High-Shear, Low-CAPE (HSLC) Event Across ZHU Air space

Eric Zappe

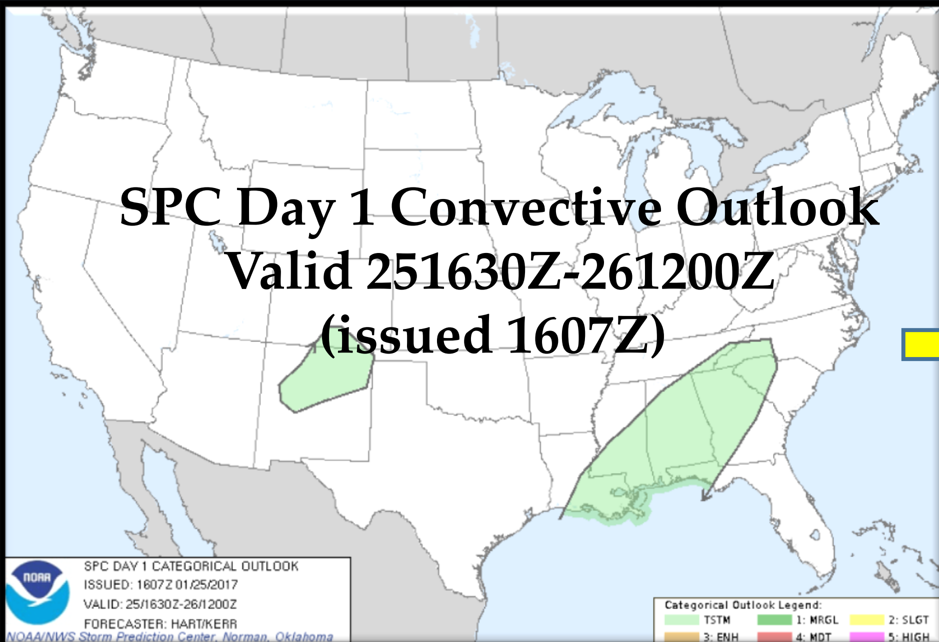
National Weather Service

Houston Center Weather Service Unit

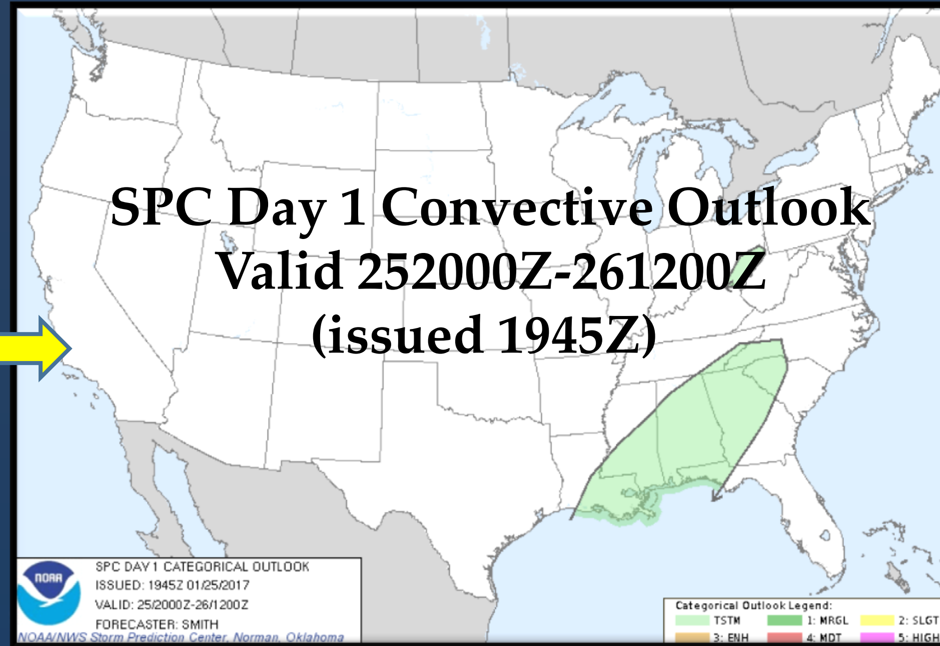
- This tutorial will demonstrate the importance of maintaining situational awareness when discrete/weak thunderstorms are forecast.

- This event took place during the late afternoon/evening of Jan 25, 2017 across central portions of Gulf Coast region.

Background

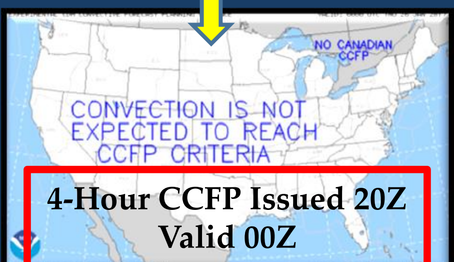


SPC Day 1 Convective Outlook
Valid 251630Z-261200Z
(issued 1607Z)
SPC DAY 1 CATEGORICAL OUTLOOK
ISSUED: 1607Z 01/25/2017
VALID: 25/1630Z-26/1200Z
FORECASTER: HART/KERR
NOAA/NWS Storm Prediction Center, Norman, Oklahoma
Categorical Outlook Legend:
TSTM
1: MRGL
2: SLGT
3: ENH
4: MDT
5: HIGH

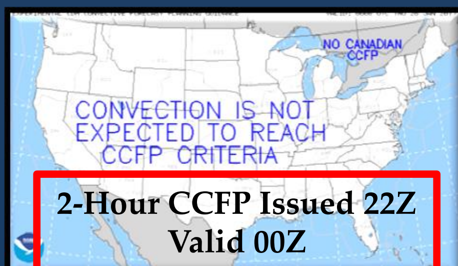


SPC Day 1 Convective Outlook
Valid 252000Z-261200Z
(issued 1945Z)
SPC DAY 1 CATEGORICAL OUTLOOK
ISSUED: 1945Z 01/25/2017
VALID: 25/2000Z-26/1200Z
FORECASTER: SMITH
NOAA/NWS Storm Prediction Center, Norman, Oklahoma
Categorical Outlook Legend:
TSTM
1: MRGL
2: SLGT
3: ENH
4: MDT
5: HIGH

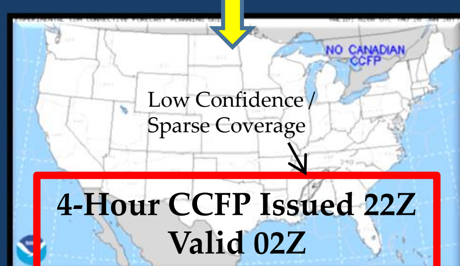
NO CANADIAN CCFP
CONVECTION IS NOT EXPECTED TO REACH CCFP CRITERIA
2-Hour CCFP Issued 20Z
Valid 22Z



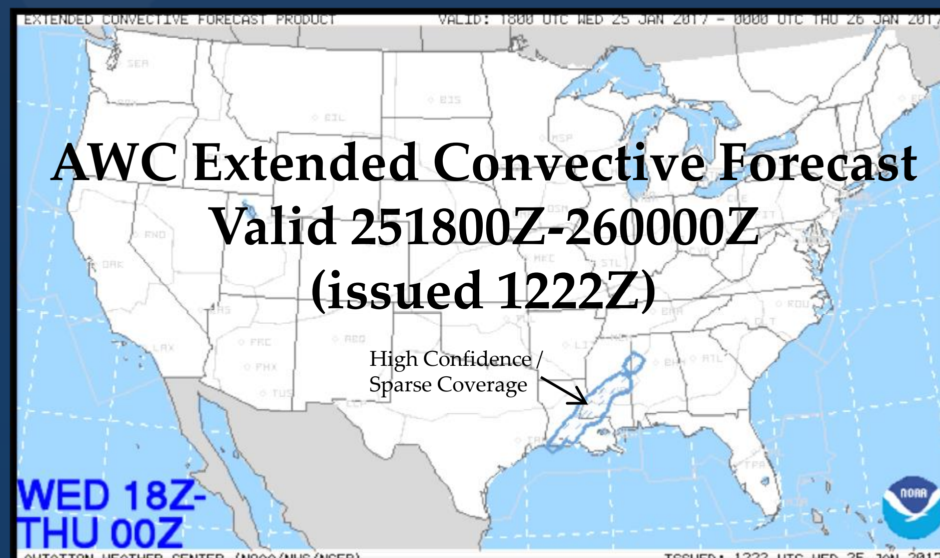
NO CANADIAN CCFP
CONVECTION IS NOT EXPECTED TO REACH CCFP CRITERIA
4-Hour CCFP Issued 20Z
Valid 00Z



