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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

Research and Development Division
Geospatial Information Branch

Cropland Data Layer (CDL) Program

2007 CDL States
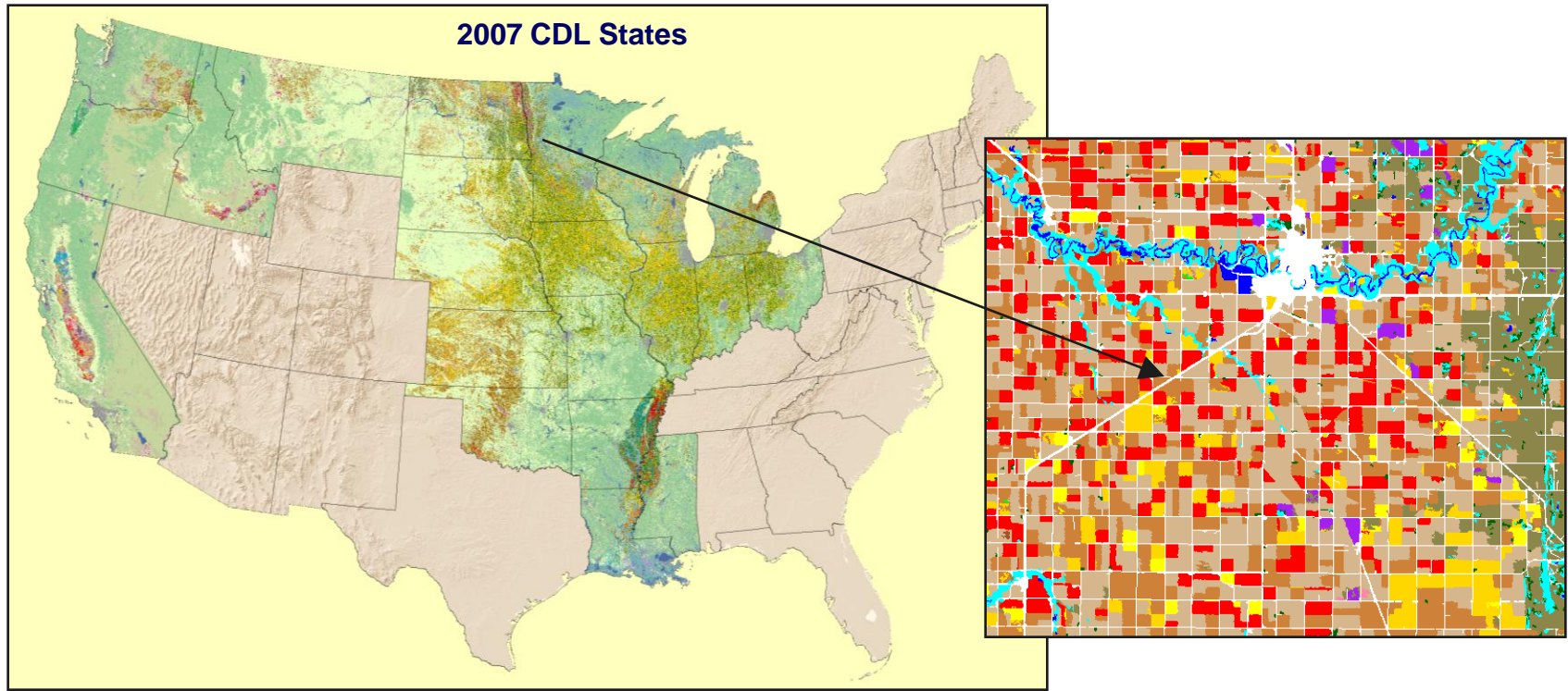
- State specific land cover classifications emphasizing row crop agriculture
  - Some regions done annually (Corn Belt, The Delta)
  - Others "one-and-done" (California, Northwest)
- Within NASS, CDL used to
  - Increase precision on survey derived acreage estimates
  - Improve county level acreage estimates

Resourcesat-1

IRS-P6 THREE TIER IMAGING

70 Km

1/3 OF SWATH
(ELECTRONIC STEERING)

±26° MECHANICAL
STEERING
THROUGH PSM

817Km

141Km

740Km

796Km

AWiFS-(A) & (B) GSD: 56m

LISS-3* GSD: 23.5m

LISS-4 GSD : 5.8m

ALTITUDE = 817 Km
(Nominal)

GROUND TRACK

INCLINATION = 98.731

MEAN SOLAR
TIME = 10.30 am

DIRECTION OF
TRAVEL

ORBIT PERIOD = 101.35 minutes

ASRC
Management Services

इसरो isro
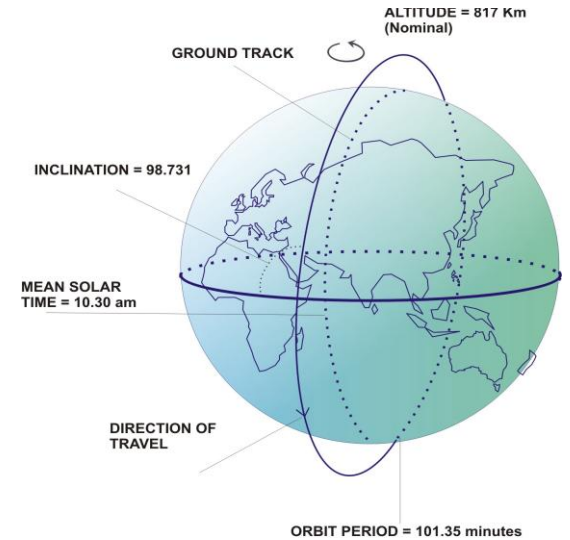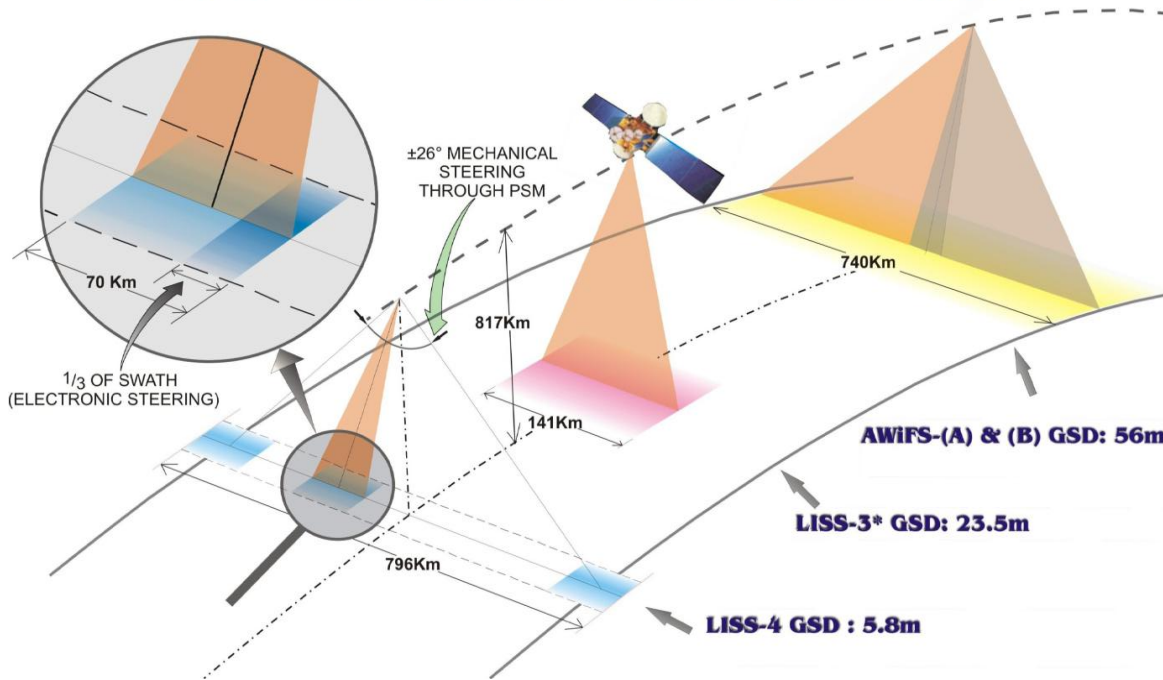
Department of Space
Indian Space Research Organisation

