U.S. Geological Survey

Gordon P. Eaton, Director
Lesley Ogrosky and
Kathleen Gohn, Bureau Editors

Theodore Roosevelt Dam, shown at right after a $430 million refurbishing completed last year, is on the Salt River in Arizona. One of the first federal dams completed in the early years of this century, it began an era of U.S. dam building. Photo by J. Madrigal, Jr.

A New Look Downstream

The Environmental Consequences of Dams

ıms provide many benefits—reducing flood ızards, providing reliable water supplies, oducing hydroelectric power, and providing aces for flatwater boating.

ıt with those benefits come environmental nsequences—eroding river banks, changes in terfowl habitat, concerns for safe recreational e, and the loss of river sand bars, according to a w report by the U.S. Geological Survey. *Dams and vers: Primer on the Downstream Effects of Dams* itlines the role of science in restoring or herwise altering these downstream effects.

he USGS has spent more than 100 years onitoring the nation's rivers and streams and oviding the hydrologic data needed to design the ıtion's infrastructure of dams," said **Robert M.**

Warning on the Chattahoochee River immediately below Buford Dam.

The Rio Grande River above Mesilla Dam near Las Cruces, New Mexico.

Hirsch, USGS chief hydrologist. "Today, the era of dam building in the United States is largely over and the USGS has turned some of its monitoring and research focus towards providing dam managers and resource planners with the kind of in-depth information they need to reduce some of the more harmful downstream effects of dams on river environments."

The USGS report looks at dams and rivers in seven selected areas of the country to focus on specific downstream effects of dams and the management issues related to their operation. The areas are the Upper Salt River in central Arizona; the Snake River in Idaho, Oregon and Washington; the Rio Grande in New Mexico and Texas; the Chattahoochee River in Georgia; the Platte River in Wyoming, Colorado and Nebraska; the Green River in Utah; and the Colorado River in Arizona.

The 94-page, richly illustrated USGS report has a special section on the role of science in the management of dams to minimize downstream impacts. For example, research provides hard data on environmental changes that might occur if water releases are altered. By using computer modeling, management plans can be developed that best balance needs of users with concerns for the environment. Monitoring and long-term data sets of streamflow trends can help in the development of better predictions of the movement of water and sediment below dams.

"The downstream effects of dams are a subject of much public controversy and debate," said Hirsch. "In asking our scientists to produce this report, we wanted to emphasize the important role that science has in helping society make informed decisions about the management of the nation's dams and river systems.

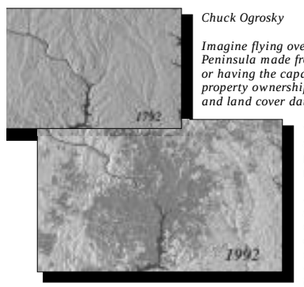
Written for a general audience, the USGS report also provides an extensive bibliography of available resources for a more technical investigation on the general topic and the specific river systems.

Single copies of the report, published as USGS Circular 1126, *Dams and Rivers: Primer on the Downstream Effects of Dams*, by **Michael Collier, Robert H. Webb** and **John C. Schmidt**, are available free of charge from the Branch of Information Services, USGS, Box 25286, Denver Federal Center, Denver, CO, 80225.

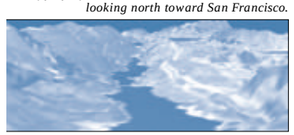
Geographic Information Systems: A Primer

Chuck Ogrosky

Imagine flying over a three-dimensional model of the San Francisco Peninsula made from elevation data and Landsat satellite imagery; or having the capability to overlay and analyze data on complex soils, property ownership, drainage, and slope; or being able to map land use and land cover data from aerial photographic or satellite image sources.



Above, partial frames for 1792 and 1992 from the computer generated animation show Baltimore-Washington urban growth. Below, a frame from a fly-by of the San Andreas Fault shows a view looking north toward San Francisco.



Would you like to learn to use these sophisticated approaches to visualizing or analyzing spatial patterns and interactions to address a unique problem in your own discipline?

Almost every issue in geology, hydrology, biology, or any other discipline that deals with the spatial distribution of phenomena has a geographic dimension. Knowing how to collect, update, merge, manage, analyze, and display information about where phenomena occur and how they have interacted and changed over time, and being able to model how they might change in the future, is key to solving land and resource management, environmental hazards, and other problems.

Geographic information systems help scientists, managers, and policy makers to apply geographic data (data that are spatially referenced) to any discipline. Popularly known as GIS, geographic information systems are made up of hardware, software, procedures, standards, data, and people. GIS provides the power not only to answer "where" questions, but also to analyze why things are where they are and how they might change in the future.

