NATIONAL GEOGRAPHIC News Watch **Water Currents**

Ideas and insights about the world of freshwater

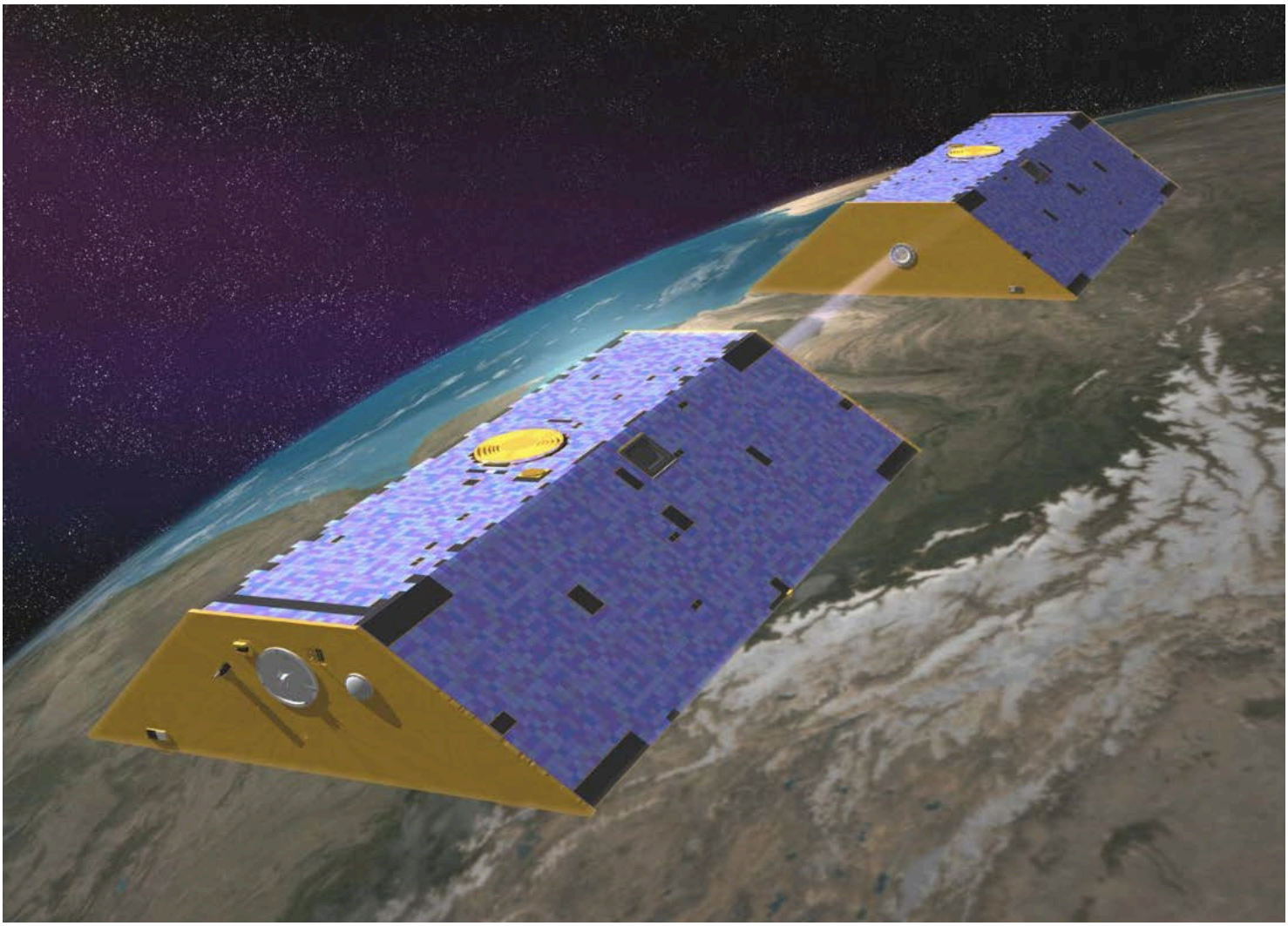
Menu

- Change the Course
- Freshwater Resources
- Freshwater Species of the Week
- Water Portal

Groundwater Depletion in Colorado River Basin Poses Big Risk to Water Security

Posted by Sandra Postel of National Geographic's Freshwater Initiative in Water Currents on July 30, 2014

(32)



An artist's rendering of the twin satellites of NASA's Gravity Recovery and Climate Experiment (GRACE). Using data from this mission, scientists have determined that a vast volume of groundwater has been depleted from the Colorado River Basin over the last decade. Credit: NASA/JPL

Let's step back for a minute and consider the implications of the study released last week on the depletion of groundwater in the Colorado River Basin.

For anyone concerned about the future of the American West, the findings of this study – which was published online in the journal *Geophysical Research Letters* and conducted by a team of scientists from NASA, the University of California-Irvine, and the National Center for Atmospheric Research in Boulder, Colorado—can make the heart pound.

Let's start with a little context above ground, before going below.

Lake Mead is the largest reservoir in the United States and the granddaddy of reservoirs on the Colorado River. This giant man-made lake, formed by the construction of Hoover Dam in the 1930s, can hold nearly two years of the Colorado River's historic flow.

Some 40 million people – including those in Las Vegas, Los Angeles, Phoenix, Tucson and San Diego — and 4 million acres of farmland rely on water from the Colorado River Basin, much of it stored in Lake Mead.

In 2000, Lake Mead was just about full. Then a drought hit that has more or less continued to this day. This has been the driest 14-year period in the Colorado Basin in the last 100 years. Demand for the Colorado River's water by the seven US states and Mexico, which share the river, now exceeds the ten-year average supply.

