Weather101: Observations in 3D

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Observations in 3-D: METARs and U/A Patterns

What we will cover in this class:

- The ins and outs of METARs
- How are METARs used?
- Upper air patterns
  - Why are some storm systems stronger than others

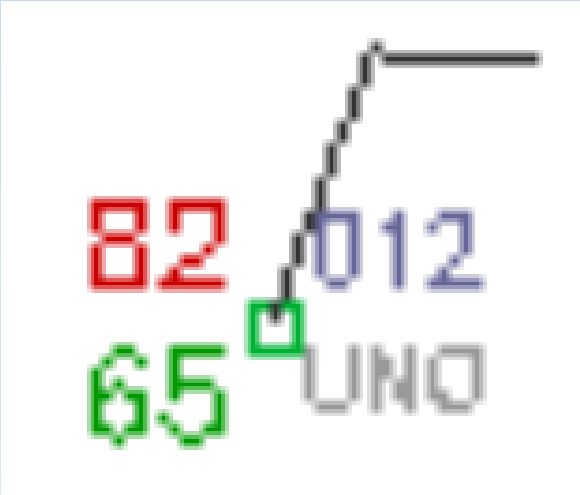
Observation in 3-D: METARs

METAR: Meteorological Terminal Aviation Routine

Raw METAR

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KCKV 022052Z AUTO 14006KT 10SM CLR 28/09 A2998 RMK AO2 SLP148 T02780089 58023
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Plotted METAR



Raw METARs

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KBNA 190153Z 20005KT 10SM OVC095 19/16 A3014 RMK AO2 RAE12 SLP202 P0004 T01940156
KBNA 190101Z VRB06KT 3SM -RA BR BKN035 BKN047 OVC090 19/16 A3012 RMK AO2 P0004 T01940161
KBNA 190053Z 24007G19KT 1 3/4SM R02L/5500VP6000FT +RA BR SCT031 BKN039 OVC050 19/16 A3013 RMK AO2 RAB35
SLP200 P0013 T01940156
KBNA 190049Z 22010G18KT 200V270 1 3/4SM R02L/5500VP6000FT +RA SCT031 BKN039 OVC050 19/16 A3013 RMK AO2
VIS 1V5 RAB35 P0005
KBNA 182353Z 20003KT 7SM FEW060 OVC080 19/17 A3008 RMK AO2 SLP185 60013 T01890167 10206 20183 55002
KBNA 182253Z 00000KT 8SM FEW060 BKN090 OVC200 20/17 A3008 RMK AO2 RAE06 SLP182 P0000 T02000172
KBNA 182153Z 17012KT 9SM -RA FEW080 OVC100 19/17 A3006 RMK AO2 RAB31 SLP178 P0001 T01940167
KBNA 182053Z 18007KT 8SM SCT039 OVC080 19/17 A3009 RMK AO2 RAE35 SLP186 P0000 60012 T01940172 56018
KBNA 181953Z 17007KT 4SM -RA BR FEW048 BKN060 OVC080 19/17 A3010 RMK AO2 SLP189 P0004 T01890172 $
KBNA 181918Z COR 16008KT 4SM -RA BR SCT014 SCT048 OVC060 18/17 A3011 RMK AO2 P0002 T01830167 $
KBNA 181853Z 27003KT 4SM -RA BR BKN018 BKN050 OVC075 18/17 A3013 RMK AO2 SLP201 P0008 T01830167
KBNA 181753Z 21004KT 3SM RA BR SCT015 BKN021 OVC028 18/17 A3014 RMK AO2 SLP205 P0031 60032 T01830167
10206 20100 55005
KBNA 181739Z 22005KT 3SM RA BR BKN023 OVC027 18/16 A3015 RMK AO2 P0026 T01830161
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Raw METARs

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Raw METARs

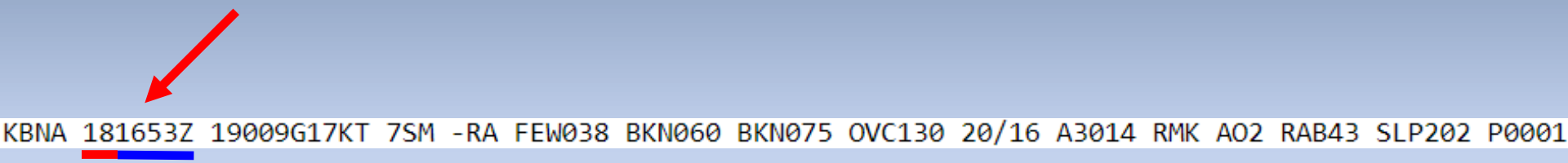
Station Identifier



KBNA 181653Z 19009G17KT 7SM -RA FEW038 BKN060 BKN075 OVC130 20/16 A3014 RMK AO2 RAB43 SLP202 P0001

Raw METARs

Date/Time Stamp in UTC



XXYYYYZ

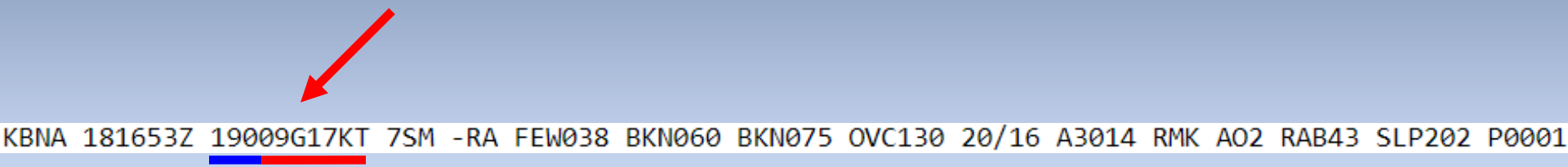
XX: The date

YYYY: The time in UTC

Z: UTC or Zulu time

Raw METARs

Wind Direction and Speed



KBNA 181653Z 19009G17KT 7SM -RA FEW038 BKN060 BKN075 OVC130 20/16 A3014 RMK AO2 RAB43 SLP202 P0001

AAABBGCCKT

AAA: Direction from which the wind is blowing

BB: Sustained wind speed

G: Gust

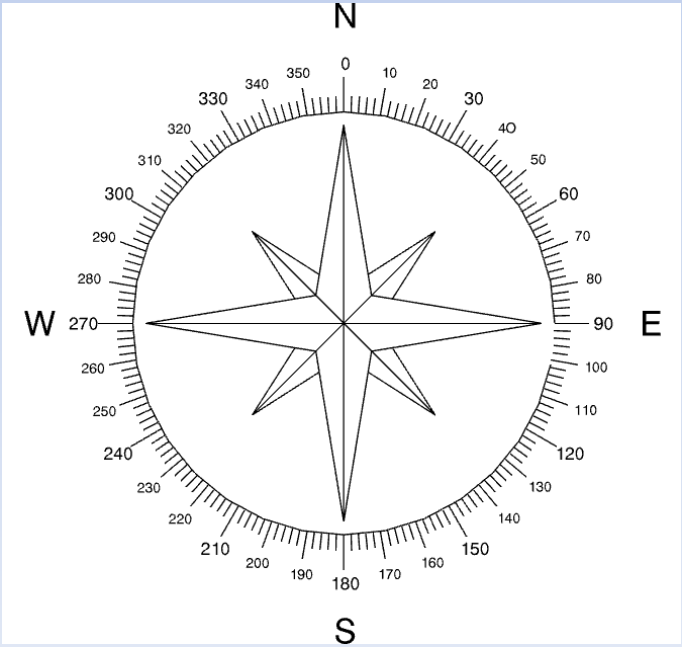
CC: Speed of any wind gusts

KT: Knots

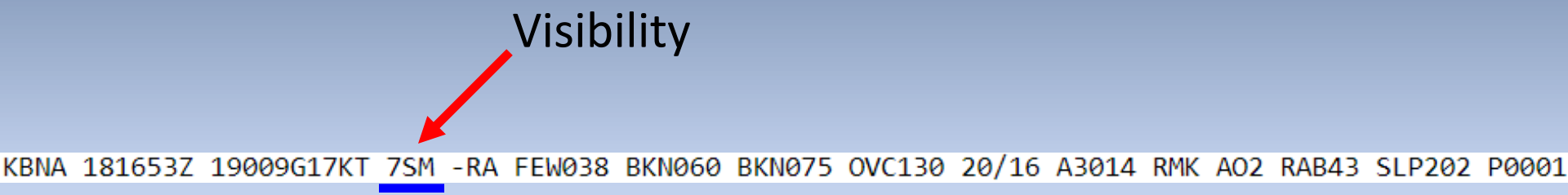
Raw METARs

Wind Direction and Speed

KBNA 181653Z 19009G17KT 7SM -RA FEW038 BKN060 BKN075 OVC130 20/16 A3014 RMK AO2 RAB43 SLP202 P0001



Raw METARs

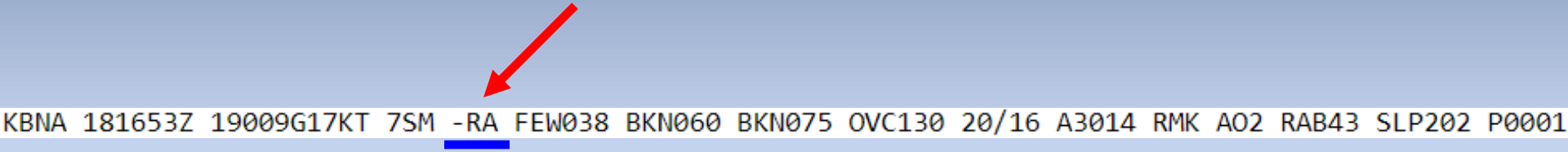


Horizontal restrictions:
P6SM is perfect visibility
SM: Statute Miles (just think in miles, for simplicity)

What can restricts visibility? Fog, Haze, Smoke

Raw METARs

Present Weather



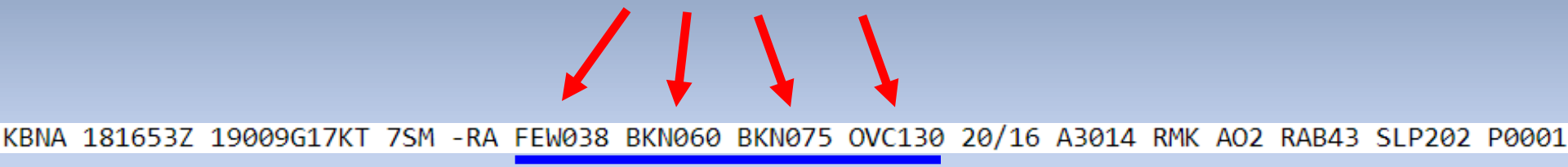
Raw METARs

QUALIFIER				WEATHER PHENOMENA					
INTENSITY OR PROXIMITY		DESCRIPTOR		PRECIPITATION		OBSCURATION		OTHER	
1		2		3		4		5	
-	Light	MI	Shallow	DZ	Drizzle	BR	Mist	PO	Dust/Sand whirls
	Moderate[2]	PR	Partial	RA	Rain	FG	Fog	SQ	Squalls
+	Heavy	BC	Patches	SN	Snow	FU	Smoke	FC	Funnel Cloud, Tornado, or Waterspout[4]
VC	In the Vicinity[3]	DR	Low Drifting	SG	Snow Grains	VA	Volcanic Ash	SS	Sandstorm
		BL	Blowing	IC	Ice Crystals (Diamond Dust)	DU	Widespread Dust	DS	Duststorm
		SH	Shower(s)	PL	Ice Pellets	SA	Sand		
		TS	Thunderstorms	GR	Hail	HZ	Haze		
		FZ	Freezing	GS	Small Hail and/or Snow Pellets	PY	Spray		
				UP	Unknown Precipitation				

1. The weather groups are constructed by considering columns 1 to 5 in the table above in sequence, i.e., intensity followed by description, followed by weather phenomena, e.g., heavy rain shower(s) is coded as +SHRA.
2. To denote moderate intensity no entry or symbol is used.
3. See text for vicinity definitions.
4. Tornadoes and waterspouts are coded as +FC.

Raw METARs

Ceilings or cloud levels

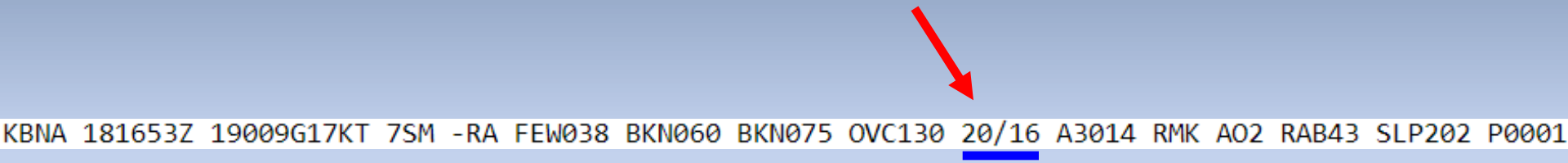


Add “00” to the end of each number to get the height above the ground (in feet)

These examples:
038 = 3800 ft
060 = 6000 ft
075 = 7500 ft
130 = 13000 ft

Raw METARs

Temperature / Dew Point in Celsius



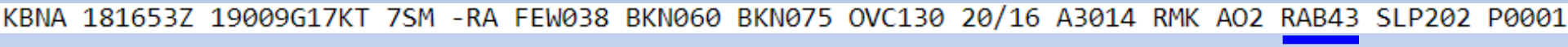
XX / YY

XX: Environmental Temperatures (Celsius)

YY: Dew point (Celsius)

Raw METARs

If it rained, you'll get this group

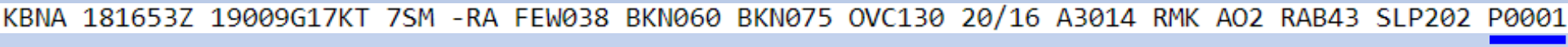


RAB: The time the rain began
RAE: The time the rain ended

This is example: 1643Z

Raw METARs

Amount of rain



KBNA 181653Z 19009G17KT 7SM -RA FEW038 BKN060 BKN075 OVC130 20/16 A3014 RMK AO2 RAB43 SLP202 P0001

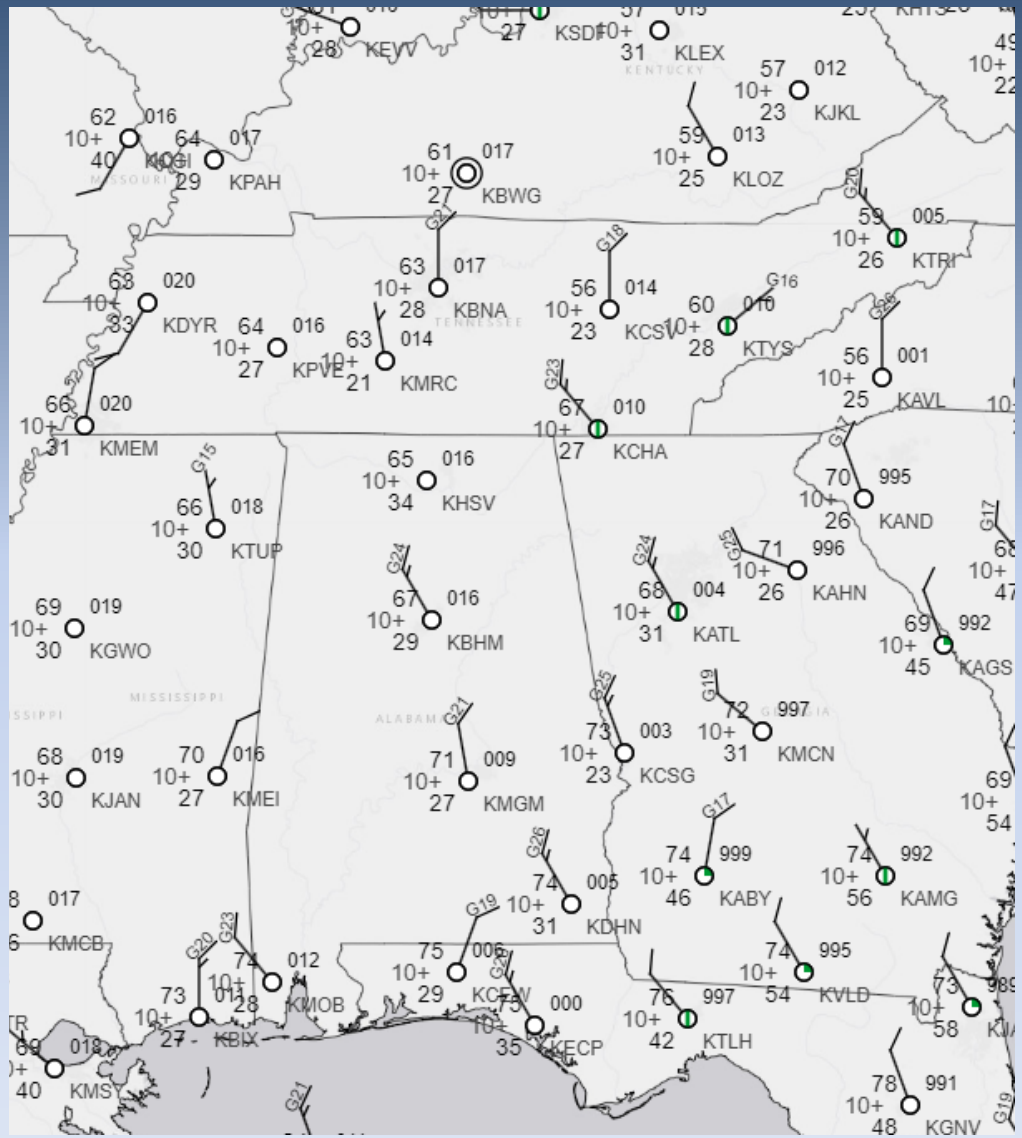
Starts with P: the amount of rain that hour (in hundredths)
Starts with 6: 6-hour rainfall total (in hundredths)

For the amount, the last two digits are the tenths and hundredths

This example: 0.01”

