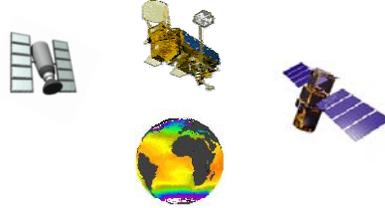




# USDA Overview for Joint Agency Commercial Imagery Evaluation Workshop

Glenn R. Bethel  
USDA Remote Sensing Advisor  
[glenn.bethel@usda.gov](mailto:glenn.bethel@usda.gov)

March 25, 2008



## High Altitude Airborne

Cross Calibration  
Verification and Validation

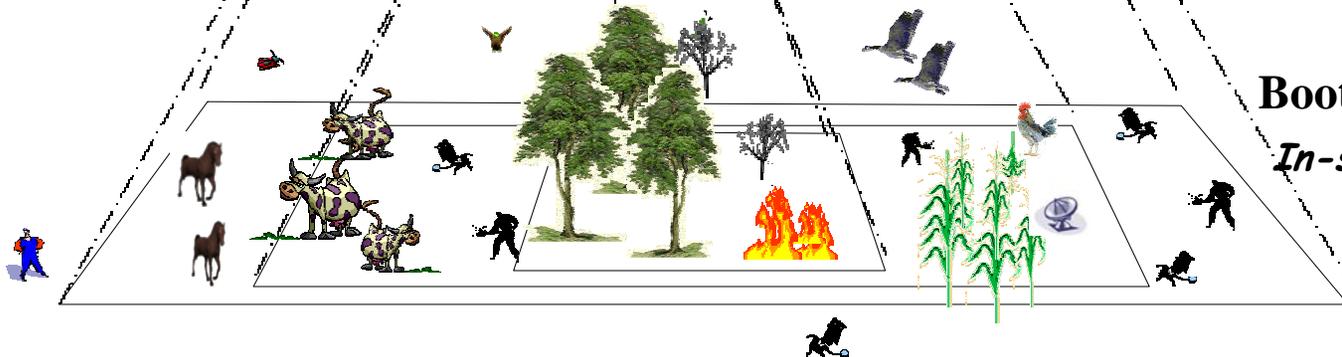


## Low Altitude Airborne



## Boots on the Ground

*In-situ* measurements





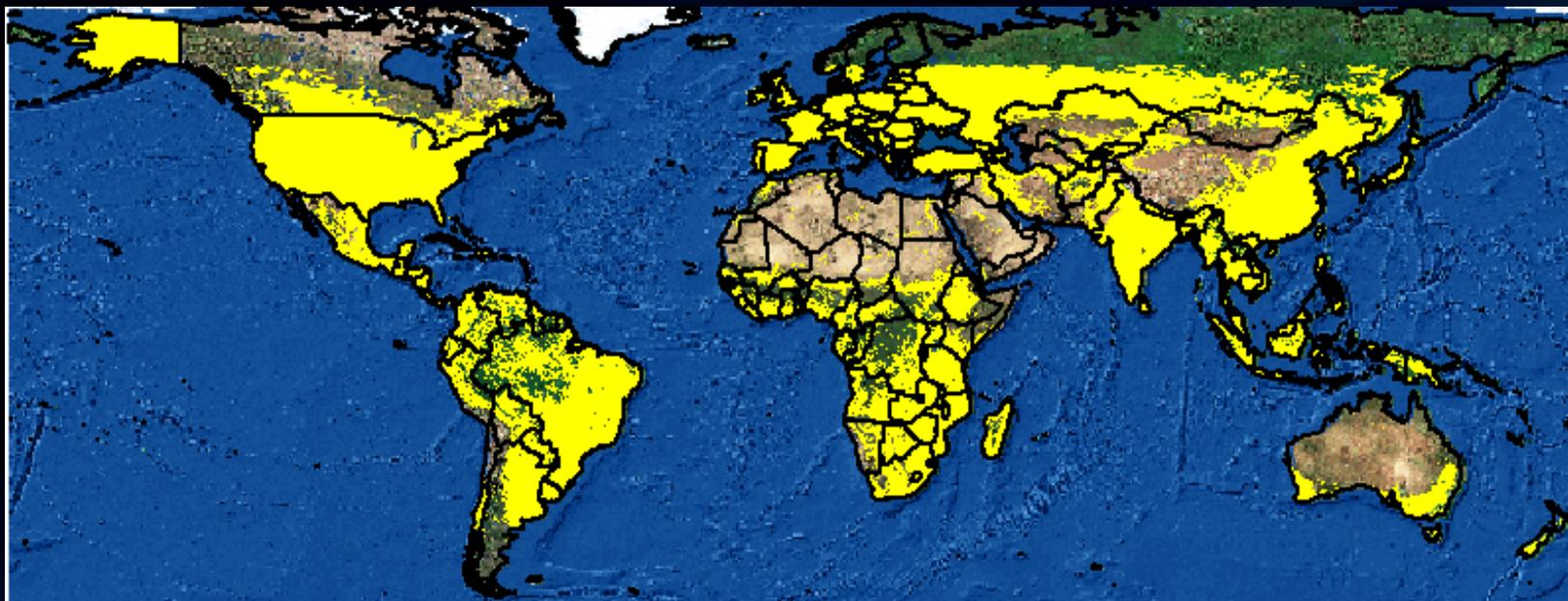
- **Agricultural Competitiveness**
- **Agro-Terrorism Preparedness**
- **Carbon Syntheses**
- **Compliance**
- **Crop Area Monitoring**
- **Crop Condition Assessment**
- **Cropland Data Layer** !
- **Disaster Assistance**
- **Disaster Monitoring**
- **Drought Monitoring**
- **Early Warning**
- **Environmental Monitoring**
- **Forest Health**
- **Fire Suppression**
- **Homeland Security**
- **Inventory**
- **Invasive Species**
- **Land Use Conversion**
- **Water Supply**
- **Soil Mapping**
- **Tillage Practice Monitoring**
- **Yield Monitoring**



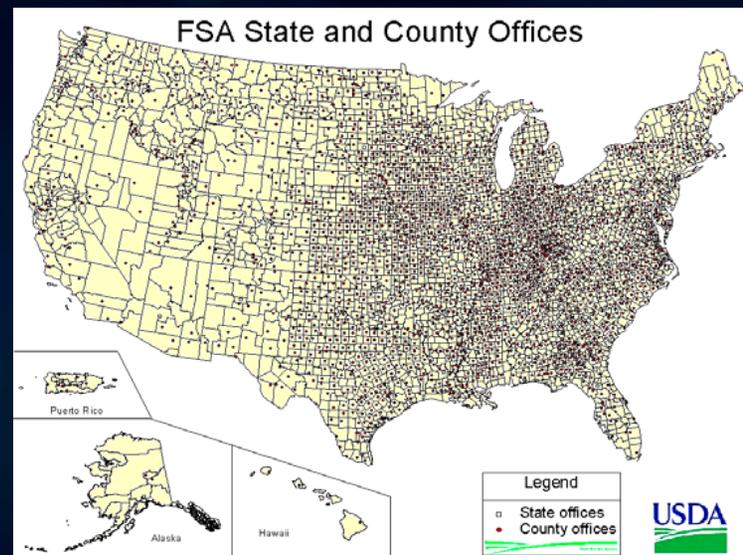
# Global to Field Level Requirements



## Global Monitoring



32,000 employees  
380,000 miles of roads  
23,000 recreation sites  
7,700 miles of scenic byways  
860 million recreation days/yr  
3.4 billion board feet timber sales  
4,400 miles of wild and scenic rivers  
\$21 billion worth of hunting & fishing to U.S. economy

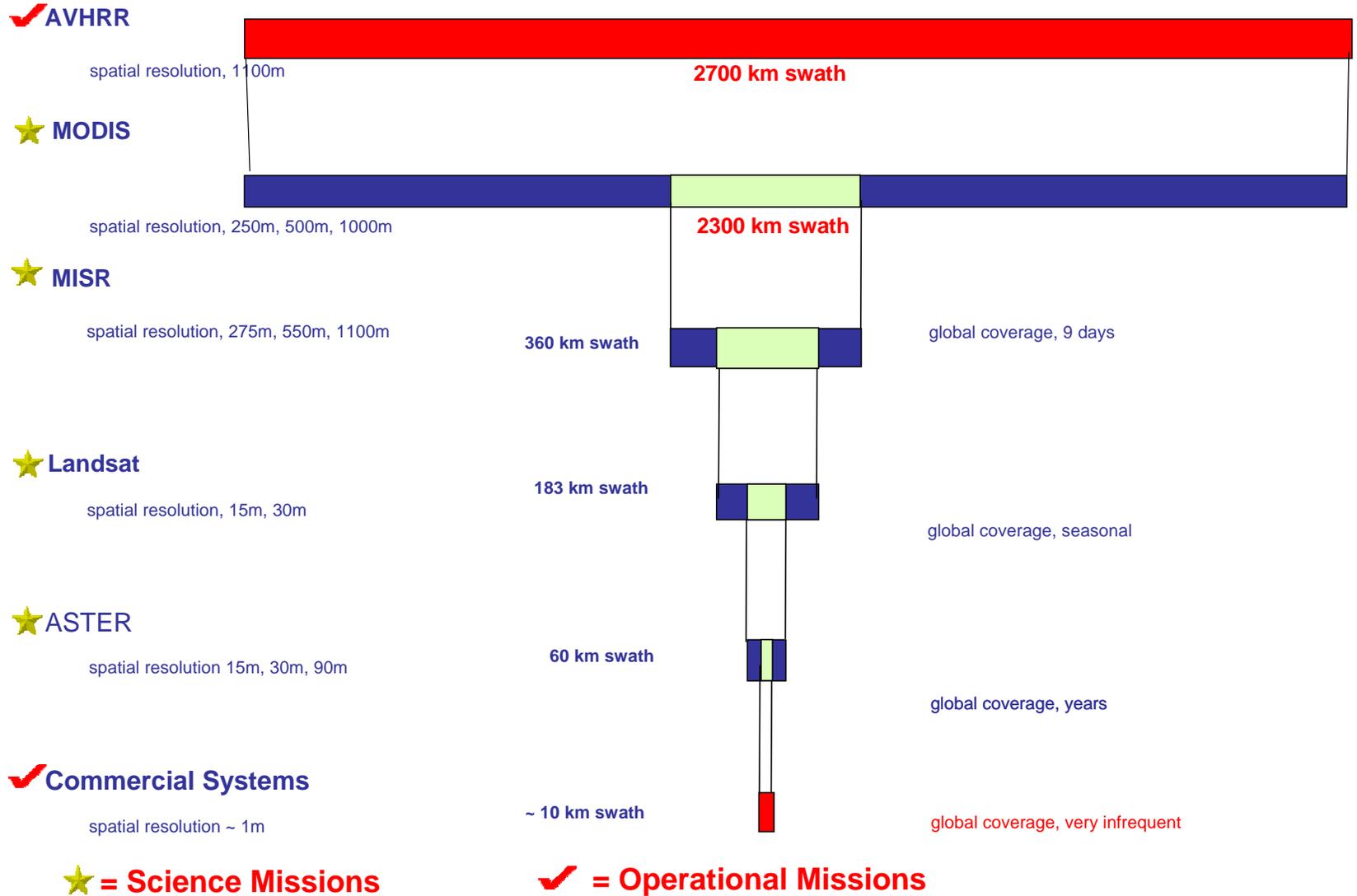


FSA State and County Offices

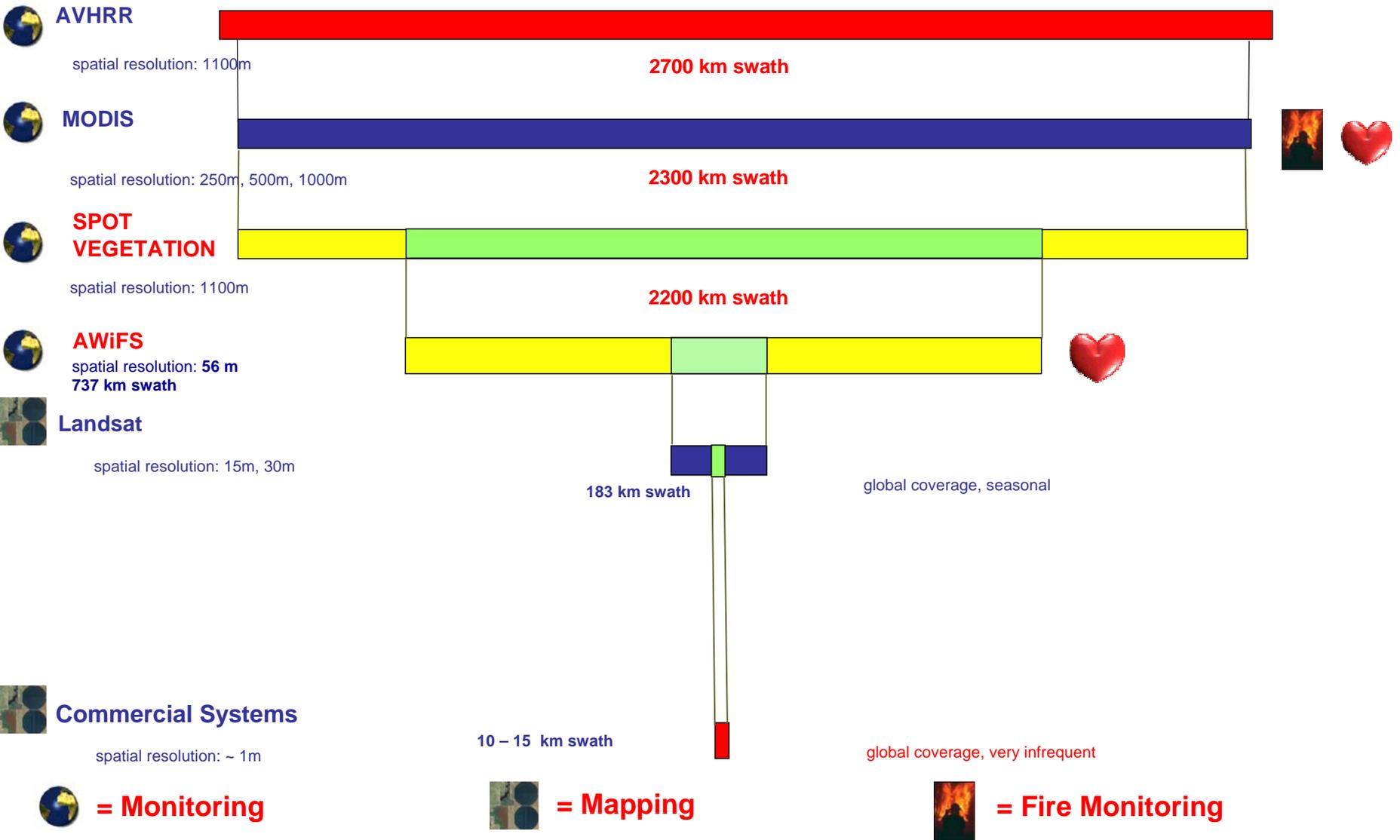
Legend  
□ State offices  
• County offices



