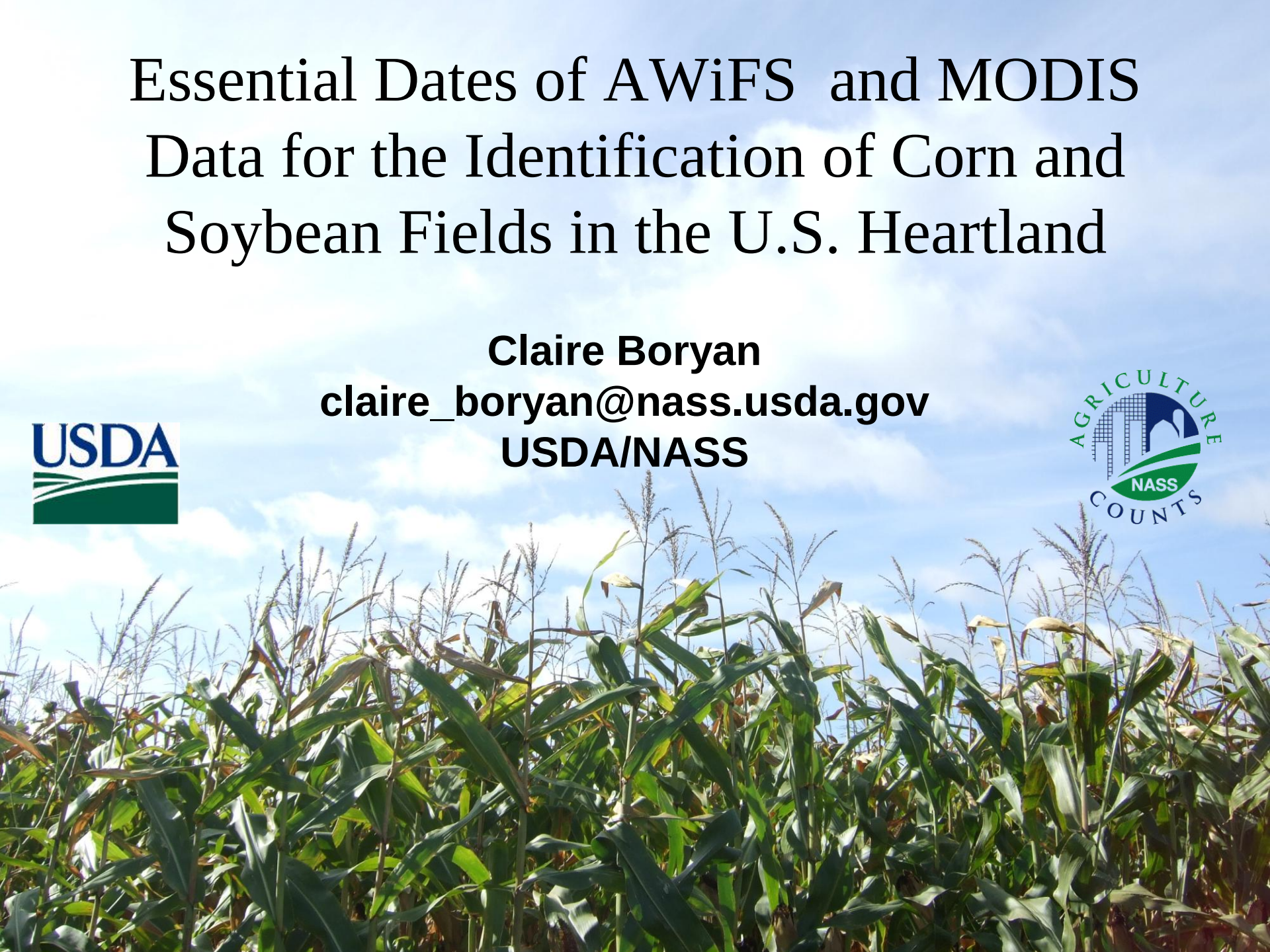
Essential Dates of AWiFS and MODIS Data for the Identification of Corn and Soybean Fields in the U.S. Heartland

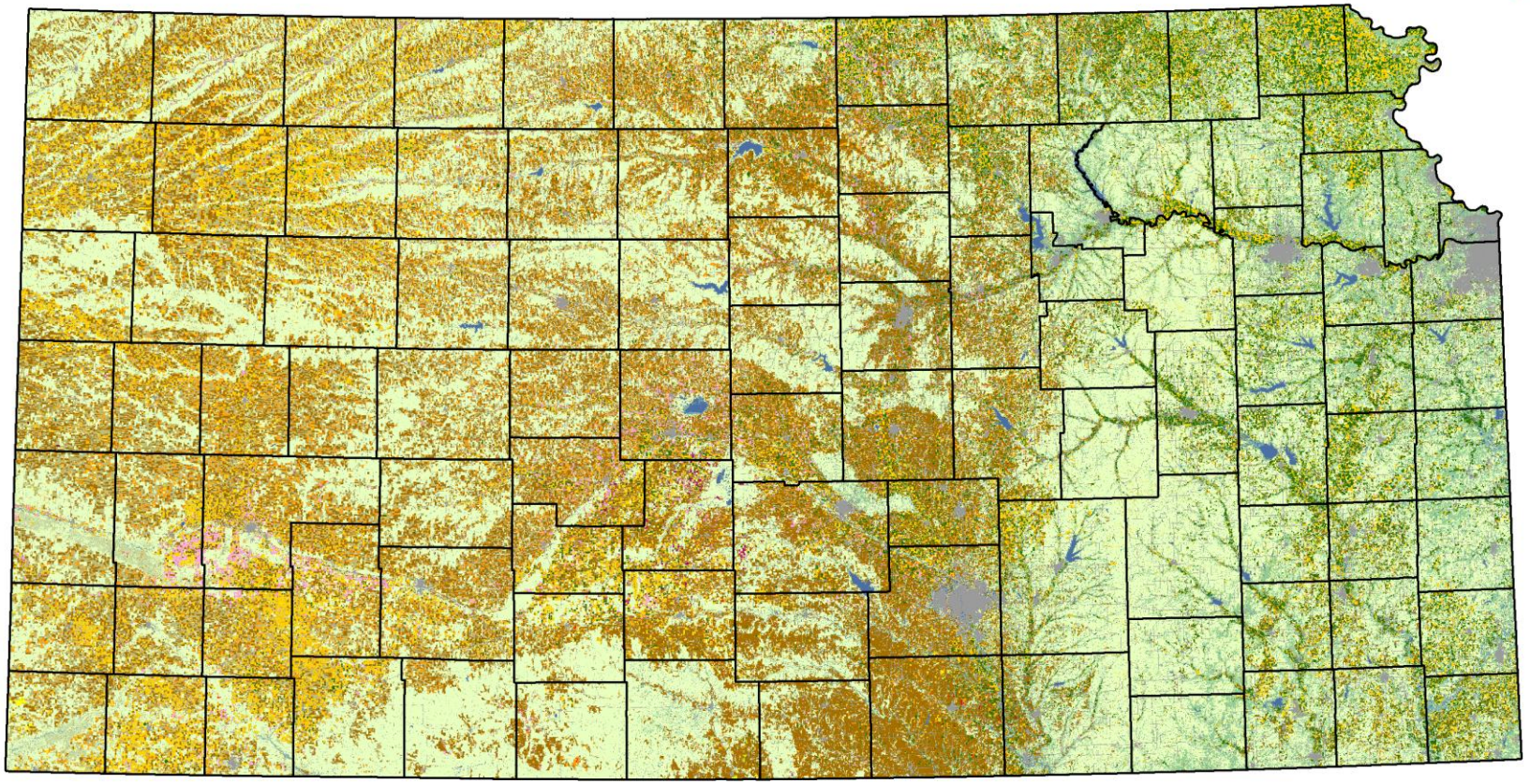
Claire Boryan
claire_boryan@nass.usda.gov
USDA/NASS



