



40 Years of Landsat Science and the Landsat Data Continuity Mission (LDCM)

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LDCM
L A N D S A T

data continuity mission

Landsat Beginnings

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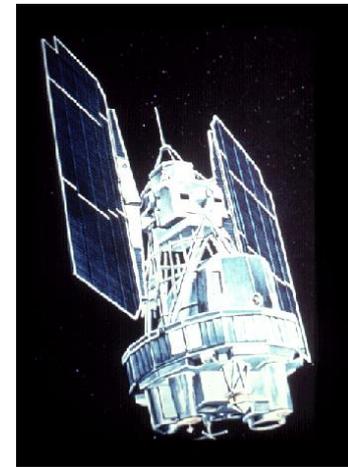
- Visionary leaders and photographs of the Earth's surface during Mercury, Gemini, and Apollo missions provided inspiration for a *civilian satellite* that would observe the Earth's *terrestrial* surface.
- In 1970, NASA initiated building the ***Earth Resources Technology Satellite-1*** (ERTS-1), later renamed ***Landsat 1***.
- ERTS-1 was ***launched in 1972***, starting the Landsat era.



William T. Pecora
Director, USGS



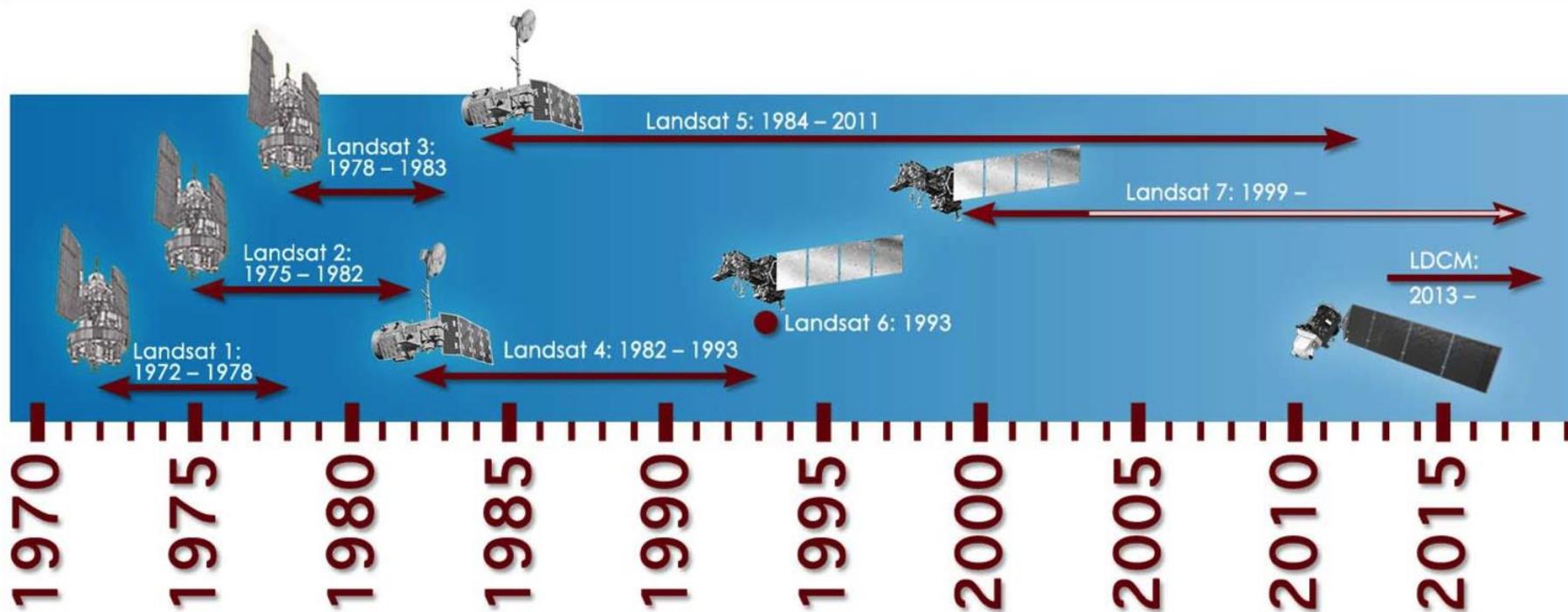
"Earthrise" (Apollo 8, 1968)



Artist's sketch of Landsat 1

40 Years of Global Land Surface Observations

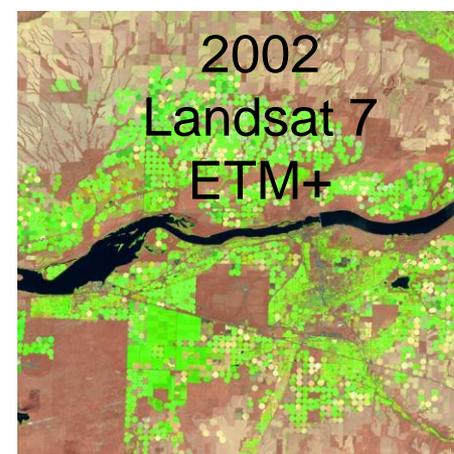
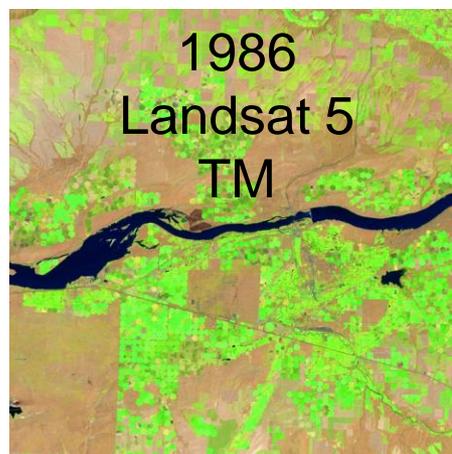
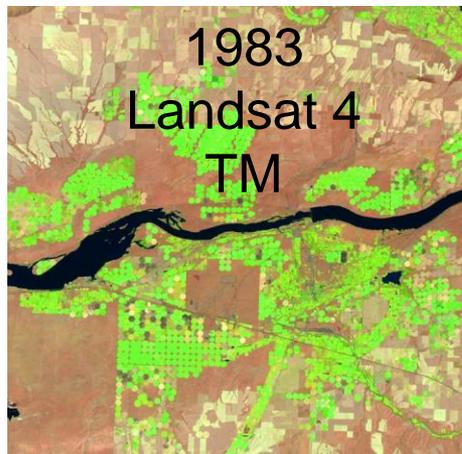
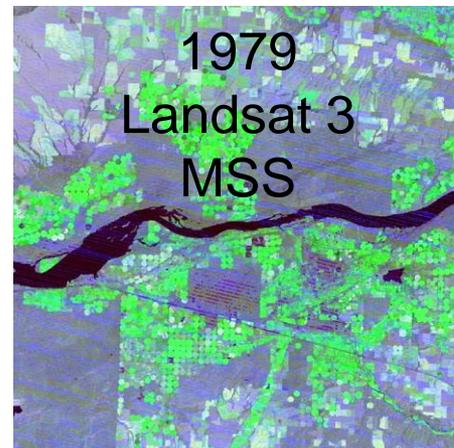
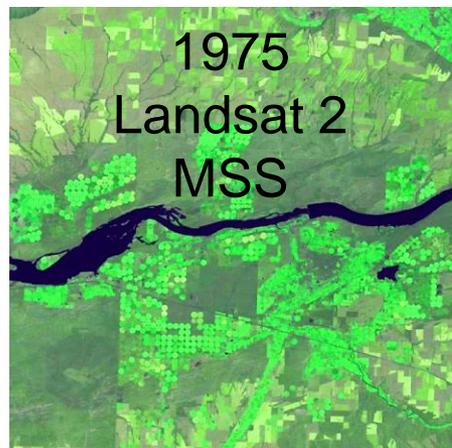
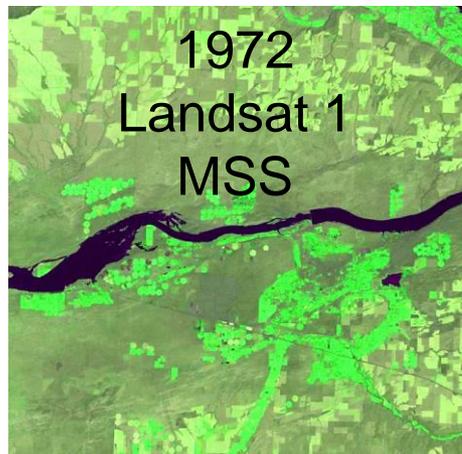
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An Evolution in Sensor Technology

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40-Year Record of Change near the Columbia River, OR/WA



MSS – Multispectral Scanner: 80m resolution, 4 spectral bands

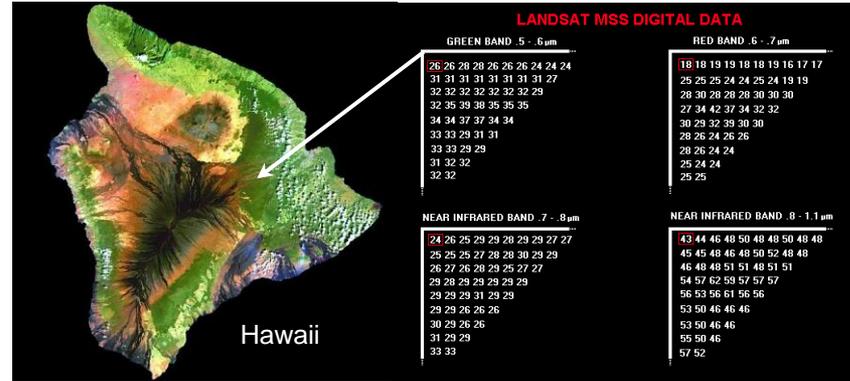
TM – Thematic Mapper: 30m resolution, 7 spectral bands

