

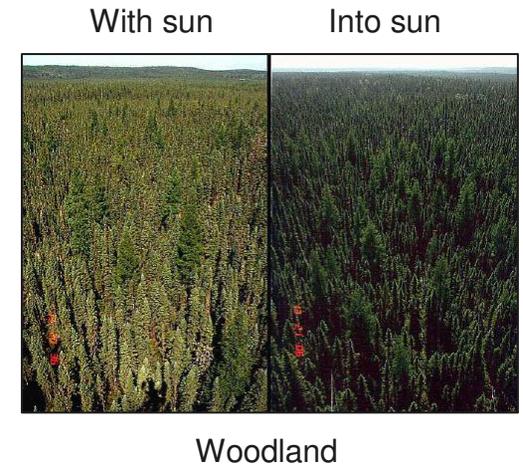
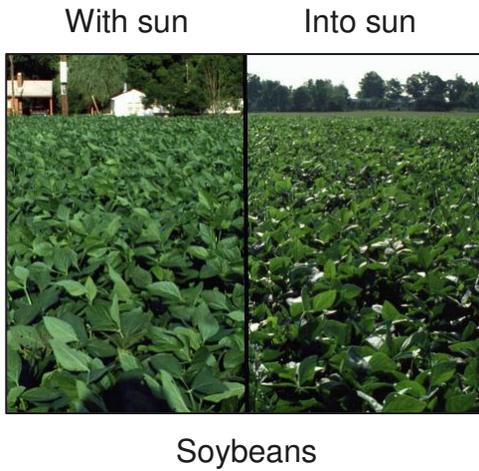
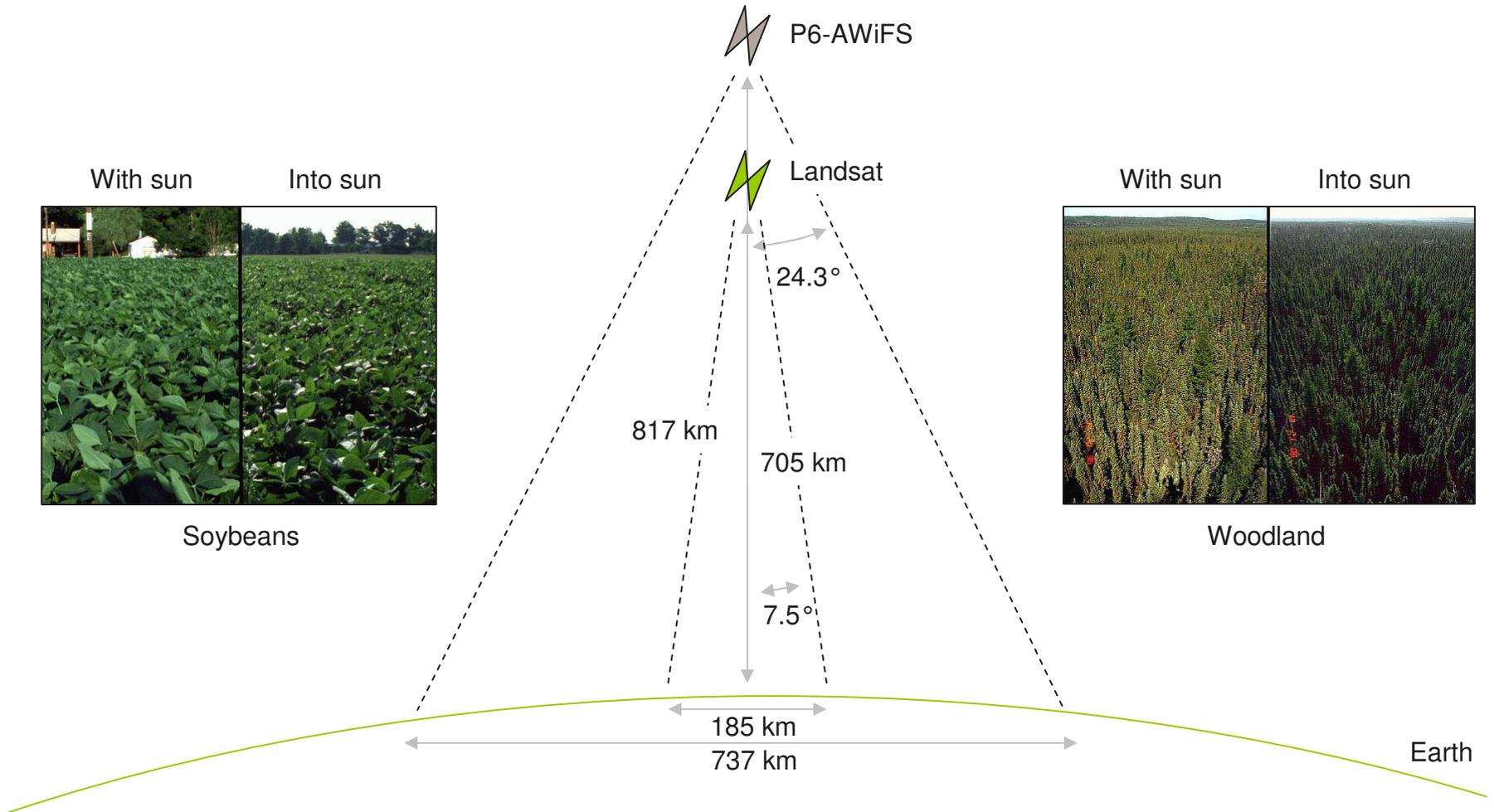
**Dave M. Johnson**  
Geographer

**United States Department of Agriculture  
National Agricultural Statistics Service  
Research and Development Division  
Spatial Analysis Research Section**

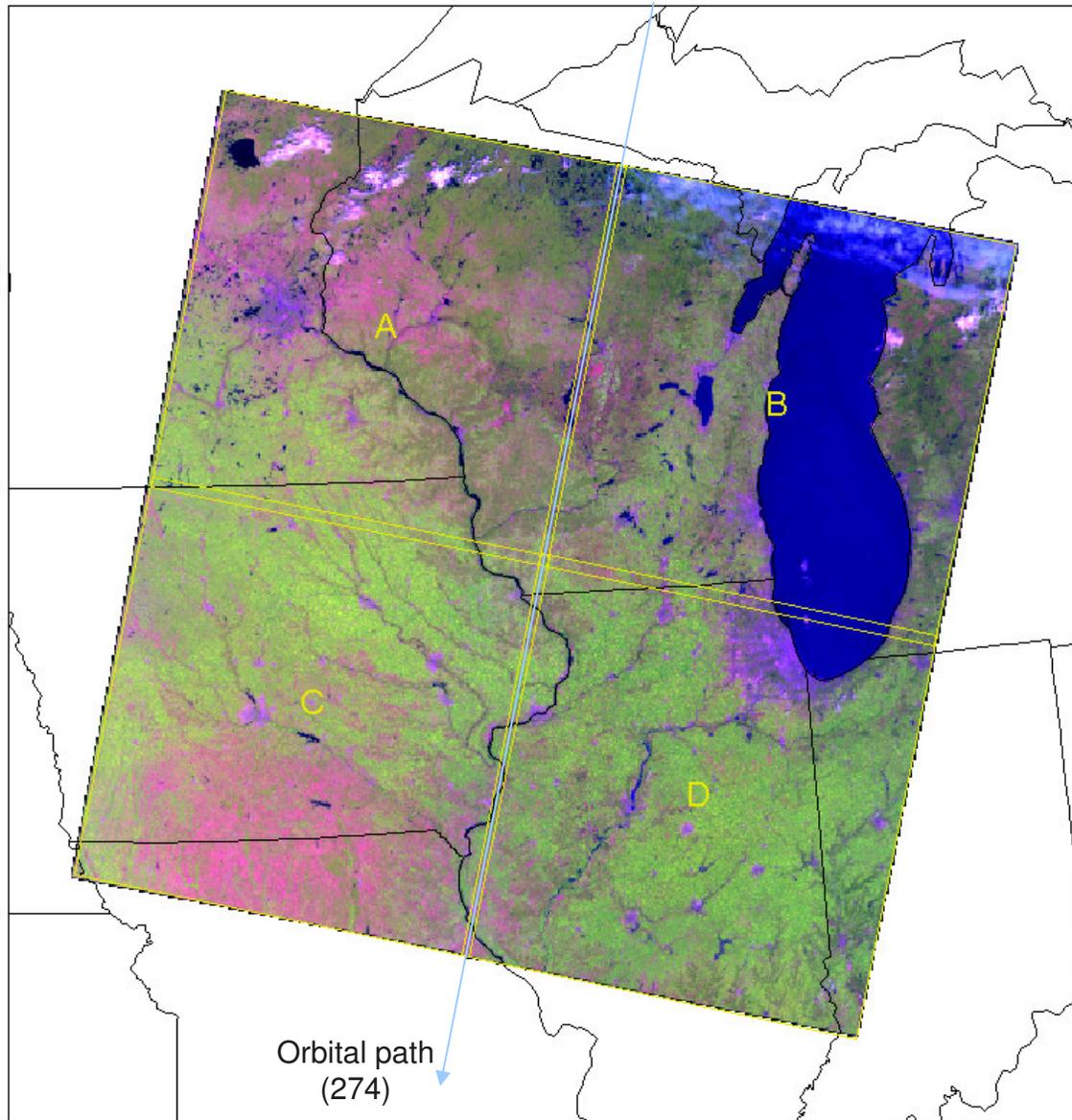
# **Cropland classification accuracy as a function of AWiFS incidence angle**



