

# USGS National Land Imaging Program Update

CEOS WGISS

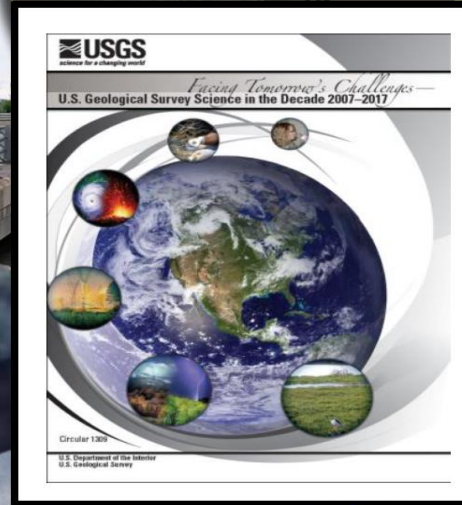
21 October 2021



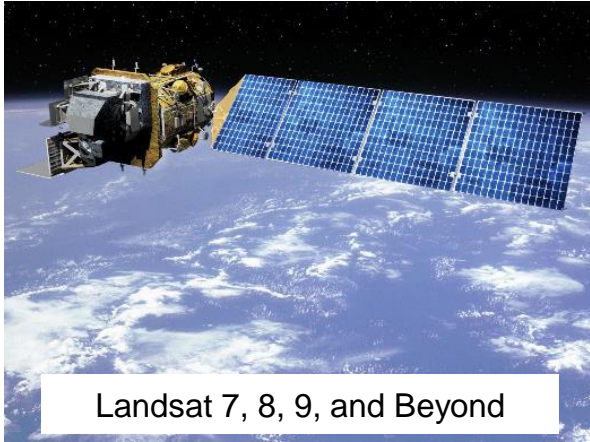
# USGS Mission: *Linking Science to Decisions*

The USGS serves the Nation by providing reliable scientific information to:

- describe and understand the Earth.
- minimize loss of life and property from natural disasters.
- manage water, biological, energy, and mineral resources.
- enhance and protect our quality of life.



# USGS National Land Imaging (NLI) Program – Mission Overview



***Delivers a national and global capability to ensure broad public and scientific availability of observations of the Earth's land surface***

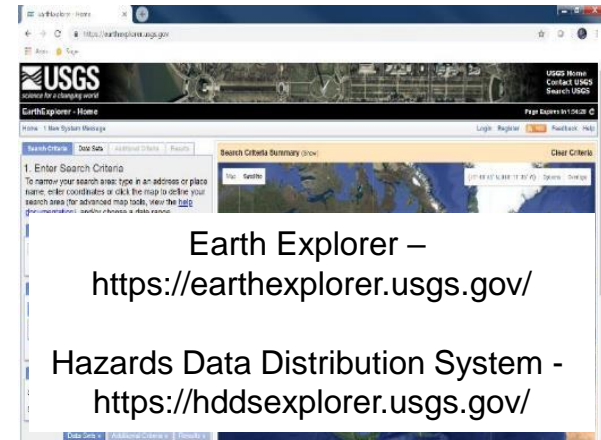
***Coordinates and integrates civil Earth observations with other sources of data, including international, commercial and National Security space systems***