AGRICULTURE COUNTS
NASS

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
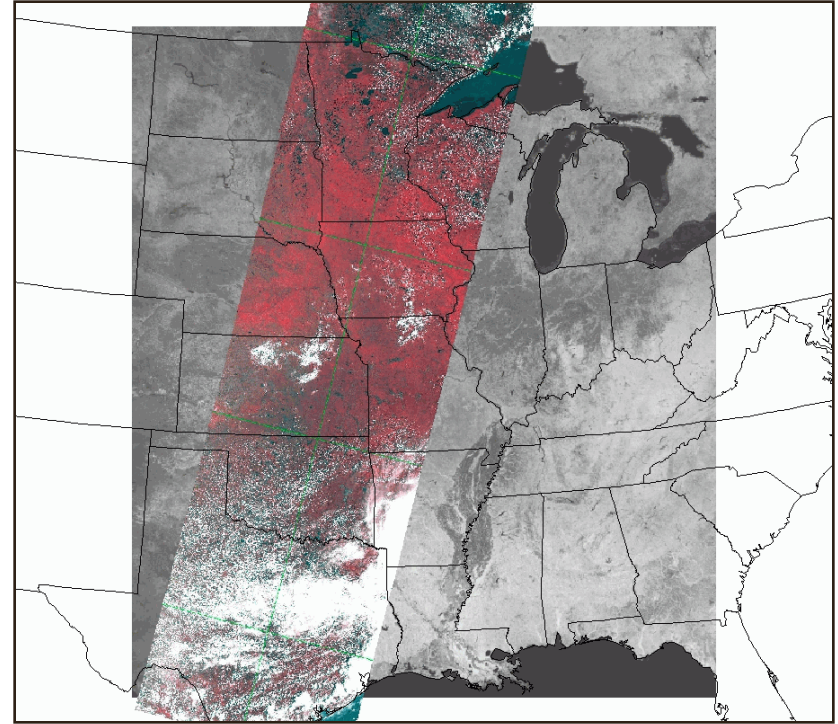
History of NASS AWiFS Use

- 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
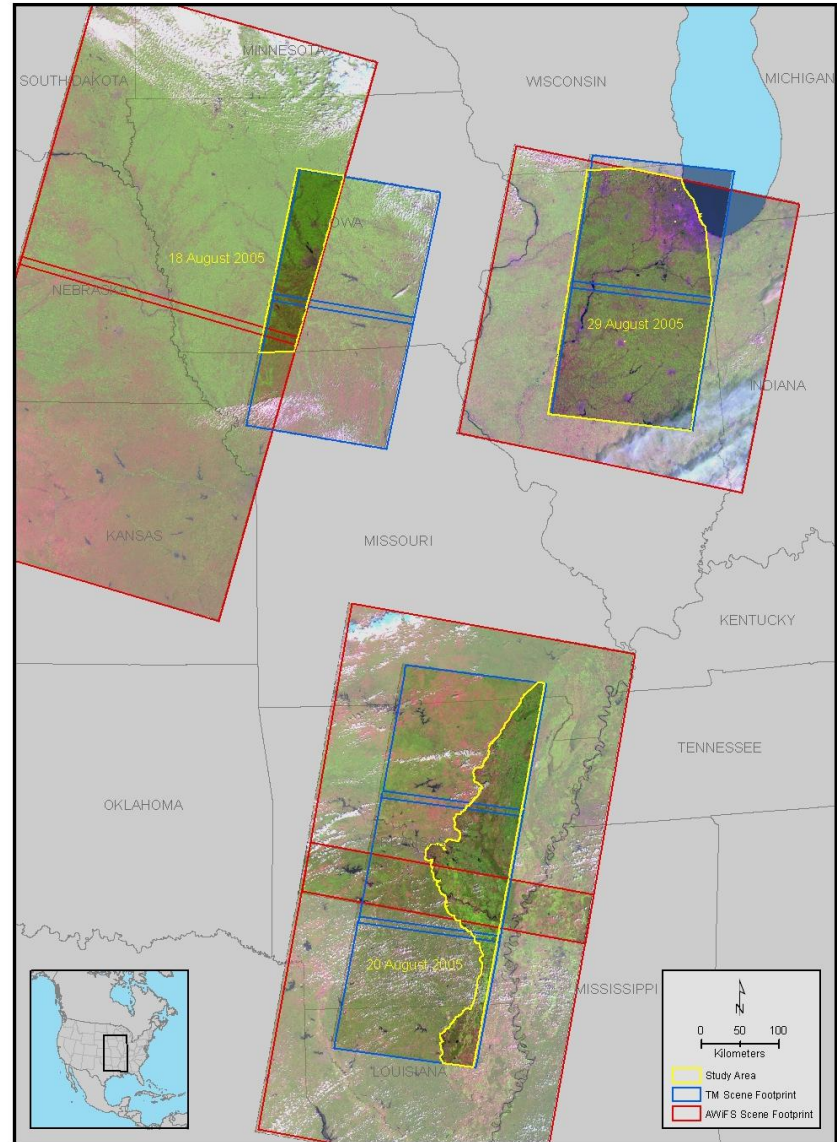
Results of TM versus AWiFS

