

Coastal Flooding, Climate Change, and Your Health

What You Can Do to Prepare



Coastal flooding in the United States is already occurring and the risk of flooding is expected to grow in most coastal regions, in part due to climate change. The Centers for Disease Control and Prevention (CDC) developed this booklet to identify steps that you can take now to prepare for the health risks associated with coastal flooding—and to help your families, friends, and neighbors, too. This booklet answers some of the key questions about coastal flooding in a changing climate: why these events are on the rise; how it might affect your health; and what you can do before, during, and after a coastal flooding event to stay safe. Scientific information used in this document is derived from peer-reviewed synthesis and assessment products, including those published by the United States Global Change Research Program and the Intergovernmental Panel on Climate Change, as well as other peer-reviewed sources and federal agency resources.

For more information, contact CDC at climateandhealth@cdc.gov.

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What is Coastal Flooding?

A flood is a general and temporary inundation of normally dry land areas. When a coastal process—such as waves, tides, storm surge, or heavy rainfall from coastal storms—produces that flood, it is called a coastal flood. Coastal areas, like all areas, can also flood from high rainfall or overflowing streams.

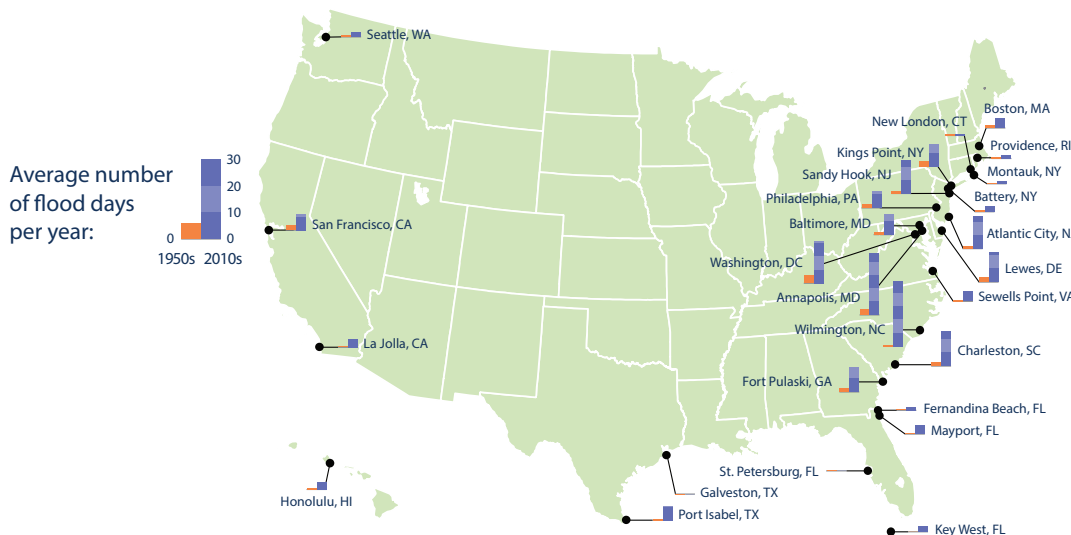
Coastal areas can experience various kinds of flooding. One type is nuisance or tidal flooding, which typically occurs during extremely high tides, causing seawater to spill onto land and inundate low-lying areas until the tide recedes.¹ Other types include moderate and major floods that can be caused by heavy rains, storm surges, and high waves that occur during coastal storms.

People living in coastal areas, which are home to roughly half of the nation's population², are at risk of health impacts from increased coastal flooding. Climate change will increase people's exposure to coastal flooding, which can lead to drowning, injuries, diarrhea or stomach illnesses associated with contaminated water, and mental health consequences. (See section on How Can Coastal Flooding Affect Me? for more information on health impacts.)

How Often Does Coastal Flooding Occur?

The map below shows the number of nuisance flooding events and the less frequent moderate and major floods that occurred in the 1950s as compared to the 2010s. Since the 1950s, almost all of the sites shown in the map have had increases in the number of days per year with floods.³

Frequency of Flooding Along U.S. Coasts, 2010-2015 Versus 1950-1959



Source: U.S. EPA (U.S. Environmental Protection Agency). 2016. Climate change indicators in the United States. <https://www.epa.gov/climate-indicators/climate-change-indicators-coastal-flooding>.

Flooding can occur on a sunny day. Even on days when it isn't raining or stormy, higher than average high tides can cause seawater to spill onto land and cause nuisance flooding.⁴



The local Weather Forecasting Offices of NOAA's National Weather Service determine nuisance flooding thresholds based on local conditions (such as elevation) for several coastal city locations in the U.S. For example, in Boston, the nuisance flood level is 0.68 meters above the daily average highest tide. In Honolulu, the nuisance flood level is 0.22 meters above the daily average highest tide.⁵



Nuisance Flooding During a Spring High Tide in Maryland



Source: Wanda Diane Cole, NOAA. <https://www.climate.gov/news-features/understanding-climate/understanding-climate-billy-sweet-and-john-marra-explain>

Extreme flooding caused by storm conditions



Source: NOAA. <http://www.nssl.noaa.gov/projects/>

National Weather Service Coastal Flood Advisory, Warning, and Watch Definitions

A **Coastal Flood Advisory** is issued when minor or nuisance coastal flooding is occurring or imminent. A **Coastal Flood Watch** is issued when moderate to major coastal flooding is possible. Such flooding would potentially pose a serious risk to life and property. A **Coastal Flood Warning** is issued when moderate to major coastal flooding is occurring or imminent. This flooding will pose a serious risk to life and property.⁶





Why is Coastal Flooding on the Rise?

The risk of coastal flooding is growing in most coastal regions in the U.S. and is expected to continue to grow. Many factors influence coastal flooding, such as development along the coast. Another factor is climate change. Rising temperatures from climate change are contributing to increases in sea level, severe storms and storm surges, and changes in precipitation patterns (see more below). These changes are increasing the number of coastal floods, worsening their effects, and causing floods to last longer and extend further inland.⁷ All of these changes increase health risks associated with coastal flooding.⁸

Sea Level Rise

Sea level rise in any amount will increase the frequency and duration of coastal flooding. Rising global temperatures from climate change are leading to sea level rise in two primary ways: (1) by warming and expanding ocean waters and (2) by melting glaciers and ice sheets on land. Since 1880, global mean sea level has risen eight to nine inches with about three of those inches occurring since 1993. By 2100, sea level is expected to rise another 12 to 60 inches, depending on the future rise in global temperature, although a sea level rise of up to 100 inches cannot be ruled out.⁹

The amount of sea level rise that is occurring varies in different parts of the coast based on many factors. For example, land in some coastal areas is rising or sinking due to sediment accumulation or erosion, removal of underground resources like groundwater and fossil fuels, and geologic changes. Where land is sinking, the relative rate of sea level rise will be higher than average. In the United States, many locations in the Southeast, like New Orleans and Miami, are experiencing particularly fast rates of sea level rise due to sinking land, which increases the risk of coastal flooding.¹⁰

What Is Climate Change?