***Supports government policy and decision makers***

***Guides National decisions to meet Government needs for land science and land observation***



National Civil Applications Center





# NLI Requirements, Capabilities, and Assessment Process



Identify & Assess  
Individual Earth Observation Systems

Develop User Needs  
& Capabilities Information for Sustainable Land Imaging

Assess  
Broader Architecture Solutions

2015

2016

2017

2018

2019

2020

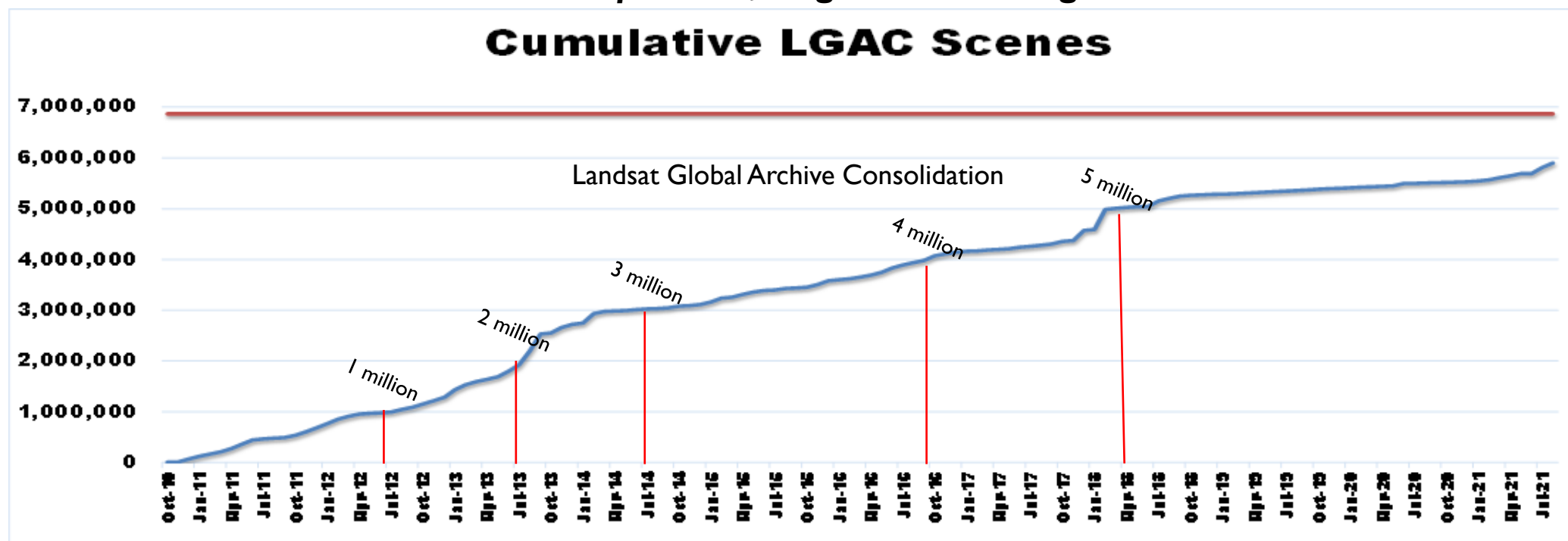
2021

# Landsat International Cooperator (IC) Network



- USGS-managed international partnership of Landsat ground station operators
- Longstanding pillar of U.S. international S&T policy for civil space cooperation
- 5+ million unique Landsat scenes have been added to the USGS global archive

*19 international partners, 28 ground receiving stations*



# Landsat Operations and Development Status

**Active**  
**In Development**  
**Planned**

## **Landsat 8 Flight Operations (2013-)**

Collecting up to 740 new scenes per day; frequent night and off-nadir imaging of volcano and fire imaging.

## **Landsat 7 Flight Operations (1999-)**

Collecting about 470 new scenes per day; the science mission will end shortly after L9 becomes operational

## **Landsat 9 (Target Launch NET 27 September)**

Near-clone of Landsat 8, but with important improvements for accuracy and resiliency, TIRS stray light, 14-bit OLI data.

## **Landsat Next (~ late 2020s launch)**

NASA and USGS have set up formal Projects to pursue Landsat Next; RFIs and Instrument studies have been initiated

Working towards the Mission Concept Review and official project formulation in early CY2022; system architecture and instrument(s) still being studied

## **Landsat Archive Operations**

Over 9 million Landsat scenes available, with 100 million downloads since Landsat data become freely available in 2008

