Advanced Thunderstorm Topics for SKYWARN Spotters

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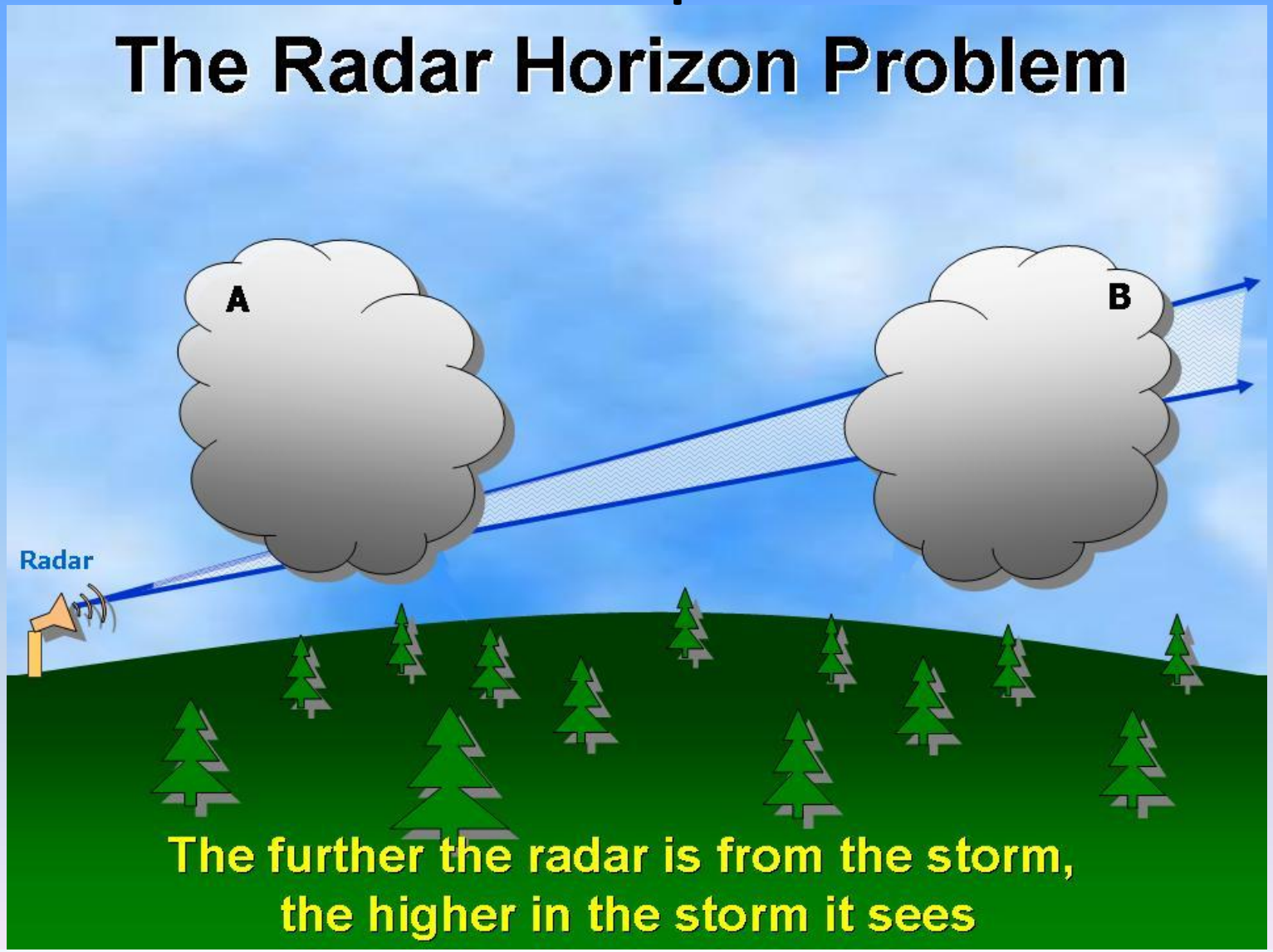
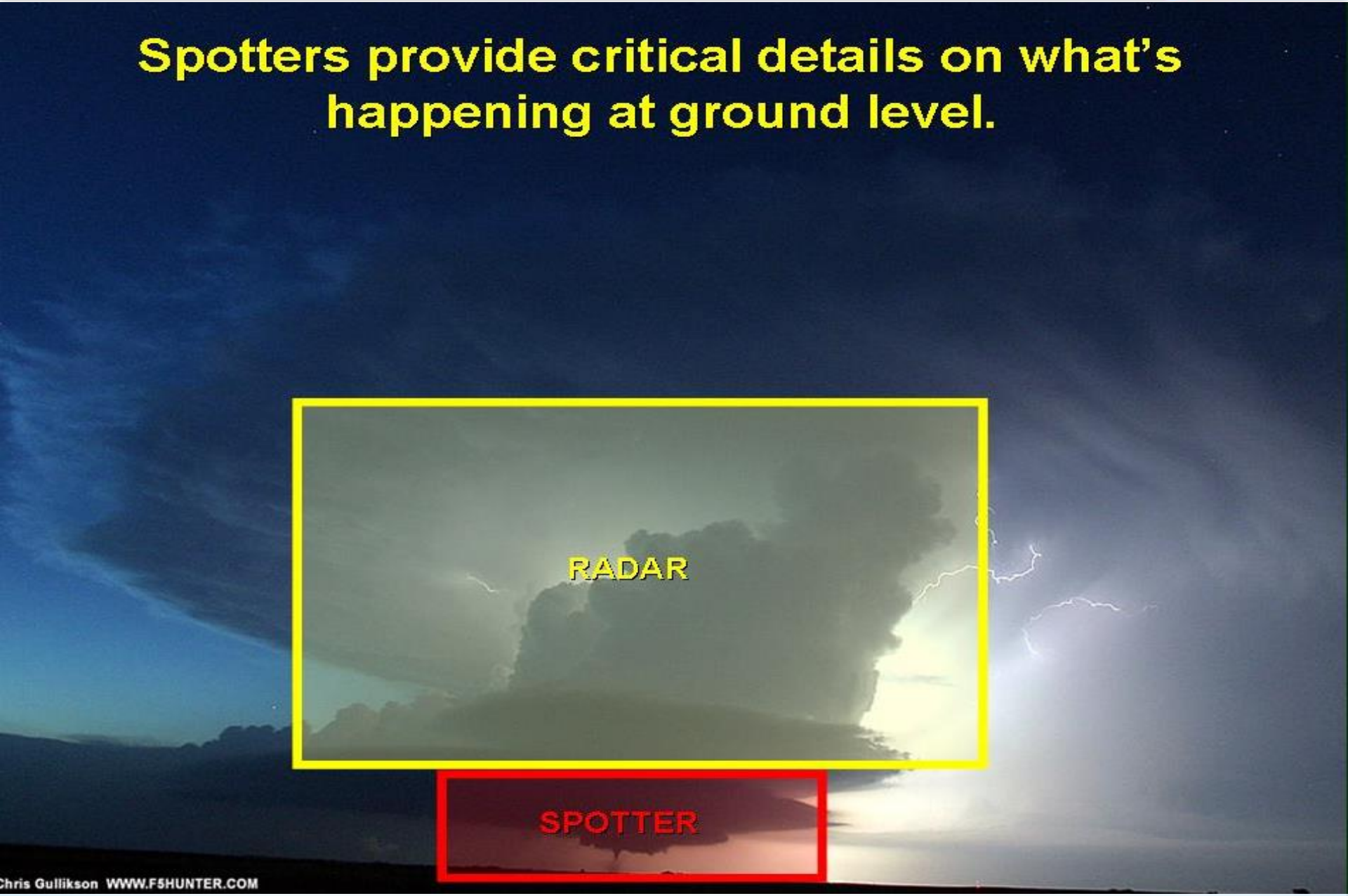
What We'll Cover

- Review – why are you so important to us?
- SKYWARN Spotter Safety Review
- Thunderstorm Life Cycle/Structure
  - Evaluation of features
- Night Spotting
- Suggested Training Resources
- Communicating with us

You Are Important!