Although there is a relationship between weather and climate, they are not the same. Weather is a specific event or condition that happens over a period of hours or days. For example, a thunderstorm, a snowstorm, and today's temperature all describe the weather. Climate refers to the average weather conditions in a certain place over many years (usually at least 30 years).

Climate change is a pattern of change in average weather over many years, such as warming temperatures. A rise in the average global temperature has led to other changes around the world—in the atmosphere, on the land, in the oceans—such as changing rain and snow patterns, more extreme weather events, melting glaciers, and warmer seas.

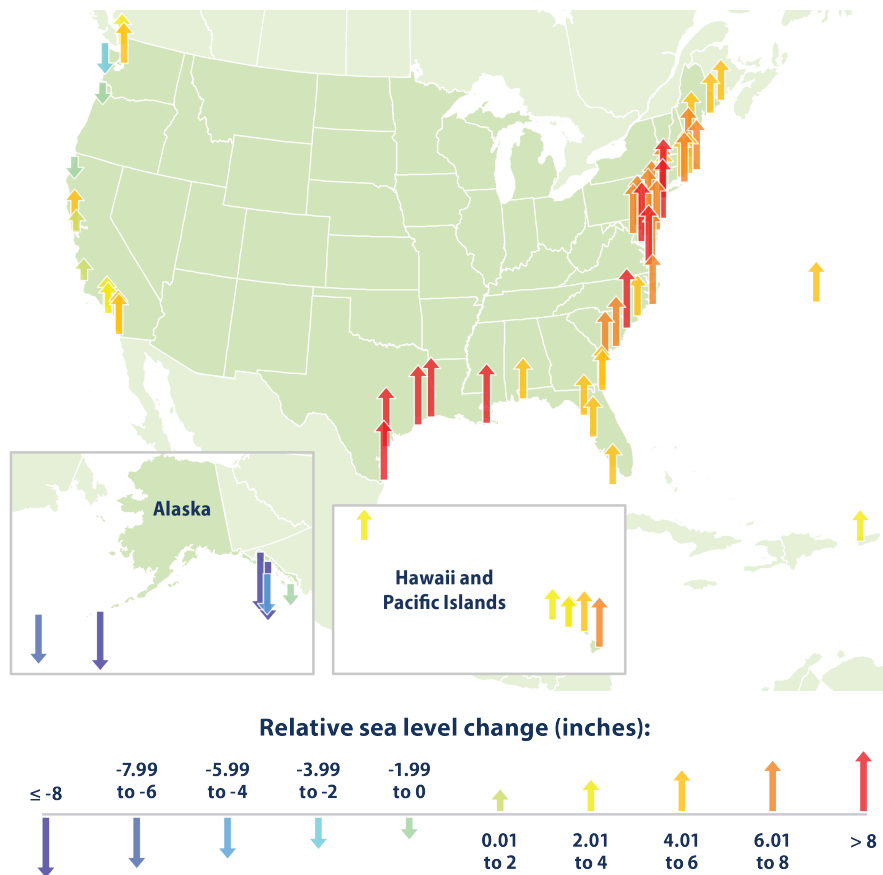
What Is Sea Level Rise?

Sea level is an average level of the surface of the ocean from a standard reference point. Relative sea level is the height of the ocean relative to the land at a particular location. Absolute sea level is the height of the ocean above the center of the earth.¹¹ Sea level is measured using tide stations and satellites. Although sea level changes vary by location, sea level rise is the overall average global rise in the level of the ocean surface.

More than 90% of the increased atmospheric heat associated with human emissions is absorbed by the ocean, which expands as it warms and leads to higher sea levels.¹²



Relative Sea Level Change Along U.S. Coasts, 1960–2015



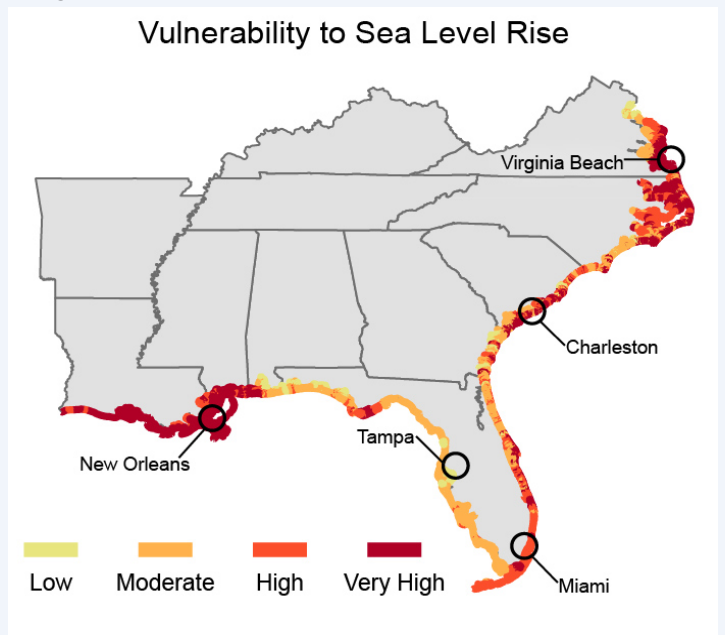
Source: NOAA (National Oceanic and Atmospheric Administration). 2015 update to data originally published in: NOAA. 2009. Seal level variations of the United States 1854-2006. NOAA Technical Report NOS CO-OPS 053. http://www.tidesandcurrents.noaa.gov/publications/Tech_rpt_53.pdf. For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climatechange/indicators.

Why is the Atlantic Coast Especially Vulnerable to Sea Level Rise?

The land along the Atlantic coast of the United States is flat and close to sea level. Much of the land in this area is sinking. During the last ice age, about 20,000 years ago, ice sheets covered much of what is now Canada and the northern United States. When these thick sheets of ice weighed down the underlying land in the north, they caused the land further south to rise. Although the ice sheets melted a long time ago, the land is still slowly adjusting to the removal of their weight, causing the land in northern areas to rise, and land further south, particularly in the Mid-Atlantic region from New York to North Carolina, to sink. This process worsens the effect of sea level rise along the Mid-Atlantic coast.¹³

Vulnerability to sea level rise

Many areas along the Southeast coast are vulnerable to sea level rise. The Coastal Vulnerability Index (from low to very high) is based on tidal range, wave height, coastal slope, shoreline change, landform and processes, and historical rate of relative sea level rise.¹⁴



Increases in Severe Storms and Storm Surges

Coastal storms and storm surge can contribute to increased frequency and severity of coastal flooding.

