USGS
science for a changing world

Quarterly Report

EROS Data Center

Third Quarter FY 2004

This is the Quarterly Report of the EROS Data Center (EDC) for the third quarter of FY 2004. It is not designed or intended to be a comprehensive accounting of all activities at the EDC. Rather, it is a synopsis of significant events, agreements, publications, progress, and results. Current plans call for this report to be prepared for the first three quarters of each fiscal year. A more in-depth Annual Report will review overall annual activity of the EDC and will be produced following the fourth quarter of the fiscal year.

Table of Contents

Questions regarding individual reports should be addressed to the contacts listed at the end of each report. Questions or comments regarding the overall Quarterly Report should be addressed to Dennis Hood at 605-594-6547, or hood@usgs.gov.

Featured Activity

Landsat Data Continuity Mission

The USGS and NASA jointly are developing a prototype image data calibration and validation system for the Operational Land Imager (OLI) instrument. OLI will be the replacement for the ETM+, which has flown on Landsat 7 since 1999. The OLI instrument will be flown on the Landsat Data Continuity Mission (LDCM), to be launched in the 2009 timeframe. OLI will use a "pushbroom," or staring array, sensor in which a fixed linear array of 70,000 detectors will image a 185-km wide swath as the spacecraft orbits the earth. The Landsat 7 ETM+ imager uses a scanning mirror to incrementally expose the entire swath upon just 100 detectors. The 700X difference in the number of detectors greatly complicates the task of accurately calibrating the sensor for long-term earth observations.

Because the imaging technologies are so different, NASA and the USGS decided to devise and test prototype algorithms based on a similar instrument jointly managed by the two agencies. The instrument, called the Advanced Land Imager (ALI), is one of several technology demonstration instruments onboard NASA's Earth Observing-1 spacecraft. The ALI instrument uses the same staring-array technology as envisioned for OLI, except that it uses only 5,000 detectors and images only a 37-km swath. Since the underlying technologies are similar, ALI data allow radiometric and geometric

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

technologists to construct and validate correction and calibration algorithms as test-beds for future OLI data. The prototype image calibration system is called the Advance Land Imager Assessment System (ALIAS), which itself is based on a Landsat 7 heritage system.

Over a period of 18 months, the team will devise and test algorithms that represent a seminal approach to calibration of highly complex spaceborne instruments. The primary challenge will be to equalize the radiometric calibration of all 70,000 detectors. Other characteristics to be modeled include handling "leaky" or dead detectors, compensating for earth rotation during imaging, and adjusting for parallax induced over areas of high terrain relief. A database of image parameters will be compiled that, for the OLI instrument, will exceed one terabyte (1 TB) in size by the end of the seven-year mission.

The team has completed several algorithms and is configuring hardware to support development of the complex database. The first of two deliveries to NASA radiometric scientists is planned for the end of October. (Contact: John Boyd, 605-594-6163)

Information Sciences

In support of the National Synthesis Project, Information Sciences staff participated in the North Carolina (NC) OneMap requirement and design team. The outcome of this involvement was a new viewer design with enhanced functionality, including address locator and routing tools. The viewer operates with its own catalog, a feature that will aid in populating ***The National Map*** and in transitioning the viewer application to North Carolina. (Contact: Mike Buswell, 605-594-2827)

On another front, the EDC and the City of Sioux Falls signed an annex to an existing Memorandum of Understanding that allows the EDC to use selected geospatial data in return for providing the City with interoperable map services and an off-site archive. (Contact: Terry Bobbie, 605-594-6807)

Land Sciences

Amphibian Research and Monitoring Initiative

Researchers with the Amphibian Research and Monitoring Initiative have been modeling terrestrial suitability for a number of amphibian species. Amphibians navigate the terrestrial landscape to find food, shelter and breeding habitat. Major factors that limit their movements include temperature extremes, excessive evaporation, and landscape barriers such as steep terrain. By merging a model that predicts the internal temperature and moisture content of amphibians under different air temperature and humidity conditions with GIS data on weather, solar radiation, terrain characteristics, and vegetation cover it was possible to generate maps predicting the amphibian "friendliness" of a test area adjacent to Yellowstone National Park. Using field data for known "start" and "stop" locations (where amphibians exit their breeding habitat and end up at the close of the summer season, respectively), a biophysical least-cost path between start and stop points was developed. Researchers then created a corridor corresponding to the part of the landscape within 5% cost increments of the least-cost path. Very high correlations exist between these corridors and actual paths taken by amphibians within the first 5% increment. (Contact: Alisa Gallant, 605-594-2696)

