



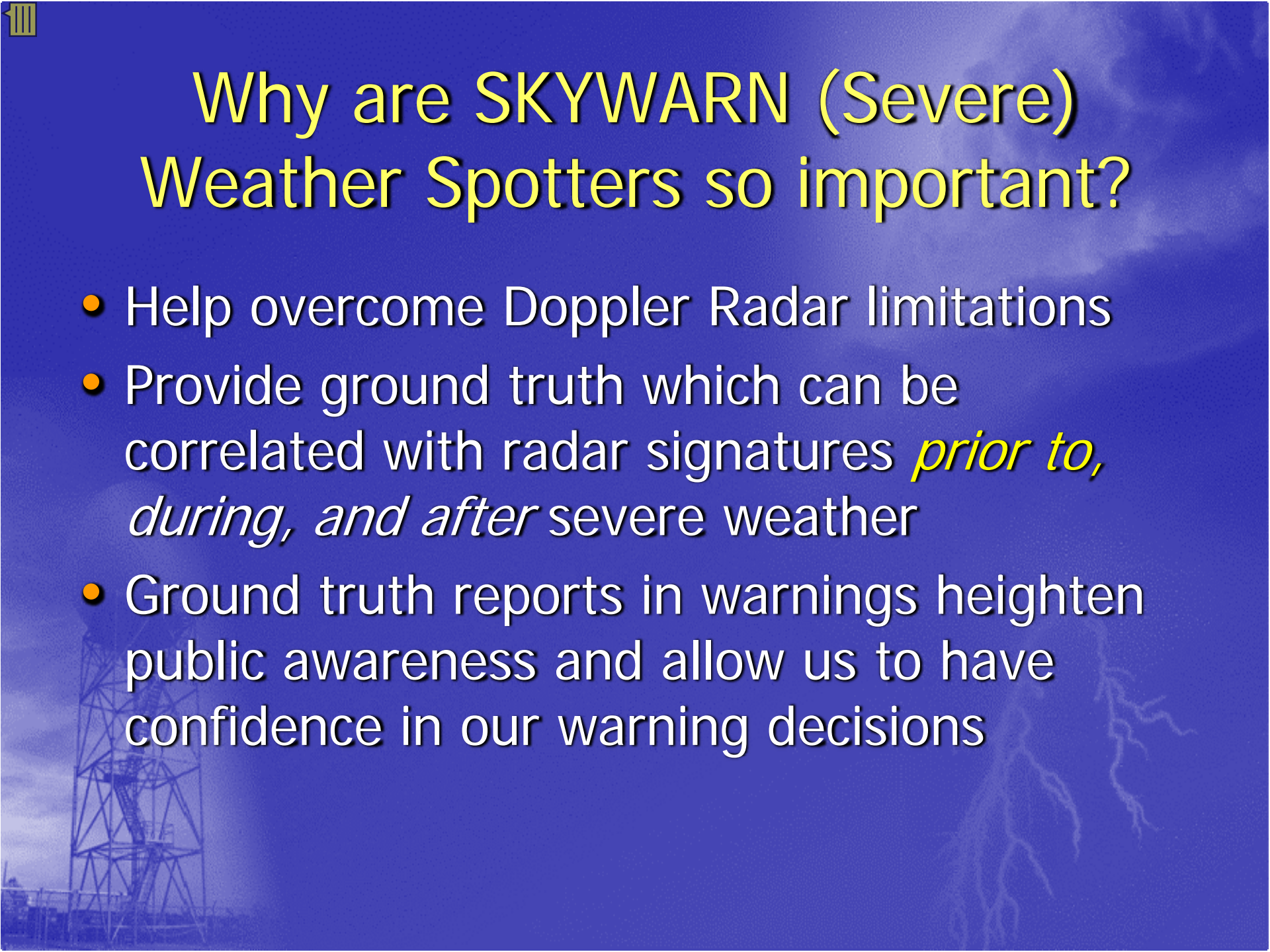
National Weather Service  
Gaylord Michigan

# Storm Spotter and Safety Course



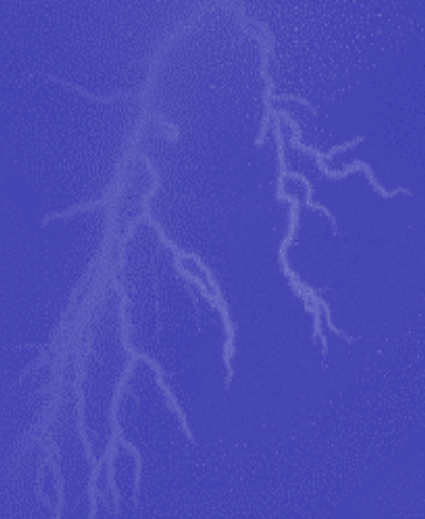


# Why are SKYWARN (Severe) Weather Spotters so important?

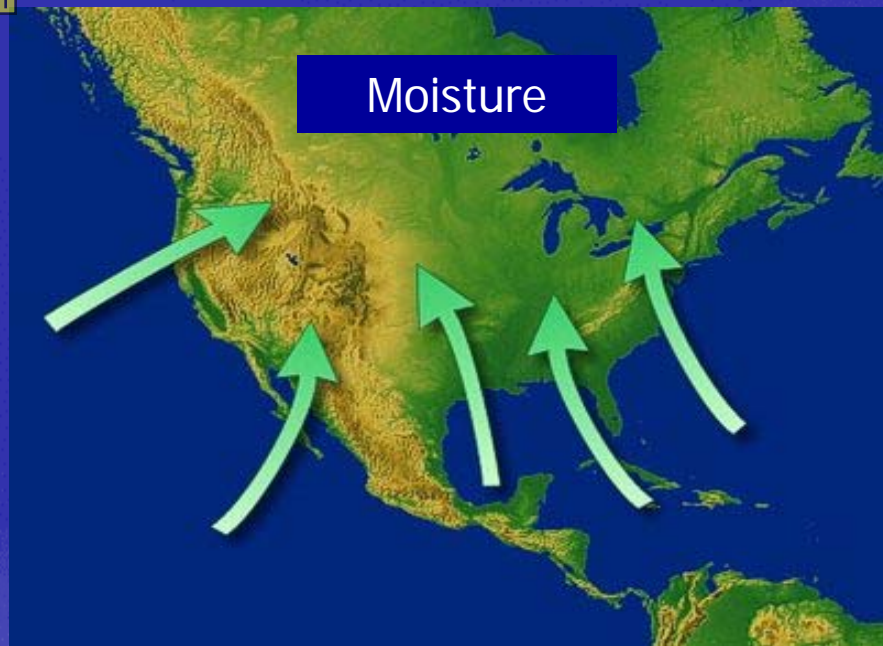
- Help overcome Doppler Radar limitations
  - Provide ground truth which can be correlated with radar signatures *prior to, during, and after* severe weather
  - Ground truth reports in warnings heighten public awareness and allow us to have confidence in our warning decisions
- 

# What 3 things do thunderstorms need in order to develop?

- Moisture
- Instability
- Lift



## Moisture

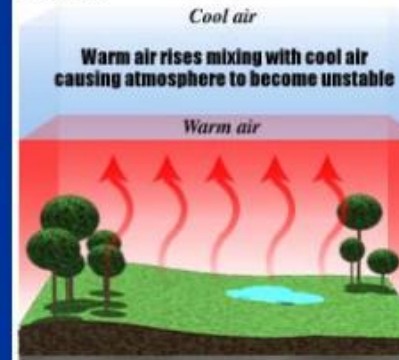


## Instability

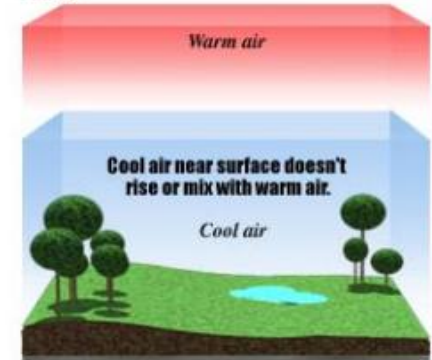


### How atmosphere becomes stable or unstable

#### Unstable



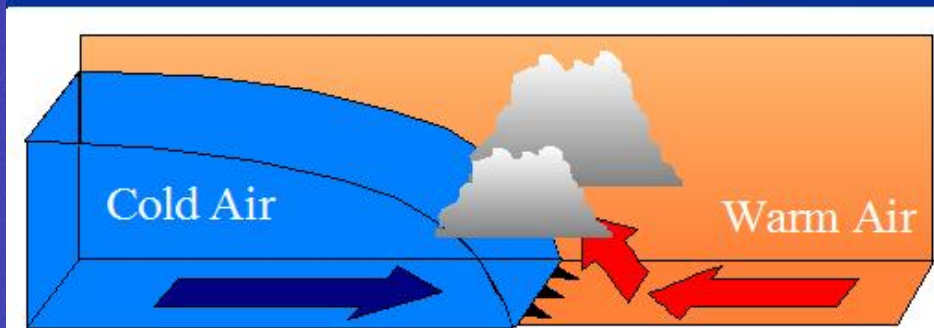
#### Stable



## Lift associated with cold front



- Colder more dense air pushes underneath warmer moist air, creating condensation and cloud development.
- Air converges along a frontal boundary, forcing it to rise.



# Thunderstorm Life Cycle

## Developing Stage

Towering Cumulus (rising air)

Usually little if any rain

Lasts about 10 minutes

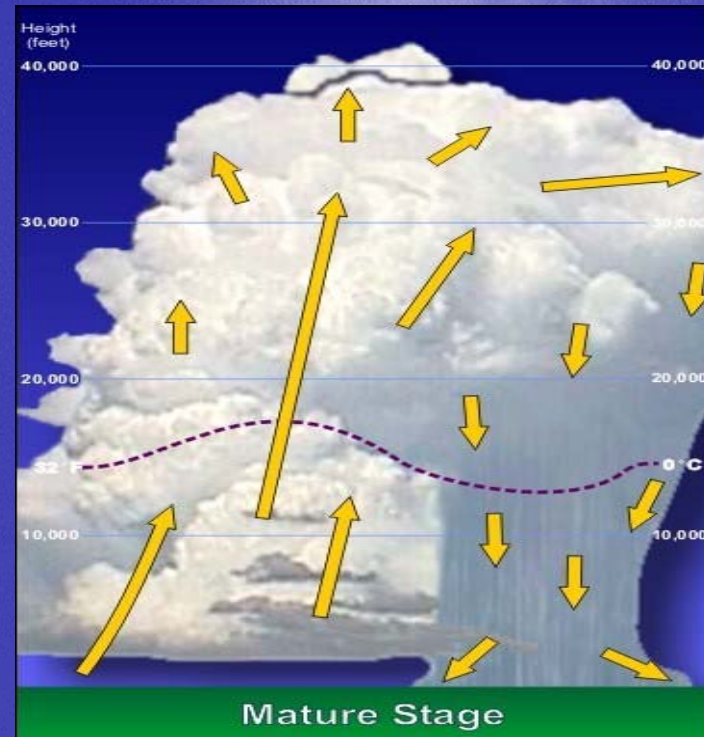
Occasional lightning

## Mature Stage

Most likely time for hail  
heavy rain, frequent  
lightning, strong winds, and  
tornadoes

