USDA Collection Strategy for Resourcesat

Robert Tetrault, Satellite Imagery Archive Manager

1. Background of USDA Satellite Imagery Archive
2. Why did USDA switch to Resourcesat?
   - Applications using remote sensing
   - Problems with the Landsat series and the Landsat data gap
   - Goals of Operational Agricultural Monitoring
3. Who is doing the Purchasing? How and Why?
   - What is the Collection Strategy?
   - How is data distributed? How much? Value?
   - How quickly does the data arrive?
4. Next Steps

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.

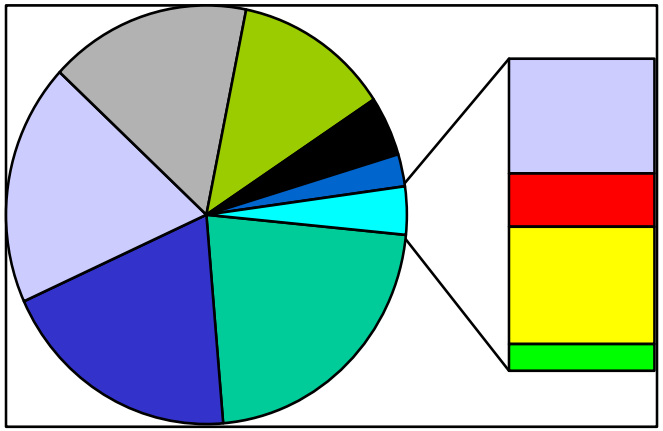
USDA purchases satellite imagery using the investment of the Commodity Credit Corporation

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

- USDA has Transitioned from Landsat to Resourcesat-1 AWiFS data.
  - 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.

Applications of Field-level* Satellite Data in FY 2007



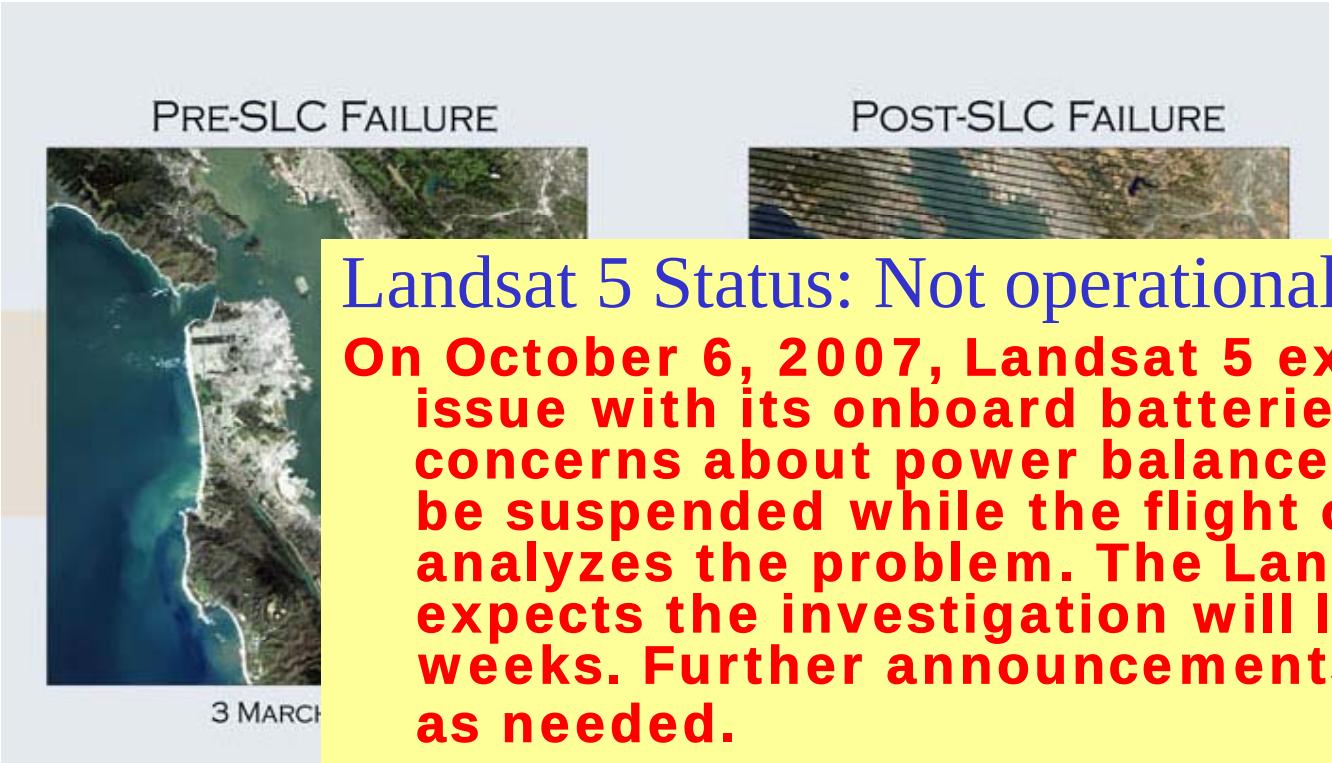
- Compliance-22%
- Early Warning-19%
- Research-19%
- Cropland Data-16%
- Crop Assessment-12%
- Land Cover-5%
- Area Frame-2%
- Fire-1%
- Forest Pest-1%
- LDGS-1%
- Soil Modeling-1%

* Field-level satellite imagery allows users to distinguish fields or forest land parcels. It is typically defined by GSD of 5 to 100 meters.

