Weather Safety and Preparedness
By
John Lindsey and Ray Weymann

Introductory remarks by RW

As readers know, this website is devoted to climate science education, and one of the key points to convey is the distinction between "weather" and "climate". "Climate" is the *average* over a couple of decades of all the things we associate with the day-by-day "weather": temperature, precipitation, wind, storms etc. For a very amusing explanation of this distinction by NASA oceanographer (and standup comic!) Dr. Josh Willis, see this short
4 ½ minute video: https://www.youtube.com/watch?v=WGfKRfyhvd0]

Thus, the topic of this essay may seem quite a departure from most of the topics discussed here. In fact, they are closely connected because it is becoming abundantly clear that increasing temperatures, driven by CO2 emissions, are increasing the frequency of several kinds of "extreme weather" events. Therefore, it is prudent to talk about safely preparing for such events. It is a pleasure to be joined by my good friend, PG&E Marine Meteorologist Mr. John Lindsey, in writing this essay.

I would also like to thank reader Keri Evans who sent me information on tornado safety that she asked me to post. Her contribution provided the motivation for this entire essay.

General Tips on Weather Preparedness

To paraphrase: **"An ounce of preparation is worth pounds of heartache and possible tragedy"**

Almost independent of the types of extreme weather events we will describe, there are several steps that families ought to take to be ready for them.

- Have portable radios with fresh batteries ready and battery-operated flashlights with fresh batteries or solar powered flashlights regularly charged. Weather emergencies can occur on short notice and at night, so have flashlights at your bedside.

- If you have a cordless phone or answering machine that requires electricity to work, have a standard telephone or cell phone ready as a backup. Keep your cell phone charged and a portable charger on hand in case of evacuation.

- Listen for alerts on your radio and check your phone for emergency messages. Identify neighbors who might have received messages you missed, and also identify neighbors who might need extra help in dealing with weather emergencies.

- If you do receive a warning or evacuation order *take it seriously*. Do not assume you can "ride it out".

- Freeze plastic containers filled with water to make blocks of ice that can be placed in your refrigerator/freezer during an outage to prevent food from spoiling.

- If you have a stand-by generator, notify your local power company (PG&E here in San Luis Obispo County) and make sure that it's installed safely to avoid risking damage to your property and endangering utility workers who could be working on power lines in your neighborhood. Information on the safe installation of generators can often be found on your local utility's website. (In the PG&E service area see: www.pge.com/generator.) A commercially-sponsored source of good information is: https://www.petro.com/articles/generator-facts-safety-tips

- Downed power lines are a common result of extreme weather events, including high winds, wild fires, heavy snow and ice storms. Always consider downed power lines active and dangerous. Stay away from the lines and keep others away from them. Call 911 immediately to report the location of a downed line.

The rest of this essay deals with a wide variety of weather events that can be harmful or dangerous and the precautions and preparations to take to minimize the risks they pose. Many of them are becoming more frequent and severe as the climate changes.

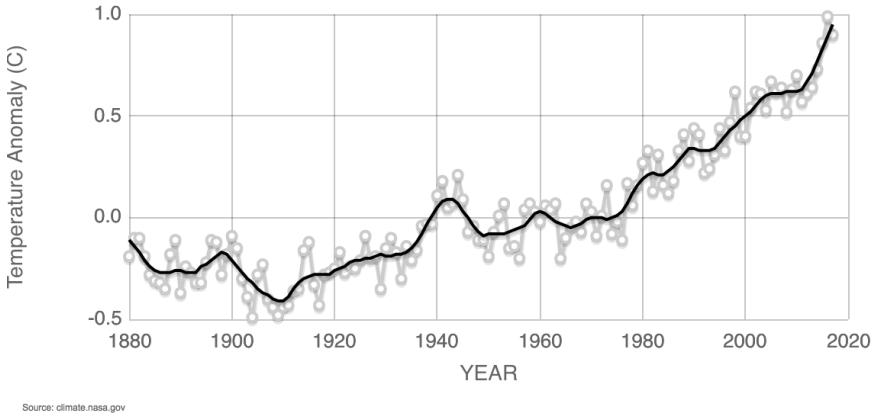
Much of the material in this essay is taken from a wonderful website maintained by the National Weather Service ("NWS"): https://www.weather.gov/safety. That site provides links to safety tips and other information for all the weather events we discuss.

Here is a list of the weather events we discuss, some of which may be of more interest than others, depending on where you live. You may therefore wish to scroll down to those that you are most likely to encounter.

Extreme heat
Drought
Wildfires
Flooding and mudslides
High winds
Thunderstorms and Lightning
Tornados
Hurricanes
Extreme cold and winter weather
Fog Safety
Rip currents and "rogue" waves
Earthquakes and Tsunamis

Extreme heat

As described in the tutorials on this website, the relentless increase of carbon dioxide and other greenhouse gases is warming the planet, as shown here in this global temperature record:



In much of California, for example in the Sacramento region of the Central Valley, annual summer temperature averages are projected to increase between nearly 4 degrees and 7 degrees Fahrenheit. Actual daily temperatures ("weather") spread about the average ("climate") at any time which means that very hot weather will become more common and record-setting temperatures will occur frequently.

