BASIC SPOTTERS' FIELD GUIDE

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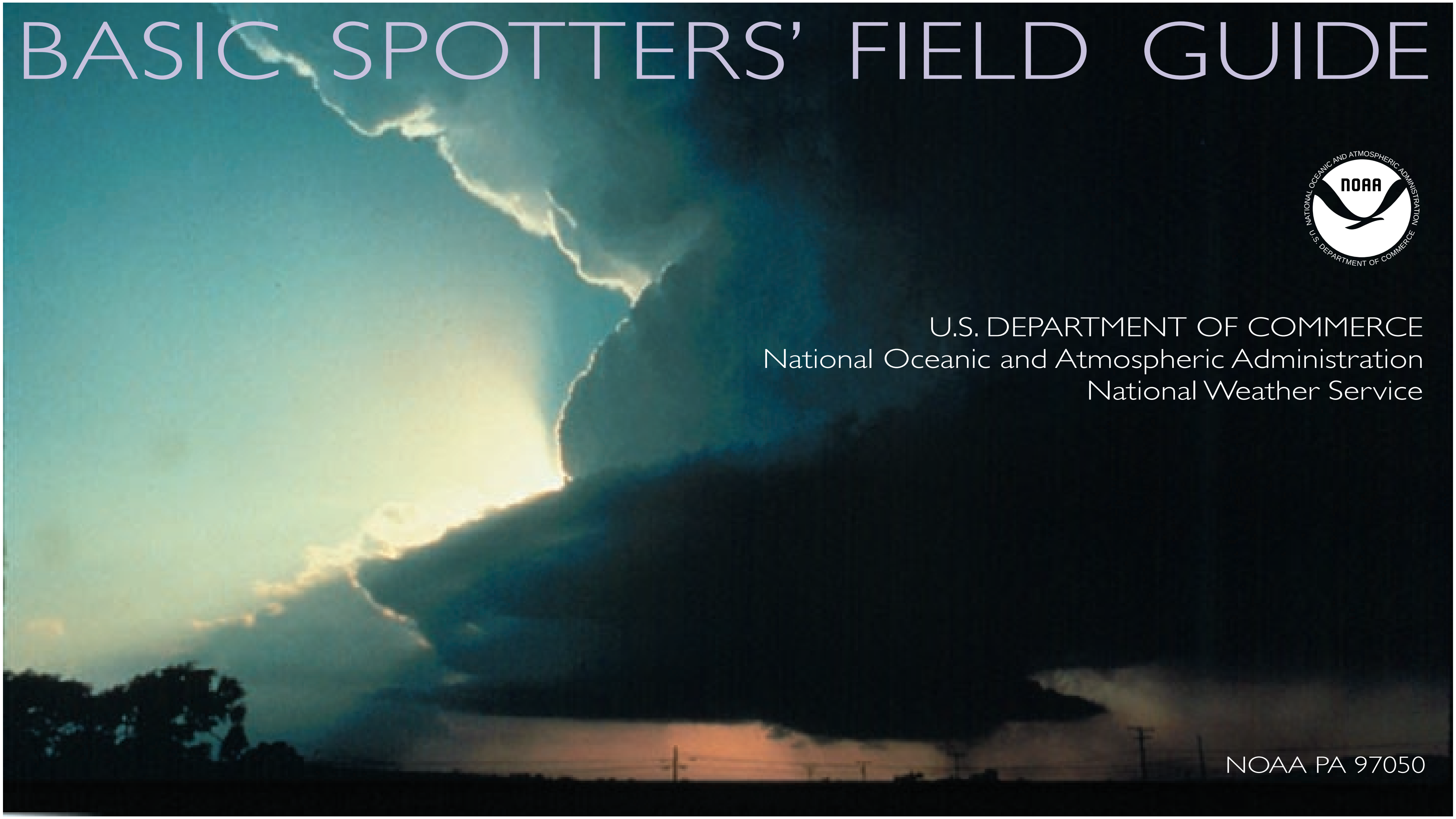

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service

NOAA PA 97050

Cover Photo - National Severe Storms Laboratory

BASIC SPOTTERS' FIELD GUIDE

TO THE SEVERE LOCAL STORM SPOTTER:

SEVERE WEATHER!!! Its effects are felt by many of us during our lifetimes. To obtain critical weather information, the National Weather Service of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration, and cooperating organizations, have established SKYWARN Spotter Networks. Although SKYWARN spotters are essential information sources for all types of weather hazards, your largest responsibility as a SKYWARN spotter is to identify and describe severe local storms. In the average year, 10,000 severe thunderstorms, 5,000 floods, and over 900 tornadoes occur across the United States. During the past 10 years, tornadoes, severe thunderstorms, and flash floods have killed nearly 2,300 people in the United States and injured thousands of others. Because of storm spotter reports, such as those you provided, plus the addition of new technology and improved warning dissemination, this death toll was reduced by more than 800 from the previous 10 years. While the figures still appear staggering, several thousand lives have been saved by reports from storm spotters.

Your information, coupled with Doppler radar, satellite, and other data, has enabled the National Weather Service to issue more timely and accurate warnings for tornadoes, severe thunderstorms, and flash floods. This guide has been designed to assist you in the important task of observing and reporting hazardous weather and protecting yourself during your encounters with hostile weather situations. I am pleased that you are part of the ranks of those who form the Nation's first line of defense against severe weather. There can be no finer reward than to know that your efforts have given a community the precious gift of time...seconds and minutes that can save lives.

