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NSSL The National Severe Storms Laboratory

SEVERE WEATHER 101

Frequently Asked Questions about Tornadoes

If your question is not answered below, check this excellent, comprehensive list of tornado FAQs from the NOAA Storm Prediction Center.

Where do tornadoes come from?

Tornadoes come from the energy released in a thunderstorm. As powerful as they are, tornadoes account for only a tiny fraction of the energy in a thunderstorm. What makes them dangerous is that their energy is concentrated in a small area, perhaps only a hundred yards across. Not all tornadoes are the same, of course, and science does not yet completely understand how part of a thunderstorm's energy sometimes gets focused into something as small as a tornado.

Where do tornadoes occur?

Whenever and wherever conditions are right, tornadoes

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are possible. In the U.S. they are most common in the central plains of North America, east of the Rocky Mountains and west of the Appalachian Mountains. They occur mostly during the spring and summer; the tornado season comes early in the south and later in the north because spring comes later in the year as one moves northward. They usually occur during the late afternoon and early evening. However, they have been known to occur in every state in the United States, on any day of the year, and at any hour. They also occur in many other parts of the world, including Australia, Europe, Africa, Asia, and South America.

What type of damage can tornadoes do?

The damage from tornadoes comes from the strong winds they contain and the flying debris they create. It is generally believed that tornadic wind speeds can be as high as 300 mph in the most violent tornadoes. Wind speeds that high can cause automobiles to become airborne, rip ordinary homes to shreds, and turn broken glass and other debris into lethal missiles. The biggest threat to living creatures (including humans) from tornadoes is from flying debris and from being tossed about in the wind. It used to be believed that the low pressure in a tornado contributed to the damage by making buildings “explode” but this is no longer believed to be true.

Can a tornado dig up the ground?

There have been reports of tornadoes blowing dirt and creating a trench 3 feet deep, but it is very uncommon. Tornadoes have been known to strip asphalt pavement.

How are tornadoes detected?

Today, the development of Doppler radar has made it possible, under certain circumstances, to detect a tornado's winds with a radar (see our section on Tornado detection). In some cases, it is also possible to detect the flying debris created by a tornado with radar. However, human beings remain an important part of the system to detect tornadoes, because not all tornadoes occur in situations where the radar can “see” them. Ordinary citizen volunteers make up what is called the SKYWARN network of storm spotters, who work with their local communities to watch for approaching tornadoes, so those communities

FAQ

- Floods
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WHAT TYPES OF DAMAGE CAN A TORNADO DO?

Wind speeds in tornadoes can rip ordinary homes to shreds [+]

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can take appropriate action in the event of a tornado. Spotter information is relayed to the National Weather Service.

You can be a storm spotter too! Visit www.skywarn.org . On this site there is a link to local SKYWARN groups. If your area is not listed, contact your local National Weather Service Office .

How do tornadoes form?

See our explanation in the Tornado Types section.

Can tornadoes be predicted?

Yes, but only to a limited extent. Although the process by which tornadoes form is not completely understood, scientific research has revealed that tornadoes usually form under certain types of atmospheric conditions. When forecasters see those conditions, they can predict that tornadoes are likely to occur. However, it is not yet possible to predict in advance exactly when and where they will develop, how strong they will be, or precisely what path they will follow. Once a tornado is formed and has been detected, warnings can be issued based on the path of the storm producing the tornado, but even these cannot be perfectly precise about who will or will not be struck.

What are the people called who study tornadoes?

People who study tornadoes are just research meteorologists or atmospheric scientists. You may have heard another term—storm chaser—but that really refers to people who chase tornadoes and storms for a hobby. Research meteorologists have a scientific purpose behind their pursuit of severe weather. They have to come up with questions they think they can answer by taking certain measurements.

What are the wind speeds in a tornado?

The biggest threat to living creatures (including humans) from tornadoes is from flying debris and from being tossed about in the wind. [+]

WHAT IS A GUSTNADO?