Storm may have black or  
dark green appearance

Lasts an average of 10 to 20  
minutes, but may last much  
longer



## Dissipating Stage

Rainfall decreases in intensity

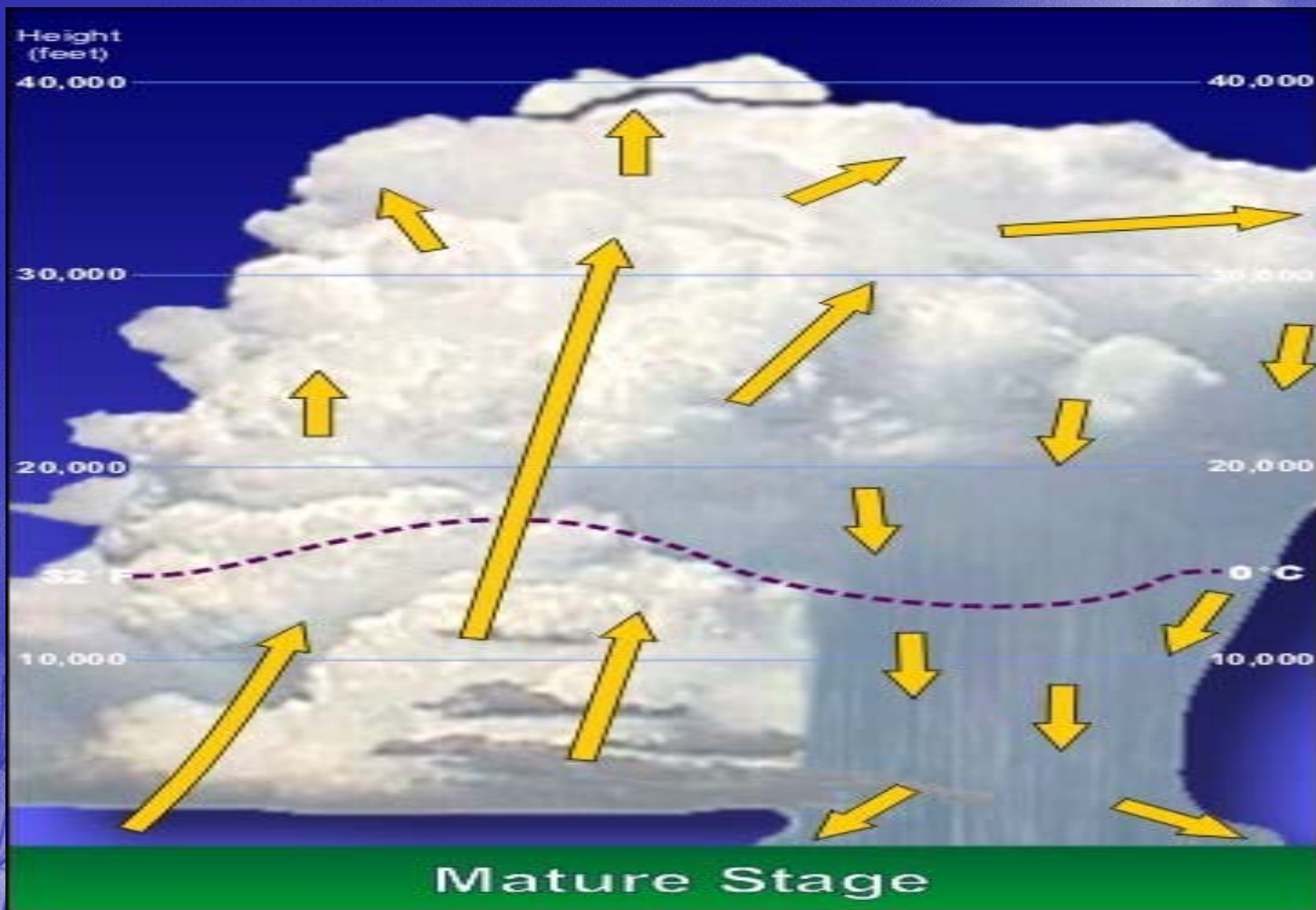
Can still produce a burst of strong winds

Lightning remains a danger

# Let's look at a few thunderstorm hazards...

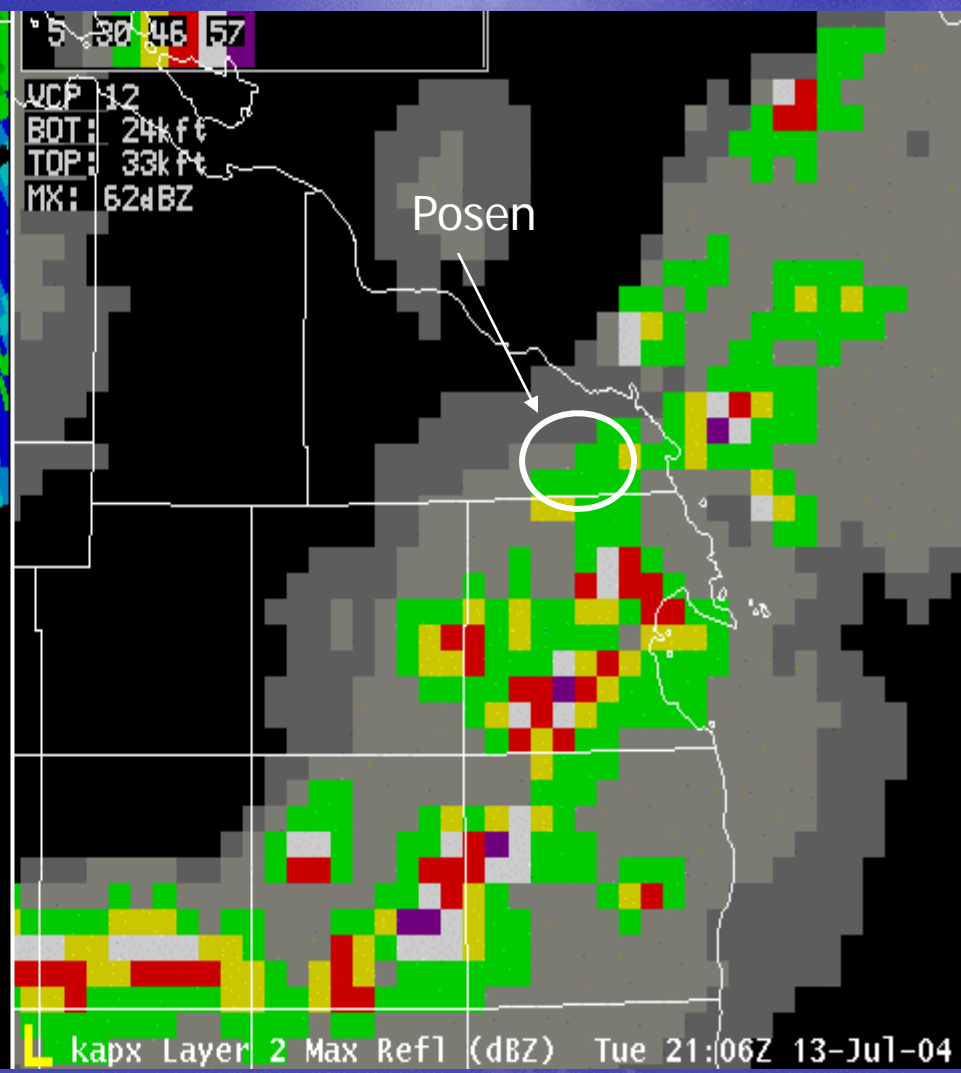
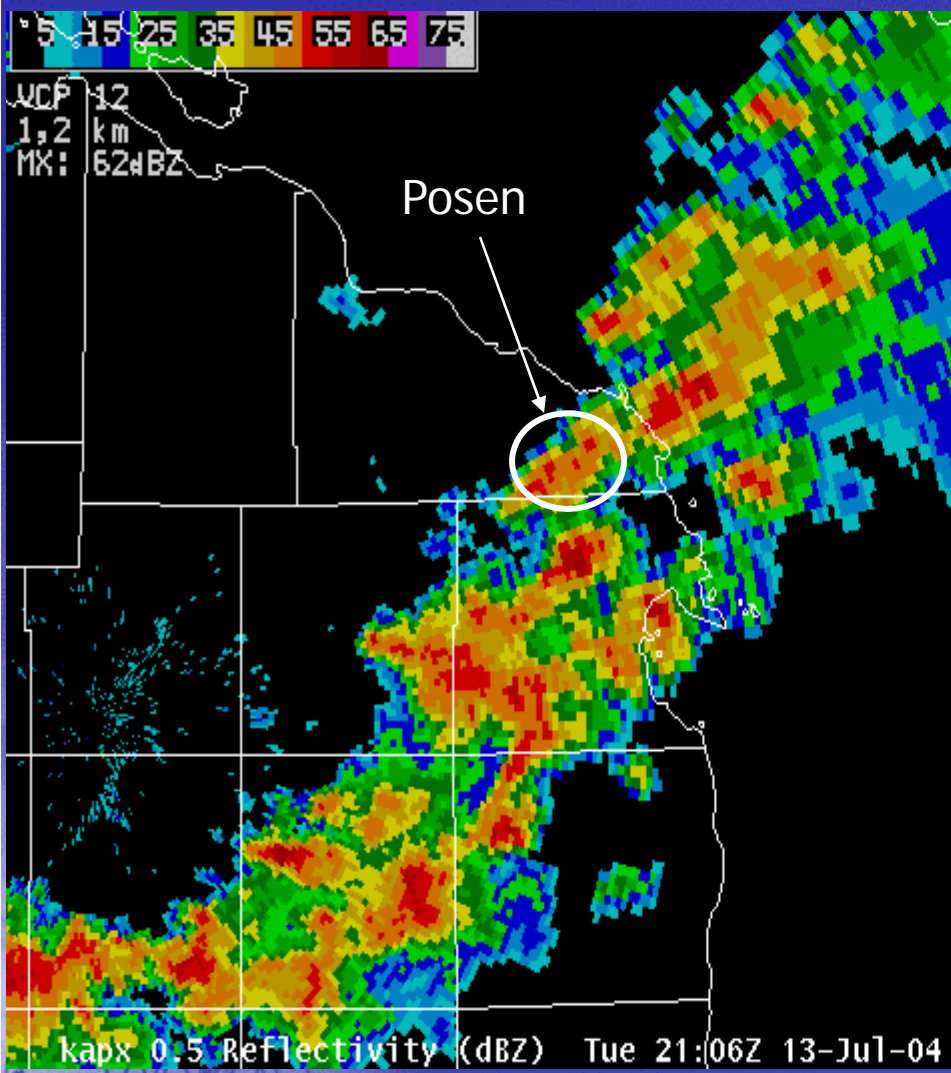


# How does hail form?



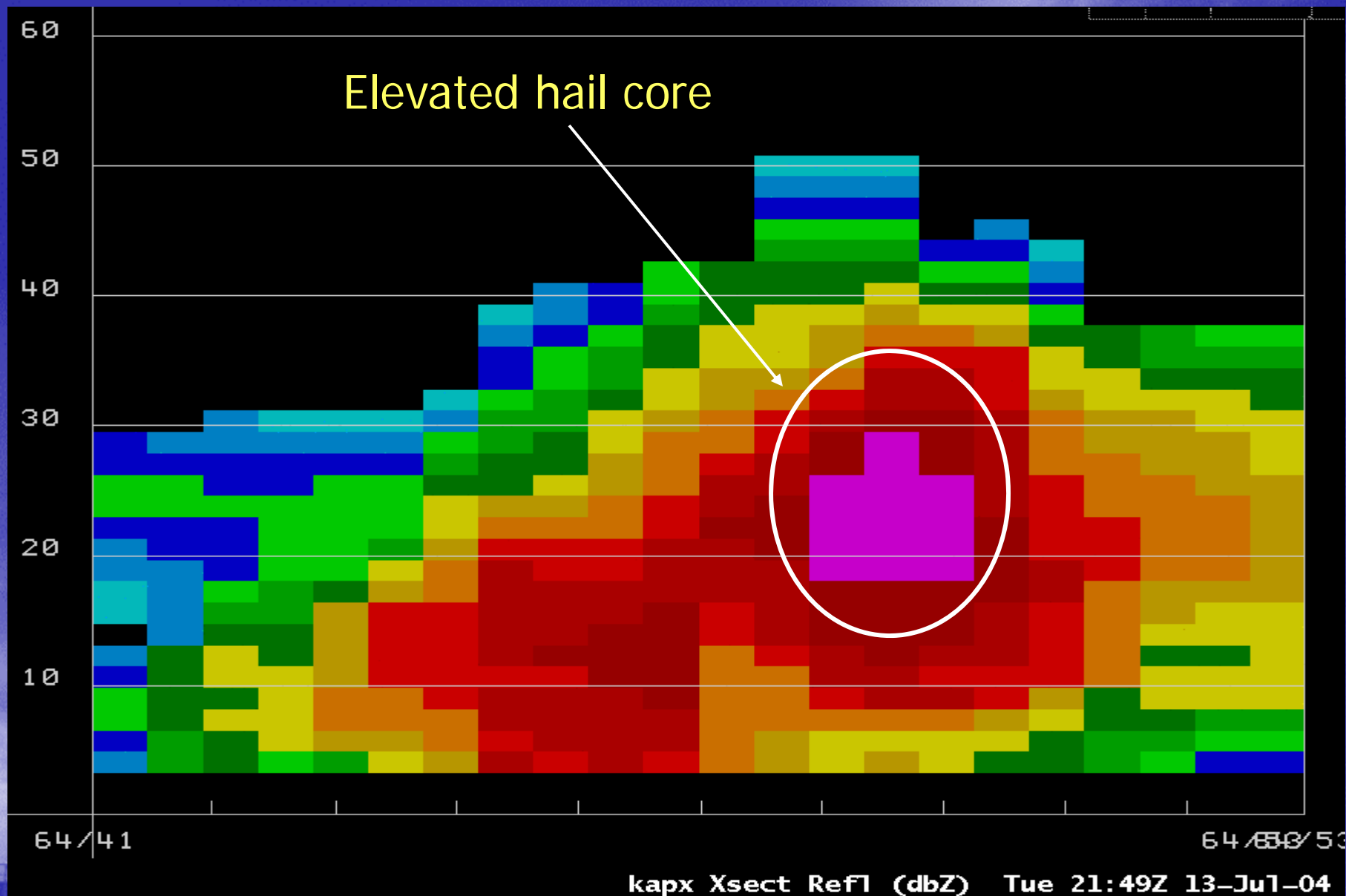
Where is it in the storm?

