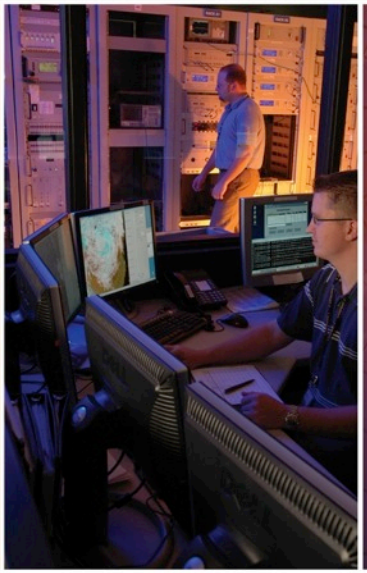
Landsat: Building a Future on 40 Years of Success



U.S. Department of the Interior
U.S. Geological Survey

Tom Holm.
EROS Center
April 2013

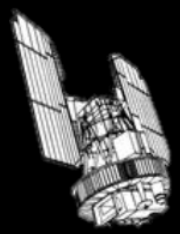
Landsat Satellite Program

1966 - Initiated Earth Resources Observation Systems Program

"…the time is now right and urgent to apply space technology towards the solution of many pressing natural resource problems being compounded by population and industrial growth."

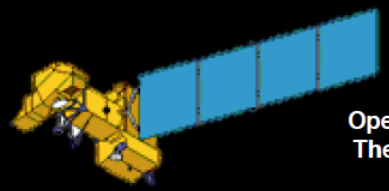
Secretary of the Interior Stewart L. Udall, 1966

Landsat 1 - 3
Multi-Spectral Scanner (MSS) 79 meter
Return Beam Vidicon (RBV) 80/40 meter



Landsat 4 - 5
Multi-Spectral Scanner (MSS) 79 meter
Thematic Mapper (TM) 30 meter

Landsat 7
Enhanced Thematic Mapper
Plus (ETM+) 30/15 meter

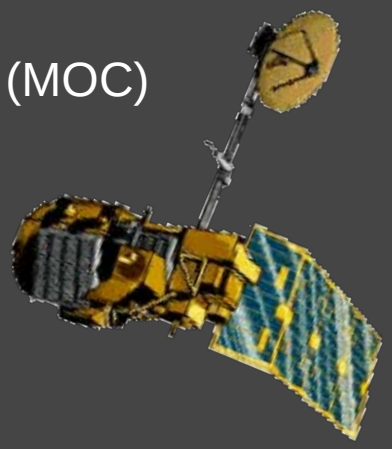


Landsat 8
Operational Land Imager (OLI) 30/15 meter
Thermal Infrared Sensor (TIRS) 120 meter

USGS

Status: Landsat 5

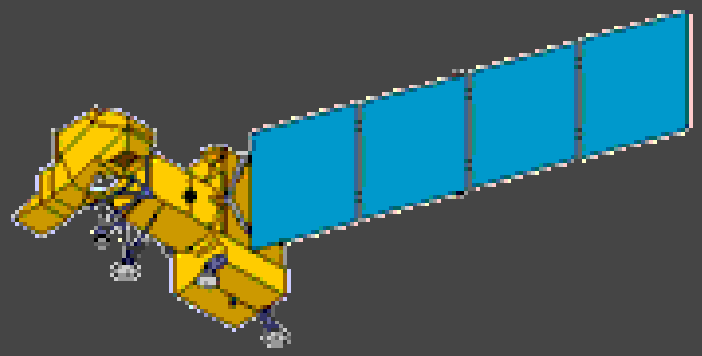
- **Landsat 5 was officially "retired" when deorbiting and decommissioning began on January 15, 2013**
  - Launched in 1984, Landsat 5 exceeded its 3 year design life by 25 years.
  - Four Decommission Phases
    - Phase I – Initial 705Km orbit lowering – complete!
    - Phase 2 – Lowering perigee to minimize time of reentry
      - Begins April 17th and will extend until A) out of fuel or B) no additional benefit to burns
      - Planned completion no later than 6/30
    - Phase 3 – Render the spacecraft passive
    - Phase 4 – Closeout the Mission Operations Center (MOC)
      - Completed before the end of the fiscal year



USGS

Status: Landsat 7

- **Landsat 7 is collecting global data**
  - Launched in 1999 with a 5 year design life, the Landsat 7 mission just began its 14th year.
  - Robust global acquisitions are continuing, collecting nearly 400 scenes a day
  - Fuel-based end-of-life is 2017
  - Successfully completed the underflight with LDCM, collecting all images that LDCM collected for a three day period
    - This data is invaluable for the cross calibration of LDCM and Landsat 7



USGS

LDCM Mission
Launched February 11, 2013

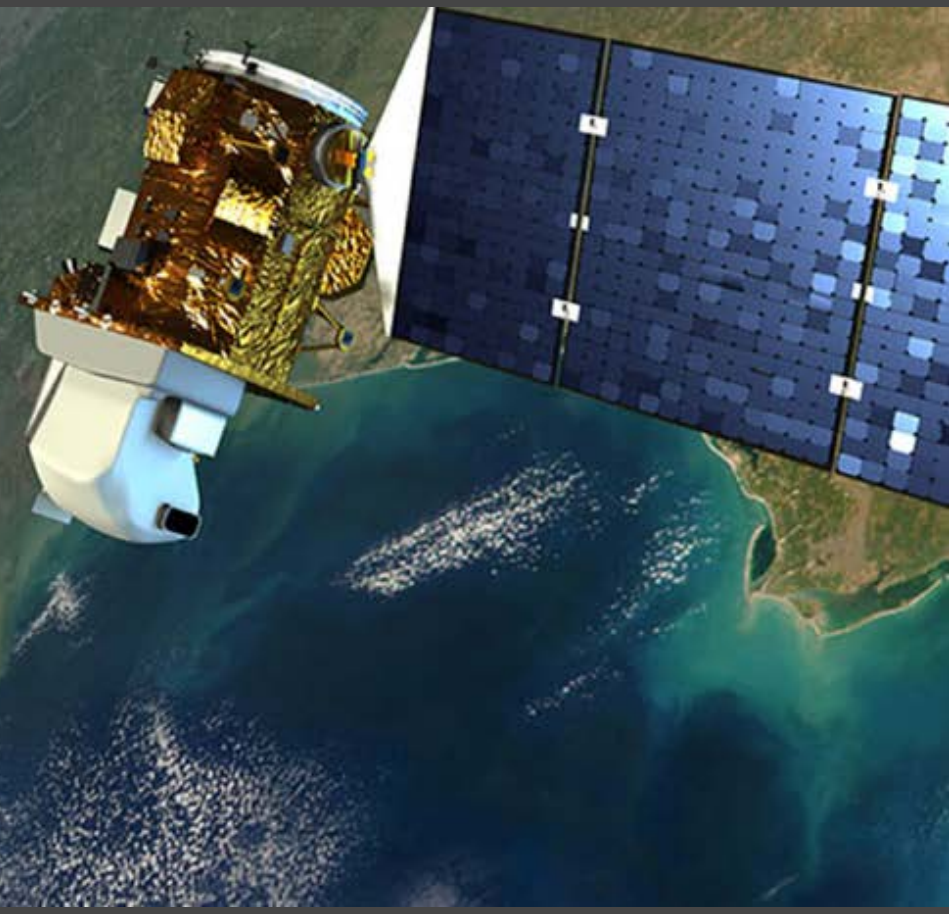
Provide continuity in the 40+ years of Landsat land surface observations to study, predict, and understand the consequences of land surface dynamics, such as:

What are the changes in global land cover and land use? What are their causes?

