# SKYWARN

# 2011

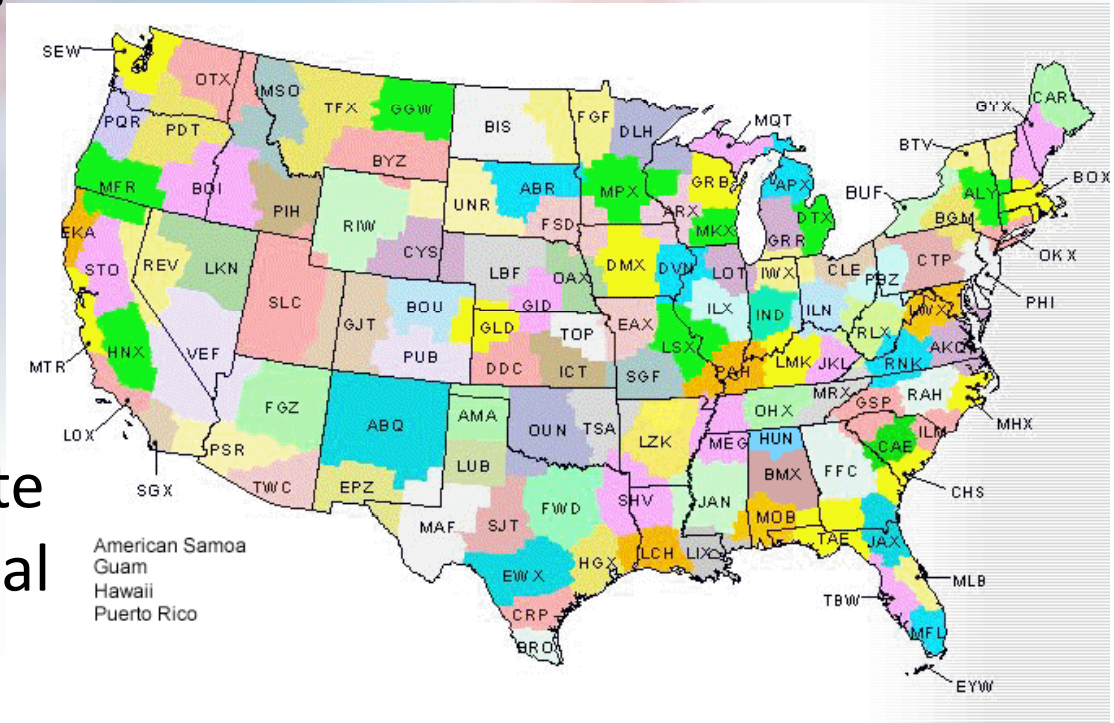
# 2011 Spotter Training

## Part 1

- Introduction
- 2010 Overview
- Thunderstorm Hazards, Safety
  - Before the Storm
  - During the Storm
  - After the Storm
- What, when and how to report

# National Weather Service

- Federal government
  - Department of Commerce
    - National Oceanic and Atmospheric Administration (NOAA)
- 13 River Forecast Centers
- 21 Central Weather Service Units
- 6 Regional Headquarters
- 122 Weather Forecast Offices
- 9 Offices which provide special services on a national level (Storm Prediction Center, Climate Prediction Center, Tropical Prediction Center)

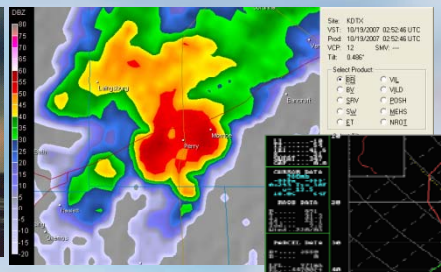


# NWS Detroit/Pontiac

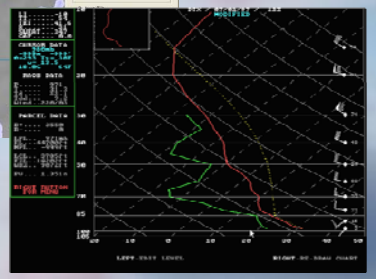
- A team of 24 professionals
  - Meteorologist, Hydrologist,
  - Electronics/IT, Administrative
- Mission: Forecasts and warnings for the protection of life and property
- Forecasts and warnings issued 24/7
- 17 counties in Southeast Michigan
- All or portions of Lakes Huron, St. Clair and Erie

# From Spotters to Warning the Public

Spotter



Radar



Environment

Public - Action

NWS

Dissemination

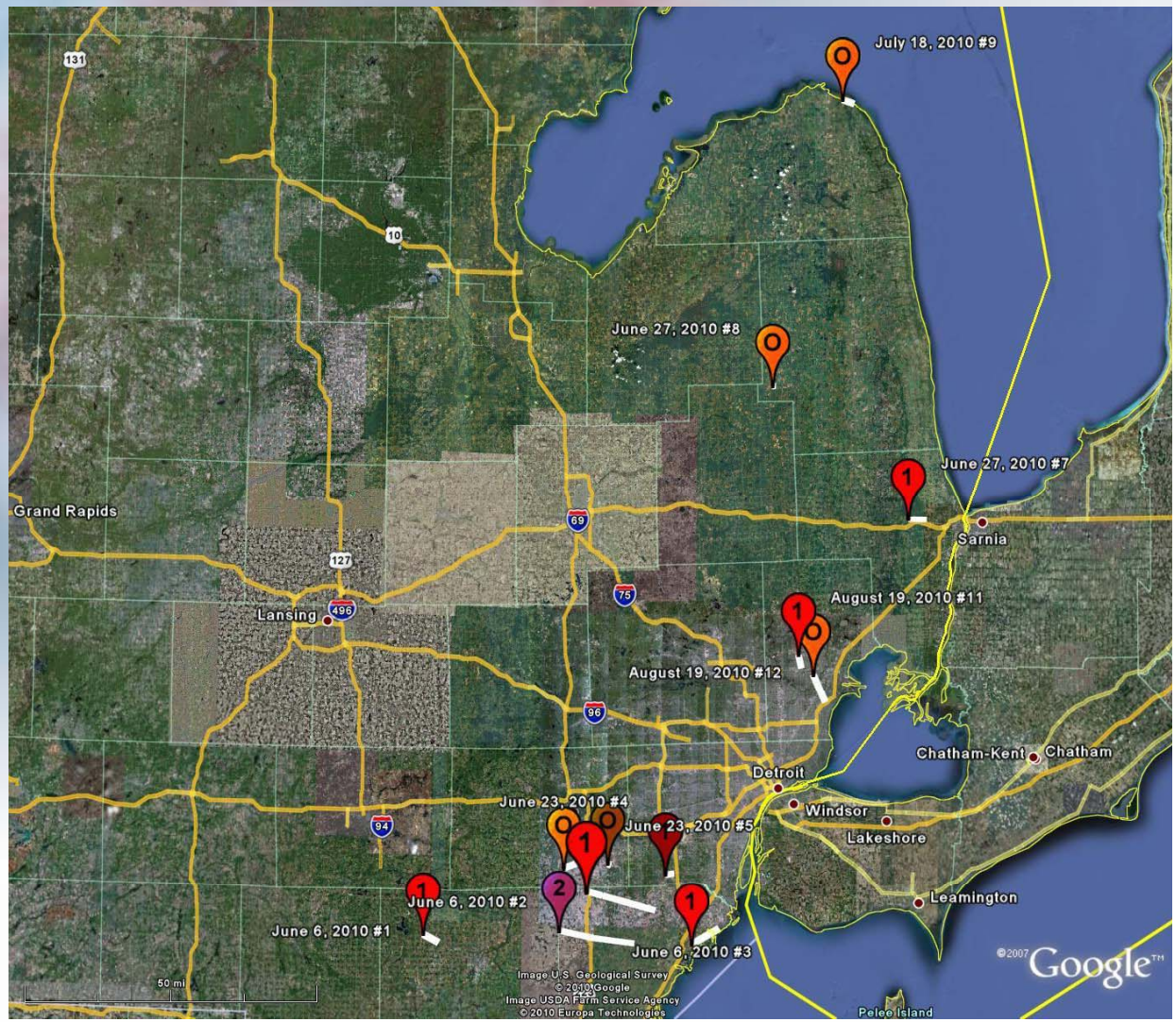
# Review of Last Year

| DTX | Warnings | Warnings Verified | NOT Verified | Events | Fully Warned | Partially Warned | NOT Warned | Lead Time | LT 1st Event |
|---|---|---|---|---|---|---|---|---|---|
| 2008 | 139 | 102 | 37 | 341 | 297 | 1 | 43 | 23.0 | 22.9 |
| 2009 | 54 | 32 | 22 | 102 | 91 | 0 | 11 | 23.1 | 23.1 |
| 2010 | 122 | 82 | 40 | 230 | 209 | 4 | 17 | 23.6 | 23.6 |

| Year(s) | Severe Event Detection | False Alarm | Lead Time |
|---|---|---|---|
| 1995-2007 | 81 % | 27 % | 19.3 |
| 2008 | 87 % | 27 % | 23.0 |
| 2009 | 89 % | 41 % | 23.1 |
| 2010 | 91% | 33% | 23.6 |

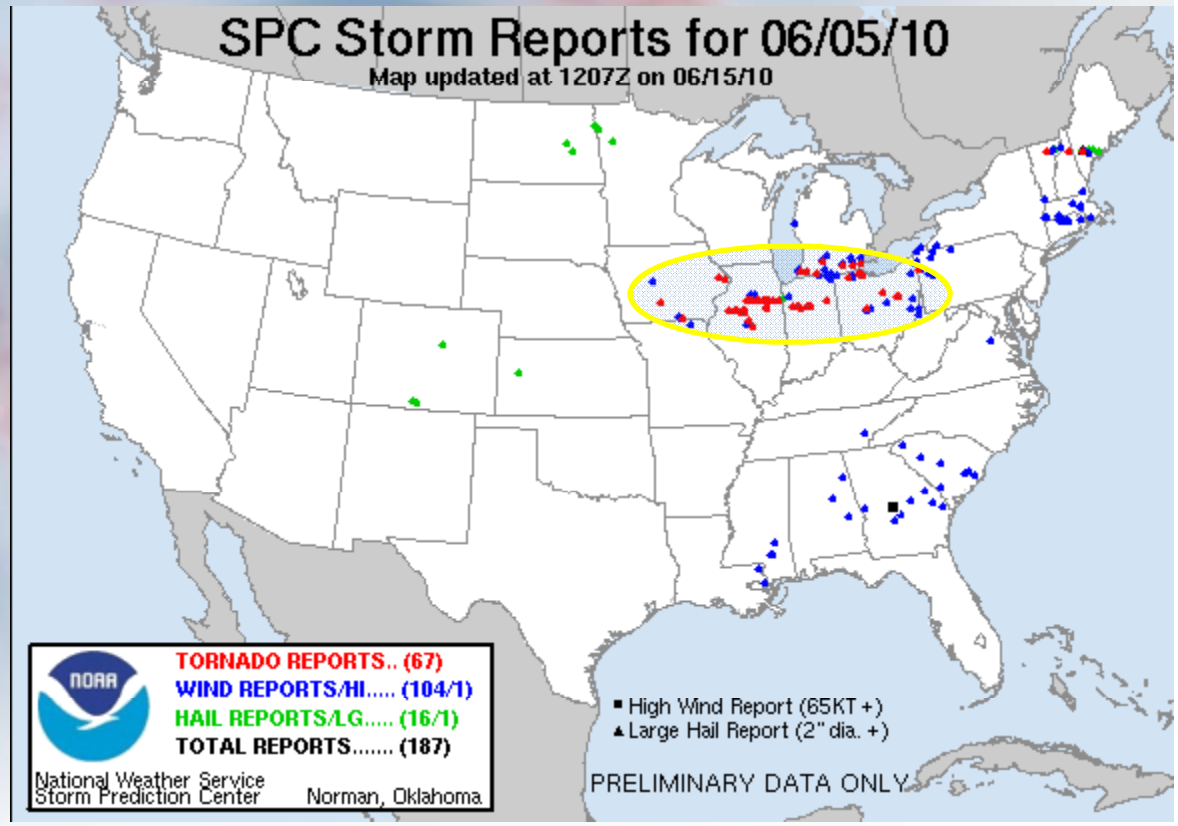
# 2010 Tornadoes

- Southeast MI
  - 12 Tornadoes
  - 6th most in SE MI History
  - Most since 2004
- All of Michigan
  - 27 Tornadoes
  - Most since 2001



# June 5-6 Southern Great Lakes Tornado Outbreak

- 43 tornadoes
- IA to PA
- 5 p.m. June 5 to 7 a.m. June 6
- 9 deaths and 75 injuries
- EF Scale

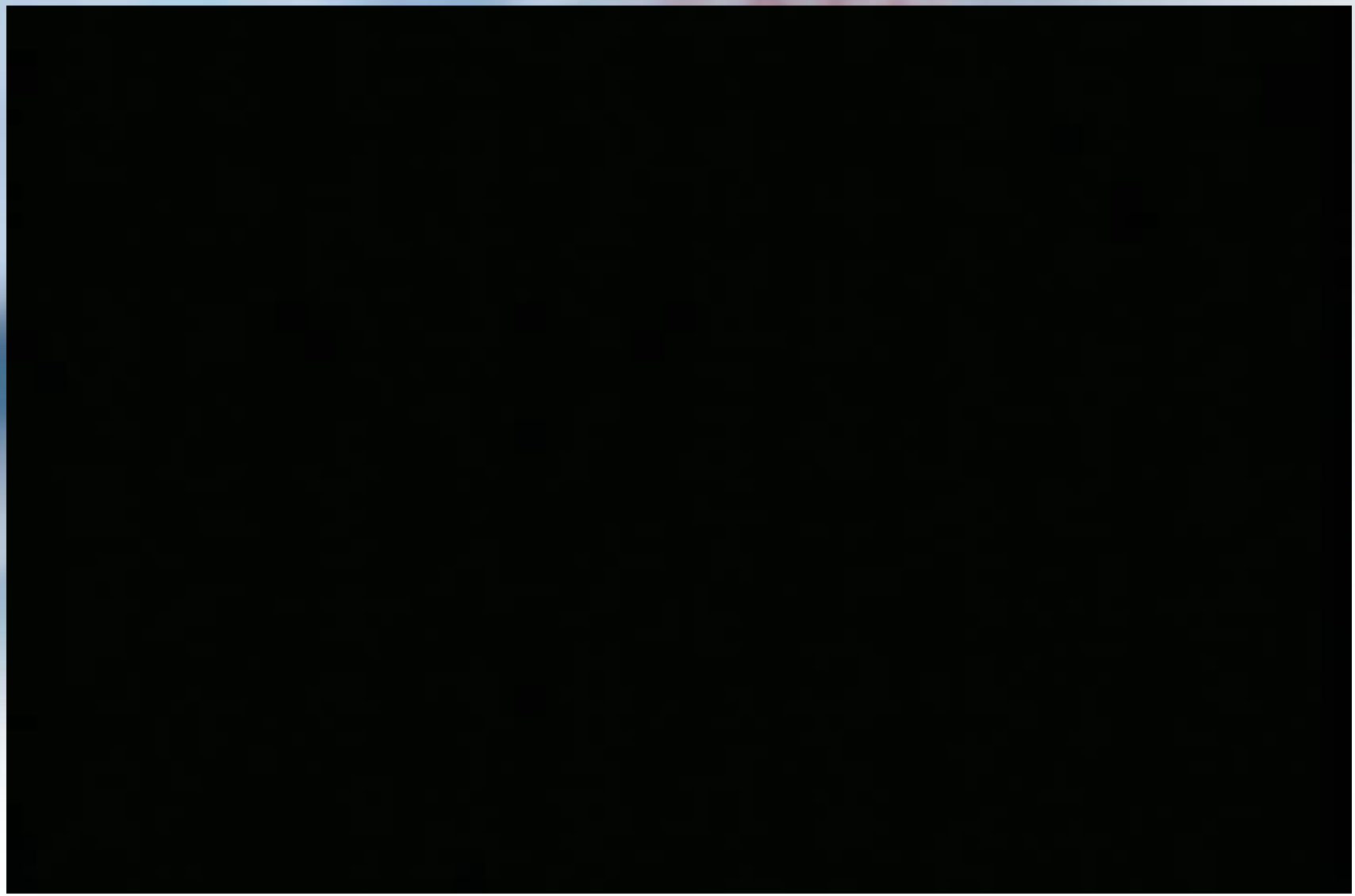



| EF Scale | EF 0 | EF 1 | EF 2 | EF 3 | EF 4 |
|---|---|---|---|---|---|
| Number | 15 | 14 | 10 | 3 | 1 |

# Local June 5-6 Tornado Outbreak

- Dundee EF2
- Toledo Area EF4

# Dundee Tornado



Courtesy of WDIV-TV

# However….

- Those were not the only significant events…

Courtesy of Saginaw News

September 21 Tri Cities, Flint and Thumb Squall Line

Unfortunately, 1 death and 4 injuries.

Arbor, and Adrian

# Thunderstorm Hazards - Tornadoes

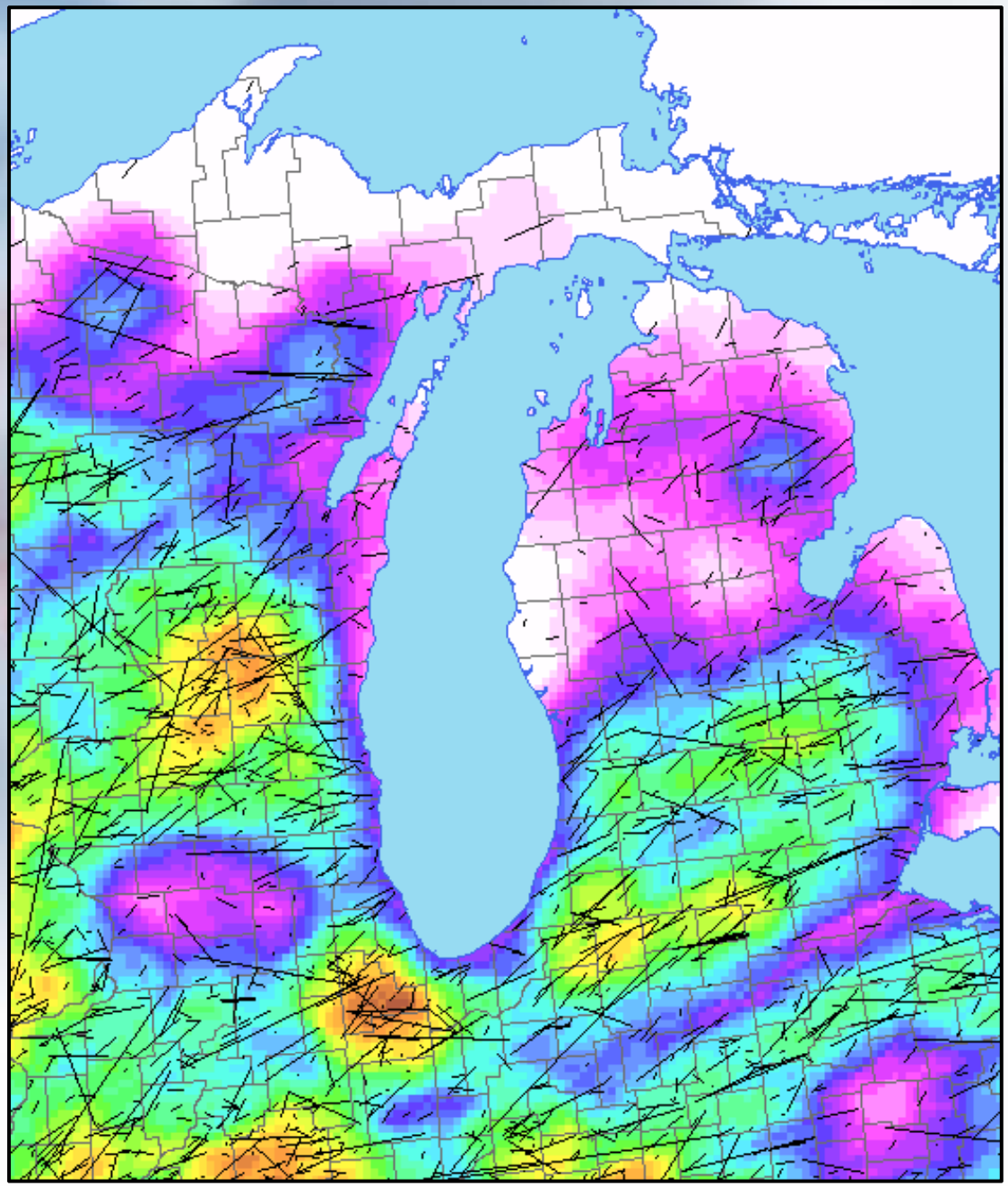
Willow, MI (Southern Wayne County) June 27th, 2010

# Thunderstorm Hazards - Tornadoes

Willow Tornado

- Michigan averages 15 tornadoes a year
- Southeast Michigan averages 5.5 tornadoes a year
- The United States receives more tornadoes than any other country in the world, more than 1,000 annually!

# Tornado Density



# Michigan Tornadoes

- 67% Classified as EFO or EF1 (Weak)
  - On ground for < 10 minutes; typically track < 3 miles
  - Wind Speeds of 65-110 MPH
  - Can develop quickly and occasionally without warning
- Around 30% Classified as EF2 or EF3 (Strong)
  - Typically on ground for over 10 minutes and track 10-25 miles
  - Wind Speeds of 111-165 MPH
  - Typically develop from well developed storms, so usually have longer lead times.
- <5% Classified as EF4 or EF5 (Devastating)
  - Typically on ground for up to an hour and can track 20-50 miles
  - Winds Speeds > 165 MPH
  - Develop from well defined supercell storms, so usually have longer lead times.

