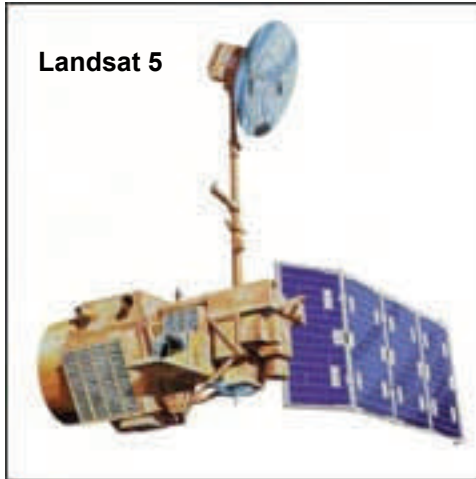




Overview of Landsat Program and Image Archive



Document Updated: August, 2009



- Both **Landsat 5** and **Landsat 7** are currently operational (as of July 2009).
- **Archived Landsat scenes** are available from 1972 to the present (including MSS).
- **Landsat Thematic Mapper** and **ETM+** 30-meter resolution imagery is available from July 1982 to the present.

Landsat Program

Landsat is the longest running spaceborne Earth imagery acquisition program. The first Landsat satellite was launched in 1972; the most recent, Landsat 7, was launched on April 15, 1999. The sensors on the Landsat satellites have acquired more than four million archived scenes, including approximately 250,000 covering the United States. Approximate scene size is 170 km north-south by 183 km east-west (106 mi by 114 mi). See appendix 1.

The Landsat Multispectral Scanner (MSS) was a sensor onboard Landsats 1 through 5 and acquired images of the Earth nearly continuously from July 1972 to October 1992. Landsat MSS image data consist of four spectral bands. The resolution for all bands is 79 meters.

The Landsat Thematic Mapper (TM), a sensor carried onboard Landsat 4 and 5, has acquired 7-band images of the Earth nearly continuously at a 30-meter resolution from July 1982 to the present, with a 16-day repeat cycle. Landsat 7's Enhanced Thematic Mapper Plus (ETM+) began imaging in July 1999, and added a 15-meter panchromatic band. On both TM and ETM+, Band 6 is a 60-meter resolution thermal band. See appendix 2.

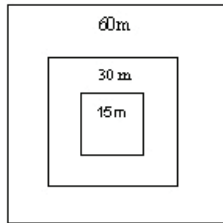
Landsat 5 was originally designed for a three-year mission, and remains in service after 25 years. Landsat 7 is still operating with a faulty scan line corrector. The next NASA land surface imaging mission is called the Landsat Data Continuity Mission and is scheduled for launch in December 2012.

Landsat Chronology

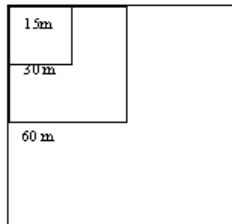
- Landsat 1 - launched July 23, 1972, terminated operations January 6, 1978.
- Landsat 2 - launched January 22, 1975, terminated January 22, 1981.
- Landsat 3 - launched March 5, 1978, terminated March 31, 1983.
- Landsat 4 - launched July 16, 1982, terminated 1993.
- Landsat 5 - launched March 1, 1984, still functioning.
- Landsat 6 - launched October 5, 1993, failed to reach orbit.
- Landsat 7 - launched April 15, 1999, still functioning, but with faulty scan line corrector (since May 31, 2003).
- The Landsat Data Continuity Mission, scheduled to be launched in 2012, will be the next satellite in the Landsat series.



What's the difference between **radiance** and **reflectance**? *Spectral reflectance refers to the reflective properties of objects on the ground. Satellites measure spectral radiance, the amount of energy reaching the sensor. The difference between the two is caused by atmospheric and other factors.*



Upper Left Coordinates of LPGS and NLAPS Products as of December 2008



Upper Left Coordinates of NLAPS Products prior to December 2008

Landsat Scene Archive

The U.S. Geological Survey has been expanding the digital geospatial data from its Earth Resources Observation and Science (EROS) Center archive that are available at no cost.

