

Science for Stewardship of California's Water Resources

The U.S. Geological Survey (USGS) is the primary Federal agency responsible for scientific evaluation of the natural resources of the United States, including its water. To meet the demands of a growing California, the U.S. Geological Survey's California Water Science Center provides essential science to help Federal, State, and local water agencies evaluate and manage California's critical water resources; adapt to a changing climate; assess, predict, and mitigate natural hazards, such as mudslides and debris flows; and protect the health of rivers, forests, wetlands, and other habitats.

The following are some of the ways the USGS is working with other agencies to protect California's water resources and assure that Californians have safe and reliable water supplies for now and in the future.

Keeping Watch on Groundwater Quality

Groundwater provides more than 40 percent of California's drinking water. To protect this vital resource, the State of California created the Groundwater Ambient Monitoring and Assessment (GAMA) Program. Under GAMA, the USGS is working with the State Water Resources Control Board to monitor and assess water quality in groundwater basins that are used for public supply. With the cooperation of local water agencies and well owners, the USGS is testing groundwater quality in those basins over a 10-year period. (<http://ca.water.usgs.gov/gama/>)



Meg Hurst prepares water-quality samples in a mobile laboratory.

- The USGS California Water Science Center brings many capabilities and tools to the understanding, management, and protection of California's water and other natural resources. The Center's approximately 200 scientists and technicians are leaders in:
- **Conducting long-term monitoring of streamflow and water quality.**
 - **Developing new sampling, analytical, and interpretive methods to assess groundwater quality.**
 - **Studying the geology of groundwater systems to help managers protect and optimize supplies.**
 - **Devising new computer models that can play a key role in everything from managing surface-water and groundwater supplies to assessing the impact of climate change on individual watersheds.**
 - **Conducting multi-disciplinary ecosystem and watershed research, including large-scale studies in the Sacramento-San Joaquin River Delta and San Francisco Bay.**

CALIFORNIA WATER SCIENCE CENTER

Helping Agencies Manage and Protect Groundwater

USGS scientists are helping local water agencies throughout California better understand, manage, protect, and maximize the effective use of groundwater basins. Scientists are conducting water-quality assessments, developing groundwater computer models that simulate a variety of scenarios, and devising new strategies for replenishing groundwater basins and using them in conjunction with surface-water supplies.

For instance, USGS scientists, working with the city of Victorville and the Mojave Water Agency, have found innovative new ways to recharge water through 400 feet of dry earth in California's Mojave Desert. Research could help the agencies use groundwater basins that were previously thought to be unavailable for municipal water storage. (http://ca.water.usgs.gov/news/releaseMarch13_2008.html)



USGS geologist David O'Leary measures the depth to the water table at a pilot-study recharge pond near Yucca Valley.

Maintaining a Long-Term Stream Monitoring Network

The USGS, in cooperation with State, local and Tribal agencies, operates more than 500 stream gages in California for monitoring of streamflow and water quality. This statewide network is part of a nationwide program that provides streamflow

information for a variety of purposes, including drought and flood monitoring. It also provides long-term data to detect changes in streamflow caused by human activities or climate change. USGS streamflow gaging stations equipped with real-time telemetry are integral components of reservoir operations and river-forecast and flood-warning systems. Real-time streamflow information is available online at <http://waterdata.usgs.gov/nwis/rt>.

Understanding the California Delta

The Sacramento-San Joaquin River Delta is the hub of California's water system and also an imperiled habitat for fish and other wildlife. The USGS California Water Science Center is working with several Federal, State, and local agencies to develop the science for addressing a number of Delta issues. These issues range from fish migration and water flow to pesticides, water quality, and land-surface subsidence. In one of the largest projects, USGS scientists are conducting a high-tech study in cooperation with the California Department of Water Resources to gather data on route selection and survival of juvenile salmon as they make their way through the Delta to the ocean. This research involves many scientific disciplines and the use of emerging technologies in fisheries science and hydrodynamic measurement, including a remote-controlled boat (below) that gathers data on river flows (http://ca.water.usgs.gov/news/ReleaseNov14_2008.pdf).



Scientists release tagged juvenile salmon into the California Delta. A remote-controlled boat gathers stream data.

Planning for Climate Change

A changing climate will have profound and wide-ranging impacts across California. Water and environmental-resource managers need new scientific tools that will help them predict how a changing climate will affect local watersheds, groundwater basins, forests, and wetlands. USGS scientists are developing those tools. Using their knowledge of hydrology and physical processes, scientists are able to create a link between future climate scenarios and what may happen to ecosystems and water supplies.