© 2007 mesovortex.com

# Non-Tornadic Severe Weather Events

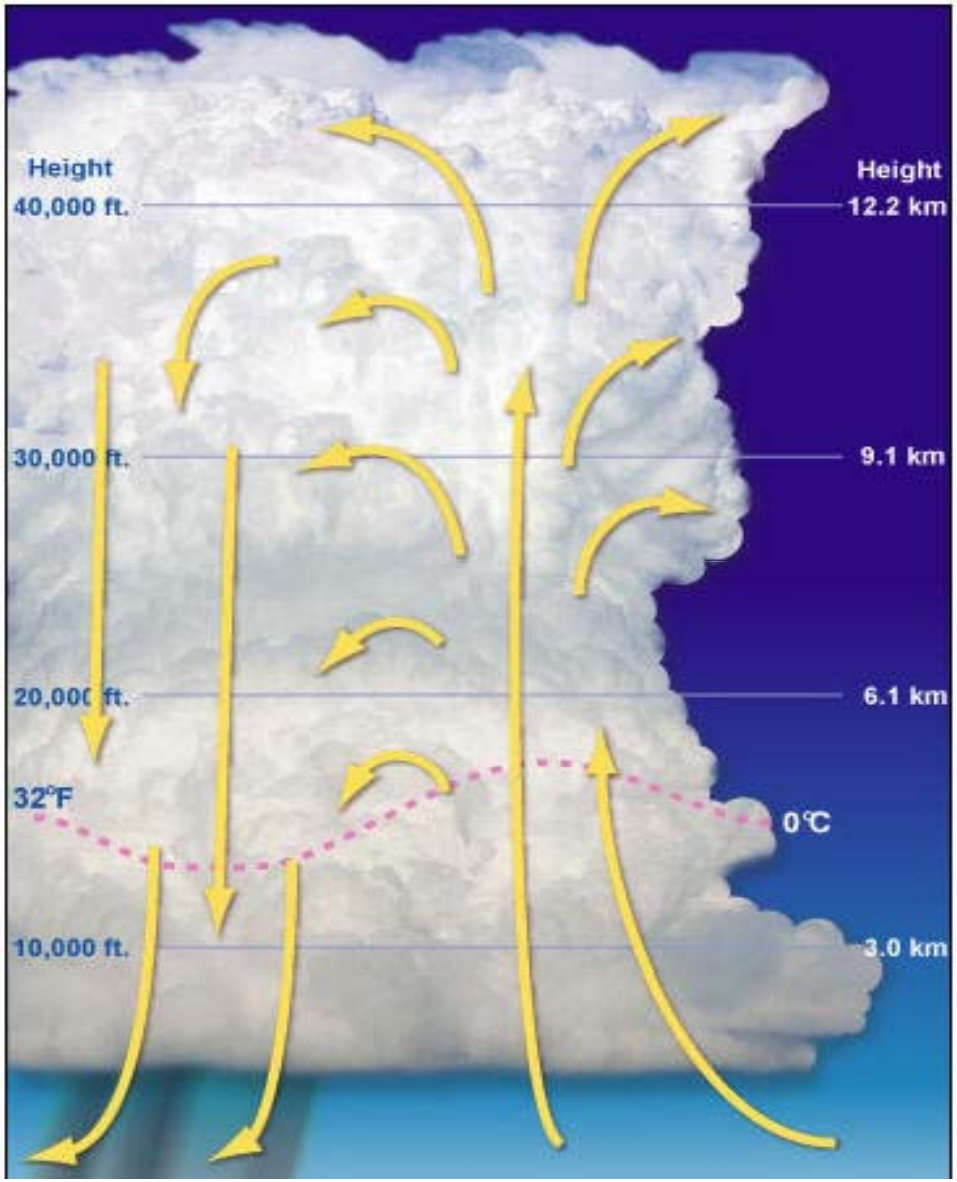
# Straight Line Winds

- **Severe Thunderstorm Winds >= 58 mph.**
- Can exceed 100 mph on rare cases.
- Damage is more widespread than tornadoes but less extreme.

# Straight Line Winds

-Outflow from a thunderstorm that blows in one direction.
-Also called downbursts or microbursts.

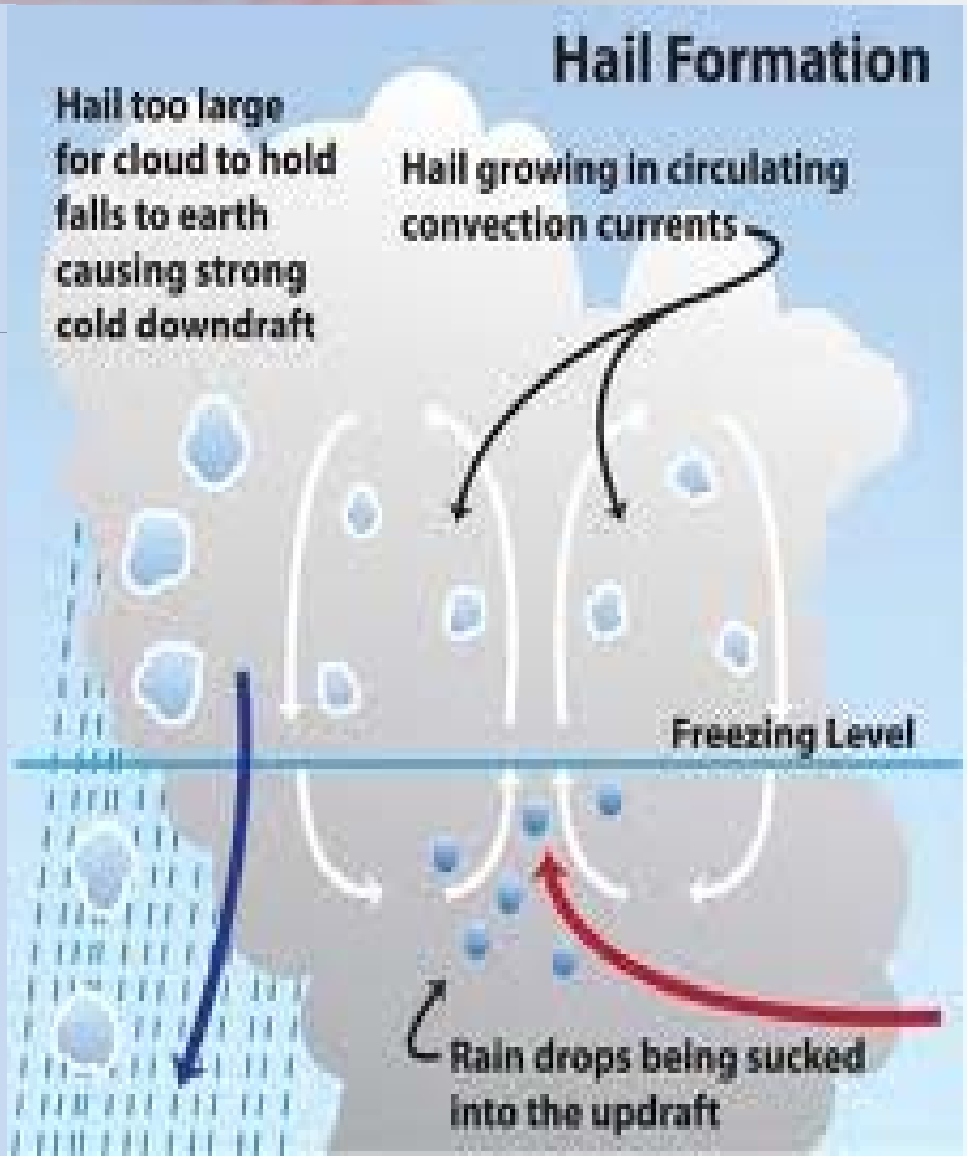
# Straight Line Winds



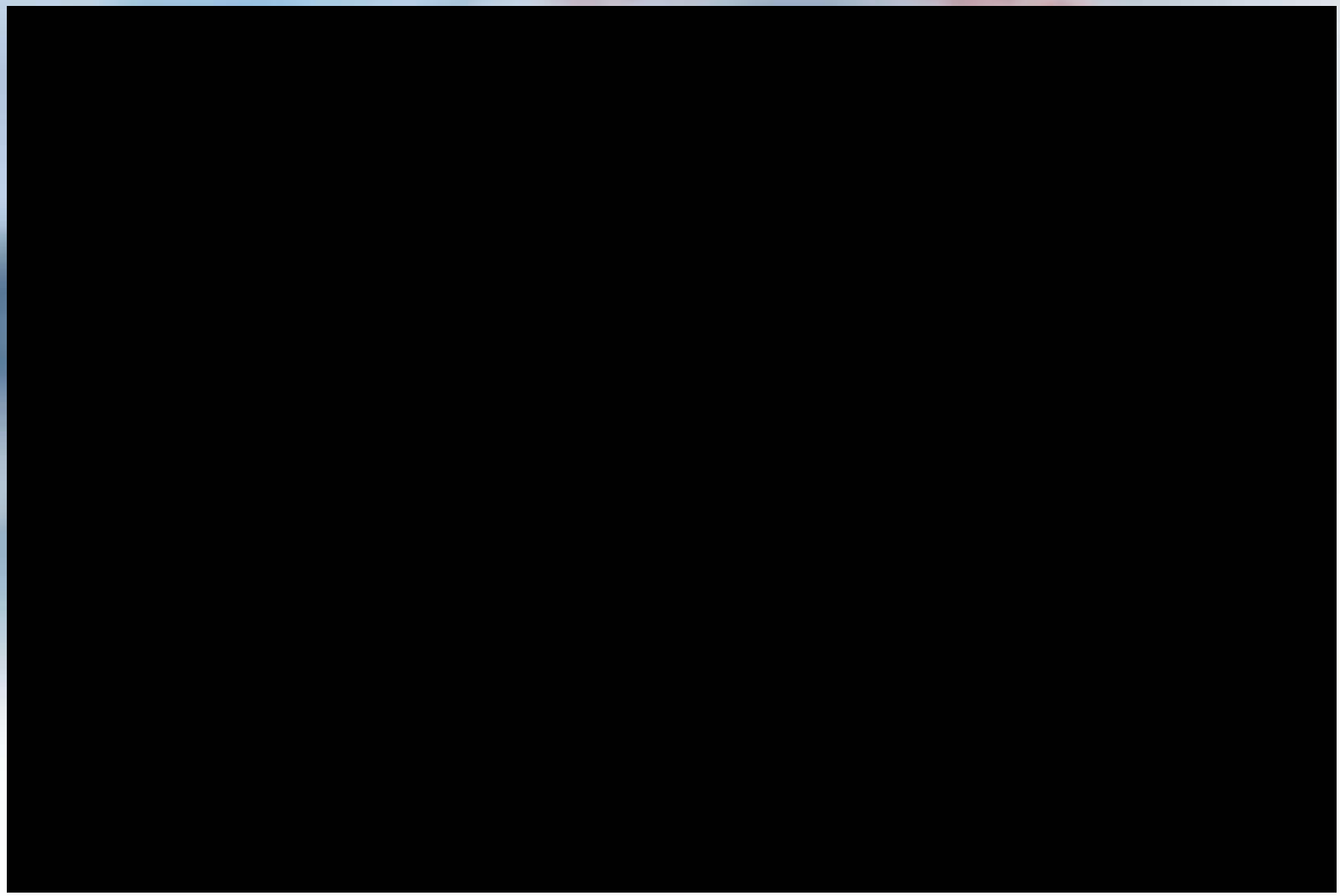

- The stronger the thunderstorm updraft, the higher the region of raindrops will be in the tops of the cloud.
- The downdraft originates from precipitation drag associated with falling raindrops.
- Evaporative cooling from dry air on the edge of the cloud accelerates the downdraft (cold air is more dense).
- The stronger the updraft, the higher up the downdraft will originate, so the stronger the winds will be when the downdraft reaches the ground.

# Hail

- Forms as supercooled rain drops collide with and freeze to ice crystals.
- Need a strong thunderstorm updraft to sustain large ice particles in the clouds.
- Cold and dry air aloft promote more ice crystals in the top of clouds and thus provide a more favorable environment for hail.
- When hail becomes too large for the updraft, it falls to the ground.
- **HAIL ONE INCH IN DIAMTER OR LARGER IS CONSIDERED SEVERE.**



# Baseball Size Hail Oklahoma City



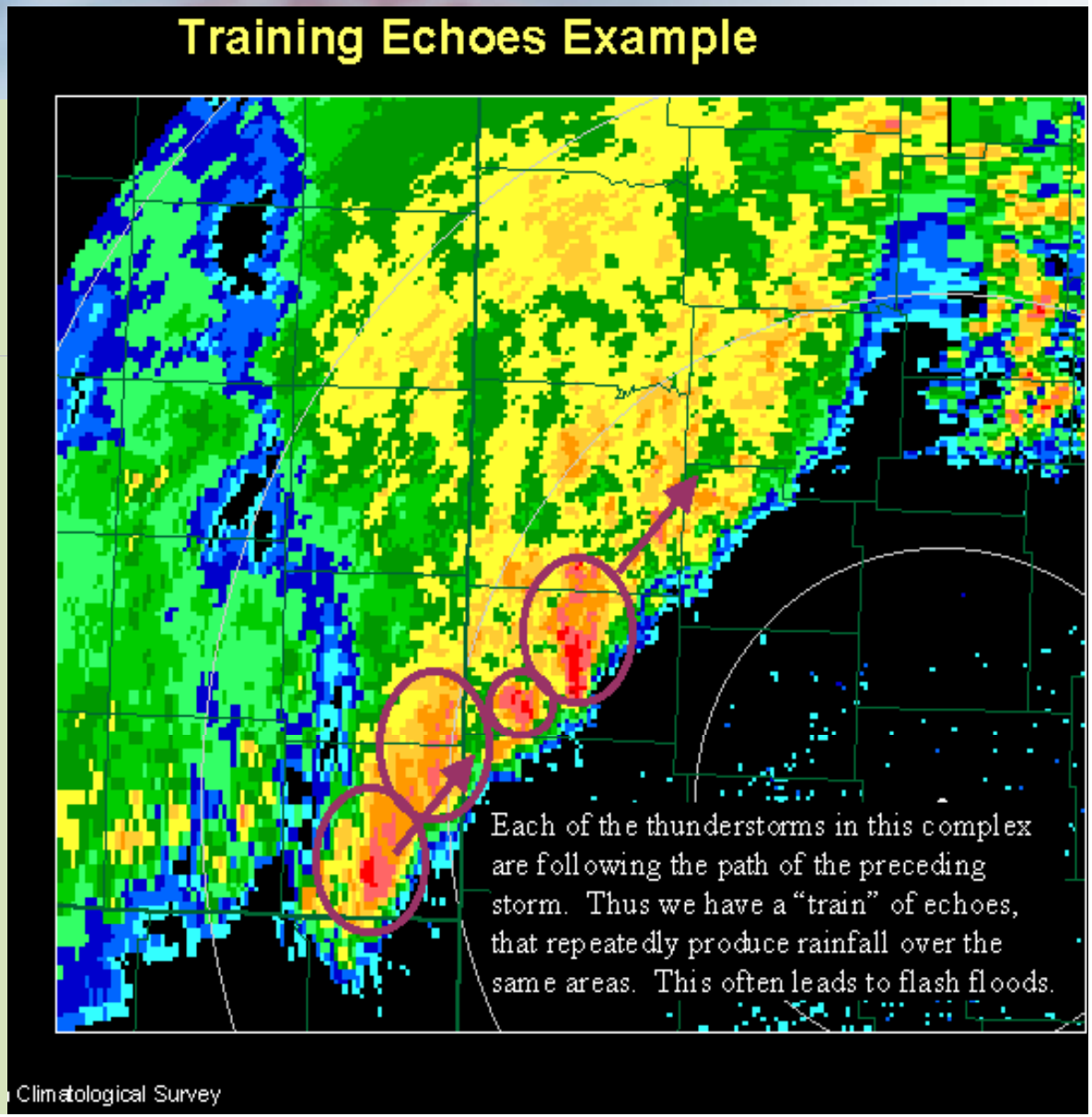
# Flash Flooding

- Flash Flooding
  - Localized heavy rain from thunderstorms
  - Typically 3-5” in under 3 hours
  - A greater problem in urban areas
- Areal Flooding
  - Widespread flooding due to heavy rain on saturated soils over a longer time period.

Marion, IL

# Flash Flooding

- Need very high atmospheric moisture and slow moving thunderstorms.
- Echo Training is common during these events. This is where storms develop in one single location and repeatedly move over the same areas.

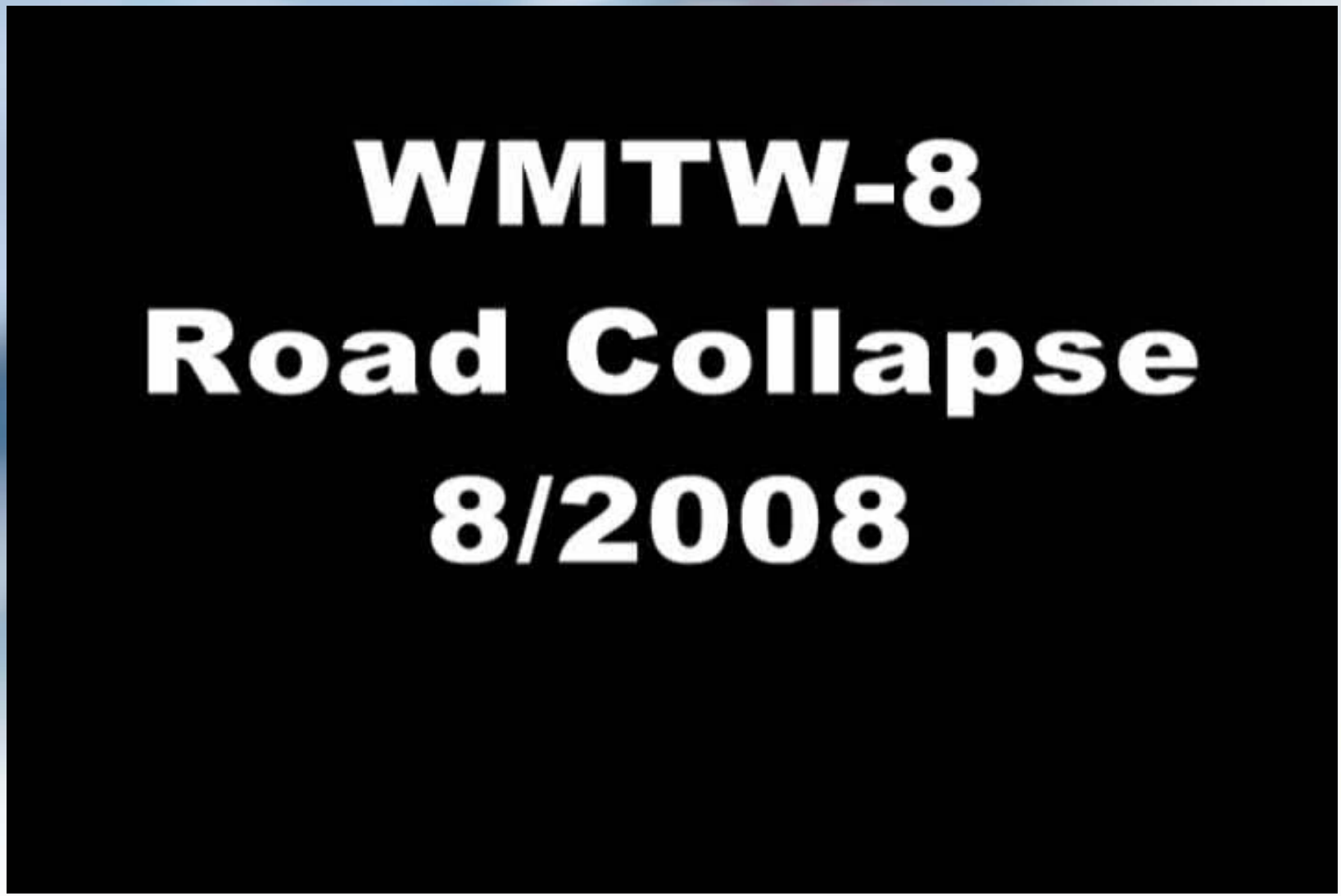


# Flooding

- River Flooding
  - Combination of heavy rain, snow melt, ice jams, frozen ground

