Geoscience is Everywhere

Geoscience is the scientific study of Earth: the lithosphere, atmosphere, hydrosphere, and cryosphere—where all spheres interact. Everyone can relate to and observe the Earth around us with one of our five senses. Geoscientists believe that we need to extend our understanding of the planet or ‘beautify’ it as we use the land. We need to extend our sensibilities to help us monitor our changing environment and develop beneficial and attractive visualizations that will help us live every day.

A Vision for Earth Observation

Following the August 2019 meeting of the Interior Stew-
art Udall announced his vision to create “a program aiming at gathering facts about the natural resources of the United States from space.” In 1972, the Landsat series of satellites has been keeping a watchful eye over our planet. Landsat’s 47-year accumulation of imagery has provided stunning images of the Earth and enabled geoscientists globally to document our changing landscapes.

An Unraveled Revolution

Landsat’s high-quality scientific data are routinely used for water, food, and carbon management across the globe and Landsat data serve as the base for Google Maps and make Earth Engine’s time-lapse app possible. Modern analytical and computing capa-
tibilities have enabled data users to harness Landsat’s extensive temporal coverage of changing land conditions. This data record provides an unraveled resource for geoscience applications over a timescale of decades.

Access is for everyone

Landsat data is a base for mapping applications and research projects, from archaeological excavations to a wide range of simple to sophisticated tools. Anyone with a smartphone can view imagery of his or her location. Landsat data provides critical information on the state of a local or far-off environment, and see how it changes over time, whether that’s a month or a century.

Benefits to Society

Landsat data, used in combination today with advanced geographic information systems, image processing software, and cloud computing, enable individual users and research teams to process as many features as needed for Earth analysis. Many archived images of a single site can now be easily obtained and analyzed for land-surface change over time. Analysis Ready Data (ARD) delivers a time-limited database of imagery adjusted to a common reference model. This allows a user to see land-cover or land-use conditions over time and across an entire area of interest, such as natural resource management, agriculture, disaster risk management, biodiversity, and water supply.

Current applications

The primary use of Landsat data is natural resource management. It improves understanding of water availability and quality issues.

Identifies environmental challenges and opportunities

Accessing Earth since 1972 with Landsat Satellites

Remote sensing enables studying Earth from so many perspectives. A combination of science and engineering has expanded our knowledge about our planet’s system functions. Satellite imagery, like those on the Landsat platform, complement Earth-based sensors. Geoscience disciplines like geophysics, oceanography, and ecology are only a few of the many areas of study for which Landsat provides reliable information.

Since the first Landsat satellite was launched in 1972, the mission has become an indelible part of our national infrastructure, providing a decades-long, unique and irreplaceable record of our changing landscapes—with many practical uses for our lives and livelihoods.

Future Data

The series of Landsat satellites, which will continue with Landsat 9, has collected reliable, consistent, and objective observations of the global land surface for nearly 50 years. The U.S. Geological Survey (USGS) and NASA have agreed to fund the development of Landsat 9. In 2008 the USGSP opened the archive to the public allowing anyone to search, browse and download more than 8 million images online for free.

The Power of Pixels

Landsat provides valuable information by measuring and reflected light energy in both visible and infrared portions of the spectrum. With the upcoming launch of the newest Landsat satellite, the Landsat 9, its critical role is continuing to expand, monitoring the land resources needed to support the human population. (Image: USDA-NRCS)

This information, taken over an area that is 30 meters by 30 meters, is recorded digitally as a pixel. Landsat pixels are about the size of a baseball diamond.

Birds-eye view, Landsat images of the landscape are built up to provide data at the scale necessary to effectively manage our land, our cities, and our natural resources over time.

The Just-Right Satellite

Earth cover and land around the globe are changing faster than ever before. This has sweeping consequences. Landsat collects data at the scale of human interactions with the land and with the frequency necessary to detect, monitor and understand changes in land use and cover. Managing our land and water resources in a sustainable way is important for life on Earth—and if you want to manage something well, you need to be able to map it well.

