Why so Many Killer Tornadoes in 2011?

Several killer tornadoes struck the eastern half of the USA in April, May, and June, 2011.

Many questions were raised by citizens and the media across the country –

"Why so many deaths?
"Is the warning system broke?"
"I thought tornadoes don't hit cities."
"Is this the result of global warming."
"Are these tornadoes following a pattern – or is it just a coincidence?

Without getting into the climate change question, let's concentrate on the issues of why there have been so many deaths in 2011, the warning system, and some tornado myths.

Tornado Basics: Here's What we Know

The U.S. has the greatest number of tornadoes for any continent, averaging around 1300 per year. This is a result of the unique combination of un-impeded (no mountain blocking) flows of warm, moist air from the Gulf of Mexico, cool air from Canada, and dry air from the Southwest U.S. Mix in daytime heating to make the atmosphere unstable, along with low pressure systems, cold fronts, and warm fronts, and you get supercell thunderstorms with tornadoes!

About 55 to 60 people die, on average, each year from tornadoes. Most of these fatalities are due to falling/crushing debris. The Storm Prediction Center (SPC) in Norman, OK, maintains national statistics.

Most of the U.S. tornadoes east of the Rocky Mountains, and can spin up any time of the day. The late afternoon and evening hours are favored times. However, killer tornadoes do occur at night.

The peak tornado season runs from March to August east of the Rocky Mountains. However, the peak period is March to May near the Gulf Coast on up to July and August in some of the far northern states. Some locations near the Gulf Coast have a secondary peak in November! Tornadoes have occurred in all months – even Wisconsin and Illinois have had tornadoes in December and January!

Some tornado seasons are quiet – as in 1987, and others are busy – such as in 2004 and this year. This variation is probably related, at least in part, to the effects of El Nino, La Nina, the Arctic Oscillation, jet stream patterns, other atmospheric teleconnections, and oceanic currents. In other words – no two years are the same.

Tornado Myths

There is never a shortage of tornado myths in the U.S. Our time on this earth is limited, but the weather goes on for millions of years. Therefore, we are not around long enough to experience all the tornado variations that occur. This leads to the formation of tornado myths such as:

Tornadoes don't occur in cities because the tall buildings split storms (what about the tornadoes in Dallas, St. Louis, Joplin, Birmingham, Nashville, Springfield MA, Salt Lake City, Miami, Chicago, and Milwaukee Mitchell Field?)
Tornadoes don't occur over mountains, ridges, hills, plateaus, or ledges (what about a tornado at 13,000 feet elevation in the Sierra Nevada Mountains?)
Tornadoes don't go down into river valleys (what about the Springfield, MA, tornado in the Connecticut River Valley?)

Tornadoes don't cross over ponds, lakes, swamps, marshes, or bogs (what about the tornado that spun up over the Horicon Marsh, WI?)
Low Pressure in a Tornado Causes a Building to Explode. The tornado winds and flying debris-missiles slamming into buildings cause most structural damage.
Windows Should be Opened Before a Tornado Approaches to Equalize Pressure and Minimize Damage. Opening windows allows damaging winds to enter the structure. Leave the windows alone; instead, immediately go to a safe place.
The Southwest Side of a Basement is the Safest Place in a Basement. Since most tornadoes move southwest to northeast, it was assumed that most of the debris would be carried northeast away from the southwest part of a building. However, tornadoes can move west to east, or even northwest to southeast. Additionally, large pieces of debris or even vehicles can crash into a basement.
Tornadoes Don't Visit the Same Place Twice. Different tornadoes have traveled through the same location on the same day. They have visited the same county in three consecutive years. It's just a matter of time – maybe not in your lifetime – but eventually it will happen.

Is the Warning System Broke?

No, the warning system isn't broken. It's not perfect, but it is much improved compared to a couple decades ago. The National Weather Service (NWS), through better technology, increased training, and more highly-trained severe weather spotters, has increased the average warning lead time from about 3 minutes in the late 1970s to over 13 minutes in 2010. Theoretically, a greater lead time allows people more time to seek a sturdy shelter.

The warning system consists of three tiers:
1) Doppler radar detection of thunderstorms that can spawn a tornado,
2) The issuance and dissemination of tornado warnings, and
3) The reception of and the proper response (seek a sturdy shelter) to the warning by the general public.