NO CANADIAN CCFP
CONVECTION IS NOT EXPECTED TO REACH CCFP CRITERIA
2-Hour CCFP Issued 22Z
Valid 00Z

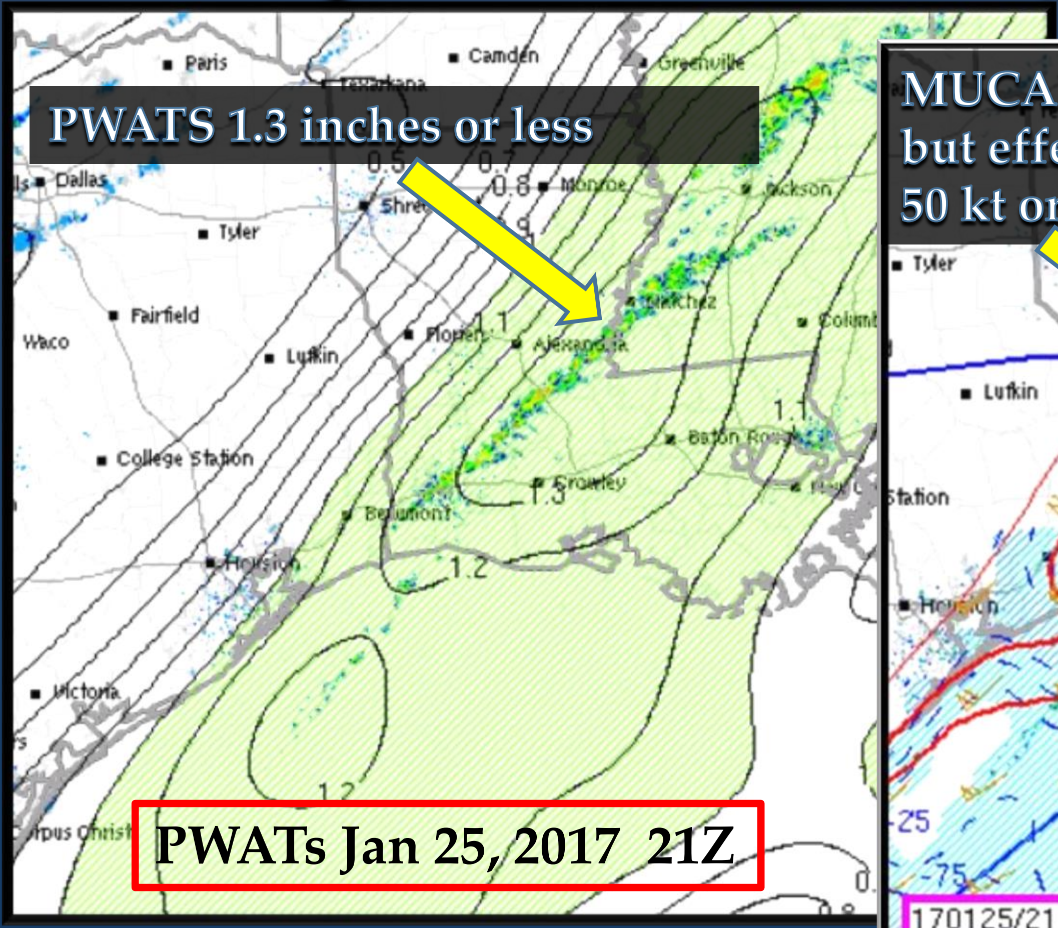


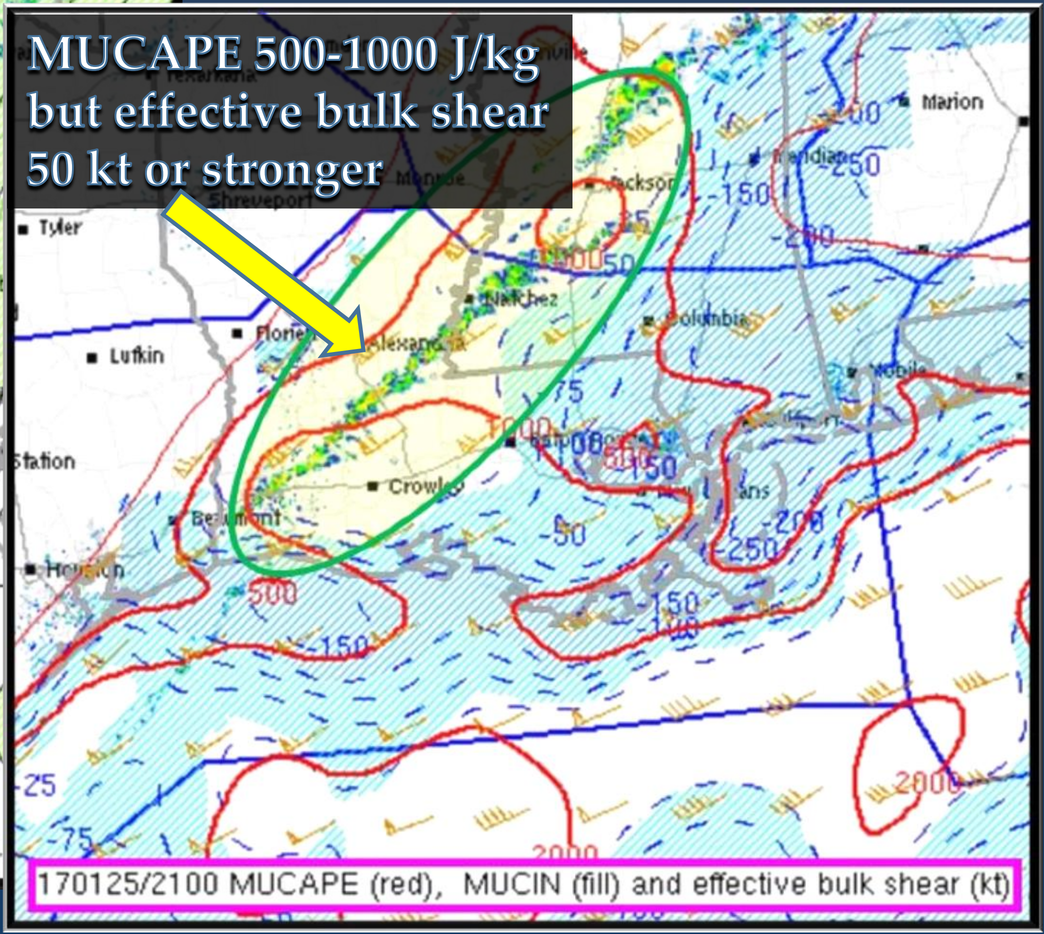
NO CANADIAN CCFP
Low Confidence / Sparse Coverage
4-Hour CCFP Issued 22Z
Valid 02Z



