



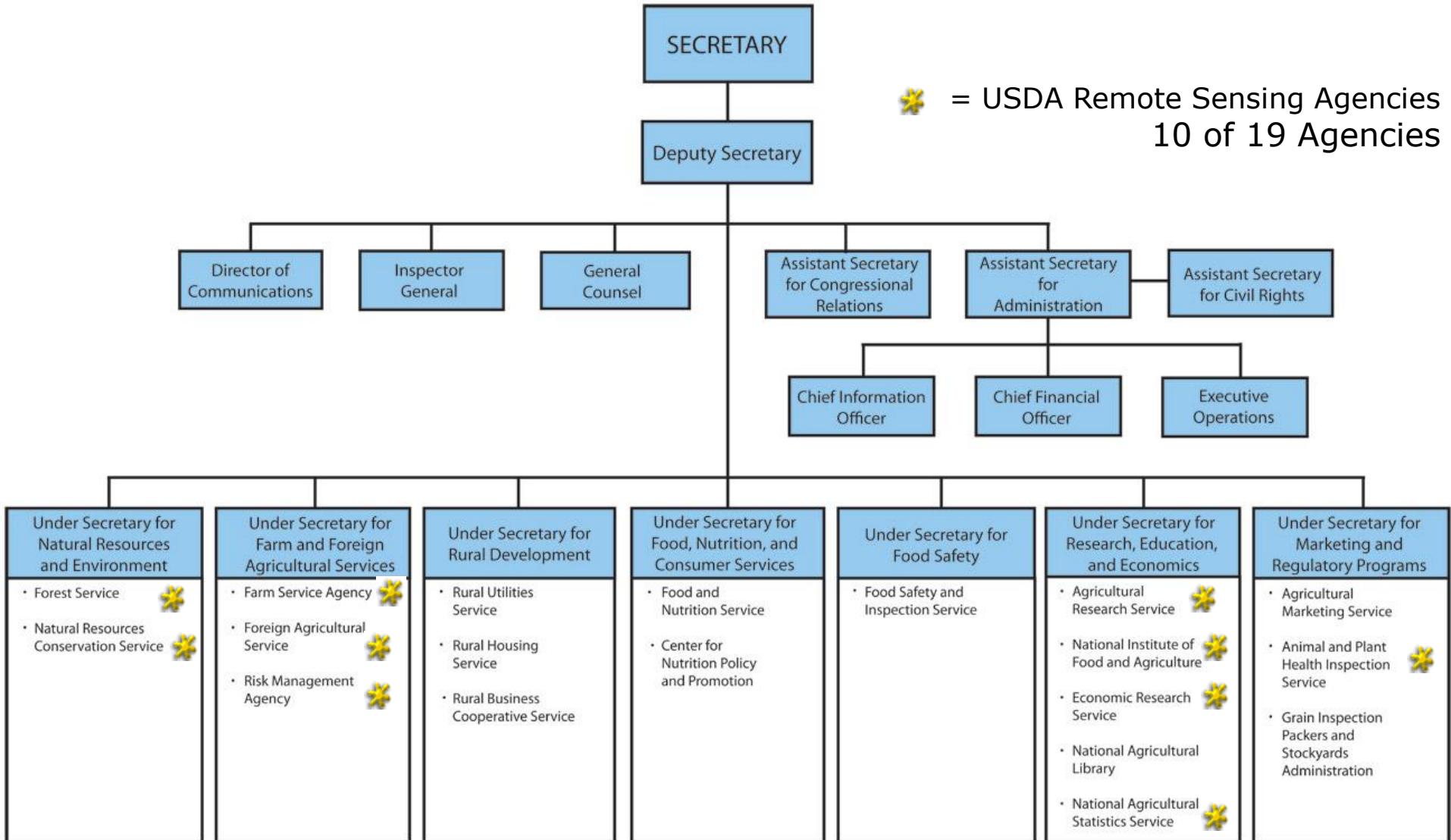
USDA

Remote Sensing Overview

JACIE March 16, 2010

Glenn R. Bethel
USDA Remote Sensing Advisor





★ = USDA Remote Sensing Agencies
10 of 19 Agencies



USDA's Interrelated Policy and Program Considerations

- Commodity programs
- Conservation
- Agricultural trade
- U.S. Nutrition programs
- Rural development
- Agricultural research, education, and extension
- Forestry
- Biofuels
- Sustainable Agriculture
- Disaster programs
- Wildland fire
- Carbon Markets
- Environment
- Climate change
- Trade Policy
- Access to food by poorest consumers in poorest countries
- Dealing with longer-term scarcity concerns:
 - Land availability
 - Water
 - Food production inputs, especially energy
- Energy (total supply & demand)

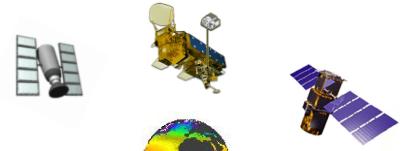


Outline

- USDA National Aerial Programs
- National and Global Satellite Imagery Programs
 - USDA Satellite Image Use
 - MODIS
 - AWiFS
- Imagery to support Disaster response / recovery



Satellites



Cross Calibration
Verification and Validation

High Altitude Airborne

Low Altitude Airborne

In-situ measurements



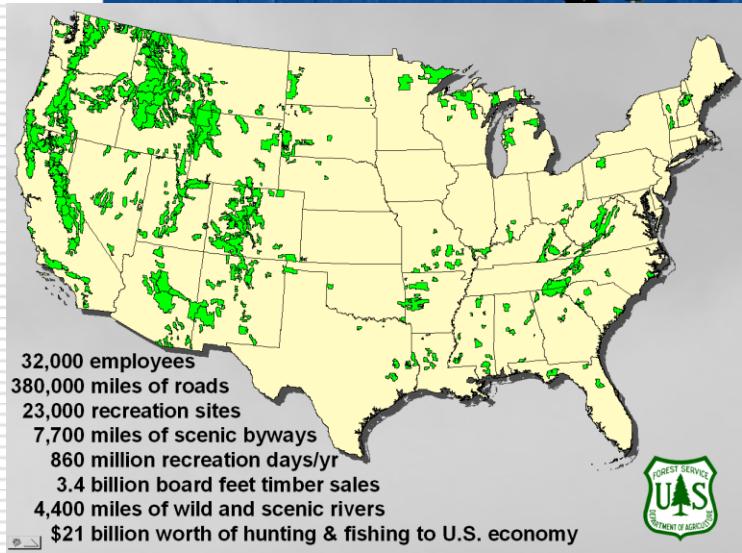
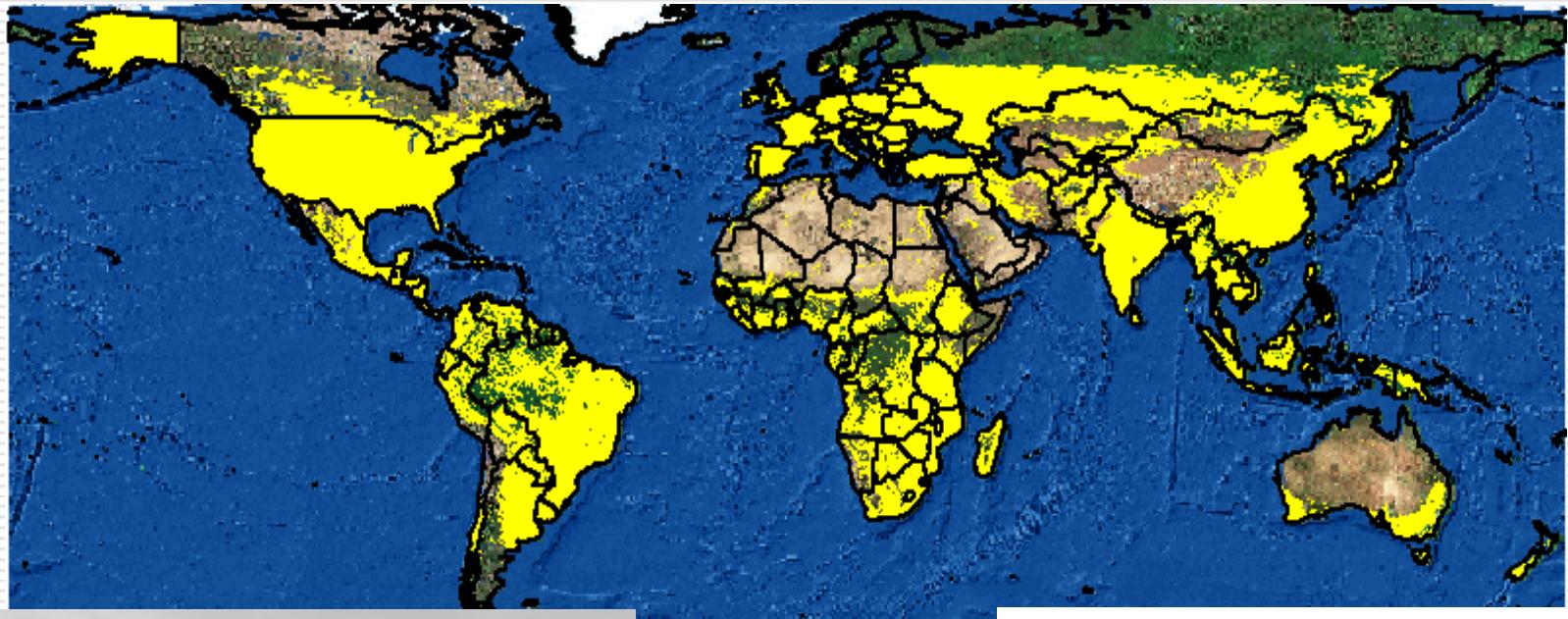
10,000+ USDA personnel on the landscape every day

Bethel JACIE 2010

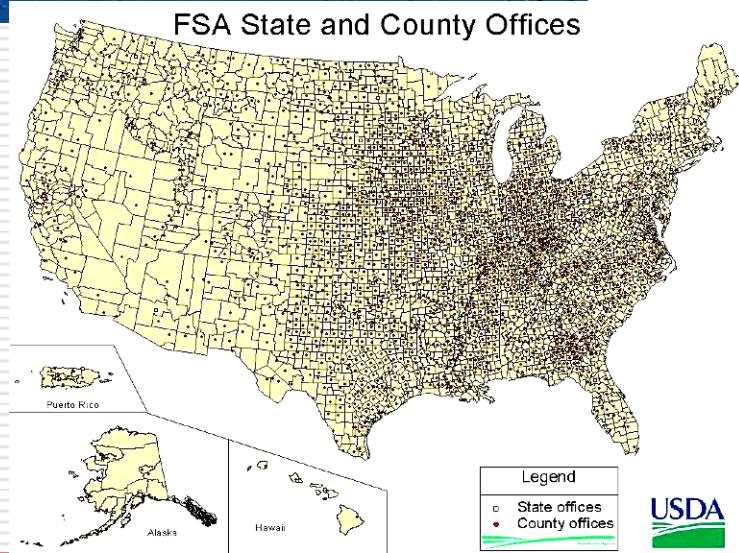
Global to Field Level Requirements



Global Crop Monitoring



Bethel JACIE 2010



Accomplishments:

- Largest single civilian mapping program in U.S. history
- Complete 1 meter CONUS coverage (most \leq 2 years)
- Effective cost-share partnerships (27% of total costs)



Challenges:

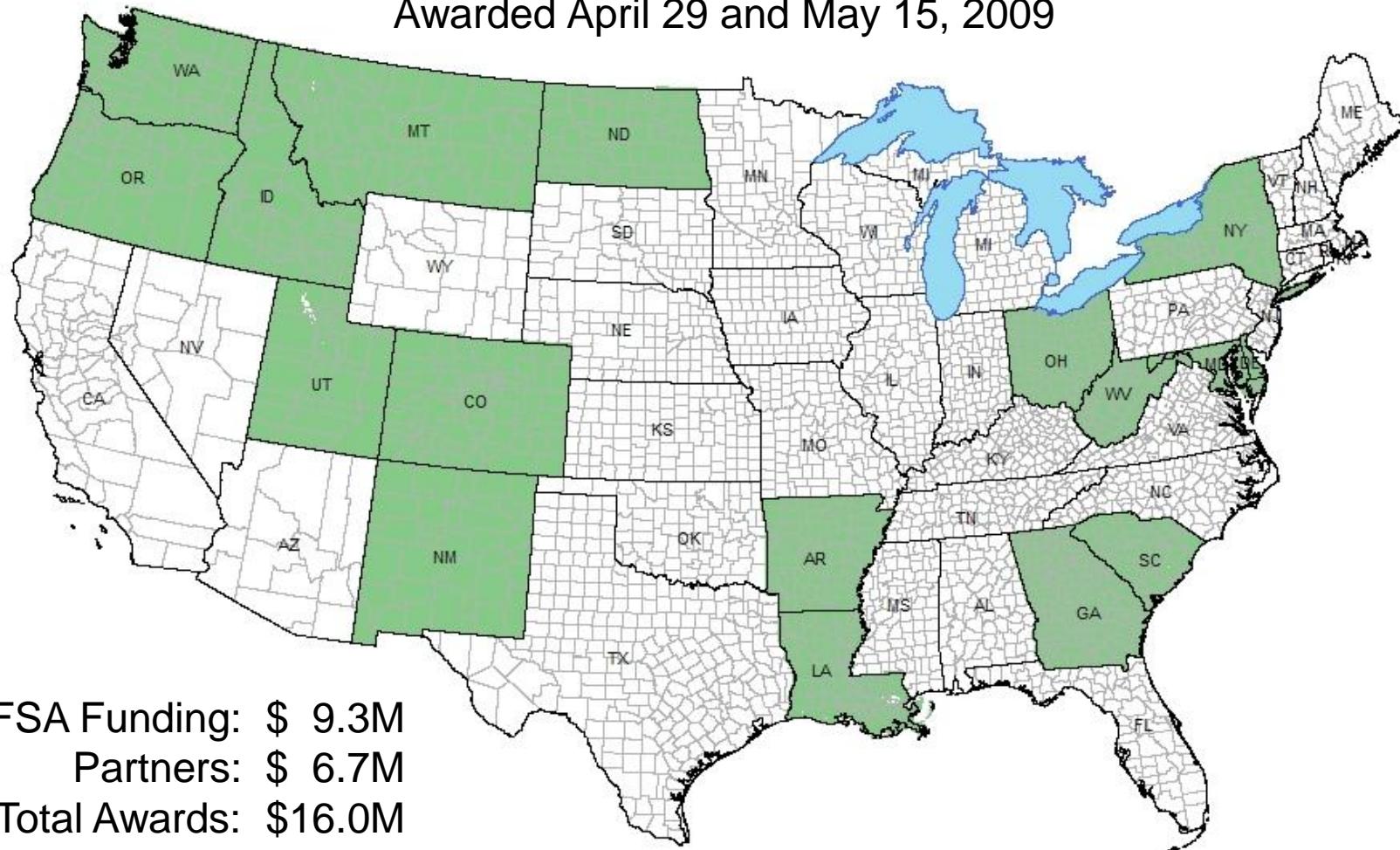
- Inconsistent funding (makes planning difficult)
- Establishing a predictable refresh cycle (inconsistent funding)
- Providing a fixed, stable program for partners (states) to plan their budgets



