

**Regional Meteorological Centre
India Meteorological Department
Ministry of Earth Sciences**

Frequently Asked Questions on thunderstorm and Lightning

Q: What is a thunderstorm?

Ans. As per World Meteorological Organisation (WMO) "A thunderstorm is one or more sudden electrical discharges, manifested by a flash of light (**lightning**) in the sky and a sharp or rumbling sound (**thunder**). "Thunderstorm is generally associated with severe weather.

Q: What is the audible range of thunderstorm?

Ans. The audibility of thunderstorm is normally about 20km i.e. you can hear a thunder if it occurs with a distance of upto 20km around you. Sometimes, it can be heard 40 km away.

Q: What is a thunder cloud?

Ans: The cloud which produces thunder and lightning is called a thunder cloud. Scientifically, it is known as cumulonimbus (Cb) cloud. It is a type of convective cloud which can extend up to a height of 10-15 km.

Q: Is lightning associated with every thunderstorm?

Ans. Yes, as thunder is just a loud sound produced by the process of electric discharge between the different charges in cloud or between a cloud and ground which also produces sharp flashes of light. The common example of this can be seen during a short circuit in household electric wiring.

Q: Why is the lightning produced?

Ans. The thunder cloud contains ice particles and small hail particles called 'Graupel'. When they collide, charge transfer takes place between them. The +ve and -ve charges gets accumulated at different parts of the cloud. The earth's surface also contains +ve and -ve charges. When these charges exceeds a certain limit they break the insulating barrier of air and get neutralised through discharging process which produces a sharp flash of light.

Q: How dangerous is lightning?

Ans. Lightning is highly dangerous for us as it can have 100 million to 1 billion volts, and contains billions of watts of electricity and huge quantity of heat (more than 35,000 degrees Fahrenheit) which can melt metal and turn sand into glass. So, it is highly dangerous and fatal for us.

Lightning kills hundreds of people around the world every year. Even in India, according to National Crime Bureau of India report it kill more than 2500 persons every year.

Q: What are the types of lightning?

Ans. Based on whether the discharge process is between clouds or cloud and earth, the lightning is of three types:

(i) Intra cloud (IC) Lightning: When the discharge takes place between opposite charges accumulated at different parts of the same cloud.

(ii) Cloud to cloud(CC) Lightning: When the discharge takes place between opposite charges accumulated in different clouds.

(iii) Cloud to ground (CG) Lightning: When the discharge takes place between opposite charges accumulated in a cloud and earth's surface.

The third one, that is cloud to ground lightning is dangerous for us.

Q: What are negative and positive cloud to ground (CG) lightning?

Ans. When discharge occurs between negative charges in cloud and positive charges at earth's surface it is termed as negative cloud to ground lightning. On the other hand if discharge takes place between positive charges in cloud and negative charges at earth's surface it is termed as positive cloud to ground lightning

Q. How do I recognize that a thunderstorm is approaching my location?

Ans. There are certain changes associated with the approaching thunderstorm?

1. Rush of cool air towards you.
2. Appearance of huge greyish-black tall cylindrical cauliflower like clouds in the sky.
3. Thunder sound produced by a cloud and lightning in the sky.
4. Hair standing up on the back of your neck could indicate that lightning is imminent very close to you.

Q. When do I need to take action to protect myself?

Ans. Strictly follow the '30-30 Rule' of WMO which offers best Lightning Safety Guidance for the general public. When you see lightning, count the time until you hear thunder. If that is 30 seconds or less, the thunderstorm is close enough to be dangerous – seek shelter (if you can't see the lightning, just hearing the thunder is a good back-up rule). Wait 30 minutes or more after the lightning flash before leaving shelter.

Q. Can I calculate approximate distance of origin of lightning and thunder from myself?

Ans. Yes, it is very easy. Start counting the seconds when you see the lightning flash till you hear the thunder. Simply divide these no. of seconds by 3, you will get the distance of origin of lightning & thunder from you in kms.

