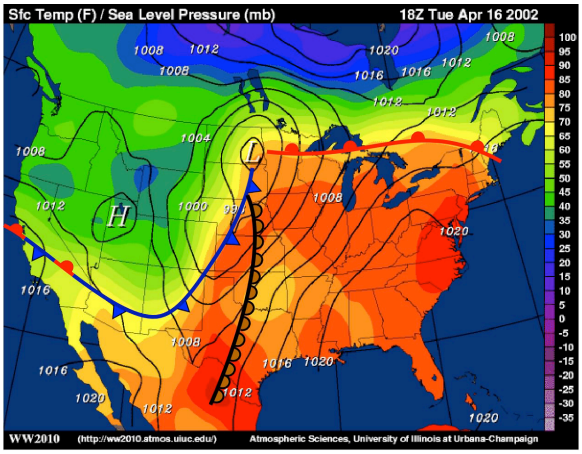
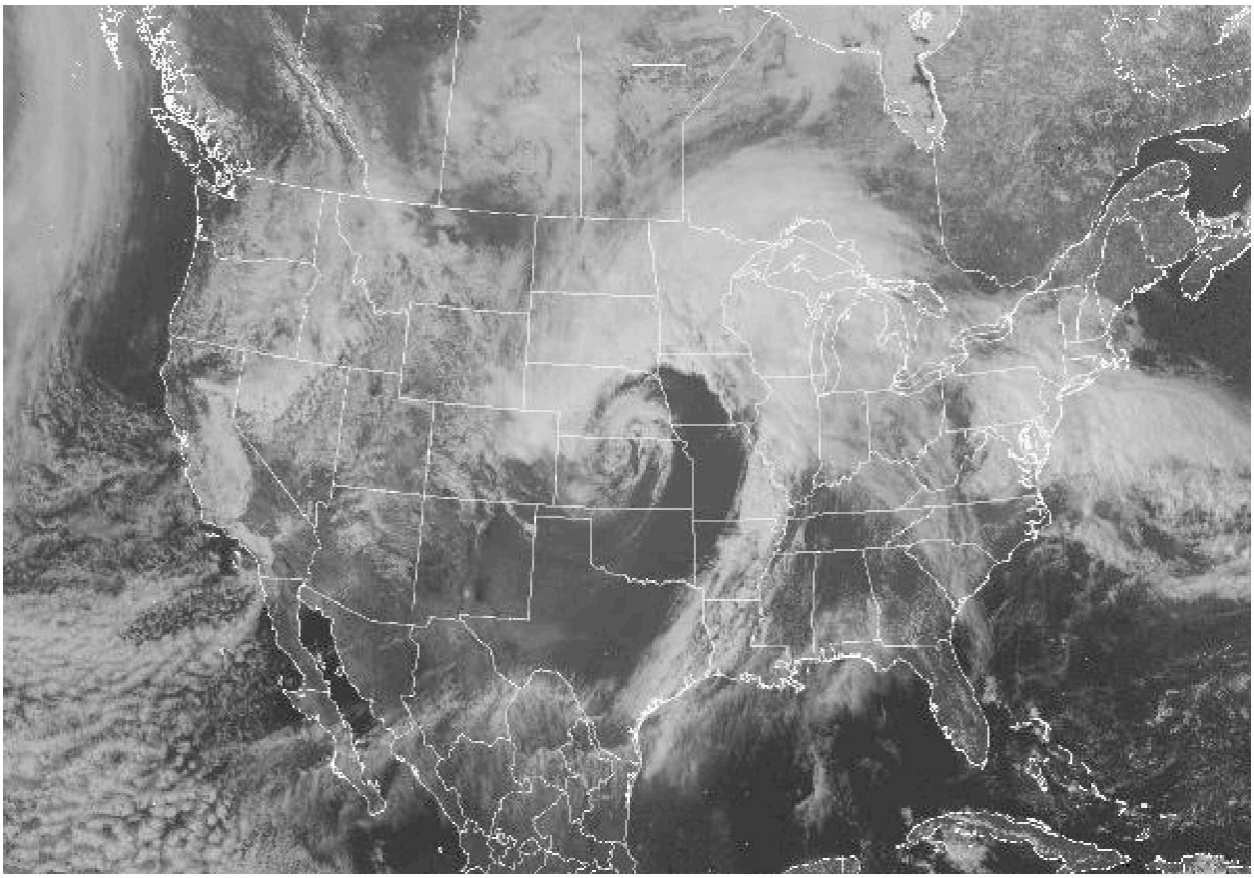


