

## Landsat Update

Volume 5 Issue 4, 2011

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**Twitter, Flickr, and Facebook**

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**Meetings – SilvaCarbon Workshop**

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**Tips and Tricks - GloVis Popout Viewer**

**Landsat Image of Interest - Elephant Butte Reservoir**

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### **Twitter, Flickr, and Facebook**

The USGS Landsat Project has started up a Twitter Account and a Flickr page for the ability to immediately post new images, new LDCM developments, or other timely information. As a direct result of our Twitter feed, Landsat 5 data turned up on Connecticut TV! In a very short time, social media has become a powerful outreach tool.

Our Twitter Feed is posted on the USGS Landsat Missions website (<http://landsat.usgs.gov>) or you can search for @USGSLandsat while logged into Twitter. Our Flickr account is: <http://www.flickr.com/usgslandsat>. We are also partnering with the Landsat Facebook page, which was initiated by the NASA Landsat team and already has 1,000 followers.

See you online!

### **WELD Project**

The WELD (Web-Enabled Landsat Data) Project creates data that are yearly, monthly, seasonal and weekly Landsat mosaic composites that have terrain, radiometric, and atmospheric corrections applied.

Current project requirements encapsulate Continental United States (CONUS) and Alaska using Landsat 7 Enhanced Thematic Mapper Plus (ETM+). WELD products provide consistent data that can be used to derive land cover. They are processed so no converting to reflectance or radiance values are needed. All products align precisely and are projected to the same coordinate system for easy temporal and geographical applications.

WELD is a collaboration that is led by South Dakota State University and supported by NASA and the U.S. Geological Survey. WELD is available as tiled HDF products downloadable from SDSU via FTP server. For more information please visit this website: <http://landsat.usgs.gov/WELD.php>

## Meetings - SilvaCarbon Workshop

The U. S. Geological Survey (USGS) and REDD (Reducing Emissions from Deforestation and Forest Degradation) hosted international scientists for the SilvaCarbon Workshop September 19-22, 2011. Scientists received training and timely satellite data for their areas of study.

The SilvaCarbon Workshops are designed to coordinate with project partners in distribution of products to organizations in need and to help address issues of deforestation and carbon reduction. Each workshop has participants sharing discourse on projects and accomplishments in their regions, accessing and downloading datasets pertinent to their studies, and meeting with leading scientists from USGS EROS. Two additional workshops are planned in 2012.

## Upcoming Meetings

CEOS SAR Calibration and Validation Workshop  
November 7-9, 2011  
Fairbanks, Alaska

William T. Pecora Memorial Remote Sensing Symposium – Pecora 18  
November 14-17, 2011  
Herndon, Virginia  
<http://pecora.asprs.org/>

AGU Fall Meeting  
December 5-9, 2011  
San Francisco, California, USA  
<http://sites.agu.org/fallmeeting/>

AAG Annual Meeting  
February 24-28, 2012  
New York, NY  
<http://www.aag.org/annualmeeting>

ASPRS Conference  
March 19-23, 2012  
Sacramento, California  
<http://www.asprs.org/Annual-Conferences/Sacramento-2012/>

## Tips and Tricks – GloVis Popout Viewer

Are you an avid GloVis user? If you miss the old pop-out viewer, check out the <http://glovis.usgs.gov/ImgViewerHelp.shtml#AdvancedUsers> page. This page is full of beneficial hints and tips for users, including the pop-out viewer. To start GloVis with a "pop-out" window rather than having the Browse Image Viewer embedded in the browser window, use `popout=TRUE`, such as <http://glovis.usgs.gov?popout=TRUE>. Other tips that can be found on this website include changing the default geographic location, or limiting the sensor collection.

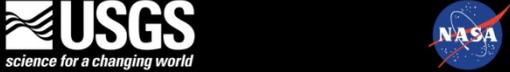
## Landsat Image of Interest – Elephant Butte Reservoir

Prolonged drought in the southwestern United States has affected many water bodies, such as Elephant Butte Reservoir along the Rio Grande River, north of Truth or Consequences, New Mexico. The hydroelectric reservoir has had declining water levels over the past 20 years, as indicated in these Landsat images.