# Current US Land Remote Sensing Missions



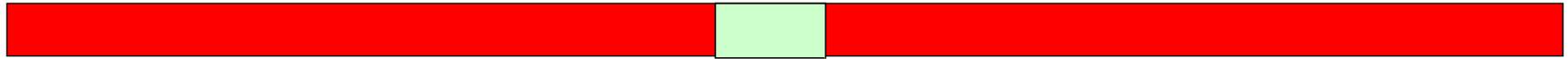
# Current USDA Land Remote Sensing Uses



# Future US Land Remote Sensing Missions



**VIIRS**



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

global coverage, 2x/day/satellite



**Landsat**

spatial resolution, 15m, 30m

183 km swath



global coverage, seasonal



**Commercial Systems**

spatial resolution ~ 1m

10- 15 km swath



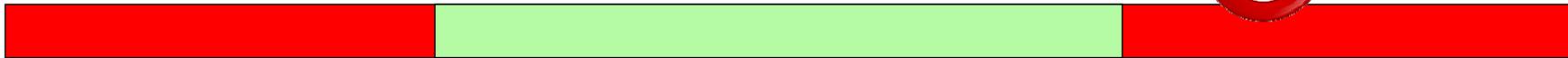
global coverage, very infrequent

 = Science Missions

 = Operational Missions

# Future Operational Monitoring Satellites used by USDA

VIIRS

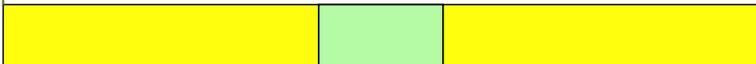


spatial resolution: 400/800m (nadir(Vis/IR))  
3300 km swath



global coverage, 2x/day/satellite

AWiFS



spatial resolution: 25 m  
600 km swath



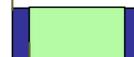
Spatial Resolution Increase to 25 m

Landsat



spatial resolution: 15m, 30m

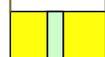
183 km swath



global coverage, seasonal

LISS-3:

spatial resolution: 23.5 m  
141 km swath



Commercial Systems



spatial resolution ~ 1m

10 - 20 km swath



global coverage, very infrequent



= Monitoring

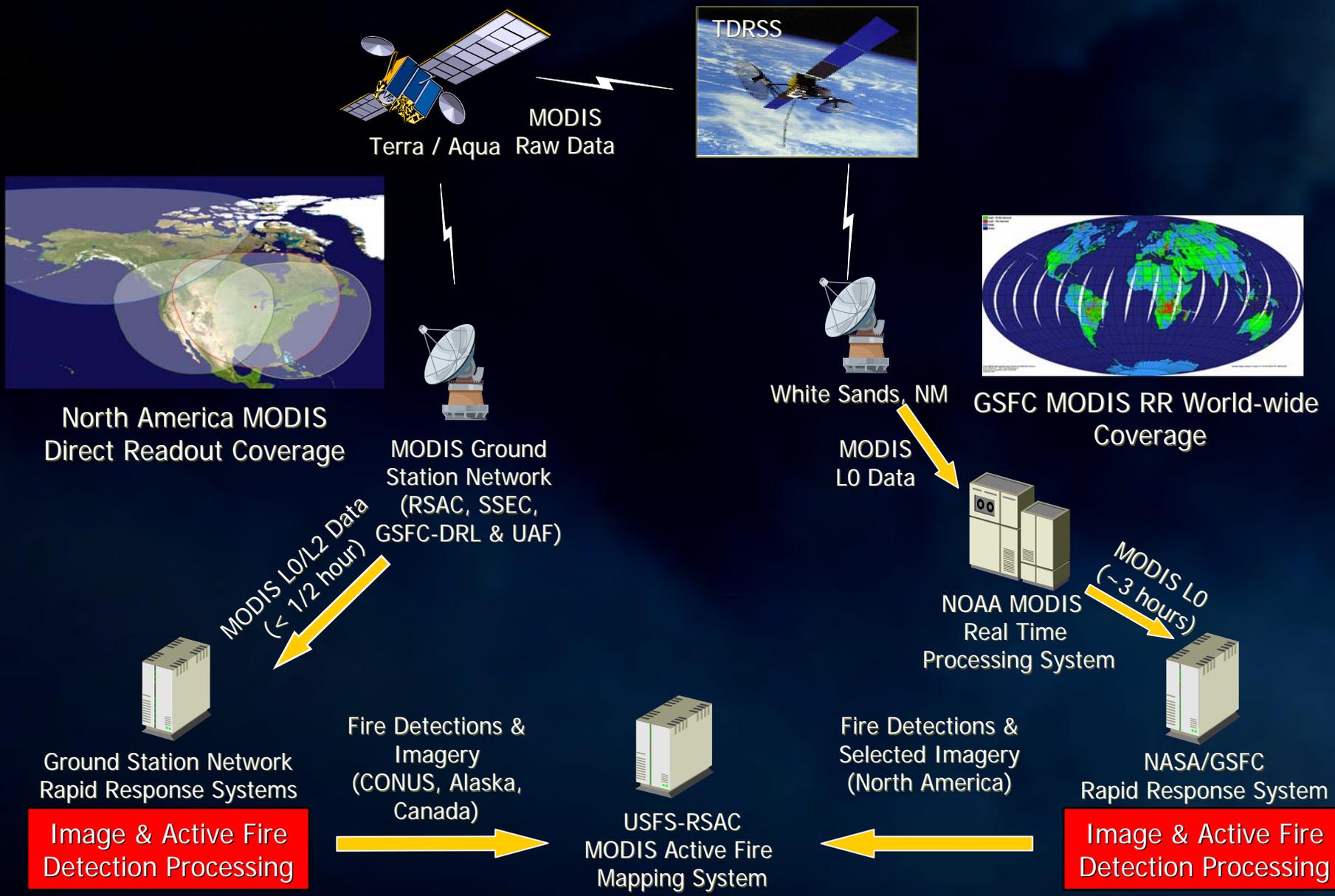


= Mapping



= Fire Monitoring

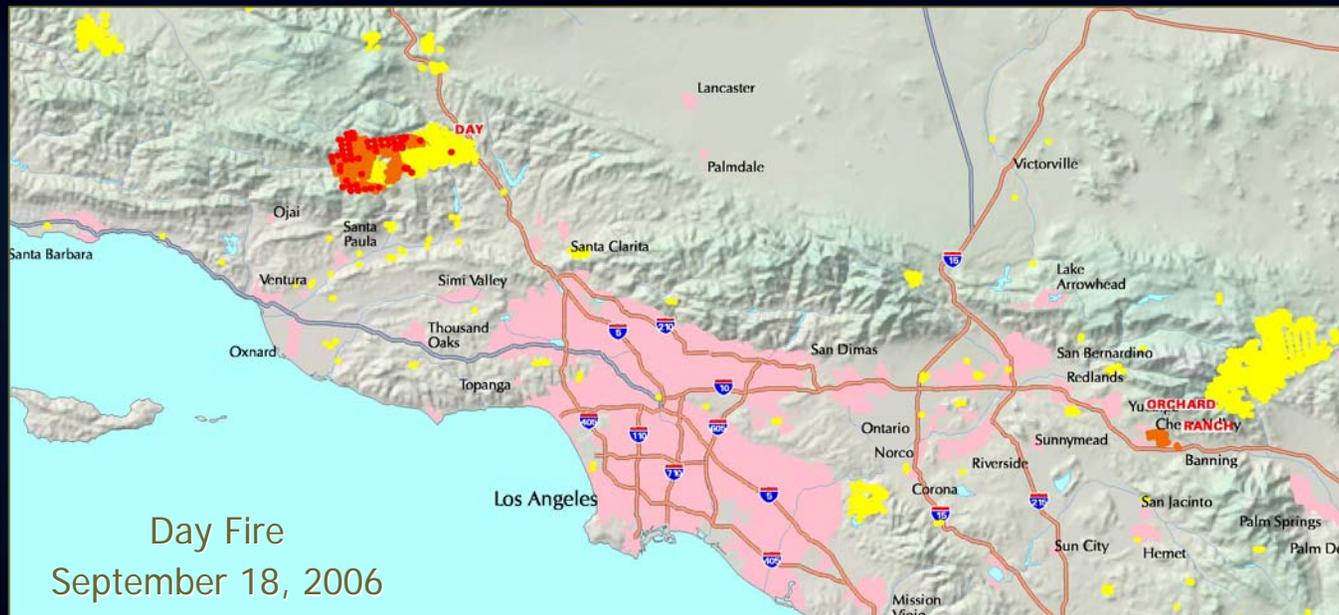
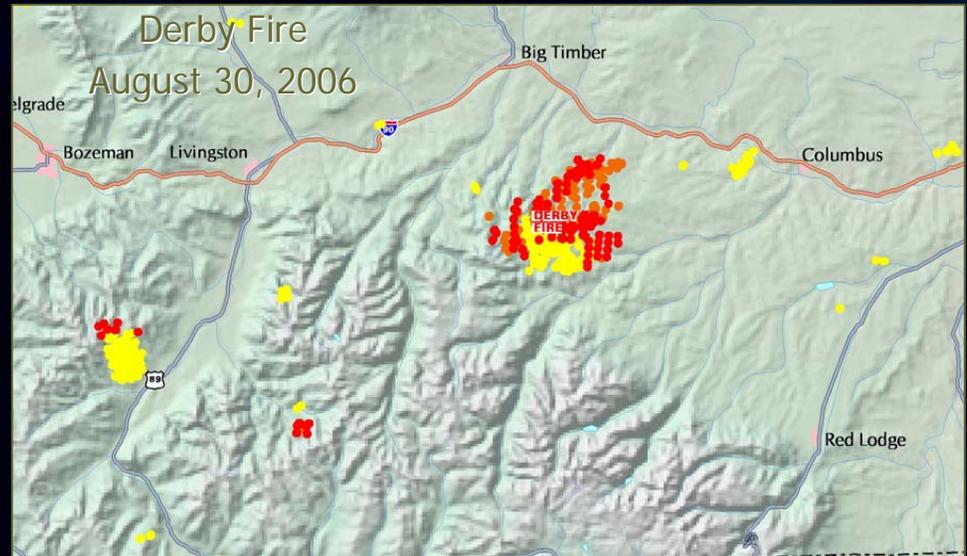
# Overview: MODIS Data Acquisition and Processing



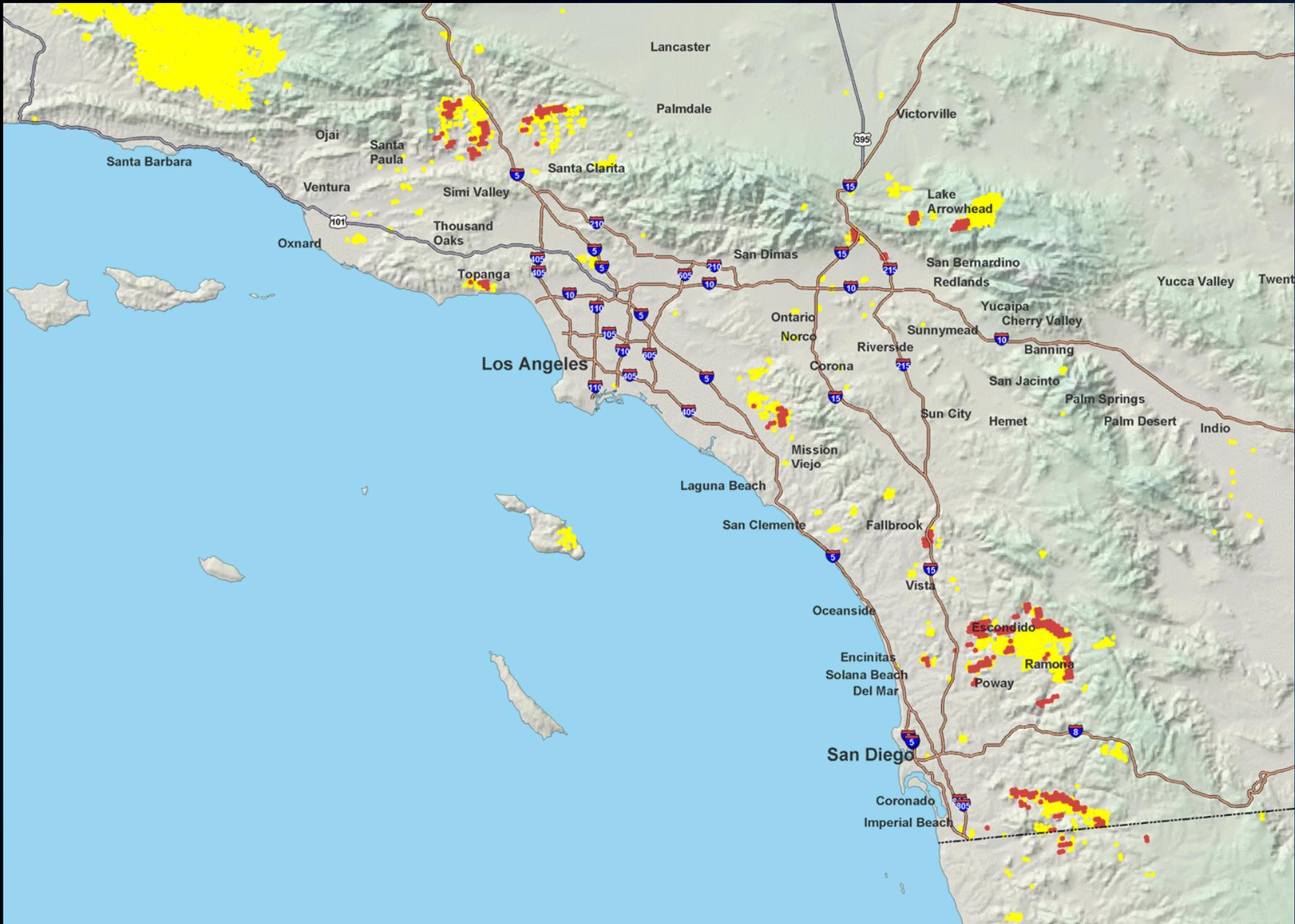
# MODIS Active Fire Map Examples



-  Actively Burning Area (Last 12 hours)
-  Actively Burning Area (Last 24 hours)
-  Previously Burned Area (Since January 1st)
-  VISTA NIFC Situation Report Fire
-  Interstate Highways
-  U. S. Highways



# MODIS Active Fire Map & Imagery Products



# MODIS Active Fire Map & Imagery Products





# User Community Depends On MODIS Active Fire Mapping

## USDA MODIS Active Fire Mapping Program Website Stats 2001-2007

	2001*	2002	2003	2004	2005	2006	2007#
Hits	1.5 Millio	3.3 Million	24.9 Million	18.7 Million	25.8 Million	35.9 Million	43.9 Million
Users	42,000 0	502,00 0	1.5 Million	817,200	960,00 0	1.54 Million	2.7 Million
Data Volume	12 GB	215 GB	750 GB+	1 TB+	4 TB	2 TB	4.6 TB

Transferred

\* - complete statistics not available for entire year

# - through October 25, 2007

Critical source of timely wildfire geospatial data...

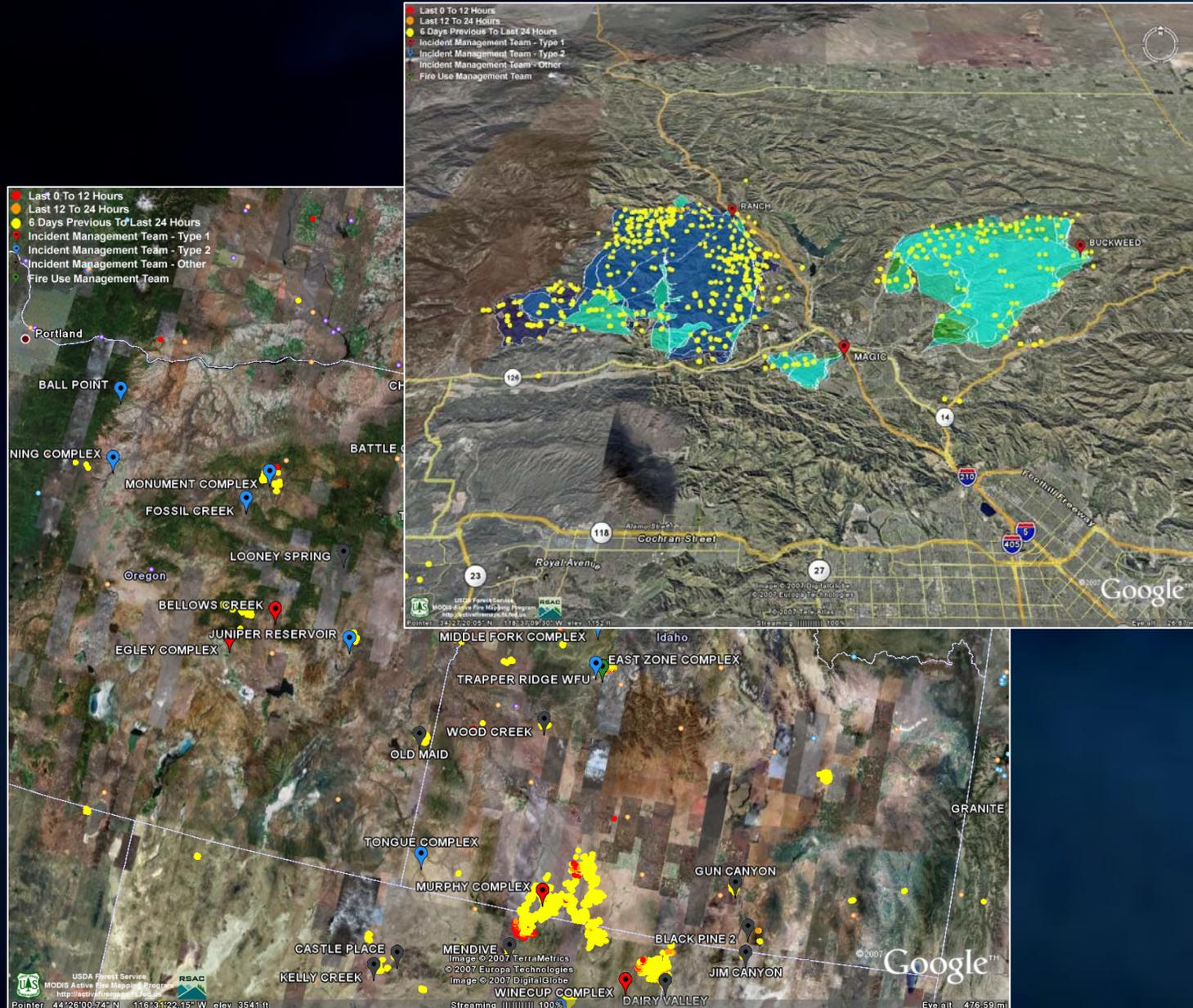
*Data provided by MODIS Active Fire Mapping Program is also relayed to other fire support websites and data portals*



