



Earth Observations from Space – U.S. Geological Survey

Geography – Land Remote Sensing Program

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U.S. Geological Survey



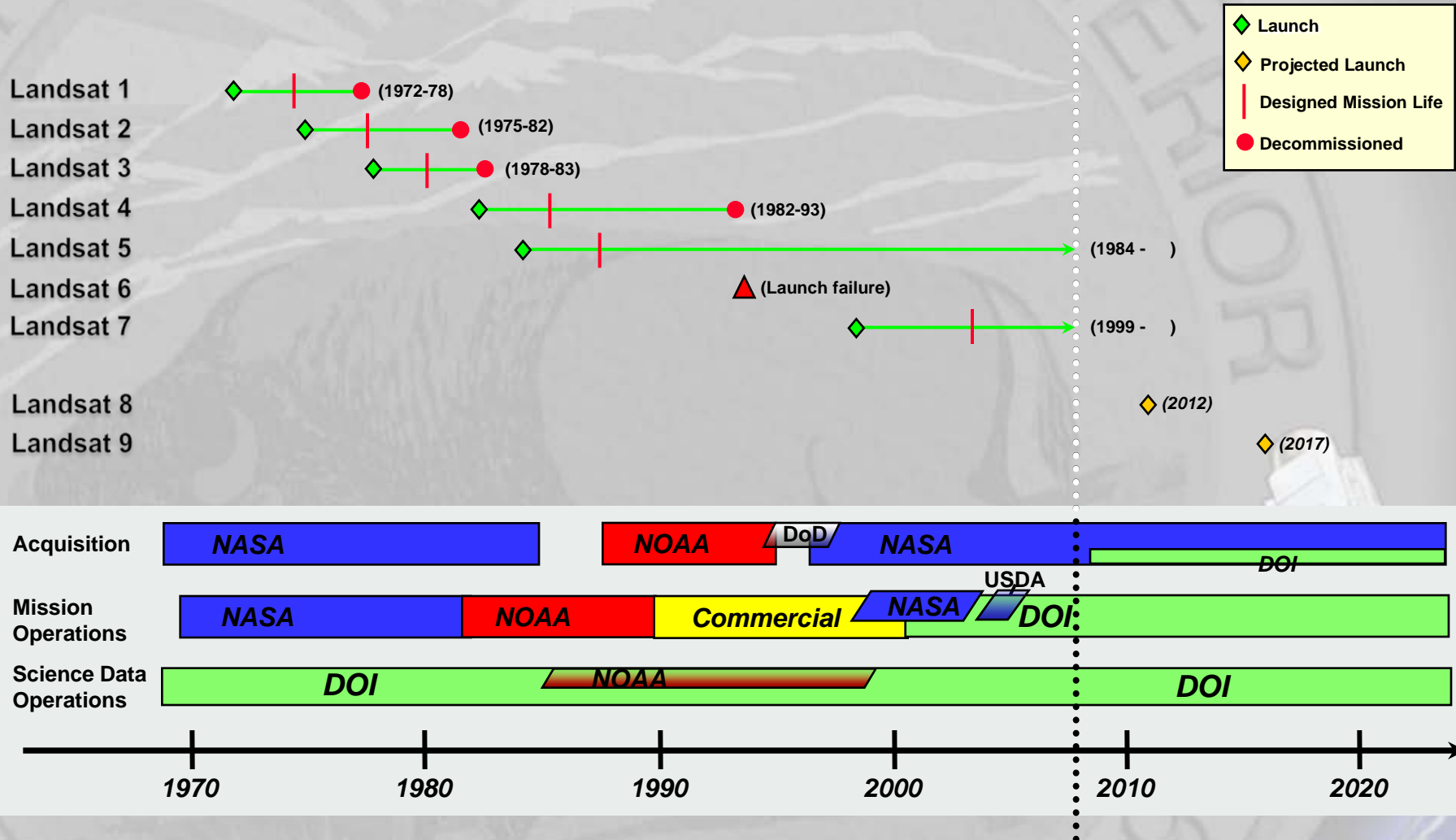
USGS Landsat Historical Involvement

- ◆ **Initiated multi-agency Earth Resources Observation Satellite Program in 1966**
- ◆ **Manage and distribute imagery from Landsats 1-4, 5 and 7 missions**
- ◆ **Operate Landsat 7 (since 2000) and Landsat 5 (since 2001)**
- ◆ **Building the ground system to operate Landsat 8 (LDCM) to launch in December 2012**
- ◆ **Participated in Landsat Program since 1972**
- ◆ **Invested over \$300 million in Landsat operations, training, and research since 1972**

USGS Landsat Historical Involvement, cont.

