How to communicate Cascadia Subduction Zone earthquake hazards

Tom Brocher
Research Geophysicist
Earthquake Science Center
U.S. Geological Survey
Menlo Park, California

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Lessons from other earthquakes

- Provide context – discuss the hazard in relation to what people have experienced in the past
- Be realistic about hazards – don’t conflate them
- Be clear about what is known and what is not known – make sure everyone appreciates that our knowledge will evolve over time
- Coordinate our communications with emergency managers, engineers, and public health officials
- Use simple language and a range of formats
To encourage preparedness

- Provide examples of how preparedness has made a difference in previous earthquakes and tsunamis
- Talk about what is already been done to prepare
- Tell people what they can do to prepare
- Showing images of others preparing will more likely lead the audience to take action

Retrofit House

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Learning Lessons for Resiliency from Similar Earthquakes


There is good news: Modern building codes in Japan (2011) and in Chile (2010, 2015) resulted in relatively little building damage to newer buildings.

Biggest lesson: Almost all of the property damage and fatalities resulted from the tsunamis produced by the earthquakes and submarine landslides.
Tsunami Hazard Mitigation

Tsunami inundation maps, signed evacuation routes, tsunami sirens

Training in coastal communities that when one feels the earthquake to evacuate when the shaking stops*

Vertical evacuation structures: one is under construction in Westport, Washington

Hazard avoidance: Land use planning and zoning
Tools are in place to hasten recovery

Cascadia subduction zone earthquakes have been included in the USGS National Seismic Hazard Map since 1996 and in the building codes since International Building Code 2000. The USGS National Seismic Hazard Maps and building codes are updated about every 6 years to incorporate the latest science into local resilience.

In the 2011 Japan and the 2010 and 2015 Chilean subduction earthquakes, similar building codes prevented significant building damage to modern buildings.

USGS earthquake scenario maps

USGS is performing supercomputer simulations of strong ground motions: these show that ground motions in the I-5 corridor will be lower than those on the coast.
We’ve experienced similar shaking levels before (albeit not the duration of the shaking)

The expected shaking levels along the I-5 urban corridor are comparable to the shaking levels experienced in the M6.8 2001 Nisqually earthquake

Shaking levels are reduced by fact that the earthquake is primarily offshore and deep
USGS National Seismic Hazard Maps include many possibilities to cover all unknowns and uncertainties, including the possibility of M8 earthquakes anywhere on the Cascadia subduction zone.

Once again, shaking levels along the I-5 urban corridor are comparable to those of the Nisqually earthquake.
Tools to mitigate aftershocks

Large (magnitude 6 to 7) aftershocks will begin immediately after the earthquake.

Aftershocks will be widespread: along the megathrust, in the downgoing oceanic crust, and in the crust of the Coast Ranges.

Aftershocks can cause additional damage, hamper rescue operations, and take a psychological toll on people.

USGS issues aftershock forecasts.

After the 1989 Loma Prieta earthquake the USGS issued real-time aftershock alerts to rescuers working in a collapsed freeway.
Earthquake Early Warning Basics

1. In an earthquake, a rupturing fault sends out different types of waves. The fast-moving P-wave is first to arrive, but damage is caused by the slower S-waves and later-arriving surface waves.

2. Sensors detect the P-wave and immediately transmit data to an earthquake alert center where the location and size of the quake are determined and updated as more data become available.

3. A message from the alert center is immediately transmitted to your computer or mobile phone, which calculates the expected intensity and arrival time of shaking at your location.
Shaking Warning

The USGS, University of Washington, UC Berkeley, and Caltech are partnered on a prototype earthquake early warning system called ShakeAlert.

A similar system in Japan worked during the M9 2011 Tohoku, Japan earthquake.

ShakeAlert will provide up to a few minutes of warning for a Cascadia subduction zone earthquake.

Among many other uses, aftershock alerts can reduce anxiety and inform rescue operations.
There will be a new coastline along the Pacific Ocean.

There will be an instant and permanent lowering of the Pacific coast of 3 to 6 feet and daily tides will reach further inland in many low-lying areas.

Plan for immediate flooding hazard resulting from this “instant” sea level rise.

Plan for longer term coastal erosion.
Mitigate known vulnerabilities

Older pre-code & other vulnerable buildings

- unreinforced masonry buildings
- buildings with structurally weak first stories
- pre-code buildings in soft soils
- tall buildings in sedimentary basins

Tsunami evacuation challenges

USGS authored report, 2015
Hazard Assessment led to a successful mitigation: Alaska Oil Pipeline in 2002 M7.9 Denali earthquake
We have recognized the hazards before the event, now they can be mitigated.

Geological histories going back thousands of years converge on 500 years as an approximate average amount of time between back-to-back earthquakes along most of the Cascadia subduction zone. This average interval implies a one-in-ten chance of a Cascadia earthquake as large as magnitude 9 within 50 years.

For context, the odds of a repeat of a M6.8 Nisqually type earthquake in the Puget Lowland within 50 years are about 8 to 9 times higher.
Contact me:

Tom Brocher
Earthquake Science Center
U.S. Geological Survey
Menlo Park, California
brocher@usgs.gov