Landsat Update

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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.

Mission News

Landsat 7 Acquires Over 2 Million Scenes
The Landsat 7 satellite, launched on April 15, 1999, has continuously acquired land images worldwide for 16 years, and now has captured over 2 million scenes! All data have been added to the USGS archive and made available for download at no charge from EarthExplorer or GloVis.

Landsat Missions Fact Sheet Updated
The USGS has published a new Landsat Fact Sheet that offers a complete and up-to-date summary of the Landsat program, sensors, and band designations. Since 1972, Landsat satellites have continuously acquired space-based images of the Earth's land surface, providing data that serve as valuable resources for land use/land change research and a number of applications in forestry, agriculture, geology, land cover mapping, and water and coastal studies. Currently, Landsat 8 and Landsat 7 together acquire over 1,200 new images per day. This is more data than at any other time in the history of the Landsat program. This rich and consistent archive, combined with a no-cost data policy, allows users to exploit time series of data over extensive geographic areas to monitor land surface change over time.

Level 1 Data Product News

Reminder: Recent Processing System and Data Changes

The previous [Landsat Update](#) gave details on the planned changes to data products, including the [Ground Control Points Phase 2 updates](#), Landsat 8 Thermal data framing changes, and the ability to process nearly 14,000 Landsat 5 Thematic Mapper scenes acquired in the 1980s, that were formerly available only as products created by the heritage [National Land Archive Production System (NLAPS)](#). System releases enabling these changes were made the first week of December 2015. The NLAPS scenes will be processed through the Landsat Level-1 Product Generation System (LPGS) and will become available for download from [EarthExplorer](#) or [GloVis](#) when processing is complete.

Landsat 8 Thermal Infrared Sensor Anomaly

At approximately 4:00 PM Central Standard Time (22:00 GMT) on Sunday, November 1, 2015, the Thermal Infrared Sensor (TIRS) experienced an anomalous condition related to the instrument's ability to accurately measure the location of the Scene Select Mechanism (SSM). The anomaly caused the upper bits of the encoder counts in the ancillary data to be corrupt, resulting in the TIRS bands becoming misregistered by approximately 500 meters (18 pixels). The encoder was powered off during a morning EROS station pass on Monday, November 2, 2015.

Landsat 8's Operational Land Imager (OLI) data are not affected. TIRS data continue to be collected, but Level 1 products will be populated with zero-fill data until the geometric model parameters are finalized, and the algorithms and code in the Landsat Level-1 Product Generation System (LPGS) have been updated, tested, and verified. These activities are expected to be completed no sooner than February 2016. Following the implementation of a successful alternate TIRS processing capability, the Landsat 8 scenes containing zero-fill will be reprocessed and made available from the USGS archive.

Mission operations will continually assess potential opportunities for return to normal operations using the B-side encoder electronics. However, at this time, the schedule for return to normal operations is unknown. More details will be provided on the [Landsat Missions Web site](#) as they become available.

Landsat 8 Scenes Acquired in Lower Truncation

The detectors of Landsat 8's Operational Land Imager (OLI) can register data up to 14 bits. However, only the upper or lower 12 bits can be transmitted to the ground. In normal operations, the upper 12 bits are transmitted. When acquiring in the upper 12-bit mode, the lower 2 bits collapse (saturate) into the lowest data value and are very noisy.

