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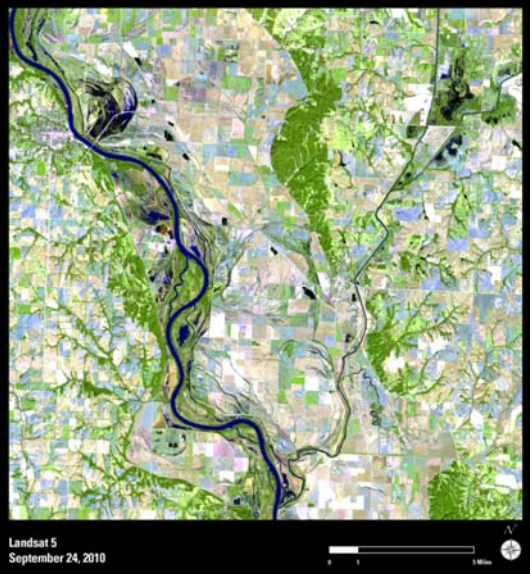
science for a changing world

Landsat Program Status to the National Geospatial Advisory Committee

Missouri River: Flooding near Hamburg, Iowa



Presented by
Bruce K. Quirk
Land Remote Sensing Program Coordinator

April 18, 2012

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

LANDSAT 40

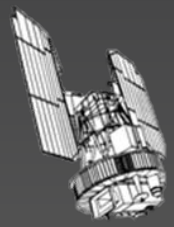
Satellite Remote Sensing at DOI

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."

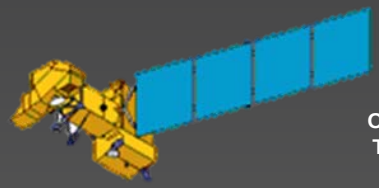
Secretary of the Interior Stewart L. Udall, 1966

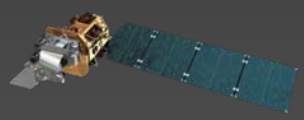
Landsat 1 - 3
Multi-Spectral Scanner (MSS) 79 meter
Return Beam Vidicon (RBV) 80/40 meter



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

International Collaboration in Earth Observation

USGS

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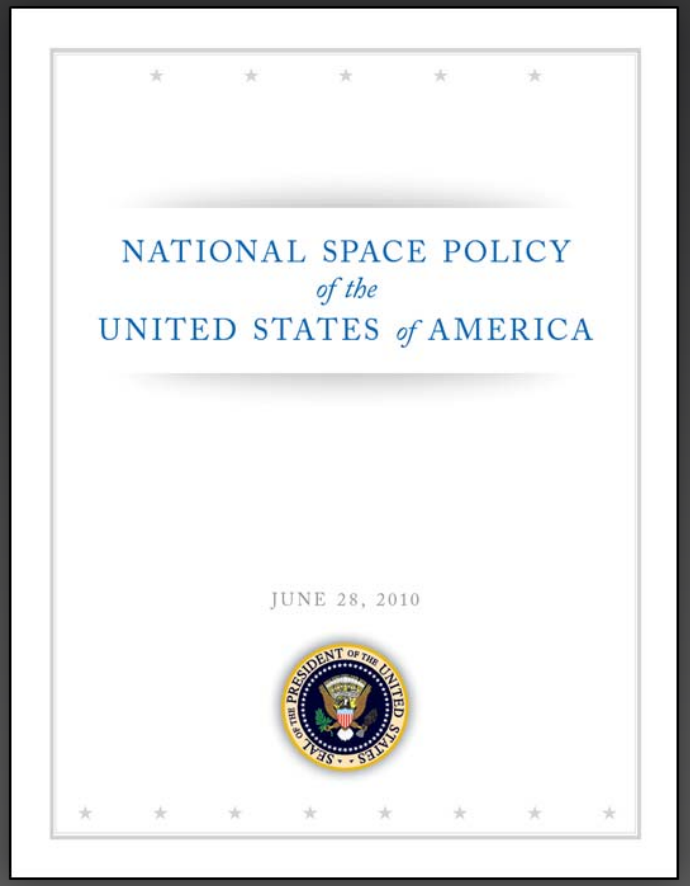
The Role of Interior in the U.S. National Space Policy

National Space Policy 2010

Land Remote Sensing

The Secretary of the Interior, through the Director of the United States Geological Survey (USGS), shall conduct research on natural and human-induced changes to Earth's land, land cover, and inland surface waters, and manage a global land surface data national archive and its distribution; determine the operational requirements for collection, processing, archiving, and distribution of land surface data to the United States Government and other users; and

The Director of the USGS, and the NASA Administrator shall work together in maintaining a program for operational land remote sensing observations



