USDA Remote Sensing Data Collections Implications for Land-Use Land-Cover Applications

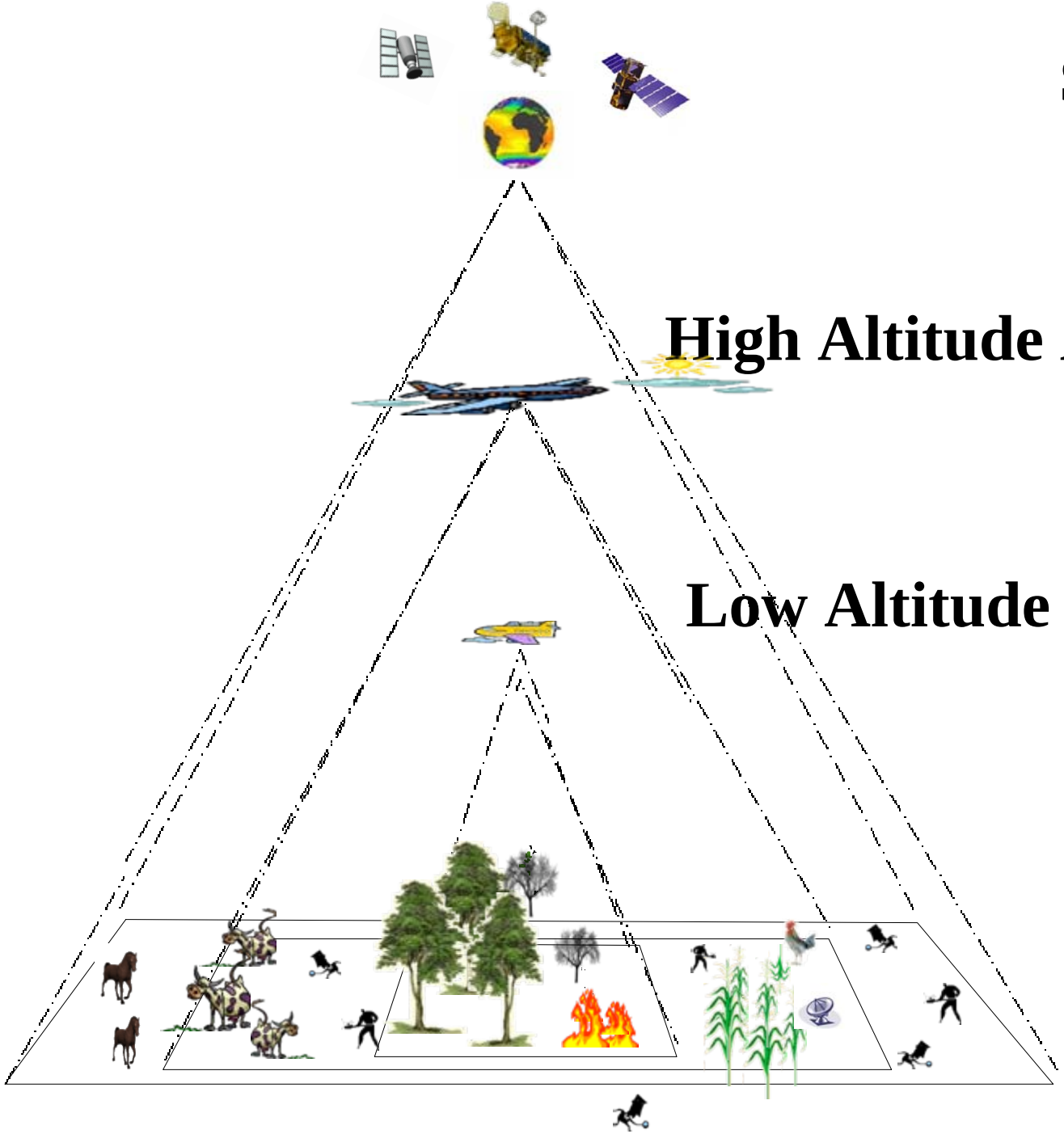
For Workshop on *New Developments in U.S. Land-Use Data Collection and Analysis: Implications for Agriculture and Rural Land*

Glenn R. Bethel

USDA Remote Sensing Advisor

glenn.bethel@usda.gov

October 16, 2007


Satellites
High Altitude Airborne
Low Altitude Airborne
Boots on the Ground

USDA's Investments: National GIS Implementation

- Creation of Accurate Image Base Maps.
- Digitization of Business Data Layers
- Keeping data current
  - USDA Imagery Programs
  - USDA Monitoring Programs

ERS ECONOMIC RESEARCH SERVICE U.S. DEPARTMENT OF AGRICULTURE

USDA Farm Service Agency

USDA FOREIGN AGRICULTURAL SERVICE

RMA

NRCS Natural Resources Conservation Service

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

APHIS

Creation of Accurate Digital Image Base Maps.

- Acquired 1 meter or Better Imagery for the Continental US and Puerto Rico
  - Partnerships: National Digital Orthophoto Program (NDOP)
    - Federal Agencies
    - National States Geographic Information Council

Areas Outside of CONUS: Mixture of Aerial and Satellite Imagery

- Commercial Satellite Imagery
  - Create Base Maps for Hawaii and US Territories.
  - Create Base Maps for populated Areas in Alaska.
  - Not Complete!

CNMI-PAJAROS QuickBird

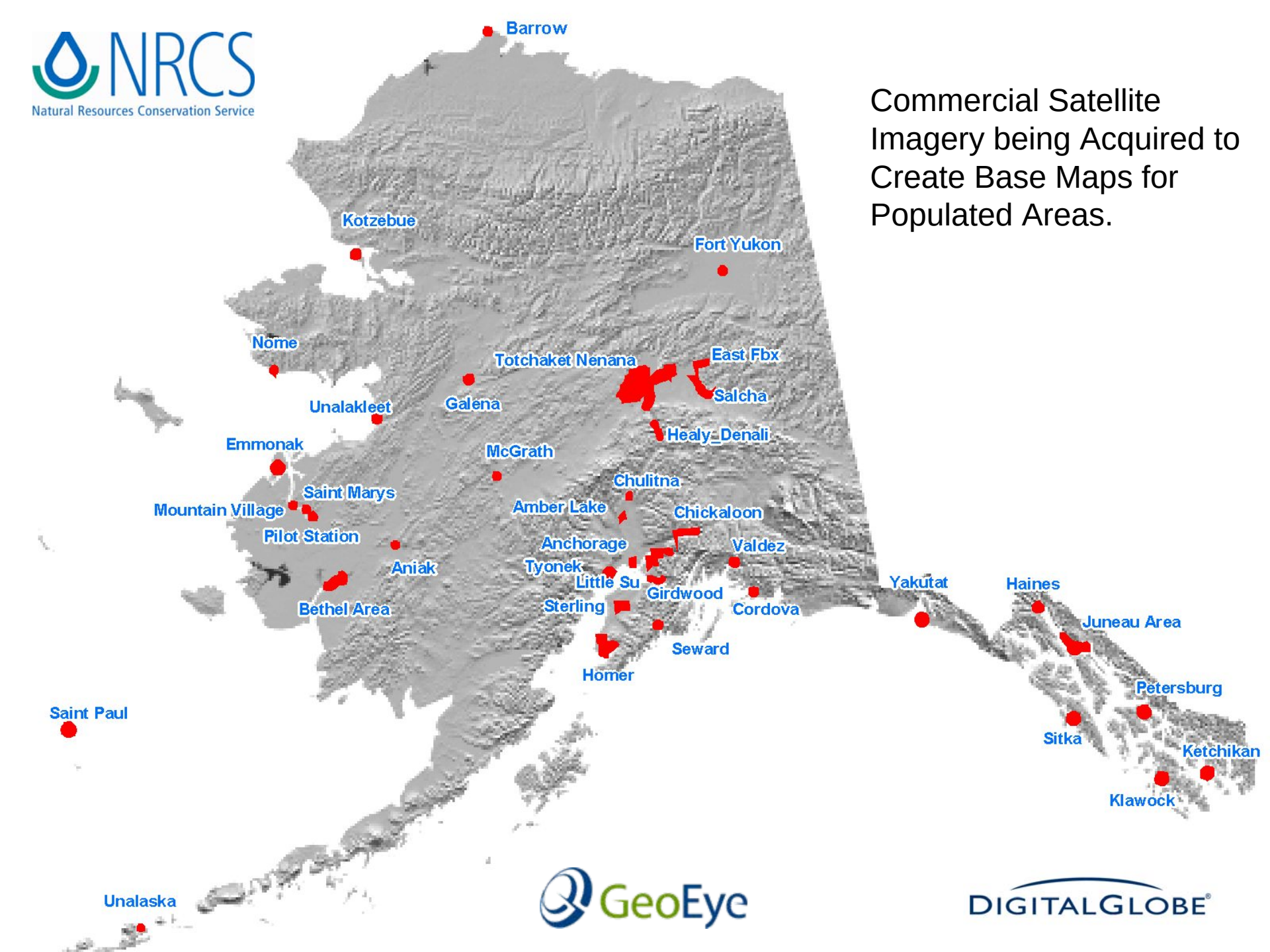
GeoEye

DIGITALGLOBE

Maug

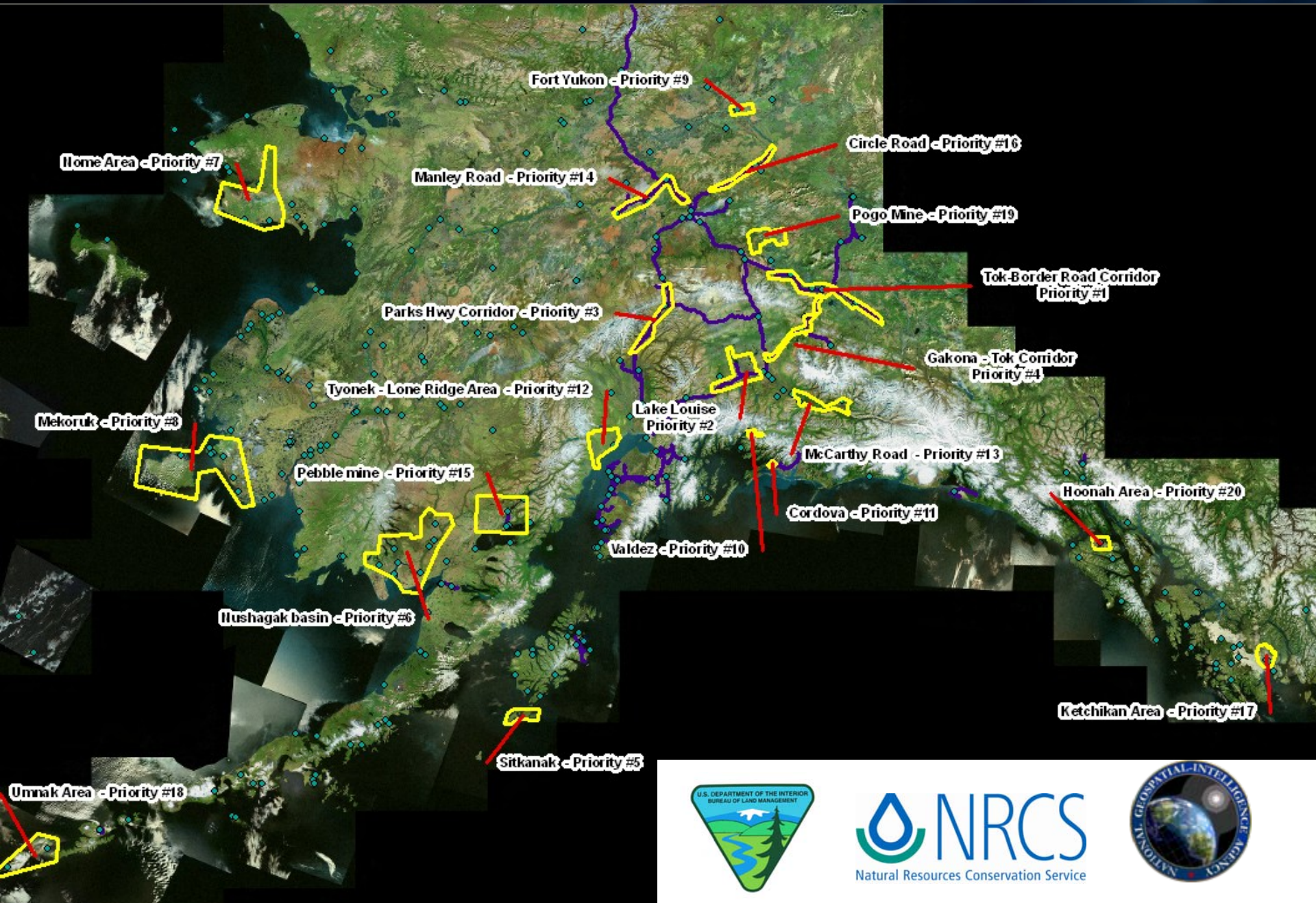
NRCS Natural Resources Conservation Service

USDA Farm Service Agency



Commercial Satellite Imagery being Acquired to Create Base Maps for Populated Areas.

NRCS Priority Area for Alaska Imagery



U.S. DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT

NRCS
Natural Resources Conservation Service

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY

Create Seamless ‘Ready to Use’ Base Imagery

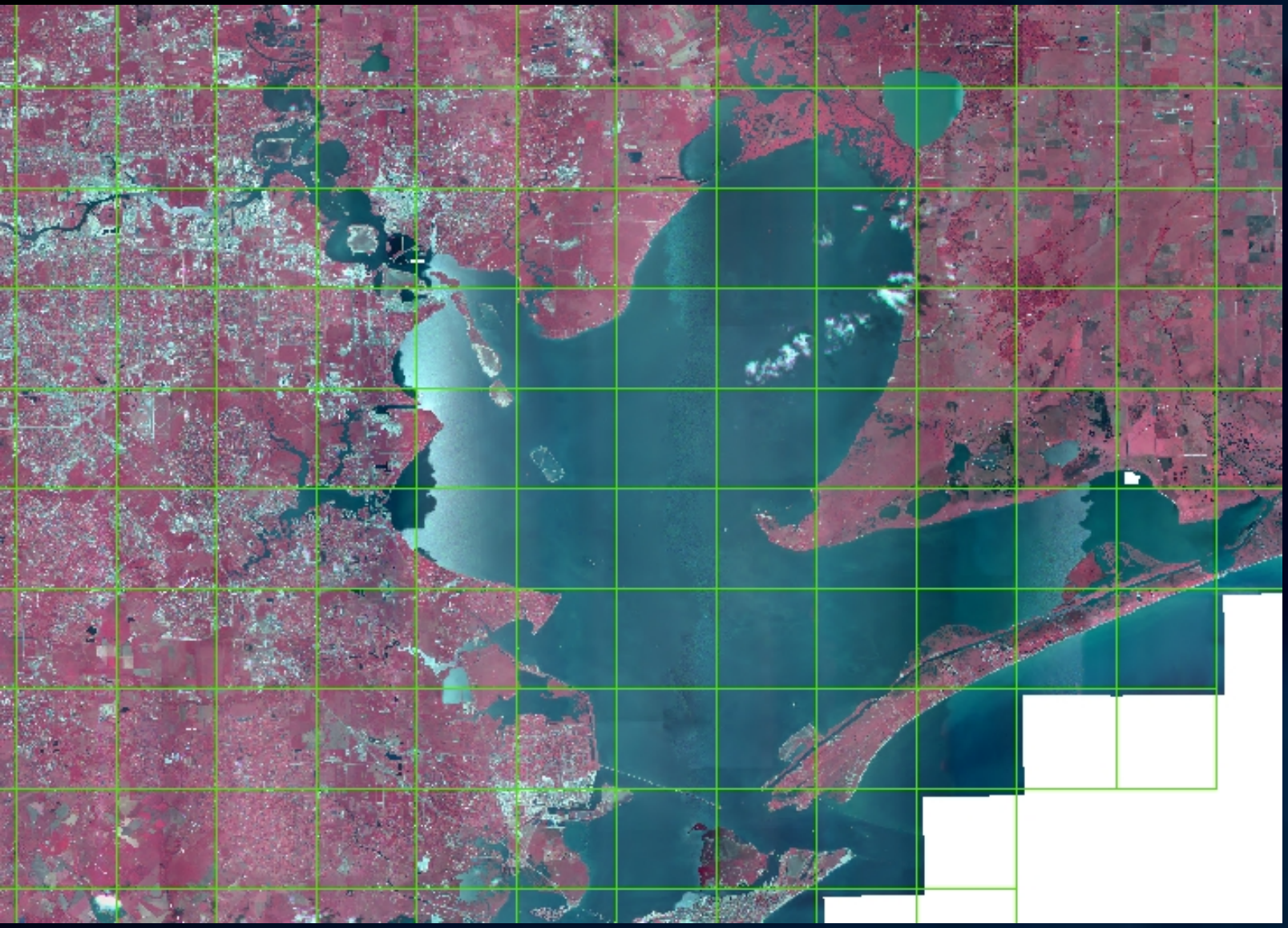
- Compressed County Mosaics
  - Reduces number of files delivered to end user
  - Common Base for Digitization
  - Matched Business Needs
  - Deliverable In NAIP
  - ESRI Ready to Use
    - Increased Usability
    - Increased Quality
    - Decrease Disk Space

USDA Farm Service Agency

Large Block of Images Mosaicked and Toned Balanced

Galveston Bay, Texas

Quarter Quad Boundaries Over Mosaic



Galveston Bay, Texas

NAIP 2004

Mosaics = Less Data files to Handle

Conversion from Hardcopy: Enlarged and Scaled Aerial Photography

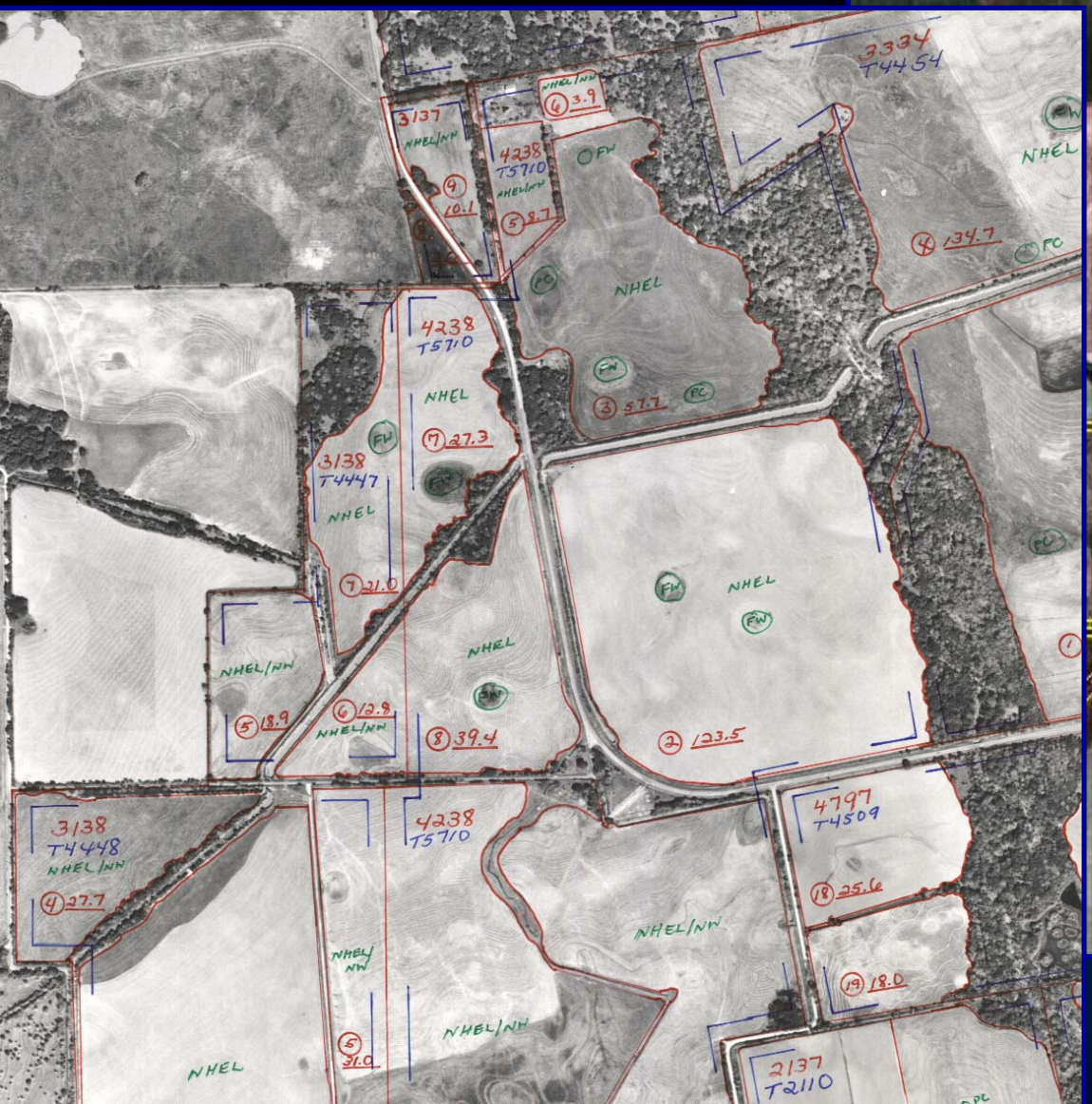
Digitize Farm Information

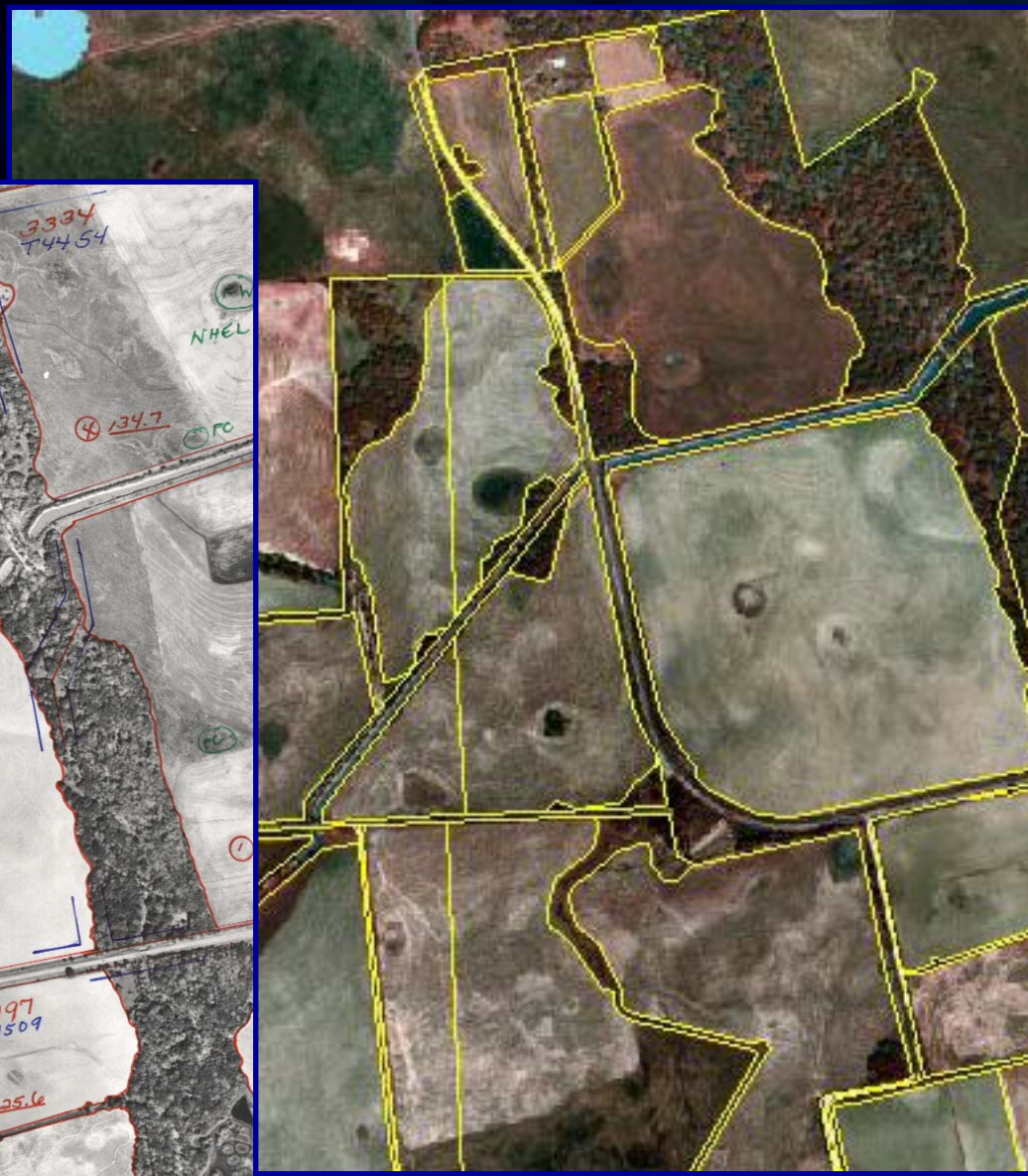
- Digitize Spatial Information required to perform missions.
- Quality Control
  - Owner Certification

USDA Farm Service Agency

From Hardcopy Source Map to Digital Data

From Source Map to Digital Data

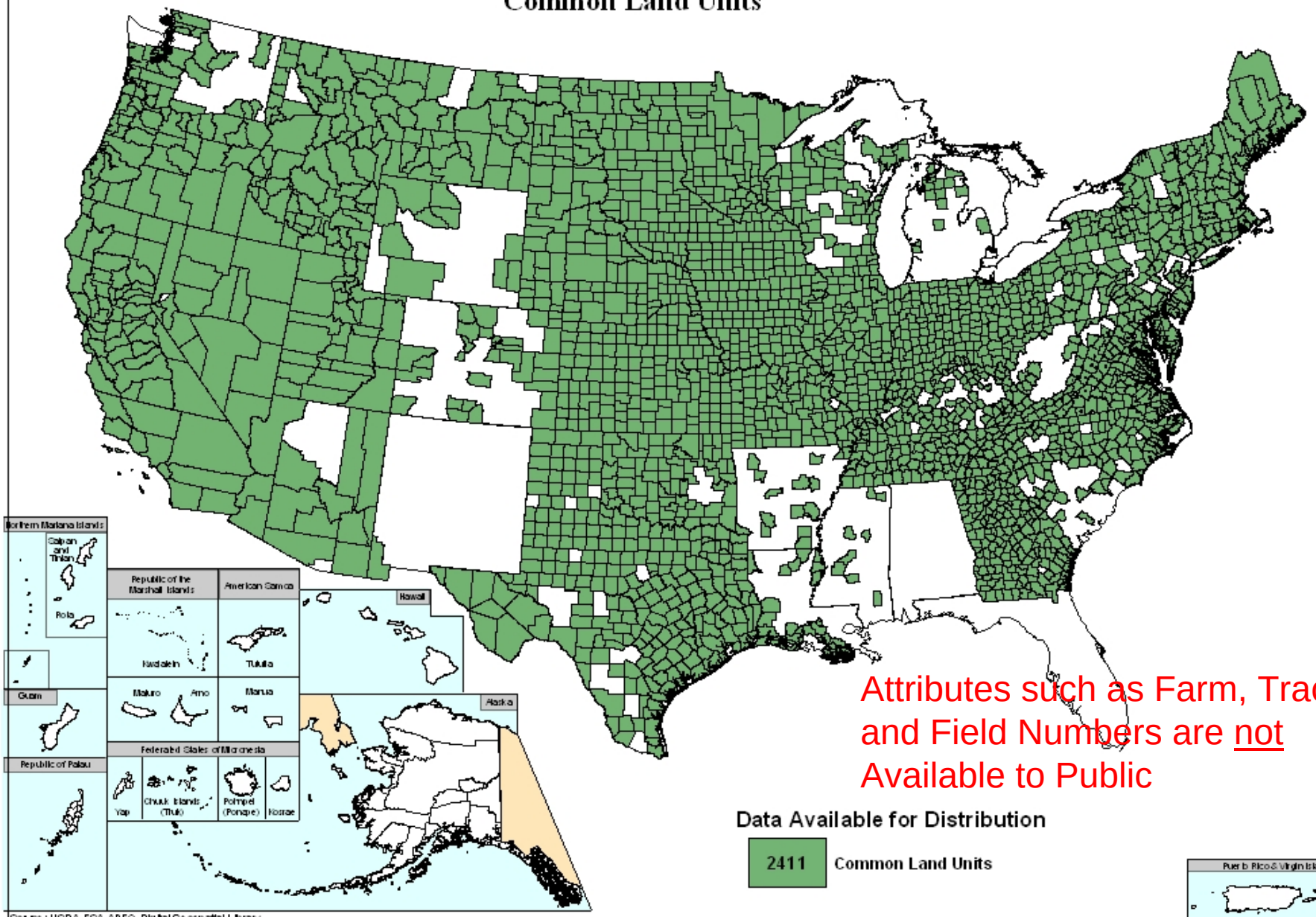




US DEPARTMENT OF AGRICULTURE

FARM SERVICE AGENCY

Common Land Units



Attributes such as Farm, Tract, and Field Numbers are <u>not</u> Available to Public

Data Available for Distribution

2411	Common Land Units

Source : USDA FSA APFO Digital Geospatial Library.

