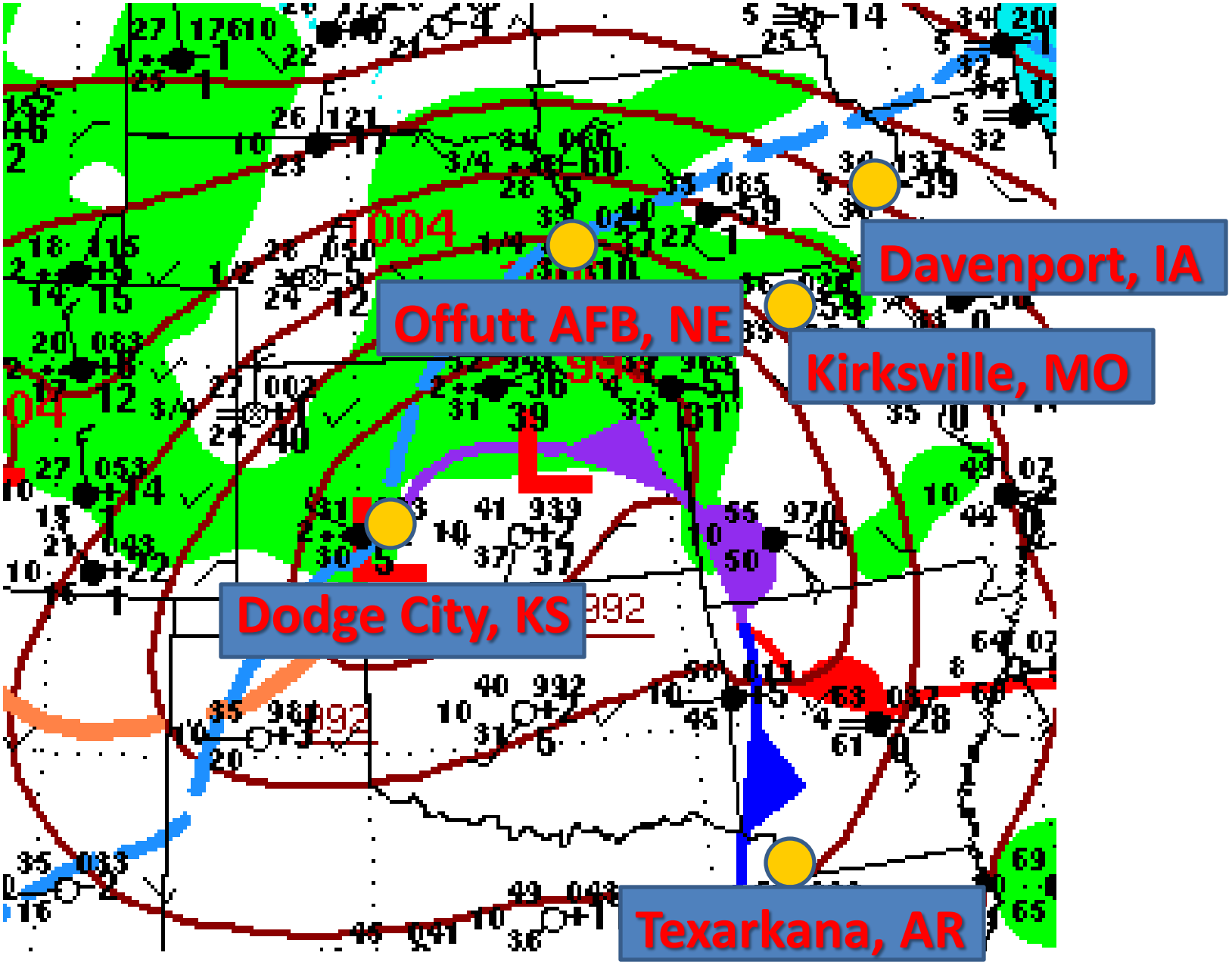
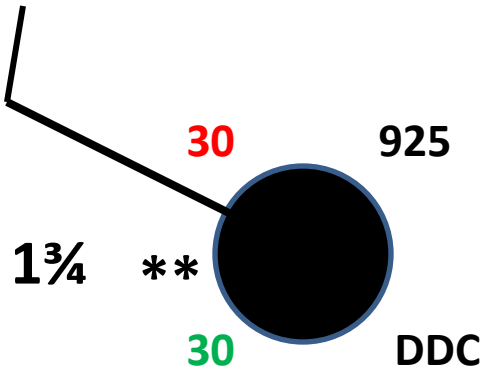
ATMO 574
Homework #1 Key
100 points Total

Part 1: Surface map
50 points

Isobars/isotherms: 10 points
Station models: 20 points
Fronts, pressure centers: 10 points
CAA/WAA: 5 points
Precipitation: 5 points

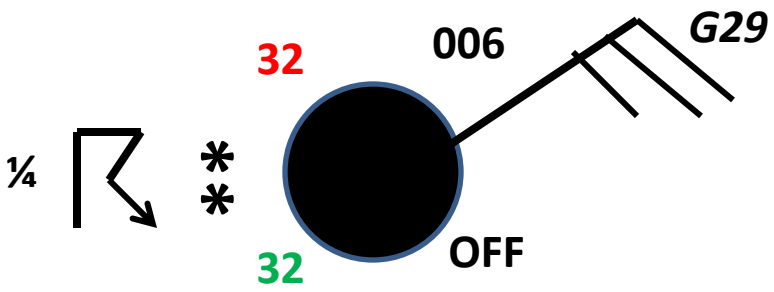

Davenport, IA
Offutt AFB, NE
Kirksville, MO
Dodge City, KS
Texarkana, AR

DODGE CITY, KANSAS (DDC)



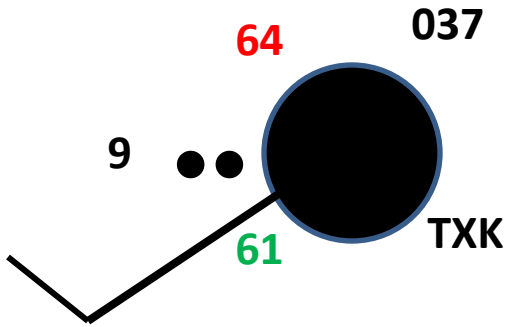
Winds: 8 kts at 300 degrees
Visibility: 1 ¾ miles
Precipitation: Light snow
Sky conditions: Overcast
Surface pressure: 992.5 mb
Temperature: 30°F
Dew point: 30°F