ETM+ - Enhanced Thematic Mapper Plus, 30m resolution, 8 bands

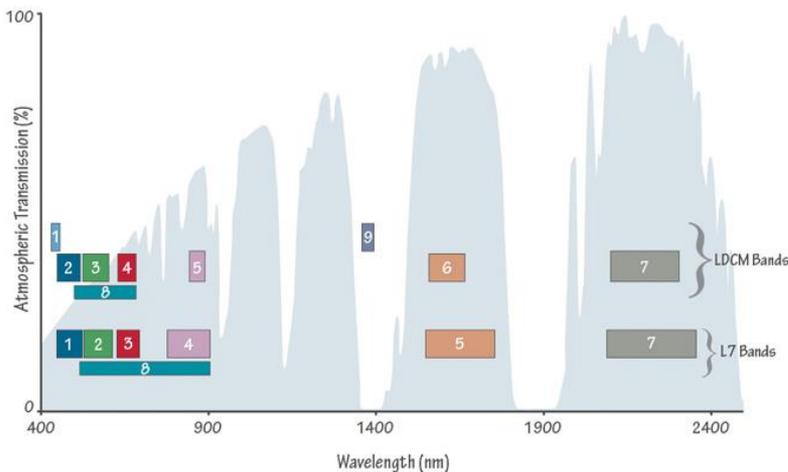
Key Landsat Attributes (1)

- a) Landsat sensors measure **electromagnetic energy reflected and emitted from the Earth surface**

Instruments provide scientific data, not just "pictures"



- a) Landsat data are **multispectral**, and bands are selected based on their ability to detect, characterize and discriminate clouds and surface features

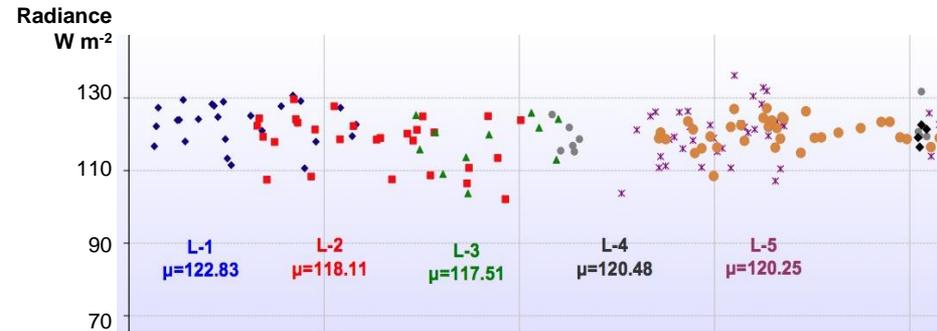


Landsat acquires data from multiple wavelengths within and beyond the range of human vision

Key Landsat Attributes (2)

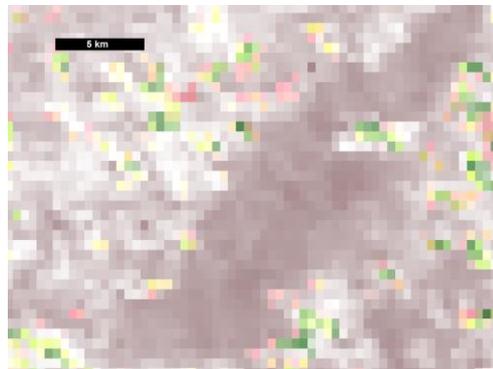
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c) Landsat data are *rigorously calibrated*



Accurate, precisely geolocated, and consistent across the 40 year archive

d) Spatial Resolution (~30m) is sufficiently fine to *monitor “patch” landscape dynamics*, and sufficiently coarse to allow *seasonal global acquisitions*



MODIS Data
250m spatial resolution
Near-daily global coverage

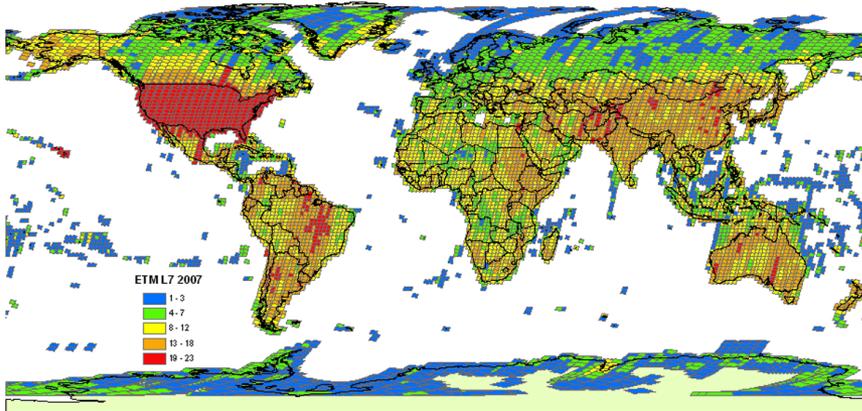


Landsat 7 ETM+ Data
30m spatial resolution
Seasonal global coverage

Key Landsat Attributes (3)

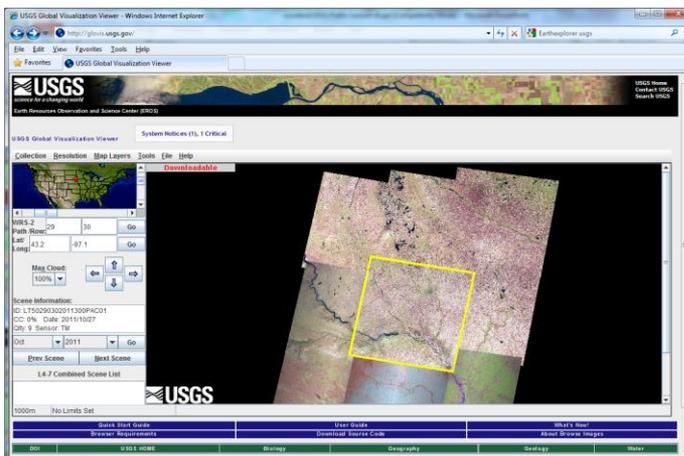
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- e) Landsat provides ***systematic coverage of the global land surface on a seasonal basis*** via a long term acquisition plan (LTAP)



No other satellite system has yet achieved even annual global coverage at the Landsat scale

- f) USGS EROS distributes Landsat data for ***FREE!***

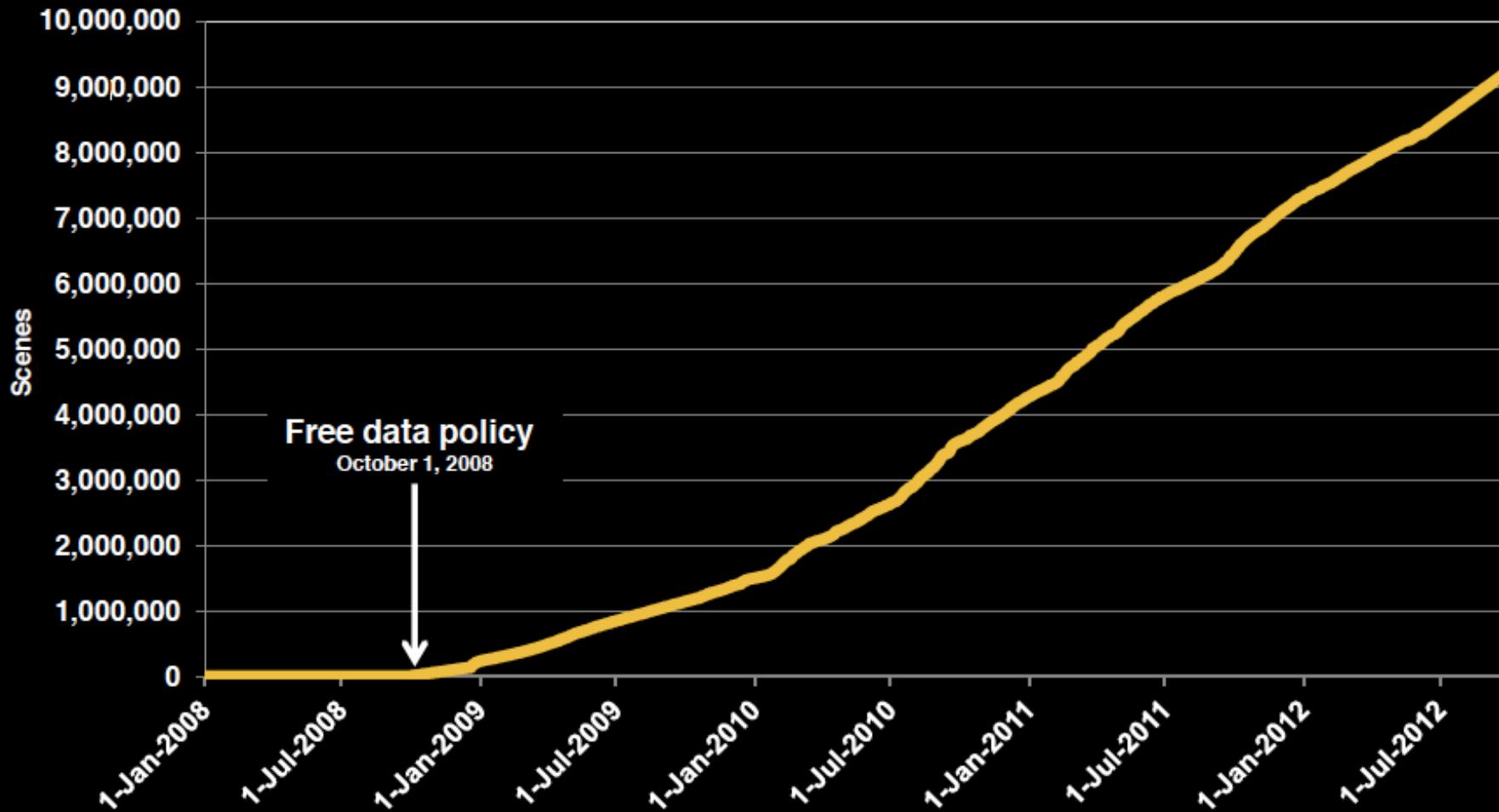


- USGS EROS archive contains ~3.7 million scenes
- Each year ~3 million scenes are distributed to users in over >180 nations and territories
- *"The opening of the Landsat archive to free, web-based access is like giving a library card for the world's best library of Earth conditions to everyone in the world."* (Adam Ferrand, UN-FAO)

