



USGS Land Remote Sensing Program Update

Briefing for the
National Geospatial Advisory Committee

Tim Newman
Land Remote Sensing Program Coordinator
U.S. Geological Survey

April 7, 2016

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

USGS Land Remote Sensing Program

The USGS delivers a national and global capability to ensure broad public and scientific availability of observations of the Earth's land surface:

- Create and preserve a long-term record of the Earth's land surface at local, regional, and global scales
- Expand scientific understanding and application of remotely sensed data to government and private users nationally and globally
- Support decision makers and policy officials in fulfilling their public responsibilities
- Guide National decisions about meeting current and future needs in land science and land observation
- Coordinate and integrate civil Earth observation with other sources of data including commercial and National Security space systems

Fundamental goal: Ensure public availability of a primary data record about the current state and historical condition of the Earth's land surface



USGS LRS Program Components

Develop and operate systems to acquire, produce, preserve, and deliver LRS products and services to meet civil Earth observation research and operational requirements

- Collect, archive, process & disseminate Landsat & Landsat-like data (L1-8, S2)
- Operate the Landsat 7 and 8 satellites, calibrate and validate the incoming data
- Develop the Landsat 9 ground system in concert with NASA for 2020/2021 launch
- Collect, maintain and analyze user requirements; inform 2018 Landsat 10 decision

Conduct research and technology investigations to improve upon and develop new LRS products and services

- Work with states, industry & universities to identify & promote new technologies to be applied to future Earth observation, data management and distribution activities
- Investigate potential Federal civil uses of unmanned aerial systems, hyperspectral, lidar, radar and other remote sensing technologies

Manage National Civil Applications activities, Civil Applications Committee (CAC)

- Provide geospatial data from National Security Space Systems to support a wide range of missions like hazard warning and response, natural resource management, and scientific research; Manage multi-agency CAC for the Nation's civil agencies

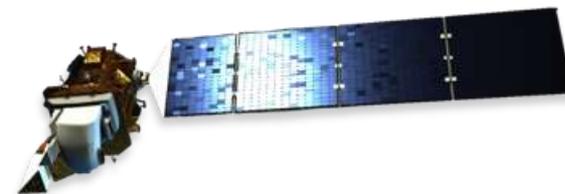


Landsat Operational Satellite Status

Landsat 8

Collecting up to 725 new scenes per day; supports 8-day revisit:

- Crisper images; less color saturation
- Better resolution of snow and ice-covered regions
- Detection of water-column constituents
- Better cloud screening

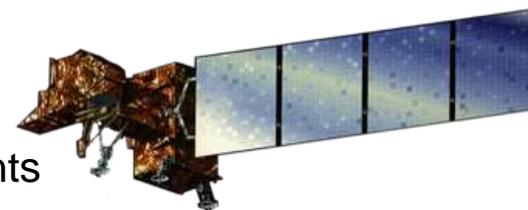


Thermal Infrared Sensor (TIRS) continues to operate on B-side subsystems with observatory engineers closely tracking hardware performance; A-side systems available for future use

Landsat 7

Collecting about 475 new scenes per day; about 22% of pixels missing per scene (faulty scan-line corrector)

L7 collection strategy modified to concentrate on continental coverage; L8 capturing islands and reefs in addition to continents



Following less atmospheric drag than anticipated, plus highly efficient orbit-correction burns, the latest fuel estimate projects L7 operating into 2020/2021, barring failure of a key subsystem

USGS goal is to reduce or eliminate the gap between the end of L7 and the launch of L9, maintaining 8-day revisit

How Does USGS Determine Requirements?

USGS Requirements, Capabilities & Analysis (RCA) Activity

- Comprehensively understand US and International use of and needs for Earth observations
- Requirements Elicitation identifies fundamental information needed by the user (what needs to be observed or measured): Geographic Coverage, Horizontal & Vertical Resolution, Sampling Interval, Accuracy, Length of data record, Data latency, etc.

