Total:

County Total:

Download data as CSV | XML | PDF

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Legend

Scale: National | Zero or Data Withheld

(Changes the data range based on National or State level)

Comparisons: 6 | 20,000 | 40,000 to 60,000 | 60,001 to 80,000 | 80,001 to 100,000 | 100,001 +

Color: Green

Source: USDA-NASS 2002 Census of Agriculture © USDA-NASS 2005-2006

Navigate: Mouse-over a specific state/county to view the state/county level data. Right click to zoom (option-click for MAC users). Hold the Alt key and click+drag to pan. For additional assistance with this application, click here to view the support page.

All Milk Price, Wisconsin Annual Average, 1985 - 2002 1/2

Wisconsin Dairy Herds by Herd Size

Milk cow herd size	May 2002 herds	May 2007 herds (projected) 1/2	Change 2007/2002
1 - 29	2,800	1,440	-45
30 - 49	4,700	3,440	-27
50 - 99	7,400	5,600	-24
100 - 199	1,900	2,080	+10
200 - 499	700	600	-29
500+	200	440	+120
Total	17,500	15,900	-20

1/2The May 2007 projection is based on farmers' opinions May-June 2002, with the assumption that milk prices for the next five years will be at the same level as the past five years.

Wisconsin Dairy Farmers Plans for May 2007 1/2 by Herd Size

Herds	Keep same herd size	Increase herd size	Discontinue milking
2,800	47	17	58
4,700	71	9	20
7,400	63	19	18
1,900	53	37	10
700	33	59	8
200	22	78	0
17,500	92	29	20

1/2The projection is based on farmers' opinions May-June 2002, with the assumption that milk prices for the next five years will be at the same level as the past five years.

Percent of Herds by Size Group 2007 Projection

Legend: 1-29, 30-49, 50-99, 100-199, 200-499, 500+

# Research and Development Division

## Geospatial Information Branch

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NASS - Research and Science

USDA United States Department of Agriculture  
National Agricultural Statistics Service

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### Research and Science

#### Spatial Data

Vegetation Condition Images

Cropland Data Layer

**Image Gallery** (2003) available for these states: Arkansas, Illinois, Indiana, Iowa, N. Dakota, Mississippi, Missouri, Nebraska, Wisconsin

Land Use Strata for Selected States

#### Census of Agriculture

**2002 Census Map Gallery**

2002 Maps: Gallery | Star Tree | List

Interact with Data (1997)

"Linked Micromap" Plots (1997):  
Corn | Cotton | Hay | Soybeans | Wheat

#### Animated Maps

**Crop Acreage** | **Vegetation Condition**

Corn | Cotton | Oats  
Soybeans | Wheat

#### Reports, Papers and Presentations

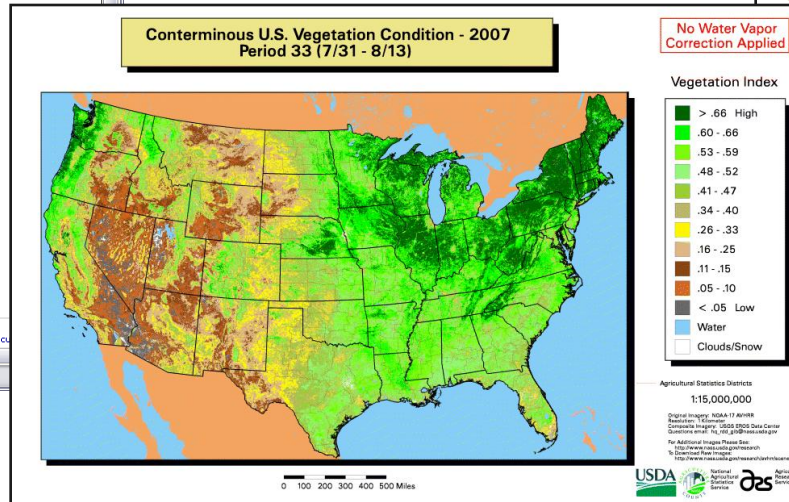
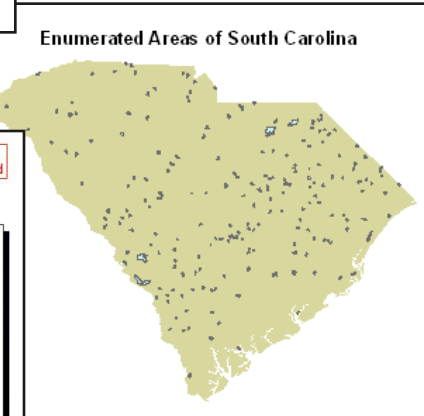
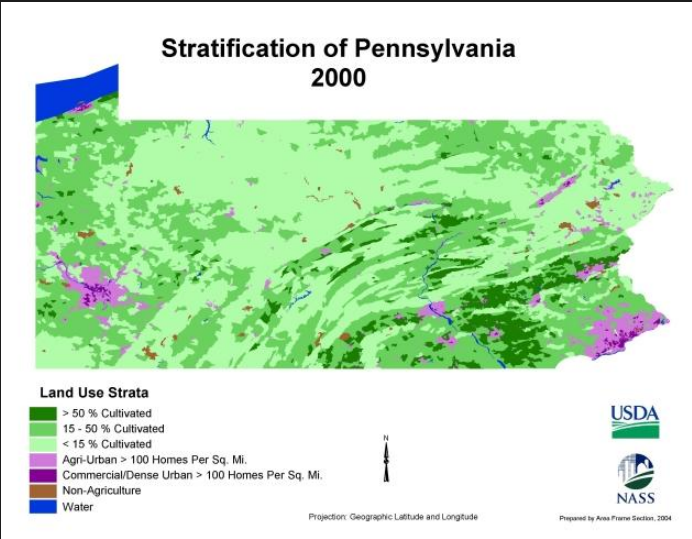
Research Reports

- **New!** Access 733 archived reports available by subject area: GIS | Survey | Yield

