

Landsat Update

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Landsat Collection 1 Reprocessing Starting Soon

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.

In this article, we highlight the top-level changes that are required to implement **Collection 1** this year. More details about these changes are available on the Landsat Collections Web page: <http://landsat.usgs.gov/landsatcollections.php>.

Data Reprocessing Schedule

In order to apply the changes required for Collection 1, it is necessary to reprocess the existing data held in the Landsat archive and create Collection 1 Level-1 data products.

Starting July 2016, reprocessing will begin for Landsat 4-5 (L4-5) Thematic Mapper (TM) and Landsat 7 (L7) Enhanced Thematic Mapper Plus (ETM+) scenes. Data will start becoming available early August 2016. Current estimates indicate that it will take about 9 months to reprocess the L4-5 TM and L7 ETM+ data in the USGS archive.

In October 2016, reprocessing will begin for Landsat 8 (L8) Operational Land Imager (OLI)/Thermal Infrared Sensor (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 are 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.

Data Changes

The following actions are required to implement Collection 1. (Please refer to the Landsat Collections Web page for more information: <http://landsat.usgs.gov/landsatcollections.php>.)

- 1) Place Landsat scenes into specific "Tiers," according to defined geometric accuracy specifications
 - Tier 1 (T1): highest processing level; suitable for time-series processing analysis; ≤ 12 m root mean square error (RMSE)
 - Tier 2 (T2): scenes not meeting criteria for Tier 1 (Users can analyze the RMSE and other properties to determine the suitability for use in individual applications and studies).
 - Real Time (RT): Temporary designation for new L7 and L8 acquisitions
- 2) Incorporate new Landsat Collection 1 processing correction level designations
 - Precision terrain (L1T) will become L1TP
 - Systematic terrain (L1Gt) remains L1GT
 - Systematic (L1G) will become L1GS
- 3) Create a Collection 1 Landsat Product Identifier to replace existing Scene ID
 - Add the following items into the Landsat Product Identifier:
 - Processing correction level
 - Processing date
 - Collection number
 - Collection category (Tier number)
- 4) Implement a single cloud cover algorithm
 - The C Function of Mask (CFMask) populates fill, cloud, cloud confidence, cloud shadow, and snow/ice
- 5) Add new supporting files to Level-1 data product
 - Quality Assessment (QA) band for L4-5 and L7 scenes (updated for L8)
 - Angle Coefficient files (L4-8)
- 6) Add new fields to the Metadata file (MTL.txt)
 - Saturation bits parameter (L4-8)
 - Land-based cloud cover score (L4-7)
- 7) Rename existing ancillary files to correspond with Collection 1 Landsat Product Identifier
 - Calibration Parameter Files (CPF)
 - CPFs supporting each sensor's Pre-Collection and Collection 1 data sets will be available

Data Access

Initially, Collection 1 Level-1 data products will be available only on EarthExplorer:

<http://earthexplorer.usgs.gov>.

- The EarthExplorer Data Sets tab will clearly display Collection 1 and Pre-Collection data sets within the Landsat Archive menu
- 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+**

On EarthExplorer, the Pre-Collection data sets will be retained for 6 months after each data set has completed reprocessing to Collection 1. Newly acquired L7 and L8 data will be processed and placed into both the Pre-Collection and Collection 1 data sets for continuity until the reprocessing campaigns for each data set have been completed.

Changes to USGS Global Visualization Viewer (<http://glovis.usgs.gov/>) and the LandsatLook Viewer (<http://landsatlook.usgs.gov/>) are planned.

Sample Data Products

TM and ETM+ Collection 1 Level-1 data product samples are available from the Landsat Collections Web page: <http://landsat.usgs.gov/landsatcollections.php>. Users are encouraged to download and analyze the data, and contact us with any questions (custserv@usgs.gov).

Landsat 8 Surface Reflectance Algorithm Changes

Users may be aware of the artifacts contained the current provisional Landsat 8 Surface Reflectance (L8SR) data products. After extensive research and redevelopment, a new version of the algorithm is ready for release, and it will improve L8 Surface Reflectance data products.

