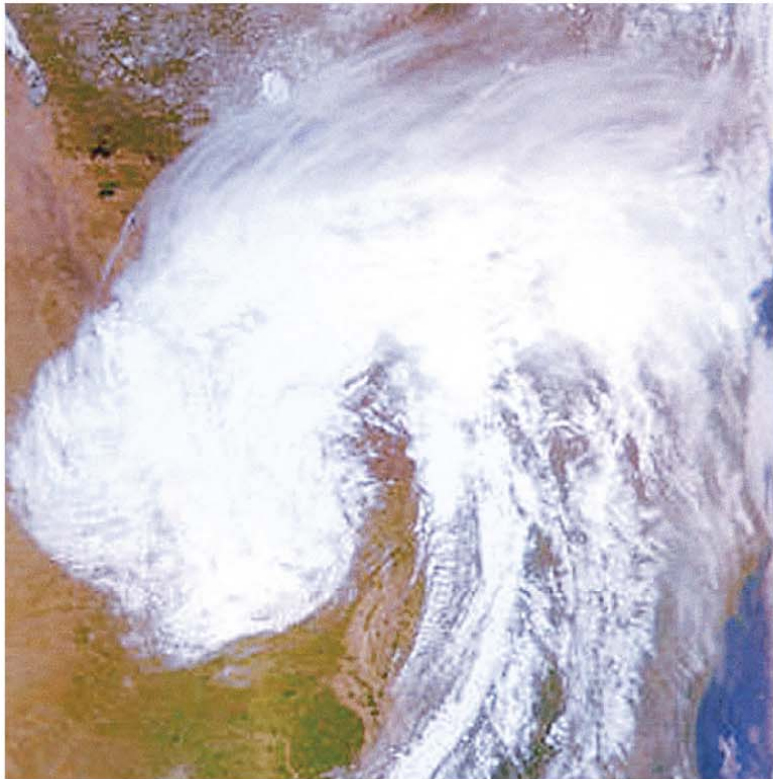
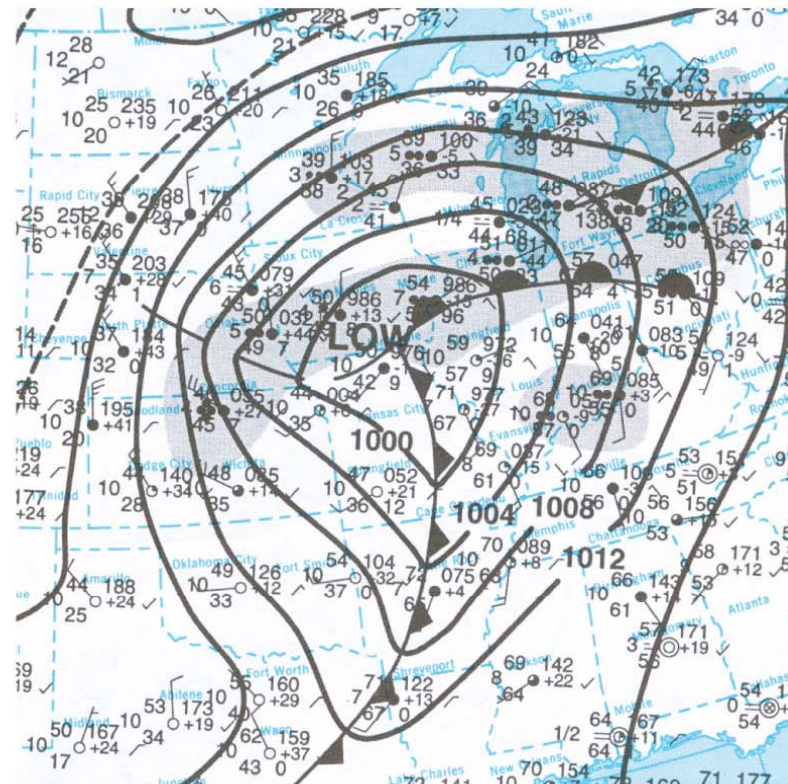


Mid-latitude Cyclonic Storm System

The Cloud Shield is Usually Comma Shaped with the Head around the Low Pressure Center and the Tail Just ahead of the Cold Front



(a)

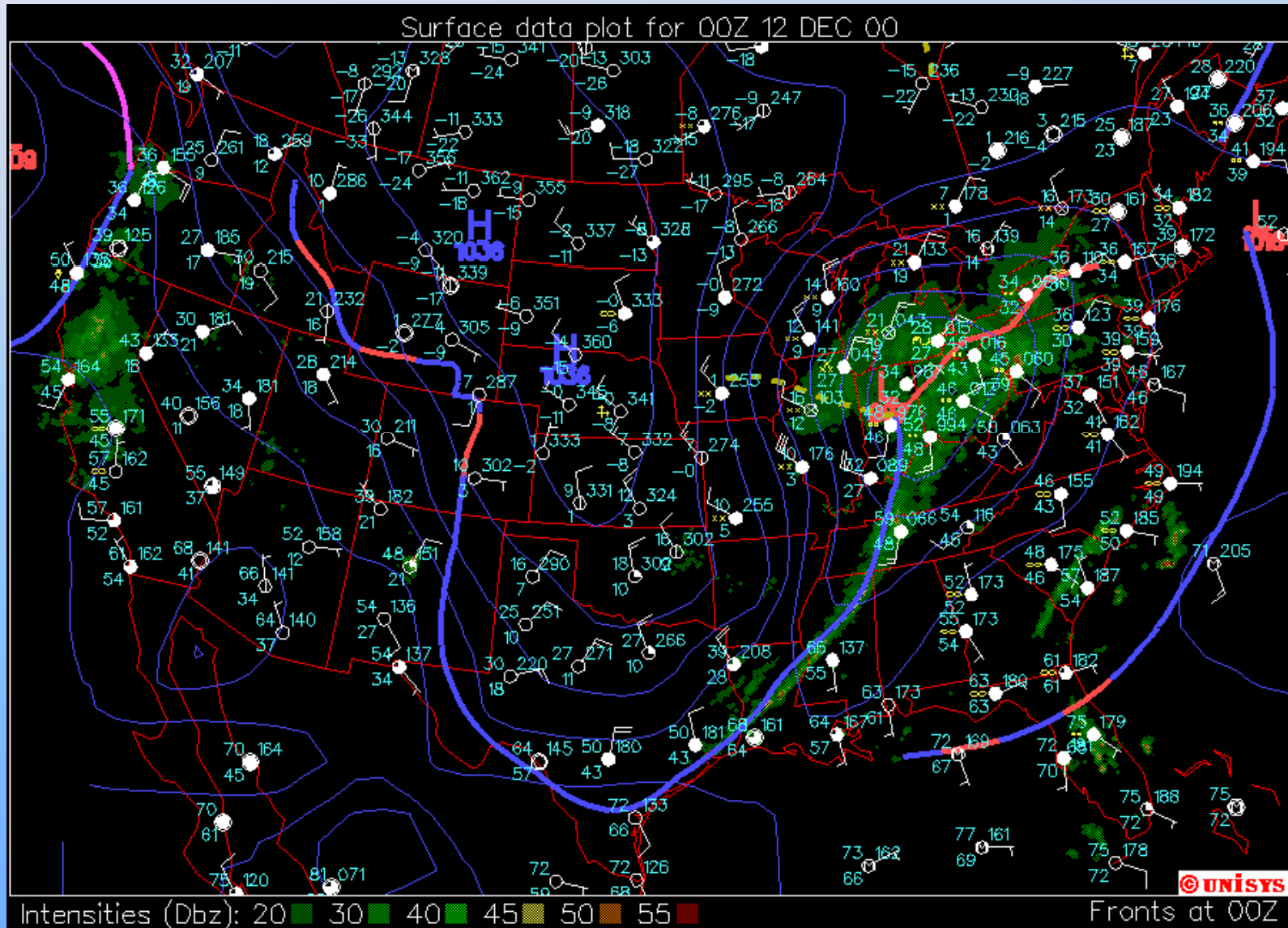


(b)

Mid Latitude Cyclone Storm System (MLCSS)

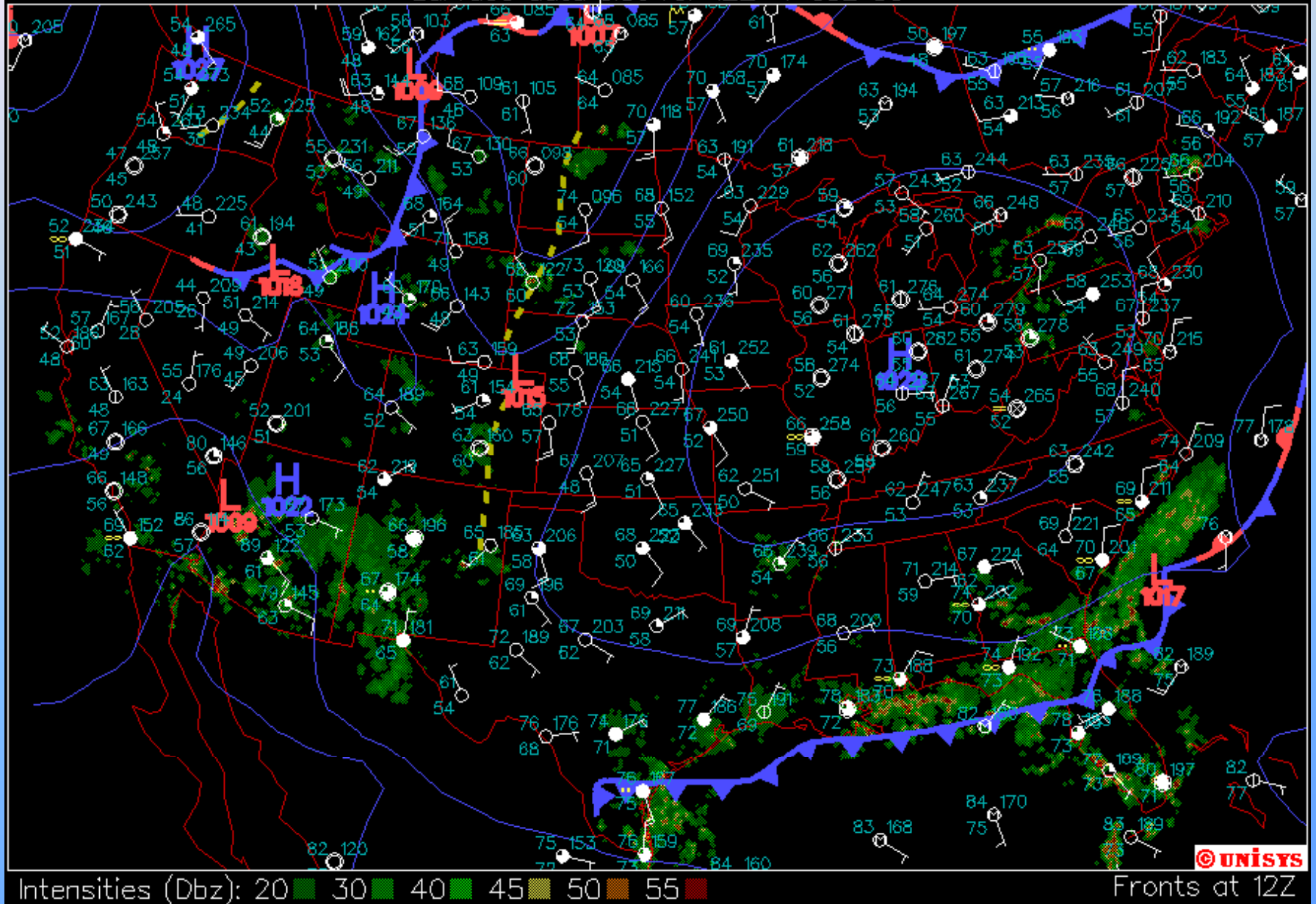
- It has several names. Cyclone, Cyclonic Storm, Cyclonic System, Depression.
- Cyclonic Storms are the weather maker for mid-latitude locations and create the changeable pattern of weather there.
- The cyclonic storm consists of a center area of low pressure which anchors the fronts attached to the low. This gives a comma shaped cloud shield on the satellite image.
- The cyclonic system pulls air masses of very different character together. This results in local thunder storms along the fronts.
- The cyclonic system can destabilize the atmosphere over a large region of the U.S. causing many areas of thunderstorms that are not located along fronts.
- The cyclonic systems are short lived (1 week) and migrate moving generally west to east.
- Cyclonic systems are created by the westerlies and jet stream aloft. The surface low pressure cell is connected to a trof aloft and is created by the trof.

Strong Cyclonic System over Eastern U.S. With Counterclockwise Pattern of Rotation around Low



Clockwise Circulation around Anticyclone Centered over Indiana

Surface data plot for 12Z 7 JUL 06

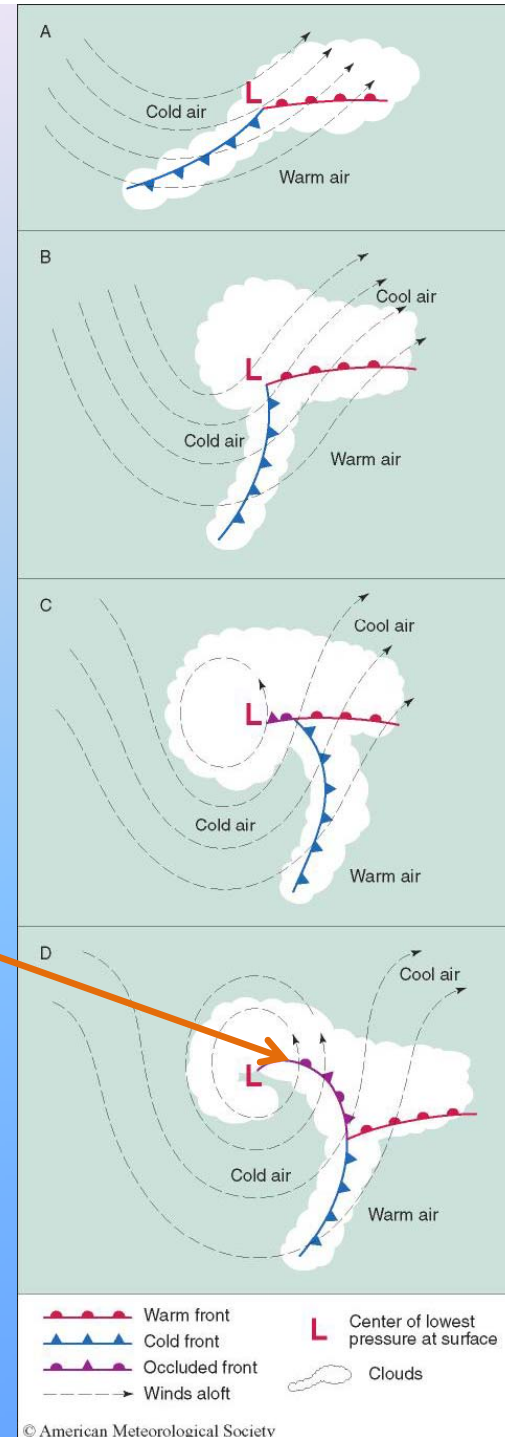


Stages in Life Cycle of a Cyclonic System

1. Cyclogenesis. Low develops along frontal boundary with winds showing rotation.
2. Mature or Open. Classic fully developed cyclonic system with pronounced warm sector of maritime tropical air wedged between the fronts.
3. Occlusion or Occluded System. Cold front has overtaken the warm front and lifted it off the surface. System is also losing upper air support as it approaches the crest of the next ridge.