Q: Why do I need to protect myself when a thundercloud is far away from my location?

Ans. Lightning strikes have been recorded 10-12 km away from a thundercloud. Hence a thundercloud need not be overhead to be harmful.

Q: Where is lightning more likely to strike?

Ans. The lightning is more likely to strike raised places over earth's surface like tall buildings or structures, trees, metallic objects, electric wires, standing animals and humans, water bodies etc. as these objects provide easy conduction path for discharging process and hence lightning strike.

Q: What is a "bolt from the blue"?

Ans. It means lightning that strikes the ground from blue sky i.e. without any cloud. We know that a lightning is originated in a thunder cloud, but sometimes, it happens that the lightning travels horizontally away from the cloud up to a few kilometres and then strike the ground. It appears that lightning has originated from blue sky and hence got its name.

Q: How does a cloud form?

Ans. Due to the heating of earth's surface particularly in summer season, the air near the ground also gets heated and becomes lighter which in turn starts rising. As this air rises, it cools and the moisture contained in the air starts condensing into water droplets, which leads to cloud formation. So, cloud is composed of condensed water vapours.

Q: Is thunder cloud dangerous?

Ans. Thunder cloud is the most dangerous cloud as this is the only cloud that gives thunder, lightning, strong winds, flash floods etc. which are highly destructive in nature and are associated with huge loss of life and property.

Q: Are all thunderstorms equally dangerous?

Ans. No, the severity of the thunderstorms depends on many factors like atmospheric instability, moisture availability, local orography, presence of large scale weather systems, prevailing winds at different levels etc. So, when a thunderstorm encounters the suitable environment with all factors supporting its growth, it becomes dangerous.

Q: Which season is more favourable for severe thunderstorms?

Ans. In India, the March to August period is most favourable for severe thunderstorms. Hail is more frequent during February to May period, squall and gusty winds during April to July, flash floods during April to September and lightning during April to September period. However, please check from the local Meteorological Centre for the most prevalent period for your region.

Q: In addition to actually seeing them, what instruments detect thunderstorms?

Ans. In addition to visual detection, thunderstorms can be detected by (a) weather Radar, (b) Satellites and (c) Lightning sensors.

Q: What is the height of the thunder cloud?

Ans. The base of the thunder cloud is about 1km or less, but top is very high- about 10 to 15 km or higher.

Q: Do thunderclouds affect aircraft movement?

Ans: Yes, on account of high wind turbulence associated with thunderstorms, aircrafts are not allowed to land or take off during thunderstorms over an airport. While in flight, aircraft avoid thunderstorm clouds to prevent inflight turbulence inside the aircraft and icing on the body of the aircraft.

Q: What are various stages of thunderstorm life cycle.

Ans. The life cycle of thunderstorm cloud has three stages: 1. Growing Stage, 2. Mature Stage 3. Dissipating Stage.

Q: Which stage of the thunder cloud is dangerous?

Ans. The mature stage of the thunder cloud is most dangerous as only this stage of thunder cloud is associated with all types of severe weather.

Q: What are various types of thunderstorms?

Ans: Various types of thunderstorms are:

Isolated or single-cell thunderstorms: These are small, brief, weak storms and die within an hour or so.

Multi-cell thunderstorm: It contains number of cells having different stages of life cycle.

Supercell thunderstorm: It is a long-lived and highly organized storm with a tilted or rotating updraft. The rotating updraft is called a mesocyclone and is well captured by Doppler radar. It lasts

Squall-line thunderstorm: A line of thunderstorms usually hundreds of kilometre in length and a few km in width and propagating perpendicular to its axis.

Q: What is the life time of the thunderstorm?

Ans. The life time of an isolated thunderstorm is about half an hour to one hour or slightly more. On the other hand the life time of multi-cell thunderstorm or super cell or a squall line may be upto several hours (8-10 hours on an average).