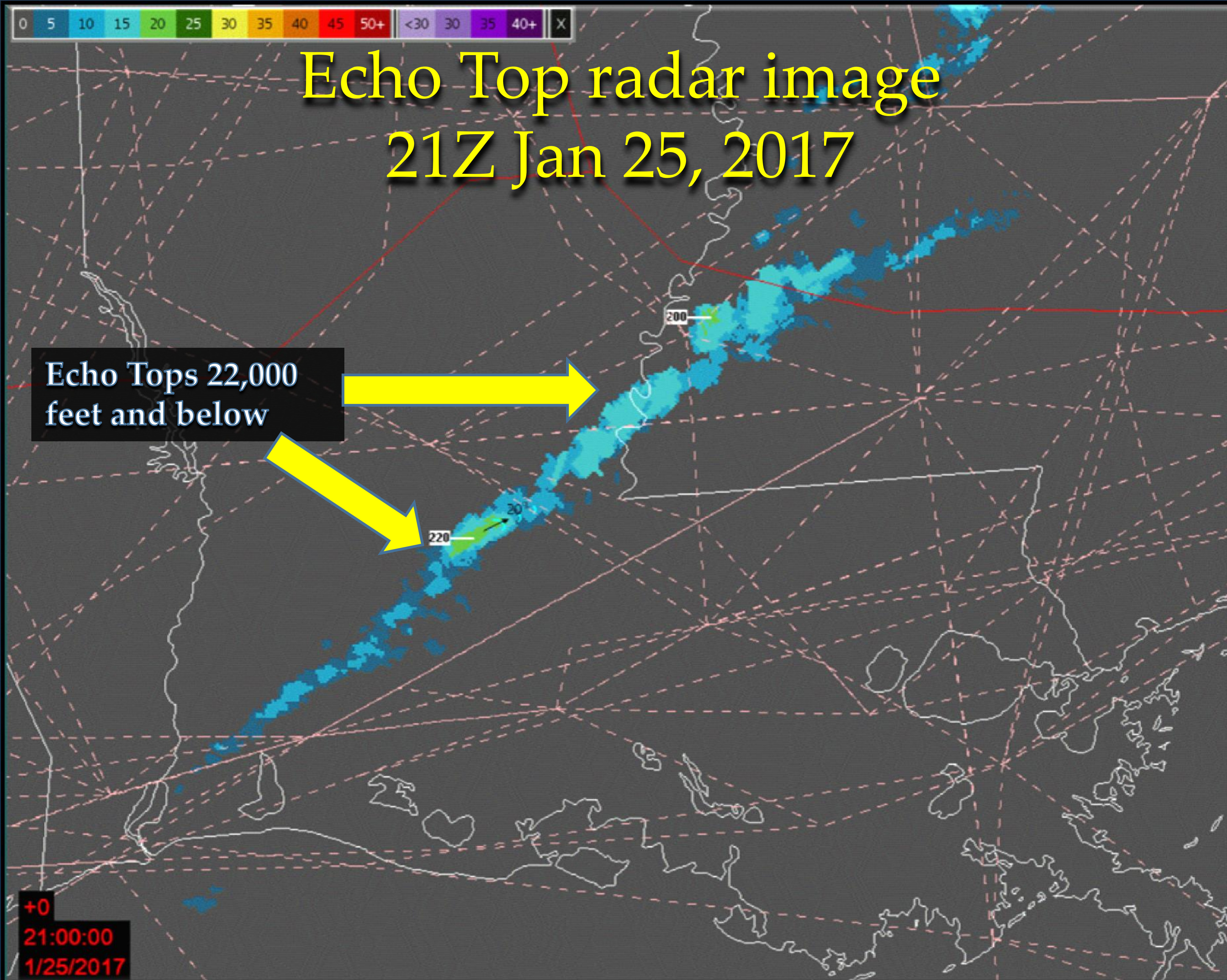
EXTENDED CONVECTIVE FORECAST PRODUCT
VALID: 1800 UTC WED 25 JAN 2017 - 0000 UTC THU 26 JAN 2017
AWC Extended Convective Forecast
Valid 251800Z-260000Z
(issued 1222Z)
High Confidence / Sparse Coverage
WED 18Z-THU 00Z
AVIATION WEATHER CENTER (NOAA/NWS/NCEP)
ISSUED: 1222 UTC WED 25 JAN 2017

These are snapshots from SPC Mesoscale Analysis pages showing beginning stages of this particular event (21Z Jan 25, 2017)



