Early Warning

THE GREAT EAST JAPAN EARTHQUAKE SPURS MORE ACCURATE EMERGENCY BROADCASTS

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"THIS is the Earthquake Early Warning announcement. Please be prepared for strong tremors."

From its widespread launch in October 2007 to the end of 2014, this early warning announcement has aired a total of 145 times (*1) on TV and radio, via cellphone, smartphone and a wireless-activated disaster warning system. It's probably the most recognizable public emergency broadcast in Japan.

When an earthquake strikes, the preliminary tremors—called P-waves—arrive first, followed by the stronger shocks of the S-waves. The P-waves are read at the seismic observation points, which instantaneously estimate the quake's magnitude and epicenter. The Earthquake Early Warning system then issues a warning message before the S-waves arrive. If the tremor is predicted to be of a maximum intensity in the lower 5 range or above on the seismic intensity scale of the Japan Meteorological Agency (JMA), areas predicted to experience tremors of an intensity of 4 or more will be the target area for the Earthquake Early Warning.

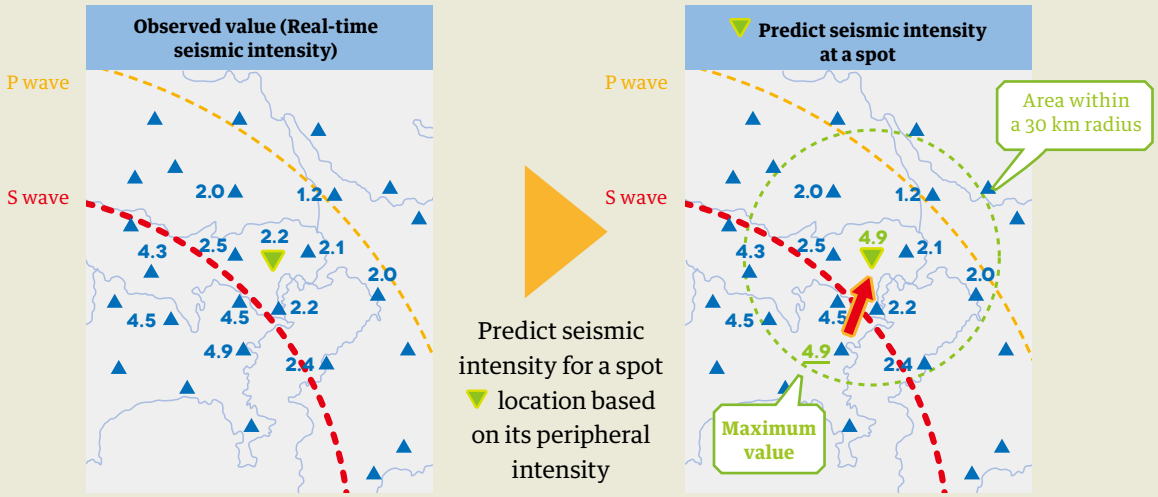
Nariaki Okawara, director of the management section of the Seismological and Volcanological Department at the JMA, provided details about the system. "This early warning system, which covers the whole country, is unique to Japan," he explains. "Japan has approximately a thousand seismic observation points nationwide, plus a vast communications infrastructure to send and receive vast quantities of data instantaneously—which enabled us to put this system in place.

"When putting the system into practical use, the technical side—developing a method for high calculation accuracy and high-speed transfer for large amounts of data—was of course crucial, but promoting the system to the public and raising awareness was itself a big issue," Okawara continues. "Before the system's introduction, the seismic intensity of earthquakes was reported in the media after the quakes had already struck, and people who felt the quake are used to getting information about it on TV or radio afterward; not many people had experience with pre-quake predictions. So before implementing it, we promoted the system gradually for about a year through PSAs, pamphlets, TV and radio commercials and other events. We even held a contest for campaign slogans."

Since implementation, the system has proved useful in preventing and limiting the effects of earthquake disasters in various situations. In the Great East Japan Earthquake of March 2011, people who heard the early warning announcement were reportedly able to take actions to protect their safety throughout the country.

However, it has posed a new challenge at the same time. "In northeast Japan, we aired an early warning before the S-waves arrived, but for an earthquake of such intensity and affecting such a large area, instant prediction was not possible. Therefore, we couldn't issue the warning in the Kanto region, which was far removed from the epicenter," Okawara notes. "And after the Great East Japan Earthquake, multiple seismic events were felt repeatedly over a wide area, making it more difficult to accurately predict the scale and epicenters of the earthquakes. As a result, some of our warnings overestimated the intensity of tremors. To improve the system in these areas,

PLUM METHOD CONCEPT MAP



1. Based on the observed values (in blue: real-time seismic intensity) at various seismic observation points (▲) within 30 km radius of the anticipated spot (▼)
2. Equate the seismic intensity at the anticipated spot (▼) to the maximum observed value (4.9 in the above graph), assuming the intensity of the tremor does not reduce upon reaching the anticipated spot.
3. Repeat this prediction process for all seismic observation points.

Source: JMA

we are developing the IPF method (*2) to enable the system to detect the primary epicenter more accurately when multiple quakes occur simultaneously, and the PLUM method (*3), to predict the seismic intensity at an expected target based on the intensity of a strong earthquake nearby. From the simulations we've conducted for each method, we've confirmed that we can address the previous issues," says Okawara.

At the earliest, the IPF method is scheduled to go online in autumn 2015, with the PLUM method coming in 2016. By supplementing the existing notification system with these two technologies, the accuracy of the Earthquake Early Warning system should be considerably improved. It's said that in the next three decades, there will be a 60 to 70 percent probability of Japan being struck by several large-scale earthquakes, including the Tonankai Trough and Nankai Trough, which alone makes the new developments in the Early Warning System very reassuring news.

"It's true that there are still technical limitations, and a possibility of inaccurate bulletins," Okawara states. "Also, if you are very close to where the epicenter happens to be, the early warning system will be of little help. When you hear the Earthquake Early Warning or feel the tremors, however, it's essential to keep doing what we've done so far: don't panic, and protect yourself even if you don't feel tremors. It is equally important to prepare yourself for future quakes, like having safety devices installed on your furniture to prevent it from overturning, and having your emergency provisions ready at all times."

*1 When an earthquake with a maximum intensity of 3 or more—or a magnitude of 3.5 or greater—is predicted, the announcement is classified as a "forecast." Since these announcements are not part of the normal operations of the Earthquake Early Warning system, they are not counted.

*2 The IPF (Integrated Particle Filter) method was jointly developed by Disaster Prevention Research Institute of Kyoto University and JMA.

*3 The PLUM (Propagation of Local Undamped Motion) method was developed by the Meteorological Research Institute.