Applications and Agency

- Compliance/Regulatory Use (RMA)
- Early warning of potential food supply disruptions (FSA and FAS)
- Research (ARS and other agencies)
- Cropland data layer (NASS)
- Planted area of US corn and soybean (NASS)
- Foreign crop condition assessment (FAS)
- Land Cover (USGS and other agencies)
- Area Frame (NASS)
- Fire and Forest Pest (USFS)
- Soil Modeling (NRCS)
- Landsat Data Gap Study (USGS)

USDA Satellite Imagery Archive



Landsat 5 Status: Not operational (Oct. 29, 2007)

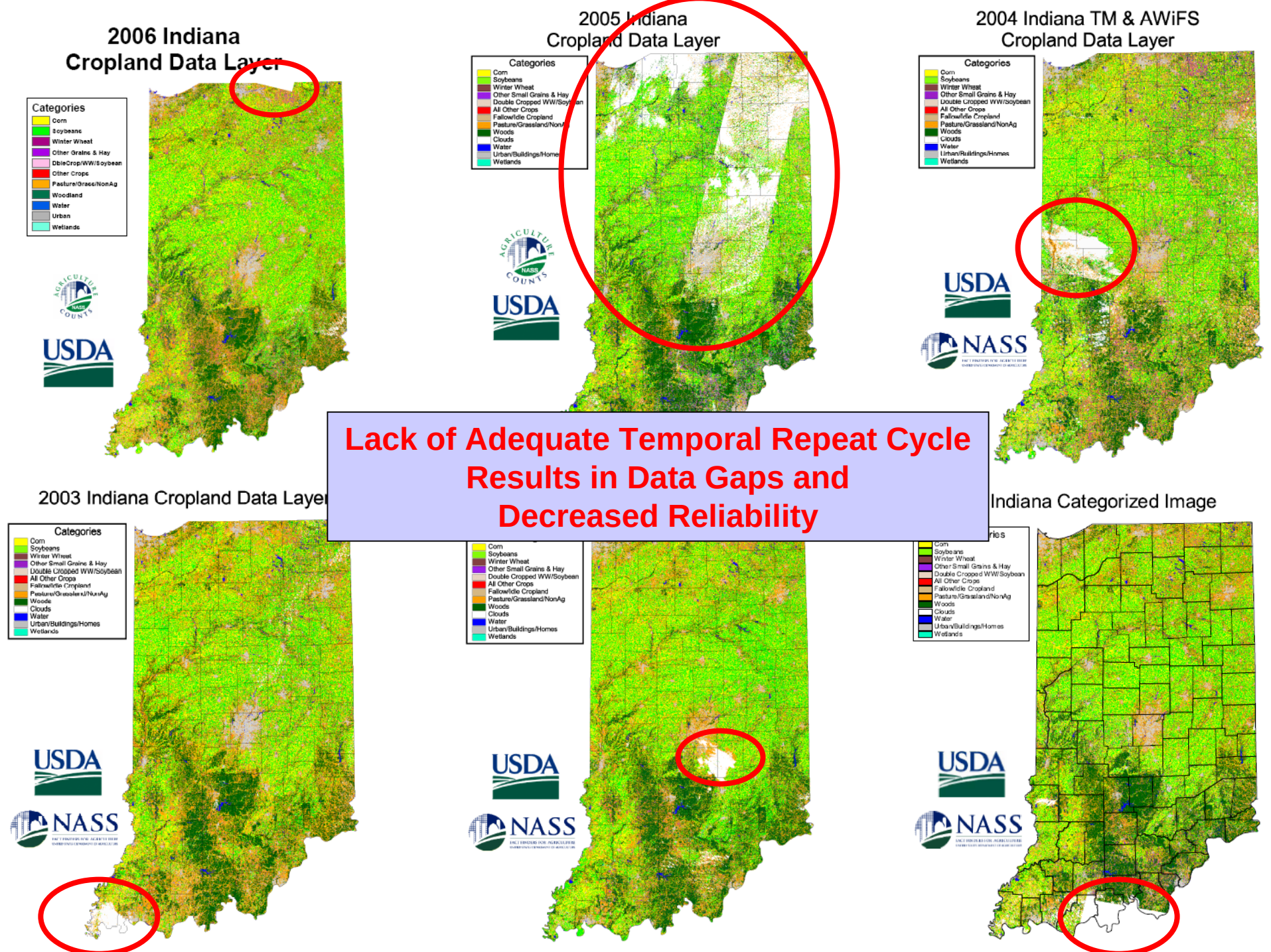
On October 6, 2007, Landsat 5 experienced an issue with its onboard batteries, leading to concerns about power balance. Imaging will be suspended while the flight operations team analyzes the problem. The Landsat team expects the investigation will last from 2 to 3 weeks. Further announcements will be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

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.

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

Landsat Data Gap

- The extent of the Landsat Data Gap 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 when operational provided only 16-day revisit.
    - Indefinite: No US government plans to provide better than 16-day revisit.


2006 Indiana
Cropland Data Layer
Categories
Corn
Soybeans
Winter Wheat
Other Grains & Hay
DbleCrop/WW/Soybean
Other Crops
Pasture/Grass/NonAg
Woodland
Water
Urban
Wetlands
USDA
2005 Indiana
Cropland Data Layer
Categories
Corn
Soybeans
Winter Wheat
Other Small Grains & Hay
Double Cropped WW/Soybean
All Other Crops
Fallow/Idle Cropland
Pasture/Grassland/NonAg
Woods
Clouds
Water
Urban/Buildings/Homes
Wetlands
USDA
2004 Indiana TM & AWiFS
Cropland Data Layer
Categories
Corn
Soybeans
Winter Wheat
Other Small Grains & Hay
Double Cropped WW/Soybean
All Other Crops
Fallow/Idle Cropland
Pasture/Grassland/NonAg
Woods
Clouds
Water
Urban/Buildings/Homes
Wetlands
USDA
NASS
Lack of Adequate Temporal Repeat Cycle
Results in Data Gaps and
Decreased Reliability
2003 Indiana Cropland Data Layer
Categories
Corn
Soybeans
Winter Wheat
Other Small Grains & Hay
Double Cropped WW/Soybean
All Other Crops
Fallow/Idle Cropland
Pasture/Grassland/NonAg
Woods
Clouds
Water
Urban/Buildings/Homes
Wetlands
USDA
NASS
Indiana Categorized Image
Corn
Soybeans
Winter Wheat
Other Small Grains & Hay
Double Cropped WW/Soybean
All Other Crops
Fallow/Idle Cropland
Pasture/Grassland/NonAg
Woods
Clouds
Water
Urban/Buildings/Homes
Wetlands
USDA
NASS

Operational Agricultural Monitoring Needs: Better than 16-day Revisit & Large Area Coverage

- Global coverage of agricultural areas should be acquired during the growing season that will enable analysts to identify crops and to assess crop conditions.
  - Spatial resolution at the field-level and appropriate spectral bands.
- Observations should be acquired at least once per month.
  - Observations should be more frequent during critical growing periods, such as flowering.
  - Observations should be frequent enough to assess damage from events.
- Resourcesat-1AWiFS is suited for this task.

