USGS
science for a changing world

Landsat at 40:

Prime Productive Years or Mid-Life Crisis?

New York City area
Landsat 5 image acquired March 17, 2011

AAG Annual Meeting

New York City
25 February 2012

Anne Castle

Assistant Secretary for Water and Science
U.S. Department of the Interior

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

LANDSAT 40

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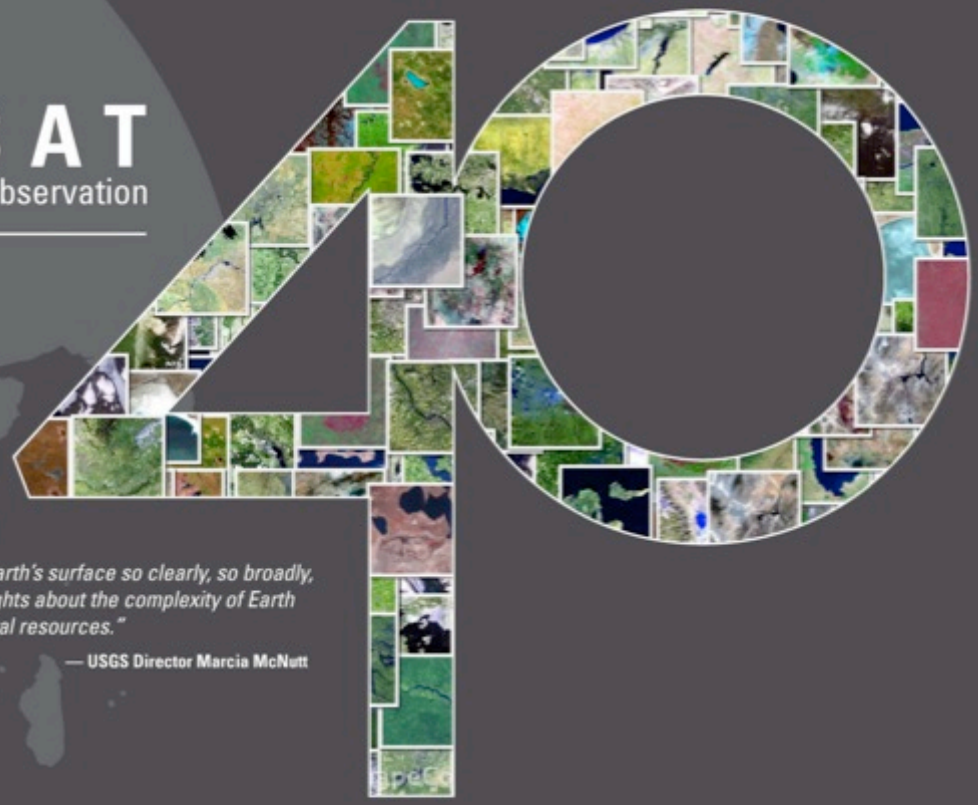
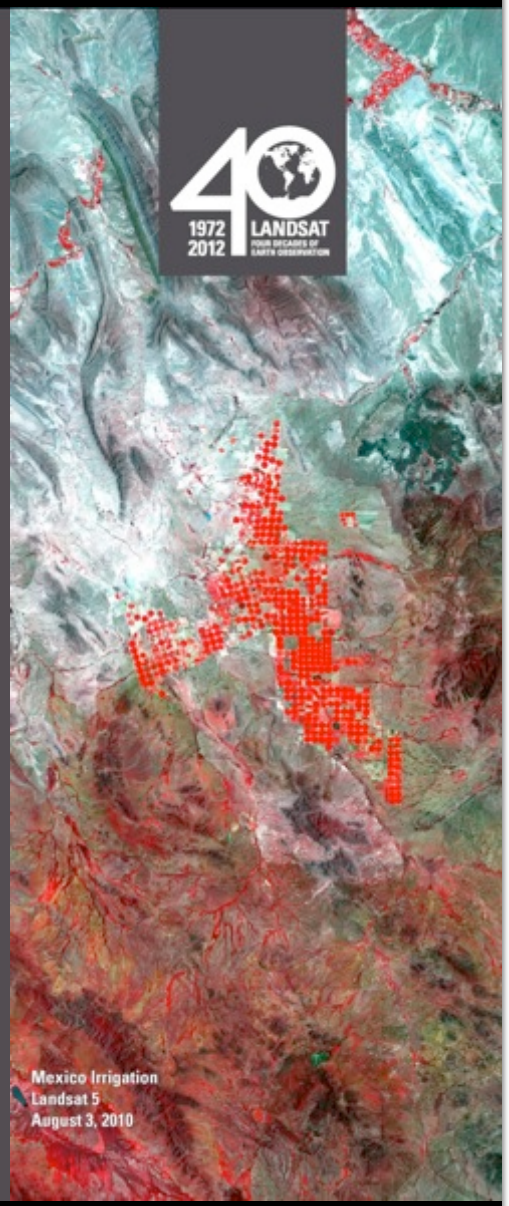
NASA