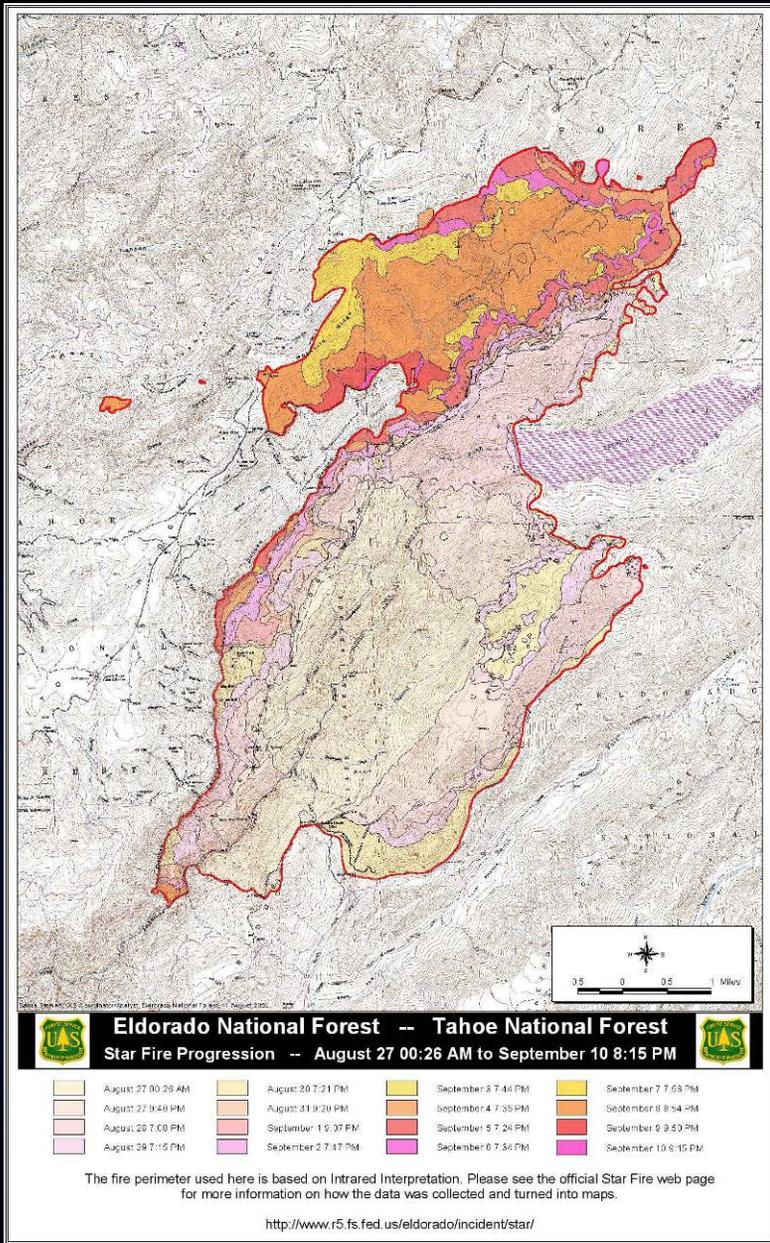
# GIS Data Access – KMLs/KMZs

## Available KMLs

- Current Large Incidents (w/ICS209)
- MODIS Fire Detections (w/attributes)
- Current Fire Perimeters (Prototype; w/attributes)
- NWS Imagery & Warnings
- 7-day Fire Potential Product



# Tactical Scale Active-Fire Mapping



High resolution fire map products needed for daily 6:00 AM Incident Command briefing

Delineate fire perimeter and active fire fronts

Determine line of containment

Identify problem areas - hot spots inside & outside containment line

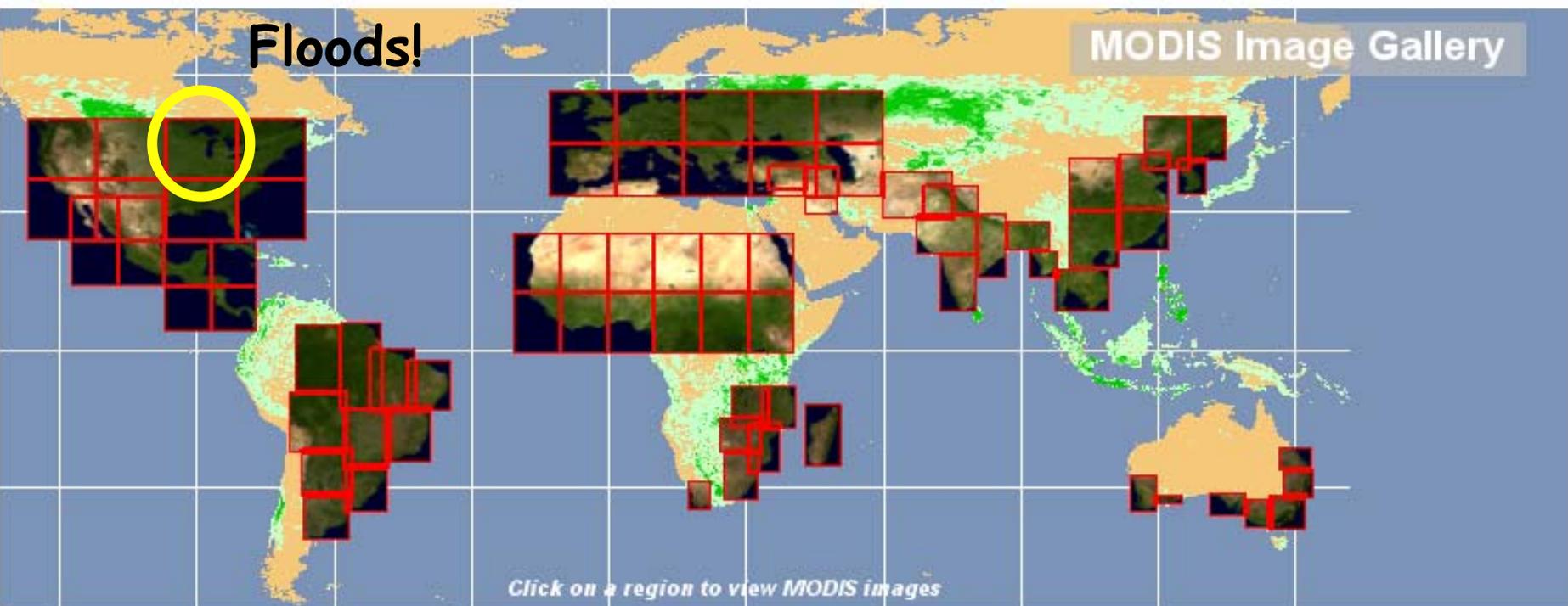
# Global MODIS



Toolbox

**Floods!**

MODIS Image Gallery



*Click on a region to view MODIS images*

*[Click here to add your Comments/Feedback](#)*

## Project Information

NASA Satellites Improve Response To Global Agricultural Change



# Cloud Screen Daily Imagery

## MODIS Summary

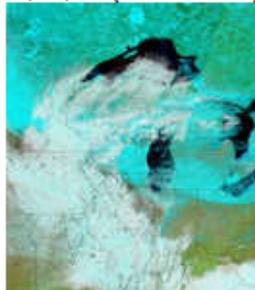
Select Satellite

Satellite: terra.721 Region: USA3 Year: 2008

03/24/08 (084 of 2008)

Image  
Not  
Available

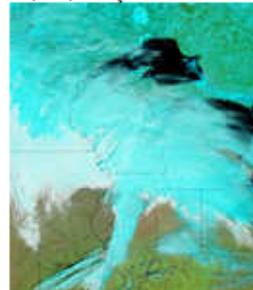
03/23/08 (083 of 2008)



03/22/08 (082 of 2008)



03/21/08 (081 of 2008)



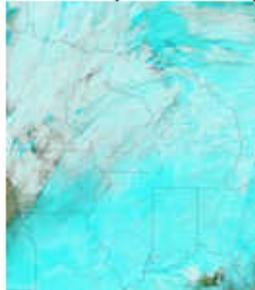
03/20/08 (080 of 2008)



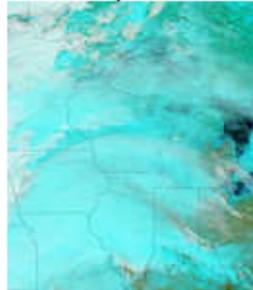
03/19/08 (079 of 2008)



03/18/08 (078 of 2008)



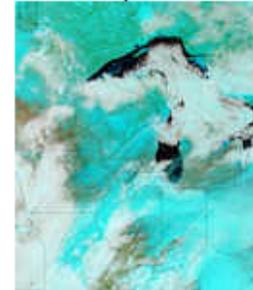
03/17/08 (077 of 2008)



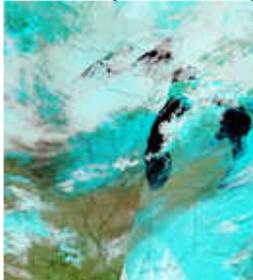
03/16/08 (076 of 2008)



03/15/08 (075 of 2008)



03/14/08 (074 of 2008)



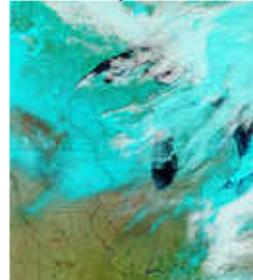
03/13/08 (073 of 2008)



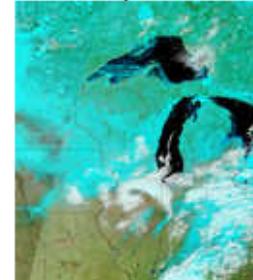
03/12/08 (072 of 2008)



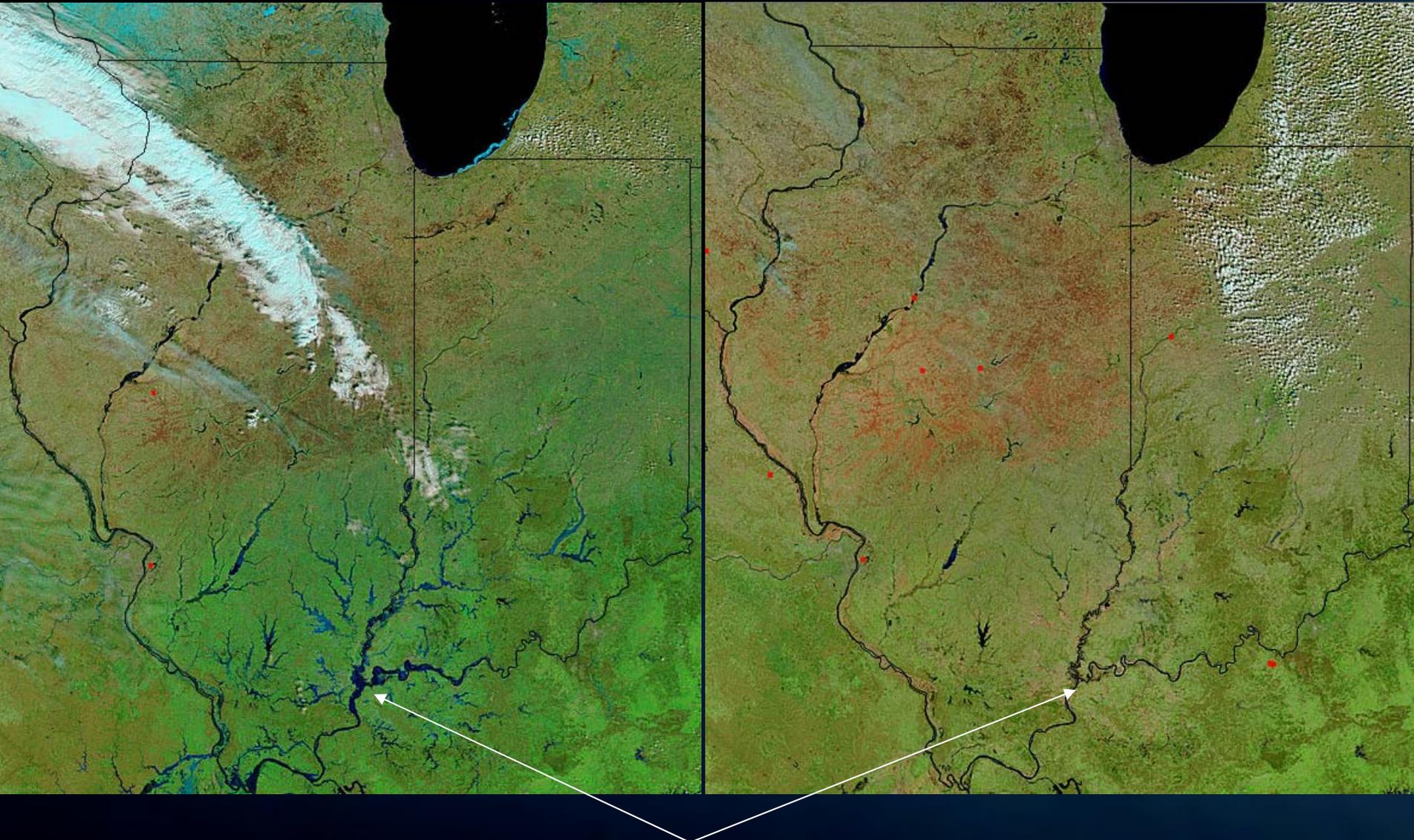
03/11/08 (071 of 2008)



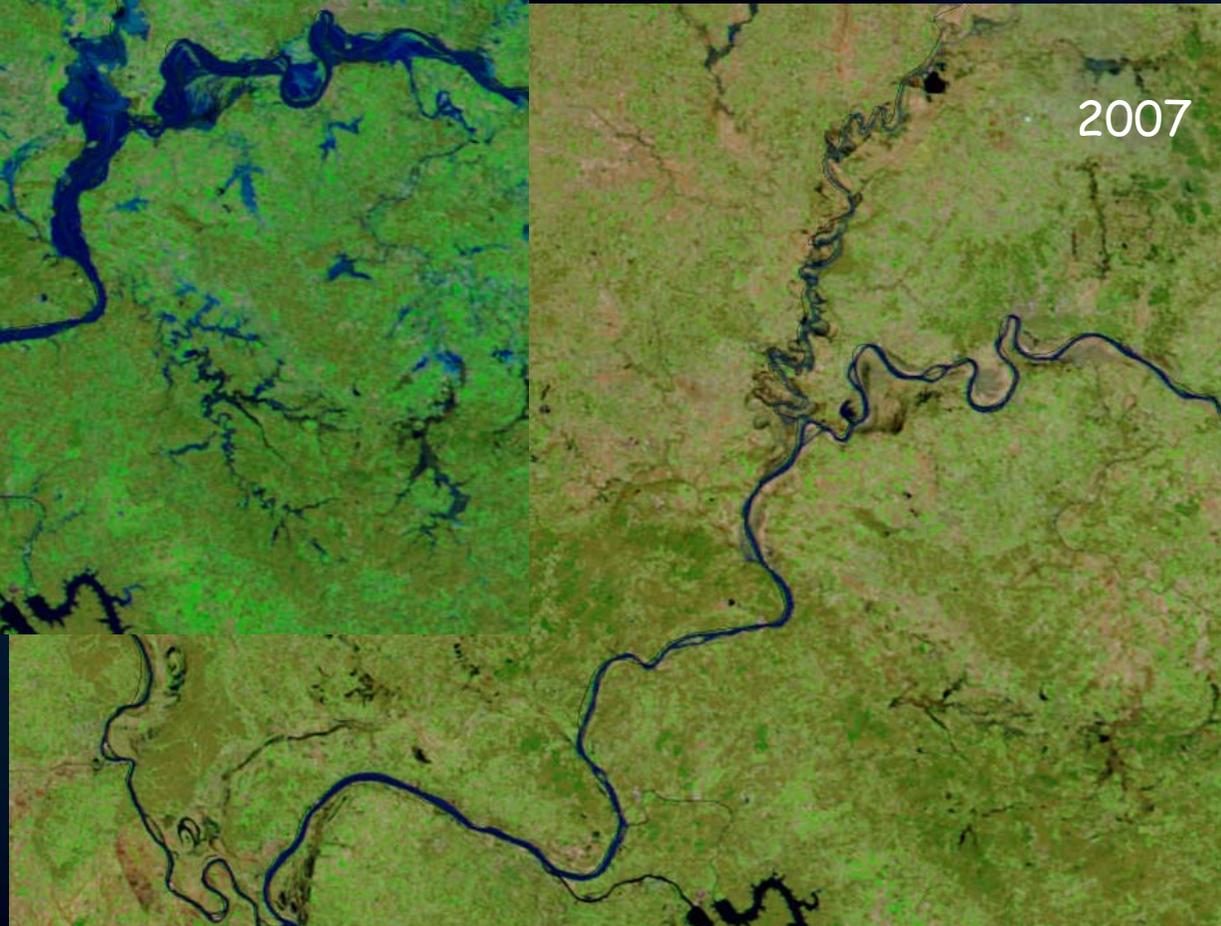
03/10/08 (070 of 2008)



