Landsat Technical Guide

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Overview

This guide provides users the details they need to employ imagery downloaded from the GLCF. This is not intended as a seminal instruction on this topic, but rather a first step toward practical utilization.

Landsat imagery is relatively high resolution earth observation data that is acquired through sensors on one of the NASA Landsat satellites. The satellite sensors acquire high integrity images of the planet surface in a systematic fashion. Users can take this imagery and use it to determine the health and type of vegetation, amount of built surfaces, success of agriculture, or apply it for a myriad other uses. Please visit the **Landsat program** for further introduction.

Orbit & Acquisition Characteristics

Imagery from the Landsat satellites has been acquired since 1972, with a variety of characteristics to consider. There have been six operational Landsat satellites, with three different useful sensors, all of which are available through the GLCF. **The MSS sensor** provides the oldest and lowest quality Landsat data, from 1972 – present. **The TM sensor** has improved quality and is available from 1984 – present. **The ETM+ sensor** on the Landsat 7 satellite was the best quality of all, until a mechanical anomaly occurred on the sensor in May, 2003. Landsat 7 imagery is still being collected, even with this unfortunate defect. Landsat satellites acquire imagery in a regular, tiled fashion, following the **World Reference System** (WRS1 for MSS, WRS2 for TM and ETM+). The Landsat satellites follow a repetitive, circular, sun-synchronous, near earth orbit. Please visit the **Landsat program** for further details.

Table 1: Orbit & Acquisition Characteristics

Satellite	Sensor	Swath (km)	Scene Size (km)	Altitude (km)	Revisit (days)
L 1-5	MSS	180	180 x 170	917	18
L 4-5	TM	185	170 x 183	705	18
L 7	ETM+	185	170 x 183	705	16

Radiometric Characteristics

Landsat imagery is acquired in a very precise manner, to better emphasize particular land cover aspects. Some of the parameters of this precision involve a scene's radiometry, providing distinct characteristics to components of the image scene. These measures help determine what the images are good for, from a science perspective. For example, Bands 1, 2 and 3 are used together to approximate how the real world appears. Bands 4, 5 or 7 from ETM+ are used in combination with 1, 2 or 3 to demonstrate vegetation conditions. It is sometimes necessary to convert the radiometric values from the initial at-sensor measures, to compensate for atmospheric interference. Please visit the **Landsat Program** for general details or the **Landsat 7 Science Handbook** for specific radiometric characteristics details about that sensor.

Table 2: Radiometric Characteristics

Satellite	Spectral Resolution (μm)	Band	Spatial Resolution
Landsat 1-3	**MSS**		(meters)
	Band 4: 0.50 - 0.60	Green	79
	Band 5: 0.60 – 0.70	Red	79
	Band 6: 0.70 – 0.80	Near IR	79
	Band 7: 0.80 – 1.10	Near IR	79
Landsat 4-5	**MSS**		
	Band 4: 0.50 – 0.60	Green	82
	Band 5: 0.60 – 0.70	Red	82
	Band 6: 0.70 – 0.80	Near IR	82
	Band 7: 0.80 – 1.10	Near IR	82
	TM		
	Band 1: 0.45 – 0.52	Blue	30
	Band 2: 0.52 – 0.60	Green	30
	Band 3: 0.63 – 0.69	Red	30
	Band 4: 0.76 – 0.90	Near IR	30
	Band 5: 1.55 – 1.75	Mid IR	30
	Band 6: 10.4 – 12.5	Thermal	120
	Band 7: 2.08 – 2.35	Mid IR	30
Landsat 7	**ETM+**		
	Band 1: 0.450 – 0.515	Blue	30
	Band 2: 0.525 – 0.605	Green	30
	Band 3: 0.630 – 0.690	Red	30
	Band 4: 0.760 – 0.900	Near IR	30
	Band 5: 1.550 – 1.750	Mid IR	30
	Band 6†: 10.40 – 12.5	Thermal	60
	Band 7: 2.080 – 2.35	Mid IR	30
	Band 8: 0.52 – 0.92	Pan	15

† Band 6 on Landsat 7 is divided into two bands, high and low gain.

Data Format Properties

Landsat imagery is provided to the user from the GLCF in a specific series of formats, all of which are designed for maximum coverage of users who have access to basic graphical software. Each Landsat scene is available with bands as separate files. Users download the files/bands they want. Most files are compressed using **gzip**, so that files have a ".gz" extension. The first step a user must follow after download is to 'gunzip' the file. This opens the Landsat image band in its native **GeoTIFF** file format. A GeoTIFF file can be used as a TIFF file in any graphical software, or it the user has spatial software the GeoTIFF header will provide georeference information. The georeference formats employed by the GLCF for Landsat imagery include a UTM projection and a WGS84 datum and ellipsoid. In addition to this georeference information, a Landsat image file from the GLCF will have been processed using a **resampling** technique. Finally, the Landsat image may have been **orthorectified**, especially if it is a Landsat **GeoCover** image. All these characteristics are listed in the metadata file accompanying the scene. Most of these characteristics can be converted to other format options, depending on need and software. Contact the **GLCF** or visit the **Landsat program** for further details.

Primary Links

- **Landsat 7 Science Data Users Handbook: http://ltpwww.gsfc.nasa.gov/IAS/handbook/handbook_toc.html**
- **NASA Landsat Program: http://geo.arc.nasa.gov/sge/landsat/landsat.html**

  OR

  http://landsat.gsfc.nasa.gov/
- **USGS, "Landsat: A Global Land- Observing Program," Fact Sheet 023-03, March 2003: http://erg.usgs.gov/isb/pubs/factsheets/fs02303.html#system.**
- **Landsat QuickLook: http://msl.jpl.nasa.gov/Programs/landsat.html**
- **USGS Landsat Project: http://landsat7.usgs.gov/index.php**