

Natural Hazards Around the World

About Wildfires

When an uncontrolled fire burns vegetation (trees, brush, or other plants), it is called a wildfire. Sometimes wildfires start if people use fire without care or safety. Other times they start naturally, such as when lightning strikes. Wildfires happen most frequently when lots of dry vegetation and extreme heat come together. They can spread fast when hot, dry wind is blowing in the area of a fire.

Wildfires happen all over the world. In North America, wildfires occur most often in the west, especially in places where precipitation only falls during the winter. Wildfire is also common in the drier parts of Australia and Asia. In South America and Africa, tropical rainforests are being cleared by humans, causing dry conditions. This makes wildfires more common in these areas, too. Scientists know that wildfires are larger during drier years. They predict that the amount of land burned by wildfires will increase in the future because of climate change. As global temperatures rise and dry areas get drier, wildfires will burn longer, burn hotter, and destroy far more land than before.

In the past 20 years in the US, approximately 5-10 million acres of land have burned due to wildfires each year. 10 million acres is about the size of both Massachusetts and Connecticut combined. In early 2020, Australia experienced very large wildfires that burned 46 million acres of land.

Wildfires can travel up to 14 miles per hour, which is faster than most people can run. They are also very hot. Wildfires can reach temperatures of 1000°F (590°C), which is hot enough to completely destroy nearly everything in its path.

Scientists are developing a way to categorize wildfires by how strong they are. Right now, they are categorized by damage (how many acres have burned) and containment (how much of the fire is under the control of firefighters). For example, a new wildfire may have only burned 10 acres, but it could also be only 5% contained. This would mean that 95% of the fire is still uncontrolled and could still damage trees and property.

We often think of fire as destructive, but naturally-occurring wildfires help many ecosystems. Some trees need fire to release their seeds, and fire can increase the health of a forest by clearing away dry and dead vegetation. Indigenous people in North, Central, and South America have carefully used fire to restore nutrients to soil for centuries.

Helpful Resources

NASA Fire and Smoke Monitoring: https://www.nasa.gov/mission_pages/fires/main/index.html

USDA Forest Service, Active Fire Maps: <https://fsapps.nwcg.gov/afm/>

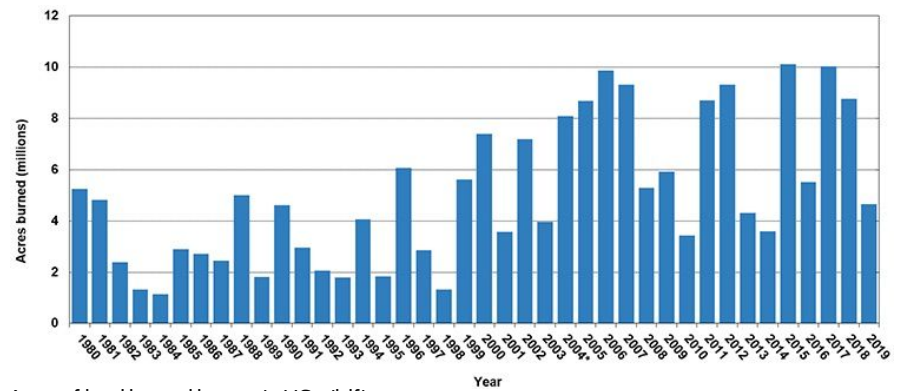
NOAA Storm Prediction Center, Fire Weather Outlook: https://www.spc.noaa.gov/products/fire_wx/

FEMA Wildfire brochure: <https://www.ready.gov/sites/default/files/2020-03/wildfire-information-sheet.pdf>

CDC, Wildfire: <https://www.cdc.gov/disasters/wildfires/index.html>



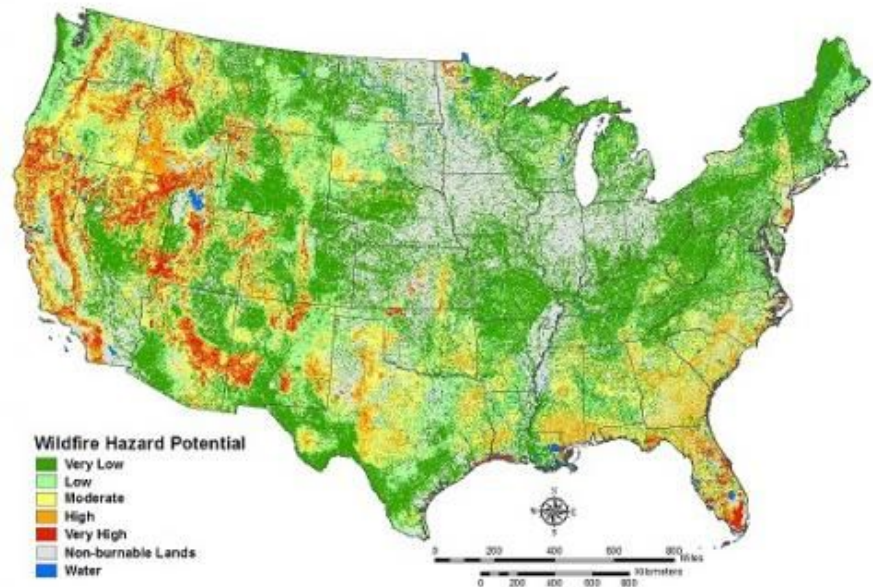
Wildfire outside a neighborhood



Acres of land burned by year in US wildfires



Firefighters fighting a wildfire.



Place at risk of wildfire. Red indicates very high risk

What technologies and design solutions exist to detect, warn, or reduce damage?

Wildfire

Detect

Most wildfires are detected by visual contact. They can be observed by people nearby, or by aerial surveillance, and satellite imagery.

Wildfires begin quickly and when conditions are right, they might grow in size quickly.

Warn People

- Local community firefighters and law enforcement often coordinate warnings and evacuations with neighborhoods.
- The US Emergency Alert System (EAS) and National Oceanic & Atmospheric Administration (NOAA) Weather Radio provide wireless alerts to people's cell phones.

Reduce Damage

- Home building options: Use fire-resistant materials to build or repair homes.
- Create a fire-resistant zone free of leaves, debris, or flammable materials for at least 30ft away from home.
- Shut off all gas and propane to the house.
- Wet your roof and areas at least 50ft away from home to keep air moisture high.

What can people do to prepare for, respond during, and recover after this hazard?

Wildfire

Prepare

- Sign up for the local community warning system.
- Know community risk, response, or evacuation plan.
- Find several ways to leave the area.
- Have a plan for livestock and pets.
- Gather emergency supplies (N95 respirator mask).
- Keep a supply of everyone's updated medication.
- Designate a room that can be closed off from outside air.
- Set up portable air cleaners inside the house.
- Pay attention to air quality alerts

Respond

- Evacuate immediately if authorities tell you to.
- If you are not ordered to evacuate, stay inside where smoke levels are lower.
- Use N95 masks.
- Do not use anything in the house that burns.
- If outside, look for shelter among rocks, lie face down, and cover your body with soil.
- Breathe air close to the ground.
- If trapped, call 911 and give them your location. Turn on lights to help rescuers find you.
- Listen to EAS, NOAA Weather Radio, or local alert systems for current emergency info and instructions.