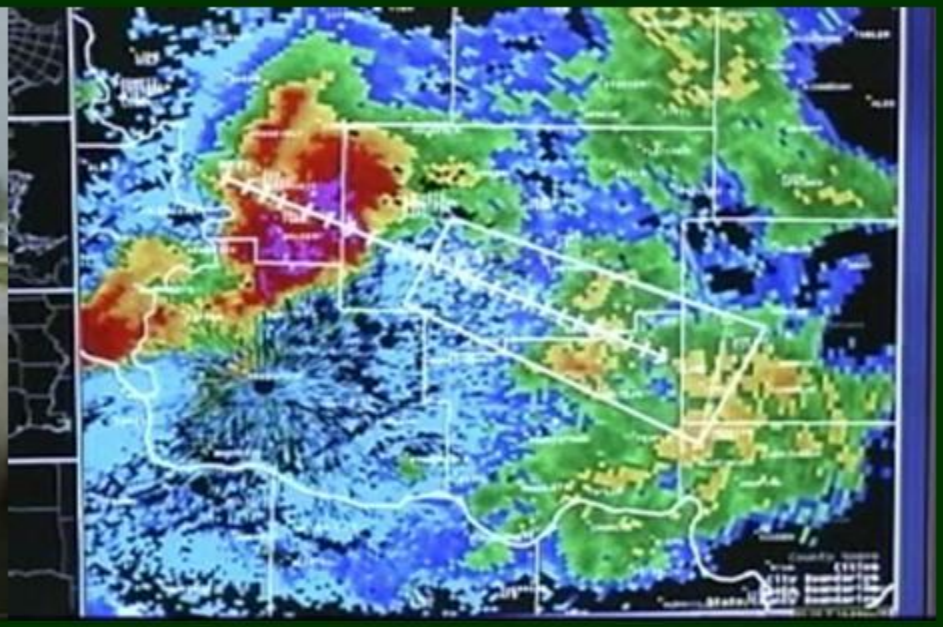


Spotters provide critical details on what's happening at ground level.



Spotter reports…

… verify/confirm the need for a warning
… verify storm impacts on the ground
… help NWS warn people in the next county
… help NWS calibrate our radar tools



WHAT HAPPENS TO YOUR REPORT?

SEVERE THUNDERSTORM WARNING

TORNADO WARNING

SEVERE WEATHER STATEMENT

LOCAL STORM REPORT

Official NWS Historical Database

STORM DATA

Spotter Safety Review

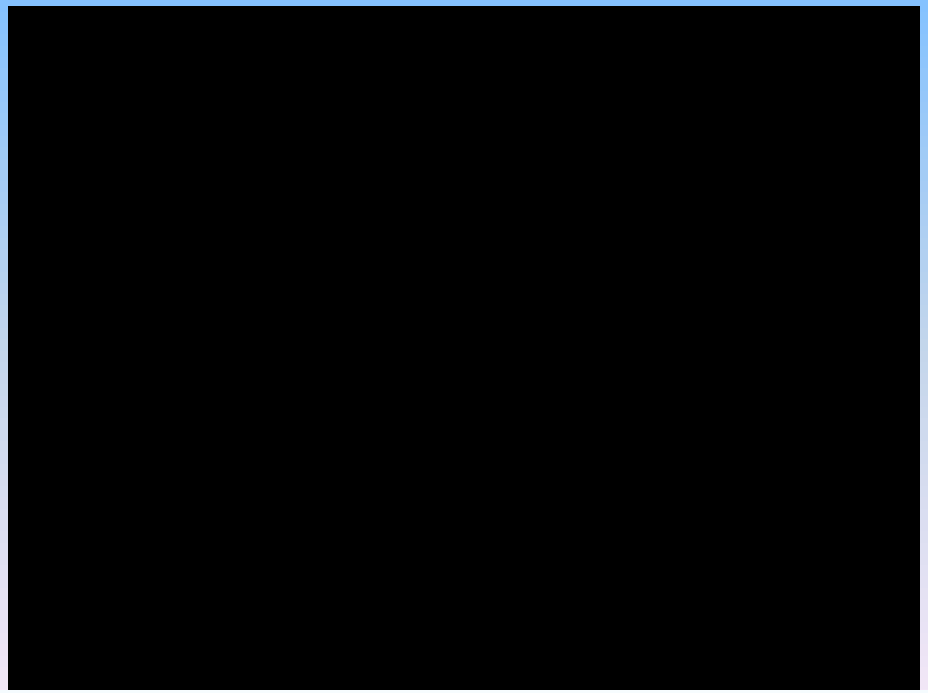
- Spotting can be dangerous!
- Hazards include
  - Storm chasers
  - Other traffic
  - Flash flooding
  - Lightning
  - Winds
  - Hail
  - Tornadoes

Lightning Safety

- Lightning is the 2nd leading weather killer for the general public
- Lightning is the ***NUMBER 1*** weather hazard for spotters