In 2013 and again in 2015, some Landsat 8 scenes were acquired in lower truncation—meaning data from only the lower 12 bits were captured. During acquisitions in lower truncation, regions of high brightness within a scene exceed the lower 12-bit range of 4096, causing the bit count to begin again from the 13th and 14th bits. This causes the numeric values to "roll over" and start counting from zero again. Pixels affected by roll over do not correctly represent the measurement of surface brightness and will visually appear as noise (see Figure 1). These roll over values cannot be differentiated from valid values elsewhere in the image, and the cloud information in the Quality Assessment (QA) bands will be unreliable. Users should be cautious when using these images for operational activities, although most cloud free data will not be affected.
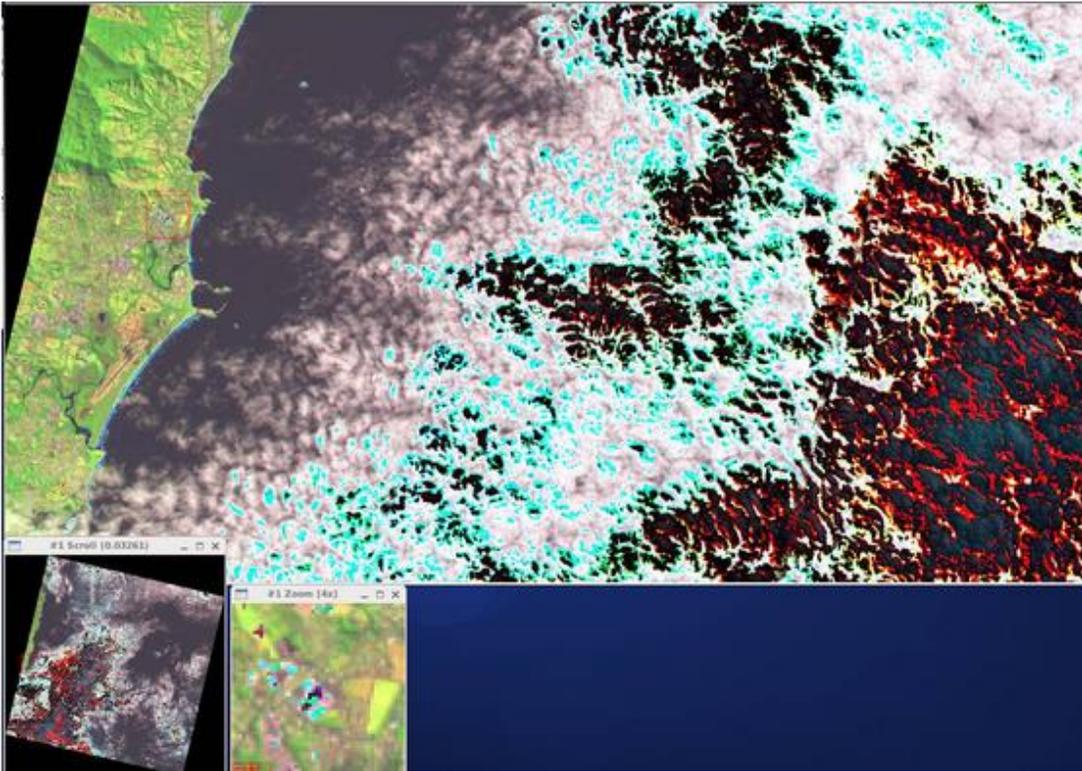
Figure 1. – This image shows the levels of over-saturated pixels in Landsat 8 Operational Land Imager (OLI) data acquired with the lower 12 bits only. Black pixels have lower saturation levels, while the red pixels have the highest level of saturation.

The 2013 scenes were acquired during the on-orbit checkout period and these are listed in 2013_Lower-12-bit-scenes.xlsx.

The scenes acquired in 2015 are being used to investigate the value of the lower two bits to inform a change in requirements for Landsat 9 to downlink all 14 bits of data. In support of these studies, two intervals of data were acquired: 1) a night interval over the western United States covering fires and urban areas, and 2) a day interval off the coast of eastern Australia over dark water. The artifacts are most noticeable over fires in the night data and over clouds in the daytime data. The locations and dates of the intervals are listed in the table below.

Area	Path	Rows	Dates	Features
Western United States (nighttime acquisitions)	139	202 to 217	08/22/2015 (DOY 234) 09/07/2015 (DOY 250) 09/23/2015 (DOY 266)	San Diego (row 207) Los Angeles (row 208) Lake Tahoe (row 211) Portland, Mount Saint Helens, Mount Hood (row 216) Mount Adams, Mount Adams Wildfire (row 216) Seattle, Mount Rainier (row 217)
Eastern Australia dark water coastal (daytime acquisitions)	88	75 to 84	09/01/2015 (DOY 244) 09/17/2015 (DOY 260) 10/03/2015 (DOY 276)	Coastal Australia (rows 80-82) Cato Reef (row 76)

Table 1. Areas and scenes affected by 2015 Landsat 8 12-bit lower truncation studies.

We welcome any feedback about the value these data.

Science Data Product News

Increasing Requests for Surface Reflectance Data

Since 2012, the EROS Science Processing Architecture (ESPA) has been generating Surface Reflectance, Top of Atmosphere Reflectance, and Brightness Temperature data, along with related Spectral Indices for Landsat 4–5 and 7. Provisional Landsat 8 surface reflectance and brightness temperature products have been available since December 2014.

In the past months, the ESPA system has responded to an increasing demand and has fulfilled requests for tens of thousands of data products each day. The importance of these data to fulfill science investigations is fully recognized, and the system is optimized to deliver orders as quickly as possible. As of November 2015, over 625 terabytes (TB) of data have been processed and made available for download to support user requests. We are interested in receiving user community feedback on the quality of these science data products.

