

# WELCOME to EROS



U.S. Geological Survey  
Department of Interior



# WELCOME TO THE EARTH RESOURCES OBSERVATION AND SCIENCE (EROS) CENTER



## OUR MISSION IS IN OUR NAME

**EARTH:** EROS operates the satellites of the USGS Landsat Program—now on our 9<sup>th</sup> satellite—Landsat contributes more than \$3.45 billion in value worldwide each year when it comes to managing our land and natural resources.

**RESOURCES:** Satellite imagery captured at EROS is used in all 50 of the United States to assist city planners, county and state land managers, agricultural producers, fish and wildlife managers and more. Landsat satellite imagery plays a critical role in managing natural resources like water and minerals, helps forecast drought conditions before famine and thirst set in, and provides timely information when wildland fires, hurricanes or natural disasters threaten our homes and property.

**OBSERVATION:** In addition to satellite imagery, the EROS archive includes other types of remotely sensed imagery of Earth, including imagery from airplanes, uncrewed aerial systems (drones), declassified early-satellite data to NASA's International Space Station mission data.

**SCIENCE:** EROS has more than 100 scientists who study remotely sensed data and provide helpful information and products to support disaster relief efforts, to provide operational information on crop production, wildland fires, water quality conditions, glacier movement and more.

# DIRECTOR'S WELCOME



It's my honor to welcome you to the EROS Center—a place like no other on Earth—where we explore the Earth's landscapes, one satellite image at a time.

Our mission at EROS is three-fold: to operate the Landsat satellites; to acquire, archive, and distribute the data; and to study the imagery with scientific curiosity to help manage the lands and natural resources of our nation.

EROS Center work with Landsat satellite data empowers decision makers at all levels in our country. Landsat has been cited thousands of times in U.S. policy and even more in journals and publications about management of our lands and natural resources. USGS and EROS' Landsat data is used in every U.S. state, publicly and privately, to continually learn and improve industries like agriculture and crop production, water resources, wildland and forest fires and climate studies.

I hope you enjoy learning about our work, our people and our passion on your tour.

Sincerely,

*Peter Doucette*

Director, EROS Center

WELCOME TO EROS



# OUR STORY STARTS IN SPACE

## EROS FLIES THE USGS SATELLITES

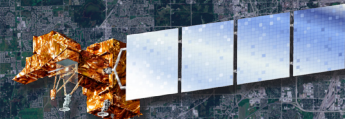
EROS flies the Landsat satellites orbiting 438 miles above the Earth's surface. Currently Landsat 8 and Landsat 9, two nearly identical satellites, orbit overhead and cross over the United States about 14 times a day. The satellites collect images of the Earth and send the data back to Earth. EROS stores the data, and our scientists study the imagery to understand how and where the Earth's surface is changing.

## A MODEL SATELLITE

The satellite hanging in the atrium above you is a 1/3-scale model of Landsat 8. Landsats 8 and 9 are about the size of a package delivery truck and weigh 6,000 pounds.

The solar panel is 30 feet long and powers the satellite, recharging its battery with solar energy. In the event we need to move the satellite out of the way of space debris, we do keep some rocket fuel onboard for such emergencies.

The shiny, reflective wrap around the body of the satellite helps minimize extreme changes in temperature when the satellite moves in and out of sunlight.



## HOW SATELLITE DATA BECOMES AN IMAGE

Sensors on the satellites capture images of Earth as they pass over land areas and then beam the data back to Earth. The smallest element of a satellite scene is a pixel. It is about 30 meters by 30 meters wide, about the size of the in-field of a baseball diamond. Pixels combine to make scenes, which make up swaths. As the Earth rotates and Landsat satellites image the Earth's surface, swaths of data are collected and then downlinked back to EROS.

## EROS—A NATIONAL ARCHIVE

EROS is the National Satellite and Land Remote Sensing Data Archive of the United States—as designated by Congress in 1992.