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The Landsat Revolution

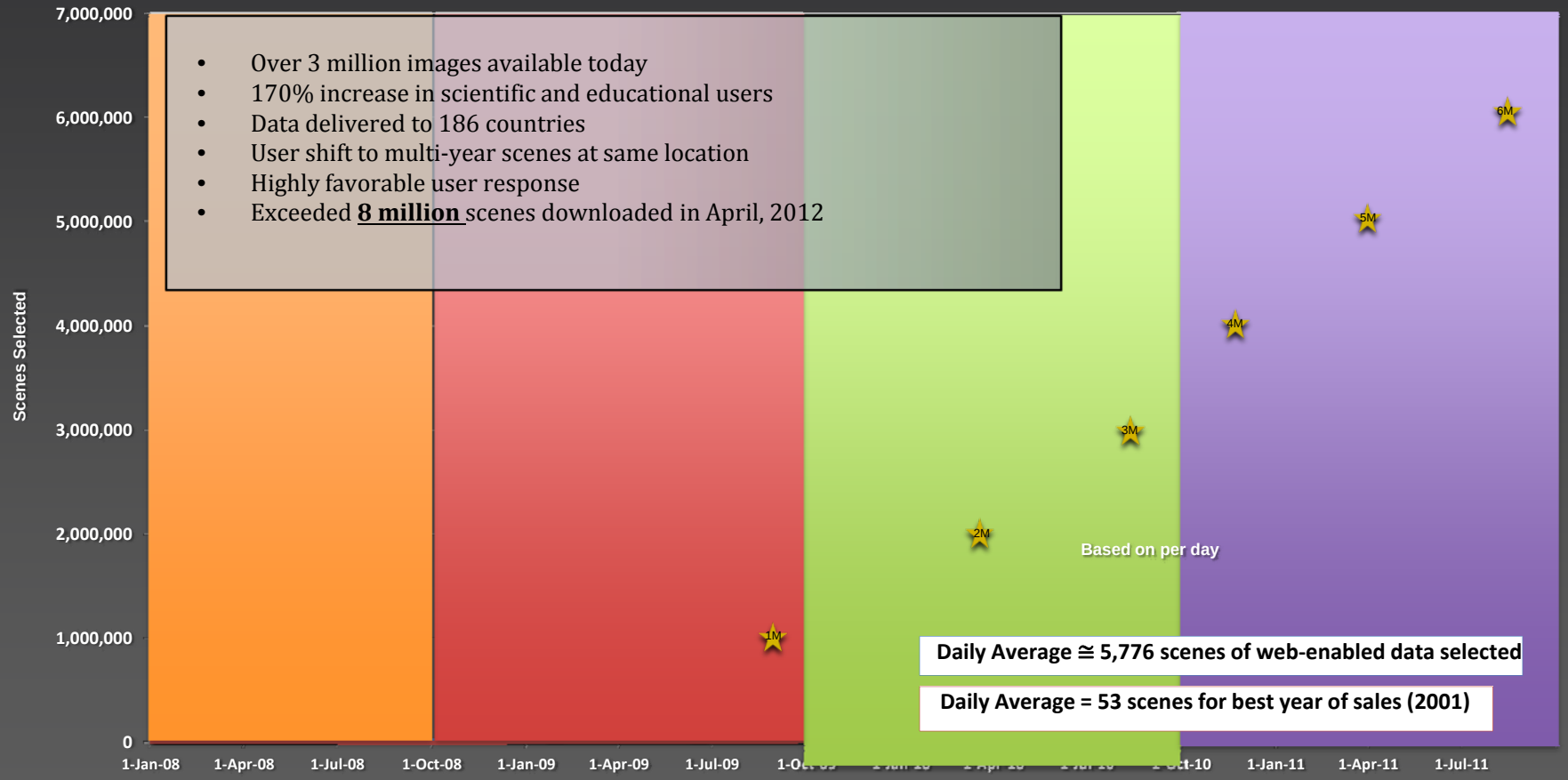
In October 2008, the USGS made the entire Landsat archive, over 3 million images, available via the Internet at no cost

The opening of the Landsat archive reshaped the future of moderate resolution Earth observations

Mount St. Helens, WA

Landsat Internet Data Distribution

40-year archive of global data provided freely on the Internet



- Over 3 million images available today
- 170% increase in scientific and educational users
- Data delivered to 186 countries
- User shift to multi-year scenes at same location
- Highly favorable user response
- Exceeded **8 million** scenes downloaded in April, 2012

Total Landsat Scenes Selected By Users Since January 1, 2008

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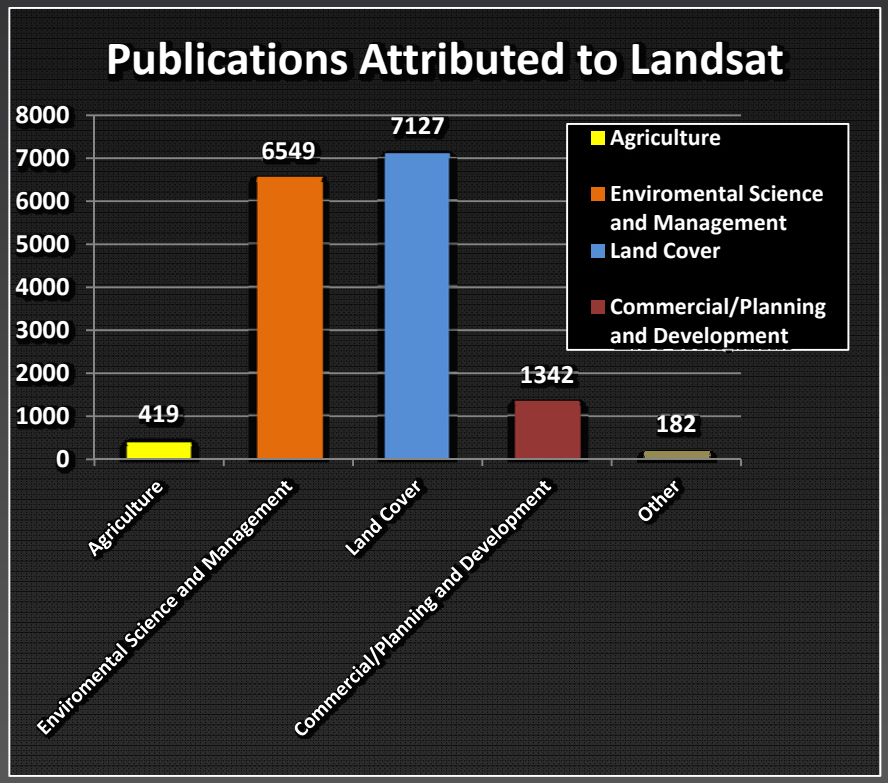
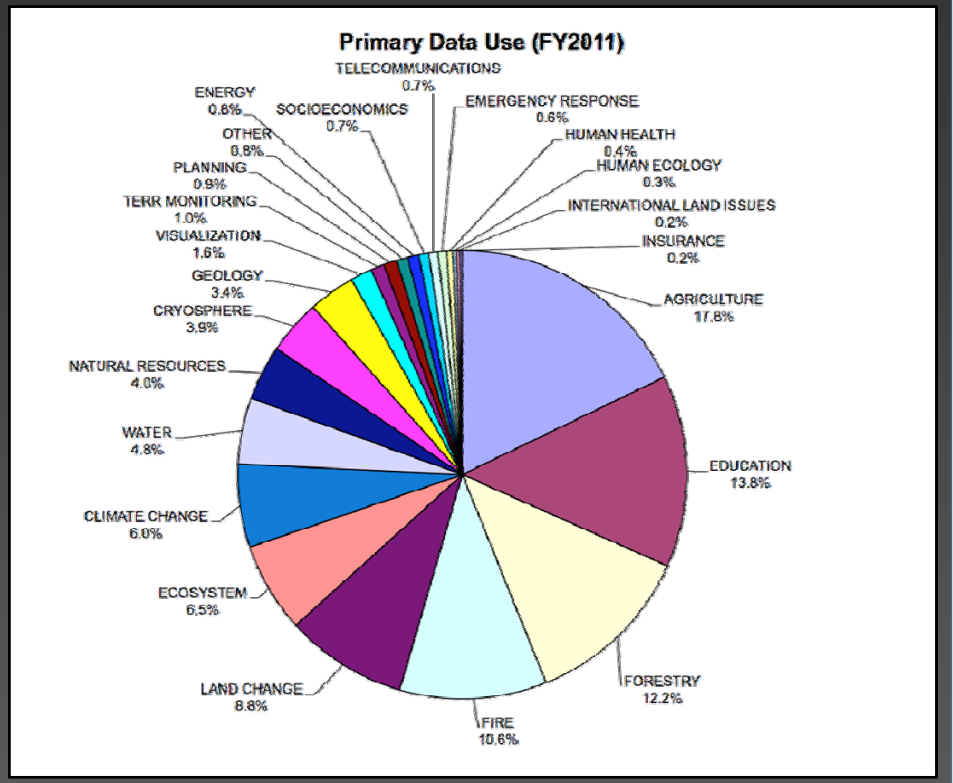
Primary Landsat User Applications