OFFUTT AFB, NEBRASKA (OFF)



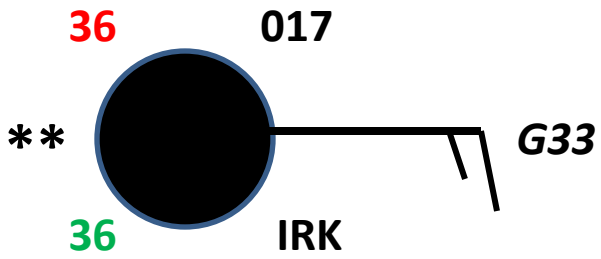
Winds: 23 kts at 50 degrees
Visibility: ¼ miles
Precipitation: Heavy thundersnow
Sky conditions: Overcast
Surface pressure: 1000.6 mb
Temperature: 32°F
Dew point: 32°F

TEXARKANA, ARKANSAS (TXK)



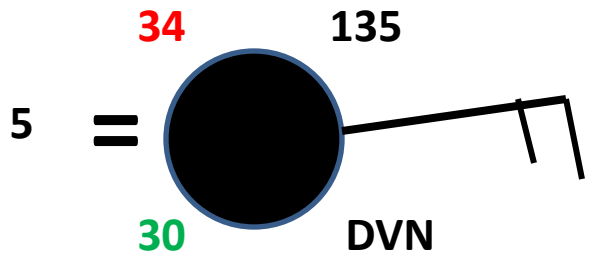
Winds: 9 kts at 240 degrees
Visibility: 9 miles
Precipitation: Light rain
Sky conditions: Overcast
Surface pressure: 1003.7 mb
Temperature: 64°F
Dew point: 61°F

KIRKSVILLE, MISSOURI (IRK)