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

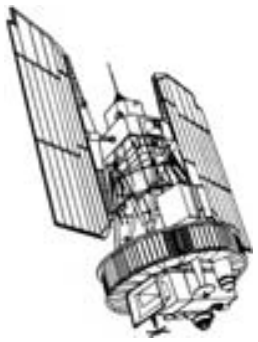


Satellite Remote Sensing at DOI

1966 - Initiated Earth Resources Observation Systems Program

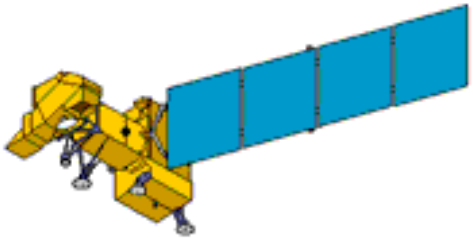
"…the time is now right and urgent to apply space technology towards the solution of many pressing natural resource problems being compounded by population and industrial growth."

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

DOI Applications of Landsat Imagery

Agriculture & Forestry	Crop and Timber Inventories and Forecasting Crop, Irrigation, & Forest Management
Wildlife & Public Lands	Vegetation, Species, Habitat & Wetlands Inventories & Management
Commerce & Industry	Natural Resource, Mineral Wealth, Rangeland Management Mines, Mineral Resources, & Energy Exploration & Management
Regional, State, and Local Government	Navigation Land Surveys, Soils & Geologic Mapping Water Resource Administration, Consumptive Use Flooding Prediction & Analysis, Flood Plain Assessment Erosion Control

DOI Applications of Landsat Imagery

Disaster Management -- Hazard Analysis -- Mitigation & Planning -- Damage Assessment -- Recovery & Relief	Hurricanes & Severe Storms Floods & Landslides Wildfires & Forest Fires Earthquakes & Volcanoes
Intl. Economic Development National Security Homeland Security	Global Coastal Mapping & Monitoring, Emergency Response, Theater Mapping, Illicit Crop Detection
Global Change Policy & Research	Deforestation, Desertification, Sea Water Intrusion Snow cover & Glaciation Ecosystem Analysis, Urban and Rural Geography

An expanding global society pressures global resources

USGS

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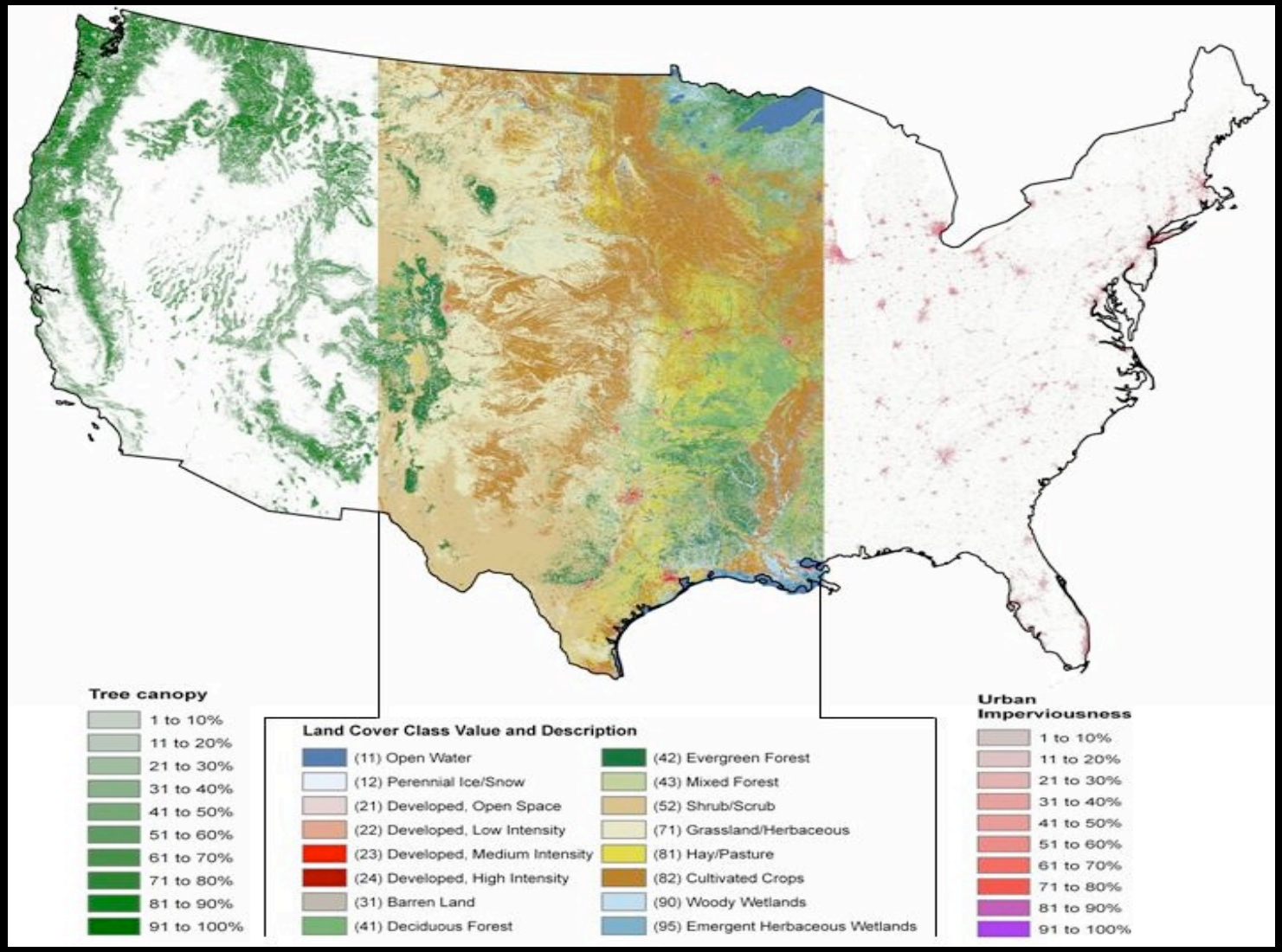
National Land Cover Database (NLCD 2006)