2004 MEXSAI "Star Tree" Diagram  
Ron Bosecker, Presenter

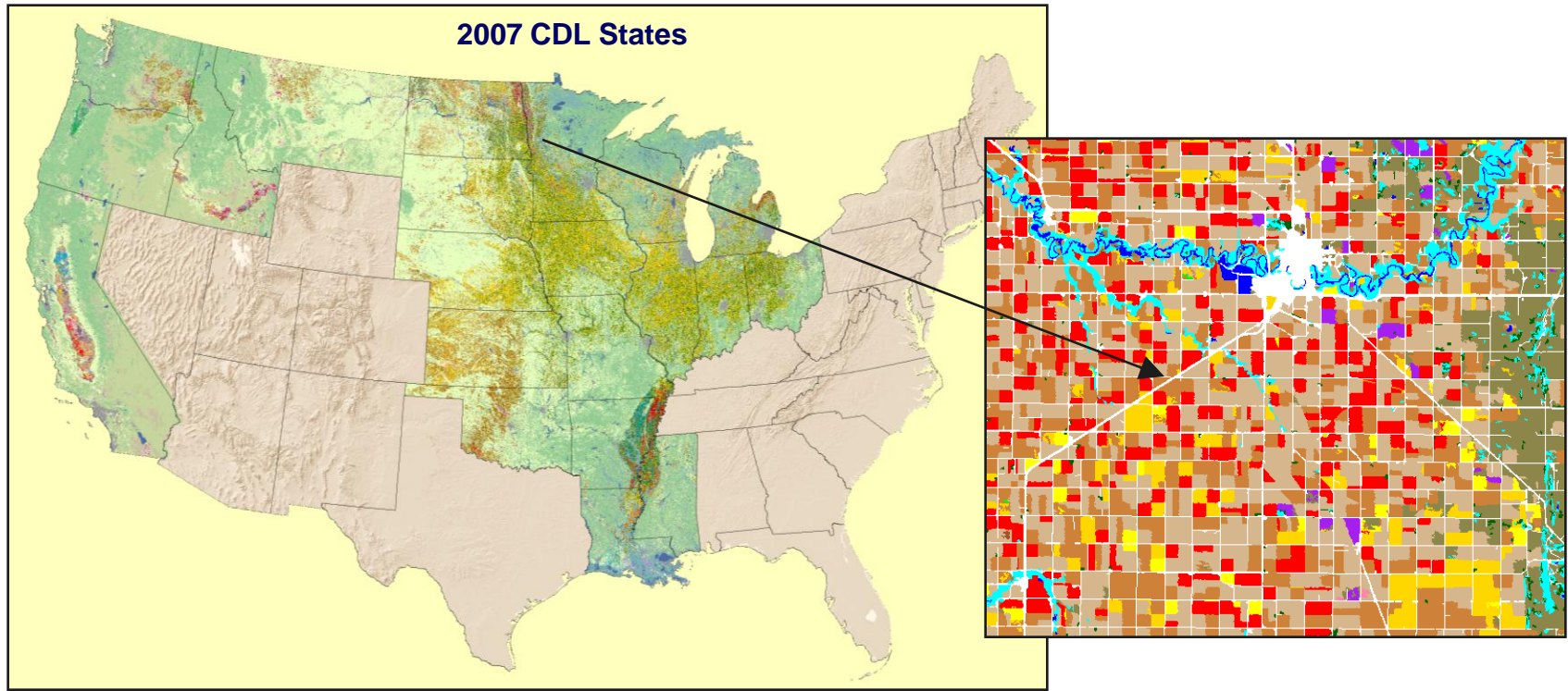
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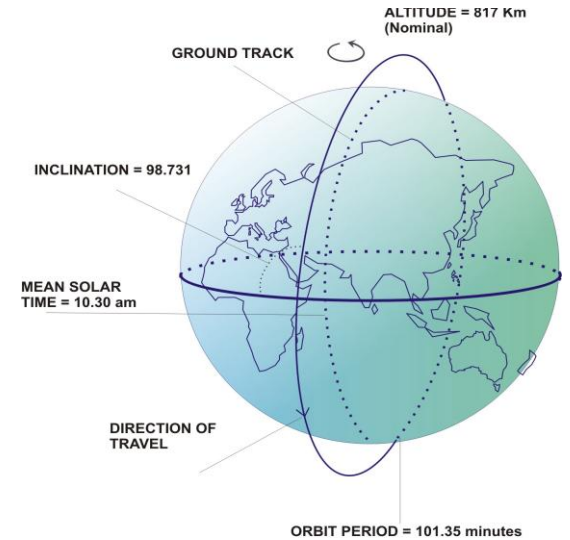
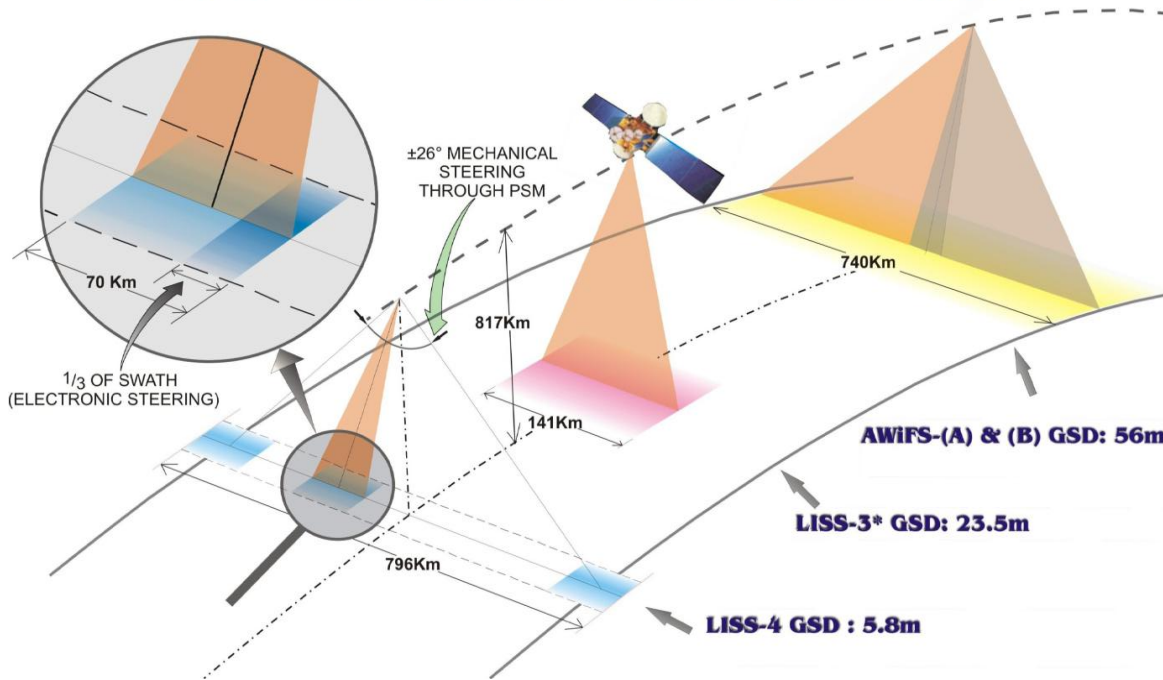
# Cropland Data Layer (CDL) Program



- State specific land cover classifications emphasizing row crop agriculture
  - Some regions done annually (Corn Belt, The Delta)
  - Others “one-and-done” (California, Northwest)
- Within NASS, CDL used to
  - Increase precision on survey derived acreage estimates
  - Improve county level acreage estimates

# Resourcesat-1

## IRS-P6 THREE TIER IMAGING

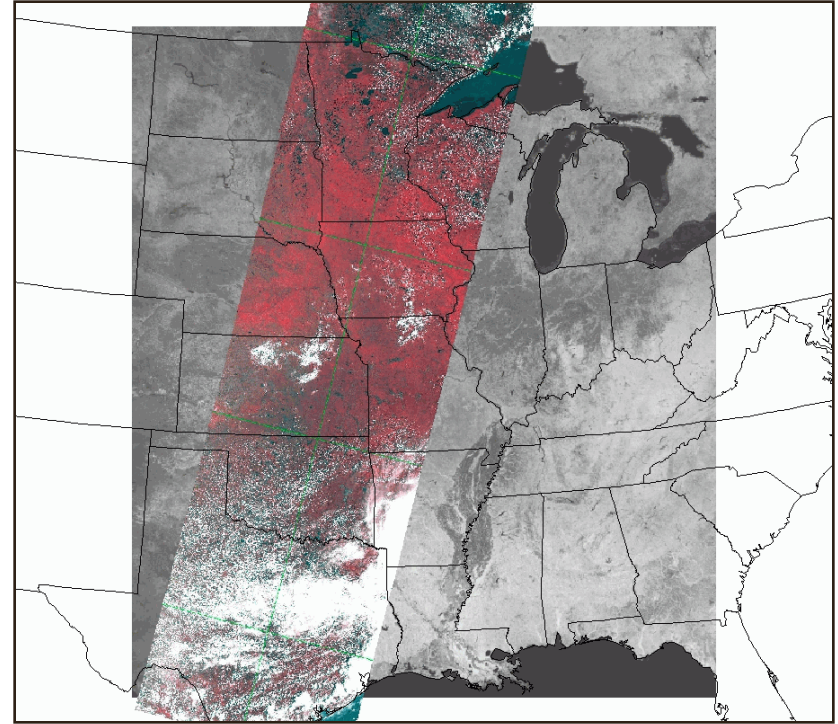


**Department of Space**  
*Indian Space Research Organisation*



# Why NASS Likes AWiFS

- Large swath width
- Inclusion of red, NIR, SWIR spectral bands
- Tolerable spatial resolution at 56m
- Cost effectiveness
- Operational nature
- Fast data delivery by vendor
- Healthy satellite
- Follow-on system (Resourcesat-2) already built