Revised October 5, 2007

USDA FSA Aerial Photography Field Office, Salt Lake City, Utah 2007.

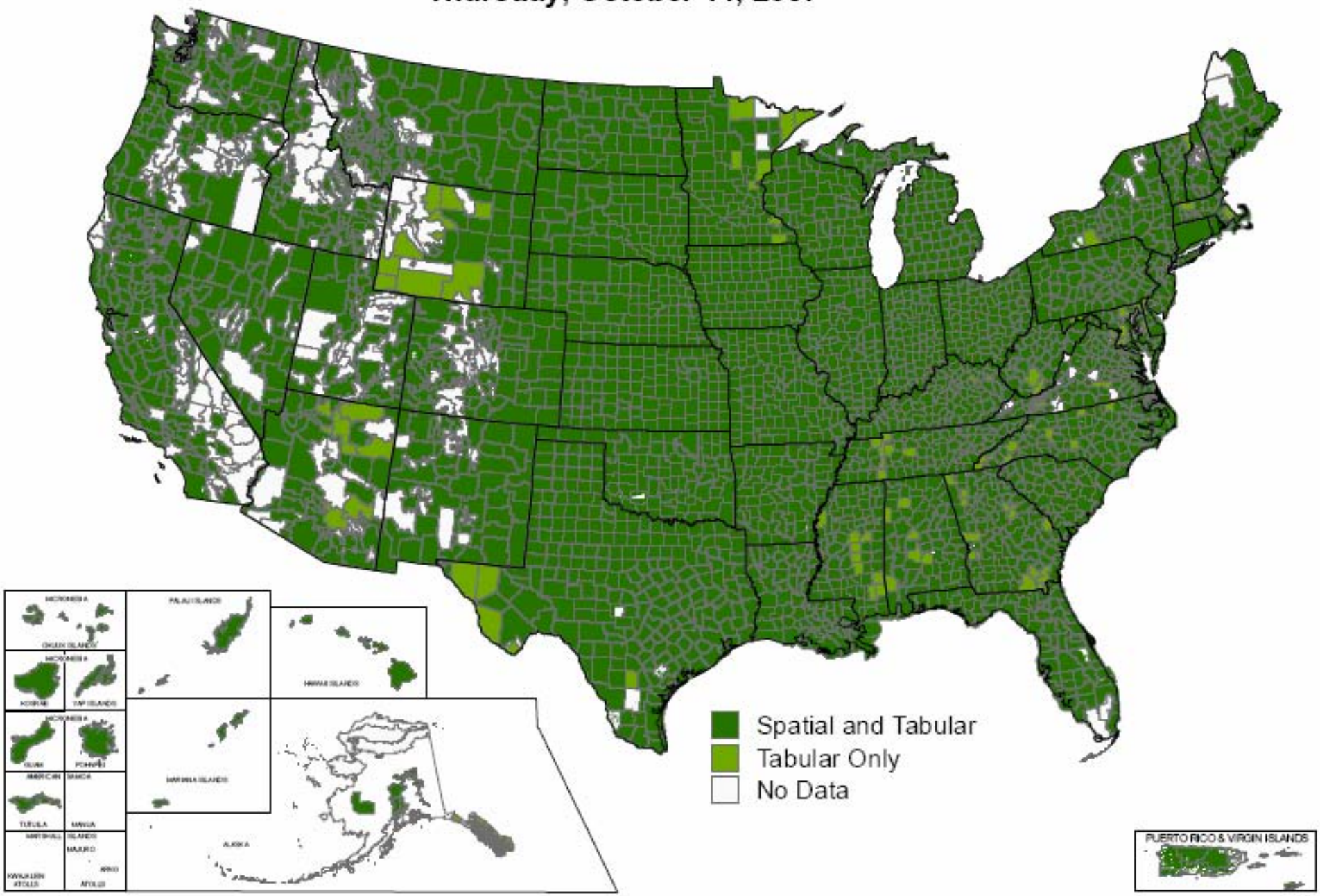
Digitize Soils

NRCS
Natural Resources Conservation Service

U.S. DEPARTMENT OF AGRICULTURE

Available Soil Survey Data
Thursday, October 11, 2007

NATURAL RESOURCES CONSERVATION SERVICE



produced 10/11/2007 5:57:06 AM Mountain Daylight Time

visit Soil Data Mart at http://soildatamart.nrcs.usda.gov

Keeping Data Current

USDA Imagery Programs
USDA Monitoring Programs

Imagery Used to Keep GIS Data Current and Administer Programs

- National Agriculture Imagery Program (NAIP)
  - New One Meter County Mosaic Every 5 years (Goal)
  - New Two meter County Mosaic Every year (Goal)
  - 2006 has been the only fully funded NAIP acquisition.
    - **2,601,081 Square Miles**
- Uses
  - Update Farm Records
  - Compliance Checks for Farm Programs

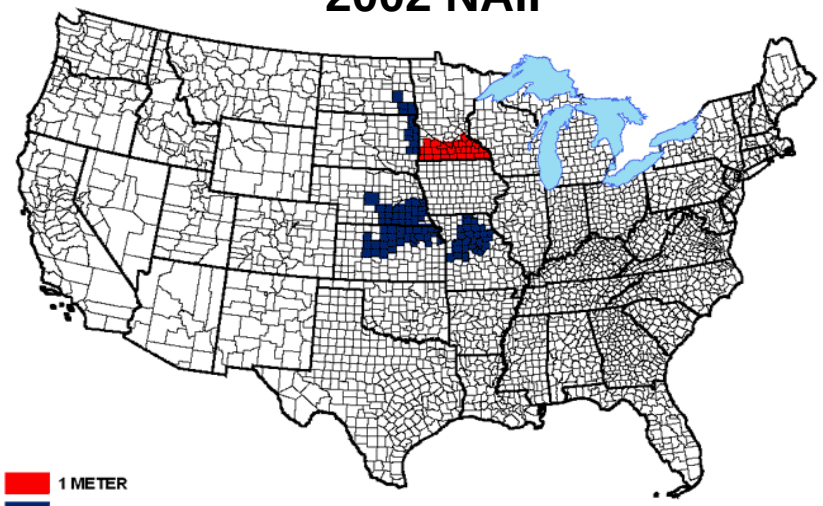
USDA Farm Service Agency

NRCS Natural Resources Conservation Service

USGS science for a changing world

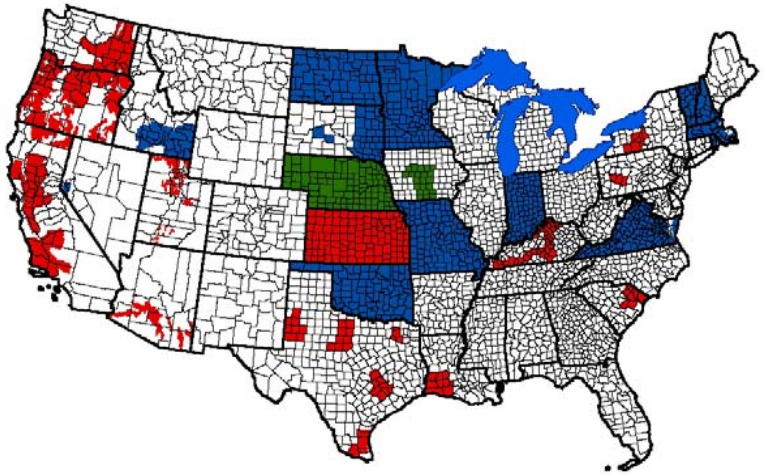
NSGIC

2002 NAIP



121 Counties

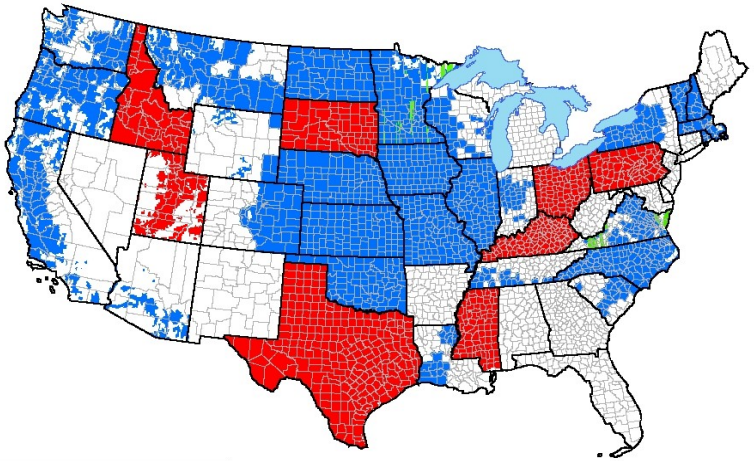
2003 NAIP



1,038 Counties

2004 NAIP

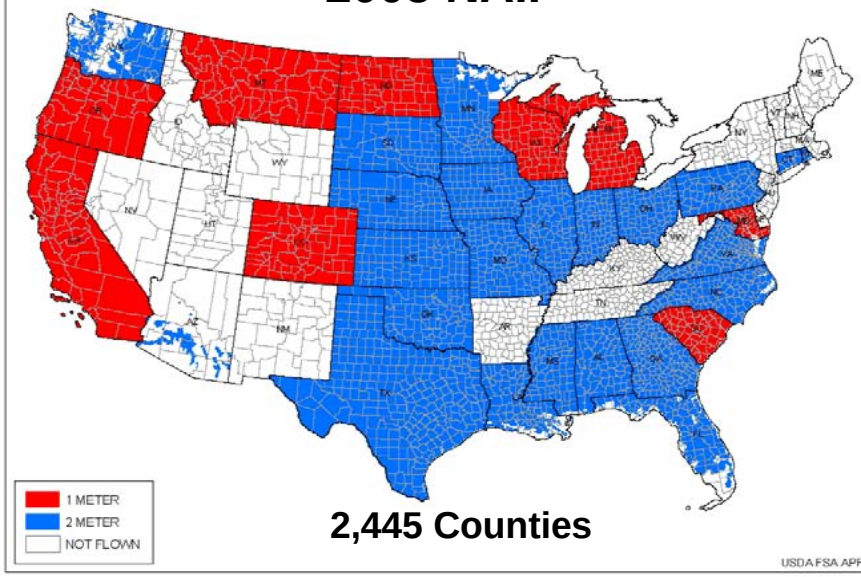
May 27, 2004



2,089 Counties

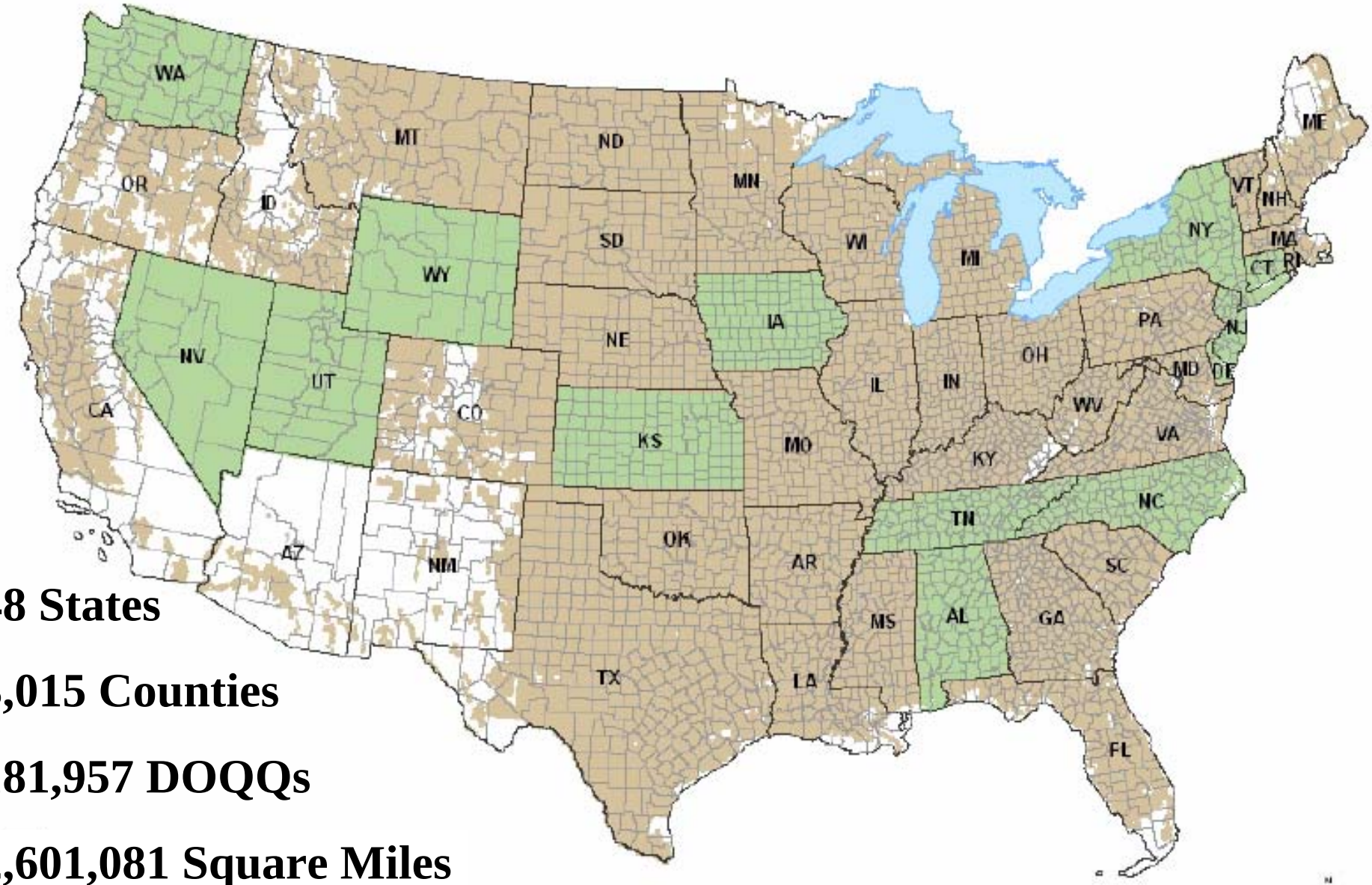
2005 NAIP

MAY 24, 2005



2,445 Counties

2006 NAIP COVERAGE



48 States

3,015 Counties

181,957 DOQQs

2,601,081 Square Miles

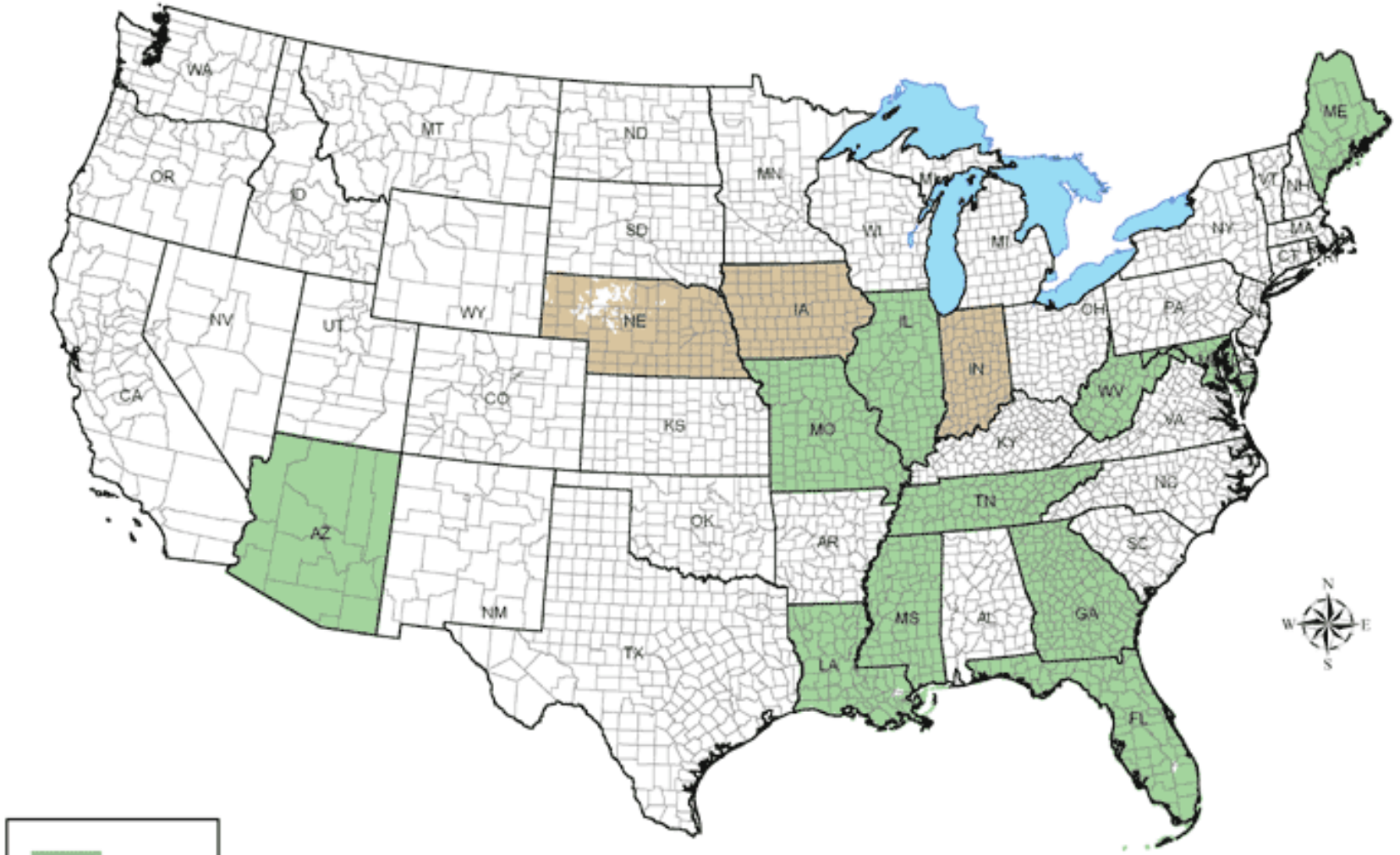
1 Meter Coverage

2 Meter Coverage

0 162.5 325 650

USDA-FSA-APFO

2007 NAIP COVERAGE



1 Meter

2 Meter

0 145 290 580 870 1,160 Miles

USDA FSA APFO

Goals of NAIP Coverage

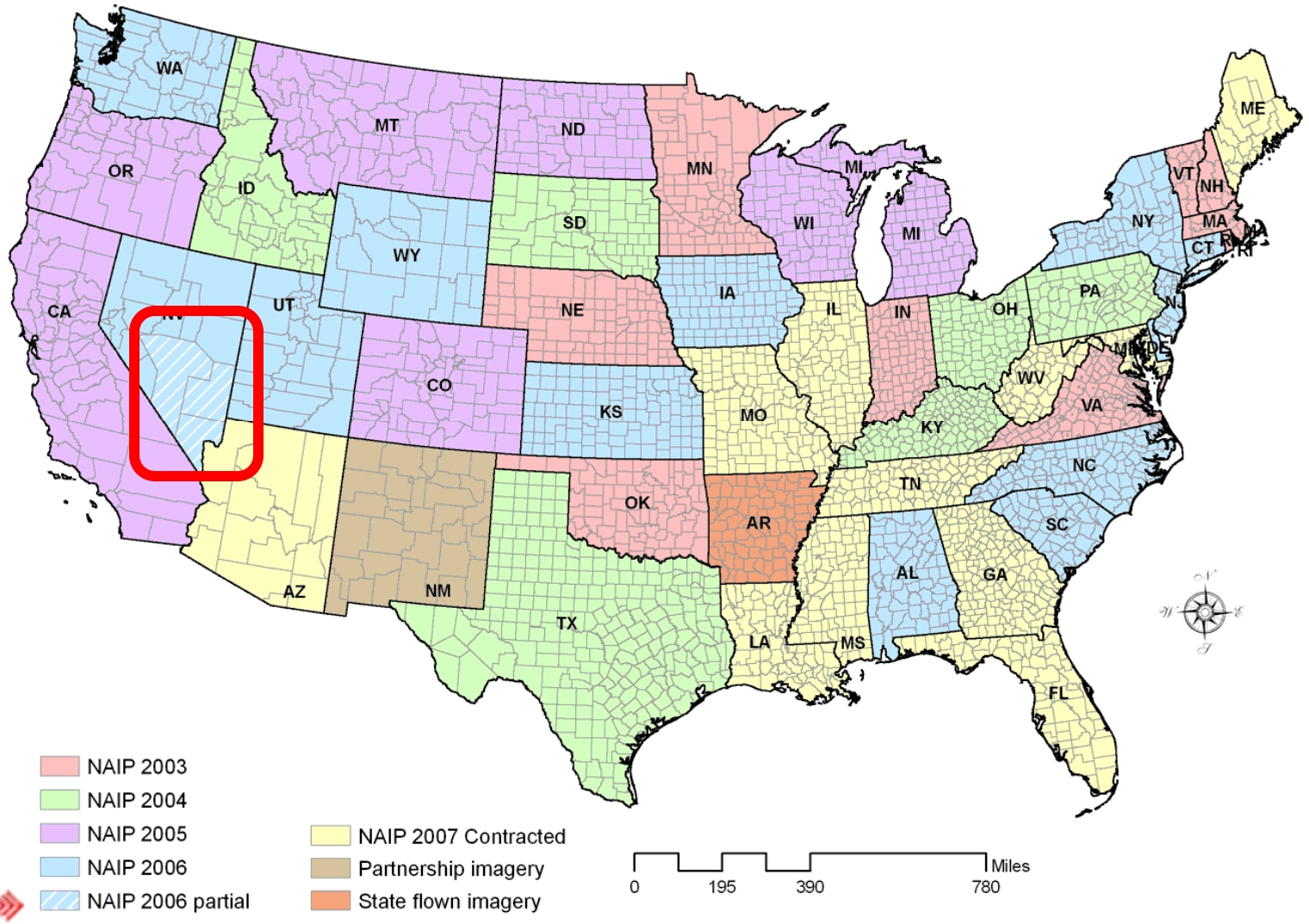
- Agricultural Land Updates (Compliance)
  - Areas that participate in Farm Service Agency (FSA) programs
  - Currently two meter coverage ★
  - Flown Every Year

- Base Map Updates
  - One meter coverage
  - Five Year Cycle for CONUS
    - Cycle I (2003-2007)
    - Cycle II (2008-2012)

★ Imagery for the Nation would change to yearly one meter

NATIONAL AGRICULTURE IMAGERY PROGRAM
CYCLE 1

April 25, 2007



Approximately 10 states or 20% one meter coverage per year

USDA-FSA-APFO

CYCLE I (2003 – 2007)

NAIP 2006 Holiday also NDOP Holiday

NAIP

NDOP

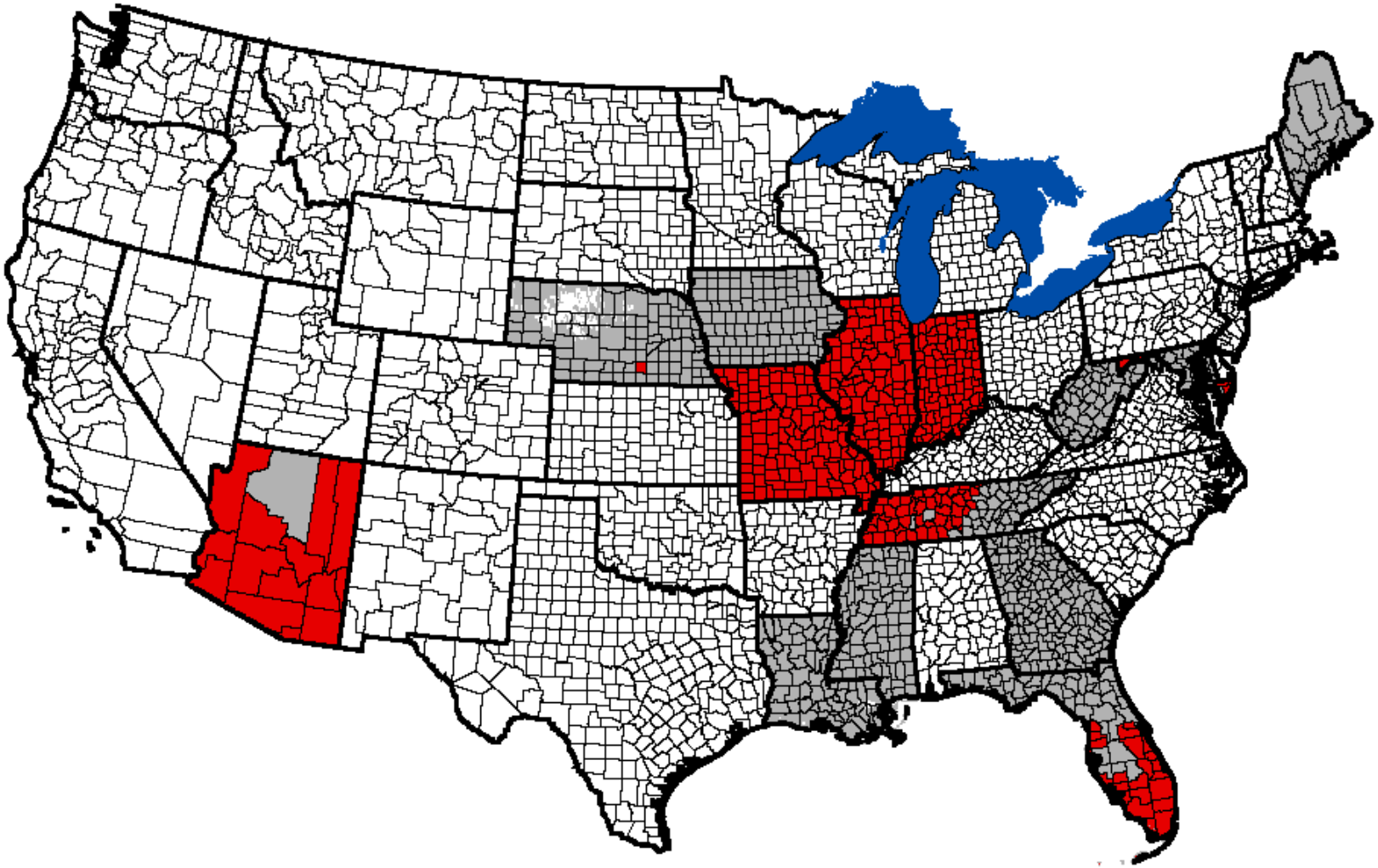
Deliverable Products:

- Digital Orthorectified Imagery
  - Compressed County Mosaics (CCM) → New Base Maps

    - Fielded 30 days after acquisition (Goal)
    - MrSID MG3 format → JPEG2000 (Future)
    - Compression Ratios: 50:1 (in 2004) → 15:1 (2005-present)
  - 1 or 2 meter Quarter Quads GEOTIFFS
- Source Data from Point of Acquisition
  - Film
    - Film is a Deliverable
    - USDA owns film even if frames are rejected.
  - Direct Digital
    - Original Digital Data not currently a Deliverable.