Analysis of water conductivity continued at amphibian survey sites throughout the Greater Yellowstone Ecosystem. Earlier investigations indicated that high conductivity might confer resistance to disease for amphibians. Initial results indicated that Western toads (*Bufo boreas*) and Columbia spotted frogs (*Rana luteiventris*) showed preference for sites with higher water conductivity while Chorus frogs (*Pseudacris maculata*) selected sites having lower conductivity. Tiger salamanders (*Ambystoma tigrinum*) exhibited no preference at all. This analysis, however, did not address the difference in detectability rates among species in the field. Tiger salamanders had low detectability, while the other three species had high detectability. When different detectability rates were taken into account, it was found that Tiger salamanders also prefer sites with higher water conductivity. A manuscript of this study is in preparation. (Contact: Alisa Gallant, 605-594-2696)

Topographic Sciences

Processing was completed for lidar data covering nine 7.5-minute quadrangles over the area of Lincoln, Nebraska. The data were acquired as part of a partnership between the EDC and the city of Lincoln and Lancaster County. Bare-earth processing of the data was completed to produce 3-meter-resolution elevation data for the nine-quad area, and also to produce

1-meter-resolution data for one quarter quad over downtown Lincoln. Final data were delivered to the Nebraska project partners during this quarter and are being used in various GIS applications. The EDC is integrating the 3-meter elevation data into the National Elevation Dataset (the elevation layer of ***The National Map***) and using both the 3-meter and 1-meter datasets for ongoing lidar feature extraction and visualization research. (Contact: Sue Greenlee, 605-594-6011)

Fire Science

LANDFIRE

The LANDFIRE team has finished the vegetation and structure data development, including canopy cover, canopy height, and composite data sets, for Zone 19 (Central Rockies). These data constitute the team's contribution to the deliverables developed by the USGS and the Fire Lab in Missoula. This work completes the second of two prototype areas and makes way for national implementation of LANDFIRE mapping methods. Posters, papers, and ancillary information are currently being developed for eventual presentation and/or distribution. (Contact: Jeff Eidenshink, 605-594-6028)

Student Conservation Association interns were trained to collect new rangeland field reference data at a workshop held in Missoula, Montana, in May; seventeen student interns collected data in the field. As a precursor to this workshop, a LANDFIRE vegetation sampling scheme and datasets for each mapping zone were developed. Student Conservation Association interns implemented the datasets and protocols. (Contact: Jeff Eidenshink, 605-594-6028)

A meeting was held in Anchorage, Alaska, to evaluate options to map the state for land and vegetation conditions and to meet the needs for LANDFIRE, MRLC, and GAP programs. A pilot study will be conducted in the near future to resolve technical issues. Alaska mapping work is expected to begin in FY05. (Contact: Jeff Eidenshink, 605-594-6028)

A LANDFIRE presentation was given at the 2004 Western SD Hydrology Conference in Rapid City in April. A presentation titled "LANDFIRE: A National Fire Fuels and Risk Assessment Project" (Vogelmann, J.E., Zhu, Z., and Rollins, M.) was given at the annual ASPRS conference in Denver, CO, in May. (Contact: Jeff Eidenshink, 605-594-6028)

Fire Danger Monitoring

The National Weather Service (NWS) in Sioux Falls requested that Minnesota and Iowa be included in the operational grassland fire danger activity. As a result, the USGS now provides the NWS with weekly, by-county estimates of grassland conditions for North Dakota, South Dakota, Nebraska, Kansas, Colorado Montana, Wyoming, Minnesota, and Iowa. Grassland conditions are derived from conterminous U.S. vegetation condition data. The NWS runs a model that includes daily weather information and vegetation condition to predict grassland fire danger conditions. (Contact: Jeff Eidenshink, 605-594-6028)

Burn Severity Mapping

Staff conducted an evaluation of the utility of gap-filled SLC-Off imagery for non-emergency burn severity mapping. Gaps were simulated in a gap-free scene containing a large (500,000 ac) fire. Comparisons were made of burn severity maps compiled using the gap-free and gap-filled imagery. Using an image differencing technique called Differenced Normalized Burn Ratio (DNBR), each image was compared to a pre-fire image in order to map the burn severity within the fire. The DNBR images were analyzed to evaluate the differences within the gap-filled areas. Results showed no significant difference for almost 80% of the DNBR pixels within the gap-filled areas. There was 98% agreement over the entire fire area. This study will be published as a Highlight article in the August 2004 issue of *Photogrammetric Engineering* and Remote Sensing. (Contact: Jeff Eidenshink, 605-594-6028)

Remote Sensing Systems

AVHRR

Advanced Very High Resolution Radiometer (AVHRR) data from NOAA satellites continued to be acquired and archived in support of scientific applications, including agricultural assessment, fire

science research, fire burn mapping, and land cover mapping. Generation and distribution of 7- and 14-day greenness composite image maps of the conterminous U.S. and Alaska were provided to cooperators and customers (Figure 1). The EDC no longer creates global AVHRR composites (this activity ran from 1992 through 1995). However, these historical data are still available in the USGS archive. (Contact: Ken Boettcher, 605-594-6575)