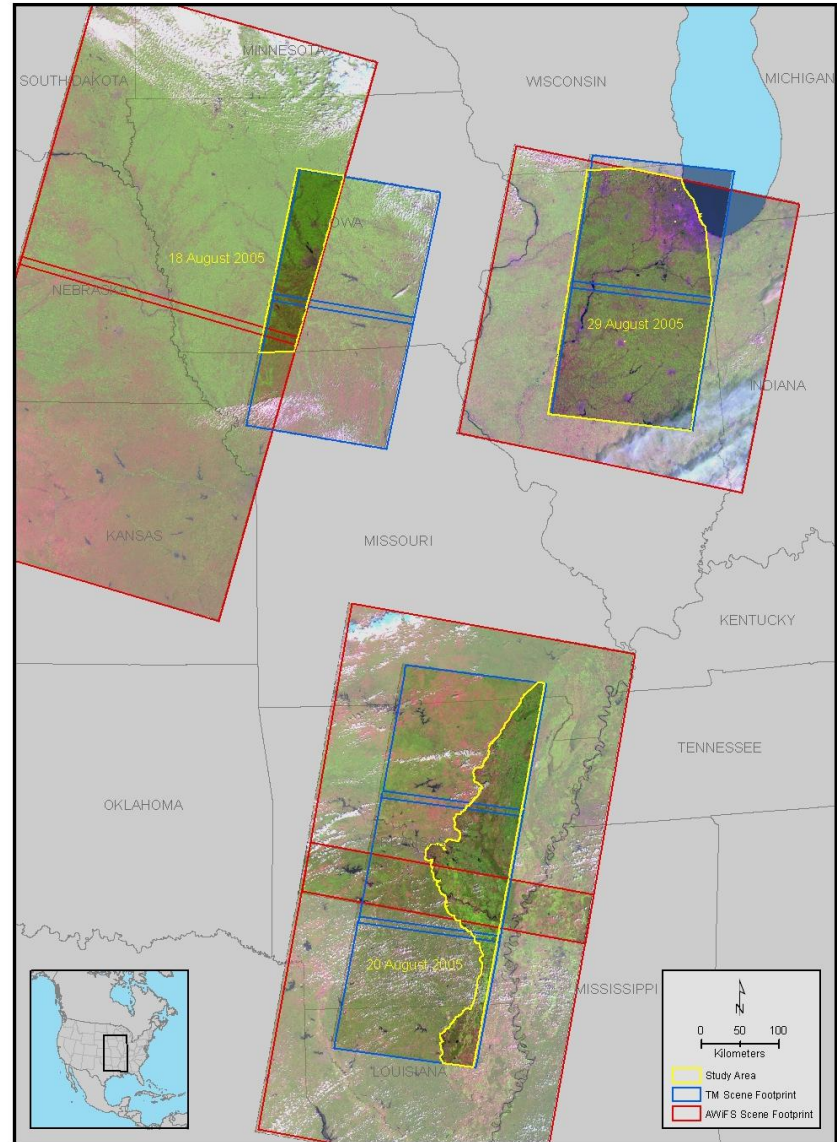
# History of NASS AWiFS Use

- 2004
  - Obtained AWiFS August imagery
  - Used to augment TM images collected during entire summer
- 2005
  - Obtained AWiFS June and August imagery
  - Used to augment or replace TM
  - Assessed quantitative differences
- 2006
  - Switched from Landsat to Resourcesat at a USDA-wide level
  - Obtained AWiFS during entire summer growing season
- 2007
  - Obtained even more AWiFS during entire summer growing season
- 2008
  - Proceeding forward with AWiFS



# AWiFS versus TM Study

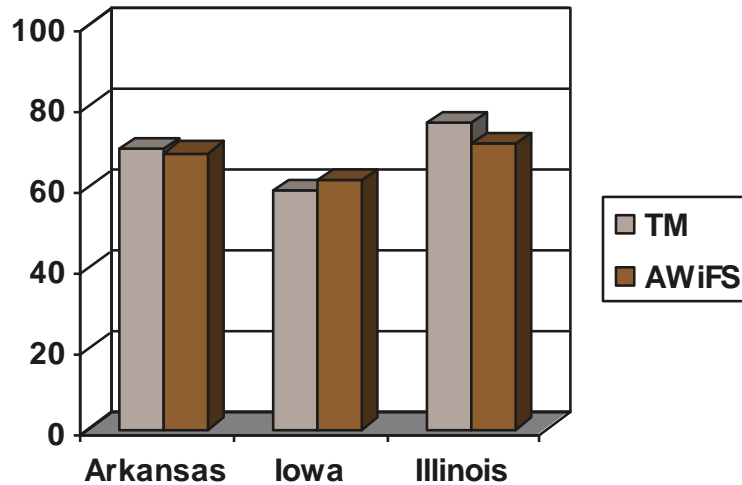
**Compared classification accuracy over three study sites using same date coincident TM and AWiFS data from 2005 growing season**





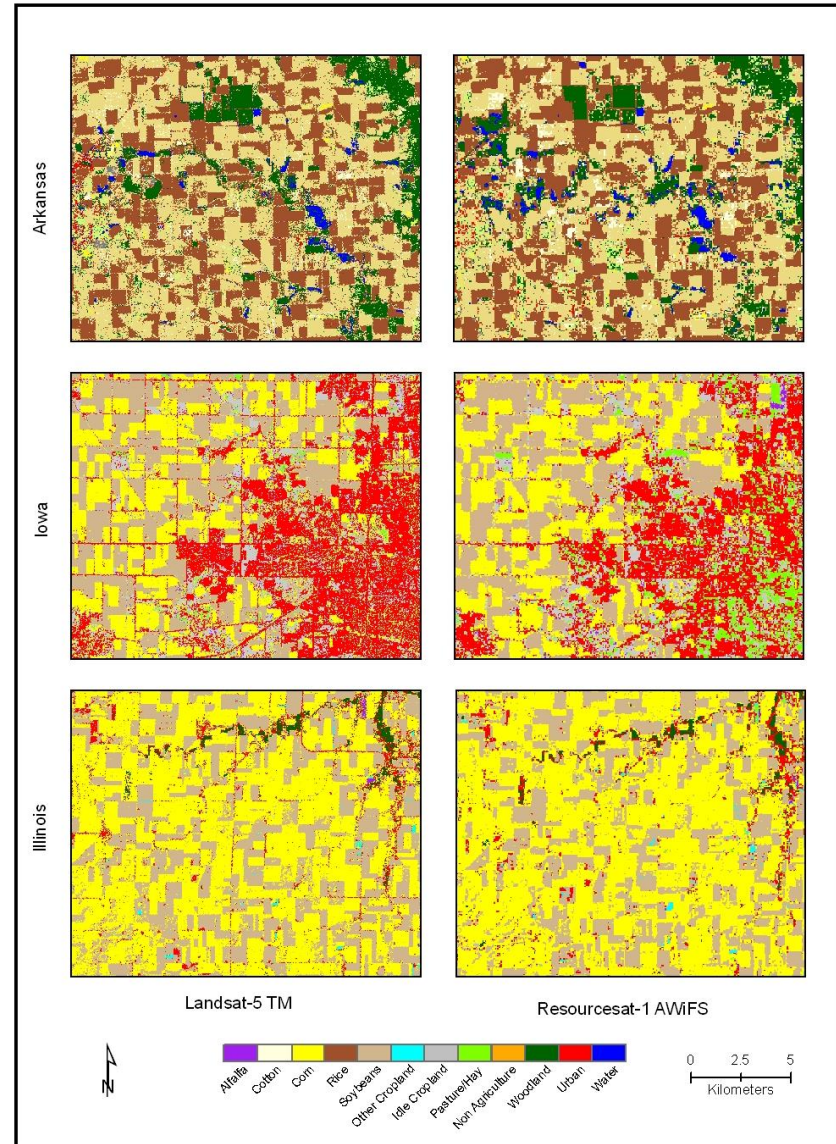
# Results of TM versus AWiFS

Overall Accuracy



TM usually outperforms AWiFS.