A **coastal storm** is a storm at sea that is directing stronger than normal winds or waves toward the shoreline. Tropical storms and hurricanes, or a low pressure system called a “nor’easter,” are examples of coastal storms. Scientists predict that as global temperatures warm, coastal storms will become more intense, with higher wind speeds and heavier rains over the course of the 21st century.¹⁵

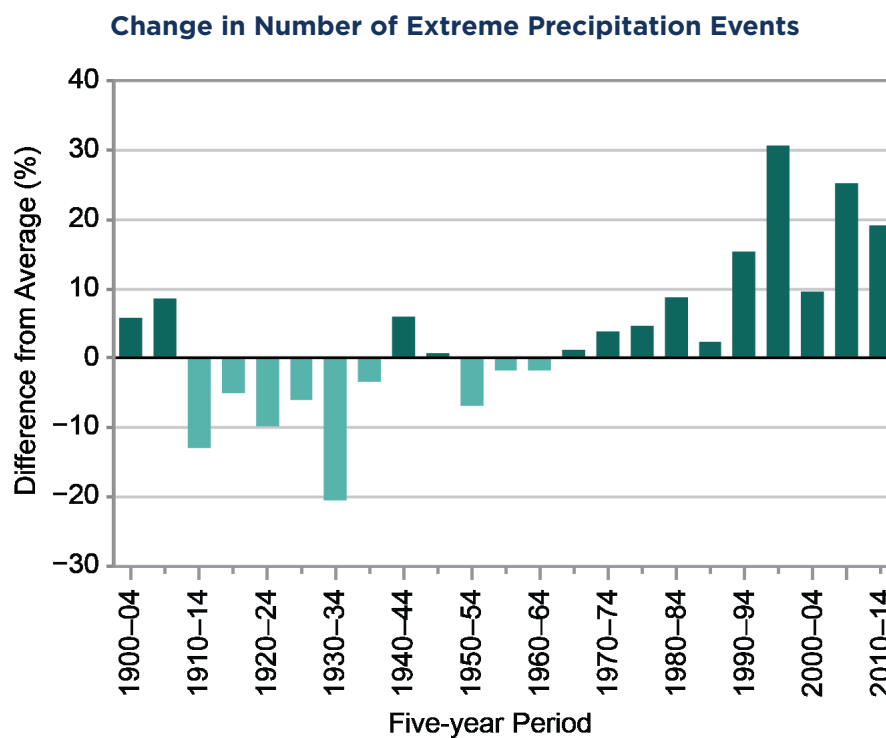
Storm surge is an abnormal rise in the water that is over and above the regular tide level. Storm surges are caused by wind, waves, and low atmospheric pressure from severe storms, such as hurricanes. Storm surges can be particularly damaging when they occur at the same time as the daily high tide.¹⁶

Changes in Precipitation Patterns

Higher temperatures at the Earth’s surface result in increased evaporation and greater overall precipitation. Increased amounts of precipitation, although generally associated with inland flooding, can also increase the risk of coastal flooding.

However, more evaporation will not necessarily lead to more precipitation everywhere. Although warming occurs everywhere, precipitation patterns are variable across the U.S. Wet areas may become wetter, dry areas may become drier, and some areas may experience the same amount of total rainfall, but in one or two extremely heavy precipitation events.¹⁷

These heavy precipitation events are already occurring more often in the U.S. due to our warming climate.¹⁸ The figure below shows how the annual number of heavy downpours, defined as extreme two-day precipitation events, for the contiguous United States has increased – particularly between the 1950s and the 2000s.



Source: USGCRP (U.S. Global Change Research Program). 2016. The impacts of climate change on human health in the United States: A scientific assessment. Chapter 1 Introduction: Climate Change and Human Health. P. 27. (<http://dx.doi.org/10.7930/JOVX0DFW>)



What Might I Experience in the Future?

Coastal flooding occurs in many forms, from small but inconvenient nuisance flooding to major flooding events. Nuisance, moderate, and major floods are already increasing in number and severity, meaning people are exposed to more health threats more often. Scientists expect coastal floods to continue to increase in the future as the sea level rises.

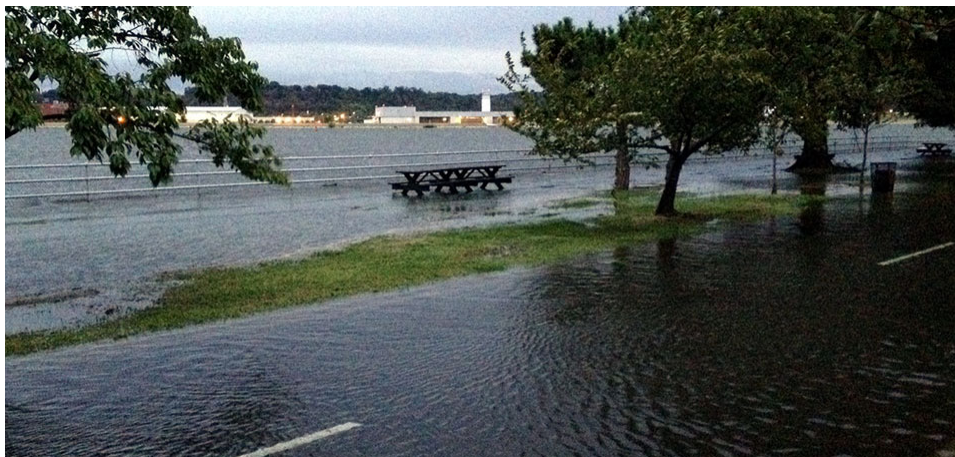
Nuisance Floods

Nuisance floods are recurring, minor floods that happen when water levels exceed local thresholds defined by the National Oceanic and Atmospheric Administration (NOAA) – generally about 1.5 feet above the historical average daily high water maximum.¹⁹ In the mid-20th century, nuisance floods occurred once every couple of years during storm events. However, due to sea level rise, land subsidence (sinking), and loss of natural buffers such as wetlands, nuisance floods have increased in frequency and now occur several times per year.²⁰ With higher sea levels, coastal areas can even experience nuisance flooding when high tides cause seawater to spill onto land and inundate low-lying areas.²¹

Nuisance floods do not usually cause severe property damage, but can lead to degraded storm and wastewater systems, contamination of fresh water supplies, and disruptions to business. These impacts represent a growing problem for many cities, putting citizens at risk more often.

Scientists project that, in the future, sea level rise will make nuisance floods worse and reduce the time between floods. In other words, today's flood will become tomorrow's high tide, as sea level rise will cause coastal flooding to occur more frequently and for longer durations of time. Nuisance flooding is expected to increase the most along the East and Gulf Coasts.²²

Nuisance Flooding During a High Tide: An Extreme High Tide Caused Coastal Nuisance Flooding Conditions at Hains Point in Washington, D.C.