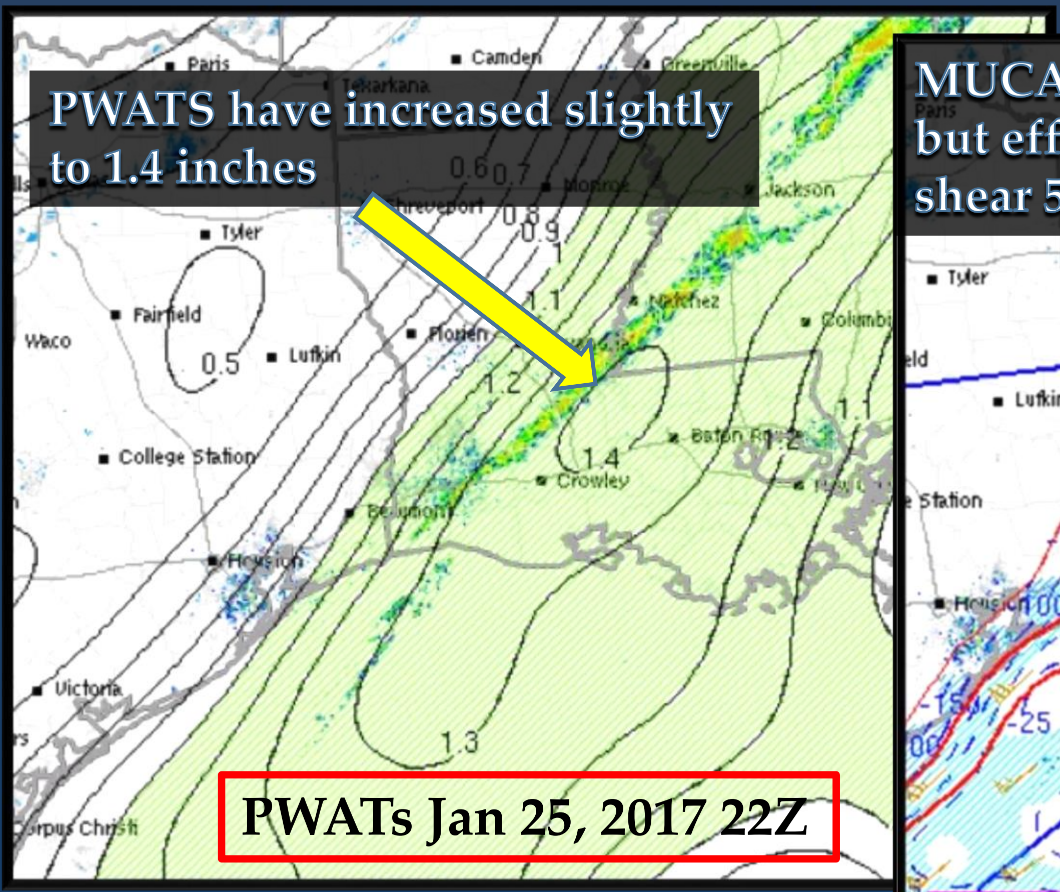


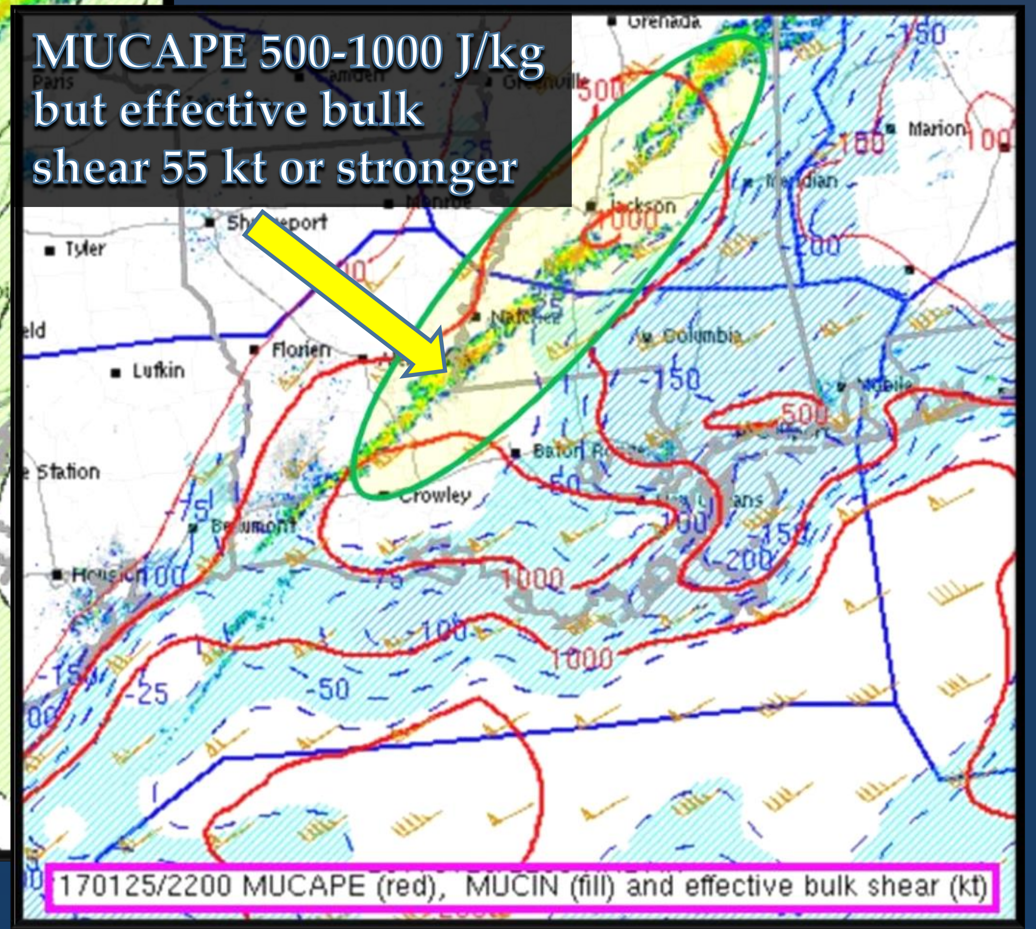
http://www.spc.ncep.noaa.gov/exper/mesoanalysis/



0 5 10 15 20 25 30 35 40 45 50+ <30 30 35 40+ X
Echo Top radar image
21Z Jan 25, 2017
Echo Tops 22,000 feet and below
200
220
20
+0
21:00:00
1/25/2017

