Dave M. Johnson
Geographer

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Research and Development Division
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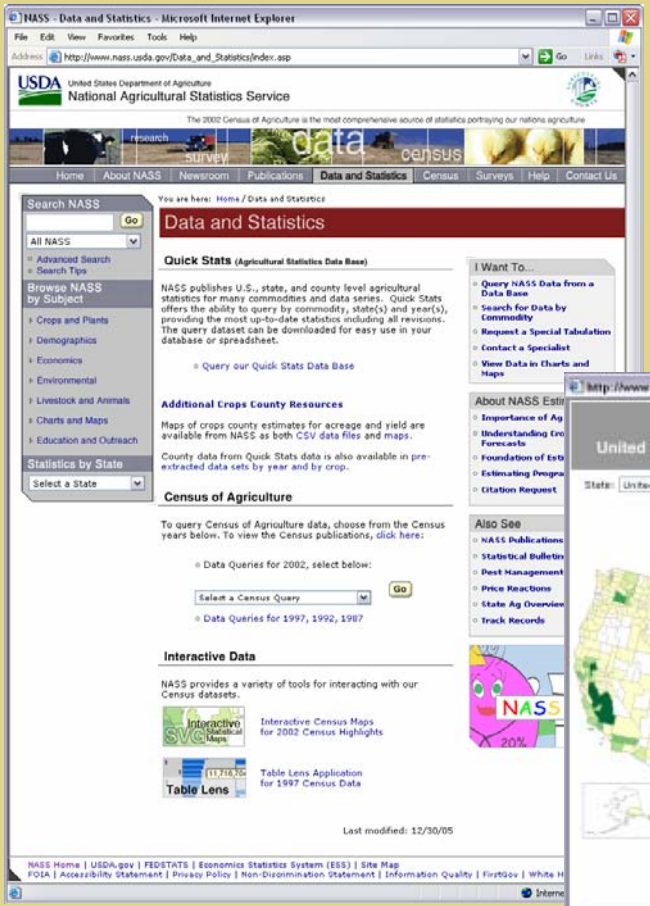
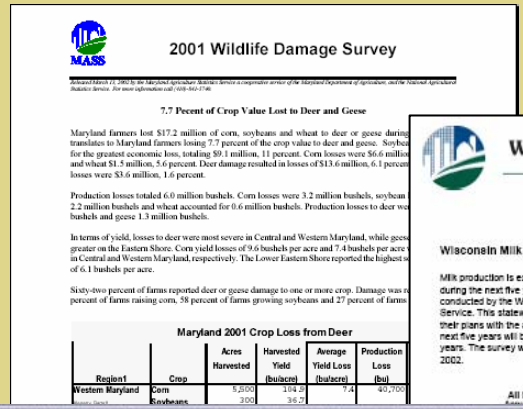
An Evaluation of Resourcesat-1 LISS-III *vs* AWiFS Imagery for Mapping Croplands

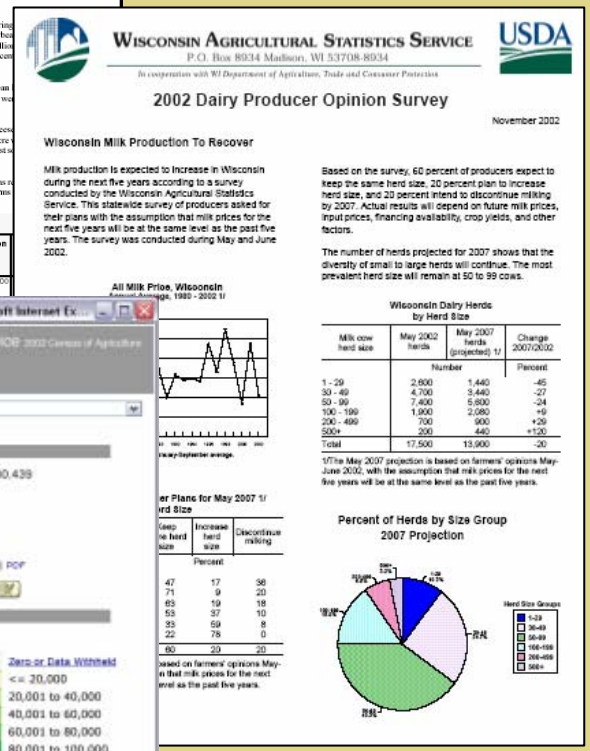
Monitoring Agriculture from Space with Commercial Imagery

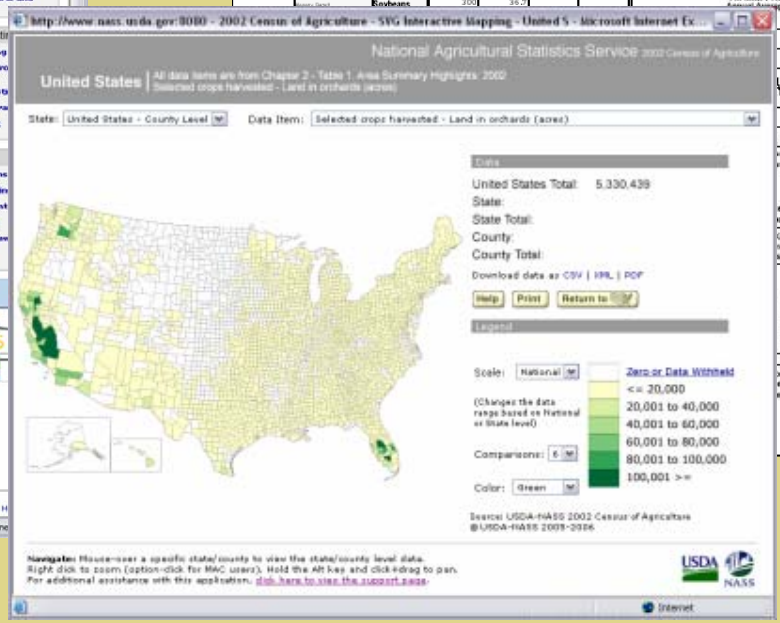
NASS Background

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









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NASS Spatial Analysis Research Section

Developing methodologies and tools to improve NASS' ability to collect, manage, and disseminate statistics on US agriculture utilizing remotely sensed, GIS, and GPS data

Agriculture Atlas of the USA
Land Cover Classification
Mobile GIS
Crop Condition
Tree Inventorying