2007 NAIP COMPRESSED COUNTY MOSAICS (CCM)

October 3, 2007



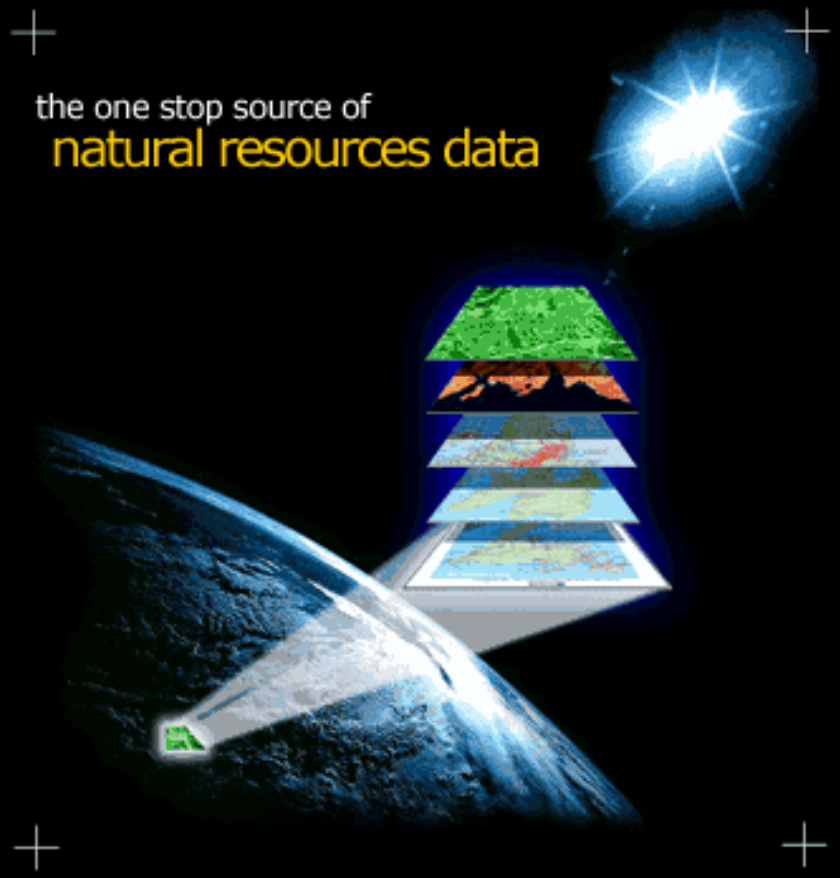
COUNTIES AVAILABLE

COUNTIES CONTRACTED

Get Data | Login | Check Order | Status Maps | News | FAQ | About | Contact | Administration

+ Natural Resources Conservation Service +
+ Farm Service Agency +
+ Rural Development +

Geospatial



The Geospatial Data Gateway provides One Stop Shopping for natural resources or environmental data at anytime, from anywhere, to anyone. **The Gateway** allows you to choose your area of interest, browse and select data from our catalog, customize the format, and have it downloaded or shipped on CD or DVD.

SYSTEM STATUS

October 9, 2007 3:00PM MST
SOIL orders are now being processed. It could take up to 3 days to get through all orders that were queued up.

NAIP 2003, 2004 and 2005 products are available but due to hardware limitations at the data service site these products will process very slowly. Please do not order these products unless you really need them. If you wish to order quantities of these products, please go **here**.

Effective 13-DEC-06, JRE 1.5 (or higher) is REQUIRED for Step 1 and 2. The JRE can be downloaded and installed here. In addition, see FAQ #2 on how to configure your browser.

Data Gateway

Example NAIP Mosaics for Lafayette Parish, LA
Great Source for Base Maps!

2004

2005

One file per year!

Much better than using 10-10,000 quarter quads

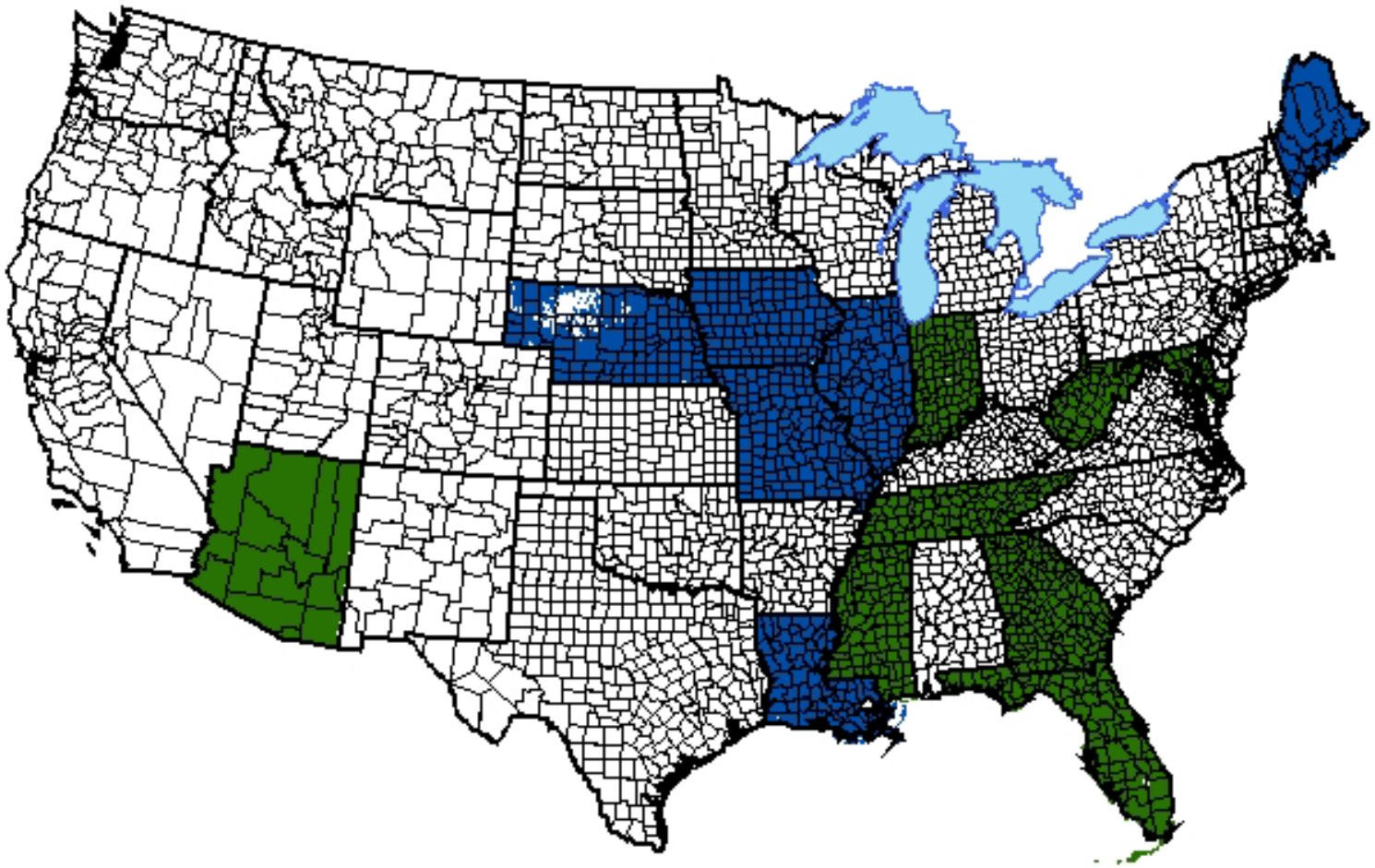
IMAGERY READY TO USE

CCM
CLU
Reported Crops

Compliance

USDA
Farm Service Agency

2007 NAIP DIGITAL OR FILM ACQUISITION



DIGITAL ACQUISITION

FILM ACQUISITION

Airborne Digital Sensor Systems

Large Format Precision Digital Cameras

Leica ADS40 System:
Multispectral CCD lines,
2 x 12,000 pixels

Vexcel UltraCam System:
Fixed digital
array camera

Z/I DMC System:
Fixed digital
array camera

= Promising for Land-Cover Applications

Future: Yearly 4-Band 1 Meter Stereo?

- Imagery used for Base Maps
- Four Band Digital Cameras acquiring in stereo will allow for robust automated information extraction.
  - Change Detection
  - Increase in Information content possible by using 3-D Classification.

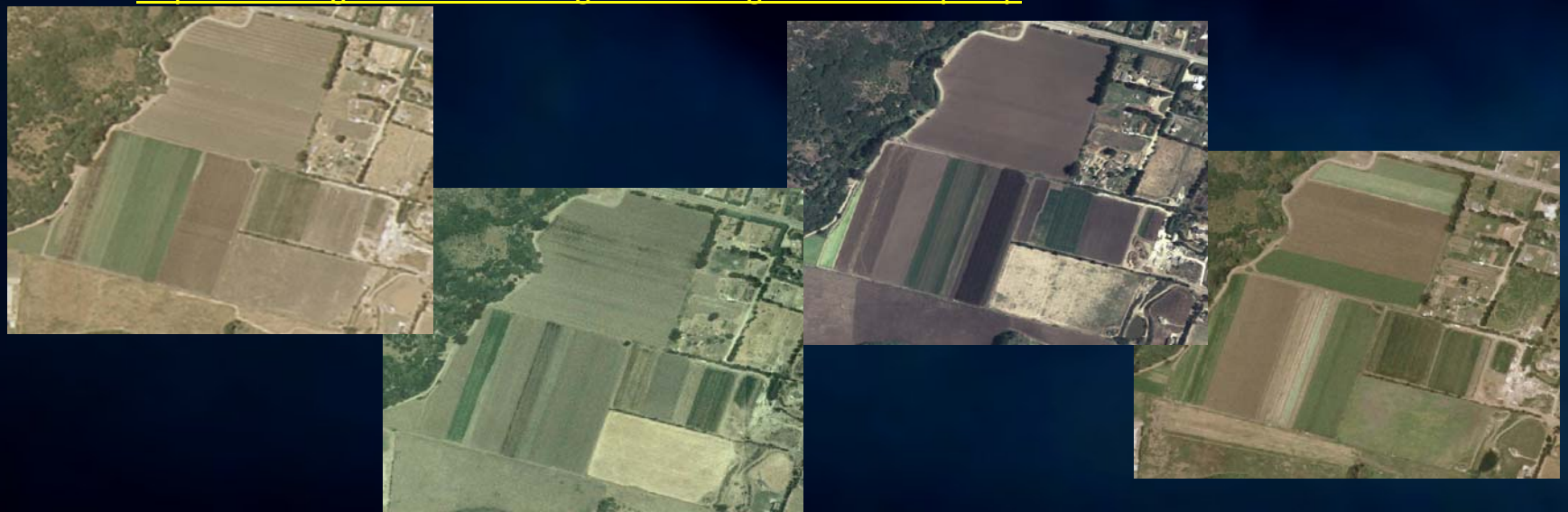
BETTER LAND-USE INFORMATON EXTRACTION!

- Value of 11-bit 4-band stereo imagery not fully understood.

NEED Inexpensive 3-D technologies

New Technology Challenges

- Time Series Data Management
  - Imagery
    - Image Metadata
      - Granular information: e.g. Acquisition Date
  - Polygon/Shapefile History
  - Image Watermarks?
    http://www.digitalwatermarkingalliance.org/membership.asp



More USDA Imagery Programs

Resource Photography

National Resources Inventory (NRI)

Medium Resolution (AWiFS and Landsat)

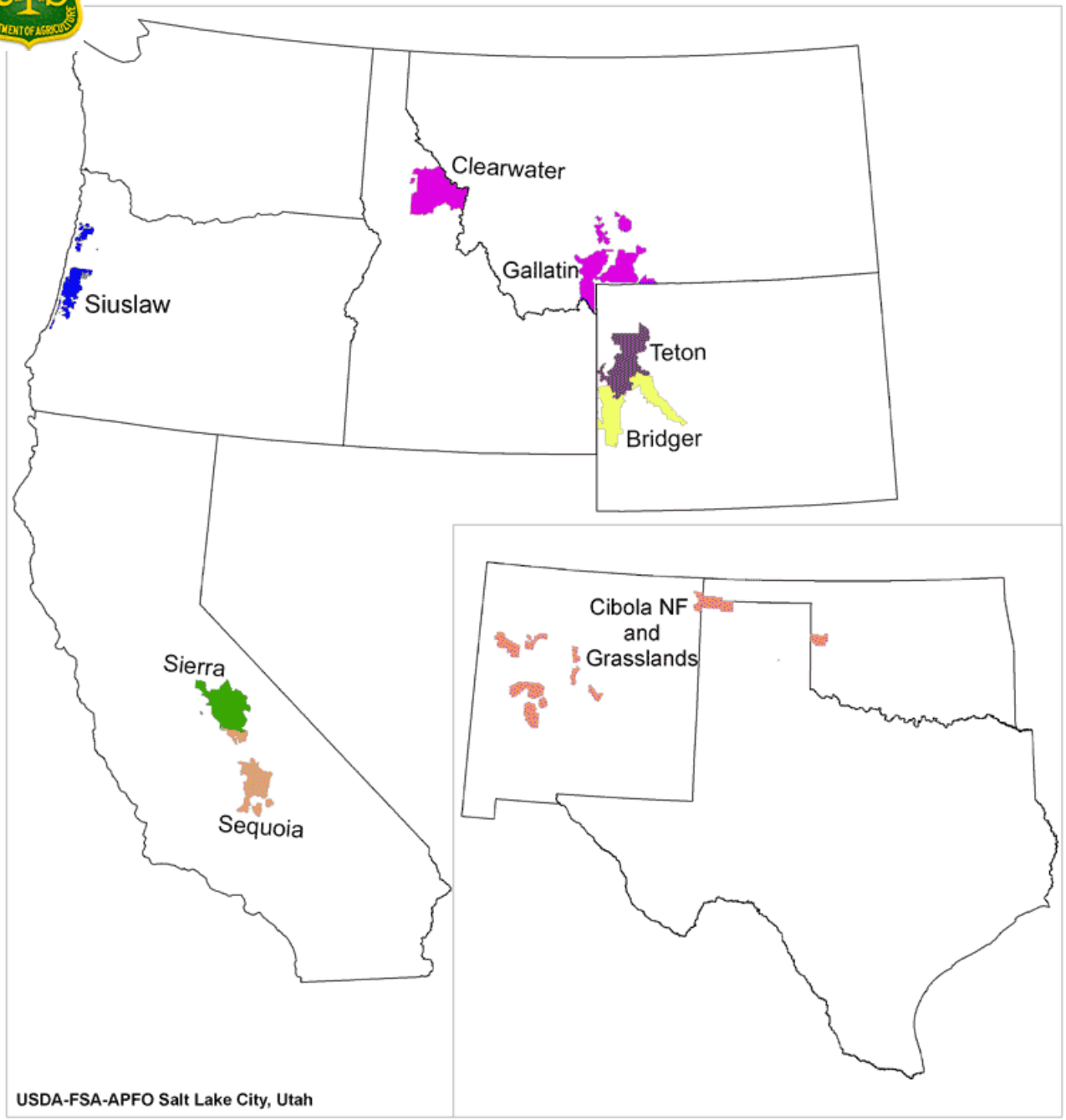
PROPOSED 2006 RESOURCE AERIAL PHOTOGRAPHY PROJECTS