Increasing Demand for Landsat Data

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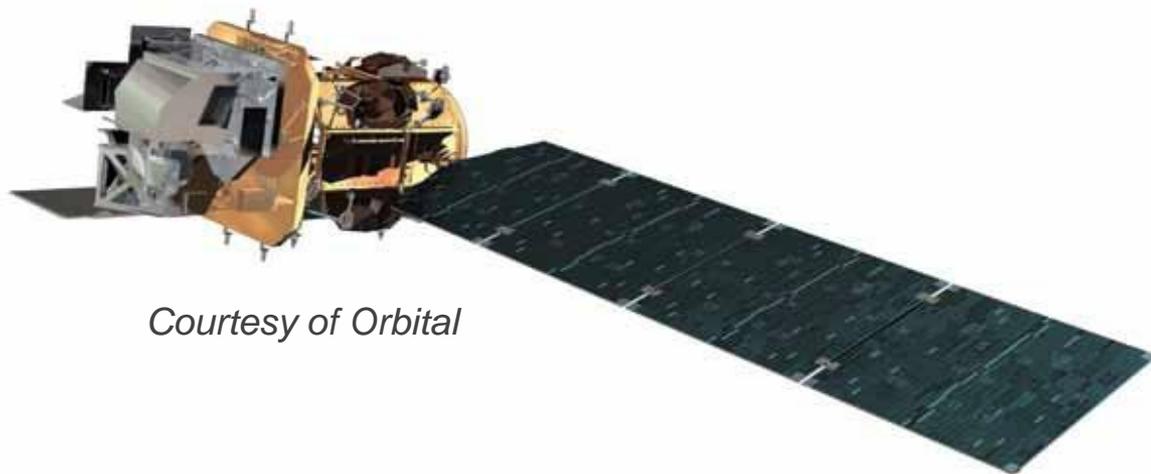
Total Landsat Scenes Provided to Users Since January 1, 2008



USGS has distributed over 11 million scenes at no cost



LDCM / Landsat 8



Courtesy of Orbital

LDCM
LANDSAT



data continuity mission



LDCM Launch!

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LDCM successfully launched on an **ATLAS-V** from **Vandenberg AFB, CA**, on **February 11, 2013**

All launch and spacecraft operations nominal



What's New With LDCM?

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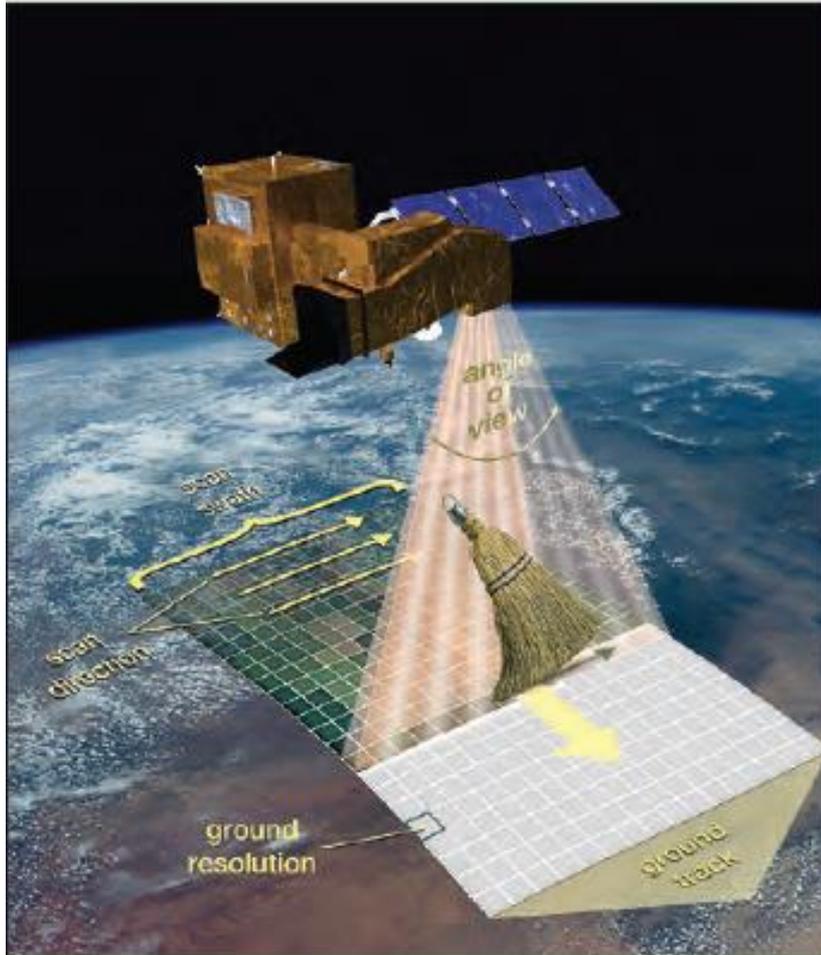
Instrument, Data and Science Improvements:

- **Pushbroom sensors** give improved signal-to-noise & dynamic range (now 12 bit rather than 8 bit radiometry), and fewer moving parts
- **New VNIR/SWIR spectral bands** (deep-blue band for coastal water and atmospheric aerosols; infrared band for cirrus cloud detection)
- **2 @ Thermal IR bands** to support split-window atmospheric correction
- **Narrower panchromatic bandwidth** (for improved contrast)
- Advanced, **multi-source calibration**
- **Off-nadir viewing capability** (to be used rarely)
- **Increased acquisition capacity** (400 scenes per day)
- New product format including **QA information**

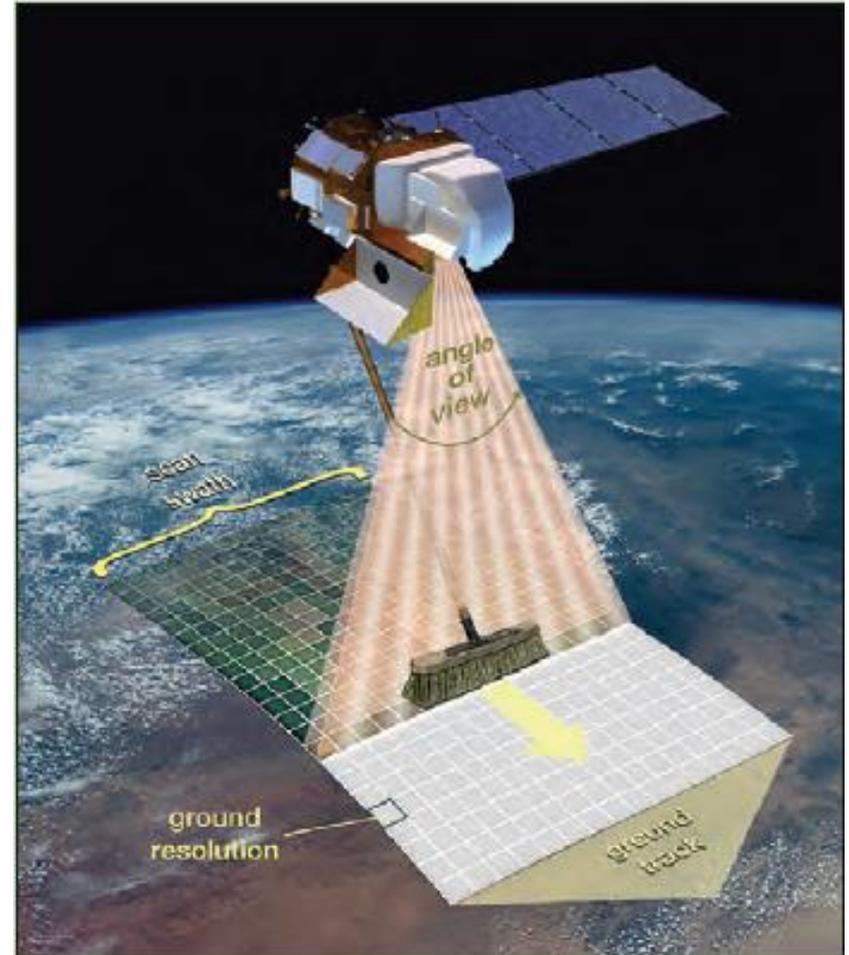
Sensor Architecture Evolution

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MSS, TM, ETM+
Whiskbroom Sensors