Yield Modeling
Change Detection
Crop Progress
County Level Crop Maps
Imagery Exploitation

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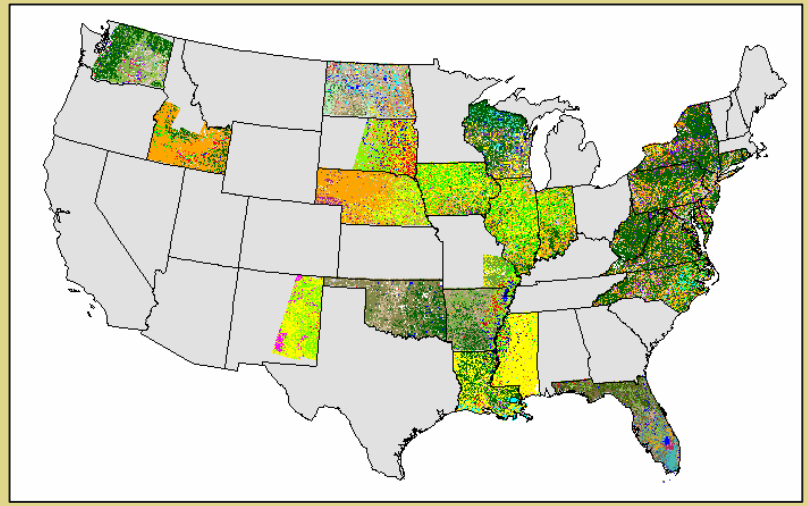
Cropland Data Layer (CDL) Program

- State specific land cover classifications emphasizing row crop agriculture
  - Some regions done annually
    - Corn Belt, The Delta
  - Others “one-and-done”
    - Mid-Atlantic, Idaho, Florida
- Within NASS, CDL used to
  - Tighten confidence intervals on survey derived acreage estimates
  - Improve county level acreage estimates



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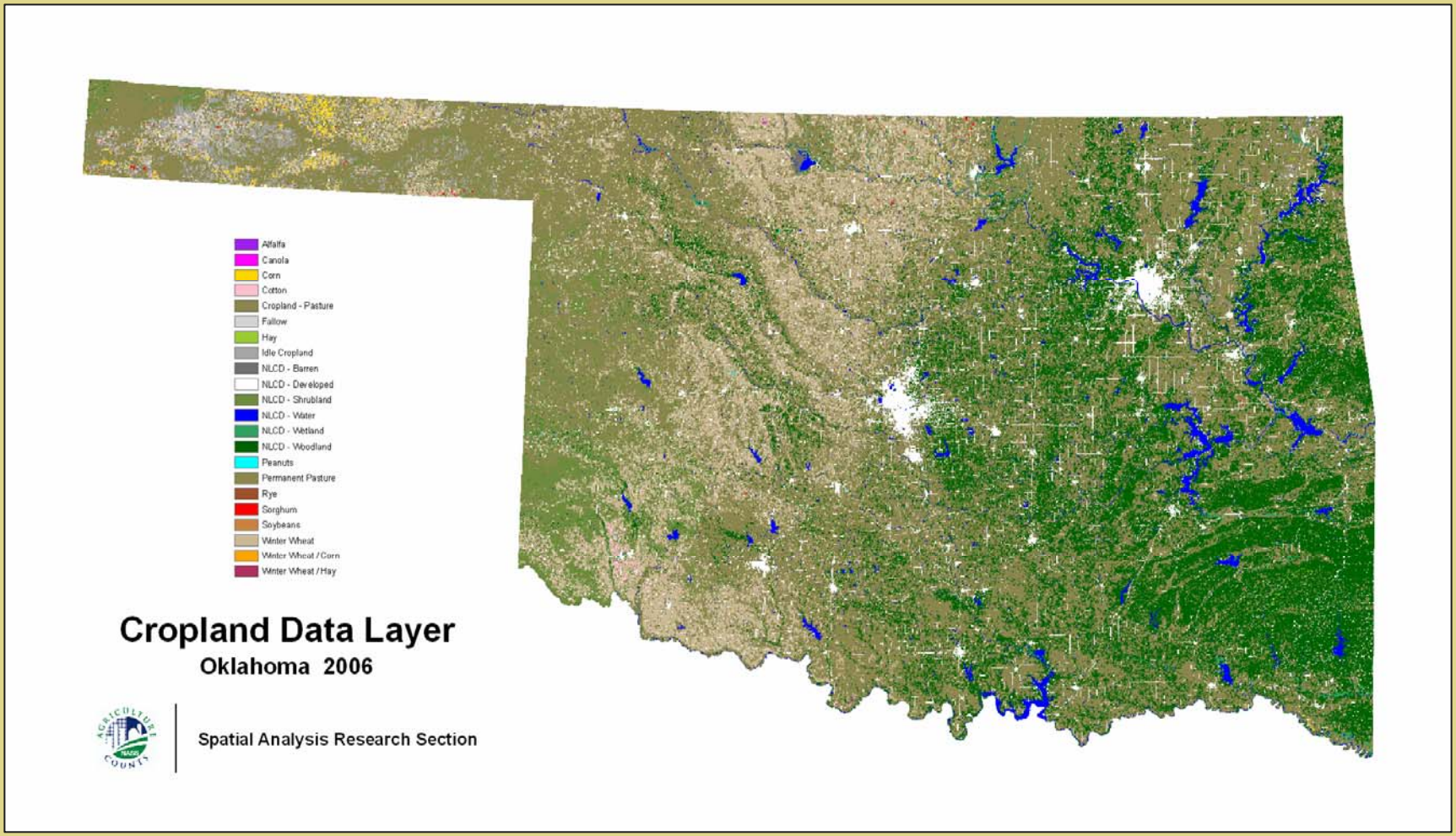
Example CDL


Alfalfa
Canola
Corn
Cotton
Cropland - Pasture
Fallow
Hay
Idle Cropland
NLCD - Barren
NLCD - Developed
NLCD - Shrubland
NLCD - Water
NLCD - Wetland
NLCD - Woodland
Peanuts
Permanent Pasture
Rye
Sorghum
Soybeans
Winter Wheat
Winter Wheat / Corn
Winter Wheat / Hay
Cropland Data Layer
Oklahoma 2006
Spatial Analysis Research Section

