

Thunderstorms

Thunderstorms and their sequelae are the single greatest cause of human death in natural disasters in the United States. The greatest damage is the result of flooding, lightning, wind, hail, and tornadoes. Although the effect of thunderstorms is invariably localized, the storms occur so frequently that the total deaths, injuries, and damages exceed all other disasters together. Each year approximately 100,000 thunderstorms develop in the United States. Of these, approximately 10% (10,000) are severe and about 3% (3000) produce tornadoes.

Between 1975 and 1995, 327 federal disaster declarations resulted from thunderstorms. Severe thunderstorms are characterized by sustained winds over 58 mph, hail that is 3/4 inch or more in diameter, or the development of tornadoes.

When severe thunderstorm watches or warnings are issued, the potential for tornado development always exists. Animals, especially dogs, can often hear thunderstorms before humans and may show this by becoming anxious, hiding, and vocalizing. Horses sometimes run frantically around their pasture.

Development of Thunderstorms

Three conditions are necessary for thunderstorms to develop: moisture, unstable air (warm air rising), and a lift of the air (fronts, sea breezes, mountain topography). Typically the conditions that result in thunderstorms are:

Convective air currents: hot air rising; this occurs most commonly in the afternoons of spring and summer months, when warm, moist air is met by east-moving cold fronts

Orographic lifting: warm air ascending the sides of mountains in its path

Nocturnal air currents: usually causing storms between 10 PM and 6 AM in late summer

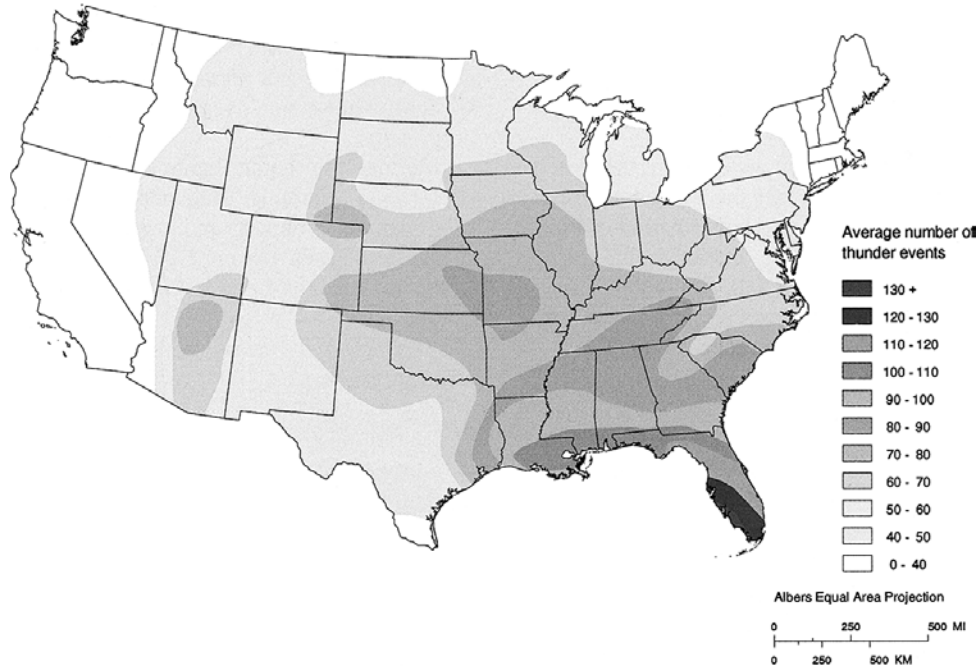
Thunderstorms that arise in frontal systems are the most likely type to become severe. In the spring in the Central Plains thunderstorms commonly occur along the “dry line” of weather that separates very warm, moist air to the east from hot, dry air to the west. Thunderstorms caused by this weather pattern occur most commonly in the afternoon. Some snowstorms also have favorable conditions for thunderstorms to develop.

Thunderstorms go through several stages of development:

Developing or cumulus stage: Towering cumulus clouds appear, rising rapidly to up to 20,000 feet. This rising air is called updraft. At this stage there is no rain, but thunder sometimes can be heard.

Mature stage: Huge, dark clouds have developed, rising up to 40,000 feet and extending forward up to 50 miles into the “anvil” of the storm. The clouds in the center become dark in appearance, and strong winds, rain, hail, and tornadoes can occur. Rain falls along a “wall” perpendicular to the direction of the forward direction of the storm. The falling rain creates a drag in the air that produces a downdraft of air. Downdrafts can produce winds of up to 100 mph, often referred to as “straight-line winds.”