IRS Resourcesat-1

Launched on October 17, 2003

817 km orbit, following IRS 1-C ground track

Spacecraft lift-off mass: 1360kg

5 year mission

Local time: 10:30 +/- 5 minutes

12 Orbits per day, 101.35 minutes

On-board memory: 152 GB (BOL), 120 GB (EOL)

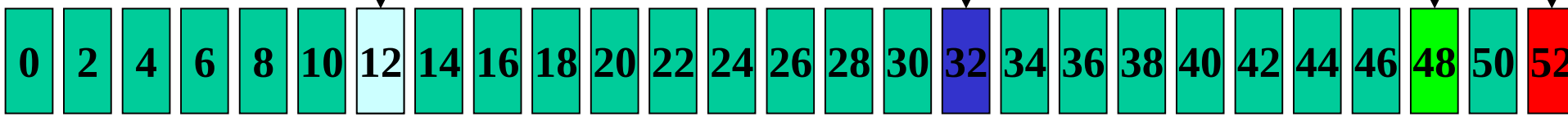
GeoEye

- LISS-3: 141 km swath, 23.5 m resolution (all bands).
  - B2: 0.52 - 0.59
  - B3: 0.62 - 0.68
  - B4: 0.76 – 0.86
  - B5:1.55 – 1.70
- LISS-4: 23.5 km (Mx mode) & 70.3 km (mono) swath, 5.8 m resolution (all bands).
  - B2: 0.52 - 0.59
  - B3: 0.62 - 0.68
  - B4: 0.76 – 0.86
- AWiFS: 737 km combined swath, 56 m resolution at nadir, 70 m resolution at field edges.
  - B2: 0.52 - 0.59
  - B3: 0.62 - 0.68
  - B4: 0.76 – 0.86
  - B5: 1.55 – 1.70

Operational Agricultural Monitoring

Satellite Revisit or Repeat cycle (in days)

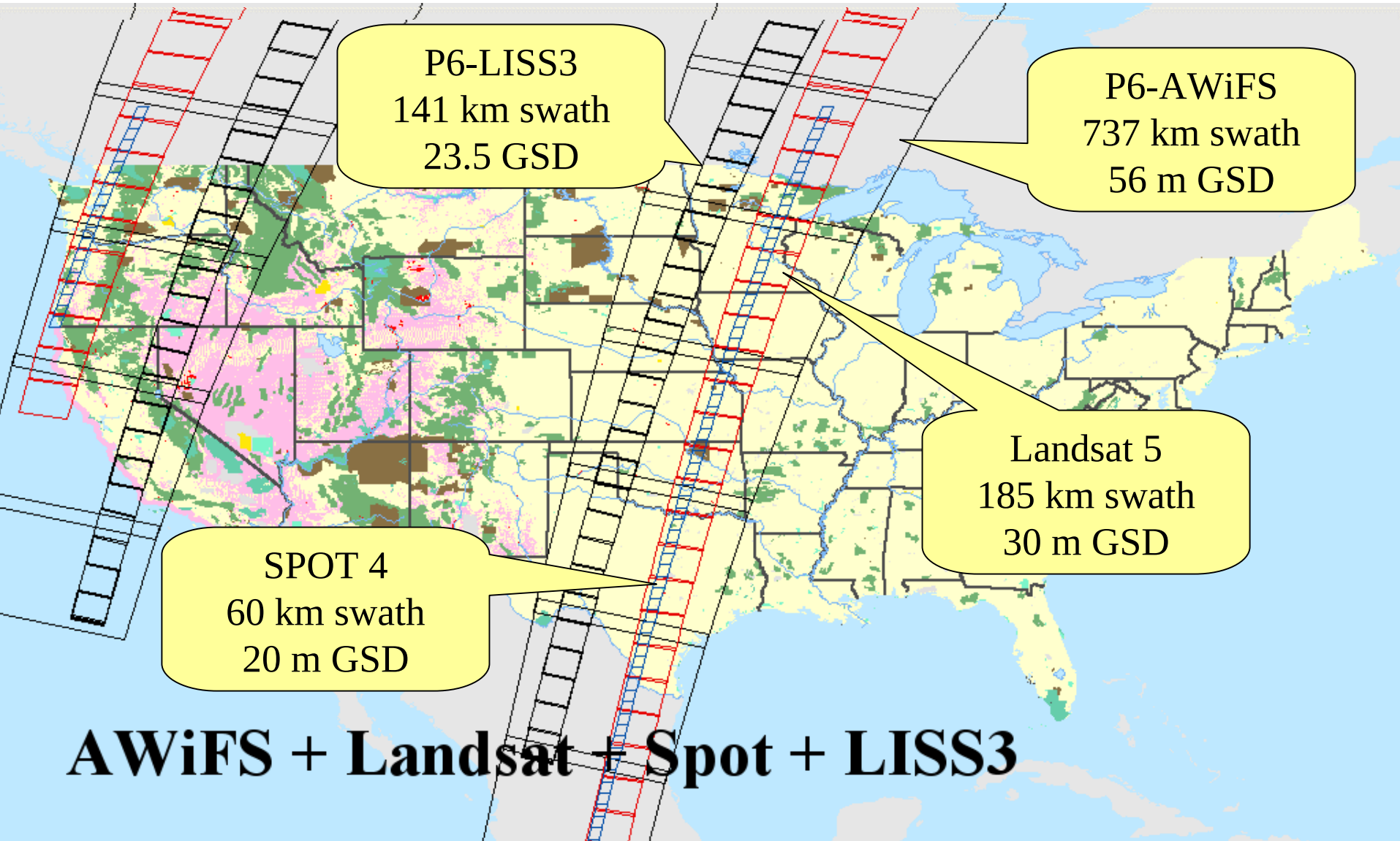
Probable Revisit (in days); assumes 50% of scenes w/ clouds.