These are snapshots one hour later… 22Z Jan 25, 2017

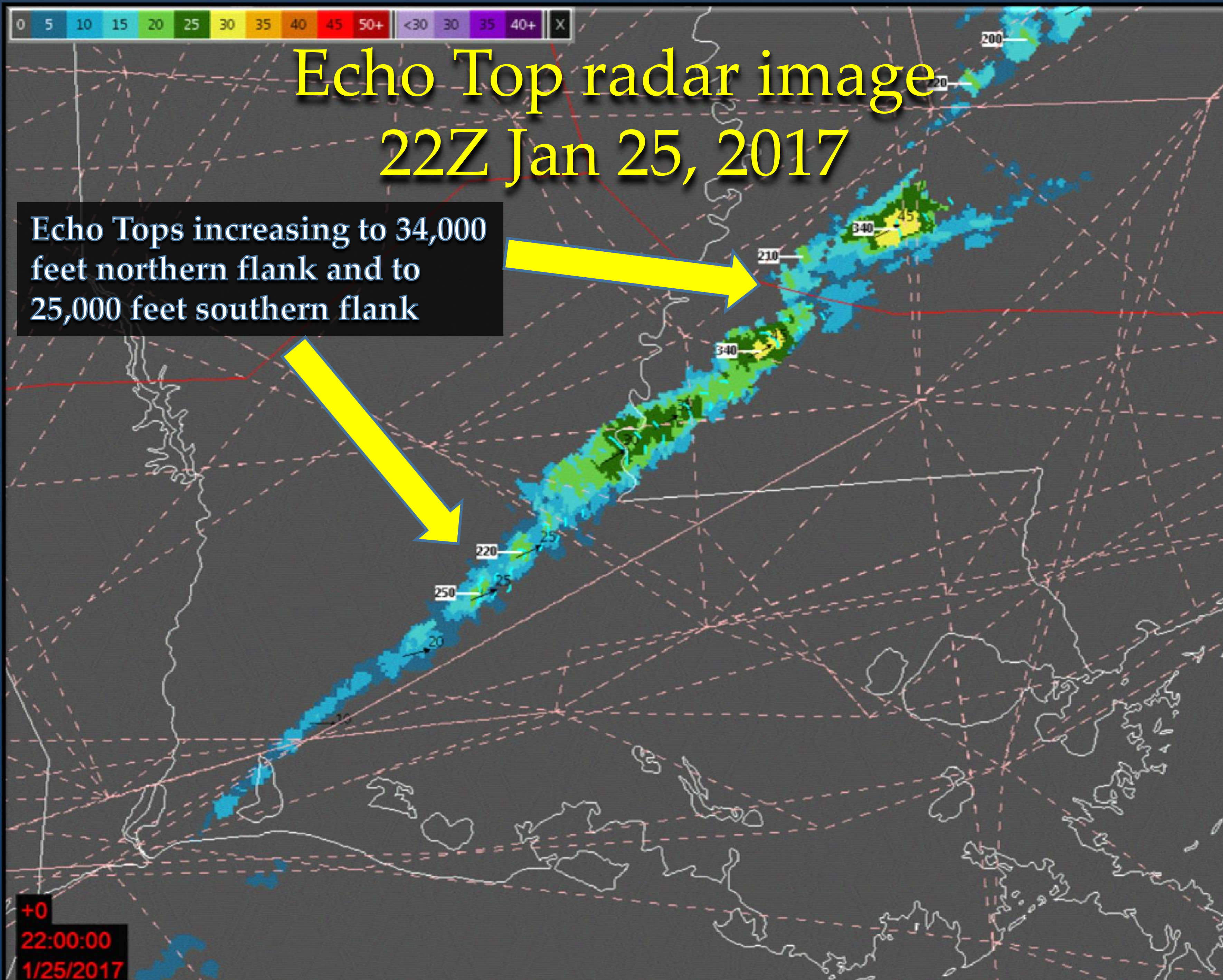




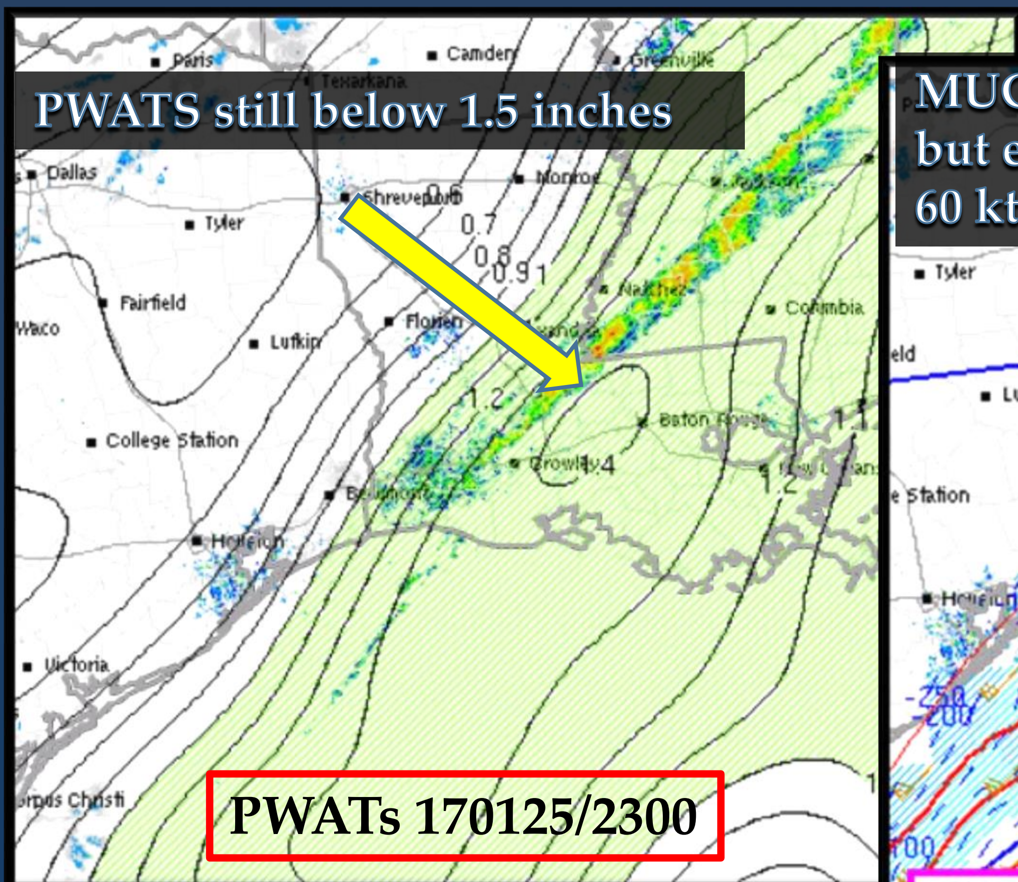
http://www.spc.ncep.noaa.gov/exper/mesoanalysis/

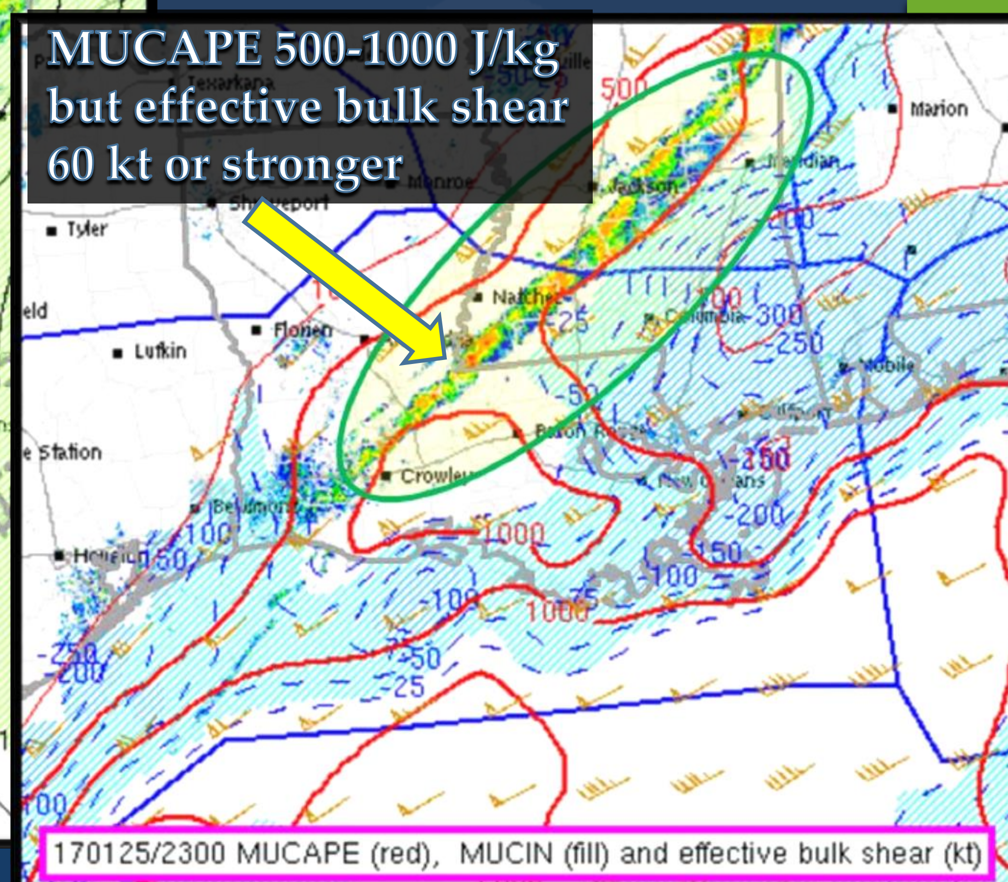
Echo Top radar image
22Z Jan 25, 2017

Echo Tops increasing to 34,000 feet northern flank and to 25,000 feet southern flank