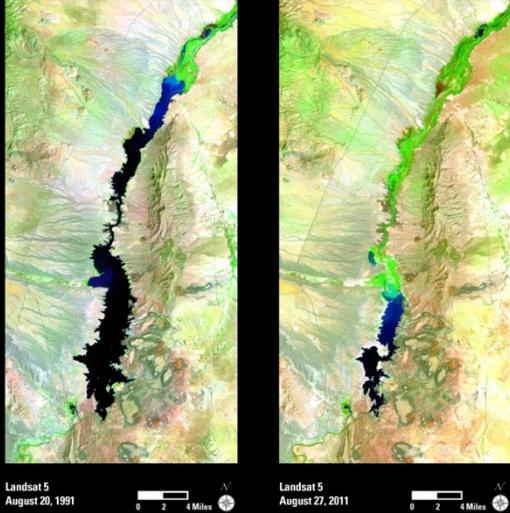
In 2009, the Bureau of Reclamation established a plan to implement conservation measures to restore water levels in the reservoir.

Landsat images are useful in monitoring water bodies for change over time and provide decision makers a visual effect of the declining water levels.

This and more images can be found at <http://landsat.usgs.gov/gallery.php>.



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Landsat 5  
August 20, 1991

Landsat 5  
August 27, 2011

### Elephant Butte Reservoir

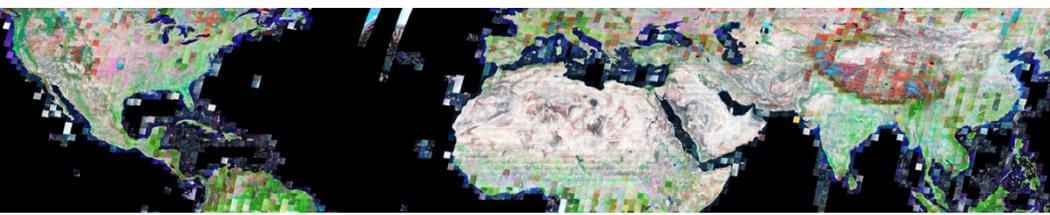
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U.S. Department of the Interior  
U.S. Geological Survey



## **Landsat Update    Volume 5 Issue 3, 2011**

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**Landsat Images on Display at the Library of Congress**

**Landsat Document Donation**

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**Tips and Tricks – What is the Processing level of a Landsat scene?**

**EROS Authors in Recent Publications**

**Landsat Image of Interest –Shrinking Lake Meredith, Texas**

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### **Landsat Images on Display at the Library of Congress**

The most recent USGS Earth as Art exhibit, the third in the series of award-winning Landsat satellite images, will be on display at the Library of Congress beginning May 31, 2011.

The images will be on display for one year.

<http://www.usgs.gov/newsroom/article.asp?ID=2808>

### **Landsat Document Donation**

We need your help!

For 40 years, the Landsat program has been influential in imaging the earth. These data are assets to science, education, and industry communities across the globe. Efforts are underway to collect historical documents relating to the Landsat project. If you or your company has documents, news clippings, or letters concerning Landsat, we want them. These documents are integral to keeping data quality; and may allow us to make strides in developing improvements towards a unified global archive.

## Wind, Fire, and Water

The Landsat Image Gallery displays images collected through the month of June, 2011, that depicts-landscape changes through tornados, fires, and floods.

<http://landsat.usgs.gov/gallery.php>

Jun. 8, 2011 • On June 1, 2011, a supercell thunderstorm developed over western Massachusetts. Landsat 5 satellite captured this natural-color image on June 5, 2011

Jun. 9, 2011 • The second largest fire in Arizona history, the Wallow Fire is graphically depicted by this Landsat image, taken June 7, which shows burning in the mountains of eastern Arizona near the border with New Mexico.

Jun. 11, 2011 • In a Landsat 5 satellite image captured June 11, 2011, flooding is still evident both east and west of the Mississippi River near Vicksburg, Miss.

## Landsat Technical Working Group Meeting Held



The Landsat Technical Working Group (LTWG#20) meeting was held in Sioux Falls, SD, USA, May 23-27, 2011. Participants from 17 countries, including members of the USGS and NASA Landsat and Landsat Data Continuity Mission (LDCM) Projects, represented 23 U.S. and international ground stations and discussed a wide range of technical topics. Special guest, Anne Castle, U.S. Department of the Interior (DOI) Assistant Secretary for Water and Science, welcomed the attendees and

provided perspective on the key role played in current and future international land imaging cooperation.

