Introduction to Lightning and Lightning Safety

Lightning: Possibly the most common side effect of storms, the most photographed, and possibly the most dangerous to a storm chaser. You can get out from under the storm, you can out-maneuver the core, but if you can see the storm, the lightning can "see" you.

Many people are unaware of the millions of dollars in damage that lightning causes, and the loss of life resulting from it. The National Weather Service publication Storm Data recorded 3,239 deaths and 9,818 injuries from lightning strikes between 1959 and 1994, but there is no actual reporting service that compiles a true database of people/lightning-related incidents; most of Storm Data is compiled from newspaper reports. The actual number is probably much more than that. If you add this number to the number of fires, electronic systems, forest fires, structure fires, communication systems melt downs... one quickly becomes aware that lightning kills and destroys at a huge level. Only flash floods and river floods cause more weather-related deaths.

What is this thing we call lightning? Well, lightning is very little more than a giant spark, and thunder is the sound made by that spark. The earth is usually negatively charged, but as a thunderstorm passes over, the ground becomes positively charged as a result of the negatively charged cloud base. The following explanation is from a paper written by NOAA, "The negative charge in the base of the cloud induces a positive charge on the ground below and for several miles around the storm. The ground charge follows the storm like an electrical shadow, growing stronger as the negative cloud charge increases. The attraction between positive and negative charges makes the positive ground current flow up buildings, trees, and other elevated objects in an effort to establish a flow of current. But air, which is a poor conductor of electricity, insulates the cloud and ground charges, preventing a flow of current until huge electrical charges are built up. Lightning occurs when the difference between the positive and negative charges -- the electrical potential -- becomes great enough to overcome the resistance of the insulating air and to force a conductive path for current to flow between the two charges. Electrical potential in these cases can be as much as 100 million volts."

As the particles of a cloud interact with each other via the turbulence of a cloud, the larger heavier ones become negatively charged and are carried to the bottom layer of a cloud by gravity and downdrafts,

while the smaller, lighter particles become positively charged and are carried to the top of the storm by updrafts. As the differential builds, so does the potential for a discharge. The discharge or spark between the two oppositely charges areas is lightning.

The most common type of lightning is intra-cloud lightning, (a discharge within the cloud) not to be confused with cloud-to-cloud lightning (a discharge between two separate storms). More rare, and quite dangerous is what is knows as cloud-to-ground lightning.

Almost like a probe, a "streamer" can start to reach down from the positively charged area of the storm, just previous to the first true flash. This is called a stepped leader, called stepped because it seeks in finite steps, defined when visible and giving a jagged look. This stepped leader deposits charge along a channel it creates... much like Hansel and Gretel dropping crumbs in the woods to find there way back. This deposit of positive charge creates a channel, or "way home." Typically, another streamer launches up to meet the stepped leader, and the channel is complete. It is the return step that launches up this path that causes the tremendous release of energy and the lightning flash. It lasts a fraction of a second, and is composed of 3 or 4 different strokes, which cause lightning to have the flickering look. If there is charge present between these strokes, it is referred to as HOT lightning. If these strokes have no charge between them, they are referred to as COLD lightning. Hot lightning is responsible for fires, because the heat generated from COLD lightning is not sustained long enough to start a fire.

Thunder is the sound generated along the lightning channel from hyperheated air (about 54,000 degrees Fahrenheit) producing a shock wave that creates an acoustic wave. The lightning bolt is actually multiple stokes grouped together, so the shock waves are created at different altitudes (why thunder seems to rumble). Though the lightning and the thunder occur at virtually the same time, we see the flash before we hear the thunder because light travels faster than sound. People use this fact to determine how far they are from the storm (more properly described as how far they are from the lightning) by counting the seconds between the flash and the sound. If you take the difference, and divide by 5, you have the approximate distance in miles that you are from that particular lightning event. This method of determining the distance of a storm should only be used for general interest or amusement, as it really only determines how far you are from THAT particular flash. In severe weather events, there can be many flashes and determining which thunder is associated with them can be difficult. Also, this method only lets you know how far away the LAST lightning stroke was, not where the next one will be. Another method of lightning detection is Sferics. Sferics are radio waves generated by lightning that are audible on your AM radio. The further away you move from the storm, the fainter the sounds become. If you move closer to the storm, or it moves closer to you, the sferic sound becomes louder.

Other types of lightning are as follows:

- Ground to Cloud lightning: When the stepped leaded initiates from a point on the ground
- Anvil lightning: When a bolt of lightning reaches out from the anvil of the storm, many times to sites not even under the storm, as much as 10km out from the cloud ~ sometimes under sunny rain-free skies
- Cloud to Air lightning: A discharge from a cloud into charged air
- Ball lightning: a true rarity, not yet captured on film (to my knowledge). Some even doubt its existence. Some have described an illuminated sphere of varying speeds. I feel that with the technology of digital video cameras, it's only a matter of time before someone is able to freeze frame a ball lightning event. MESO chasers experienced what I believe to be a ball lightning event in '98. It appeared for a fraction of a second, following a cloud to air discharge, as a white ball that shot across the sky.
- Heat Lightning: Actually, heat lightning is simply lightning viewed from afar when visibility is clear enough to see the lightning flashes from a distant storm. The lightning itself is not spawned by heat, but a storm... one so far away that you can't see the bolt or hear the thunder, merely the light given off by it.
- Sprites and Jets: Associated with Cloud to ground lightning, but occurring high above the storm in brief faintly-lit displays.

