Today and Tomorrow

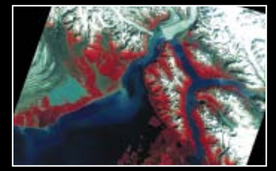
Twenty years after the launch of Landsat 1, President George Bush signed the Land Remote Sensing Policy Act of 1992, which repealed the 1984 Act and transferred oversight from NOAA and operations by EOSAT to a joint NASA and Department of Defense (DoD) Landsat Program Management. The basis for this reversal was that a broad national constituency, including state and local governments, had become dependent on Landsat observations just as they are dependent on observations from meteorological satellites and, therefore, the federal government needed to guarantee the availability of past, present, and future Landsat data.

In May 1994 President Bill Clinton signed a Presidential Decision Directive to stabilize further the Landsat Program. This directive clarified the roles of NASA and the Departments of Commerce, Interior, and Defense. In particular, it charged NASA with assuming the responsibilities previously shared with DoD and with developing a strategy to maintain the continuity of Landsat-type data beyond Landsat 7. The National Oceanic and Atmospheric Administration (NOAA) will manage Landsat 7 mission operations. The U.S. Geological Survey's Earth Resources Observation Systems (EROS) Data Center of the Department of Interior will maintain the national archive of existing and future Landsat-type remote sensing data within the United States and will make this data readily available to the federal government and other users.

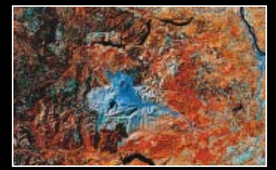
Landsat observations have become invaluable in helping us understand changes in the land surface, to cope with the challenges of nature, and to exploit the bounty of the Earth. Landsat no longer is an experiment; it now is a fundamental part of the country's infrastructure.

Landsat Data Handling Facility at the U.S.G.S., EROS Data Center, Sioux Falls, South Dakota