# Allows for Rapid Selection of Image Pairs for Change Detection: March 20, 2008 – March 18, 2007

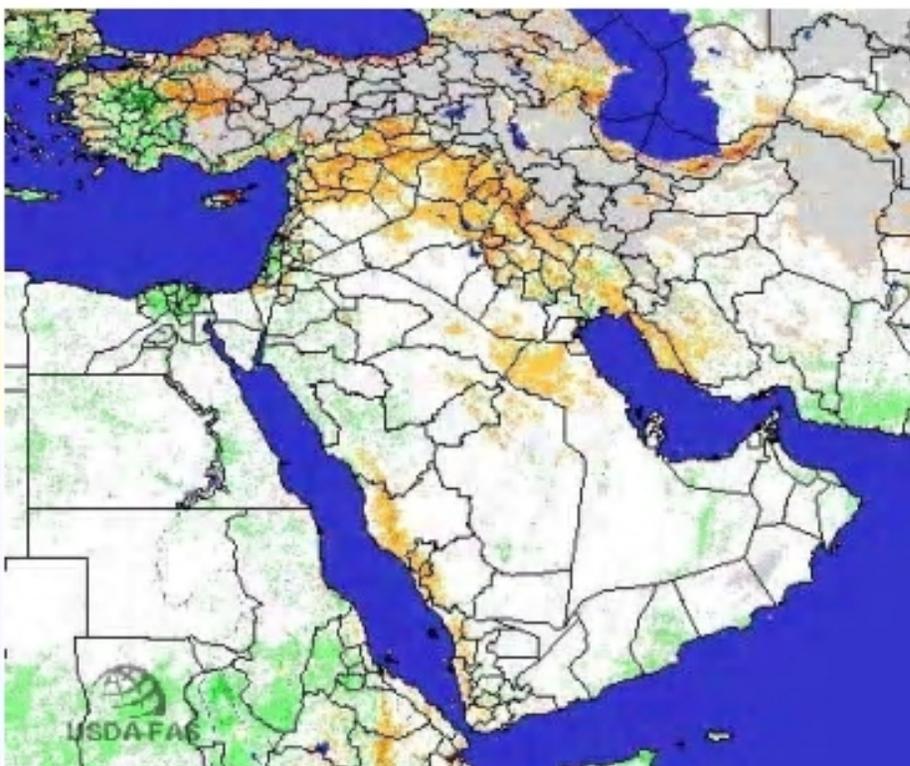


# Allows for Rapid Selection of Image Pairs for Change Detection: March 20, 2008 – March 18, 2007

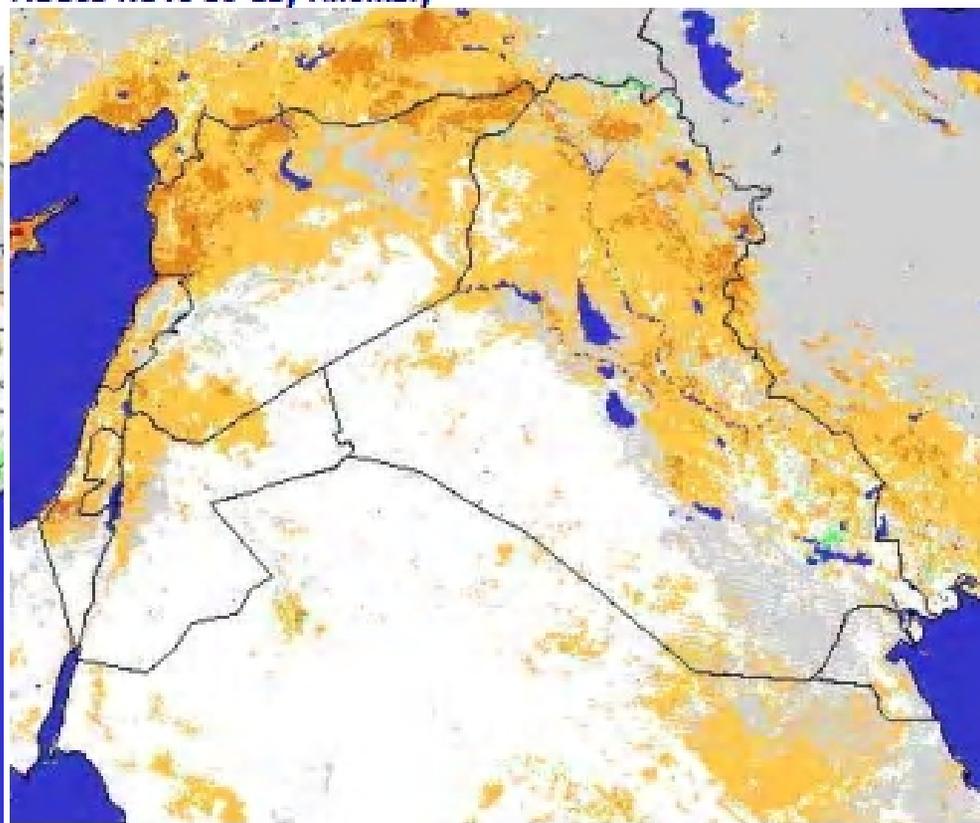


# SPOT-VEG Departure from 7-year Average

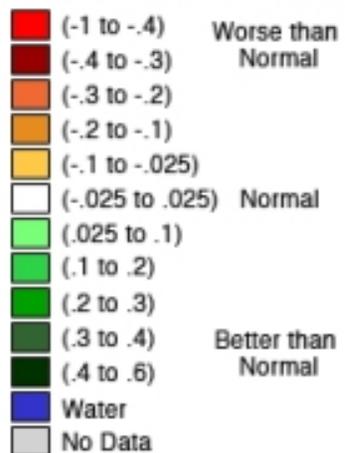
02/01/08 - 02/10/08



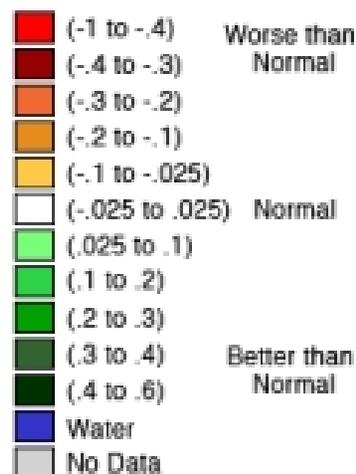
# MODIS NDVI 16-day Anomaly



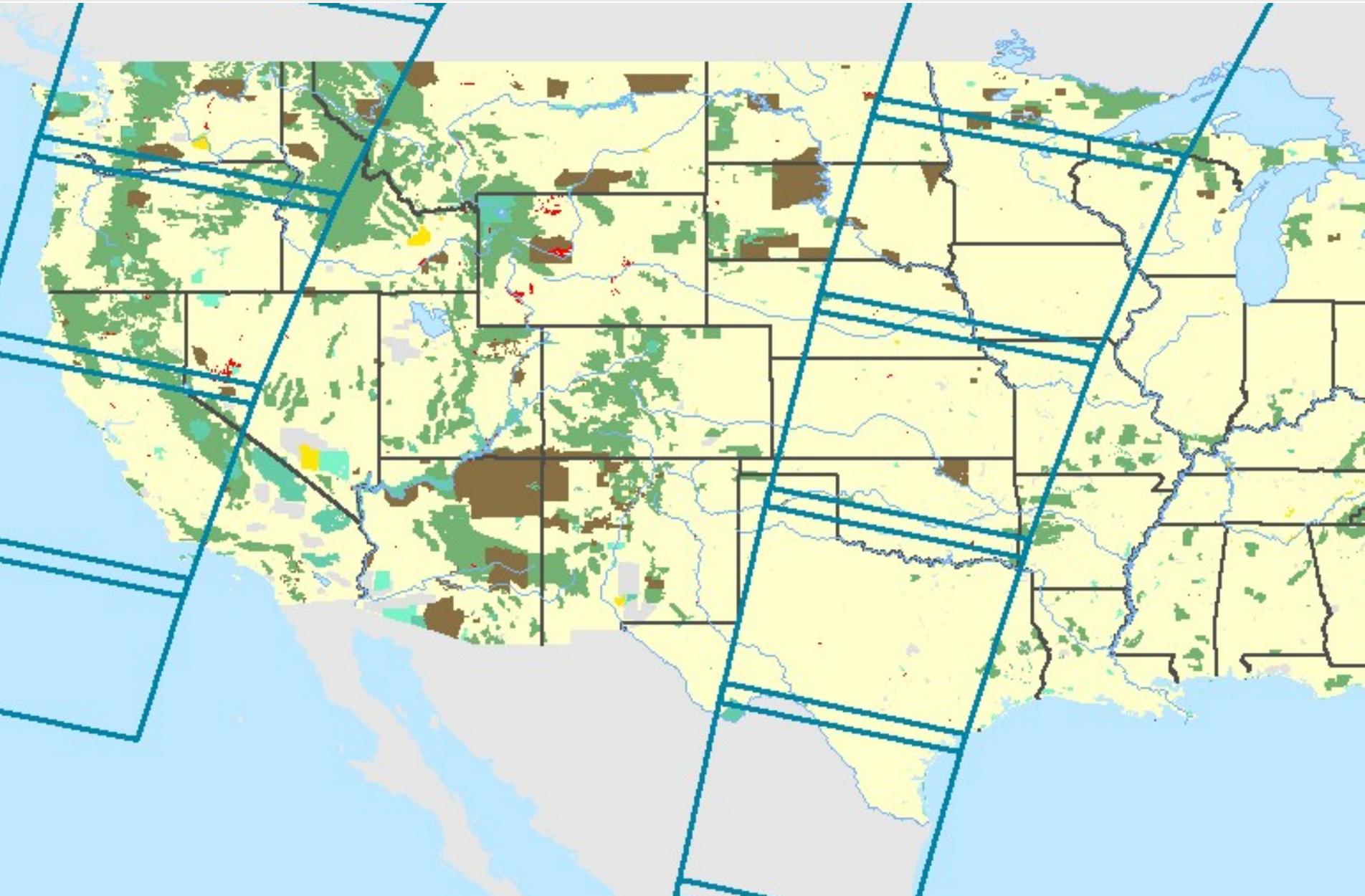
SPOT-VEG NDVI  
Departure from 7-year Average



MODIS NDVI  
Departure from 5-year Average



# AWIFS Path / Rows



# AWIFS with Landsat Path / Rows

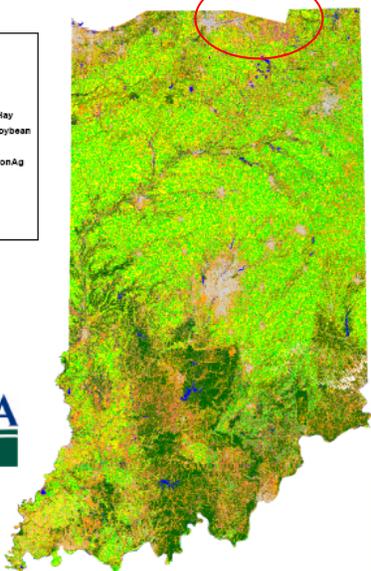


# AWIFS with Landsat and SPOT Path / Rows



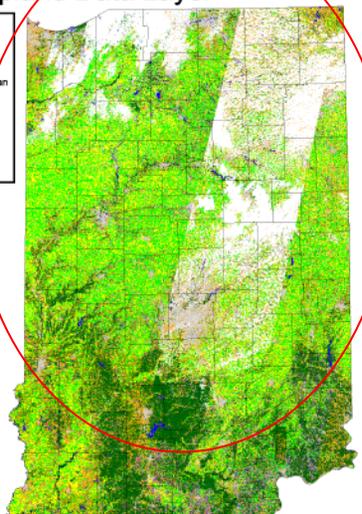
## 2006 Indiana Cropland Data Layer

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



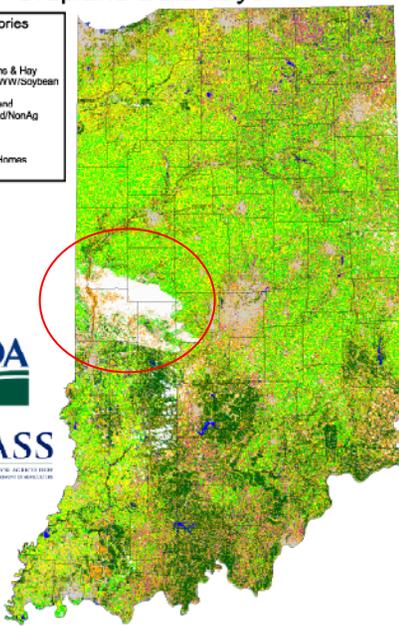
## 2005 Indiana Cropland Data Layer

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



## 2004 Indiana TM & AWiFS Cropland Data Layer

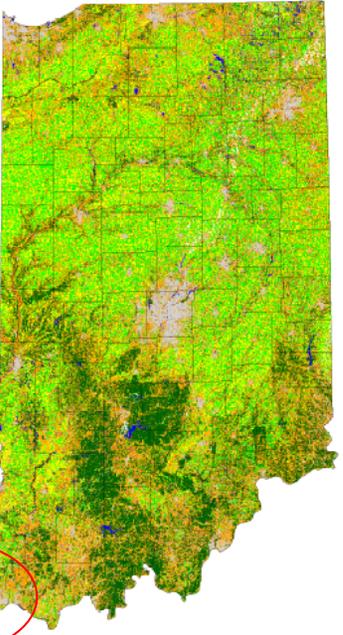
- Categories
- Yellow: Corn
  - Light Green: Soybeans
  - Purple: Winter Wheat
  - Dark Green: Other Small Grains & Hay
  - Pink: Double Cropped WW/Soybean
  - Red: All Other Crops
  - Orange: Fallow/Idle Cropland
  - Dark Green: Pasture/Grassland/NonAg
  - Dark Green: Woods
  - Blue: Clouds
  - Blue: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



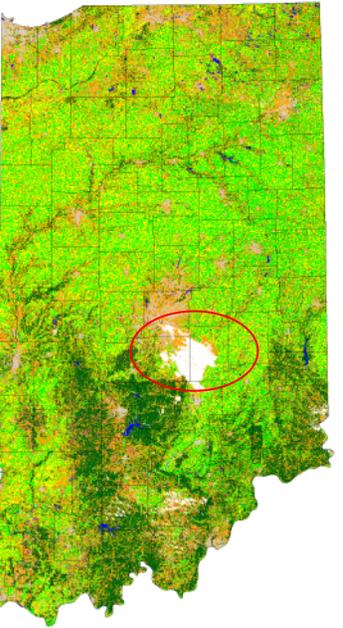
Lack of Temporal Repeat Cycle Results in Data Gaps and Decreased Reliability

## 2003 Indiana Cropland Data Layer

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

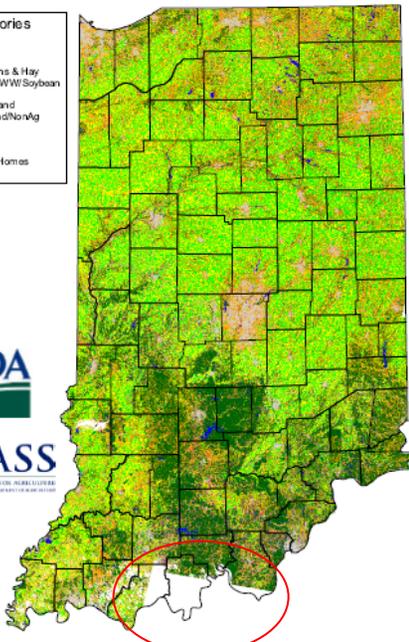


- Categories
- Yellow: Corn
  - Light Green: Soybeans
  - Purple: Winter Wheat
  - Dark Green: Other Small Grains & Hay
  - Pink: Double Cropped WW/Soybean
  - Red: All Other Crops
  - Orange: Fallow/Idle Cropland
  - Dark Green: Pasture/Grassland/NonAg
  - Dark Green: Woods
  - Blue: Clouds
  - Blue: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

