

**T**his is the Quarterly Report from the EROS Data Center (EDC) for the first quarter of FY 2004. It is not designed nor intended to be a comprehensive report of all activities at the EDC. Rather, it is intended to be a reporting of significant events, agreements, publications, progress or results. Current plans call for this report to be prepared for the first three quarters of each fiscal year. An Annual Report, which will be a much more inclusive document intended to capture the overall annual activity of the EDC, will be produced following the fourth quarter of the fiscal year.

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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

### Mapping Malaria Risk in Africa

*Tracking African rainfall anomalies to identify potential malaria epidemics.* Worldwide there are approximately 400 million cases of malaria each year. Ninety percent of these cases occur in sub-Saharan Africa, leading to the death of a million children under five years of age annually. Suffering among all age groups can be widespread when epidemics occur, with adverse impact on human productivity and food security. Climatic factors such as rainfall and temperature exert a strong control on the parasite and the mosquito vector responsible for transmission.

The USGS/EDC routinely processes many of the same environmental and climatic variables for the Famine Early Warning System Network (FEWS NET) of USAID, for operational monitoring of drought and flood hazards that threaten food security in sub-Saharan Africa. Building on this experience, for the last two years EDC has worked with the International Research Institute (IRI) for Climate Prediction to produce, every ten days, maps of rainfall anomalies in areas of malaria epidemic potential. The activity contributes to the Roll Back Malaria initiative of the World Health Organization (WHO). The maps are accessible on the World Wide Web and in the form of products that can be used with WHO's HealthMapper software.

The maps have been well received. A May, 2003, letter to the British medical journal *The Lancet* cited the rainfall anomaly maps from USGS/EDC as the best of three predictors of malaria outbreaks that were tested in western Kenya. The maps outperformed monthly surveillance of malaria outpatients and seasonal climate forecasts.

Encouraged by these results, USGS/EDC and IRI are now implementing a GIS-based vectorial capacity model that not only uses satellite rainfall estimates from NOAA, but also surface air temperature fields from numerical weather forecast models and USGS HYDRO1k digital elevation data. (Contact: Jim Verdin, 605-594-6018, or Robert Klaver, 605-594-6067)

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## Urban Dynamics

### *Urban Dynamics Topical Report.*

A plan for developing the Urban Dynamics Topical report was successfully initiated. Report editors (William Acevedo, Janis Taylor, Dave Hester, Carol Mladinich, and Sonya Glavac) are meeting weekly via conference call to discuss progress. Each editor has been assigned one section of the Topical Report, including initiating the peer review process and editing. (Contact: William Acevedo, 650-329-4383)

### *GAM Science Workshop.*

Urban Dynamics staff attended the GAM Science Workshop in Fort Collins, CO on Nov. 12-14, 2003. Presentations were given on the Design of a Nationwide Impervious Surface Monitoring Strategy and a status update on plans for the Status and Trends Synthesis Report. (Contact: William Acevedo, 650-329-4383)

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## Amphibian Research and Monitoring Initiative (ARMI)

### *Amphibian Research - Stressors database web application.*

A web-enabled GIS application for viewing and serving geospatial data on potential environmental stressors of amphibians and their habitat is under development. This is a collaborative activity among NMD, BRD, and WRD. Representatives presented the features of the web application at the annual ARMI meeting in November 2003, and received very strong positive feedback from scientists in both BRD and WRD. The new national ARMI coordinator was sufficiently impressed with the

value of the Stressors Database and web application that he has agreed to fund the activity for a third year. (Contact: Alisa Gallant 605-594-2696)

### *Amphibian Research – Breeding habitat models developed.*

Researchers used ARMI field data on amphibian use of wetlands to develop geospatial models predicting the distribution of breeding habitat in Yellowstone National Park. Predictor data included wetland probability model output, vegetation cover, landforms, and surficial geology. Models were developed for each of the 4 species inhabiting the Park. An informal peer review of the breeding habitat models by the leading herpetologist of the Greater Yellowstone Ecosystem was very positive. Refinement to improve the models is underway. (Contact: Alisa Gallant, 605-594-2696)

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## Land Remote Sensing Applications

