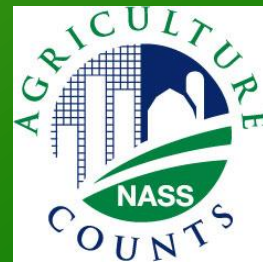


# **The NASS Cropland Data Layer Program:**

## **Potential Cooperator Benefits in Washington State**





United States Department of Agriculture

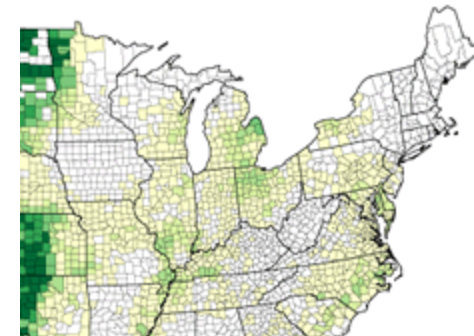
National Agricultural Statistics Service

USDA/NASS  
Washington Field Office  
P.O. Box 609, Olympia, WA 98507  
(360) 902-1940 Fax (360) 902-2091

# Washington Crop Weather

Released: July 31, 2006  
Week Ending: July 30, 2006  
CWP WA-CW3106

Wheat 2005  
Acres by County



## Temperatures Cooled Off Across the State

### Field Crops

The temperatures cooled off across the state, especially on the west side where light rains took place over the weekend. The wheat harvest and potato harvest were in full swing, while the green pea harvest ended. Yields from harvested winter wheat have been mostly average. Christmas tree growers were busy shearing Grand fir and top working Noble fir.

Range and Pasture conditions continued to decline

Volume 93, No. 31 <http://www.usda.gov/oc>

# WEEKLY AND CRO



# NASS

FACT FINDERS FOR AGRICULTURE  
UNITED STATES DEPARTMENT OF AGRICULTURE

Washington, D.C.

## Crop Production

Released  
Agriculture

# What is NASS?

U.S. DEPARTMENT OF COMMERCE



## PRESS RELEASE

NATIONAL AGRICULTURAL STATISTICS  
United States Department of Agriculture • Washington  
Washington Field Office • Olympia, WA  
Ag Statistics Hotline: 1-800-727-9540 • www.usda.gov

Released on July 12, 2006

Media Contact

United States Department of Agriculture

National Agricultural Statistics Service

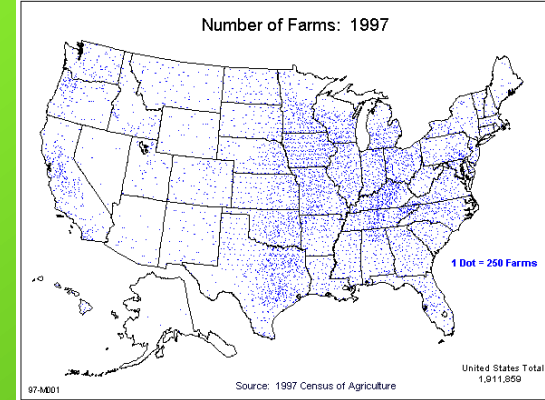
## Washington's 2006 Potato Acreage Update

OLYMPIA, Wash., July 12, 2006-- In a report issued today by



## Potatoes and Sweet Potatoes Final Estimates 1997-2002

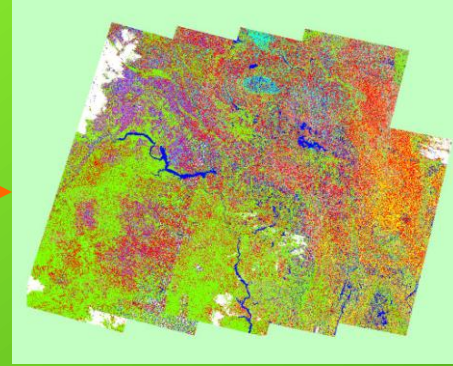
# Agency Background



- United States Dept. of Agriculture
  - National Agricultural Statistics Service
  - June Agricultural Survey (JAS) – National in Scope
    - 41,000 farms visited
    - 11,000 one-square mile sample area segments visited
    - Most states contain between 150 – 400 segments
    - Derive planted acreage estimate
  - Cropland Data Layer piggybacks on JAS
    - Unbiased statistical estimator of crop area
      - State and county level estimates

# Program Purpose

AL	Cherokee	1	20	19	15499199
AL	Cullman	1	20	43	15499199
AL	De Kalb	1	20	49	15499199
AL	Etowah	1	20	55	15499199
AL	Jackson	1	20	71	15499199
AL	Lauderdale	1	10	77	15499199
AL	Lawrence	1	10	79	15499199
AL	Limestone	1	10	83	15499199
AL	Madison	1	10	89	15499199
AL	Marshall	1	20	95	15499199
AL	Morgan	1	10	103	15499199
AL	Talladega	1	30	121	15499199
AL	D10 Comb	1	10	888	15499199
AL	D20 Comb	1	20	888	15499199
AL	D30 Comb	1	30	888	15499199
AL	D40 Comb	1	40	888	15499199
AL	D50 Comb	1	50	888	15499199
AL	D60 Comb	1	60	888	15499199
AL	D10 North	1	10	999	15499199
AL	D20 Moun	1	20	999	15499199
AL	D30 Upper	1	30	999	15499199
AL	D40 Black	1	40	999	15499199
AL	D50 Coast	1	50	999	15499199
AL	D60 Wireg	1	60	999	15499199

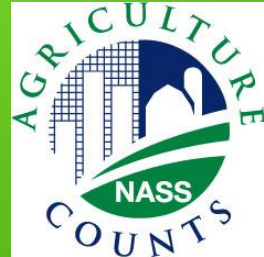


- Remote sensing based cropland acreage indications
  - County and state level “major crops”
- Produce categorized crop specific Cropland Data Layer
  - Distribute to public (CD/DVD)
    - Cost of reproduction
  - Publish accuracy statistics/metadata

# Program Players



- USDA/NASS Research Division
  - Spatial Analysis Research Section
    - Remote sensing analysts
    - Software developers



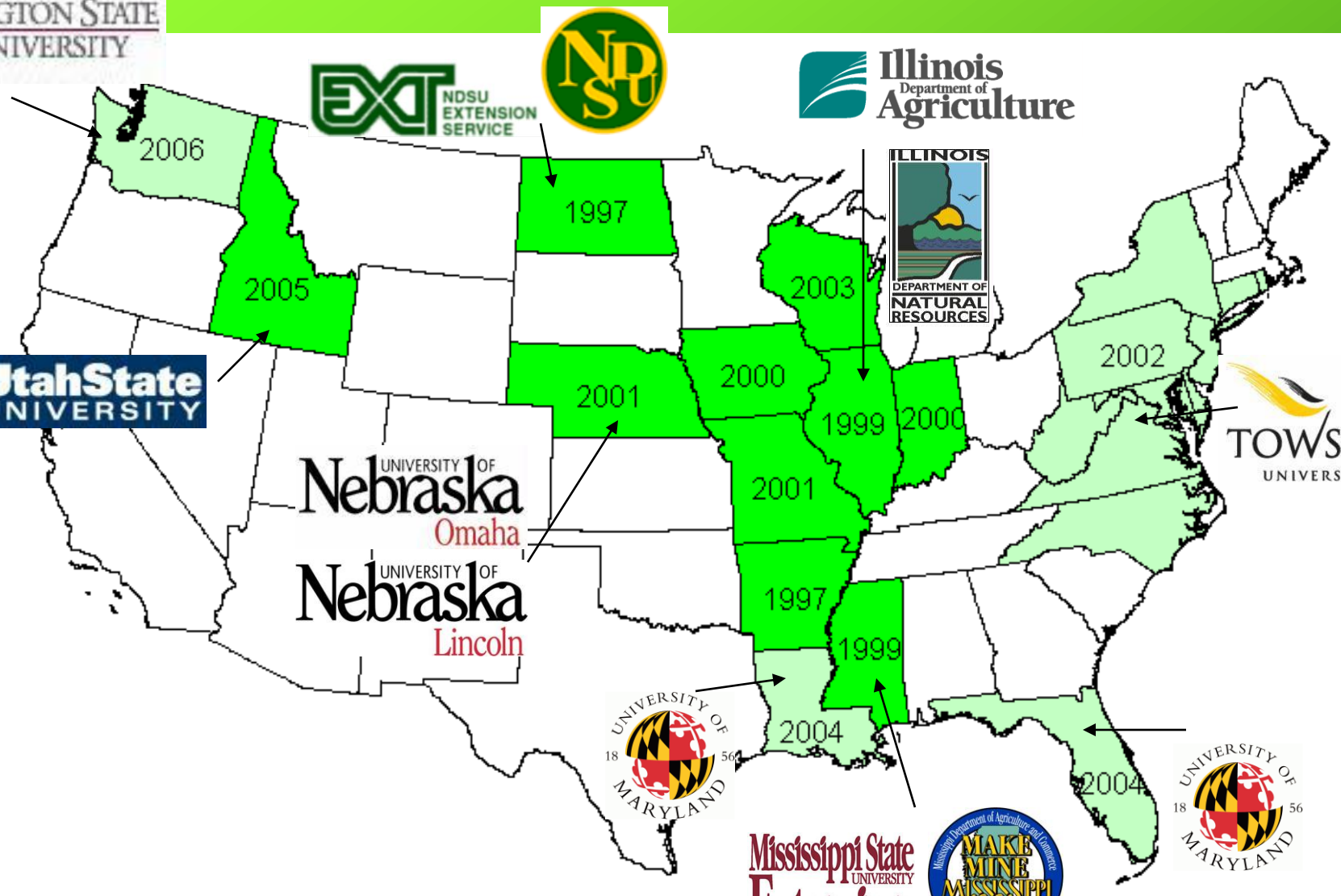
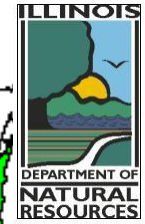
- USDA/Foreign Ag Service
  - PECAD (Production Estimates & Crop Assessment Division)
  - Our satellite imagery source



- State/Federal/University Cooperators
  - Seek partnerships
    - Digitizing & editing
    - Remote sensing analysts



# 23 States & Program Cooperators



# Cropland Data Layer Benefits

- Internal
  - Digitize the entire June Agricultural Survey (JAS)
    - Cleans up JAS problems
  - Cropland acreage indications
  - Include other data sets for training (sharing)
    - Vector or raster
  - Create annual CDL products