Remote Sensing Acreage Estimation Program Objectives

- "Census by Satellite"
  - Without area duplication
  - Major corn and soybean regions
- Provide timely, accurate, useful independent estimates
  - Measurable error
  - County and state level
- Output crop specific Cropland Data Layer
  - Distribute to public at the cost of reproduction
    - NRCS Geospatial Data Gateway
  - Publish accuracy statistics/metadata
  - County and state level

Kansas 2008 Cropland Data Layer



Land Cover Categories

(Ordered by Decreasing Acreage)

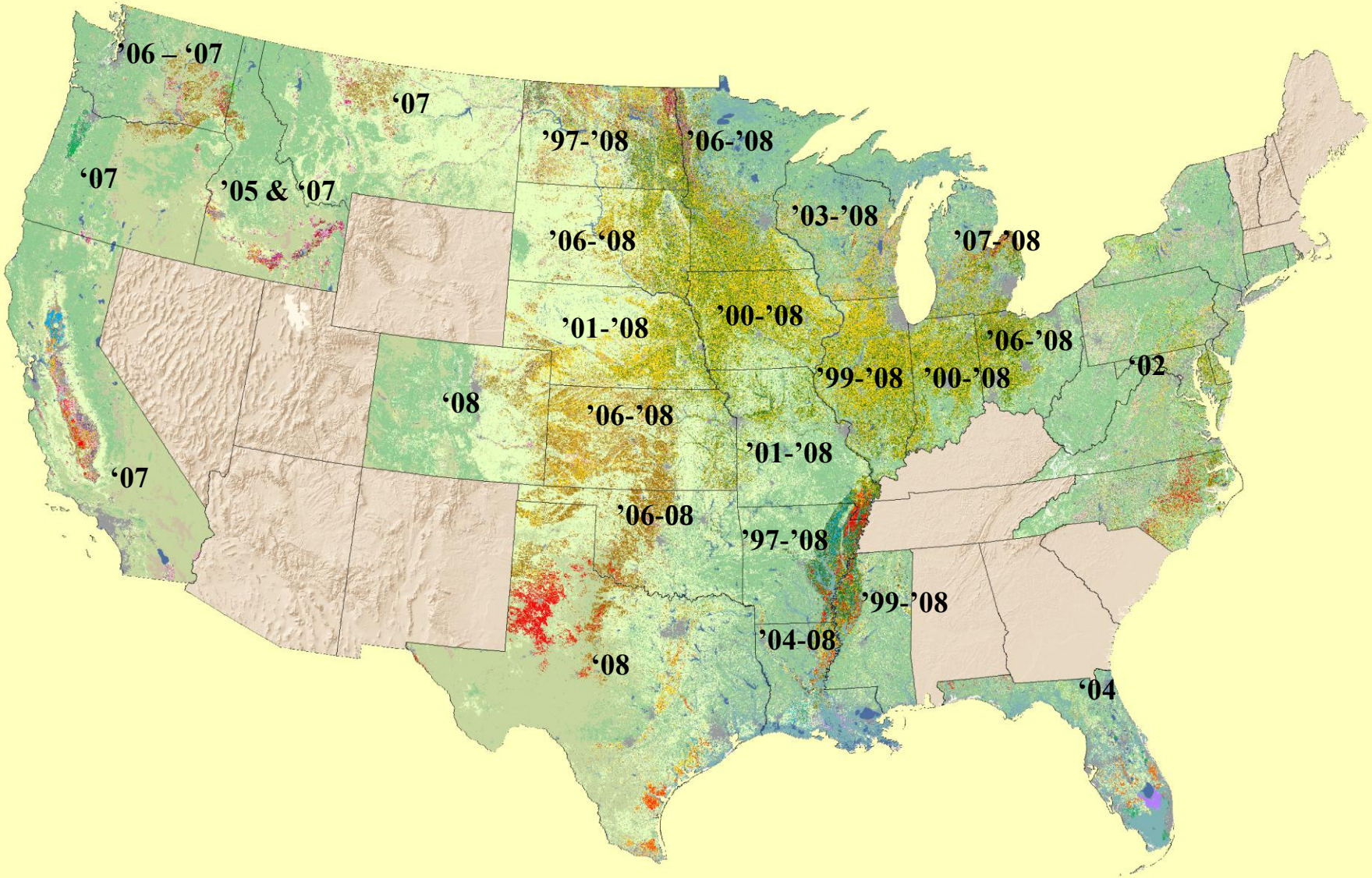
Agricultural

- Winter Wheat
- Corn
- Sorghum
- Soybeans
- Alfalfa
- W. Wht./Soy. Dbl. Crop.
- Sunflowers
- Rye
- Cotton
- Other Small Grains
- Clover/Wildflowers
- Oats
- Potatoes
- Seed/Sod Grass
- Canola
- Millet
- Other Crops
- Barley
- Other Tree Nuts
- Peas
- Apples
- Misc. Vegs. & Fruits

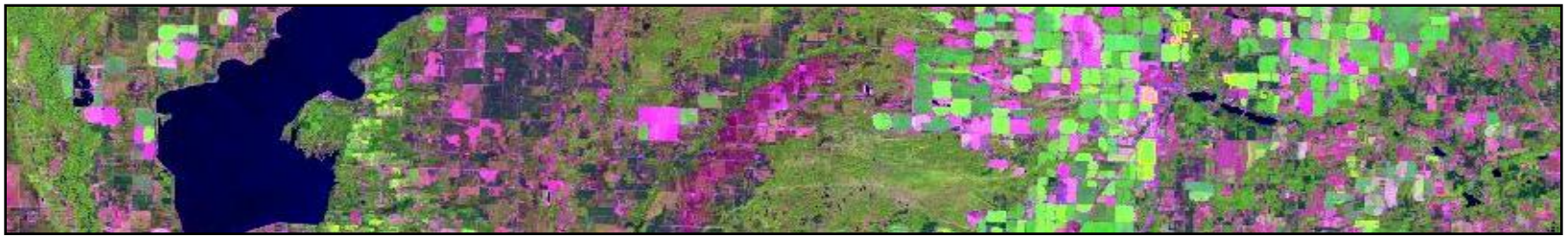
Non-Agricultural

- Grass/Pasture/Non-Ag
- Urban/Developed
- Woodland
- Fallow/Idle Cropland
- Water
- Wetlands
- Shrubland
- Barren

Cropland Data Layers
1997 - 2008



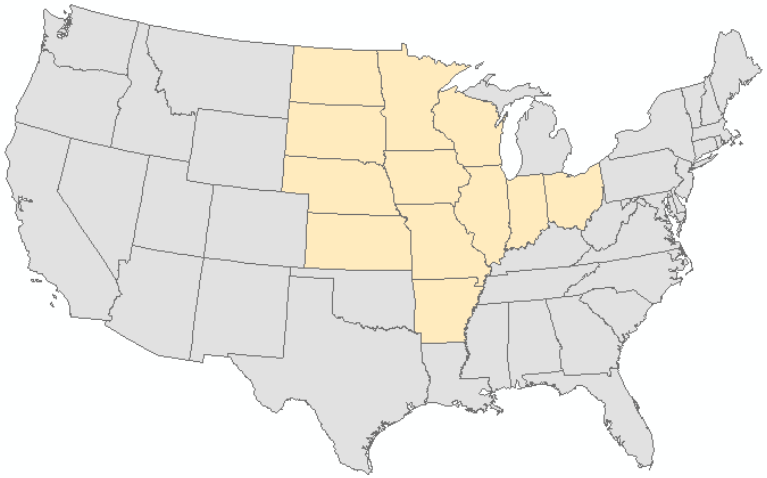
Cropland Data Layer Program



- Inputs
  - Resourcesat-1 AWiFS imagery
  - Farm Service Agency – Common Land Unit
  - Ancillary data
  - Commercial software suite
- Outputs
  - Acreage Estimates
  - Cropland Data Layer