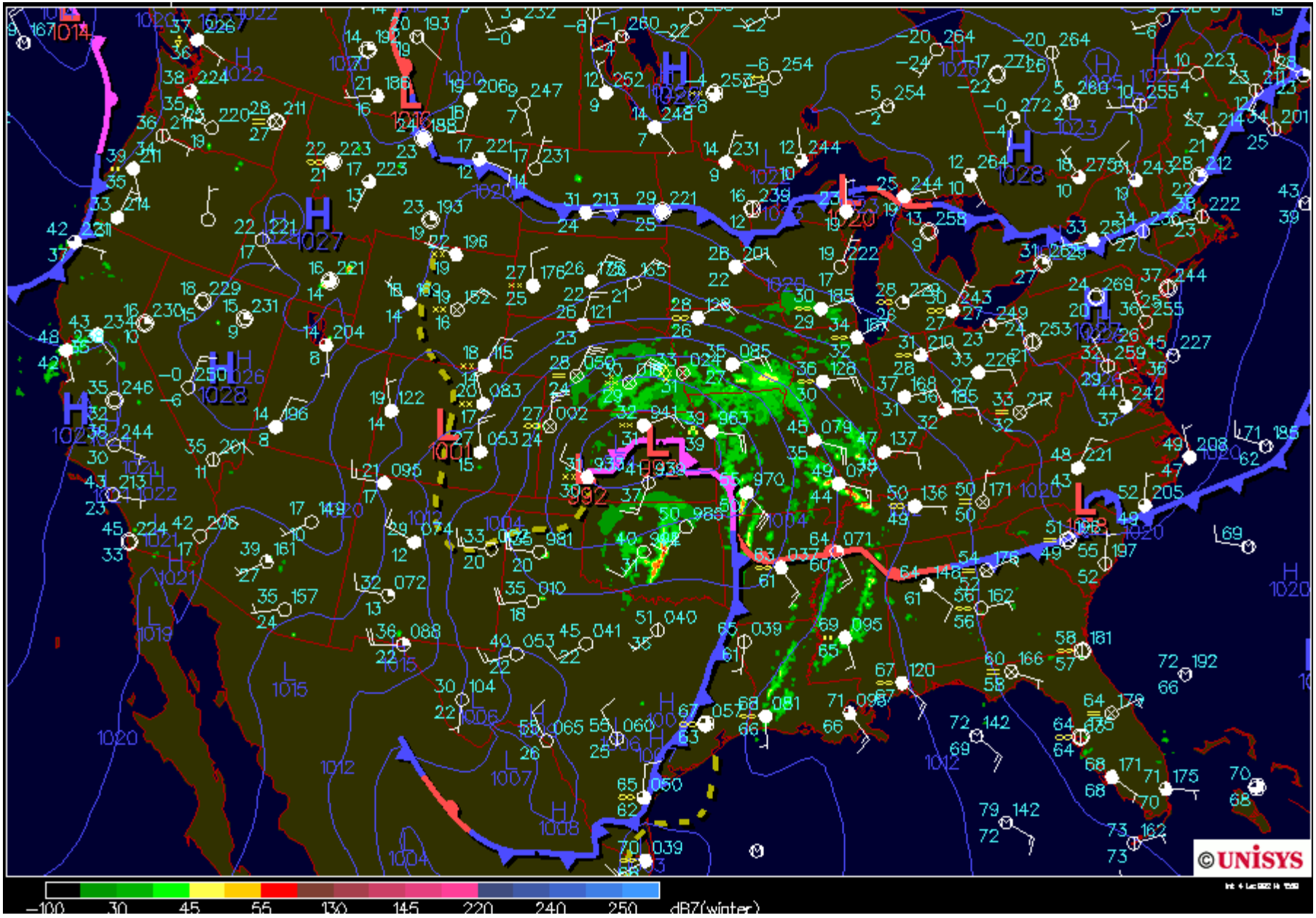


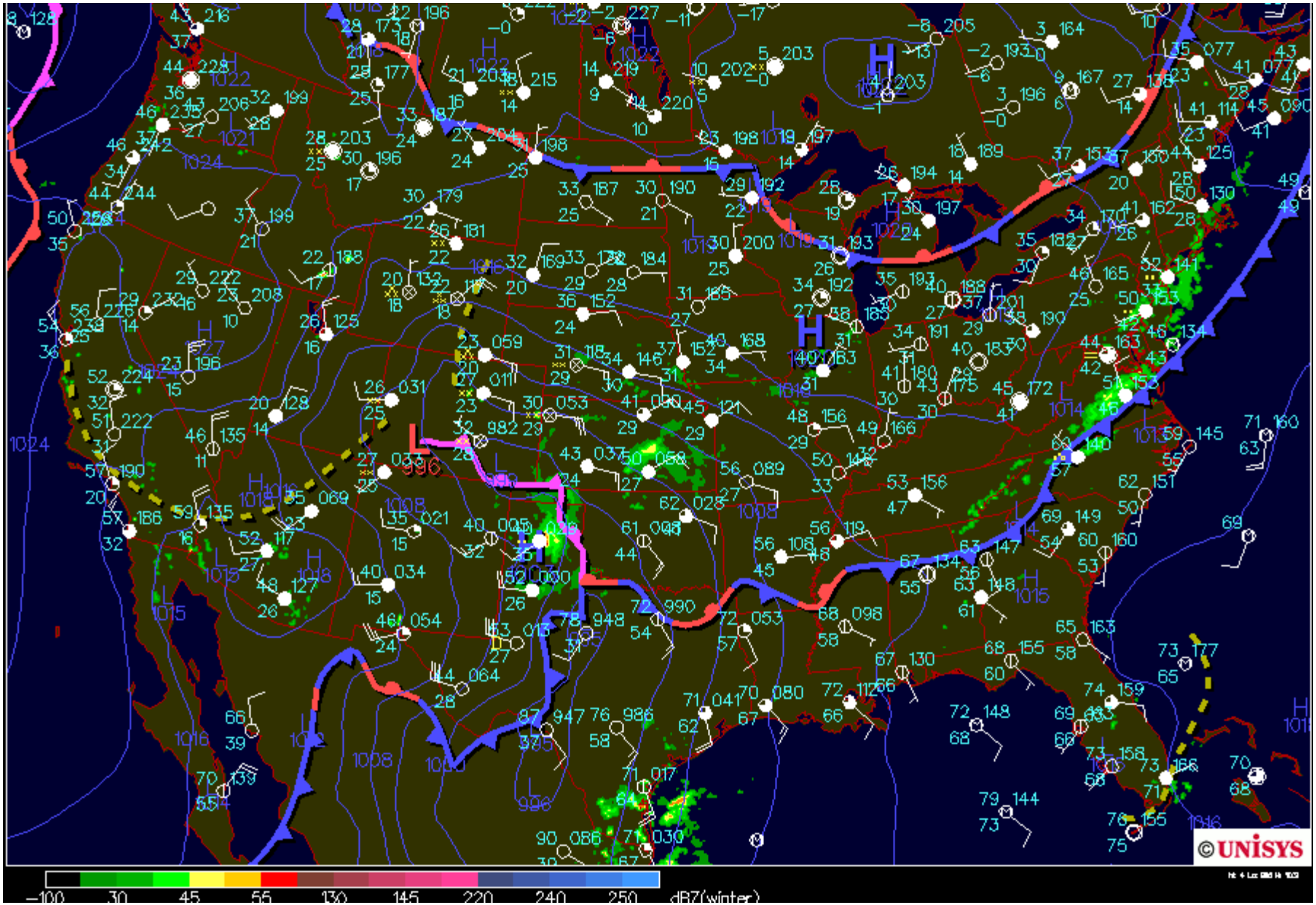
Winds: 14 kts, gusting to 33 kts at 90 degrees
Visibility: N/A
Precipitation: Light snow
