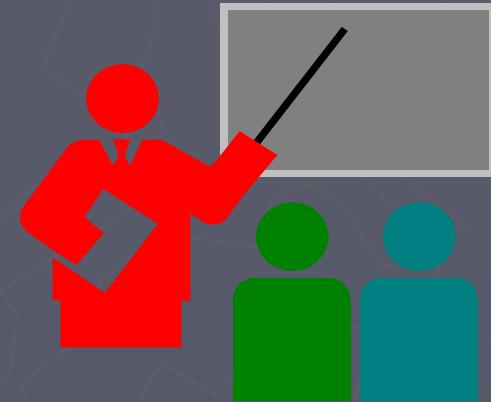


# Weather

Dave Fuller K4DMF  
Dan Ozment W4DTO

# Lesson Objective

- ▶ What Causes Weather
- ▶ Recognizing Signs Of Change
- ▶ Weather And Clouds
- ▶ The Signs Of Bad Weather
- ▶ Reportable Weather events
- ▶ Repeater usage during events
- ▶ Contact Information and Resources



# Weather & Heat

- ▶ Sun Heats Earth & Earth Heats Air
- ▶ Warm Air Rises
  - Creates Low Pressure
- ▶ Cooler Upper Air Falls
  - Creates High Pressure
- ▶ Air Flows From Highs Toward Lows
  - Creates Wind
- ▶ Greater The Pressure Difference
  - Stronger The Wind

# Heat & Humidity

- ▶ Warm Air Can Hold More Moisture Than Cold Air
- ▶ Relative Humidity
  - The Amount Of Moisture In Air, Compared To The Maximum Amount It Could Hold At That Temperature
- ▶ Cooling Air To Its Dew Point Creates 100% Relative Humidity And Moisture Condenses Out

# Land & Water

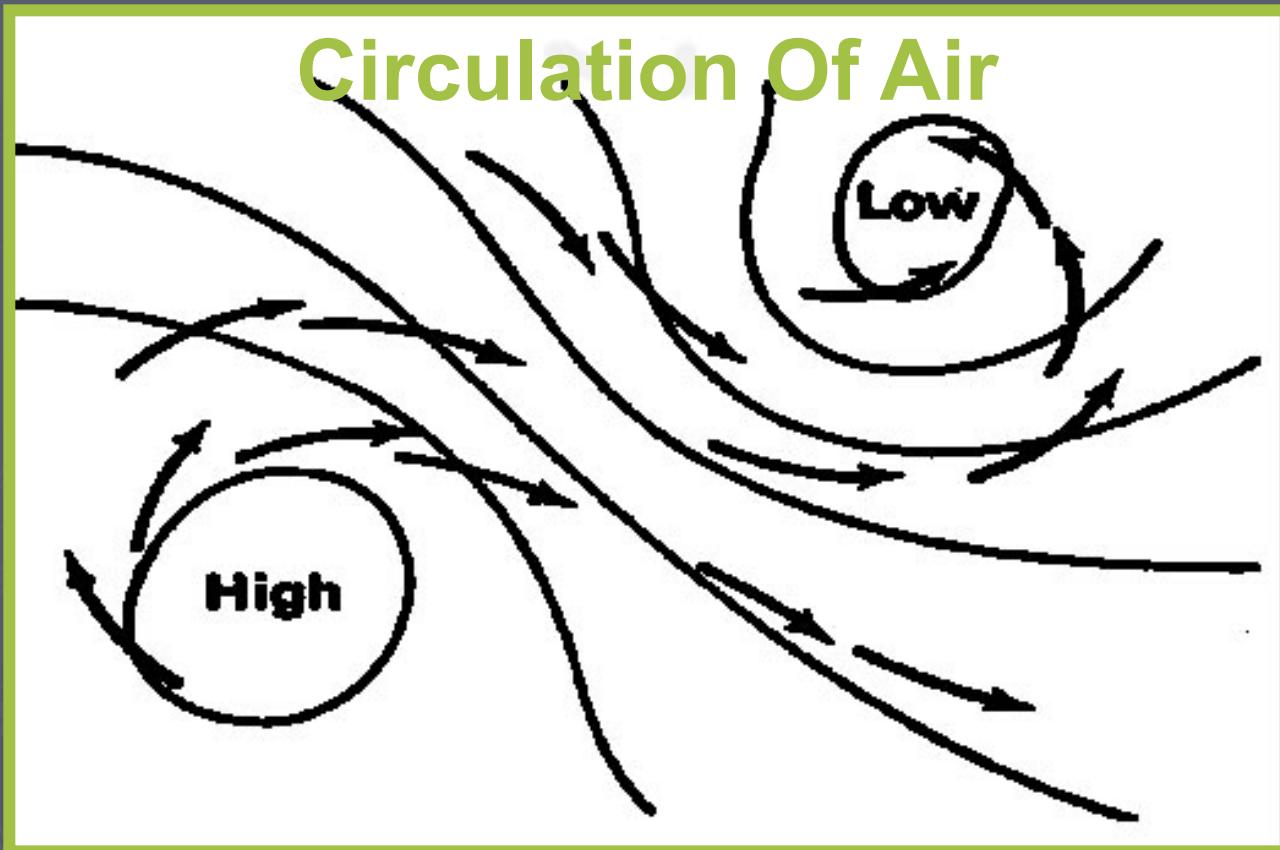
- ▶ Water Gains Heat Slower Than Land
- ▶ Water Loses Heat Slower Than Land
- ▶ Daytime
  - Land Warmer Than Water
    - ▶ Air Warms, Rises Over Land And Air Flows In From Sea – *Sea Breeze*
- ▶ Nighttime
  - Water Warmer Than Land
    - ▶ Air Warms, Rises Over Water And Air Flows From Land to Sea – *Land Breeze*

# Coriolis Force

## ► Northern Hemisphere

- Earth's Rotation Causes Any Air Motion To Bend To The Right
- Air Moving Down & Out Of A High Pressure Area
  - ▶ Bends To The Right Causing A Clockwise Motion
- Air Rushing Into A Low Pressure Area
  - ▶ Rises, Bends To The Left

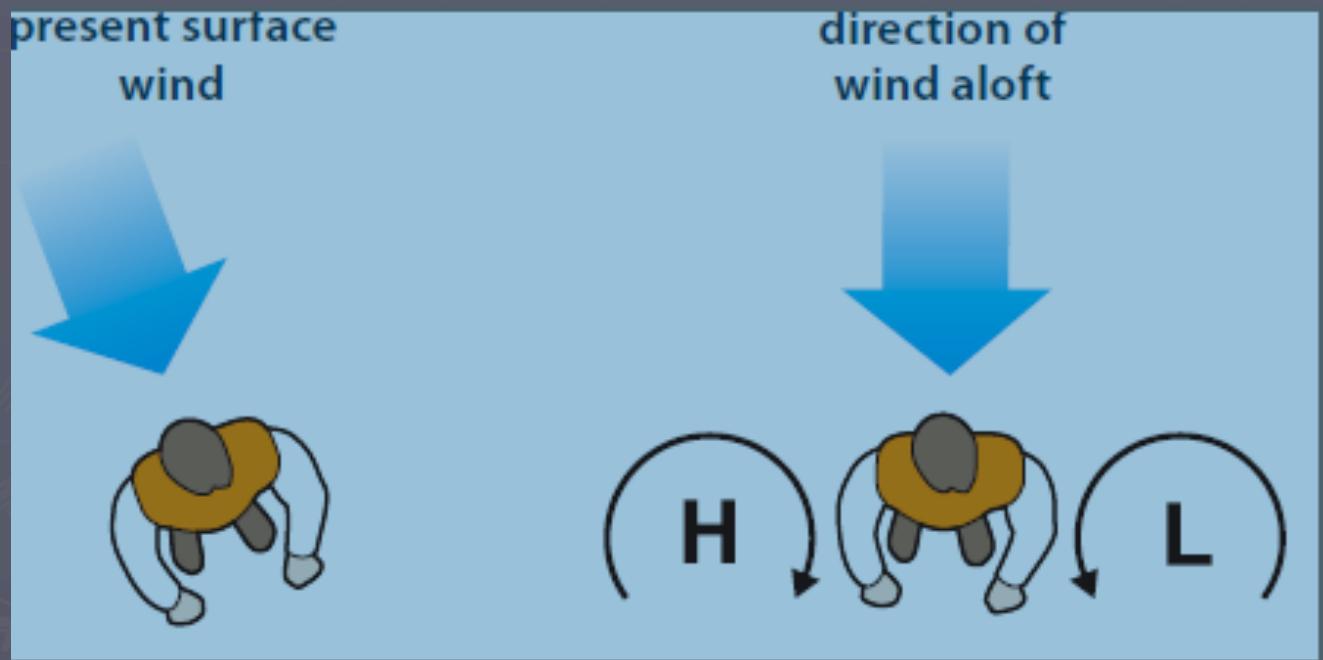
# Circulation of Air



Down, Out & Clockwise  
around High

Toward & Up Counterclockwise  
around lows

# Using Buys Ballot's Law to determine the direction of a low-pressure system.

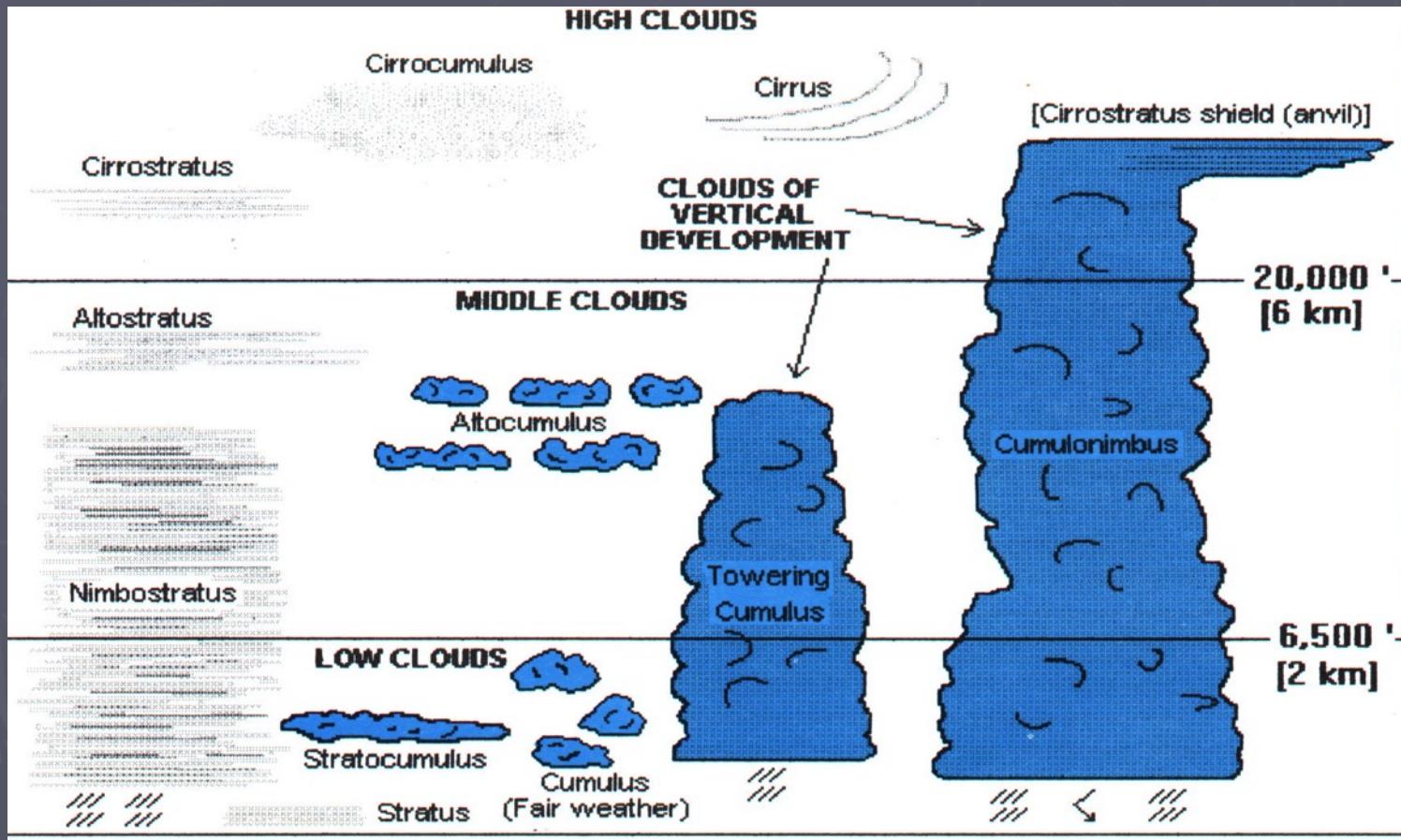


Stand with back to wind and rotate right 45 degrees. High is to the right and low is to the left. Whichever pressure is to the west is coming your way as the one to the east has already passed you.

