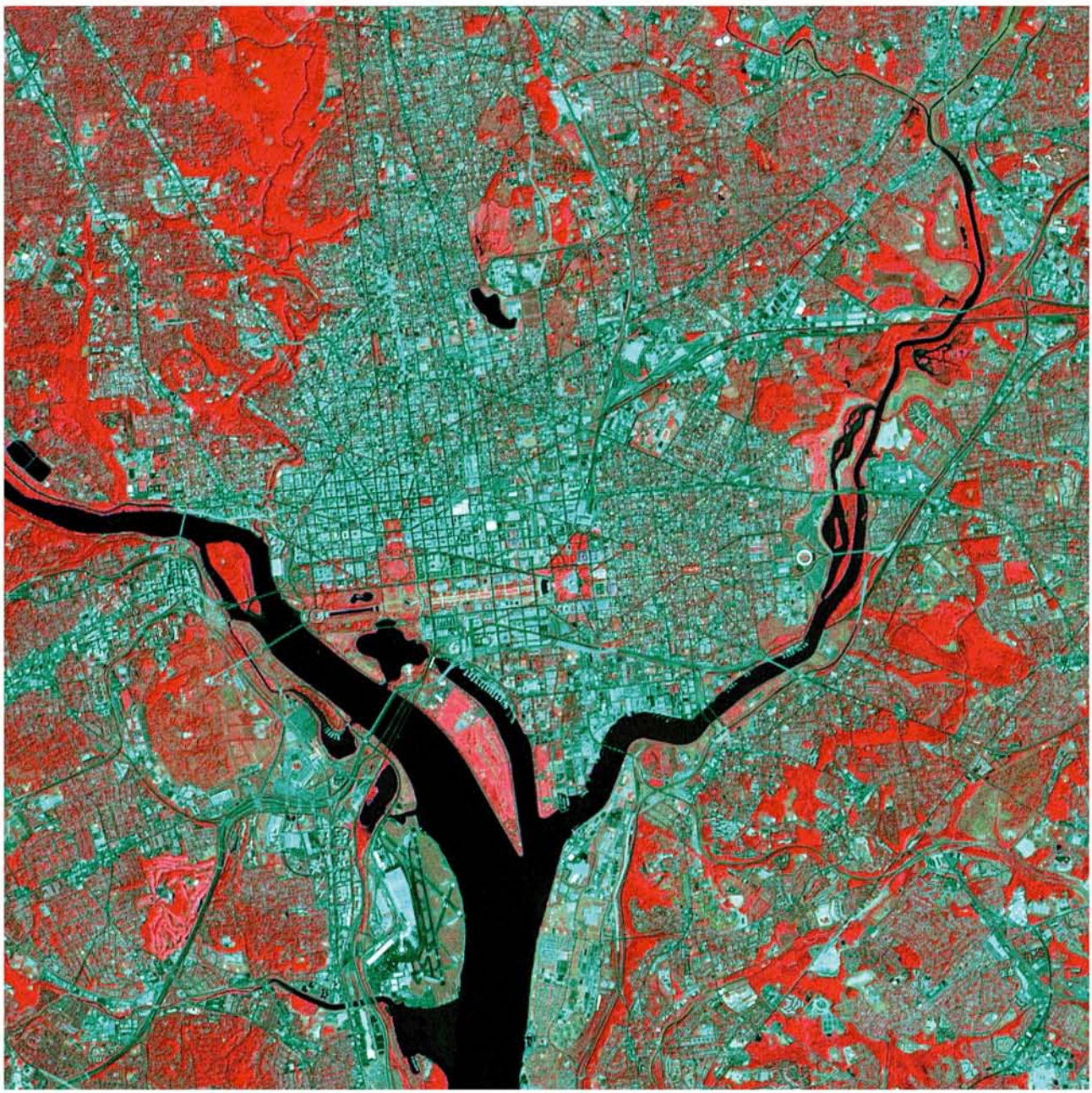
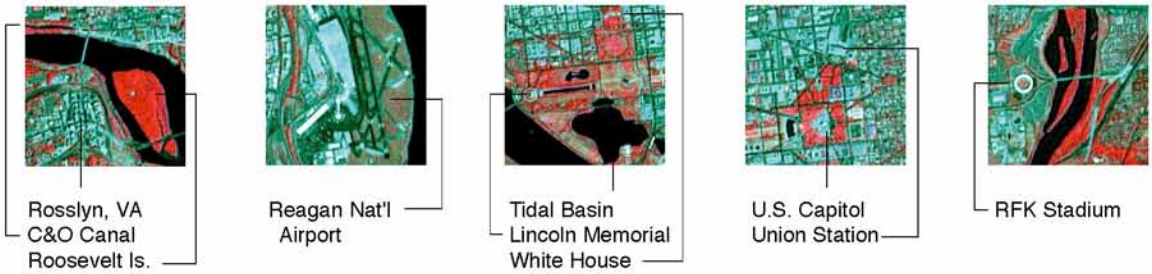
National Aeronautics and
Space Administration
Goddard Space Flight Center