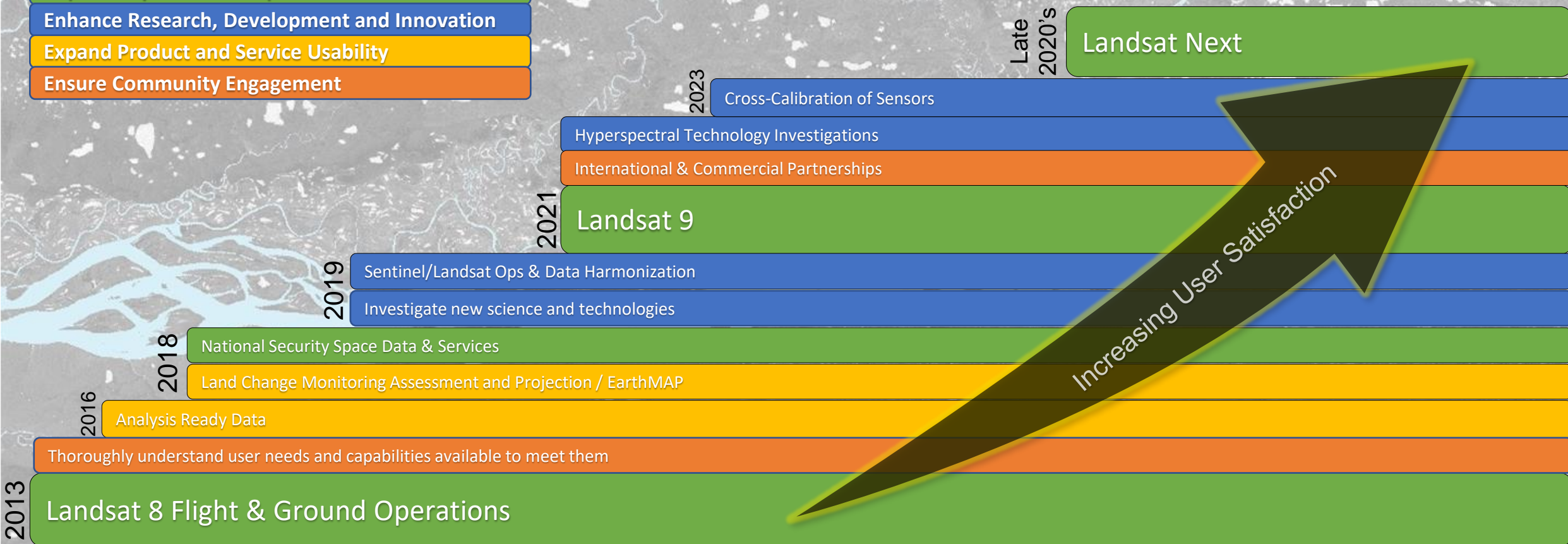


# National Land Imaging (NLI) Program Future Directions

*Leveraging the diversity of Earth Observations to meet the Diverse Needs of Science & Operational Users*

## NLI Program Goals

- Improve Operational Capabilities
- Enhance Research, Development and Innovation
- Expand Product and Service Usability
- Ensure Community Engagement





# Landsat

The world's longest, most widely used and cited land remote sensing data set, helping us understand and manage natural and human-induced landscape change via a multitude of land, water, and natural resource management applications.



## Common Uses of Landsat data by Federal Agencies, States, and the private sector:

- Agriculture and Forestry
- Regional Land Use Planning
- Land Use/Land Cover
- Fire/Disaster Management
- Energy and Mineral Mapping
- Water Quality and Resources
- Global Change Science
- Flood Management
- National Security
- Ecosystem Monitoring
- Famine Early Warning
- Carbon Assessment
- Drought Monitoring
- Transportation Planning
- Calibration/Validation