Recover

- Listen to authorities to find out when it's safe to return.
- Avoid hot ash, charred trees, smoldering debris, and live embers--these may still be extremely hot.
- Wear gloves and heavy-soled shoes to protect hands & feet.
- Avoid fallen power lines.
- Reach out to family and friends using text, email, or social media. Make phone calls only in emergencies.
- Wet debris to reduce dust particles.
- Dispose of food exposed to heat or smoke.
- Check for burns on tree trunks--damaged trees may not survive and pose a hazard.
- Be aware that flood risk is higher after wildfires for up to five years or until vegetation is restored.

About Severe Thunderstorms

A short-lived rain shower that produces lightning is called a thunderstorm. In the US, thunderstorms usually form when dry, cold air from the North meets with warm, moist air from the South. These conditions commonly occur in late spring and early summer. Some thunderstorms are severe, and can produce winds of over 50mph, hail, and tornadoes, in addition to lightning. Hailstones are chunks of ice that fall from strong thunderstorms. A tornado is a column of rotating air that is in contact with the ground. Even though they are made of air, they are visible because you see the dust and debris that are caught in them. Flash flooding also occurs during severe storms and you can find information on the “Flooding” card in this reference section. Thunderstorms are common worldwide and at all times of year. There are about 100,000 thunderstorms in the United States each year alone, but only 10% of these become severe. Some thunderstorms are small, but they can also grow very large. Lines of thunderstorms can stretch across several states for hundreds of miles!

Conditions associated with thunderstorms:

- *Tornadoes* occur most often in the Great Plains and Midwest, but they do occur in other parts of the country. Tornadoes move very fast (up to 50mph) and can destroy or cause severe damage to structures on the ground.
- *Hail* does about 1 billion dollars in damage to crops and property each year in the United States. The National Weather Service classifies hail as “severe” if the hailstones have a diameter of 1 inch or more, but smaller hail can damage crops by bruising fruit meant to be sold to a store or restaurant.
- Humans are involved in *lightning strikes* over 200,000 times a year. Most lightning victims survive, but often have long-term health issues such as hearing damage. About 44 people die from lightning strikes each year in the United States. Because Florida experiences more thunderstorms than any other state, it has the most lightning fatalities each year.

Depending on the type of storm, different notifications can be issued at different times. Here are what some of the notifications mean:

- **Severe Thunderstorm Watch:** A severe thunderstorm watch indicates that conditions are favorable for the formation of severe thunderstorms.
- **Severe Thunderstorm Warning:** A severe thunderstorm warning means that the area has or will have severe thunderstorm conditions. This includes wind speeds of 58 miles per hour or greater and/or hail that is one inch in diameter or larger.
- **Tornado Watch:** A tornado watch is issued when weather conditions could lead to tornadoes. A watch can cover parts of a state or several states.
- **Tornado Warning:** A tornado warning is issued when a tornado has been reported by spotters or has shown up on radar images. A warning will be issued for the area that would be in the path of the tornado and means people and animals should find a safe place.

Helpful Resources

NOAA Severe Storms Laboratory: <https://www.nssl.noaa.gov/education/svrwx101/>

North Carolina Climate Office, Severe Weather Hazards: <https://climate.ncsu.edu/edu/SevereHazards>

FEMA Storms and Lightning: https://www.fema.gov/media-library-data/2607c3fe71a68fe165a53ec189fba37e/FEMA_FS_thunderstorm_508.pdf

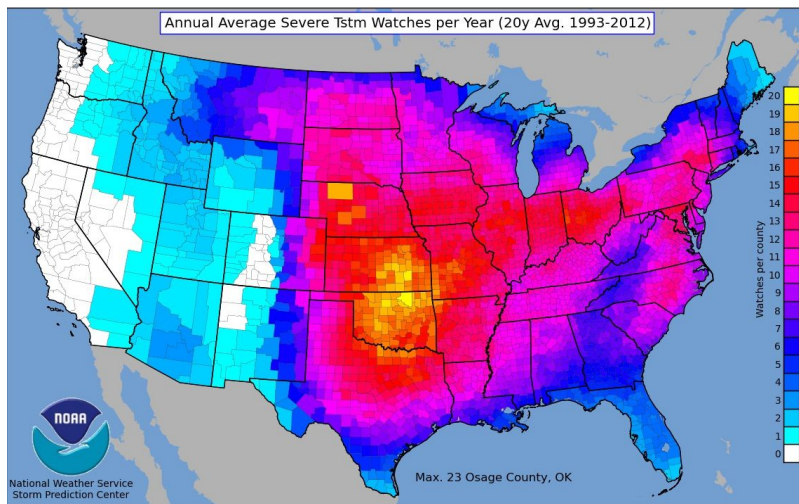
FEMA Tornadoes: https://www.fema.gov/media-library-data/20130726-1622-20490-7783/tornadoesfactsheet_final.pdf



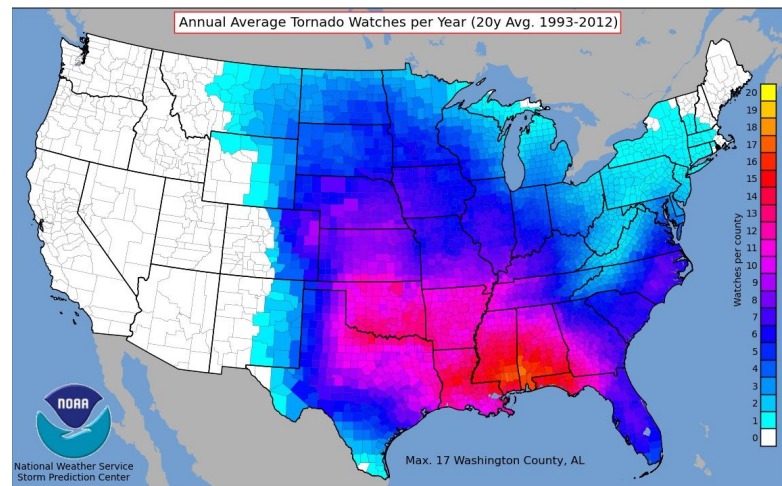
Thunderstorm with lightning strike.



Thunderstorm with tornado.



Annual Thunderstorm Watches per year.



Annual Tornado Watches per year.

What technologies and design solutions exist to detect, warn, or reduce damage?

Thunderstorms

Detect

- Satellites track clouds and their data and send that information to meteorologists and the National Weather Service.
- Meteorologists and the National Weather Service use weather radar to get more data about the storms.
- Data on the storm's wind speed, direction, amount of precipitation, density, and movement help meteorologists determine what might be happening.
- Lightning data is sensed by radar and satellites.
- These same readings can help determine if there is hail.
- A tornado can be detected in a severe storm by looking for patterns in the radar images. Trained storm spotters can also spot funnel clouds.
- Computers analyze data to predict tornado formation.

Warn People

Severe storm and tornado alerts are issued in a number of ways:

- Weather radios
- Phone apps
- TV
- Radio
- Tornado sirens
- Local emergency management (police, fire, and other government organizations) patrol areas with sirens on to help alert families, if necessary.

Reduce Damage

- Bring outdoor items like patio furniture and plants inside, so they do not become flying objects.
- Add extra support to roofs and check to make sure sheds are bolted to the concrete.
- Use hail-resistant siding, storm windows, and roofing materials.

What can people do to prepare for, respond during, and recover after this hazard?