Spatial resolution somewhat more important than loss of blue and mid-infrared bands.



# Hypothetical Question Raised



“Would classification accuracy improve if one had access to AWiFS swath width sized imagery but with LISS-III’s 23.5 m pixel resolution?”

Better?

Worse?

No difference?

# Testing of the Question

- Can it be tested?
  - Yes!
- Conveniently, AWiFS and LISS-III
  - Ride in tandem on the same platform
  - Collect data in parallel
  - Are very similar instruments





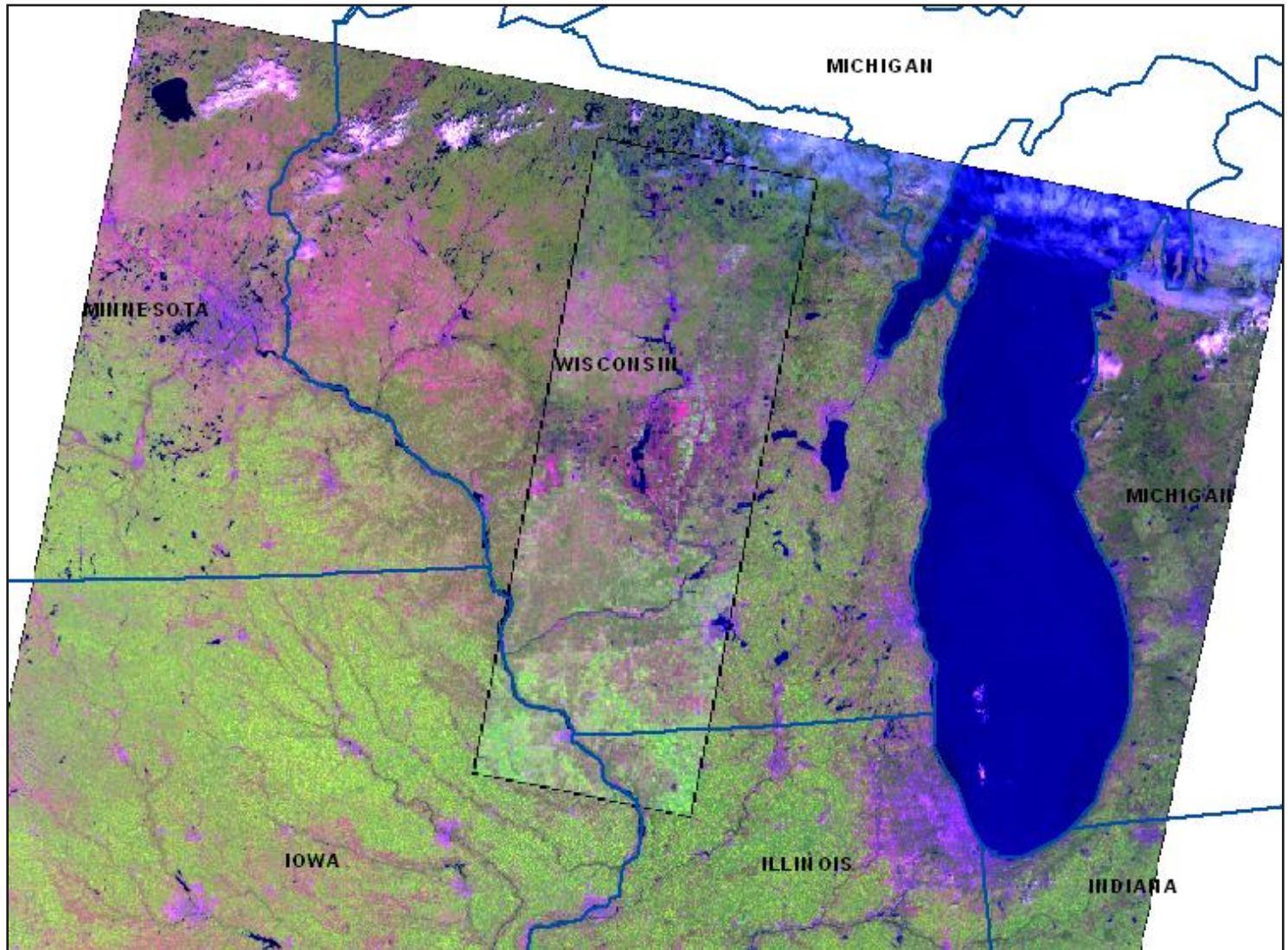
# Sensor Specifications

	<b>AWiFS</b>	<b>LISS-III</b>
<b>IGFOV</b>	56m (nadir) 70m (field edge)	23.5 m
<b>Spectral bands</b>	B2: 0.52-0.59 B3: 0.62-0.68 B4: 0.77-0.86 B5: 1.55-1.70	B2: 0.52-0.59 B3: 0.62-0.68 B4: 0.77-0.86 B5: 1.55-1.70
<b>Swath</b>	370 km each head 737 km (combined)	141 km
<b>Integration time</b>	9.96 msec	3.32 msec
<b>Quantization</b>	10 bits	7 bits (SWIR band has 10-bit quantization, selected 7 bits out of 10 bits will be transmitted by the data handling system)
<b>Number of gains</b>	1	4 for B2, B3 and B4. For B5 dynamic range obtained by sliding 7 bits out of 10 bits