All three tiers of the warning system have to be successful in order to minimize the loss of life and property. The NWS has done pretty good with items #1 and #2 above, and it is committed to continued improvement in warning lead times and better utilization of communication tools; including social media outlets such as Twitter, Facebook, etc. Everyone in this country needs to pull together to improve item #3 above.

Why so Many Tornado Deaths?

Many factors influence determine how many people are killed by a tornado. Some of the possibilities are listed below:

- The population of the U.S. has more than doubled since 1950. We have urban sprawl and expanding suburbs. A significant shift in the population has occurred – more people than ever live in cities as some rural areas lose people. More people and higher concentrations of people equal increased chances of death.
- Strength of Tornado. The stronger a tornado is the higher the speed of its winds and therefore the greater the chances for fatalities and destruction. Tornadoes strength is rated on a scale from 0 to 5, with 5 being the strongest. EF0 and EF1 tornadoes (65 to 110 mph) are considered "weak," EF2 and EF3 tornadoes (111 to 165 mph) are considered "strong," and EF4 and EF5 tornadoes (166 mph to over 200 mph) are considered "violent."

  Below is a table showing the percentage breakdown of number of tornadoes in the U.S. (1950-1994) by EF-Scale group, as well as the percentage of deaths for each group.

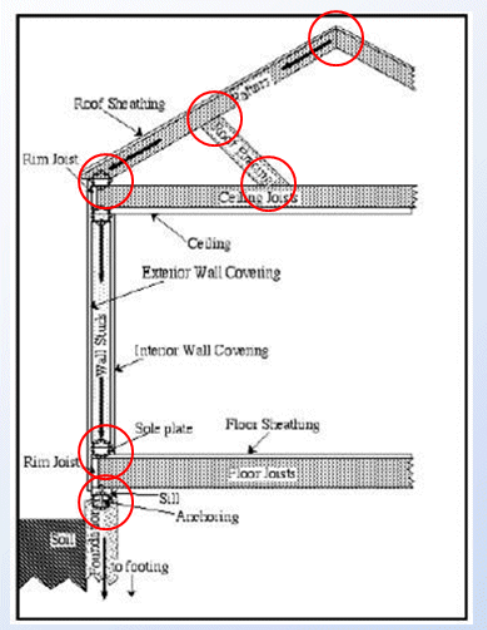
EF-Scale Rating	% of all Tornadoes	% of all Fatalities
EF0 & EF1 (65 to 110 mph)	74%	4%
EF2 & EF3 (111 to 165 mph)	25%	29%
EF4 & EF5 (166 mph to 200+ mph)	1%	67%

Violent tornadoes basically destroy and/or level standard, stick-built residential homes and most other structures that don't have a steel or concrete core or have extra anchoring devices that enhance that building's wind-resistant capabilities. So for most people in this country, there isn't much that can be done when it comes to EF4 and EF5 tornadoes unless they are in a storm shelter or safe room designed to withstand such a tornado (see other related factors in this listing). End result is increased chances of death with violent tornadoes.

