NASS Cropland Data Layer Efforts
Tracking Bioenergy Crops In Tennessee

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ASA-CSSA-SSSA 282-4 Meetings
11/4/09
NASS Estimation Systems

NASS Surveys → NASS Field Offices → NASS Ag Statistics Board → National/State/District/County Estimates

Satellite Systems → *Geospatial Decision Support Systems → USDA Administrative Data

*NASS uses Geospatial Decision Support Systems to provide updated information to the Ag Statistics Board and data users.
What is the Cropland Data Layer (CDL)?

A tool to identify agriculture type and location

Each pixel represents a type of crop or land cover

An example:
- Yellow: Corn
- Brown: Winter Wheat
- Blue: Rice
- Green: Soybeans
- Red: Cotton
- Pink: Alfalfa
Cropland Data Layer (CDL) Objectives

- “Census by Satellite”
  - Annually cover major program crops and regions
  - Crops accurately geo-located

- Deliver in-season remote sensing acreage estimates
  - For June, July, August, September, and October Official Reports
  - Update planted area
  - Reduced respondent burden

- Provide timely, accurate, useful estimates
  - Measurable error
  - Unbiased/independent estimator
  - State, District, County

- Public domain crop specific crop classification
  - Hosted @ NRCS Geospatial Data Gateway & http://www.nass.usda.gov/research/Cropland/SARS1a.htm
CDL Program

- **Inputs**
  - Resourcesat-1 AWiFS imagery
  - Farm Service Agency – Common Land Unit
  - NASS June Ag Survey
  - Ancillary data
    - NLCD & derivative products

- **Outputs**
  - Acreage Estimates
  - Cropland Data Layer

- **Process**
  - Commercial software suite
Data Partnerships

- Foreign Agricultural Service
  - Resourcesat-1 AWiFS
- Farm Service Agency
  - Common Land Unit “ground truth”
- US Geological Survey
  - National Land Cover Dataset
- US Geological Survey/ NASA
  - Landsat TM 5 & 7
CDL Processing Method

Satellite Imagery
Ancillary Data
Ground Truth

Sampling Done by

See5

Decision Tree

Classification

Iowa 2008 Cropland Data Layer

Land Cover Categories
(Ordered by Decreasing Acreage)

Agriculture
- Corn
- Soybeans
- Pasture/Grass
- Alfalfa
- Oats
- Winter Wheat
- Spring Wheat
- Grassland
- Barley
- Clover/Whiteclovers
- Other Cropped
- Fallowed Cropland
- Durum Wheat
- Sorghum
- Rye
- Dry Beans
- VDM/Other Dir. Crop.

Non-Agriculture
- Urban/Developed
- Woodland
- Wetlands
- Water
- Barren
- Shrubland
Tennessee 2009 Cropland Data Layer

Landcover Categories:
- Alfalfa
- Barley
- Christmas Trees
- Corn
- Cotton
- Dry Beans
- Millet
- Misc. Vgs. & Fruits
- Barren
- Forest
- Developed
- Grassland Herbaceous
- Open Water
- Shrubland
- Woody Wetlands
- Oats
- Other Crops
- Other Hays
- Pasture/Grass
- Peaches
- Rice
- Rye
- Seed/Sod Grass
- Sorghum
- Soybeans
- Sweet Corn
- Switchgrass
- Tobacco
- W. Wht./Soy. Dbl Crop
- Winter Wheat
## TN Accuracy Assessments

<table>
<thead>
<tr>
<th>Crop categories only</th>
<th>Correct Accuracy</th>
<th>Error</th>
<th>Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Accuracy 2009</td>
<td>223010 86.44%</td>
<td>13.56%</td>
<td>0.8179</td>
</tr>
<tr>
<td>Overall Accuracy 2008</td>
<td>219563 88.16%</td>
<td>11.84%</td>
<td>0.8374</td>
</tr>
</tbody>
</table>

### Producer’s Accuracy
- Errors of Omission: occur when a pixel is excluded from the correct category.

### User’s Accuracy
- Errors of Commission: occur when a pixel is included in an incorrect category.

### Kappa Coefficient
- A statistics measure of agreement, beyond chance, between two maps.

### Individual Categories 2008

<table>
<thead>
<tr>
<th>Cover Type</th>
<th>Attribute Code</th>
<th>Correct Pixels</th>
<th>Producer’s Accuracy</th>
<th>Omission Error</th>
<th>Kappa</th>
<th>User’s Accuracy</th>
<th>Commission Error</th>
<th>Kappa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>1</td>
<td>58257</td>
<td>92.62%</td>
<td>7.38%</td>
<td>0.9205</td>
<td>91.64%</td>
<td>8.36%</td>
<td>0.9101</td>
</tr>
<tr>
<td>Cotton</td>
<td>2</td>
<td>23065</td>
<td>87.40%</td>
<td>12.60%</td>
<td>0.8704</td>
<td>92.44%</td>
<td>7.56%</td>
<td>0.9222</td>
</tr>
<tr>
<td>Soybeans</td>
<td>5</td>
<td>91449</td>
<td>90.97%</td>
<td>9.03%</td>
<td>0.8978</td>
<td>87.49%</td>
<td>12.51%</td>
<td>0.8591</td>
</tr>
<tr>
<td>WW / Soybeans</td>
<td>26</td>
<td>43890</td>
<td>91.68%</td>
<td>8.32%</td>
<td>0.9118</td>
<td>87.51%</td>
<td>12.49%</td>
<td>0.8681</td>
</tr>
<tr>
<td>Switchgrass</td>
<td>60</td>
<td>124</td>
<td>29.25%</td>
<td>70.75%</td>
<td>0.2923</td>
<td>57.67%</td>
<td>42.33%</td>
<td>0.5765</td>
</tr>
</tbody>
</table>

