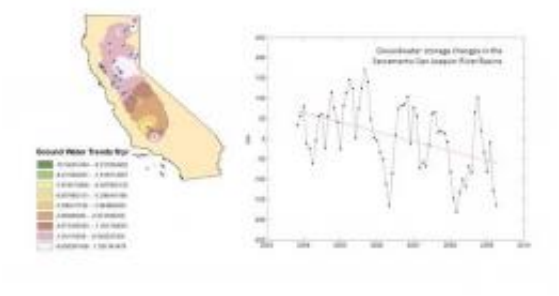
California's troubled waters: Satellite-based findings reveal major groundwater loss in Central Valley (w/ Video)

December 14 2009



Grace observed trends in groundwater levels, October, 2003 - March, 2009
Image Credit: University Of California Center For Hydrologic Modeling

New space observations reveal that since October 2003, the aquifers for California's primary agricultural region - the Central Valley - and its major mountain water source - the Sierra Nevada - have lost nearly enough water combined to fill Lake Mead, America's largest reservoir. The findings, based on satellite data, reflect California's extended drought and increased pumping of groundwater for human uses such as irrigation.

At the American Geophysical Union meeting this week in San Francisco, UC Irvine and NASA scientists detailed the state's groundwater changes and outlined research on other global aquifers conducted via twin satellites called the Gravity Recovery and Climate

Experiment. GRACE monitors tiny month-to-month differences in Earth's gravity field primarily caused by the movement of water in the planet's land, ocean, ice and atmosphere. Its ability to "weigh" changes in water content provides new insights into how climate change is affecting Earth's water cycle.

Combined, California's Sacramento and San Joaquin drainage basins have shed more than 30 cubic kilometers of water since late 2003, said Jay Famiglietti, UCI Earth system science professor and director of the UC Center for Hydrologic Modeling. A cubic kilometer is about 264.2 billion gallons, enough to fill 400,000 Olympic-size pools. The bulk of the loss occurred in the state's agricultural Central Valley. The Central Valley depends on irrigation from both groundwater wells and diverted surface water.

"GRACE data reveal groundwater in these basins is being pumped for irrigation at rates that are not sustainable if current trends continue," Famiglietti said. "This is leading to declining water tables, water shortages, decreasing crop sizes and continued land subsidence. The findings have major implications for the U.S. economy, as California's Central Valley is home to one-sixth of all U.S. irrigated land and the state leads the nation in agricultural production and exports."

"By providing data on large-scale groundwater depletion rates, GRACE can help California water managers make informed decisions about allocating water resources," said project scientist Michael Watkins of NASA's Jet Propulsion Laboratory.

Preliminary studies show most of the water loss is coming from the more southerly located San Joaquin basin, which gets less precipitation than the Sacramento River basin farther north. Initial results indicate the Sacramento River basin is losing about 2 cubic kilometers of water a year. Surface water losses account for half of this, while groundwater

losses in the northern Central Valley add another 0.6 cubic kilometers annually. The San Joaquin basin is losing 3.5 cubic kilometers a year. More than 75 percent of this is due to groundwater pumping in the southern Central Valley, primarily to irrigate crops.

Famiglietti said recent California legislation decreasing the allocation of surface water to the San Joaquin basin is likely to further increase the region's reliance on groundwater for irrigation. "This suggests the decreasing groundwater storage trends seen by GRACE will continue for the foreseeable future," he said.

The California results come just months after Matt Rodell of NASA's Goddard Space Flight Center, Isabella Velicogna of UCI, and Famiglietti found groundwater levels in northwest India declining by 17.7 cubic kilometers per year between October 2002 and August 2008, a loss attributed almost entirely to pumping and consumption of groundwater by humans.

"California and India are just two of many regions around the world where GRACE data are being used to study droughts, which can have devastating impacts on societies and cost the U.S. economy $6 billion to $8 billion annually," said Rodell, who was Famiglietti's doctoral student at the University of Texas at Austin.

Other regions under study include the southeastern U.S., where GRACE clearly captured the evolution of an extended drought that ended this spring; Australia; and the Middle East-North Africa region. There, Rodell is leading an effort to assess regional water resources by using GRACE and other data to systematically map water and weather-related variables. He said GRACE may also help predict droughts, since it can identify pre-existing conditions favorable to the start of a drought, such as a deficit of water deep below ground.

Source: University of California - Irvine