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By Pat Brennan

Groundwater vanishing in Central Valley

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An orchard withers near Coalinga. Photo courtesy UC Davis Agricultural Sustainability Institute.

Over-pumping is pulling vast and unsustainable amounts of groundwater from the heart of California farming, the Central Valley, a new UC Irvine satellite study shows – with enough lost over four years to fill two-thirds of Lake Mead.

The phenomenon shows no sign of slackening despite two wet winters in a row, and the rate of extraction is likely greater than the estimated depletion rate, said Earth System Science professor Jay Famiglietti, the study's lead author.

"It'll be an impact on food prices for sure," Famiglietti said, as well as water supply. "We get about 25 percent of our water shipped down from up north," he said. "So as that snowpack starts to decline, there will be less water to export to Southern California."

Using NASA's GRACE satellites to measure gravitational changes as groundwater levels drop, Famiglietti saw the surprisingly steep decline between April 2006 and March 2010.

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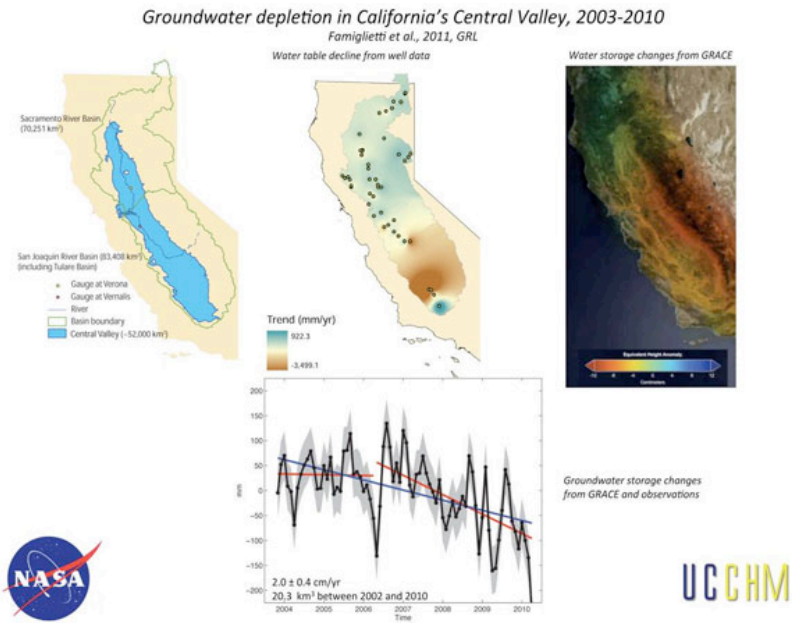

It works out to 12.8 trillion gallons, or 40 million acre feet – enough to cover almost half of California under a foot of water, Famiglietti said.

The depletion was especially heavy in the southern, San Joaquin portion of the Central Valley, he said.

And it was the third largest drop in 50 years, all of them tied to drought conditions.

"This is sort of a tradition in California," he said. "And it's not just the Central Valley. It's all over the world."

As drought intensifies, he said, farmers increase their reliance on groundwater.

Restrictions on pumping from the California Delta to protect a threatened fish called the delta smelt also drove farmers to pump more groundwater.

"Allocations to farmers have been severely restricted during the drought, in part because of lack of available water and in part for ecological protection," Famiglietti said. "In some cases, surface water allocations were cut by as much as 90 percent."

Unrestricted pumping from private wells complicates the problem, he said, as well as a booming population requiring more and more water to sustain it.

But accurate estimates of groundwater pumping are notoriously difficult.

"The beauty of satellite measurements is, they can give a holistic view of the whole aquifer that is very difficult to construct from traditional methods," said Famiglietti, who directs the UC Center for Hydrologic Modeling. "The other thing that's great about remote sensing is, it doesn't really know the political boundaries."

The processing of satellite data typically involves about a six-month lag, he said, so data from this winter are not yet available.

Powerful winter storms increased the snowpack this year, with state water officials reporting full reservoirs. But that doesn't mean the depletion will be substantially reversed, or that drought conditions that lead to depletion will disappear.

"Last winter was pretty wet, too, and we did not see any significant recovery of groundwater," he said.

The trend toward decreasing rainfall and more frequent drought will likely continue because of climate change, Famiglietti said – perhaps as much as a 90 percent decrease in snowpack by the end of the century.

"If we have a wet winter, that does not change the fact that we are facing a very long-term decline in precipitation," he said. "A couple of wet winters doesn't end a drought. Don't get me wrong: It's a great boost to water resources. But in the long term, it's a problem we have to deal with."

Famiglietti relied on measurements from GRACE, or the Gravity Recovery and Climate Experiment, a joint project of NASA and the German Aerospace Center. Changes on the surface also mean slight changes in gravity; by precisely comparing distances between them, the two satellites can make gravitational maps that reveal the changes.

The study was published online Saturday in the science journal Geophysical Research Letters.

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