Severe Storm Spotting & Safety

National Weather Service

Lincoln, IL

Presented by

Ed Shimon

Welcome to Spotter Training!

Severe storm spotting is a CRITICAL PART of public safety and NWS Warning Operations

ACCURATE & TIMELY reports:

- **Improve public response to severe storms/tornadoes**
- **Enhance NWS warnings**
- **Allow neighboring communities & counties to prepare in advance**

08/09/21 Esmond, IL Tornadic Storm
Video by Brett Adair

Outline

Thunderstorm Structure & Terminology

- Updrafts and downdrafts
- Wall cloud, overshooting top, flanking line…

Supercells and Tornadoes…

- Rotations in storms, supercell tornadoes
- Non-supercell tornadoes

Damaging Winds and Hail

- Downbursts, wind from Squall Lines, Derechos
- Hail formation, Hail on radar

Outline

Spotter Challenges

- Judging distances and obstructions
- Look-alikes, low hanging clouds, night spotting

Spotter Safety and Reporting

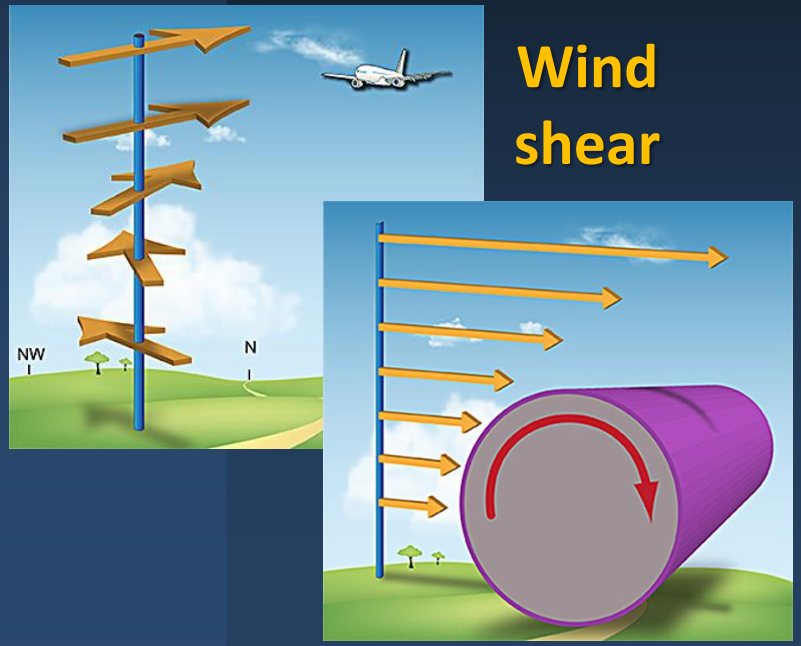
- How to stay safe while spotting
- What to report

THUNDERSTORM STRUCTURE & TERMINOLOGY

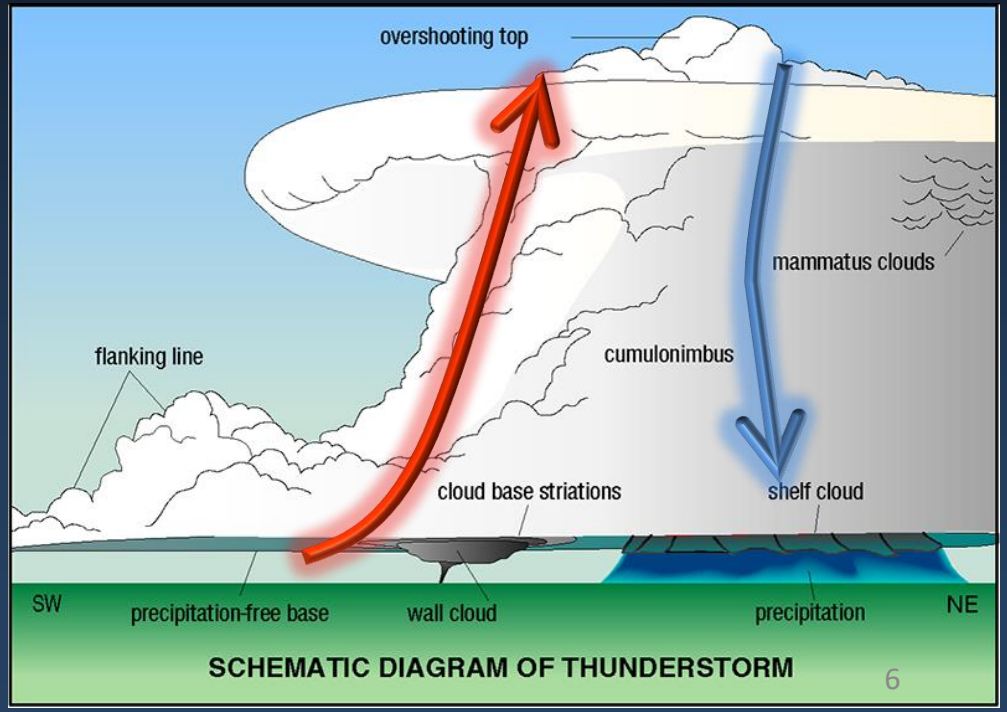
Storm Structure & Terminology

UPDRAFT and DOWNDRAFT develop with help from instability

They separate and tilt due to wind shear.



