



# Access and Availability of Resourcesat-1 Advanced Wide Field Sensor (AWiFS) Data for Agriculture

Robert Tetrault

USDA Foreign Agricultural Service

USDA Satellite Imagery Archive



# Access and Availability of Resourcesat-1 for Agriculture

---

## Agenda

1. What is the USDA Satellite Imagery Archive?
  - Who participates? How?
  - Is it only Resourcesat-1 data? Why?
2. What Resourcesat-1 AWiFS data is available?
  - How is current data ordered by the USDA?
  - How fast does it arrive?
3. How is the Resourcesat-1 AWiFS data accessible?
  - Who gets the data?
4. What is Resourcesat-1 AWiFS data used for?



# Access and Availability of Resourcesat-1 for Agriculture

## Background on the USDA-Satellite Imagery Archive (USDA-SIA)

USDA-SIA is a program within the Foreign Agricultural Service that:

- Provides access to satellite imagery purchased by USDA for participating agencies.
- Cost-sharing program to maximize the cost effectiveness of Department expenditures on satellite imagery.
- Reduces the per-image price paid by USDA agencies.
- Takes advantage of contracts already in place.
- Benefits from leveraging the power of a single USDA purchasing body.





# Access and Availability of Resourcesat-1 for Agriculture

---

## Who pays for the satellite imagery?

- Participating agencies pay an annual fee for access to the USDA Satellite Imagery Archive.
  - Fees do not cover the purchase of new imagery.
- USDA purchases satellite imagery using the investment of the Commodity Credit Corporation.
  - This is the USDA's standing order
- If agencies need additional imagery not in the standing order, the purchase needs to be funded separately.
- The benefits to participating are high, if the area and time frame coincide with the USDA's standing order.



## Access and Availability of Resourcesat-1 for Agriculture

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

- USDA has Transitioned from Landsat to Resourcesat-1 AWiFS data. FY2008 is our third year.
  - Global Coverage, Rapidly Delivered (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

**Not all applications have transitioned; 85% for P6-AWiFS, 14% for Landsat.**



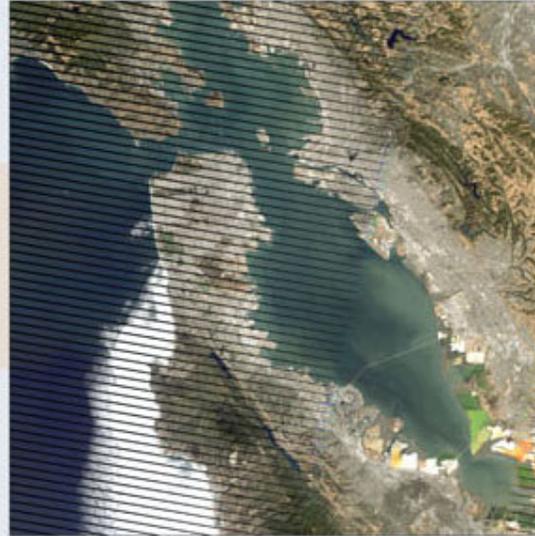
# Access and Availability of Resourcesat-1 for Agriculture

PRE-SLC FAILURE



3 MARCH 2000

POST-SLC FAILURE



20 SEPTEMBER 2003

**Partial scene**

## Landsat 5 Status: Back in Operation (Feb. 29, 2008)

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

**By the end of November, the team will have sufficient information to make a recommendation on the Landsat 5 mission concept – return to full operations or a more limited operations concept.**

**Limited operations concept relies more on direct power from the solar array. Schedule changes were made to limit imaging during the winter months and to resume all routine imaging over the continental U.S. from March through September. Some concessions will also be made to limit imaging over international sites.**

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



# Access and Availability of Resourcesat-1 for Agriculture

## The Landsat Data Gap: The USDA View

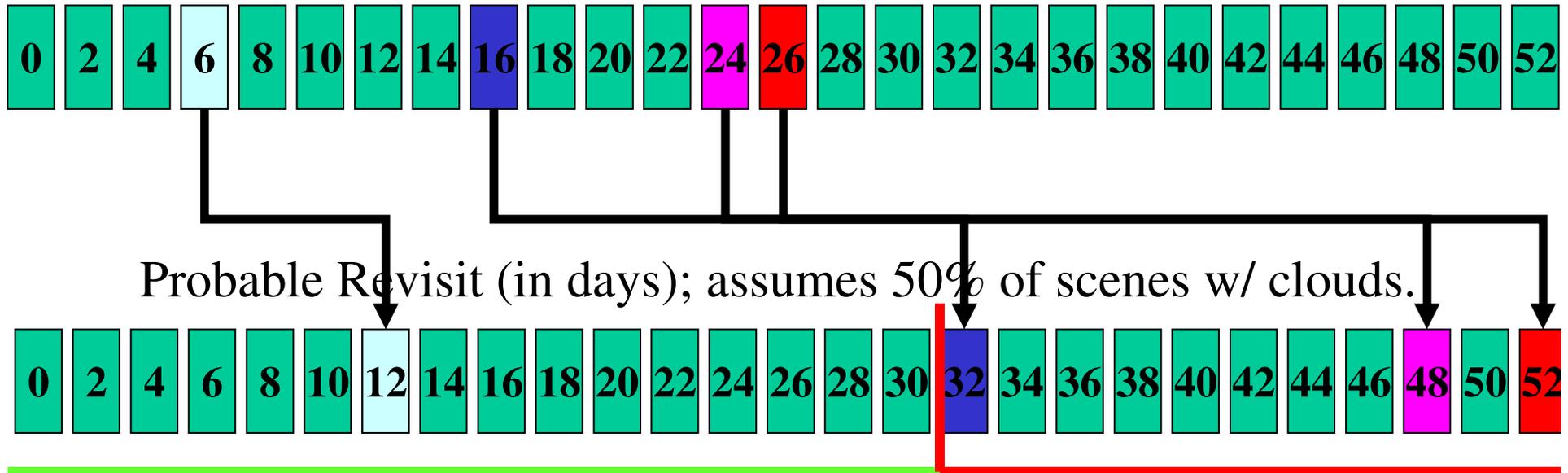
- The extent of the Landsat Data Gap is based on numerous assumptions:
  - Complete Gap: **2008 to 2011**
    - 2008:
      - fuel depleted for Landsat-5; battery malfunction
      - 10% probability for Landsat-7 gyro failure.
    - 2011: Launch of the Landsat Data Continuity Mission (LDCM)
      - Assumes one satellite, similar to Landsat-7.
      - Ends Complete Gap
  - Partial Gap: **2003 to Indefinite**
    - 2003:
      - Landsat-7 SLC anomaly;
      - Landsat-5 provides only 16-day revisit.
    - Indefinite: No US government plans to provide better than 16-day revisit.

**Partial Gap means that several USDA applications can not function.**



## Operational Agricultural Monitoring

Satellite Revisit or Repeat cycle (in days)

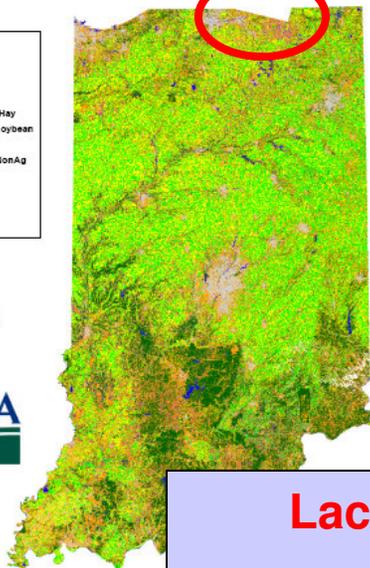


One **Landsat**, one **SPOT**, and one **LISS3** does not meet goal of monthly data collection.

**AWiFS** meets Ag. monitoring goals due to its high degree of overlap.

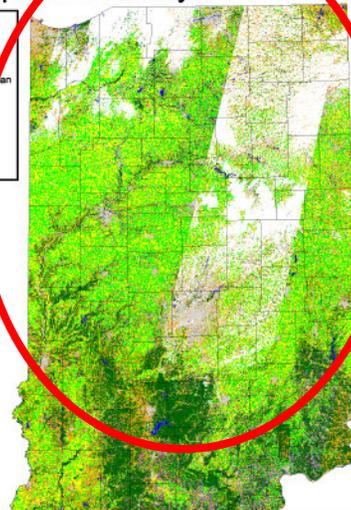
2006 Indiana Cropland Data Layer

- Categories
- Yellow: Corn
- Green: Soybeans
- Purple: Winter Wheat
- Light Purple: Other Grains & Hay
- Dark Purple: Double-Cropped WW/Soybean
- Red: All Other Crops
- Orange: Fallow/Idle Cropland
- Light Green: Pasture/Grassland/NonAg
- Dark Green: Woodland
- Blue: Water
- Light Blue: Urban
- Cyan: Wetlands



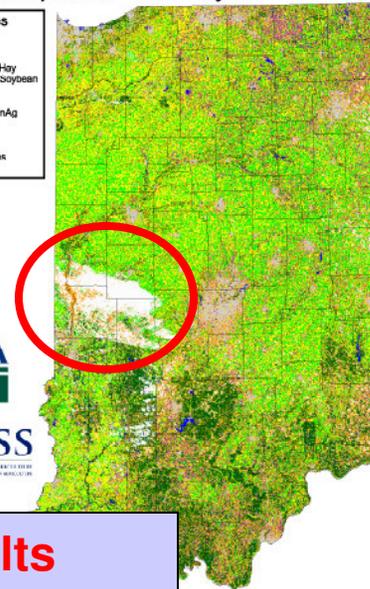
2005 Indiana Cropland Data Layer

- Categories
- Yellow: Corn
- Green: Soybeans
- Purple: Winter Wheat
- Light Purple: Other Small Grains & Hay
- Dark Purple: Double-Cropped WW/Soybean
- Red: All Other Crops
- Orange: Fallow/Idle Cropland
- Light Green: Pasture/Grassland/NonAg
- Dark Green: Woods
- Blue: Water
- Light Blue: Urban/Buildings/Homes
- Cyan: Wetlands



