Landsat Collections - 2016

What are Landsat Collections?   **http://landsat.usgs.gov/landsatcollections.php**

During the summer of 2016, the USGS will make changes to manage the Landsat archive as a tiered Collection of Landsat data. A Collection will provide a stable environmental record. If significant radiometric or geometric changes are required, all data will be reprocessed and a new Collection will be released. The tiered structure clearly identifies the subset of the Landsat archive that meets radiometric and geometric criteria suitable for time series analysis and the creation of data stacks/cubes, while continuing to provide access to the entire Landsat archive.

Starting with **Collection 1**, every Landsat 4-5 (L4-5) Thematic Mapper (TM), Landsat 7 (L7) Enhanced Thematic Mapper Plus (ETM+), and Landsat 8 (L8) Operational Land Imager (OLI)/Thermal Infrared Sensor (TIRS) scene is assigned to a specific tier. There are many changes being implemented to Landsat Level-1 data products to support this effort, including new Landsat Product Identifiers, "Collection" and "Tier" designations, metadata changes, and additional supporting files included with Level-1 data products.

What are Landsat Tiers?

Landsat Tiers are the inventory structure for Landsat Collection 1 Level-1 data products and are based on data quality and level of processing. The purpose of the tier definition is to (1) support rapid and easy identification of suitable scenes for time-series pixel level analysis and (2) provide a holding zone for real-time data prior to availability of definitive calibration information.

During Collection 1 processing, each Landsat scene is assigned to a "Tier". All Landsat data are cross-calibrated (regardless of sensor) across the full collection.

Tier 1: Landsat scenes with the highest available data quality are placed into Tier 1 (T1) and are considered suitable for time-series processing analysis. Tier 1 includes Level-1 Precision Terrain (L1TP) processed data that are inter-calibrated across the different Landsat sensors. The georegistration of Tier 1 scenes will be consistent and within prescribed tolerances [≤12m radial root mean square error (RMSE)].

Tier 2: Landsat scenes not meeting Tier 1 criteria during processing are assigned to Tier 2 (T2). This includes Systematic Terrain (L1GT) and Systematic (L1GS) processed scenes, as well any L1TP scenes that do not meet the Tier 1 specifications due to significant cloud cover, insufficient ground control, and other factors. Users interested in Tier 2 scenes can analyze the RMSE and other properties to determine the suitability for use in individual applications and studies.

Real-Time (Temporary designation): Newly acquired L7 and L8 data require a period of evaluation and calibration adjustment after acquisition, but are processed immediately based on preliminary calibration coefficients, assigned to the temporary Real-Time (RT) Tier, and made available for download. When definitive calibration information becomes available, RT scenes are reprocessed and assigned to the appropriate Tier 1 or Tier 2 category. The details about the follow-on processing for both L7 and L8 are described below. After the follow-on processing is complete, the data are moved from RT to Tier 1 or Tier 2, and the Landsat Product Identifier is updated to reflect the correct tier.

- L8 TIRS data may not meet specifications for co-registration with OLI. TIRS line-of-sight model parameters are refined based on data acquired during biweekly calibration maneuvers and scenes are updated within a few weeks of acquisition.
- L7 ETM+ data use predicted ephemeris and initial bumper mode parameters during initial processing. During a short period of instrument trending/characterization (about 1 week), calibration parameter adjustments finalize the geometric correction model, the data are reprocessed.

The Tier designation is visible at the end of the Landsat Product Identifier, as shown in the examples below:

Tier 1:   LE07_L1TP_016039_20040918_20160211_01_**T1**
Tier 2:   LT04_L1GS_017036_19821115_20160315_01_**T2**
Real-Time: LE07_L1GT_037035_20160314_20160314_01_**RT**

What changes will be made to Landsat data products?

Changes to processing level designations, a new Landsat Product Identifier, new files and new metadata fields are also being implemented and delivered with the Level -1 data products. Details about these changes were introduced on http://landsat.usgs.gov/about_LU_Vol_10_Issue_1.php.

Processing Level Designation Changes

The processing level designations will be changing in Collection 1 Level-1 data products. The table below displays the levels currently used compared to those being implemented for Collection 1 data products.