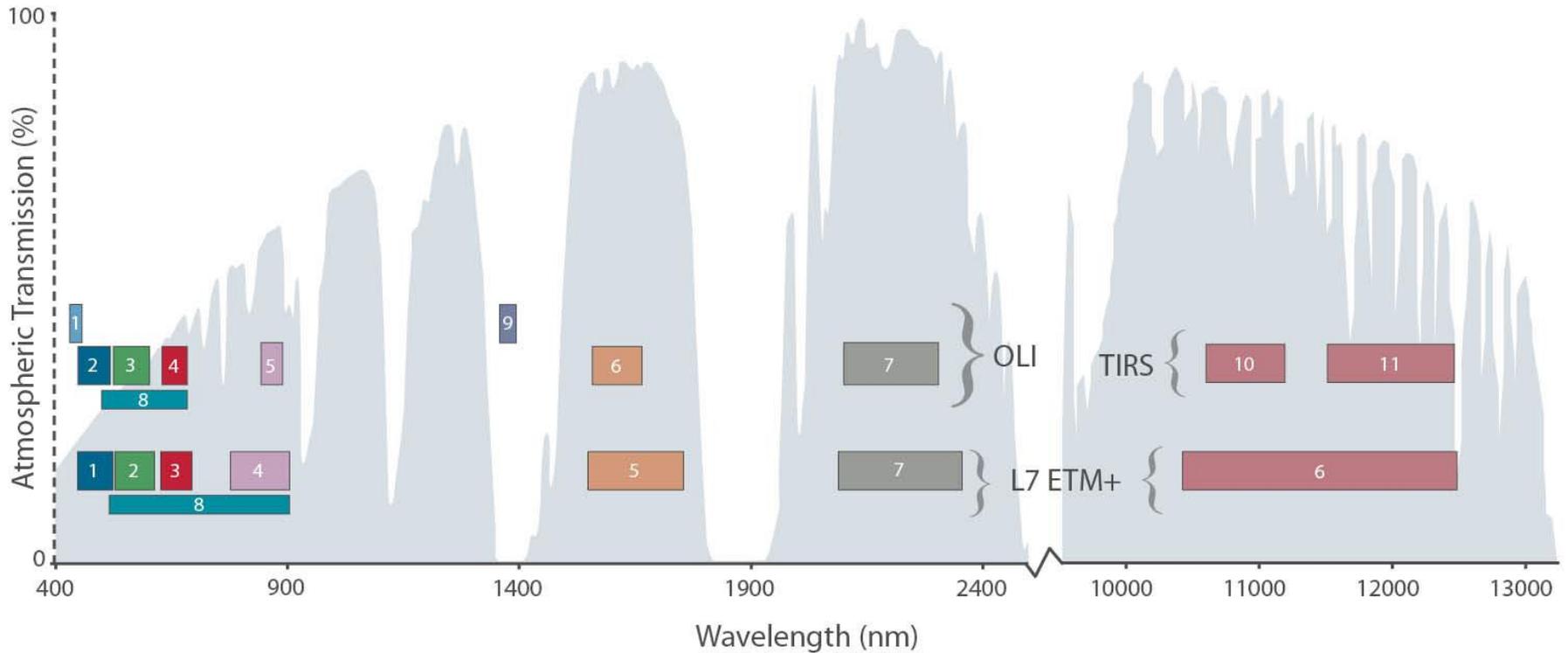


OLI & TIRS
Pushbroom Sensors



Comparison of LDCM & LS7 Spectral Bands

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Landsat Ground Stations

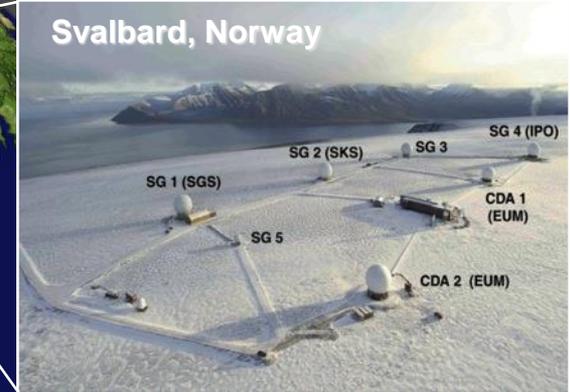
Gilmore Creek, Fairbanks, AK



GLC

SGS

Svalbard, Norway

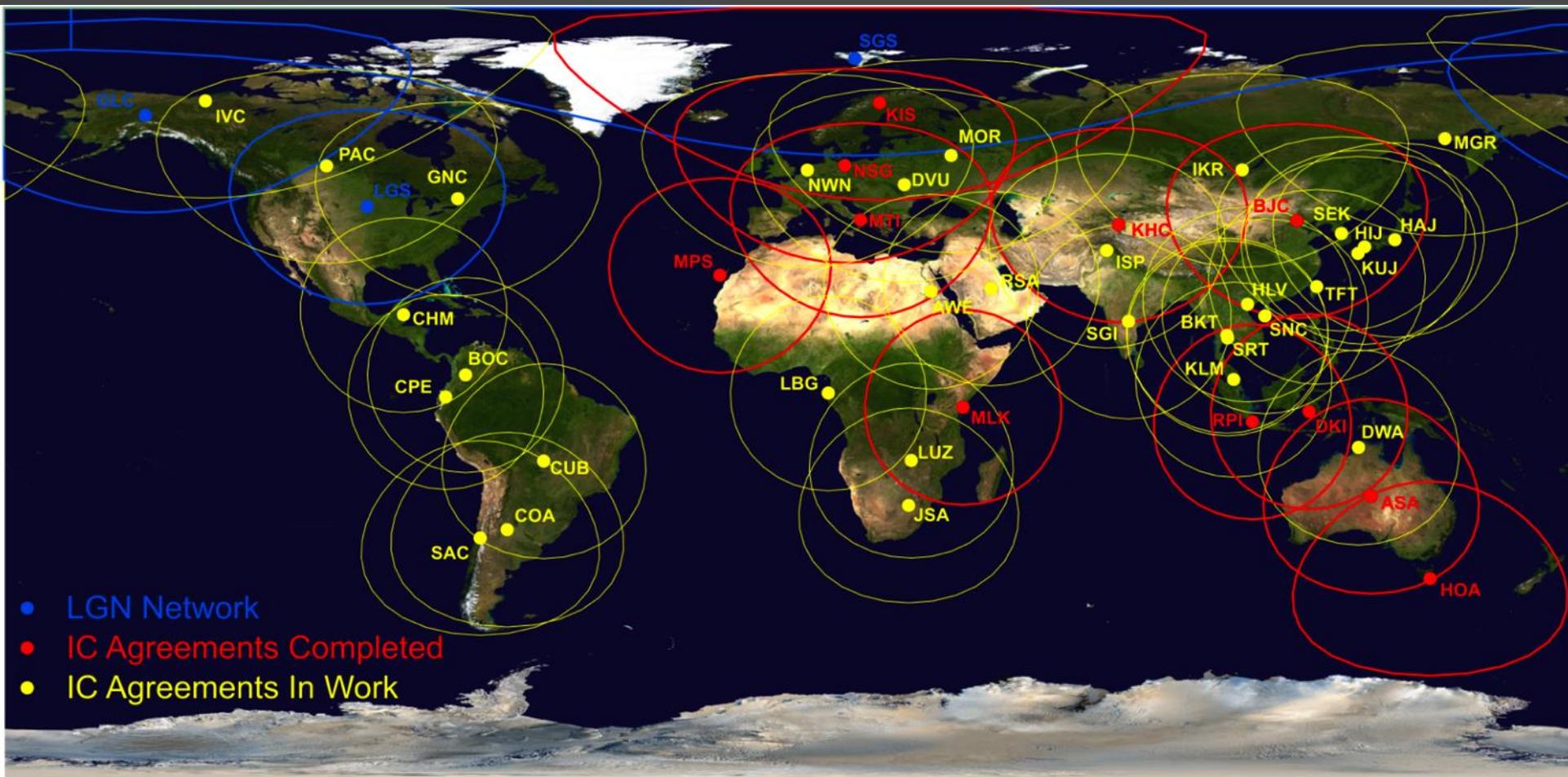


LGS

EROS, Sioux Falls, SD



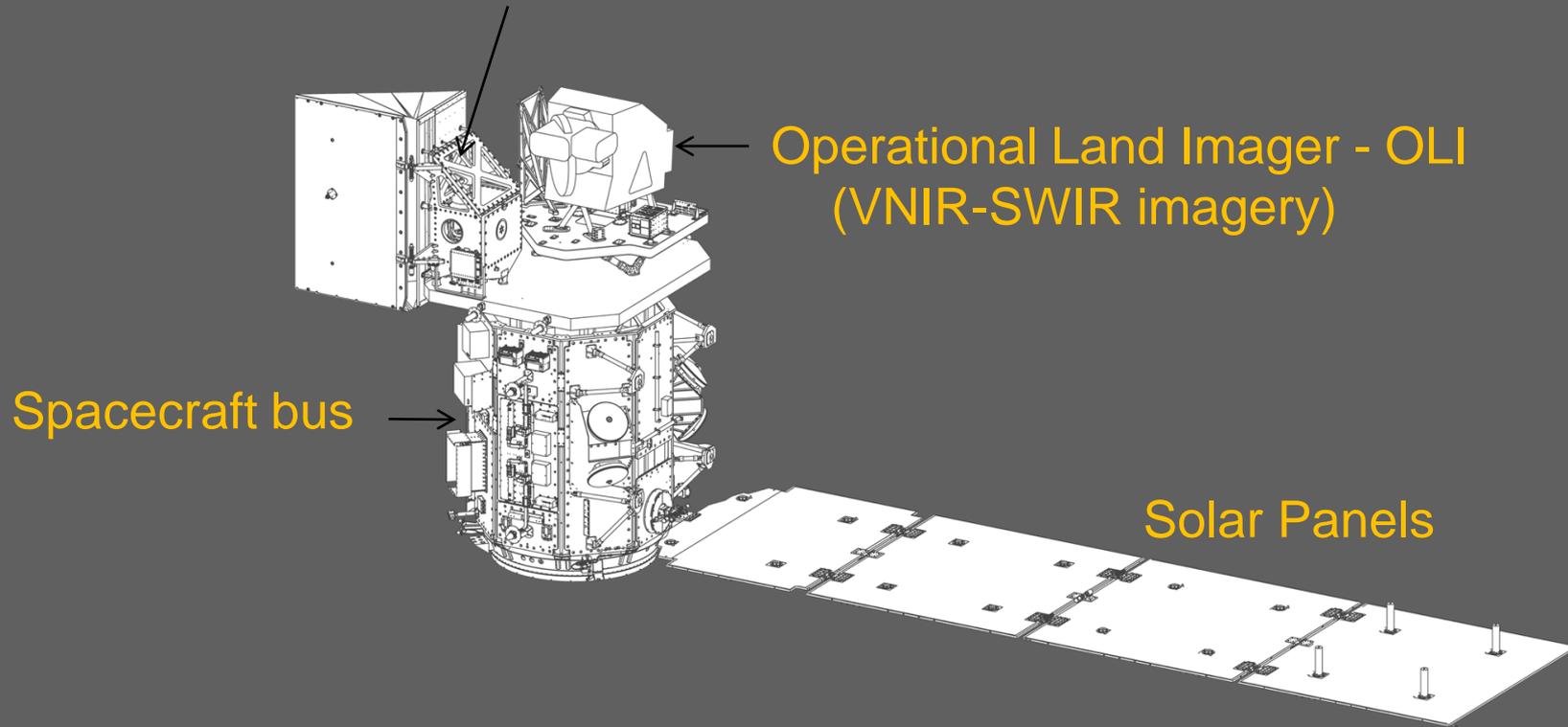
Potential LDCM International Cooperators



