

Pumping water for crops may trigger earthquakes in Central California

By Los Angeles Times, adapted by Newsela staff on 05.28.14

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Nick Hill, farm manager at Green Leaf Farms in Sanger, Calif., holds a Valencia orange. Scientists believe irrigation for the Central Valley's crops may be to blame for an increase in earthquakes in the area. Photo: Jim Gensheimer/San Jose Mercury News

LOS ANGELES—Scientists have a new theory about the forces that are pushing up California's Sierra Nevada and central coast ranges, causing more earthquakes in one part of Central California.

Their theory is this: The quakes are triggered in part by the pumping of groundwater in the Central Valley, which produces crops that feed the nation.

“These results suggest that human activity may give rise to a gradual increase in the rate of earthquake occurrence,” said the study published in the journal *Nature*.

The scientists found that mountains closest to California's Central Valley were growing at a faster-than-expected rate compared to nearby ranges. The growth spurt — about 1 to 3 millimeters a year — was enough to lift them by half a foot over the last 150 years.

Groundwater is very heavy, and depresses the Earth's upper crust like a weight. Remove that weight, and the Earth springs upward — and that change in pressure can trigger more small earthquakes, the researchers said.

Earthquakes During Dry Months

“It reduces the forces that are keeping the fault clamped together — leading to more small earthquakes during dry periods of time,” said Colin B. Amos, the study’s lead author.

Other scientists studying a seismically active area of southern Monterey County observed that there are often more earthquakes during dry months than during wet months. The number of earthquakes there every year has roughly doubled between 1984 and 2005.

“During wet periods of time when the fault is loaded down, the forces that are keeping the fault clamped down are greater. It inhibits the sliding of the fault,” Amos said.

But the question as to why earthquakes have been increasing in Parkfield over time has been a mystery. The groundwater theory introduced by Amos and his coworkers gives one possible answer.

“Over the long term, because we’re losing more groundwater, it could give rise to more seismicity by reducing these overall forces,” Amos said.

Quenching Their Thirst

Groundwater has been slowly depleted in the Central Valley to quench the thirst of farms and cities since the mid-1800s.

That irrigation has already caused dramatic changes. In the 1930s, water rerouting prompted the disappearance of Tulare Lake, once the largest body of fresh water west of the Mississippi River. Tulare Lake was 60 miles wide from end to end.

Over the last 150 years, the Central Valley’s groundwater reserve has lost about 38 cubic miles of water. That’s enough to drain Lake Tahoe.

About 20 percent of the nation’s groundwater comes from Central Valley aquifers, according to the U.S. Geological Survey. It’s the second-most-pumped aquifer system in the United States. The Central Valley produces one-quarter of the nation’s food, including 40 percent of fruits, nuts and other food.

The study published Wednesday does not suggest the next Big One to hit Los Angeles or San Francisco will be caused by human activity, Amos said.

“Large earthquakes are going to occur on the San Andreas fault no matter what we do,” Amos said. But what is important is the idea that human activity could trigger more seismic activity.

Affecting The San Andreas Fault

“It’s really opening up a possibility that humans are changing stresses on faults,” Amos said. “It’s a simple realization that human use of groundwater is having small but perhaps measurable impacts on the San Andreas fault.”

The San Andreas fault is a major source of earthquakes. It runs from San Diego to San Francisco.

U.S. Geological Survey seismologist Susan Hough said the idea that groundwater depletion can trigger earthquakes is very possible.

Hough went a step further than the researchers, saying it's possible that smaller earthquakes in the Parkfield area could eventually trigger larger earthquakes that head south toward Los Angeles.

"If you raise the rate of little earthquakes, you also raise the probability of a bigger earthquake," Hough said.

"It Could Happen"

Parkfield was the starting point of a magnitude 7.9 earthquake that hit the San Andreas fault in 1857. The fault unzipped south for nearly 200 miles, down to the San Gabriel Mountains and ending in Wrightwood. That fault was so massive that shaking lasted from 1 to 3 minutes, trees were uprooted, and buildings were destroyed.

"As near as we can tell, the foreshocks were in the Parkfield area," Hough said.

"It won't necessarily happen that way" again in our lifetime, she said. "But the fact that it did happen once means that it could happen."

Hough said further study was needed to determine whether groundwater depletion in other areas could trigger earthquakes elsewhere. The part of the San Andreas fault around Parkfield is fairly weak — meaning not much change in pressure is needed to loosen the fault and cause earthquakes.

In contrast, sections of the San Andreas closer to San Francisco and Los Angeles are much stronger and more locked.

Steve Ingebritsen, a hydrogeologist with the U.S. Geological Survey, called the theory interesting and said that more study was needed. He called the suggestion that groundwater depletion could lead to more earthquakes "somewhat controversial."

Quiz

- 1 Select the sentence from the introduction that BEST summarizes the article.
- (A) Remove that weight, and the Earth springs upward — and that change in pressure can trigger more small earthquakes, the researchers said.
 - (B) Scientists have a new theory about the forces that are pushing up California's Sierra Nevada and central coast ranges, causing more earthquakes in one part of Central California.
 - (C) Their theory is this: The quakes are triggered in part by the pumping of groundwater in the Central Valley, which produces crops that feed the nation.
 - (D) “These results suggest that human activity may give rise to a gradual increase in the rate of earthquake occurrence,” said the study published in the journal *Nature*.

- 2 Read the sentence from the article.

Hough went a step further than the researchers, saying it's possible that smaller earthquakes in the Parkfield area could eventually trigger larger earthquakes that head south toward Los Angeles.

Select the paragraph from the section “It Could Happen” that portrays the assertion in the sentence above as uncertain.

- 3 Read the paragraph from the article.

That irrigation has already caused dramatic changes. In the 1930s, water rerouting prompted the disappearance of Tulare Lake, once the largest body of freshwater west of the Mississippi River. Tulare Lake was 60 miles wide from end to end.

How does the paragraph contribute to the article’s portrayal of water usage in California?

- (A) it introduces an example of how groundwater rerouting and drainage can lead to earthquakes
- (B) it introduces an example of how water rerouting and drainage can lead to earthquakes
- (C) it describes how much groundwater has been drained in California without being replaced
- (D) it describes how much water has been drained in California without being replaced

- 4 Why does the author discuss the Parkfield Earthquake and the San Andreas fault in the section "It Could Happen"?
- (A) to list events that, according to the researchers, may have been caused by groundwater reduction
 - (B) to categorize earthquakes and faults affected by groundwater reduction
 - (C) to explain what might happen if the little earthquakes cause bigger ones
 - (D) to interpret the researcher's findings and categorize them

Answer Key

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 - (D) “These results suggest that human activity may give rise to a gradual increase in the rate of earthquake occurrence,” said the study published in the journal Nature.

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Paragraph 26:

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