

# **Feature Mapping and Decision Support with Digital and Analog Air- borne Data Mesh**

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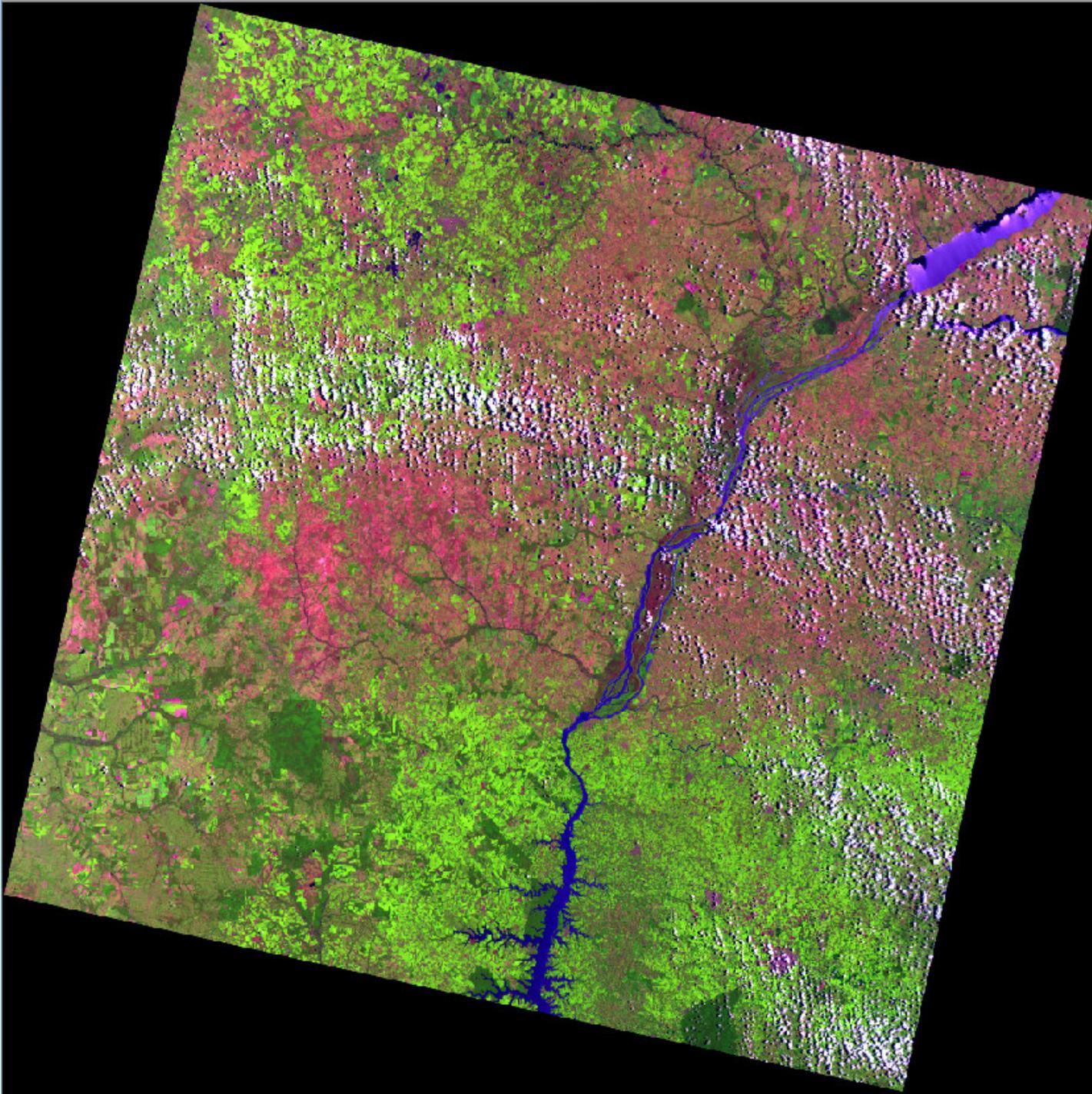
**Civil Commercial Imagery Evaluation Workshop  
the Joint Agency Commercial Imagery Evaluation (JACIE)  
March 25-27, 2008**



# Crops

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**P6-AWiFS:**  
**02/03/2008**  
**path 322**  
**row 93**  
**quad D**  
**Brazil/Paraguay**



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# Crops

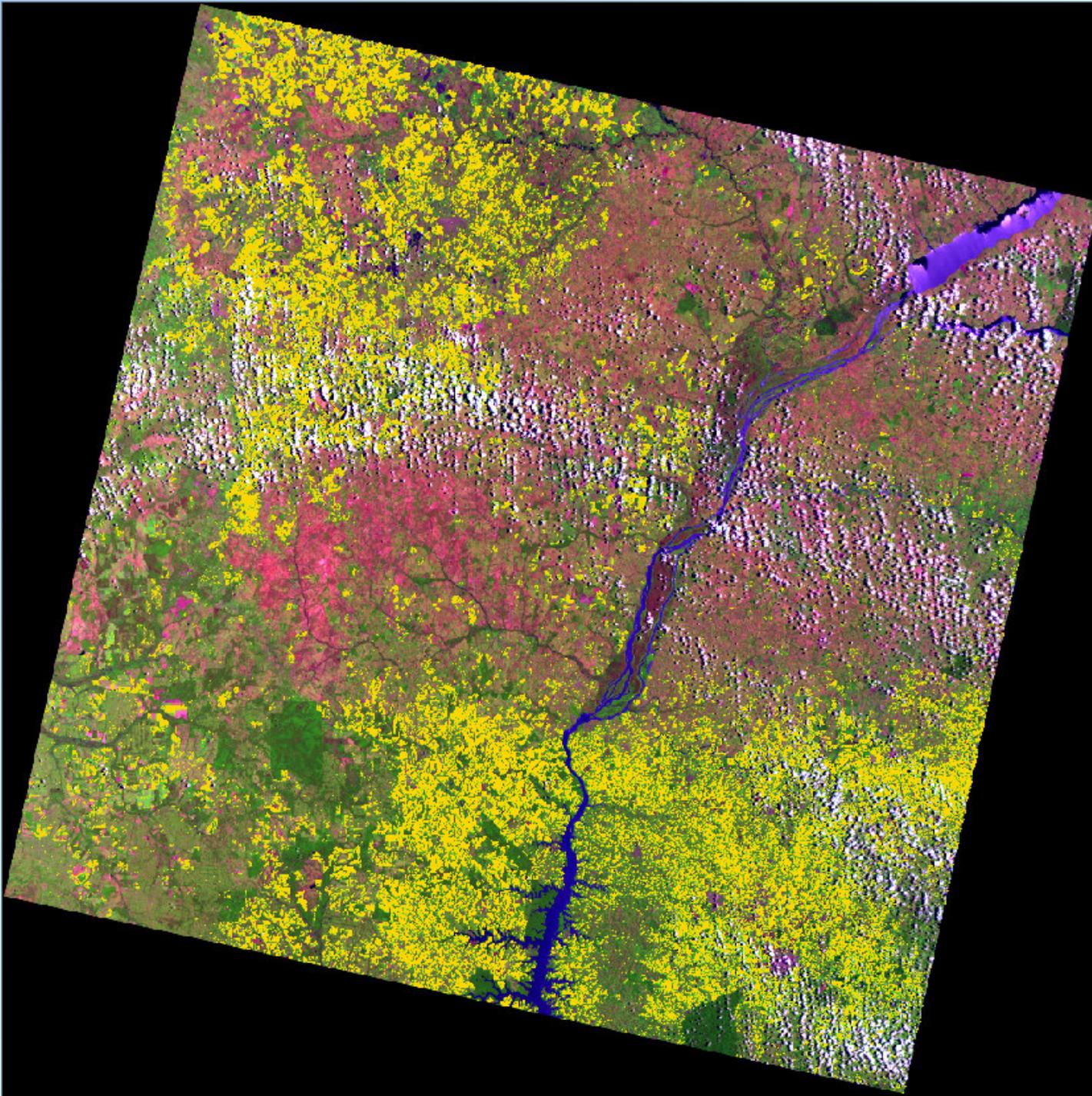
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**P6-AWiFS:**  
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 soybeans