In addition to the 50-plus years of Landsat data, the EROS archive holds aerial imagery (from planes and drones), declassified military, NASA's space imagery and other collections—all available at no cost to the public.

As of 2024, the EROS archive holds 74 petabytes of data in storage—1 petabyte = 1,000,000 gigabytes! And we're continuously adding more, an average of xxx,xxx scenes or xxx,xxx GB per day.

EROS also leverages Cloud storage and its high-speed processing capabilities to meet the demand for Landsat data today and in planning for tomorrow.

## FUN FACTS

### Landsat Satellite Statistics

- Landsats 8 and 9 orbit 438 miles above Earth's surface at 17,000 mph
- Satellites cross the equator about 10 a.m. local time, and each pass takes 99 minutes
- With about 30 passes each day, Together, Landsats 8 and 9, collect a complete snapshot of Earth every 8 days



# LANDSAT SERVES ALL COMMUNITIES

## MAKING A DIFFERENCE

Visitors love the beautiful imagery and detailed maps at EROS—and so do we! But Landsat data also affect your daily life in unexpected ways. Projects at EROS track resources people need and help before, during and after natural disasters. Our scientists also measure the effects of human actions on the planet.

## WATER AND AGRICULTURE

*Surveying crops:* Landsat watches over water sources, from dropping reservoir levels at Lake Mead in Nevada to the growth of Lake Thompson in South Dakota. Monitoring water helps crops: 80% of water in the United States is used for agriculture! Scientists also use different light spectrum combinations to tell whether plants are healthy.

*Predicting drought:* For decades, EROS has partnered with the Famine Early Warning Systems Network to help predict crop failures and food shortages in Africa and elsewhere. Researchers use a variety of remote sensing data to monitor evapotranspiration—a combination of the rate of evaporation from the soil and transpiration from plants. If drought is likely, decision makers can start relief efforts early, before famine develops.



## MONITORING DISASTERS

*Priority on prevention:* Several EROS-based projects keep tabs on fire. Knowing where previous fires happened helps fire managers know where future ones might occur and where to set managed burns. Scientists also study potential fire fuel—beetle-riddled trees, dry brush, flammable invasive grasses.

*How much damage?* Whether it's a fire, flood, hurricane, landslide or volcano, emergency responders need to know how far the damage reached. The Hazards Data Distribution System at EROS is set up to share remote sensing data worldwide as quickly as possible after a disaster.

*Route to recovery:* For major disasters like the 1980 Mount St. Helens eruption or the Yellowstone fires of 1988, the path back to normal takes years rather than months. The 50-plus year record in the EROS archive helps researchers take the long view of nature's recovery.

## PEOPLE AND THE PLANET

*Industrialization:* How do factories, mines and other business efforts affect the landscape? Are lakes, forests or wildlife disturbed? Landsat helps answer those questions. For example, Landsat keeps a watchful, neutral eye on a coal mine as it expands in Wyoming—and as it restores the land to nature once excavation is done.

*Urban growth:* Nothing reveals the explosive growth of cities like Phoenix or Las Vegas in the past 50 years like watching a time series from the EROS archive! Using Landsat's Thermal Infrared Sensor, scientists also measure "urban heat islands," the heat produced by concrete and other hard surfaces in cities.

*Climate:* If greenhouse gases raise temperatures, many of the places that would reveal the most change are in hard-to-reach locations—polar ice caps, Arctic tundra and glaciers. Landsat provides constant, unbiased monitoring of those regions, now even offering the opportunity to take extra images during long periods of darkness during winter.



# U.S. AND THE WORLD

## NAVIGATE YOUR STATE

How does Landsat help Utah, New York or Georgia? Scan the QR code to check out all the resources for your state!



Our 50 fact sheets show 3 benefits per state. Learn about protecting the yellow-billed cuckoo in Idaho, mapping the Texas coastline or tracking the extent of flooding in Michigan.