The LDCM Observatory

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Thermal Infrared Sensor – TIRS
(Thermal IR Imagery)



Drawing courtesy of Orbital Sciences Corporation

The LDCM Observatory

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Operational Land Imager

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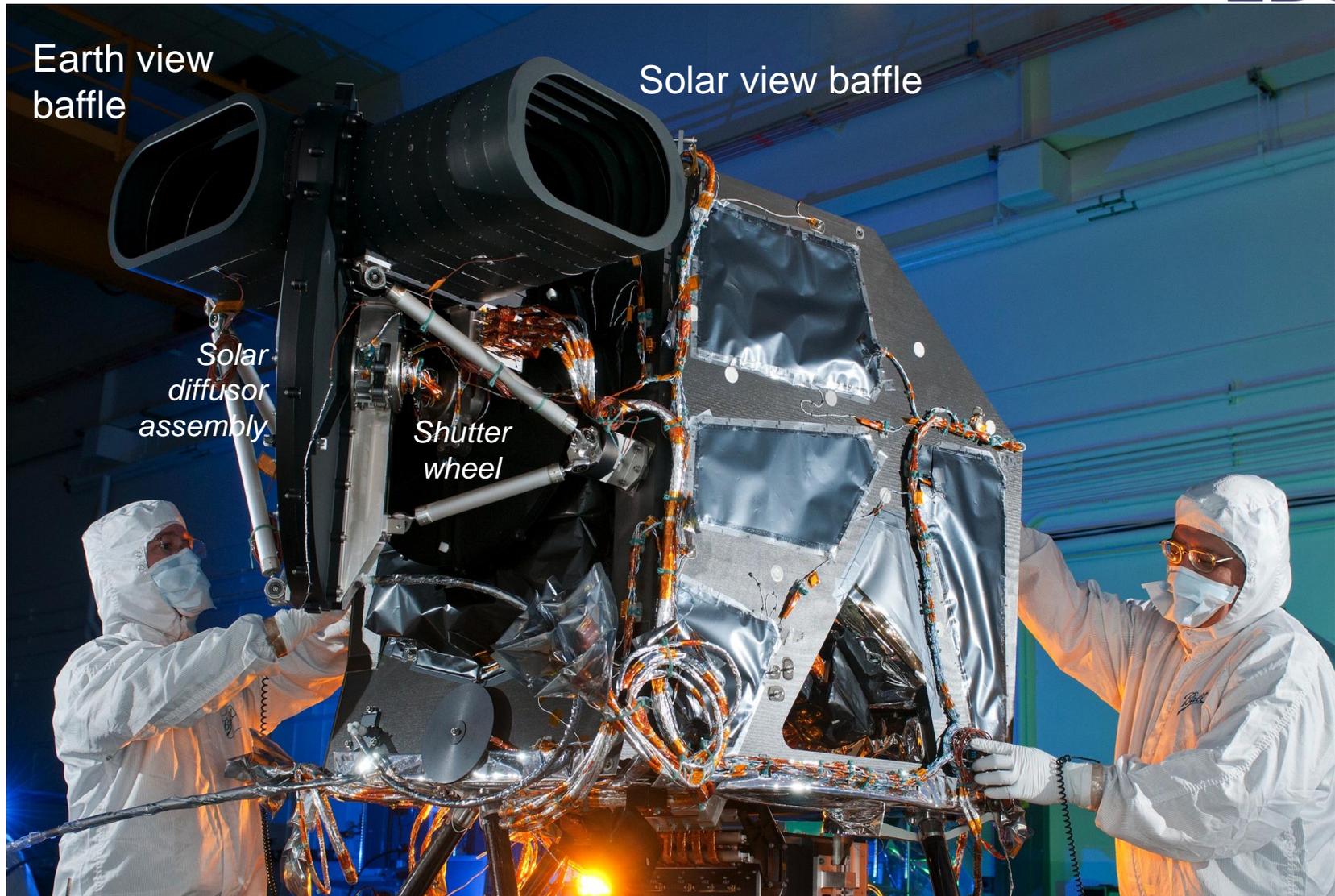
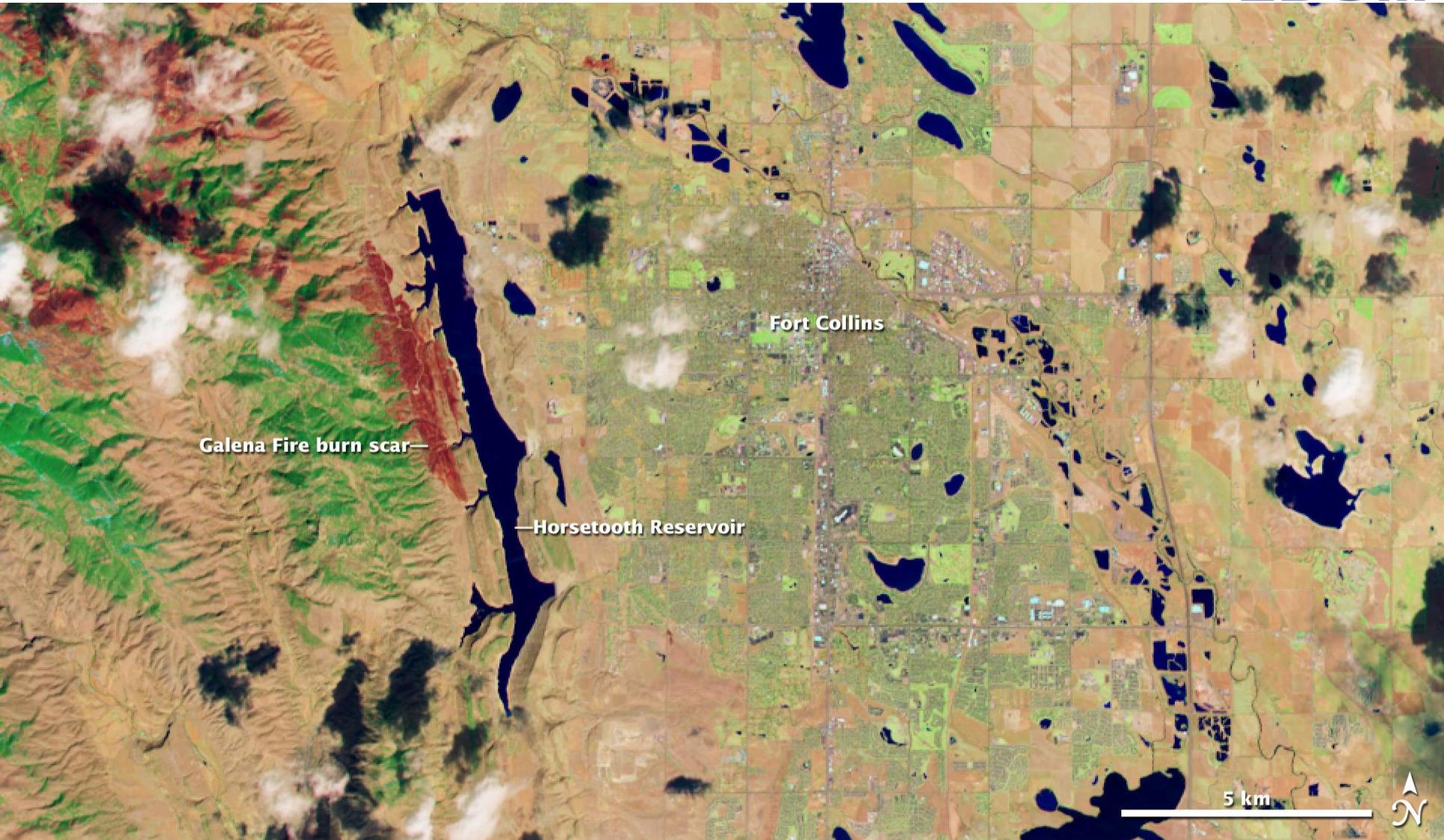