1990s



Hubbard Glacier, Alaska



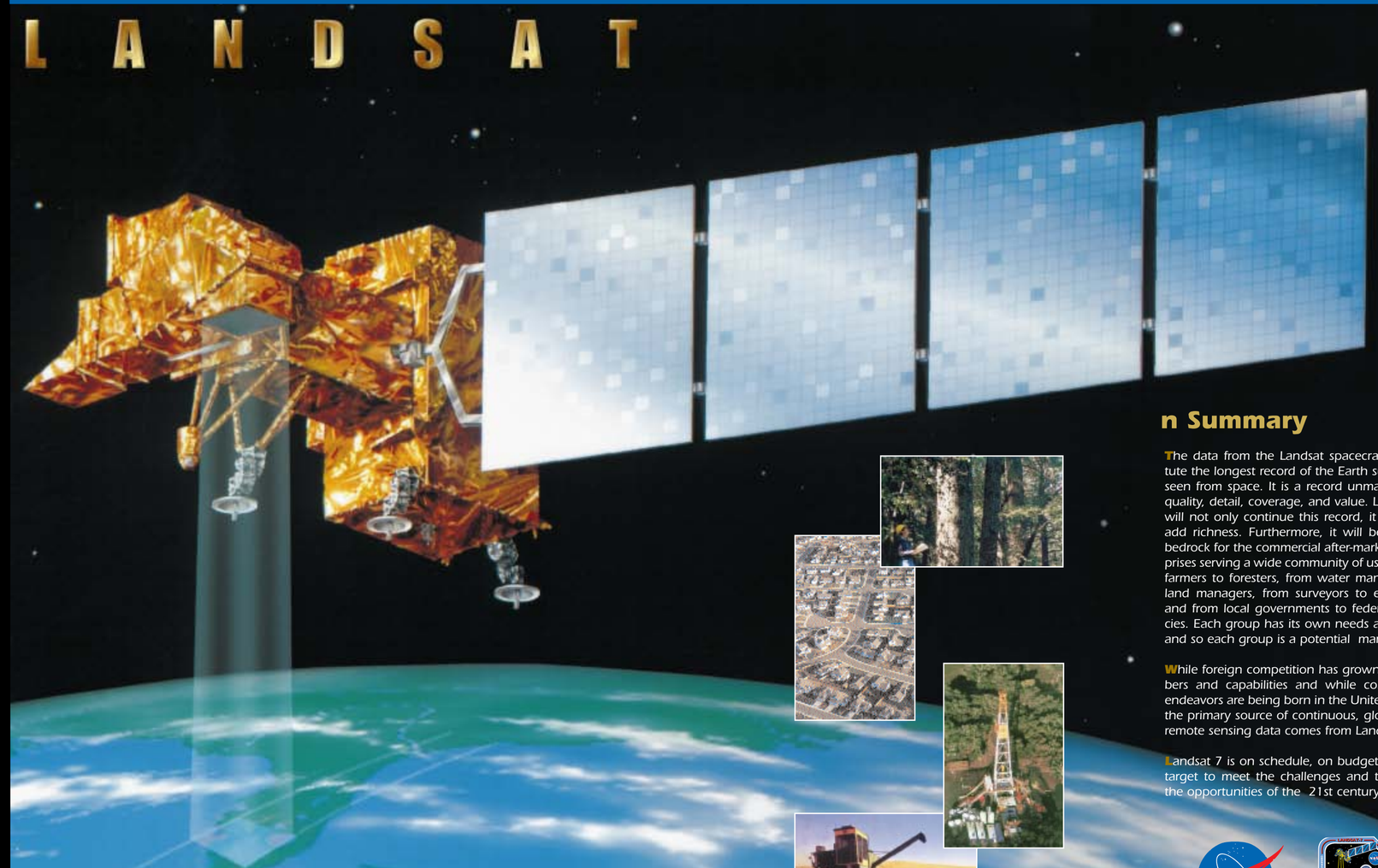
Mount St. Helens, Washington

Imperial Valley, California and Mexican Border

Gobi Desert, China

San Rafael Region, Chile

LANDSAT



Time Present, Time Past, and Now Time Future

The Landsat Mission has evolved from an experimental system in the 1970s to a required capability for the 21st Century. It has enjoyed bipartisan support and challenge. Its capabilities have been honed by political and scientific debate. Its history reflects well the leadership of the United States in space, and its future ensures our ability to explore, to characterize, to monitor, and to manage the land surfaces of the Earth.

n Summary

The data from the Landsat spacecraft constitute the longest record of the Earth surface as seen from space. It is a record unmatched in quality, detail, coverage, and value. Landsat 7 will not only continue this record, it also will add richness. Furthermore, it will be a solid bedrock for the commercial after-market enterprises serving a wide community of users: from farmers to foresters, from water managers to land managers, from surveyors to explorers, and from local governments to federal agencies. Each group has its own needs and skills, and so each group is a potential market.

While foreign competition has grown in numbers and capabilities and while commercial endeavors are being born in the United States, the primary source of continuous, global land remote sensing data comes from Landsat.

Landsat 7 is on schedule, on budget, and on target to meet the challenges and to secure the opportunities of the 21st century.

NP-1997 (09) -025-GSFC

The Beginning

Earth remote sensing from space began with the launch of the first Television Infrared Observation Satellite (TIROS 1) in 1960, which brought views of the Earth's cloud cover down to Earth. TIROS 1 was so successful that plans for an advanced, pre-operational meteorological system arose almost immediately. The first Nimbus, launched in 1964, became the test-bed platform for meteorological observations while TIROS developed into the operational system.

Following the early success of the TIROS and Nimbus series, the possibilities of an expanded basis of Earth remote sensing from space not only awakened geologists and biologists but also excited a broad community of farmers and miners, timber and water resource managers, and engineers and business leaders.

The first Landsat, Landsat 1, was launched in 1972 in response to this new sense of opportunity. Although the spacecraft was based on the Nimbus framework, its primary sensor was specifically designed for land remote sensing. This new instrument, the Multi-Spectral Scanner (MSS), proved so valuable that a version of it has been flown on each of the first five Landsat missions.