Round 1 Task Order Awards

17 States

Awarded April 29 and May 15, 2009



FSA Funding: \$ 9.3M

Partners: \$ 6.7M

Total Awards: \$16.0M

 2009 NAIP Coverage

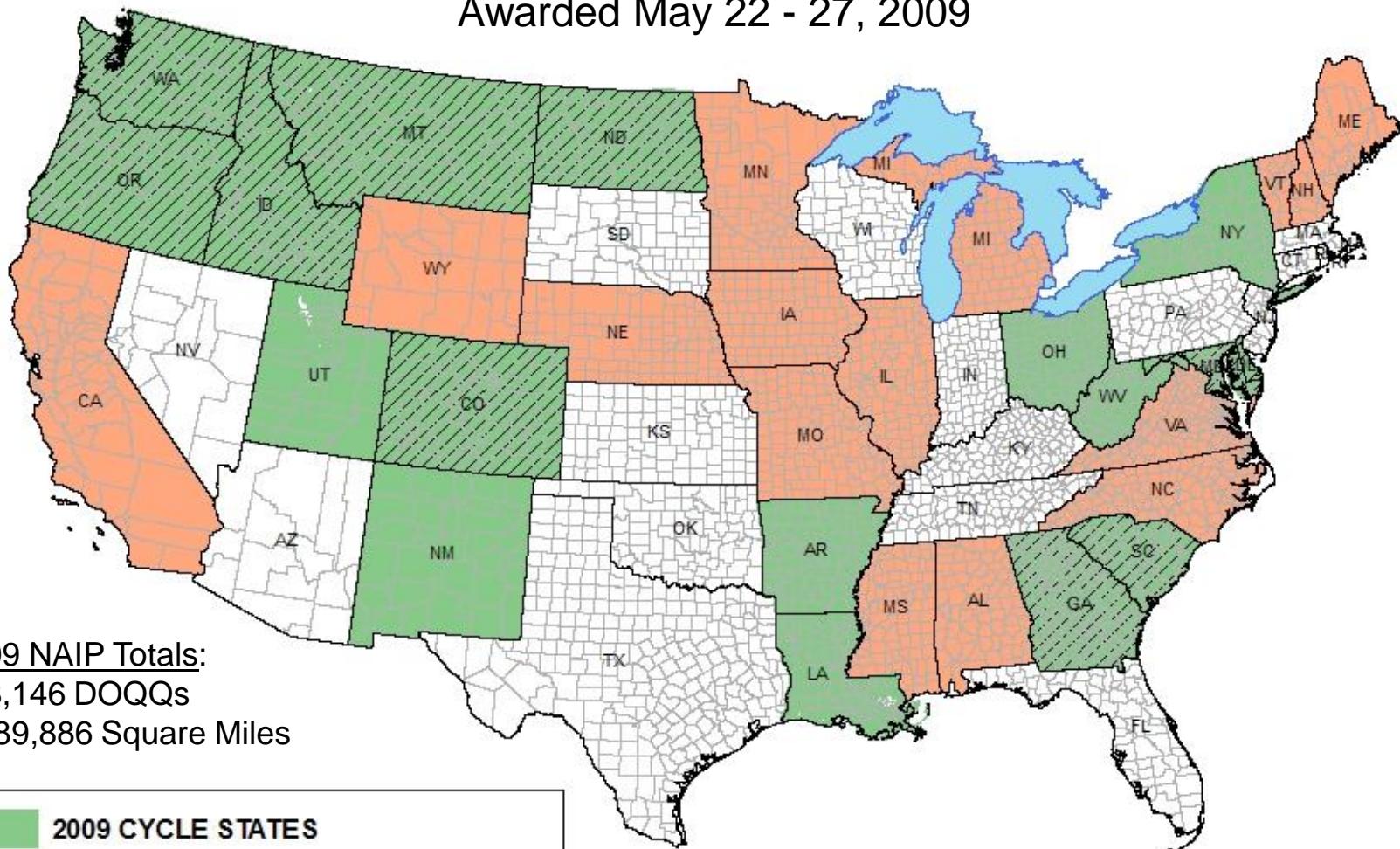
81,435 DOQQs covering 1,141,090 Square Miles

USDA-FSA-APFO

Round 2 Task Order Awards

15 Additional States

Awarded May 22 - 27, 2009



2009 NAIP Totals:

148,146 DOQQs

2,089,886 Square Miles

2009 CYCLE STATES

2009 ADDITIONAL STATES

2009 STATE PARTNERSHIPS (4 BAND)

2010 PROPOSED STATES

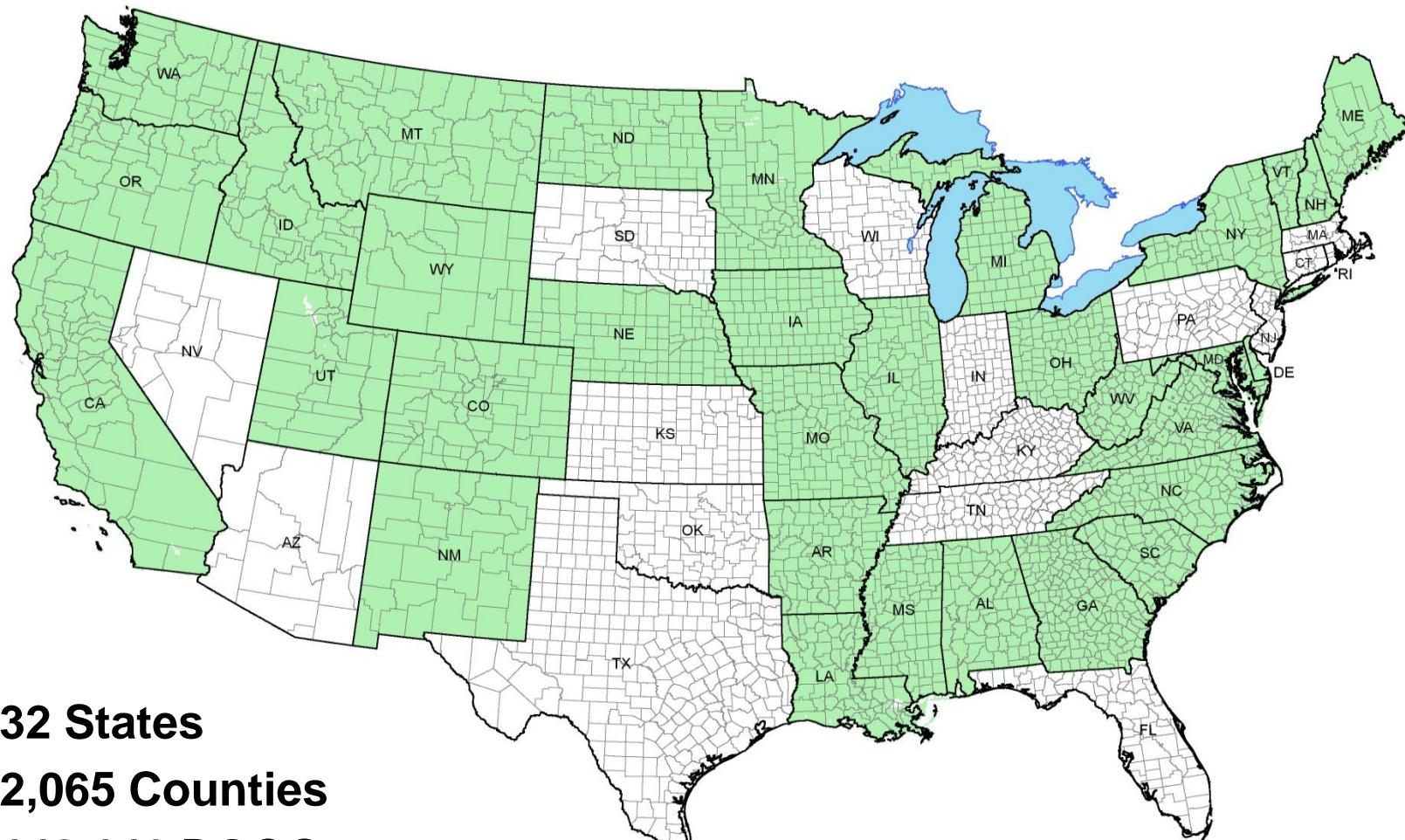
FSA Funding: \$22.8M

Partners: \$ 7.1M

Total Awards: \$29.9M

USDA-FSA-APFO

2009 NAIP – CONTRACTED STATES



32 States

2,065 Counties

148,146 DOQQs

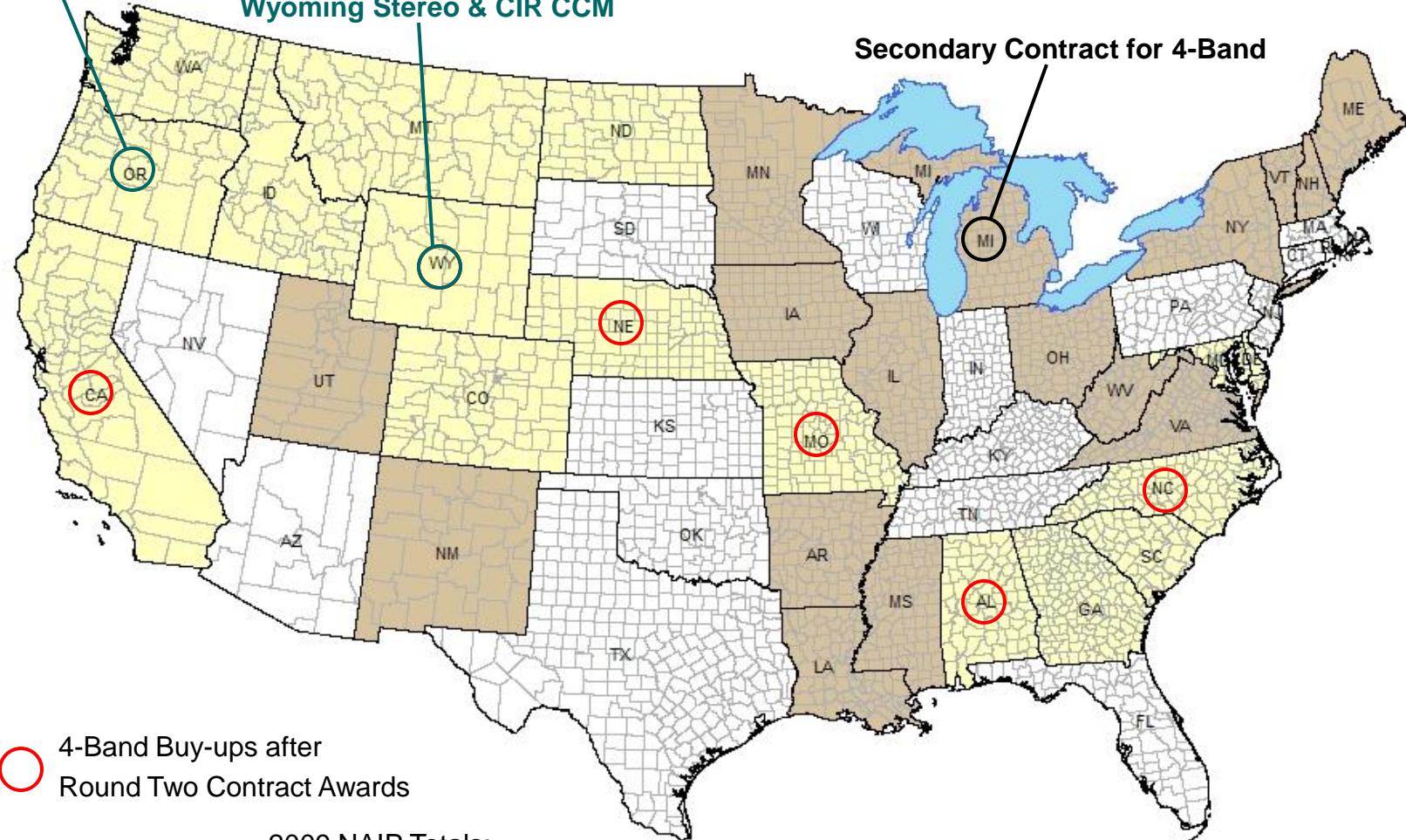
2,089,886 Sq. Miles

2009 NAIP 3 BAND VS 4 BAND

Oregon ½ meter

Wyoming Stereo & CIR CCM

Secondary Contract for 4-Band



4-Band Buy-ups after
Round Two Contract Awards

2009 NAIP Totals:

4 BAND

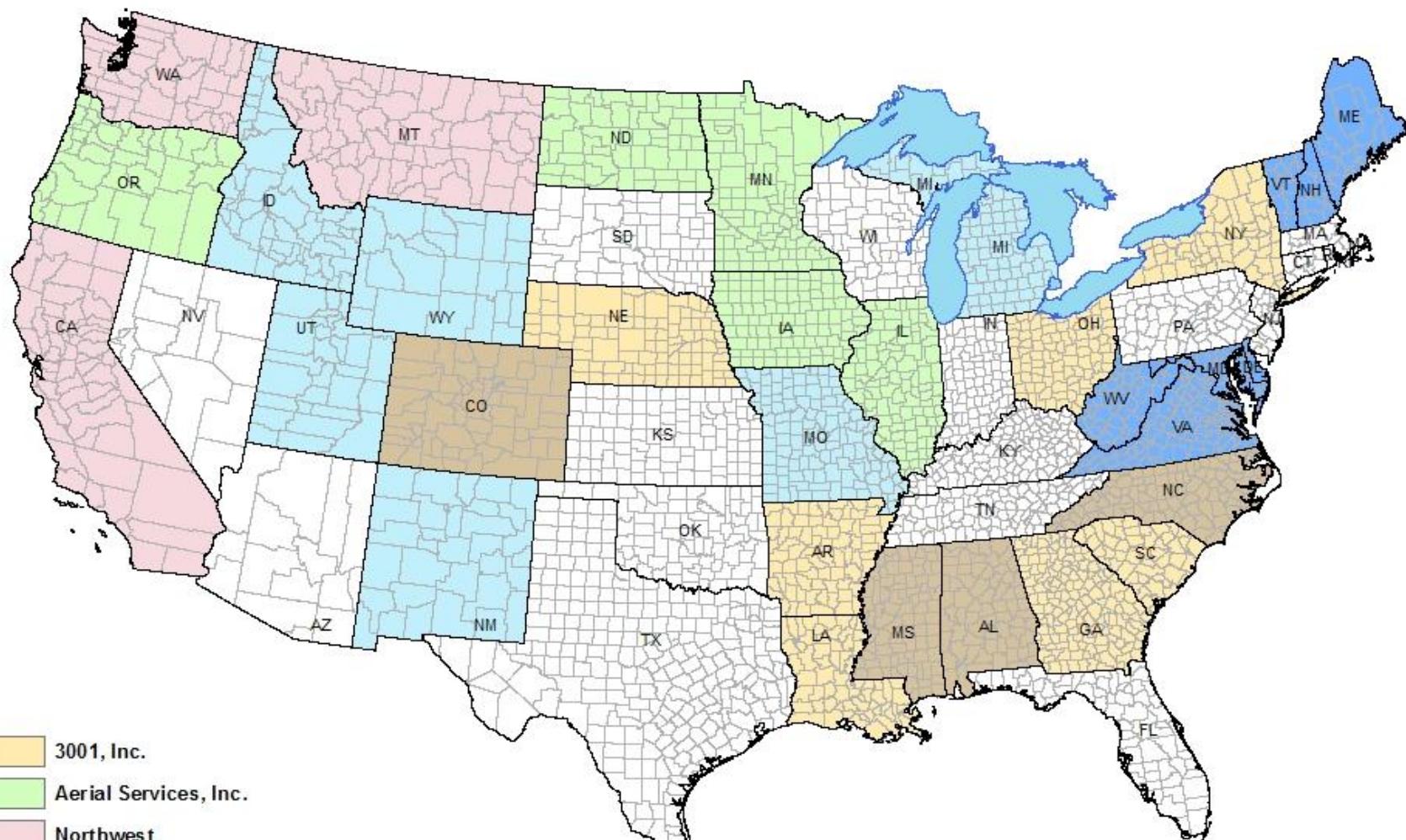
87,950 DOQQs 59% 4-Band

3 BAND

60,196 DOQQs 41% 3-Band

USDA-FSA-APFO

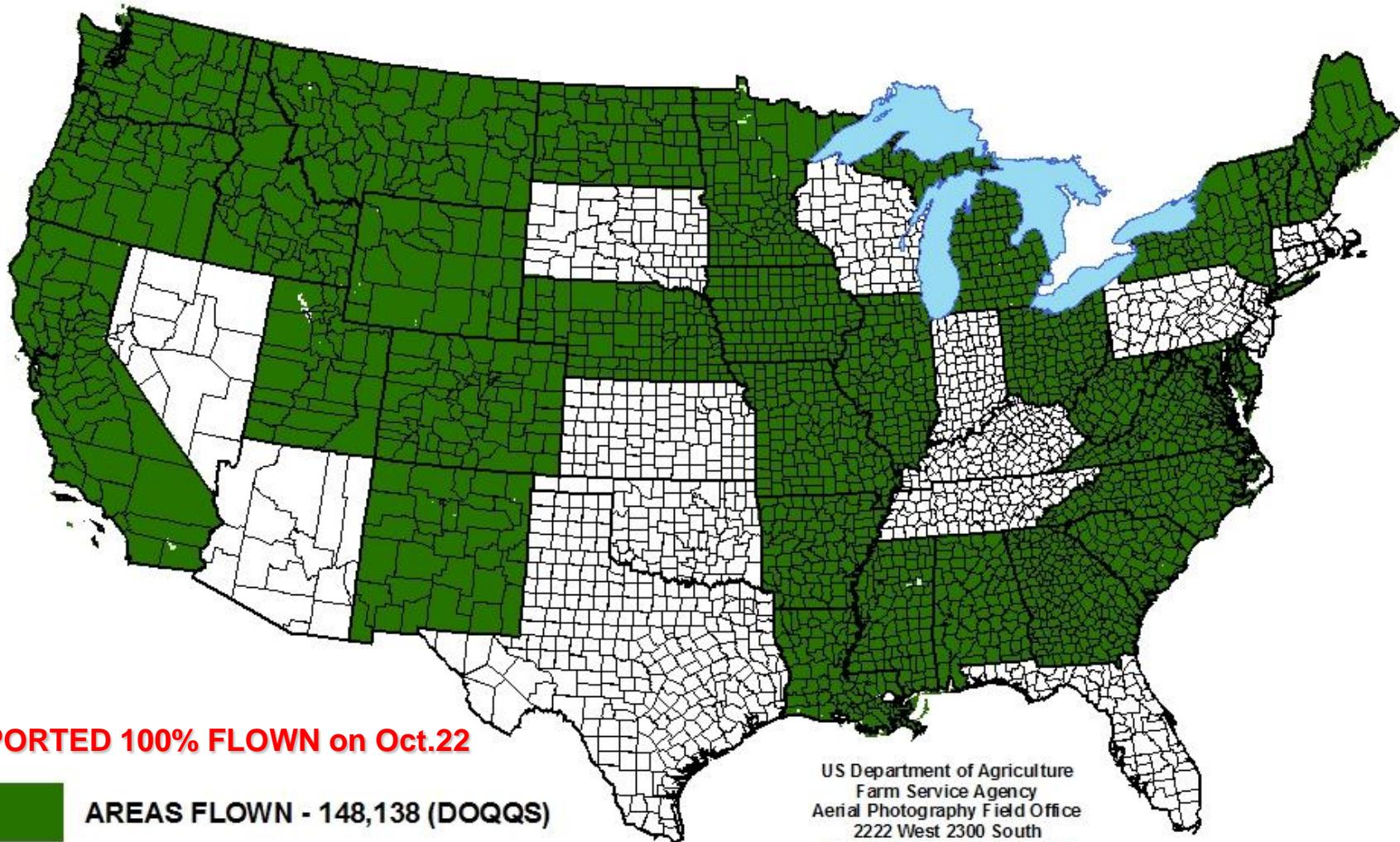
2009 NAIP Contractors



- 3001, Inc.
- Aerial Services, Inc.
- Northwest
- Photoscience
- Sanborn
- Surdex