Source: <https://oceanservice.noaa.gov/facts/nuisance-flooding.html>

Moderate and Major Floods

Heavy rains, storm surges, and high waves that occur during coastal storms can cause moderate to extreme flooding and potentially tremendous damage, particularly if a storm coincides with a normal daily high tide. Storm-related coastal flooding can be especially dangerous because it can flood large areas of the coast. As the sea level rises, any given storm surge will be more damaging.

In the future, continuing sea level rise is projected to cause storm surges to be eight to nine inches higher than they would have been in 1880. By 2100, storm surges will occur on top of an additional 12 to 60 inches of sea level rise, depending on the future rise in global temperature and the response of the ice sheets to warming, although a sea level rise of up to 100 inches cannot be ruled out. In addition to sea level changes, changes in storm severity, frequency, and precipitation will change future flood probabilities.²³

New Orleans after Hurricane Katrina



Source: <https://toolkit.climate.gov/topics/coastal-flood-risk>.

Storm Surge from Hurricane Dennis (2005) near Panacea, Florida



Source: <https://soundwaves.usgs.gov/2005/09/fieldwork3.html>

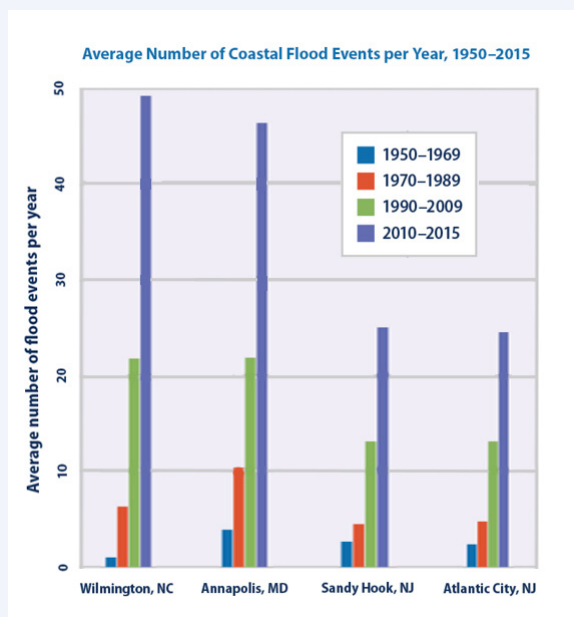


Source: <http://oceanservice.noaa.gov/facts/coastalthreat.html>

Which Cities are Facing the Biggest Increase in Coastal Flooding?

Some of the most dramatic overall increases in flooding frequency over the last half century have occurred on the Mid-Atlantic Coast, in Wilmington, North Carolina; Annapolis, Maryland; and Sandy Hook and Atlantic City, New Jersey. Floods are now at least 10 times more common in these areas than they were in the 1950s.²⁴ For example, Wilmington experienced an average of 49 flood days per year during the five-year period of 2010 to 2015 as compared to an average of 1 flood day per year during the 20-year period of 1950 to 1969. Other areas with large increases in nuisance flooding include Texas and California.

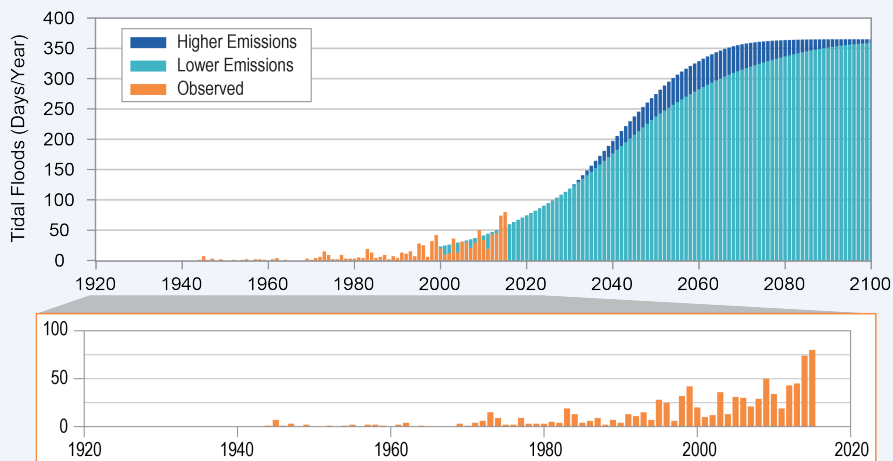
Cities with Most Dramatic Increases in Coastal Flooding



Source: Adapted from U.S. EPA (U.S. Environmental Protection Agency). 2016. Climate change indicators in the United States. <https://www.epa.gov/climate-indicators/climate-change-indicators-coastal-flooding>.

This graphic provides more detailed flood data for Wilmington, NC, showing the increase in floods over time. The number of observed tidal flood days per year is shown as orange bars. Projections are also shown for two possible futures: lower emissions (light blue) and higher emissions (dark blue).

Observed and Projected Annual Number of Tidal Floods for Wilmington, NC



Source: <https://statesummaries.ncics.org/sites/default/files/downloads/NC-screen-hi.pdf>

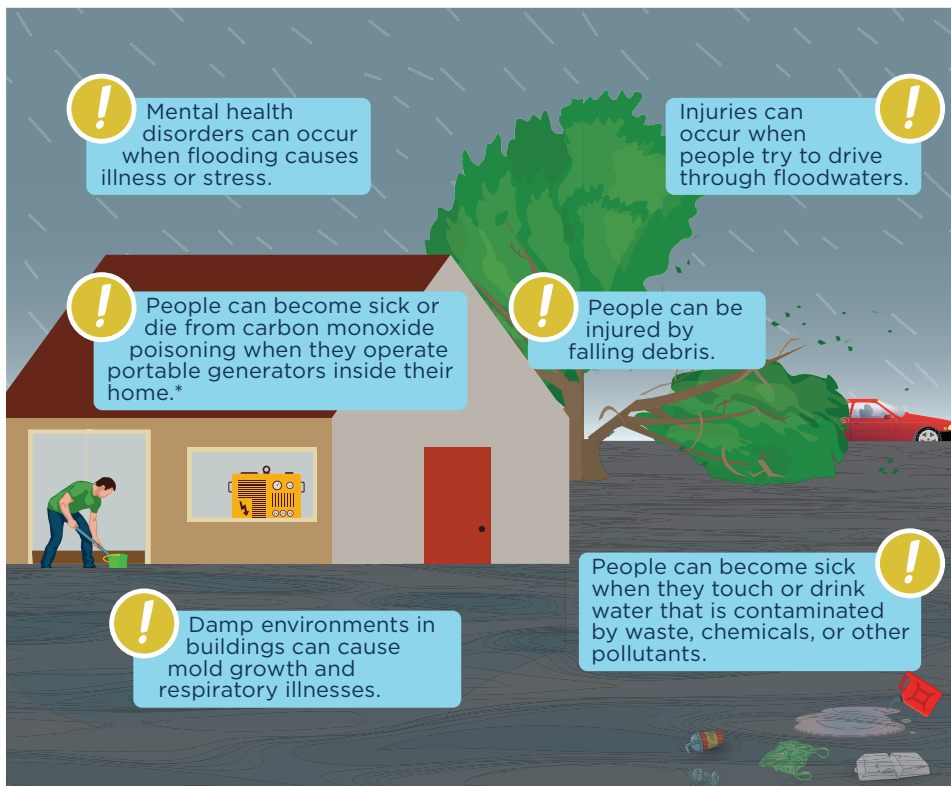


How Can Coastal Flooding Affect Me?

