USDA NASS Geospatial Data

Patrick Willis
National Agricultural Statistics Service

“...providing timely, accurate, and useful statistics in service to U.S. agriculture.”
Who is NASS?

- statistical survey agency of the USDA
  - non-political
  - non-policy making
  - independent-objective-unbiased
  - appraisers of U.S. agriculture

- collects and disseminates data on all facets of agriculture
Who uses NASS official statistics?

farmers
  individual & corporate farmers
  growers’ associations
  farmer cooperatives

agribusinesses
  seed companies
  equipment companies
  chemical companies
  warehouse & storage companies
  transportation companies
  food processors
  feed processors
  other suppliers & buyers

economic firms
  banks & lending institutions
  commodity traders
  insurance companies
  marketing firms

university researchers

government policy makers

media
  newspapers
  magazines
  radio
  television

November 20, 2013
University of Illinois Research Park
Provider of timely, accurate, and useful statistics in service to U.S. agriculture

collects data by a variety of survey methods including mail, phone, personal interview, or internet
Spatial Analysis Research Section

Early limitations: Budget/Satellites/Technology
Corn Condition, Good + Excellent
Week Ending July 29, 2012

USDA Crop Progress and Condition: Corn in Illinois, 2013

1997 – 2007 Coverage:

All historical CDL products use standardized: color scheme, categories names and codes, projection, metadata.

All historical CDL products use standardized: color scheme, categories names and codes, projection, metadata.
CDL Basics

- Crop-specific land cover data layer
- Annual
- 30 meter spatial resolution
- GIS-ready
  - Georeferenced
  - Raster
- Interagency collaborations
  - Illinois Interagency Landscape Classification (IILC) Project
    - Illinois Department of Natural Resources (IDNR)
    - Illinois Department of Agriculture (IDA)
  - Foreign Ag Service (FSA), Satellite Image Archive
  - Farm Service Agency (FAS), Common Land Unit
  - US Geological Survey (USGS), National Land Cover Dataset
Purpose of the Cropland Data Layer (CDL) Program

The CDL program goals are:

1) Combine remote sensing imagery, USDA/Farm Service Agency reported data and NASS survey data to produce *supplemental*, unbiased independent acreage estimates for the state's major commodities.

2) Production of a crop-specific digital land cover data layer for distribution in industry standard formats.

Annual CDL states traditionally focused in the Midwest and Mississippi Delta States - Corn, Cotton, Rice, Soybeans, Winter Wheat
• In-season acreage indications

J = June indications
A = August indications
S1 = September indications
S2 = September small grains
O = October indications
D = December final indications
Methodology

- “Stack” satellite imagery and ancillary data layers within a raster GIS
  - 30 meter grid cells, Albers Conic Equal Area projection

- Sample spatially from stack within known ground truth from FSA and NLCD

- Data-mine samples using Boosted Classification Tree Analysis to derive best fitting decision rules

- Apply derived decision rules back to input data stack

- Create land cover map

- Create probability map

- Assess map accuracy

- Derive acreage estimates
Methodology (continued)

• Satellite Imagery
  – Landsat 8, Disaster Monitoring Constellation (DMC)
  – NASA Terra MODIS 16-day composite NDVI
  – Past sensors (IRS ResourceSat-1 AWiFS, Landsat 5 & 7)

• Ancillary data layers
  – USGS National Elevation Dataset (NED)
  – USGS NLCD Impervious and Tree Canopy layers

• Ground Truth
  – Agricultural training & validation
    • Farm Service Agency (FSA) Common Land Unit (CLU)
  – Non-Agricultural training & validation
    • USGS 2006 National Land Cover Dataset (NLCD)
  – State-specific
    • USBR, WDA, UPGA, Gallo

• Software
  – Ground Truth Preparation: ESRI ArcGIS and SAS
  – Imagery Preparation: ERDAS Imagine
  – Decision-Tree Software: Rulequest See 5.0
  – Classification: NLCD Mapping Toolkit and ERDAS Imagine
  – Acreage Estimation: SAS
## Satellite Sensors

