

# How to Stay Safe When the Big One Comes

BY KATHRYN SCHULZ



Unless you're in the tsunami-inundation zone, you will almost certainly survive even the worst Cascadia earthquake. But the aftermath may be as devastating as that of the 2011 Tohoku,

Japan, quake and tsunami, pictured here.

For most of the past three years, I've worked as a book critic, which is not a job that affords me many opportunities to scare the living daylights out of my readers. (Authors, occasionally; readers, no.) But earlier this month, when a story I wrote about a dangerous fault line in the Pacific Northwest hit the newsstands, the overwhelming response was alarm. "Terrifying," the story kept getting called; also "truly terrifying," "incredibly terrifying," "horrifying," and "scary as fuck." "Don't read it if you want to go back to sleep," one reader warned. "It's hard to overhype how scary it is," BuzzFeed said. "New Yorker scares the bejesus out of NW," the *Seattle Post-Intelligencer* wrote.

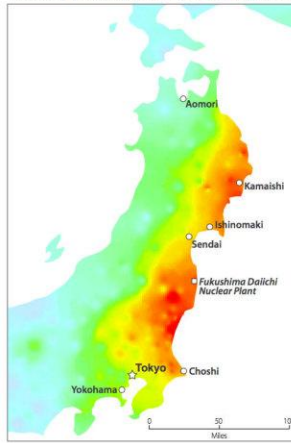
Novelists and screenwriters can terrify people, feel pretty good about themselves, and call it a day. But for journalists, or at least this one, fear is not an end in itself. At best, it is a means to an end, a way to channel emotion into action. To achieve that, however, you need to navigate between the twin obstacles of panic (which makes you do all the wrong things) and fatalism (which makes you do nothing). In an effort to help people to do so, I've answered, below, some of the questions I've heard most often since the story was published, and also provided a little advice about how best to prepare for the Cascadia earthquake and tsunami, and their aftermath.

### Who will be affected by the earthquake?

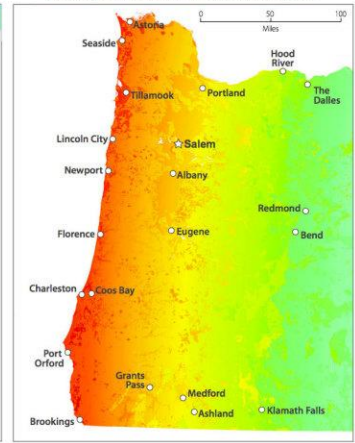
The Cascadia subduction zone runs from Cape Mendocino, California, to Vancouver Island, Canada. Those who live anywhere in that region and west of the Cascade Mountains are at risk—but how much risk and what kind varies considerably, based on where exactly you live in relationship to the fault line, how susceptible your area is to liquefaction and landslides, what kind of structure you're in when the quake occurs, and your local seismic codes. In general, however, the shaking will be strongest on the coast and diminish somewhat as you move inland.

It's maddeningly difficult to find a good map of the entire region showing relative risk. But here's one, courtesy of the Oregon Department of Geology and Mineral Industries (DOGAMI), that shows the actual shake map from the 2011 earthquake in Tohoku, Japan, and the anticipated one for the state of Oregon from the full Cascadia earthquake:

ShakeMap for March 11, 2011 Tohoku M9 earthquake

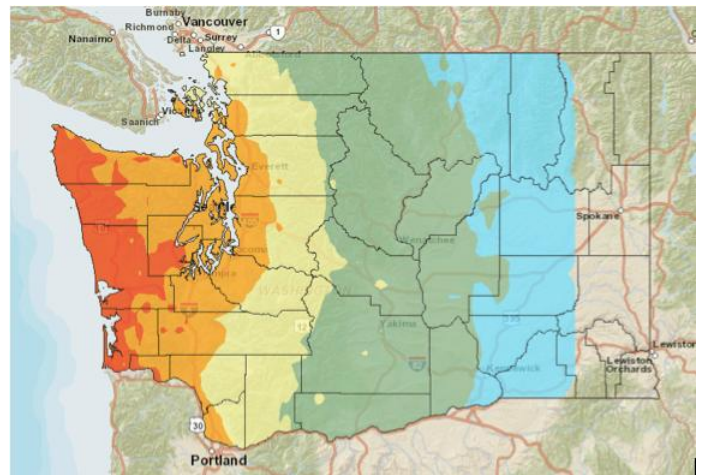


ShakeMap for SIMULATED M9 Cascadia earthquake

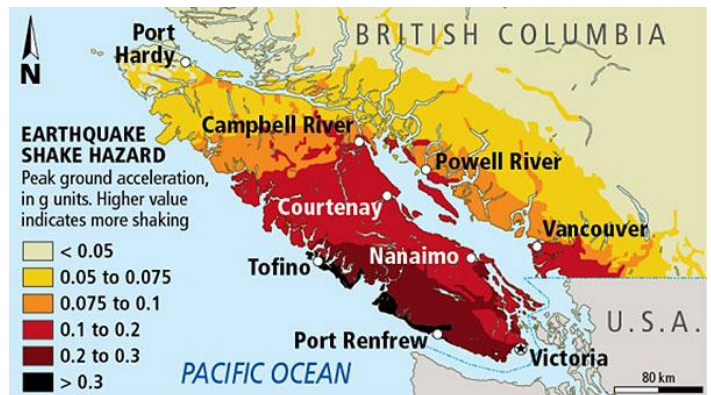


The lightest shaking, indicated here in pale green, will be just strong enough to wake people out of sleep and knock over unsecured objects. That intensity will gradually increase as you move west; in the hardest-hit areas, indicated by dark red, the shaking will be strong enough to seriously damage even well-built structures.

Here's another map, courtesy of the Washington State Seismic Hazards Catalog, that shows expected shaking intensity in Washington. (The color scheme has changed but the gist is the same: here, the cooler colors indicate lighter shaking, the warmer ones greater intensity.) As you can see, the zones of severity basically extend in parallel vertical bands across the region.



Finally, here's a map for Vancouver Island, Canada. (This one shows peak ground acceleration—a different metric than intensity, but one that also captures the relative severity of the earthquake across the region.)



## Who is at risk from the tsunami?

Only those who are inside the inundation zone when the earthquake strikes. That zone is as long as the fault line—seven hundred miles, from California to Canada—but very narrow. Exactly how far inland the zone extends varies considerably, not only with the size of the earthquake but also with the shape and height of the coastline and factors like the presence of rivers (which function as hoses, creating a narrower channel in which the water will travel further). At most, however, the tsunami will reach just three miles inland.

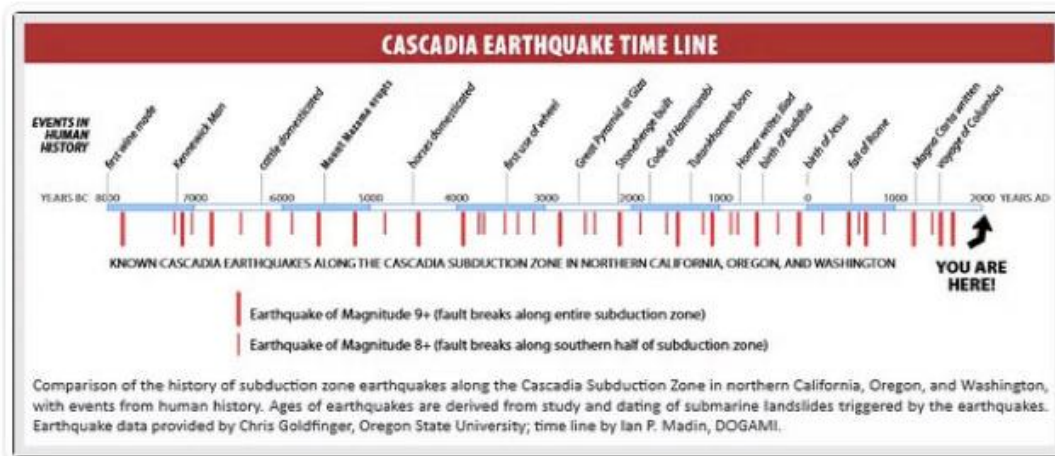
The problem, of course, is that the narrow band of the inundation zone corresponds to the most popular and populous places on the coast: the area where homes, businesses, and tourists all tend to congregate. Yet within that area, the devastation will be almost total. DOGAMI is in the process of compiling maps that will indicate the inundation zone and evacuation routes for every Oregon coastal town, as well as note the estimated wave-arrival times at various places in each town, together with the estimated time needed to reach high ground. In the meantime, most places on the Pacific Northwest coast have an evacuation map (like this one, for the towns of Seaside and Gearhart, which appear in the original article). Google the relevant map before you visit; memorize it if you live there.