Photo courtesy of Ball Aerospace

Fort Collins, CO: March 18, 2013

LDCM



Galena Fire burn scar

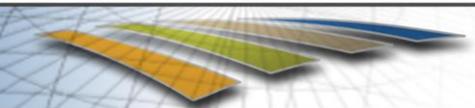
Fort Collins

Horsetooth Reservoir

5 km



False Color: OLI bands 7, 5, 3



Aral Sea in “True Color”

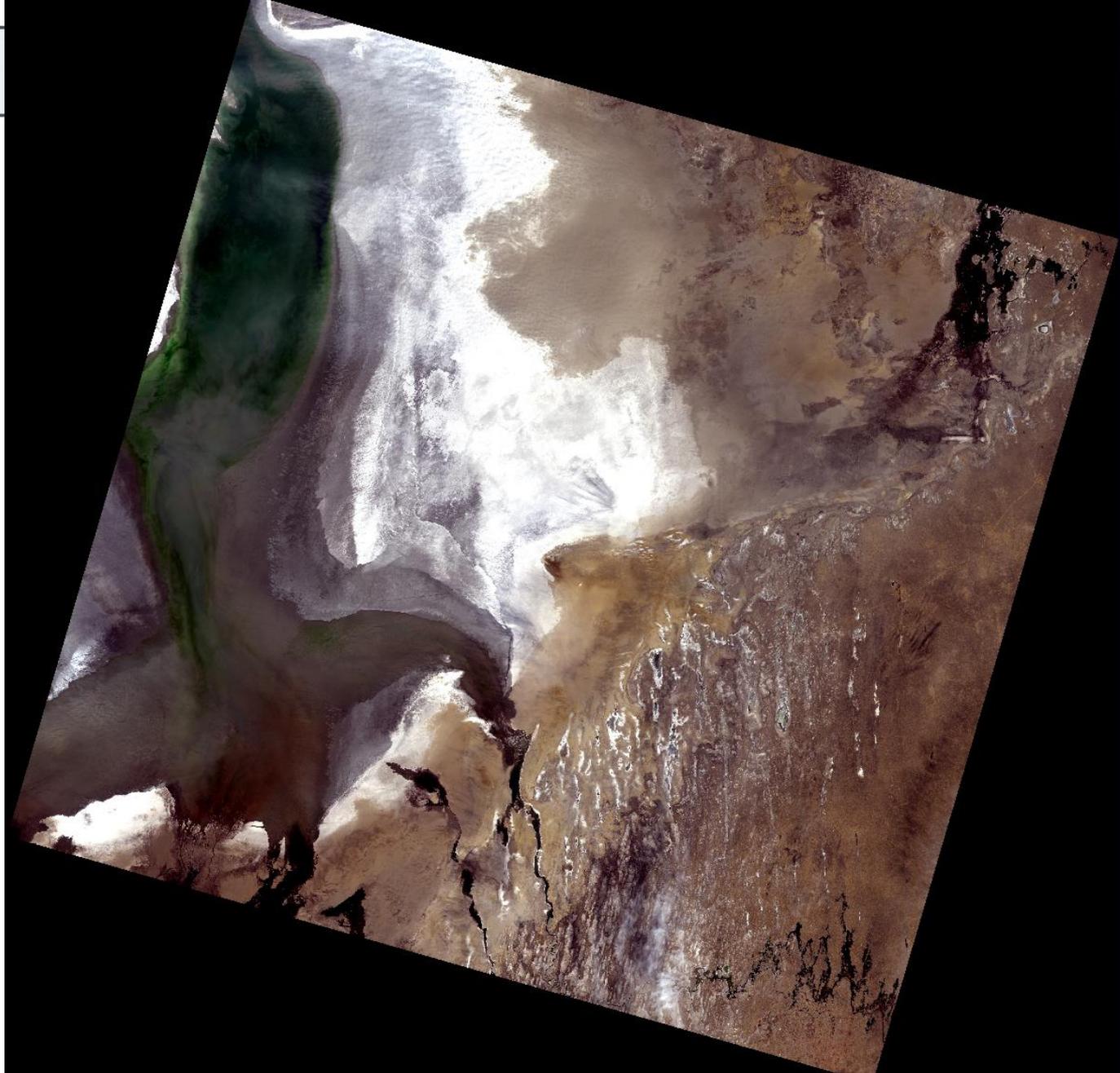
Bands:

4 (red)

3 (green)

2 (blue)

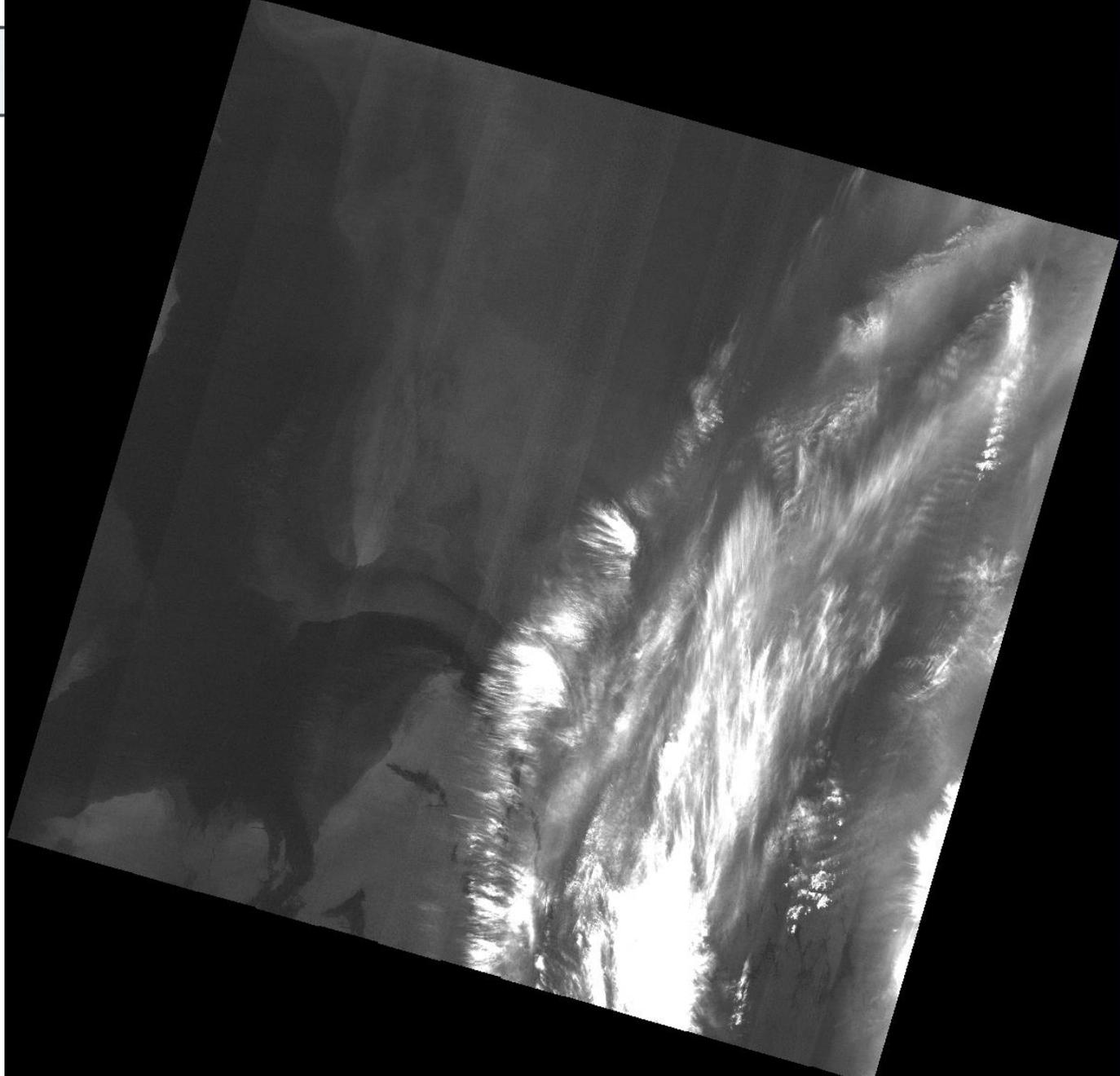
From
Pat Scaramuzza/EROS





Aral Sea w/ Cirrus Band (9)