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<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
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<tbody>
<tr>
<td>TM</td>
<td>9:45 ± 15 minutes</td>
<td>10:30 ± 5 minutes</td>
<td>10:30 ± 5 minutes</td>
<td>10:00 ± 15 minutes</td>
</tr>
<tr>
<td>AWiFS</td>
<td>10:30 ± 5 minutes</td>
<td>10:30 ± 5 minutes</td>
<td>10:30 ± 5 minutes</td>
<td>10:00 ± 15 minutes</td>
</tr>
</tbody>
</table>

| Temporal Resolution      | 16 days | 5 days | 2 - 3 days | 16 days |

| Spatial Resolution       | 30 x 30 m (reflective) | 56 x 56 m | 22 x 22 m (resampled to 30) | 30 x 30 m (reflective) |
|                          | 120 x 120 m (thermal) |            | 100 x 100 m (thermal)      |                    |

| Radiometric Resolution   | 8 bit (256) | 10 bit (1024) | 10 bit (1024) | 12 bit (4096) |

| Spectral Resolution      | 6 (B, G, R, NIR, SWIR, MIR) + Thermal IR | 4 (G, R, NIR,SWIR) | 3 (G, R, NIR) | 10 (B, G, R, NIR, SWIR, MIR) + Thermal IR |

| Swath wide               | 185 km | 737 km | 600 km | 185 km |
2011 Available Imagery:

Landsat 5  
DMC  
Total

3972 Scenes
1262 Scenes
5234 Scenes
Agriculture Ground Truth
Provided by Farm Service Agency
USDA programs (crop subsidy, disaster relief)
Program crops (may under report specialty crops)
GIS-ready (less labor intensive for NASS)

Divide known fields into 2 sets
70% used for training
30% used for validation
Old Ground Truth (1997 – 2006 CDLs)

June Agricultural Survey (JAS) – National in Scope

• 41,000 farms visited, 11,000 one-square mile sample area segments

• Illinois ~ 400 segments statewide
First year of Illinois CDL production

Cropland Data Layer - Champaign-Urbana, Illinois
New Walmart construction
Construction done, farming returns to small parcel of land

Croppland Data Layer - Champaign-Urbana, Illinois
Example of typical corn-soybean rotation

Cropland Data Layer - Champaign-Urbana, Illinois
Example of typical corn-soybean rotation
Urban expansion on North Prospect Avenue
2004 CDL based on two Landsat scenes – April 4 & June 23

Cropland Data Layer - Champaign-Urbana, Illinois
Cropland Data Layer - Champaign-Urbana, Illinois

Last year using only Landsat
First year using AWiFS imagery in addition to Landsat, still using old maximum likelihood classifier and June Area Survey as ground truth.
First year using new decision-tree based classifier, first year using Farm Service Agency (FSA) Common Land Unit (CLU) and the 2001 NLCD for ground truth.
Non-agricultural ground truth based on 2001 NLCD
First year using newly available 2006 NLCD for non-agricultural ground truth.
## Accuracy Assessment

USDA, National Agricultural Statistics Service, 2012 Illinois Cropland Data Layer
STATEWIDE AGRICULTURAL ACCURACY REPORT

<table>
<thead>
<tr>
<th>Crop Specific Covers Only</th>
<th>Correct</th>
<th>Accuracy</th>
<th>Error</th>
<th>Kappa</th>
</tr>
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<tbody>
<tr>
<td><strong>OVERALL ACCURACY</strong></td>
<td>651,931</td>
<td>92.3%</td>
<td>7.2%</td>
<td>0.865</td>
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</table>