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
  - Proceeding forward primarily with AWiFS

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Why NASS Likes AWiFS

- Large swath width
- Inclusion of red, NIR, SWIR spectral bands
- Tolerable spatial resolution at 56 m sq
- Cost effectiveness
- Operational nature
- Fast data delivery by vendor
- Healthy satellite

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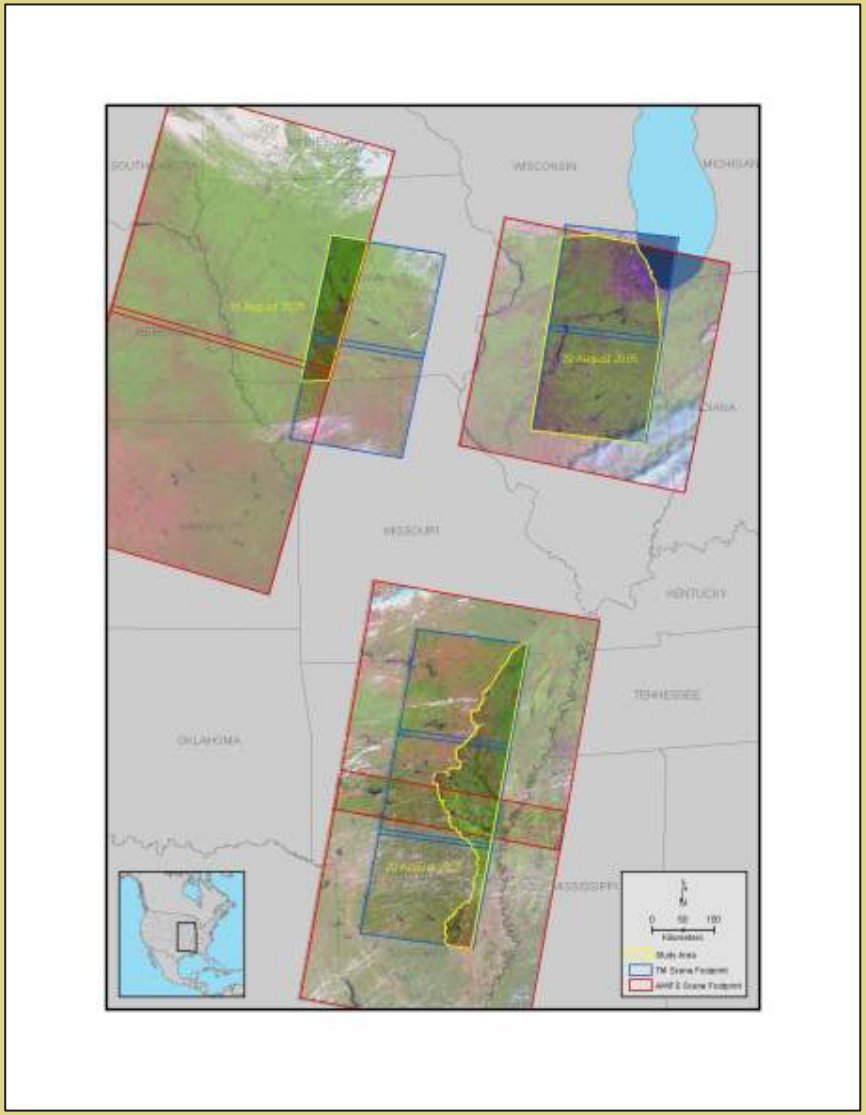
AWiFS versus TM Study

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



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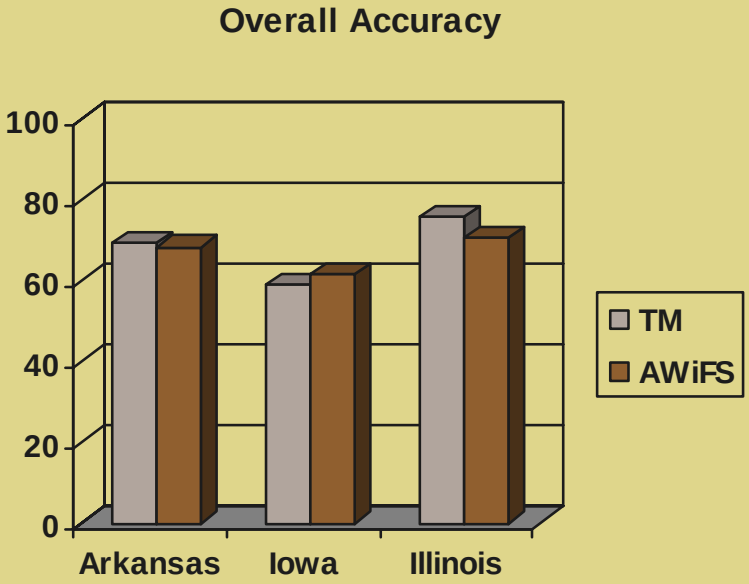
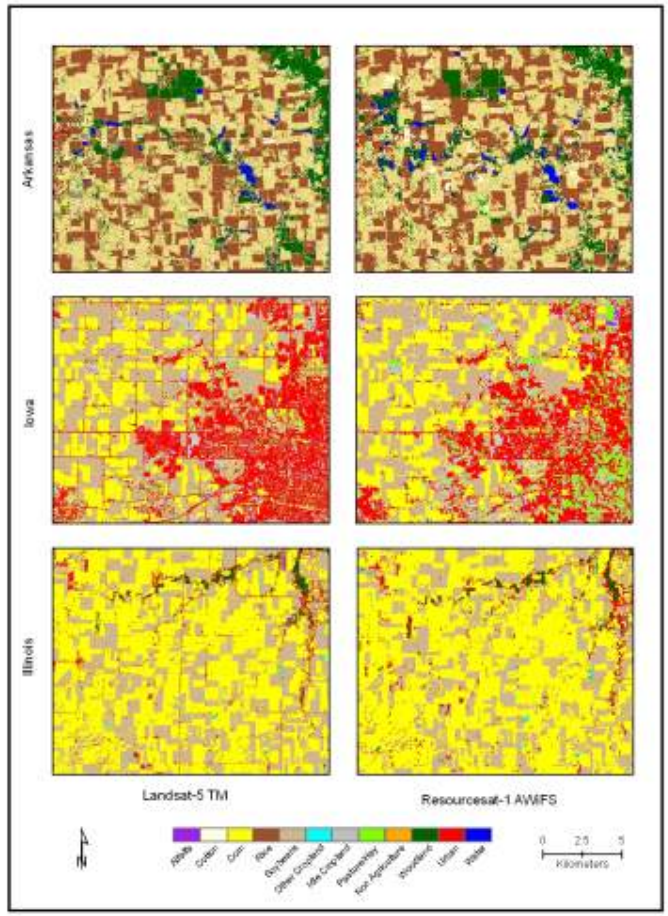
Results of TM versus AWiFS





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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?