Heat waves pose health risks. Elderly folks and those working outside are especially vulnerable. If you must be outside it is important to wear light clothing and a hat. Be sure to have water available as dehydration exacerbates the health risks of severe heat. Many communities provide cooling centers where relief may be found for those seeking it. (For information on cooling centers in the PG&E service area see: https://www.pge.com/en_US/safety/emergency-preparedness/natural-disaster/heat/cooling-centers.page?WT.mc_id=Vanity_coolingcenters)

For more on health risks from severe heat, as well as precautions to take to avoid them, see the NWS link on heat: https://www.weather.gov/safety/heat. This site calls attention to an especially dangerous hazard to children and pets during warm weather: leaving them in a car while you run an errand. To quote from that site:

"It is **NEVER** safe to leave a toddler, disabled person or pet locked in a car, even in the winter. So far in 2018, one toddler has died due to heat. **That death occurred in February!** Cars can heat up quickly when left in the sun… Children locked in cars have died in December and in 70 degree weather, even with a window left open a little."

Heat waves are frequently accompanied by unhealthy air, especially in urban areas.
See: https://www.weather.gov/safety/airquality.
There are at least two kinds of hazardous substances contributing to unhealthy air. One is ozone, which is formed in the presence of heat and sunlight together with products from vehicle exhaust and some industrial emissions. (This ozone is called "ground level" ozone and should not be confused with the ozone layer high up in the stratosphere that shields us from part of the harmful ultraviolet radiation from the sun.)

From the NWS link above:

"Even at low concentrations, ozone can trigger a variety of health problems such as lung irritation and inflammation, asthma attacks, wheezing, coughing, and increased susceptibility to respiratory illnesses." Those with asthma or other respiratory issues are especially vulnerable. Stay inside if need be or at least avoid strenuous outdoor activity under these conditions.

A second kind of unhealthy air pollution involves very fine solid particles of soot that may consist of emissions from diesel trucks, as well a small dust particles or smoke from wildfires. From the NWS website once again:

"This pollution can cause chronic bronchitis, asthma attacks, decreased lung function, coughing, painful breathing, cardiac problems and heart attacks.

Since heat waves provide an incentive for folks to shed clothing and perhaps go to swimming pools, lakes or the beach, it is important to also be aware of precautions to avoid exposure to damaging ultraviolet radiation (which leads to skin cancers) and sunburn. The NWS site dealing with that is here: https://www.weather.gov/safety/heat-uv

Drought

In contrast to many of the topics in this essay, drought is not a sudden event like a tornado or thunderstorm. Nevertheless, it can have significant indirect impacts on our well-being as, well as devastating economic impacts, especially in the agriculture sector.

From the NWS drought page (**https://www.weather.gov/safety/drought)** we learn that between 1980 and 2014 there were 22 drought events in the U.S. each causing losses in excess of $1 billion dollars. During droughts, the chances of wildfires are of course increased and droughts impact the availability of potable drinking water.

A subtler impact involves the disease known as valley fever. It involves the fungus coccidioidomycosis that grows in the soil. Valley fever can be a serious health issue and here in San Luis Obispo County the incidence is on the rise. It is weather related in that months of abnormal wet weather followed by months of especially hot dry weather allow the spores to grow and then to become airborne as the soil becomes dusty. Infection results when the dust is inhaled. Climate scientists project that, in fact, alternating periods of very dry, then very wet, weather are likely to become more frequent as the world warms. A study by UCLA climate scientists called this "climate whiplash" — transitions from very wet to very dry weather — similar to what California experienced from 2016 to 2017.

Valley fever can take a long time to get over and can be very debilitating. In severe cases, it can lead to other serious health complications.

Here is advice from the Center for Disease Control (CDC) on precautions to take to avoid catching valley fever (which, by the way, is **NOT** transmitted from human to human):
"Stay inside during dust storms and close your windows. **Avoid** activities that involve close contact to dirt or dust, including yard work, gardening, and digging. Clean skin injuries well with soap and water to reduce the chances of developing a skin infection, especially if the wound was exposed to dirt or dust."

Wildfires

Increasing temperatures, along with more frequent and severe droughts, are lengthening the wildfire season and making for larger and hotter wildfires. Combined with the encroachment of developments into areas of fuel sources for wildfires, this is already a very serious issue as California residents have recently experienced with tragic results. The duration of the wildfire season and the amount of area burned are both projected to significantly increase across the western U.S. but there are wide variations from state to state and within each state.

There are many precautions to take to minimize the risk to your home and property. Here is the NWS page on wildfires. At the top of the NWS page
https://www.weather.gov/safety/wildfire click on the "warning vs. watch" and the "preparedness" buttons.
Here is a link prepared by FEMA.
https://www.fema.gov/pdf/hazard/wildfire/wdfrdam.pdf
Many local fire departments will come to your home to inspect your property for fire safety.