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Attribute Code</th>
<th>Correct Pixels</th>
<th>Producer's Accuracy</th>
<th>User's Accuracy</th>
<th>Error</th>
<th>Kappa</th>
<th>Error</th>
<th>Cond1</th>
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<tbody>
<tr>
<td>Corn</td>
<td>1</td>
<td>394135</td>
<td>97.6%</td>
<td>3.1%</td>
<td>0.96</td>
<td>96.01%</td>
<td>3.99%</td>
<td>0.93</td>
</tr>
<tr>
<td>Rice</td>
<td>3</td>
<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00</td>
<td>100.00%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Sorghum</td>
<td>4</td>
<td>41</td>
<td>6.8%</td>
<td>93.17%</td>
<td>0.07</td>
<td>67.82%</td>
<td>32.18%</td>
<td>0.83</td>
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<tr>
<td>Soybeans</td>
<td>5</td>
<td>241126</td>
<td>96.38%</td>
<td>3.61%</td>
<td>0.96</td>
<td>94.66%</td>
<td>5.34%</td>
<td>0.93</td>
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<tr>
<td>Sunflower</td>
<td>6</td>
<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00</td>
<td>100.00%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Tobacco</td>
<td>11</td>
<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00</td>
<td>100.00%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Sweet Corn</td>
<td>12</td>
<td>86</td>
<td>33.86%</td>
<td>66.14%</td>
<td>0.34</td>
<td>46.81%</td>
<td>53.19%</td>
<td>0.84</td>
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<tr>
<td>Pop or Orn Corn</td>
<td>13</td>
<td>560</td>
<td>47.22%</td>
<td>52.78%</td>
<td>0.47</td>
<td>37.56%</td>
<td>62.44%</td>
<td>0.95</td>
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<tr>
<td>Barley</td>
<td>21</td>
<td>0</td>
<td>0.00%</td>
<td>100.00%</td>
<td>0.00</td>
<td>100.00%</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Winter Wheat</td>
<td>22</td>
<td>1022</td>
<td>60.22%</td>
<td>39.78%</td>
<td>0.60</td>
<td>75.69%</td>
<td>26.31%</td>
<td>0.74</td>
</tr>
<tr>
<td>Dbl Crop WinH/w/Soybeans</td>
<td>26</td>
<td>11609</td>
<td>90.03%</td>
<td>9.97%</td>
<td>0.90</td>
<td>82.40%</td>
<td>17.60%</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Ary, Oats, Millet, Alfalfa, Other Hay/Non Alfalfa, Dry Beans, Potatoes, Other Crops, Watermelons, Cucumbers, Peas, Herbs, Clover/Wildflowers, Soy/Grass Seed, Switchgrass, Fallow/idle Cropland, Peaches, Apples, Grapes, Christmas Trees, Walnuts, Aquaculture, Triticale, Cantaloupe, Peppers, Strawberries, Squash, Dbl Crop WinH/Corn, Dbl Crop Oats/Corn, Pumpkins, Dbl Crop WinH/Sorghum, Dbl Crop Soybeans/Oats, Dbl Crop Corn/Soybeans, Gourds, Dbl Crop Barley/Soybeans

*Correct Pixels represents the total number of independent validation pixels correctly identified in the error matrix.

**The Overall Accuracy represents only the FSA row crops and annual fruit and vegetables (codes 1-61, 66-99 and 200-255). FSA-sampled grass and pasture, aquaculture, and all NLCD-sampled categories (codes 62-65 and 81-199) are not included in the Overall Accuracy.
Acreage not just about counting pixels

Regression-based Acreage Estimator

Regression used to relate categorized pixel counts to the ground reference data

- \( (X) \) – Cropland Data Layer (CDL) classified acres
- \( (Y) \) – June Agricultural Survey (JAS) reported acres

Using both CDL and JAS acreage results in estimates with reduced error rates over JAS alone

Outlier segment detection - correction or removal from regression analysis
### REGRESSION VARIABLES:

<table>
<thead>
<tr>
<th>Dependent</th>
<th>Independent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enumerated JAS Segments</td>
<td>CDL Classified Acres</td>
</tr>
<tr>
<td><strong>Soybeans</strong></td>
<td>227</td>
</tr>
<tr>
<td><strong>Wheat</strong></td>
<td>337</td>
</tr>
</tbody>
</table>
CDL Metadata

- Detailed metadata files for each CDL state/year available online at:
  http://www.nass.usda.gov/research/Cropland/metadata/meta.htm