**Flooding in Monroe (left) and Dundee(top) along the River Raisin March 10-14, 2009**

# River Flooding Video

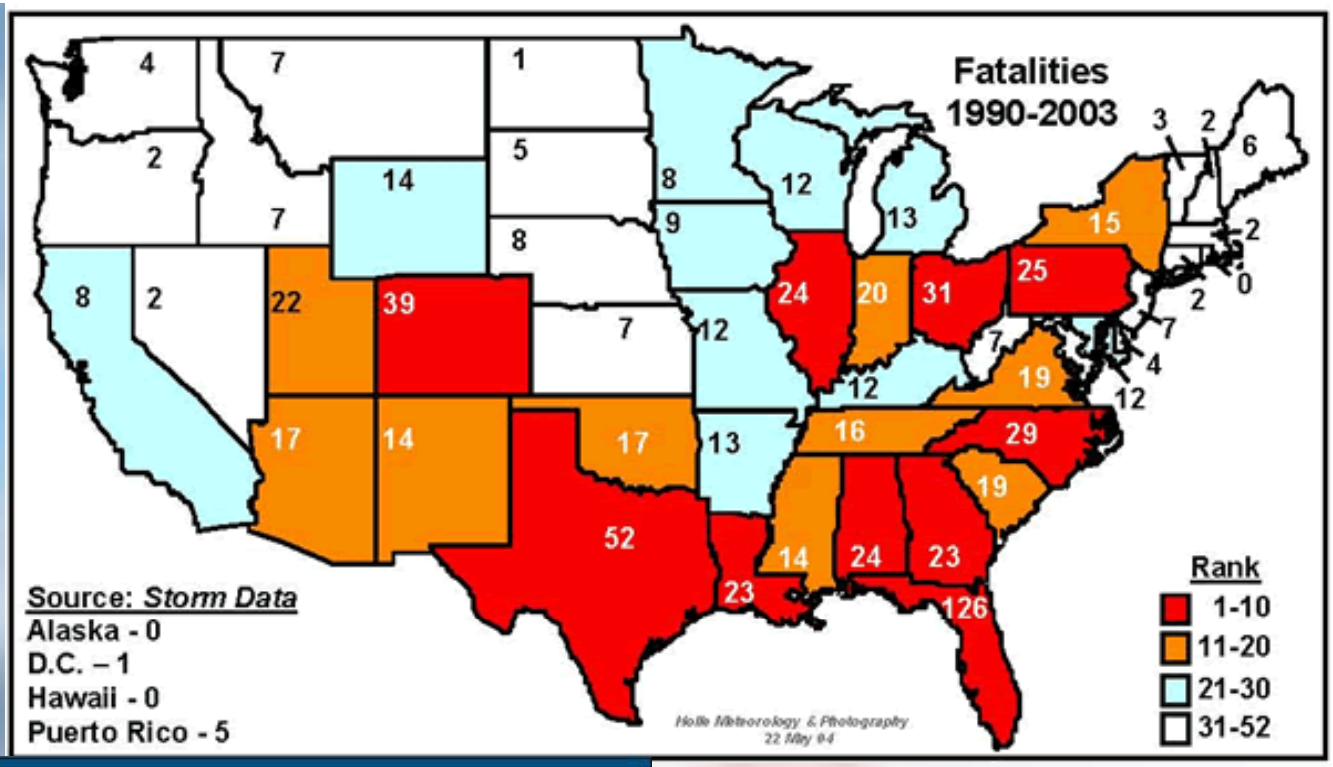


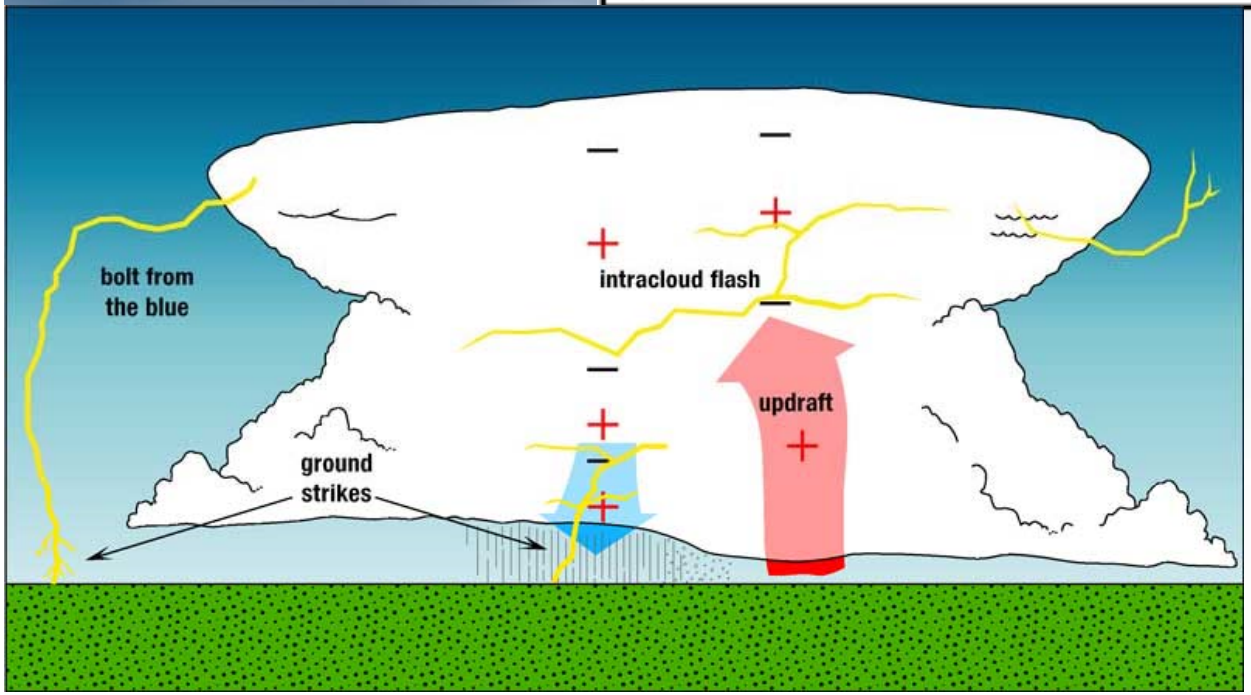

**Freeport, Maine**
**August 2008**

# Lightning

- Forms due to charge separations between the tops of thunderstorms, the base of thunderstorms and the ground.
- The charge separation is thought to occur when ice and supercooled water become present in the tops of the clouds.

Midland Sep 21, 2010
Photo Courtesy of John McCoy


Fatalities
1990-2003
Source: Storm Data
Alaska - 0
D.C. – 1
Hawaii - 0
Puerto Rico - 5
Rank
1-10
11-20
21-30
31-52
Holle Meteorology & Photography
22 May 04


bolt from
the blue
intracloud flash
updraft
ground
strikes

# Weather Hazards Review

Which of the following is not enough to classify a thunderstorm as severe?

Answer

a) Hail greater than 1 inch in diameter

b) Lightning

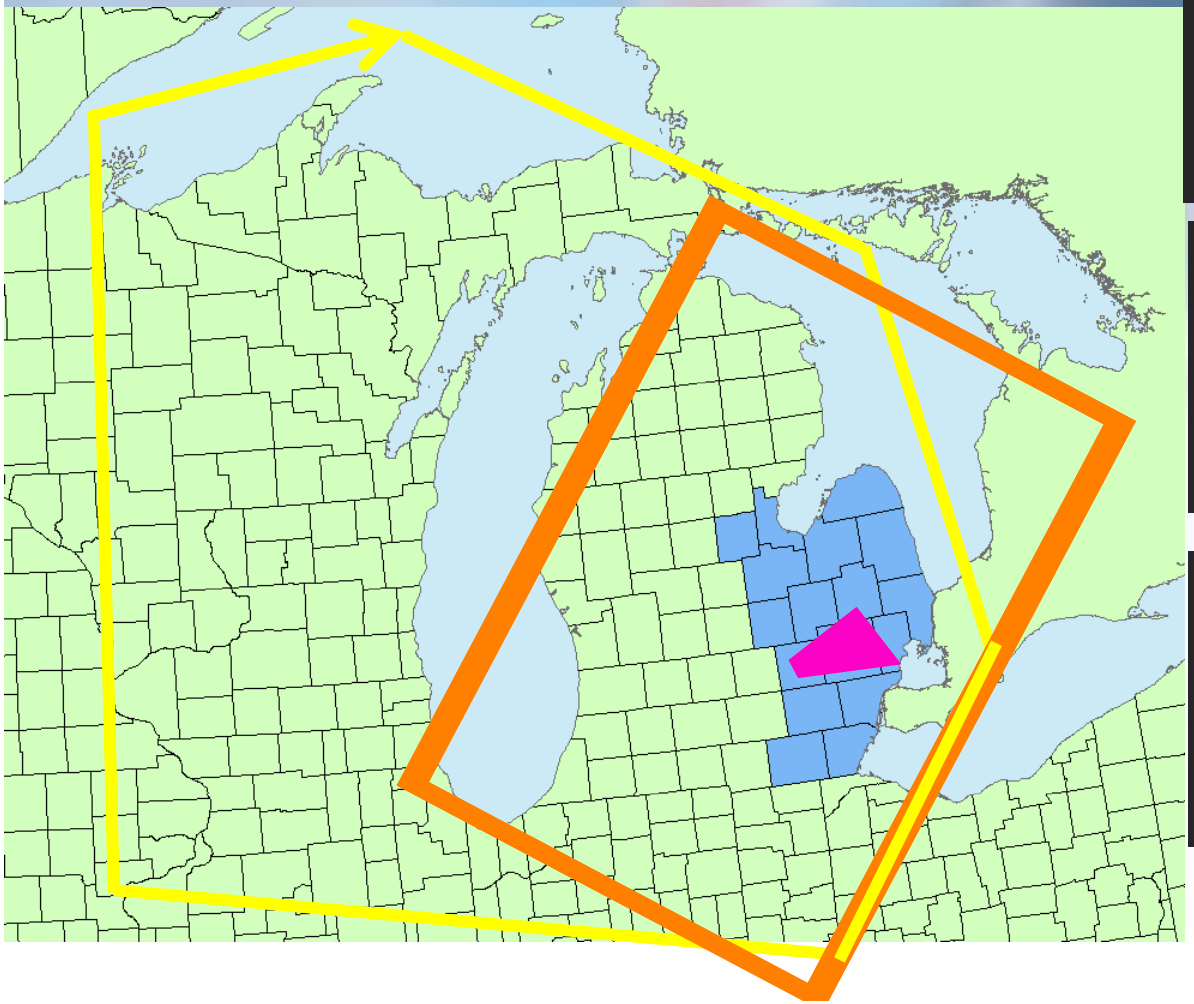
c) A Tornado

d) Strong wind gusts in excess of 58 mph

# Before the Storm Arrives

- Thunderstorm Outlooks
  - Convective outlooks issued by Storm Prediction Center
  - Hazardous Weather Outlook Issued by NWS Detroit/Pontiac
- Watches
  - Conditions favorable for severe weather in or near the watch area
  - Issued by the Storm Prediction Center
- Warnings
  - Severe weather is imminent or occurring in the warning area
  - Issued by the NWS Detroit/Pontiac

# NWS Products Issued for Severe Weather



## Outlook

- Several days in advance
- General idea of area and what is expected

## Watch

- 2-6 hours in advance
- More specific threat, area, and timing

## Warning

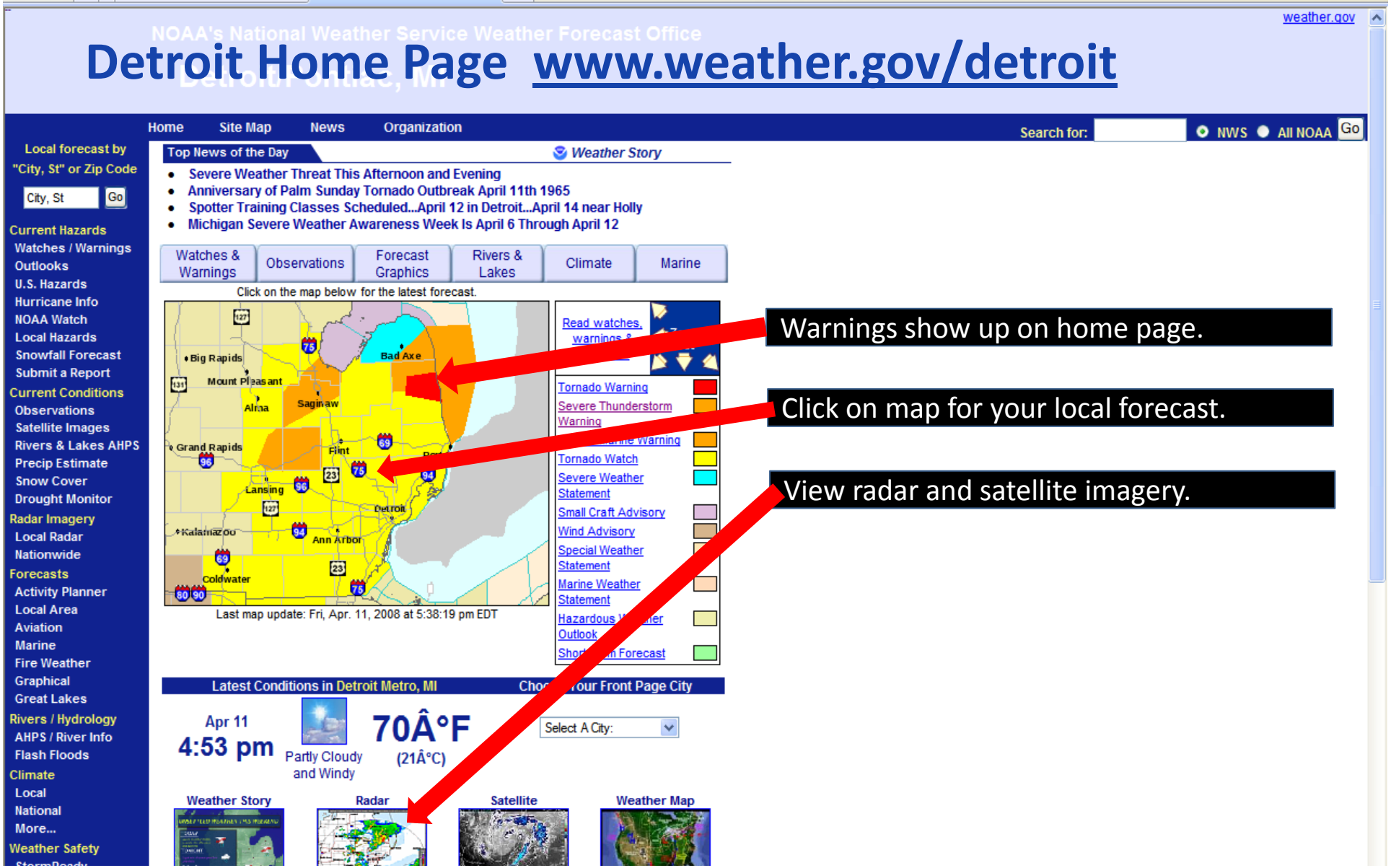
- 10-60 minutes in advance
- Very specific threat, area, and timing

# Before the Storm Arrives

- Severe Thunderstorm Warning
  - **Thunderstorm Wind Gusts >= 58 MPH**
  - **And/Or Hail 1 Inch in Diameter or Larger**
- Tornado Warning
  - Doppler Radar Indicates Strong Rotation
  - Confirmed Reports of a Tornado

# Weather Resources

## Detroit Home Page www.weather.gov/detroit




Warnings show up on home page.

Click on map for your local forecast.

View radar and satellite imagery.

# Weather Resources

Fcst_DTX_Schd.pdf (application/pdf Ob... | Storm Prediction Center

NOAA's National Weather Service

## Storm Prediction Center

www.spc.noaa.gov

Site Map | News | Organization | Search for:

Local forecast by "City, St" or "ZIP"
City, St Go

UTC/GMT/Zulu Time
19 : 19 : 17

*Overview*
SPC Products
- All SPC Forecasts
- Current Watches
- Meso. Discussions
- Conv. Outlooks
- Fire Wx Forecasts
- RSS Feeds

Weather Information
- Storm Reports
- NWS Hazards Map
- Watch/Warning Map
- National RADAR
- Product Archive
- Norman, OK WX

Research
- Non-op. Products
- Forecast Tools
- Svr. Tstm. Events
- SPC Publications

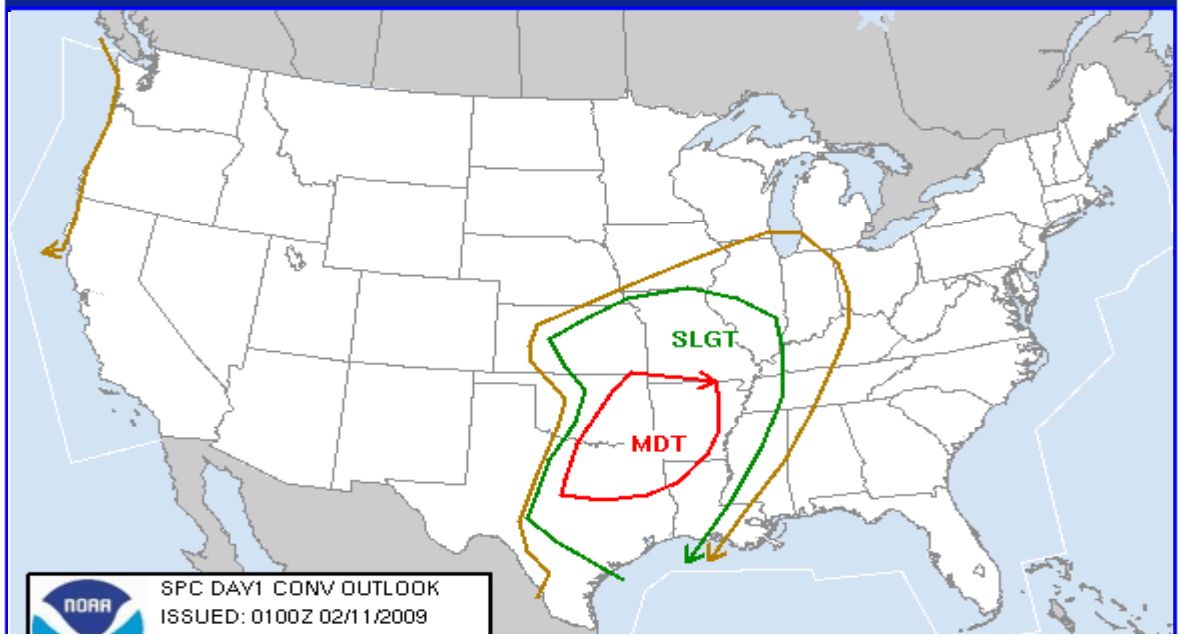
Education & Outreach
- About the SPC
- SPC FAQ
- About Tornadoes
- About Derechos
- WCM Page
- Enh. Fujita Page
- Cool Images
- Our History
- Public Affairs

**Top News of the Day**

- **The following Weather Watches are currently in effect:** 18...
- **The following Mesoscale Discussions are currently in effect:** 145...
- **Note:** Starting **January 5, 2010**, the daily storm report summaries will record **1 inch and greater diameter hail**, as well as severe thunderstorm wind and tornado reports. Please see this link for more information.

More news items below the overview graphic. Updated: 2010-02-24 19:12:18 GMT

Overview | Conv. Outlooks | Watches | MDs | Reports | Mesoanalysis | Fire | Hazards




National Weather Service • Since 187

# Weather Resources

Local Television and Radio Broadcasts

Easily view warning polygons on TV!

# Weather Radio

Broadcasts
- weather forecasts
- observations
- warnings

Programmable
- for your county
- for specific hazards

Battery back-up during power outages.

Tone Alerts for warnings when not in use!

# Mobile Alerts

- http://mobile.weather.gov to access radar or warning information
- Free Email or Text Alerts for Severe Weather
  - Available from many local news stations and the Weather Channel
  - Based on Zip Code
- Phone Voice Alerts for Severe Weather
  - Based on Zip Code
  - Usually a monthly fee

# Future Technology

- CMAS(Commercial Mobile Alert System)
  - Free Service to the public
  - Uses location of cell tower to alert all persons in affected areas for
    - Tornado Warnings
    - Presidential Emergency Messages
    - Amber Alerts
    - Automatically enrolled with option to opt out
  - Targeted for spring 2012 with current testing in California and Florida

# Before the Storm Arrives – Cloud Features
# Shelf Clouds

# Before the Storm Arrives
# Lightning Safety

- Best Place to be is Indoors (Closed Structure)

- Get Out of the Water
- Automobile Can Offer Safety
- Do NOT go Outside to Film the Storm

# Before the Storm Arrives

- Go indoors and stay away from windows
- Be alert to possible Severe Thunderstorm or Tornado Warnings
- Be ready to report severe weather to the NWS

# Before the Storm Arrives

- No need to report anything – your safety should be your top priority
- Do not report dark or scary clouds
- No need to report shelf clouds
- Do not report radar signatures

# During the Storm

# During the Storm – Wall Clouds

Washtenaw Co May 21, 2010

Lapeer Co Aug 15, 2010

# During the Storm – Tornadoes and Funnel Clouds

## Tornado

A violently rotating column of air extending from a thunderstorm and in contact with the ground.

## Funnel Cloud

A rotating, funnel-shaped cloud extending from a thunderstorm base, but not in contact with the ground.

Note: Funnel does not touch ground and no debris is seen at the surface!

# Tornado VS Funnel Cloud

# During the Storm – Tornado Safety

When a TORNADO WARNING is in effect…

- Go to the basement immediately!
- Get under something sturdy
  - Desk, stairwell
- Get in the tornado safety position
- Cover yourself with pillows, blankets, extra clothes to shield debris
- Stay in basement until warning expires

# During the Storm – Tornado Safety

When a TORNADO WARNING is in effect and there is NO BASEMENT available…

- Seek shelter in an interior room with no windows
  - Closet, bathroom
  - Stay away from exterior walls
  - Debris can puncture walls

- If driving…pull over and get into a building
- DO NOT try to out-run the tornado

# During the Storm – Green Sky

- Effect of the reflection of the water droplets in the storm cloud.
- The reflection usually produces a dark blue color, but can be green in the evening when the blue light mixes with red light.
- Typically need a very strong storm with a lot of big rain drops or hail.

