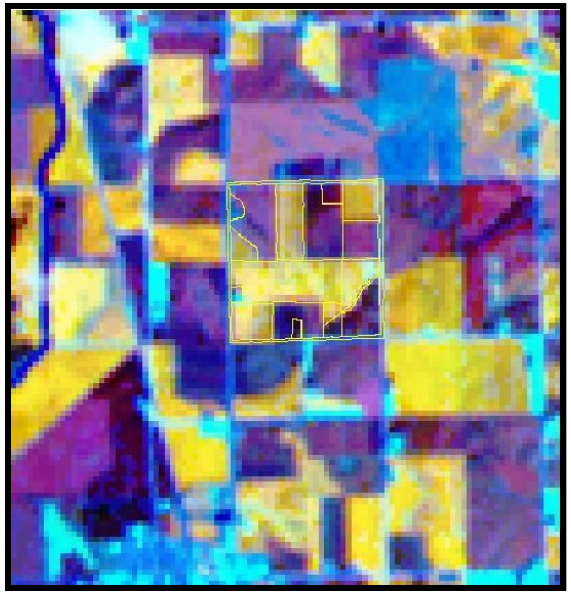
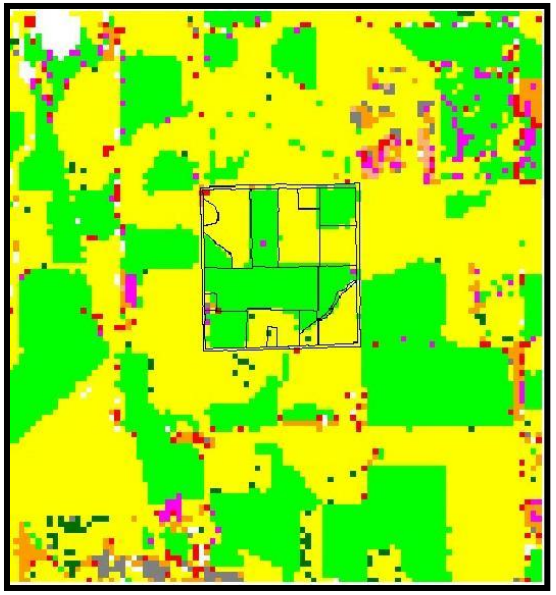
Multiresolution Landsat TM and AWiFS Sensor Assessment in Nebraska





Claire Boryan, Mike Craig, Rick Mueller, and Patrick Willis

703-877-8000

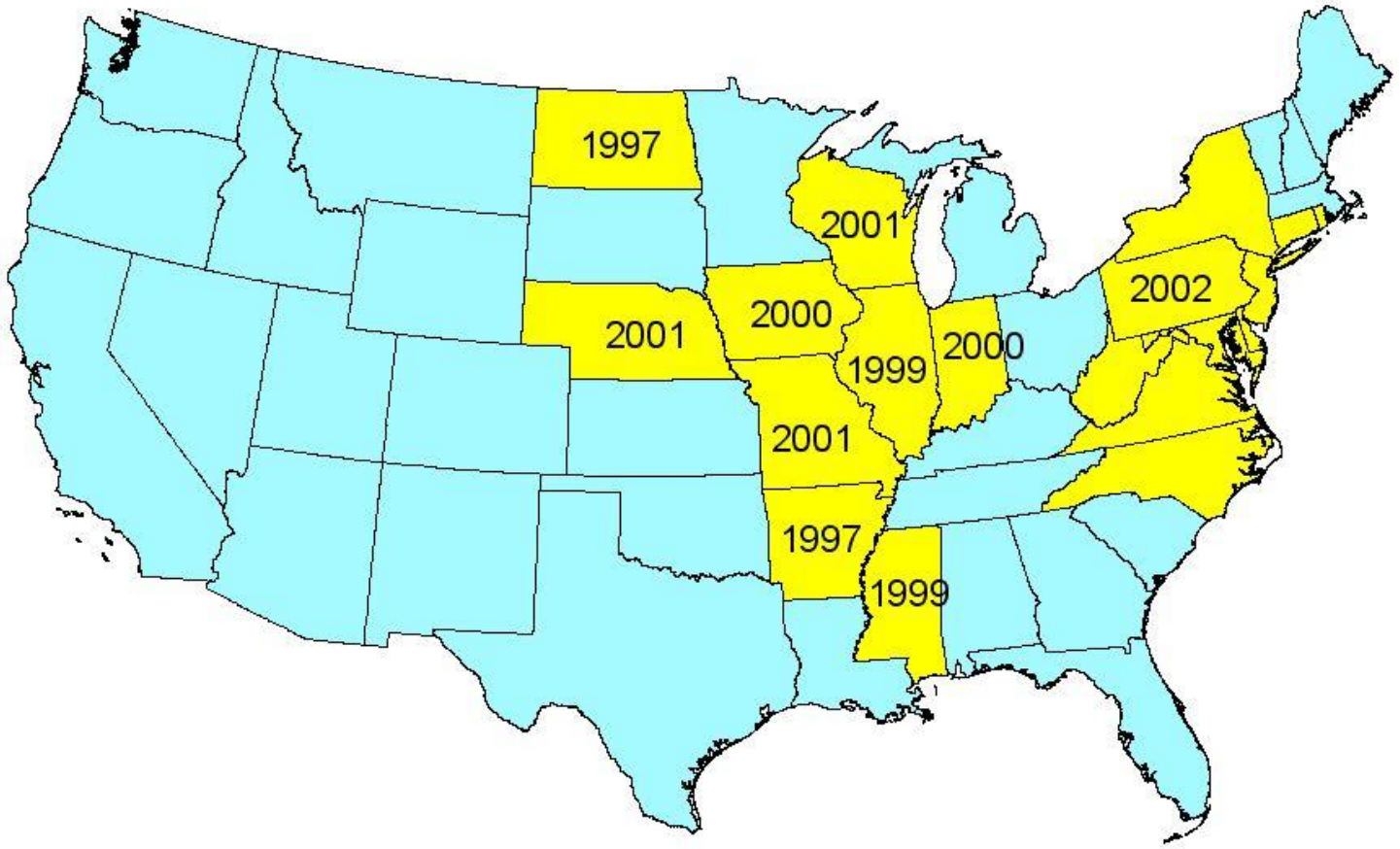
claire_boryan@nass.usda.gov

NASS
FACT FINDERS FOR AGRICULTURE
UNITED STATES DEPARTMENT OF AGRICULTURE

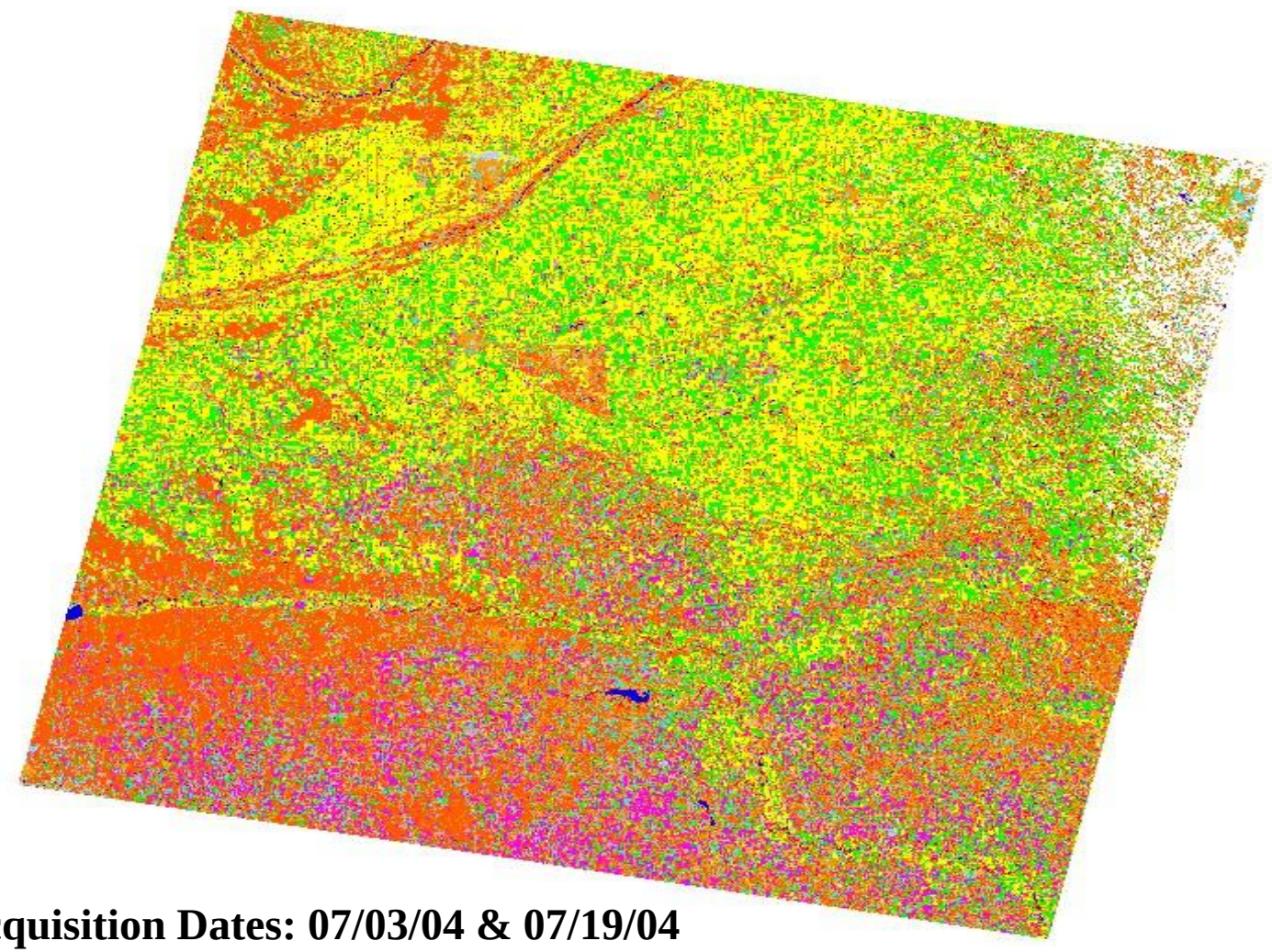
"Responsible for providing statistical data on US agriculture"

