Landsat Update

Volume 4 Issue 4, 2010

New Landsat 5 Thematic Mapper Acquisition Scheduler

A new Landsat 5 Thematic Mapper (TM) acquisition scheduler was released on May 6, 2010. Similar to that employed by Landsat 7 operations, the new scheduler incorporates daily global cloud forecasts along with seasonal cloud climatology to increase the relative likelihood of acquiring usable imagery. This system has the goal of extending the Landsat 5 Mission while targeting scene opportunities most likely to yield high quality imagery for the global archive.

Landsat 7 Turns Eleven

On Apr. 15, 1999, Landsat 7 was launched into orbit. Considered the most accurately calibrated Earth-observing satellite, Landsat 7 measurements are extremely accurate when compared to the same measurements made on the ground. Excellent data quality, consistent global archiving scheme, and free data are hallmarks of its impressive tenure.

The Landsat 7 mission had few issues until May 2003 when a hardware component failure left wedge-shaped spaces of missing data on either side of its images. Despite these problems and the resulting data loss of 22 percent of each image, Landsat 7 data is still highly useful for many scientific applications.

Landsat YouTube:

A Space Age Water Gauge

Water specialists Rick Allen, Bill Kramber and Tony Morse have created an innovative satellite-based method that maps agricultural water consumption. The team uses Landsat thermal band data to measure the amount of water evaporating from the soil and transpiring from plants leaves. Evapotranspiring water absorbs energy, so farm fields consuming more water appear cooler in the thermal band. The Landsat observations provide an objective way for water managers to assess on a field-by-field basis how much water agricultural growers are using. Landsat is a joint program of NASA and the US Geological Survey.

http://www.worldvideonews.net/nasa-usgs-landsat-a-space-age-water-gauge/

A Landsat Flyby

The Landsat program is the longest continuous global record of the Earth's surface, and continues to deliver both visually stunning and scientifically valuable images of our planet. This short video highlights Landsat's many benefits to society. For more information: landsat.gsfc.nasa.gov

http://www.worldvideonews.net/nasa-a-landsat-flyby/

Dr. Jeff Masek Named NASA Landsat Project Scientist

Jeff Masek has been named the NASA Landsat Project Scientist replacing Darrel Williams who recently retired from NASA. Masek had been serving as Deputy Project Scientist for the Landsat Data Continuity Mission (LDCM) since 2002. Masek is a Research Scientist in the Biospheric Sciences Branch at NASA Goddard Space Flight Center whose research interests include mapping land-cover change in temperate environments, application of advanced computing to remote sensing, and satellite remote sensing techniques.

http://landsat.gsfc.nasa.gov/news/news-archive/news_0255.html

Meetings & Conferences

Landsat Technical Working Group Meeting

The 2010 Landsat Technical Working Group (LTWG-19) meeting was held in Phuket, Thailand, on March 22–26, 2010. The meeting was jointly organized by the USGS and NASA and was hosted by the Thailand Geo-Informatics and Space Technology Development Agency (GISTDA).

Participants from 9 countries, including members of the USGS Landsat and Landsat Data Continuity Mission (LDCM) Projects, represented 14 international ground stations and discussed a wide range of technical topics.

Upcoming Meetings

ESRI International User Conference
July 12-16, 2010 - San Diego, California

EROS Authors in Recent Publications

Angal, A., Xiong, X., Choi, T.-Y., Chander, G., and Wu, A., 2010, Using the Sonoran and Libyan Desert test sites to monitor the temporal stability of reflective solar bands for Landsat 7 Enhanced Thematic Mapper Plus and Terra moderate resolution imaging spectroradiometer sensors: Journal of Applied Remote Sensing, v. 4, no. 1, p. 043525-12.
http://dx.doi.org/10.1117/1.3424910

Xian, G., and Homer, C.G., in press, Updating the 2001 National Land Cover Database impervious surface products to 2006 using Landsat imagery change detection methods: Remote Sensing of Environment.
http://dx.doi.org/10.1016/j.rse.2010.02.018

Hansen, M.C., Stehman, S.V., and Potapov, P.V., 2010, Quantification of global gross forest cover loss: Proceedings of the National Academy of Sciences.
http://dx.doi.org/10.1073/pnas.0912668107