Lightning Safety Tips

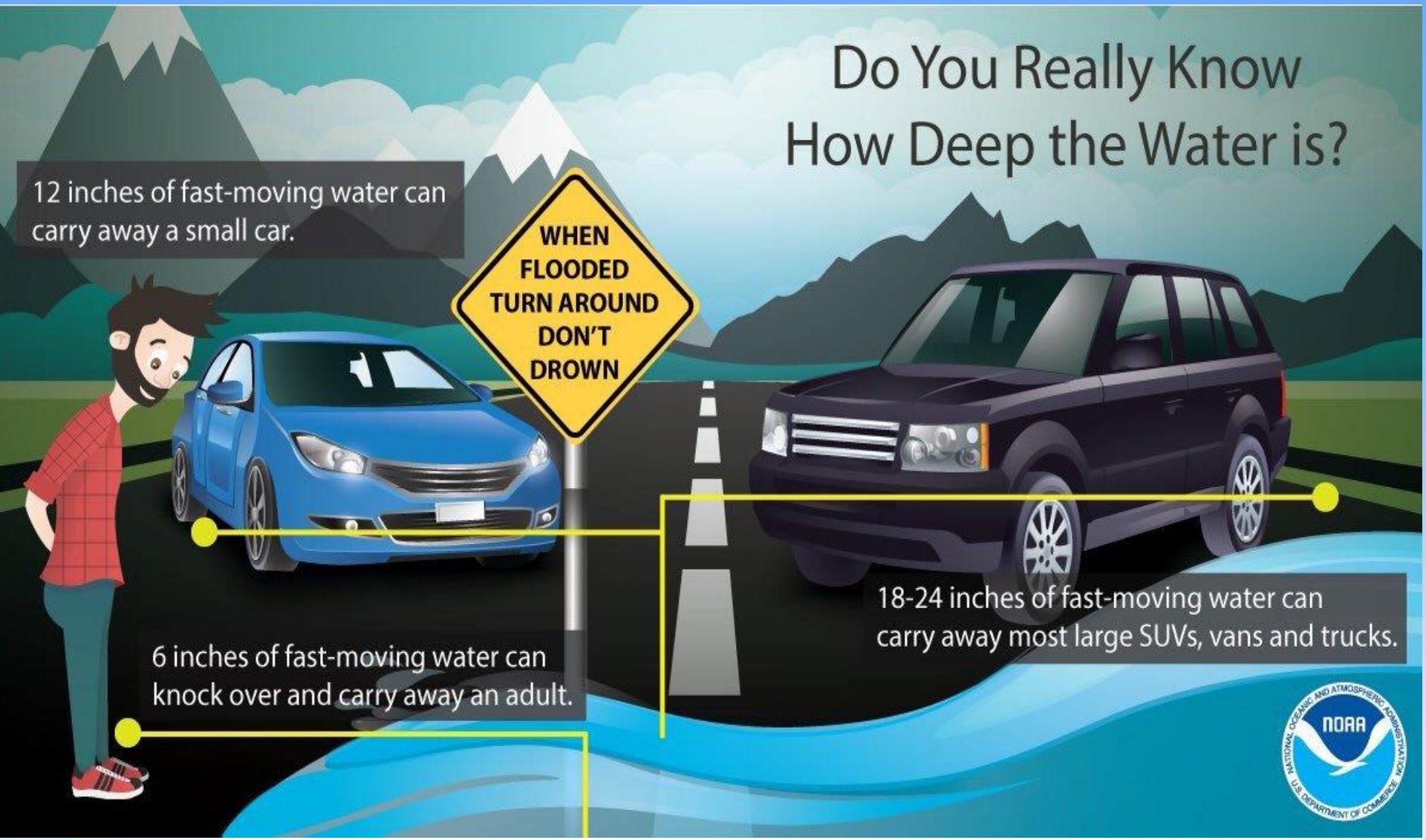
- Lightning tends to strike the tallest object in the area…make sure it's not you!
  - **Remain in your spotting vehicle whenever possible**
- If you must go outside…crouch down to make sure you are a poor lightning target



Flash Floods

- Kill more people than any other weather hazard
- Spotting will frequently take you to easily flooded side roads
- If your vehicle stalls in high water leave it! …*Seek higher ground*
- Be especially careful at night
  - Many floods happen at night
  - Floods are harder to recognize
  - TURN AROUND, DON'T DROWN!

Flash Floods



Hail Safety Tips

- Substantial structures offer the best protection
- Your spotting vehicle offers *some* protection for hail smaller than golfball size (unless strong winds are present)
- Pull over when encountering hail
- Keep blankets in your car for protection if glass breaks!

Downburst Wind Safety Tips

STRAIGHT LINE WINDS

- ✓ Straight line winds can exceed 100 mph, and affect large areas.
- ✓ Strong winds can knock over semi-trucks, trees and powerlines.
- ✓ Stay indoors away from windows.
- ✓ Avoid trees, power lines, and objects that could blow around.
- ✓ If driving, slow down and keep two hands on the wheel.

- ✓ **Watch for low visibility (dust, heavy rain, etc.).**
- ✓ **Better yet, PULL OVER away from trees, power lines, structures that can produce flying debris.**
- ✓ **If possible, point vehicle INTO the wind (lowest profile)**

Tornado Safety

Pampa, Tx 6/95 (Todd Lindley)

- Spotters in open rural areas may be able to drive away from an approaching tornado
  - This does ***not*** apply to urban spotters, spotters in low visibility areas, or the general public!
  - Determine storm movement, drive away at ***RIGHT ANGLES***
- If you can't avoid an oncoming tornado, seek shelter in the basement or strongest interior room in center of a sturdy building
- If none are available, seek shelter in a ditch, culvert or other low area
- Cover your head and neck

Track of Newcastle Tornado along I-44

Overpasses are not safe shelter!!

- On May 3rd 1999 at least 2 people were killed by taking shelter under overpasses
- Your best bet is to pay attention to information on storm position
- These deaths were preventable…***no one*** had to die this way!!

Overpasses As Shelters Are A Myth…

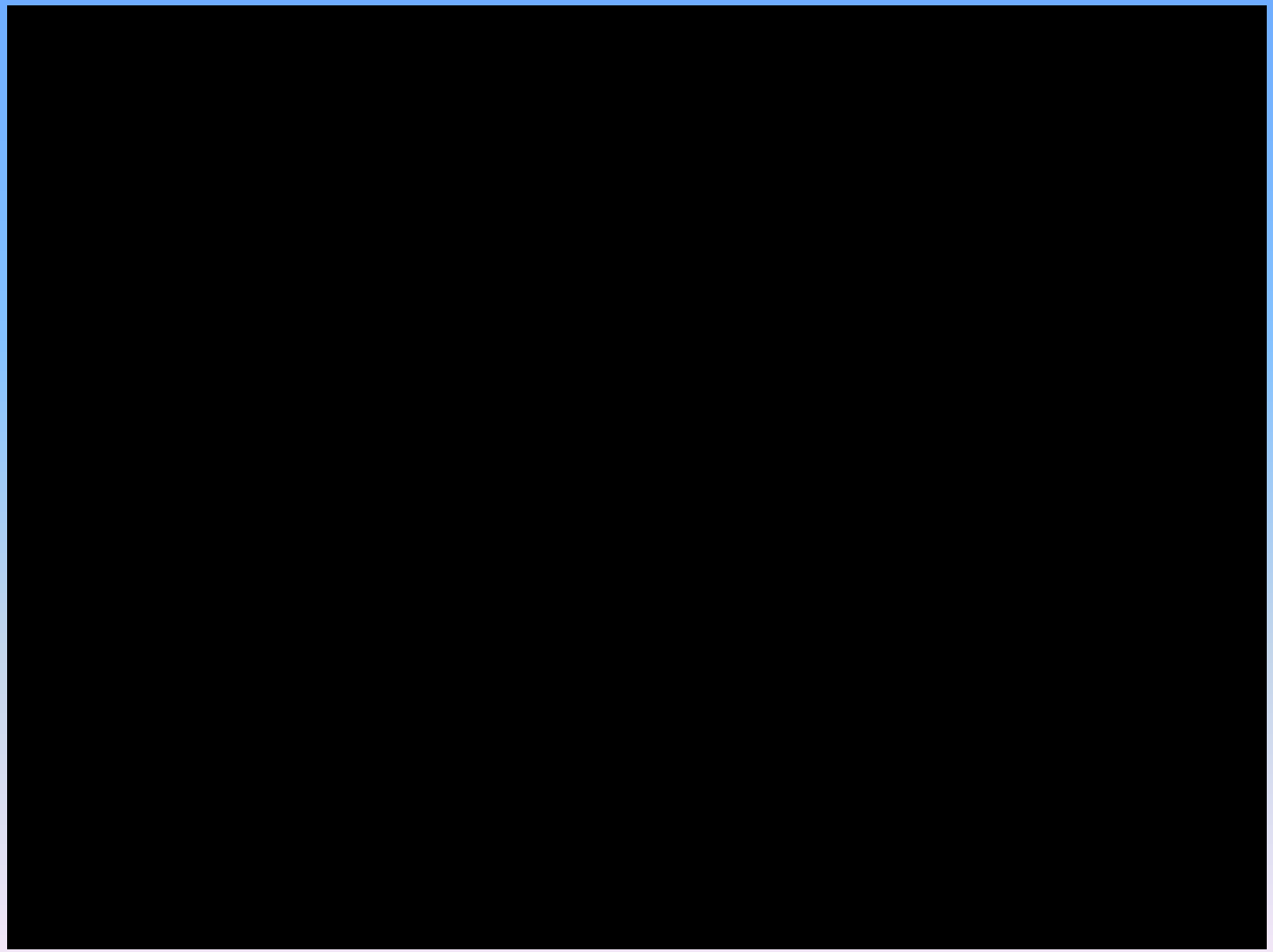
BRIDGES AND OVERPASSES ARE NOT SAFE STORM SHELTERS!