# AWiFS viewing geometry

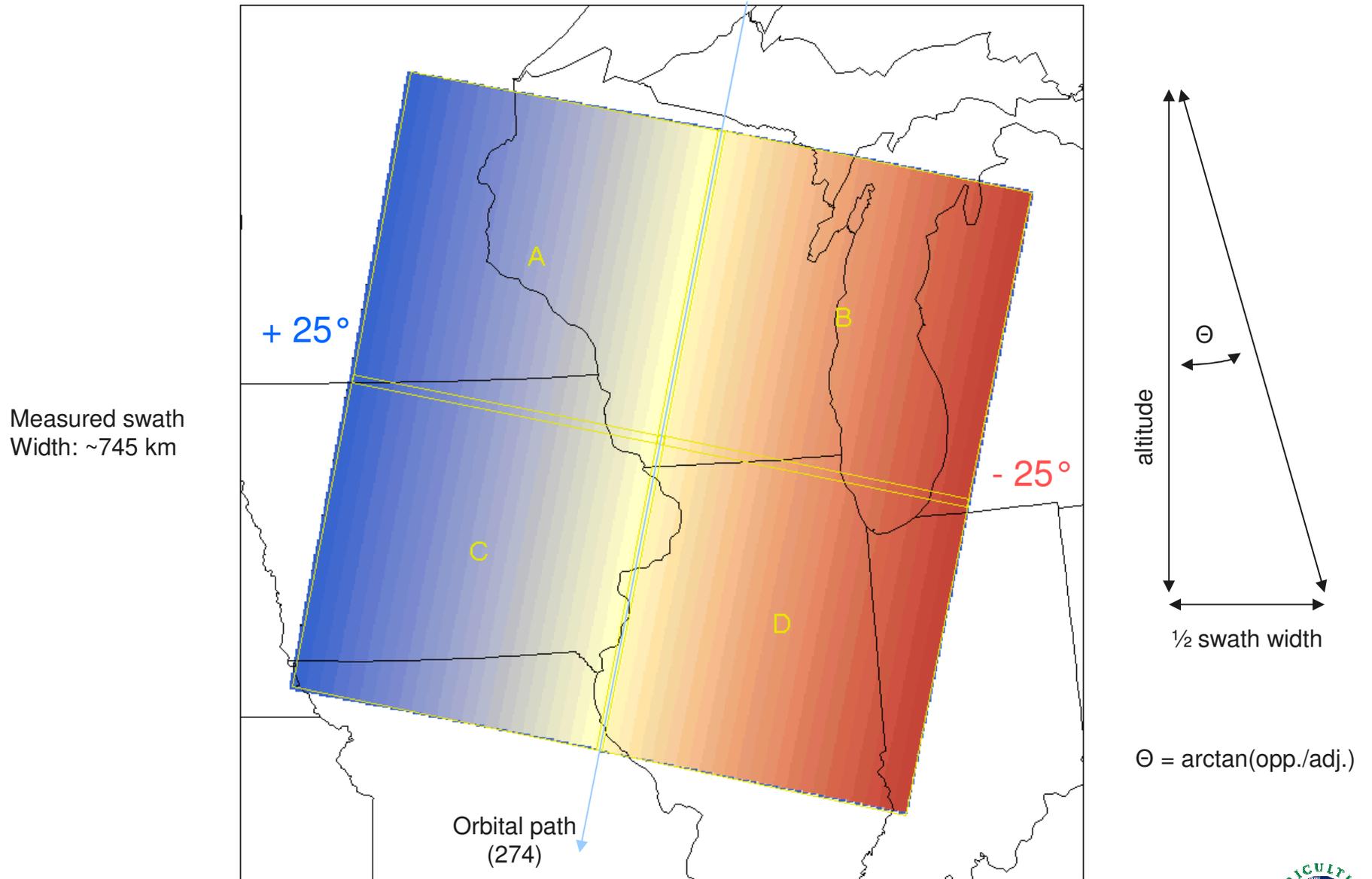


# Example four quad, same date/path AWiFS collect

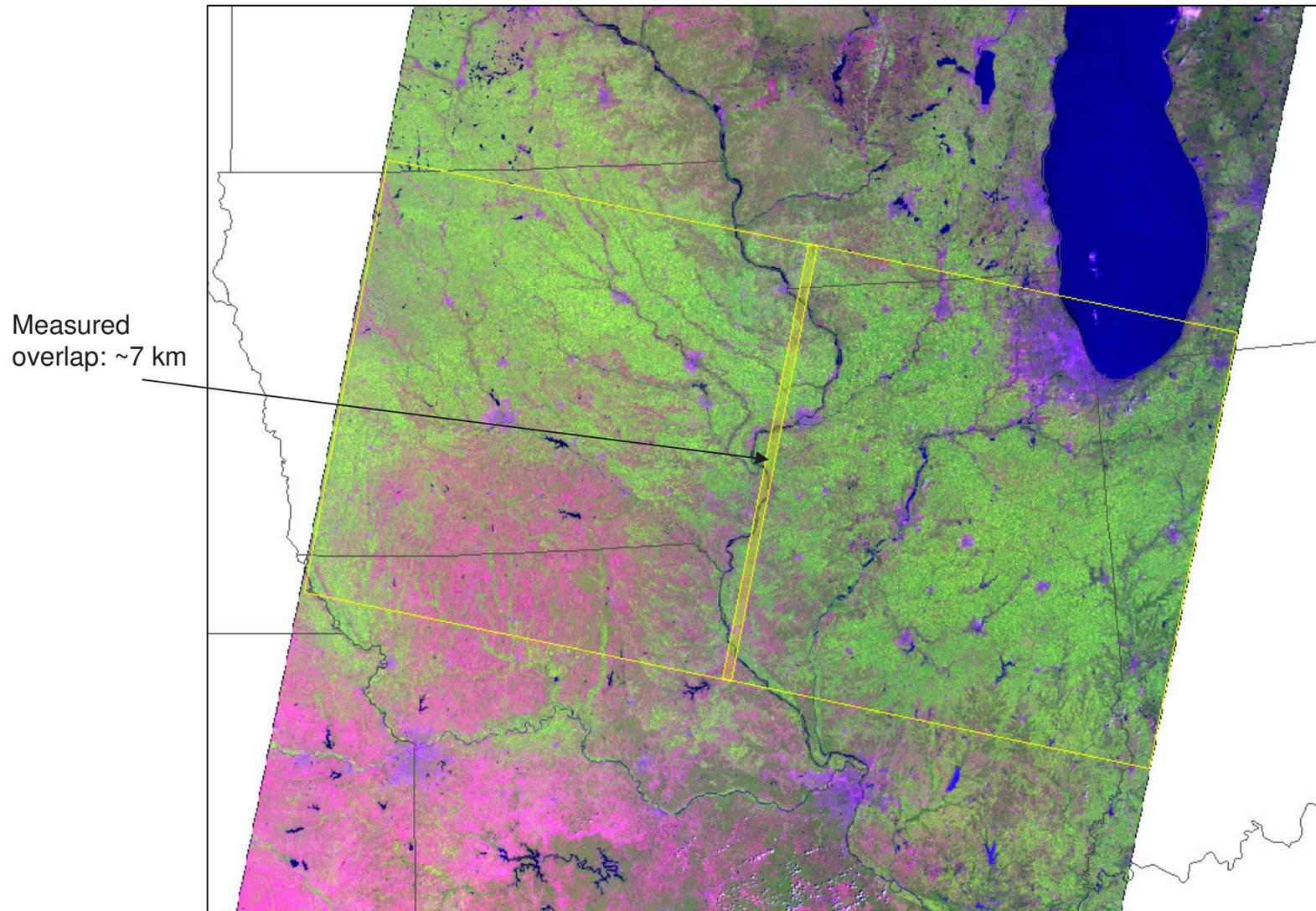


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# Angle from nadir calculation