A gustnado is a small and usually weak whirlwind which forms as an eddy in thunderstorm outflows. They do not connect with any cloud-base rotation and are not tornadoes, but because gustnadoes often have a spinning dust cloud at ground level, they are sometimes wrongly reported as tornadoes. [+]

We're not really sure what the highest wind speed might be inside a tornado, since strong and violent tornadoes destroy weather instruments. We really only have measurements of the winds inside weaker tornadoes. Mobile Doppler radars can measure wind speeds in a tornado above ground level, and the strongest was 318 mph measured on May 3, 1999 near Bridge Creek/Moore, Oklahoma.

How fast do tornadoes move?

We don't have detailed statistics about this. Movement can range from almost stationary to more than 60 mph. A typical tornado travels at around 10–20 miles per hour.

How long is a tornado usually on the ground?

Detailed statistics about the time a tornado is on the ground are not available. This time can range from an instant to several hours. The average is about five minutes.

Does NSSL do things like they showed in the movie *Twister*?

The movie *Twister* was based upon work NSSL did in the mid-1980s using a 55-gallon drum outfitted with various meteorological sensors. It was called TOTO (TOtable Tornado Observatory). NSSL tried for several years to put it in the path of an oncoming tornado, but had minimal success. TOTO did not have the sensors that fly up into the tornado; that depiction in the movie is entirely fiction and the technology doesn't exist. It is possible that the technology could exist someday; however there are significant challenges with observations such as these.

Read more about *Twister* science

Has every state had a tornado?

Yes, although some states have many more tornadoes than others.

Are there tornadoes in the Arctic Circle?

We are not aware of any tornadoes occurring in the Arctic Circle. Tornadoes need moisture and warm air to form, which is unusual at that latitude. Plus tornadoes or their evidence have to be observed by someone, and the Arctic

Circle has few residents!

Do tornadoes really stay away from gullies, rivers and mountains?

A gully could actually make a tornado more intense, just as an ice skater spins faster when he or she stands up tall and stretches their arms up straight over their heads. Every major river east of the Rockies has been crossed by a significant tornado, and high elevations in the Appalachians, Rockies, and Sierra Nevada have all experienced tornadoes. A violent tornado crossed the Continental Divide in Yellowstone National Park.

Do tornadoes always come from a wall cloud?

A wall cloud is not always present. It is also possible that you cannot see a wall cloud because of your viewing angle or low level clouds.

What does a tornado sound like?

People who have been in a tornado say it sounds like a jet engine or a freight train and is very loud. They said it hurt their ears, but they were more worried about what might happen to them than they were about the pain in their ears.

Can tornadoes be stopped?

You have to consider that the tornado is part of something bigger: the supercell thunderstorm. Unless you disrupt the supercell thunderstorm itself, you would likely have another tornado, even if you were able to destroy the first. The thunderstorm's energy is much greater than the tornado. No one has tried to disrupt the tornado because the methods to do so could likely cause even more damage than the tornado. Detonating a nuclear bomb, for example, to disrupt a tornado would be even more deadly and destructive than the tornado itself. Lesser tactics (like deploying huge piles of dry ice or smaller conventional weaponry) would be too hard to get into the right place fast enough, and would likely not have enough impact to affect the tornado much anyway.

Thunderstorms, and all of the hazards they produce, are part of a natural earth cycle. Taking actions sufficient to disrupt this cycle could lead to unintended consequences.

What is the difference between a tornado watch and a tornado warning?

A **tornado watch** defines an area where tornadoes and other kinds of severe weather are possible in the next several hours. It means that you need to be alert, and be prepared to go to safe shelter if tornadoes happen or a warning is issued. If you have a NOAA Weather Radio and have it set up correctly it will alert you to the watch. Tune in to local TV, radio or internet for more information. A **tornado warning** means that a tornado has been spotted, or that Doppler radar shows a thunderstorm circulation which can spawn a tornado. When a tornado warning is issued for your area, seek safe shelter immediately. The Storm Prediction Center issues tornado and severe thunderstorm watches. Your local National Weather Service office issues tornado warnings, as well as thunderstorm warnings, which include the possibility of tornadoes.