# CLOUDS



# BASIC CLOUD TYPES



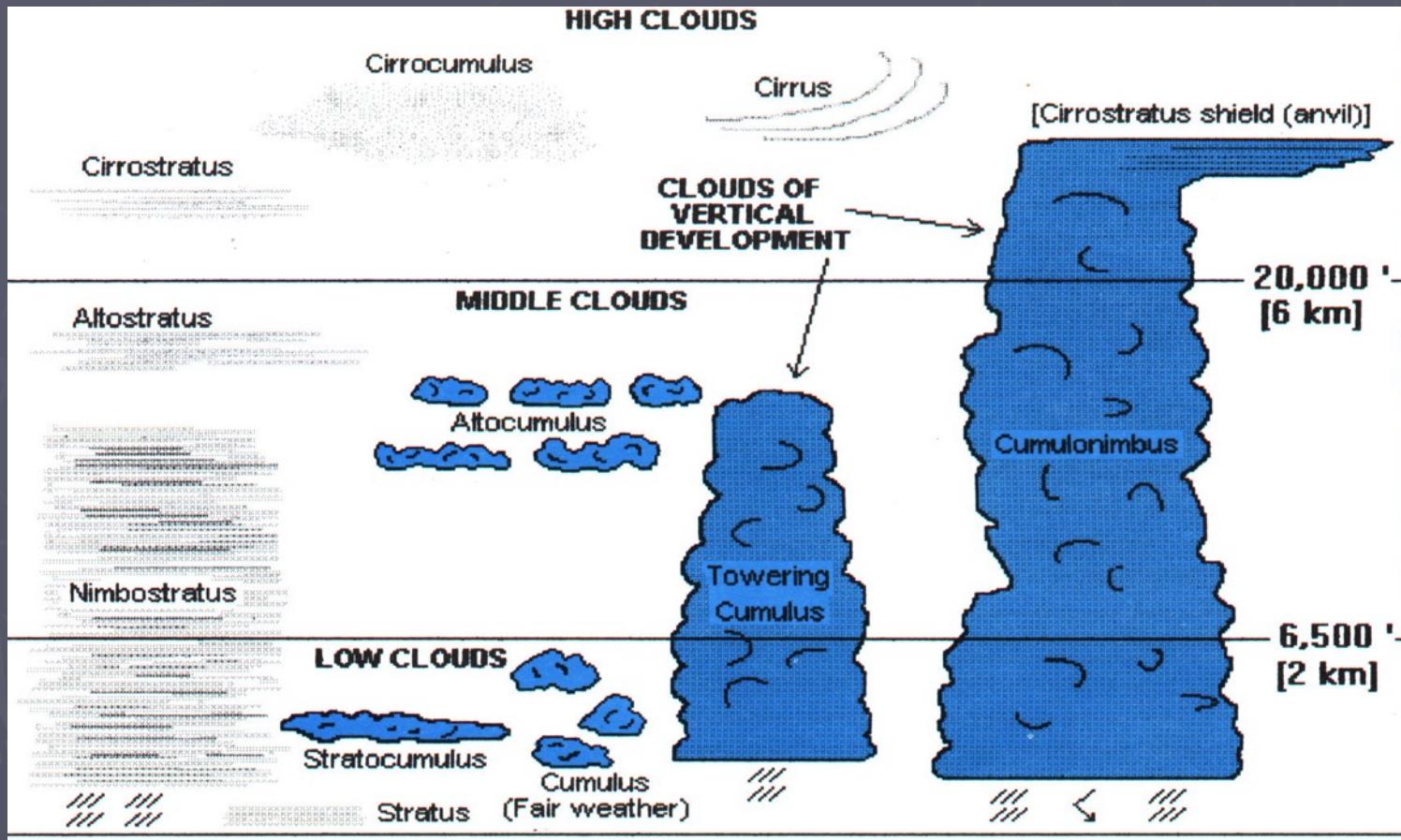
# Cloud Families

- ▶ High – Cirriform = **> 20,000 feet**
  - Cirrus, Cirrocumulus, Cirrostratus
    - ▶ Mostly Ice – No Precipitation
- ▶ Middle – Alto = **6500 to 20,000 feet**
  - Altostratus, Altocumulus, Nimbostratus
    - ▶ Mostly Water
- ▶ Low = **< 6500 feet**
  - Stratus, Stratocumulus, Cumulus
    - ▶ Mostly Water

# High Clouds

- ▶ Cirrus
  - Mares' Tails
- ▶ Cirrocumulus
  - Mackerel Scales
- ▶ Cirrostratus
  - Like A Sheet Or Veil

# BASIC CLOUD TYPES



# Middle Clouds

## ► Altostratus

- Mid-level, Layered

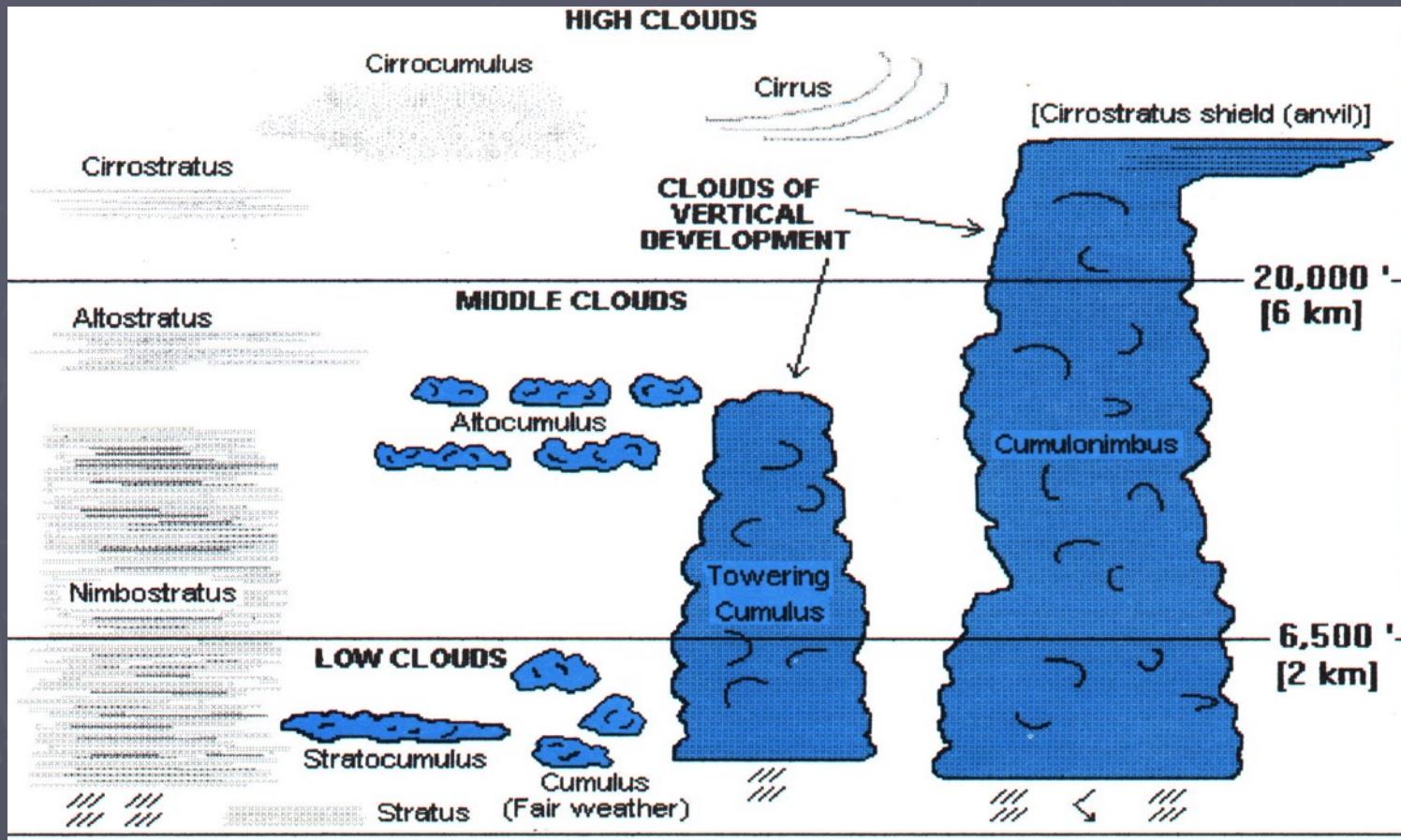
## ► Altocumulus

- Cumulus Clouds Gathered In Layers

## ► Cumulonimbus

- Rain Clouds
- May Develop Into Thunderheads (Towering Cumulus)