In Reston, Virginia, the **Geospatial Technology Laboratory** of the USGS helps scientists from USGS Divisions and cooperating agencies use GIS and related capabilities, such as multimedia and image processing and analysis. Under the leadership of the National Mapping Division and its Mapping Applications Center, the Lab provides access to state-of-the art systems and software, and expertise in geo-referenced data.

By developing partnerships with subject matter experts, Lab staff demonstrate new capabilities and processes, provide training in GIS and related applications, investigate advances in GIS systems, and promote the exploitation of existing geo-referenced data and new data sources such as aerial photography and satellite imagery. Lab staff are available for consultation on GIS issues and undertake prototype applications projects that advance the state of the art in using geographic information.

"The Lab hosts hundreds of visitors every year from the private sector and from universities and public agencies to demonstrate GIS technologies and applications, and to explore cooperative research and development possibilities," said **Tony Herr**, the Lab's chief. Available demonstrations include San Francisco Seismic Hazard Zonation, Fly-Bys of Yellowstone and Great Basin National Parks, and animation of 200 years of changes in population and transportation in the Baltimore-Washington region.

For more information about the Lab, or to schedule demonstrations or discussions about spatial data, GIS, and related tools and their applications please contact Tony Herr (programs-mission) at (703) 648-5393, or **Richard Moore** (scheduling-training) at (703) 648-5623.

Measuring Ground Failure in Earthquakes

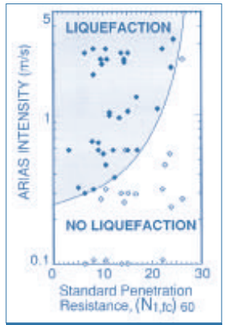
USGS Researcher Introduces "Arias Intensity" Method

A new method of assessing the danger of ground failure due to soil liquefaction during an earthquake was presented at the annual meeting of the American Geophysical Union in San Francisco in December.

Liquefaction typically occurs in sandy, water-saturated soils. During earthquake shaking, water pressure in tiny spaces (pores) within the soil is elevated temporarily, usually for a matter of minutes. During that time, the high pore pressures can cause soil to lose nearly all its strength, and potentially cause the soil to flow like a liquid.

Robert Kayen, a researcher at the USGS in Menlo Park, California, described the "Arias intensity" method of assessing the danger of liquefaction. Kayen and fellow researcher, **James Mitchell**, of Virginia Polytechnic Institute and State University, developed the innovative technique using computer models of earthquake waves as they propagate through soil to estimate an energy-based measure of earthquake shaking severity ("Arias" intensity), rather than conventional stress-based techniques

Central to this method is a graph of data from 81 soil sites in the United States and Japan that have undergone known levels of earthquake shaking. Along the horizontal axis is the strength of the soil layers below the ground surface. On the vertical axis is Arias intensity. For each site, Kayen and Mitchell plotted the ground properties against estimated earthquake shaking intensities. They noted on the plot whether the soil at each site had liquefied or not, and discovered a sharp boundary on the plot between sites that had liquefied and sites that had not.

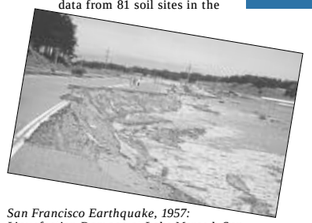


Using Arias intensity, Kayen and Mitchell found that a distinct boundary separates sites that liquefied from those that did not. Liquefaction can only occur in the shaded field above the boundary curve.

Up until now, Kayen said, liquefaction potential has been assessed by a conventional engineering method based on the peak stress exerted on soil during an earthquake.

"But earthquakes of different magnitudes and durations can exert the same peak stress on a soil while subjecting the soil to very different levels of earthquake shaking intensity; the greater the magnitude and-or duration of the earthquake, the greater the number of damaging waves that propagate through the soil. So, conventional, stress-based methods have to be corrected for factors such as earthquake magnitude and duration." Kayen said. "And Arias intensity incorporates these factors."

The new method will allow civil engineers to use common soil-foundation tests along with estimates of earthquake shaking intensity to make better assessments of liquefaction potential at a given site, and will also guide them in efforts to increase the strength of soil at a site and thus increase its resistance to liquefaction.



San Francisco Earthquake, 1957: Liquefaction Damage at Lake Merced, San Francisco, during a magnitude 5.3 earthquake.

New Mineral Named after USGS Geologist

Dr. George E. Ericksen

Charles G. Cunningham

A newly identified mineral has been named after a prominent USGS geologist to honor his pioneering work that led to the discover of new minerals.

The International Mineralogical Association Commission on New Minerals and Mineral Names recently announced the formal acceptance of the name **georgeericksenite** for a newly described mineral in honor of **Dr. George E. Ericksen**, a USGS geologist who passed away in January 1996.