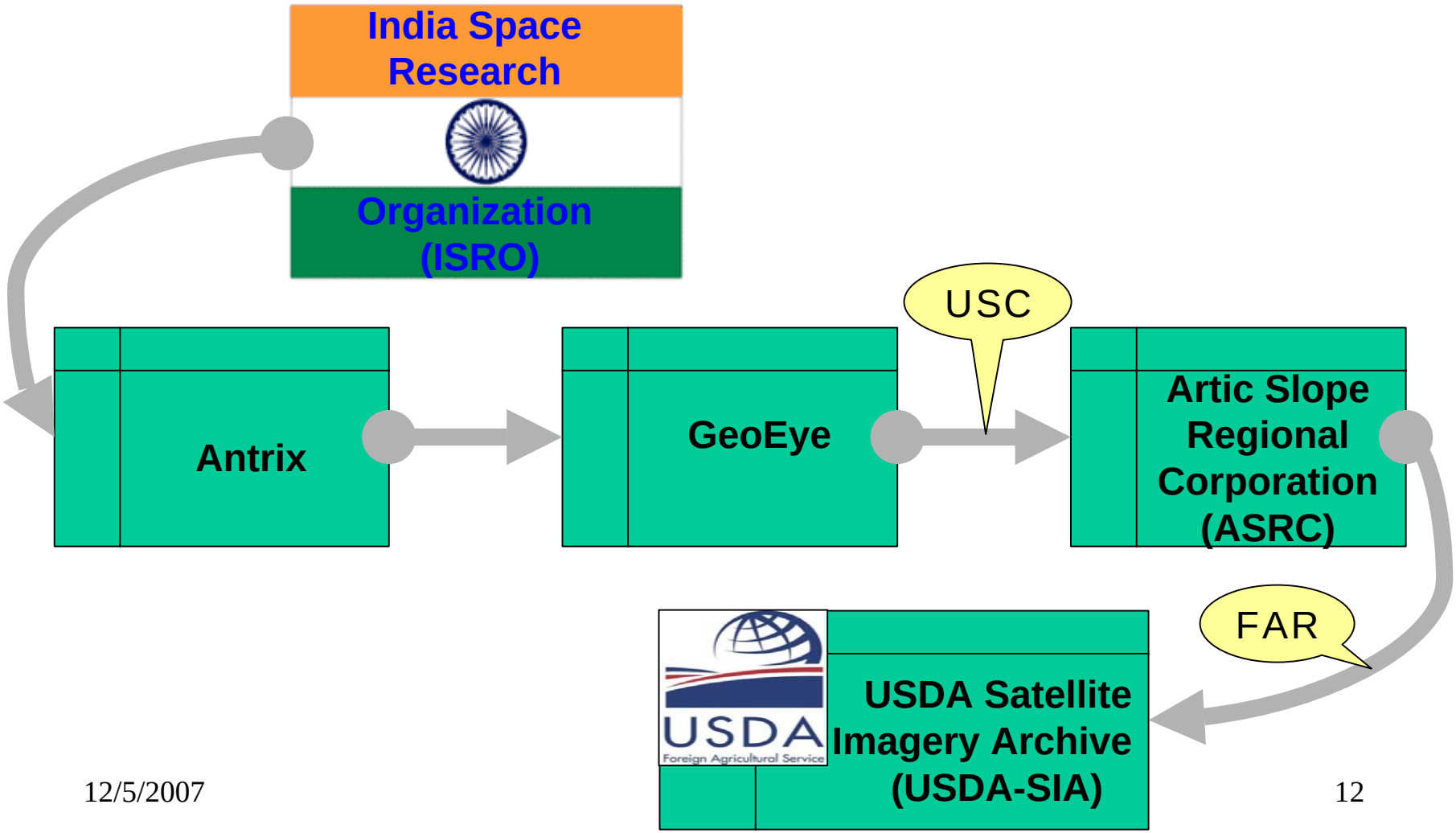
One Landsat, one SPOT, and one LISS3 does not meet goals.

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

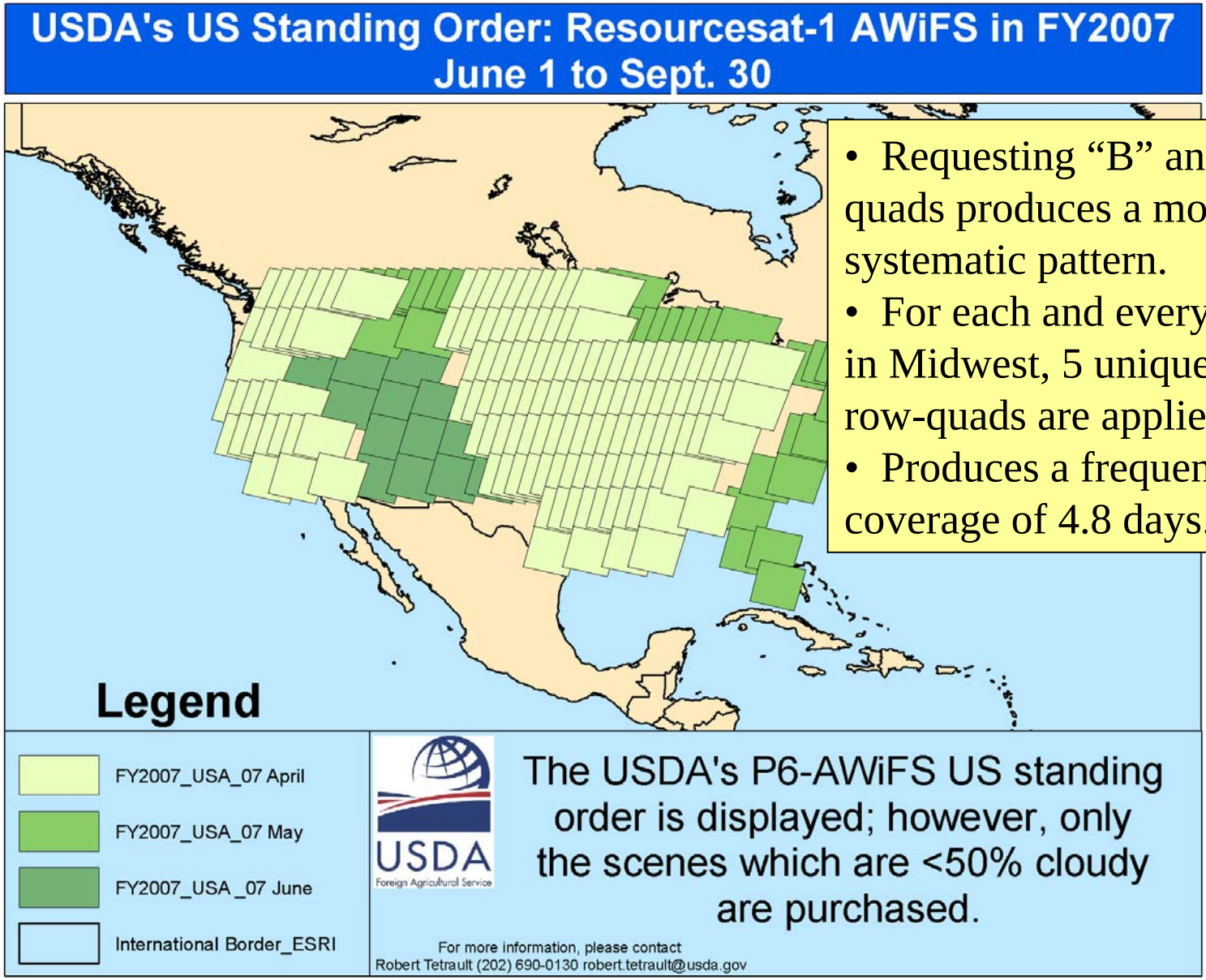
Large Area Coverage: Comparing Single-Pass Collection