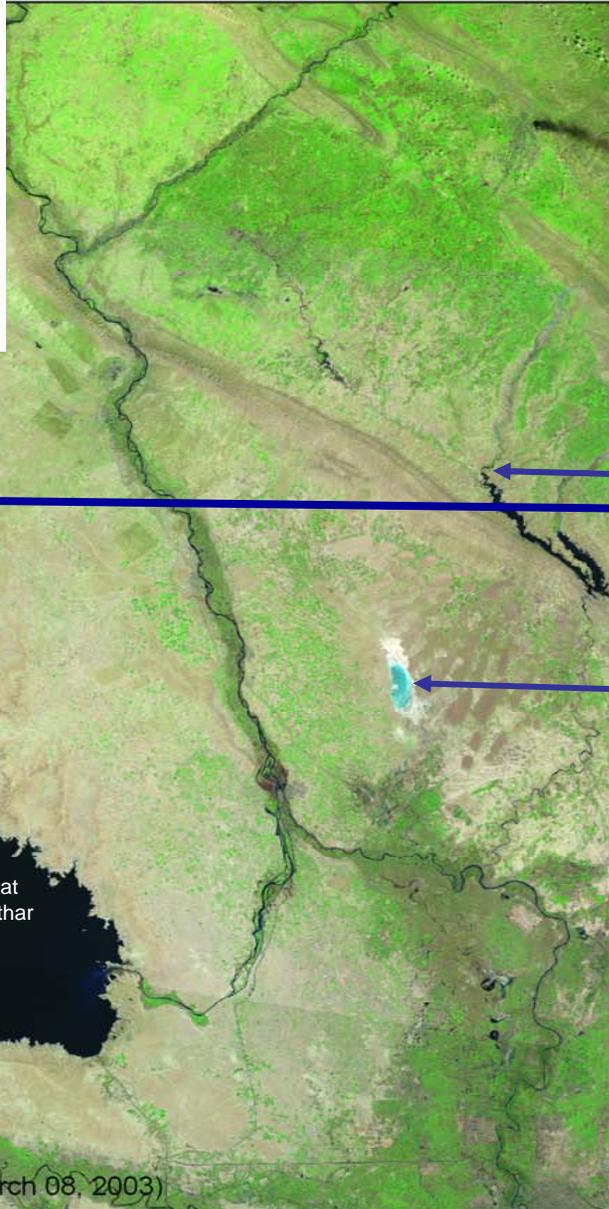


## Indiana Categorized Image

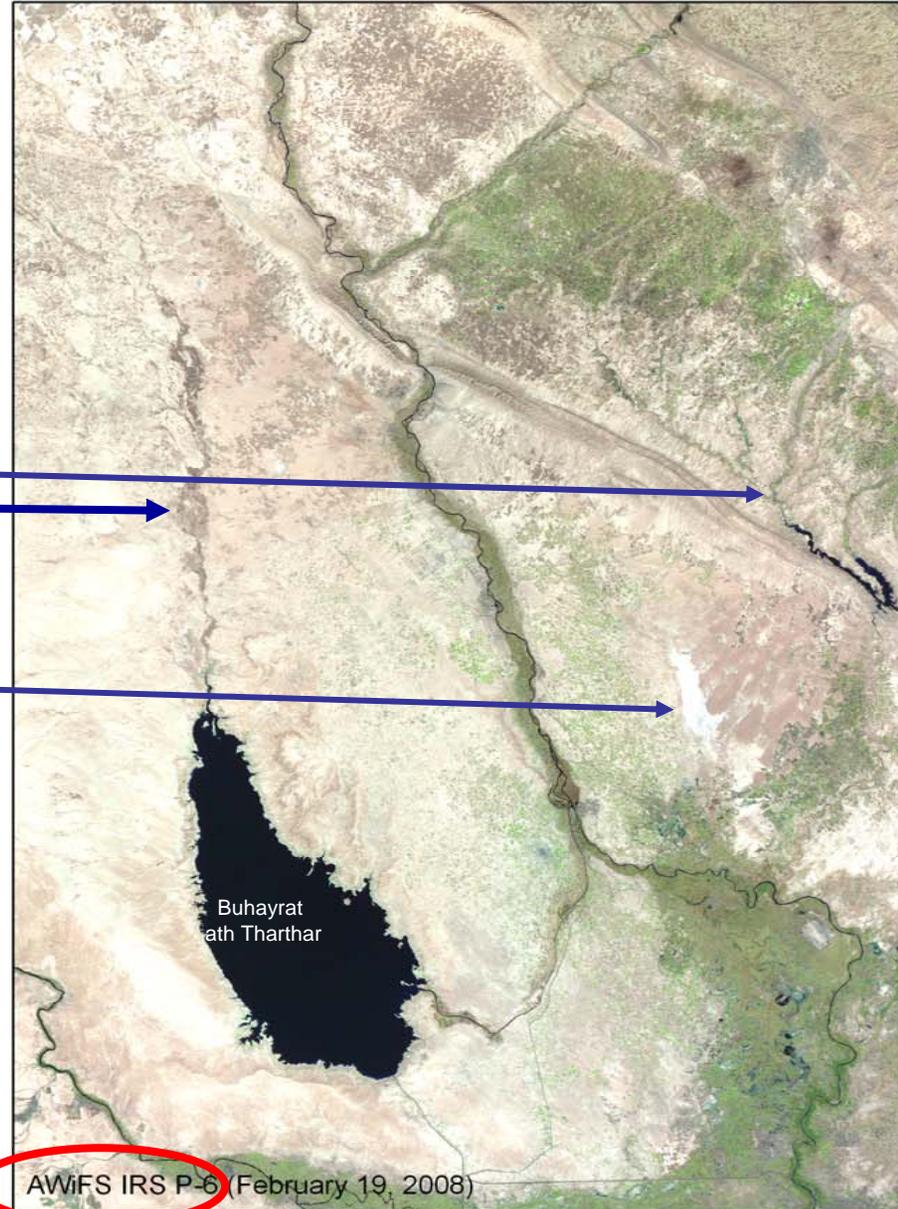
- Categories
- Yellow: Corn
  - Light Green: Soybeans
  - Purple: Winter Wheat
  - Dark Green: Other Small Grains & Hay
  - Pink: Double Cropped WW/Soybean
  - Red: All Other Crops
  - Orange: Fallow/Idle Cropland
  - Dark Green: Pasture/Grassland/NonAg
  - Dark Green: Woods
  - Blue: Clouds
  - Blue: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



# Imagery Comparison: 2003/04 and 2008/09 Market Year



Landsat 7 ETM+ (March 08, 2003)

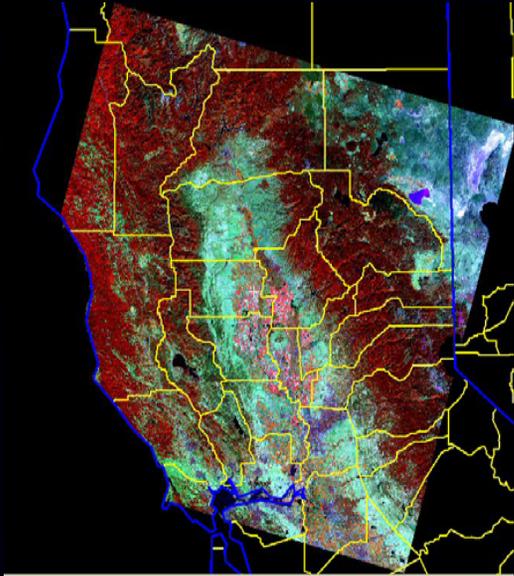


AWiFS IRS P-6 (February 19, 2008)

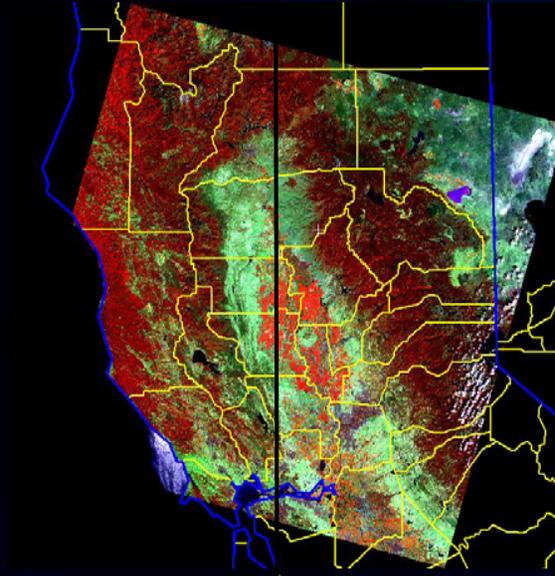
Can we trust cross sensor comparisons?



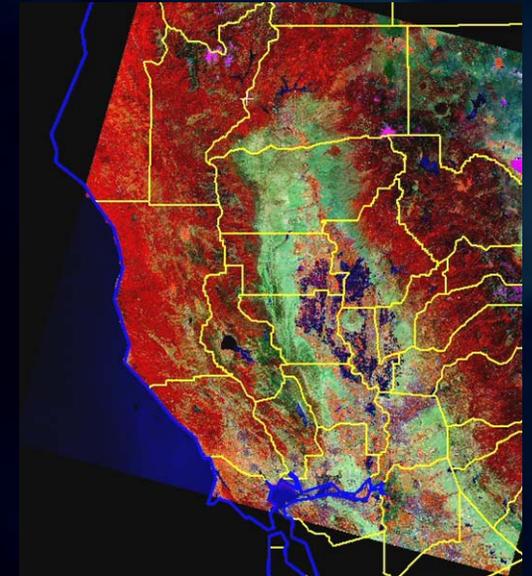
# Northern California - AWiFs



May 28, 2007

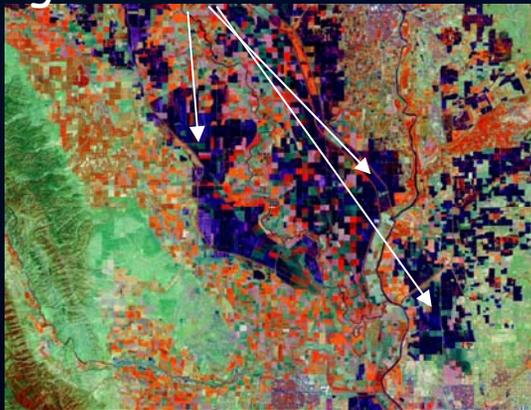


September 1, 2007



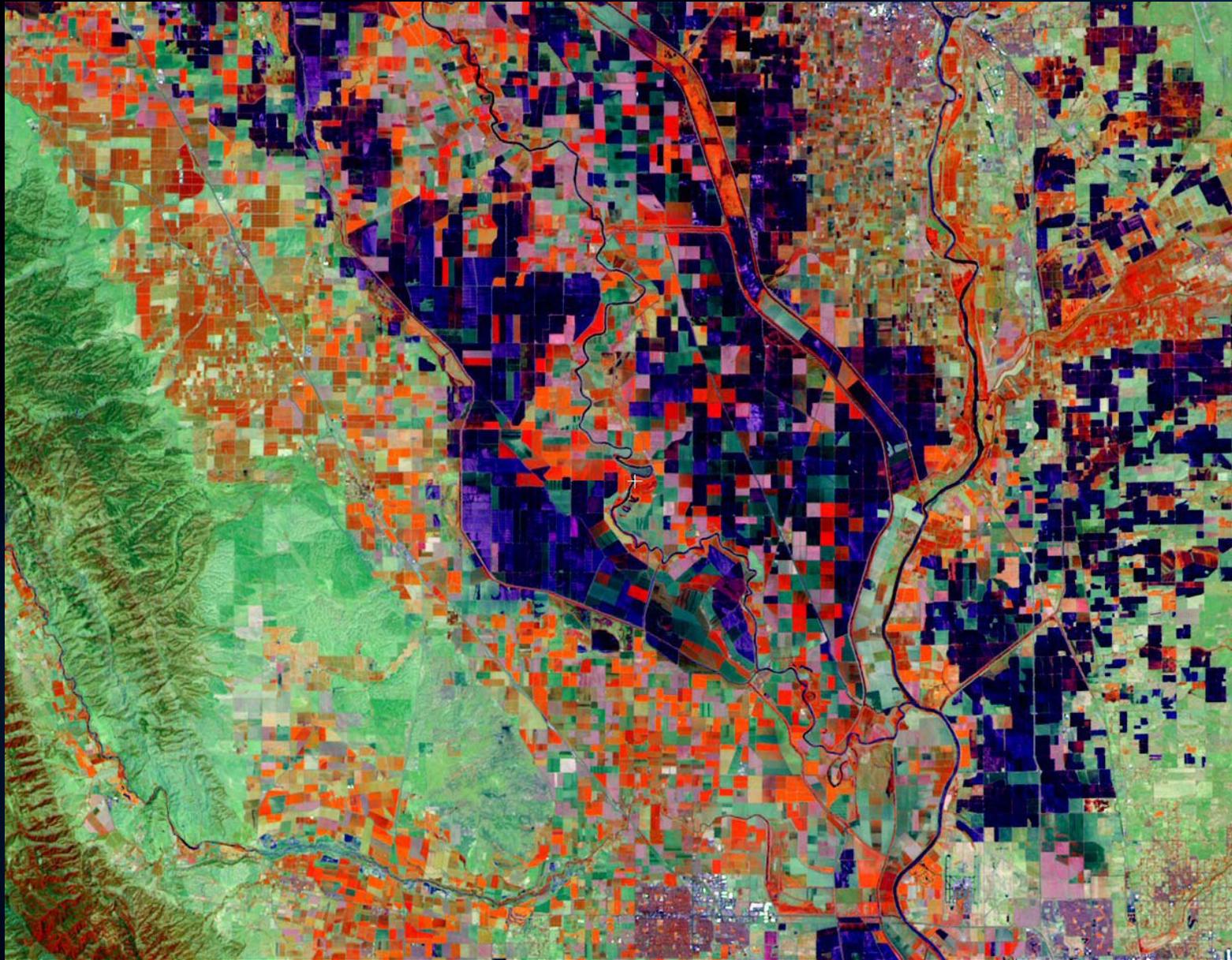
September 25, 2007

## Irrigated Rice

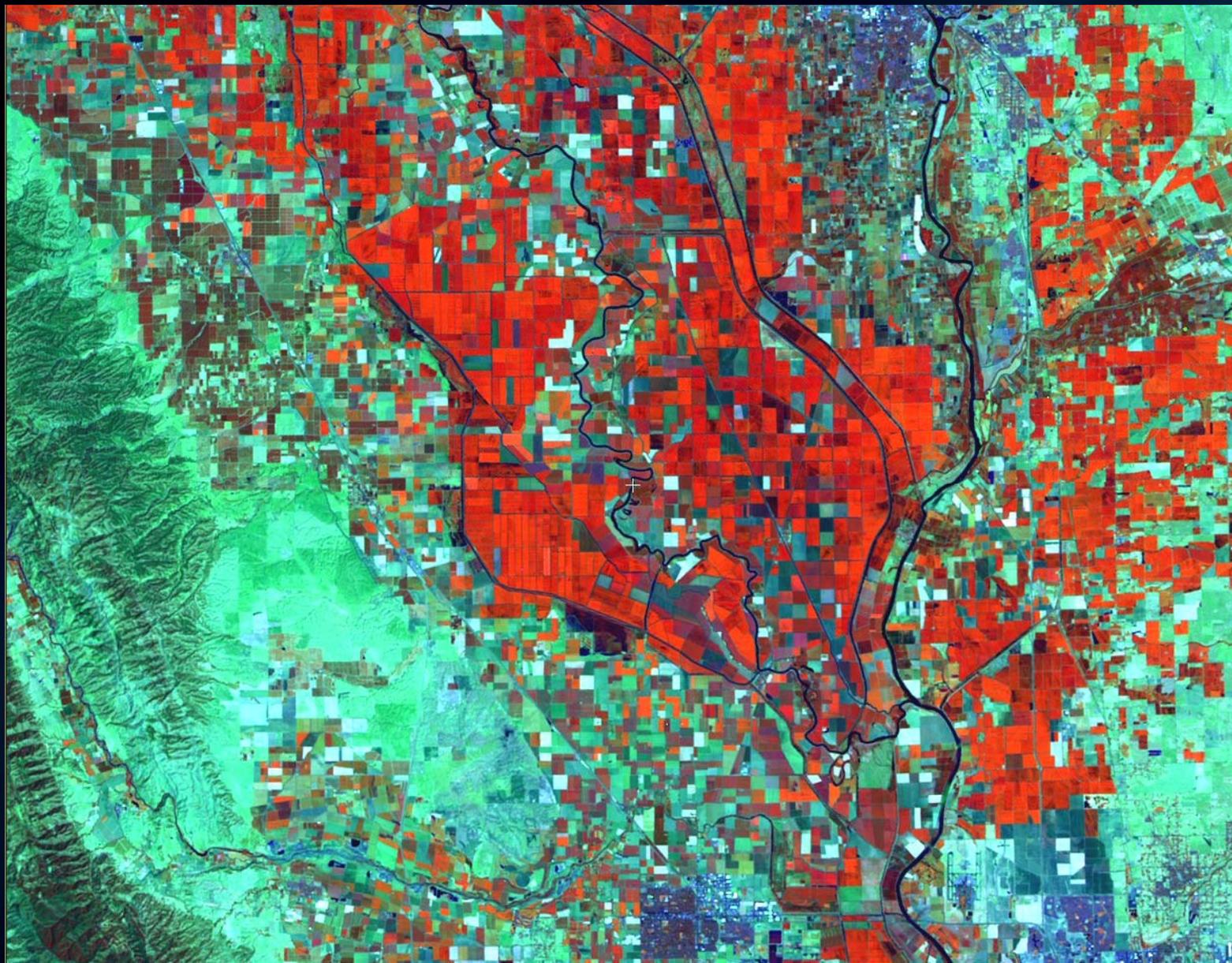
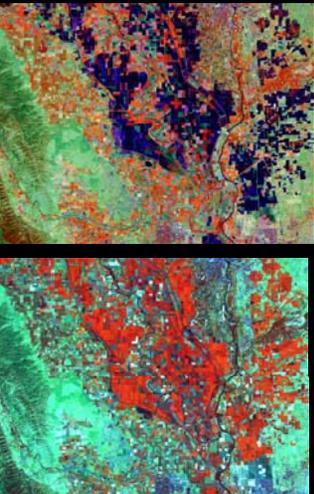


