



1ST  
EDITION

# THUNDERSTORMS, LIGHTNING, & TORNADOES



A Preparedness Guide | SkyWarn UK

# Thunderstorms, Lightning, Tornadoes

## Natures Most Violent Storms

This preparedness guide explains the thunderstorms and their hazards and suggests life-saving action you can take. With this information you can recognize severe weather hazards, plan for severe weather, and be prepared for when severe weather strikes.

### Why Worry About Thunderstorms?



#### Lightning...

- Kills an average 3 – 6 people per year, and 30 – 60 injuries
- Occurs with every thunderstorm
- A 'thunderstorm day' may have over 10,000 lightning strikes

#### Tornadoes...

- An average of 40 or more tornadoes occur in the UK each year
- May produce wind speeds over 100 mph
- Can cause damage, injury, and on rare occasions fatalities

#### Straight-line Winds...

- Can exceed 70 mph
- Can cause damage comparable to that of a tornado
- Dangerous to aviation

#### Flash Floods...

- Rainfall rates of over 100 mm/hr can cause flash flooding

#### Hail...

- Can be over 20 mm diameter
- Causes damage to crops and property

# Thunderstorms

A thunderstorm affects a relatively small area when compared to other weather systems. A typical thunderstorm is usually no more than 15 miles across and lasts no longer than 30 minutes. However, **ALL** thunderstorms are dangerous.

The UK Meteorological Office does not classify Severe Thunderstorms. However, SkyWarn UK and TORRO classify severe thunderstorms as having one or more of the following: Wind gusts of at least 55 mph; hail of at least 20 mm diameter; tornado(es)

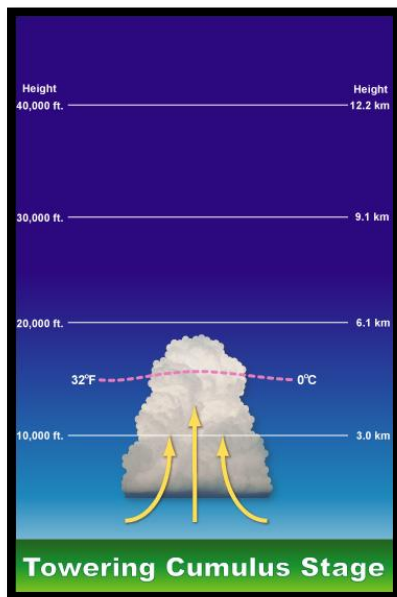
## What Are Thunderstorms? What Causes Them?

### Every Thunderstorm Needs:

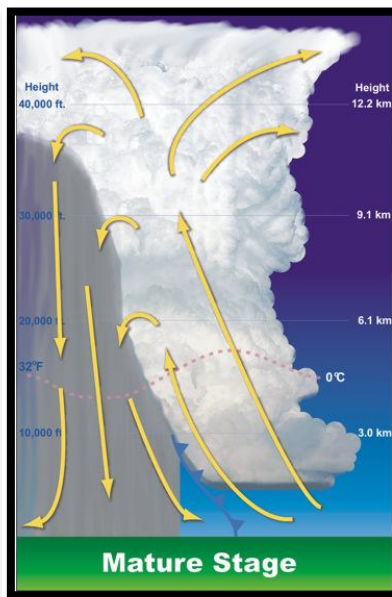
- **Moisture** – to form clouds and rain
- **Instability** – warm air that can rise rapidly
- **Lift** – caused by warm or cold fronts, sea breezes, mountains, or the sun's heat

On average there are around 1,800 thunderstorms occurring at any given time around the world. That's 16 million thunderstorms per year!