LANDSAT 7

USGS
science for a changing world



Washington, DC



National Aeronautics and Space Administration
Goddard Space Flight Center

Landsat 7

USGS
science for a changing world

About this Image

This false color image of the Washington, D.C. metropolitan area was taken on the morning of May 28, 1999, from the recently launched Landsat 7 spacecraft. It is the first cloud-free Landsat 7 image of this region, acquired prior to the satellite being positioned in its operational orbit. The image was created by using ETM+ bands 4,3,2 (30m) merged with the 15-meter panchromatic band. Using this band combination trees and grass are red, developed areas are light blue/light green and water is black. Landsat images of urban and suburban areas are utilized to study and monitor population growth patterns and the extent of such growth over time.

Landsat 7 Program

Landsat 7 is part of NASA's Earth Science Enterprise (ESE) program, a long term coordinated research effort dedicated to studying how our global environment is changing. It is the latest in a series of satellites that have provided a continuous set of calibrated Earth science data to users worldwide since the early 1970s. Landsat 7 will provide images of the land surface and surrounding coastal regions to national and international users conducting global change research, regional environmental change studies, national security activities and other civil and commercial purposes. Landsat 7 was launched on April 15, 1999, from the Western Test Range/ Vandenberg, Air Force Base, Calif., on a Delta-II expendable launch vehicle. To learn more about Landsat 7 see http://landsat.gsfc.nasa.gov.

Program Objectives

Continuity of data with previous Landsat missions is a fundamental goal of the Landsat program. To accomplish this, images will be taken that are consistent in terms of data acquisition format, geometry, spatial resolution, calibration, coverage characteristics, and spectral characteristics with previous Landsat data, extending the consistent 26-year record of the Earth's continental surfaces. Landsat 7 will image large areas of the sunlit Earth daily, revisiting the same areas every 16 days to refresh a global archive. Digital copies of all images in the archive will be available to users for the cost of fulfilling the request (estimated to be $600 or less per each 115 by 106 mile (183 by 170 km) image).

Application

Landsat data are used by those who observe, monitor, characterize, study, map and manage the Earth's continental surfaces over time. Some examples of applications are: monitoring global deforestation, monitoring wildfire damage, mapping snow cover, and monitoring flood, storm, earthquake and volcanic eruption damage. In addition, Landsat has been used to monitor strip mining reclamation, population changes in and around metropolitan areas, and to assess water quality in lakes.

Spacecraft and Instrument

The Landsat 7 satellite consists of a spacecraft bus provided under a NASA contract with Lockheed Martin Missiles and Space in Valley Forge, Pa., and the Enhanced Thematic Mapper Plus (ETM+) instrument procured under a NASA contract with Raytheon (formerly Hughes) Santa Barbara Remote Sensing in Santa Barbara, California.

The ETM+ instrument acquires data in the visible, near infrared, short-wave infrared, and thermal infrared spectrums. The spatial resolution is 15 meters in the panchromatic band, 30 meters in the visible, nearinfrared, and short-wave infrared bands and 60 meters in the thermal infrared band. The instrument images the Earth in 115 mile (183 kilometer) swaths.

History

The first Landsat, originally called the Earth Resources Technology Satellite (ERTS-1), was developed and launched by NASA in July 1972. Subsequent launches occurred in January 1975 and March 1978. Meanwhile, a second generation of Landsat satellites was developed with an improved sensor, the Thematic Mapper. Landsat-4 was launched in July 1982. Landsat-5, launched in March 1984, is still providing images. As a result, there is a continuous set of Landsat images available from mid-1972 until the present. Landsat-6, a commercially managed and built spacecraft/instrument package, failed to reach orbit in October 1993.