USDA-FSA-APFO Salt Lake City, Utah

Western States Area

February 9, 2006

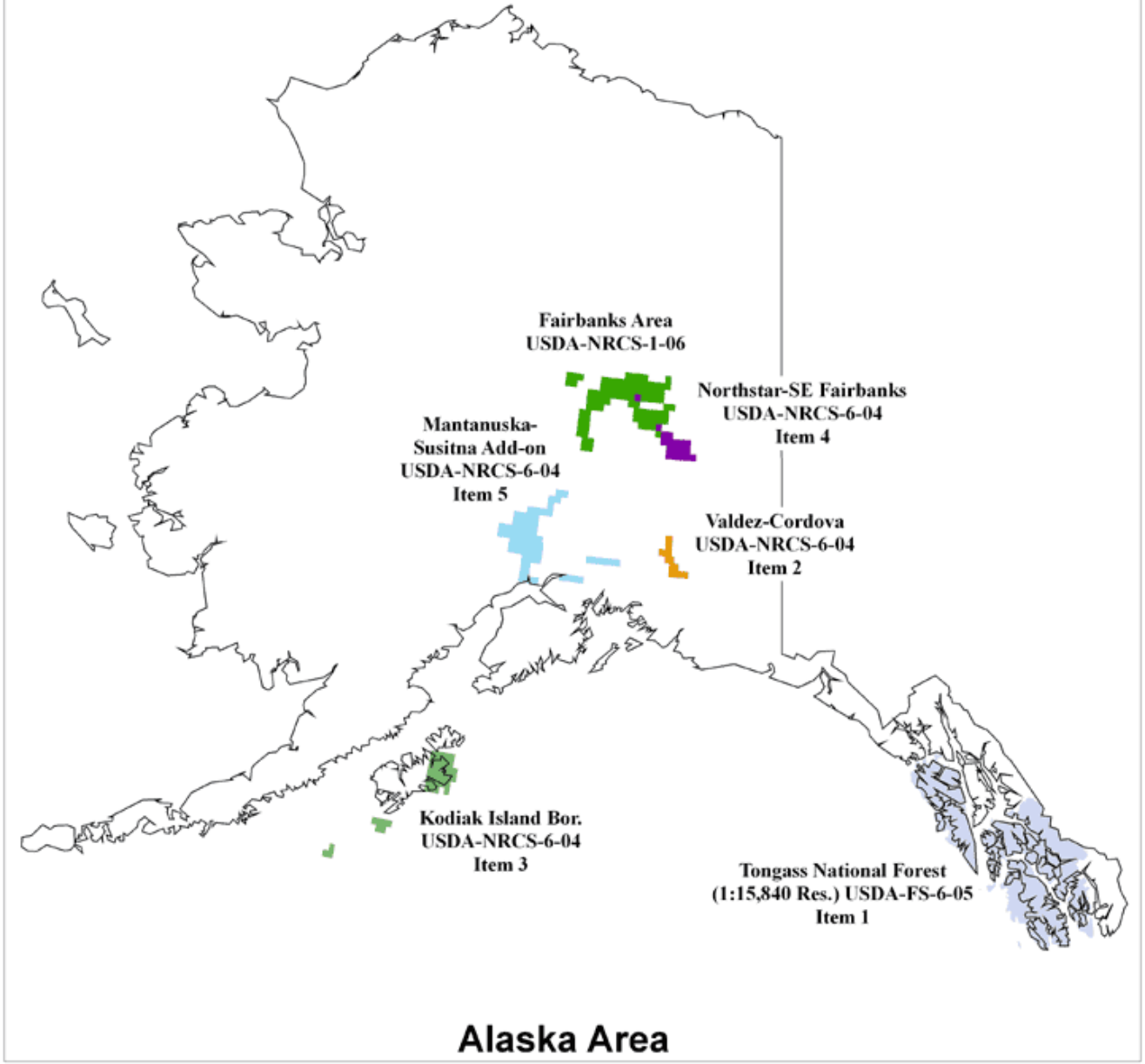
2007 RESOURCE ACQUISITIONS



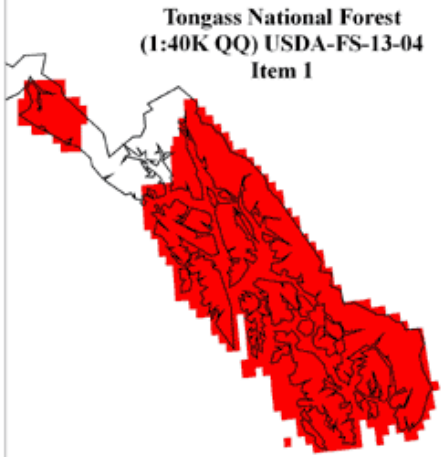
USDA-FSA-APFO Salt Lake City, Utah

USDA Aerial Photography Resource Projects - Alaska

Natural Resources Conservation Service



Alaska Area



Alaska
Panhandle Area

National Resources Inventory (NRI)
Aerial Photograph

FILM

7,920 / (125 lp/mm x 1000 mm/m) = GRD

0.063 m or 0.206 ft or 2.5 in = GRD

SCAN

7,920 / (600 dpi / 12”) = GSD

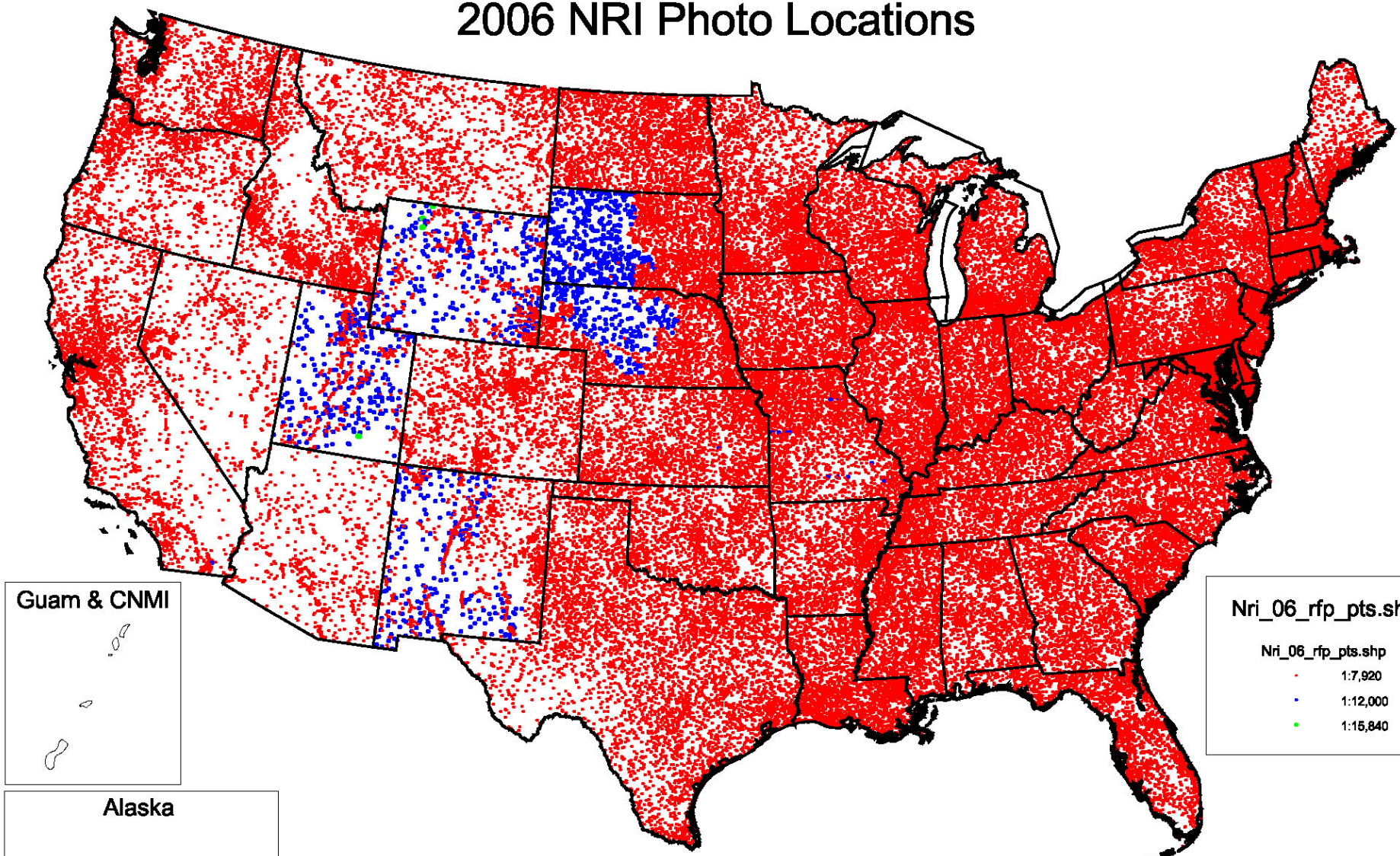
1.1 ft = GSD

Washington Coast

U.S. Department of Agriculture

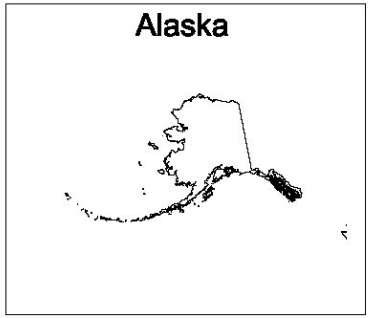
Natural Resources Conservation Service

2006 NRI Photo Locations

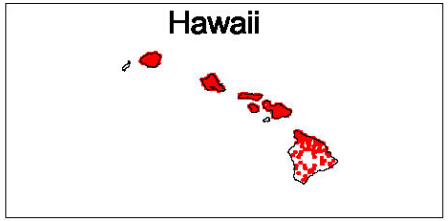


Guam & CNMI

Alaska



Hawaii



Nri_06_rfp_pts.shp

Nri_06_rfp_pts.shp

1:7,920

1:12,000

1:15,840

CONUS = 70,689
Hawaii = 375
Puerto Rico = 450
Total = 71,514

PR & USVI

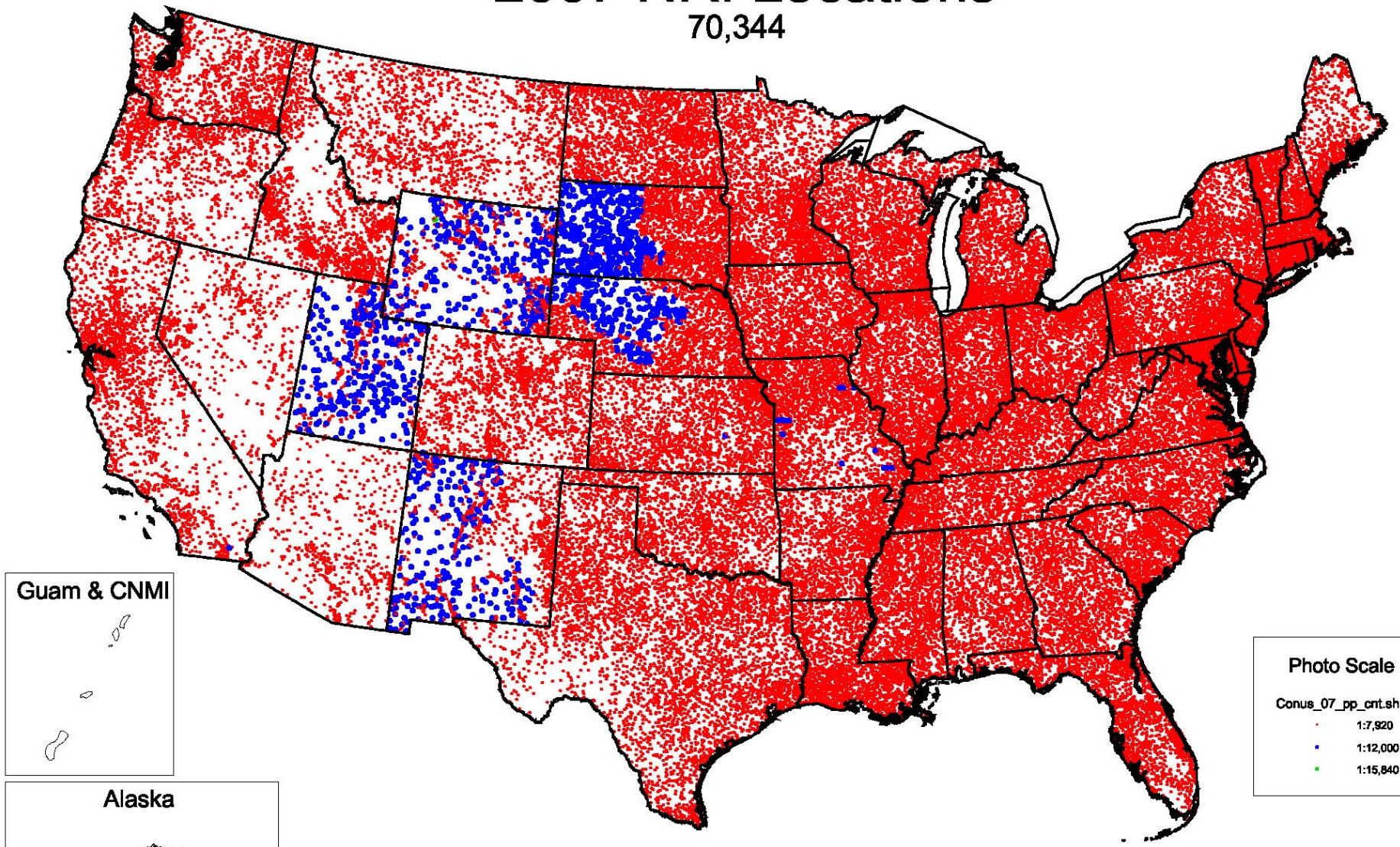
USDA-NRCS-NCGC, Fort Worth, TX, Dec. 2005

U.S. Department of Agriculture

2007 NRI Locations

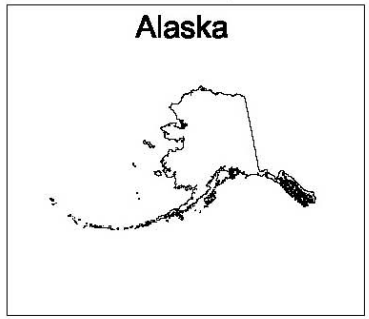
70,344

Natural Resources Conservation Service



Guam & CNMI

Alaska



Hawaii

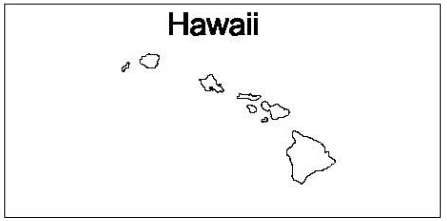


Photo Scale

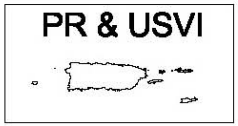
Conus_07_pp_cnt.shp

1:7,920

1:12,000

1:15,840

PR & USVI

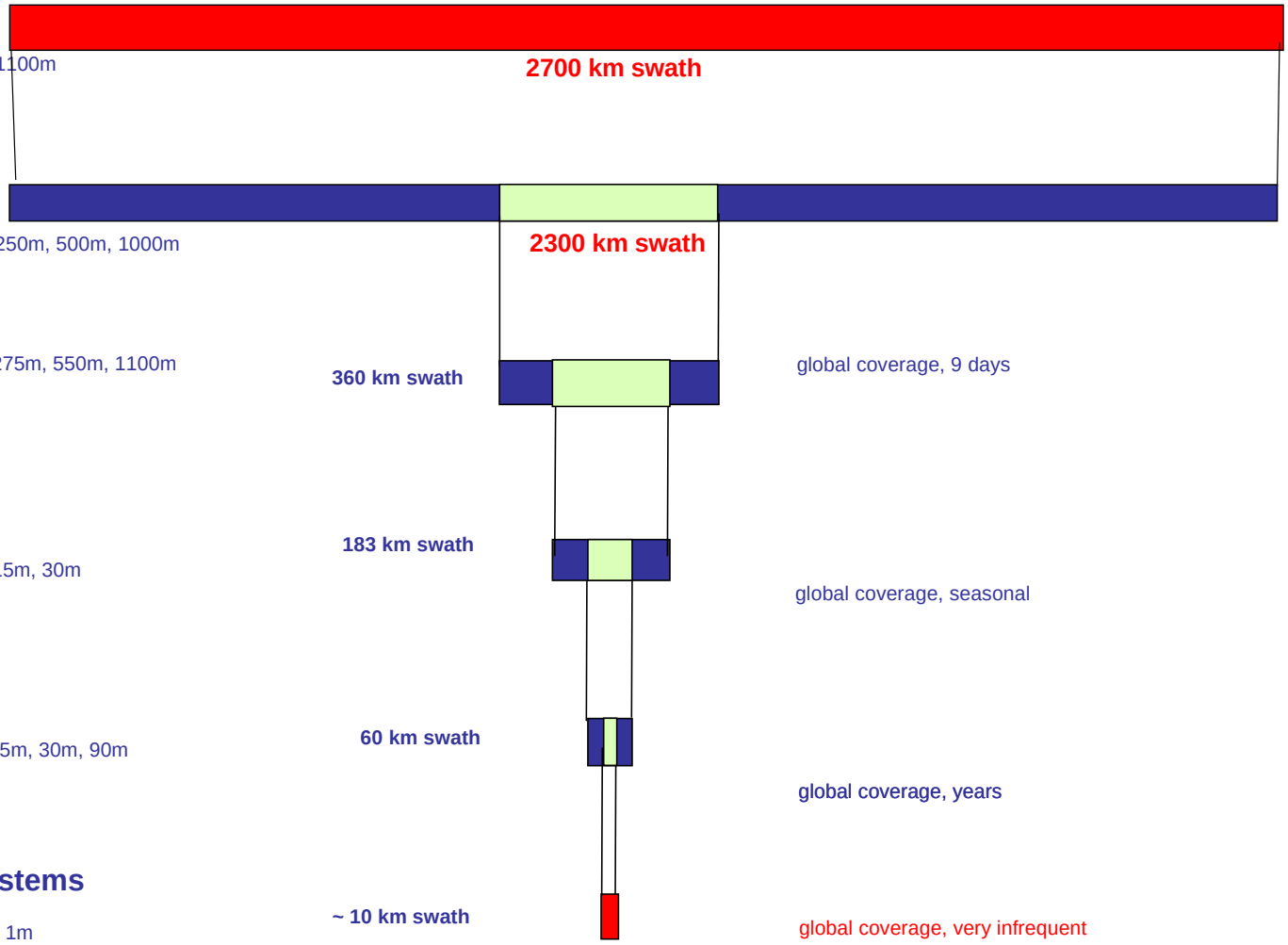


USDA-NRCS-NCGC, Fort Worth, TX, Nov. 2006

Satellite Imagery Applications

- Global crop condition monitoring (FAS)
- Area sampling frame construction (NASS)
- Cropland Data Layer (NASS)
- Input into crop acreage estimates for select States (NASS)
- Burned Area Estimates Report (Forest Service)
- Forest Inventory (Forest Service)
- Crop tillage (NRCS)
- Natural Resources Inventory (NRCS)
- Agricultural Research (ARS)
- Crop insurance compliance (RMA)
- Farm program compliance (FSA)
- Invasive species management (APHIS)

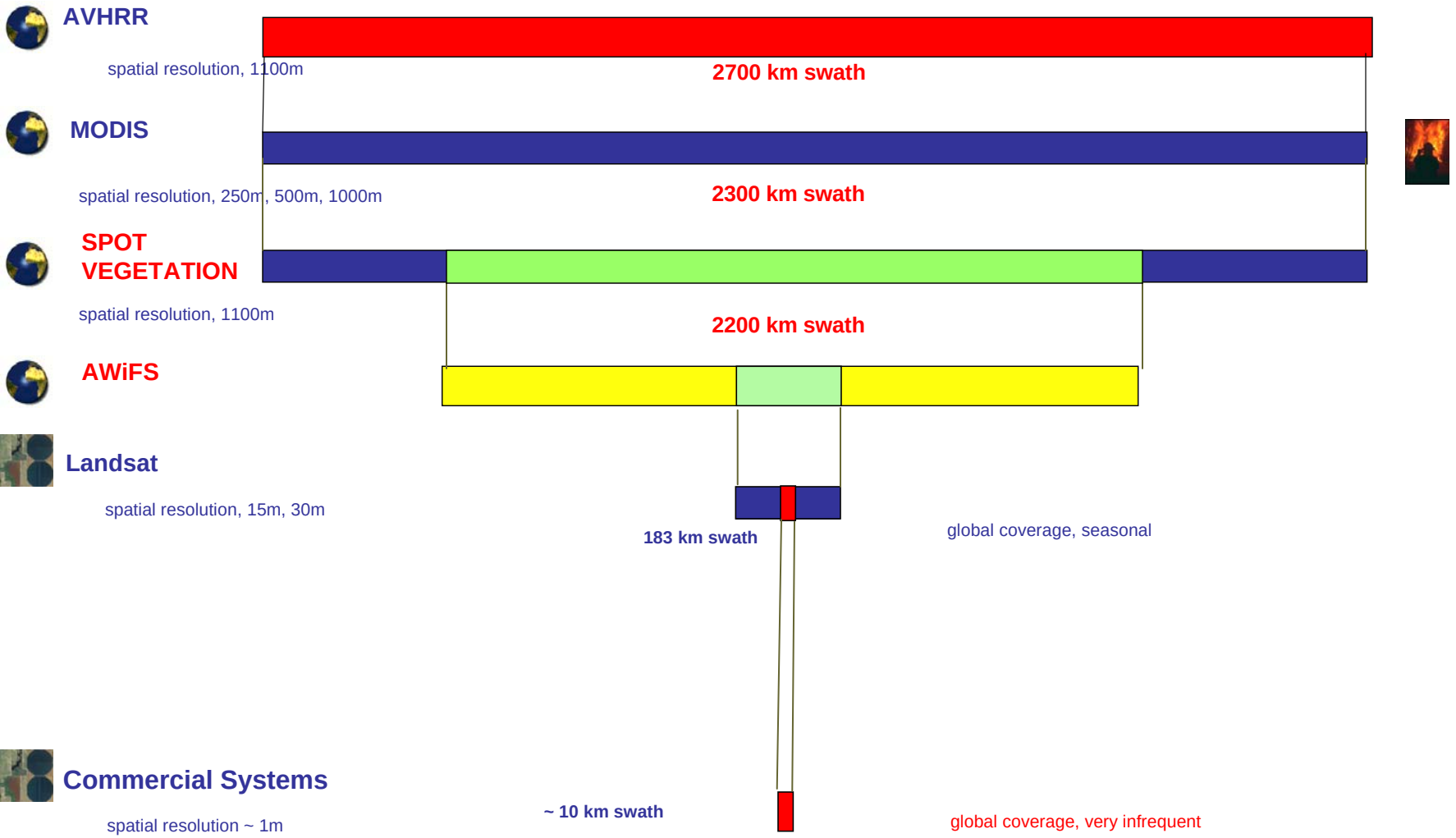
Current US Land Remote Sensing Missions



= Science Missions

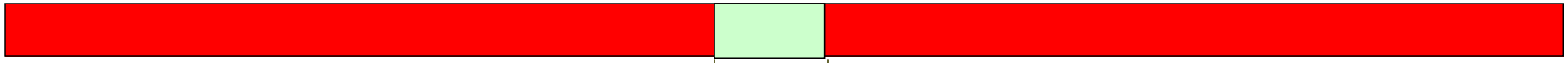
= Operational Missions

Current USDA Land Remote Sensing Uses



Future US Land Remote Sensing Missions

✔ **VIIRS**



spatial resolution, 400/800m (nadir(Vis/IR))
3300 km swath

global coverage, 2x/day/satellite

✔ **Landsat**

183 km swath

spatial resolution, 15m, 30m

global coverage, seasonal

✔ **Commercial Systems**

~ 10 km swath

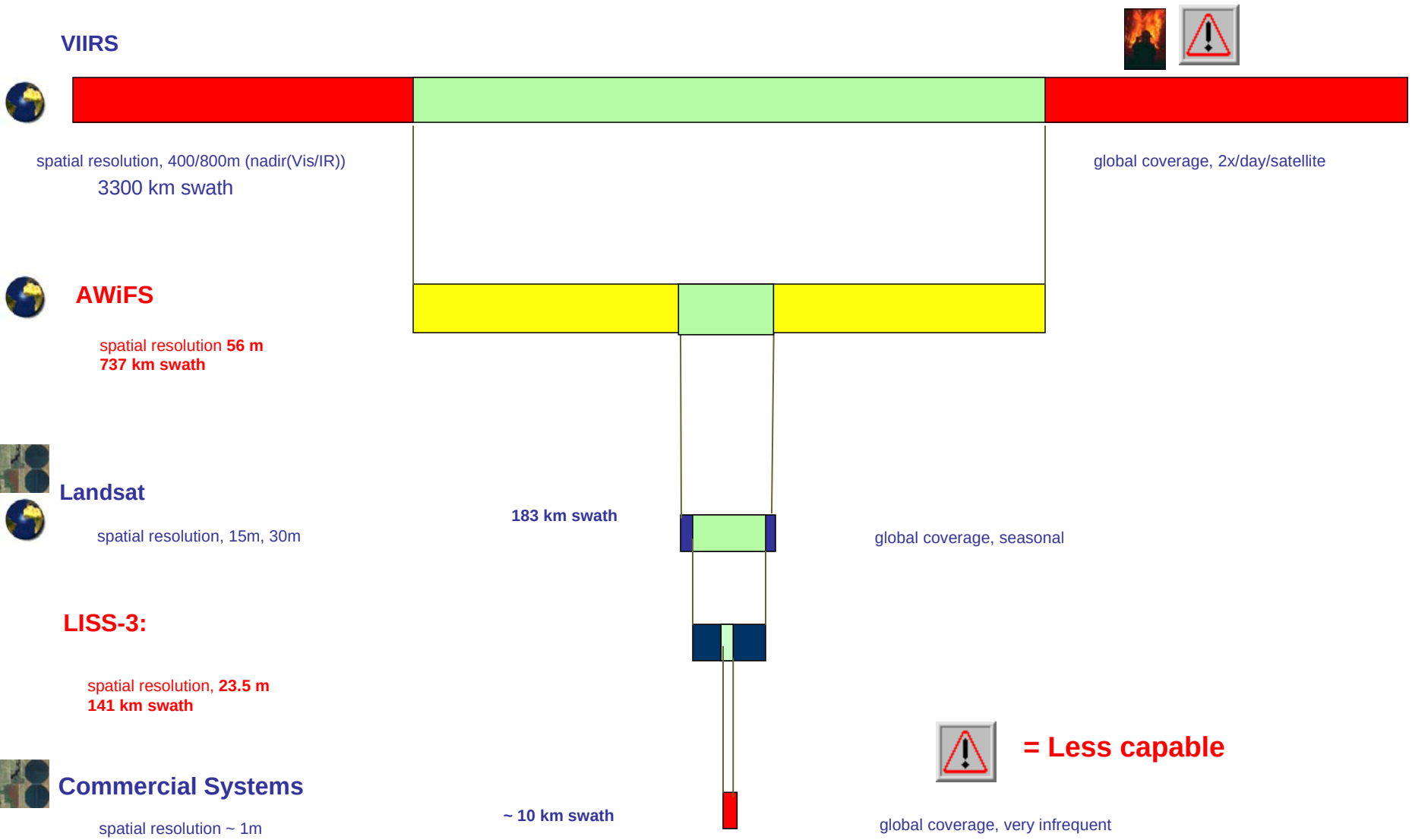
spatial resolution ~ 1m

global coverage, very infrequent

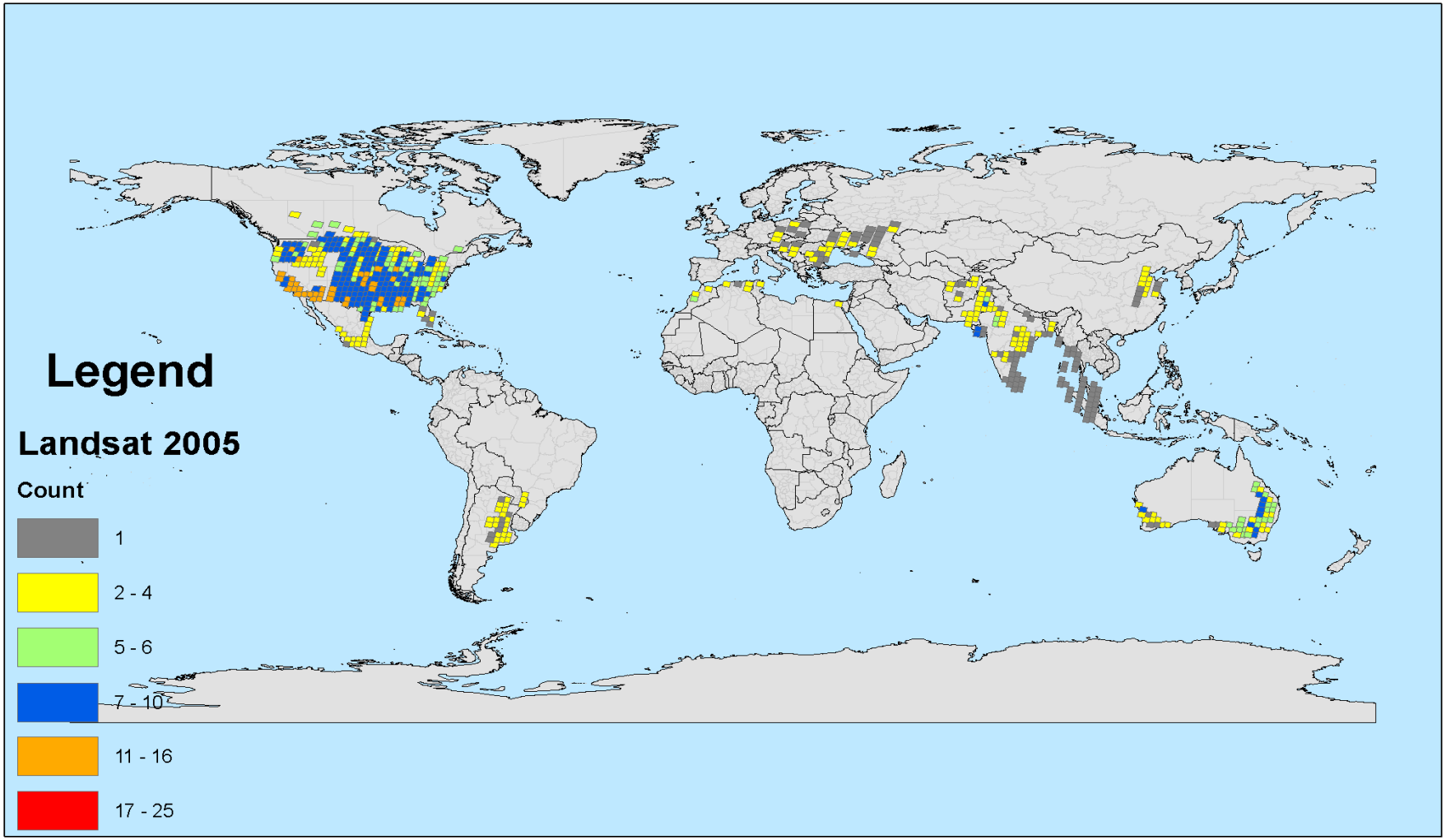
★ **= Science Missions**

✔ **= Operational Missions**

USDA Operational Monitoring Satellites



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

Impact of the Landsat-7 ETM+ SLC Anomaly

PRE-SLC FAILURE

3 MARCH 2000

POST-SLC FAILURE

20 SEPTEMBER 2003

Note that the images show partial scenes

Landsat-5 Status

Not operational

On October 6, 2007, Landsat 5 experienced an issue with its onboard batteries, leading to concerns about power balance. Imaging will be suspended while the flight operations team analyzes the problem. The Landsat team expects the investigation will last from 2 to 3 weeks. Further announcements will be made as needed.

Source: http://landsat.usgs.gov/

Landsat Data Gap

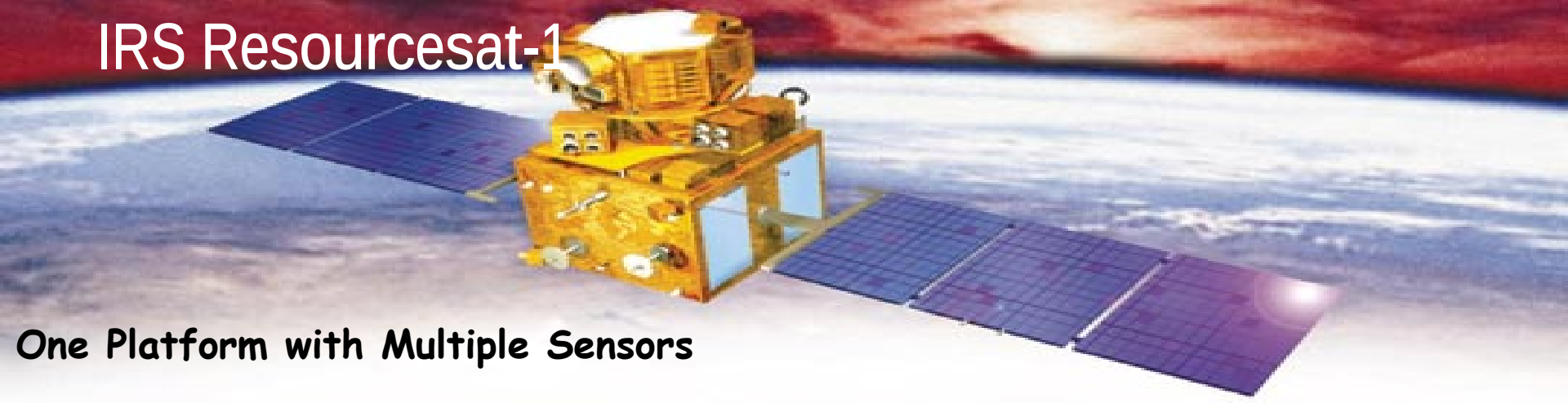
- The extent of the Landsat Data Gap based on numerous assumptions:
  - Complete Gap: ***2007 to 2011***
    - 2008:
      - fuel depleted for Landsat-5;
      - 10% probability for Landsat-7 gyro failure.
    - 2011: Launch of the Landsat Data Continuity Mission (LDCM)
      - Assumes one satellite, similar to Landsat-7.
      - Ends Complete Gap
  - Partial Gap: ***2003 to Indefinite***
    - 2003:
      - Landsat-7 SLC anomaly;
      - Landsat-5 when operational provided only 16-day revisit.
    - Indefinite: No US government plans to provide better than 16-day revisit.
      - Does not meet requirements for operational agricultural applications.

