

# National Weather Service

## *Advanced* Storm Spotter Training

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NWS BIRMINGHAM, AL



# Advanced Spotter Training Outline

*--Disclaimer: This is Not Storm Chaser Training--*



## Part I



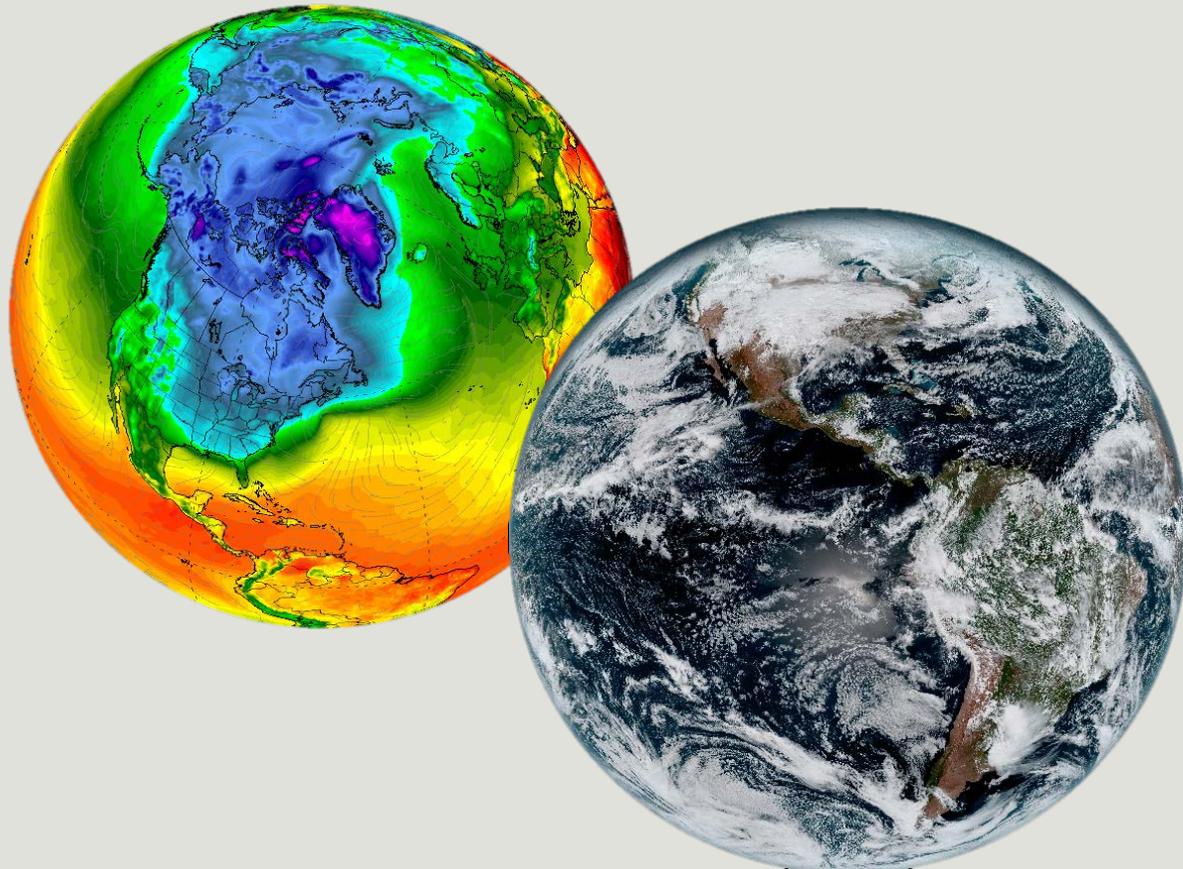
- Atmospheric features, types and scale
- Severe weather ingredients
- Using our products

## Part II

- Basic course recap
- RADAR signatures
- Tornadogenesis
- Demo a severe weather event

# The Atmosphere

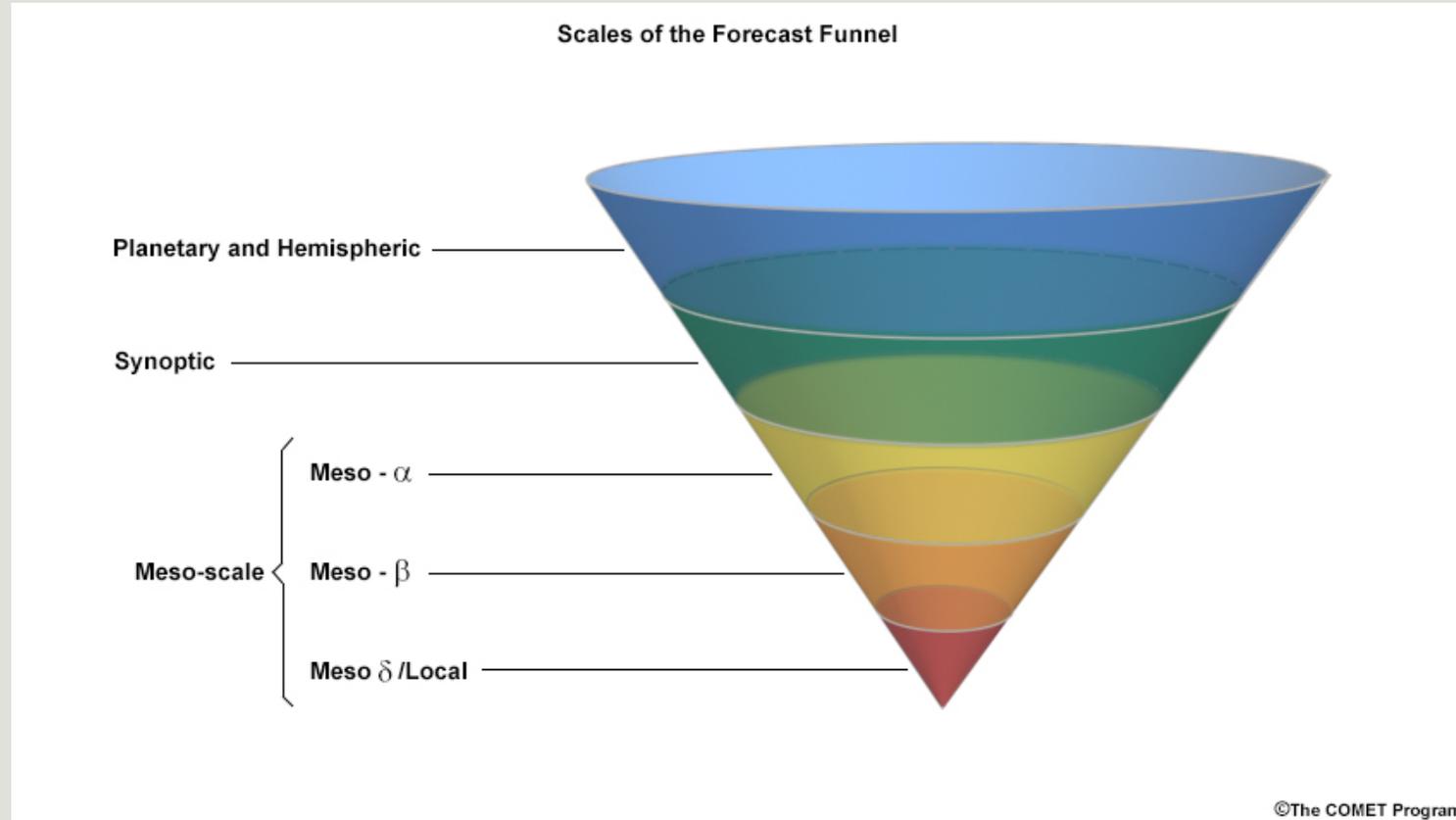
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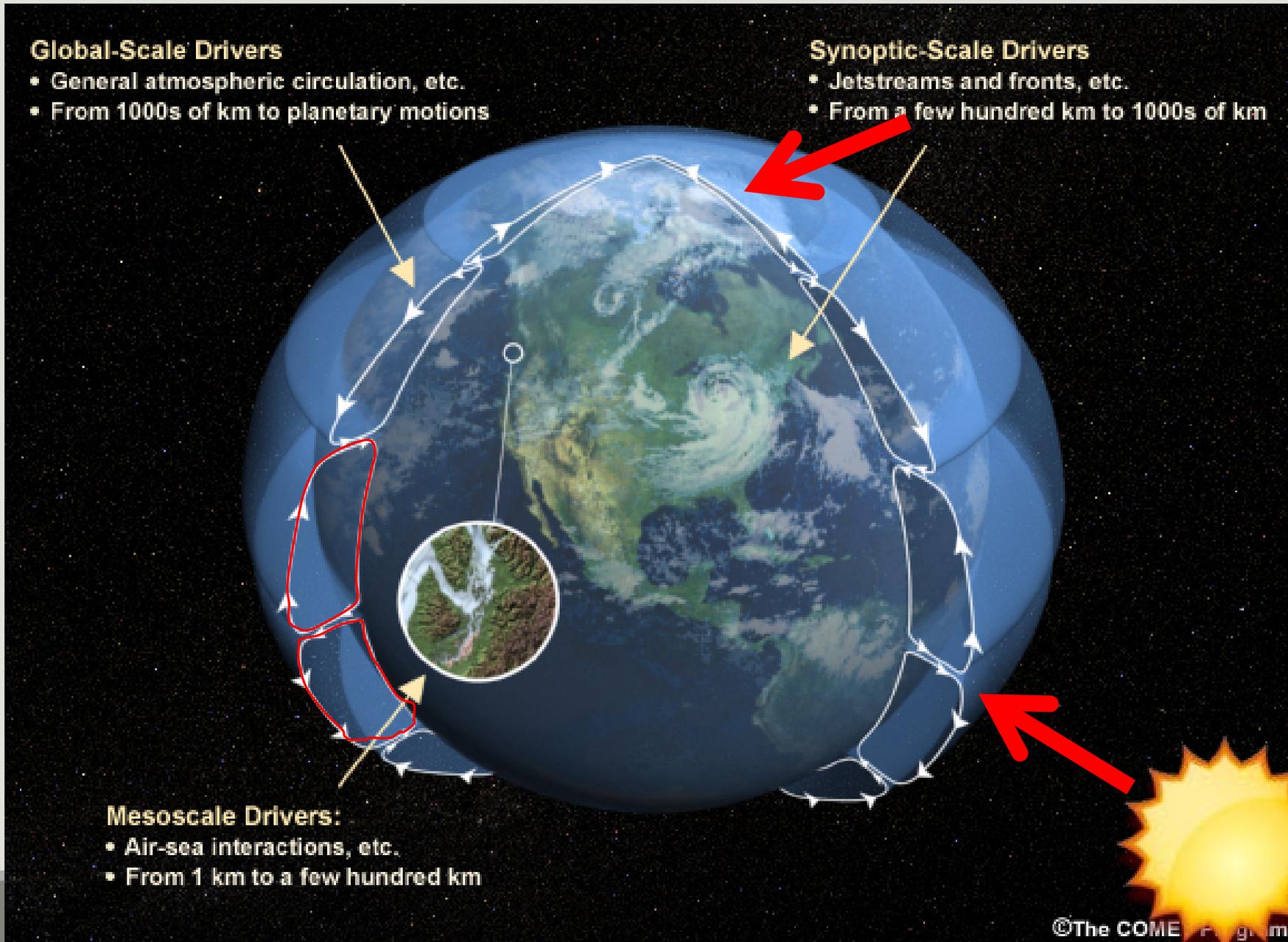
## Large to Small Scale

- *Global (Largest)*
- *Synoptic (Large)*
- *Mesoscale (Small)*

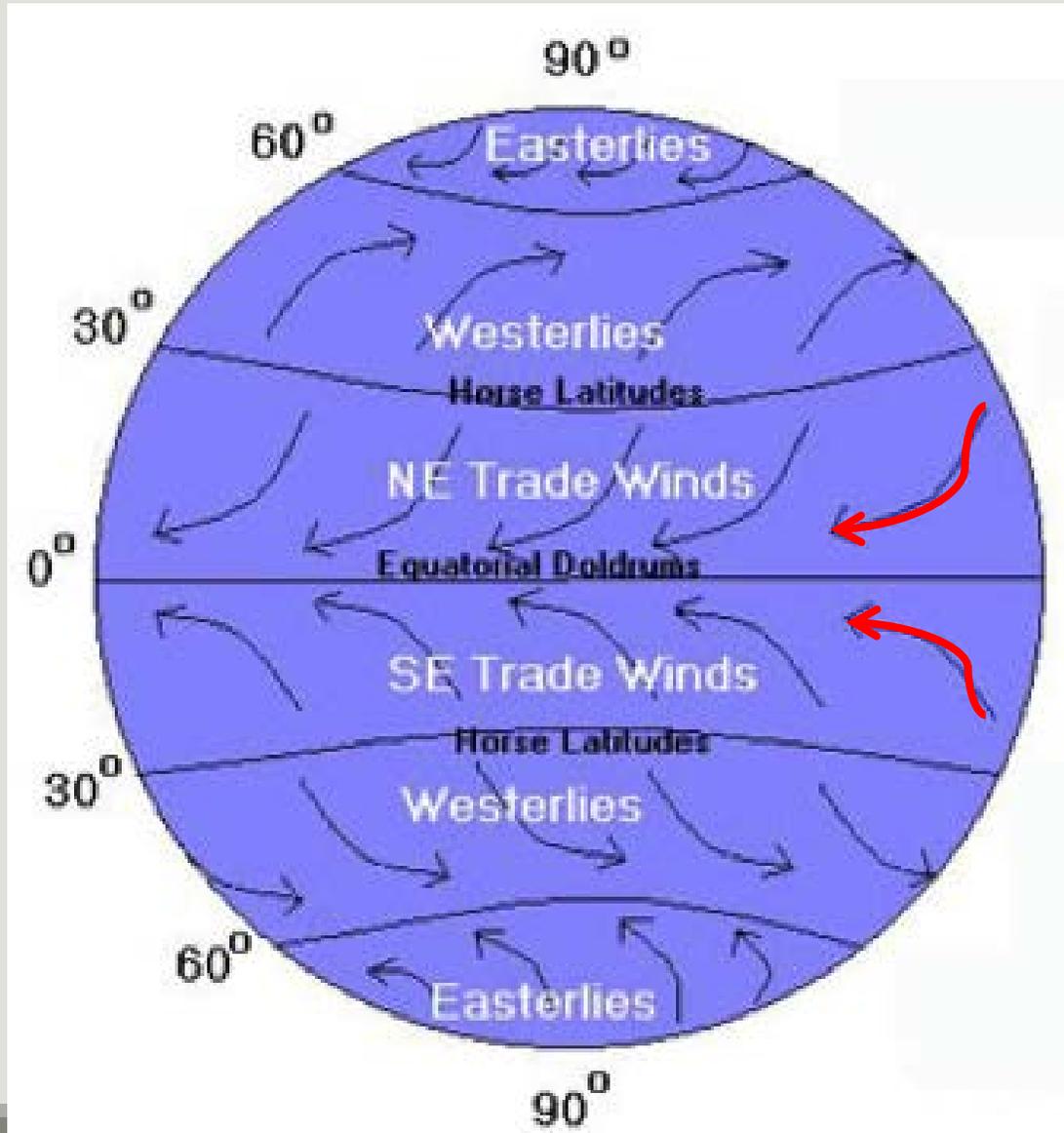
# “Forecast Funnel”



# Global Weather Patterns



# Global Weather Patterns



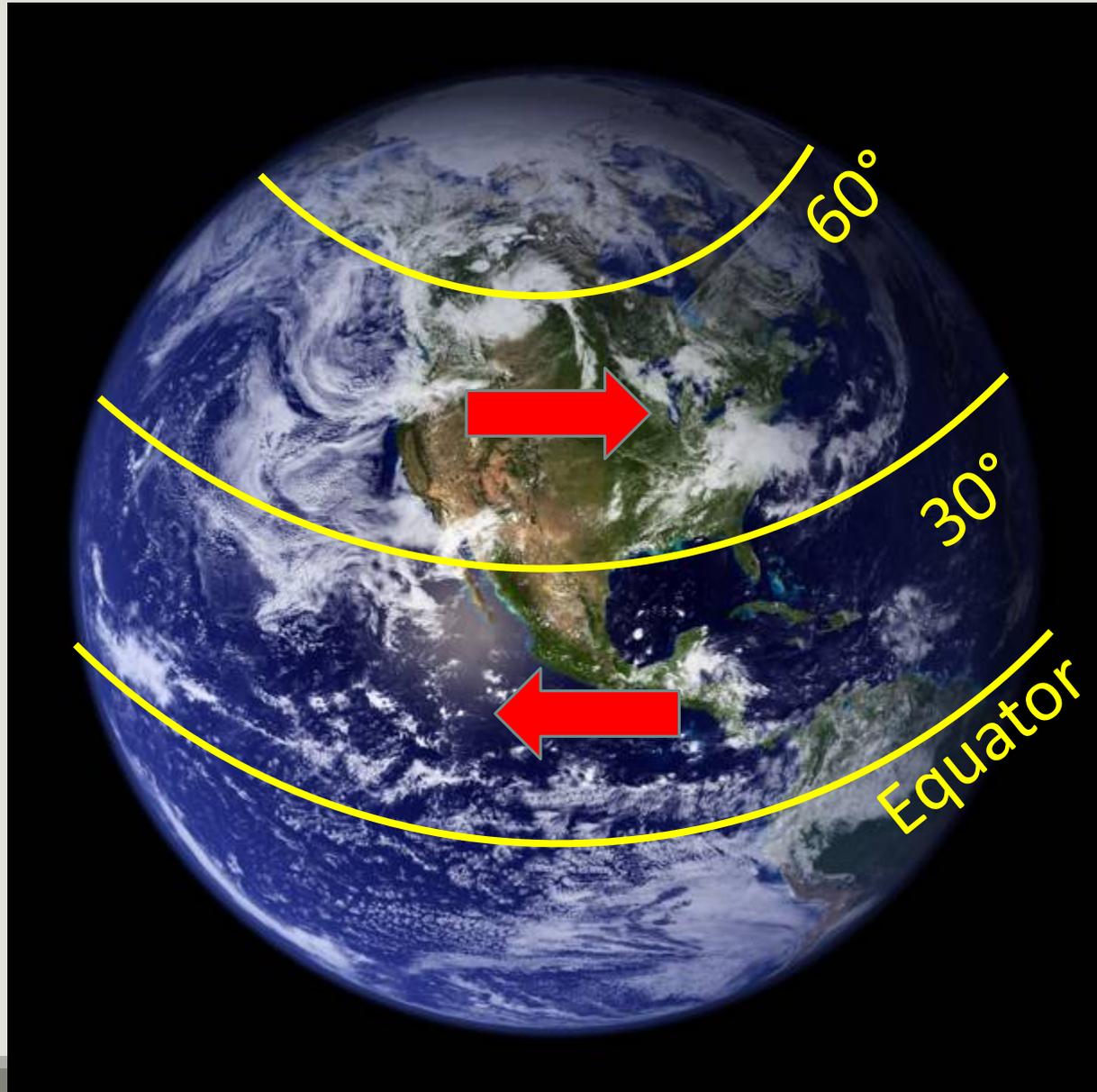
Weather Patterns  
should flow  
North to South, RIGHT?

Two More Things to  
Factor in:

- Rotation of the Earth
- Gravity

**Coriolis Effect**

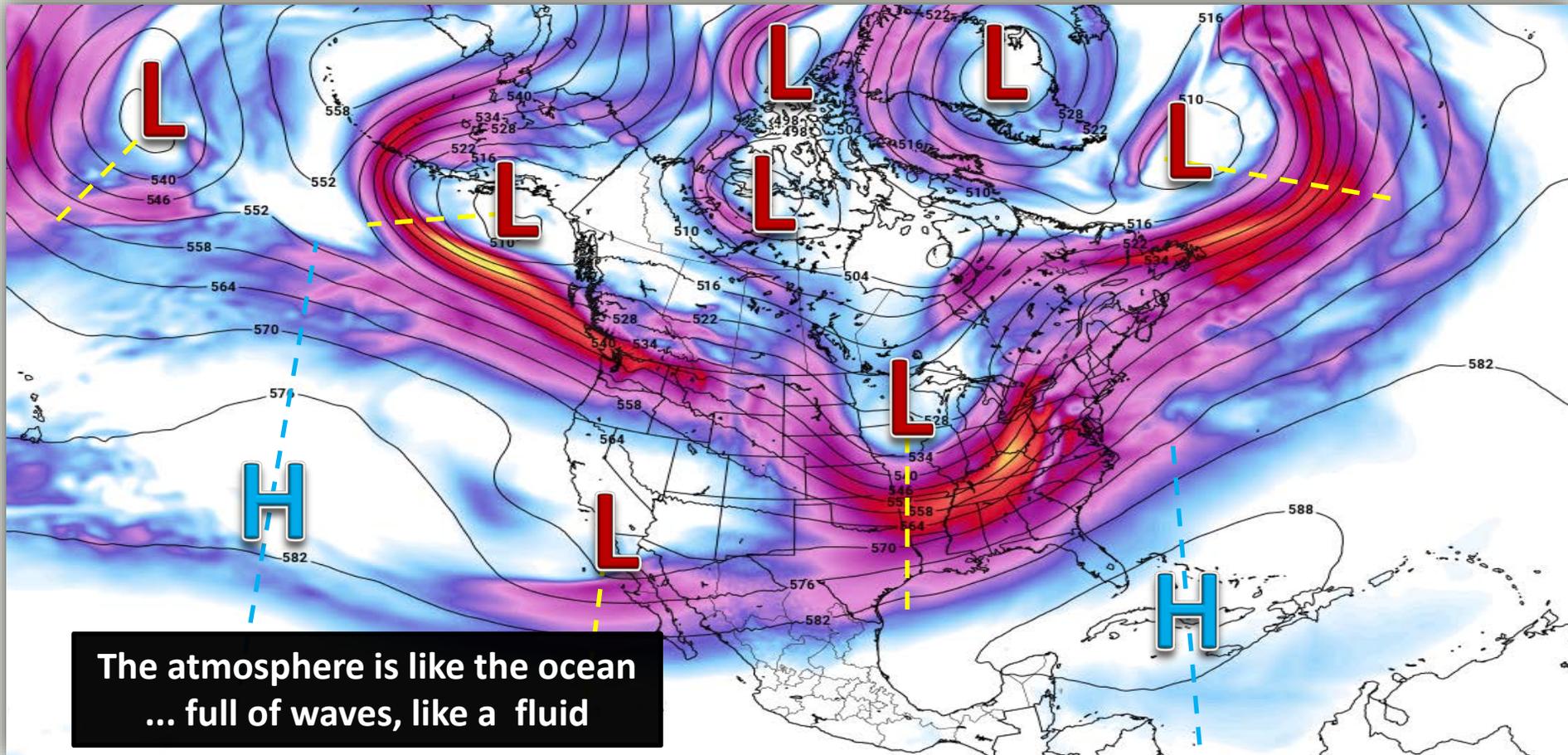
# Global Weather Patterns



## Westerlies vs. Easterlies

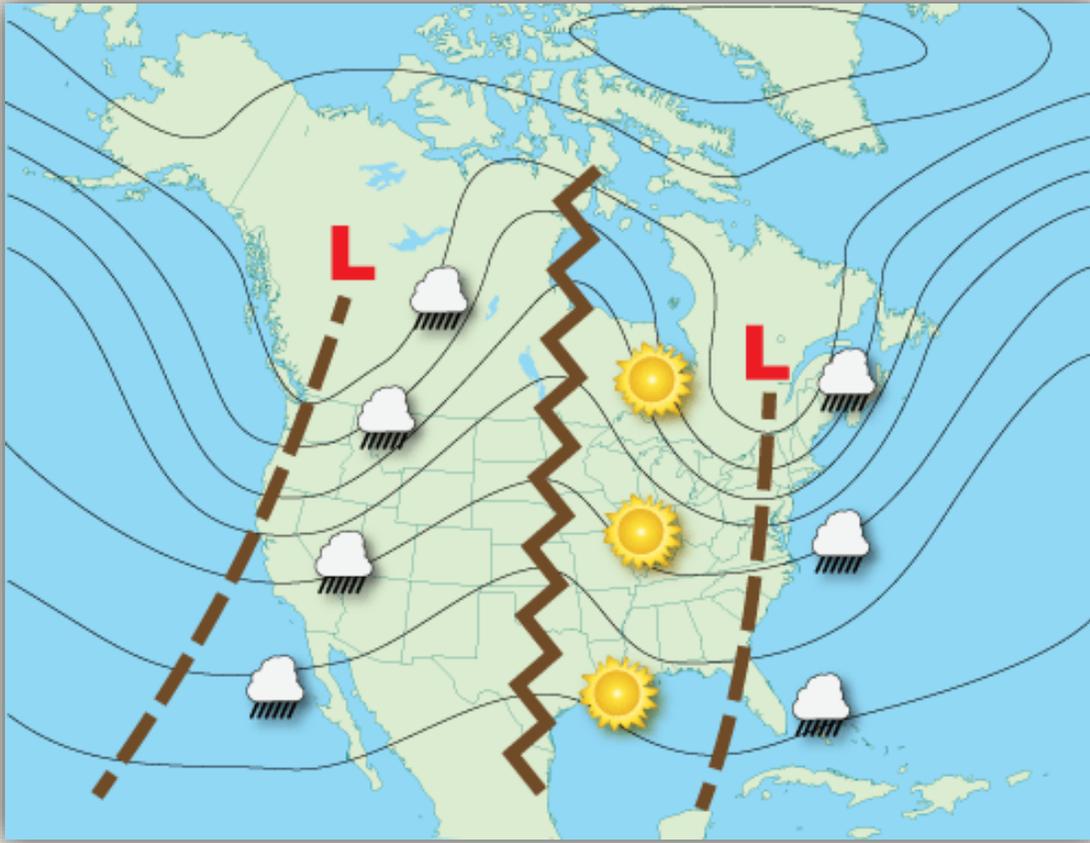
- Most of our weather comes from the west
- Hurricanes come from the east

# Synoptic Weather Patterns



# Neutrally-Tilted Troughs

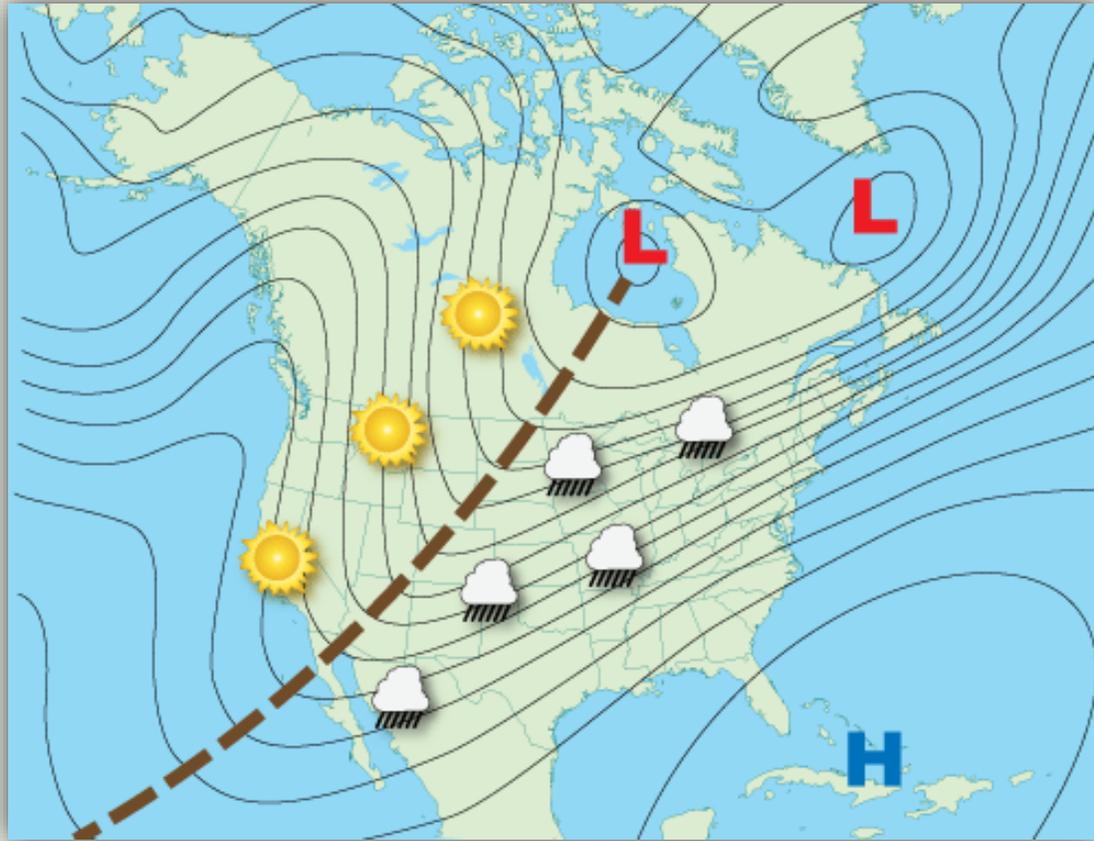
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- Trough axis extends from the lowest pressure north to south
- Active weather occurs between the trough and downwind (eastward) ridge

# Positively-Tilted Trough

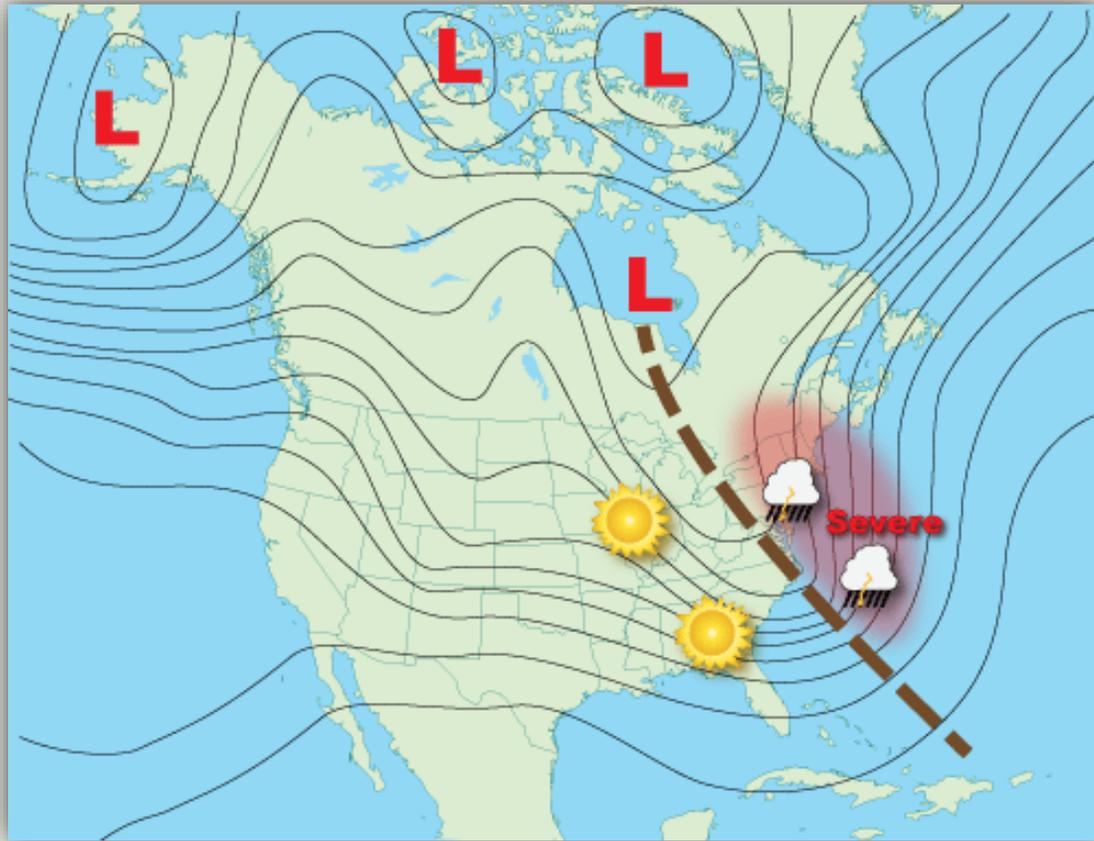
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- Trough axis extends from the lowest pressure northeast to southwest
- Active weather can occur, but not 'too much' in the way of severe storms

# Negatively-Tilted Trough

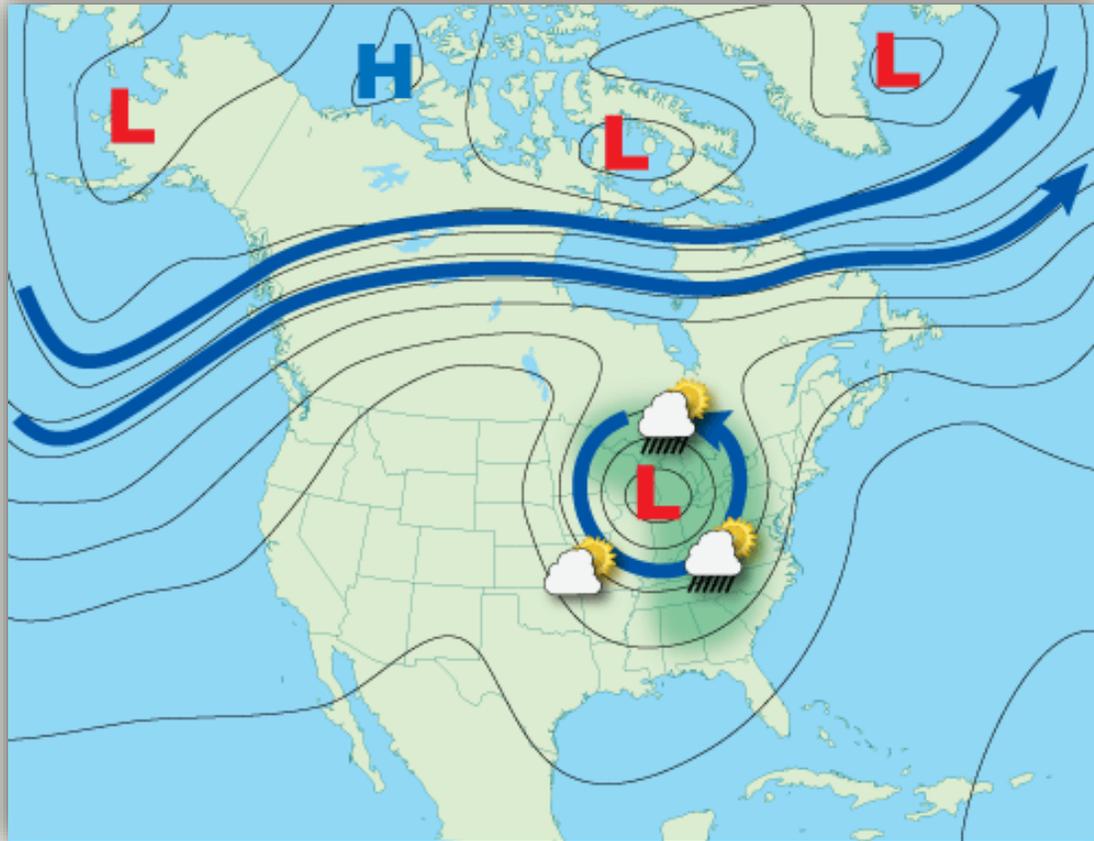
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- Trough axis extends from the lowest pressure northwest to southeast
- Active weather + highest severe potential