NE Yolo Co., California

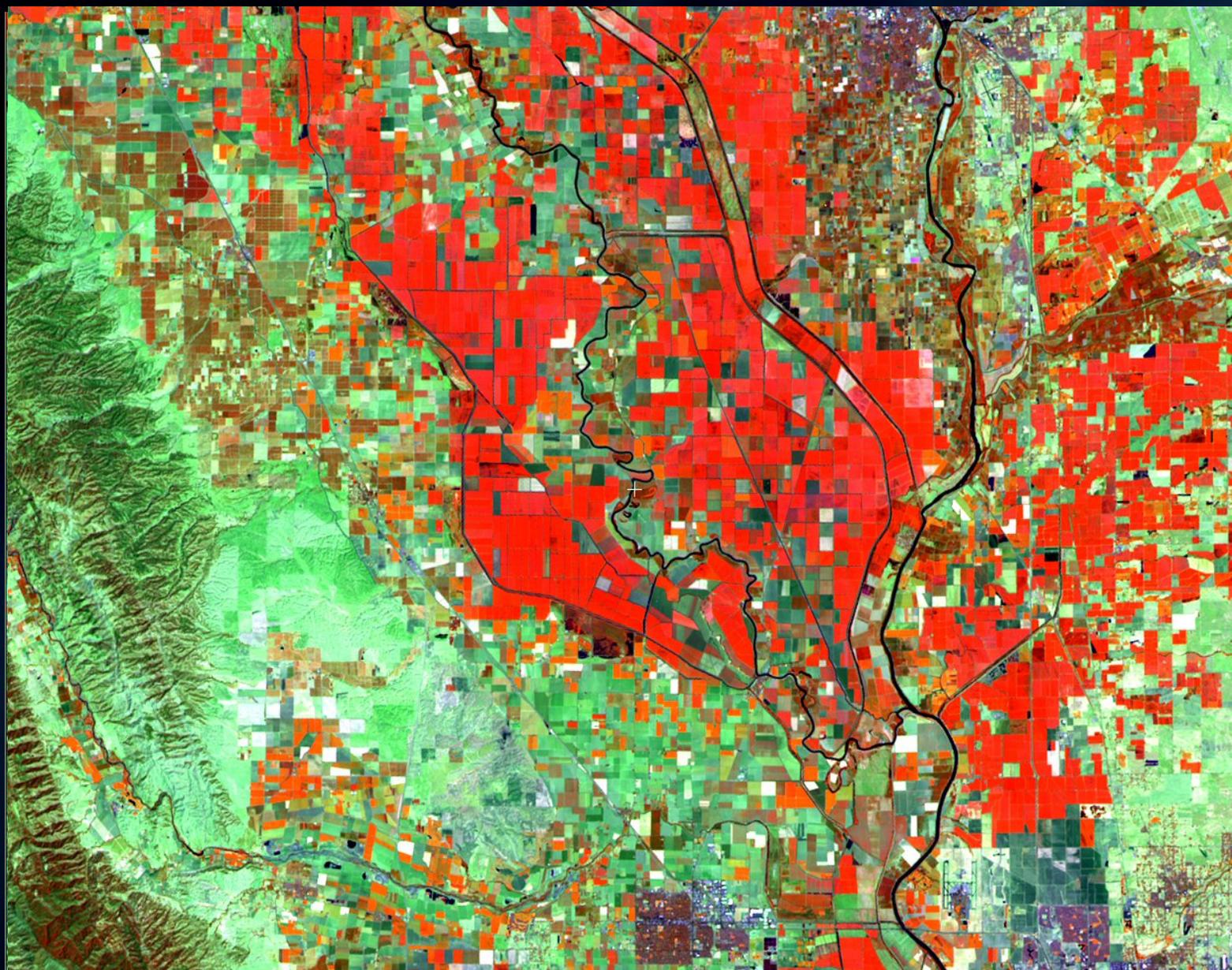
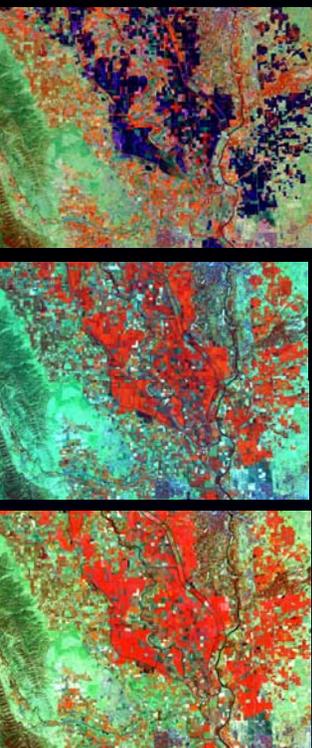
# Sutter and Yolo Co., California May 28– September 30, 2007



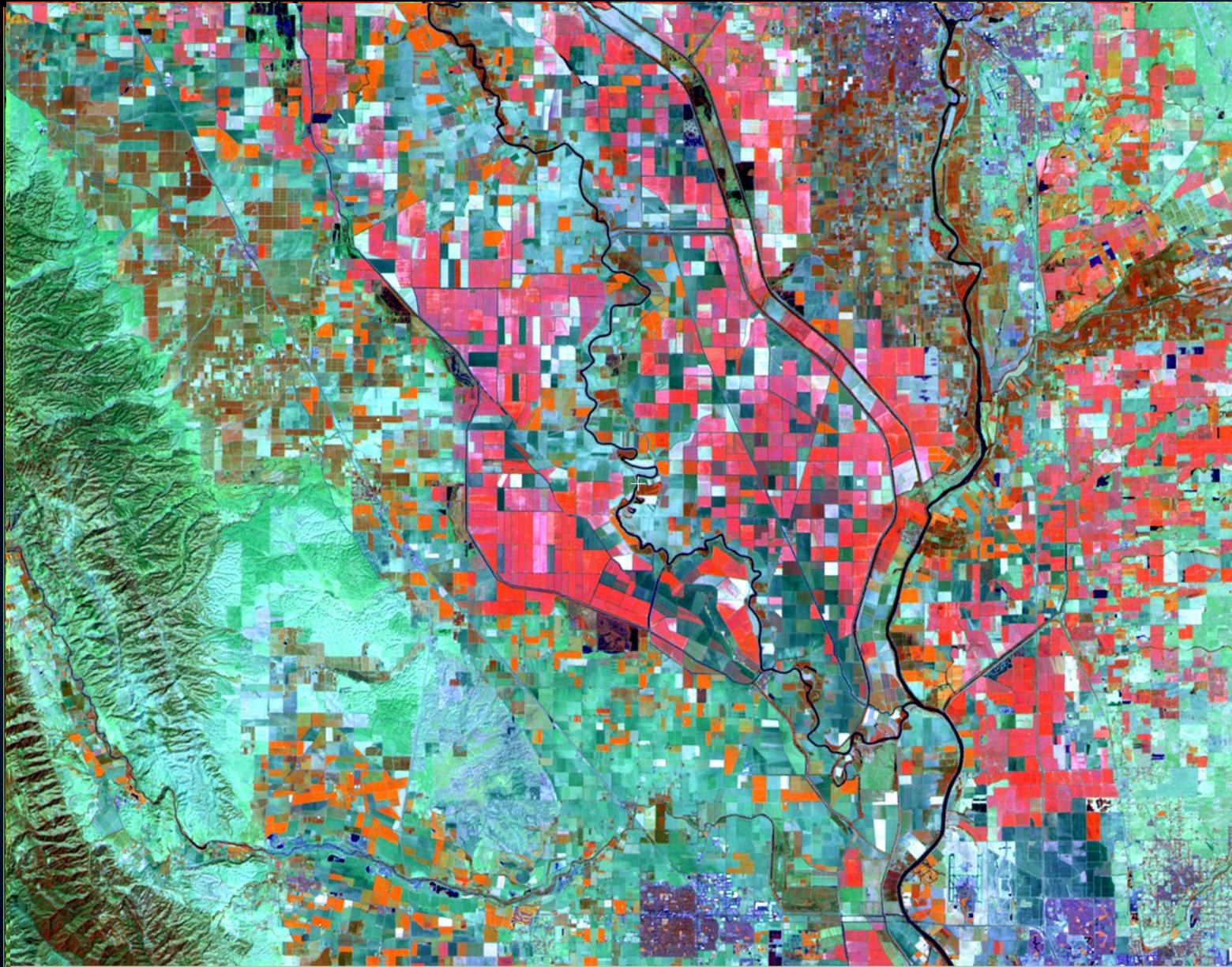
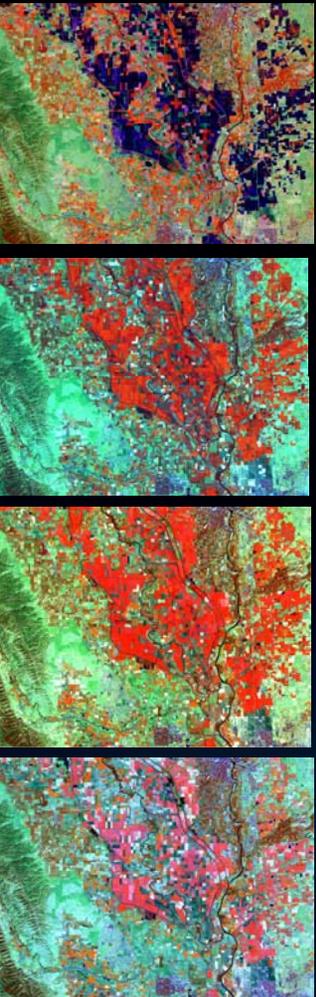
# Sutter and Yolo Co., California May 28– September 30, 2007



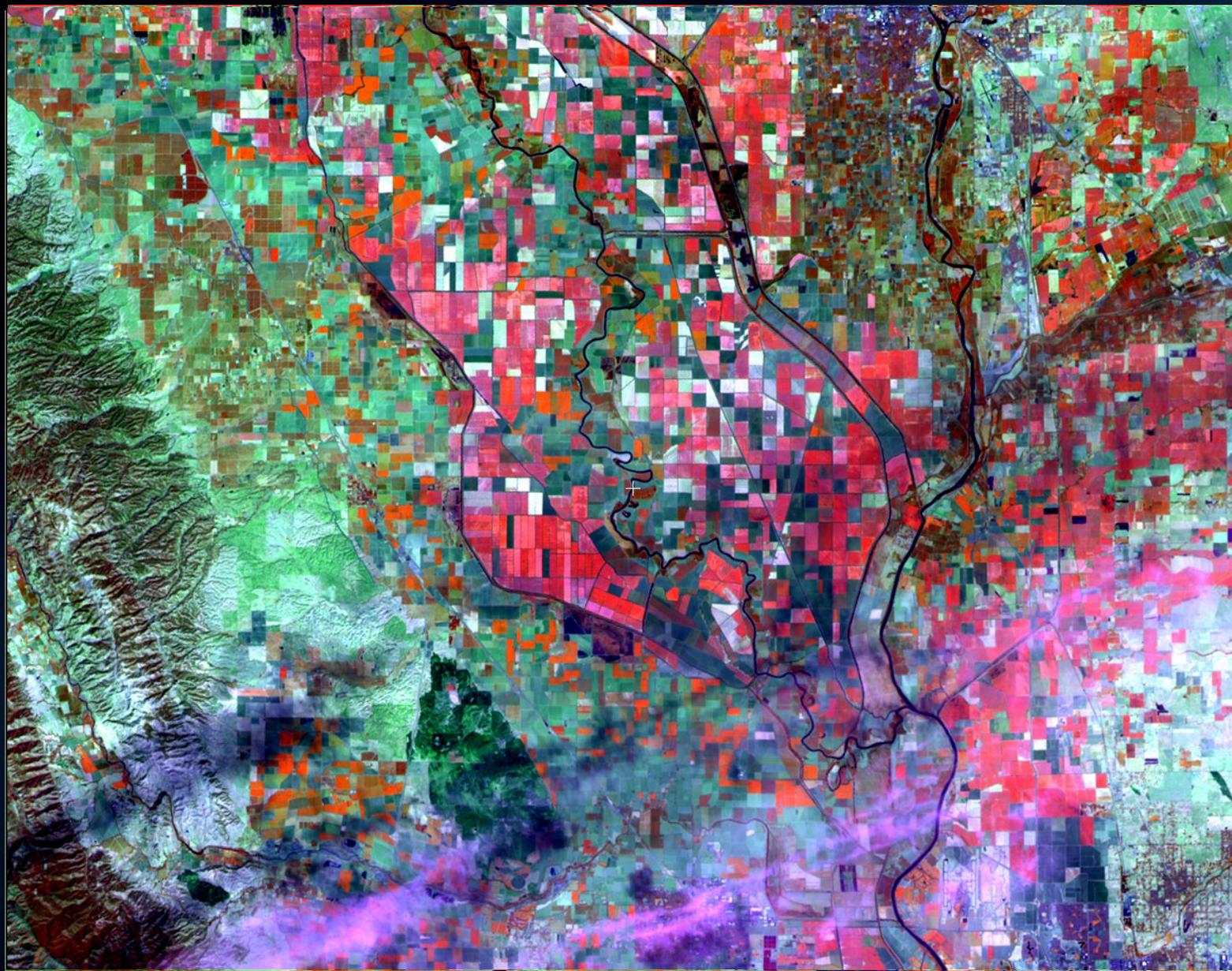
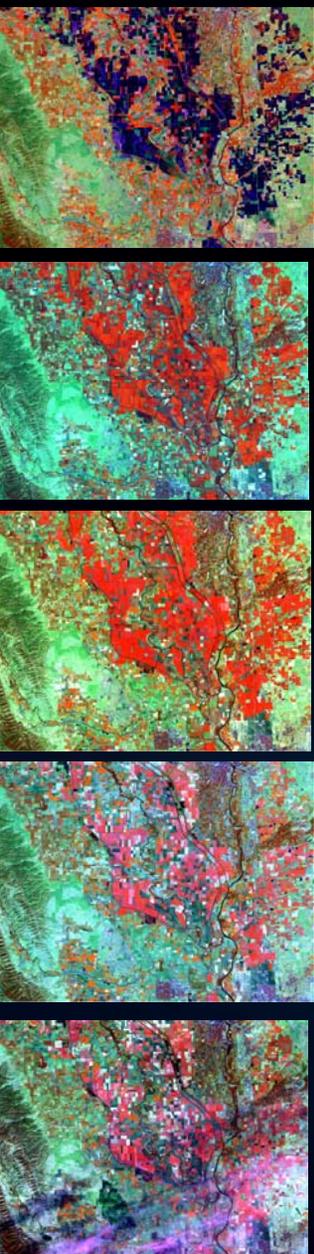
# Sutter and Yolo Co., California May 28– September 30, 2007



# Sutter and Yolo Co., California May 28– September 30, 2007



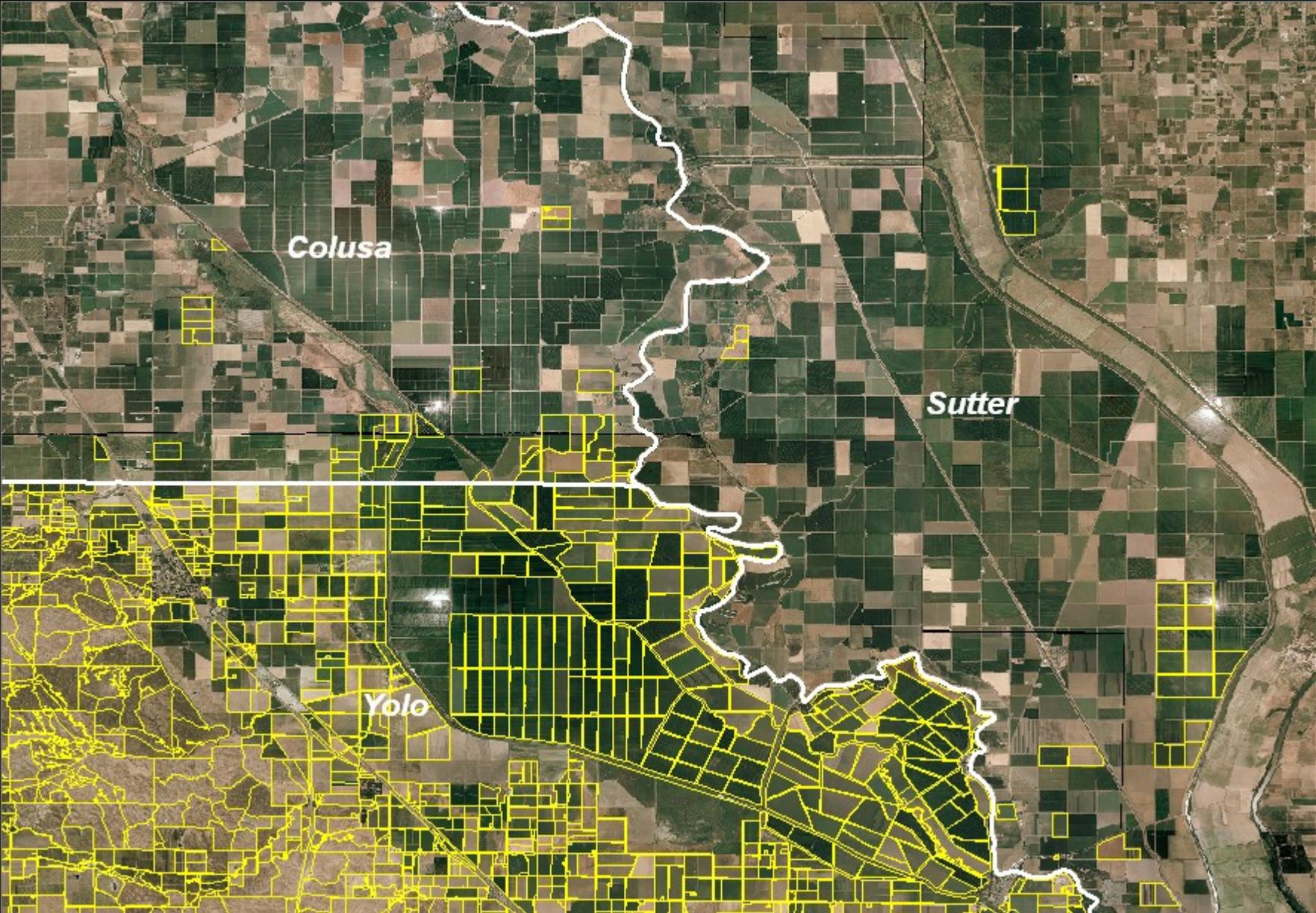
# Sutter and Yolo Co., California May 28– September 30, 2007