- **Produce acreage estimates with reduced error rates over the June Agricultural Survey.**
- **Create and distribute the Cropland Data Layer Product.**

19 Cropland Data Layer States



Multitemporal Landsat TM Scene Classification of Nebraska



Acquisition Dates: 07/03/04 & 07/19/04
Path/Row: 29/32

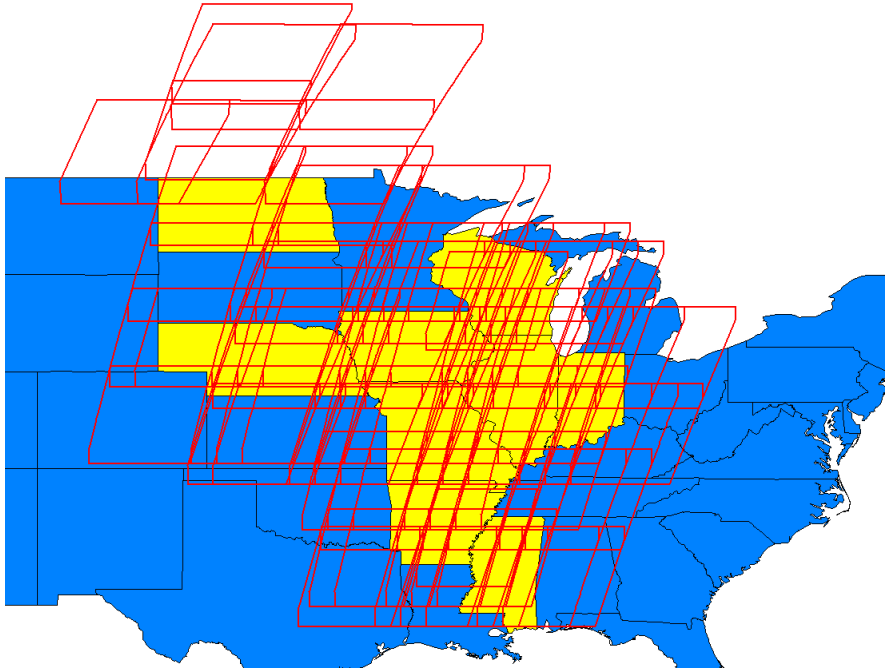
The Landsat Data Gap

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

Indian Remote Sensing Satellite: RESOURCESAT-1

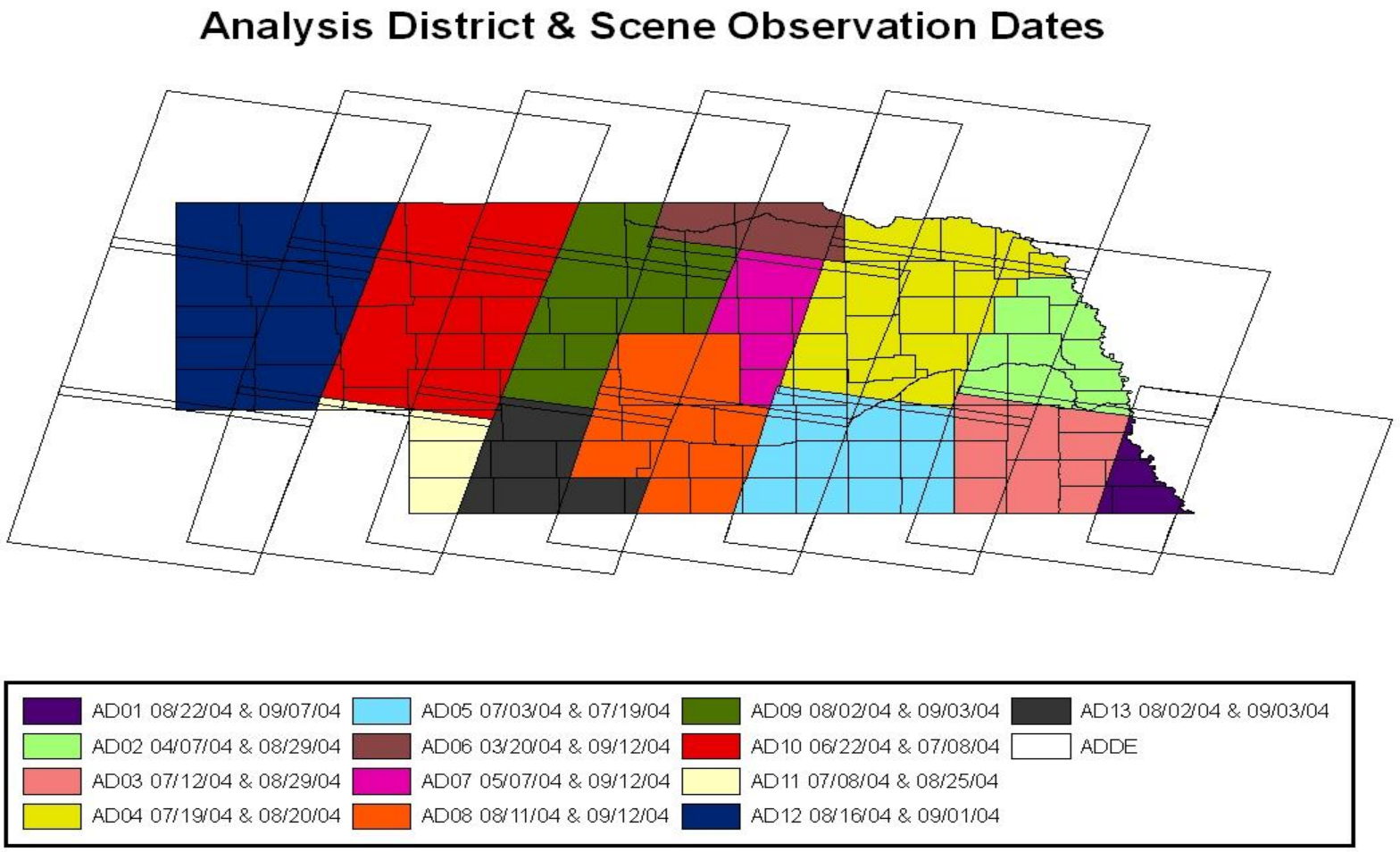
Advanced Wide Field Sensor (AWiFS)

- **AWiFS:** Swath: 370 km each head, 740 km combined, 56 m resolution at nadir, 70 m resolution at field edges.
- **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)**