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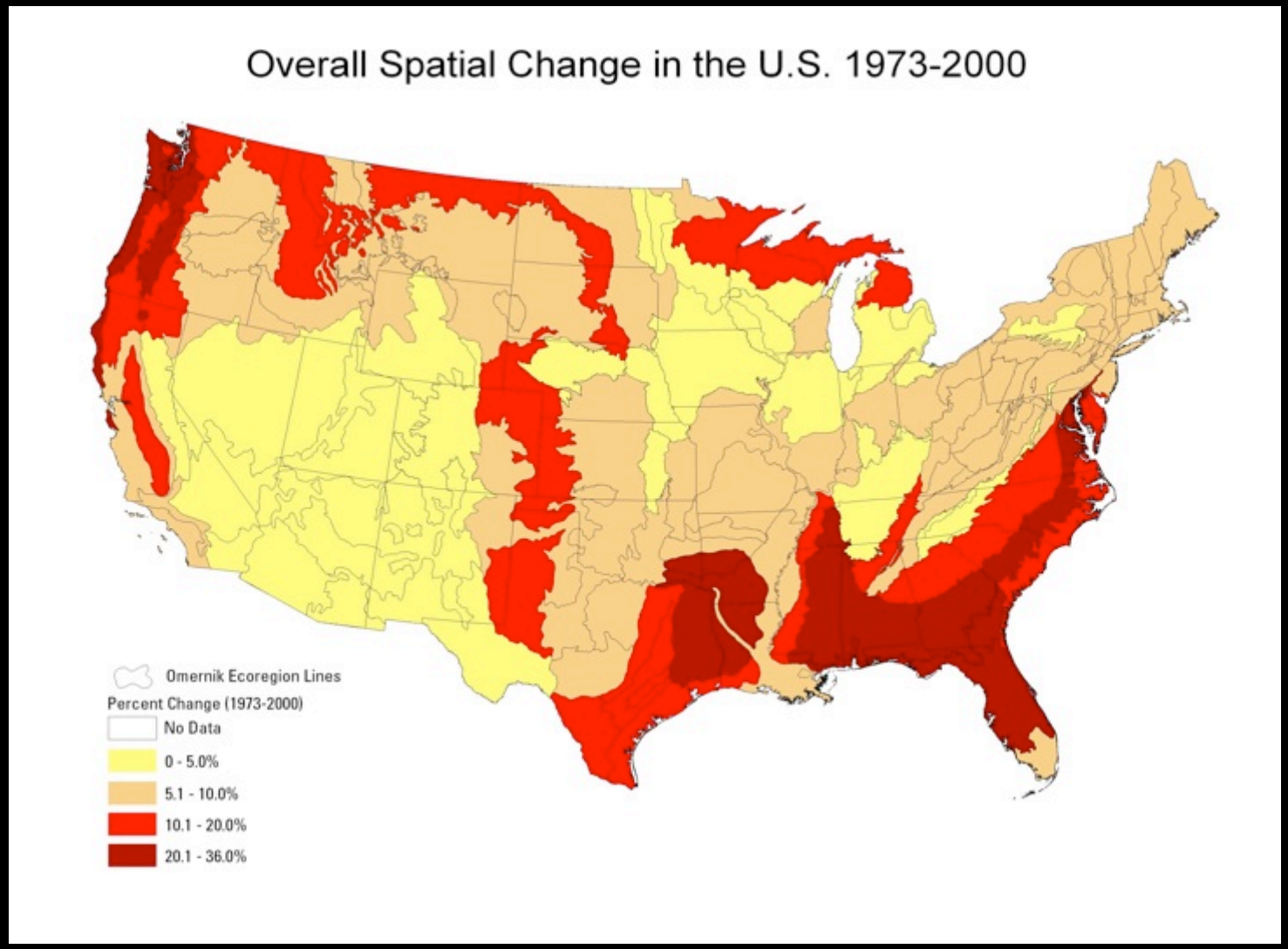
Historical Landsat data can show rates of land change