Commercial Channel for IRS Resourcesat-1 Data allows for Purchase by the USDA

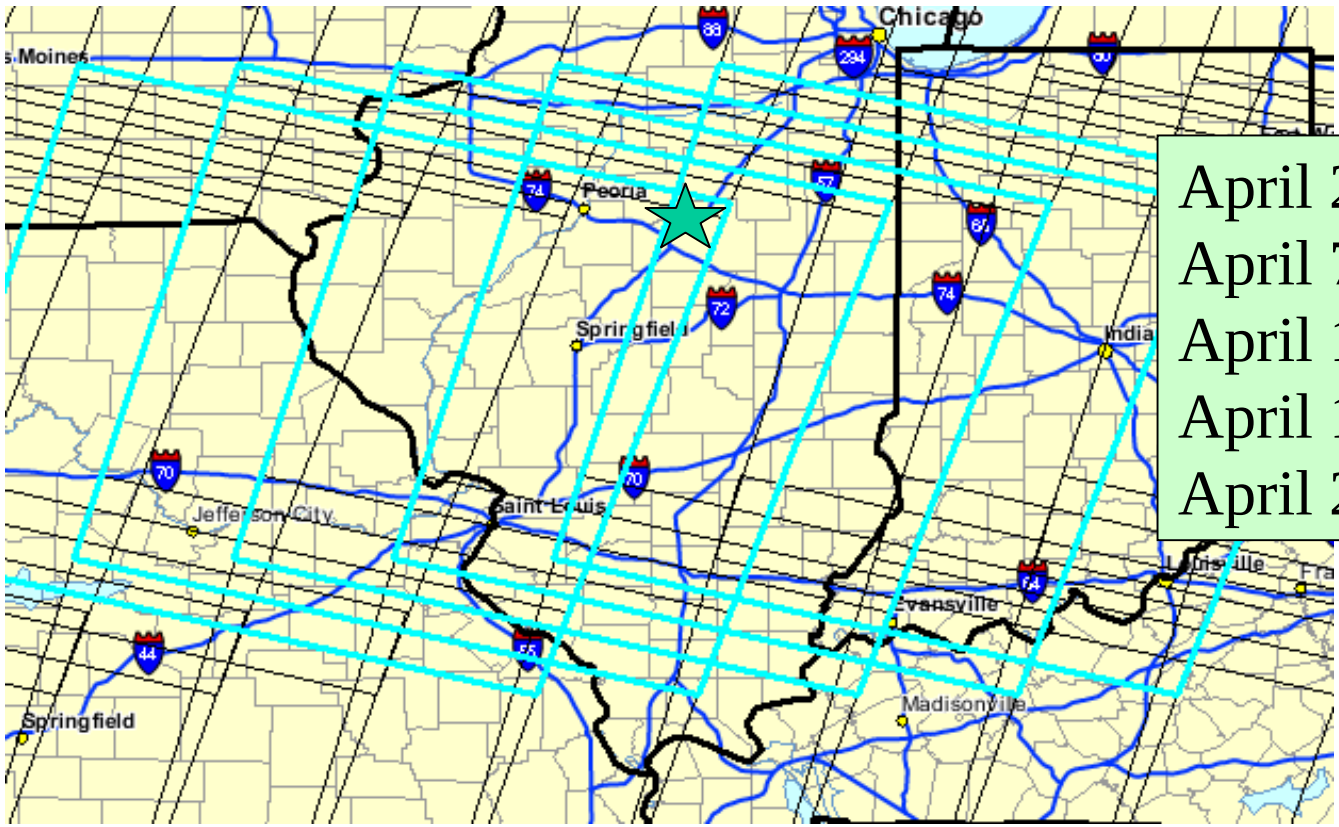


USDA Satellite Imagery Archive



- Requesting “B” and “D” quads produces a more systematic pattern.
- For each and every point in Midwest, 5 unique path-row-quads are applied.
- Produces a frequency of coverage of 4.8 days.