Goals of AWiFS & MODIS Essential Dates Assessment

- **To determine the necessary dates of AWiFS and MODIS data for the identification of corn and soybean fields in the U.S. Heartland.**



Corn

Soybeans

January

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

8:● 15:◐ 22:○ 30:◑

February

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	

6:● 13:◐ 20:○ 28:◑

March

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

7:● 14:◐ 21:○ 29:◑

April

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

5:● 12:◐ 20:○ 28:◑

May

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

5:● 11:◐ 19:○ 27:◑

June

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

3:● 10:◐ 18:○ 26:◑

July

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
27	28	29	30	31		

2:● 10:◐ 18:○ 25:◑

Crop Production Report

August

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
	4	5	6	7	8	9
	11	12	13	14	15	16
	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

1:● 8:◐ 16:○ 23:◑ 30:●

September

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

7:◐

Small Grains Annual Summary

October

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
			8	9	10	11
			15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

7:◐ 14:○ 21:◑ 28:●

Crop Production Report

November

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

5:◐ 13:○ 19:◑ 27:●

December

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

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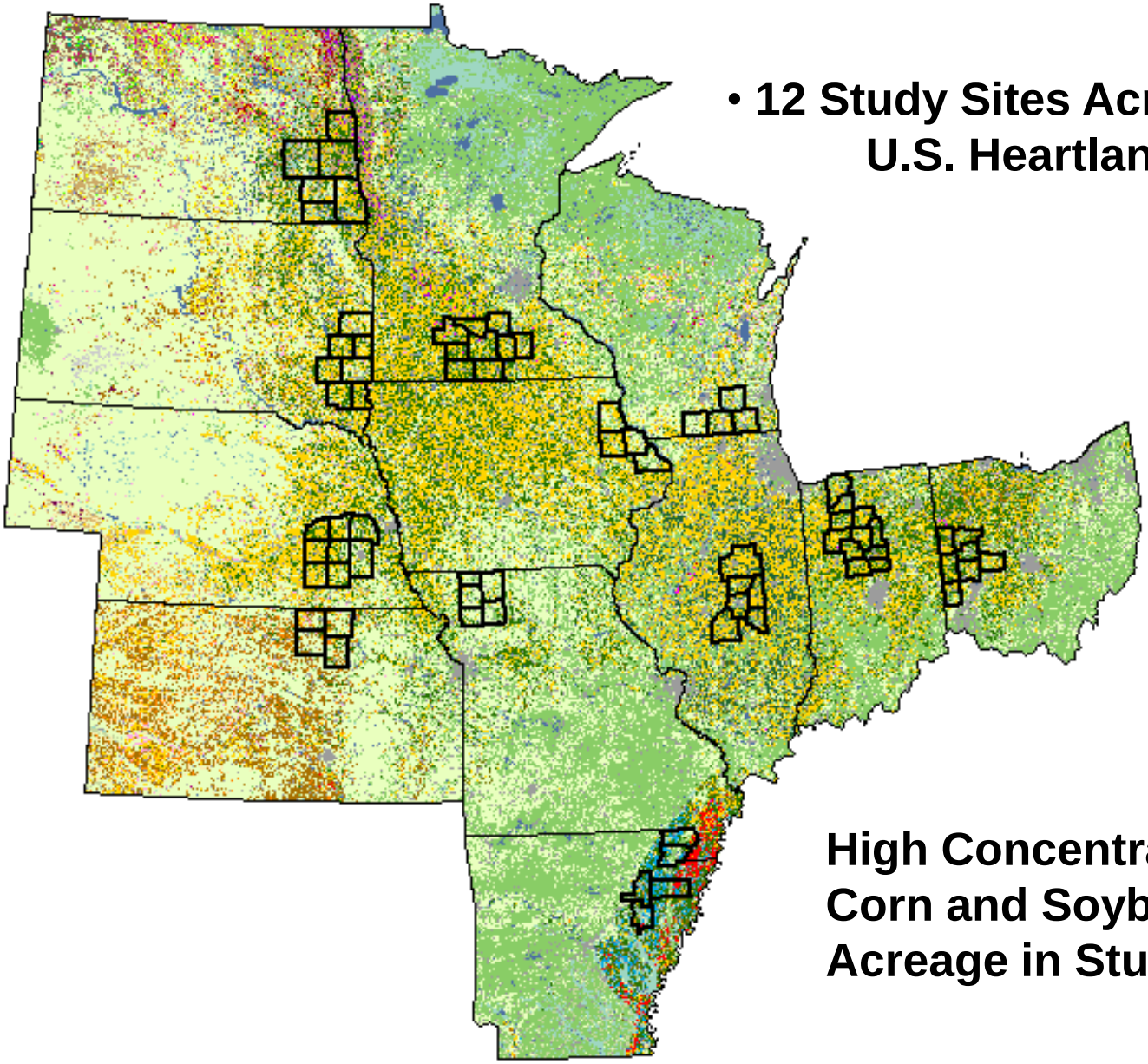
Methodology