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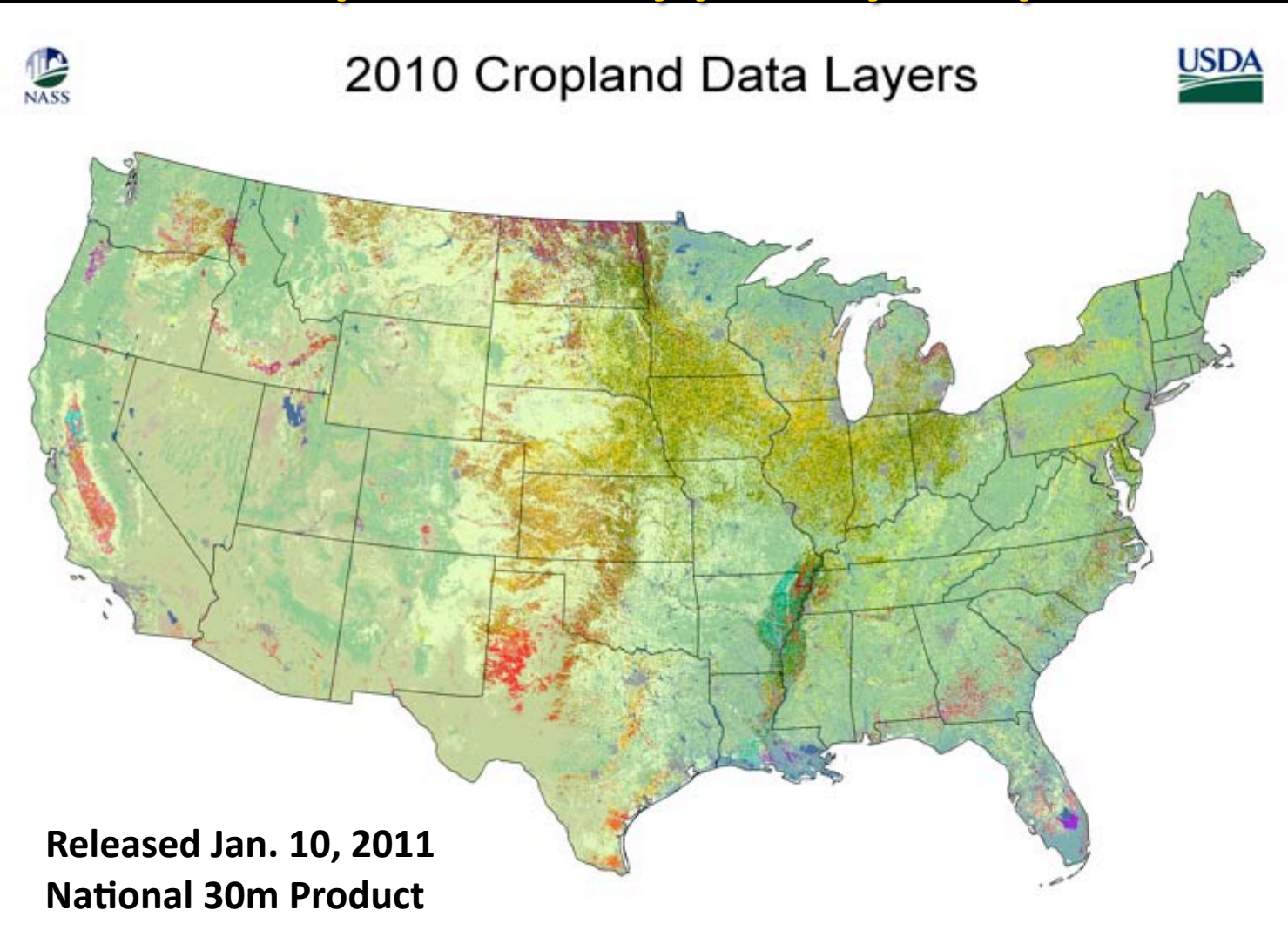
Landsat comprehensively portrays crop status



Released Jan. 10, 2011
National 30m Product

USGS

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Evapotranspiration (ET) monitoring with Landsat

USGS

LANDSAT 40

Harvard's Ash Institute's Innovations in American Government Award - 2009

Idaho Department of Water Resources and University of Idaho
"Mapping Evapotranspiration from Satellites"

"METRIC….is measurably more accurate, fast, and cost-effective than the traditional, cumbersome, slow and expensive methods that were commonly used in the last century."

"…it would be practically *impossible* to adjudicate water rights disputes in the future without [TIRS]."

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.

USGS

LANDSAT 40

Landsat Data: 40 Years of Global Data Free Online

Innovative Benefits of Open Availability

Studies indicate societal value exceeds data acquisition and distribution costs

Encourages development of research applications leading to innovative commercial endeavors

"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 Gerrand, Food and Agriculture Organization of the United Nations