# Cropland Data Layer Benefits

- External
  - Commercial image format - GeoTIFF
  - Ortho-rectified image product
    - MDA GeoCover base
  - Detailed breakdown of cropland area
  - Distribute CDL into public domain
  - Access into FAS image archive
  - Access to NASS software and training
  - New methods address non-ag areas



# Program Resources

## Hardware

- Computational intensive jobs (i.e. cluster/classify/regression/mosaic)
  - Windows XP
- Digitizing/ground truth editing
  - Windows XP

## Software

- Image processing
  - PEDITOR public domain
- Digitizing/ground truth
  - Remote Sensing Project
- Batch job processing
  - XLNT – COTS
  - [www.advsyscon.com](http://www.advsyscon.com)
- New research - See5.0
  - [www.rulequest.com](http://www.rulequest.com)

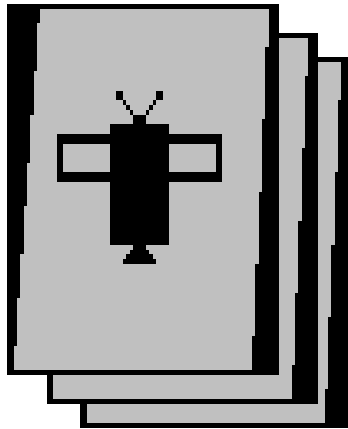


# Program “In-House” Software

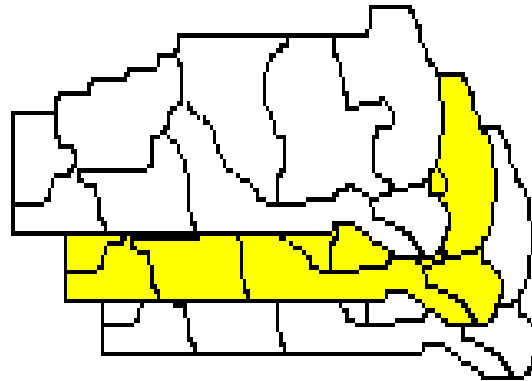
- PEDITOR - 1970's
  - Developed in Delphi, Pascal and Fortran
  - Performs
    - Digitizing/clustering/classification/estimation/mosaicking
    - Optimized for dual processors
    - “Expert” rules built into processing routines
  - Optimized for area sampling frame processing
- Remote Sensing Project (RSP) – 1990's
  - Developed in Microsoft Visual FoxPro
  - Manages ground truth database
  - Performs digitizing and ground truth editing



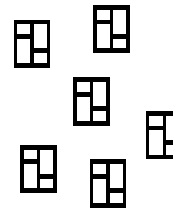
# Acreage Estimation Inputs



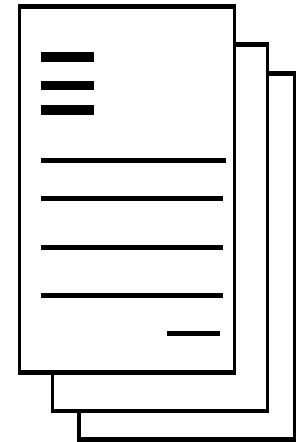
Satellite  
Images



Area Frame  
Strata Boundaries

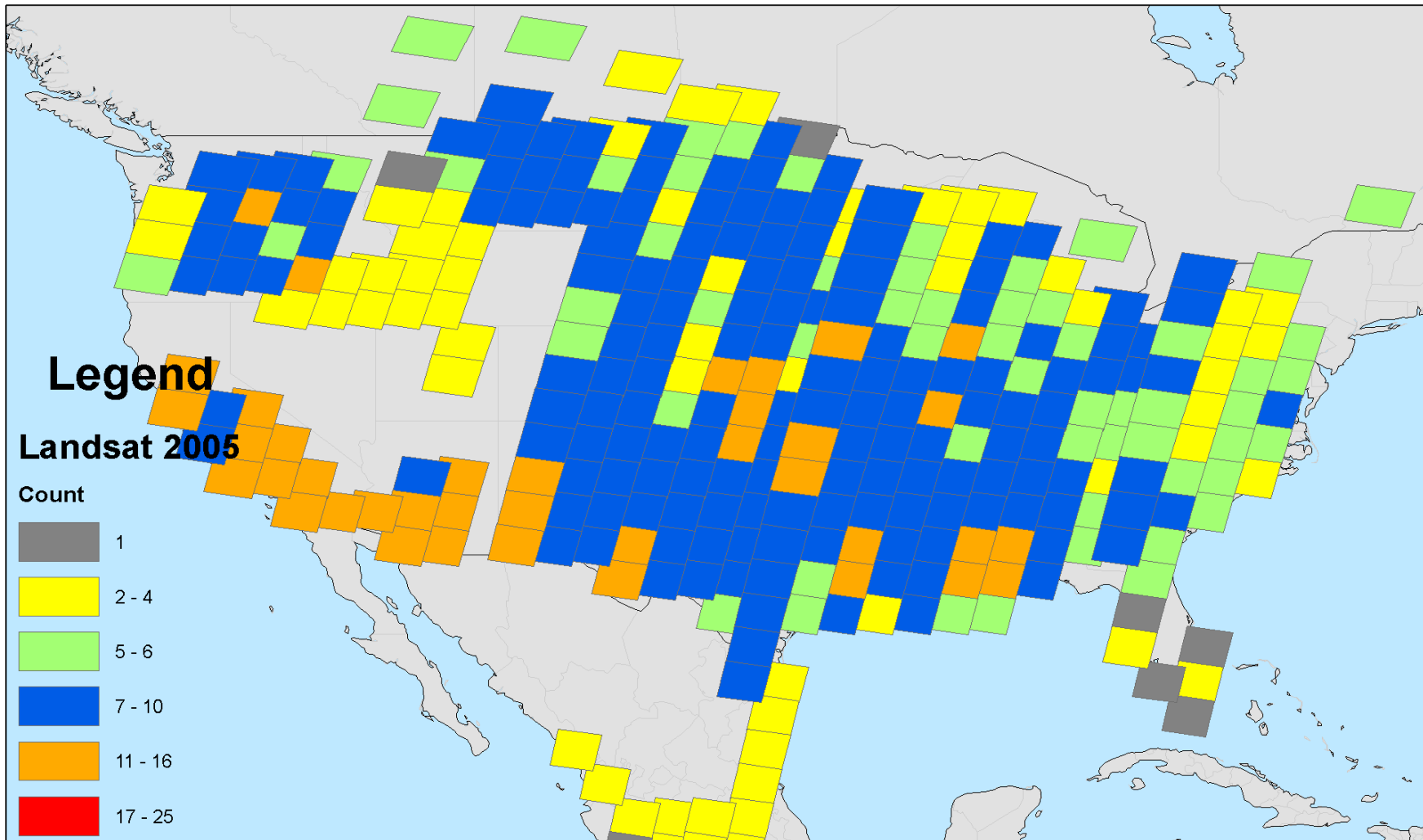


Segment  
Boundaries



Section D  
from Area  
Questionnaire

# 2005 Landsat in the USDA-SIA



USDA Satellite Imagery Archive (USDA-SIA)  
Contact: Robert Tetrault (202) 690-0130  
robert.tetrault@usda.gov  
<http://www.pecad.fas.usda.gov/remote.cfm>

USDA-SIA  
Collection includes Landsat 5  
and Landsat 7  
2005 Calendar year

# Why Not Landsat?



Landsat 7 ETM+  
SLC failure



## News Release

November 30, 2005 Ron Beck

703-648-6168

[beck@usgs.gov](mailto:beck@usgs.gov)

## Landsat 5 Experiencing Technical Difficulties

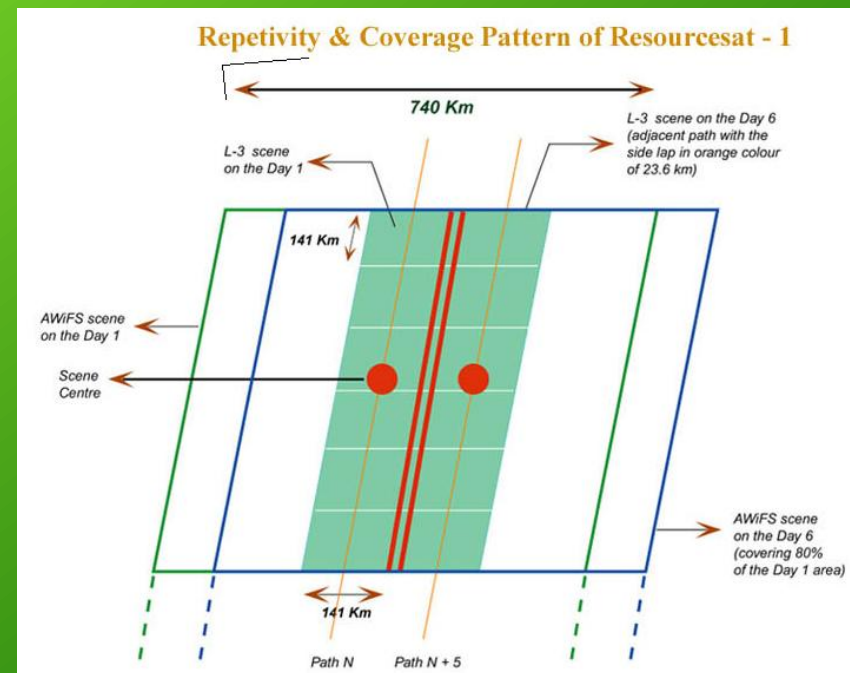
On November 26, 2005, the back-up solar array drive on Landsat 5 began exhibiting unusual behavior. The solar array drive maintains the proper pointing angle between the solar array and the sun. The rotation of the solar array drive became sporadic and the solar array was not able to provide the power needed to charge the batteries. Maintaining power to the batteries is critical to sustain proper operation of the spacecraft. The primary solar array drive failed under similar circumstances last January. As a result of this current situation, imaging operations will be suspended for at least the next two weeks or until attempts to solve the problem have been resolved.