# Cut-off Low

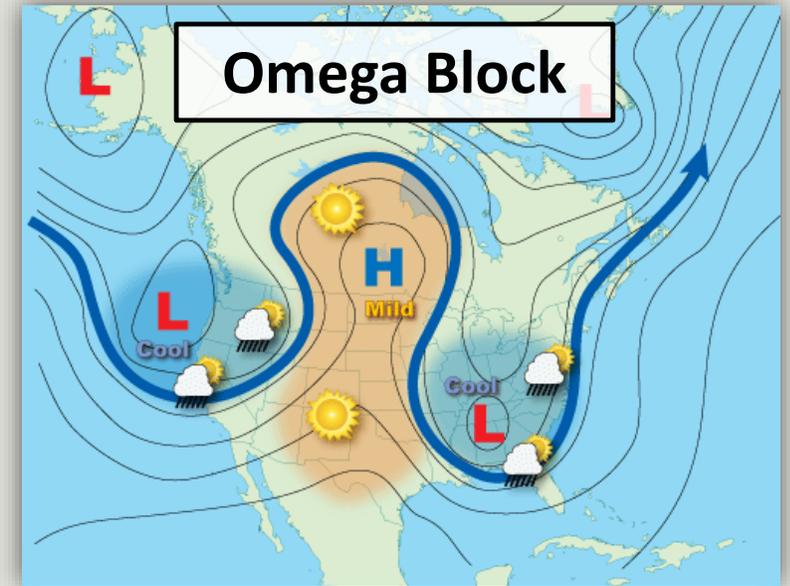
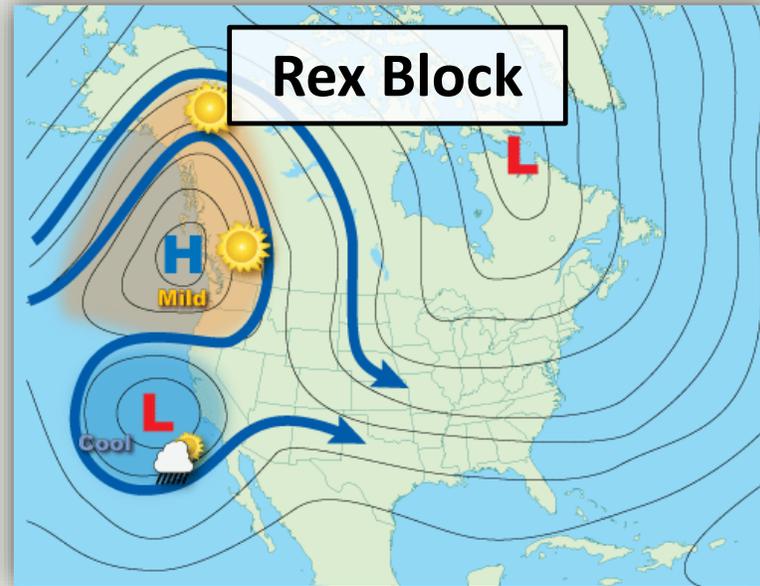
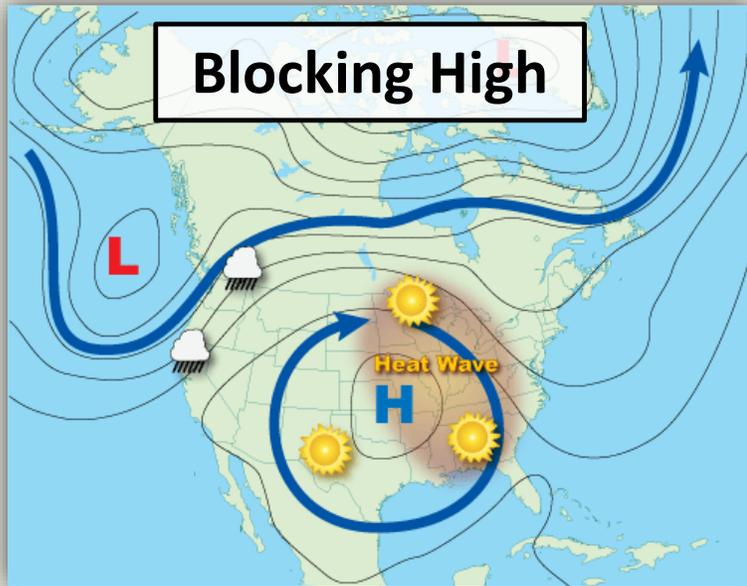
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- Persistent area of low pressure removed from the steering flow
- Can meander for several days, sometimes over a week
- Produce unsettled weather

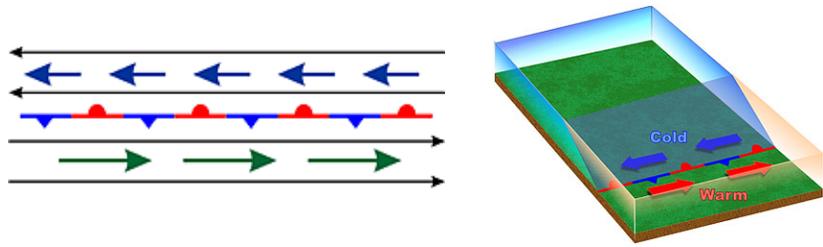
# Blocking Patterns

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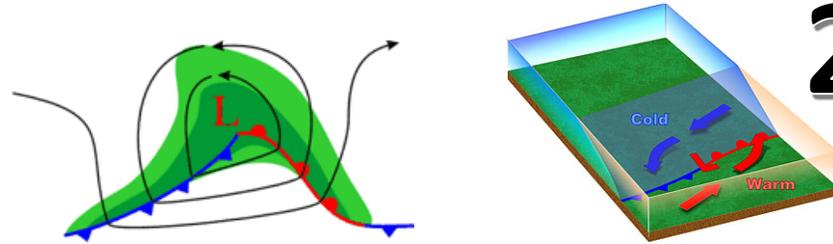


- When weather systems set up in a way that prevents progressive movement
- Result in long spans of persistent weather conditions for a given area

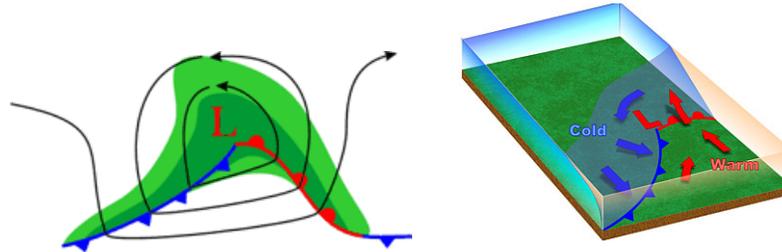




**1** Boundary between warm, cooler air

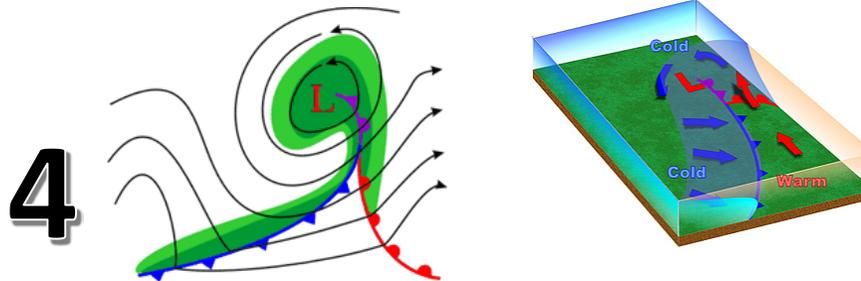


**2** With upper-level impulse, surface wave forms; precipitation develops



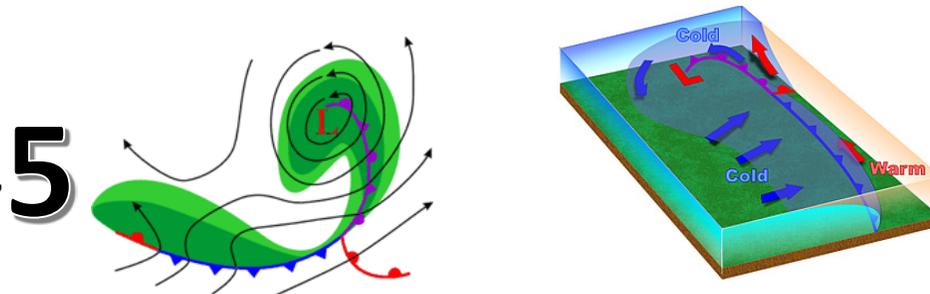
**3** Wave intensifies, fronts become better organized

Low pressure matures. Cold front overtakes warm front and forms an occluded front



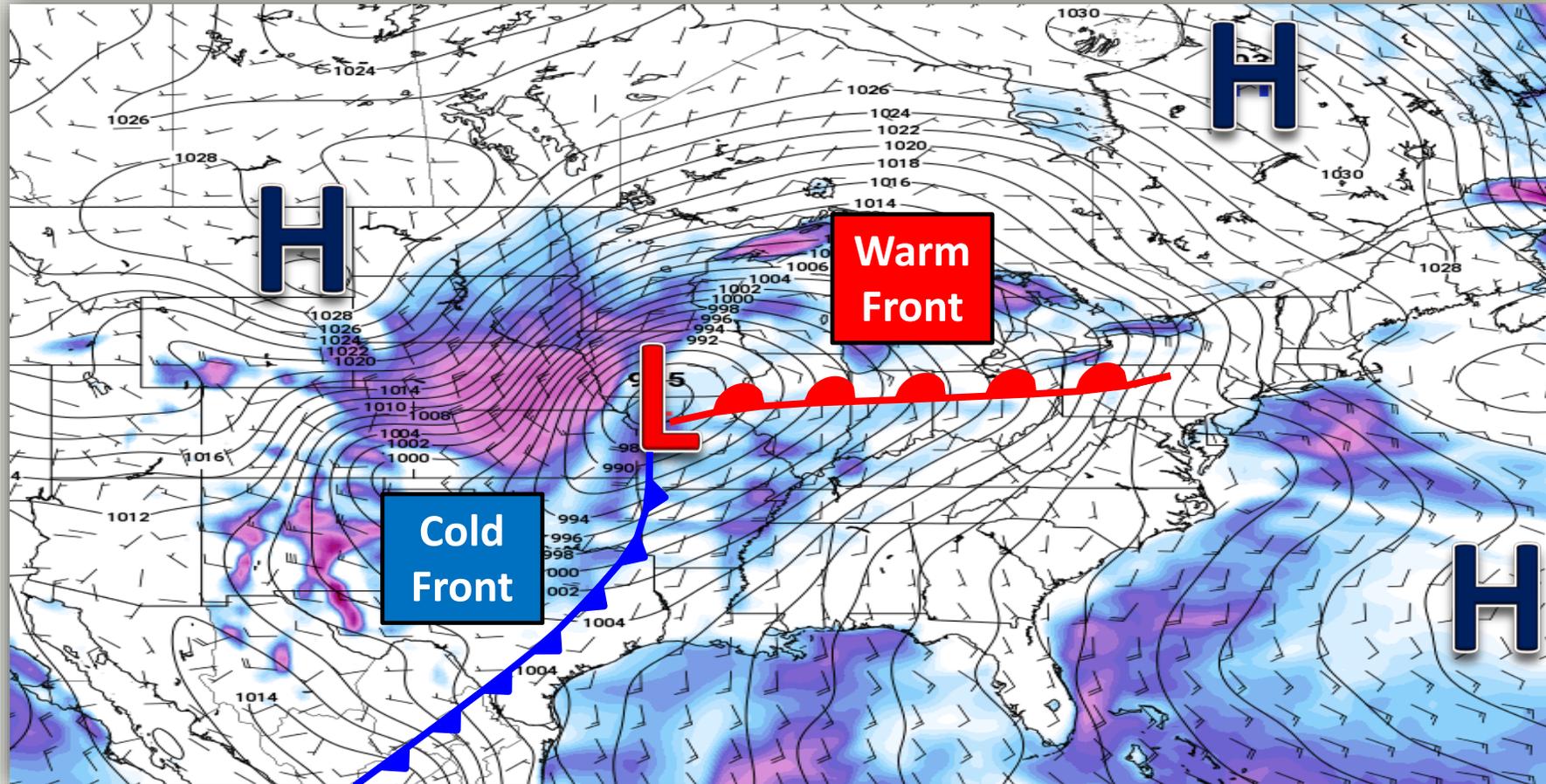
**4**

Cold front continues to advance on warm front and eventually cuts off supply of warm, moist air. Low pressure gradually dissipates

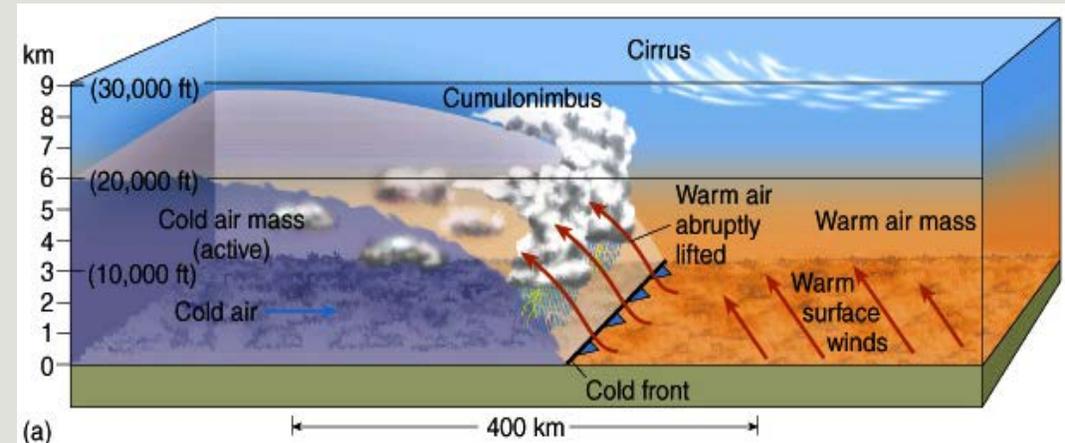
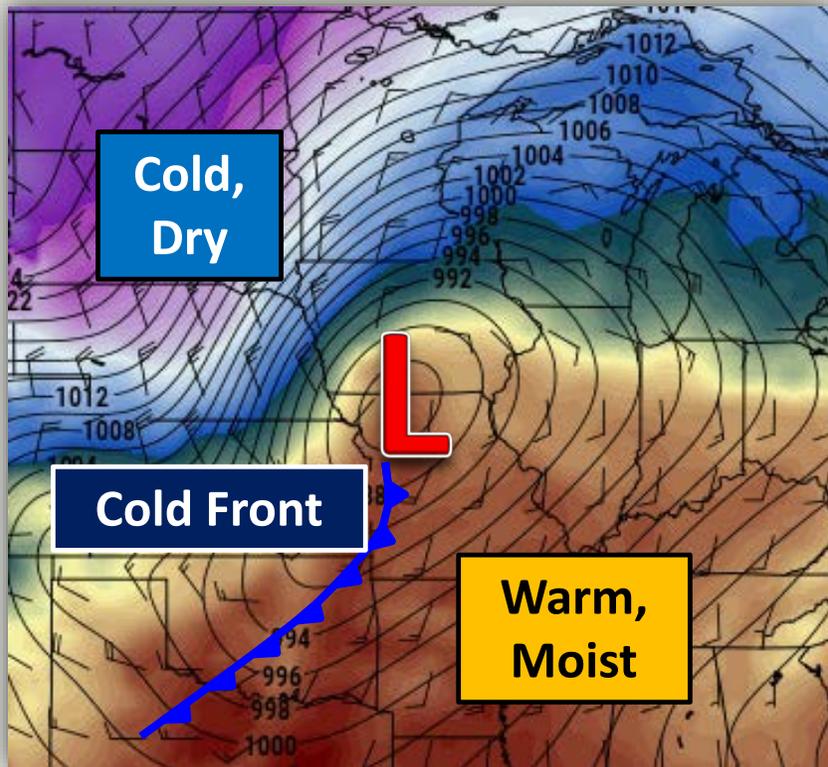


**5**

# Features Associated with Surface Low Pressure



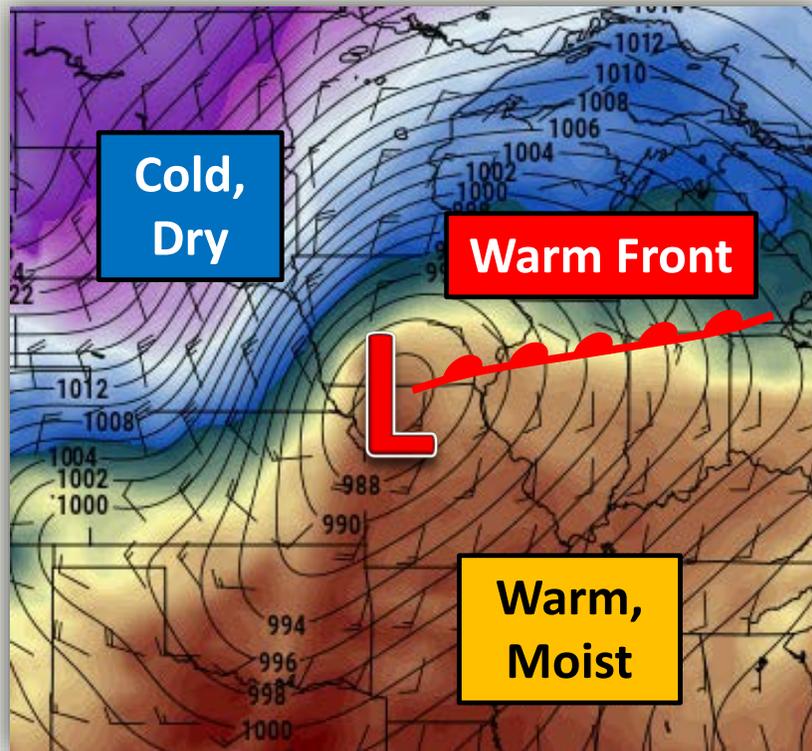
# Cold Front Structure



**Cold front definition: A zone separating two air masses, of which the cooler, denser mass is advancing and replacing the warmer air mass**

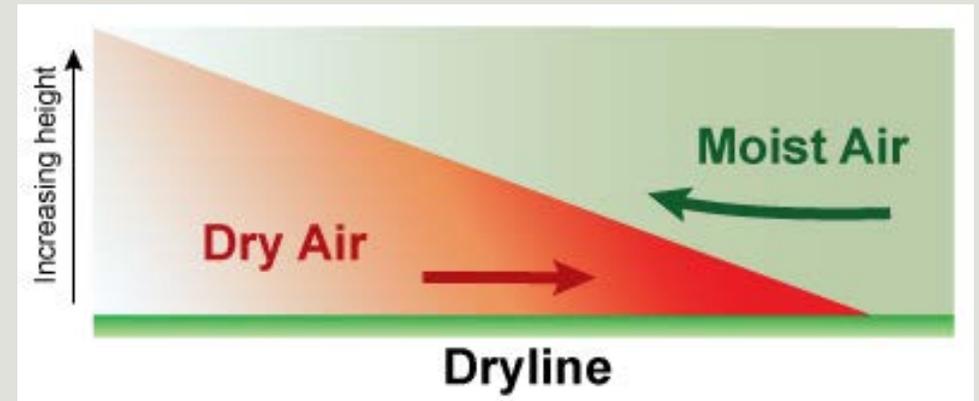
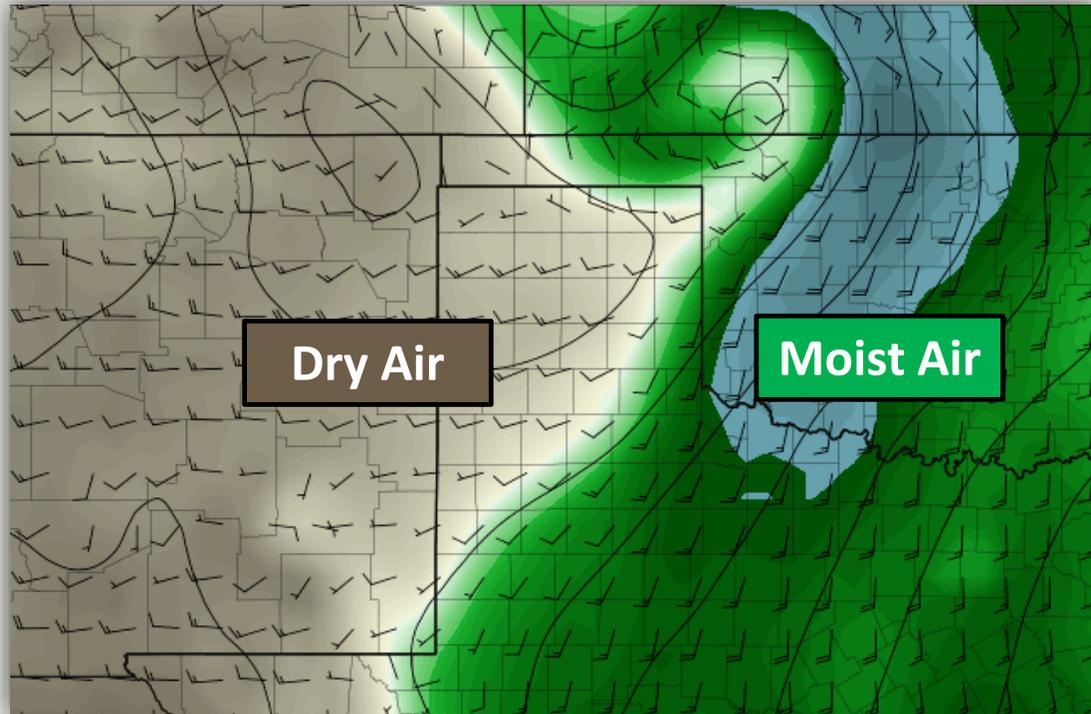
# Warm Front Structure

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**Warm front definition: A transition zone between a mass of warm air and the colder air it is replacing**

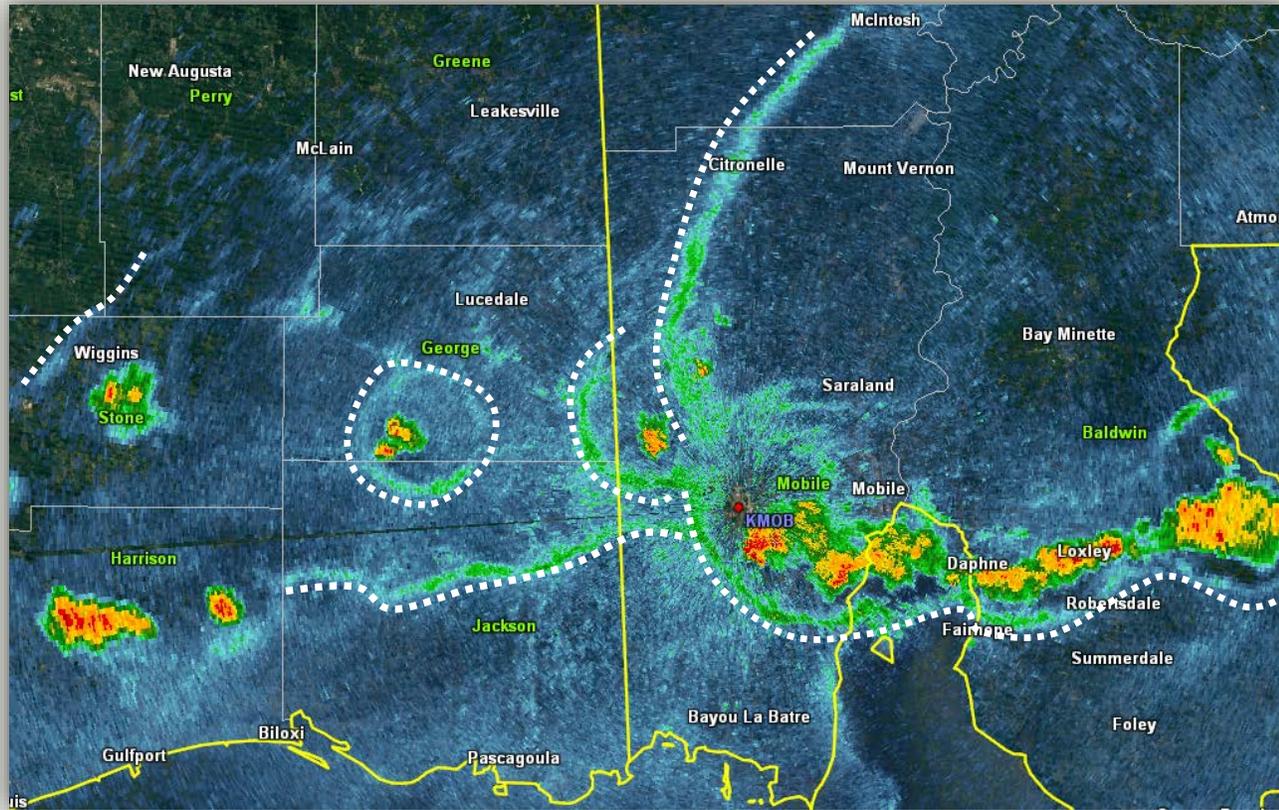
# Other Boundaries – Dryline



**Dryline definition: The boundary between a moist and dry air mass. Dry air forces moist air upward as the boundary moves eastward, which can trigger severe storms.**

\*most common in the Plains, though strong weather systems can sometimes sweep the dryline eastward into the Mississippi Valley region

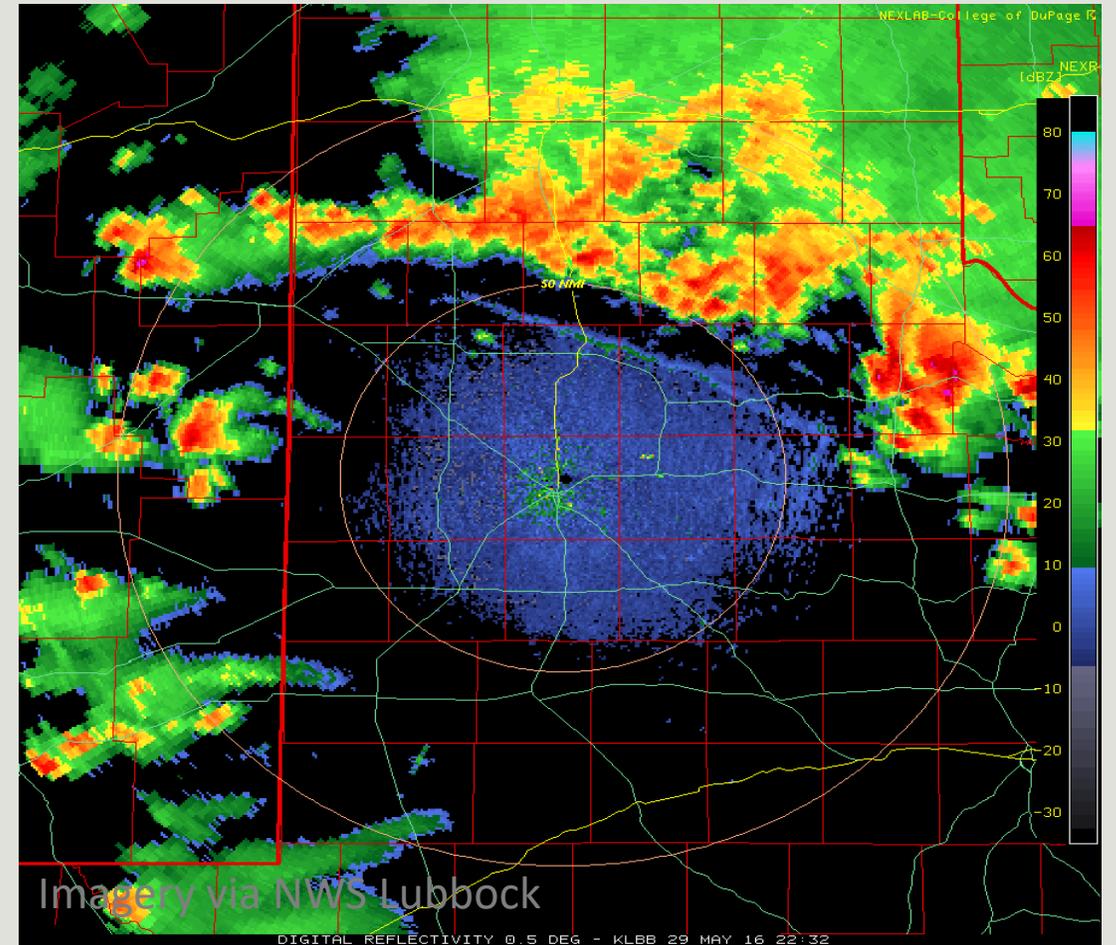
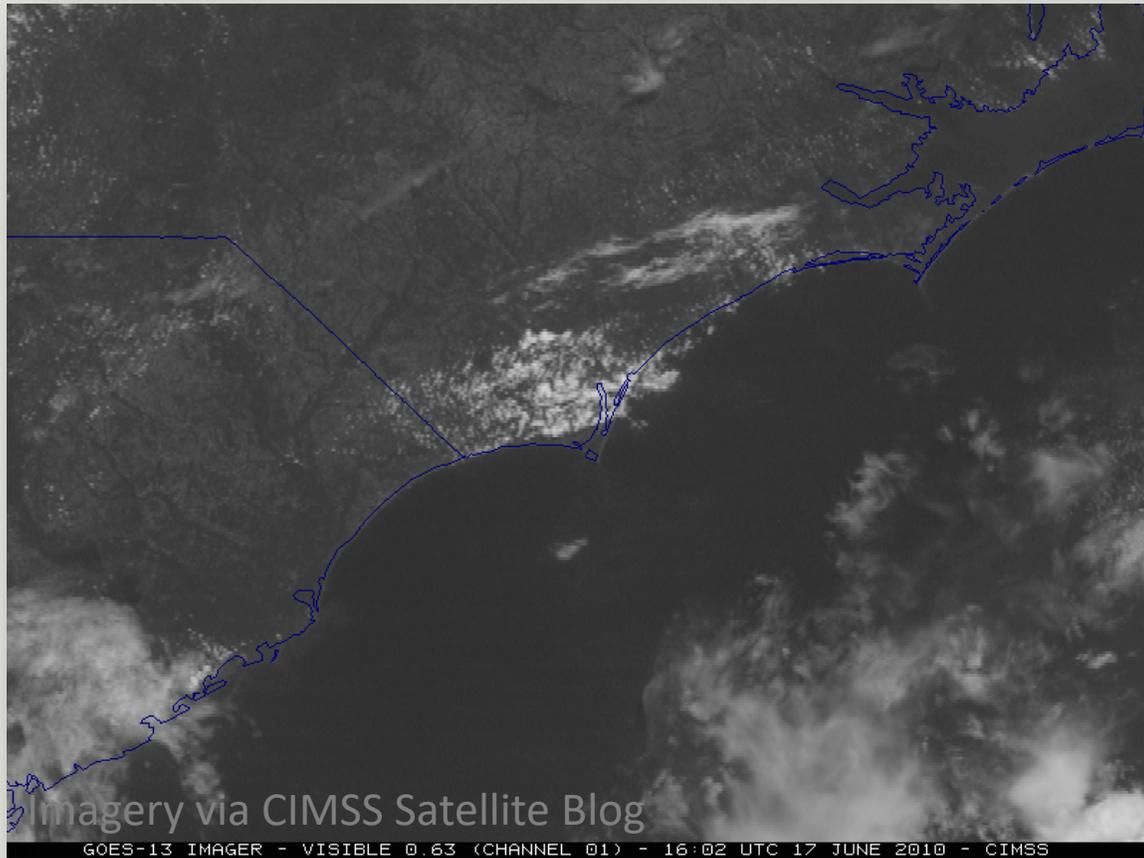
# Other Boundaries – Outflow



**Outflow boundary definition: A small-scale boundary that separates rain-cooled air from the surrounding air**

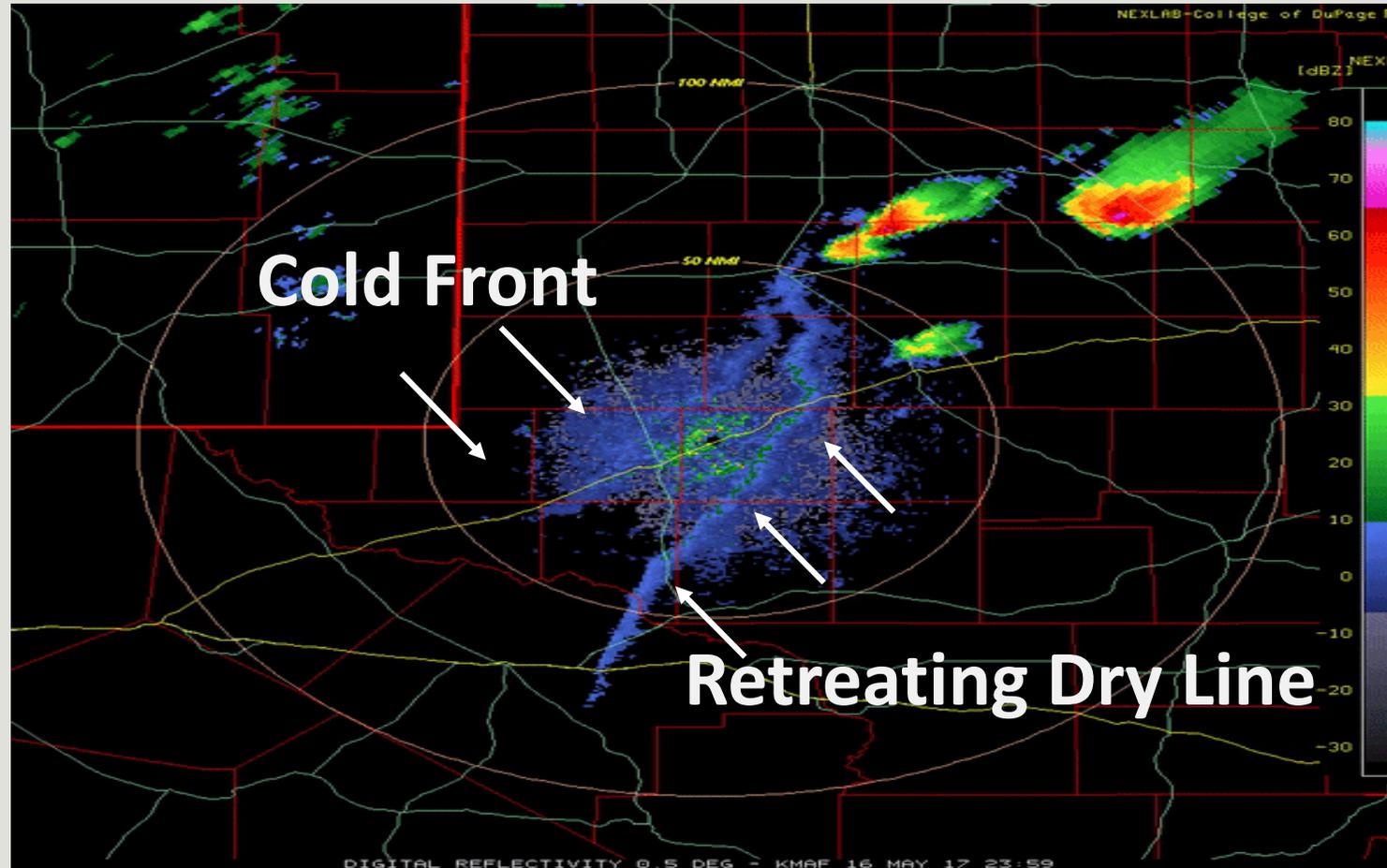
\*similar in effect to a cold front. Passage is marked with a wind shift/increase and drop in temperature. These boundaries can trigger new showers and storms.