What would it be like to be in the eye of a tornado?

There is no “eye” to a tornado like there is in a hurricane. This is a fiction largely caused by the movie *Twister*. Tornadoes are complex and can have multiple small structures called “sub vortices” rotating inside the larger parent circulation. There may be some downward motion inside the tornado itself, but observations of this and other properties of tornadoes are difficult as the instrumentation needed to observe them doesn’t survive the tornado itself.

How many tornadoes hit the US each year?

About 1200, though it can vary significantly from year to year or location to location.

I have a theory about tornadoes; who do I talk to?

We receive literally hundreds of ideas for observing, controlling, or stopping destructive storms. Our scientists are likely to look at ideas that are investigated by a researcher who publishes the results in a peer-reviewed journal. In this way they can review, and if necessary, replicate the results, which then will suggest the next step to move the science forward.

I would like to volunteer to help NSSL during a tornado intercept field project.

Unfortunately, government regulations make it impossible to accept offers from the public to do volunteer field work for any tornado intercept programs. Legal liability questions prevent NSSL from accepting volunteers, even at their own risk.

How is the strength of a tornado determined?

The rating scale for tornadoes is based entirely on the damage they cause. From the damage, we can estimate the wind speeds. An "Enhanced Fujita Scale " was implemented by the National Weather Service in 2007 to rate tornadoes in a more consistent and accurate manner. The EF-Scale takes into account more variables than the original Fujita Scale (F-Scale) when assigning a wind speed rating to a tornado, incorporating 28 damage indicators such as building type, structures and trees. For each damage indicator, there are 8 degrees of damage ranging from the beginning of visible damage to complete destruction of the damage indicator. The original F-scale did not take these details into account. The original F-Scale historical data base will not change. An F5 tornado rated years ago is still an F5, but the wind speed associated with the tornado may have been somewhat less than previously estimated.

Strong or violent tornadoes can and do occur in areas where minimal damage occurs, leading to a low EF scale rating.

Do tornadoes target mobile home parks?

While it may appear tornadoes target mobile home parks, they actually do not. An EF1 tornado might do significant damage to a mobile home, and cause minor damage to a site built home, looking like the tornado "skipped" the house. Mobile homes are, in general, much easier for a tornado to damage and destroy than well-built houses and office buildings. A mobile home, or manufactured home, by definition, is built at a factory and taken to the place they will occupy, so they are much more affordable than a house built on-site. They are often built with lighter-weight materials, which do not hold up well in tornadic winds.

Straight-line winds can also destroy a mobile home as easily as a tornado, especially one that is not anchored. Any wind gust that is sustained for 3 seconds over 50 mph

can cause damage to mobile homes.

These websites may be of interest to you:

- Mobile Home Danger (NOAA Storm Prediction Center)
- Mobile Homes and Severe Windstorms (AMS)
- Mobile Homes and Weather: Left to the Elements (WeatherZine)

Some states are beginning to require storm shelters for their residents. The problem of warning and sheltering mobile home residents has become the biggest obstacle to continuing to reduce death tolls from tornadoes.

Do wider tornadoes cause more damage?

There is a statistical trend toward wide tornadoes having higher EF-scale damage. This can be because of stronger winds or because of greater opportunity for targets to be damaged, or a combination of both. However, the size or shape of any particular tornado does not say anything conclusive about its strength. Some small tornadoes can still do very violent damage of EF4 or EF5. And, some very large tornadoes over a quarter-mile wide have produced only weak damage.

What is the difference between a tornado and a cyclone?