How do ecosystems, land cover, and biological, geological and chemical factors respond to and affect environmental change?

What are the consequences of land cover and land use change for human societies and the sustainability of ecosystems?

What are the consequences of increased human activities on coastal regions?

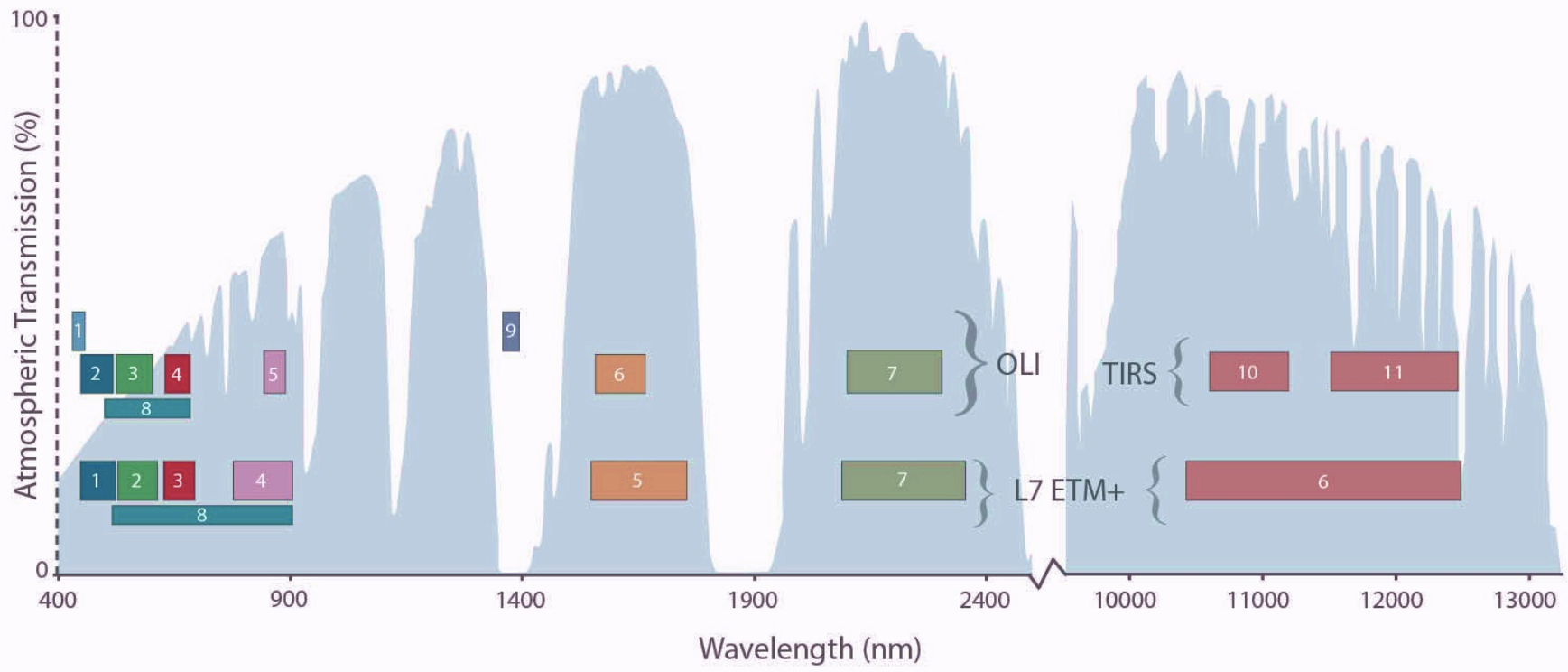


USGS

USGS LDCM Status Launch Video.wmv saved seperately

USGS

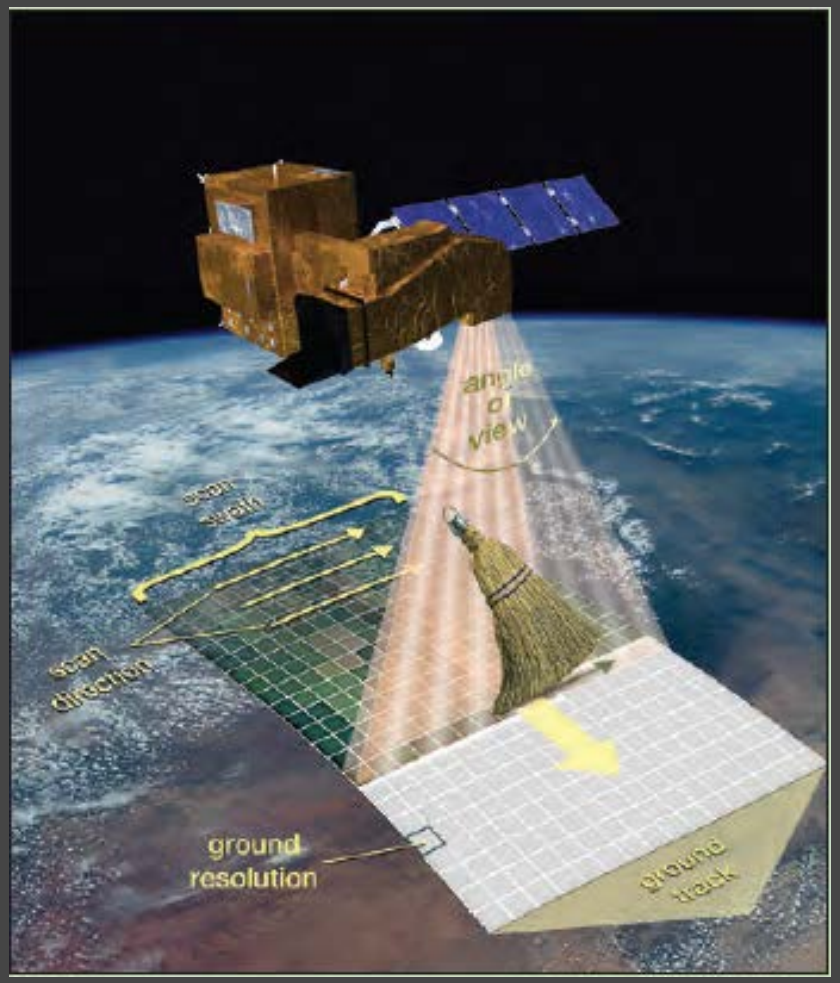
OLI & TIRS Spectral Bands



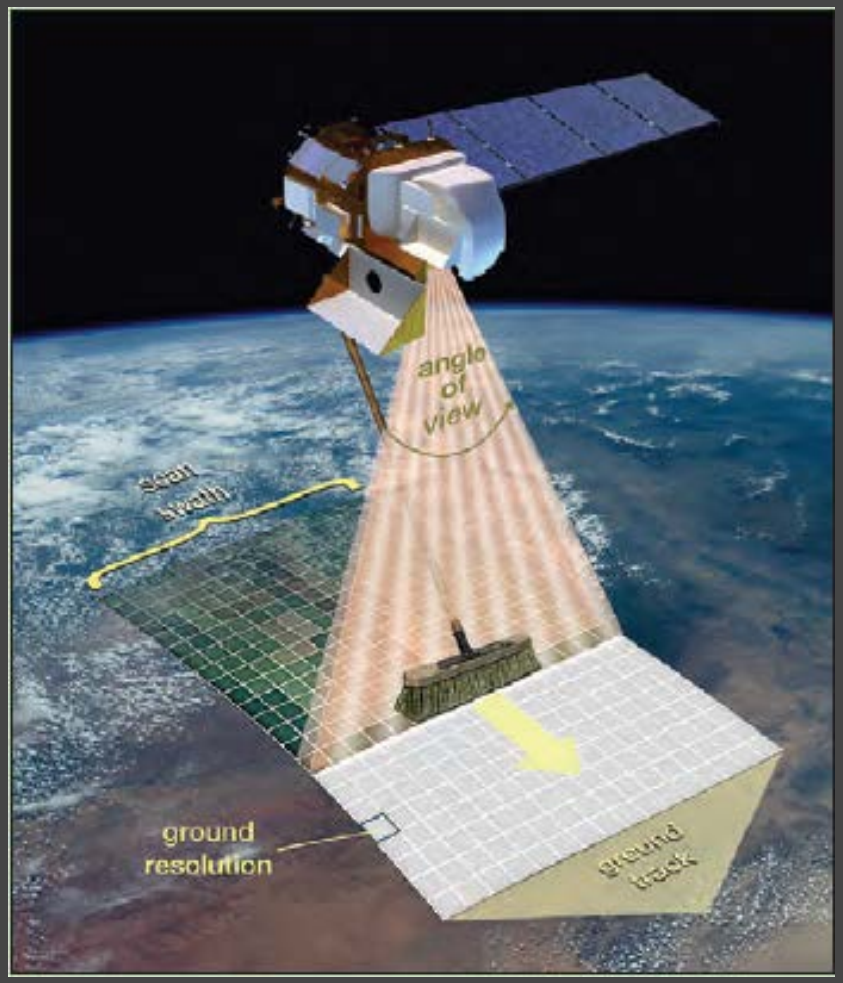
USGS

Sensor Architecture Evolution

Whiskbroom (Landsat 1-7)



Pushbroom (LDCM)



