USGS
science for a changing world

# Landsat Updates - Volume 1, Issue 2, 2007

## Landsat Science Team Spotlight

To address the science goals of the Landsat Data Continuity Mission (LDCM), the Landsat Science Team has been selected to investigate and advise the U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA) on issues critical to the success of this endeavor. With that in mind, we would like to take the opportunity to introduce you to some of these people.

**Mike Wulder and Joanne White**
**Pacific Forestry Centre – Canadian Forest Service**


**Mike Wulder**
**Research Scientist, Forest Inventory and Analysis**

**Background/Education**
B.S. (Honours – geography), 1995, University of Calgary; M.E.S. (environmental studies), 1996, University of Waterloo; Ph.D. (remote sensing), 1998, University of Waterloo

**Primary Focus**
- Studies optical and light detection and ranging (LIDAR) remote sensing (laser altimetry), geographical information systems (GIS), spatial statistics, and change detection

- Estimates forest inventory and structural parameters

**Projects**

- Canada's National Forest Inventory and Earth Observation for Sustainable Development (EOSD):

  - EOSD Project Summary
    - http://www.fao.org/DOCREP/ARTICLE/WFC/XII/0639-B1.HTM

  - EOSD Land Cover
    - http://www.eosd.cfs.nrcan.gc.ca/cover/index_e.html

**Joanne White**
**Spatial Analyst, Forest Inventory and Analysis, Forest Information, Landscape Management**

**Background/Education**

B.S. (geography), 1994, University of Victoria; M.S. (geography), 1998, University of Victoria.

**Primary Focus**

- Conducts analysis incorporating optical remote sensing, geographic information systems, and spatial statistics

**Projects**

- EOSD
http://www.fao.org/DOCREP/ARTICLE/WFC/XII/0639-B1.HTM

- Mountain Pine Beetle Initiative
http://mpb.cfs.nrcan.gc.ca/index_e.html

**Publications from Mike Wulder and Joanne White**

- **Forest inventory height update through the integration of LIDAR data with segmented Landsat imagery** (*Can. J. Remote Sensing*, Vol. 29, No. 5, pp. 536–543, 2003)

- **An accuracy assessment framework for large-area land cover classification products derived from medium resolution satellite data** (*International Journal of Remote Sensing*, Vol. 27, No. 4, pp. 663-683, Wulder, M., S. Franklin, J. White, J. Linke, and S. Magnussen, 2006*)*

- **Validation of a large-area land cover product using purpose-acquired airborne video** (*Remote Sensing of Environment*, Vol. 106, No. 4, pp. 480-491, Wulder, M., J. White, S. Magnussen, and S. McDonald, 2007*)*

**These and many more publications can be accessed through the Canadian Forest Service Bookstore:**
http://bookstore.cfs.nrcan.gc.ca/searchpubs_e.php?AuthorIDs=AU11091

## Happy 35th Anniversary!

On July 23, 2007, the Landsat Program celebrated the 35th anniversary of the launch of its first satellite, ERTS-1 (Earth Resources Technology Satellite-1). Renamed Landsat 1 in 1975, it was followed by two very similar satellites: Landsat 2, launched on January 22, 1975, and Landsat 3, launched on March 5, 1978. The legacy continues today with Landsats 5 and 7, two operational satellites that augment a global archive that is maintained at the U.S. Geological Survey's Center for Earth Resources Observation and Science (EROS). The Landsat Data Continuity Mission is currently developing a new satellite with a planned launch date of 2011.

This 35-year legacy of land imaging reveals how land changes over time, whether caused by forces of nature or humans. USGS scientists can estimate timber removal from the Amazon rainforest, monitor regrowth after wildfires or volcanic eruptions, document the expansion of our world's largest cities, or evaluate how policies affect changes in agriculture. The Landsat project is a key tool for understanding our changing world.

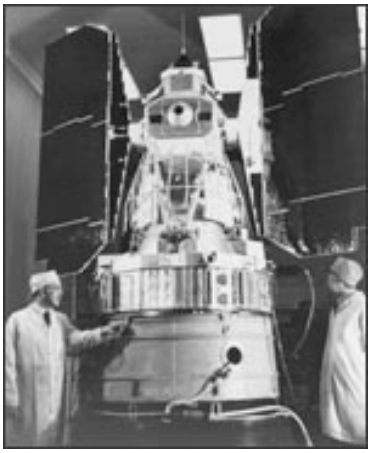


**Figure 1. Landsat 1 in the assembly room**

## Landsat—Protecting the Price of Bread

By Laura Rocchio
Reprinted from *NASA GoddardView*, Volume 3, Issue 7, May 2007
www.nasa.gov

Year-to-year we expect the price of bread to remain relatively stable, but rarely do we realize the complex interactions and activities that are responsible for that price stability. And even less often do we realize that Landsat satellite data are behind the accurate global crop production estimates that enable such price stability.