A tornado is a small-scale cyclonic circulation, and in the past, has been referred to as a cyclone. The term cyclone was used to describe anything that rotated counterclockwise, so often tornado (a small-scale cyclonic circulation) and cyclone were interchangeable. Modern meteorology now restricts the use of the term, “cyclone,” to the larger-scale circulations—usually also accompanied by low pressure and bad weather. However, people still use it both ways.

What is a gustnado?

A gustnado is a small and usually weak whirlwind which forms as an eddy in thunderstorm outflows. They do not connect with any cloud-base rotation and are not tornadoes, but because gustnadoes often have a spinning dust cloud at ground level, they are sometimes wrongly reported as tornadoes. Gustnadoes can do minor damage

(e.g., break windows and tree limbs, overturn trash cans and toss lawn furniture), and should be avoided.

Are there electromagnetic or magnetohydrodynamic explanations for the development of tornadoes?

As far as scientists understand, tornadoes are formed and sustained by a purely thermodynamic process. As a result, their research efforts are towards that end. They have spent a lot of time modeling the formation of a tornado and measuring many parameters in and around a tornado when it is forming and going through its life cycle. They have not seen any evidence to support magnetism or electricity playing a role.

Can my TV signal detect tornadoes?

You may have read about a technique called “the Weller Method” of tornado detection. The idea was to be able to use your TV as a lightning detector to detect the radio waves emitted by a lightning flash, with the assumption that tornadic thunderstorms were very active lightning producers. But, not all tornadic storms produce large amounts of lightning. Also, TVs are all different and have different sensitivities, and some are even made to filter out lightning signals. Plus, if you are connected to cable, it won't work. The method was found to be completely unreliable and it has mostly been abandoned.

Do tornadoes occur when it is cold?

There is no particular temperature at which tornadoes form. It is more about what the surface temperature is in relation to the temperature higher up in the atmosphere. Even if it is cold near the surface, as long as it is colder higher up, the winds are right to set up low-level wind shear, along with other necessary ingredients, a tornado is possible.

What direction do tornadoes spin?

More tornadoes in the Northern Hemisphere spin counterclockwise than clockwise.

Do rocks, hills, or trees increase or decrease the wind speeds in a tornado?

Unfortunately, there is no clear answer. Both observations

(of real tornadoes), computer simulations, and laboratory studies (in tornado vortex chambers) have shown that the "surface roughness", i.e., the measure of how disrupted the wind near the ground is by objects such as dirt, rocks, hills, trees, and even houses, can either increase or decrease the wind speeds in a tornado. How can trees increase the wind speeds? Well, the strongest winds in a tornado occur when air from outside the tornado can flow closest to the center of the vortex. The conservation of angular momentum, e.g., the rotation in the air, requires that as the air flows toward the center of the tornado (as it spirals in) its rotation must increase. Depending on the configuration of the airflow outside of the tornado, sometimes there is not ENOUGH "inflow" toward the center, and so blobs of air outside the tornado do not get very close to the center of rotation before they are lifted upward off the ground. In this case, INCREASING the surface roughness helps get these blobs of air closer to the center of the tornado, where they rotate even faster than before. So occasionally we see in tornado videos the vortex increasing in intensity when it travels from one type of ground surface (say a field) into a grove of trees or a housing subdivision. It does not always happen, but often enough that we are aware of it. This is a case where "friction," which people normally think of slowing things down, actually speeds them up!

Can you recommend a good storm shelter manufacturer?

We do not endorse any particular company or type of storm shelter. Consider checking out the Federal Emergency Management Agency website . They work with communities on tornado preparedness.

Where is Tornado Alley?

"Tornado Alley" is a just a nickname for an area of relatively high tornado occurrence; it is not a clearly defined area. Is Tornado Alley the area with the most violent tornadoes, or is it the area with the most tornado-related deaths, or the highest frequency or tornadoes? It depends on what kind of information you want!

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