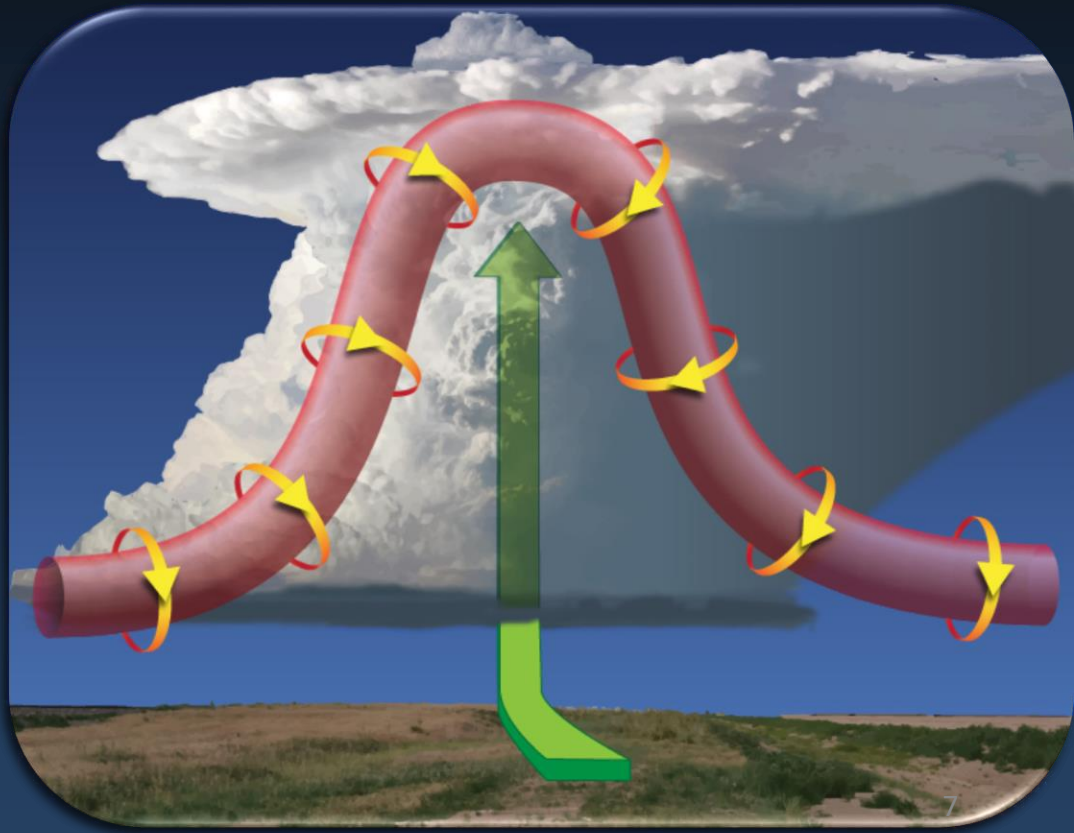
Wind shear



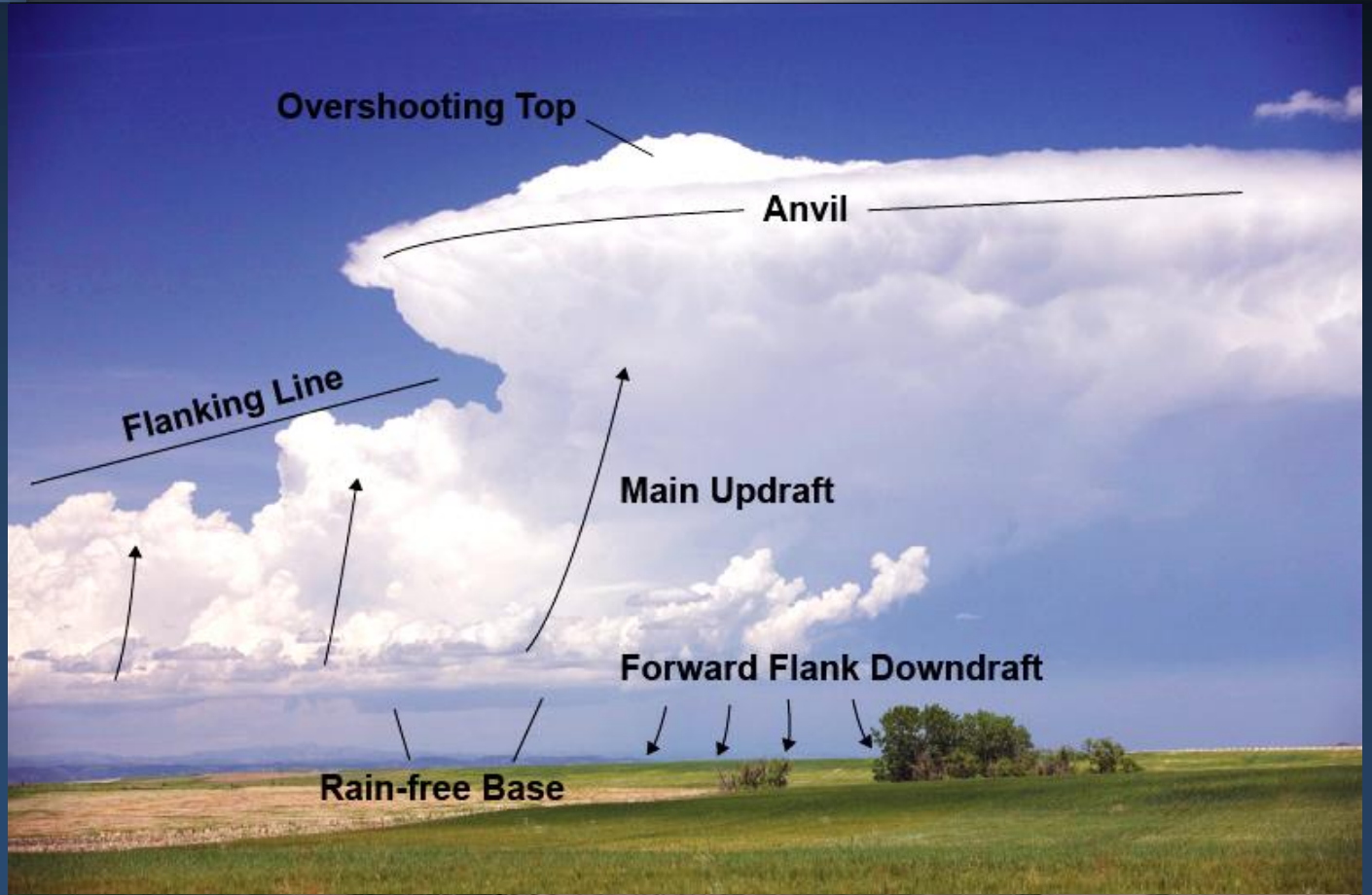
Wind Shear → Source of Rotation

With STRONG wind shear:

- A horizontal rotation develops near the ground
- The UPDRAFT pulls the horizontal rotation upward
- This allows strong UPDRAFTS to start rotating vertically
- This strong rotating updraft is a SUPERCELL



Visual Clues: **Severe Storm Features**



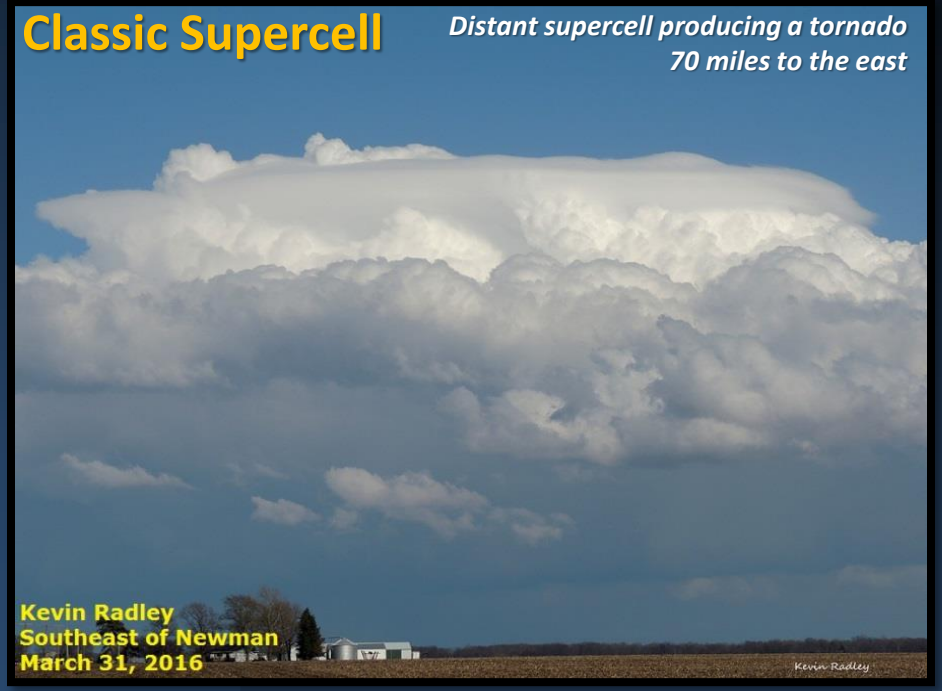
SUPERCELLS and TORNADOES…


Photo by Winston Wells
Near Virginia, IL 7/10/21


Photo by Brad Emel
Near Bethany, IL 5/6/21

Supercell Variations

Classic Supercell



- Higher potential for long-track tornadoes *(10-20 miles or more)*
- Tornadoes are "typically" easier to see

High Precipitation (HP)

- More common east of Mississippi River
- Rotation usually hidden by heavy rain *("rain-wrapped" tornadoes)*

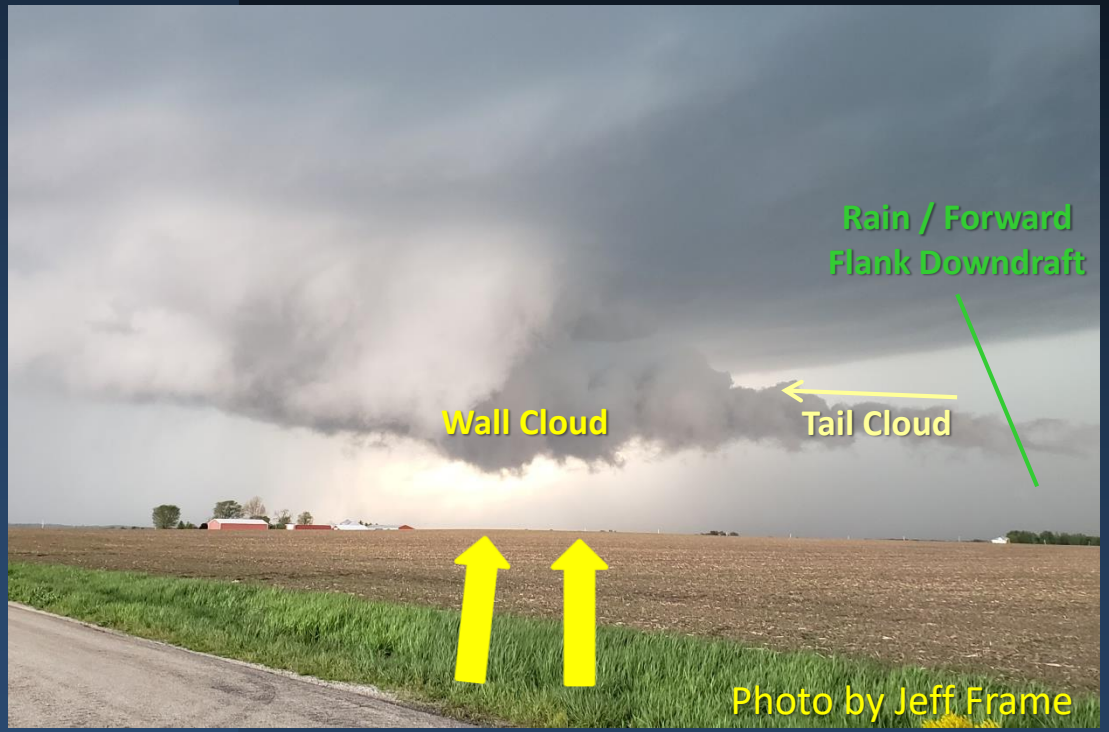
Supercell Visual Clues: Rotating Updraft