Some readers wondered if Seattle is vulnerable to the tsunami because of its location on the Puget Sound; it is not. (That city and others could experience some seiches, mini-tsunamis in lakes and other inland bodies of water, but those would be just a few feet tall, at most—and they should be correspondingly

low on the list of things to worry about.) Nor will other major cities along the I-5 corridor be directly affected by the tsunami. (Another reader wondered if those in Hawaii should be nervous. Nope: the western half of the Cascadia tsunami will miss the Hawaiian Islands by a wide margin. It will hit Japan, but by then it will have lost most of its height—and Japan, a highly tsunami-ready nation, will have more than enough advance warning to protect its citizens.) If you're wondering if some other location is safe or at risk, you can enter the address in this handy tsunami-evacuation-zones Web site.

## Are we overdue for the Cascadia earthquake?

No, although I heard that word a lot after the piece was published. As DOGAMI's Ian Madin told me, "You're not overdue for an earthquake until you're three standard deviations beyond the mean"—which, in the case of the full-margin Cascadia earthquake, means eight hundred years from now. (In the case of the "smaller" Cascadia earthquake, the magnitude 8.0 to 8.6 that would affect only the southern part of the zone, we're currently one standard deviation beyond the mean.) That doesn't mean that the quake won't happen tomorrow; it just means we are not "overdue" in any meaningful sense. The odds I cite in the story are correct: there is a thirty-per-cent chance of the M8.0–8.6 Cascadia earthquake and a ten-per-cent chance of the M8.7–9.2 earthquake in the next fifty years. Here's a handy chart from DOGAMI showing the earthquake history on the Cascadia subduction zone and our own current location on that time line:



## Will everything west of I-5 really be toast?

Perhaps no line in the entire six-thousand-word piece attracted as much attention as this declaration by Kenneth Murphy, head of the FEMA division responsible for Cascadia: "Our operating assumption is that everything west of Interstate 5 will be toast." The first important thing to note about that remark is that, needless to say, Murphy really said it, and stood by it in the fact-checking process—so, clearly, FEMA is anticipating that the region will be in very grave shape.

That said, "toast" is not what you would call a precise description, so let me be more specific. What Murphy did not mean is that everyone west of I-5 will be injured or killed; FEMA's casualty figures, while horrifying, amount to under one-half of one per cent of the population of the region. Nor did he mean that every structure west of the interstate will fail, although there the numbers are grimmer: region-wide, the

agency expects to see seriously damaged or destroyed eighty-eight per cent of ports and potable water sources; seventy-seven per cent of fire stations and waste-water treatment plants; two-thirds of all airports, hospitals, railways, and schools; almost half of all highway bridges, police stations, and emergency command centers; plus almost three thousand miles of natural gas pipelines, seven hundred and forty-three electric power facilities, and nearly a million residential buildings.

That does start to seem pretty toast-like. Meanwhile, another issue, one not apparent from those numbers, also helps explain why Murphy is so concerned. From an emergency-management perspective, access is everything: it's easier to deal with ten thousand hungry, thirsty, injured, exposed, displaced people along an open truck route than five hundred such people in a town whose only road in has failed. Because

there is very little redundancy in the transportation infrastructure of the Pacific Northwest, and because that infrastructure is so vulnerable, the Cascadia earthquake will turn countless places within the region into towns like that. (Nor do you even need a given town's access points to be destroyed for it to be rendered inaccessible. If a single bridge or highway section two or twelve or twenty miles east fails, emergency crews can't get there anyway.) So a better analogy than toast is this: the Cascadia earthquake is going to hit the Pacific Northwest like a rock hitting safety glass, shattering the region into thousands of tiny areas, each isolated from one another and all extremely difficult to reach. That's why Murphy's plan involves, in his words, "leasing, buying, or stealing any helicopter I can get my hands on." Helicopters can't do everything, but they can, at least, get almost anywhere. (FEMA has also made arrangements with the U.S. Navy Third Fleet to conduct a massive sea-lift operation for those stranded on the coast—but, for logistical reasons, it will take the fleet seven days from the time of the quake to arrive.)

**Realistically, given all that vulnerable infrastructure and the huge scale of the problem, is there anything individuals can do to protect themselves?**

Absolutely, and most of it is simple and inexpensive or free. The Red Cross, FEMA, and local, city, and state governments all provide guides to emergency preparedness for individuals and families. If you live in the region, the best bet is to look up a guide that's tailor-made for your area, since different places have different needs, as well as different resources available to community members. But for what it's worth, here's my own take on how best to stay safe during—and remain functional after—the Cascadia earthquake:

**If you own a home anywhere west of the Cascade Mountains, bolt it to its foundation.** The majority of private homes in the timber-rich Pacific Northwest are made of wood—and wooden homes, like trees themselves, are supple enough to withstand even powerful shaking. Those that are bolted to their foundations should fare very well in the Cascadia earthquake. Conversely, those that are not bolted down will jolt off their foundations and collapse, imperiling everything—and everyone—inside them. Securing a home to its foundation generally costs between \$2,000 and \$6,000—by far the most expensive seismic upgrade facing individuals, but a whole lot less costly than losing the entire house.