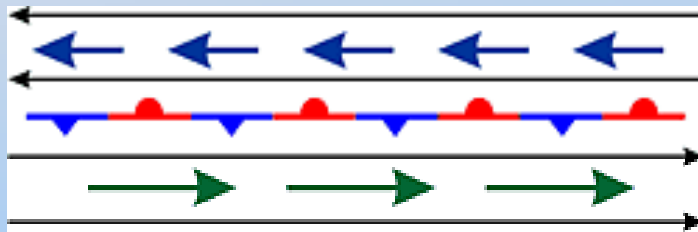
Stages in the Life Cycle of a Cyclonic Storm System

The cold front moves faster than the warm front eventually overtaking it and lifting it off the ground forming an occluded front.

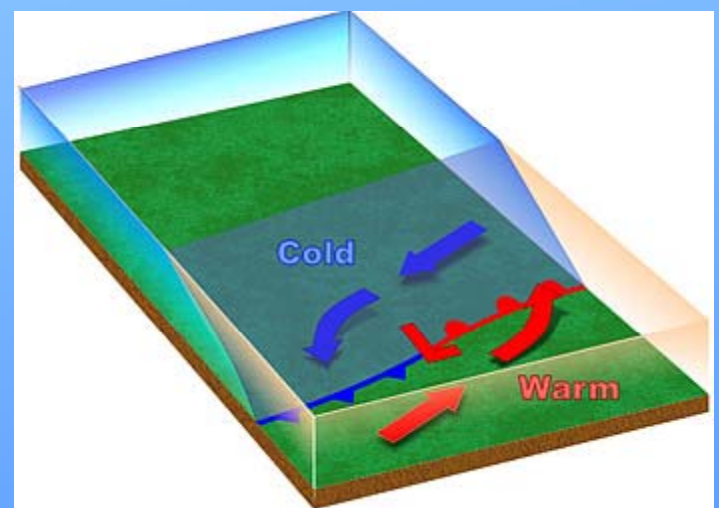
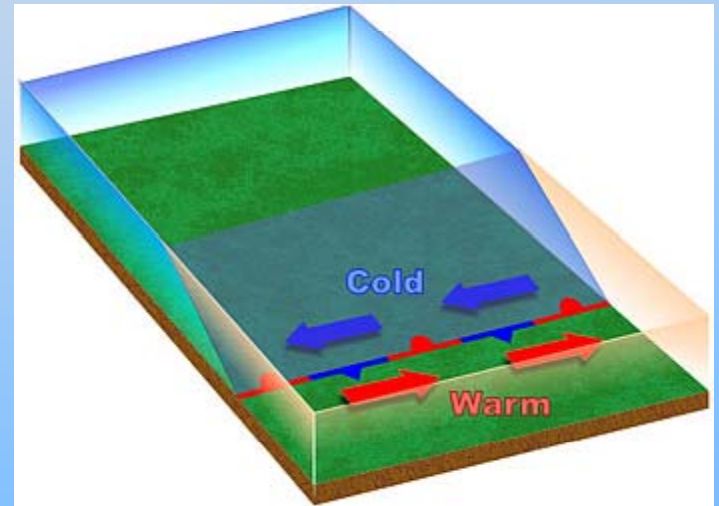
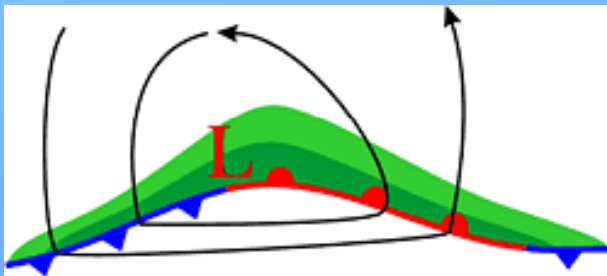


Norwegian Cyclone Model

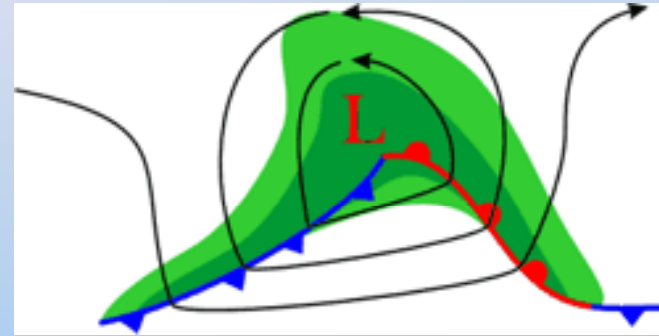
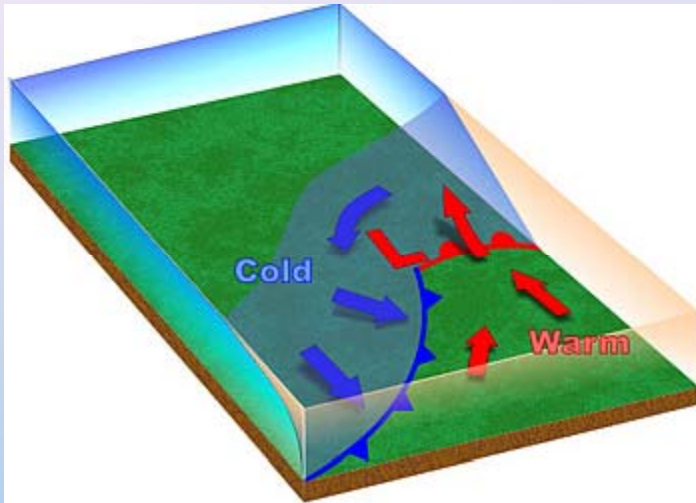
The Norwegian cyclone model, so named to honor the Norwegian meteorologists who first conceptualized the typical life cycle of cyclones in the 1910s and 1920s, presents the evolution of a cyclone. In this model, there will initially be a boundary, or front, separating warm air to the south from cold air to the north. The front is often stationary.



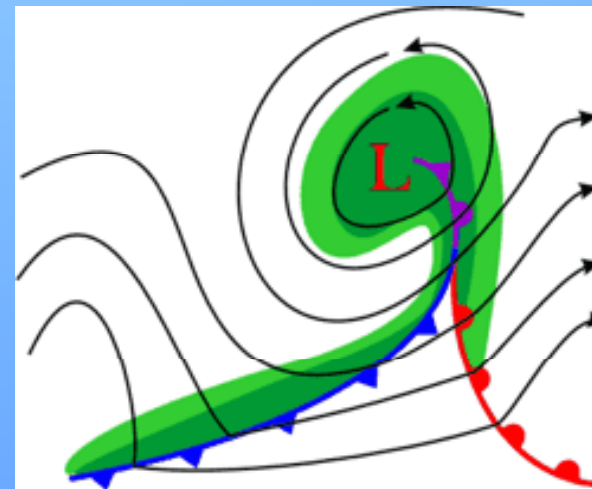
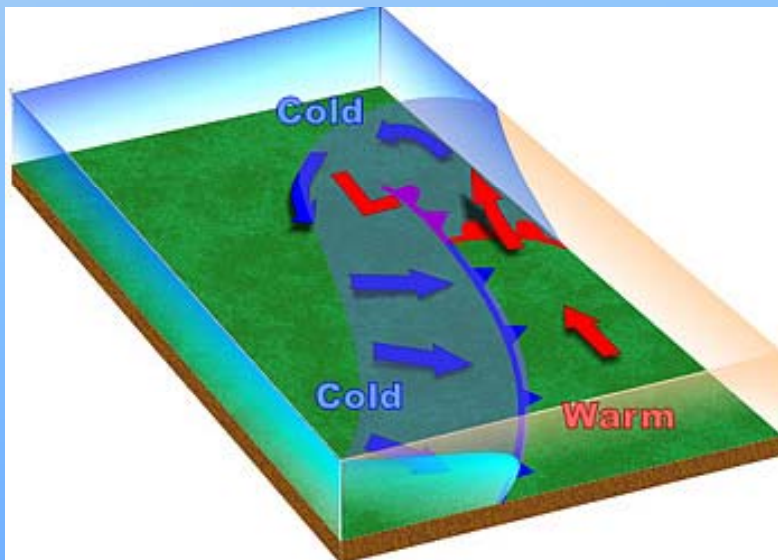
A wave on the front will form as an upper level disturbance embedded in the jet stream moves over the front. The front develops a "kink" where the wave is developing. This process is called cyclogenesis. Precipitation will begin to develop with the heaviest occurrence along the front (dark green).



As the wave intensifies, both cold and warm fronts become better organized.

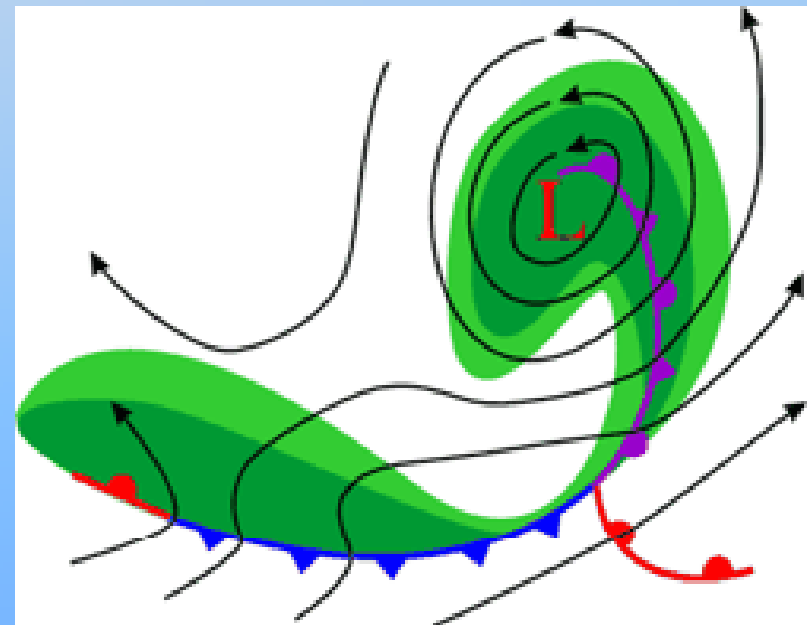
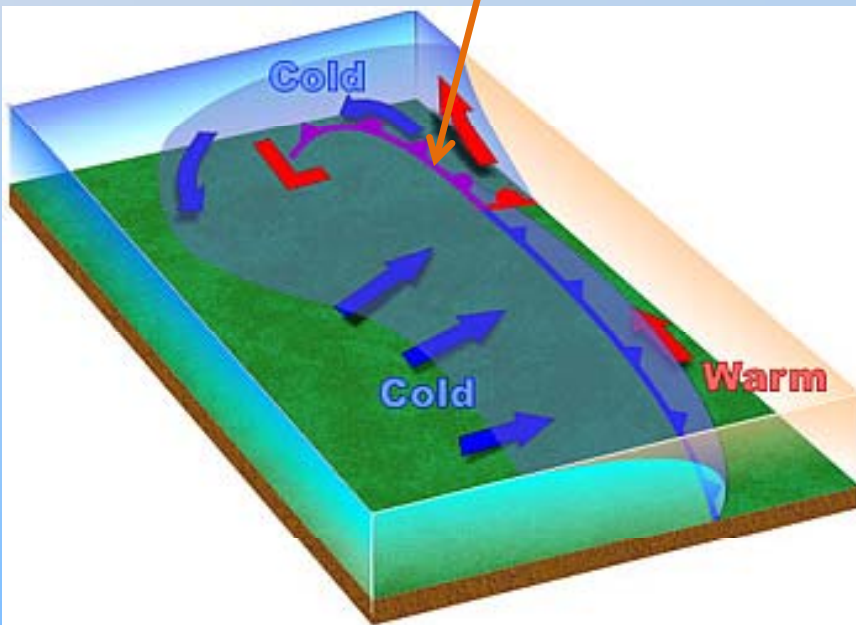


The wave becomes a mature low pressure system, while the cold front, moving faster than the warm front, "catches up" with the warm front. As the cold front overtakes the warm front, an occluded front forms.



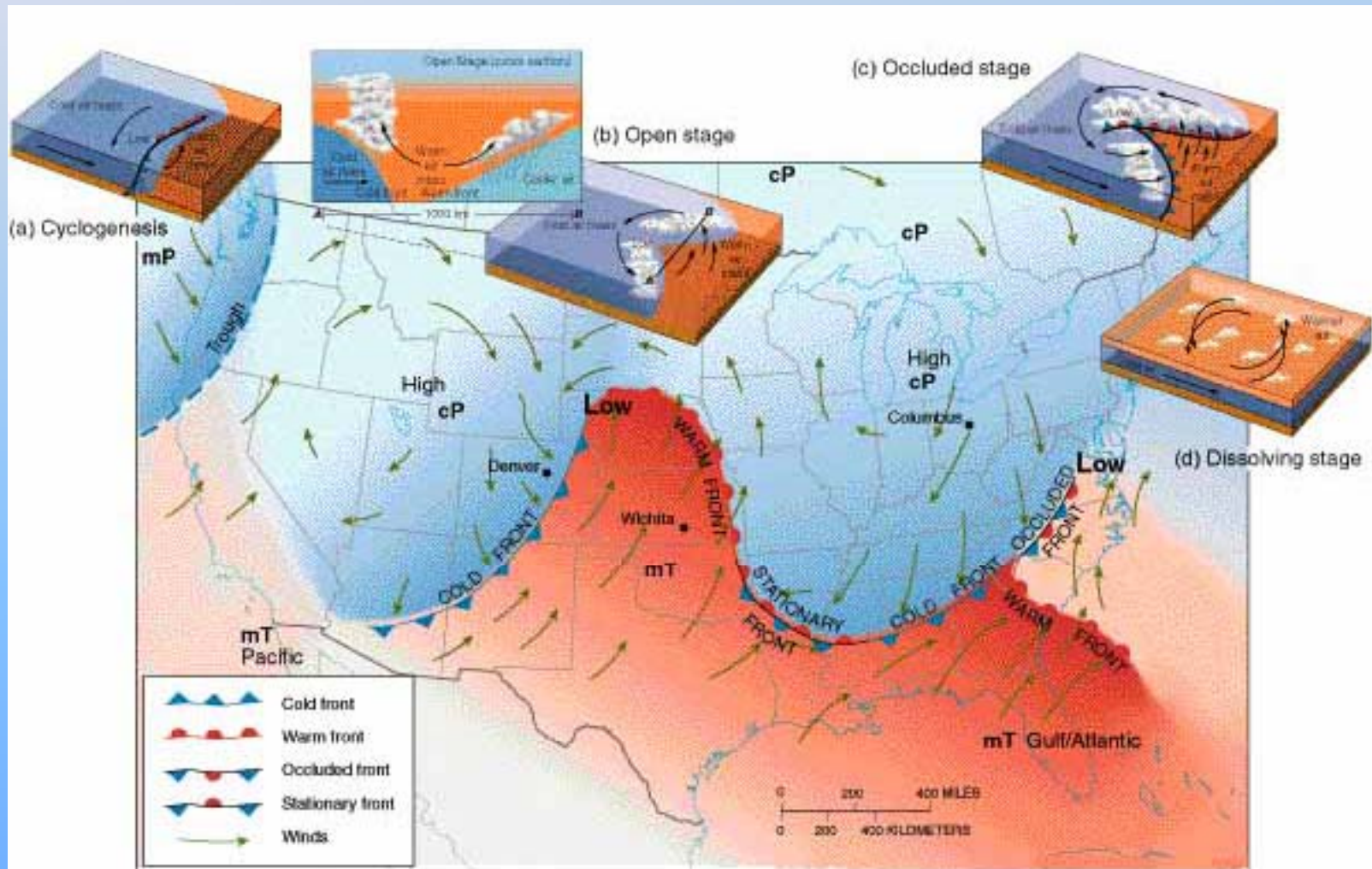
The cold front under runs the warm front and lifts it off the ground. The occluded front is actually a messy sandwich of frontal boundaries and air masses.

As the occlusion process continues, the system loses its upper level support from the jet stream and the core pressure begins to rise.