Sky conditions: Overcast, thunderstorms in vicinity
Surface pressure: 1001.7 mb
Temperature: 36°F
Dew point: 36°F

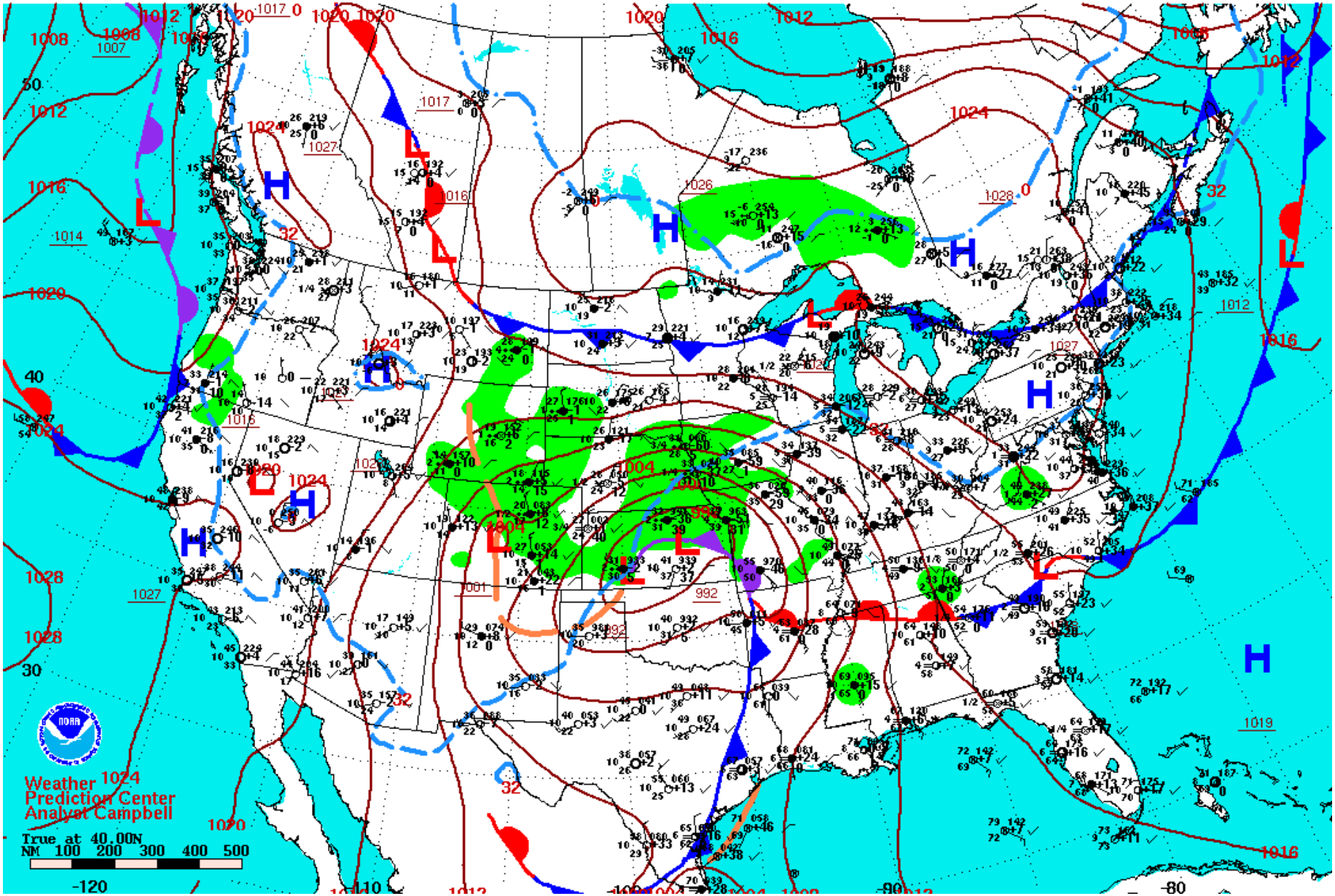
DAVENPORT, IOWA (DVN)