## Multi-spectral coverage in VNIR-SWIR-TIR

-> to map surface composition & temperature

## 15 / 30 / 100 meter spatial resolution

-> to resolve human-scale land dynamics

## 16-day revisit frequency (8-days w/ two satellites)

-> global, seasonal coverage

## Broad area collection => 12,000+ square miles per image

-> 1200 images/day = 15 million square miles/day

## Highly calibrated “science quality” data

-> to resolve long-term trends & retrieve biophysical variables

## Free and Open Data policy since 2008

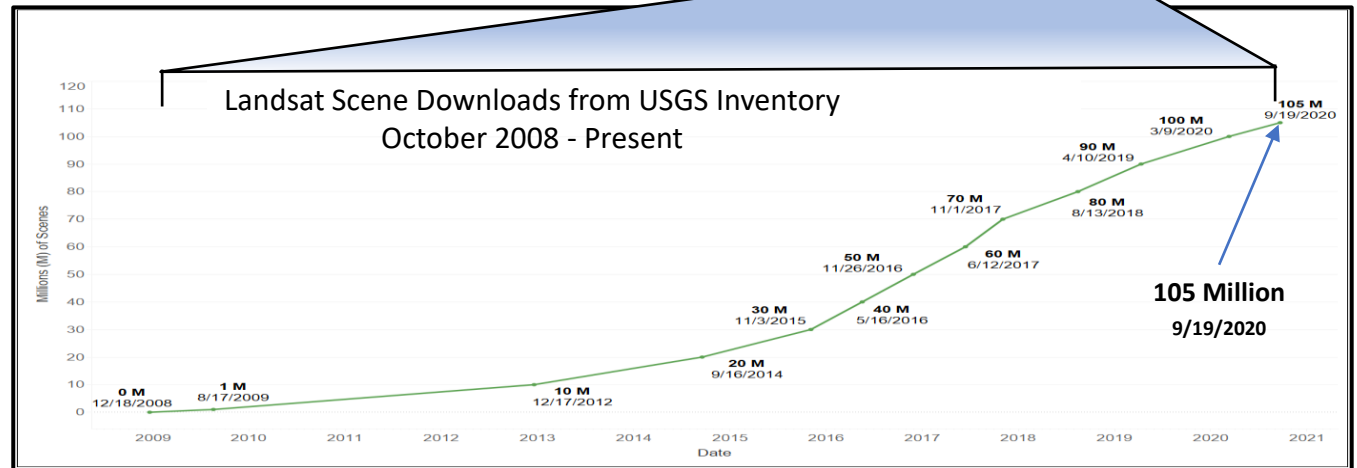
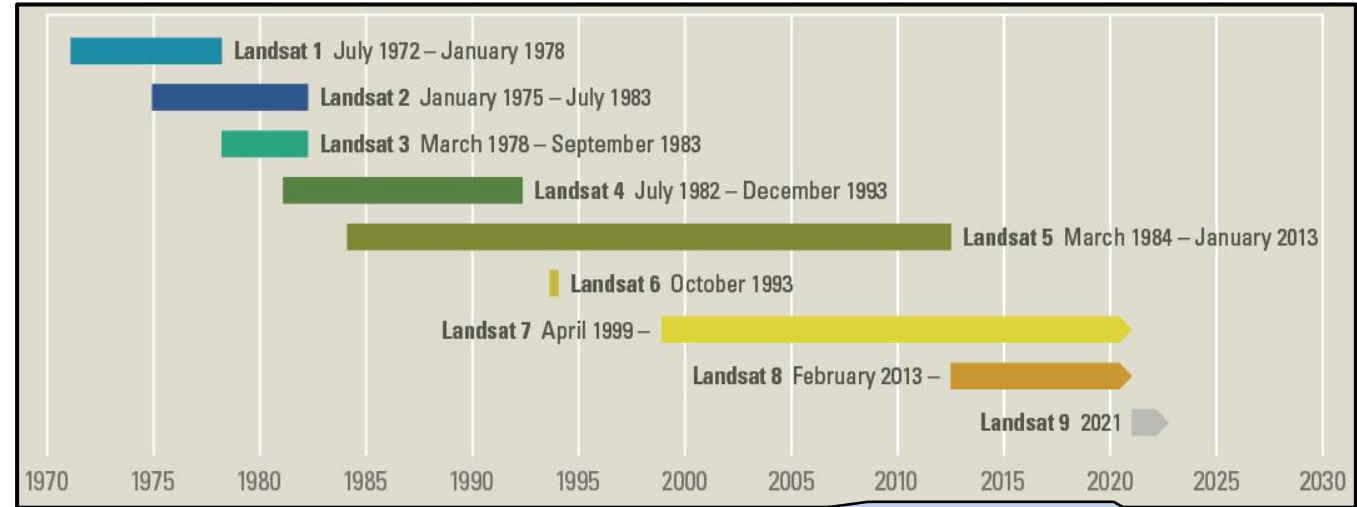
-> 30 million products distributed by USGS last year





# The Landsat Program

- ◆ Landsat first launched in 1972, and has continuously provided Earth imagery ever since
- ◆ There are now more than 9 million Landsat scenes available for download from USGS
- ◆ More than 105 million scenes have been downloaded from USGS and cloud hosting sites since the archive became freely available in October 2008!
- ◆ Millions more scenes have been and are being re-distributed by commercial cloud vendors





# Public Research & Engagement

"The opening of the Landsat archive to free, web-based access is like giving a library card to the world's best library of Earth conditions to everyone in the world."