Landsat Project presentations included Landsat 5 and Landsat 7 mission statuses, Global Land Survey status, the Landsat Global Archive Consolidation initiative, operational Data Validation & Exchange (DV&E) status, and Calibration/Validation. The Landsat Project also hosted a technical workshop on Landsat 1-5 Multi-Spectral Scanner (MSS) Data Processing current progress and future plans. LDCM presentations included Project and Ground System status including plans and timelines for LDCM Ground System processing software availability, the LDCM Space-to-International Cooperator (IC) interface, and DV&E and Ground Station Certification. A Landsat Science Team update was also presented, providing information on several key application and research projects. NASA also provided attendees with an overview of the overall LDCM mission status. Concurrent with the typical LTWG agenda, the USGS also hosted a 3-day Ground System Technical Workshop for its International Cooperator attendees. The workshop covered both Landsat and LDCM (Landsat 8) ground system technical information such as requirements, interfaces, design, and implementation details.

Each International Cooperator briefed the group on the status of their ground systems including electronic data delivery capabilities and challenges, presented their future satellite mission(s), provided an overview of their data distribution model(s), and discussed current status of their Landsat Global Archive Consolidation activities.

International Cooperators and U.S. attendees included representatives from the following countries and organizations:

- Argentina (CONAE)
- Australia (GA-NEO)
- Australia (DCCEE)
- Brazil (INPE, AMS Kepler)
- Canada (CCRS, MDA)
- China (CEODE)
- Ecuador (CLIRSEN)
- Europe (ESA)
- Germany (DLR)
- Indonesia (LAPAN)
- Japan (RESTEC)
- Mexico (CONABIO)
- Russia (ScanEx)
- Saudi Arabia (KACST)
- South Africa (SANSA, PinkMatter)
- Sweden (SSC)
- Thailand (GISTDA)
- United States (DOI, USGS, NASA, Aerospace, Honeywell, Lockheed Martin, SeaSpace, SGT, Virtuoso)

## Upcoming Meetings

ESRI International User Conference

July 11-15, 2011

San Diego, California

<http://www.esri.com/events/user-conference/index.html>

William T. Pecora Memorial Remote Sensing Symposium – Pecora 18

November 14-17, 2011

Herndon, Virginia

<http://www.asprs.org/Pecora18>

## Tips and Tricks –What is the Processing Level of a Landsat scene?

The processing levels of Landsat scenes [Level 1G-systematic (L1G) or Level 1T-terrain (L1T)] can be viewed in the metadata of a particular scene, or by searching the Data Type Level field within the Additional Criteria tab on EarthExplorer (<http://earthexplorer.usgs.gov>).

## EROS Authors in Recent Publications

Cao, C.X., Upreti, S., Xiong, J., Ungar, S., Wu, A., Jing, P., Smith, D., **Chander, G.**, and Fox, N., 2010, Establishing the Antarctic Dome C community reference standard site towards consistent measurements from Earth observation satellites: Canadian Journal of Remote Sensing, v. 36, no. 5, p. 498-513. (Also available online at <http://dx.doi.org/10.5589/m10-075>.)

**Vogelmann, J.E., Kost, J.R., Tolk, B.L., Howard, S.M.,** Short, K., **Chen, X.**, Huang, C., **Pabst, K., and Rollins, M.G., 2011**, Monitoring landscape change for LANDFIRE using multi-temporal satellite imagery and ancillary data: IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, v. 4, no. 2, p. 252-264. (Also available online at <http://dx.doi.org/10.1109/JSTARS.2010.2044478>.)