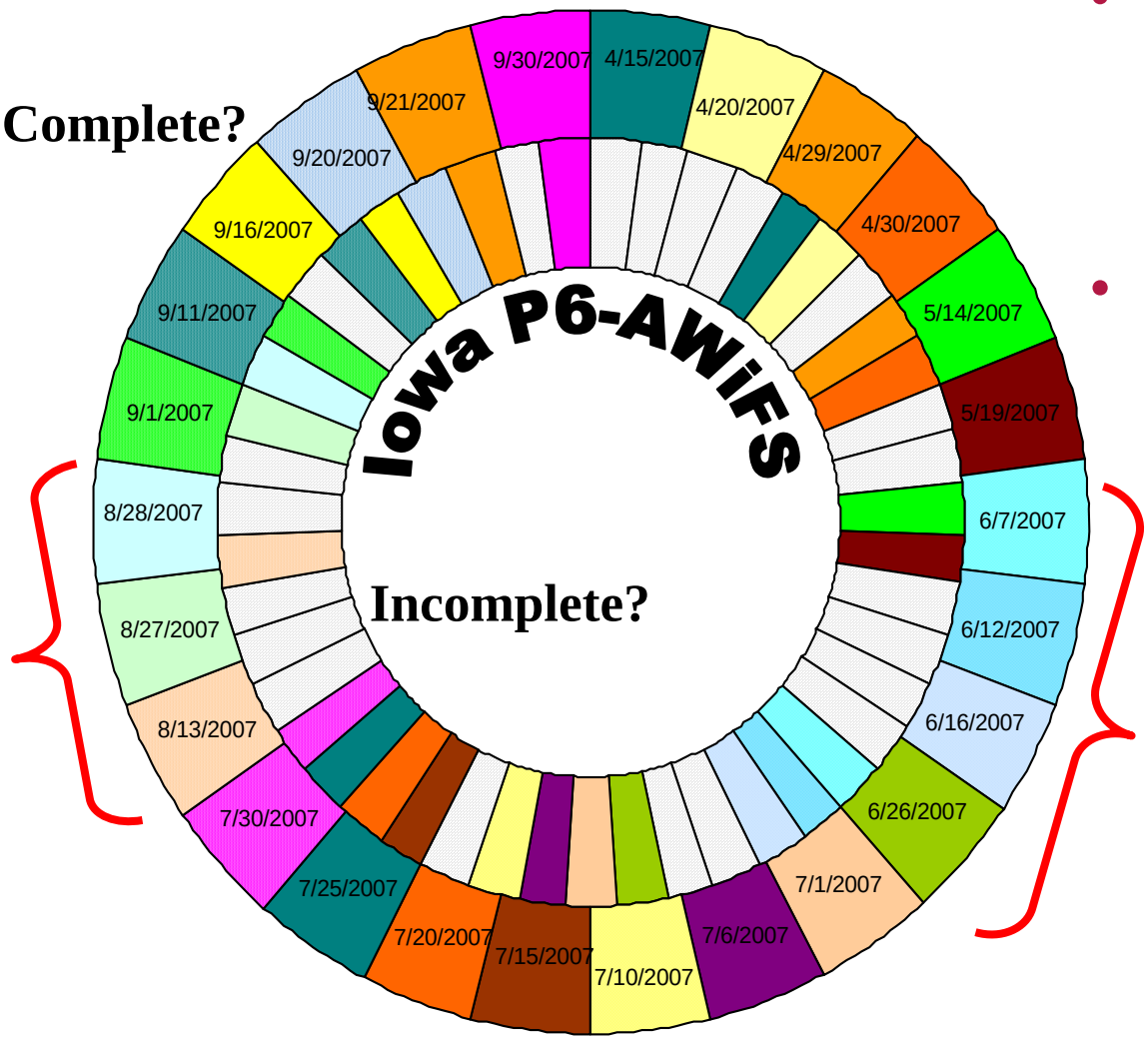
High Temporal Frequency for Resourcesat-1 AWiFS



April 2	April 26
April 7	May 1
April 11	May 5
April 16	May 10
April 21	May 15

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

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



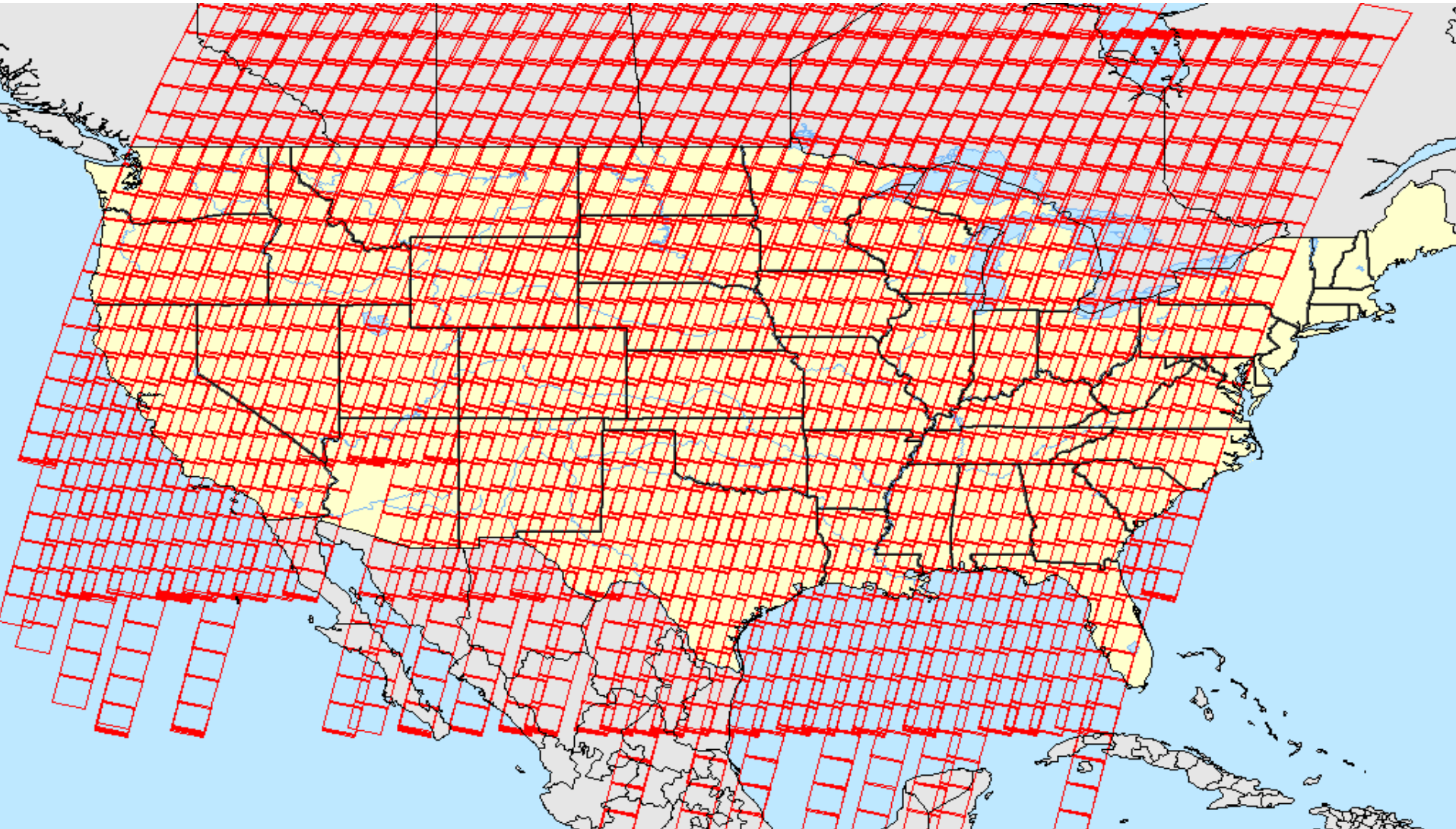
- Repeat cycle is every 4.8 days, however, actual purchases are unevenly distributed.
- There may be too few purchases in August and too many in September for Iowa.
  - Iowa is defined as scenes whose centroid falls within Iowa.
  - Inner ring are acquisition dates.
  - Outer ring are purchased scenes.

