ShakeAlert™

ShakeAlert® Joint Committee for Communication, Education, and Outreach (JCCEO)
"Supporting the ShakeAlert System through coordination, collaboration, and community building."
California – Oregon – Washington

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ShakeAlert® Protective Actions Guidelines – November 2020

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Summary Statement

When one receives an earthquake alert delivered by a ShakeAlert® partner utilizing USGS issued ShakeAlert Messages or feels shaking, the "Drop, Cover, and Hold On" (DCHO) protective action and related guidelines as found in Step 5 of the Seven Steps to Earthquake Safety, (https://www.earthquakecountry.org/step5) are the protective action guidelines advocated by the ShakeAlert Earthquake Early Warning System. All USGS funded ShakeAlert branded products, programs, and messaging will be aligned with these guidelines.

Purpose

The purpose of this document is to clarify messaging and instructions regarding recommended protective actions during earthquakes advocated by the USGS, state agencies, and the universities that support the ShakeAlert Earthquake Early Warning System. The guidelines in this document will frame the design and development of USGS funded education and training materials that will be available for use throughout the ShakeAlert System, whether for public education or other purposes by ShakeAlert partners. The USGS is not a regulatory bureau but a fact-finding bureau. Protective actions and recommendations largely fall under our partner's roles: our federal (Federal Emergency Management Agency - FEMA) and state (California Governor's Office of Emergency Services – Cal OES, Washington Emergency Management Division – EMD, and Oregon Office of Emergency Management - OEM) partners. The USGS must work closely with these partners to ensure that the evidence from social science research and their recommendations are closely followed. Federal and state agencies and other organizations are not mandated to adopt this position.

However, responsibility for any guidelines, etc. that do not align with or go beyond what is stated in this document and linked web content at: https://www.earthquakecountry.org/step5 is assumed by that agency or organization.

ShakeAlert Trademark

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Development

This document was developed using previous protective actions research, as summarized in the Protective Actions White Paper (Wood, 2018) which was prepared for the Washington EMD, the Oregon OEM and the Cascadia Region Earthquake Workgroup. Subsequently, JCCEO convened a focus group to summarize findings of this paper and to gather inputs from other resources and experts in order to develop a ShakeAlert guidelines on protective actions.

We recognize that there is no perfect message that will meet all situations for all people. The purpose of identifying messages is on the basis of "what works best for most people." A warning message, at its core, must be short for people to understand what is happening and what they could do about it. Therefore, we cannot include all possible protective actions within one constrained message.

ShakeAlert Core Message Content for Alerts

The core message content to be delivered by ShakeAlert distribution partners, as developed in the JCCEO Warning Message Focus Group White Paper (JCCEO, 2017) is:

"Earthquake, Earthquake

Expect Shaking
Drop, Cover, Hold On.
Protect yourself now"

This message was developed to inform the receiver that shaking is imminent, what they could expect, and the protective action which has two components: the Drop, Cover, and Hold On (DCHO) and references to "protect yourself now". There exists slight variations of this message content, however, the DCHO, component must be present in all alerts delivered by ShakeAlert distribution partners.

Rationale

A. Why ShakeAlert will use the Drop, Cover, and Hold On Messages.

Drop, Cover, and Hold On (DCHO) is the main action that has been supported through years of research, as outlined in the Protective Actions White Paper (Wood, 2018), which reviews decades of literature on protective actions and earthquakes. Further, DCHO is also supported with the ShakeOut Earthquake Drills (ShakeOut.org), a campaign started in 2008 and reached over 63 million people in more than 50 countries worldwide in 2018. It is a message that some tourists will understand, given the consistency of the message internationally. Finally, it is the main action supported by all State Emergency Managers and our partners at FEMA, the federal agency most responsible for providing guidance on issuing public safety statements in emergencies (https://www.ready.gov/earthquakes).

Figure 1: Social science evidence of DCHO.