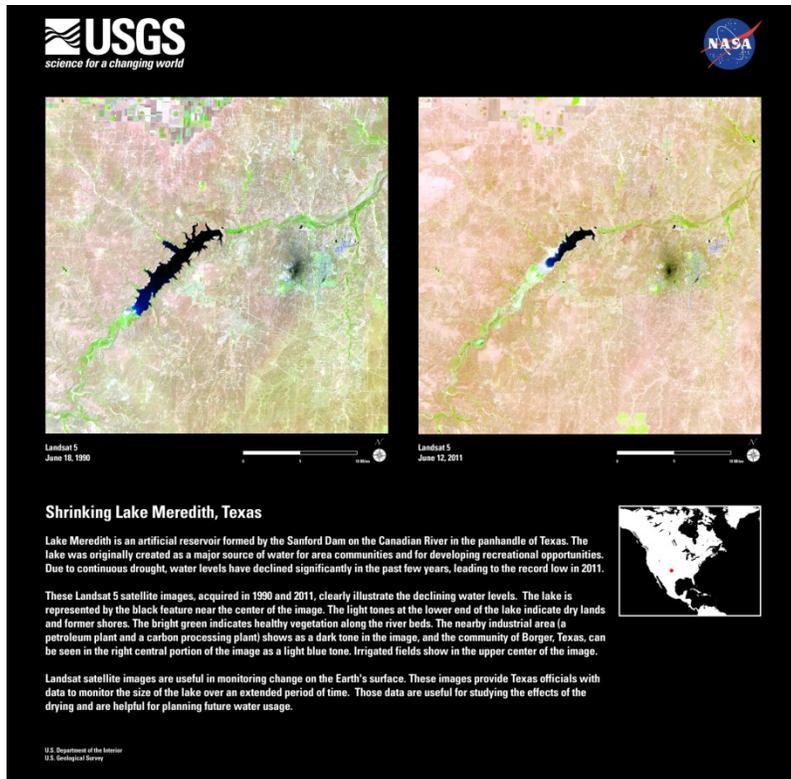
# Landsat Image of Interest – Shrinking Lake Meredith, Texas

Lake Meredith is an artificial reservoir formed by the Sanford Dam on the Canadian River in the panhandle of Texas. The lake was originally created as a major source of water for area communities and for developing recreational opportunities. Due to continuous drought, water levels have declined significantly in the past few years, leading to the record low in 2011.

These Landsat 5 satellite images, acquired in 1990 and 2011, clearly illustrate the declining water levels. The lake is represented by the black feature near the center of the image. The light tones at the lower end of the lake indicate dry lands and former shores. The bright green indicates healthy vegetation along the river beds. The nearby industrial area (a petroleum plant and a carbon processing plant) show as a dark tone in the image, and the community of Borger, Texas, can be seen in the right central portion of the image as a light blue tone. Irrigated fields show in the upper center of the image.

Landsat satellite images are useful in monitoring change on the Earth's surface. These images provide Texas officials with data to monitor the size of the lake over an extended period of time. Those data are useful for studying the effects of the drying and are helpful for planning future water usage.

Landsat Images of Interest can be downloaded from the Landsat Image Gallery - <http://landsat.usgs.gov/gallery.php>.



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**NASA**

Landsat 5  
June 18, 1990

Landsat 5  
June 12, 2011

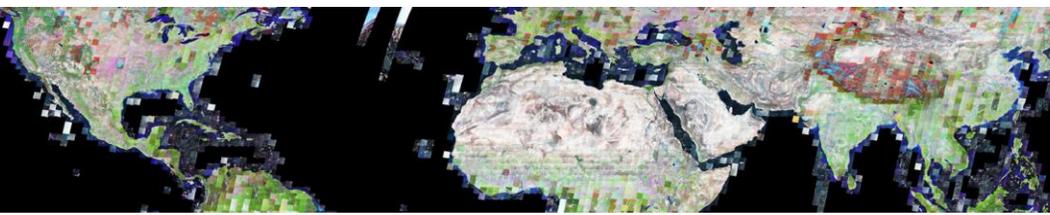
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U.S. Department of the Interior  
U.S. Geological Survey



# Landsat Update

Volume 5 Issue 2, 2011

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**Call for Pecora 2011 Award Nominations**

**Landsat 4 Thermal Band Calibration Update**

**LandsatLook Images**

**Global Land Survey 2010 Available**

**Meetings - Landsat Science Team Meeting Held**

**Upcoming Meetings**

**Tips and Tricks – Landsat Download Video Demonstration**

**EROS Authors in Recent Publications**

**Landsat Image of Interest – Fires in Western Texas**

**View Printable Version - .pdf (530 KB)**

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## **Call for Pecora 2011 Award Nominations**

The William T. Pecora Award is presented annually to individuals or groups that have made outstanding contributions toward understanding the Earth by means of remote sensing. The Department of the Interior (DOI) and the National Aeronautics and Space Administration (NASA) jointly sponsor the award. The award was established in 1974 to honor the memory of Dr. William T. Pecora, former Director of the U.S. Geological Survey and Under Secretary, Department of the Interior. Dr. Pecora was a motivating force behind the establishment of a program for civil remote sensing of the Earth from space. His early vision and support helped establish what we know today as the Landsat satellite program.