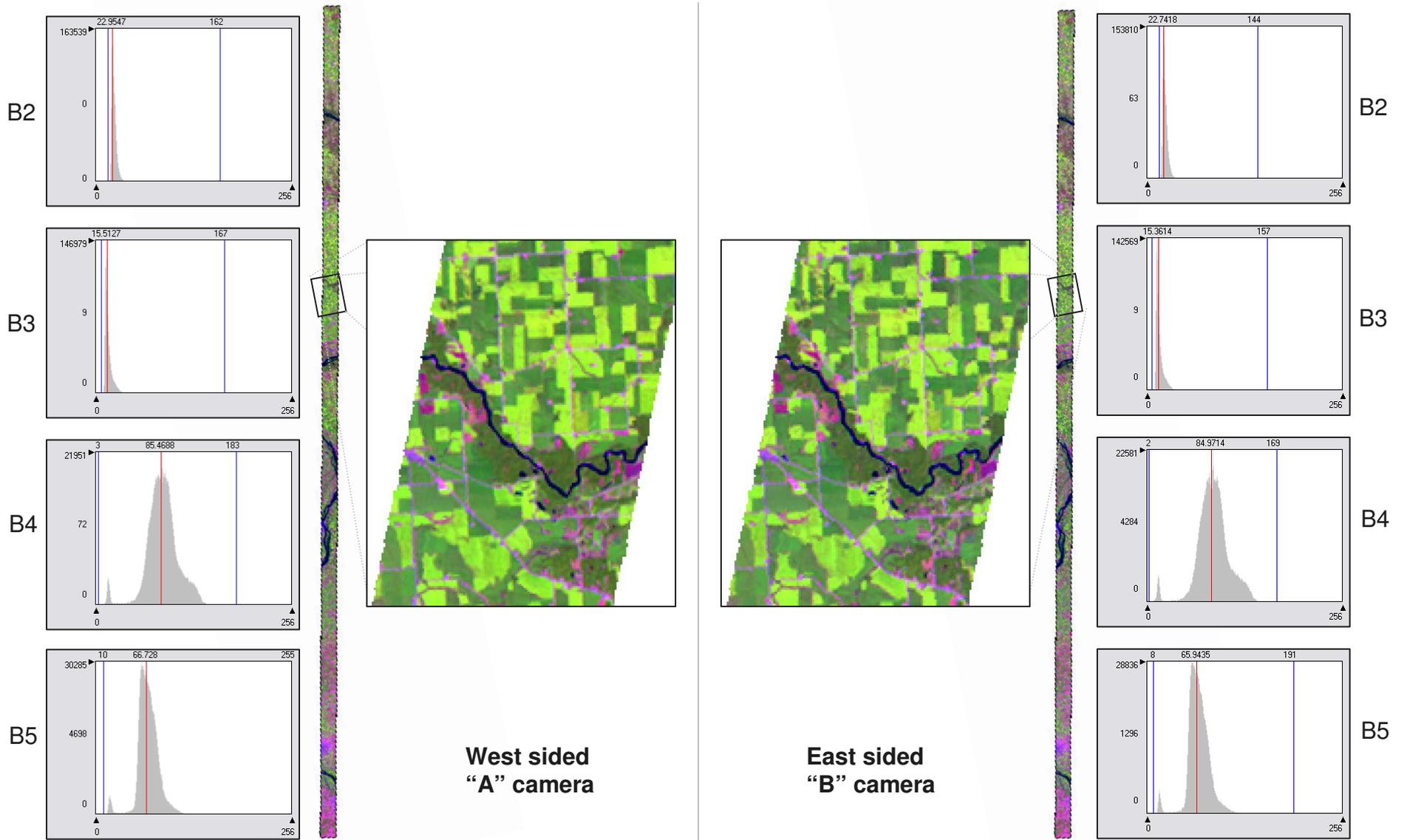


# Comparison of nadir overlap area

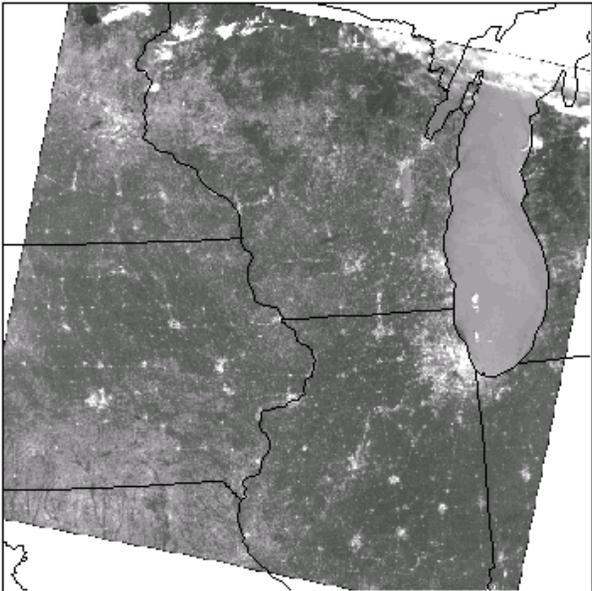
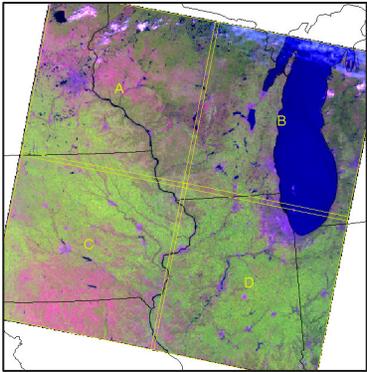


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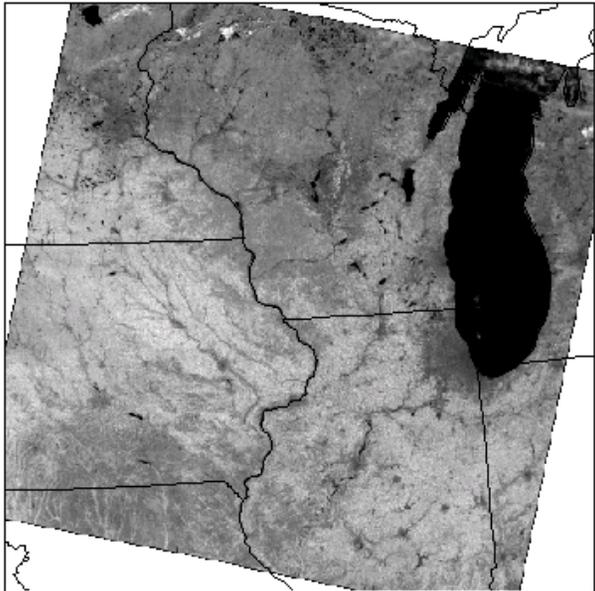
# Inspection of nadir overlap area



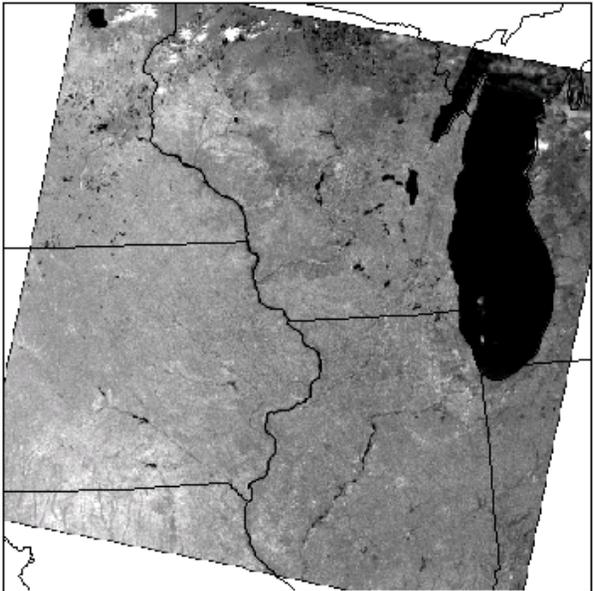
# Inspection of across swath reflectance



