Data Partnership Synergy

The Cropland Data Layer

Rick Mueller Head/Spatial Analysis Research rick_mueller@nass.usda.gov USDA/NASS

USDA



NASS Estimation Systems



*NASS uses Geospatial Decision Support Systems to provide updated information to the Ag Statistics Board and data users.

Cropland Data Layer Objectives

Census by Satellite"

- Annually cover major program crops
- Ag intensive states/regions

Provide timely, accurate, useful indications

- Measurable error
- Unbiased/independent estimator
- State, County, Agricultural Statistics Districts

Operationalize indications delivery

- For June, July, August, September and October
 - Agricultural Statistics Board
 - Field Offices
 - Update planted area

Output crop specific CDL

- Distribute to public at the cost of reproduction
 - NRCS Geospatial Data Gateway







Brown County, South Dakota 2008 Cropland Data Layer





Land Cover Categories (Ordered by Decreasing Acreage)

Agriculture Corn

Soybeans

Alfalfa

Spring Wheat

Winter Wheat

Dry Beans

Sunflowers

Sorghum

Other Crops

Grass/Pasture/Non-Ag

Urban/Developed

Oats

Millet

Barley

Non-Agriculture

Wetlands

Water Woodland Fallow/Idle Cropland Barren Shrubland

Rye

Pocahontas County, Iowa 2008 Cropland Data Layer



Land Cover Categories (Ordered by Decreasing Acreage) Agriculture Com Soybeans Pasture/Grass Alfalfa Oats Winter Wheat Spring Wheat Clover/Wildflowers Non-Agriculture Urban/Developed Wetlands Woodland Water Barren

USDA

USDA

Cuming County, Nebraska 2008 Cropland Data Layer





Land Cover Categories (Ordered by Decreasing Acreage) Agriculture

Corn

Soybeans

Alfalfa

Oats

Dry Beans

Sunflowers

Other Crops

Non-Agriculture

Woodland

Barren Wetlands Shrubland

Water

Urban/Developed

Rye

Peas

Clover/Wildflowers

Pasture/Grass

Fallow/Idle Cropland

Misc. Vegs. & Fruits

W. Wht./Soy. Dbl. Crop.

Seed/Sod Grass

Winter Wheat



McLean County, Illinois 2008 Cropland Data Layer





Data Partnerships

- Foreign Ag Service
 - Satellite Image Archive
 - Resourcesat-1 AWiFS
 - 5 day repeat/56 meter resolution/740 KM swath
- Farm Service Agency
 - Common Land Unit
 - Agricultural specific ground truth
- US Geological Survey
 - National Land Cover Dataset
 - Non-agricultural specific ground truth



United States Department of Agriculture Farm Service Agency





CDL Program

Inputs

- Resourcesat-1 AWiFS imagery
- Farm Service Agency Common Land Unit
- NASS June Ag Survey
- Ancillary data
 - NLCD & derivative prod
- Outputs
 - Acreage Estimates
 - Cropland Data Layer
- Process
 - Commercial soft





Sensor Specifications Compared

| | <u>TM</u> | AWiFS | | |
|--------------------------|---|-----------------------|--|--|
| Altitude | 705 km | 817 km | | |
| Equatorial crossing time | 9:45 ± 15 minutes | $10:30 \pm 5$ minutes | | |
| Temporal Resolution | 16 days | 5 days | | |
| Spatial Resolution | 30 x 30 m (reflective) 120 x 120 m (thermal) | 56 x 56 m | | |
| Radiometric Resolution | 8 bit (256) | 10 bit (1024) | | |
| Spectral Resolution | 6 (B, G, R, NIR, SWIR, MIR) + Thermal IR | 4 (G, R, NIR,SWIR) | | |
| Swath wide | 185 km | 737 km | | |
| Scene size | 184 x 152 km | 370 x 370 km | | |

Agricultural Ground Truth FSA Common Land Unit



United States Department of Agriculture Farm Service Agency



Non-Agricultural Ground Truth USGS/National Land Cover Dataset 2001

Proportional sampling Improve CDL coverage of non-ag classes



Ground Truth – Ancillary



Ancillary datasets help separate the agricultural landscape; determining agricultural potential





