EDITORIAL

# Quake warnings, seismic culture

Since 1990, nearly one million people have died from the impacts of earthquakes. Reducing those impacts requires building a local seismic culture in which residents are aware of earthquake risks and value efforts to mitigate harm. Such efforts include earthquake early warning (EEW) systems that provide seconds to minutes notice of pending shaking. Recent events in Mexico provide an opportunity to assess performance and perception of an EEW system and highlight areas for further improvement. We have learned that EEW systems, even imperfect ones, can help people prepare for earthquakes and build local seismic culture, both beneficial in reducing earthquake-related losses.

Public EEW systems are deployed in Japan and Mexico and are being implemented elsewhere around the globe, including ShakeAlert in the United States. Mexico's EEW system, SASMEX, was built following the 1985 Michoacán earthquake in which more than 9500 people died. Seismic sensors covering much of the country provide alerts in select cites. In Mexico City, roughly 12,000 pole-mounted speakers can sound a siren to indicate that an earthquake is imminent. Alerts are also distributed by radio and television.

On 7 September, the magnitude (M) 8.1 Chiapas mainshock triggered the city's sirens roughly two minutes before shaking was felt. The quake had little impact in Mexico City due to the 700-kilometer source distance. The sirens were triggered again on 19 September by the M7.1 Puebla earthquake, although the alert was not issued in Mexico City until approximately 5 seconds after the widely felt P-waves arrived, due to the close proximity of the quake source to the city. The 23 September M6.0 aftershock of the Chiapas mainshock activated the system again. Most people in Mexico City, however, did not feel shaking from this event.

After these events, we were deployed to Mexico City by the Earthquake Engineering Research Institute (EERI). Although considerable research and technology underlie the seismic sensing capability, and SASMEX has issued alerts for more than 150 quakes over three decades, what has been missing—hence the focus of our mission—is an assessment of public perception of the system. These first major damaging earthquakes since SASMEX was built provided a rare opportunity to learn how people perceived and responded to EEW.

Our findings point to a collectively positive attitude toward SASMEX, with the public generally accepting of the technical limitations. They show a greater tolerance for alerts associated with little or no perceptible shaking than for late or missed alerts. Residents said that all alerts provide an opportunity to practice protective actions and that hearing, seeing, or talking about EEW helps build awareness of earthquake risk and appropriate protective actions. These findings are consistent with surveys regarding EEW in Japan done after the 2011 Tohoku-Oki M9.0 earthquake.

***"EEW systems are seen as being valuable despite technical limitations."***

We draw several recommendations from our reconnaissance. EEW systems are seen as being valuable despite technical limitations. This should give us added confidence to accelerate deployment of EEW systems elsewhere. Also, EEW systems should provide an initial alert that is as simple as possible to prompt people to take immediate action. Follow-up information from authoritative institutions is needed in the seconds and minutes after an alert is issued and shaking has subsided. A wide range of media channels should be used. In addition, the warning information and messaging provided by all EEW systems must be consistent and distributed widely. In Mexico, information from the public SASMEX system did not always align with information from the private SkyAlert system. Importantly, an EEW system is only as good as the likelihood that effective action is taken to reduce harm. This means closely pairing EEW development with disaster preparedness research, education, planning, and policy.

**– Richard M. Allen and the EERI Reconnaissance Team***

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