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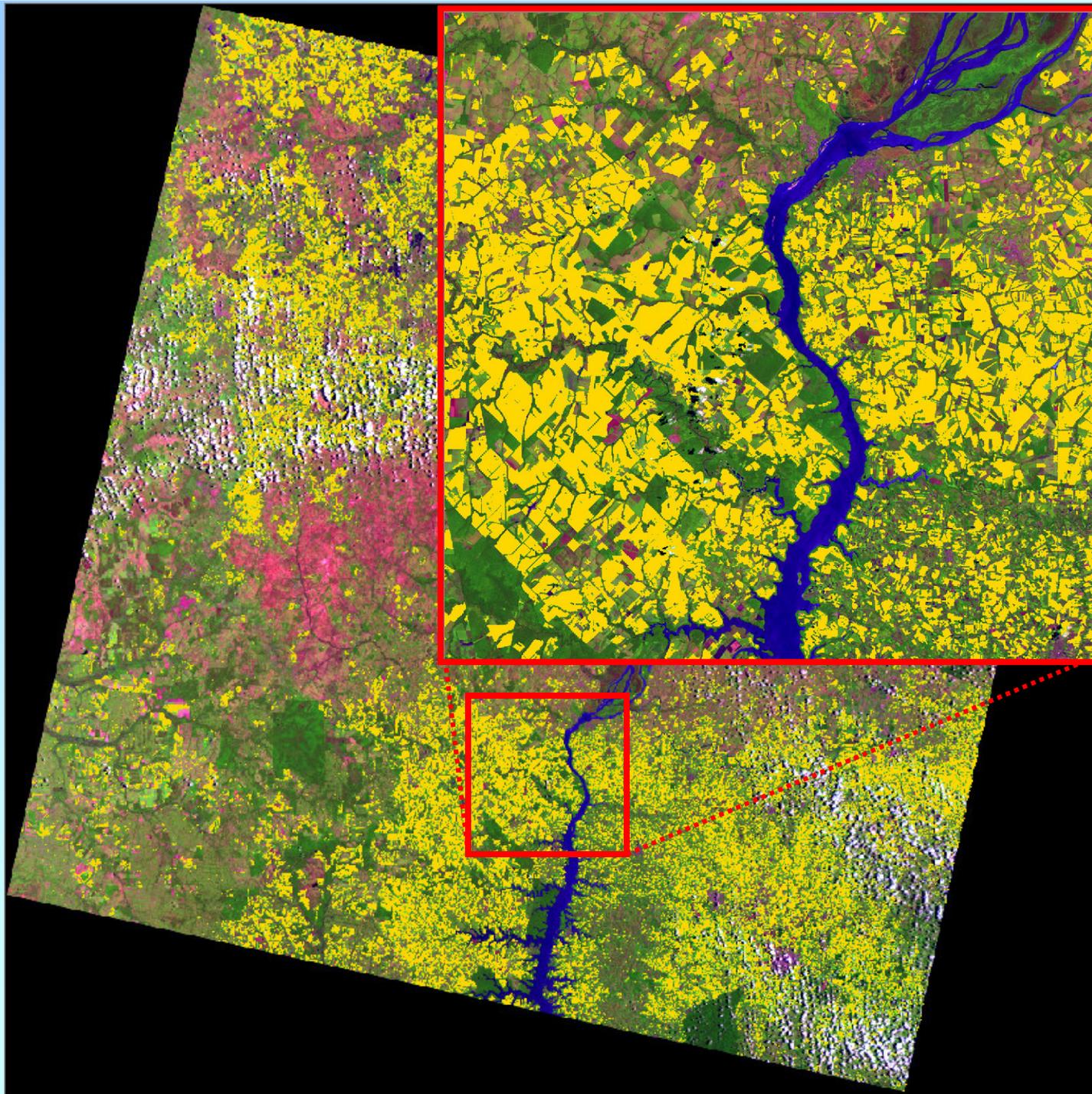
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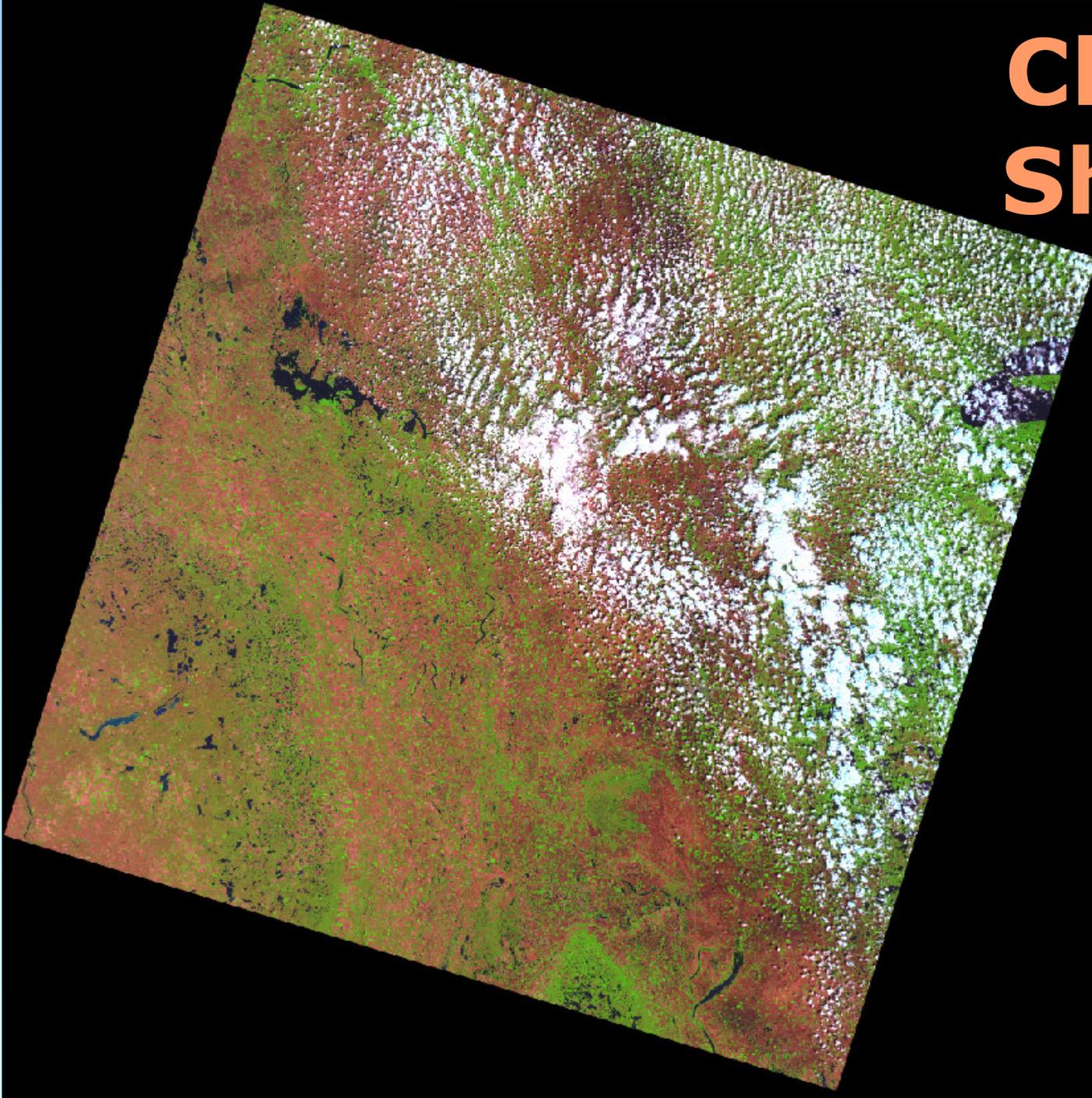
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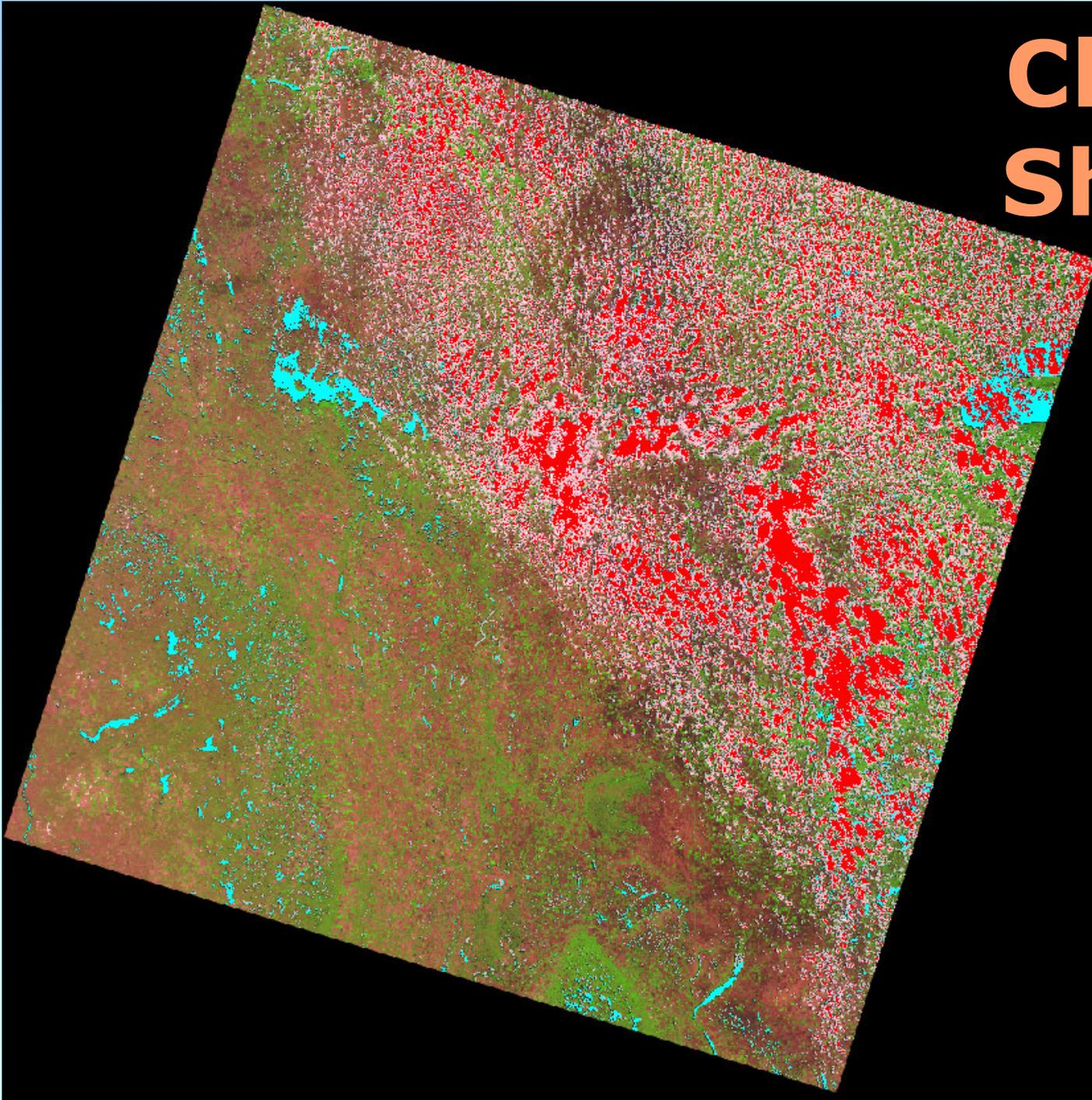
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# Clouds & Shadows