A fireproof safe in which to keep important documents is a good precaution.

With many recreational areas for hikers and campers in wildfire prone areas, it is also important to be aware of precautions to take should wildfires occur during your outing. Wildfires can be extremely unpredictable with rapidly shifting wind conditions. Here is a link to some safety tips for outdoor enthusiasts: https://www.active.com/outdoors/articles/seven-w-s-of-hiking-safety-wildfires

A nasty feature of wildfires is that they can denude hillsides of vegetation that holds soil in place. Thus, when a hilly area has been burned, and that area is then subject to a heavy downpour, devastating mudslides can occur as described in the following section.

Flooding and mudslides

As described in the appendix of topic 3 in the updated tutorials on this website, the rate of evaporation from water increases as its temperature increases, and warmer air will hold more water vapor before condensation of the water vapor back into liquid drops (i.e. clouds) occurs.

Flood safety is a complicated topic to lump into a single category because flooding can occur under a wide variety of circumstances and poses different kinds of hazards. The image above is from the steady heavy rain over several days resulting from Hurricane Harvey

One point should be emphasized at once though and that is the force exerted by rapidly flowing water. This is especially hazardous for people in a car trying to drive across rapidly flowing water. Drowning while trying to do this is a leading cause of fatalities. Look at this link and the video that accompanies it:

https://weather.com/safety/floods/news/flash-flooding-vehicle-danger-20140717

Hiking in narrow canyons can be extremely dangerous even though heavy rains (as in thunderstorms) are a long way off, since flash floods can sweep down such a canyon with little warning: http://www.yourhikeguide.com/flash-floods/

Here is the NWS page on flood safety: https://www.weather.gov/safety/flood. Click on the "before", "during" and "after" flood buttons at the top of that page.

As mentioned above, burned areas in hilly terrain can be subject to mudslides when hit by heavy downpours.

The power of rapidly flowing water is attested to in this image taken in the Santa Barbara area. Tragically, about 20 fatalities resulted from these mudslides. As always, heed warnings and evacuation instructions.

High winds

We associate most wind damage with very severe weather such as tornados, violent thunderstorms and hurricanes, all discussed in sections below. But significant damage can occur from other types of wind events.

One type of high wind is associated with bands of thunderstorms but, in contrast to the violently rotating winds of tornados, these winds are "straight ahead" winds, called "derechos" which is Spanish for "straight ahead". They form in front of rapidly moving bands of thunderstorms from strong downdrafts associated with rapidly cooled and heavy air which spreads out in front of the band of storms. New thunderstorms are spawned along the path of these bands. The damage is typically a long swath of a few hundred miles with wind speeds of at least 60 mph but which can exceed 100 mph.

Often during the winter on the California central coast, storms approach with the winds circulating around a storm system. A very rapid change in temperature between the advancing cold weather as it encroaches on warmer air defines a "front". The large change in pressure across the front produces high winds which shift in direction as the front passes.

Here in central and southern California we are familiar with "Santa Ana" winds: From the NWS website: (https://www.weather.gov/safety/wind)

"Santa Ana Winds occur when air from a region of high pressure over the dry, desert region of the southwestern U.S. flows eastward towards low pressure located off the California coast. This creates dry winds that flow east to west through the mountain passages in Southern [and central] California. These winds are most common during the cooler months of the year, occurring from September through May. Santa Ana winds typically feel warm (or even hot) because as the cool desert air moves down the side of a mountain it is compressed, which causes the temperature of the air to rise. These strong winds can cause major property damage. They also increase wildfire risk because of the dryness of the winds and the speed at which they can spread a flame across the landscape."

In the northern great plains and into Canada just east of the Rocky Mountains, something similar occurs: Moist air from the Pacific rises and releases much of its moisture and cools as it ascends over the Rocky Mountains. Then, as in the case of the Santa Ana winds, it is warmed as it is compressed moving down the eastern slopes. These "Chinook" winds, reaching 60 mph, and higher if they are funneled through passes, can cause dramatic rises in temperature in a very short time, sometimes leading to flooding as snow is melted.

Regardless of which of these wind events are involved, there are hazards that need to be kept in mind. Falling trees can cause damage to person and property.

Trim trees and remove dead trees and branches. Downed power lines from falling trees during high winds are common. As noted in the general safety tips above, stay away from them and notify your local utility. Driving cars and trucks with high vertical profiles during high winds is also hazardous. Gusts can cause loss of control over even overturn vehicles. Slow down or if need be pull over.

See the NWS wind safety web page for more information.

Thunderstorms and Lightning

Although severe thunderstorms, and the lightning, high winds and heavy rain or hail that often occur with them are not frequent along the California coast, they do occur, especially in mountain areas and throughout much of the rest of the country.