Adam Gerrard, Food & Agriculture Organization of the United Nations



**MINNESOTA and Landsat**

Minnesota, the "Land of 10,000 Lakes," treasures the beauty of its natural environment. The state is also home to a wide array of agriculture, manufacturing, recreation, and natural resource industries. Minnesota understands the need to give these resources and manage their resources in an environmentally responsible manner.

Landsat land imaging combines satellite public and private sector data in the state and across the Nation for effective adaptation to changing landscapes. These decisions often lead to enhanced agricultural productivity, smart urban development, and sustainable forest management. Landsat also enables more accurate related data science modeling, improved water resource management, effective water use, more robust climate research, and other related values. These examples for the State of Minnesota follow:

**Smart Urban Development**

The Twin Cities of Minneapolis and St. Paul are home to about 12 percent of Minnesota's population. Municipal infrastructure must balance residential, commercial development and the surrounding urban growth to maintain harmony with the surrounding environment. Landsat allows users to monitor the changing urban landscape. The data can be used to monitor the growth of urban sprawl and land use, identify increasing impervious surface area (for example, buildings, roads, and parking lots), observing land cover effects, and making urban growth and land-use pattern change.

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U.S. Geological Survey

**ALASKA and Landsat**

Alaska is the "Last Frontier," a stunning and diverse landscape whose rugged terrain has fascinated and captivated Americans since its acquisition from Russia in 1867 by Secretary of State William Seward. The Arctic land of the 49th State remains widely regarded as a natural resource. The state contributes to the Nation's energy security through its natural and energy resources and for its important place in the U.S. wildlife industry.

Landsat land imaging provides a wide range of satellite imagery and other remotely sensed data to government, commercial, academic, and public users. These data can get worldwide access to Landsat satellite data through the National Land Imaging Program, funded by USGS Earth Resources Observation and Science Center.

**National Land Imaging Program Benefits—Alaska**

The U.S. Geological Survey (USGS) National Land Imaging Program provides a wide range of satellite imagery and other remotely sensed data to government, commercial, academic, and public users. These data can get worldwide access to Landsat satellite data through the National Land Imaging Program, funded by USGS Earth Resources Observation and Science Center.

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

**OHIO and Landsat**

In Ohio, remote sensing systems such as Landsat play an important role in monitoring natural resources and informing government decisions on everything from emergency response to disaster recovery to crop yield estimation and more.

Landsat imagery supports public and private sector decisions in Ohio and across the Nation for effective adaptation to changing landscapes. These decisions include:

**Monitoring Events**

The resolution of Landsat imagery and the size of Landsat's footprint makes critical insight for visible, high-resolution flood monitoring along the Ohio River and other Ohio waterways.

- Pre-flooding Landsat images show waterways during normal times.
- Landsat imagery during an event helps managers prepare officials estimate flood areas, particularly in urban areas where flooding can be very catastrophic.
- Landsat data are compared with flood models, supporting floodplain topographic assessments for more efficient disaster management.

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

**MAINE and Landsat**

As the Nation's northeasternmost State, Maine's reputation is that of rocky coastlines, such as numerous bays, peninsulas, and islands during the warm months, and verdant waters like the granite and spruce forests of Acadia National Park.

The State is a place of change too. The State has witnessed a major transition in the last 150 years. Spruce is being cut, being replaced by pine, and the State's forest industry is being replaced by other industries. Landsat satellite data through the National Land Imaging Program, funded by USGS Earth Resources Observation and Science Center.

**National Land Imaging Program Benefits—Maine**

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U.S. Geological Survey

**NEW MEXICO and Landsat**

Landscapes of rose-colored deserts, broken mesas, and high, snow-capped peaks give New Mexico its reputation as the "Land of Enchantment." To monitor the well-being of those areas, and to manage their recovery in the aftermath of disasters, New Mexico relies on observations from the Landsat series of satellites operated by the U.S. Geological Survey (USGS).

Data from Landsat also assist New Mexico in managing its precious water resources for agriculture, recreation, and industrial and community consumption. Landsat supports a variety of public and private sector decisions across New Mexico and the Nation for effective adaptation to changing landscapes.