Landsat 5 TM  
Solar Array

# Indian Remote Sensing Satellite: ResourceSat-1

## Advanced Wide Field Sensor (AWiFS)

- 370 km swath per quad
- 740 km combined
- 56 m resolution at nadir
- 70 m resolution at scene edges
- Launched 2003



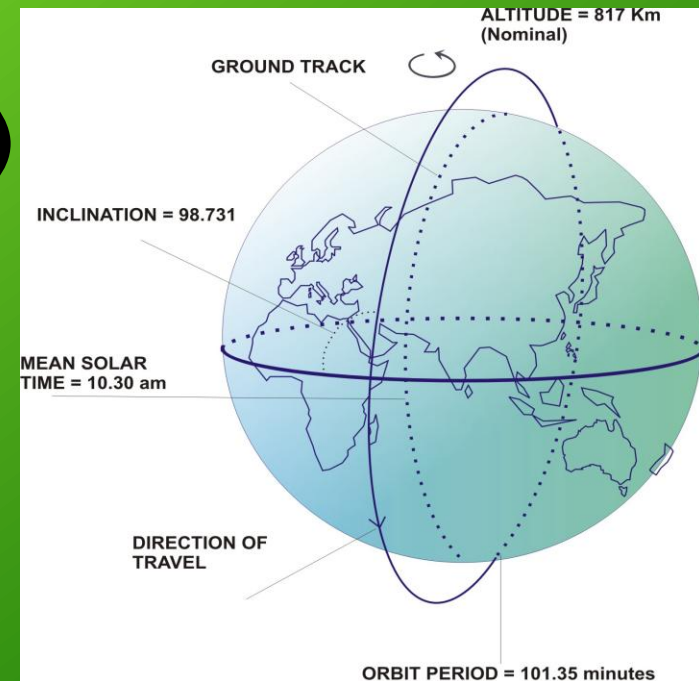


# Advanced Wide Field Sensor (AWiFS)

## Spectral Bands:

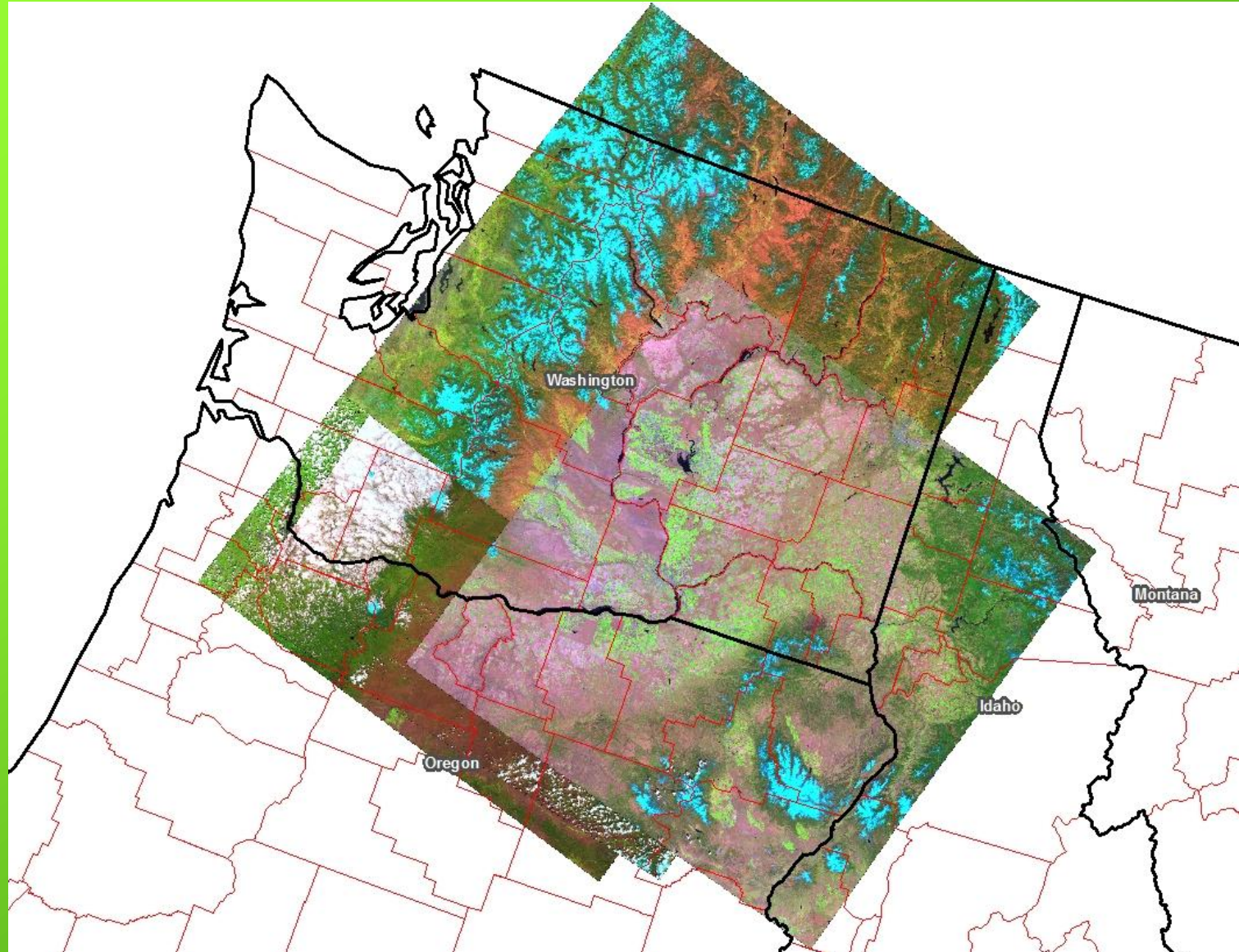
- B2: 0.52-0.59 (Visible Green)
- B3: 0.62-0.68 (Visible Red)
- B4: 0.77-0.86 (Near Infrared)
- B5: 1.55-1.70 (Middle infrared)

**5 day repeat cycle**

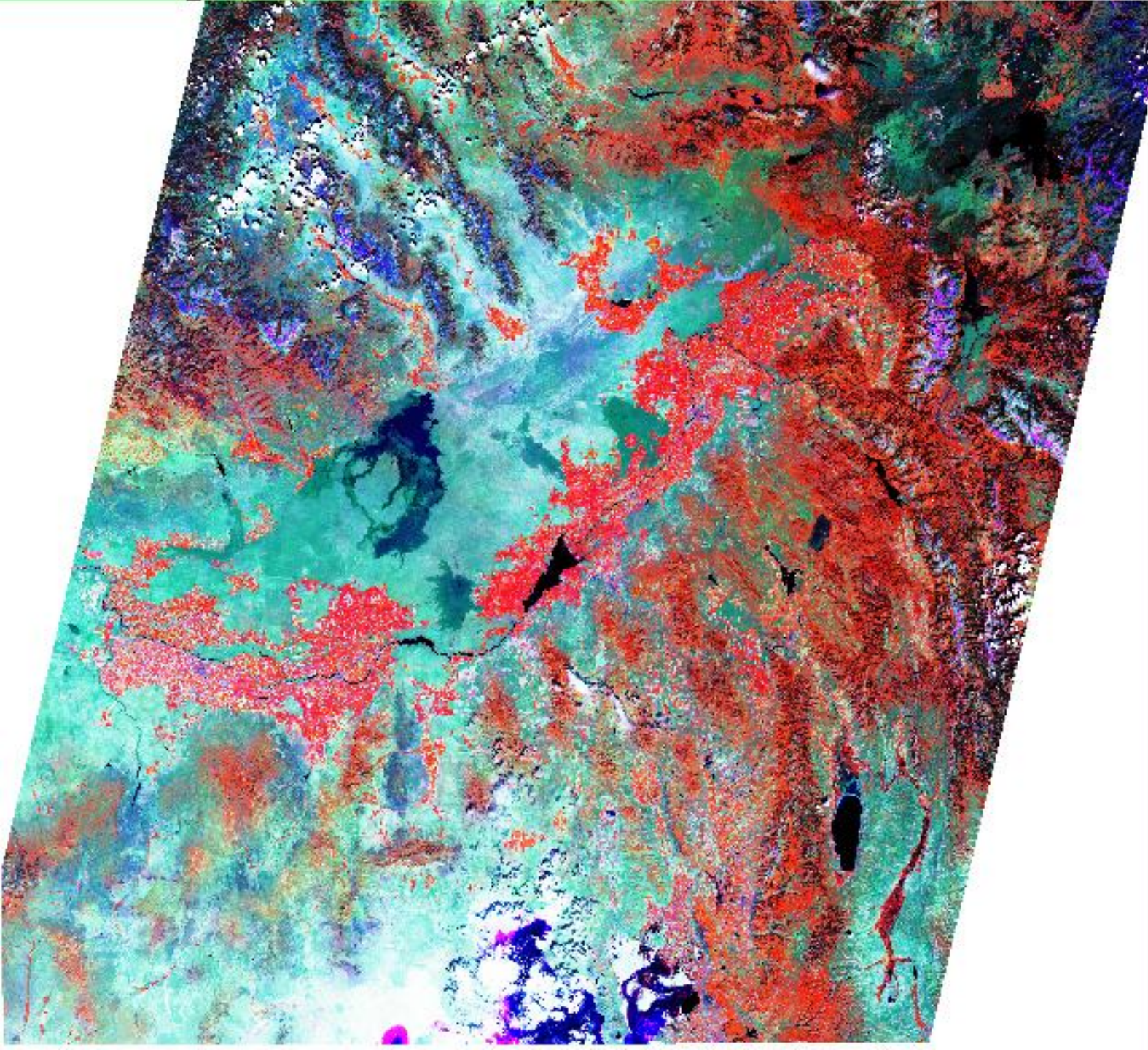


# AWiFS Scene Footprints

All scenes ortho-rectified by GeoEye





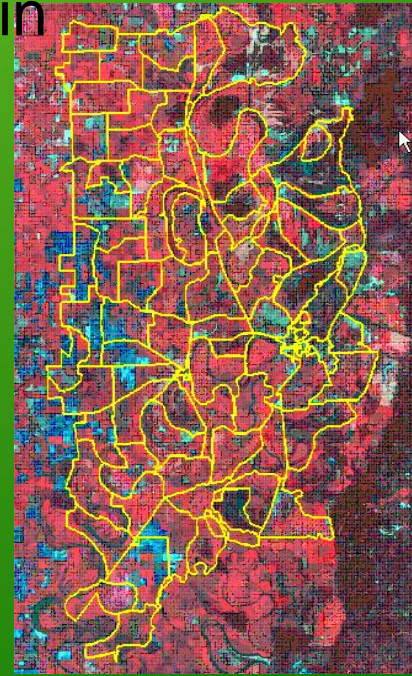
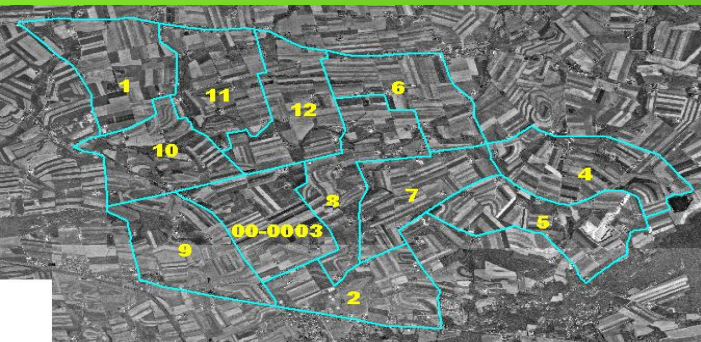


