



Landsat Science Team / July 2016
**Integrating Field-Level Biophysical Metrics
Derived from Landsat Science Products into a
National Agricultural Data Warehouse Status
Update**

Jim Hipple, PhD

Physical Scientist / Remote Sensing Specialist

USDA Risk Management Agency

Office of Compliance

Strategic Data Acquisition & Analysis (SDAA)



Risk Management Agency



CY2015 Efforts



- Data integration
 - Processing scripts for data ingestion into Teradata appliance (SR, derived indices)
 - Multi-step process
 - Download
 - Process to surface reflectance (Applied GeoSolutions)
 - Compute metrics (NDVI, NDWI, LSWI, ...)
 - ‘Vectorize’ at pixel level (for Teradata)
 - QA/QC

CY2016 Efforts



- Re-scope ‘mapping’ system
 - How do we deliver results to users in a meaningful manner?
 - Combining **USDA FSA (farm program)** data and **USDA RMA (crop insurance)** at the field level (the WHERE)
 - **CLU** (common land unit) => FSA
 - » crop, practice, plant date, acreage
 - **UNIT** (crop unit - basic, optional, enterprise) => RMA
 - » Coverage and losses are determined at a unit level
 - » crop, loss date, cause of loss, reported yield, etc

CY2016 Efforts, continued ..



- Technology ‘refresh’
 - Updated hardware/software
- User training

- Not a lot of ‘sexy’ remote sensing going on => a lot of work on background
 - Mapping core re-engineered
 - Geospatial Enterprise Architecture (completed by RMA CIO)
 - Data integration

Lessons learned as they relate to the Landsat Program



- Data Mining: We would rather use analysis ready products than ingesting raw Landsat data
 - Vectorization was a challenge
 - Options for National level analysis ready data sets
 - We spent too much time on data ingestion & preprocessing and not enough on analysis
- Case Work: Landsat 8 is proving useful and is high quality
 - Most of our work lags back on average 2-3 years

Old Mapping



The screenshot displays a web-based mapping application. The main map area shows the United States with a greenish-brown background and a white grid overlay. Two arrows point from the text labels to the toolbar and legend.

Map Tools

Spatial Layers

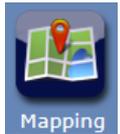
Map Interface Elements:

- Toolbar (Left):** A vertical toolbar containing various icons for map navigation and interaction, such as pan, zoom, and home.
- Legend (Right):** A panel titled "Spatial Layers" with a "Refresh Map" button and a checked "Automatically Refresh" checkbox. It is divided into "Image Layers" and "Base Layers".
 - Image Layers:** Includes "NAIP Photo 2013" with a "Set" button.
 - Base Layers:** Includes "States", "Counties", "RCO", and "RO", each with a visible checkbox and a legend icon.

HyDRA Mapping Viewer



Connects users to a new interactive window displaying spatial RMA, FSA, and weather data on a map for the 48 contiguous states.



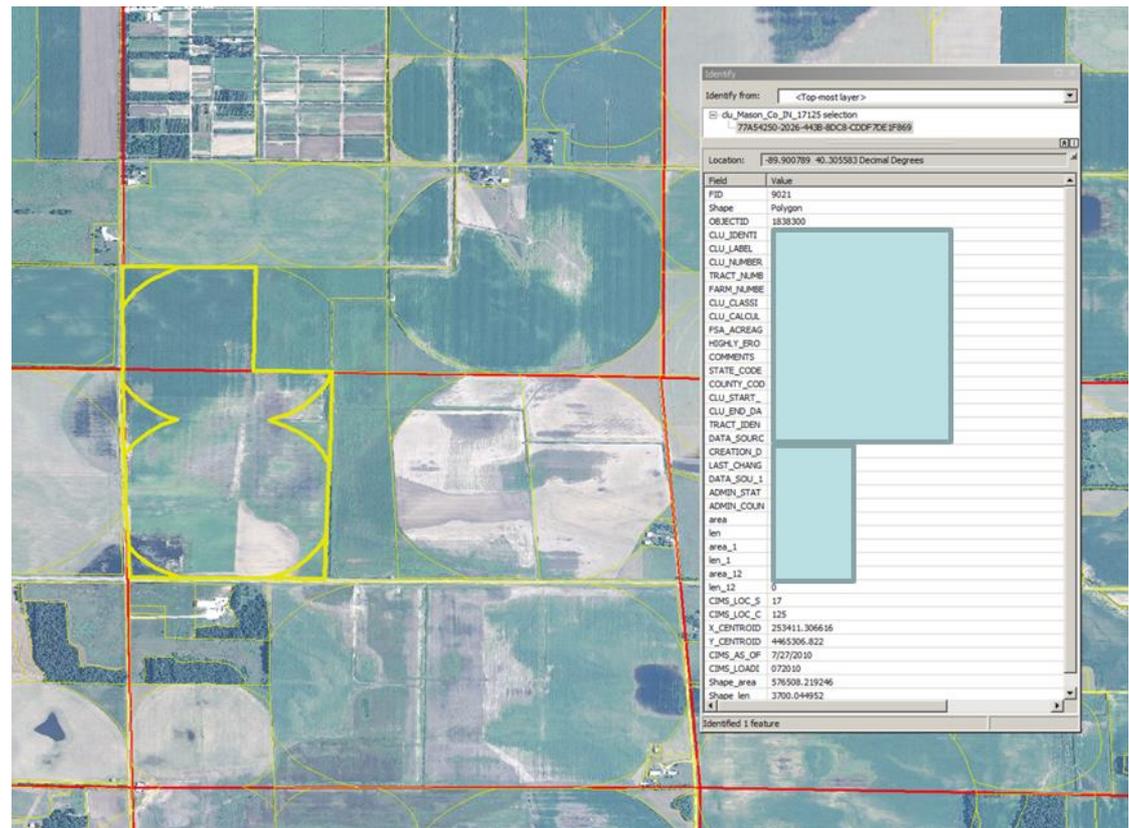
The screenshot displays the HyDRA Mapping Viewer interface. The main map shows the contiguous United States with state boundaries and major cities. The interface includes several key components:

- Map Tools:** A toolbar at the top center containing navigation and interaction icons.
- Spatial Layers:** A vertical sidebar on the left with a list of layers. The 'STATE' layer is checked, and other options include 'HAIL (Daily)', 'PRISM (Monthly)', 'PRECIPITATION (Daily)', 'RADAR (10 minutes)', 'NEXRAD STATIONS', 'CLU (Yearly)', 'PLSS', 'HIGH RISK LAND (Yearly)', 'RCO', 'RO', 'COUNTY', and 'Imagery and Base Maps'.
- Legend:** A window on the right titled 'Visible Layers' showing 'STATE' with a checked box and 'ESRI Basemap: Topographic'.
- Map Date:** A header at the top left indicating 'Map Date: Jan 1, 2014'.
- Scale:** A scale bar at the bottom left showing 400km and 300mi.
- Table:** A 'Table' button at the bottom right.

FSA CLU Identification



- identified by farm, tract, and field numbers
- each CLU gets a unique identifier called the CLU ID
- CLU ID is a globally unique identifier (GUID) that is system generated, primarily used by automated systems, and generally not known by the producer





The RMA Unit: What is it?