The Award Committee must receive nominations for the 2011 award by June 1, 2011. Instructions for preparing a nomination and other information about the award can be found on the Pecora Award web site: <http://remotesensing.usgs.gov/pecora.php>

## **Landsat 4 TM Thermal Band Calibration Update**

Effective April 1, 2011, the calibration of the thermal band on the Landsat 4 Thematic Mapper (TM) was updated to correct for an offset error of  $-0.43 \text{ W/m}^2 \text{ sr } \mu\text{m}$ , for all data acquired after April 1, 1986.

Using the network of National Oceanic and Atmospheric Administration (NOAA) buoys deployed in open water around the continental U.S., the vicarious calibration team at the Rochester Institute of Technology was able to determine that the Landsat 4 data acquired between launch and March 31, 1984 were calibrated to within  $\pm 0.99\text{K}$ . Data acquired after July 1, 1986 exhibited a calibration error of  $-0.43 \text{ W/m}^2 \text{ sr } \mu\text{m}$  or about  $3.1\text{K}$  at  $300\text{K}$ . There were no data acquired between April 1984 and July 1986 due to several failures on board Landsat 4, one of which likely led to the calibration error. The thermal band calibration for the TM instrument relies on predetermined calibration coefficients. When the instrument was turned back on in 1986, it operated at much colder temperatures. The calibration error is likely caused by not adapting the calibration coefficients to the new operating temperatures.

The Calibration Parameter Files for the affected date range were updated on April 1, 2011. All Landsat 4 TM data processed after this date are considered calibrated to within  $\pm 0.80\text{K}$ . For data processed before April 1, 2011, users can add  $0.43 \text{ W/m}^2 \text{ sr } \mu\text{m}$  to the radiance image product and consider the data calibrated or reorder the data. This information can also be found at:

[http://landsat.usgs.gov/calibration\\_update\\_L4\\_TM.php](http://landsat.usgs.gov/calibration_update_L4_TM.php)

## **LandsatLook Images**

LandsatLook images are full resolution .jpeg files that are included as options when downloading Landsat data from EarthExplorer (<http://earthexplorer.usgs.gov>) or GloVis (<http://glovis.usgs.gov>). Derived from Landsat Level 1 data products, these images are useful for image selection and for visual interpretation. Bands 5, 4, 3 were used for the color composite. Algorithms applied to the images will cause minor local smoothing to the data values of the images, and while this should not affect interpretation of the images, it is not recommended that they be used in digital analysis.

<http://landsat.usgs.gov/LandsatLookImages.php>

## **Global Land Survey 2010 Available**

In the past, the USGS and NASA collaborated on the creation of four global land data sets from Landsat images: one from the 1970s, and one each from circa 1990, 2000, and 2005. Each of these global data sets was created from the primary Landsat sensor in use at the time: the Multispectral Scanner (MSS) in the 1970s, the Thematic Mapper (TM) in 1990, Enhanced Thematic Mapper Plus (ETM+) in 2000, and a combination of TM and ETM+ in 2005.

To extend this multi-decadal Landsat data collection, NASA and the USGS have again partnered to develop the Global Land Survey 2010 (GLS2010), a new global land data set with core acquisition dates of 2009-2010. The data will consist of both Landsat TM and ETM+ images.

[http://landsat.usgs.gov/science\\_GLS.php](http://landsat.usgs.gov/science_GLS.php)

## Meetings – Landsat Science Team Meeting Held

The Landsat Science Team met in Mesa, AZ from March 1-3, 2011 to review the status of the Landsat Data Continuity Mission (LDCM) development, Landsat 5 and Landsat 7 activities, and recent activities and updates regarding future Landsat missions.

The team toured the Orbital Sciences facility in Gilbert, AZ where the LDCM spacecraft is being built and heard that key LDCM systems (Operational Land Imager, Thermal Infrared Sensor, spacecraft, and ground system) are on schedule for the planned December 2012 launch.

The team also discussed the President's FY2012 budget request that would establish the National Land Imaging program within the Department of the Interior and USGS, and authorize the development of Landsat 9.

Meeting presentations are available at [http://landsat.usgs.gov/science\\_LST\\_mar1\\_3\\_2011.php](http://landsat.usgs.gov/science_LST_mar1_3_2011.php).