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# Clouds & Shadows

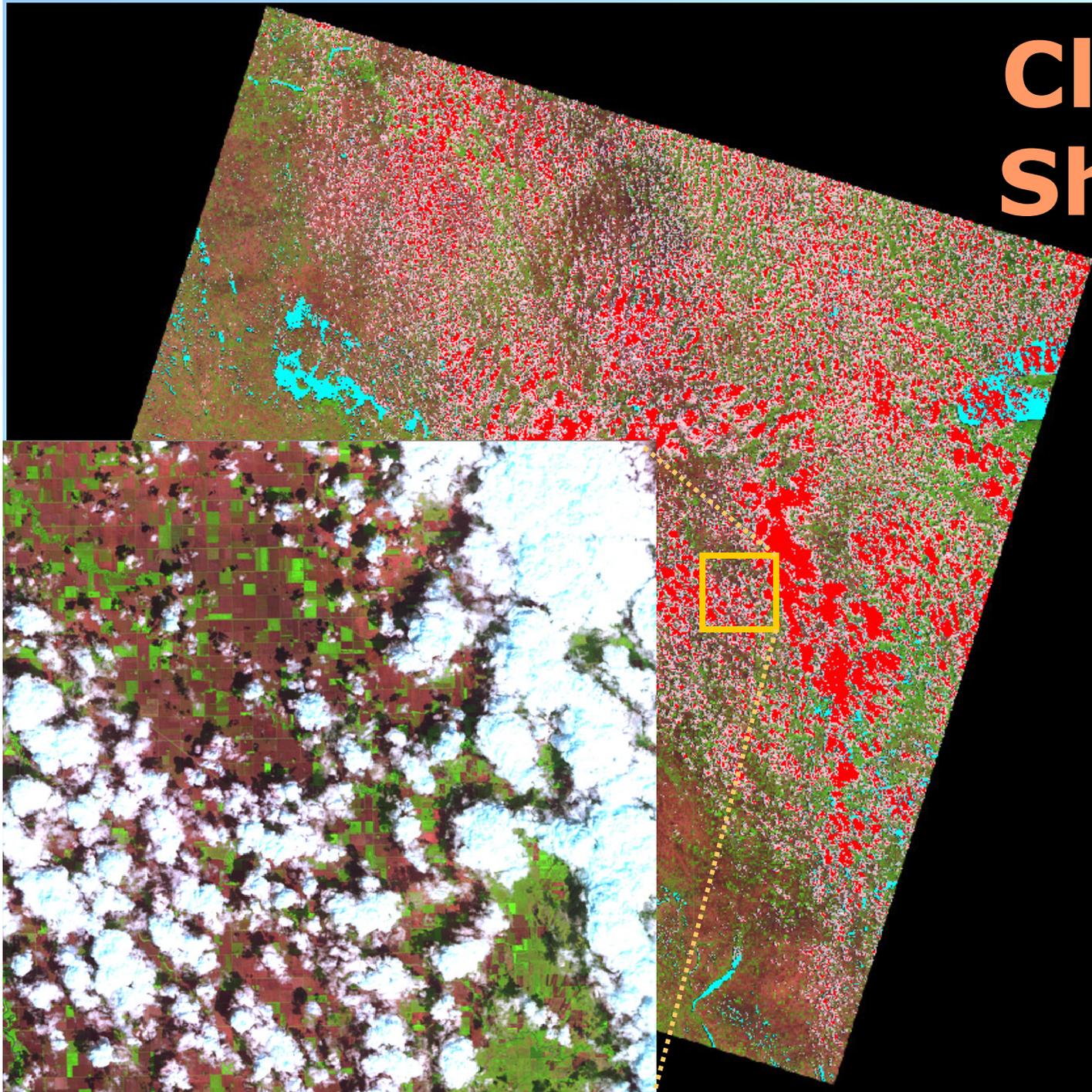


-  dense cloud
-  light cloud / haze
-  cloud shadow
-  water



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# Clouds & Shadows

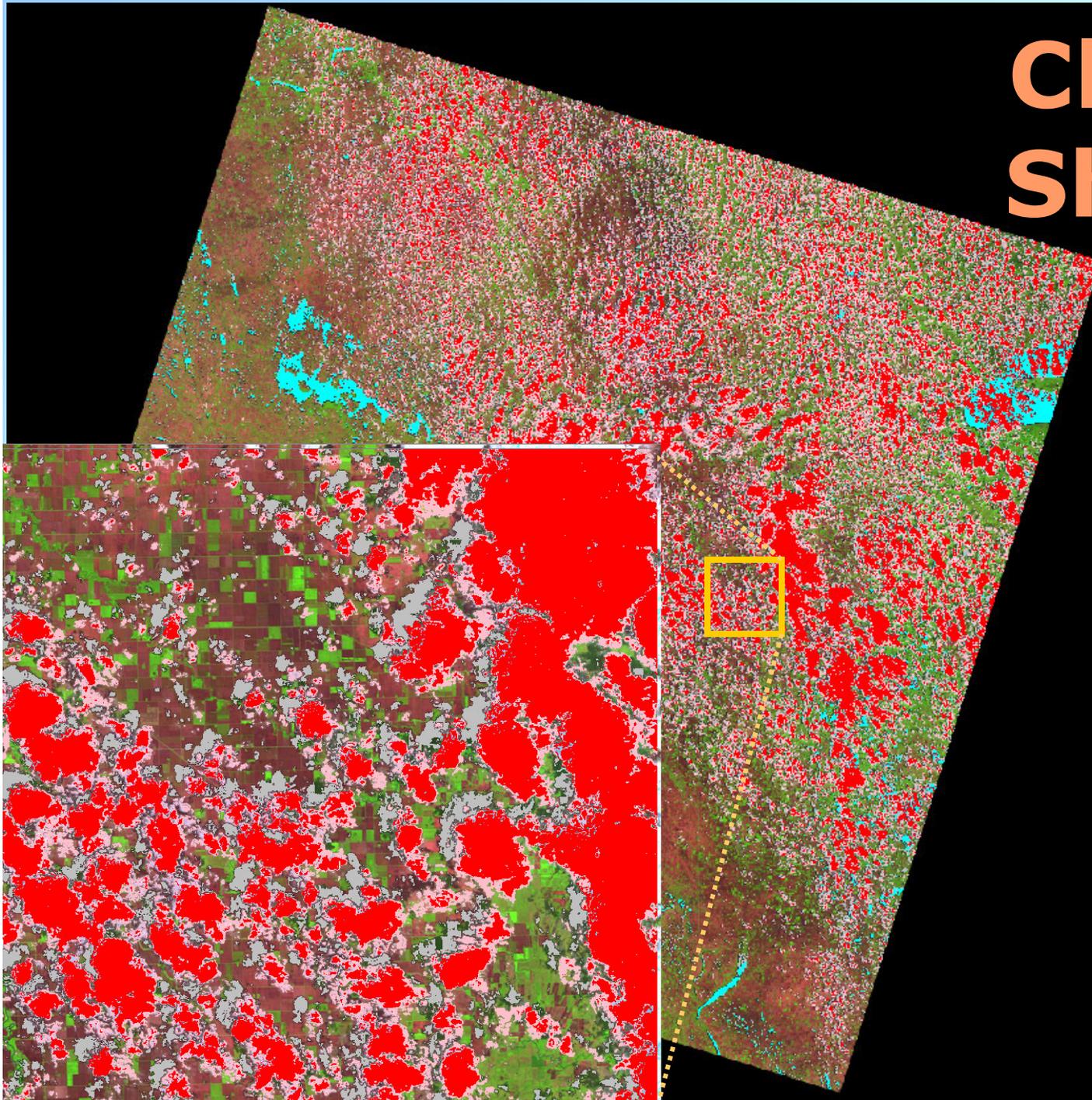


