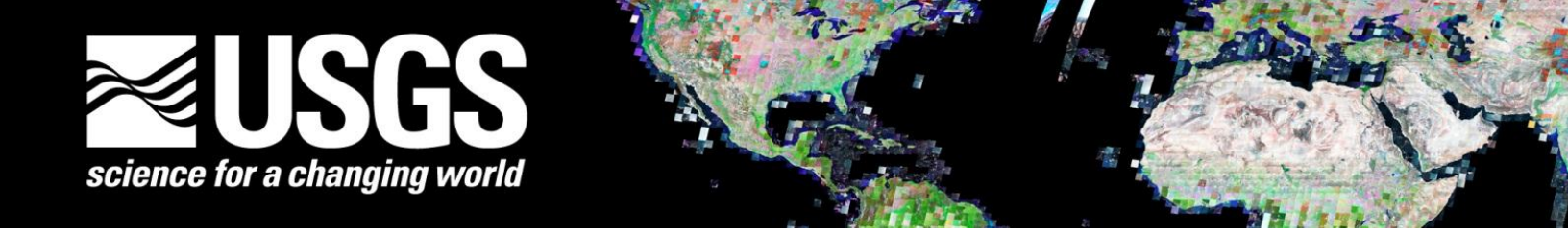

Landsat Update

Volume 7 Issue 4, 2013

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Note: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Landsat Mission News

Landsat 8 Pre-WRS2 Data Available

Nearly 10,000 Landsat 8 scenes collected by the Operational Land Imager (OLI) and/or Thermal Infrared Sensor (TIRS) sensors during the commissioning period after launch (February 11, 2013 through April 11, 2013), when the satellite achieved operational orbit on World Reference System-2 (WRS-2) are now available for download from EarthExplorer (http://earthexplorer.usgs.gov) and GloVis (http://glovis.usgs.gov).

Since these data were acquired before the mission achieved the final orbital altitude and position in the WRS-2 orbit, they should not be considered nominal. While these data meet the quality standards and have the same geometric precision as data acquired on April 12, 2013 and beyond, the geographic extents of each scene will differ from the normal WRS-2 footprints. Most data will be processed to an L1T (as other standard products), and the pixel size is 30 meters.

During the on-orbit commissioning period the calibration team performed calibration updates for the data and a reprocessing of the archive took place, but further calibrations of the pre-WRS-2 data will not be a priority for this period. There are also slight differences (up to +/- 1 percent of the radiance) in the early TIRS images due to intentional telescope temperature changes. These radiance differences increase or decrease the discrepancies described in the TIRS section below depending on the temperature of the telescope.

Data acquired during the Landsat 7/Landsat 8 Underfly on March 29 - 30, 2013, are also available to download. This information can also be found on http://landsat.usgs.gov/LDCM_DataProduct.php.

Landsat 8 Data Products - What have we learned?