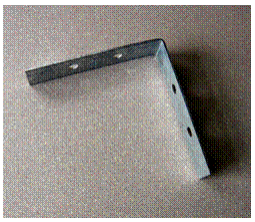
- Day of week and time of day. More people are traveling during certain periods of the week when they are less likely to monitor the weather or understand which part of a county is under a tornado warning, and less able to seek a sturdy shelter. There may be a graduation ceremony, a state or county fair, a major sporting event. Since most people sleep at night, there are increased chances of some people not being aware of a tornado warning and an approaching tornado. End result is increased chances of death.
- Ability to Acquire Warning Information. The NWS recommends that people have multiple means of acquiring warning information. Do not rely solely on one method such as outdoor sirens. Outdoor sirens are not designed to be heard indoors, and they can be damaged by a tornado or stop working due to loss of electricity if they don't have a battery backup. If you lose commercial power, you may not be able to obtain warning information via commercial TV or radio. Every home and business should have a NOAA Weather Radio All Hazards receiver unit with battery backup capabilities. Weather radios are a direct source of warning information. Smart telephones, cell phones, and other portable electronic devices allow a person to acquire warning and radar information. Social media outlets such as Twitter, Facebook, etc., allow people to acquire "word-of-mouth" warning information from relatives and friends. In the end it doesn't matter how a person acquires warning information; responding properly and seeking a sturdy shelter increases the chances of survival.
- Type of building a person is in. Southern states tend to have a higher percentage of homes that are considered mobile/trailer which are not as safe as a standard stick-built or brick residential home. Additionally, southern states tend to have a higher percentage of homes and buildings without basements. Although you are not 100% safe in a basement (large pieces of debris can fall into basements), being in a basement is safer than being above ground level. Earth-berm houses obviously offer more protection than any standard residential home. Additionally, certain roof types are stronger than others, and some buildings, such as round or octagonal, are more wind resistant. Large, big-box buildings or auditoriums are typically less safe because their large ceilings can easily fall on people. End result is increased chances of death
- Cultural, economic, and religious factors may determine what kind of a building a person lives in as well as influence their response to a tornado warning. Some people may not seek a sturdy shelter if their belief system dictates that "when their time is up, it's over – there's no sense in seeking a sturdy shelter." End result is increased chances of death.
- State of Denial and Lack of Experience. Some people simply believe they will never be impacted by a tornado. In fact, most people in the U.S. will never personally see a tornado off in the distance, let alone have a tornado hit their home, condo, or apartment. Ask yourself – how many times has a tornado impacted one of the homes you lived in? So the majority of people in this country don't have personal experiences to draw upon when a tornado does approach their location. Surveys have shown that if a person has experienced a weather disaster before, they will likely react more quickly to a similar future situation with more confidence.

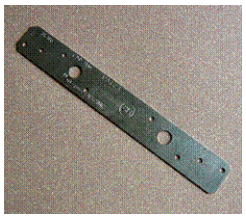
- Structural strength of a building. The greater the amount of concrete or steel that surrounds a person, the safer they are. Buildings with a steel skeleton or appreciable amounts of concrete and brick can withstand higher winds compared to standard, stick-built homes. Also, the greater the number of metal structural connectors installed in a building (such as residential homes) where wood meets wood, the stronger the winds that building can withstand. Most standard-built residential homes can't withstand tornado winds unless the tornado is weak. Some homes are not anchored to their foundation and will easily slide and then fall apart in the tornado winds. End result is increased chances of death.

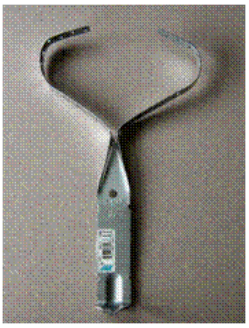
  The graphic below shows locations (red circles) of possible "weak links" in a residential home – where wood meets wood. Installing extra metal structural connectors, above and beyond what is dictated by local and state building codes, will significantly increase the ability of the home to withstand strong winds. Flying debris missiles will still result in damage. Use your favorite search engine to find additional information on "structural connectors." Work with your building contractor to have extra metal structural connectors installed as an added expense.



The chances of any single building in the U.S. being hit by a tornado in any given year are incredibly small. However, it is a given that dozens or hundreds of buildings will be damaged or destroyed by tornadoes every year in this country. So the question is – is it worth the expense to have extra metal structural connectors installed in a building? Most people would answer 'no." However, some people would consider the expense of installing the extra anchoring devices to be an "insurance" policy.







Metal structural connectors

- Language or hearing/handicap barriers. An increasing number of people in the U.S. do not use English as their primary language. Therefore, some people simply do not understand the warning message. Some people are hard of hearing or have a total hearing loss. These people may not be aware of a tornado warning. Other physical handicaps may make it difficult for a handicapped person to receive, understand, and react to a tornado warning. End result is increased chances of death.
- A person's response time. Public surveys have shown that many people need to confirm that a tornado warning has been issued via a second or even third source. They may need to turn on the TV, or telephone a relative, friend, neighbor, or 911, and reconfirm their first source of the warning information was correct. The younger population may do the reconfirmation via smart phones and social media outlets such as Twitter and Facebook. This takes time. End result is increased chances of death.
- Location of person within a building or outside. You are safer in a basement than being above ground level. However, large pieces of debris or even vehicles can crash into a basement and crush a person. Buildings tend to destruct from the outside in. Therefore, an interior closet or room offers more protection than a room on the outside of a home. The more walls you have around you the safer you are. Stay away from windows since they break easily in tornadic situations. Some people have saved their life by jumping into a bathtub (it may be bolted to the floor and less likely to move). If you are in a motor vehicle, drive away from a tornado at right angles, assuming there is time, and seek a sturdy

shelter. If there is no time and the tornado is close to your vehicle, you have a choice – either remain in your vehicle with seat belts on, or get out of your vehicle and lie flat on the ground. You risk injuries or death with either choice. Do not go under a highway overpass – tornado winds blow stronger under the overpass and flying debris-missiles may impact you. Keep in mind that debris-missiles can impale a vehicle and you, resulting in increased chances of death.