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# Clouds & Shadows



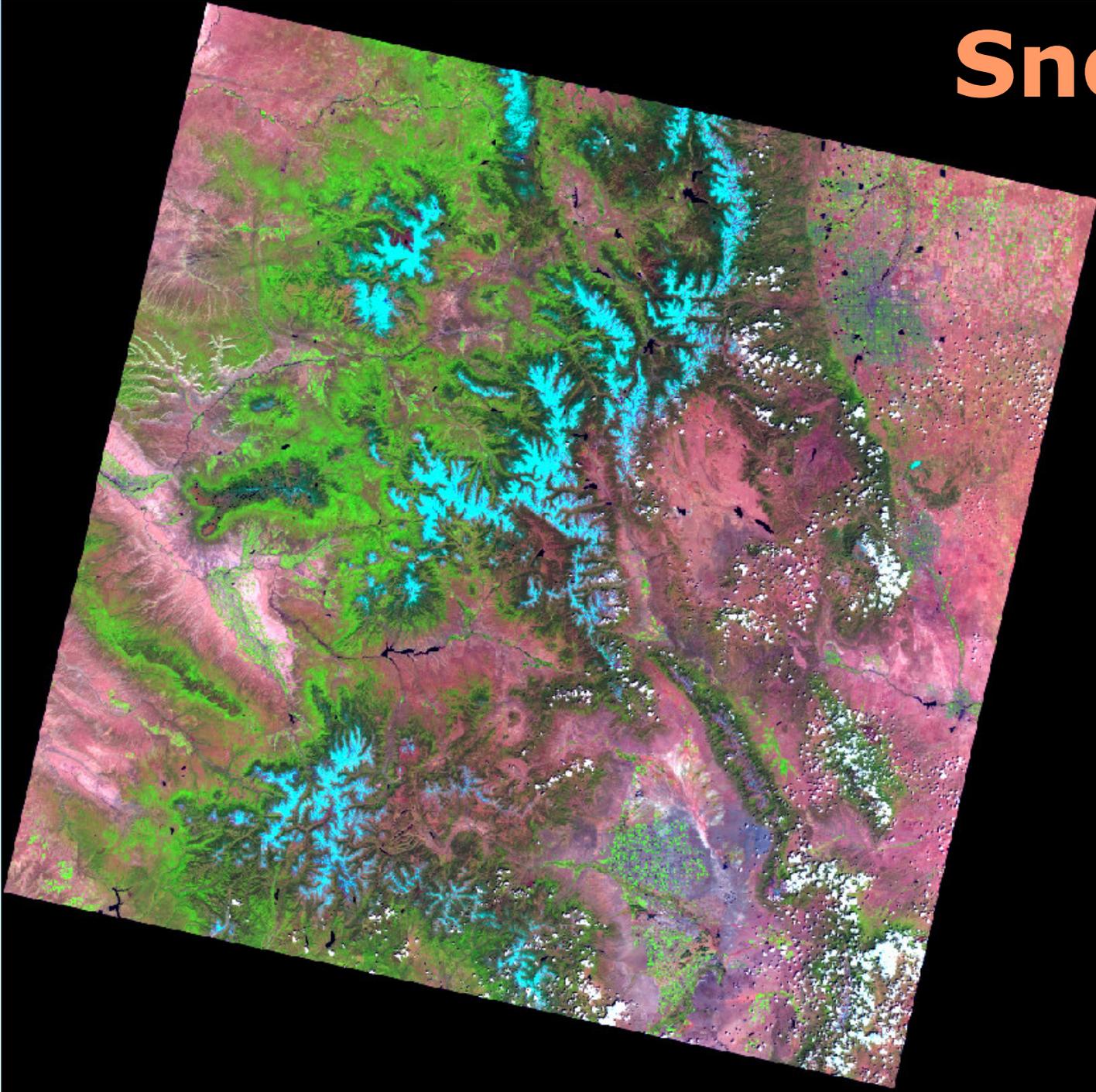
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# Snow/Ice

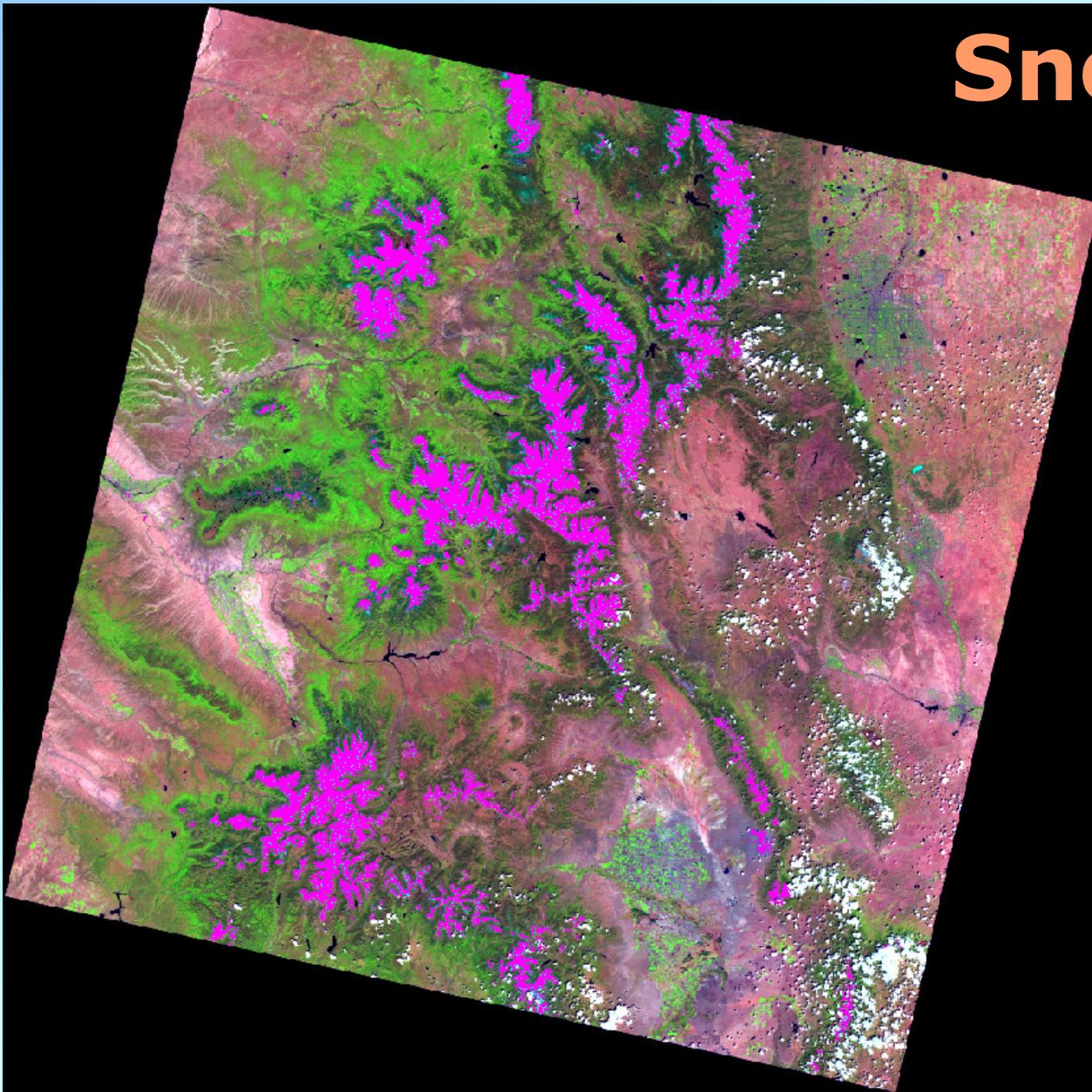
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# Snow / Ice

