**Alert Times in the Pacific Northwest**

**Washington, Oregon, and Northern California**

From the animation: <https://www.iris.edu/hq/inclass/animation/778>

Earthquakes can occur in a variety of ways in the Cascadia Subduction Zone. The complex plate tectonics of the region present challenges, *and opportunities,* for earthquake early warning. How much warning time can we expect? TheShakeAlert Earthquake Early Warning System, now operational in California, Oregon, and Washington, uses a network of ground motion sensors to detect earthquakes. Processing centers estimate the earthquake’s location, magnitude or size of an earthquake, and expected strength of shaking. ShakeAlert then works with distribution partners to rapidly deliver alerts to people through public address systems, TVs, radios, cellphone apps, smartphone operating systems, and through FEMA’s Wireless Emergency Alert system, which is also the source of AMBER alerts. Every earthquake will have different alerting times that depend on location, magnitude, earthquake type, and the alert delivery method.

In Washington, Oregon, and Northern California, three main types of earthquakes occur for which you may receive an alert:

1. *Shallow crustal-fault earthquakes with magnitudes up to 7.5*
2. *Deep earthquakes with magnitudes up to 7.5, and*
3. *Megathrust earthquakes with magnitudes up to 9.*

Every earthquake will have different warning times that depend on location, magnitude, and earthquake type.

Almost half of ShakeAlert-powered alerts will originate from shallow crustal-fault earthquakes ***within*** the internally deforming North American plate, about 10 kilometers below the surface. Examples include faults beneath city centers like Portland and Seattle that could cause loss of life and major damage. Because it takes a few seconds for ShakeAlert to detect earthquakes and for alerts to be delivered, those who live closest to the fault may not receive an alert until *after* the shaking begins.

Earthquakes that occur around 50 kilometers deep within the subducting Juan de Fuca plate often happen where the brittle subducting plate bends as it dives *beneath, and pushes on* the North American Plate. An example is the 2001 magnitude 6.8 Nisqually earthquake, which generated strong ground shaking in Puget Sound. Deep earthquakes as large as these happen every 30-50 years and will account for up to half of ShakeAlert-powered alerts.

ShakeAlert could provide about the same amount of warning time for shallow, crustal earthquakes and deep earthquakes. Prepare for fewer than 10 seconds of warning before strong shaking arrives!

What about the ‘Big One? Although they are rare, megathrust earthquakes can have the greatest impact. Earthquakes greater than magnitude 8 rupture the Cascadia subduction zone on average every 300 to 500 years.  The last one occurred on January 26, 1700 when a magnitude 9 megathrust earthquake ruptured the full length of the plate boundary where the Juan de Fuca plate subducts beneath the North American plate.

Megathrust earthquakes, like those that have occurred in Chile, Alaska, Sumatra, and Japan, often start offshore and rupture for several minutes along the fault surface as the magnitude increases.  Computer simulations teach us that for large offshore megathrust quakes, ShakeAlert can provide up to tens of seconds of warning to residents of inland areas, such as Puget Sound and Willamette Lowlands! **But** if you are close to where the earthquake starts -- and it might start near the coast -- you will only get a few seconds before strong shaking arrives. Remember, the earthquake can start *anywhere along the subduction zone*, so it’s important to be prepared for a short alert time, or even none at all. If you feel shaking or get an alert, DROP, COVER, and Hold ON.

Today, ShakeAlert can effectively detect earthquakes throughout the three-state system and deliver alerts via its distribution partners before people experience strong shaking.The ShakeAlert system continues to improve, potentially leading to longer warning times. As the Pacific Northwest Seismic Network and the California Integrated Seismic Network install more sensors, ShakeAlert will detect earthquakes faster and more accurately. Plus, ShakeAlert scientists are constantly working behind the scenes, to improve the earthquake detection algorithms, making them better at rapidly determining when a small initial rupture has grown larger to become a mega-quake.

As soon as you receive an alert *or* feel shaking, take action to protect yourself! The best way to do so is to Drop..., Cover... and Hold On. Quickly get low to the ground, cover your head and neck, take cover under a sturdy desk or table if possible, and hold on to your cover until the shaking stops. If you are on the coast, or in a tsunami-prone area, quickly move to high ground **as soon as the shaking stops**. Remember, the earthquake itself is your warning that a tsunami may be coming.

For more information on how to protect yourself before, during, and after an earthquake, visit [www.earthquakecountry.org](http://www.earthquakecountry.org), and your local Emergency Management Agency