Any type of coastal flood can cause injuries, illness, and fatalities both during and after the flood.²⁵ It is important to understand these health threats so that you can prepare for a coastal flood and reduce your risks.

Hurricanes and other tropical storms present significant risks for people who live along the Atlantic coast. Drowning in floodwaters was the leading cause of death (estimated 2,544 persons) among people directly exposed to hazards associated with hurricanes and coastal storms from 1963 to 2012. Most of the deaths associated with tropical cyclones occurred as a result of storm surges and rainfall-induced flooding. Others died from drowning in rip currents, large waves, or boating incidents, or from being hit by falling trees, debris, and other objects during high winds and tornadoes.²⁶

Coastal Flooding is Increasing Exposure to Health Risks



* Only use generators outside, more than 20 feet away from your home, doors, and windows.

Adapted from: Melillo, J.M., T.C. Richmond, and G.W. Yohe (eds.). 2014. Climate change impacts in the United States: The third National Climate Assessment. U.S. Global Change Research Program. <http://nca2014.globalchange.gov/report/sectors/human-health#graphic-16653>.

Fatalities from Hurricane Katrina

Hurricane Katrina was responsible for almost half of the hurricane-related deaths over the past 50 years, with the majority of deaths directly related to the storm in Louisiana. An estimated 971 to 1,300 people perished due to drowning or flood-related physical trauma due to the failure of the levees in New Orleans.



What are the health risks of coastal flooding?²⁷

During a flood:

- Most deaths that occur during coastal floods are due to drowning in floodwaters.
- Fatal and non-fatal injuries often include blunt trauma from the impact of falling debris and building collapses, and falls when walking on slippery surfaces or through floodwater. Other non-life threatening injuries include cuts, sprains, and strains.
- Motor vehicle related-injuries can occur when people attempt to drive through floodwaters and lose control of their vehicles or become stranded.
- If electrical equipment comes into contact with floodwater, people who are exposed to the water are at risk of electrocution.
- Hypothermia is a potential concern for people, especially children, who become trapped in floodwaters.
- Exposure to floodwaters or drinking water that is contaminated with pathogens or harmful chemicals can cause gastrointestinal issues; wound infections; and ear, nose, and throat infections. People are more likely to be exposed to contaminated drinking water if local water infrastructure is flooded.
- Carbon monoxide poisoning can occur when floods cause power outages, and people resort to using portable generators or cooking and heating appliances in their home.

After a flood:

- Increased instances of waterborne disease outbreaks can occur if floodwaters become contaminated with agricultural waste, raw sewage, chemicals, or other pollutants.
- Mold can grow in buildings that were inundated by flood water. This mold growth creates indoor air quality problems if not properly treated before occupants return to their building.
- People living in damp indoor environments can be prone to more episodes of asthma, rhinitis cough, wheeze, and respiratory infections.
- Mental health and stress-related disorders can occur, including depression, anxiety, post-traumatic stress disorder (PTSD), or behavioral changes like increased aggression. These health impacts are especially prevalent when extreme events – such as severe coastal storms and flooding – lead to physical injury or illness, require evacuation or dislocation, or cause economic hardship and stress.

The Mental Health Impacts of Hurricane Sandy

Research showed that New York residents affected by Hurricane Sandy were at an increased risk of depression, anxiety, and PTSD in the years following the storm. While most people who are exposed to a traumatic event, like a flood, can be expected to recover over time, some individuals develop chronic conditions, particularly when faced with recurring disasters.³⁹

The National Oceanic and Atmospheric Administration's (NOAA's) Storm Events Database houses information on the occurrence of storms that cause loss of life, injury, and significant property damage. Its data show that 1,079 people in the U.S. and its territories lost their lives from coastal flooding and storm surge between 2000 and 2016.

You can find information for your state or area at www.ncdc.noaa.gov/stormevents/





Who is Most at Risk from Coastal Flooding?

Coastal floods can affect everyone living on or near the coast. However, three key factors put some people at a higher risk than others:²⁸

- **Exposure:** Some people, particularly those who live in flood-prone zones (also called floodplains) are more exposed to damaging coastal floods than others. People who work as first responders, emergency workers, and other outdoor occupations are also at higher risk during coastal storms and floods. For example, storm-related fatalities are associated with cleanup activities, post-storm construction, public utilities restoration, and security and policing jobs. Also, after disasters first responders tend to experience increased mental health disorders such as anxiety and depression.
- **Sensitivity:** Persons with disabilities, compromised immune systems, and existing illnesses are at an increased risk, especially if they are dependent on frequent medical treatments or drug prescriptions that they might have difficulty accessing during or after a flood. Pregnant women and newborns are also especially vulnerable to coastal floods. After Hurricane Katrina, flood exposure was associated with preterm births and low birth weight.
- **Ability to prepare and respond:** Some people are less able to prepare for coastal floods or respond to flood events than others. Those with limited incomes, especially if they are unemployed or uninsured, are at a higher risk. Minority communities of color and low-income groups can be particularly at-risk to illness, injury, and mortality when a flood occurs. For example, the black adult mortality rate from Katrina was 1.7 to 4 times higher than that of whites. These communities are more at risk because they are more likely to live in flood-prone areas and areas with older infrastructure, and to have limited access to transportation. Furthermore, low-income populations are generally less able to evacuate in response to a disaster warning.

The Federal Emergency Management Agency (FEMA)



develops flood maps that show the risk of floods in various coastal areas. In high-risk areas, there is at least a 1 in 4 chance of flooding during a 30-year period. You can check to see the risk level of your area at <http://msc.fema.gov/portal>.



Coastal Flooding: Who's at Risk?

Persons with disabilities, compromised immune systems, and existing illnesses

Minority communities and low income groups, especially unemployed or uninsured people

People who work as first responders and emergency workers

People who live in floodplains

People who work in outdoor occupations

Pregnant women and newborns





What Can I do to Prepare for a Flood?