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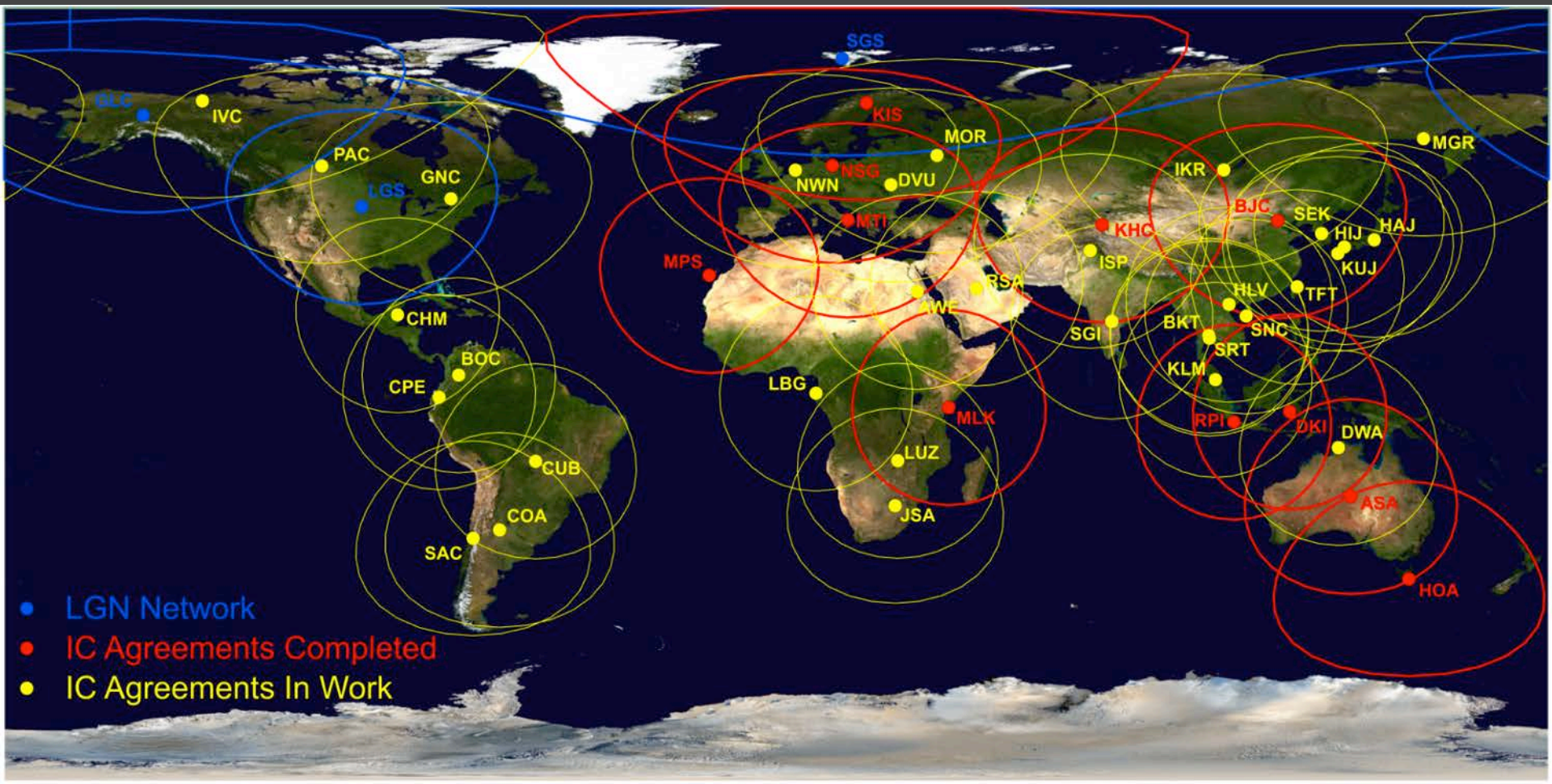
Landsat Ground Stations

USGS

Potential LDCM International Cooperators



USGS

LDCM Science Improvements

More image data –

- 40 year record is extended to 45-50 years, or more
- 60% more coverage – 400 scenes/day vs. 250 scenes/day with Landsat 7
- 100% of data collected goes to the US archive each day vs. ~40% with Landsat 7

Better image data – provides greater sensitivity to detect changes in surface properties

- 5x improvement in signal to noise ratios
- 12 bit quantization (256 vs 4096)
- Improved cartographic accuracy due to advanced spacecraft geo-location capabilities