And… damaged vehicles may block First Responders from saving lives.

WHY IS TAKING SHELTER UNDER A BRIDGE OR AN OVERPASS A BAD IDEA?

- It provides NO protection from a tornado.
- You could block the road, exposing others to damaging hail or from reaching their safe shelter.

May 24, 2011 – Again Near Newcastle, OK



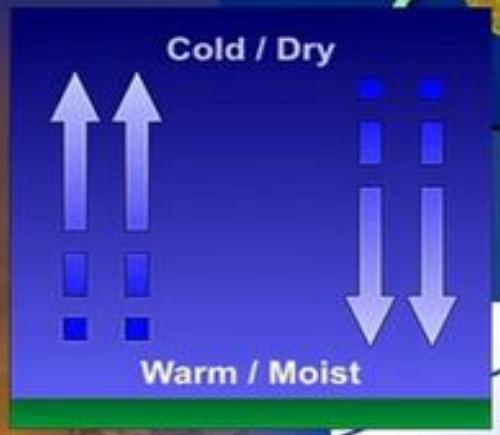
Automobiles…unsafe in tornado winds!

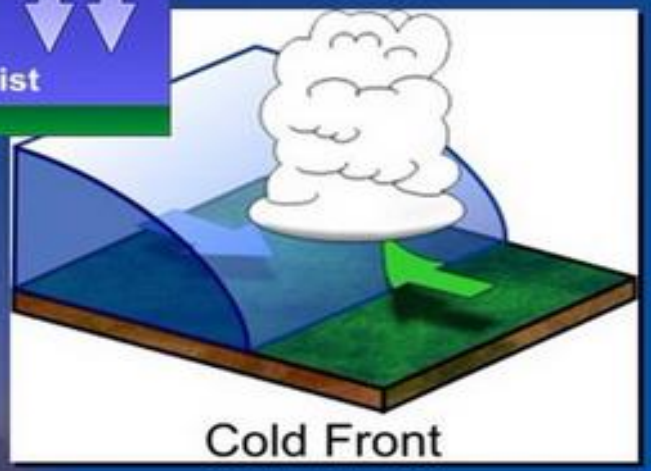
- Scenes like this are common in strong and violent tornadoes
- Automobiles may be lifted and tossed long distances
- It's not necessary (or desirable) for any spotter to get this close!
- A vehicle is not a tornado shelter

May 31, 2013 El Reno, OK

Thunderstorm Life Cycle
&
Structure

Thunderstorm Formation





3 Main Ingredients

Moisture - Preferably in the lower to mid levels of the atmosphere.

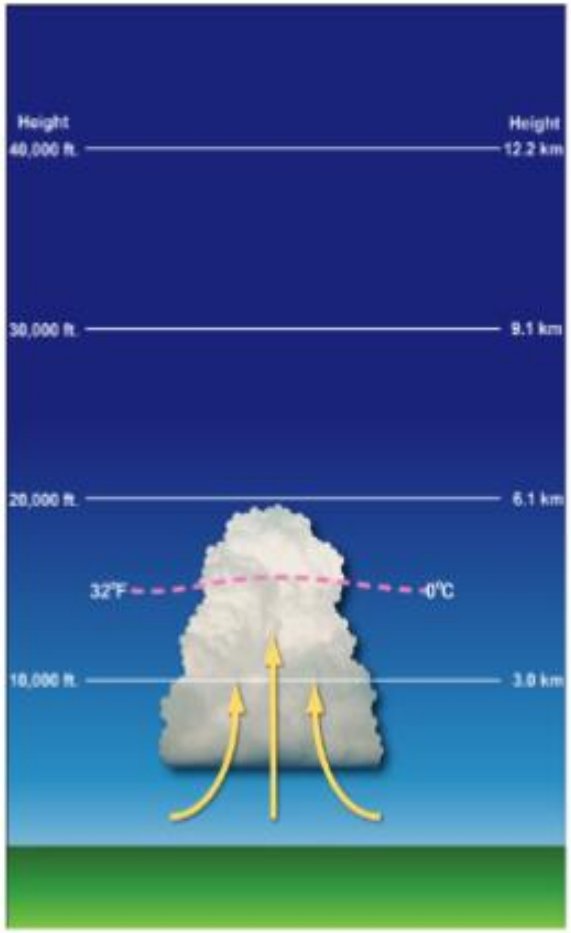
Instability - Ability for air to accelerate upward or downward when started up or down.

Lift - Agent which lifts moist unstable air, which starts the thunderstorm.

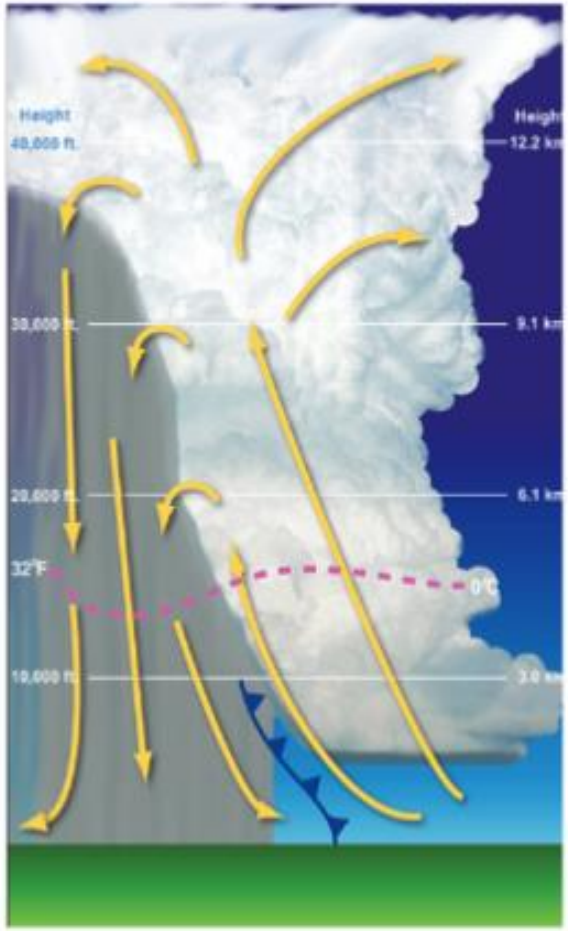
- Cold and Warm Fronts
- Gust Fronts (from other thunderstorms)

What else can act as LIFT?