# What to Report: Wind

## Wind Gusts of 40 MPH or Greater

- 25-31 Large branches in motion; whistling heard in telephone wires
- 32-38 Whole trees in motion; inconvenience felt in walking against the wind
- **39-54** Twigs break off trees; wind generally impedes progress
- **55-72** Damage to chimneys, TV antennas; pushes over shallow rooted trees
- **73-112** Peels surfaces off roofs; windows broken; light mobile homes overturned; moving cars pushed off road
- **113-157** Roofs torn off houses; cars lifted off ground

# What to Report: Wind

## Estimating Wind Speed

- Takes experience (most people over-estimate)
- Avoid “heavy” or ”strong” to describe wind
- If possible, measure the wind with an anemometer

## When Reporting High Winds…

- Did you <u>measure</u> or <u>estimate</u> the wind gust?
- Did the wind produce damage?
- Describe any damage

Oxford Apr 25, 2009

# What to Report: Hail

## When Reporting Hail…

- Let us know whether it was measured or estimated
- If you cannot measure the hail, use coins or other known objects to describe the size
- Avoid using “marble-sized” to describe hail
- Report size of largest hailstone

# What to Report: Hail

## Hail ½ inch or Greater

| | | | |
|---|---|---|---|
| Pea | 0.25 - .375 inch | Lime | 2.00 inches |
| Plain M&M | 0.50 inch | Tennis Ball | 2.50 inches |
| Penny | 0.75 inch | Baseball | 2.75 inches |
| Nickel | 0.88 inch | Large Apple | 3.00 inches |
| Quarter | 1.00 inch (15/16") | Softball | 4.00 inches |
| Half dollar | 1.25 inch | Grapefruit | 4.50 inches |
| Walnut/Ping Pong | 1.50 inch | Computer CD/DVD | 4.75 - 5.00 inches |
| Golf ball | 1.75 inch | | |

# What to Report: Funnel Clouds

Funnel Cloud: A rotating column of air that is NOT in contact with the ground, tops of buildings, or tree tops

Monroe, MI

Sarnia, Ontario

# What to Report: Tornadoes

- Report all tornadoes
- Please tell us your location and direction you are looking
- Seek shelter!
- Do NOT report a wall cloud, unless it is present with a tornado or funnel cloud

# What to Report: Tornadoes

## When Reporting a Tornado…

- Is it rotating?  Do you see debris or electrical flashes?
- Good and accurate reports = Good warnings
- Bad reports lead to false alarms
  - If not sure, wait and keep watching.

***Provide Frequent Updates!***

# What to Report: Flooding

- Rainfall of 1 inch or greater in a “storm”
  - 12-24 hours in winter
  - 1-3 hours for thunderstorms
- Flooding that covers roads or threatens property
- River flooding
- Ice jams

# After the Storm – Safety

*Don’t rush out to find damage!

Possible Dangers Include:

- Downed power lines
- Lightning (can strike up to 10 miles away from storm)
- Trees and/or water across roadways
- Weakened structures

# After the Storm - LSR

- Local Storm Report (LSR)
  - Primary Means to Distribute Storm Information to the Public and Media
  - Storm Spotters Comprise Most of the Reports
- Storm Prediction Center's Storm Reports Archive
  - www.spc.noaa.gov/climo/online/

# After the Storm – Post Storm Damage

# What to Report: Post-Storm Damage

- Please tell us about any storm damage
  - Large tree limbs
  - Downed trees and power lines
  - Structural damage
- Damage reports, even after the fact, help us verify warnings

St Clair Co Tornado Damage June, 2010

# What to Report: Post-Storm Precipitation

## HAIL

- Largest hail stone in the area

## RAINFALL

- Storm total rainfall amounts

# How to Report

1) Toll-Free Spotter Hotline
   - Unlisted, 24 hours

     **1-800-808-0006**

2) Amateur Radio, Local Nets, and MICON

3) Packet Radio

   **K8DTX-5, 145.76 MHz**

4) eSpotter

   **espotter.weather.gov**

# How to Report

- When reporting, tell us:
  - Your location
    - City
    - Address or closest major intersection
- What you are seeing
- If you are reporting wind or hail, please tell us if its Measured or Estimated
- Time of the event (if known)
- Any Damage

***Remember: TEL (TimeEventLocation)***

Halftime
10 Minute Break

# 2011 Spotter Training

## Part 2

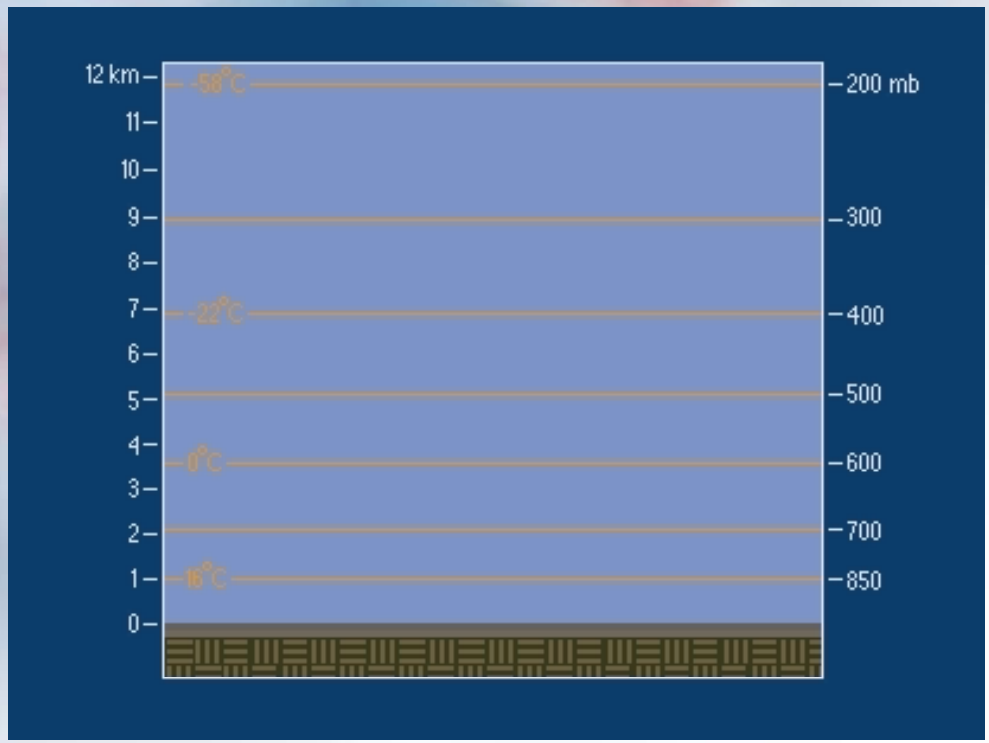
- Thunderstorm Overview
- Thunderstorm Types
  - Single Cell
  - Multicell
  - Squall Line
  - Supercell
- Shelf vs. Wall Cloud
- Tornado vs. Tornado Look-a-likes
- Review of what, when and how to report

# Thunderstorm Overview

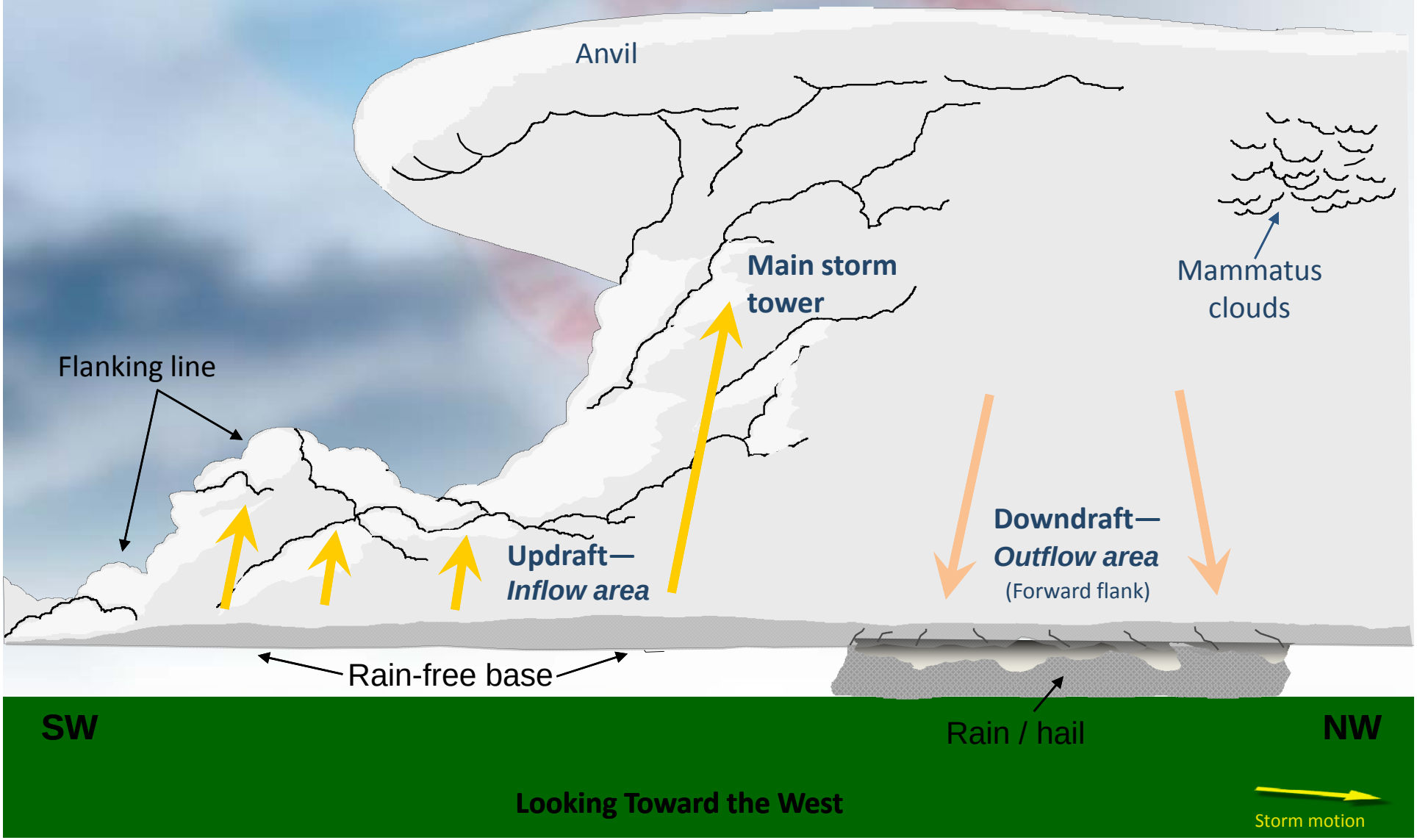
# Recipe for a Thunderstorm

Three simple ingredients:

- Moisture
- Unstable Air
- Lift



# Basic Parts of a Thunderstorm



# Thunderstorm Types

| Single Cell | Multicell Cluster or Line | Supercell |
|---|---|---|

Weak, brief updraft (non-severe or severe)

**Slight threat** for brief severe weather events

Moderate updraft (non-severe or severe)

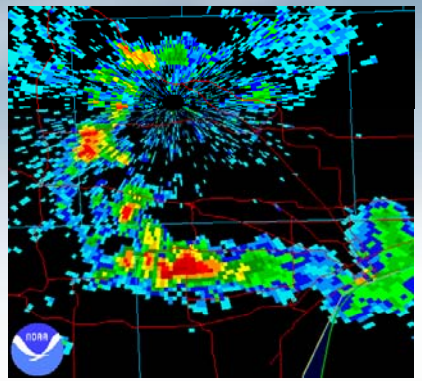
**Moderate threat** for brief or sustained severe weather events

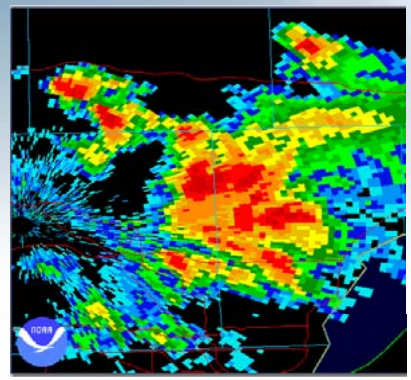
Intense, rotating updraft (always severe)

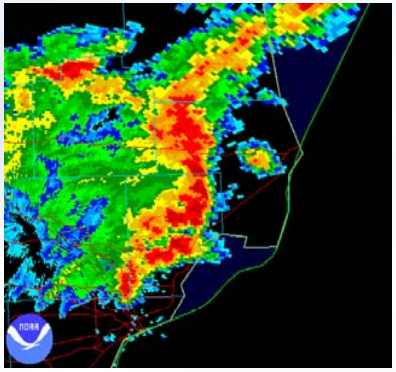
**High threat** for long-lived severe weather events

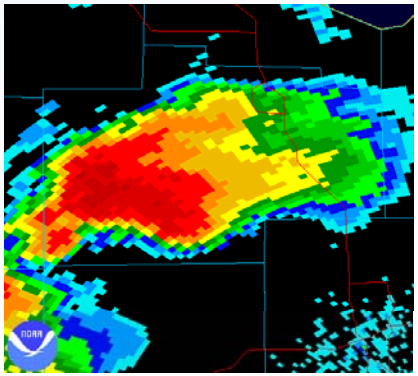
# Thunderstorm Types

| Single Cell | Multicell Cluster or Line | Supercell |
|---|---|---|





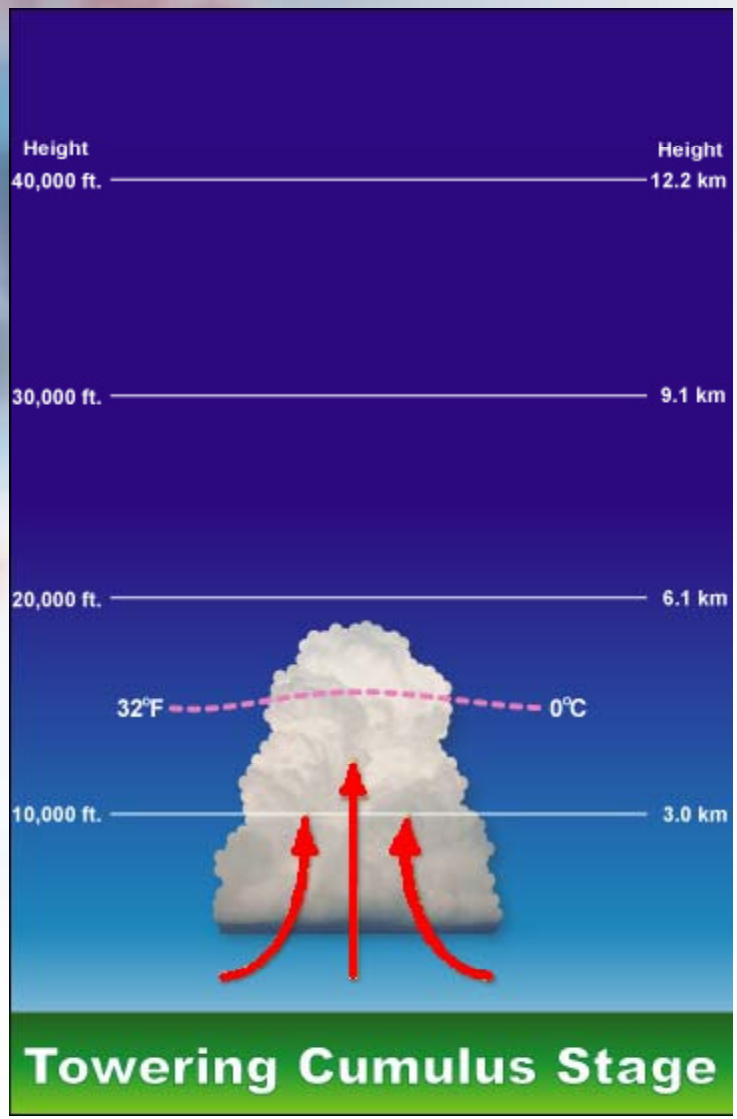




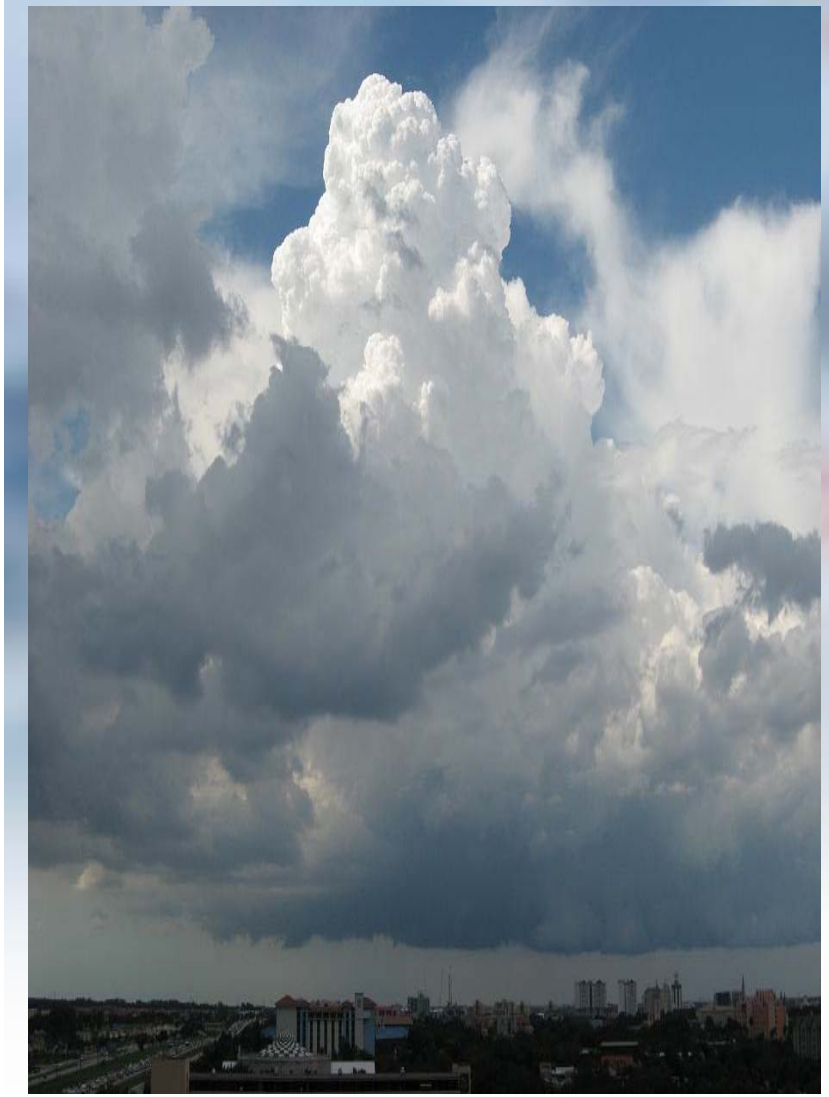
# Identify Each Thunderstorm Type

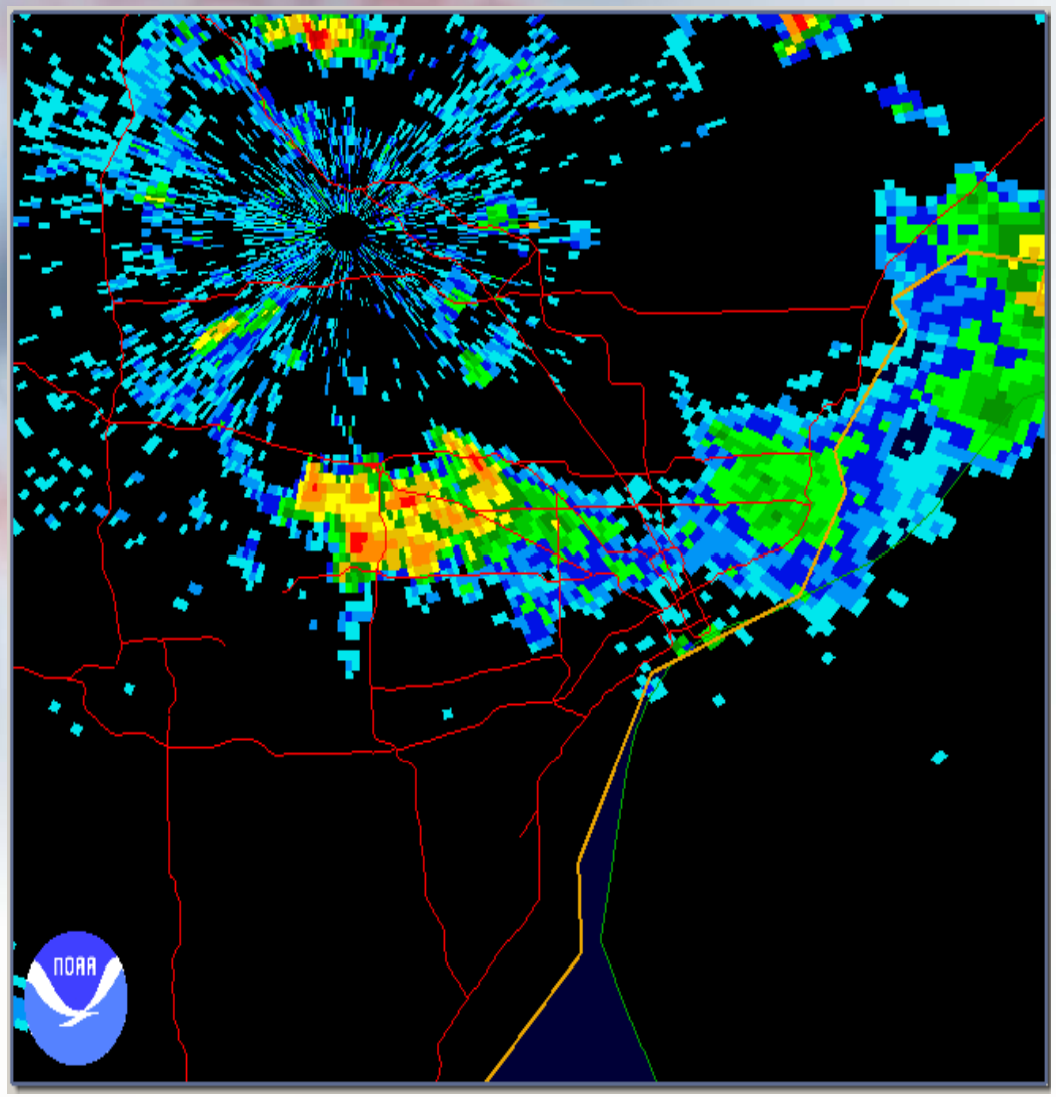
# Developing Single Cell

- Towering Cumulus Stage
- All motion is upward
- Tops around 20,000 ft
- Little or no precipitation