- **12 Study Sites Across the U.S. Heartland**

High Concentration of Corn and Soybean Acreage in Study Sites

Methodology

Identical Methodologies using ERDAS Imagine and See5 Decision Tree Software

Four Classifications (per study site) vary only by the dates of AWiFS data used

4 dates- May, June, July, August

3 dates- May, June, July

2 dates- May, June

1 date - May

IRS Resourcesat-1 AWiFS Imagery

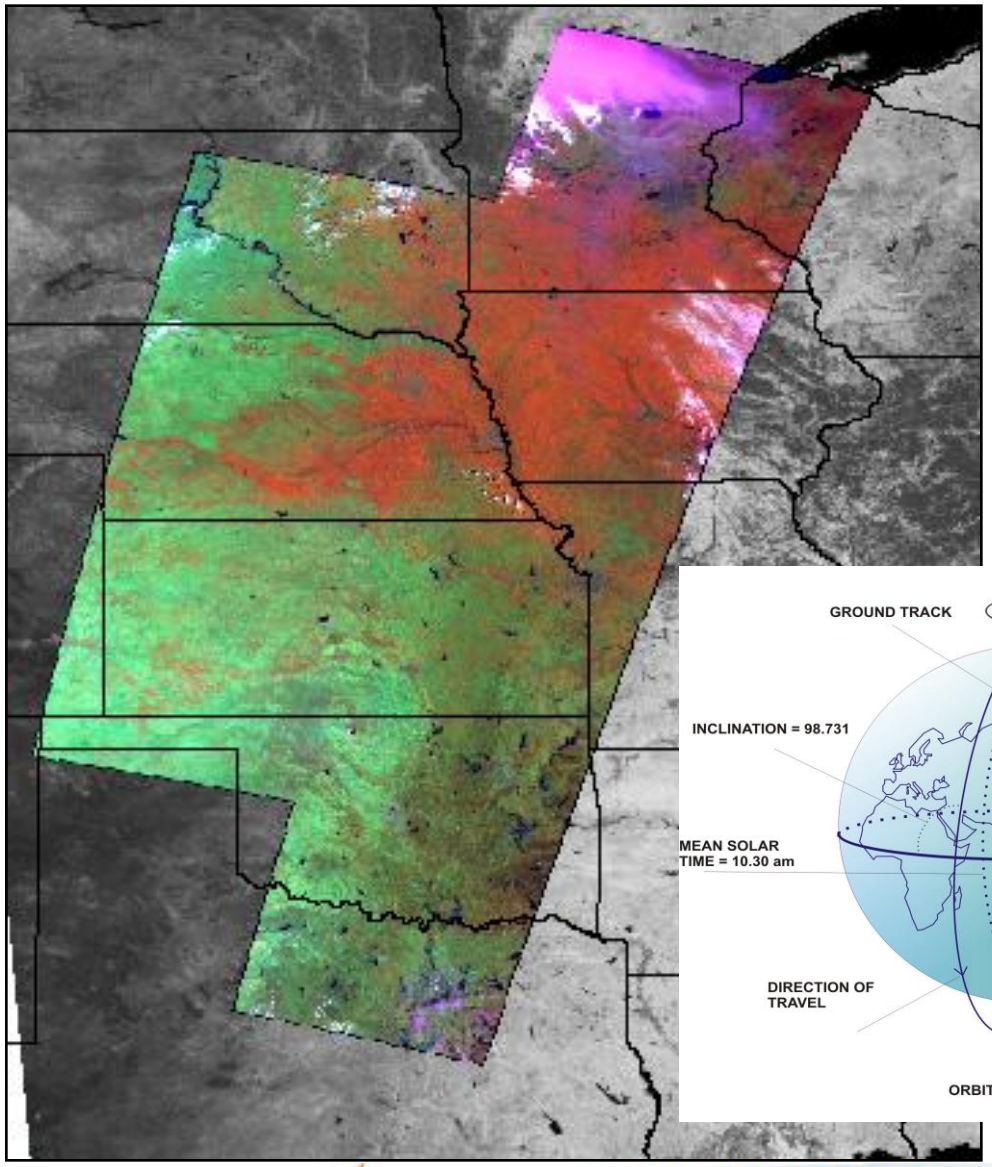
340 km swath per head
740 km combined

5-day revisit

4 spectral bands
- B2: 0.52 - 0.59
- B3: 0.62 - 0.68
- B4: 0.76 – 0.86
- B5: 1.55 – 1.7

56 m nadir/70 m field edges

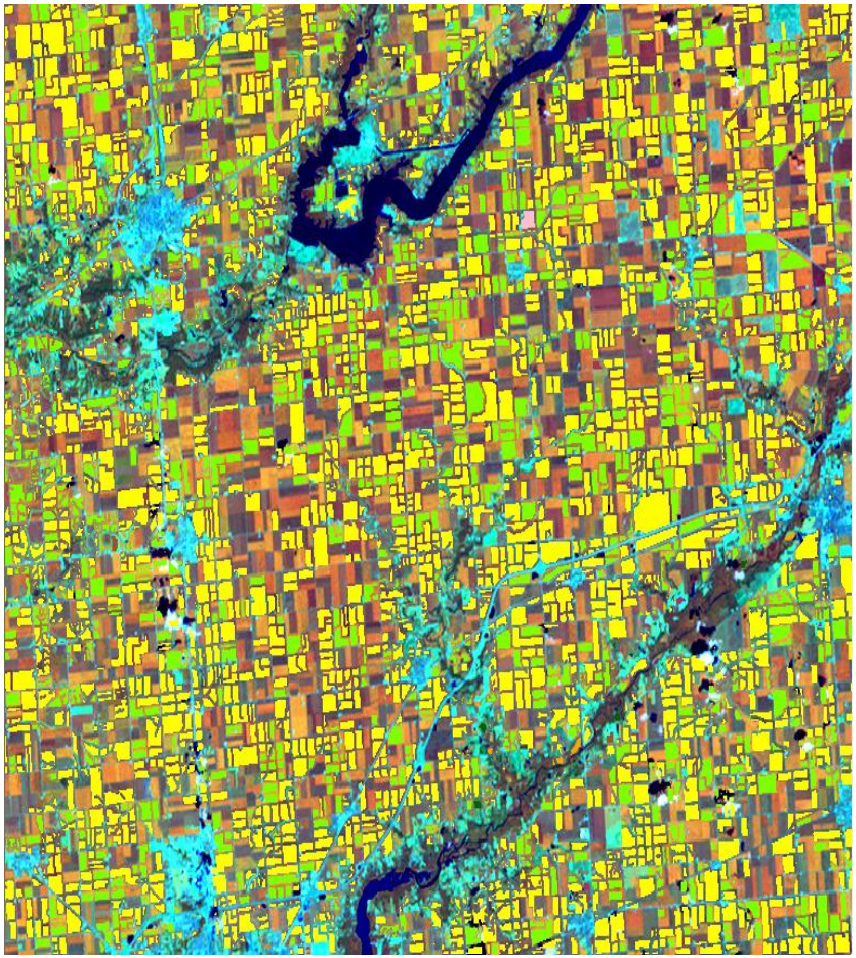
Data provided by Arctic Slope Regional Corporation



13 Aug 2007

Department of Space
Indian Space Research Organisation

Agricultural Ground Truth

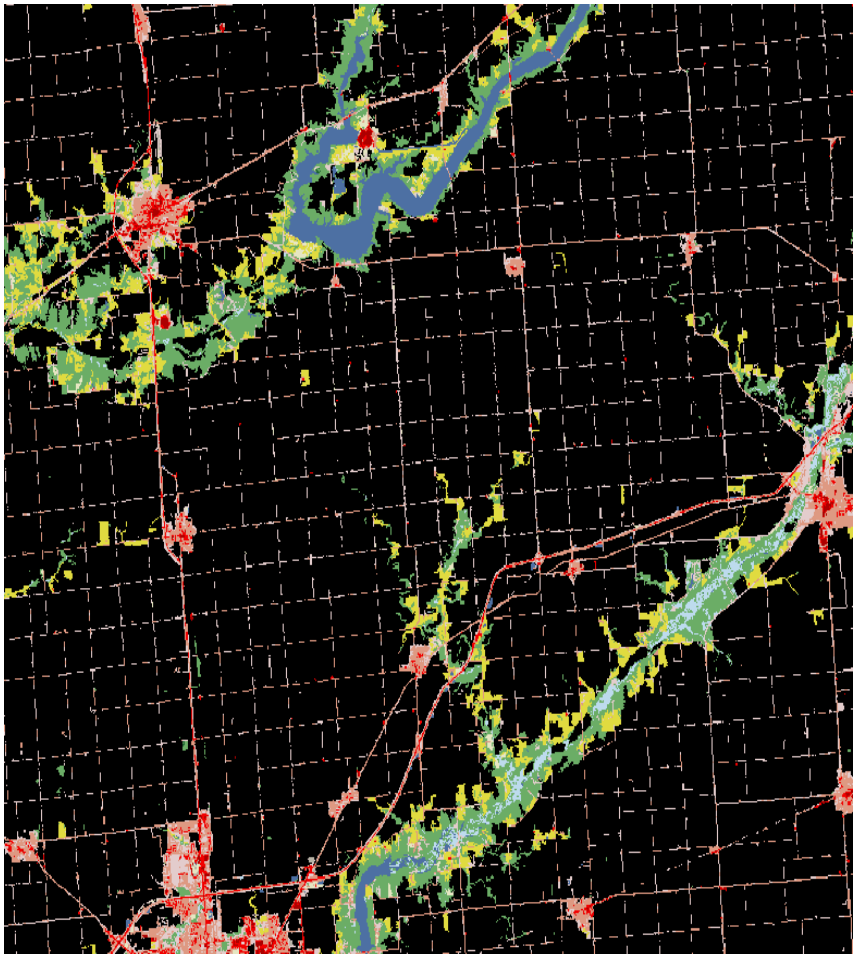


Farm Service Agency (FSA)