ALL STATES EXCEPT IL, IA AND MN ARE BEING FLOWN WITH DIGITAL CAMERAS

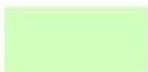
2009 NAIP IMAGERY STATUS



REPORTED 100% FLOWN on Oct.22



AREAS FLOWN - 148,138 (DOQQS)

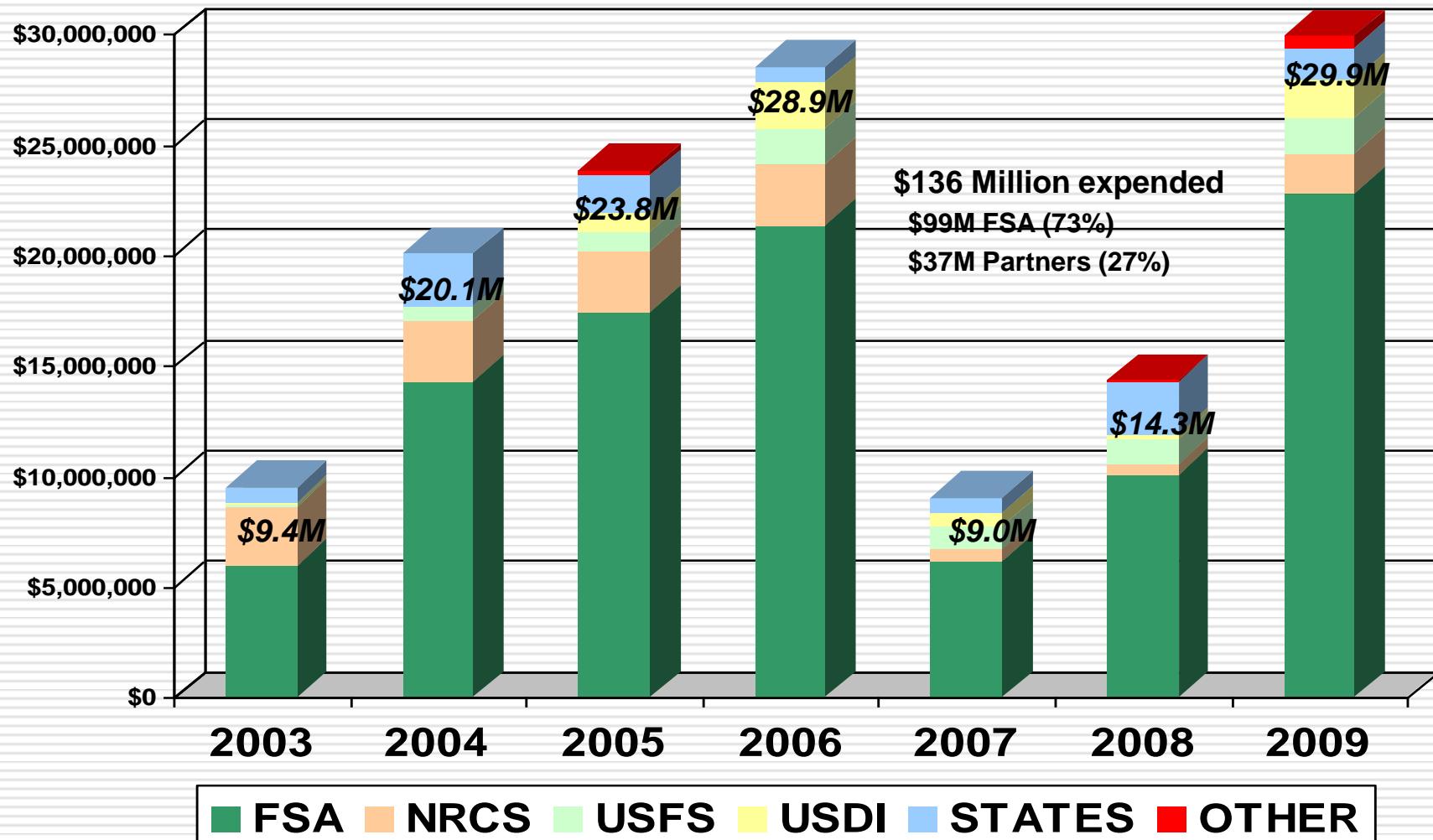


AREAS CONTRACTED - 148,146 (DOQQS)

US Department of Agriculture
Farm Service Agency
Aerial Photography Field Office
2222 West 2300 South
Salt Lake City, UT 84119-2020
Bridget Barlow
Tel: 801-844-2911 Fax: 801-956-3640
Email: bridget.barlow@slc.usda.gov
Website: www.apfo.usda.gov

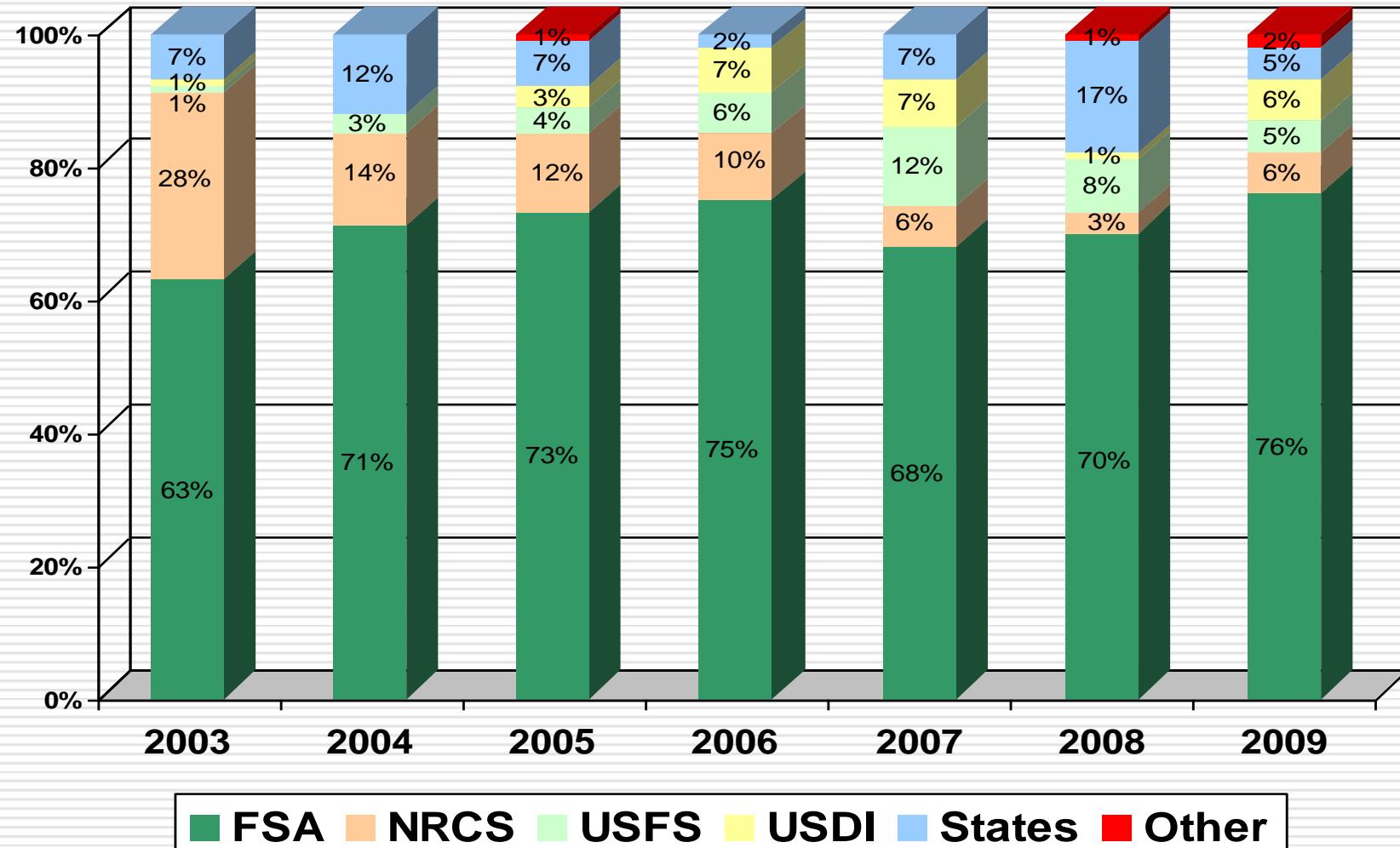
NAIP Funding History

2003 - 2009 FSA NAIP Contracts



NAIP Funding History

2003 - 2009 FSA NAIP Contracts





2009 NAIP Funding Sources



FSA Funding Amount **\$22,809,911**

U.S. Forest Service **\$1,640,000**

Natural Resource Conservation Service **\$1,750,000**

U.S. Geological Survey **\$1,750,000**

Other Federal Agencies **\$183,000**

State Governments **\$1,770,495**

Total 2009 Cost Shares: **\$7,093,495**

2009 NAIP Funding Total: **\$29,903,406**



Bethel JACIE 2010



NAIP 3 Year Cycle Plan

2010-2012



- “Ortho Base” imagery replacement for 3 year cycle (48 states)
 - Build in more stability and consistency for funding and planning
 - 1 meter resolution only (no 2 meter)
 - Full state coverage
 - Natural color base imagery (**partners fund 4-band upgrades**)
- Deliverables
 - Compressed County Mosaics (CCMs)
 - 15:1 Compression, MrSID MG3 format for 3-band states
 - MrSID MG3 format for 4-band states delivered as 3-band natural color
 - Digital Ortho Quarter Quads (DOQQs)
 - GeoTIFF, full resolution
 - CCMs and DOQQs released to all users 30 to 45 days after flying season end date

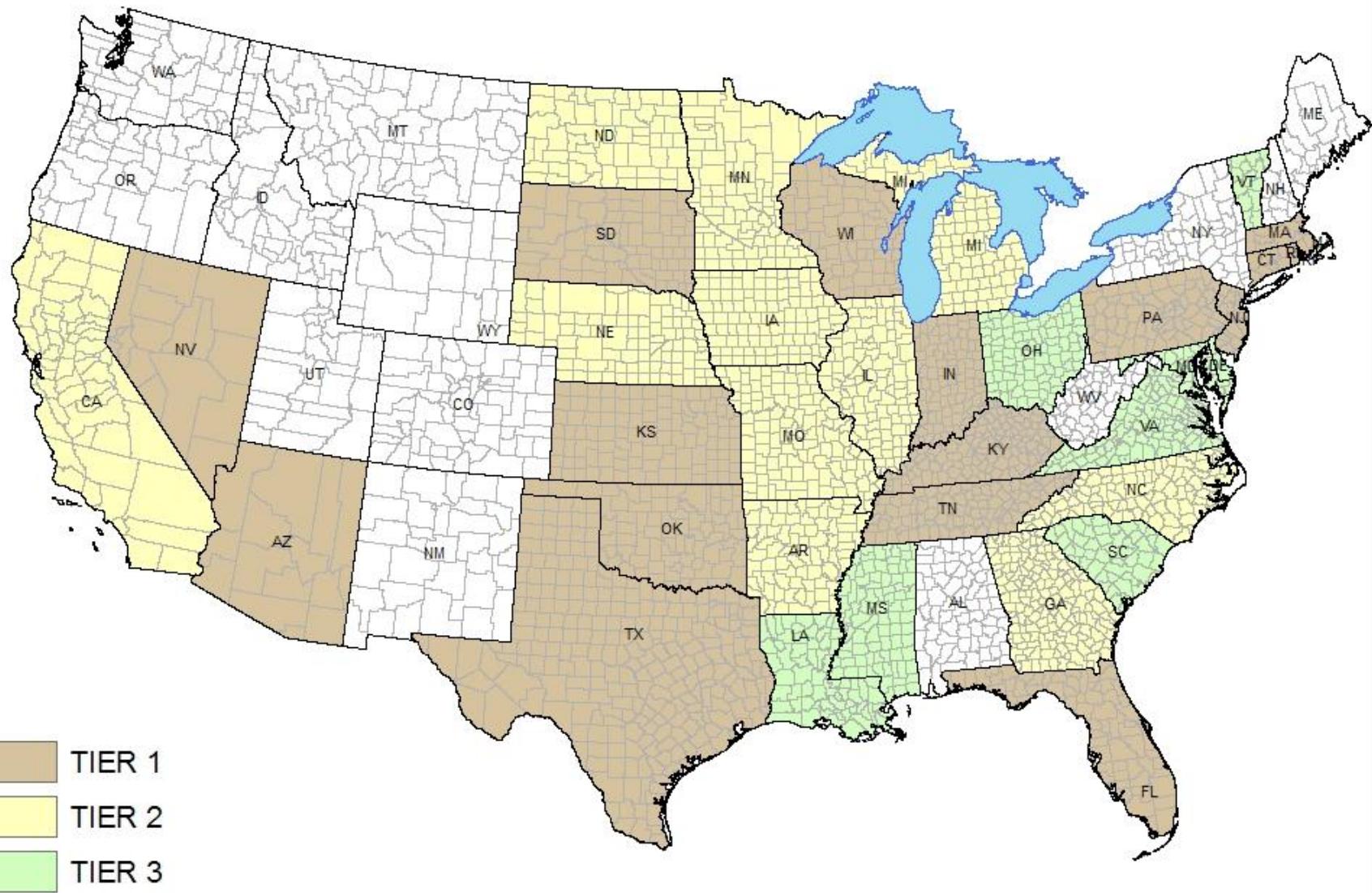
- Flying Season**
 - Leaf-on under peak crop growing conditions
 - Flying Seasons determined by FSA
- Projection**
 - UTM zones with CCMs projected in single zone
- <10% cloud cover**
- Deliverables available approximately **45 days** after flying season
- Absolute Horizontal Accuracy Specification
 - **6 meters** from “true ground” position
- All **1 meter**

NAIP 2010

Changes

- Adding “Inland lakes water quarter quads” to state coverage
- Quarter quads available sooner to partners
 - Approximately 45 to 60 days after flying season close
 - Pass automated QA check on file headers
 - Single delivery on portable hard disk drives
 - No partial delivery
- Dropping JPEG2000 format for now
 - Several unresolved issues
 - Web service planned for color infrared for GIS users