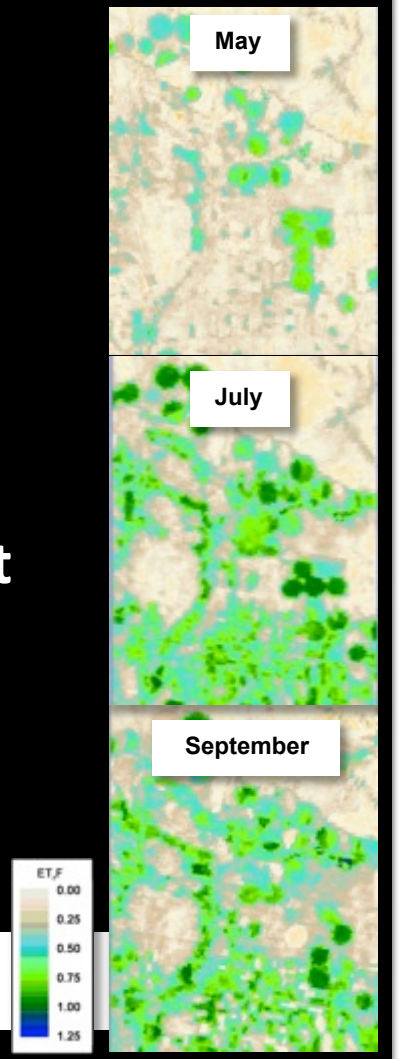
Economic Advantages of Open Availability

Commercial data use has increased under free distribution policy

- Google Earth/TerraMetrics
- ESRI "Change Matters" product.

Economic cost savings for environmental management

- Landsat imagery data gap loss would be $935M per year
- Water managers will save an estimated $1 billion over the next decade



Progression of Evapotranspiration overtime – Nebraska, *Landsat 5 1997*

Why are Earth observations important for civil society?

Continuous Earth imaging from space ensures that events are registered and cannot be concealed, even if the traces of the event have been removed on-site (for example, oil spills).

O. Gershenzon, RussiaTransparent World Partnership, 2011.

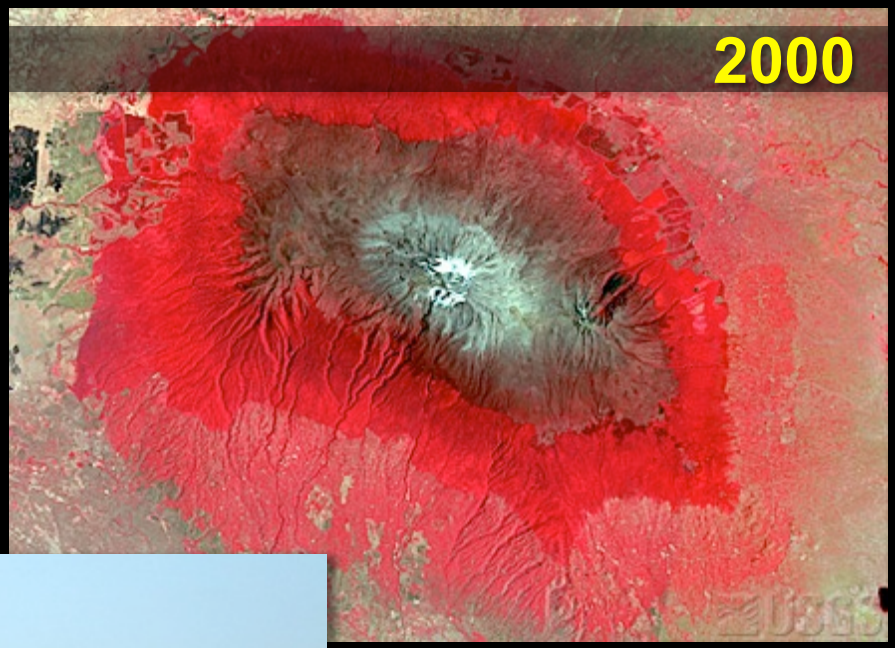
Landsat is akin to the Earth's free press. With its global perspective, we have objective and indisputable evidence of the condition of the planet.

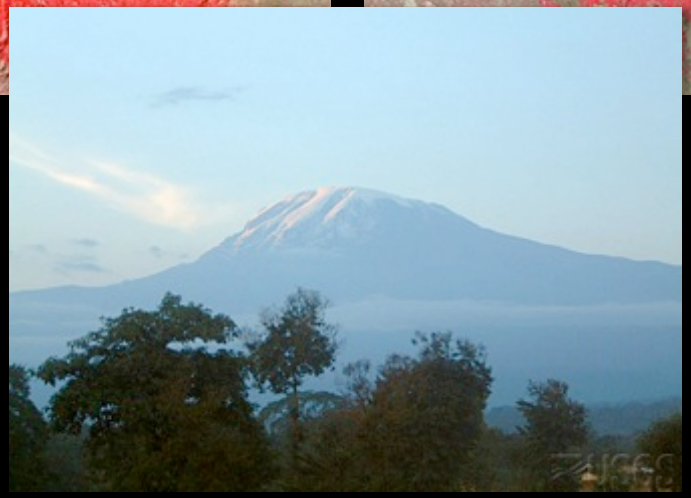
Curtis Woodcock, Boston University, 2011.