Thunderstorms

Prepare

- Know your area's risk for thunderstorms, tornados, lightning, and hail.
- Get a weather radio and know your local siren and alert sounds.
- Identify nearby, sturdy buildings close to where you live, work, study, and play. Practice going there.
- Cut down or trim trees that may be in danger of falling on your home.
- Consider buying surge protectors or a lightning protection system to protect your home, appliances, and electronic devices.
- Know the signs of a tornado: a rotating, funnel-shaped cloud; an approaching cloud of debris; or a loud roar—similar to a freight train.
- Watch for tornado danger signs: dark, often greenish clouds--a phenomenon caused by hail; wall cloud-- an isolated lowering of the base of a thunderstorm; cloud of debris.
- Secure items that can be picked up by the wind and bring companion animals indoors.

Respond

IF YOU ARE UNDER A THUNDERSTORM OR TORNADO WARNING, FIND SAFE SHELTER RIGHT AWAY!

- When thunder roars, go indoors!
- For tornadoes, go to a safe room, basement, or storm cellar.
- If you are in a building with no basement, go to a small interior room on the lowest level. Use blankets to protect yourself.
- Stay away from windows, doors, and outside walls.
- Avoid running water or using landline phones.
- Unplug appliances and other electronic devices. Secure outside furniture.
- If boating or swimming, get to land and find a sturdy, grounded shelter or vehicle immediately.
- If necessary, take shelter in a car. Do not touch metal.
- Avoid flooded roads.
- Do NOT park your car under an overpass or bridge in a tornado. You're safer in a low, flat location.
- Use your arms to protect your head and neck.
- If in a mobile home, vehicle, or camper, find access to a sturdy shelter.

Recover

- Keep listening to EAS, NOAA Weather Radio, and local authorities for updated information.
- If you are trapped, cover your mouth with a cloth or mask to avoid breathing dust. Try to send a text, bang on a pipe or wall, or use a whistle instead of shouting.
- Stay clear of fallen power lines or broken utility lines.
- Do not enter damaged buildings until they are safe.
- Save your phone calls for emergencies.
- Use texts or social media to communicate with family and friends.
- Wear thick-soled shoes, long pants, and work gloves during clean up.

About Winter Storms

Winter storms are combinations of very cold temperatures, large amounts of frozen precipitation, and high winds. There are several types of winter storms:

- **Blizzards** are dangerous winter storms that come with blowing snow and wind, making it hard to see. They often have heavy snowfalls and severely cold temperatures.
- An **ice storm** is a storm which places at least .25" of ice on surfaces. This can be hazardous for driving and walking. Tree branches and powerlines can easily snap under the weight of the ice.
- **Lake effect storms** are cold, dry air masses that move over the Great Lakes regions and pick up lots of moisture from the water. The water in the air becomes snow, and the storm dumps the snow in areas generally to the south and east of the lakes.
- **Snow squalls** are brief, intense snow showers that come with strong, gusty winds.

Cold air, moisture, and lift are all needed to form a winter storm. Lift happens when cold and warm fronts meet, or as air travels up a mountainside. These storms happen every year in the United States from mid to late fall through late spring. Winter storms can hit all areas of the United States. Local climate conditions cause different kinds of storms in different areas.

Winter storms and blizzards can last anywhere from a few hours to several days. They can be small and concentrated in one area, or can be large and stretch across several states. These storms can knock out heat, power, and communication to homes and businesses. People who leave home during winter storms are at risk for car accidents, hypothermia and frostbite. People who heat their homes using gas are at a higher risk of carbon monoxide poisoning.

Depending on the conditions, different notifications can be issued at different times. Here are what some of the notifications mean:

- **Winter Weather Advisory:** Winter weather is expected, but it is not going to be hazardous enough to meet warning criteria.
- **Winter Storm Watch:** A significant winter storm could happen. Watch out for weather conditions to change.
- **Winter Storm Warning:** Life-threatening, severe winter conditions have begun or will begin within 24 hours.
- **Blizzard Warning:** Winds and wind gusts of 35 miles per hour or more are happening right now. There is a lot of falling or blowing snow that makes it impossible to see more than a quarter of a mile. This is expected to happen for 3 hours or longer.

Helpful Resources

NOAA Severe Storms Laboratory: <https://www.nssl.noaa.gov/education/svrwx101/>

Ready.gov, Winter Storms: <https://www.ready.gov/winter-weather>

FEMA: https://www.fema.gov/media-library-data/2607c3fe71a68fe165a53ec189fba37e/FEMA_FS_thunderstorm_508.pdf

CDC, Winter Storms: <https://www.cdc.gov/disasters/winter/index.html>



Snow plow clearing snow in blizzard.

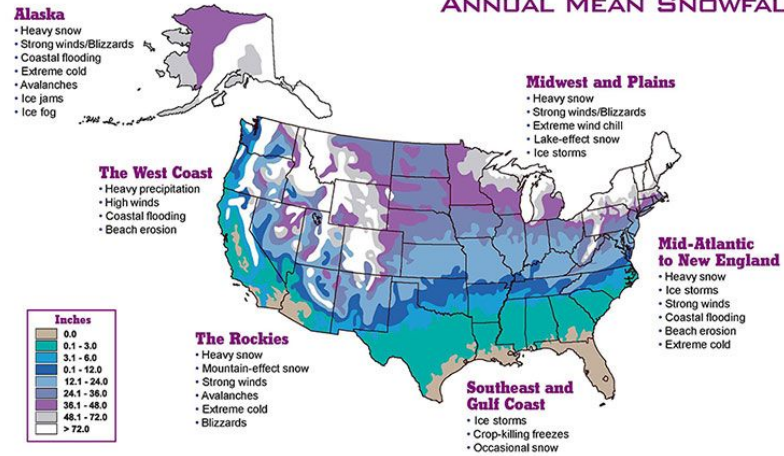


Vehicles covered in snow.



Winter storm in a neighborhood.

WINTER STORM HAZARDS IN THE U.S. ANNUAL MEAN SNOWFALL



Map of Winter Storm Chances in US.

What technologies and design solutions exist to detect, warn, or reduce damage?

Winter Storms

Detect

The US has satellite and radar imaging, along with hundreds of weather stations throughout the US. The sensors track air conditions and alert meteorologists when conditions are right for a winter storm to occur. Generally, people have several days of warning based on this detection system.

Warn People

If your National Weather Service local location detects a winter storm, they will send out a watch or a warning for your area.

Some ways people are notified:

- Cell phone alerts
- Radio alerts
- Tv alerts
- Cell phone apps
- Newspapers (if known far enough in advance)

Reduce Damage

Many cities have response systems in place to keep roads clear of snow to reduce hazardous driving conditions.

What can people do to prepare for, respond during, and recover after this hazard?

Winter Storms

Prepare

- Develop a plan with your family.
- Winterize vehicles and put on winter tires or chains.
- Prepare an emergency roadside kit.
 - Keep the gas tank full.
 - Keep a supply of non-clumping kitty litter to make walkways and steps less slippery.

Preparing your home:

- Protect pipes from freezing.
- Make sure windows are sealed.
- Add storm windows, or cover windows with plastic from the inside.
- Consider buying emergency heating equipment.
- If you have a fireplace, keep a supply of firewood or coal.
- Know location of emergency shelter and your local snow routes.
- Create an emergency kit.
- Be sure you have enough heating fuel.