Q: What is the spatial extent of thunderstorm?

Ans. A thunderstorm is a weather system having spatial scale of a few kilometres (isolated thunderstorm) to a few hundred kilometres (multi-cell, super-cell and squall line thunderstorms).

Q: What is a hailstorm?

Ans. Sometimes we observe solid ice balls of size ranging from that of a peato cricket ball size falling from clouds to ground. These ice balls are termed as hailstones or simply hail and the phenomenon is called hailstorm. They sometimes reach the ground at speeds of up to 150 km/h.

Q: How does hail form?

Ans. In thunderclouds, there is ice formation at heights beyond freezing level. When the thundercloud is especially severe, these ice particles grow while they collide with each other and grow to larger size. When the resulting ice balls gain weight they come down due to gravity and falls on ground and are known as hail.

Q: Do all thunderclouds contain hail particles?

Ans. All thunder clouds have height well beyond freezing level, and contain small ice particles. But generally these particles melt and fall as rain on the ground due to warm air below the cloud base.

Q: Why are strong winds associated with a thunder cloud?

Ans. In a thunder cloud, air from the upper parts of the cloud which is colder and heavier, rush downwards with a great force along with hydrometeors (water in liquid or solid form). These sudden puffs of strong winds cause gusty winds at the surface.

Q: What is a squall?

Ans. Squall is a special case of gusty winds in which there is a sudden sharp increase of winds by at least 16kts(32 kmph) and reaching to 22kts(45 kmph) and lasting for at least one minute.

Q: What is a tornado?

Ans: A tornado is a narrow and violently rotating column of air that extends from the base of a thunder cloud to the ground resembling the shape of a funnel. Therefore, it is also called a funnel cloud. It leaves a trail of destruction in the form of debris along its path and is very violent.

Q: What is a waterspout?

Ans: Waterspouts are tornadoes that occur on water bodies. They are generally less severe than land tornadoes.

Q: Can frogs or small fishes or water creatures come down with rain?

Ans: Yes, in association with waterspouts, sometimes along with water small water creatures are lifted up to the sky by the strong updrafts of convection. These creatures fall down elsewhere along with rain.

Q: Do tornadoes occur in India?

Ans: Tornadoes are some times observed over India in the summer months of March to May. The tornado prone areas in India include West Bengal, Assam & adjoining states and north India plains. Over Asia, violent tornadoes are common over Bangladesh. A recent moderate intensity tornado hit the Bakainwala village in the Fazilka district of Punjab on 24th March, 2023, causing extensive damage to over 50 houses and injuring over half a dozen people(**source:** media).

Q: In what kind of clouds do tornadoes occur?

Ans: Tornadoes occur in severe thunderstorm systems such as Bow echo squall lines and supercells. The tornado can also occur in the forward sector of a cyclone approaching land. Recently in 2021 there was a tornado in association with Cyclone YAAS, which crossed Odisha coast on 26th May 2021.

Q: Why house roofs are blown during severe wind storm like tornado?

Ans. High-speed winds due to a tornado, reduce the air pressure inside closed spaces like a house. This low pressure inside pushes the roof upwards and windows

outwards. That's why roofs of the kutcha houses and huts are blown off during high-speed winds or tornado.

Q: What is a dust storm?

Ans. When strong downward winds from the thunder cloud hit the ground with a great force they raise the loose soil/dust from the ground which reduces the horizontal visibility to less than 1km. This is known as convective duststorm. It is generally called 'Andhi' in North India as it makes a person momentarily visually impaired (Andha). Duststorm mainly occurs over north Indian states of Rajasthan, Haryana, Punjab, Uttar Pradesh. It does not last for a long time and ceases if there is sufficient rain wetting the ground.