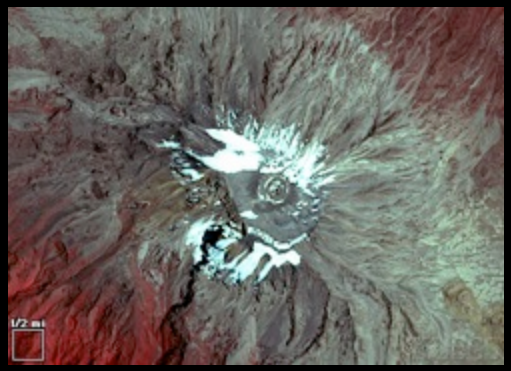
USGS

LANDSAT 40

The Vanishing Snows of Kilimanjaro







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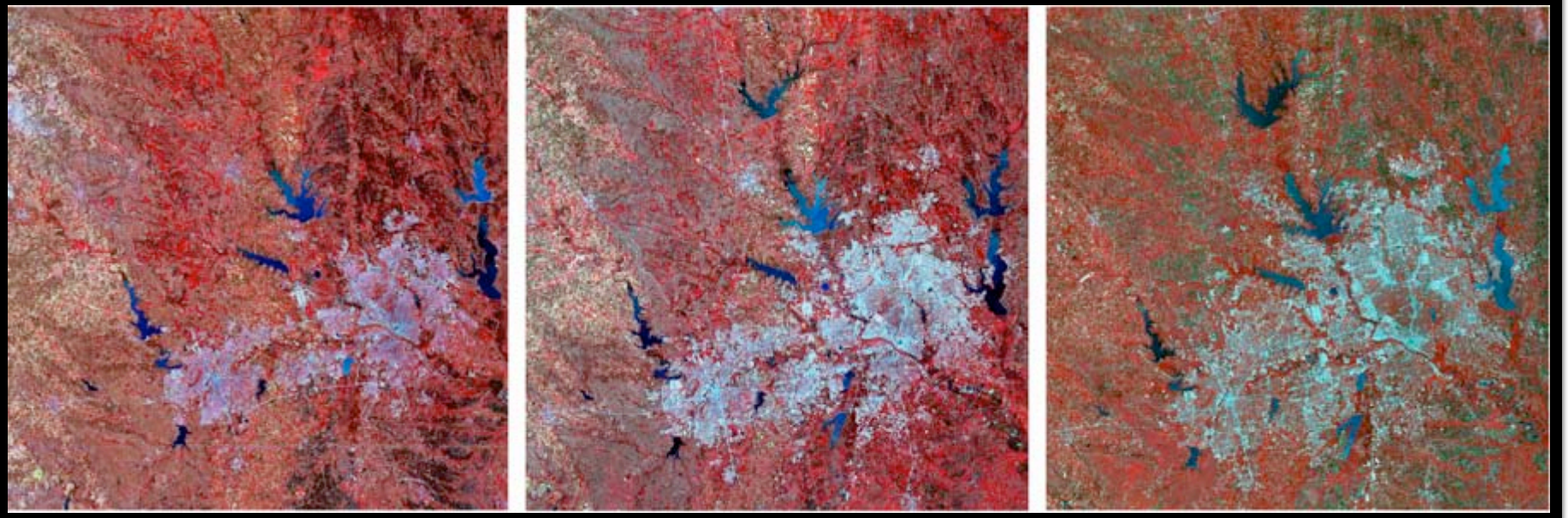
Dallas-Fort Worth, Texas



1974 1989 2002

The combined Dallas-Fort Worth metroplex has grown rapidly:
2,378,000 in 1970,
3,776,000 in 1988,
5,568,150 in 2002,
6,371,773 in 2010.

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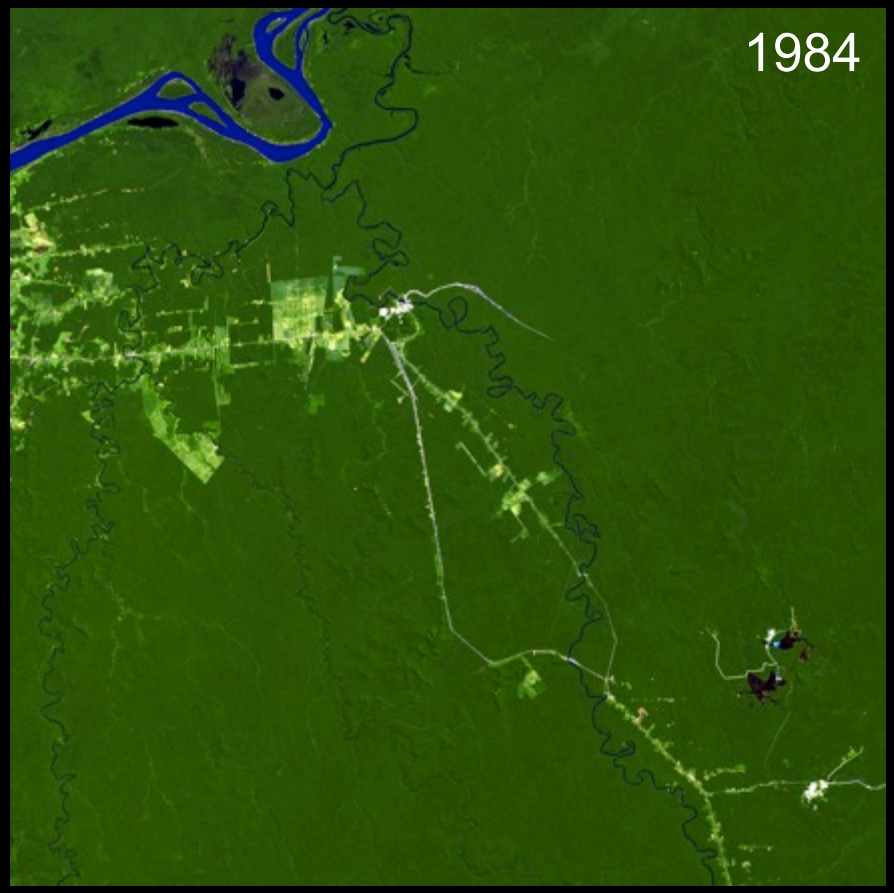
Samuel Dam on the Jamari River - Rondonia, Brazil