2004 Indiana TM & AWiFS Cropland Data Layer

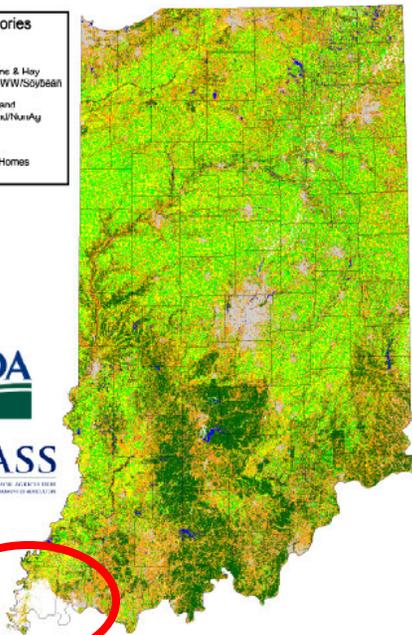
- Categories
- Yellow: Corn
- Green: Soybeans
- Purple: Winter Wheat
- Light Purple: Other Small Grains & Hay
- Dark Purple: Double-Cropped WW/Soybean
- Red: All Other Crops
- Orange: Fallow/Idle Cropland
- Light Green: Pasture/Grassland/NonAg
- Dark Green: Woods
- Blue: Water
- Light Blue: Urban/Buildings/Homes
- Cyan: Wetlands



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

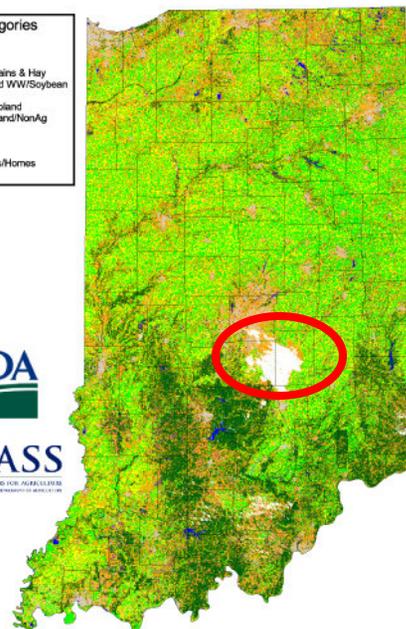
2003 Indiana Cropland Data Layer

- Categories
- Yellow: Corn
- Green: Soybeans
- Purple: Winter Wheat
- Light Purple: Other Small Grains & Hay
- Dark Purple: Double-Cropped WW/Soybean
- Red: All Other Crops
- Orange: Fallow/Idle Cropland
- Light Green: Pasture/Grassland/NonAg
- Dark Green: Woods
- Blue: Water
- Light Blue: Urban/Buildings/Homes
- Cyan: Wetlands



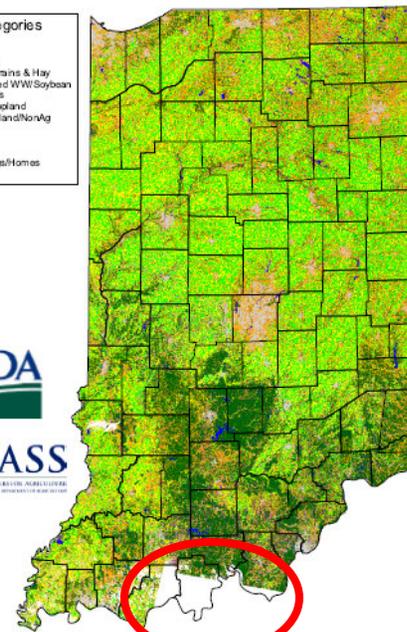
2002 Indiana Cropland Data Layer

- Categories
- Yellow: Corn
- Green: Soybeans
- Purple: Winter Wheat
- Light Purple: Other Small Grains & Hay
- Dark Purple: Double-Cropped WW/Soybean
- Red: All Other Crops
- Orange: Fallow/Idle Cropland
- Light Green: Pasture/Grassland/NonAg
- Dark Green: Woods
- Blue: Water
- Light Blue: Urban/Buildings/Homes
- Cyan: Wetlands



2001 Indiana Categorized Image

- Categories
- Yellow: Corn
- Green: Soybeans
- Purple: Winter Wheat
- Light Purple: Other Small Grains & Hay
- Dark Purple: Double-Cropped WW/Soybean
- Red: All Other Crops
- Orange: Fallow/Idle Cropland
- Light Green: Pasture/Grassland/NonAg
- Dark Green: Woods
- Blue: Water
- Light Blue: Urban/Buildings/Homes
- Cyan: Wetlands





# Access and Availability of Resourcesat-1 for Agriculture

## USDA and Resourcesat-1 AWiFS: A short history

- Resourcesat-1 launched *October 17, 2003*
- Sample data to USDA/NASS *August, 2004*
- NASA begins to characterize AWiFS *November 2004*
- Sample data to USDA/FAS *December, 2004*
- Purchases by USDA/NASS *August, 2005*
  - Problems with data collects (programming and delivery)
- Purchases by USDA/FAS *November, 2005*
- First standing order from USDA/FAS *December, 2005*
  - Set delivery terms; set price from contract
- First Operational Year *Calendar 2006*
- Second operational year *Calendar 2007*
  - Changed pattern of US collects to B & D quads for every 5<sup>th</sup> row

**USDA has 3,203 Resourcesat-1 AWiFS quads**



# Access and Availability of Resourcesat-1 for Agriculture

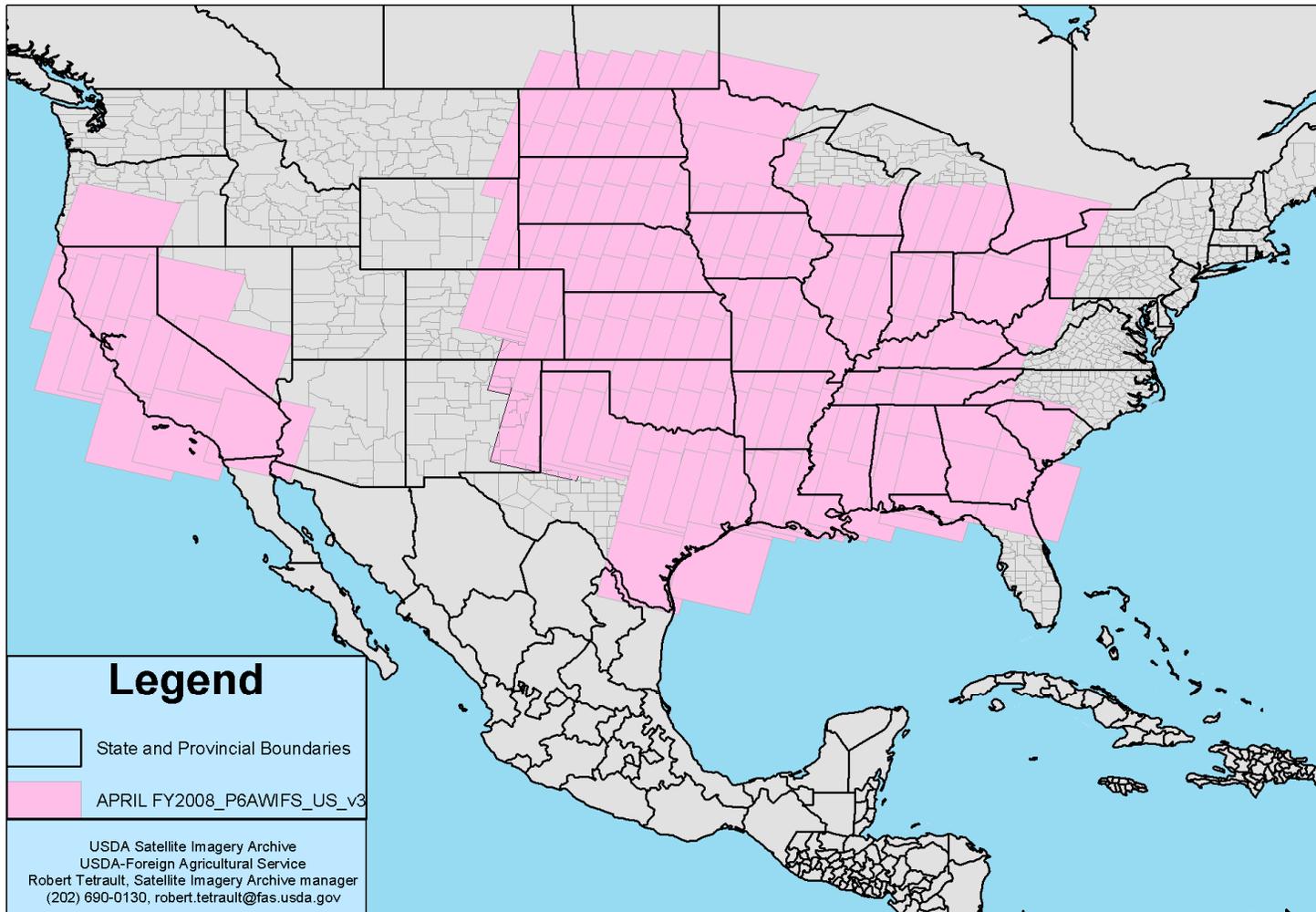
## Plans for FY2008 CONUS Coverage USDA's Standing Order

- Collection starts April 1, 2008
- Standing Order is slightly smaller in FY2008
- ASRC-MS / GeoEye has standing order and is ready to go.
- Same price and same delivery terms as last year.
  - USDA receives a discounted price per orthorectified quad.
  - Delivery terms are: No later than 3 days after date of acquisition for North America (in Norman, OK's cone).