Landsat Archive – Pre-Collection	Landsat Collection 1
L1T (Precision terrain) systematically, radiometrically, geometrically, and topographically corrected; highest quality	**L1TP** (Precision terrain) systematically, radiometrically, geometrically, and topographically corrected using ground control points; highest quality; scenes suitable for time-series pixel level analysis
L1GT (Systematic terrain) systematically, radiometrically, geometrically and topographically corrected using digital elevation model (DEM) source data	**L1GT** (Systematic terrain) systematically, radiometrically, geometrically and topographically corrected using digital elevation model (DEM) source data
L1G (Systematic) systematically, radiometrically, geometrically corrected; no topographical correction applied	**L1GS** (Systematic) systematically, radiometrically, geometrically corrected; no topographical correction applied

New Landsat Processing Identifiers

Along with information inherited from the Scene ID, the new Landsat Product Identifier also includes the updated processing levels, processing date, collection number, and collection category (noted in red in the graphic below).

Scene ID	Landsat Product Identifier
LXSPPPRRYYYYDDDGSIVV	**LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX**
L = Landsat X = Sensor S = Satellite PPP = WRS path RRR = WRS row YYYY = Year DDD = Julian day of year GSI = Ground station identifier VV = Archive version number	L = Landsat X = Sensor ("C" = OLI/TIRS Combined, "O"= OLI-only, "T" = TIRS-only, "E" = ETM+, "T" = TM, "M"= MSS) SS = Satellite ("07" = Landsat 7, "08" = Landsat 8) LLLL = Processing correction level ("L1TP": Precision Terrain, "L1GT": Systematic Terrain, "L1GS": Systematic) PPP = WRS path RRR = WRS row YYYYMMDD = Acquisition year (YYYY) / Month (MM) / Day (DD) yyyymmdd = Processing year (yyyy) / Month (mm) / Day (dd) CC = Collection number ("01","02") TX = Collection category: ("RT" for Real-Time, "T1" for Tier 1 , or "T2" for Tier 2)
Examples: LC80290302015343LGN00 LE70160392004262EDC02 LT40170361982320XXX08 LM10170391976031AAA01	**Examples:** LC08_L1GT_029030_20151209_20160131_01_RT LE07_L1TP_016039_20040918_20160211_01_T1 LT04_L1GS_017036_19821115_20160315_01_T2 LM01_L1GS_017039_19760131_20160225_01_T2

Along with the new Landsat Product Identifier, new files and additions to metadata are also being implemented and delivered with the Level -1 data products:

New Files included in Level-1 data products*
- Quality Assessment (QA) bands (NEW to Landsat 4-5 TM and Landsat 7 ETM+; UPDATED for Landsat 8 OLI/TIRS) (http://landsat.usgs.gov/collectionqualityband.php)
- Angle Coefficient Files (Landsat 4-5 TM, Landsat 7 ETM+, and Landsat 8 OLI/TIRS) (http://landsat.usgs.gov/solar_illumination.php)

Additional Metadata (MTL.txt) fields
- Saturation bits field identifies which bands contain saturated pixels (Landsat 4-5 TM, Landsat 7 ETM+, Landsat 8 OLI/TIRS)
- Land cloud cover assessment estimates the percent of the land in a scene that is covered by clouds (Landsat 4-7)

New Cloud Cover Algorithm
- The C Function of Mask (CFMask) algorithm will used to populate fill, cloud, cloud confidence, cloud shadow, and snow/ice in Landsat 4-5, Landsat 7, and Landsat 8 scenes, and will be populated in the Quality Assessment (QA) band.

*These files will increase the size of the Level-1 product (sizes listed below indicate compressed and uncompressed):
Landsat 7 ETM+   Pre-Collection: 225 MB / 650 MB   Collection 1:   235 MB / 785 MB
Landsat 4-5 TM   Pre-Collection: 140 MB / 380 MB   Collection 1:   150 MB / 500 MB

Landsat 8 file size comparisons will be published after data becomes available later in 2016.

How are the LandsatLook Images changing?

The file names of full-resolution LandsatLook Images will be changing to match the new Collection 1 Product ID naming convention. Landsat 4-5 and Landsat 7 LandsatLook Images will also include the new Quality Images.

How will Landsat Higher-Level data products (Surface Reflectance) be changing?