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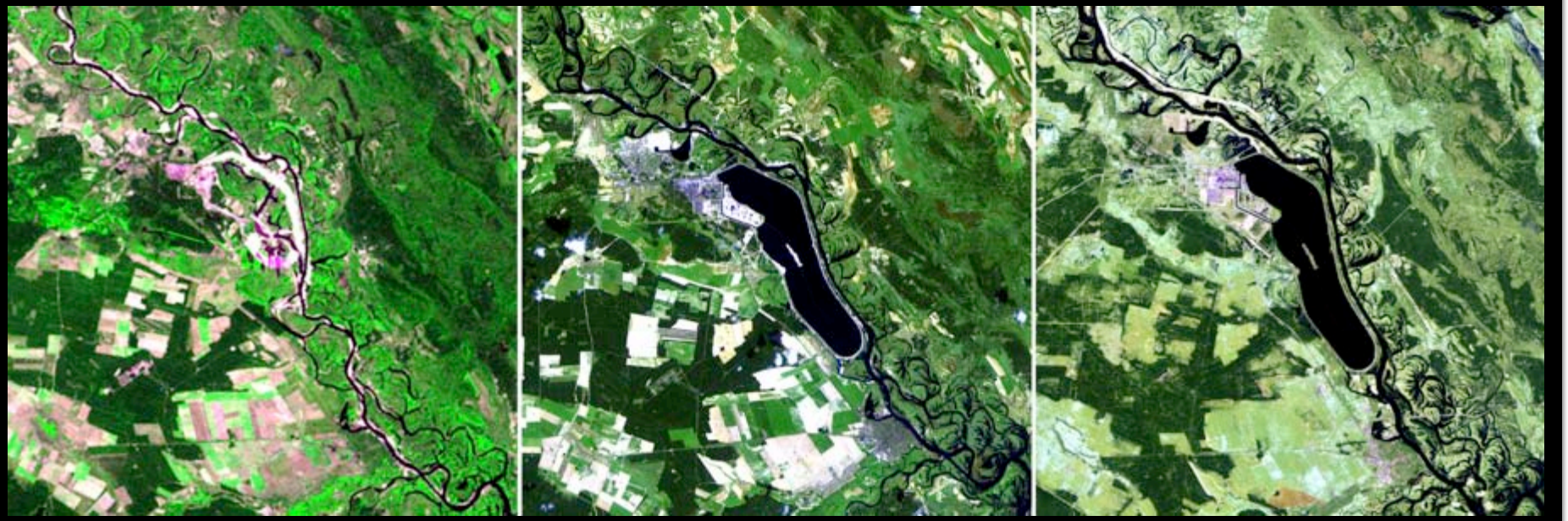
Chernobyl - Ukraine



1975 1986 2011

Operation Desert Storm - 1991

Kuwait
August 31, 1990

Kuwait
February 23, 1991

Kuwait
November 14, 1991

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Gulf Oil Spill

Landsat 7 – May 1, 2010

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LANDSAT 40

New York City - 9/11/2001

Landsat 7
12 Sept. 2001

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Four Decades of Earth Imaging: Current Status

Landsat 5

- Launched by NASA in 1984 (3-year design life)
- 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

Four Decades of Earth Imaging: A Turning Point

Landsat 8 (Landsat Data Continuity Mission, LDCM)

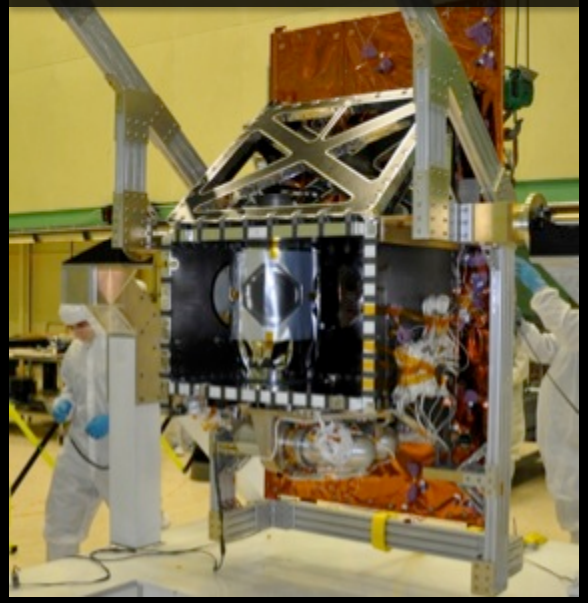
- Five year design life, with 10 years of fuel
- Two instruments
  - Operational Land Imager (OLI) - 9 spectral bands
  - Thermal Infrared Sensor (TIRS) – 2 thermal bands
- All data will be freely available over the Internet
- Projected launch date: January 2013