- ◆ **Key role in developing operational data applications**
 - fire-fuels mapping
 - famine early warning system
 - glacier/ice shelf monitoring
 - deforestation mapping
 - land use/land cover mapping
- ◆ **Full partner with NASA in Landsat Program Management via PDD/NSTC-3 revision, October 16, 2000**
- ◆ **Participated in a multi-agency team, led by OSTP, that produced a *National Land Imaging Program* plan to establish**
 - A Federal Land Imaging Council of civil, intelligence, and defense agency representatives to derive national requirements and establish priorities for sustained, operational, moderate-resolution land imaging
 - A Federal Advisory Committee to add perspective from state/local government, academic, industry, and non-profit organizations

Shifting Federal Responsibilities



USGS Landsat Current Involvement

- ◆ **Distribute over 2500 free Landsat scenes per day to broad range of users***
 - Over 455,000 scenes delivered since October 1, 2008
 - Seven fold increase in scientific and educational users
 - User shift toward multi-year scenes of same location
 - Landsat data downloaded in 155 countries
 - Highly favorable user responses
- ◆ **Considering Landsat flight operations, data capture, archive, processing, and distribution**
- ◆ **Developing terrestrial Essential Climate Variables and Climate Data Records from Landsat data**
- ◆ **Routinely collect, archive, and distribute data from other sensors (e.g. Advanced Land Imager, Hyperion, MODIS, ASTER, and AVHRR)**

*Averaged 53 scenes sold per day in best sales year (2001)

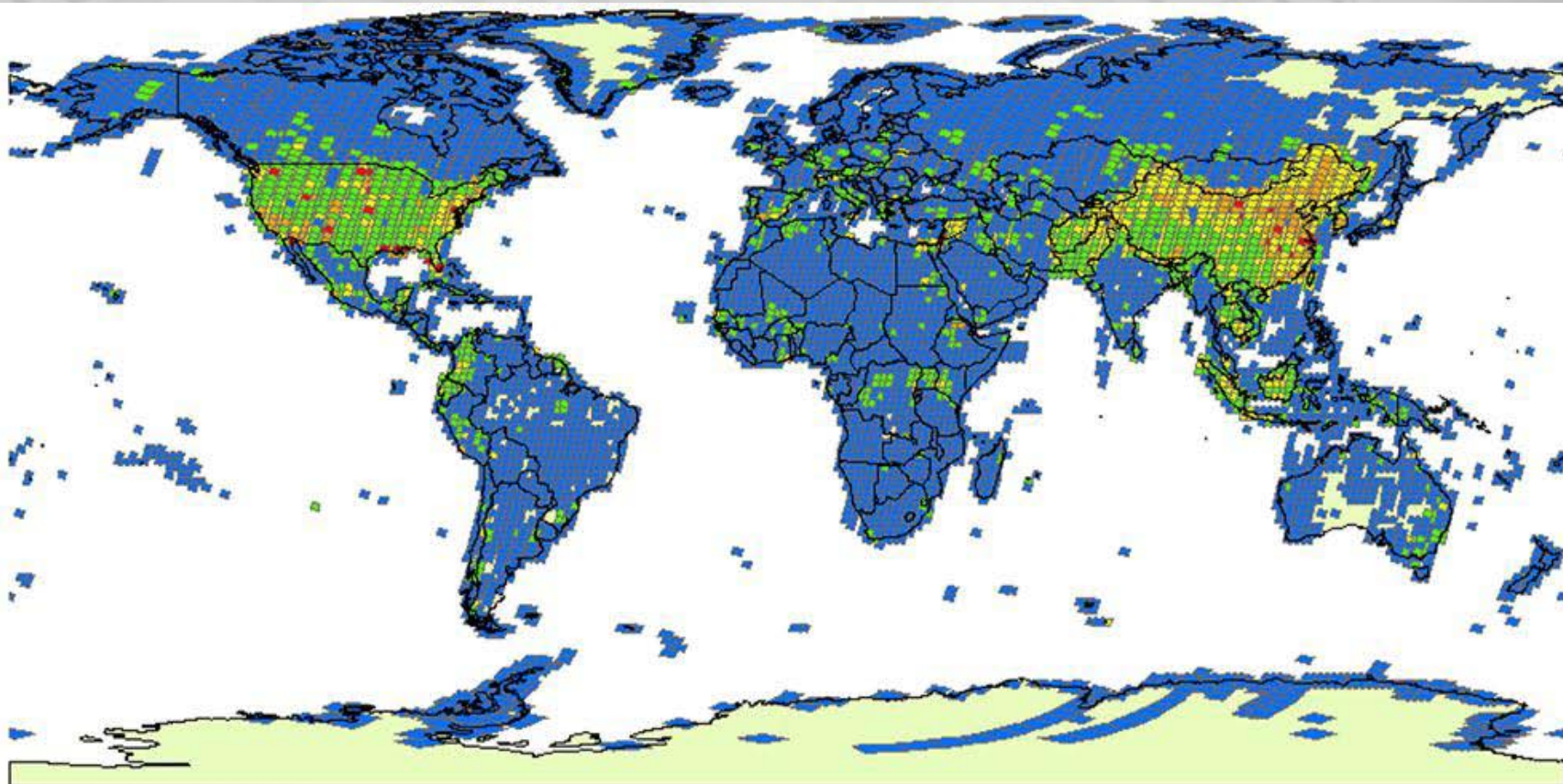
USGS Landsat Current Involvement, cont.