Band 2 - Red



Band 3 - Near Infrared

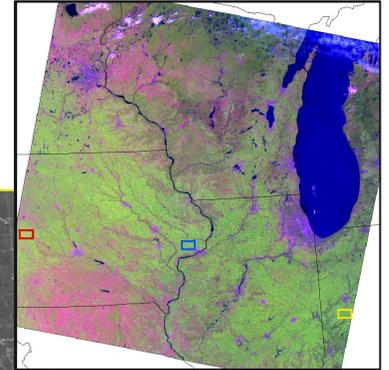
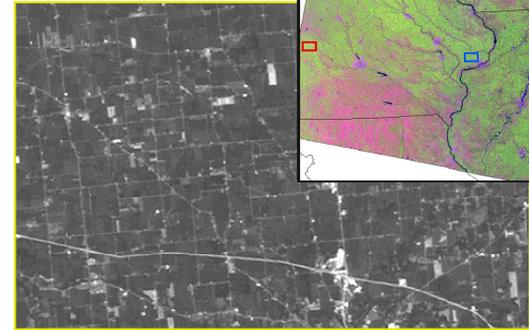
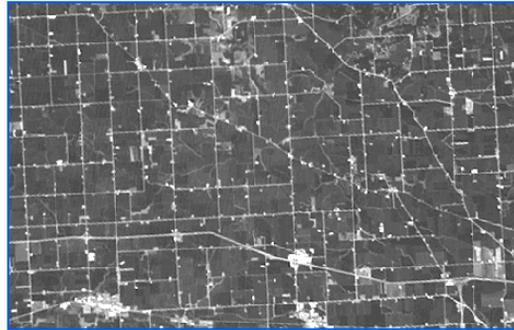
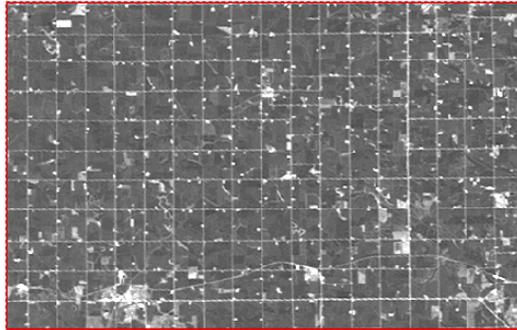


Band 4 - Shortwave Infrared

# Across track reflectance

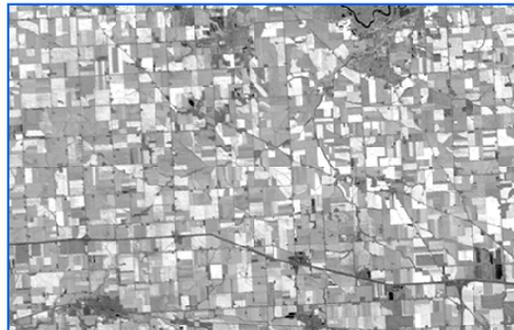
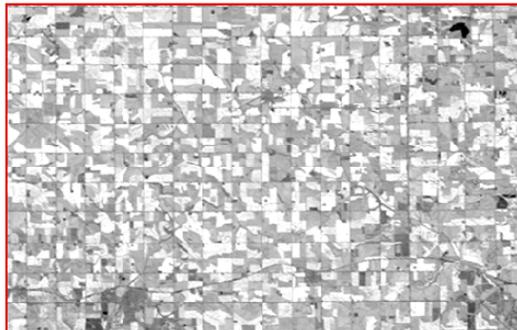
Band 2

Red



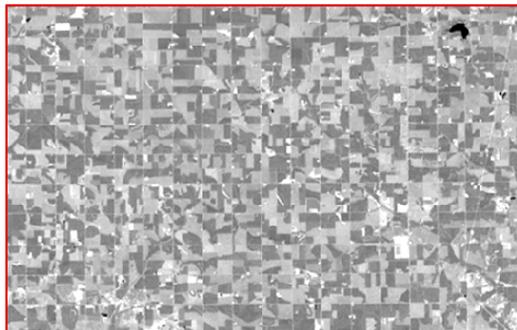
Band 3

NIR



Band 4

SWIR

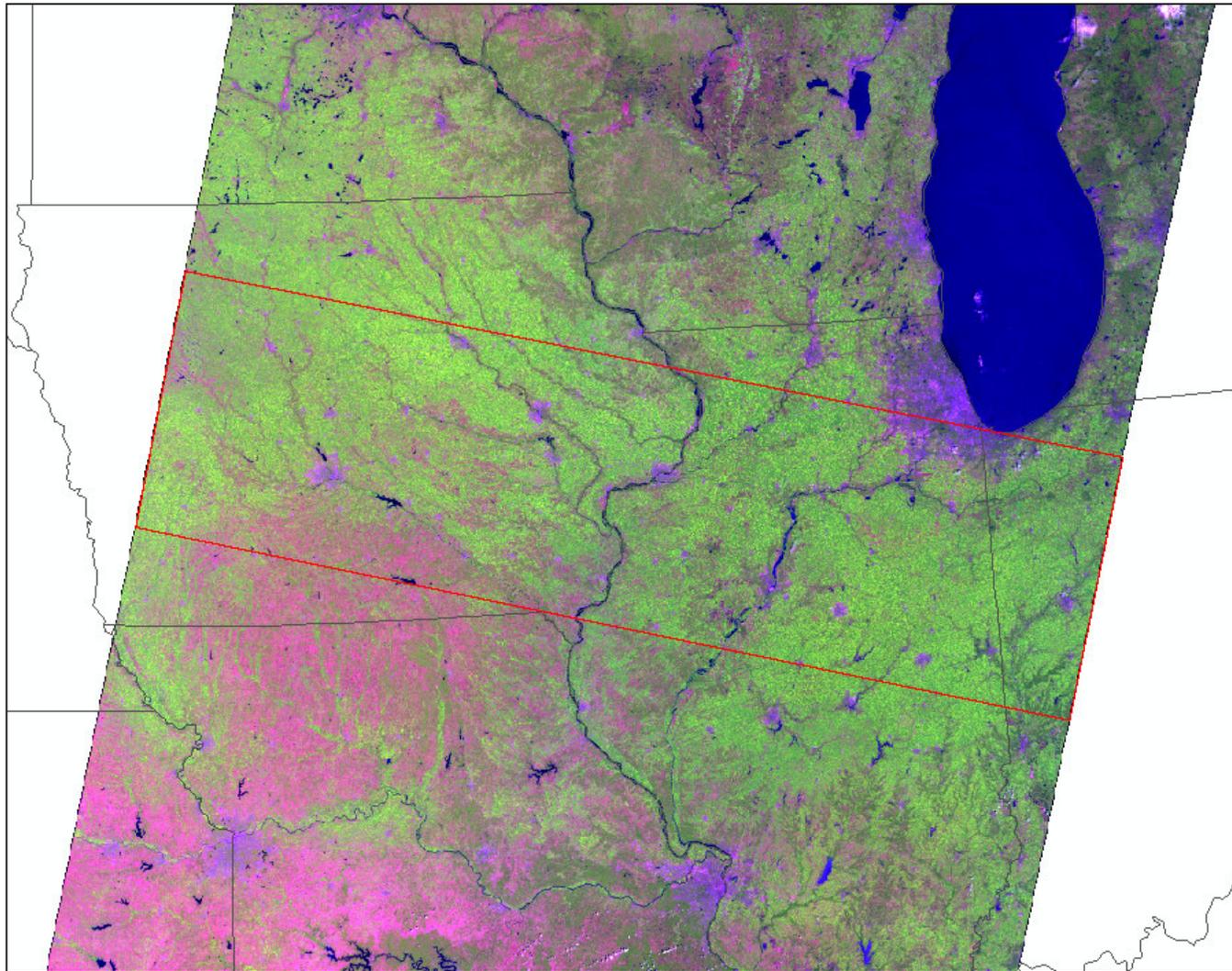


West

Nadir

East

# Classification across track study area



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# Dominant cover types in region



## Cropland

Corn  
Soybeans  
Winter Wheat  
Alfalfa

## Non cropland

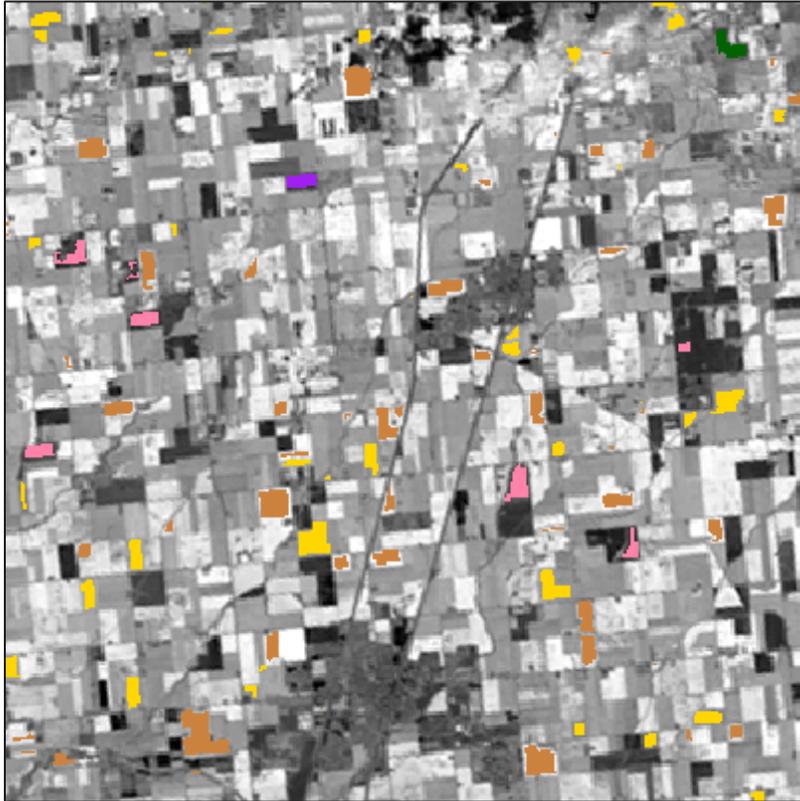
Grassland  
Woodland  
Developed  
Water