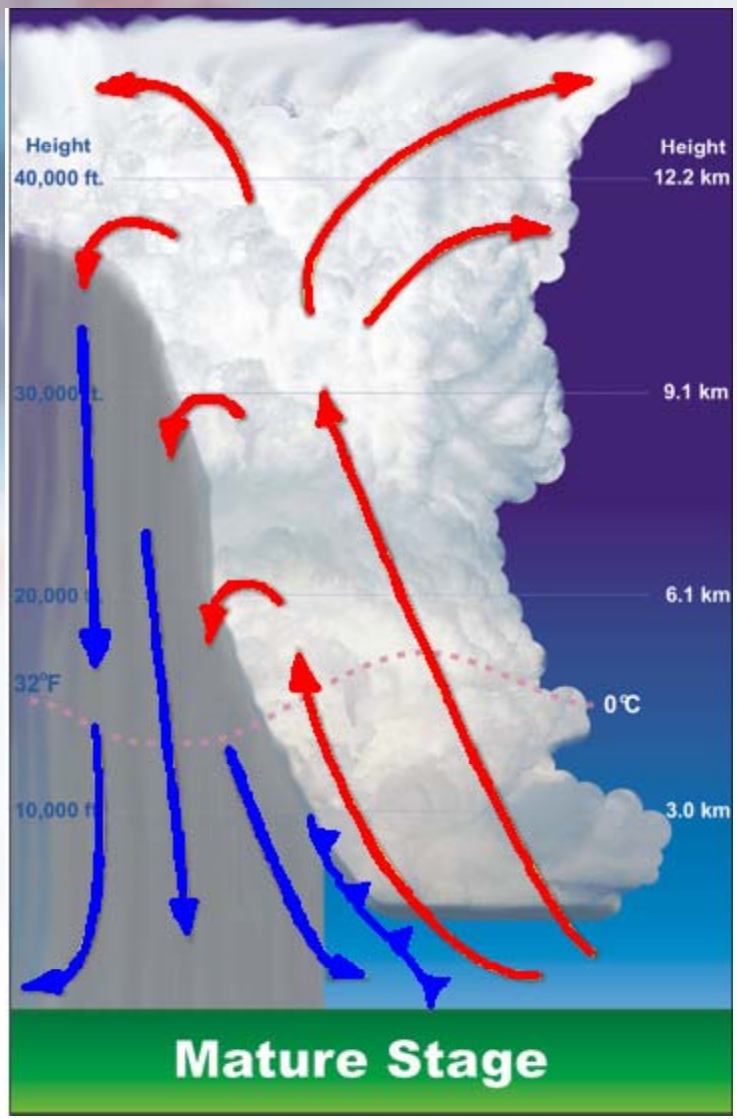
# Developing Single Cell



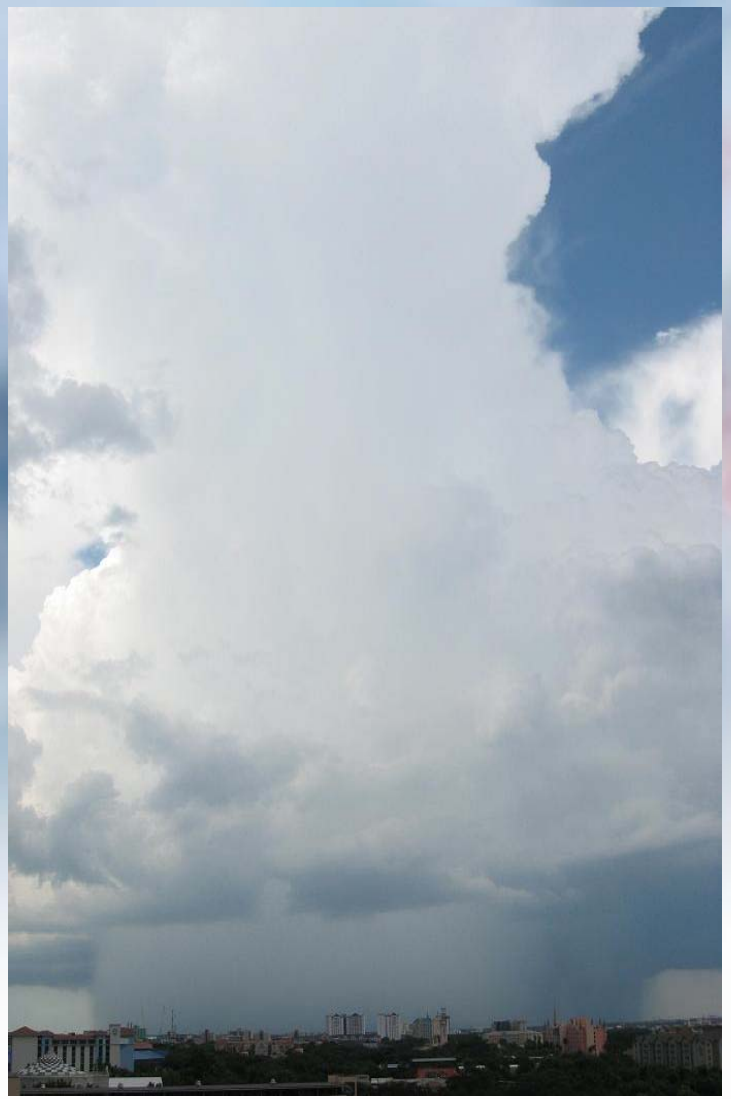


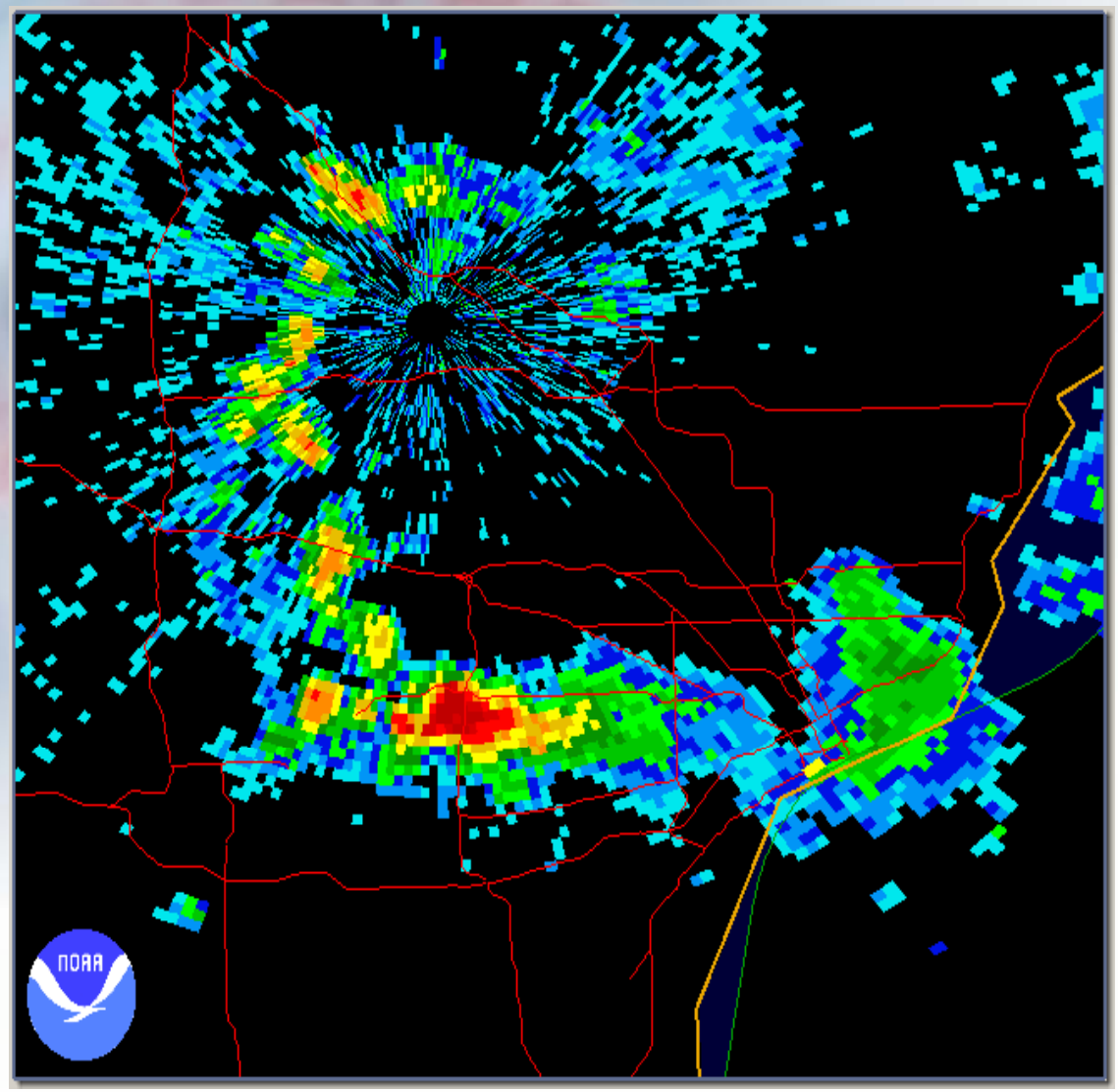
# Mature Single Cell

- Strongest and most dangerous stage
- Both upward and downward motion
- Tops around 40,000 ft
- Precipitation in the downdraft
- Gust front forms



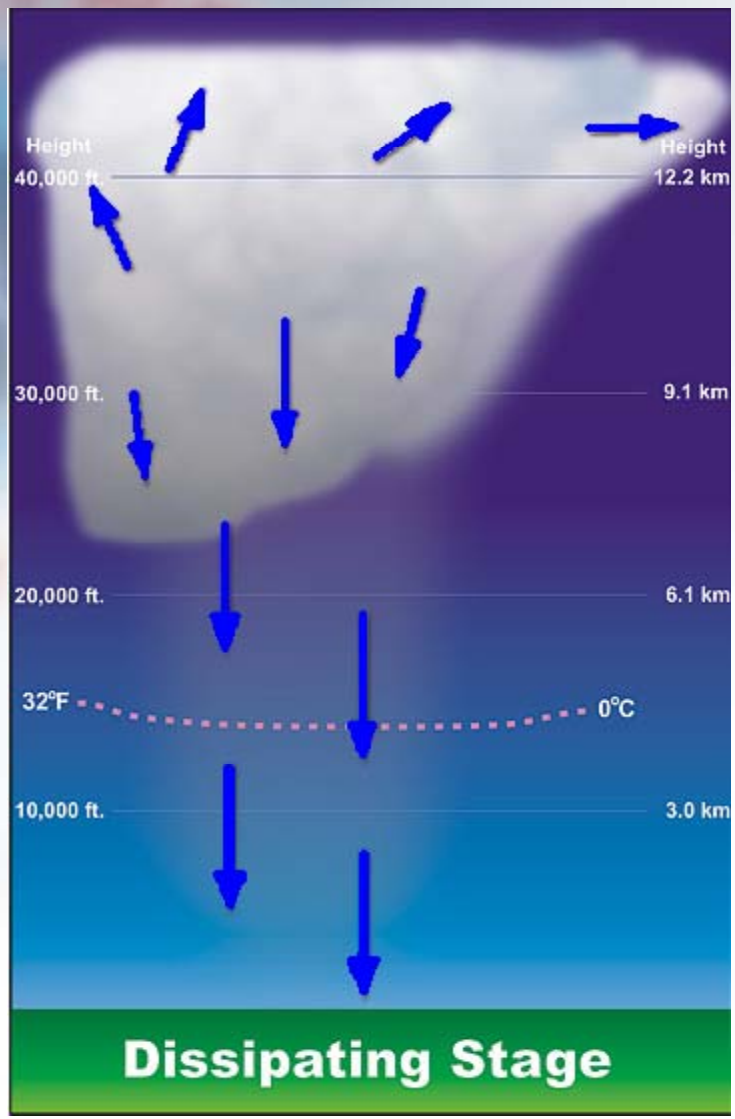
# Mature Single Cell



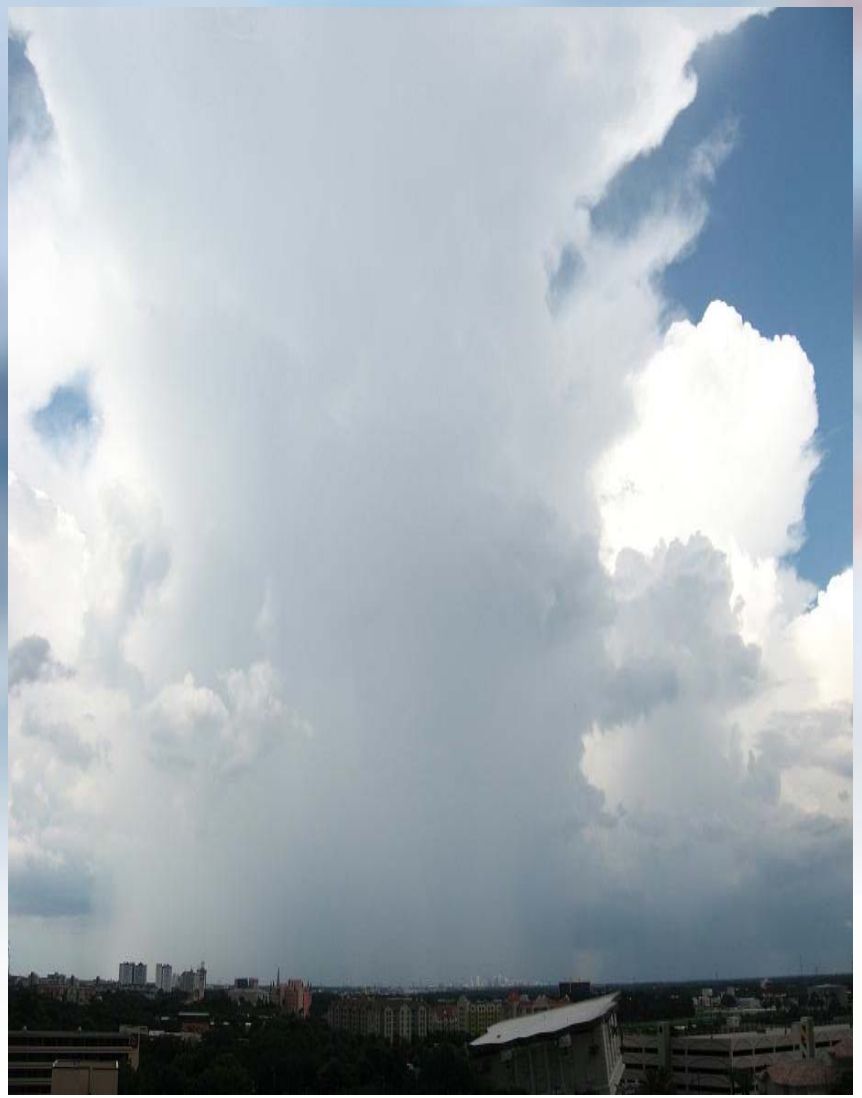


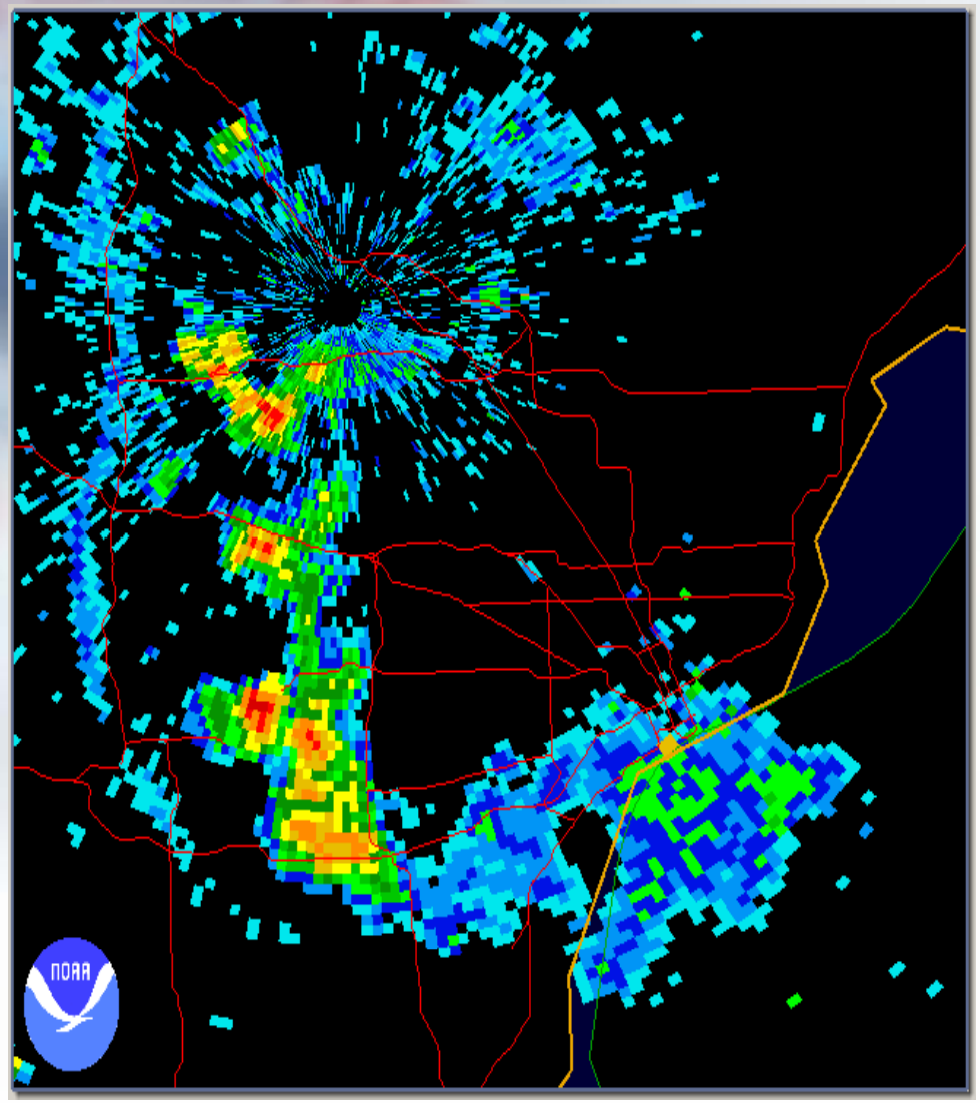
# Dissipating Single Cell

- Gust front moves out away from the storm and chokes off updraft
- All motion is downward
- Overshooting top disappears