- acreage considered when determining guarantee, premium, and amount of any indemnity
 - basic unit
 - optional unit
 - enterprise unit



Crop Timeline Summary

(as reported to Insurance Company)

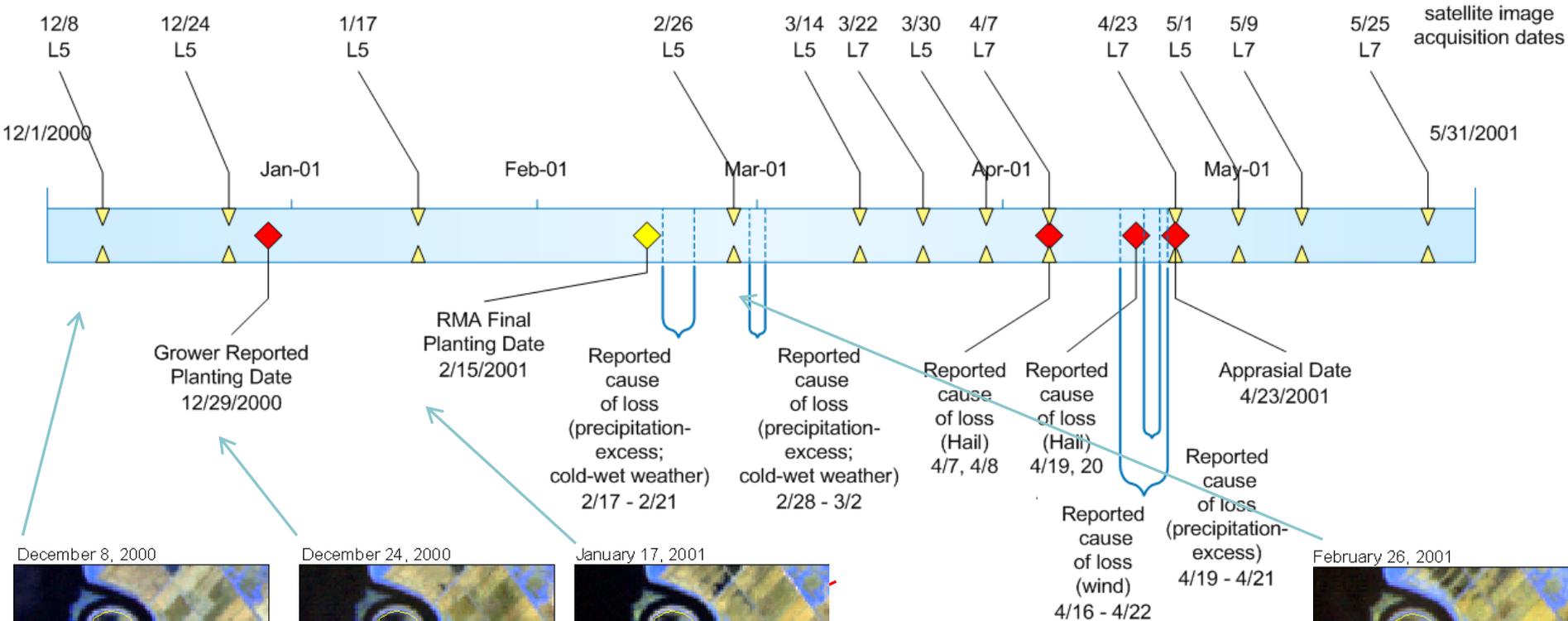


- Grower Reported Planting Date: December 29, 2000
- Grower Reported Acreage: 647.9 acres
- RMA Final Planting Date: February 15, 2001
- Grower Reported Cause of Loss Date: February 17 – 21, 2001
Cause of Loss: precipitation (excess), cold-wet weather
- February 28 – March 2, 2001
precipitation (excess), cold-wet weather
- April 7, 8, 19, 20, 2001
hail
- April 16-22, 2001
wind
- April 19-21, 2001
precipitation (excess)
- Loss Adjustment Appraisal Date: April 23, 2001

Crop & Satellite Image Timeline

8-DAY FREQUENCY EXAMPLE

Crop Year 2001 Timeline: WHEAT



December 8, 2000



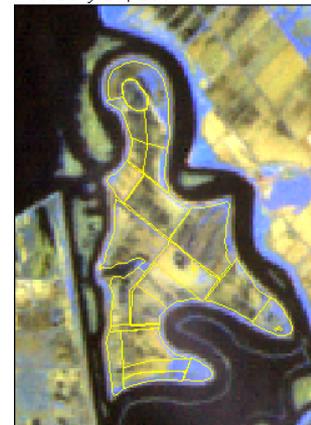
December 24, 2000



January 17, 2001



February 26, 2001



Standing water and water saturated soil is evident on numerous fields December 8, 2000 through January 17, 2001.

The area under standing water and water saturated soil increases through January 17, 2001.

Most of the standing water or water saturated soil is gone by February 26, 2001.

Site Visit: December 15, 2009



Precipitation between
December 1, 2009 & December 17, 2009 (~2.09")

FSA NAIP Aerial (June 2003)