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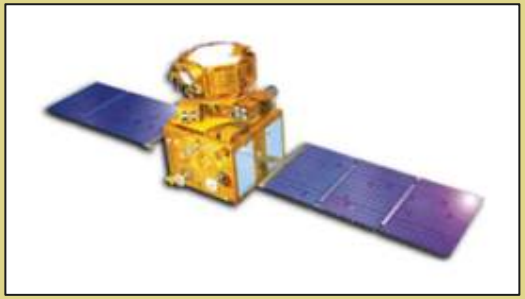
Testing of the question



- 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 740 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.”

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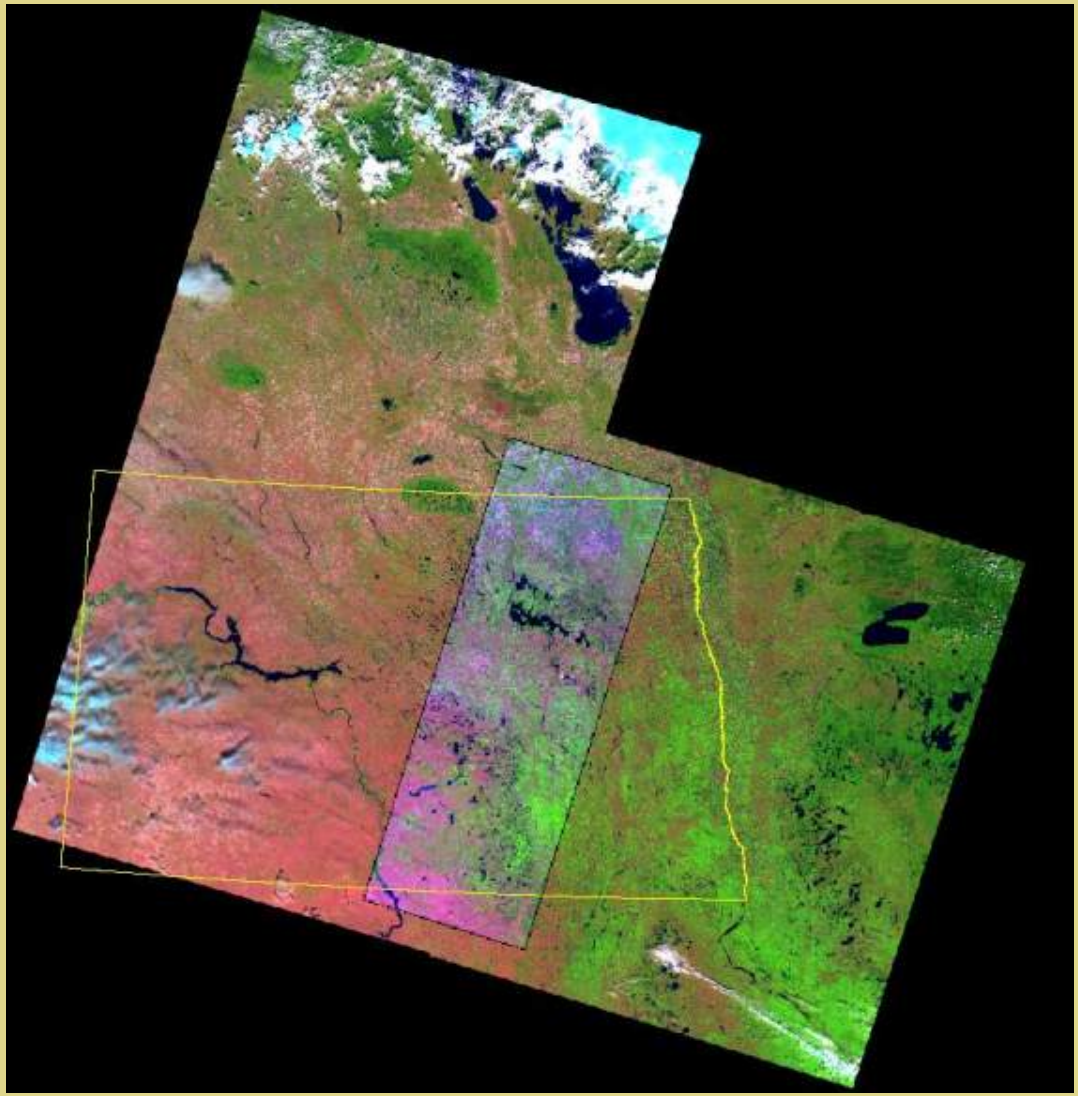
North Dakota Test Case

22 August 2006



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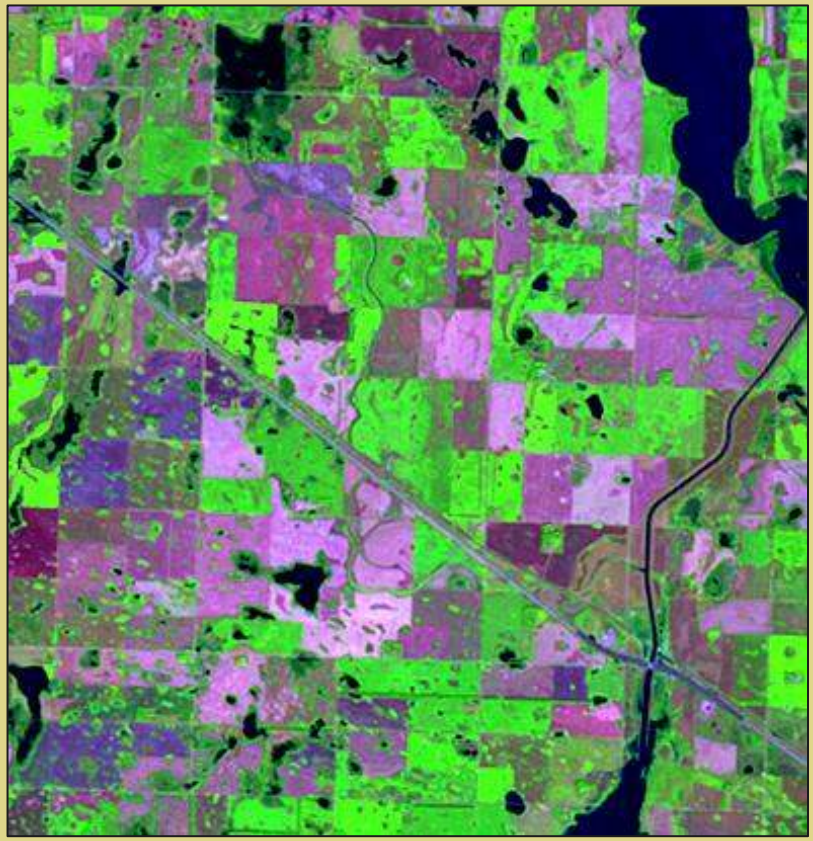
North Dakota Raw Data