Stable food prices are the result of a delicate balance between food supply and demand. To drastically simplify: if agricultural supply is too high, prices fall to a level where farmers cannot afford to plant; if supply is too small, food prices can soar. So, an unstable agricultural commodities market can lead to wild food price fluctuations—much like the gas price fluctuations caused by recent oil market swings.

To read the full story, visit http://www.nasa.gov/centers/goddard/news/gnews_detail.html and click on the Volume 3, Issue 7 link.

## LTWG-16 Meeting Held in Brazil

**May 14 •** The 16th Landsat Technical Working Group (LTWG) meeting was held in Brazil May 14–18, 2007. The meeting was organized by USGS and hosted by the Instituto Nacional de Pesquisas Espaciais (INPE) in São José dos Campos, Brazil. International Cooperator representatives from nine countries and members of the USGS Landsat project and NASA Landsat Science Office discussed topics of technical interest, including the status of LDCM, Landsat 5 and 7 operational issues, the Mid-Decadal Global Land Survey (MDGLS), results from a geometric accuracy analysis of the tri-decadal survey, data validation and exchange, redefinition of the metadata format, and Landsat Science Team activities. Each International Cooperator presented a station report, including the status of their historical archive. The Japan delegation briefed the group on the status of the Advanced Land Observing Satellite (ALOS) mission. INPE hosted visits at two of their facilities located in São José dos Campos and Cachoeira Paulista, including a tour of the Center for Weather Forecast and Climate Studies. INPE also briefed the group on the China Brazil Earth Resources Satellite (CBERS) program and the processing system that handles CBERS and Landsat data.

### Meeting Actions

USGS took actions to assist the International Cooperators in updating their data processing software to accommodate changes in the Enhanced Thematic Mapper Plus (ETM+) and Thematic Mapper (TM) telemetry. The USGS will also continue efforts to keep the International Cooperators current on the status of LDCM. Finally, initial steps were taken to catalog the capabilities of the stations to read older media formats, with an eye toward archive preservation and recovery from deteriorating physical media.

*Contributor: Terry Arvidson*

## Is USGS meeting the needs of our core Landsat users?

USGS LDCM, in conjunction with the USGS Office of Budget and Performance, conducted a customer satisfaction survey to measure how satisfied Landsat users are and to identify key product characteristics and data delivery strategies. The survey was sent to non-Federal users who had purchased data from the USGS Center for Earth Resources Observation and Science (EROS). (Federal users were surveyed in a separate effort.) We received 243 viable responses, providing a response rate of 48 percent.

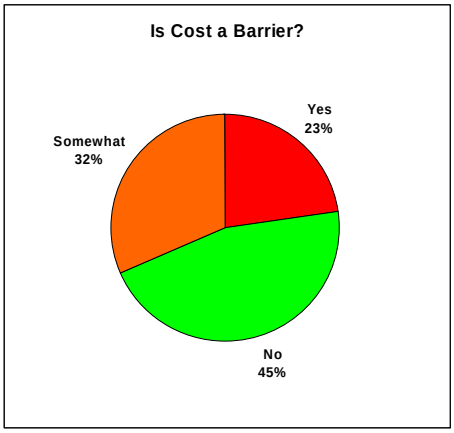
**What did the survey find?**

Users were asked to rate the importance and satisfaction of several things related to Landsat data. Ratings were from 1 to 5, with 1 being high and 5 low. Most of the satisfaction indicators were rated fairly high, but the factors that users rated lower in satisfaction, but higher in importance were:

1. Cost (mean importance 1.83, mean satisfaction 2.46)
2. Geometric accuracy (mean importance 1.63, mean satisfaction 2.22)
3. Geometric consistency
    a. With adjacent scenes (mean importance 1.89, mean satisfaction 2.28 and
    b. Over time (mean importance 1.8, mean satisfaction 2.38)
4. Radiometric accuracy (mean importance 1.88, mean satisfaction 2.3)
5. Geodetic datum (mean importance 1.8, mean satisfaction 2.28)

More than 55 percent of users indicated that cost is at least somewhat of a barrier, and many said why, including:

- Funding for data purchases is limited for:
    - Educational institutions
    - Small businesses
    - Small non-governmental organizations (NGOs)
    - Nonprofit organizations
    - Developing countries
    - Local, regional, and state government
- Some would use it for potential new business, but pass because of the cost.
- For larger areas (especially at a national scale or higher), the cost is prohibitive.
- For cloudy areas, they would like to buy more scenes to make cloud-free composite images.
- It is difficult to afford enough images to do a time-series analysis.
- For industry, the higher the cost, the harder it is to justify to the client—or it may impact the scope of the study.