Sincerely,

Susan F. Zevin
Deputy Assistant Administrator for Operations

Use of this Guide:

The information contained in this guide is provided as a reference to supplement the National Weather Service's spotter training film and slide series. It is not sufficient to qualify you as a SKYWARN spotter. This guide has been compiled for use by trained spotters in the field (both fixed and mobile spotters) and communication specialists who receive and relay the reports. The safety tips contained in this guide are geared primarily for mobile spotters, but the technical concepts that are outlined are applicable to spotters of all types. This guide is not a general handout for the public. As a result of its specialized subject matter, a number of technical terms are used. Their meanings are explained in the text. Many of the photos used in this guide were taken in the Great Plains area of the United States where visibilities usually are good. Spotters in other areas of the country, especially the southern states, may have difficulty seeing some of the thunderstorm's features because of poor visibility caused by terrain, trees, heavy rainfall, or low clouds.

Definitions and Terminology

Severe local storms occur in all parts of the continental United States in an average year. As part of their training, storm spotters should be aware of severe storm definitions and terminology used by the National Weather Service.

Watch — Conditions are favorable for the severe weather event in or near the watch area. Watches are issued for tornadoes, severe thunderstorms, and flash floods.

Warning — The severe weather event is imminent or occurring in the warned area. Warnings are issued for tornadoes, severe thunderstorms, flash floods, and river flooding.

Severe Thunderstorm — A storm that produces hail 3/4 inch in diameter or larger and/or wind gusts of 58 mph or more.

Tornado — A violently rotating column of air attached to a thunderstorm and in contact with the ground.

Funnel Cloud — A rotating, funnel-shaped cloud extending downward from a thunderstorm base.

Downburst — A strong downdraft with an outrush of damaging wind on or near the ground.

Flash Flood — A rapid rise in water, usually within 12 hours of a period of heavy rain or other causative agent (i.e., dam break).

Severe Weather Reporting Criteria

Many types of weather information are needed from storm spotters; however, some types of information are much more important than others. Strict adherence to the reporting criteria allows vital information to be communicated as soon as possible. Also, some of the reporting criteria should receive higher priority communication than others. You should report the following weather events.

Urgent Priority

Tornado
Funnel cloud
Rotating wall cloud
Flash flooding

High Priority

Hail 3/4-inch diameter or larger
Wind speed greater than 58 mph
Persistent non-rotating wall cloud
Rainfall 1 inch or more per hour

Lower Priority

Hail 1/2-inch diameter or larger
Wind speed greater than 40 mph
Cloud features suggesting storm organization
Other locally-defined criteria

NOTE: When reporting 1/2-inch diameter hail, do not use the term "**marble**" since marbles can come in a variety of sizes. In areas prone to severe weather, some offices may not need reports of 1/2-inch hail. Contact your local NWS office for specific adjustments to the criteria suggested above.

Receiving Hazardous Weather Information

Spotters, both point and mobile, should have access to reliable hazardous weather information. Many spotters have access to amateur radio networks. These networks will likely have one or more radio operators stationed at NWS offices for providing radar and other meteorological information to the net. Spotter networks not affiliated with amateur radio groups should consider having one or more members monitor NOAA Weather Radio and other outlets for weather information. These networks may wish to select a liaison person who could work with nearby amateur radio groups or the local NWS office.

Another means of receiving hazardous weather information is the Emergency Managers Weather Information Network (EMWIN). EMWIN is a low-cost, low-speed data stream of NWS products (warnings, observations, etc.) provided as a service to local emergency managers. The signal may be received directly from the GOES weather satellites, processed for local use, and/or rebroadcast to the surrounding area on VHF radio. Numerous EMWIN systems are coming on line across the country, which should allow both point and mobile spotters access to critical NWS information. This in turn should allow for more efficient operation of spotter networks in the area.

Thunderstorm Hazards and Safety Tips

Flash Floods

Flash flooding is a major killer. Many flash floods occur at night, which makes them more difficult to see. As a storm spotter, you may encounter flash floods at any time. Heeding the following flash flood safety rules may save your life.

- **DO NOT** attempt to drive or walk across a flooded roadway or low water crossing. Nearly half of all flash flood deaths are vehicle-related. Moving water 2 feet deep will carry away most cars.
- If your vehicle becomes caught in high water and stalls, leave it immediately and seek higher ground if you can do so safely. Rapidly rising water may sweep a vehicle and its occupants away.
- Be especially careful at night when flash floods are harder to recognize.

Lightning

Lightning occurs in **all** thunderstorms and is also a significant threat to life (figure 1). Storm spotters are especially vulnerable to being struck by lightning since they are often in prime strike locations, such as in open fields or on hilltops. The following lightning safety rules are important.

- Lightning tends to strike the tallest object in an area...make sure it is not you. Remain in your vehicle or an indoor location whenever possible.
- If you must go outside, crouch down to make yourself a poor lightning target. Do not lie flat on the ground since you will be more likely to be severely shocked if lightning strikes close to you.

Figure 1: Cloud-to-ground lightning. Photo - Courtesy Roger Edwards.

Hail

Although large hail rarely causes fatalities, it is the most destructive element associated with severe local storms and can cause considerable property damage (figure 2). If the storm you are observing produces a tornado, it will likely form very near the shaft of large hail.

Figure 2: Hail Damage. Photo - Courtesy James Purpura.

These hail safety tips can help minimize damage to your vehicle and possible injury to you.

- Substantial structures and highway overpasses (out of traffic lanes) offer the best hail protection.
- Hard-top vehicles offer fair protection from hail up to about golf ball sized, but significant windshield and auto body damage can result with hail larger than golf balls.

