Pumping Water for Thirsty Crops May Cause Some California Earthquakes

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LOS ANGELES—California's Sierra Nevada and central coast mountain ranges are being pushed up, causing more earthquakes in one part of Central California. Scientists have a new theory about what is happening.

The scientists believe the earthquakes are triggered in part by the pumping of groundwater in the Central Valley. The Central Valley 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 presses on 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.

"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.

**Thirsty Farms And Cities**

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.

Groundwater has been slowly drained 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.

Studying The Fault

The study 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.

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

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

Hough went a step further than the researchers. She said 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.

Trigger Earthquakes Elsewhere?

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. That means 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 scientist with the U.S. Geological Survey, called the theory interesting. But he said that more study was needed. He called the suggestion that less groundwater could lead to more earthquakes “somewhat controversial.”