# BASIC CLOUD TYPES



# Low Clouds

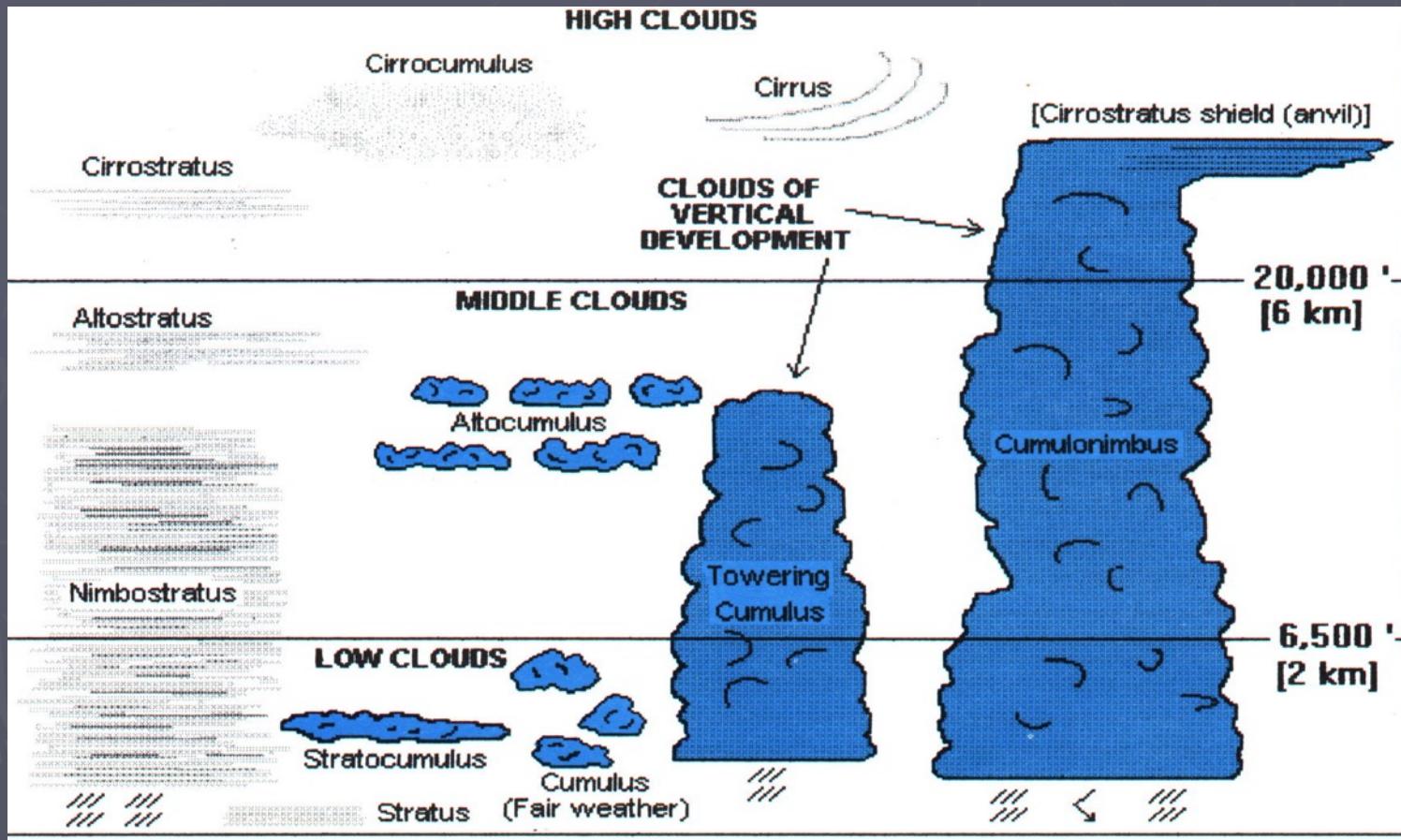
## ► Stratus

- Low Layers Of Solid Cloud Cover

## ► Nimbostratus

- Rain Clouds
- Intermittent Or Steady Rain

# BASIC CLOUD TYPES



# Cloud Identification

## ► Cumulus

- Fluffy, White, Fair Weather Clouds
- May Grow To Cumulonimbus

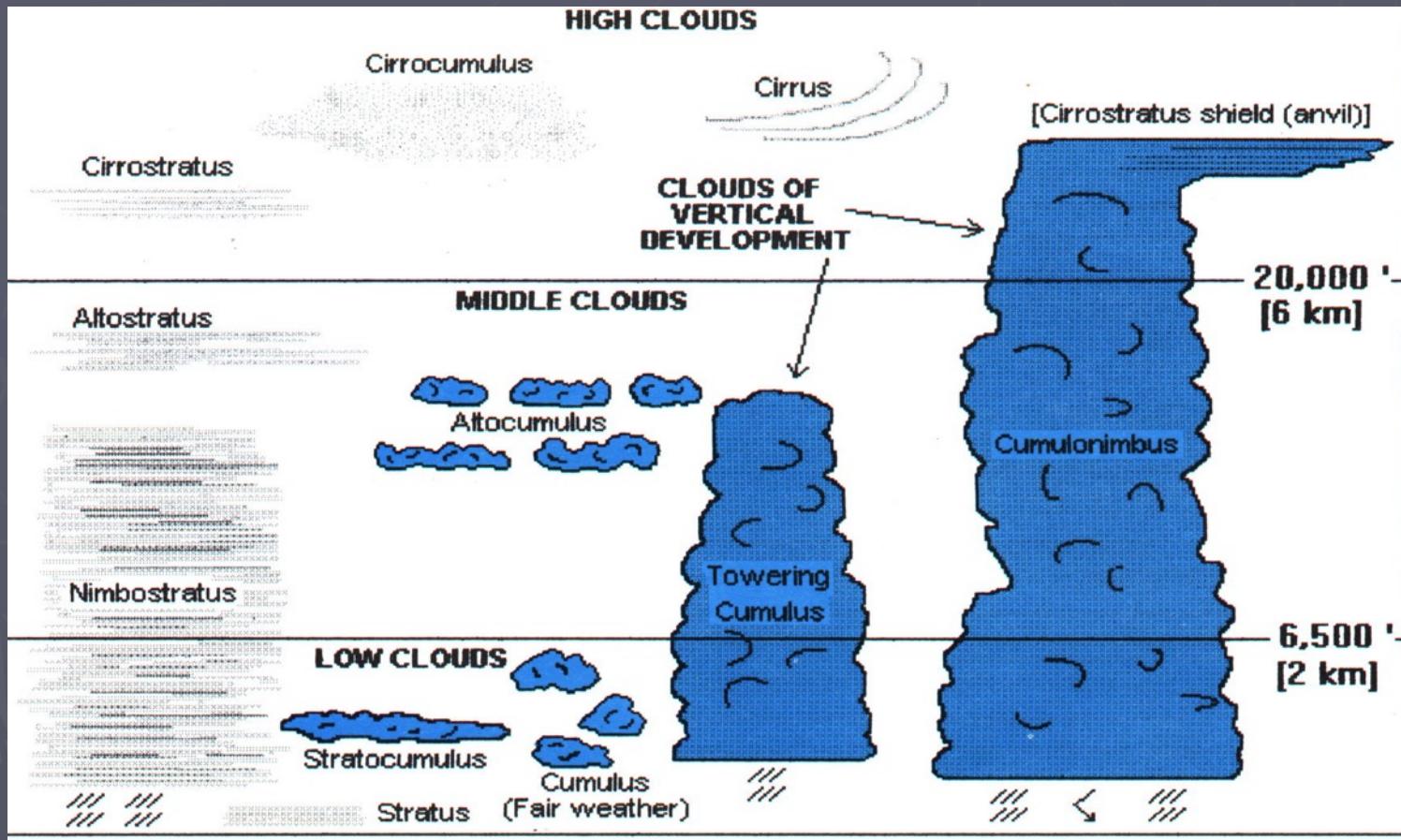
## ► Stratus

- Layered

## ► Nimbo/Nimbus

- Rain Clouds

# BASIC CLOUD TYPES



# Cumulus Family

## ► Cumulus

- Summer Afternoon Cotton Balls
- Generally No Precipitation Unless Building

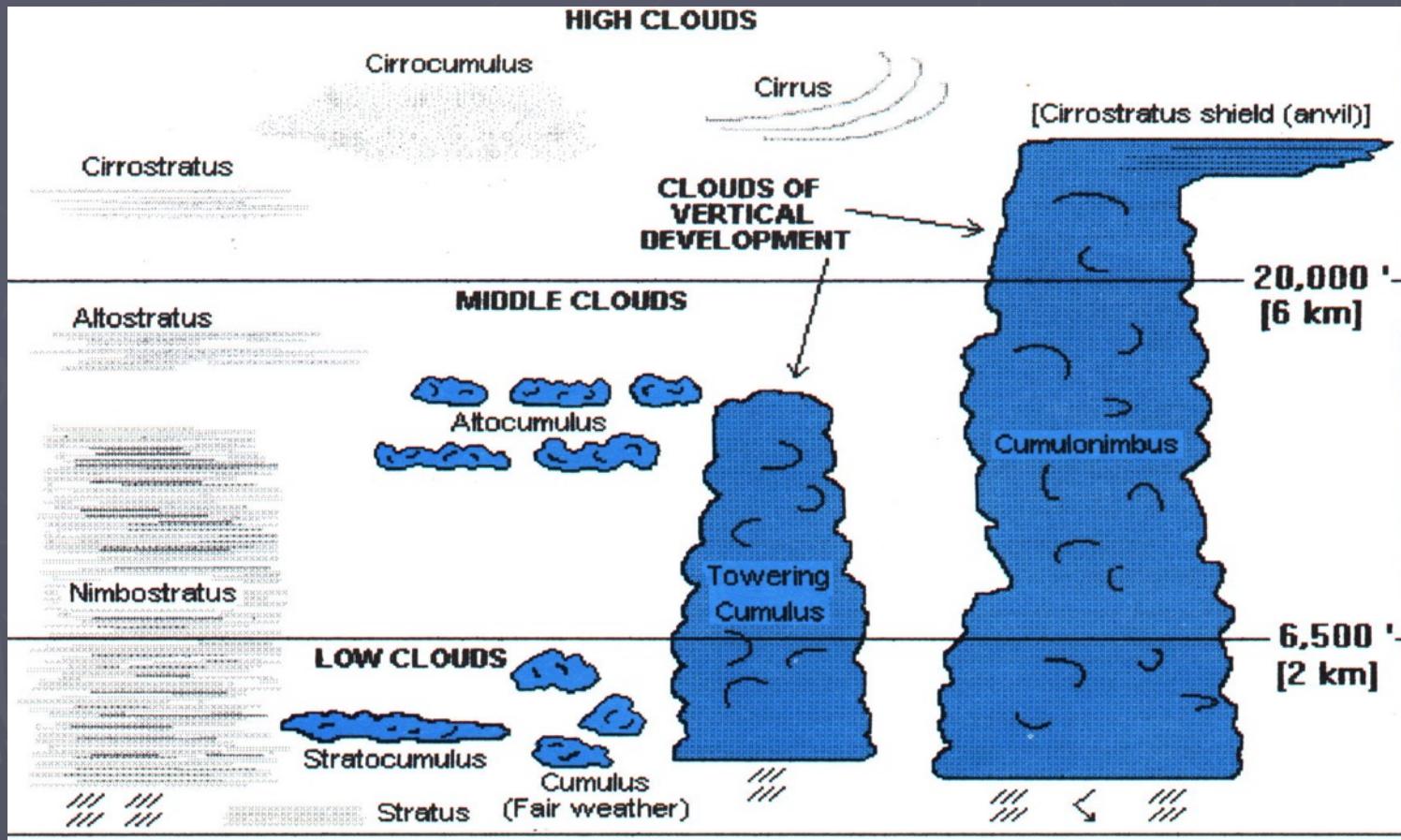
## ► Towering Cumulus

- Building Cumulus
- Deep Layer Of Unstable Air
- Thundershowers Can Result

## ► Cumulonimbus

- Thunderhead/Thunderstorm Cloud

# BASIC CLOUD TYPES



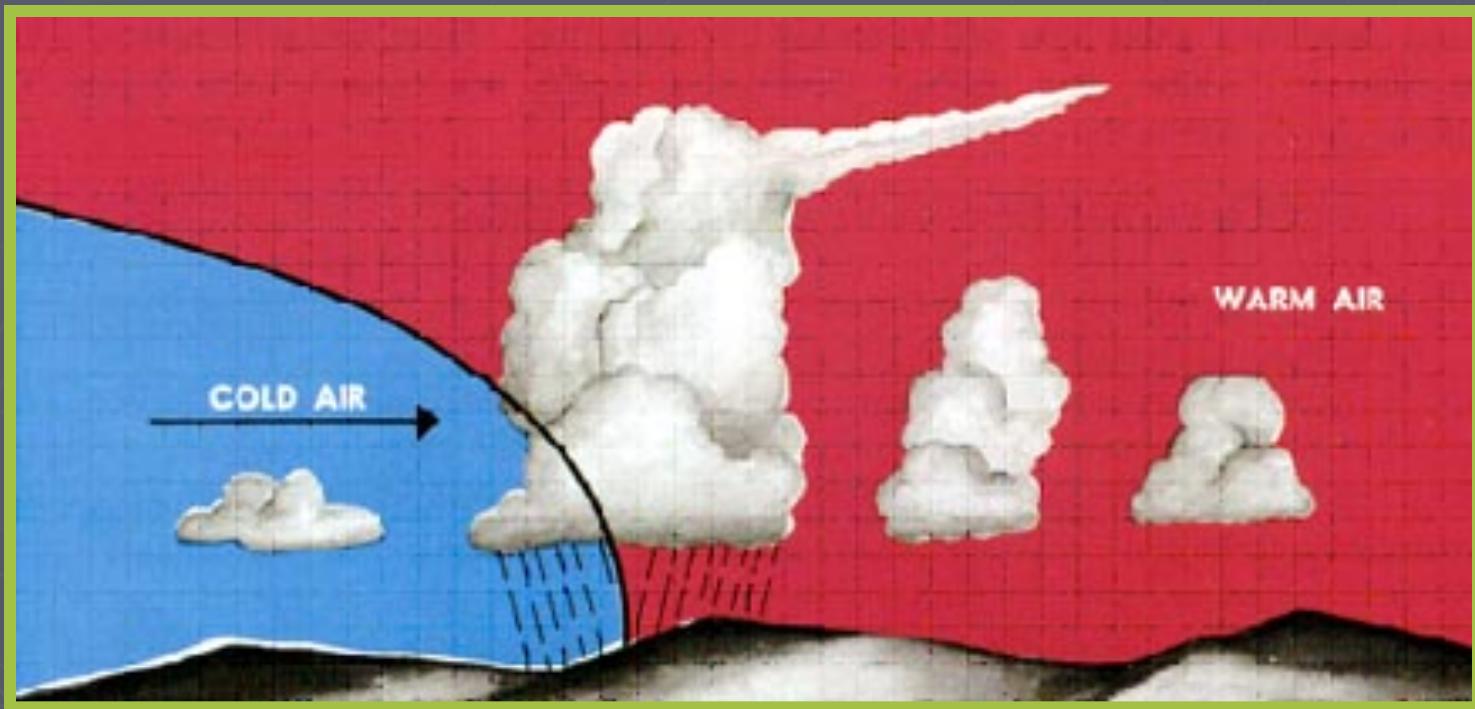
# Fronts

- ▶ Defined As Zone Between Two Different Air Masses
- ▶ Differences In:
  - Temperature
  - Humidity
  - Wind – Direction & Speed
  - Air Pressure

# Cold Fronts

- ▶ Air Cooler Behind Than Ahead
- ▶ Fast Moving
- ▶ Can Create Violent Weather
- ▶ When Passes
  - Pressure Rises Abruptly
  - Temperature Falls
  - Relative Humidity Decreases
  - Wind Shifts Direction

# Cold Fronts



TYPICAL CLOUD SEQUENCE AHEAD OF COLD FRONT

MODERATE TO HEAVY SHOWERS

TYPICAL SPEED OF ADVANCE: 20 – 30 KNOTS

CIRRUS

CUMULONIMBUS

CIRROCUMULUS

TOWERING  
CUMULUS

ALTOCUMULUS

CUMULUS

SQUALL LINE CAN BE 50 TO 100  
MILES AHEAD OF FRONT

FRONT

0

50

100

150

200

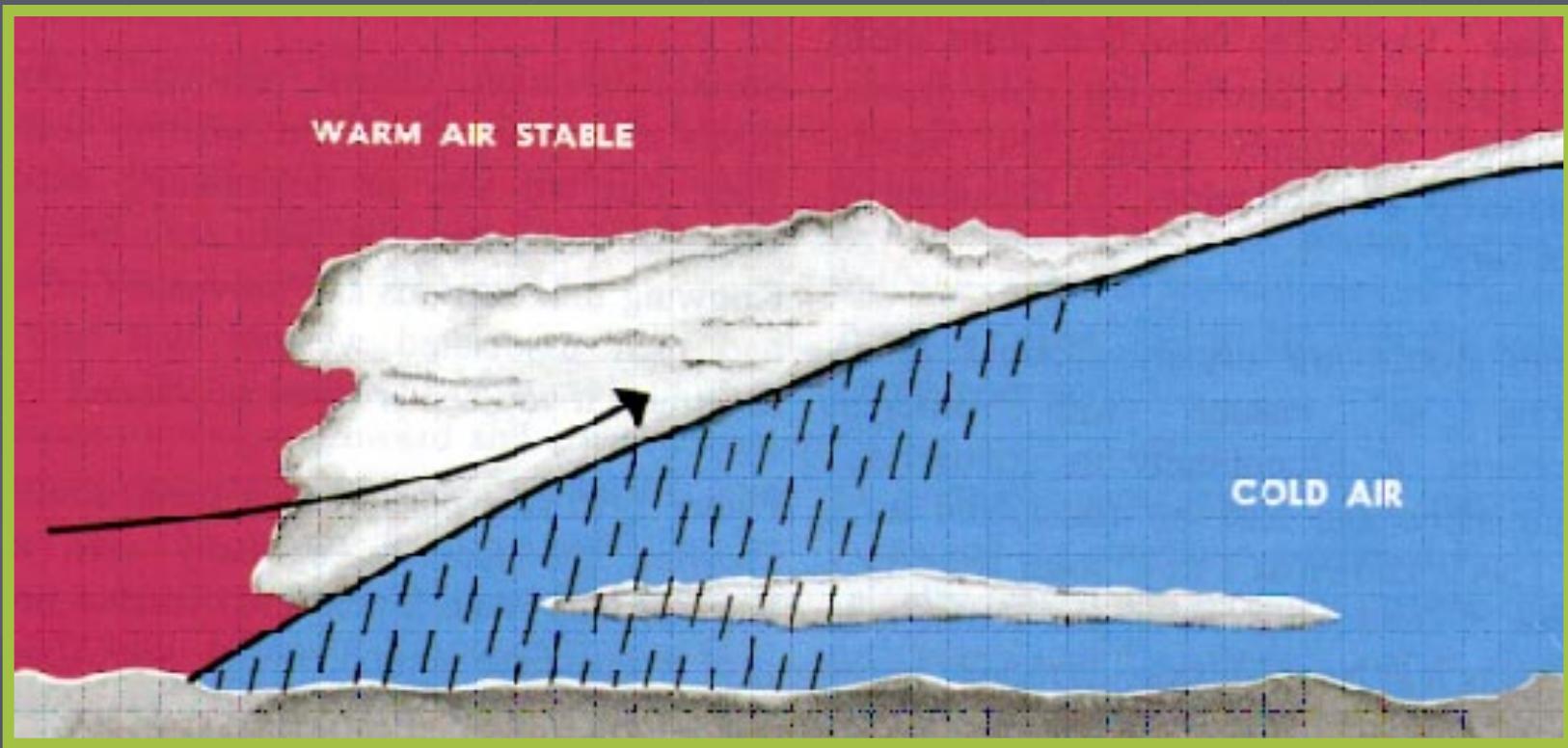
MILES



# Warm Fronts

- ▶ Air Warmer Behind Than Ahead
- ▶ Slow Moving
- ▶ Non-Violent Weather
- ▶ Nighttime Fog Frequent
- ▶ Can Have Long Periods Of Rain
- ▶ When Passes
  - ▶ Little Pressure Change
  - ▶ Little Temperature Change

# Warm Front



# TYPICAL CLOUD SEQUENCE AHEAD OF WARM FRONT

RAINFALL

LIGHT TO MODERATE

STEADY OR INTERMITTENT

TYPICAL SPEED OF ADVANCE: 12 – 15 KNOTS

CIRRUS

CIRROSTRATUS

ALTOSTRATUS

STRATUS

NIMBOSTRATUS



FRONT

0



500

1,000  
MILES

# **THUNDERSTORMS TORNADOES**



# THREE ESSENTIAL CONDITIONS

## MOISTURE

(LATENT) HEAT SOURCE  
SURFACE DEW POINTS ABOVE 60°F (15°C)

## LIFT

THE TRIGGER THAT STARTS UPDRAFTS  
FRONTAL  
OROGRAPHIC  
CONVERGING WINDS (LOW LEVEL)  
DIVERGING WINDS (ALOFT)  
INTENSE SURFACE HEATING