Operations

After being launched into a Sun-synchronous polar orbit, the satellite used the on-board propulsion to adjust its orbit to a circular altitude of 438 miles (705 kilometers) crossing the equator at approximately 10 a.m. on its southward track. This orbit will place Landsat 7 along the same ground track as previous Landsat satellites and Landsat 7 will fly over the same place on the globe every 16 days. Daily commands are sent to the spacecraft defining which images to record and when to downlink data either to U.S. or international ground stations. NASA Goddard Space Flight Center currently manages these day-to-day operations. On October 1, 2000, when flight operations will be turned over to U.S. Geological Survey (USGS).

The primary U.S. ground station receiving Landsat 7 data is located at the USGS's Earth Resources Observation Systems (EROS) Data Center (EDC). Supporting stations are located in Alaska and Norway. The ETM+ data received by these three U.S.-operated stations are all processed, archived, and distributed by EDC. The ETM+ data archive held by EDC provides global coverage of the Earth's continental and coastal surfaces on a seasonal

NASA's Earth Science Enterprise

Landsat 7 is an important satellite in a series of missions that comprise NASA's global-scale examination of the Earth. This multi-faceted research program is designed to investigate the interactions of all the components - air, water, land, and plant and animal life – that comprise the Earth's system. The goal of this program, called the Earth Science Enterprise (formerly known as Mission to Planet Earth), is to improve our understanding of the Earth and develop accurate predictive computer models that can help inform decision makers about global environmental trends, allowing us to protect the planet's and humanity's future.

The Earth Science Enterprise has three main components: a series of Earth-observing satellites, an advanced data system and teams of scientists who will study the data. Key areas of study include clouds; water and energy cycles; oceans; chemistry of the atmosphere; land surface; water and ecosystem processes; glaciers and polar ice sheets; and the solid Earth.

The Earth Science Enterprise is NASA's contribution to the U.S. Global Change Research Program, a multi-agency effort to understand how our Earth changes over time. The U.S. program complements a larger international effort to study the environment, including the International BiosphereGeosphere Program and the World Climate Change Research Program.

For The Classroom

The use of satellites, such as Landsat, provides the opportunity to study the earth from above. From this unique perspective we can collect data about earth processes and changes that may be difficult or impossible to collect on the surface. For example, if you want to map forest cover, you do not need nor want to see each tree. In this activity, students will explore the idea that being closer is not necessarily better or more informative. The optimal point of observation, or perspective, depends on what you want to find out.

Objectives:

The students will be able to explain perspective, range, and resolution. They will also be able to explain how the optimal viewing zone varies with what it is they want to know.

Materials:

A large sign, photograph or poster
metric ruler or measuring tapes
chalk
magnifying glass
note pads to record discoveries

Procedure:

1. Set up a large sign, photograph or poster on in a location that allows students to view the item from a distance (20-30 m or more). You may want to have more than one poster, and/or have the students work in small groups.
2. Have the students approach the poster in one or two meter intervals, recording their observations at each interval. Instruct students to mark the distance where they could first identify the object on the poster. They should then approach the item posted until they are so close they can no longer tell what it is. Have them record that distance. Finally, have the students move right up to the item posted and observe the poster with a magnifying glass and record what they see.
3. Students then determine the two distances from the poster. These distances define the range or "window" within which their "remote sensors" (eyes) are capable of gathering the most useful information.

Discussion:

1. Engage you students in a discussion about their observations and their perceptions of what they observed. What sort of information can be gathered from far-away observations? Close-up observations? Intermediate observations? .
2. Explain that scientists gathering data by remote sensing do the same kind of exercise that your students just did. They figure out just how close or far away the camera needs to be to give them the information they want.
3. Discuss the types of data they think the Landsat 7 satellite will be able to provide to scientists.

Adapted with permission from the Aspen Global Change Institute's Ground Truth Studies Teacher Handbook - second edition

NOTE: Additional Landsat educational materials are available by on the Landsat Project website, http://landsat.gsfc.nasa.gov/main/education.html