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Need for the Landsat Advisory Group

- At a crossroads
  - Landsats 5 and 7 are well beyond their design lives and could fail at any time
  - After Landsat 8 launch in 2013, there are no other missions planned/funded
  - Opening the Landsat archive has revolutionized global change research
  - President's Space Policy direction to determine the operational requirements for land surface data and to maintain an operational land remote sensing program
- Advise the Federal Government on the requirements, objectives and actions of the Landsat Program working towards the creation of a program for operational land remote sensing observations

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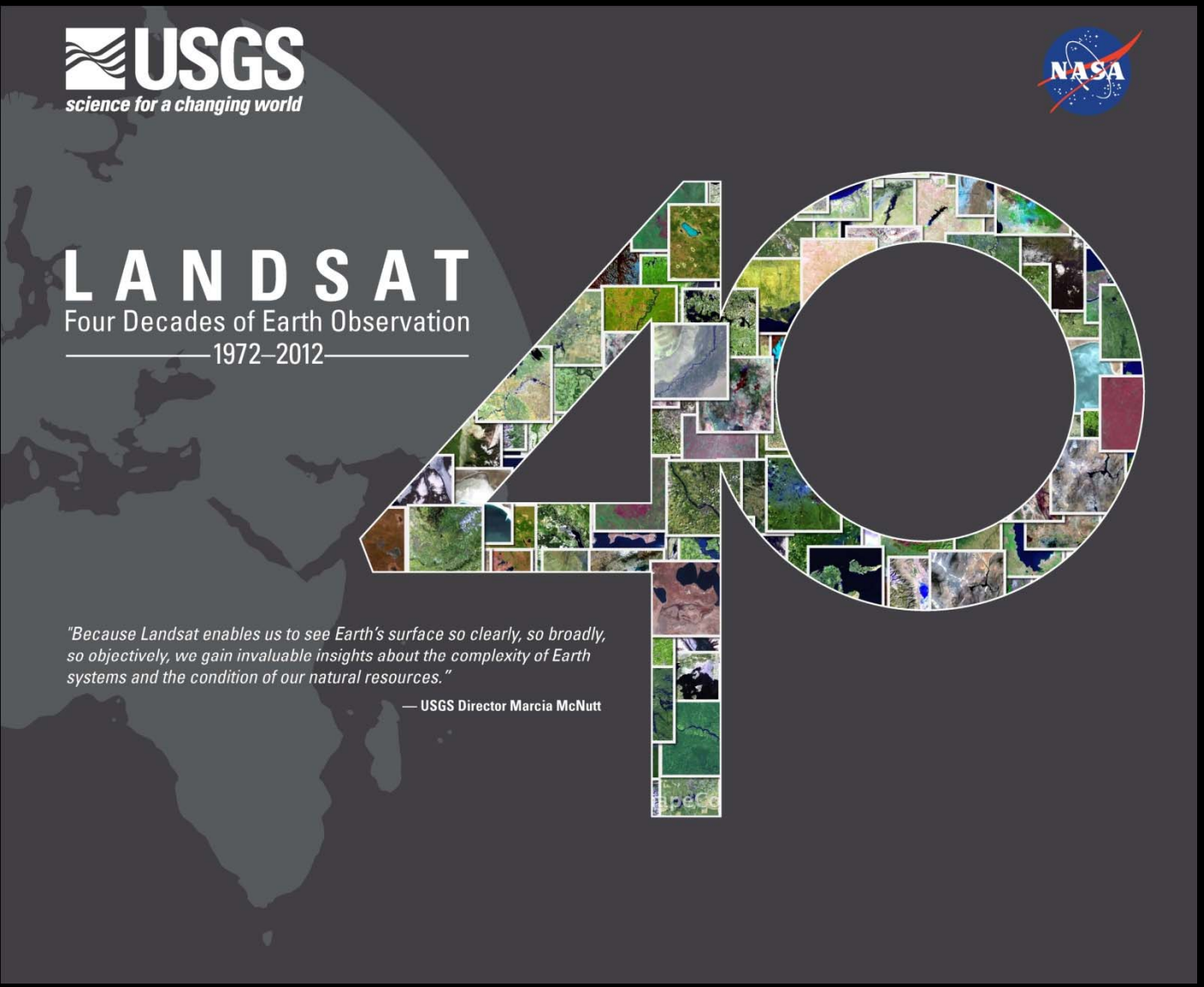
Questions?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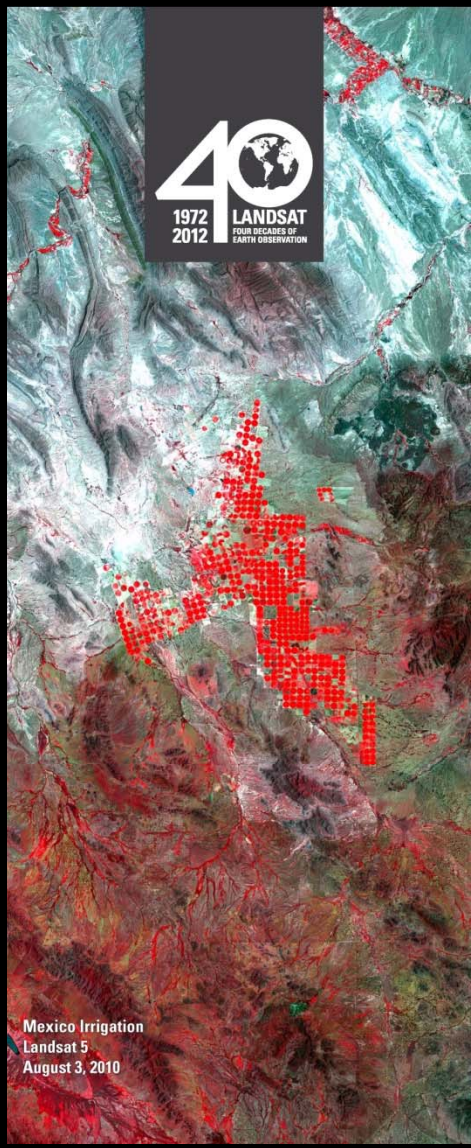
science for a changing world
NASA
LANDSAT
Four Decades of Earth Observation
1972–2012
"Because Landsat enables us to see Earth's surface so clearly, so broadly, so objectively, we gain invaluable insights about the complexity of Earth systems and the condition of our natural resources."
— USGS Director Marcia McNutt