AWiFS

Red=Red, Green=NIR, Blue=SWIR



LISS-III

Red=Red, Green=NIR, Blue=SWIR

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Ground truth – two sources

- NASS - June Agricultural Survey (JAS)
- Farm Service Agency (FSA) - Common Land Unit (CLU) / 578 data

NASS

FSA

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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 (BCT) Analysis (implemented in See5.0)
  - Random half of FSA CLU/578 utilized for training
- Accuracy assessed
  - Against other half of ground truth.

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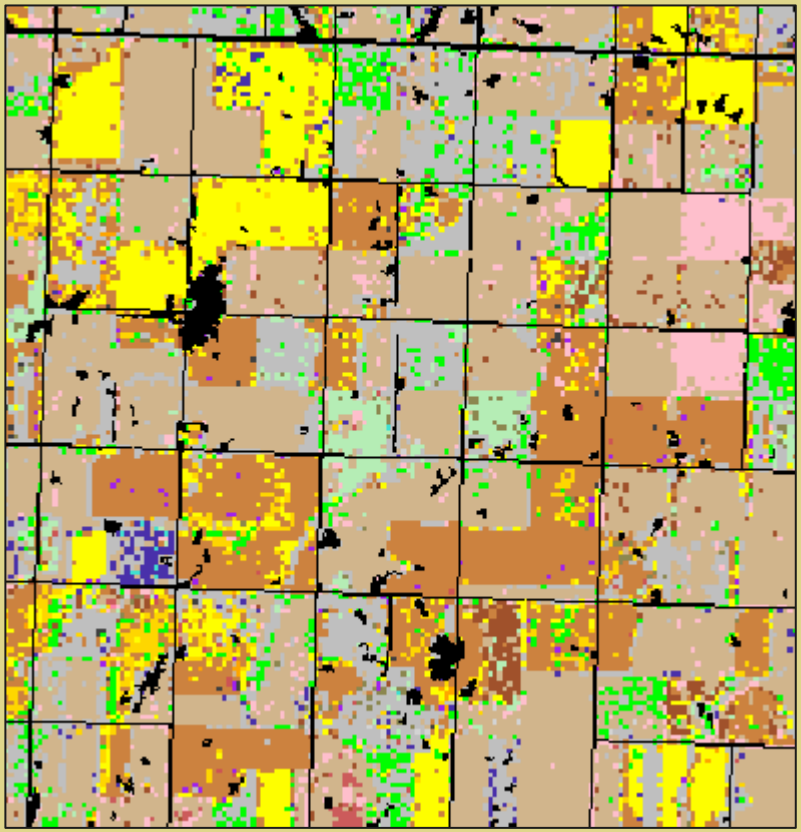
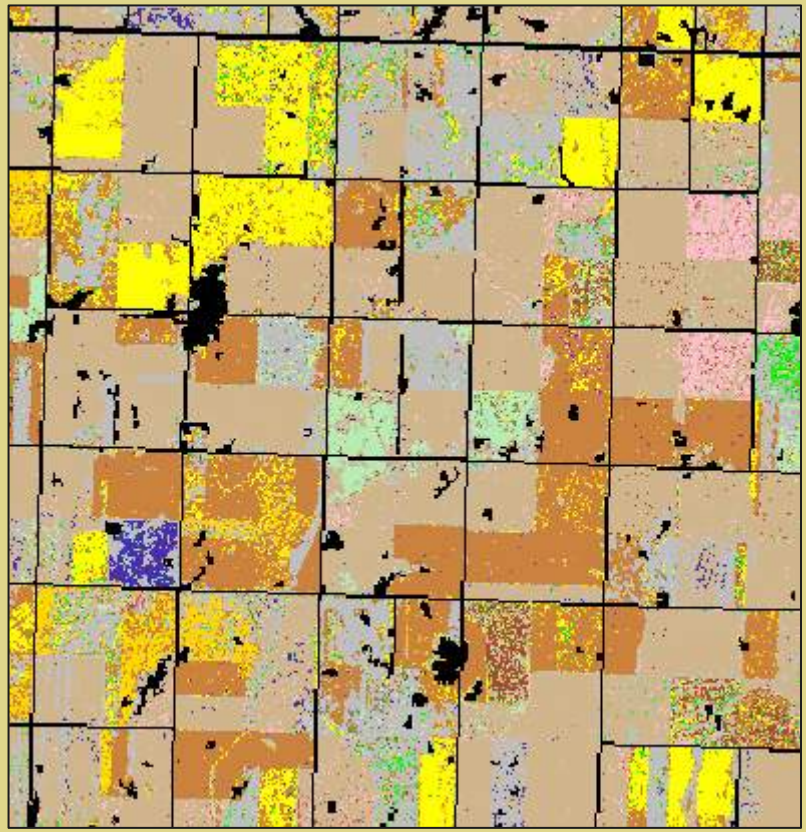
North Dakota - Results