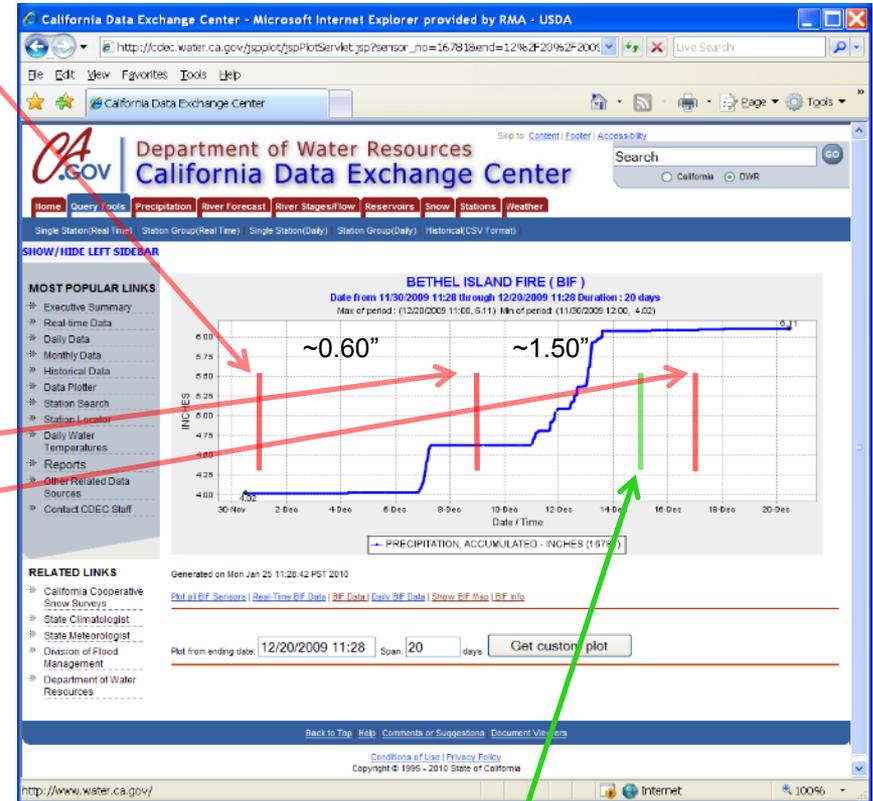
Landsat - December 1, 2009



Landsat - December 9, 2009



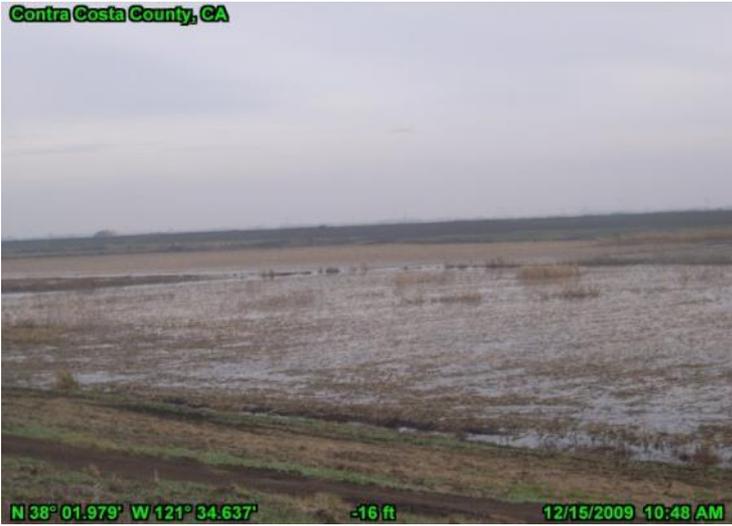
Landsat - December 17, 2009



Site Visit

Site Visit: December 15, 2009

Contra Costa County, CA



N 38° 01.979' W 121° 34.637' -16 ft 12/15/2009 10:48 AM

Looking east toward Tract 1169, Field 3 (standing water).



N 38° 02.323' W 121° 34.636' -52 ft 12/15/2009 11:09 AM

Looking east toward Tract 1169, Field 14 (standing water).

Contra Costa County, CA



N 38° 02.226' W 121° 34.379' -26 ft 12/15/2009 11:24 AM

Looking west toward Tract 1169, Field 2 (no standing water).



Contra Costa County, CA



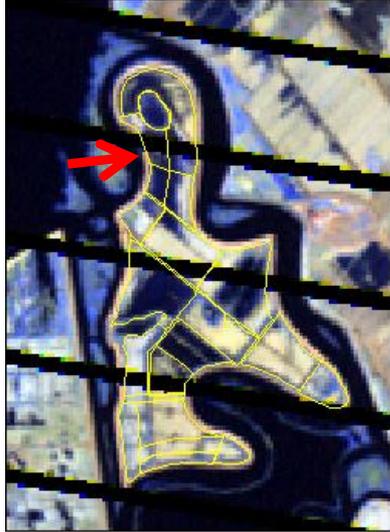
N 38° 01.098' W 121° 34.426' -39 ft 12/15/2009 1:01 PM

Looking west toward Tract 1169, Field 13 (standing water). 14

Field Condition Comparison



December 9, 2009



December 17, 2009



Imagery acquired concurrent with December 15, 2009 site visit

Contra Costa County, CA



Looking east toward Tract 1169, Field 3 (standing water)

December 24, 2000



January 17, 2001



2000/2001 satellite imagery, and 2009 satellite imagery acquired concurrent with December 15, 2009 site visit, are indicative of standing water and water saturated soil in fields

The grower reported a planting date of December 29, 2000 – five days after the December 24, 2000 image. Between the December 24, 2000 image and the January 17, 2001 image the amount of standing water and water saturated soil increased.

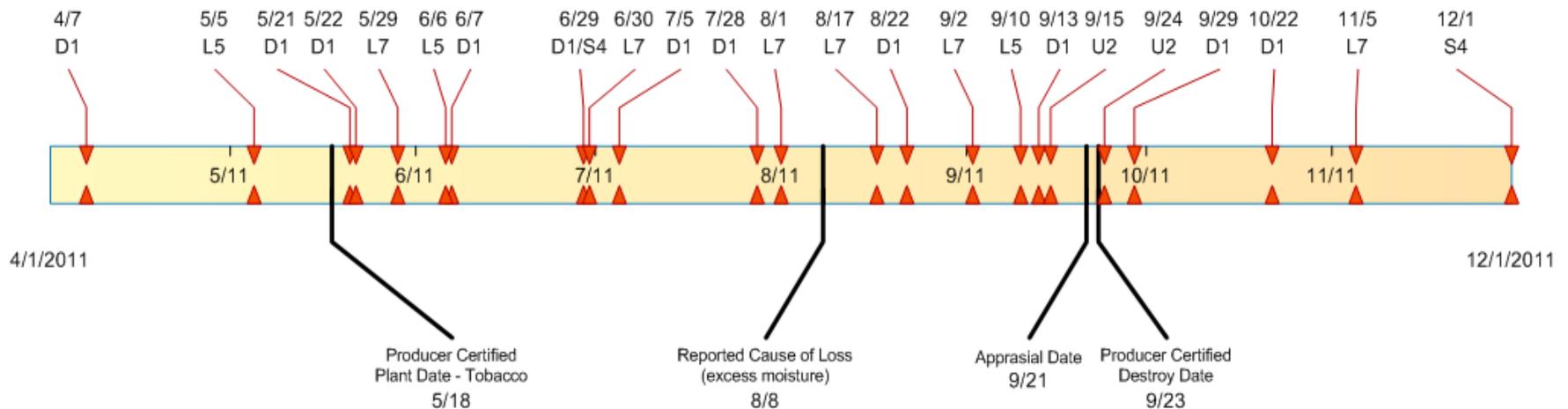
Crop Timeline



8-DAY FREQUENCY EXAMPLE (plus DMC (USDA) & SPOT (USGS/USDA))