**National Land Imaging Program Benefits—New Mexico**

The USGS National Land Imaging Program provides a wide range of satellite imagery and other remotely sensed and geospatial data to government, commercial, academic, and public users. Those users can get worldwide access to Landsat satellite data through the National Land Imaging Program, funded by USGS Earth Resources Observation and Science Center.

Here are some examples of Landsat's benefits to New Mexicans.

**Wildland Fires**

With warming temperatures, trees weaken and die at increasing rates. The result is climate-stressed vegetation burning in unusually large and severe wildfires across the West. New Mexico is no exception. Landsat data can inform New Mexico land managers on areas where fuel loads are high and where prescribed burns can remove that fuel before wildfires occur.

Burn maps derived from Landsat data show managers where land is vulnerable after wildfires, exposing soil to erosion, flooding, and mudslides from subsequent rainstorms. Sediments running downhill and downstream can damage houses, fill reservoirs, and put endangered species and community water supplies at risk. Maps created from Landsat images identify those potential risk areas and help to inform mitigation efforts.

The depth of the Landsat archive tells the story of the Las Conchas wildfire that burned more than 156,000 acres near Las Alamos in June 2011. The top image shows acquired days before the wildfire started, the center image shows the footprint of the burned area, and the bottom image from October 2019 shows the landscape's partial recovery.

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U.S. Geological Survey

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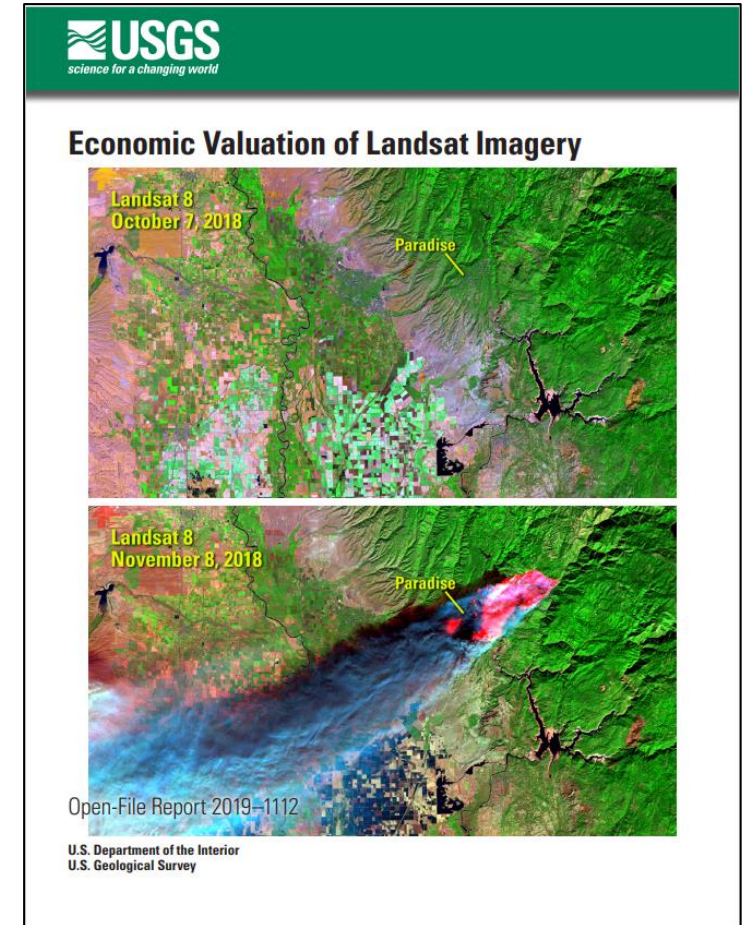




# Updated economic valuation of Landsat

“Landsat imagery provided domestic and international users an estimated **\$3.45 billion in benefits in 2017** compared to \$2.19 billion in 2011, with U.S. users accounting for \$2.06 billion of those benefits.”

(Does not include value of scenes downloaded by cloud vendors or other downstream economic benefits such as value-added products)



## Economic Valuation of Landsat Imagery

Open-File Report 2019-1112

Crista L. Straub, Stephen R. Koontz, and John B. Loomis

<https://doi.org/10.3133/ofr20191112>