Smartphone data to give early warning of earthquakes

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Many were wearing fitness trackers. Once the quake was over, tracker company Jawbone gathered the data in a public graphic, using it to detail the differences in disturbance for lifeloggers in Berkeley, Oakland and San Jose.

Now new research shows that sensors in smartphones can give early warning of an earthquake too.

While Jawbone's post didn't inspire confidence in the privacy of users' data, it did make a point: humans can be useful sensors. Many of us walk around laden with devices that compile data on our movements and interests – data that seismologists now want to help spot the next major earthquake.

At the US Geological Survey, Benjamin Brooks is looking to smartphones rather than finely tuned scientific instruments to predict big quakes. Smartphones come equipped with GPS sensors that can tell where you're standing, give or take a few metres. On an ordinary day, these are what allow us to map our way to a store or geolocate our tweets. They can also sense a sudden lurch in one direction – the kind of movement that, when logged by many people at once, might be a sign of a seismic shift.

"Imagine all of Portland was out at a cafe on a sunny day, and everyone's smartphones were sitting on the table when one of these great earthquakes happened," says Brooks. "The whole city would appear to move."

Brooks and his colleagues have now tested what crowdsourced GPS data might look like in a real earthquake. One simulation explored a model magnitude 7.0 earthquake along the Hayward fault, and another used actual location data recorded at scientific stations during Japan's devastating 2011 megaquake.

Both scenarios suggested that data from around 5000 people would be enough to spot the beginnings of a major earthquake, leaving about 5 seconds to warn major population centres that hadn't yet felt its effects (*Science*, DOI: 10.1126/sciadv.1500036).

When an earthquake is coming, a few seconds of warning can be crucial. Fire-station doors could start to raise, gas pipelines could automatically shut off, and city residents could jump to safety under a nearby desk.

"You get out in front of the situation and inform people before any ill effects," says Brooks.

Smart sensing

This isn't seismologists' first foray into smartphones. Two years ago, researchers at the California Institute of Technology in Pasadena came out with an app, Crowdshake, which monitors a phone's accelerometer. Unfortunately, with GPS data it isn't as simple as building an app: smartphone manufacturers don't currently provide access to the raw data required.

Until then, Brooks and his colleagues plan to keep putting smartphones to the test. In an upcoming pilot in Chile, about 250 phones will be stripped of their standard GPS cards and placed in boxes around the country, where they'll lie in wait to record the next big earthquake.

Others have found ingenious ways to tap into human activity to locate quakes. At the European-Mediterranean Seismological Center, seismologists rely on the internet to pinpoint where earthquakes are happening around the globe.

Whenever there's a sudden surge of traffic to their website, they look at where visitors are accessing it from to get a sense of where the earthquake is and how strong it might be. They also monitor Twitter for relevant keywords. Within a couple of minutes, they have enough information to publish their first unconfirmed reports of the quake.

"The internet is the nervous system of the planet," says Rémy Bossu, secretary general at the centre. "If we want to make rapid earthquake information available to the public and authorities, we have to focus on the earthquakes that matter for them."