Recommended

FEMA considered evidence for each element of DCHO as robust/sufficient (FEMA, 2016, November 15). The authors of this report recommend providing guidance about this set of actions. People should be instructed to take as many of the DCHO actions as possible, to the extent of their ability in their given situation. There is a lack of research on performing the set of actions in combination. The following additional research is needed to further develop guidance about this protective action:

· Factors that may influence the decision to DCHO, and the efficacy of different types of cover, including research on when it would be preferable to move in a limited manner to improve cover;

· Definitions of and decision factors for taking different types of cover, such as sturdy furniture, low-lying furniture, using a pillow, or taking personal cover (see “c” below);

· How advanced warning of an earthquake may influence the decision to move within a building, evacuate a building, or DCHO.

Summary: ShakeAlert supports DCHO as the main message for protective actions, and its suite of supportive actions if DCHO is not an option (https://www.earthquakecountry.org/step5/).

B. Situational Awareness - Critical Component of ShakeAlert’s Success

Understanding seismic risk within the built environment is critical to people making the best choices for taking action to protect themselves when they receive an alert. Specifically, emergency managers and other message providers should encourage people to develop situational awareness by learning basic earthquake safety principles, becoming more aware of

their environment, and using their own judgment to determine the best course of action to take in a given situation (GeoHazards International, 2015b, pp. 5-6, 20). This means educating people to assess hazards in their area before taking action. If their floor is covered in glass, then perhaps another protective action is required for injuries to be prevented. The suite of DCHO actions, are outlined here: https://www.earthquakecountry.org/step5/. This includes when people are driving, outdoors, indoors, in bed, and other situations. Building owners and managers are requested to refer to the actions in these guides when providing guidelines to people in their buildings.

Summary: Situational awareness must be developed pre-alert, with various publics. The "protect yourself now" message can cover a wide variety of other protective actions acceptable for a wide variety of situations, including while people are in bed, driving, or taking other actions where covering and holding may not be the best course of action.

C. ShakeAlert's Position on Building Evacuation:

Evidence from the Protective Action White Paper (2018) suggests that attempting to evacuate a building during an earthquake has been identified as a risk factor for death and injury. Research on the Whittier Narrows (1987), Loma Prieta (1989), and Northridge (1994), California earthquakes found that moving from a building during an earthquake was associated with injury (Shoaf, Sareen, Nguyen, & Bourque, 1998). Among people who reported attempting to move during the Northridge earthquake,10.4% reported injury, whereas just 6.1% of those remaining in place reported injury (Shoaf et al., 1998, p. 227). Further, injuries reported in the 2001 M6.8 Nisqually earthquake (1 death, 400 injuries) but there is no indication that these occurred from collapsed structures; falls were the main reason for reported injuries (Kano, 2005). Further reports from Niqually indicate that there were also head injuries and crushing due to falling brick (Staff Scientists of the Pacific Northwest Seismic Network, 2001). Falls – the leading cause of hospitalized injury in that event – were most commonly associated with movement from a building (Peek-Asa, Ramirez, Seligson, & Shoaf, 2003, pp. 462, 464). In that earthquake, very few serious, non-fatal injuries were associated with building collapse (Mahue-Giangreco, Mack, Seligson, & Bourque, 2001, p. 355).

Figure 2: Recommended messaging from FEMA. (excerpt from the Protective Actions White Paper, 2018).

Recommended

According to FEMA, evidence for staying indoors is considered robust/sufficient (FEMA, 2016, November 15). In the U.S., multiple studies have shown that exiting a building to go outdoors during an earthquake increased the chance of death and injury resulting from falling and from being struck by falling debris.