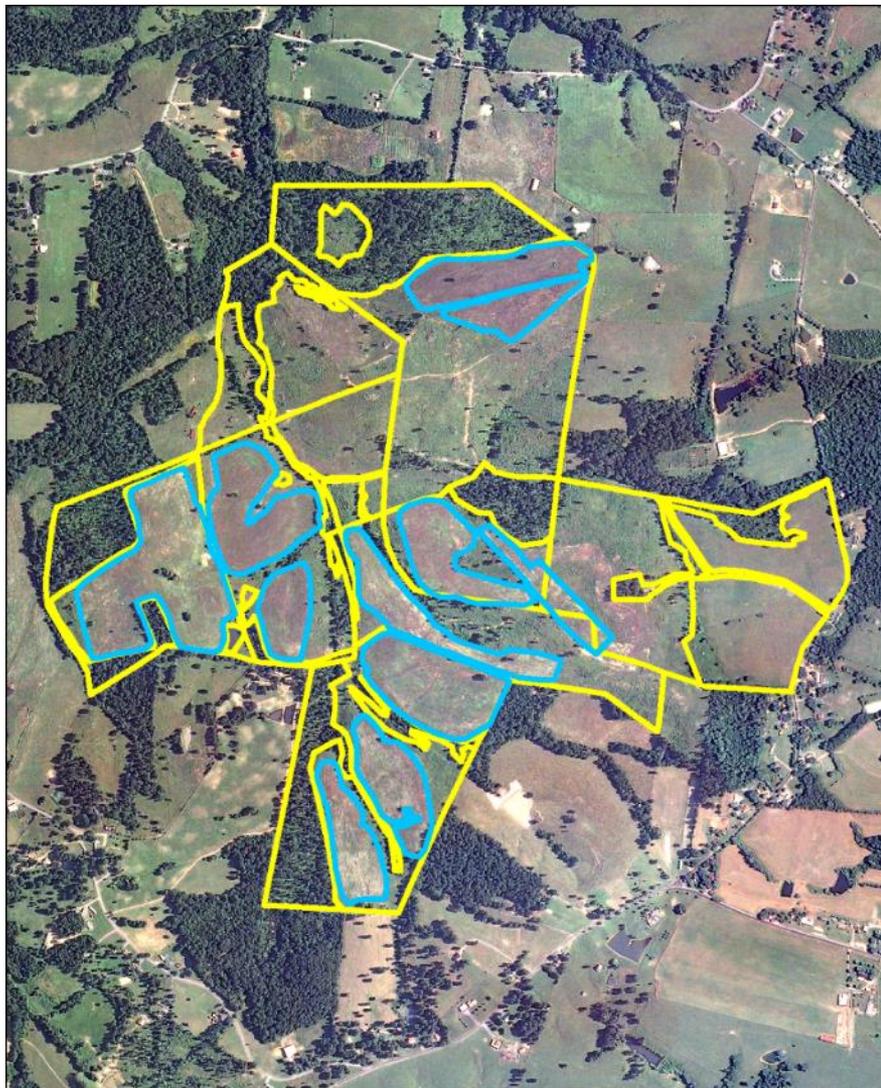
Satellite Imagery Sources

- D1: Deimos 1
- L5: Landsat 5
- L7: Landsat 7
- S4: SPOT 4
- U2: DMC UK-2



Satellite imagery was acquired from Landsat 5 (30-meter pixel), Landsat 7 (30m) and SPOT 4 (20m) (Source: USGS); and Disaster Monitoring Constellation (DMC) Demios-1 (23m) and UK-2 (23m).

Field Preparation

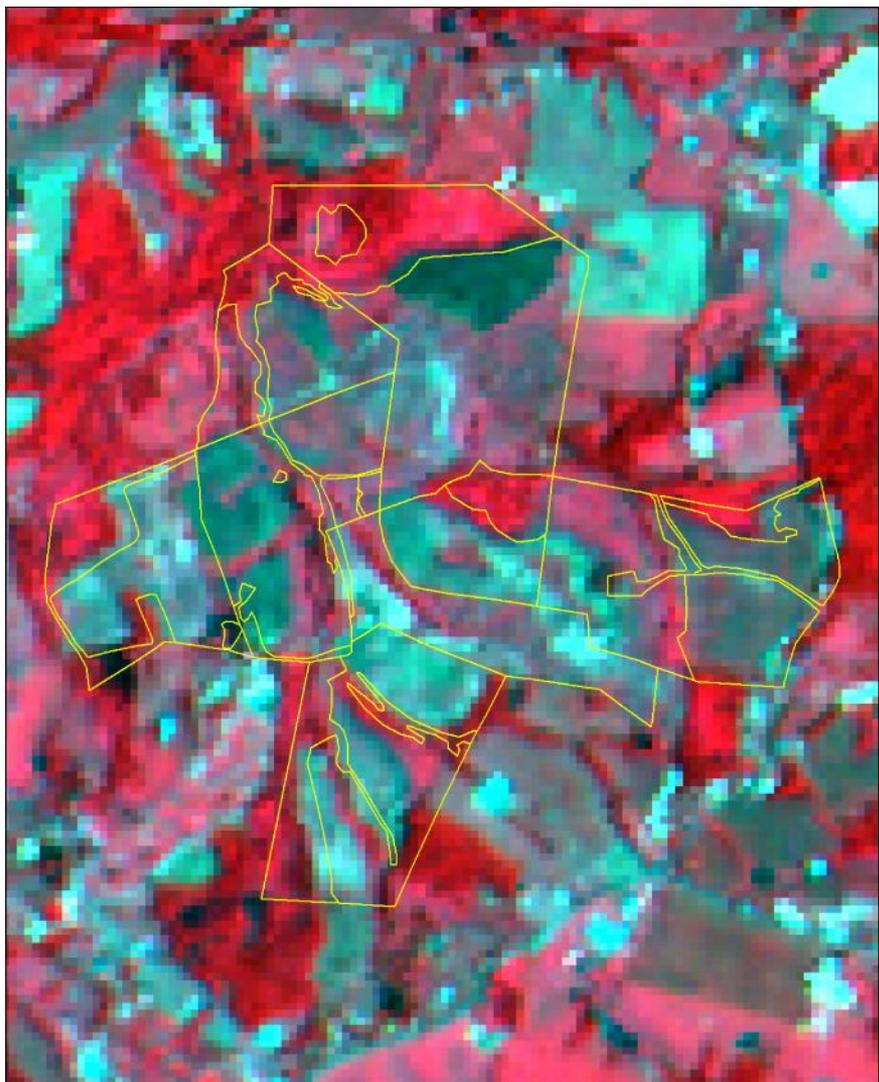


The blue boundaries represent areas that were prepared by the producer. The acreage measurements derived from the imagery are presented in parentheses.

Were the fields prepared by the producer reported planting date?

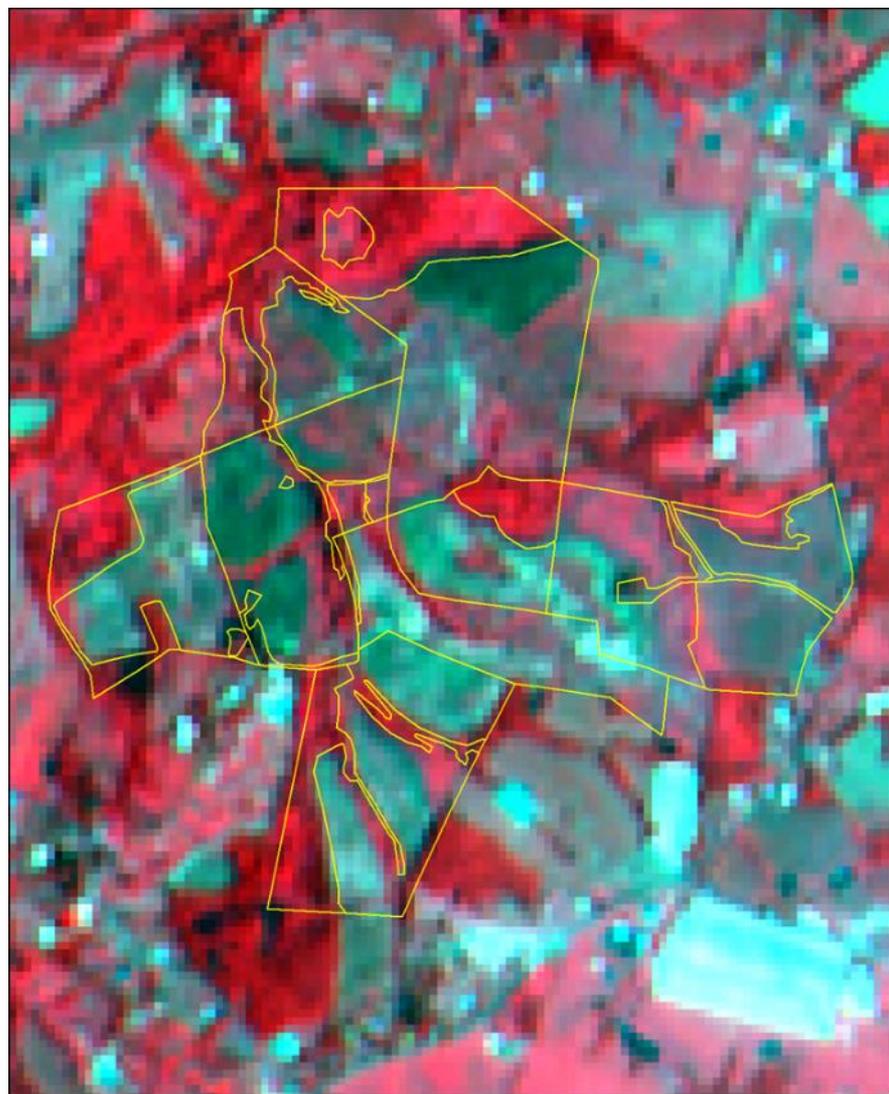
The field break-out date is identified via satellite imagery and presented in the following slides.