### *Geological Applications – InSAR publications.*

Scientists are making good progress working with satellite interferometric synthetic aperture radar (InSAR) data, with an emphasis on technique development and applications of InSAR to volcanoes, earthquakes, and urban subsidence research: Several papers are in work, and six papers were presented at national and international conferences. The project website ([http://edc.usgs.gov/Geo\\_Apps/](http://edc.usgs.gov/Geo_Apps/)) is up and running. (Contact: Zhong Lu, 605-594-6063)

### *Geological Applications – Denali Fault Zone.*

Scientists are utilizing satellite interferometric synthetic aperture radar (InSAR) data and investigating applications of the technology for monitoring land surface deformation and subsidence. Radar satellite data were acquired before and after a November 3, 2002, earthquake, which occurred along the Denali Fault Zone, south of Fairbanks, Alaska. An interferogram created from the radar data clearly depicts the land surface change that resulting from this seismic event. Other research has evaluated the complementary characteristics of InSAR and Landsat-7 data for mapping volcanic features. Multi-year lava flows of the Westdahl volcano were mapped using both SAR and Landsat-7 data. (Contact: Zhong Lu, 605-594-6063)

### *Biological Applications – Phenological Trends.*

Trend analysis software has been developed, and work is progressing on the development of a

database of agricultural statistics and climate data to support phenological trend analysis. Phenology metrics software was successfully ported to the Windows operating system in a collaborative effort with software developers at Augustana College in Sioux Falls, SD. A prototype drought map was produced for a seven-state pilot study area, and methods for using regression tree models to assess drought impact were developed. (Contact: Brad Reed, 605-594-6012)

#### *Agricultural chemicals and human health.*

Scientists at the EDC are using remotely sensed imagery to map specific land cover characteristics associated with high agricultural chemical concentrations (e.g., specific crop types, irrigation practices, large animal feeding operations). Once the land cover information is derived, chemical exposure is estimated by integrating land cover information with other environmental data such as chemical use and hydrology in geographical information system models.

Partners and collaborators include: National Institutes of Health/National Cancer Institute (NIH/NCI); Environmental Health Advanced Systems Laboratory at Colorado State University (CSU); USGS Water Resources Discipline (WRD); National Cancer Institute (NCI); and Center for Health Effects of Environmental Contamination (CHEEC). (Contact: Susan Maxwell, 605-594-6008)

#### *New research and development initiatives and support/coal bed methane.*

This task provides developmental support to new initiatives that have potential to expand into larger efforts or focused short duration activities. During the quarter the Coal Bed Methane/Sage Grouse subtask mosaicked Landsat scenes covering the Powder River Basin to delineate Sage Grouse habitat and surface water features. Digital orthophoto quadrangle (DOQQ) mosaics were acquired and reprojected to provide complete coverage for Sheridan and Campbell counties in Wyoming and Big Horn County in Montana. Digital versions of the 2001 color infrared NAPP photos were acquired, scanned, and registered to the 1994 DOQQs. The images dramatically illustrate the impact of Coal Bed Methane extraction on the terrain in the vicinity of Gillette, WY. (Contact: Randy McKinley, 605-594-2745)

## **Land Cover Trends**

#### *Synopsis.*

In early November, the NASA ESE program funded the research proposal "The Influence of Historical and Projected Land Use and Land Cover Changes on Land Surface Hydrology and Regional Weather and Climate Variability". The funding provides \$200,000 per year for next 3 years, and will enable us to expand our capabilities into the forecasting of future land use and land cover change. Sample block analysis for EPA Level III ecoregions continues to progress, with the Northeastern Coastal Zone Ecoregion being completed during this quarter, and the Coast Range Ecoregion nearing completion. The first part of FY2004 also saw the printing of the first official USGS Fact Sheet for the Land Cover Trends Project. This Fact Sheet provides results from the Trends project for the Atlantic Coastal Pine Barrens Ecoregion. (Contact: Tom Loveland, 605-594-6066)

#### *Reconstruction of regional land use history.*

The paper, "Crop Freezes and Land-Use Change in Florida", by C.H. Marshall, R.A. Pielke Sr., and L.T. Steyaert was published as a Brief Communication in the November 6, 2003, issue of the journal Nature. Research findings from a USGS and Colorado State University (CSU) study suggest the potential for increased severity of agriculturally damaging winter freeze events associated with the conversion of natural wetlands to farmlands in South Florida, including extensive areas of vegetable and citrus crops. Atmospheric modelers at CSU used USGS-derived land cover data for pre-1900 natural vegetation and 1992/93 land use in a series of modeling simulations. This joint USGS and CSU research has demonstrated the utility of the USGS National Land Cover Dataset (NLCD) derived from Landsat as highly appropriate for regional modeling studies concerning the consequences of land use change. (Contact: Lou Steyaert, 301-614-6675)