**Strap down your water heater.** A water heater is basically a bomb in your basement: big heavy object, open flame, gas line. If it topples over during an earthquake, it can smash that line and start a fire. Or it can smash the water line and cause a flood. Or it can do both. You can hire a plumber to secure your heater, or do so yourself with a water-heater-strap kit, available at any home-improvement store for around twenty dollars. (And while you're down in your basement, **make sure you know how to turn off your gas and water main.** You'll want to shut off both after the quake—not a good moment to be figuring out how to do so for the first time.)

**Redecorate your home with an eye to gravity.** Computers, blenders, vases, houseplants, your daughter's soccer trophies, your TV: everything you are accustomed to thinking of as home décor will be requisitioned as a weapon during the Cascadia earthquake. Your job is to prevent that, and you can do so in a couple of hours and at essentially no cost. Bolt

bookshelves and tall furniture to the wall. Move heavy objects from higher shelves to lower ones. Don't hang pictures, mirrors, shelves, or anything else sharp-edged or heavy above a bed. Install latches on your cabinets. And don't store booze above waist level. Airborne wine bottles do not do good things to human heads.

**Make a plan with your family.** No matter when it strikes—though especially if it does so during school and business hours—the earthquake will leave countless people separated from their loved ones. At the same time, it will cut or severely compromise telecommunications systems, making it difficult or impossible to track one another down via phone calls, e-mails, or texts. Ask a friend or relative outside the region to agree to serve as a contact person for your family; if it does become possible to send messages in some form, you're more likely to get through to someone when their end of the communications systems is functional and the lines aren't overloaded. Choose a meeting place for your family, remembering that many bridges will be down and many roads impassable. Find out if your city has designated earthquake-gathering areas, where food, water, and first aid will be available; some, like Portland, do. If you have children, learn the earthquake plan at their schools, day-care centers, camps, and after-school activities. If you live across a bridge from where you work or where your children attend school, arrange in advance for a friend to pick them up or meet them at home if the earthquake occurs during school hours and you cannot get there yourself.

**Get to know your neighbors.** In most disasters, neighbors become the de-facto first responders, since they are already on the scene when calamity strikes. That will be especially true in the Cascadia earthquake, where widespread damage to the infrastructure will make travel difficult for heavy vehicles like fire trucks and ambulances. (Portland could be in particular trouble in this respect because, by a sociopolitical quirk, the majority of the city's emergency responders live across the Columbia River, in Vancouver, Washington—a short commute on a normal day, but a nearly impossible one after the earthquake, since, at present, no bridges over the Columbia are expected to survive.) Find out which of your neighbors has an elderly relative on a ventilator, which one has a generator, which one has a past as a paramedic. Knowing facts like these about each other can save lives: theirs, or yours. Seattle, Portland, and many other cities have programs to help promote and organize neighborhood meetings and earthquake training.

**Keep an earthquake kit in a safe, accessible spot in your home.** Unless you're in the tsunami-inundation zone, you will almost certainly survive even the worst Cascadia earthquake. Which is exactly why you should plan for it: you're still going to be around afterward, when life gets physically, emotionally, and logistically hairy. You can make things easier—on yourself, your family, your neighbors, and emergency responders—by assembling a decent earthquake kit and storing it in a safe, accessible place. Some things to include:

- Emergency-contact information
- Copies of important documents (birth certificates, passports, driver's licenses, wills)
- Cash (A.T.M.s won't work after the quake)
- Prescription drugs (these expire, so, as with food, you'll have to periodically replace them)

- Flashlights
- Extra batteries
- Spare eyeglasses
- A whistle (attach one to your key chain, too, in case you wind up trapped somewhere)
- Basic first-aid supplies
- Warm clothing
- Sturdy shoes
- Rain gear
- Sleeping bags
- A tent

You should also store food and water. The conventional wisdom among emergency planners is that every household should have a three-day supply of each on hand (figure a gallon of water per person per day, for drinking as well as washing), but in the Cascadia event that won't be nearly enough. The more realistic target is a three-*week* supply, but that's a daunting amount for those with limited means or limited storage space. My own theory about earthquake preparedness is that the perfect is the enemy of the good: don't choose to stock nothing because you can't stock everything. Got money and space to spare? Great: fill a shelf with water and nonperishable foods. Throw in duct tape and a tool kit. Throw in a hand-cranked radio, a water purifier, iodine. Don't have much money or space? Make a small kit with whatever you can fit and afford. Everything you have, you'll use; everything you can do for yourself frees up emergency resources for those in even greater need.