# Outflow Boundaries in Action (GIF) --via Satellite and RADAR--

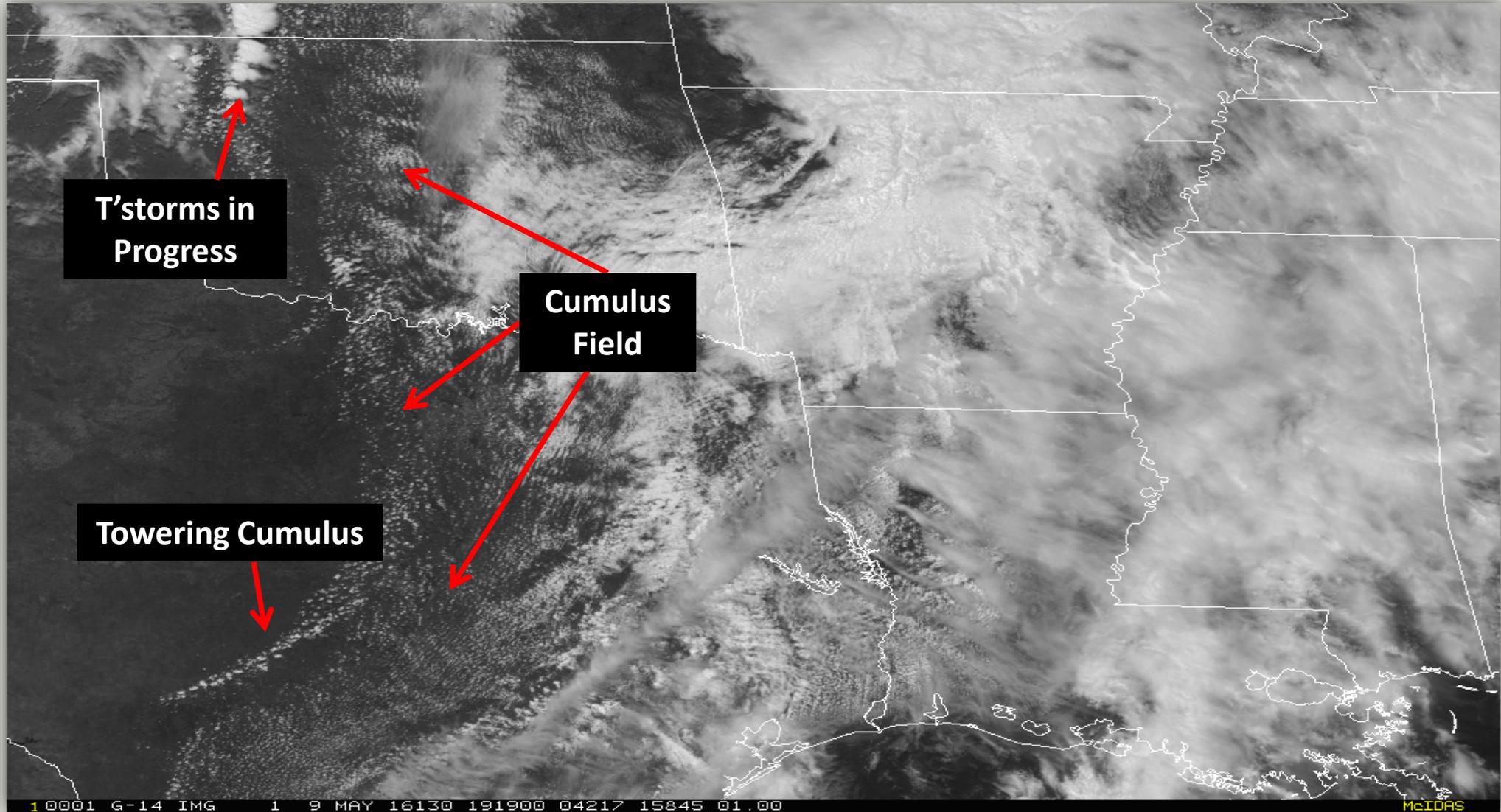


# Collision of 2 Boundaries

--Interesting Things Happen at the Boundaries--



# Stages of Activity



# GOES-16 One-Minute Imagery



1 0001 G-16 IMG 2 8 JUN 17159 233053 00697 00736 01.00 CIRA/RAMMB

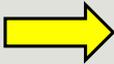
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## Part II

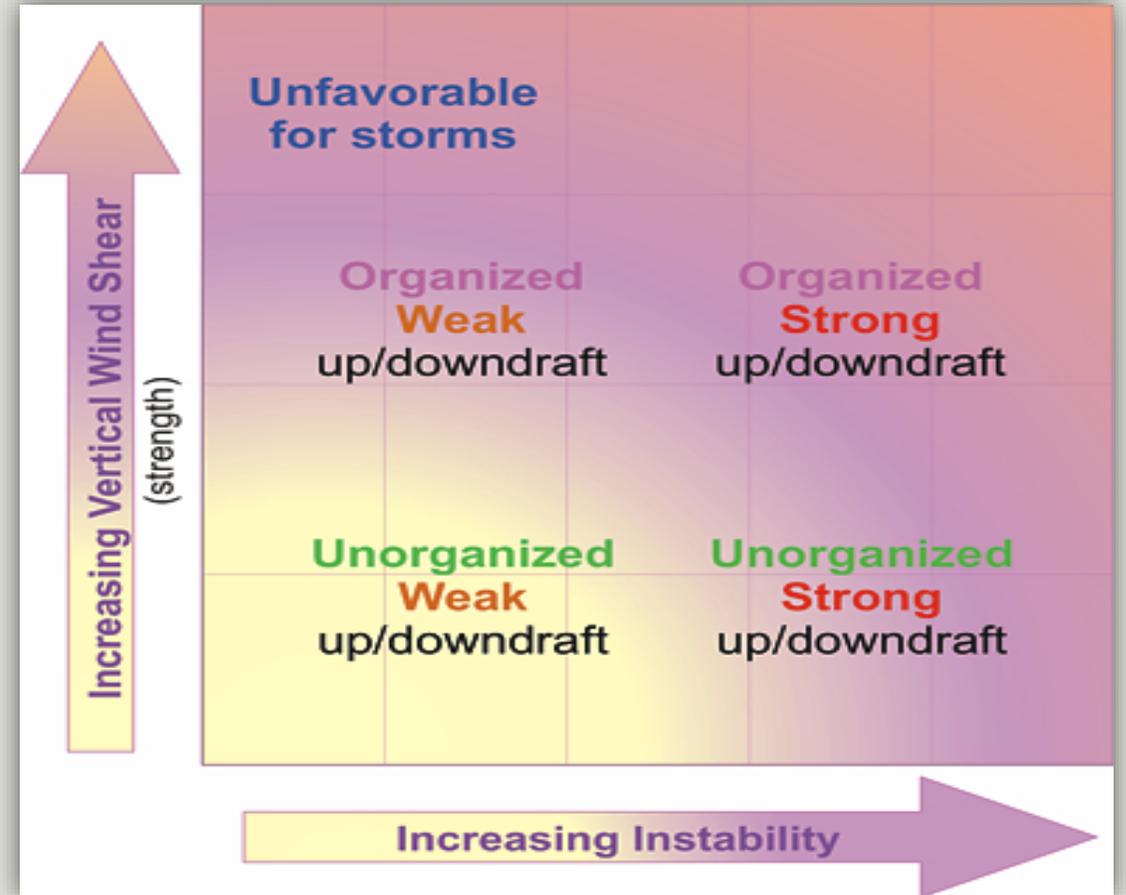
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# Ingredients for Thunderstorm Formation

- Source of lift
  - Cold front
  - Warm front
  - Gust front/outflow boundary
  - Terrain (upslope flow)
  - Surface heating

- Moisture
- Instability

\*Wind shear helps with thunderstorm organization/longevity and severity



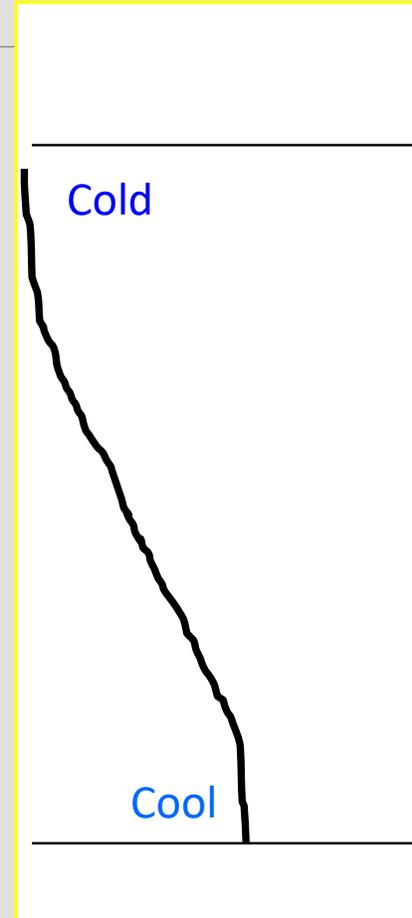
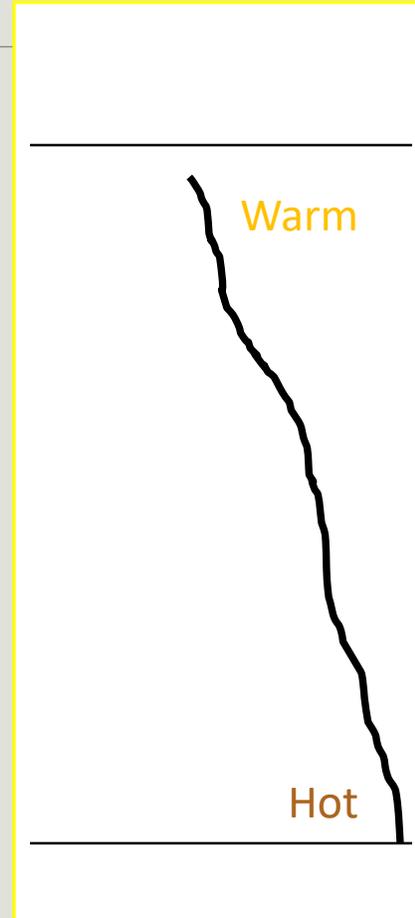
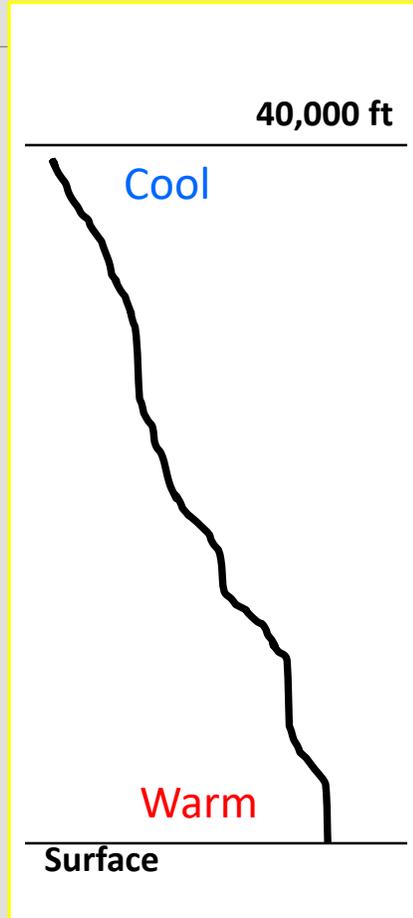
# The 3-Dimensional Atmosphere Instability



General

Summer

Winter



In basic terms, the instability of the atmosphere is measured based upon how warm it is at the surface versus how cold it is aloft.

In general, the atmosphere gets colder as you go up.

During the summer, it is a lot hotter at the surface, but it also warm aloft

In the winter it is colder at the surface, but it is also colder in the upper atmosphere, as well.

Temperature Increasing →

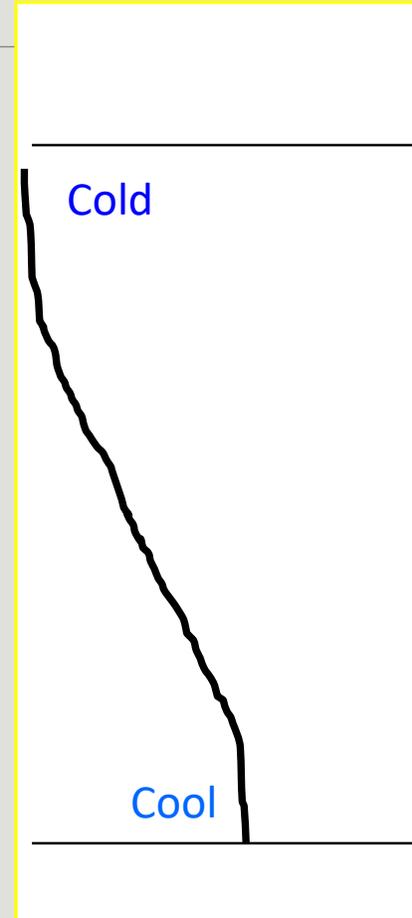
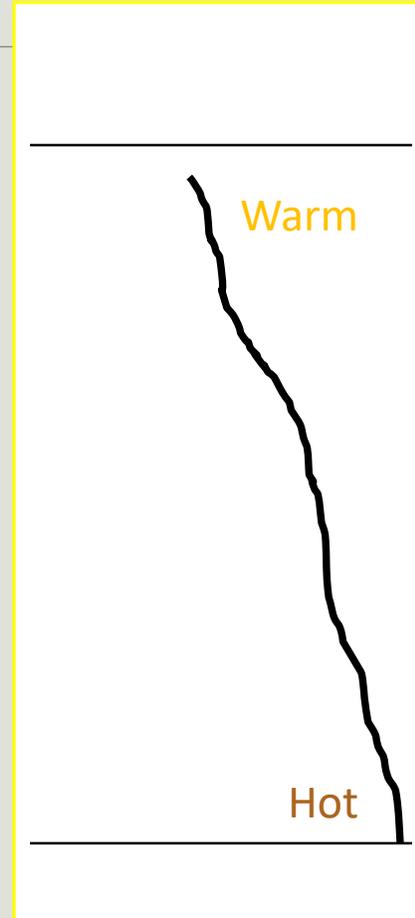
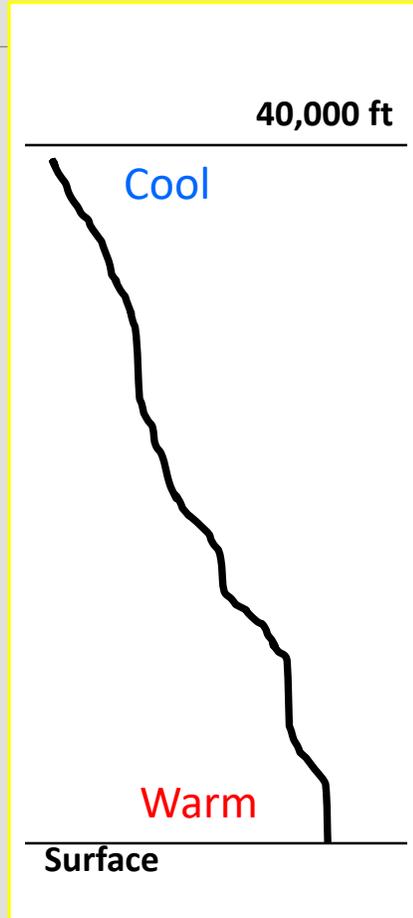
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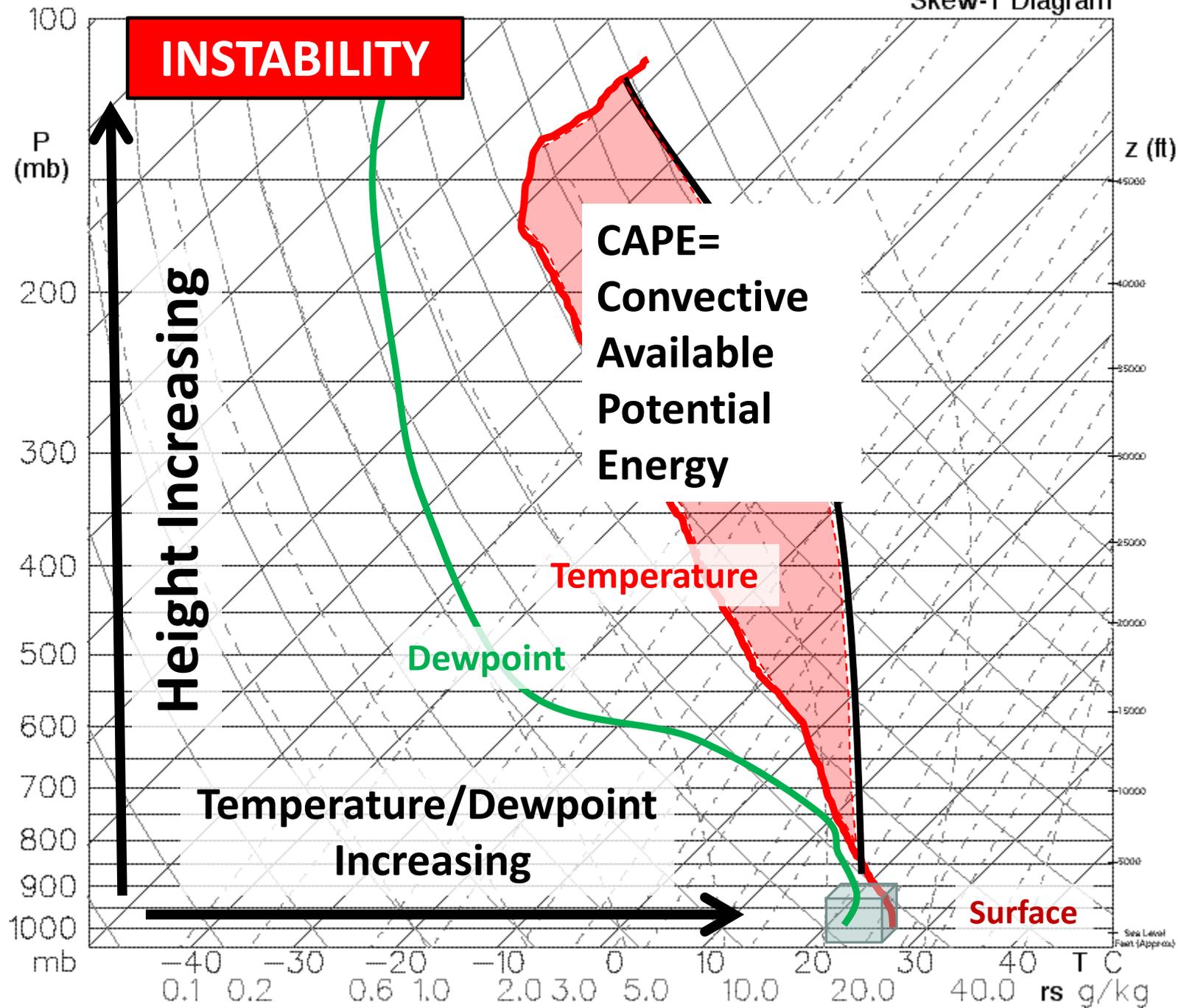
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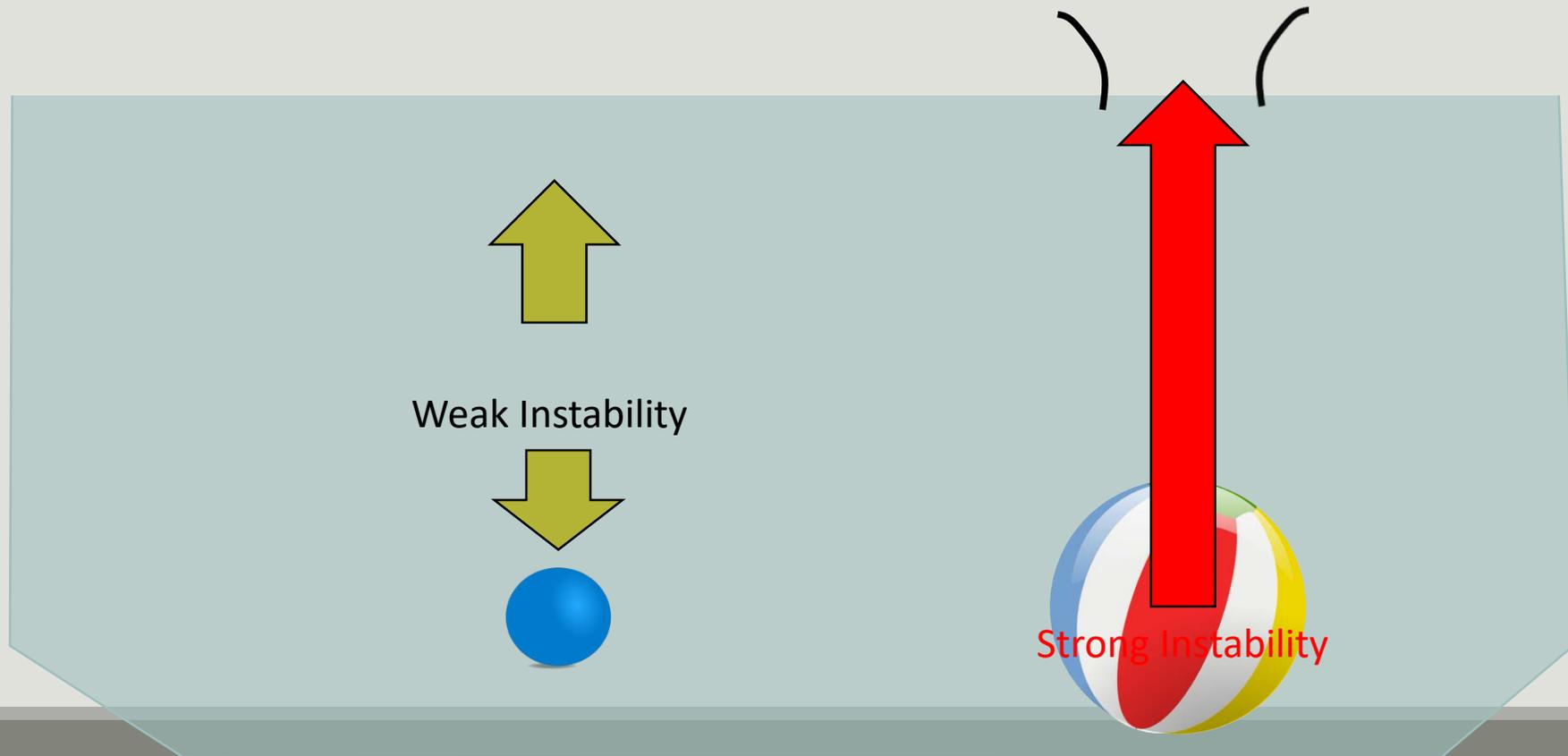
**How is the instability calculated?**

Temperature  
Increasing →

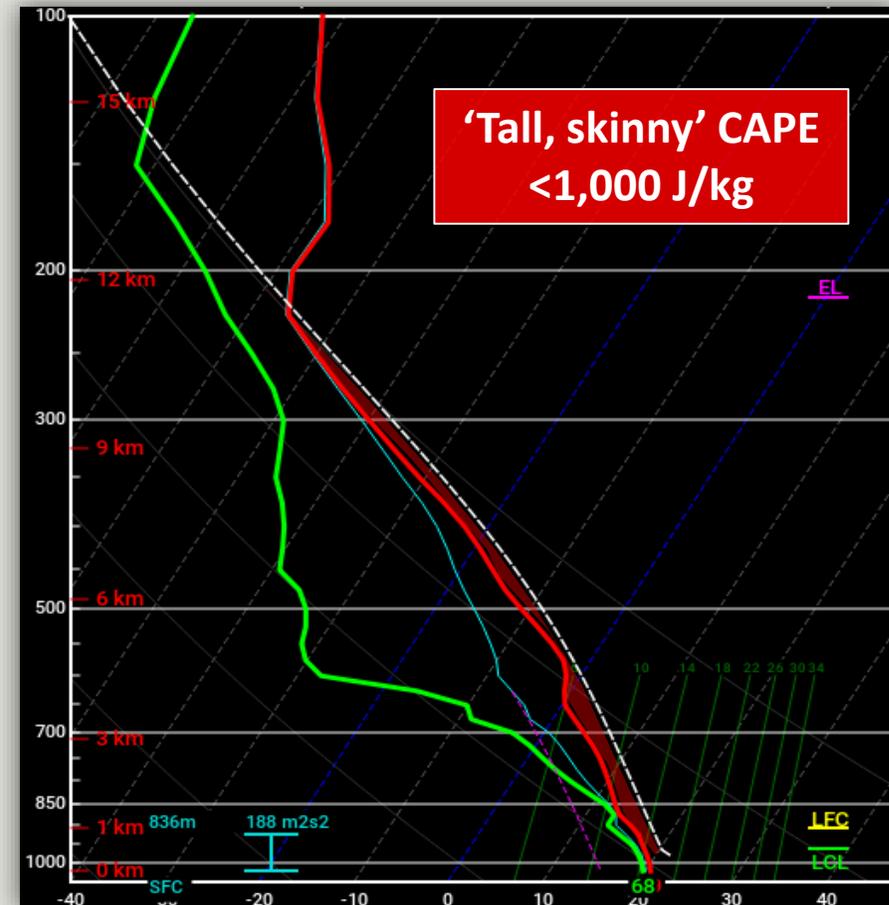
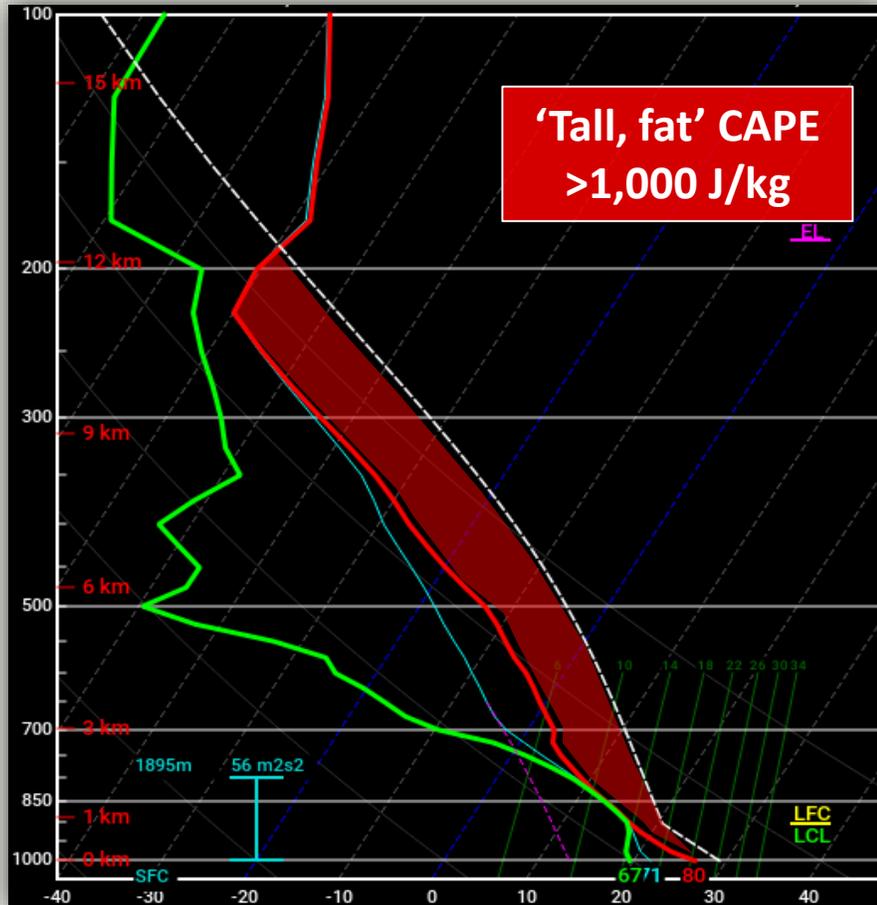


# The 3-Dimensional Atmosphere Instability

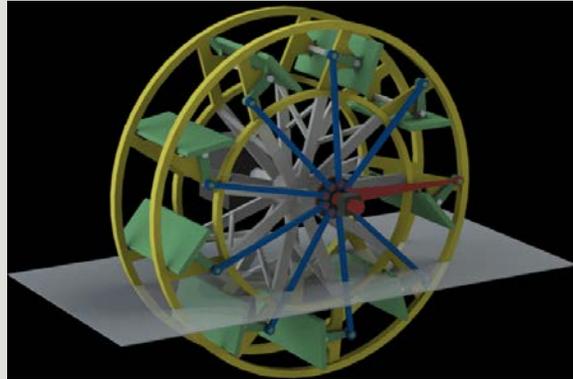
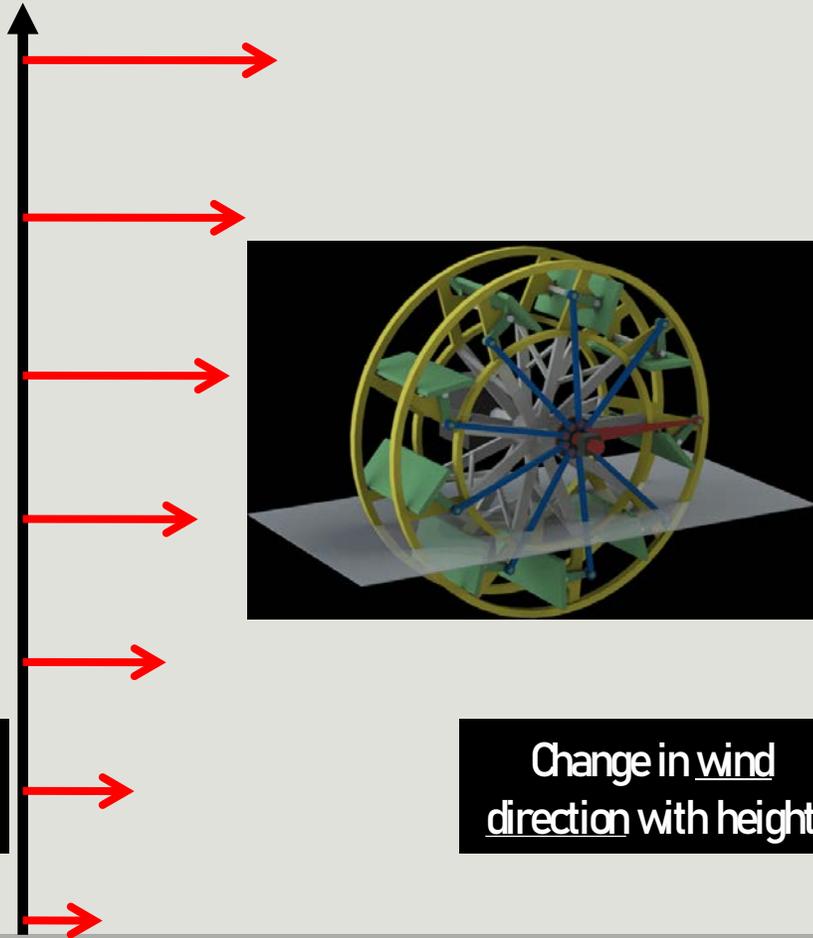
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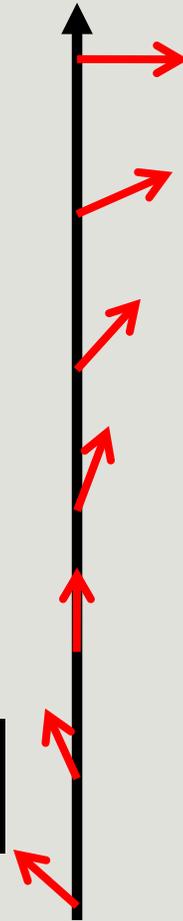
# Instability - Weak vs. Strong CAPE