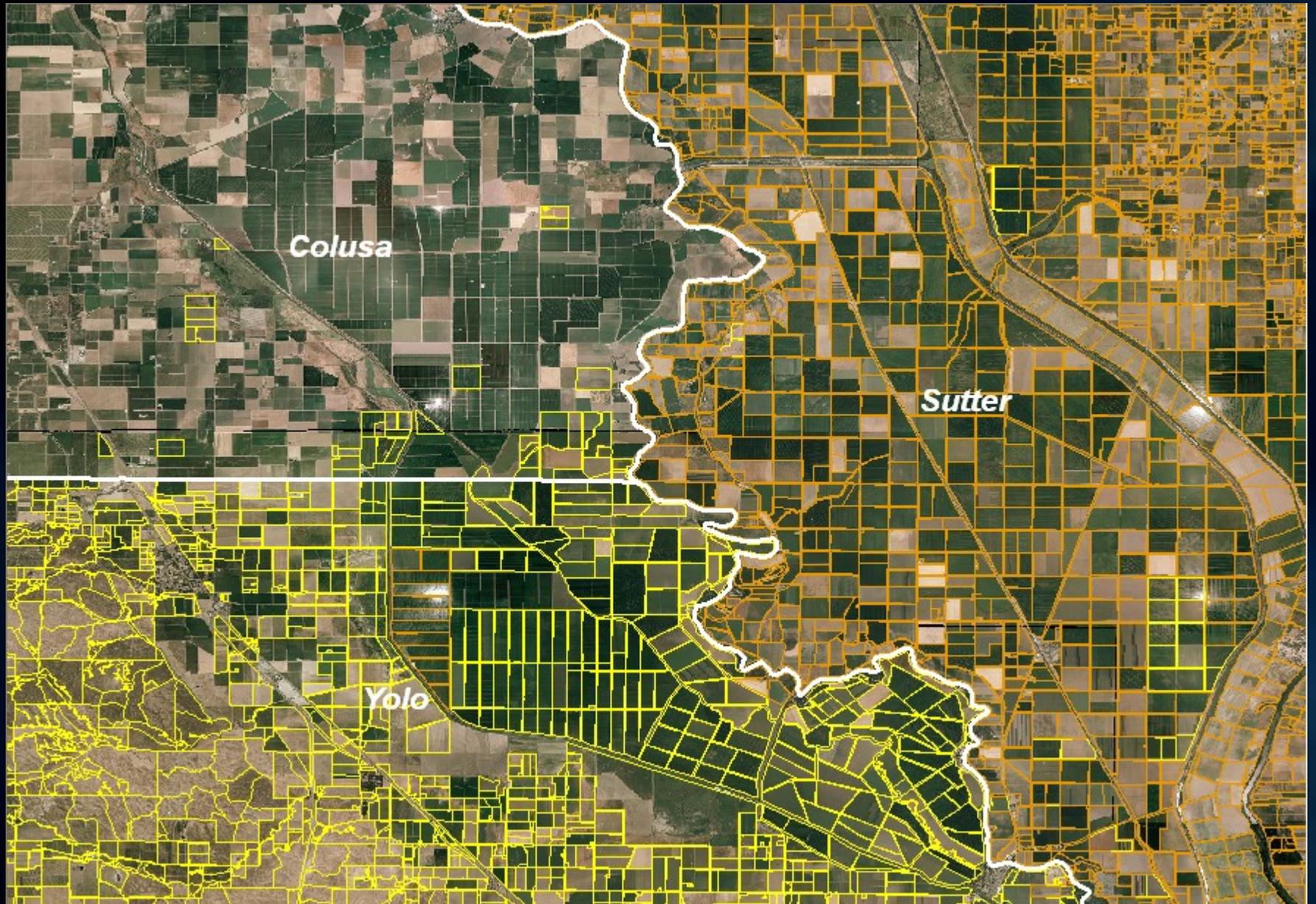
# NAIP Compressed County Mosaics



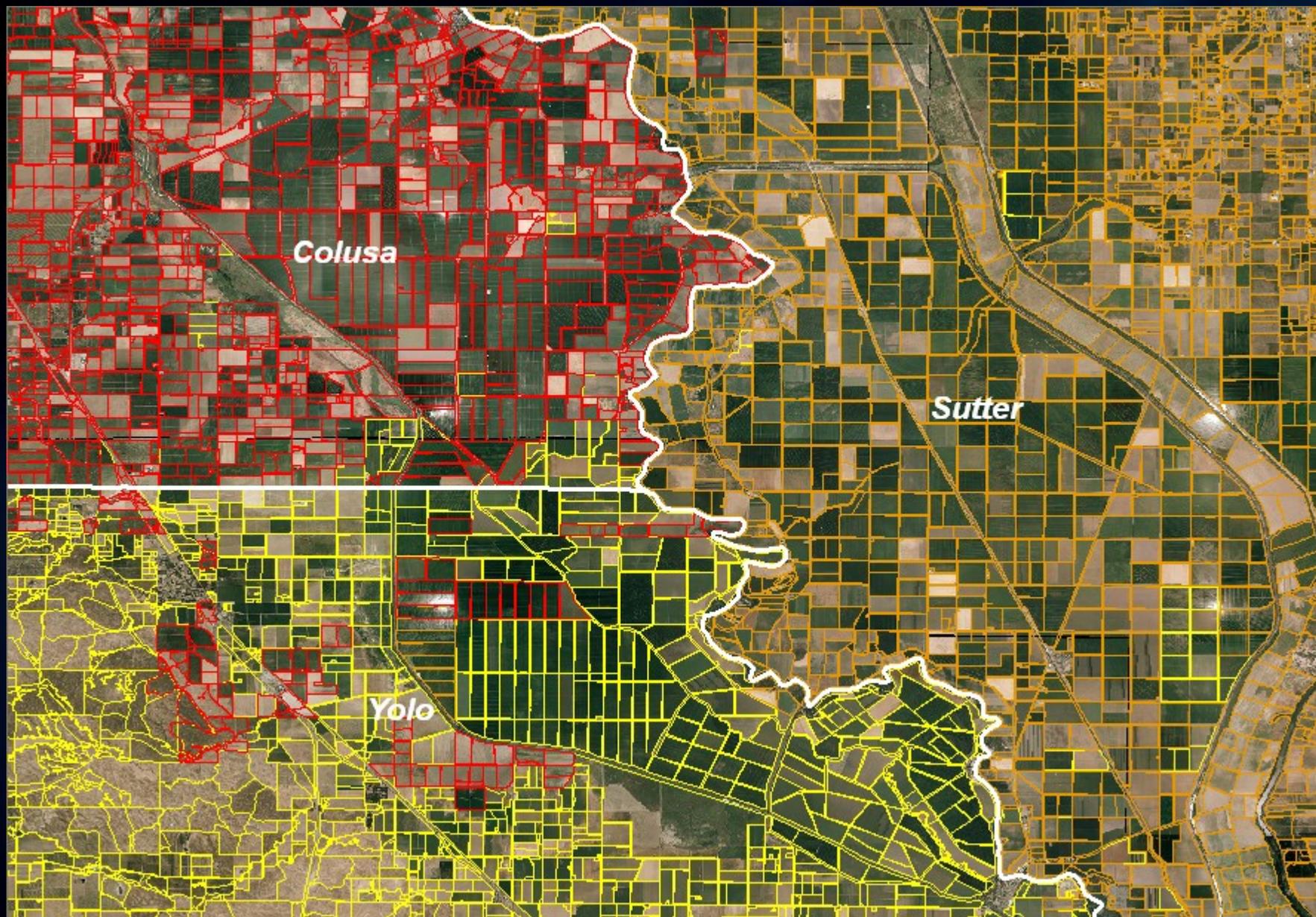
# Property Managed by County Selected by Owner (Yolo)



# Sutter County + Yolo County



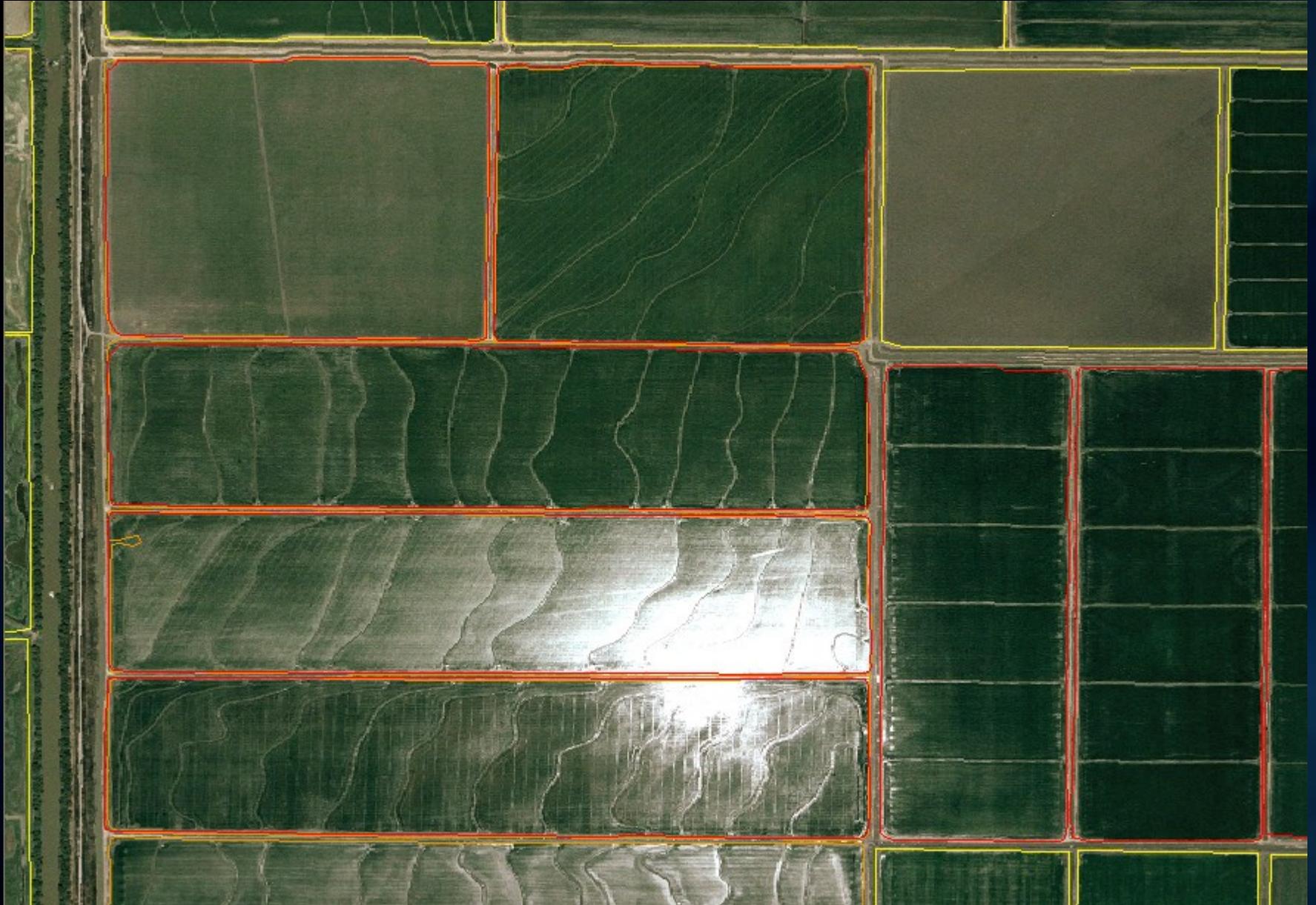
# Colusa County + Sutter County + Yolo County



# Ownership Helps add Context



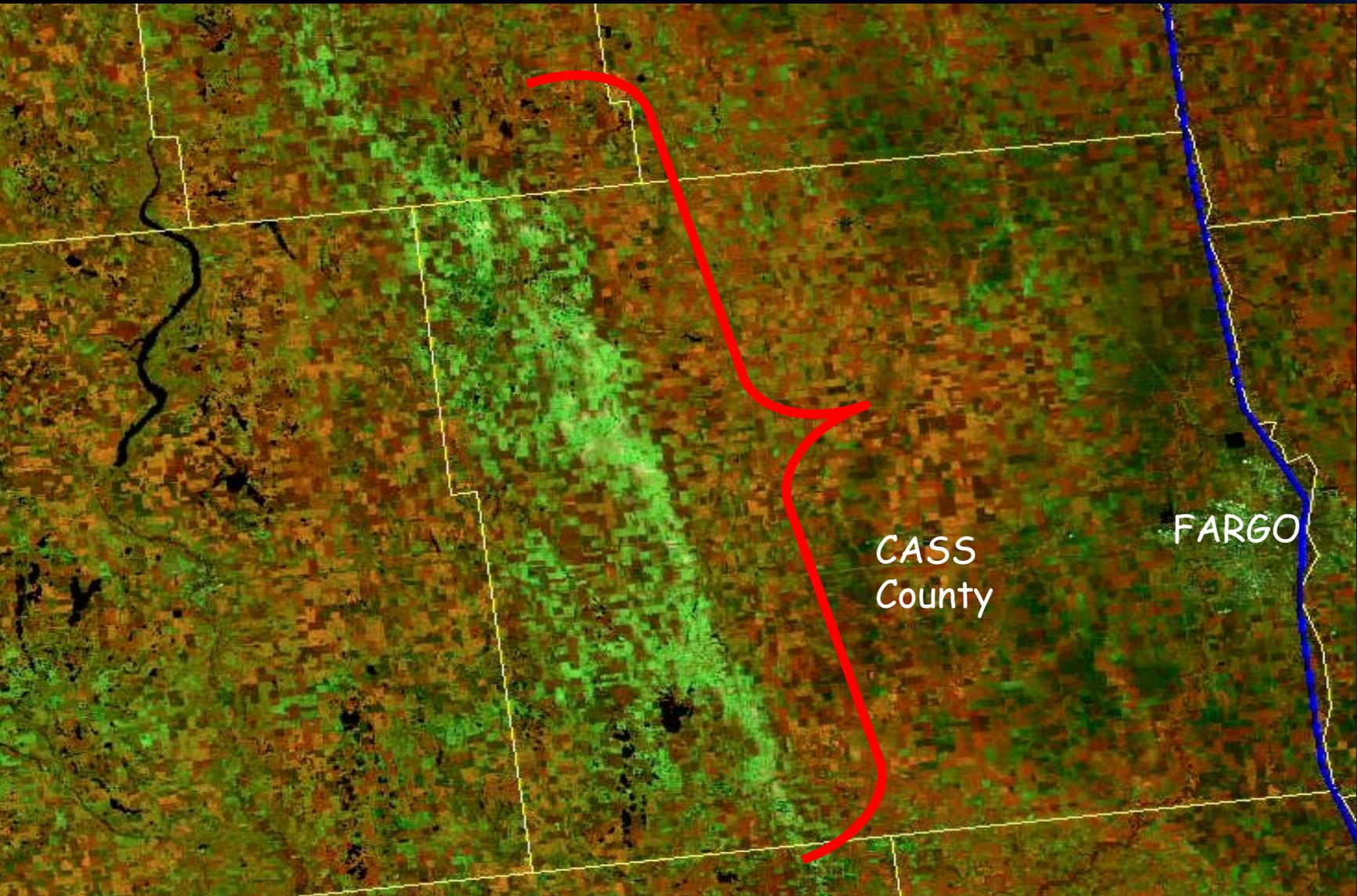
# Cropped Area Certified by Property Owner



Unplanted areas are not digitized. Provides Context to Minimize Mixed Pixels.