**AWiFS Full  
Scene  
6/19/05**

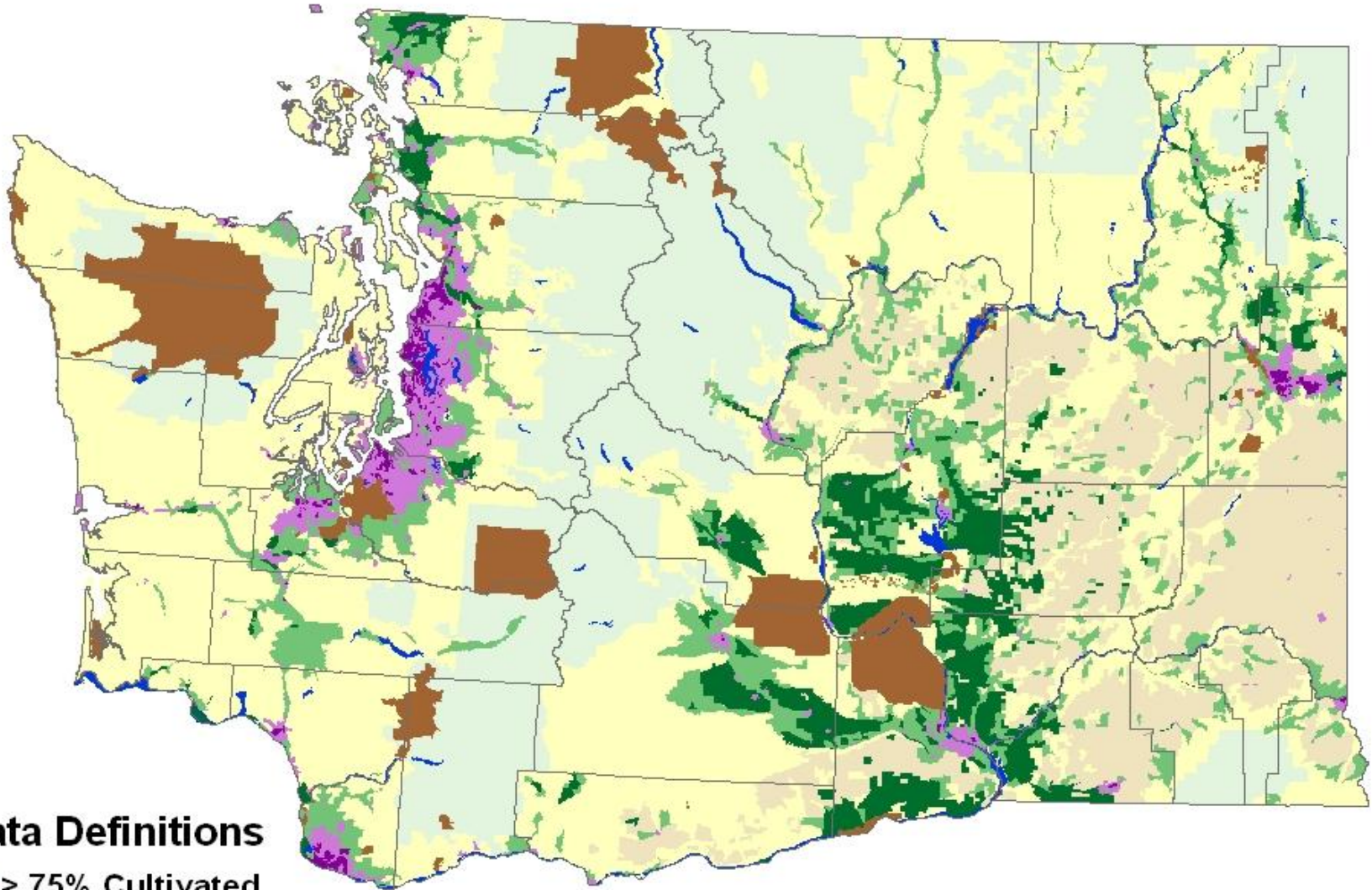


# Area Sampling Frame

- Stratify based on percent cultivated land
- Subdivide strata into primary sampling units or PSU's
  - Selected PSU's divided into secondary sampling units or segments
  - Segments are selected randomly & used in successive years
  - 20 percent segment rotation/year
    - Entire sample replaced every 5 years



# Washington Land Use Strata



## Strata Definitions

**> 75% Cultivated**

**25% - 75% Cultivated**

**< 25% Cultivated, National Forest**

**< 25% Cultivated, Non-Forest**

**Dryland Grain**

**Agri-Urban > 100 Homes/Sq. Mi.**

**Commercial > 100 Homes/Sq. Mi.**

**Non-Agricultural**

**Water**



# 2006 June Agricultural Survey



**NATIONAL  
AGRICULTURAL  
STATISTICS  
SERVICE**

Authority for collection of information on the June Agricultural Survey is Title 7, Section 2204 of the U.S. Code. The information will be used to compile and publish agricultural estimates for individual States and for the United States. Individual reports are held confidential. Response is voluntary.

### Washington Field Office

P.O. Box 609  
Olympia, WA 98507-0609  
1-800-435-5883  
Fax: 1-800-265-6275  
E-mail: [nass-wa@nass.usda.gov](mailto:nass-wa@nass.usda.gov)

Washington

## JAS Questionnaire

Segment Number: \_\_\_\_\_ Tract Letter: \_\_\_\_\_ County: \_\_\_\_\_

State	Stratum	Segment	Tract No
_____	_____	00000	00

OFFICE USE -OPTIONAL	
407	408

- Enumerators account for all land usage in segment
  - Draw off field location by direct observation
  - Directly link questionnaire to segment photo

10.							
11.	Acres irrigated and to be irrigated [if double cropped, include acreage of each crop irrigated.]		620	620	620	620	620
12.	Spring Wheat Other than Durum (include cover crop)	Planted and to be planted	550	550	550	550	550
13.		For grain or seed	768	768	768	768	768
16.	Winter Wheat (include cover crop)	Planted	540	540	540	540	540
17.		For grain or seed	541	541	541	541	541
20.	Oats (include cover crop)	Planted and to be planted	533	533	533	533	533
21.		For grain or seed	534	534	534	534	534



# Segment Boundaries

- June Agricultural Survey (JAS) segments
  - Enumerator records field extents, cover types, and acreage