**Figure 1: Landsat Science Team, March 2011**

## Upcoming Meetings

APSRs Annual Conference

May 1-5, 2011

Milwaukee, Wisconsin

<http://www.asprs.org/milwaukee2011/>

Landsat Technical Working Group Meeting

May 23-27, 2011

USGS EROS

Sioux Falls, South Dakota

ESRI International User Conference

July 11-15, 2011

San Diego, California

<http://www.esri.com/events/user-conference/index.html>

William T. Pecora Memorial Remote Sensing Symposium – Pecora 18

November 14-17, 2011

Herndon, Virginia

[www.asprs.org/Pecora18](http://www.asprs.org/Pecora18)

## Tips and Tricks – Landsat Download Video demonstration

A recent posting to the AmericaView Blog included a video that demonstrates how to download Landsat data from GloVis (<http://blog.americaview.org/2011/03/accessing-landsat-data-and-using-it-in.html>). It goes on to show how to work with Landsat Images in ArcGIS.

This Blog is set up by members of AmericaView, a nationwide program that focuses on satellite remote sensing data and technologies in support of applied research, K-16 education, workforce development, and technology transfer.

## EROS Authors in Recent Publications

Anderson, J.E., Ducey, M.J., Fast, A., Martin, M.E., Lepine, L., Smith, M.-L., Lee, T.D., Dubayah, R.O., Hofton, M.A., Hyde, P., **Peterson, B.E.**, and Blair, J.B., 2011, Use of waveform lidar and hyperspectral sensors to assess selected spatial and structural patterns associated with recent and repeat disturbance and the abundance of sugar maple (*Acer saccharum* Marsh.) in a temperate mixed hardwood and conifer forest: *Journal of Applied Remote Sensing*, v. 5, citation identifier 053504, available only online at <http://dx.doi.org/10.1117/1.3554639>.

Chen, J., Zhu, X., **Vogelmann, J.E.**, Gao, F., and **Jin, S.**, 2011, A simple and effective method for filling gaps in Landsat ETM+ SLC-off images: *Remote Sensing of Environment*, v. 115, no. 4, p. 1053-1064. (Also available online at <http://dx.doi.org/10.1016/j.rse.2010.12.010>.)

\*Previously in press, now published.

Li, A., Huang, C., Sun, G., **Shi, H.**, Toney, C., Zhu, Z., **Rollins, M.G.**, Goward, S.N., and Masek, J.G., in press, Modeling the height of young forests regenerating from recent disturbances in Mississippi using Landsat and ICESat data: *Remote Sensing of Environment*. (Also available online at <http://dx.doi.org/10.1016/j.rse.2011.03.001>.)

