Landsat at 40: 
Prime Productive Years or Mid-Life Crisis?

AAG Annual Meeting
New York City
25 February 2012

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

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

<table>
<thead>
<tr>
<th>Category</th>
<th>Applications</th>
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<tbody>
<tr>
<td>Agriculture &amp; Forestry</td>
<td>Crop and Timber Inventories and Forecasting &lt;br&gt;Crop, Irrigation, &amp; Forest Management</td>
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<td>Wildlife &amp; Public Lands</td>
<td>Vegetation, Species, Habitat &amp; Wetlands Inventories &amp; Management</td>
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<td>Regional, State, and Local Government</td>
<td>Navigation &lt;br&gt;Land Surveys, Soils &amp; Geologic Mapping &lt;br&gt;Water Resource Administration, Consumptive Use &lt;br&gt;Flooding Prediction &amp; Analysis, Flood Plain Assessment &lt;br&gt;Erosion Control</td>
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DOI Applications of Landsat Imagery

Disaster Management
-- Hazard Analysis
-- Mitigation & Planning
-- Damage Assessment
-- Recovery & Relief

Intl. Economic Development
National Security
Homeland Security

Global Change Policy & Research

Hurricanes & Severe Storms
Floods & Landslides
Wildfires & Forest Fires
Earthquakes & Volcanoes

Global Coastal Mapping & Monitoring,
Emergency Response, Theater Mapping,
Illicit Crop Detection

Deforestation, Desertification, Sea Water Intrusion
Snow cover & Glaciation
Ecosystem Analysis, Urban and Rural Geography
An expanding global society pressures global resources
National Land Cover Database (NLCD 2006)
Historical Landsat data can show rates of land change

Overall Spatial Change in the U.S. 1973-2000
Landsat comprehensively portrays crop status

2010 Cropland Data Layers

Released Jan. 10, 2011
National 30m Product
Evapotranspiration (ET) monitoring with Landsat

American Falls Reservoir
Lake Walcott
Albion, ID
Snake River
Irrigated Fields/ Water Rights

Growing Season ET -- April – October, 2006 from METRIC-Landsat
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.
# Landsat Data: 40 Years of Global Data Free Online

Total Landsat Scenes Provided to Users Since January 1, 2008

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Free data policy
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
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.
The Vanishing Snows of Kilimanjaro

1976

2000

USGS

Landsat 40
Dallas-Fort Worth, Texas

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.
Samuel Dam on the Jamari River - Rondonia, Brazil
Chernobyl - Ukraine
Operation Desert Storm - 1991
Gulf Oil Spill

Landsat 7 – May 1, 2010
New York City - 9/11/2001

Landsat 7
12 Sept. 2001
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
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.