**If you live in the tsunami zone, know how to get out.**

Those who live in the inundation zone need to be at least as prepared for the earthquake as everyone else, since the shaking will be stronger in coastal areas than inland. But if you live in the inundation zone, you aren't bolting your home to its foundation to save it; nearly every building in that zone will be lost. You're doing so to protect yourself from injury so that you can get out as quickly as possible after the shaking stops. Nor are you building an earthquake kit that you can subsist on for weeks; you're building one that you can grab and take with you when you leave, so you should focus on the lightweight and the crucial: important documents, medicine, a flashlight. Most important, learn your evacuation routes—from home, from work, from school, from anywhere else you routinely find yourself—and practice walking them, both by day and by night. And when the actual quake hits and you get to high ground, stay there; after the initial wave, others will continue to strike for up to twenty-four hours. One good way to die in a tsunami is to venture back into the inundation zone after the water first recedes, to investigate the damage or look for missing loved ones.

**If you are visiting the tsunami zone for the day, walk or drive the evacuation route before settling in.** The coastline of the Pacific Northwest is beautiful, and I definitely do not discourage visiting it—so long as you choose places with accessible high ground and figure out in advance how to reach it. You'll be doing so on foot (the earthquake will leave roads impassable), so be realistic about how far you and your companions can walk or run.

**If you are an out-of-towner planning to spend the night in the tsunami zone: don't.** Of the almost thirteen thousand

people expected to die in the Cascadia event, one thousand will perish in the earthquake. The others will be killed by the tsunami—and they amount to nearly one in five people who are in the zone when the water arrives. That's a grim enough figure that it changed my own beach-going behavior in the Northwest. Go to the coast by day, for sure. But if you're staying overnight, book a vacation rental, hotel room, or campsite outside the inundation zone. (In most coastal towns, such places are easy to find.) It's one thing for locals who know their way around to get themselves to safety in a tsunami. But, as a tourist, you don't want to wake up in the middle of the night in the middle of an earthquake in a strange town and realize that you have no idea how to find a flashlight, let alone high ground.

**Demand better seismic safety.** Reporting this story turned me into a big believer in individual preparedness—but no amount of it can keep you safe if the bridge you're on collapses. Many of the worst problems facing the region will require major public-works projects to fix them, and others will require private companies (such as utilities) to commit to solutions, but the general public can play an important role in bringing about that kind of change. In Portland, a city whose citizens have successfully lobbied for curbside composting and hundreds of miles of bike lanes, parents send their children off every morning to brick schools that have not been retrofitted. Part of the problem is obliviousness, or disbelief. "Most people think someone is handling this," Chris Goldfinger, the seismologist featured in the original story, said. "And that's not true. No one is handling it." If you're alarmed by seismic issues that exceed your own capacity to solve them, find the person who *should* be handling it and make some noise.

**One final answer to a question I'm suddenly getting asked a lot: what on earth am I doing out here?**

I live in New York most of the year, but I spend my summers in Oregon. Nothing in my personal or professional life obliges me to do so. Clearly, I am not oblivious to the risks. Given all that, and given the scenario I outlined in this article, why do I still choose to spend time here?

Part of my answer is, I imagine, one I share with many people in the region: this place feels like home. I used to live here year-round, I still have family and friends in the area, and I dearly love it—so much so that there is an inverse correlation between the airplane descending into the Portland airport and my own spirit rising. Part of why I'm so happy here is that I'm something of a mountain freak; as often as I can, I slip away from work to head out into the Cascades to run or bike or climb. Those are not risk-free activities, so I think a lot about the amount of danger I choose to tolerate in order to do the things I love. Or, more precisely, I think about the amount of danger I must *mitigate* to do the things I love.

That's one way of looking at life in the Pacific Northwest: it's a wonderful activity, but to do it safely you need to understand its inherent risks and work to allay them. That's the other reason I'm still here: I've done that work, and I'm comfortable with the level of risk I now live with. I'm still scared for the region, but I am not scared in it. Take some basic steps to protect yourself, work to draw attention to those issues that demand collective action—do that, and you need not be overly scared either.