## **Landsat Image of Interest – Fires in Western Texas**

April Fires in Western Texas

Sensor: L5 TM

Acquisition Date: February 27, 2001, April 16, 2011

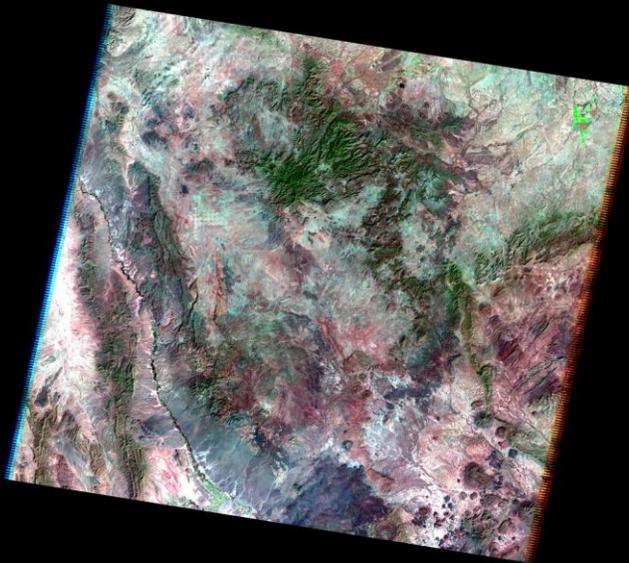
Path/Row: 31/39

Lat/Long: 30.300/-104.100

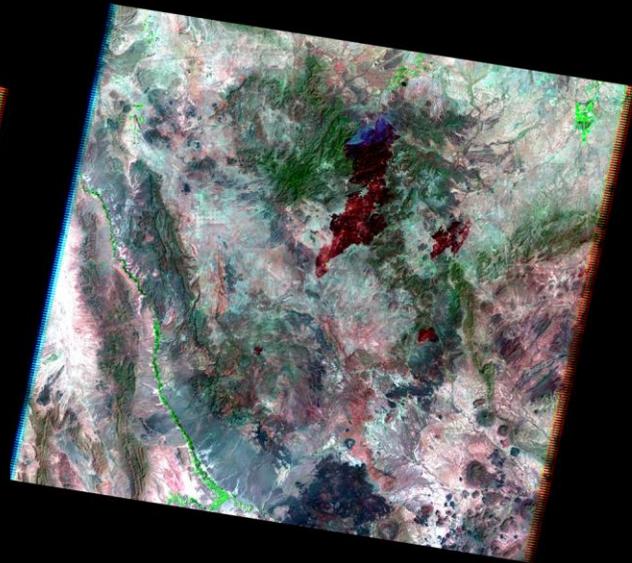
Extreme drought and high winds have fueled many wildfires in west Texas recently. More than a dozen fires have scorched at least 400 sq. miles of land since April 14, 2011.

As seen by the large, dark tone in the April 16, 2011 image, the Rock House fire has scorched more than 120,000 acres and ravaged dozens of structures in and around Fort Davis. Scars from other fires can also be seen in the image.

Landsat imagery illustrates the fire scars and smoke from burning fires. Smoke from an active fire can be seen in the northern portion of the largest scar. In the center of the large fire scar is the town of Fort Davis, one of many small towns that lost many homes and businesses because of the fire.



Landsat 5  
February 27, 2011



Landsat 5  
April 16, 2011



## April Fires in Western Texas

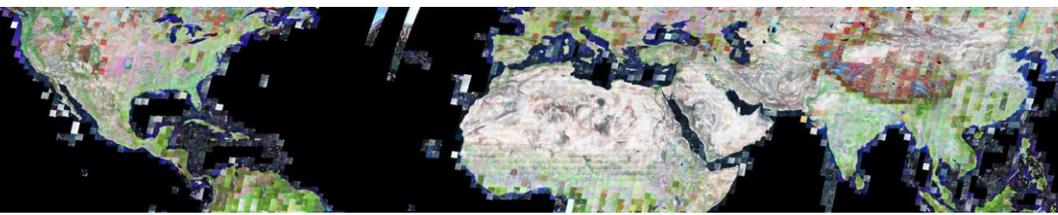
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**Figure 2: April Fires in Western Texas**



### **MSS Data Products now created with LPGS processing system**

### **A Landsat Milestone: Four Million Scenes**

### **Too Close for Comfort**

### **Meetings and Conferences**

### **Tips and Tricks - G-Verify Image**

### **EROS Authors in Recent Publications**

### **Landsat Image of Interest – Gulf of Carpentaria, Queensland, Australia**

### **View Printable Version - .pdf (494 KB)**

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### **MSS Data Products now created with LPGS processing system**

As of September 15, 2010, all MSS data are processed using the LPGA processing system. Previously processed using NLAPS, the new products are now consistent with Landsat ETM+ and TM data products.

### **A Landsat Milestone: Four Million Scenes**

When the U.S. Geological Survey (USGS) opened the Landsat archive to user access at no charge in October, 2008, nobody could have predicted that four million scenes would be distributed in such a short period.

On Thanksgiving Day, November 25, 2010, a user downloaded the four-millionth Landsat image from a USGS Web site at its Earth Resources Observation and Science (EROS) Center in Sioux Falls, South Dakota. Presently, more data are distributed in one week than in the year prior to the archive being opened.

“USGS satellite operations and its data archives at EROS enable experts, or any interested member of the public, to see the land objectively with unbiased, consistently calibrated data. The historical depth and reliability of these earth observations are vital to scientists and land managers across the country and across the Department of the Interior in projects that range from climate change studies

and invasive species surveys to the monitoring of drought and assessment of wildfire damage,” said Secretary of the Interior, Ken Salazar.

The Landsat science mission is to gather data of the Earth’s land surfaces at a scale where natural and human-induced changes can be detected, characterized, and monitored over time. These data are used for a wide array of activities such as monitoring land change, assessing the impacts of wildfires, and detecting evidence of climate change.

Landsat scenes can be previewed and downloaded through the USGS Global Visualization Viewer (<http://glovis.usgs.gov>) or USGS EarthExplorer (<http://earthexplorer.usgs.gov>).

## **Too Close for Comfort**

Both Landsat 5 and Landsat 7 orbit the earth at 705 km above the surface (about 435 m) and travel at around 17,000 miles per hour. At these speeds, crashing into something else, like another orbiting satellite or space debris, could do major damage. When a communication satellite owned by Iridium (a U.S. company) collided with a non-functioning Russian satellite (COSMOS 2251) in February 2009, it created over 2,500 pieces of debris, and that doesn’t count the small pieces!