- Common Land Unit (CLU)
- 578 Attributed Reporting Data

Soybeans **Corn**

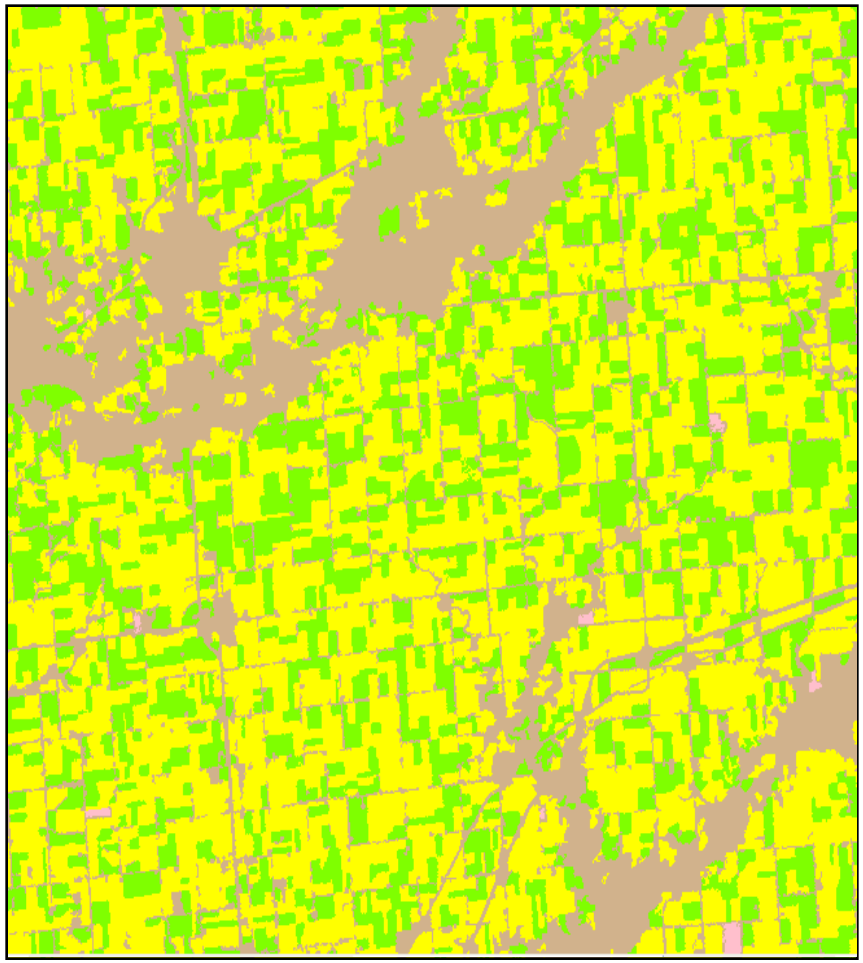
Non Agricultural Ground Truth

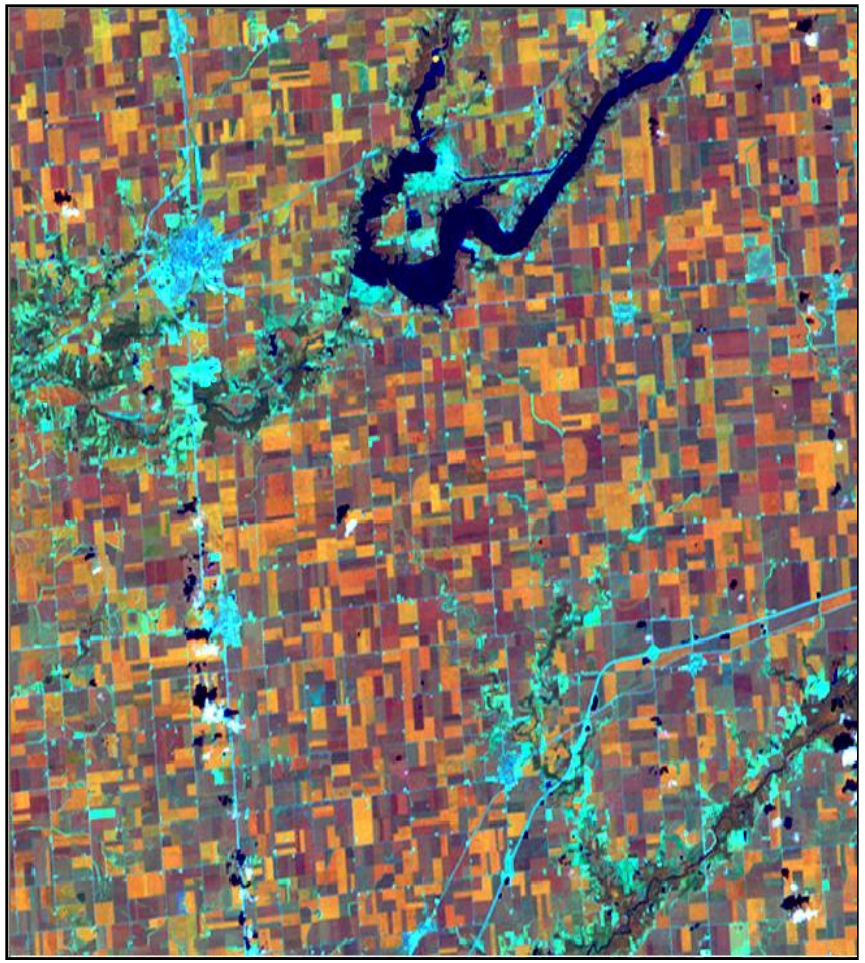


National Land Cover Dataset from USGS, 2001

- Proportional sampling
- Improve CDL coverage of non-agricultural classes

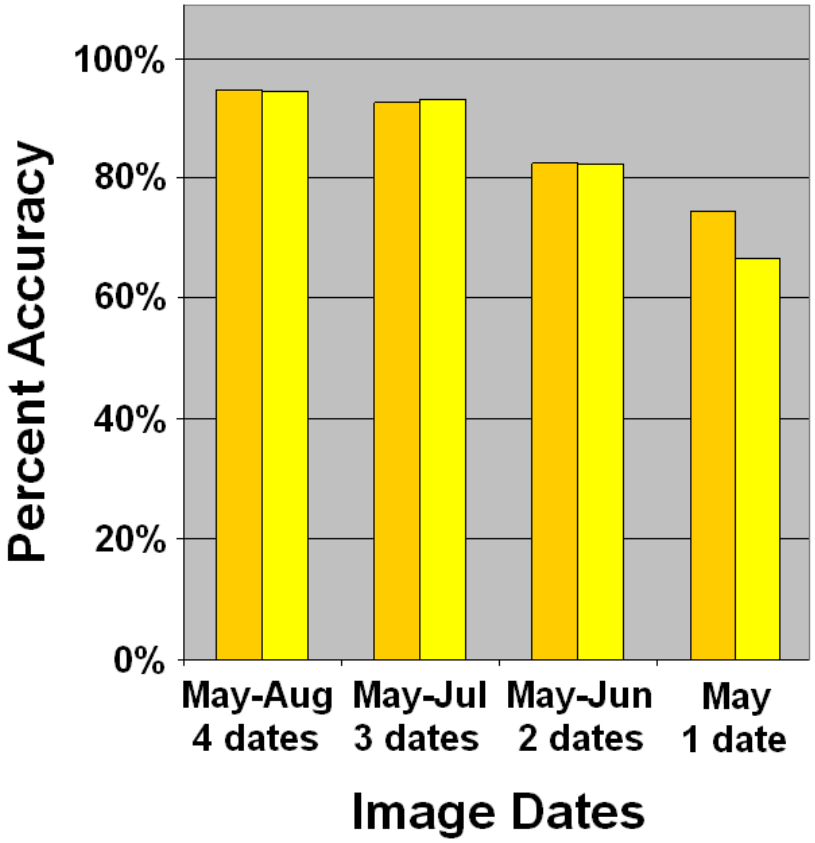
AWiFS Imagery Time Series Classification Results