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## **Early Warning and Environmental Monitoring**

#### *Drought – Growing season report.*

A special report was prepared for FEWS NET by synthesizing all available monitoring and forecast data to assess prospects for the Southern Africa 2003/2004 growing season. (Contact: Jim Verdin, 605-594-6018)

*Drought – New software.*

New crop water balance modeling software was completed and shared with colleagues in Africa for custom processing addressing special cases of planting date, soil water holding capacity, and other variables. Written in Visual Basic, the program is distributed to cooperators without charge. (Contact: Jim Verdin, 605-594-6018)

*Drought – Chapter in new book.*

EDC scientists completed a book chapter entitled “FEWS Drought Monitoring Techniques”. It will appear in *Agricultural Drought: Global Monitoring and Prediction*, published by Oxford University Press. (Contact: Jim Verdin, 605-594-6018)

*Flood – Technology transfer.*

The Geospatial Stream Flow Model (GeoSFM) is used to operationally model rivers in the Greater Horn of Africa. Technology transfer was accomplished so that all computer processing is now done in Nairobi at the Regional Center for Mapping for Resource development (RCMRD) and posted to a web server at EDC. The USGS regional hydrologist for FEWS NET oversees all processing. Previously, all processing was done at the EDC. (Contact: Jim Verdin, 605-594-6018)

*Outreach – Atlas published.*

The “Atlas of Disaster Preparedness and Response for the Limpopo Basin of Mozambique” was released. The atlas describes various scenarios of drought, flood, and tropical cyclone and their impacts on livelihood systems in the basin. EDC was a major contributor to the atlas, a joint effort of several U.S. and Mozambican organizations. (Contact: Larry Tieszen, 605-594-6056)

*Outreach – Afghanistan poster.*

Custom ASTER imagery was prepared to provide before and after views of the new U.S.-financed highway linking Kabul and Kandahar in Afghanistan. The poster was requested for presentation to the White House in conjunction with a briefing on USAID activities in that country. (Contact: Jim Verdin, 605-594-6018)

*Outreach – Caribbean web server.*

UNEP launched its new “White Water to Blue Water” web server for the Caribbean Environment Program. UNEP also hosted an exhibit at the 30th International Symposium on Remote Sensing of the Environment. (Contact: Larry Tieszen, 605-594-6056)

*Food security.*

EDC activities in support of FEWS NET were presented at the Second International Conference on Early Warning in Bonn, Germany. This led to the opportunity to meet with remote sensing counterparts supporting the new European project “Global Monitoring for Food Security”; joint activities in 2004 were planned to address the problem of remote sensing of cropped area in Sub-Saharan Africa. (Contact: Jim Verdin, 605-594-6018)

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## **Native American Activities**

*Tribal College Consortium.*

The report of the Second Tribal College Forum was completed and is being reviewed by the Tribal College Leadership Group. The report will be distributed to all 34 Tribal Colleges in the country. (Contact: Gene Napier, 605-594-6088)

*Native American Heritage Month.*

A Native American Heritage Month poster was developed. The Bureau’s Office of Communications, EDC Outreach, and the Central Region Native American Liaison developed the poster from an image from the Blue Cloud Abbey collection of historical photography of the Dakotas. The poster was used by the USGS as the Native American Heritage Month poster. There were many requests for the poster from individuals and Native American groups around the country. (Contact: Gene Napier, 605-594-6088)

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## **Topographic Science**

*EDNA – New web site.*

A new interactive web site entitled “Watershed Delineation and Classification Tools for Assessment: Lake Michigan Basin Demonstration” was released. This innovative web site combines standard web-mapping technology along with state-of-the-art tools providing web-based modeling. The Lake Michigan watershed was chosen as the demonstration site to fulfill an Environmental Protection Agency requirement. The web site will be used for classification of watersheds and assess their vulnerability to various stressors. These classifications will be used to assist in design of a sampling strategy for the Nation’s watersheds. The web-based tools launched on this web site include a regression-based stream flow model, interactive watershed delineation tool (with download

capabilities) and a watershed characterization tool. The watershed characteristics include land-use, impervious area, climatological variables (such as precipitation, temperature and snowfall), and soil parameters. The web site is viewable at <http://gisdata.usgs.net/website/LakeMich/> (Contact: Sue Greenlee, 605-594-6011)