1972
2012
LANDSAT
FOUR DECADES OF EARTH OBSERVATION
Mexico Irrigation
Landsat 5
August 3, 2010

Landsats 5 and 7

Landsat 5

- Launched by NASA in 1984 (3-year design life), just turned 28!
- Operated by USGS since 2001
- November 2011: USGS suspended imaging temporarily to investigate electronic problem

Landsat 7

- Launched by NASA in 1999 (5-year design life)
- Operated by USGS since 2000
- Acquiring over 350 images/day worldwide
- Estimated end of mission, based on fuel supply only: January 2017

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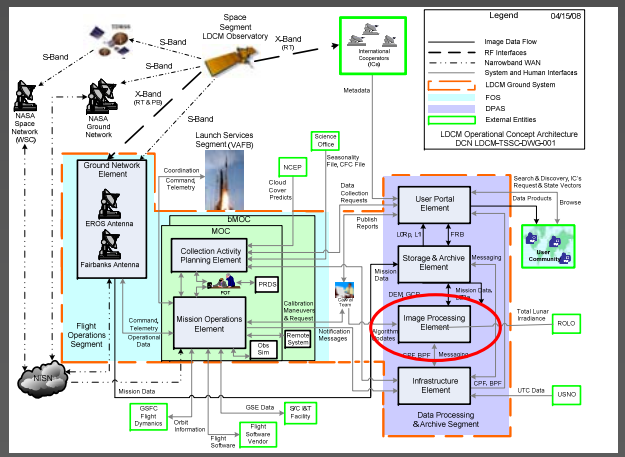
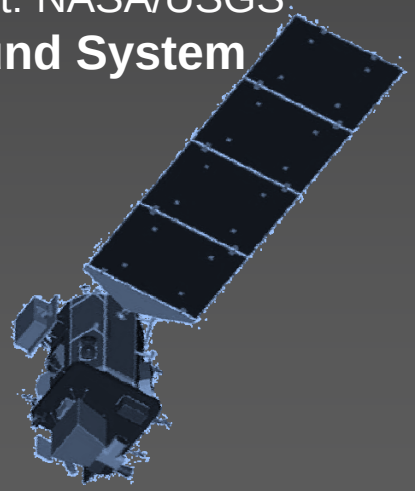
Landsat Data Continuity Mission (LDCM) or Landsat 8

Mission Characteristics

- Orbit: Polar, 705km, sun-synchronous (WRS2), 98.2° inclined, mid-morning, 16-day repeat
- **Launch Date: Jan. 2013; Launch Vehicle: Atlas V**
- Mission Life: 5 Years (with consumables 10 years)
- Mission Project Management: NASA/USGS

DOI USGS developed Ground System





Operational Land Imager (OLI)

- 9 spectral bands 30m resolution for VIS/NIR/SWIR, 15m for PAN
- 185km swath width
- Collect 400 WRS-2 scenes/day; 265Mbps

Thermal Infrared Sensor (TIRS)

- TIRS in initial design at NASA; proposed in American Recovery and Investment Act of 2009 Approximately 100m resolution in 2 bands; 185km swath

Spacecraft

- Observatory mass of 3085kg
- Maximum power of 2130W
- 3Tb Solid State Recorder
- 384Mbps X-band downlink

