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Landsat Level-1 Product Collections and Implementation - Plans for 2016

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The USGS is implementing a collection management scheme for Landsat Level-1 products. The intention is to provide a quality-controlled selection of radiometrically calibrated and consistently geolocated data; particular geodetic accuracy and error tolerances are specified to align pixels for time series analysis through the full Landsat record.
A number of changes are being made to support this effort: incorporating new Landsat product identifiers, a tiered structure for the Landsat product inventory, and numerous improvements to product content and metadata attributes. This poster highlights the changes in support of the Landsat Collections effort.

Data Collection Tier Structure

All Landsat data will be reprocessed to establish Collection 1. Landsat 7 Enhanced Thematic Mapper Plus (ETM+) and Landsat 4-5 Thematic Mapper (TM) data will be reprocessed first, followed by Landsat 8 Operational Land Imager (OLI)/Thermal Infrared Sensor (TIRS) data. Landsat 1-5 Multispectral Scanner (MSS) data will be reprocessed last. Collection 1 will be organized by a tiered inventory structure, described here.

Tier 1 (Highest available quality and processing level)

- Inter- calibration of Landsat sensor observations enables Level-1 product comparability.
- Scenes processed to Level-1T (L1T) within prescribed geodetic accuracy, <11.9 meters radial root mean square error (RMSEr), allow for the construction of "data cubes."
- Radiometric calibration accuracy and stability support time-series analysis of measurements.
- Product ID will contain the "T1" designation.

Tier 2 (Do not meet Tier 1 geometric quality criteria)

- Scenes with significant clouds and insufficient ground control to generate precision and terrain corrected products do not meet Tier 1 criteria.
- Landsat 8 OLI Level-1G (L1G) scenes have no ground control available to verify that they meet Tier 1 requirements.
- Landsat 7 ETM+ L1G scenes do not meet Tier 1 geodetic accuracy requirements.
- Landsat 4-5 TM scenes that contain incomplete payload correction data (PCD) or missing parameters in the original archive data and are processed to Level-1S (L1S).
- Landsat 1-5 MSS scenes do not meet Tier 1 geodetic accuracy requirements.
- Product ID will contain the "T2" designation.

Real Time (Temporary designation)

- Landsat 7 ETM+ scenes require a short period of instrument trending/characterization after acquisition. This time is needed to adjust calibration parameter files, and finalize the geometric correction model (about 1 week).
  - Initially processed in "near-real time" using predicted ephemeris and initial bumper mode parameters and made available for download.
    - Product ID will contain the "RT" designation.
  - After geometric processing parameters (e.g., definitive ephemeris, bumper mode parameters) are finalized, scenes are reprocessed and moved to Tier 1 or Tier 2.
  - Based on the RMSEr determined from the post-fit verification of the geometric model.
- Landsat 8 TIRS data are processed in near-real time with initial line of sight model parameters that are routinely updated within a few weeks of acquisition.
  - OLI and TIRS data are routinely processed in near-real time, however, TIRS data may not meet specifications for co-registration with OLI.
  - TIRS line of sight model parameters will be refined based on the data acquired during biweekly calibration maneuvers.

Collection 1 Reprocessing Timeline

The reprocessing effort will begin with the most recently-acquired data and will move backwards into the archive. The conterminous United States will be processed first, then reprocessing will begin for international areas.

Planned Reprocessing Start Dates

Landsat 4-5 TM and Landsat 7 ETM+	June 2016
Landsat 8 OLI/TIRS	October 2016
Landsat 1-5 MSS	2017

New Landsat Product Identifier

A new Landsat product ID will better identify in which collection a scene is contained, and will be used to identify Level-1 data products, replacing the current scene ID in the EarthExplorer (EE) search results.

LXSS_LLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_TX

L =	Landsat (constant)
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)
LLL =	Processing Correction level ("L1T" = precision and terrain, "L1G" = systematic terrain, "L1S" = 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" = real-time, "T1" = Tier 1 , or "T2" = Tier 2)

The current scene ID will remain in the EE visible metadata, as well as in the metadata file (MTL.txt) for reference.

Additional Data Changes Applied During Reprocessing

Along with the new product ID, 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 product

- Quality Assessment (QA) bands (NEW to Landsat 4-5 TM and Landsat 7 ETM+; UPDATED for Landsat 8 OLI/TIRS)
- Sun Angle Coefficient Files (Landsat 4-5 TM, Landsat 7 ETM+, and Landsat 8 OLI/TIRS)

Metadata File Additions

- Saturation bits parameter (Landsat 4-5 TM, Landsat 7 ETM+, Landsat 8 OLI/TIRS)
- Land-based cloud cover score (Landsat 1-7)
- TIRS Scene Select Model (Landsat 8 TIRS)

Changes to EarthExplorer Data Portal

The following changes will be made to EarthExplorer (EE) - *http://earthexplorer.usgs.gov*

Dataset Name Changes

- Landsat 8 OLI/TIRS and Landsat 8 OLI/TIRS Pre-WRS-2 will combine to become **L8 OLI/TIRS**
- Landsat 7 ETM+ SLC-on and the Landsat 7 ETM+ SLC-off will combine to become **L7 ETM+**

Dataset Structure Management

As Landsat scenes within each dataset are reprocessed and placed into Collection 1 datasets with the new Product ID, the scenes will remain in the Collection 0 datasets for 6 months after each dataset has completed reprocessing.

Changes will also be made to EE's Additional Criteria tab to support the dataset name changes.
[Future changes will be considered for the USGS Global Visualization Viewer (GloVis) and the LandsatLook Viewer]

Supporting Information Sources **Landsat Collections Web page** http://landsat.usgs.gov/landsatcollections.php **Landsat Missions Web site** *http://landsat.usgs.gov*