AWiFS

50.1% pixels correct



LISS-III

52.4% pixels correct

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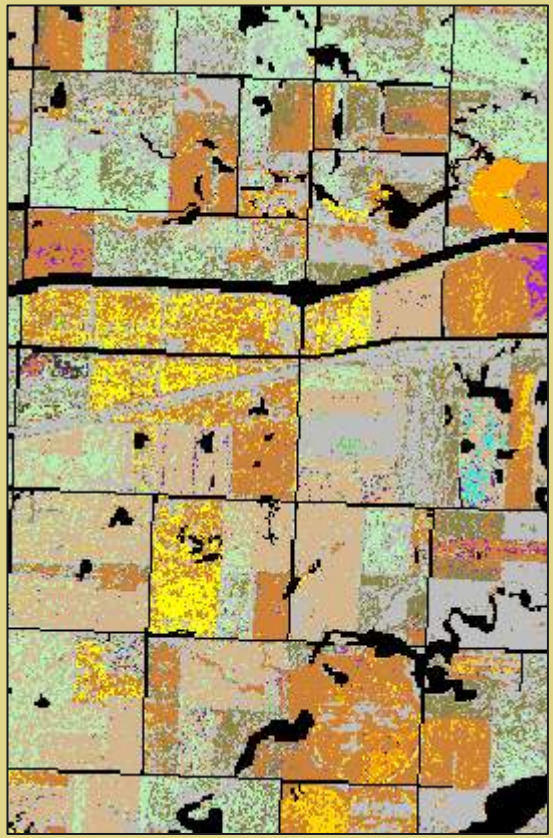
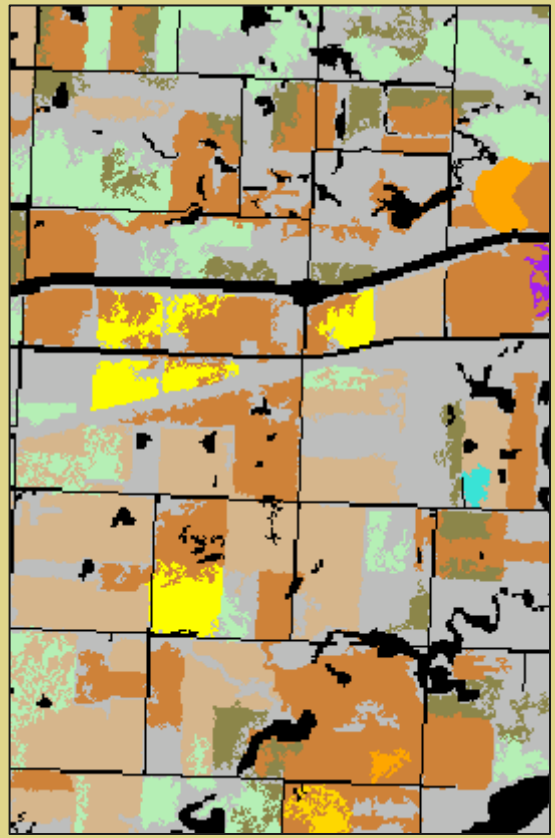
Post Classification Polishing

Method A. Applying a 20 acre minimum mapping unit

Raw Scene



Initial BCT Classification



20 acre MMU

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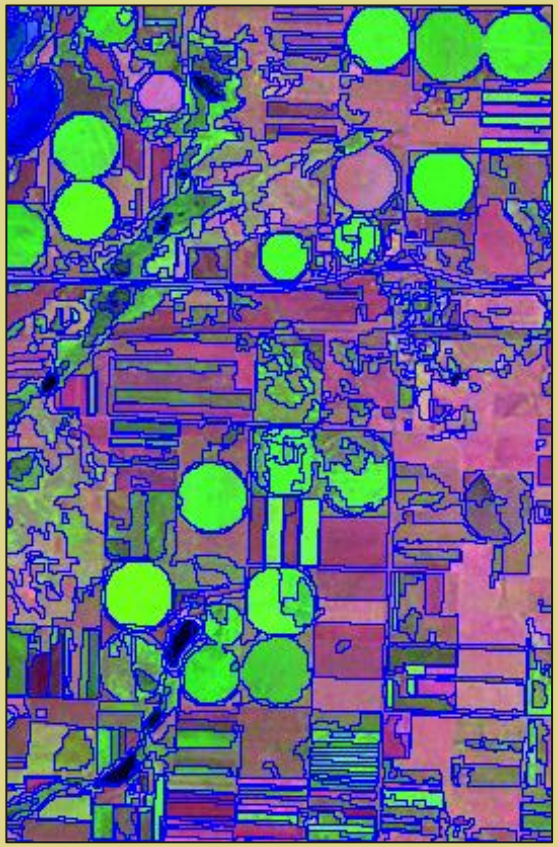
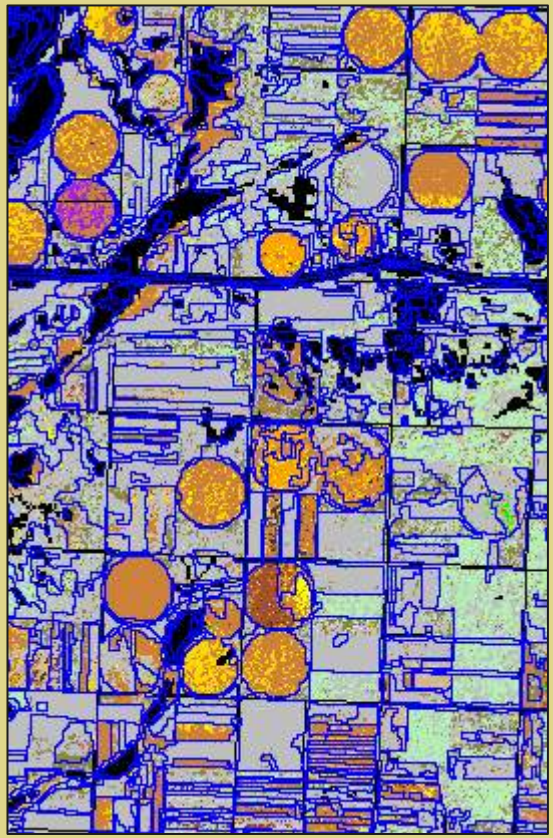
Post Classification Polishing