# Classification methodology

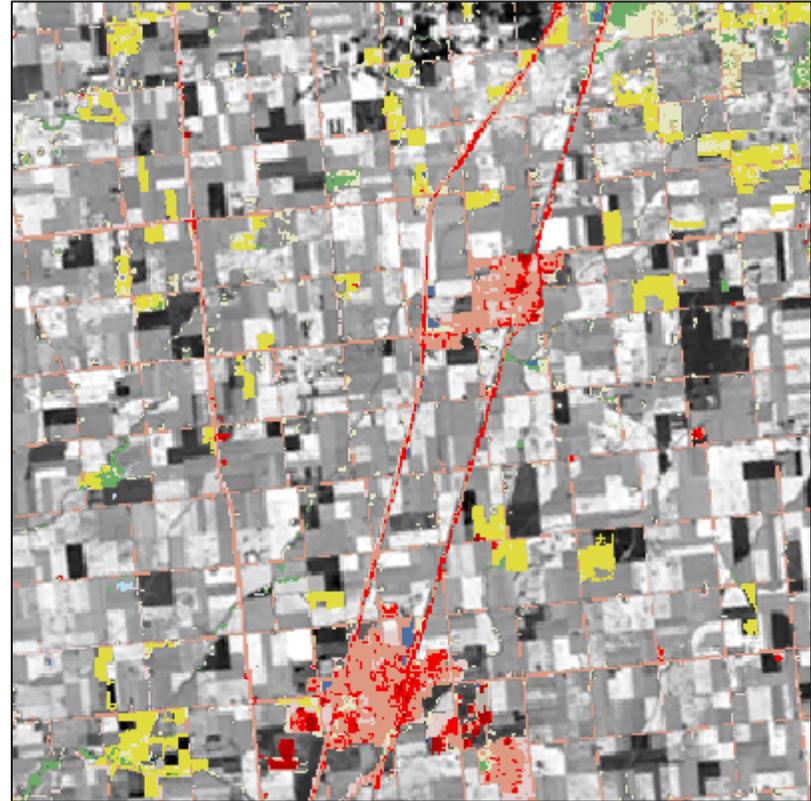
- 1) Mosaic (if needed) same-date AWiFS quads and reproject to common USGS Albers Conic Equal Area projection with 56 m grid cells
- 2) Sample spatially AWiFS imagery at known ground truth areas (USDA FSA CLU/578 data for agriculture categories and USGS 2001 NLCD for non-agriculture categories)
- 3) Data-mine samples using Boosted Classification Tree Analysis to derive best fitting decision rules (implemented within Rulequest See5.0)
- 4) Apply derived decision rules back to input data
- 5) Create land cover map
- 6) Assess map accuracy (using independent set of ground truth)



# Example ground truth sampling



USDA 2006 Farm Service Agency CLU/578 Data

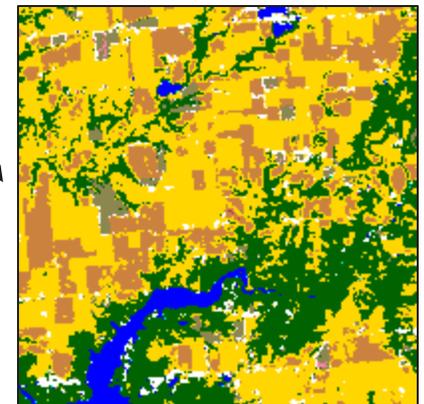
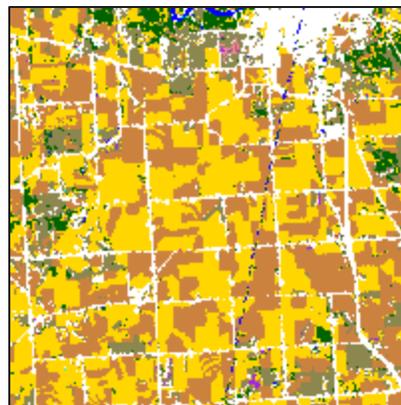
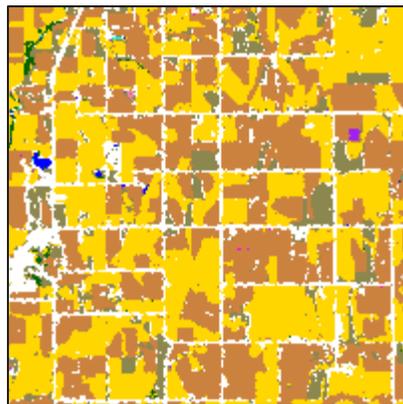
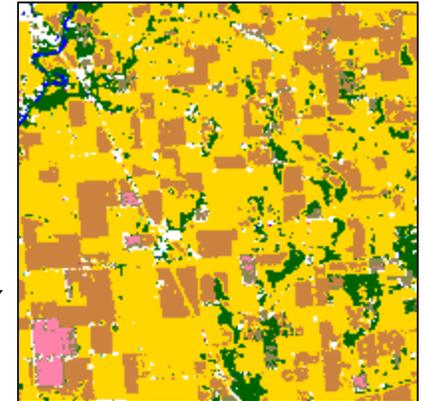
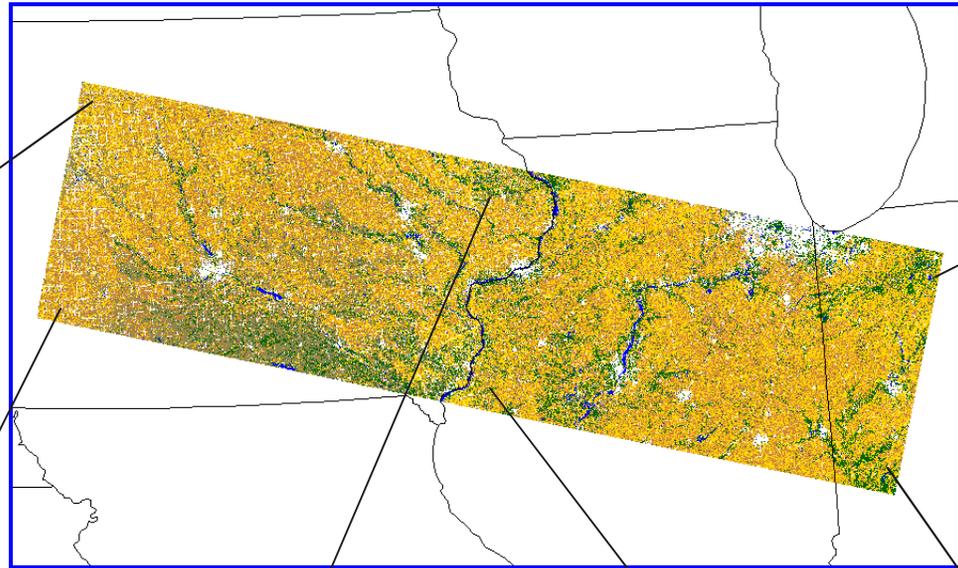
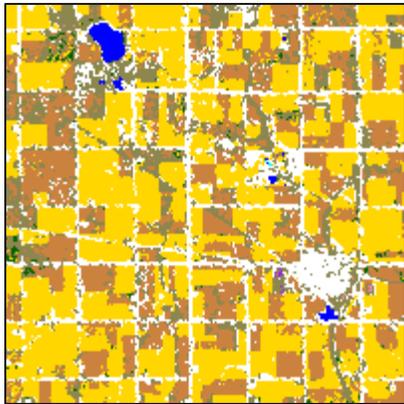