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Landsat 8 Spectral Bands

Operational Land Imager (OLI)		
LDCM	**Wavelength (micrometer)**	**Resolution (meters)**
Band 8 (pan)	.500-.680	15
Band 1	.433-.453	30
Band 2	.450-.515	30
Band 3	.525-.600	30
Band 4	.630-.680	30
Band 5	.845-.885	30
Band 9	1.360-1.390	30
Band 6	1.560-1.660	30
Band 7	2.100-2.300	30
Band 10*	10.3 - 11.3	120
Band 11*	11.5 - 12.5	120

Enhanced Thematic Mapper Plus (ETM+)		
Landsat 7	**Wavelength (micrometer)**	**Resolution (meters)**
Band 8	.52-.90	15
Band 1	0.45-0.52	30
Band 2	0.53-0.61	30
Band 3	0.63-0.69	30
Band 4	0.78-0.90	30
Band 5	1.55-1.75	30
Band 7	2.09-2.35	30
Band 6	10.40-12.50	60

* Thermal Infrared Sensor (TIRS)

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Genie GS-1
Genie GS-2646

Landsat 9

- **Landsat 9 and beyond**
  - **Administration supports converting Landsat to an operational program**
  - **USGS is working with NASA and the White House Office of Science and Technology Policy to assess options for Landsat 9 and beyond**
    - **Landsat Data Continuity Concepts Request for Information - primary objective is to explore approaches to providing a cost-efficient, dependable, long-term source for Landsat-like data to follow the Landsat Data Continuity Mission (LDCM, or Landsat 8).**

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Summary

- Landsats 5 and 7 are well beyond their design lives and could fail at any time
- After Landsat 8 launch in 2013, there are no other missions funded
- Opening the Landsat archive has revolutionized global change research
- An operational Landsat Program is the first step in creating an OPERATIONAL LAND IMAGING PROGRAM

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Current and future Landsat data, information product definitions, and methods for accessing and distributing these products

Current and Planned Standard Landsat Data and Information Products

- **Current**
  - Level 1 Terrain corrected (L1T)
  - 3-band full spatial resolution browse (“natural color” [bands 5,4,3])
  - Thermal image full spatial resolution browse

- **Planned Landsat Data Continuity Mission (LDCM)**
  - Level 0 (L0)
  - L1T
  - 3-band and thermal full spatial resolution browse images
  - Top of Atmosphere Reflectance
    - Normalizing for Earth-Sun distance and sensor viewing geometries

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Planned Future
Landsat Data and Information Products

- Climate Data Records (Under Development…building blocks for ECV's)
  - Surface reflectance
  - Surface temperature
  - etc.
- Essential Climate Variables (Future)
  - Land Cover
  - Leaf area index
  - Surface water extent
  - Burned area

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LRS Program Goal
Landsat Data and Information Products

- Our goal is to progress from providing “data” to providing information operational starting with CONUS and working towards global

- Our philosophy is to develop the capability for processing current acquisitions, extend these back through the archive of ETM+ and TM data, and forward with OLI and TIRS

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Current and Future
Methods for Accessing and Distributing Landsat

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- **GloVis** -- http://glovis.usgs.gov
- **Earth Explorer** -- http://earthexplorer.usgs.gov
- **Web Enabled Landsat Data (WELD)** -- http://landsat.usgs.gov/WELD.php
- **Web Map Services (WMS)**
- **Cloud**

Clients making use of Landsat

- **Change Matters (Esri)**
- **Google Earth**

Majority over Internet, little physical media

Scene to Pixel

Tools

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Operation Desert Storm - 1991

Kuwait
August 31, 1990

Kuwait
February 23, 1991

Kuwait
November 14, 1991

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Priorities and Communication of the Landsat Program

Current and Future Priorities and Communication

- Facebook
- Twitter (@USGSLandsat)
- Image of the Week (http:landsat.usgs.gov)
- Landsat User Survey (http://www.fort.usgs.gov/landsatsurvey/)
- NRC Committee study on Operational Land Imaging (http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_065886)
- Landsat 40th
- OSTP workshop