*EDNA – New power potential estimates.*  
The Elevation Derivatives for National Applications (EDNA) database was used to assess the total low-head/low-power potential for the states of Alaska and Hawaii. This work followed completion of a similar analysis for the lower-48 states in fiscal year 2003. Estimates were made of mean annual stream flow for every stream segment in the EDNA database. This information, combined with head drop along the stream segment, also EDNA derived, was used to estimate total power potential. This work was done with funding from the Department of Energy's Idaho National Engineering Laboratory. (Contact: Sue Greenlee, 605-594-6011)

*High-resolution elevation data.*  
The elevation component of *The National Map* was enhanced by the addition of high-resolution elevation data for the Puget Sound region in Washington. The Puget Sound Lidar Consortium, a group of local, state, and federal partners cooperating on the collection of high-quality data derived the data from lidar data provided. The staff at EDC worked cooperatively with the staff at MCMC to integrate the lidar data into the highest resolution layer of the National Elevation Dataset (NED), which forms the elevation component of *The National Map*. The 1/9-arc-second resolution elevation data represent the initial offering of high-resolution NED derived from non-USGS source data. The data are available to the public via the Web on the seamless data distribution system ([seamless.usgs.gov](http://seamless.usgs.gov)). (Contact: Sue Greenlee, 605-594-6011)

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## Fire Science

*National Park Service burn mapping.*  
During this reporting period, the USGS/EDC and the National Park Service mapped over 40 individual fires (from 2002 and 2003) on 25 National Parks and adjacent lands. The products have been staged on the NPS/USGS Burn Severity website ([http://edc2.usgs.gov/fsp/severity/fire\\_main.asp](http://edc2.usgs.gov/fsp/severity/fire_main.asp)). The results of a comparison of burn maps compiled from a single scene vs. an image pair was presented

at the 2nd Intl Wildland Fire Ecology conference in November 2003. (Contact: Don Ohlen, 605-594-6026)

*Fire danger monitoring.*  
The 15 year time series of vegetation condition information for the conterminous U.S. has been reprocessed using an advanced cloud screening technique. Elimination of cloud contamination has improved the sensitivity and reliability of the data for measuring vegetation changes that effect fire danger conditions. (Contact: Collin Homer, 605-594-2714)

*LANDFIRE – Funding approval.*  
The LANDFIRE technical team conducted a briefing to the Wildland Fire Leadership Council in October and received endorsement and funding approval from the council for national implementation of LANDFIRE, which began this fiscal year. (Contact: Jeff Eidenshink, 605-594-6028)

*LANDFIRE – Utah prototype.*  
The LANDFIRE prototype in Utah was successfully completed on schedule. Several products have been staged to the LANDFIRE web site (<http://www.landfire.gov>). A prototype was developed for seamless distribution of LANDFIRE data via the web. (Contact: Zhi-liang Zhu, 605-594-6131)

*Papers and presentations.*  
Research results on 12 different topics were presented at a special technical session at the International Fire Ecology and Management Conference in Orlando, FL in November 2003. (Contact: Zhi-liang Zhu)

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## Remote Sensing, Modeling, and Carbon Cycle

Carbon Cycle – Grasslands quantitative estimation. Detailed information on carbon exchanges into and out of the atmosphere associated with photosynthesis ecosystem respiration, and net ecosystem exchange has been scaled up to the regional level using remotely sensed and environmental data. This allowed the mapping of gross primary production and ecosystem respiration at one km resolution and a ten-day interval for the Northern Great Plains and Kazakh Steppe (Central Asia) grasslands, providing regional quantitative estimates of carbon sources and sinks. (Contact: Bruce Wylie, 605-594-6078)