Coastal flooding is on the rise, but there are many things you can do now to prepare your family and home for a future flood. These preparations will lessen your risk of becoming injured or ill if a flood occurs. They will also help reduce the risk of flood waters damaging your home and requiring costly repairs. Here are some ideas.

Make an emergency plan that covers topics such as:²⁹

- How will my family get emergency alerts and warnings?
- How will my family get to safe locations during an emergency? Remember you'll need to know how to reach higher ground quickly and on foot, since driving might be dangerous.
- How will my family get in touch if our cell phone, internet, or landline doesn't work?
- How will I let loved ones know I am safe?
- How will my family get to a meeting place after the emergency?
- What will I do with my pets during a flood?

Create an emergency preparedness kit (see the next page for details)



Volunteers prepping sandbags ahead of expected flooding along the Chariton River in Iowa. (photo credit: FEMA)

Source: <http://www.floodsafety.noaa.gov/before.shtml>

Be prepared at home:³⁰

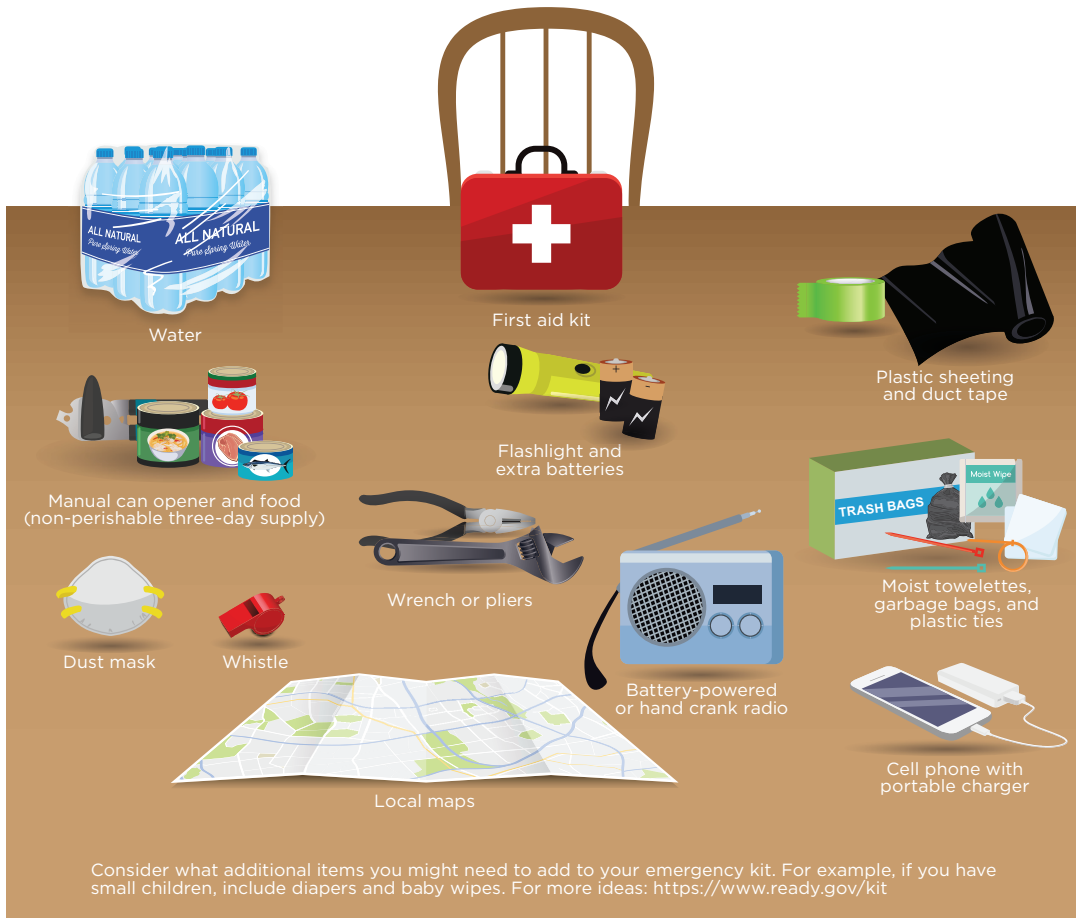
- Determine if your home is in a current floodplain by consulting the FEMA Flood Map Service Center <https://msc.fema.gov>
- Research flood insurance options. You can find more information about flood insurance on the National Flood Insurance Program's website: <https://www.fema.gov/national-flood-insurance-program>. Most standard homeowners insurance does not cover flooding. If you decide to purchase flood insurance, ensure that you are covered by buying it before there is even a threat of flooding. Policies can take at least 30 days to go into effect.
- Create a home inventory that documents your belongings in case you need to submit a flood insurance claim.
- Ensure that your sump pump is properly functioning and consider having a backup.
- Clearly mark your circuit breakers or fuses to indicate which area of your home they serve.
- Determine if you need to flood proof your home. Possible actions include installing flood damage-resistant flooring, installing a drainage system, applying sealants to outside walls, and installing flood barriers that can be placed temporarily over doorways and windows when flood warnings are issued.
- If you plan to buy or rent a new home, learn about and comply with your community's flood control requirements. If possible, move to a home that is safe from sea level rise and coastal flooding. If moving to a home where flooding could occur, investigate its flood protection features – is it elevated above the 500-year flood elevation? Was it built using flood damage-resistant materials? Is it protected by community floodwalls or levees?

Be prepared in your community:^{31, 32}

- Ask your local officials about your community's coastal flood plan. Is there a plan and if so, what does it contain? How will you receive flood watch and flood warning notices? Is there a community shelter you can move to if necessary? Are there emergency contact numbers you can call before, during, and after a flood? Are there opportunities for you to participate in preparedness education and training?
- Check with your children's school or day care center and with your workplace to learn about their flood and evacuation plans. Get involved with your employer or children's school to help develop or revise their flood plan.
- Participate in opportunities to support your local government as it develops measures to protect the community from coastal flooding. These actions could include flood control plans; open space acquisition, reuse, and preservation plans for flood-prone areas; and establishing standards for buildings located in areas susceptible to storm surge, coastal inundation, flooding, and erosion.

Create an Emergency Preparedness Kit

Consider what additional items you might need to add to your emergency kit. For example, if you have small children, include diapers and baby wipes. For more ideas: <https://www.ready.gov/kit>.^{33, 34}



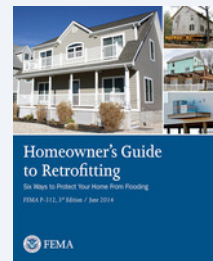
Want to Learn More?

Check out the additional resources in the sidebar.