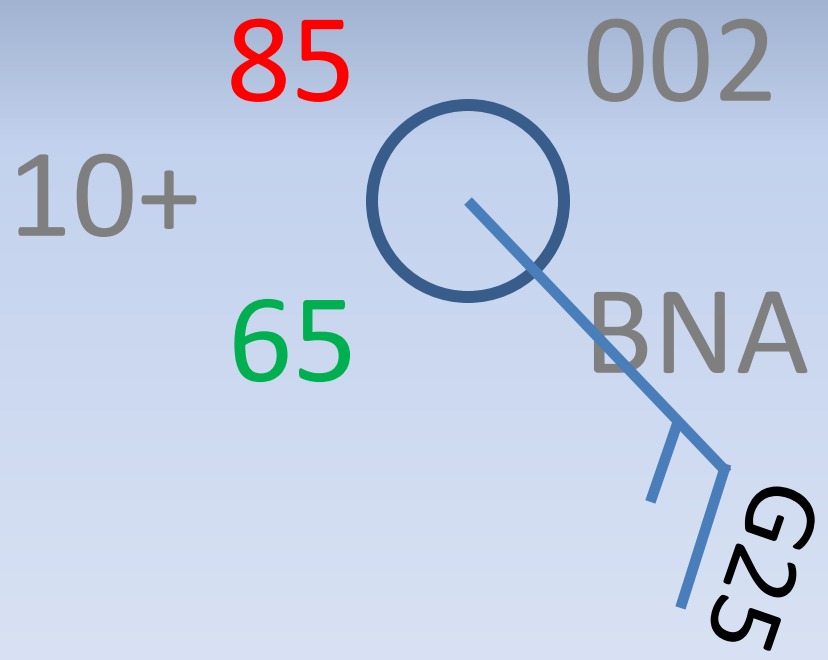
Note:
P0000 or 60000 = Trace

Plotted METARs



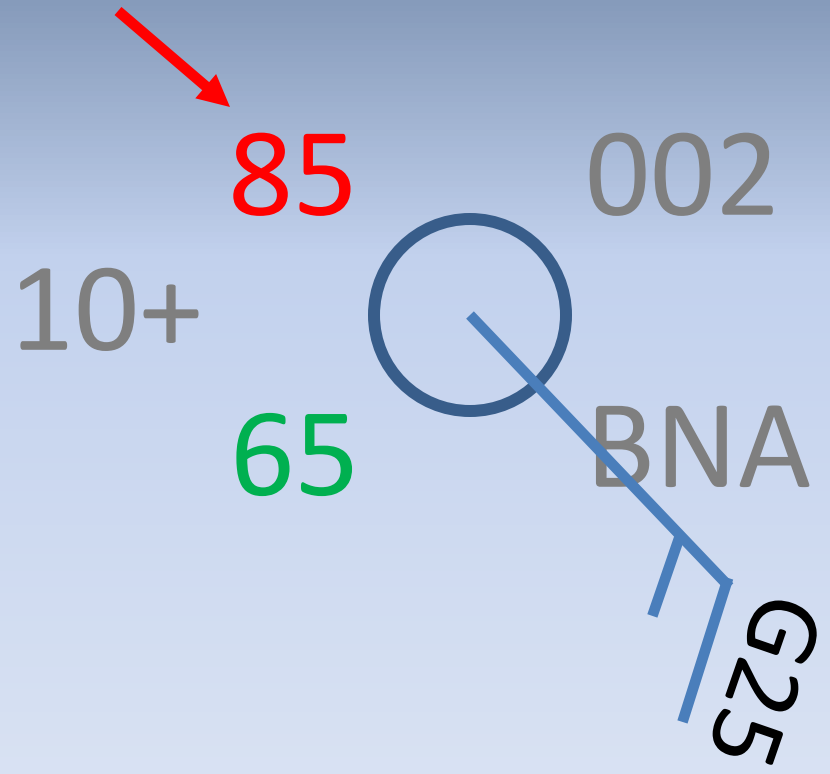
[Aviation Weather Center GFA: Observations]

Plotted METARs

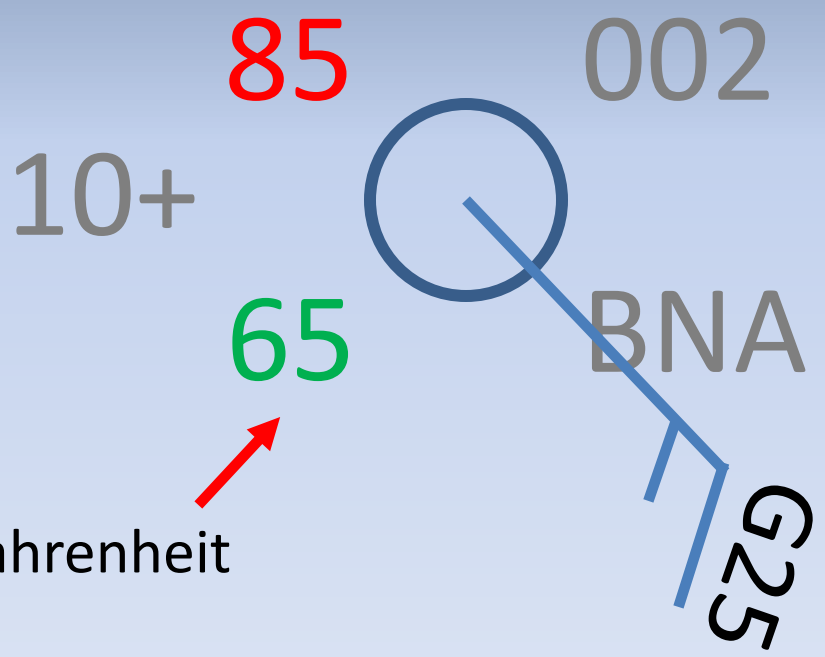


Plotted METARs

Temperature in Fahrenheit

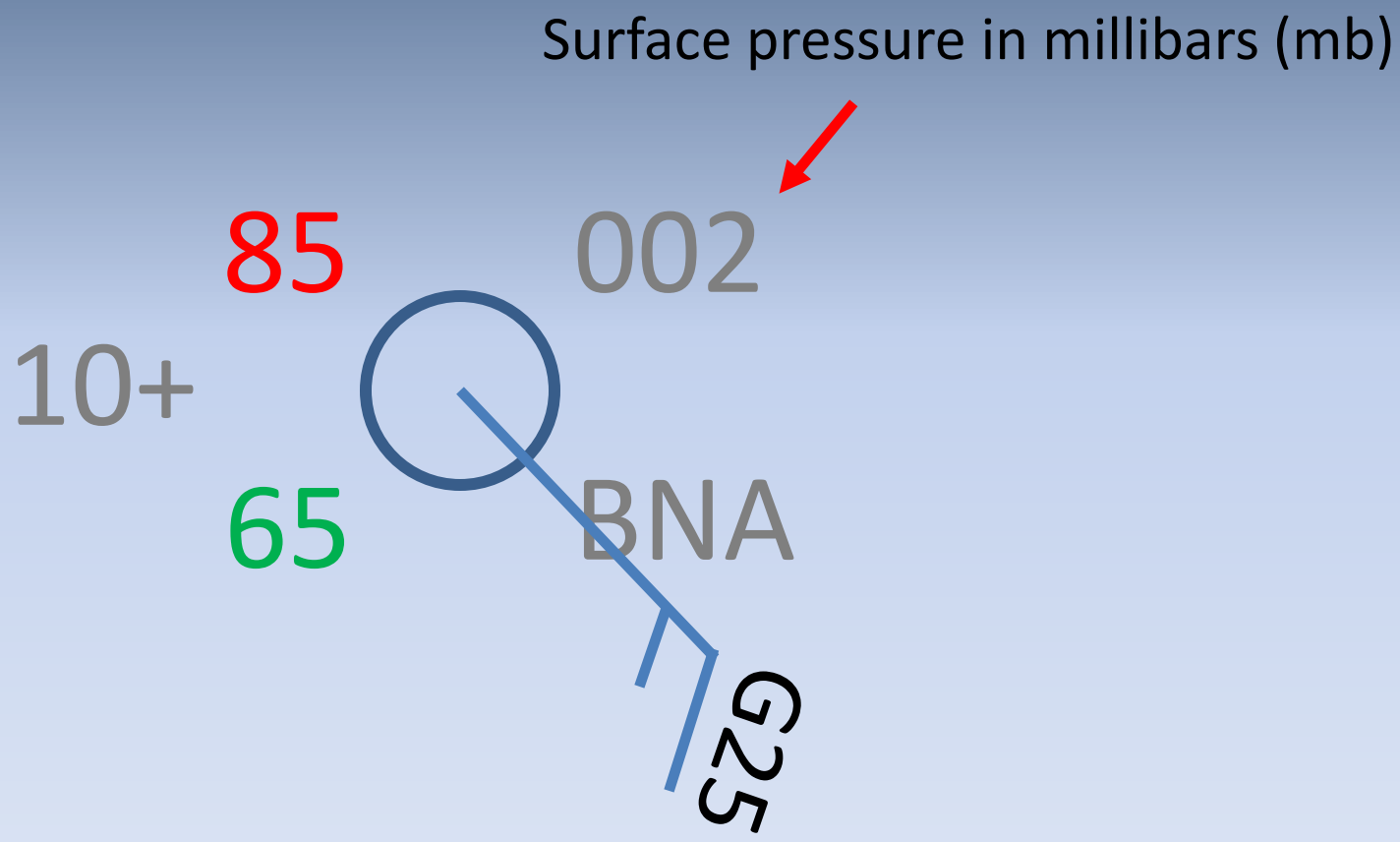


Plotted METARs

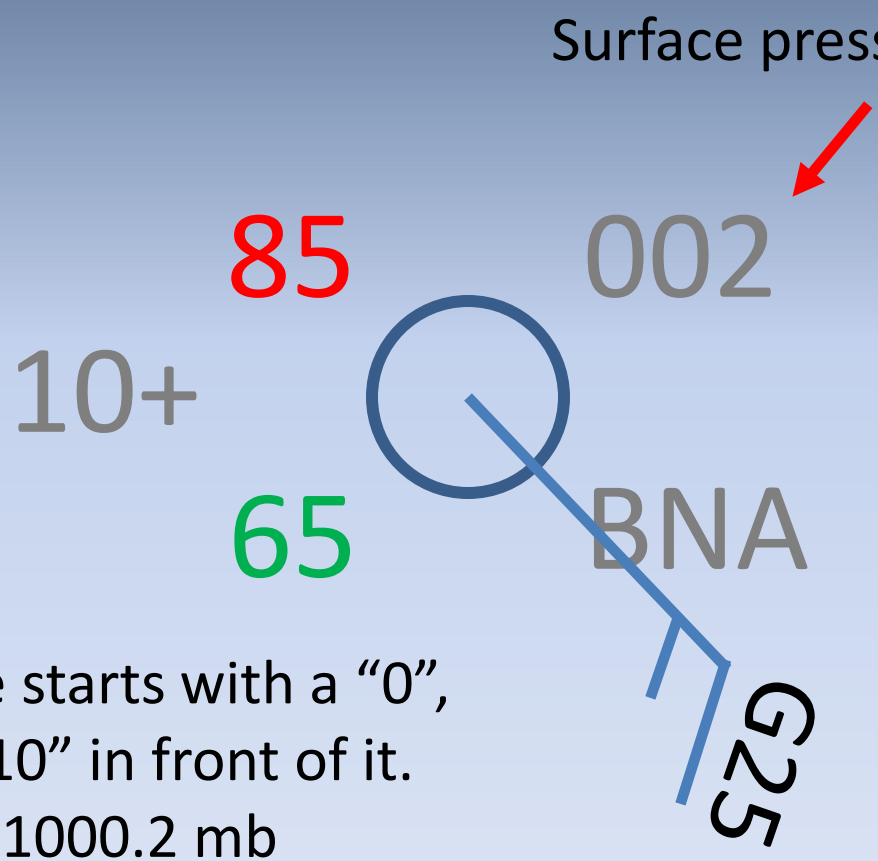


Dew Point in Fahrenheit

Plotted METARs



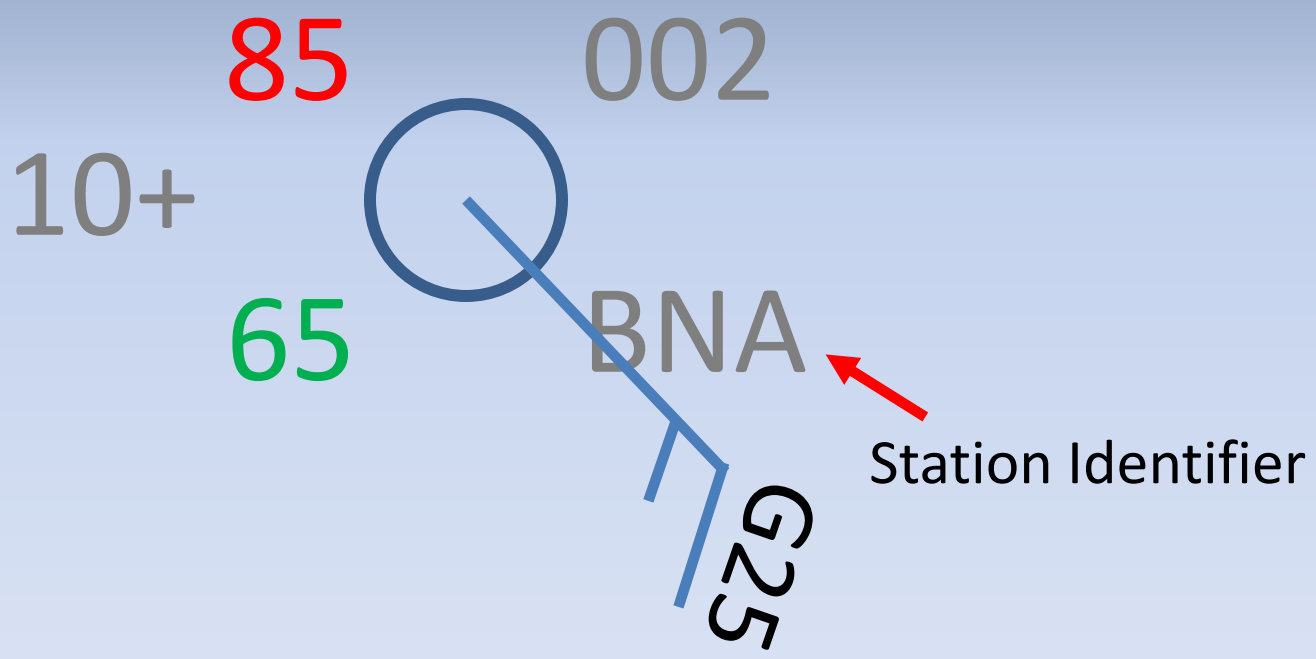
Plotted METARs



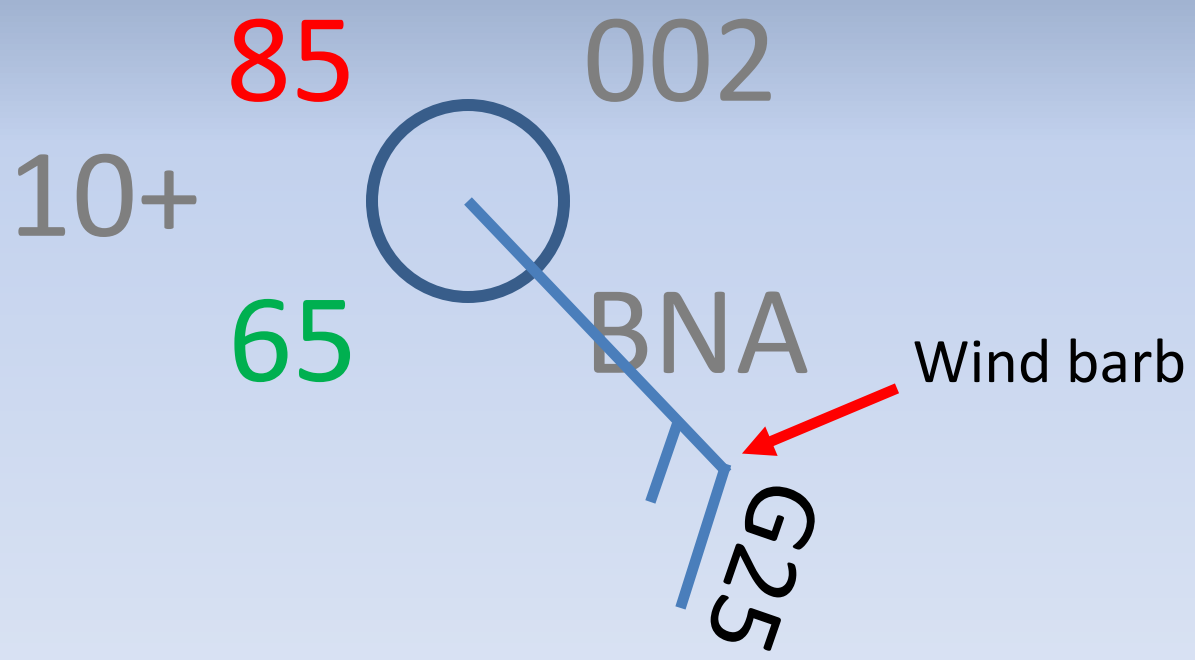
Additional notes:

- If the pressure starts with a “0”, put another “10” in front of it. This example: 1000.2 mb
- If the pressure starts with an 5 through 9, put another “9” in front of it. A display of 823, then becomes 982.3

