Student Page

Natural Hazards

Earthquakes (Geologic hazard)

The shaking of the ground that results from the fracturing and displacement of rock, that is produced by a fault, or that results from subsequent movement along the fault.

- Earthquakes are the most destructive natural force.
- The severity of an earthquake is measured using the Modified Mercalli Intensity Scale and the Richter Magnitude Scale (see boxes). For example, the 1994 earthquake in Los Angeles showed a magnitude of 6.6 on the Richter Scale.
- Earthquake probabilities are estimated in two ways: (1) by studying the historical frequency of large earthquakes in a specific area and (2) by studying the rate at which strain accumulates in the rock. For example, in 1983 specialists predicted a 47–83 percent probability that an earthquake of a magnitude around 6.5 would strike in California's Santa Cruz mountains over the next 30 years. Such an earthquake occurred in 1989, with a magnitude of 6.9.
- According to records since 1900, 18 major earthquakes and 1 great earthquake are expected to occur in a given year worldwide; however, the occurrences in most years since 1969 have been below the expected average.

Richter scale ratings of earthquakes:*

<4.0	insignificant
4.0–4.9	minor
5.0–5.9	damaging
6.0–6.9	destructive
7.0–7.9	major
>8.0	great

*Each unit represents a magnitude that is 10 times greater than the previous unit.

Modified Mercalli Intensity Scale

This scale rates the intensity of an earthquake on a scale of I to XII. The scale consists of certain key responses. For example, an earthquake felt by only a few people is rated as I; an earthquake felt by nearly everyone is rated V; an earthquake that causes total damage is rated XII.

- Most seismic activity occurs at plate boundaries, though a small percentage of earthquakes do occur within plate interiors, such as the 1811–1812, earthquake in New Madrid, Missouri.
- Tsunamis (giant sea waves) can be caused by earthquakes (as well as local seismic events, submarine landslides, and volcanic eruptions). They develop when the sea floor suddenly deforms and vertically displaces the water above. Population pressures in the coastal areas of the Pacific Ocean and Caribbean are resulting in an exceedingly high amount of shoreline development, which places residents, tourists, and property at a certain level of risk of being impacted by a tsunami.

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Natural Hazards

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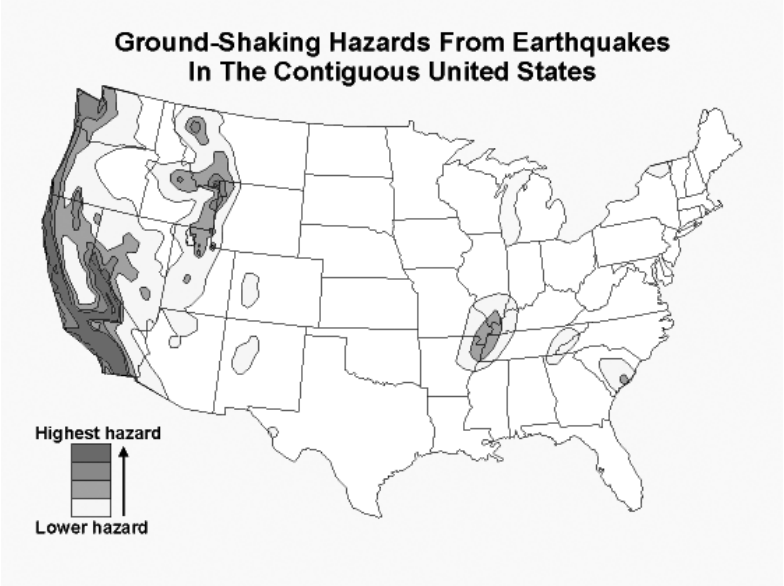
Mitigating earthquake damages

Studying earthquake patterns can contribute to reducing the hazards presented by earthquakes. Such studies identify places where building foundations should be strengthened, where protective zoning should be implemented, and where evacuation plans should be prepared. Studies also help in developing appropriate land use policies for areas at risk of being affected by earthquakes and/or tsunamis.

For more information on earthquakes, go to:
http://earthquake.usgs.gov



U.S. Geological Survey

Loma Prieta, California, Earthquake October 17, 1989. Boulder Creek in the Santa Cruz Mountains. The lack of adequate shear walls and construction on fill contributed to the failure of this structure. U.S. Geological Survey

Natural Hazards

continued

Volcanoes (Geologic hazard)

Vents or fissures in the Earth's surface through which magma, liquid lava, and gases are released into the environment.

- As the population increases, more people are living near the world's volcanoes. According to the U.S. Geological Survey, up to approximately 500 million people may be at risk from a volcanic explosion by the year 2000.
- About 10 percent of the more than 1,500 volcanoes that have erupted in the past 10,000 years are located in the United States. Most of them are found in the Aleutian Islands, Alaska Peninsula, Hawaiian Islands, and Cascade Range of the Pacific Northwest.
- About 80 percent of the world's active, above-sea volcanoes are in the Pacific Basin.
- Prediction of volcanic eruptions, when the prediction is based on the eruptive history of a volcano or volcanic center, has improved in this century.
- Benefits of volcanoes include beautiful scenery, geothermal phenomena (such as geysers), geothermal energy, and highly fertile soil produced by the weathering of lava.
- Over the past 400 years, more than 500 volcanoes have erupted; approximately 600 active volcanoes exist worldwide—though even a volcano that has been dormant for hundreds of thousands of years is not 100 percent free from the risk of eruption.
- More than 35 volcanoes in the United States, mostly in the Cascade Range of the Pacific Northwest, are likely to erupt in the future. The most dangerous are those that have erupted on average every 200 years or that have erupted in the past 300 years (these eruptions include Mt. Saint Helens, Mono-Inyo Craters, Lassen Peak, Mt. Shasta, Mt. Rainier, Mt. Baker, and Mt. Hood).
- The severity of volcanic risks to people depends on the volcano and lava type, climate, topography, and population density.
- A variety of signs may warn of a potential volcanic eruption, though none can accurately predict when a volcano will erupt. The greater the number of signs warning of volcanic activity that occur simultaneously, the greater the probability of an eruption.