### *Carbon sequestration in the Sahel.*

A special publication has been assembled for the Journal of Arid Environments that presents the research contributions of USGS/EDC scientists and numerous international collaborators for a project in Senegal. This project, Sequestration of Carbon in Soil Organic Matter (SOC SOM), has shown the dramatic loss of carbon during the last 35 years, the management practices that could restore soil carbon and fertility, the potentially devastating impact of projected climate change in the next century, and an economic analysis of farm and community level projects. This work is now being extended across the Sahel jointly with the Italian government as a result of a bilateral agreement. (Contact: Larry Tieszen, 605-594-6056)

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## **International Spatial Data Infrastructure**

### *USGS interests incorporated into the Pan American Institute of Geography and History's (PAIGH) Mandate.*

The PAIGH approved all of the US National Section (USNS) resolutions submitted in 2003. These resolutions required major changes within the organization. Resolutions that have been repeatedly presented by the USNS and rejected by the Directing Council were approved. The USNS secured the USGS supported candidates to the PAIGH positions of Secretary General and President of the Commission of Cartography. These candidates strongly favor incorporating the GSDI and *The National Map* concepts into the Caribbean and Central and South America. (Contact: Jacie Klaver, 605-594-6961)

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## **UNEP/GRID**

### *North American land cover map.*

The Land Cover Map of North America was printed and distributed. It depicts major land cover types of North America for the year 2000 using data acquired by the VEGETATION instrument on-board the SPOT 4 satellite. Copies are available from UNEP/GRID Sioux Falls. (Contact: Gene Fosnight, 605 594-6051)

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## **Landsat**

### *Landsat 1-5 archive and production combined.*

The Landsat team seamlessly incorporated all Landsat 1-5 archive and production operations into

the Landsat project at the beginning of the fiscal year. This transition will result in streamlining of Landsat 1-5 operations. The team is working to incorporate all systems in the existing Landsat 7 configuration control process. The on-going Landsat Archive Conversion System (LACS) project will benefit by utilizing Landsat 7 expertise and automated archive systems. LACS will update the aging Landsat 1-5 archive tapes by placing data on new tapes in an automated silo. This will allow the project to make data available to customers in a short amount of time for both archived data and new data acquired from the satellite. (Contact: Steve Labahn, 605-594-2701)

### *Landsat 7 SLC-off production.*

The Landsat team developed software changes for the processing algorithms allowing the system to process the anomalous SLC-off data. The team accomplished these changes within a very aggressive schedule. The rollout of this capability was 2 weeks ahead of schedule. The timeliness of this work was instrumental in providing information to the Landsat International Cooperators at the LGSOWG meeting in Japan. (Contact: Steve Labahn, 605-594-2701)

### *Major software releases speed data delivery.*

The Landsat team completed major releases of the Data Capture System (DCS) and the Landsat Processing System (LPS). A transition from obsolete Silicon Graphics hardware to high-end PCs running Linux incorporated new Storage Area Network (SAN) drives. With the Linux systems and the SAN drives in place, capture and initial processing time of Landsat 7 data is greatly improved. Now, new live downlink Landsat 7 data is typically available for ordering in less than one hour. (Contact: Bill McElroy, 605-594-2683)

### *Lifetime calibration of Landsat 1-5 data.*

The cooperative agreement between the EDC and South Dakota State University (SDSU) enables cooperative research, technical support, and operational functions between the SDSU Electrical Engineering Department's Image Processing Laboratory and the Landsat Project at the EDC. This agreement also provides the USGS and SDSU a unique opportunity to enhance the calibration of USGS Landsat data and to further SDSU's satellite image data calibration research and education activities. The overall goal of this cooperative agreement is to utilize SDSU's unique skills in Landsat calibration to develop and operate a Multispectral Scanner (MSS) and Thematic Mapper

(TM) calibration system for Landsat 1, 2, 3, 4 and 5. Because of this agreement, the Landsat data user community will benefit from the improved radiometric and geometric calibrations on over 30 years of Landsat data. (Contact: Mike Headley, 605-594-2644)

*LGSOWG yearly meeting.*

The Landsat project held its yearly Landsat Ground Station Operators Working Group (LGSOWG) meeting in Japan, October 13-17, 2003. More than 50 attendees representing 15 countries attended the 32nd LGSOWG meeting. Of critical importance were discussions related to the Landsat 7 SLC failure. With the anomaly investigation completed, the meeting focused on results of the investigation and attempted recovery, continued operations of the satellite, and necessary processing changes due to the anomaly. (Contact: Tracy Zeiler, 605-594-2677)