The **Build an Emergency Supply Kit** website provides in-depth information on how to prepare for coastal flooding. <https://www.ready.gov/build-a-kit>



The **Homeowner's Guide to Retrofitting** presents information on how to protect your home from flooding. <https://www.fema.gov/media-library/assets/documents/480>



The **NOAA Weather Radio All Hazards (NWR)** is a nationwide network of radio stations that broadcast continuous weather information directly from the nearest National Weather Service office. Radios with these logos will receive National Weather service warnings, watches, forecasts, and other hazard information for your local area. <http://www.nws.noaa.gov/nwr/index.php>





How Can I Stay Safe During a Flood?

Do

During a flood watch:³⁵

- Monitor TV, radio stations, or phone alerts for the latest weather updates and emergency information.
- Review your emergency plan, and be ready to act quickly if needed.
- Bring outdoor furniture inside and move important household items to the highest floor to protect them from floodwaters.
- If you have time, lay out sandbags or other materials to help block flood waters from entering your property or home.
- If instructed, turn off your gas and electricity at the main switch or valve. This helps prevent fires and explosions.

During a flood warning:³⁶

- Listen for updates from local authorities. If directed by authorities to evacuate, follow their instructions.
- Move to higher ground if you are not already there.
- If you are driving and become trapped in floodwater, abandon the car and move to higher ground only if the surrounding water is not moving. If the water is moving, do not leave the car.

Don't³⁷

- Drive near or through flood waters. A vehicle can be swept away by flood waters in seconds. Twelve inches of water can float a car or small SUV, and 18 inches of water can carry away large vehicles.
- Walk near or through flood waters. It takes only six inches of water to knock you off your feet.
- Leave your home unlocked, if you are instructed to evacuate.
- Enter a room if water covers the electrical outlets or cords are submerged. You could be in danger of electrocution.
- Touch electrical items if you are wet or standing in water.
- Drive at night, if possible. When it is dark outside, it is harder to see possible flood dangers.

What's the difference between a flood watch and a flood warning? A

flood watch means you should be aware that conditions are right for flooding to occur in your area. A **flood warning** means that you should take action; your area is flooding or it will flood soon.





Flood waters rush around a house in Long Island, New York. (photo credit: USGS).

Source: <http://www.floodsafety.noaa.gov/during.shtml>



Source: <http://www.nws.noaa.gov/os/water/tadd/>



How Can I Stay Safe After a Flood?

After the storm is over and flooding starts to subside, protect yourself and your family in the following ways:³⁸

- Be careful if you walk and drive in flooded areas, even after the flood waters recede. Floods often erode sidewalks and roads.
- If you evacuated during a flood, return to your home only when authorities say it is safe.
- Stay tuned to local news for information on road conditions.
- Ensure that water is safe to touch, drink, cook, or clean with after a flood. It may contain toxins, chemicals, or sharp debris. If you use well water, contact your local or state health department for help evaluating whether your well has been contaminated.
- Do not use a portable generator inside your home or garage. It can cause carbon monoxide poisoning.
- Exercise caution when turning power on or off. Contact an electrician if you have any concerns.
- Take care when reentering your home. You may encounter mold that grew from the damp conditions inside.
- Avoid flood disaster areas. Your presence may hamper emergency rescue operations.
- Practice good hygiene after contacting flood waters. Do not let children play in flood water or with toys that were contaminated by flood water. Clean and cover any open wounds with a waterproof bandage.
- Contact your insurance agent as soon as possible to discuss any damages to your property.



Source: <http://www.floodsafety.noaa.gov/after.shtml>

Protect Yourself After a Flood...

1 Are you outdoors in a flooded area?

- Avoid flood disaster areas; your presence may hamper emergency rescue operations.
- Be careful walking and driving in flooded areas even after the flood water recede; floods can erode sidewalks and roads.

2 Are you driving?

- Stay tuned to local news for information on road conditions.
- Do not drive through moving flood water.

3 Was your home flooded?

- Take care when reentering your home. You may encounter mold that grew from the damp conditions inside.
- If you were evacuated, return to your home only when authorities say it is safe.
- Contact your insurance agent as soon as possible to discuss any damages to your property.

5 Did your home lose power?

- Do not use a portable generator inside your home or garage. It can cause carbon monoxide poisoning.
- Exercise caution when turning power on or off. Contact an electrician if you have any concerns.

4 Did you make contact with water?

- Practice good hygiene after contacting flood water.
- Do not let children play in flood water or with toys that were contaminated by flood water.
- Clean and cover any open wounds with a waterproof bandage.
- Ensure that water is safe to touch, drink, cook, or clean with after a flood. It may contain toxins, chemicals, or sharp debris.

Learn more: <https://www.cdc.gov/disasters/floods/after.html>

8 TIPS TO CLEAN UP MOLD



Protect Yourself

Put on personal protective equipment (gloves, mask, goggles) to protect your eyes, nose, mouth, and skin.



Toss!

Take it out! Anything that was wet with flood water and can't be cleaned and dried completely within 24 to 48 hours should be taken outside. Take photos of discarded items for filing insurance claims.



Air it out

Open all doors and windows when you are working, and leave as many open as you safely can when you leave.



Circulate

When electricity is safe to use, use fans and dehumidifiers to remove moisture.



Don't mix cleaners

If you use cleaning products, do not mix cleaning products together. **DO NOT** mix bleach and ammonia because it can create toxic vapors.



Scrub surfaces

Clean with water and a detergent. Remove all mold you can see. Dry right away.



Don't cover it, remove it

Painting or caulking over mold will not prevent mold from growing. Fix the water problem completely and clean up all the mold before you paint or caulk.



Dry it up

Dry your home and everything in it as quickly as possible – within 24 to 48 hours if you can.

<http://www.cdc.gov/mold/cleanup.htm>



For more information on mold clean-up, visit the EPA's Indoor Air Quality Program website at www.epa.gov/.