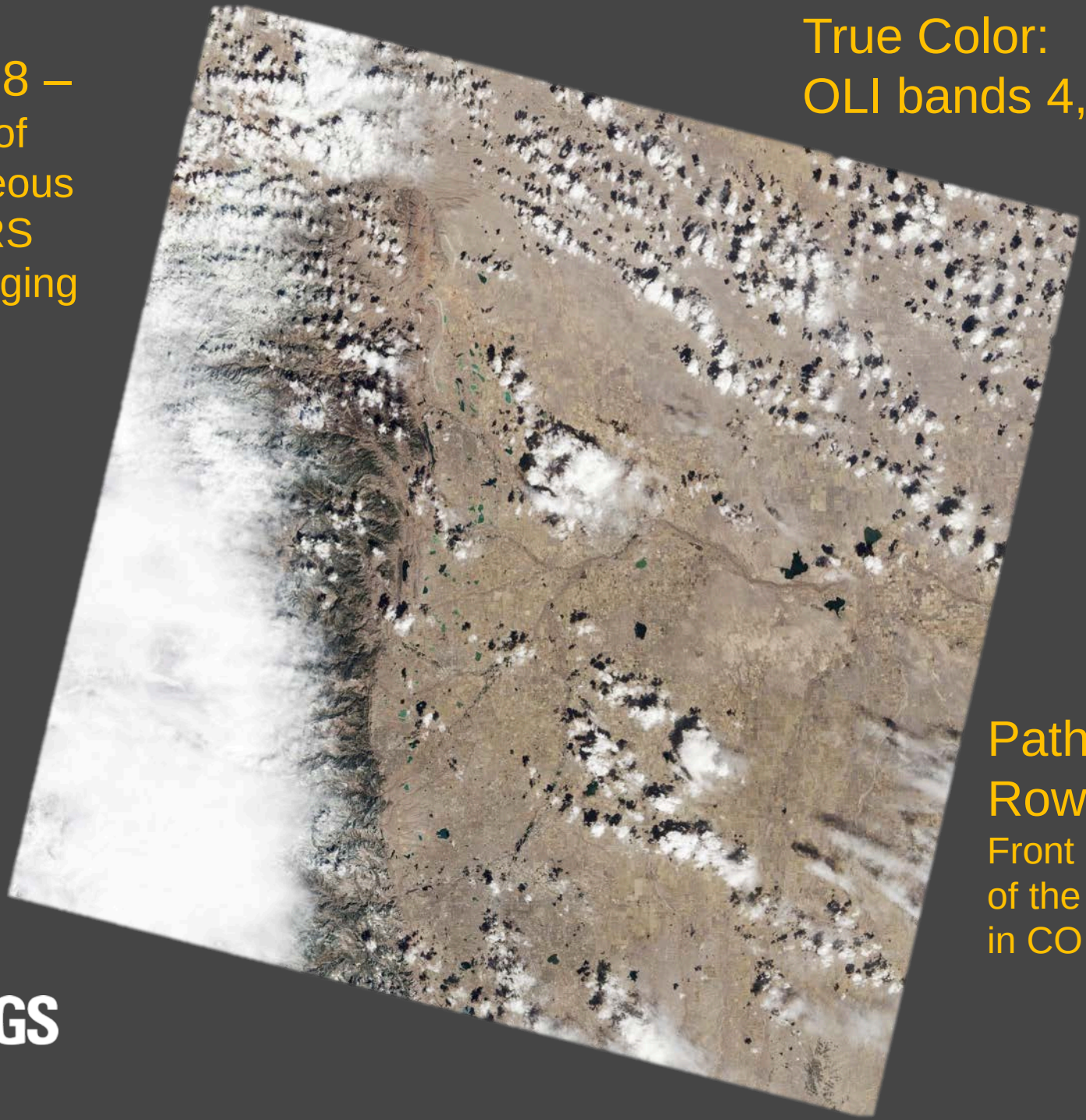
New measurements – and new applications

- Coastal aerosol band (0.433–0.453 µm) –detection of water column constituents (e.g., chlorophyll, suspended materials)
- Cirrus band (1.360–1.390 µm) – improves overall image quality because of better cloud screening
- Additional thermal band – improves accuracy and precision of temperature measurements