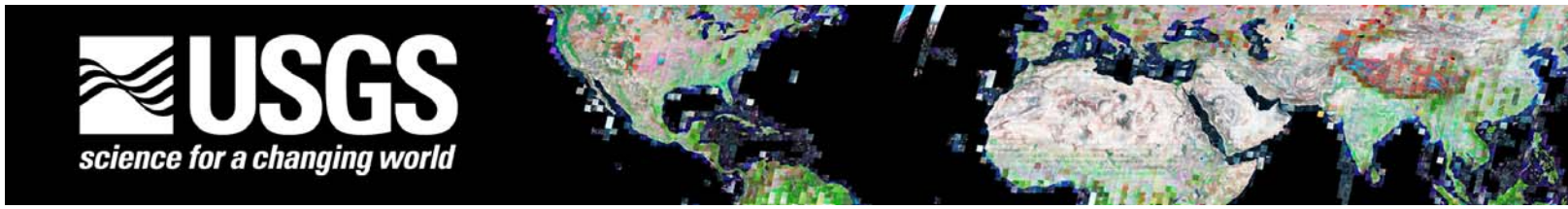
Lu, Z., Zhang, J., Zhang, Y., and Dzurisin, D., 2010, Monitoring and characterizing natural hazards with satellite InSAR imagery: Annals of GIS, v. 16, no. 1, p. 55-66.
http://prod.informaworld.com/10.1080/19475681003700914

Zhang, J., Xu, Y., Yao, F., Wang, P., Guo, W., Li, L., and Yang, L., 2010, Advances in estimation methods of vegetation water content based on optical remote sensing techniques: Science China Technological Sciences, p. 1-9.
http://www.springerlink.com/content/r777367u5565612h/

Landsat Image of Interest

These Landsat 5 images show how record-breaking rainfall from severe storms on May 1 and 2, 2010, affected the Mississippi River along the state borders of Tennessee, Kentucky, Arkansas, and Missouri.

The water has receded from the populated areas of Memphis, which is just south of the image, but some families are still living in shelters due to health hazards that resulted from the flooding.



Landsat Update

Volume 4 Issue 3, 2010

Modification to Landsat 5 Acquisition Plan

During Landsat 5's first 25 years, the Thematic Mapper (TM) sensor acquired data over assigned ground stations regardless of cloud cover or season. This resulted in the collection of significant numbers of TM scenes unsuitable for analysis. In order to maximize the life of the components on the spacecraft, the U.S. Geological Survey's Flight Operations Team has begun creating a new scheduling tool, designed to avoid acquiring data over areas considered to be too cloudy or off-season. Other variables will also be analyzed, including the time period since the scene was last acquired, the location of calibration sites, the degree of land area overlap between scenes, and more.

Although this is a substantial change to Landsat 5 operations, the USGS believes the effect of the change will be to maximize quality data acquisitions, reduce the number of unusable scenes in the archive, and extend the life of the mission. The new acquisition plan will maintain the long-standing policy of prioritizing collection of the continental U.S., while continuing to provide direct downloads to our International Cooperators. Questions or concerns about the new Landsat 5 acquisition plan can be sent to custserv@usgs.gov.

Stewart Udall, Grandfather of the Landsat Mission

With Stewart Udall's recent passing there have been many powerful obituaries (e.g; Washington Post, March 21, 2010) noting the amazing heritage that Stewart Udall left, particularly in his service to the nation as Secretary of the Department of the Interior (DOI), under the Presidential administrations of John Kennedy and Lyndon Johnson. His contributions to our National Parks and protection of our natural resources were indeed remarkable.

However, one critical aspect of Secretary Udall's contributions to US society and technology appears to have been missed by many reporters. In the early 1960s, as the space race with the Soviet Union continued to heat up, many U.S. Geological Survey (USGS, a DOI Bureau) scientists – under Dr. William T. Pecora's direction – became increasingly involved with NASA and the US Department of Agriculture (USDA) in the application of newly evolving "remote sensing" methods to the monitoring of the Earth's resources. By the mid-1960s NASA's plans to develop a land satellite observatory were still slowly evolving, with most of NASA's attention focused on the Apollo missions. Dr. Pecora and his USGS team, recognizing the immediate value of satellite-acquired land observations, became increasingly anxious that a satellite land observation system be developed and deployed for agencies such as DOI and USDA.

By 1966 Dr. Pecora had convinced Secretary Udall that DOI should announce plans to develop their own satellite system, the Earth Resources Observation Satellite (EROS). This probably in part was done to get NASA to pay more attention to this mission. He prepared a memo for Secretary Udall that explained why USGS and DOI needed EROS to monitor land cover dynamics. Announcement of a USGS-led EROS program took place on September 21, 1966. Curiously, the Secretary was on a rafting trip down the Colorado River with his good friend Ladybird Johnson when this announcement was made.