References

1. Sweet, W.V. and J.J. Marra. 2016. 2015 State of U.S. “Nuisance” Tidal Flooding. State of the Climate. National Oceanic and Atmospheric Administration’s National Centers for Environmental Information. <https://www.ncdc.noaa.gov/monitoring-content/sotc/national/2016/may/sweet-marra-nuisance-flooding-2015.pdf>
2. Melillo, J.M., T.C. Richmond, and G.W. Yohe (eds.). 2014. Climate change impacts in the United States: The third National Climate Assessment. U.S. Global Change Research Program. <http://nca2014.globalchange.gov>.
3. U.S. EPA (U.S. Environmental Protection Agency). 2016. Climate change indicators in the United States. <https://www.epa.gov/climate-indicators/climate-change-indicators-coastal-flooding>
4. <https://toolkit.climate.gov/topics/coastal-flood-risk/shallow-coastal-flooding-nuisance-flooding>
5. https://www.epa.gov/sites/production/files/2016-08/documents/coastal-flooding_documentation.pdf
6. <https://www.weather.gov/lwx/WarningsDefined#Coastal%20Flood%20Watch>
7. Moser, S. C., M. A. Davidson, P. Kirshen, P. Mulvaney, J. F. Murley, J. E. Neumann, L. Petes, and D. Reed, 2014: Ch. 25: Coastal Zone Development and Ecosystems. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 579-618. doi:10.7930/JOMS3QNW.
8. Bell, J.E., S.C. Herring, L. Jantarasami, C. Adrianopoli, K. Benedict, K. Conlon, V. Escobar, J. Hess, J. Luvall, C.P. Garcia-Pando, D. Quattrochi, J. Runkle, and C.J. Schreck, III, 2016: Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. U.S. Global Change Research Program, Washington, DC, 99-128. <http://dx.doi.org/10.7930/J0BZ63ZV>
9. Sweet, W.V., Kopp, R.E., Weaver, C.P., Obeysekera, J., Horton, R.M., Thieler, E.R., and C Zervas. 2017. Global and Regional Sea Level Rise Scenarios for the United States . National Oceanic and Atmospheric Administration. Silver Spring, Maryland.
10. U.S. EPA (U.S. Environmental Protection Agency). 2016. Climate change indicators in the United States. <https://www.epa.gov/climate-impacts/climate-impacts-coastal-areas>.
11. U.S. EPA (U.S. Environmental Protection Agency). 2016. Climate change indicators in the United States. <https://www.epa.gov/climate-indicators/climate-change-indicators-sea-level>.
12. Melillo, J.M., T.C. Richmond, and G.W. Yohe (eds.). 2014. Climate change impacts in the United States: The third National Climate Assessment. U.S. Global Change Research Program. <http://nca2014.globalchange.gov>.
13. U.S. EPA (U.S. Environmental Protection Agency). 2016. Climate change indicators in the United States. <https://www.epa.gov/climate-indicators/atlantic-coast#tab-2>.
14. Carter, L. M., J. W. Jones, L. Berry, V. Burkett, J. F. Murley, J. Obeysekera, P. J. Schramm, and D. Wear, 2014: Ch. 17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 396-417. doi:10.7930/JON-P22CB.
15. www.stormsurge.noaa.gov/surge/

16. <http://www.nhc.noaa.gov/surge/>
17. Walsh, J., D. Wuebbles, K. Hayhoe, J. Kossin, K. Kunkel, G. Stephens, P. Thorne, R. Vose, M. Wehner, J. Willis, D. Anderson, S. Doney, R. Feely, P. Hennon, V. Kharin, T. Knutson, F. Landerer, T. Lenton, J. Kennedy, and R. Somerville, 2014: Ch. 2: Our Changing Climate. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 19-67. doi:10.7930/J0KW5CXT.
18. U.S. EPA (U.S. Environmental Protection Agency). 2016. Climate change indicators in the United States. <https://www.epa.gov/climate-indicators/climate-change-indicators-heavy-precipitation>.
19. Sweet, W.V., Kopp, R.E., Weaver, C.P., Obeysekera, J., Horton, R.M., Thieler, E.R., and C Zervas. 2017. Global and Regional Sea Level Rise Scenarios for the United States . National Oceanic and Atmospheric Administration. Silver Spring, Maryland.
20. Sweet, W.V., J. Park, J. J. Marra, C. Zervas, S. Gill (2014), Sea level rise and nuisance flood frequency changes around the United States, in NOAA Technical Report NOS COOPS 73, 53 pp.
21. Sweet, W.V. and J. Park (2014), From the extreme and the mean: Acceleration and tipping points of coastal inundation from sea level rise. Earth Futures, 2 579-600. DOI: 10.1002/2014EF000272
22. Sweet, W.V., Kopp, R.E., Weaver, C.P., Obeysekera, J., Horton, R.M., Thieler, E.R., and C Zervas. 2017. Global and Regional Sea Level Rise Scenarios for the United States. National Oceanic and Atmospheric Administration. Silver Spring, Maryland.
23. Sweet, W.V., Kopp, R.E., Weaver, C.P., Obeysekera, J., Horton, R.M., Thieler, E.R., and C Zervas. 2017. Global and Regional Sea Level Rise Scenarios for the United States. National Oceanic and Atmospheric Administration. Silver Spring, Maryland.
24. U.S. EPA (U.S. Environmental Protection Agency). 2016. Climate change indicators in the United States. <https://www.epa.gov/climate-indicators/climate-change-indicators-coastal-flooding>.
25. Bell, J.E., S.C. Herring, L. Jantarasami, C. Adrianopoli, K. Benedict, K. Conlon, V. Escobar, J. Hess, J. Luvall, C.P. Garcia-Pando, D. Quattrochi, J. Runkle, and C.J. Schreck, III, 2016: Ch. 4: Impacts of Extreme Events on Human Health. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. U.S. Global Change Research Program, Washington, DC, 99-128. <http://dx.doi.org/10.7930/J0BZ63ZV>
26. Rappaport, Edward N. Fatalities in the United States from Atlantic Tropical Cyclones: New Data and Interpretation. Bulletin of the American Meteorological Society 95.3 (2014): 341-46. DOI:10.1175/BAMS-D-12-00074.
27. <https://health2016.globalchange.gov/extreme-events> and https://www.cdc.gov/climateandhealth/effects/precipitation_extremes.htm
28. USGCRP (U.S. Global Change Research Program). 2016. The impacts of climate change on human health in the United States: A scientific assessment. <https://health2016.globalchange.gov>.
29. <https://www.ready.gov/make-a-plan>
30. Federal Emergency Management Agency's (FEMA) Homeowner's Guide to Retrofitting. <https://www.fema.gov/media-library/assets/documents/480>.
31. FEMA [Ready.gov](https://www.ready.gov) website. Community and Other Plans. <https://www.ready.gov/community-and-other-plans>
32. Draft HUD Community Resilience Toolkit. Sea Level Rise and Coastal Storms. Not yet available for public citation.

33. <https://www.ready.gov/kit>
34. https://www.fema.gov/media-library-data/1390846764394-dc08e309debe561d866b05ac84daf1ee/checklist_2014.pdf
35. <http://www.floodsafety.noaa.gov/index.shtml>
36. <http://www.floodsafety.noaa.gov/index.shtml>
37. <https://www.cdc.gov/disasters/floods/cleanupwater.html>
38. <https://www.cdc.gov/mold/cleanup.htm>
39. Dodgen, D., D. Donato, N. Kelly, A. La Greca, J. Morganstein, J. Reser, J. Ruzek, S. Schweitzer, M.M. Shimamoto, K. Thigpen Tart, and R. Ursano, 2016: Ch. 8: Mental Health and Well-Being. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. U.S. Global Change Research Program, Washington, DC, 217- 246. <http://dx.doi.org/10.7930/J0TX3C9H>



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