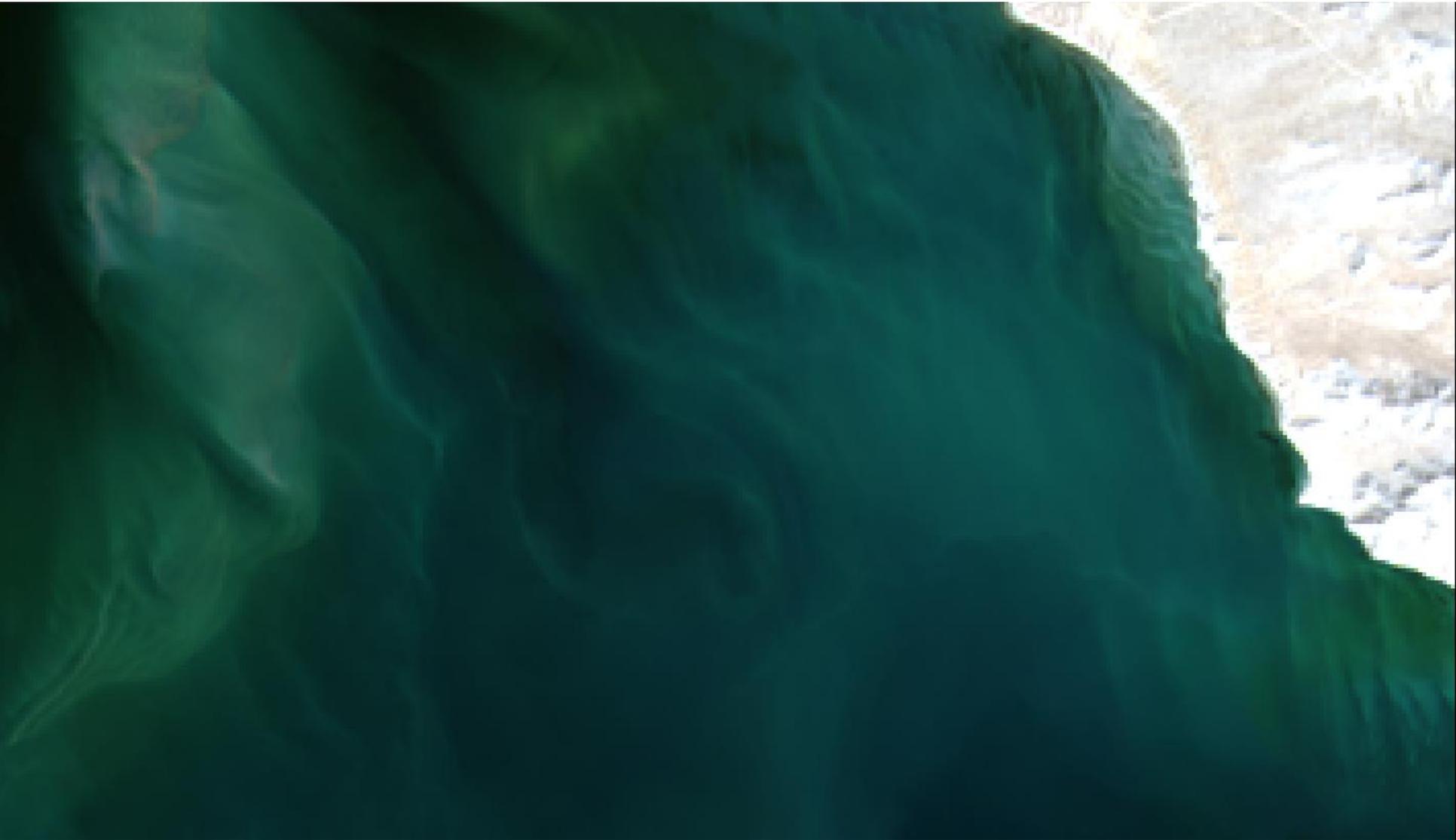
From
Pat Scaramuzza/EROS





LDCM OLI Natural Color (4,3,2)

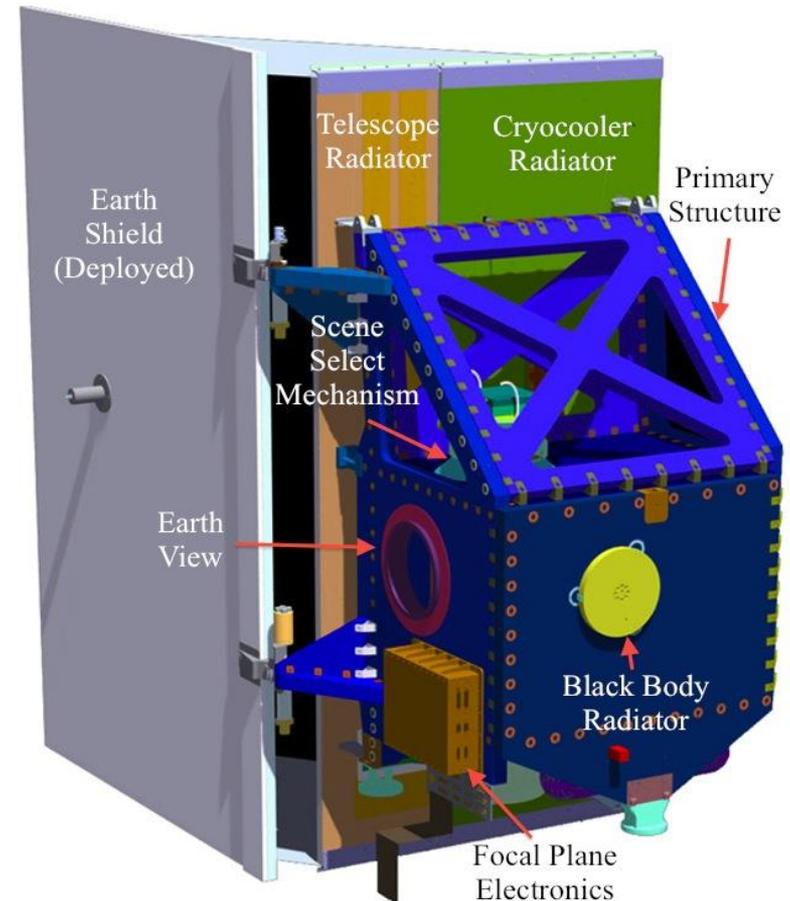
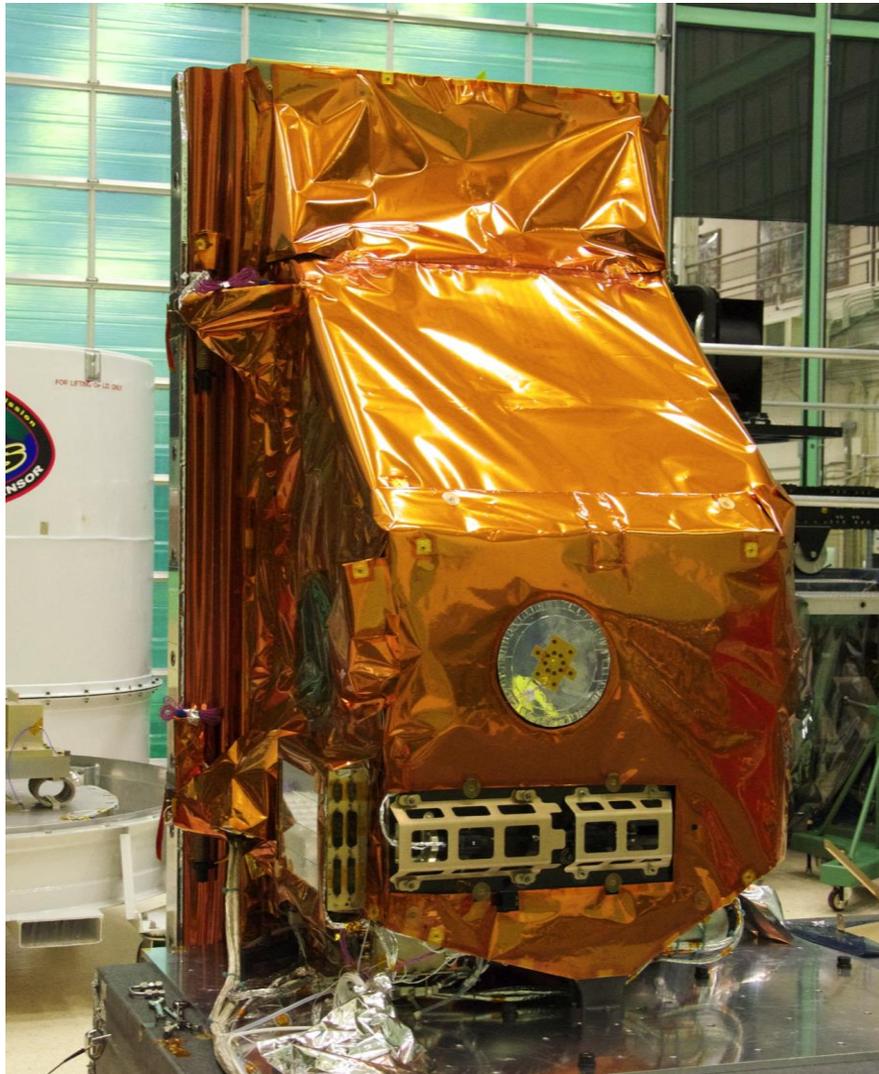
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Thermal Infrared Sensor (TIRS)

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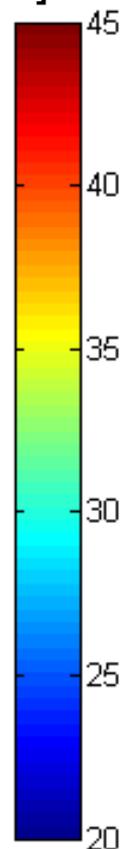
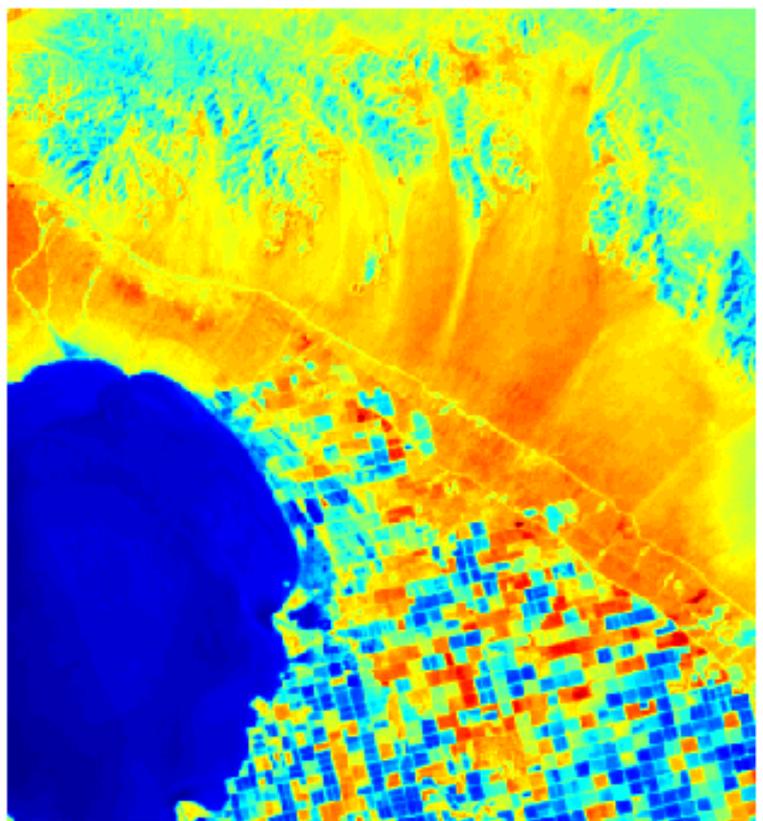
Built by NASA Goddard Space Flight Center, Greenbelt, MD