The Udall announcement created a storm of political protest from NASA and Defense agencies, neither of which wanted another competitor in the Earth observations business. Rumor has it that President Johnson, furious with the resulting controversy, never spoke again with Secretary Udall. Nevertheless, the Udall EROS announcement did capture considerable Washington attention, which led NASA to begin development of the Earth Resources Technology Satellite (ERTS) in 1967. ERTS-1 was placed into orbit on July 23, 1972 and renamed Landsat 1 in 1975. The Landsat mission has been operating continuously since that time, documenting the Earth's land dynamics—through six individual observatories—for nearly 40 years now. Landsat data is archived at the USGS National Satellite Land Remote Sensing Data Archive (NSLRSDA) held at the Earth Resources Observations and Science (another EROS) Center in Sioux Falls, South Dakota. This observation record provides the only permanent, continuous basis for understanding the Earth's land dynamics over the last half century.

Not only did Stewart Udall raise our concerns about the Earth's environment and resources and take steps to preserve some of the most beautiful areas of our country, but he also took the politically brave steps needed to ensure that we used our new space technologies to monitor the Earth's land areas. We are only beginning today to appreciate the magnitude of this important contribution to understanding the recent history of our evolving uses of our critical land areas—a truly amazing contribution to our future generations.

Landsat Thermal Band Pixel Size Change

Commercial software has difficulty aligning the 30-meter multispectral bands of Landsats 4-7 with the 60-meter thermal band. This forces users of the Landsat thermal band to resample data. Effective February 25, 2010, the pixel size for all thermal data is processed at 30 meters. More details can be found at http://landsat.usgs.gov/about_LU_Vol_4_Issue_Special_Edition.php.

Calibration Update to ETM+ Thermal Band

Effective January 1, 2010, the calibration of the ETM+ thermal band was modified to correct for a lifetime gain error detected by the various calibration teams. Changes were made to the Calibration Parameter File (CPF) to correct a gain error that has been present since the launch of the instrument. This gain error causes the thermal band to predict too hot at cold temperatures and too cold at hot temperatures. http://landsat.usgs.gov/science_calibration.php.

Meetings & Conferences – Landsat Science Team Meeting Held

The Landsat Science Team Meeting was held January 19–21, 2010 at the Computer History Museum in Mountain View, California. Landsat 5 and 7 status updates, proposed Landsat processing changes, MSS calibration, LDCM progress and more was discussed. More details are available on the Landsat Science Team Meetings webpage: http://landsat.usgs.gov/science_LST_Team_Meetings.php.

Figure 1 Landsat Science Team January 2010

Meetings & Conferences – Upcoming

AAG Annual Meeting

April 14-18, 2010
Washington, DC
http://aag.org/annualmeetings/2010/index.htm

ASPRS Annual Conference
April 26 – 30, 2010
San Diego, California
http://www.asprs.org/SanDiego2010/index.html

Tips & Tricks – How Do I Determine the Processing Level of the Landsat Scene I have Downloaded?

The processing level of a downloaded scene can be found in either the metadata (MTL.txt) or processing history (WO.txt) files. These files are delivered with the data band files and other ancillary data. The MTL.txt file is included when a scene is processed through the Level 1 Product Generation System (LPGS). All Landsat 7 ETM+ (1999–present) and most Landsat 4-5 TM (1982–present) scenes are processed through LPGS. The WO.txt file is included when a scene is processed through the National Land Archive Production System (NLAPS). All Landsat 1–5 MSS (1972–83) and some Landsat 4-5 TM (1982–1990) scenes are processed through NLAPS.

After downloading the scene, locate and open the MTL.txt file or the WO.txt file.

Within the MTL.txt file, the processing level is listed as **PRODUCT TYPE**. L1T designates terrain corrected processing. L1Gt designates systematic terrain corrected processing. L1G designates systematic corrected processing.

Within the WO.txt file, the processing level is listed as **Processing Level**, as seen in the example below. Precision Geocorrection designates terrain corrected processing, similar to L1T processing listed in the MTL.txt example listed above. Systematic Geocorrection designates systematic corrected processing.

These details, along with graphics showing the files can be found at
http://landsat.usgs.gov/processing_level_of_the_Landsat_scene_I_have_downloaded.php

LDCM News – FY 2011 Budget for USGS Includes LDCM Funding

In a fiscally responsible budget that emphasizes cost containment, management efficiencies and program savings, the President's proposed $1.1 billion budget for the U.S. Geological Survey (USGS) in fiscal year 2011 reflects his commitment to use science as the basis for natural resource management decisions.

"Science is a cornerstone for sound decision making," said Marcia McNutt, USGS director. "Today's complex, interrelated natural resource issues—such as climate change, energy conservation and development, and water quality and availability—demand that policy makers and managers start with timely, unbiased science. The President's budget supports that vital perspective."