***Imagery required extensive (30 –50 pt.) registration of scenes vs. 1 pt registration for Landsat TM data**

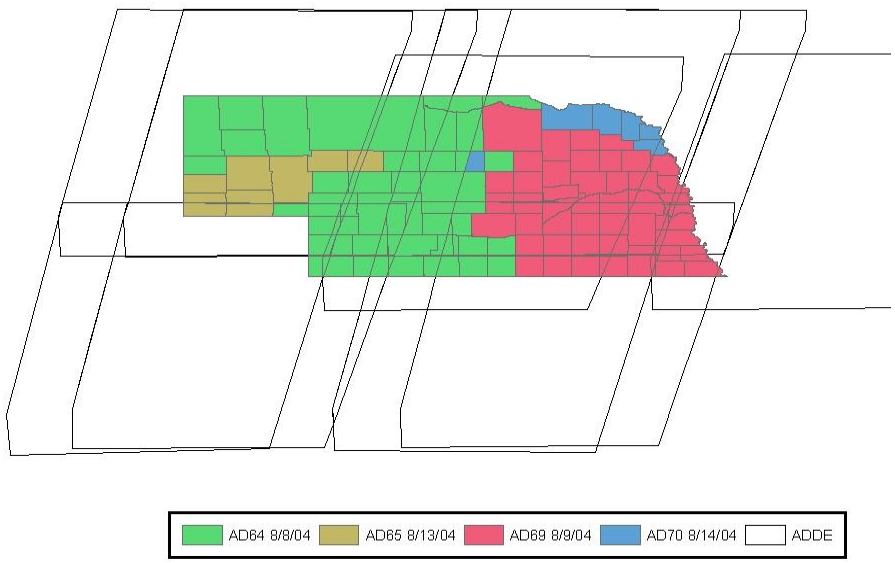
Multitemporal Analysis of Nebraska using Landsat TM data



Nebraska – 2004
Unitemporal Analysis

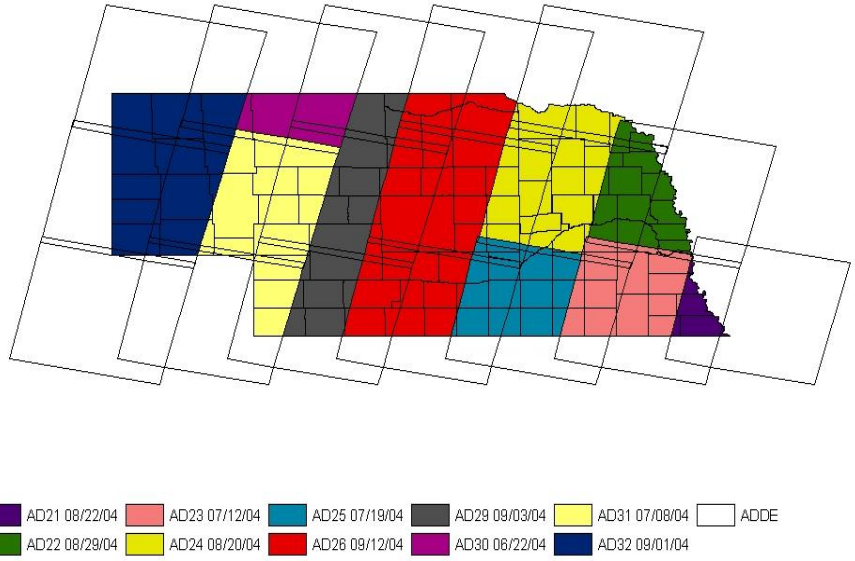
AWiFS

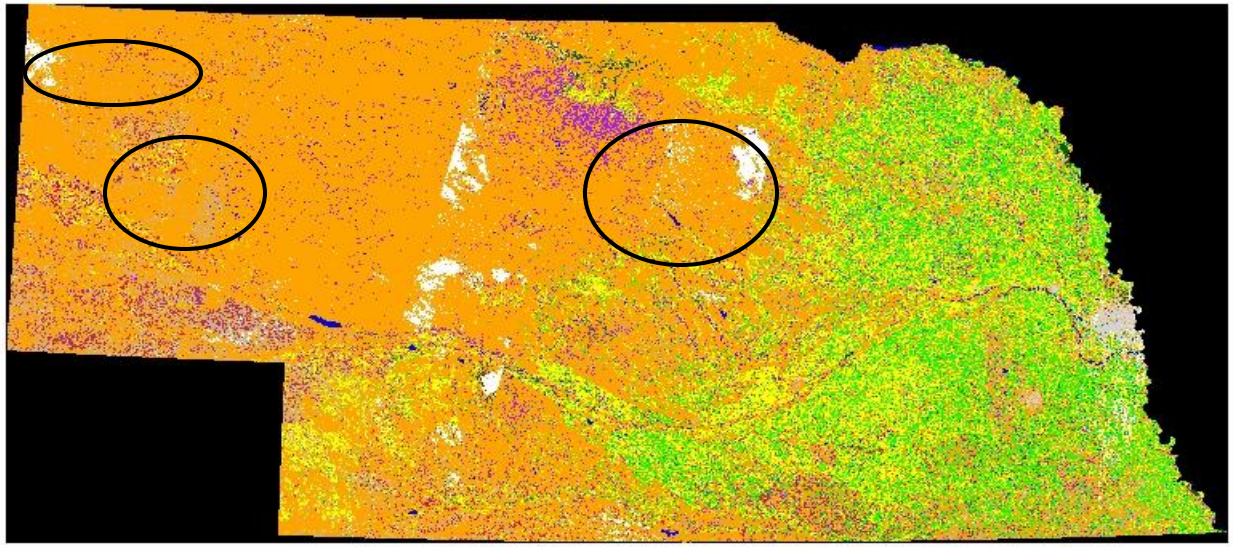
Analysis Districts (AD)
and Scene Observation Dates