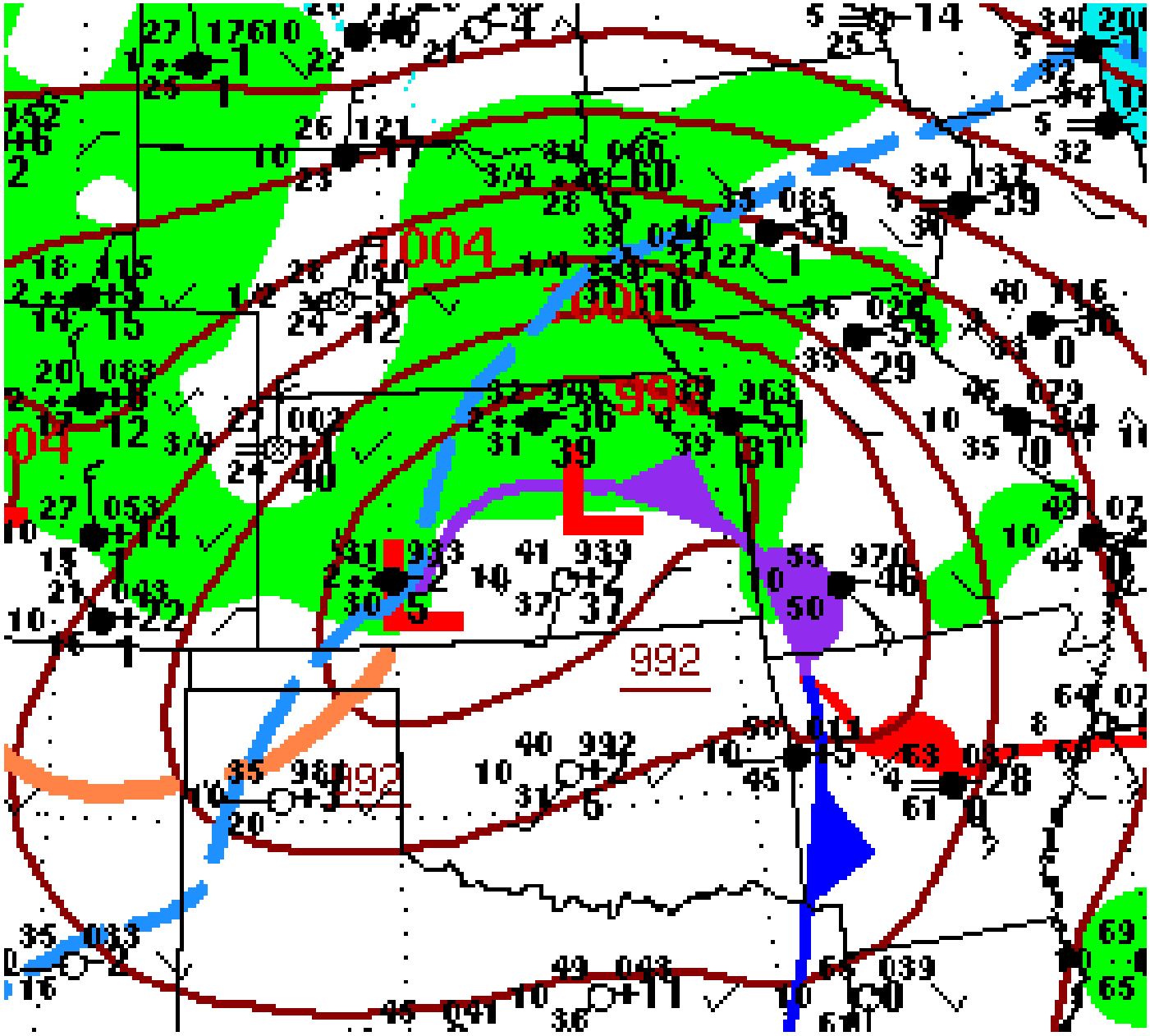


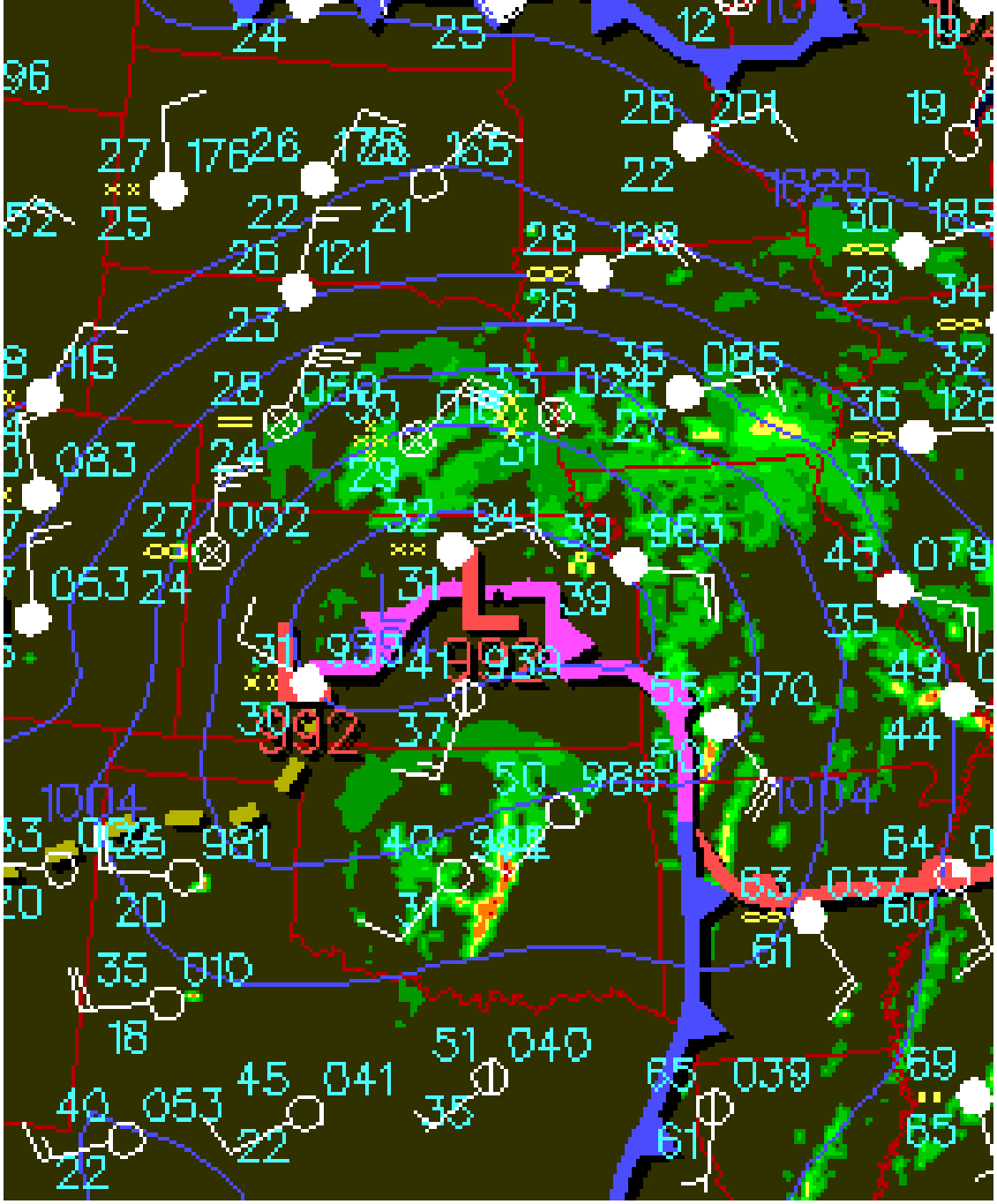
Winds: 13 kts at 80 degrees
Visibility: 5 miles
Precipitation: Mist
Sky conditions: Overcast
Surface pressure: 1013.5 mb
Temperature: 34°F
Dew point: 30°F