Q: Is there any other reason for duststorm:

Ans. Yes, duststorm may also be caused by the steep pressure gradient i.e. change in pressure with distance during the summer months. During the summer months, high surface temperatures produces low pressure over Rajasthan with a steep pressure gradient all around. To fill this low pressure, air from all directions rushes towards this low pressure area raising the loose dust from the surface to great heights resulting in duststorms. This raised dust remains suspended in air for many days.

Q: Is there any standard scale to estimate wind speeds based on associated effects?

Ans: Yes, one of the first scales to estimate wind speeds based on the effects was created by Britain's Admiral Sir Francis Beaufort (1774-1857). He developed the scale in 1805 to help sailors estimate the winds via visual observations. The scale starts with 0 (0 Kts) and goes to a force of 12(67-71Kts). Beaufort scale is still used today to estimate wind strengths. Another scale which starts from last level of Beaufort scale, and estimates property damage associated with strong cyclonic storms is Saffir-Simpson Hurricane Wind Scale with 1 to 5 rating based on a hurricane's (very severe cyclonic storm in north Indian Ocean) sustained wind speed. The Fujita scale measures the strength of a tornado based on wind speed.

Q: What are the damages expected from strong winds associated with thunderstorms?

Ans. The table below gives the different levels of strong winds and associated impact on various sectors along with the suggested actions.

Category/Wind Speed	Structures	Communication & Power	Agriculture	Suggested Actions

Light Thunderstorm <41 kmph (21 knots)	Nil	Nil	Nil	Nil
Moderate Thunderstorms 41 – 61 kmph (22-33 knots)	Minor damage to loose / unsecured structures	Nil	Minor damage to Banana trees. Damage to ripe paddy crops.	People are advised to keep a watch on the weather for worsening conditions and be ready to move to safer places accordingly.
Severe Thunderstorms 62 -87 kmph (34 -47 knots)	Damage to thatched huts.	Minor damage to power and communication lines due	Some damage to paddy crops, banana, papaya trees and orchards and Standing crops.	People are advised to take shelter in pukka structures and avoid taking shelter under trees. Farming operations to be temporarily suspended during occurrence of event.
Very Severe Thunderstorms Greater than 87 kmph {(47Kt) in gusts/ squall}	Major damage to thatched houses/ huts. Roof tops may blow off. Unattached metal sheets may fly.	Minor damage to power and communication lines.	Breaking of tree branches, uprooting of large avenue trees. Moderate damage to banana and papaya trees. Large dead limbs blown from trees. Damage to Standing crops.	People are advised to stay away from weak walls and structures and take shelter in pukka structures. People in affected areas to remain indoors and avoid water bodies and flying projectiles. Farming operations to be temporarily suspended during occurrence of event.
Thunderstorm associated with Hailstorm	Major damage to Kutcha structures and tin and asbestos roofed houses, cars		The fruit, vegetable and field crops at maturity stages are more prone to damage. Damage to Standing crops.	People are advised to stay away from weak walls and structures and take shelter in pukka structures. People in affected areas to remain indoors.

Q: Can we avoid lightning strike to our house or any other premises?

Ans. Yes, by installing lightning arrester. These are special instruments installed over a building which save the building from lightning strike along a particular area around it.

Q: How lightning arrester works?

Ans. The lightning arrester neutralizes the charge accumulated over a cloud by providing it a conduction path. The charge accumulated in a cloud passes to deep in the earth through the conducting mechanism provided by the lightning arrester.

Q: Can lightning be detected using some instrument?

Ans. Yes, the lightning can be detected by a special kind of instrument called lightning sensor or lightning detector?

Q: How can I save myself from lightning ?

Ans. 'When thunder roars', go indoors means go to a safe shelter immediately to avoid metal structures and constructions with metal sheeting. Safe shelters include pukka home, pukka building, or hard top vehicles with the windows rolled up.

Q: What should I do if struck outside in open?