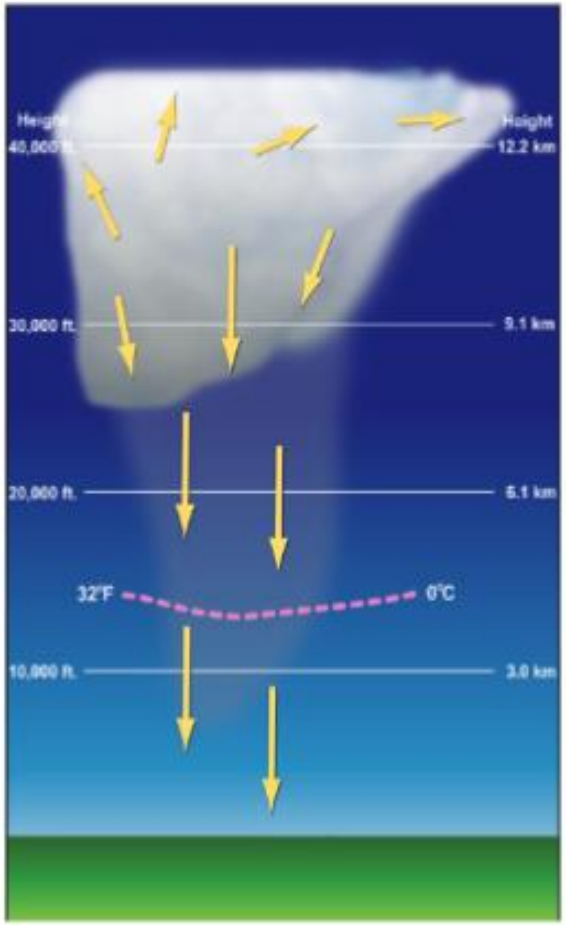
Life Cycle



Towering Cumulus Stage



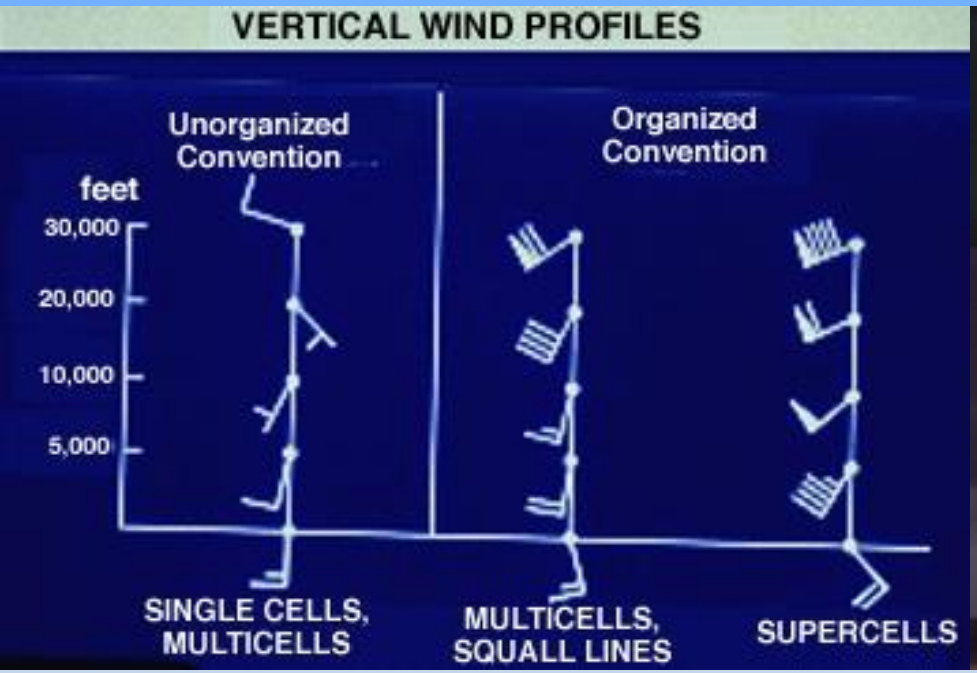
Mature Stage



Dissipating Stage

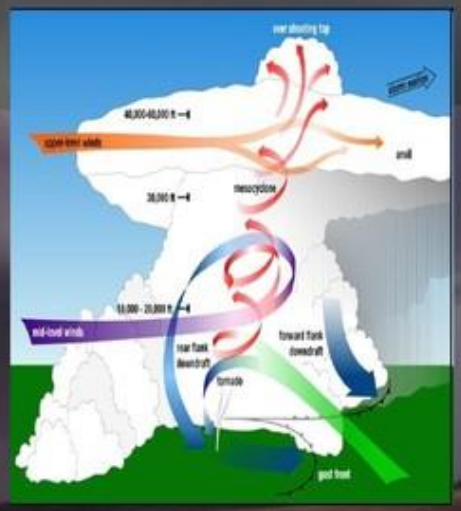
Which stage has the best potential for severe? Any others?

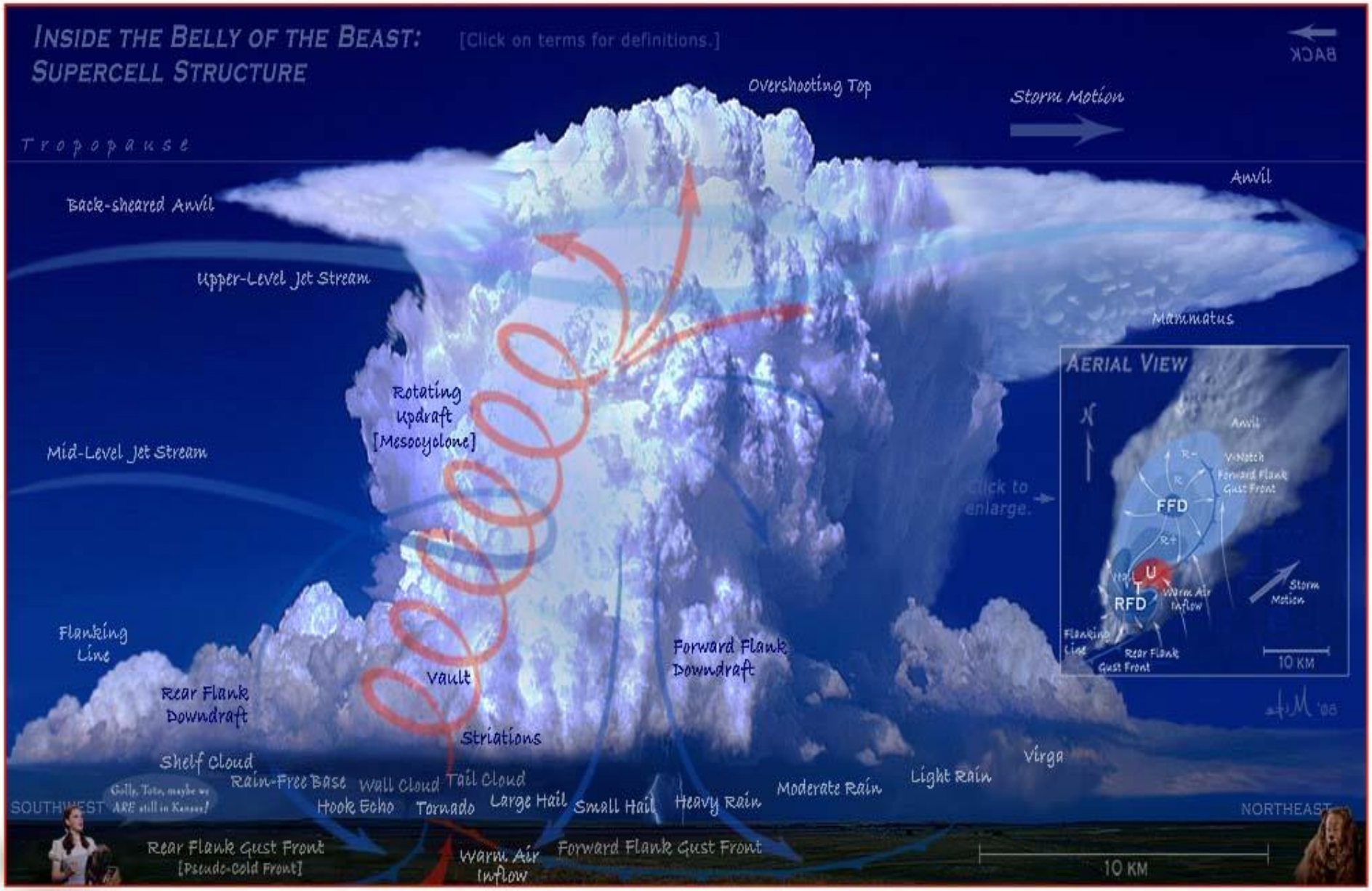
Shear Is Important For Severe Development