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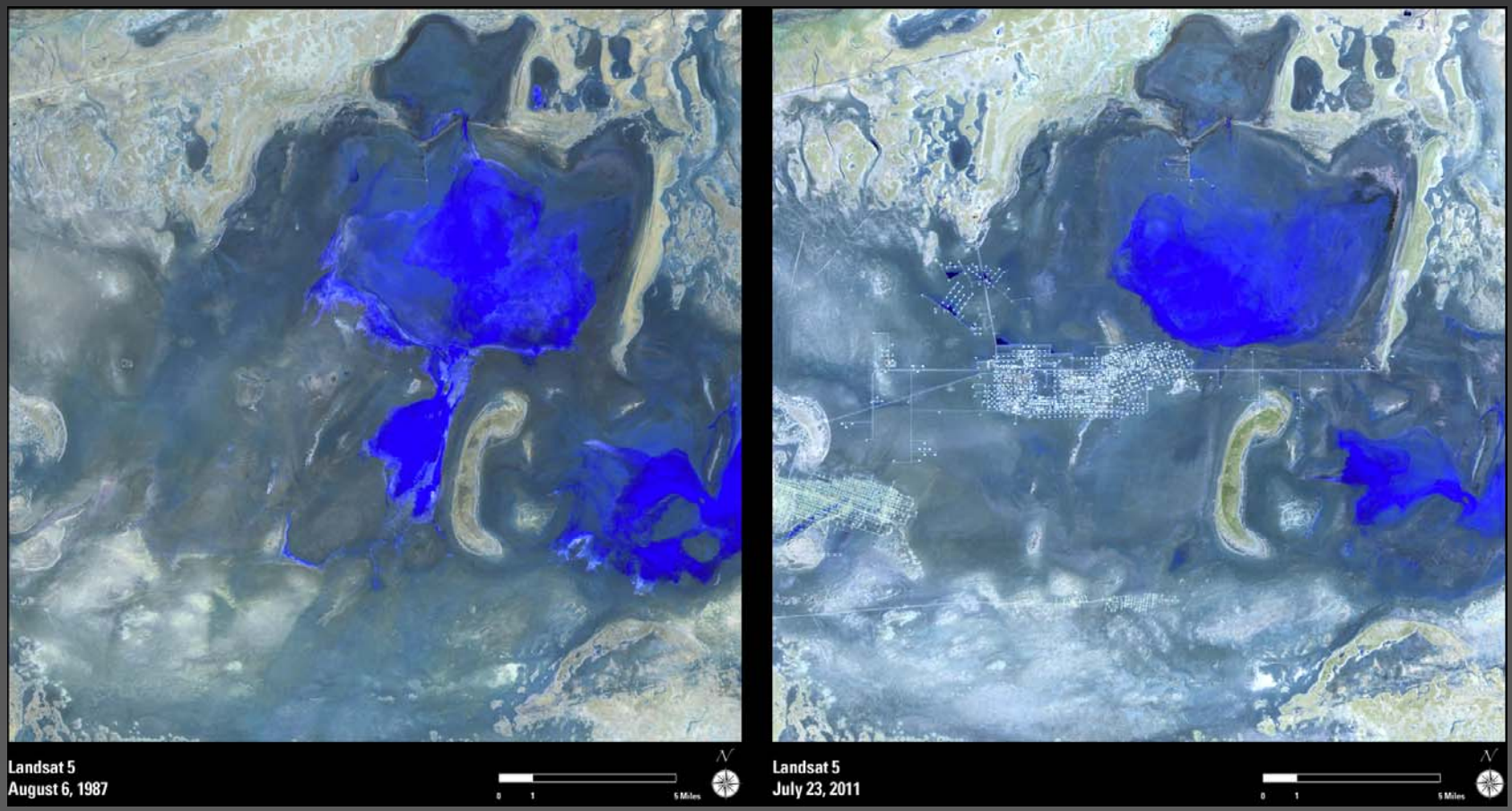
Expanding oil production in Kazakhstan



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What are the outcomes/deliverables we want from the LAG in the near term?

Near Term Support

- Determine what is needed operationally
- Help us in determining the data and information products
- Help us determine what is the role of the commercial sector
- Quantify the benefits of Landsat
- Explain why Landsat is important
- Help us through advice on how to better communicate the value of the program

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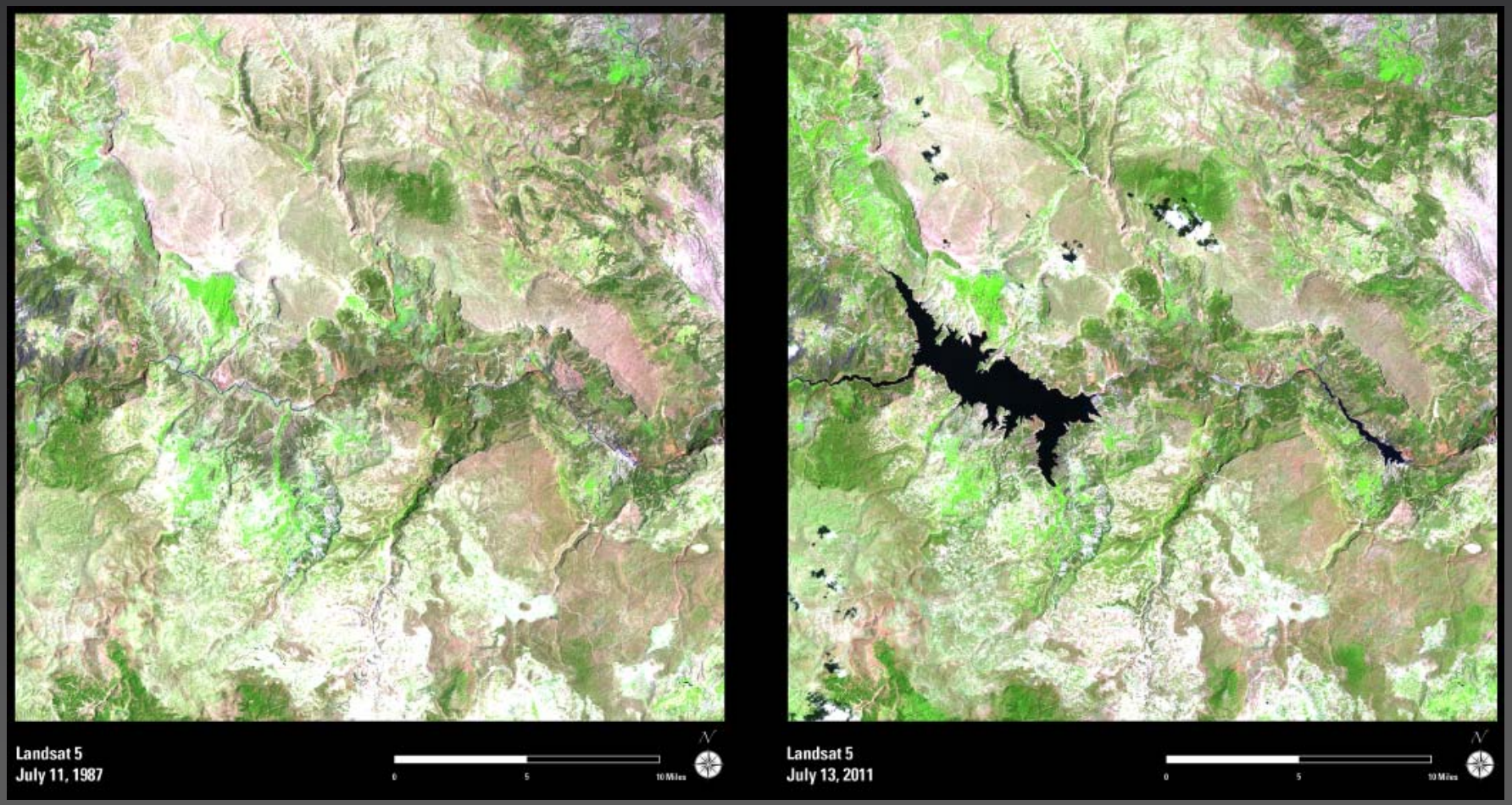
What does the LAG envision as a set of National capabilities for Landsat?