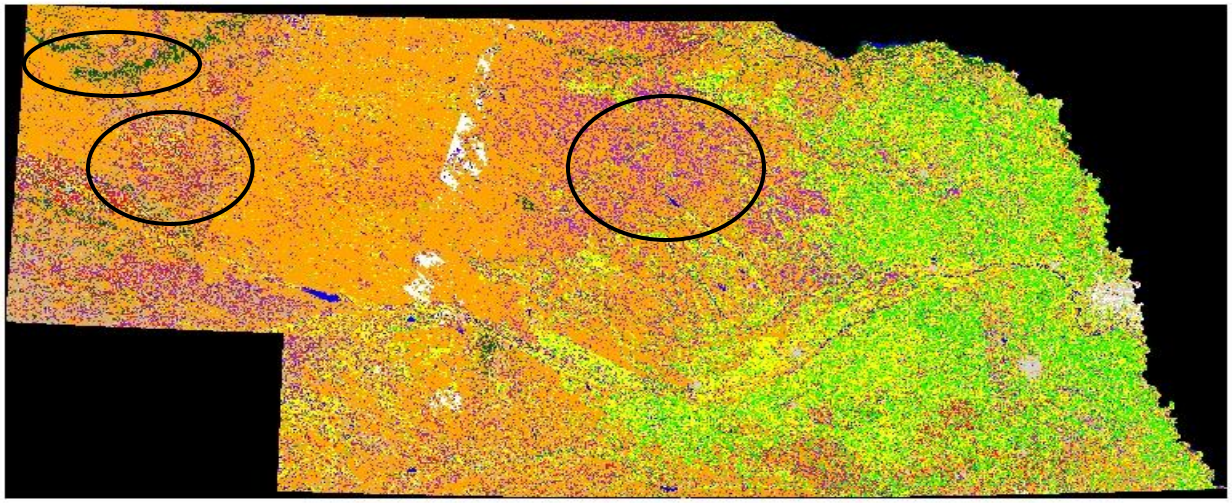
Landsat TM

Analysis Districts (AD)
and Scene Observation Dates

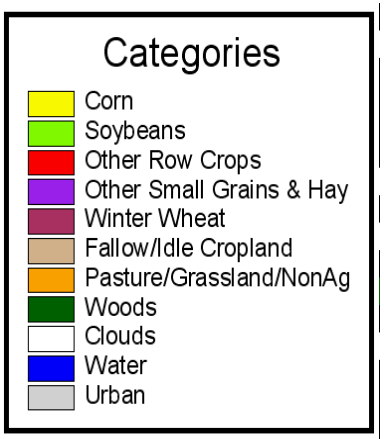


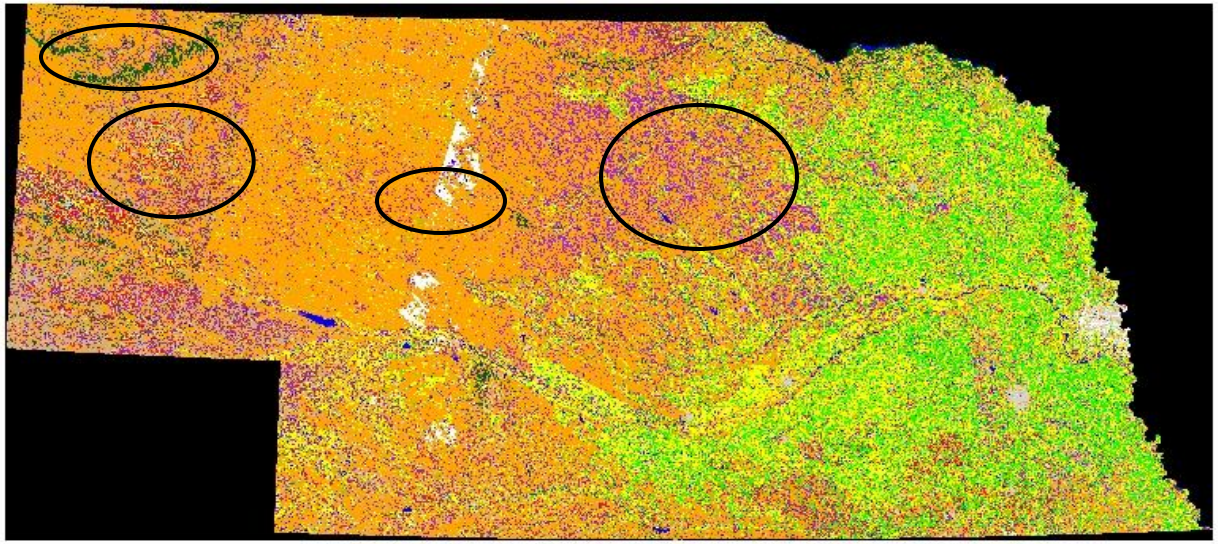


TM Multitemporal Classification

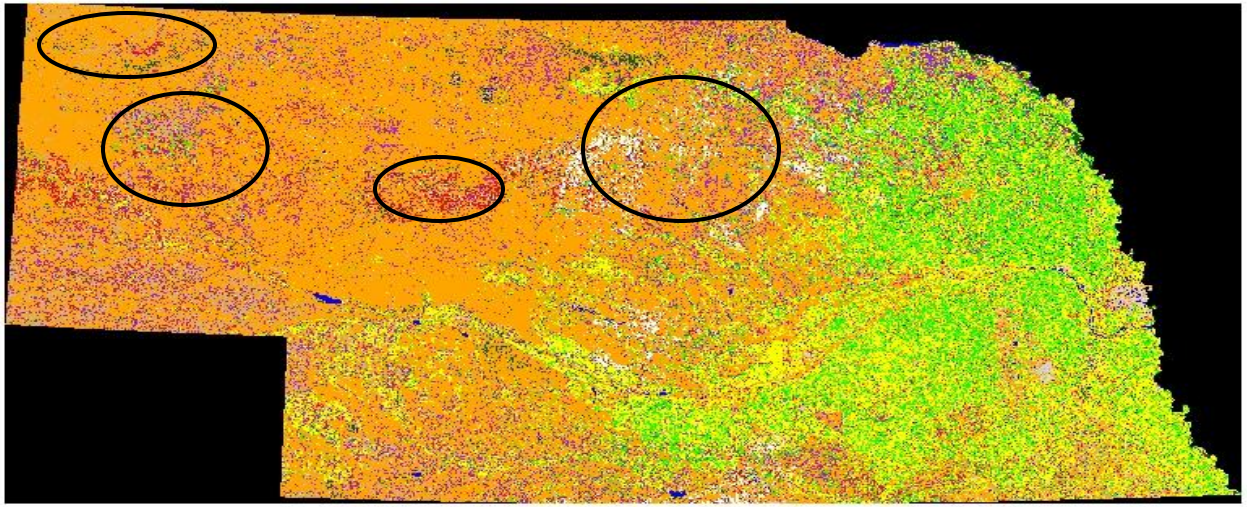


TM Unitemporal Classification

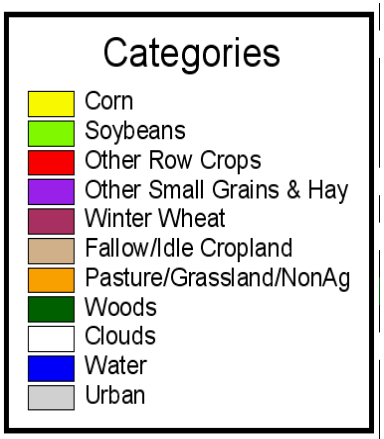




TM Unitemporal Classification



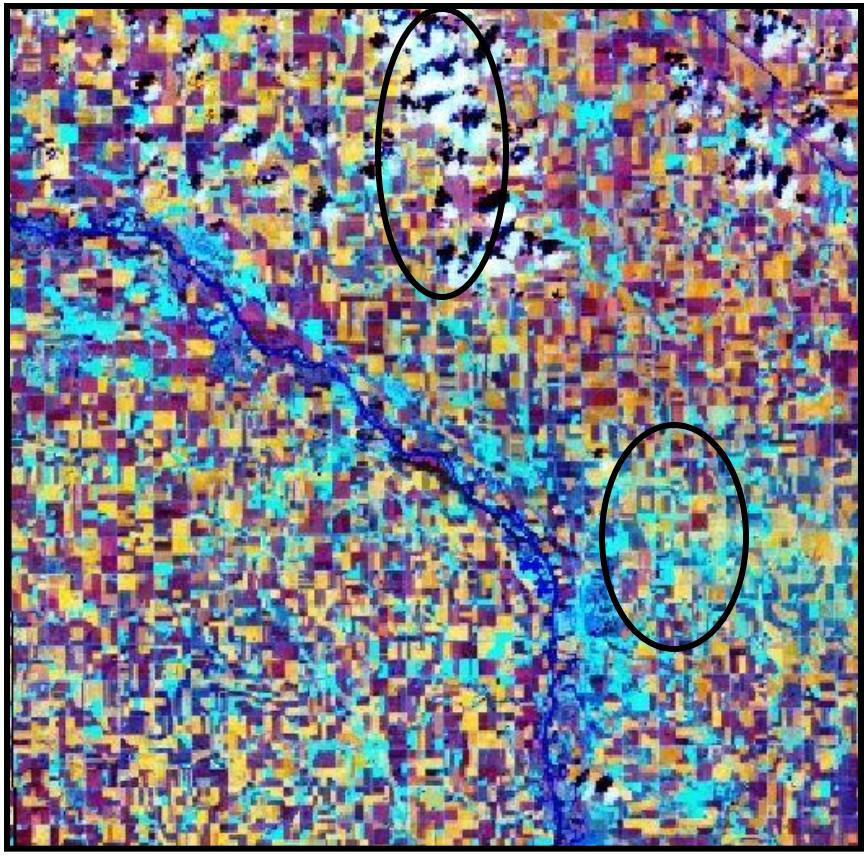
AWiFS Unitemporal Classification



Cuming County, Nebraska

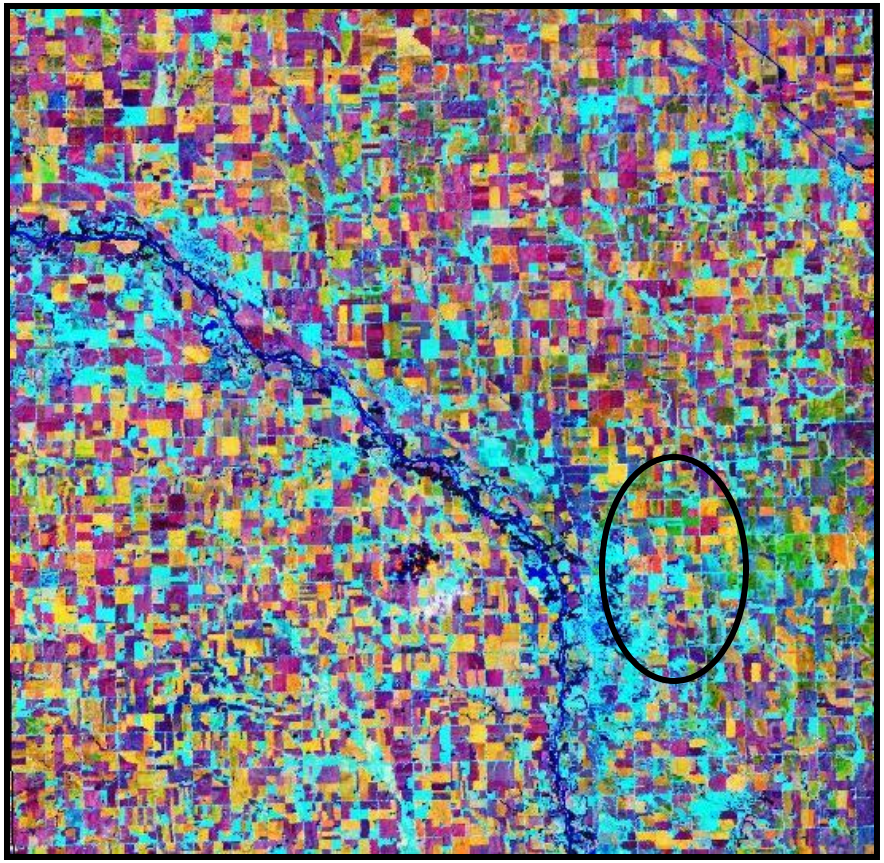
AWiFS: 08/09/2004

BANDS: 4, 5, 3 (RGB)