The USGS is also developing a pilot project to potentially reverse, or minimize, one of the causes of global warming – the emission of greenhouse gases to the atmosphere. The project might also help save one of California's most-imperiled landscapes – the Sacramento-San Joaquin River Delta. Throughout the Delta, oxidation of the soils from farming practices has



A test "carbon-capture" farm shows promise for making Delta islands less vulnerable to flooding.

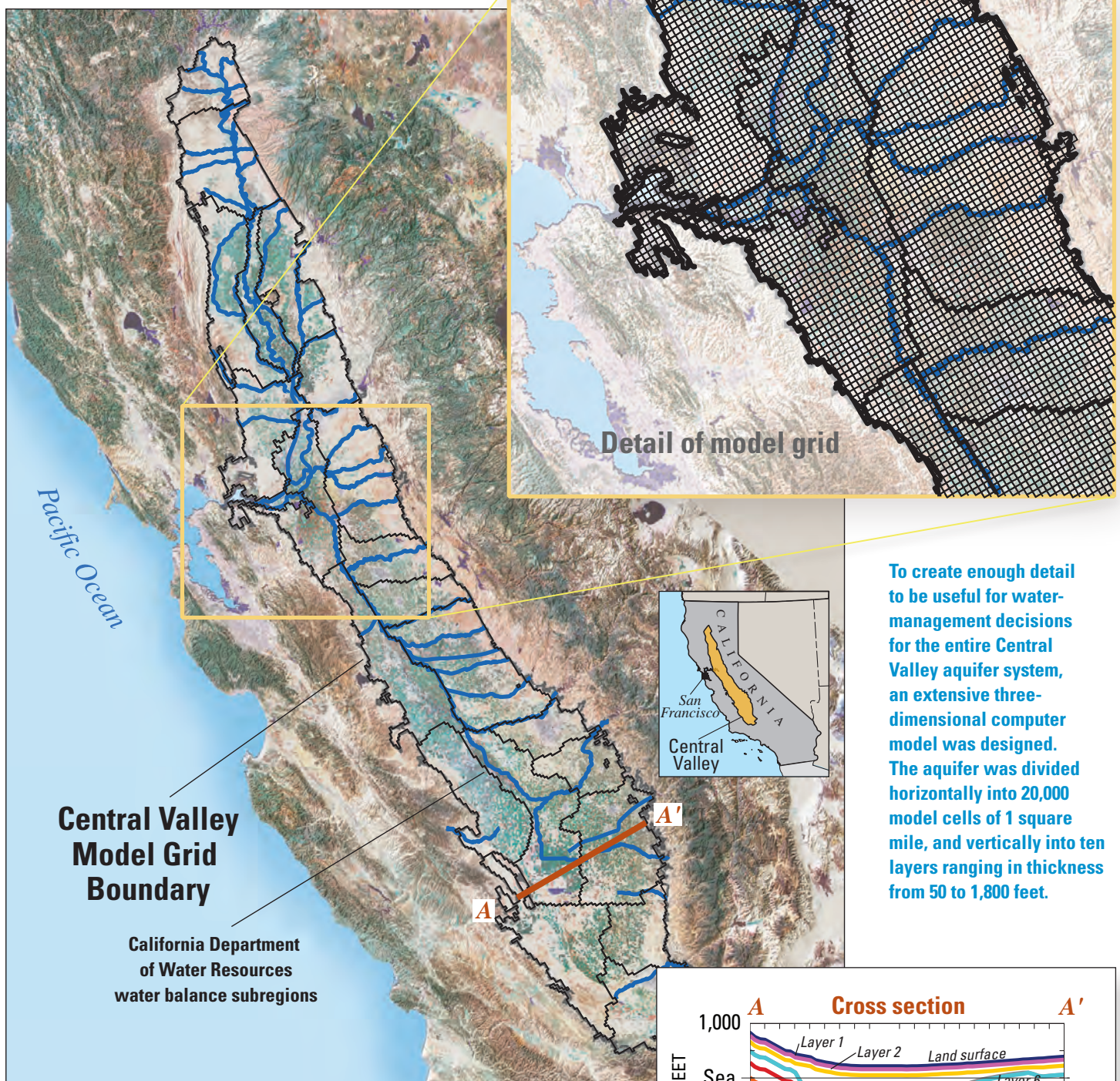
resulted in a steady loss of land-surface elevation. As a result, most of the farmed Delta islands – such as Twitchell Island, above – are more than 20 feet below the surrounding waterways and must be permanently protected by levees. The USGS, working with the California Department of Water Resources and the University of California, is conducting research on a new type of farming that traps atmospheric carbon dioxide and rebuilds lost soils (http://ca.water.usgs.gov/news/Release-July23_2008.html).

