USGS
science for a changing world

c-screen-max image res and the Movies

Lights! Cameras! Disasters!

Throughout the history of Hollywood, disaster films have been sure-fire winners for moviemakers. Beginning with "The Wind" in 1928, Americans have been plagued by a "Twister" and "The Perfect Storm." And we've survived "Volcano" and "Earthquake" and "The Swarm" all followed by "Armageddon." That's not even mentioning us getting through "The Towering Inferno" and finally making it to "The Day After."

With amazing special effects, it's easy to get caught up in the fantasy disaster epic. But real-world science is often at odds with Hollywood. What makes a great science fantasy film often bears no relation to real facts or the hazards people truly face.

The U.S. Geological Survey is the lead federal agency responsible for researching, monitoring and forecasting geologic hazards such as earthquakes, volcanoes and landslides. And we have the further responsibility to educate Americans about the real hazards they face and to separate science fact from science fantasy.

Since earthquakes are featured in the most recent offering in the made-for-television disaster film genre, let's start with some science-based information on them.

Big earthquakes are naturally occurring events well outside the powers of humans to create or stop. An earthquake is caused by a sudden slip on a fault, much like what happens when you snap your fingers. Before the snap, you push your fingers together and sideways. Because you are pushing them together, friction keeps them from slipping. When you apply enough stress to overcome this friction, your fingers move suddenly, releasing energy. The same "stick-slip" process goes on in the earth. Stresses in the earth's outer layer push the side of the fault together. The friction across the surface of the fault holds the rocks together so they do not slip immediately when pushed sideways. Eventually enough stress builds up and the rocks slip suddenly, releasing energy in waves that travel through the rock to cause the shaking that we feel during an earthquake.

Unlike finger-snaps, earthquakes typically originate several to tens of miles below the surface of the Earth. It takes many years – decades to centuries – to build up enough stress to make a large earthquake, and the fault may be tens to hundreds of miles long. The scale and force necessary to produce earthquakes are well beyond our daily lives. Likewise, people cannot prevent earthquakes from happening or stop them once they've started – giant nuclear explosions at shallow depths, like those in some movies, won't actually stop an earthquake.

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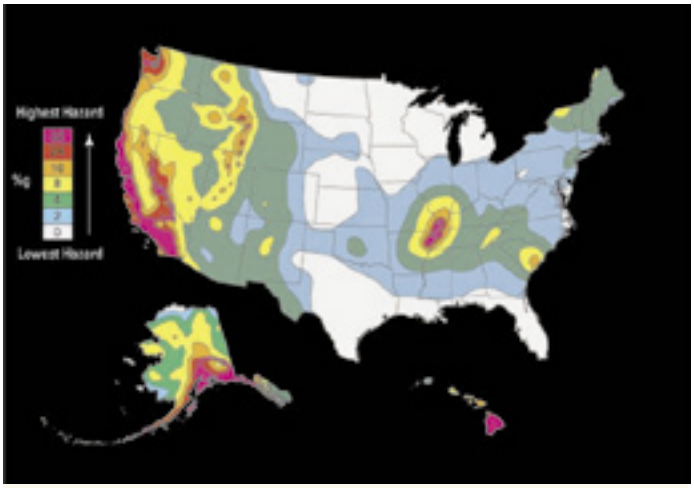

U. S. Geological Survey Earthquake Hazard Map for the United States showing areas in the country where earthquake hazards are the most (in red and orange) and least (white). This map is based on known seismic activity and the long-term rates that faults are moving. It takes into account how often earthquakes occur in a given area and at what magnitude. Some local areas may face higher hazards due to they way local geology and soils may make earthquake shaking worse

It's well known that California, the Pacific Northwest and Alaska all have frequent earthquakes, some of which are quite damaging. Some areas of the country are more at risk than others, but, in fact, 38 states have an earthquake risk.

A full map of seismic hazards in the United States can be found at:
eqhazmaps.usgs.gov/html/map_graphic.html

The two most important variables affecting earthquake damage are the intensity of ground shaking caused by the quake and the quality of the engineering of structures in the region. The level of shaking, in turn, is controlled by the proximity of the earthquake source to the affected region and the types of rocks that seismic waves pass through en route (particularly those at or near the ground surface). Generally, the bigger and closer the earthquake, the stronger the shaking. But there have been large earthquakes with very little damage either because they caused little shaking or because the buildings were built to withstand that shaking. In other cases, moderate earthquakes have caused significant damage either because the shaking was locally amplified, or more likely because the structures were poorly engineered.

People can't stop earthquakes from happening. People can significantly mitigate their effects by identifying hazards, building safer structures, and learning about earthquake safety.