Vertical Wind Shear

- Increases storm organization
- Increases storm longevity
- Increases the threat for severe weather
- Rotation within the storm indicates the biggest threat




INSIDE THE BELLY OF THE BEAST:
SUPERCELL STRUCTURE
[Click on terms for definitions.]
BACK
Overshooting Top
Storm Motion
Tropopause
Anvil
Back-sheared Anvil
Upper-Level Jet Stream
Mammatus
Rotating Updraft [Mesocyclone]
Mid-Level Jet Stream
Click to enlarge.
AERIAL VIEW
Anvil
V-Notch
Forward Flank Gust Front
FFD
RFD
Warm Air Inflow
Storm Motion
Flanking Line
Rear Flank Gust Front
10 KM
Flanking Line
Forward Flank Downdraft
Vault
Rear Flank Downdraft
Striations
Shelf Cloud
Virga
Rain-Free Base
Wall Cloud
Tail Cloud
Light Rain
Moderate Rain
Golly, Toto, maybe we ARE still in Kansas!
SOUTHWEST
Hook Echo
Tornado
Large Hail
Small Hail
Heavy Rain
NORTHEAST
Rear Flank Gust Front [Pseudo-Cold Front]
Warm Air Inflow
Forward Flank Gust Front
10 KM

Upper-Level Evaluation
(As seen 30 miles or more)

- Overshooting Top
  - Dome like bubble "overshooting" the anvil
    - Indicates strong updraft
    - Updraft has passed Equilibrium Level (E.L.) in storm
  - Significant when persistent for more than 10 minutes (indicates strong storm, may continue to strengthen)

Overshooting Top

Upper-Level Evaluation

- Anvil Characteristics
  - Thick cumuliform anvil indicates strong updraft
    - Indication of liquid water quickly moved upward above freezing level
  - Thin translucent anvil signifies weak or weakening updraft
  - Mammatus Clouds

Question: Does this anvil indicate a strong or weak updraft? Why?

- A: Strong updraft! The anvil is not totally cumuliform…but is quite thick. This indicates large amounts of liquid water pumped high into the storm

Question: Does this anvil indicate the storm is strong or weak?

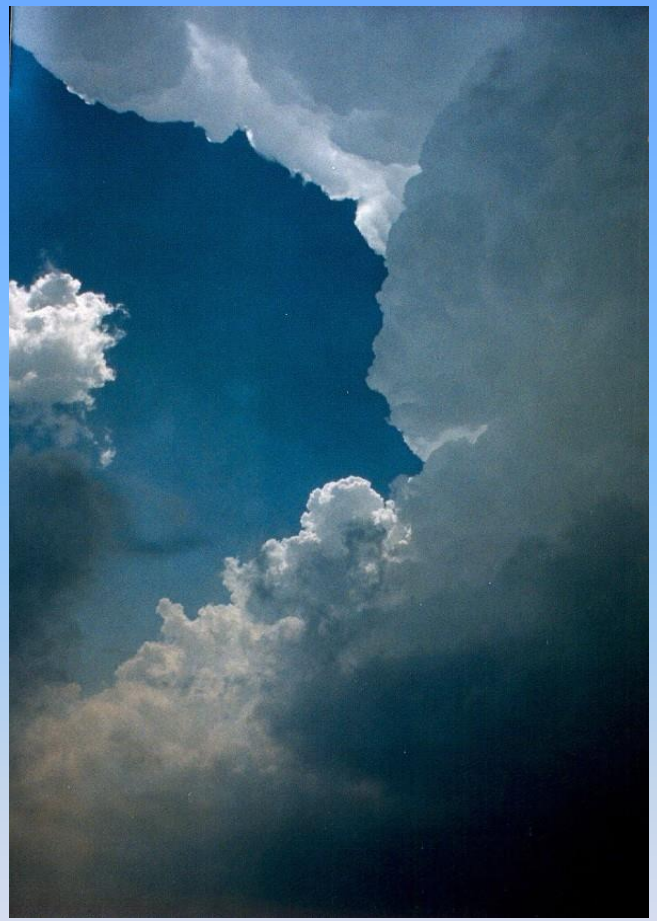
- A: The storm's anvil has a fuzzy appearance to it…indicating it is weak or weakening

Mid-Level Storm Clues

(Seen from 10 to 20 miles from storm)

- Main Storm Tower
  - Hard, sharp cauliflower texture
- Presence of a flanking line
  - Indicates greater storm-scale organization

Question: strong or weak updraft?



- A: Strong updraft…look at the hard, cauliflower appearance and outline to the updraft

Question: strong or weak updraft?

- A: Weak updraft. Note the "fuzziness" in the updraft elements.

Low-Level Storm Clues

(Best seen 3 to 8 miles from storm)

- Rain-Free Base
  - Marks the updraft area of storm
  - Located between the rain-free (updraft) base and precip area is the **updraft-downdraft interface**…watch it as a favored location for severe weather
- Wall Cloud
  - Isolated lowering of rain-free base
  - (In classic and LP supercells) to the rear of the precip area
  - Attached to the cloud base

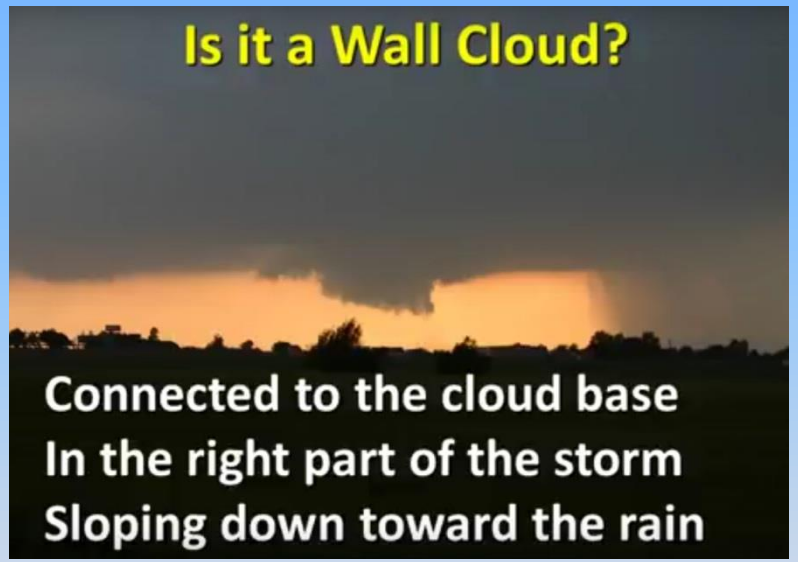
- Is there a rain-free base here?
- How about a wall cloud?