**“The CCDs used in AWiFS are identical to those of LISS-III.”**

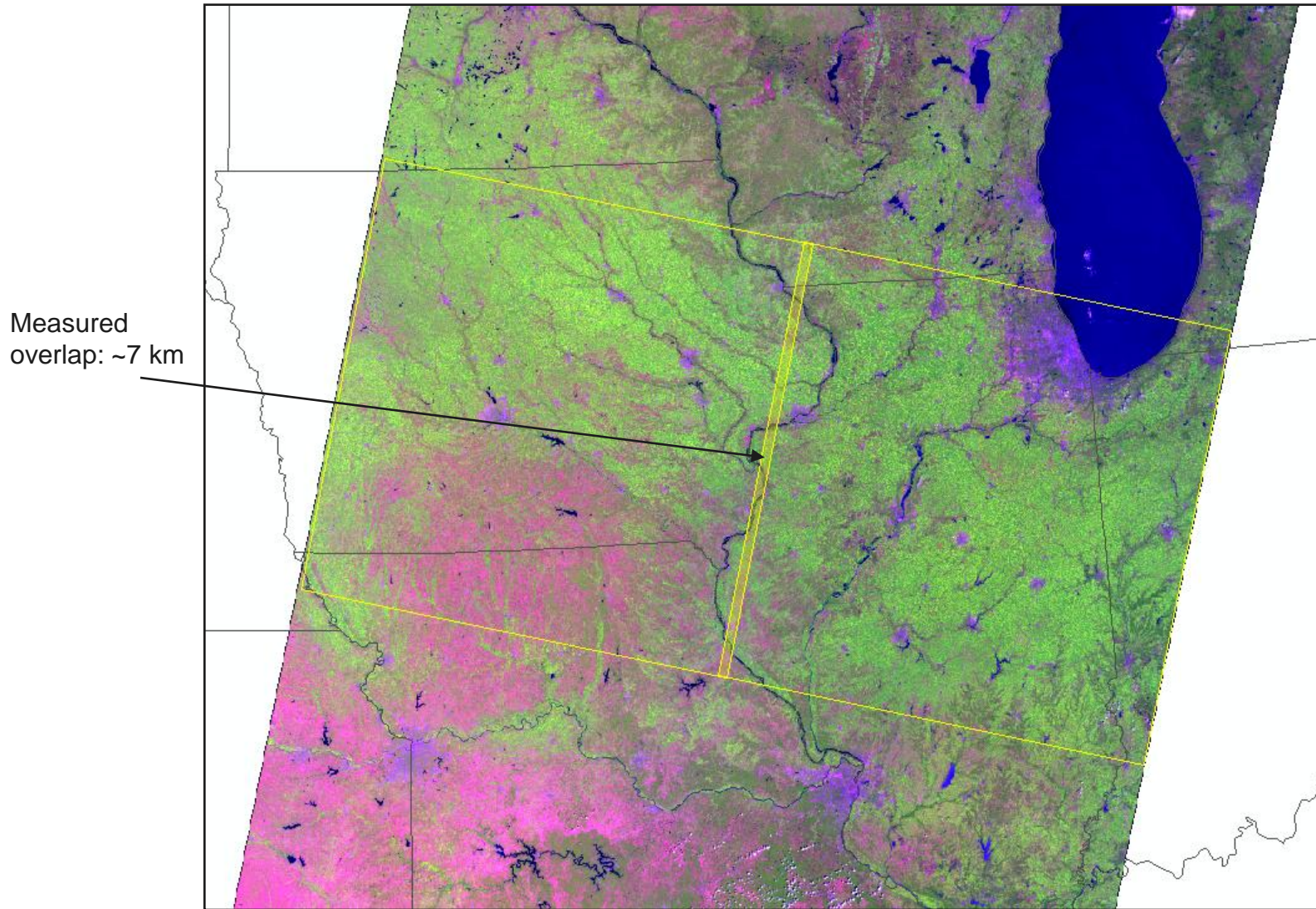
# Wisconsin Test Case

31 July  
2006





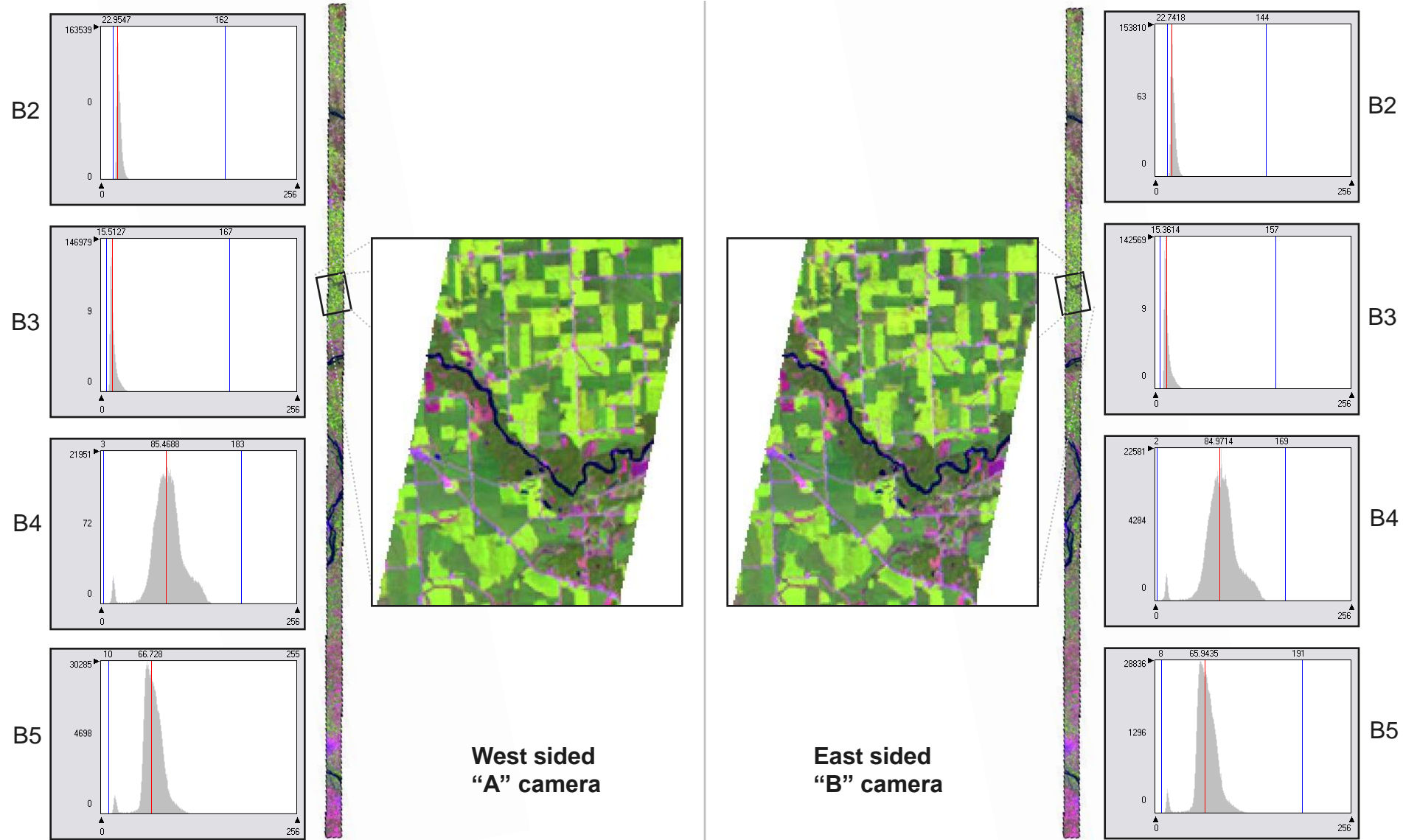
# Comparison of Nadir AWiFS Overlap Area