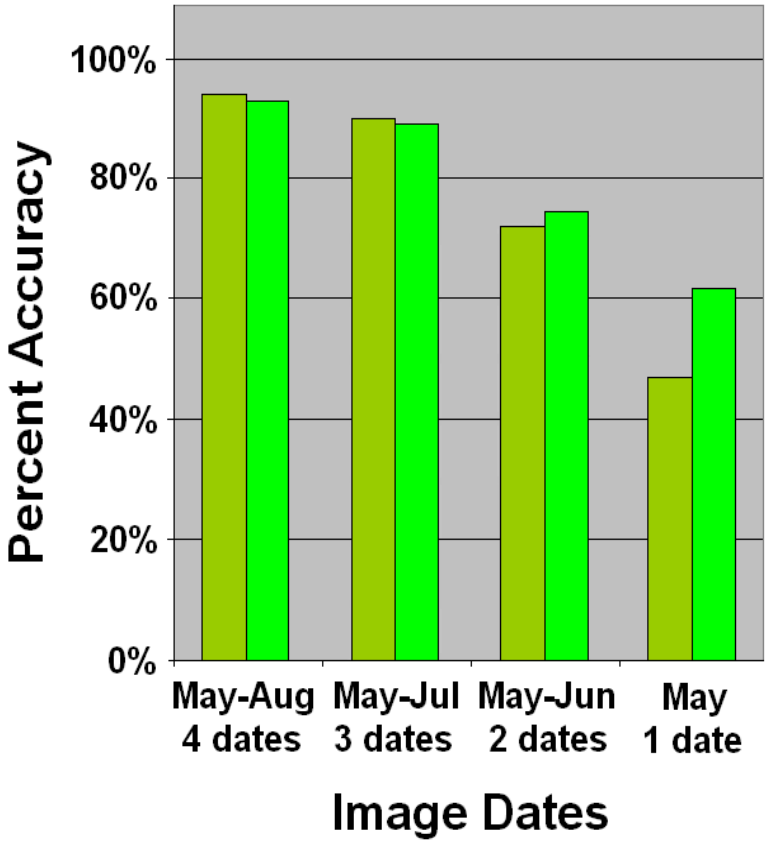


Soybeans Corn Other Crop Non Agriculture

Average Corn Accuracy US Heartland (AWiFS Only)



Average Soybean Accuracy US Heartland (AWiFS Only)



Methodology

Identical Methodologies using ERDAS Imagine and See5 Decision Tree Software

Four Classifications (per study site) vary only by the dates of AWiFS and MODIS data used

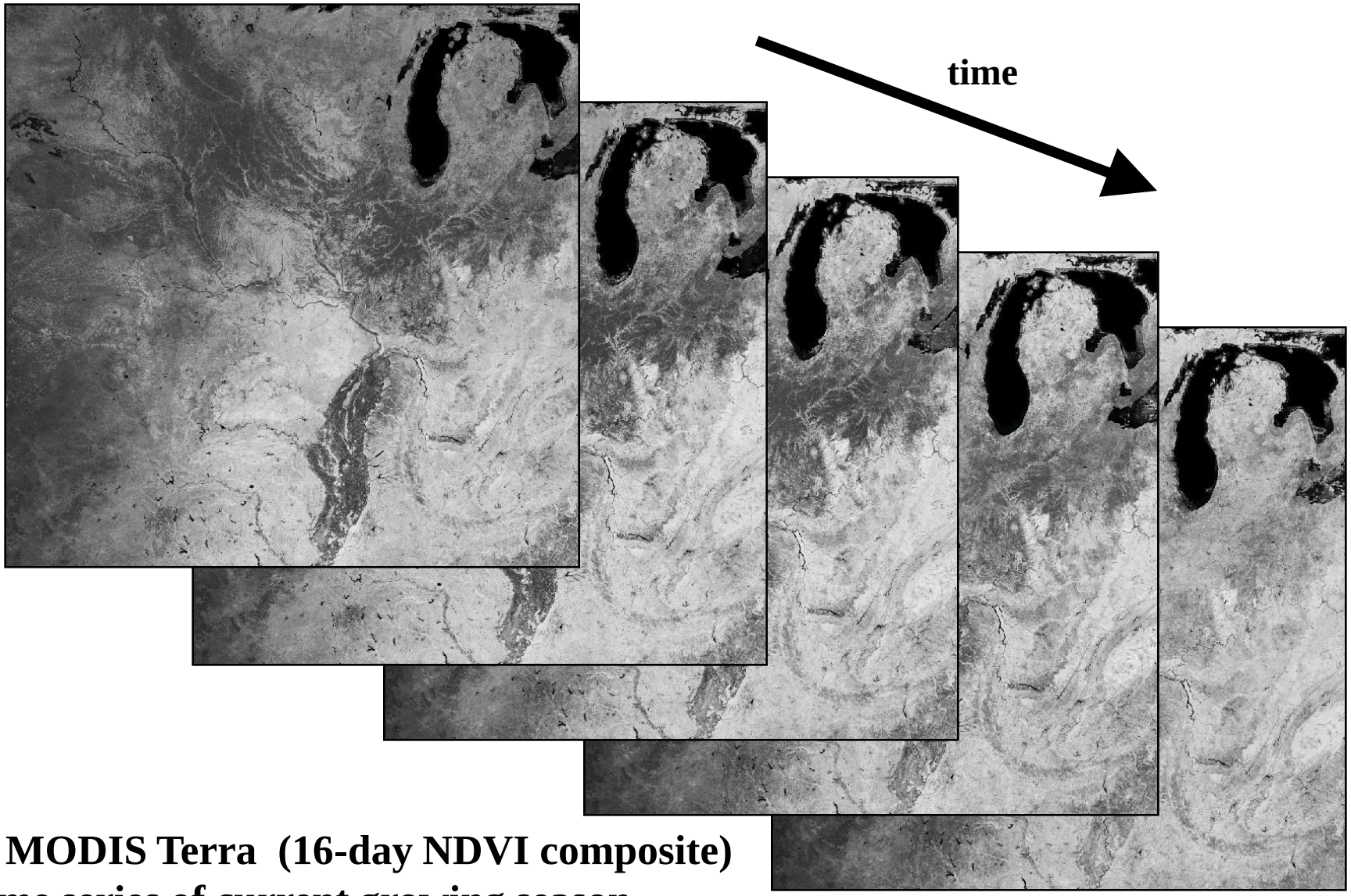
4 dates- May, June, July, August

3 dates- May, June, July

2 dates- May, June

1 date - May

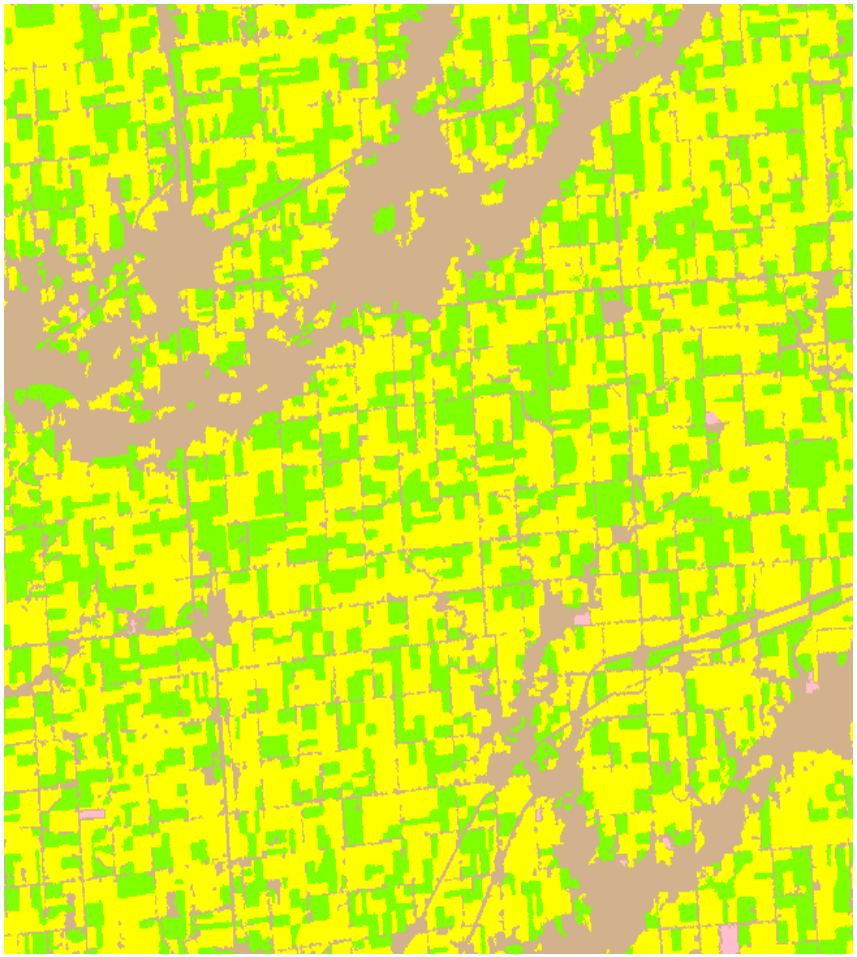
MODIS NDVI Imagery



NASA MODIS Terra (16-day NDVI composite)

