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The social component: Understanding the public need and support for an EEW system in Central America.

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Abstract

Earthquake Early Warning (EEW) systems are well established and provide public alerts in countries like Japan, Mexico, and along the US West Coast. Despite their specific and often unique characteristics (e.g., EEW algorithm, alert threshold criteria, tectonic settings, sensor network geometry), these systems have all faced similar challenges with regard to social aspects.

In Japan, the EEW system faced its biggest test during the M9.1 Tohoku-Oki earthquake (2011). The alert was promptly and successfully delivered to the Tohoku region; however, the magnitude was underpredicted and hence, an alert for the adjoining region of Kanto was not issued. In the aftershock sequence, for nearly two months public users experienced 17 inaccurate and 20 missed alerts (Hoshiba and Ozaki, 2014).

The original purpose of SASMEX, the EEW system in Mexico, was to alert Mexico City of earthquakes happening in the Guerrero subduction zone. Although the alert system now provides alerts over a more comprehensive region, experience from the original system has created a misconception that the average warning time was 60 s (Santos-Reyes, 2019). The epicenter of the M7.1 Puebla earthquake (2018), was much closer and the alert was not delivered in time, resulting in substantial damage and casualties without warnings (Suárez, 2022).

ShakeAlert, the EEW system for the US West Coast, successfully detected and accurately located the 7.1 Ridgecrest earthquake (2019). Public alerts were warranted but were not sent because the predicted shaking in L.A. county was below the alerting threshold. The negative reaction to the lack of alerts suggested that the public appreciates alerts not only for damaging levels but also for felt earthquakes (Cochran and Husker, 2019; Del Rio, G.M.N., 2019; R.G. Lin, 2019). In response to public demand, the alerting thresholds were subsequently lowered.

These major earthquakes in countries where EEW systems are already operating highlight the importance of communicating the limitations of these systems to the public, analyzing the public's tolerance towards alert malfunctions, and taking into consideration the public's preferred system attributes (e.g., warning thresholds). In the main, the priority in EEW systems has been to first improve the scientific and technical aspects and be concerned about the societal issues afterwards.

The Swiss Seismological Service (SED) at ETH Zurich and core partners have been developing EEW systems across Central America since 2016. Major investment has been made to steer the seismic networks towards a state of EEW readiness, and satisfactory performance in terms of accuracy and latency of alerts has been achieved. Costa Rica and Nicaragua have recently started sending EEW alerts to early adopters, including stakeholders in private and national institutions.

As the ATTAC[1] project moves toward an operational system and sends alerts to the public, we want to focus on the social components of EEW systems in the region and take into account the lessons learned in order to improve the future public EEW system across Central America. To achieve this, we are conducting national surveys in Costa Rica and Nicaragua. Our survey is based on the theoretical framework of people's behavior to warnings (Dunn et al., 2016; Lindell and Perry, 2012; Mileti and Sorensen, 1990). A number of questions are adapted from previous EEW surveys (Becker et al., 2020; Dallo and Marti, 2021; Japan Meteorological Agency, 2012), fitting the context of Central America, to also make cross-country comparisons. The three main goals of the survey are presented here:

First Goal: Public's attitude towards the EEW system

Second Goal: Public's preference for EEW system attributes

Third Goal: Public's behavioral response to EEW alerts

EEW is complex and public expectation of its performance should be realistic. For some large earthquakes, EEW systems will be unable to deliver timely alerts to the target public which can diminish the support for the system. In the survey, we thus ask the participants to evaluate the trade-off between the main benefits and limitations of EEW so that we can estimate the public attitude towards the EEW system.

To explore the public preference for EEW system attributes, participants will be asked to select the level of intensity of the alert threshold and the preferred channel to receive alerts (i.e sirens, TV, radio, etc.). Additionally, participants will be asked to select the preferable

[1] Alerta Temprana de Terremotos en América Central

warning message from three hypothetical mobile phone alerts, ranging in complexity of message content.

Nicaragua and Costa Rica have experienced damaging earthquakes in the past, and continue to be at great risk, primarily due to the vulnerability of non-seismic resistant constructions and the steady rise of population density. Protective actions can vary with situational conditions (e.g., shaking intensity, emotional state), but permanent components (i.e. earthquake experiences, risk, and preparedness) play a major role in how behavioral responses are shaped. We will thus analyze the public's behavioral response to alerts through a hypothetical scenario where an earthquake triggered the EEW system. Additionally, we will also try to leverage the growing amount of user experience from the emerging EEW system by targeting particular users who have already received alerts.

At the conference, we will present the insights from the two surveys and provide practical recommendations for the further development of EEW systems in Central America in order to increase the societal effectiveness of these systems.

Bibliography

Becker, J.S., Potter, S.H., Vinnell, L.J., Nakayachi, K., McBride, S.K., Johnston, D.M., (2020). Earthquake early warning in Aotearoa New Zealand: a survey of public perspectives to guide warning system development. Humanit. Soc. Sci. Commun. 7, 138. https://doi.org/10.1057/s41599-020-00613-9

Cochran, E.S., Husker, A.L., (2019). How low should we go when warning for earthquakes? Science 366, 957–958. https://doi.org/10.1126/science.aaz6601

Del Rio, G.M.N., (2019). ShakeAlertLA will Drop Threshold for Earthquake Alerts, Amid Gripes People not Alerted. Los Angeles Times.

Dallo, I., & Marti, M. (2021). Earthquake Early Warning in countries where damaging earthquakes only occur every 50 to 150 years—The Swiss case study. General Assembly of the European Seismological Commission ESC2021, Corfu.

Dunn, P.T., Ahn, A.Y.E., Bostrom, A., Vidale, J.E., (2016). Perceptions of earthquake early warnings on the U.S. West Coast. Int. J. Disaster Risk Reduct. 20, 112–122. https://doi.org/10.1016/j.ijdrr.2016.10.019

Hoshiba, M., Ozaki, T., (2014). Earthquake Early Warning and Tsunami Warning of the Japan Meteorological Agency, and Their Performance in the 2011 off the Pacific Coast of Tohoku Earthquake, in: Wenzel, F., Zschau, J. (Eds.), Early Warning for Geological Disasters, Advanced Technologies in Earth Sciences. Springer Berlin Heidelberg, Berlin, Heidelberg, pp. 1–28. https://doi.org/10.1007/978-3-642-12233-0_1

Japan Meteorological Agency, (2012). Survey results on utilization and application of earthquake early warning.

Lindell, M.K., Perry, R.W., (2012). The Protective Action Decision Model: Theoretical Modifications and Additional Evidence: The Protective Action Decision Model. Risk Anal. 32, 616–632. https://doi.org/10.1111/j.1539-6924.2011.01647.x

Mileti, D.S., Sorensen, J.H., (1990). Communication of emergency public warnings: A social science perspective and state-of-the-art assessment (No. ORNL-6609, 6137387). https://doi.org/10.2172/6137387

R.G. Lin, (2019). 2 Quakes in 2 Days, No Warning from ShakeAlertLA. Now the App Is Getting Reworked, Los Angeles Times, 2019, August 14.

Santos-Reyes, J., (2019). How useful are earthquake early warnings? The case of the 2017 earthquakes in Mexico city. Int. J. Disaster Risk Reduct. 40, 101148. https://doi.org/10.1016/j.ijdrr.2019.101148

Suárez, G., (2022). The Seismic Early Warning System of Mexico (SASMEX): A Retrospective View and Future Challenges. Front. Earth Sci. 10.