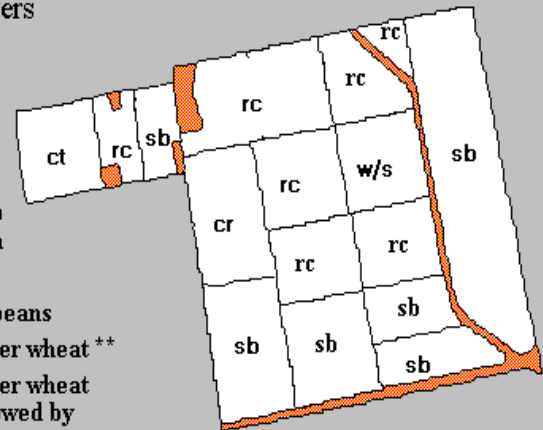


SEGMENT 3193

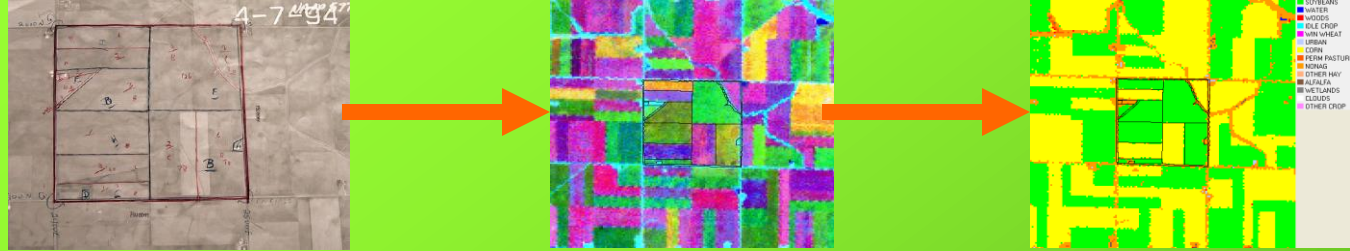
Field Covers

1997

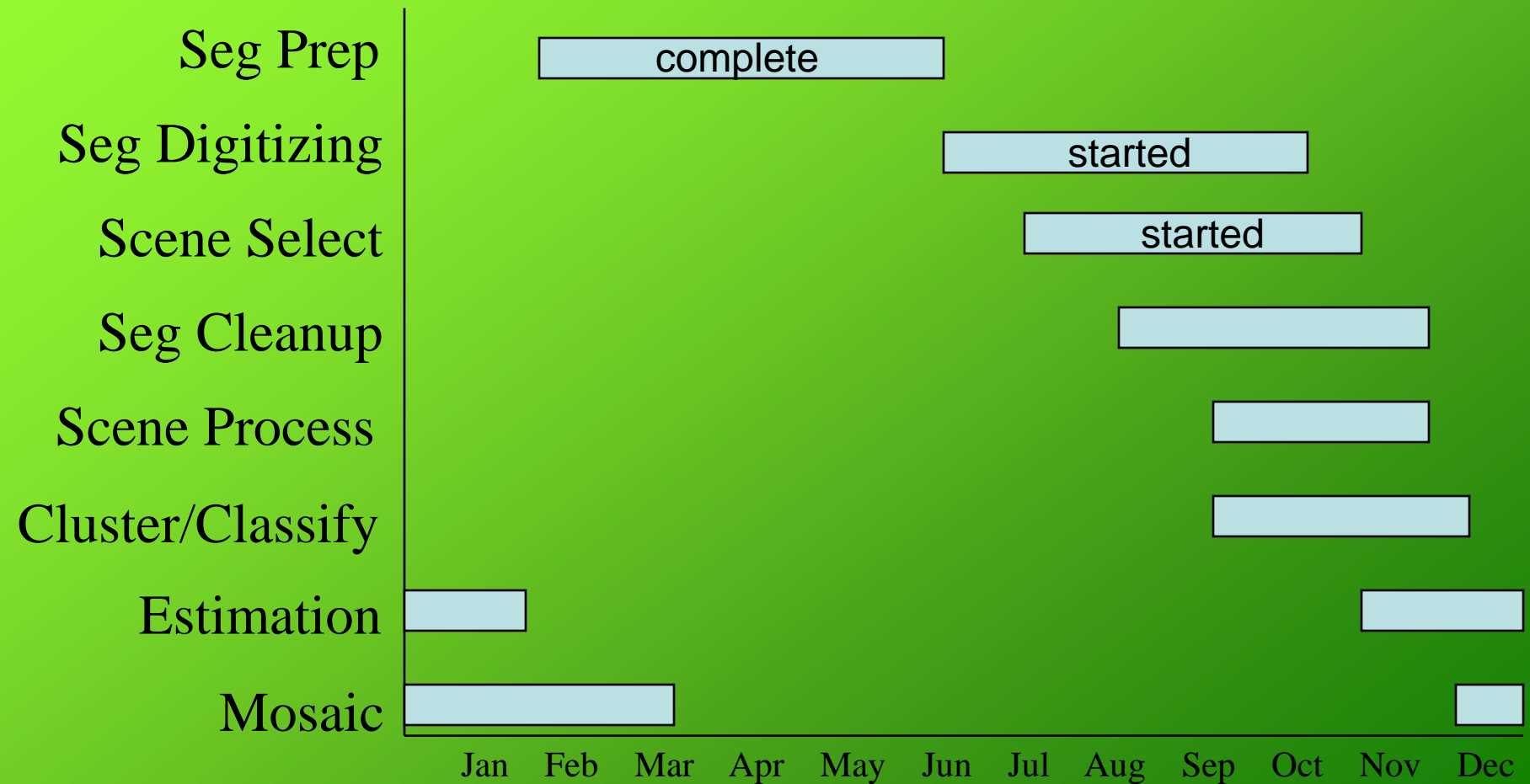
ct cotton  
cr corn  
rc rice  
sb soybeans  
ww winter wheat \*\*  
w/s winter wheat followed by soybeans  
waste, water or nonagricultural



\*\* winter wheat not followed by another crop



# Program Timeline

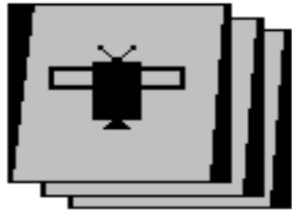


# Classification Overview

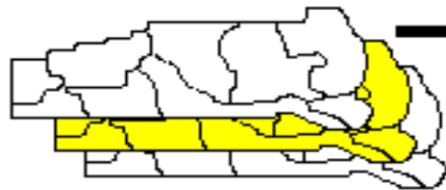
Spectral  
Signature  
File



Satellite  
Images

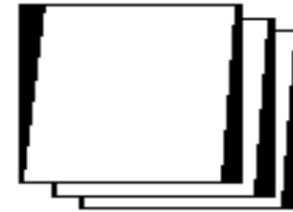


Area Frame  
Strata



c  
a  
t  
e  
g  
o  
r  
i  
z  
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b  
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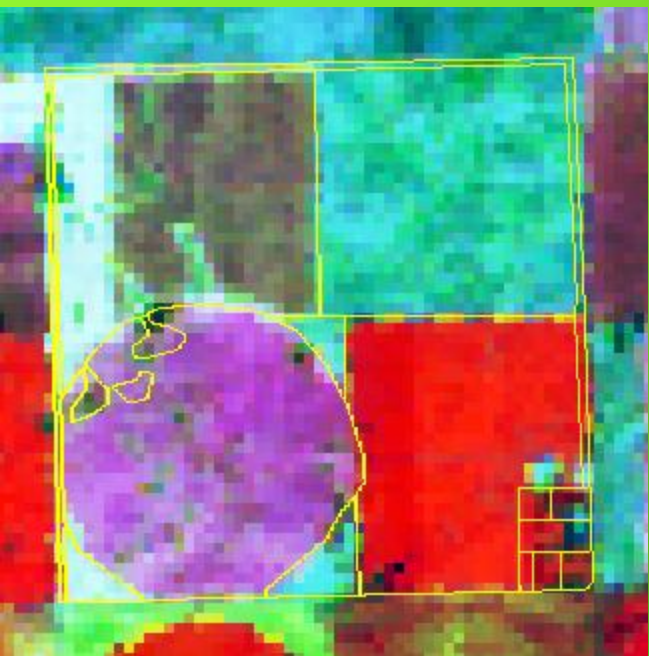
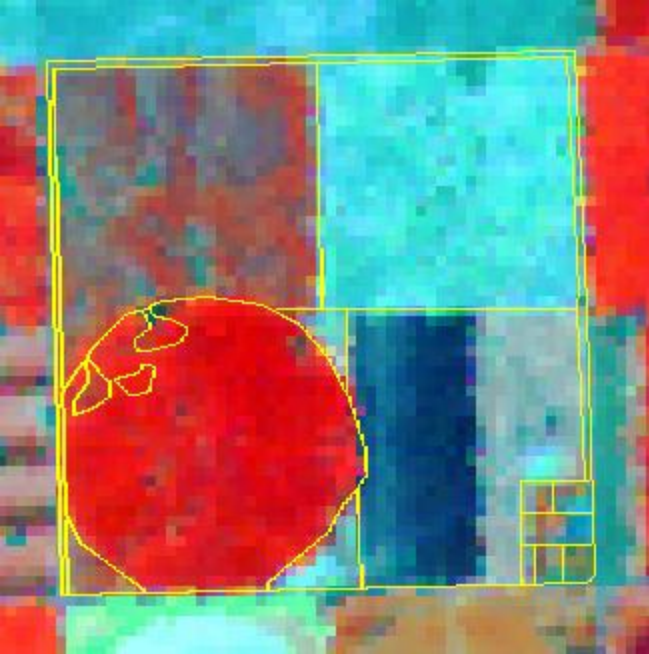


Categorized  
Satellite  
Imagery

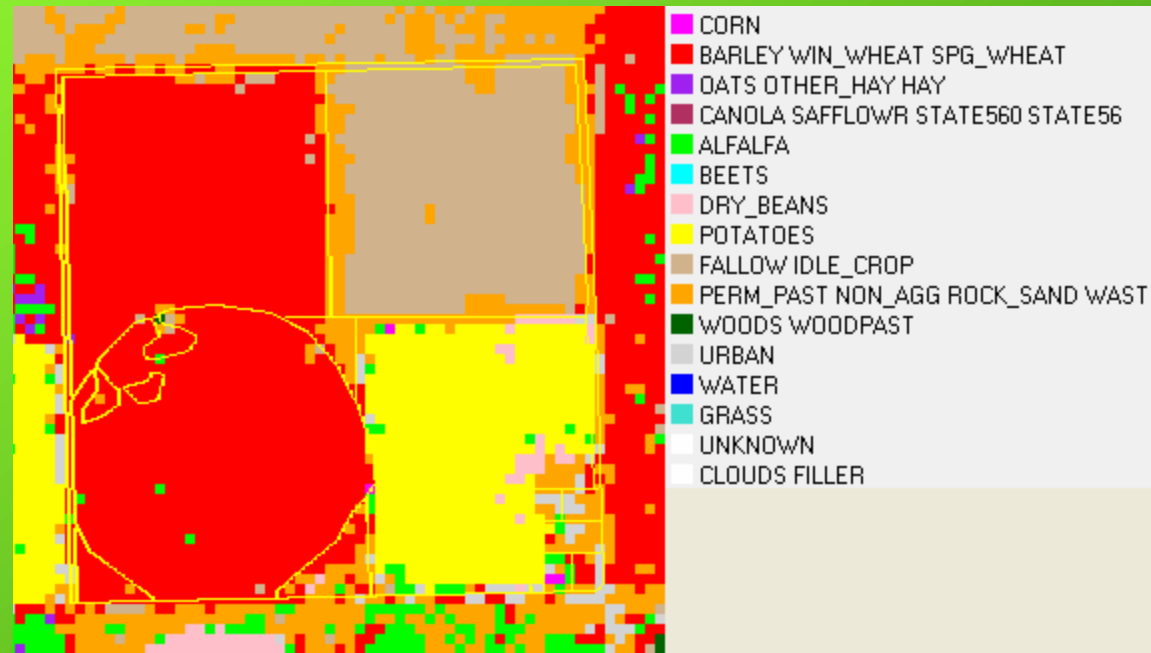


Tabulation  
for Each  
Crop Cover  
by Stratum  
and County

# Training Data



Raw image



Categorized output

# Training Data



- CORN
- BARLEY WIN\_WHEAT SPG\_WHEAT
- OATS OTHER\_HAY HAY
- CANOLA SAFFLOWR STATE560 STATE56
- ALFALFA
- BEETS
- DRY\_BEANS
- POTATOES
- FALLOW IDLE\_CROP
- PERM\_PAST NON\_AGG ROCK\_SAND WAST
- WOODS WOODPAST
- URBAN
- WATER
- GRASS
- UNKNOWN
- CLOUDS FILLER