- Knowledge of safety rules. Some people may not know how or when to drive away from a tornado, or know what a sturdy shelter looks like, or where to go once they are in a sturdy shelter. If a person practices in a tornado drill, they will be more likely to react quickly and properly when the real thing hits. Let's face it, when a tornado is bearing down, some people may panic or freeze. End result is increased chances of death.
- Ability to recognize what a tornado looks like. Tornadoes come in different shapes, sizes and colors. Hills, trees, and buildings may block a person's view of a tornado until the last second. Some tornadoes are almost invisible while others just look like a low, dark cloud. Consequently, some people drive their vehicles or boats dab smack into a tornado without realizing what they are doing. During the night it is even more difficult to recognize a tornado. End result is increased chances of death.
- Location in the U.S. The area east of the Rocky Mountains has most of the tornadoes in this country. There is a tornado alley of some sort in the southern and central plains states, and there are other warm or hot spots in the Gulf States and parts of Arkansas, Illinois, Indiana, Wisconsin, Kentucky, and Tennessee. Live in an area that has more tornadoes climatologically and you increase the chances of death.

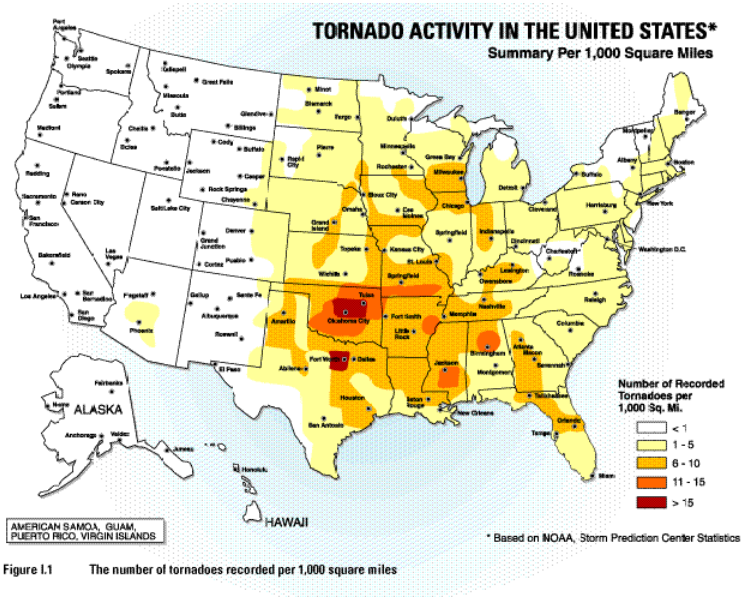


Figure I.1 The number of tornadoes recorded per 1,000 square miles

- Presence of a Storm Shelter or Safe Room. Many commercial companies manufacture reinforced rooms or structures that can be incorporated into a building or installed underground. These storm shelters or safe rooms are engineered to withstand EF4 and EF5 tornadoes. Capacity of these structures ranges from 2 or 3 on to up 15 or more, and their cost can run into the thousands of dollars. Some home owners may be able to build their own concrete/steel storm shelter in the corner of their basement, or construct an underground storm shelter in their back yard.

The chances of any single building in the U.S. being hit by a tornado in any given year are incredibly small. However, it is a given that dozens or hundreds of buildings will be damaged or destroyed by tornadoes every year in this country. So the question is – is it worth the expense to have a storm shelter or safe room installed in a building or underground in the back yard? Most people would answer 'no."

However, some people would consider the expense of installing a storm shelter or safe room to be an "insurance" policy.

- Loss of Electrical Power. In some cases, a person at a medical facility may be on a life-support system. If the electrical power is lost, and there is no back-up power, that person may die.
- Degree of luck. In some cases, it's a matter of inches or feet whether a person survives or is crushed to death by tornado debris, or picked up by the tornado winds and thrown against a wall.