**What are we doing to improve?**

**Cost:** USGS is moving toward "Web enabling" or downloading Landsat data. A pilot study began on June 4 to "Web-enable" Landsat 7 terrain corrected data over the United States—this is the first step toward what will be standard practice in the LDCM era.

The approach LDCM is planning at the moment is to deliver the LDCM "standard" product in the preferred projection (UTM), datum (WGS84), and format (GeoTIFF) with a goal of web enabled download via File Transfer Protocol (FTP). The results of this survey seem to confirm that this approach will meet the bulk of the Landsat data users' needs and will reduce the barriers that the current cost of the data imposes on small business, educational and nonprofit institutions, large-scale studies, and exploratory analyses.

Much more information from this survey is available. You are welcome to contact Ann Krause at akrause@usgs.gov for more survey results, or to provide your own thoughts.

## Did you know?

**The USGS Landsat project provides links to many educational sites!**

*Landsat's Educational page:* http://landsat.usgs.gov/links/educational_links.php

Landsat's education and outreach program has spawned many educational resources. To enable educators' seamless access to all of these resources, Landsat and LDCM education are united into one program. Their goal is to enable you to access and use the entire Landsat Program's data, imagery, and associated science content for your own purposes.

We hope you enjoy exploring these myriad free educational and interpretive resources, images, classroom activities, modules, tutorials, and more.

### Landsat Educational Links:

1. http://landsat.gsfc.nasa.gov/education/compositor/
2. http://ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php
3. http://rst.gsfc.nasa.gov/
4. http://landsat.gsfc.nasa.gov/education/teacherkit/
5. http://www.nasa.gov/audience/forkids/home/index.html
6. http://remotesensing.usgs.gov/education.php
7. http://ldcm.gsfc.nasa.gov/outreach.html
8. http://landsat.gsfc.nasa.gov/education/activity_matrix.html
9. http://craters.gsfc.nasa.gov/index.htm
10. http://www.earthfromspace.si.edu/default.asp

## Conferences

**International Geoscience and Remote Sensing Symposium (IGARSS)**

July 23–27, 2007, Barcelona, Spain

Link to the IGARSS homepage:

http://www.igarss07.org/frontal/Inicio.asp

**Ecological Society of America (ESA)**

August 5–10, 2007, San Jose, California

Link to the ESA annual meeting homepage:

http://esa.org/sanjose/

**Trip Report**

Landsat personnel recently participated in the Association of American Geographers (AAG) and the American Society for Photogrammetry and Remote Sensing (ASPRS) conferences. AAG was held in San Francisco, California, April 17–21, 2007. There were more than 5,000 registered attendees and more than 3,000 individual sessions. Landsat helped support the USGS booth. ASPRS was held in Tampa, Florida, May 7–11, 2007. There were approximately 1,500 attendees and 77 exhibit booths. The Landsat project collaborated with the Commercial Data Acquisition and Management (CDAM) project to staff an exhibit booth.

**The Landsat project just returned from the International Symposium on Remote Sensing of Environment (ISRSE) conference.**

June 25–29, 2007, San José, Costa Rica

Landsat Project Booth 4

Link to the ISRSE homepage:

http://www.cenat.ac.cr/simposio/index.htm

# Landsat Image

## Three Gorges Dam in China

When completed, the $25 billion Three Gorges Dam on the Yangtze River will be the largest hydroelectric dam in the world, more than five times the size of the Hoover Dam in the United States. Spanning more than two kilometers (km) across and 185 meters (m) above the world's third longest river, its reservoir will stretch more than 600 km upstream.