- ◆ **Coordinate civil agency requirements and data purchases in support of 2003 Commercial Remote Sensing Space Policy**
- ◆ **Support GEO and USGEO programs by**
 - Provide in situ and remotely sensed Earth observations
 - Provide key leadership roles
 - Leads CEOS Land Surface Imaging constellation
- ◆ **Developing ground data-processing and flight-operations systems for Landsat 8/LDCM as NASA develops satellite and sensor for December 2012 launch**
 - Operational Land Imager (OLI) instrument development on schedule
 - Thermal instrument proposed in American Recovery and Investment Act of 2009
 - Thermal instrument in initial design phase at NASA
 - Spacecraft meeting key Preliminary Design Review milestone this week

USGS Landsat Current Involvement, cont.

- ◆ **Expanding free electronic data distribution to other USGS-managed data sets**
 - Historical SPOT satellite scenes over U.S.
 - Scanned photos from declassified intelligence-satellite archives
 - Scanned photos from USGS aerial mapping archives
- ◆ **Enabling access to other satellite data providers through Commercial Remote Sensing Data Contracts**
 - GeoEye
 - Digital Globe
 - SPOT
 - EADS North America
 - DMC International Imaging
- ◆ **Preparing multi-source data-acquisition plan, including enterprise architecture and business model options, to mitigate potential Landsat data gap and augment single-satellite (Landsat 8) data stream**

Free Landsat Scenes Distributed Since 10/1/08



WRS2 Standard L1T Downloads
via User Interface and Bulk Users
October 1, 2008 through March 24, 2009
455,293 Total Scenes
8,479 Unique Locations