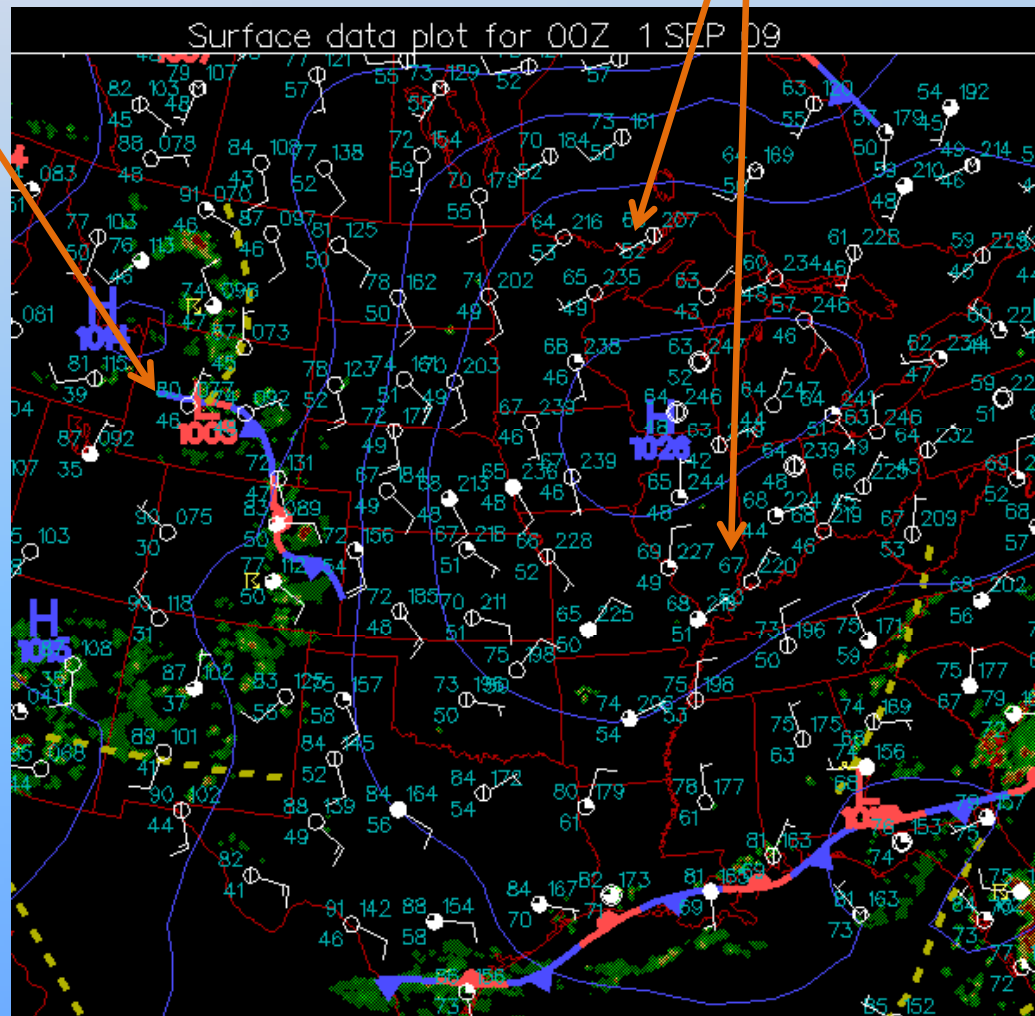
Stages in the Life Cycle of a Cyclonic Storm System

Since cyclonic systems move from west to east, the cyclogenetic systems form farther west and the occluded systems farther east. Note the block diagrams. The lifting along the cold front is under-running while along the warm front it is over-running.



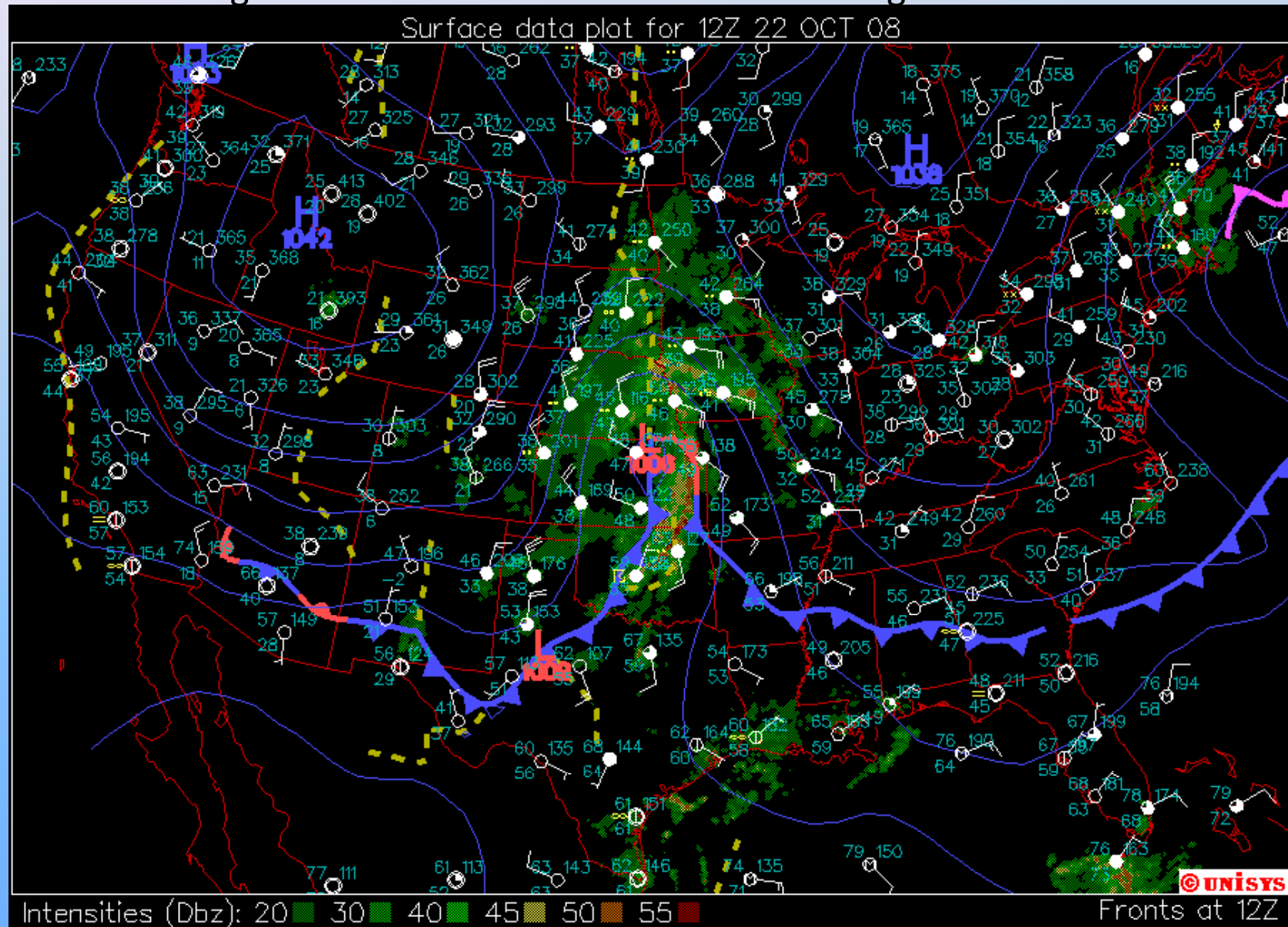
Cyclogenic System Forming in Wyoming. This is Cyclogenesis.

Note incipient counter clockwise pattern of rotation around this low and also the fairly well defined clockwise pattern around the High over Wisconsin.



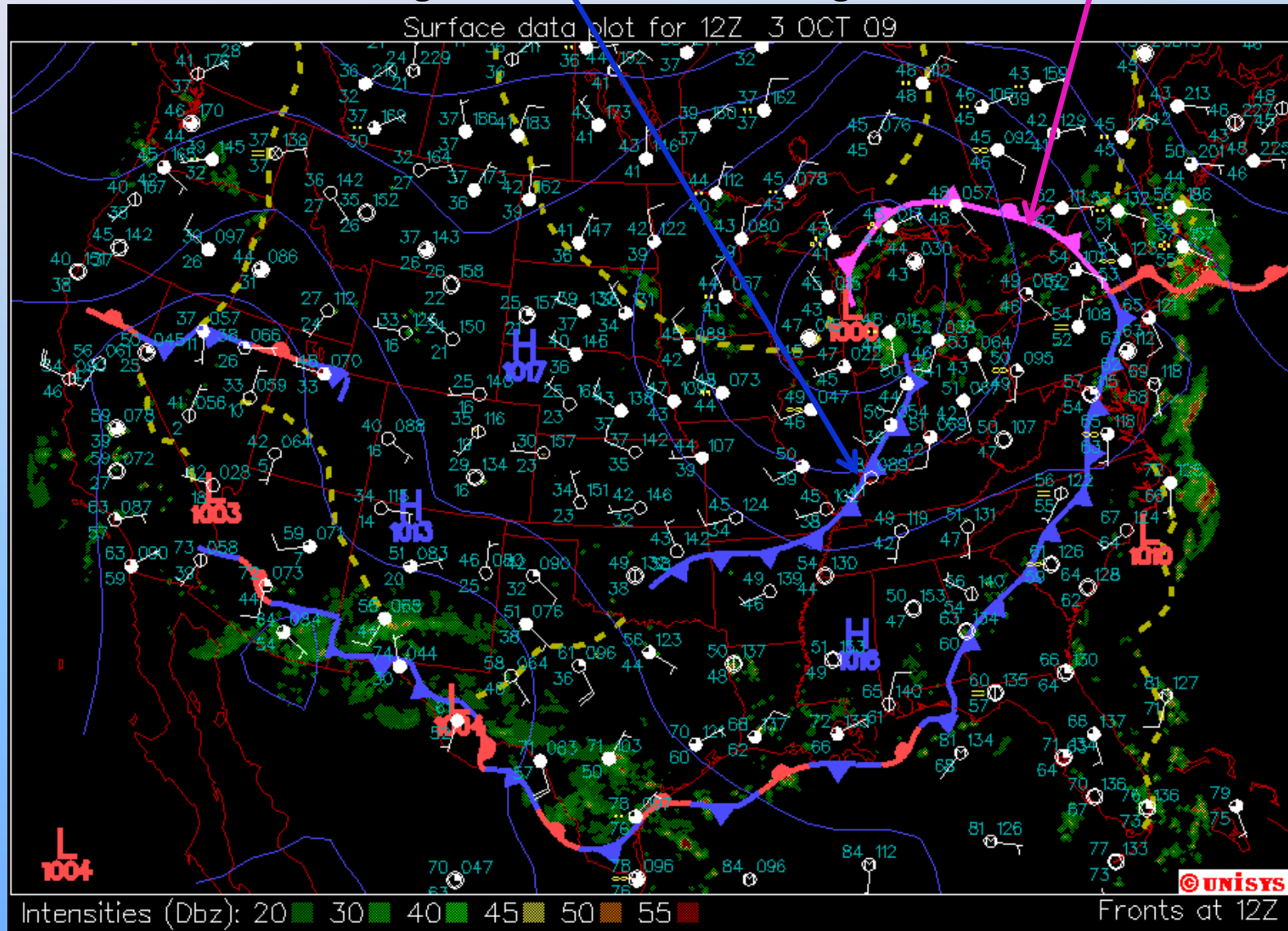
Classic Open Stage of Cyclonic System.

Cold Front is About Ready to Pinch Off the Warm Front in Kansas. There is a strong line of thunderstorms in the narrowing warm sector.

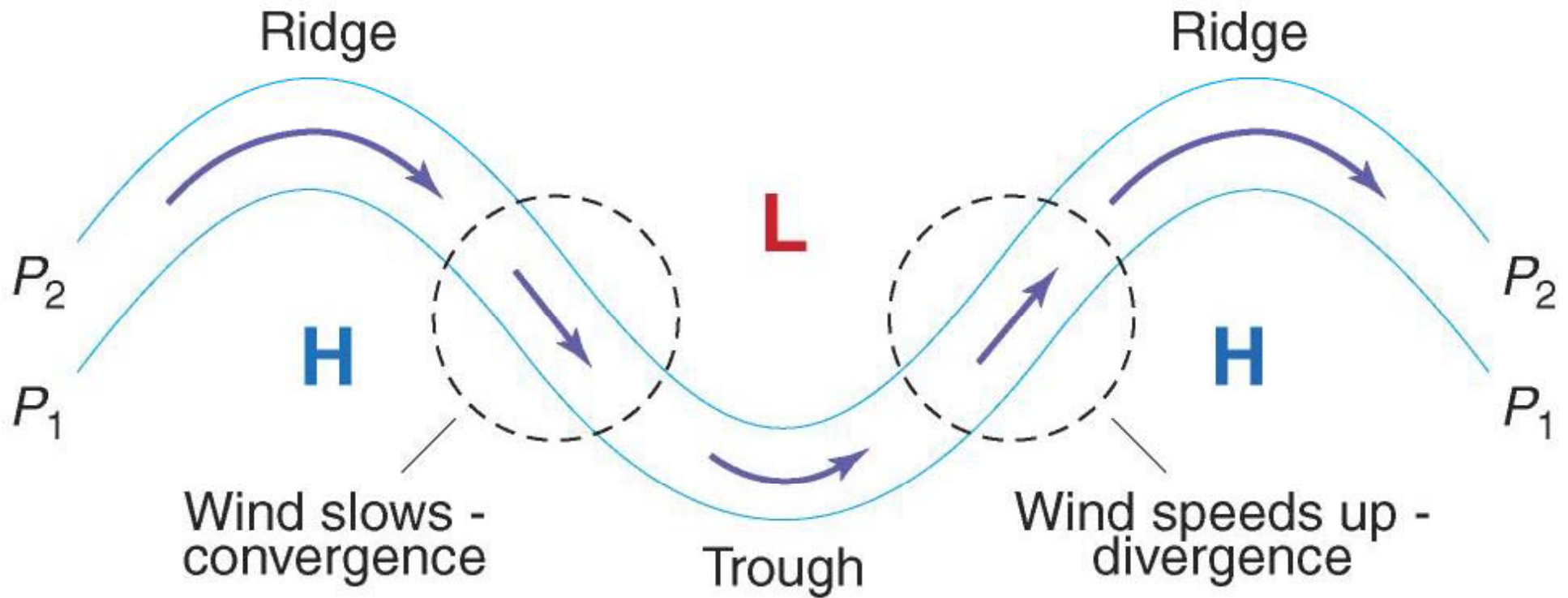


Occluded Cyclonic System with Occluded Front Arcing from Low in Wisconsin to New York.