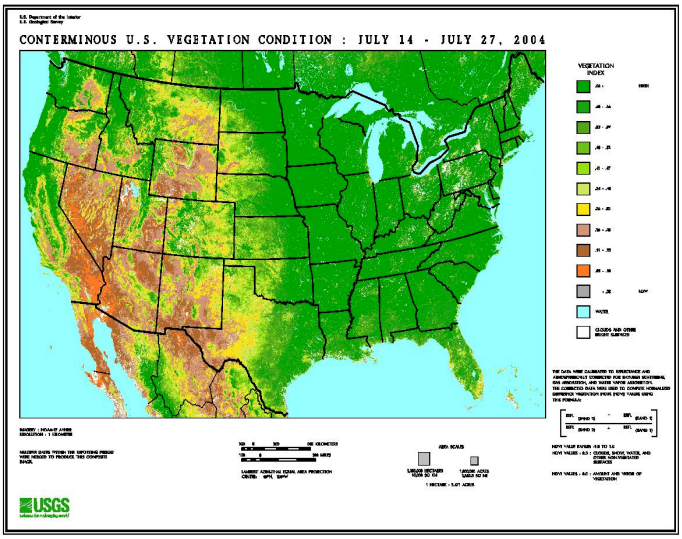

Figure 1. An example of an AVHRR greenness map of the conterminous United States.

Early in FY 2004, the NOAA 16 satellite experienced a serious scan motor mechanical problem. To ensure data continuity to USGS scientists and customers, greenness mapping was successful transitioned to the NOAA 17 satellite on April 28, 2004. Consequently, acquisition of NOAA 16 AVHRR data was terminated on May 1, 2004. (Contact: Wayne Miller, 605-594-6084)

Commercial Remote Sensing

Calibration/Validation

The Geography Discipline of the USGS has the mission to provide basic cartographic information for the United States. Primary sources of these data are airborne film mapping cameras. Since 1973, the USGS Optical Science Laboratory has been responsible for calibrating these cameras for the aerial mapping community. During FY 2003, a Digital Camera Calibration Laboratory was established at the EDC to begin research on digital camera calibration methodologies. In addition to the film and digital calibration laboratories, an “In Situ” Camera Calibration Range was established during the third quarter of FY 2004. This range covers a 4-square-mile area around the EDC and contains approximately 150 calibration points (Figure 2). Each point has been surveyed to an accuracy of better than 2 cm for latitude, longitude, and elevation. Both digital and film cameras can be mounted in aircraft and flown over the range to collect imagery with corresponding time and GPS information. The resulting digital images are entered into software programs that calculate the geometric and spatial qualities of the sensor system. This range is currently being used to research new camera calibration procedures and methodologies that will support future digital sensor policy and standards development. (Contact: Ronald Parsons, 605-594-6557)

Figure 2. An example of calibration points in the Camera Calibration Range.

CRSSP Implementation

The Commercial Remote Sensing Space Policy (CRSSP) Implementation Project (CIP) completed a report on the civil agency short-term data requirements that were gathered through the CRSSP

Implementation Working Group (IWG). This report was then used to identify three budget initiatives that were developed and presented to the CRSSP Senior Steering Committee for consideration.

The CIP also hosted an IWG meeting at the EDC in July. This meeting included attendees from USDA, NASA, NOAA, NGA, DHS, and other DOI agencies. Among the topics discussed and presented were a demonstration of USGS systems and CRSSP infrastructure, a brainstorming session on the three budget initiatives, and a review of commercial remote sensing data contracts. NGA also gave a presentation on their current and future system architecture. (Contact: Jennifer Willems, 605-594-2505)

Landsat

The historical Landsat data archive, dating back to 1972, largely exists on aging analog tape media retrieved and handled manually for product requests. The Landsat Archive Conversion System (LACS), which began operations in June 2004, will convert analog data from these tapes to digital data stored in an automated near-line silo (Figure 3). Additionally, LACS also significantly automated the processes of collecting new Landsat 5 data from the satellite and placing those data in the archive. This process previously took approximately 24 hours from the time of data collection until data became available for customers to order. With LACS, the process takes only 3 hours. (Contact: Kristi Kline, 605-594-2585)

The Landsat Project released a new product for Landsat 7 Enhanced Thematic Mapper Plus (ETM+) data captured after the Scan Line Corrector (SLC) anomaly. This new product uses Landsat 7 data collected before the anomaly to fill the missing areas due to the non-functional SLC. Two scenes are geometrically registered and a histogram matching technique is applied to fill the pixels that provide the best-expected radiance values for the missing data (Figure 4). This product, as well as future products, will increase the utility of the Landsat 7 data affected by the anomaly. (Contact: Kristi Kline, 605-594-2585)

Figure 3. Historic data archive (top) and automated silo storage (bottom) located at the EDC.