See your state from space! Each state mosaic map is compiled from cloudless Landsat images, with only the county lines and a few major cities added for context. The state flag and interesting facts are included.

The state puzzles in our Remote Sensing Classroom are not just for kids! Make it harder by increasing the number of pieces from 10 to 100.

As a bonus, follow the links to see videos, podcasts, stories and interactive tools about your state.



Hartford

Sioux Falls

Tea

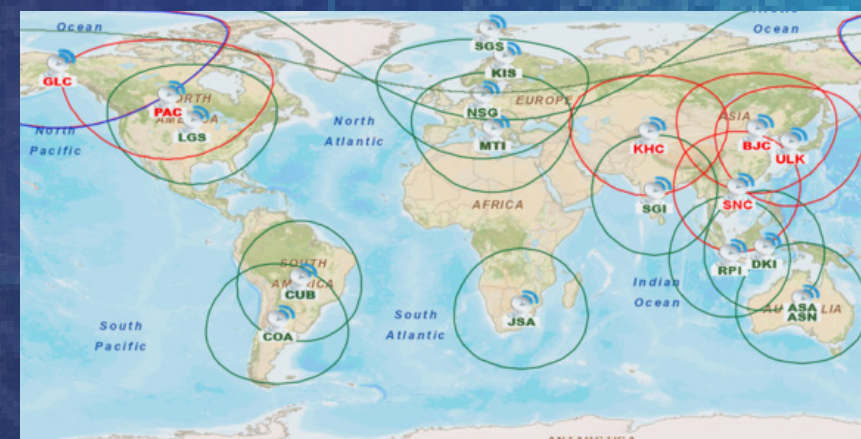
EROS Center

Brandon

## A GLOBAL OUTLOOK

It's natural for EROS to have a world-wide perspective—we collect data every day from every continent! Throughout our history, we've forged connections with other countries.

*Flags:* The flags in the atrium represent the home countries of participants in the Landsat International Cooperator Network. The network offers members a direct data downlink and a chance to collaborate on remote sensing research benefiting their region.



Learn more about International Cooperators on the curved display in this area.

*Landsat Ground Station Network:* In addition to U.S. ground stations in Sioux Falls and Gilmore Creek, Alaska, 3 partners routinely collect data for the EROS archive—Alice Springs, Australia; Neustrelitz, Germany; and Svalbard, Norway. Fun fact: The two antennas at Alice Springs are decorated with Aboriginal art (native to Australia) and Lakota art (from South Dakota)!

*Science:* Even before the EROS Center was built, Sioux Falls hosted the first International Workshop to teach about remote sensing science. Throughout our history, EROS has worked with researchers around the world to develop projects benefiting people.



# MAKING HISTORY

## LANDSAT LORE

*First flight:* In the 1960s, USGS scientists proposed a novel idea—send a satellite to space to gaze back at Earth! NASA launched Earth Resources Technology Satellite-1 (ERTS-1) on July 23, 1972, from Vandenberg Air Force Base in California.

*Name change:* Right before the second satellite's launch, NASA changed the mission name to Landsat—and we liked it! Landsats 1, 2 and 3 had a 1-year design life; all exceeded that, lasting 5-7 years.

*Record setter:* Landsats 4 and 5 carried extra fuel to allow them to navigate to a space shuttle for repairs, an operation that never happened. But having extra juice in the tank is partly responsible for Landsat 5's longevity. With more than 28 years in orbit, Landsat 5 set the Guinness World Record as the longest-operating Earth observing satellite! Good thing it did, too—it faithfully kept the mission running when EOSAT-operated Landsat 6 failed to achieve orbit.

*Extended mission:* Landsat 7 also proved to be a workhorse, lasting from its 1999 launch to spring 2024. When Landsat 8 launched in 2013 and Landsat 9 in 2021, EROS had three “birds” in the air at once. Landsat 7 was sent to a lower orbit in 2022 for an extended science mission, helping validate data quality.