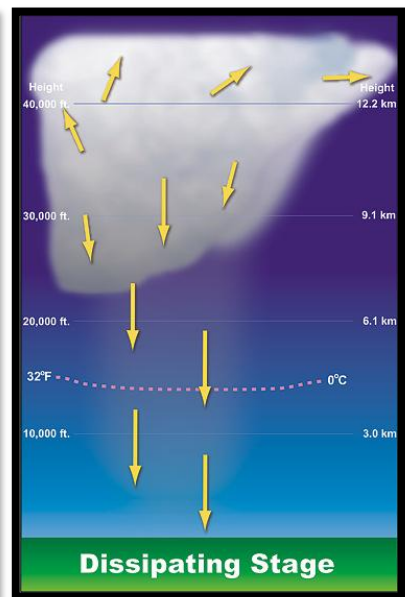
### The Thunderstorm Life Cycle



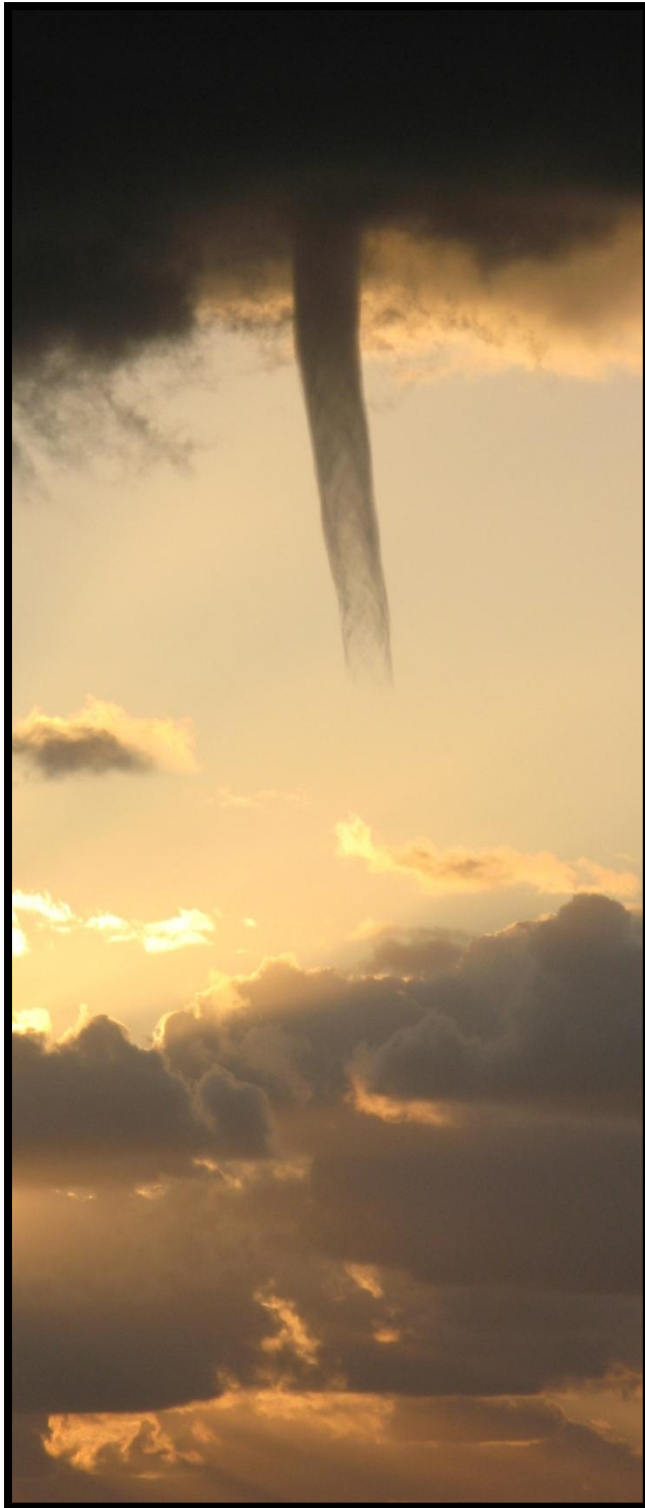
- Towering cumulus indicates rising air
- Usually little, if any, rain
- Lasts about 10 minutes
- Occasional lightning



- Most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes
- Storm may occasionally have a black or dark green appearance
- Lasts an average of 10 to 20 minutes, but some may last longer



- Downdraft dominate the storm
- Rainfall intensity decreases
- Can still produce a burst of strong winds
- Lightning remains a danger



A funnel cloud, the type often seen in the UK

## Tornadoes

Although tornadoes are most often associated with the USA, the UK has an average of 40 per year. More information on UK tornadoes can be found at [www.torro.org.uk](http://www.torro.org.uk)

