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
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.
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
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

Urban  Water  Forest  Pasture  No Data
AWiFS Imagery Time Series Classification Results
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
Average Corn Accuracy
US Heartland (AWiFS & MODIS)

![Bar chart for Average Corn Accuracy](chart1.png)

- **Percent Accuracy**
  - 100%
  - 80%
  - 60%
  - 40%
  - 20%
  - 0%

- **Image Dates**
  - May-Aug 4 dates
  - May-Jul 3 dates
  - May-Jun 2 dates
  - May 1 date

- **Legend**:
  - Yellow: Corn Producer Accuracy
  - Yellow: Corn User Accuracy

Average Soybean Accuracy
US Heartland (AWiFS & MODIS)

![Bar chart for Average Soybean Accuracy](chart2.png)

- **Percent Accuracy**
  - 100%
  - 80%
  - 60%
  - 40%
  - 20%
  - 0%

- **Image Dates**
  - May-Aug 4 dates
  - May-Jul 3 dates
  - May-Jun 2 dates
  - May 1 date

- **Legend**:
  - Green: Soybean Producer Accuracy
  - Green: Soybean User Accuracy
### Average Change in Corn and Soybean Accuracy - US Heartland
**AWiFS only vs. AWiFS & MODIS**

#### May Only Data

<table>
<thead>
<tr>
<th></th>
<th>AWiFS Only (1 date)</th>
<th>Change in Accuracy</th>
<th>AWiFS &amp; MODIS (1 date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>74.34%</td>
<td>+6.26</td>
<td>80.60%</td>
</tr>
<tr>
<td>CU</td>
<td>66.48%</td>
<td>+10.50</td>
<td>76.98%</td>
</tr>
<tr>
<td>SP</td>
<td>47.39%</td>
<td>+15.14</td>
<td>62.53%</td>
</tr>
<tr>
<td>SU</td>
<td>62.04%</td>
<td>+8.60</td>
<td>70.64%</td>
</tr>
</tbody>
</table>

#### May – June Data

<table>
<thead>
<tr>
<th></th>
<th>AWiFS Only (2 dates)</th>
<th>Change in Accuracy</th>
<th>AWiFS &amp; MODIS (2 dates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>82.58%</td>
<td>+3.92</td>
<td>86.50%</td>
</tr>
<tr>
<td>CU</td>
<td>82.10%</td>
<td>+3.46</td>
<td>85.56%</td>
</tr>
<tr>
<td>SP</td>
<td>72.25%</td>
<td>+4.34</td>
<td>76.59%</td>
</tr>
<tr>
<td>SU</td>
<td>74.51%</td>
<td>+5.58</td>
<td>80.09%</td>
</tr>
</tbody>
</table>

#### May – July Data

<table>
<thead>
<tr>
<th></th>
<th>AWiFS Only (3 dates)</th>
<th>Change in Accuracy</th>
<th>AWiFS &amp; MODIS (3 dates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>92.61%</td>
<td>+.08</td>
<td>92.69%</td>
</tr>
<tr>
<td>CU</td>
<td>93.07%</td>
<td>+.39</td>
<td>93.46%</td>
</tr>
<tr>
<td>SP</td>
<td>89.99%</td>
<td>+.19</td>
<td>90.07%</td>
</tr>
<tr>
<td>SU</td>
<td>88.88%</td>
<td>+.05</td>
<td>89.93%</td>
</tr>
</tbody>
</table>

#### May – August Data

<table>
<thead>
<tr>
<th></th>
<th>AWiFS Only (4 dates)</th>
<th>Change in Accuracy</th>
<th>AWiFS &amp; MODIS (4 dates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>94.55%</td>
<td>-.14</td>
<td>94.41%</td>
</tr>
<tr>
<td>CU</td>
<td>94.48%</td>
<td>+.24</td>
<td>94.72%</td>
</tr>
<tr>
<td>SP</td>
<td>93.90%</td>
<td>-.03</td>
<td>93.87%</td>
</tr>
<tr>
<td>SU</td>
<td>92.81%</td>
<td>+.11</td>
<td>93.00%</td>
</tr>
</tbody>
</table>

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