Downbursts and Outflow Winds

A downburst is defined as a strong downdraft with an outrush of damaging wind on or near the ground. Downbursts are responsible for most thunderstorm wind damage. Winds may exceed 100 mph in very strong downbursts (see figures 14 and 15). The following downburst safety rules are important.

- Keep a firm grip on your vehicle's steering wheel to maintain control. Wind speed and direction can change rapidly in a downburst.
- Blowing dust or heavy rain may accompany downbursts. Be prepared for sudden changes in visibility that may create hazardous spotting conditions.
- Point spotters observing from a substantial building should move away from windows as the downburst approaches.

Tornadoes

Tornadoes pose a significant threat to all spotters. High winds and flying debris can result in hazardous spotting conditions and significant damage to vehicles and buildings (figure 3). Be especially alert for tornadoes when storm spotting. These safety rules could save your life.

- Mobile spotters in high visibility areas, such as open rural areas, may be able to drive away from an approaching tornado. **REMEMBER, THIS DOES NOT APPLY TO SPOTTERS IN URBAN AREAS, INEXPERIENCED SPOTTERS, SPOTTERS IN LOW VISIBILITY LOCATIONS SUCH AS IN HEAVILY WOODED AREAS, OR MEMBERS OF THE GENERAL PUBLIC.** Spotters should be familiar with their area and have a planned escape route.

Figure 3: Tornado. Photo - © Alan Moller.

- If you can't avoid an oncoming tornado, you should take shelter in a substantial building, ditch, ravine, or other low spot (but be cautious of flash flooding).

Safe Viewing Tips

Mobile spotters should try to view a storm from its right flank. This will usually provide the best viewing angle, the best contrast, and it will generally keep spotters out of the storm's path. For storms moving to the northeast, the best viewing location is from the south or southeast. With east or southeast moving storms, a viewing angle from the south or southwest (respectively) is preferred although spotters will need to be more conscious of the storm's movement and have an escape route available.

Thunderstorm Life Cycle

All thunderstorms, whether they become severe or not, proceed through a 3-stage life cycle.

a. *Cumulus Stage* (figure 4) — Occurs when thunderstorm development begins. At this stage, the storm consists only of updrafts (upward-moving air currents). These updrafts reach heights of around 20,000 feet above the ground. In the western United States, the development stage may begin as higher based altocumulus clouds. As moisture becomes more plentiful, the base of the storm may lower.

b. *Mature Stage* (figure 5) — This is the strongest and most dangerous stage of the storm's life cycle. At this stage, the storm contains both upward and downward moving air currents (updrafts and downdrafts) with precipitation in the downdraft area. The downdraft results from precipitation evaporating, which causes cooling. To a lesser extent, the falling precipitation itself creates downward drag. When the cool downdraft hits the ground, it spreads out and forms a gust front, which may include damaging winds called a downburst. At the top of the storm, the updraft rapidly decelerates and clouds spread out and form an anvil. If the updraft is strong, a "bubble" of cloud, called an "overshooting top," will be pushed above the anvil. Spotters should pay particular attention to a storm with an overshooting top since the area beneath the top is a preferred area for severe weather formation.

c. *Dissipating Stage* (figure 6) — Eventually, excessive precipitation and downdraft will weaken the updraft. Downdrafts dominate the storm and any overshooting top disappears. At the surface, the gust front will move away from the storm and cut off the inflow of energy into the storm. This is indicative of the dissipating stage.

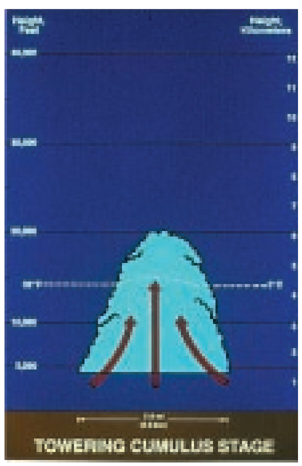

Figure 4: Towering cumulus stage of a thunderstorm.

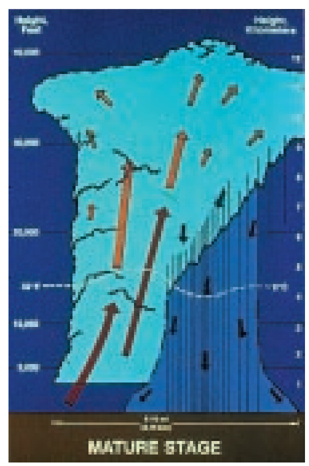

Figure 5: Mature stage of a thunderstorm.

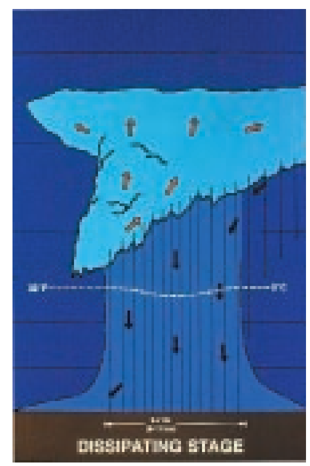

Figure 6: Dissipating stage of a thunderstorm.

Depending on the type and number of cells, thunderstorms may be divided into four main categories:

- **Single-cell** storms are generally weak, short-lived, and poorly organized. "Pulse storms" are strong single-cell storms and thus are quite rare.
- **Multicell cluster** storms are the most common type of storm and consist of a series of cells moving along as one unit.
- **Multicell line** storms, commonly called "squall lines," consist of a long line of storms with a continuous gust front at the leading edge.
- **Supercell** storms have a single updraft, are very strong, and always produce significant severe weather. (See figure 7 for additional information about each type of thunderstorm. These thunderstorm types will be discussed in more detail in the advanced storm spotter's training program.)