# Dissipating Single Cell

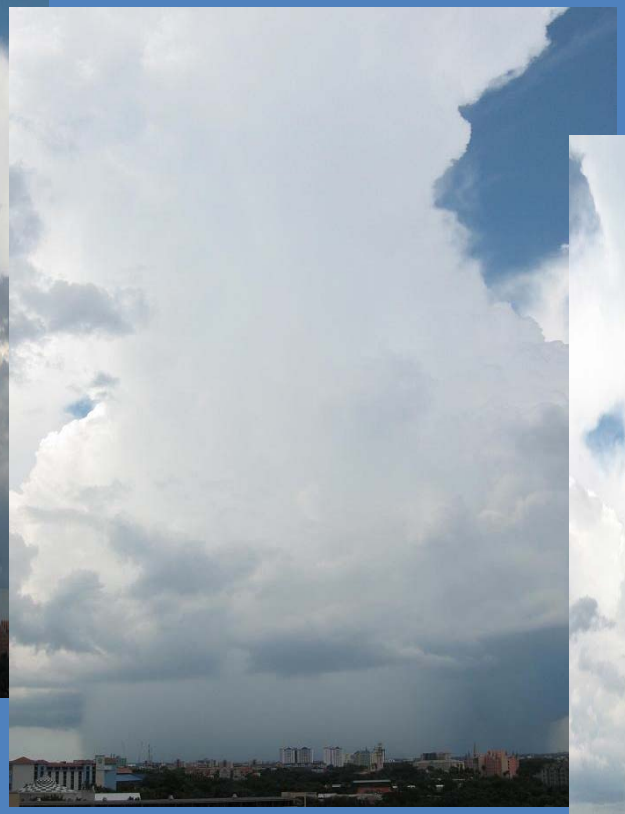




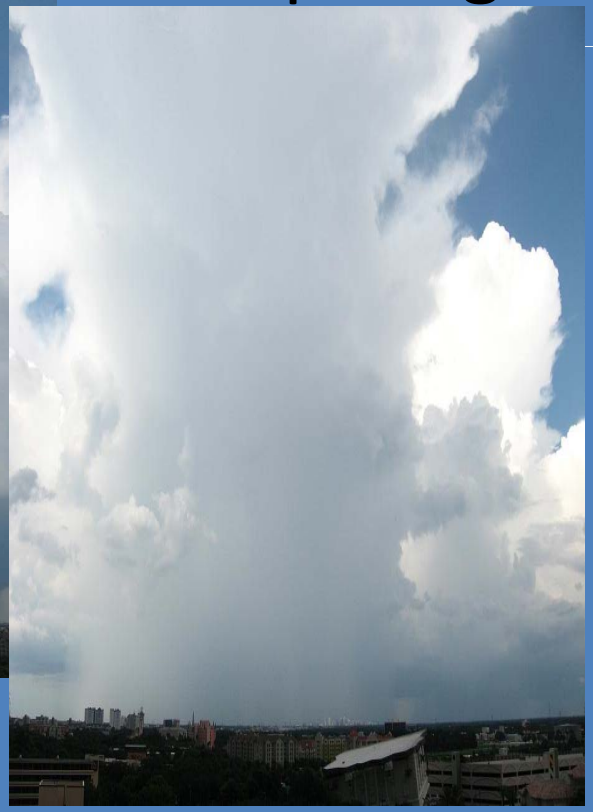
# Single Cell Life Cycle

Developing

Mature

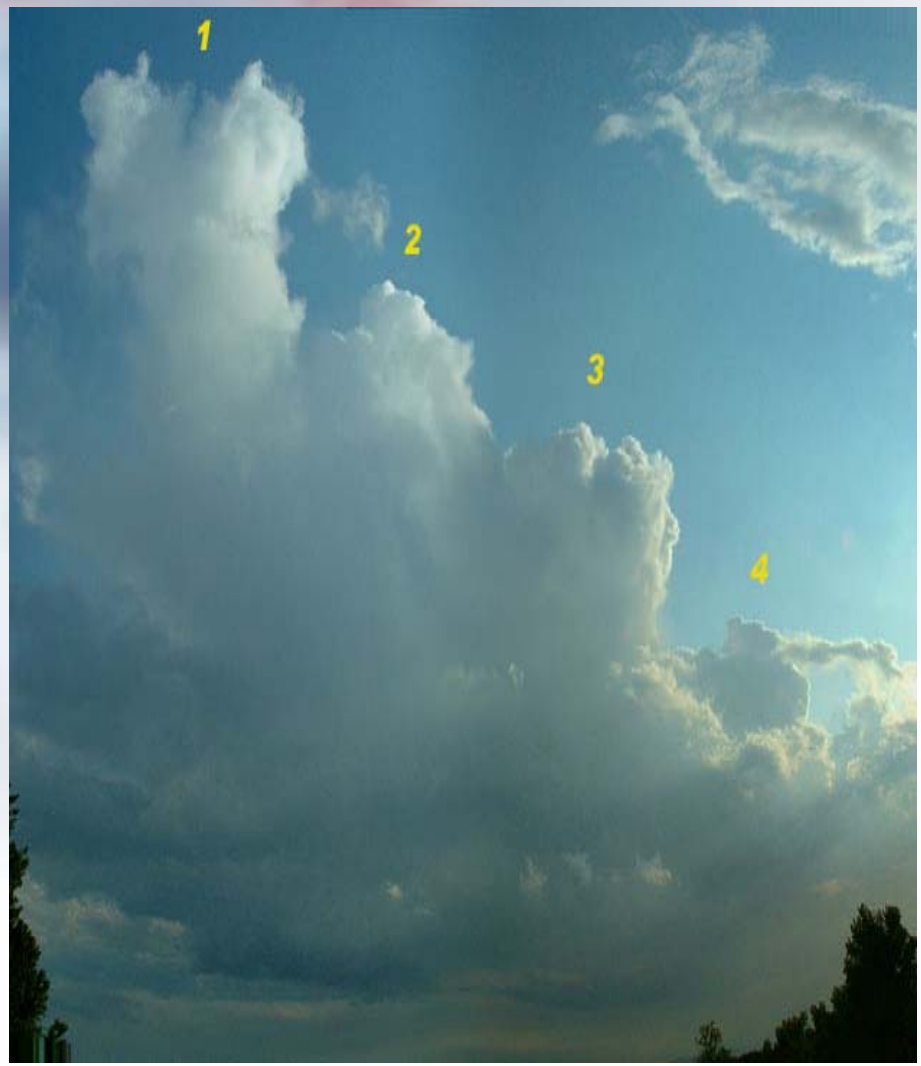


Dissipating

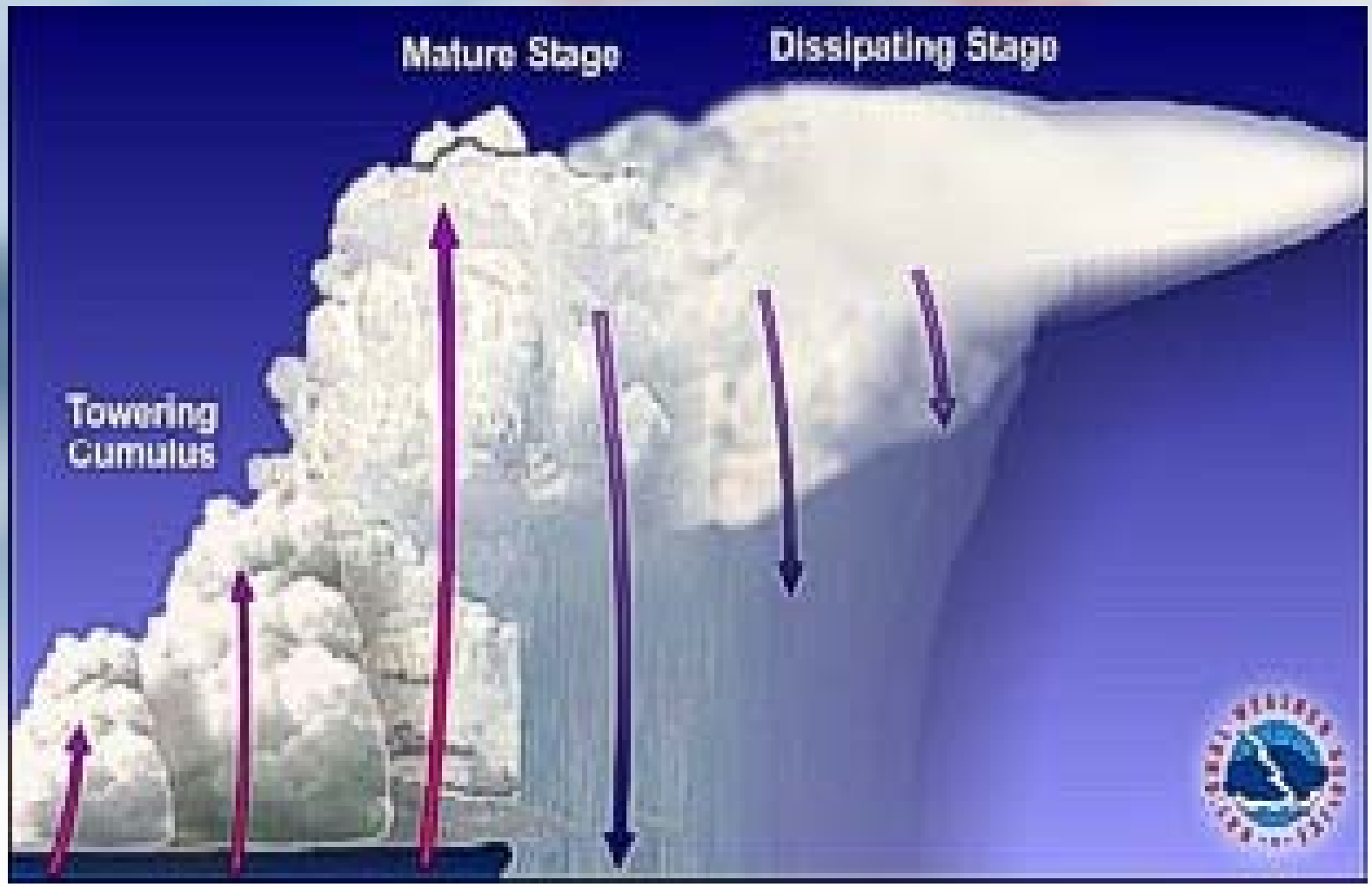


# Multicell Cluster

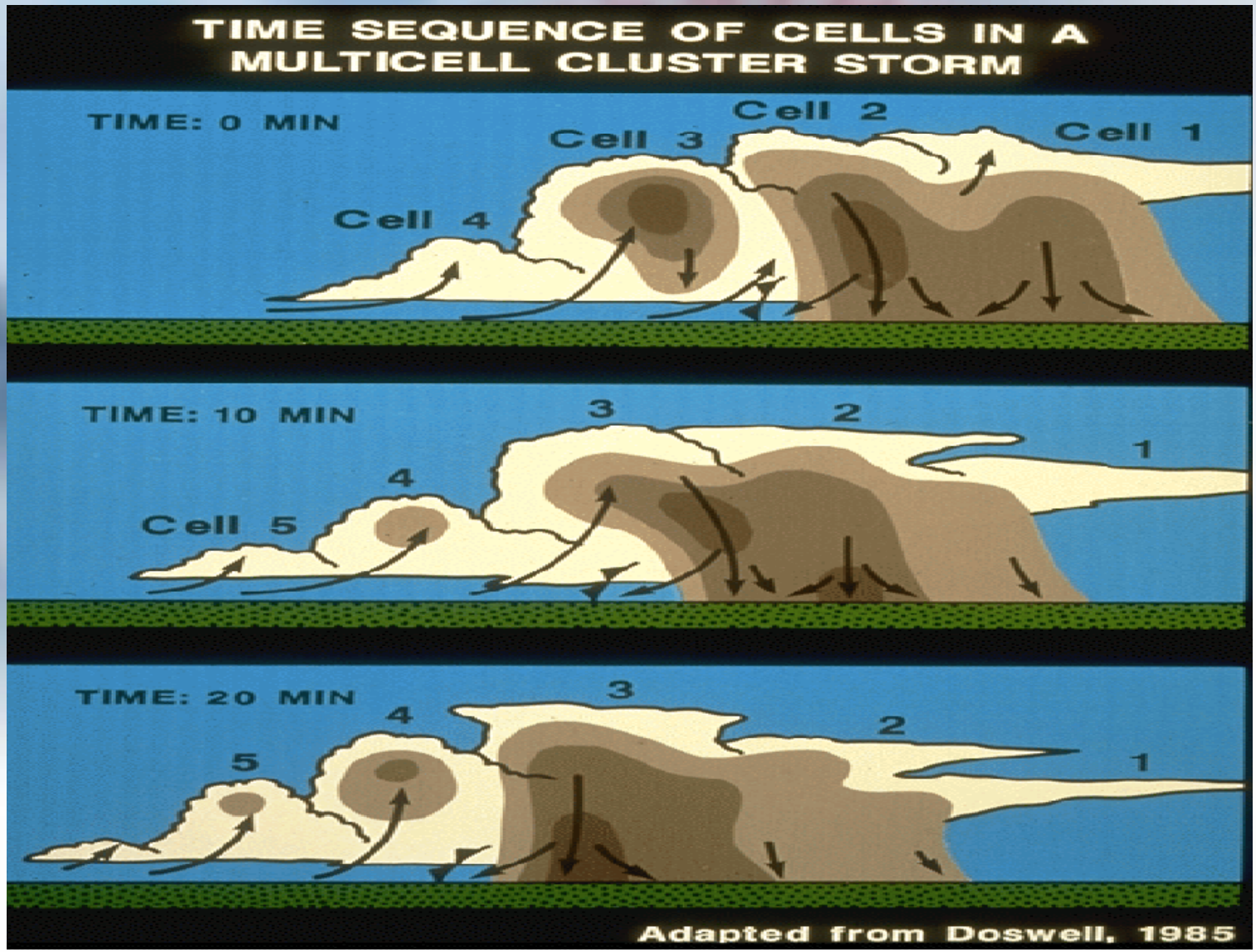
- Multiple single cells can organize into clusters that move as one unit
- Clusters can last for hours
- Most common type of thunderstorm



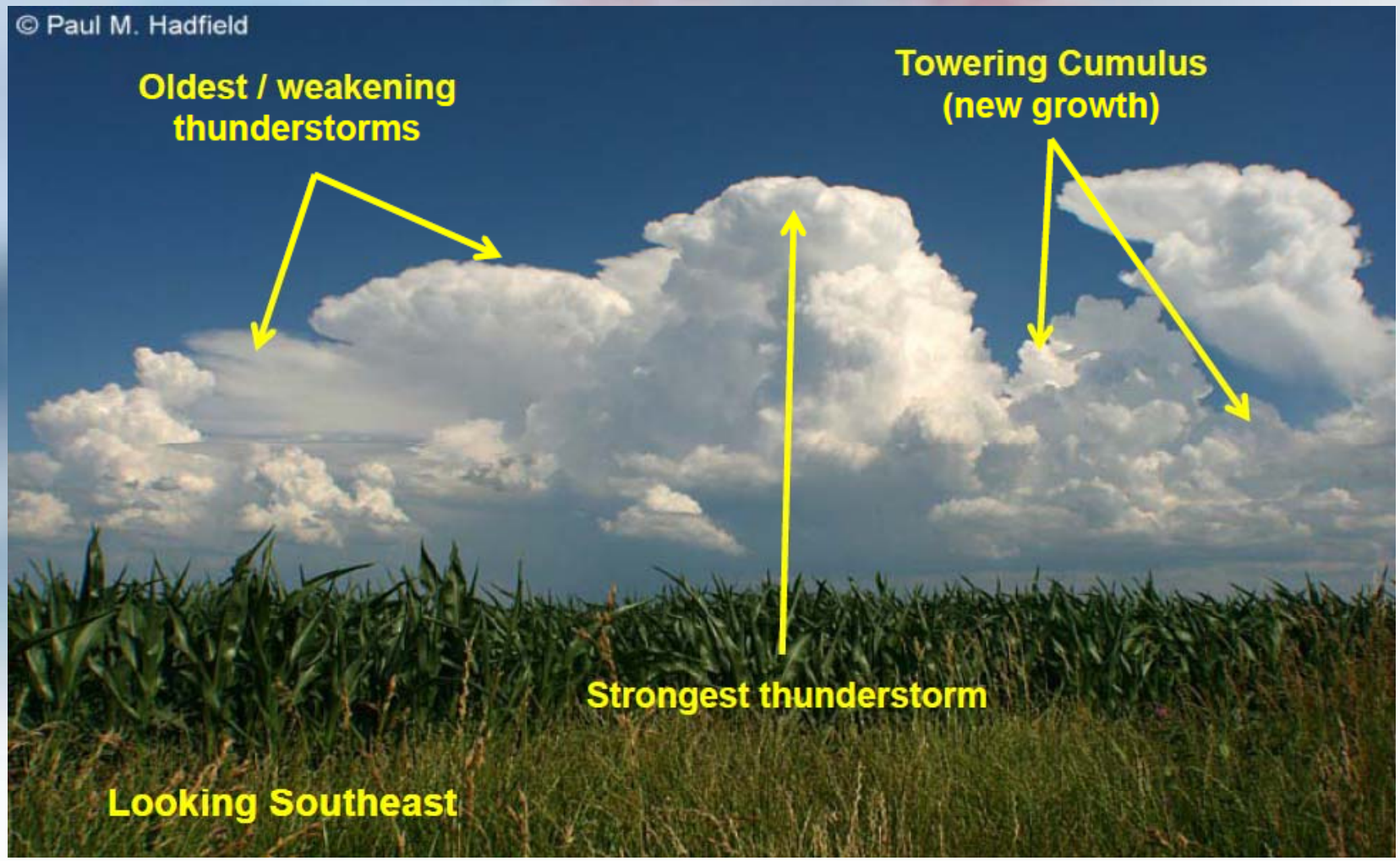
# Multicell Cluster



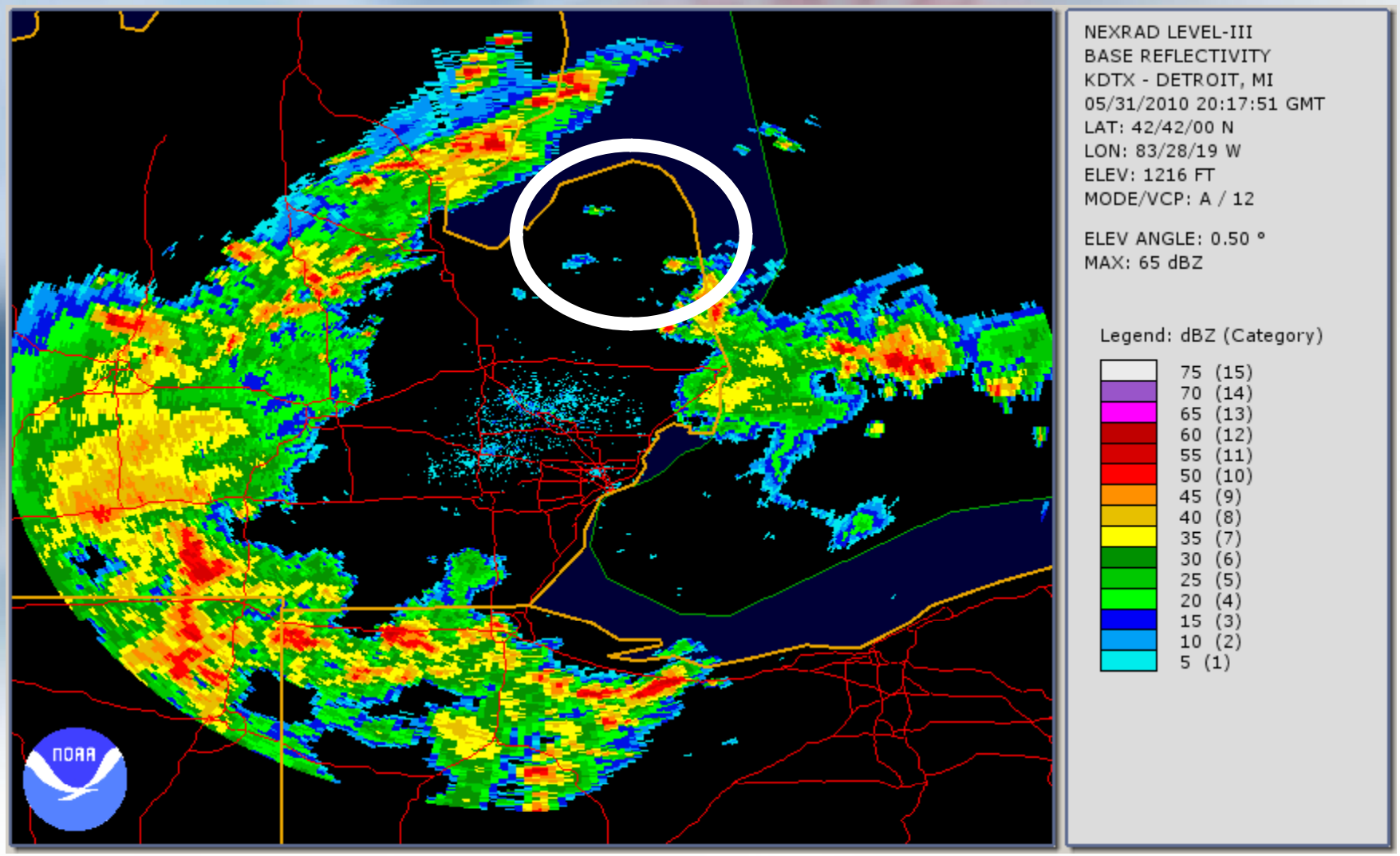
# Multicell Cluster



# Multicell Cluster



# Multicell Cluster



# Review

- Place the following in the correct order of development

1

2

3

A. 1, 3, 2
B. 3, 2, 1
C. 2, 3, 1
D. 2, 1, 3
E. 1, 2, 3

# Thunderstorm Type:  Multicell Line

# Multicell Line or Squall Line

- Severe Straight Line Winds are main threat
- Wind Speeds of 60-100 mph
- Shelf Cloud on leading edge
- Widespread Severe Weather Possible