The producer reported planting by **June 20** (final planting date of **June 23**)



SPOT 4

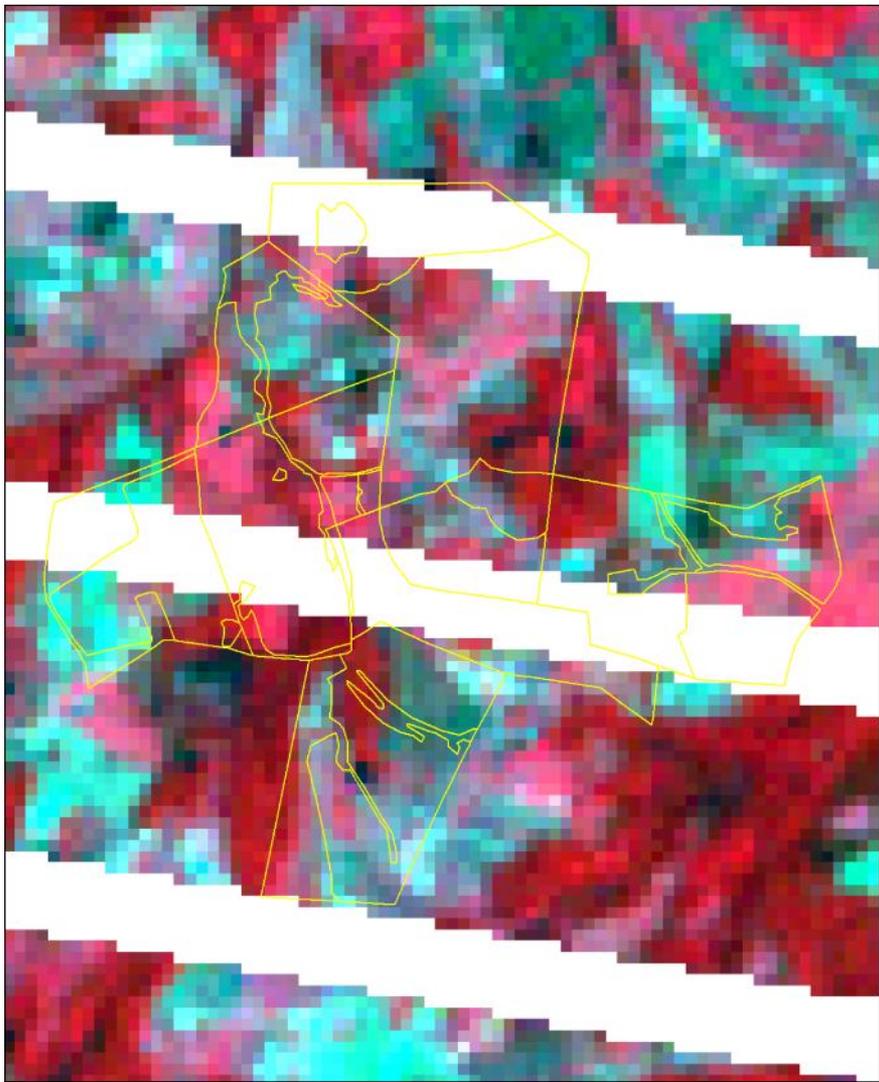
June 3



SPOT 4

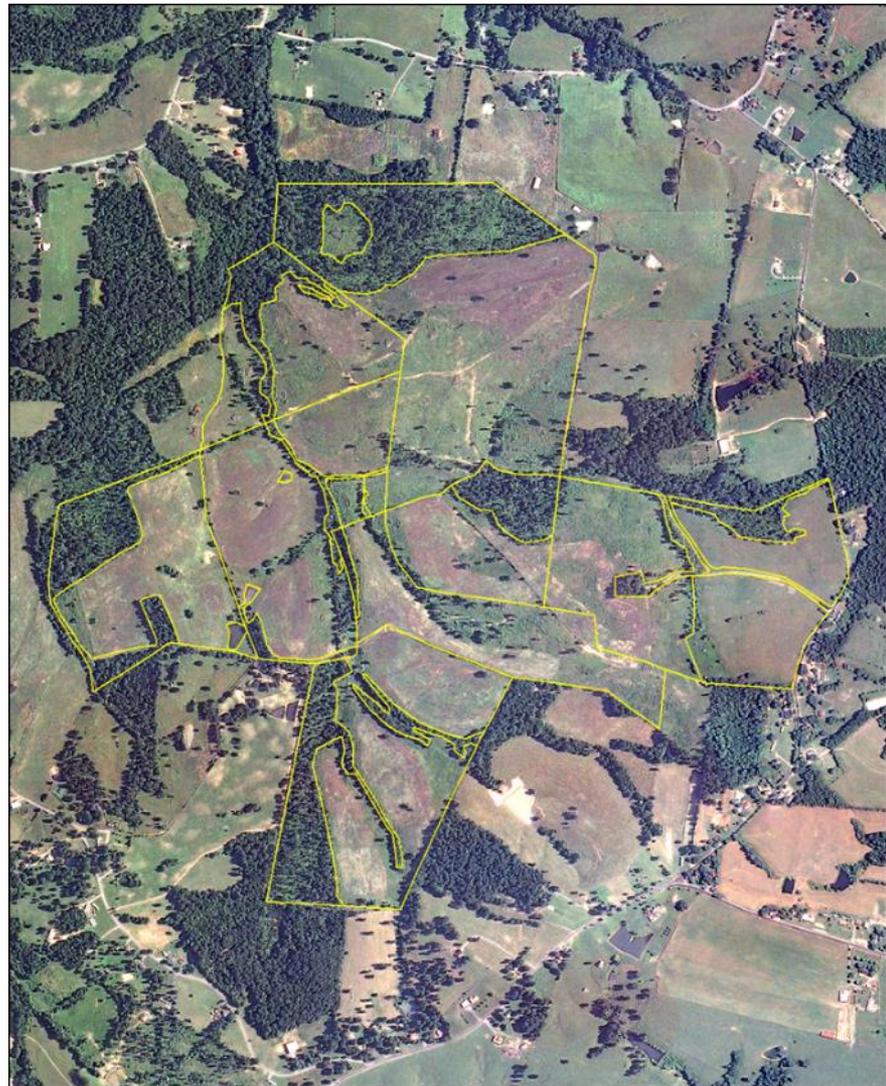
June 8





June 18