Salton Sea, CA, USA – Growing Fields

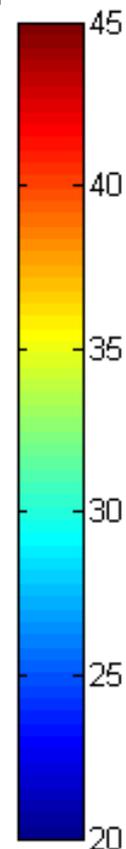
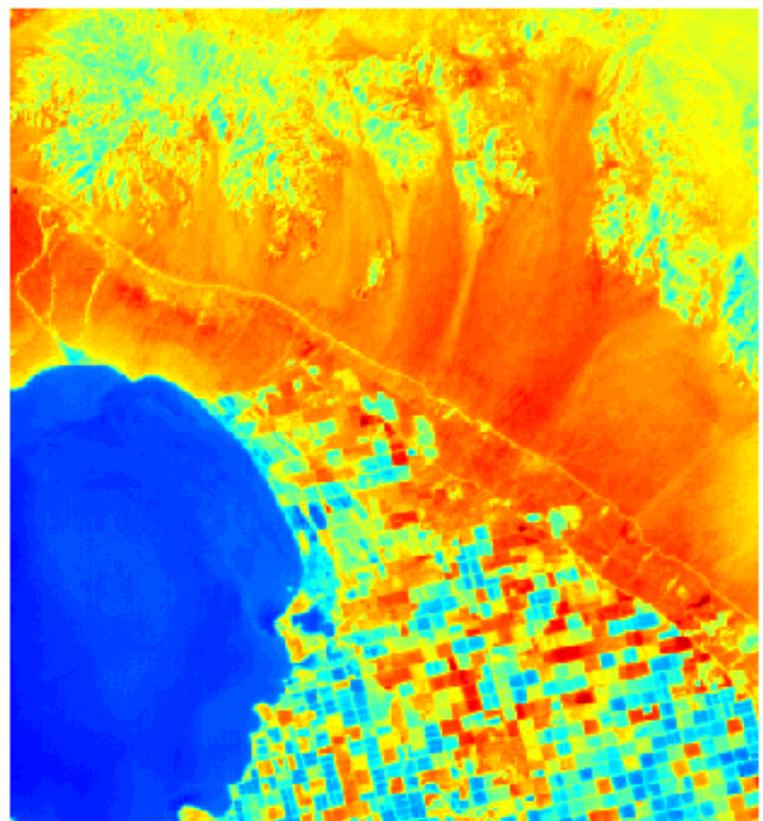
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10.8 μm Brightness Temperature [C]



2 km

12.0 μm Brightness Temperature [C]

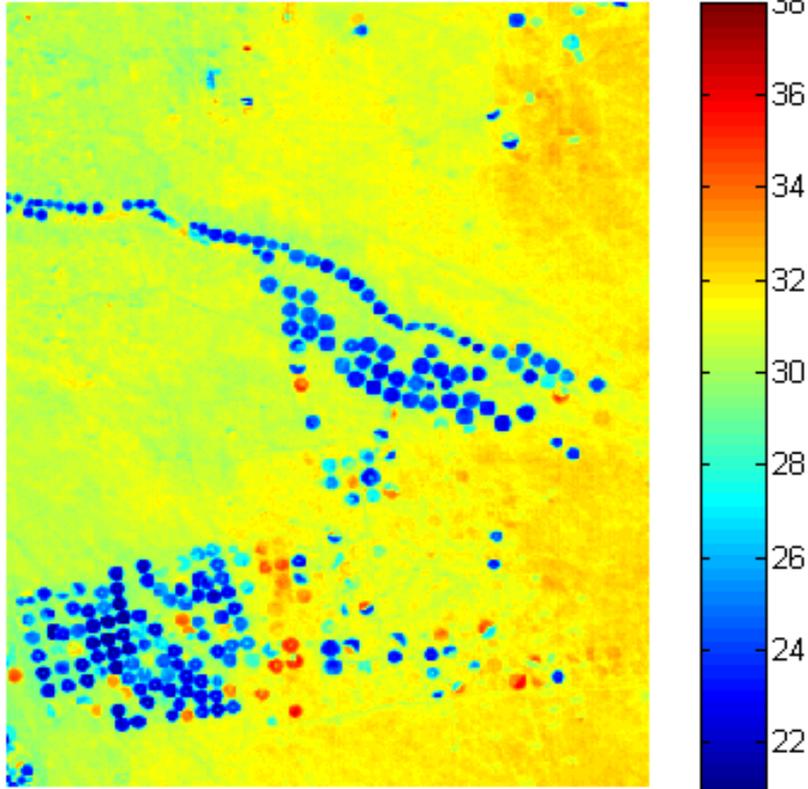


(~40km width)

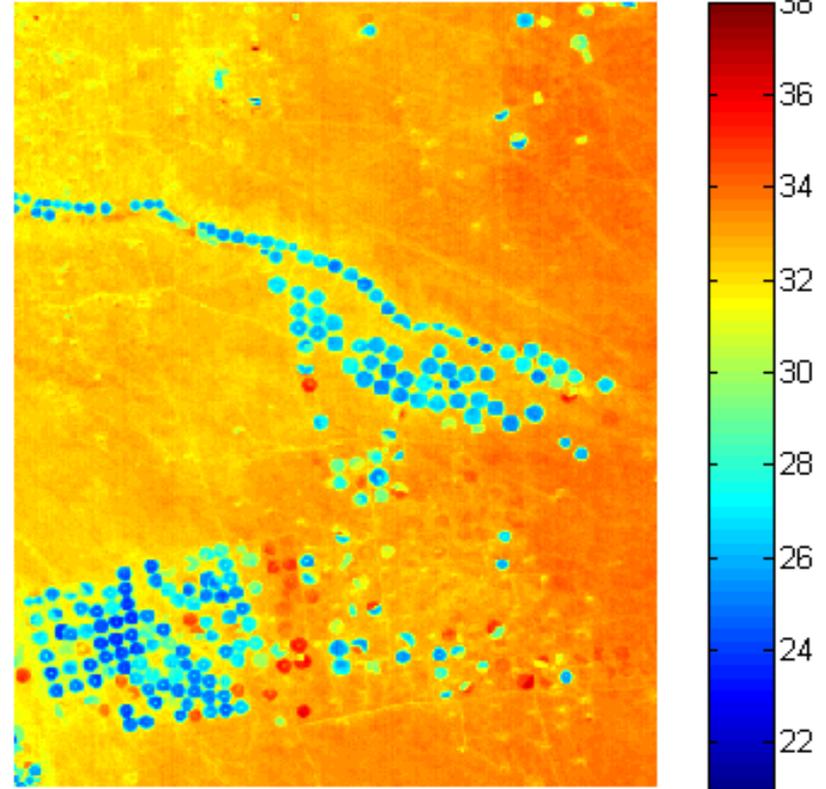
Center Pivot Irrigation Fields, Saudi Arabia

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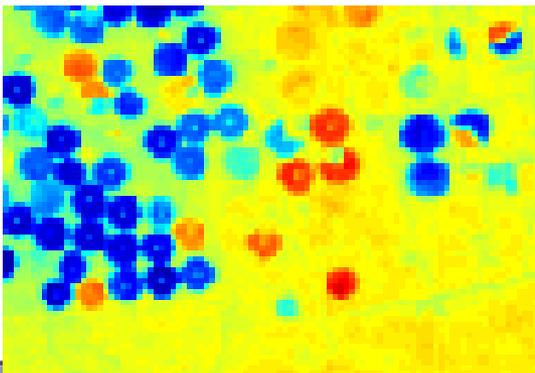
10.8 μm Brightness Temperature [C]



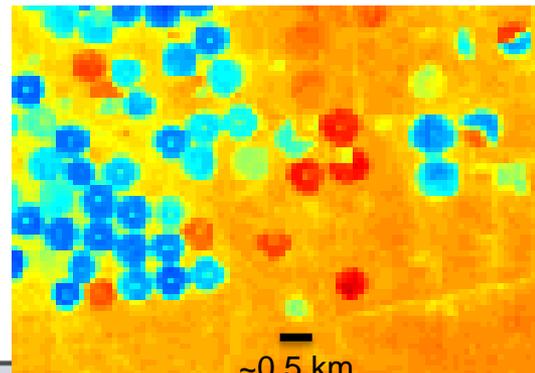
12.0 μm Brightness Temperature [C]



(~60km width)



Close-up of growing and non-growing fields



~0.5 km

Commissioning Activities

LDCM

- **LDCM on WRS-2 orbit** **April 11**
- **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**

Web Sites:

<http://landsat.usgs.gov/>

<http://www.nasa.gov/landsat>



Landsat

Continuing to Improve Everyday Life