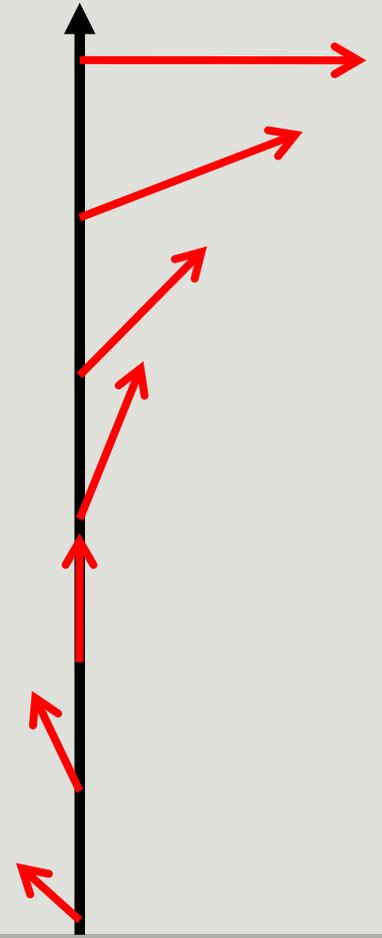
# Wind Shear



Change in wind direction with height

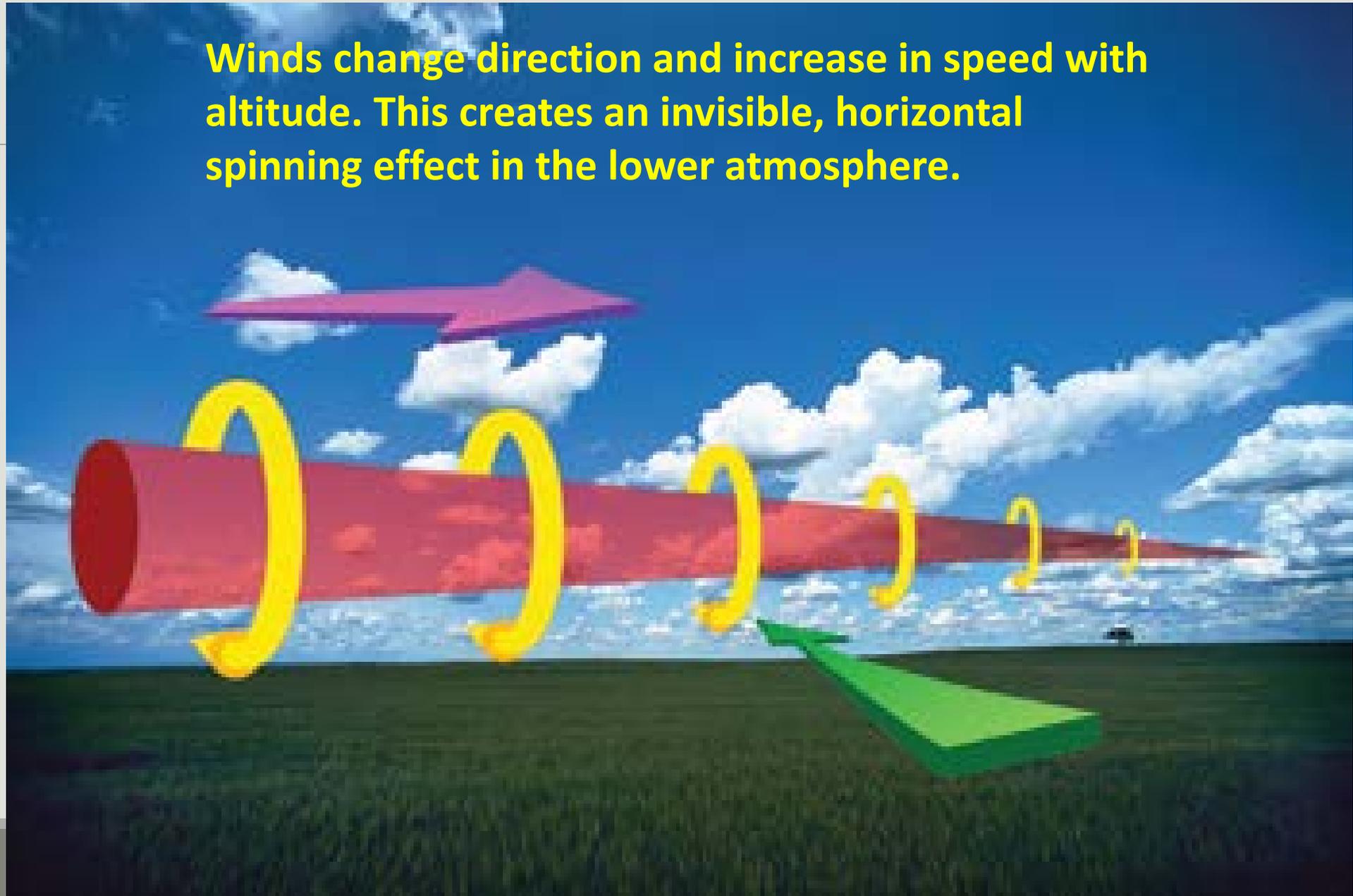


Change in wind speed and direction with height



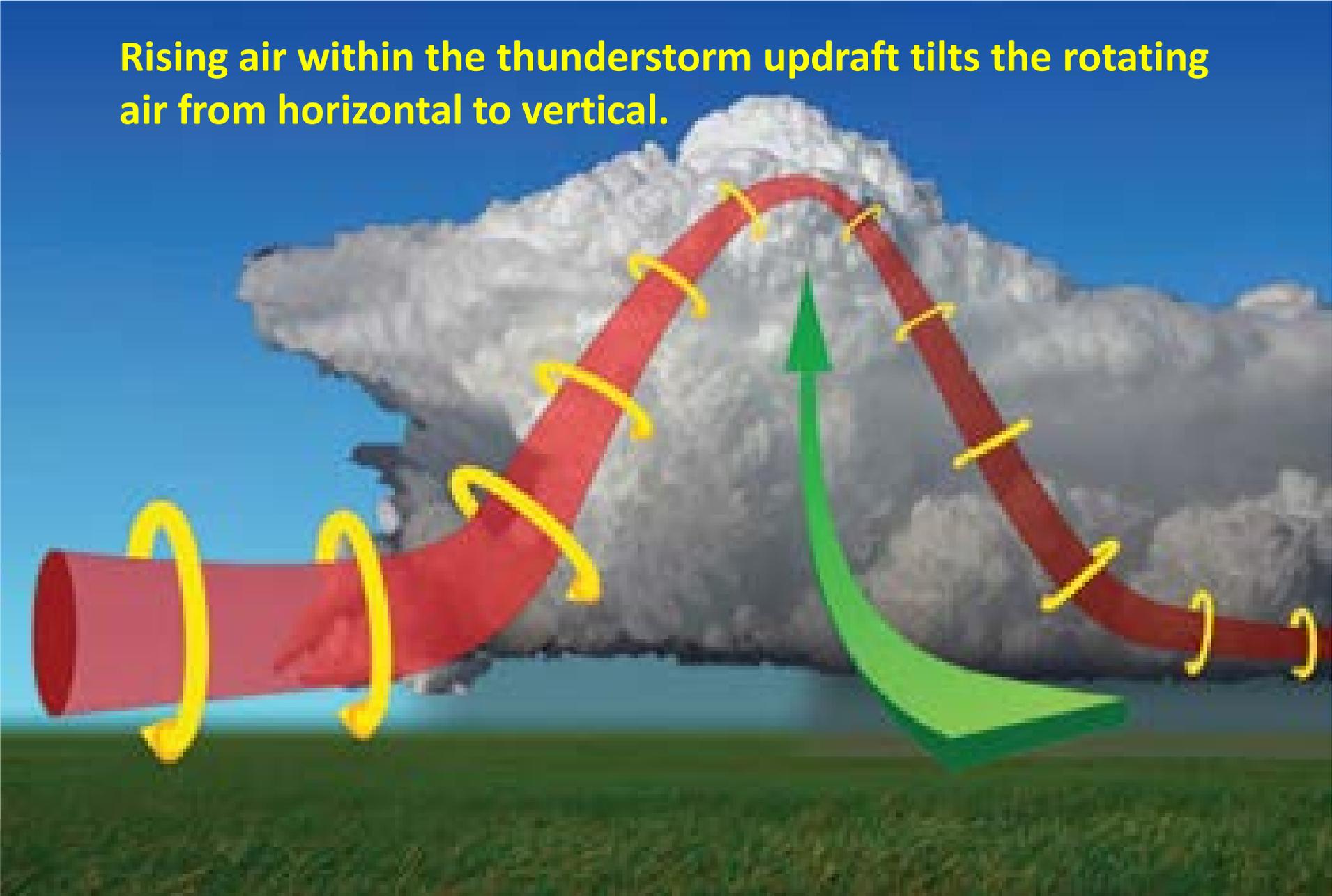
# Wind Shear

Winds change direction and increase in speed with altitude. This creates an invisible, horizontal spinning effect in the lower atmosphere.



# Wind Shear and Updraft

Rising air within the thunderstorm updraft tilts the rotating air from horizontal to vertical.



# Mesocyclone Formation

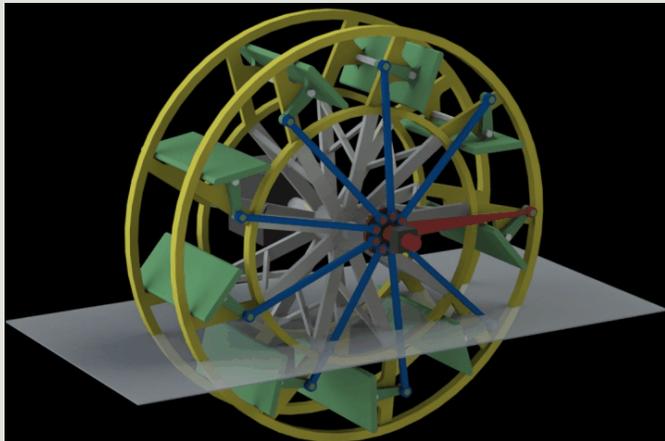
A mesocyclone, an area of rotation 2-6 miles wide, now extends through much of the storm.



# Bulk Shear

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- Difference in wind vectors (speed + direction) between 2 levels.
- >35 kts of bulk shear between the surface and 6 km above the surface means supercells can form.
  - *(if there is instability, lift, and moisture)*
- Wind shear between the surface and 3 km and surface and 1 km also important.



# Storm Relative Helicity

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- Potential for updraft rotation
- Required for corkscrew/helix-shaped flow



# Storm Relative Helicity

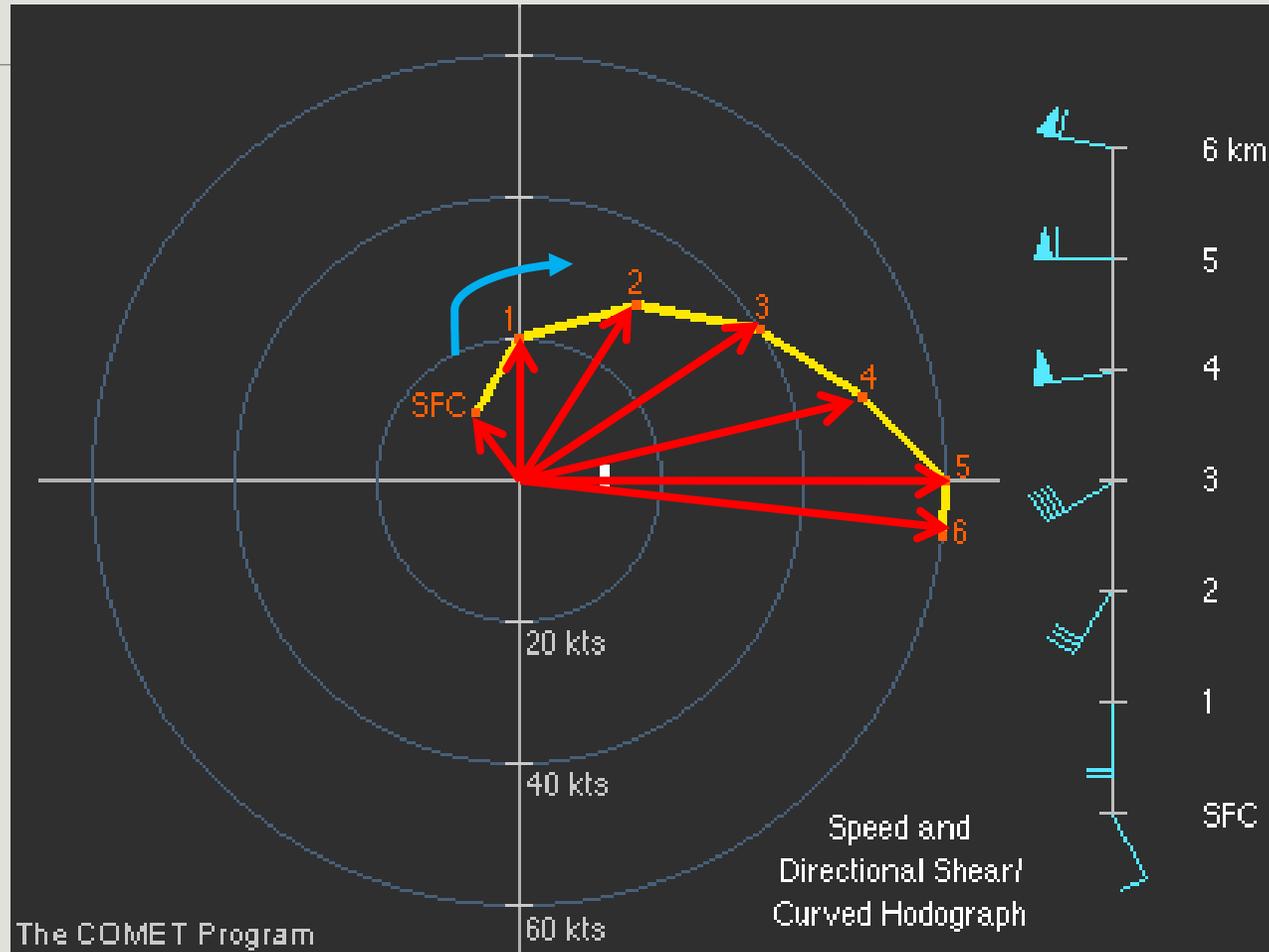
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Indicator of streamwise vorticity (spin): football spiral

Instead of crosswise vorticity: frisbee



# Storm-Relative Helicity



Observed via a hodograph

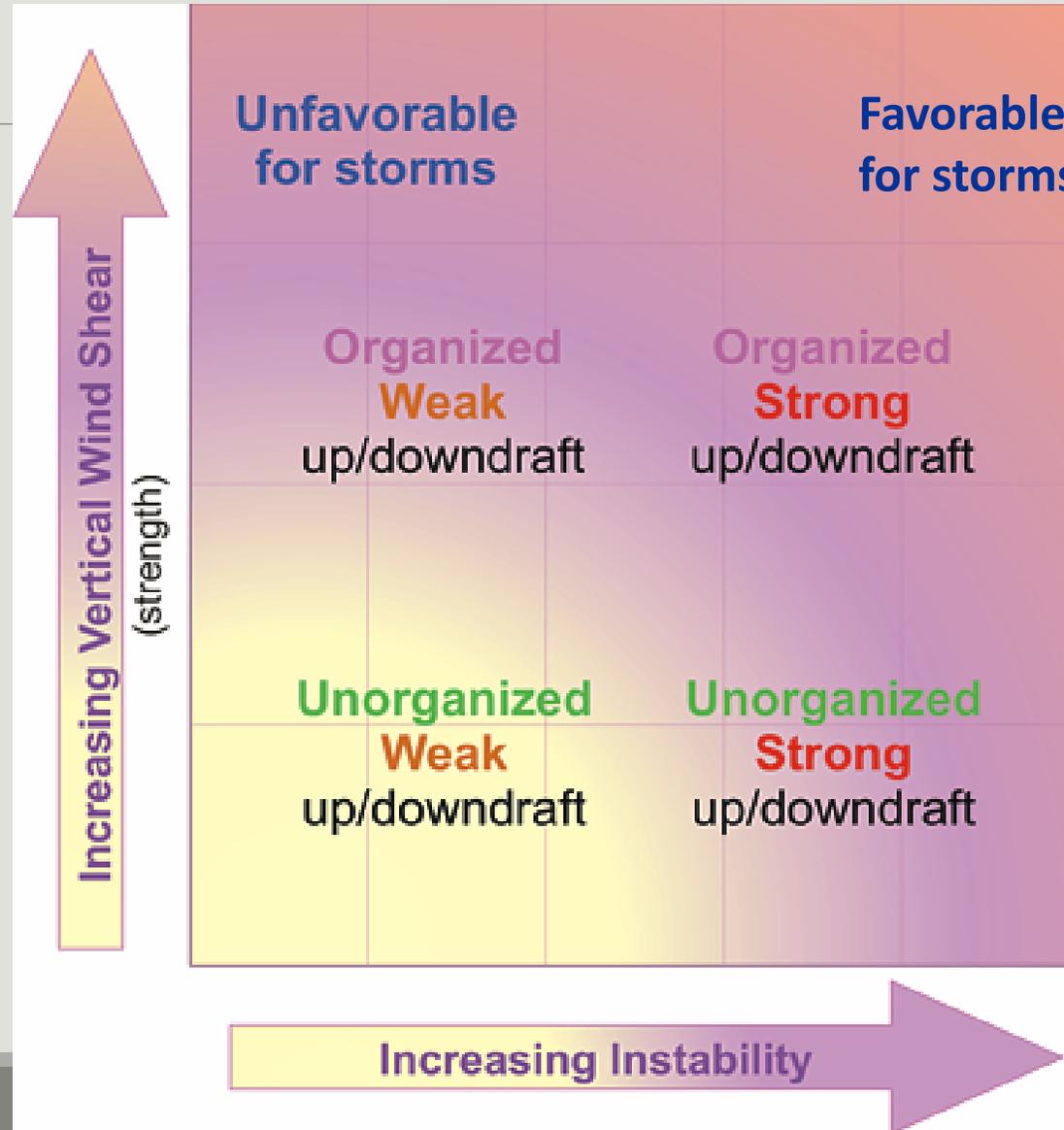
Wind vectors (length based on speed) drawn at multiple heights

Hodograph connects the tips of these vectors

Look for long hodograph (deep layer shear) and curved shape at low-levels (typically the left side)

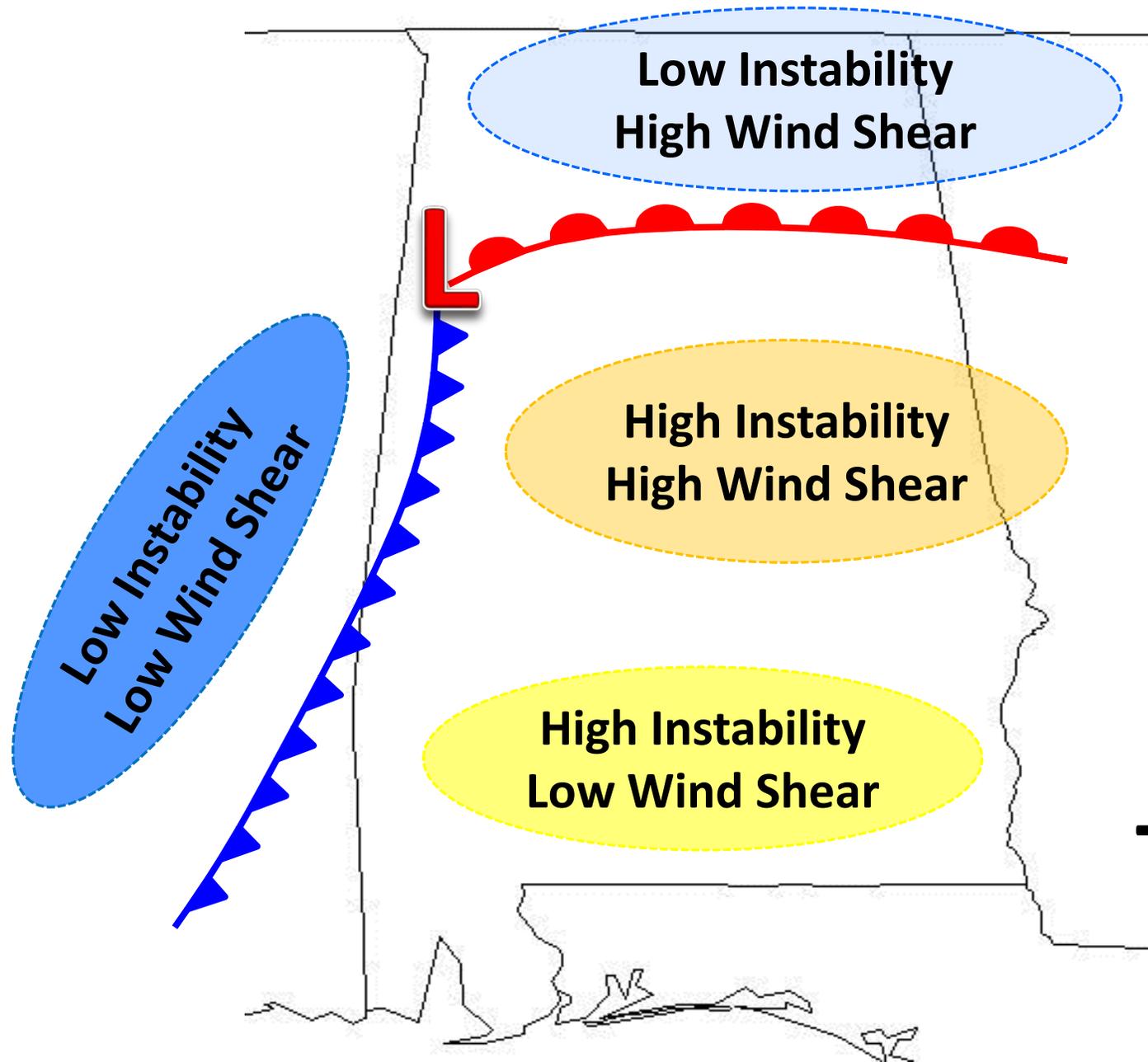
# Finding the Perfect Balance

## Instability versus Wind Shear



Finding the perfect balance between instability and wind shear remains a forecast challenge.

All about the favorable **mode of convection**.



**Typical surface  
low setup.**

# Lifting Condensation Level (LCL)

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- Measure of height of cloud base
- Function of near-ground humidity—related to temperature-dew point difference
- Lower LCL = less humid environment = downdraft temperature won't be as cool relative to environment compared to if the LCL was high



Low LCL: favorable for tornadoes



High LCL: favorable for straight-line winds

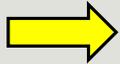
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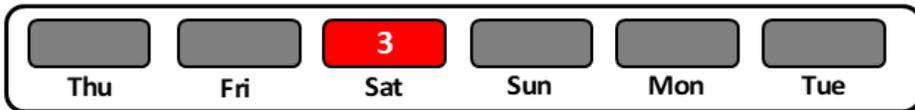
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# National Weather Service Birmingham Hazardous Weather Outlook

ISSUED: 4:29 PM Wednesday, April 3, 2019

EXPIRES: 6:30 AM Thursday

- Tropical
- Tornado
- Severe Storms
- Wind
- Heat/Cold
- Flood
- Fog
- Fire
- Winter Weather
- No Hazards



# weather.gov/bmx

Hazardous Weather Outlook  
National Weather Service Birmingham AL  
311 AM CDT Wed Apr 3 2019

ALZ011>015-017>050-041115-  
Marion-Lamar-Fayette-Winston-Walker-Blount-Etowah-Calhoun-Cherokee-  
Cleburne-Pickens-Tuscaloosa-Jefferson-Shelby-St. Clair-Talladega-  
Clay-Randolph-Sumter-Greene-Hale-Perry-Bibb-Chilton-Coosa-Tallapoosa-  
Chambers-Marengo-Dallas-Autauga-Lowndes-Elmore-Montgomery-Macon-  
Bullock-Lee-Russell-Pike-Barbour-  
311 AM CDT Wed Apr 3 2019

This Hazardous Weather Outlook is for the counties served by the National Weather Service office in Birmingham.

.DAY ONE...Outlook through Tonight.

No hazardous weather is expected at this time.

.DAYS TWO THROUGH SEVEN...Thursday through Tuesday.

No hazardous weather is expected at this time.

SPOTTER INFORMATION STATEMENT...

Activation of storm spotters and emergency management is not expected at this time.

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# weather.gov/bmx

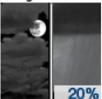
MY FORECAST  
Birmingham AL



Mostly Cloudy

**73°F**  
23°C [Get Detailed info](#)

Tonight



20%  
Mostly Cloudy then Slight  
Chance Showers  
Low: 55°F

Monday



60% 80%  
Showers Likely then T-  
storms  
High: 70°F  
[change location](#)

**National Weather Service Forecast Office**  
**Birmingham, AL**  
Weather.gov > NWS Birmingham, Alabama

**NWS Birmingham, Alabama**  
Weather Forecast Office

Current Hazards Current Conditions Radar **Forecasts** Rivers and Lakes Climate and Past Weather Local Programs

Monday Severe **2** Tonight Monday

Hourly View  
Forecaster's Discussion  
Activity Planner  
Fire  
Graphical  
Tropical Weather  
Aviation Weather  
Air Quality Forecast

**Severe Storms Possible**  
Monday Afternoon/Evening (1)

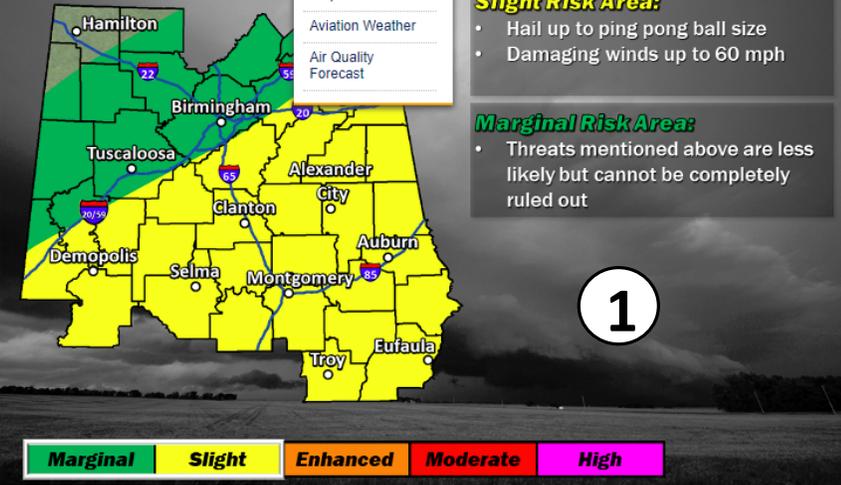
Weather Forecast Office  
Birmingham, AL  
Issued March 24, 2019 1:14 PM CT

**Slight Risk Area:**

- Hail up to ping pong ball size
- Damaging winds up to 60 mph

**Marginal Risk Area:**

- Threats mentioned above are less likely but cannot be completely ruled out



**Marginal** **Slight** **Enhanced** **Moderate** **High**

[f](#) [t](#) [v](#) NWSBirmingham weather.gov/bmx

Severe storms possible in the afternoon and evening.

--Slight Risk of severe storms Monday afternoon to evening w/ large hail and damaging wind potential--

2

A shortwave trough will move from the Midwest toward the Central Appalachian region on Monday while a secondary shortwave trough moves from the Southern Plains into the Southeastern CONUS. The secondary trough will be the primary factor in Monday's severe threat.

The primary forecast complication is with respect to upstream precipitation that is forecast to move into the northwestern part of the forecast area early morning Monday. It appears that this activity should begin weakening as it continues eastward, setting the stage for a lingering boundary/differential heating zone. As the secondary impulse arrives during ensuing daytime heating, we'll be looking at an increasingly unstable air mass with support for renewed convection. Pending this scenario, strong to severe storms could occur during the afternoon and evening hours.

Surface flow ahead of the associated cold front won't be ideal for rapid or significant recovery/advection of higher-dew point air, though guidance continues to agree with a corridor of upper 50s to around 60 dews arriving by/into the afternoon hours. This will coincide with peak daytime heating, aiding in ample surface-based and mixed-layer CAPE for strong to severe convection given bulk shear of ~40-50 knots. A look at forecast soundings across Central Alabama show a low-level inverted-V profile with steep lapse rates. This will support a risk of damaging winds up to 60 MPH. A plume of mid-level dry air moving into the base of the trough + some overlap of the convective area and leading edge colder 500mb temperatures will supply mid-level lapse rates in the mid-upper 6 degrees C range. This will support a risk of severe-caliber hail. Given the unidirectional flow, a tornado threat isn't evident at this time. Due to limited vertical moisture content and surface convergence, we shouldn't see a high number of severe-caliber storms.

# Types of Tornado Warnings

BULLETIN - EAS ACTIVATION REQUESTED  
Tornado Warning  
National Weather Service Birmingham AL  
158 PM CST SUN MAR 3 2019

The National Weather Service in Birmingham has issued a

\* Tornado Warning for...  
Central Lee County in east central Alabama...  
Northwestern Russell County in southeastern Alabama...

\* Until 245 PM CST.

\* At 158 PM CST, a severe thunderstorm capable of producing a tornado was located near Tuskegee National Forest, or 9 miles south of Auburn, moving east at 60 mph.

HAZARD...Tornado.

SOURCE...Radar indicated rotation.

IMPACT...Flying debris will be dangerous to those caught without shelter. Mobile homes will be damaged or destroyed. Damage to roofs, windows, and vehicles will occur. Tree damage is likely.

\* Locations impacted include...

Auburn, Phenix City, Opelika, Smiths, Smiths Station, Ladonia, Beauregard, Bleecker, Griffen Mill, Bibb City, Monterey Heights, Chewacla State Park, Ladonia Sports Complex, Marvyn and Bartletts Ferry Dam.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

TAKE COVER NOW! Move to a basement or an interior room on the lowest floor of a sturdy building. Avoid windows. If you are outdoors, in a mobile home, or in a vehicle, move to the closest substantial shelter and protect yourself from flying debris.

&&

LAT...LON 3239 8544 3250 8544 3250 8549 3253 8556  
3268 8511 3267 8509 3265 8509 3265 8511  
3263 8508 3262 8509 3258 8507 3251 8500  
3249 8499 3247 8500 3245 8499

TIME...MOT...LOC 1958Z 252DEG 53KT 3246 8552

TORNADO...RADAR INDICATED

HAIL...<.75IN

\$\$

Severe Weather Statement  
National Weather Service Birmingham AL  
207 PM CST SUN MAR 3 2019

ALC081-113-032045-  
/O.CON.KBMX.TO.W.0023.00000T0000Z-190303T2045Z/  
Lee AL-Russell AL-  
207 PM CST SUN MAR 3 2019

...A TORNADO WARNING REMAINS IN EFFECT UNTIL 245 PM CST FOR CENTRAL LEE AND NORTHWESTERN RUSSELL COUNTIES...

At 206 PM CST, a confirmed large and extremely dangerous tornado was located near Society Hill, or 10 miles southeast of Auburn, moving east at 55 mph.

This is a PARTICULARLY DANGEROUS SITUATION. TAKE COVER NOW!

HAZARD...Damaging tornado.

SOURCE...Radar confirmed tornado.

IMPACT...You are in a life-threatening situation. Flying debris may be deadly to those caught without shelter. Mobile homes will be destroyed. Considerable damage to homes, businesses, and vehicles is likely and complete destruction is possible.

Locations impacted include...

Auburn, Phenix City, Opelika, Smiths, Smiths Station, Ladonia, Beauregard, Bleecker, Griffen Mill, Bibb City, Monterey Heights, Chewacla State Park, Ladonia Sports Complex, Marvyn and Bartletts Ferry Dam.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

To repeat, a large, extremely dangerous and potentially deadly tornado is on the ground. To protect your life, TAKE COVER NOW! Move to a basement or an interior room on the lowest floor of a sturdy building. Avoid windows. If you are outdoors, in a mobile home, or in a vehicle, move to the closest substantial shelter and protect yourself from flying debris.

&&

LAT...LON 3239 8544 3250 8544 3250 8549 3253 8556  
3268 8511 3267 8509 3265 8509 3265 8511  
3263 8508 3262 8509 3258 8507 3251 8500  
3249 8499 3247 8500 3245 8499

TIME...MOT...LOC 2006Z 258DEG 48KT 3247 8538

TORNADO...OBSERVED  
TORNADO DAMAGE THREAT...CONSIDERABLE

HAIL...<.75IN

Severe Weather Statement  
National Weather Service Birmingham AL  
209 PM CST SUN MAR 3 2019

ALC081-113-032045-  
/O.CON.KBMX.TO.W.0023.00000T0000Z-190303T2045Z/  
Lee AL-Russell AL-  
209 PM CST SUN MAR 3 2019

...TORNADO EMERGENCY FOR southern Lee County and northern Russell County...

...A TORNADO WARNING REMAINS IN EFFECT UNTIL 245 PM CST FOR SOUTHEASTERN LEE AND NORTHWESTERN RUSSELL COUNTIES...

At 209 PM CST, a confirmed large and destructive tornado was located near Griffen Mill, or 11 miles southeast of Auburn, moving east at 60 mph.

TORNADO EMERGENCY for southern Lee County and northern Russell County. This is a PARTICULARLY DANGEROUS SITUATION. TAKE COVER NOW!