### Tornado Facts

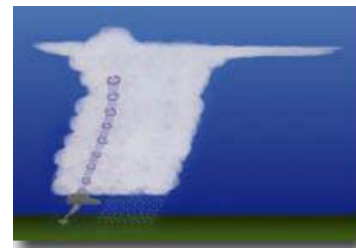
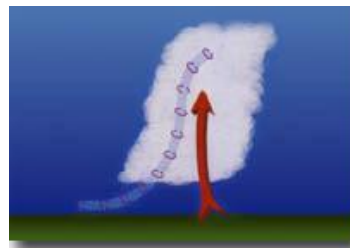
- A tornado is a violently rotating column of air extending from a cloud base to the ground
- Tornadoes may appear transparent until dust and debris are picked up, or a condensation funnel forms
- Tornadoes often move southwest to northeast, but can move in any direction, change direction suddenly, and move forward at speeds up to 70 mph
- Tornadoes may produce winds over 200 mph
- Waterspouts are tornadoes that occur over water
- Tornadoes can occur at any time of day, at any time of the year, and are not always associated with thunderstorms

### The Enhanced Tornado Intensity Scale

SkyWarn UK uses the ETI to assign a tornado a rating based on estimated wind speeds and the damage caused:

ETI Rating	Wind speeds
0	39 – 54 mph
1	55 – 72 mph
2	73 – 92 mph
3	93 – 114 mph
4	115 – 136 mph
5	137 – 160 mph
6+	161+ mph

## How Tornadoes Form in a Thunderstorm



Before a thunderstorm develops, winds change direction and increase in speed with height. This creates an invisible, horizontal rotating effect in the lower atmosphere.

Rising air within the thunderstorm updraft tilts the rotating column of air from horizontal to vertical.

An area of rotation now some 2 to 6 miles wide now extends through much of the storm. Most tornadoes associated with thunderstorms form within this area of rotation.

## Tornadoes in the UK

As previously stated, tornadoes are not as uncommon as some might think. The UK sees an average of 40 tornadoes per year. However, the number varies greatly. In fact, on November 23, 1981 the UK saw a total of 105 tornadoes in an outbreak that lasted 5 ½ hours. The strongest tornado to occur in the UK was a T8 tornado with winds of up to 240 mph. This tornado struck London on October 23, 1091.

The average UK tornado is relatively weak, usually no stronger than T2 or T3, with winds of between 70 and 110 mph. They are often no more than 20 – 100 meters wide on the ground, and track for around 1 to 3 miles. Most UK tornadoes are not associated with super-cell thunderstorms, unlike the more damaging tornadoes that occur in other parts of Europe and the USA.

The tornado that struck Birmingham on July 28 2005 was rated a T5 at its strongest point. It uprooted approximately 1,000 trees, damaged roofs and buildings, and caused an estimated £40 million in damage. It was the costliest UK tornado of modern times.

## Tornado Fiction and Fact

**Fiction:** Lakes, rivers, and mountains protect areas from tornadoes

**Fact:** No geographic location is safe from tornadoes

**Fiction:** A tornado can cause a building to 'explode' as it passes over

**Fact:** Violent winds and blowing debris cause the most structural damage

**Fiction:** Open windows before a tornado approaches to equalize pressure and minimize damage

**Fact:** Most buildings 'leak'. Leave windows closed and seek safe shelter immediately

**Fiction:** It is safe to take shelter in a closet, bathroom, or interior room of a mobile home

**Fact:** Mobile homes are extremely unsafe in high winds. Leave them for safe shelter immediately

# Lightning

Lightning occurs in all thunderstorms. As warm air rises within the thundercloud it condenses and forms freezing precipitation within the cloud. This freezing precipitation includes very small ice crystals, as well as pellets of ice and snow. As the air rises within the thundercloud, the smaller ice pellets are carried higher up while the larger pellets remain suspended or begin to fall through the cloud. As these pellets move they collide, and this leads to an electrical charge within the cloud – positive on the smaller ice crystals and negative on the larger pellets. This results in the top of the cloud become positively charged while the mid and lower sections of the cloud become negatively charged. At the same time, the ground beneath the cloud becomes charged oppositely of the charges overhead.



When the difference between the charge on the ground and in the cloud above becomes too great a conductive channel of air develops between the cloud and the ground. A small amount of charge, known as a step leader, begins to travel through this channel from the cloud towards the ground. As it nears the ground a step leader of opposite charge begins to move from the ground towards the cloud. When these two step leaders meet a powerful discharge occurs between the cloud and the ground, this discharge we see as lightning.