## INSTABILITY

KEEPS UPDRAFTS IN MOTION TO GREAT HEIGHTS

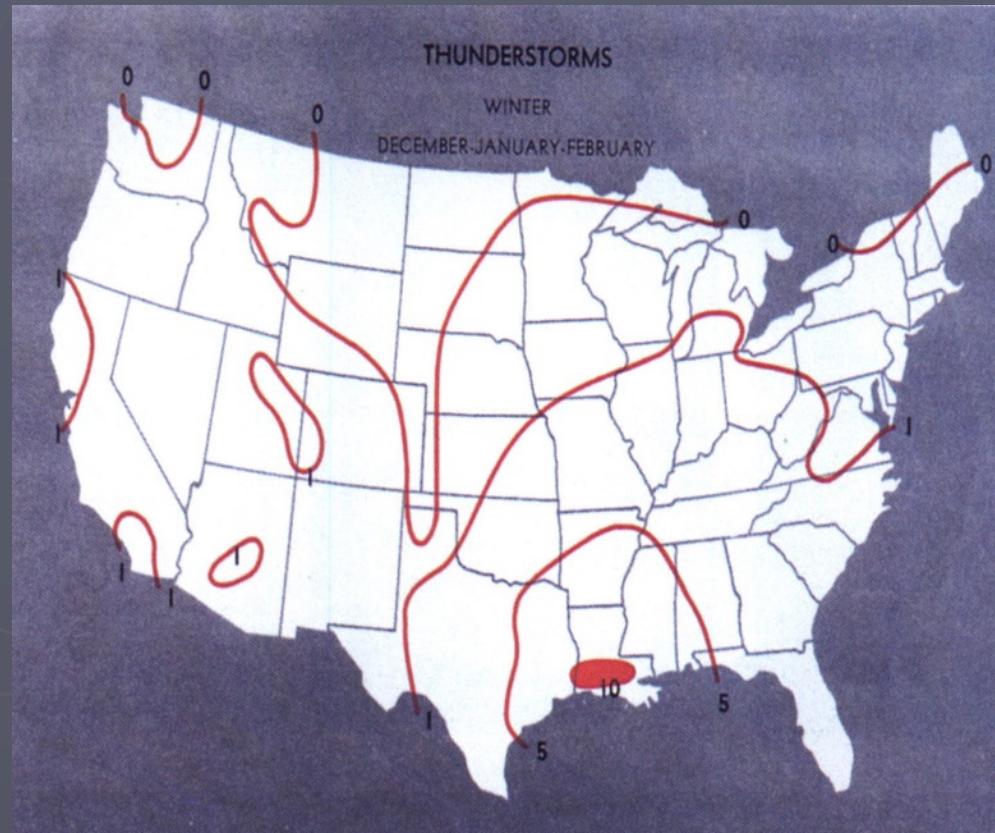
# THUNDERSTORMS

## WHEN AND WHERE THEY FORM



# THUNDERSTORMS

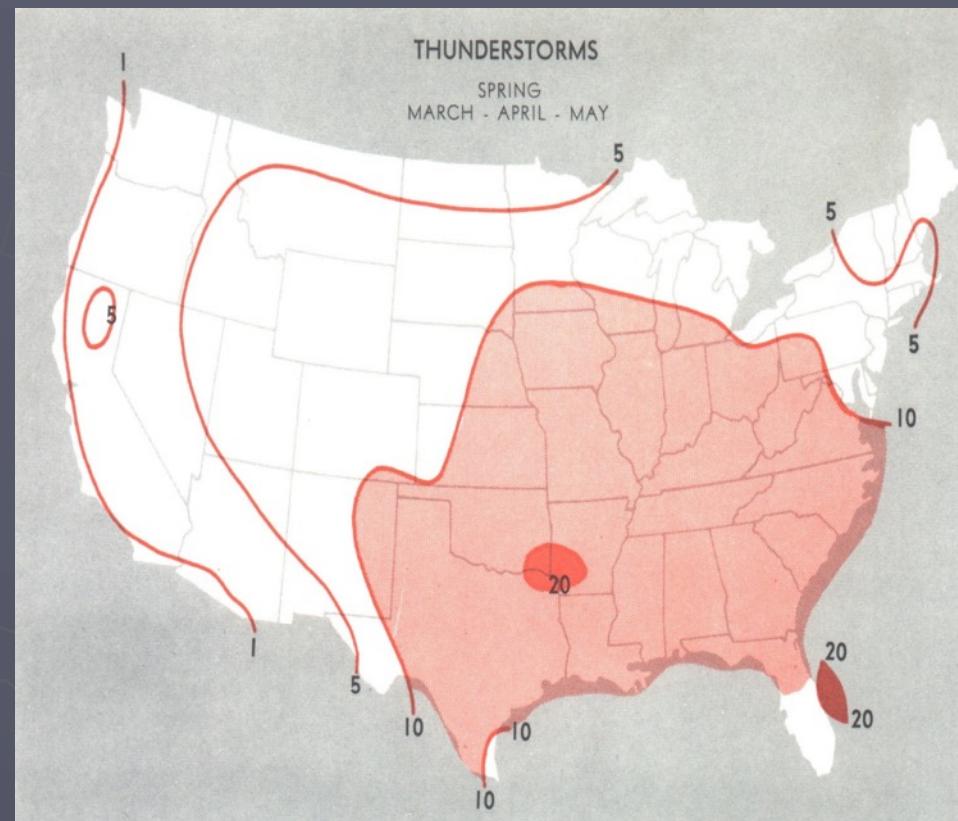
NUMBER OF  
THUNDERSTORM  
DAYS IN WINTER.  
  
DECEMBER,  
JANUARY,  
FEBRUARY



# THUNDERSTORMS

AVERAGE NUMBER  
OF THUNDERSTORM  
DAYS IN THE  
SPRING.

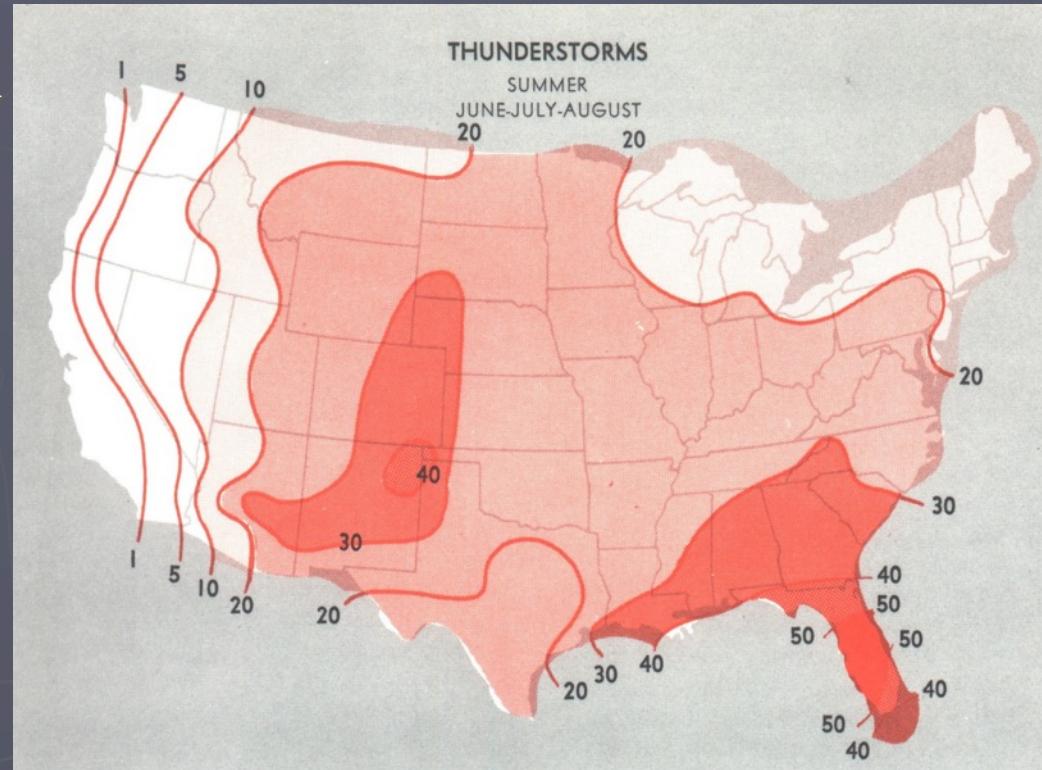
MARCH, APRIL, MAY



# THUNDERSTORMS

AVERAGE NUMBER  
OF DAYS WITH  
THUNDERSTORMS  
IN THE SUMMER.