By the time Landsat 1 was retired in 1978, it had provided over 300,000 images of Earth. More importantly, the quality and value of the information exceeded all expectations. This led Dr. James Fletcher, Administrator of the National Aeronautics and Space Administration (NASA), to state in 1975 – on the eve of the launch of Landsat 2 – that if he had one space-age development to save the world, it would be Landsat and its successor satellites.

Transitions and Experimentation

With the 1982 launch of Landsat 4, the Thematic Mapper (TM) sensor was introduced. The TM was a significant improvement over the MSS, providing greater resolution in the visible and near-infrared regions (30 meters versus 80 meters) and three additional spectral bands. The Landsat 3 version of the MSS also was flown to ensure data continuity with the new sensor and to provide additional backup. The same payload was on Landsat 5, launched in 1984.

Technological innovation was not the only form of experimentation with Landsat. The 1980s also saw a fundamental shift in the country's policy toward Earth remote sensing. Intense discussion focused on the roles of the government and the private sector. One view was that all civilian Earth remote sensing – meteorological, oceanic, and land – should be done by the private sector. An opposing view was that this was a proper function of government since it was for a common good. The compromise focused on the land: With passage of the Land Remote Sensing Commercialization Act of 1984, the National Oceanic and Atmospheric Administration (NOAA) was charged with transferring the Landsat program to the private sector. The Earth Observing Satellite Company (EOSAT) was awarded a contract to operate the Landsat system for 10 years and to develop and build two new satellites, including the ground system.

As in any transition, there was much to learn. The spatial, spectral, and coverage capabilities of Landsat proved to be more consistent with a global agenda, similar to meteorological missions, than with the site-specific detail required by the private sector. The experimentation did, however, promote interest in land remote sensing and commercial opportunities. Today there is a market for a land remote sensing mission that is private-sector-based and private-sector-oriented, but this is a significantly different enterprise from Landsat – with different objectives and different products.

Landsat has opened the door for a truly private-sector, American-based business in land imaging; moreover, Landsat will continue to provide the global context and, thereby, enhance the value of the high-resolution products flowing from these emerging United States enterprises.

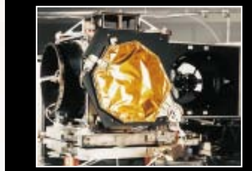
1970s

Landsat 1

Santa Lucia Mountain Range
• *Early MSS Image*

1980s

Landsat 4



ETM+ Scanner Assembly

Sandwich Bay,
New Foundland Province
• *Early TM Image*

A National Resource

The Landsat Mission is a central pillar of our national remote sensing capability. Landsat has:

- ***Established the United States as the world leader in land remote sensing***
- ***Contributed significantly to understanding of the Earth's environment***
- ***Spawned revolutionary uses of space-based data by the commercial value-added industry***
- ***Encouraged a new generation of commercial satellites that will provide site specific, very high resolution images.***

Today it is more important than ever for the United States to maintain its leadership across the many dimensions of this highly competitive international endeavor. Landsat 7 will ensure American leadership in Earth remote sensing.

For more than 25 years, the Landsat Mission has provided detailed observations about the surface of our planet. Agricultural evaluations, forest management inventories, geological surveys, water resource estimates, coastal zone appraisals, and a host of other applications have been performed with Landsat data to meet the needs of business, government, science, education, and even national security.

Nile Delta, Egypt

Flood of the Mississippi, St. Louis
(Red indicates flooded area)

Landsat images of urban growth patterns from the Nile River Delta to Phoenix, Arizona, have given information to business for investment decisions and to governments for meeting population needs both today and tomorrow. Water resource estimates based on Landsat observations from Lake Turkana, Ethiopia, to Choke Canyon Lake, Texas, form the basis for balancing the requirements of people, of industry, and of agriculture. Landsat has provided detailed assessments of both the extent and the evolution of floods in the Midwest. Monitoring changes in coastal boundaries and sea levels from the Aral Sea to the Gulf Coast of Louisiana has allowed engineers and local officials to prepare for coastal flooding from storms and surges. Landsat scenes taken during the Gulf War exposed both the positions of enemy emplacements and the horror of the oil fires.