# Access and Availability of Resourcesat-1 for Agriculture

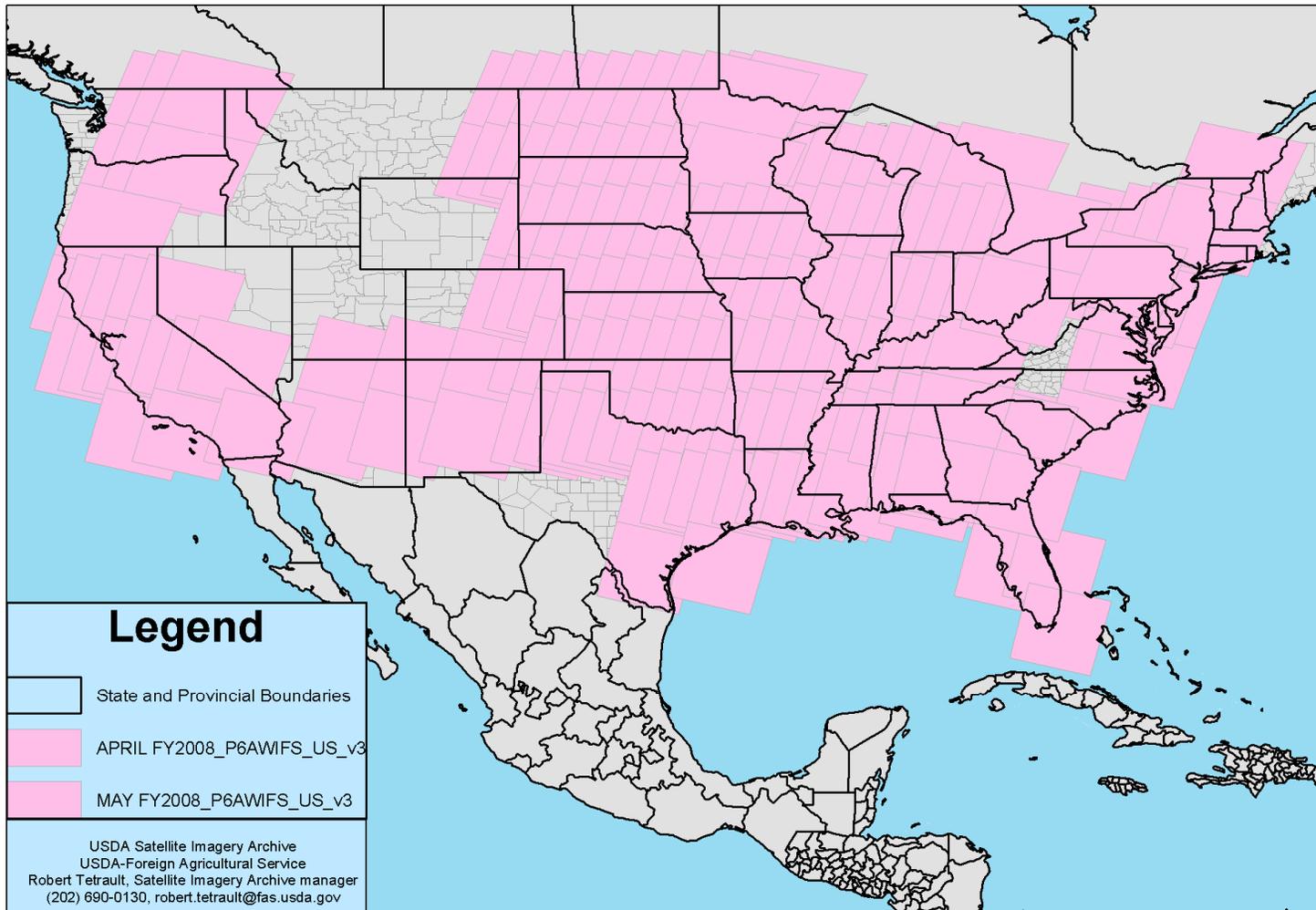
## USDA's FY2008 Standing Order for P6-AWIFS CONUS





# Access and Availability of Resourcesat-1 for Agriculture

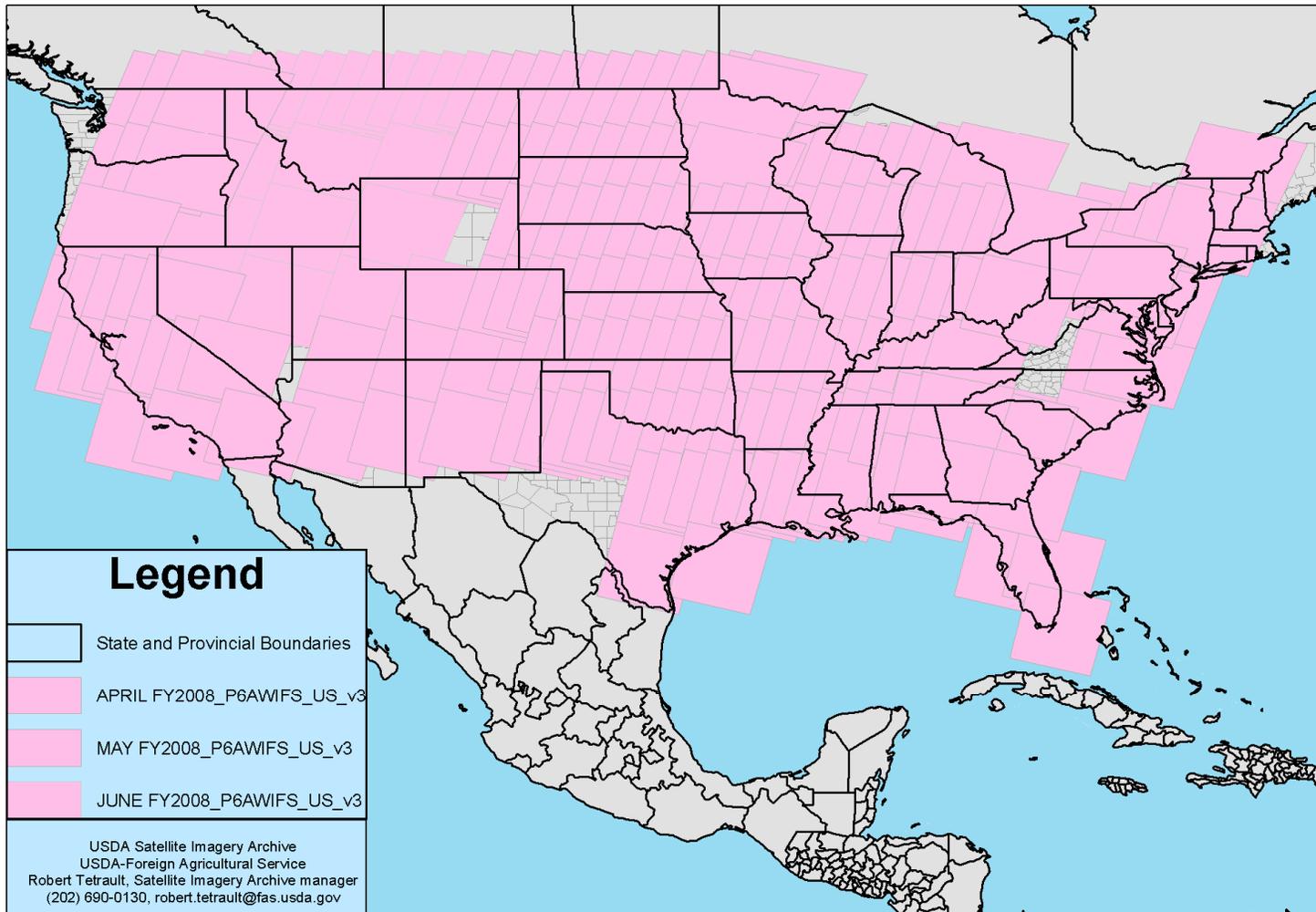
## USDA's FY2008 Standing Order for P6-AWIFS CONUS