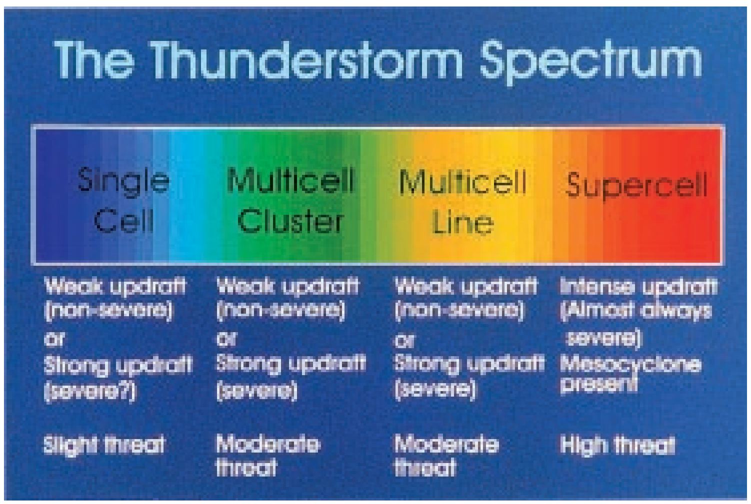

Figure 7: Overview of the thunderstorm spectrum, with characteristics of each primary storm type.

Visual Indications of Updraft Strength and Organization

Several visual clues will help the spotter determine if a storm has severe weather potential. These clues are evident in the upper, middle, and lower levels of the storm. The spotter should pay particular attention to these clues, especially when watching more than one storm at a time.

a. *Upper-Level Storm Clues* — These clues are best seen at a distance of 30–40 miles from the storm, so they may be difficult to see in poor visibility areas. The primary clues are a large overshooting top that persists for more than 10 minutes and an anvil with sharp and well-defined edges (figure 8). Storms with weaker updrafts will usually have an anvil that is thin, wispy, and fuzzy.

Figure 8: Distant supercell storm showing upper-level visual clues of storm strength. Photo - Courtesy Bill Martin.

b. *Mid-Level Storm Clues* — These clues are best seen at a distance of 10–20 miles from the storm, and again, some of these features will be difficult to see in poor visibility areas. These features are concentrated in the main storm tower area. The primary clues are the following.

- A solid appearing updraft tower with a sharp, cauliflower definition in the storm tower (again, see figure 8). Some storms have a soft or "mushy" appearance indicative of a weaker updraft and therefore are a poor candidate for producing severe weather (figure 9).
- A flanking line — a row of small cloud towers that build up (stair-step) into the main storm tower from the south or southwest. The flanking line does not suggest updraft strength, but it does indicate storm-scale organization necessary for persistent severe weather (figure 10).

c. *Low-Level Storm Clues* — These clues are best seen at a distance within 10 miles of the storm and are the easiest clues to detect in lower visibility areas. Low-level storm features can be the most critical in determining a storm's severe potential but can result in the most confusion among storm spotters. The primary clues are the following.

- The *rain-free base* — a low, flat cloud base from which little visible precipitation is falling. However, the precipitation in this area is often in the form of large hail. The rain-free base defines the primary inflow and updraft area in the storm. The preferred area for severe weather formation is near and just north/east of the rain-free base (figure 11).
- The *wall cloud* — an isolated lowering of the rain-free base. It is always attached to the cloud base. It indicates the storm's strongest updraft area, and it is the primary location for severe weather development. Wall clouds with persistent rotation (10 minutes or more) are especially significant since they denote a very dangerous storm that may produce large hail, strong downbursts, or a tornado (figure 12).

Figure 9: Non-severe multicell storm. Photo - NSSL.

Figure 10: Distant supercell storm with flanking line building into main storm tower. Photo - Courtesy Roger Edwards.

Figure11: Rain-free base. Photo - NSSL.

Figure12: Wall cloud. Photo - NSSL.

Non-Tornadic Severe Weather Events

There are other types of severe weather events that spotters should report besides tornadoes. These include downbursts and large hail. Spotters should continue to report these phenomena even if a tornado is in progress since this information is important to the NWS, public, and aviation interests.

A **downburst** is defined as a strong downdraft from a thunderstorm with an outrush of damaging wind on or near the ground. Damaging downbursts, although relatively rare themselves, are much more common than tornadoes. Because of their small size and short lifespan, it is difficult to detect and warn for downbursts. Downbursts are divided into two categories.

- Macroburst — Swath of damaging wind is 2.5 miles or more wide.
- Microburst — Swath of damaging wind is less than 2.5 miles wide.

Figure 13 shows the life cycle of a downburst. The initial stage begins as the downburst starts to descend from the cloud base. The second stage, called the "impact" stage, occurs when the downburst makes contact with the ground and begins to spread outward. Expect the strongest wind speeds shortly after the downburst hits the ground. The impact stage is also the most dangerous stage for aviation as aircraft caught in the strong winds may see wing lift

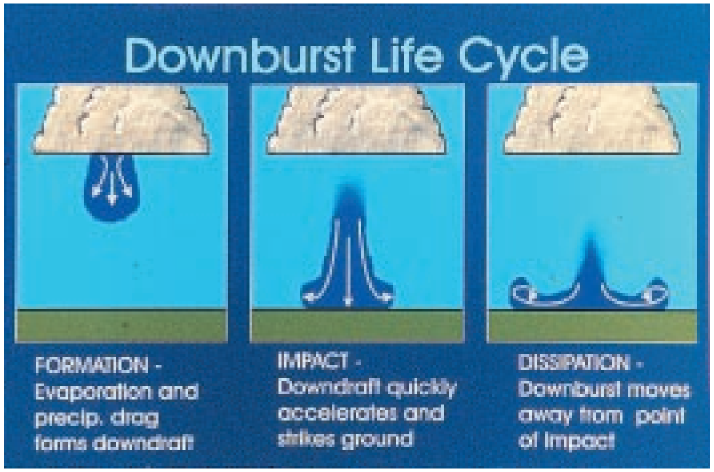

Figure13: Life cycle of a microburst.

decreased, possibly causing the plane to stall and crash. "Dissipation," the final stage, occurs when the downburst spreads out and weakens. Beware, other downbursts may form later.