Assessing Groundwater Availability in the Central Valley

Managing the Central Valley's vast aquifer system – California's biggest water reservoir – is an increasingly complex endeavor that is critical to the water supply of the entire State. The USGS has created a new water-modeling tool, the Central Valley Hydrologic Model, to help local water managers assess, understand, and address the myriad of issues affecting Central Valley groundwater supplies. The model could be used by managers to:

- Effectively manage the interdependent use of surface water and groundwater.
- Conserve farmland.
- Assess the effect of land-use changes on water resources.
- Assess the effects of climate change on groundwater supplies.

Central Valley Hydrologic Model



This new tool simultaneously accounts for changing water supply and demand. It simulates irrigated agriculture and surface-water and groundwater flow across the entire Central Valley hydrologic system. The detail and breadth of this hydrologic model makes it invaluable to water-resource managers faced with increasing water-management challenges and constraints.

Real-Time Monitoring of Hydrologic Hazards

The USGS California Water Science Center has installed a network of webcams across California in conjunction with its stream gages. Several of the webcams are in watersheds in Santa Barbara, Ventura, Orange, Los Angeles, and San Diego Counties that, because of recent fires, are at high risk of

flooding or debris flows during heavy rainfall. The webcams provide visual data to the National Weather Service, first-responders, and area residents of real-time conditions in creek channels. The webcams, which can be viewed and operated remotely by the public, can be accessed at <http://ca.water.usgs.gov/webcams/>.

Assessing the Fate and Transport of Pesticides

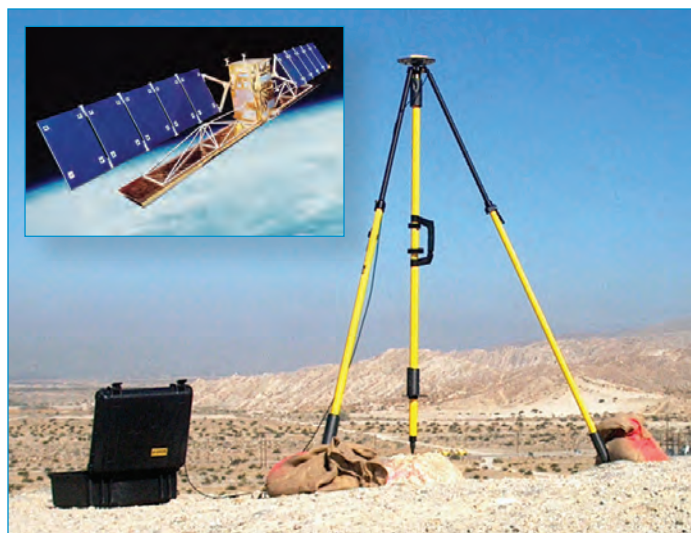
The USGS Pesticide Fate Research project is a series of studies that assess the occurrence, transport, and fate of current-use pesticides in water throughout California, including the San Francisco Bay watershed, the Salton Sea, and central California coastal rivers. Working with toxicologists and ecologists, USGS scientists are focusing on the potential effects of compounds on aquatic organisms and human health. Scientists have developed analytical methods for measuring pesticide concentrations in water, sediments, and biological tissues at environmentally relevant levels. They are conducting field studies to track when and where these pesticides occur in waterways. Complementary laboratory studies are also under way to understand the factors controlling the breakdown rates of pesticides in the environment. (http://ca.water.usgs.gov/user_projects/toxics/)



USGS researcher Kelly Smalling gathers fish-tissue samples for a pesticide study on California's Central Coast.

Measuring Land Subsidence

The USGS is studying land subsidence in several regions, including the Coachella Valley in Southern California. Since the 1920s, groundwater has been a major source of agricultural, municipal, and domestic supply in the valley. Overpumping has caused underground water tables to drop as much as 100 feet. That has led to declining land-surface elevations, known as subsidence, which can disrupt surface drainage; reduce aquifer storage; cause earth fissures; and damage wells, buildings, roads and utility infrastructure. The USGS and the Coachella Valley Water District launched the research in 1996. USGS scientists are using Global Positioning System (GPS) surveying and a satellite mapping process known as Interferometric Synthetic Aperture Radar (InSAR) to document the drops in elevation. The data collected are helping the Coachella Valley Water District develop new water-conservation and management initiatives to eliminate overpumping. (<http://ca.water.usgs.gov/news/release071217.html>)



The USGS uses a Global Positioning System (GPS) to measure changes in the position of Earth's surface (subsidence) over time at 20 bench marks in the Coachella Valley.



For more information on the California Water Science Center, visit our Web site at <http://ca.water.usgs.gov/> or call the Sacramento Project Office at (916) 278-3000 or the San Diego Project Office at (619) 225-6100.

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