## LANDSAT NEXT

The next Landsat mission—aptly called Landsat Next—is targeted to reach orbit in about 2030 with not one but 3 new satellites collecting imagery of Earth's surface more frequently and in greater detail. Taking a complete snapshot of Earth every 6 days and measuring 26 bands of light and thermal energy measured, the LNext trio will produce 20 times more data than Landsat 9! Many folks at EROS are already busy preparing for the launch and the large amount of data that will be coming.

## SEE WHAT LANDSAT SEES

Soar aloft with Landsat 8 or 9 in real time with EarthNow! The viewer shows cities (including their populations) and landmarks as well as thermal hot spots. Maybe you'll catch a glimpse of a volcano! Recently recorded orbits also are available—see if you can find a flyover near your hometown.

## HOW EROS CAME TO SIOUX FALLS

Scan the QR code for a storymap of the full history of the Center—highlights include Chernobyl, the Yellowstone fires and a hailstorm that wrecked our antenna! Here's a brief timeline about the origins of EROS.



**1966:** Interior Secretary Stewart Udall created the EROS program via press release—even before it was official!

**1969-1970:** Sioux Falls business leaders realized their city was in the “sweet spot” for the data center—an oval in the middle of the U.S. that could receive satellite data for the Lower 48—and started lobbying. They even offered to pay for the land! South Dakota Senator Karl Mundt announced Sioux Falls would be the host city in March 1970 via yet another preemptive press release.

**1971:** EROS opened in the Downtown Office, a temporary spot for employees to learn about photo developing and imaging by using aerial imagery. Meanwhile, officials negotiated the purchase of 320 acres of farmland north of Sioux Falls.

**1972:** A groundbreaking ceremony with a mule-drawn plow in April was followed a few months later by the launch of Landsat 1 (ERTS-1). EROS employees developed the “first-light” photo of Dallas, Texas, at the Downtown Office.

**1973:** More than 2,000 well-wishers showed up for the August 7 grand opening of the first-of-its kind data center.



# COMPUTING THE SCIENCE

👉 Ready to geek out on EROS technology and data? Check out our interactive display at Computer Room 2 to explore everything from artificial intelligence to cloud computing to the world-class quality of our data.

## HIGH PERFORMANCE COMPUTING

EROS hosts Hovenweep, Denali and Tallgrass—supercomputers that enable complex science projects throughout USGS to crunch data. In reality, they are high performance computing (HPC) systems, harnessing multiple central processing units (CPUs) to work in tandem.

The HPCs are named after National Parks.

Tallgrass is equipped to deal with modern AI and deep learning.

Hovenweep is the latest addition, superseding Denali. It's all part of the long-term USGS dedication to cutting-edge HPCs—Hovenweep's replacement is already being planned!

## FUN FACTS

### Hovenweep

- Is the most powerful system within the DOI
- Can perform 640 trillion calculations per second
- Has 18,432 CPU cores



## DATA CAPTURE PROCESSING FACILITY

In the far left corner of Computer Room 2, you'll see what looks like an arrival chart at the airport. It tells us the exact ETA when the satellites will be within range of EROS. We receive downlinks from both Landsat 8 and Landsat 9, up to 3 passes each per day and 3 passes each per night.

When the satellites are within range of EROS, their signal is picked up by the antenna in the radome, which tracks it from horizon to horizon until the downlink has finished. This takes roughly 10-15 minutes. The data that is downlinked is processed and then stored in the servers on the left.



## A PARTNERSHIP WITH NASA

Landsat isn't the only satellite mission that links USGS and NASA. EROS is the home for NASA's Land Processes Distributed Active Archive Center (LP DAAC). On the right side of Computer Room 2 are servers that store NASA data.

*Mission to Planet Earth:* This NASA project set up 12 DAACs in the 1990s, and Land Processes was a natural fit for EROS. The addition to house the LP DAAC doubled the size of the Center.