Lower level storm features, including the updraft and downdraft area. Photo by Jim LaDue.

What is a Wall Cloud?

- A local, often abrupt lowering of a rain free (or nearly rain-free) base.
- Many wall clouds exhibit counter-clockwise rotation.
- Many strong and violent tornadoes come from the wall cloud.
- However…wall clouds are not that rare.

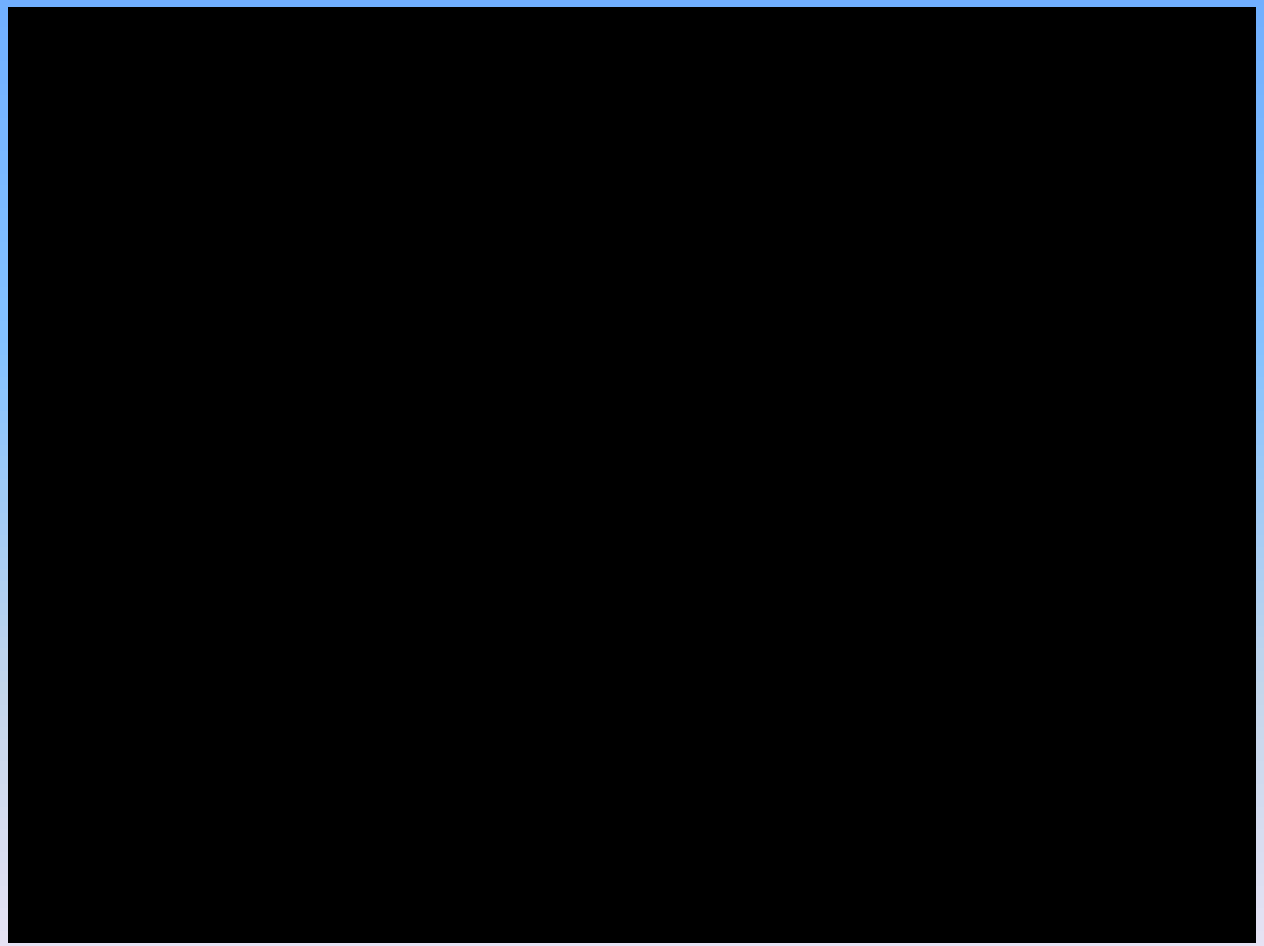
Characteristics of a Tornadic Wall Cloud



- Persistent
  - 10 to 20 minutes (or more)
- Persistently Rotating
  - Visible
  - Violent
- Surface-Based Inflow
  - 20 to 30 MPH or more
- Rapid Vertical Motion(s)

SC Spotter Problems

Do you see a wall cloud?



Video courtesy of Spotter Chris Jackson. Location: Lexington, SC

Key Points Concerning Wall Clouds

- Look for persistent rotation
- Is rotation horizontal…or vertical??
- Difficult to tell when moving.
  - Pull over occasionally
  - Wait and watch closely
- Shelf and roll clouds are often mistaken for wall clouds.
- **KNOW WHERE YOU ARE AT ALL TIMES IN RELATION TO STORM STRUCTURE**
- Have a safe zone or escape route.

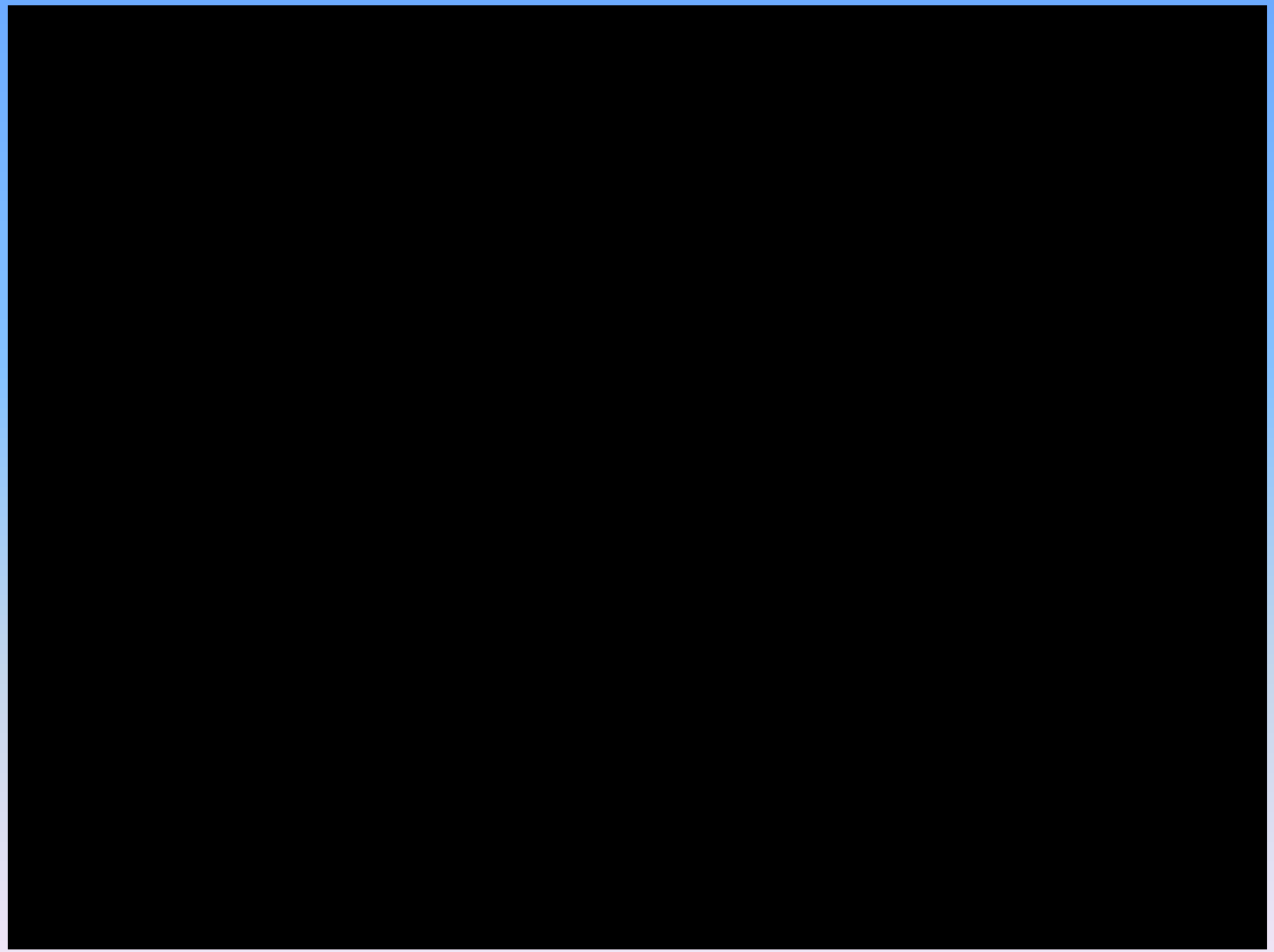
Remember Definition of Tornadoes!