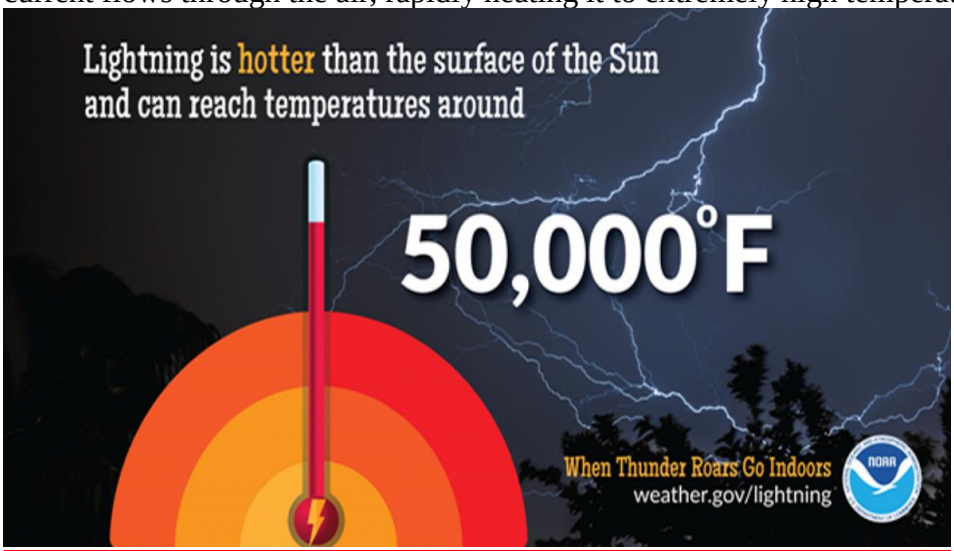
In addition to lightning, thunderstorms are often accompanied by high winds (one example being the "derecho" winds described above) and sometimes the especially destructive tornados, discussed in a separate section below.

Downpours like the one pictured above during a thunderstorm in Phoenix, Arizona can cause flash floods. As noted in the section on flooding, hikers in canyons need to be aware of the fact that heavy downpours many miles away can cause sudden floods that may overtake the unwary with little warning.

Another hazard, though not so much to humans as to crops, is hail. Frozen drops of water are carried up and down by very strong updrafts and downdrafts, each time adding to the weight of the frozen drops until they are heavy enough to fall through the updrafts. In the most severe thunderstorms, hail the size of grapefruit has been recorded.

Lightning safety

Lightning results when positive and negative electrical charges are built up between clouds or between clouds and the ground. When the resulting electric field becomes large enough, a surge of electric current flows through the air, rapidly heating it to extremely high temperatures, as illustrated here:



This extremely hot air expands and this is what causes thunder. The surge of current ignites fires (and is of course a major cause of forest fires, along with careless humans) and can be injurious or lethal to humans.

Nationwide, only about 50 deaths per year result from lightning strikes. (About 10 times as many people are struck but survive.) But there is no reason to needlessly expose yourself to a strike. If you can hear thunder from a thunderstorm, it is time to seek the best available shelter. The NWS lightning safety page provides these safety guidelines: **https://www.weather.gov/safety/lightning**

The main message is to get indoors—there are few outdoor locations which give protection against lightning strikes. “WHEN THUNDER ROARS, GO INDOORS”. “Indoors” does not mean open shelters, but sturdy buildings. A house is a safe place to be during a thunderstorm as long as you avoid anything that conducts electricity. This means staying off corded phones, electrical appliances, wires, TV cables, computers, plumbing, metal doors and windows. Windows are hazardous for two reasons: wind generated during a thunderstorm can blow objects into the window, breaking it and causing glass to shatter and second, in older homes, in rare instances, lightning can come in cracks in the sides of windows. Cars with metal roofs are relatively safe.

If you are outdoors, avoid high peaks and ridges and the tallest trees, especially isolated ones. Seek gullies rather than ridges. Injury can result without being directly struck as the result of “ground currents” that can spread from the impact point of the bolt. Avoid flat open areas like golf courses or ball fields. See the NWS website for more detailed safety tips

Tornados

Tornadoes are violently rotating columns of air that reach from the cloud base to the ground. They are associated with severe thunderstorms, especially “supercell” thunderstorms which have strong rotating updrafts. The wind speeds in severe tornadoes can approach and possibly exceed 300 mph, far in excess of top hurricane speeds, though such severe ones are rare. The air pressure may drop dramatically directly under the funnel and this has led to the belief that windows should be kept open to equalize the pressure and keep the house from “exploding”. Keep the windows closed, but stay away from windows anyway (see below.)