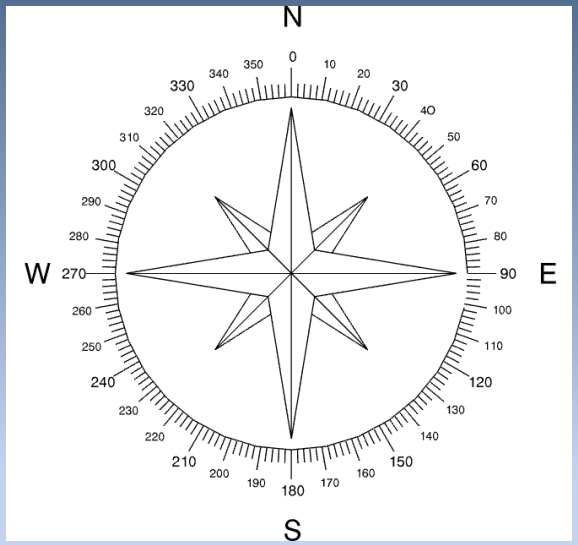
Plotted METARs

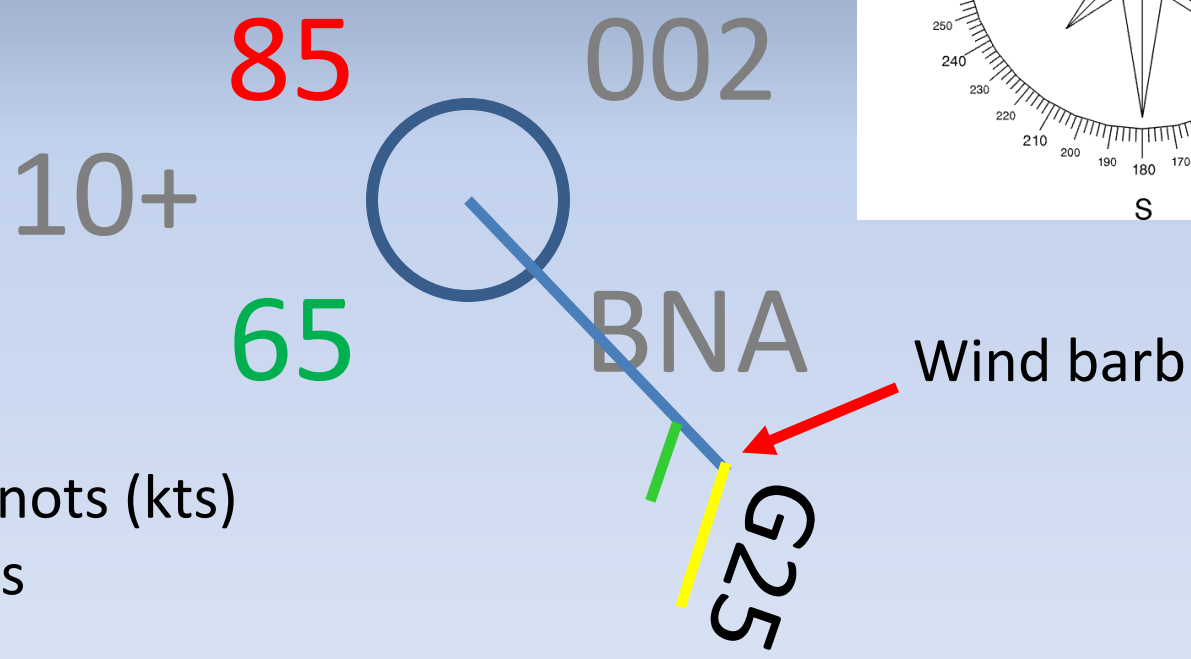


Plotted METARs



Plotted METARs



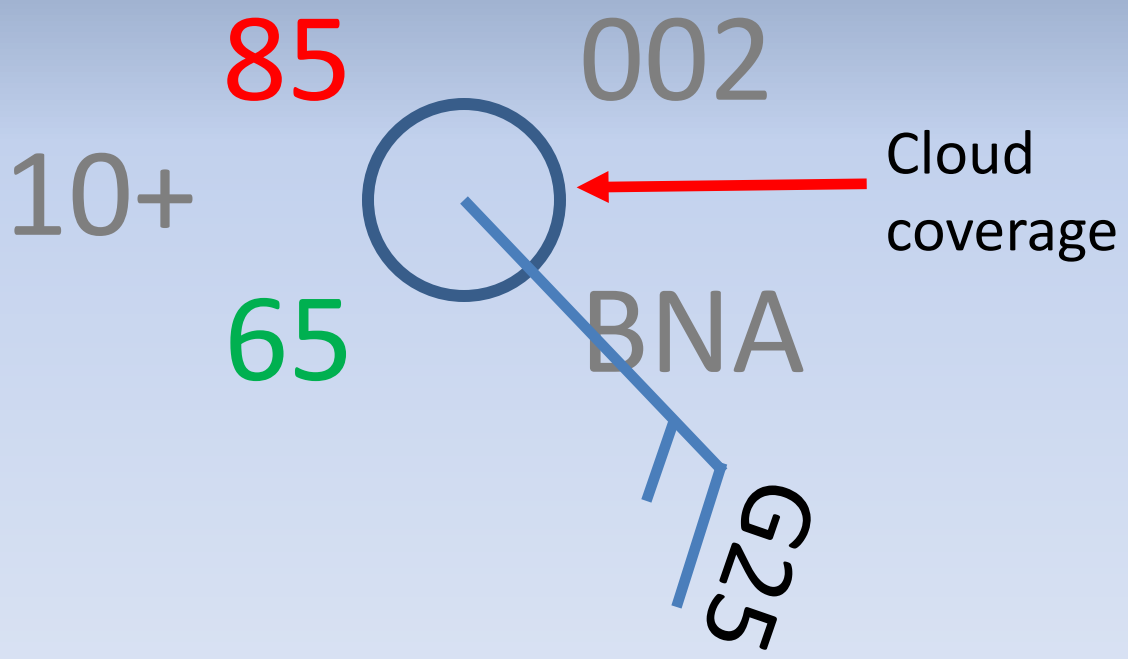


Additional notes:

- Long line = 10 knots (kts)
- Short line = 5 kts
- Flag = 50 kts
- “G” indicates Gusts. In this example,

the wind is out of the southeast at 15 kts, gusting to 25 kts

Plotted METARs



Plotted METARs

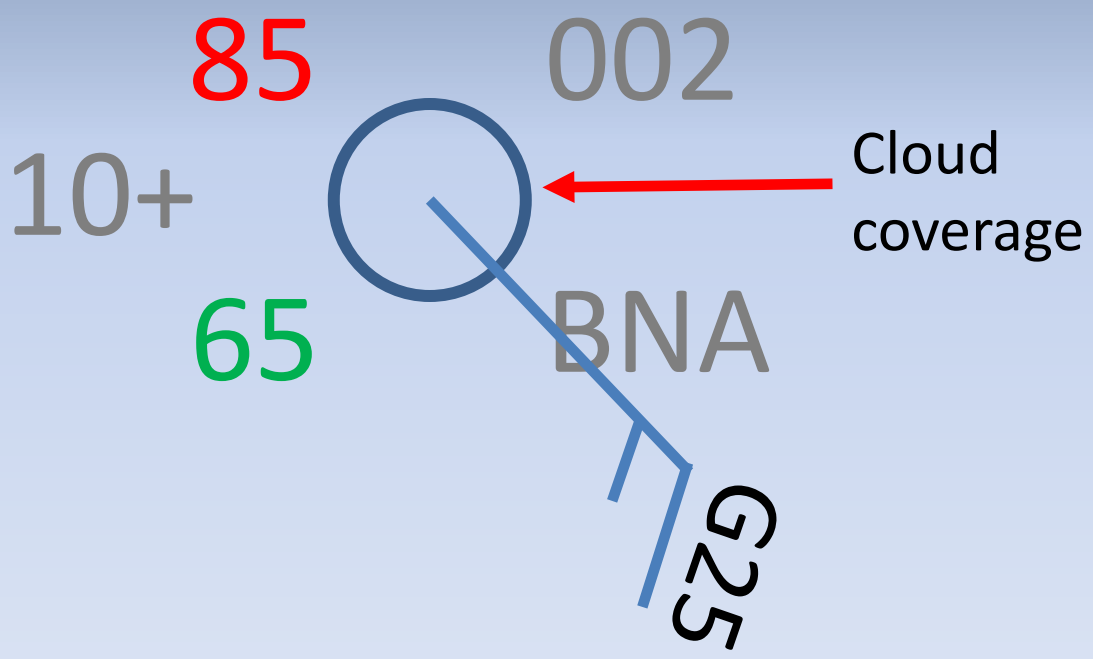
Additional notes:

Clear/Few (SKC or FEW)

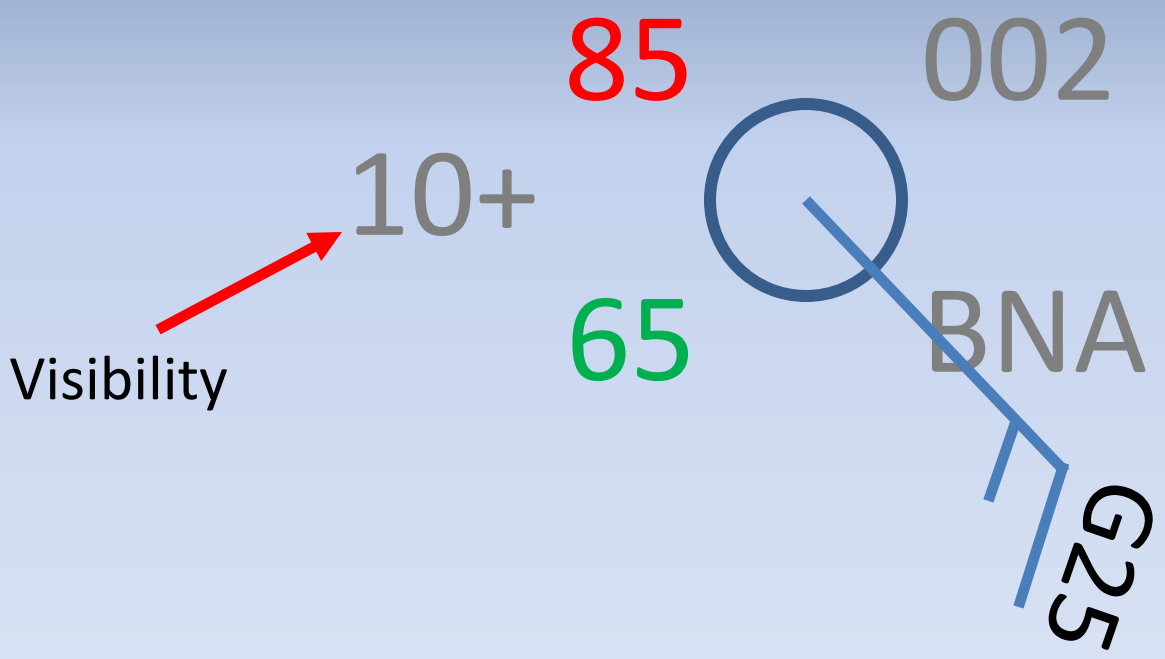
Scattered Clouds (SCT)

Broken Clouds (BKN)

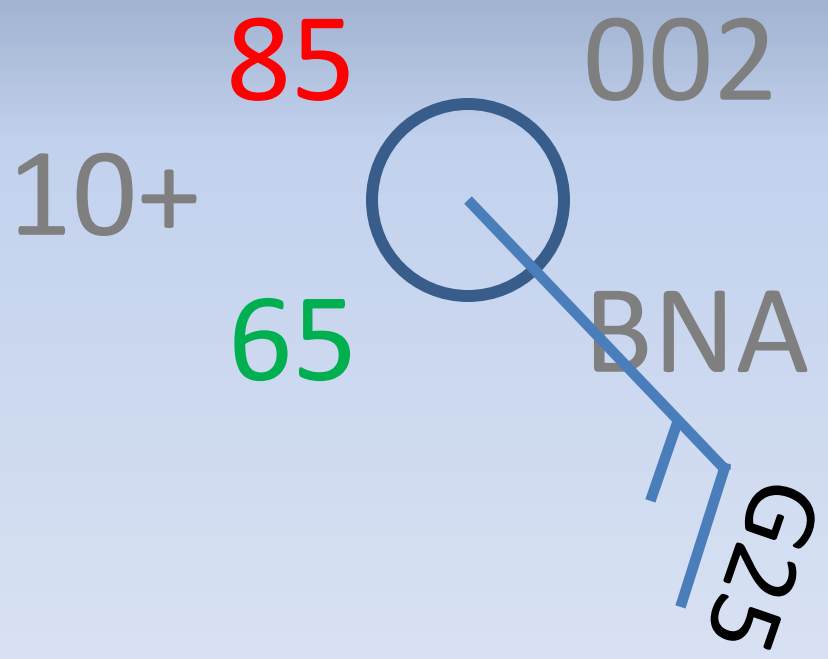
Overcast (OVC)



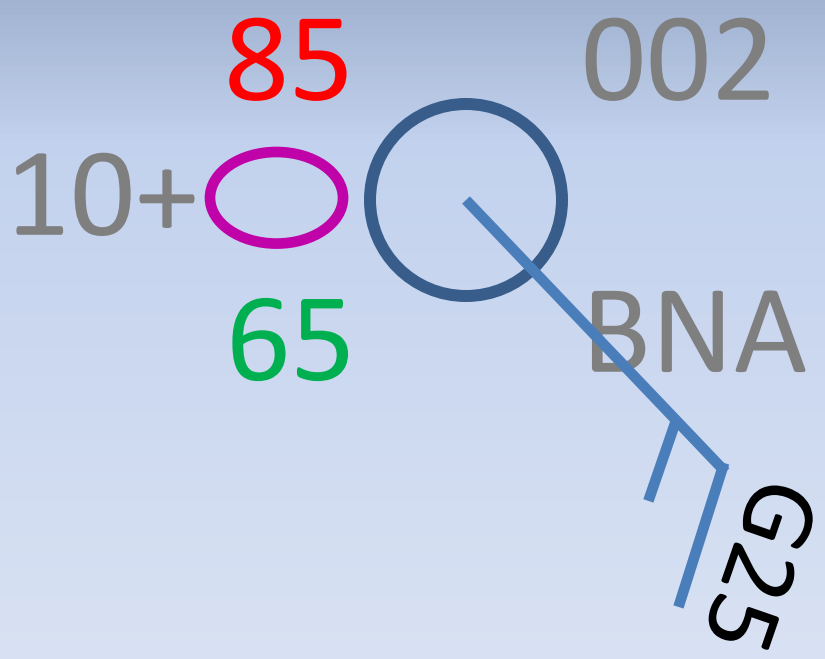
Plotted METARs



Plotted METARs

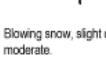


Plotted METARs



WEATHER SYMBOLS

Numbers indicate the weather code as used in synoptic weather reports (**ww**, present weather reported from a manned weather station, as defined in WMO Pub. No. 306-A).

00  Cloud development not observed/observable during past hour.	01  Clouds generally dissolving during past hour.	02  State of sky unchanged during past hour.	03  Clouds generally forming or developing during past hour.	04  Visibility reduced by smoke.	05  Haze.	06  Dust suspended in the air, but not raised by wind.	07  Dust or sand raised by wind.	08  Dust devils now or within past hour.	09  Duststorm or sandstorm not at station but within sight.
10  Mist.	11  Patches of shallow fog at station, not deeper than 2 m (10 m at sea).	12  Continuous shallow fog at station, not deeper than 2 m (10 m at sea).	13  Lightning visible, but no thunder heard.	14  Precipitation visible but not reaching ground at station.	15  Precipitation reaching the ground not at or near the station but at a distance.	16  Precipitation reaching the ground not at the station but nearby.	17  Thunder heard but no precipitation at the station.	18  Wind squall now or during the past hour.	19  Tornado, waterspout, or funnel cloud observed now or during past hour.
20  Recent drizzle (not freezing, not showers) during past hour.	21  Recent rain (not freezing, not showers) during past hour.	22  Recent snow (not showers) during past hour.	23  Recent rain and snow (not showers) during past hour.	24  Freezing drizzle or rain (not showers), not now but during past hour.	25  Rain showers, not now but during past hour.	26  Snow showers, not now but during past hour.	27  Hail or hail and rain, not now but during past hour.	28  Fog, not now but during past hour.	29  Thunderstorm, with or without precipitation, not now but during past hour.
30  Slight/moderate duststorm or sandstorm, decreased during hour.	31  Slight/moderate duststorm or sandstorm, no change during hour.	32  Slight/moderate duststorm or sandstorm, increased during hour.	33  Severe duststorm or sandstorm, which has decreased during hour.	34  Severe duststorm or sandstorm, no change during past hour.	35  Duststorm or sandstorm, severe, has increased during past hour.	36  Drifting snow, slight or moderate.	37  Drifting snow, heavy.	38  Blowing snow, slight or moderate.	39  Blowing snow, heavy.
40 Fog at a distance but not at station during past hour.	41 Patchy fog.	42 Fog, sky discernable, and has become thinner during past hour.	43 Fog, sky not discernable, and has become thinner during past hour.	44 Fog, sky discernable, no change during past hour.	45 Fog, sky not visible, no change during past hour.	46 Fog, sky visible, has begun or become thicker during past hour.	47 Fog, sky not visible, has begun or become thicker during past hour.	48 Freezing fog, sky visible.	49 Freezing fog, sky not visible.
50 Drizzle, light, intermittent, not freezing.	51 Drizzle, light, continous, not freezing.	52 Drizzle, moderate, intermittent, not freezing.	53 Drizzle, moderate, continuous, not freezing.	54 Drizzle, heavy, intermittent, not freezing.	55 Drizzle, heavy, continous, not freezing.	56 Freezing drizzle, light.	57 Freezing drizzle, moderate or heavy.	58 Drizzle and rain mixed, light.	59 Drizzle and rain mixed, moderate or heavy.
60 Rain, light, intermittent, not freezing.	61 Rain, light, continous, not freezing.	62 Rain, moderate, intermittent, not freezing.	63 Rain, moderate, continuous, not freezing.	64 Rain, heavy, intermittent, not freezing.	65 Rain, heavy, continous, not freezing.	66 Freezing rain, light.	67 Freezing rain, moderate or heavy.	68 Rain and snow mixed, light.	69 Rain and snow mixed, moderate or heavy.
70 Snow, light, intermittent.	71 Snow, light, continous.	72 Snow, moderate, intermittent.	73 Snow, moderate, continous.	74 Snow, heavy, intermittent.	75 Snow, heavy, continous.	76 Ice needles, with or without fog.	77 Snow grains, with or without fog.	78 Snow crystals, with or without fog.	79 Ice pellets (sleet).
80 Rain showers, light.	81 Rain showers, moderate or heavy.	82 Rain showers, torrential.	83 Rain/snow showers mixed, light.	84 Rain/snow showers mixed, moderate or heavy.	85 Snow showers, light.	86 Snow showers, moderate or heavy.	87 Ice pellet showers, light.	88 Ice pellet showers, moderate or heavy.	89 Hail, light, not associated with thunder.
90 Hail, moderate or heavy, not associated with thunder.	91 Rain, light. Thunder heard during past hour but not now.	92 Rain, moderate or heavy. Thunder heard during past hour but not now.	93 Light snow or rain/snow mixed with hail. Thunder heard during past hour.	94 Moderate or heavy snow or rain/snow with hail. Thunder in past hour.	95 Thunderstorm, light or moderate. Rain or snow, but no hail.	96 Thunderstorm, light or moderate, with hail.	97 Thunderstorm, severe. Rain or snow, but no hail.	98 Thunderstorm, with duststorm or sandstorm.	99 Thunderstorm, severe, with hail.