USGS

March 18 –
First day of
Simultaneous
OLI & TIRS
Earth imaging

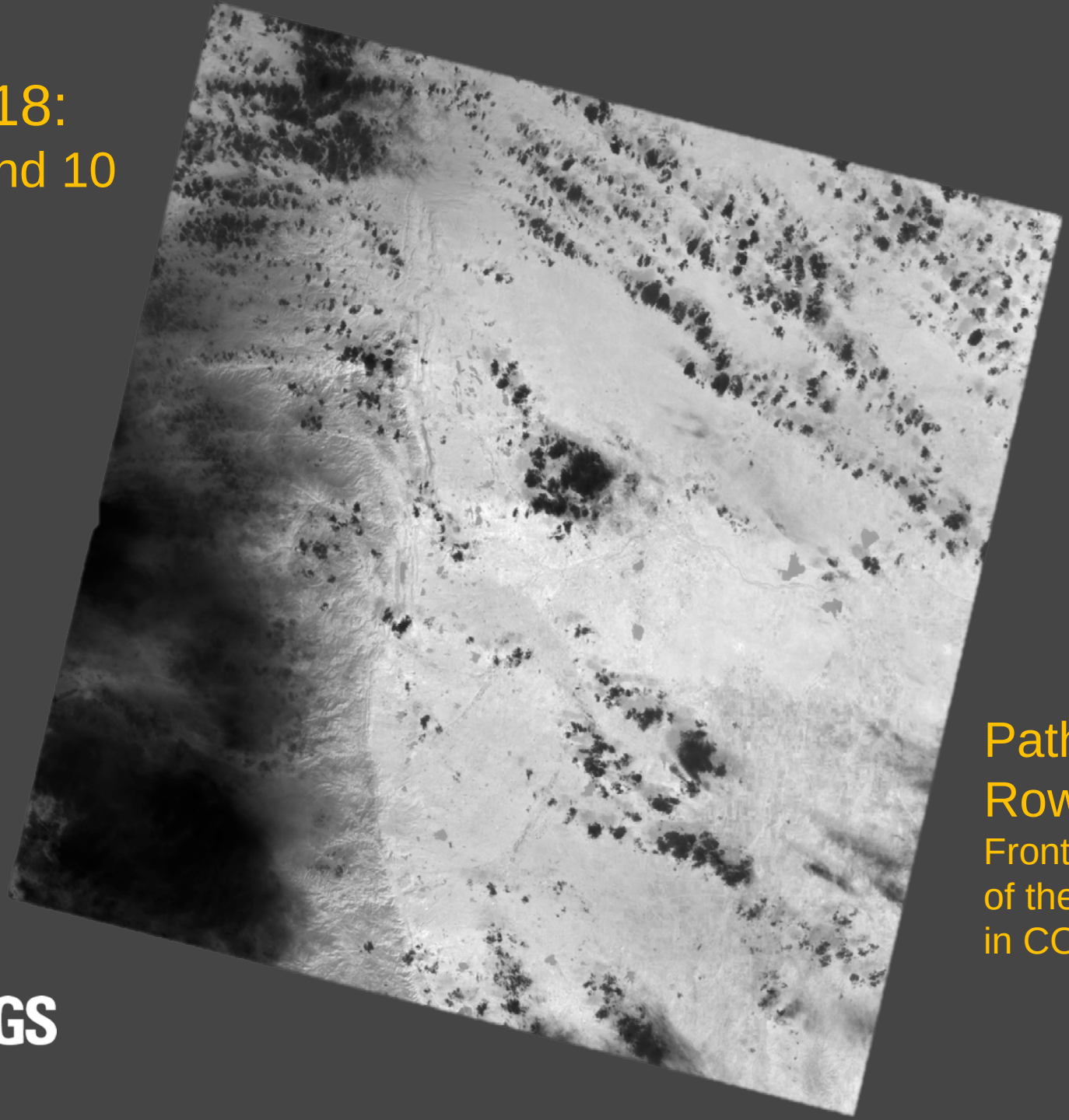
True Color:
OLI bands 4, 3, 2



Path 33
Row 32
Front Range
of the Rockies
in CO & WY

USGS

March 18:
TIRS band 10



Path 33
Row 32
Front Range
of the Rockies
in CO & WY

USGS

Boulder, CO: March 18, 2013

USGS

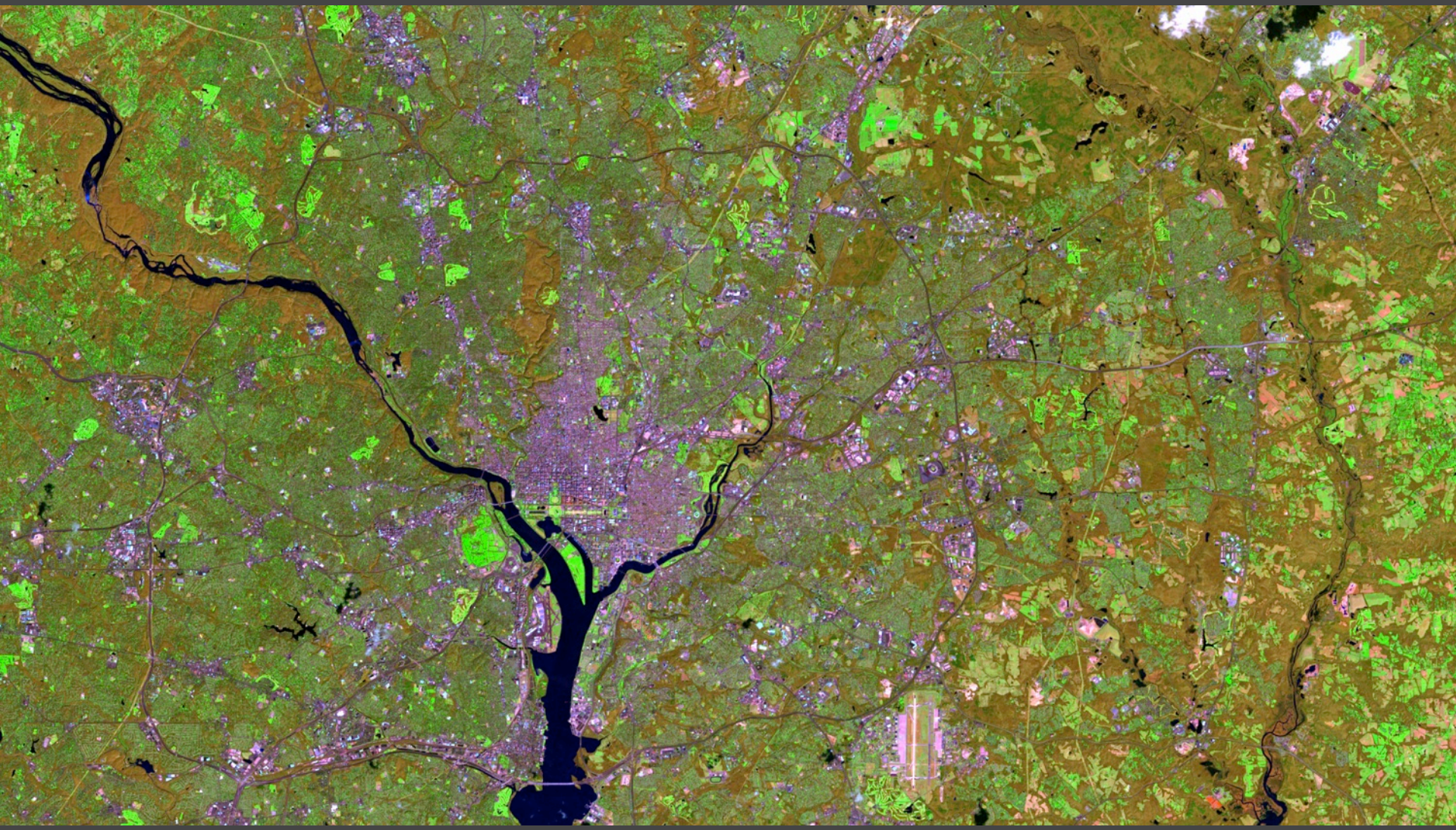
http://landsat.usgs.gov/

Fort Collins, CO: March 18, 2013

USGS

False Color: OLI bands 7, 5, 3

LDCM of Greenbelt/D.C. Area



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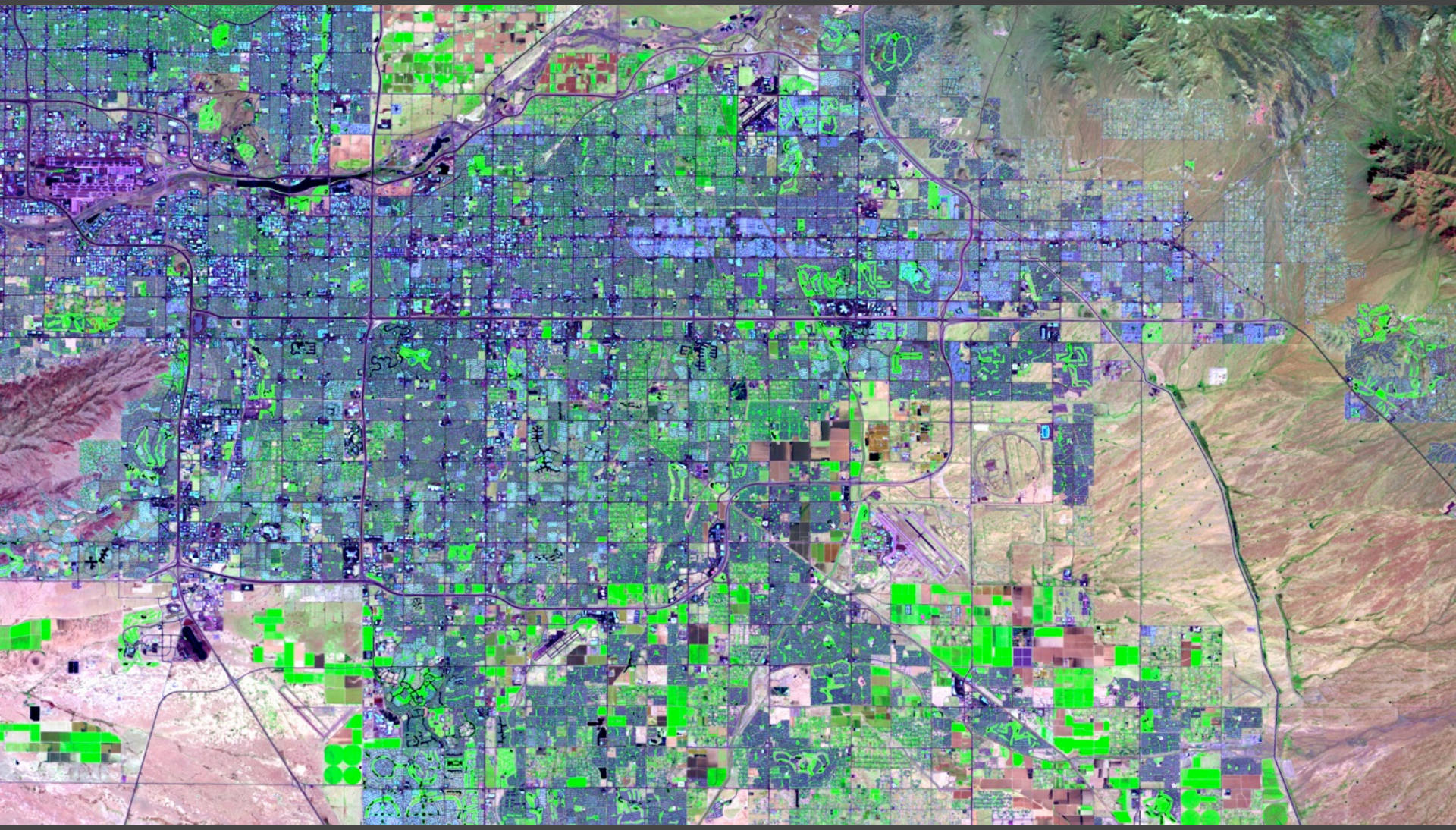
LDCM of Phoenix, Arizona Area