1 - 59 60 - 175 176 - 356 357 - 678 679 - 1511

Primary Uses of Free Landsat Data

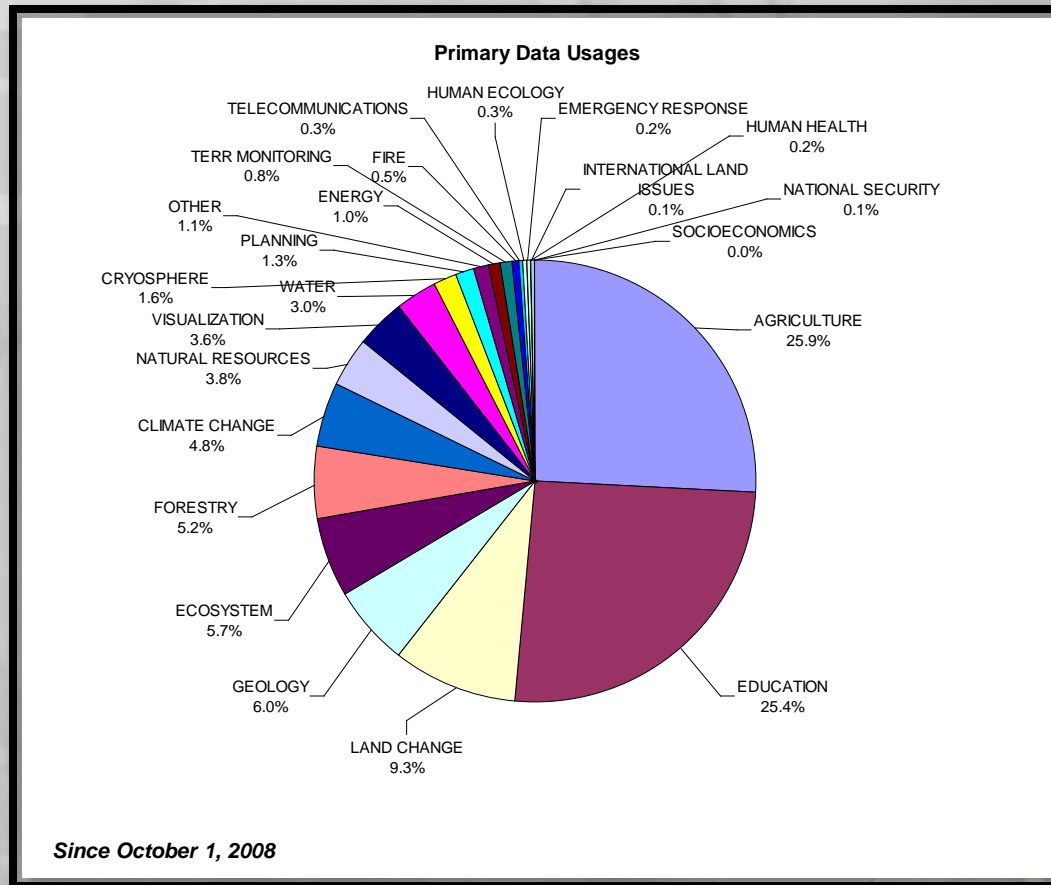
Strong user endorsement of free data

Strong user demand for multiple historical scenes over specific locations vs. current scenes only

Increased use by scientists and educators




Working to improve web-enabling capability for users

Wider range of data uses - global forest inventory, tracking global deforestation, etc.



USGS Multi-Mission Operations

Summary list of Multi-Mission Data Sets at EROS

-  *NASA Funded Data Sets*
-  *NGP Funded Data Sets*
-  *LRS Funded Data Sets*

USGS Satellite Film and Digital Data Sets	
Film Data Sets	Digital Data Sets
Skylab	Landsat Processed Data Collection
Gemini	TM Scrounge
Large Format Camera	NASA (V0) Landsat Processed Data Collection
Declassification I (CORONA, ARGON, LANYARD)	Landsat Orthorectified Scenes and Mosaics
Declassification II (KH-7, KH-9)	North American Landscape Characterization (NALC)
Landsat MSS, TM, and RBV Film	Global Land Cover Test Sites (GLCTS)
Digital Data Sets	Shuttle Imaging Radar-C (SIR-C)
EO-1	Global Land Cover Characterization (GLCC)
SPOT	Multi-Resolution Land Characterization (MRLC)
Shuttle Radar Topography Mission (SRTM)	AVHRR Greenness maps (7/14 day)
AVHRR	ALOS Pulsar
Landsat 1-5,7	WorldView
NASA LPDAAC Digital Data	QuickBird
MODIS	AWIFS
ASTER	SPOT / Eagle Vision
USGS Aerial Film and Digital Data Sets	
Department of Interior (DOI) Film	NASA Film
USGS Aerial Mapping Photography	Ames Research Center
National Aerial Photography Program (NAPP)	Johnson Space Center
National High-Altitude Photography (NHAP)	Wallops Island
High Resolution Ortho Imagery (Urban Areas)	Stennis
Bureau of Land Management	Kennedy Space Center
Bureau of Reclamation	Marshall Space Flight Center
National Park Service	Environmental Research Institute of Michigan
South Dakota State University	Digital Aerial Data Sets
InterMountain Survey	NASA Daedalus Scanner
McDonnell Douglas	Airborne Ocean Color Imager Aerial Scanner
Corp of Engineers (COE)	Side Look Airborne Radar (SLAR)
Department of Defense (DOD) Film	National Uranium Resource Evaluation (NURE/LIL)
Army Map Service	NPS Geophysical Research Program
U.S. Air Force	Advanced Solid-State Array Sensor (ASAS)
U.S. Navy	MODIS/ASTER Airborne Simulator (MASTER)
Scientific Committee on Antarctic Research (SCAR)	LIDAR
USGS Carto/Topo Digital Data Sets	
Digital Orthophoto Quad (DOQ)	Digital Elevation Model (DEM)
Digital Raster Graphic (DRG)	Digital Line Graph (DLG)
High ResOrtho Digital Imagery	National Atlas