The FY 2011 USGS budget includes $13.4M towards Landsat Data Continuity. Scientists, educators and the general public around the globe use USGS Landsat data for a wide array of activities ranging from supporting disaster relief efforts to making agricultural crop assessments to identifying sites for cell phone towers. The USGS will accommodate ground-system requirement changes for the Landsat Data Continuity Mission associated with moving the Operational Land Imager to a free-flying satellite and the addition of a Thermal Infrared Sensor on board the spacecraft. These activities are required to meet the mission launch in December 2012.

EROS Authors in Recent Publications

Chander, G., Xiong, X., Choi, T., and Angal, A., in press, Monitoring on-orbit calibration stability of the Terra MODIS and Landsat 7 ETM+ sensors using pseudo-invariant test sites: Remote Sensing of Environment
http://dx.doi.org/10.1016/j.rse.2009.12.003

Gu, Y., Brown, J.F., Miura, T., van Leeuwen, W.J., and Reed, B., 2010, Phenological classification of the United States—a geographic framework for extending multi-sensor time-series data: Remote Sensing, v. 2, no. 2, p. 526-544.
http:dx.doi.org/10.3390/rs2020526

Roy, D.P., Ju, J., Mbow, C., Frost, P., and Loveland, T.R., 2010, Accessing free Landsat data via the Internet—Africa's Challenge: Remote Sensing Letters, v. 1, no. 2, p. 111-117.
http://www.informaworld.com/smpp/content~db=all?content=10.1080/01431160903486693

Napton, D.E., Auch, R.F., Headley, R.M., and Taylor, J.L., 2010, Land changes and their driving forces in the southeastern United States: Regional Environmental Change, v. 10, no. 1, p. 37-53.

http://dx.doi.org/10.1007/s10113-009-0084-x (abstract only)

Rover, J.A., Wylie, B.K., and Ji, L., in press, A self-trained classification technique for producing 30-m percent-water maps from Landsat data: International Journal of Remote Sensing.
(Not yet available online)

USGS
science for a changing world

NASA

Landsat 1
May 29, 1973

Landsat 5
October 18, 2009

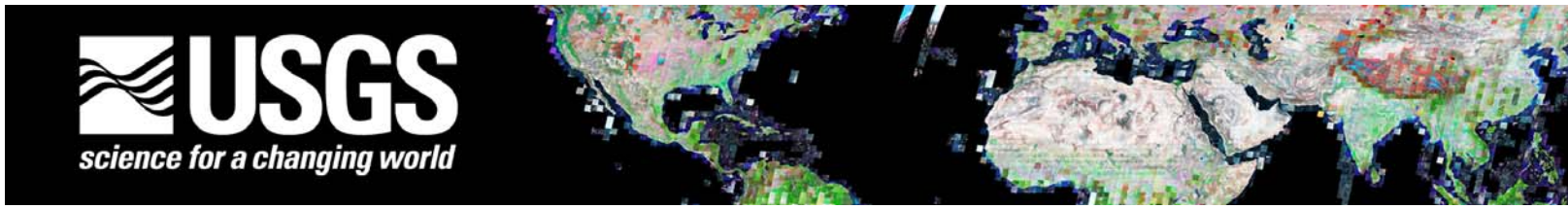
Aral Sea

The Aral Sea, once the 4th largest lake in the world, continues to shrink and is now 10% of its original size. U.N. Secretary General Ban Ki-moon recently called the drying up of the Aral Sea one of the planet's most shocking disasters.

Feeder streams to the sea have been diverted by irrigation and by the completion of upstream dam projects. The result has been the ruin of the local fishing and shipping economy, and wind-carried salty sands have created regional health problems.

Landsat satellite imagery acquired May 29, 1973, and October 18, 2009, show the dramatic change in the region.

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



Landsat Update

Volume 4 Issue 2, 2010

Landsat 5 Anomaly

On December 18, 2009 Landsat 5 experienced a transmitter failure onboard the spacecraft. The following is a brief summary of the resolution of the anomaly and the return to full operations that occurred on January 10, 2010.

A key component of successful data transmission is the Traveling Wave Tube Amplifier (TWTA). The primary TWTA was in operation when Landsat 5 launched in 1984. After several issues in late 1986 and 1987, the primary TWTA was turned off and the secondary, or redundant, TWTA has been used since. It was this redundant TWTA that failed on December 18, 2009. The TWTA that operated successfully on January 7, 2010 was the primary TWTA, the one that was disabled in 1987. Because of the extensive knowledge that the USGS Flight Operations Team has gained in sustaining the redundant TWTA for such a long time, they were able to apply that information to the primary TWTA for its first successful transmission in over 22 years.