USDA Can No Longer Rely on Landsat to Meet Operational Monitoring Needs

- USDA hasTransitioned from Landsat to AWiFS data.
  - Global Coverage (other than India)
  - Excellent Revisit Cycle
  - Excellent Value for USDA
  - Other Sensors Acquiring Data at Same Time!

- USDA is no longer using Landsat imagery for operational monitoring applications because of the data gap.
  - No global coverage
  - No adequate revisit cycle
  - Not the best value for USDA

IRS Resourcesat-1



One Platform with Multiple Sensors

AWiFS:

- **56 m resolution at nadir**
- **737 km combined swath**

LISS-3:

- **23.5 m resolution**
- **141 km swath**

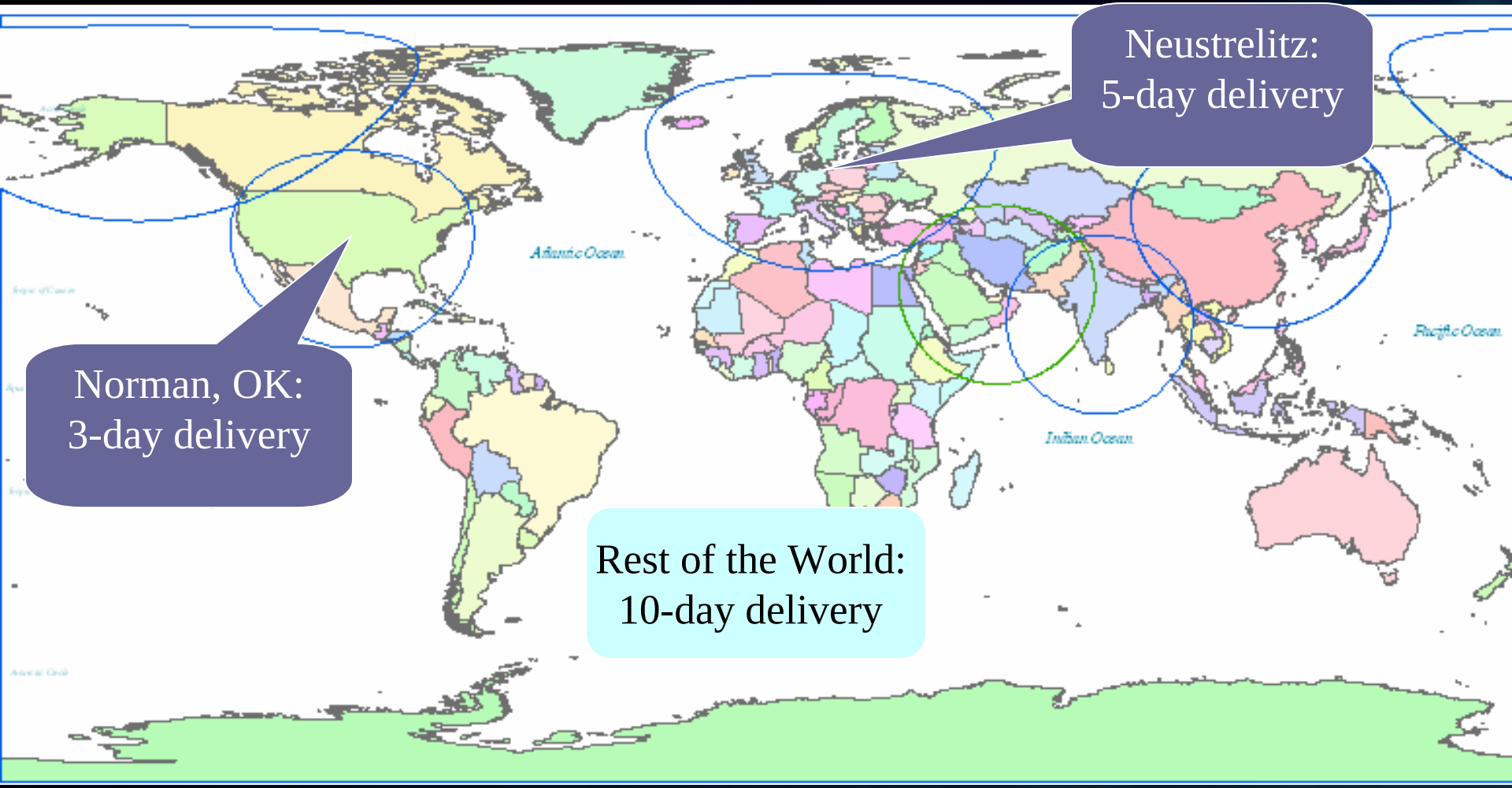
B2: 0.52 - 0.59
B3: 0.62 - 0.68
B4: 0.76 – 0.86
B5: 1.55 – 1.70

LISS-4:

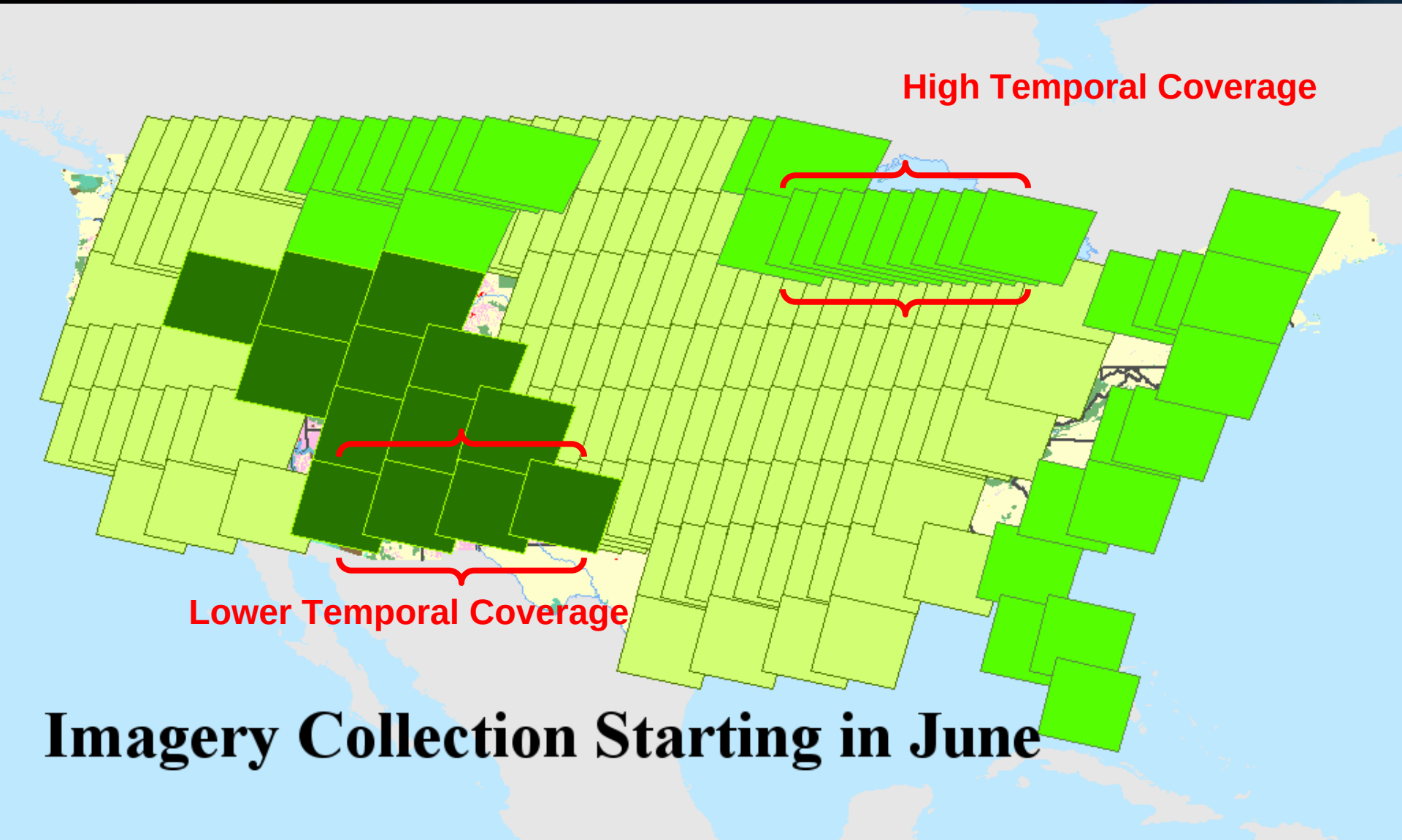
- **5.8 m resolution**
- **70.3 km (mono) swath**
- **Pointing**

B2: 0.52 - 0.59
B3: 0.62 - 0.68
B4: 0.76 – 0.86

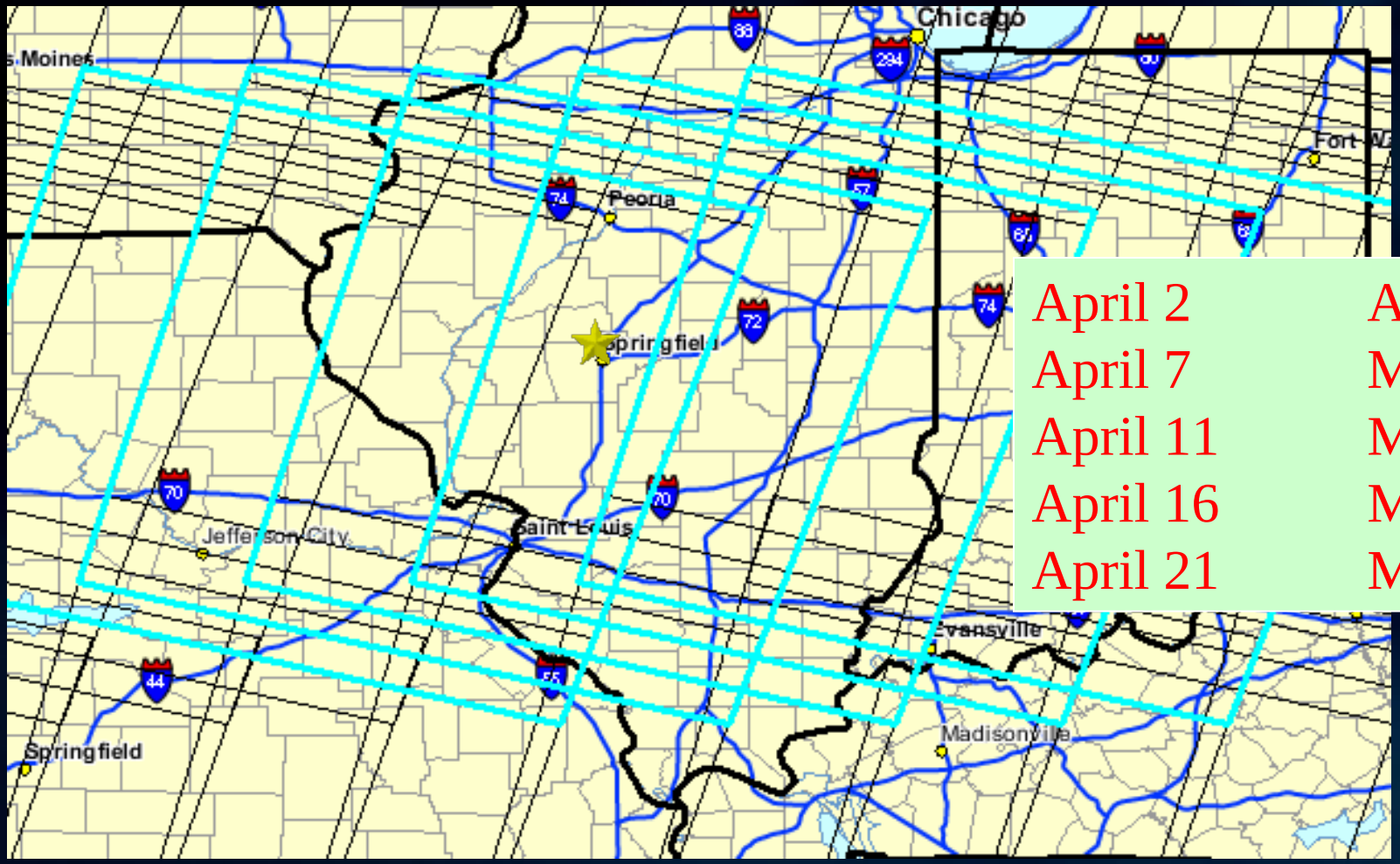
Delivery Times Stipulated in the USDA 2007 Resourcesat-1 Contract Varies by Ground Station



Monitoring US Crop Conditions with AWIFS Collections Stop On September 30

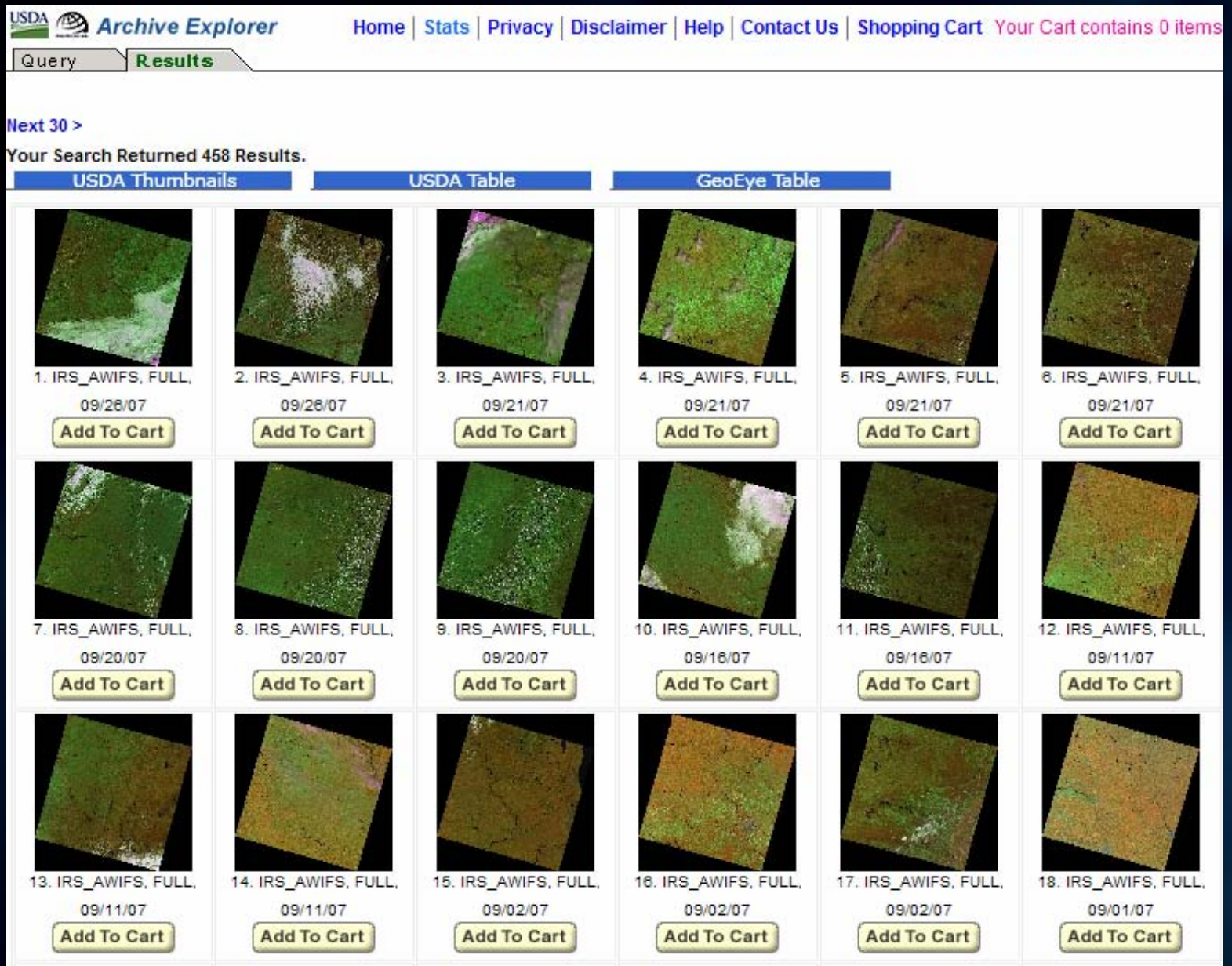


Overlap Provides Excellent Temporal Repeat Cycle: AWiFS Data

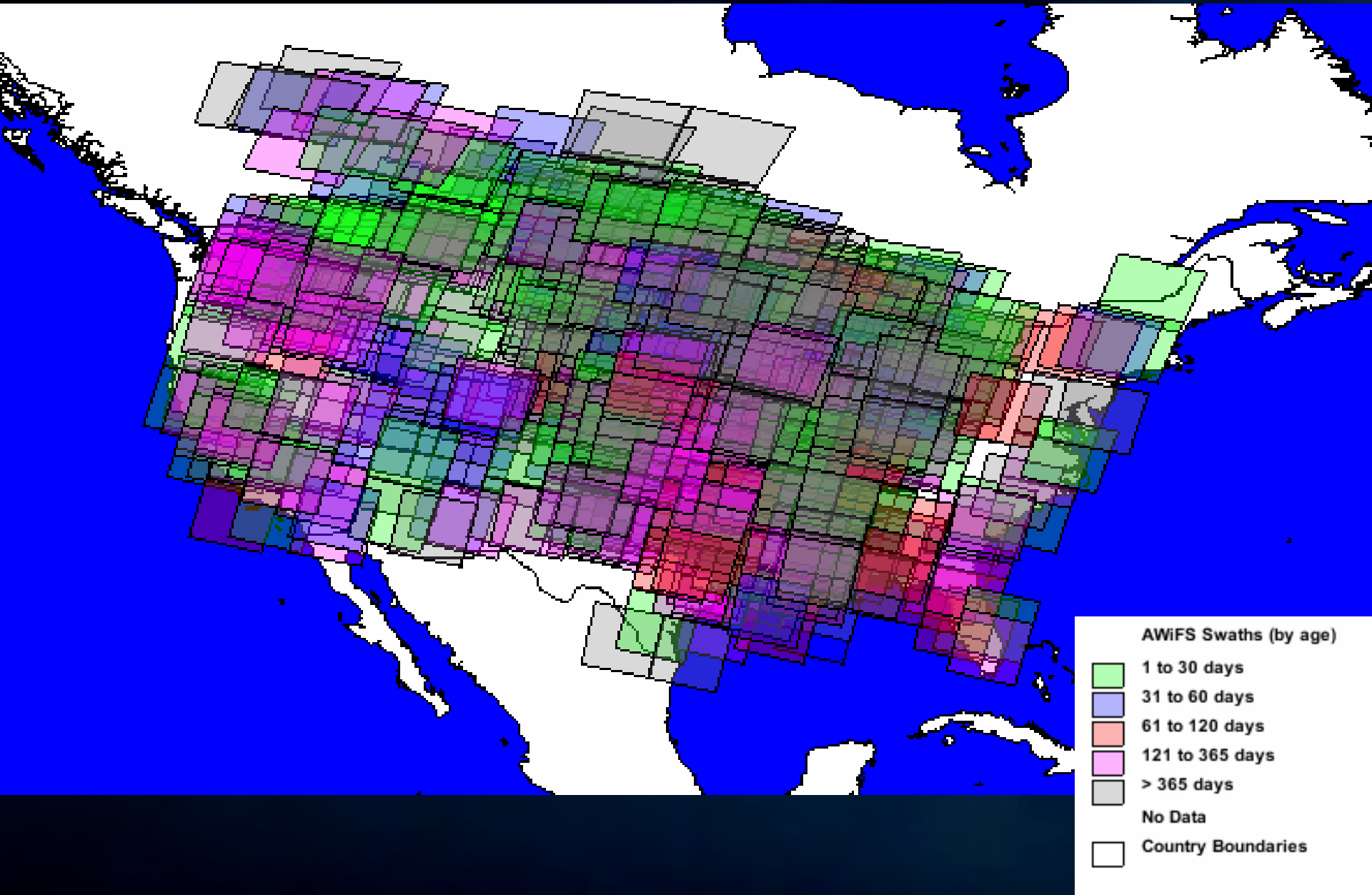


- This example results in a 4.8 day frequency
  - 5 opportunities in a 24 day cycle
- Star is on McLean County, Illinois

Selecting a single point in Kansas Generated 458 images from the USDA Satellite Archive

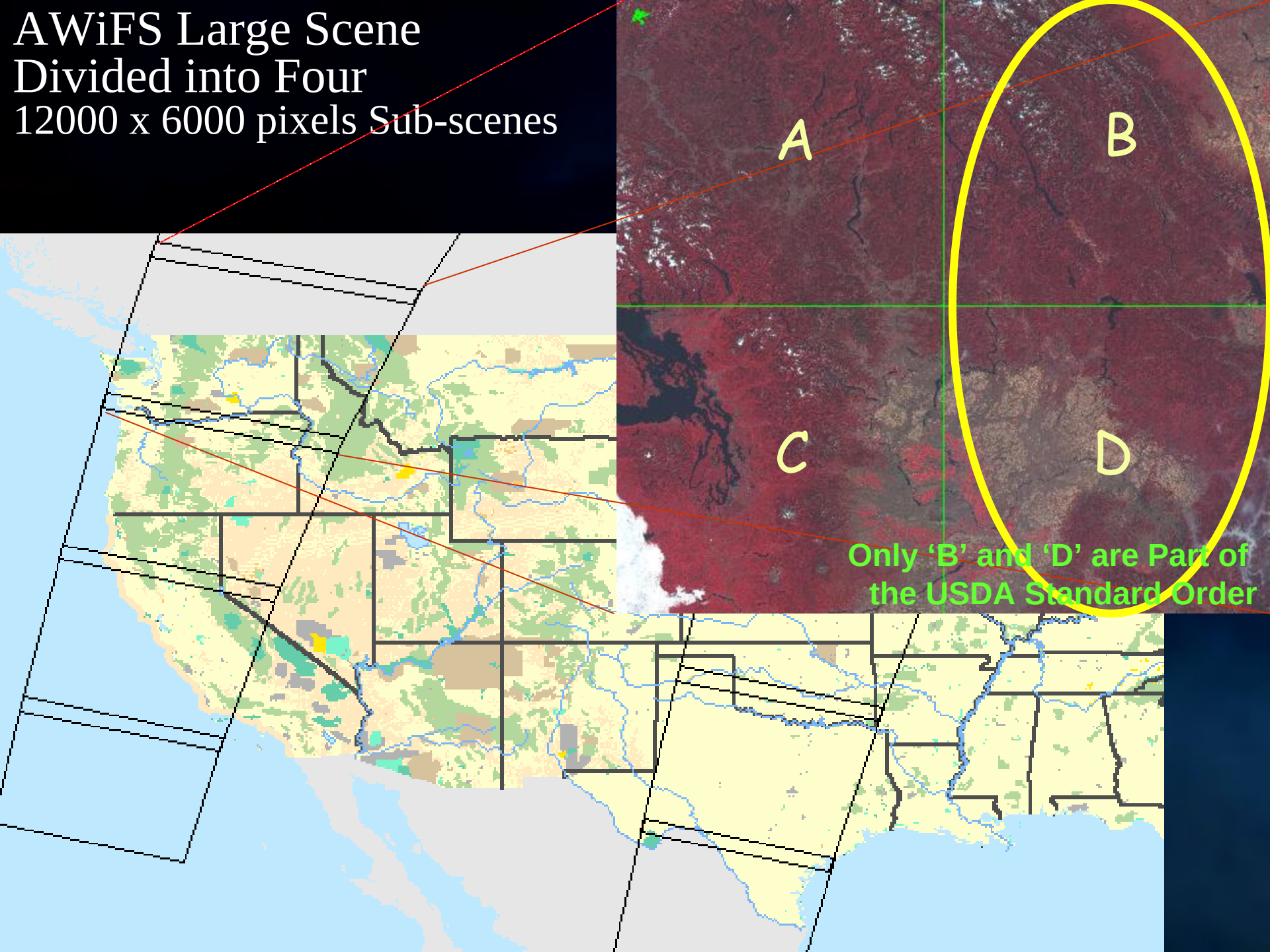


AWiFS Data: USDA Satellite Imagery Archive (SIA)

