Deadly earthquakes trigger hunt for speedier alerts

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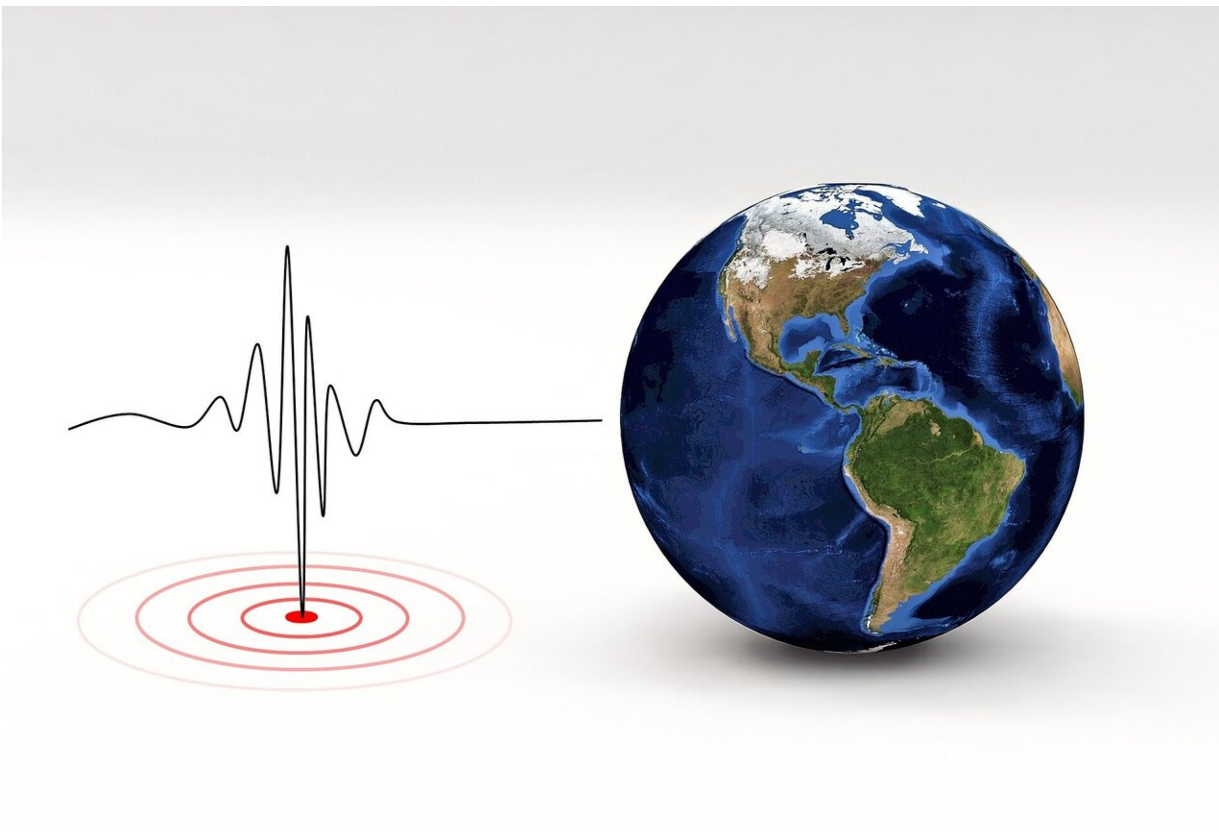

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Researchers in Europe have identified an underground signal that may be a precursor to strong quakes.

Dr. Quentin Bletery has some good news regarding an all-too-often gloomy subject: earthquakes.

A researcher at the French National Research Institute for Sustainable Development, or IRD, Bletery thinks it might one day be possible to predict strong earthquakes minutes or even hours in advance.

Signal discovery

Earthquakes are usually caused by the movement of two tectonic plates on either side of deep geological underground fractures known as fault lines.

"The fault starts slipping sometime before the earthquake," said Bletery. "The question is: does this accelerate in a microsecond or is it something that takes more time and could be tracked?"

Based on past experiments, Bletery has reason to believe that gradual slips do occur. Now he may have even more reason.

Bletery and IRD colleague Dr. Jean-Mathieu Nocquet discovered a signal that could—theoretically—be used to give an alert about strong shaking beforehand.