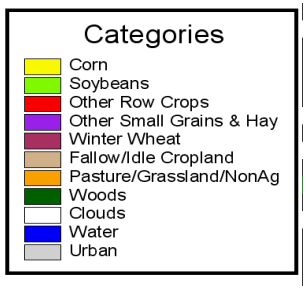


LANDSAT 5 TM: 08/29/2004

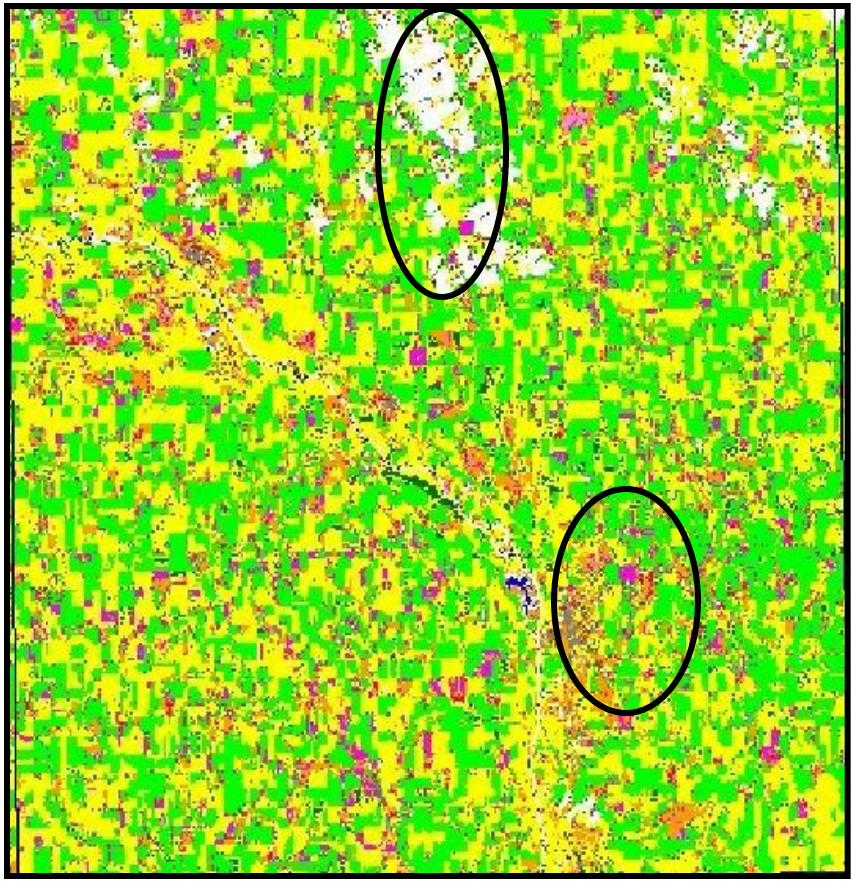
BANDS: 4, 5 3 (RGB)



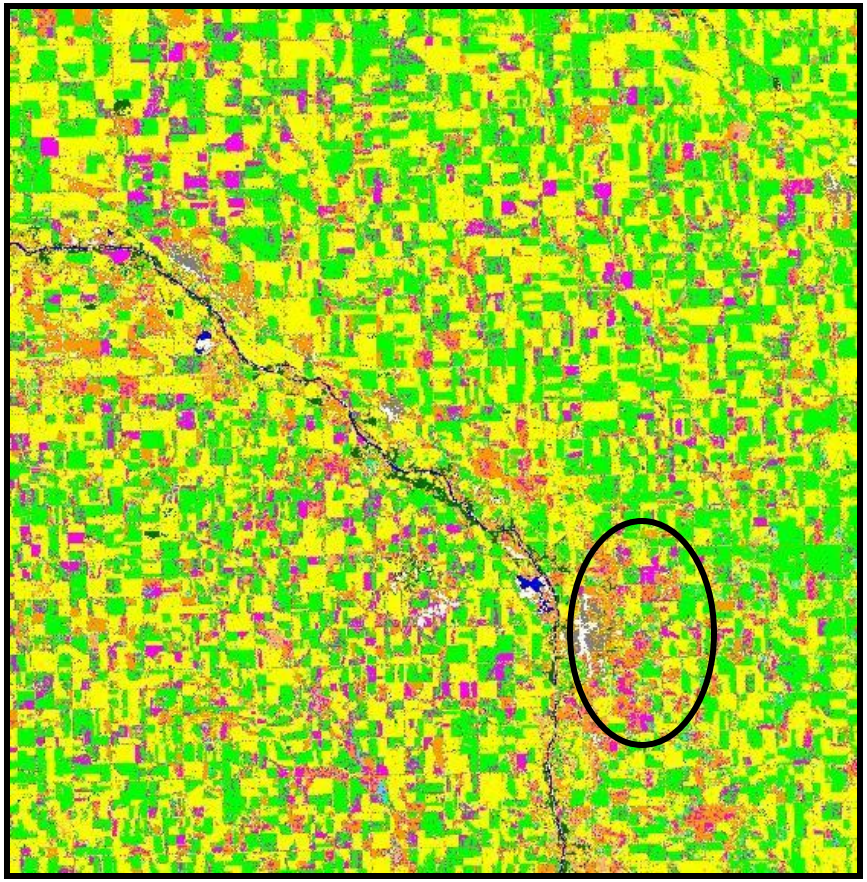
Classified
Cuming County, Nebraska



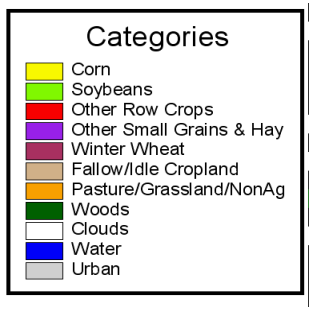
AWiFS Unitemporal: 08/09/2004



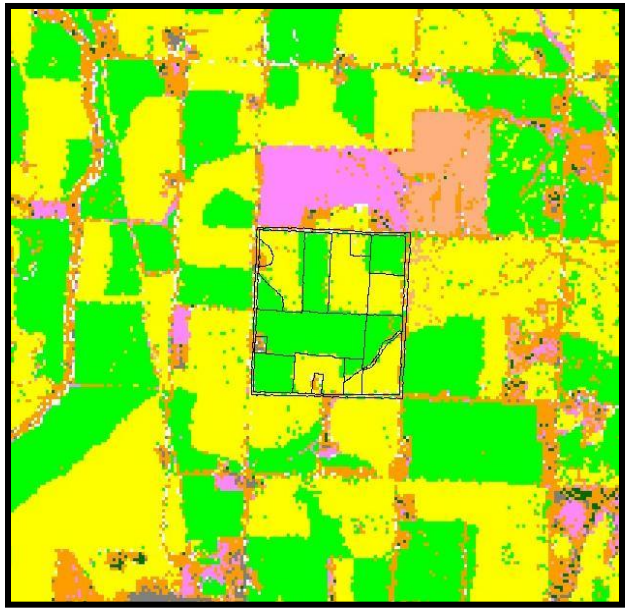
TM Unitemporal: 08/29/2004



Segment Area Classifications



Multitemporal TM
4/07/04 & 08/19/04



Unitemporal LandsatTM
08/29/2004

AWiFS
08/09/2004

Kappa Statistics for Classifier Accuracy

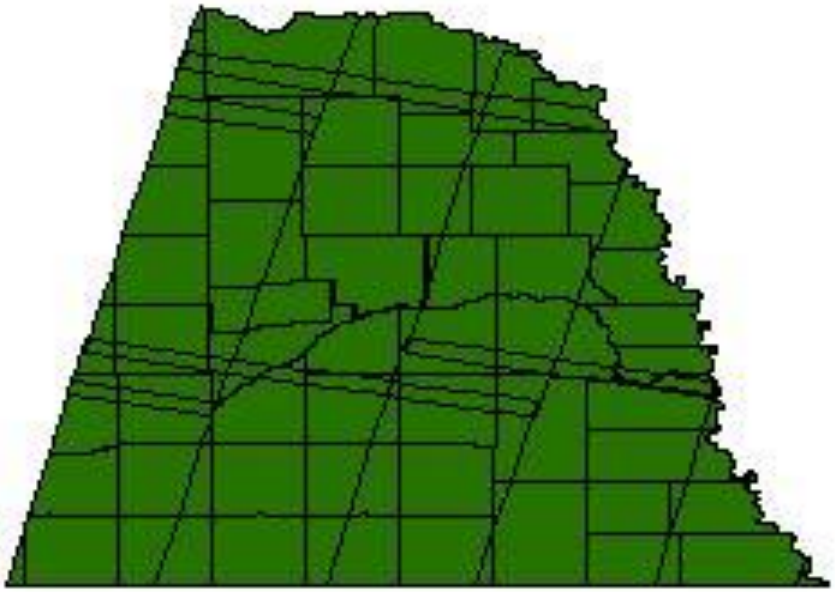
Eastern Nebraska

Corn	-------- TM ---------		AWIFS
Area	Multi	Uni	Uni
AD01	93.89%	73.42%	
AD02	96.18%	93.54%	
AD03	93.91%	92.67%	86.47%
AD04	92.85%	89.90%	
AD05	96.85%	93.22%	