Here in California, tornados are extremely rare—but they do happen as discussed in a Weather Watch column by one of us (JL): http://www.sanluisobispo.com/news/weather/weather-watch/article205702959.html

There are many sources for tornado safety. Here are three:

This is the link provided by Keri Evans regarding tornado safety:
https://usinsuranceagents.com/home-tornado-safety

The NWS also has a tornado safety page and the photo above is taken from that page:
https://www.weather.gov/safety/tornado

This one from NOAA (National Oceanic and Atmospheric Administration) is also very instructive:
http://www.spc.noaa.gov/faq/tornado/safety.html

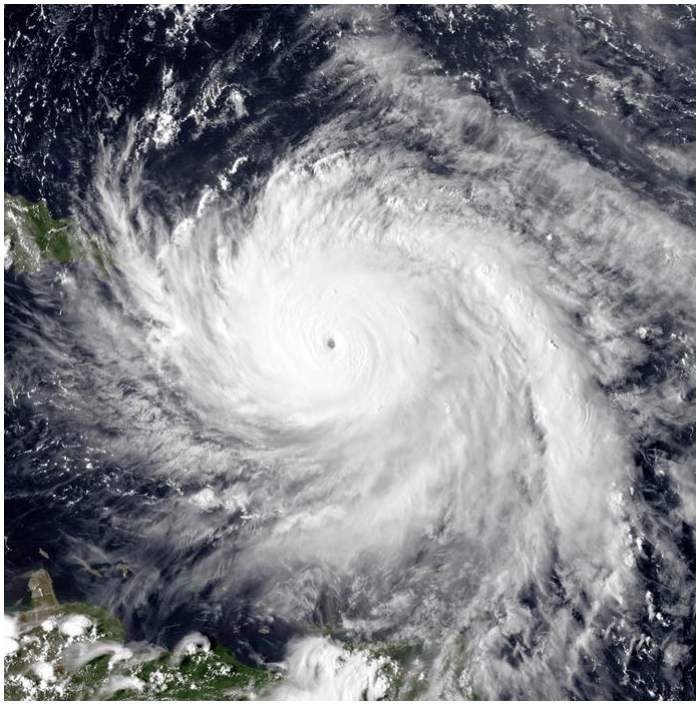
Here are some key points:

- There is no safe place outdoors that will protect you from a tornado, including a car. If you are caught in the open and cannot get to a shelter, seek a gully or ditch.
- Mobile homes are not safe. Identify a shelter and the route to get to it at any hour of the day or night even before you move in. Here is a short video about mobile homes and tornadoes: https://stormaware.mo.gov/what-to-do-in-a-mobile-home/
- Know the difference between a tornado **watch** and a tornado **warning**. A **watch** means that conditions in your particular area (which may mean a set of counties or even an entire state) are favorable for tornados to form. But forecasting has not reached the point where the exact path of a tornado can be predicted, even hours in advance. A tornado **warning** means that a tornado has actually been sighted or detected by radar. If you are anywhere near its path, take shelter immediately.
- If you live in areas where tornadoes are not that uncommon, invest in a special weather radio. A network of transmitters broadcasts information on hazardous weather 24/7; weather radios equipped with a special alarm tone feature can sound an alert and give you immediate information about a life-threatening situation.
- From the NOAA page: **In a house with a basement:** Avoid windows. Get in the basement and under some kind of sturdy protection (a heavy table or work bench), or cover yourself with a mattress or sleeping bag. Know where very heavy objects rest on the floor above (pianos, refrigerators, waterbeds, etc.) and do not go under them. They may fall down through a weakened floor and crush you. Head protection, such as a helmet, can boost survivability also. **In a house with no basement**, a dorm, or an apartment: Avoid windows. Go to the lowest floor and a small center room (like a bathroom or closet), under a stairwell, or in an interior hallway with no windows. Crouch as low as possible to the floor, facing down; and cover your head with your hands. A bath tub may offer a shell of partial protection. Even in an interior room, you should cover yourself with some sort of thick padding (mattress, blankets, etc.), to protect against falling debris in case the roof and ceiling fail. A helmet can offer some protection against head injury.

- There are many techniques for raising the level of safety or "hardening" appropriate rooms in existing homes and other buildings or for new homes; FEMA provides this information: https://www.fema.gov/fema-p-320-taking-shelter-storm-building-safe-room-your-home-or-small-business

In contrast to many of the weather hazards described in this essay, climate scientists have not determined what the effects of global warming will be on the frequency or severity of tornadoes.

Hurricanes



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Hurricane preliminaries

If you would like some information about hurricane basics, here is a nice tutorial from the NWS: https://www.weather.gov/jetstream/tc If you go to that site you will see that the topic is actually called "Tropical Cyclone" introduction, not "Hurricane" introduction. That's because hurricane-like events go by different names depending on where in the world they occur. In the Atlantic, Gulf of Mexico and the Eastern pacific (off the west coast of central America and Mexico) they are indeed called **hurricanes.** But in the western pacific—affecting the Philippines, Japan, China, Taiwan etc.—they are called **typhoons.** While in the Indian ocean and southern hemisphere (Australia, Bangladesh, India) they are called **cyclones**. But professional meteorologists use the term "Tropical Cyclones" to cover all these storms— "tropical" because far from the equator the ocean is too cool for them to form.