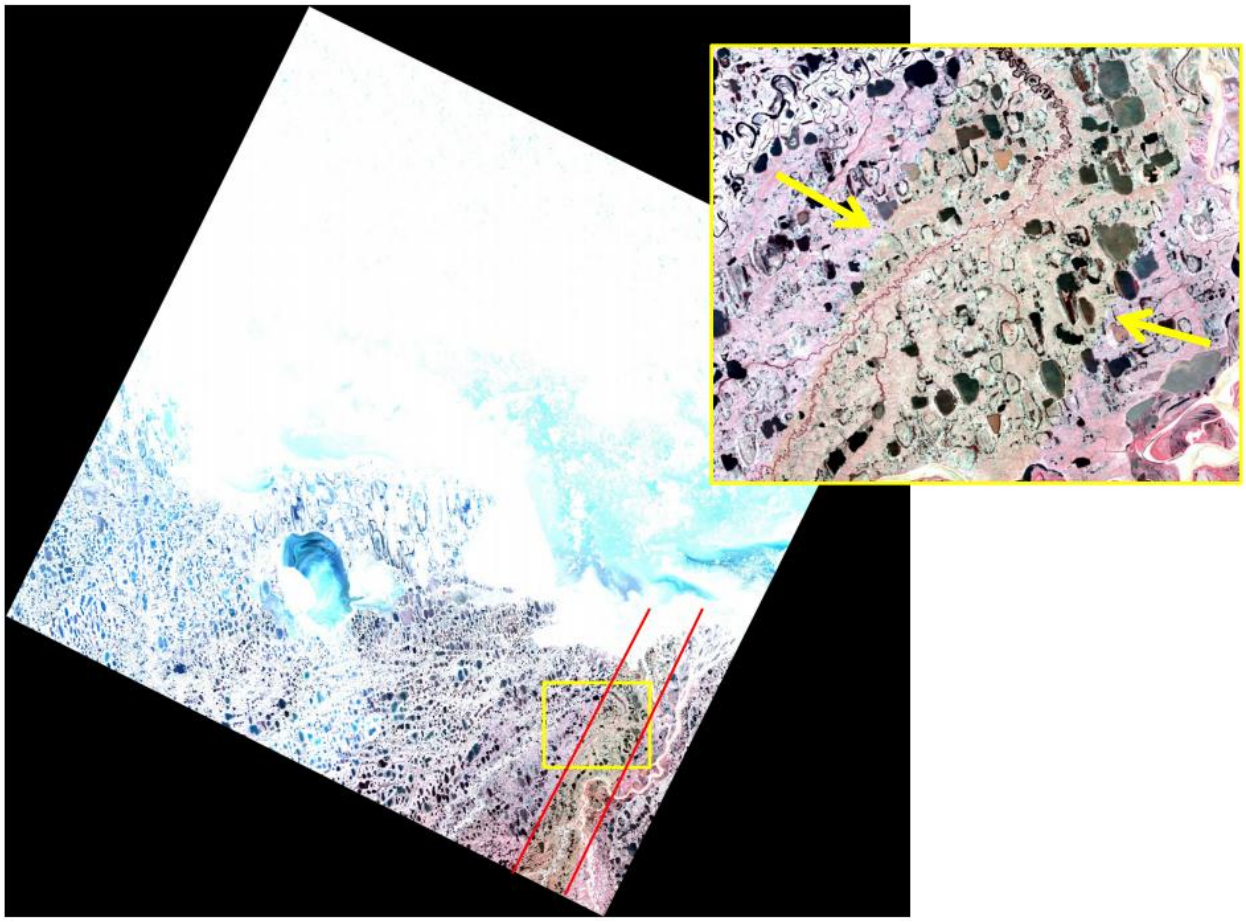
Data products from Landsat 8's OLI and TIRS have proven to be highly accurate and are a great addition to the Landsat archive.

A few things to keep in mind about Landsat 8 data products and related systems:

1) Landsat Level 1 data products are available to download within 24 hours of acquisition.

2) There are days which Landsat 8 data were not collected due to testing of either the OLI or TIRS instruments. A list of days is available on the Landsat Acquisitions page: http://landsat.usgs.gov/tools_acq.php.

3) Characterization and calibration of Landsat 8's OLI instrument data are still ongoing, and there are residual image artifacts evident in some scenes, such as radiometric discontinuities between the different sensor chip assemblies. This example displays the artifacts:



4) Landsat 8 acquisitions are not displayed on EarthNow! Viewer. A new interface will be introduced in the near future that will display previously acquired Landsat 8 images.

5) The Landsat 8 Data Users Handbook will be made available in the near future. This will be a great source of technical documentation about the Landsat 8 mission.

6) Keep in mind that the LandsatLook files (http://landsat.usgs.gov/LandsatLookImages.php) can be very useful, when the full 16-bit science data are not needed. The .jpg files are very easy to download and use in applications.

Landsat 8 Distribution Statistics

Since becoming publically available on May 30, 2013, over 106,000 Landsat 8 Level 1 data products have been downloaded by users around the world. In addition, over **63,000** full-resolution LandsatLook files of Landsat 8 scenes have also been downloaded!

Landsat 5 Decommissioning Complete

For over 29 years, Landsat 5 observed our changing planet. It has recorded the impact of natural hazards, climate variability and change, land use practices, development and urbanization, ecosystem evolution, increasing demand for water and energy resources, and changing agricultural demands worldwide.

With the satellite's fuel reserve completely depleted, the U.S. Geological Survey Flight Operations Team transmitted the last command to the satellite to shut off all moving mechanisms and constrain the spacecraft's ability to generate and store power from its solar arrays. The final command shut down the transmitter, silencing the mission permanently on June 5, 2013.

Landsat 5 orbited the planet over 150,000 times while transmitting over 2.5 million images of the Earth's land surface, long outliving its original three-year design life.

Landsat Global Archive Consolidation Update

As of August 1, 2013, over 2.2 million scenes have been received and placed into the USGS archive from international ground stations as part of the Landsat Global Archive Consolidation (LGAC) effort.

In addition, the first international Multi-Spectral Scanner (MSS) data from Canada have been added to the archive. MSS data, captured by the first Landsat missions, are often the most difficult to ingest and process, but yet can be the most valuable for time series analysis.

The Canada Centre for Remote Sensing contributed the data months ago, but the software to ingest these data successfully just released in late June.

For more information on LGAC, visit
http://landsat.usgs.gov/Landsat_Global_Archive_Consolidation.php.