Overall Accuracy
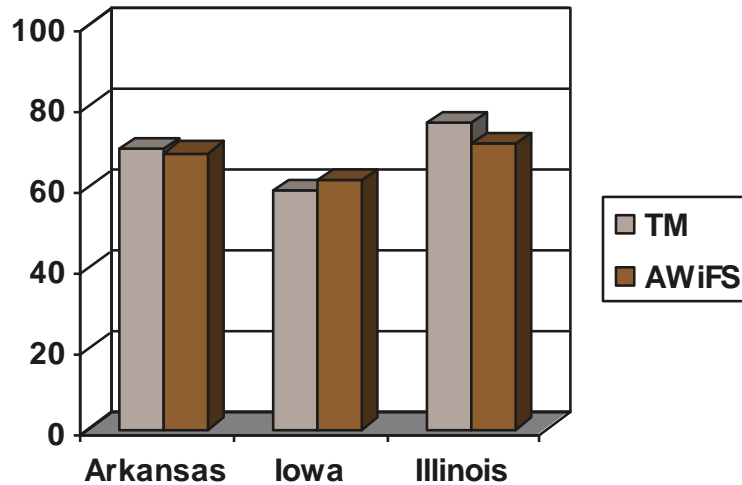
TM usually outperforms AWiFS.

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

Landsat-5 TM

Resourcesat-1 AWiFS

Alfalfa Cotton Corn Rice Soybeans Other Cropland Idle Cropland Pasture/Hay Non Agriculture Woodland Urban Water

0   2.5   5
Kilometers
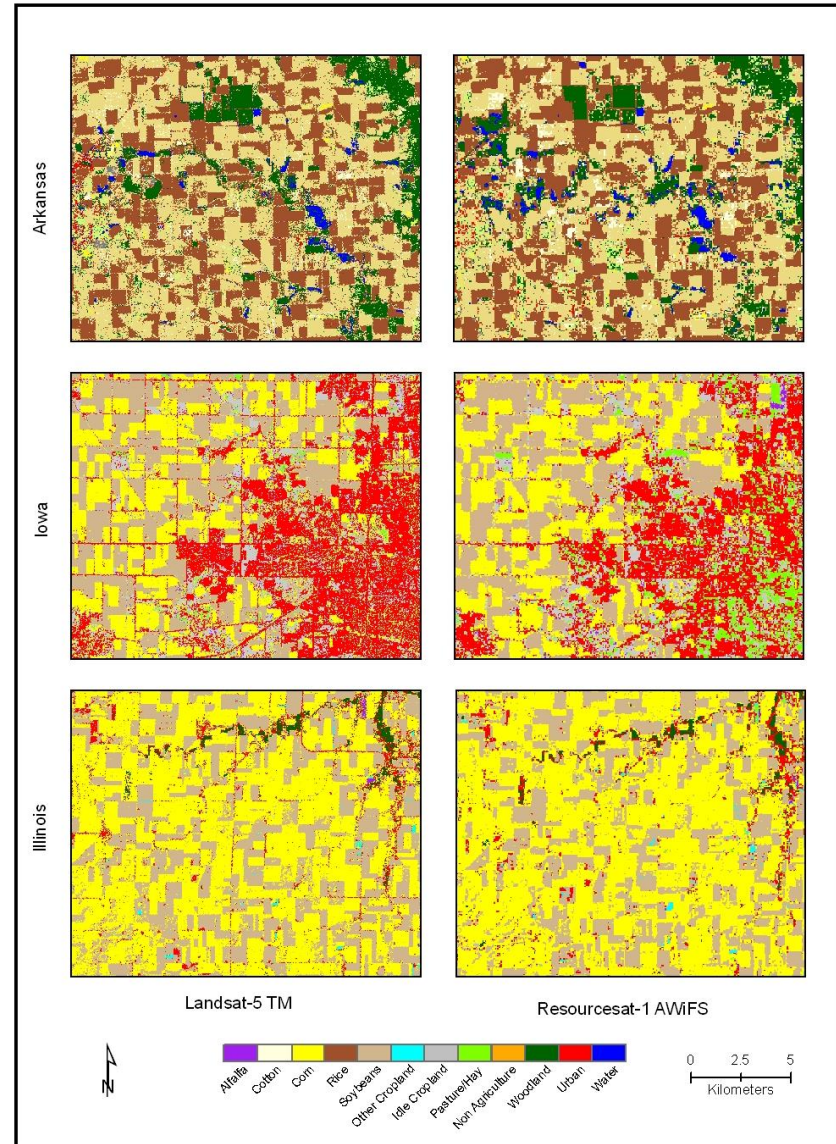
Hypothetical Question Raised