# Posen Hail Storm July 13, 2004

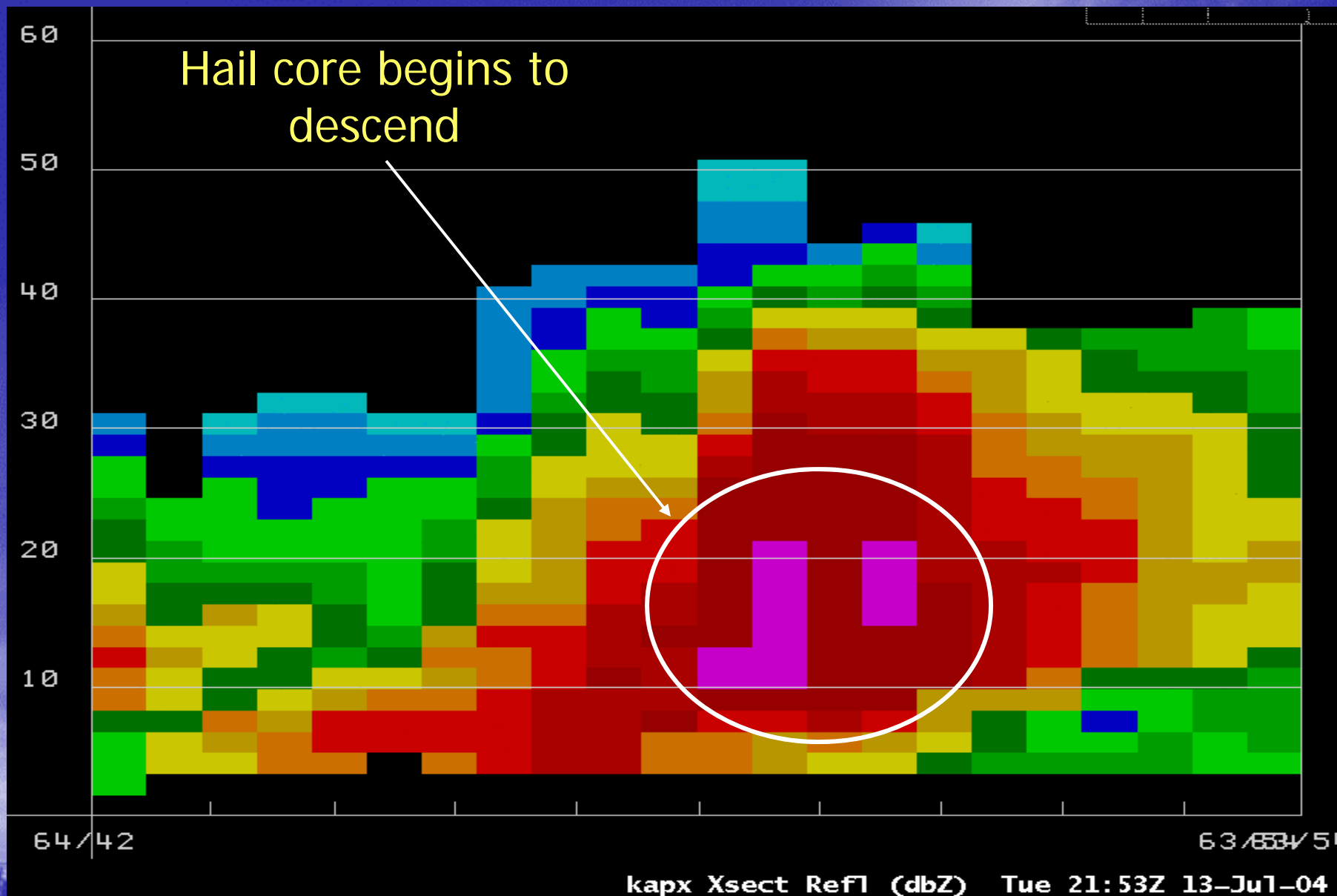




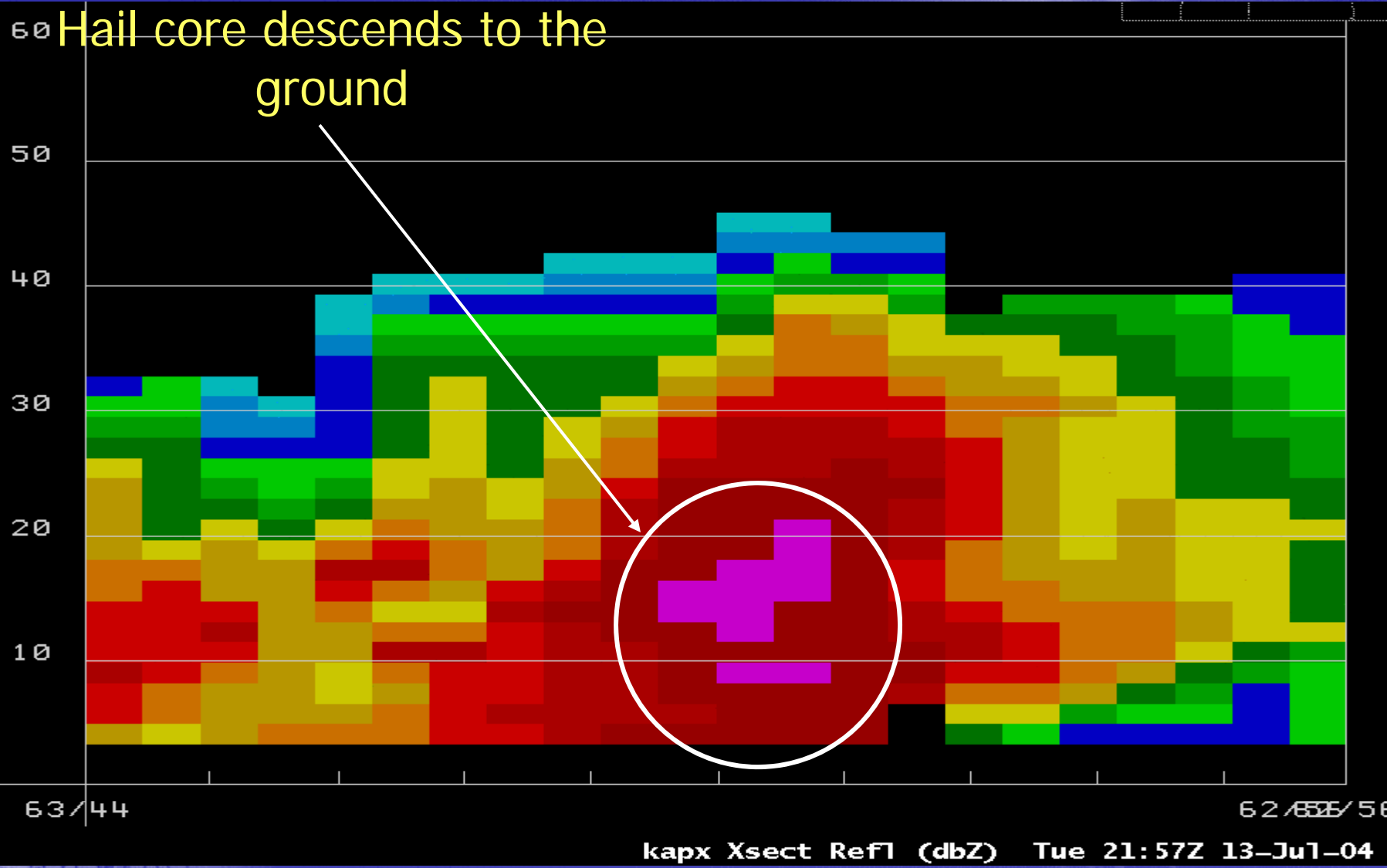
# Cross Section of the Posen Hail Storm 549 PM



# Cross Section of the Posen Hail Storm 553 pm



# Cross Section of the Posen Hail Storm 557 pm





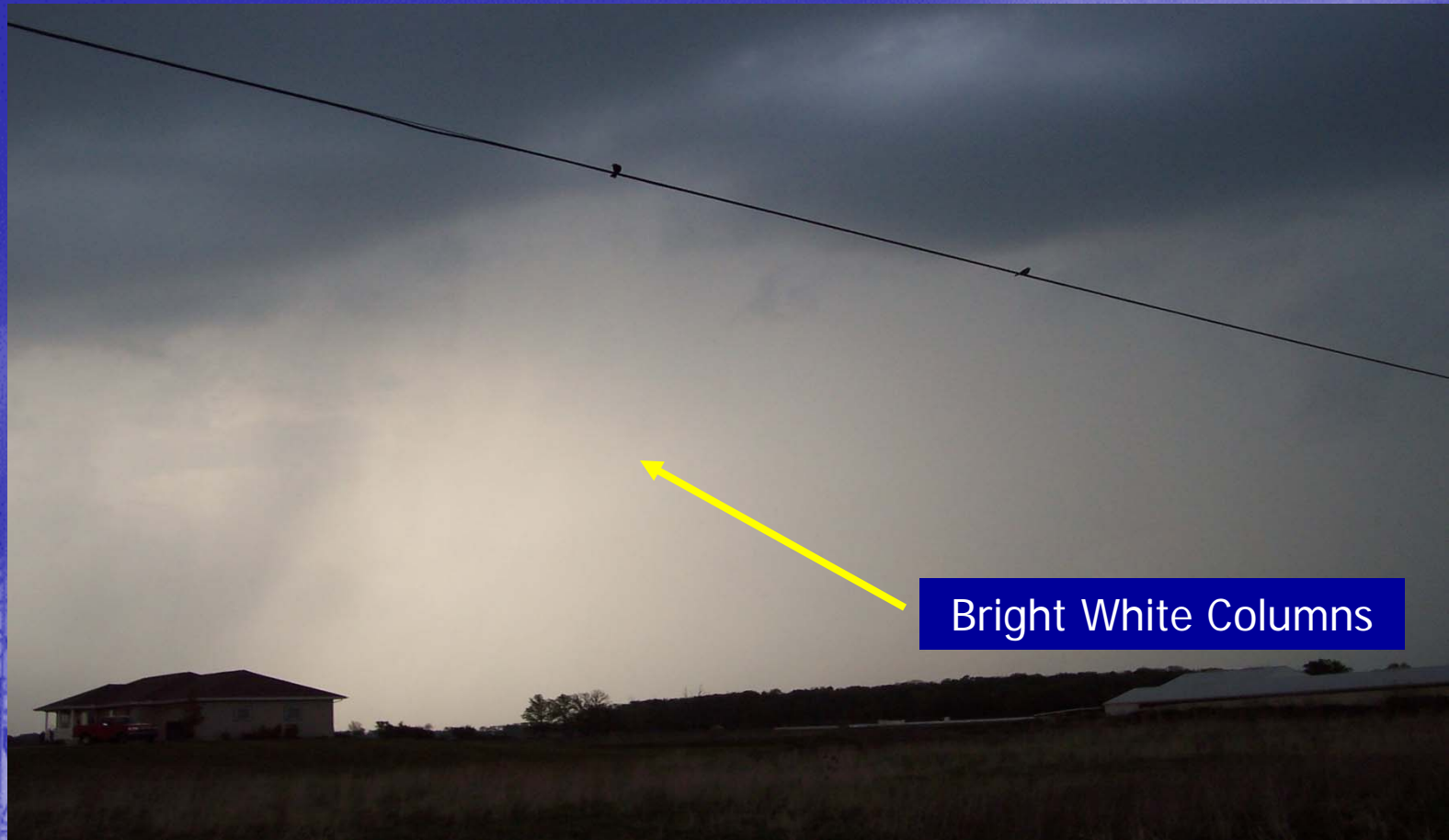
# Cloud clues to identify hail producing thunderstorms