Through the [USGS Global Visualization Viewer](#) (GloVis), all of the archived Landsat 7 ETM+ images and all of the Landsat 4-5 TM and Landsat 1-5 MSS images are now available for free download as standard products. If a scene is not available for immediate download, it may be submitted for on-demand processing to a standard product— normally free of charge.

See the GloVis Tutorial and Guide for instructions on how to use GloVis to browse for available Landsat data that can be downloaded or ordered. Before acquiring Landsat imagery, you should be familiar with the data formats, the Landsat 7 "SLC-off" issue and the WRS path and rows (appendix 1).

Data Format: Level 1 Product Generation System (LPGS)

LPGS scenes represent radiance data, as opposed to reflectance (see note at left). The LPGS Level 1T terrain corrected product is standard, with few exceptions. The standard project is Universal Transverse Mercator (UTM), with Polar Stereographic used for Antarctica scenes. The output format is GeoTIFF (Geographic Tagged Image-File Format). Pixel sizes for Thematic Mapper and ETM+ bands are 30 m (bands 1,2,3,4,5 & 7), 60 m (band 6), and 15 m (Landsat 7 panchromatic band).

Data Format: National Land Archive Production System (NLAPS)

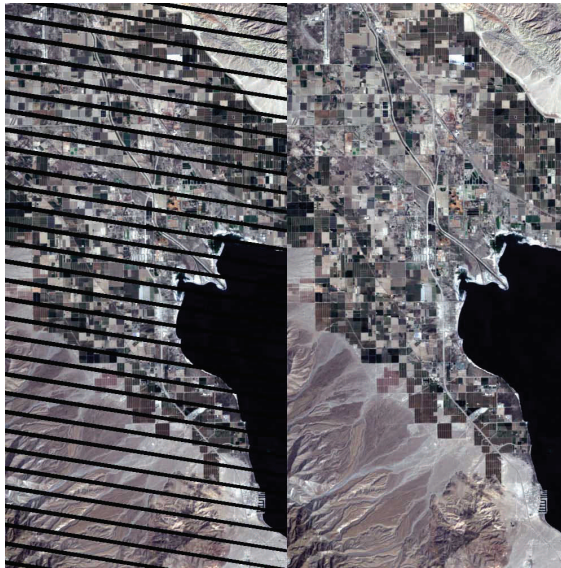
The NLAPS Data Format was used for Landsat scenes originally acquired through the [Multi-Resolution Land Characteristics Consortium](#) (MRLC). The entire MRLC Scene Library can be accessed through GloVis by selecting "Landsat MRLC" as the collection. This option is useful if you already have MRLC scenes and are looking for additional scenes to match this format.

MRLC scenes are available in a reflectance-corrected version, in addition to radiance.

Most MRLC scenes are in an Albers Conical Equal Area projection. MRLC NLAPS formatted scenes can also be obtained in LPGS format.

While the products generated by the LPGS and NLAPS systems are very similar, users should be aware that several differences exist. There are differences in geometry, radiometric scaling, and GeoTIFF format.

For more information, see the USGS [LPGS and NLAPS Processing Systems Comparison](#).



SLC-off

SLC-on

SLC-on and SLC-off

On May 31, 2003, Landsat 7 suffered a permanent failure of the scan line corrector (SLC). A component of the ETM+ sensor, the SLC compensates for the orbital motion of the satellite to produce a rectilinear scan pattern instead of the zig-zag pattern that would be produced without it.

The Landsat 7 ETM+ is still acquiring useful image data with the SLC turned off, particularly within the central part of any given scene. The Landsat 7 ETM+ therefore continues to acquire image data in the "SLC-off" mode. All Landsat 7 SLC-off data are of the same radiometric and geometric quality as data collected prior to the SLC failure.

The SLC-off effects (see example) are most pronounced along the edge of the scene and gradually diminish toward the center of the scene. The maximum width of the data gaps along the edge of the image would be equivalent to one full scan line, or approximately 390 to 450 meters. The precise location of the missing scan lines will vary from scene to scene. The middle of the scene, approximately 22 kilometers wide, contains very little data loss, and this region of each image is very similar in quality to previous ("SLC-on") Landsat 7 image data.