USGS 2001 National Land Cover Dataset

# Full swath classification output

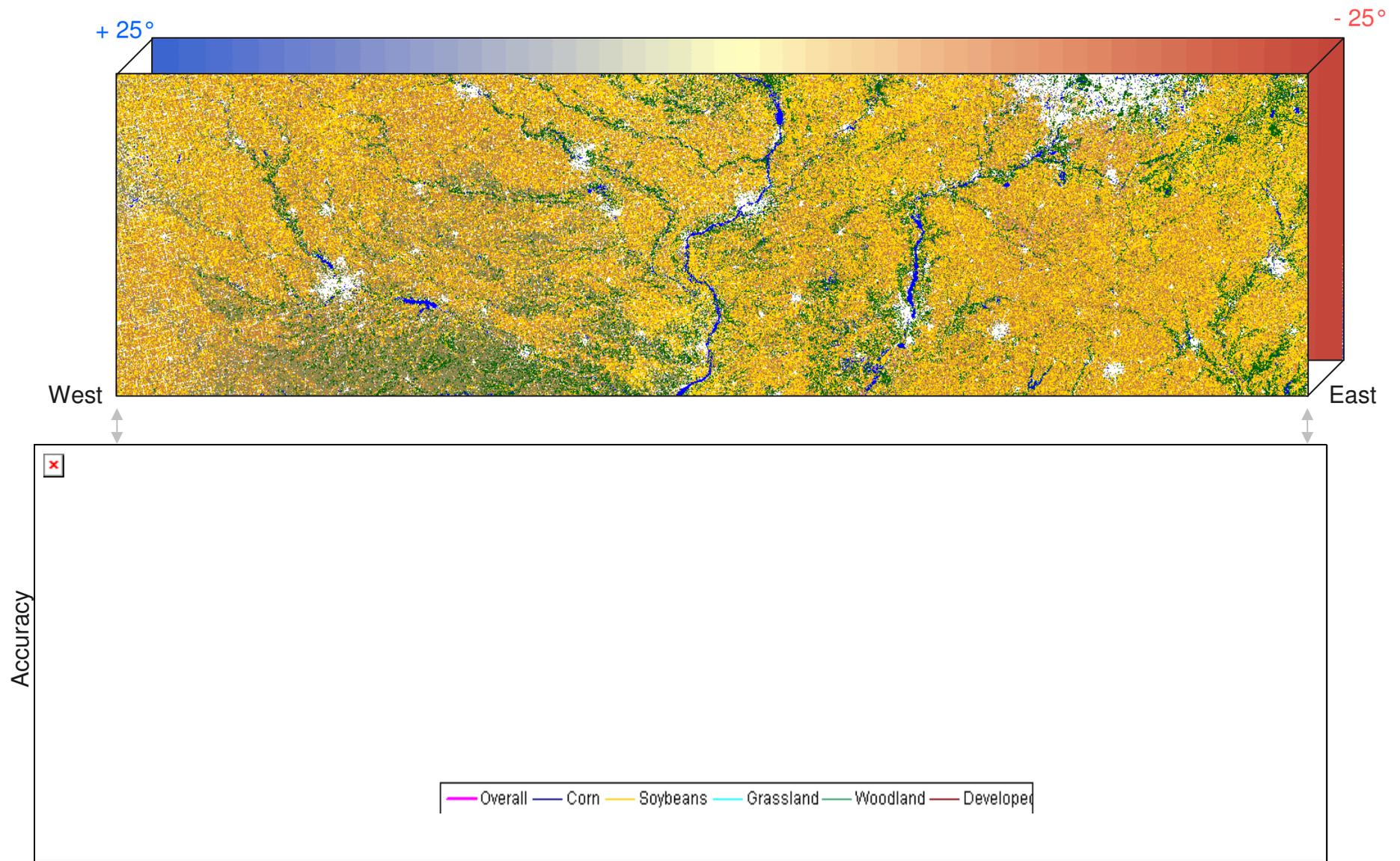
Overall Accuracy = 82.5%

Kappa = 0.758

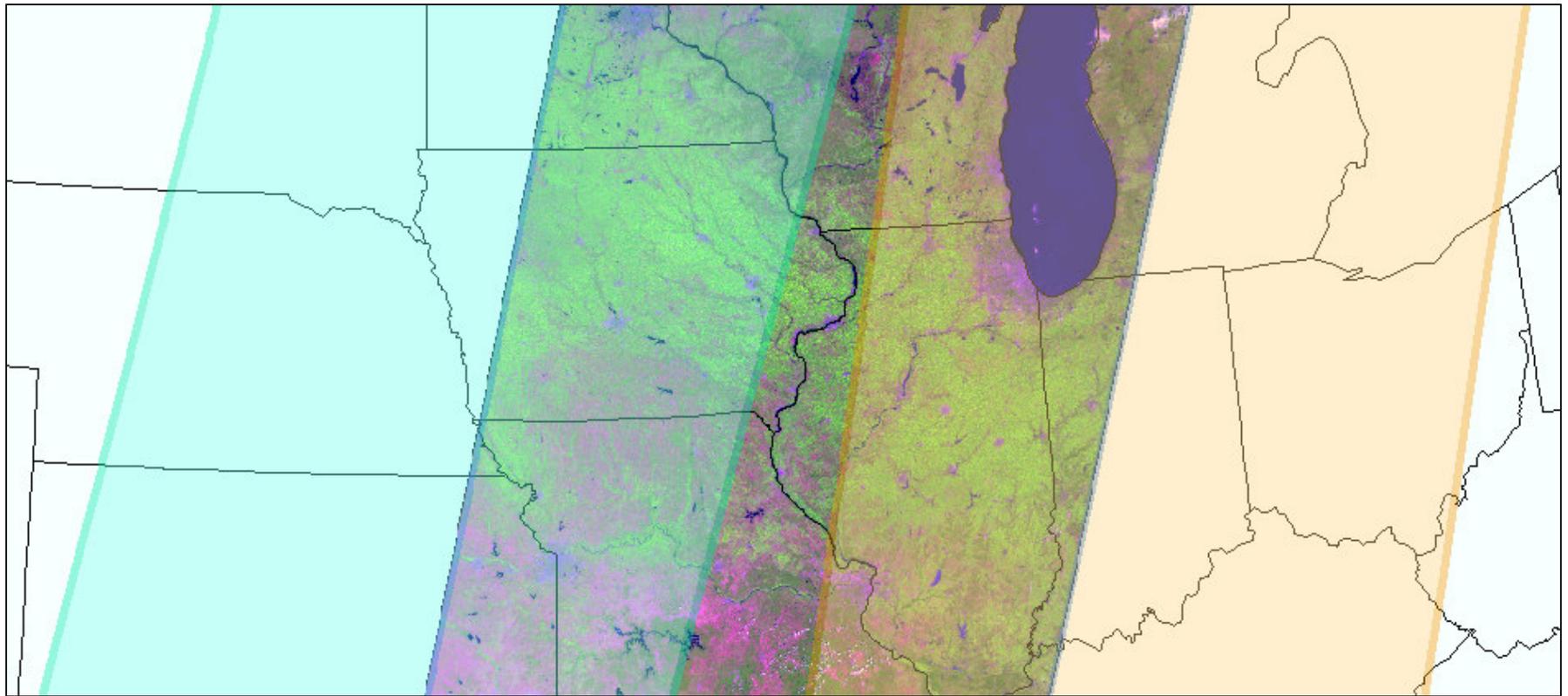


-  Corn
-  Developed
-  Grassland
-  Soybeans
-  Water
-  Winter wheat
-  Woodland