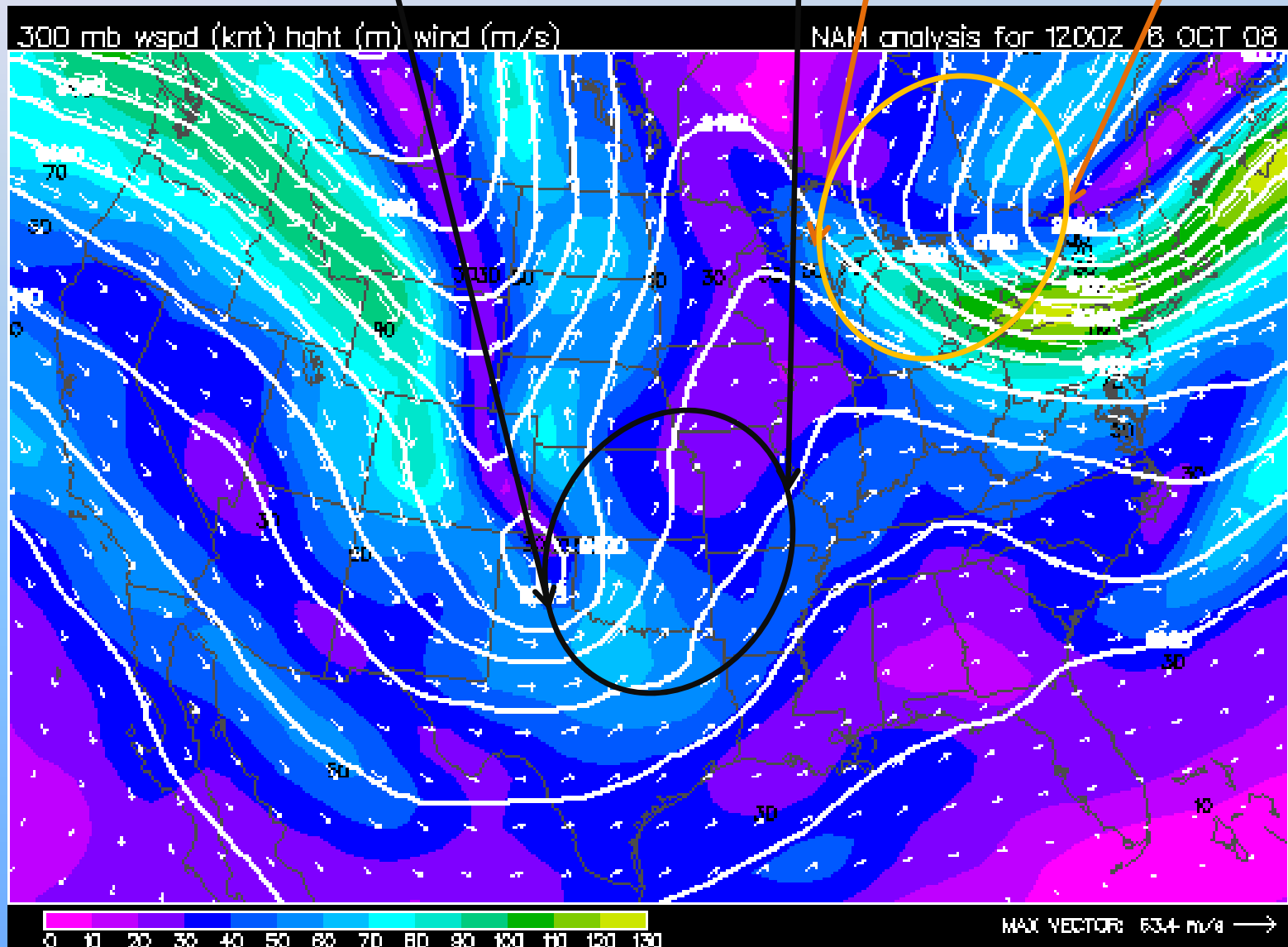
Note Reinforcing Cold Front from Michigan to Oklahoma



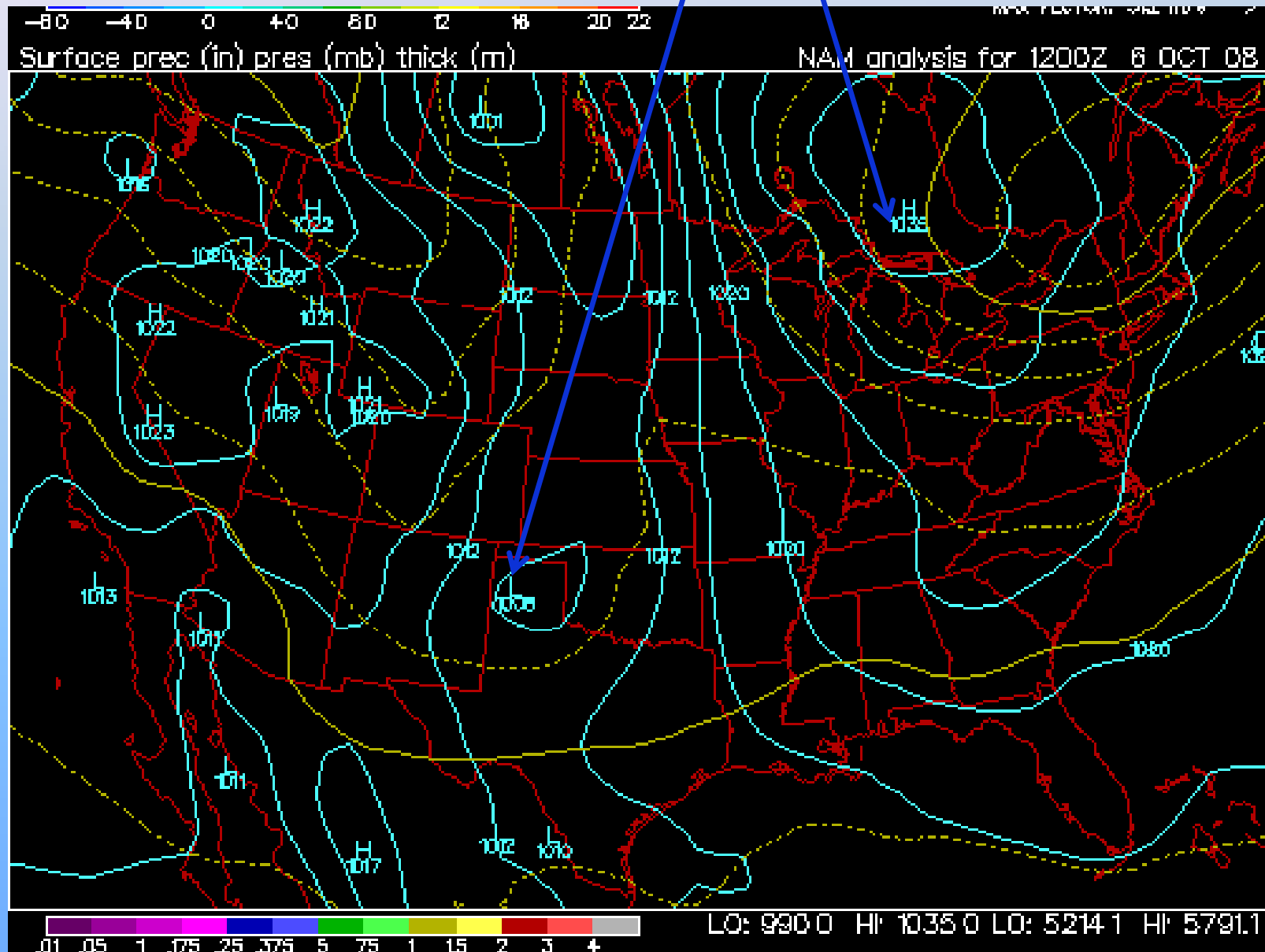
Meandering of the Westerlies Creates Areas of Convergence and Divergence Displaced to the East of Corresponding Upper-Level Feature



Strong Divergence Field from N. Texas to Missouri Strong Convergence Field across Great Lakes



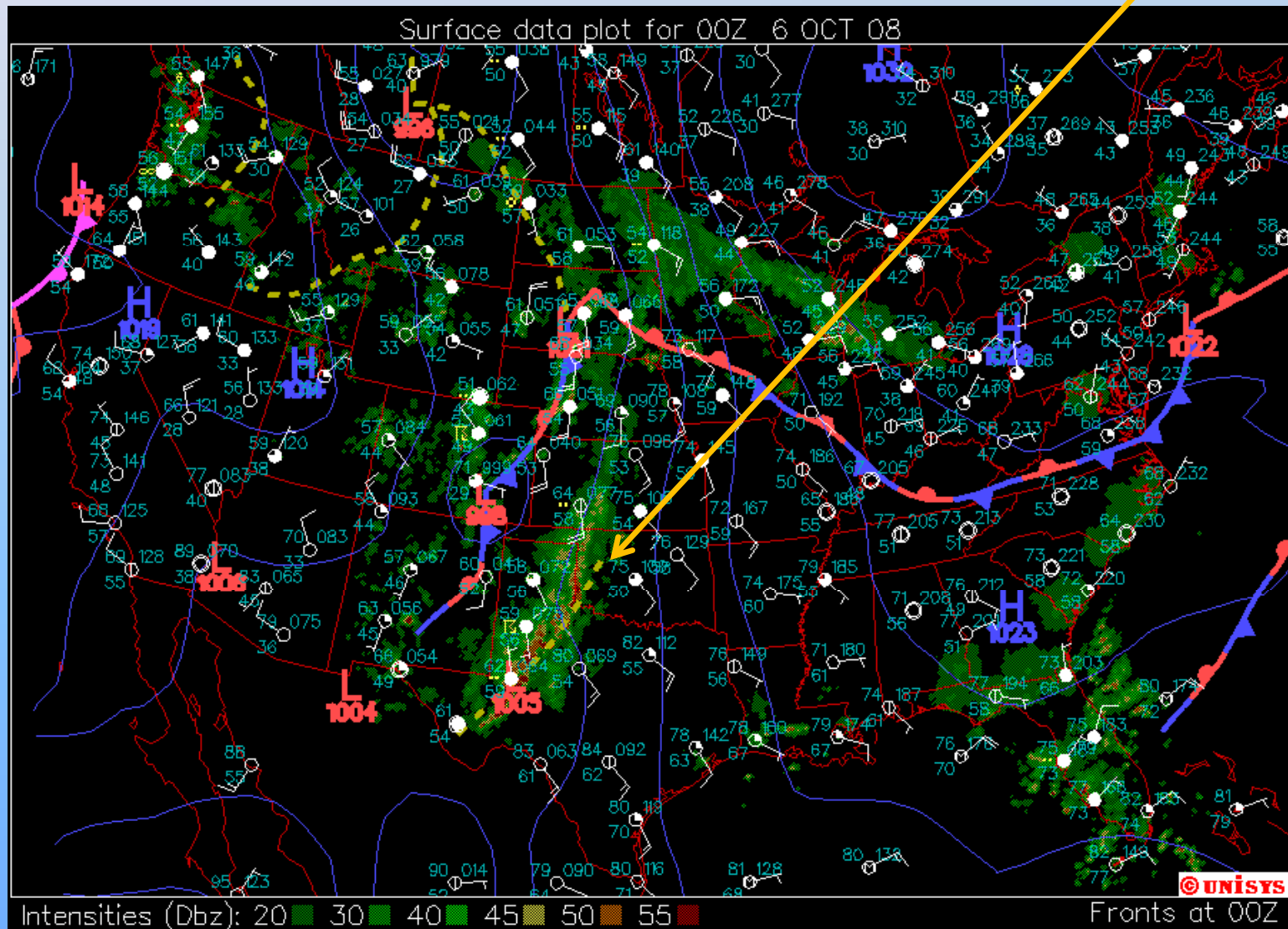
Divergence Aloft Causes Low in TX Panhandle Convergence Aloft Causes High Over Gt. Lakes



Surface Map for Same Day Shows Family of Cyclones Associated with a Trof Aloft.

Overrunning Causes Band of Showers in MN & WI.

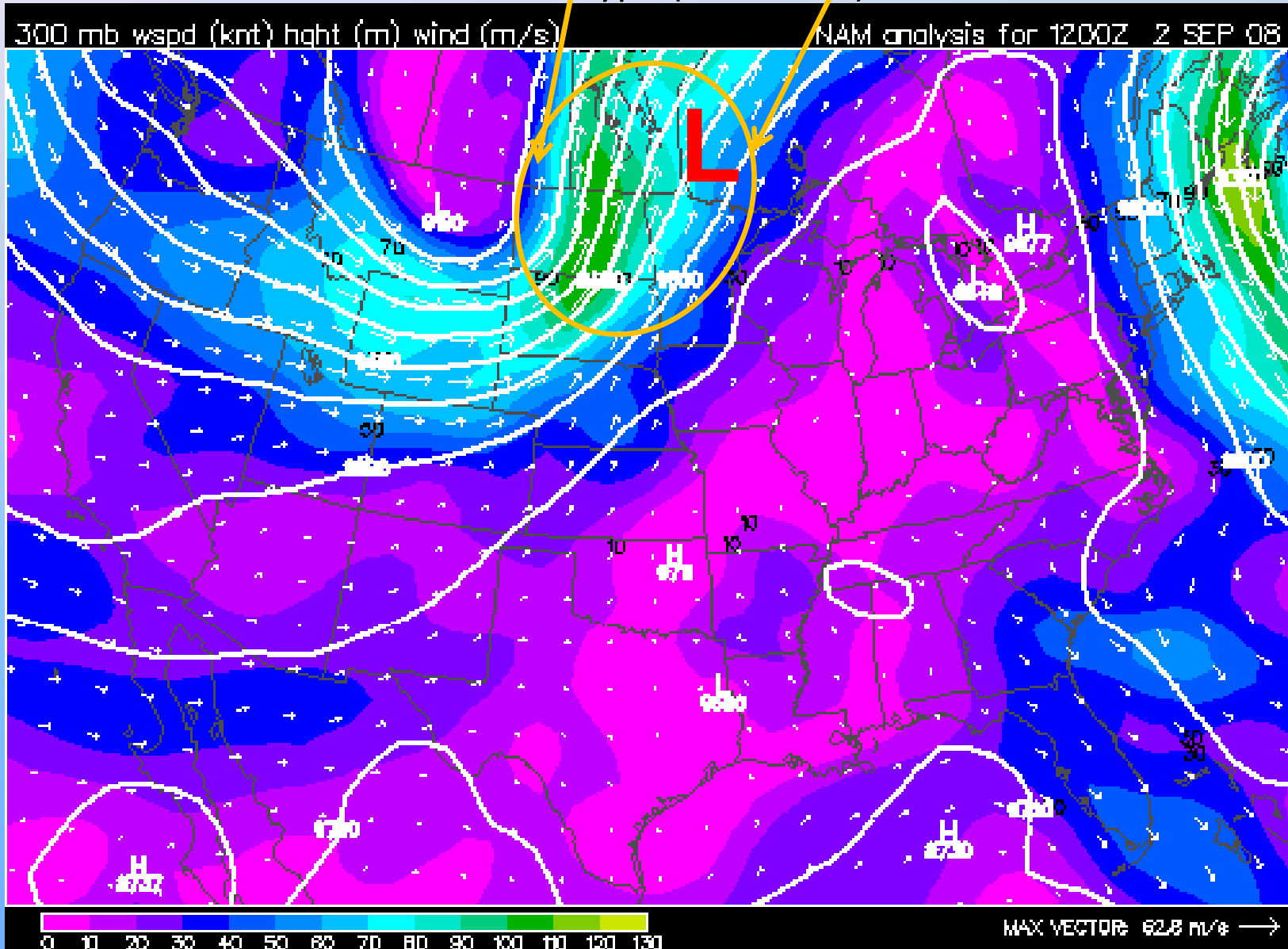
The severe storms in the warm sector are related to the trof aloft (dashed yellow line).