"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

	AWiFS	LISS-III
IGFOV	56m (nadir) 70m (field edge)	23.5 m
Spectral bands	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
Swath	370 km each head 737 km (combined)	141 km
Integration time	9.96 msec	3.32 msec
Quantization	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)
Number of gains	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
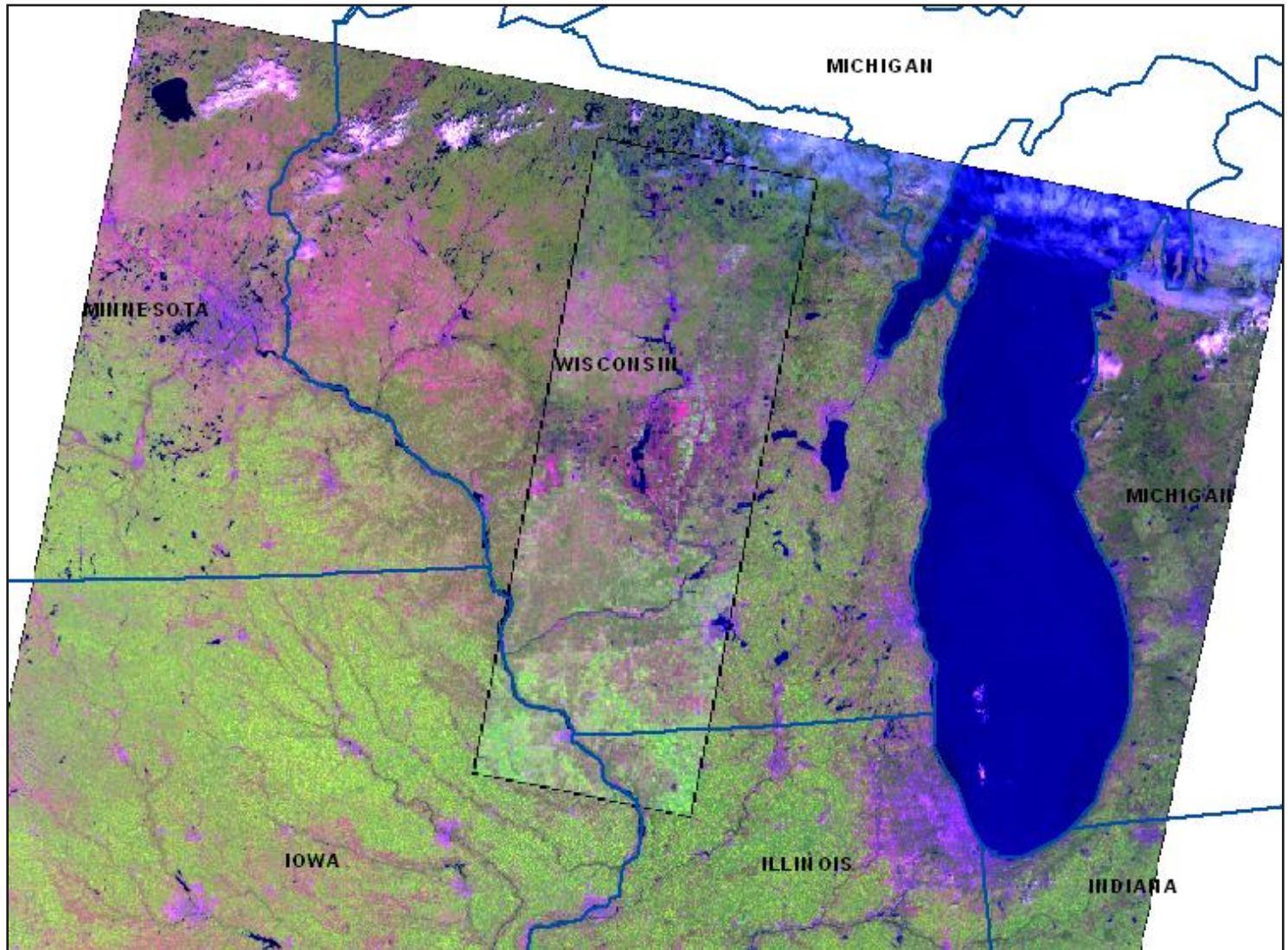
Comparison of Nadir AWiFS Overlap Area