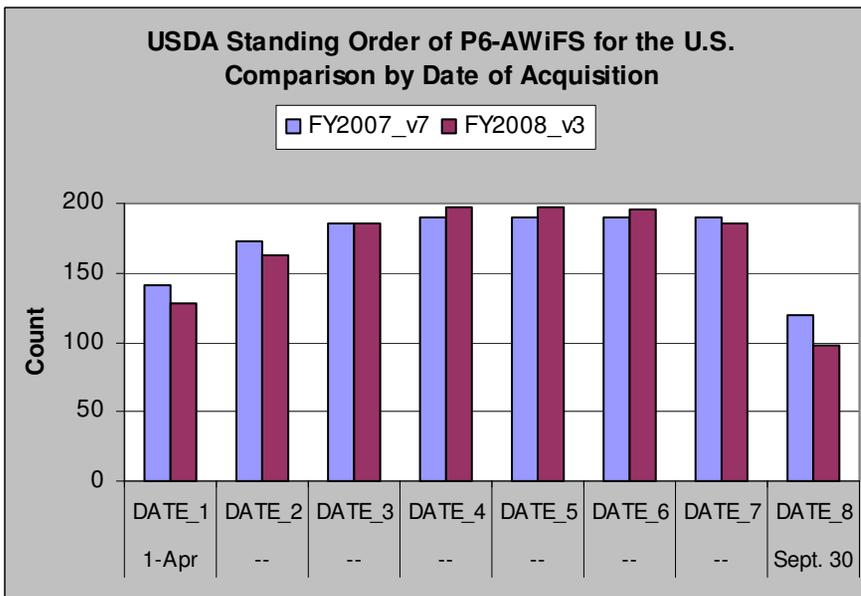
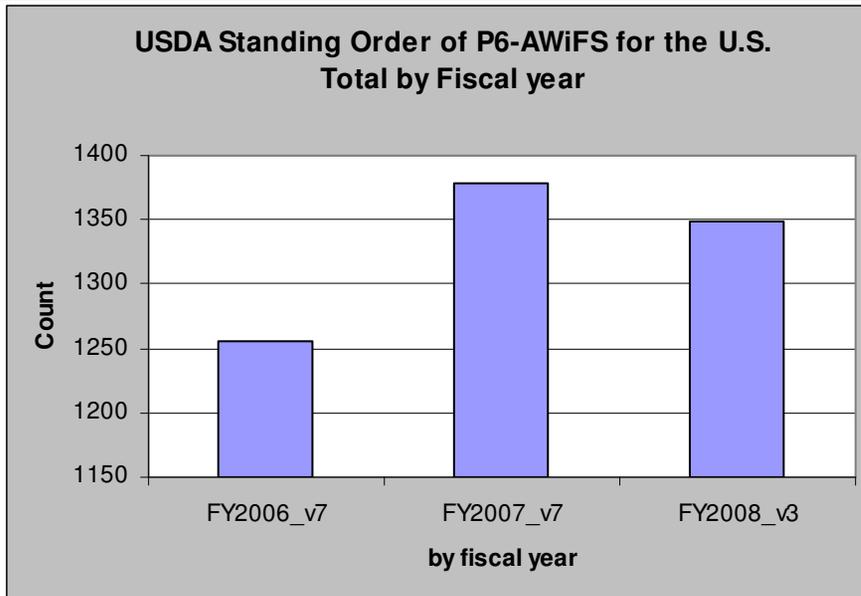
# Access and Availability of Resourcesat-1 for Agriculture

## USDA's FY2008 Standing Order for P6-AWIFS CONUS





# Access and Availability of Resourcesat-1 for Agriculture



## Fewer Scenes for FY2008 CONUS Order

- USDA plans on ordering about 30 fewer scenes in the standing order for FY2008
- Seasonal distribution changed too
  - Fewer April and Sept.
  - More mid-season



# Access and Availability of Resourcesat-1 for Agriculture

---

## USDA Standing Order

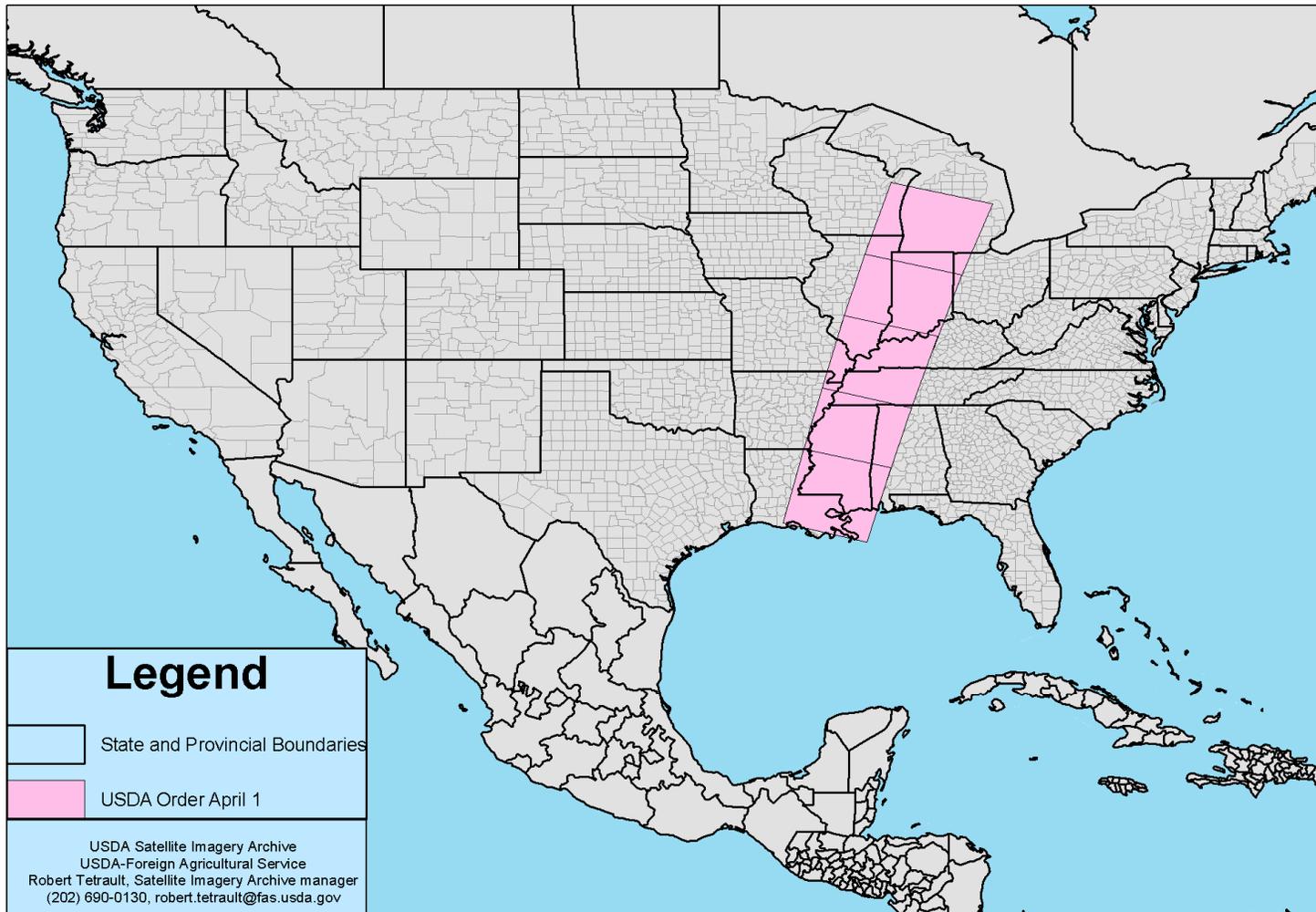
### Affects what is collected over the United States

- The USDA is the largest purchaser of Resourcesat-1 AWiFS data.
  - Largest in 2006, 2007 and probably 2008
- USDA purchases (and induces coverage) from April 1 to September 30
- Few purchases (and little coverage) from October 1 to March 31.



# Access and Availability of Resourcesat-1 for Agriculture

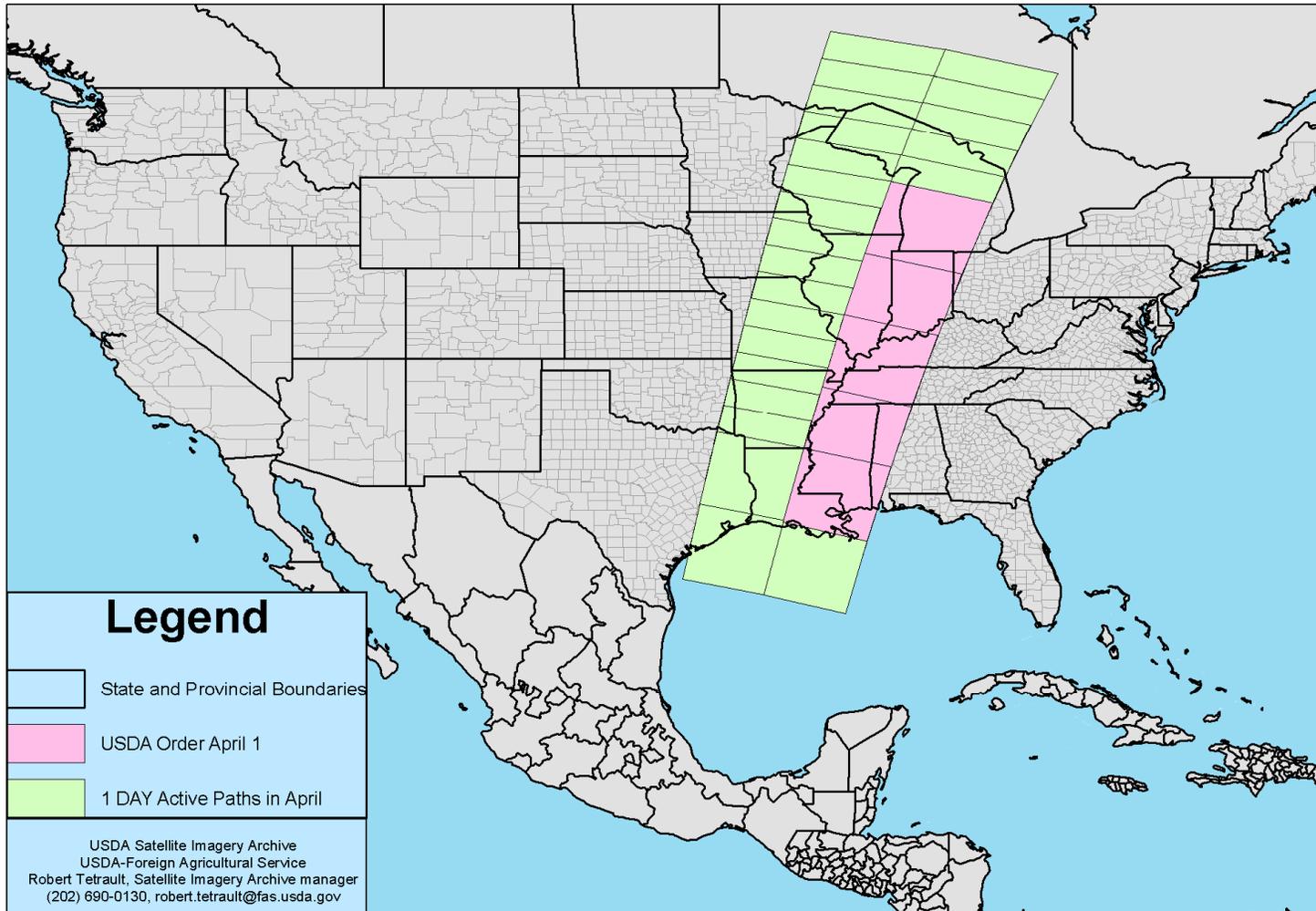
## USDA Order for P6-AWiFS CONUS: April 1, 2008