USGS Requirements Surveys

- USGS/NASA Landsat Applications Survey of 33 Landsat products (2012)
- USGS National Land Imaging Requirements Pilot Project with 12 federal agencies (2014)

Landsat Science Team (Co-chaired by USGS and NASA)

- 21 scientists & engineers from the Federal Government, academia & international organizations

National Geospatial Advisory Council Landsat Advisory Group

- Provides advice to the Federal Government on Landsat requirements, objectives and actions

DOI Remote Sensing Working Group

- Team of remote sensing experts from all DOI bureaus working together to share expertise

OSTP-led Activities

- National Plan for Civil Earth Observations (2014), Earth Observation Assessments (2012, 2016)

Others: NRC Reports, USGEO activities, AmericaView, Case Studies, User feedback

How does USGS Meet Requirements?

NASA:

- Work with NASA on Landsat 9 and future Sustainable Land Imaging systems
- Use NASA earth observation systems like MODIS, ASTER, GRACE, Aura

International:

- Negotiate Bilateral agreements with European Union (for Sentinel-2 data)
- Leverage international agreements (for India's Resourcesat data)

National Security Space Systems:

- Use Civil Applications Committee to access National Security Space system data
- Digitize declassified imagery (Corona, Argon, KH-9) and make it publicly available

Aerial systems:

- Use USDA aerial imagery
- Operate unmanned aerial systems to collect data for many applications

Commercial systems:

- Leverage USGS Commercial Remote Sensing Data Contracts (DigitalGlobe and others)
- Use the Joint Agency Commercial Imagery Evaluation forum to assess satellite data

USGS:

- Make the datasets we have more accessible by enabling others to redistribute (Google, Amazon)
- Expand our menu of products based on existing datasets: create Landsat-based products like surface reflectance, surface temperature, burned area & surface water extent, biomass, Landsat JPEGs, etc.
- Conduct remote sensing research and technology investigations



NASA/USGS Sustainable Land Imaging Program

2013 - National Research Council Space Studies Board Report: The U.S. Government should establish a “Sustained and Enhanced Land Imaging Program” with persistent funding for current and future needs; a “comprehensive, integrated program that capitalizes on NASA and USGS strengths, maintains current capabilities, and enhances imaging capabilities and data products via emerging technology.”

2014 - Sustainable Land Imaging Architecture Study Team Report: Established trade space via expert knowledge, RFI responses; explored hundreds of architecture alternatives via several design cycles

2015, 2016 - President’s 2016, 2017 Budgets: The Sustainable Land Imaging program includes investments in technology and innovation to ensure a world class land imaging program for the next 25 years:

- Landsat 9 (fully Risk Class-B rebuild of Landsat 8) to launch in 2020/2021
 - Low programmatic risk implementation of a proven system, upgrades to bring system to Class B; intended to assure observational continuity of Landsat-Class data to the community
- Land Imaging Requirements Collection and Analysis
 - USGS is partnering with Federal agencies to document the uses of and requirements for Earth observation data, and map these requirements to a range of Earth observing systems
 - Enables the Nation’s future Landsat systems to be driven by the Nation’s land imaging requirements
- Land Imaging Technology and Systems Innovation
 - NASA is conducting instrument reduction studies, business model studies and other technology investigations to reduce cost and risk in next-generation Landsat missions
- Landsat 10 (Next-generation Landsat system) to launch in mid-late 2020s
 - Mission definition to be informed by Requirements and Technology investments in 2015 – 2018, leading to a key decision point in 2018, project initiation in 2019



Candidate Topics for Consideration of the LAG in 2016 (still in coordination)

- **Revisit of the smallsat investigation from the FY15 NGAC study**
 - Formulate a comprehensive narrative on the pros and cons of existing smallsat technology juxtaposed with Landsat 8 and Landsat 9 capabilities
- **The feasibility and utility of implementing temporal data cubes to support projection or ‘forecast’ models of land change trends**
 - In addition to Landsat, what other data sources (EO, SAR, LIDAR) are optimally suited for leveraging (e.g., co-registered) to support data cube implementations for land change analysis and forecast modeling?
 - Which organizations with expertise in forecast modeling are best postured to evaluate and demonstrate the forecast potential from a Landsat-based temporal data cube?
- **Data continuity mission enhancements**
 - To what extent could ‘significant’ sensor enhancements be made in future Landsat missions, while maintaining acceptable backward compatibility? What would be the suggested methods for data aggregation and validation?
- **Government and Private Sector roles in a future land remote sensing architecture**
 - Provide recommendations for improving efficiencies in support of government operations, scientific research, and commercial profitability.