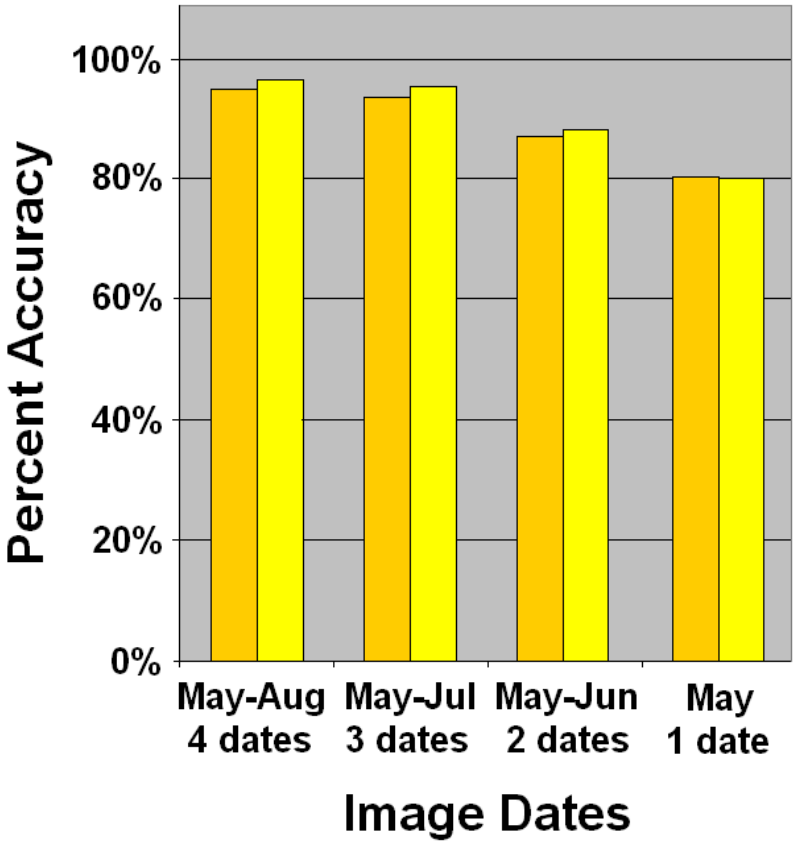
- **Time series of current growing season**
- **Fall scenes from previous year**

AWiFS and MODIS Time Series Classification Results

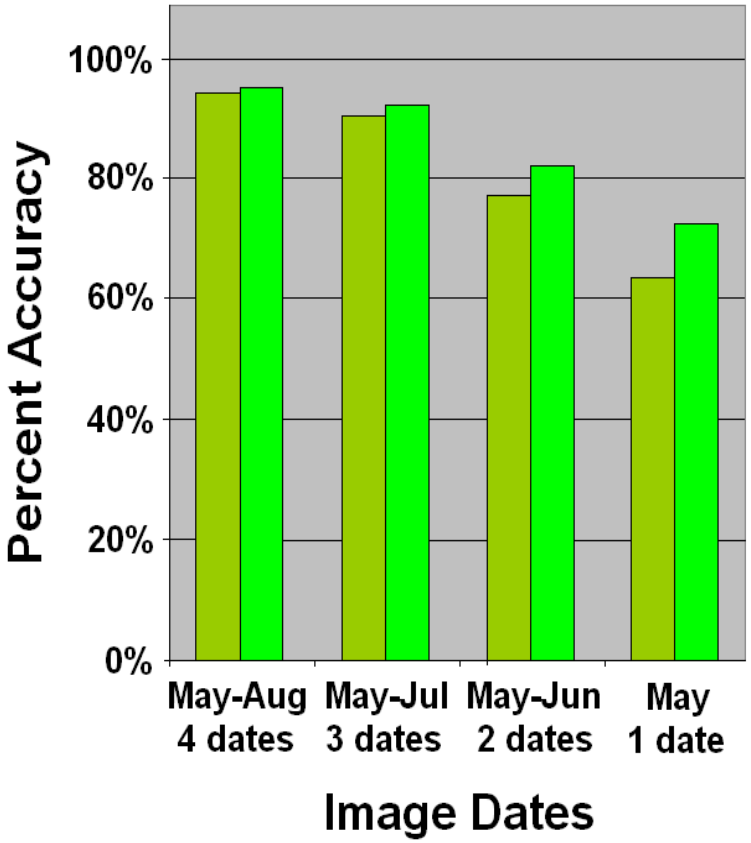


Soybeans Corn Other Crop Non Agriculture

Average Corn Accuracy US Heartland (AWiFS & MODIS)



Average Soybean Accuracy US Heartland (AWiFS & MODIS)



Average Change in Corn and Soybean Accuracy - US Heartland
AWiFS only vs. AWiFS & MODIS

May Only Data

	AWiFS Only (1 date)	Change in Accuracy	AWiFS & MODIS (1 date)
CP	74.34%	+6.26	80.60%
CU	66.48%	+10.50	76.98%
SP	47.39%	+15.14	62.53%
SU	62.04%	+8.60	70.64%

May – June Data

	AWiFS Only (2 dates)	Change in Accuracy	AWiFS & MODIS (2 dates)
CP	82.58%	+3.92	86.50%
CU	82.10%	+3.46	85.56%
SP	72.25%	+4.34	76.59%
SU	74.51%	+5.58	80.09%

May – July Data

	AWiFS Only (3 dates)	Change in Accuracy	AWiFS & MODIS (3 dates)
CP	92.61%	+.08	92.69%
CU	93.07%	+.39	93.46%
SP	89.99%	+.19	90.07%
SU	88.88%	+.05	89.93%