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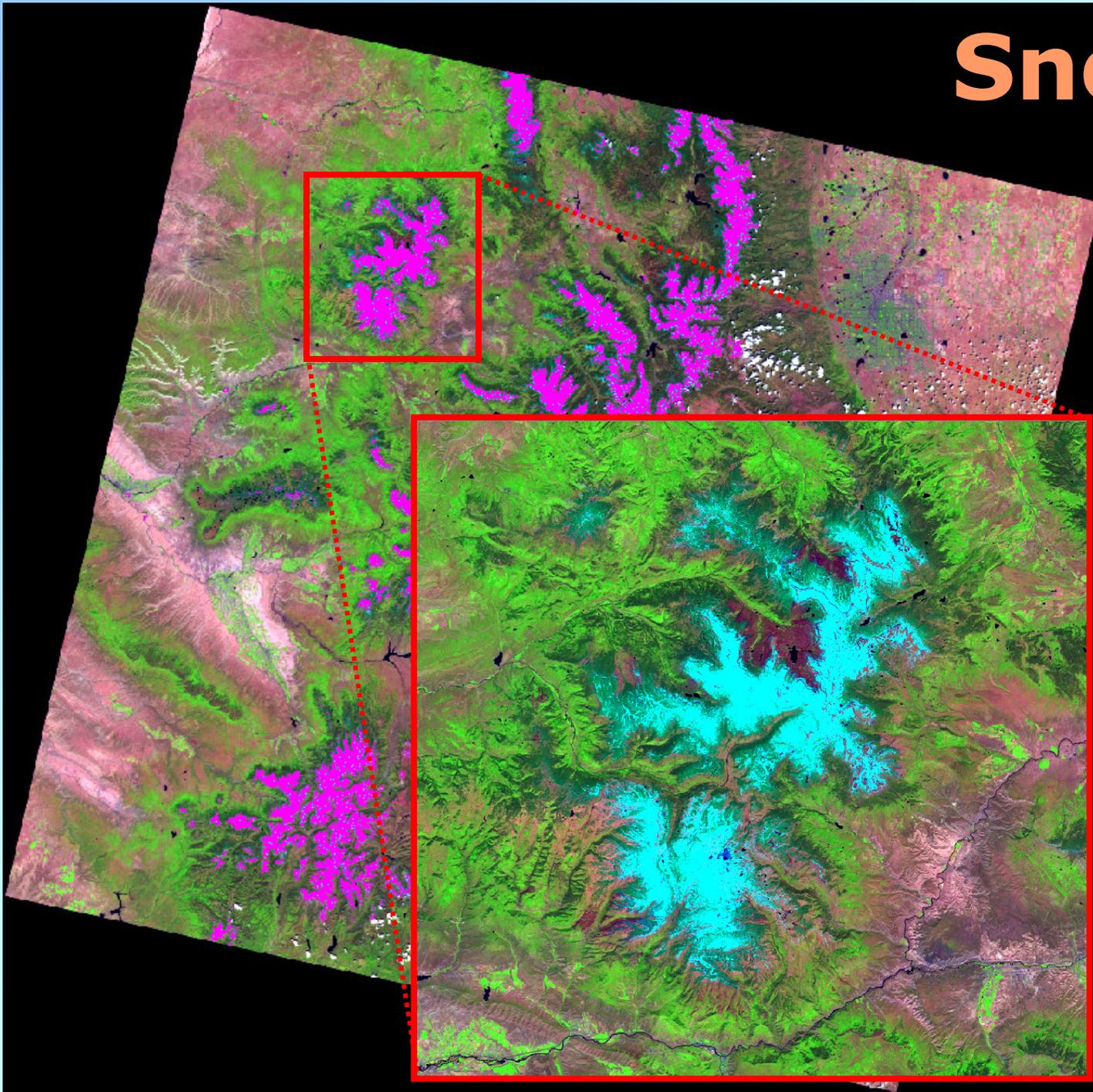