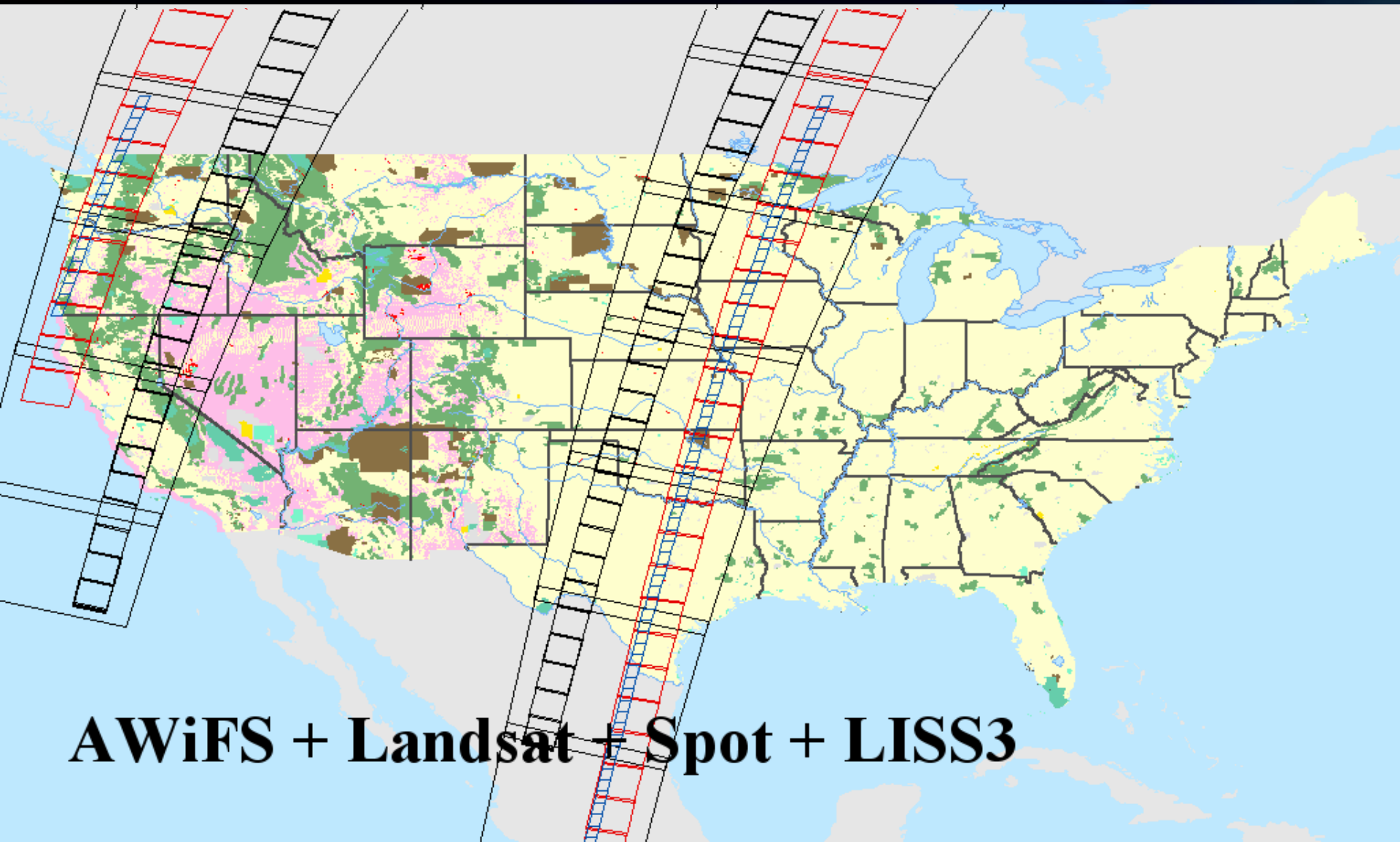


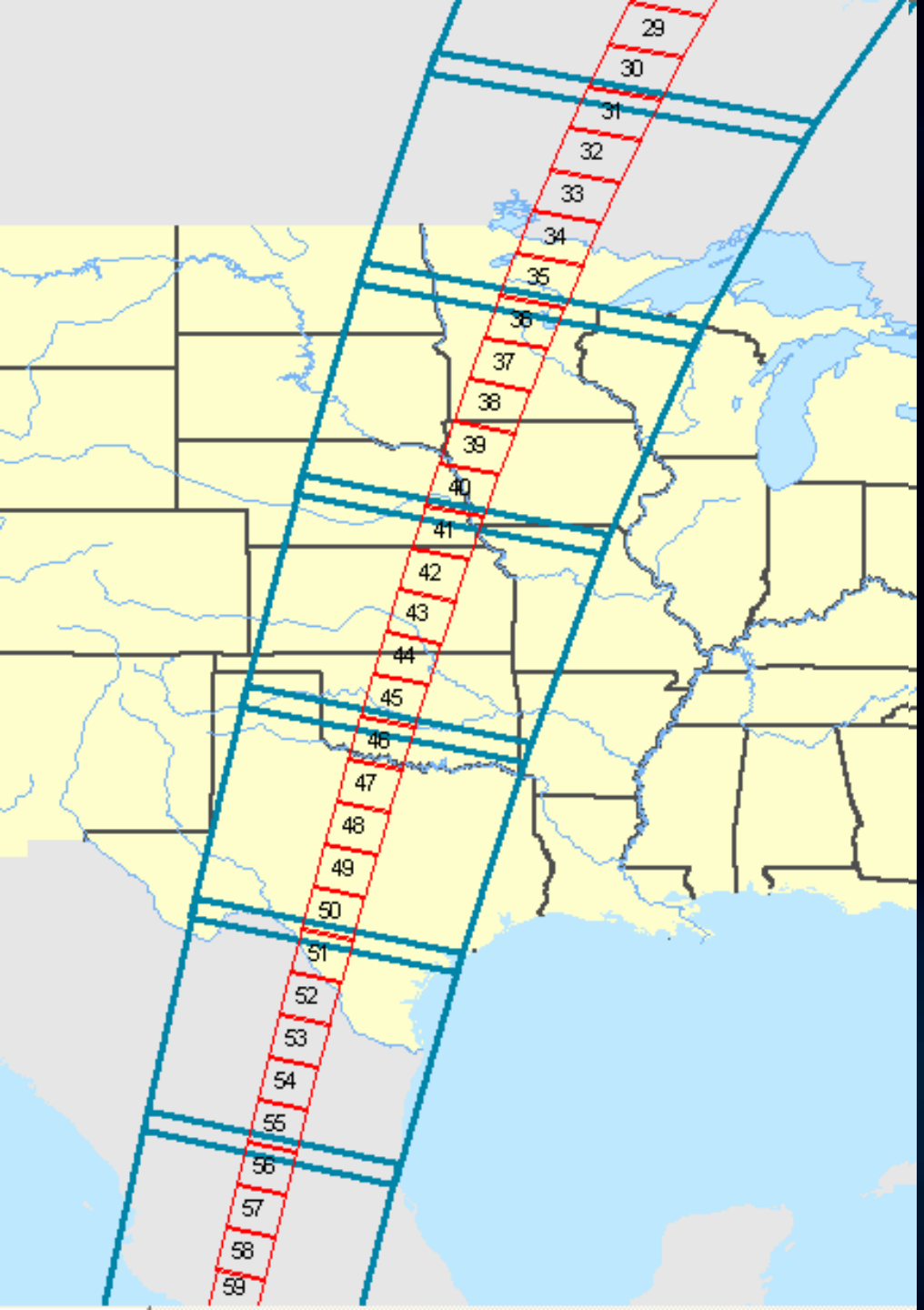
AWiFS Large Scene Divided into Four

12000 x 6000 pixels Sub-scenes



Comparing Single Pass Collection Capability



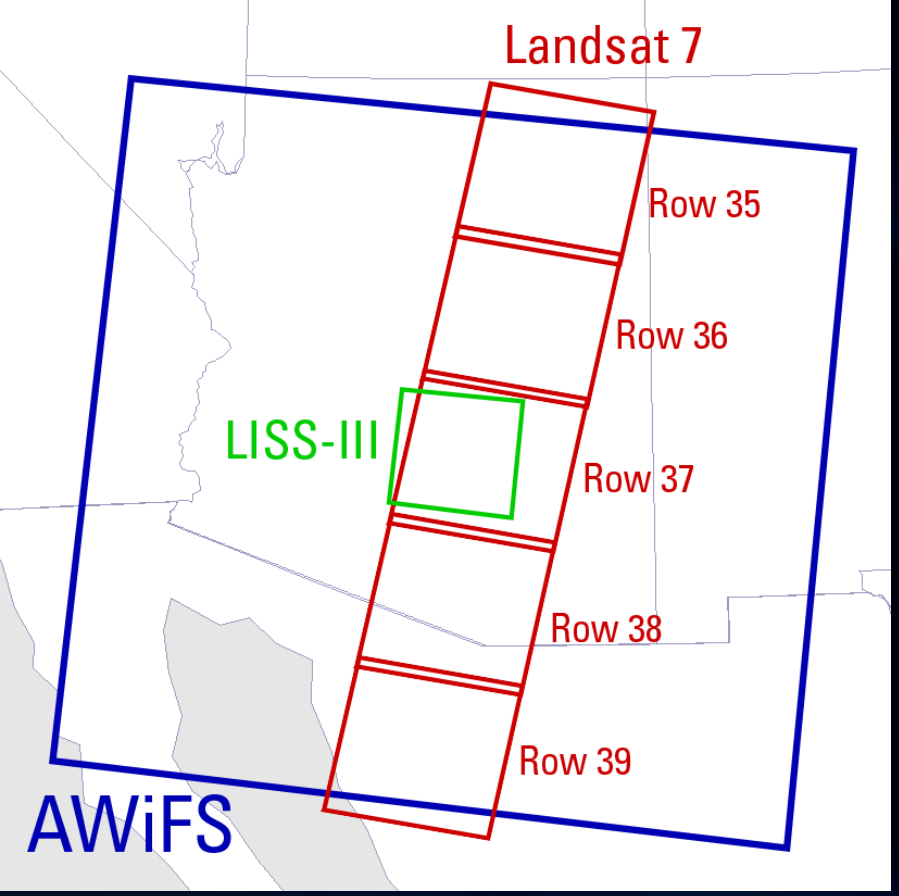


AWiFS and LISS3

LISS3 is Acquired at Nadir

Naming of AWiFS Rows is Driven by LISS3

Example Path 269



Swath Widths

AWiFS: 740 km

56 m gsd

Landsat: 181 km

30 m gsd

LISS-III: 141 km

23.5 m gsd

AWiFS Weaknesses

- Less resolution; No Band 1 or Band 7

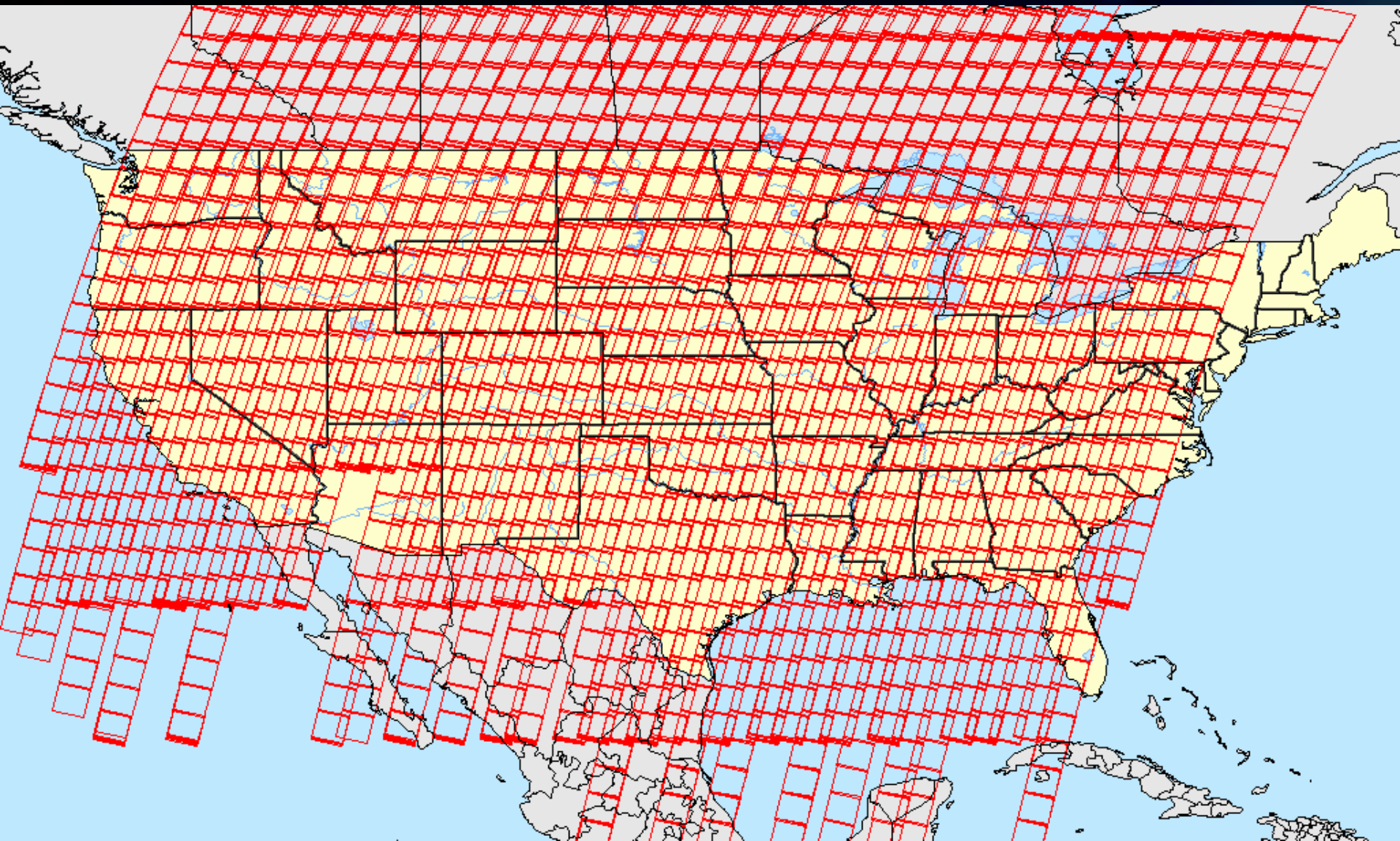
AWiFS Strengths

- Broad Coverage and Rapid Repeat (5 days!)
- Radiometric Resolution (10 bits)
- Cost & Timeliness
- Generally High Quality

Landsat Weakness

- Its Broken
- Poor Repeat Coverage

2007 LISS-3 Coverage
Sitting at GeoEye Waiting to be Ordered!



Upcoming Seminar on Resourcesat

2007 USDA FAS SEMINAR
ResourceSat - AWiFS and LISS Data

USDA FOREIGN AGRICULTURAL SERVICE

Announcing the 2007 series of the ResourceSat (AWiFS and LISS) Data Seminar

ASRC MANAGEMENT SERVICES

USDA FAS will again sponsor the 2007 Seminar on:

Tuesday, November 27, 2007

Please save the date in your calendar and look for additional details in the near future

If you are interested in presenting/speaking, sponsoring an event, or to pre-register contact Sherry Loy at Global Marketing Insights, Inc. at 216-525-0600, or email sherryloy@globalinsights.com

USDA Applications Benefiting from Timely Land-Cover Monitoring

- Agro-Terrorism
- Compliance
- Crop Monitoring
- Cropland Mapping
- Disease Monitoring
- Disaster Monitoring
- Drought Monitoring
- Environmental Monitoring
- Farm Records
- Forest Health
- Fire Suppression
- Homeland Security
- Invasive Species
- Land Use Monitoring

Global Crop Condition Assessment

- Combine with GIS
  - Daily, weekly, and Monthly Global Multi-Resolution Imagery with
  - Multiple Sources of Global Weather with
  - Multiple Sources of Global GIS data with
  - Multiple Crop Models with
  - Multiple sources of Crop Reports
- Create Global Estimates for Commodity Production

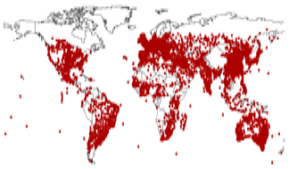
FOREIGN AGRICULTURAL SERVICE
USDA

Global Monitoring Data Sources for Estimating Crop Production

FAS/Office of Global Analysis

United States Department of Agriculture
Foreign Agricultural Service

WMO STATION Data



- Daily station data for rainfall, & min/max temperatures
- Archive from1979

COARSE-RESOLUTION Imagery

METEOSAT

GMS

GOES

SSMI

MEDIUM-RESOLUTION Imagery

SPOT Veg

TERRA/AQUA

HIGH-RESOLUTION Imagery

SPOT

IKONOS

QuickBird

Landsat

Resourcesat 1

AWiFS

ECONOMIC INFORMATION

Attaché reports (from USDA/FAS) for area harvested, yield, & production.

75 offices monitoring 110 countries

GRIB (RASTER)

USDA Satellite Imagery Library

Rainfall images (8-km)

AVHRR

LAC

GAC (from NASA)

AGRMET

- Daily polygrid data (25-51-km) for rainfall, snow, solar radiation, min/max temperatures, potential ET, and actual ET
- Archive from 1981

Monitor Vegetation conditions.

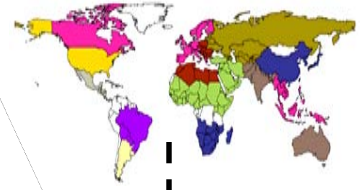
Image analysis

- Vegetation classification
- Vegetation stress
- Area planted estimates

- OGA Agricultural Economists for Grains, Cotton, and Oilseeds
- National production data & News Wires
- Regional experts + crop assessment travel

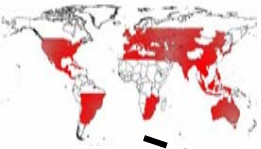
OGA REGIONAL CROP ASSESSMENT ANALYSTS

10 regional analysts monitoring 100 countries



Automated Product Generation (WWW)

Convergence of Evidence Analysis



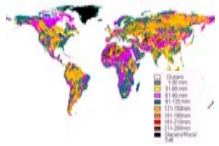
Station & polygrid data utilized to generate rainfall, temperature, & soil moisture images.

GIS Analysis/Integration (Multi-year comparisons)

SOIL MOISTURE Models

BASELINE REFERENCE Data

Historical crop area, yield, production,& trends connected to regional weather anomalies



ALARM Models

- Act as meteorological data filters by providing early warning to adverse weather conditions that affect crop growth.
- Models crop stages for corn, wheat, and sorghum.
- Flags regional weather anomalies that exceed temperature and soil moisture thresholds for the particular crop.

CROP Models

- Wheat (CERES, AGRISTARS, Maas, URCROP),
- Corn (AGRISTARS, URCROP)
- Soybean (Sinclair)
- Sorghum (AGRISTARS)
- Barley (URCROP).

- Historical crop production databases
- Administrative boundaries
- Average temperature & rainfall spatial data
- Soil texture & water-holding capacity

CROP PRODUCTION ESTIMATES

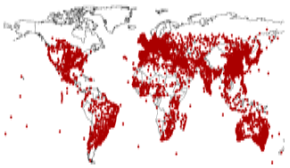
- Preliminary production estimates
- "Lockup" with USDA's World Outlook Board
- *USDA official production estimates released on the second week of each month*

Global Monitoring Data Sources for Estimating Crop Production

FAS/Office of Global Analysis

United States Department of Agriculture
Foreign Agricultural Service

WMO STATION Data



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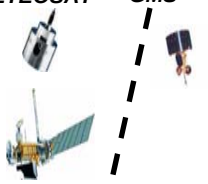
COARSE-RESOLUTION Imagery

METEOSAT GMS GOES



SSMI

GRIB (RASTER

Rainfall

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SPOT Veg TERRA/AQUA

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GAC (from NASA)

Monitor Vegetation conditions.

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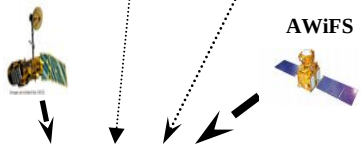
SPOT IKONOS QuickBird

Landsat Resourcesat AWiFS



USDA Satellite Imagery Library

Economic Causes, Rumors and Ground Truth

75 offices monitoring 110 countries

Agriculture Land Cover Change "Natural" Cause

(Growing conditions)

Agriculture Land Cover Change: What Actually Happened?

- Vegetation classification
- Vegetation stress
- Area planted estimates

- OGA Agricultural Economists for Grains, Cotton, and Oilseeds
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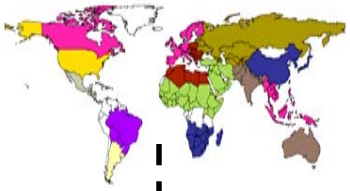

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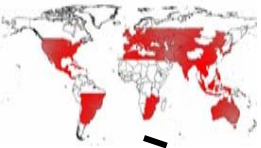

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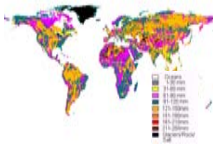

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- Soil texture & water-holding capacity

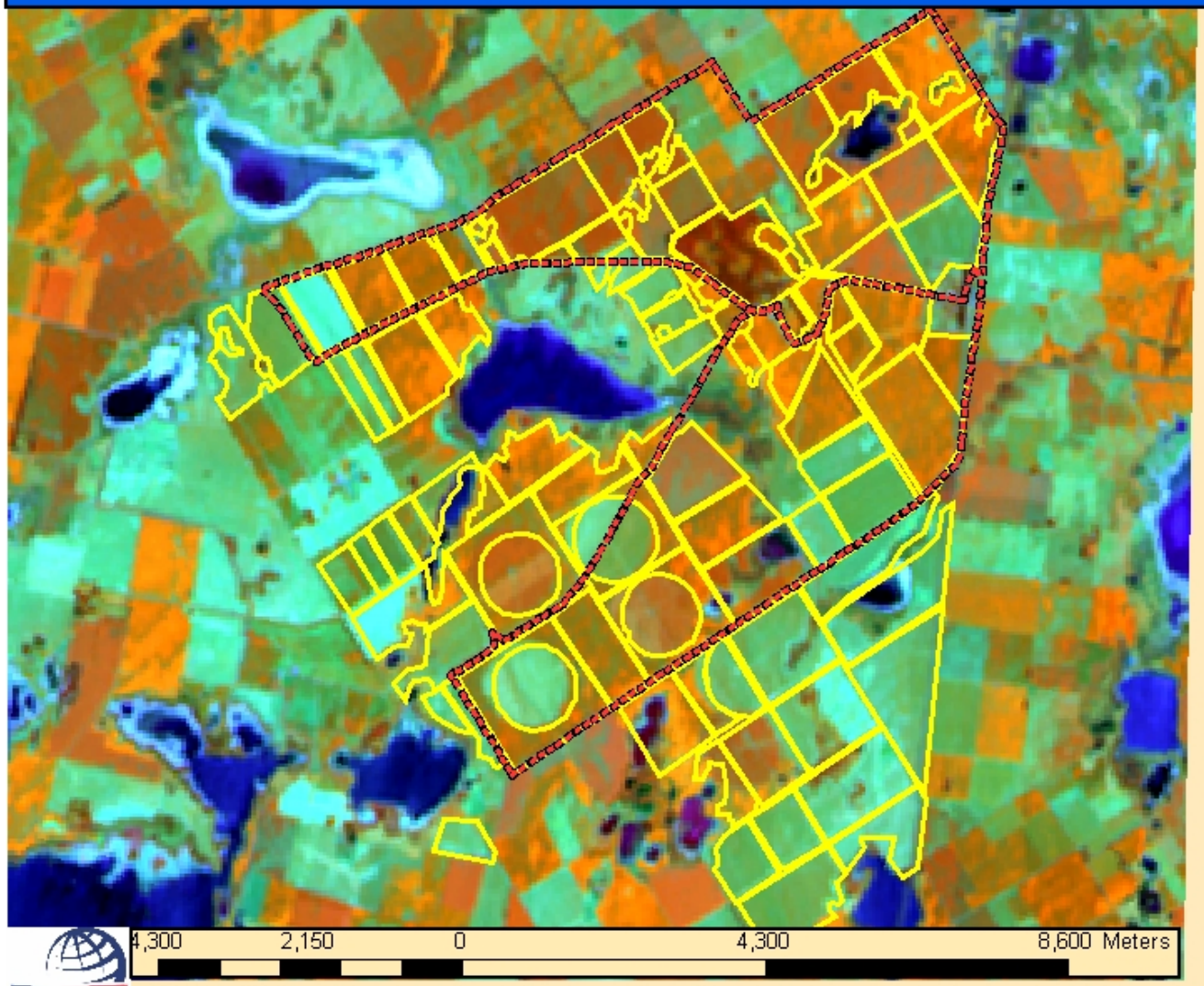
CROP PRODUCTION ES

- Pre
- "Lo Bo

Drives Markets

- *USDA official production estimates released on the second week of each month*

El Carmen: January 19, 2006
Venado Tuerto Delegation, Santa Fe Province, Argentina



El Carmen Field Map
Courtesy of ADECO

N

Fieldwork 2005

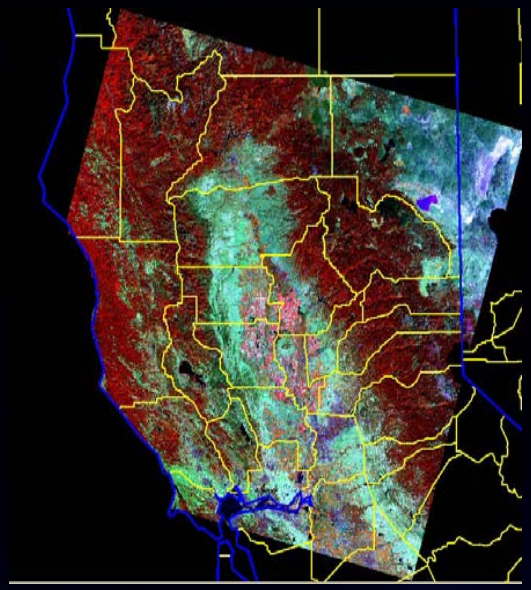
GPS tracks

Fields_0405

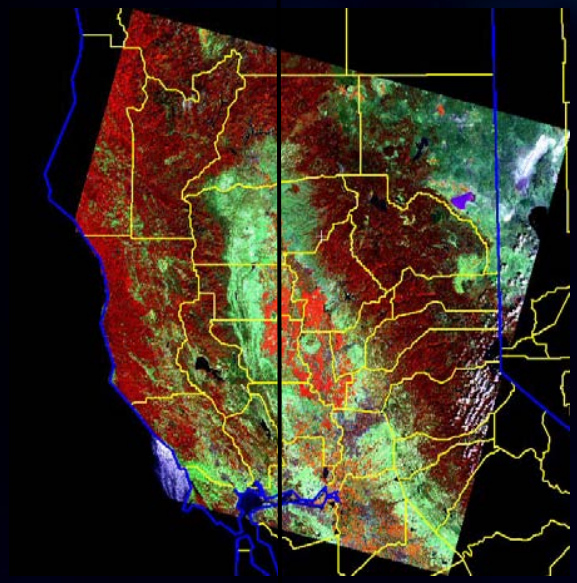
U.S. Department of Agriculture
Foreign Agricultural Service
Production Estimates and Crop Assessment Division
http://www.pecad.fas.usda.gov/