USDA Satellite Imagery Archive

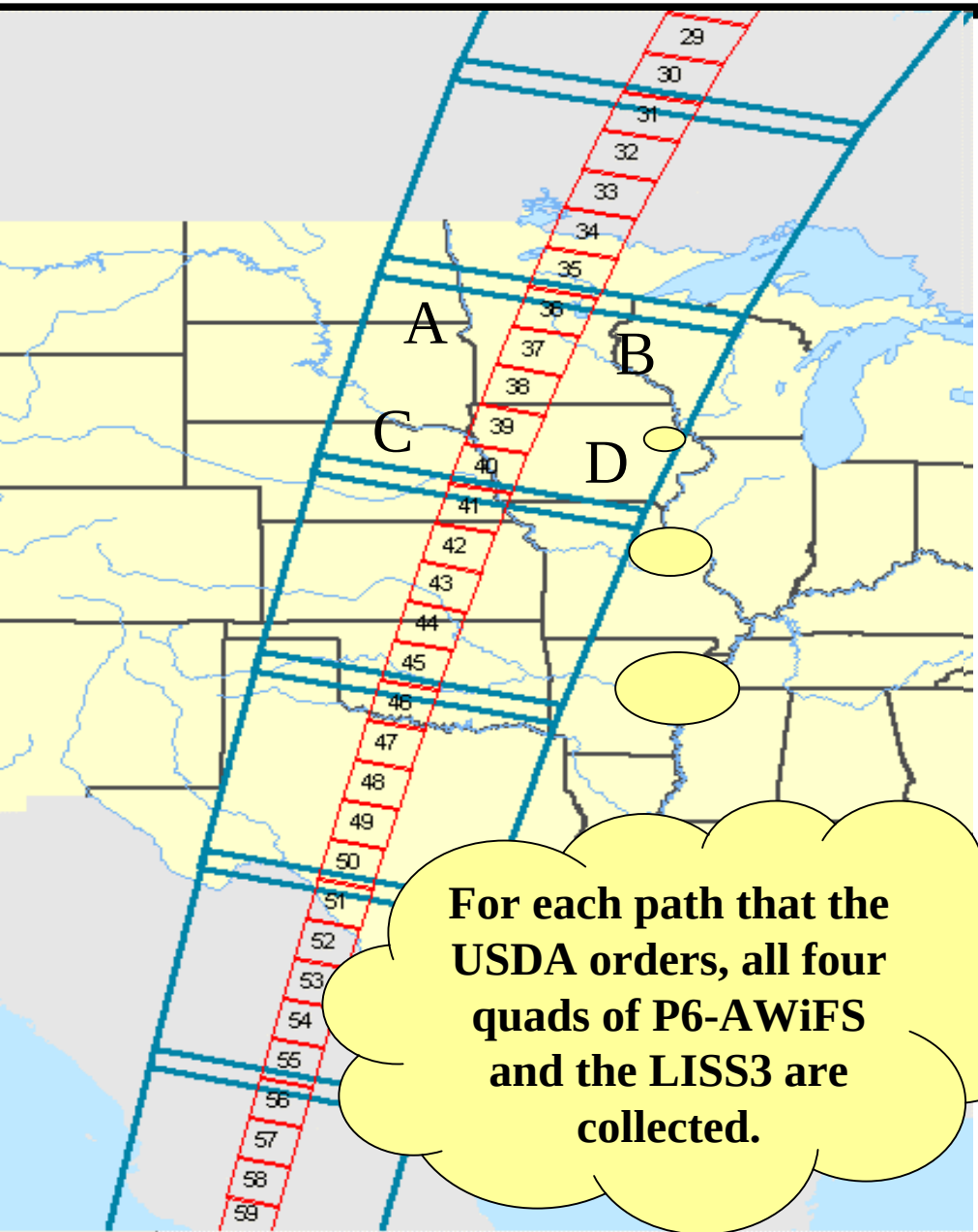
In FY2007, USDA purchased 789 Resourcesat-1 AWiFS quads and USDA caused acquisitions of ~3,000 AWiFS quads for the U.S.