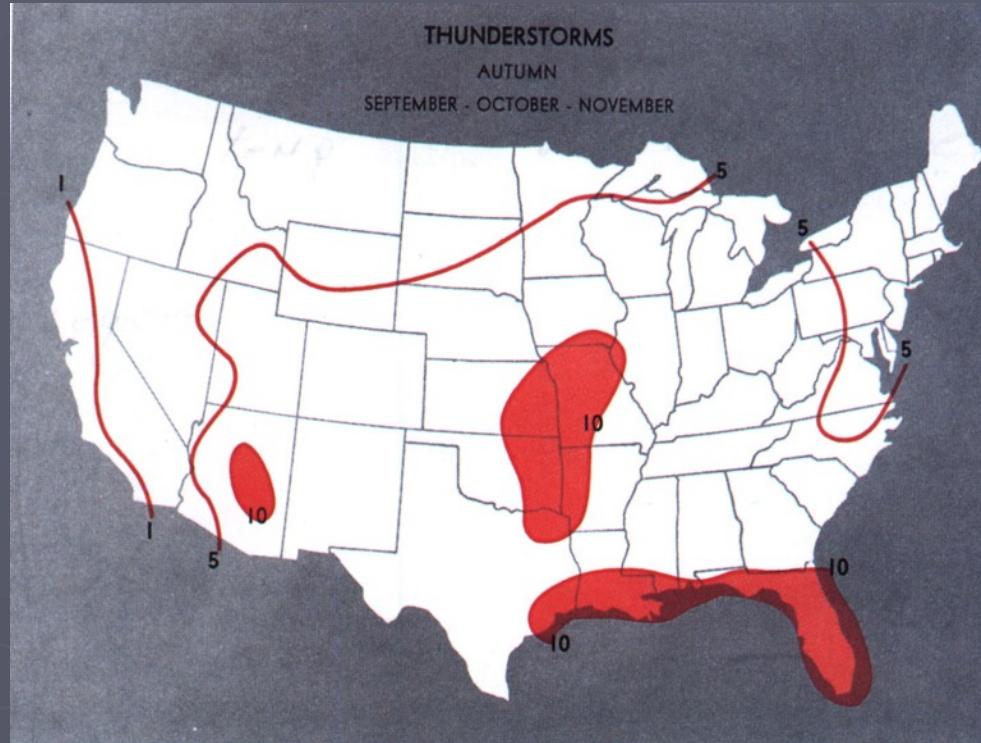
JUNE, JULY,  
AUGUST



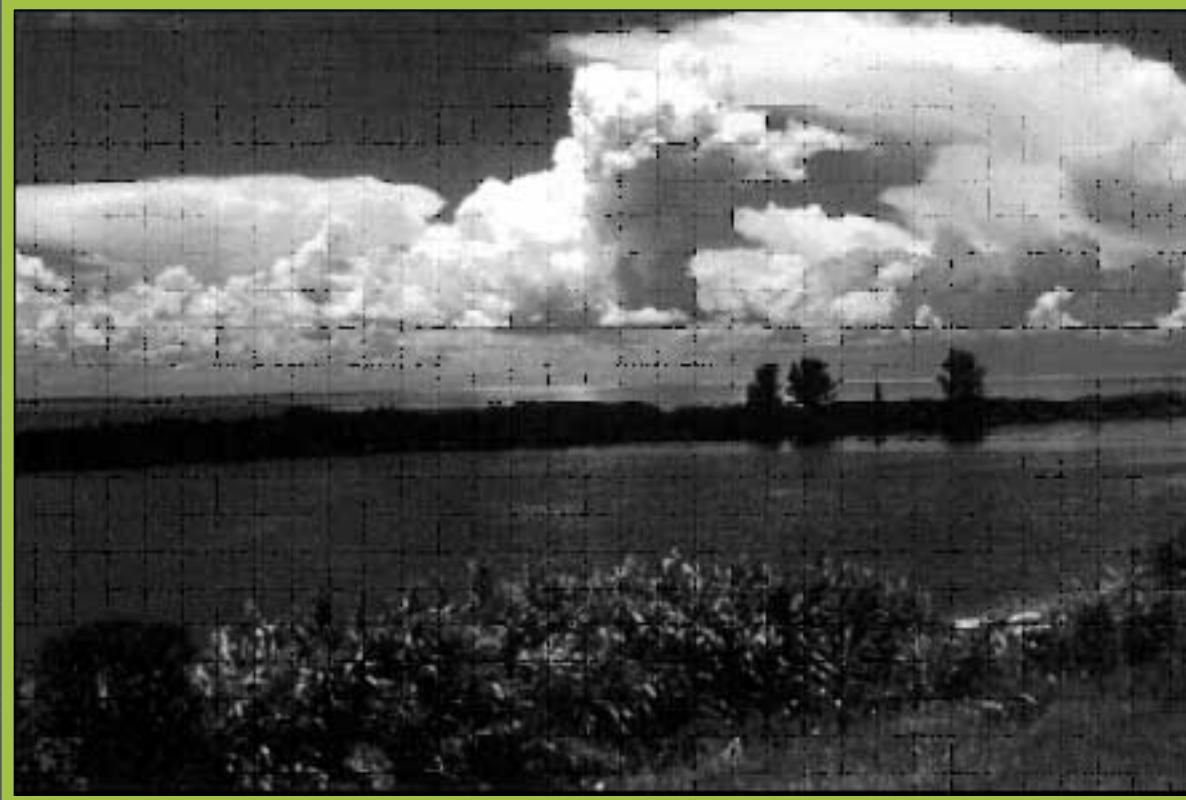
# THUNDERSTORMS

THUNDERSTORM  
DAYS AUTUMN

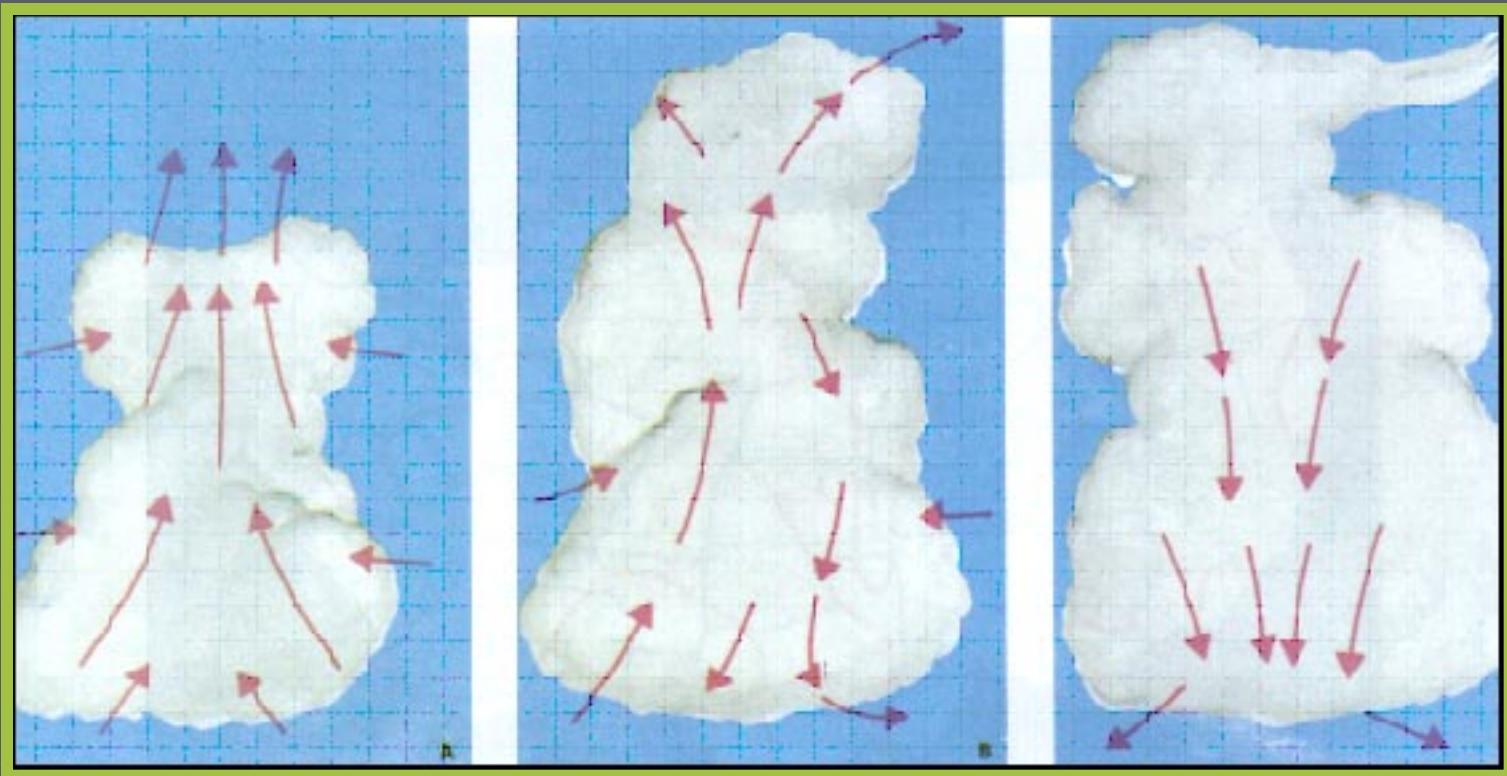
SEPTEMBER,  
OCTOBER,  
NOVEMBER



# Thunderstorms In A Squall Line



# Stages Of A Thunderstorm



Building

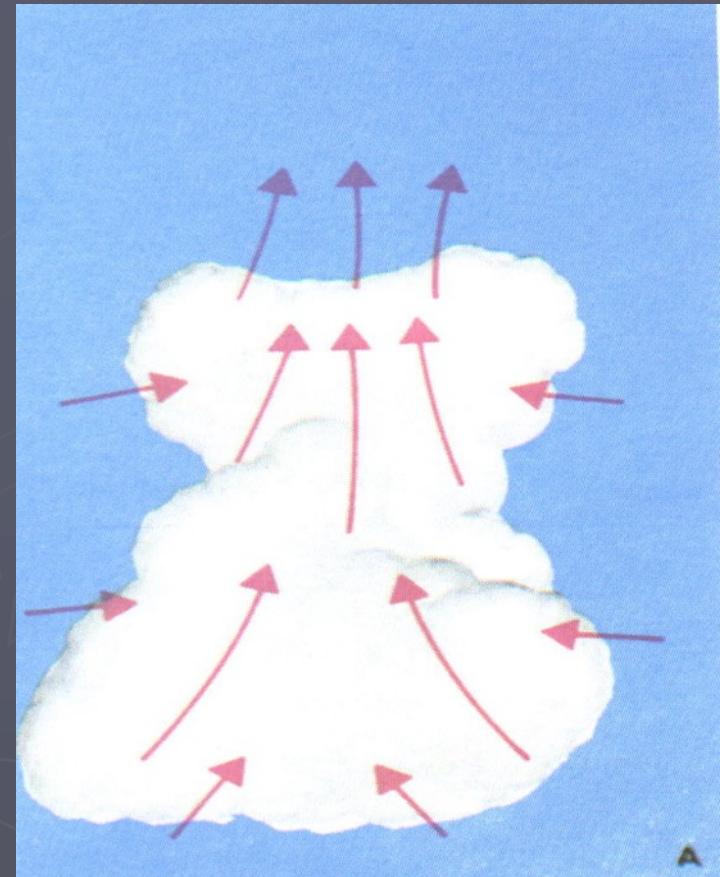
Mature

Dissipating

# THUNDERSTORMS CUMULUS STAGE

The beginning or FIRST stage of the thunderstorm.

Mostly UPDRAFTS and inflow.

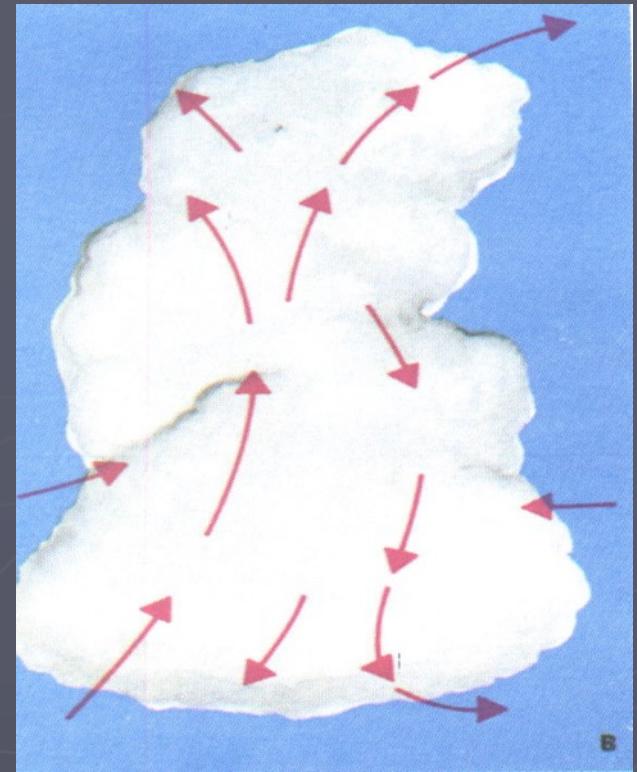


# THUNDERSTORMS MATURE STAGE

Towering Cumulus (TCu)

NOTE the beginning of DOWNDRAFTS on the leading edge, at the base.

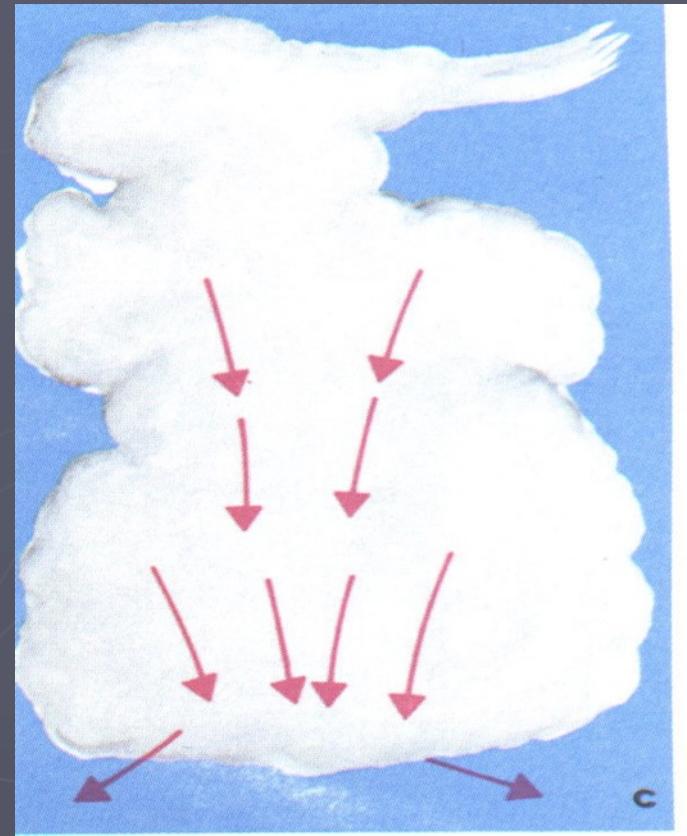
Movement from LEFT to RIGHT.



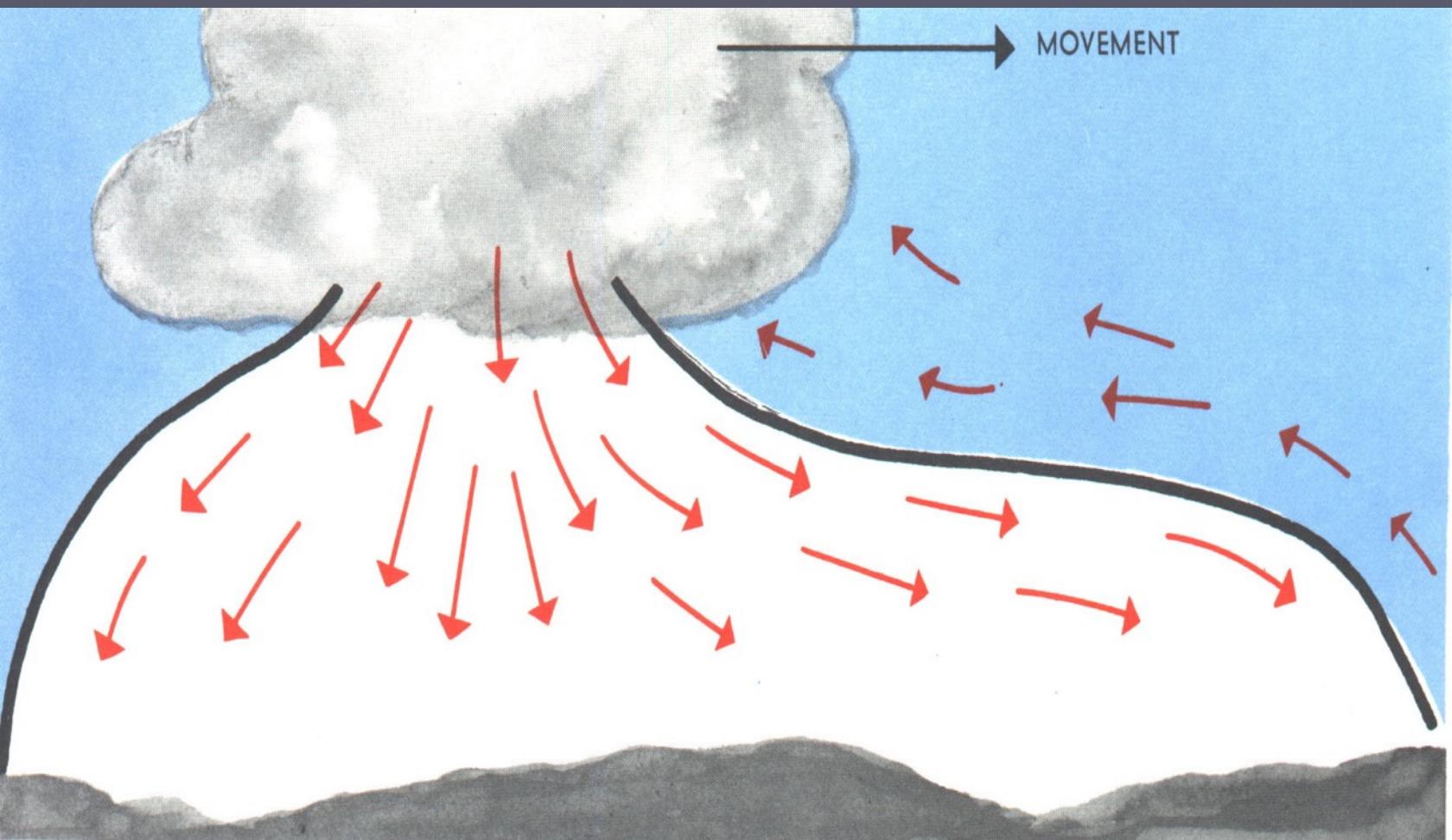
# THUNDERSTORMS DISSIPATION STAGE

CUMULONIMBUS (CB)

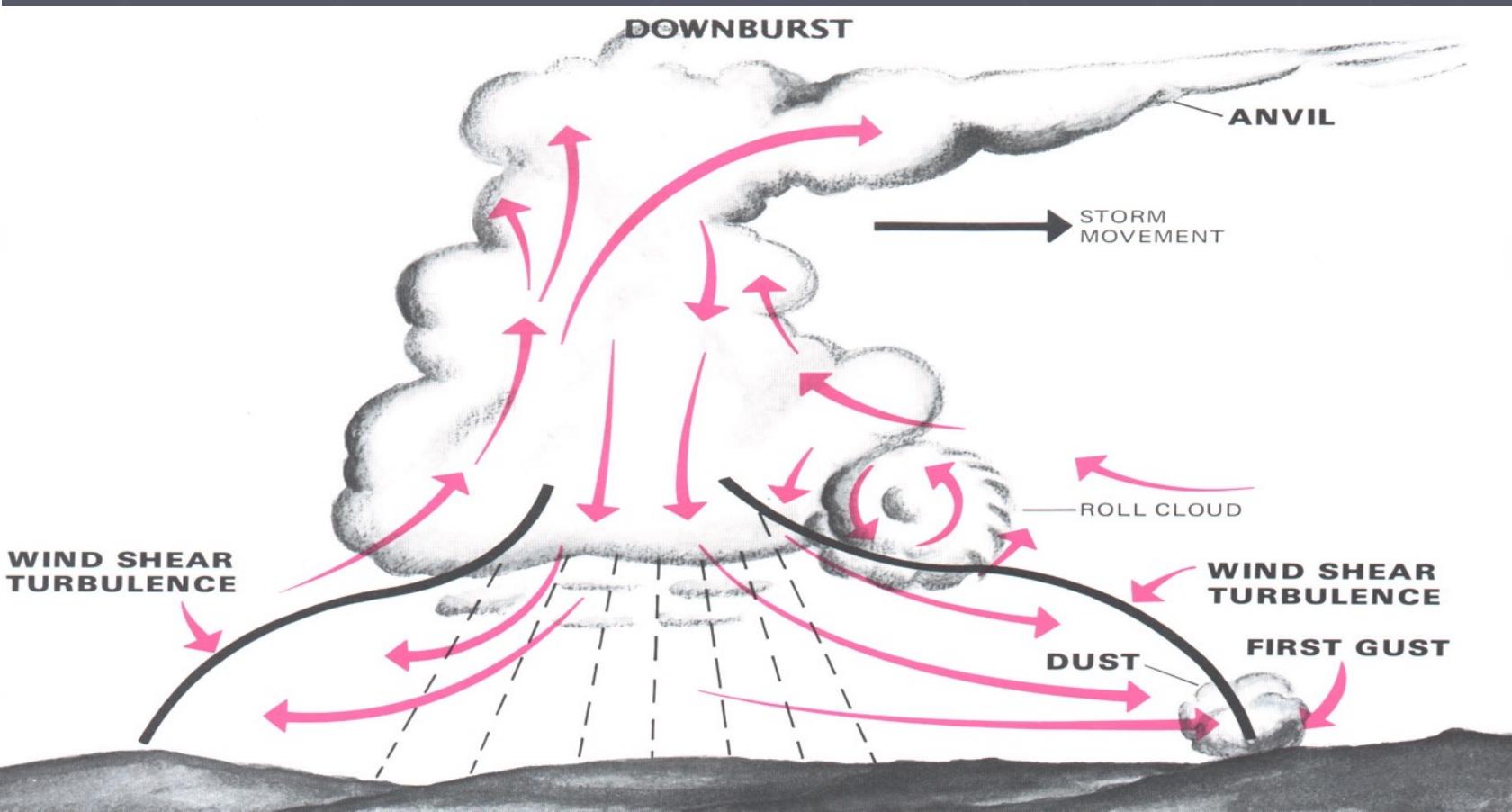
Predominately  
DOWNDRAFTS, all the  
way to the surface!