One of two primary ways to detect a downburst is to spot a **rain foot**. The rain foot is a pronounced outward deflection of the precipitation area near the ground (figure 14), marking an area of strong outflow winds. The second identification method is the presence of a **dust foot**, a plume of dust raised as the downburst reaches the ground and moves away from the impact point (figure 15). The dust foot is most common in the High Plains, western states, and over plowed fields.

Large hail is a common occurrence in strong thunderstorms, especially supercells. Hail forms as supercooled water is carried aloft by the updraft and freezes. Hail size is determined by the updraft strength, i.e., the stronger the updraft, the larger the hailstones. Single cell storms can produce hail up to about nickel size, multicell storms to about golf ball size, and supercells up to about softball size. If you spot hail larger than golf balls, you are very near a supercell's main updraft and should go quickly to a safe place as described in the Thunderstorm Hazard and Safety Tips section of this Guide.

Figure 14: Microburst rain foot, visible on left side of rain area. Photo - © Alan Moller.

Figure 15: Microburst dust foot. Strong winds blowing left to right away from rain area. Photo - NWS.

Supercell Structure and Appearance

A supercell thunderstorm is a long-lived storm containing a mesocyclone — an area of intense, storm-scale rotation extending through much of the depth of the storm. Supercell storms are usually separated from other thunderstorms or may even be isolated. This separation allows them to feed upon warm, moist air from miles around. Supercell occurrences are rare but pose a significant threat to life and property.

Figure 16 is a schematic side view of a supercell as a spotter might see it when he/she is looking west/northwest at a northeast moving storm. This is the safest viewing angle for the spotter. For east or southeast moving storms, spotters should position themselves to the south or southwest (respectively) of the storm for a safe viewing angle. The storm is generally moving from left to right. The main updraft of warm, moist air is entering the storm at the cloud base below the *main storm tower*. Strong winds aloft are blowing from the southwest to northeast. Air in the upper portion of the updraft eventually becomes colder than the surrounding air and upward motion decelerates. The cloud spreads rapidly, forming an "anvil." As precipitation begins to occur, downdrafts are created.

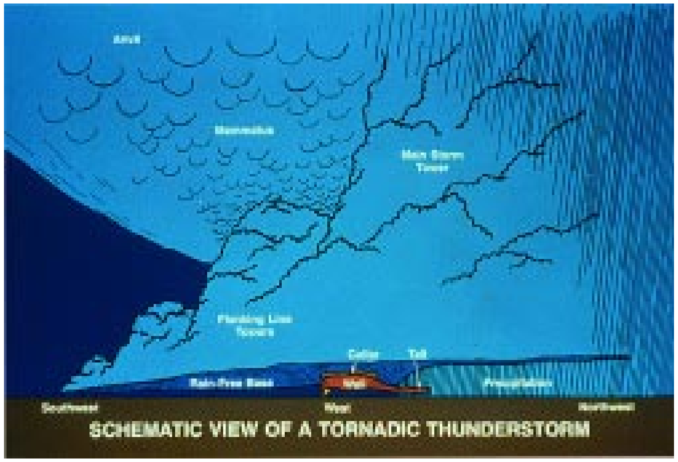

Figure 16: Slide-view diagram of a "classic" supercell storm.

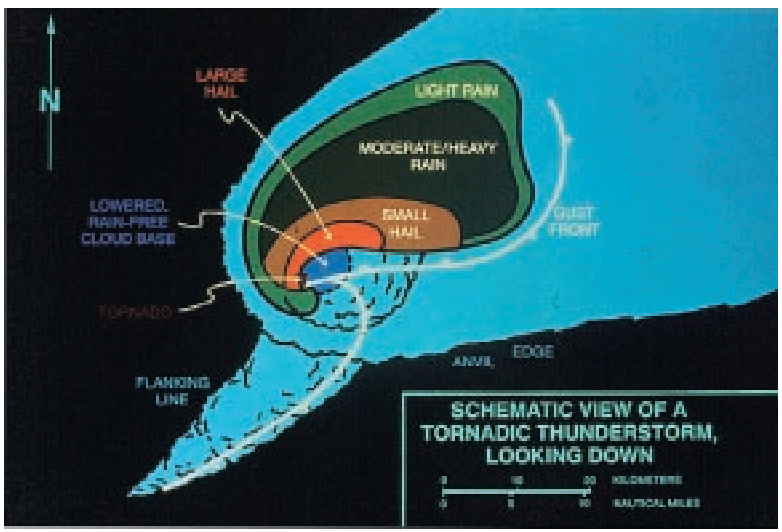

Figure 17: Plan-view diagram of a "classic" supercell storm.