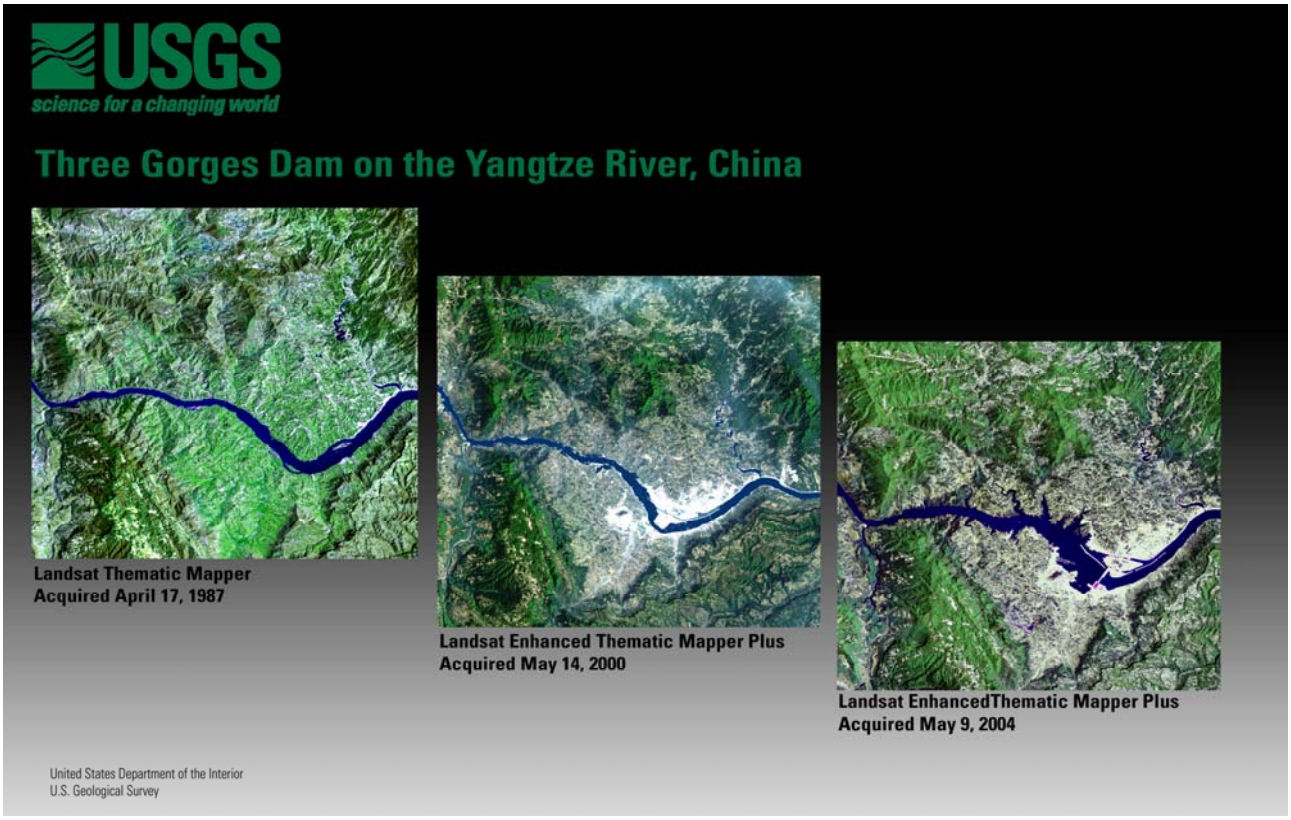
Construction began in 1994, with the dam itself completed in May 2006. Several generators still have to be installed, and the dam is not expected to become fully operational until approximately 2013.

Although there are economic benefits from flood control and hydroelectric power, the project has been plagued by massive corruption problems, spiraling costs, technological problems, human rights violations, and resettlement difficulties.

In addition, there is concern about the displacement of residents; as of 2006 nearly one million people had lost their homes. Many are living under poor conditions with no recourse to address outstanding problems with compensation or resettlement. It is estimated that more than two million people will be displaced by the time of completion.

The loss of many valuable archaeological and cultural sites, as well as the effects on the environment, is also plaguing the project. It is believed that the dam is a contributing factor in the extinction of the Yangtze River dolphin.

The dam is located at a latitude of 30.83° North and a longitude of 111.01° East (30.827778° N 111.009167° E).



# Landsat Information

## USGS Ground Stations

Sites in both South Dakota and Australia capture data from the Landsat satellites. The Landsat Ground Station (LGS) is located at the USGS EROS in Sioux Falls, South Dakota. The Alice Springs (ASN) site is located at the ACRES facility (http://www.ga.gov.au/acres/) in Alice Springs, Australia. These sites receive both science data (via X-band Radio Frequency [RF] link) and spacecraft health and safety data (via S-band RF link). LGS also provides tracking services and a command link to the spacecrafts. LGS and ASN send all S-band data to the Mission Operations Center (MOC) in real-time for immediate health and safety monitoring. Science data collected at ASN are sent to EROS where the Landsat 7 Processing System (LPS) or the Landsat Archive Conversion System (LACS) processes either the Landsat 7 or Landsat 5 data, respectively. The NASA Tracking Data and Relay Satellite System (TDRSS) (http://msl.jpo.nasa.gov/Programs/tdrss.html) is also used to provide S-band support for Landsat 7.

Ground sites in Poker Flat, Alaska (DataLynx), and Svalbard, Norway (SGS), are used as backup sites during times when extra ground resources are necessary to fulfill mission objectives.

The LGS has one main 10 meter antennae for both X-band and S-band and a 5.4 meter antennae for backup, when necessary. The 10 meter antennae downlinks two X-band frequencies so the LGS can downlink international data stored onboard the spacecraft and live data as it passes over the U.S. This capability is not needed for Landsat 5 as it does not have onboard storage. To see live passes over the United States, go to EarthNow!. http://earthnow.usgs.gov

In the next Landsat Update: a look at the International Ground Station (IGS) Network