# THUNDERSTORMS DRAFT PATTERN

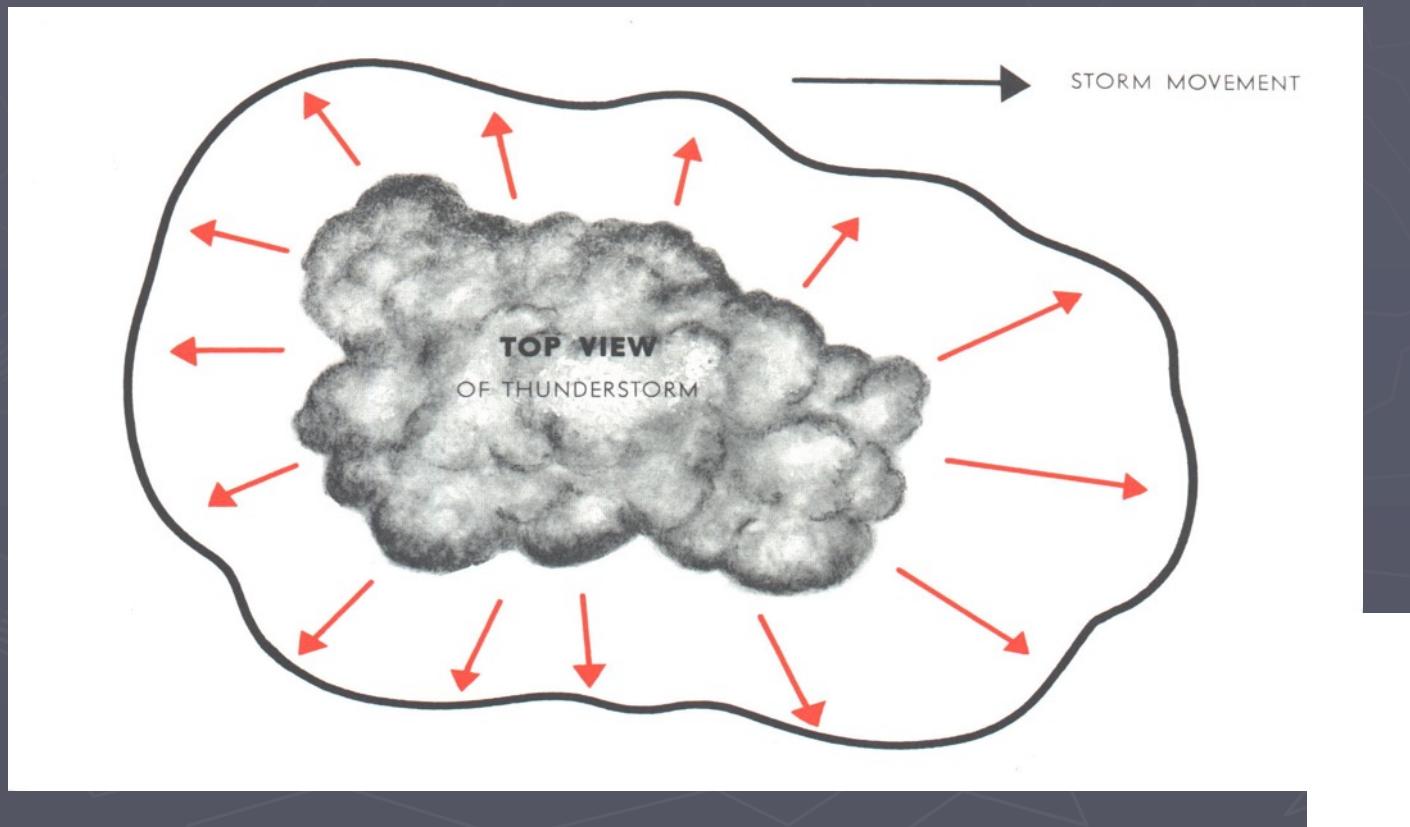


# THUNDERSTORMS AIR MASS TYPE



# THUNDERSTORMS

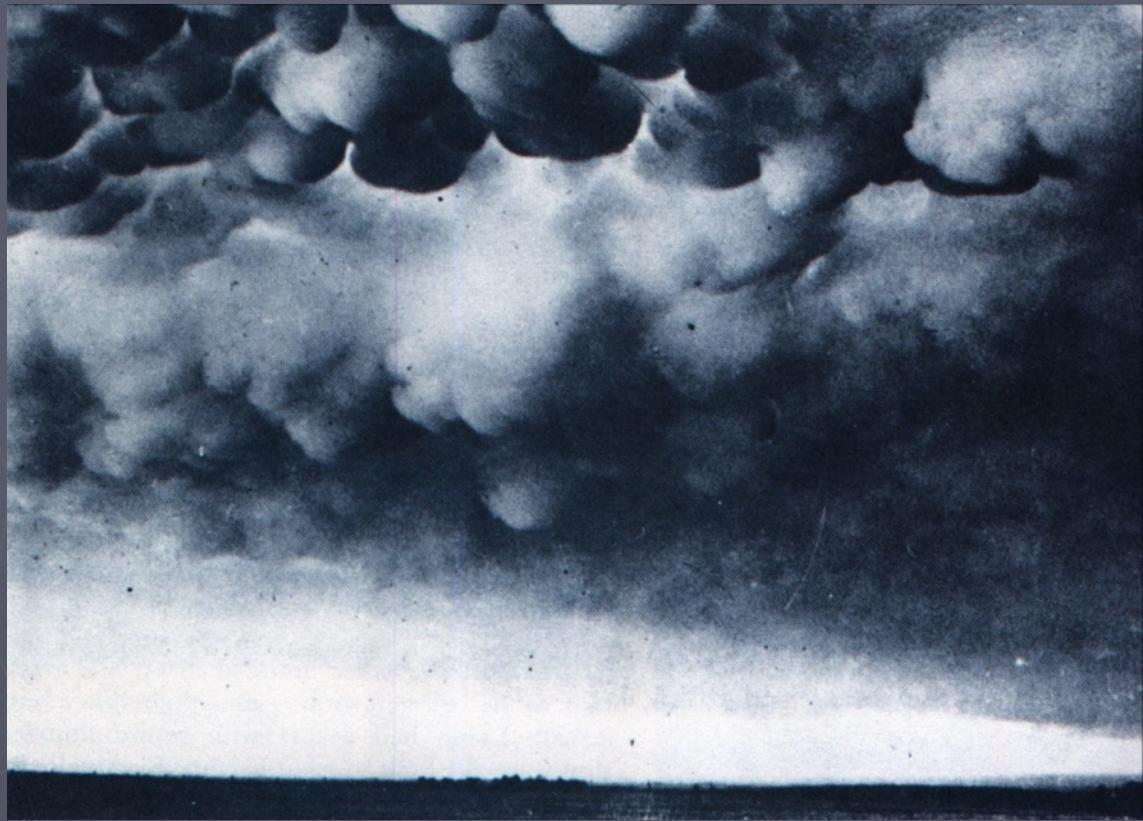
## MICROBURST



# Violent Weather Imminent

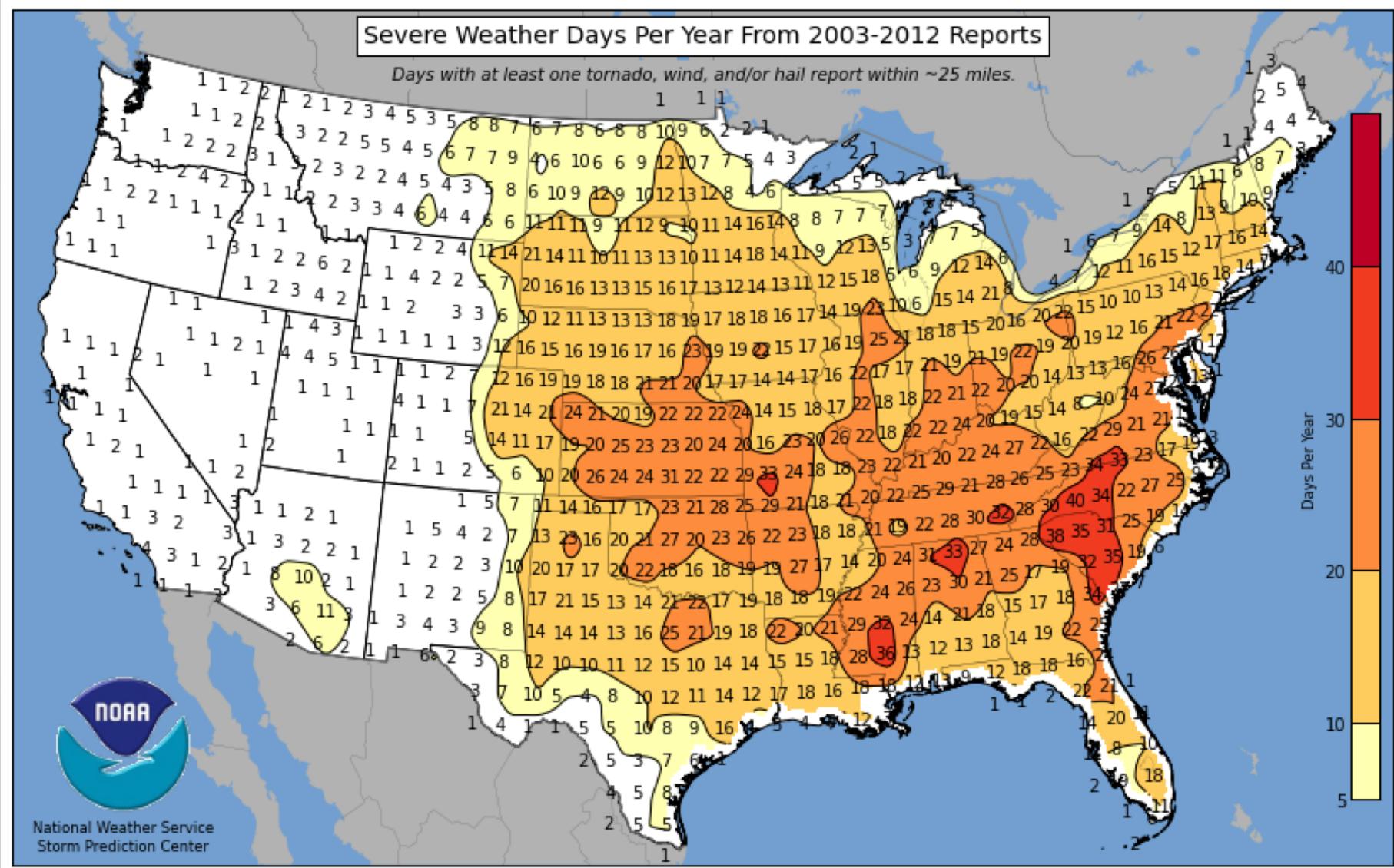
MAMATOCUMULUS

A pre-cursor of  
EXTREME  
TURBULENCE under  
a THUNDERSTORM.



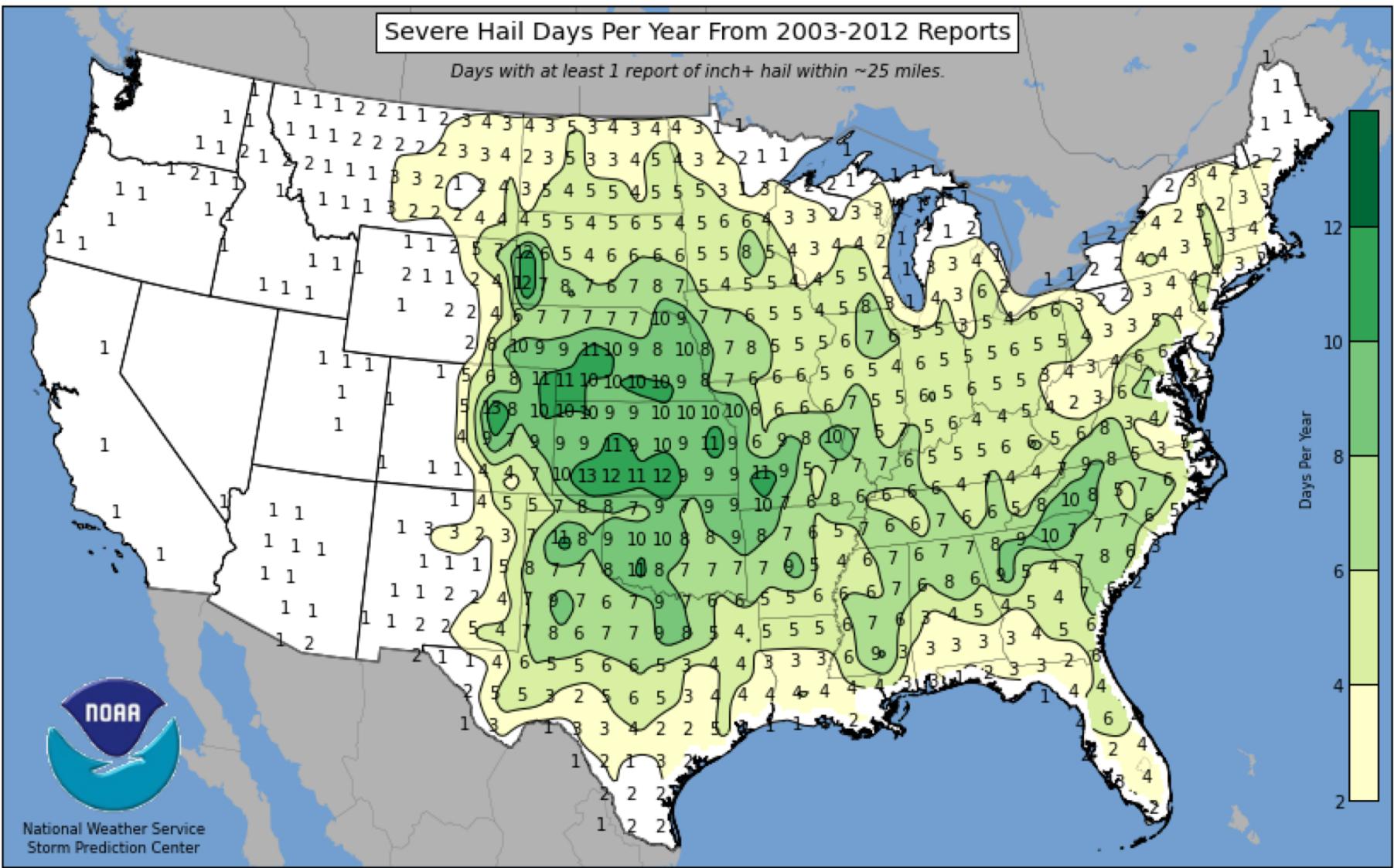
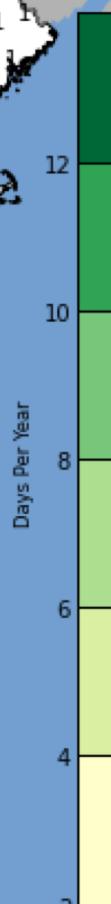
## Severe Weather Days Per Year From 2003-2012 Reports

Days with at least one tornado, wind, and/or hail report within ~25 miles.