Figure 17 is a "bird's eye" view of the same storm and its associated weather from above, looking down. The intense updraft, which is rising out of the page, is located within the main storm tower generally above the rain-free cloud base. The "front flank" downdraft (FFD) sinks to the ground in the area where precipitation is falling in the forward position of the storm (usually north or northeast of the updraft). A second downdraft forms just southwest of the updraft. This is the area, near the intersection of the updraft and this "rear-flank" downdraft (RFD), where a tornado is most likely to occur. Large hail is likely to fall just outside the updraft core, mainly northeast of the updraft. Tornadoes also may form along the *gust front* and *flanking line*; however, these are usually weak and short-lived.

As described earlier, some of the more important features associated with supercells include the rain-free base and the wall cloud.

The rain-free base is an area of smooth, flat cloud base beneath the main storm tower from which little or no precipitation is falling. The rain-free base is usually just to the rear (generally south or southwest) of the precipitation area and marks the main area of inflow where warm, moist air at low levels enters the storm.

The wall cloud is an isolated cloud lowering attached to the rain-free base. It is usually about 2 miles in diameter and marks the area of strongest updraft in the storm. As the thunderstorm intensifies, the updraft draws in low-level air from the precipitation area. This rain-cooled air is very humid, thus, the moisture in the air quickly condenses to form the wall cloud. The wall cloud is sometimes to the rear (generally south or southwest) of the precipitation area but at other times may be on the east or southwest side of the precipitation. Table 1 (below) shows a list of tornadic wall cloud characteristics. Less than

Table 1
Tornadic Wall Cloud Characteristics

- ➤ Persistence
- ➤ Persistent rotation
- ➤ Strong surface-based inflow
- ➤ Rapid vertical motion (both upward and downward)

half of the observed wall clouds will actually produce tornadoes, and not every tornadic wall cloud will have all of these characteristics. Nevertheless, they are good rules of thumb.

Wall clouds are not rare. They can form at the base of any thunderstorm, supercell or otherwise, having a sufficiently strong updraft and adequate moisture available in the sub-cloud layer. In fact, spotters, especially mobile ones, may see several wall clouds during an average severe weather season. Your key will be to use the rules of thumb to determine which wall clouds are potential tornado producers.

Typical Tornado Life Cycle

The typical tornado goes through a three-stage life cycle: developing, mature, and dissipating. Figure 18 shows the developing tornado. A rotating wall cloud is evident, with tighter rotation evident in the base of the wall cloud. As the tornadic circulation continues to develop, the condensation funnel appears. It may not be a tornado yet since the visible cloud is less than half way to the ground; however, in some cases you will see a dust whirl on the ground indicating a tornado before the condensation funnel touches down.

Figure 19 shows the mature tornado. The storm is still getting a good inflow of warm, moist air, and the circulation is near its maximum size and intensity. The inflow becomes disrupted a short time later, which starts the dissipating stage.

Figure 20 shows a dissipating tornado. This stage is sometimes called the “rope stage.” The condensation funnel becomes tilted and shrinks into a contorted, ropelike configuration. ***The tornado is still dangerous even at this late stage in its life.*** Some tornadoes, especially larger ones, dissipate as the funnel lifts into a bowl-shaped lowering of the cloud base.

Figure 18: Developing stage of a tornado. Photo - © Alan Moller.

Figure 19: Tornado in mature stage. Photo - © Alan Moller.

Figure 20: Tornado in its dissipating stage. Photo - Courtesy Gary Woodall.

Tornado Classification

Tornado intensities are classified by the Fujita Damage Scale developed by Dr. T. Theodore Fujita, a renowned severe weather researcher. The scale ranges from F0-F5, with F5 storms creating incredible damage. The NWS also uses a broader, three-level classification scale, consisting of "weak" (F0-F1), "strong" (F2-F3), and "violent" (F4-F5). Figures 21, 22, and 23 are examples of these tornado classifications. Dimensions shown in figures are upper limits, not averages.

Weak tornadoes may not be associated with mesocyclones. They are difficult to detect and forecast; thus, there is a heavy reliance on spotters to identify and report these storms.

Strong tornadoes are typically associated with mesocyclones. They are easier to infer from radar, but spotter reports of these storms are still a very important part of the warning process.

Violent tornadoes are virtually always associated with a powerful mesocyclone. Their signatures are often easily detectable on radar, but spotter reports provide vital ground truth of actual storm conditions.

Many strong and violent tornadoes develop as multiple vortex tornadoes. They consist of one large circulation (vortex) with several smaller circulations rotating around it. The smaller vortices usually are responsible for the extreme winds and damage associated with violent tornadoes.

As discussed earlier, storm spotters should **NOT** wait for a condensation cloud to reach the ground before reporting a tornado. Instead, spotters should look for a rotating dust/debris cloud on the ground below the funnel. This rule is especially true in the western states, where storm cloud bases are relatively high and the air below the cloud base can be quite dry.

Although the tornadoes pictured here are typical of the intensities shown, spotters should not attempt to judge tornado intensity based only on size. Cases have been documented of small, violent tornadoes and weak tornadoes with large condensation funnels.

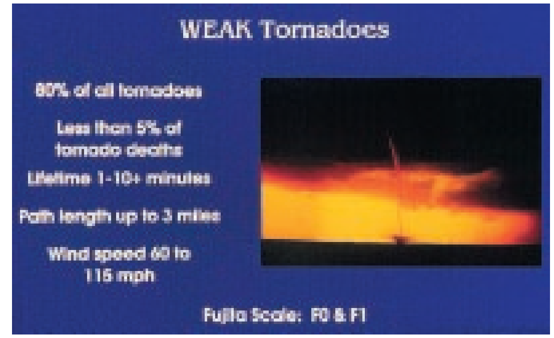

Figure 21: Typical weak tornado. Photo - © Tim Marshall.