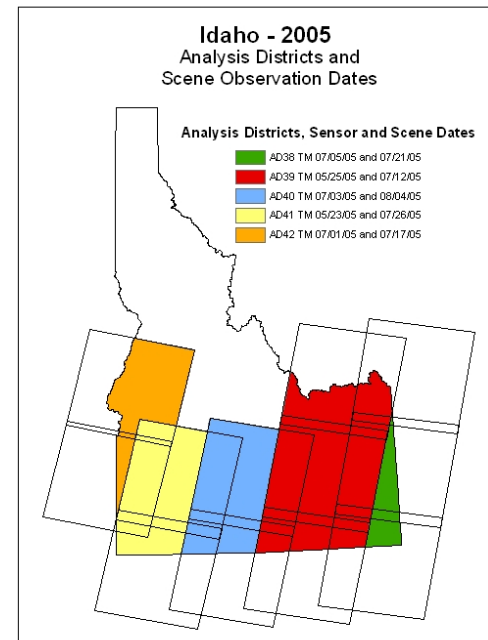
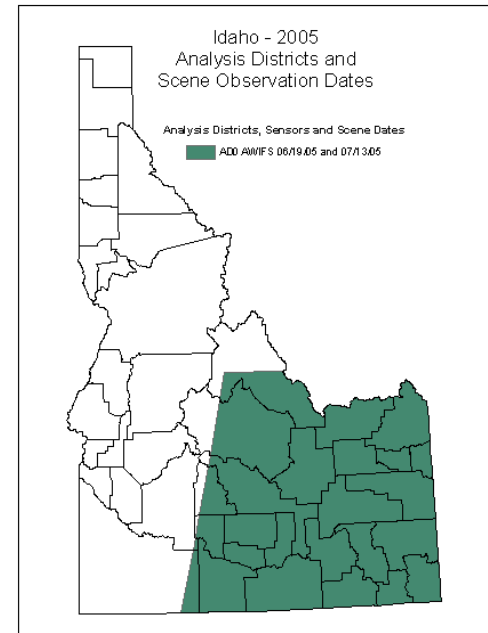
Categorized output

Raw image



# Scene Analysis Districts

- Can be defined by
  - Contiguous same date coverage
  - Scene edge or county boundary
- Cloud free or near cloud free dates
- Unitemporal
  - One date
- Multi-temporal
  - Two date(s) overlay





# Regression Template

## Sample Based

D4 Area  
Survey  
Data



$y$



Tabulate Crop  
Covers by  
Sample Segment



$n, x, b$



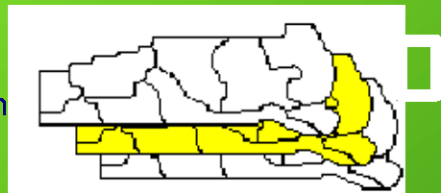
R  
e  
g  
r  
e  
s  
s  
i  
o  
n  
  
E  
s  
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a  
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r

Indication



## Population Based

Area Frame  
Strata Population



$N$



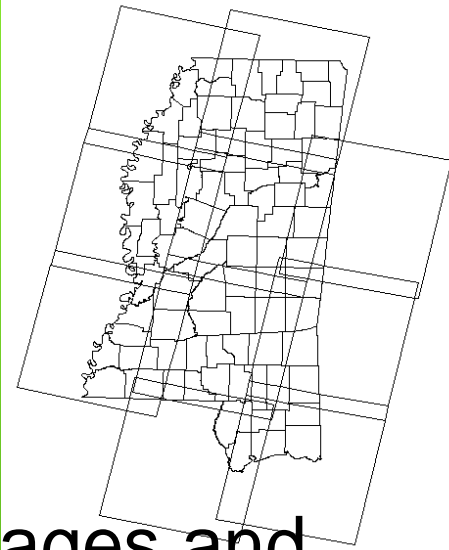
Tabulate Each  
Crop Cover by  
Stratum & County  
from Full Scene



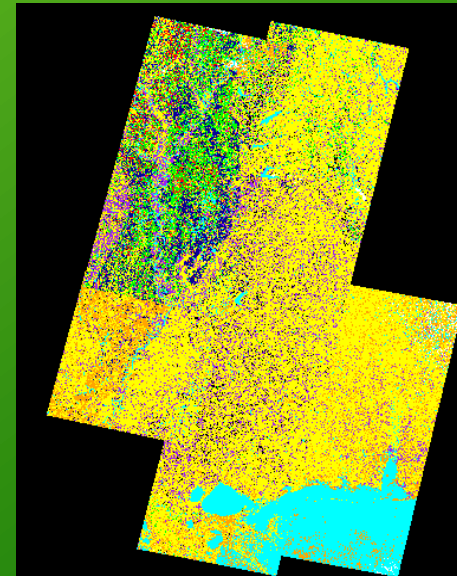
$X$



# Mosaic Method



- Run block correlation between all raw images and MDA's GeoCover Stock Mosaic
  - Co-register raw images to GeoCover's band 2 (green)
- Register all categorized scenes to GeoCover base
  - Use calibration coefficients
- Mosaic all categorized images
  - Establish scene overlap priorities
  - Clip by scene edge or county boundary
  - Mask out clouds via priority schemes



# State-wide CDL Distribution

- Held until county estimates released
- Bundle images with [ESRI's ArcReader](#)
  - Ancillary vector layers
  - Area Sampling Frame
- No copyright restrictions
- Publish accuracy statistics

SIGNATURES, PERCENT CORRECT AND KAPPA BY ANALYSIS DISTRICT - ARKANSAS 2000  
(Percent Correct on Known Good Fields Only)

ANALYSIS DISTRICT AD01 - DATES = 4/09/00 & 8/31/00 LANDSAT 5 TM - PATH: 23, ROW: 35; 14 CHANNELS 144 CROP / COVER TYPE SIGNATURES						
<u>Mosaic Category</u>	Crop / Cover *	Original # Categories	Original # Pixels	Percent Correct*	Commission Error (%)	Kappa Coefficient
1	CORN	19	2358	98.05	0.39	98.00
2	COTTON	19	19352	95.93	3.54	94.93
81	FILLER	1	0	0.00	0.00	0.00
59	FESCUE SEED	1	105	81.90	18.10	81.89
61	IDLE CROP	10	1458	95.47	10.25	95.40
62	NON AGRIC	10	7795	71.19	10.28	69.24



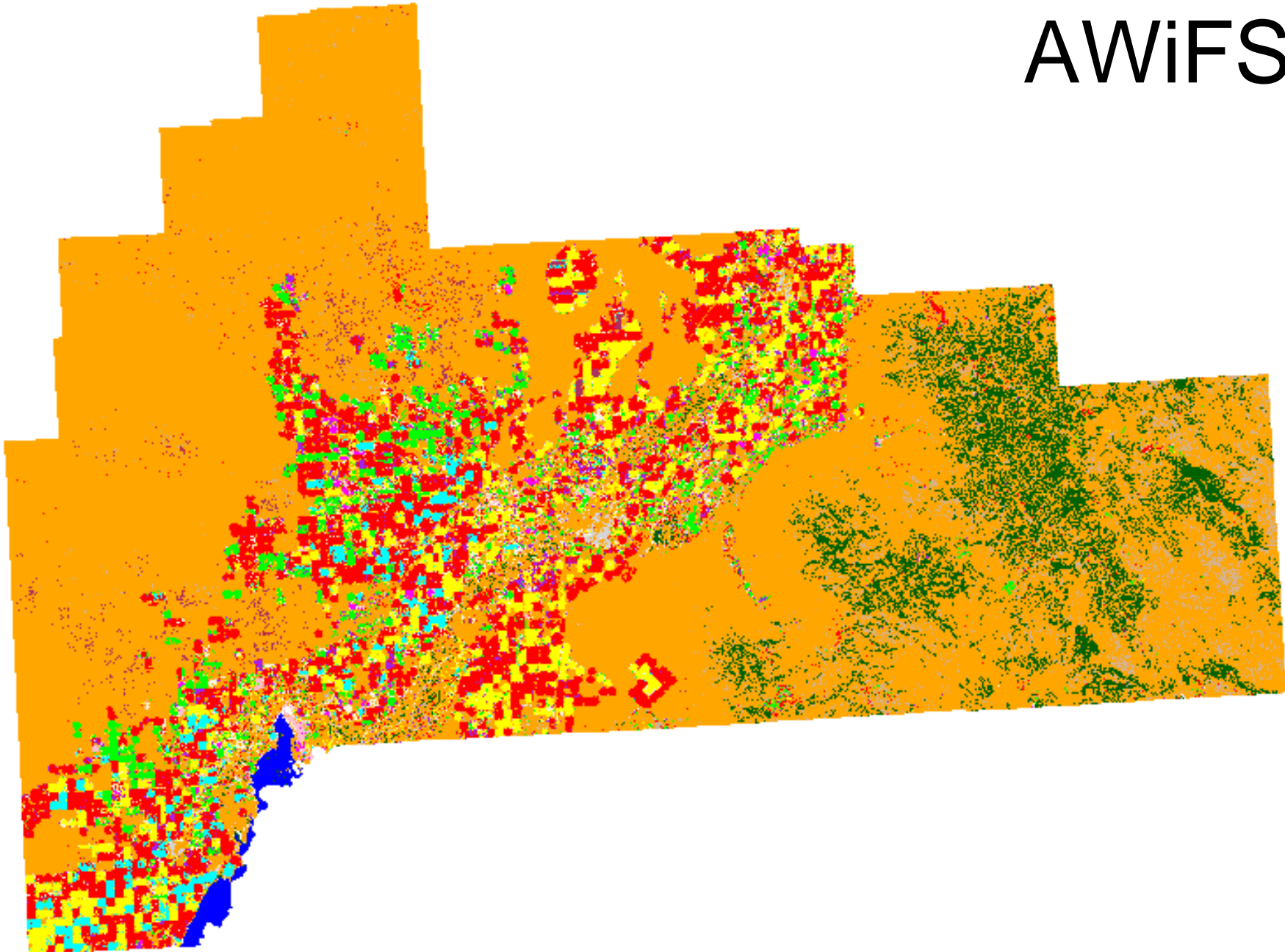
LANDSAT COVERAGE / ANALYSIS DISTRICTS [2000](#) or [2001](#)

REGRESSION ANALYSIS - BY CROP [2000](#) or [2001](#)

SIGNATURES, PERCENT CORRECT AND KAPPA - BY ANALYSIS DISTRICT [2000](#) or [2001](#)

SAMPLING AND AREA FRAME INFORMATION ([BOTH YEARS](#))