HAZARD...Deadly tornado.

SOURCE...Radar confirmed tornado.

IMPACT...You are in a life-threatening situation. Flying debris may be deadly to those caught without shelter. Mobile homes will be destroyed. Considerable damage to homes, businesses, and vehicles is likely and complete destruction is possible.

Locations impacted include...

Phenix City, Smiths, Smiths Station, Ladonia, Bleecker, Griffen Mill, Bibb City, Monterey Heights, Ladonia Sports Complex, Marvyn and Bartletts Ferry Dam.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

To repeat, a large, extremely dangerous, and potentially deadly tornado is on the ground. To protect your life, TAKE COVER NOW! Move to an interior room on the lowest floor of a sturdy building. Avoid windows. If in a mobile home, a vehicle or outdoors, move to the closest substantial shelter and protect yourself from flying debris.

&&

LAT...LON 3242 8540 3250 8544 3268 8511 3267 8509  
3265 8509 3265 8511 3263 8508 3262 8509  
3258 8507 3251 8500 3249 8499 3247 8500  
3245 8499

TIME...MOT...LOC 2009Z 252DEG 53KT 3248 8533

TORNADO...OBSERVED  
TORNADO DAMAGE THREAT...CATASTROPHIC

HAIL...<.75IN

# Halftime! 10-minute Break



Matt Grantham & Gerald Satterwhite

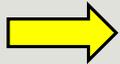


# Advanced Spotter Training Outline



## Part I

- Atmospheric features, types and scale
- Severe weather ingredients
- Using our products
- Basic course recap



## Part II

- RADAR signatures
- Tornadogenesis
- Demo a severe weather event

# What Makes a Storm Severe?

---

## SEVERE THUNDERSTORM WARNING POTENTIAL OF \_\_ OCCURRING, OR OBSERVED

- Wind gusts of 58 mph or greater, and/or
- Hail 1 inch or more in diameter



## TORNADO WARNING POTENTIAL OF \_\_ OCCURRING, OR OBSERVED

- A tornado
  - Tornadic storms can also produce damaging straight-line winds and large hail

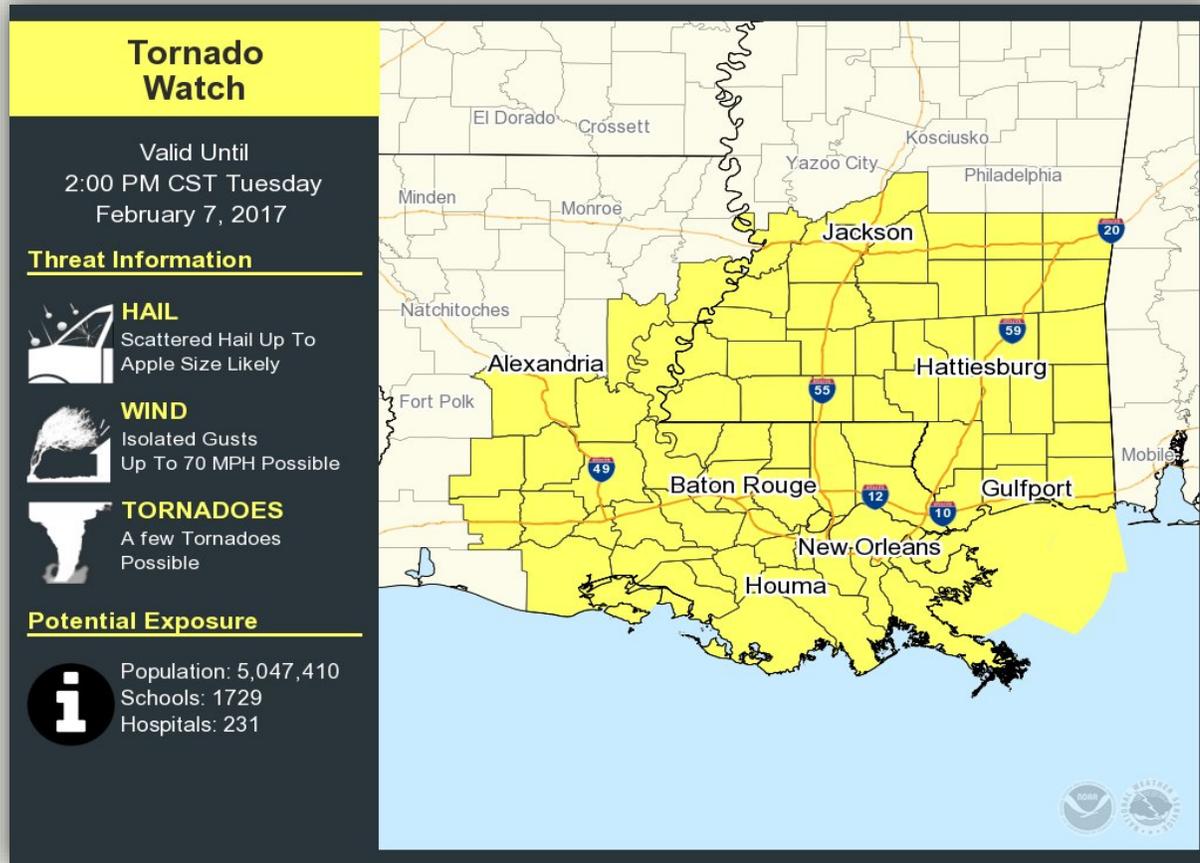


# Understanding Severe Thunderstorm Risk Categories

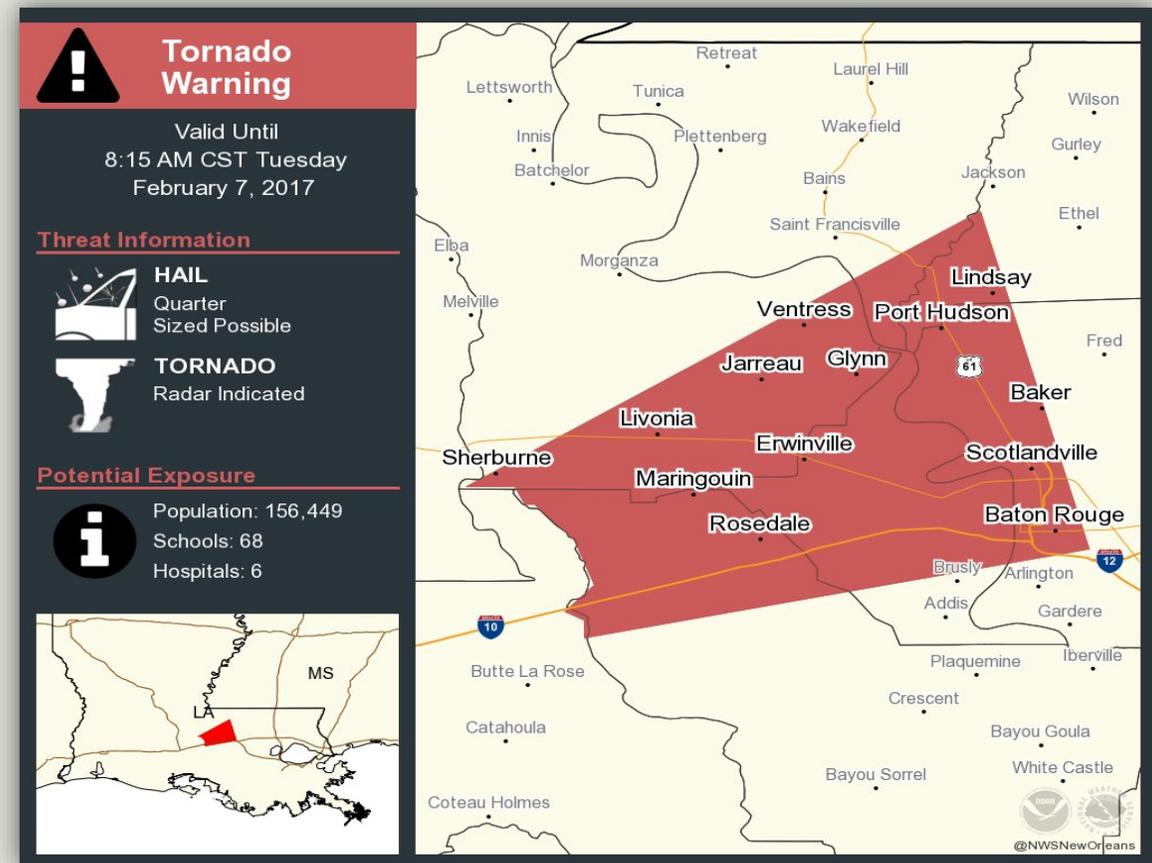
| <b>THUNDERSTORMS</b><br>(no label)   | <b>1 - MARGINAL</b><br><b>(MRGL)</b>  | <b>2 - SLIGHT</b><br><b>(SLGT)</b>   | <b>3 - ENHANCED</b><br><b>(ENH)</b>   | <b>4 - MODERATE</b><br><b>(MDT)</b>   | <b>5 - HIGH</b><br><b>(HIGH)</b>   |
|--|---|--|---|---|--|
| <p><b>No severe* thunderstorms expected</b></p> <p>Lightning/flooding threats exist with <u>all</u> thunderstorms</p>  | <p><b>Isolated severe thunderstorms possible</b></p> <p>Limited in duration and/or coverage and/or intensity</p>  | <p><b>Scattered severe storms possible</b></p> <p>Short-lived and/or not widespread, isolated intense storms possible</p>  | <p><b>Numerous severe storms possible</b></p> <p>More persistent and/or widespread, a few intense</p>   | <p><b>Widespread severe storms likely</b></p> <p>Long-lived, widespread and intense</p>   | <p><b>Widespread severe storms expected</b></p> <p>Long-lived, very widespread and particularly intense</p>  |
|  <ul style="list-style-type: none"> <li>• Winds to 40 mph</li> <li>• Small hail</li> </ul> |  <ul style="list-style-type: none"> <li>• Winds 40-60 mph</li> <li>• Hail up to 1"</li> <li>• Low tornado risk</li> </ul> |  <ul style="list-style-type: none"> <li>• One or two tornadoes</li> <li>• Reports of strong winds/wind damage</li> <li>• Hail ~1", isolated 2"</li> </ul> |  <ul style="list-style-type: none"> <li>• A few tornadoes</li> <li>• Several reports of wind damage</li> <li>• Damaging hail, 1 - 2"</li> </ul> |  <ul style="list-style-type: none"> <li>• Strong tornadoes</li> <li>• Widespread wind damage</li> <li>• Destructive hail, 2" +</li> </ul> |  <ul style="list-style-type: none"> <li>• Tornado outbreak</li> <li>• Derecho</li> </ul> |

\* NWS defines a severe thunderstorm as measured wind gusts to at least 58 mph, and/or hail to at least one inch in diameter, and/or a tornado. All thunderstorm categories imply lightning and the potential for flooding. Categories are also tied to the probability of a severe weather event within 25 miles of your location.

# Watch vs. Warning



**WATCHES:** Conditions are favorable for severe weather to develop; cover large areas and last several hours. *BE AWARE & PREPARED!*



**WARNINGS:** Severe weather is very likely soon or is occurring; cover smaller areas and last an hour or less. *TAKE ACTION!*

# What to Report

## --Strong or Damaging Wind--

---



**Estimating wind speed is difficult.** It will be much easier to describe damage. If you report a speed, let us know if it was estimated or measured.

- ☁️ Trees or large limbs blown down
  - Snapped or uprooted
  - Were the trees or limbs dead or alive
- ☁️ Power poles downed
- ☁️ Damage to buildings

# What to Report

## --Hail--

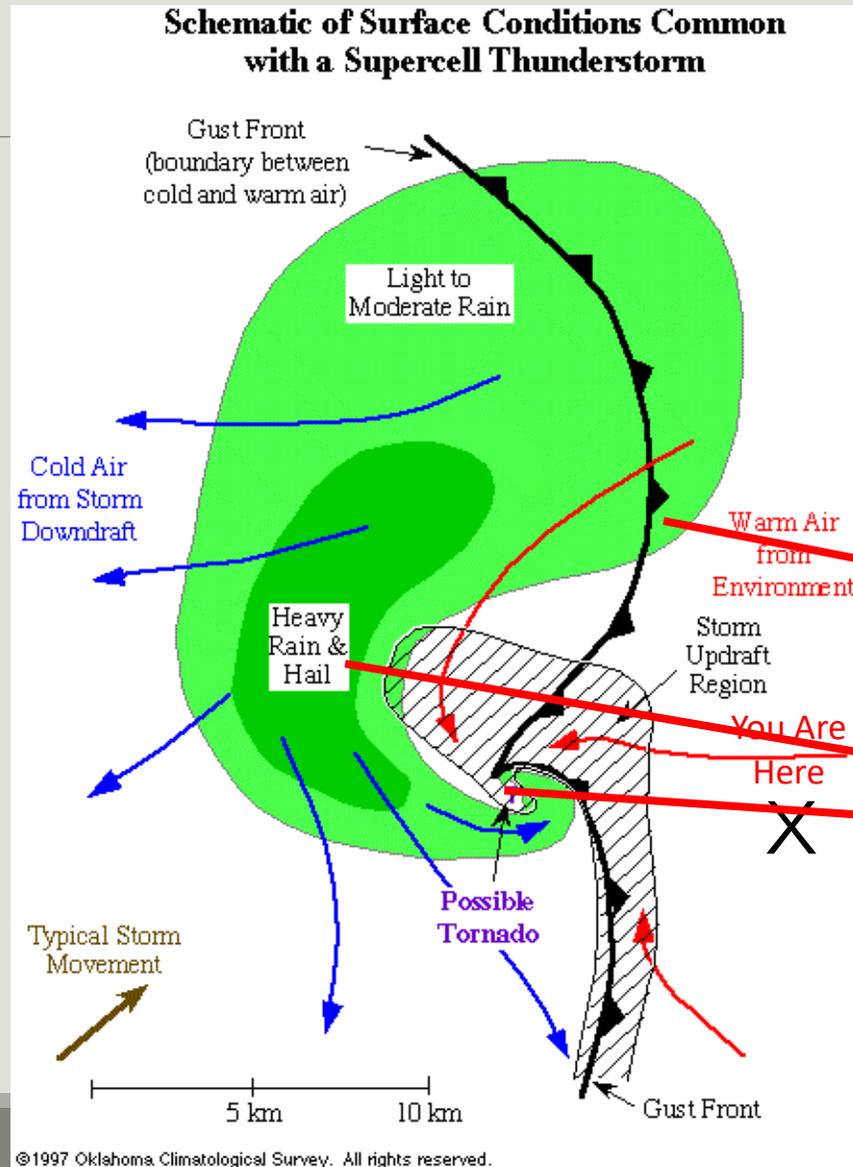


Report the size of the largest hail stone you see. ***Please do not report “marble-sized hail.”***

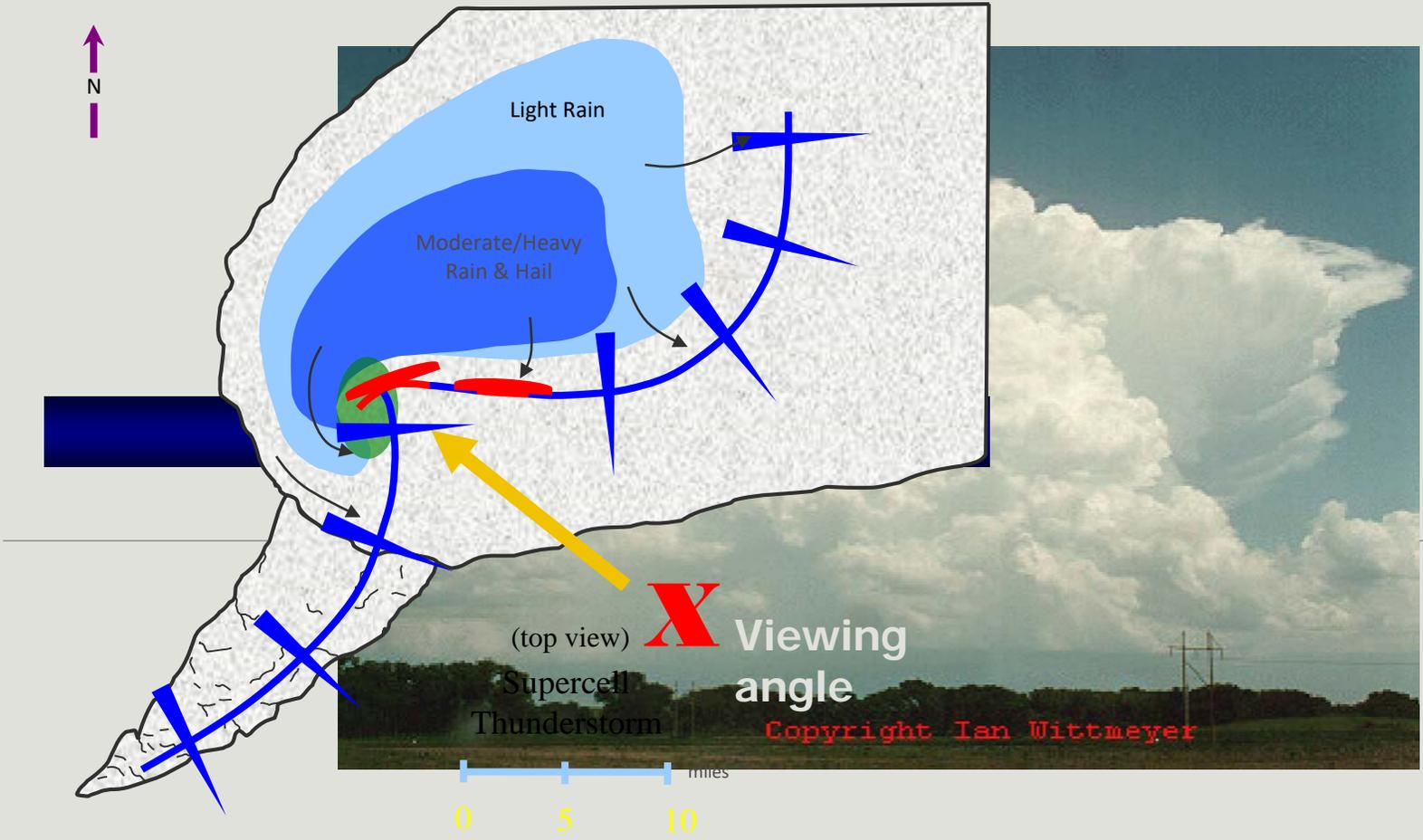


- ☁️ Measure with a ruler or caliper
- ☁️ Reference a common item
  - Coins (quarter, half-dollar, etc.)
  - Sporting equipment (golf ball, tennis ball, etc.)
- ☁️ Did the hail cause damage?

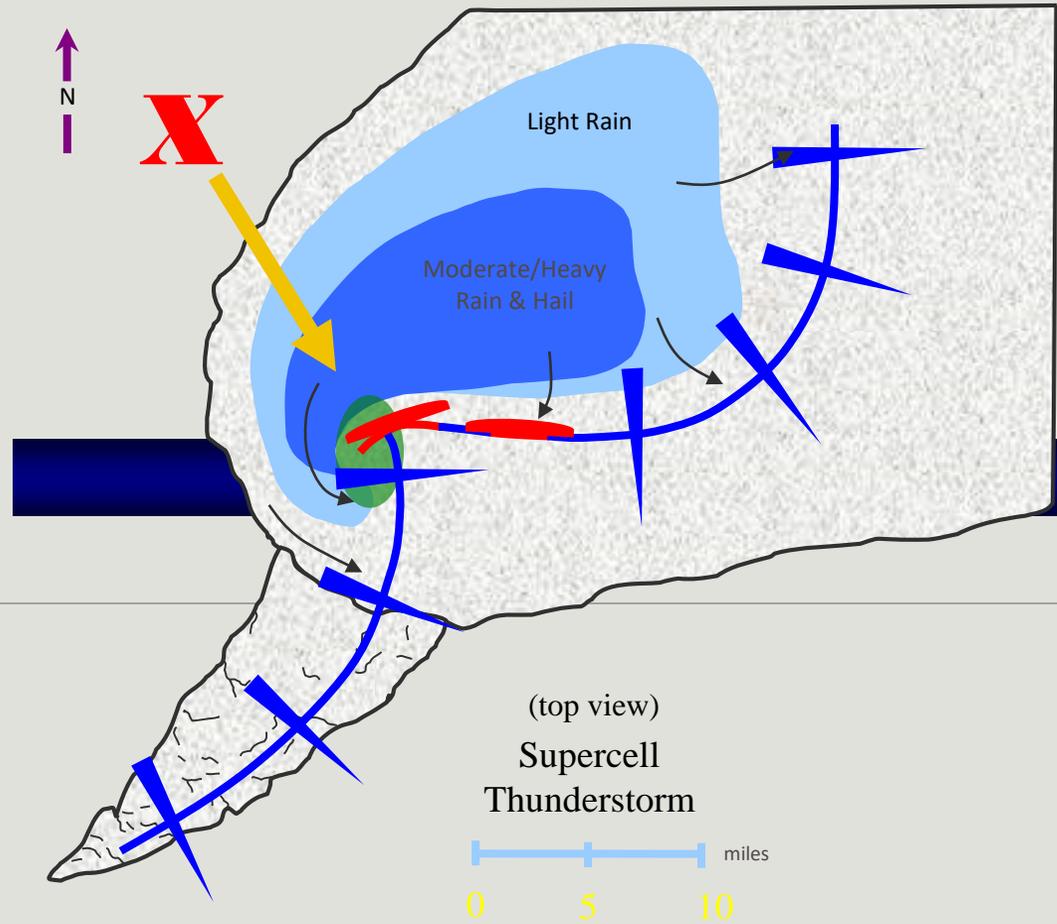
# What We Observe When Spotting Supercell



# Spotter Location



# NOT Ideal Spotter Location



# Wall Cloud -> Tornado Evolution



# Reporting Options Recap

---

- Call the NWS office: 205-664-3010, option 2
- Social media: Twitter and Facebook
- Spotter Network
- HAM radio
- Our webpage: [weather.gov/bmx](http://weather.gov/bmx) -> Submit a Storm Report page
- After-the-event reports: [sr-bmx.dss@noaa.gov](mailto:sr-bmx.dss@noaa.gov)  
- Don't use e-mail for urgent reports

A screenshot of the 'Storm Report' form on the NOAA website. The form includes fields for Name, Location of the Report, Date/Time, and Event Type (with a 'Select all that apply' instruction). It also has sections for 'Send' (with a dropdown menu), 'How Was Event' (with a dropdown menu), 'Specialty: Hazard Class', 'Wind Damage', 'Water Penetration', 'Other', 'Funding Expenditure', and 'How to Use'. There is an 'Additional Details' section at the bottom with a text area and a link to 'How to Report a Storm'.

# Advanced Spotter Training Outline

*--Disclaimer: This is Not Storm Chaser Training--*



## Part I

- Atmospheric features, types and scale
- Severe weather ingredients
- Using our products

## Part II

- Basic course recap
- RADAR signatures
- Tornadogenesis
- Demo a severe weather event

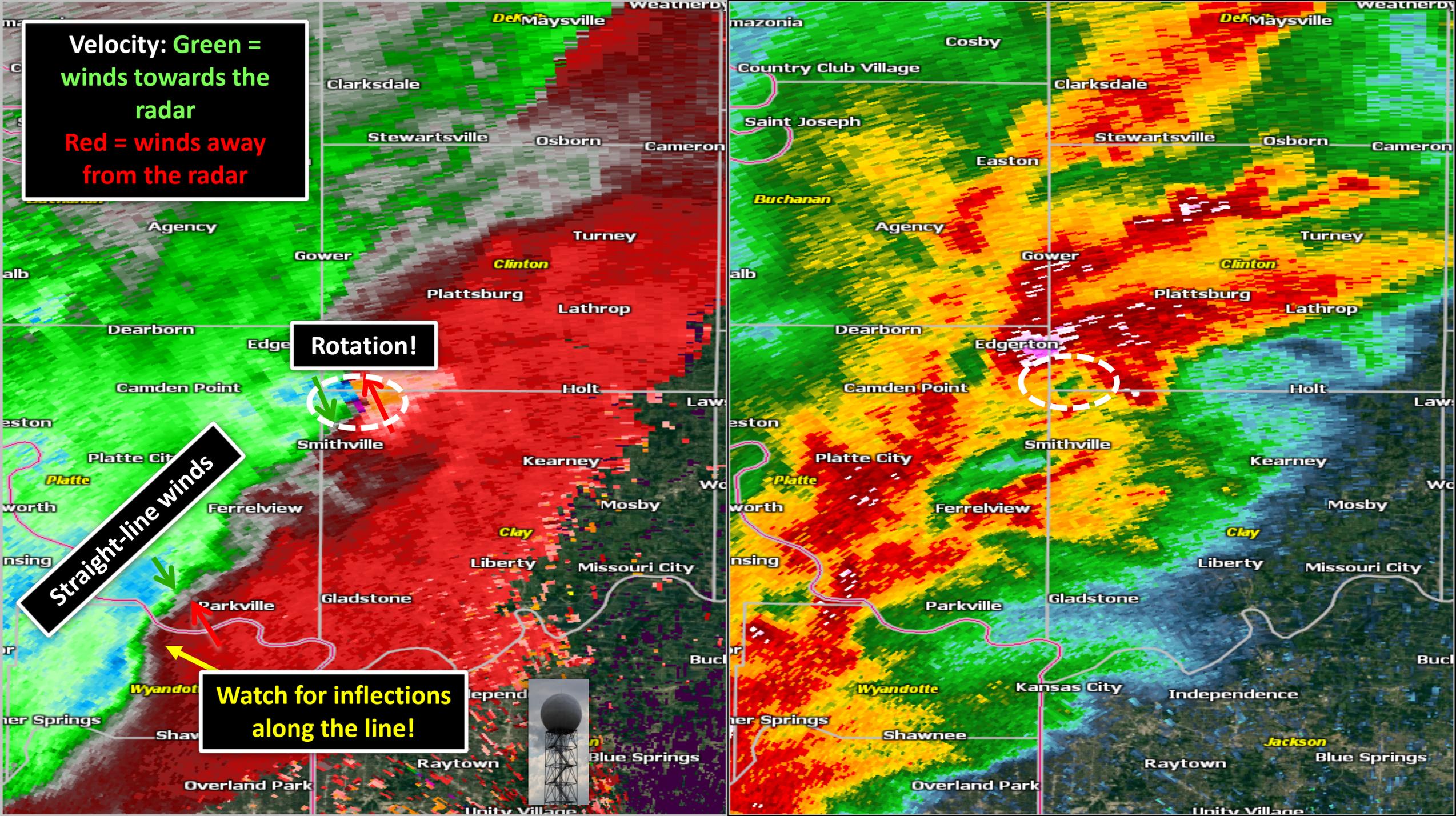


**Velocity: Green = winds towards the radar**  
**Red = winds away from the radar**

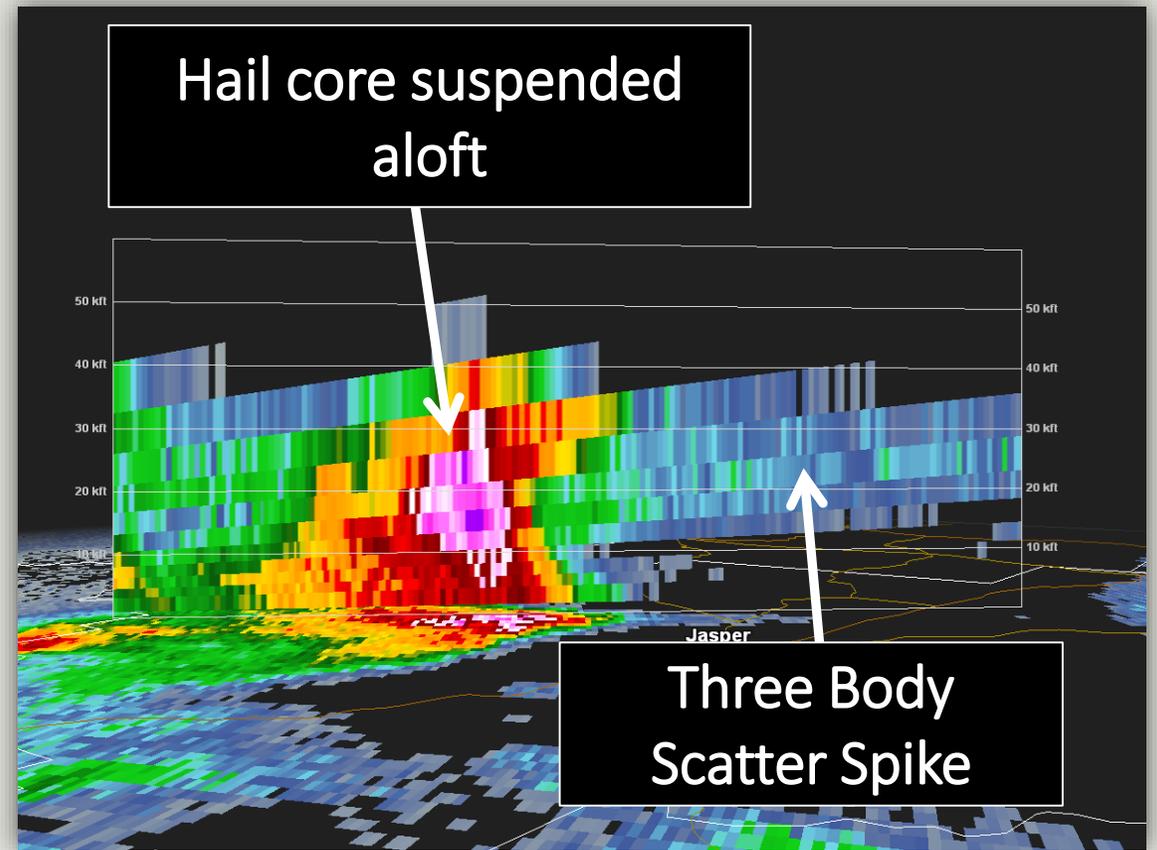
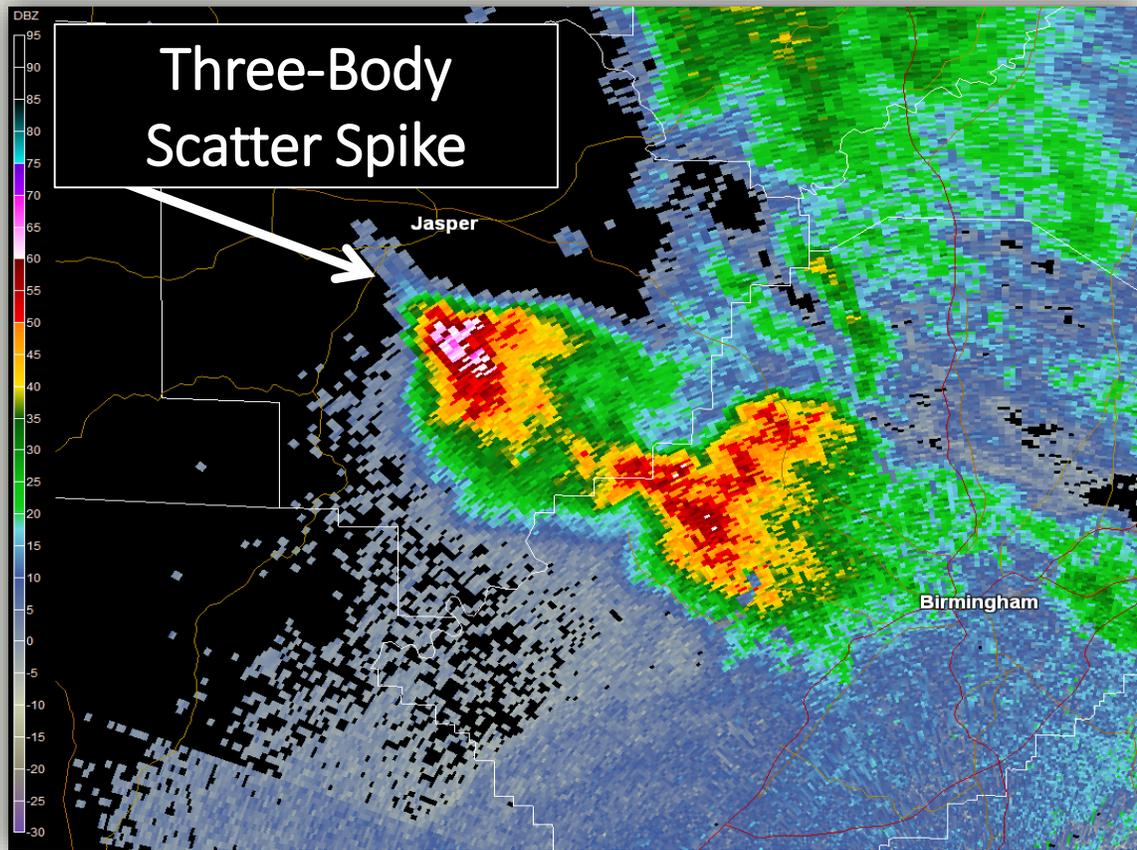
**Rotation!**