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Participation Time

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KMEM 292310Z 06015KT 2 1/2SM +TSRA BR BKN013 OVC035CB 25/25 A3008 RMK AO2 WSHFT 2255 LTG DSNT ALQDS OCNL
LTGICCG ALQDS TS ALQDS MOV E P0019 T02500250 $
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Taking into consideration this raw METAR, what is the visibility at this site?

A. 25 SM
B. 2 ½ SM
C. ½ SM
D. 13 SM

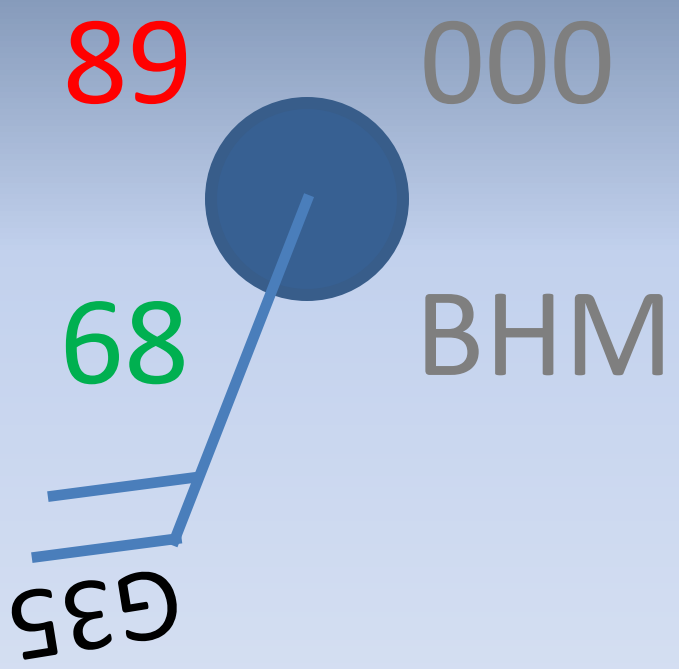
Participation Time

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KMEM 292310Z 06015KT 2 1/2SM +TSRA BR BKN013 OVC035CB 25/25 A3008 RMK AO2 WSHFT 2255 LTG DSNT ALQDS OCNL
LTGICCG ALQDS TS ALQDS MOV E P0019 T02500250 $
```

Taking into consideration this raw METAR, what is the visibility at this site?

A. 25 SM
B. 2 ½ SM
C. ½ SM
D. 13 SM

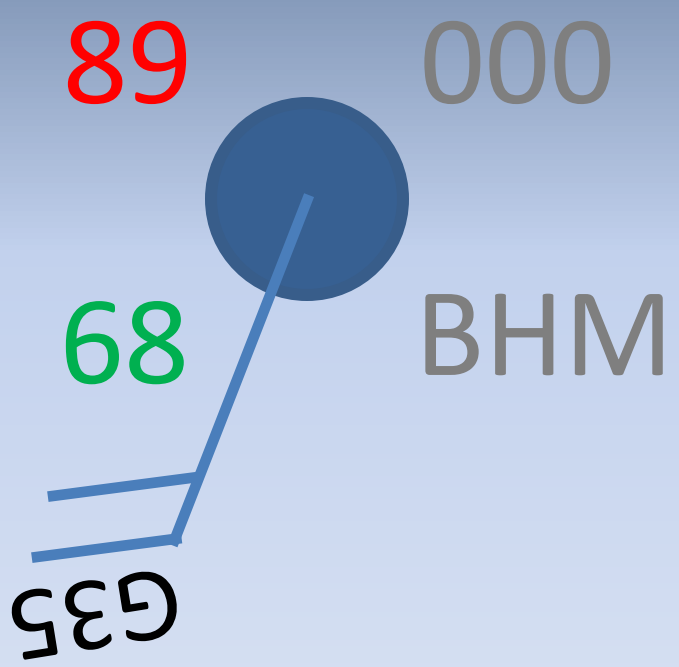
Participation Time



Taking into consideration this plotted METAR, what is the wind direction at this site?

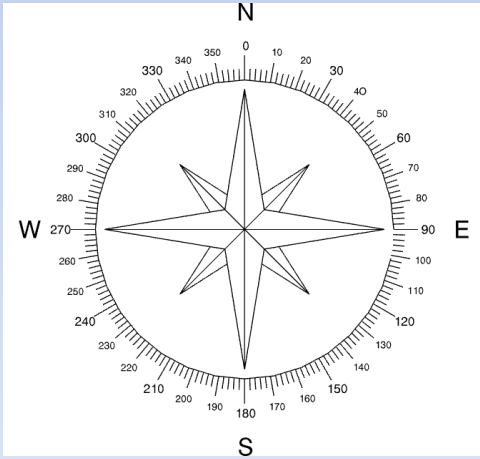
A. North
B. South
C. Southwest
D. Southeast

Participation Time

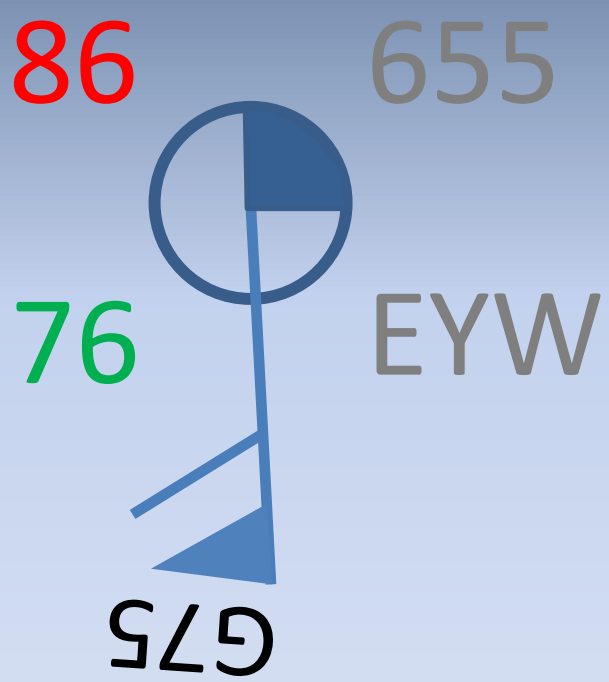


Taking into consideration this plotted METAR, what is the wind direction at this site?