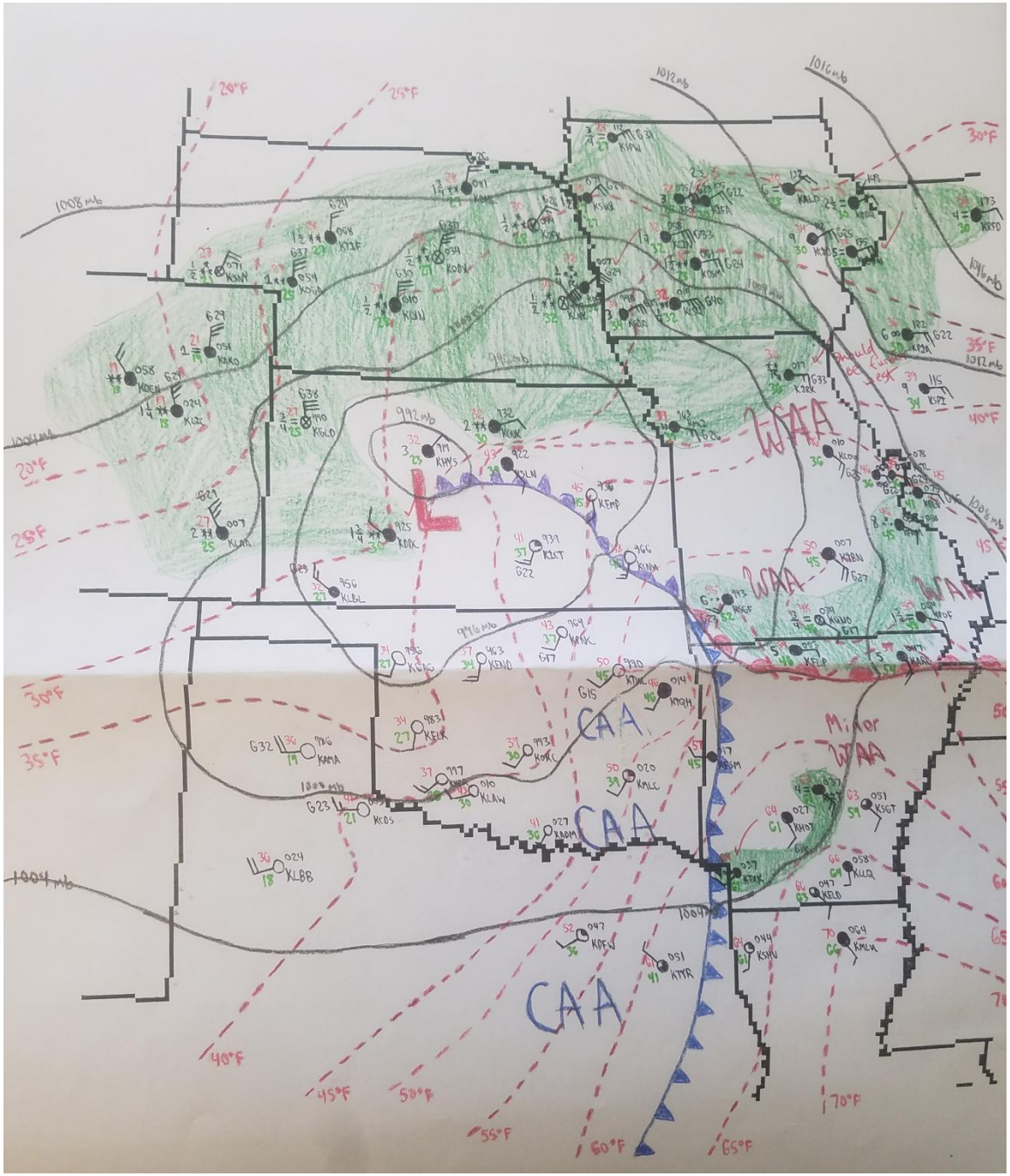

−100 30 45 55 130 145 220 240 250 dBZ(winter)
©UNISYS

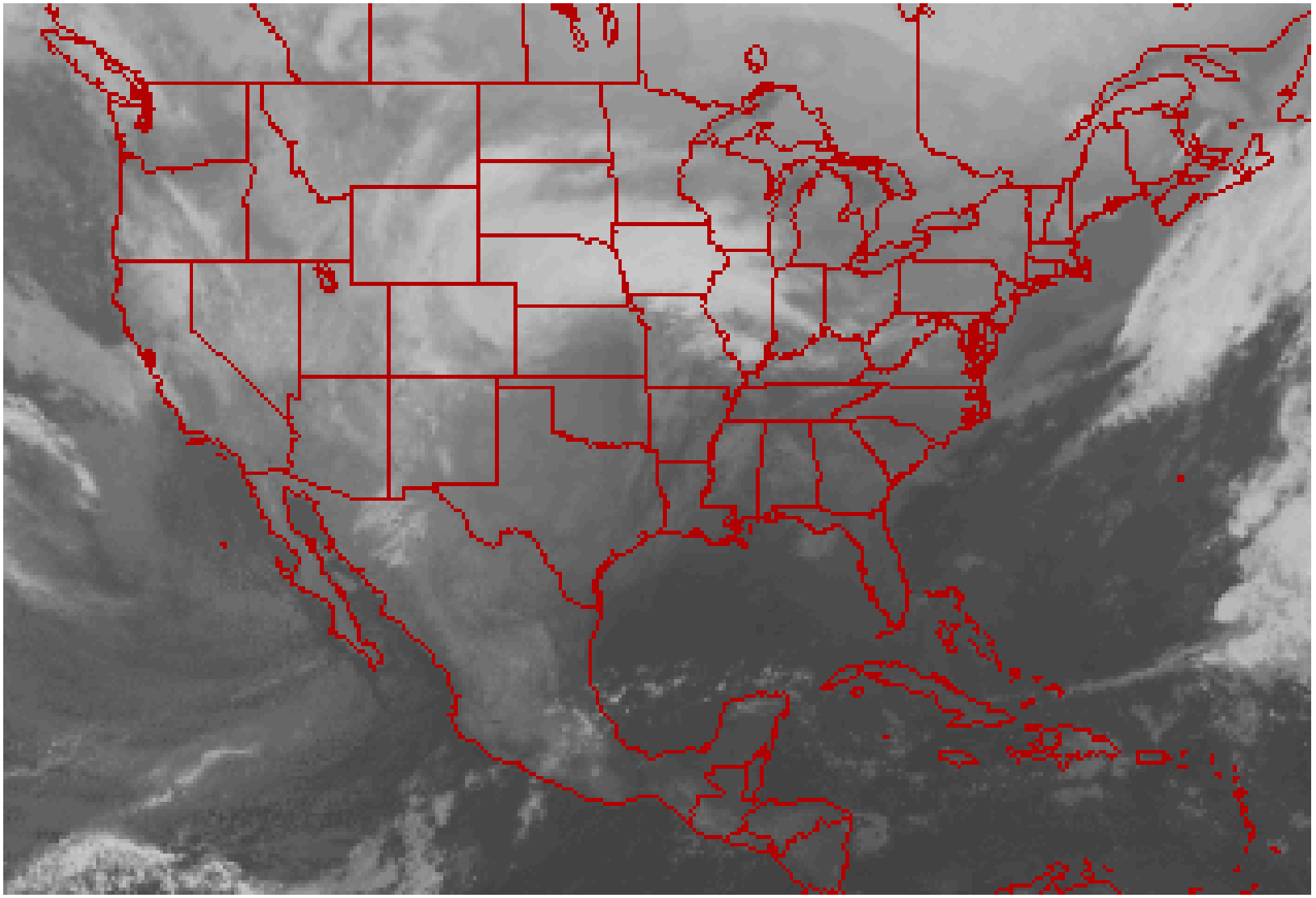

−100 30 45 55 130 145 220 240 250 dBZ(winter)
©UNISYS


Weather Prediction Center
Analyst Campbell
True at 40.00N
NM 100 200 300 400 500


1004
1000
996
992
992




WAA
WAA
WAA
CAA
CAA
CAA
Mixed
WAA
1008 mb
1012 mb
1016 mb
1004 mb
996 mb
992 mb
20°F
25°F
30°F
35°F
40°F
45°F
50°F
55°F
60°F
65°F
70°F



Part 2: Summary points for discussion (25 points)

Relatively strong surface low (992-mb) centered in north central Kansas. Surface pressure with this low is indicative of a mid-latitude cyclone near its peak intensity in the Norwegian cyclone model, so likely some occlusion has already occurred.

Best indicator of front is pressure trough that extends from the center of the low through southeast Kansas, southwest Missouri, and western Arkansas. A "'correct" map should have the pressure troughs and fronts in this area.

Given the relative lack of temperature contrast around the center of the surface low, the front in eastern Kansas is best analyzed as occluded. Greater temperature and dew point contrasts (on order of 10 degrees F or greater) are found further to the south and east along the front following the pressure trough.

A cold front is best analyzed in western Arkansas extending south through east Texas. There is CAA to the west of the cold front and lower temperatures/dewpoints with winds out of the west; WAA ahead of the cold front in the warm sector in southern Arkansas, northern Louisiana where temperatures are in the low to mid-60s, air is nearly saturated, and winds out of the south.

Part 2: Summary points for discussion (25 points)

A warm front is best analyzed in central to northern Arkansas. There is relatively strong WAA ahead of the warm front in Missouri with some precipitation observed at reporting stations in this area too. Triple point is located somewhere in northwest Arkansas.