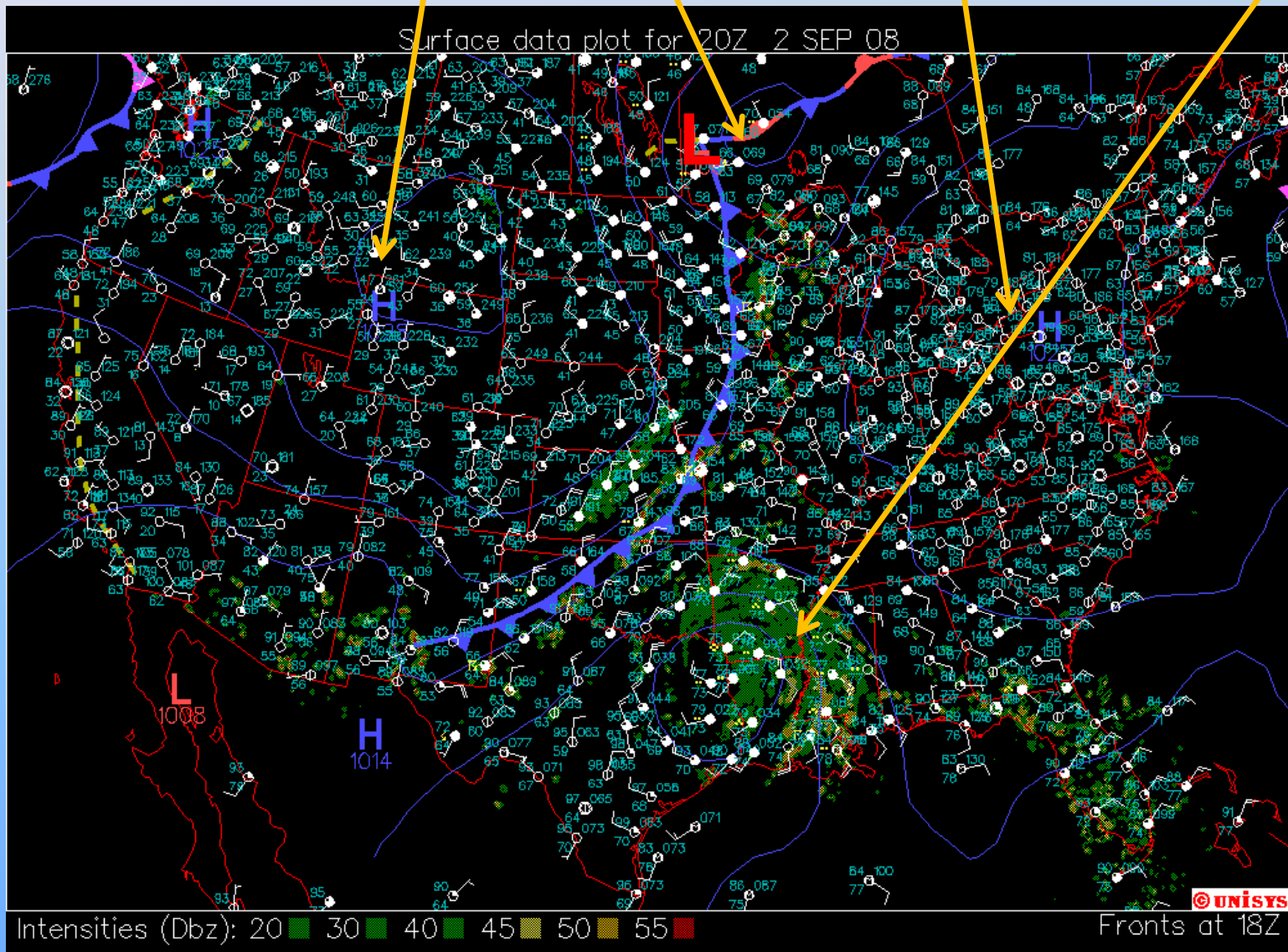
Types of Cyclonic Systems

1. Trof Type is the most common. Cyclonic system develops near the base of the trof and moves up the east side. No closed isobars aloft. These often exist as families. (6 Oct. Maps)
2. Long Wave Type is big and tends to occur during cooler half of year. Key is upper level support showing at least one closed isobar aloft. Often have more than two closed isobars.
3. Short Wave Type is smaller, form rapidly, and move quickly. It is connected to short wave aloft. Since these often form quickly, they are called the forecaster's nightmare.

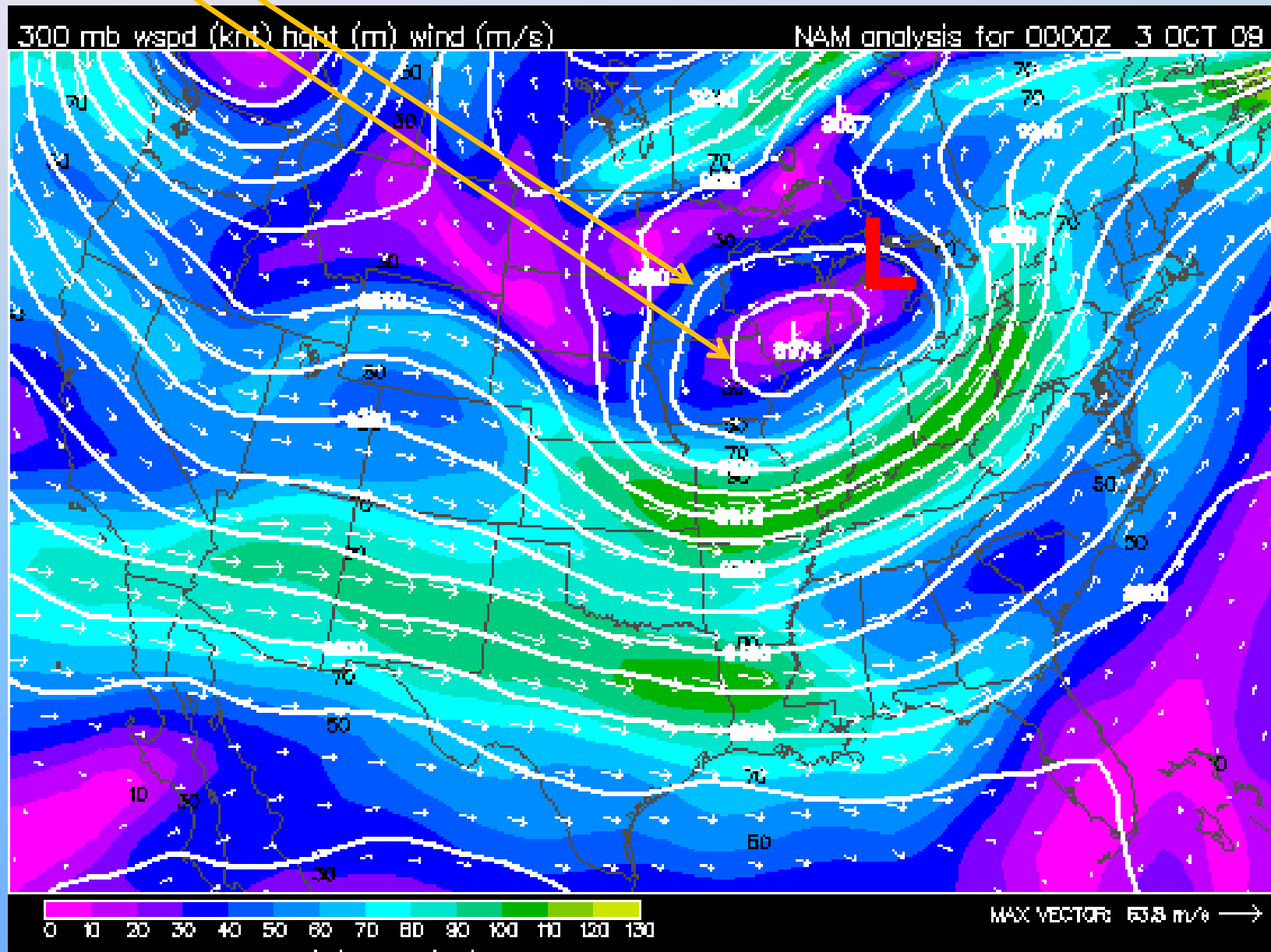
300 mb Chart for 2 Sept, '08. Showing Trof across Northern Great Plains Advancing towards Midwest. It Has a Divergence Field Across Southern Manitoba and Ontario. "L" Indicates Position of Surface Low. Since the Trof Contains No Closed Isobars, the Cyclone at the Surface Would be a Trof Type (Next Slide).



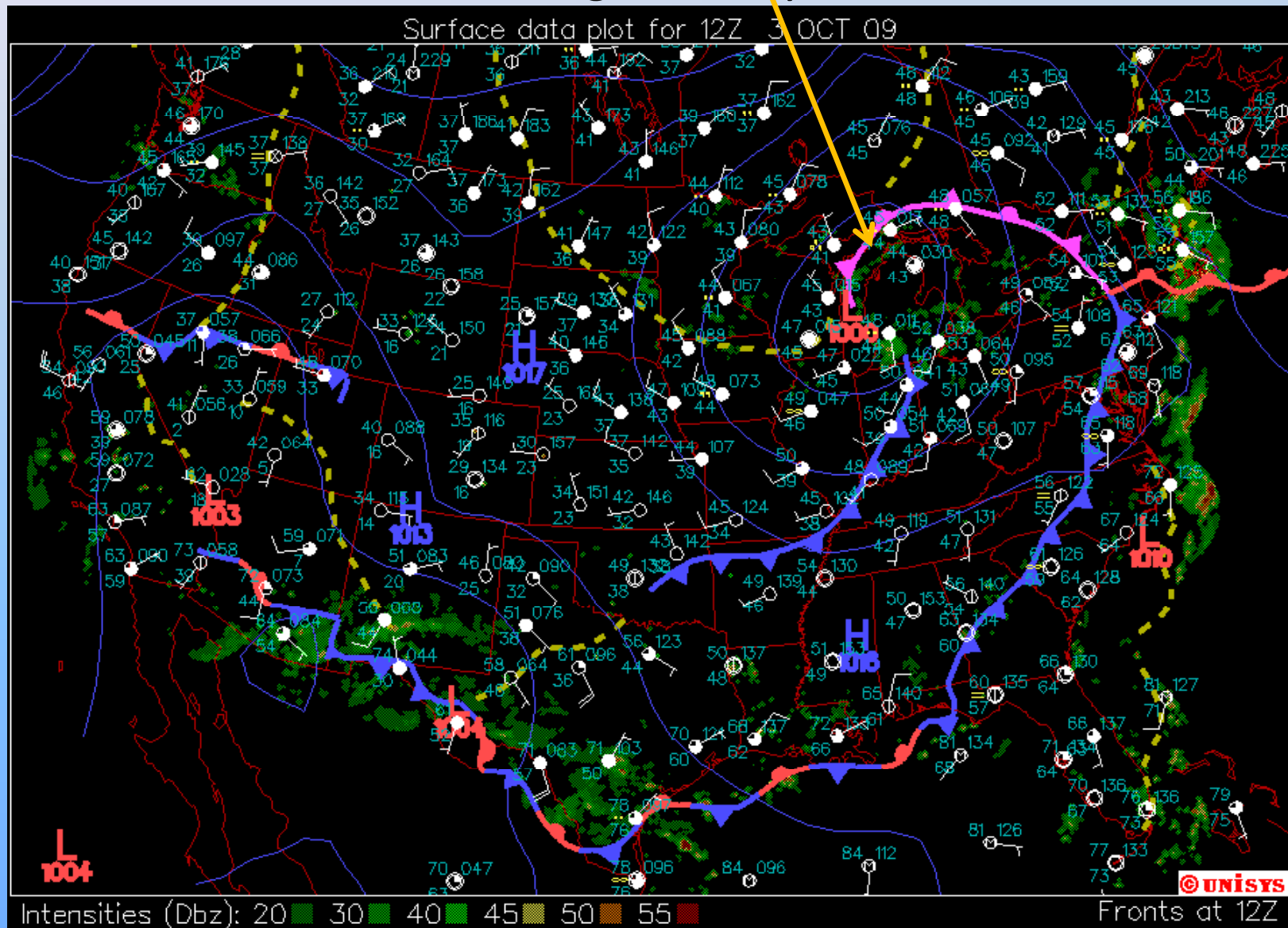
Surface Map for 2 Sep, '08. Strong Cyclonic System in Southern Canada Wedged between Two Strong Anticyclones. Hurricane Gustav is over Louisiana and Arkansas. Cyclone is a Trof Type Indicated in Previous Slide.



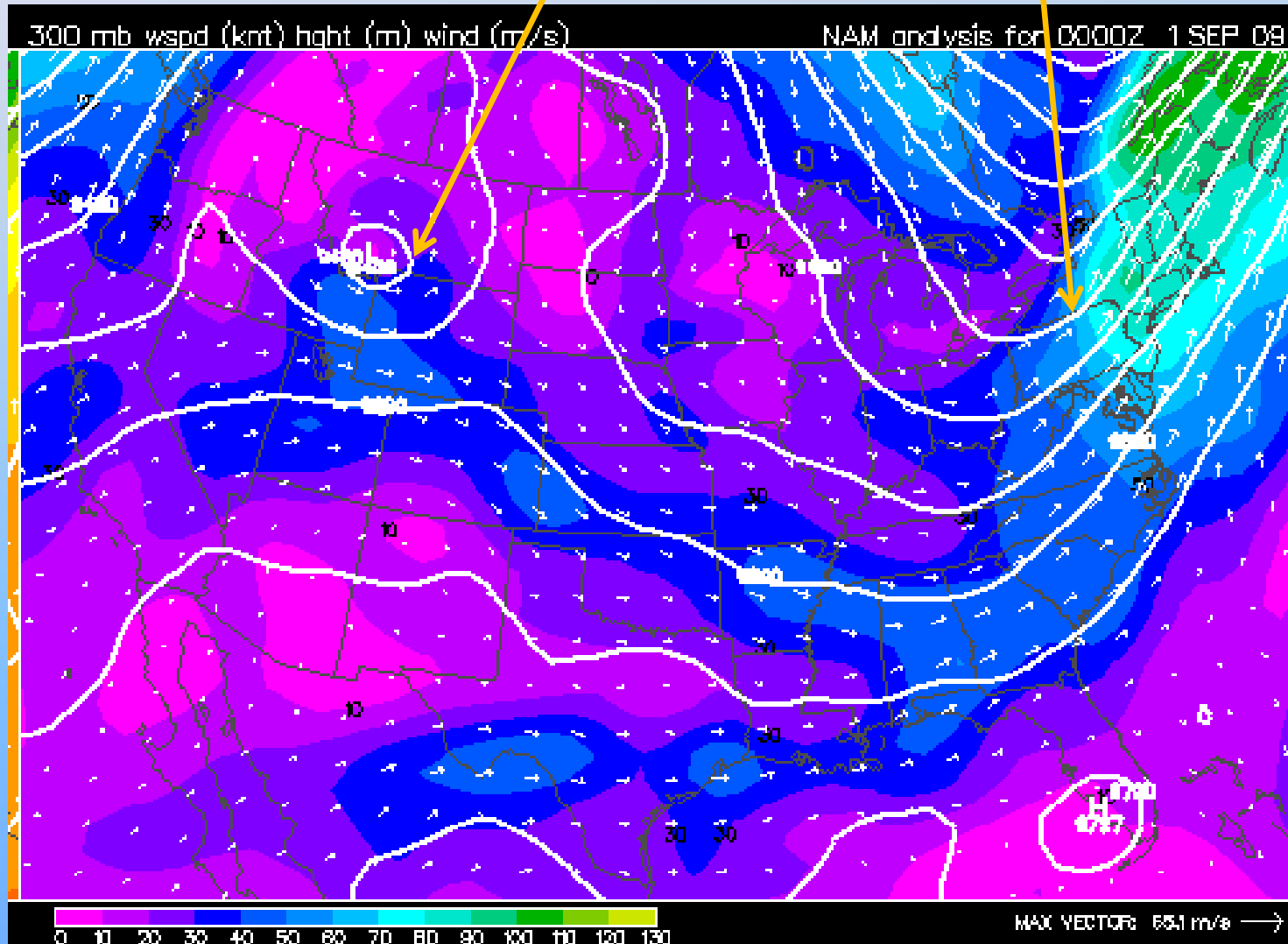
300 mb Chart for 3 Oct, '09. Shows Cutoff Low Imbedded in Trof over Great Lakes.
2 Closed Isobars Indicate a Long Wave Cyclone at Surface in Midwest (next Slide).
“L” Indicates Position of Surface Low