2010 NAIP PROPOSED STATES



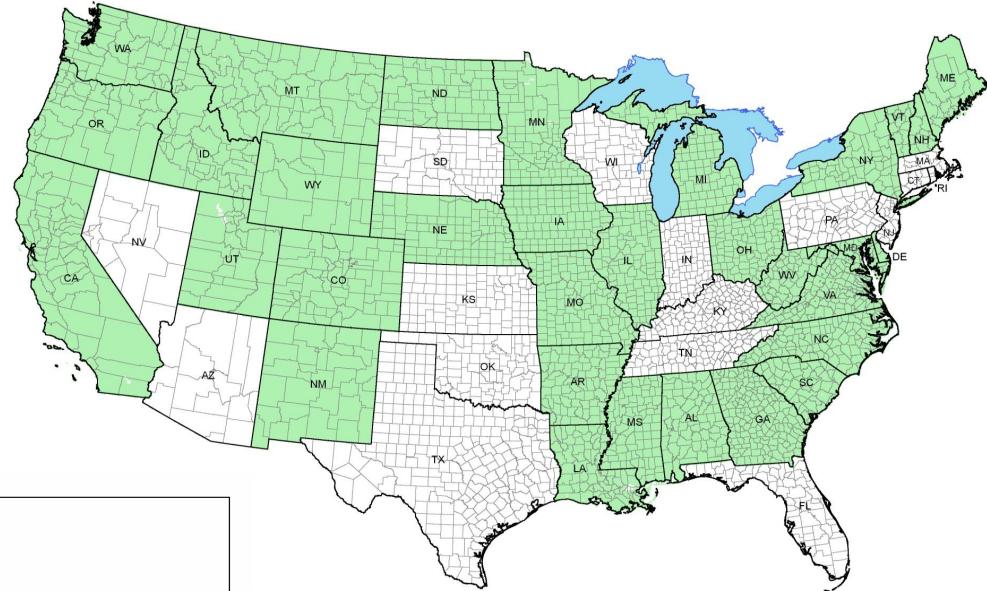
NAIP 2010 Acquisition Plans



- Tier 1
 - Based on 3 year cycle
 - \$10.8 M FSA
 - \$4.73 M fed partners
 - Fed partner commitment
 - Full state coverage
- Tier 2
 - Based on Potential Additional funding to FSA
 - \$24 Million total FSA
- Tier 3
 - Based on “significant” cost share from state
 - FSA will cost share on case by case basis

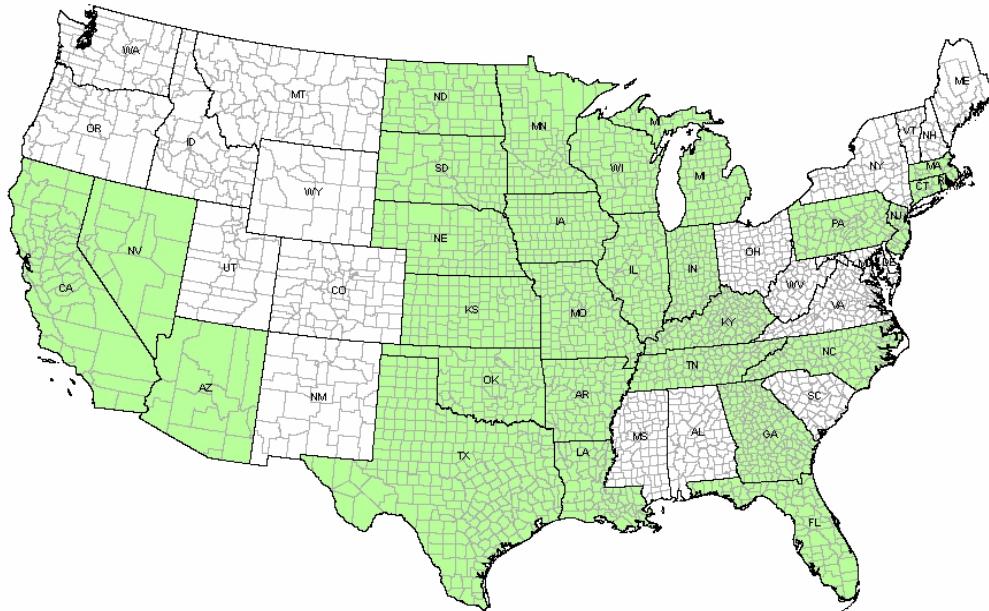
100% + Coverage in Two Years

2009 NAIP COVERAGE



USDA-FSA-APFO

2010 NAIP



Assumes Tier 2 Funding

0

2010 Partnership Strategy

- NAIP 2010 will be full state coverage
 - Federal cost share
 - Additional FSA funding
- Cost Share Partners can “Buy Up” to 4 band
 - 10% of total cost per state
 - This is a set, pre-determined amount that is based on estimated 2010 costs.
 - Price list is here:
 - <http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=docs&topic=nai>

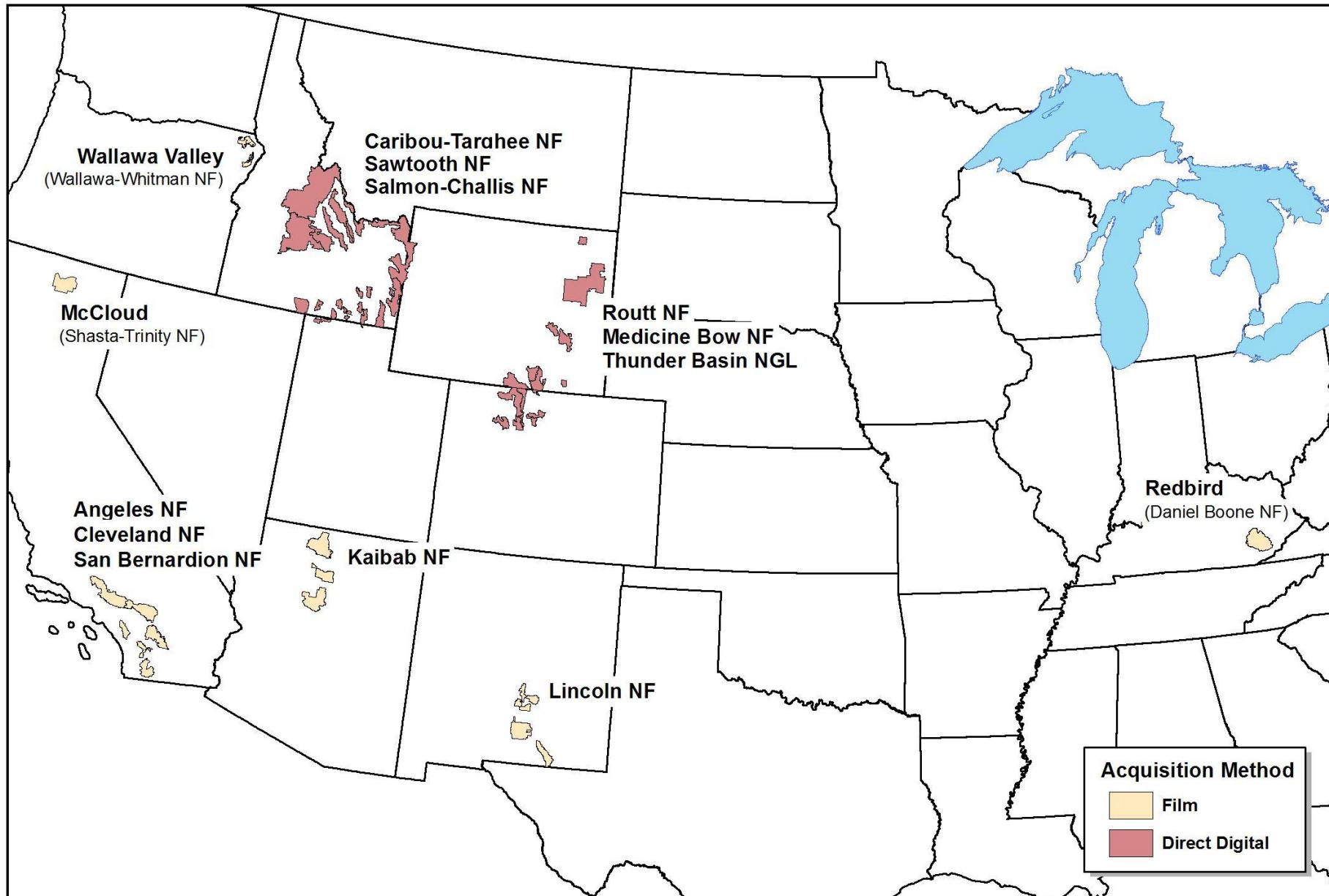


USDA Aerial Programs: One Acquisition, Many Products

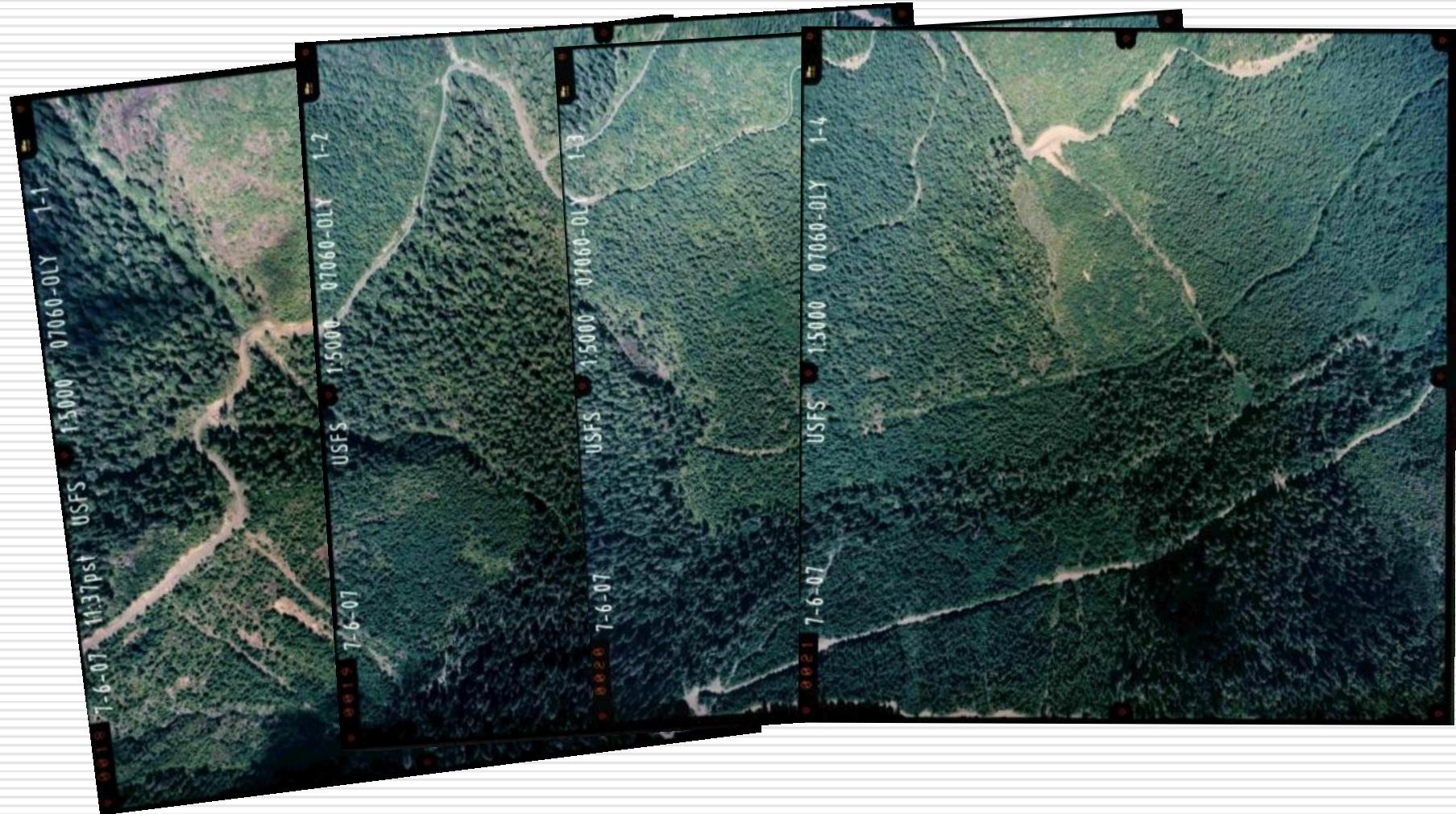
- High-End
 - 4-bands, 16 bit, Stereo
- Mid-level
 - 4-band, 8-bit, orthorectified
 - GIS Ready
 - Quad/Quarter Quad
- Common-Use
 - 3 or 4-band 8-bit, orthorectified
 - Tone Balanced
 - Mosaicked
 - GIS Ready



2009 RESOURCE PROJECTS



Use of Contact Prints for Stereo





Use of Hardcopy and Derive Ortho



NIROPS Aircraft

Main function: Wildfire mapping from April-November



144Z: Cessna Citation Bravo



149Z Beechcraft 200 Super King Air



PHOENIX

FS Phoenix sensor
is the primary
tactical fire
sensor.

IR Analysts
Interpret
Orthorectified
Imagery to
create Fire
Boundary
Shapefiles.



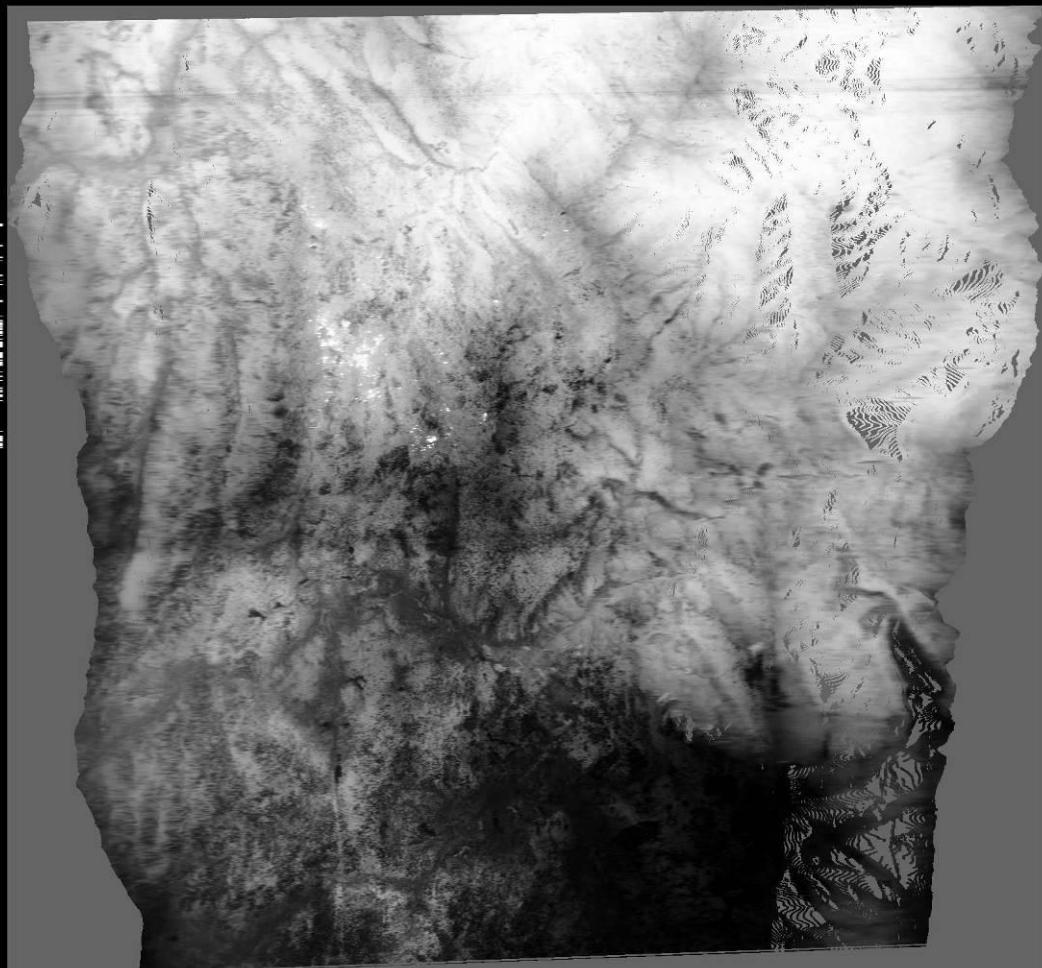
END ORTHORECTIFICATION -- 080929_2223_HIDDEN_1 IR TECH: BERAIN HEADING: 180

Image Scale = 29.6 ft/pixel (50 pix/acre) -- Width = 9.0 miles -- Length = 8.4 miles