 Snow / Ice



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# Snow/Ice

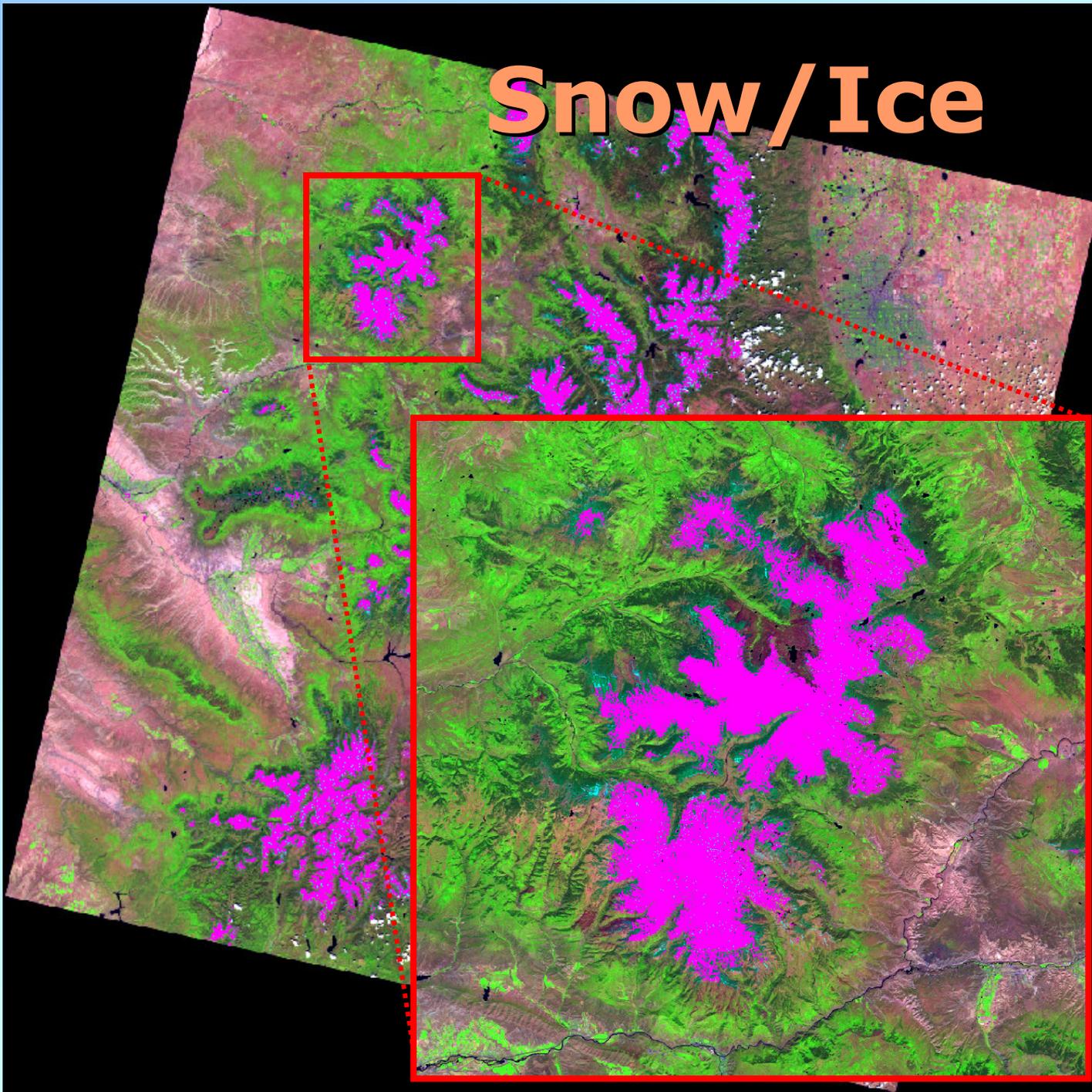


 Snow / Ice



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# Snow / Ice



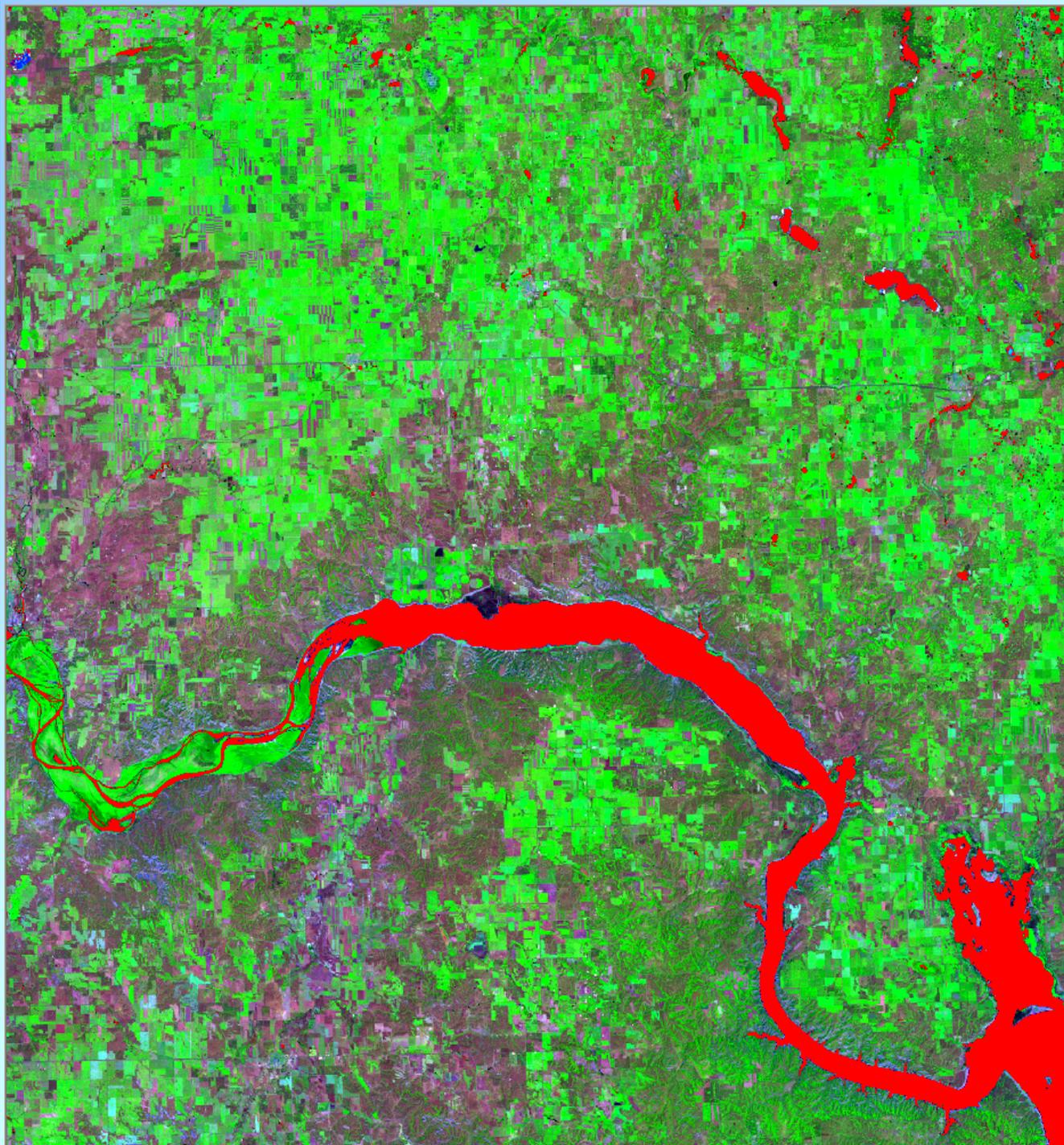
 Snow / Ice



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# Water

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 water



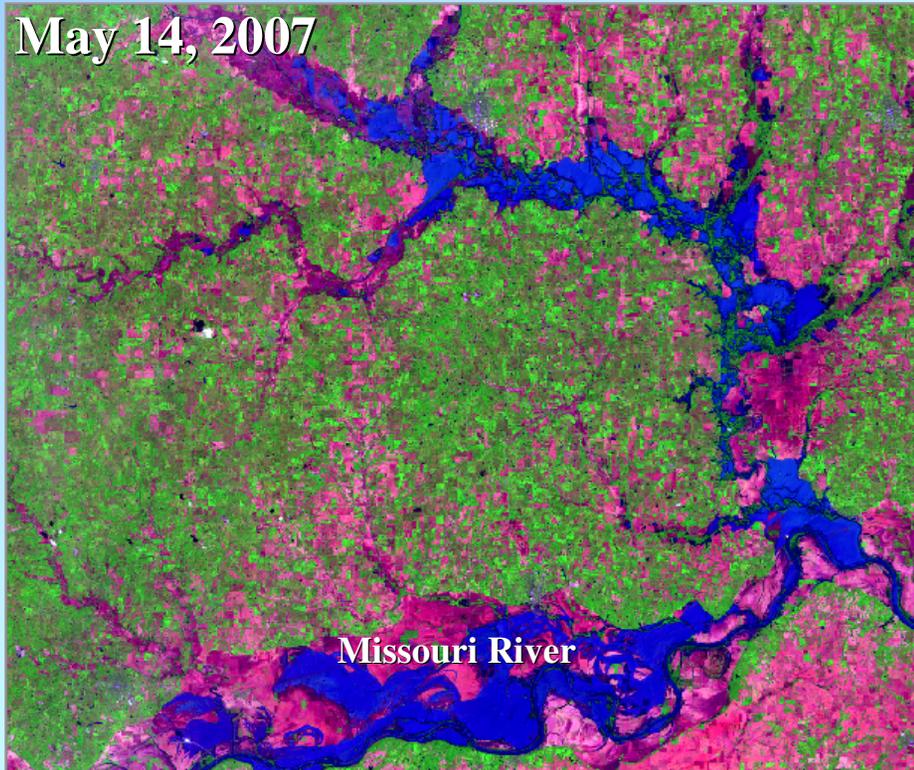
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# Flood Mapping

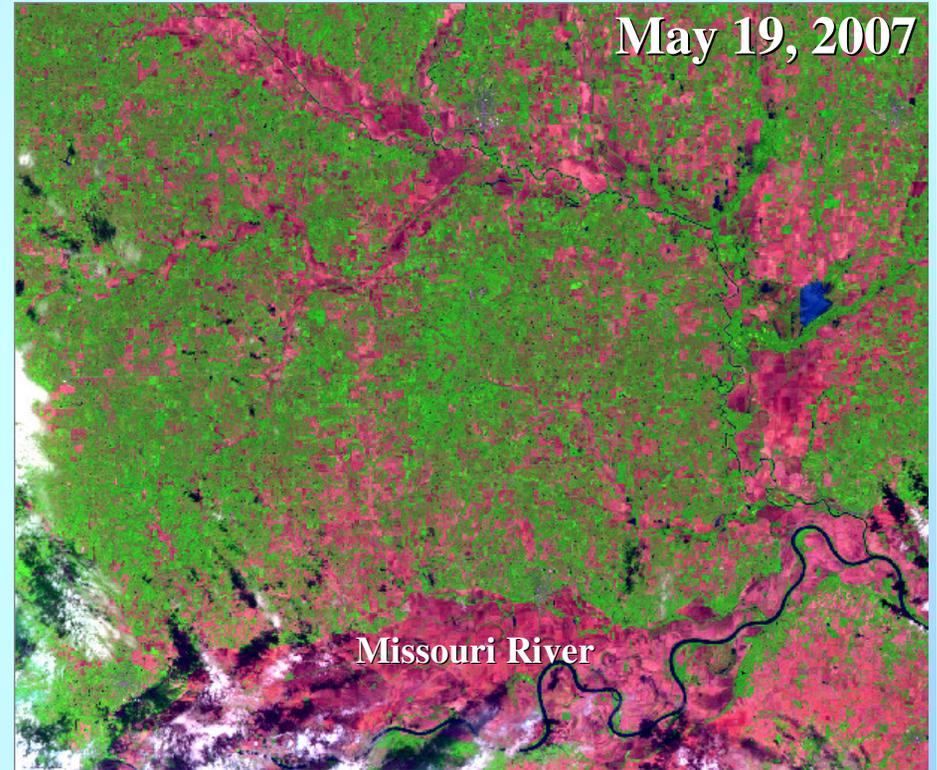
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## North-Western Missouri: May 2007