See5 Decision Tree Classifier

- Efficient and robust image classifier
- Incorporates a powerful ensemble method known as "boosting"
- Allows hundreds of layers of data
- The "NLCD Mapping Tool" was integrated into ERDAS Imagine
 - Provided gratis by USGS

RULEQUEST

RESEARCH

data mining tools



Accuracy Assessments

| | Cover Type | Attribute Code | *Correct Pixels | Producer's Accuracy | Omission Error | Kappa | User's Accuracy | Commission Error | Cond'l Kappa |
|----|------------------|-------------------|--------------------|------------------------|-------------------|------------------|--------------------|---------------------|------------------|
| IA | Corn Soybeans | 1 5 | 2197719 1471094 | 96.58% 96.24% | 3.42% 3.76% | 0.9226 0.9392 | 97.86% 95.78% | 2.14% 4.22% | 0.9509 0.9320 |
| IL | Corn | 1 | 2258219 | 98.06% | 1.94% | 0.9527 | 98.58% | 1.42% | 0.9650 |
| | Soybeans | 5 | 1339089 | 96.36% | 3.64% | 0.9438 | 97.96% | 2.04% | 0.9681 |
| NE | Corn | 1 | 1856422 | 97.29% | 2.71% | 0.9605 | 97.32% | 2.68% | 0.9608 |
| | Soybeans | 5 | 849249 | 95.83% | 4.17% | 0.9513 | 96.95% | 3.05% | 0.9643 |
| SD | Corn | 1 | 803251 | 94.29% | 5.71% | 0.9342 | 95.78% | 4.22% | 0.9513 |
| | Soybeans | 5 | 707383 | 95.03% | 4.97% | 0.9439 | 97.72% | 2.28% | 0.9741 |

| | Crop-specific covers only | *Correct | Accuracy | Error | Kappa |
|-----|---------------------------|----------|----------|--------|--------|
| ΤΔ | OVERALL ACCURACY | 3688803 | 95.74% | 4.26% | 0.9145 |
| 171 | | | | | |
| Π | OVERALL ACCURACY | 3730093 | 97.05% | 2.95% | 0.9426 |
| | | | | | |
| NF | OVERALL ACCURACY | 3071960 | 94.05% | 5.95% | 0.8981 |
| | | | | | |
| SD | OVERALL ACCURACY | 2306428 | 87.51% | 12.49% | 0.8416 |
| | | | | | |

Producer's Accuracy: relates to the probability that a ground truth pixel will be correctly mapped and measures errors of omission.

Errors of Omission: occur when a pixel is excluded from the correct category.

User's Accuracy: indicates the probability that a pixel from the classification actually matches the ground truth data and measures errors of commission. **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.



How many acres are inside this blue tract boundary drawn on the photo (map)?...

Now I would like to ask about each field inside this blue tract boundary and its use dyring 2000

| | FIELD NUMBER | 01 | 02 | |
|----|--|------|-----|-----|
| 1. | Total acresin field | 828 | 828 | 828 |
| 2. | Croportanduse.[<i>Specify</i>] | | | |
| 3. | Occupied farmstead or dwelling | .843 | | |
| 4. | Waste, unoccupied dwellings, buildings and structures, roads, ditches, etc. | • | | |
| 5. | Woodand | 831 | 831 | 831 |
| | Permanent (not in croprotation) | 842 | 842 | 842 |
| D. | raauic | 856 | 856 | 856 |

Estimation Components: Area Sampling Frame+ June Ag Survey+ Questionnaire

Regression-based Acreage Estimator

Simple Linear Regression

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

Outlier segment detection - removal from regression analysis

Using regression results in estimates reduces error rates over using JAS alone



Acreage not just about counting pixels



2009 Plans and Beyond

- Operational in-season estimates in 27 states
- Seeking outside funding for a national CDL
 - FY10 for crop year 2009
- AWiFS & Landsat sustainability questionable
- Develop CDL ArcGIS Web Server Portal