# Accuracy as a function of angle from nadir



# Collects one day before and one day after

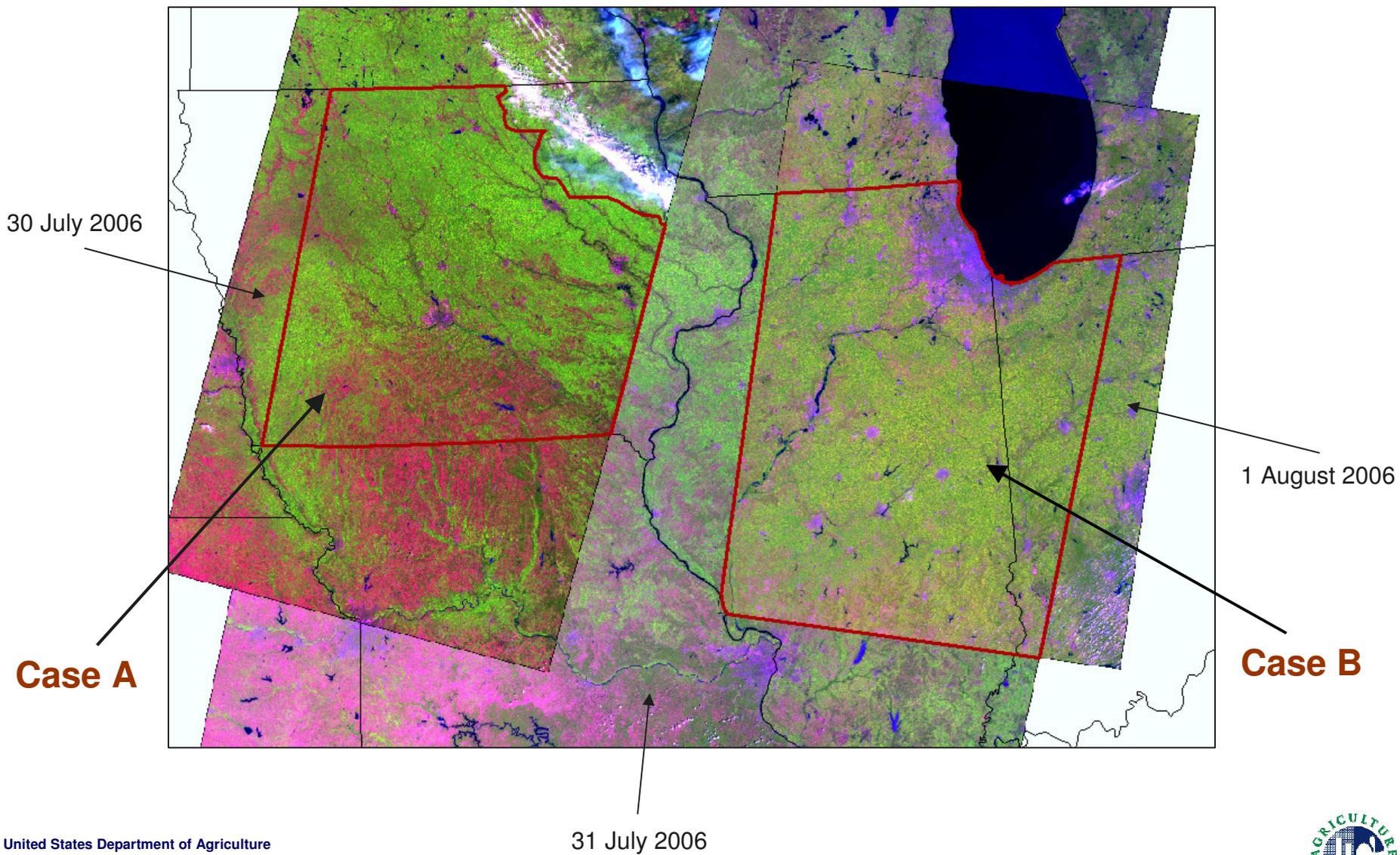


30 July 2006  
(path 269)

31 July 2006  
(path 274)

1 August 2006  
(path 279)

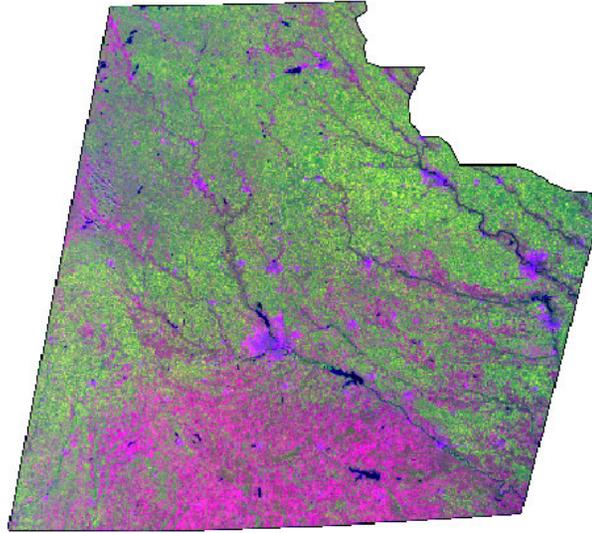
# Overlap study areas



# One day different classifications: case A

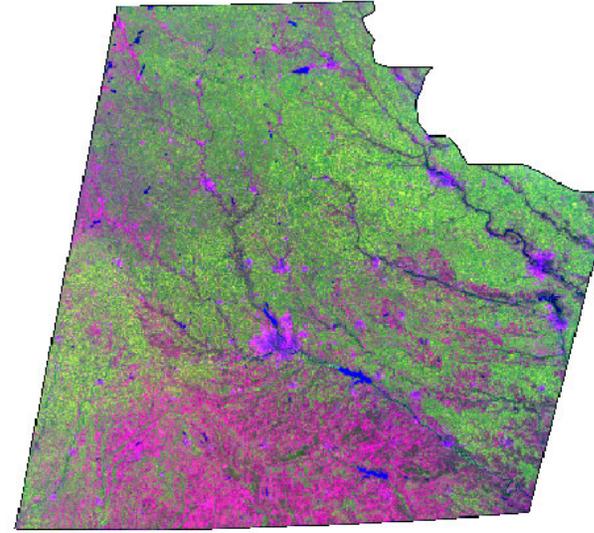
West sided  
"A" camera

31 July 2006



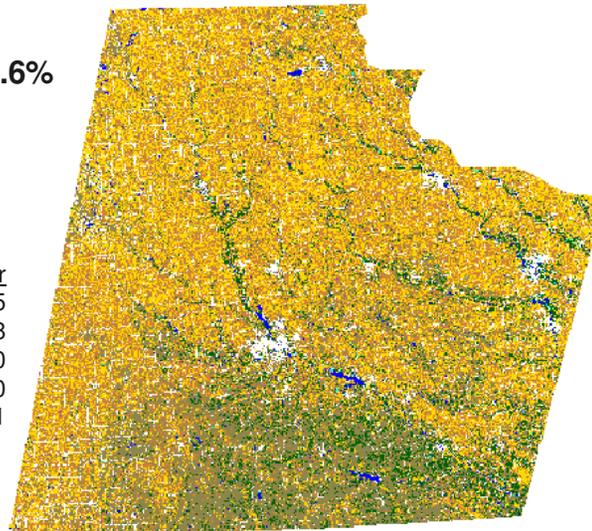
East sided  
"B" camera

30 July 2006



Overall Accuracy: **83.6%**  
Kappa: **0.771**

Cover Type	Prod.	User
Corn	95.0	89.5
Soybeans	92.8	88.8
Grassland	75.2	78.0
Woodland	61.9	60.0
Developed	57.9	63.1



Average angle: **15.4°**

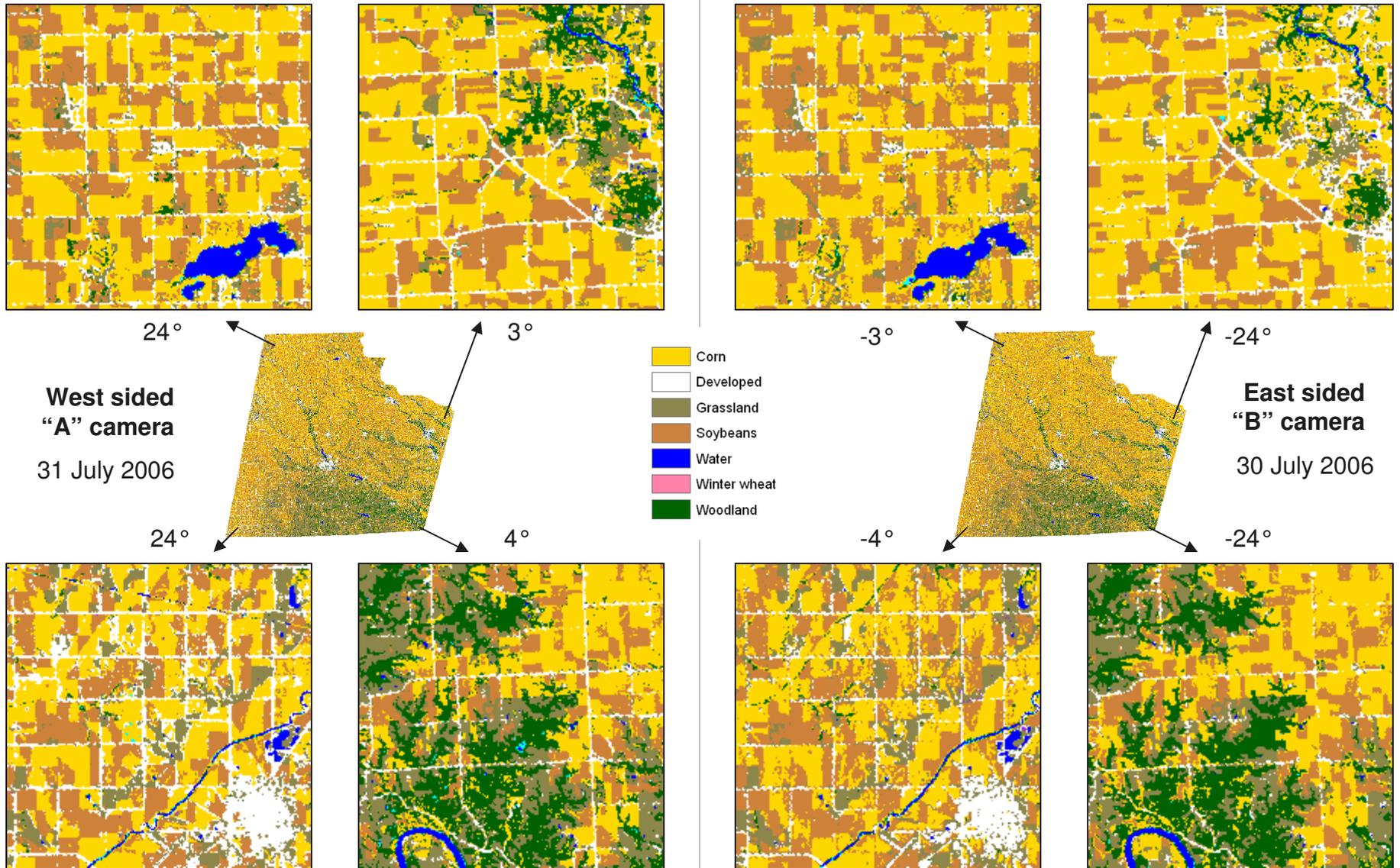
Overall Accuracy: **79.9%**  
Kappa: **0.725**