LDCM News – Launch Date Confirmed!

On December 16, 2009, LDCM was confirmed for a December 2012 launch. Confirmation is a major event in a project life cycle. It is at this point that NASA commits to Congress to build a satellite.

New Bulk Download Tool Available for Landsat Data

For the first 1.1 million free Landsat scenes, users had to download one scene at a time. The Landsat Project has developed a bulk download tool so users can more easily download entire lists. After uploading a list of Landsat Scene IDs, scenes that are available on-line can be immediately downloaded. For those scenes that need to be processed, a link is provided directly into our EarthExplorer ordering system (there is no charge for processing). GloVis, EarthExplorer, or user-generated Landsat Scene ID lists can be used. Please go to http://landsat.usgs.gov/Landsat_Search_and_Download.php for more information.

Meetings & Conferences – LGSOWG # 38 Held in Berlin

The Landsat Ground Station Operators Working Group (LGSOWG#38) meeting was held in Berlin, Germany, September 28–October 5, 2009. The meeting was jointly organized by the USGS and NASA and was hosted by the German Aerospace Center (DLR). Participants from 11 countries represented 14 international ground stations and discussed a wide range of programmatic and technical topics.

Presentations included Landsat 5 and Landsat 7 mission status, the Landsat Project's Web-enabled product distribution statistics, Landsat 4 Thematic Mapper (TM) and Landsat 1-5 Multi-Spectral Scanner (MSS) product development progress, the Global Land Survey Projects, the Landsat Global Archive Consolidation initiative, proposed data validation and exchange modifications, and future development plans. LDCM-related presentations included project and ground system status, ground system and downlink overview, data processing flow, and the LDCM Ground System-to-International Cooperator (IC) interface, including the IC Web Portal. Additionally, the USGS Land Remote Sensing Program provided the attendees with an overview of the future land remote sensing satellite data downlink framework agreement, along with the National Land Imaging initiative's international vision and goals. A Landsat Science Team update was also presented, providing an update on its working group activities and several key research projects.

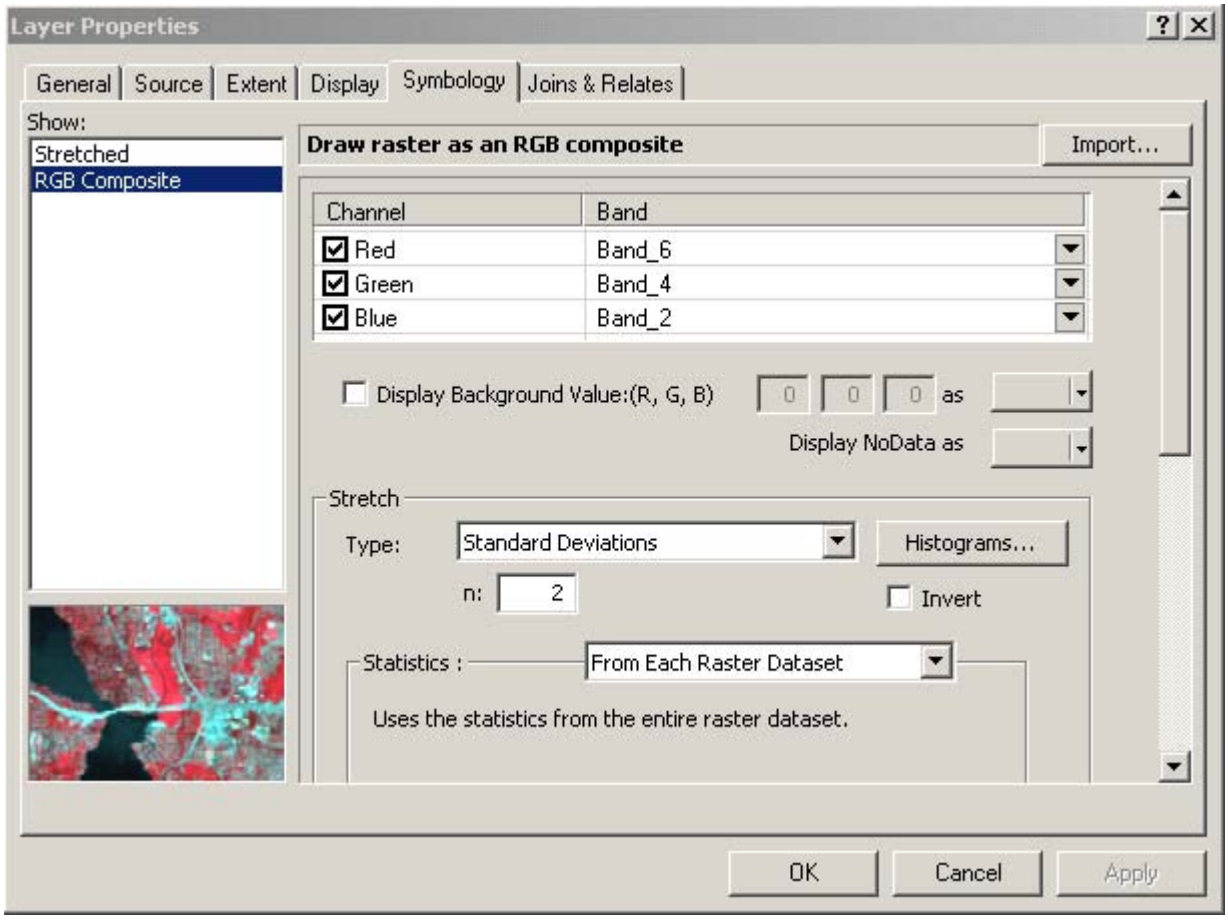
Each International Cooperator briefed the group on the status of their systems, addressed their future satellite mission(s) and ground system plans, and provided an overview of their data distribution statistics and business model impacts since the introduction of Landsat web-enabled data. Finally, a representative from the Australian Department of Climate Change capped the meeting with a briefing on the Group on Earth Observation (GEO) Forest Carbon Tracking (FCT) initiative.
ICs in attendance included representatives from the following countries and organizations:

Australia (GA-NEO)	Brazil (INPE)	Canada (CCRS)	China (CEODE)	Europe (ESA)
Germany (DLR)	Indonesia (LAPAN)	Japan (RESTEC)	Mexico (CONABIO)	Sweden (SSC)
Thailand (GISTDA)				

Tips & Tricks –How to create an RGB image using ArcMap and Remove Black Fill

(Please note that this does not signify an endorsement by the USGS EROS)

1. Load all of the bands, or just the three bands you'd like to composite, into ArcMap
   (For more information on Landsat band combinations, please refer to:
   http://biodiversityinformatics.amnh.org/tool.php?content_id=141)
2. Open the Arc Toolbox
3. Select 'Data Management', then 'Raster', then 'Composite Bands'
4. Within the 'Composite Bands' dialog box, select the three bands you'd like to use
5. Navigate to the location where you would like the composited bands saved and name the output raster
6. Click 'OK'
7. Once the composited dataset has been added as a layer, right click on the layer and select 'Properties'
8. Under the 'Symbology' tab, make sure that 'RGB Composite' is highlighted on the left-hand side
9. Click the check box next to 'Display Background Value: (RGB) and leave the default display type (this removes the black fill around the image)
10. Click 'OK'



EROS Authors in Recent Publications

Roy, D.P., Ju, J., Kline, K.L., Scaramuzza, P.L., Kovalskyy, V., Hansen, M., Loveland, T.R., Vermote, E., and Zhang, C., 2009, In Press, Web-enabled Landsat Data (WELD)–Landsat ETM+ composited mosaics of the conterminous United States: Remote Sensing of Environment.
http://dx.doi.org/10.1016/j.rse.2009.08.011

Ramsey III, E., Werle, D., Lu, Z., Rangoonwala, A., and Suzuoki, Y., 2009, A case of timely satellite image acquisitions in support of coastal emergency environmental response management: Journal of Coastal Research , v. 25, no. 5, p. 1168-1172.
http://dx.doi.org/10.2112/JCOASTRES-D-09-00012.1

Huang, C., Goward, S.N., Masek, J.G., Thomas, N., Zhu, Z., and Vogelmann, J.E., In Press, An automated approach for reconstructing recent forest disturbance history using dense Landsat time series stacks: Remote Sensing of Environment.
http://dx.doi.org/10.1016/j.rse.2009.08.017

Chander, G., Huang, C., Yang, L., Homer, C.G., and Larson, C. 2009, Developing consistent Landsat data sets for large area applications–the MRLC 2001 Protocol: IEEE Geoscience and Remote Sensing Letters, v. 6, no. 4, p. 777-781
http://dx.doi.org/10.1109/LGRS.2009.2025244

Roy, D.P., Ju, J., Kline, K.L., Scaramuzza, P.L., Kovalskyy, V., Hansen, M., Loveland, T.R., Vermote, E., and Zhang, C., 2010, In Press, Web-enabled Landsat Data (WELD)–Landsat ETM+ composited mosaics of the conterminous United States: Remote Sensing of Environment, va. 114, no. 1, p. 35-49.
http://dx.doi.org/10.1016/j.rse.2009.08.011