NATIONAL



N144Z - v3.3e

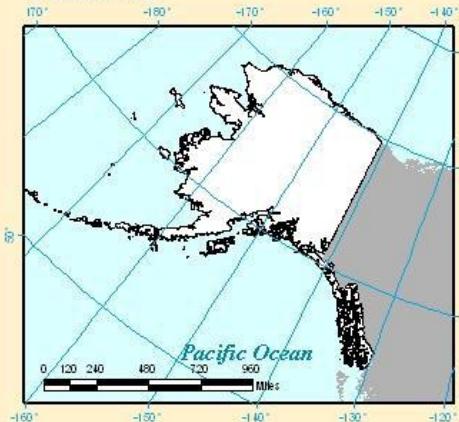


START ORTHORECTIFICATION -- 080929_2223_HIDDEN_1 -- HEADING: 180

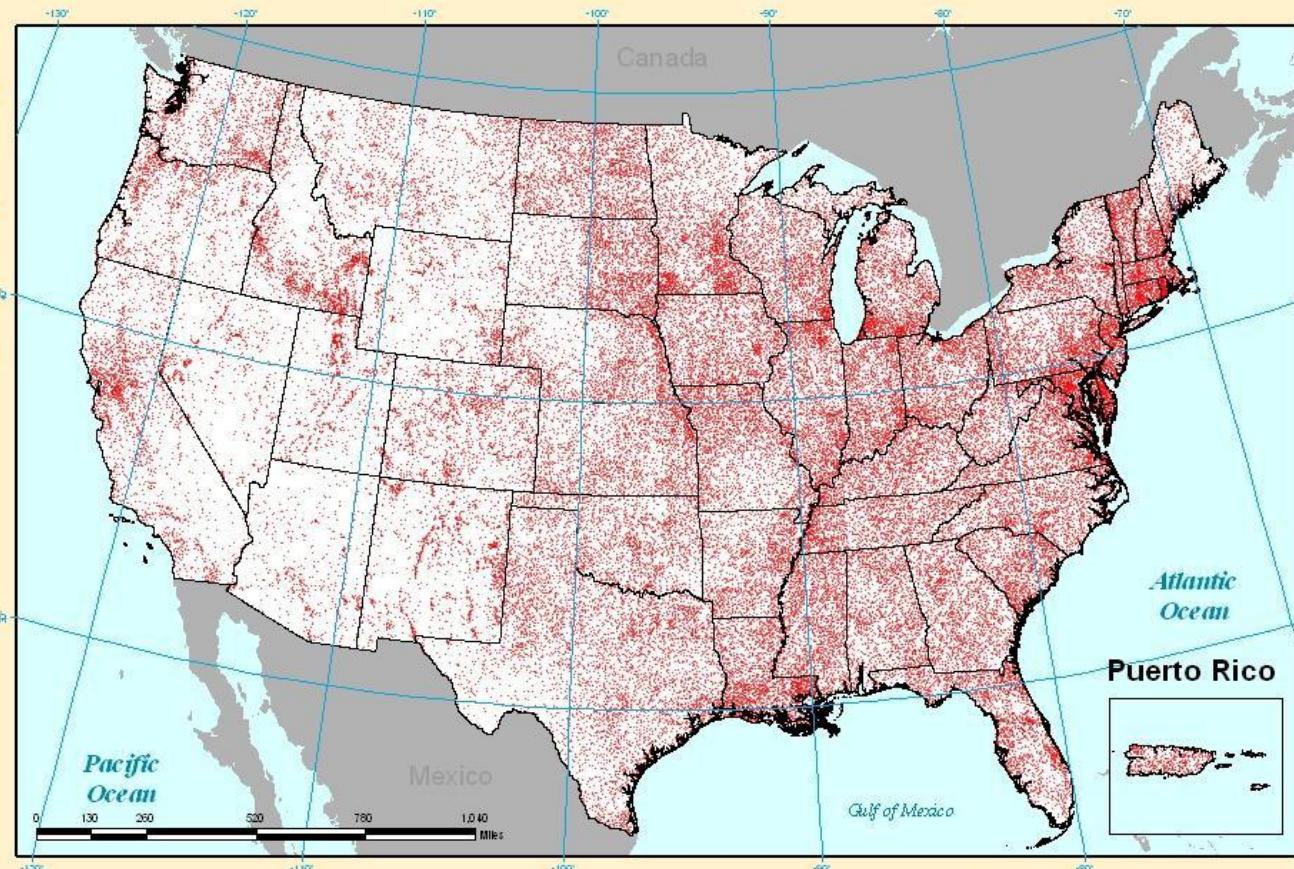
Natural Resource Inventory



Alaska



Hawaii



Alberts Projection
Central Meridian: 95
1st GM Parallel: 20
2nd GM Parallel: 50
Latitude of origin: 40

CONUS: 70,076
Puerto Rico: 450
Hawaii: 375

2010 NRI Sample

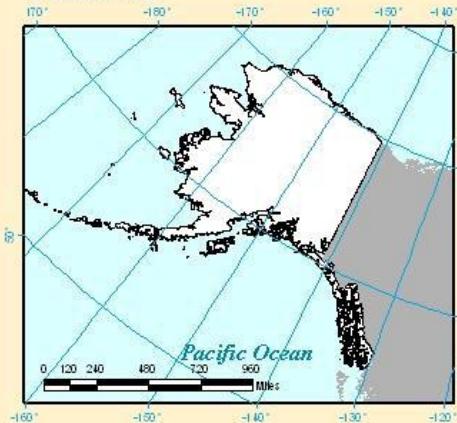
October 2009
USDA-NRCS-NCGC
Fort Worth, TX

70,076 Areas in CONUS, 450 Areas in Puerto Rico, 375 Areas in Hawaii
1:7,920 (1 inch = 660 feet) with a resolution of (3-6 inches)

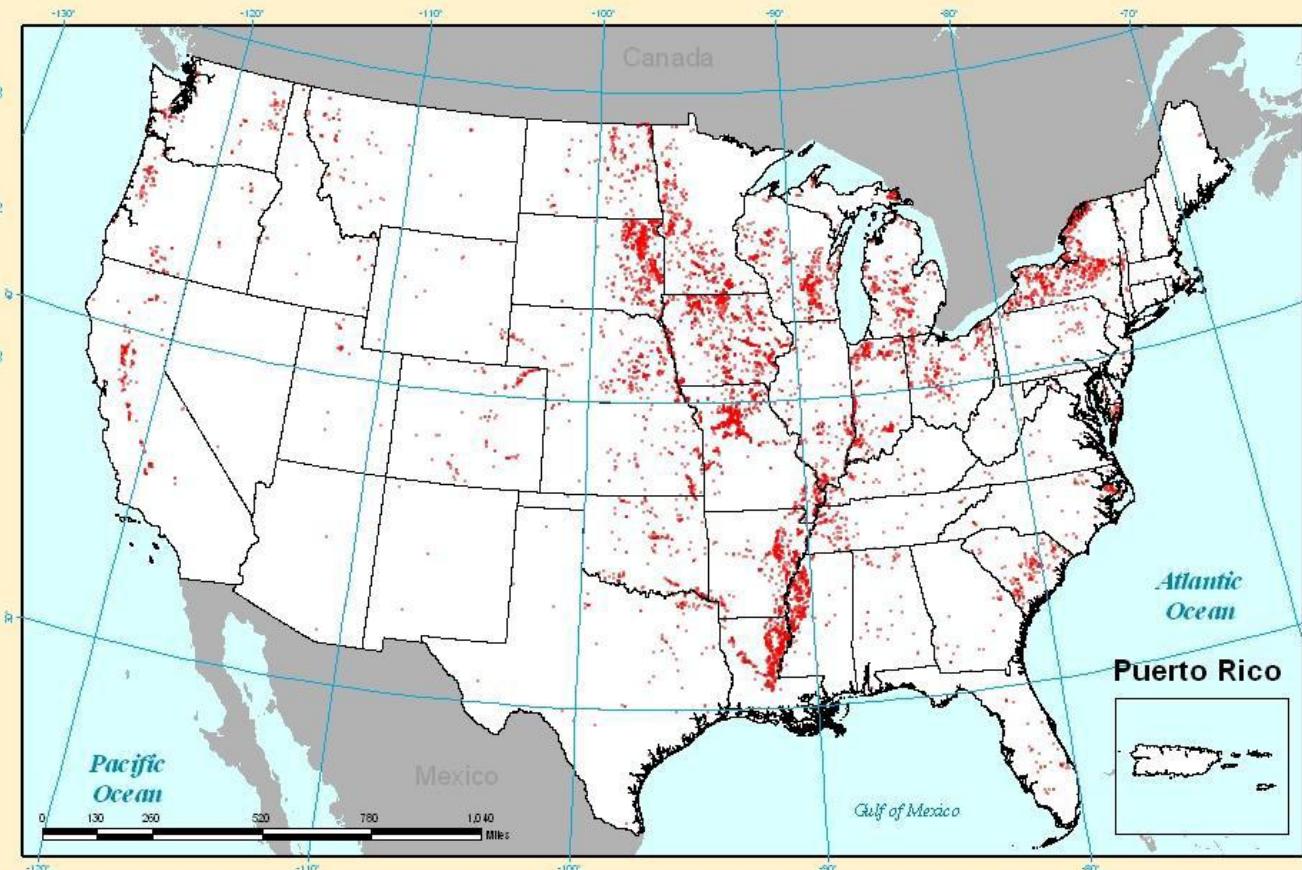
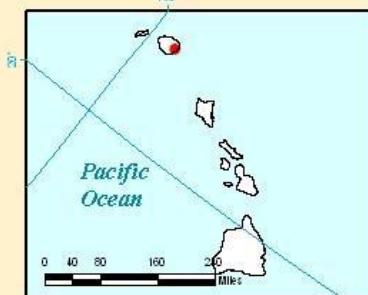
Wetland Reserve Program



Alaska



Hawaii



Albers Projection
Central Meridian: 95
1st GM Parallel: 30
2nd GM Parallel: 60
Latitude of origin: 40

10,306 Easements

2010 WRP Sample

October 2009
USDA-NRCS-NCGC
Fort Worth, TX

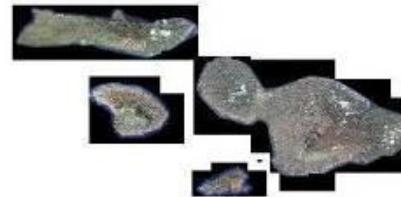
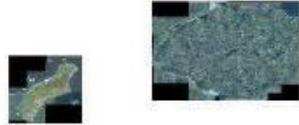
3-6 inch resolution imagery used to monitor 10,306 Easements, 2 Million acres in WRP. WRP is voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property

Four Band Imagery Increases Applications



UltraCamX – Color and CIR – 8" GSD
Bethel JACIE 2010

Hawaii

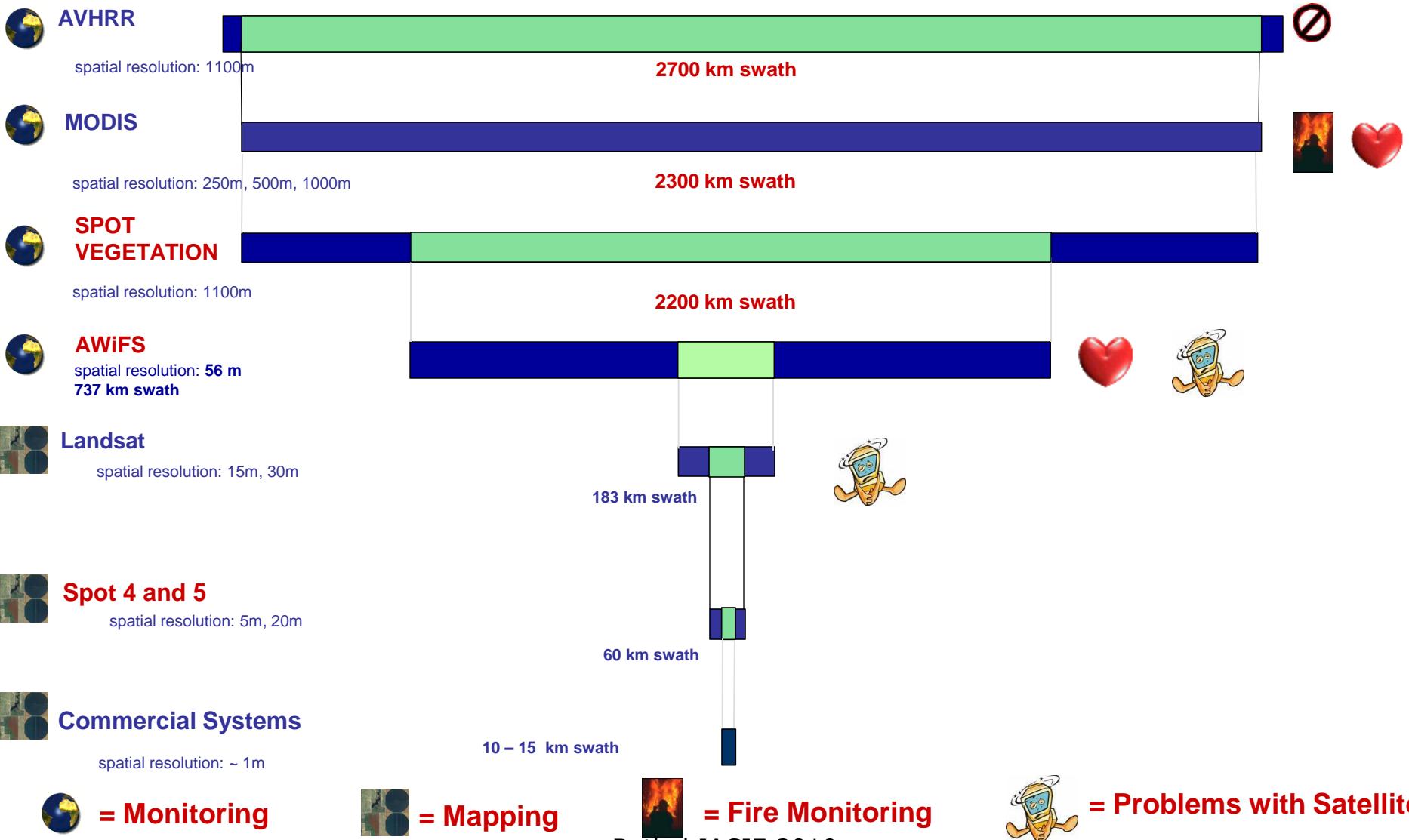


- All islands have .6 Meter Resolution, Four Band Orthoimagery data except Oahu (1 Ft., Natural Color).
- Hawaii (Big Island) dataset is around 250 GB.