The main conditions for hurricane formation require warm water (greater than 80 degrees F to a depth of 150 feet or so,) a lack of significant "wind shear"—a change in direction with altitude,—and a low pressure area acting as a 'seed'. The warm water leads to rapid evaporation, and as this very moist air rises it cools and condenses back into liquid water. In the process, it releases latent heat (see the appendix in updated tutorial 3) and this further drives the ascending air. Air moves in to takes its place and an organized rotating system with heavy rain and high wind is formed. This rotation is a consequence of the Coriolis effect (see https://stratus.ssec.wisc.edu/courses/gg101/coriolis/coriolis.html) and the Coriolis force also prevents the incoming air from reaching the very center, hence the "eye" of the hurricane where the air is calm.

The favorable conditions described above for the U.S. run from around June 1 to the end of November, with the peak in mid-September. One last comment, before discussing hurricane safety, involves a bit more terminology: tropical storms are not classified as "hurricanes" until the wind speed during a one minute period exceeds 74 mph. Then the familiar hurricane categories from one to five depend on these wind speeds, with the highest, category five, involving sustained winds of 157 mph or greater. But even storms not having wind speeds high enough to be classified as hurricanes can be dangerous since they can lead to very heavy rains. These are termed "tropical storms" for winds between 39-74 mph and below that "tropical depressions".

Hurricane safety

Although hurricanes are not as violent weather events as tornadoes, because they cover much larger areas, they can do a lot more damage. In contrast to tornadoes, a hurricane can be predicted well in advance. Of course, the closer it approaches, the more accurate the path and intensity forecasts become.

There are three kinds of hazardous conditions associated with hurricanes: wind damage, flooding and storm surge. The severity of the damage from these factors depends upon more than just the category of the hurricane. It involves its exact path, the topography of the coast where it makes landfall, the size of the storm, the speed with which it moves, and in the case of storm surge, even the phase of the moon because whether landfall occurs at low tide or high tide influences the severity of the storm surge.

Even the moderate winds associated with tropical storms can uproot trees and damage property. Winds in category 3 hurricanes or higher can inflict severe damage from flying debris and can tear off roofs. Storm surges result from the wind piling up the water and driving it well on shore. Heavy rain can cause dangerous flooding. Hurricane Maria did severe wind damage to Puerto Rico and knocked out power almost totally. Hurricane Sandy did severe damage from its storm surge even though it was only a category one hurricane, though it was very large in extent. And hurricane Harvey did most of its damage in the Houston area due to flooding from over four feet of rain.

If you have read the safety tips for others of these weather hazards, you will have gotten the message that preparation well in advance of the bad weather is key. This is especially true of hurricanes. If you live in an area that is prone to hurricanes (the gulf coast and east coast for the continental U.S.) then *before* the beginning of each hurricane season, advance preparations are advised.

Here is a check list of these advance preparations from the NWS:
https://www.weather.gov/safety/hurricane-plan.
Not waiting until the last moment to get needed supplies is especially important since stores will quickly run out.

During the hurricane itself, the safety precautions are similar to those for tornadoes:
https://www.weather.gov/safety/hurricane-action

A final note regarding the impact of global warming on hurricanes: In contrast to tornadoes, where there is substantial uncertainty concerning the effect of climate change on the frequency and severity of those events, there is substantial consensus on what is to be expected:
All categories of hurricanes will not become more frequent, but the most severe ones will. Another way to put this is that in the absence of global warming conditions that would have produced a category 3 or 4 storm will instead result in a category 5 storm. There is already observational data supporting the higher intensity of strong storms.

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Extreme cold and winter weather

In California, we tend to think that there is no hazard from very cold weather. But even California "cold snaps" can be hazardous to humans and pets, and can damage agricultural crops. And of course, it can be extremely cold in other parts of the country. But with ski resorts beckoning in the mountains in California, temperatures can be dangerously low, especially with a wind chill factor, as explained below. There are two dangers: hypothermia and frostbite.

Hypothermia: This is generally defined to occur when the body temperature, normally at a temperature of 98.6 F drops lower than about 95F or 96F. When exposed to cold weather the body loses more heat then it generates by normal metabolism. Hypothermia can range from mild to severe and ultimately can be fatal. In fact, while not as spectacular as lightning, there are far more yearly fatalities from hypothermia in the U.S. (about 1300) than from lightning (about 47).
Symptoms include mental confusion, slurred speech and drowsiness, among others.

A cautionary note: it is possible to suffer hypothermia even inside for temperatures in the 50's, especially for the elderly.

Most of the loss of heat from our bodies takes place from the surface of the skin, so the obvious precaution is to wear warm clothing, literally from head to toes, and to use layers of warm clothing.