Raster
Attribute Domain Values and Definitions: ROW CROPS 1-20

Categorization Code  Land Cover
"1"  Corn
"2"  Cotton
"3"  Rice
"4"  Sorghum
"5"  Soybeans
"6"  Sunflowers
"10"  Peanuts
"11"  Tobacco
"12"  Sweet Corn
"13"  Popcorn or Ornamental Corn

Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard Parallels: 29.500000
Standard Parallel: 45.500000
Longitude of Central Meridian: -96.000000
Latitude of Projection Origin: 23.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 56
Ordinate_Resolution: 56
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257223563

CLASSIFICATION INPUTS:
AVIFS DATE 20080413 PATH 264 ROW(S) &QUADRANT(S) 35b 40d 45bd
AVIFS DATE 20080418 PATH 265 ROW(S) &QUADRANT(S) 35bd 40abcd 45abcd 49b
AVIFS DATE 20080427 PATH 262 ROW(S) &QUADRANT(S) 40bd
AVIFS DATE 20080428 PATH 267 ROW(S) &QUADRANT(S) 40d 45bd
AVIFS DATE 20080503 PATH 266 ROW(S) &QUADRANT(S) 35bd 40bcd 45abcd 49bd
AVIFS DATE 20080512 PATH 265 ROW(S) &QUADRANT(S) 40bcd 45abcd
AVIFS DATE 20080517 PATH 266 ROW(S) &QUADRANT(S) 35d 40bd 45b
AVIFS DATE 20080606 PATH 270 ROW(S) &QUADRANT(S) 40d 45b
AVIFS DATE 20080614 PATH 262 ROW(S) &QUADRANT(S) 35bd 40bd 45b
AVIFS DATE 20080625 PATH 269 ROW(S) &QUADRANT(S) 40d 45b 50bd
AVIFS DATE 20080629 PATH 265 ROW(S) &QUADRANT(S) 40bd 45b
AVIFS DATE 20080704 PATH 266 ROW(S) &QUADRANT(S) 35a 40d 45bd
AVIFS DATE 20080713 PATH 263 ROW(S) &QUADRANT(S) 35abcd 40abcd 45b
AVIFS DATE 20080715 PATH 273 ROW(S) &QUADRANT(S) 35cd 40abcd 45abcd 50b
AVIFS DATE 20080802 PATH 267 ROW(S) &QUADRANT(S) 35d 40abcd 45abcd
AVIFS DATE 20080808 PATH 273 ROW(S) &QUADRANT(S) 35d 40bc 45a
AVIFS DATE 20080812 PATH 269 ROW(S) &QUADRANT(S) 35c 40ac 45a
AVIFS DATE 20080904 PATH 264 ROW(S) &QUADRANT(S) 40bd 45bd
AVIFS DATE 20080909 PATH 265 ROW(S) &QUADRANT(S) 35bd 40bd
AVIFS DATE 20080914 PATH 266 ROW(S) &QUADRANT(S) 40d 45bd
AVIFS DATE 20080915 PATH 271 ROW(S) &QUADRANT(S) 45bd 50b

MODIS 16 DAY NDVI COMPOSITE DATE 20071016
MODIS 16 DAY NDVI COMPOSITE DATE 20071101
MODIS 16 DAY NDVI COMPOSITE DATE 20071117
MODIS 16 DAY NDVI COMPOSITE DATE 20080305
MODIS 16 DAY NDVI COMPOSITE DATE 20080321
MODIS 16 DAY NDVI COMPOSITE DATE 20080406
MODIS 16 DAY NDVI COMPOSITE DATE 20080422
MODIS 16 DAY NDVI COMPOSITE DATE 20080508
MODIS 16 DAY NDVI COMPOSITE DATE 20080524
MODIS 16 DAY NDVI COMPOSITE DATE 20080609

USGS, NATIONAL ELEVATION DATASET ELEVATION
USGS, NATIONAL LAND COVER DATASET 2001 TREE CANOPY
USGS, NATIONAL LAND COVER DATASET 2001 IMPERVIOUSNESS
Future of the CDL Program?