- ***TORNADO*** – A violently rotating column of air pendant from a thunderstorm and in contact with the ground. A *condensation funnel* does not have to be present
  - A rotating *debris cloud* can confirm the presence of a tornado
  - If not touching the grounnd…report as a FUNNEL CLOUD
- REMEMBER…THE GOOD SPOTTER KEEPS AN EYE TO THE SKY…AND THE GROUND!

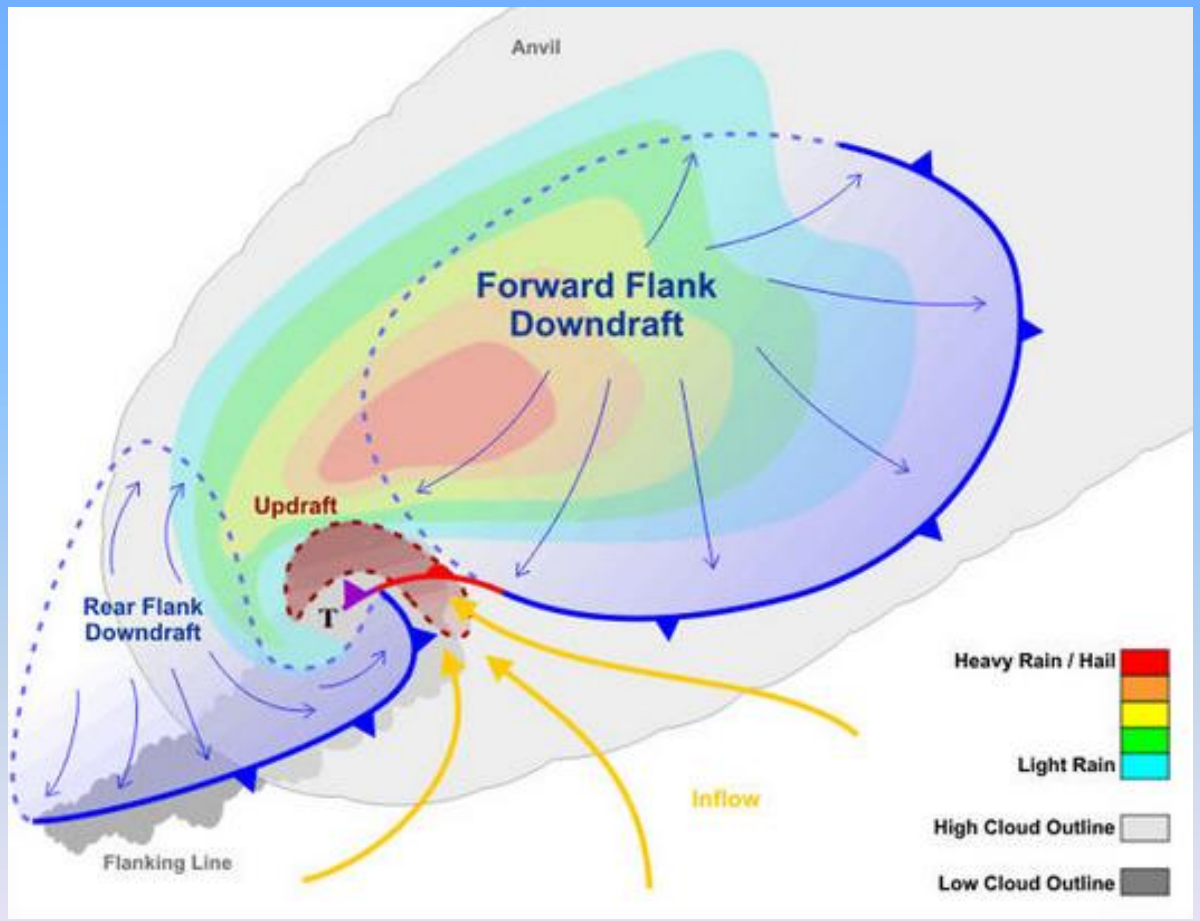
Night Spotting

- Added dangers exist while you are night spotting, especially with poor visibility
- Some new tools now exist to aid the night spotter
  - Night vision binoculars (pros/cons)
- As we see more night videos of tornadoes we realize how alert spotters need to be
  - Watch For
    - Lightning flashes
    - Illuminating features – powerline and transformer flashes
  - Listen For
    - Roaring sounds
    - Transformer pops

What do you see?



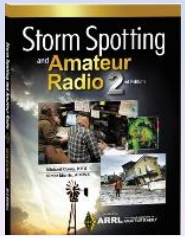
Last Words

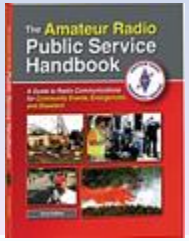


- Learn and know storm structure
- Your positioning will determine:
  - What you see
  - Your safety
- Know movement
- Escape routes!

Suggested Training Resources

- Basic Radar Interpretation – NWS Norman, OK
  - https://www.youtube.com/watch?v=sreogytRrD4
- MetEd Online Courses – www.meted.ucar.edu
  - SKYWARN Spotter Training
  - Role of the SKYWARN Spotter
  - SKYWARN Spotter Convective Basics
  - Anticipating Hazardous Weather & Community Risk
- ARRL publications





Communicating With Us

- Via SKYWARN Net Control Stations
- NWSCHAT – open to ham radio operators & official users
  - Sign up for NWSCHAT at: *https://nwschat.weather.gov/create.php*
  - *Must complete required training to get/use an account*
- *Unlisted Spotter Number*
- *Facebook: NWSColumbia Twitter: @NWSColumbia*
- *Web Page Local Storm Report Interface*
  - https://www.srh.noaa.gov/StormReport_new/SubmitReport.php?site=cae

Questions?

- Contact John Quagliariello
  - National Weather Service
  - 2909 Aviation Way
  - West Columbia, SC 29170
  - john.quagliariello@noaa.gov
  - See our Web Page http://www.weather.gov/cae/skywarn.html