Also acquiring imagery over US Territories



Current USDA Land Remote Sensing Use



Future Operational Monitoring Satellites used by USDA





Toolbox Weather Soil Moisture Vegetation Index Satellite Data Growing Season

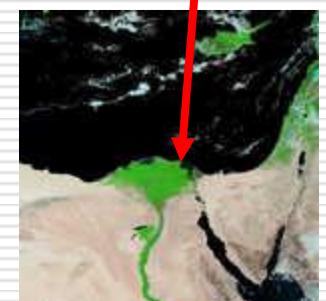
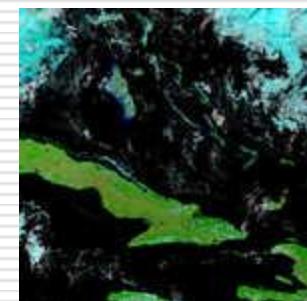
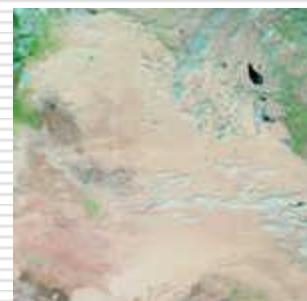
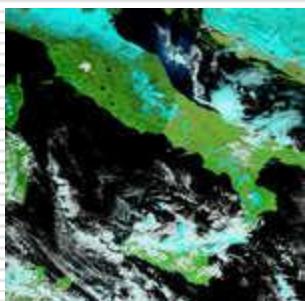
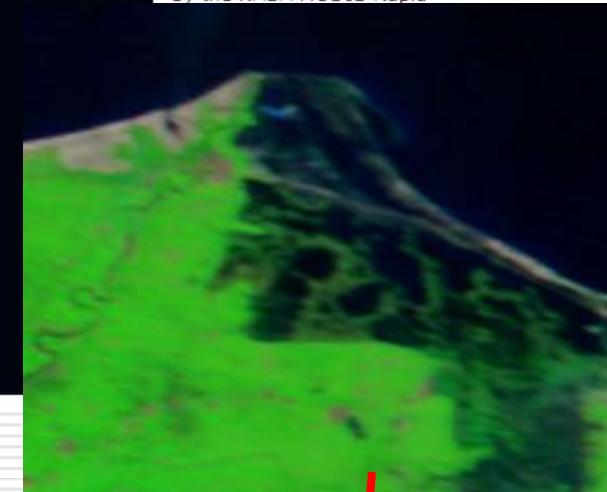
World – MODIS Image Gallery System Status

Click on a region to see MODIS images



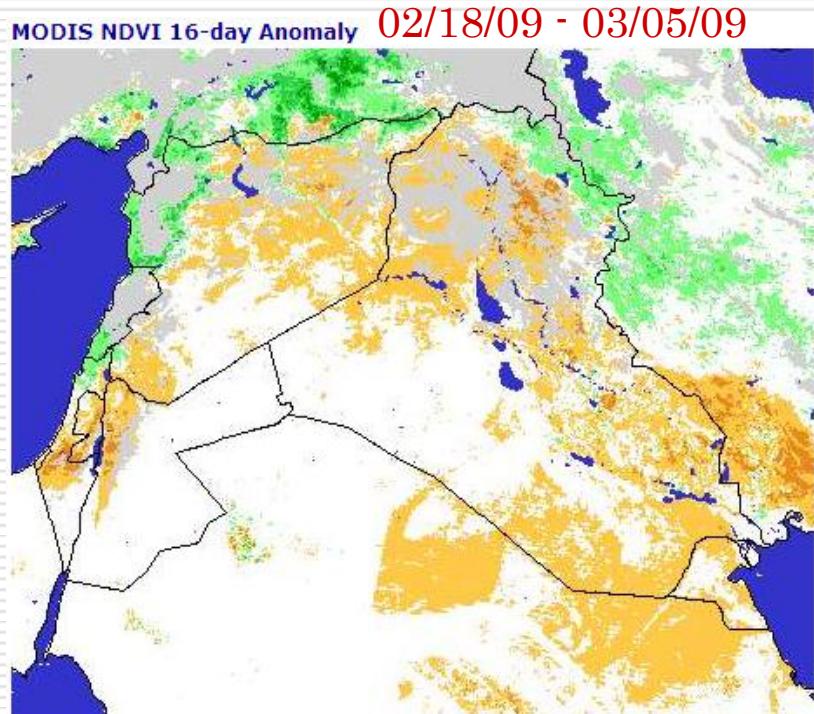
Agricultural Production Regions and MODIS

Mosaic images were created by the NASA MODIS Rapid



MODIS Processed Data

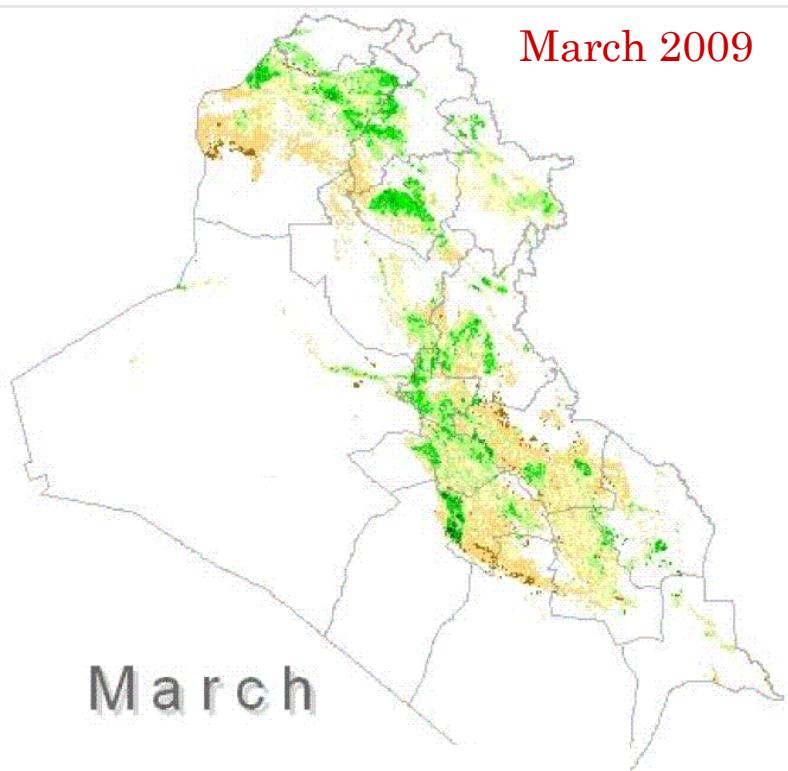
NDVIs related to 5-Year Average



MODIS NDVI
Departure from 5-year Average

(-1 to -.4)	Worse than Normal
(-.4 to -.3)	
(-.3 to -.2)	
(-.2 to -.1)	
(-.1 to -.025)	
(-.025 to .025)	Normal
(.025 to .1)	
(.1 to .2)	
(.2 to .3)	
(.3 to .4)	Better than Normal
(.4 to .6)	
Water	

NDVIs related to Cropland



March

Crop Abundance

NDVI

0 to 0.1	
0.11 to 0.2	Sparse
0.21 to 0.3	
0.31 to 0.4	
0.41 to 0.5	
0.51 to 0.6	
0.61 to 0.7	Dense
0.71 to 0.8	

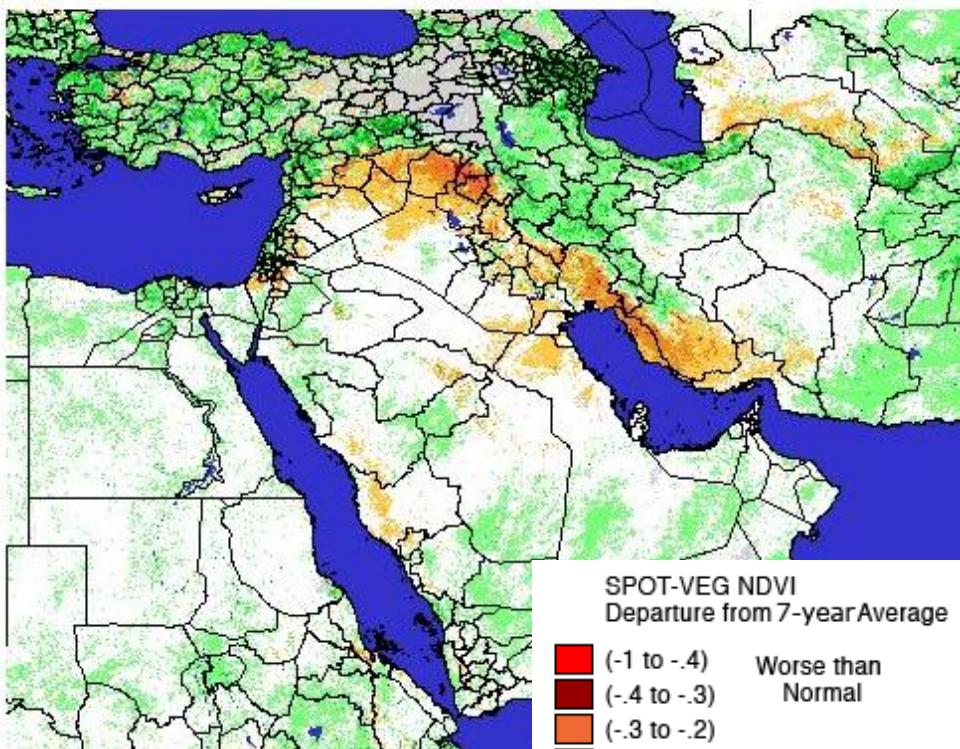
Processing Global SPOT Vegetation NDVI



Crop-masked SPOT-VEG Departure from Short-term Average
03/11/09 - 03/20/09



SPOT-VEG Departure from Short-term Average
03/11/09 - 03/20/09



SPOT-VEG NDVI
Departure from 7-year Average

Red	(-1 to -.4)	Worse than Normal
Dark Red	(-.4 to -.3)	
Orange	(-.3 to -.2)	
Yellow	(-.2 to -.1)	
Light Yellow	(-.1 to -.025)	
White	(-.025 to .025)	Normal
Light Green	(.025 to .1)	
Green	(.1 to .2)	
Dark Green	(.2 to .3)	
Very Dark Green	(.3 to .4)	
Black	(.4 to .6)	Better than Normal
Blue	Water	
Grey	No Data	

USDA Global AWiFS Coverage

(March 16, 2010)



31 to 60 days

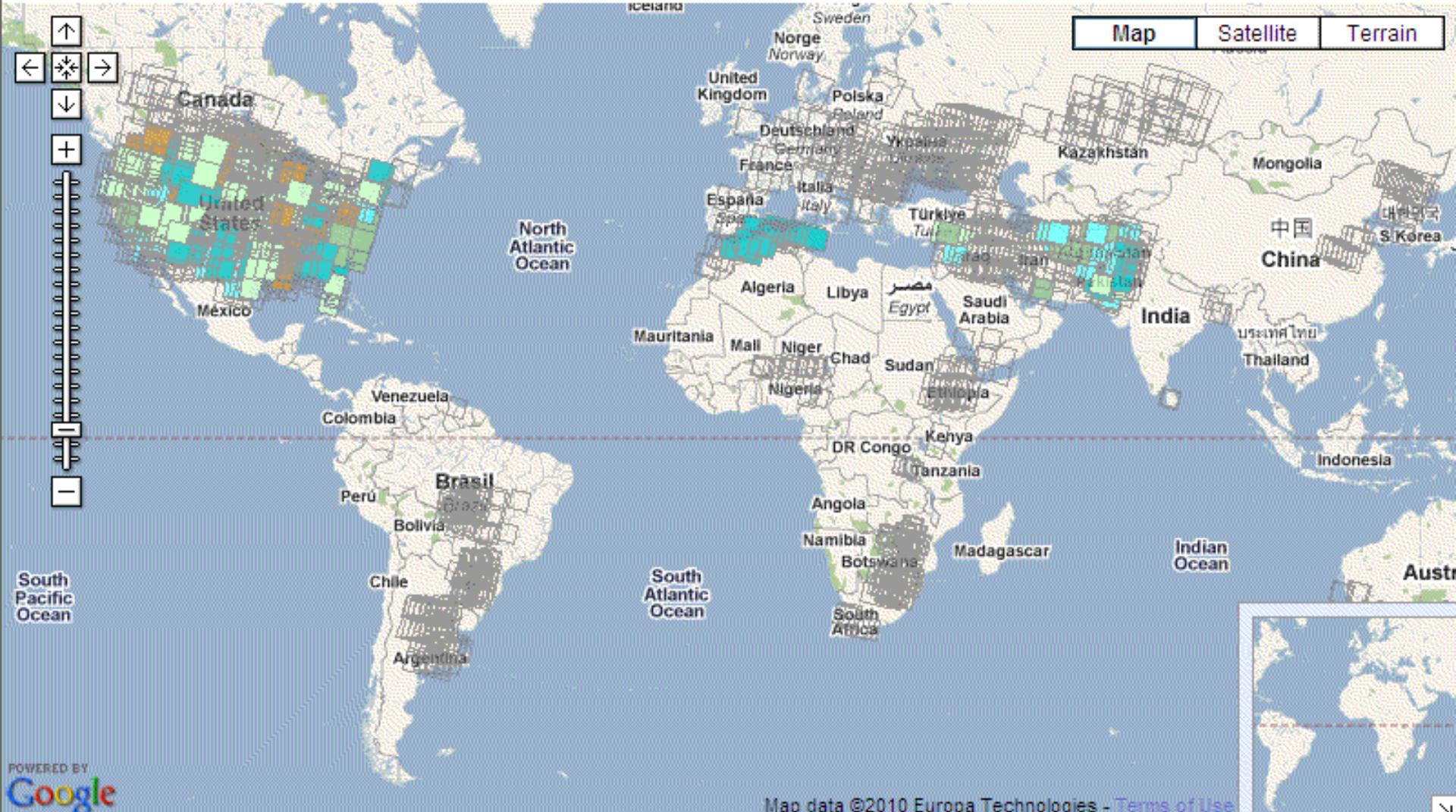
91 to 120 days

> 150 days

Map

Satellite

Terrain



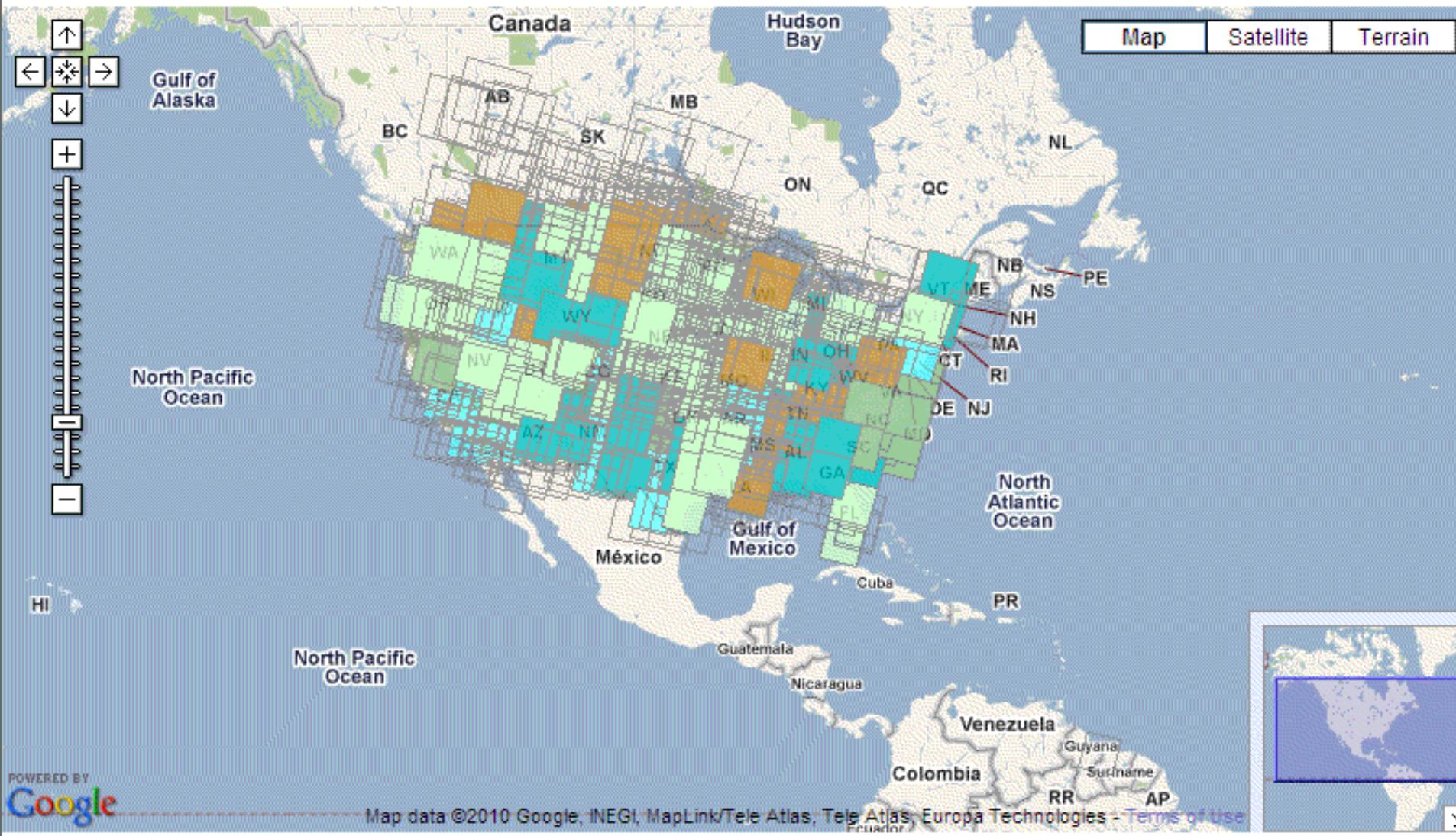
Map data ©2010 Europa Technologies - Terms of Use

USDA AWIFS

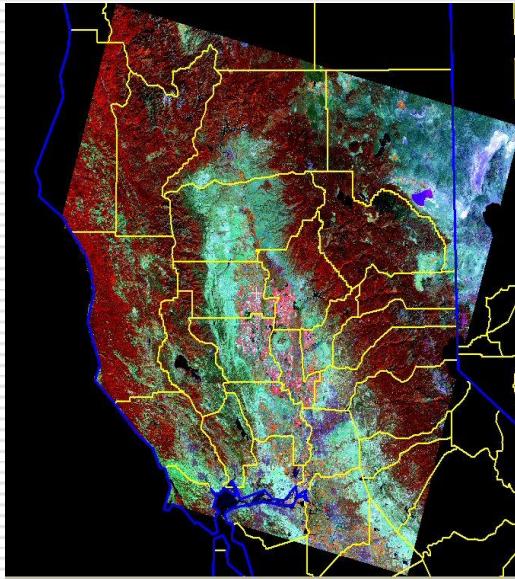
(March 16, 2010)