May 14, 2007



May 19, 2007

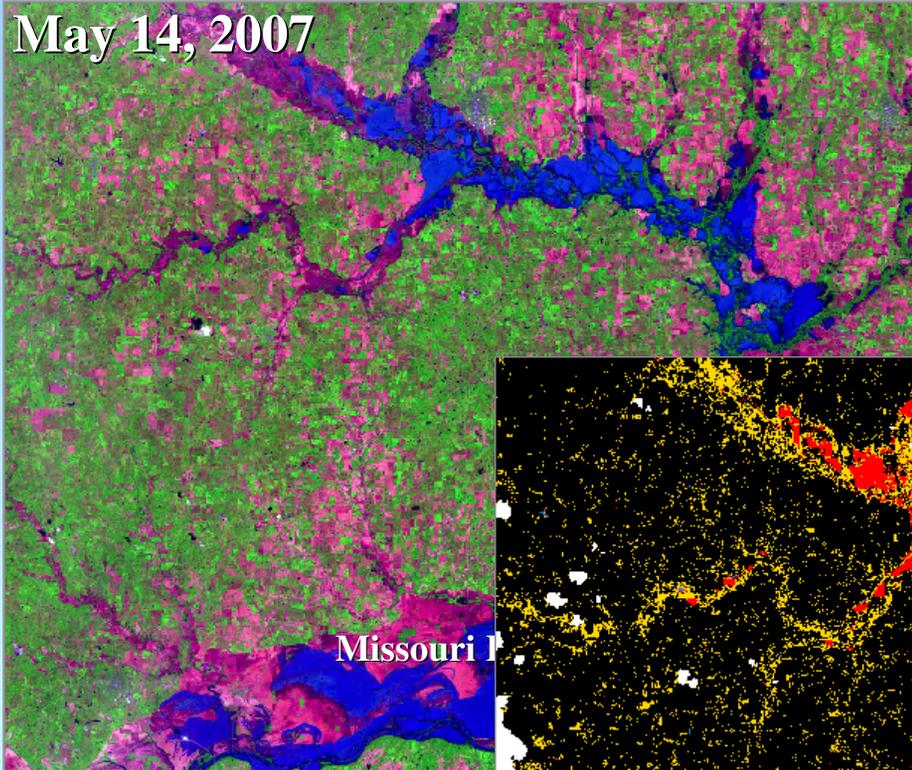


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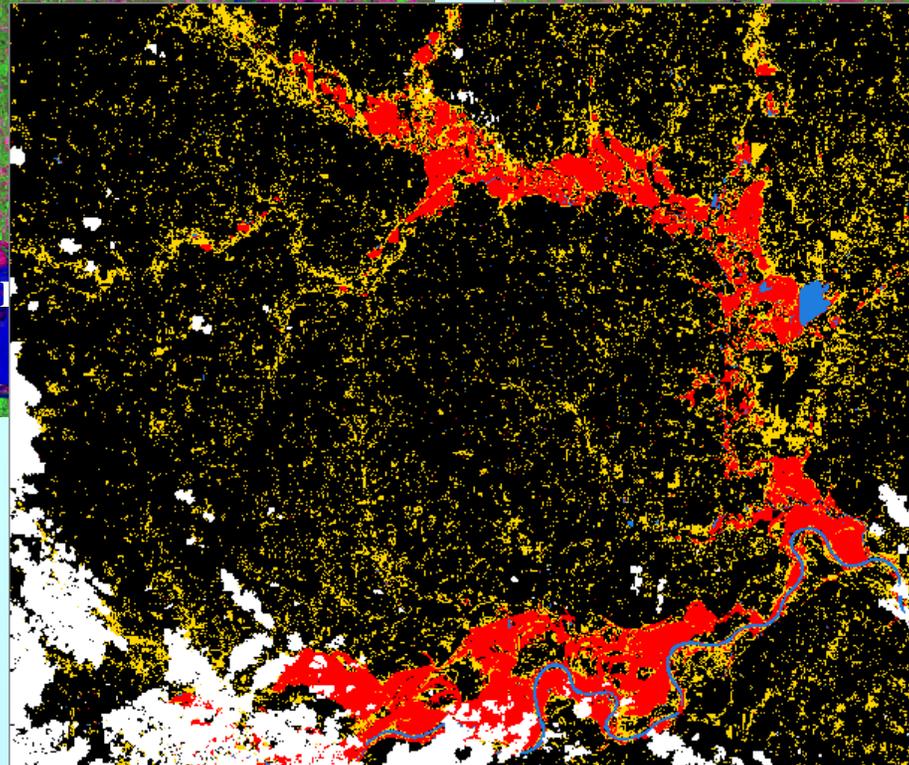
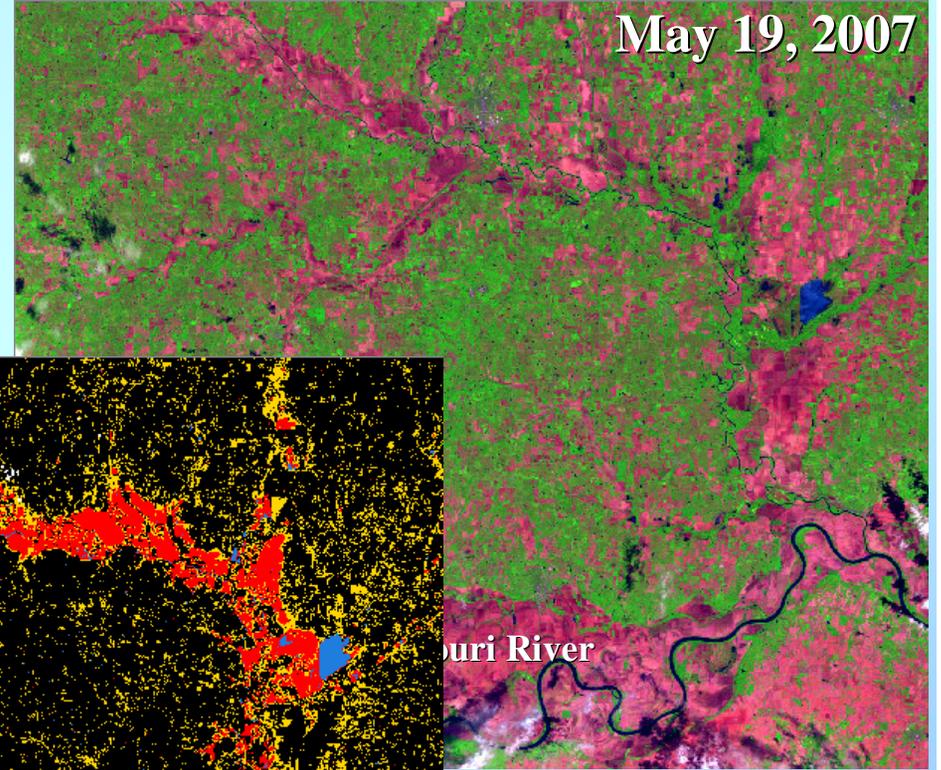
# Flood Mapping

## North-Western Missouri: May 2007

May 14, 2007



May 19, 2007



-  Water: No Change
-  Flood Areas
-  Wet Soil: New Areas
-  Areas of Data Gaps



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# **Invasive Spartina Project**

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**The California State Coastal Conservancy established the Invasive Spartina Project (ISP) in 2000. The overall goal of the project is to coordinate regional efforts to preserve California's coastal biological resources by addressing the rapid spread of introduced and highly invasive *Spartina* (cordgrass) species in the San Francisco Estuary through its eradication.**



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# **Invasive *Spartina* in CA**

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- **Invasive *Spartina* cordgrass is highly aggressive**
- **Significantly alters both the physical structure and biological composition of Californian tidal marshes, mudflats and creeks**
- **Invasive *Spartina*, and especially *Spartina alterniflora* easily hybridizes with native *Spartina* species**
- **If left unchecked, invasive *Spartina* threatens to invade over 70,000 acres of the San Francisco Estuary**

## **Invasive *Spartina* impacts:**

- **Habitat Change of Endangered Species**
- **Conversion of Tidal Mudflat to Meadow**
- **Loss of Shorebird Foraging Habitat**
- **Loss of Critical Channel Habitat**
- **Local Extinction of Native California Cordgrass**
- **Failure of Local Wetland Restoration Project Objectives**



# Local Extinction of *S. foliosa*



**Hybrid *S. alterniflora* clone established in native *S. foliosa* marsh. Hybrids easily pollinate the native cordgrass to produce more hybrid seed**



**Comparison of native *S. foliosa* inflorescence (left) to hybrid *S. alterniflora* inflorescence (right)**

**Photo: Stephen Joseph.**

**<http://www.spartina.org/invasion.htm>**

# *S. alterniflora* Colonization

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*S. alterniflora* hybrid clones accrete and stabilize sediment among their dense stems, actually increasing the elevation of the mudflat for further colonization.

Photo: Stephen Joseph. <http://www.spartina.org/invasion.htm>



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# *S. alterniflora* Patterns



Individual *S. alterniflora* hybrid clones coalesce to form a cordgrass meadow.  
Photo: Stephen Joseph. <http://www.spartina.org/invasion.htm>



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# *S. alterniflora* Patterns

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Photo: Stephen Joseph.  
<http://www.spartina.org/invasion.htm>

*S. alterniflora* hybrids (circular growth pattern on mudflat) have colonized this 49 acre restoration site near Whale's Tail Marsh in Hayward



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# Project Overview

Over the years, ISP has relied on analog airborne data to hands-on map invasive *Spartina* and to monitor eradication progress throughout the San Francisco Estuary

In 2007 some of the airborne imagery was acquired with digital UltraCam camera



# Project Overview

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**GDA is tasked to develop an interactive GIS expert system for mapping invasive cordgrass (hybridized *Spartina alterniflora*) in the San Francisco Estuary.**

**The system is to rely on high-resolution digital and analog airborne imagery, ancillary spatial datasets, a knowledge base on anticipated properties of *Spartina*, and expert input to map cordgrass sites.**

**The system will improve and simplify:**

- (i) mapping and monitoring of invasive *Spartina*,**
- (ii) assessments of plant eradication progress, and**
- (iii) delivery of actionable information to decision makers.**



# GDA Approach

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- **Task Specific GIS Expert System**
- **Use of Multiple Lines of Evidence**
  - Spectral
  - Spatial (size, shape)
  - Spatial Context / Pattern / Association (for pixels and objects)
  - Temporal
  - Thematic Context (*e.g.*, to be found only within the tidal zone)
  - Ancillary Data
- **Highly Automated yet Interactive**
- **From Global to Scene Specific Knowledge Base**
- **Iterative, Hierarchical Self-Learning**



# Challenges

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**One of the main challenges of this work is the need to use both:**

- (i) radiometrically stable / predictable and calibratable digital imagery and**
- (ii) analog, film collected airborne data.**

**Ability to simultaneously explore such different sources of airborne data would allow to expand analysis to all areas where airborne data is available and to assess eradication progress over time.**