Overshooting Top



Anvil with overshooting top

# Cloud clues to identify hail producing thunderstorms



Bright white columns

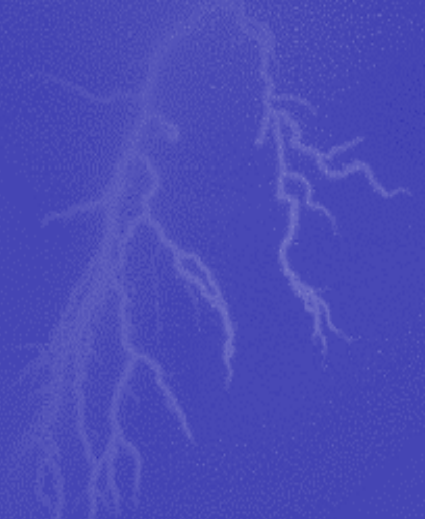
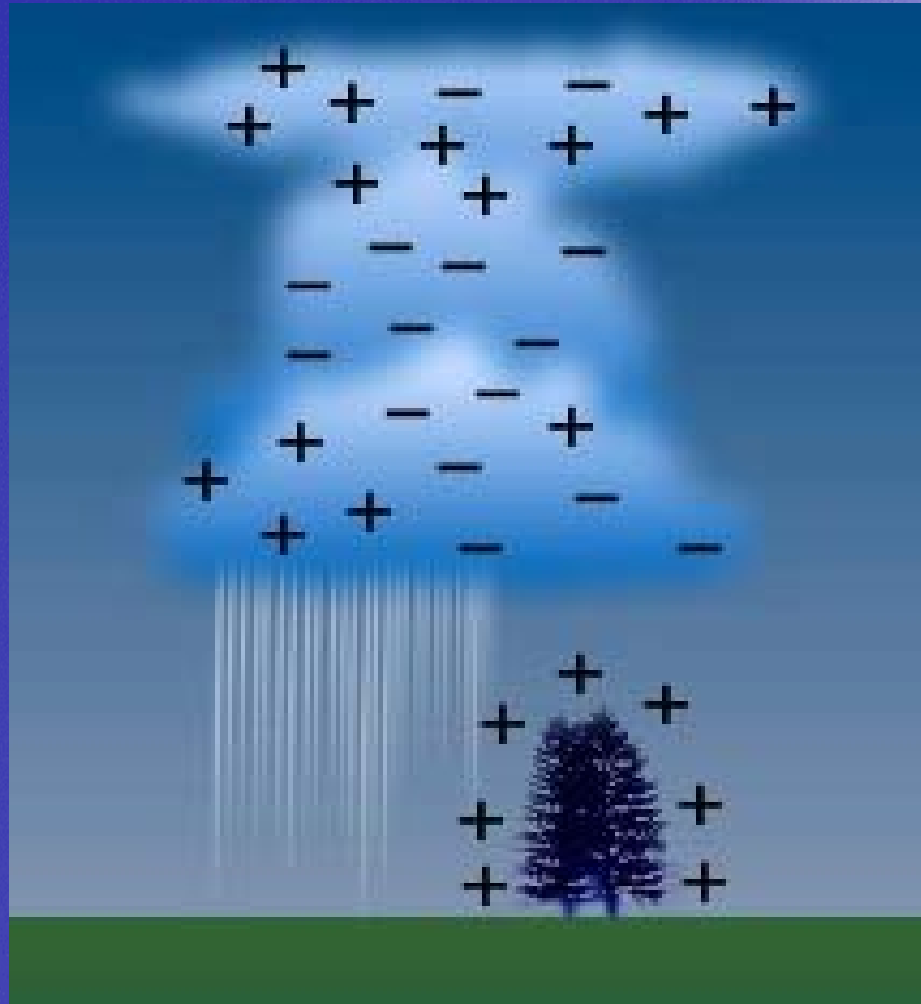


# Lightning





# How does lightning form?

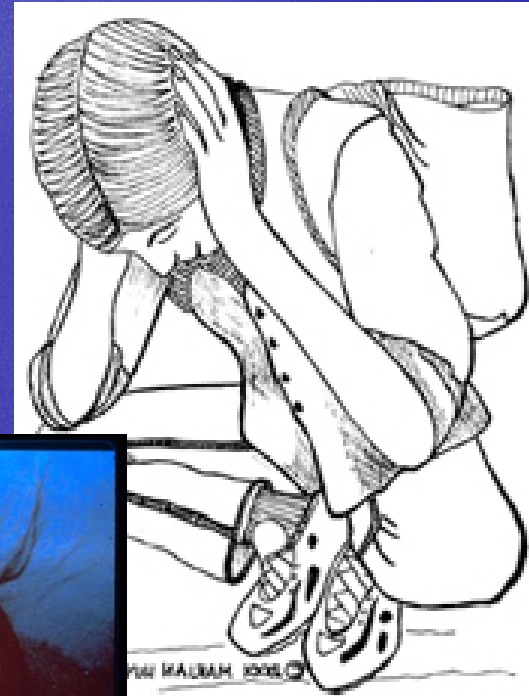




# Lightning Safety

Remember, if you can hear thunder, you are close enough to be struck by lightning!

- If lightning is occurring, move to a sturdy building or car
- If caught outdoors, find a low spot away from tall objects
- If you feel your skin tingle or hair stand up, squat low to the ground on the balls of your feet





# Flooding – The #1 weather killer



Miami County Indiana - July 15, 2003

# Flooding in Northern Michigan in 2006

Manistee County, August 2006



Kalkaska County, June 2006



Oscoda County, July 2006



# Flood safety tips

- Never drive across areas where water covers the road
- Each foot of water displaces about 1500 pounds of vehicle
- Be especially cautious at night, when flash flooding is harder to recognize



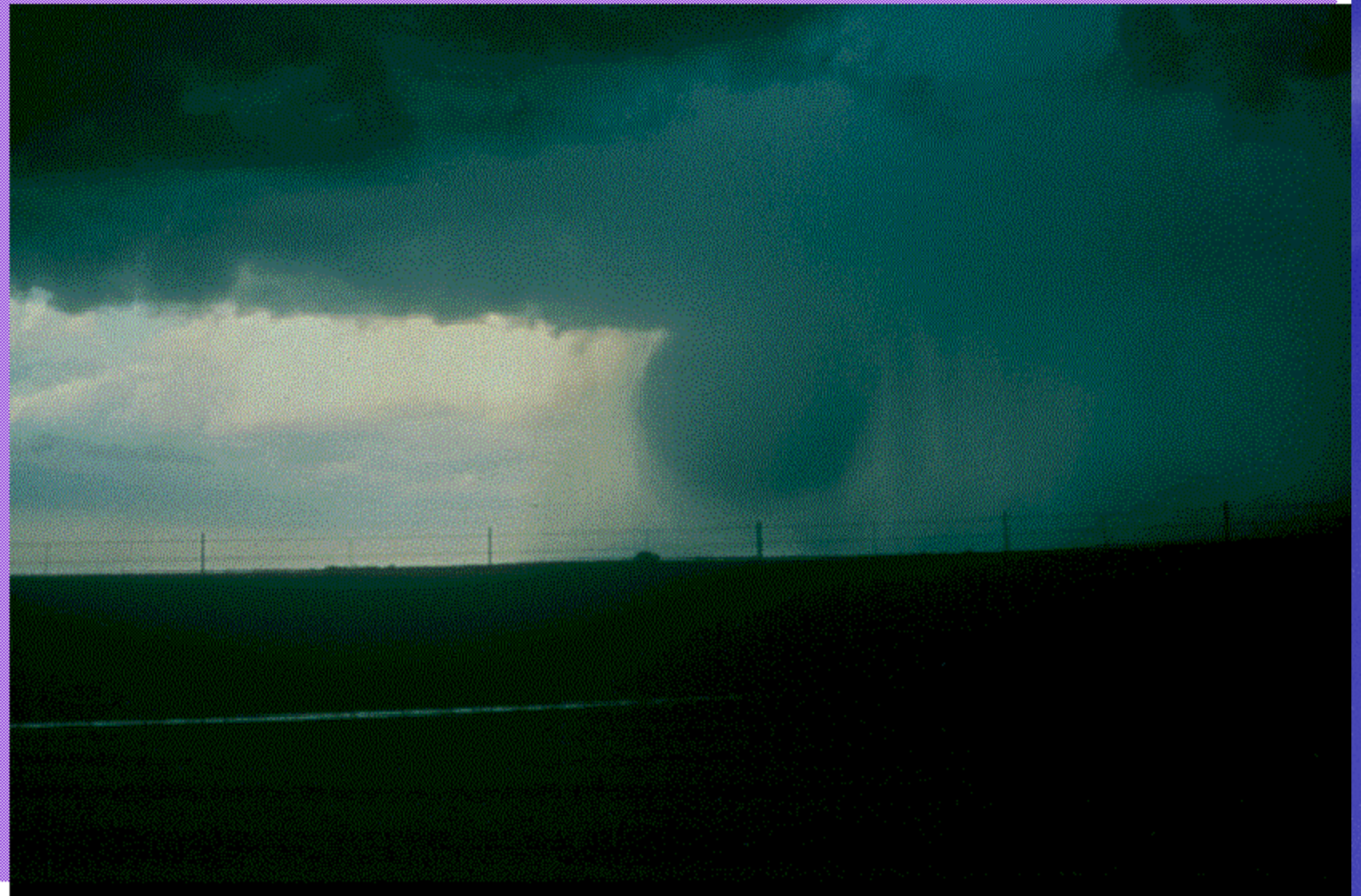
# Non-tornadic thunderstorm winds

- Most of the wind damage in northern Michigan is in the form of straight line winds
  - Downburst
  - Squall line (bow echo)