**Straight-line winds**

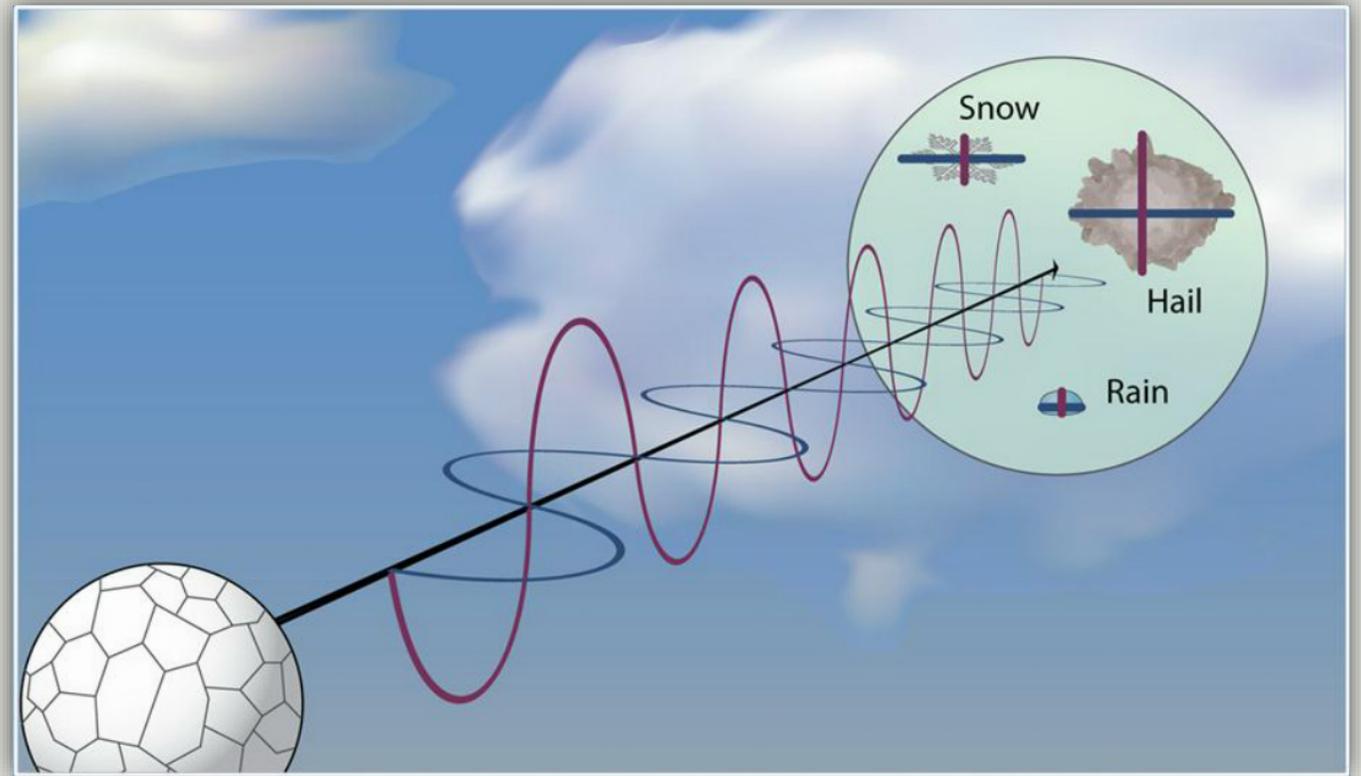
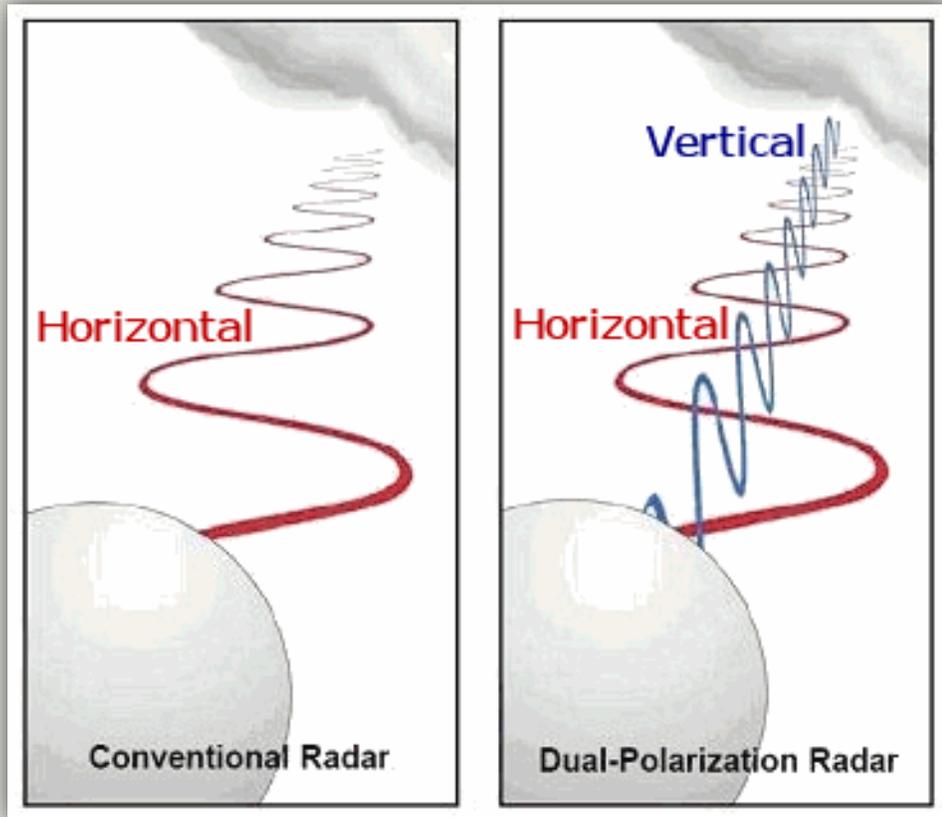
**Watch for inflections along the line!**



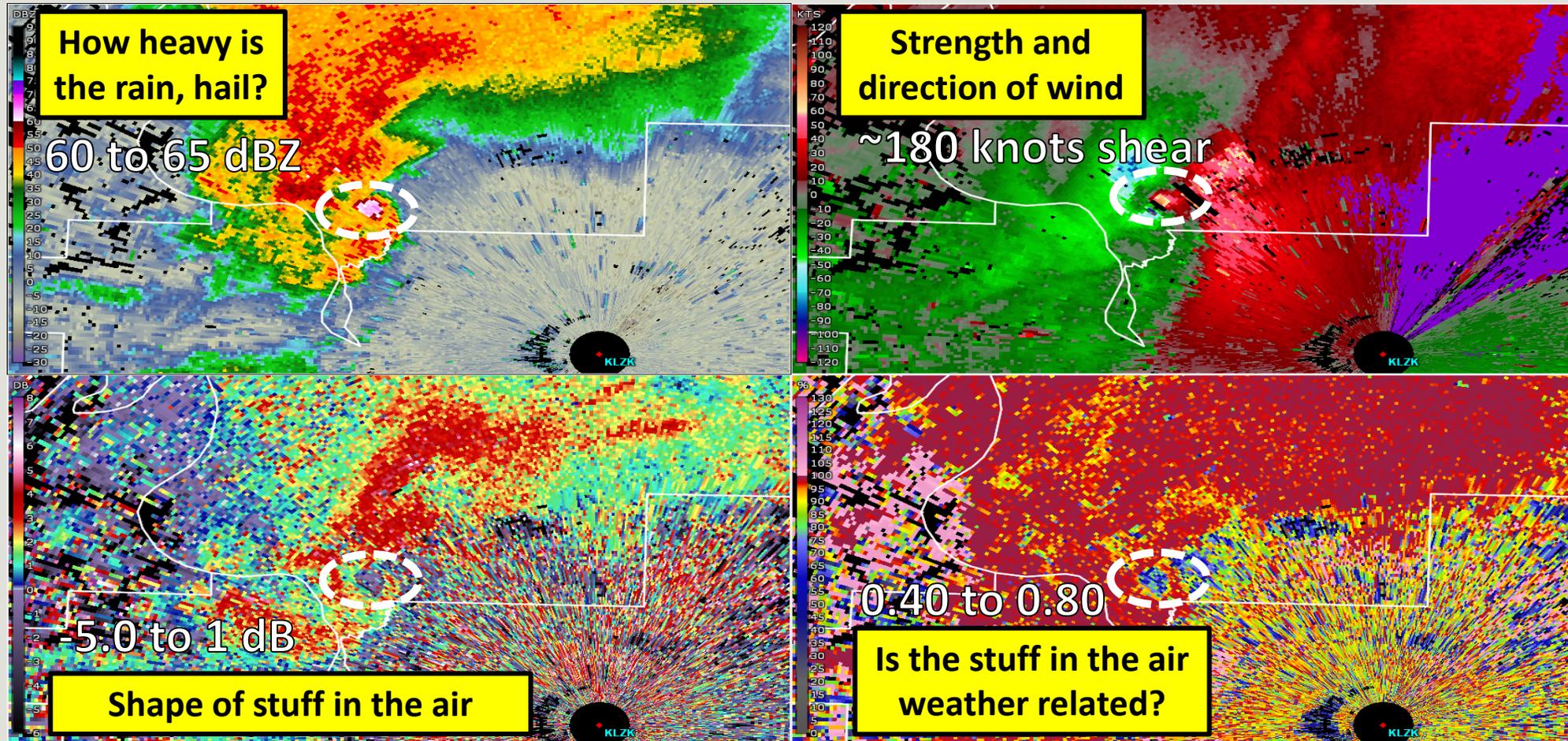
# Three Body Scatter Spike > Large Hail



# Dual-polarization Radar



# Confirming Tornado Debris on RADAR



# BEWARE: Not all 'Blue' on CC is Tornado Debris!

--This takes a trained eye--

---

It could be...

- Contaminants in the inflow region
- Hail
- Noise in the data
- Non-uniform beam filling
- Terrain, communication towers, buildings, wind farms, etc.

**At minimum we must use a combination of reflectivity, velocity, and CC + RADAR scans over time and depth.**

# Advanced Spotter Training Outline

*--Disclaimer: This is Not Storm Chaser Training--*



## Part I

- Atmospheric features, types and scale
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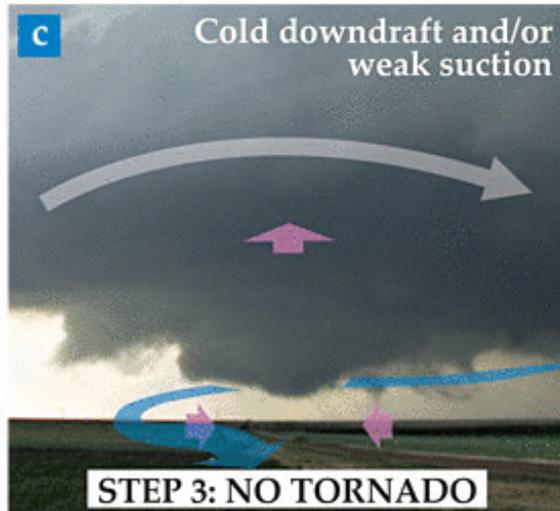
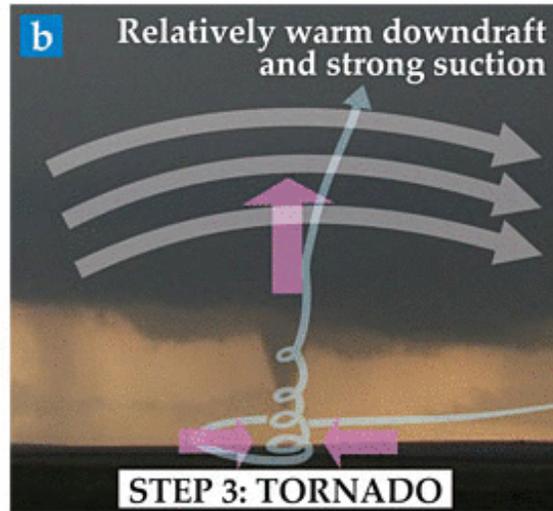
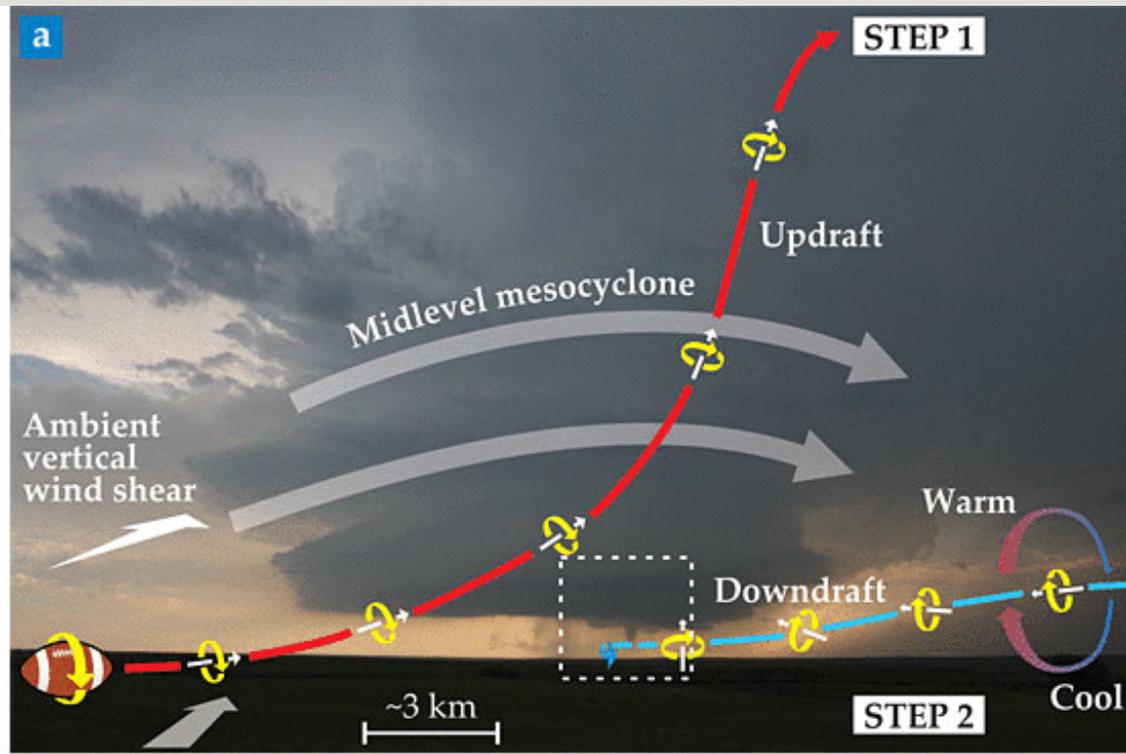
## Part II

- Basic course recap
- RADAR signatures
- Tornadogenesis
- Demo a severe weather event





Markowski and Richardson 2014



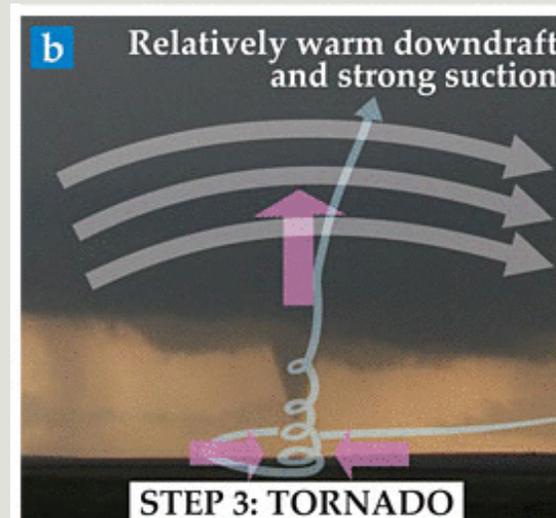
# Tornado pet peeves

---

Tornadoes do not actually “touch down” and “lift”, they “spin up” and “dissipate”.

“The tornado was up in the tree tops but not on the ground”

- Weakest part of the tree is the top



# Advanced Spotter Training Outline

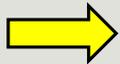


## Part I

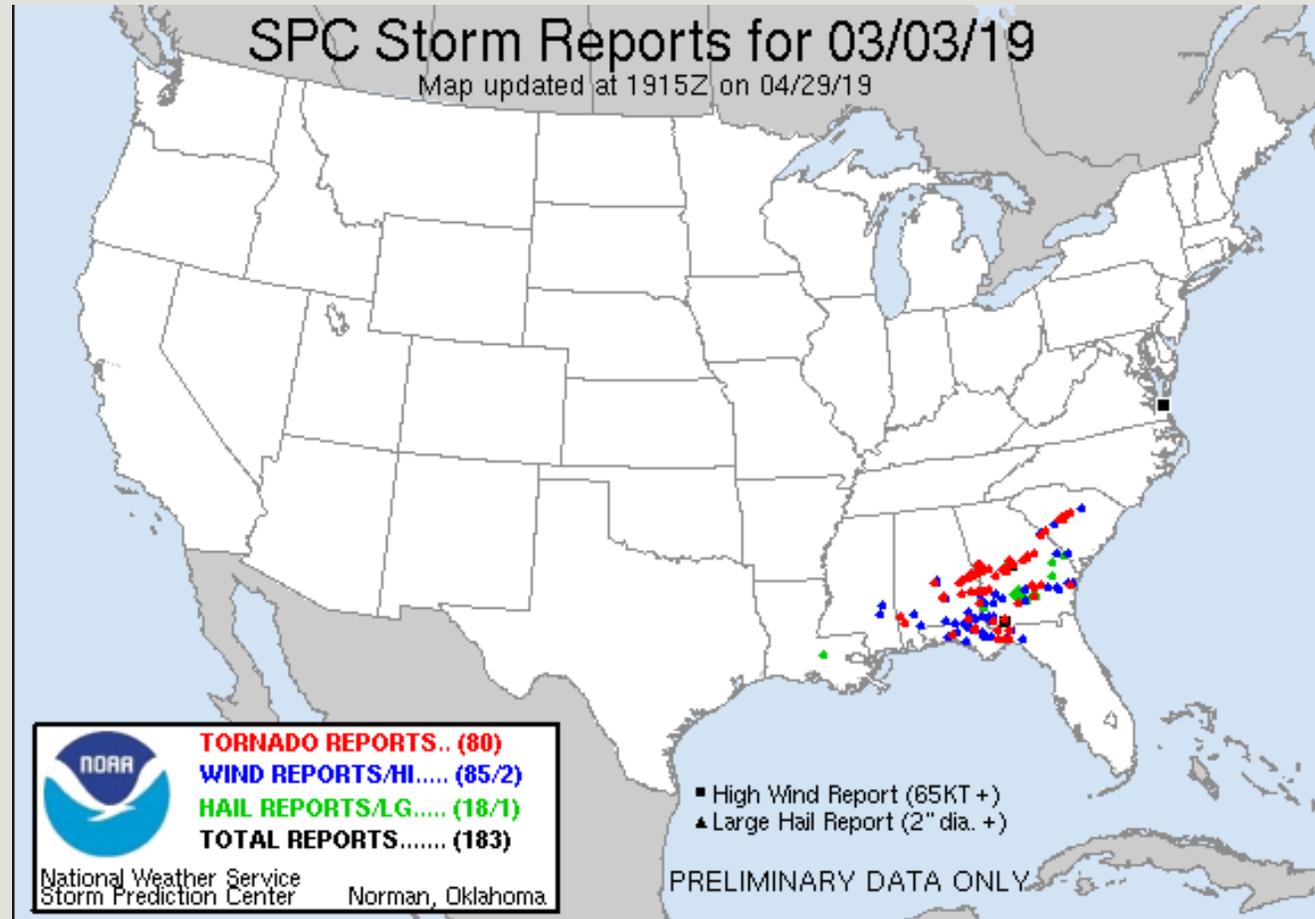
- Atmospheric features, types and scale
- Severe weather ingredients
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## Part II

- RADAR signatures
- Tornadogenesis
- Demo a severe weather event

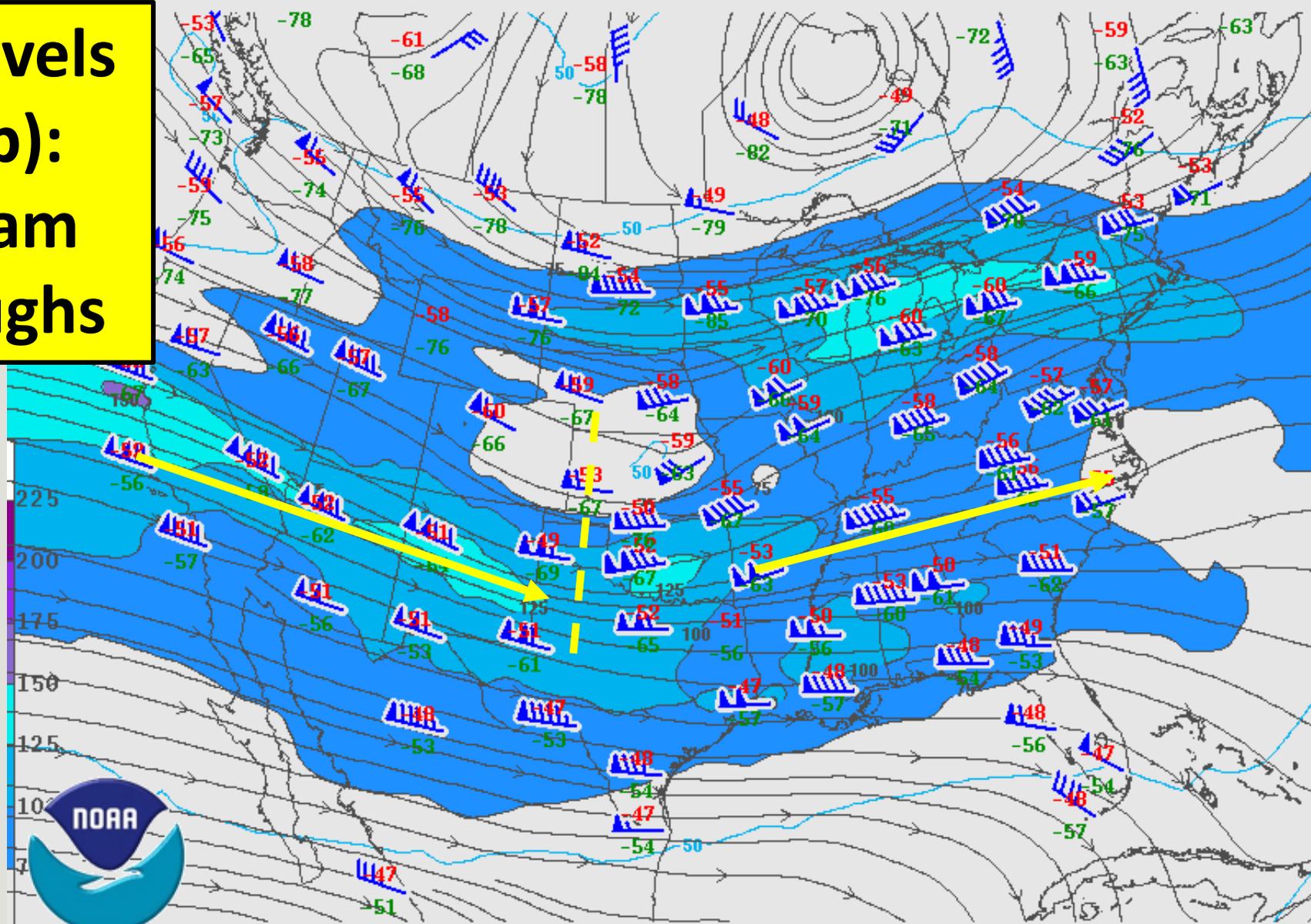


# March 3, 2019 Case Review (Lee County Tornado)



<https://www.spc.noaa.gov/climo/online/>

# Upper-levels (250mb): jet stream and troughs

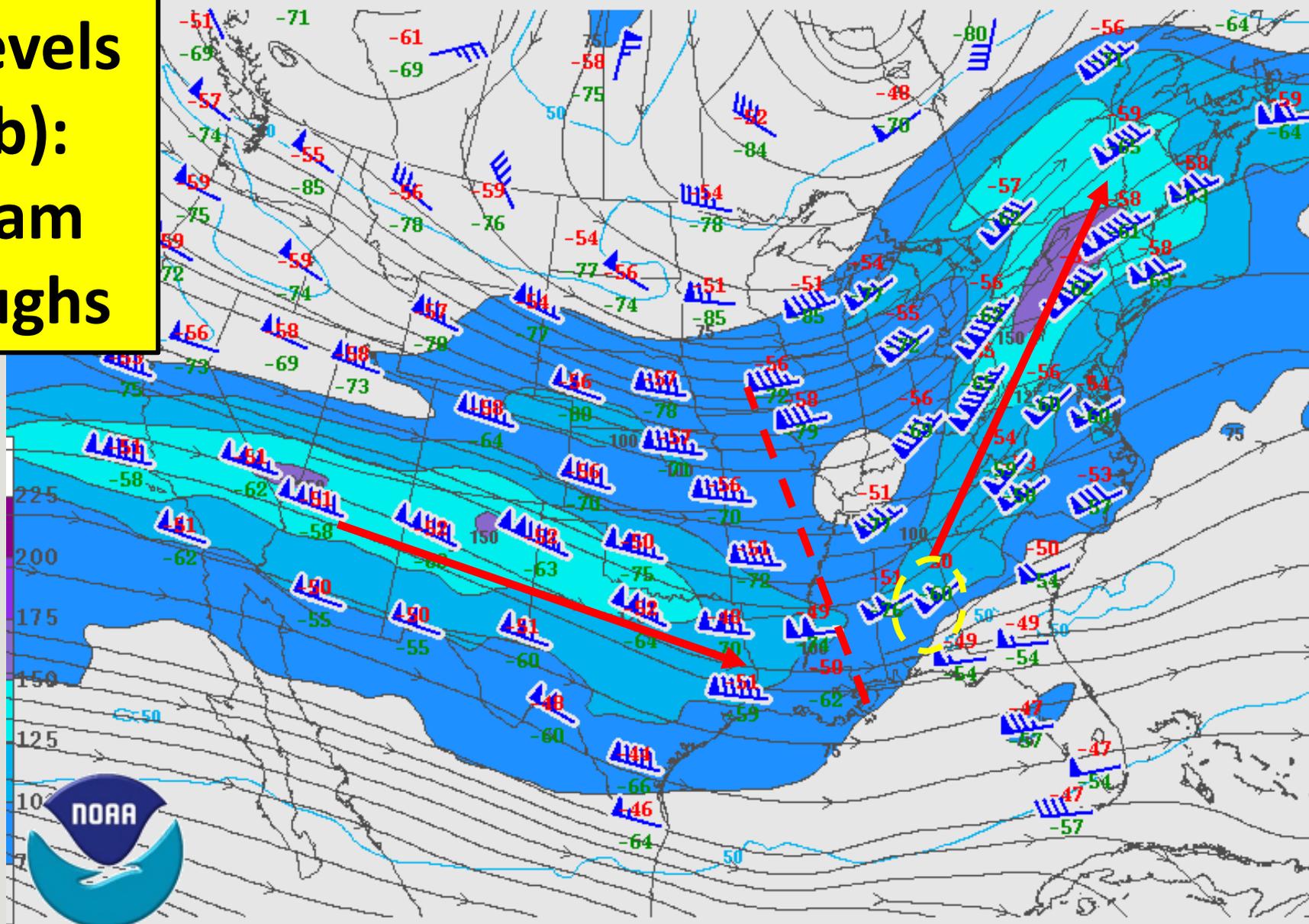


National Weather Service  
Storm Prediction Center

190303/1200 250 MB UA OBS AND ISOTACHS

<https://www.spc.noaa.gov/obswx/maps/>

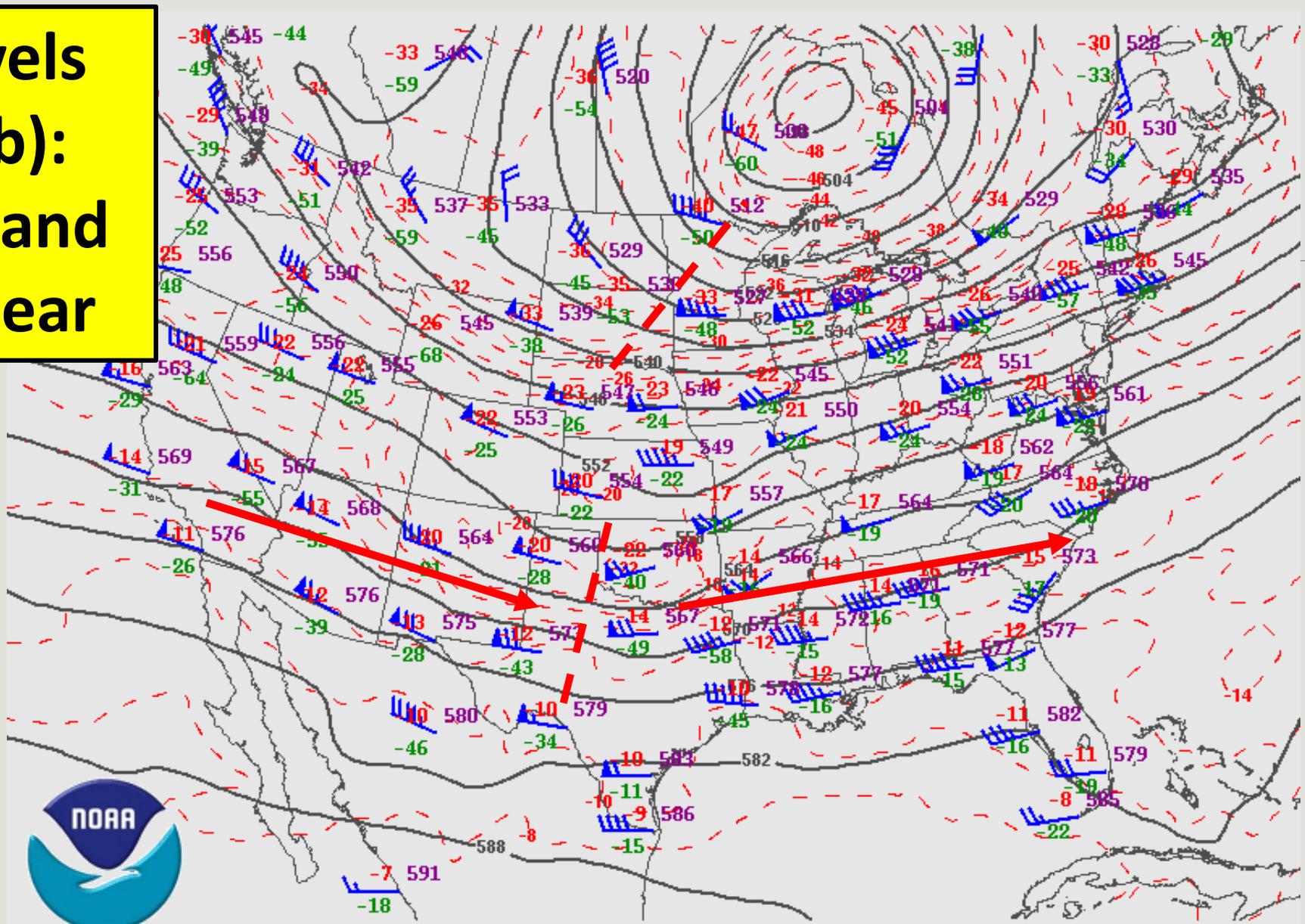
# Upper-levels (250mb): jet stream and troughs