After Collection 1 Level-1 data product implementation, plans will be finalized for Higher-Level Science data products (such as Surface Reflectance), with the details posted on the Higher Level Science Data Products web page: http://landsat.usgs.gov/CDR_ECV.php.

When will Landsat Collection 1 Level-1 data become available?

Starting July 2016, reprocessing will begin for L4-5 TM and L7 ETM+ scenes. Data will start becoming available early August 2016.

In October 2016, reprocessing will begin for L8 OLI/TIRS scenes. Data will start becoming available November 2016.

Landsat 1-5 Multispectral Scanner (MSS) data will be considered after the TM, ETM+ and OLI/TIRS reprocessing efforts have completed.

The reprocessing of each data set will start with the most recently acquired data and move backwards into the archive, and process the conterminous United States first, followed by international areas.

When reprocessing begins, newly acquired Landsat 8 and Landsat 7 scenes will be processed into the Pre-Collection data sets, as well as the new Collection 1 data sets – using the parameters established for each.

Pre-Collection data sets will be retained for 6 months after each data set is completely reprocessed into Collection 1. Announcements will be made to alert users when the data set has completed Collection 1 processing, and when we plan to remove the Pre-Collection data sets.

How will I access Collection 1 Level-1 Data Products?

Initially, Collection 1 Level-1 data products will be available only on EarthExplorer (EE) (http://earthexplorer.usgs.gov). (Changes to GloVis (http://glovis.usgs.gov) and the LandsatLook Viewer (http://landsatlook.usgs.gov) are planned.)

The EE Data Set tab will clearly display Collection 1 and Pre-Collection data sets, as shown in the graphic below. Changes include consolidating the Pre-Collection data sets below for Collection 1:

L8 OLI/TIRS and L8 OLI/TIRS Pre-WRS-2 = **L8 OLI/TIRS**
L7 ETM+ SLC-off and L7 ETM+ SLC-on = **L7 ETM+**
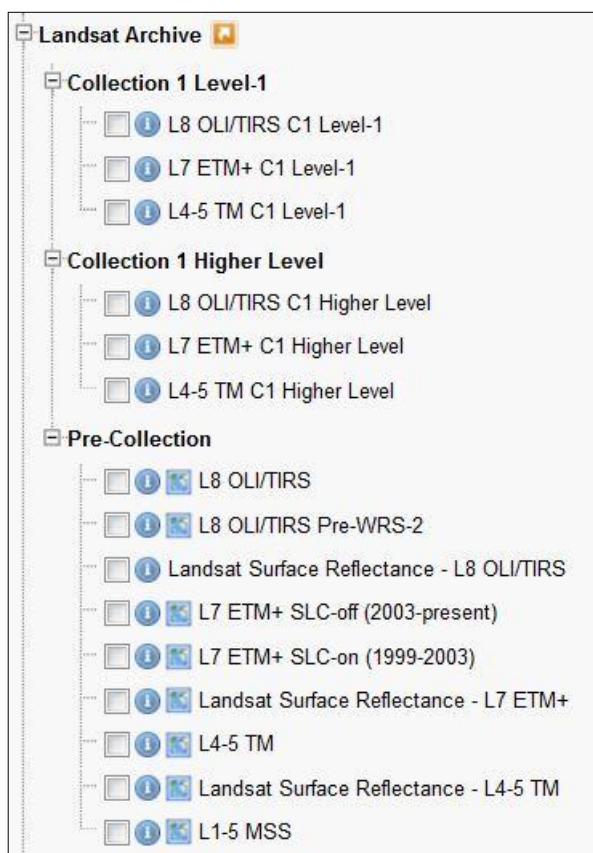
Also, the Additional Criteria tab for each Collection 1 data set allows users to select parameters for each Landsat sensor (i.e., Landsat 7 SLC-on/SLC-off, T1/T2/RT, or RMSE range).

Are samples of Landsat Collection 1 Level 1 data products available?

Landsat 7 and Landsat 5 Collection 1 Level-1 samples are available for download from the Landsat Collections Web page: http://landsat.usgs.gov/landsatcollections.php. This page also provides more details about everything noted in this document, and is updated as soon as new information becomes available.

Where can I send questions about Landsat Collections?

Questions about Landsat Collections can be sent to custserv@usgs.gov.