Note the rotation of the spiral bands in the upper part of the storm illustrating the rotating updraft

Video by Matt Woods
9/29/19
Champaign County, IL

THIS is what we often see on RADAR – the ROTATING UPDRAFT

Definition: Wall Cloud



- A persistent lowering near the updraft, which MAY be rotating
- Usually long lived – the key is rotation
- Upward motion present with surface wind moving toward wall cloud *(inflow)*
- May contain a "tail cloud" due to rain nearby

Visual Clues: Wall Clouds

Photo by Mark Stacey

Definition: Funnel Cloud

Photo by Andrew Pritchard
12/1/18 near Beardstown, IL
Tornado developed seconds later…

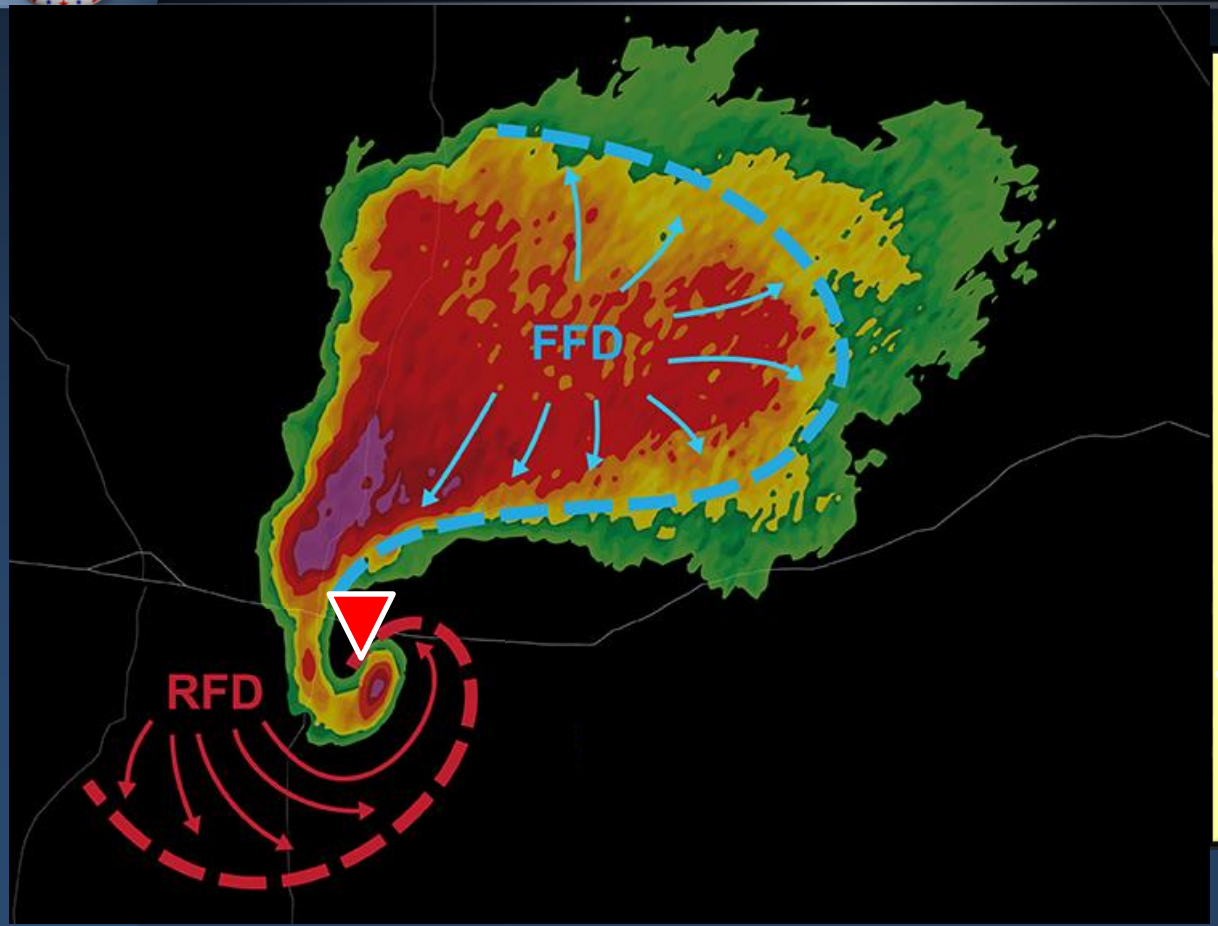
A funnel-shaped cloud associated with a rotating, vertical column of air, extending from the base of a storm …but NOT yet reaching the ground

Definition: Tornado

A rotating column of air, extending from the base of a cloud which is <u>in CONTACT</u> with the ground

