

Warnings work, but must be better

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The Japan Meteorological Agency has one of the most advanced systems in the world for providing real-time warnings of tsunamis and earthquake shaking. The earthquake early warning system, which provides information about strong shaking within seconds of a quake, has been in place since 2007 and has provided more than 10 warnings of strong earthquakes — by cellular phone, television, radio and local-community speaker system. But it could be better.

The system detected the earthquake off the Pacific coast of Tohoku and, about 8 seconds after the first primary wave arrived at the closest seismic station, issued a warning to the public in the region close to the epicentre. Twenty seven bullet trains were stopped without derailments in this region. Three minutes later, warnings for very large tsunamis were issued to Iwate, Miyagi and Fukushima prefectures. The damaging waves arrived 15–20 minutes later at the closest shores.

However, the overall performance of the system was not satisfactory, mainly because of the complex character and relatively small amplitude of the beginning of the rupture. The system underestimated ground motion and tsunami heights, so the large population in the greater Tokyo region, where many areas experienced strong and damaging shaking, received no warning (see ‘False comfort’). That said, updates did improve as more information became available.

Early warnings for strong shaking were broadcast more than 70 times for aftershocks. The system worked well for these smaller events, but there were some errors in determining event locations because of the complication of simultaneously occurring earthquakes.

The unexpected character of the seismic data at the start of the earthquake fooled the early warning system’s algorithms. But the system has the potential to work well for the next great earthquake — such as the widely expected Nankai earthquake in the Kansai region — if technical improvements are made to recognize great earthquakes quickly. The earthquake early warning system in Japan should become a truly effective mitigation tool in a society that has already accepted and learned to expect such information.