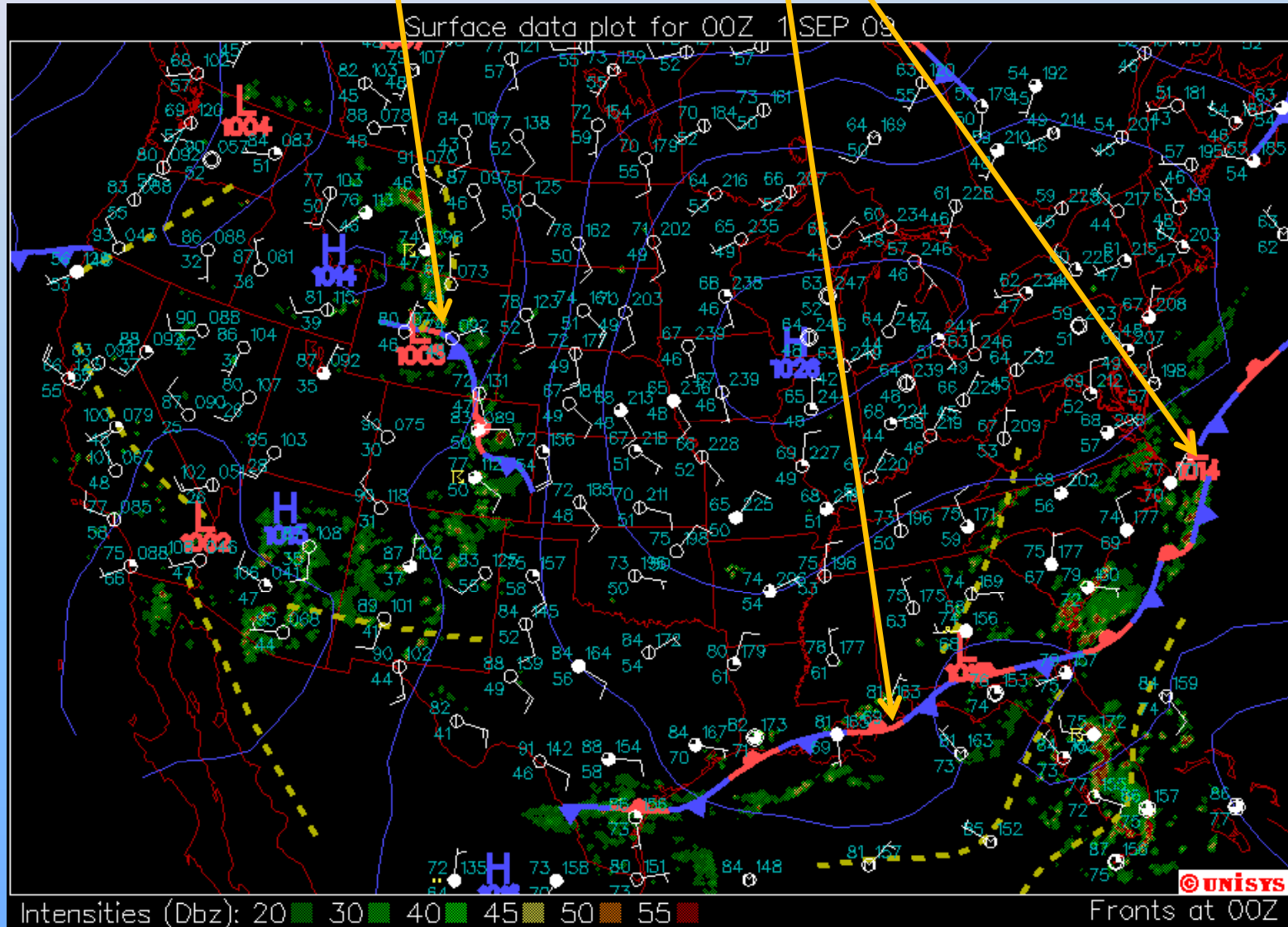
Surface Map of 3 Oct, '09 Shows Complicated Cyclone Dominated by One, Big Occluded System over Great Lakes. This is a Long Wave Cyclone.



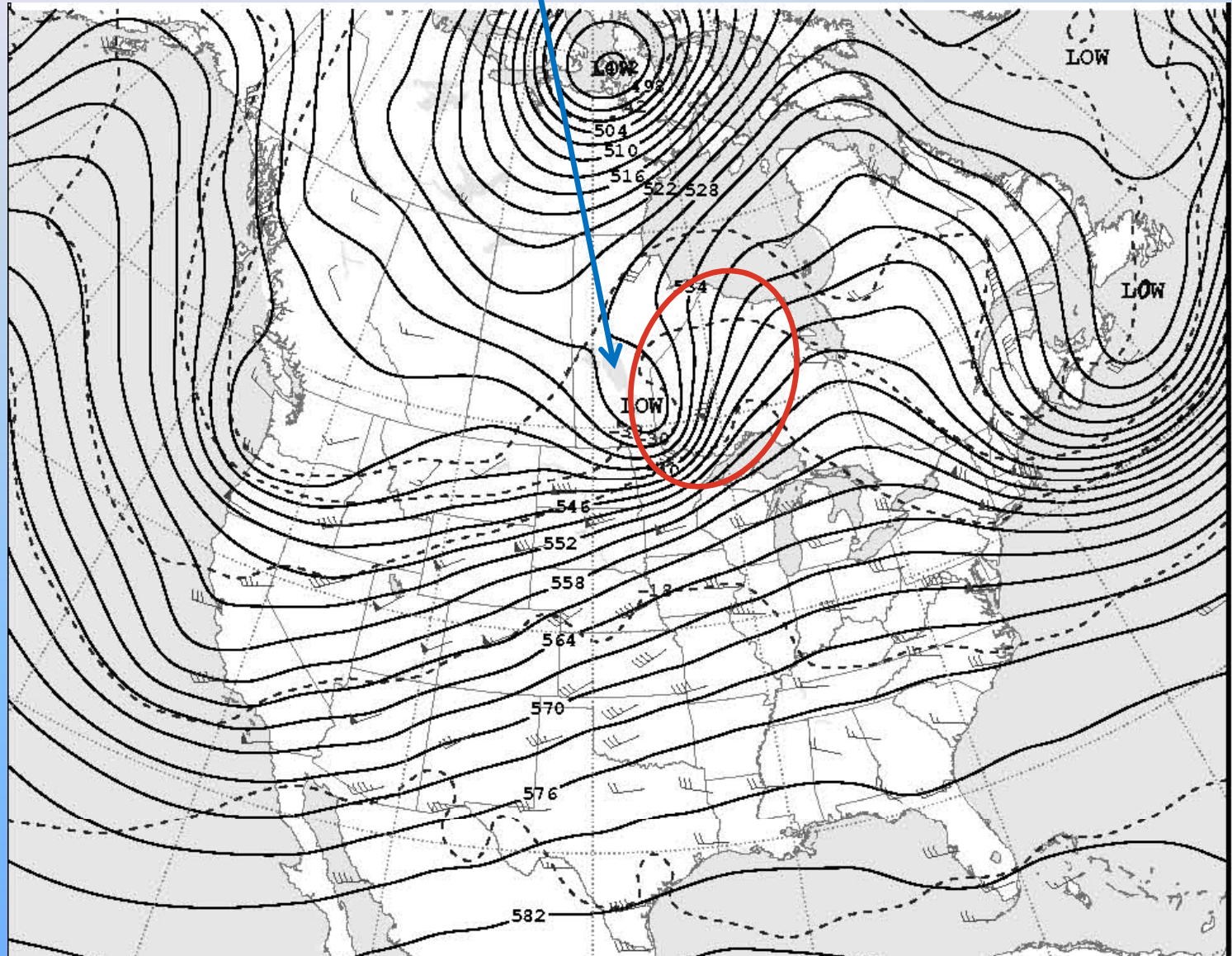
Upper Air Chart for 1 Sep, '09 Shows Short Wave Trof over Wyoming. Even Though there Is One Closed Isoobar, the Trof is Too Small to Be a Long Wave. There Is a Long Wave over Eastern Atlantic Coast.



Small Size of Cyclone Centered over Wyoming Indicates a Short Wave Type. Long Stationary Front Along Atlantic and Gulf Coasts.

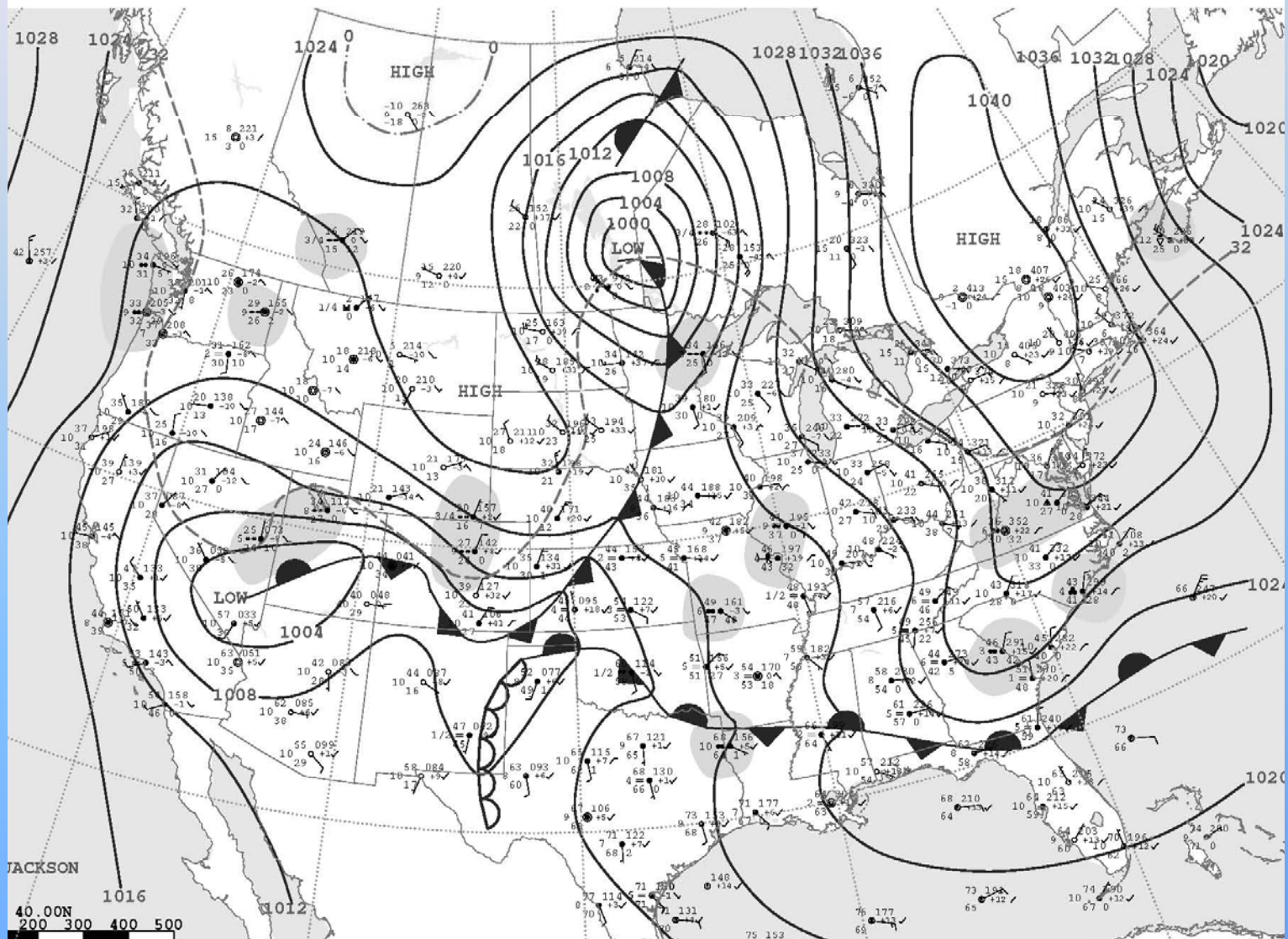


Upper Air Chart for March 30, 2008.
The Little Trof in Saskatchewan Is a Short Wave with a Very Strong Divergence Field to the East.

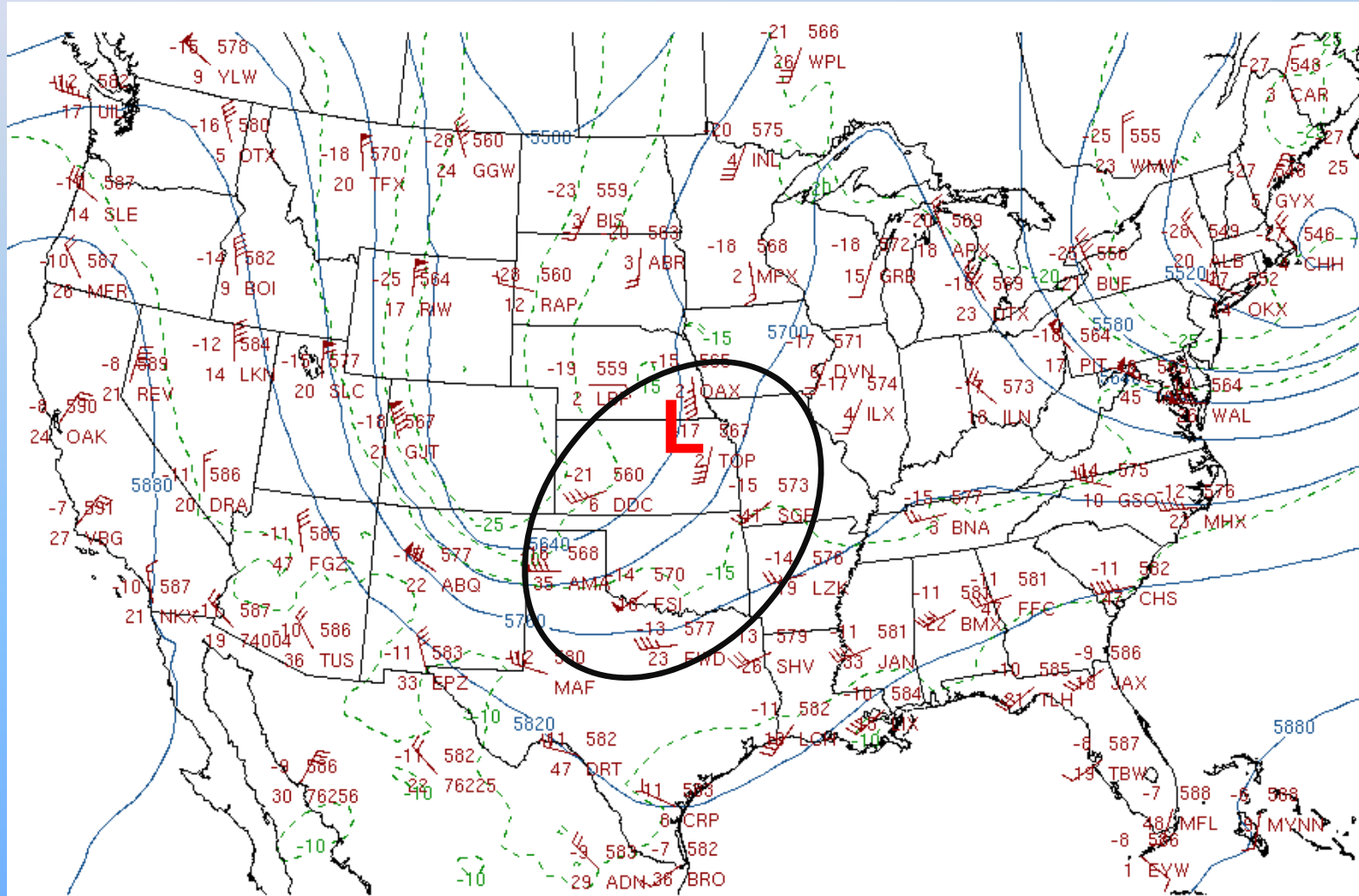


Daily Weather Map for March 30, 2008.