Radar view - Illustration

Classic Supercell Tornadoes



FFD = Forward Flank Downdraft

- Heavy rain, large hail, high wind gusts

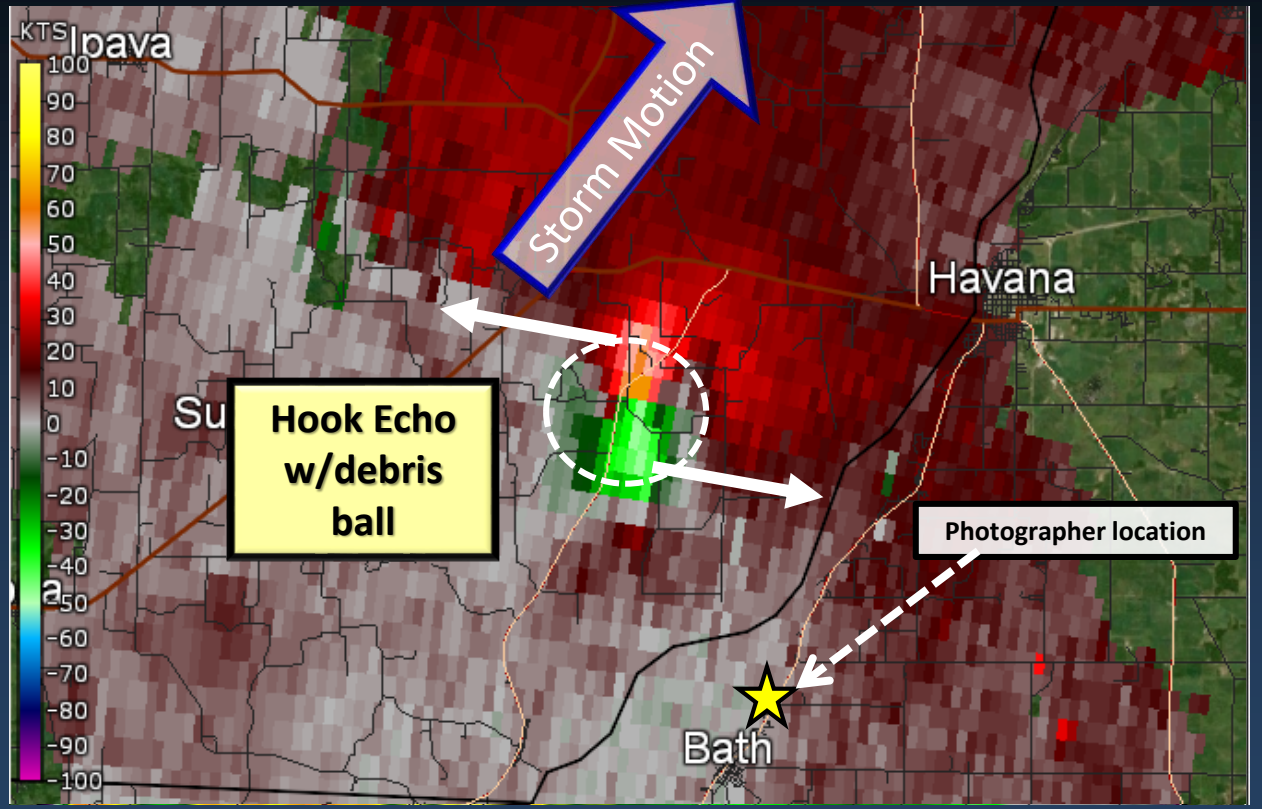
RFD = Rear Flank Downdraft

- High wind gusts
- Area where lower clouds appear to clear or get brighter
- "Horseshoe" look to clouds near the "Hook Echo" on radar

▼ Location of rotating updraft, merger of FFD & RFD, and the TORNADO

Radar and spotter view

Classic Supercell Tornadoes



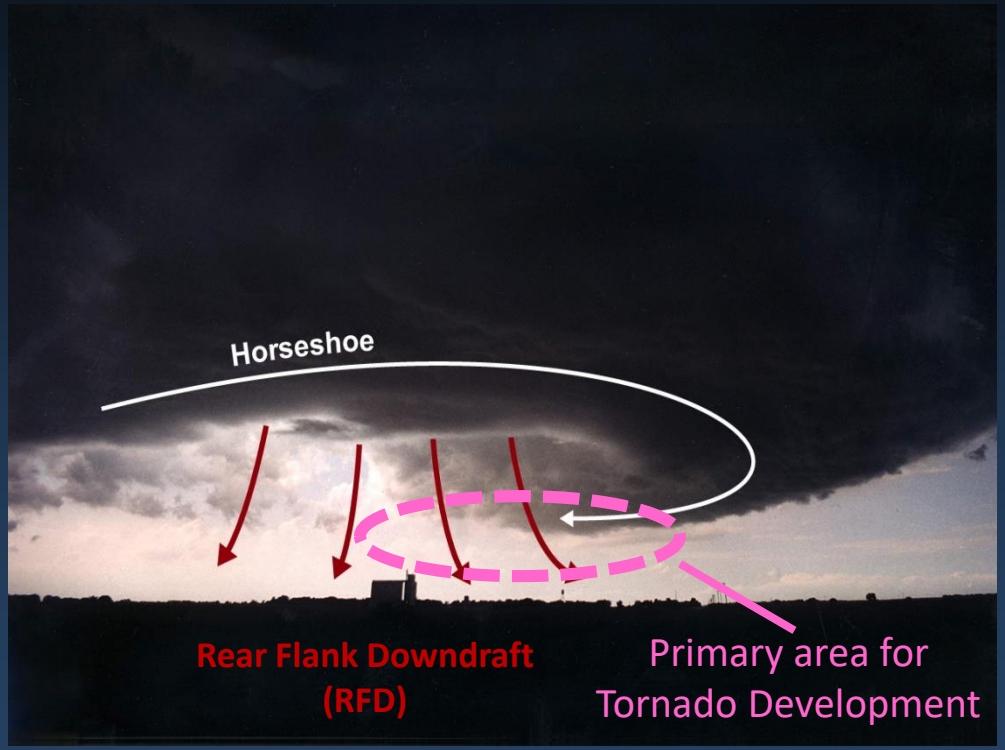
Fulton County/Lewistown Tornadic Supercell 12/1/18

Developing Stage

Classic Supercell Tornado Life Cycle

Watch for:

1. A brighter area near the wall cloud and/or developing funnel. That is the RFD!
2. Clouds that may take on a “Horseshoe” shaped appearance



Classic Supercell Tornado Life Cycle

Developing Stage

Watch for:

Rotation and dust whirl at the ground AND a connection to the wall cloud or funnel – that is the beginning of the tornado

A tornado is NOT a solid object – it is a rotating column of wind!

Mature Stage

Classic Supercell Tornado Life Cycle

The MOST DANGEROUS stage of the tornado!

Dissipating
(Rope) Stage

Classic Supercell Tornado Life Cycle

Even though the tornado appears small, it still has powerful wind speeds

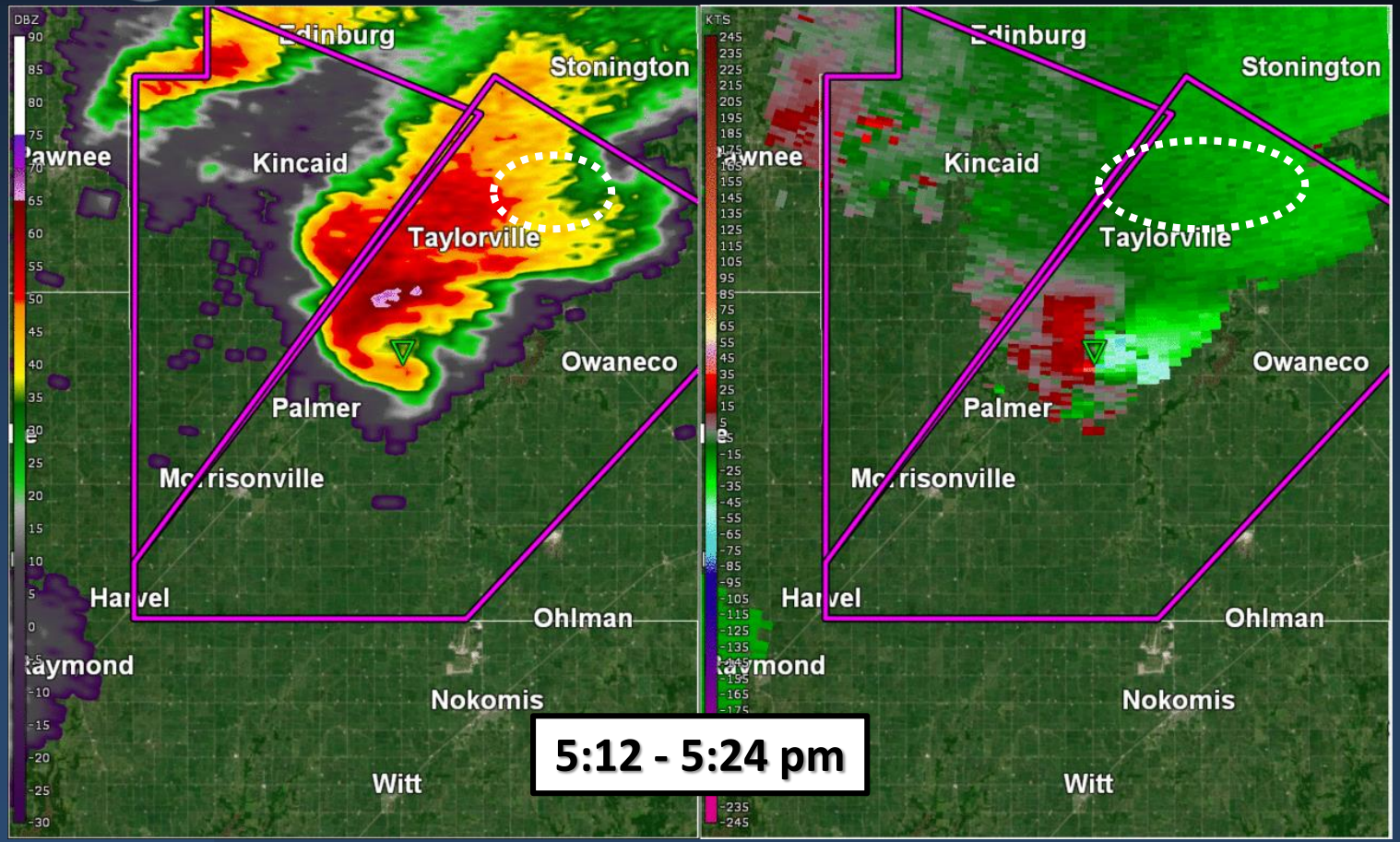
Watch for another tornado to develop a few miles or so downstream *(Usually E or SE)* of the dissipating one