The mineral occurs as tiny, yellow crystals, and was identified by a group of Canadian mineralogists led by **A. C. Roberts** of the Geological Survey of Canada. It is an evaporate mineral that dissolves in water and was found in the dry, desert environment between the city of *Antofagasta* and the *Salar de Atacama* in northern Chile.

Ericksen's 50-year career with the USGS was primarily concerned with the economic geology of metals and non-metallic minerals. He was a world expert on nitrate minerals, and his studies of minerals of many different origins provided new information about saline mineral occurrences. In conjunction with USGS mineralogists, these studies led to the identification of six new minerals.

In 1983, Ericksen was decorated by the government of Chile as Commander of the Order of Bernardo O'Higgins, the highest honor that the president of Chile can bestow on a foreign civilian. In 1985 he was awarded the Distinguished Service Award, the highest honor of the Department of the Interior. Dr. Ericksen spent much of his career improving the knowledge of geology and the teaching of young geologists in South American Andean countries.

USGS Offers Web Access to Special Images

David Terrell

At tourist spots and outdoors-oriented shops all over southern Florida, visitors can find a most engaging map—a satellite image map created by the USGS's Earth Resources Observation Systems (EROS) Data Center. Deep blue and black depict Lake Okeechobee and the Everglades, while growing vegetation shows up as green, and dormant plants and harvested crops are rust-colored. The right angles of cultivated fields are clearly superimposed on the random landforms of nature. In all, it's about as revealing a picture of that flat, wet landscape as one can find.

Owners of the image may have got hold of it in any number of ways, but the easiest way now is through a new World Wide Web site called Special Projects Images at edcwww.cr.usgs.gov/bin/html_web_store.cgi. It's an on-line catalog of unusual pictures of the planet.

The EROS Data Center did not set out to produce an office ornament. This particular image was created for the South Florida Ecosystem Restoration Initiative, an intergovernmental effort aimed at restoring the natural balance and function of the delicate and threatened region it represents.

This satellite image map of south Florida is an example of the kinds of images that can be browsed and bought from the Special Projects Image WWW page.

But in this case, as in many others, the image was attractive, even arresting. It is commercially salable for purposes other than science and mapping. When you produce millions of satellite images and aerial photographs, as the Data Center does, you'll find some like that.

Realizing this, the people who run the EROS Data Center's World Wide Web site (edcwww.cr.usgs.gov) set out to find a few such images and offer them for sale directly to the public. The result is the Special Projects Images collection. It contains not just southern Florida but dozens of images held in the Center's archive, from Space Shuttle photographs to old satellite images of the Middle East to pictures of vicious hurricanes and cataclysmic volcanic eruptions.

The collection is organized into categories—states, cities of the United States, cities of the world, natural hazards, and so on. Under Natural Features, a visitor might find Niagara Falls, along with a thumbnail-size graphical image file, or GIF; a caption explaining that this image is a low-altitude, oblique-angle color photo of the falls and their surroundings; and an order number. By double-clicking on the GIF, the visitor can bring up a much larger image, in higher resolution, along with a price ($16 for a nine-inch-square print) and an on-line order form.

The USGS is not turning into a mail-order house. In fact, the same images have been available for many years, along with the thousands of USGS maps, reports, and other publications. But because the Web is a powerful outreach tool, EROS Data Center management feels that it offers a way to get more USGS products to more customers at the modest cost of reproduction and distribution.

USGS (Continued)

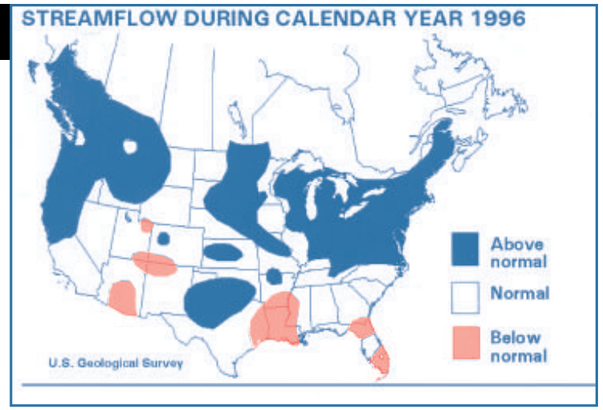
t Was A Very Wet Year

reamflow was well above normal in about half the untry last year. With the major flooding in California, vada, and the Pacific Northwest early in the new year d again in late January, the trend seems to be ntinuing into 1997, according to scientists with the S. Geological Survey.

the 173 key index stations in the USGS reporting twork of streamgaging stations across the country, 50 rcent of the stations recorded flows for 1996 that re well above normal—in the highest 25 percent of e historic record. On the drier side, well below normal ws—within the lowest 25 percent of record—were corded at 29 percent of the stations, mostly in the uthwest, Gulf Coast area and Florida.