Product News

Additional Information on Landsat 8 Reflectance and Radiance Conversions

In the last issue, we provided information on converting the Landsat 8 OLI digital number (DN) pixel values to top of atmosphere (TOA) reflectance and at-sensor spectral radiance, and for converting TIRS digital number pixel values to brightness temperature. We would like to provide more calibration details:

1) The previously known LMIN, LMAX and QCALMIN, QCALMAX values have been replaced with RADIANCE_MINIMUM_BAND_X, RADIANCE_MAXIMUM_BAND_X, QUANTIZE_CAL_MIN_BAND_X, QUANTIZE_CAL_MAX_BAND_X. Instead of using these values, a single set of coefficients, **RADIANCE_MULT_BAND_x** and **RADIANCE_ADD_BAND_x** (x = the band number), have been developed for ease of use and have been added into the metadata files (MTL) delivered with the product for easy access.

2) Conversion formulas to convert OLI DNs to at-sensor spectral radiance and TOA Reflectance, and converting TIRS DNs to Brightness Temperature are located at **http://landsat.usgs.gov/Landsat8_Using_Product.php**. To convert to TOA reflectance users should always use L1 image DN values (Qcal) and MTL values (REFLECTANCE_MULT_BAND_x and REFLECTANCE_ADD_BAND_x, where x is the band number) specific to your image. Landsat 8 has a 16 bit product with a better dynamic range than the previous satellites. Because of this, it allows the instrument to detect a broader range of TOA reflectance compared to historical Landsat sensors.

3) REFLECTANCE_MULT_BAND_X and REFLECTANCE_ADD_BAND_X values found in the MTL are the same for each band within a scene because they cover the same range of reflectance values. These values may change in the future and should always be referenced from the MTL file that is delivered with the product.

4) It is possible to have TOA reflectance calculations outside of the 0-1 range. Users will need to apply solar zenith angle corrections, and exclude fill values, when calculating TOA reflectance.

Landsat 8 Thermal Infrared Sensor (TIRS) Calibration Notice

Discrepancies have been noted between calibrated Landsat 8 thermal data, TIRS Bands 10 and 11, and surface-water temperature measurements collected to validate thermal band calibration.

Surface-water temperatures derived from TIRS data, after correction for atmospheric transmission and emissivity, are warmer than measured surface-water temperatures by 2 K or more. These discrepancies also may not be consistent across the focal plane. This indicates a possible bias or other error in TIRS calibration that places the calibration uncertainty beyond the specified performance of 2 percent.

Users are cautioned to be aware of potential impacts to their analyses and results. The calibration team continues to analyze TIRS data and compare results to surface-water temperature measurements to discover the source of the discrepancy.

Updates to TIRS calibration coefficients will be incorporated into Landsat 8 data processing as soon as the discrepancy is sufficiently understood. Details will be provided on the Calibration Notice web site (https://landsat.usgs.gov/calibration_notices.php) and in future Landsat Updates.

Questions about Landsat 8?

Questions about Landsat 8, the Landsat Missions, or Landsat products can be directed to Landsat Customer Services: custserv@usgs.gov.

Land Surface Reflectance Product now Available for Landsat 4 TM scenes

Recent upgrades to the Earth Resources Observation and Science (EROS) Science Processing Architecture (ESPA) Ordering Interface now allow Landsat 4 Thematic Mapper (TM) scenes to be processed to Land Surface Reflectance products, by uploading a list of scenes to https://espa.cr.usgs.gov/new, or accessing the Landsat CDR Data Set Section of EarthExplorer: http://earthexplorer.usgs.gov. Details about Land Surface Reflectance products can be found on http://landsat.usgs.gov/CDR_LSR.php.