Respond

- Stay indoors, wear warm clothes.
- Listen to weather reports.
- Bring your animals inside.
- Make sure animals have liquid water.
- Lower the thermostat, close off unused rooms, and cover windows at night.
- Check on relatives, neighbors, friends, and others at-risk.
- Knock ice and snow off of your roof using a roof rake.
- Clear snow and ice from furnace vents.
- Use ice melt and shovel walkways.
- Wear warm layers of clothing.
- Cover your mouth to protect your lungs from cold air and keep dry.
- Avoid doing too much work outside.
- Walk carefully like a penguin to help avoid slipping.

Recover

- Continue to monitor your local news and weather radio for the most up-to-date information.
 - Avoid driving until conditions have improved.
 - Check state transportation apps and maps to determine safety of roads.
 - Avoid overexertion as heart attacks may occur from shoveling heavy snow.
 - If using a portable generator, take precautions against carbon monoxide poisoning, electrocution, and fire.
- Take these steps to avoid frostbite and hypothermia:
- Dress warm and avoid staying in the cold too long. Wear a hat and gloves.
 - Drink warm fluids, but avoid caffeine and other drinks that can dehydrate you.
 - Take frequent breaks from the cold.

About Hurricanes

Rotating storm systems that develop over warm ocean water are called tropical depressions or tropical storms. Once the winds inside reach 74 miles per hour or more it is called a hurricane. This type of storm has different names, depending on where it forms: Hurricanes form in the North Atlantic and Northeast Pacific Oceans; cyclones form over the South Pacific and Indian Oceans; and typhoons form over the Northwest Pacific Ocean.

Hurricane season for the US is from June 1st through September 30th. 97% of hurricanes occur during this time. In the United States, most hurricanes make landfall on the Atlantic Coast, the coast off the Gulf of Mexico, and the Hawaiian Islands. Some hurricanes are strong enough to reach further inland to states that are not on the coast. Some hurricanes are small and others are large. The smallest hurricane recorded was only 22 miles across. The largest (Typhoon Tip) was over 1,250 miles wide. The strength of a hurricane can change as time goes on. Scientists use wind speed to classify the strength of a hurricane on the Saffir-Simpson scale:

- **Category 1:** Winds range from 74-95mph. making them as fast as a major league baseball throw. Can cause damage to roofs, shingles, gutters, and siding. Large branches of trees and some full trees may fall. Power lines will be damaged, leaving people without electricity for several days. The storm surge is generally 4-5 feet above normal.
- **Category 2:** Winds range from 96-110mph. making them as fast as a fastball pitch. Causes major roof and siding damage, trees are snapped or uprooted, and power outages can last days to weeks. The storm surge is generally 6-8 feet above normal.
- **Category 3:** Winds range from 111-129mph. making winds as fast as a professional tennis serve. Homes suffer major damage and roofs will be removed. Trees will be uprooted or snapped, electricity and water will be unavailable for days or weeks after. Storm surge is generally 9-13 feet above normal. Some roads may be damaged or blocked by trees.
- **Category 4:** Winds range from 130-156mph. making them faster than the world's fastest roller coaster. Homes can lose roofs and some outside walls. Most trees will be uprooted and power poles will come down. Power outages and water will last weeks or months, making the areas unsafe until the repairs are made. Storm surge is generally 13-18 feet above normal. Most category 4 storms come with orders to evacuate the coastal region as far as 6 miles inland. Some roads and bridges are damaged.
- **Category 5:** Winds range at or above 157mph. making them as fast or faster than a skydiver falling head first, or a high speed train. Most homes and trees are completely destroyed. Power and water will be out for weeks or months, making the area unsafe to live in. All category 5 storms come with evacuation orders. Storm surge will be 19 or more feet above normal. Evacuations are generally required for those living 5-10 miles from the shoreline. Damage to roads, bridges, and other structures cause safety issues for the communities.

We typically know about hurricanes forming approximately 5 days in advance. Once detected, a general model of the hurricane path is made. As the storm develops and more data is collected, these models are made more precise. Once a storm reaches hurricane status, we usually have 2 days of warning to prepare for the storm. Depending on the conditions, different notifications can be issued at different times. Here are what some of the notifications mean:

- Hurricane Watch: hurricane conditions (winds of 74 miles per hour or more) are possible in the area.
- Hurricane Warning: hurricane conditions (winds of 74 miles per hour or more) are expected in the area.

Helpful Resources

Ready.gov, Hurricanes: <https://www.ready.gov/hurricanes>

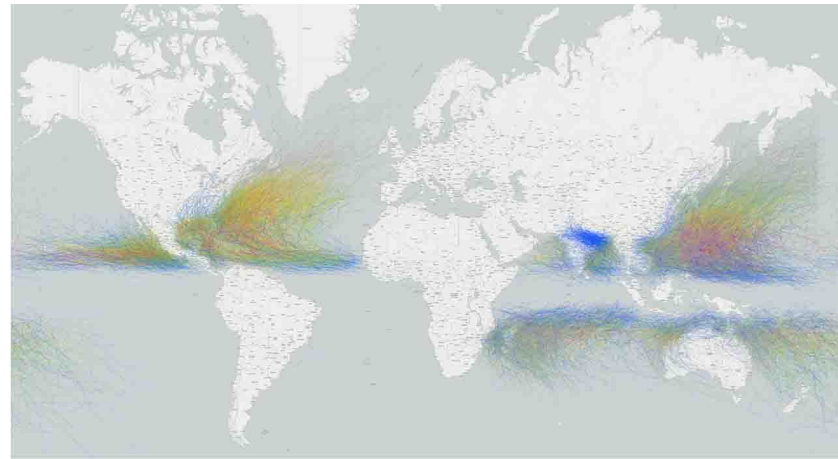
FEMA factsheet: https://www.fema.gov/pdf/hazard/hurricane/2010/hurricane_week_preparedness_factsheet_ready.pdf

CDC, Hurricanes: <https://www.cdc.gov/disasters/hurricanes/index.html>

Video explaining why hurricane predictions are so variable: <https://www.youtube.com/watch?v=e1lcGGsBu8>



Hurricane from space.



Historical hurricanes around the world.



Storm surge from a hurricane.



Example of a hurricane tracking map.

What technologies and design solutions exist to detect, warn, or reduce damage?

Hurricanes

Detect

- Satellites collect data about the storm and look at cloud structure, the amount of rainfall, temperature, wind speed, take pictures, and record other important measurements and information.
- Drifter buoys send data about ocean currents and sea levels to scientists.
- Planes drop special tools called dropsondes into the hurricane to collect additional data.
- Supercomputers use all the data to create models of the hurricane path and severity.
- Meteorologists evaluate and communicate information to the community and government.

Warn People

- Local and state governments issue watches and warnings based upon forecasts.
- Watches and warnings are communicated across television, radio, and cellular services.
- Local emergency management (police, fire, and other government organizations) help inform and evacuate families, if necessary.
- Storm surge watch/warnings are issued to help coastal communities prepare for potential flooding.

Reduce Damage

- Avoid building in areas such as flood plains, or areas that could be impacted by storm surge.
- Sandbags can help prevent flooding.
- Cover windows with shutters to help protect against flying objects.
- Secure or bring in objects that could fly or float away (i.e. outdoor furniture and boats).

What can people do to prepare for, respond during, and recover after this hazard?