Field Data: USDA/FAS/PECAD
Image Data: IRS-AWiFS [IR,SWIR,R]
Projection: Lambert Conformal Conic, WGS 84
Contact: Nicole.C.Wagner@usda.gov

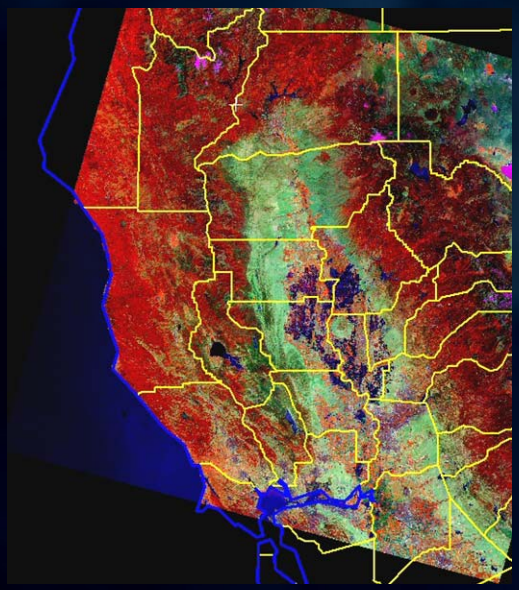
Northern California - AWiFs



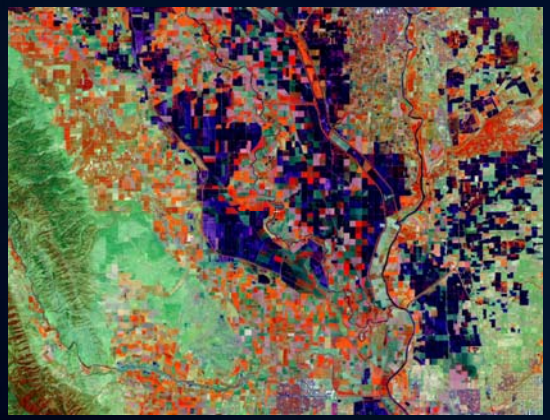
May 28, 2007

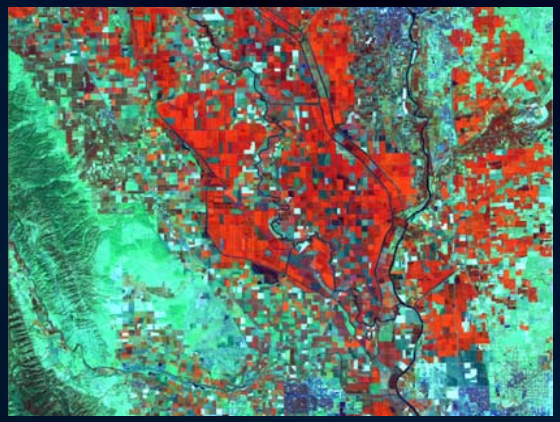


September 1, 2007



September 25, 2007



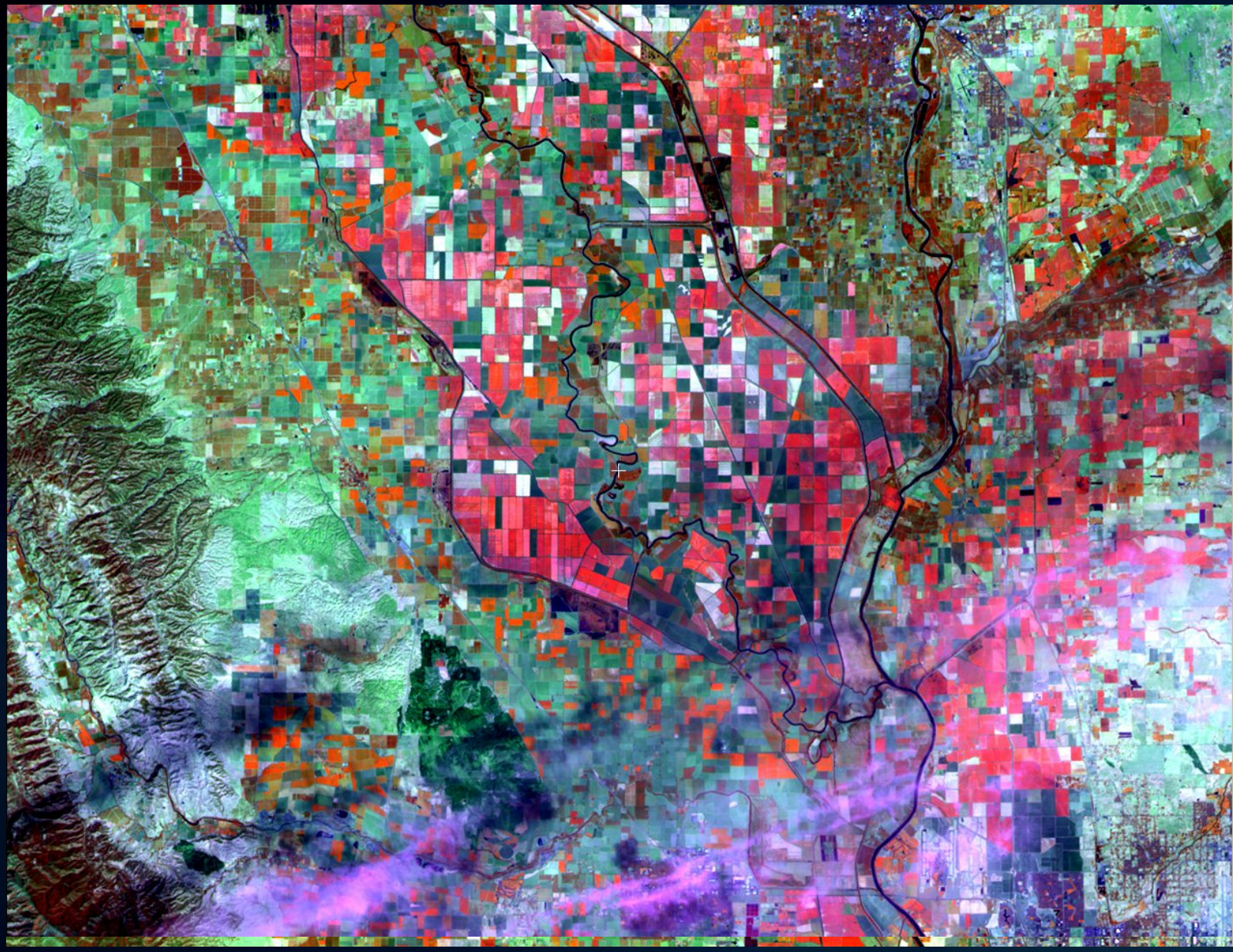


NE Yolo Co., California

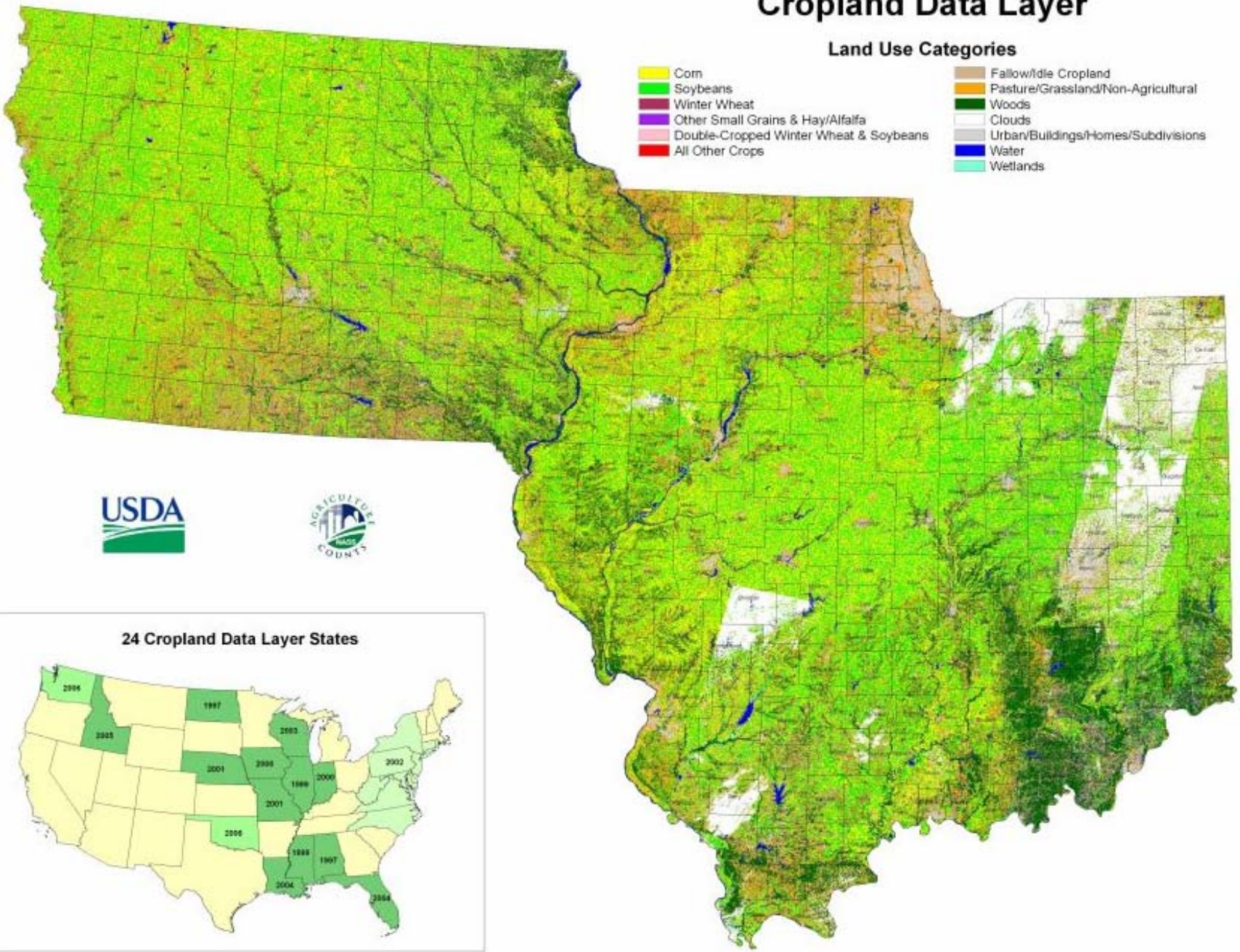
AWiFs Ch. 4,5,3

FFAS Center for Remote Sensing Analysis

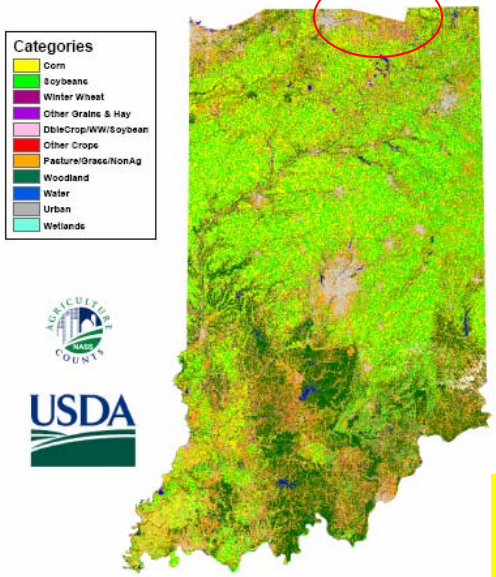
NE Yolo Co., California May 28– September 30, 2007



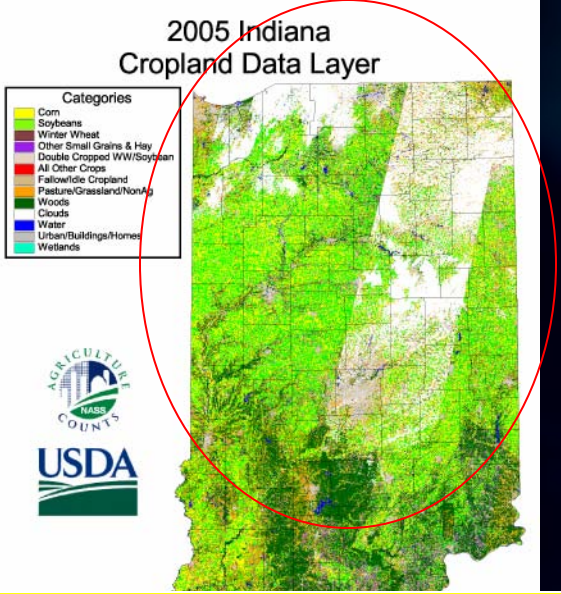
2005 Iowa-Illinois-Indiana Cropland Data Layer



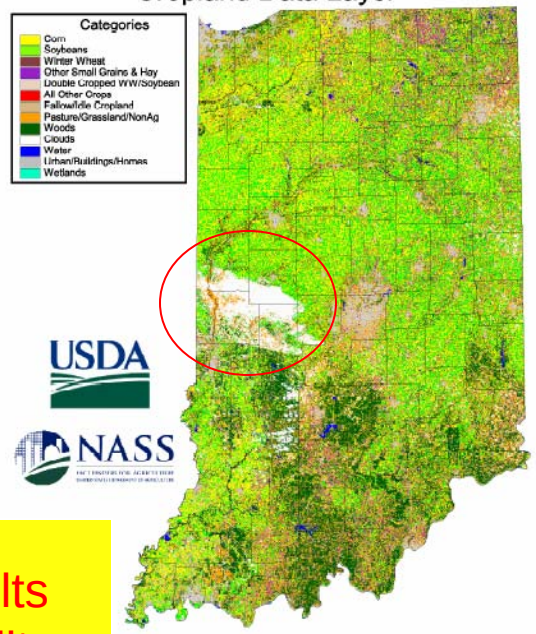
2006 Indiana Cropland Data Layer



2005 Indiana Cropland Data Layer

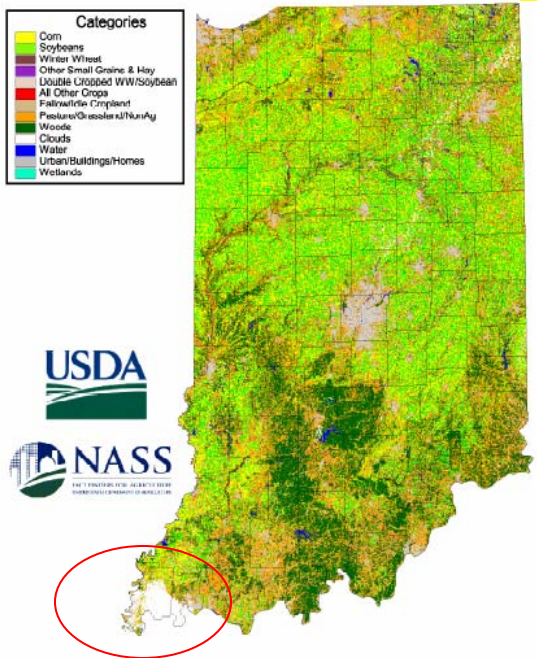


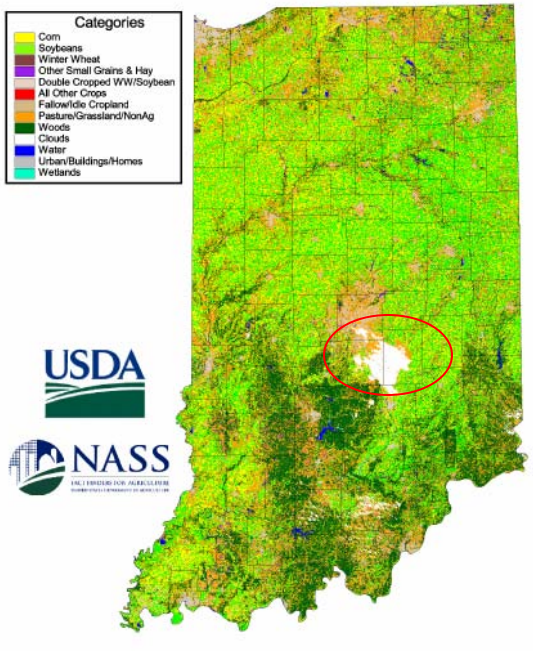
2004 Indiana TM & AWiFS Cropland Data Layer



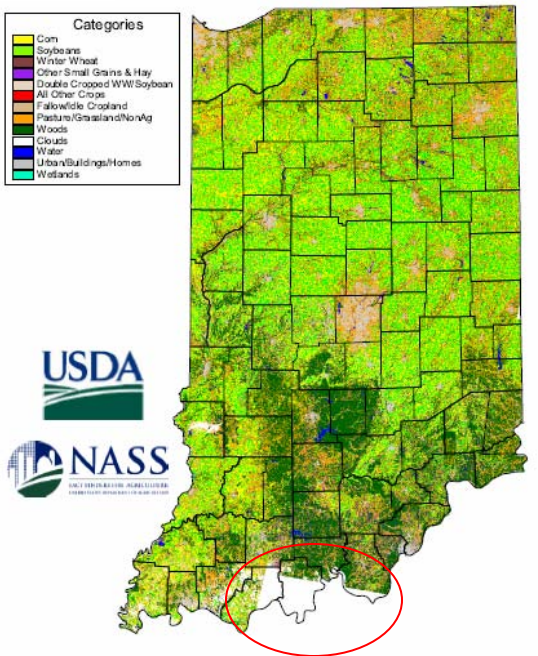
Lack of Temporal Repeat Cycle Results in Data Gaps and Decreased Reliability

2003 Indiana Cropland Data Layer





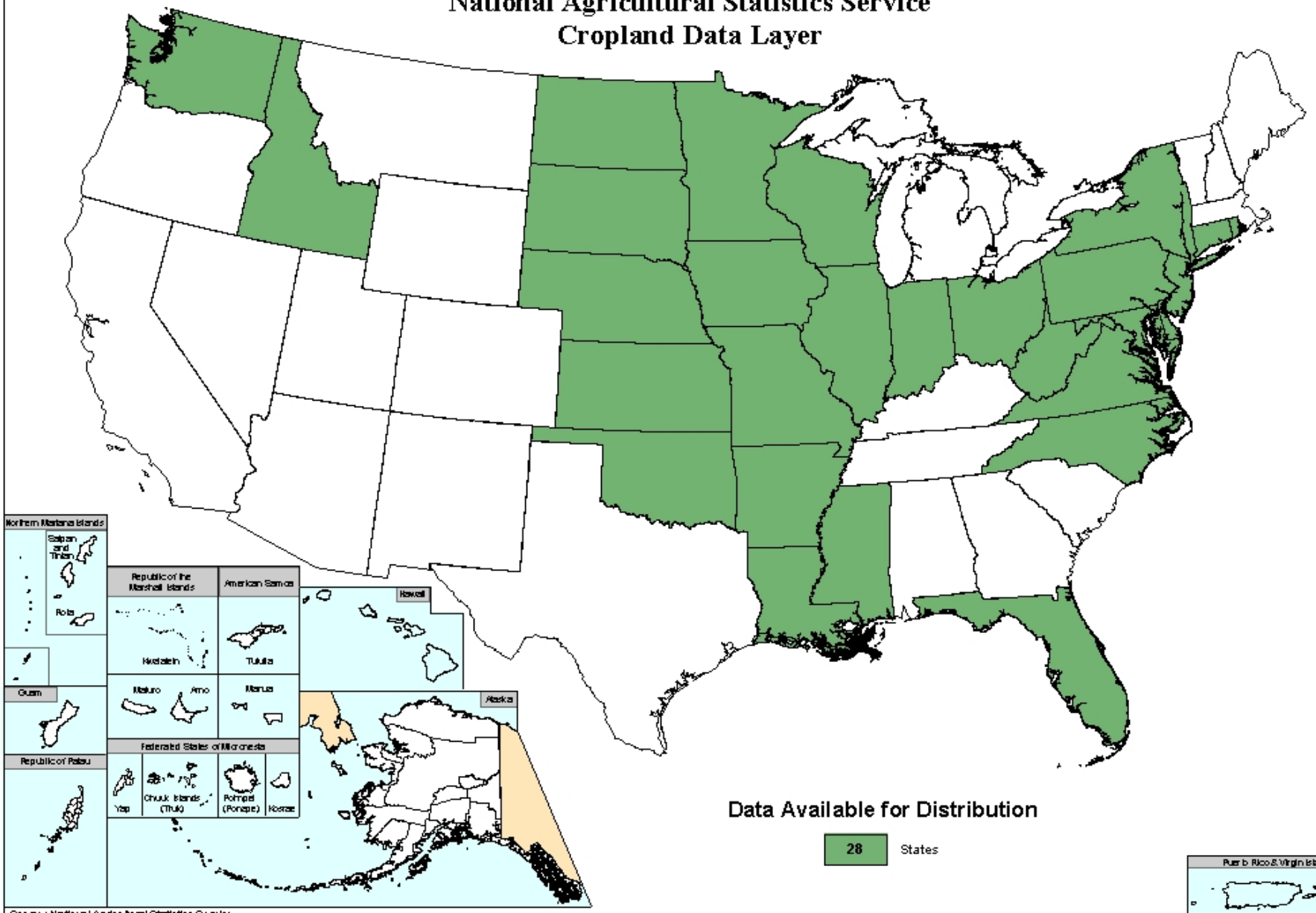
Indiana Categorized Image



US DEPARTMENT OF AGRICULTURE

NATURAL RESOURCES CONSERVATION SERVICE

National Agricultural Statistics Service
Cropland Data Layer



Source : National Agricultural Statistics Service.

Revised September 25, 2007

USDA NRCS National Cartography & Geospatial Center, Fort Worth, Texas 2007.

Links for Future Information and Data

- **USDA Aerial Photography Field Office**
  - **NAIP and USDA Aerial**
    - **http://apfo.usda.gov**
- **USDA Data Gateway**
  - **Data products packaged by county**
    - **http://datagateway.nrcs.usda.gov**
- **Forest Service geospatial data clearinghouse**
  - http://fsgeodata.fs.fed.us
  - **Data for National Forests**
    - **http://svinetfc4.fs.fed.us/**
- **Forest Service's Remote Sensing Applications Center (RSAC)**
  - **Fire Mapping, Resource Information**
    - **http://www.fs.fed.us/eng/rsac/**
- **Foreign Agricultural Service Crop Explorer (Global imagery, weather)**
  - http://www.pecad.fas.usda.gov/cropexplorer/
- **National Agricultural Statistics Service**
  - NASS **Cropland Data Layer**
  - http://www.nass.usda.gov/research/Cropland/SARS1a.htm

Future Inputs

- AWiFS:
  - Multispectal with high Temporal Resolution
- NAIP
  - 4 Band
  - 1 meter
  - Stereo?
- CLU
  - Available for Context
  - Some USDA Agencies Can Access Crop Reporting information linked to CLU
    - Privacy Implications

Future Outputs

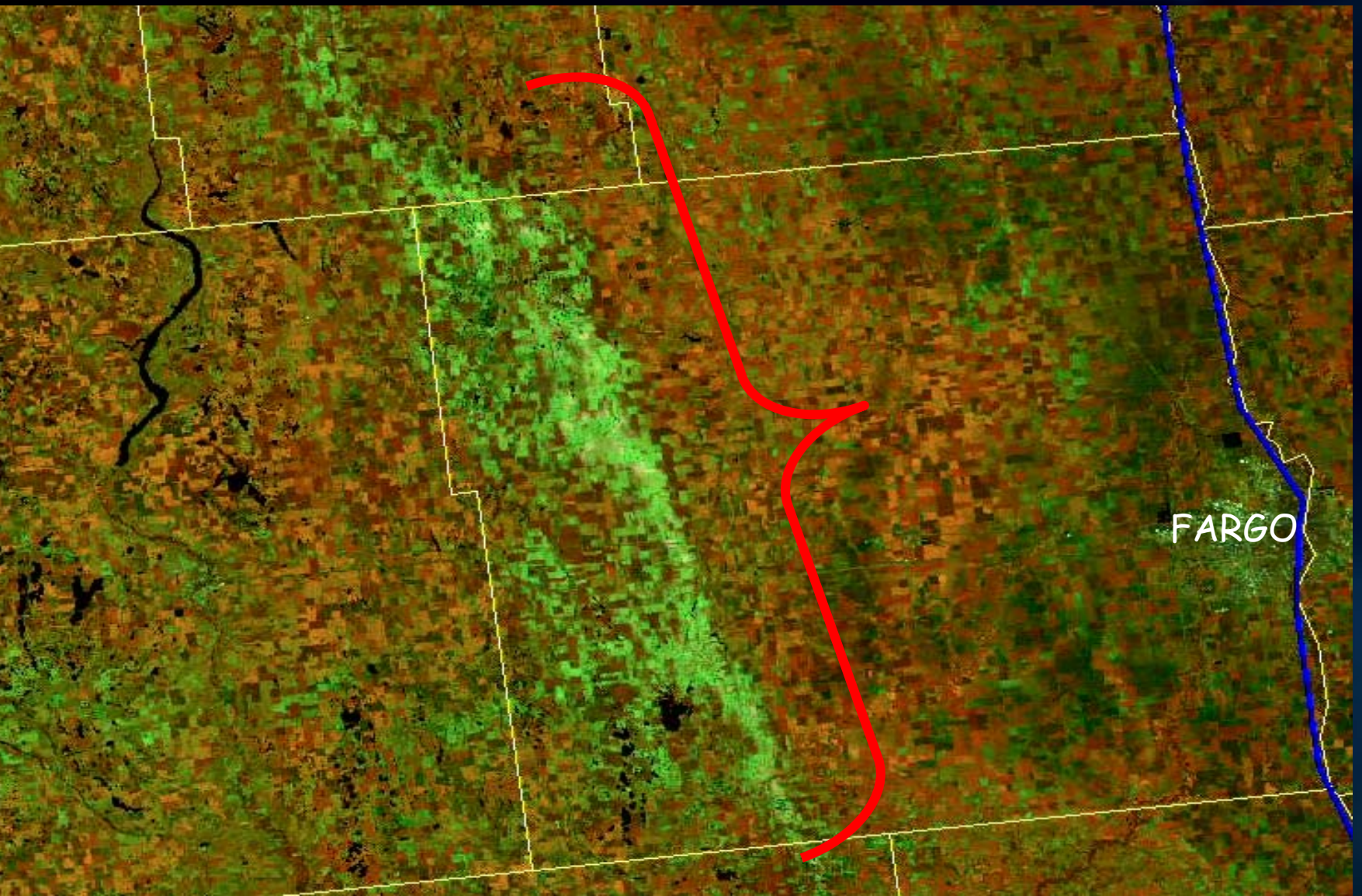
- Plant Stress / Disease indications
- Invasive Species Detection
- Episodic Event Alarm/Assessment
- Automated Compliance Alarm/Assessment