Dissipating stage: The amount of rain that falls decreases. The downdraft of air spreads outward to cover the entire lower region of the storm. These downdrafts still will cause strong bursts of wind, and lightning still may occur. The height of the cloud formation decreases.



Distribution of thunderstorms in the United States. (From Federal Emergency Management Agency: *Multi-hazard identification and risk assessment: a cornerstone of the national mitigation strategy*, Washington, DC, 1997, FEMA.)

Table 4-1 Estimated deaths and damages related to thunderstorms and their sequelae

Cause of damage	Average number of deaths and injuries per year	Damages (\$) per year
Floods	140 deaths	2 billion
Lightning	90-100 deaths 300 injuries	Several hundred million
Wind		300 million
Hail		1 billion (property and crops)
Tornadoes	80 deaths 1500 injuries	Several hundred million

Storms often last for less than an hour, but they can last for several hours. Frequently several storms follow one another in short succession.

Another type of severe thunderstorm is the “super cell.” These are tornadic mesocyclones that are often over 100 miles in diameter. They are more commonly associated with extremely high levels of rainfall and hail of greater than 2 inches in diameter. They are less frequently associated with tornadoes. If tornadoes do form in super cells, they are weak and occasionally in multiples (tornado family).

The National Severe Storms Forecast Center in Kansas City, Missouri, issues severe thunderstorm watches. Local National Weather Service offices issue warnings and statements about severe weather and localized storms. The following are terms that these services use:

A severe thunderstorm watch means that conditions are right for lightning, damaging winds

greater than 58 mph, hail that could reach a diameter of 3/4 inch, and heavy rain. A thunderstorm watch indicates that you should take action to protect yourself and your animals.

A *severe thunderstorm warning* means that severe thunderstorms have been sighted in your area.

Guidelines if Caught Outside in a Thunderstorm

- Do not stand underneath a natural lightning rod, such as a tall, isolated tree in an open area.
- Keep yourself and any animals away from open water, such as a lake, pond, or river.
- Keep yourself and any animals away from tractors and other metal farm equipment.
- Get off of and stay away from motorcycles, scooters, golf carts, and bicycles. Put down golf clubs.
- Keep yourself and any animals away from wire fences, clotheslines, metal pipes, rails, umbrellas, and other metallic paths that could carry lightning to you from some distance away.
- Move yourself and any animals to a low place such as a ravine or valley, but remain alert for flash floods.
- If you feel your hair stand on end (which shows that lightning is about to strike), drop to your knees and bend forward, putting your hands on your knees. Do not lie flat on the ground.
- A person or animal struck by lightning will receive a severe electrical shock and may be burned. The victim will carry no electrical charge and can be handled safely. Give First Aid and seek emergency medical assistance immediately.

Victims who appear only stunned or otherwise unhurt may also need appropriate medical attention. Check for burns in people, especially fingers and toes next to buckles and jewelry. In animals check areas around collars and leashes.

Table 4-2 Assessment of wind speeds using visible features

Wind speed (mph)	Noticeable effects over land	Noticeable effects over water
1-3	Calm; smoke rises vertically	Ripples are soft with appearance of fish scales
4-7	Smoke drifts, indicating direction of wind	Small wavelets with crests of glassy appearance develop
8-12	Wind felt on face; weather vanes start to move	Large wavelets develop; on some the crest will break
13-18	Leaves and small twigs are in constant motion	Small waves develop with numerous white caps
19-24	Dust, leaves, and loose paper are blown up from the ground	Moderate size waves develop
25-31	Small trees begin to sway	Larger waves form, and white caps occur nearly everywhere
32-38	Large branches on trees sway, and whistling can be heard from wind blowing past wires	Water heaps up, and white foam blows in streaks
39-46	Twigs and small branches may be broken off trees	Moderately high waves of noticeable length develop
47-54	Minor structural damage occurs because of slate blown off roofs	High waves begin to roll, and spray reduces visibility
55-63	Structural damage significant; trees broken off	Very high waves with overhanging crests develop
64-72	Significant structural damages common	Exceptionally high waves develop, and water covered with white foam
>72	Violent action and massive destruction occur	Air filled with foam, water is white, and visibility is very poor

- More than one storm may strike an area within a few hours. Once one storm subsides, be certain no more storms are approaching before resuming your normal activity.

- Provide fresh feed for animals because many will refuse to eat waterlogged feed and minerals.

- If you are inside during the storm, avoid using the telephone except for emergencies and stay away from windows.