Sharing our Understanding and Engaging with Geoscience through Landsat and Earth Observations

Geoscience is everywhere. The image shows satellite images of the Earth from space. (Image: NASA)

B. Wetland Ecology in the Sacramento River Valley

In the early 1990s, the National Aeronautics and Space Administration (NASA) began using Landsat imagery to map the wetlands of California. This work was used to enhance the Sacramento River Valley Environmental Management Plan, which guides the agricultural production in this region. This region is dominated by agriculture, shown by the square fields in this Landsat image. The middle portion of this field is rice, requiring a lot of water, every season. These rice fields are frequently flooded to provide the water needed for the seeds' growth to continue.

D. Brazillian Mine

The image of the largest mines of Brazil’s Comodoro Minerals Company shows a mine that is quite large. The terraced appearance is a result of the open pit mining method. Landsat imagery was used from 2007 to 2013, mining at first of South metal’s main pits has produced 2.3 billion tons of high-grade iron ore. A site now quarried by Latin America’s largest mining company—Comodoro’s—this mine has the southern part of Earth’s history. With the discovery of these iron-ore deposits, Brazil will continue to be a major supplier of iron ore for the rest of the world.

C. South Dakota Hail Damage

The Hailstorm affected the entire state of South Dakota, a state of about 750,000 square miles. This satellite image is used to study the impacts of extreme weather events. Images captured from the Landsat 8 platform in April 2013 allow for real-time analysis and injury assessment. Such images provide critical information to local, state, and federal decision-makers. The collected imagery can enable prediction of low flow conditions that can cause damage to crops and livestock on land. Marine biologists, food production managers, and environmental organizations need this information to determine where and when to deploy ground-based resources to protect the fisheries that will likely occur due to already saturated soil, additional rainfall and overuse of water.

J. Niger Delta

The Niger Delta is a wetland landscape in southern Nigeria that is rich in biodiversity. The Niger Delta wetlands are one of the few remaining large wetlands in the world. The Niger Delta is a delta formed by the Niger River. The delta provides a habitat for migratory birds and is described as the most biologically diverse wetland in the world. Images captured from the Landsat 8 platform in August 2013 show the extent of the flood, which is described as the most extensive flooding event in the history of the Niger Delta. The flood affects a large portion of the delta and impacts a wide range of marine species. The flood also impacts agricultural production and infrastructure development.

K. Rockhouse Fire in Texas

In the spring and summer of 2011, following more than a decade of wet conditions, the West experienced above-normal rainfall, from hundreds of wildfires. The Rockhouse Fire burned through northern and northern Texas, in the Davis Mountains and the adjacent regions of West Texas over an almost one-month period. On June 22, 2017, an early-morning storm system traveled through central and eastern South Dakota and into southwest Minnesota, bringing severe hail and high winds to the area. The storm system produced at least 200 large hailstones, and the highest wind gusts in Minnesota. The image from the Landsat 8 satellite in April 2019 allows wildlife agencies and first responders to analyze the extent of the fire and its impact on the landscape. The collected imagery can enable prediction of low flow conditions that can cause damage to crops and livestock on land. Marine biologists, food production managers, and environmental organizations need this information to determine where and when to deploy ground-based resources to protect the fisheries that will likely occur due to already saturated soil, additional rainfall and overuse of water.

L. Lake Erie Algal Bloom

In the summer of 2017, a harmful algal bloom occurred on Lake Erie, which is a significant water body in the United States. The bloom caused significant environmental and economic impacts. The collected imagery can enable prediction of low flow conditions that can cause damage to crops and livestock on land. Marine biologists, food production managers, and environmental organizations need this information to determine where and when to deploy ground-based resources to protect the fisheries that will likely occur due to already saturated soil, additional rainfall and overuse of water.

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