Just as there are cooling centers for excessive heat, there are also warming centers for excessive cold. Here is a FEMA file giving information on warming centers:
https://www.fema.gov/media-library-data/1391020693076-2696150f57d28895c7d0135a61e89a9c/Finding_Warming_Centers.pdf

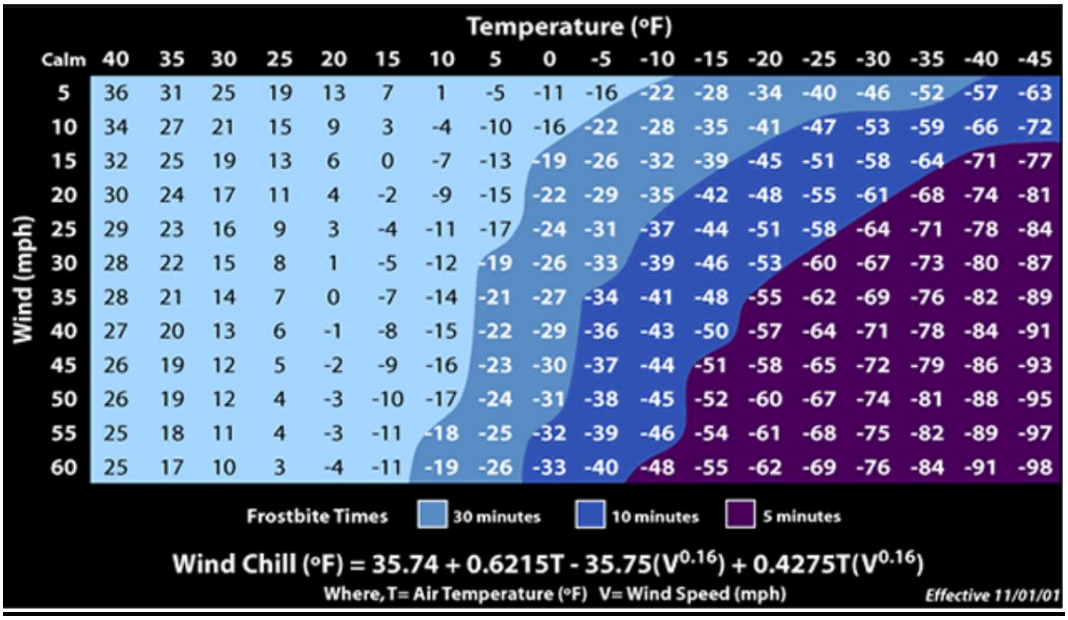
Frostbite: Frost bite, like hypothermia, ranges from mild to severe, depending upon how cold and for how long skin--specially fingers, toes, ears, nose, cheeks and chin--are exposed. In severe cases, the skin and underlying tissue cells freeze and die; gangrene can set in and result in the necessity of amputation.

Here is the Mayo Clinic website on frostbite: https://www.mayoclinic.org/diseases-conditions/frostbite/symptoms-causes/syc-20372656

As for hypothermia precautions, proper clothing protecting the skin is the key.

Wind Chill

Most readers have probably heard weather forecasts where the temperature itself is projected to be pretty low, say 20 degrees--(low for much of California, at least) but the forecaster will then add "but with a wind chill factor of 3 degrees.". What does this mean, and why do you need to pay attention? The chart below explains much of this. The numbers across the top row refer to the actual temperature (20 degrees F in our example), but then reading down the column under the 20, you come to 3 degrees F in the row where the wind speed is 25 mph. The presence of moving air is a very efficient way of removing heat from the body. Roughly speaking, the wind chill temperature (3 degrees) means that at 20 degrees and a wind of 25 mph, heat is removed at the same rate as it would be with no wind at 3 degrees. Thus, a windy day can significantly increase the danger of hypothermia or frostbite.



Note the different shaded areas that give the amount of time before exposed skin is at risk for frostbite.

Here are the NWS links to cold and winter weather safety:
https://www.weather.gov/safety/winter
https://www.weather.gov/safety/cold

Fog safety

It may seem odd to list fog as a weather-related safety hazard, but in fact it is the cause of a substantial fraction of serious traffic accidents. Of course, other types of weather contribute to car accidents which altogether are estimated to be responsible for nearly a quarter of all car accidents.
Ice and heavy rain are obvious hazardous driving conditions, but light rain falling after a dry spell also can be hazardous: oil that has not yet been washed clean from previous rain becomes mixed with the water and makes for slippery roads.

A general safety practice, even in good weather, is to obey the "three second" rule whenever possible (and of course more in bad weather): arrive at a given point along the road at least three seconds later than the car ahead of you.

Fog, by the way, is by no means confined to areas near the coast. Some of the worst fog in California, tule fog, occurs in the Central valley but also in other inland valleys. One of us (JL) has written a newspaper column about it:
(http://www.sanluisobispo.com/news/weather/weather-watch/article182807596.html)
The "driving in fog" button from the NWS website https://www.weather.gov/safety/fog-driving gives these tips.