- Expand geographic scope?
  - Testing Hawaii in 2013
- Improved categories?
  - Grassland
    - Pasture/hay/grass
  - Specialty Crops
- Imagery?
  - Future sensors
  - Finer spatial resolution
- Derivatives?
  - Cultivated Data Layer (Crop Mask)
  - Crop rotation patterns
- Other ancillary data?
  - Soils
  - Climate
- Improved online distribution
  - CropScape
CDL Visualization, Dissemination and Querying Needs

• Prior Distribution Methods:
  – Online bulk FTP downloading via NRCS Geospatial Data Gateway
  – Online, telephone and mail requests:
    • Printed maps
    • CD/DVD delivery

• NASS Needed...
  – Capabilities for on-line geospatial crop information access, geospatial query and on-line analytics via interactive maps
  – Disseminate all data to decision makers and users via real time retrieval, processing and publishing over the web through standards-based geospatial web services
Solution - CropScape

- A web service based interactive map visualization, dissemination and querying system for U.S. cropland
  - No burden on users
    - No client software development & installation
    - No special software tools needed

- Collaboration with George Mason University/ Center for Spatial Information Science and Systems
CropScape Functions

- Select any historical CDL by state and year circa 1997
- Zoom in/out & Pan
- Search by county and year
- Sub-setting by state, county, and year
- Sub-setting for any area of interest
- Re-projecting data to a user specified map projection
  - Albers, Geographic, UTM
- Download the CDL subset in GeoTiff format
- Exporting selected CDL subset to Google Earth (KML)
CropScape Functions –Cont.

- Online pixel counting & acreage statistics
- Online statistics graphing/charting
- Maps showing the change of crop types for a state, county, or any area specified between any two years of CDL
- On-the-fly single/multi crop map generation, display and download
- Web service implemented
  - Geospatial query statistics data delivery
  - CDL map AOI data delivery
Visual Tools

Area of Interest

Maps/Downloads

Point Query

Stats/Change

Help/Tutorials
Pixel counting is usually downward biased when compared to official estimates. Counting pixels and multiplying by the area of each pixel will result in biased area estimates and should be considered raw numbers needing bias correction. Official crop acreage estimates are available at http://www.nass.usda.gov.
CropScape Download & Export
CropScape “Mashups”

From: https://www.bioenergykdf.net/
CropScape Future Improvements

• Additional GIS layers
  – watershed, congressional districts

• More analysis functions

• Improved map production/printing services
### CropScape Google Analytics

<table>
<thead>
<tr>
<th>Region</th>
<th>Visits</th>
<th>Pages / Visit</th>
<th>Avg. Visit Duration</th>
<th>% New Visits</th>
<th>Bounce Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>73,303</td>
<td>1.21</td>
<td>00:01:23</td>
<td>57.84%</td>
<td>86.33%</td>
</tr>
<tr>
<td><strong>% of Total</strong></td>
<td>89.78%</td>
<td>81,690</td>
<td>Site Avg: 1.20 (0.32%)</td>
<td>Site Avg: 00:01:21 (1.85%)</td>
<td>Site Avg: 86.52% (-0.22%)</td>
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<td>California</td>
<td>5,511</td>
<td>1.22</td>
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<td>85.18%</td>
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<tr>
<td>Illinois</td>
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<td>1.21</td>
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<td>59.65%</td>
<td>86.59%</td>
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<tr>
<td>Minnesota</td>
<td>4,962</td>
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<tr>
<td>Virginia</td>
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<td>Iowa</td>
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<td>86.06%</td>
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<td>Texas</td>
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<td>85.24%</td>
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<tr>
<td>Missouri</td>
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<td>88.02%</td>
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<td>Colorado</td>
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<td>Kansas</td>
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<tr>
<td>District of Columbia</td>
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<td>1.18</td>
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<td>86.61%</td>
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</tbody>
</table>
# CropScape Google Analytics

![World Map with Google Analytics Data](image)