Classic Supercells : They often produce more than one tornado

Spotter view

Classic Supercells : They often produce more than one tornado

Radar view



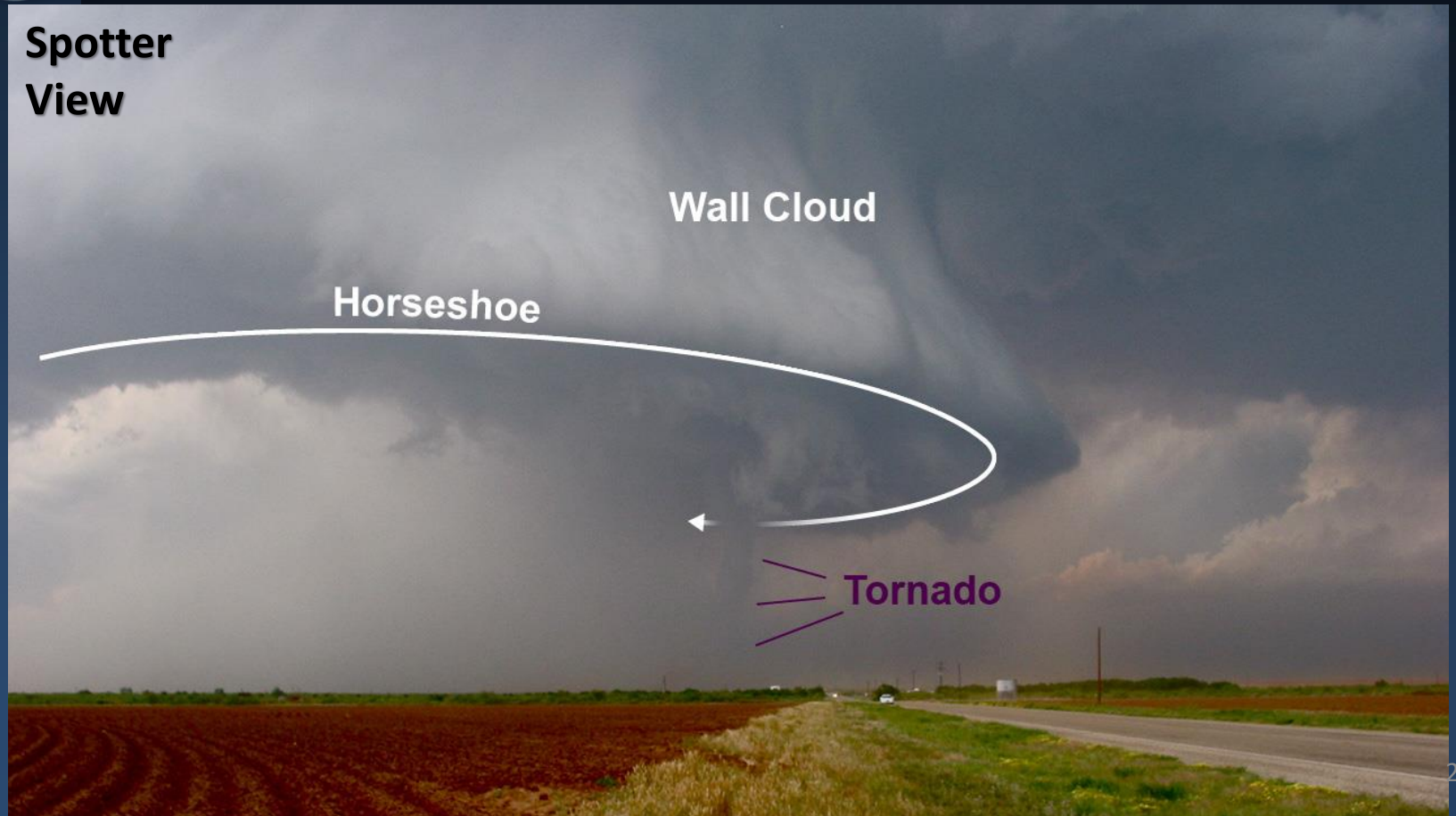
12/1/18

Tornadic supercell

Note change in rotation *(right image)* & development of new hook *(left image)*

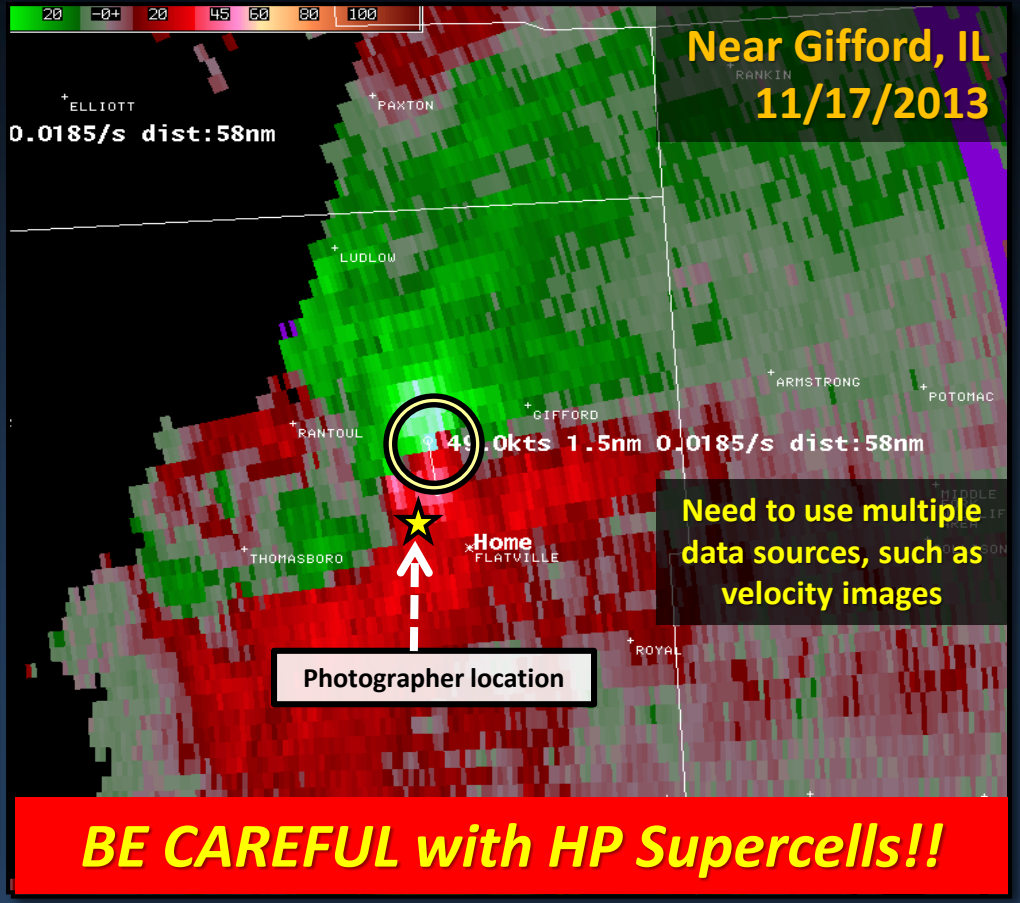
This supercell produced 13 tornadoes!