- Slow down and allow extra time to reach your destination. Also, as pointed out in JL's column, fog creates a visual illusion of slow motion when you might actually be speeding.
- Make your vehicle visible to others both ahead of you and behind you by using your low-beam headlights since this means your taillights will also be on. Use fog lights if you have them.
- Never use your high-beam lights. Using high beam lights causes glare, making it more difficult for you to see what's ahead of you on the road.

- Leave plenty of distance between you and the vehicle in front of you to account for sudden stops or changes in the traffic pattern.
- To ensure you are staying in the proper lane, follow the lines on the road with your eyes.
- In extremely dense fog where visibility is near zero, the best course of action is to first turn on your hazard lights, then simply pull into a safe location such as a parking lot of a local business and stop.
- If there is no parking lot or driveway to pull into, pull your vehicle off to the side of the road as far as possible. Once you come to a stop, turn off all lights except your hazard flashing lights, set the emergency brake, and take your foot off of the brake pedal to be sure the tail lights are not illuminated so that other drivers don't mistakenly run into you, thinking you are still driving.

Rip currents and "rogue" waves

Rip currents (sometimes called "rip tides") are fast-moving currents of water that can pull even the strongest swimmer away from the shore. According to the United States Lifesaving Association, rip currents account for at least 100 deaths each year at U.S. surf beaches.

Signs of rip currents include a break in the pattern of incoming waves; a channel of churning, choppy water; an area with a noticeably different water color; and a line of foam, seaweed or debris moving steadily seaward.

The NWS website on rip currents is here https://www.weather.gov/safety/ripcurrent and provides these safety tips:

How to Survive a Rip Current:

- Don't fight the current. It's a natural treadmill that travels an average speed of 1-2 feet per second, but has been measured as fast as 8 feet per second—faster than an Olympic swimmer.
- Relax and float to conserve energy. Staying calm may save your life.

- Do NOT try to swim directly into to shore. Swim along the shoreline until you escape the current's pull. When free from the pull of the current, swim at an angle away from the current toward shore.
- If you feel you can't reach shore, relax, face the shore, and call or wave for help. Remember: If in doubt, don't go out!

“Rogue” waves or “sneaker waves”

Again, from the NWS link above:

“Sneaker waves are deadly, larger-than-average swells that can suddenly and without warning surge dozens of feet higher up the beach than expected, overtaking the unwary. They can break over rocks and lift logs on the beach with deadly force. Individuals caught in the path of these deadly waves can wind up being pulled off the beach into frigid water and swift ocean currents.
Sneaker waves strike people who seriously underestimated the risk they are in. They are called *sneaker waves* because they often appear with no warning after long periods of quiet surf and much smaller waves, lulls that can last for 10 to 20 minutes. People arriving on the beach see the smaller waves and assume they are not going to run up on the beach any higher than what they are currently observing. Based on what they see, they get too close to the water and stop paying attention. It is this calm that lulls people into a sense of security. Survivors all say the same thing: They thought they were far enough from the surf to be safe. They never saw the wave coming.” “Some of these waves can surge more than 150 feet (45 meters) up the beach.”

Although this is a hazard that affects our central coast, it is especially dangerous up north along the coast of Northern California, Oregon and Washington, partly because if you are dragged out to sea in these northern coastal regions the water may be dangerously cold. The message is simple but important: When you are near the surf, NEVER TURN YOUR BACK ON THE OCEAN.

Earthquakes and Tsunamis

Of course, earthquakes are not really weather events, but they require the same kind or general preparedness as many of the more extreme weather events we have discussed. The same is true of Tsunamis which result from strong offshore earthquakes. So, we mention these topics here, especially because most readers of this website live in California. Unlike many weather events however, earthquakes cannot be predicted except in the most long term statistical sense. But tsunami warnings can be issued after severe off shore earthquakes.

Ultimately, California may be equipped with a warning system that alerts the population to an immediate earthquake (Mexico has such a system.) But this will only provide advance warning of several seconds to a minute or so at most. This is possible because of the difference between the speed of electronic messages and the speed of earthquake waves. Thus, preparation is the best precaution. Here are some recommended steps for earthquake preparedness:

https://earthquakeauthority.com/earthquake-risk-preparedness

It is especially important to have gas-heated hot water heaters securely braced to walls. Bolt tall structures that might topple over to walls and attach latches so that breakable items will stay in drawers and cupboards.

Tsunamis:

Tsunamis (sometimes called ‘tidal waves’) most often are the result of strong offshore earthquakes. They can travel across vast expanses of ocean and still be very damaging as they strike distant shores. In deep water, they may travel at speeds of several hundred miles per hour.

One important warning: A tsunami is in general not a single wave. After the first wave strikes, the water may withdraw far out to sea. This has lured onlookers to wander far out from the shore only to be overtaken by a second incoming wave with tragic results. Once again, heed official warnings, get to high ground as soon as possible and do not return to low ground until advised that it is safe to do so.

See: http://ssc.ca.gov/disasters/tsunami.html for more information about tsunamis and safety tips.