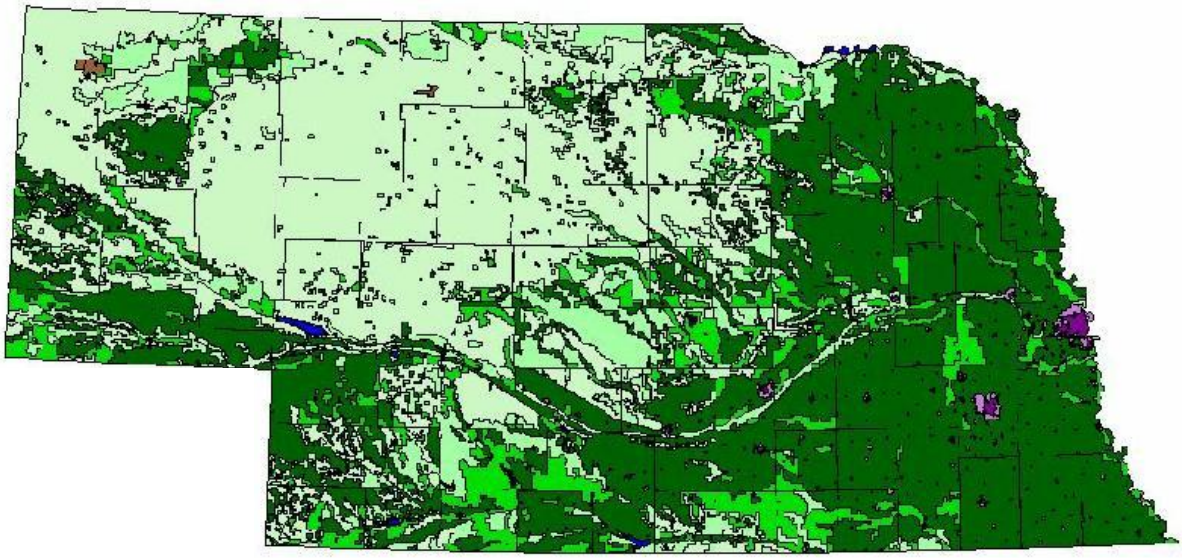
Soybean	-------- TM ---------		AWIFS
Area	**Multi**	**Uni**	**Uni**
AD01	99.12%	93.39%	
AD02	96.81%	89.93%	
AD03	98.72%	93.40%	77.41%
AD04	95.41%	88.37%	
AD05	96.67%	85.69%	

Overall	-------- TM ---------		AWIFS
Area	**Multi**	**Uni**	**Uni**
AD01	96.01%	80.02%	
AD02	96.19%	86.57%	
AD03	95.60%	85.37%	75.18%
AD04	93.50%	81.79%	
AD05	92.88%	85.91%	

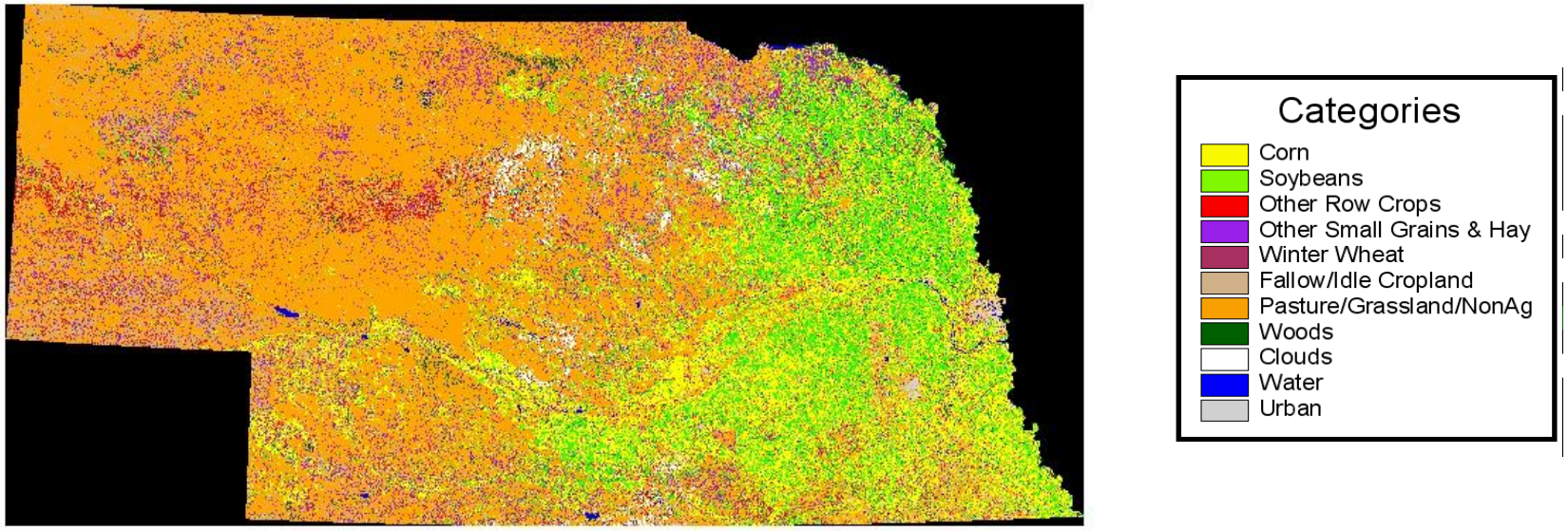
Analysis Districts & Scene Observation Dates



Nebraska Land Use Stratification - 2004



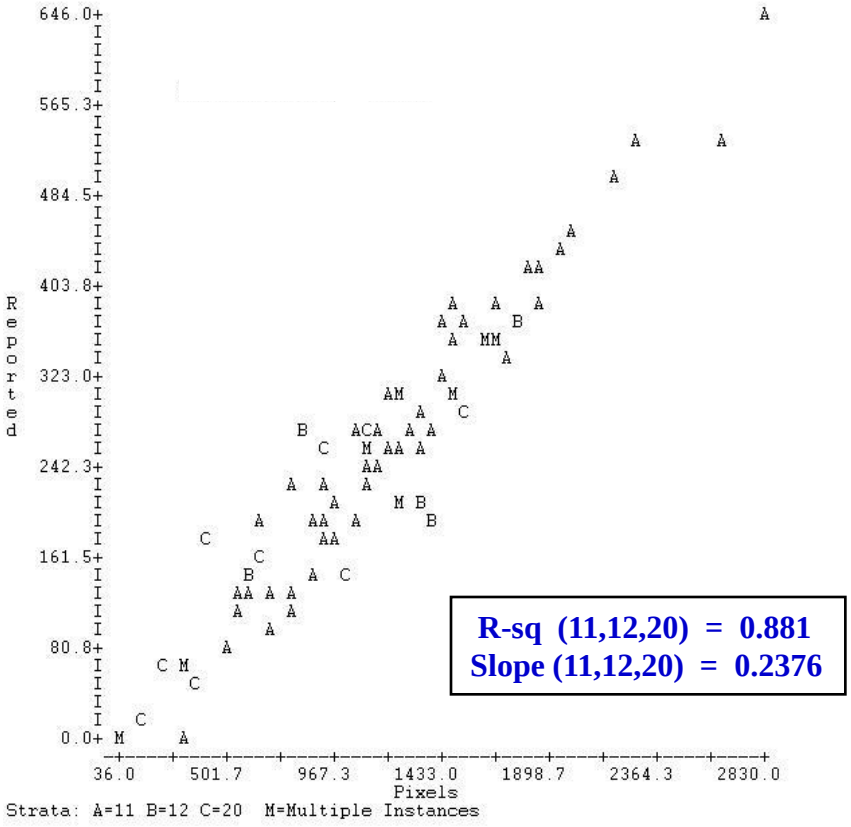
Nebraska Unitemporal AWiFS Classification - 2004