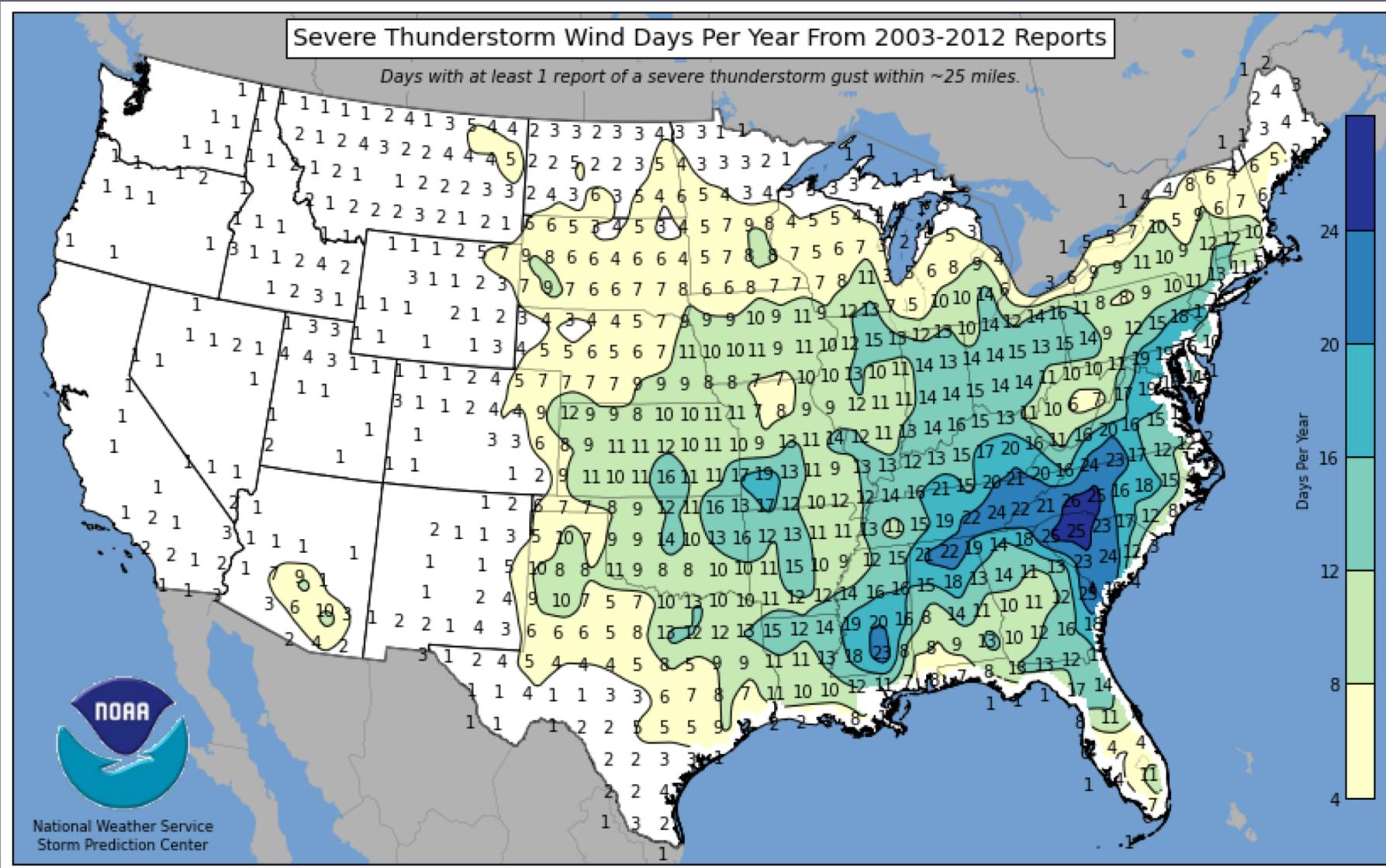


## Severe Hail Days Per Year From 2003-2012 Reports

Days with at least 1 report of inch+ hail within ~25 miles.



National Weather Service  
Storm Prediction Center



# Craig Mann – Cullman Tribune



# 8.9 Ounces



# Measurements



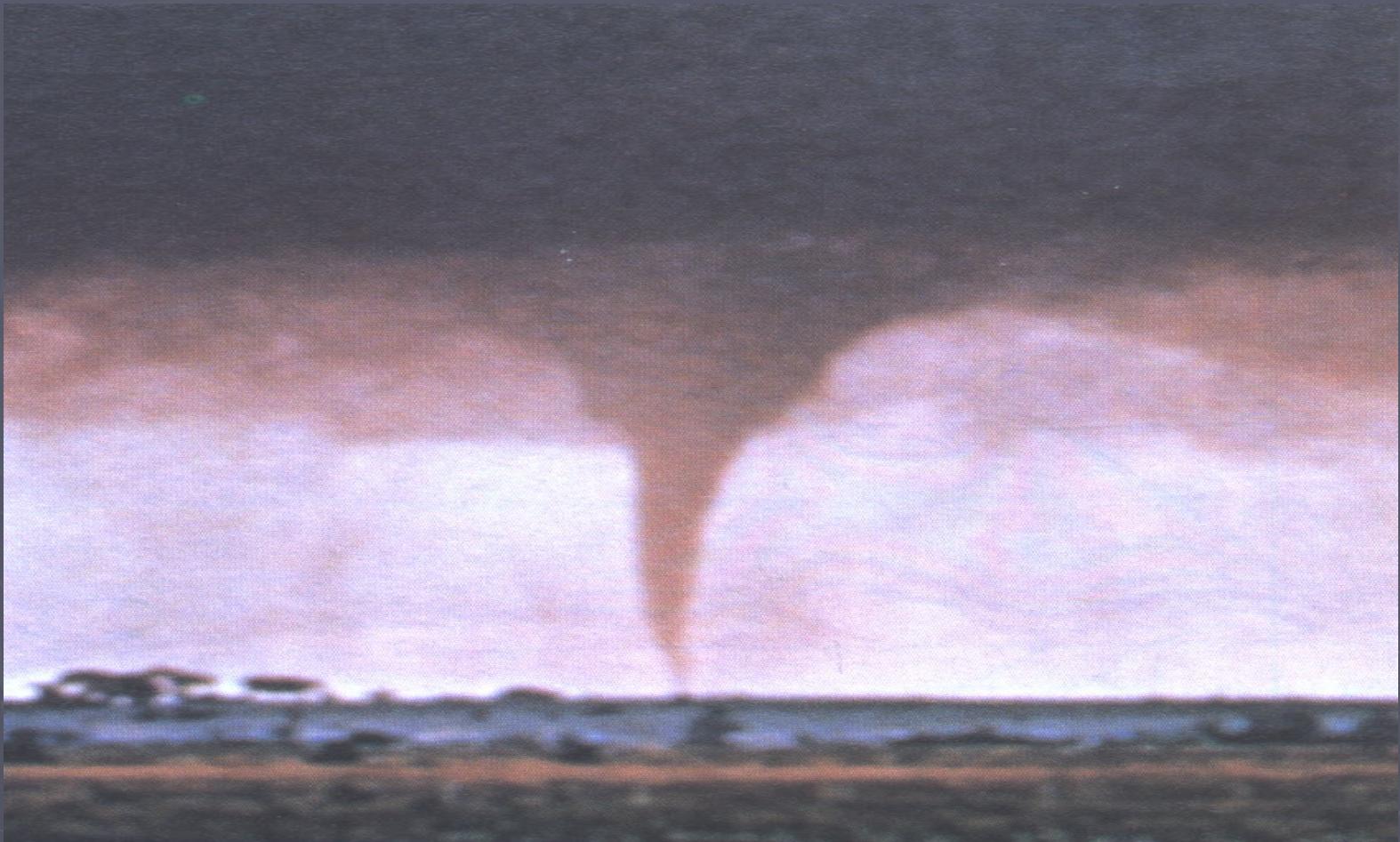
# Hail

- ▶ The hailstone measured approximately 5.25 inches in peak width, with a circumference of 13.75 inches, and weighed 8.9 ounces. There is not an official record hail size for the state of Alabama. But the largest entry found in Storm Data was 4.25 inches. If found to be official this hailstone will be marked as the largest hailstone recorded in the state of Alabama.

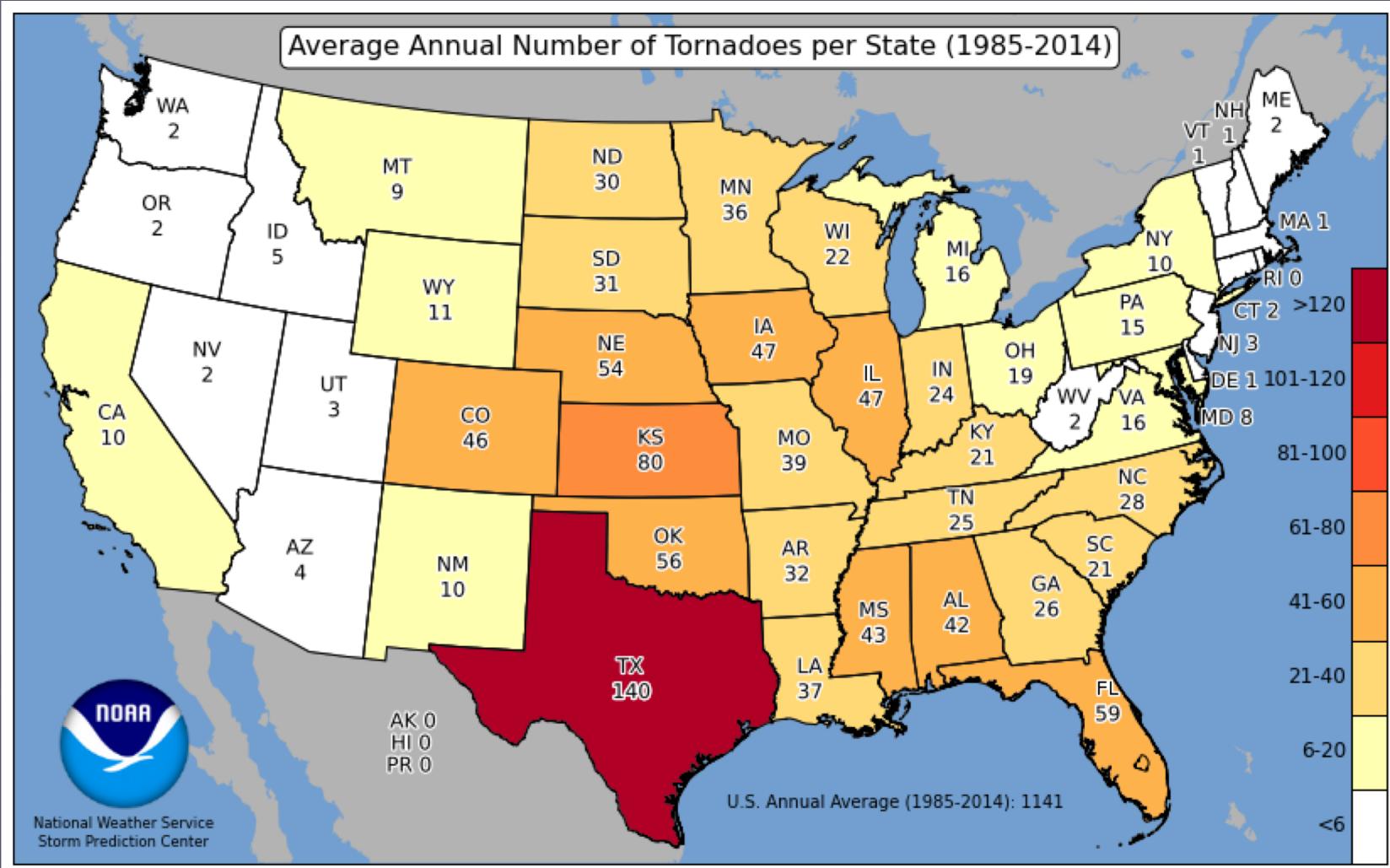
# Hail

- ▶ For reference, the largest hailstone ever recorded fell on July 23rd, 2010 in Vivian, South Dakota. It measured 8.0 inches in diameter, 18.62 inches in circumference and weighed 1.93 pounds.

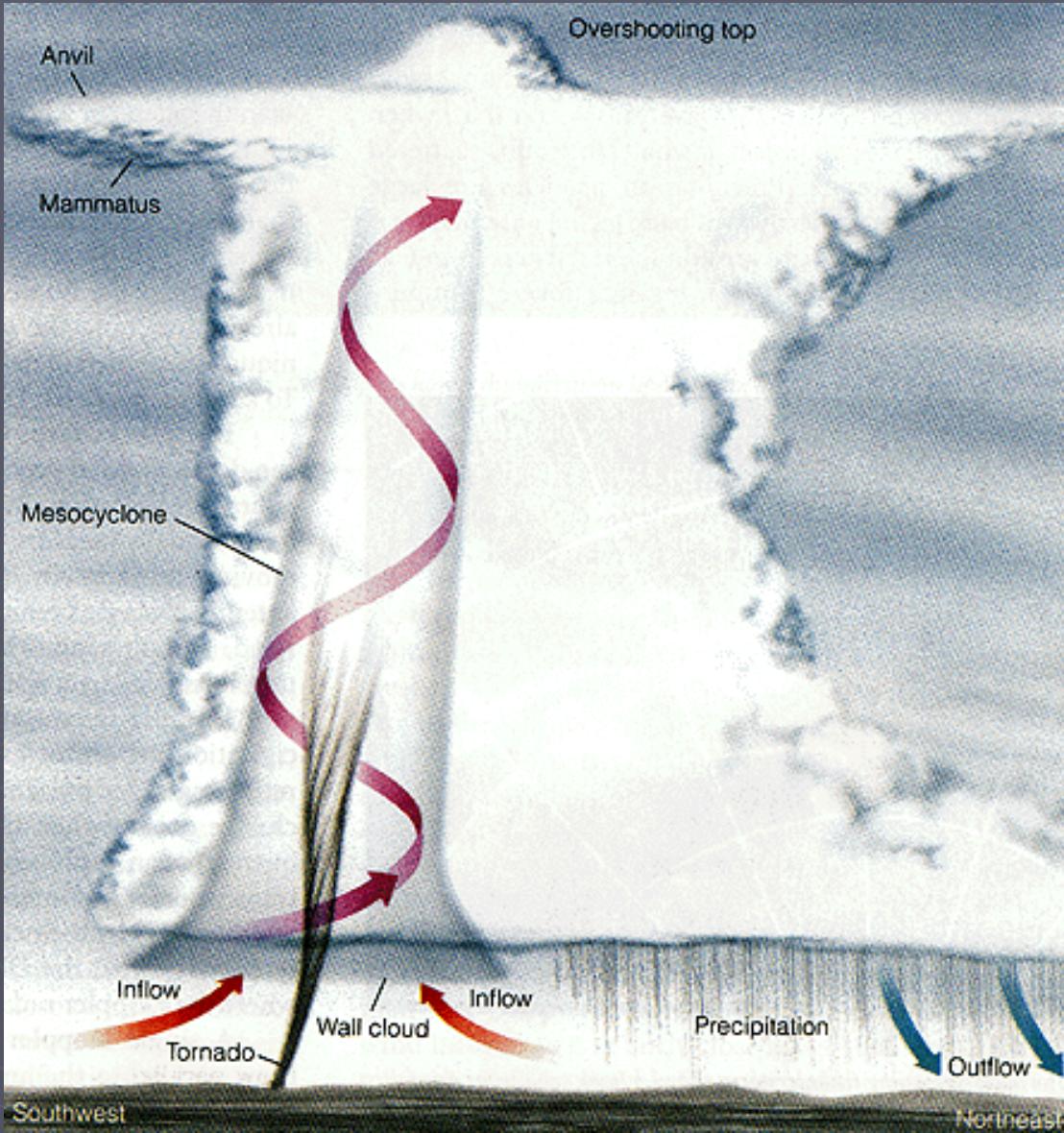
# TORNADO



# TORNADOES



# Wall Cloud



# Wall Cloud



# Funnel Clouds

Until it touches  
the ground, it is  
called a  
**“FUNNEL  
CLOUD”**



# WATER SPOUTS

A WATER  
SPOUT IS A  
“WET”  
TORNADO



# Tropical Weather

## ► Classifications

- Tropical Depression
  - ▶ Wind Up To 34 Knots (38 MPH)
- Tropical Storm
  - ▶ Wind 35 - 64 Knots (39 – 73 MPH)
- Hurricane
  - ▶ Wind 65 Knots Or More (74 MPH)