Chander, G., Xiong, X., Angal, A., Choi, T., and Malla, R., 2009, Cross-comparison of the IRS-P6 AWiFS sensor with the L5 TM, L7 ETM+, & Terra MODIS sensors, *in* Meynart, R., Neeck, S.P., and Shimoda, H., eds., Sensors, Systems, and Next-Generation Satellites XIII, Berlin, Germany, Aug. 31, 2009, Proceedings of SPIE Vol. 7474: Bellingham, WA, Society of Photo-Optical Instrumentation Engineers, p. Article 74740Z.
http://dx.doi.org/10.1117/12.830502

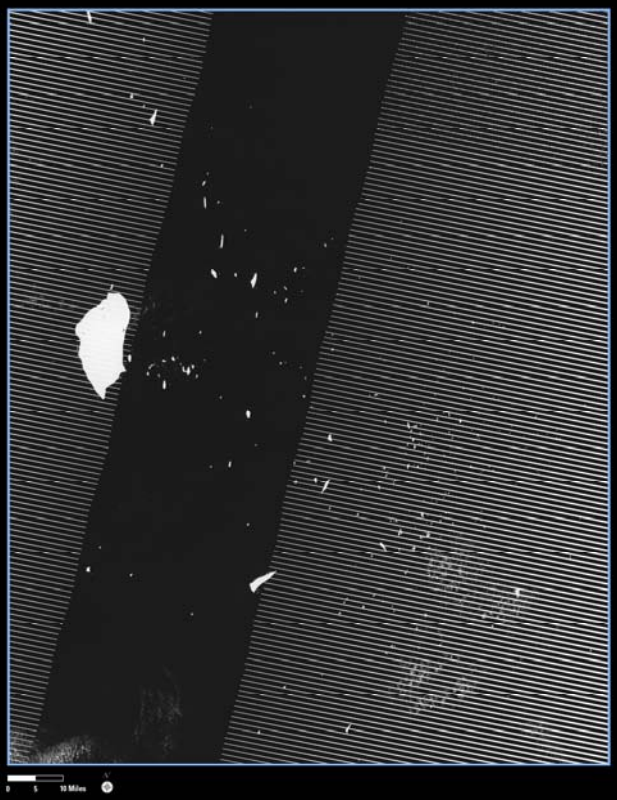
Xiong, X., Cao, C., and Chander, G., in press, An overview of sensor calibration inter-comparison and applications: Frontiers of Earth Science in China.
http://dx.doi.org/10.1007/s11707-010-0006-8

Karstensen, K.A. and Sayler, K.L., 2009, Land-cover change in the Lower Mississippi Valley, 1973–2000: U.S. Geological Survey Open-File Report, 2009-1280, 12 p.
http://pubs.er.usgs.gov/usgspubs/ofr/ofr20091280?from=home

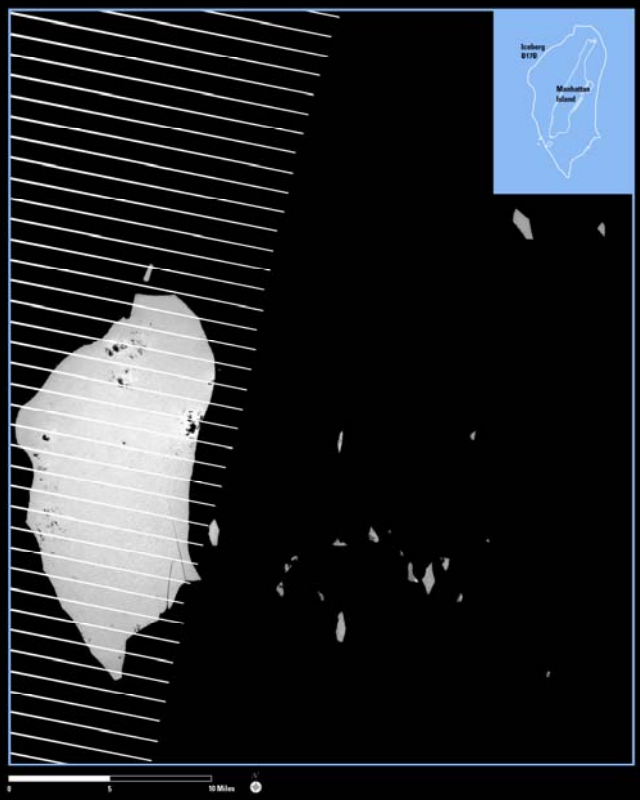
Landsat Images of Interest – Iceberg B17B

USGS
science for a changing world

NASA



Landsat 7
December 13, 2009.