Regression Analysis from Unitemporal Sample Estimation

Landsat TM Corn

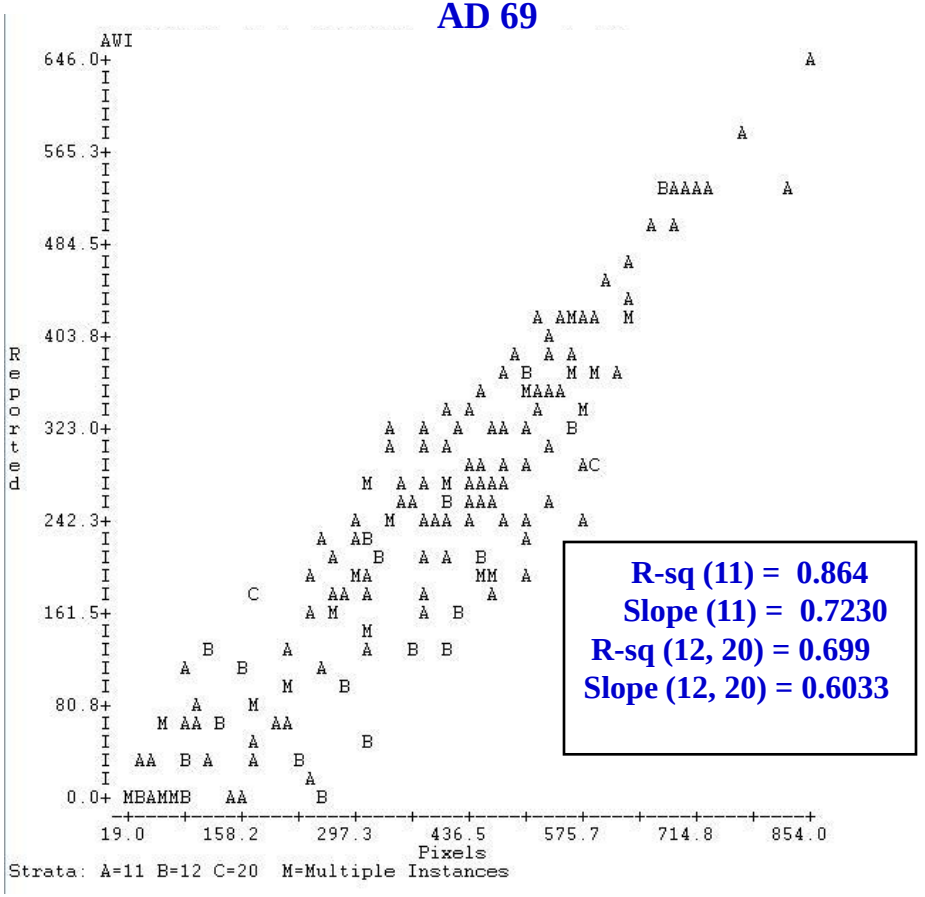
AD 24



R-sq (11,12,20) = 0.881
Slope (11,12,20) = 0.2376

AWiFS Corn

AD 69



R-sq (11) = 0.864
Slope (11) = 0.7230
R-sq (12, 20) = 0.699
Slope (12, 20) = 0.6033