<table>
<thead>
<tr>
<th>Country / Territory</th>
<th>Visits</th>
<th>Pages / Visit</th>
<th>Avg. Visit Duration</th>
<th>% New Visits</th>
<th>Bounce Rate</th>
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<tbody>
<tr>
<td>United States</td>
<td>73,303</td>
<td>1.21</td>
<td>00:01:23</td>
<td>57.84%</td>
<td>86.33%</td>
</tr>
<tr>
<td>Canada</td>
<td>1,100</td>
<td>1.16</td>
<td>00:01:07</td>
<td>67.36%</td>
<td>88.36%</td>
</tr>
<tr>
<td>China</td>
<td>913</td>
<td>1.25</td>
<td>00:01:28</td>
<td>60.24%</td>
<td>82.56%</td>
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<tr>
<td>Germany</td>
<td>502</td>
<td>1.12</td>
<td>00:00:47</td>
<td>58.76%</td>
<td>91.24%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>441</td>
<td>1.15</td>
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<td>89.57%</td>
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<tr>
<td>Argentina</td>
<td>393</td>
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</tr>
<tr>
<td>France</td>
<td>388</td>
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<td>62.11%</td>
<td>86.34%</td>
</tr>
<tr>
<td>Brazil</td>
<td>362</td>
<td>1.15</td>
<td>00:01:03</td>
<td>68.78%</td>
<td>87.85%</td>
</tr>
<tr>
<td>Spain</td>
<td>300</td>
<td>1.14</td>
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<tr>
<td>Mexico</td>
<td>291</td>
<td>1.19</td>
<td>00:01:37</td>
<td>54.64%</td>
<td>86.60%</td>
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</tbody>
</table>
Purpose of VegScape

• On-line satellite-based U.S. crop condition vegetation assessment and monitoring
• Improve objectivity, robustness, quantification, and defensibility of nationwide crop condition monitoring program
• Provide tools for data exploration and visualization
• Publically disseminate geospatial vegetation condition at daily, weekly, and biweekly time periods
• Supports ethos of data democratization
  – free and open access to digital geospatial data layers
  – open geospatial standards
  – supporting transparent and collaborative government initiatives
• 1995-2012

• NDVI Vegetative Condition

• Static Maps

• Based on AVHRR sensor (1.1 km spatial resolution)
2013

**VegScape** – web service

- Multiple vegetation indices
- Interactive web mapping: navigate, download, etc.

MODIS sensor: daily repeat, 250m resolution (~15 acres /6.25 hectares)

Composites: daily, weekly, bi-weekly

Built on CropScape framework/architecture

- Web-based interactive mapping
- Derive daily/weekly/biweekly composites
- Automated updates
- Online navigation, zooming, panning, downloading
- Hosted/maintained by George Mason University/Center for Spatial Information Science and Systems
Vegetation Indices

• The Normalized Difference Vegetation Index (NDVI) is used to measure and monitor plant growth, vegetative cover, and biomass production

• NDVI values range from 0 to 1, where higher values indicate stronger plant vigor and high chlorophyll content
  – Lower values indicate low vegetative content/plant heartiness

• Additional derivative vegetation indices can be displayed: Vegetative Condition Index; Ratio VCI; Ratio Median VCI; Mean VCI

\[
NDVI = \frac{\text{Band}_2 - \text{Band}_1}{\text{Band}_2 + \text{Band}_1} \times 125 + 125
\]

Resulted data are in the range of [0, 250].
Vegetation Indices

- **NDVI** – Normalized Difference Vegetation Index
  \[ NDVI = \frac{IR - Red}{IR + Red} = \text{Shows greeness} \]
  Healthy vegetation has high NDVI ratio values (1.0 max)
  low red light & high near-infrared reflectance values

- **RNDVI** - NDVI change ratio to previous year

- **RMNDVI** - NDVI change ratio to median

- **VCI** - Relative NDVI change with respect to minimum historical (referenced) NDVI value

- **MVCI** - Mean referenced VCI (vegetation condition index)
Follow these five steps to add products for analysis:

1) Select vegetative index

2) Time period
   - Type: NDVI
   - Period: Weekly
   - Year: Daily
   - Date: Biweekly