## ► Other Names For Hurricanes

- Typhoon
- Cyclone
- Willy-Willy

# Hurricane Categories

- ▶ TD: Winds ≤33 knots (38mph)
- ▶ TS: Winds 34-63 knots (39-73 mph)
- ▶ Cat 1: Winds 64-82 knots (74-95 mph)
- ▶ Cat 2: Winds 83-95 knots (96-110 mph)
- ▶ Cat 3: Winds 96-113 knots (111-130 mph)
- ▶ Cat 4: Winds 114-135 knots (131-155 mph)
- ▶ Cat 5: Winds 136+ knots (156+ mph)

# Tropical Storm Warnings

- ▶ Warnings issued by NOAA's National Hurricane Center in Miami
- ▶ Tropical Storm Watches issued when Tropical Storms possible landfall within 48 hours
- ▶ Hurricane Watch 48 hours
- ▶ Hurricane Warning 36 hours

# Lightning

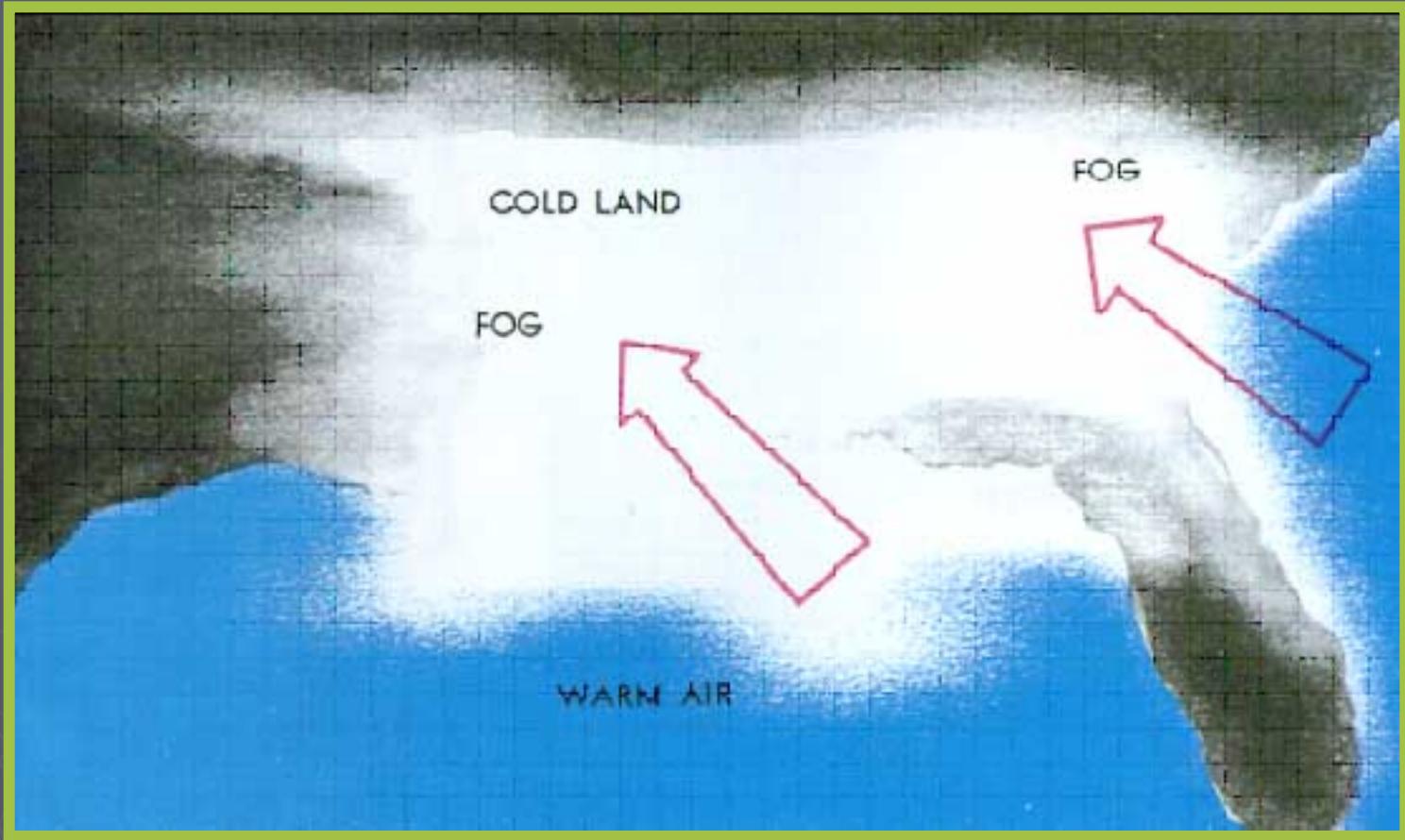
## ► Cause

- Friction Of Raindrops & Ice Particles In Thunderstorms Creates Electrical Charge

## ► Distant Lightning

- Heard As Static In AM Radios
- More Frequent The Static, The More Severe The Storm

# Fog



# Fog

## ► Radiation

- Clear Sky
- Little Or No Wind
- Small Temp – Dew Point Spread
- Burns Off In Morning

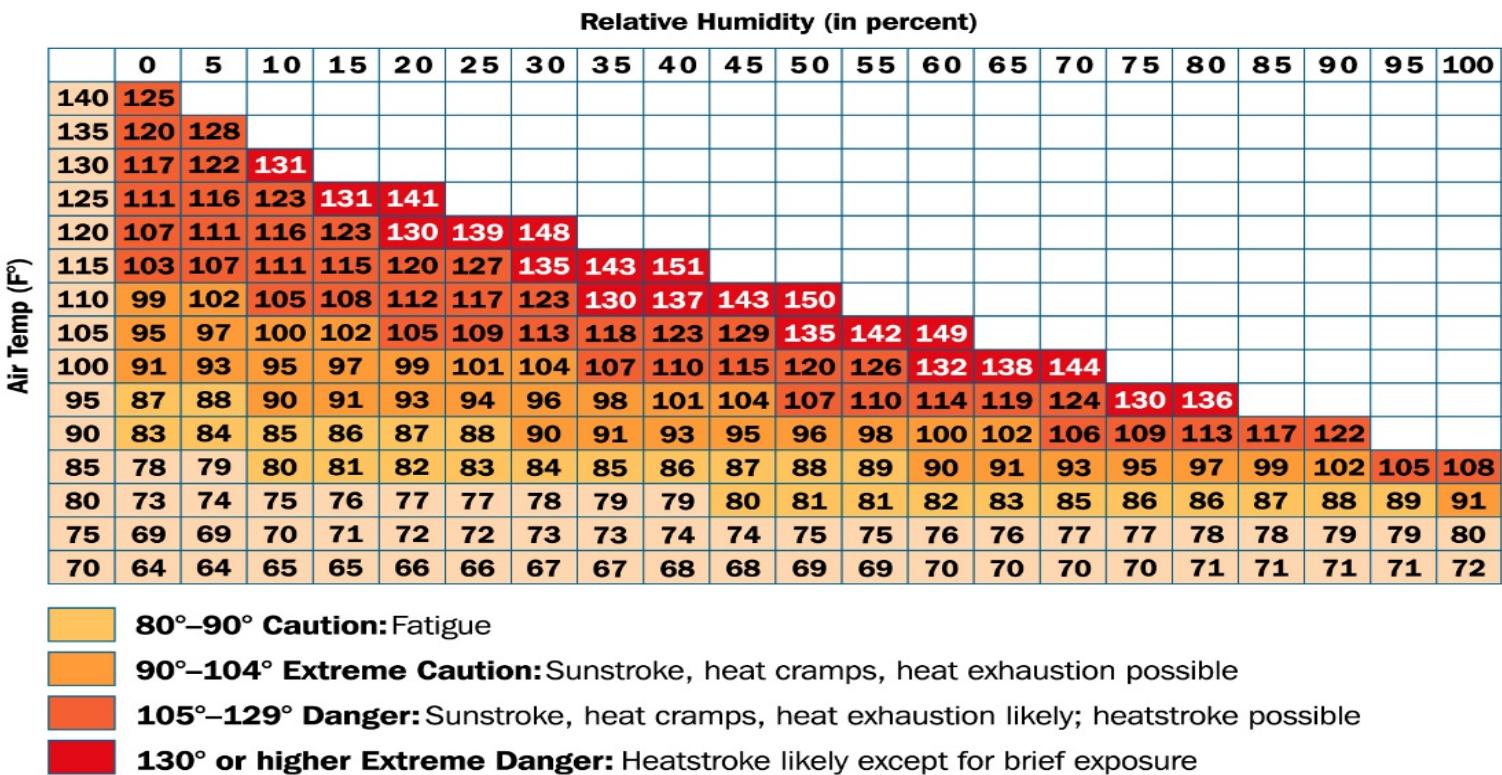
## ► Advection

- Sea Fog
- Needs Light Winds – Up To 15 MPH
- Warm Moist Air Moving Over A Colder Body
- Long Lasting

# Heat Index

## The heat index

The heat index is a general guide to how the danger of heat increases as the temperature and relative humidity increase. Effects on individuals will vary greatly. The figures are based on effects of prolonged exposure when you are in the shade. Direct sunlight can increase index values by as much as 15 degrees Fahrenheit.



Courtesy of the American Meteorological Society

# Wind Chill Temperature

	Temperature (F)																		
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63	
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72	
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77	
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81	
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84	
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87	
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89	
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91	
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93	
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95	
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97	
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98	

*Frostbite occurs in 15 minutes or less*

Courtesy of the American Meteorological Society

# Severe Weather Reporting

## Urgent Priority

- ▶ Tornado
- ▶ Funnel Cloud
- ▶ Rotating Wall Cloud
- ▶ Flash Flooding

# Severe Weather Reporting

## High Priority

- ▶ Hail  $\frac{3}{4}$  inch diameter or larger
- ▶ Wind speed 58 mph or greater
- ▶ Persistent non rotating wall cloud
- ▶ Rainfall 1 inch or more per hour

# Severe Weather Reporting

## Lower Priority

- ▶ Hail 1/2 inch to ¾ inch diameter
- ▶ Wind speed 40 mph or greater
- ▶ Cloud features suggesting organization
- ▶ Any other local considerations



# How Big is that Hail??

Actual Hail Reports from NWS Offices Nationwide!

**Ice cube**

**Sonic ice**

**Rock**

**Bird seed**

**Rock salt**

**Hominy**

**Radish**

**Fist**

**End of my finger**

**Half as big as the end of my finger**

**Size of your thumb**

**Mothball**

**Half-sucked jawbreaker**

**Cat's head**

**Meatball**

**Oreo**

**Barley**

**Sand**

**Hummingbird egg**

**Pheasant egg**

**Bantam hen egg**

**Blue wren's egg**

# Reporting Procedures

- ▶ **What:** What you have seen
- ▶ **Where:** Specific location where event occurred (crossroads)
- ▶ **When:** When did you see it
- ▶ **What was it doing:** Direction and speed of travel, size, intensity, destructiveness

# Repeater Usage

- ▶ 146.955 - (77hz) WB4QOJ is local liaison repeater: use for local reports to be relayed to the NWS in Peachtree City
- ▶ Several agencies listen to this repeater for real time reports

# Liaison of Local Reports

- ▶ Only one operator makes liaison reports to NWS
- ▶ Telephone 770-486-8535 770-486-9629  
1-888-529-5300 1-866-763-4466
- ▶ NWS Chat for authorized users only

# Liaison with other counties

- ▶ Net control should assign liaison to monitor other counties and bring those reports to our net.

# Additional Training

- ▶ Basic Spotter class on-line:

[https://www.meted.ucar.edu/training\\_courses.php?id=23](https://www.meted.ucar.edu/training_courses.php?id=23)

- ▶ NWS Peachtree City Spotter page:

<http://www.srh.noaa.gov/ffc/skywarn/>

- ▶ Spotter's Field Guide:

<http://www.nws.noaa.gov/om/brochures/SGJune6-11.pdf>

# Additional Resources

- ▶ Vortex SE:

<http://www.nssl.noaa.gov/projects/vortexse/>

# NWS Contacts

- ▶ Web sites [www.noaa.gov](http://www.noaa.gov)  
[www.srh.noaa.gov/ffc](http://www.srh.noaa.gov/ffc)  
[www.nhc.noaa.gov](http://www.nhc.noaa.gov)  
[www.georgiaskywarn.com](http://www.georgiaskywarn.com)
- ▶ For Forecast information 770-486-1133

# Summary

- ▶ What Causes Weather
- ▶ Recognizing Signs Of Change
- ▶ Weather And Clouds
- ▶ The Signs Of Bad Weather
- ▶ Reportable Weather events
- ▶ Repeater usage during events
- ▶ Contact Information and Resources