Hurricanes

Prepare

- Consider flood insurance.
- Make a plan for your family and pets. Review the local evacuation plan.
- Prepare an emergency kit.
- Know important emergency numbers and have them written down somewhere safe.
- Trim old or dead trees and tree limbs.
- Know your nearest hurricane shelter location.
- Have flashlights, NOT candles.
- Purchase a sump pump and make sure it's working properly.
- Stockpile emergency protective items, like plywood, plastic sheeting, and sandbags.

Respond

If you have to evacuate:

- Make sure you have at least a half tank of gas.
- Bring any outdoor furniture or planters inside your home.
- Grab your emergency "go bag."
- If possible, help others evacuate.
- Don't drive on any water covered or flooded roads.

If remaining in your home or community:

- Move to a hurricane shelter or higher ground, if needed.
- Pick an out-of-state contact to call to check in on you.
- Board up and stay away from windows, reinforce doors.
- If possible, go to a windowless room on the lowest floor not likely to flood.
- Use flashlights for light.
- Do NOT climb into a closed attic.
- Stay off bridges over fast moving water.

Recover

- If you evacuated, wait for the all clear signal before returning.
- Don't wade into floodwaters.
- Don't drive on flooded roads.
- Don't enter a building until it has been inspected for mold, gas leaks, live electric lines, and dangerous debris.
- Wear equipment (i.e. mask, gloves, boots) to protect yourself.
- Don't use electrical equipment around water.
- Don't drink tap water until the local authority says it's safe.
- Throw out any rotten or exposed food, including food from gardens.
- Air out and dry your house.
- Clean and disinfect everything.

About Extreme Heat

Extreme heat is a period of high heat and humidity for at least 2-3 days. These events are caused when high pressure air in the upper atmosphere traps heat at the surface of the Earth. Extreme heat tends to happen in the summer months, but there is no official “heat season.”

Extreme heat can happen almost anywhere in the United States. Heat waves rarely occur in Alaska and are more frequent further South. A certain temperature and humidity level might be considered extreme in one area, but typical in another. This means the definition of extreme heat varies by location. For example, 86°F high temperatures in Anchorage, Alaska broke a record in 2019, but the same temperature is common in parts of Florida.

Extreme heat events can last for several days without a break in the temperatures. In some places, temperatures could exceed 130°F. Heat waves are becoming more common today than they were in the past.

Extreme heat events can develop quickly in an area, but they are often predicted several days ahead of time. This can give people time to prepare. Depending on the conditions, different notifications can be issued at different times. Here are what some of the notifications mean:

- **Excessive Heat Warning:** issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this warning is when the maximum heat index temperature is expected to be 105° or higher for at least 2 days and night time air temperatures will not drop below 75°. However, these criteria vary across the country, especially for areas not used to extreme heat conditions.
- **Excessive Heat Watch:** issued when conditions are favorable for an excessive heat event in the next 24 to 72 hours. A watch is used when the risk of a heat wave has increased, but its occurrence and timing is still uncertain.
- **Heat Advisory:** issued within 12 hours of the onset of extremely dangerous heat conditions. The general rule of thumb for this advisory is when the maximum heat index temperature is expected to be 100° or higher for at least 2 days, and night time air temperatures will not drop below 75°. These criteria vary across the country, especially for areas that are not used to dangerous heat conditions.
- **Excessive Heat Outlook:** issued when the potential exists for an excessive heat event in the next 3-7 days. An outlook provides information to those who need considerable lead-time to prepare for the event.

Helpful Resources

Ready.gov, Extreme Heat: <https://www.ready.gov/heat>

EPA, Extreme Heat: <https://www.epa.gov/sites/production/files/2016-10/documents/extreme-heat-guidebook.pdf>

CDC, Extreme Heat: <https://www.cdc.gov/disasters/extremeheat/index.html>

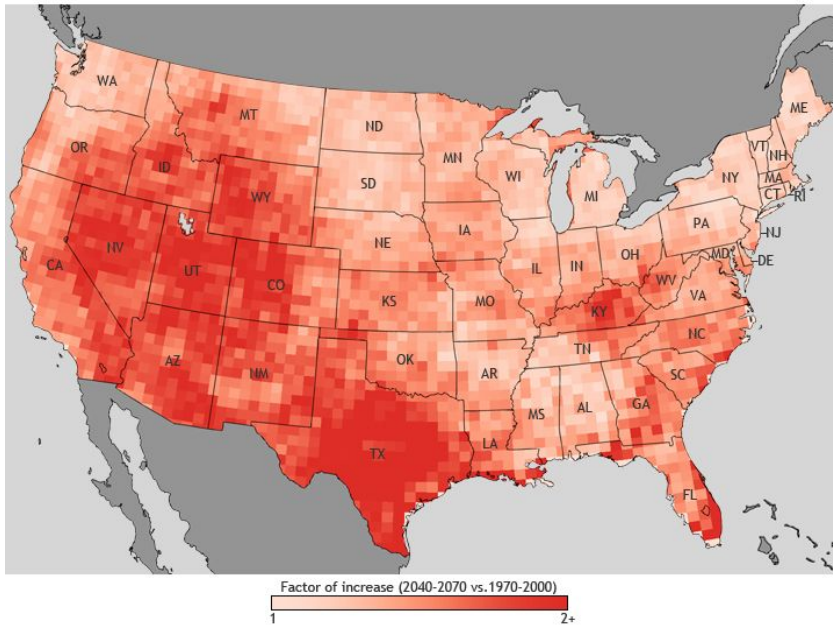


Woman cooling down with a fan.



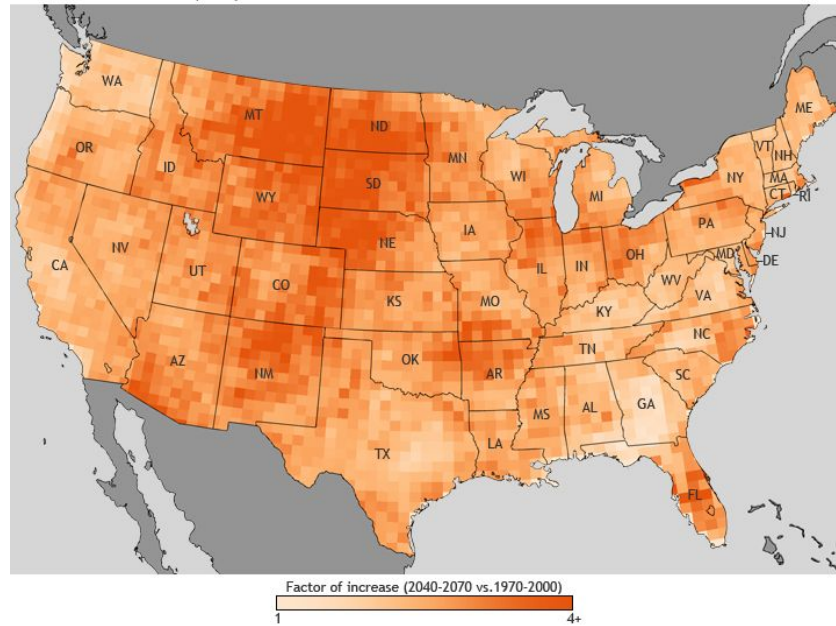
Rooftops painted white in New York City.

Increase in heatwave duration



Climate.gov map showing potential increases in heatwave duration in 2040-2070.

Increase in heatwave frequency



Climate.gov map showing potential increase in heatwave frequency in 2040-2070.