Tips and Tricks

Using the L-LDOPE Toolbelt with Landsat 8 QA band

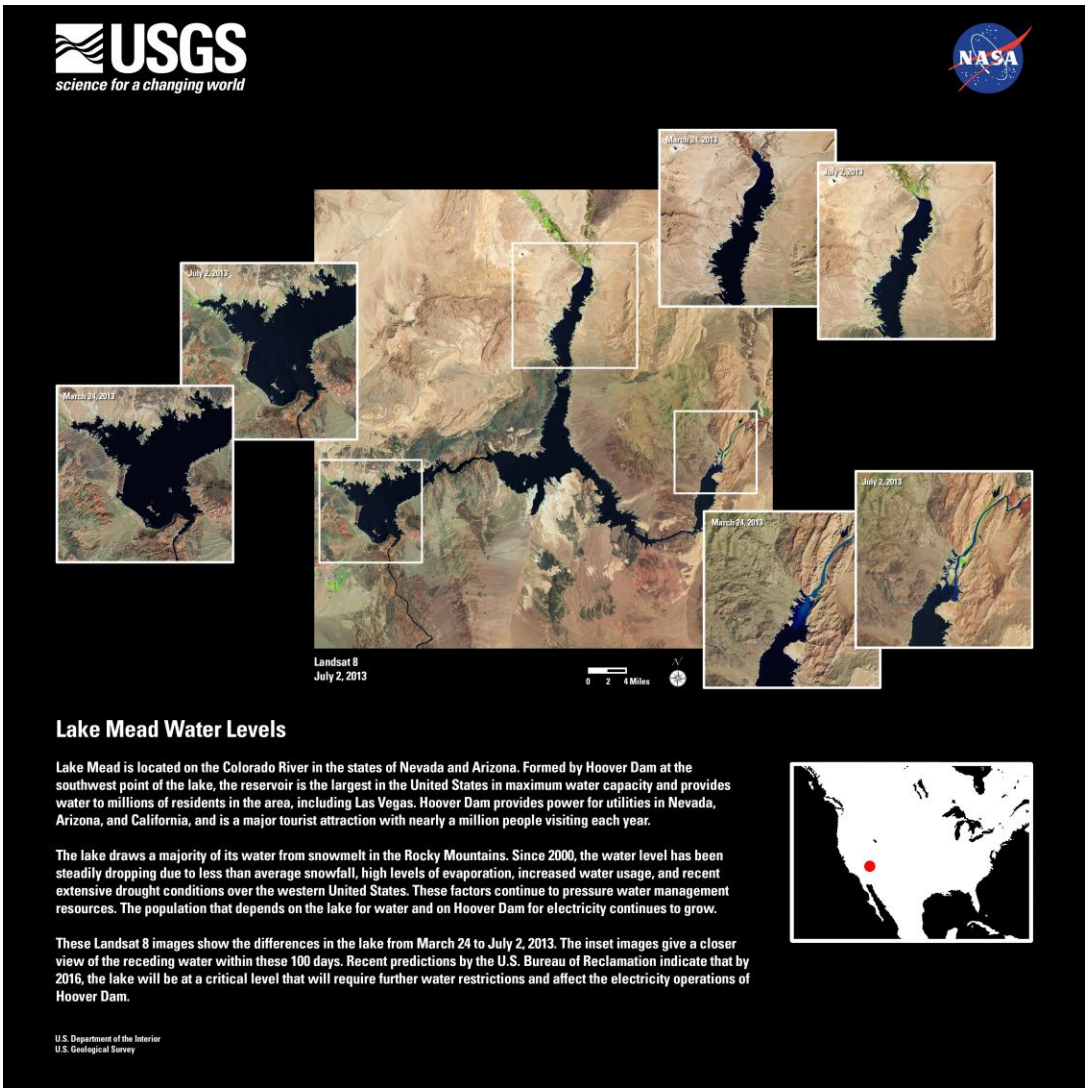
Landsat 8 scenes include a Quality Assessment (QA) band, which provides bit-packed information in decimal translation of binary strings. Used effectively, QA bits improve the integrity of science investigations by indicating which pixels might be affected by instrument artifacts or subject to cloud contamination.

To easily extract the bit-packed information, the L-LDOPE Toolbelt now contains code to extract the bits from the OLI QA band to allow easy identification and interpretation of pixel condition. The Toolbelt can be downloaded as a zip file that contains the executables compiled for Linux 32-Bit, Linux 64-Bit, Windows 32-Bit, and Windows 64-Bit systems, accompanied by the source code and a readme file. Each command can be run directly by typing the executable name and its parameters from the tools directory.

Details can be found on http://landsat.usgs.gov/L-LDOPE_Toolbelt.php.

Landsat Image of Interest

Lake Mead Water Levels 2013



Lake Mead is located on the Colorado River in the states of Nevada and Arizona. Formed by Hoover Dam at the southwest point of the lake, the reservoir is the largest in the United States in maximum water capacity and provides water to millions of residents in the area, including Las Vegas. Hoover Dam provides power for utilities in Nevada, Arizona, and California, and is a major tourist attraction with nearly a million people visiting each year.

The lake draws a majority of its water from snowmelt in the Rocky Mountains. Since 2000, the water level has been steadily dropping due to less than average snowfall, high levels of evaporation, increased water usage, and recent extensive drought conditions over the western United States. These factors continue to pressure water management resources. The population that depends on the lake for water and on Hoover Dam for electricity continues to grow.

These Landsat 8 images show the differences in the lake from March 24 to July 2, 2013. The inset images give a closer view of the receding water within these 100 days. Recent predictions by the U.S. Bureau of Reclamation indicate that by 2016, the lake will be at a critical level that will require further water restrictions and affect the electricity operations of Hoover Dam.