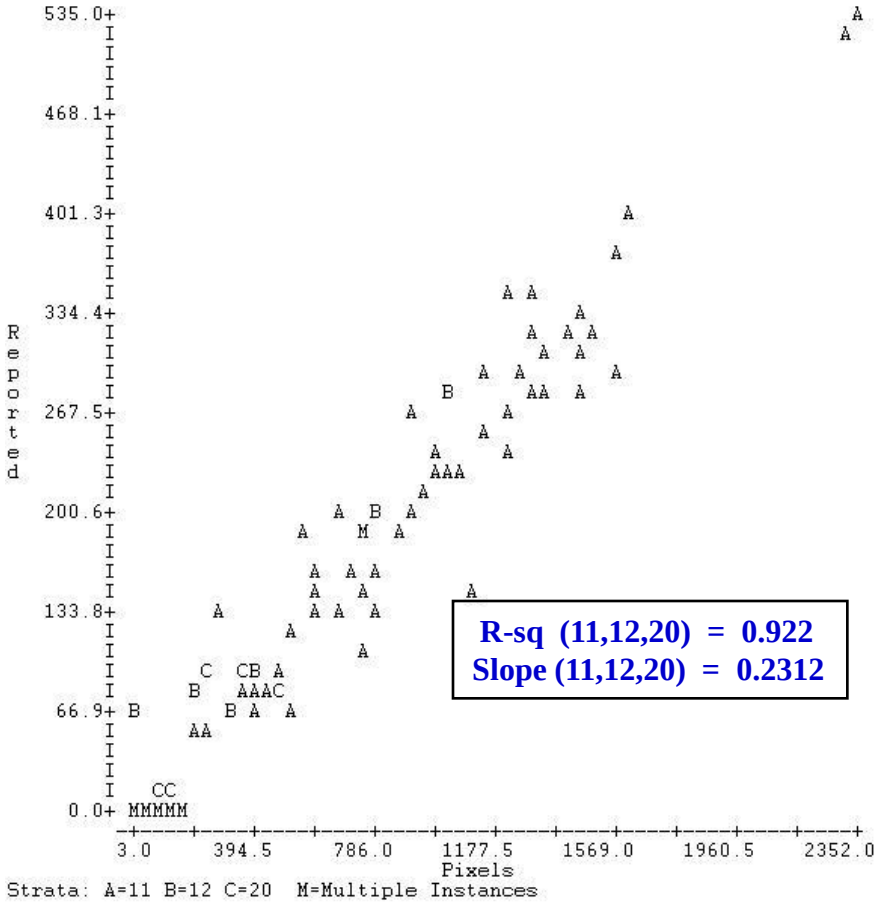
Pixel Sq meter/acres- .2224

Pixel Sq meters/acres - .7747

Outliers Removed

Regression Analysis from Unitemporal Sample Estimation

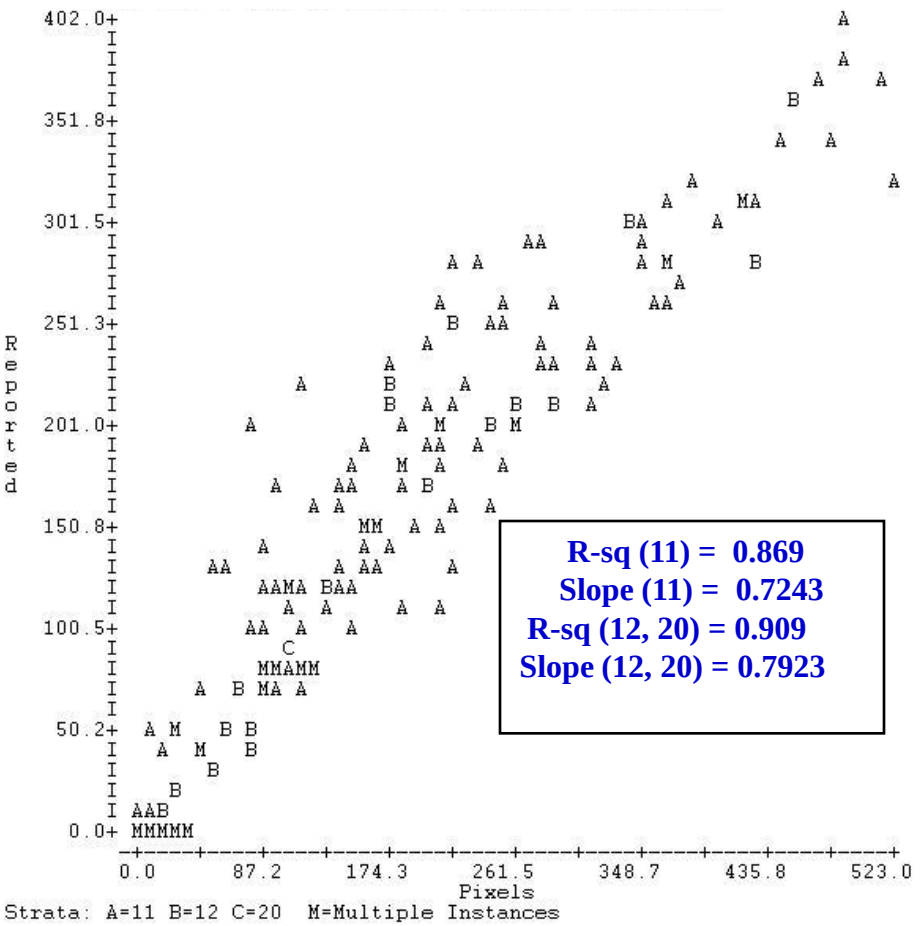
Landsat TM Soybeans
AD 24



R-sq (11,12,20) = 0.922
Slope (11,12,20) = 0.2312

Pixel Sq meter/acres- .2224

AWiFS Soybeans
AD 69

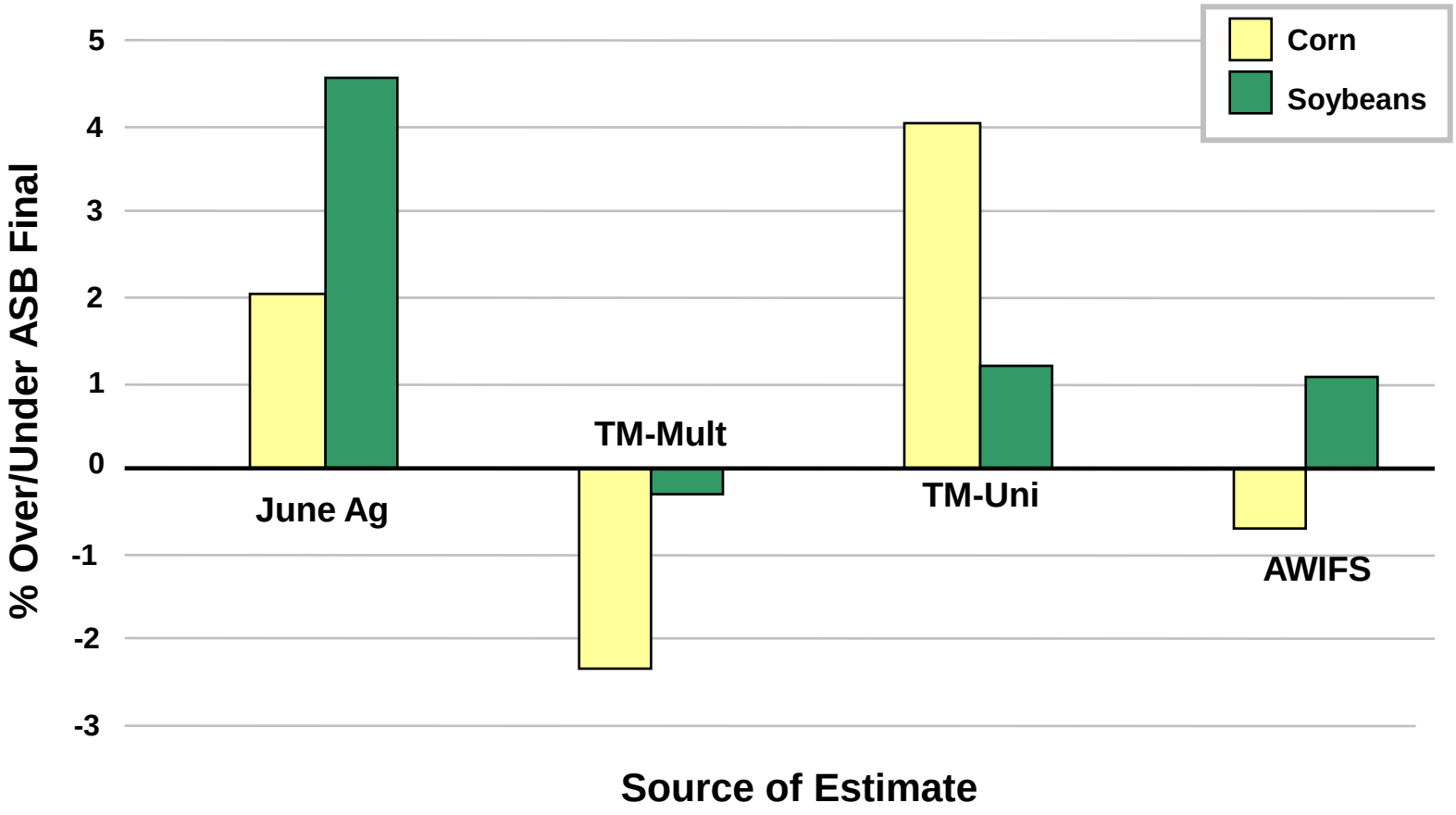


R-sq (11) = 0.869
Slope (11) = 0.7243
R-sq (12, 20) = 0.909
Slope (12, 20) = 0.7923

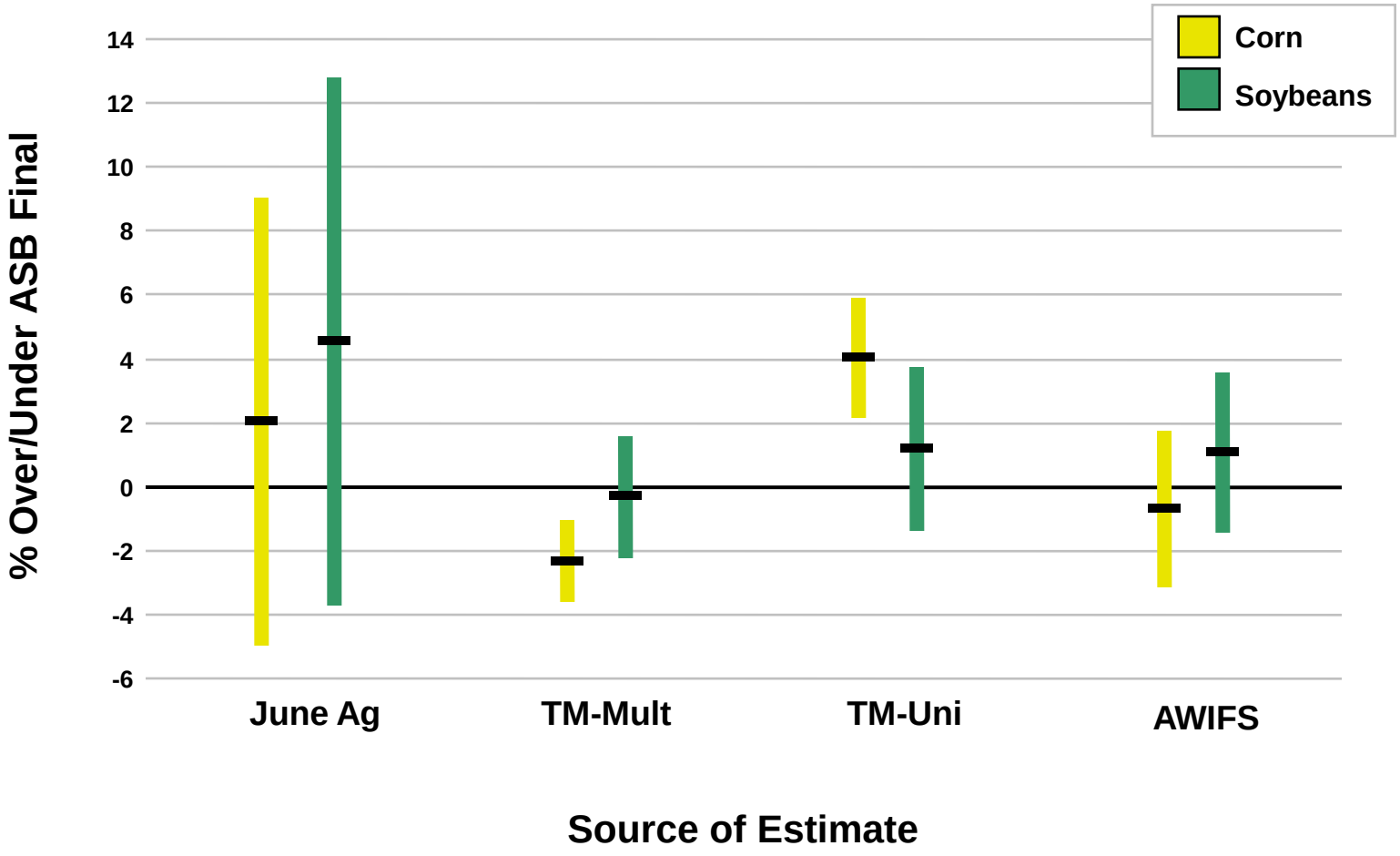
Outliers Removed

Pixel Sq meters/acres - .7747

State Level Estimates as % Over/Under Agricultural Statistics Board (Final)



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



Conclusions

- **Classification results derived using the AWiFS data are not as accurate as those derived using either multitemporal or unitemporal Landsat data.**

- **Reductions in classification accuracy can be attributed to:**
  Spatial resolution - AWiFS (56m) vs. TM (30m)
  Spectral Resolution- AWiFS (4 bands) vs. TM (7 bands)

- **In the future, improvements in classification accuracy are likely to be achieved due to increased temporal frequency of the AWiFS sensor (5 day) vs. the TM sensor (16 day) repeat cycle.**

- **This should significantly increase the availability of cloud free imagery.**

Conclusions

- **AWiFS data appears acceptable for crop acreage estimation over large crop areas such as the Mid-West, the Delta and the Northern Great Plains.**

- **Furthermore, unitemporal AWiFS provided reasonable and consistent estimates for production of the Crop Land Data Layer product.**

- **We anticipate that use of multitemporal AWiFS data would improve the results to a level that is acceptable for NASS.**