As a result, the level of Lake Mead has steadily dropped. At full capacity, the lake's level is 1,221.4 feet above mean sea level. Today its level is at 1,080.9 feet, the lowest it has been since 1937, just after the completion of Hoover Dam.

The now-famous white bathtub ring around Lake Mead's perimeter tells this story.

Because the lake is shaped like a coffee filter –wider at the top and narrower at greater depths – a seemingly small decline in water level represents a disproportionately large drop in the volume of water it's storing. Today, instead of holding two year's worth of Colorado River water, the lake holds about 9 months worth.

Water managers and officials have known for at least four decades that when surface supplies became scarce in the basin, farms and cities would turn to groundwater to meet their water needs, especially during times of drought.

But with groundwater management left to the states, there has been no overarching assessment of what's happening to water underground – nothing equivalent to Lake Mead's bathtub ring to signal a problem for the basin as a whole.

Until now.

The white "bathtub ring" of mineral deposits marks the decline of Lake Mead, which is able to store two years of the Colorado River's historic annual flow. It currently holds only 9 months worth of that flow. Photo courtesy of US Bureau of Reclamation.

Thanks to a NASA satellite mission called the Gravity Recovery and Climate Experiment, or GRACE, which began in 2002, we are getting a look at changes in water storage both above and below ground in watersheds around the world.

Using twin satellites, the GRACE mission measures the mass of the earth over time and space. Because changes in water storage result in changes in mass, GRACE provides fairly accurate estimates of water depletion over time.

When Stephanie Castle of the University of California-Irvine and her colleagues analyzed GRACE data for the whole Colorado River Basin over the period December 2004 –

November 2013, what they found stunned them: the Colorado Basin had lost nearly 53 million acre-feet of water (65 billion cubic meters) – equivalent to two full Lake Meads.

Even more striking, 77 percent of that loss – some 41 million acre-feet – was water stored underground. That's enough to meet the home water use of the entire US population for *eight years*.

(An acre-foot is the volume of water that would cover an acre of land one foot deep. It equals 325,850 gallons, roughly the amount eight people in the U.S. would use at home in a year.)

"We don't know exactly how much groundwater we have left, so we don't know when we're going to run out," Castle said in a press release announcing the study.

"This is a lot of water to lose. We thought that the picture could be pretty bad, but this was shocking."

Now, it's common for farms and cities to pump more groundwater during droughts in order to make up the gap between supply and demand. The assumption is, that during times of surplus, the groundwater basins will fill back up.

But what if they don't re-fill?

Some groundwater basins do not receive much recharge even in wet times. I wrote last week about how drought is leading farmers to pump more heavily from the Ogallala Aquifer beneath northwest Texas, a largely irreversible loss of groundwater. Areas of similar "non-rechargeable" aquifers also exist in the Colorado River Basin.

"This is a lot of water to lose. We thought that the picture could be pretty bad, but this was shocking." — Stephanie Castle, lead author of the study.

In addition, virtually all the climate models indicate that the Southwest is in for hotter and drier times, meaning more losses to evaporation, less replenishment of aquifers, and higher water demand from farms and cities.

Jay Famiglietti, senior water scientist at the NASA Jet Propulsion Laboratory, Earth systems science professor at UC-Irvine, and a co-author of this study, pointed out in his post in Water Currents last week that during the severe drought of the past decade, Colorado Basin water demands have outpaced supplies by as much as 30 percent, with groundwater filling the gap.

By focusing only on the drop in Lake Mead and paying too-little attention to the drop in water levels underground, we have placed the West's water security in serious jeopardy.

Imagine having a bank account for which you don't know (1) how much money is in the account, (2) how much gets withdrawn, or (3) how much will get deposited, or when.

Such a money-management circumstance would offer little hope of keeping a family fed, clothed and sheltered over the long term, much less of sending a child to college.

So, we have two choices: continue flying water-blind into the future and leave the consequences to the next generation, or get our heads out of the sand and take action to monitor, manage and balance our water books.

If we choose the second option, what's needed is fairly clear.

First, conservation and efficiency improvements in homes, businesses and, especially, on farms – which account for some 80 percent of water consumed in the basin – remain the most cost-effective, environmentally sound ways of meeting our water demands. While we've made some solid gains, we have a long way to go and many solutions yet to tap.

Second, we need to manage and regulate — yes, regulate — groundwater. It's a finite supply, and as long as there's no limit on the number of straws in the cup and how much they can slurp, the water level will keep going down. Pumping limits would promote more efficient water use.

Third, we should stop letting antiquated water laws trump sound economics. If farmers were readily able to sell or lease water to cities and conservationists, they would have incentive to invest in more efficient irrigation practices, switch to less thirsty crops, or fallow a portion of their fields so they could sell the conserved water to others. A healthier water market could help cities meet long-term needs and even help rivers weather a drought.

This, in part, is the spirit behind the Colorado River System Conservation Program, which would pay for voluntary reductions in water use – whether by fallowing farm fields, installing more efficient irrigation systems, recycling industrial water, or other means – that benefit the basin as a whole.

Lastly, management of Colorado River Basin water is overseen by a long list of federal and state authorities. While collaboration has improved greatly in recent years, it's imperative to cooperate around groundwater monitoring and reporting in order to get a basin-wide view of what's happening underground.

The findings of this study are a wake-up call, and it would be foolish beyond measure to push the snooze button.

[Disclaimer: The editors of *Geophysical Research Letters* asked me to serve as a reviewer of the Castle et al. manuscript, which I did.]

Sandra Postel is director of the Global Water Policy Project, Freshwater Fellow of the National Geographic Society, and author of several books and numerous articles on global water issues. She is co-creator of Change the Course, the national freshwater conservation and restoration campaign being piloted in the Colorado River Basin.

Keywords: Change the Course, Colorado River Basin, GRACE, groundwater depletion, NASA