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## **Earth Observing Systems (EOS)**

*Land Processes DAAC development.*

During the reporting quarter, significant changes were made to the processing, customer access and collections transitions of data. The LP DAAC completed first-time processing of more than 247,000 ASTER Level-1A scenes to Level-1B for the acquisition period beginning March, 2000 through January 2002. The processing rate averaged 1000 scenes/day with no impact to archival, processing, or distribution of MODIS or ETM+ data. Collaboration with the Seamless Data Distribution Project has led to the development of mosaics of Terra/MODIS 16-day 1km vegetation indices for the conterminous U.S., available as part of The National Map through the Seamless Data Distribution system. This initial phase makes the Terra/MODIS vegetation indices accessible using Open GIS Consortium (OGC) compliant Web Mapping Services (WMS) using the Seamless data viewer. The LP DAAC finalized the transition of Version 0 Data Collections to the Remote Sensing Data Management project as part of the Memorandum of Understanding between NASA and the USGS to transfer NASA EOS Land Data to the USGS for Long Term Archiving. (Contact: Thomas A Kalvelage, 605-594-6556)

## **AmericaView**

*AmericaView data access.*

The AmericaView project continued to successfully operate and maintain the MODIS (Moderate Resolution Imaging Spectroradiometer) Direct Broadcast capability. The initial MODIS passes are available for download by registered users within three hours of acquisition from the satellite. The retrieval site is located at <http://edc.usgs.gov/modisdata/>. There are currently 130 registered users for this site. In addition, algorithms have been implemented for time-composited products, vegetative indices, and conterminous U.S. mosaics. In particular, a rolling seven-day Normalized Difference Vegetative Index (NDVI) for the conterminous U.S. is processed nightly and sent to the USGS seamless server (<http://seamless.usgs.gov>) where it is made available as a layer for *The National Map*.

During this quarter, the USGS Global Visualization team completed the development work needed to include additional Landsat-related data collections in the system; it gives a researcher visual access to a broader set of the Landsat satellite data holdings than was previously available. In particular, the addition of the Landsat Orthorectified datasets also is significant as it marks a contribution by the Land Remote Sensing (LRS) program to the data available for *The National Map*. (Karen Zanter, 605-594-6945)

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## **Remote Sensing Data Management**

*Earth as Art images available.*

Earth as Art images are now available through the USGS EROS Data Center's web site at no cost, if the data are downloaded electronically. Through the first quarter of FY2004 over 5,500 Earth as Art files have been provided to the user community at no cost. Access to these 83 images can be obtained by logging onto the EDC Image Gallery at <http://edc2.usgs.gov/ImageGallery> (Wayne Miller, 605-594-6084)

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## **New Missions Initiatives**

*ALIAS.*

The Advanced Land Image Assessment System (ALIAS) is in the initial stages of formation. USGS and NASA technical staff have partnered to develop a prototype capability to evaluate sensor performance of an instrument likely to fly on the

follow-on mission to the highly successful Landsat 7. The follow-on imager is expected to have characteristics similar to the Advanced Land Imager (ALI) flown on the Earth Observing-1 technology demonstration mission. USGS staff will develop prototype geometric algorithms and implement them to assist ALI image assessment. NASA scientists will develop prototype radiometric algorithms, and USGS staff will implement these in future software releases. The project will facilitate greater understanding of ALI sensor performance, as it may be applied to the design of the follow-on Landsat imager. (John Boyd, 605-594-6163)

*EO-1 product generation.*

The USGS role for archiving and product distribution of Earth Observing-1 data was given a technology infusion this quarter with implementation of a more efficient archive mechanism, a Redundant Array of Independent Disks (RAID) architecture. The RAID replaces high-density tapes for near-term (one year) storage of raw data. Products now can be generated quickly and easily from the RAID. As a result of the efficiency improvement, prices for the end-user products from both ALI and Hyperion were reduced 50 percent. (Contact: Chris Doescher, 605-594-2649)

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## **Facilities Operation and Maintenance**

*New roof for old building.*

EDC's Facility Management Office oversaw the completion of the roof replacement project on the main building. The area of roof replaced was 98,000 square feet. The new roof, a PVC membrane system, reduces roof weight by at least two-thirds and should significantly reduce air conditioning costs. (Contact: Gary Dinkel, 605-594-6081)

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*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.*