Named EARLI, the project began in January 2021 and is due to last through 2027 following a one-year prolongation.

Forecasting frustration

Earthquakes occur around the world on a daily basis. Most are too small to be felt on the surface.

Larger quakes, above magnitude 6, are often deadly. For example, one that struck Turkey and Syria in February 2023 killed more than 50 000 people and left around 1.5 million others homeless.

Over the past two decades, earthquakes have killed about 1 million people worldwide, according to EARLI.

Not only can earthquakes be measured with precision but where they tend to strike is also well known. Southern Europe including the Mediterranean, Japan, Indonesia, Chile and the US states of California and Alaska are all hotspots.

Until now, scientists have been unable to identify any detectable sign of gradual fault slips.

Suspecting that any such signal might be too weak to be picked up by seismometers, Bletery and Nocquet instead used high-rate Global Positioning System data from more than 3,000 stations worldwide.

GPS information is an alternative to seismological data for gauging how much the ground moved during an earthquake and in between quakes.

The GPS information included data recorded hours before each of 90 earthquakes of magnitude 7 or above.

This approach paid off. The researchers found a barely noticeable, but still statistically significant, pattern that starts to show two hours before earthquakes near the eventual epicenter.

"It's only a small signal, but you can't find it randomly in other places and at some other time," said Bletery. "Its very intriguing."

He said that more research is needed to expand understanding of the observed signal and to consider the feasibility of earthquake prediction.

One obstacle is that current earthquake-monitoring instruments lack the coverage and precision for this kind of research, according to Bletery.

An answer here might be to attach acoustic sensors to optical fiber cables that lie on seabeds as well as underground and that are the backbone of today's global communications system.

Smaller, faster indicator

Meanwhile, the EARLI researchers have a more modest goal: to speed up existing alerts to people on their mobile phones minutes before an earthquake.

These alerts are based on the seismic waves caused by the quake and recorded by seismometers.

Bletery and his team are seeking to improve such alerts by using seismometers to measure something else: perturbations in the Earth's gravity field caused by massive movements of rock.

While this indicator is much smaller than seismic waves, it's faster.

Bletery and his team employed an artificial-intelligence (AI) algorithm to analyze this type of data and estimate the danger of a potential tsunami.

The existing warning system for a tsunami needs 20 to 30 minutes for the first estimation. The EARLI method, while still experimental, required one minute.

"The goal is to make early-warning systems a lot faster," said Bletery.

Damage control

Limiting the consequences of earthquakes is also a research priority.

This was the focus of another project. Called RISE, it ran from September 2019 through May 2023.

"Our starting point was to make Europe more resilient to earthquakes," said Professor Stefan Wiemer, director of the Swiss Seismological Service at ETH Zurich. "And there is no single measure to achieve that."

Wiemer led a group of engineers and experts in seismology, information technology, geology and social sciences from two dozen organizations in 13 countries ranging from Japan and Italy to Israel and Mexico.

New Europe-wide map

The researchers improved the EU's ability to estimate casualties and damage caused by an earthquake—something called "rapid impact assessment."

The team built on existing global services including ShakeMap, which gathers data on ground shaking in areas struck by earthquakes.

Using new, more detailed data, the researchers established a European version of the ShakeMap service. European Shakemap automatically receives any recorded data when an earthquake above magnitude 4 strikes.

At the same time, it compiles relevant information such as the number of people living in the area, the local soil conditions and the vulnerability of structures in the zone that was hit.

"We can estimate within only 30 minutes after an event an approximate number of victims, injured people and various levels of damage and costs," said Wiemer, who is also chair of seismology at the Department of Earth Science at ETH Zurich.

This not only is useful for urgent decisions in the wake of an earthquake but also can improve knowledge of what would happen in a particular area if another quake ever struck there.

The system is the first of its kind to become operational at the European level and is now also operational in Italy and Switzerland.

RISE also advanced methods—including through AI—for forecasting stronger aftershocks. In the aftermath of an earthquake, hundreds or thousands of smaller tremors can overwhelm seismic networks.

"It's difficult to process all these data, especially when you have to do it manually," said Wiemer. "With machine-learning techniques, we can now process these events more rapidly and accurately."

More information:

- EARLI
- RISE

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