Measured overlap: ~7 km
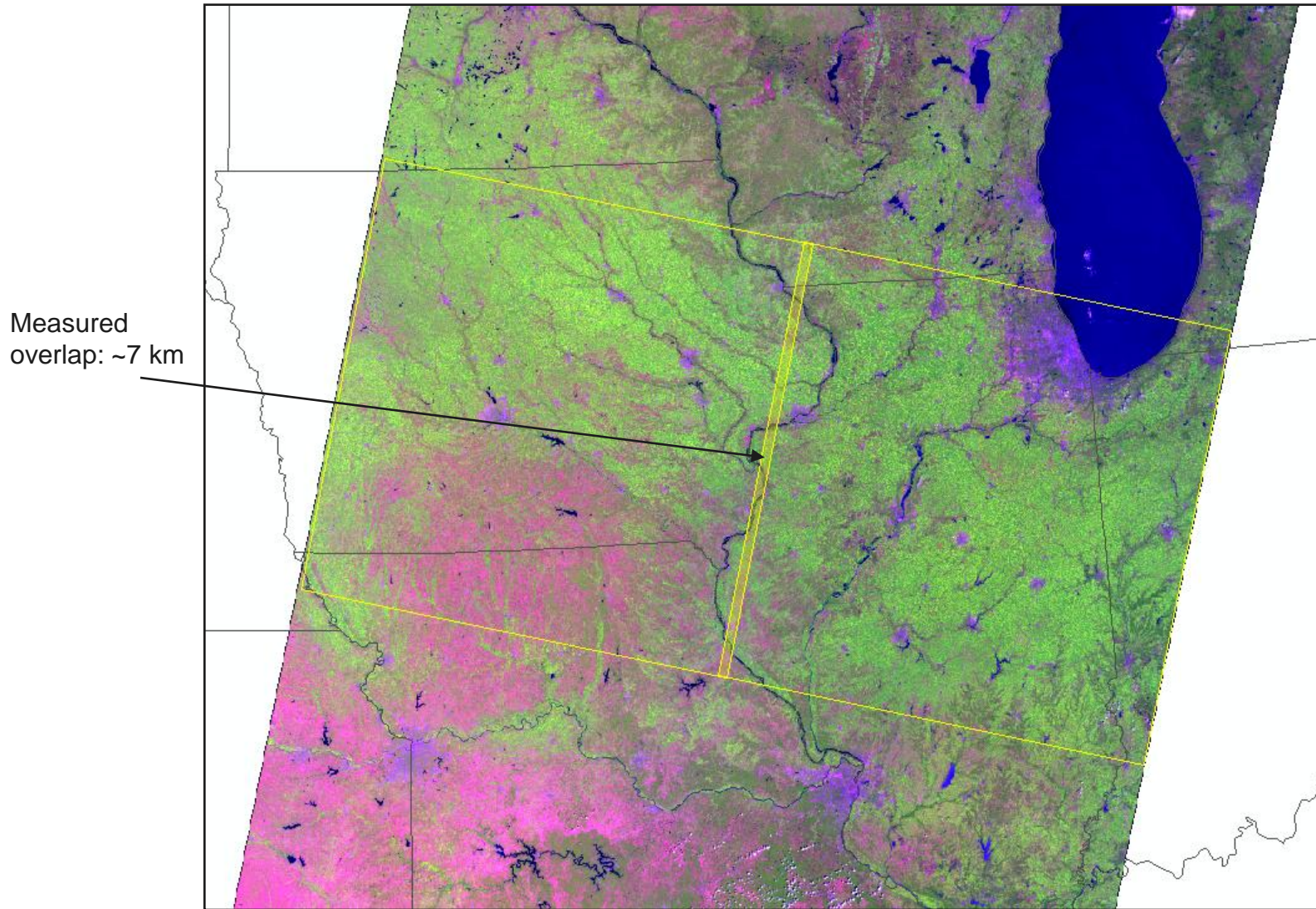
31 July 2006

Inspection of Nadir AWiFS Overlap Area

West sided
"A" camera

East sided
"B" camera
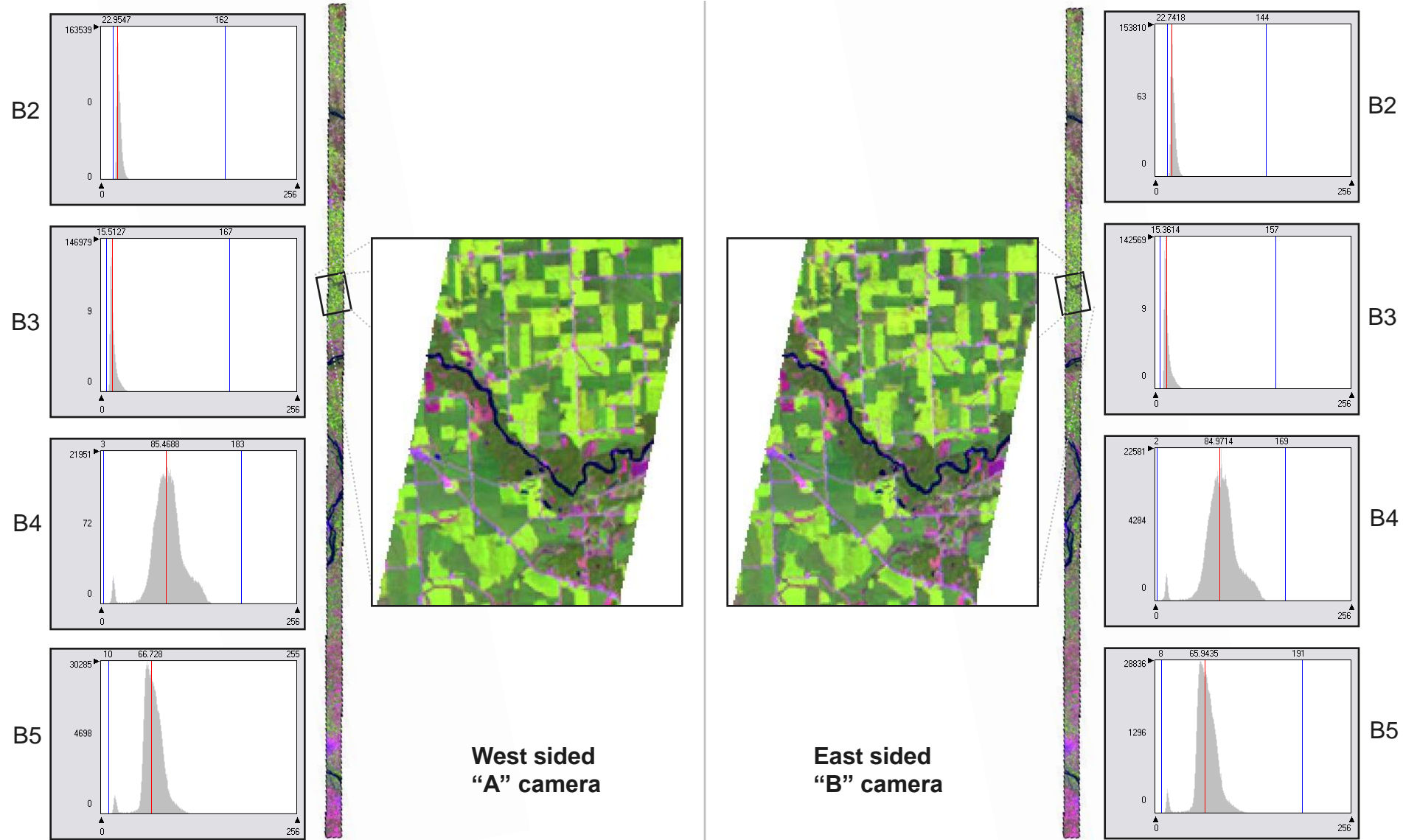
Wisconsin Raw Data
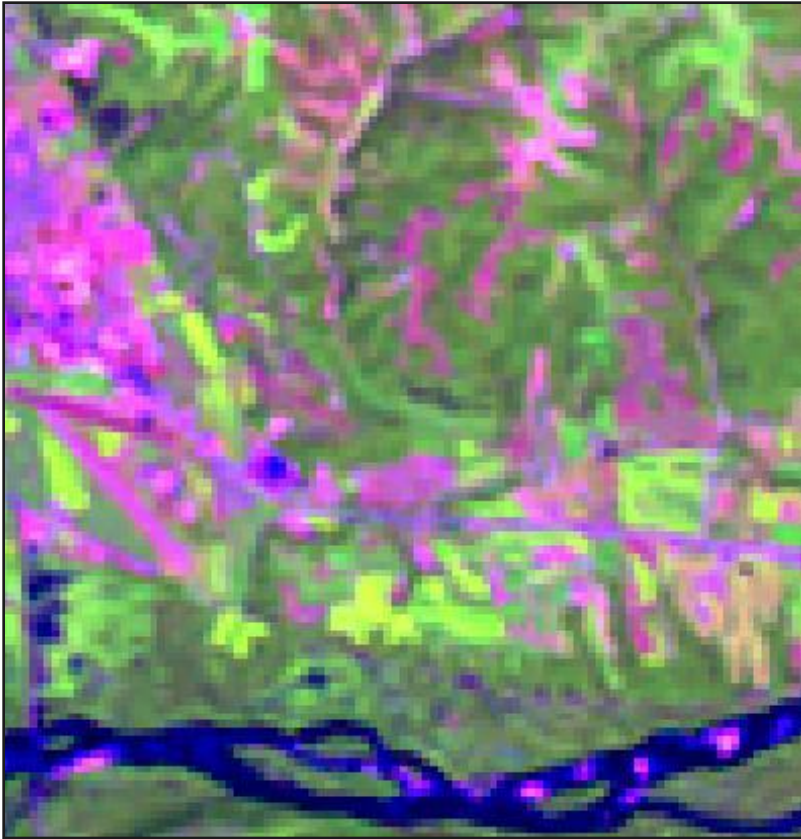
AWiFS
Red=Red, Green=NIR, Blue=SWIR
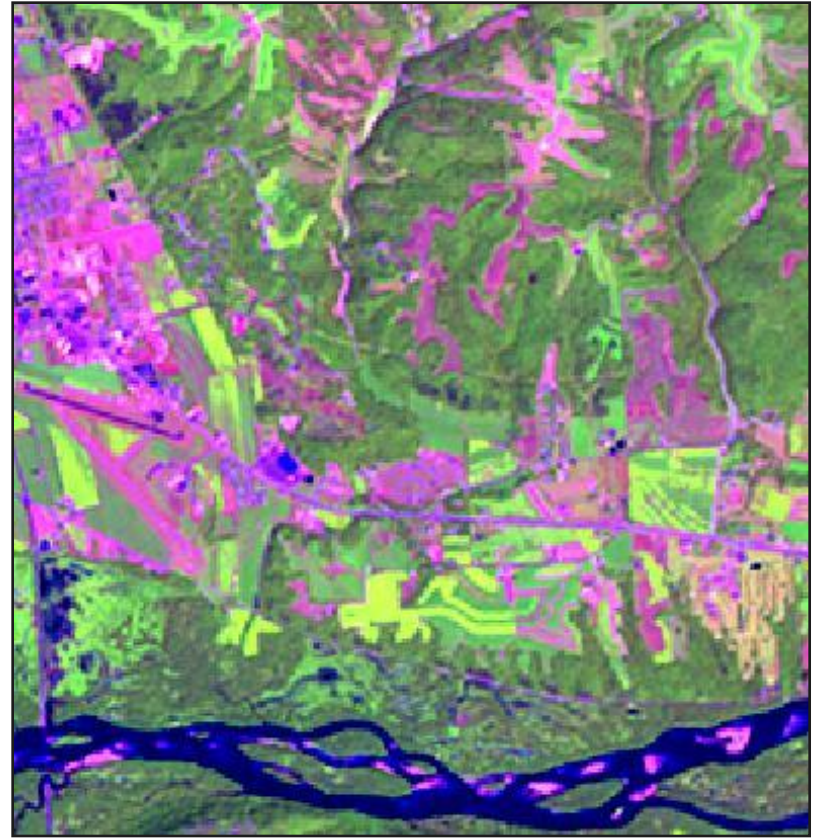
LISS-III
Red=Red, Green=NIR, Blue=SWIR