In California, residential housing is largely wood-framed, which is less prone to collapse than adobe, concrete, and masonry buildings (Peek-Asa et al., 2003, p. 65). In Washington and Oregon, there is some evidence of better building codes and local interventions but there is still a number of unreinforced masonry buildings or buildings prone to collapse in heavy shaking (Hasenberg & Rad, 1999; May, 1998; Wallace & Miller, 2008). There is more evidence of taller buildings being structurally retrofitted in populated areas in British Columbia (Chiauzzi et al., 2012).

Summary: Building evacuation **is not recommended** as a protective action to be communicated by member agencies of the ShakeAlert JCCEO. The ShakeAlert JCCEO is comprised of representatives from the U.S. Geological Survey (USGS); the Emergency Management Agencies and Geological Surveys of Washington, Oregon, and California; and academic partners at the University of Washington, the University of Oregon, the University of California, Berkeley and the California Institute of Technology. JCCECO also includes affiliate members from Canada.

D. ShakeAlert Does not Replace Sound Safer Building Policy

One issue we must consider is that some city, county, or state officials may conflate ShakeAlert's earthquake alerting capability as a policy replacement for increasing building code requirements and or retrofitting historic buildings. ShakeAlert was not intended to be a replacement for sound seismic risk reduction policy nor should it be used as such. The ShakeAlert System does not solve issues with the built environment, including historic buildings, poor design/structurally unsound buildings, non-structural hazards, and/or building in unsafe locations.

We recognize that ShakeAlert has limitations to alerting in time to save some lives, including the "late alert zone." Those closest to the earthquake will be unlikely to receive an alert in time to act before shaking arrives. The shaking will be the prompt to take a protective action. The latest research exploring alerting times suggests that, in most cases, only a few seconds of alerting is possible (Minson et al., 2019). This is a physical limitation to the system that is unlikely to be overcome, even with years of development and it is one issue recognized across Japan, Mexico, Taiwan, and other earthquake early warning systems. Therefore, ShakeAlert alone should not be deemed a complete system that will consistently save lives, it is one element of earthquake mitigation. We strongly support other mitigation/risk reduction efforts, to complement the ShakeAlert System.

At the time of the publication of this brief, the ShakeAlert System while operational, is not a fully built out and publicly available system. The System is still in development in terms of instrumentation, telemetry, alert dissemination, education, and training. There is no guarantee, at this point, that the System can reliably deliver messages to technical users and various publics quickly enough throughout the whole System.

Finally, ShakeAlert requires a full public education program, supporting the DCHO messaging, for it to be effective.

Summary: ShakeAlert is not capable of saving all lives in all earthquake situations, given its technical and physical limitations. It is there to provide most people a higher chance of protecting themselves, but it is not a guarantee. ShakeAlert can also assist with infrastructure protection, such as slowing down of communter trains. ShakeAlert is also not a replacement for sound policy decisions on building codes, safety exercises, lifelines hardening, and seismic retrofitting. ShakeAlert will also not be effective without ensuring education, training, and outreach are successfully delivered to end-users so that they may take proper protective actions with the limited amount of warning the system can provide.

E. Concluding Statement

All relevant and supporting evidence recommends DCHO and its related guidelines when one receives an earthquake alert or feels shaking. These guidelines can be found in the Seven Steps to Earthquake Safety, Step 5: https://www.earthquakecountry.org/step5/. All USGS funded ShakeAlert branded products and programs will include these guidelines, which includes recommended messaging. We reiterate that DCHO represents only the best approach in most situations but not all, and there may be special circumstances that require situational awareness and/or additional safety guidelines specific to the area.

ShakeAlert was not created to replace updated building codes or mitigation actions. Rather, it acts as part of a suite of public safety initiatives and is one of the many USGS tools that contribute to earthquake risk reduction (USGS, 2006-3050). Updated building codes that address mitigation of unsafe buildings are still a critical component of earthquake safety.

This document is a “living” document. It will be revisited and may be revised as the ShakeAlert System develops further and more social science research becomes available. It is suggested that a review of this document occur within eighteen months of full public rollout and at bi-annual intervals or as required.

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