High Precipitation (HP) Supercell Features



Radar and Spotter View

HP Supercell Tornadoes

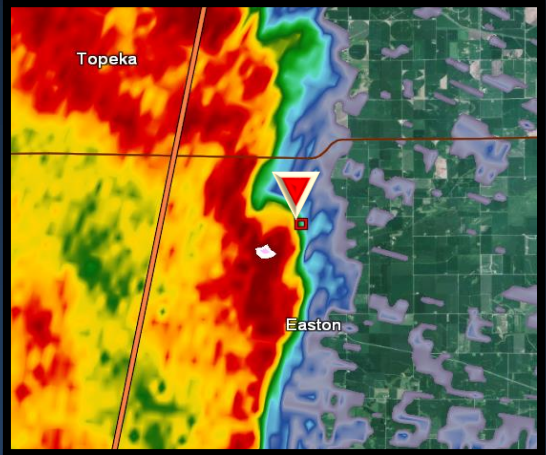


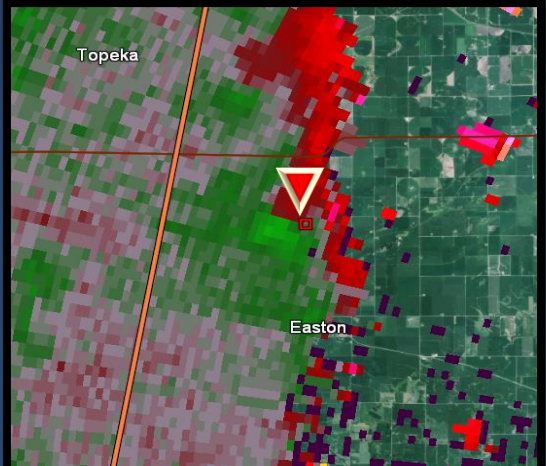
Other Tornadoes

- **Tornadoes with a Line of Storms**
  - High shear, moderate instability
  - Rotation may be visible on radar, but not until just before the tornado forms
  - VERY difficult for spotters to see these due to lots of rain nearby & quick formation
  - Tornadoes can produce up to EF-2 damage, but are usually shorter lived than supercell tornadoes

Radar Views

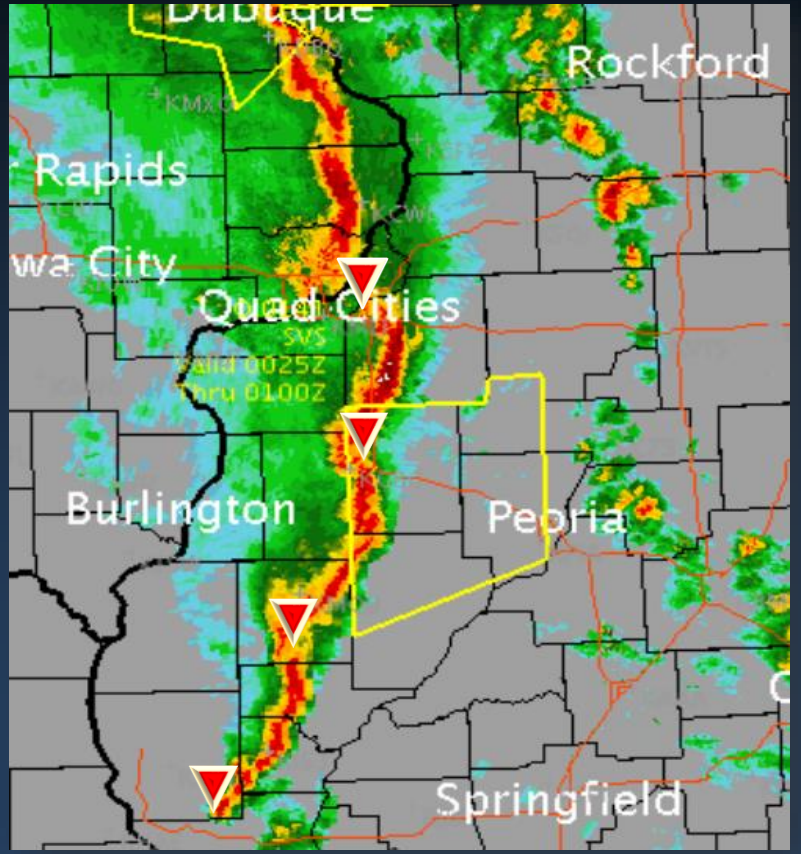
Other Tornadoes





Look for:

- Breaks or Kinks in the line of storms
- North of where the line “surges” out farther
- The very end of a line of storms
- Use radar velocity to help look for rotation



DAMAGING WIND AND HAIL

What is a Downburst?

Video by Andrew Pritchard
Near Manchester, IL 3/15/2016

Definition:

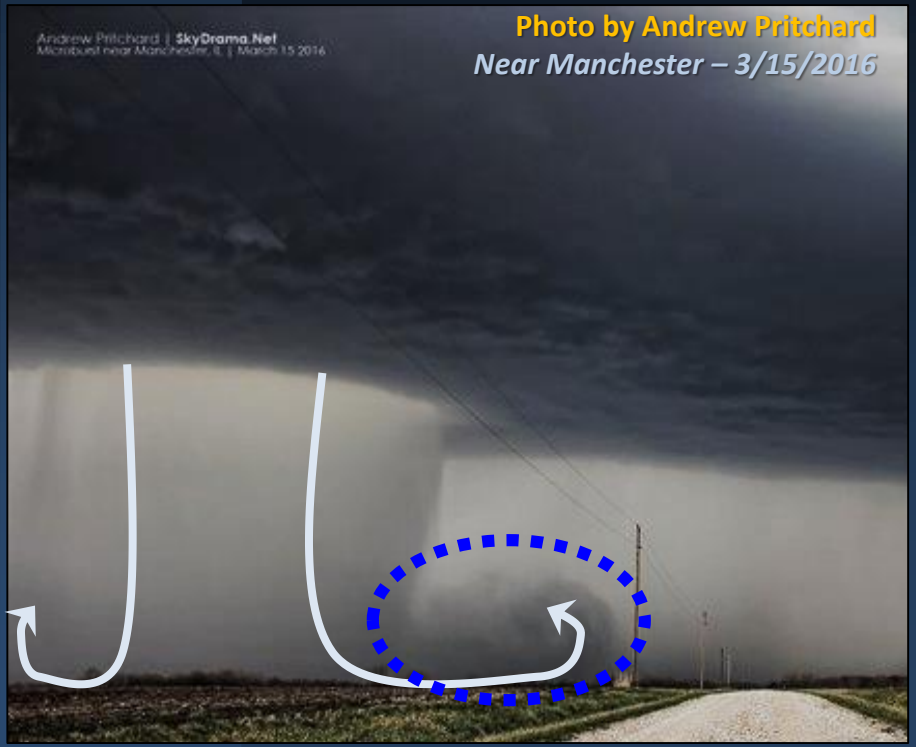
Rain-cooled air rapidly descending in a T-storm – an INTENSE DOWNDRAFT

Can create SEVERE wind gusts

Most in Illinois occur with very heavy downpours

Can last several minutes, and produce significant wind damage

Downbursts



Visual Identification:

Wind speeds generally 60-80 mph, but can be >100 mph!

- Damage can be the same as an EF2 tornado

Rain-foot indicates strongest winds

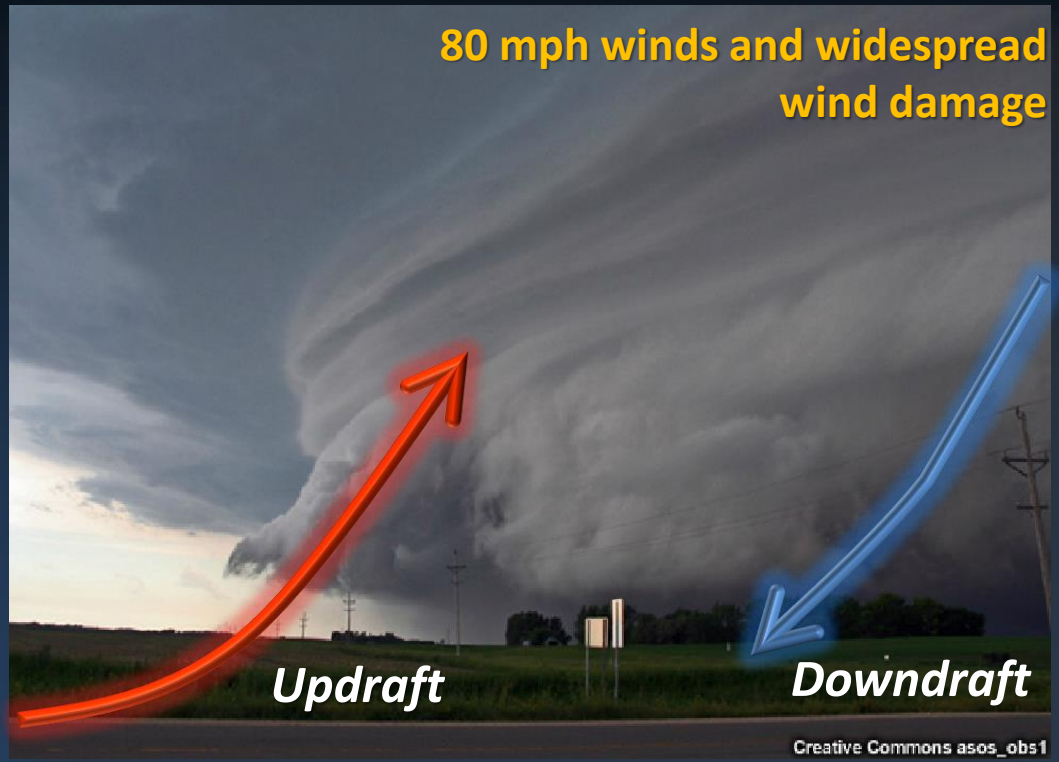
- Wind can change direction quickly as the downburst moves through