Landsat 7
December 13, 2009.

Iceberg B17B South of Australia

On December 13 the U.S. Geological Survey's Landsat 7 earth observing satellite imaged a massive iceberg drifting toward Australia. The iceberg, labeled 'B17B' came off the Antarctic ice shelf in 2000 and recently got caught in wind and current patterns that pulled it north. The size of the iceberg (originally 140 X 115 square km), makes this break from the ice shelf a unique event. The iceberg is in the process of breaking up as it drifts north and east into warmer waters. Scientists and navigation experts are tracking the icebergs as they pose risks for shipping in the region.

Portions of a larger Landsat scene illustrate the larger iceberg and the smaller units which have broken off. A sensor problem causes the lines in the image along the off center portions. Nevertheless, the data are valuable as they show the size of the iceberg and the smaller units as they 'calve.' Subsequent images will be used to track the direction and size of the units as they continue to drift into shipping lanes.

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

USGS science for a changing world

Landsat Update

Volume 4 Issue 1, 2010

New Thermal Band Resampling: 30-meter pixels

Free Landsat data is currently delivered with the following pixel sizes:

Landsat 7 Enhanced Thematic Mapper Plus (ETM+)
- Multispectral: 30 meters
- Thermal: 60 meters
- Panchromatic: 15 meters

Landsat 4 & 5 Thematic Mapper (TM)
- Multispectral: 30 meters
- Thermal: 60 meters

Landsat 1-5 Multispectral Scanner
- Multispectral: 60 meters

Commercial software has difficulty aligning the 30 meter multispectral data of Landsats 4-7 with the dissimilar thermal pixel size (see Figure 1). This forces users of the Landsat thermal band to resample data. To remedy this issue, the USGS, in consultation with the Landsat Science Team - particularly Dr. Richard Allen of the University of Idaho Research and Extension Center, will set the pixel size for all thermal data at 30 meters (Figure 2) as of February 17, 2010. This new pixel size will align the thermal band with the multispectral bands.

All data newly processed on February 17, 2010 and later will have the new pixel size. Anything previously processed will have the 60-meter thermal pixels. The data with 60-meter pixel sizes will roll off gradually over the next six months. Also, by changing the pixel size of the thermal band to 30 meters, the size of the thermal bands will increase by 4x. This will result in an average increased scene size of 14 percent for ETM+ data and 12 percent for TM data.

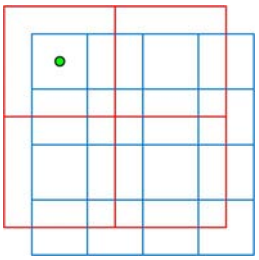


Figure 1. The USGS Landsat processing system uses pixel centers for resampling, which causes an offset in commercial software packages. The blue frame represents a 30-meter ETM+ multispectral pixel, while the red frame represents the 60-meter ETM+ thermal pixels. (J.Kjaersgaard and R.Allen, 2009)

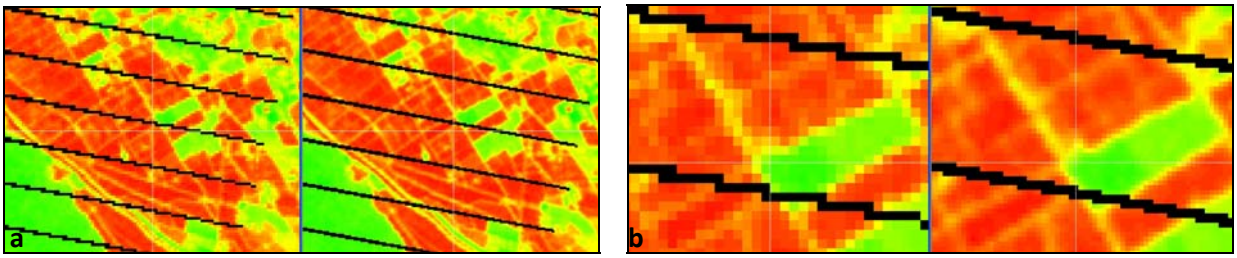


Figure 2. a) Thermal band resampled to 60 meters (left) and USGS prototype 30 meters (right) for an area south of Las Cruzes, NM. b) Close-up of the thermal band resampled to 60 meters (left) and prototype 30 meters (right), NM. DN=0 is black; DN 130-150 red through yellow; DN 150-170 yellow through green. (J.Kjaersgaard and R.Allen, 2009)

If you have questions or concerns, please contact USGS Landsat at custserv@usgs.gov or 605-594-6151.