Users are reminded that Landsat 8 scenes acquired after November 1, 2015, cannot yet be processed to Surface Reflectance at this time, due to the Thermal Infrared Sensor (TIRS) anomaly that started on November 1. The Landsat 8 OLI surface reflectance retrieval algorithm is dependent on TIRS data for cloud detection, and the algorithm is not currently configured to use the existing quality assessment (QA) band attribute for cloud contamination.

New Science Data Products in Development

As the importance of provisional Surface Reflectance and associated data becomes more apparent for a variety of science studies, new derived science data products are being developed:

- Land Surface Temperature (LST)
- Burned Area (BA)
- Dynamic Surface Water Extent (DSWE)
- Fraction of Snow Covered Area (fSCA)

The timeframes for these data becoming available have not yet been established, but future announcements regarding the status will be placed on the Landsat Missions Web site.

Meetings of Interest

Landsat Ground Station Operators Working Group (LGSWOG) Meeting
December 7 – 11, 2015
Paris, France

American Geophysical Union (AGU)
December 14 – 18, 2015
San Francisco, California

American Association of Geographers (AAG)
March 29 – April 2, 2016
San Francisco, California

Interesting News and Images

USGS Projects Large Loss of Alaska Permafrost by 2100

A recent USGS News Release discusses the decline of permafrost in northern latitude tundra and boreal forest areas, due to an accelerated warming trend, that is greater than in other parts of the world.
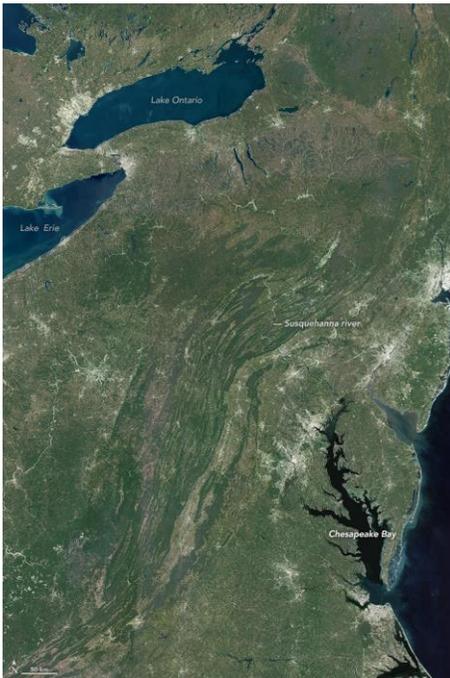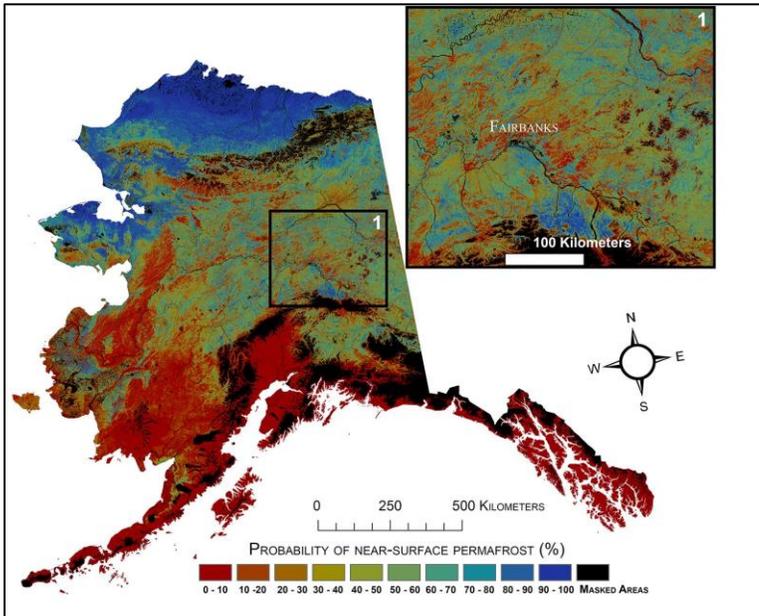
A String of Pearls Viewed from Space

A Landsat mosaic of the Chesapeake Bay Watershed was unveiled at a November 12, 2015, String of Pearls ceremony in Easton, Maryland.

The Chesapeake Bay is the largest estuary in the United States and third largest in the world.

Over 40 individual Landsat 8 scenes—roughly 662 million cloud free 30-meter pixels—were used to create this image.

Explore the World with TIME

In 2013, TIME TIMELAPSE became available and helps tell the story of how the Earth's surface has changed over the years, with example time-lapse imagery over urban areas, deforestation, and glaciers retreating. The vast archive of Landsat data was used in the creation of this informational and easy-to-use interface.