# Access and Availability of Resourcesat-1 for Agriculture

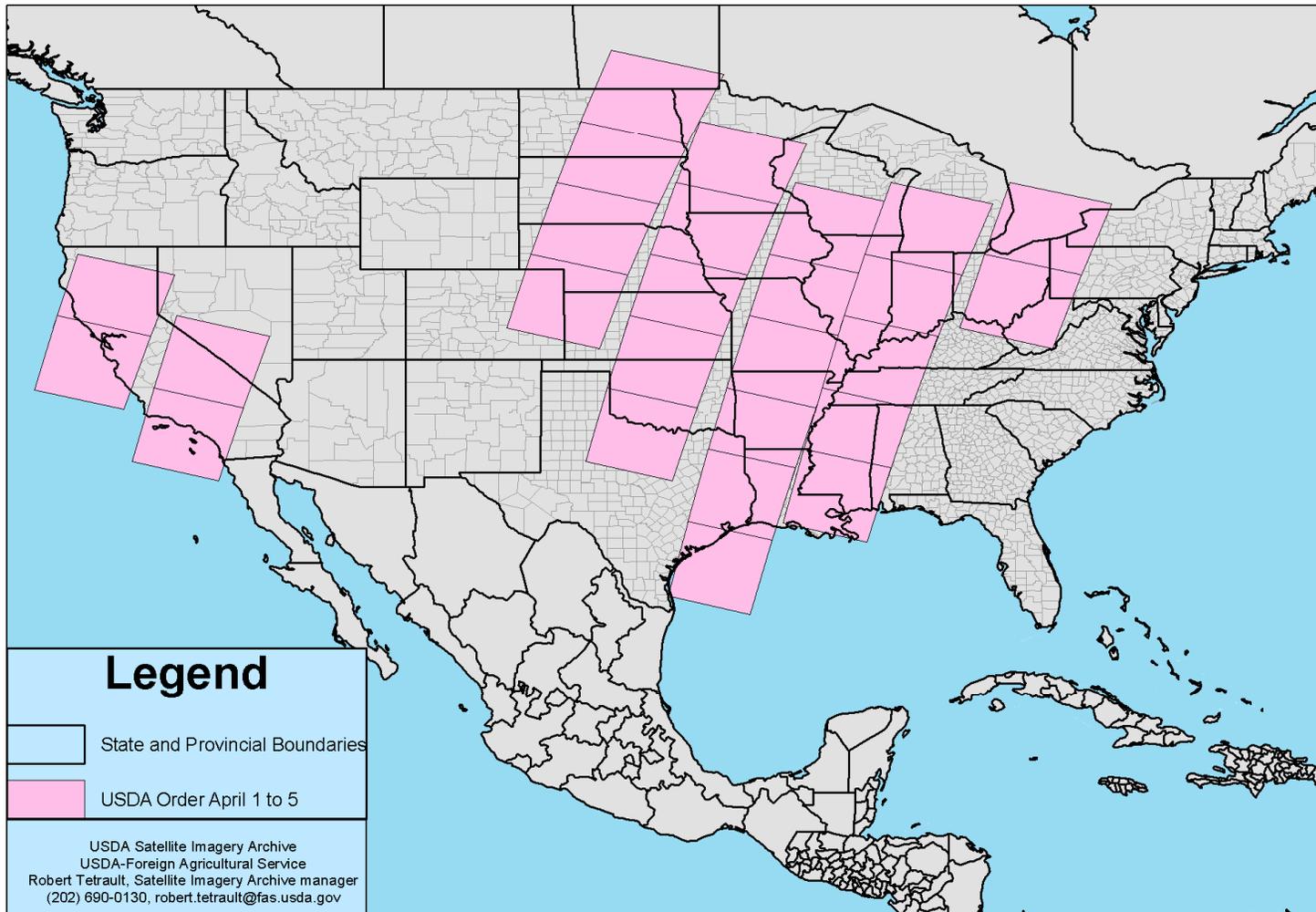
## Active Paths for P6-AWiFS CONUS: April 1, 2008





# Access and Availability of Resourcesat-1 for Agriculture

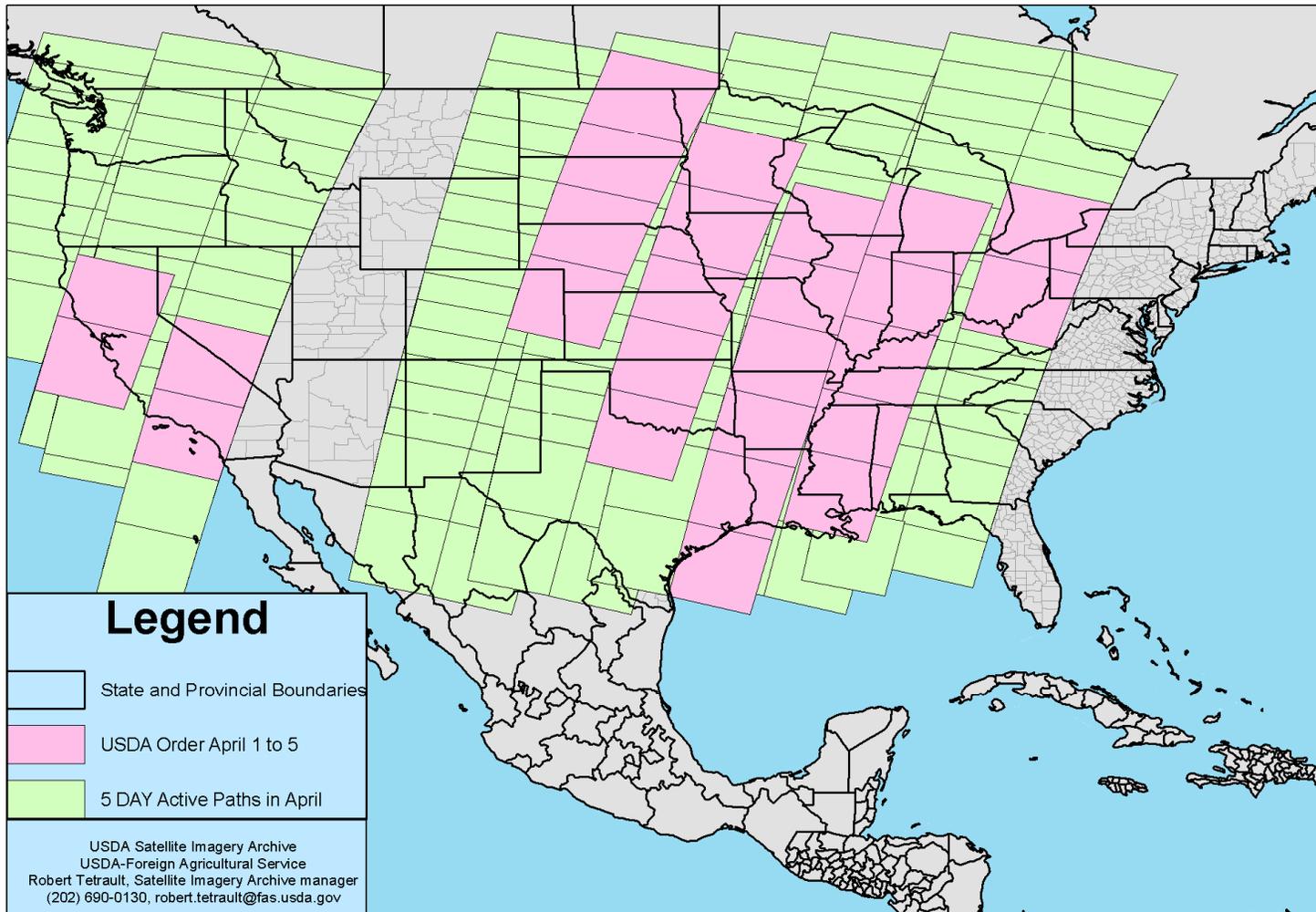
## USDA Order for P6-AWiFS CONUS: April 1 to 5, 2008