It behooves anyone associated with live observations of severe weather to be constantly aware of the dangers of lightning. The rule of thumb is that if you can hear it or see it, you are at risk. The closer you are to it, the greater the risk. The risk factor is then multiplied depending on where you are. Many people have reported the feeling of their hair bristling just prior to a lightning strike. Have you ever put your hand up to you TV screen and seen the effect it has on the tiny hairs on your arm or hand? That is comparable to the feeling people have reported just before a lightning strike. Seek shelter immediately and if no shelter is available, make yourself as small and low a target as you can, with minimal contact to the ground (squat down balancing on the balls of your feet).

The National Lightning Safety Institute defines areas of higher risk as: High places and open fields, isolated trees, unprotected gazebos, rain or picnic shelters, baseball dugouts, communications towers, flagpoles, light poles, bleachers (metal or wood), metal fences, convertibles, golf carts, water (ocean, lakes, swimming pools, rivers, etc.). As Storm Chasers, we tend to seek out places of good visibility; high places and open fields for example. Many of us stand out there (making ourselves the highest point on a plane) with portable lightning rods (excuse me, tripods). Laboring under the misconception that if the core of a storm is a distance away, our risks are relatively low. Lightning has demonstrated time and time again its ability to "reach out and touch someone."

Vehicles, fully enclosed ones, can also offer safety. Most of us are aware of this fact, but I was amazed at how few realized that you shouldn't be touching any of the metal on a vehicle if you are seeking safety in it from thunderstorms.

Stay away from tall structures! At least 2 meters. I have labored under the misconception that by standing near Brian McNoldy, who is quite tall, while viewing storms that I was quite safe. True, Brian may sustain the first jolt, but I could get a secondary discharge every bit as devastating.

Safety in structures is dependent on the structure itself, what if any lightning safety features are on or in it, and what the building is made of. Generally, larger buildings are better, but stay away from windows and off the phone, out of the tub or shower, off the computer, and unplug as many things as you can safely.

In 1999, one of MESO's members received quite a jolt when he innocently reached out his hand to steady himself and touched am irrigation pipe. Subsequent discussions have lead us to believe he was zapped by ground current from a remote CG lightning strike. When lightning strikes the ground, it spreads out from the point of contact in what is call ground current. If this ground current finds a friendly path like household plumbing, it can travel into a house through the pipes still carrying quite a charge. Be aware of the fact that even a strike from a distance away can travel along friendly paths for some distance. Possibly one of the most tragic things about lightning fatalities is that we are just beginning to find out that most people hit by lightning could survive if proper emergency action was taken. Lightning hits can emulate death-like conditions in victims, but resuscitation is possible more times than not.

The National Lightning Safety Institute advises the following:

First Aid Recommendations for Lightning victims:

Most lightning victims can actually survive their encounter with lightning, especially with timely medical treatment. Individuals struck by lightning do not carry a charge and it is safe to touch them to render medical treatment. Follow these steps to try to save the life of a lightning victim:

• First:

Call 911 to provide directions and information about the likely number of victims.

• Response:

The first tenet of emergency care is "make no more casualties". If the area where the victim is located is a high risk area (mountain top, isolated tree, open field, etc.) with a continuing thunderstorm, the rescuers may be placing themselves in significant danger.

• Evacuation:

It is relatively unusual for victims who survive a lightning strike to have major fractures that would cause paralysis or major bleeding complications unless they have suffered a fall or been thrown a distance. As a result, in an active thunderstorm, the rescuer needs to choose whether evacuation from very high risk areas to an area of lesser risk is warranted and should not be afraid to move the victim rapidly if necessary. Rescuers are cautioned to minimize their exposure to lightning as much as possible.

• Resuscitation:

If the victim is not breathing, start mouth-to-mouth resuscitation. If it is decided to move the victim, give a few quick breaths prior to moving them. Determine if the victim has a pulse by checking the pulse at the carotid artery (side of the neck) or femoral artery (groin) for at least 20-30 seconds. If no pulse is detected, start cardiac compressions as well. In situations that are cold and wet, putting a protective layer between the victim and the ground may decrease the hypothermia that the victim suffers which can further complicate the resuscitation. In wilderness areas and those far from medical care, prolonged basic CPR is of little use: the victim is unlikely to recover if they do not respond within the first few minutes. If the pulse returns, the rescuer should continue ventilation with rescue breathing if needed for as long as practical in a wilderness situation. However, if a pulse does not return after twenty to thirty minutes of good effort, the rescuer should not feel guilty about stopping resuscitation.

Let good sense prevail, and take every precaution. Don't take lightning for granted!

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