Surface Pressure Cells Correspond Well to Upper Level Patterns (Previous Slide).



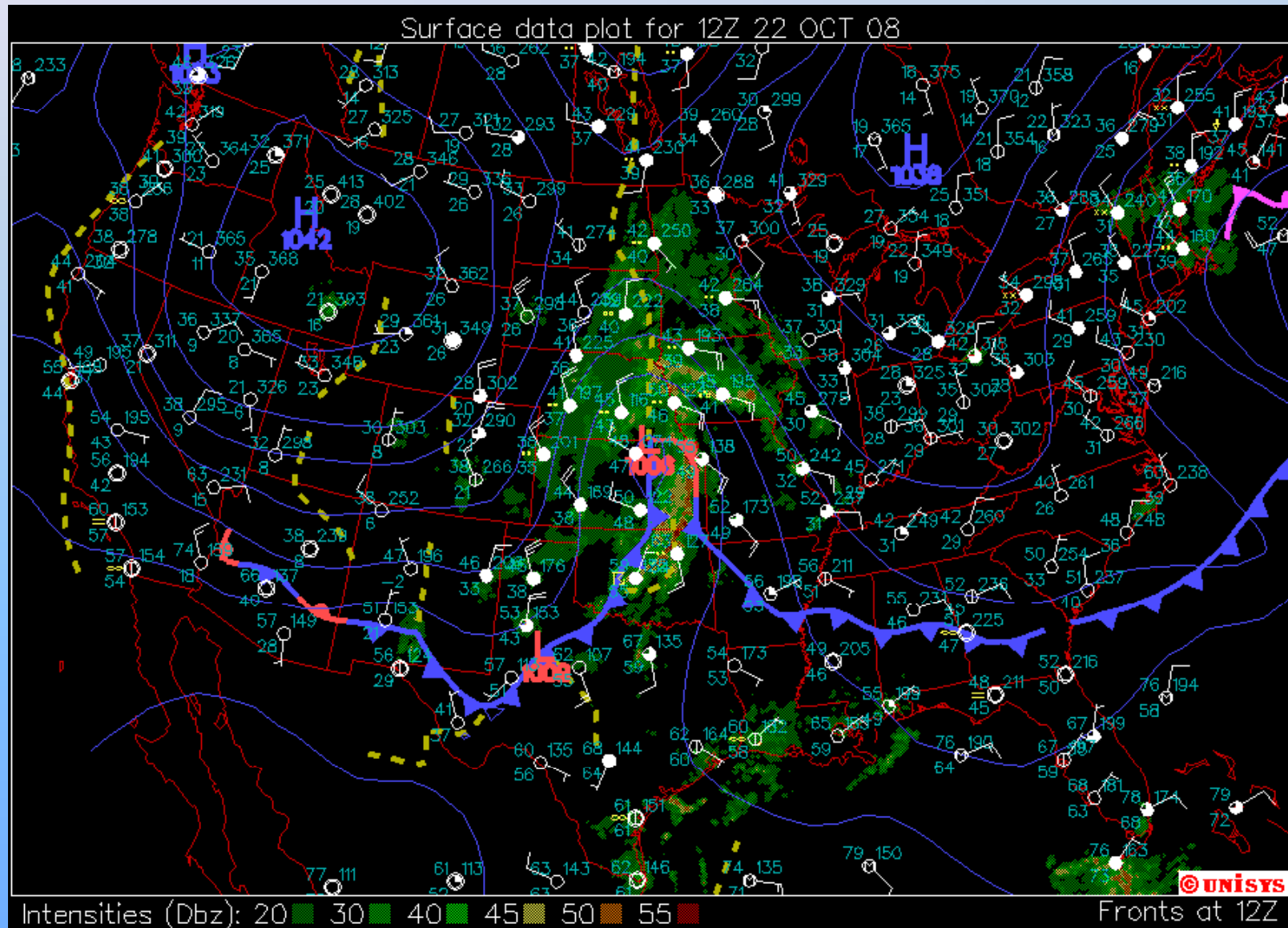
Upper Air Chart, 500 mb, for Oct 22. Showing Deep Trof over Great Plains and Strong Divergence Field from Nebraska to Texas. Surface Cyclone Is in Same Place (Next Slide).



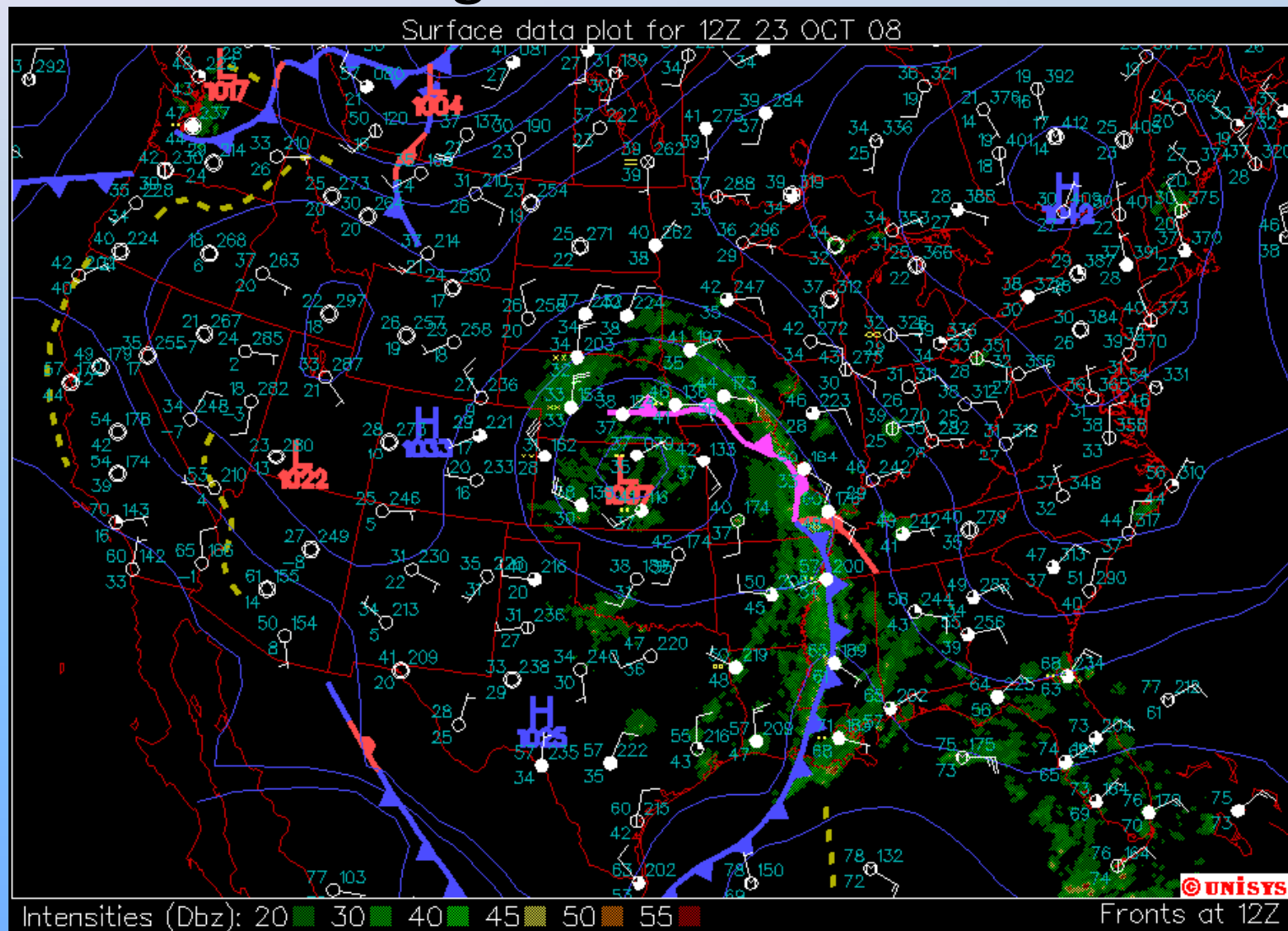
12Z 22 Oct 2008 500 mb

University of Wyoming

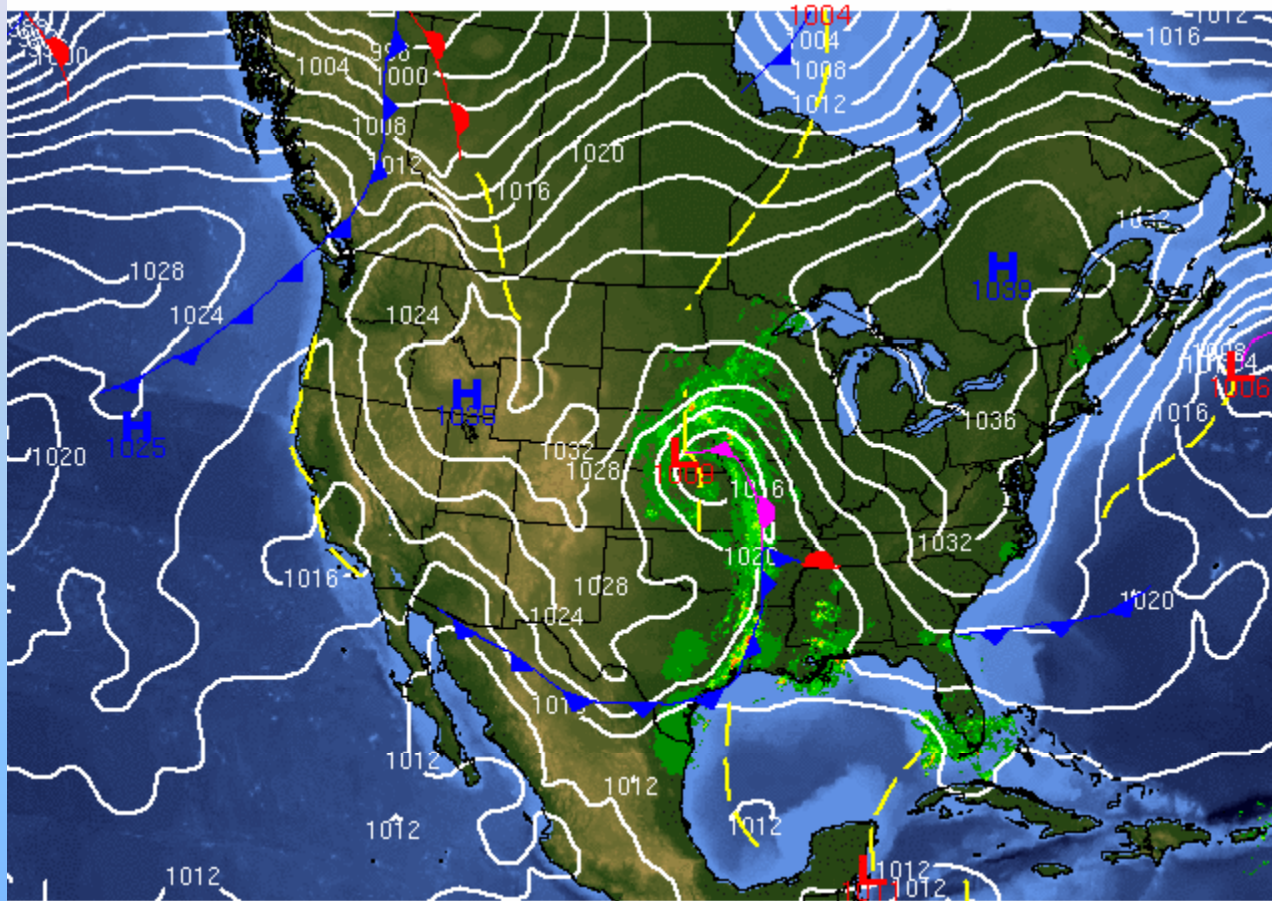
Looking at the 22 Oct. Map Again: It Is a Trof Type Cyclone Centered in Kansas Connected to Trof Aloft



On the Next Day the System Occludes Warm Front Merges with Cold Front East of Low.



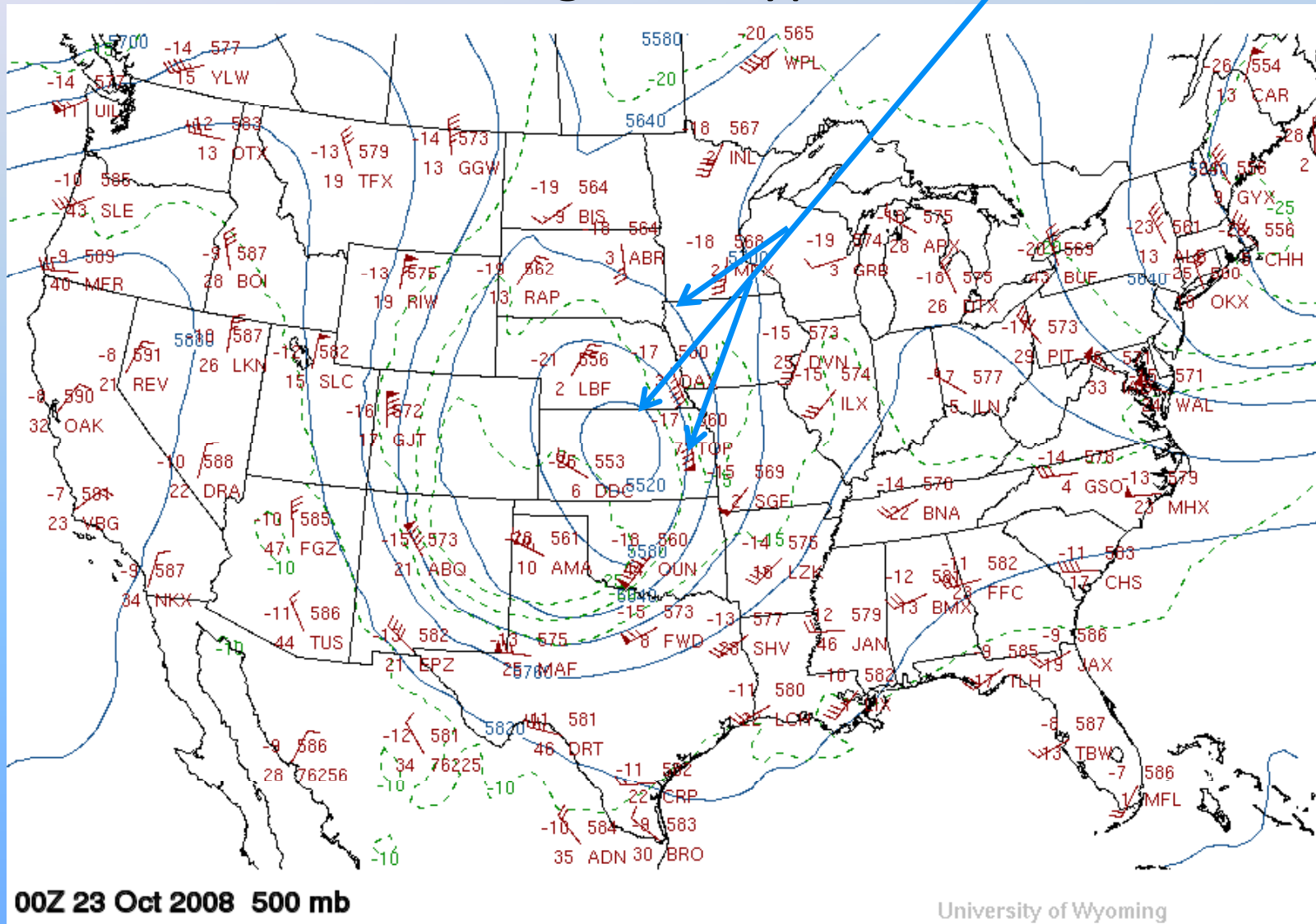
Same Occluded System Only Different Weather Map