In the archive, Landsat 7 scenes acquired in 1999-2003 before the SLC failure are designated "SLC-on." Scenes acquired after the failure (2003-present) are "SLC-off."

- *The Landsat 7 ETM+ **scan line corrector** failed in May 2003. Images acquired by Landsat 7 since then are designated "SLC-off."*
- ***SLC-off scenes** contain black stripes that become narrow and disappear near the center of the scene.*



Appendix 1—Landsat Worldwide Reference System



Path and Row

The Worldwide Reference System (WRS) is a global notation system for Landsat. It enables a user to inquire about Landsat imagery over any portion of the world by specifying a nominal scene center designated by PATH and ROW numbers.

The Landsat 4, 5, and 7 Worldwide Reference System-2 (WRS-2) is an extension of the global Landsat 1 through 3 WRS-1.

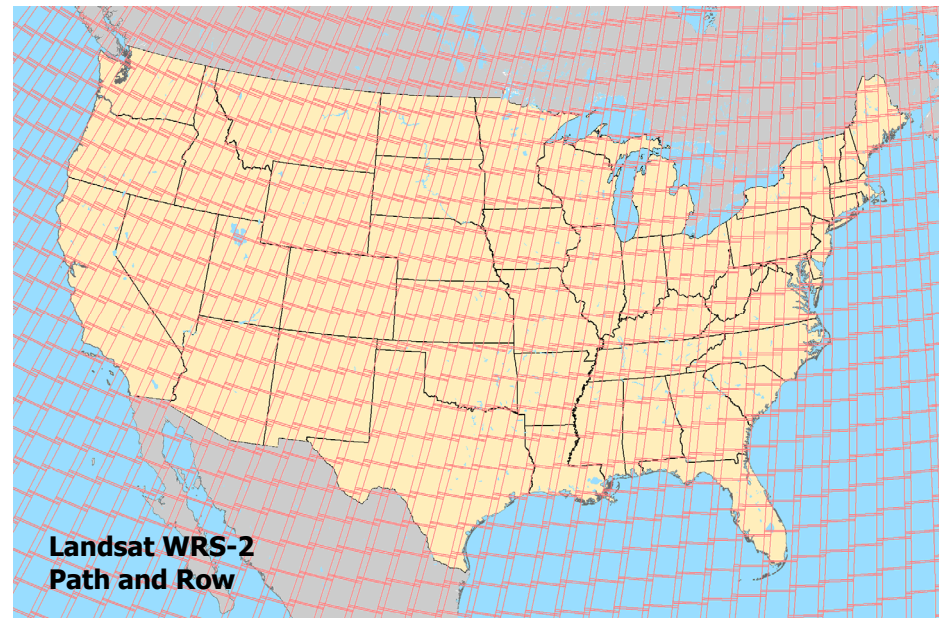
The WRS-2 system is made up of 233 paths numbered 001 to 233, east to west, with PATH 001 crossing the equator at 64.60 degrees west longitude.

At the Equator, adjacent scenes in different paths overlap at the edges by 7.3 percent. Moving from the Equator toward either pole, this overlap increases because the fixed 185 km swath width.

Landsat scenes are calculated from the equator in order to create 248 ROW intervals per complete orbit. The rows have been positioned in such a way that ROW 60 coincides with the equator during the descending (daytime) satellite overpass.

Scenes in the same path on different rows overlap by approximately ten percent.

Each Landsat satellite repeats the same pass every 16 days (the return interval).





Appendix 2—Landsat Thematic Mapper Bands



Landsat Sensors

Satellite	Sensor	Spectral Range	Bands	Pixel Res
L 1-4	MSS multi-spectral	500 – 1100 nm	1, 2, 3, 4	60 meter
L 4-5	TM multi-spectral	450 – 2350 nm	1, 2, 3, 4, 5, 7	30 meter
L 4-5	TM thermal	10,400 – 12,500 nm	6	120 meter
L 7	ETM+ multi-spectral	450 – 235 nm	1, 2, 3, 4, 5, 7	30 meter
L 7	ETM+ thermal	10,400 – 12,500 nm	6.1, 6.2	60 meter
L 7	Panchromatic	520 – 9000 nm	8	15 meter