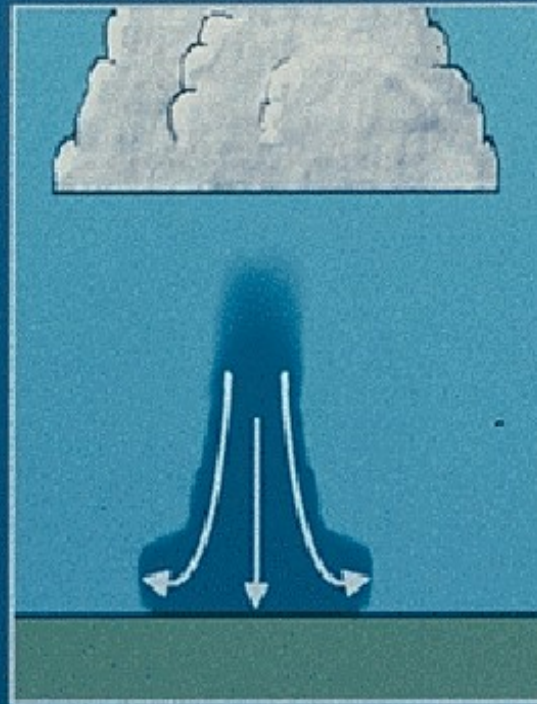
# Downbursts



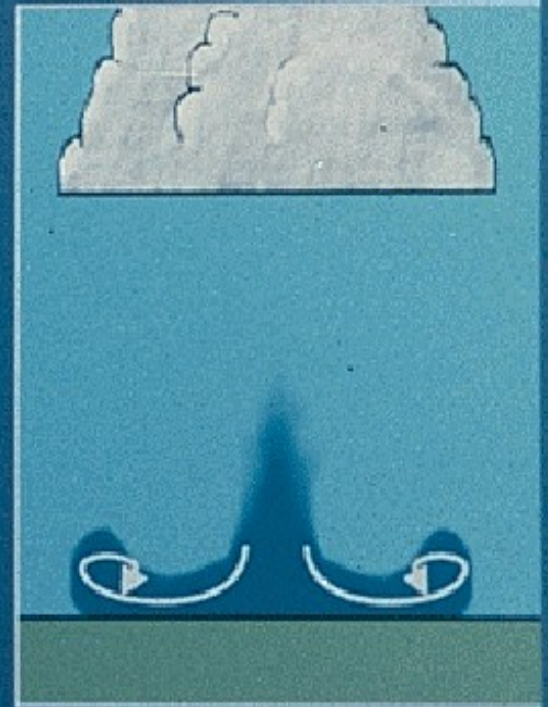
# Downburst Life Cycle



**FORMATION -**  
Evaporation and  
precip. drag  
forms downdraft



**IMPACT -**  
Downdraft quickly  
accelerates and  
strikes ground



**DISSIPATION -**  
Downburst moves  
away from point  
of impact



# Common cloud seen with squall lines - Shelf cloud

Outflow feature



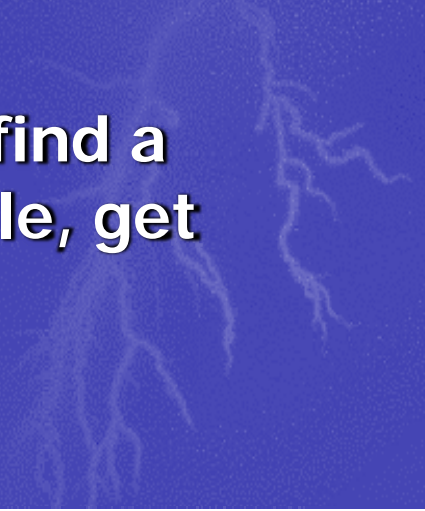
Shelf Cloud over Whitefish Bay, Lake Superior



# Safety from Thunderstorm Winds

Winds can be as strong or stronger than many tornadoes. Flying debris causes the majority of injuries, so stay away from windows!

- **If caught outdoors, move inside away from windows.**
- **If in your car, slow down and find a safe place to pull off (if possible, get out and go inside a building)**



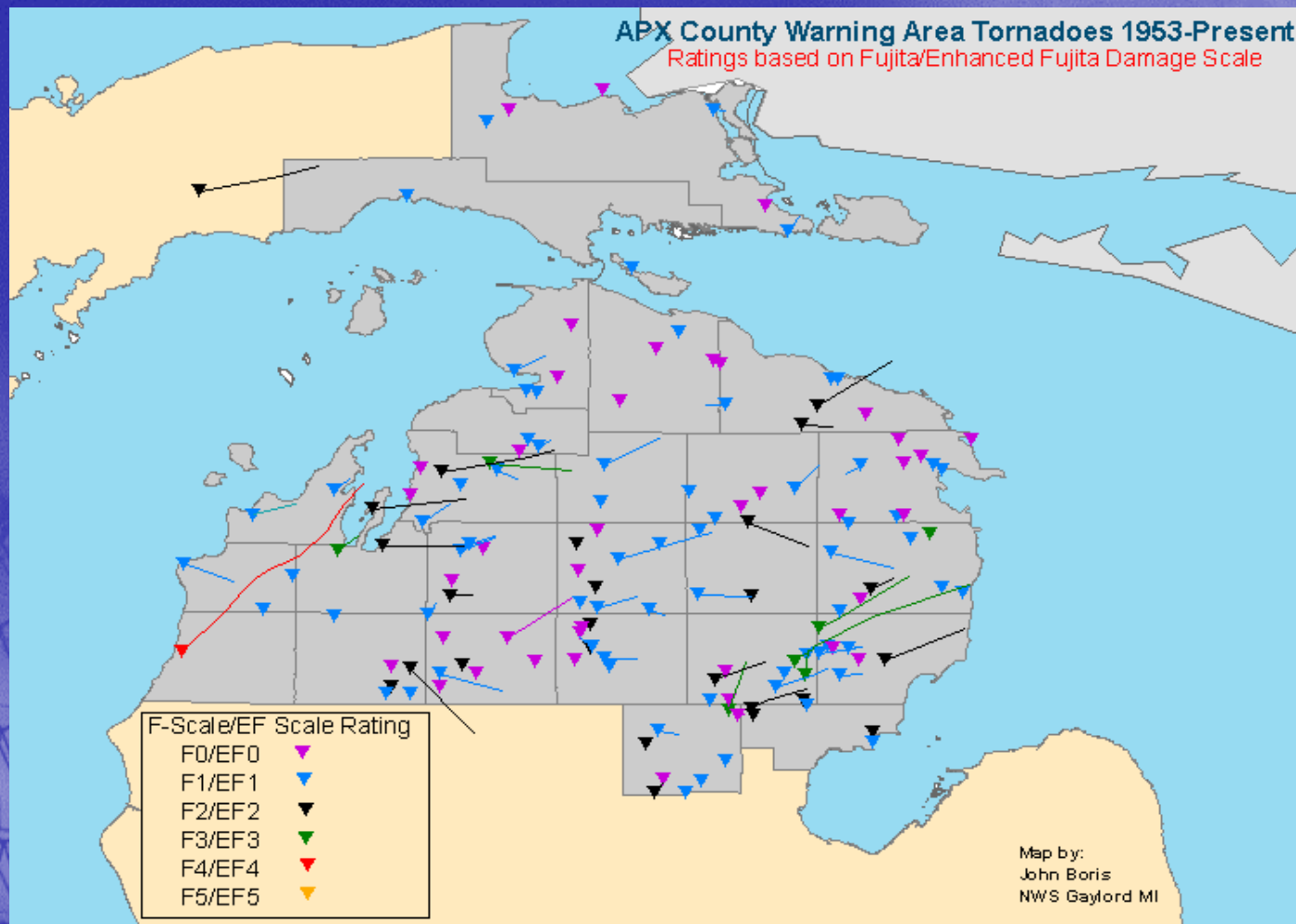
# Tornadic Thunderstorms

Long lived thunderstorms with rotating updrafts (supercells)

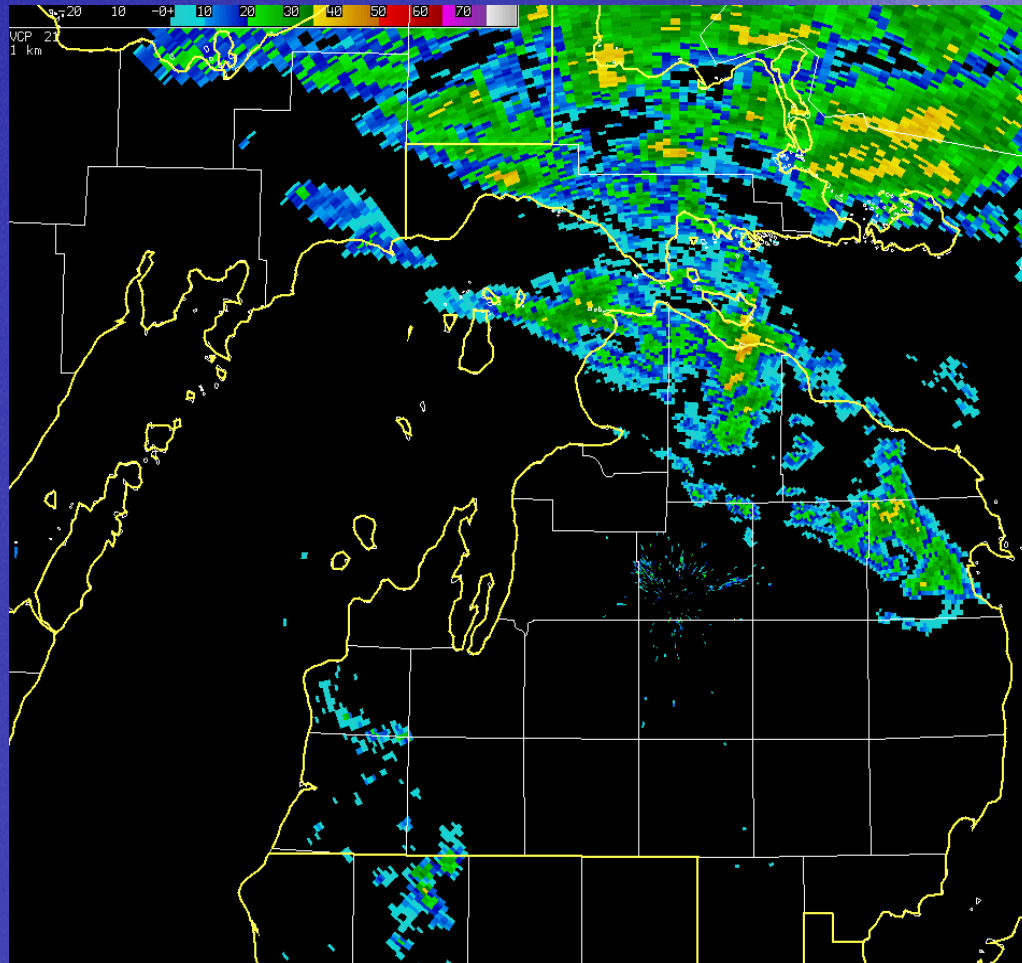


Black Lake, Cheboygan County October 2007

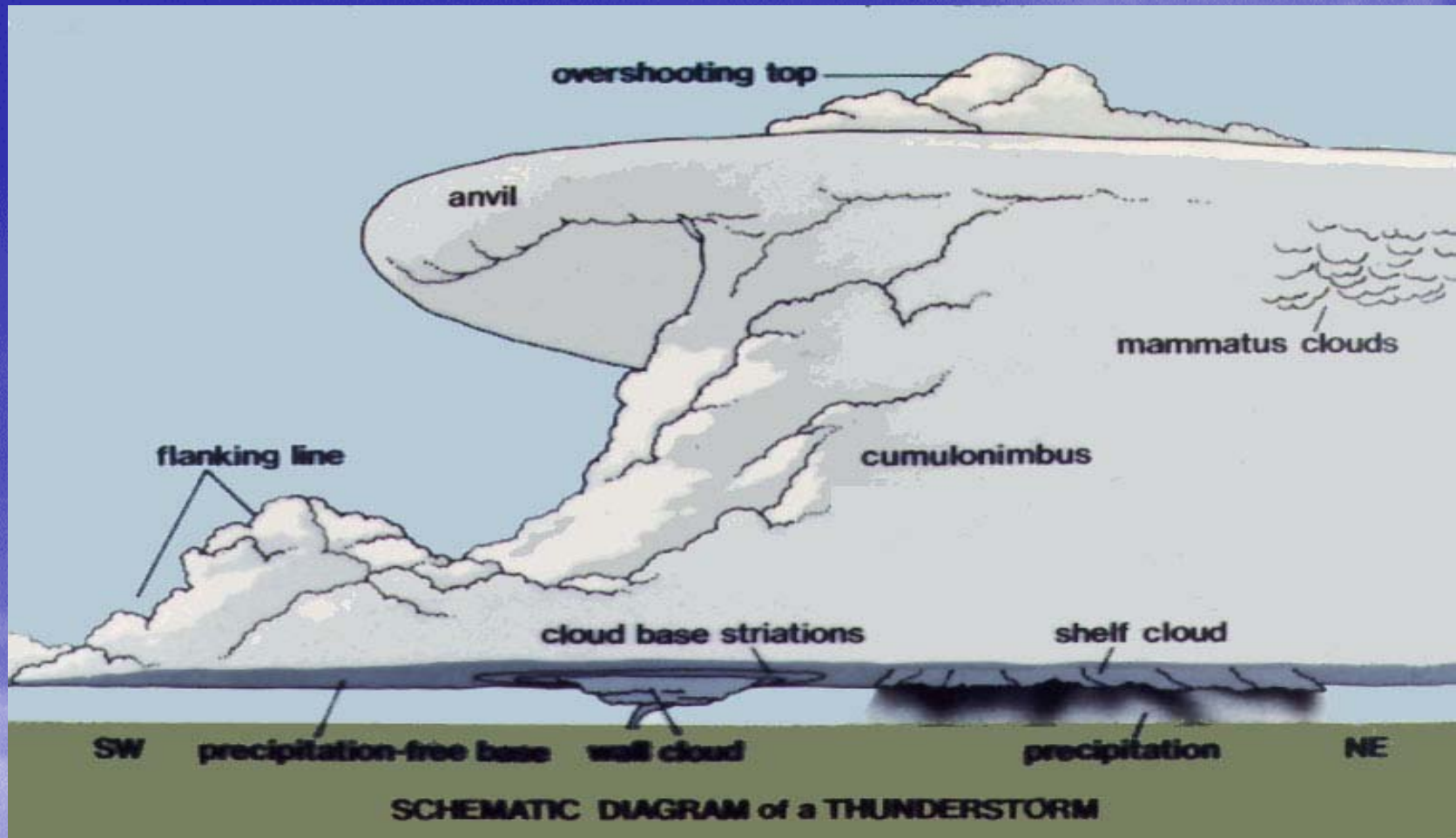
# Tornadoes in Northern Michigan 1953 - Present