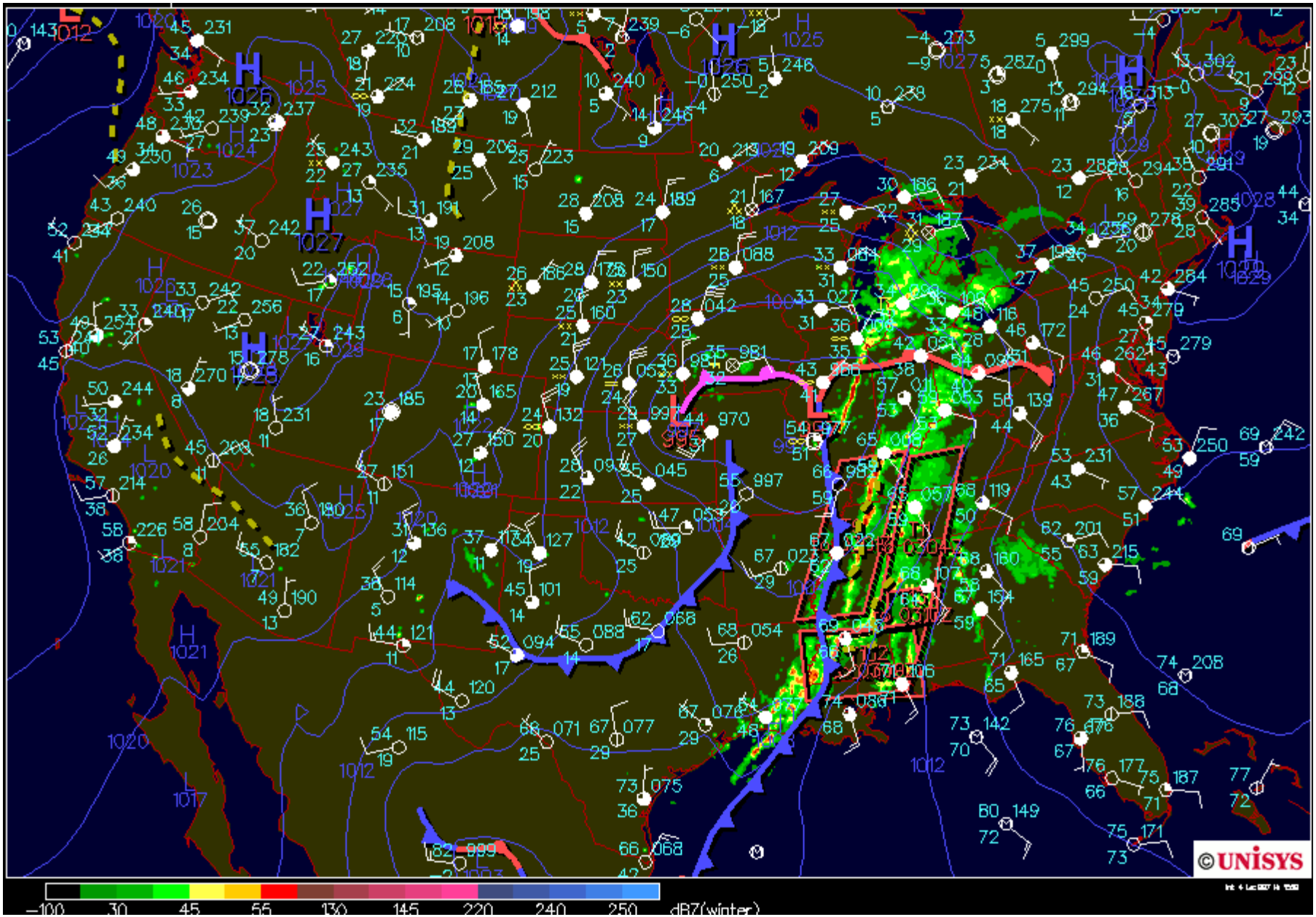
The system is still baroclinic because there is still CAA and WAA occurring, so it is probably in a fully mature to advanced occluded stage. The IR satellite imagery also shows a well formed comma-shape structure to the clouds characteristic of a mature, mid-latitude cyclone, matching the pattern of precipitation (in green on surface map) recorded at the surface stations.

The most notable weather, in terms of clear need for possible watches and warnings, is located generally to the north of the surface low. A band of moderate to heavy snow with winds exceeding 25 kts from an easterly direction is observed through a large portion of Nebraska. More scattered precipitation, in the form of showers and thunderstorms, are found in the areas to the east of the occluded front and north of the warm front.

Winter storm and/or blizzard warnings are most likely merited in Nebraska and Iowa at this time, given the observed heavy to moderate snow and strong winds from the east.

If the surface low will travel to the north and east, following the typical path of an extratropical cyclone in the central U.S. and where WAA is occurring, it would be reasonable to issue some sort of winter storm watches or warnings further east into eastern Iowa, northern Illinois, southern Wisconsin.

Some of you also noted that there could be chance of severe weather in the warm sector. Though I noted with highly mature mid-latitude cyclones that upper-level dynamics are typically more unfavorable in the warm sector for severe weather than at earlier stages, **we need to look at the subsequent 0Z map…**


−100
30
45
55
130
145
220
240
250
dBZ(winter)
©UNISYS

Part 3: Upper-level map
25 points

Best student solution + Actual map

Part 3: Summary points for discussion

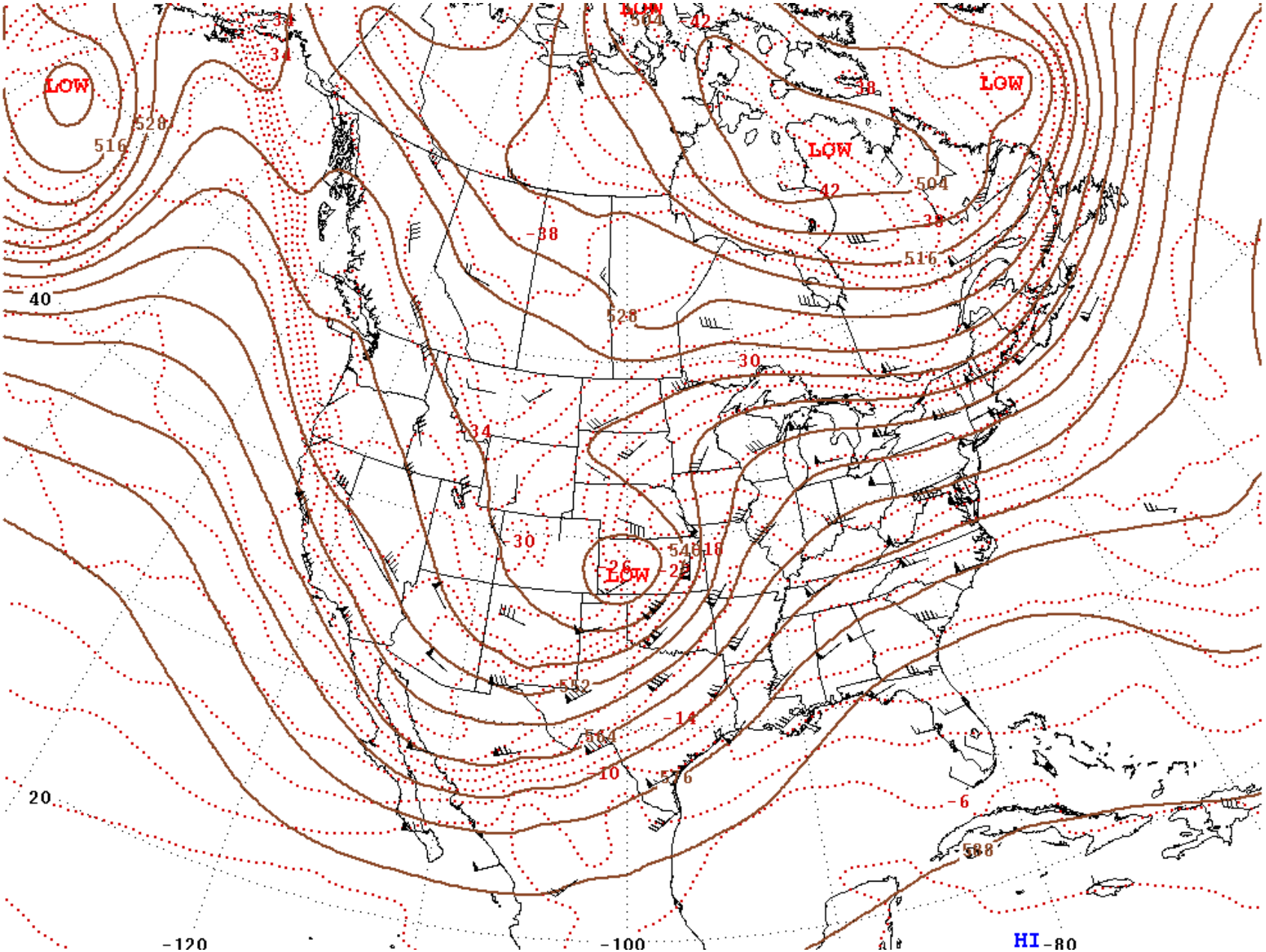
A “good’’ upper air analysis had upper low located just west of the surface low. The system is NOT vertically stacked yet because there is still some baroclinicity indicated by the presence of warm and cold advection.