# Access and Availability of Resourcesat-1 for Agriculture

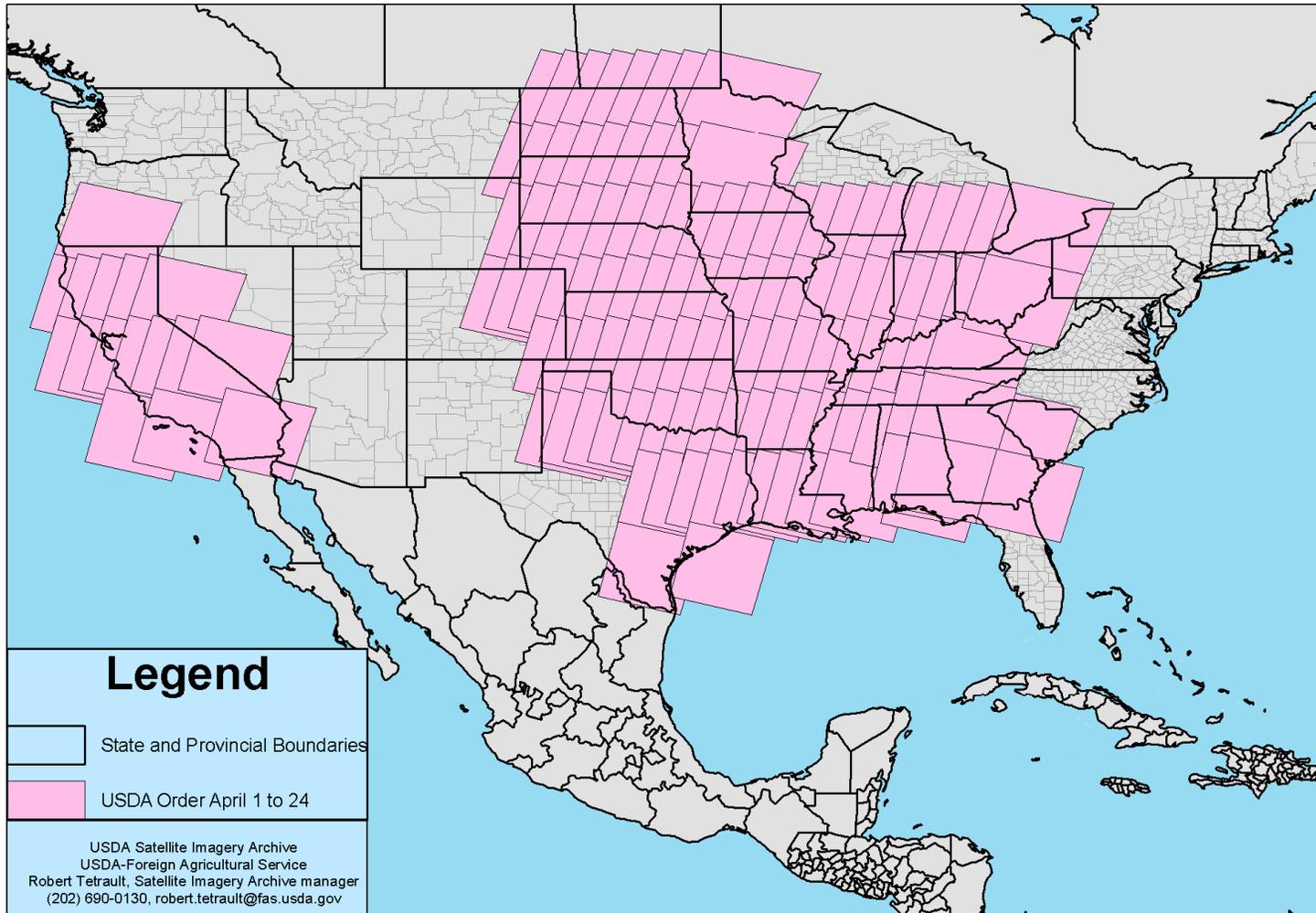
## Active Paths for P6-AWiFS CONUS: April 1 to 5, 2008