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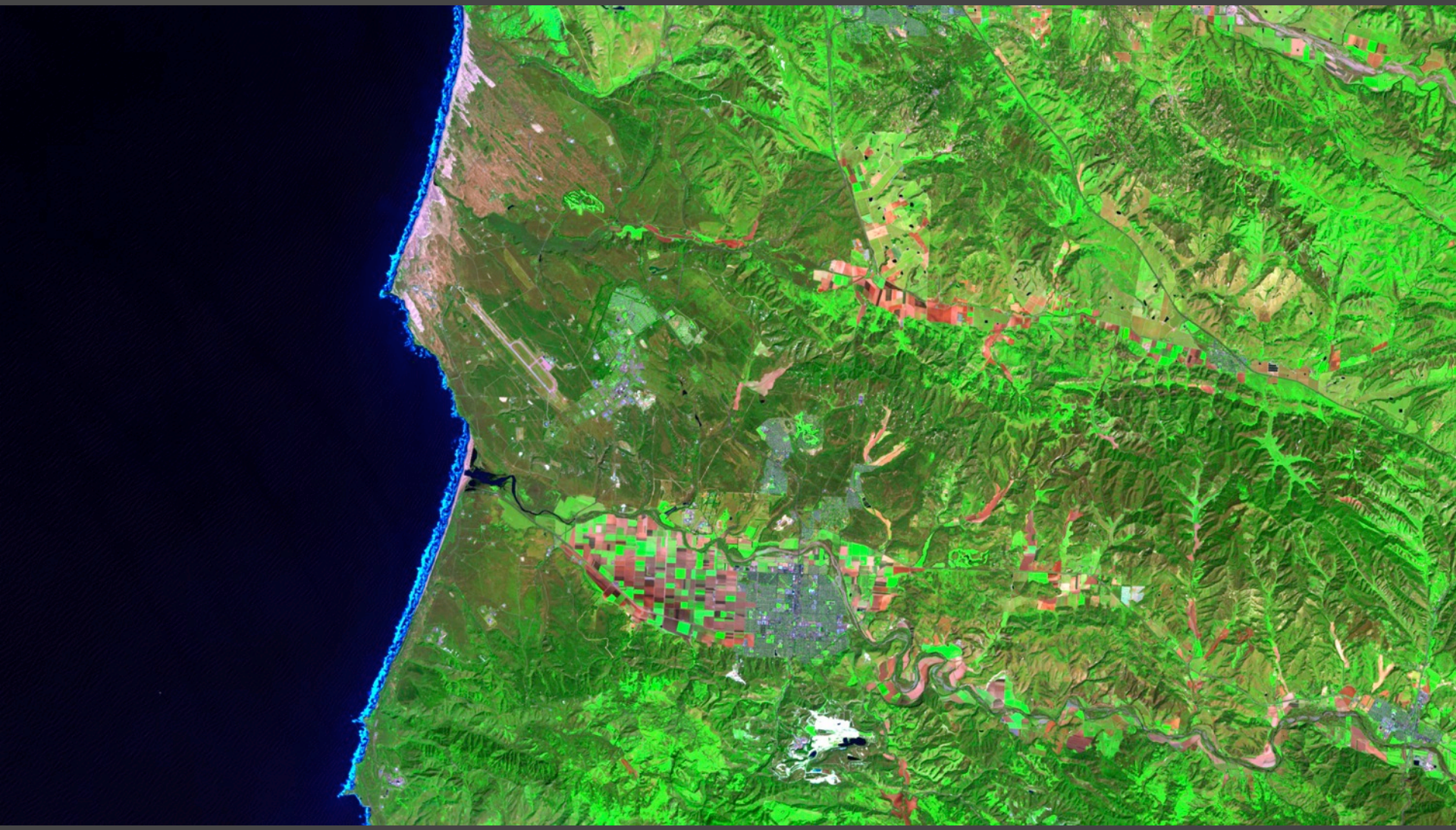
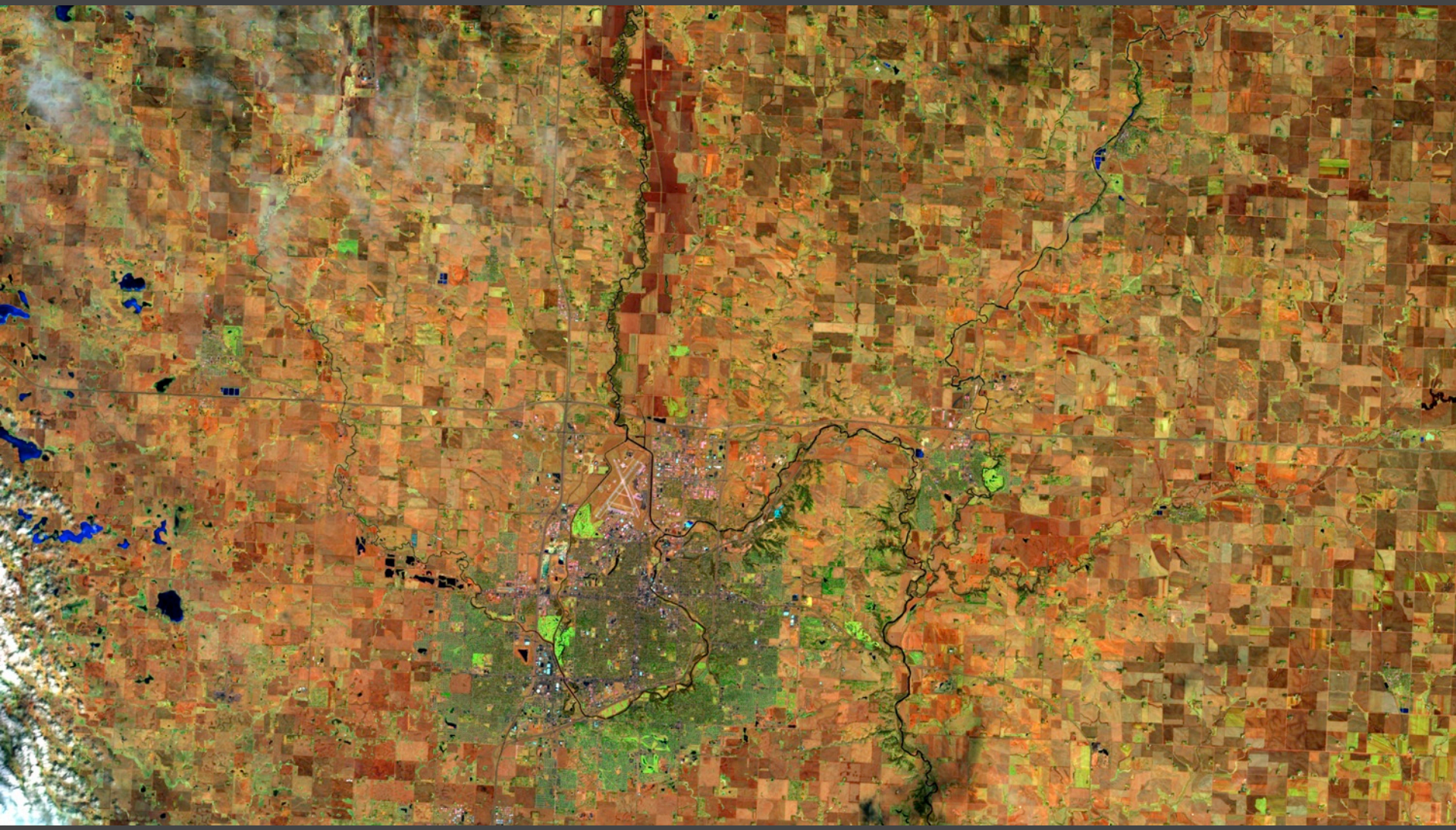
LDCM of Vandenberg Air force Base