What technologies and design solutions exist to detect, warn, or reduce damage? Extreme Heat

Detect

- Satellites actively monitor and send data about temperature and precipitation changes all over the world.
- Meteorologists can use temperature and weather patterns from all over the world to forecast heat waves.
- Heat waves can be forecast about 10 days from when they will occur.
- If the heat wave comes from over an ocean, sometimes the heat wave can be forecasted as much as 6 weeks in advance.

Warn People

- Extreme heat advisories, watches, and warnings are broadcast over television and radio.
- Push notifications can also go out on cell phones and other devices.
- Weather apps also keep up-to-date information regarding the temperature for easy access by anyone with a device.

Reduce Damage

Using what we know about light and energy, we know dark surfaces will be warmer than lighter surfaces during an extreme heat event. Some cities are painting dark surfaces white to reduce the amount of energy transferred to the surface. Roads, train tracks, and roofs are some of the many things painted white to help cool cities and reduce temperatures.

What can people do to prepare for, respond during, and recover after this hazard? Extreme Heat

Prepare

- Establish cooling centers.
- Establish a 311 line, so those that need assistance can call in and receive the help they need.
- Plan for water stations for people to gain access to water.

What individuals can do to prepare:

- Know the location of local cooling centers, libraries, and other public places with air conditioning.
- Make sure fans, air conditioners, and other items that keep people cool are working properly.
- Plant trees to provide shade.
- Add lighter colored surfaces or grass to your outdoor area, if possible.
- Check that you have easy access to water.

Respond

- Wear light colors and loose fitting clothing.
- Spend time in air conditioning at home, the local library, cooling center, or mall.
- Take cool showers or baths.
- Try to keep out of the sun.
- Drink lots of water.
- Avoid drinks with caffeine, sugar, or any other beverages that can dehydrate a person.
- Eat cool foods such as salads.
- Avoid cooking heated meals.
- Monitor yourself for signs of heat-related illnesses.
- Avoid exercising.
- Monitor pets, kids, elderly, or other people in your area to make sure they are staying cool.
- Move any outdoor work that must happen to cooler parts of the day.
- Monitor your electricity use and only use what you need.

Recover

- After the hazard, take steps to cool yourself down and your location.
- Open up windows if the temperature has dropped and it is cooler outside than inside temperatures.

About Droughts

Droughts are long periods without water or access to water in an area. Droughts occur because of a lack of precipitation, groundwater, or other water sources in an area. There is no specific drought season. Many times droughts are part of heat waves, which dry out areas causing a water shortage. See extreme heat for more details. Droughts can happen anywhere in the United States, but areas of the Midwest, South, and Southwest are especially at risk for drought conditions.

Droughts can cover areas from the size of a county to an entire country. They can last from weeks to years depending on the size and location of the drought. If farming and ranching areas are without water for long periods of time, it can result in crop damage, loss of livestock, and loss of income for many farmers. This results in reduced access to food for people who live in the area and people who buy food produced there. Droughts can vary in how much they impact an area. If water resources are well maintained, the impact of a drought can be less dramatic. The most widely discussed drought in United States history is the Dust Bowl, which occurred in the 1930s and ruined millions of acres of farmland.

The United States Drought Monitor is a map released weekly that shows both the intensity and impact of drought conditions in the US. Drought intensity is measured on a scale from D0 (abnormally dry) to D4 (exceptional drought). Impact is described as either short-term or long-term.

Helpful Resources

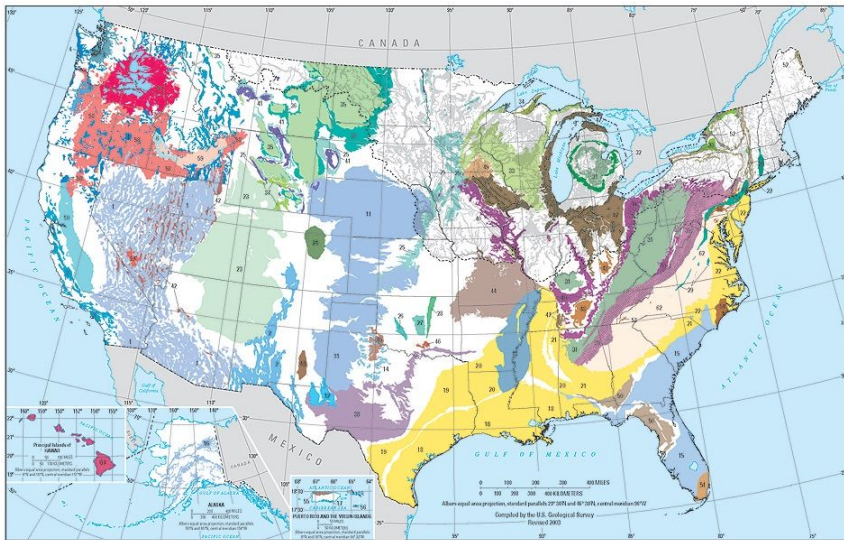
Ready.gov, Drought: <https://www.ready.gov/drought>
US Drought Monitor: <https://droughtmonitor.unl.edu/>



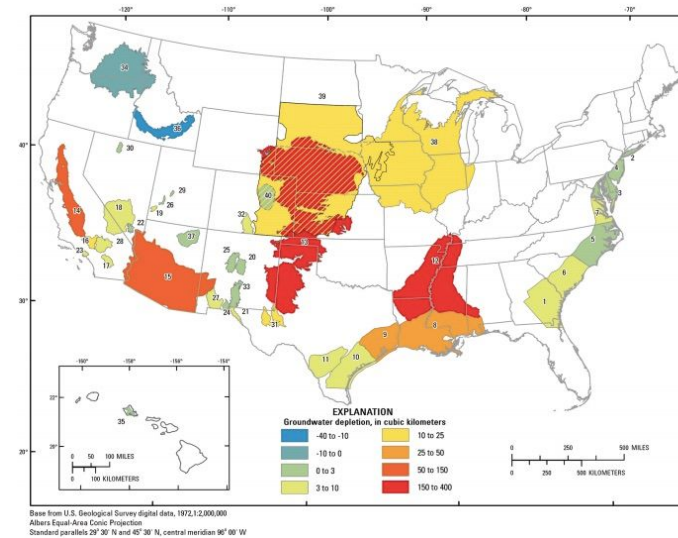
Cracked ground from lack of moisture.



Rain barrel on the side of a building.



Map of aquifers in the United States.



Map of aquifer depletion.

What technologies and design solutions exist to detect, warn, or reduce damage?

Detect

- The National Integrated Drought Information System (NIDIS) watches different areas for drought.
- The Drought Early Warning Systems (DEWS) is monitored to determine if a drought might happen.
- Seasonal drought and climate outlooks are published by climate scientists.
- Satellites monitor the amount of evaporation in an area, which can provide early warning signs of fast-occurring droughts.

Warn People

- People receive drought warnings through:
- Television and radio
 - Phone apps
 - Newspaper articles
 - Online articles
 - Weather alerts by weather radio

Reduce Damage

Aquifer storage: Water from the surface is stored in aquifers during a drought. This water can be used during and after a drought.

Plumbing: Check plumbing for breaks and leaks.

Conservation: Increase awareness and support for water conservation efforts.

What can people do to prepare for, respond during, and recover after this hazard?