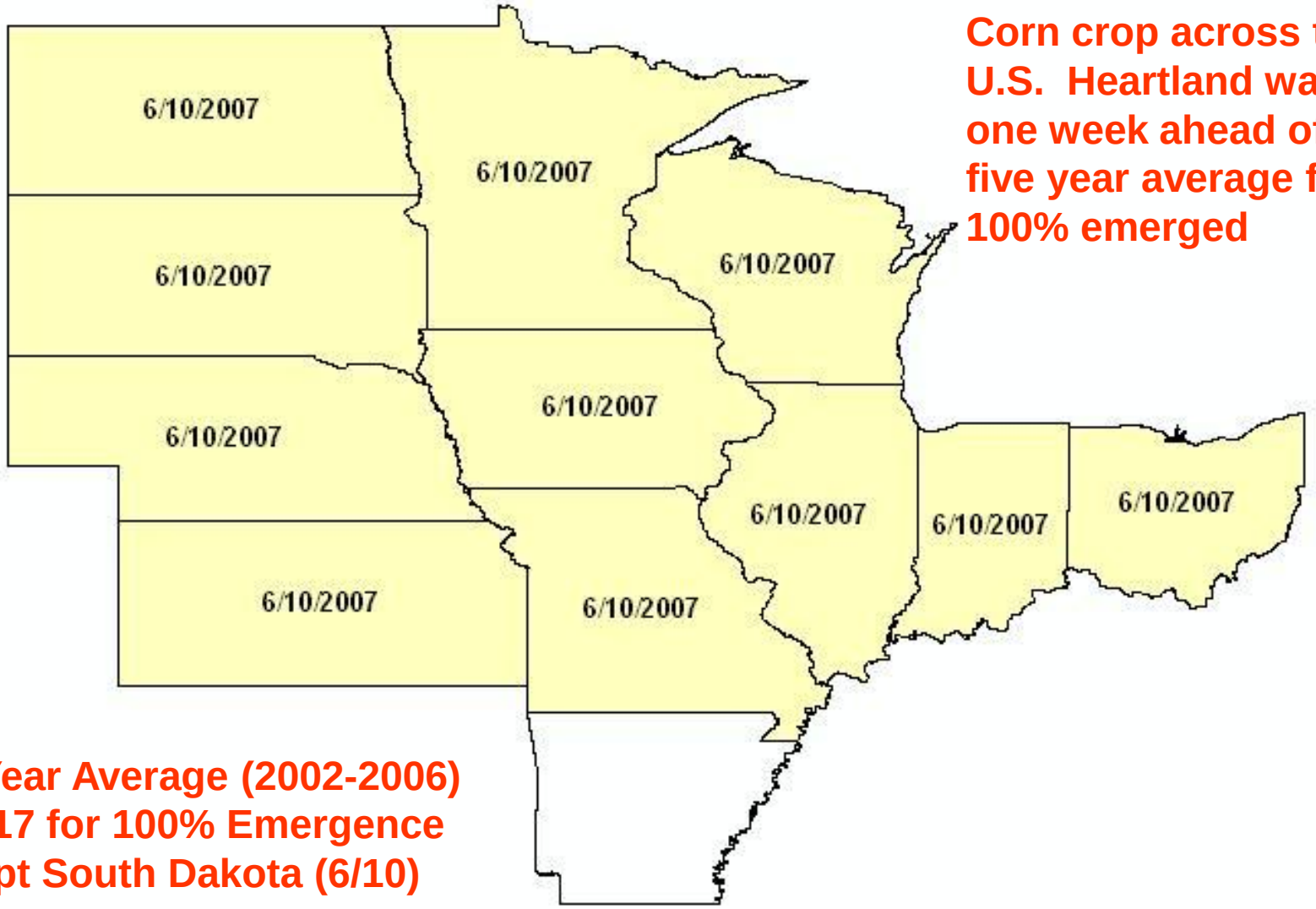
May – August Data

	AWiFS Only (4 dates)	Change in Accuracy	AWiFS & MODIS (4 dates)
CP	94.55%	-.14	94.41%
CU	94.48%	+.24	94.72%
SP	93.90%	-.03	93.87%
SU	92.81%	+.11	93.00%

CP: Corn Producer
CU: Corn User
SP: Soybean Producer
SU: Soybean User

Corn Across the U.S. Heartland

Date of 100% Emergence, 2007

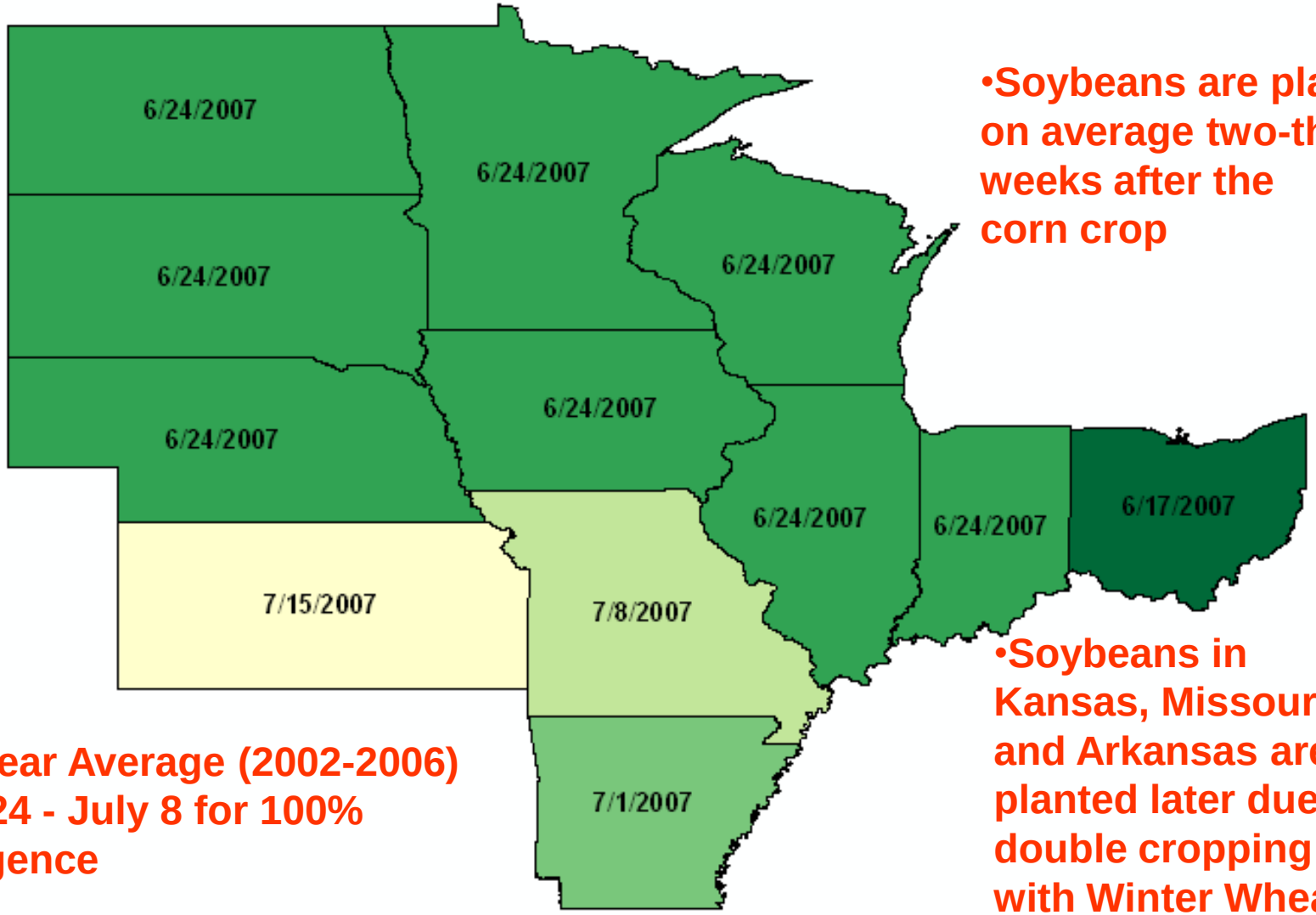


Corn crop across the U.S. Heartland was one week ahead of the five year average for 100% emerged

Five Year Average (2002-2006)
June 17 for 100% Emergence
-Except South Dakota (6/10)

Soybeans Across the U.S. Heartland

Date of 100% Emergence, 2007



- Soybeans are planted on average two-three weeks after the corn crop

- Soybeans in Kansas, Missouri and Arkansas are planted later due to double cropping with Winter Wheat

Five Year Average (2002-2006) June 24 - July 8 for 100% Emergence

Conclusions

- **Without August AWiFS Data- Reductions in Accuracy**
  - **Corn: 1.41% - 1.94%**
  - **Soybeans: 3.93% – 4.02%**
- **Without July and August AWiFS Data- Reductions in Accuracy**
  - **Corn: 11.97% - 12.38%**
  - **Soybeans: 18.30% - 21.65%**
- **AWiFS collects through July are essential to produce highly accurate corn and soybean classifications.**

Conclusions

- **Most Valuable Single Date AWiFS**
  - **Corn: July or August**
  - **Soybeans: August**

- **AWiFS & MODIS Data**
  - **MODIS data provides the greatest improvements in accuracy when AWiFS data are limited to 2 dates (May – June) or 1 date (May only). When 3 – 4 dates of AWiFS are available over a study area, the MODIS data provides only marginal improvements in accuracy.**

Thank You

Claire Boryan, Mike Craig, Mary Lindsey
claire_boryan@nass.usda.gov
703-877-8000 x107

www.nass.usda.gov
datagateway.nrcs.usda.gov