Agency Needs

- Discovering Errors in Crop Reporting
- Discerning poor farm practices
- Discovering contact violations
  - Farm Programs
  - Conservation Programs
- Monitoring Crop Disease / Agro-Terror


Questions?
Photographed by Civil Air Patrol
September 20, 2005, at 12:37 PM CDT
2005.09.20 12:37

July 19 AWIFS image Showing Path of Hail Strom



Sunflowers

Cass County, August 10, 2007

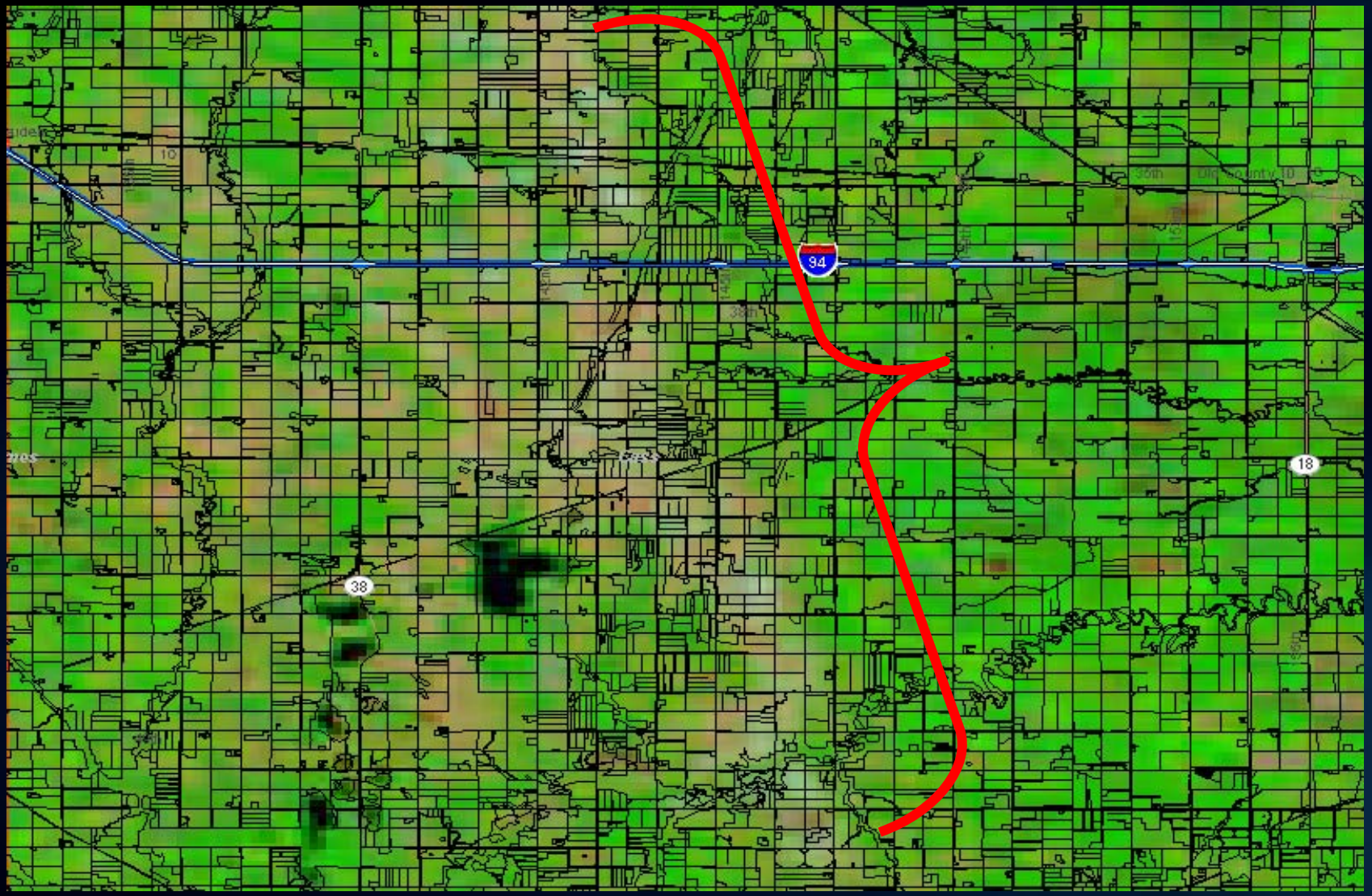
Corn

Cass County, August 10, 2007

Soybeans

Cass County, August 10, 2007

Hail Damage Visible on 250 meter MODIS



Buffering and Land Cover Analysis of Mandatory Buffers for the Columbia River Basin

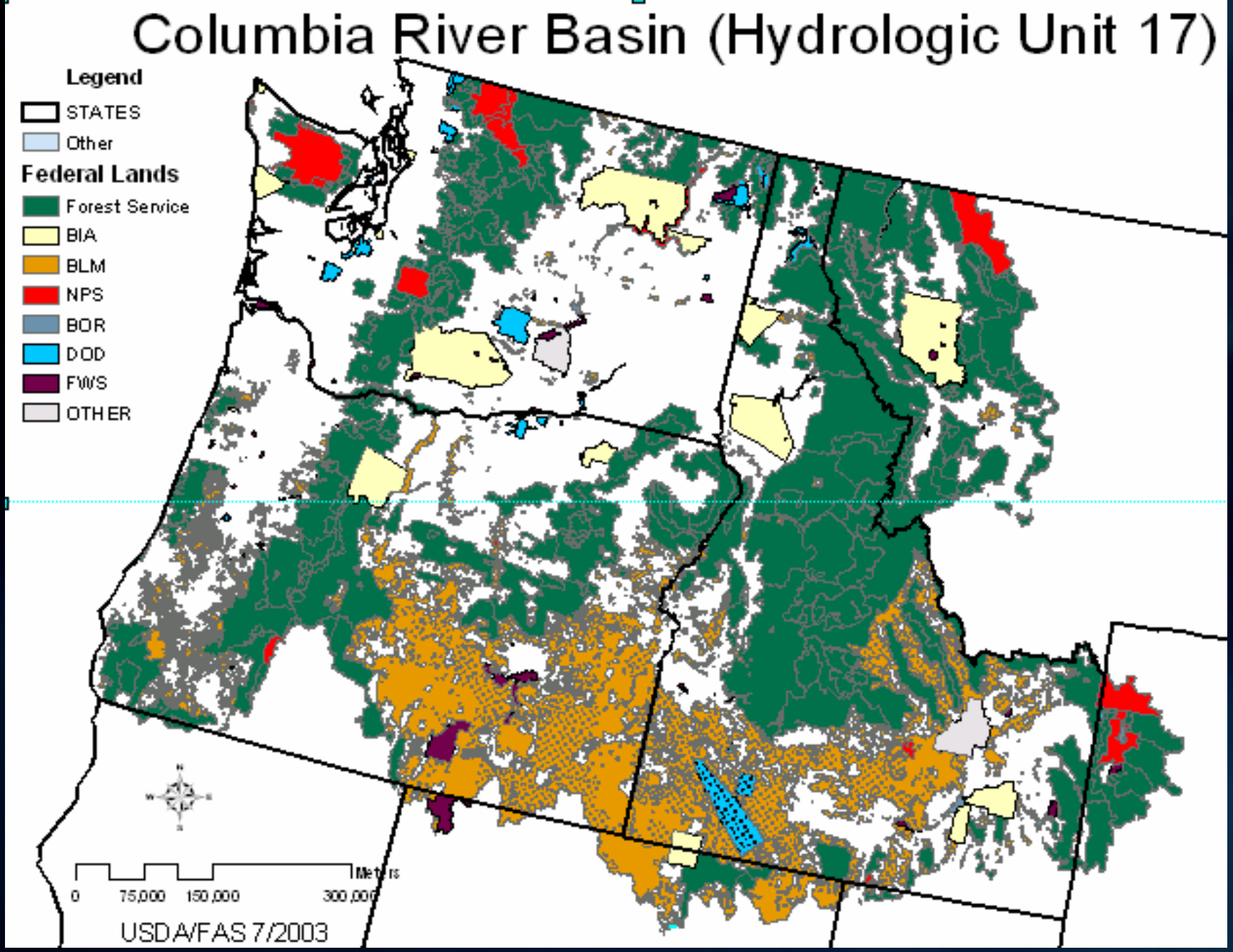
For Policy Impact of 20 and 100 Yard

No-Spray Buffers

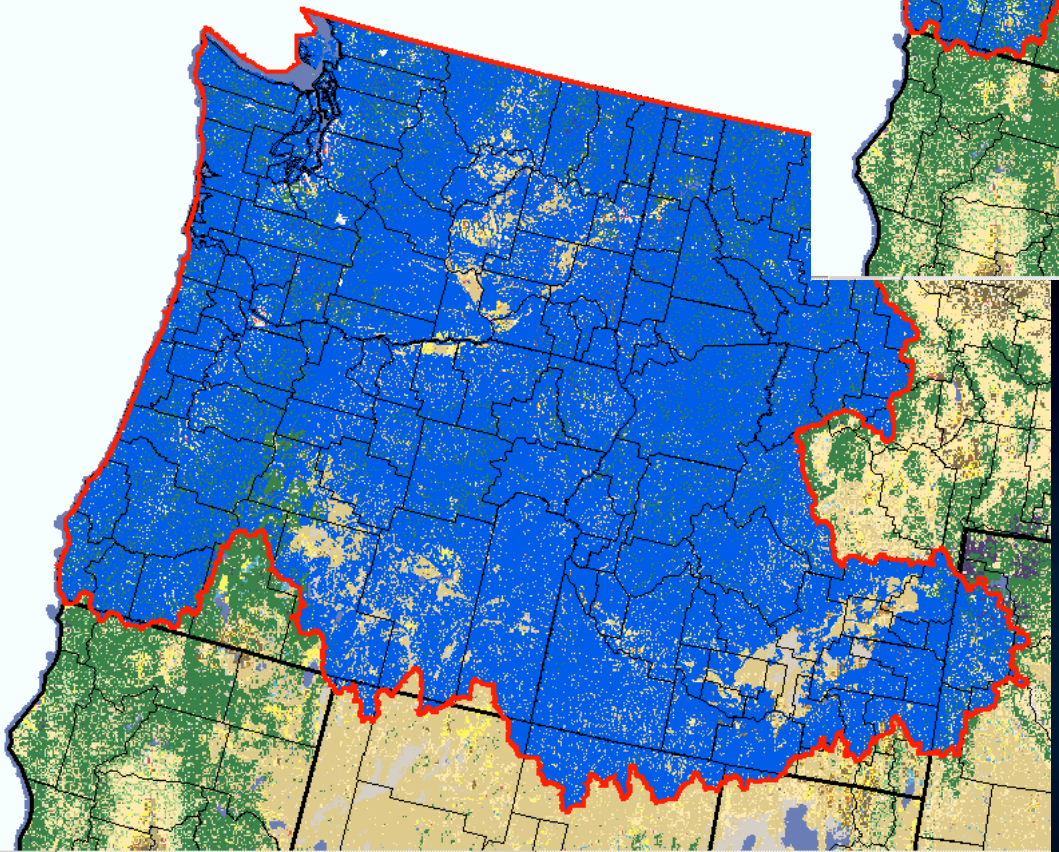
Time Given For Analysis: One Business Day + The Weekend

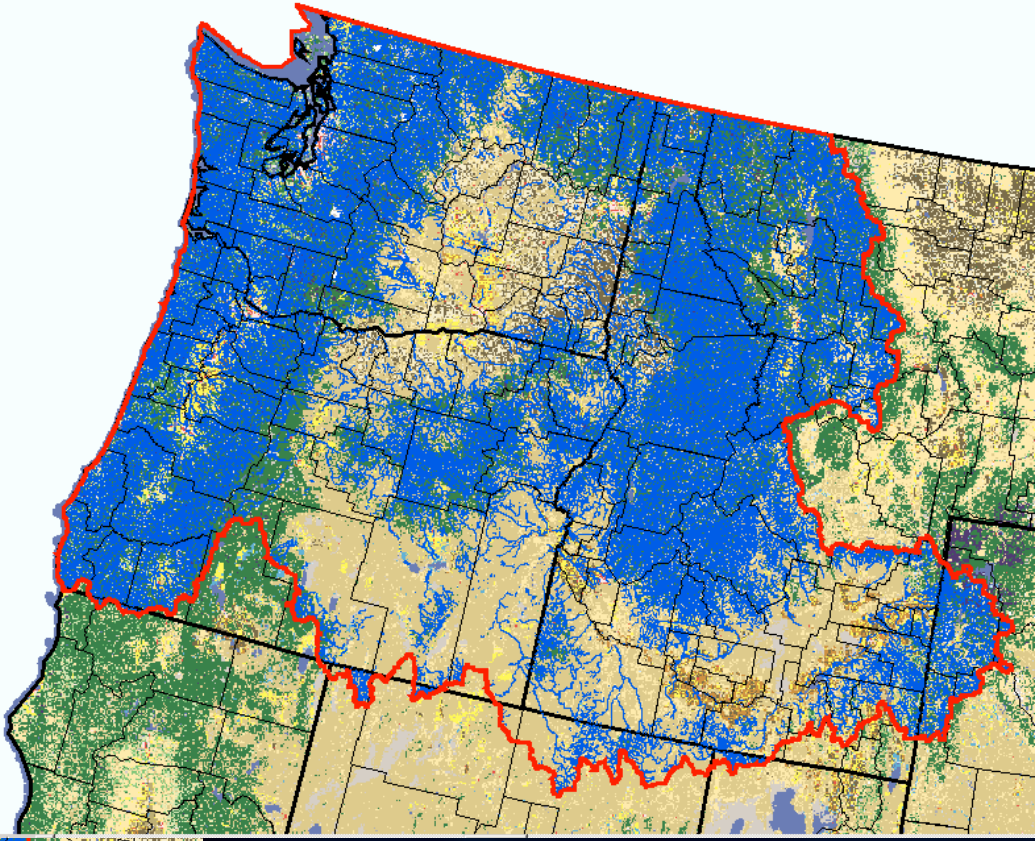
July 28, 2003

Columbia River Basin (Hydrologic Unit 17)



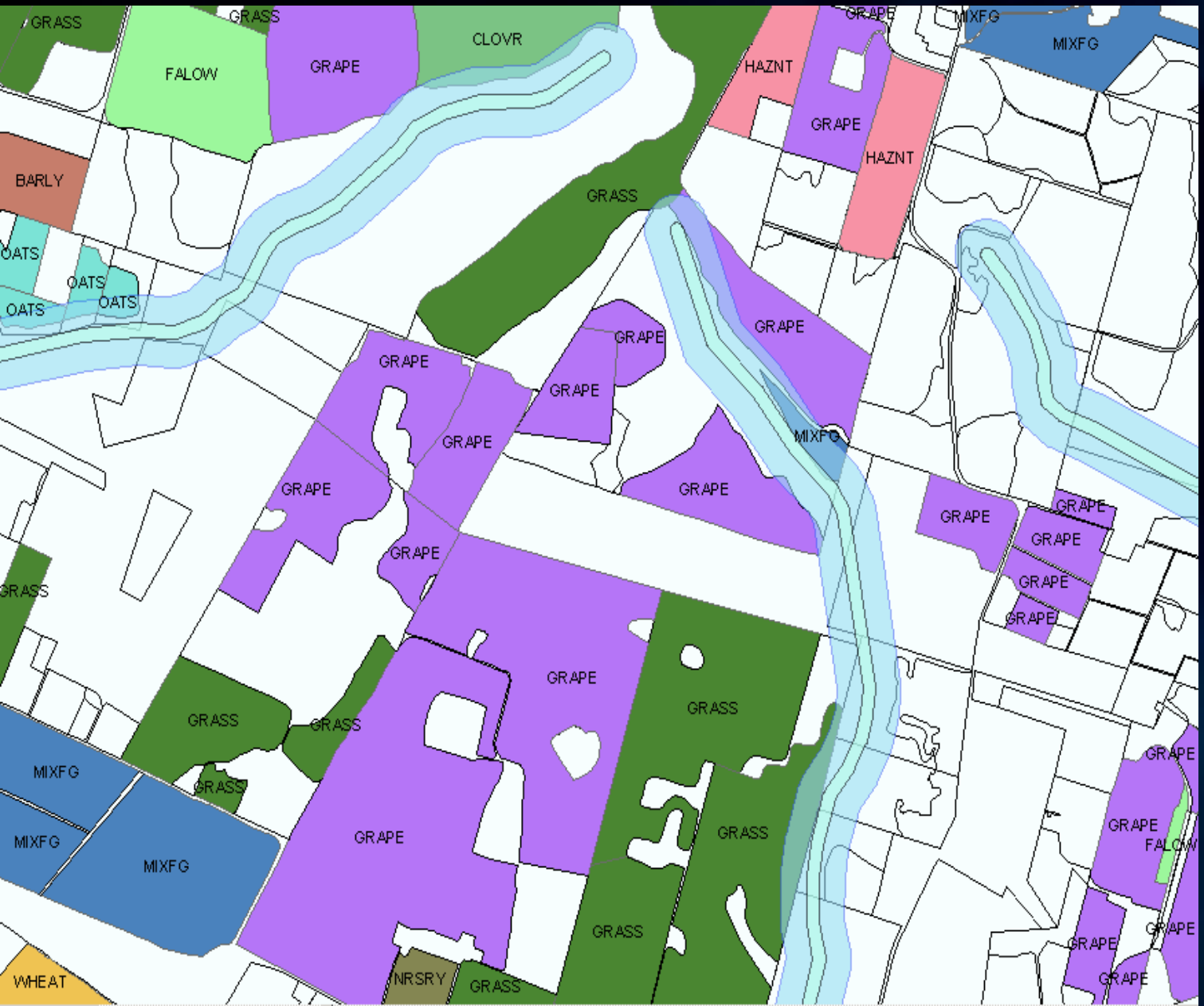
All Water Bodies



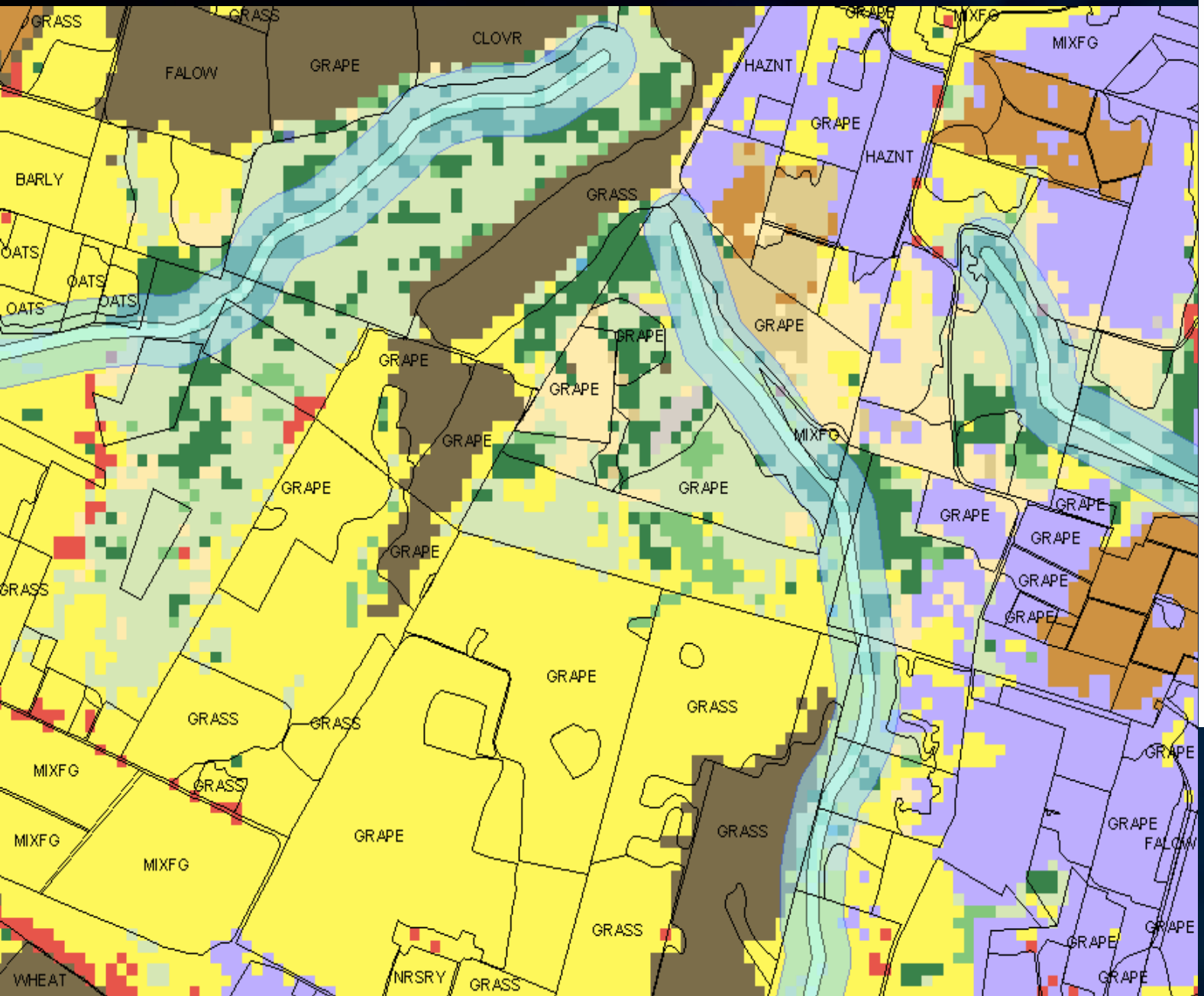


Only Perennial Water Bodies

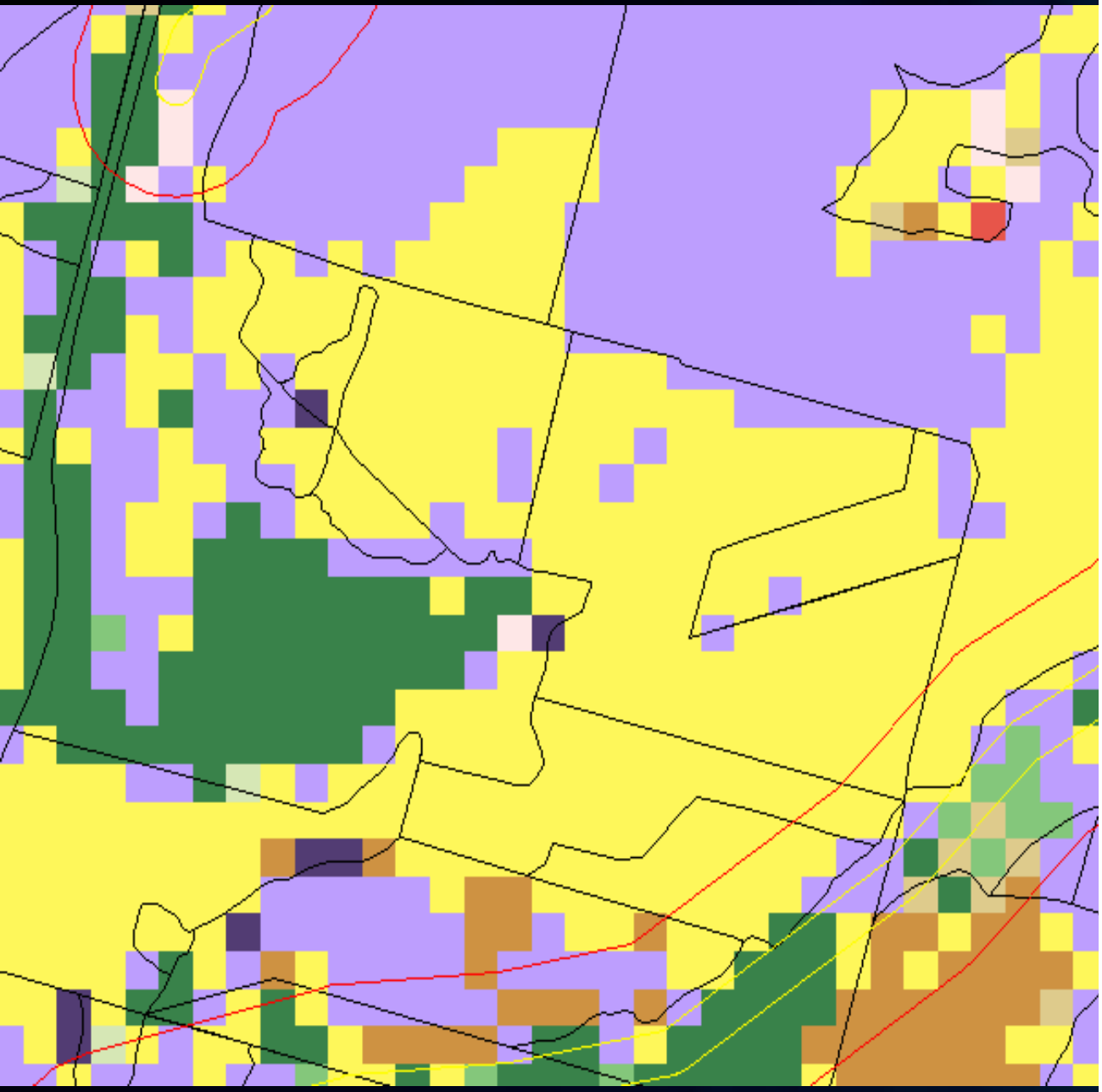
CLU, 578 (2002), Buffers



1992 NLCD + CLU and 578



NLCD View



- Open Water
- Perennial Ice/Snow
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Tran
- Bare Rock/Sand/Clay
- Quarries/Strip Mines/Grave
- Transitional
- Diciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrubland
- Orchards/Vinyards
- Grasslands/Herbaceous
- Pasture/Hay
- Row Crops
- Small Grains
- Fallow
- Urban/Recreational Grasse
- Woody Wetlands
- Emergent Herbaceous Wet

Reported to FSA as Pears