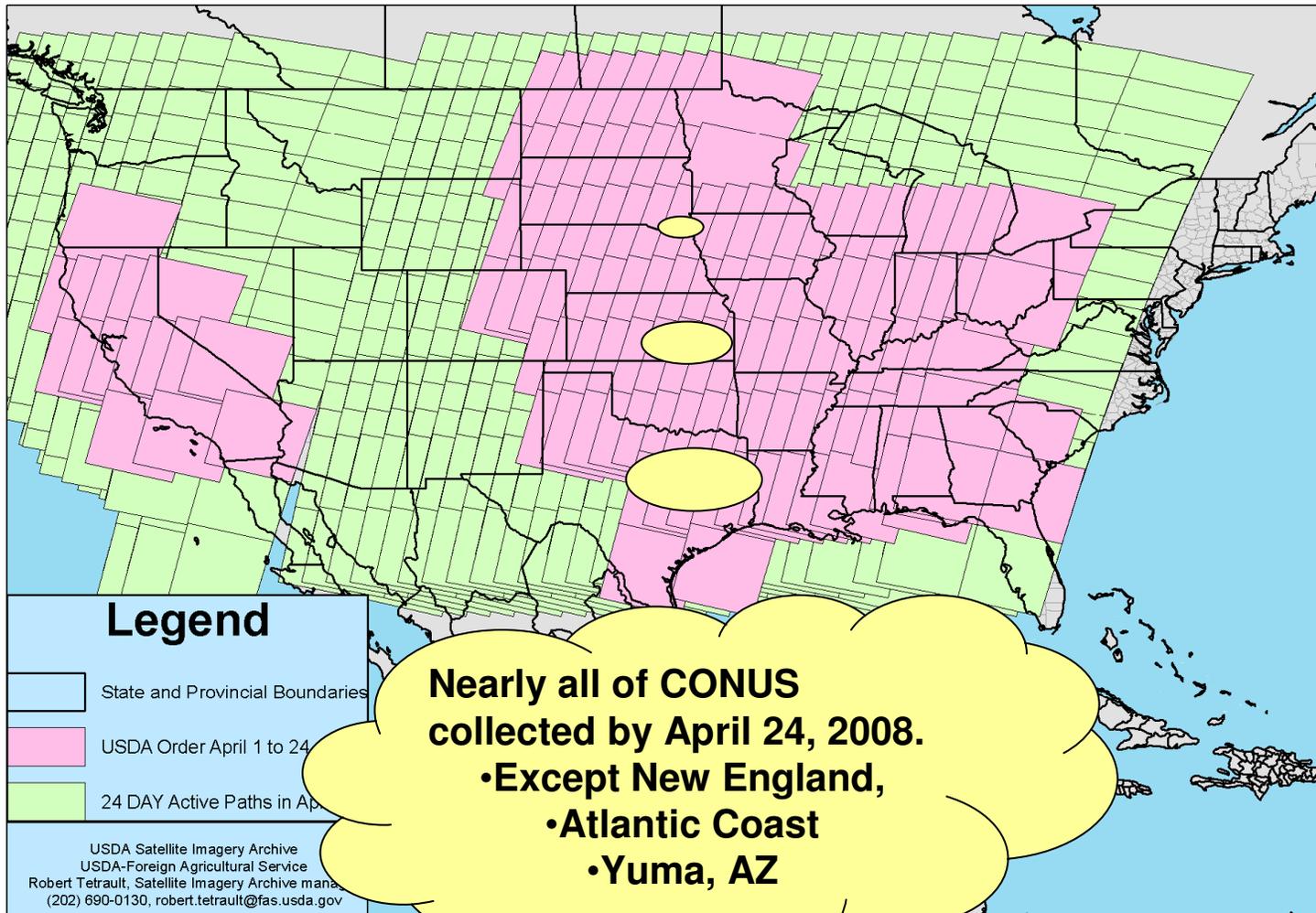


# Access and Availability of Resourcesat-1 for Agriculture

## USDA Order for P6-AWiFS CONUS: April 1 to 24, 2008

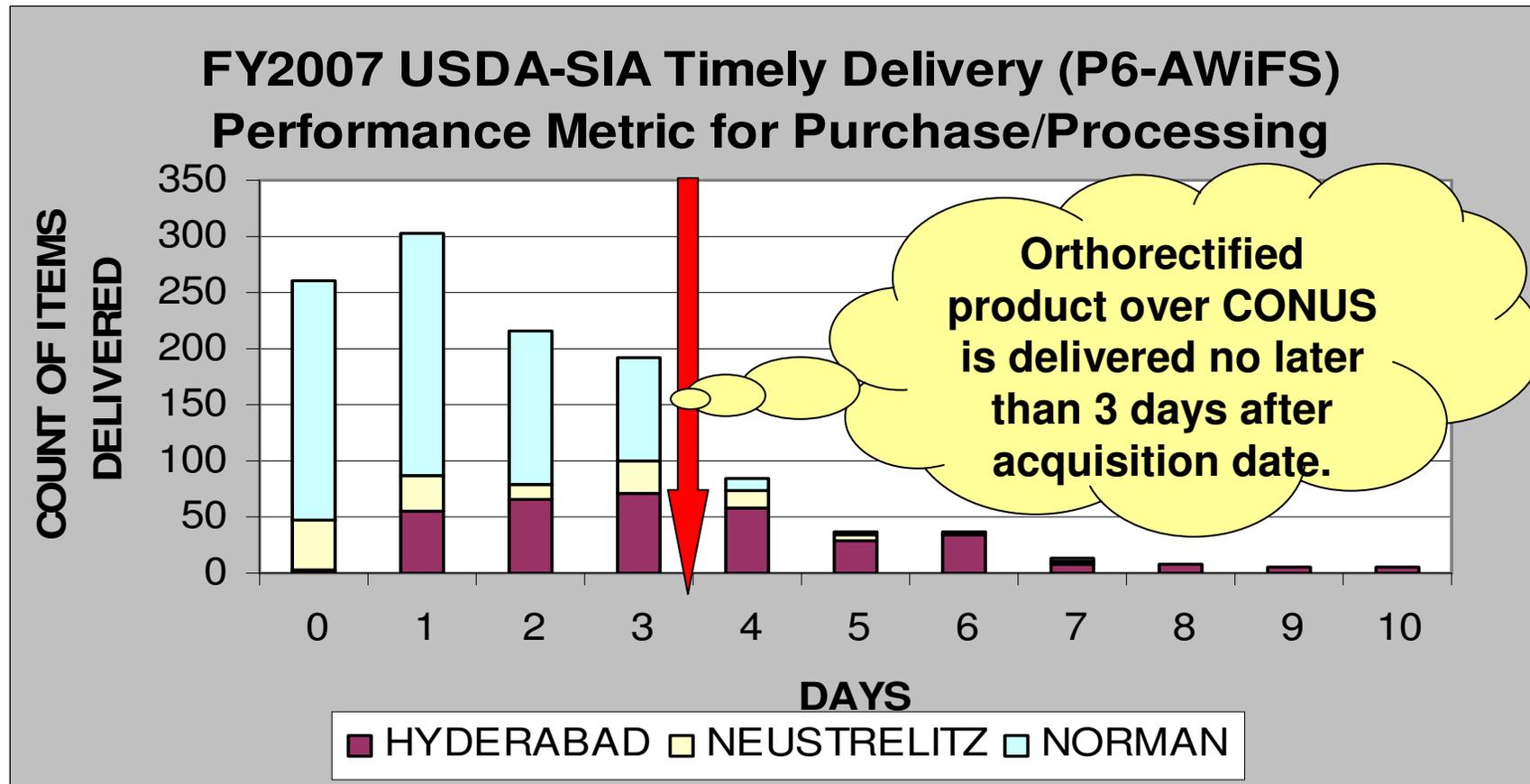


## Active Paths for P6-AWiFS CONUS: April 1 to 24, 2008





## Operational Agricultural Monitoring Needs Quick Delivery of Data





# Access and Availability of Resourcesat-1 for Agriculture

---

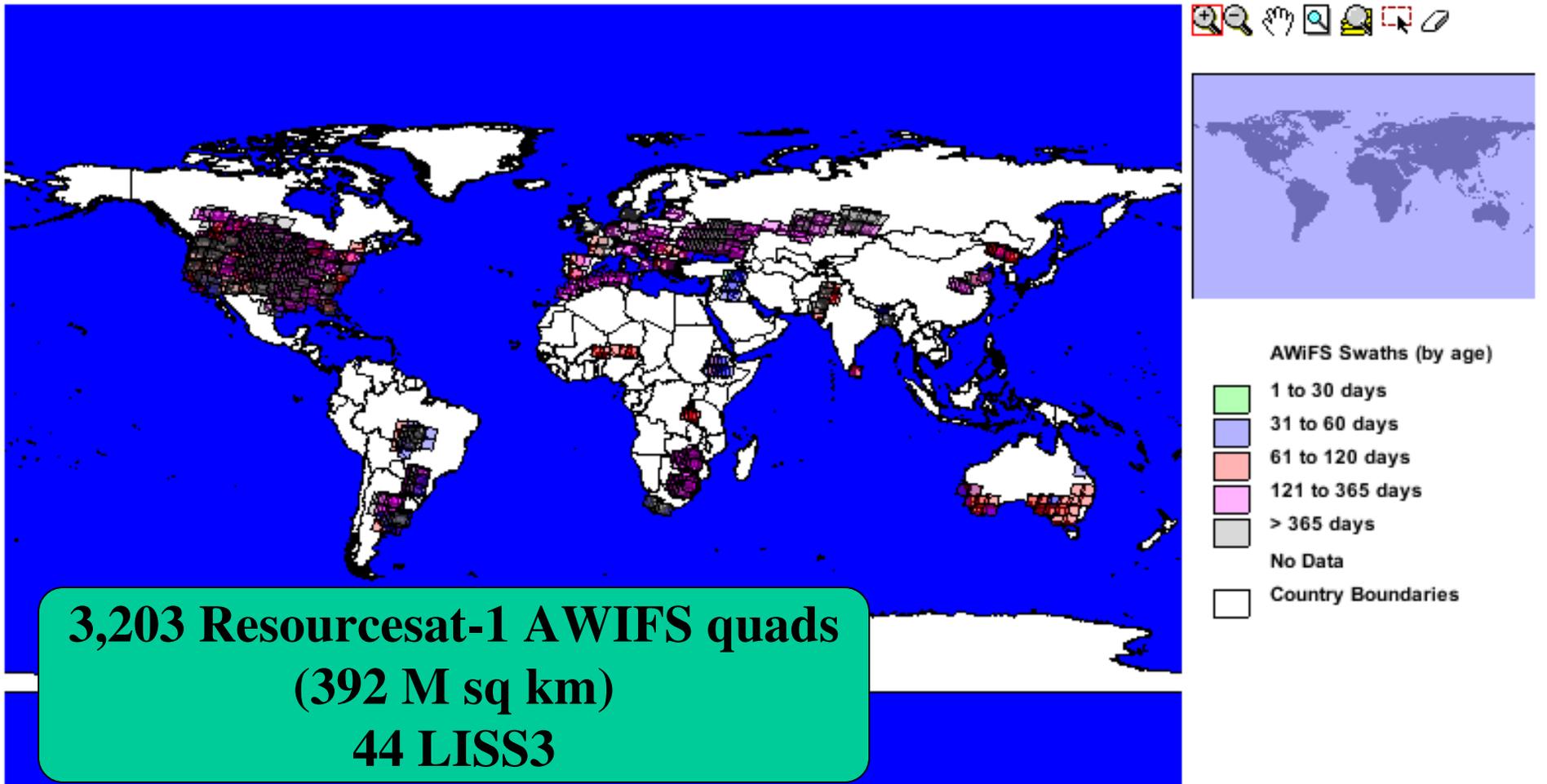
## How to Access the Resourcesat-1 Data

- For participating agencies in the USDA-SIA, please use Archive Explorer.
  - Data is free. No per-scene transactional cost. Arrives on CD via common carrier.
- USDA-SIA operates on an “all you can eat” policy.
- Data is licensed to federal civilian agencies and license restrictions apply.
  - Data cannot be redistributed. Data cannot be used commercially
  - Derived products such as the Cropland Data Layer have no license restrictions.