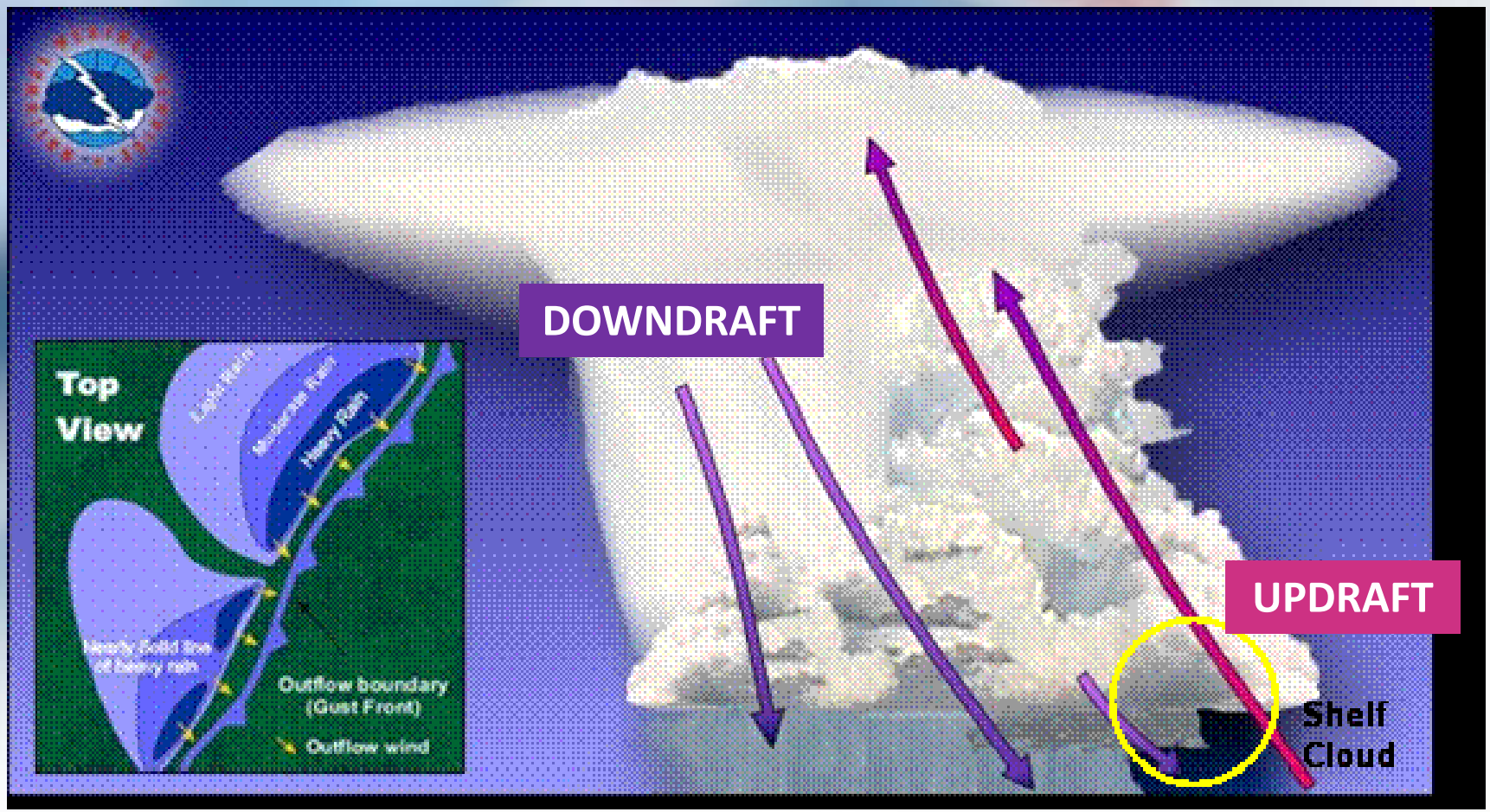
# Shelf Clouds

- Leading edge of Squall Line
- Slopes down and away from precipitation

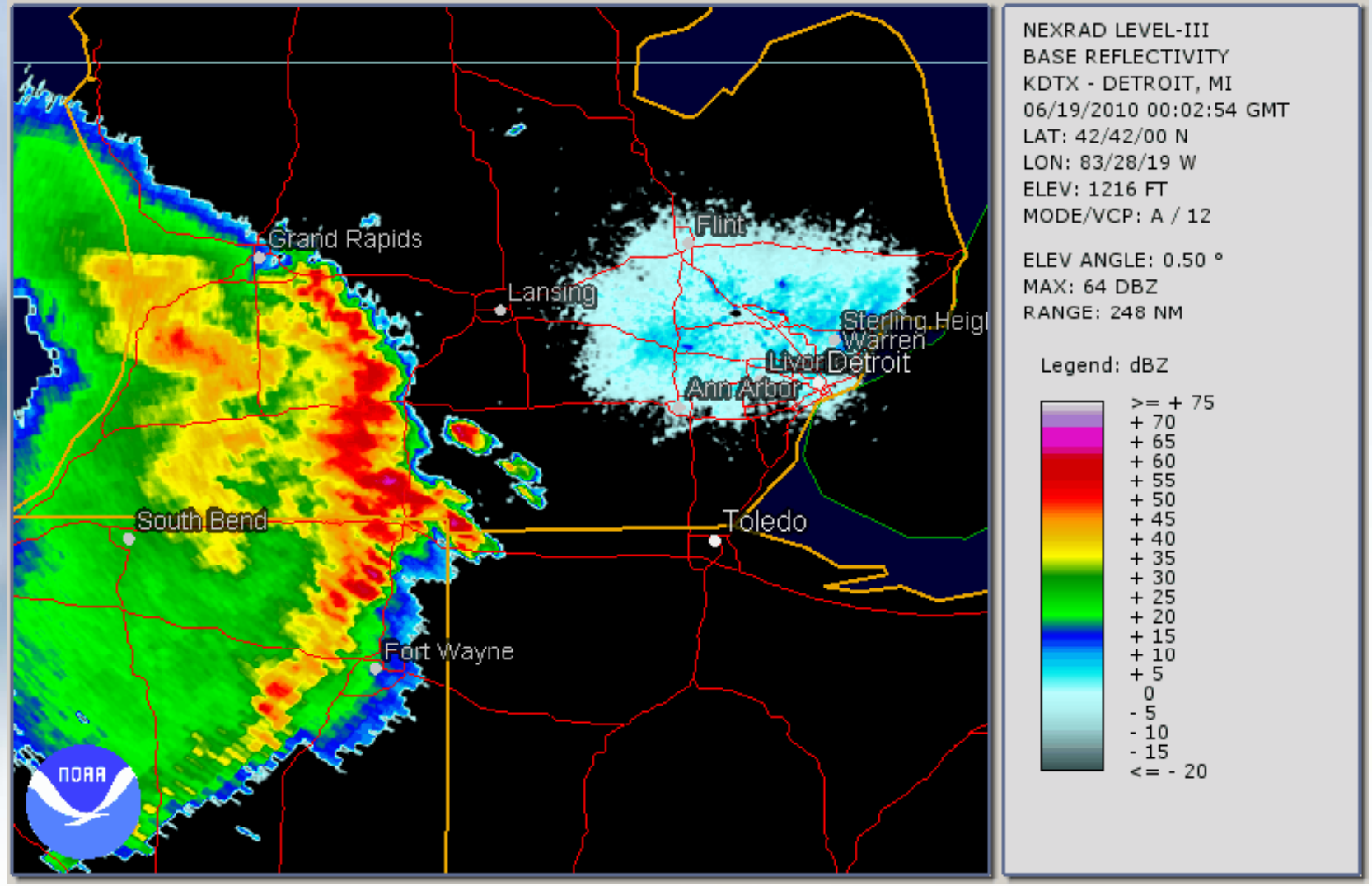
Richfield Twp. August 19, 2010

- Strong winds occur along and behind shelf cloud
- **Visible Warning!**

# Squall Line Schematic



# June 18, 2010 Squall Line



# Shelf Cloud

## June 6, 2010 Ogallala, Nebraska

# Review

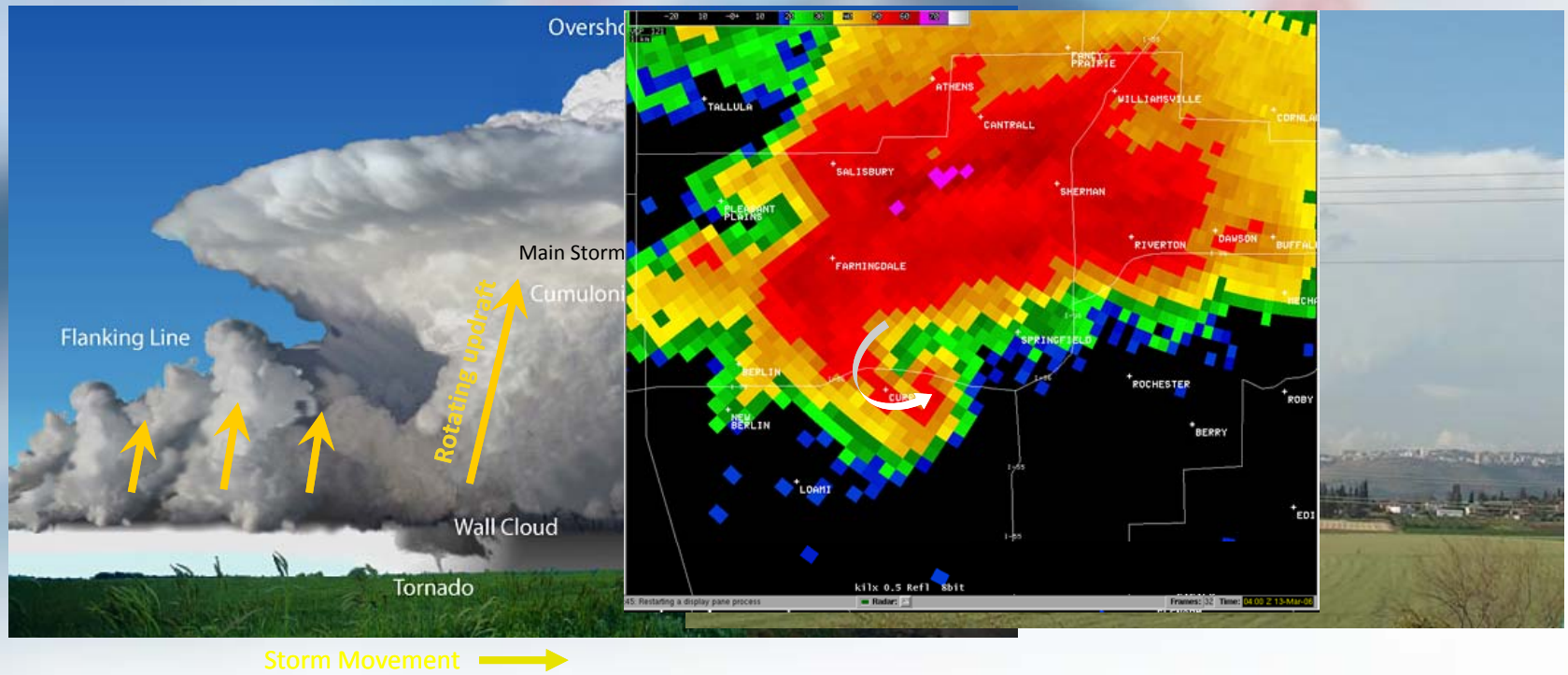
At what point during a squall line do the strongest winds typically occur?

A. Beginning/Leading Edge

B. Middle/During the Rain

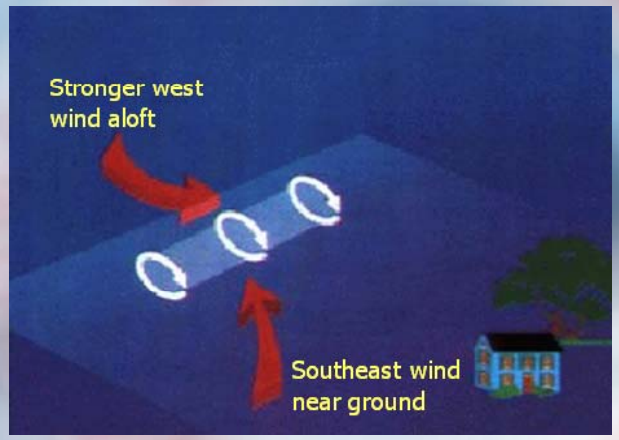
C. End/Back Edge

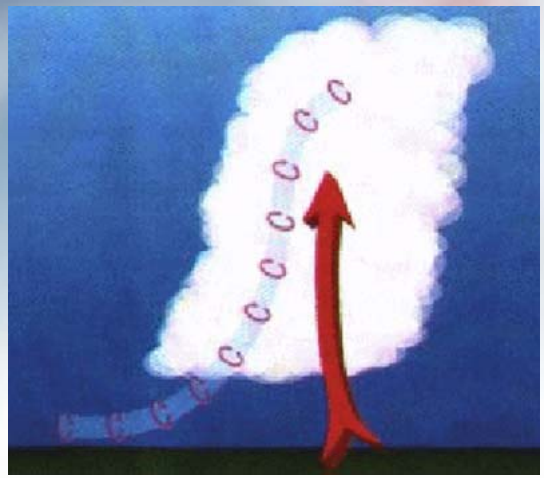
# Thunderstorm Type: Supercell

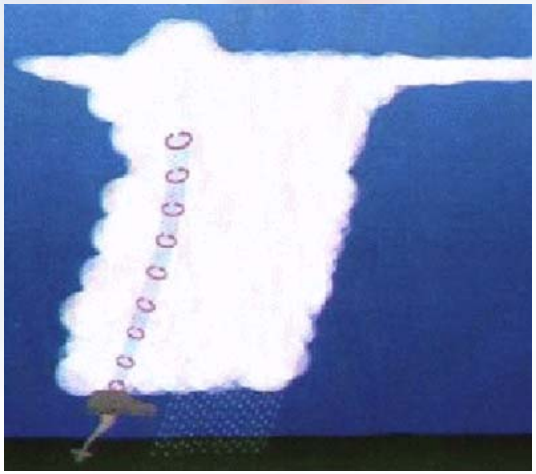



Main threats: Very large hail, high winds, tornadoes.

# Supercells: Updraft Rotation

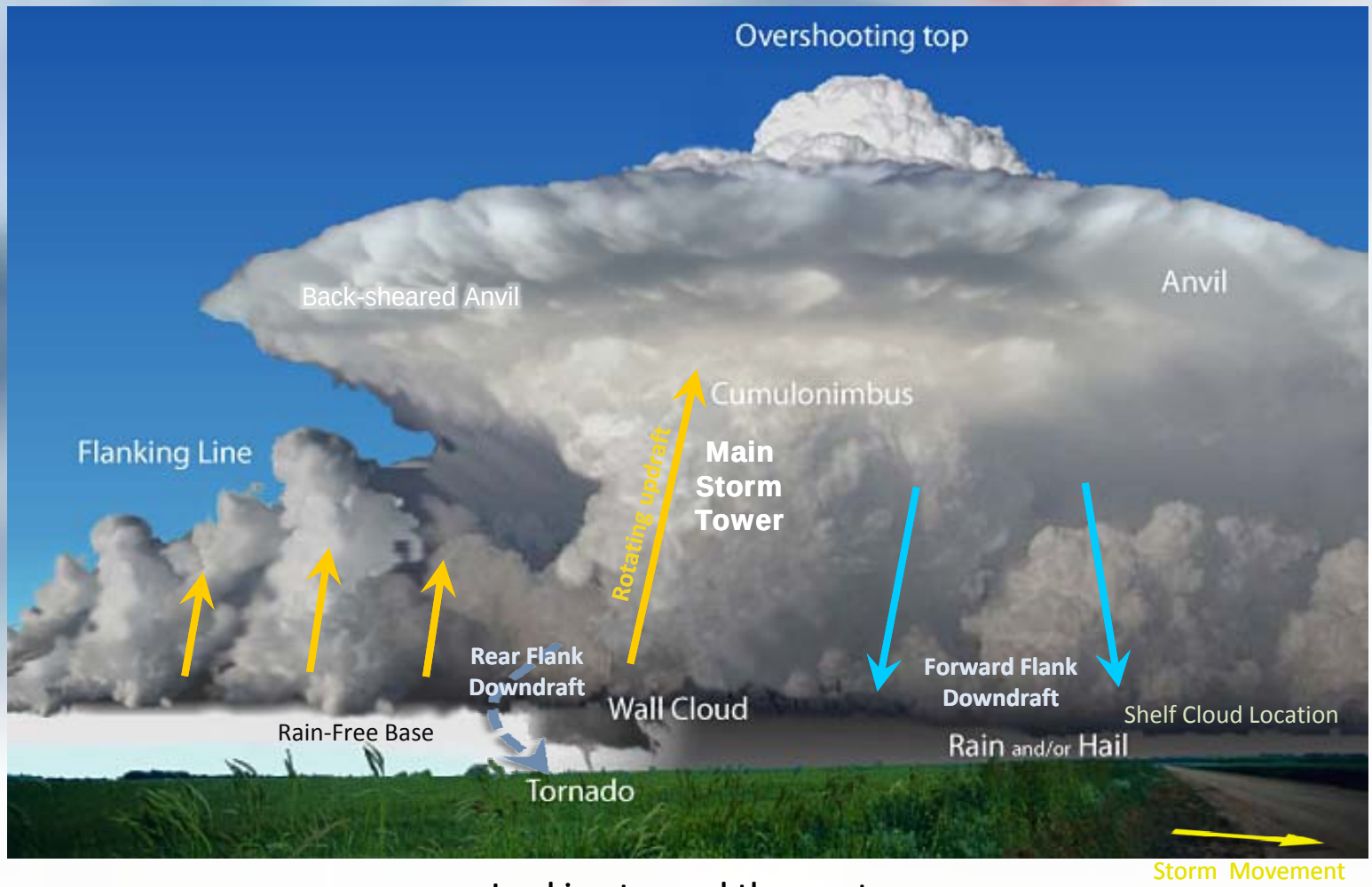




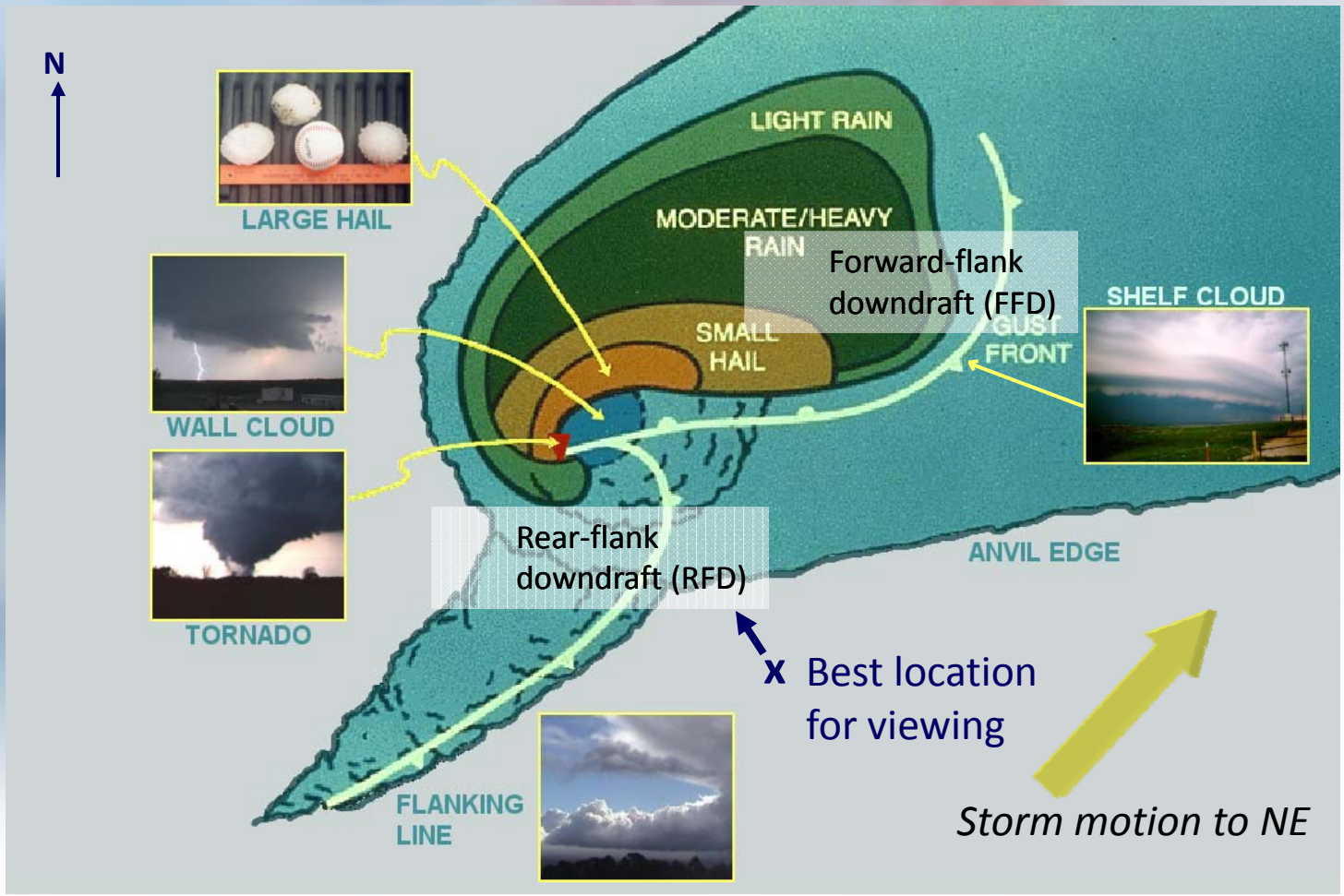
The rotating updrafts in these storms are called **mesocyclones**.