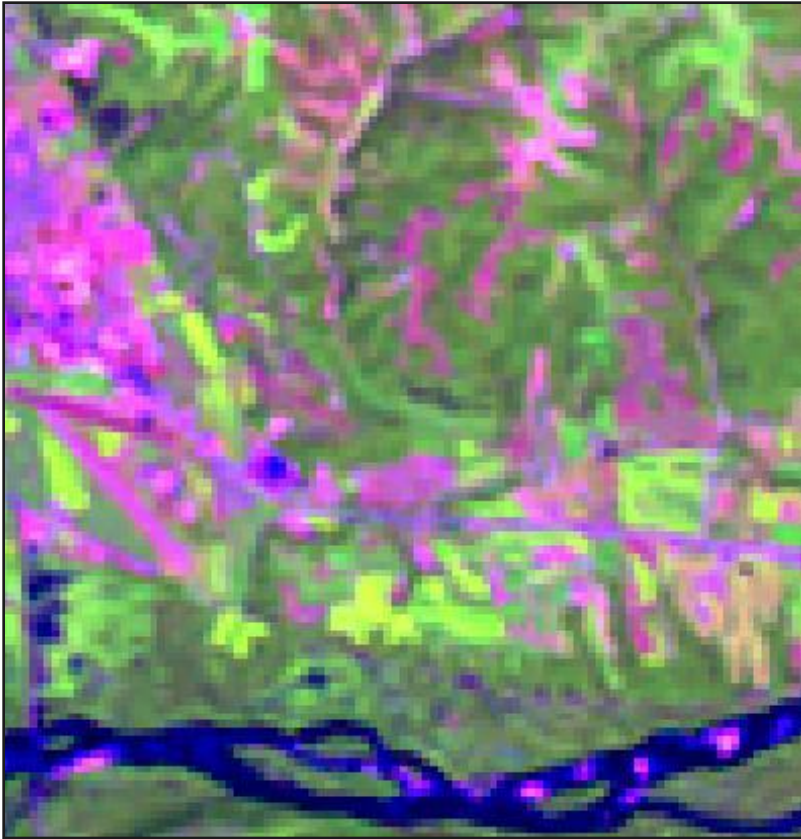
31 July 2006



# Inspection of Nadir AWiFS Overlap Area

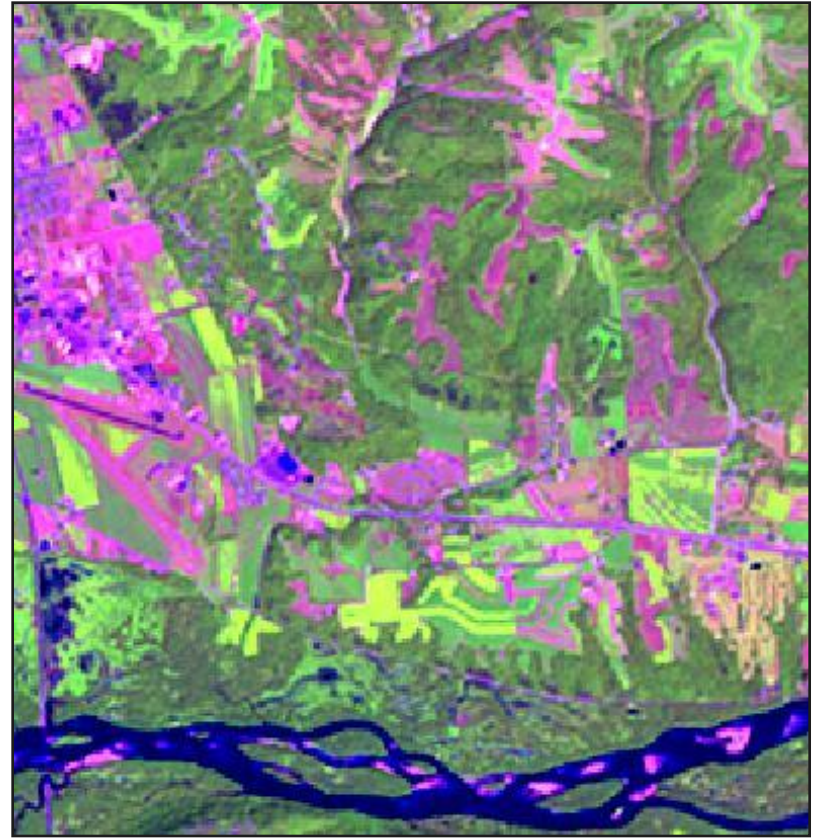


# Wisconsin Raw Data



**AWiFS**

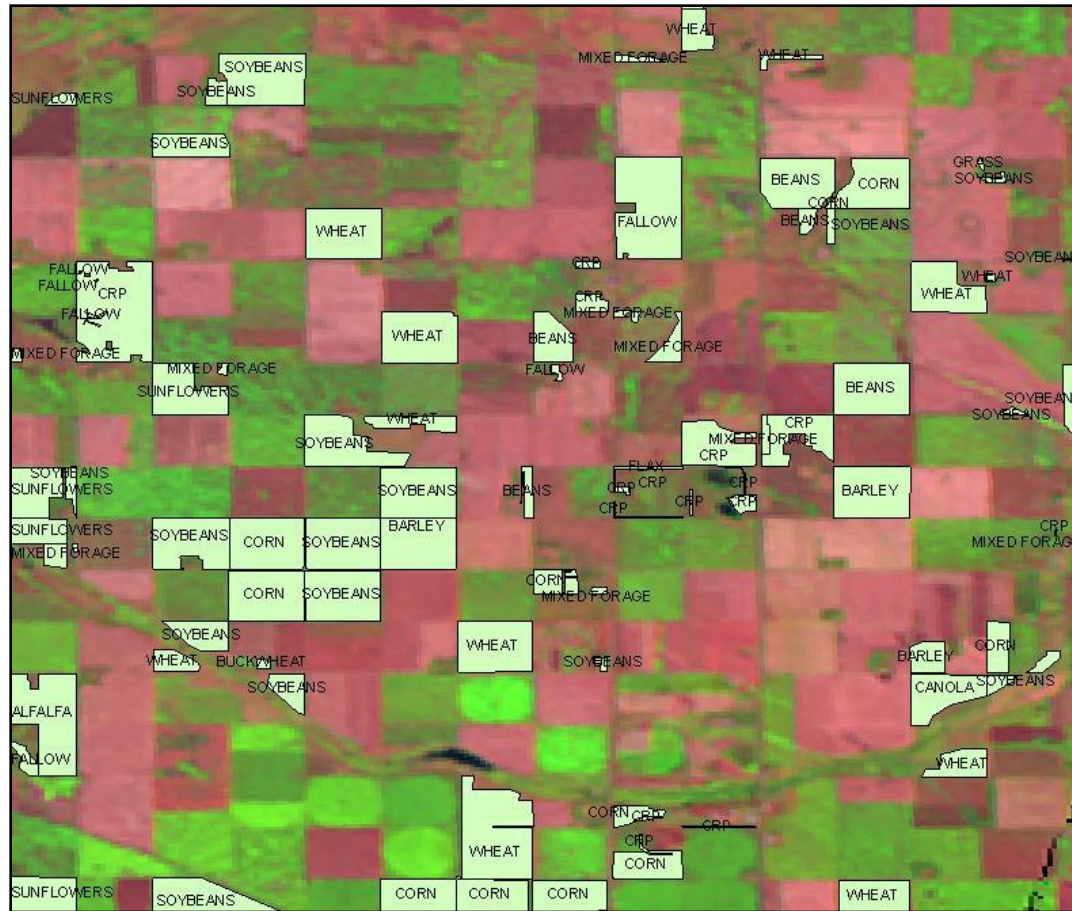
Red=Red, Green=NIR, Blue=SWIR



**LISS-III**

Red=Red, Green=NIR, Blue=SWIR

# Ground Truth



USDA Farm Service Agency (FSA) data

- Common Land Unit (CLU) with form 578 “reported” info

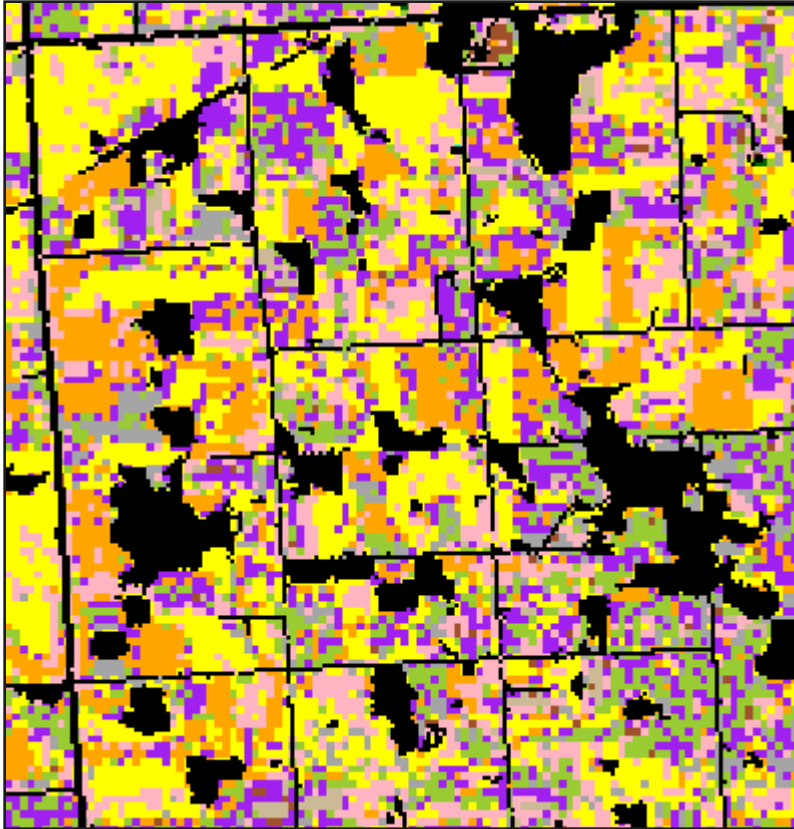


# Methodology

- Reprojected/mosaicked to common projection
- Clipped AWiFS to LISS-III's extent
  - Only comparing the region of overlap
- Ran Supervised classification
  - Boosted Classification Tree Analysis
    - implemented in Rulequest See5.0
  - Random half of FSA CLU/578 utilized for training
- Accuracy assessed
  - Against other half of ground truth.