Outflow of Mississippi River, Gulf of Mexico

Oil Wells Burning, Kuwait

This record of remarkable accomplishments continues today with Landsat 5 providing observations. When Landsat 6 failed to reach orbit in 1993, however, the thread of continuity frayed: Landsat 5 is eight years beyond its design lifetime.

Fortunately, help is on the way. Landsat 7 will be launched in 1998. It will ensure data continuity with a proven, reliable, long-lasting satellite and sensor design.

The Mission Continues

At the dawn of the 21st century, Landsat 7 will once again establish the United States as the leader in civilian Earth observations. No other observing system will match the new Landsat's combination of global data, rapid coverage, high spatial resolution, spectral range, and radiometric calibration.

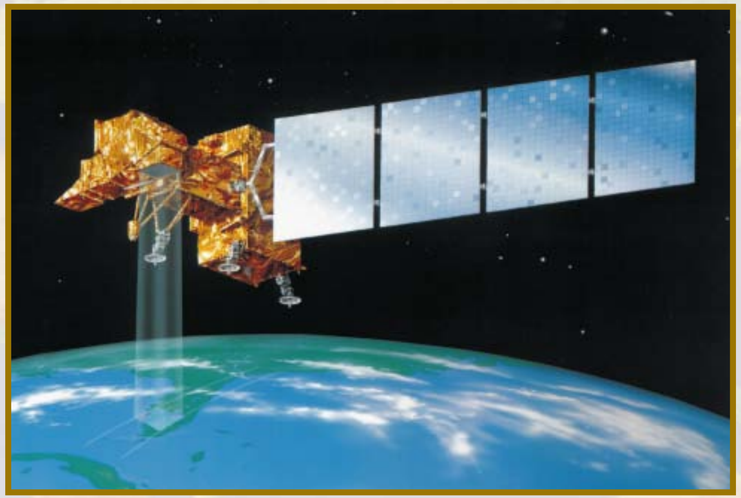
The essential role of Landsat data is well established. Initiation of a continuous, consistent, digital-image record of the continental surfaces constitutes one of the most significant technical, scientific, and cultural accomplishments of the latter 20th century.

This multi-decade record is proving to be invaluable to our understanding of how people and natural events affect the Earth. Human activity is changing the chemistry of the atmosphere, the condition and function of ecosystems, and the face of the land surface at unprecedented rates. Landsat 7 will add to the record and continue to provide the data needed by those who characterize, monitor, manage, explore, and observe the continental surfaces of the planet. As such, Landsat 7 is now an essential component of NASA's Mission to Planet Earth.

Knowing what is happening and where it is happening on the Earth's surface is critical as we enter the 21st century. The United States' return to the dominant position in Earth observation will be, in part, a result of the new Landsat payload: the Enhanced Thematic Mapper Plus (ETM+). New features on Landsat 7 include:

- Panchromatic band with 15-meter spatial resolution
- Thermal infrared channel with 60-meter resolution and both high and low gain
- On-board radiometric calibration.

The ETM+ still provides data continuity with the Thematic Mapper that flew on Landsats 4 and 5.



Landsat 7 will be a boon not only to the user community but also to the after-market data providers. The spacecraft's data and information system will be limited to applying only radiometric correction and first-order geographic registration to the digital image data. This limitation on government-produced products will open opportunities for value-added providers to furnish enhancements, interpretations, and specialty products without fear that the government would undercut their offerings. Landsat 7 will be a beacon and guide to commercial remote sensing applications in the 21st century.

No other proposed or planned satellite system will fulfill the Landsat 7 role. Although NASA's Lewis and Clark missions are intended to demonstrate the viability of smaller satellites and advanced technologies, their sensors can provide only limited geographic coverage. Commercial systems are aimed at consumers now using aerial photography for high-spatial-resolution views. They form an established and growing market suitable for commercial development. Landsat 7 will not compete with these commercial systems but will enhance them.