Squall Lines

Visual Clues:

Shelf Clouds

- Low cloud at the front of a line of storms
- Shelf clouds that are low hanging with a “wavy” look aloft often produce the highest winds



Updraft: Look for rotation

Downdraft: High wind, driving rain

Squall Lines

Severe Shelf Cloud

- Well defined leading edge with deep shelf cloud
- Wavy, turbulent clouds aloft due to strong wind shear/strong updrafts
- ***NOTE:*** Sometimes, low hanging clouds on leading edge can “look like” funnels. Look for signs of rotation to verify.

Clouds on left of image are surging forward toward photographer.
Look to circled area for possible rotation!!

Severe Shelf Cloud
Photo by Trey Zoss 06/19/18

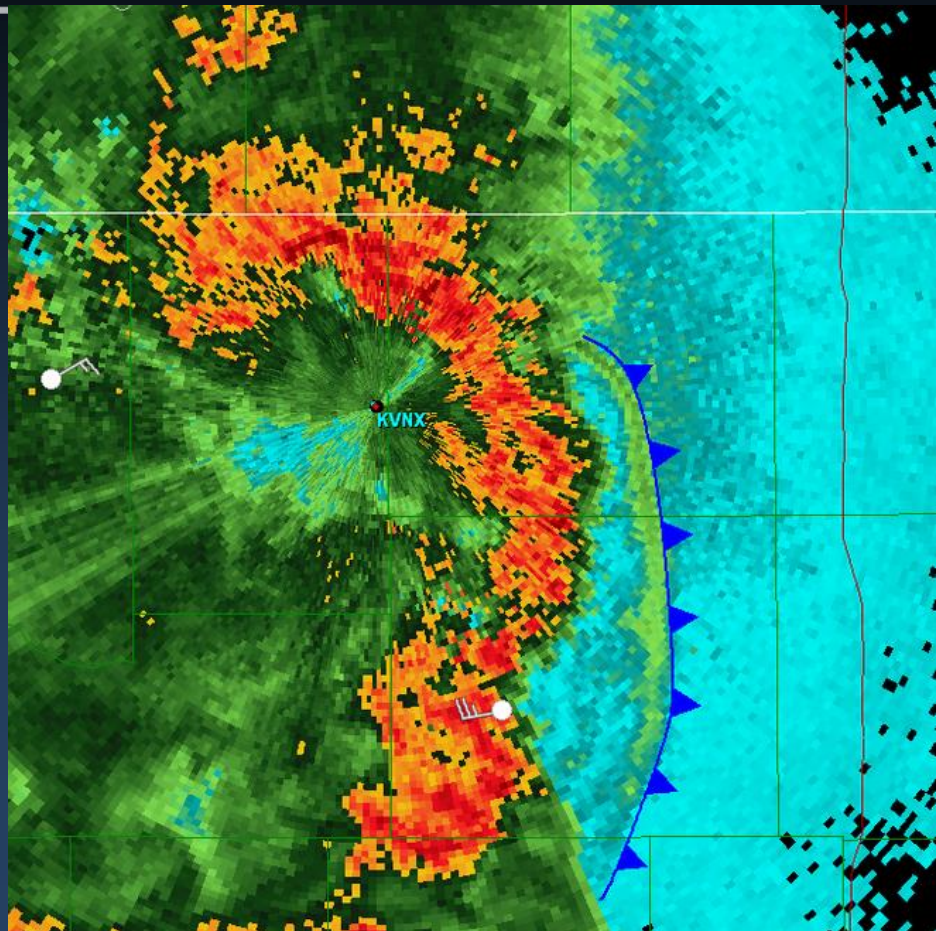
Squall Lines

Radar View

Squall Line

- **Highest wind usually found where line surges ahead AND at the leading edge of heaviest rain**
  (white curved line in image)

- **Sometimes, the highest wind can surge several miles ahead of the heavy rain echoes on radar**
  (blue pointed line on image)



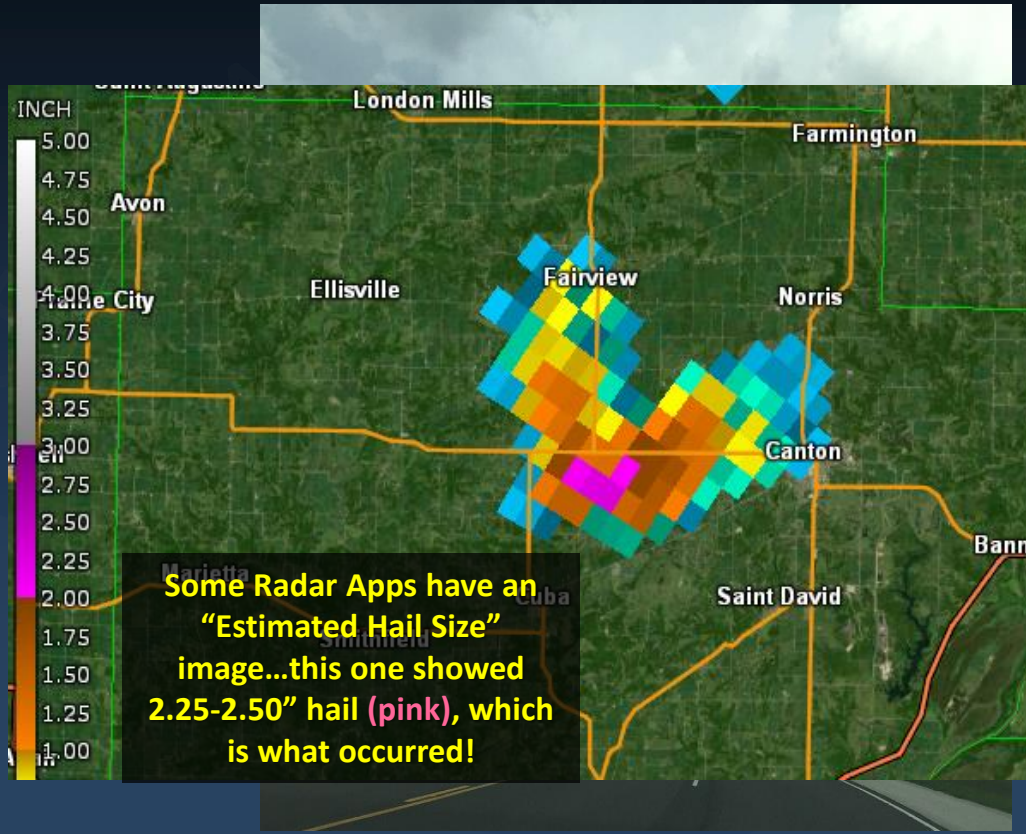
Hail

- **Any type of T-storm can produce hail**
  - The biggest hail is associated with the strongest updrafts
  - Hail bigger than a golf-ball usually means the storm is a SUPERCELL
  - Large, wind driven hail can cause extensive damage & injuries

Hail

Radar and Spotter View

- Spotters will sometimes see a “hail shaft” – a white vertical streak below the storm
- Hail is water coated ice, so it is very “reflective” on radar
- High radar reflectivity values are often associated with hail



SPOTTER CHALLENGES…

…take your time to provide the most accurate report

Spotter Challenge #1 : Obstructions to Your View

Tornado or Funnel?