National Weather Service  
Storm Prediction Center

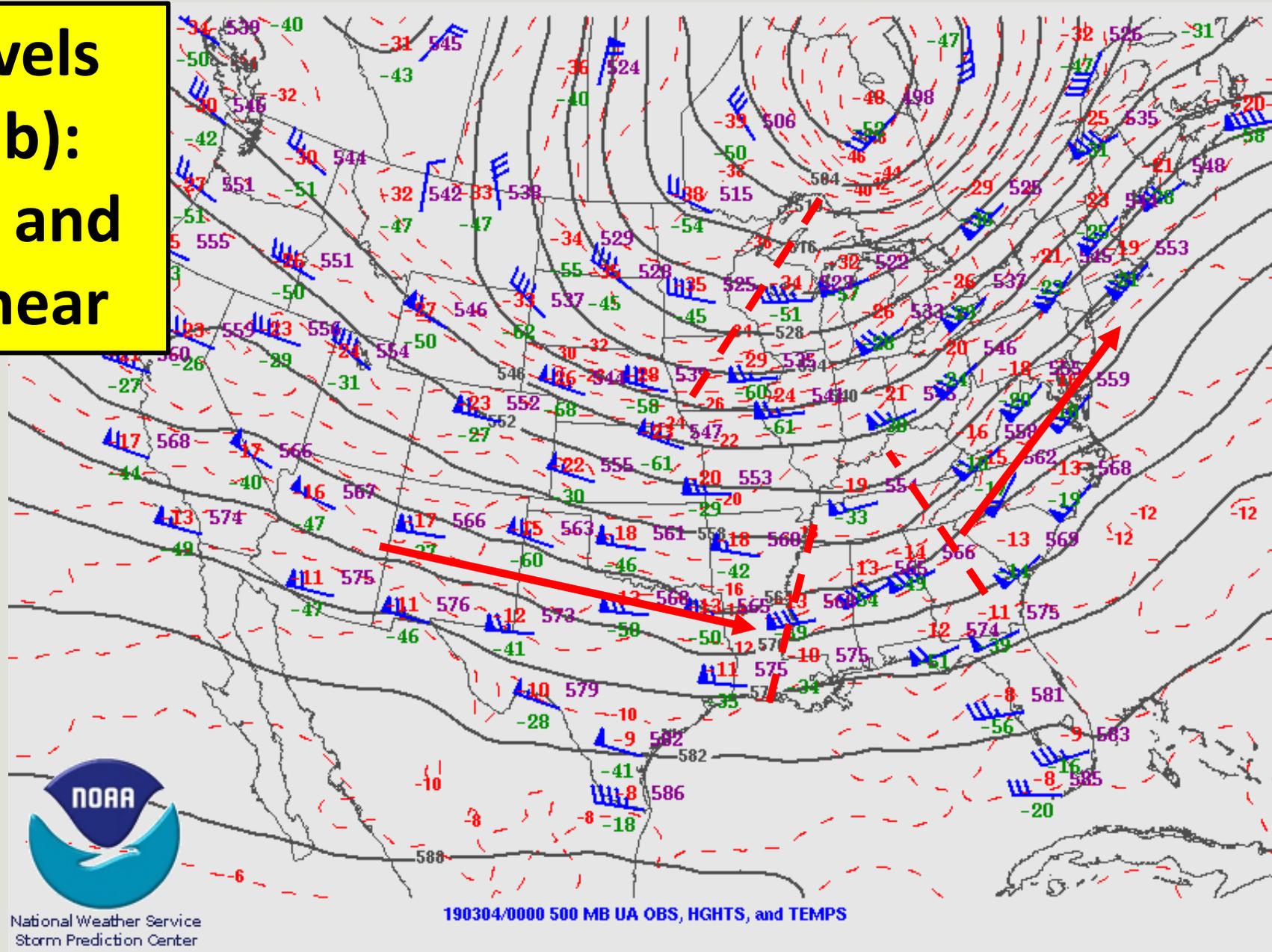
190304/0000 250 MB UA OBS AND ISOTACHS

# Mid-levels (500mb): troughs and wind shear

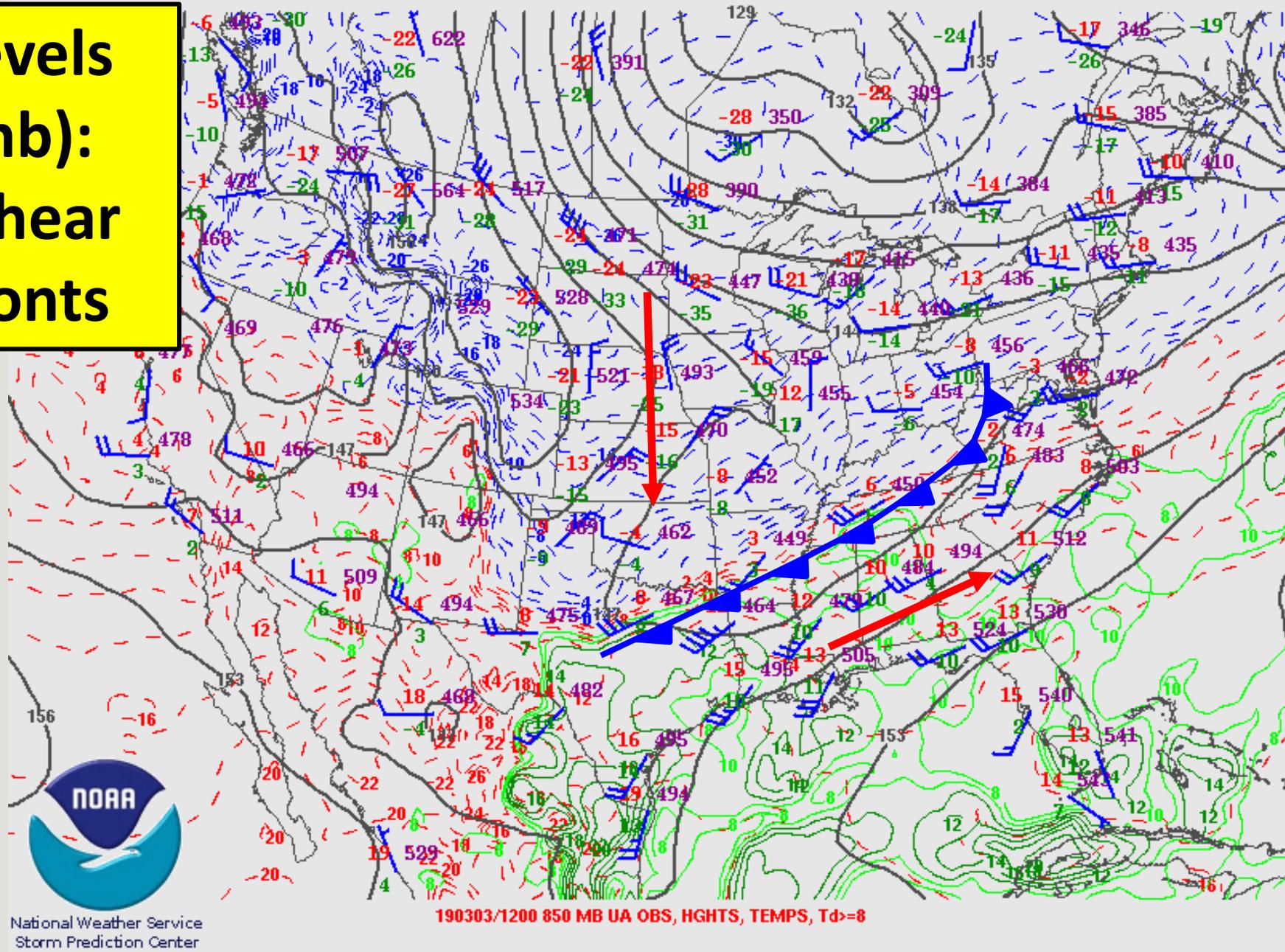


190303/1200 500 MB UA OBS, HGHTS, and TEMPS

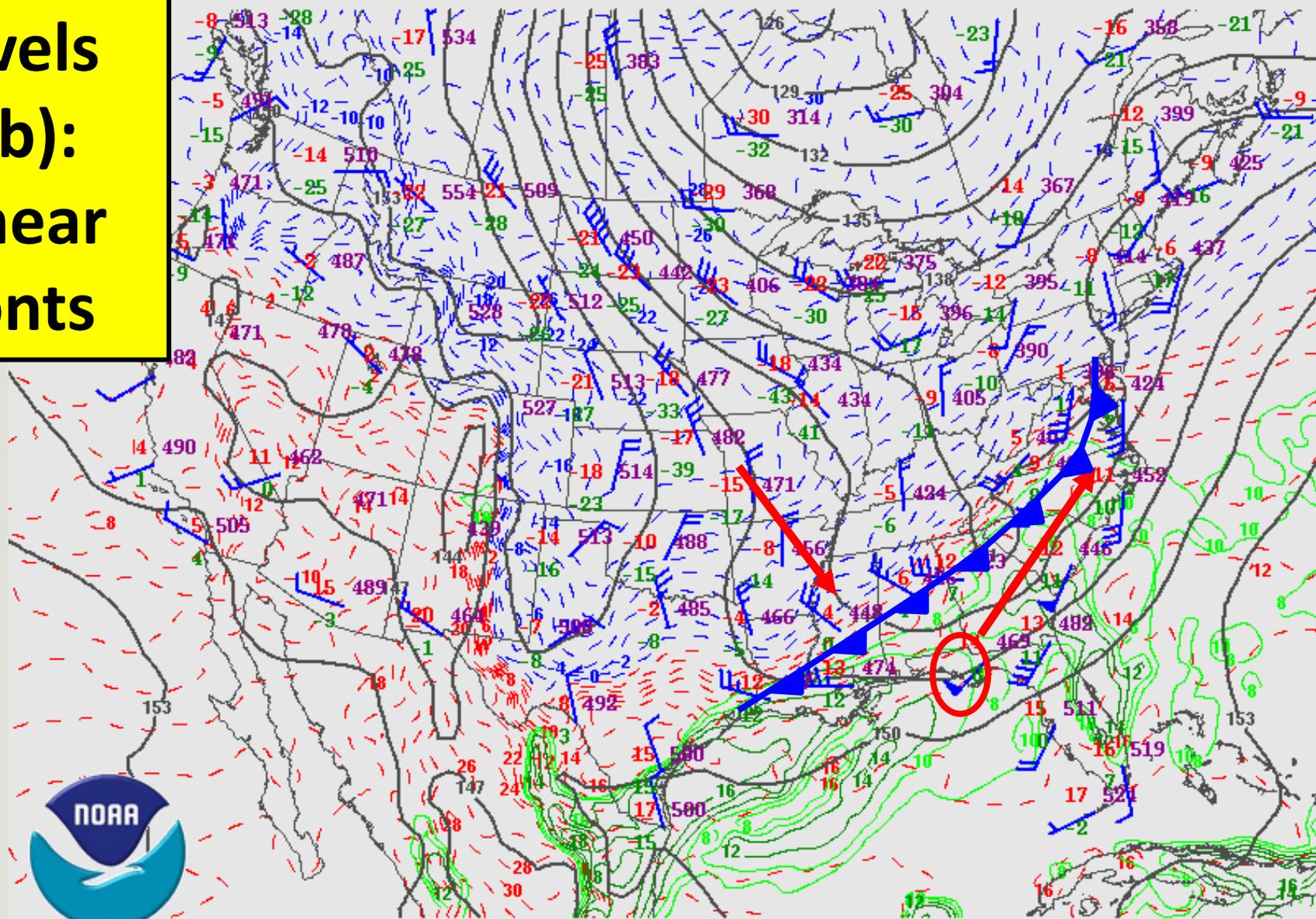
# Mid-levels (500mb): troughs and wind shear



# Low-levels (850mb): wind shear and fronts



# Low-levels (850mb): wind shear and fronts

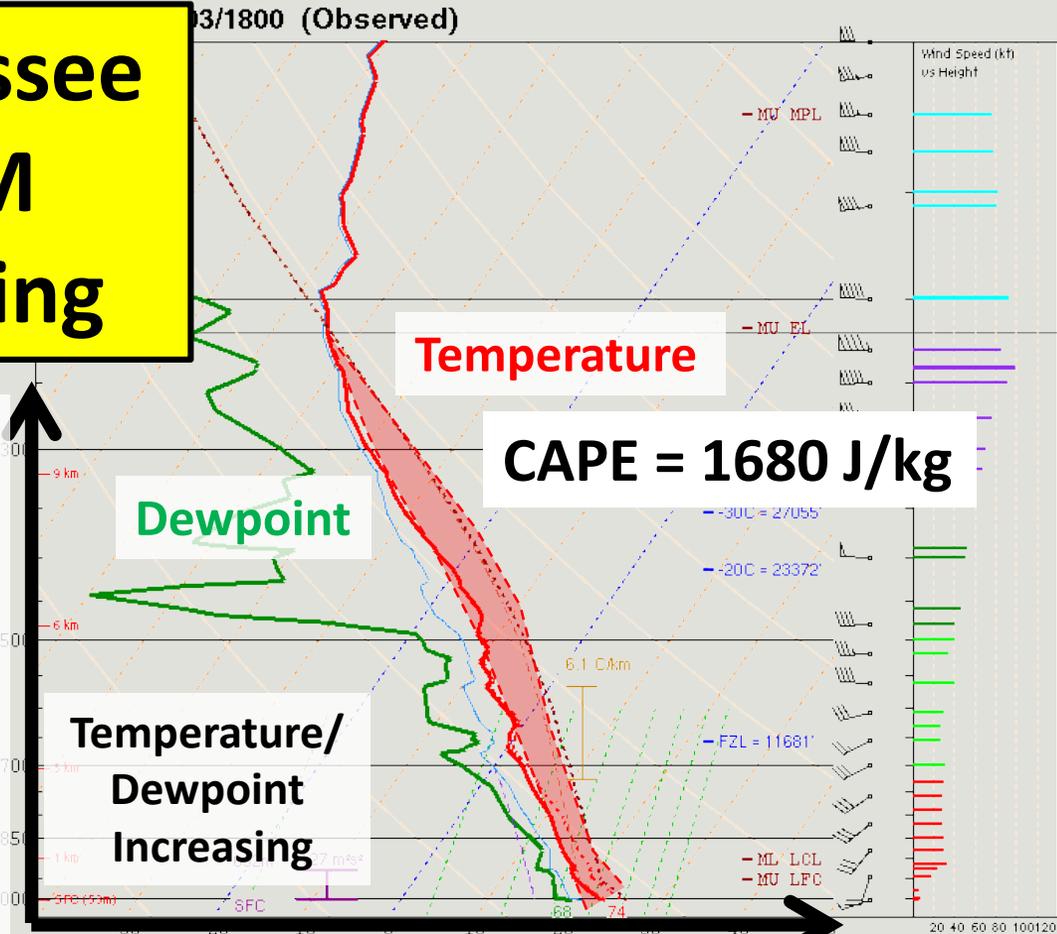


National Weather Service  
Storm Prediction Center

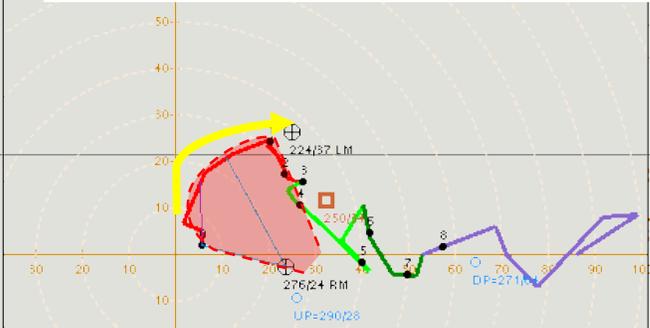
190304/0000 850 MB UA OBS, HGHTS, TEMPS, Td>=8

# Tallahassee 12PM Sounding

Height Increasing



**0-1km SRH = 201 m<sup>2</sup>/s<sup>2</sup>**



**Curved low-level  
hodograph**

<https://www.spc.nwaa.gov/exper/soundings/>

| PARCEL       | CAPE | CINH | LCL   | LI | LFC   | EL     |
|--------------|------|------|-------|----|-------|--------|
| SURFACE      | 1680 | 0    | 477m  | -4 | 477m  | 38087' |
| MIXED LAYER  | 335  | -24  | 970m  | -1 | 6431m | 32814' |
| FCST SURFACE | 1002 | 0    | 1385m | -3 | 1385m | 35391' |
| MU (1007 mb) | 1680 | 0    | 477m  | -4 | 477m  | 38087' |

|                        |                   |              |              |
|------------------------|-------------------|--------------|--------------|
| PW = 1.38 in           | 3CAPE = 38 J/kg   | WBZ = 10051' | WNDG = 0.0   |
| K = 28                 | DCAPE = 470 J/kg  | FZL = 11681' | ESP = 0.0    |
| MidRH = 70%            | DownT = 60 F      | ConvT = 78F  | MMP = 0.74   |
| LowRH = 60%            | MeanW = 11.8 g/kg | MaxT = 62F   | NCAPE = 0.15 |
| SigSevere = 6220 m3/s3 |                   |              |              |

|                                   |                              |
|-----------------------------------|------------------------------|
| Sfc-3km Agl Lapse Rate = 6.6 C/km | <b>Supercell = 3.8</b>       |
| 3-6km Agl Lapse Rate = 5.4 C/km   | <b>Left Supercell = 2.8</b>  |
| 850-500mb Lapse Rate = 5.7 C/km   | <b>STP (eff layer) = 0.2</b> |
| 700-500mb Lapse Rate = 5.5 C/km   | <b>STP (fix layer) = 1.4</b> |
|                                   | <b>Sig Hail = 0.4</b>        |

|                                 | SRH(m2/s2) | Shear(kt) | MnWind | SRW    |
|---------------------------------|------------|-----------|--------|--------|
| SFC - 1 km                      | 201        | 27        | 212/17 | 137/23 |
| SFC - 3 km                      | 236        | 26        | 226/24 | 162/20 |
| Eff Inflow Layer                | 127        | 19        | 206/12 | 126/23 |
| SFC - 6 km                      | 36         | 239/26    | 175/16 |        |
| SFC - 8 km                      | 52         | 245/28    | 183/15 |        |
| LCL - EL (Cloud Layer)          | 86         | 250/34    | 211/17 |        |
| Eff Shear (EBWD)                | 36         | 238/26    | 171/17 |        |
| BRN Shear = 46 m/s <sup>2</sup> |            |           |        |        |
| 4-6km SR Wind = 243/14 kt       |            |           |        |        |

Storm Motion Vectors

Bunkers Right = 276/24 kt

Bunkers Left = 224/37 kt

Corfidi Downshear = 271/64 kt

Corfidi Upshear = 290/28 kt

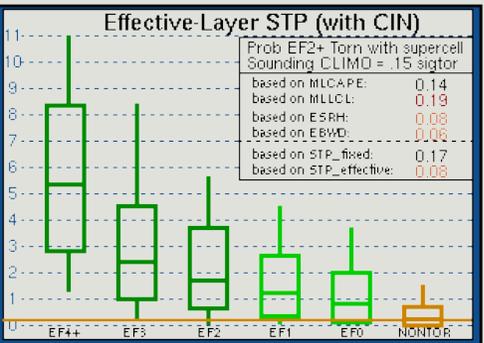
1km & 6km AGL Wind Barbs

\*\*\* BEST GUESS PRECIP TYPE \*\*\*

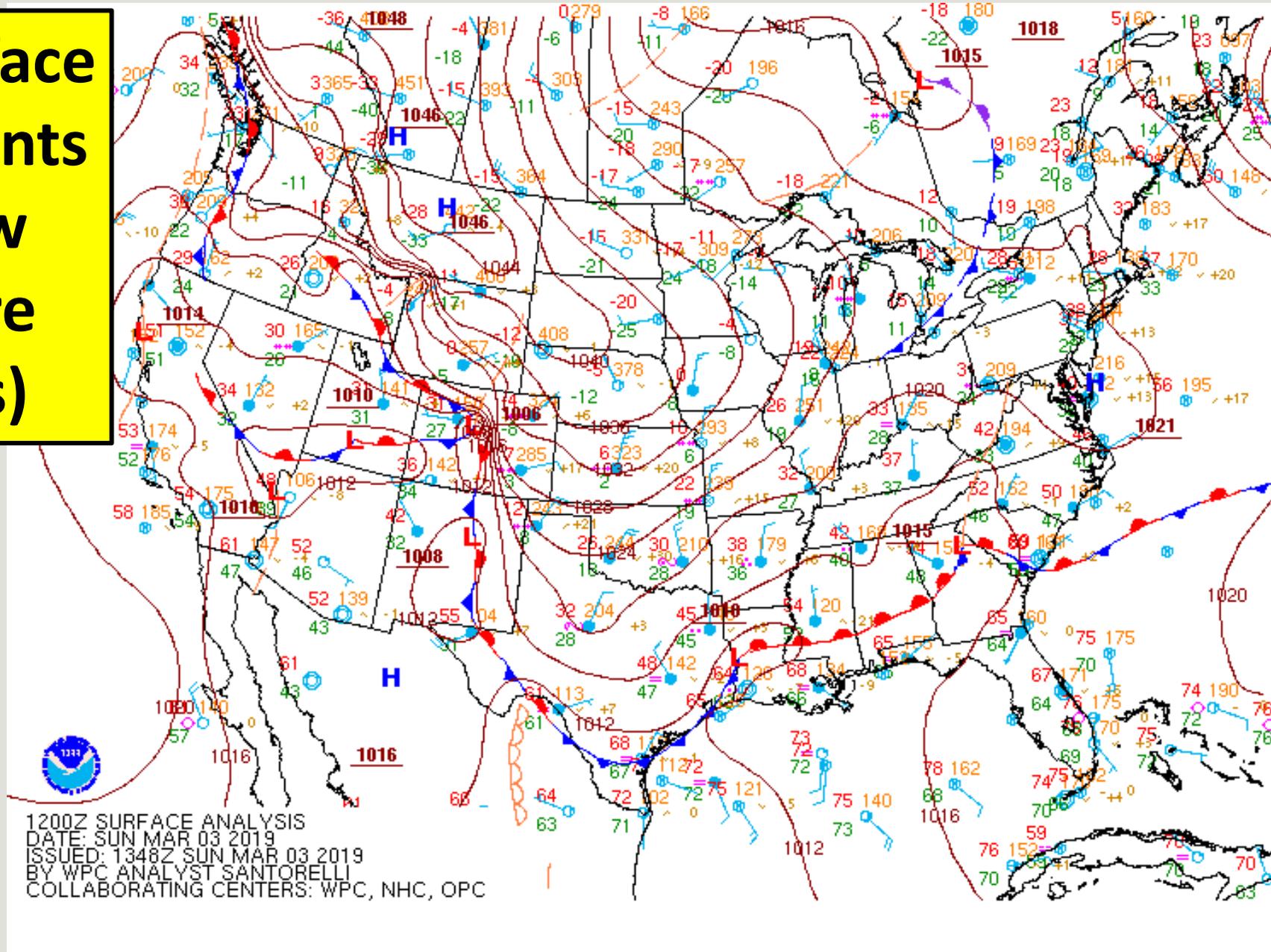
**Rain.**

Based on sfc temperature of 74.5 F.

| SARS - Sounding Analogs            |                                     |
|------------------------------------|-------------------------------------|
| SUPERCCELL                         | SGFNT HAIL                          |
|                                    | 04052300 BUF 0.75                   |
| No Quality Matches                 |                                     |
| (2 loose matches)<br>SARS: 50% TOR | (37 loose matches)<br>SARS: 22% SIG |



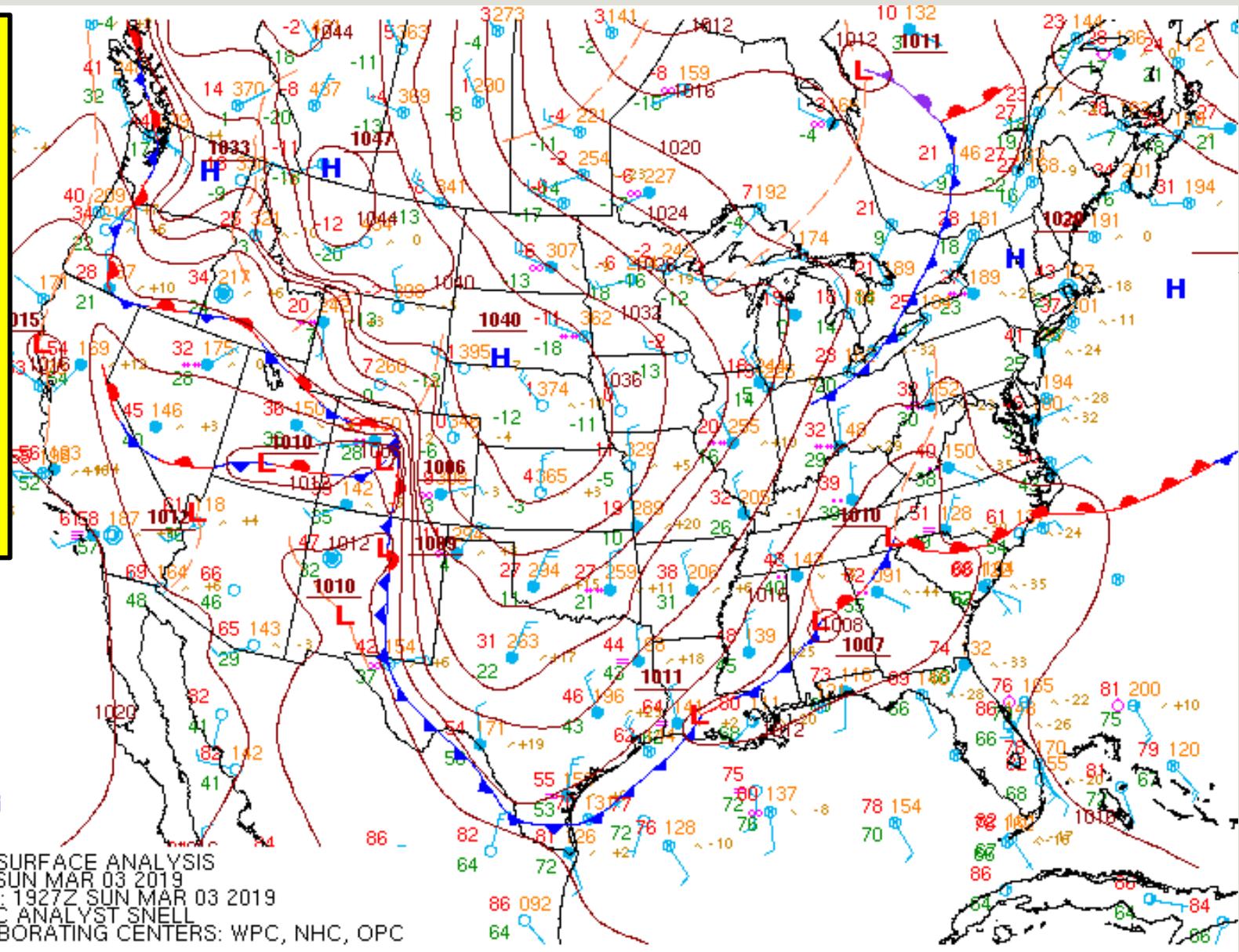
# 7AM Surface Map (Fronts and low pressure centers)



1200Z SURFACE ANALYSIS  
DATE: SUN MAR 03 2019  
ISSUED: 1348Z SUN MAR 03 2019  
BY WPC ANALYST SANTORELLI  
COLLABORATING CENTERS: WPC, NHC, OPC

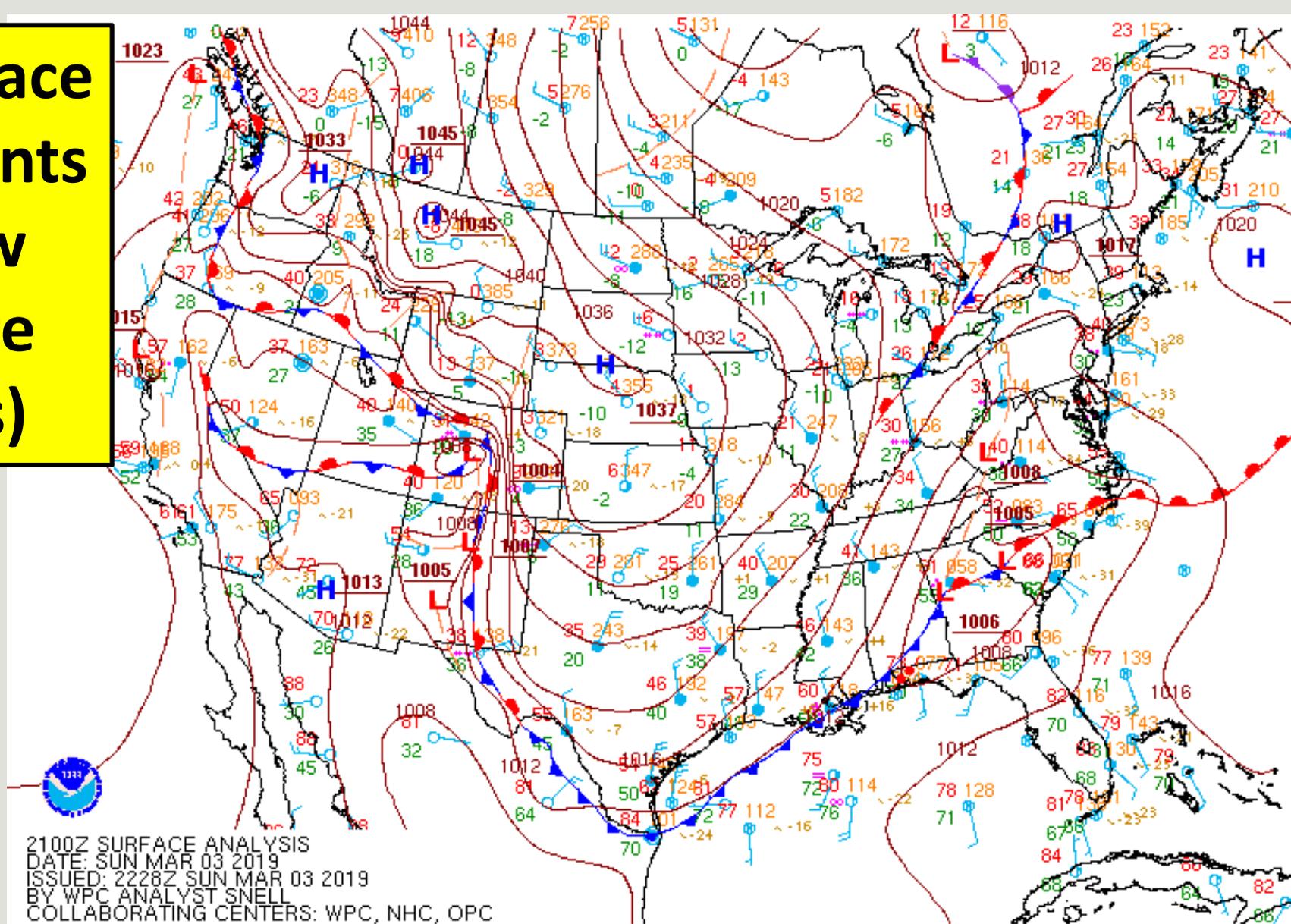
<https://www.wpc.ncep.noaa.gov/html/sfc2.shtml>

# Noon Surface Map (Fronts and low pressure centers)

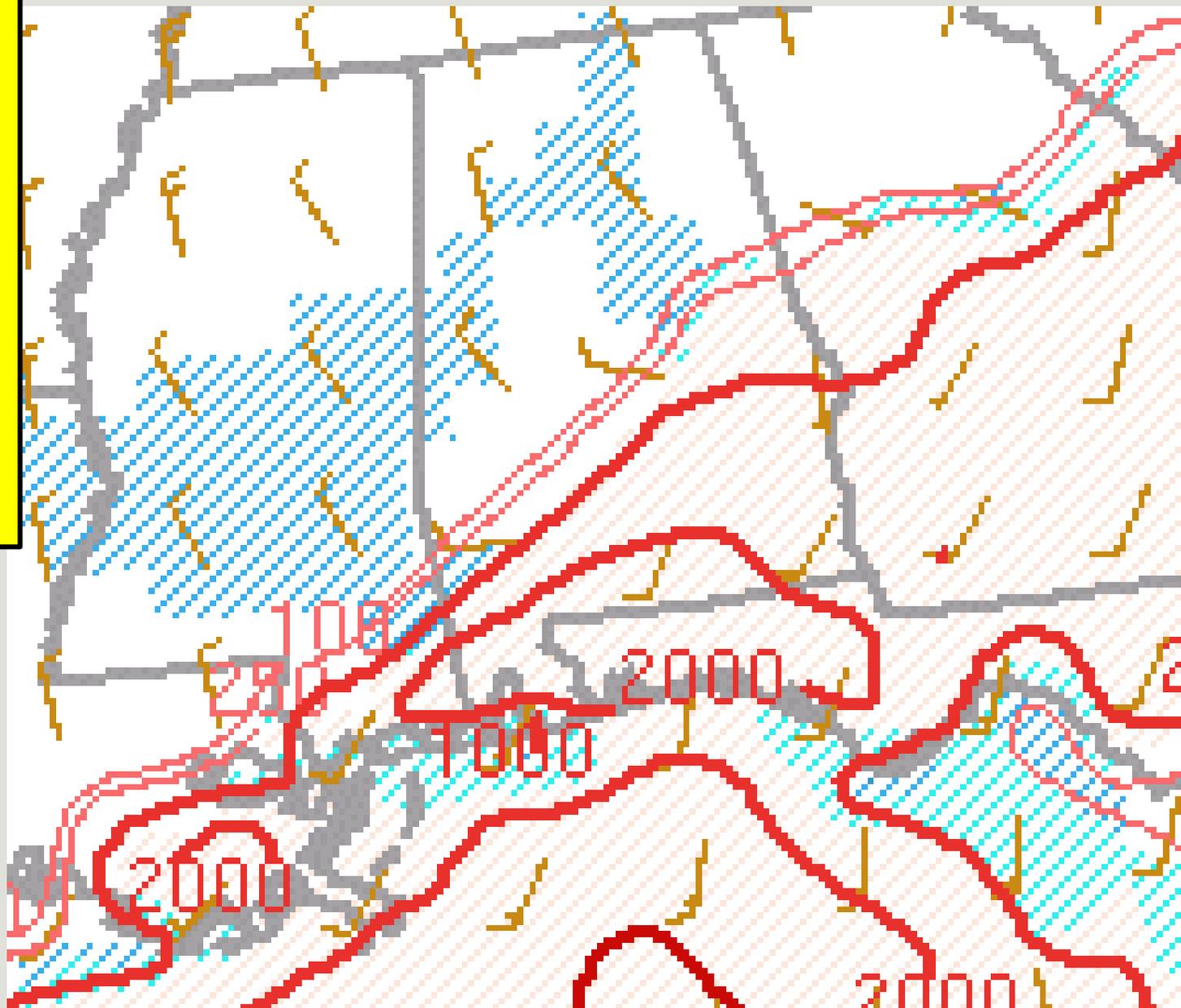


1800Z SURFACE ANALYSIS  
DATE: SUN MAR 03 2019  
ISSUED: 1927Z SUN MAR 03 2019  
BY WPC ANALYST SNELL  
COLLABORATING CENTERS: WPC, NHC, OPC