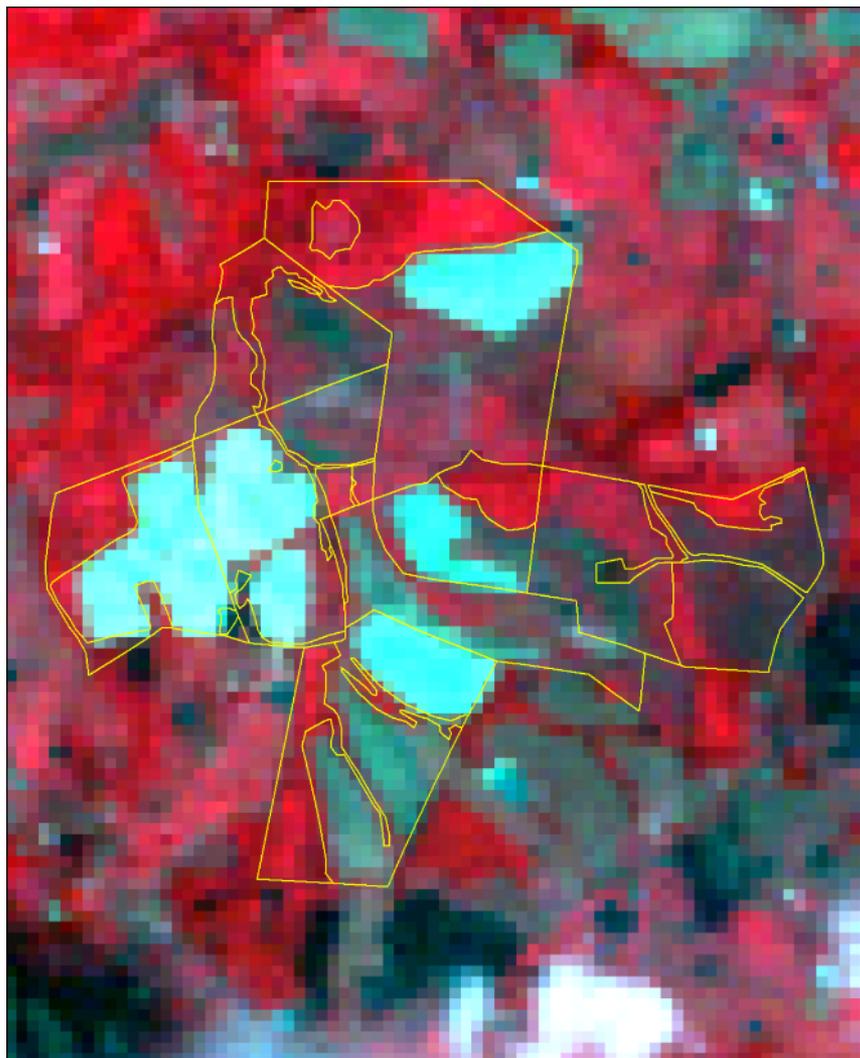
Landsat 7



June 21

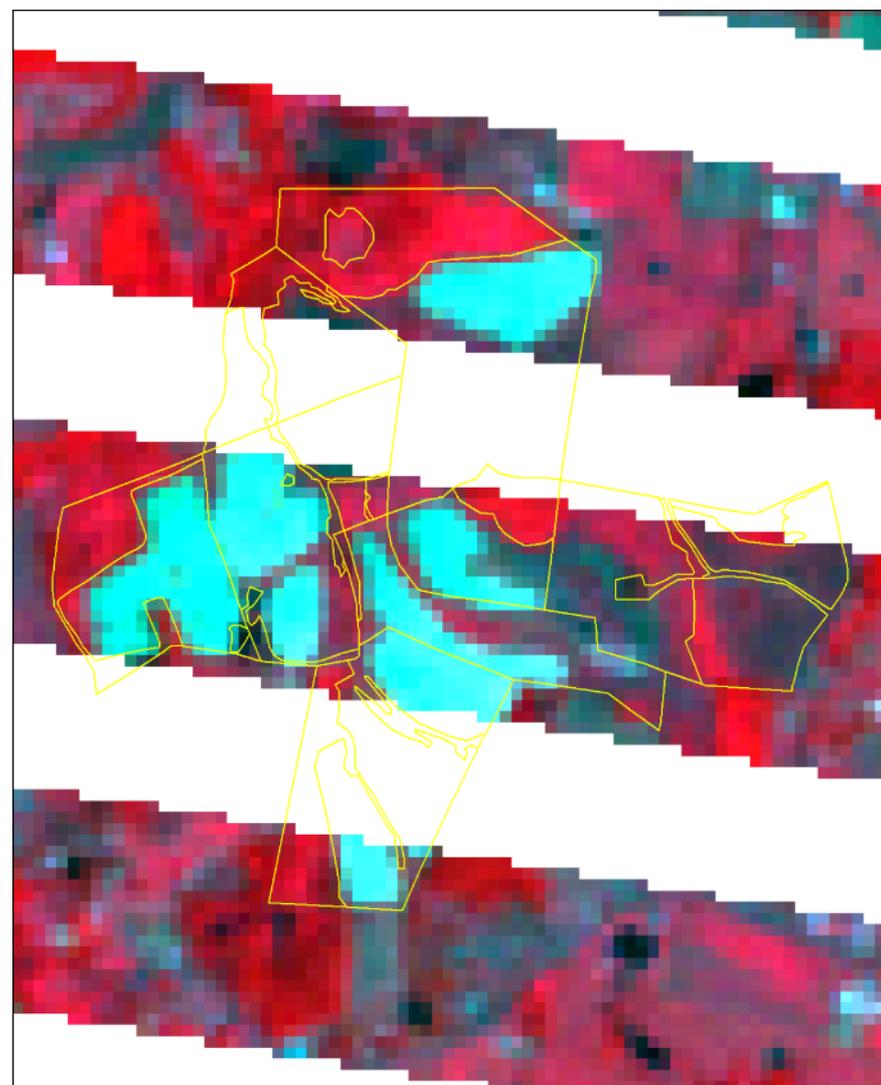
USDA FSA NAIP





June 26

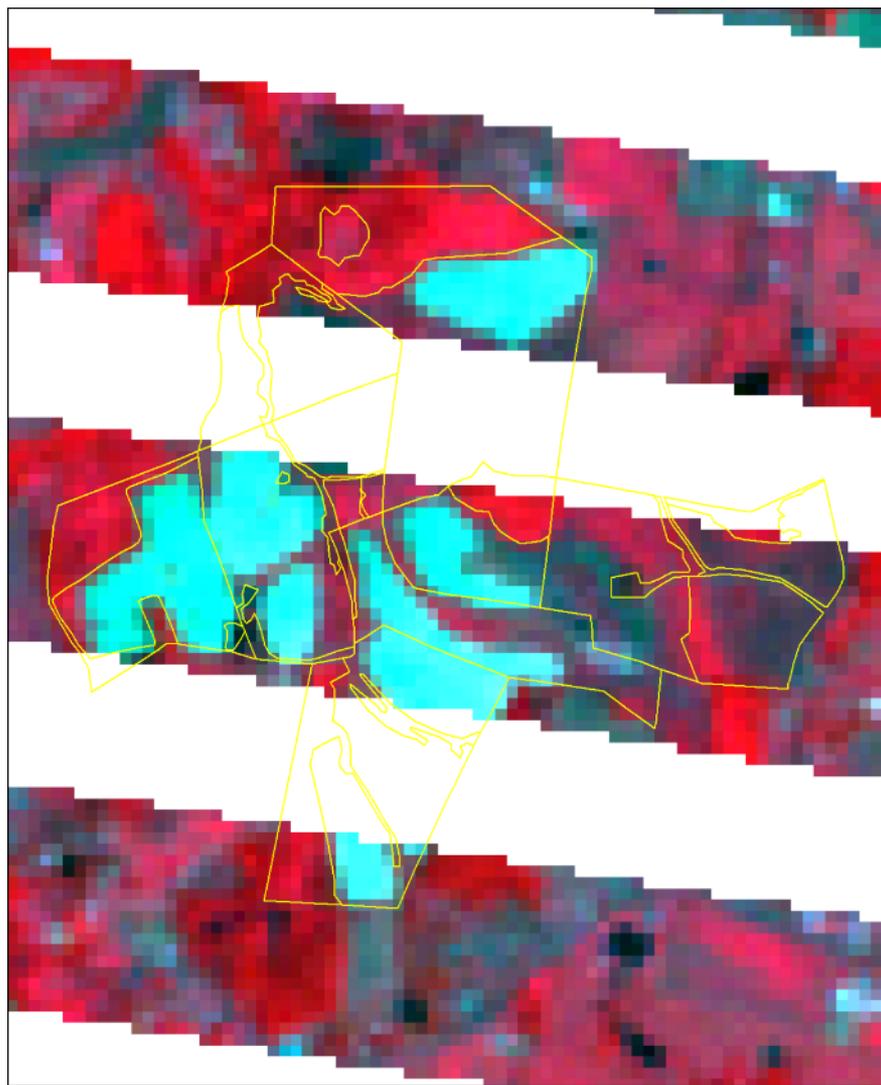
Landsat 5



June 27

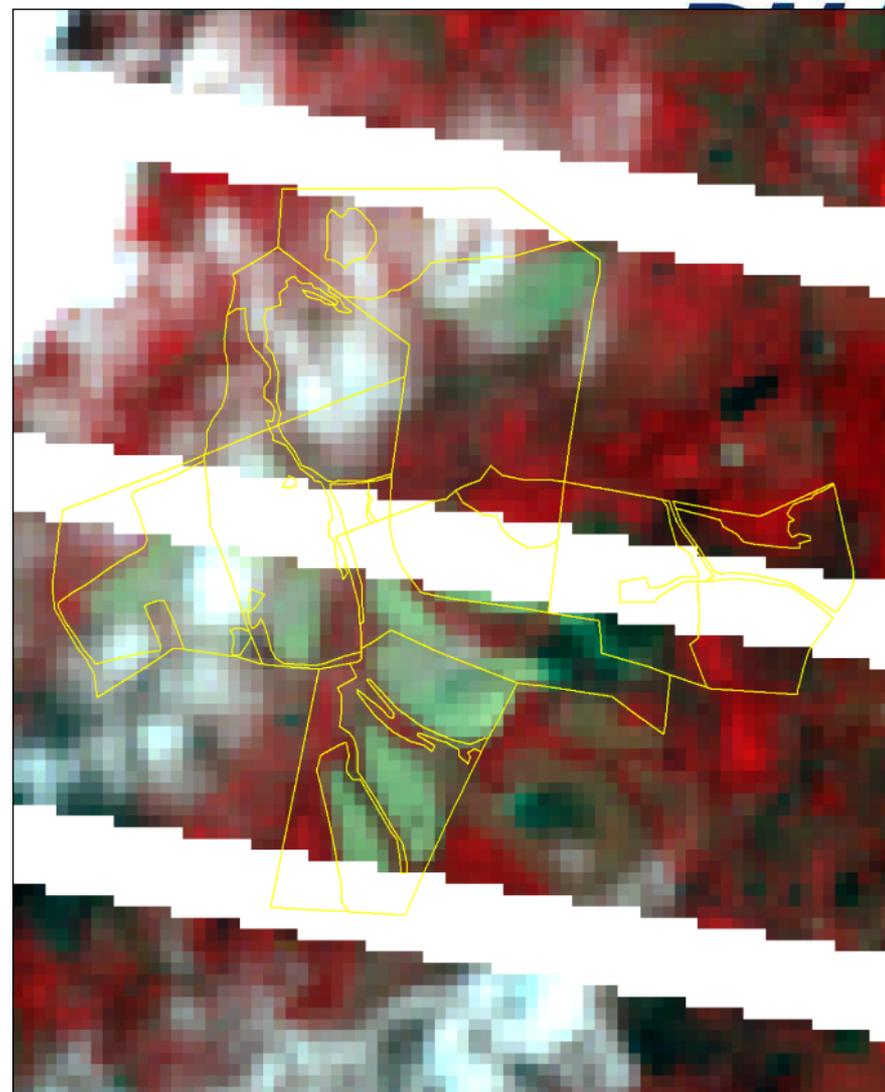