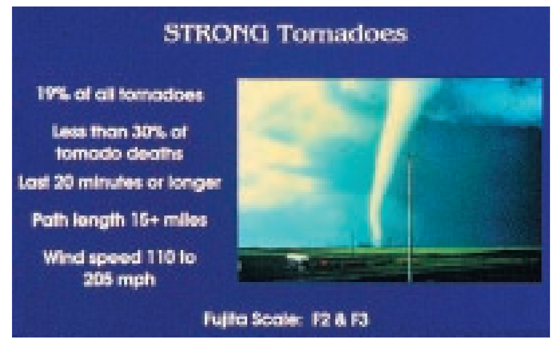

Figure 22: Typical strong tornado. Photo - NWS.

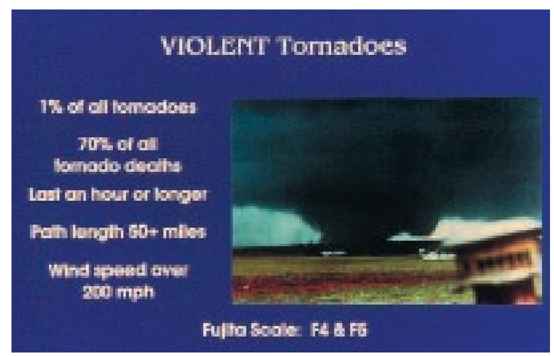

*Figure 23: Typical violent tornado.
Photo - Courtesy Jeff Formby.*

Tornado Look-Alikes

One of the biggest challenges in tornado spotting is determining whether you are seeing the "real thing" or a tornado look-alike. Two key features present with a tornado are a debris cloud near the ground and organized rotation about a vertical axis.

Rainshafts sometimes may be located in a thunderstorm where a tornado normally would be found (figure 24). Rainshafts lack a debris cloud near the ground and organized rotation about a vertical axis.

Figure 25 shows a smoke column and is one of the most convincing look-alikes ever photographed. To properly identify tougher cases, watch for a minute or so to look for rotation, both in the cloud and in the debris near the ground. Talk with your colleague. Also, talk with other spotters in the area; they may have a closer look or a better viewing angle.

Scud clouds are small, detached, wind-torn clouds that often form near thunderstorms (figure 26). Scud clouds can change shape rapidly and sometimes take on the appearance of a wall cloud or funnel cloud. Remember, though, that wall clouds are always attached to the cloud base and funnel clouds always rotate. Roll clouds form along the gust front as the cool outflow lifts warm, moist air. They take on the shape of horizontal tubes, and in some cases, you can actually see a horizontal rolling motion (figure 27).

Shelf clouds form in a process similar to roll clouds, but shelf clouds take on more of a wedge shape. You probably will see considerable motion in the shelf cloud's base. The motion will be turbulent in nature, though, without the persistent, organized rotation seen in true wall clouds. Shelf clouds are more common than roll clouds and can define areas of strong downburst winds but usually are not favorable locations for tornado development (figure 28). They are associated with cool outflow (downward vertical motion) while a wall cloud is associated with a warm updraft (upward vertical motion).

Figure 24: Distant rain shaft. Photo - © Tim Marshall.

Figure 25: Distant smoke column. Photo - Courtesy Brian Curran.

Figure 26: Scud clouds. Photo - Courtesy Roger Edwards.

Figure 27: Roll cloud. Photo - Courtesy Gary Woodall.

Figure 28: Shelf cloud. Photo - NSSL.

Supercell Variations and Unusual Situations

There are variations in the supercell model that spotters may see from time to time. The spotter should be familiar with the different types of supercells, plus other non-typical events that may occur. This guide will discuss some of these variations briefly. More in-depth discussions are included in the Advanced Severe Storm Spotters series.

The Heavy Precipitation or HP supercell is quite common east of the Great Plains and may be the most common type of supercell nationwide. The HP supercell produces tremendous amounts of precipitation around the mesocyclone, especially on the west and southwest sides of the mesocyclone. Heavy precipitation can produce poor contrast under the cloud base or completely obscure important features. If a tornado or wall cloud is obscured, striations, low level inflow bands, and mid-level cloud bands may be used to infer storm rotation (figures 29 and 30). If any of these clues suggest storm rotation, **DO NOT DRIVE THROUGH PRECIPITATION TO SEE IF A TORNADO IS PRESENT**. Even without a tornado, large hail and strong downburst winds are likely, and heavy precipitation will obscure visibility and may produce flash flooding.

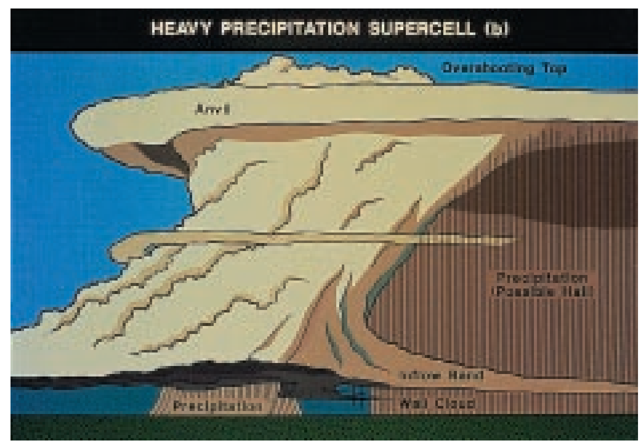

Figure 29: Side view diagram of an HP supercell.

