California to Test GPS Earthquake Warning System

Irene Klotz, Discovery News, 12-14-13

A network of GPS receivers, some outfitted with $8 accelerometers, is part of a prototype system being tested in Southern California to monitor for earthquakes and other natural hazards.

The technology is not new. Receivers that pick up signals from the constellation of Global Positioning System satellites circling Earth and calculate timing and distance have reshaped dozens of industries including farming, construction, mining and package delivery, in addition to providing air, sea, and land navigation data.

What is different is the linking of GPS receivers into a real-time network that complies and analyzes their information. The system can then be used to detect earthquakes and extreme weather in the making.

“By adding small inexpensive sensors used in popular electronic devices to existing GPS … we can greatly enhance our response to natural hazards, such as earthquakes, tsunamis, severe weather and flooding,” said researcher Yehuda Bock with the Scripps Institution of Oceanography in La Jolla, Calif.

“The goal is to save lives during natural hazards,” Bock told reporters at the American Geophysical Union conference in San Francisco this week.

Japan had a GPS monitoring system in place during its devastating 2011 earthquake and tsunami, but it relied on traditional seismic data that initially caused scientists to underestimate the strength of the earthquake and the size of the resulting tsunami.

“They initially estimated the magnitude of the earthquake to be magnitude 7 after 30 seconds. Only after nine minutes did they turn it into a 7.9 earthquake. It took 2.5 hours to finally estimate that it was as large as it was” -- a magnitude 9, Bock said.

“Our system improves on the traditional seismic monitoring … by estimating the ground motions and permanent displacements,” he said. “Ground seismic systems only measure the shaking.

A large earthquake on the southern San Andrea Fault, for example, would take about 1.5 to two minutes to reach Los Angeles, precious time that could be used to issue alerts.

The system also can quickly assess potential damage to buildings, bridges, and other structures due to ground displacement after an earthquake.

For meteorological monitoring, GPS receivers are outfitted with temperature and pressure sensors to provide a continuous map of atmosphere water vapor.

“A GPS station fundamentally is measuring the amount of time it takes signals to travel from the GPS satellites to the receiving station on the ground. That travel time also is affected by the amount of moisture in the air, so every time we calculate the position of a GPS station, we’re also measuring the water vapor,” said Angelyn Moore, a research scientist at NASA’s Jet Propulsion Laboratory in Pasadena, Calif.

“Using GPS for weather is not new. What’s new is that there are now sufficient numbers of stations in the southern California region operating near real-time for us to evaluate the benefit,” she said.

The first test run of the system occurred in July when meteorologists tracked a summer monsoon as it moved

across southern California. Equipped with real-time information about the storm's progress based on GPS signals, forecasters accurately predicted a flash flood and issued a warning.

The new project aims to add sensors to an existing 550 stations with real-time networks located along the west coast of the United States, an area susceptible to earthquakes and tsunamis. So far, 17 enhanced GPS stations are operational, Bock said.

"We hope to expand it throughout the west coast," he said.