A. North
B. South
C. Southwest
D. Southeast



Participation Time

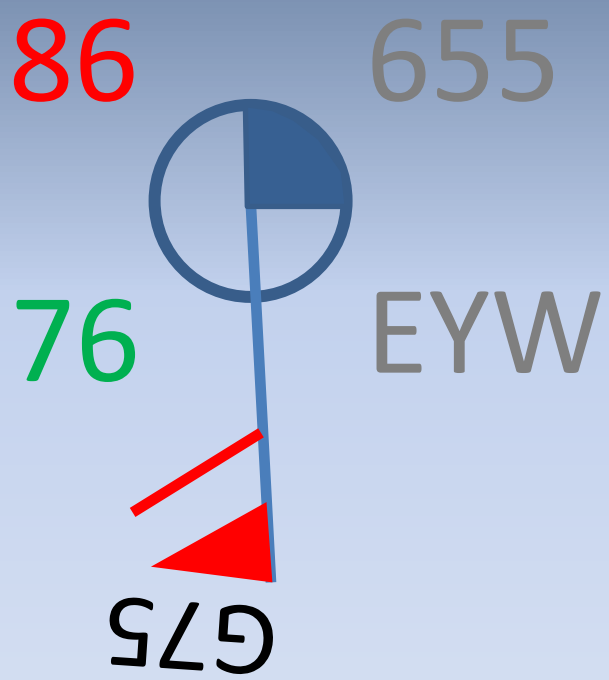


Taking into consideration this plotted METAR, what are the sustained winds?

A. 75
B. 76
C. 86
D. 60

METAR Map from weather.gov/ohx

Participation Time



Taking into consideration this plotted METAR, what are the sustained winds?

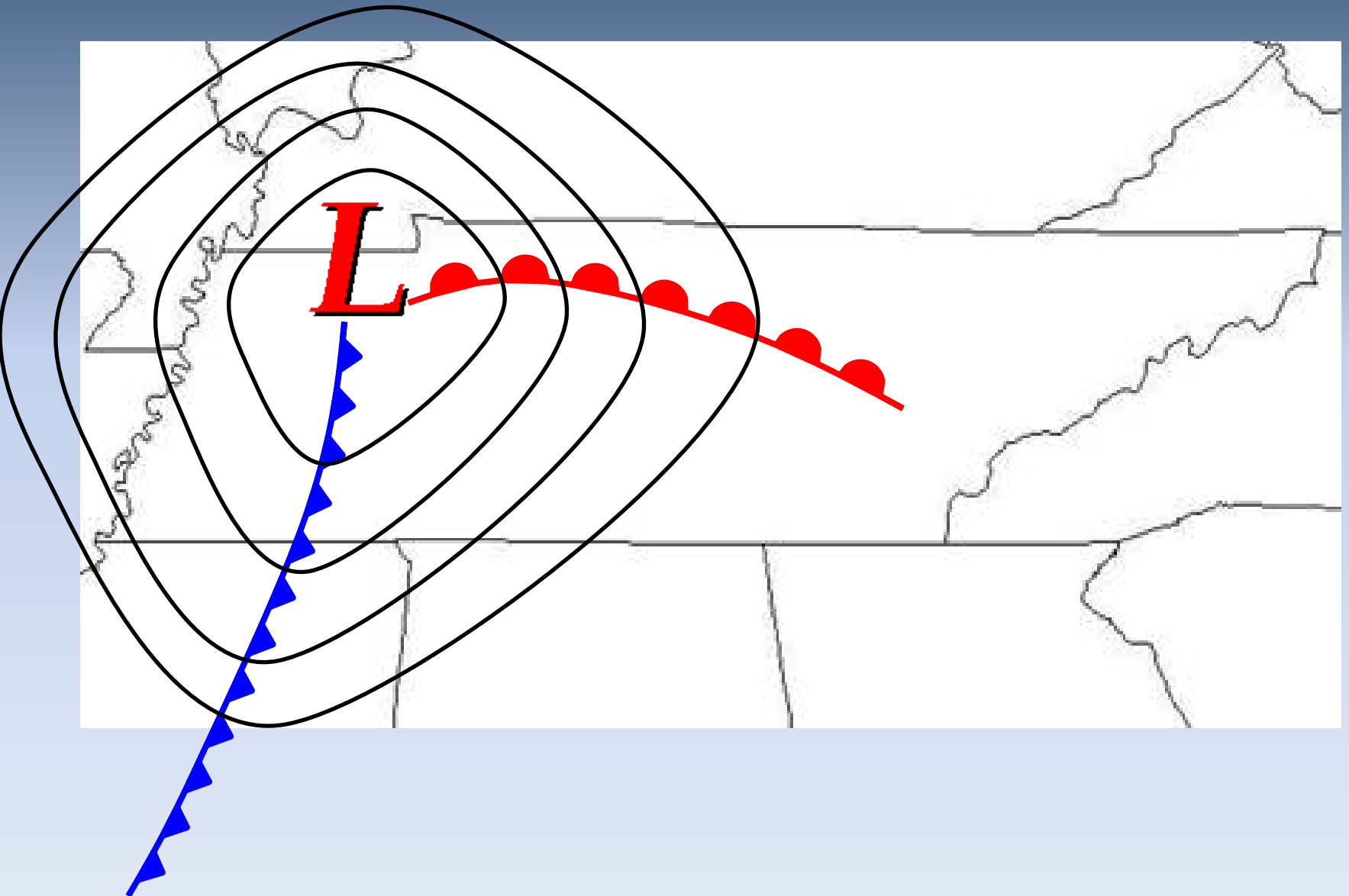
A. 75
B. 76
C. 86
D. 60

METAR Map from weather.gov/ohx

Observations in 3-D: METARs and U/A Patterns

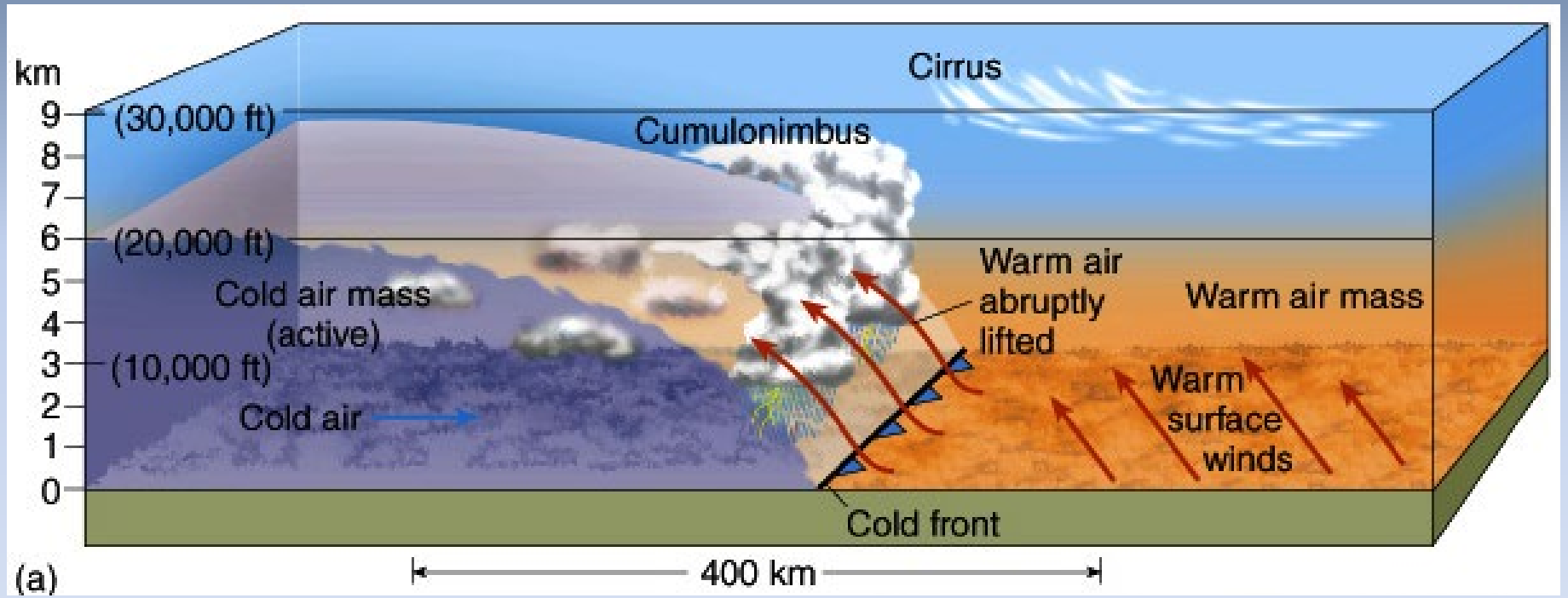
How do we use these METARs?

Observation in 3-D: Low Pressure Systems

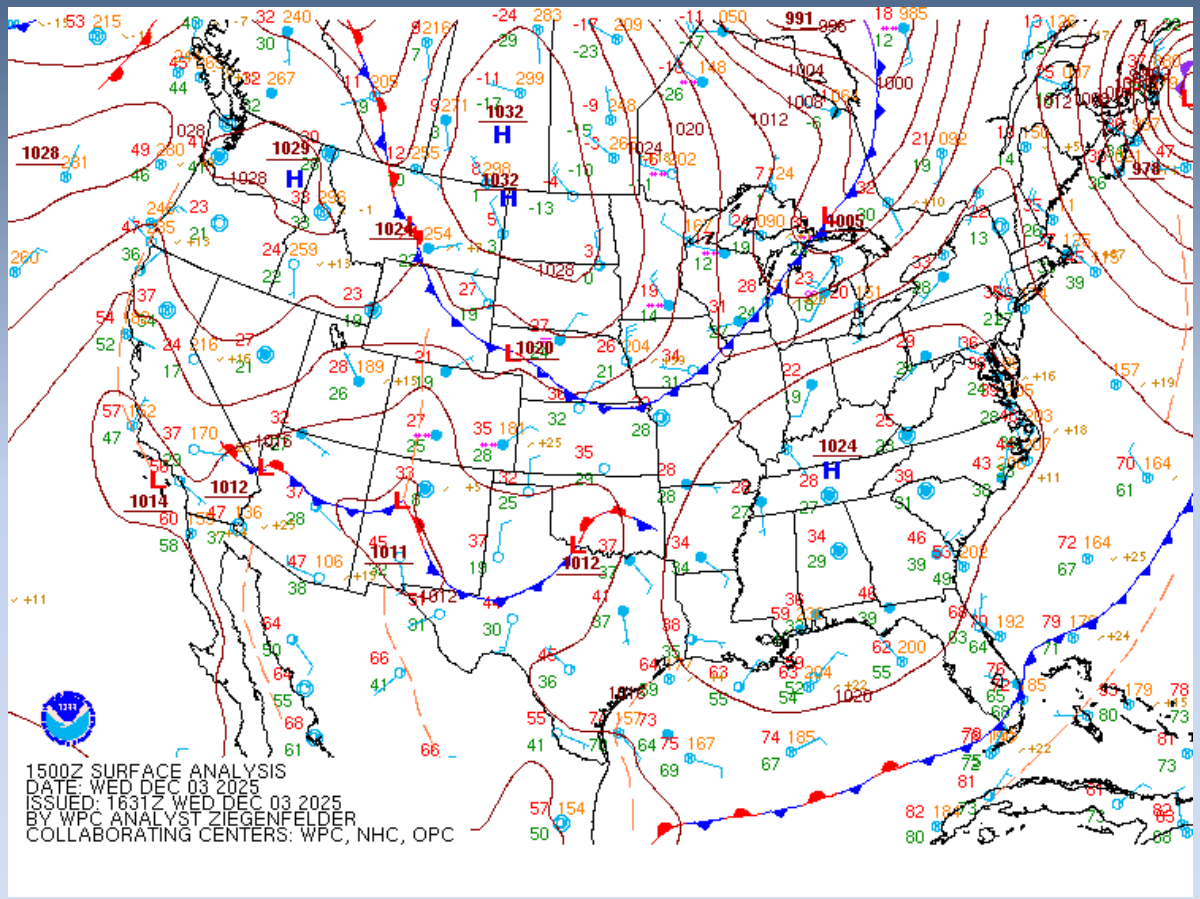


Observations in 3-D: Warm Front

Observations in 3-D: Cold Front



Live examples

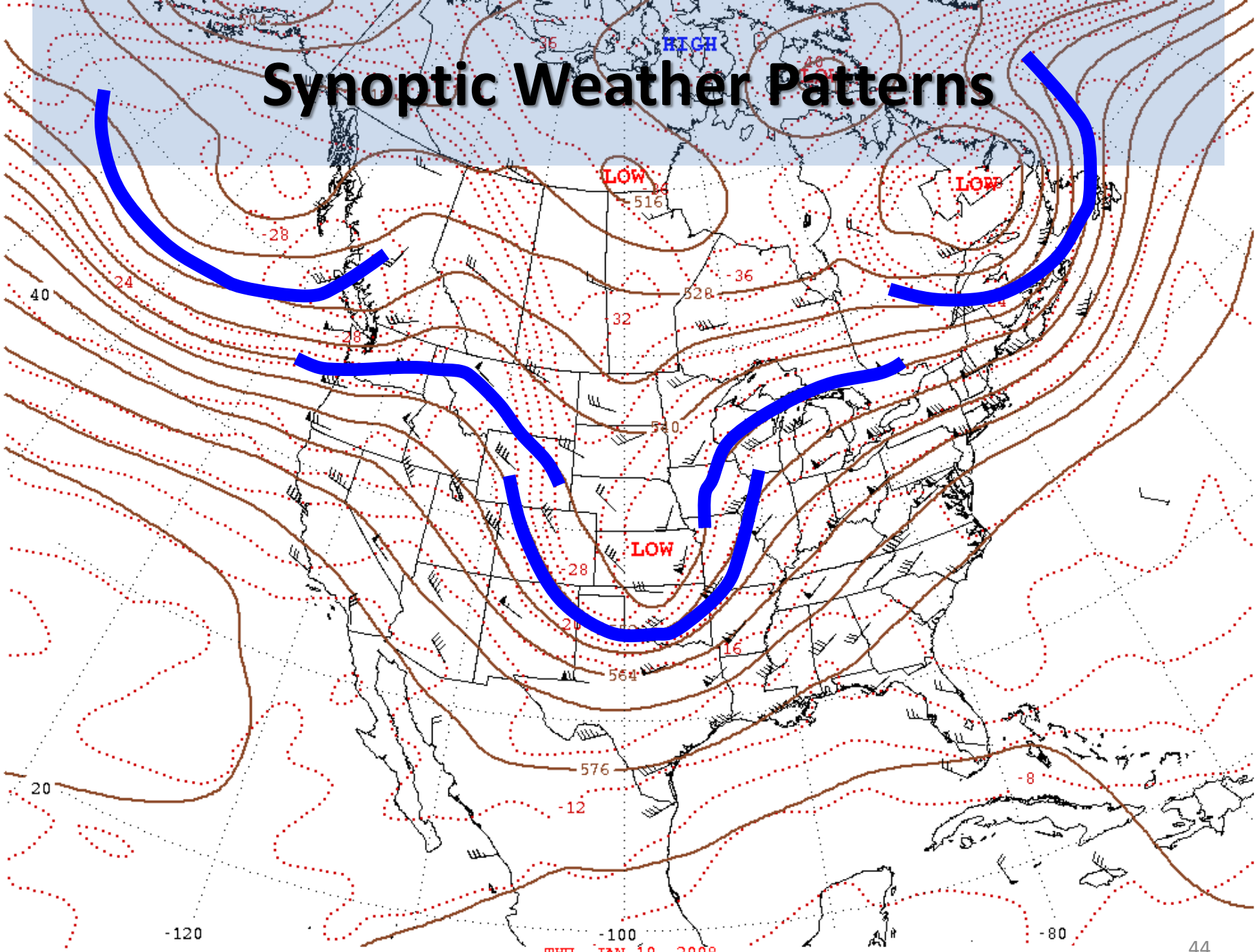


https://www.wpc.ncep.noaa.gov/html/sfc2.shtml

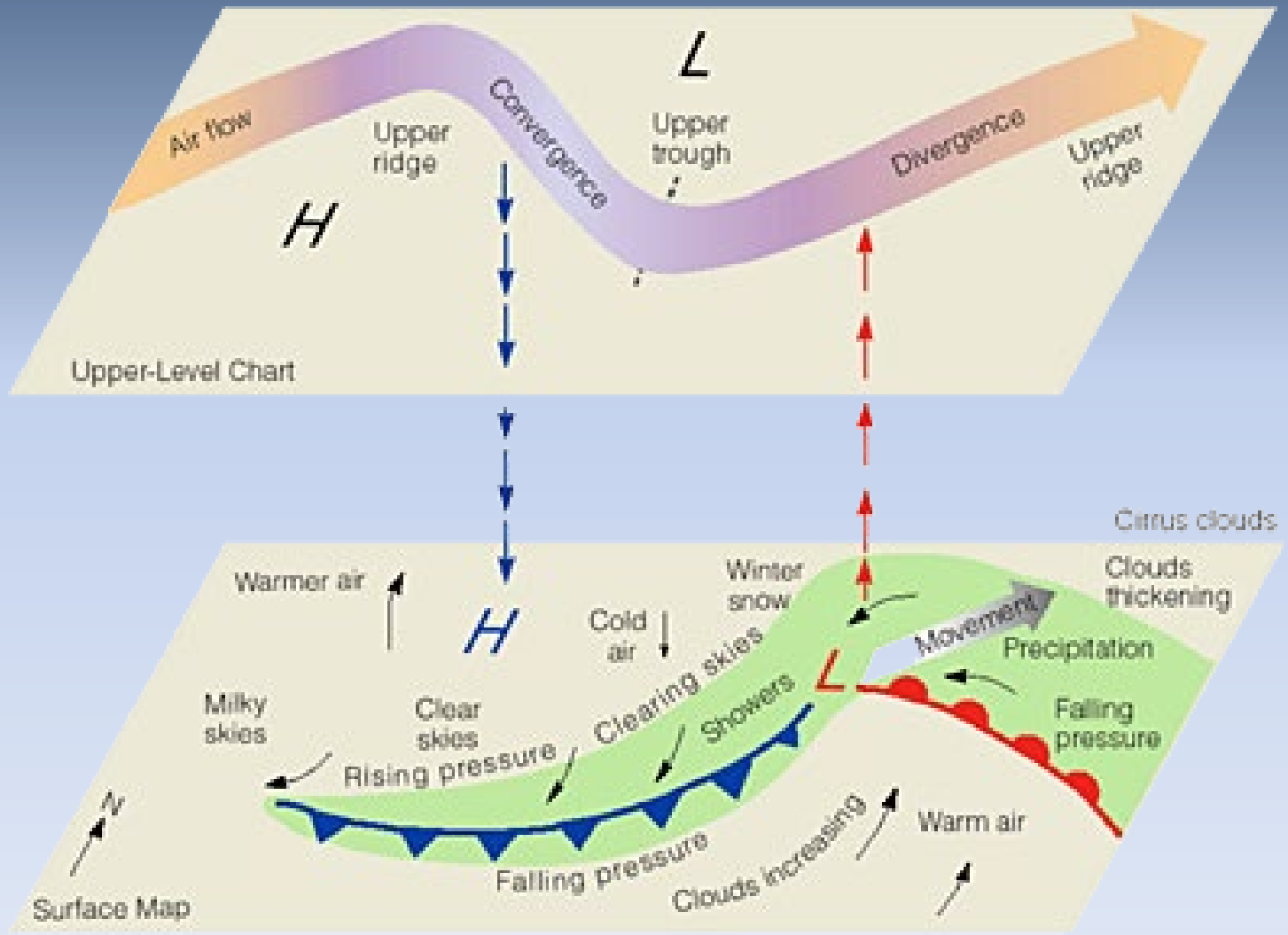
Observations in 3-D: U/A Patterns

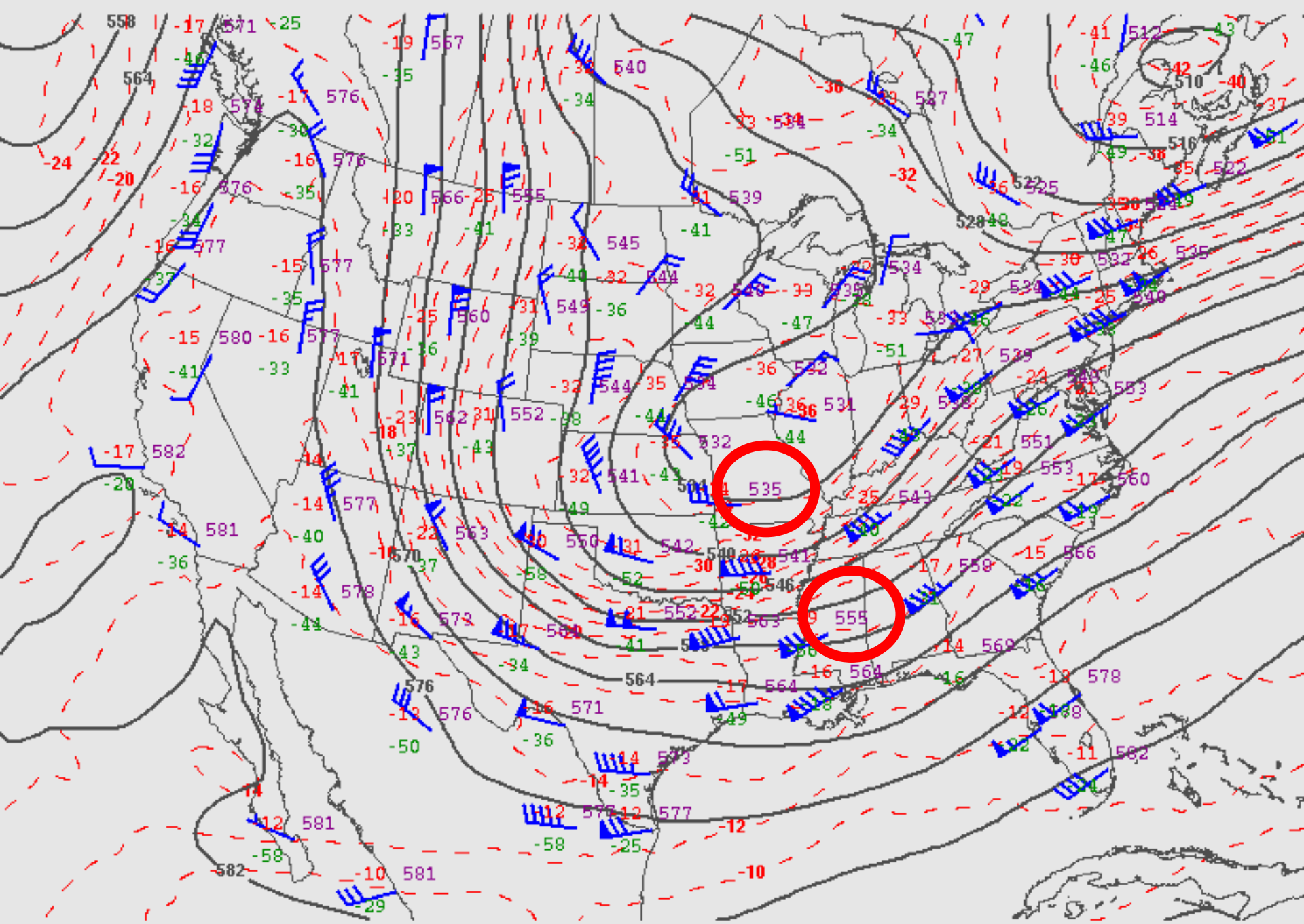
Why are some systems stronger than others?

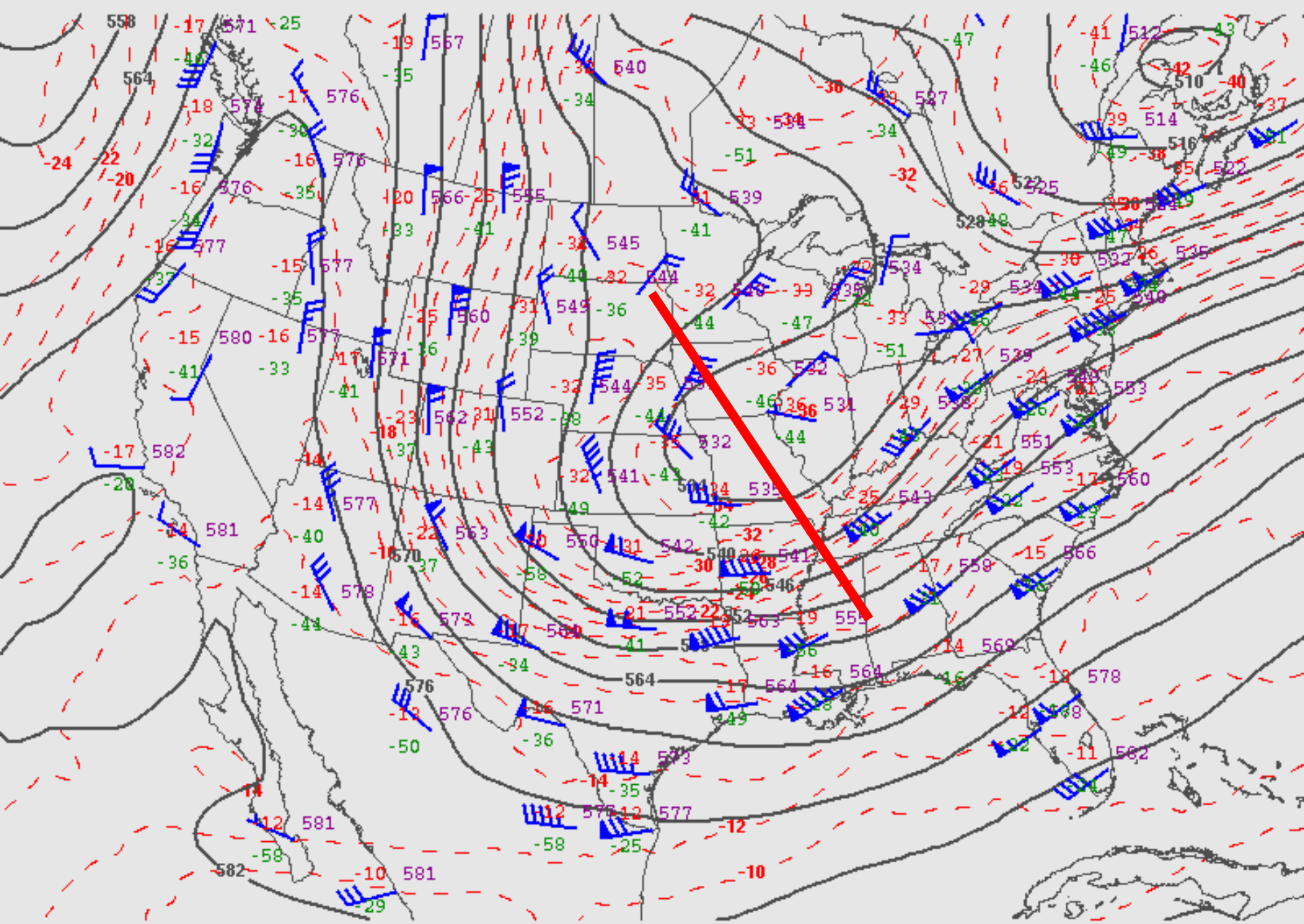
Synoptic Weather Patterns



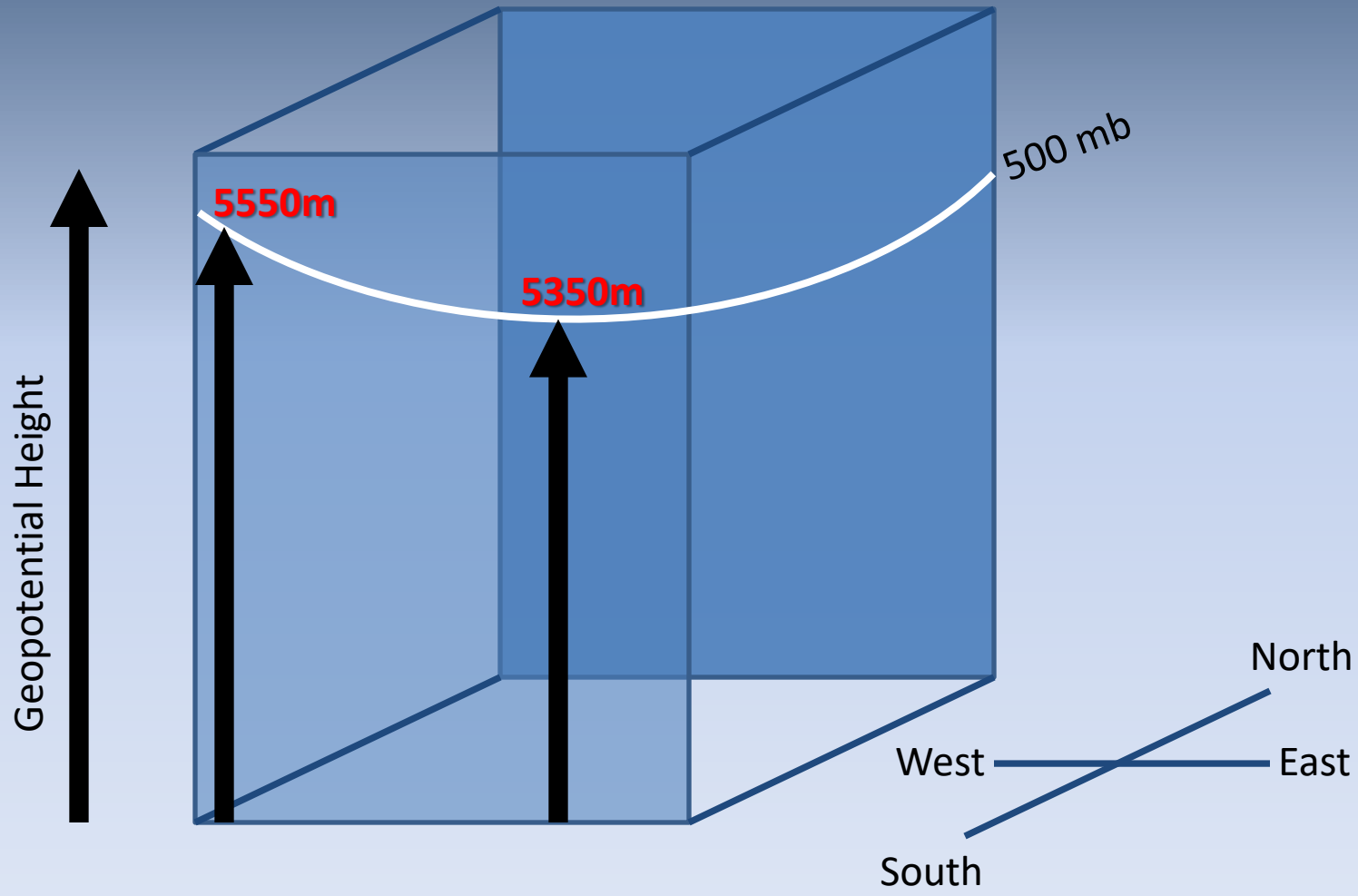
Observations in 3-D: U/A Patterns

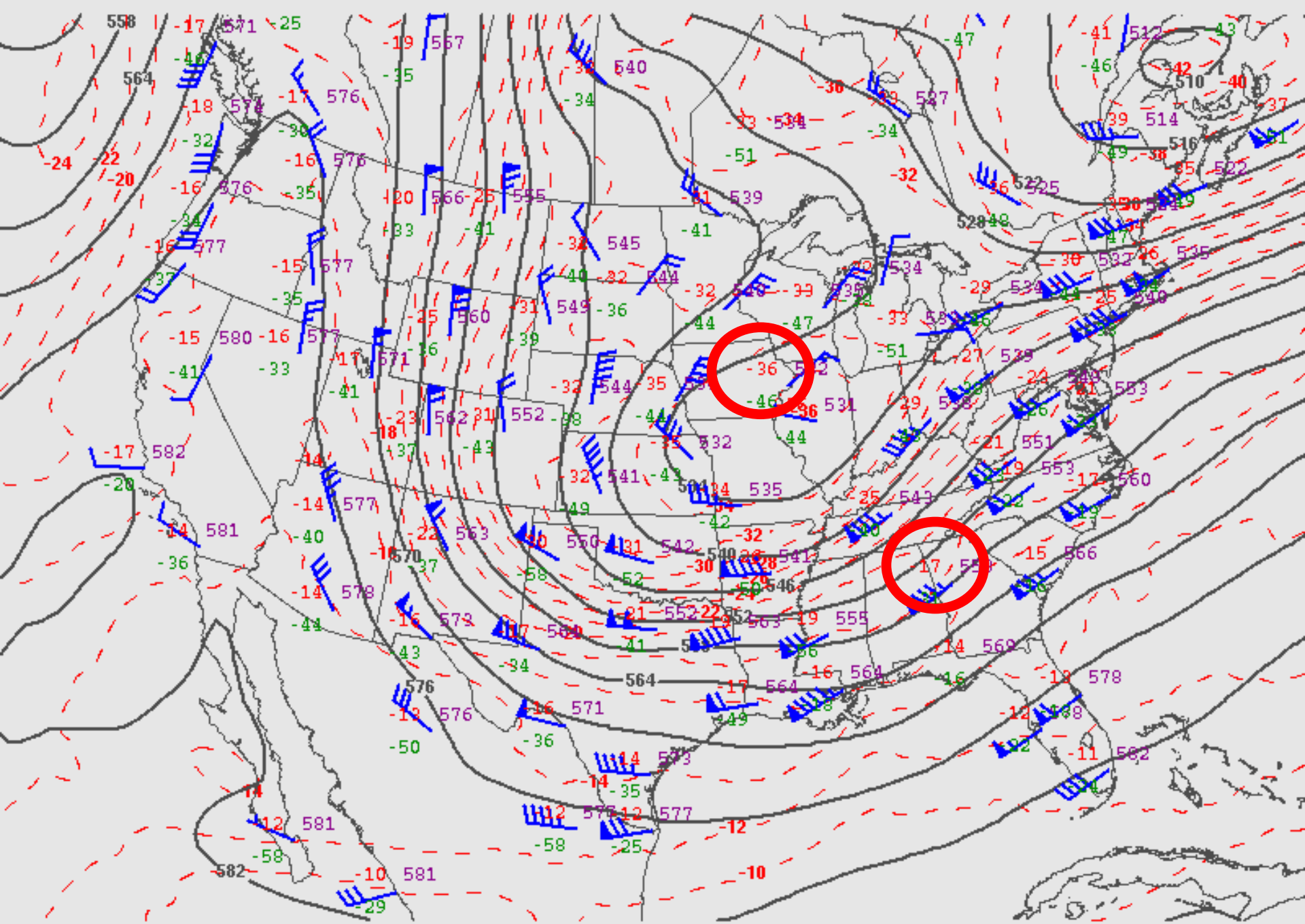


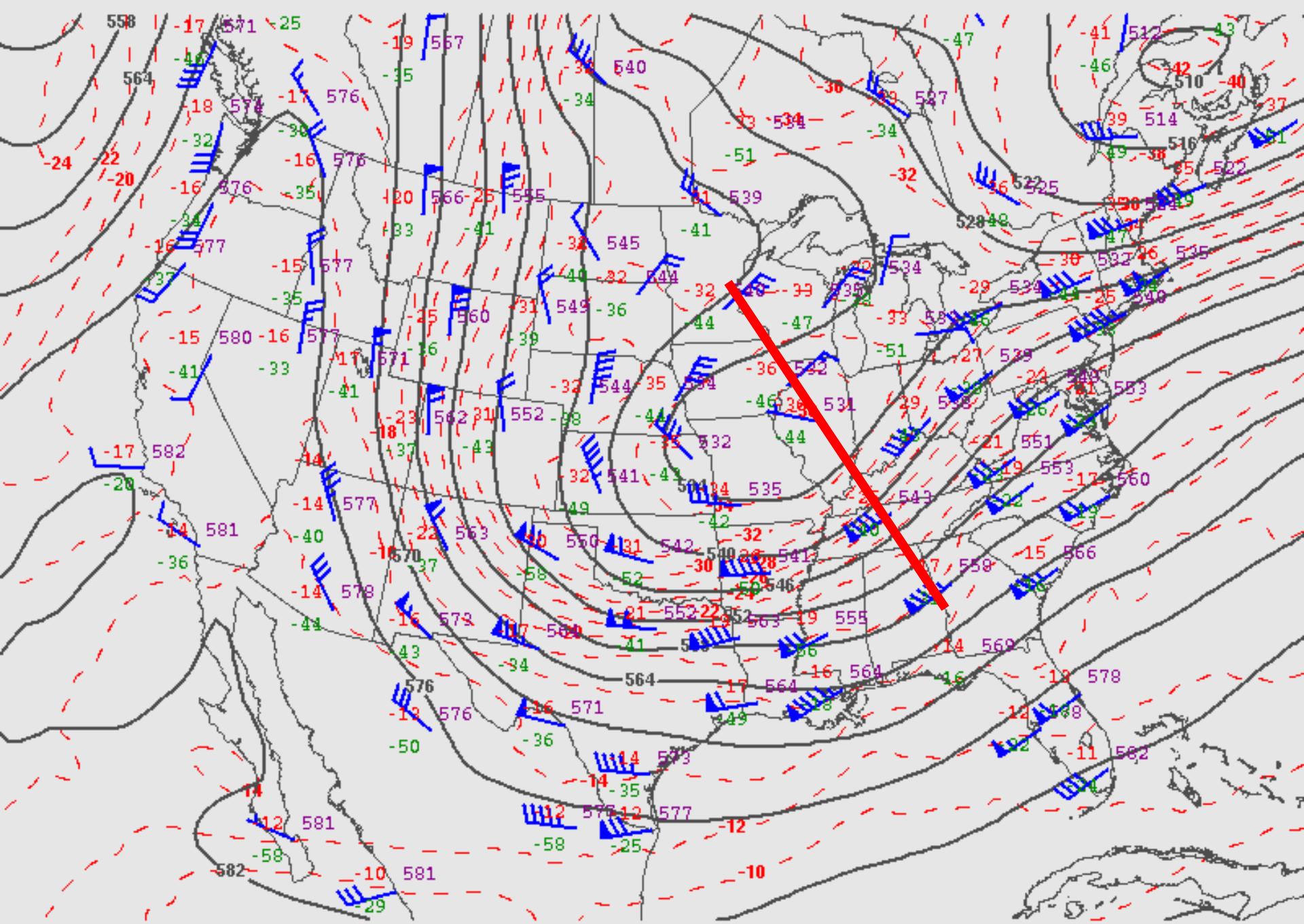