These are snapshots two hours later…
23Z Jan 25, 2017

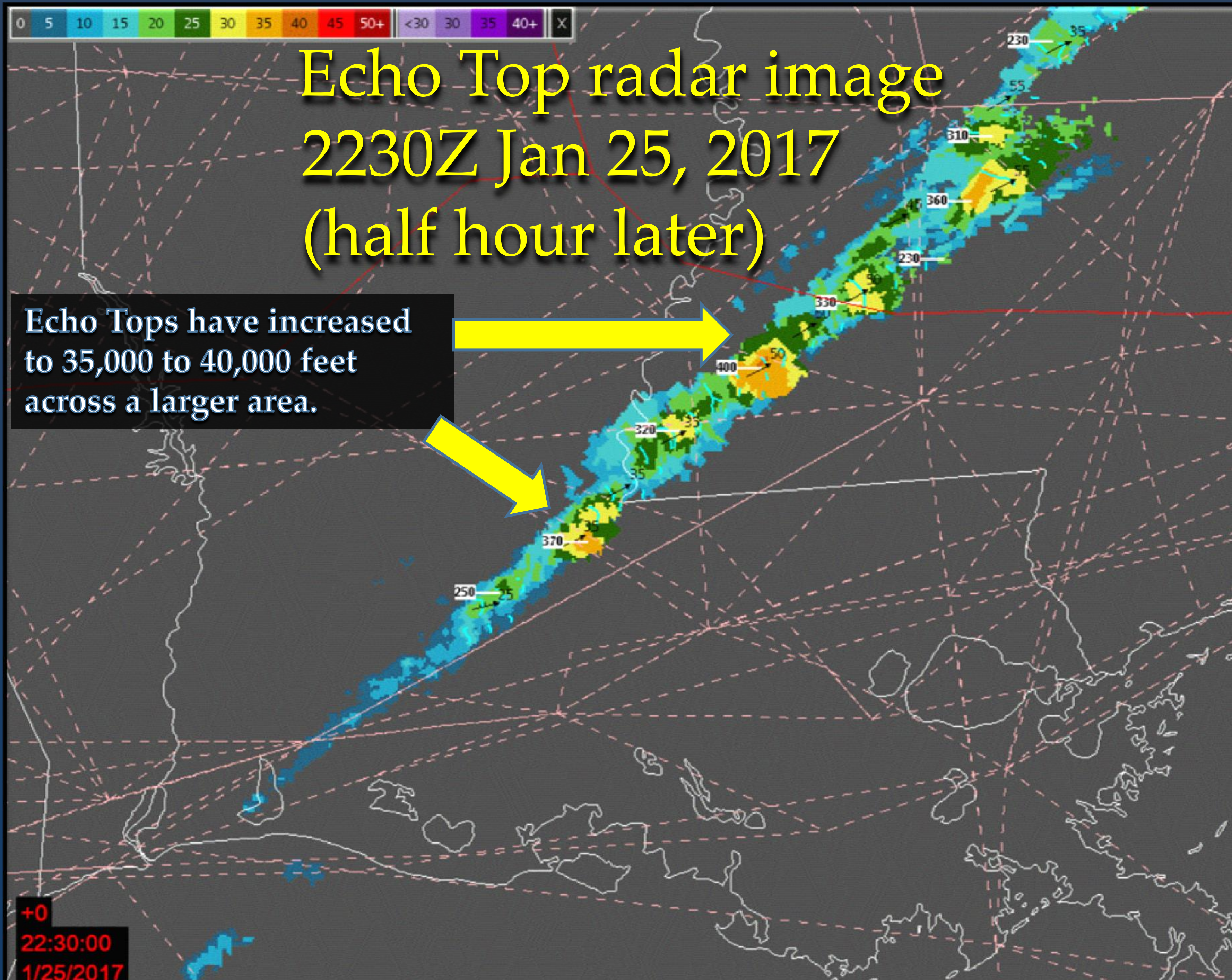




http://www.spc.ncep.noaa.gov/exper/mesoanalysis/

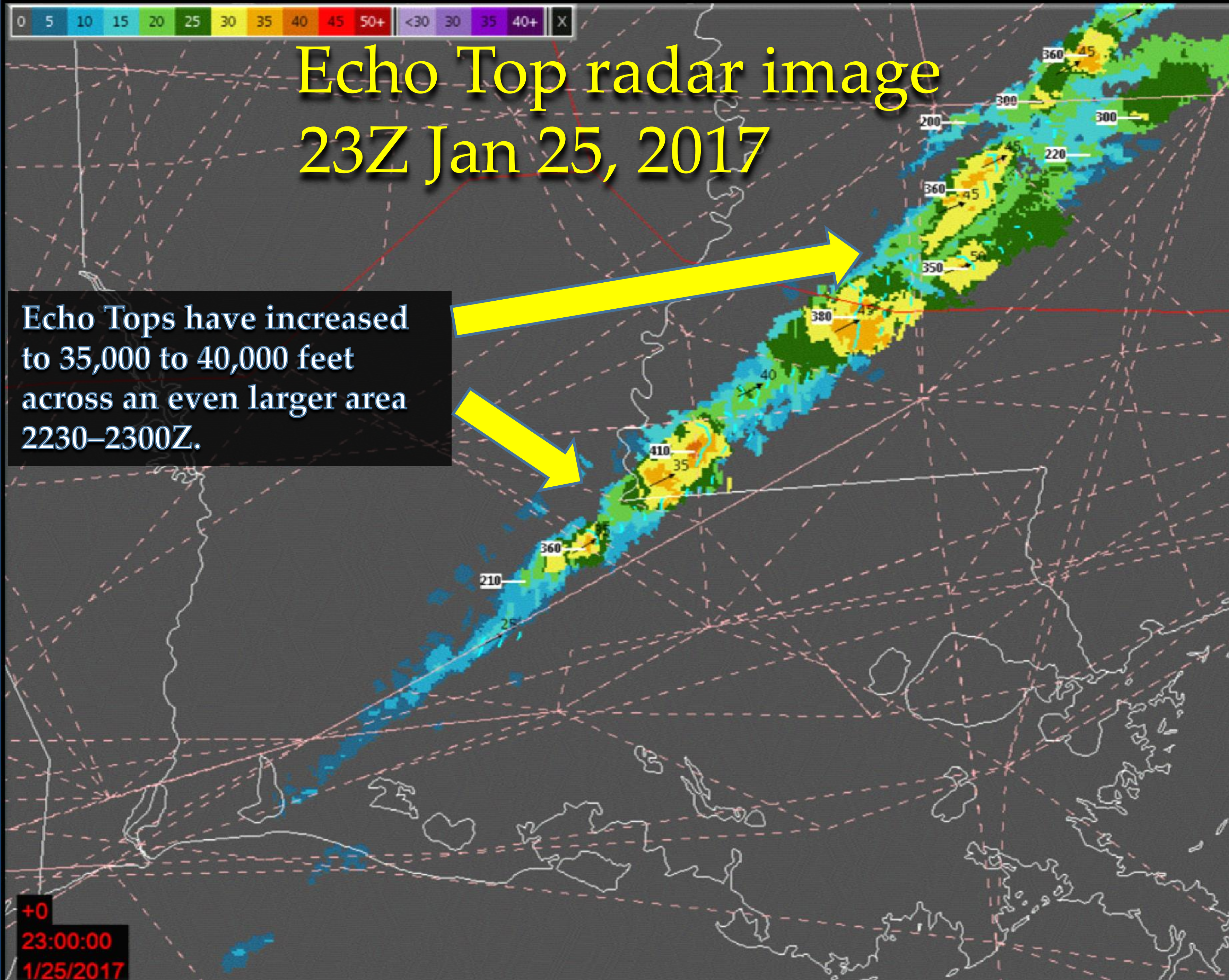
Echo Top radar image 2230Z Jan 25, 2017 (half hour later)

Echo Tops have increased to 35,000 to 40,000 feet across a larger area.