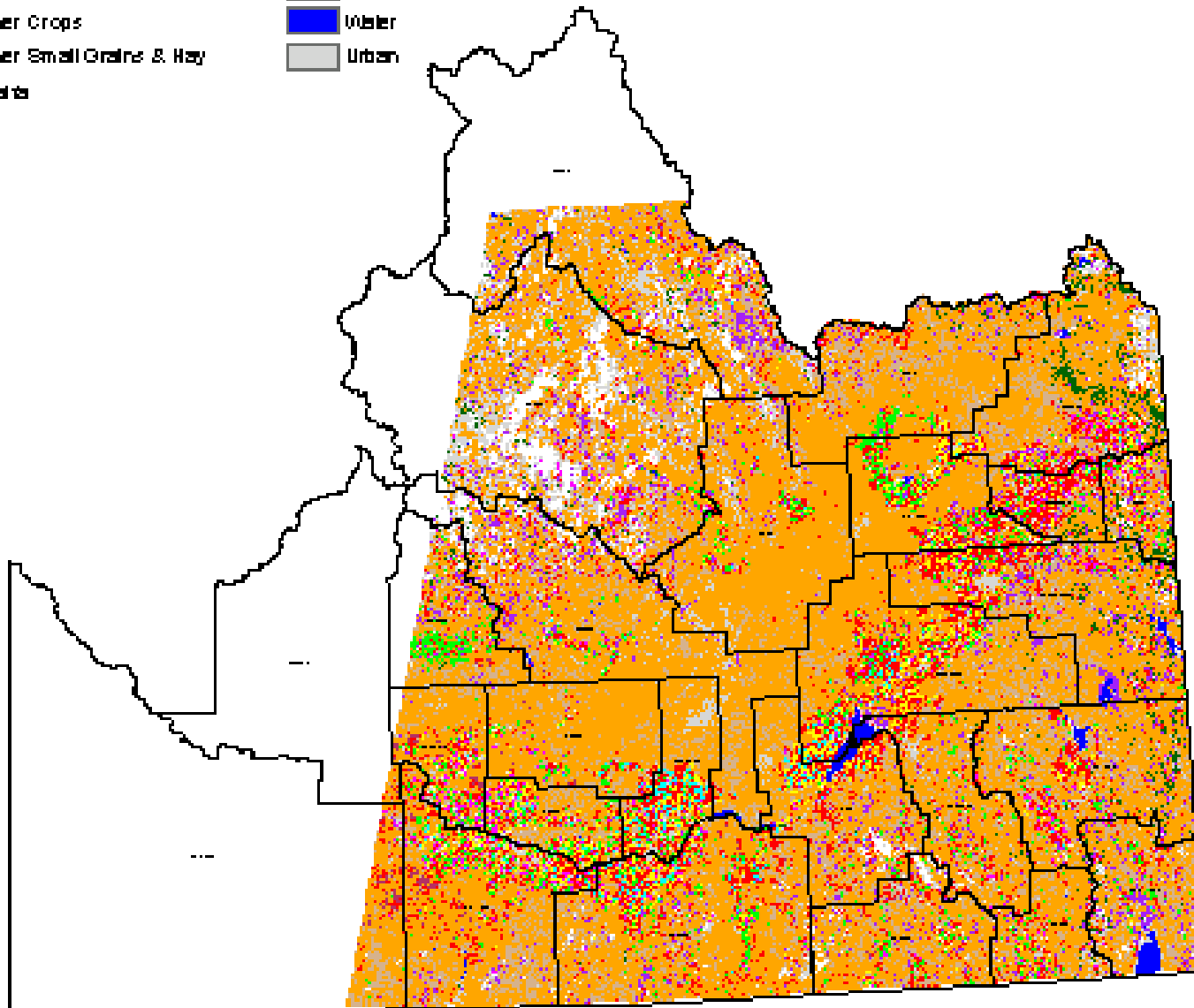
# Bingham County, ID CDL AWiFS



## Categories

 Berseem	 Grass
 Corn	 Pasture/Range/Mon-Ag
 Dry Edible Beans	 Fallow/Idle Cropland/C.R.P.
 Potatoes	 Woods
 Winter & Spring Wheat/Barley	 Clouds
 Other Crops	 Water
 Other Small Grains & Hay	 Urban
 Alfalfa	

## 2005 Idaho AWIFS Cropland Data Layer



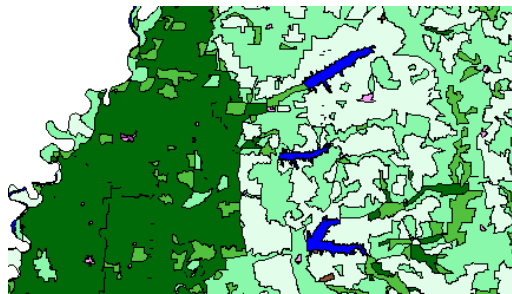


# Program Summary

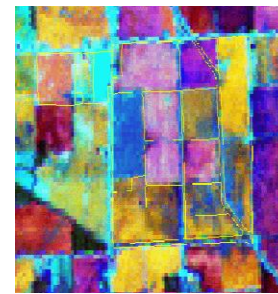
Raw Satellite Image



Area Sampling Frame



Segment Boundaries



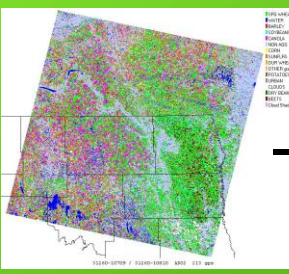
JAS Questionnaire

PAGE 2 SECTION D - CROPS AND LAND USE ON TRACT

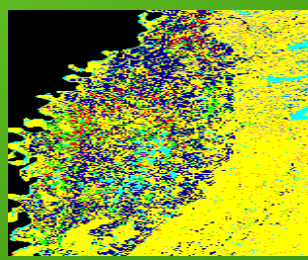
How many acres are inside the blue tract boundaries drawn on the photo (map)?

How would you like to ask about each field inside this blue tract boundary and its use during 2000?

Tract ID Number	01	02	03	04	05
1. Tobaccoless field	020	028	028	020	028
2. Conventional (Specify)					
3. Conventional (Specify)	061				
4. Field, structure, building, building and structure, roads, ditches, etc.	001	001	001	001	001
5. Woodland	062	062	062	062	062
6. Pasture	065	065	065	065	065
7. Other (Specify)	067	067	067	067	067
8. Use (Specify)	070	070	070	070	070
9. Use (Specify)	071	071	071	071	071
10. Use (Specify)	072	072	072	072	072
11. Use (Specify)	073	073	073	073	073
12. Use (Specify)	074	074	074	074	074
13. Use (Specify)	075	075	075	075	075
14. Use (Specify)	076	076	076	076	076
15. Use (Specify)	077	077	077	077	077
16. Use (Specify)	078	078	078	078	078
17. Use (Specify)	079	079	079	079	079
18. Use (Specify)	080	080	080	080	080
19. Use (Specify)	081	081	081	081	081
20. Use (Specify)	082	082	082	082	082
21. Use (Specify)	083	083	083	083	083
22. Use (Specify)	084	084	084	084	084
23. Use (Specify)	085	085	085	085	085
24. Use (Specify)	086	086	086	086	086
25. Use (Specify)	087	087	087	087	087
26. Use (Specify)	088	088	088	088	088
27. Use (Specify)	089	089	089	089	089
28. Use (Specify)	090	090	090	090	090
29. Use (Specify)	091	091	091	091	091
30. Use (Specify)	092	092	092	092	092
31. Use (Specify)	093	093	093	093	093
32. Use (Specify)	094	094	094	094	094
33. Use (Specify)	095	095	095	095	095
34. Use (Specify)	096	096	096	096	096
35. Use (Specify)	097	097	097	097	097
36. Use (Specify)	098	098	098	098	098
37. Use (Specify)	099	099	099	099	099
38. Use (Specify)	100	100	100	100	100



Categorized Images



Mosaicked CDL

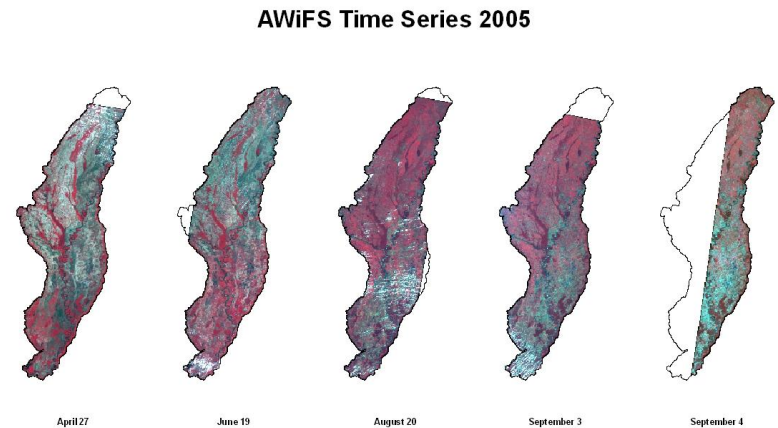
soybeans	2001	AR	Clay	21	129000	127000
soybeans	2001	AR	Conway	29	21000	20000
soybeans	2001	AR	Craighead	31	87000	85500
soybeans	2001	AR	Crawford	33	13000	12500
soybeans	2001	AR	Crittenden	35	166000	162500
soybeans	2001	AR	Cross	37	150000	149000
soybeans	2001	AR	Desha	41	87000	86000
soybeans	2001	AR	Drew	43	21000	20500
soybeans	2001	AR	Faulkner	45	7000	7000
soybeans	2001	AR	Franklin	47	2000	2000

Estimates



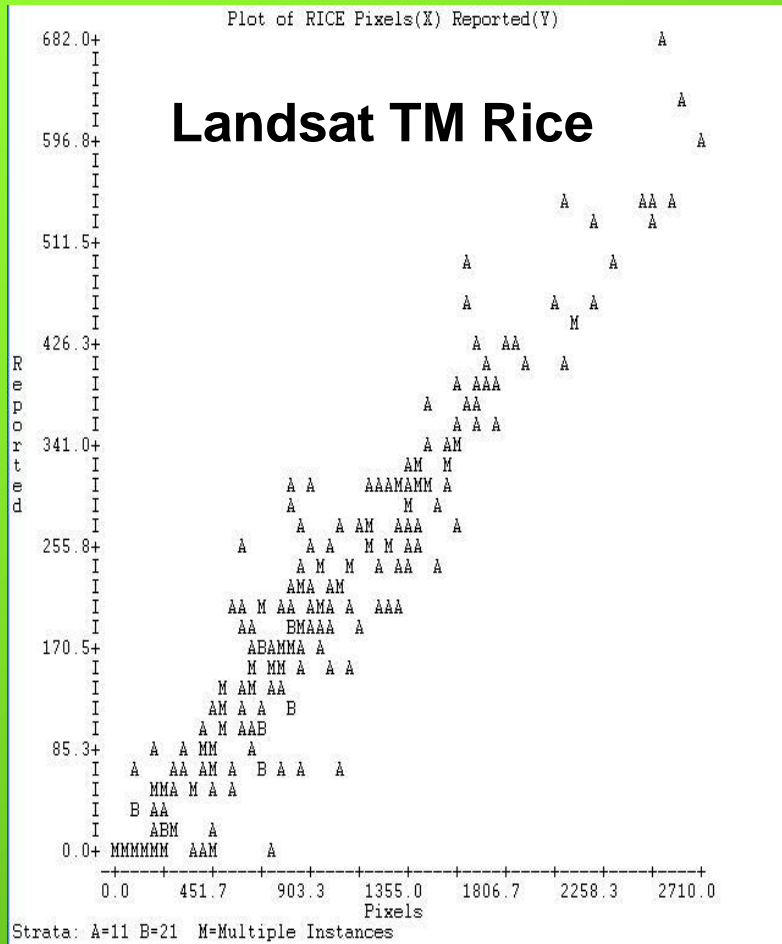
# New Program Research

- Regression tree analysis
  - See5.0 [www.rulequest.com](http://www.rulequest.com)
  - Use Erdas Imagine to prep imagery
  - Allows for overlay of ancillary dataset masks
    - NLCD/MRLC
  - Analyze numerous image layers
  - Builds regression trees based on points