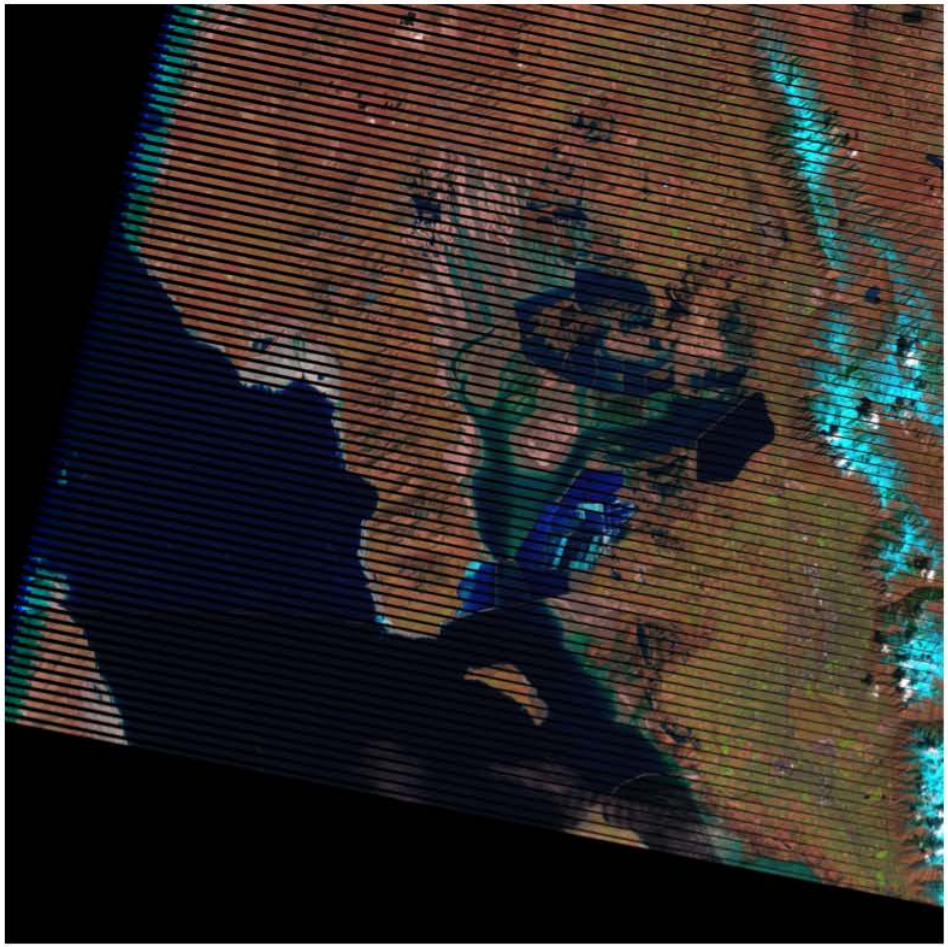
USGS

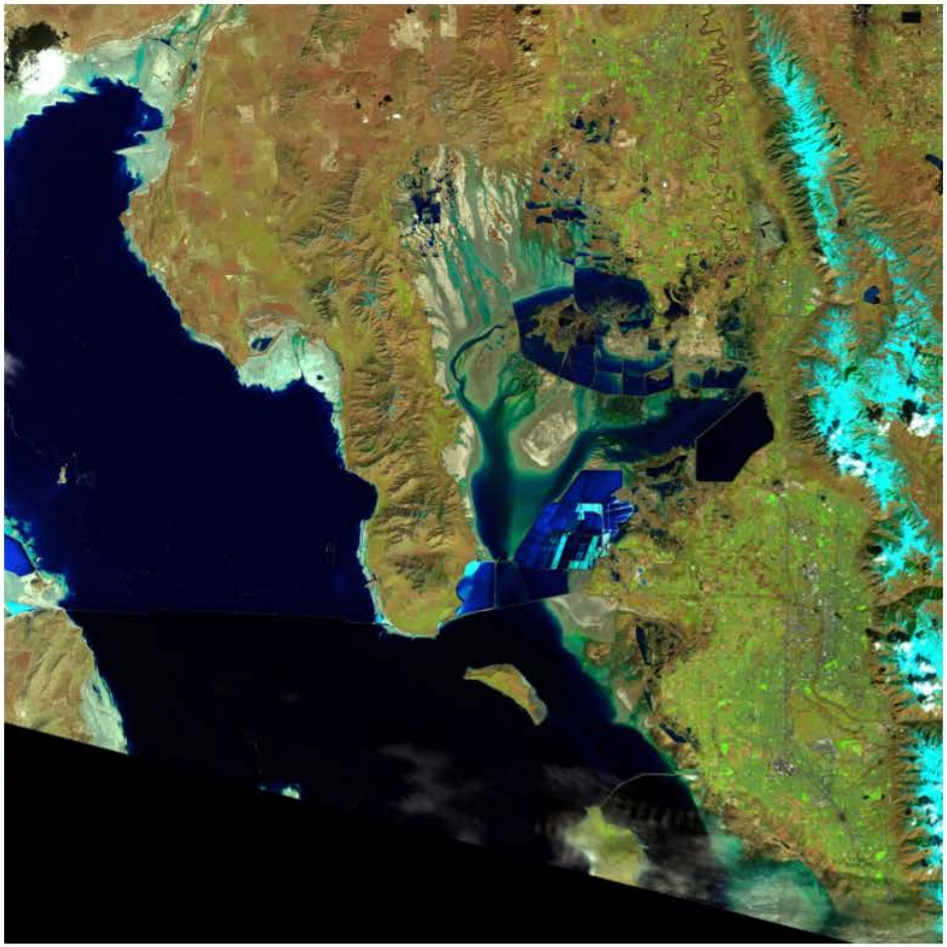
LDCM of Sioux Falls and EROS Center



USGS

Underfly of Landsat 7 – March 29, 2013





These images show a portion of the Great Salt Lake, Utah as seen by Landsat 7 (left), and LDCM/ Landsat 8 satellites (right). Both images were acquired on March 29, 2013.