060211/1200 500 MB UA OBS, HGHTS, and TEMPS


060211/1200 500 MB UA OBS, HGHTS, and TEMPS

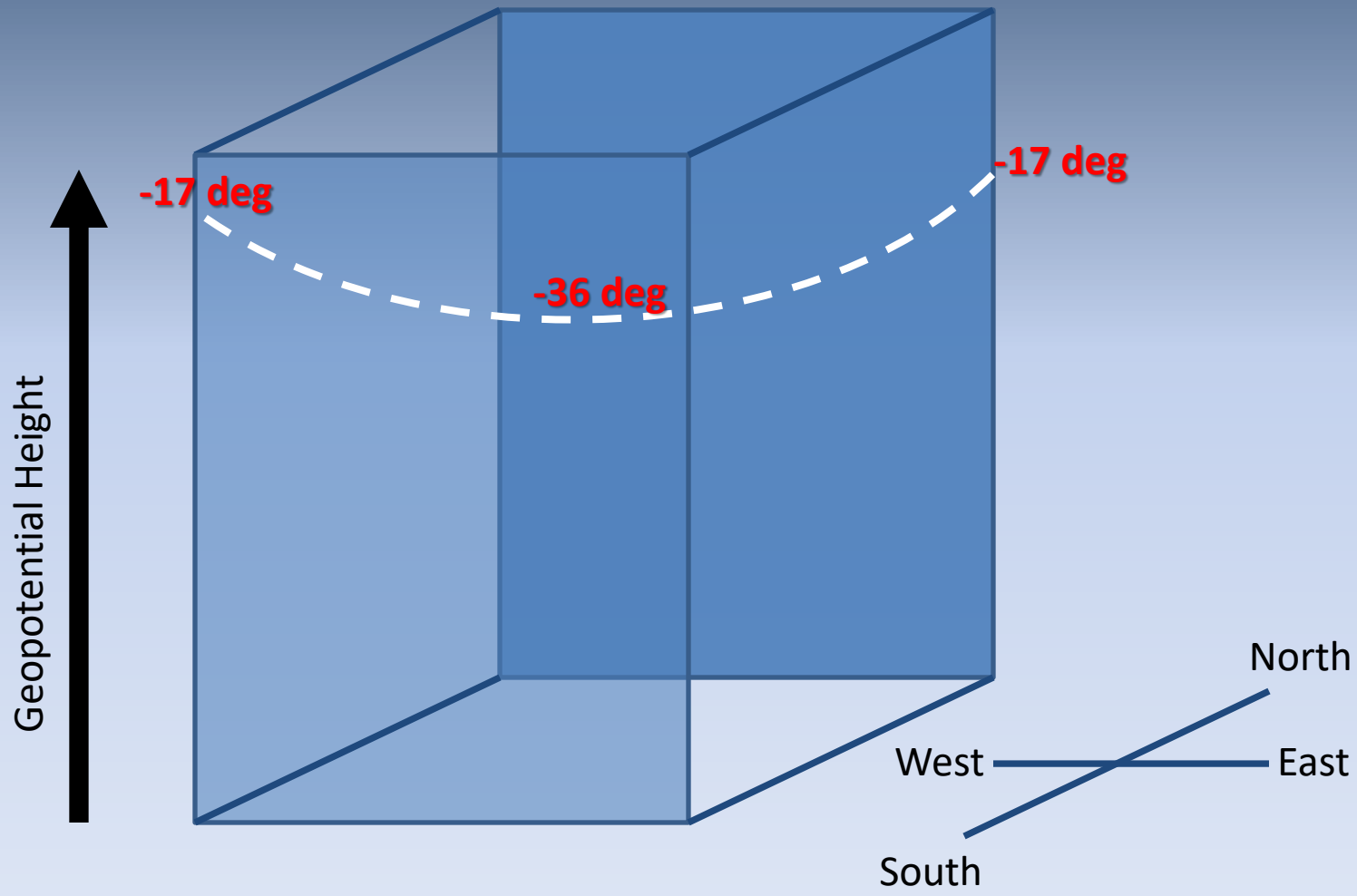
Observations in 3-D: Cross Section of Upper Low

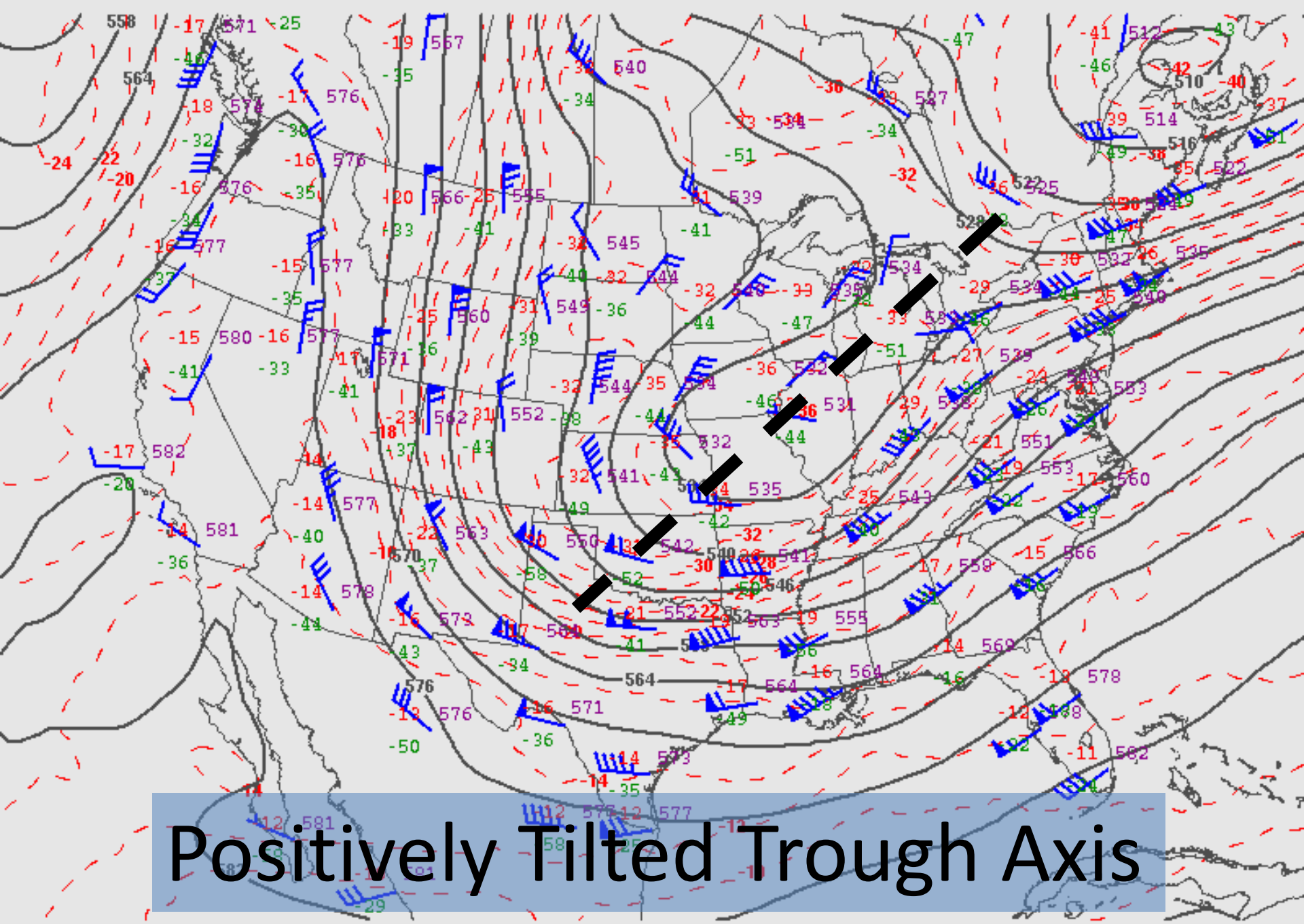



060211/1200 500 MB UA OBS, HGHTS, and TEMPS

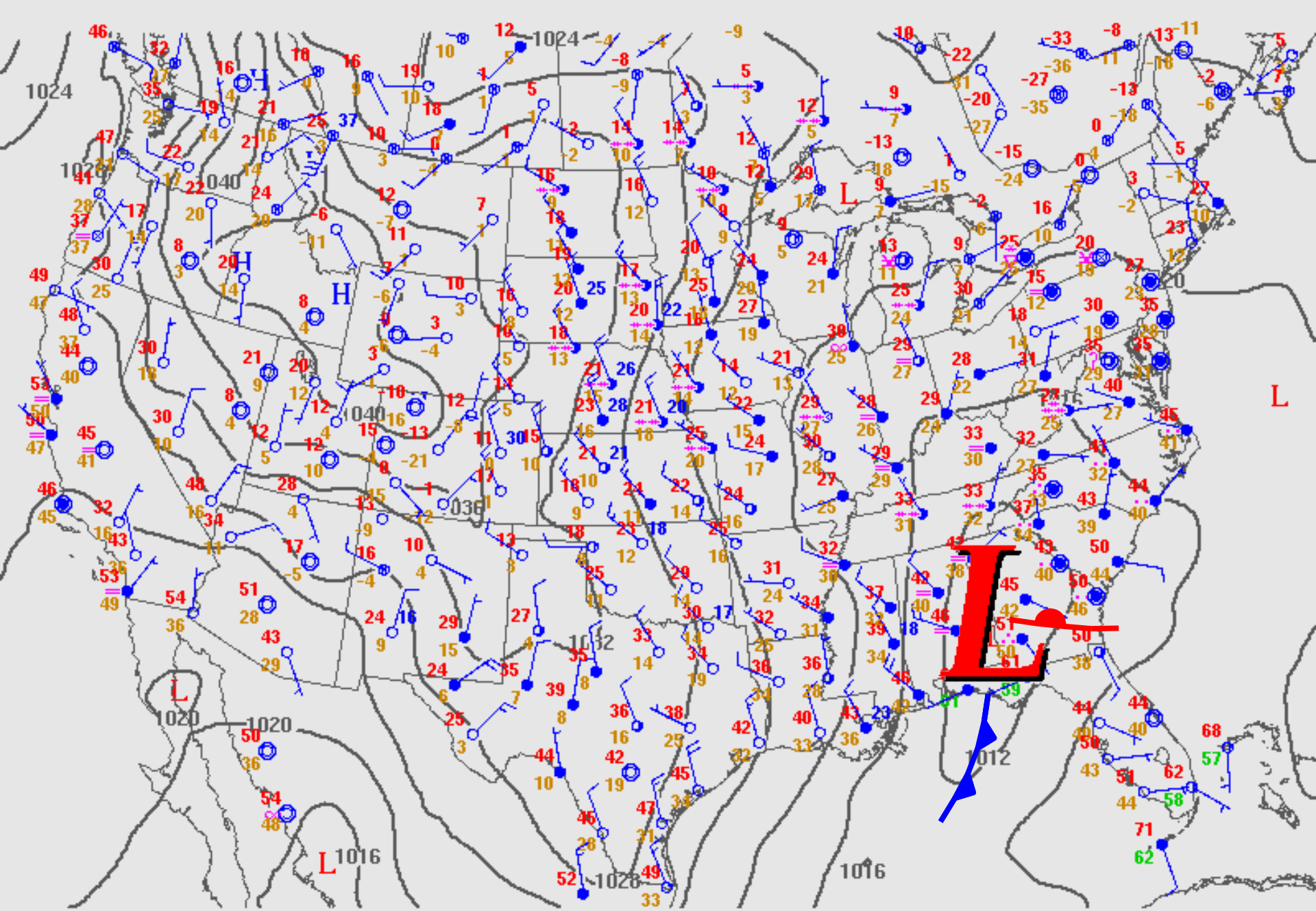

060211/1200 500 MB UA OBS, HGHTS, and TEMPS

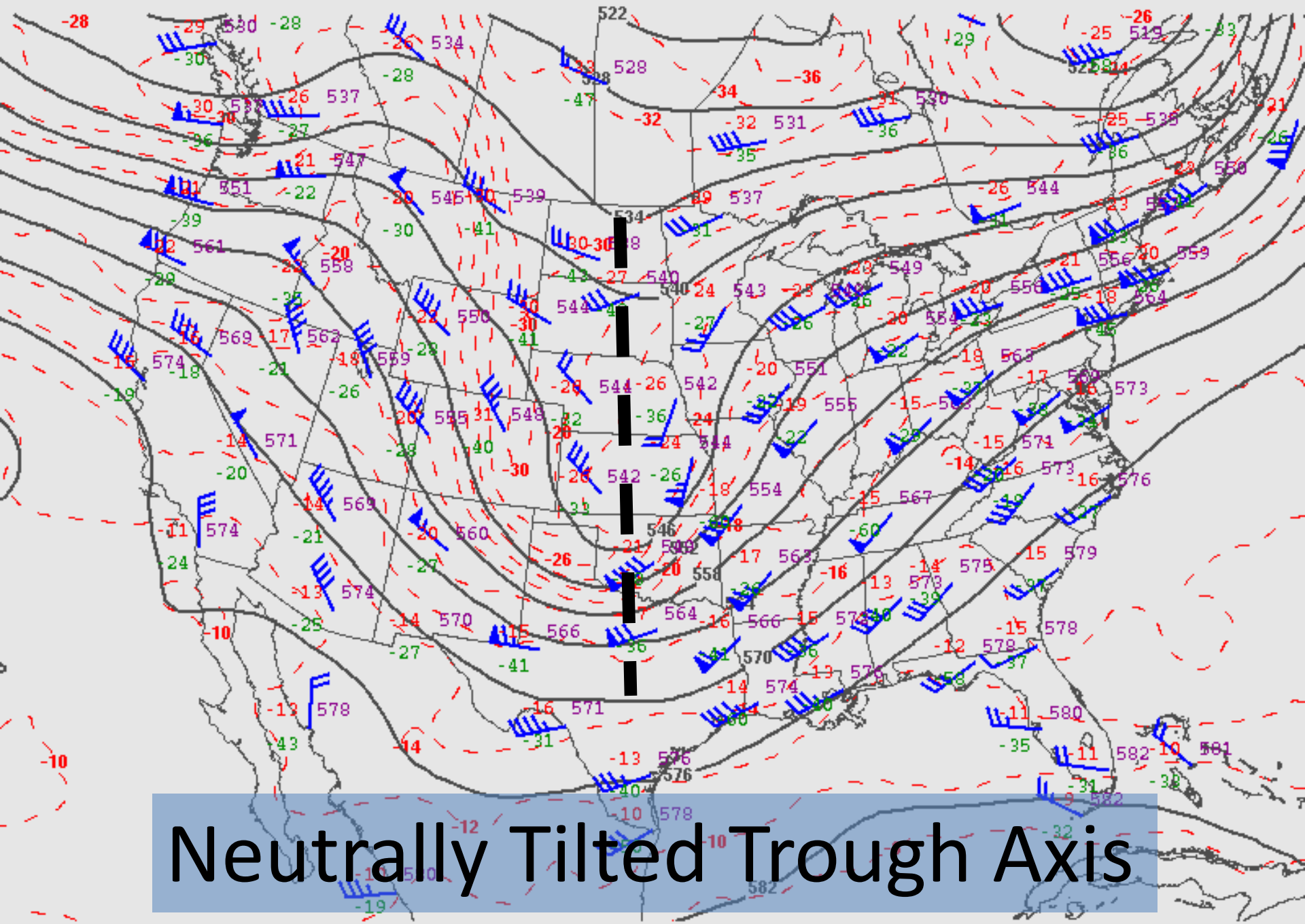
Observations in 3-D: Cross Section of Upper Low



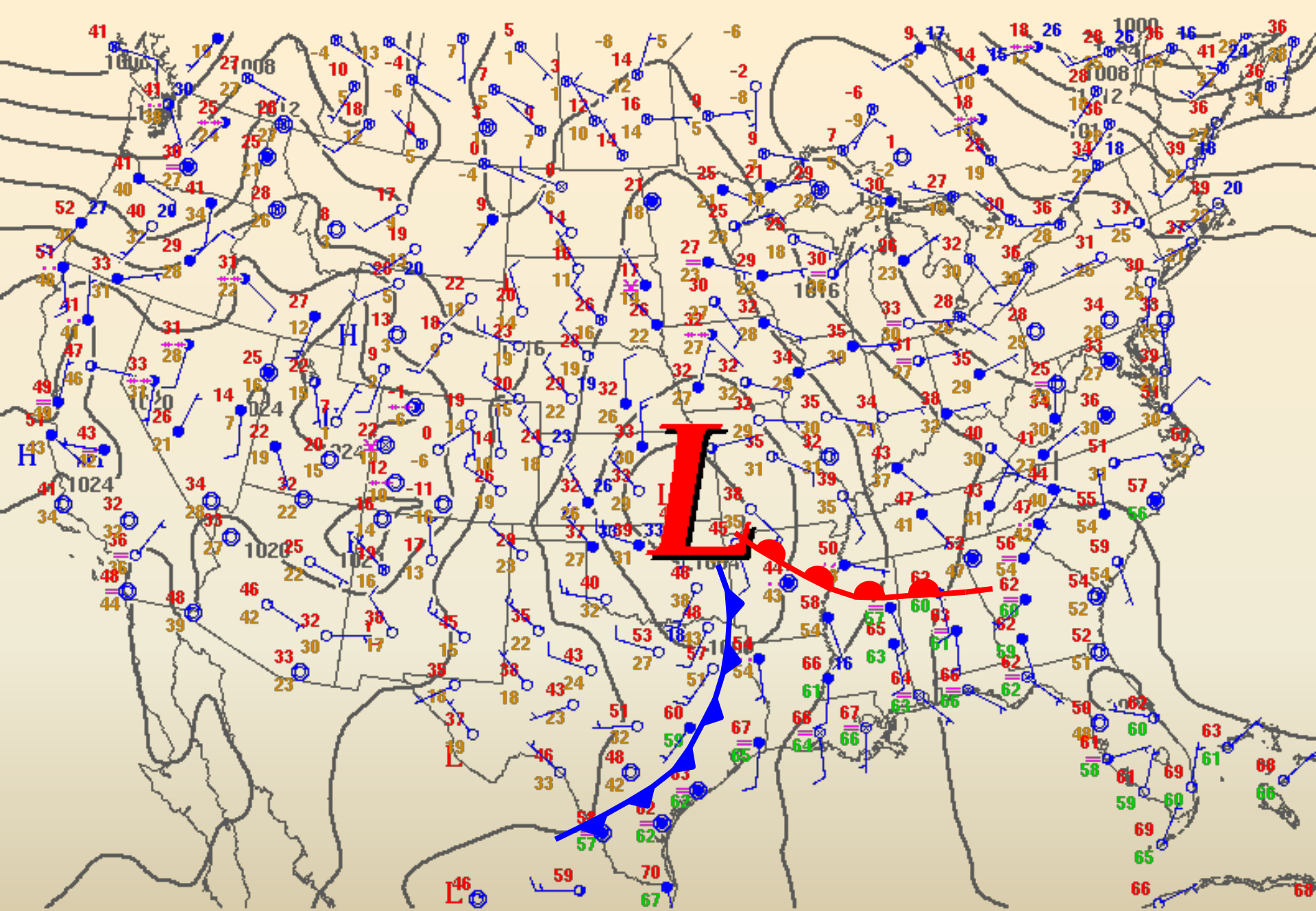


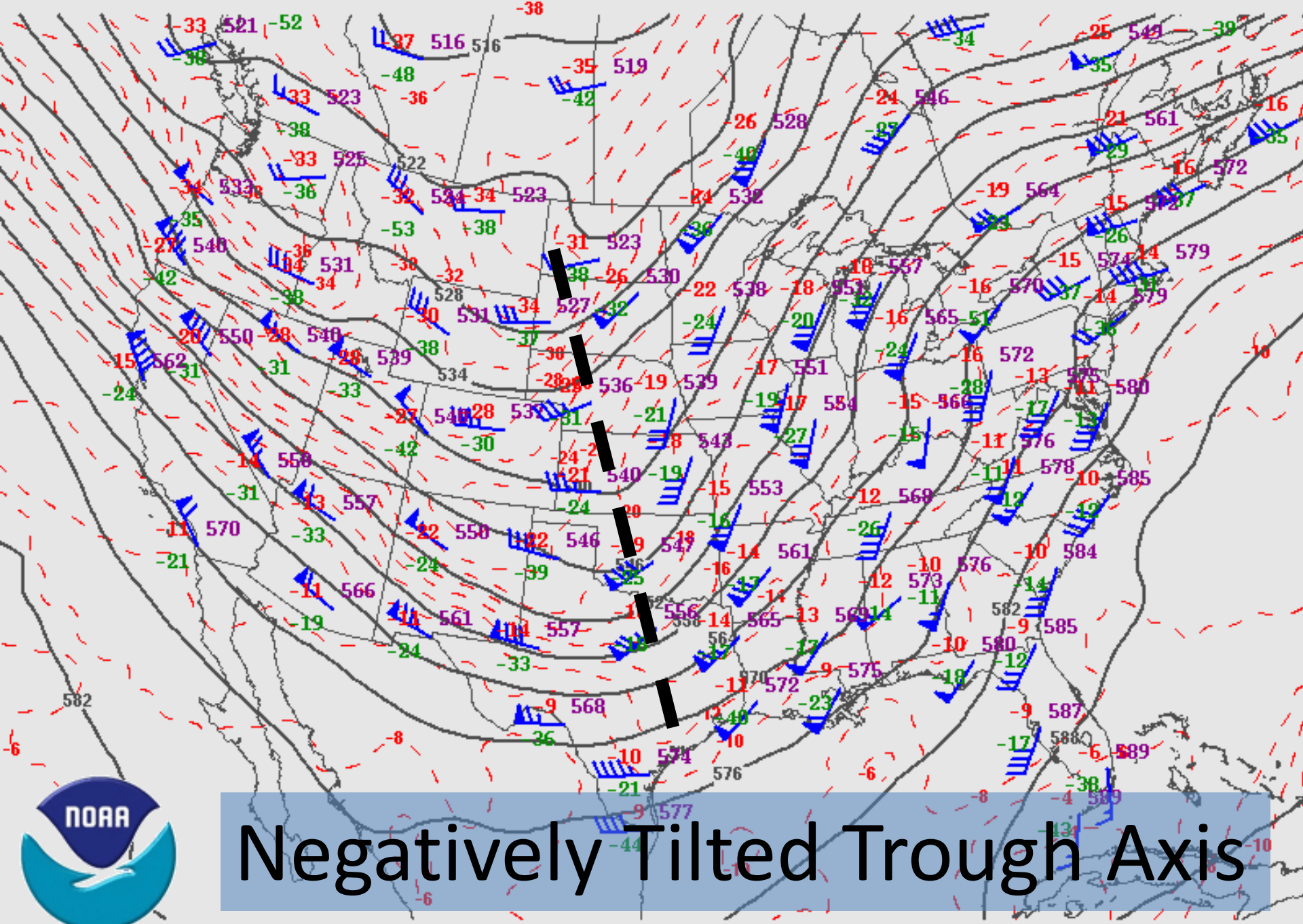
Positively Tilted Trough Axis


060211/1200 Surface OA Pressure and Obs
Weather, Temp, Dwpt, Gusts



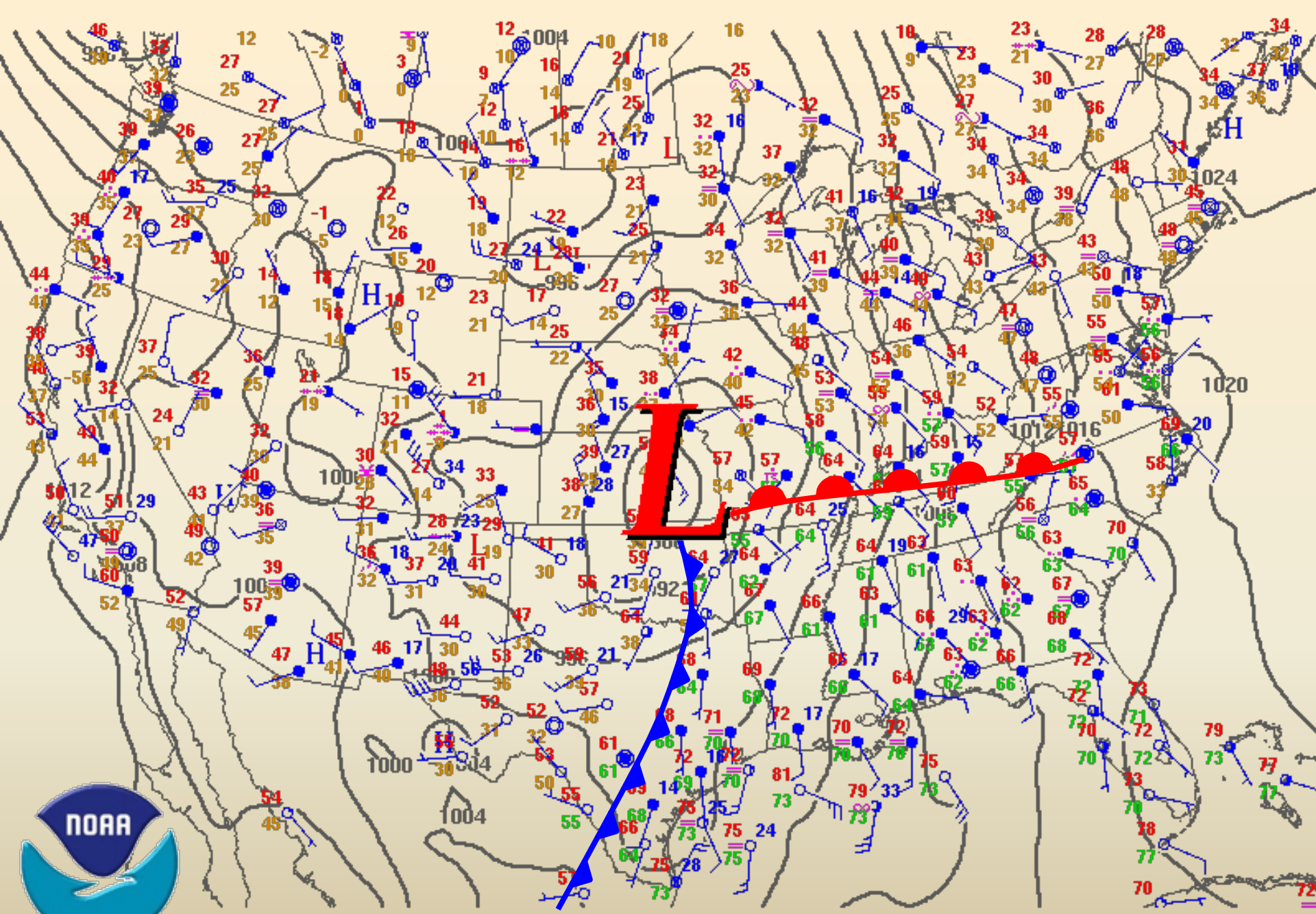
Neutrally Tilted Trough Axis


080110/1200 Surface OA Pressure and Obs
Weather, Temp, Dwpt, Gusts

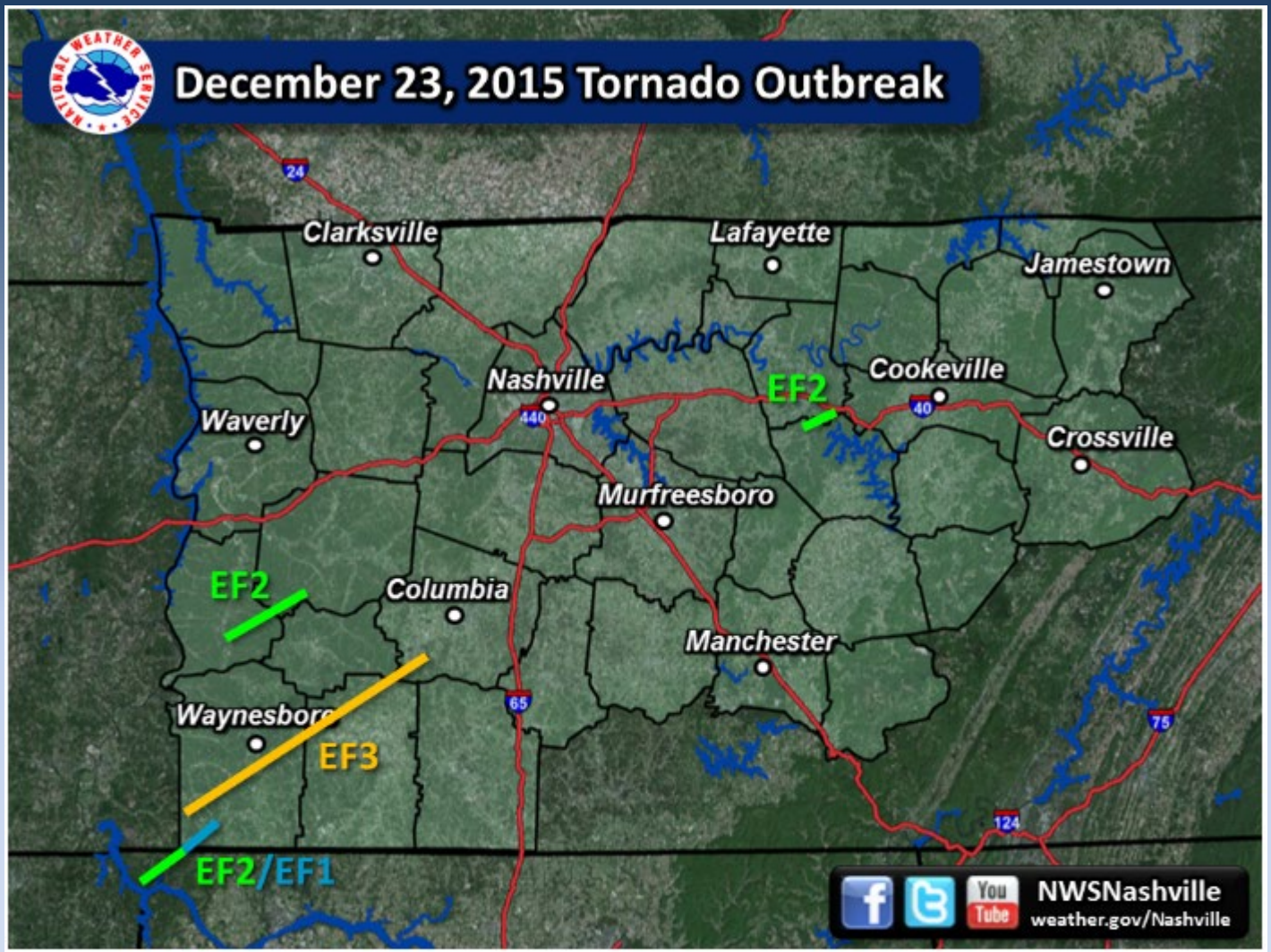


Negatively Tilted Trough Axis

National Weather Service
Storm Prediction Center

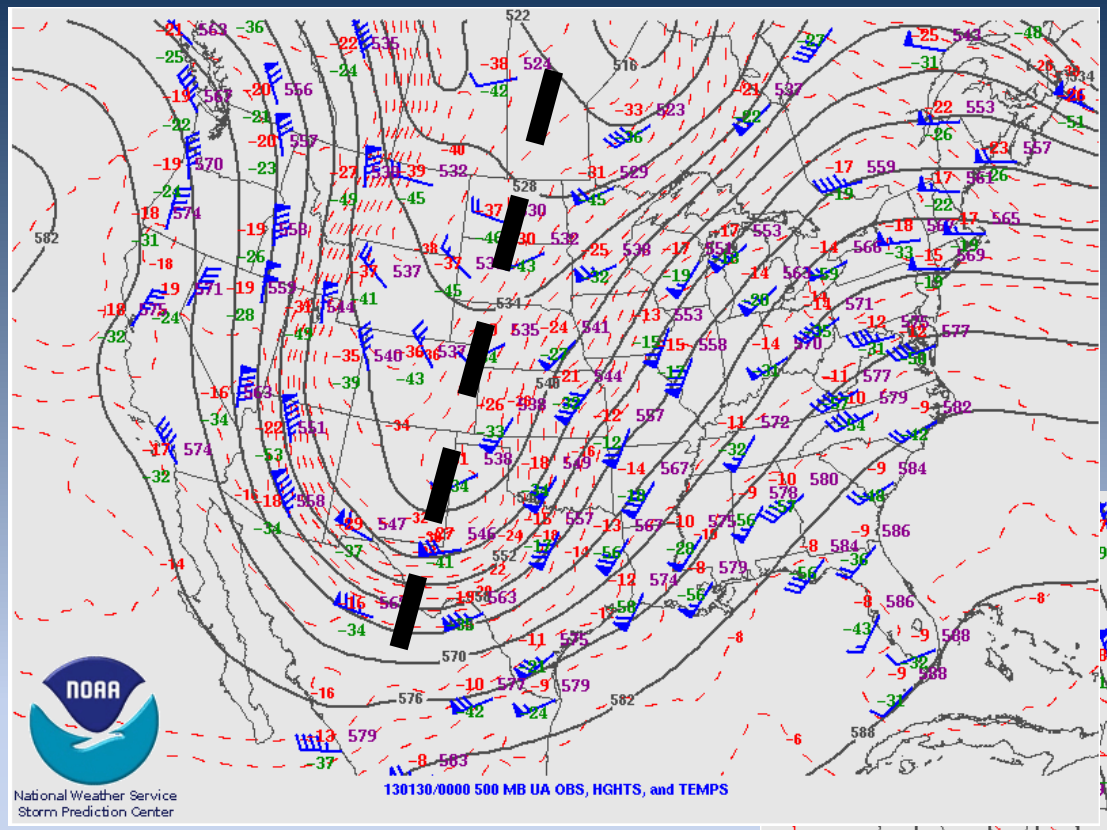


National Weather Service
Storm Prediction Center



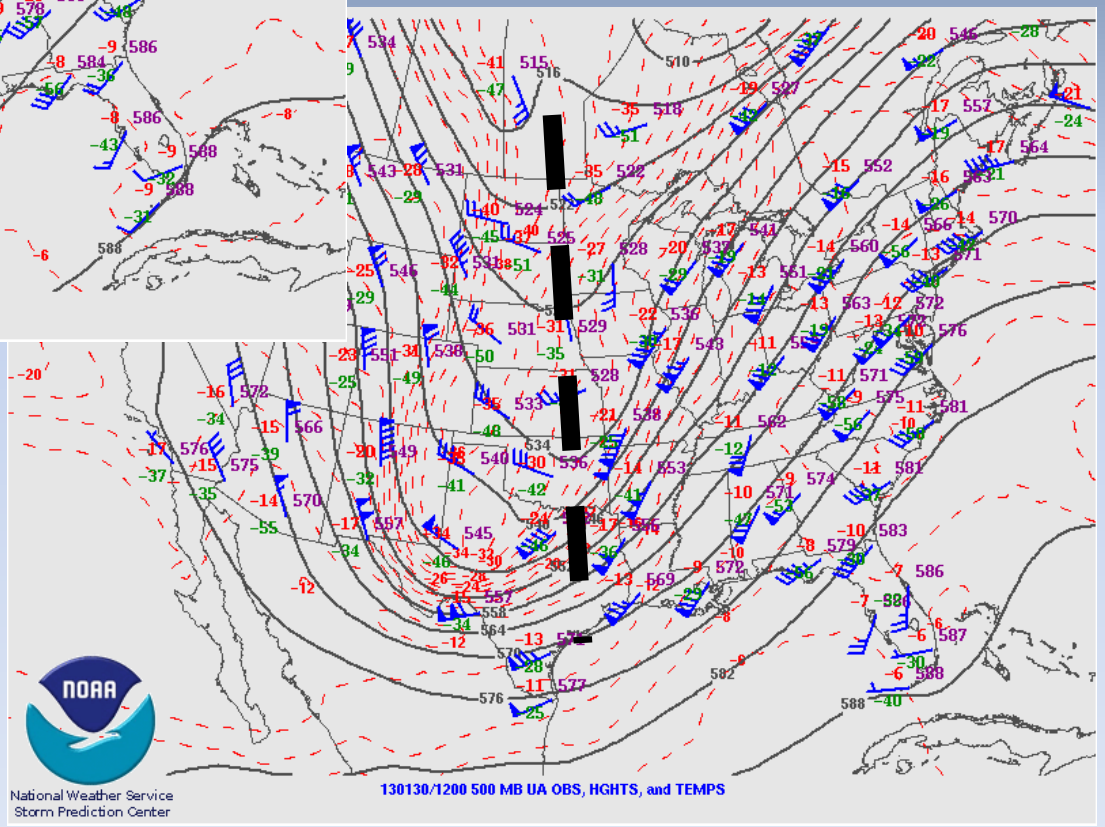
Tornado Statistics

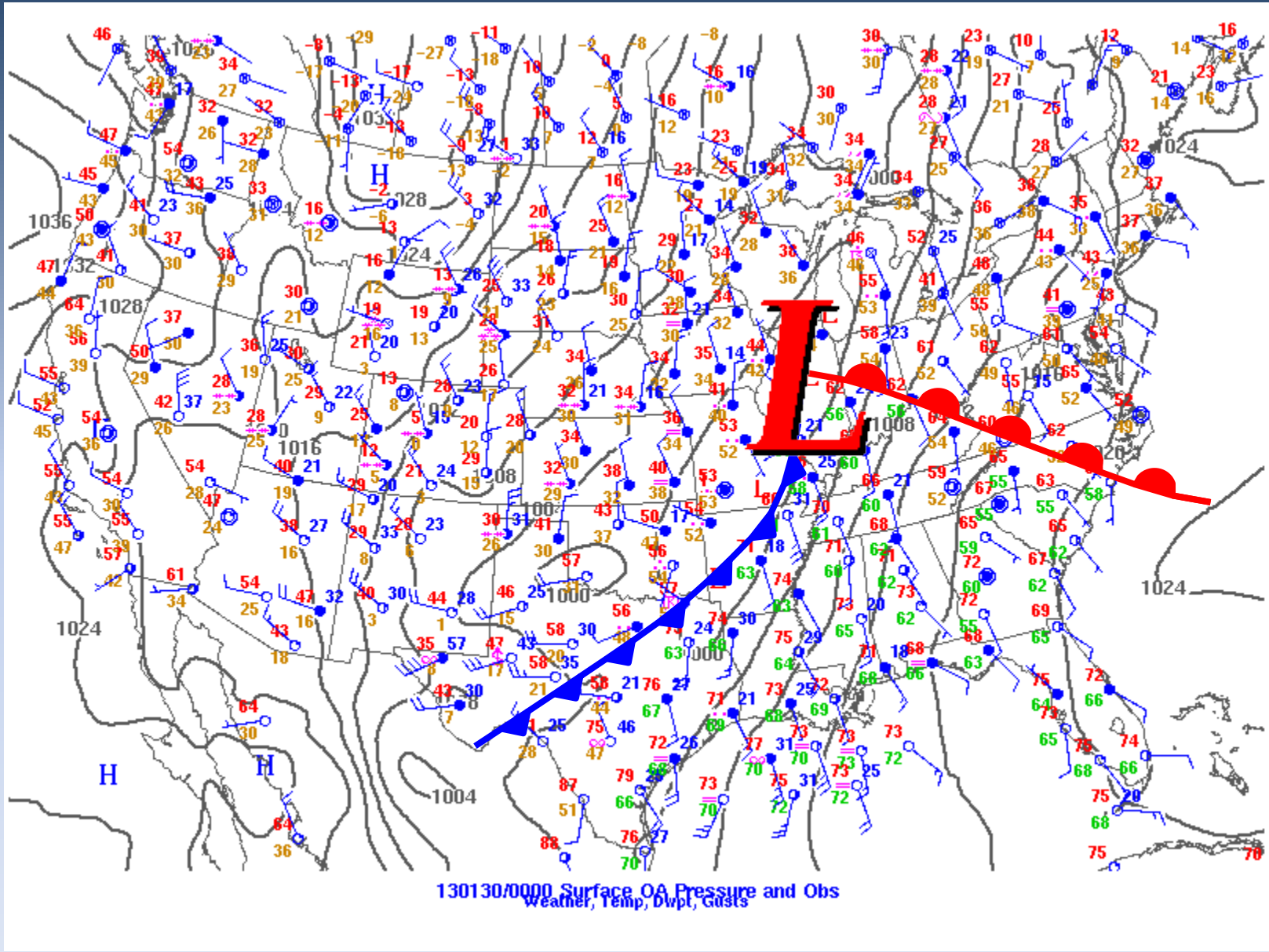
# Counties	Rating	Time (CST)	Length (miles)	Width (yards)	Fatalities	Injuries
1 Perry/Hickman	EF2	1818	13.95	500	2	0
