LANDSAT DATA PRODUCTS, FREE AND CLEAR

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ABSTRACT

The U.S. Geological Survey (USGS) released a Technical Announcement on April 21, 2008 that stated "By February 2009, any Landsat archive scene selected by a user will be processed, at no charge, automatically to a standard product recipe and staged for electronic retrieval." This announcement heralded a sea change in the use and application of data from the Landsat satellites. The USGS had previously charged a fee to data requestors receiving Landsat digital images from the archive held and managed by the USGS Earth Resources Observation and Science (EROS) Center in Sioux Falls, SD. The cost of a Landsat 7 Enhanced Thematic Mapper – Plus (ETM+) scene was, for example, $600 (USD) where each scene covers a 185-by-180 km geographic area. Prior to the 1999 launch of Landsat 9, the private industry operators of Landsat 4 and Landsat 5 had charged even greater fees with the cost of a Thematic Mapper (TM) scene rising as high as $4500 (USD). Now, with the new USGS data policy, scientific investigators and resource managers can obtain the Landsat data they need rather than be limited to the data they could afford.

The impact of the new policy on the distribution of data from USGS EROS has been immediate and dramatic. Their archive holds over two-million Landsat scenes going back to data collected in 1972 by the Multispectral Scanner System (MSS) on the Landsat 1 satellite. The images nearly cover the global land mass for each year since 1972 with global seasonal coverage available from the Landsat 7 ETM+ beginning in 2000. The largest annual distribution of Landsat data prior to 2009 occurred in 2001 when just over 25,000 scenes were delivered to requestors. USGS EROS implemented the new data policy ahead of schedule and opened its entire Landsat archive to free distribution beginning in October 2008. The Center then delivered over 1.1-million free Landsat scenes to requestors between that date and

October 2009.   The nation and the world are finally able to realize a full return in the almost four decades of investment in the development, launch, and operation of the Landsat satellite series.

USGS EROS did need to change some Landsat data distribution practices to meet this increased demand for Landsat data products.   EROS previously offered requestors data processing and data delivery options in return for the data fee.   Options included a selection of resampling algorithms, cartographic projections, and data storage media. EROS now offers data products processed to a single "recipe" and only distributes the products electronically via the Internet.   The standard products provide image data resampled by a cubic convolution algorithm for registration to the Universal Transverse Mercator (UTM) cartographic projection.   EROS makes an exception for images acquired over Antarctica where the data are registered to the Polar Stereographic projection.   The data products are delivered in a GeoTIFF format in all cases.

The new practices led to an important advancement in the distributed Landsat data products. Prior to the new data policy, EROS registered their images to the earth ellipsoid without correction for terrain relief for standard products.   EROS now incorporates the use of digital elevation models (DEM's) and ground points into data processing to create standard products that are corrected for terrain relief and are thus orthorectified. Images subjected to the standard terrain correction with DEM's and ground control are referred to as Level 1T products. Ground control points are not always available for some images due to cloud cover and other exigencies. In those cases the sensor line-of-sight is determined only from satellite ephemeris, attitude, and alignment data. Images created without the benefit of ground control yet still corrected for terrain with the use of DEM's are called Level 1Gt products. EROS does not yet correct MSS data, collected from the Landsat 1, 2, 3, 4, and 5 satellites, for terrain relief. The standard MSS data products are currently registered to the earth ellipsoid using only the satellite ephemeris, attitude, and alignment data in a process called systematic correction. The resulting images are referred to as Level 1G products. EROS is updating its MSS data processing and hopes to soon distribute Level 1T MSS data products beginning in mid 2010.   The terrain correction and use of ground control represent a major improvement in the standard products available from EROS. The Level 1T products are much more conducive to the analysis of Landsat data in conjunction with other geographically-referenced data particularly in the context of geographic information systems.

Landsat data requestors are now, with access to free data, beginning to develop the capacity to analyze large volumes of data for broad area and long term land cover change assessments. Members of the USGS-sponsored Landsat Science Team are in the vanguard of those expanding horizons. Nemani et al., 2010 [1], for example, are generating global leaf area index (LAI) products at the 30 m Landsat resolution. Huang et al., 2010 [2], are constructing forest disturbance histories using stacks of Landsat images to provide a dense time series of observations. Wulder et al., 2008 [3], have used Landsat 7 ETM+ data to map the entire forested area of Canada and to map spatially explicit biomass. Masek et al, 2010 [4], mapped decadal forest disturbance across the North American continent with Landsat data. Allen et al., 2008 [5], refined an energy-balance model of evapotranspiration rates and use Landsat data in conjunction with Landsat data to monitor water consumption by irrigators in Idaho. His methodology has propagated to state water resource department across the western states where water usage and rights are critical issues. These applications are just a few examples of the advancing societal benefits enabled by the new Landsat data policy.

Such applications and benefits will continue to advance into the future. NASA and the USGS are developing the next satellite in the Landsat series, the Landsat Data Continuity Mission (LDCM), with a launch readiness data of December 2012. The USGS will extend the free data policy to LDCM data. Additionally, the European Space Agency (ESA) is developing a Landsat-like satellite system called Sentinel-2 for launch in the same time frame and have announced that they will follow the USGS policy of distributing the data at no cost. The expanding availability of free data and the commensurate growth in the capability to conduct long-term and broad-area analyses realizes the full vision of those that conceived the Landsat program more than 40 years ago.

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