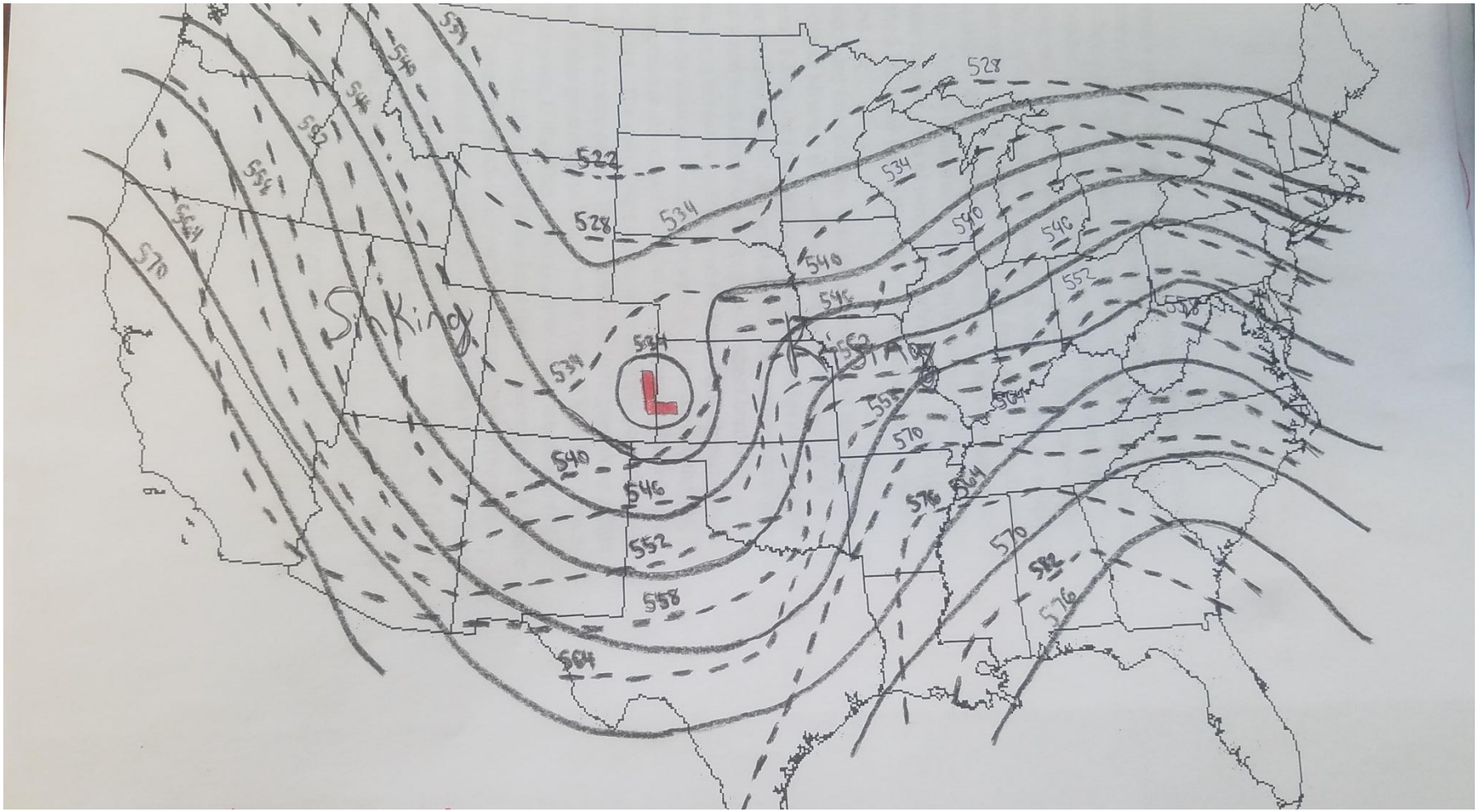
The upper-low should be fairly deep and amplified (like the example presented in class), given that it is a mid-latitude cyclone in a fairly mature stage.

The thickness lines should be oriented approximately in the same way as the surface isotherms, with the 540 dm line corresponding approximately to the transition between liquid and frozen precipitation.

To infer the structure of the 500-mb geopotential heights, either of the following were acceptable: 1) inference by looking at analogous historical cases and/or 2) thermal wind arguments.

For thermal wind arguments, the 500-mb gradient wind should reflect backing wind where there is observed cold advection, veering wind where warm advection. Can approximately back out the orientation of the upper-level wind by vector addition/subtraction, given that Vt + Vsfc = Vupper.


LOW
516
528
LOW
504
42
LOW
LOW
504
42
-38
516
-38
528
-30
534
-30
LOW
-26
-14
-10
-6
588
40
20
-120
-100
HI
-80


528
534
540
546
552
558
564
570
576
582
L
Sinking