

LANDSAT MONTHLY UPDATE

June 2004

The Landsat Program is managed by the U.S. Geological Survey under authority established by Presidential Decision Directive NSTC-3.

Landsat Product Price Adjustment

The U.S. Geological Survey (USGS) is reducing the price of Landsat 7 scenes with gaps in data resulting from a satellite anomaly in May of 2003. Scenes that contain gaps in data will be reduced from \$600 to \$250. A new product being offered for \$275 will have the gap areas filled in with Landsat 7 data acquired prior to the scan line corrector (SLC) failure at a similar time of the year. The two scenes are geometrically registered, and a histogram matching technique is applied to the fill pixels that provide the best-expected radiance values for the missing data.

The new product represents an effort by the USGS Landsat 7 Project at the USGS EROS Data Center (EDC) in Sioux Falls, South Dakota, to increase the utility of the Landsat 7 Enhanced Thematic Mapper Plus (ETM+) data affected by the non-functional scan line corrector. The USGS is continuing to research methods of providing improved data products and will continue to provide information resulting from this work as it becomes available.

A sample product, with a comparison of the degraded data, further information, a complete list of the new pricing structure, and regular updates on planned product releases can be found at http://landsat7.usgs.gov/slc_enhancements/.

Planned Landsat Product Development

The USGS Landsat Project at the USGS EDC has been taking steps to increase the utility of the ETM+ data that includes non-functional scan line corrector (SLC) artifacts. With the initial gap-filled product released on May 10, 2004, the missing pixels are replaced with data from a previously acquired SLC-on scene that is registered and histogram matched with the SLC-off image. Phase 2 of SLC product improvements will combine one or more SLC-off scenes into an SLC-off/SLC-off gap-filled product using a similar registration and histogram matching technique. Delivery is expected by the end of 2004 with a price of \$300. This product will overcome the temporal issues associated with the Phase 1 SLC-on/SLC-off gap-filled product. The Earth Explorer ordering interface will guide the user through the ordering process of choosing appropriate SLC-off scenes to generate their gap-filled product. A sample product along with further information can be found at <http://landsat7.usgs.gov/sampleproducts.php>.

Landsat 7 Mission Operations Center

Since November 2000, Honeywell has provided spacecraft flight operations and ground systems sustaining engineering support for the Landsat 7 satellite. The USGS recompeted this contract and on May 16, 2004, awarded the new 8-year contract to the incumbent, Honeywell. The Landsat 7 Mission Operations Center (MOC) is located at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Additionally, Honeywell maintains a backup MOC at their facility in Columbia, Maryland.

Landsat 7 Attitude Control System, Gyro 3

On April 7, 2004, the Landsat 7 Precision Attitude Determination System (PRADS) initiated an automatic reset. A PRADS reset is an autonomous self-preserving action that the satellite takes when it loses confidence in where it thinks it is pointed in relation to star observations. It is not uncommon for a PRADS reset to occur once or twice a year due to periods of too few identifiable stars or a misidentification of a number of stars. Between April 7th and May 5th a total of 14 PRADS resets occurred, indicating a significant and anomalous change in the spacecraft's Attitude Control Subsystem (ACS).

Starting on April 7, the Flight Operations Team (FOT) responded to this anomaly with a thorough review of all satellite systems that could impact attitude pointing. The only suspicious telemetry related to the gyro 3 motor current and a

coincident change in the biases calculated for gyros 1 and 2. (The Landsat 7 spacecraft carries three gyros in its Inertial Measurement Unit (IMU); two are required to maintain precision attitude control.)

The FOT had been closely monitoring unstable motor currents from gyro 3 for more than a year with no apparent impact to the stability and operation of gyros 1 and 2. The recently observed perturbation of these gyros' performance during gyro 3 'noisy' periods indicated a new 'cause and effect' relationship. The FOT compiled data from the anomaly investigation and forwarded it to the spacecraft manufacturer and personnel from several missions with similar gyros. The FOT soon received concurrence from these sources that the degraded performance of gyros 1 and 2 resulting in the PRADS resets was most likely caused by the mechanical vibration of a debilitated gyro 3. The FOT and subject matter experts further stated that if gyro 3's erratic behavior was affecting gyros 1 and 2, cumulative damage could result.

Based on the evidence presented and recommendations of both the FOT and spacecraft manufacturer, the USGS Flight Systems Manager directed that gyro 3 be powered off on May 5. The shut down procedure occurred without incident resulting in an immediate and positive response to the performance of gyros 1 and 2 as indicated by telemetry. Since May 5, there have been no additional PRADS resets

Landsat 5 Modular Power System, Battery #1

On May 21, 2004, Landsat 5's Battery #1 was removed from the Modular Power Subsystem (MPS) main power bus following an anomaly of the enable/disable charge relay. The nominal configuration of the charge relay is in the closed position for each of Landsat 5's three batteries so that they can supply power during spacecraft eclipse (night) periods. On Thursday, May 20, 2004, the Flight Operations Team (FOT) noted that the charge relay for Battery #1 was not operating consistently; maintaining an open circuit after having been commanded to close the circuit. Battery #1 has exhibited anomalous performance for 7+ years, more so over the past two months. With the apparent charge relay failure, the Flight Systems Manager ordered the relay commanded open and permanently removed from the main power bus.

Even with the shut down of Battery #1, Landsat 5's two remaining batteries have sufficient capacity to continue the mission with no impact to operations. The mission can operate with only one functional battery.

Landsat Technical Working Group

The Landsat Technical Working Group Meeting #13 was held in Cordoba, Argentina from April 26-30, 2004. Thirty-nine participants representing 12 countries attended the conference. The meeting provided an opportunity for the U.S. Landsat Project staff to present the current status of both the Landsat 5 and Landsat 7 missions along with a description of the events that have occurred since the last working group meeting held in June 2002. There were several in-depth presentations on development of new gap-filled products to mitigate the effect of the failed ETM+ scan line corrector. At the meeting, the USGS distributed the source code for the latest version of its Landsat Product Generation System (LPGS) containing the phase-1 gap-filling capabilities.

The next meeting with the International Cooperators will be the Landsat Ground Station Operators Working Group (LGSOWG) to be held in Chang Mai, Thailand the week of November 1, 2004. The next Landsat Technical Working Group meeting will be held in the Washington, DC area in April-May of 2005.

The Landsat Monthly Update is an informal communication tool, prepared monthly and distributed electronically to USGS Landsat partners, to provide information about Landsat activities and related topics of interest. If you have any ideas, comments, corrections, or successes you would like to share with the Landsat community, please contact Ronald Beck, USGS Landsat team, at the following e-mail address: beck@usgs.gov.