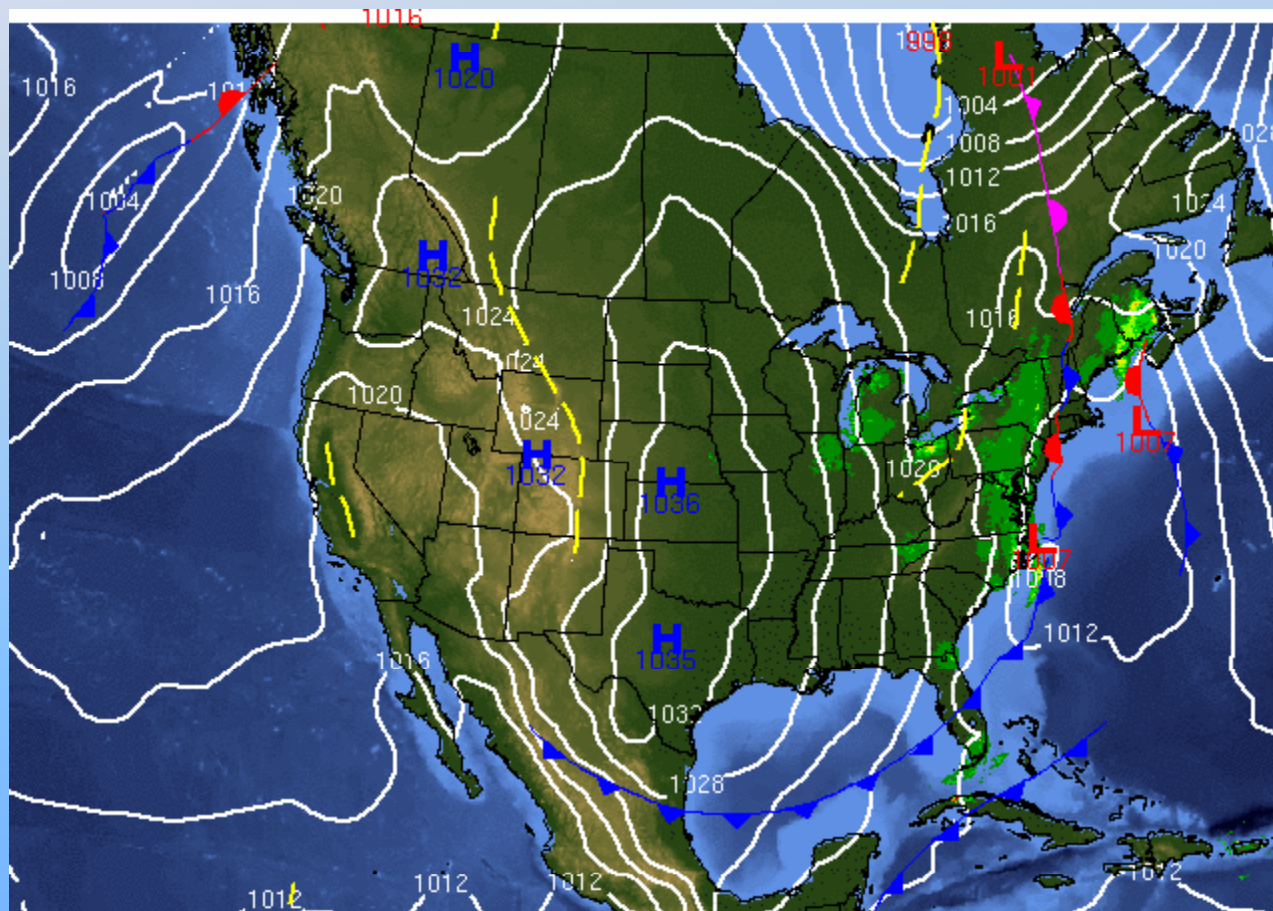
03Z 23 Oct 2008

University of Wyoming

Oct. 23 Upper Air Pattern, Showing 3 Closed Isobars; Therefore, Cyclone at Surface (Previous 2 Slides) is Longwave Type.



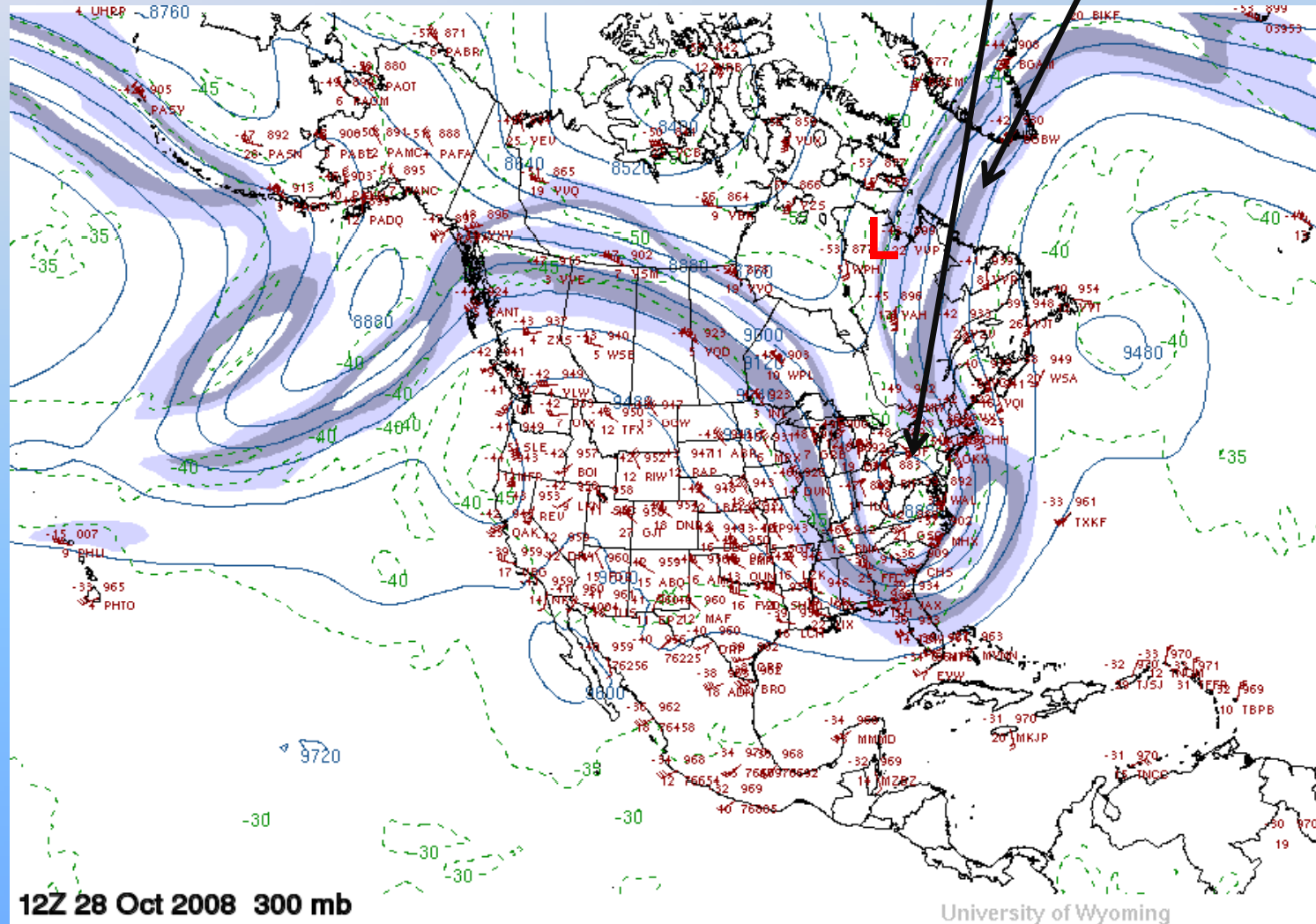
28 Oct,'08. Occluded System in Quebec. Very deep trof over eastern U.S. with Ridge in Atlantic (next slide). Low centered near Hudson Bay with occluded front extending southward to U.S. border. Long cold front arcing from Atlantic Coast to Mexico.



00Z 28 Oct 2008

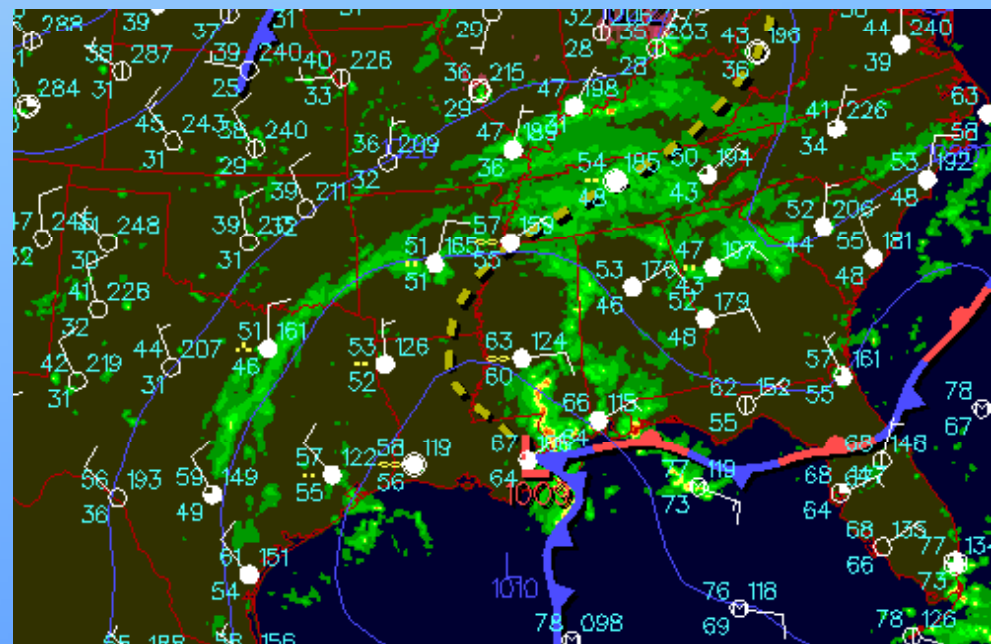
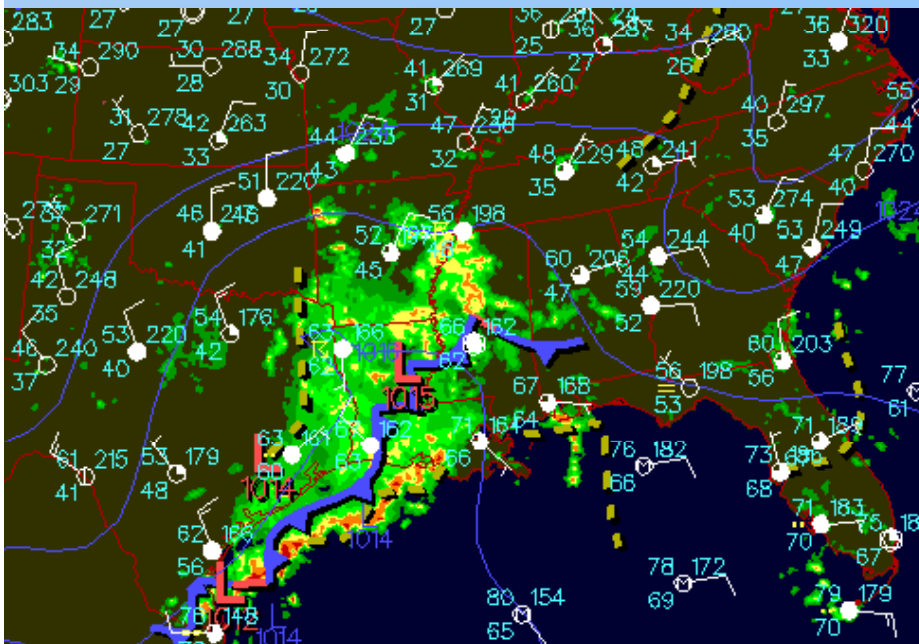
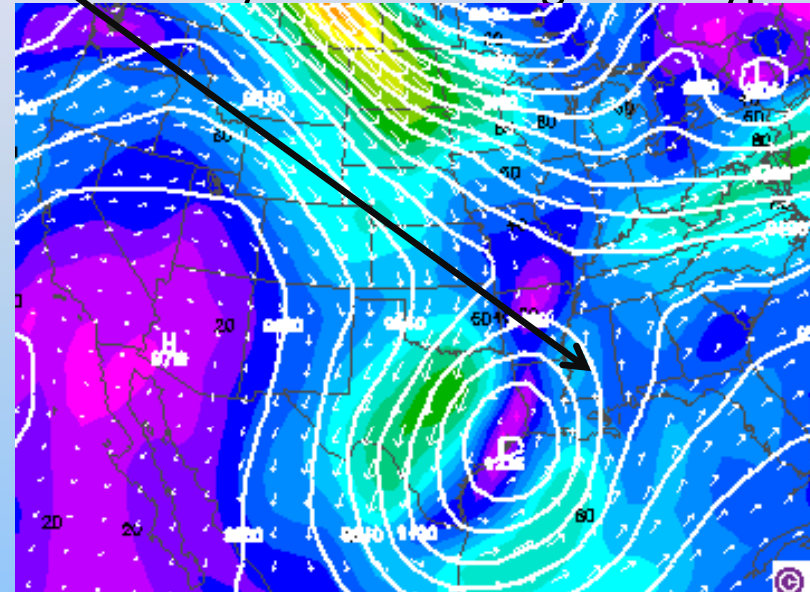
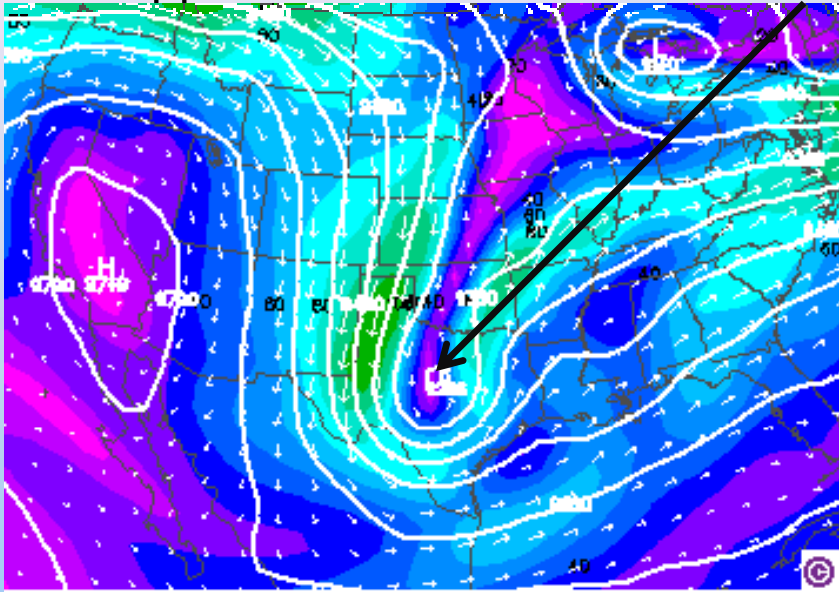
University of Wyoming

Oct 28. Upper Air Chart, 300 mb, Showing One Closed Isotherm, Therefore, Cyclone at Surface (Previous Slide) is a Long Wave Type. "L" indicates location of surface low. Since this low is approaching the crest of the ridge to the east, the low is losing its upper level support and it occludes and fills in.



12Z, 2 Nov, '10 and 12Z, 3 Nov, '10 maps show a cyclonic system in Louisiana unusually far south for early November.

Upper air charts show closed isobars so the cyclone is a long wave type



The Conveyor Belt Model of Cyclonic Storm Flows

The red arrow indicates the Maritime Tropical flow of air that provides the fuel to the system. The yellow “Dry Airstream” is air descending in the anticyclone behind the cold front. The pink “Cold Conveyor Belt” is the flow of Continental Polar air from the east or north east along the warm front.