What would be the impacts of no Landsat 9?

Goksu river dam project, Turkey



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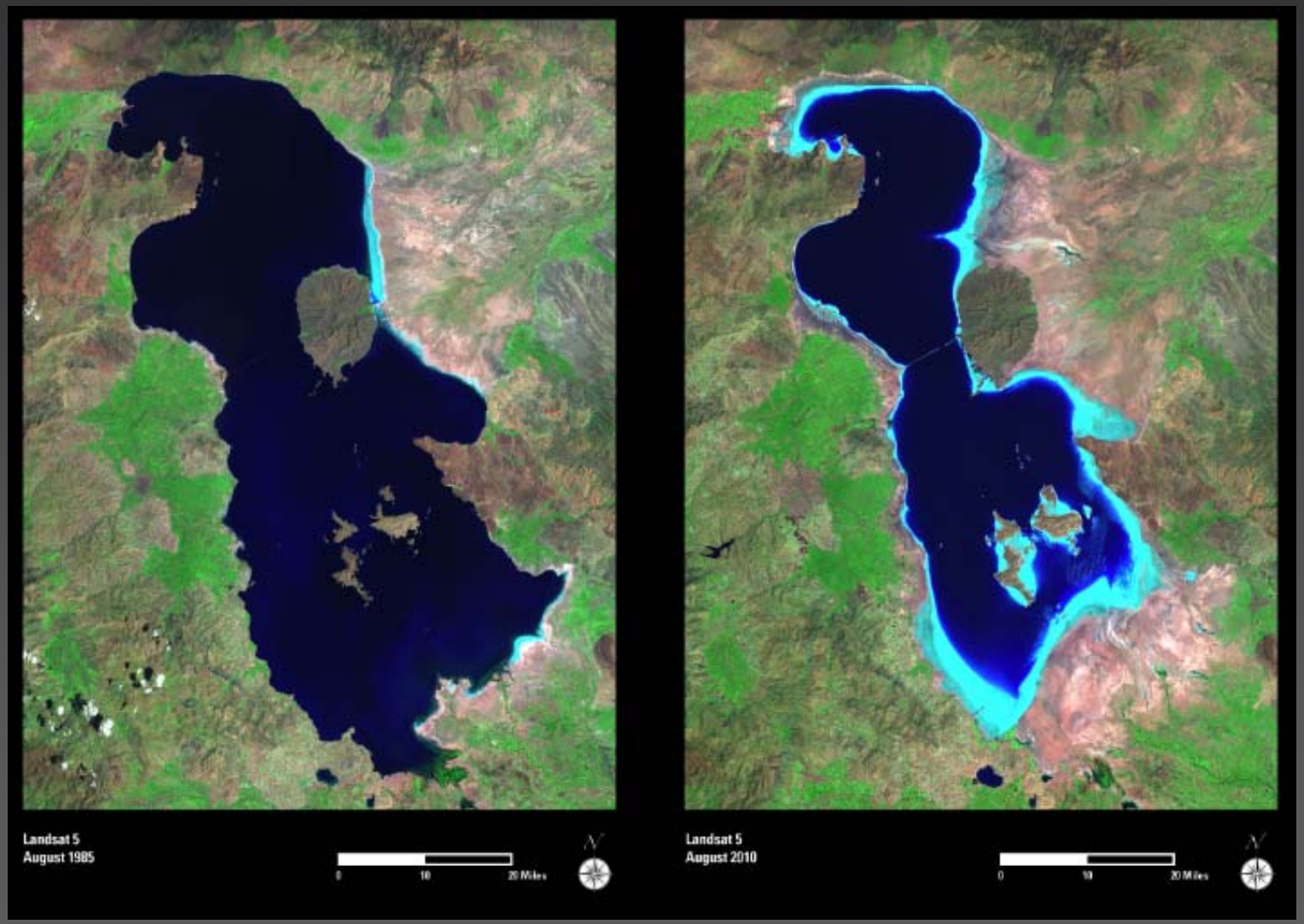
Lake Oroumeih, Iran



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Ice dynamics of Pine Island Glacier