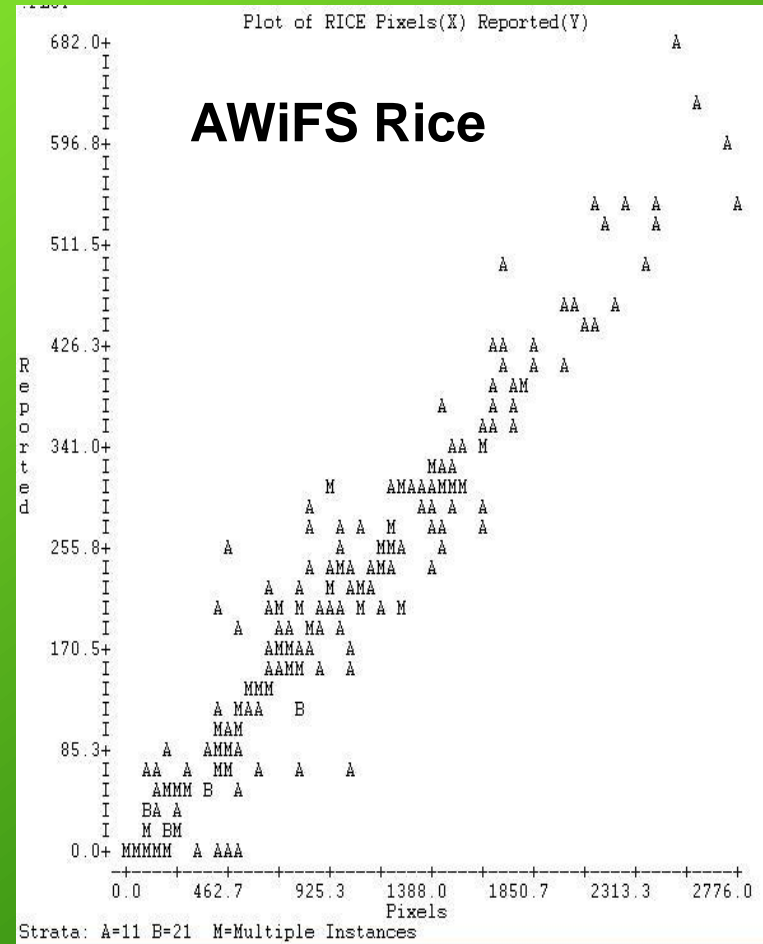


# New Program Research

- Evaluate SAS as estimator
- Using FSA as training data

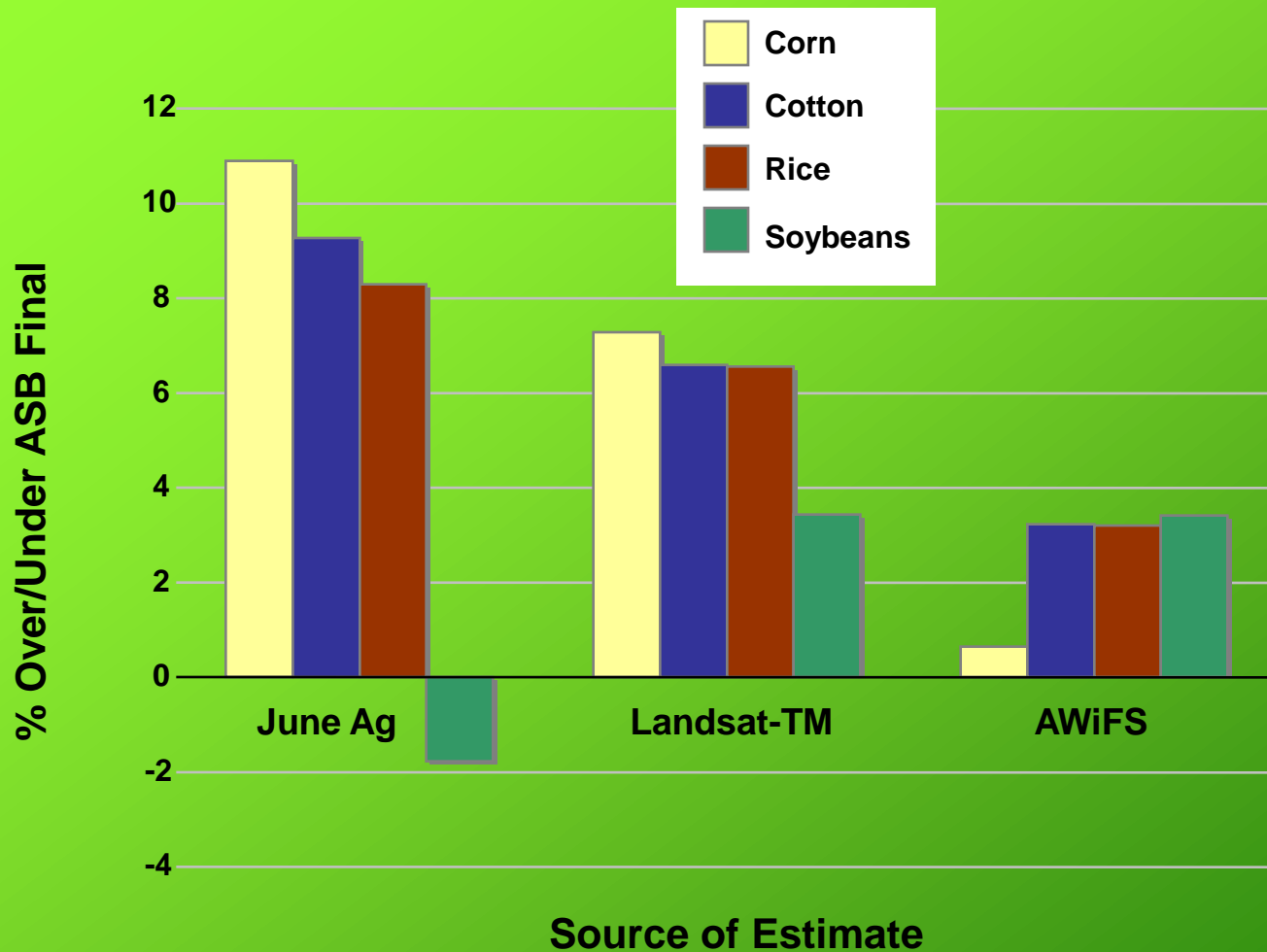


Pixel Sq meter/acres- .2224



Pixel Sq meters/acres - .2224

# Arkansas State Level Estimates as % Over/Under Agricultural Statistics Board (Final)



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



# GOOD FRUIT GROWER

Van Well Nursery

NEPLUMNE  
*varieties*

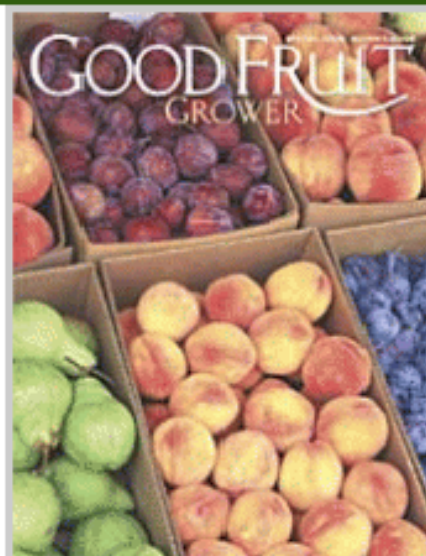
## Satellite surveys appear possible

Research by a team of students from the University of Washington suggests that satellite remote-sensing technology could be used to map Pacific Northwest grape and tree fruit crops each year, to provide growers with timely information for decision making.

Students Joan Johnson, Steve Cudd, and Carlito Tolentino looked at the possibility of combining commercial satellite imagery with processing software to develop detailed digital maps for acreage surveys and a database with information on acreage by crop and variety that can be easily updated. If the software can distinguish between crops, it would mean that growers would no longer have to spend time filling out survey paperwork.

Their research focused on a 28-square-kilometer area between Chelan and Manson in Chelan County, Washington.

More analysis is needed to determine the cost effectiveness, according to the Washington Wine Industry Foundation, which provided funding for the project from a U.S. Department of Agriculture risk management grant.



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MEXICO

*Fruit display at Reil Fruit  
Stand near Wenatchee,  
Washington. Photo by  
Lance Johnson, Yakima,  
Washington.*

## Florida Commercial Citrus Inventory Now Maintained with GIS

For more than 40 years, a primary mission of the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS)/Florida Field Office (FFO) has been to produce a biennial census of Florida's commercial citrus trees. The Florida Department of Agriculture and Consumer Services cooperate on this task sponsored by the Florida citrus industry. The number of trees in production, along with acres utilized, variety, and year planted, is tabulated. The data is aggregated and published at the county level.

The census is a major undertaking considering there are nearly 40,000 groves, totaling 700,000 acres, across peninsular Florida dedicated solely to citrus production. On average, about 130 trees are planted per acre, resulting in a total citrus tree count of around 91 million. The majority of harvested fruit is processed into orange or grapefruit juice. Citrus is estimated to be a \$9 billion a year industry and, thus, economically important to the state



Screen shot example of citrus grove boundaries overlaying one-meter resolution aerial imagery.



# CDL Conclusion

- Seeking partnerships/  
opportunities
- Publish CDL & accuracy  
assessment
  - GeoTIFF images
  - .html
- Evaluate new methods for  
operational use

Remember, in no  
case is farmer  
reported data  
revealed or derivable  
from the public use  
Cropland Data Layer  
DVD/CD-ROM's