Ground Truth
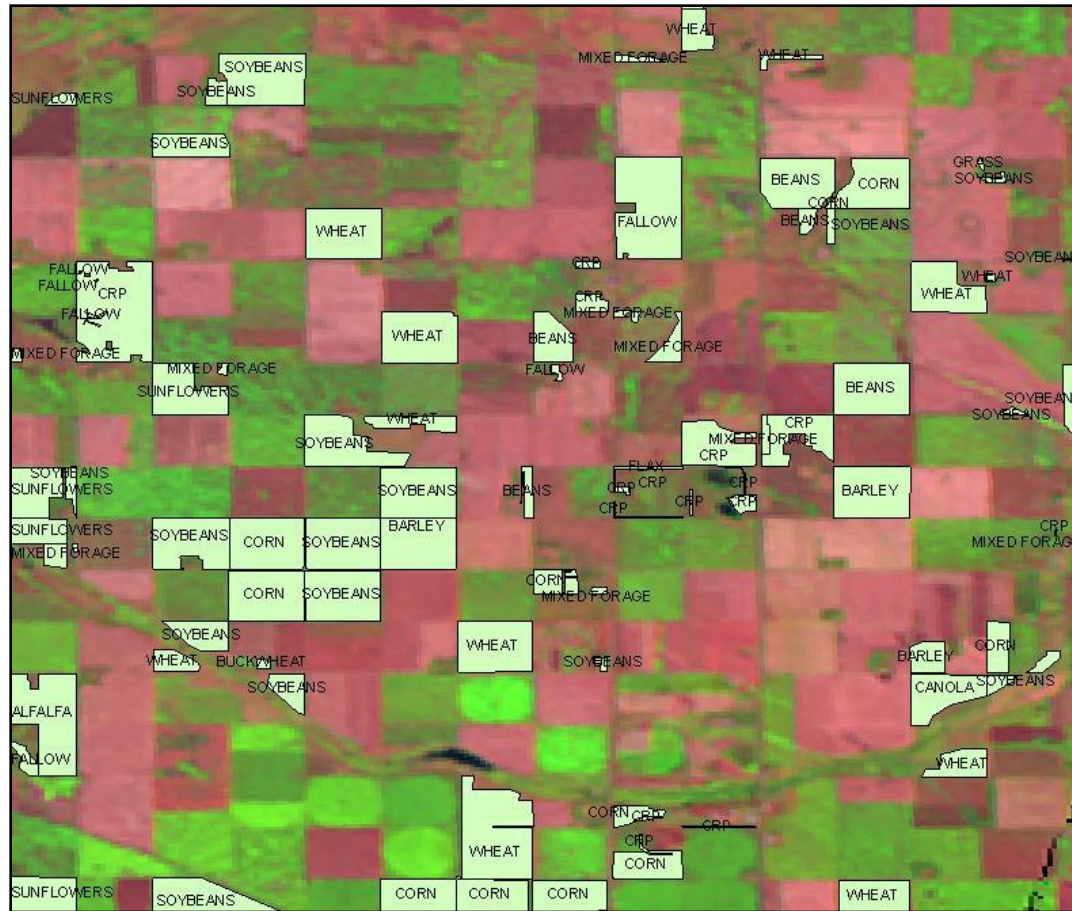
USDA Farm Service Agency (FSA) data
- Common Land Unit (CLU) with form 578 "reported" info

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
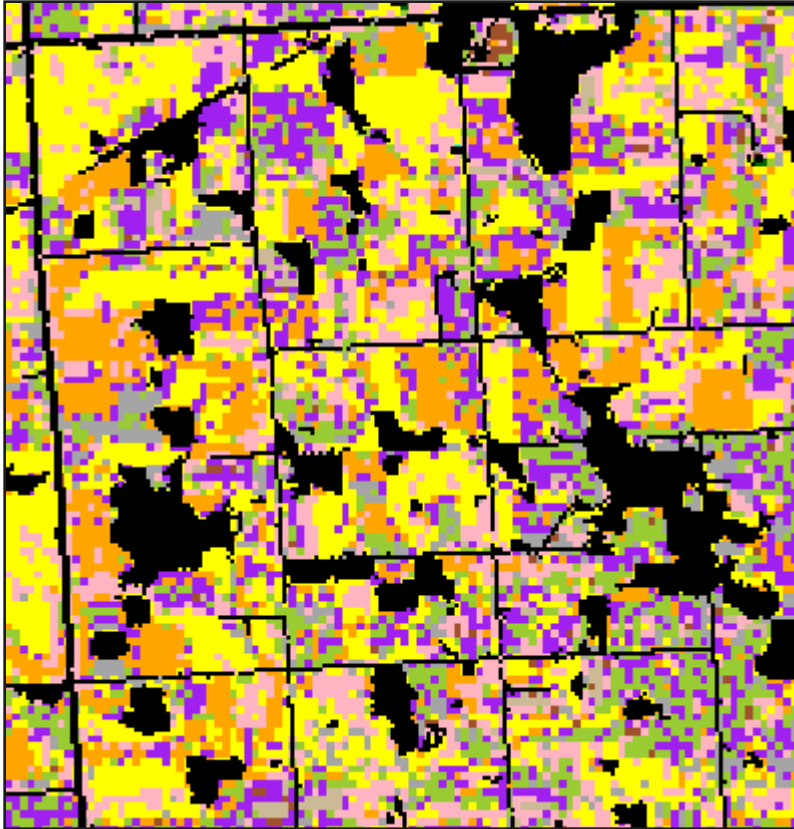
AWiFS
50.4% pixels correct