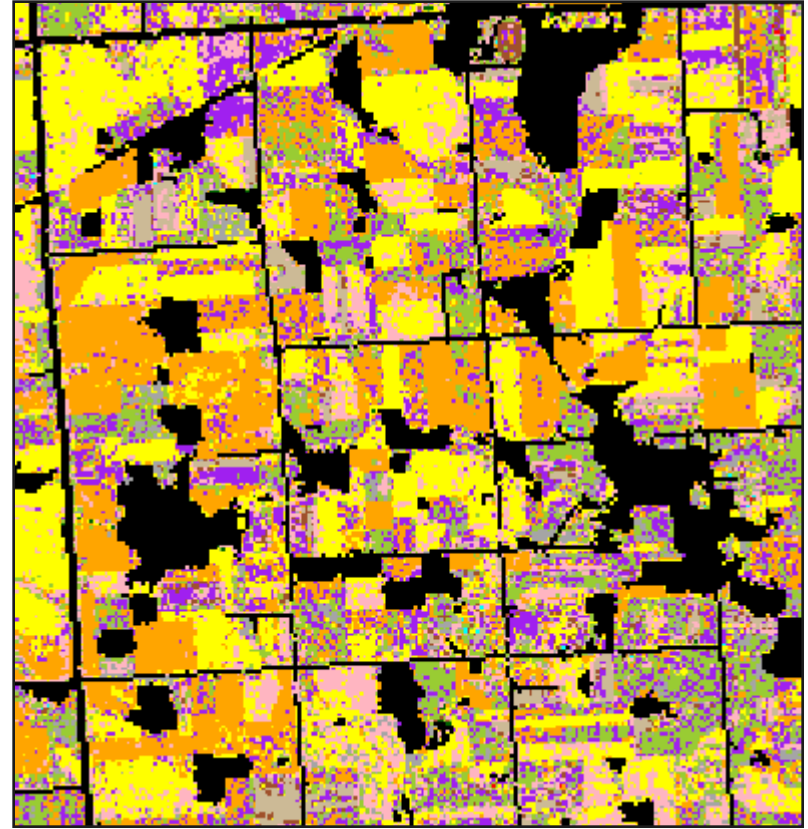


# Wisconsin Results



**AWiFS**

50.4% pixels correct



**LISS-III**

55.9% pixels correct

# Wisconsin Primary Crop Category Accuracies

	<b>AWiFS producer's accuracy</b>	<b>AWiFS user's accuracy</b>	<b>LISS-III producer's accuracy</b>	<b>LISS-III users' accuracy</b>
<b>Corn</b>	71.7%	68.7%	75.8%	75.2%
<b>Soybeans</b>	69.1%	59.5%	77.2%	62.6%
<b>Alfalfa</b>	23.6%	35.1%	33.8%	43.5%

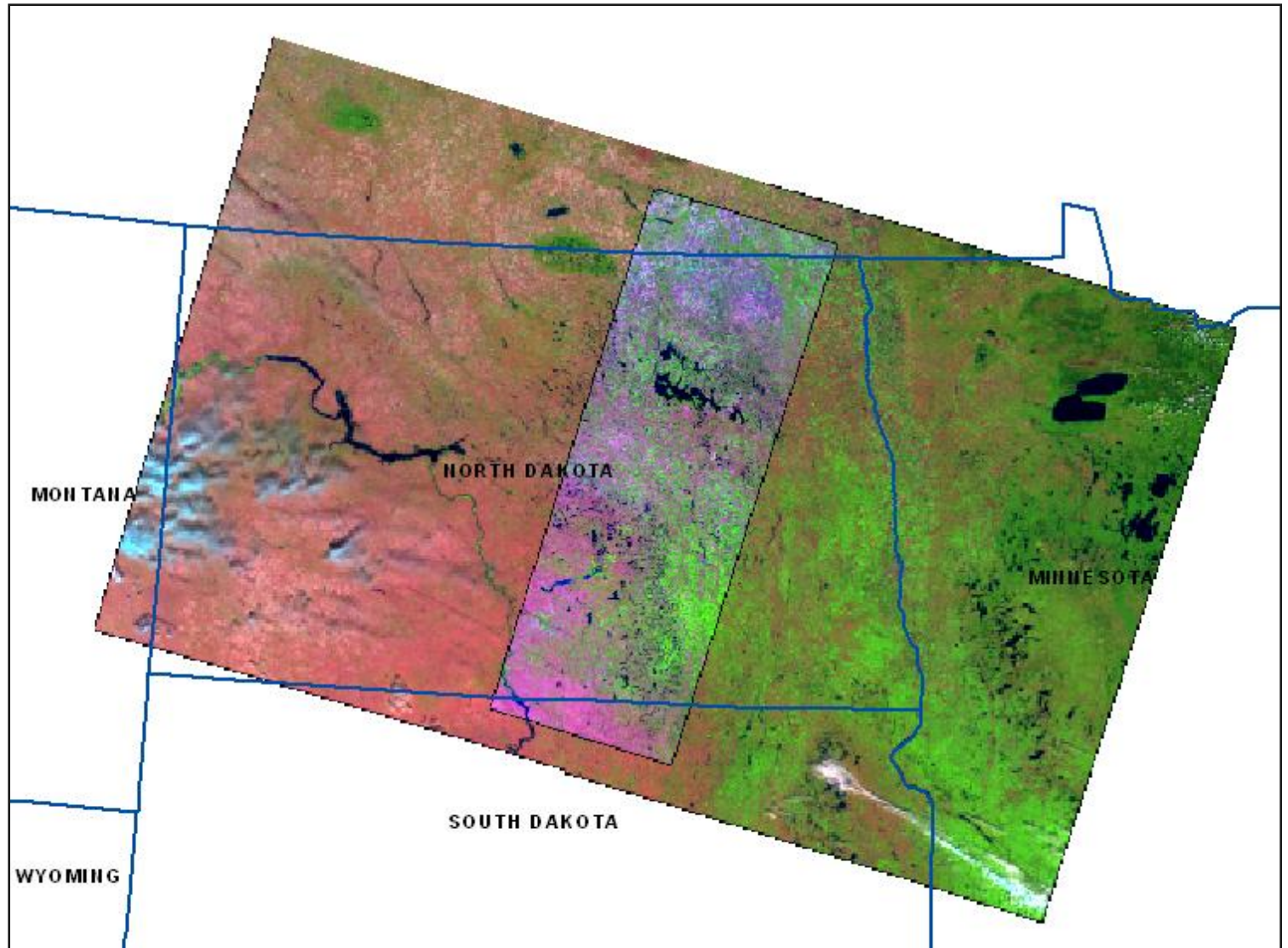
**AWiFS overall**  
50.4% pixels correct