USGS science for a changing world

NASA

Landsat Image Mosaic Of Antarctica (LIMA) **http://lima.usgs.gov/**

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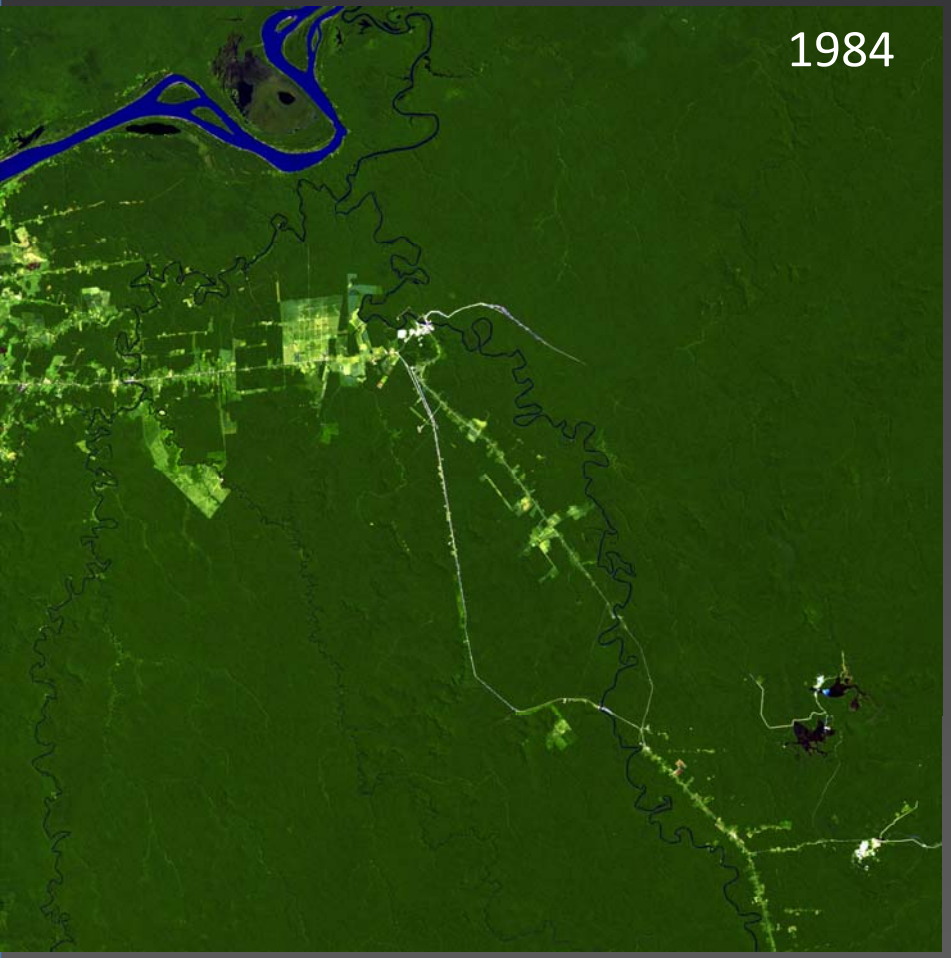
Samuel Dam on the Jamari River - Rondonia, Brazil



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Mundra Port, India

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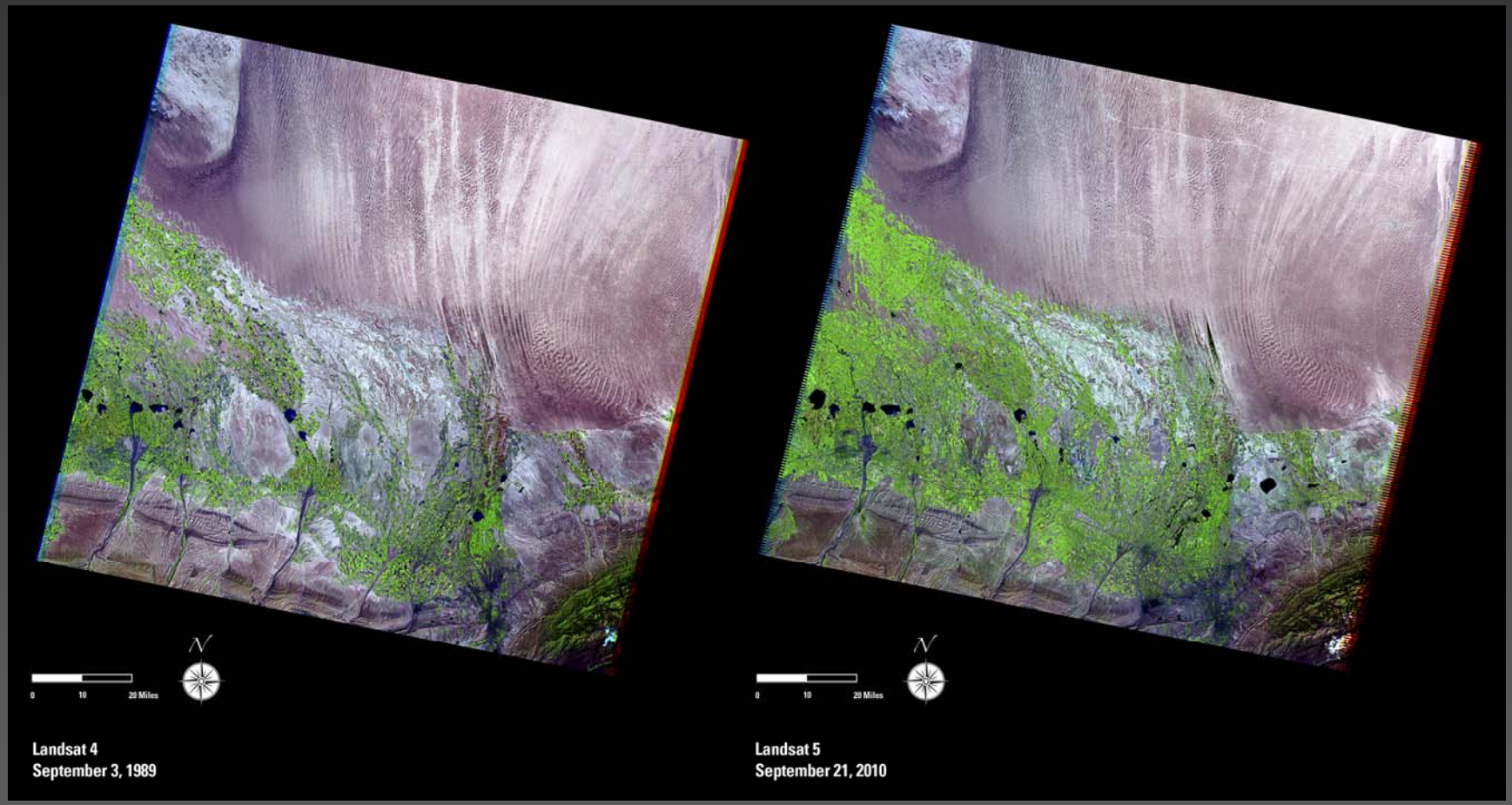
Cropland in Northwest China



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