LISS-III
55.9% pixels correct

Wisconsin Primary Crop Category Accuracies

	AWiFS producer's accuracy	AWIFS user's accuracy	LISS-III producer's accuracy	LISS-III users' accuracy
Corn	71.7%	68.7%	75.8%	75.2%
Soybeans	69.1%	59.5%	77.2%	62.6%
Alfalfa	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
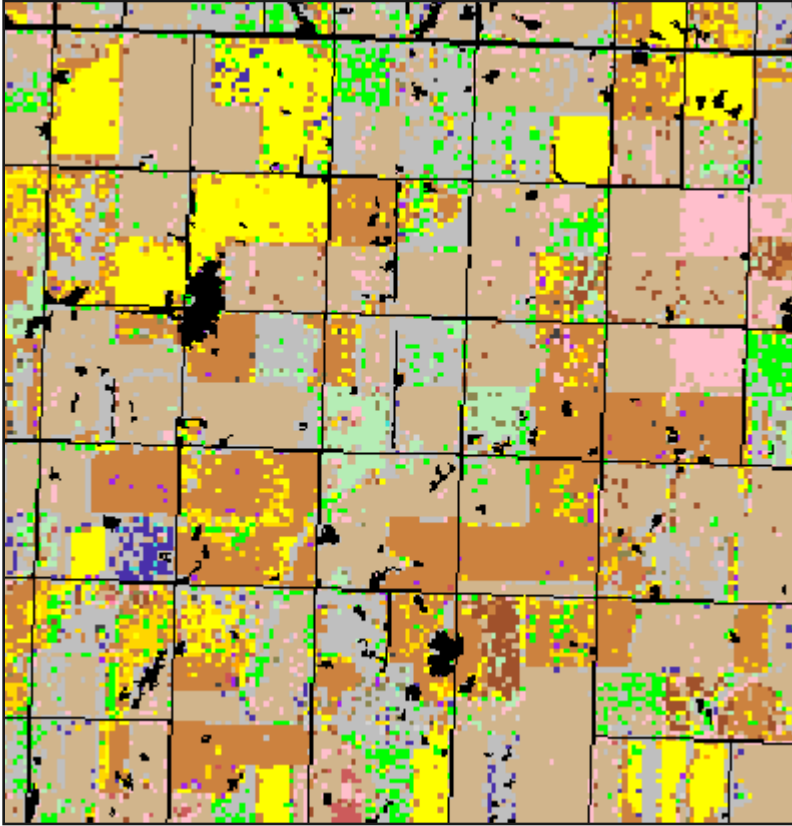
AWiFS
50.1% pixels correct
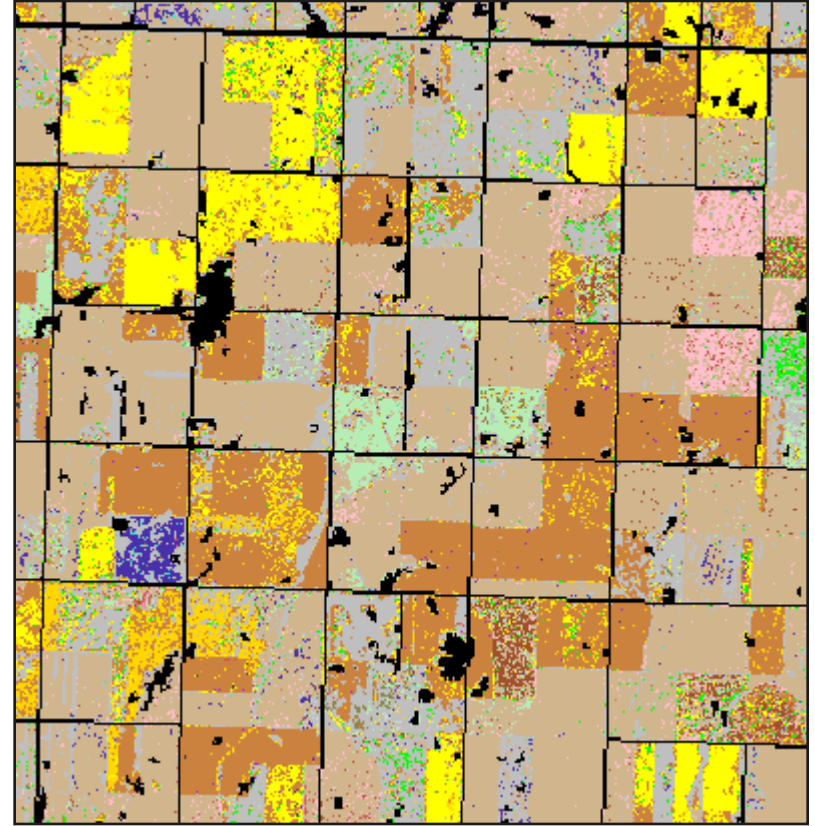
LISS-III