Free Downloadable Data Sets Managed by USGS EROS

Aerial Photography

- AHAP medium resolution (Over Alaska)
- NHAP medium resolution
- U.S. Antarctic Indexes – medium resolution single frames
- NAPP medium resolution
- DOQ
- USGS medium resolution mapping photos

Advanced Very High Resolution Radiometer (AVHRR)

- Composites
- Orbital Segments

Digital Elevation

- SRTM
- DEM/NED

Digital Line Graphs

- DLG 1:100k
- DLG Large Scale

Digital Maps

- DRG
- National Atlas

Global Land Survey

- GLS 2000
- GLS 2005

Landsat Archive

All Landsat ETM+, TM, and MSS
(Distributed by Landsat Project)

Landsat Decadal Orthorectified Data Sets

- ETM+ (1999-2003)
- ETM+ Pan (1999-2003)
- TM (1985-1996)
- TM and ETM+ Pan Mosaics
- MSS (1972-1987)

Landsat Image Gallery

- Earth as Art
- Earth as Art2
- Lewis and Clark
- Landsat Orthorectified State Mosaics

Landsat Science

- LIMA Antarctica ETM+
- MRLC/MTBS Radiance
- MRLC/MTBS Reflectance
- NALC Triplicates
- SLC-off L1T Std L1T
- Sys ETM+ (1999-2003)

NASA Earth Observing System

- MODIS**
- ASTER**
- (Distributed by Land Processes Distributed Active Archive Center)**

RADAR

- SIR-C Processed data

USGS Landsat Issues

- ◆ **Transition Landsat Program to Operational Status under USGS as recommended by OSTP and endorsed by the multi-agency team**
 - Currently no agency has responsibility for Landsat data continuity (Landsat 9 or beyond)
 - NASA role is to develop future land imaging technology as well as develop and launch operational missions funded by USGS
- ◆ **Funding pathway for an operational Landsat Program is not evident through DOI/USGS Congressional oversight committees**
- ◆ **Additional funding is required for Landsat 8**
 - Cover higher system-development costs for operating the satellite
 - Establish a reserve for development of ground system
 - Cover costs for ground system development and operation of a thermal instrument
- ◆ **Additional funding required to purchase imagery from commercial providers**
 - Provide Landsat-like imagery to supplement Landsat 8 data
 - Mitigate possible Landsat data-gap



USGS Landsat Future Involvement

- ◆ Seeking responsibility for an operational land imaging program consistent with OSTP Recommendations
 - USGS to fund replacement missions every 5 years under partnership wherein NASA develops, procures, and launches Landsat-type satellites which USGS operates
 - USGS headquarters staff to manage program
 - Future Landsats to carry one proven land imaging sensor for operational data stream and one prototype instrument (reducing research to operations costs)
- ◆ Future operation of Landsat 8 ground and flight systems; process and distribute large volumes of image data; coordinate International Cooperator activities; and sponsor Landsat Science Team
- ◆ Considering Climate Data records
- ◆ Working with European Union and European Space Agency on potential collaboration for joint Landsat 8 and Sentinel 2 operations



USGS Land Remote Sensing: Vision 2012

- **A DOI-centric, operational Earth Observation System (of systems)**
 - Needs of DOI users form primary requirements
 - Anchored by moderate resolution data – Landsat; provides consistent, high quality, calibrated, seasonal, global data
- **“Gaps” filled by other systems**
 - International moderate resolution data
 - U.S. commercial high resolution data provides site/event specific data
 - Future moderate resolution systems (small satellites)
 - Low resolution data (VIIRS)
 - Aircraft/UAVs
- **Buy data to influence future system development**
- **Robust research program**