2 Wayne/Lawrence/Lewis/Maury	EF3	1855	48.51	800	0	7
3 Lauderdale AL/Wayne	EF2/EF1	1900	11.0	400	0	0
4 DeKalb/Smith	EF2	2214	8.43	250	0	0

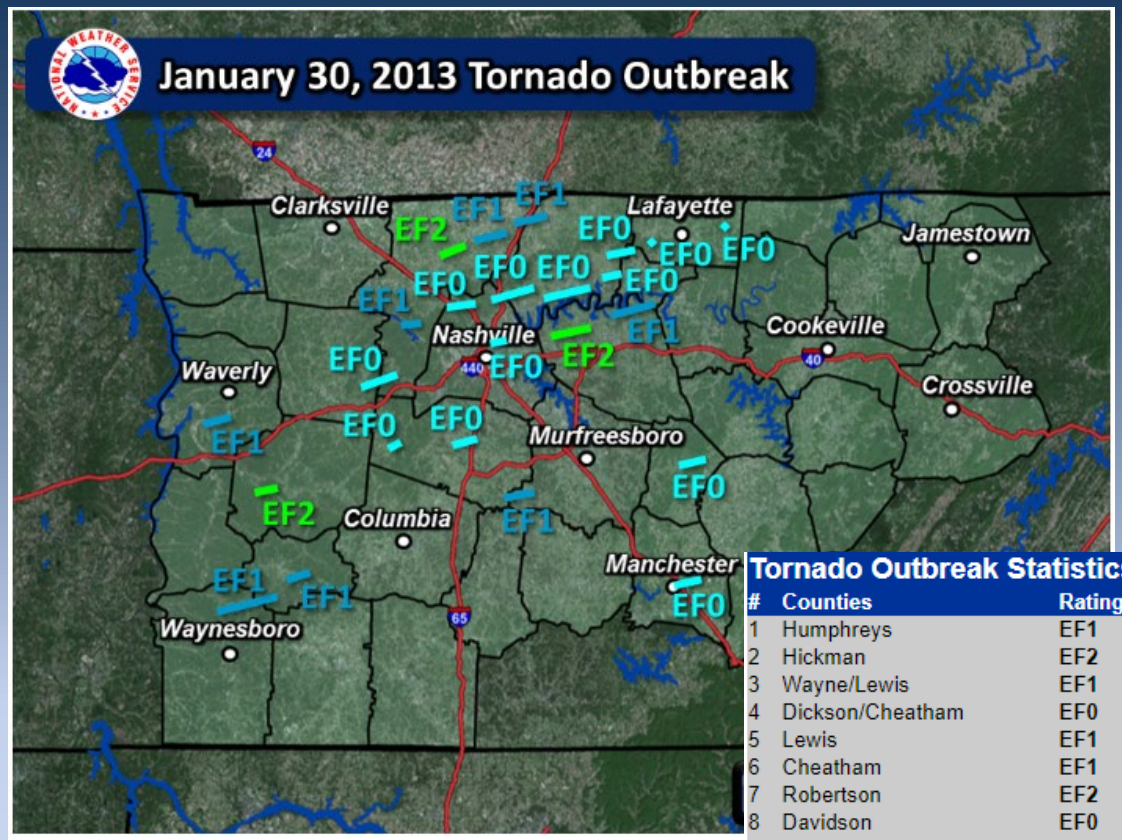


January 30th, 2013
7 am

January 29th, 2013
7 pm




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130130/0000 Surface OA Pressure and Obs
Weather, Temp, Dwpt, Gusts



Tornado Outbreak Statistics

#	Counties	Rating	Time (CST)	Length (miles)	Width (yards)	Fatalities	Injuries
1	Humphreys	EF1	0211	5.22	150	0	0
2	Hickman	EF2	0226	4.55	500	0	0
3	Wayne/Lewis	EF1	0232	9.17	100	0	0
4	Dickson/Cheatham	EF0	0245	7.10	10	0	0
5	Lewis	EF1	0246	3.74	200	0	0
6	Cheatham	EF1	0251	3.23	125	0	1
7	Robertson	EF2	0259	4.97	200	0	0
8	Davidson	EF0	0300	5.55	50	0	0
9	Williamson	EF0	0301	1.00	75	0	0
10	Robertson	EF1	0305	5.75	150	0	0
11	Davidson/Sumner	EF0	0310	13.00	75	0	0
12	Robertson/Sumner	EF1	0312	4.90	100	0	0
13	Davidson	EF0	0312	3.20	75	0	1
14	Williamson	EF0	0318	2.30	75	0	0
15	Sumner	EF0	0323	10.61	125	0	0
16	Wilson	EF2	0325	5.51	150	0	0
17	Sumner	EF0	0334	3.63	100	0	0
18	Sumner/Trousdale	EF0	0337	6.10	50	0	0
19	Wilson/Trousdale	EF1	0340	9.91	150	0	0
20	Williamson/Rutherford	EF1	0341	4.78	150	0	0