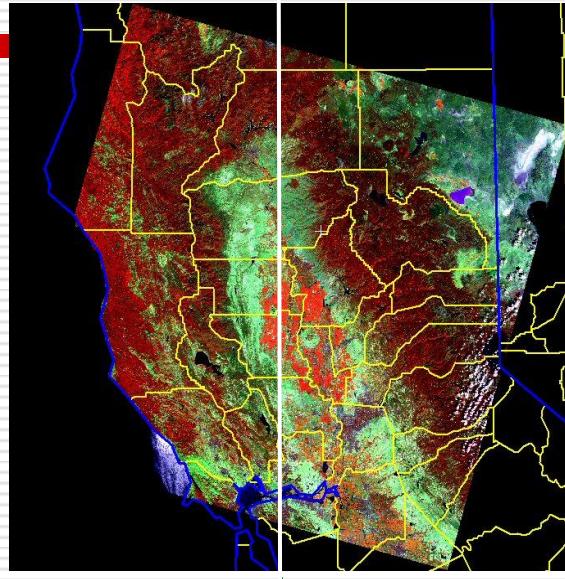
31 to 60 days 91 to 120 days > 150 days



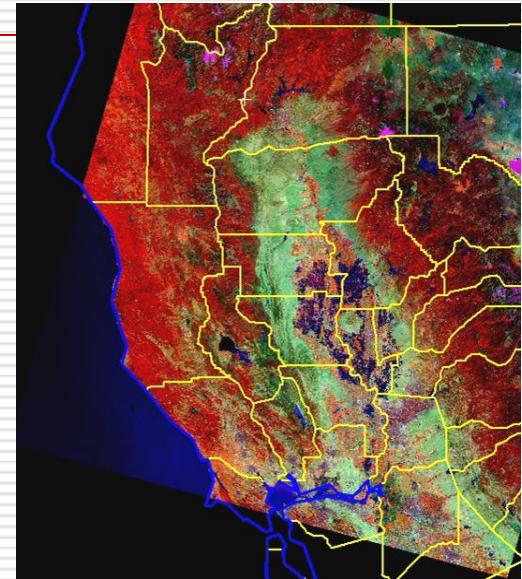
Northern California - AWiFs



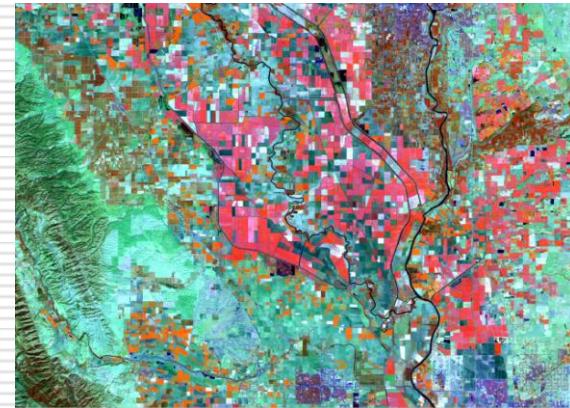
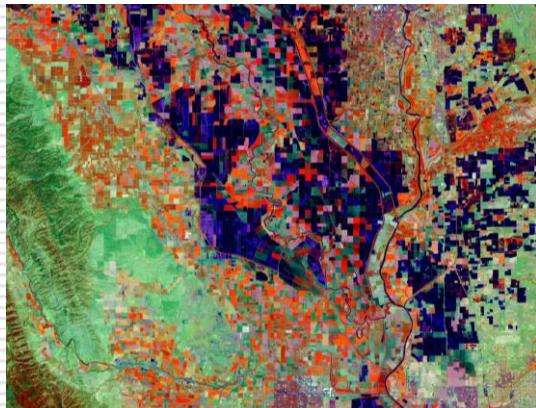
May 28, 2007



September 1, 2007



September 25, 2007



NE Yolo Co., California

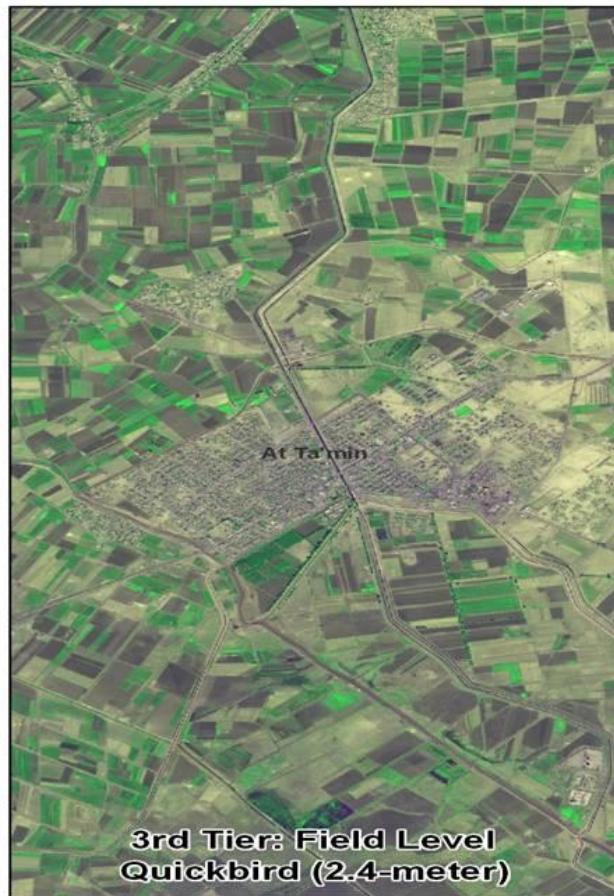
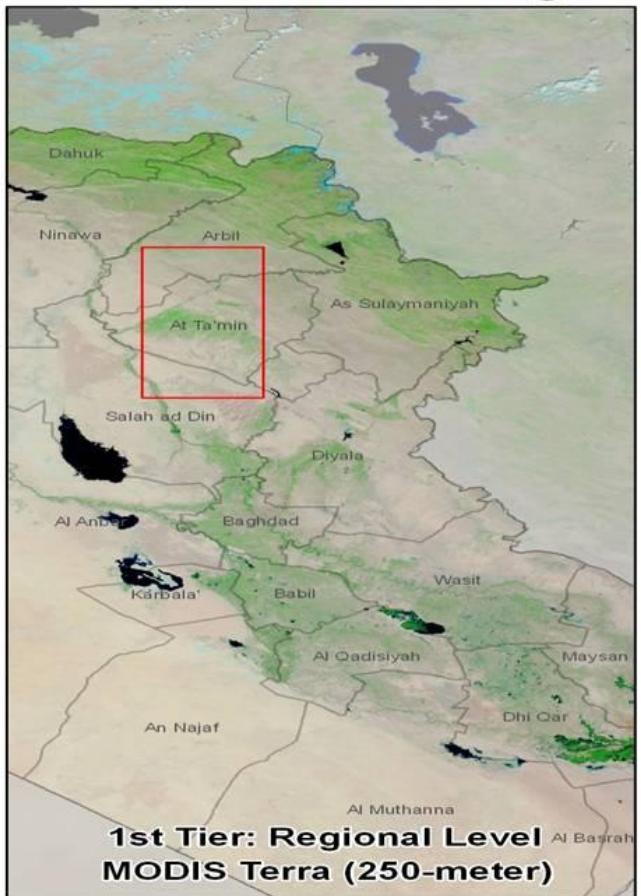
Bethel JACIE 2010

AWiFs Ch. 4,5,3

Monitoring Global Crop Conditions



Hierarchical Agricultural Monitoring: Regional to Local Scale

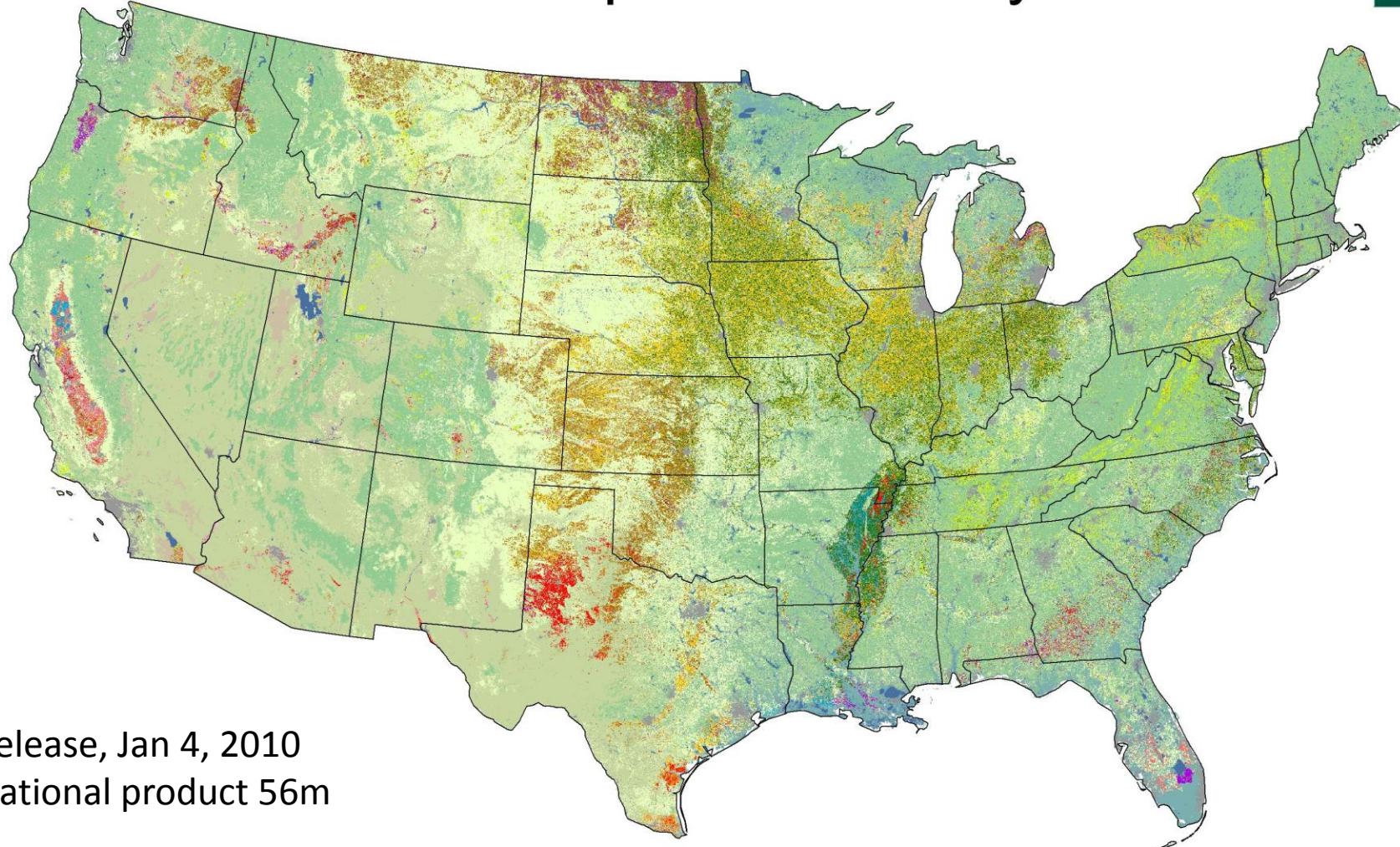


Two Collects per Day

One Collect per Week

One Collect per Month
(Sampled)

2009 Cropland Data Layers



Release, Jan 4, 2010
National product 56m

Land Cover Categories (by decreasing acreage)

Agriculture

Pasture/Grass	Fallow/Idle Cropland
Corn	Alfalfa
Soybeans	Cotton
All Wheat	Other Crops
Other Hays	Sorghum

Non-Agriculture

Woodland	Barren
Shrubland	Perennial Ice/Snow
Urban/Developed	
Wetlands	
Water	

Cropland Data Layer: Data Partnerships



- Foreign Agricultural Service
 - Resourcesat-1 AWiFS
- Farm Service Agency
 - Common Land Unit "ground truth"
- US Geological Survey
 - National Land Cover Dataset
- US Geological Survey/ NASA
 - Landsat TM 5 & 7



MRLC Consortium



CRP

Ecosystem

Climate

Soil Utilization

Water Use

Transportation

Pest Control

Land Cover

Epidemiology

Agribusiness

Wildlife Habitat

Irrigation

Erosion

Carbon

Crop Rotation

Yield

Crop Intensity

Modeling

Planning

Acreage Estimates

Land Management

Biofuel

Mapping

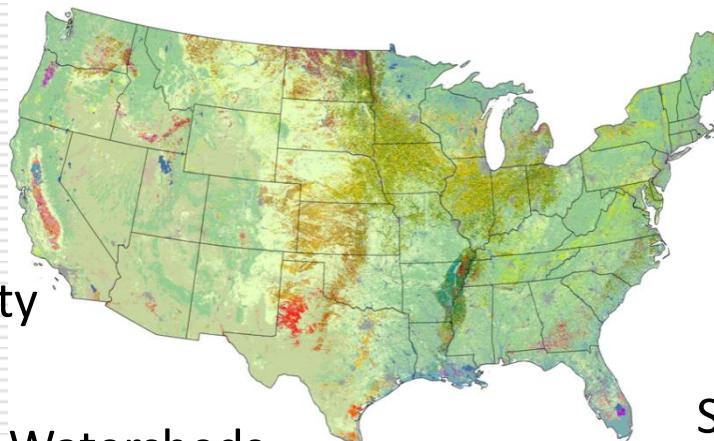
Disaster Assessment

Data Mining

Ecology

Fertilizer

Research



Commodity

Change Detection

Land Use

Water Quality

Crop Protection

Urban Growth

Environmental Risk

Fertilizer Usage

Condition Assessment

Soil and Water

Water Quality

Agribusiness

Biodiesel

Pesticides

Crop Production

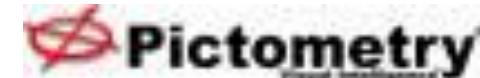
Education

Haiti:

Imagery to Support Response and Recovery

Commercial Aerial

- Google
- Microsoft
- Pictometry
- World Bank



Civil Aerial

- NOAA

DoD Aerial

- USSOUTHCOM Global Hawk
- USAF P3
- USAF U2



Haiti: Satellite Imagery to Support Response and Recovery

ASTER



EO-1

Landsat



AVNIR-2



SPOT



EROS-A and-B



Quickbird



Ikonos



WorldView 1 and 2

Haiti: Satellite Imagery to Support Response and Recovery

RADARSAT



TERRASARX



ERS SAR



UAVSAR

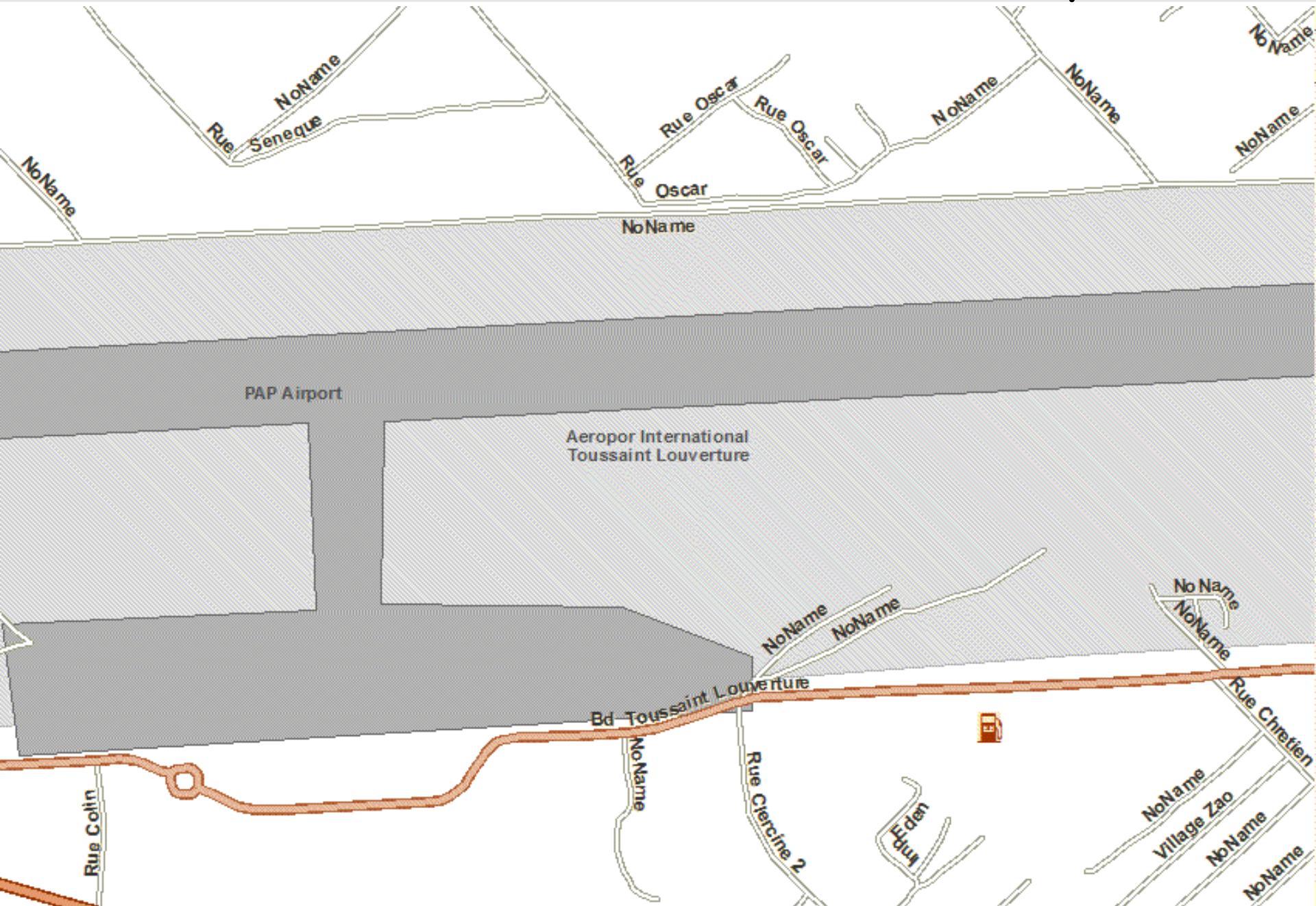


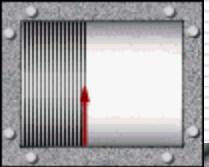
PALSAR

COSMO-SkyMed



Port Au Prince, Mais Gate (PAP) Airport





January 12, 2010, MW=7.0



GeoEye

GEOEYE

Unkown Date

ArcGIS Online



January 13, 2010



GEOEYE
Jan 13, 2010
WMS ArcGIS Online



January 17, 2010

Google™

Google Aerial
Jan 17, 2010
WMS: HDDS



January 17, 2010

Google™

Google Aerial
Jan 17, 2010
WMS: HDDS



January 17, 2010

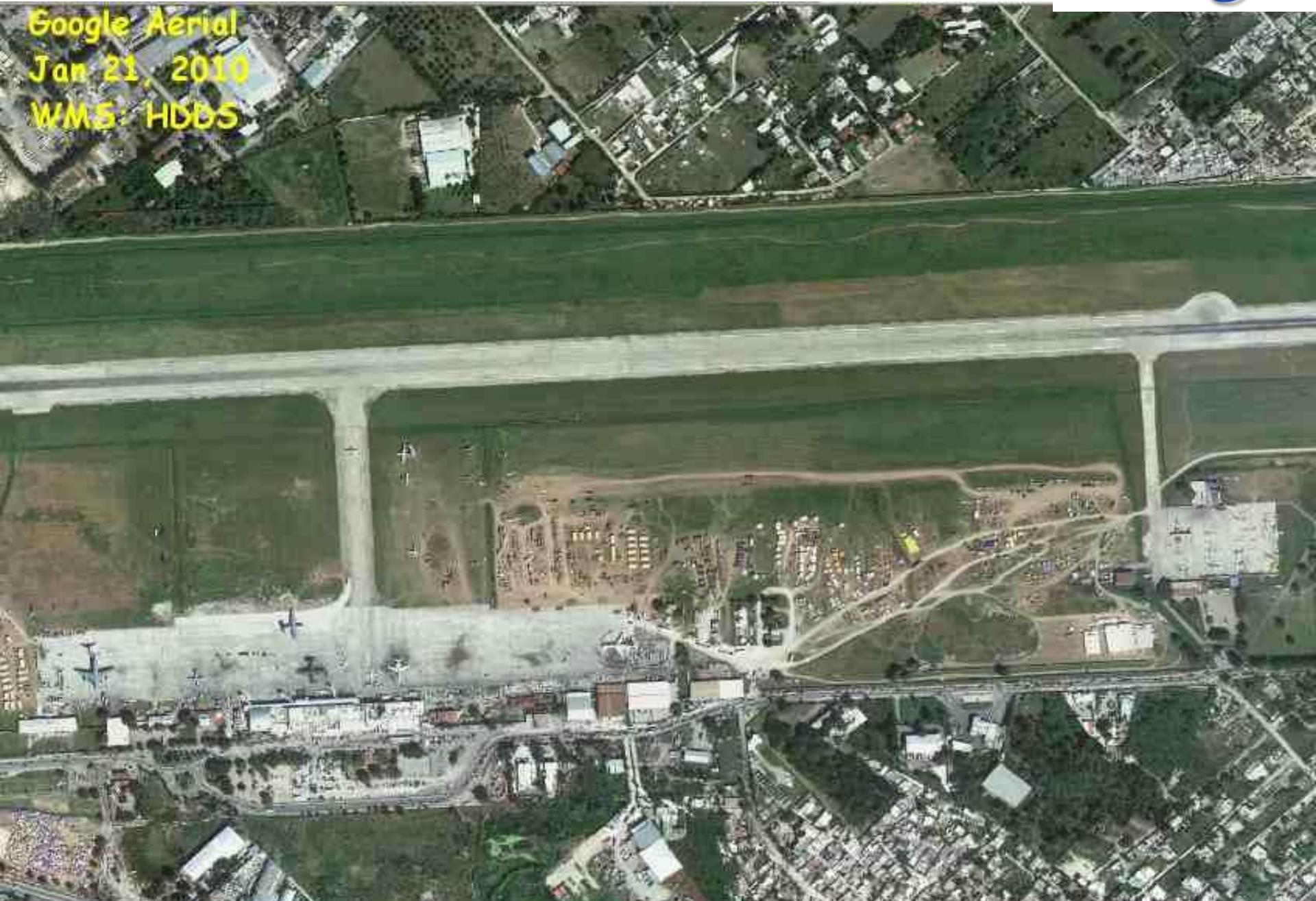
NOAA Aerial
Jan 17, 2010
WMS: HDDS



January 21, 2010

Google™

Google Aerial
Jan 21, 2010
WMS: HDFS



January 22, 2010



World Bank Aerial
Jan 22, 2010
WMS: HDDS



January 17, 2010

Google™

Google Aerial
Jan 17, 2010
WMS: HDDS



January 22, 2010

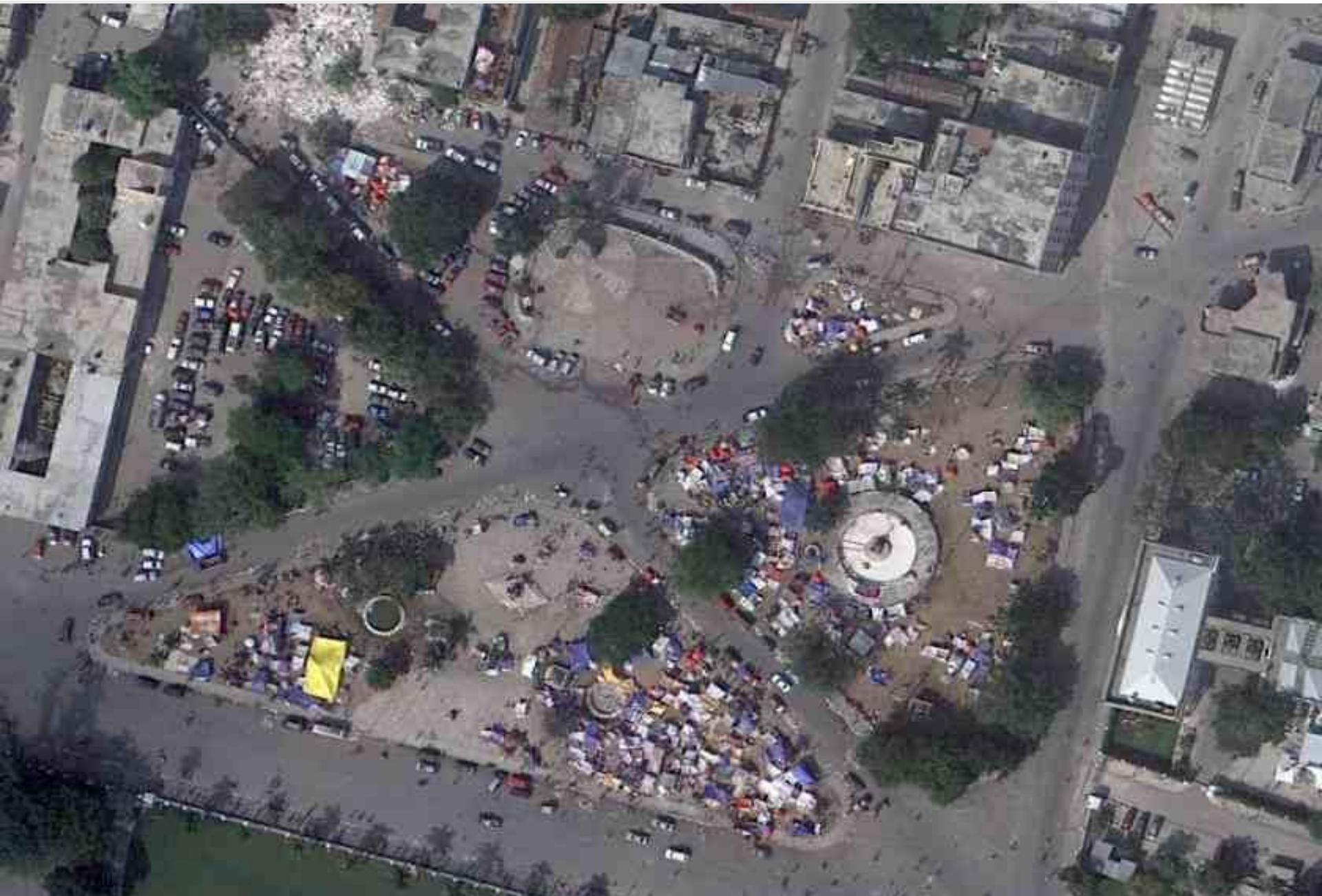


WorldBank Aerial
Jan 22, 2010
WMS: HDDS



January 17, 2010

Google™



January 21, 2010

Google™



January 21, 2010



January 17, 2010

Google™



January 21, 2010

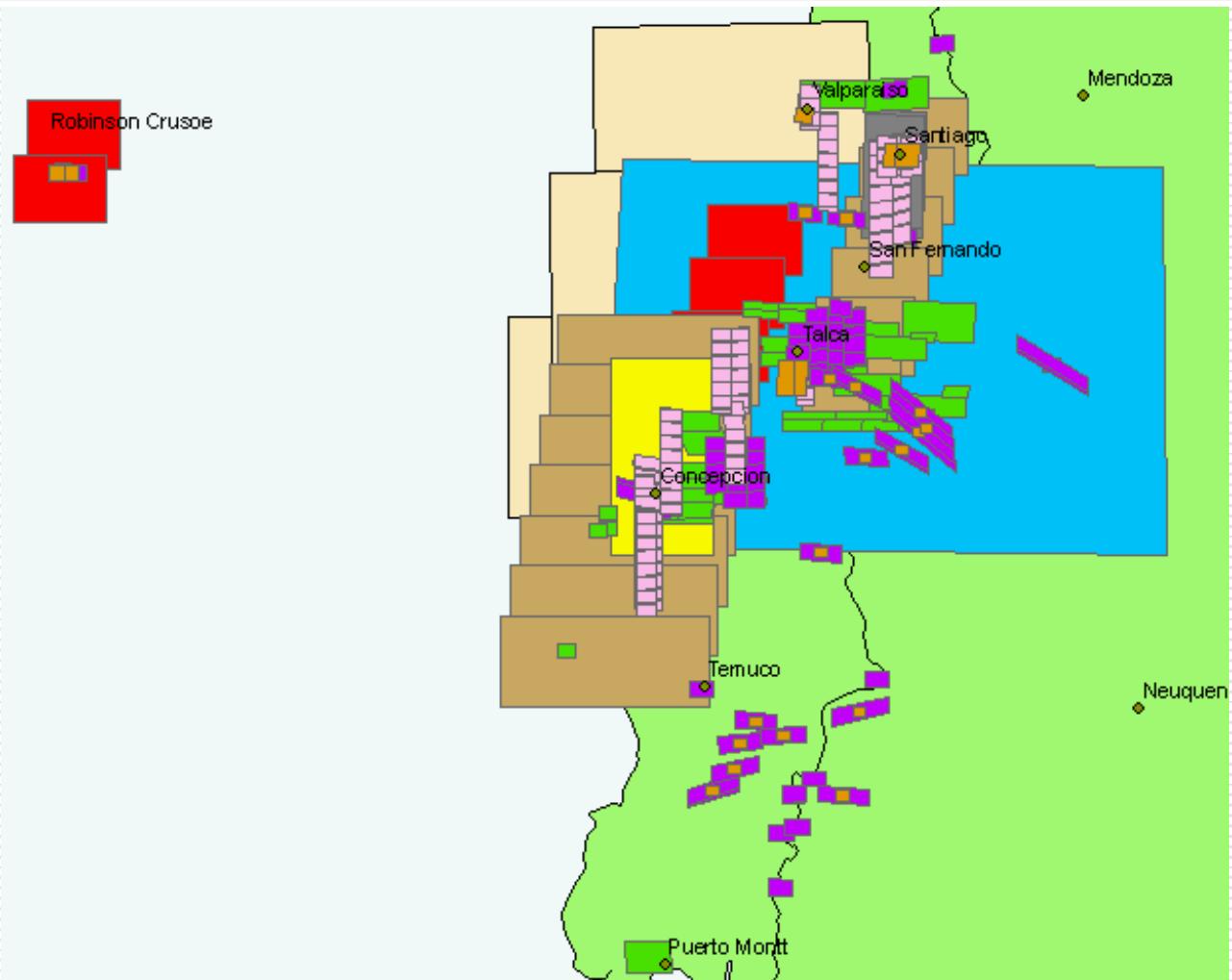
Google™



January 21, 2010



Chile has much less imagery coverage.



HJ1 (blue) WV(purple) GE (green) QB (pink) IK (Orange) JAXA (tan)
EO1 (yellow) ASTER (red) Landsat (beige) FORMOSAT (grey)

The image is a satellite view of a large industrial facility, likely a chemical plant or refinery, showing various buildings, storage tanks, and piping systems. The facility is surrounded by green fields and some trees. In the top right corner, the Google logo watermark is visible.

QUESTIONS?

Crop Explorer Portal

Portal to near-real time global agriculture conditions

www.pecad.fas.usda.gov/cropeplorer

or

Google “crop explorer”



Bethel



Forest Service Wildland Fire Support Websites

MODIS Active Fire Mapping

- <http://activefiremaps.fs.fed.us>

Forest Service's Remote Sensing Applications Center (RSAC)

<http://www.fs.fed.us/eng/rsac/>

National Infrared Operations

- <http://nirops.fs.fed.us/>

UAS's for Active Fire Mapping and Communications

- <http://nirops.fs.fed.us/UASDemo/>
- <http://geo.arc.nasa.gov/sge/WRAP/>

Burned Area Emergency Response Imagery Support

- <http://www.fs.fed.us/eng/rsac/baer>

Monitoring Trends in Burn Severity

- <http://svinetfc4.fs.fed.us/mtbs>



- NAIP Project Status
 - Browser based interactive status map (will be available once FY10 states are awarded)
<http://gis.apfo.usda.gov/naipstatus10/>
- State Based Image Services and Status Maps via ArcGIS Server for Public access
 - Add state image service or status map into ArcMap project
 - Add ArcGIS Server connection via ArcMap/ArcCatalog to list of GIS Servers
<http://gis.apfo.usda.gov/arcgis/services>
- NAIP Coverage Viewer: (browser based)
<http://gis.apfo.usda.gov/naipcoverage/>
- APFO Web site
<http://www.apfo.usda.gov>
 - Support Documents/NAIP Partnership page
<http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=docs&topic=nai>