*Satellites:* Like Landsat, NASA's Terra and Aqua satellites have a polar orbit, but at an altitude of 440 miles above Earth. Their sensors, MODIS and ASTER, have some different resolutions and capabilities than Landsat, and their data is downloaded and archived at EROS.



# A CHANGING TAPESTRY

## NLCD QUIZ

## What type of land do you notice in your region?



## NED QUIZ

### Which state has the highest contrast between its lowest elevation and highest?

For more than five decades, EROS has attracted dedicated scientists to turn the flood of Landsat data into beneficial scientific information. Many projects have been created, some in partnership with other agencies, to study specialized topics and share that info with the nation and the world. This word montage gives you just a taste of the main themes, projects, products and study topics at EROS:





# MORE TO EXPLORE

## BEFORE YOU GO

Maybe you already interacted with our globe or puzzles during the tour. But just in case, here's a few don't-miss spots to catch before you leave the building.

**Radome:** Look out the right side of the big bay windows at the back of the atrium. That igloo-shaped building houses the antenna where EROS receives all data from the satellites. The dome was installed after softball-sized hail destroyed our antenna in 1997!

Nestled in the corner next to the cafe, see the monitor with our radome video to learn more about the important role our "big golf ball on the prairie" plays at EROS. (Fun fact: There's another small radome behind the trees to the right!)

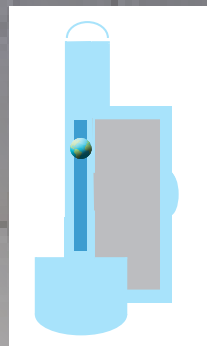
**Earth As Art:** As you face the front entrance, you'll see a series of stunning canvases lining the right side of the atrium wall. These natural masterpieces may look like abstract art but are in fact real Landsat images from countries all around the world. You can see all 6 of our collections online by scanning this QR code!



**Globe:** It's mesmerizing just to watch as the world turns in the center of the atrium. On this globe, 1 inch = 100 miles on the Earth. At that scale, Landsat satellites would orbit 4 inches above the surface—and the moon would be by the front door! Take a moment to interact with the four monitors surrounding the globe—see a flyover of Africa, fly in orbit with Landsat, view real-time Landsat imagery, and watch the latest Image of the Week video.

**Floor Puzzles:** Let the kids play! These puzzles are meant to be stepped on, pulled apart and put back together.

1. See if you can spot an airport, interstates or shopping centers in Sioux Falls or find where your house or hotel is located.
2. Read the captions on the four quarters of the Denver puzzle to learn how different parts of the light spectrum captured by Landsat give insight into changes on the ground.



## FUN FACT

### The EROS Water Tower

Maybe you noticed our water tower as you parked the car. Why does a data archive/science center need a water tower? Well, before the world went digital, EROS received its first remotely sensed imagery in the form of photography film. We needed a dedicated water supply to develop film, up to 20,000 gallons a day! Today, local volunteer fire departments depend on the tower as an additional water supply.



## ADDITIONAL ONLINE RESOURCES

The resources at EROS are not just for professional scientists!

Everyone is welcome to study how land changes over time through satellite imagery. Scan the QR code below and join us online where you will find educational activities, podcast links, videos and more.

**Remote Sensing Classroom:** Is it still educational if it's fun? Of course! In addition to lessons that let you pretend to be a scientist, try your hand at the Spot the Change Quiz, Test Your Memory, and Satellite Puzzles.

**Earthshots:** Spin the globe to find more than 100 interactive land change stories on 17 different topics—from dams to glaciers to wildlife.

**Image of the Week:** Browse through hundreds of Image of the Week videos featuring icebergs, catfish ponds, fires, volcanoes, mudslides, glaciers, floods and more!

**Eyes on Earth:** Listen to our podcasts—we interview fascinating guests with expertise in remote sensing science and satellites.

## OUR ADDRESS

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## FIND US ONLINE

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**Twitter** @USGS\_EROS  
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