- Standing Order window from April 1 to September 30
  - ½ of the year
  - Other half of year has almost no coverage because there is no order.
- Requested only B & D quads
  - ½ available; A & C quads acquired but not ordered.
- Purchased only quads which met cloud-free criteria
  - ½ available; USDA uses 50 % rule of thumb.
- USDA purchases represent about 1 out of 8 possible.
  - Full-year coverage of US CONUS at 6-day frequency, about 5,655 quads.
  - To purchase an entire year, cost would be ~ $2.5 Million.
- P6-LISS3 was also acquired and some P6-LISS4 PAN

2007 Resourcesat-1 LISS-3 Coverage at GeoEye



USDA Satellite Imagery Archive



For each path that the USDA orders, all four quads of P6-AWiFS and the LISS3 are collected.

Resourcesat-1 Naming
(example path 269)

- P6-AWiFS has path, row, quad.
- Row naming is driven by LISS3.
- LISS3 is acquired at nadir.
  - 141 X 141 km with a 23.5 m GSD.

- P6-AWiFS quad is 350 x 350 km.

GeoEye displays every fifth row of P6-AWiFS due to the 80% overlap.

USDA-SIA Distributed 4,175 Field-level Satellite Scenes in FY2007

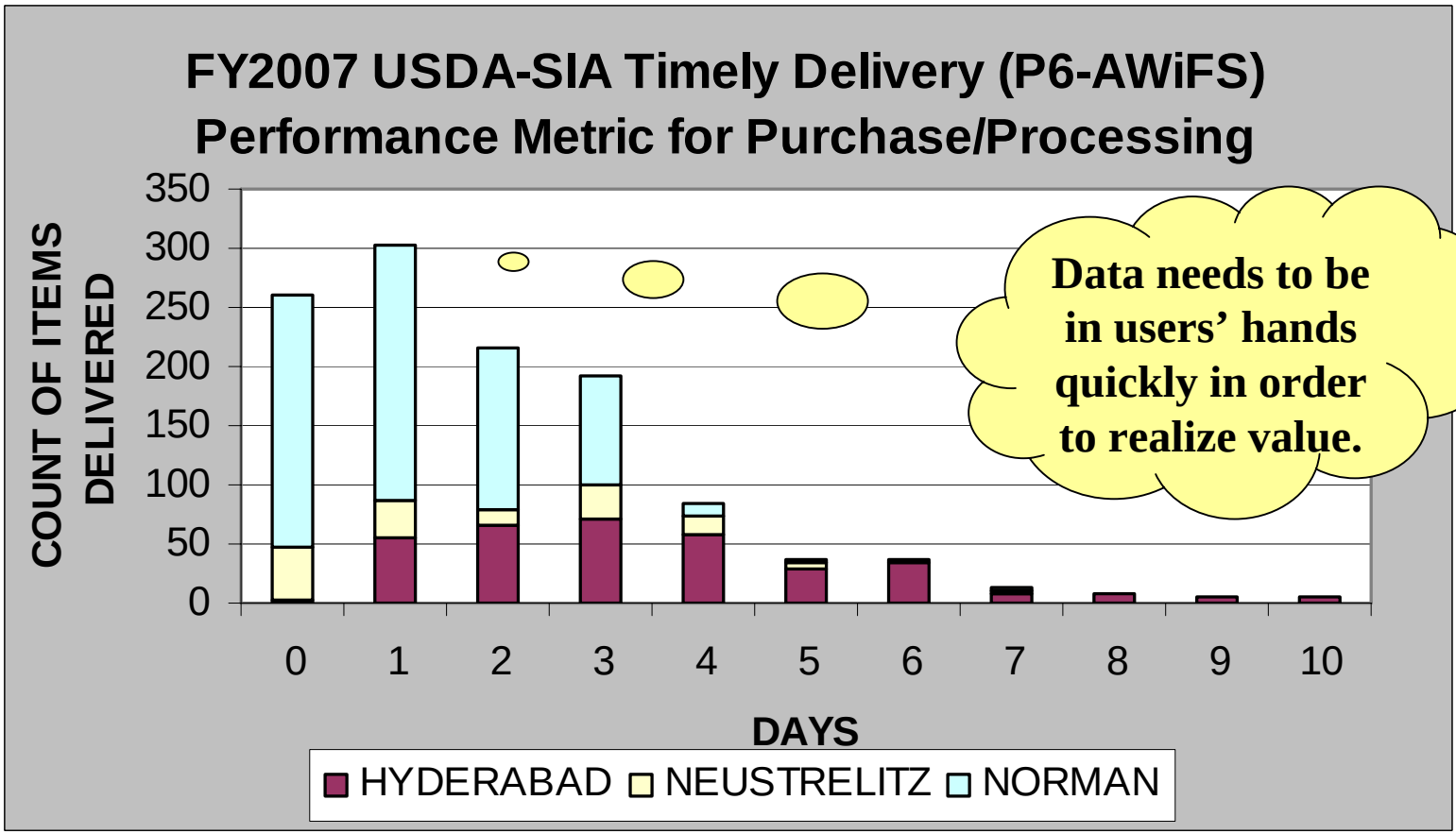
✓**The value of the distributed satellite scenes at catalogue prices (non-USDA contract) = *$4.27 million* in FY2007.**

✓ **The Department's cost avoidance is *$2.25 million* in FY2007.**

- **Net cost-avoidance after expenses.**

✓ **Value does not include benefits of applications.**

Operational Agricultural Monitoring Needs Quick Delivery of Data



USDA Plans for FY2008

- Continue purchasing Resourcesat-1-AWiFS.
- USDA agency meeting to plan out US coverage.
- Real Product Innovation
  - Higher efficiency of scene use (remove clouds)
  - Updated mosaics of critical areas
  - Accessible products
- Possible expansion for winter coverage (dependent on new source of funding)
  - Winter wheat classification—NASS.
  - Pasture and rangeland crop insurance—RMA.

USDA Satellite Imagery Archive

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- USDA switched to Resourcesat for operational agricultural monitoring.
- USDA-SIA purchases for US CONUS and select global coverage.
- USDA will continue purchasing Resourcesat for FY2008.

Thanks to…

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And to the analysts and scientists using the data at USDA and providing feedback.

Questions…

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