- Can't see the ground due to tree line in the distance
- No sign of debris being lofted yet, but trees are in the way
- ***PROBABLY*** a tornado because of RFD/Clear Slot wrapping around funnel cloud – **BUT NEED A BETTER VIEW**

Spotter Challenge #2 : Features in the Distance

Tornado or Funnel Cloud…?

- Corn is in the way; distance about 2 miles
- Signs of debris being lofted on left side of picture
- An EF-1 tornado developed shortly after this photo was taken

Spotter Challenge #3 : Scud Clouds

- Low hanging clouds
- Appear to be attached to the bottom of the storm cloud, but most are not
- Easily confused for all clouds and funnels, especially at night
- Look for a lack of rotation to confirm it is scud

Spotter Challenge #4 : Spotting at Night

Spotting at night is VERY dangerous!

This should only be done from a safe shelter *OR* if you KNOW that there is a shelter nearby

Video by Kevin Radley *(Looking SW to W)*
Near Taylorville, IL 12/01/18

Tornado was about 2 miles SW of his location at beginning of video

SPOTTER SAFETY

MAIN Objective : BE SAFE!!

- Personal safety is YOUR TOP PRIORITY
- The NWS does NOT encourage spotters to chase storms
- Some spotters MAY be mobile, MANY will NOT

ALL SPOTTERS need to be ALERT to rapidly changing conditions which could impact your safety!

Safe Shelter

- CRITICAL when you need to get away from danger
- Have clear paths allowing you to reach safety BEFORE the threat arrives
- ALL spotters: Have a secure, INDOOR shelter that will be available to you at all times
- Mobile spotters: Adequate roads or paths for you to move to a secure shelter

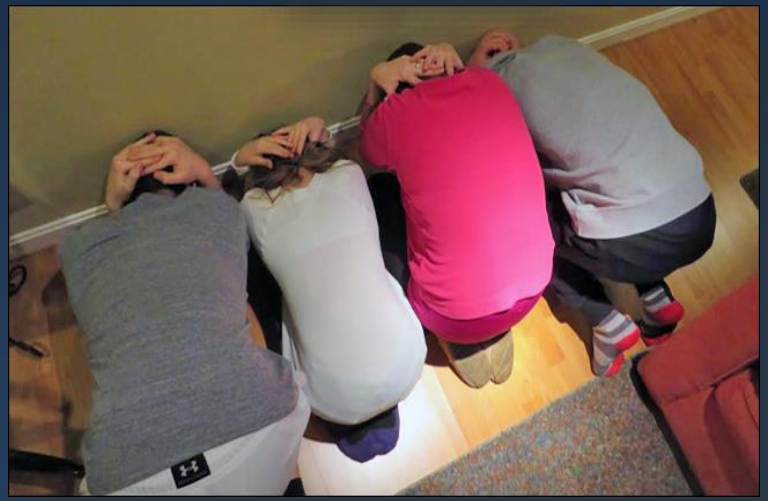
Tornado Safety

Whether indoors or outdoors:

Flying and falling debris is the greatest hazard, resulting in injuries and fatalities

Tornado Safety

- **Get in:** A sturdy shelter
- **Get down:** A basement or underground shelter is the best
  - If not available, get to the lowest level, near the center of the building, in a small room or closet
- **Cover up:** Minimizes your risk of injury from falling debris



Tornado Safety

If outdoors, find an indoor shelter.

LAST RESORT : Lie flat in a ditch to protect yourself

Photo by Chicago Sun-Times

If you stay in your vehicle, you could get seriously injured!

Tornado Safety

Avoid parking under a bridge or underpass

The tornado wind can increase significantly, blowing debris into you or tossing your vehicle

I-57 Underpass near Tuscola, IL

Flash Flooding: Characteristics

A flood where the water rises rapidly (minutes or hours, instead of days)

- Can occur in any area, especially if the ground is already moist
- Usually caused by very heavy rain in a short amount of time
  - 1 to 2 inches of rainfall or more in *60 minutes or less* is a general guideline
- Can also be caused by a dam or levee failure

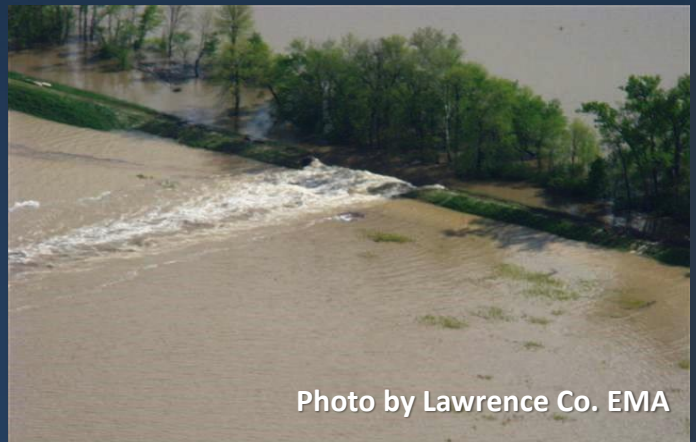


Photo by Lawrence Co. EMA

Flash Flood Safety

Flash Flood Safety

WHEN FLOODED TURN AROUND DON'T DROWN

Never cross a water covered road OR bridge in a vehicle

Turn around and take another route

Never walk into a flooded area, unless you are evacuating

Photo from Peoria Journal-Star 4/22/13

Photo by Pete Mantell Sydney, IL 12/28/15

Lightning Safety: VIDEO

Lightning is one of the GREATEST dangers to spotters!

Stay indoors or in your vehicle as MUCH as possible!

Lightning Safety: VIDEO

Lightning is one of the GREATEST dangers to spotters!

Stay indoors or in your vehicle as MUCH as possible!

Question : What was NOT happening in both videos?

Answer : It was NOT raining when lightning struck

Lightning Safety

Intense lightning can occur many miles away from the storm – in areas with NO rain!

Don't return outdoors too soon!!

Stay in a safe shelter at least 30 minutes AFTER the last rumble of thunder

Geospace Physics Lab, Dept. of Physics & Space Sciences, Florida Institute of Tech.

Lightning Safety

Safe locations:

- Secure building with the windows and doors closed
- A hard-topped vehicle with the windows closed
  - This is safe because you are enclosed in the metal frame of the vehicle – NOT because of the tires!!

When you see lightning OR hear thunder: Go to a safe location IMMEDIATELY!

What to Report

1-800-611-4570 unlisted!

Tornado

- In contact with the ground

Funnel Cloud

- NOT on the ground

Wall Cloud

- Lowering of storm cloud with rotation

"If it spins, call it in..."

Report where you are then approximately how far and in what direction funnel/tornado is from you

What to Report

Flooding

- How deep is the water?
- Water Flowing?
- Which roads are impacted?
- Any damage? Cars stranded?

Photo by Pete Mantell
Sydney, IL 12/28/15

Photo by Christina Mueller
Charleston, IL 4/3/18

What to Report

Wind

- If reporting speed:
  Measured or Estimated?

- Any wind damage?
  Describe the damage…
  - Large or small branches with sizes
  - Power lines/poles down
  - Structural damage

What to Report

Hail

0.25 inches Pea		2.00 inches Lime	
0.75 inches Penny		2.50 inches Tennis Ball	
1.00 inches Quarter		2.75 inches Baseball	
1.50 inches Ping Pong Ball		4.00 inches Softball	
1.75 inches Golf Ball		4.50 inches Grapefruit	

What to Report

WHO you are

- Trained spotter

WHAT you have witnessed

- The specific weather event

WHEN the event occurred

- Not the time you are reporting

WHERE the event occurred

- Not just your location
- Use well known roads

Final Questions?

Thank you for your time &
Be SAFE Out There !!

Spotter page: www.weather.gov/ilx/spotter

Facebook: www.facebook.com/NWSLincoln

Twitter: www.twitter.com/NWSLincolnIL

@NWSLincolnIL #ILwx

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1-800-611-4570 unlisted!