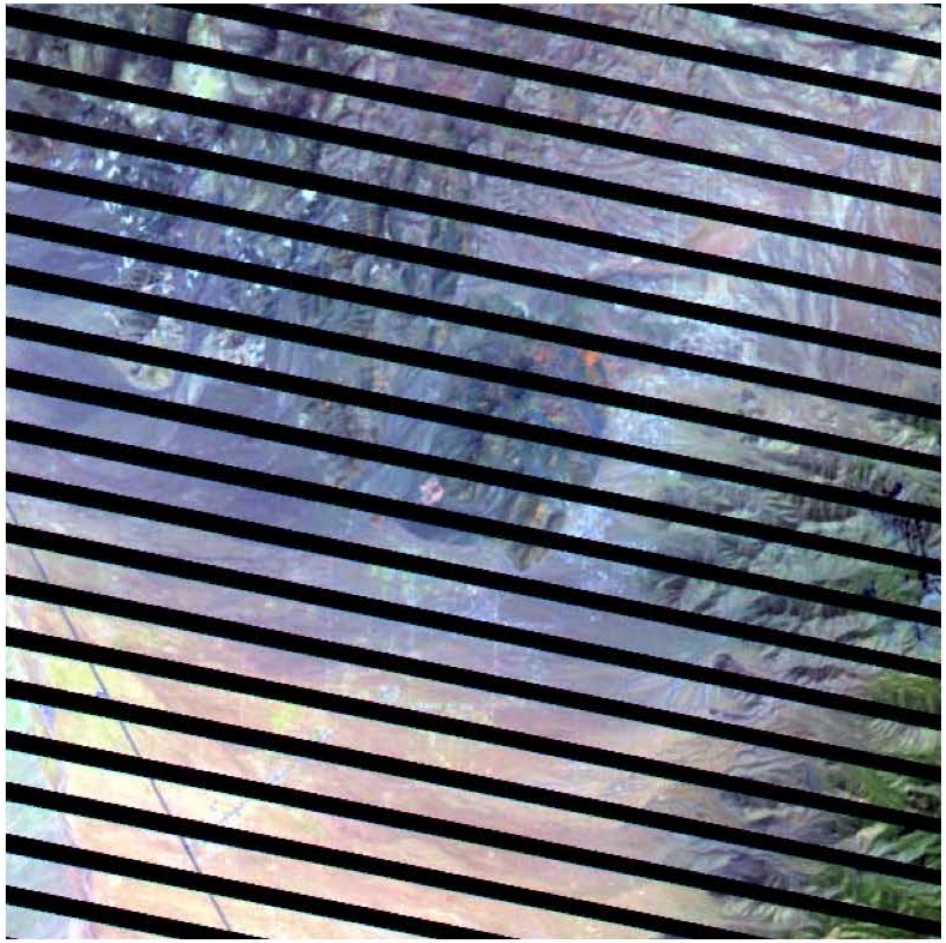
USGS

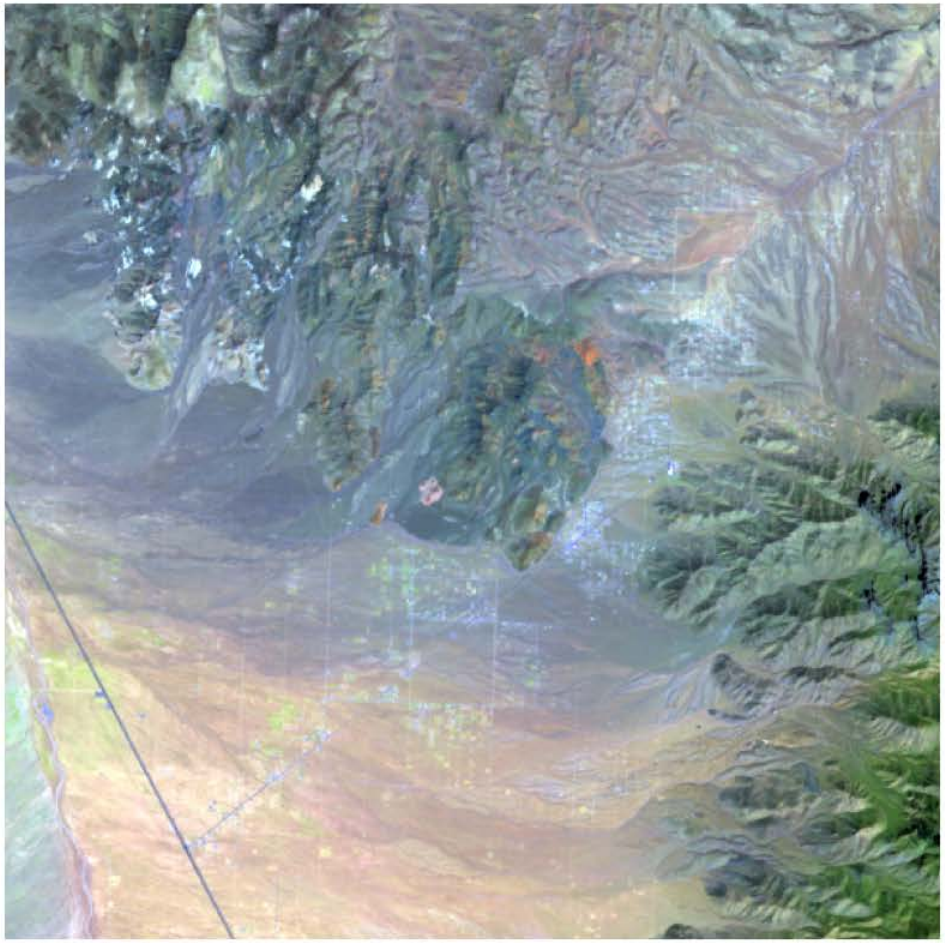
http://landsat.usgs.gov/LDCM_Underfly_with_Landsat_7.php

Underfly of Landsat 7 – March 29, 2013

Dolan Springs, Arizona

The desert area of Dolan Springs, Arizona is a vicarious calibration site, at which airborne and field spectroradiometeric measurements are collected and used to characterize, calibrate, and validate the radiomeric performance of the Landsat sensors.





These images show the area of Dolan Springs, Arziona, as seen by Landsat 7 (left) and LDCM/Landsat 8 satellites. Both images were acquired on March 29, 2013.

USGS

April 14, 2013 – 705 km Orbit

LDCM has reached her final home!

USGS

LDCM Milestones

- LDCM Launch — February 11
- First Light Images — March 18
- Underfly of Landsat 7 — March 29-30
- LDCM on WRS-2 (Success!) — April 14
- On-orbit Acceptance Review @ GSFC — May 14
- Post-Launch Assessment Review @ EROS — May 29
- Mission Transition Review @ EROS — May 30
  - LDCM renamed Landsat 8
- Full Release of Landsat 8 Data Products! May 30

http://landsat.usgs.gov/

http://www.nasa.gov/landsat

USGS

USGS
science for a changing world

NASA

Landsat

Continuing to Improve Everyday Life

http://landsat.gsfc.nasa.gov/pdf_archive/LandsatImprovingLife.pdf

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