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## Lightning Facts

- When a thunderstorm is nearby, no outdoors place is safe
- The vast majority of lightning victims left it too late to seek safe shelter
- The energy from 1 lightning flash could light a 100 watt bulb for more than 3 months
- The channel of air through which lightning passes can exceed temperatures of 50'000°F – this is hotter than the surface of the sun. Thunder is the sound made as a result of the rapid heating and cooling of the air near this channel

## How Far Away Is Lightning

To calculate how far away the lightning is follow these steps:

1. Count the number of seconds between the lightning flash and the subsequent thunderclap
2. Divide this number by 5 to get the distance in miles between you and the lightning strike
3. Remember, if outside and you can hear thunder you are at risk of being struck by lightning.



## Lightning Fiction and Fact

**Fiction:** If it is not raining, there is no danger from lightning

**Fact:** Lightning can strike outside of heavy rain, and often does so. In fact, lightning can strike up to 10 miles away from rainfall. This is especially true in 'elevated' storms that occur occasionally over parts of southern and southeastern Britain.

**Fiction:** The rubber soles of shoes or the rubber tires on a car will protect you from lightning

**Fact:** Rubber soles on footwear or rubber tires on a vehicle provide NO protection from lightning strikes. The steel frame of a hard-top car will provide some protection as long as you avoid touching the metal work. If lightning does strike a vehicle, you may be slightly injured but will still be safer than being outside.

**Fiction:** Someone struck by lightning should not be touched as they still carry an electrical charge

**Fact:** A person who has been hit by lightning carries no electrical charge. They will require immediate, professional medical help. If you come across someone who has been hit by lightning you should first dial 999 and summon the ambulance service. It is possible that a lightning strike victim may have gone in to cardiac arrest, and you may need to perform CPR until help arrives.

**Fiction:** 'Heat lightning' occurs after hot summer days and poses no threat

**Fact:** 'Heat lightning' refers to lightning that occurs too far away for thunder to be heard.

## Remember:

When thunder roars, go indoors!

## Straight-Line Winds

- Straight-line winds are any thunderstorm winds not associated with a tornado
- Straight-line winds can exceed speeds of 100 mph
- A downburst is a small area of rapidly descending air found beneath a thunderstorm
- As the picture to the right shows, downbursts can cause damage equivalent to that of a strong tornado and can be extremely dangerous to aviation
- A 'dry microburst' occurs with little or no rain



## Flash Floods and Floods

- A **flash flood** occurs within 6 hours or less of heavy or excessive rainfall, such as that in Boscastle in August 2004
- A **flood** develops more slowly than a flash flood, and is normally the inundation of a usually dry area due to high water flow
- **Six inches** of fast moving water can knock a person off their feet
- **Two feet** of rushing water can carry away most vehicles, including 4x4's and pickups
- When it comes to flooding – **turn around, don't drown**