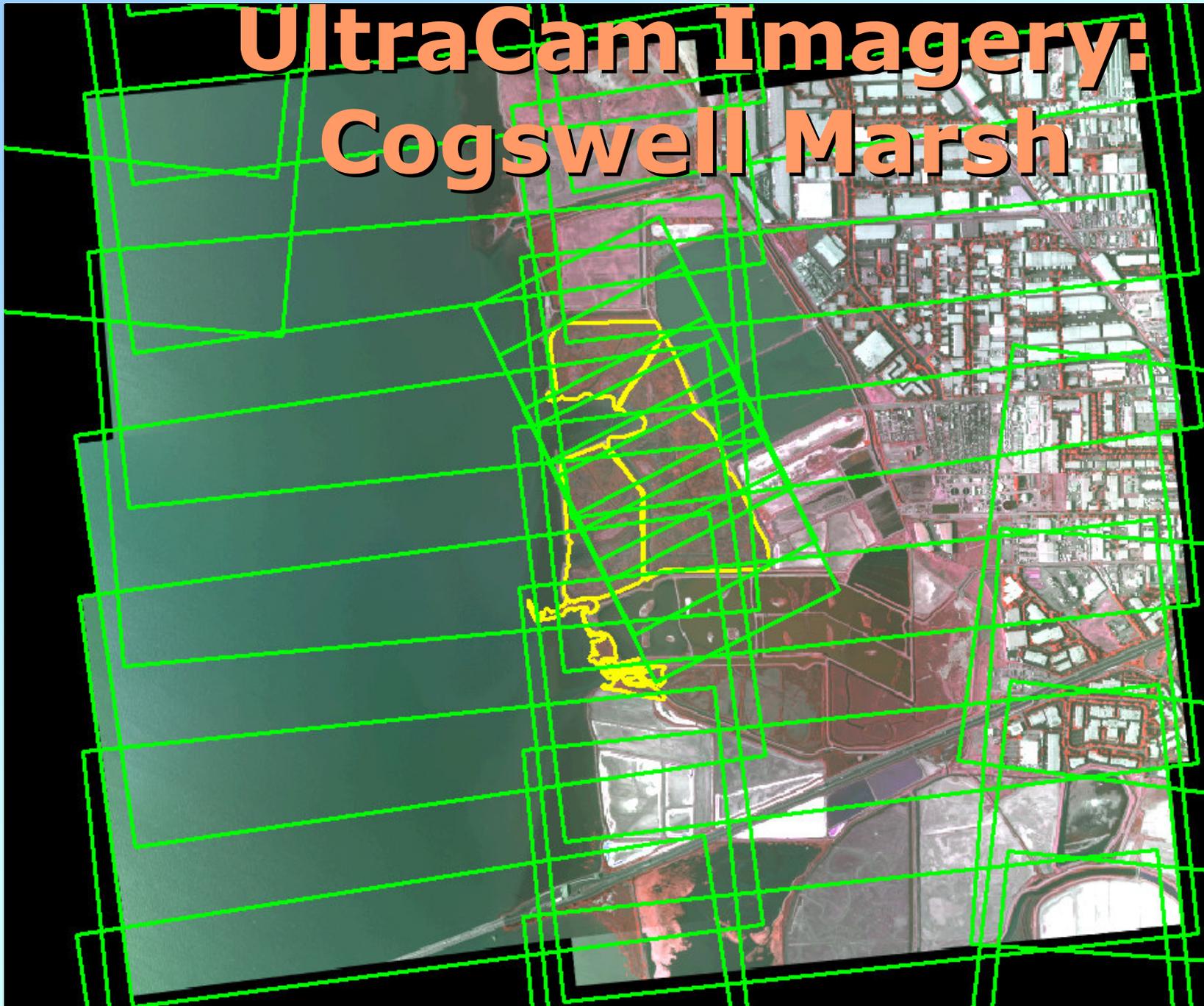


# UltraCam Imagery: Cogswell Marsh



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# UltraCam Imagery: Cogswell Marsh



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# Work Flow

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# Work Flow

2006

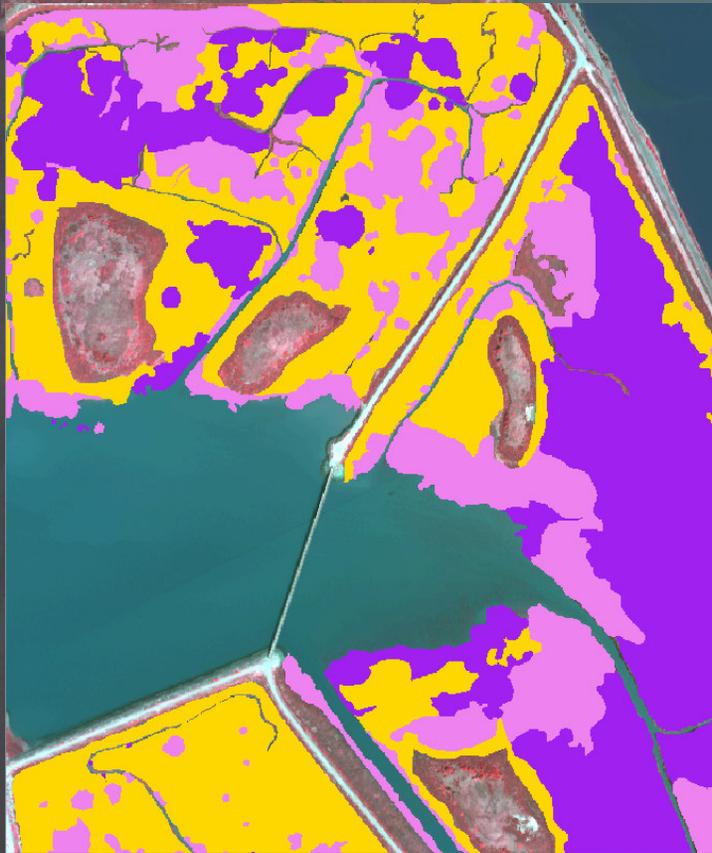
2007



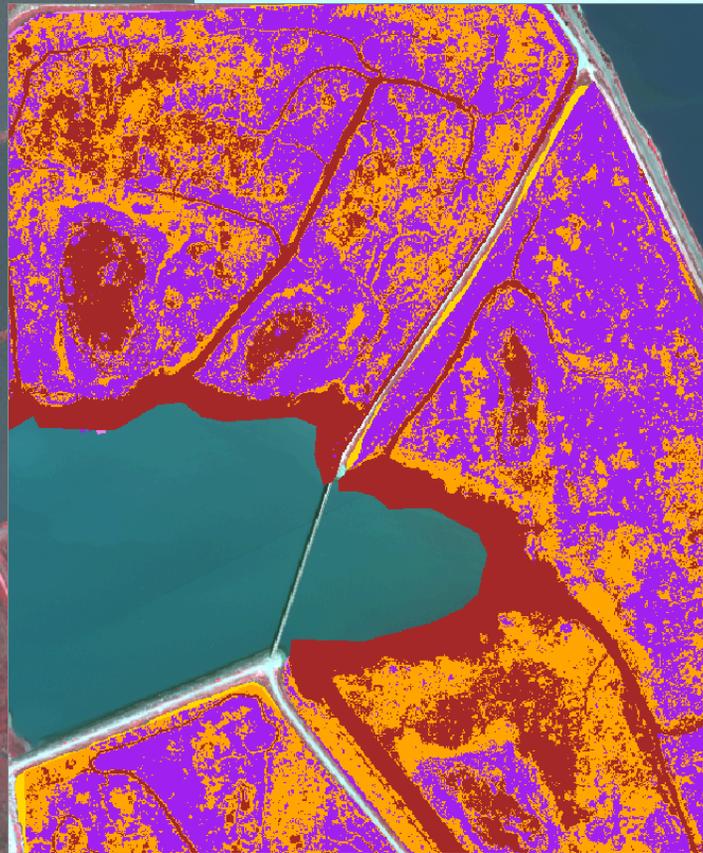
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# Work Flow

2006



2007



-  50 – 100% *Spartina alterniflora* cover
-  10 – 49% *Spartina alterniflora* cover
-  0 – 9% *Spartina alterniflora* cover

-  *Spartina alterniflora*
-  Other vegetated
-  Non-vegetated



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# Work Flow

Apply “Marsh A” Knowledge Base to map entire 2007 image dataset

Use 2007 maps to identify invasive *Spartina* in 2006 analog imagery

Assess Plant Eradication Progress

Deliver Actionable Information to Decision Makers

 50 – 100% *Spartina alterniflora* cover  
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 *Spartina alterniflora*  
 Other vegetated  
 Non-vegetated



# Conclusions

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**Airborne data uniquely offers multiple observations of the same area from various view angles, thus presenting additional information for feature detection and land cover mapping.**

**Analog and digital airborne data can be used in the same application to enhance land cover mapping and change analysis.**

**Simultaneous use of analog and digital imagery can be a cost effective way to cover larger areas and/or to compare historical and current acquisitions for the same area.**



# Acknowledgements

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2007 imagery used in the effort is courtesy of HJW GeoSpatial Inc.

## Contact Information

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