Ans. Do the following:

- (i) Suspend all agricultural activities, till weather clears.
- (ii) (ii) Immediately get off elevated areas such as hills, mountain ridges, or peaks.
- (iii) Keep away from all utility lines and objects that conduct electricity (phone, power, metal fences, wind mills, etc.)
- (iv) (iv) Immediately get out of the water bodies like ponds, water filled or wet fields.
- (v) (v) If no shelter is available, immediately get into the **lightning crouch**-position.

Q: What is the lightning crouch position?

Ans. Settle down in a ball-like position with your head tucked and hands over your ears so that you are down low with minimal contact with the ground. **This** is shown below:



Q: Can I take shelter under the tree during thunder & lightning?

Ans. A big No. Never, take shelter under a tree specially under an isolated tree, as trees conduct electricity and more prone to lightning strike. This is the most common region of lightning related deaths. Instead if you don't found any shelter, immediately get into lightning crouch position as described above.

Q: What precaution should I take at home during such weather?

Ans. Get immediately inside the house. Unplug any electronic equipment when you sense such weather around you. Stay indoors until the weather clears.

Q: What should I do if travelling in a vehicle?

Ans. If in open vehicles like motorcycles, golf carts, bicycles, farm vehicles(tractors etc.), immediately get out of them as may attract lightning. If in closed and hard top vehicles like car, bus etc. with the windows rolled up you seems to be safe.

Q: Do rubber-soled shoes and car tyres offer protection from lightning.

Ans. No, Rubber-soled shoes and car tyres do not offer any protection from lightning as lightning intensity is extremely high, can be about 100 million to 1 billion volts. The thickness of rubber sole or car tyres are not enough to protect from such a high voltage.

Q: How can I get thunderstorm or lightning alerts?

Ans. For getting lightning alerts download the Damini application from google play store. It gives the lightning alerts when some lightning is detected near your location. You can also get the details of expected weather during next 2-3 hours at or near your location or district through the colour codes nowcast warnings available on IMD website for all the 732 districts and 1166 stations throughout India updated every three hourly. The links are:

Damini App:

Android: <https://play.google.com/store/apps/details?id=com.lightening.live.damini>

Apple: <https://apps.apple.com/app/id1502385645>

District Nowcast: <https://mausam.imd.gov.in/responsive/districtWiseNowcast.php>

Station Nowcast: <https://mausam.imd.gov.in/responsive/stationWiseNowcast.php>

Q. What are colour coded warnings for thunderstorm nowcast?

Ans. Thunderstorm nowcast warnings are given different colours based on the severity of the thunderstorm as shown below:

 No warning Watch Alert Warning

It is based on the likelihood of occurrence and impact expected from the weather.

Q: Can I get thunderstorm and lightning forecast for next 2-3 or more days?

Ans. Yes, you can visit to the website of meteorological centre of India Meteorological department for your respective state for getting detailed potential area of occurrence of thunderstorm and associated severe weather. The forecast accuracy gradually increases as we approach towards the day and time of occurrence. Thus IMD issues updated forecast twice a day at district level for up to five days and nowcast every three hours valid for the next three hours.

Q: How can I contribute to weather services in India?

Ans. You can definitely contribute to weather services by reporting the weather observed at your location through the given link provided you report correct description of the observed weather event. Your contribution is very precious for India Meteorological Department for validation of forecast and improving its quality. The link on IMD website is:

https://city.imd.gov.in/citywx/crowd/enter_th_dataq.php

You can also download the app from Google Playstore:

<https://play.google.com/store/apps/details?id=com.mausam.crowdsource>

Q: What is the accuracy of thunderstorm forecast?

Ans. During the summer season of 2022,
At subdivision spatial scale and 1 day temporal scale
The All India Probability of Detection score was 0.89
The All India False Alarm Ratio score was 0.4.
At location specific spatial scale and 3 hour temporal scale
The All India Probability of Detection score was 0.83
The All India False Alarm Ratio score was 0.57.