3) Year
   - Type: NDVI
   - Period: Weekly
   - Year: 2013

4) Date
   - Type: NDVI
   - Period: Weekly
   - Year: 2013
   - Date: 05(01.29_02.04)_20 01(01.01_01.07)_2013 02(01.08_01.14)_2013 03(01.15_01.21)_2013

5) Add
VegScape Layers/Products/Legends Tab

- Turn on/off layers
- Drape crop mask
- View CDL
- Political boundaries
- Water/road layers
- Vegetation indices
VegScape Summary

• MODIS offers high spatial/temporal resolution & data continuity

• Web-based dynamic interactive mapping
  • Online navigation, zooming, panning, downloading, on-the-fly processing
  • Leveraging CropScape framework/architecture
  • Automatic data retrieval, processing, publishing, and dissemination

• Irregular, ad-hoc data retrieval and processing for emergency assessment/reporting

• Assessing crop condition and identifying the areal extent of floods, drought, major weather anomalies, and vulnerabilities of early/late season crops

• Consider VegScape operational upon start of 2013 growing season!
Quantify vegetative area condition

RatioMedian VCI - Area of Interest Statistics

04/19-04/25/11

Note: Pixel and acreage counts are not official estimates.
Other Geospatial Products

• Remote Sensing Yield
  – NASS cooperative research for over 15 years
  – Agricultural Research Service
    • Dr. Paul Doraiswamy
    • Tech transfer
  – Semi-operational for 4 years
  – Primary data source – MODIS sensor
Yield Methodology

• Utilizes NASS county-level yields as “ground truth”
  1. Farmer reported survey data
  2. Objective yield survey
     • 100s of sample sites per state
     • biophysical plant/seed measurements obtained
     • Each plot revisited a multiple times per season
• Over Speculative corn and soybean region
• Examining timely possible predictor variables
  – NDVI (Normalized Difference Vegetation Index)
     • derived from Terra satellite MODIS surface reflectance imagery
  – LST (Land Surface Temperature) from day and night
     • derived from Aqua satellite MODIS thermal imagery
  – Precipitation
     • derived from NOAA/NWS Nexrad
• Utilizing 8-day composited mosaic products from 2006-2011
  – Mid-February through late September
• Forecasting solely using Rulequest Cubist software
Estimated Soybean Yield
October 1, 2012

Experimental
Internal Use Only
Reality check – detection of extreme weather events

Path of a large hailstorm
Future Geospatial Products?

• Improve and quantize:
  – Crop Progress

• Soil Moisture
  – NASA Soil Moisture Active Passive (SMAP) mission

• Expand yield forecasting program
Discussion Topic

• Beginning with the 2013 CDL we plan to collapse all grass/pasture categories into one new category
  – The old “land cover” versus “land use” issue

• Individual analysts decide how to use grass and pasture ground truth in their particular state/region/year – this has resulted in inconsistencies at state boundaries

• Intended to reduce end user confusion

• CDL codes collapsed
  – 62 (FSA pasture and grass)
  – 171 (NLCD herbaceous grassland)
  – 181 (NLCD pasture/hay)

• Entire CDL archive will be recoded and re-released in early 2014
Several analyses have been undertaken recently to estimate possible land cover transition in the United States (US) of grassland cover types to usage for planting commodity crops (Faber et al., 2012; Johnston, 2013; Wright and Wimberly, 2013; Kline et al., 2013; Cox and Rundquist, 2013; DIS, 2013; AP?, 2013; Gibbs et al., 2013). All of the studies have used time-series analysis of the Cropland Data Layer (CDL) (Johnson and Mueller, 2010; Boryan et. al., 2011) as produced by the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) for the basis. The consensus of the findings is that cropland has indeed expanded in recent years onto grassland areas. The cause of this conversion is then ultimately tied to economic or policy change, particular in terms of corn (commonly called maize outside of the US). The overall concern of these conversions is that they are likely occurring on marginal lands and negatively impacting ecosystems at a variety landscape scales. The purpose of this communication is not to confirm or rebut any of the individual findings but put into historical perspective the development of CDL, caveat the utility of using it for area estimation (particularly for non-crop types) and propose a path forward for clarity of mapping grassland related cover types.