On July 1, 2016, L8SR will be renamed "Land Surface Reflectance Code" (LaSRC) and the following updates will be implemented:

1. The "blockiness" or image artifacts resulted from inputs to the aerosol retrieval which remained at the global climate model grid (course) resolution instead of being interpolated to the Landsat pixel (30m) resolution. These updates will eliminate the blockiness issue. A second level of blockiness occurred over areas where aerosol retrieval was not successful. The interpolation of those aerosols resulted in blocks of the same aerosol value. The implementation of a better aerosol interpolation method fixed this problem.
2. This new version of LaSRC attempts to retrieve aerosols over all pixels, except cirrus pixels. The retrievals are then tested based first on the model residual and then on the NDVI combined with Band 5 reflectance. If these tests fail, then the pixel is marked as failed for aerosol retrieval. Any pixel failing retrieval is ultimately attempted to be interpolated. Water pixels (flagged if the NDVI < 0.01), cloud pixels, and cirrus pixels are not interpolated. The final reflectance corrections are applied using both the retrieved and interpolated aerosols.
3. Aerosols were not being retrieved over coastal waters, causing significant blockiness along the coastal areas. This problem led us to implement a land/water mask to better identify coastal waters. Given that LaSRC will now attempt to retrieve aerosol over all pixels, the higher resolution land/water mask has been removed.
4. While interpolation solves the data continuity issues, it introduces additional uncertainty to the reflectance values in areas where aerosols were interpolated. Therefore, an additional Quality Assessment (QA) band (unsigned 8-bit integer) with flags is being added to indicate where aerosol measurements were successful, failed (likely water or clouds), or interpolated.

Users are encouraged to analyze the newly processed data products and contact us with any questions (custserv@usgs.gov).

The Landsat Surface Reflectance High Level Data Products Web page also contains details and documentation about LaSRC: http://landsat.usgs.gov//CDR_LSR.php.

Upcoming Meetings

Esri User Conference June 27-July 1, 2016 - San Diego, California

2016 Summer Landsat Science Team Meeting July 26-28, 2016 - SDSU, Brookings, South Dakota

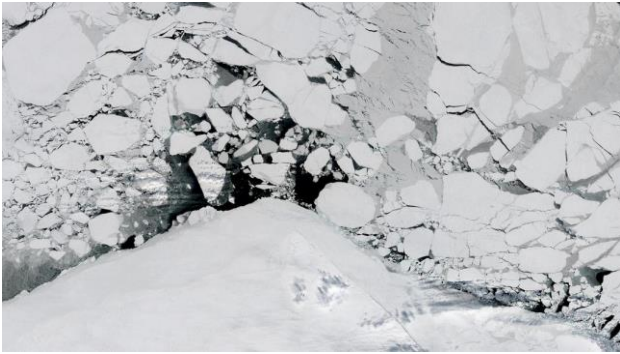
Geological Society of America (GSA) September 25-28, 2016 - Denver, Colorado

American Geophysical Union (AGU) December 12-16, 2016 - San Francisco, California

Association of American Geographers (AAG) April 5-9, 2017 - Boston, Massachusetts

Landsat Image of Interest

Beaufort Sea Ice Experiences Unusually Early Breakup



April 13, 2015



April 15, 2016

Ice covering Beaufort Sea near the Arctic Ocean typically reaches full-blown breakup by late May each year as air and water temperatures warm, and as daylight turns longer. But 2016 has been dramatically different.

This year, significant breakup and fracturing of the sea ice had occurred by mid-April, as seen in these Landsat 8 images acquired almost exactly a year apart. On April 13, 2015, the ice is largely intact, though fracturing has begun. A year later, on April 15, 2016, much more open water is visible.

Ice specialists with NASA say this year's breakup is attributable to unusually warm air temperatures during the first months of the year, and to strong winds caused by a stalled high-pressure system over the area. The same warmth that fueled the massive Fort McMurray wildfire in northern Alberta earlier in May is part of the weather pattern affecting the Beaufort Sea.

Though the region was once covered by thicker, multi-year ice, it now has largely seasonal, first-year ice that is thinner, weaker, and more easily broken up by strong winds. While the early breakup hints to the possibility that 2016 could ultimately witness the lowest sea ice extent in the history of satellite recording, that, of course, will depend on the weather conditions in the coming months. Future Landsat acquisitions will help scientists monitor the area and visualize changes.

This and other interesting images can be viewed and downloaded from the [Land Remote Sensing Program Image Collections Web page](http://remotesensing.usgs.gov/gallery/): <http://remotesensing.usgs.gov/gallery/>.