**LISS-III overall**  
55.9% pixels correct





# North Dakota Test Case



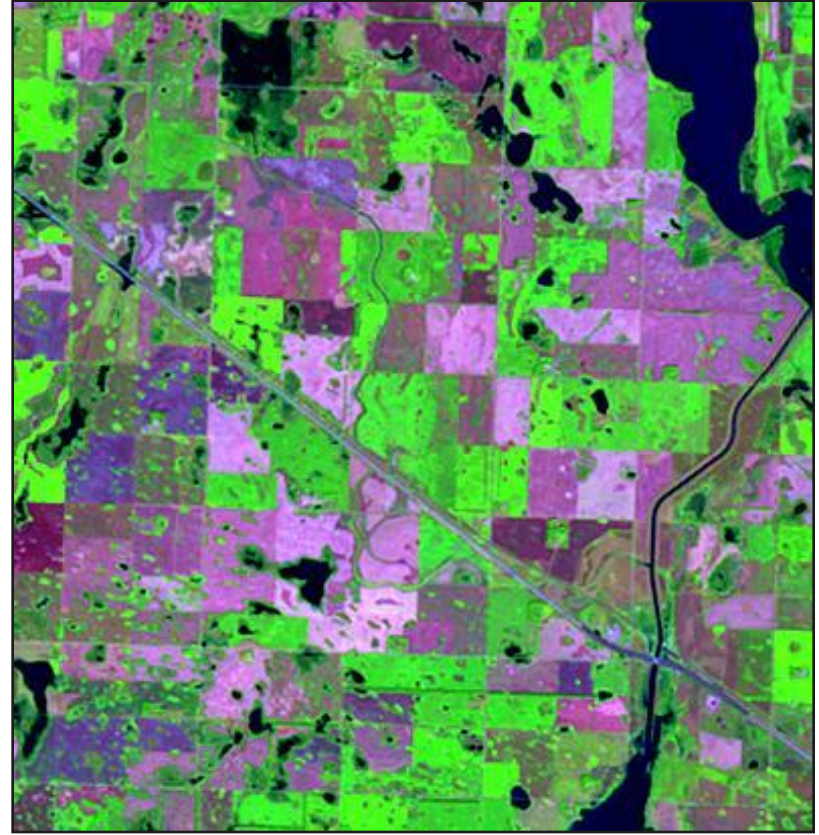
22 August  
2006

# North Dakota Raw Data



**AWiFS**

Red=Red, Green=NIR, Blue=SWIR

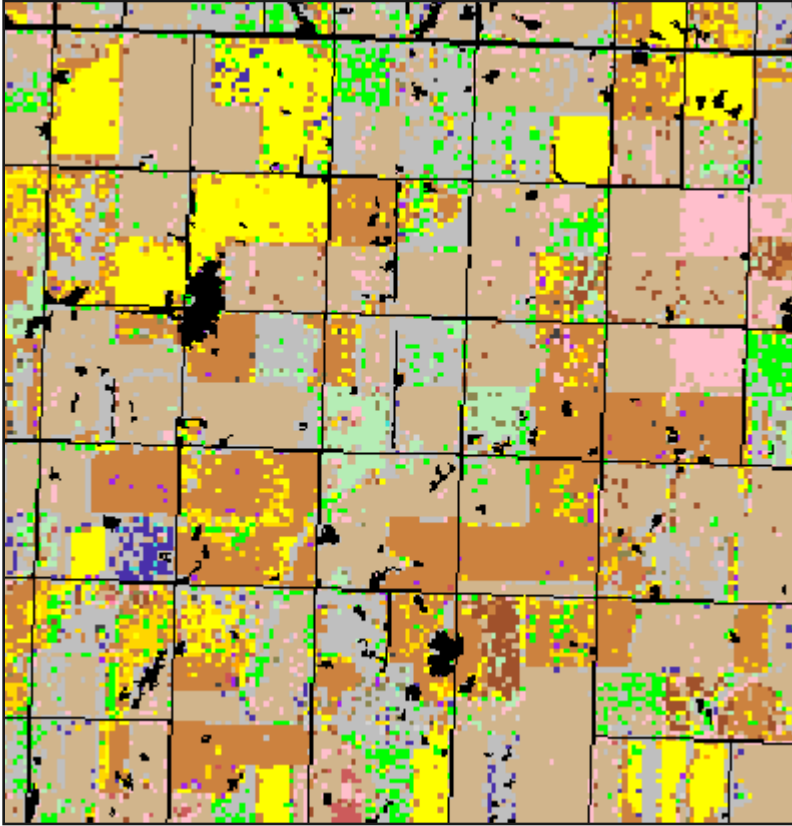


**LISS-III**

Red=Red, Green=NIR, Blue=SWIR

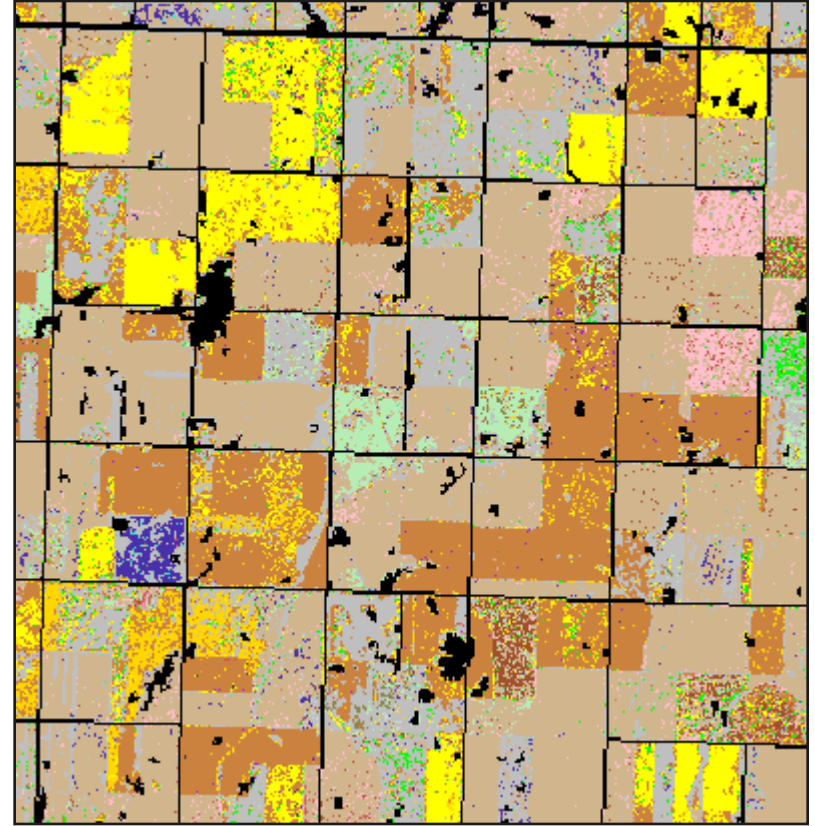


# North Dakota Overall Results



**AWiFS**

50.1% pixels correct



**LISS-III**

52.4% pixels correct



# North Dakota Primary Crop Category Accuracies

	<b>AWiFS producers accuracy</b>	<b>AWiFS user's accuracy</b>	<b>LISS-III producer's accuracy</b>	<b>LISS-III users' accuracy</b>
<b>Spring wheat</b>	67.9%	62.4%	72.6%	64.4%
<b>Soybeans</b>	64.2%	51.9%	67.0%	53.6%
<b>Sunflowers</b>	32.0%	36.3%	32.4%	38.4%

**AWiFS overall**  
50.1% pixels correct

**LISS-III overall**  
52.4% pixels correct



# Conclusions !

- A LISS-III resolution sensor with an AWiFS swath would improve NASS' ability to map croplands!
- A 5-10 % gain in map accuracy is suggested
- Accuracy gains are greater in areas with smaller field sizes
- Optimal resolution for mapping croplands is still not know but it is likely closer to 23 m than 56 m
- LISS-III is impractical today for NASS regional scale classification efforts due to limiting 141 km swath width, 26 day revisit rate, and cost



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