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

- Seek opportunities to collection bioenergy crop data
  - Need for other “non-program” farm crops
- National CDL crop year 2009
  - Funded in part by EPA/target release Jan/Jun ‘10
- Fund Geospatial CDL portal
  - George Mason Univ/Center for Spatial Information Science and Systems
- National Commodity Crop Productivity Index
  - NRCS dynamic soils layer
CDL Freely Available from the NRCS Geospatial Data Gateway

Thank You!
<table>
<thead>
<tr>
<th>Noteworthy CDL Uses</th>
<th>Analyses of Co2 fluxes</th>
<th>Assisting in education, research &amp; outreach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzing watersheds, soil utilizations, &amp; crop rotations</td>
<td>Assist with water use estimates</td>
<td></td>
</tr>
<tr>
<td>Background data for research development</td>
<td>Background information for land use categories</td>
<td>Business analysis</td>
</tr>
<tr>
<td>Carbon cycle research</td>
<td>Comparison with our Climate Atlas</td>
<td>Crop rotation analysis</td>
</tr>
<tr>
<td>Data for students to practice on in Advanced Cartography class</td>
<td>Demographic Research</td>
<td>Determine acres of crop type within conservation projects</td>
</tr>
<tr>
<td>Distribution of land among forest, urban, crops &amp; water.</td>
<td>Doing a theoretical radioactive plume impact assessment for crops</td>
<td>Environ landscape analysis</td>
</tr>
<tr>
<td>Epidemiological research</td>
<td>Fertilizer Company looking at where the acres are</td>
<td>Fertilizer usage/potential</td>
</tr>
<tr>
<td>For archival purposes</td>
<td>GIS analysis of Mallard nesting sites/targeting restoration activities</td>
<td>GIS Reference layer</td>
</tr>
<tr>
<td>Globle irrigated area mapping</td>
<td>Habitat project planning</td>
<td>Incorporate these data sets into other landcover studies</td>
</tr>
<tr>
<td>Land cover analysis</td>
<td>Land use and conservation issues along the rural-urban interface</td>
<td>Landcover to calibrate/validate in house classifications</td>
</tr>
<tr>
<td>Mapping crop areas, using MODIS images in global scale</td>
<td>Market data analysis for land sales and appraisals</td>
<td>Market research</td>
</tr>
<tr>
<td>Modeling of environmental impacts from agriculture</td>
<td>Modelling support</td>
<td>Nutrient load in watershed modeling</td>
</tr>
<tr>
<td>Overlay with health statistics to estimate pesticide exposures</td>
<td>Post-stratification of forest inventory estimates</td>
<td>Precision farming, land classification</td>
</tr>
<tr>
<td>Research on future crop loss</td>
<td>Scientific research</td>
<td>Soil erosion prediction</td>
</tr>
<tr>
<td>Study for transportation project</td>
<td>study hurican damage</td>
<td>Study of climate effects on vegetation</td>
</tr>
<tr>
<td>Teaching</td>
<td>To be used for Eco System modeling</td>
<td>To compare changes in cropping patterns overtime for Nebraska</td>
</tr>
<tr>
<td>To understand heterogeneity within AVHRR pixels</td>
<td>To use for analysis of deer habitat</td>
<td>Trend analysis of cropping patterns and verification of other data sources</td>
</tr>
<tr>
<td>Undergraduate teaching</td>
<td>Understand crop density distribution for selecting research locations</td>
<td>Use in spatial analysis by GIS consultants to crop protection industry</td>
</tr>
<tr>
<td>Use for agro-ecological zones for crop classification algorithm</td>
<td>Use to develop land management/rotation data files</td>
<td>Used for a project involving the tillage adoption by crop for counties</td>
</tr>
<tr>
<td>Used for risk assessment for pesticides/gene flow project</td>
<td>Used to constrain an ecosystem process model for estimating crop productivity</td>
<td>Validate landuse forecast model based on prior landuse classification</td>
</tr>
<tr>
<td>Will be used by our Water Use Program Manager</td>
<td>Will be used to aid in emergency operations, planning and recovery efforts for the State of Mississippi</td>
<td>Wish to test as input into area crop production estimation &amp; watershed models</td>
</tr>
</tbody>
</table>