Landsat 9 and beyond

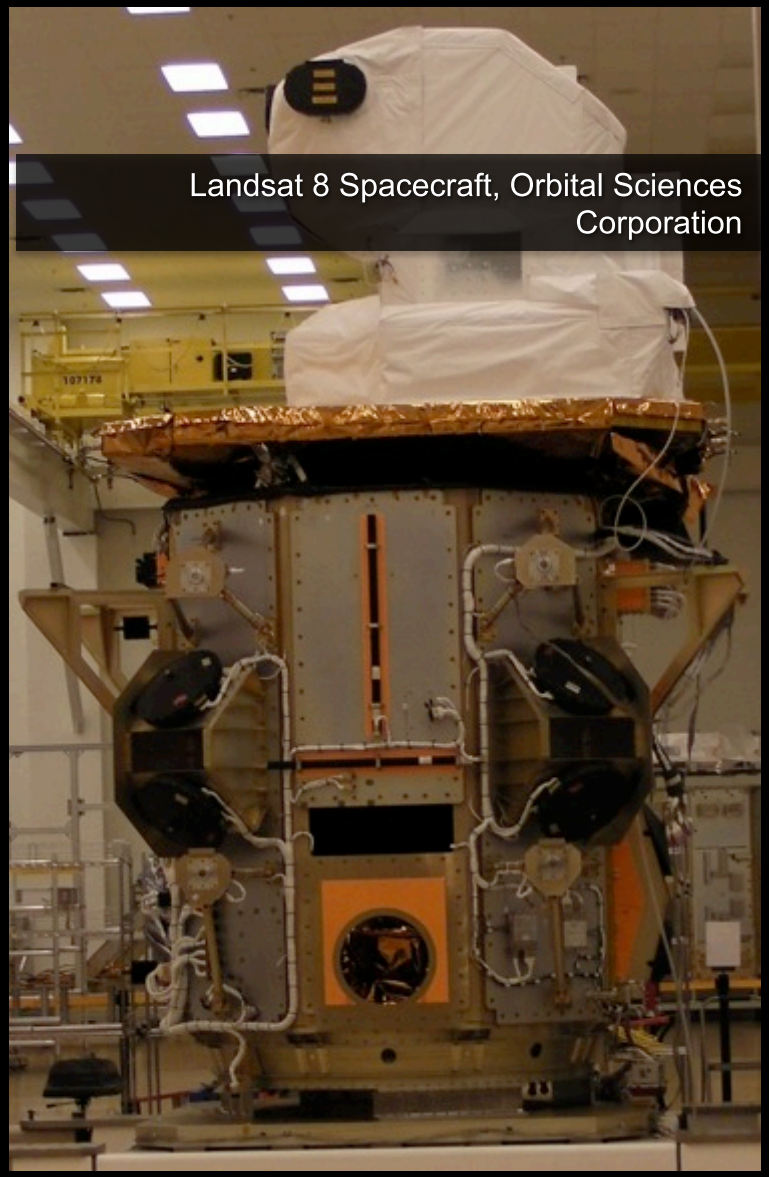
- Administration supports converting Landsat to an operational program
- USGS is working with NASA and the White House Office of Science and Technology Policy to assess options for Landsat 9 and beyond

Operational Land Imager, Ball Aerospace & Technologies Corporation

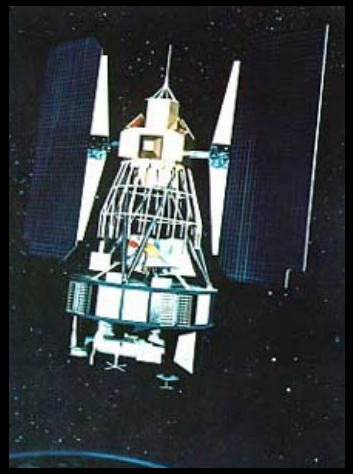
Thermal Infrared Sensor, NASA GSFC

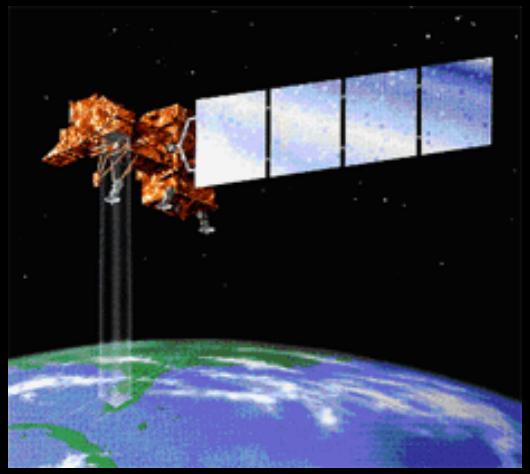


Landsat 8 Spacecraft, Orbital Sciences Corporation



Observing Earth from afar – a continuing quest





"For man must rise above this Earth - to the top of the atmosphere and beyond – for only thus will he fully understand the world in which he lives."

Socrates, ~400 B.C.

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