e wet trend is evident on both coasts: On the East ast, the Chesapeake Bay received its highest inflow of shwater in 45 years during 1996. The high flows from e Susquehanna, Potomac, James and other rivers and reams also carried unusually high loads of sediment, trients, and other chemicals that affected the water ality and living resources of the Bay.

the West Coast, San Francisco Bay received record flows in January 1997 from the Sacramento and other ers. During the West Coast flooding in early January 1997, the USGS measured all-time record peak flows at 39 streamgaging stations in California, Nevada, Washington, Oregon, and Idaho. At 18 sites, the flood peaks reached or exceeded the level of a 100-year flood—a level expected to be reached on the long-term average of once every 100 years or about a 1 percent chance in any given year. Along with other serious property damage, the New Year floods damaged or destroyed 146 USGS streamgaging stations.



USGS Hosts Meeting on Amphibians

Sam Droege, Brett Hoover, Jeff Hostetler, Jude Griffin, and Randy Schmieder

The meeting began quietly at Patuxent Wildlife Research Center on November 14, attended by more than 4000 participants from farflung locations like Slovakia, Costa Rica, Portugal, Laramie, Carbondale. More than 50 papers on amphibian monitoring and deformities were presented for discussion over the three-month duration of the meeting.

The symposium and discussions ran 24-hours a day and didn't stop for Chanukah, Christmas, or New Year's Day. Entertainment was also provided: amphibian field trips to the Kuril Islands, Taiwan, Kenya, and Brazil; a special forum on amphibian poetry; and, for the adventuresome, an exotic dancer (of the amphibian persuasion!) specially commissioned for the conference.

Such are meetings on the Internet. As part of the North American Amphibian Monitoring Program, the Patuxent Wildlife Research Center has been helping host technical meetings to resolve issues on how to create a set of continent-wide surveys for amphibians in North America. With budgets low and potential participants scattered across the continent we chose to host this year's meeting on the World Wide Web. While not everyone has direct Web access, almost all biologists have access through their office, home, or colleagues.

By putting the meeting on the Web, there are no problems with overlapping sessions, boring lectures, exorbitant travel costs, or schedule conflicts. Anyone with Web access can attend, making an international meeting as feasible to host as a local one. While this was the first meeting of its kind, in an era of increasing regional, global and interdisciplinary cooperation on environmental issues, more such meetings cannot be far behind.

Although discussions are closed, the meeting site, papers, past discussion, and field trips all remain open (http://www.im.nbs.gov/naamp3/) and will stay open indefinitely. Anyone wishing to host a similar meeting can download all the meeting codes and programs via ftp.

Reaching Out: *National Wetlands Research Center Outreach Trains Earth Stewards*

Gaye S. Farris

An important outreach program at the National Wetlands Research Center in Lafayette, Louisiana, is the Earth Steward's Program, a pilot venture jointly sponsored by the USGS, the U.S. Fish and Wildlife Service and the National Fish and Wildlife Foundation. Through the program the Center has adopted J.W. Faulk Elementary School, trained scientists and support staff, and regularly interacted with the school's classes, from kindergarten through fifth grade.

J.W. Faulk Elementary students in Lafayette get hands-on instruction in how biologists use radio telemetry to track ducks, or in this case a decoy!

Cleaning up the butterfly garden for spring is all in a school day's work for J.W. Faulk Elementary students who are learning more about the earth and its plants and animals, thanks to the Earth Steward's pilot program in which the National Wetlands Research Center participates.

Outstanding teachers have been integral to the success of Center outreach. One such teacher is **Sue Ellen Lyons**, a teacher at Holy Cross High School in New Orleans, who was recently named National Wetlands Educator of the Year by the Environmental Law Institute and the Environmental Protection Agency. Her school is one of 20 Louisiana schools participating in the Wetland Loss Mapping Program that provides software and training to more than 80 teachers and their students studying wetland changes.

Sue Ellen Lyons.

Teacher training workshops are conducted by the Center and the University of Southwestern Louisiana. The effort is developing a CD-ROM with teacher resources, wetland information, and interactive student activities on projects to save wetlands. Another outstanding educator involved in this project is **Dr. Carol Whelan**, director of the University of Southwest Louisiana's Educational Technology Review Center, where she has set up a program to teach multi-media production and web site production.

This past year the Center initiated a five-week mentoring program in which an area teacher spends time at the Center evaluating resources for educational opportunities and provides a report for use by other teachers. Last year the Center provided spatial analysis training for more than 300 people from government agencies, the private sector, and academia from 18 states and 16 foreign countries. The training schedule is reachable on the Internet at http://www.nwrc.gov/trai1997.html