# 3PM Surface Map (Fronts and low pressure centers)

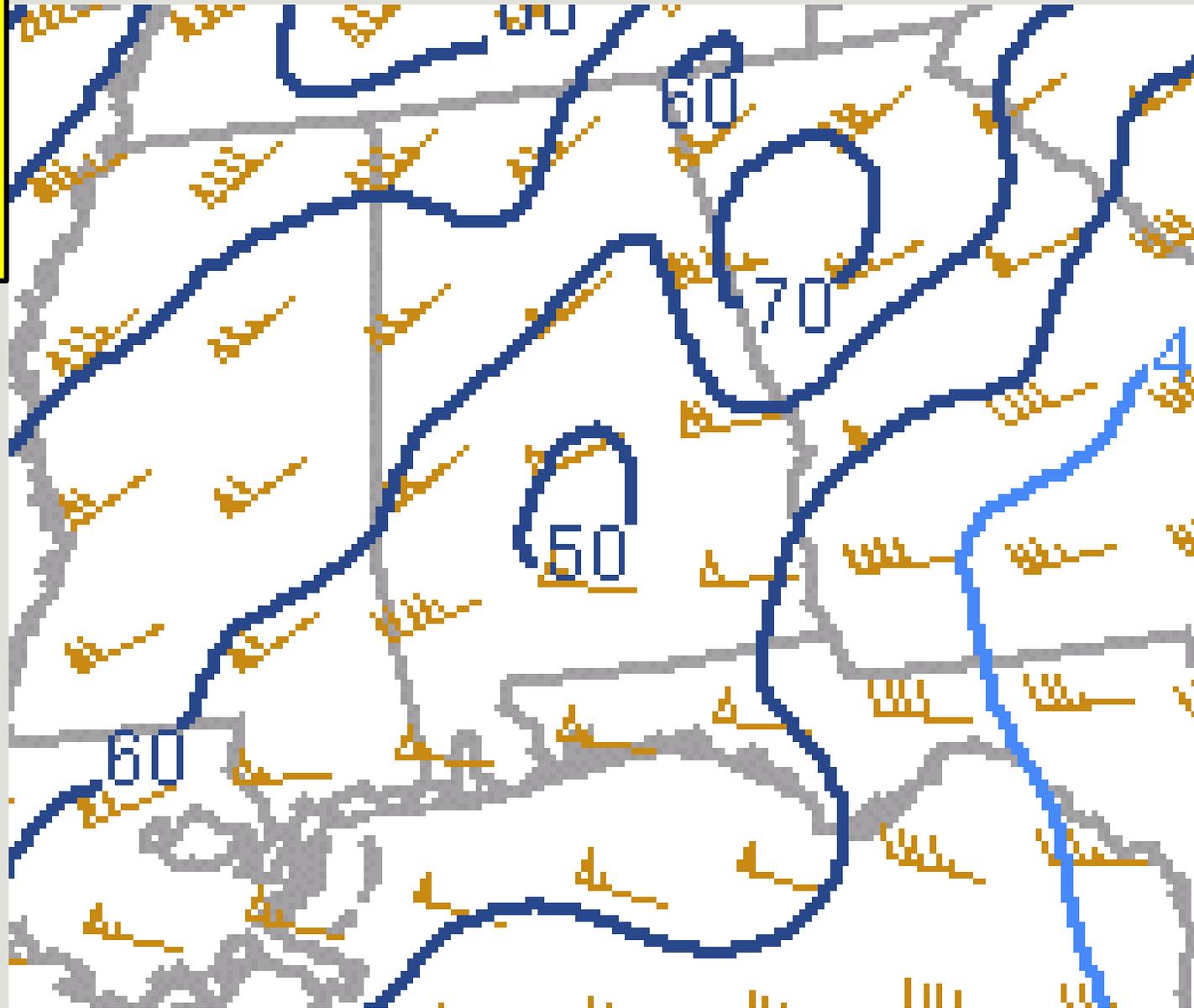


**Convective  
Available  
Potential  
Energy  
(CAPE):  
~1000 J/kg**

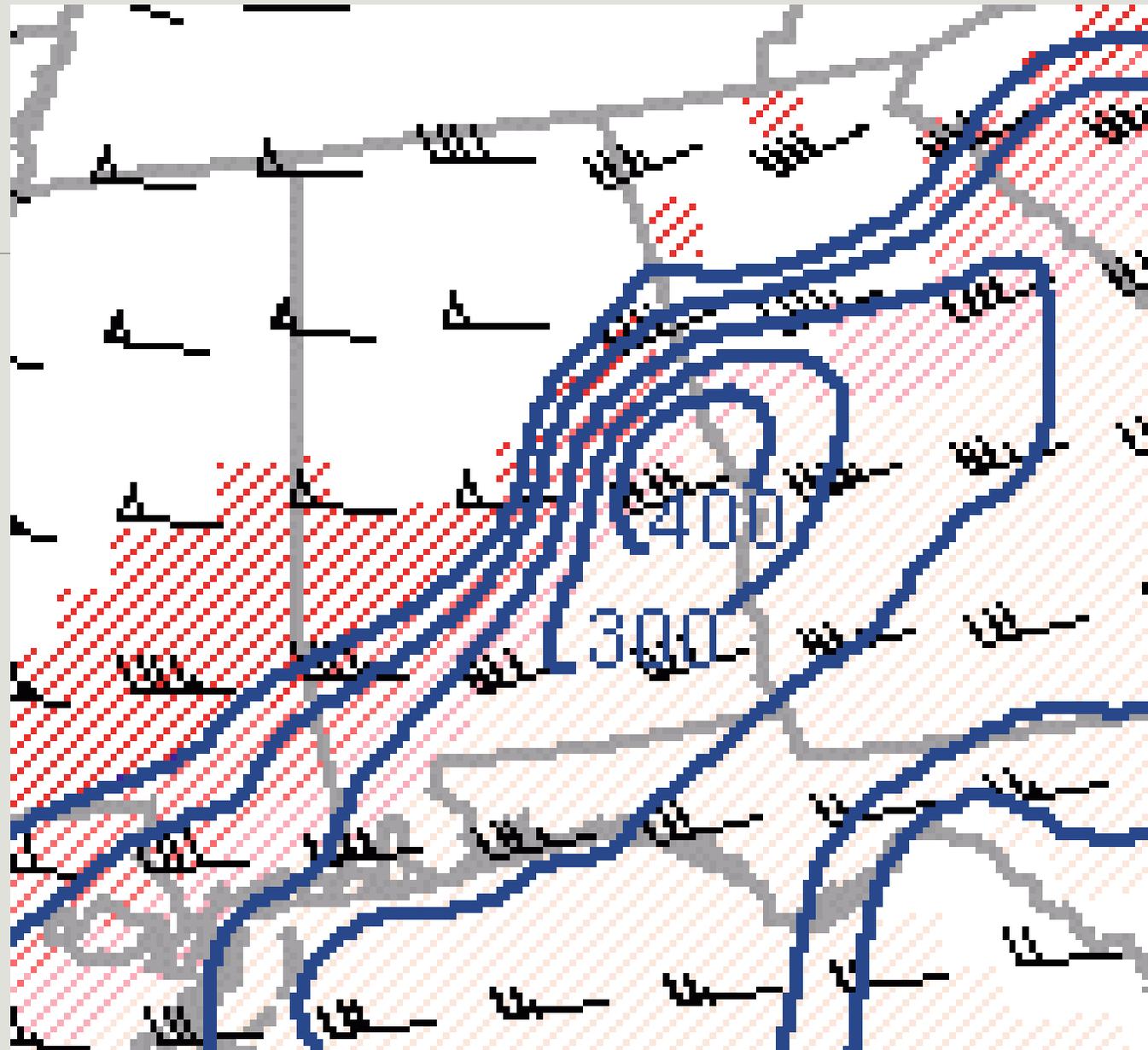


<https://www.spc.noaa.gov/exper/mesoanalyses/>

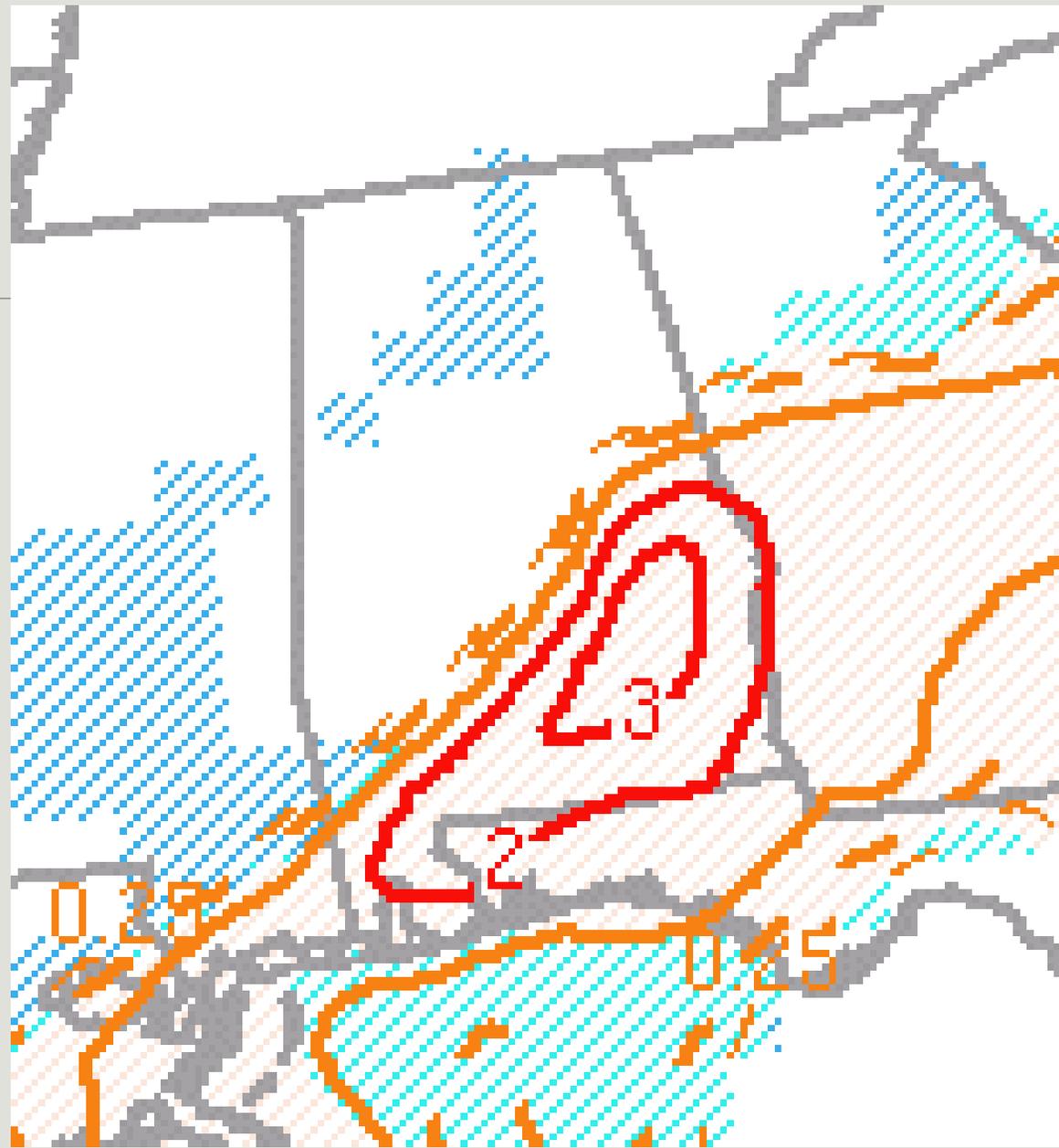
**0-6km bulk  
wind shear:  
~55 kts**



**Effective  
storm  
relative  
helicity  
(SRH):  
 $\sim 400 \text{ m}^2/\text{s}^2$**



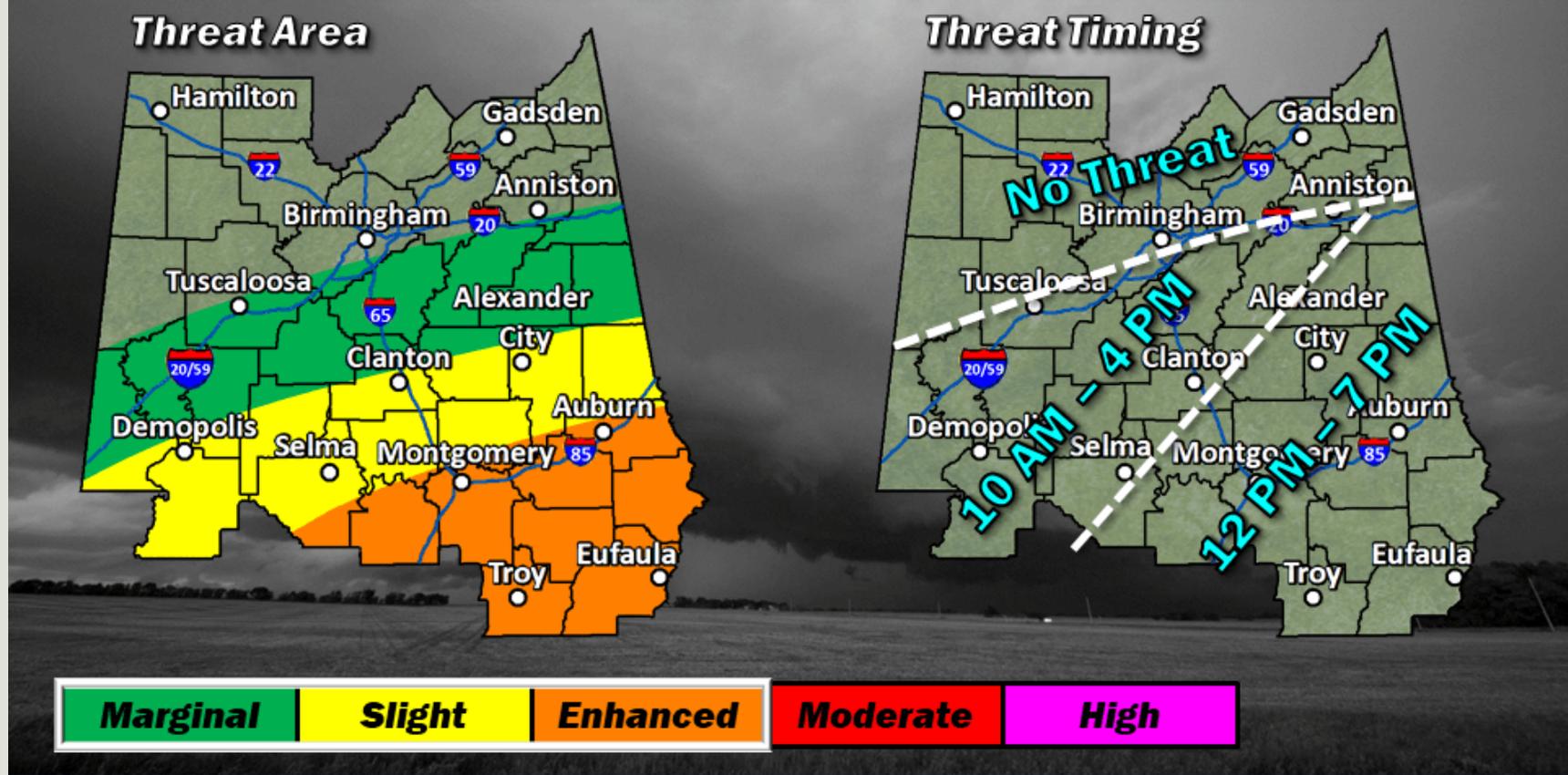
**Significant  
Tornado  
Parameter  
(STP):  
~3**



# Severe Weather Outlook

## Threats

- Enhanced Risk:** Tornadoes/Damaging winds up to 70 mph/Quarter size hail
- Slight Risk:** Tornadoes possible/Damaging winds up to 60 mph
- Marginal Risk:** Threats mentioned above are less likely but cannot be completely ruled out

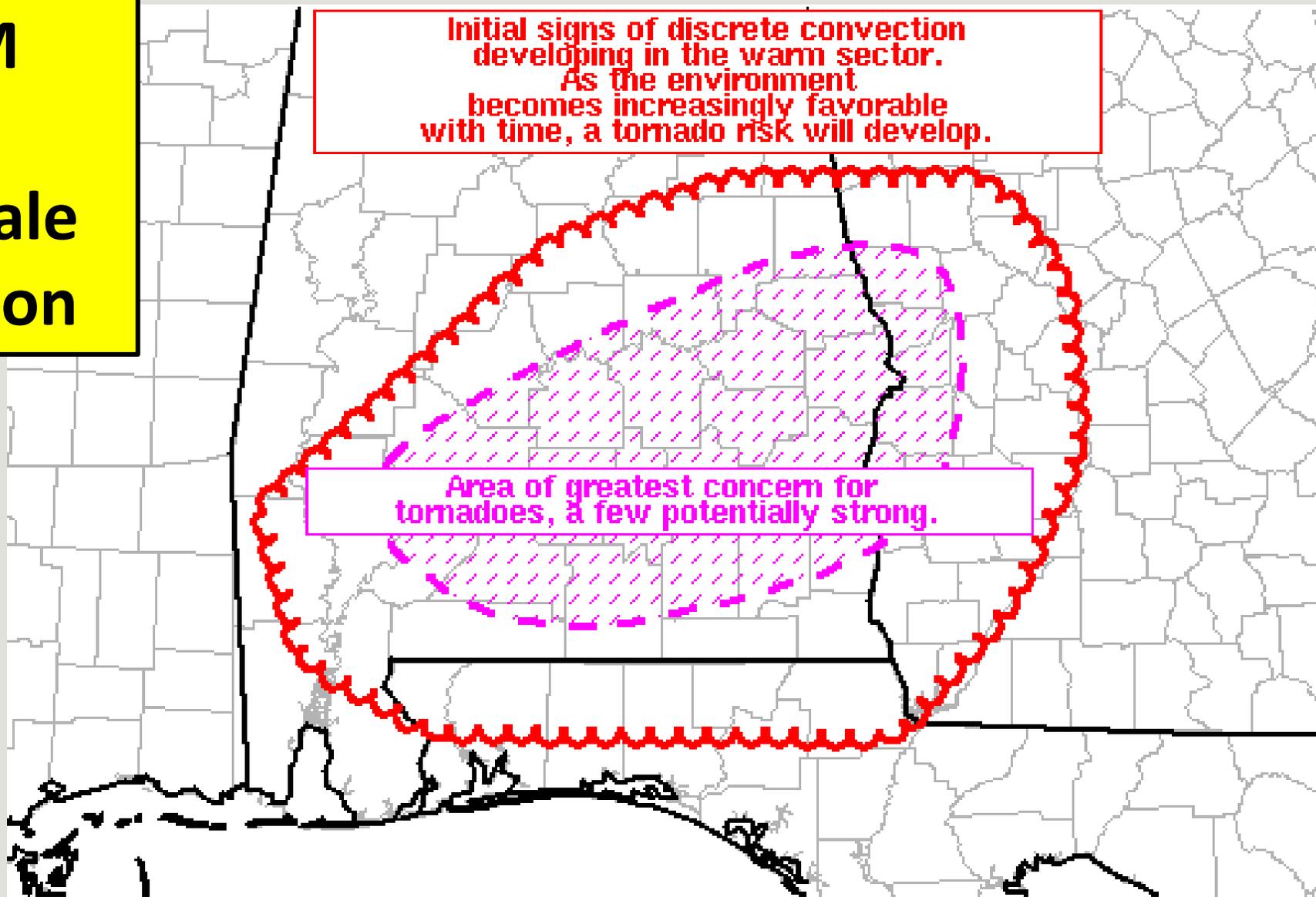


**10 AM  
SPC  
Mesoscale  
Discussion**

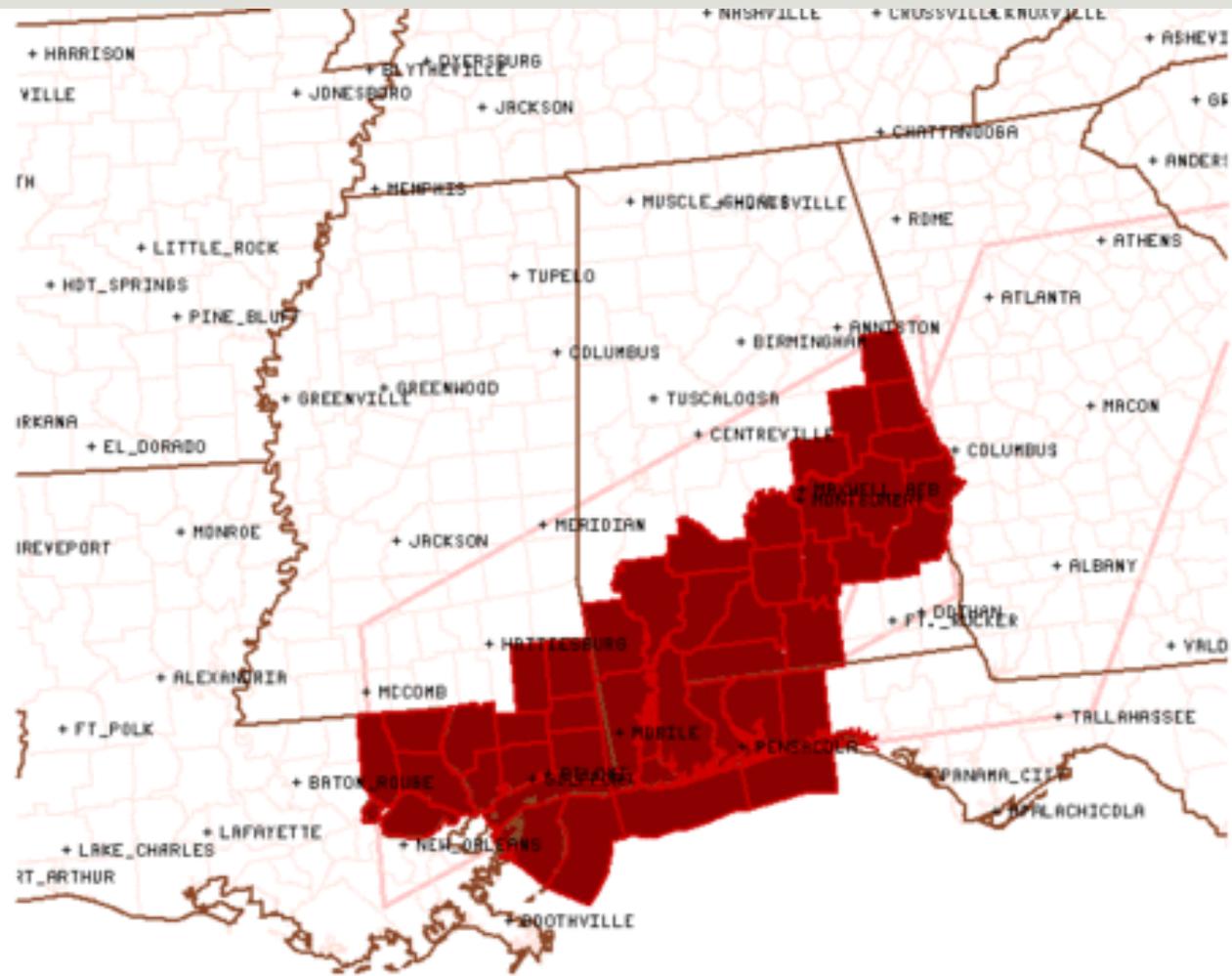
**Initial signs of discrete convection  
developing in the warm sector.  
As the environment  
becomes increasingly favorable  
with time, a tomado risk will develop.**

**Area of greatest concern for  
tomadoes, a few potentially strong.**

SPC MCD #0141



# 11 AM SPC Tornado Watch

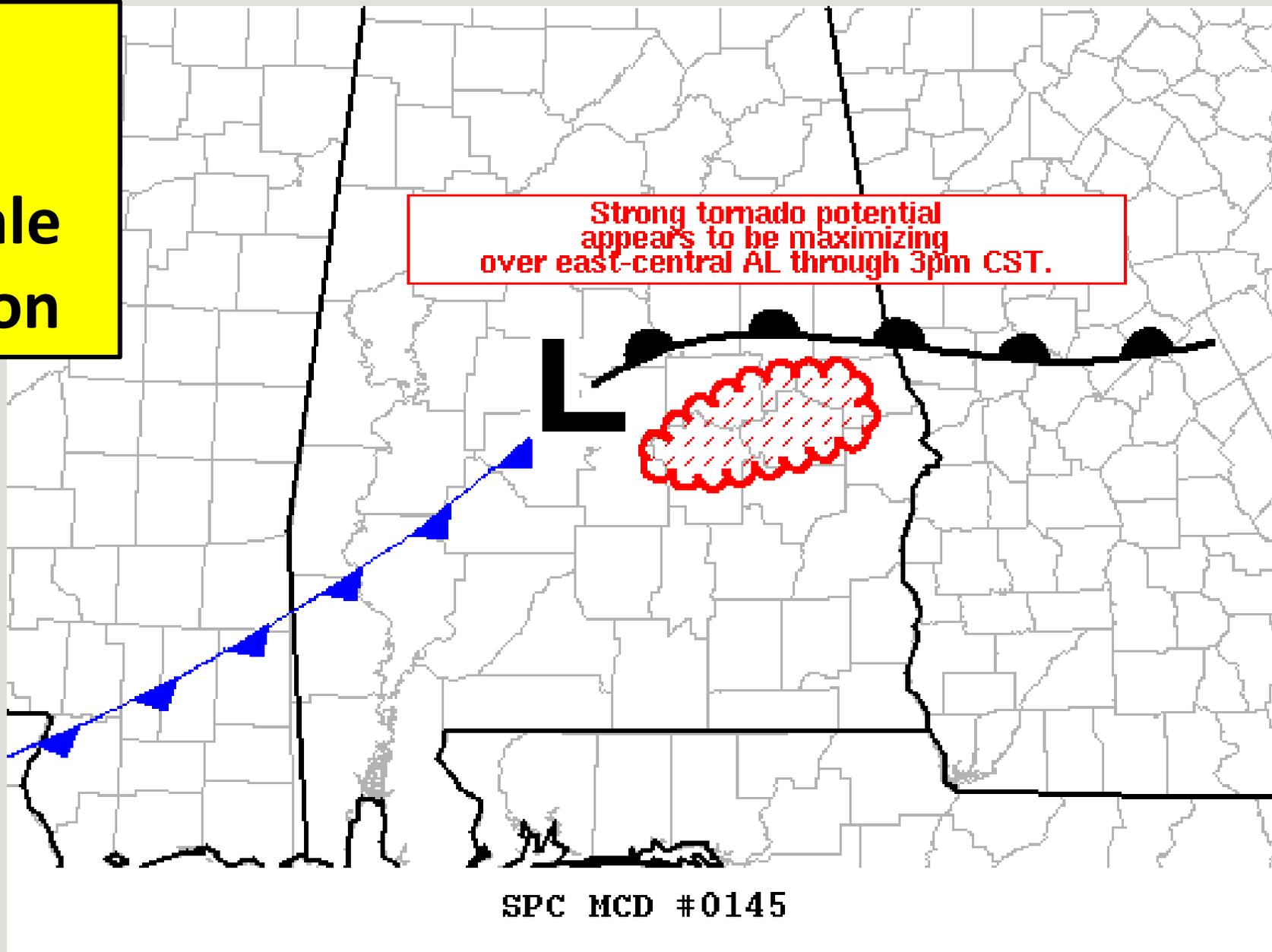


**Tornado Watch # 7 - Valid from 1105 AM until 600 PM CST**

NOAA/NWS/Storm Prediction Center

Updated: 20190303/2013 UTC

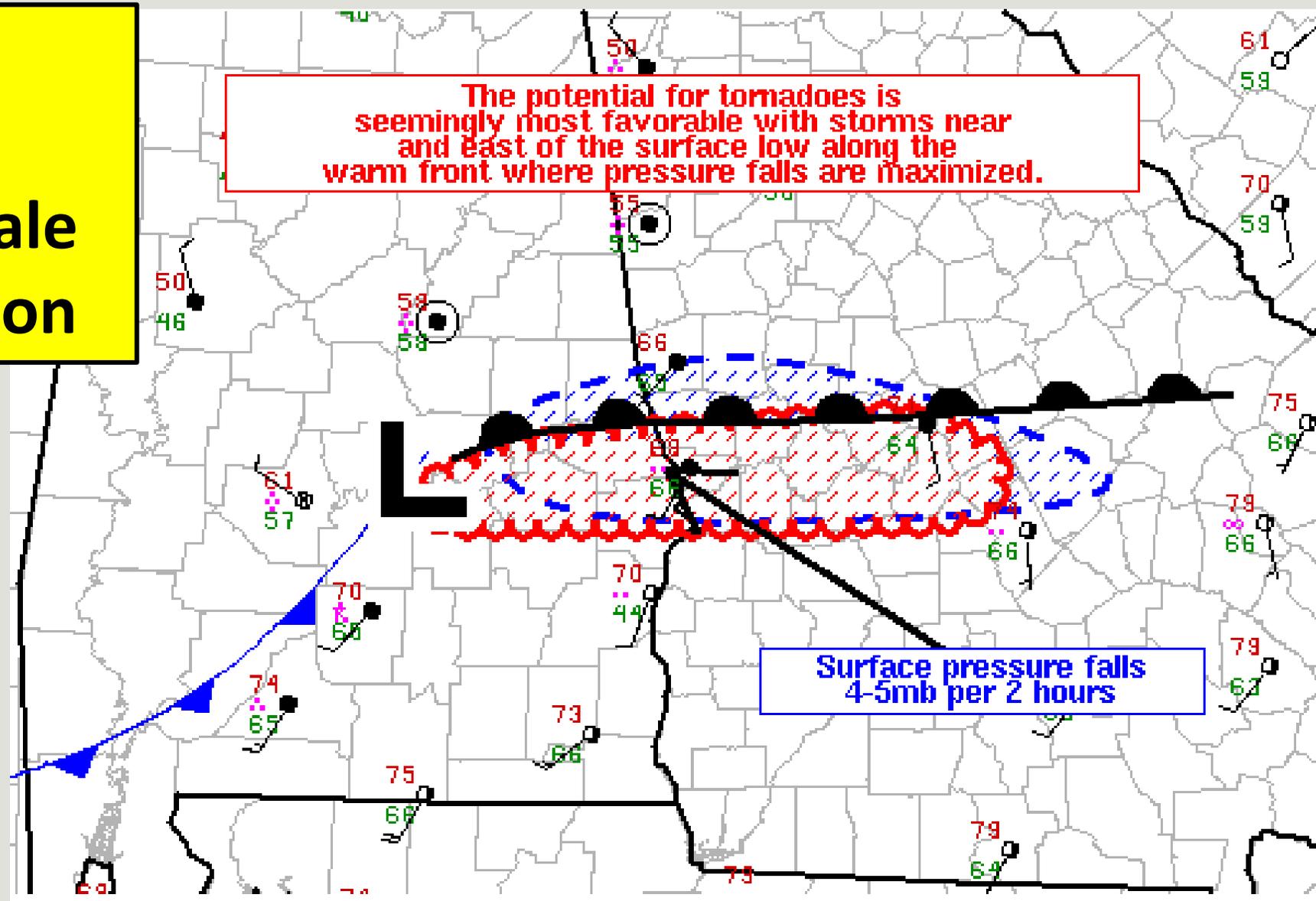
**1PM  
SPC  
Mesoscale  
Discussion**



SPC MCD #0145

**2PM  
SPC  
Mesoscale  
Discussion**

The potential for tornadoes is seemingly most favorable with storms near and east of the surface low along the warm front where pressure falls are maximized.

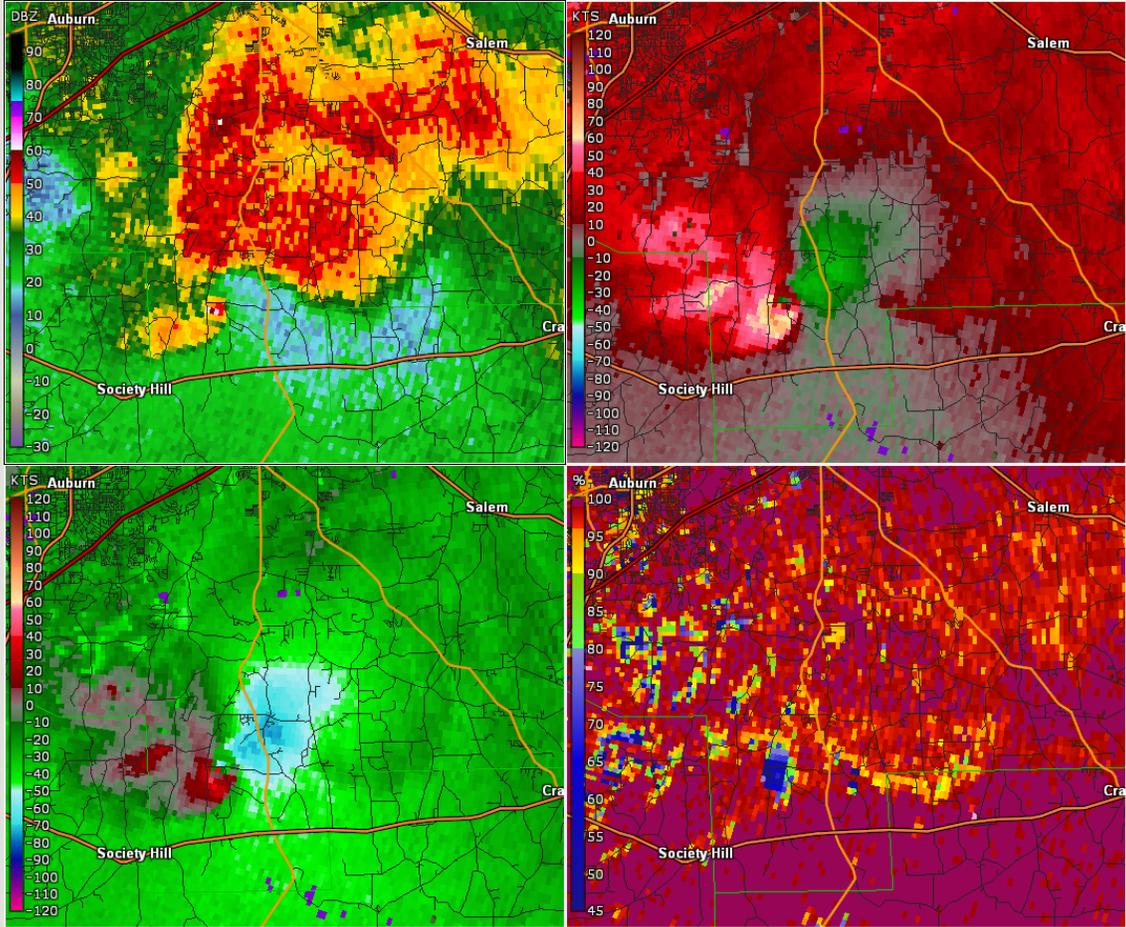


Surface pressure falls 4-5mb per 2 hours

SPC MCD #0147

# Radar Images

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# Further Training

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- COMET MetEd Modules (<https://www.meted.ucar.edu/index.php>)
  - Hundreds of free modules about all kinds of meteorological topics
- SPC Video Lecture series (<https://www.spc.noaa.gov/exper/spcousom/>)
  - Collection of lectures on severe storms from Storm Prediction Center forecasters and others given to a University of Oklahoma class
- NWS Warning Decision Training Branch Radar Applications Course (<https://training.weather.gov/wdtd/courses/rac/outline.php>) and Warning Operations Course (<https://training.weather.gov/wdtd/courses/woc/severe.php>)
  - Choose the “Web version” of each module which doesn’t require a login

# Additional Materials

Visit our SKYWARN spotter page for useful links and information: [weather.gov/bmx/skywarnschedule](http://weather.gov/bmx/skywarnschedule)

- This presentation in PDF format
- Spotter schedule
- Training materials
- Brochures and guides
- Certificate > [weather.gov/bmx/advancedspottertraining](http://weather.gov/bmx/advancedspottertraining)