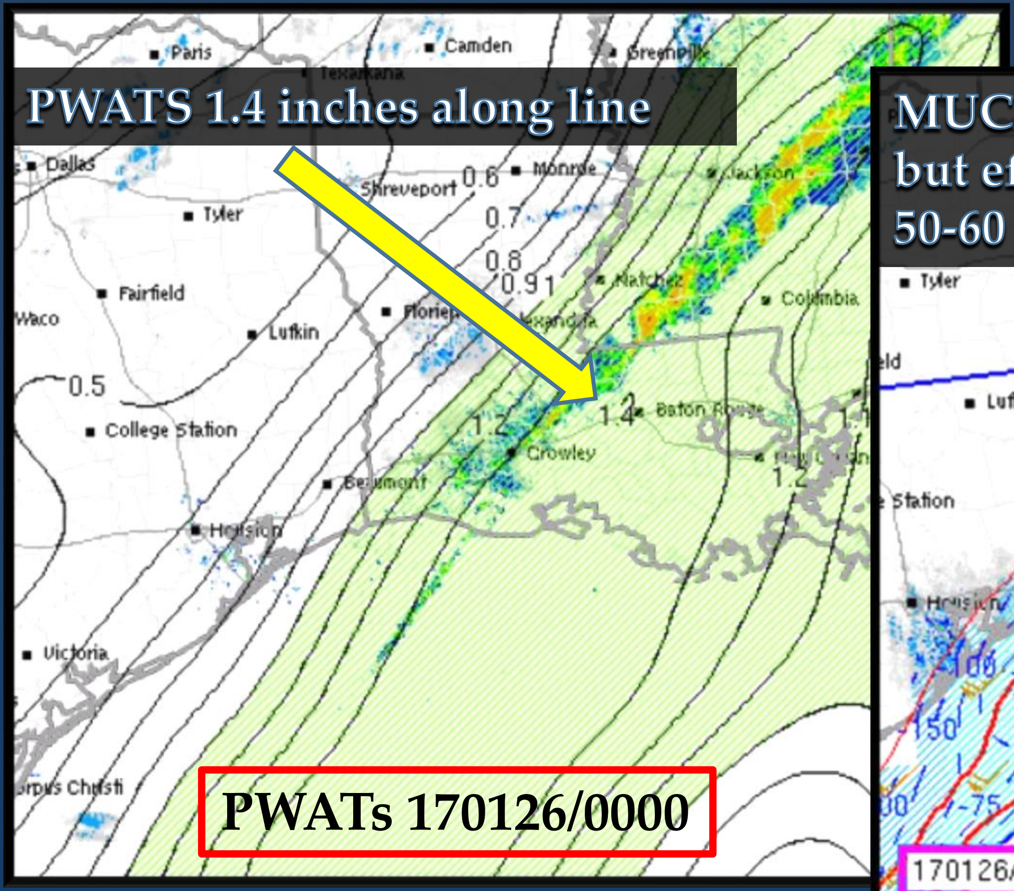


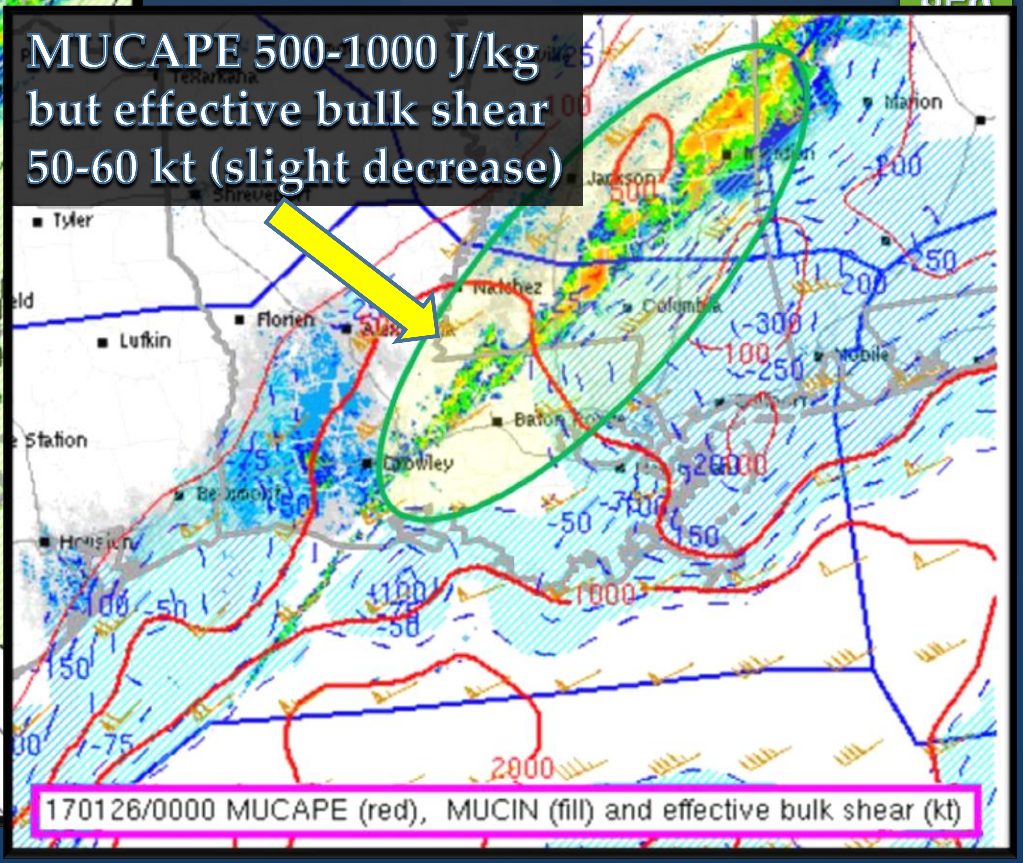
Echo Top radar image
23Z Jan 25, 2017

Echo Tops have increased to 35,000 to 40,000 feet across an even larger area 2230–2300Z.



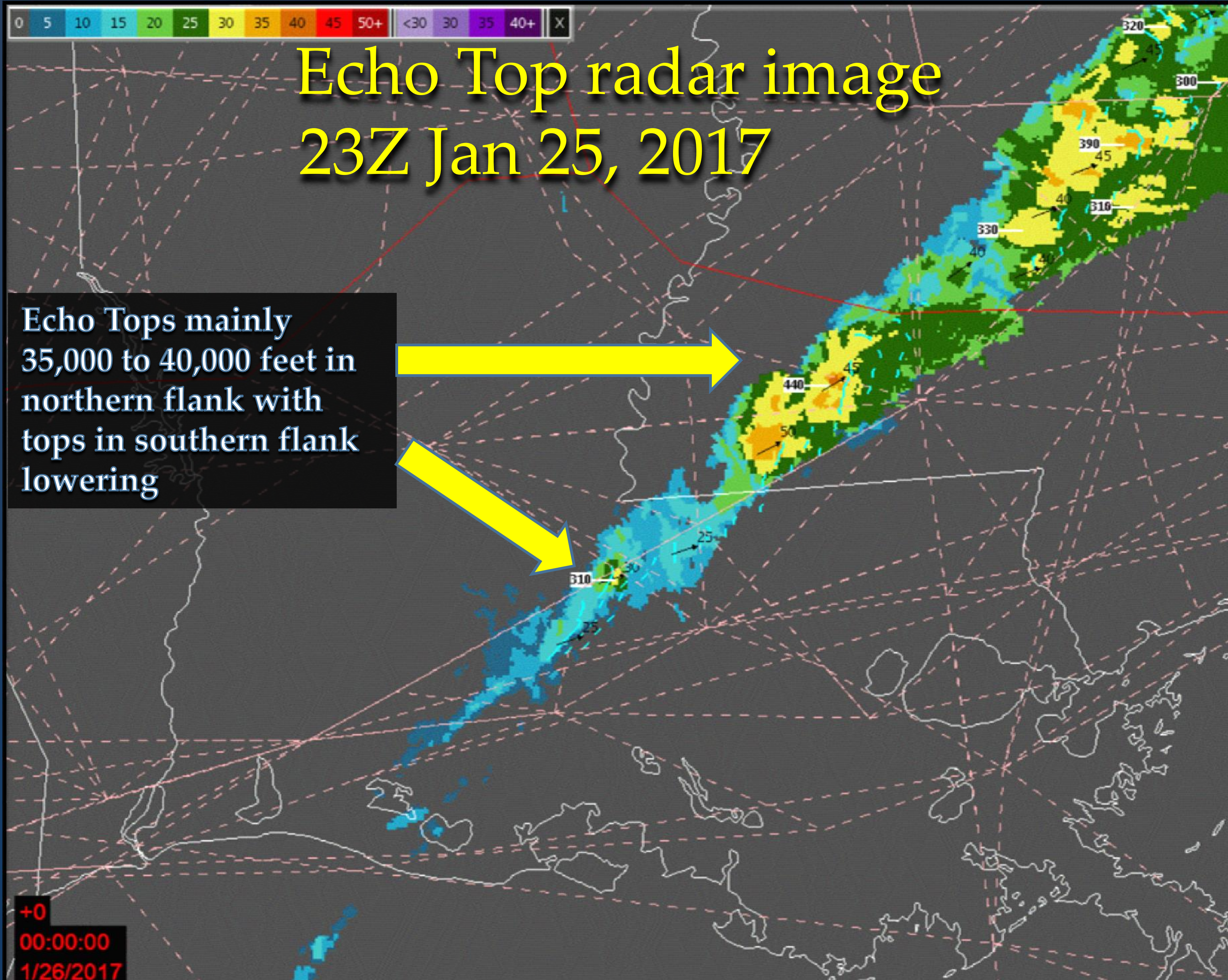
These are snapshots three hours later… 00Z Jan 26, 2017