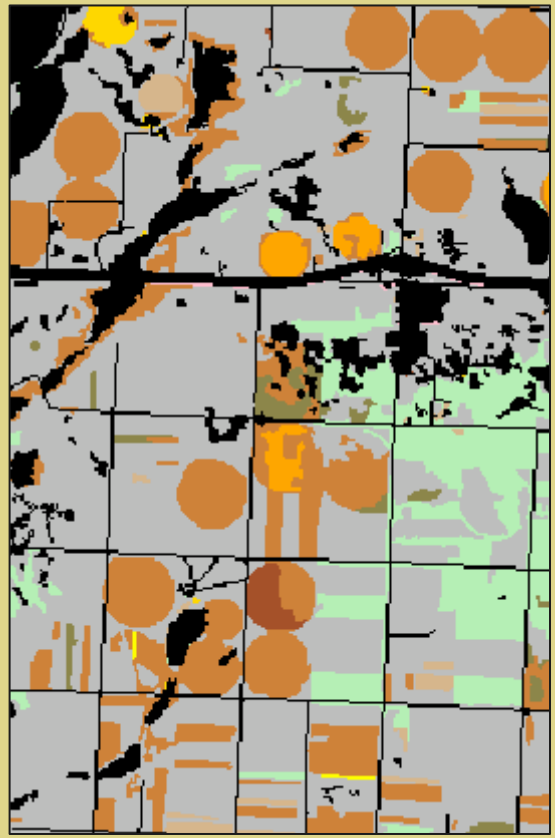
Method B. Definiens (eCognition) segment fill



Raw Segmented Scene



Initial BCT Classification



Majority Fill Segments

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North Dakota Summary

	AWiFS	LISS-III
Standard Classification	50.1%	52.4%
20 Acre MMU Applied	54.6%	57.6%
Segment Majority Filled	53.9%	55.5%

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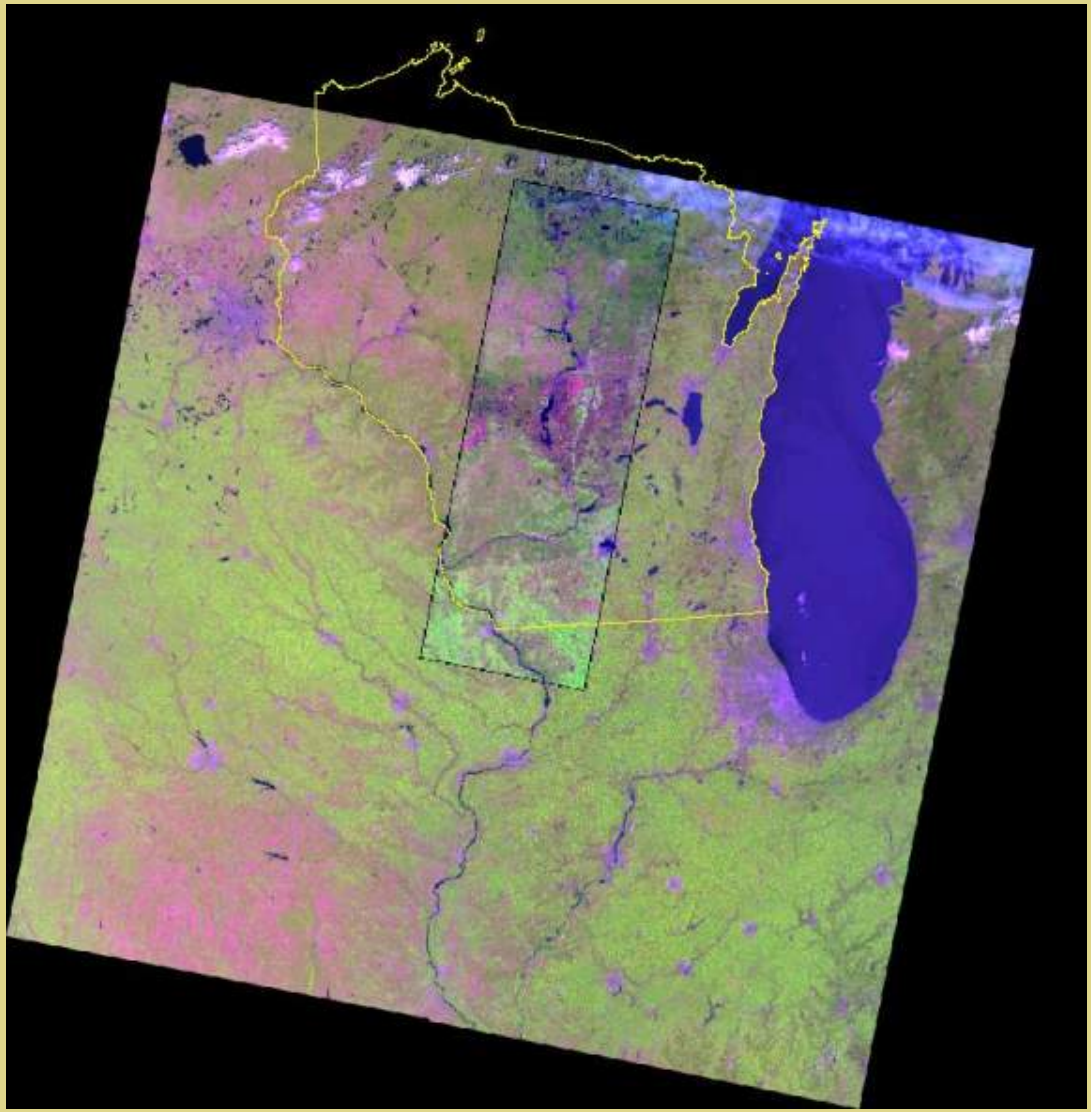
Wisconsin Test Case