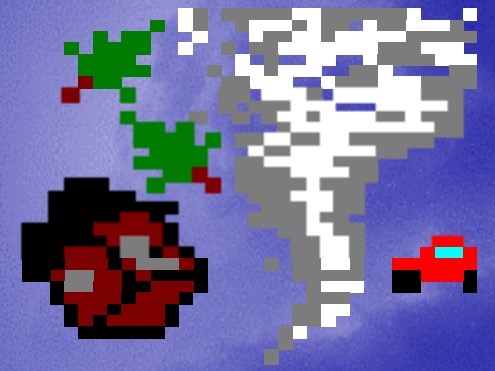


# Radar loop of October 18<sup>th</sup>, 2007 Tornado Event

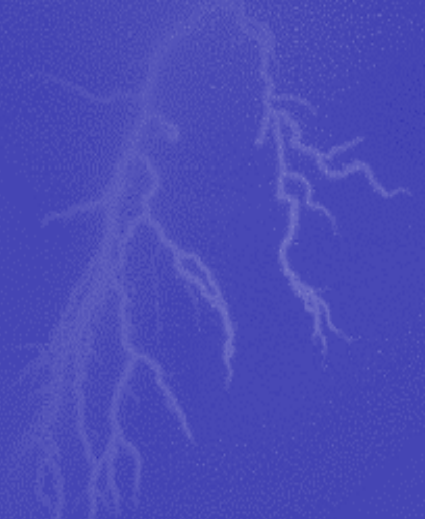


# Side View of Supercell





# How do tornadoes form?

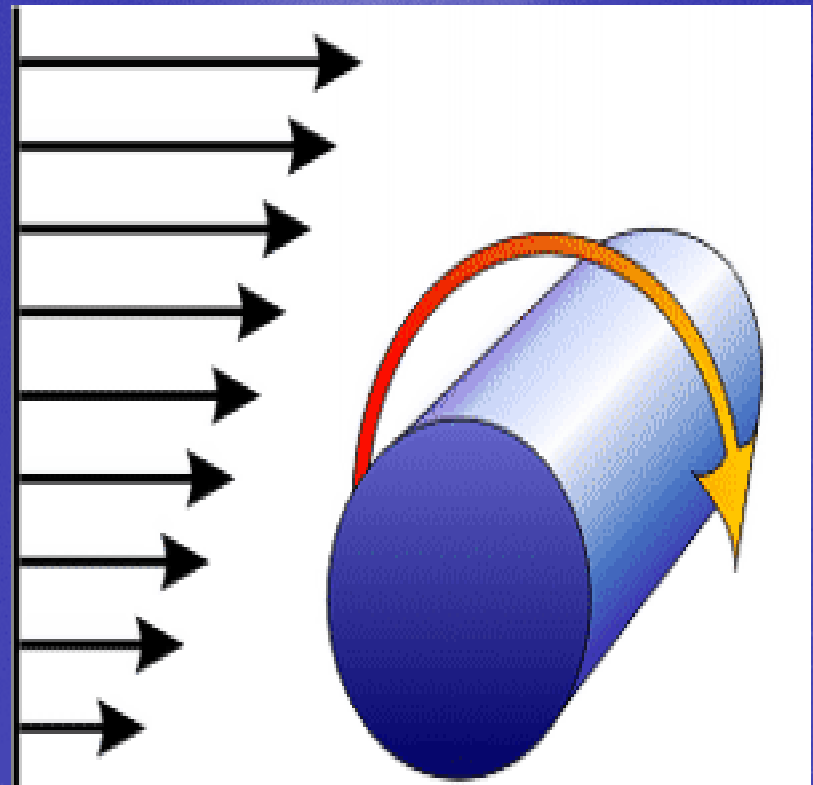


# Wind shear

Directional wind shear



Speed wind shear





# Rotation in the horizontal becoming rotation in the vertical







# Tornado safety

- Interior room on the lowest floor
- Cover yourself with blankets to protect yourself from flying debris/glass
- In cars and mobile homes, get out and find a more substantial shelter
  - Do not take cover beneath an overpass
- If you can't find a structure, lie flat on the ground in a low spot (i.e. ditch)



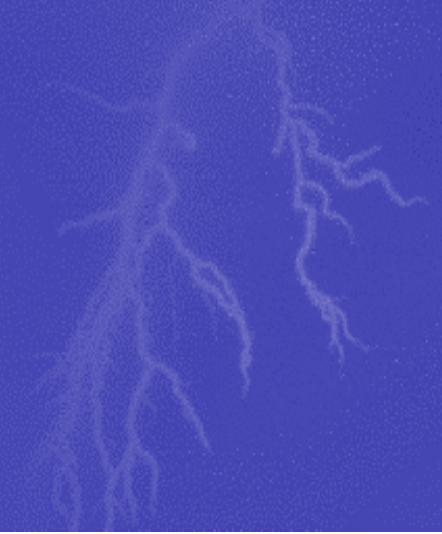
# Waterspouts

2 types – tornadic and non-tornadic

- Tornadic - A tornado over water associated with a thunderstorm. If these make landfall, they continue on land as a tornado.
- Non-tornadic - Typically occur in the early fall as cold air moves over the relatively warm waters of the Great Lakes. They dissipate rapidly upon landfall. These are much more common in Michigan than tornadic waterspouts.

# Severe weather reporting

- National Weather Service criteria and definitions
- Hail
- Wind
- Don't be fooled



# What Makes a Thunderstorm Severe?

- Tornado
- Winds at least 58 mph
- Hail at least  $\frac{3}{4}$  inch in diameter

Benzie County,  
October, 2006



Ogemaw County,  
July, 2006



Oscoda County,  
July, 2006



Wexford County,  
October, 2006





# Watch versus warning

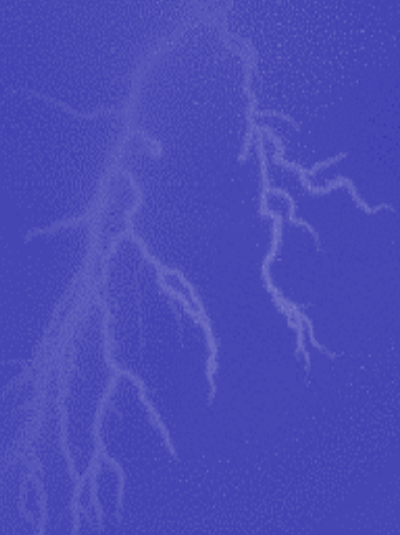
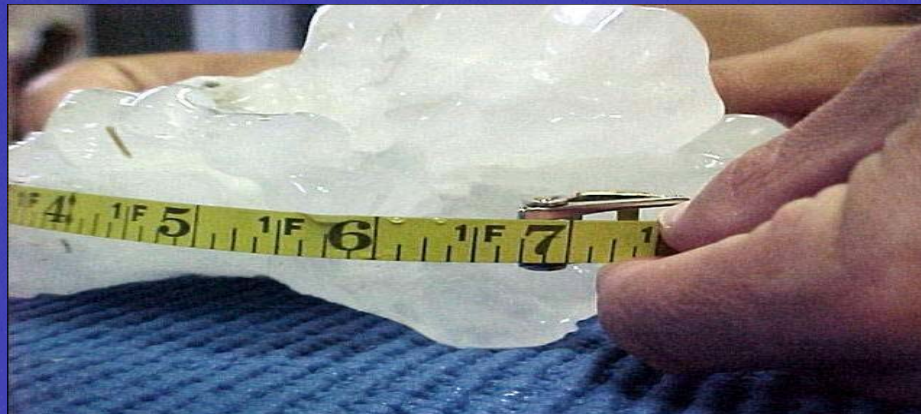
- **Warning** - Issued when a particular severe weather hazard is either imminent or is occurring. Take immediate action to protect life and property.
- **Watch** - Issued when conditions are favorable for a particular severe weather hazard to occur in the next several hours. Plan, prepare, and be aware.

# Estimating Hail Sizes



# Tips to making good hail estimates

- First and most important, be safe. DO NOT go outside to measure hail during the storm.
  - Stay away from windows
- Measure hail as soon as possible after the storm.
- There are several tools you can use to get a hail size
  - Hail estimation cards, rulers (calipers most accurate), hail boards



# Do not give hail sizes with regard to marbles



Marble size hail can mean many different things – avoid the confusion and use coins or inches.

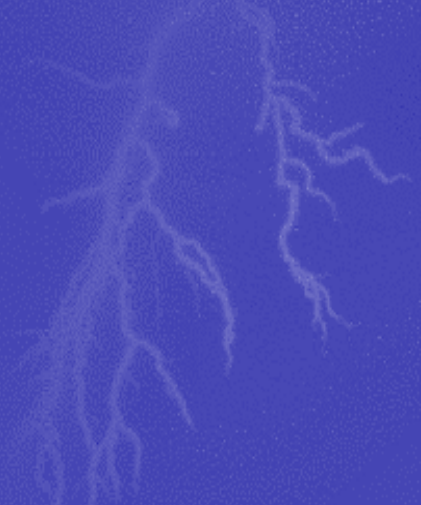


# Estimating and reporting wind speeds and damage
















# There are 2 primary ways to achieve a wind estimate

- Enhanced Fujita Scale
  - Assessment of wind speed after the event
- Beaufort Scale
  - Assessment of wind speed in real time



# Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

# Enhanced Fujita Scale

Wind estimates based on damage assessment

Original F scale	Wind Speed	Enhanced F scale	Rating 3 second gust
F0	40-72 mph	F0	65-85 mph
F1	73-112 mph	F1	86-110 mph
F2	113-157 mph	F2	110-135 mph
F3	158-207 mph	F3	136-165 mph
F4	208-260 mph	F4	166-200 mph
F5	261-318 mph	F5	>200 mph

Wind speeds in mph, 3-second gust

So what should your wind report include?