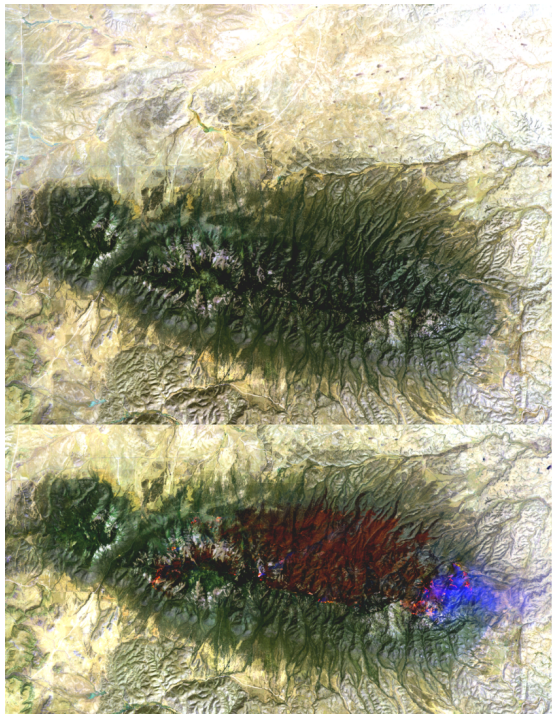

Figure 4. These images show Landsat 7 ETM+ data over New Mexico's El Capitan Mountains acquired May 11, 2003 (top) and May 29, 2004 (bottom). The lower image, a gap-filled product, shows the 2004 Peppin fire that burned more than 64,000 acres.

EDC scientists investigated the utility of the gap-filled imagery for various mapping applications. Preliminary results show that gap-filled imagery is well-suited for burn severity, geological, and impervious surface mapping. Investigation continues into promising techniques for other applications. (Contact: Kristi Kline, 605-594-2585)

AmericaView

AmericaView Inc. advertised a call for proposals for new affiliate membership during May 2004. Seven new state university groups submitted applications for consideration. Following the evaluation of these proposals by the membership committee, the full membership voted to extend membership in AmericaView Inc. to five new state consortiums from California, Hawaii, Kentucky, Louisiana, and North Dakota. This brings membership totals in AmericaView Inc. to twenty states, with fourteen full members and six affiliate members (Figure 5). (Contact: Karen M. Zanter, 605- 594-6945)

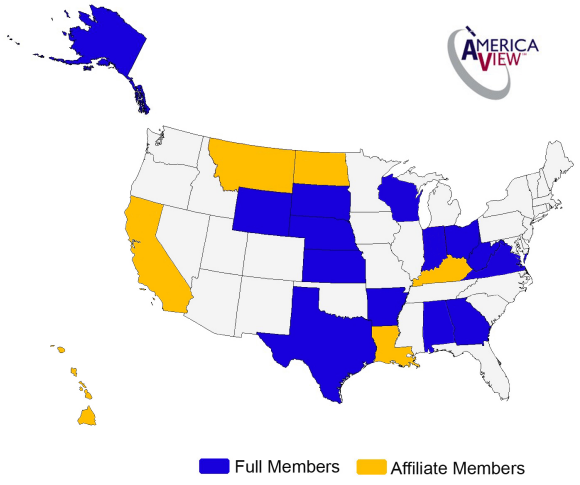

Figure 5. AmericaView Inc. membership status map, June 2004.

Remote Sensing Data Management

The EDC has in its possession thousands of rolls of film containing several million frames of historical aerial and satellite photographs dating back to the 1930's gathered from various Federal agencies. The largest portion of this archive consists of original film acquired in support of the USGS 1:24,000 topographic quadrangle map series, taken during the 1940s through the 1970s. Most of this photography is reasonably large scale to support the production of the quadrangle maps (Figure 6).

Figure 6. Digital browse of an aerial photograph.

The EDC has implemented a high-resolution, digitally scanned product. The high-resolution files are of photogrammetric quality and are created at approximately 1200 dpi with an output image size of around nine inches square. The file sizes are approximately 120 megabytes for black-and-white images and 360 megabytes for color images and are stored in a TIFF format. The high-resolution files are produced on either a Zeiss SCAI Precision Scanner using a PHODIS Photogrammetric Image Processing System or a Leica Geosystems DSW600 Digital Scanning Workstation. (Contact: Wayne Miller, 605-594-6084)

The mission of the EROS Data Center is to promote new uses, ensure ready access, and safeguard and expand our archive of remotely sensed land data.