The Low Precipitation or LP supercell most often occurs in the High Plains but has been documented in other areas. The LP supercell produces very little liquid precipitation and outflow but is a prolific hail producer. LPs can be difficult to detect on radar but are fairly easy to identify visually. The main precipitation area will be small and light, and the storm tower will be slender, striated, and bell shaped or flared out close to the ground (figures 31 and 32). It is unusual for the LP supercell to produce a large tornado.

Another non-typical event that occurs is the “gustnado” (figure 33). Sometimes vortices may develop in a gust front’s outflow as it moves across the ground. These vortices are called “gustnados.” They are not associated with the updraft area of the storm and generally do not extend up to the cloud base. Thus, in some aspects they are not “legitimate” tornadoes, however, they do pose a threat to life and property and should be reported.

Tornadoes that occur at night are obviously much more difficult to observe and recognize than those occurring during the day (figure 34). Limited assistance may be provided by lightning (although lightning may illuminate different parts of the storm at different times), power line flashes, tornado roaring sounds (although strong winds blowing through trees can produce a roaring sound similar to that of a tornado), and the presence of large hail.

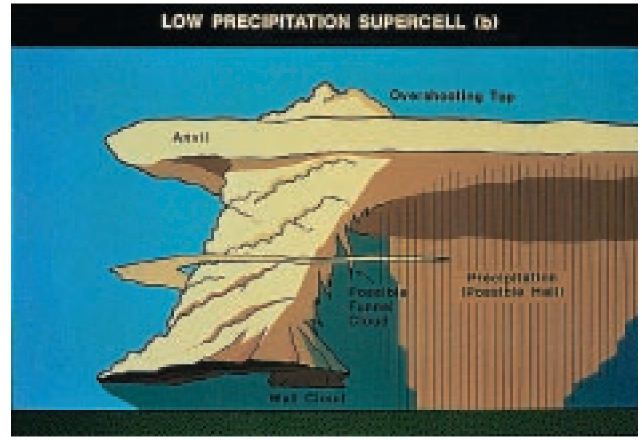

Figure 31: Side view diagram of an LP supercell.

Figure 30: Side view of an HP supercell. Photo - © Alan Moller.

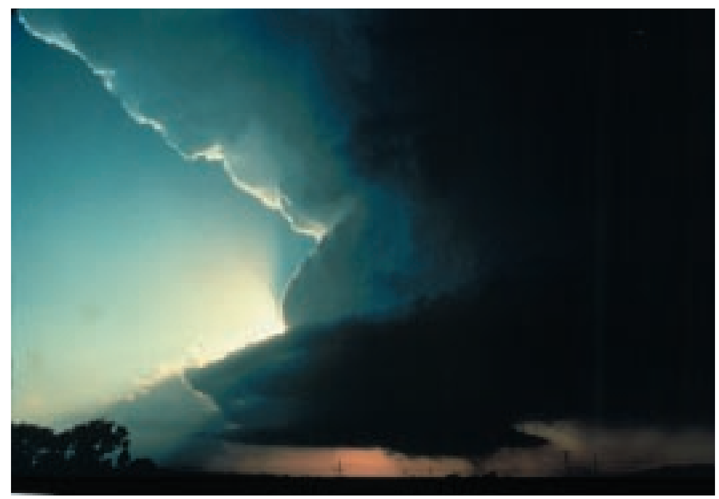

Figure 32: Side view of an LP supercell. Photo - NSSL.

Figure 33: Gustnado visible directly below shelf cloud lowering.. Photo - NSSL.

Figure 34: Lightning-illuminated supercell. Note the suspicious feature just right of the lightning. Photo - © Alan Moller.

Summary

This guide has given you an introductory look at severe thunderstorms, the hazardous weather they produce, and some of the visual clues available to help determine a storm's severity. It has provided an overview of the fundamentals of severe storm spotting. Use this guide and the presentation that accompanies it as a first step in your severe thunderstorm education, not your last step. As your experience base grows, we encourage you to attend regular refresher spotter training courses and advanced spotter training programs. These continuing programs will enable you to increase your knowledge of severe thunderstorms and become an even more valuable part of the severe weather warning system.

Figure Credits

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Notes

Spotter Reporting Procedures

- From radio or cellular phone-equipped vehicles, report severe weather observations to a central collection point and request them to relay the report to the National Weather Service.
- Law enforcement and Emergency Management spotters—report to your dispatcher or net controller via NAWAS, radio, cellular phone, or other direct communications links as prescribed by your Emergency Operations Plan.
- When the telephone is your only communications method, call your primary or alternate contact, and ask him or her to relay your report to the National Weather Service. If the call is long distance, you can make it collect. Report promptly as the storm may interrupt communications.

Report Briefly:

What you have seen: tornado, funnel cloud, wall cloud, waterspout, flash flooding, etc.

Where you saw it: the direction and distance from a known location, i.e., 3 miles south of Beltsville. To avoid confusion, make sure you report the event location and not your location.

When you saw it: make sure you note the time of your observation.

What it was doing: describe the storm's direction and speed of travel, size and intensity, and destructiveness. Include any amount of uncertainty as needed, i.e., "funnel cloud; no debris visible at the surface, but too far away to be certain it is not on the ground."

Identify yourself and your location. Give spotter code number if you have one.

Report:

1. Tornado, funnel cloud, waterspout, or wall cloud.
2. Large hail, as defined by your local NWS office.
3. Damaging winds (usually greater than 50 mph).
4. Flash flooding.
5. Other criteria as defined by your local NWS office.