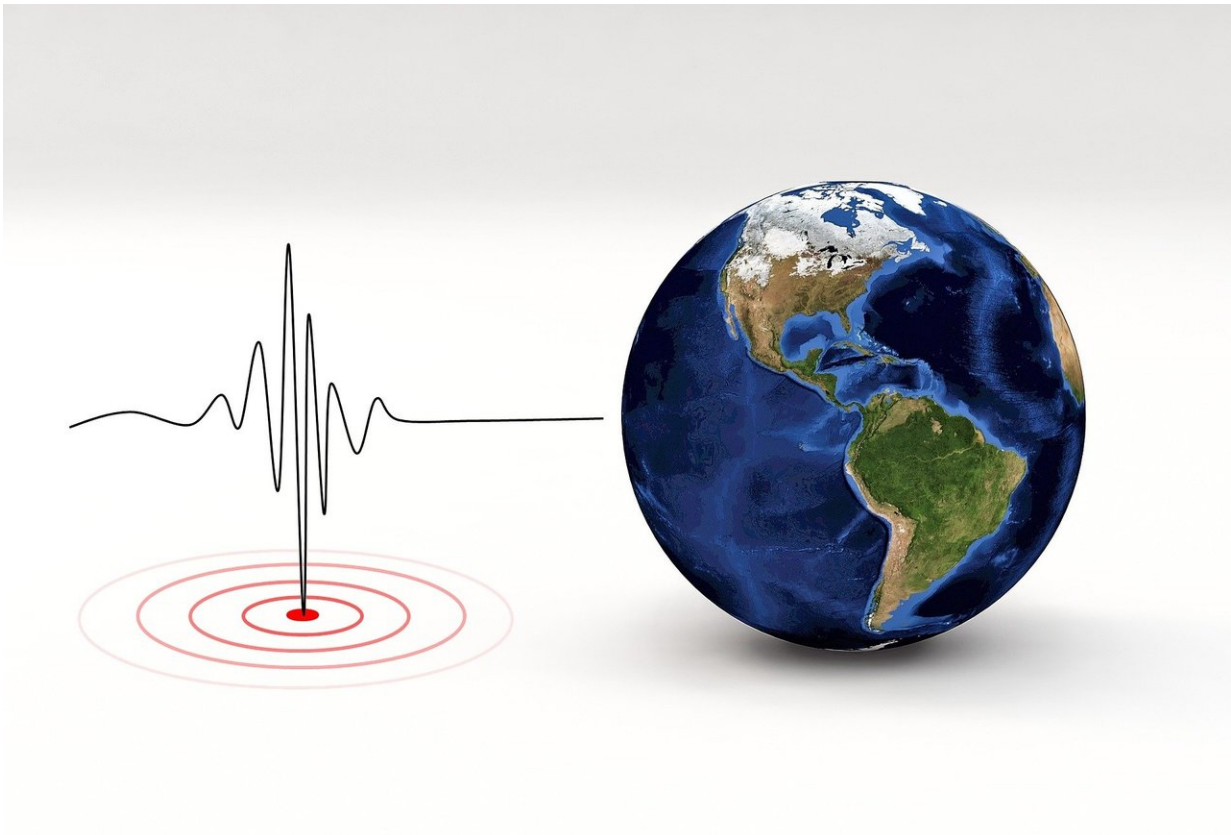


Study uses seismic noise to track water levels in underground aquifers

August 22 2018



Credit: CC0 Public Domain

Seismic noise—the low-level vibrations caused by everything from subway trains to waves crashing on the beach—is most often something seismologists work to avoid. They factor it out of models and create

algorithms aimed at eliminating it so they can identify the signals of earthquakes.

But Tim Clements thinks it might be tool to monitor one of the most precious resources in the world—water.

A graduate student working in the lab of Assistant Professor of Earth and Planetary Sciences Marine Denolle, Clements is the lead author of a recent study that used seismic noise to measure the size and the water levels in underground aquifers in California. The technique could even be used to track whether and how aquifers rebound following precipitation, and understand geological changes that might occur as water is pumped out. The study is described in a recently-published paper in *Geophysical Research Letters*.

"The way this would commonly be done today would be to take a measurement at a groundwater well," Clements said. "And if you have a network of those wells, you can develop a model where you assume a number of hydrological parameters...and that allows you to measure the health of the aquifer.

"But what we showed is we can just directly measure these waves that are travelling through the entire aquifer," he continued. "So we don't have to make those assumptions, because we can directly measure the waves."

Using those measurements, researchers were able to measure the water depth of the San Gabriel Valley aquifer, located just outside Los Angeles, to within a centimeter. Efforts to measure the size of the aquifer were limited by the existing seismic network, Clements said, and so were accurate only to about a kilometer.

"That gives us a way to begin thinking about volume," Denolle said.

"What we found is that using this method the volume we calculated as having been pumped out of the aquifer equaled the volume that was published."

"We estimated it at about half a cubic kilometer," Clements said. "And that's exactly what the San Gabriel water master said they pumped out during the drought to meet demand."

That drought, Clements said, was one reason researchers chose to focus on the San Gabriel Valley.

"They had experienced a massive drought over the last five years, and there are over 1 million people who live in this relatively small area outside Los Angeles who depend on the groundwater for all their water-use needs," he said. "Over the past five years, they had lost a large amount of ground water, and there's a large financial cost to that, so our goal was to understand if we can use seismic waves to understand what's happening with the aquifer."

The region is also already equipped with a network of seismographs, he said, making it relatively easy to obtain seismic noise data and use it to examine the aquifer.

While the study wasn't the first to hit upon the idea of using [seismic noise](#) to study groundwater, Denolle said earlier efforts were hampered because they relied on a signal that was relatively weak in comparison to environmental factors like temperature and pressure.

"This was a large signal we looked at," she said. "The aquifer oscillated with 20 meters of water-height changes in a couple years, so it's a bigger signal than any environmental influence."

The system could also be a useful tool for anyone involved in water

resource management, Clements said, because it can give them a moment-to-moment view of precisely what is happening in an underground aquifer.

"This could be used for water management," Clements said. "In this study, we looked at about 17 years of data, from 2000 to 2017, but going forward this could be used in a water management application, so you could get a picture of what's happening with the aquifer on a daily basis."

Aside from providing groundwater measurements, the technique can also be used to monitor the health of an aquifer over time.

"If we had the data, we may be able to use this technology to look back at what aquifers looked like the past and study the long-term evolution of an [aquifer](#)," Denolle said. "One of the challenges for people who manage water resources is whether aquifers still respond elastically, meaning can we recharge it with the same storage capacity or is it losing capacity over time as we pump [water](#) out? Using seismic waves, we can potentially find out whether these aquifers are elastic or not."

Going forward, Clements said, he plans to pursue ways to improve the resolution of the system at both the micro and macro levels.

Working in collaboration with faculty at Tufts University, he installed wells and seismometers on campus to track changes as groundwater is pumped to the surface to irrigate sports fields. Other efforts are focused on using the existing seismometer network in California to improve ways to measure the overall size of aquifers.

More information: Timothy Clements et al, Tracking Groundwater Levels Using the Ambient Seismic Field, *Geophysical Research Letters* (2018). [DOI: 10.1029/2018GL077706](https://doi.org/10.1029/2018GL077706)

Provided by Harvard University

Citation: Study uses seismic noise to track water levels in underground aquifers (2018, August 22) retrieved 26 June 2024 from <https://phys.org/news/2018-08-seismic-noise-track-underground-aquifers.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.