Cover Type	Prod.	User
Corn	94.1	84.3
Soybeans	88.6	83.3
Grassland	72.4	77.7
Woodland	64.3	61.5
Developed	39.7	58.7



Average Angle: **-13.4°**

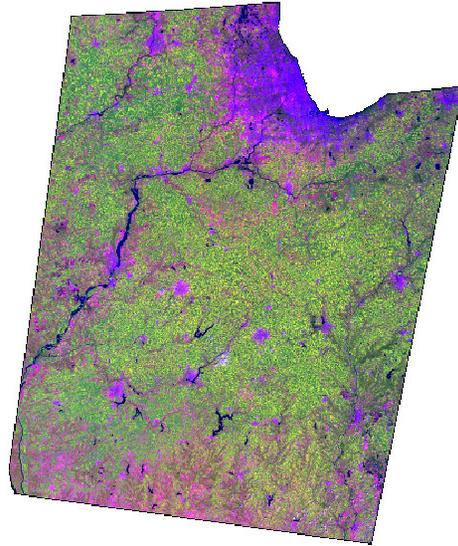
# Closer inspection: case A



# One day different classifications: case B

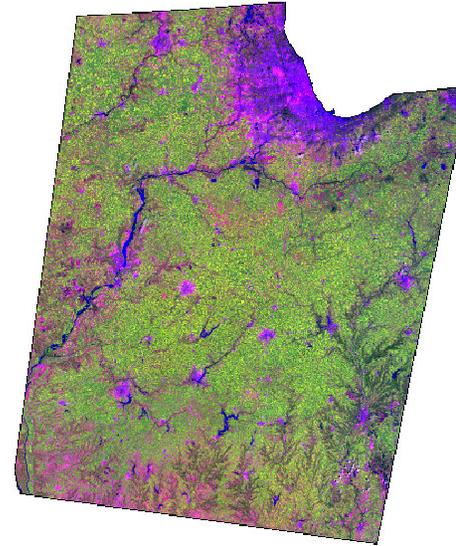
West sided  
"A" camera

1 August 2006



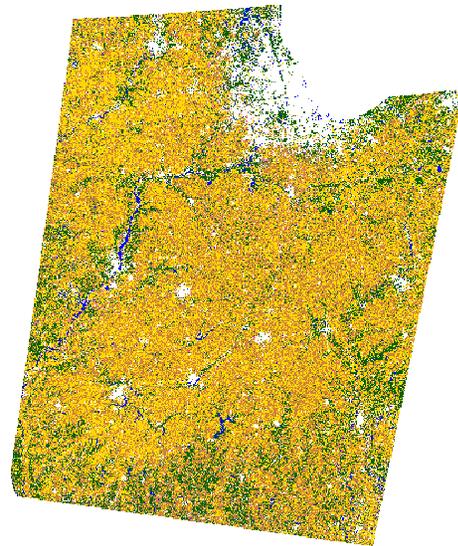
East sided  
"B" camera

31 July 2006



Overall accuracy: **82.3%**  
Kappa: **0.750**

Cover Type	Prod.	User
Corn	95.0	86.8
Soybeans	95.6	90.4
Grassland	39.3	49.2
Woodland	63.2	62.9
Developed	53.8	77.7



Average Angle: **15.0°**

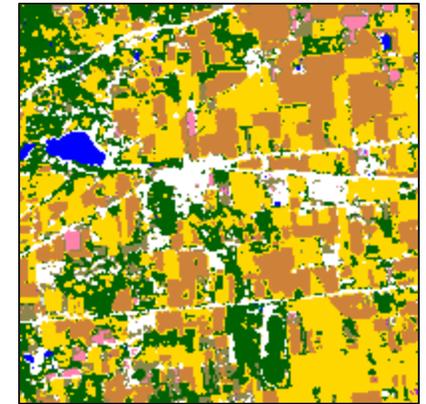
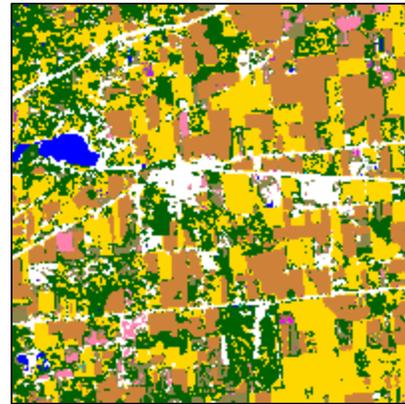
Overall accuracy: **82.4%**  
Kappa: **0.751**

Cover Type	Prod.	User
Corn	95.5	86.6
Soybeans	94.7	89.9
Grassland	35.2	47.3
Woodland	67.8	65.7
Developed	53.3	77.4



Average Angle: **-14.4°**

# Closer inspection: case B



24°

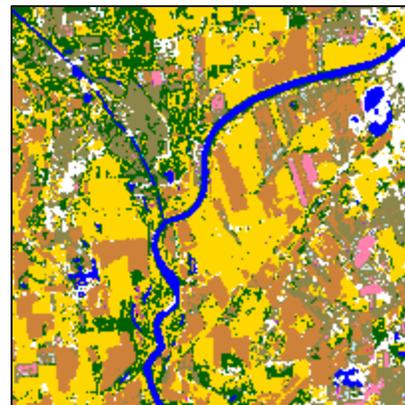
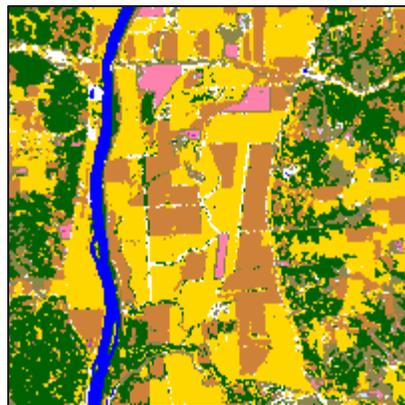
4°

West sided  
"A" camera

1 August 2006

24°

5°



-4°

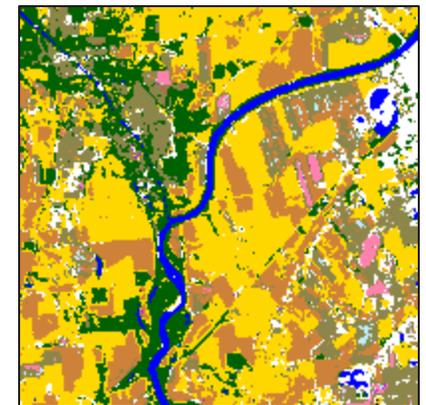
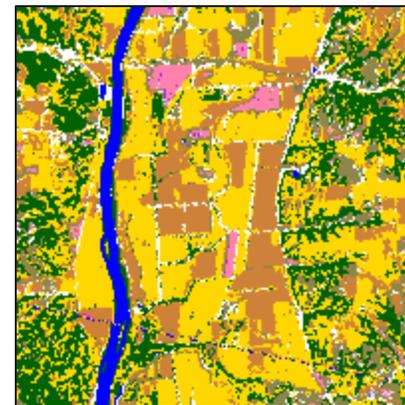
-24°

East sided  
"B" camera

31 July 2006

-5°

-24°



# Conclusions !

- Incidence angle appears to have minor impact on classification accuracy (particularly for crops)
- Nadir may not be the best viewing angle despite being best native resolution (particularly for corn)
- “Developed” category seems to have the most to lose (or gain) as a function of incidence angle (especially when classifying over entire swath)
- Classification tree methodology (with sufficient ground truth) may be compensating for any across scan spectral reflectance differences.
- Only a few cover types were investigated here - others may respond differently.
- AWiFS’ wide swath design greatly improves data coverage (even if edge pixels are ultimately compromised).





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