Prepare

- Use native plants in your yard.
- Use a watering system for your plants or crops that requires less water, or wastes less water.
- Build a water storage system like a rain barrel.
- Store water in ditches along fields.
- Look at irrigation pipes and other areas for water leaks.
- Track water use.
- Monitor crop soil moisture.
- Raise animals that don't use as much water.
- Farm native crops.
- Cover pools and spas to reduce water loss.

Respond

What communities can do:

- Limit water use by charging higher prices after certain amounts are used.
- Use water trucks to bring water to needed areas.
- Provide water pickup areas for citizens if water is unavailable.

What you can do:

- Practice water conservation.
- Only flush your toilet when needed.
- Use a bucket to catch unused shower water to water plants.
- Only use the dishwasher when it is full.
- Heat water on the stove instead of letting it run to heat up.
- Go to car washes that recycle water.
- Allow lawns to die in extreme drought.
- Check on those at-risk to make sure they have access to drinking water.

Recover

- It can take a considerable amount of time to recover from a drought, with some areas never fully able to get water levels back to pre-drought levels.
- If you are a farmer or rancher, take stock of what the drought has done to finances, livestock, or crops.
- Determine areas that could have been potentially better managed, and create a plan to improve those areas.
- If any measures were used by the city or local government to reduce water usage, analyze the data to determine how effective those measures were.

About Flooding

When large amounts of water overflow onto land that is normally dry, it is called flooding. Flooding happens all over the United States and world, and it can happen at any time of the year.

Floods happen for several different reasons. Floods that are not near coasts are usually caused by weather events like heavy rain or melting snow, which causes rivers and creeks to overflow. Coastal flooding can be caused by these, too, but also storm surges from hurricanes and large ocean waves like tsunamis.

Flooding happens in every state and territory of the United States, but some areas and the people who live and work there, are more at risk for flooding. Areas at a lower elevation ("low-lying") and near a source of water like a creek, river, or lake, flood before higher ground. Some floods happen more slowly, and some floods happen more quickly. When water rises very quickly and people have very little time to respond, it is called a "flash flood."

Sometimes floods can be only a few inches of water on the ground, but in some places it can reach as high as the tops of roofs on houses. Flooding often damages homes and businesses, causes power outages, and disrupts transportation networks.

Flooding is the most common natural hazard in the United States, and often the costliest. Because all parts of the country are at risk of flooding, the federal and state governments, and local communities, have developed many solutions to prevent or reduce flood damage, and also protect people when it happens.

Depending on the conditions, different notifications can be issued at different times. Here are what some of the notifications mean:

- Flood watch: A flood watch means a flood may occur in an area. Monitor conditions and prepare to respond if a warning occurs.
- Flood warning: A flood warning means a flood will occur in the area and to respond appropriately.

Helpful Resources

Research your own flood risk using the National Flood Maps Service: <https://msc.fema.gov/portal/home>

CDC, Floods: <https://www.cdc.gov/disasters/floods/index.html>

Ready.gov, Floods: <https://www.ready.gov/floods>



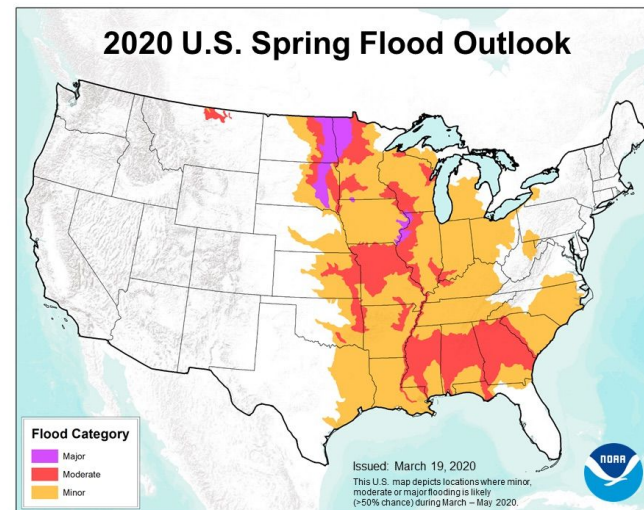
A dam holds back floodwaters.



Cars are submerged under flood waters.



A road was washed out by floodwaters.



An example of a flood map.

What technologies and design solutions exist to detect, warn, or reduce damage? Floods

Detect

- Rainfall amounts are constantly tracked.
- River levels are constantly tracked.
- Dams are inspected for weakness.
- Flood plains are monitored.
- Duration of potential storms that could cause flooding are monitored.
- River drainage basins are monitored for leaking or breakage.
- The soil moisture is monitored to see if the soil can absorb more rainfall or water.
- Ground temperature and snowpack are monitored.

Warn People

Flood alerts are issued in a number of ways:

- Weather radios
- Phone apps
- TV
- Radio
- Newspaper (if there is time)
- Local emergency management patrol areas to help alert and evacuate families, if necessary.

Reduce Damage

Dams and reservoirs: Dams can release water slowly so that downstream communities are flooded less.

Aquifer storage: If reservoirs are full when a flood happens, the reservoir water can be added to the aquifer and the new flood waters can go into reservoirs.

Wetlands: Wetlands slow the flow of floodwaters, let sediments settle, and also, microorganisms in wetlands can filter pollutants from the water.

Levees, berms, barriers: These can serve as a barrier to prevent floodwaters from entering an area and can divert water to specific areas.

What can people do to prepare for, respond during, and recover after this hazard? Floods

Prepare

- Check your flood risk (see resources.)
- Build an emergency kit.
- Have a family hazard plan.
- Move important items or documents to a high point or room.
- Place important documents into waterproof containers.
- Store pictures of important documents onto the cloud.
- Download the NOAA alert app for your phone.
- Clear the drains and gutters.
- Check your basement for leaking.
- Check your sump pump.
- Develop a plan for how pets and livestock will be cared for.

Respond

- Prepare to evacuate and confirm a safe location. Evacuate if needed.
- Check local warnings often.

Prepare your home for safety

- Boil water during a flood.
- Turn off propane tanks.
- Unplug appliances and turn off utilities if instructed to do so.

Avoid floodwaters

- Do not go through flooded areas.
- Do not go around barricades.
- If inside a building, go to its highest level. Only use the roof if absolutely necessary.

Recover

- Listen to directions from local authorities.
- Keep roads clear for emergency crews to respond to people.
- Stay out of the flood waters.
- Stay away from damaged electrical equipment.
- Wear gloves and boots to protect yourself from additional injury.
- Dispose of food that has been exposed to floodwater.
- Pump out basement water slowly to avoid a collapse in basement walls.
- Have all the sewer systems serviced.

About Earthquakes

An earthquake is a sudden shaking of the ground as seismic waves pass by an area. Seismic waves occur when tension along a plate boundary or fault builds up and then releases suddenly. These waves can sometimes occur with volcanic activity too. As seismic waves move outward, the areas further away from the epicenter experience less of the effects. There is no specific season for earthquakes. They can occur in places close to boundaries or faults, and at any time of the day or night. About 90% of earthquakes occur on plate boundaries. There are places in the world with more active plate movement, and these places tend to have more earthquake activity. Within the past 10 years, more earthquakes have been felt in states like Oklahoma where there is no large natural fault line. Some evidence shows this is now occurring because of fracking and other practices that interfere with material deeper in the Earth's outer layer.