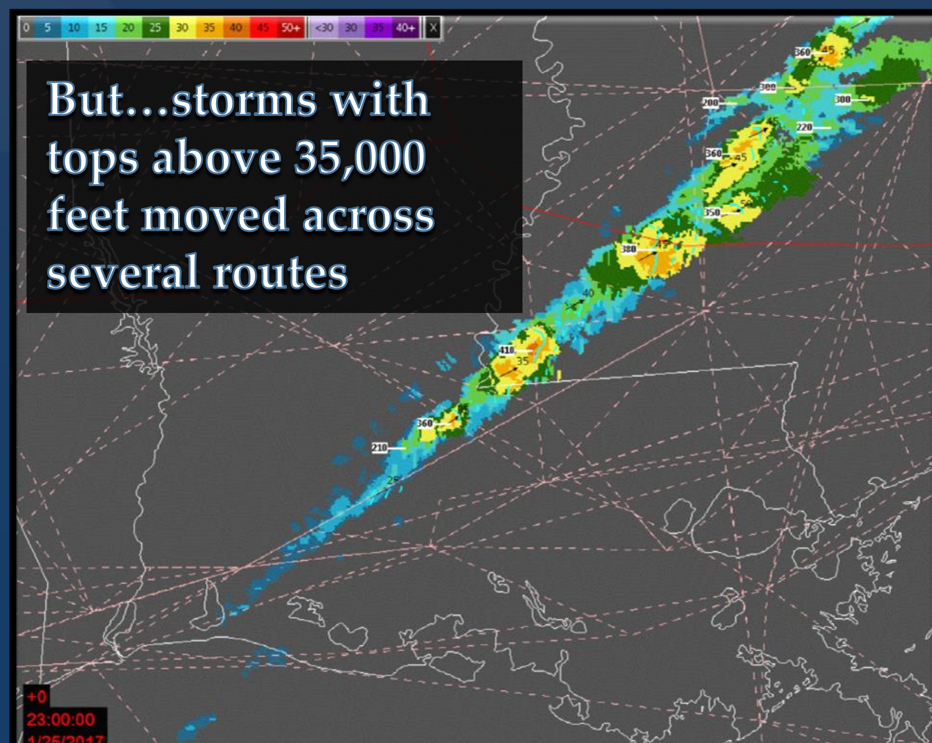
http://www.spc.ncep.noaa.gov/exper/mesoanalysis/

Echo Top radar image
23Z Jan 25, 2017



Echo Tops mainly 35,000 to 40,000 feet in northern flank with tops in southern flank lowering


SPC Storm Reports for 01/25/17
Map updated at 1209Z on 01/29/17
No storm reports for this event
NO REPORTS RECEIVED
National Weather Service
Storm Prediction Center
Norman, Oklahoma
High Wind Report (65KT +)
Large Hail Report (2" dia. +)
PRELIMINARY DATA ONLY


But…storms with tops above 35,000 feet moved across several routes
+0
23:00:00
1/25/2017

Chapter 3

CONVECTIVE WEATHER

I. THUNDERSTORMS. There are three basic storm types: single cells, multi-cells and supercells. This section will cover each storm type, unique characteristics of each, and associated severe weather. Thunderstorm-produced severe weather may consist of a combination of tornadoes, hail, strong winds, lightning, and heavy rainfall.

While upward vertical motions and instability of an air mass determine whether thunderstorms will occur, wind shear strongly influences the type of thunderstorms to expect. Other conditions being the same (and favorable to thunderstorm formation), the greater the shear, the more likely the convection will be sustained. Each type of storm can be identified by a distinctive hodograph pattern, a visual depiction of the wind shear. AWS/FM-92/002 describes hodograph construction and use. The SHARP computer program will produce hodographs from RAOB soundings. Both are available from the AFWTL. Knowing expected storm type is key to predicting severe weather.

a. Single-cell Storm Indicators.

- Weak vertical and horizontal wind shear.
- The shear profile on the hodograph has a random pattern.
- Storm motion is with the mean wind in the lowest 5 to 7 km.

b. Associated Severe Weather.

- Tornadoes are rare.
- Short-lived high winds and hail are possible.

Watch developing cells using weather radar. When severe weather occurs in single-cell storms, it usually is in the stronger and longer-duration cells. Individual cells develop stronger core reflectivity at higher elevations than surrounding cells and must be closely monitored.

FORECASTING LOW-INSTABILITY HIGH-SHEAR SEVERE WEATHER EVENTS IN ALABAMA AND GEORGIA

DANA BARKER

The southeastern United States, namely the northern and central portions of the states of Alabama and Georgia, are part of a humid subtropical climate. Especially in the summer months in these areas, atmospheric moisture, and the instability that usually accompanies it, is almost always abundant. In the transition period before and after this abundance of moisture in the Southeast, the moisture and resultant instability interacts with favorable upper-level dynamics on occasion to produce severe weather across the region, sometimes in the form of notable severe thunderstorm and tornado outbreaks. However, in the cooler months, sometimes even stronger upper-level dynamics hook up with very meager amounts of instability to create severe weather. These events, characterized by a high amount of both speed and directional shear in the atmosphere but a low amount of instability as measured by CAPE, present a big forecasting challenge for the area. Although the types of severe weather in high-shear, low-instability events are usually not as intense as those of their counterparts with higher levels of instability (e.g. EF0-EF2 tornadoes as opposed to the potential for EF2-EF4 tornadoes, the usual absence of large hail), high-shear, low-instability events are just as dangerous because they can develop on the mesoscale with little warning.

In the late fall and early winter months in the Southeast, cold front after cold front traverses the region, suppressing the truly marine air of the Gulf of Mexico further and further to the south. If this moisture is allowed to advect back northward over land and meets with a mid-latitude cyclone traveling over the Southeast at the same time, dangerous severe weather outbreaks can result. However, even a small amount of moisture coupled with ample shear aloft can result in severe weather over Alabama and Georgia in the winter months. These kind of events are the "sneakiest" of the bunch because they don't have the usual precursors such as sultry, humid air or extremely heavy rainfall accompanying them. In some cases, due to such lack of instability, there have been severe weather events, including tornadoes, without accompanying lightning or thunder.

FORECASTING LOW-INSTABILITY HIGH-SHEAR SEVERE WEATHER EVENTS IN ALABAMA AND GEORGIA

DANA BARKER

(continued)

Low-instability, high-shear severe weather events in the Southeast are a threat during the winter months and one that is not well advertised to the public. While most of the situations noted above were covered by a tornado watch, the threat of severe weather was not highlighted days in advance as with more "classic" severe weather outbreaks; in fact, the January 7, 2007 Day 1 severe weather outlook did not include a Slight Risk in all areas affected by tornadoes until the 1630Z outlook, the third one of the day. The silver lining is that due to the lack of instability, any tornado or severe weather event is usually not as severe as those events where instability is more plentiful, although there are exceptions; a similar setup produced an EF3 tornado in Carroll County, Georgia on February 26, 2008…while a severe thunderstorm warning was in effect, no tornado warning was issued (http://www.srh.noaa.gov/ffc/html/tor22608.shtml). While there may not be an official "protocol" to better forecast these such events on the mesoscale, looking at synoptic features that come into play a day or two in advance and treating any bit of convection that develops during the event as capable of producing severe weather, regardless of the amount of lightning or instability accompanying it, could be a better modus operandi in low-instability, high-shear situations. Some forecasting and warning techniques that are employed during tornado outbreaks in tropical systems (limited instability due to the central dense overcast arnd incredible shear values…sound familiar?) could also be utilized in cold season events with a lack of instability. All in all, improved short-term forecasting can help the area be better prepared for the abnormal severe weather setups that sometimes occur in the winter months in Alabama and Georgia.

Additional Reading….

Composite Environments of Severe and Nonsevere High-Shear, Low-CAPE Convective Events

Improving the Forecasting of High Shear, Low CAPE Severe Weather Environments

The High-Shear, Low-CAPE SHERB parameter and its evaluation

Climatology and Ingredients of Significant Severe Convection in High-Shear, Low-CAPE Environments

Forecasting Low-Instability High-Shear Severe Weather Events in Alabama and Georgia

The End

Eric Zappe
National Weather Service
Houston Center Weather Service Unit