In July of 2010, two pieces of debris from the Iridium/Cosmos 2251 collision came close enough to the Landsat spacecrafts to cause some concern (called conjunctions). While maneuvers can be done to avoid collisions, it uses fuel which is vital for normal operations. In these instances, the closest debris was 1.7 km, considered far enough away to avoid a maneuver. In August however, Landsat 5 was heading within 56 m (183 ft) of COSMOS 2251 debris, so an avoidance maneuver was conducted on August 24<sup>th</sup>. In all, there were 12 conjunctions in August that required monitoring to ensure spacecraft safety.

The U.S. military’s Space Surveillance Network began tracking items in space when Russia launched Sputnik I in 1957. It now tracks more than 8,000 manmade objects in Earth’s orbit. The objects are all baseball size or larger and only 7 percent are operational satellites - the rest are pieces of debris.

## **Meetings & Conferences**

Landsat Technical Working Group Meeting  
May 23-27, 2011  
USGS EROS  
Sioux Falls, South Dakota

Association of American Geographers Annual Meeting  
April 12-16, 2011  
Seattle, Washington  
<http://www.aag.org/cs/annualmeeting>

## **Tips and Tricks – G-Verify Image**

The g-verify image is a new file added to the MSS package (\_VER.jpg). This is a quick look at the geometric accuracy of an image. These points and the root mean square error (RMSE) will change from image to image dependent upon cloud cover, shadows, or drops in water bodies. The g-verify is not used as a control, but rather as an independent source for verification of geo-locational accuracy. For more information about the g-verify products, see <http://landsat.usgs.gov/NewMSSProduct.php>.

## EROS Authors in Recent Publications

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<http://www.informaworld.com/10.1080/01431161.2010.490569>

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## Landsat Image of Interest – Flooding along the Gulf of Carpentaria Queensland, Australia

Nearly every week, the USGS prepares and disseminates an image that demonstrates how Landsat can be used for a variety of land change topics or current events. Please visit <http://landsat.usgs.gov> for more information. You can also subscribe to the RSS feed to be notified of newest additions- <http://landsat.usgs.gov/landsatimagegallery.rss>

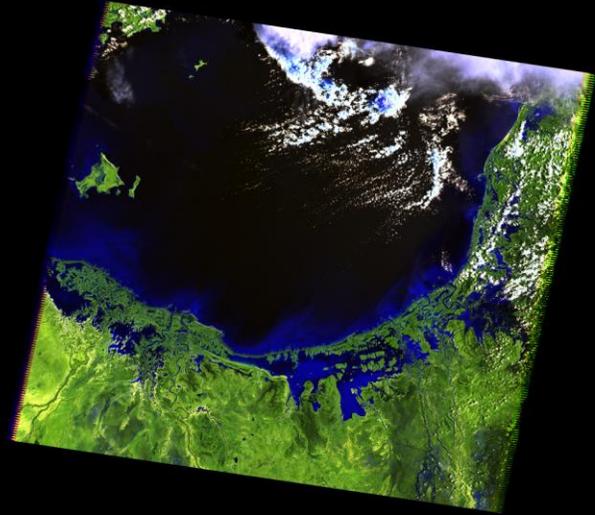
Landsat 5 data, acquired over the Gulf of Carpentaria, illustrate the dramatic effects of flooding in this northern region of Australia.

The coastal area of the Gulf is a major resort area, as well as a source for extensive bauxite and manganese excavation. The (left to right) Nicholson, Leichhart, Flinders, and Carron Rivers drain from the central lowlands of Queensland into the Gulf, eventually flowing into the Arafura Sea. The light tone along the sea coast shows the rare example of an epicontinental sea, a shallow sea on top of the continent extension.

The October 3, 2010, image shows the drainage from the rivers (in shades of blue) into the beach and salt flats along the coast. The January 23, 2011, image shows the effects of historic rainfall upstream. Blue tones show the inundation of coastal lands and turbidity masking the subsurface continental shelf.

The Landsat data provide a permanent record of land surface change, which shows the rising and eventual falling of

river levels and the effects of flooding on mining and recreational development.



Landsat 5  
October 3, 2010



Landsat 5  
January 23, 2011



## Flooding along the Gulf of Carpentaria, Queensland, Australia

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