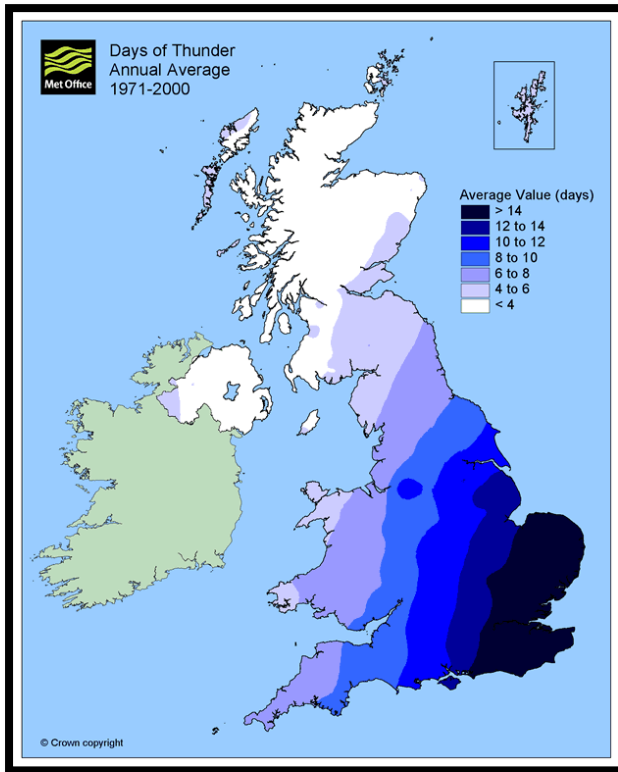


## Hail

- Strong updrafts carry water droplets high in to the cloud where they freeze. As they grow larger and too heavy to be kept aloft they fall as hail
- Large hailstones can fall at speeds over 100 mph
- The largest hailstone in the UK of recent times fell on Horsham on September 5<sup>th</sup> 1958. It weighed 190g.



# Who's Most at Risk from Thunderstorms



## From Tornadoes:

People who are in mobile homes or outdoors

## From Lightning:

People who are outdoors, or who remain outdoors when thunderstorms are nearby

## From Flash Flooding:

People who walk or drive through flood waters

## From Large Hail:

People who are caught outdoors

# When Dangerous Weather Approaches



## Avoid the Lightning Threat

- **Have a lightning safety plan.** Know where you will go for safety and how long it will take you to get there. Allow enough time to reach your safe place.
- **Postpone activities.** Before going outdoors check the latest forecast for thunderstorms. If thunderstorms are forecast consider postponing outdoor activities to avoid being caught in a dangerous situation.
- **Monitor the weather.** Look for signs that a storm may be developing, such as darkening skies, an increasing wind, and flashes of lightning.
- **Get to a safe place.** If you hear thunder, even if it is a distant rumble, move indoors to a place of safety. Remember, *when thunder roars, go indoors*. You will be best protected in fully enclosed buildings with wiring and plumbing as these give the best protection from lightning strikes. Sheds, bus shelters, tents, and porches provide very little protection from lightning. If a sturdy building is not available, seek shelter in a hard-top vehicle. You should remain indoors for no less than 30 minutes after the last rumble of thunder.
- **If you hear thunder do not use a corded telephone.** Cordless telephones, mobile telephones, and other wireless devices are safe to use.
- **Keep away from electrical equipment, wiring, and water pipes.** Sensitive electronic equipment should be unplugged well in advance of a thunderstorm. Do not take a bath or shower or use other plumbing during a thunderstorm.

## When Caught Outside in A Thunderstorm

Plan ahead to avoid being outside during a thunderstorm. As there is no safe place outside when a thunderstorm is occurring, you should endeavor to avoid this dangerous situation. If you hear thunder while outside, the only safe option is to seek shelter inside a sturdy building or hard-top vehicle.

- **Avoid open areas and stay away from isolated tall trees, utility poles, or towers.** Do not be the tallest object in the area. Lightning has a tendency to strike the tallest objects in an area.
- **Stay away from metal conductors such as wires or fences.** Metal does not attract lightning, but lightning can travel long distances through it.

## Tornado Safety Rules

- The safest place to be in a tornado is in a secure, below ground shelter such as a basement.
- If no secure, below ground shelter is available a small, windowless, interior room or hallway on the lowest level of a sturdy building is the next best option.
- Mobile homes and caravans are not safe in a tornado, and should be abandoned for more secure shelter.
- If you are caught outside during a tornado then you should seek shelter in a basement or sturdy building. If these options are not immediately available to you then you should:
  - Get in to your car, buckle the seat belt, and drive to the nearest safe shelter
  - If flying debris occurs whilst you are driving you should pull over and park. At this point you have two options:
    - Remain in the car with your seatbelt on. Lower your head below the level of the windows and cover it if possible.
    - If you can safely get noticeably lower than the road level, leave your car and lie in that area, covering your head with your hands.
  - Your choice should be driven by your specific circumstances.



## Flash Flood Safety Rules

- Do not drive or walk through flood waters. You should also avoid swimming in flood waters.
- Stay away from high water, storm drains, ditches, and culverts. Just 6" (15 cm) of fast moving water is enough to sweep you off your feet.
- Never allow children to play near storm drains.
- If you come upon a flooded roadway, never drive through it:  
***Turn around, don't drown!***



For more information on flood safety please visit: [www.environment-agency.co.uk](http://www.environment-agency.co.uk)