21	Macon	EF0	0347	0.97	50	0	0
22	Macon	EF0	0401	1.53	75	0	0
23	Cannon	EF0	0429	6.65	200	0	0
24	Coffee	EF0	0525	5.24	75	0	0

Upcoming classes

- Weather101
  - www.weather.gov/ohx/weather101
- Basic and Advanced SKYWARN Spotter Classes
  - www.weather.gov/ohx/skywarn
- All classes held each spring and fall
- Spring: March to May
- Fall: October through mid-December

The National Weather Service Presents

Weather101

Upcoming Classes (times are CT):

Mon, Nov 9	10 am	The Radar
Mon, Nov 9	7 pm	Global Circulations
Tue, Nov 10	7 pm	Tsunamis
Mon, Nov 16	10 am	Global Circulations
Tue, Nov 17	1 pm	Hurricanes

To register and for a full list of classes, visit to weather.gov/ohx/weather101

These ONLINE classes are FREE and open to people of all ages
Each class is hosted by a NWS meteorologist
Classes run 1 hour or less including a Q&A session

Questions or Comments?

- Email: scott.unger@noaa.gov
- If more than one, please send me an email with the number of people in attendance at your computer
- To download this presentation:

https://www.weather.gov/ohx/weather101presentations



U.S. Department of Commerce

National Oceanic and Atmospheric Administration

National Weather Service – Nashville, TN