# Tree damage



Grand Traverse County July, 2006

# Roof or shingle damage



Crawford County, Michigan July, 2005



# Buildings damaged or blown down





# Other damage

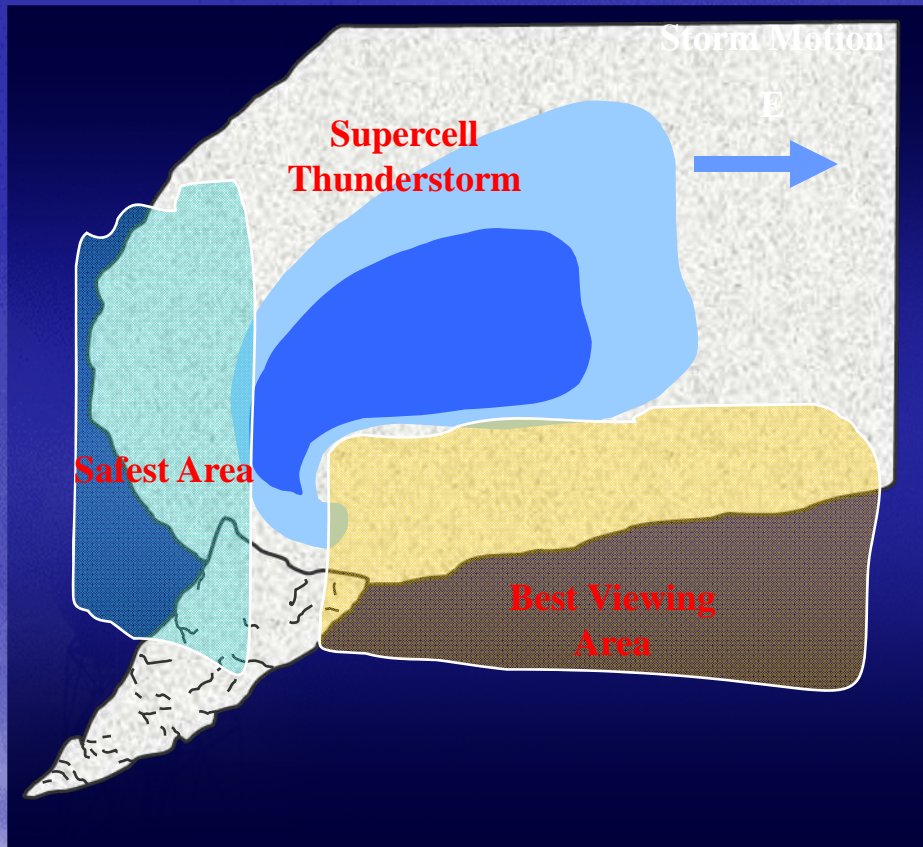
For example...Center Pivot Irrigation System tipped over



# Viewing locations



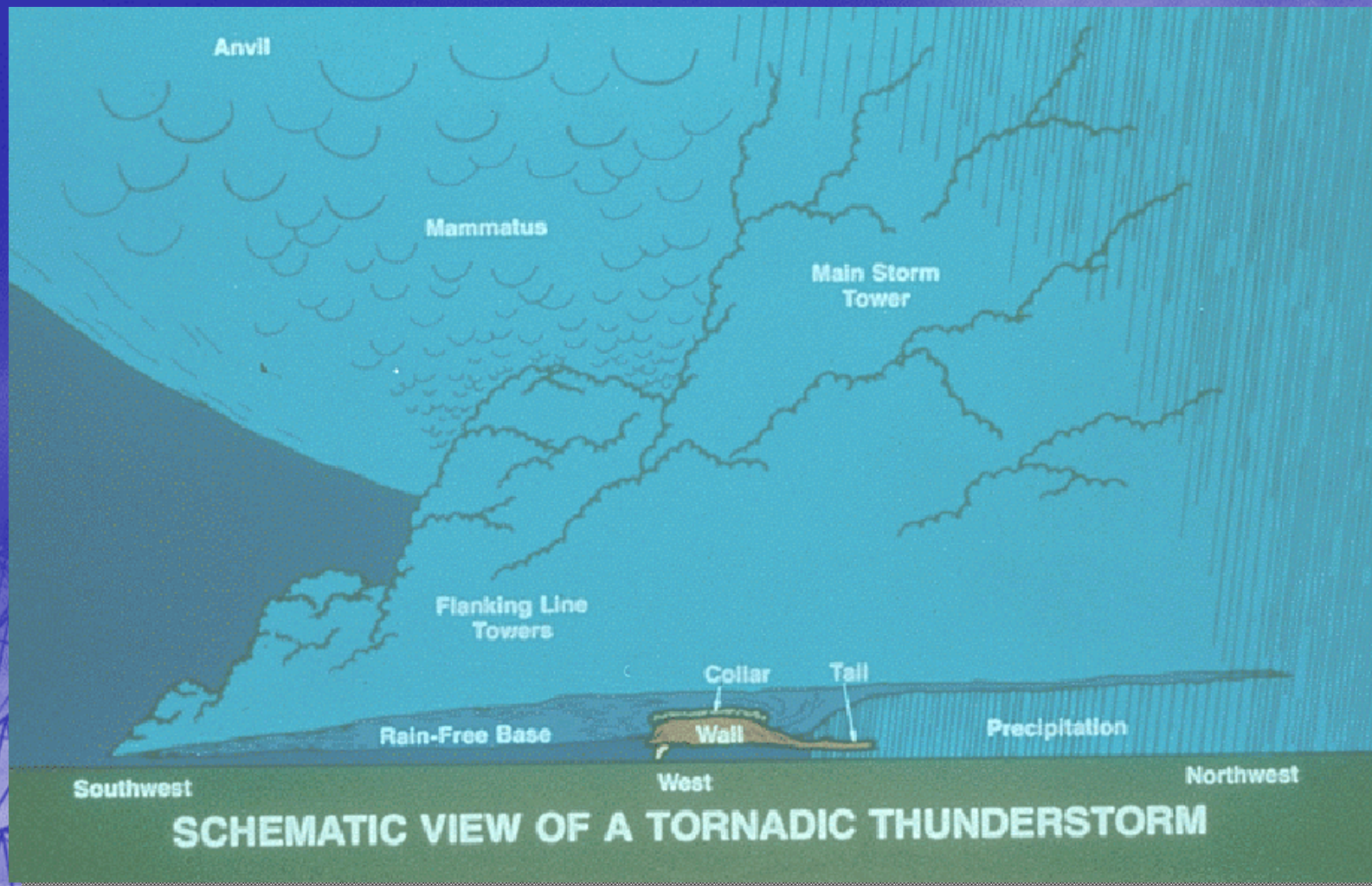
# Best viewing area versus safest area



Looking from the west – the safest place to view a tornado



# Side View of Supercell



# Cloud formations to look for





# Upper Level Storm Clues for reporting

Best seen about 20 miles from storm

- Hard, flat, cirrus anvil top - Top of the atmosphere where the cloud top flattens out.
- Overshooting top or dome - A dome of clouds which presses above the anvil top. When it persists for 10 minutes or more this is indicative of a very strong updraft and severe weather.



# Cloud clues to identify hail producing thunderstorms

Overshooting Top



Anvil with overshooting top

# Mid Level Storm Clues

Best seen 10-20 miles from storm

- Main Storm Tower
  - Solid appearance with cauliflower texture
  - May be tilted, indicating strong shear
- Flanking Line
  - Row of towering cumulus stair-stepping up to main storm tower
- Surrounding Clouds Dissipating
  - Nearby clouds and other storms may dissipate while main storm dominates
  - All available energy will go to main storm tower





# Mid Level Storm Clues

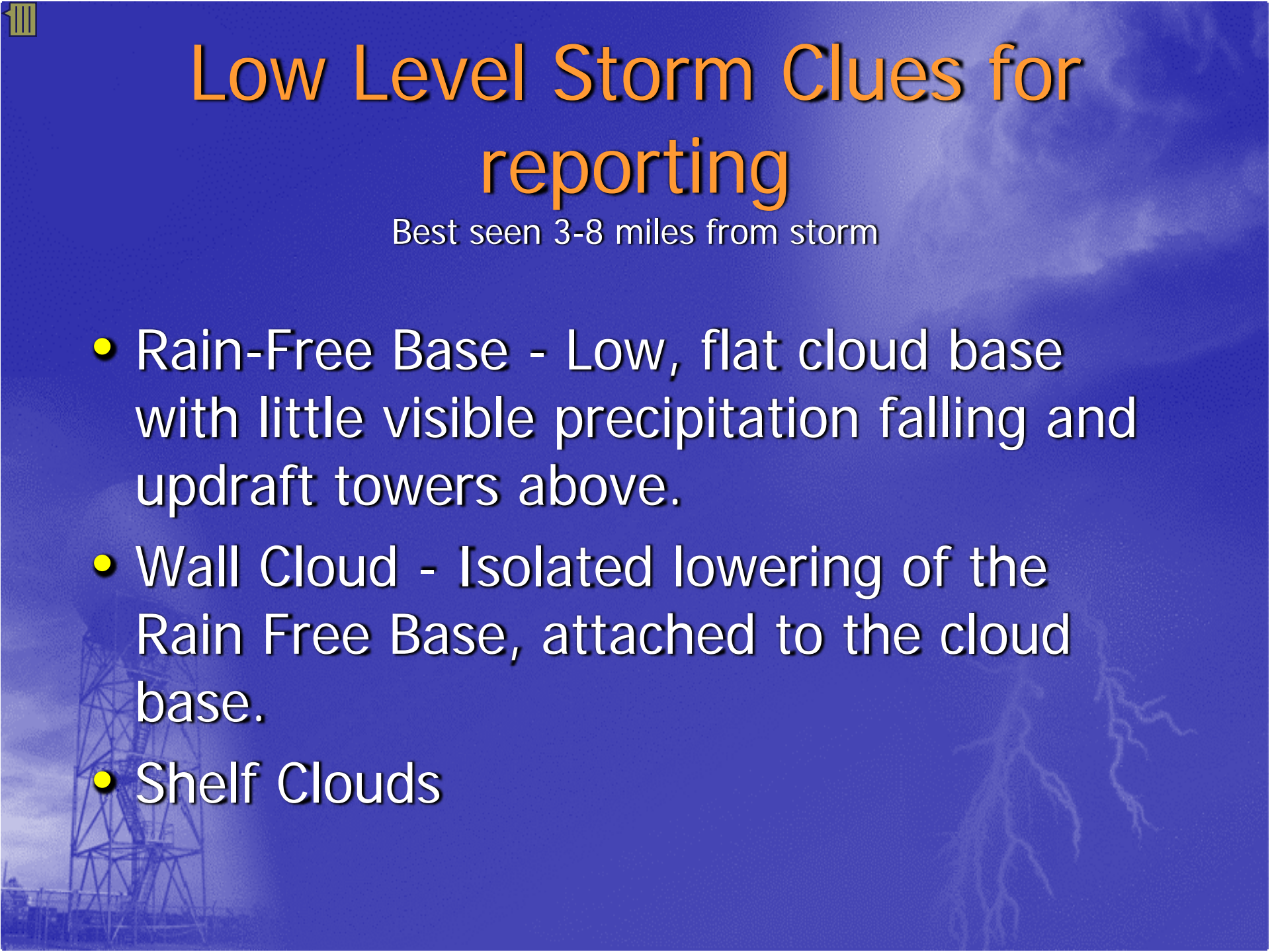
Best seen 10-20 miles from storm





# Low Level Storm Clues for reporting

Best seen 3-8 miles from storm

- Rain-Free Base - Low, flat cloud base with little visible precipitation falling and updraft towers above.
  - Wall Cloud - Isolated lowering of the Rain Free Base, attached to the cloud base.
  - Shelf Clouds
- 

# Wall cloud and rain free base





# Shelf Cloud



# Shelf Clouds vs. Wall Clouds

## What Is The Difference?

### Shelf Clouds

Suggest downdraft/outflow

Move away from precipitation areas

Horizontally orientated and can extend for miles. May "roll" like a rolling pin.



### Wall Clouds

Suggest updraft/inflow

Maintain position with respect to precipitation

Isolated, vertically orientated, *and rotating*, like a spinning skater



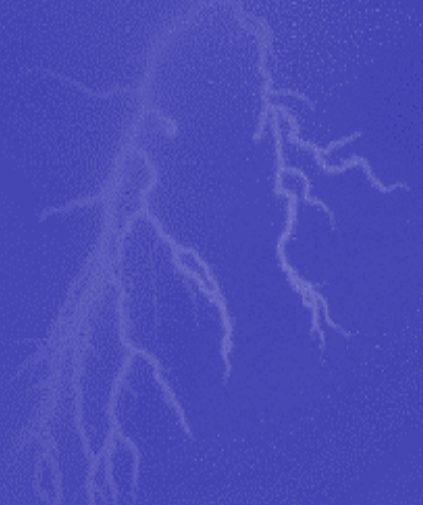
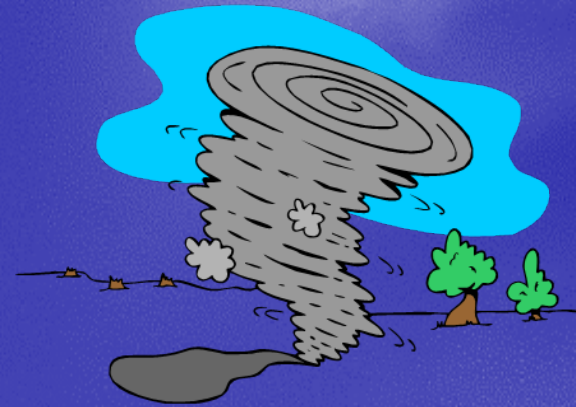
# Mammatus Clouds

Underside of a thunderstorm anvil



Copyright © 2004 - Jorn C Olsen

Don't be fooled....