# July 19 AWIFS image Showing Path of Hail Storm



# Sunflowers



Cass County, August 10, 2007

# Corn



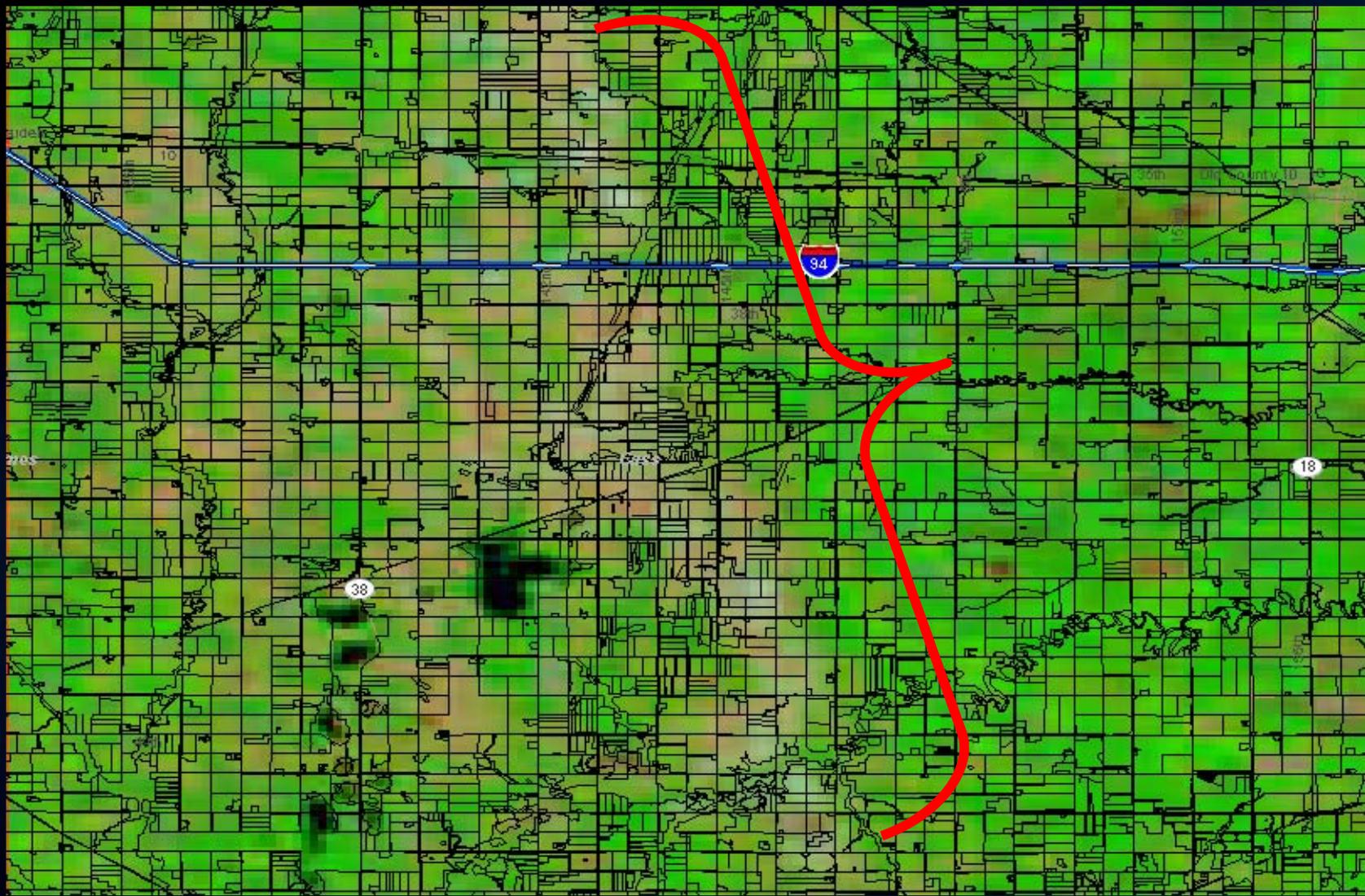
Cass County, August 10, 2007

# Soybeans



Cass County, August 10, 2007

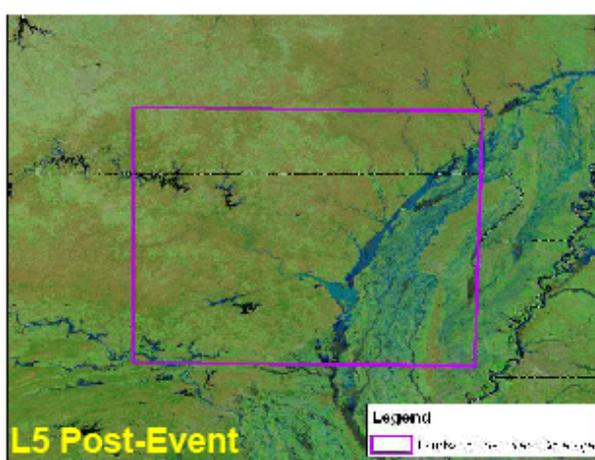
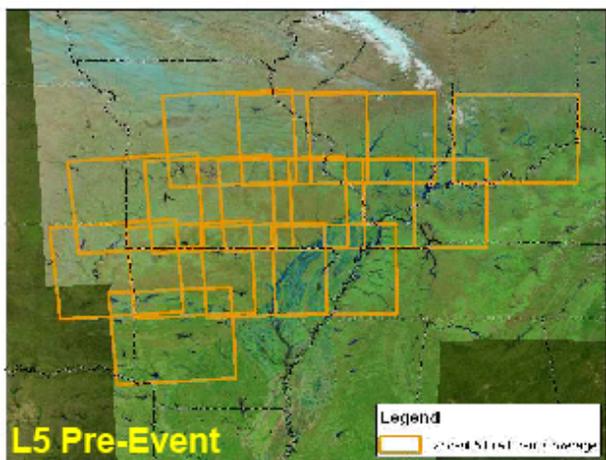
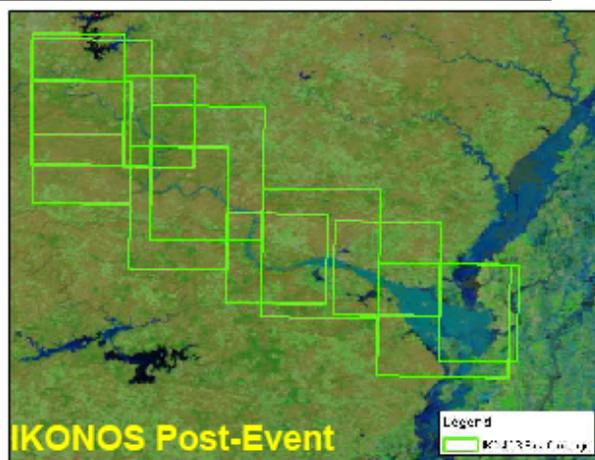
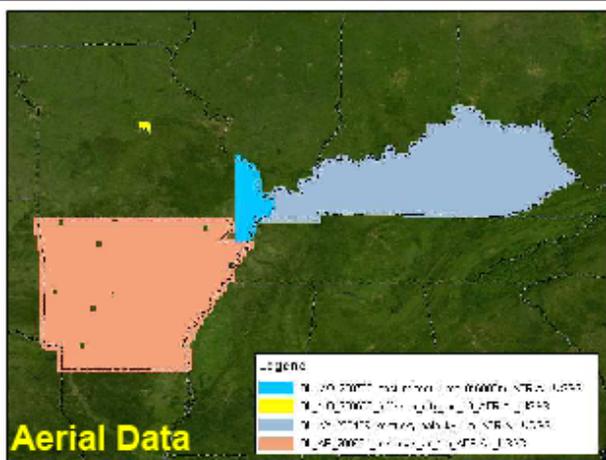
# Hail Damage Visible on 250 meter MODIS CLU Provides Context



# Imagery for MS Valley Floods

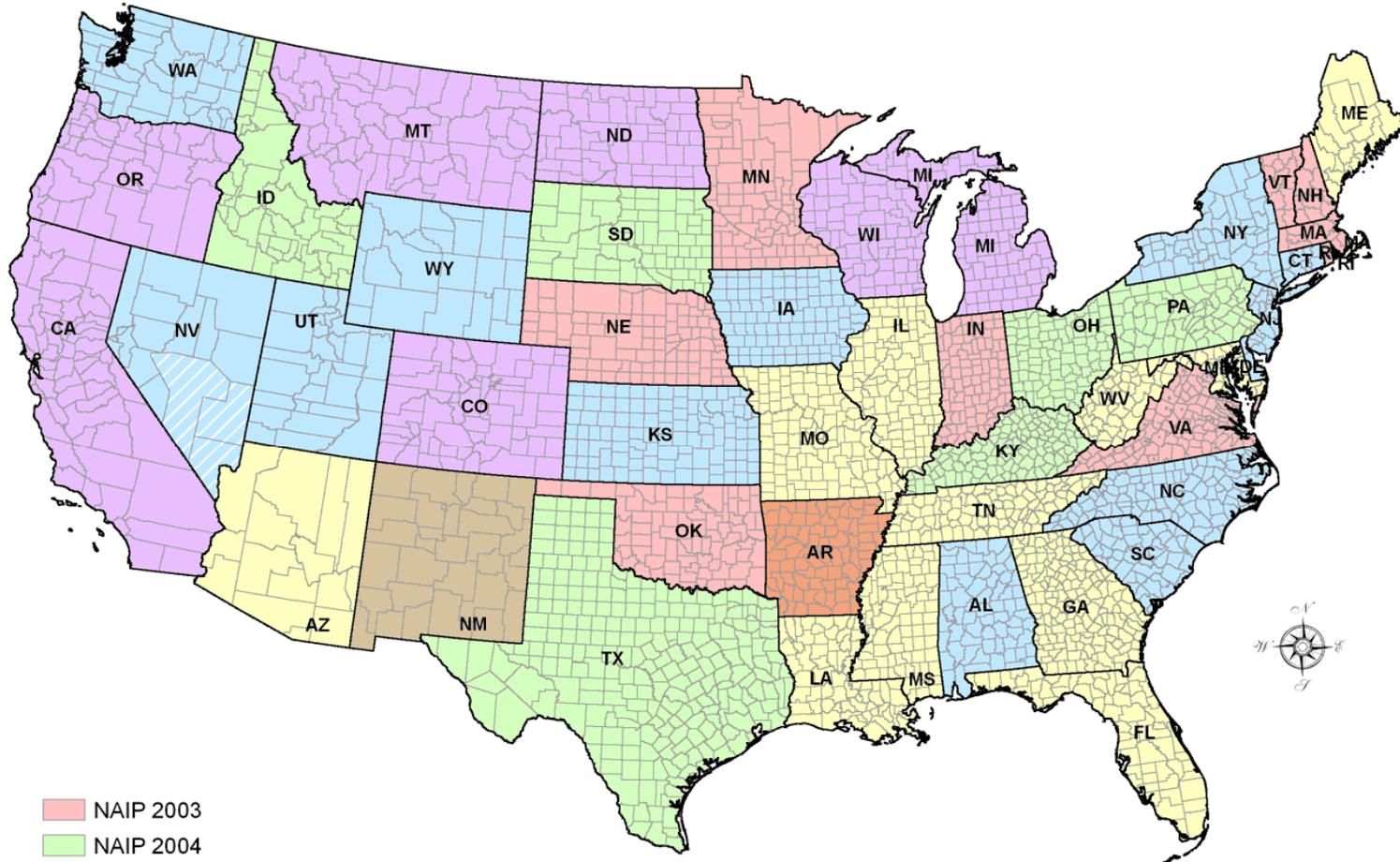


## Coverage Footprints



# NATIONAL AGRICULTURE IMAGERY PROGRAM CYCLE 1

April 25, 2007

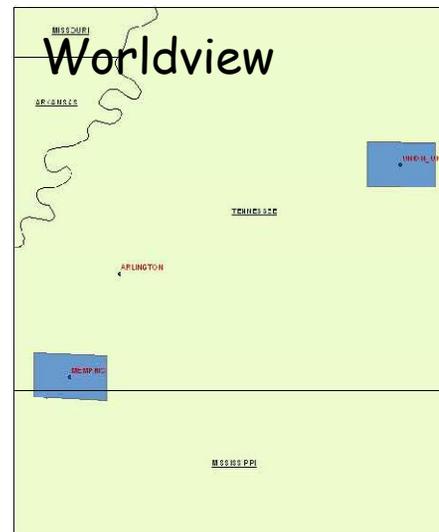
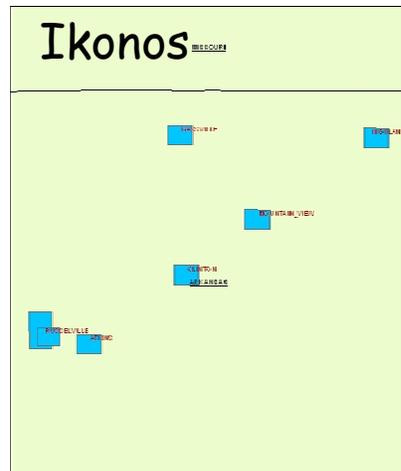
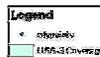
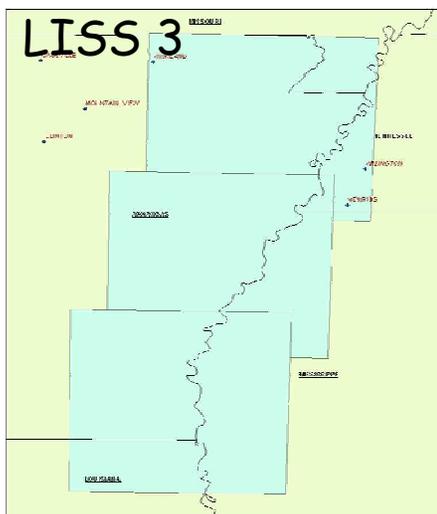
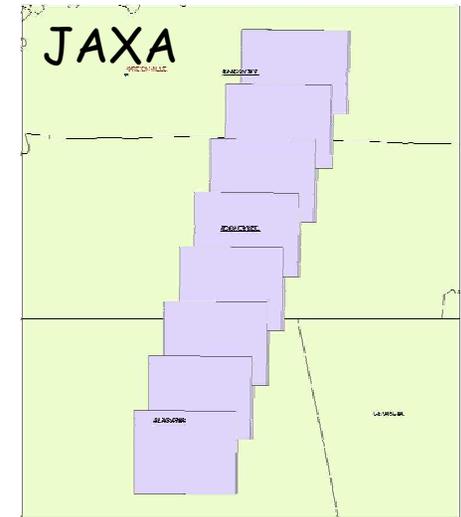
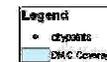
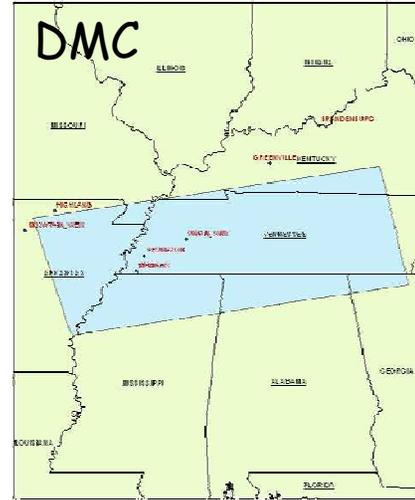
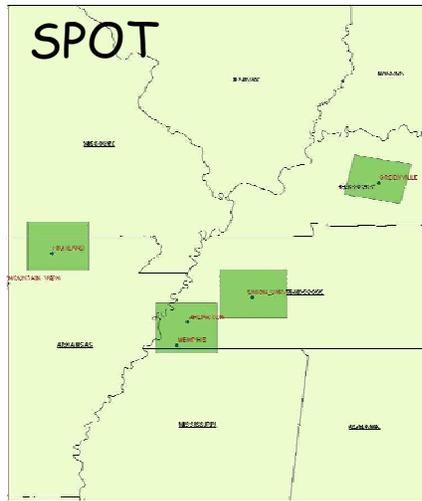
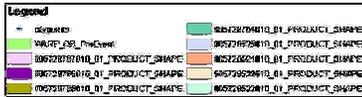


- NAIP 2003
- NAIP 2004
- NAIP 2005
- NAIP 2006
- NAIP 2006 partial
- NAIP 2007 Contracted
- Partnership imagery
- State flown imagery

0 195 390 780 Miles



# Coverage Maps for February 2008 Tornadoes



# Imagery Available for Disaster Response:

- Multiple Sensors
- Multiple Platforms
- Multiple Spatial Resolutions
- Multiple Spectral Resolutions
- Nadir → Oblique
  
- Better coordination and cooperation may result in Imagery confusion.
  - If you have a choice, which image is best for my application.
- Calibration and correlation could aid in additional quantitative analysis.

# USDA Presentations:

## ■ Farm Service Agency

- **John Mootz and Zach Adkins**
  - National Agriculture Imagery Program
  - Aerial Photography Field Office



## ■ Foreign Agricultural Service

- **Bob Tetrault**
  - Access and Availability of Resourcesat-1 AWiFS Data for Agriculture



## ■ National Agricultural Statistics Service

- **David Johnson**
  - Cropland classification accuracy as a function of P6-AWiFS incidence angle
- **Claire Boryan**
  - Research to Operational: A Paradigm Shift for Remote Sensing Based Acreage Estimates



## ■ Forest Service

- **Jess Clark**
  - Assessing Post-fire Burn Condition Using Remotely-Sensed Commercial Imagery





# 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>
  - <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>