Volcanic hazard mitigation

The development of monitoring and communication systems can help, but evacuation is the only effective safety option.

For more information on volcanoes, go to:
http://volcanoes.usgs.gov

Natural Hazards

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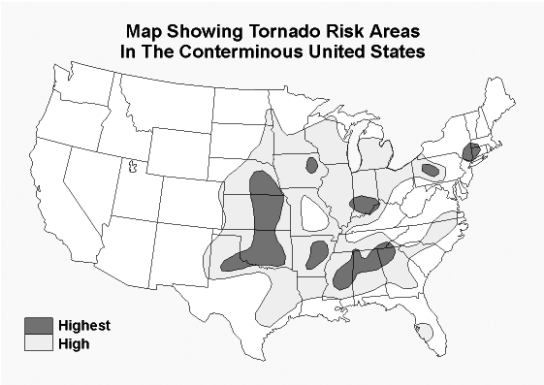
Tornadoes (Severe weather hazard)

A violent storm resulting from a mass of cool, dry air over-running warm, humid air. Tornadoes are characterized by a funnel of spinning air on the underside of a cloud, which can descend to the ground and can move at speeds up to about 300 miles per hour.

- Tornadoes are serious local hazards because of their low air pressure and high winds.
- Each year tornadoes kill about 100 people and cost millions of dollars in damages.
- Tornadoes account for almost half of all deaths attributed to weather-related disasters, yet since 1916 the number of deaths from tornadoes has been decreasing.
- In the United States, tornadoes are found most frequently east of the Rocky Mountains, though no place is safe from tornadoes.
- Although tornadoes damage the smallest area compared to hurricanes or northeasters (storms with gale-force winds), they often result in more complete damage.

Tornado hazard mitigation

The only safe option is to adhere to the tornado warning system of the weather service and to go to the interior of the lowest floor of a building or lie flat on the ground if you're outdoors.



U.S. Geological Survey

National Oceanic & Atmospheric Administration (NOAA)

Tornado Fact:

A tornado in Broken Bow, Oklahoma, carried a motel sign 30 miles and then dropped it in Arkansas!

For more information on tornadoes, go to:
http://www.outlook.noaa.gov/tornadoes

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Natural Hazards

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Hurricanes (Severe weather hazard)

A giant circular storm that develops over warm tropical waters and contains winds over 75 miles per hour.

- A hurricane can produce wind speeds of up to approximately 190 miles per hour and can cause great damage if it reaches land.
- In addition to causing damage from strong winds, hurricanes also cause severe flooding.
- We have the ability to detect hurricanes and to monitor their paths, making warnings possible, though hurricanes can display erratic behavior.
- Current technology usually provides adequate warning of approaching storms; however, evacuation from areas with limited access, such as Florida or North Carolina, is a problem.

Saffir/Simpson Hurricane Scale Ranges

Scale #	Winds (mph)	Surge (ft)	Damage
1	74–95	4–5	minimal
2	96–110	6–8	moderate
3	111–130	9–12	extensive
4	131–155	13–18	extreme
5	>155	>18	catastrophic

Mitigating hurricane damage

Preparation for hurricanes involves short- and long-term planning; adequate warning and evacuation; maintenance of beach width and dune height; zoning; and engineering solutions.

Hurricane Ivan, 2004. Destroyed houses on top of a dune in Orange Beach, AL. These houses were built on top of a dune that was severely eroded by Ivan. Note the walkways in pre-storm photo that once served as pathways down to the beach. From U.S. Geological Survey.

For more information on hurricanes, go to:
http://www.nhc.noaa.gov/pastall.shtml

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Natural Hazards

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Floods

A flow of water over the natural or artificial banks of a river channel.

- Floods are naturally occurring events that become hazards only when people inhabit and develop flood-prone areas.
- Natural flooding is most often caused by surface runoff of heavy rains or the rapid melting of snow, thus causing streams and rivers to overflow their banks and overwhelm the adjacent area, referred to as the floodplain.
- A floodplain area may be a narrow strip of wilderness area, a densely settled city, or any variation in between. The size of a floodplain can be determined by the actual or predicted flow estimate, from historical data, by probability calculations, or from a maximum possible flood calculation.
- Flood severity depends on rainfall, infiltration rate, slope, vegetation, climate, season, and human activities such as urbanization, agriculture, timbering, and flood control.
- Positive effects of flooding include the transportation of nutrients that fertilize aquatic plants, the washing of fish into isolated lakes, and the addition of nutrients to existing soils (though growing crops are destroyed in the process).
- People have long been attracted to settling on floodplains because of the fertile soil and the fact that floodplains may be the only flat land for development in hilly areas. Floodplains are also near the source of water for drinking, for irrigation, and for livestock and provide access to water transportation.
- The average annual flood hazard has been increasing because people have settled in flood-prone areas faster than flood protection projects have been implemented.
- The average annual cost of flood damage in the United States is usually more than $2 billion, and each year approximately 100 people lose their lives as a result of floods.

Flood mitigation measures

Floodways, flood walls, dams, levees, or channelization have been used extensively in the past century. However, other methods for mitigating flood risks include changing settlement patterns in floodplains and restoring natural features such as wetlands, which can reduce flooding more effectively and at far less expense.