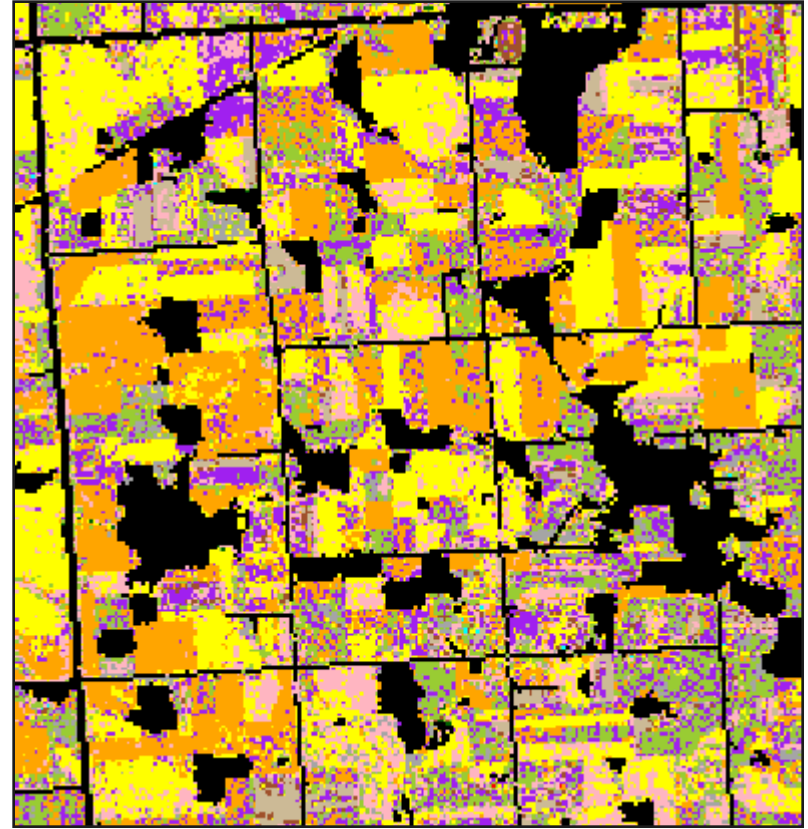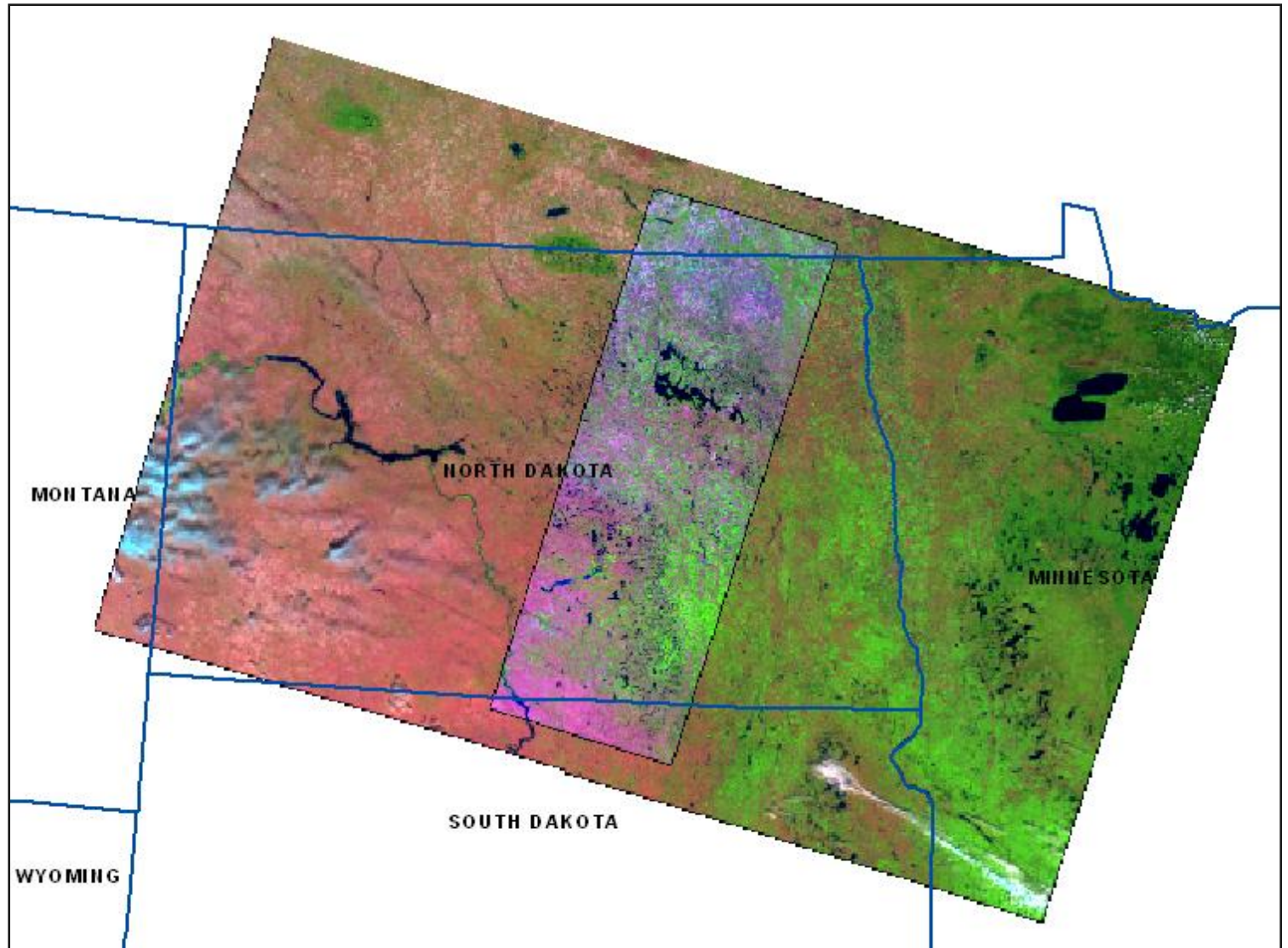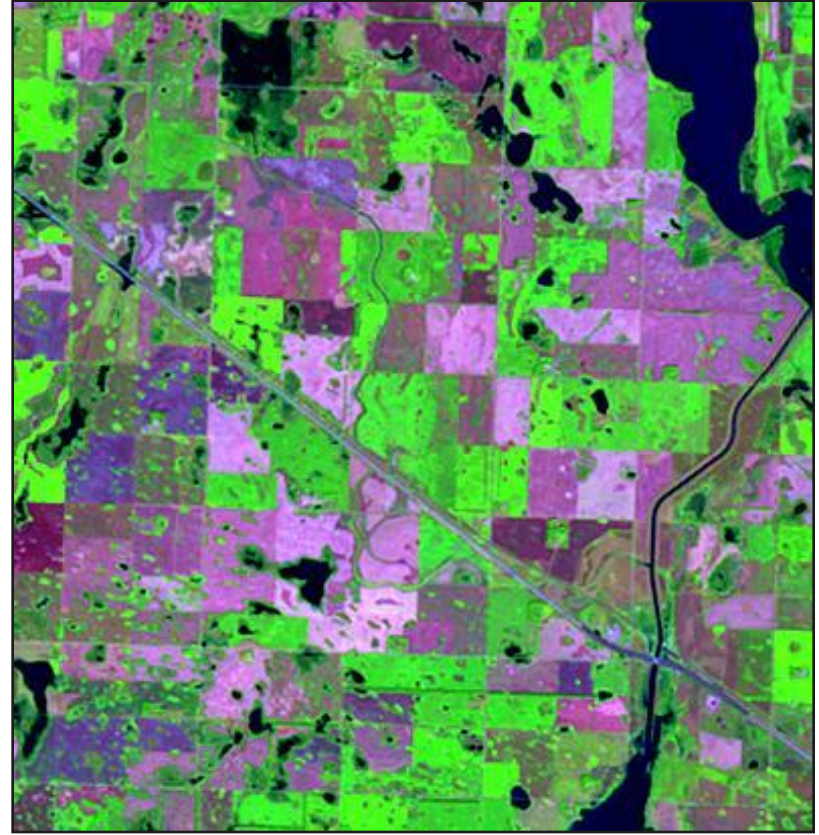52.4% pixels correct

North Dakota Primary Crop Category Accuracies

	AWiFS producers accuracy	AWIFS user's accuracy	LISS-III producer's accuracy	LISS-III users' accuracy
Spring wheat	67.9%	62.4%	72.6%	64.4%
Soybeans	64.2%	51.9%	67.0%	53.6%
Sunflowers	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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