31 July 2006



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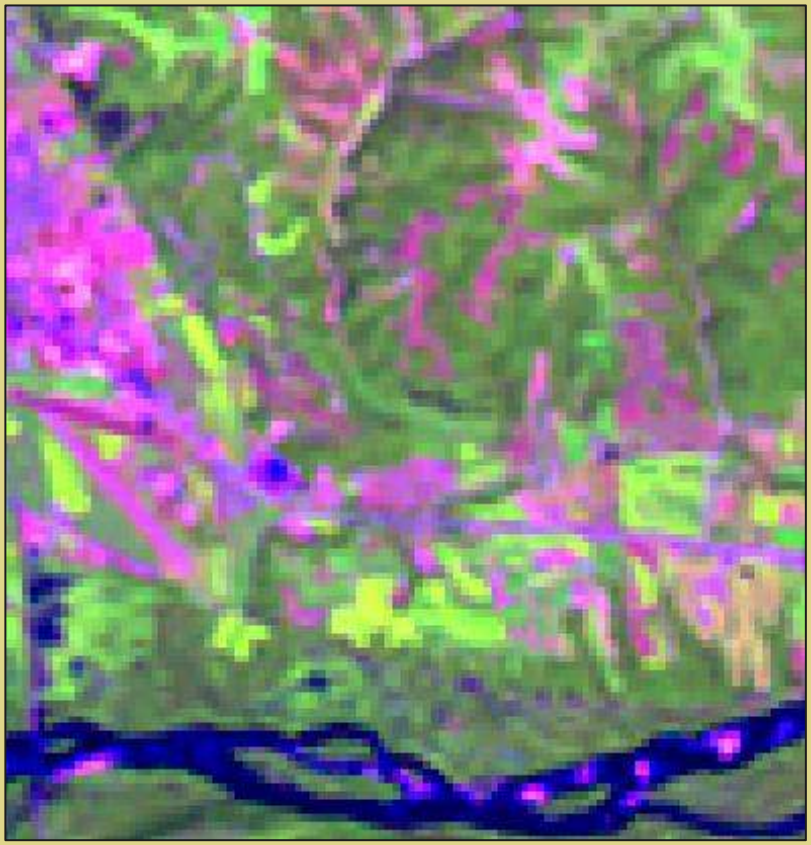
Wisconsin Raw Data



AWiFS

Red=Red, Green=NIR, Blue=SWIR

LISS-III

Red=Red, Green=NIR, Blue=SWIR

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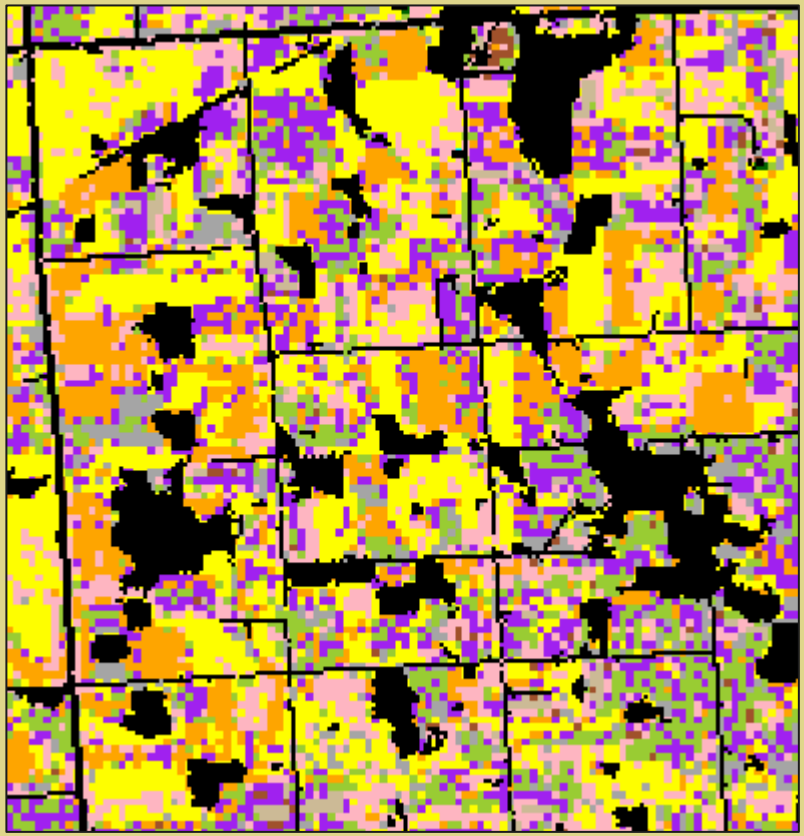
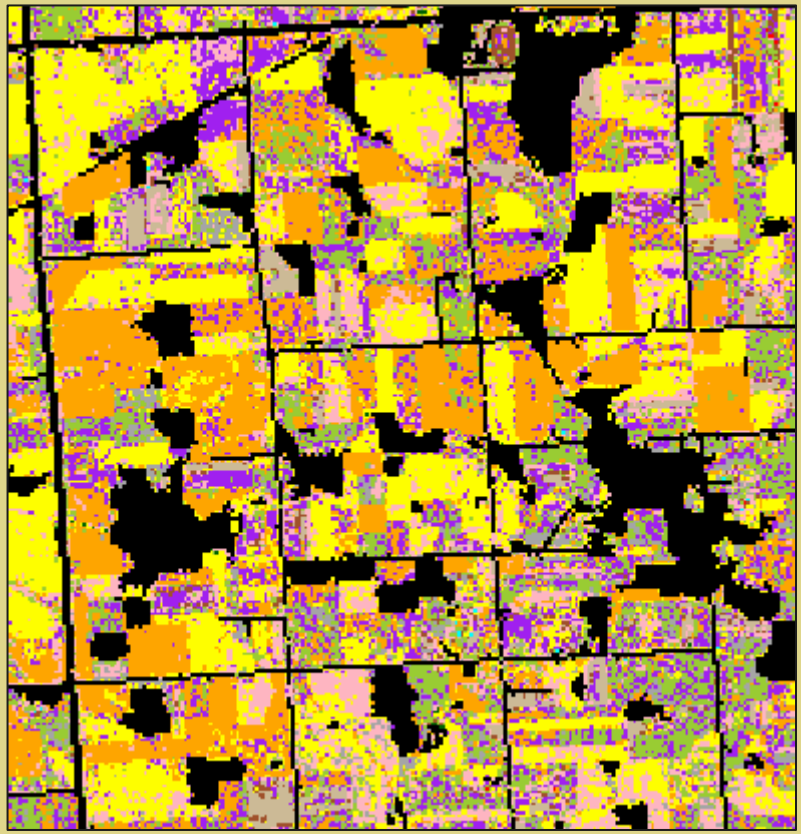
Wisconsin - Results



AWiFS

50.4% pixels correct



LISS-III

55.9% pixels correct

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Wisconsin Summary

	AWiFS	LISS-III
Standard Classification	50.4%	55.9%
10 Acre MMU Applied	53.0%	60.0%
Segment Majority Filled	51.7%	59.6%

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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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Thank You

dave_johnson@nass.usda.gov
703-877-8000 x169
www.nass.usda.gov