# Access and Availability of Resourcesat-1 for Agriculture

## USDA Satellite Imagery Archive Holdings as of March 2008

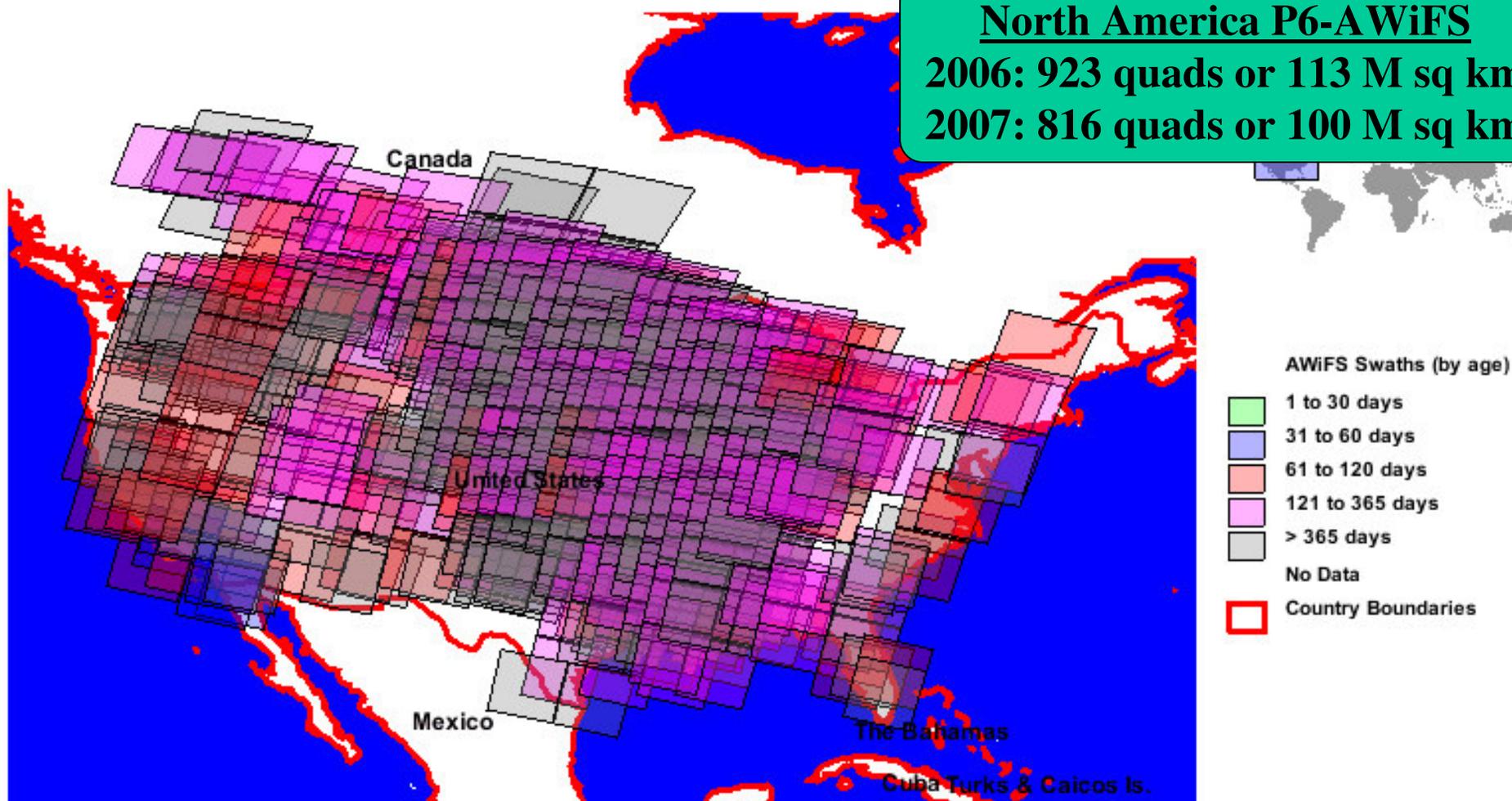




# Access and Availability of Resourcesat-1 for Agriculture

## USDA Satellite Imagery Archive Holdings as of March 2008

**North America P6-AWiFS**  
2006: 923 quads or 113 M sq km  
2007: 816 quads or 100 M sq km





# Access and Availability of Resourcesat-1 for Agriculture

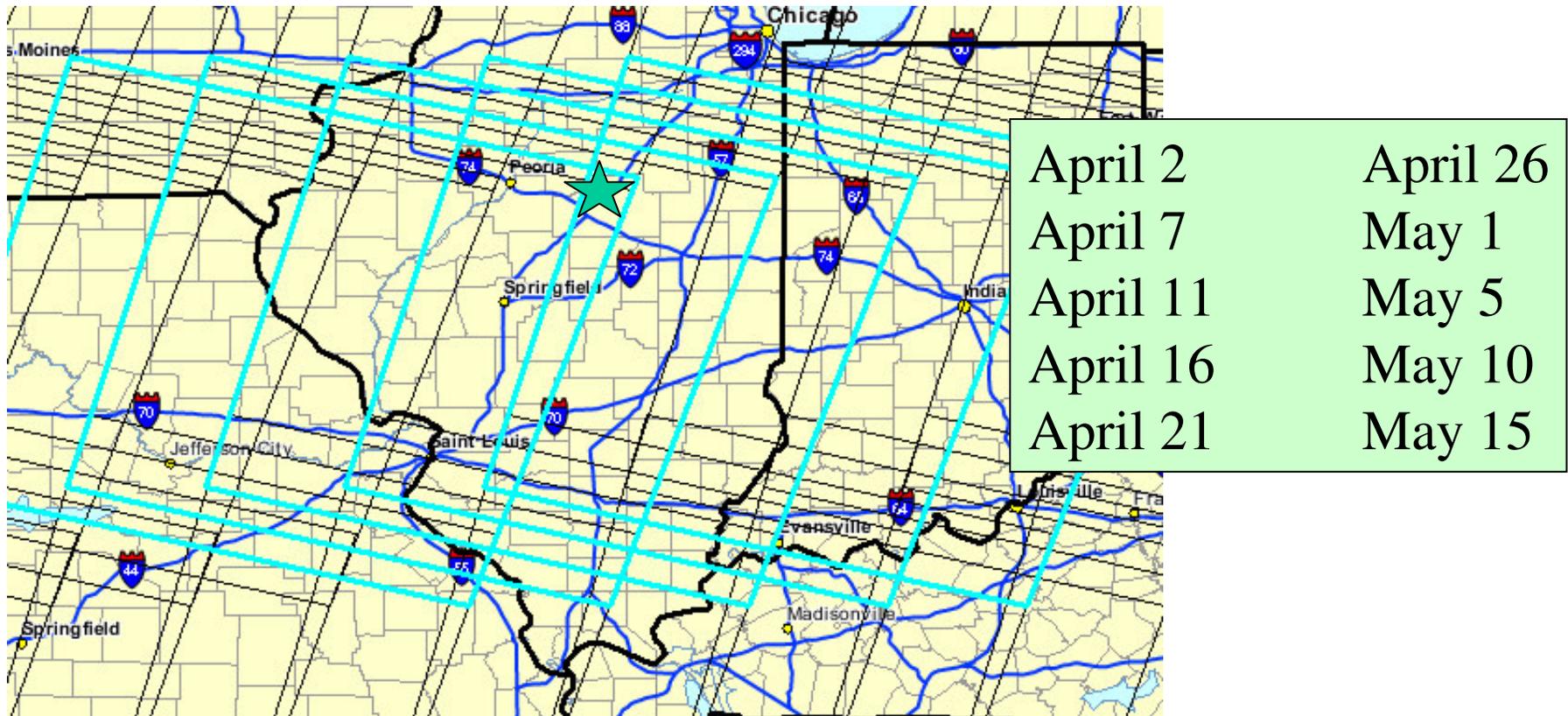
---

## Why Does the USDA Order so much?

### Who uses the data?

- USDA's Standing Order will induce nearly complete CONUS coverage by April 24, 2008.
- Corn belt areas will be targeted approximately every 5 days.
  - Large swath size has very higher percentage of overlapping swaths.
- Clouds, especially during the growing season, greatly affect probability of acquiring a useful scene.

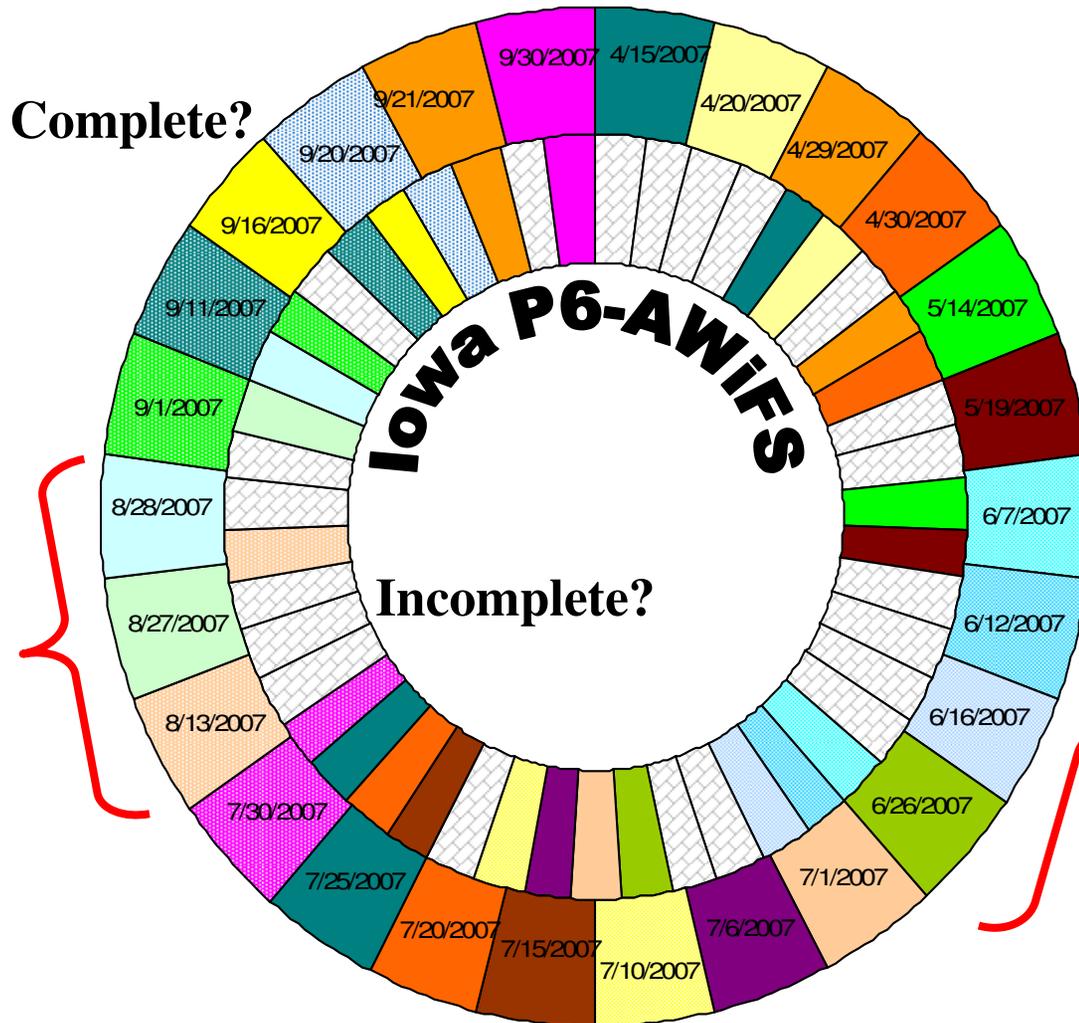
## High Temporal Frequency for Resourcesat-1 AWiFS



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

# Access and Availability of Resourcesat-1 for Agriculture

## Despite High Frequency of Collects, Still Needed Supplemental Coverage in August for Iowa 2007



- Repeat cycle is every 4.8 days, however, actual purchases are unevenly distributed.
- There may be too few purchases in August and too many in September for Iowa.

- Iowa is defined as scenes whose centroid falls within Iowa.
- Inner ring are acquisition dates.
- Outer ring are purchased scenes.



# Access and Availability of Resourcesat-1 for Agriculture

---

## Agenda

- USDA Satellite Imagery Archive and its participating agencies
- Extensive coverage of CONUS ordered by the USDA
  - Starts April 1, 2008
- Resourcesat-1 AWiFS accessible through web-based Archive Explorer
- Resourcesat-1 AWiFS designed for applications in agriculture
- USDA standing order focused on agriculture applications



# Access and Availability of Resourcesat-1 for Agriculture



Source Image: P6-AWiFS p14r46qD  
March 1, 2007 4,5,3 band combination