# Supercells: A Closer Look

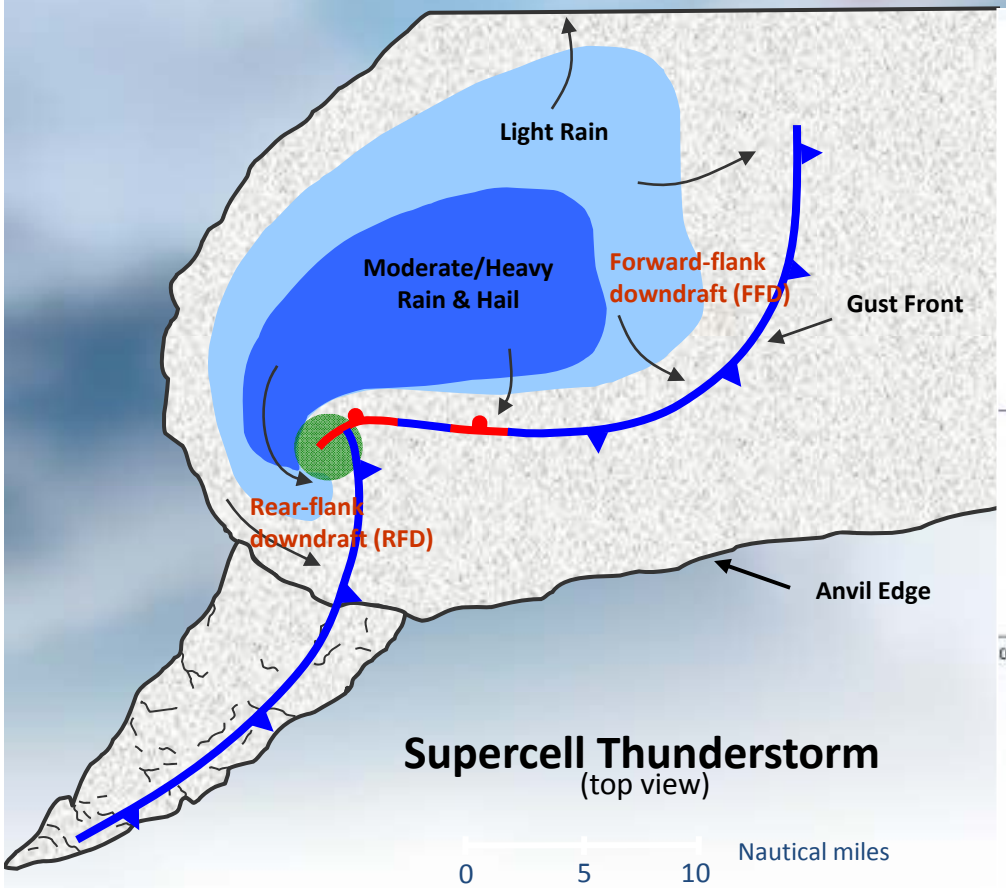


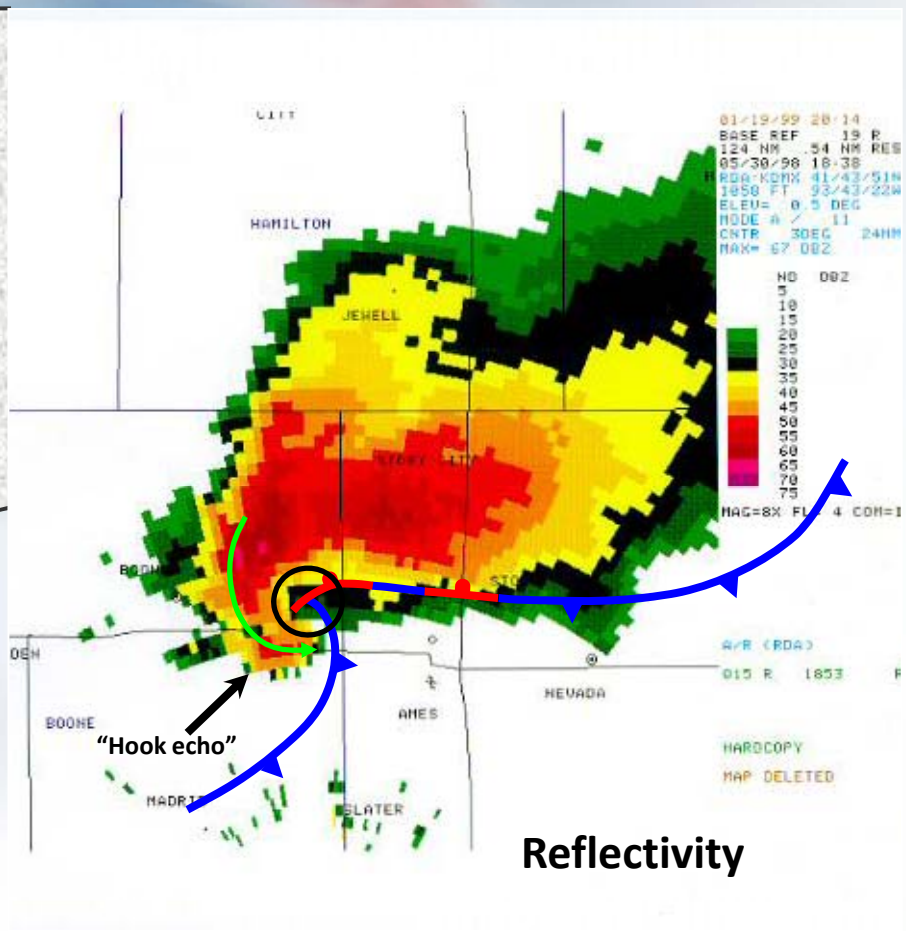

Looking toward the west

# Same Storm, Looking Down

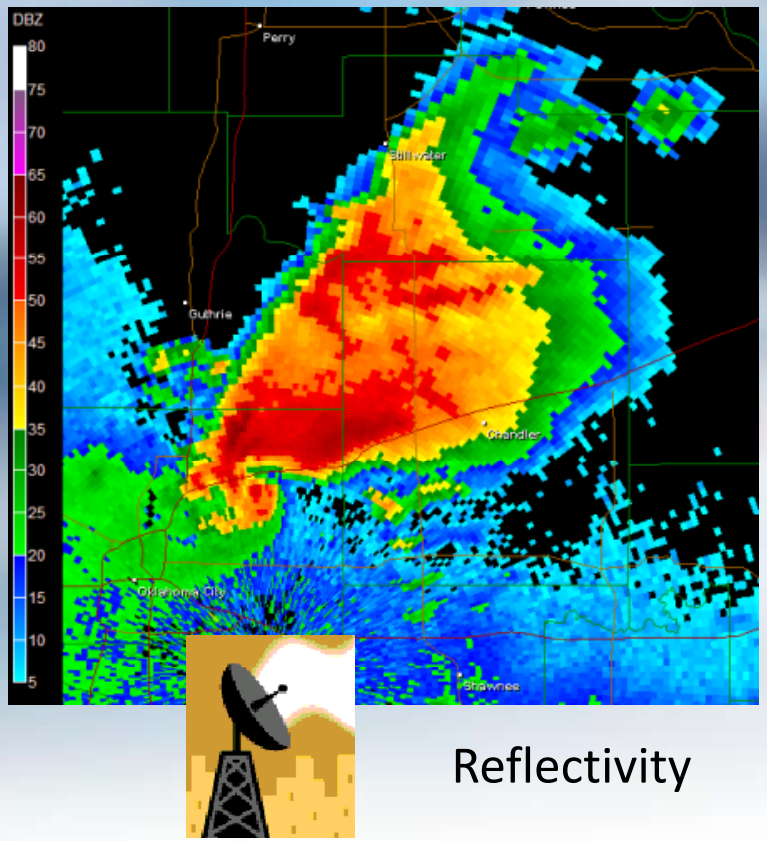


# Doppler Radar View of a Supercell

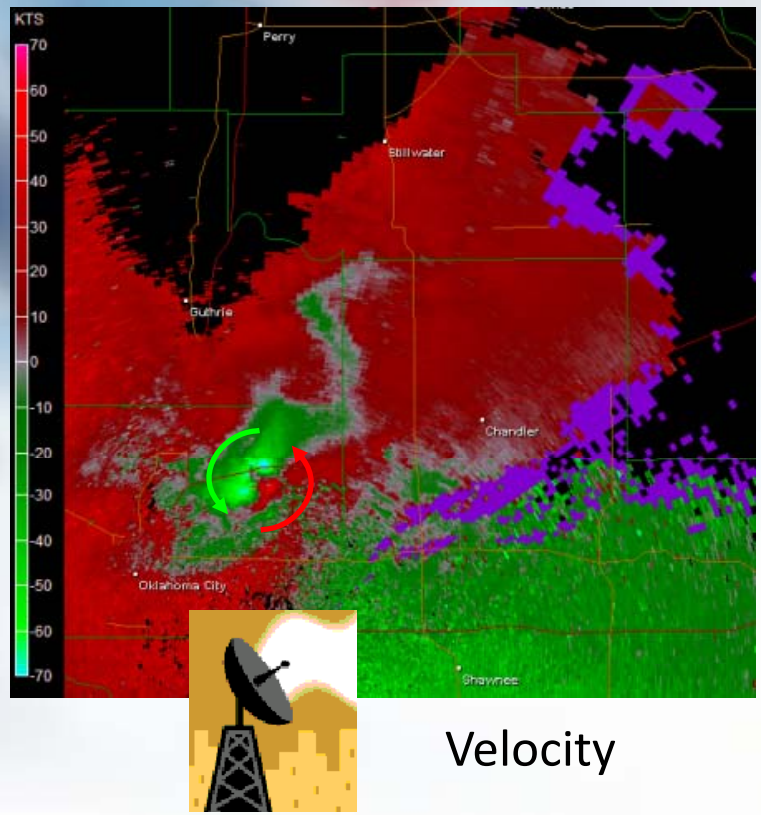


# Doppler Radar View of a Supercell




Reflectivity



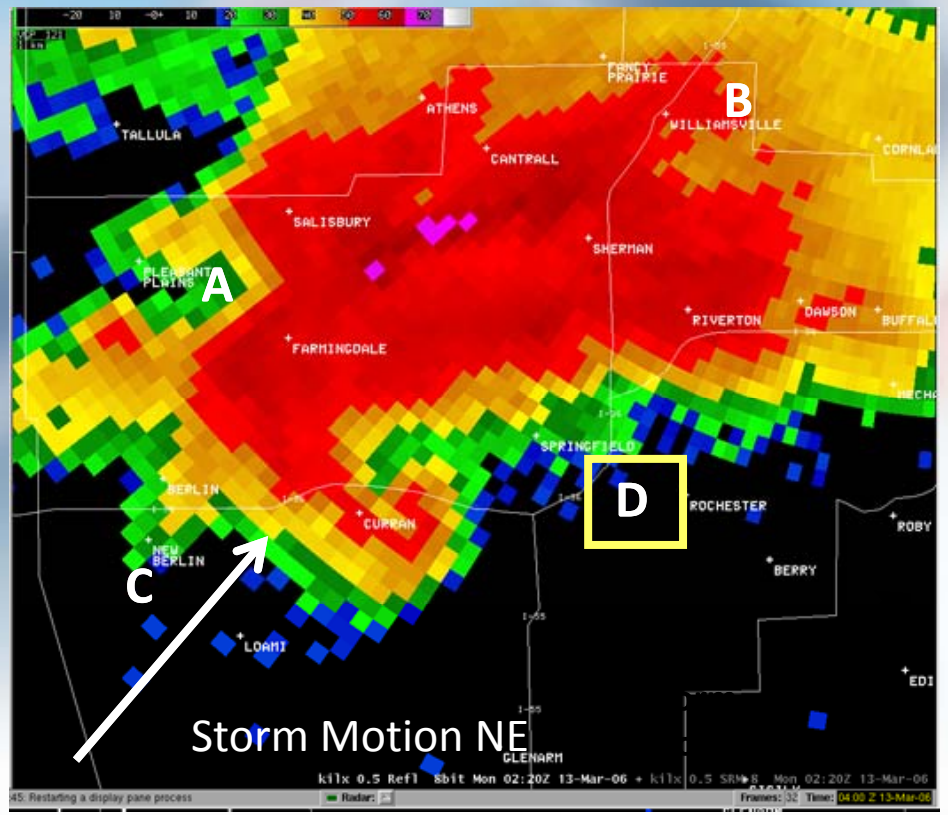

Velocity

# Examples of Supercells

# More About Supercells

- True supercells are rare.
- Supercells produce the most severe type of weather associated with thunderstorms.
- While severe storm spotting, try to identify as many thunderstorm cloud features as possible -
  supercells will have many or all of them.

You're watching this storm on radar. You have friends at the 4 locations denoted below. Who has the best view of a potential tornado?



# Tornado Look-a-Likes

- One of the biggest challenges in tornado spotting is determining whether you are seeing the “real thing” or a tornado look-a-like.
- Two key features present with a tornado:
  - debris cloud near the ground
  - organized rotation about a vertical axis
- The rotating, tornadic condensation cloud edges will be fairly “smooth.” Many look-a-likes have a more ragged-looking appearance.

Tornado

# Tornado Look-a-Likes

Low Clouds – “Scud”…

# Tornado Look-a-Likes

Rain Shafts/Virga…

# Tornado Look-a-Likes

Smoke…

# Tornado or Not?

Remember when spotting tornadoes, look for:

- Debris Cloud
- Rotation about a vertical axis
- Fairly smooth look to condensation funnel

# It's Time To Play…

WHAT IS IT?

Shelf Cloud

Funnel Cloud

SCUD

Rain Shaft

Tornado

Wall Cloud

# What is it?

Small debris cloud

Smooth condensation funnel

Rotating

# What is it?

No rotation

No debris cloud

No funnel

# What is it?

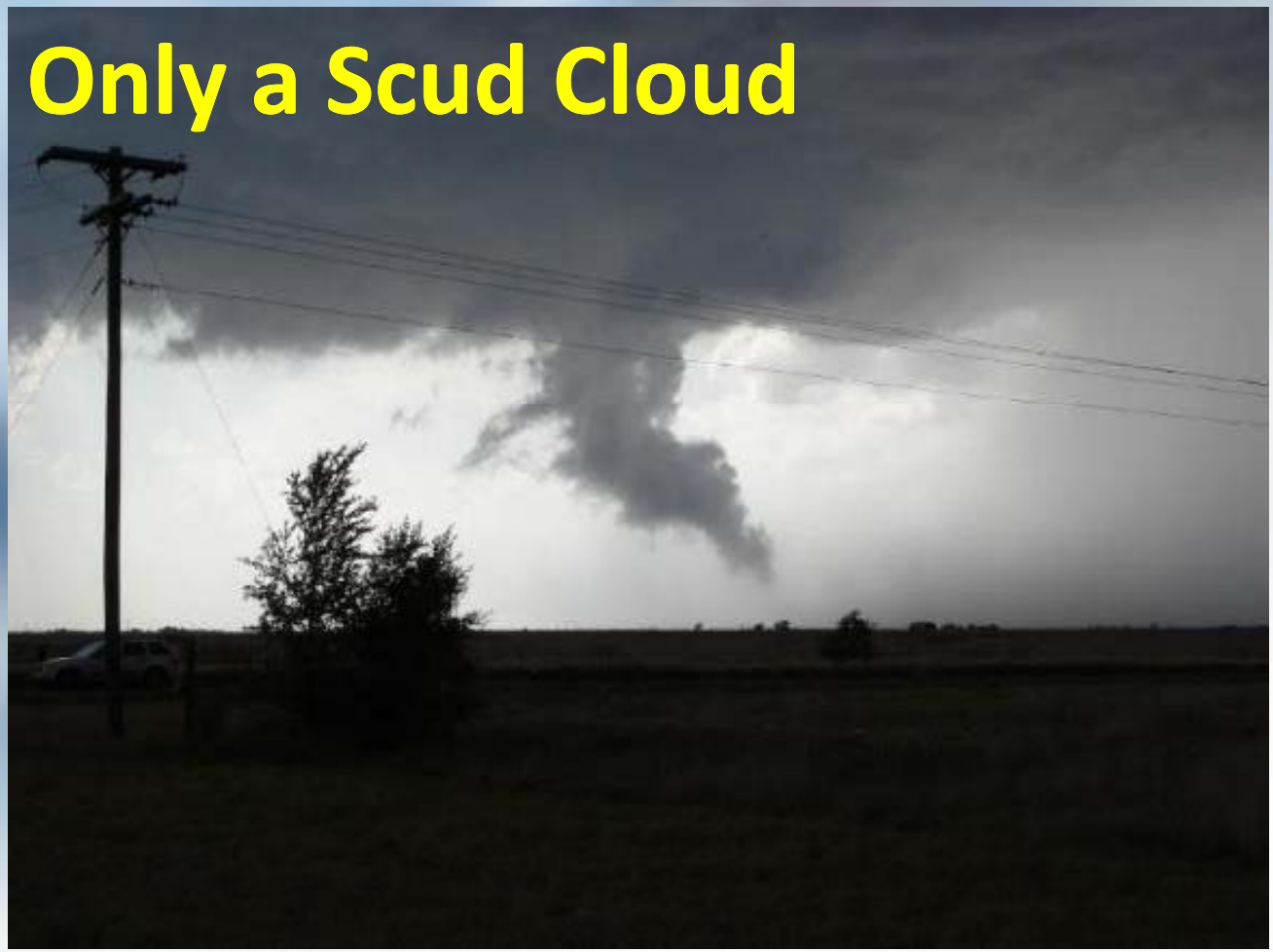
Not rotating

"Debris" cloud is smoke from a grass fire rising into the updraft

# What is it?

Not rotating
Slopes down and away from precipitation
Shelf Cloud
mesovortex.com

# What is it?




Not making contact with the ground
Not Rotating
Jagged edges

# What is it?

There is a wall cloud

Debris cloud is not rotating

# What is it?

# What is it?

# What is it?

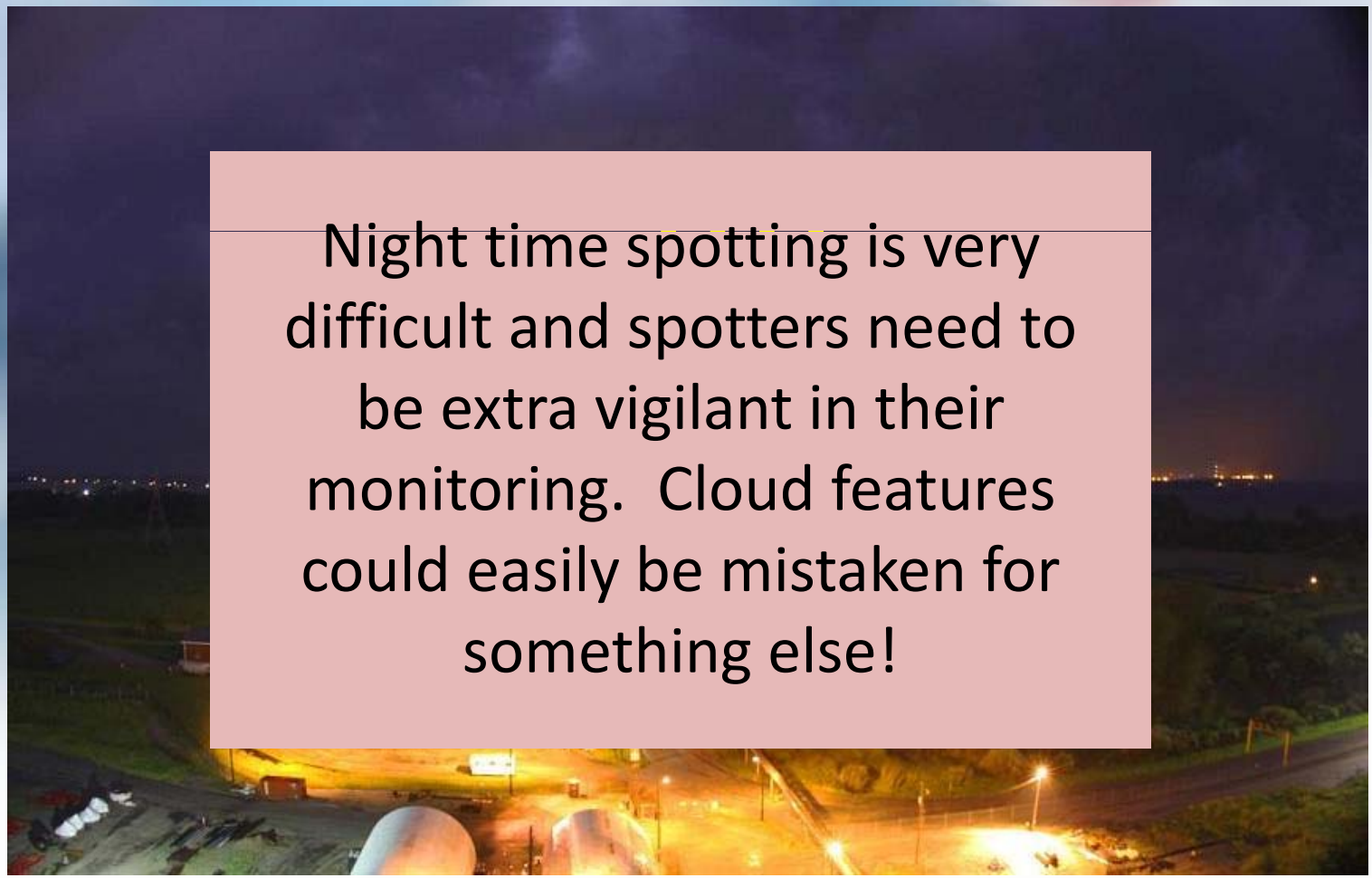
Wall Cloud

Funnel Cloud

# What is it?

# Night Time Spotting

## *What is it?*



Night time spotting is very difficult and spotters need to be extra vigilant in their monitoring. Cloud features could easily be mistaken for something else!

# What to Report: A Review

## See Complete list on Spotter Essentials Handout

**Top 5 Most Important**

1) Tornadoes, waterspouts and funnel clouds
2) All weather-related damage
3) Wind gusts over 40 mph
4) Hail: plain M&M size (1/2”) or larger
5) Flooding that threatens property or covers roads

# THANK YOU!!!