# Things to keep in mind when viewing a specific feature

- Rotation?
  - Where? How strong? Persistence?
- Orientation
  - Where is the feature with respect to rain free base? Precipitation area?
  - What direction are you looking?
- Shelf cloud, wall cloud, beavers tail?





# Is this a tornado?

© 1995 Ian Wittmeyer



**No.** These are scud clouds behind a shelf cloud.

© 1995 Ian Wittmeyer



# Is this a tornado?



Photo courtesy Barbara Hullinger

Yes. This is a small tornado.



Photo courtesy Barbara Hullinger

Would you call this into the weather service?



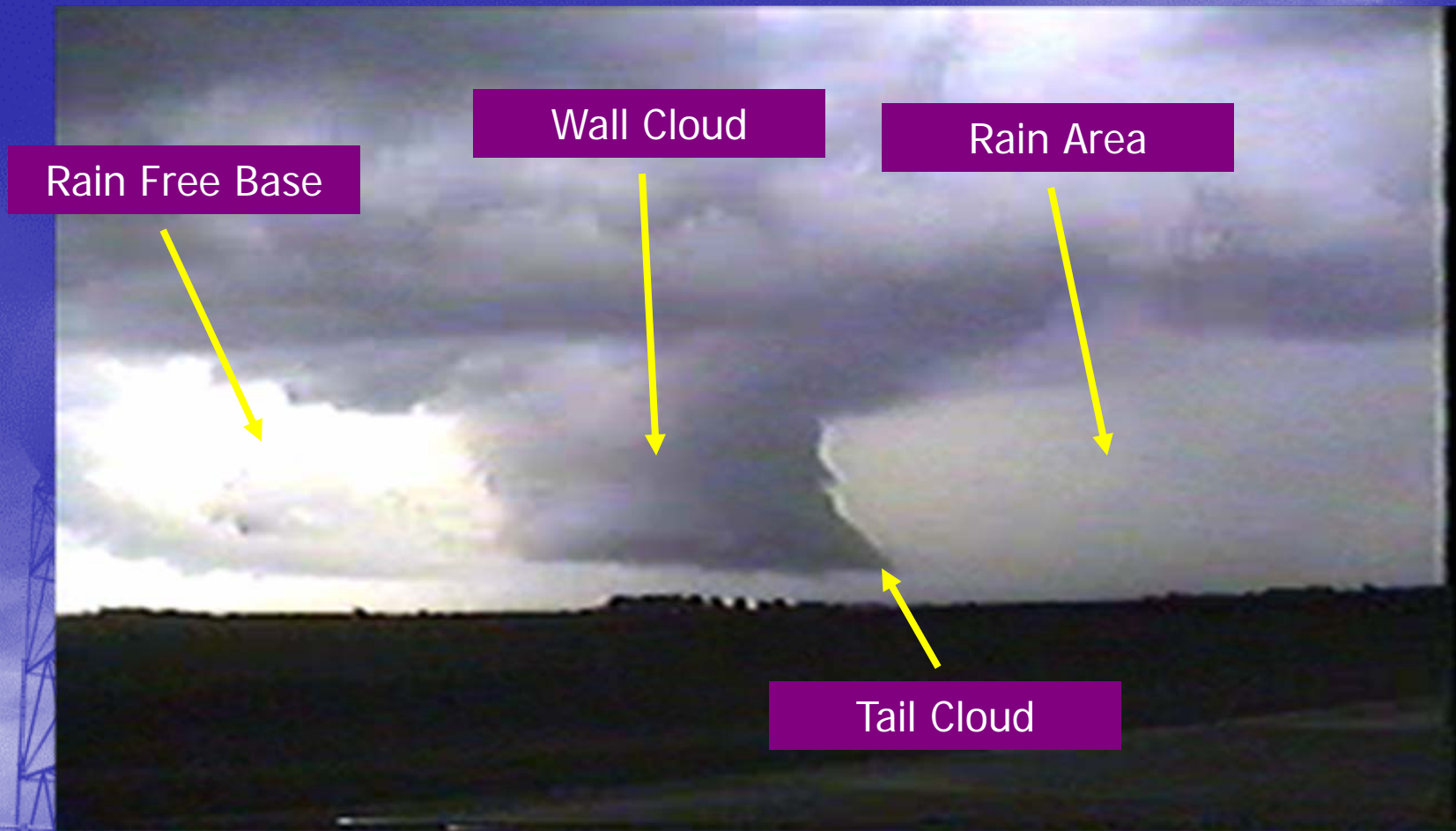
You might call the NWS upon seeing this, but you would be reporting a fire. This is a smoke plume from a distant fire.



No wall cloud here. We don't get tornadoes from low hanging stratus clouds

# Quick review

Identify the features in this picture



# Quick Review

Which of these pictures shows an outflow feature?



Shelf Cloud - Outflow



# Quick review

Which of these statements are true?

- True 1. Lightning can strike more than 10 miles from the thunderstorm center
- True 2. Supercell thunderstorms have rotating updrafts.
- False 3. If lightning is about to strike you, you should lie flat on the ground
- False 4. An overshooting top tells you whether a thunderstorm will produce a tornado.
- True 5. The safest location to view a tornado from is the west or southwest side of a storm.

# Quick review

Which of these statements would make a thunderstorm severe (according to NWS definitions)?

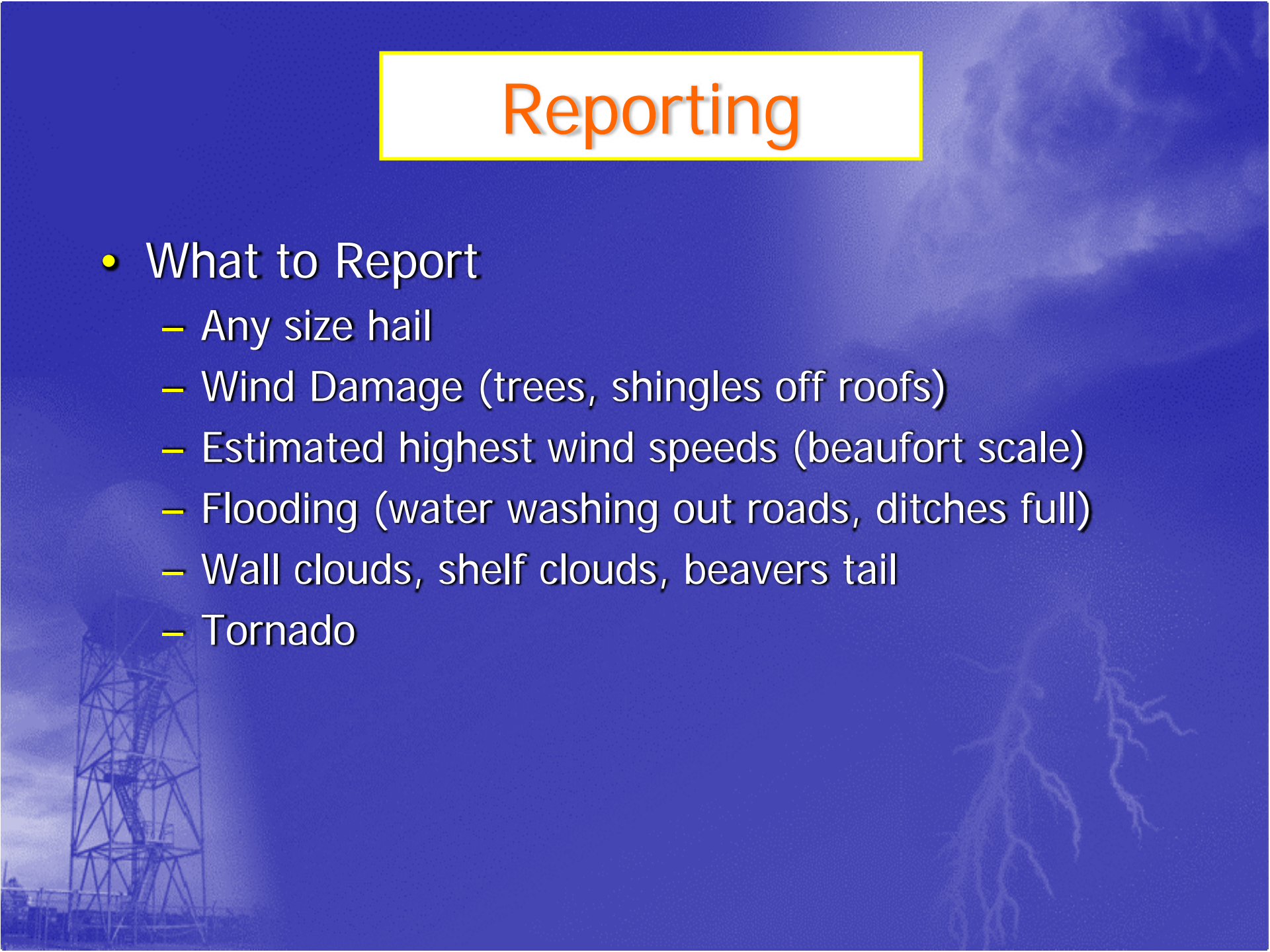
- No A. Wind gusts of 55 mph
- Yes B. Tornado
- No C. Lightning causing power outages and tree damage
- Yes D.  $\frac{3}{4}$  inch hail covering the ground
- No E. Flooding rains causing creeks and rivers to overflow their banks

Let's bring it all together  
Safety first!!!



# Reporting

- What to Report
  - Any size hail
  - Wind Damage (trees, shingles off roofs)
  - Estimated highest wind speeds (beaufort scale)
  - Flooding (water washing out roads, ditches full)
  - Wall clouds, shelf clouds, beavers tail
  - Tornado



# Winter snowfall reports are also needed

Skywarn spotting is a year round job!

## What to report:

- 12 and 24 hour snowfall
- Total depth of snow on the ground
- Heavy snow of 1"+ per hour
- Any ice accumulation

## When and how to report:

- 2 X per day (morning and evening)
- Call the office or use our free internet reporting system



# Remember to use the TEL method when making your report

- Time – When did it happen?
- Event – What did you observe?
- Location – Where did this occur?

An online reporting system which allows spotters to send reports directly to forecasters at the NWS

**Severe Weather Report Form**  
[Click Here for the Winter Weather Report Form](#)

**Date & Time**

Date: Dec / 08 / 2005  
Time: 13 : 41 EST  
 Estimated  
 Exact

**Location**

Select County, State: Otsego, MI (137)  
City/Town: 2 East of Gaylord

**Weather**

Tornado  
 Funnel Cloud  
 Wall Cloud  
 Hail  
 High Wind  
 Flood  
 Flash Flood  
 Other

\* Note if there is rotation in narrative.  
Size: [dropdown]  
Wind Speed: [input] MPH  
 Measured  
 Estimated

**Damage, Injuries, Narrative**

Any Damage?  Yes  No  
Was Anyone Hurt?  Yes  No

# eSpotter



Online Weather Reporting System

New to eSpotter? [ [Register Here](#) ]

eSpotter is a system to facilitate the submission of spotter reports online. The system is being developed to enhance and increase timely & accurate online spotter reporting and communications between spotters and their local weather forecast offices. The use of the system is currently available for trained spotters and emergency managers. eSpotter enabled offices are listed at the bottom of this page.

Registered Users: Log In

Email Address:

Password:

Forgot your password?  
[Click here.](#)

Connections made to this system are monitored. Your email address is used to verify that you are authorized to access this system, and to provide a means for contacting you to follow up on weather information you submit.

- **Big note:** Real time life threatening severe weather reports should be **CALLED** into the NWS on the 800#.

Registration is free and only takes a few minutes.  
<http://espotter.crh.noaa.gov/>





# NOAA All Hazards Weather Radio

- Voice of the NWS. Network of 583 stations nationwide
- NOAA Weather Radio can be heard by about 90% of the U.S. population
- Continuous weather information broadcasts from local forecast offices of:
  - Warnings
  - Watches
  - Forecasts
  - Observations
- For more information, visit the NOAA Weather Radio Web Site at [www.nws.noaa.gov/nwr](http://www.nws.noaa.gov/nwr)





[james.keysor@noaa.gov](mailto:james.keysor@noaa.gov)

989-731-3384 Ext 726

[www.weather.gov/gaylord](http://www.weather.gov/gaylord)