Meanwhile, let's clear up a few other things:
The idea of a "Mega-Quake" – an earthquake of magnitude 10 or larger – while theoretically possible—is very highly unlikely. Earthquake magnitude is based in part on the length of faults -- the longer the fault, the larger the earthquake. The simple truth is that there are no known faults capable of generating a magnitude 10 or larger "mega-quake."

Then there's this business of California falling off into the ocean. NOT TRUE! The ocean is not a great hole into which California can fall, but it is itself land at a somewhat lower elevation with water above it. It's absolutely impossible that California will be swept out to sea. Instead, southwestern California is moving ever so slowly (2 inches per year) towards Alaska as it slides past central and eastern California. 15 million years (and many earthquakes) from now, Los Angeles and San Francisco will be next-door neighbors.

Another popular cinematic and literary device is a fault that opens during an earthquake to swallow up an inconvenient character. But unfortunately for principled writers, gaping faults exist only in movies and novels. The ground moves parallel to a fault during an earthquake, not away from it. If the fault could open, there would be no friction. Without friction, there would be no earthquake. Shallow crevasses can form during earthquake induced landslides, lateral spreads, or other types of ground failures. Faults, however, do not gape open during an earthquake.

So when you see the next big disaster film, rest assured that movies are just entertainment. Enjoy them! And then go learn about the real-world science behind disasters and if you live in an area where hazards exist, take the suggested steps to protect you and your family.

There are plenty of things you can do right now to prepare if you live in an earthquake-prone area.

1. Make sure each member of your family knows what to do no matter where they are when earthquakes occur:

· Establish a meeting place where you can all reunite afterward.

· Find out about earthquake plans developed by children's school or day care.

· Remember transportation may be disrupted, so keep some emergency supplies--food, liquids, and comfortable shoes, for example--at work.

2. KNOW where your gas, electric and water main shutoffs are and how to turn them off if there is a leak or electrical short. Make sure older members of the family can shut off utilities.

3. LOCATE your nearest fire and police stations and emergency medical facility.

4. TALK to your neighbors--how could they help you, or you them after an earthquake?

5. TAKE Red Cross First Aid and CPR Training Course.

6. MAKE your disaster supply kit. Beyond the usual flashlights, batteries and radios, include a first-aid kit; work gloves; sturdy shoes or boots; a week's supply of any presciption medications you or your family might need; credit card and cash; personal identifcation; extra set of keys; matches in a waterproof container; map of your area; phone numbers of family and other important people (doctors, veterinarians, etc.); copies of insurance policies and other important documents; special needs equipment (diapers, baby formula, hearing aid batteries; spare eyeglasses, etc.); three gallons of water per person; three-day supply of food per person; hand tools; a portable ABC fire extinguisher; sanitation supplies for you and your family; entertainment (toys, books, coloring books and crayons, playing cards)

7: BOLT bookcases, china cabinets, tall furniture, file cabinets, etc. to wall studs. Brace or anchor heavy electronics and other heavy items. Secure items that might fall. Move heavy or fragile items to lower shelves. Fasten drawers and cabinet doors with latches or locks. Brace overhead light fixtures. Strap your water heater to wall studs and bolt down any gas appliances. Look for other non-structural steps you can take in your home and workplace to reduce your chances for injury and loss.

8. ASK AN ENGINEER about the seismic safety of your home and/or business. It's well known that unreinforced masonry structures can fail quickly during earthquakes. An inspection by a structural engineer now can help you decide if retrofitting will help your property withstand shaking.

For more factual information on earthquakes, earthquake myths and earthquake preparedness see the Earthquake Facts and Earthquake Fantasy sheet that accompanies this sheet and visit:

USGS web site for earthquake information:
http://earthquake.usgs.gov

List of recent earthquakes in the United States:
http://earthquake.usgs.gov/recenteqs/

USGS earthquake preparedness information:
http://quake.usgs.gov/prepare/prepare.html
http://earthquake.usgs.gov/hazards/prepare.html

Worldwide list of recent earthquakes:
http://earthquake.usgs.gov/recenteqsww/index.html

Did you feel it? Report an earthquake here:
http://pasadena.wr.usgs.gov/shake/

Earthquake information for kids:
http://earthquake.usgs.gov/4kids/

Cool earthquake facts (not just for kids!):
http://earthquake.usgs.gov/4kids/facts.html

USGS earthquake research projects:
http://earthquake.usgs.gov/about_us/index_p1.html

Information about ShakeMap:
http://earthquake.usgs.gov/shakemap

“Putting Down Roots in Earthquake Country” (designed for Southern California, but an excellent resource for anyone living in earthquake country!)
http://www.earthquakecountry.info/roots/roots.html

The American Red Cross’s earthquake page.
http://www.redcross.org/services/disaster/0,1082,0_500_,00.html http://www.redcross.org/services/disaster/
0,1082,0_583_,00.html

The Federal Emergency Management Agency’s earthquake page.
http://www.fema.gov/hazards/earthquakes/.