Landsat 7





June 27

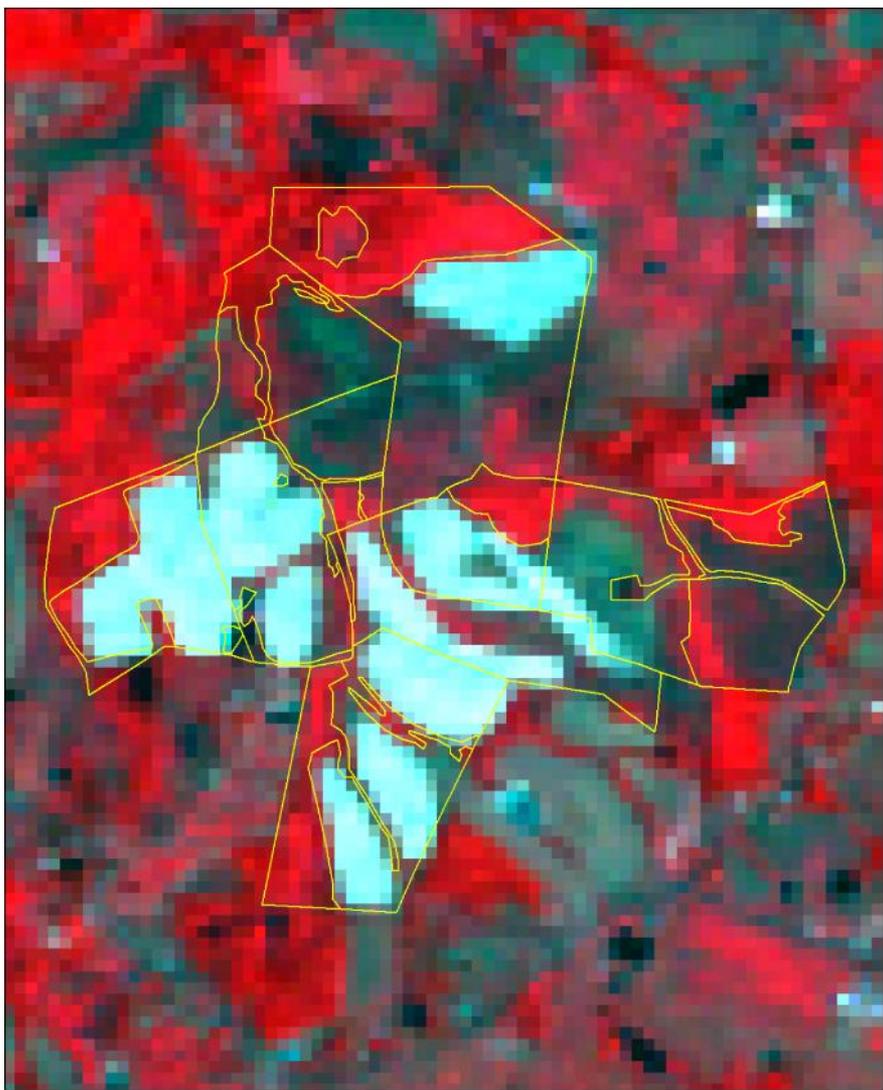
Landsat 7



July 4

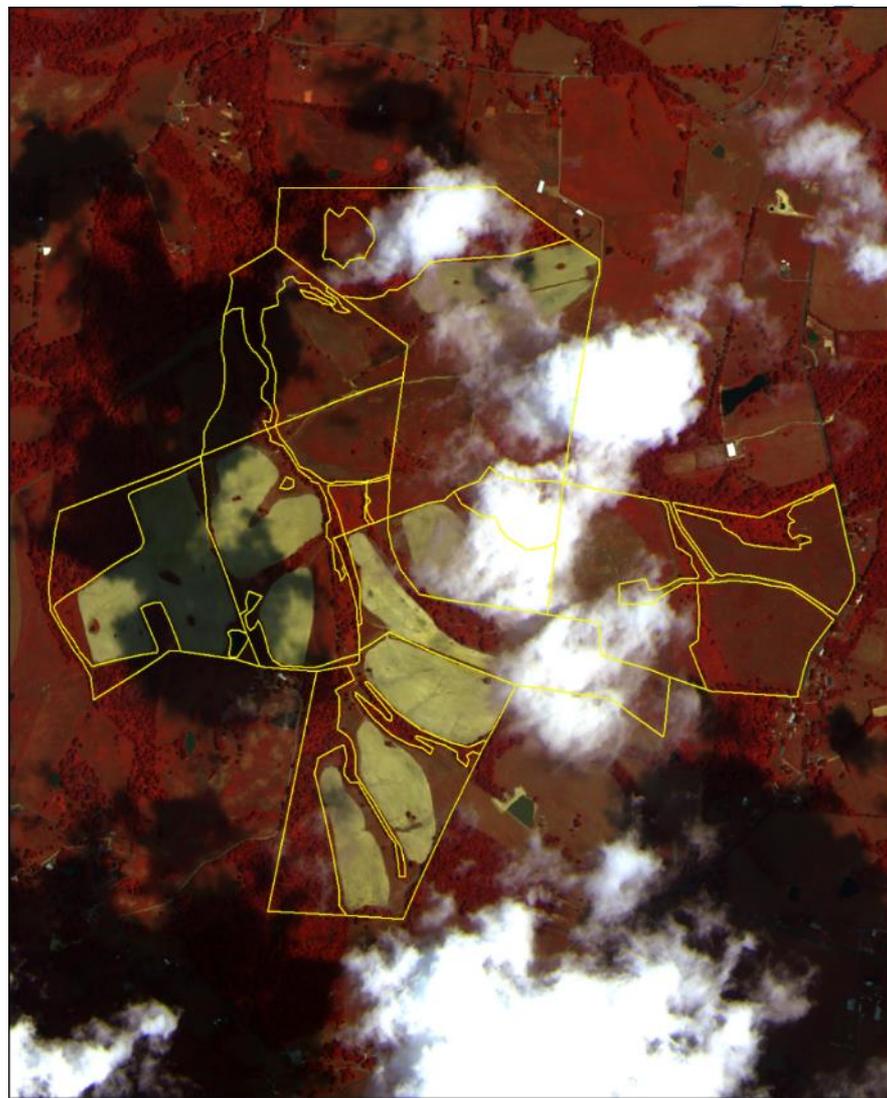
Landsat 7





July 5

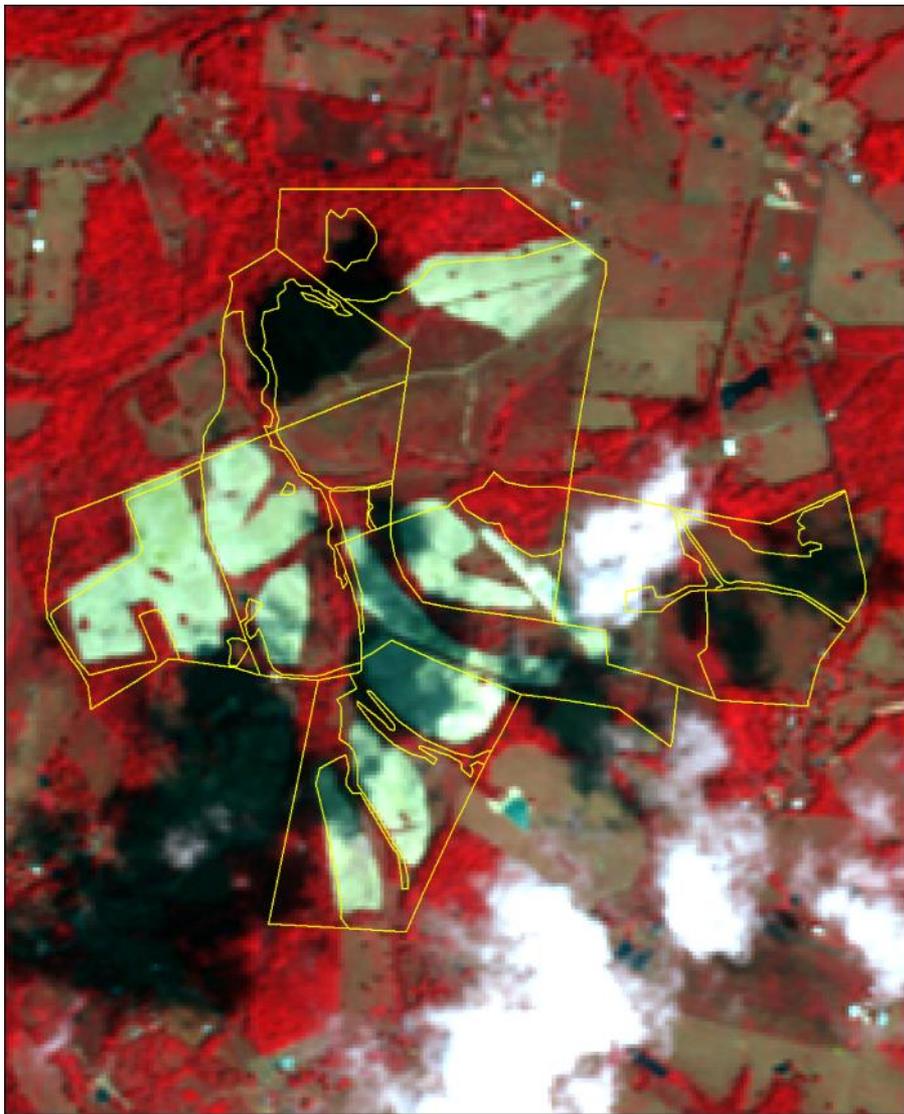
Landsat 5



July 10

WorldView-2 (multi)

22



August 6

SPOT 5



August 17

SPOT 5



Questions?



James D. Hipple, PhD

USDA Risk Management Agency

Office of Compliance

Business Analytics Division (BA)

Phone: (202) 297-9328

Email: james.hipple@rma.usda.gov