How much shaking is felt as the result of an earthquake is called the intensity. The intensity of an earthquake depends on the location where the earthquake started, the features of the plate(s), and the magnitude of the earthquake. Also, as you move further away from the earthquake's epicenter, its intensity decreases. Earthquake magnitude is measured using the Richter scale and is based near the epicenter of the earthquake.

- Magnitude up to 2.9: These earthquakes are so small that they are rarely felt by people and cause no damage to buildings.
- Magnitude 3.0-3.9: These earthquakes can be felt by people and may shake indoor objects slightly.
- Magnitude 4.0-4.9: These earthquakes shake and rattle indoor objects and some objects may fall. Very little is felt outside.
- Magnitude 5.0-5.9: Everyone feels these earthquakes, and it can cause damage to buildings that are not well-built.
- Magnitude 6.0-6.9: These earthquakes have strong to violent shaking. Most buildings will be damaged, but buildings built for earthquakes will be only slightly damaged.
- Magnitude 7.0-7.9: These earthquakes cause damage to most buildings and some may collapse. These can be felt from far away.
- Magnitude 8.0-8.9: These earthquakes cause major damage to buildings, destroying most average buildings. These earthquakes can damage large areas.
- Magnitude 9.0 and above: These earthquakes cause total destruction of large regions. Heavy damage extends far and can be felt hundreds of miles away. This magnitude tends to occur only once every 10-50 years.

Earthquakes happen suddenly and cannot be predicted. Aftershocks are common and expected with most larger earthquakes. With larger earthquakes, several aftershocks can be expected within the first hour, and earthquakes of decreasing magnitude can last for days after the large earthquake.

Helpful Resources

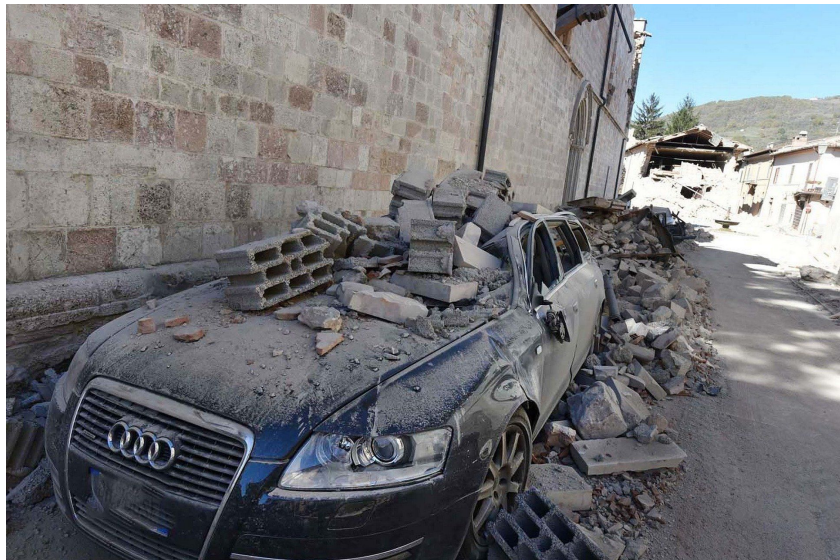
CDC, Earthquakes: <https://www.cdc.gov/disasters/earthquakes/index.html>

Ready.gov, Earthquakes: <https://www.ready.gov/earthquakes>

Earthquake Drills: <https://www.shakeout.org/dropcoverholdon/>



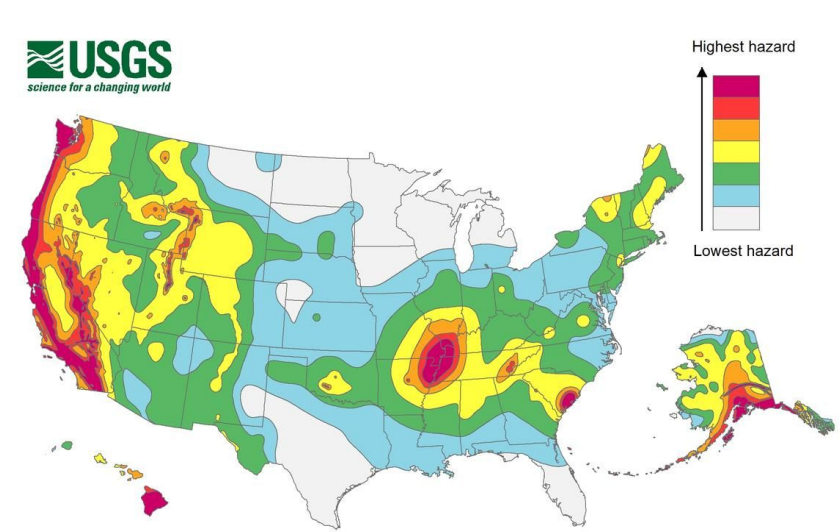
Damaged buildings from an earthquake.



Car damaged from an earthquake.



Students participating in an earthquake drill.



USA earthquake risk map.

What technologies and design solutions exist to detect, warn, or reduce damage?

Detect

Shakealert: Warning systems exist all over the world. The USGS has an early warning system called ShakeAlert. This system works by monitoring ground movement in different locations. The data is sent to monitoring stations and warnings are sent out as quickly as possible.

Smartphone Apps: Certain smartphone apps can detect earthquake movement while an earthquake is happening. If an earthquake happens and this app is on a large group of user's phones, it can be used to sense the movement of the people and alert others farther away, potentially giving them time to get to safety.

Warn People

Since earthquakes grow in size in the first few seconds, a short period of warning can sometimes be given. Sensors can provide a couple of seconds warning to ten seconds warning before the ground starts shaking in certain areas.

Shakealert: ShakeAlert sends out warnings to computers and cell phones that include the expected magnitude and time before the earthquake begins in your location.

Sirens: Cities that normally experience earthquakes may have sirens to warn citizens of a coming earthquake.

Reduce Damage

Since earthquakes happen suddenly and without warning, not much can be done in the moment to protect against these hazards. Preparation is important to protect against earthquakes. See the "How can people prepare" section of this sheet.

What can people do to prepare for, respond during, and recover after this hazard?

Prepare

- Practice drop, cover, and hold on.
- Fix structural issues in your house.
- Consider adding earthquake insurance.
- Pack a disaster kit and make a meetup plan for after a disaster with your family.
- Find a friend or family member out of state that can check in during an emergency.
- Store heavy or large objects near ground.
- Secure items that are on walls.
- Avoid placing pictures or mirrors near where someone sleeps or sits.
- Secure flammable products in a closed cabinet close to the floor.
- Check gas and water lines.
- Secure water heater.

Respond

If in your home or another building:

- Drop, cover, and hold on.
- Don't remain in a doorway.
- Move away from heavy or large objects that can fall.

If in a car:

- Pull over to a clear location.
- Keep your seatbelt on.
- Watch for any falling rocks or debris.
- Avoid bridges, elevated roads, and powerlines.
- If a powerline falls on your vehicle, DO NOT get out.

If outside:

- Find a clear spot on the ground and protect your head and neck.
- Get as far away from buildings and tall or heavy objects.

Recover

- Expect aftershocks to occur.
- Avoid driving on any potentially damaged or elevated roads.
- Get to a safe location and contact family and friends by text as phone service may be interrupted.
- Move away from damaged buildings.
- If you are trapped, make noise for others to hear. Protect your nose, eyes, and mouth from any debris.
- Pay attention to any instructions given by any authorities.