Chapter 10
Extratropical Cyclones Forming East of the Rocky Mountains

Extratropical cyclone – a storm system that forms along the jetstream between about 30 and 70 degrees latitude

These storms are also called mid-latitude cyclones.

What role do extratropical cyclones play in the atmosphere?

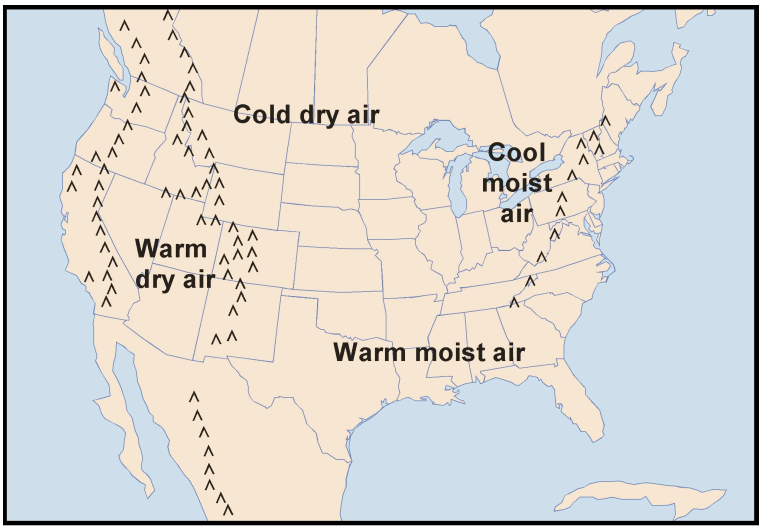


Characteristics of extratropical cyclones:

- Sea level pressure
- Airflow at the surface
- Size and appearance
- Cyclone life cycle

Where do extratropical cyclones typically form in North America?

The Environment Prior to the Development of a Cyclone

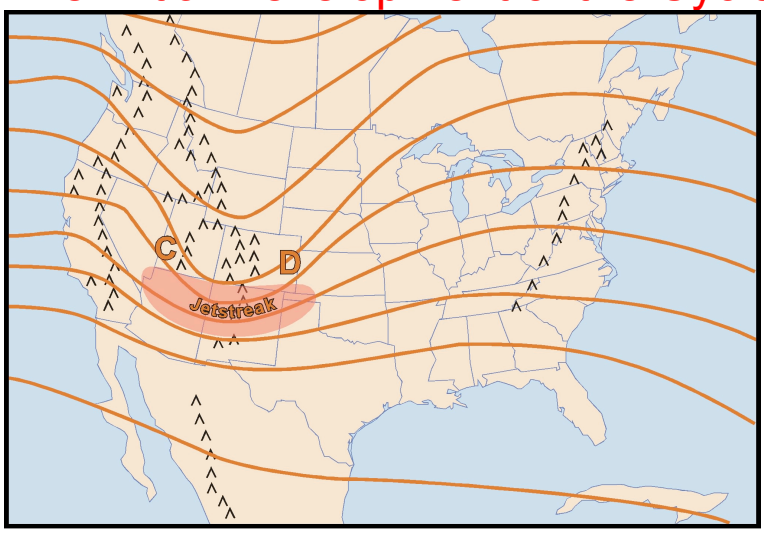


What airmasses are present prior to cyclone formation?

Surface airmasses

Upper level airmasses

The Initial Development of the Cyclone



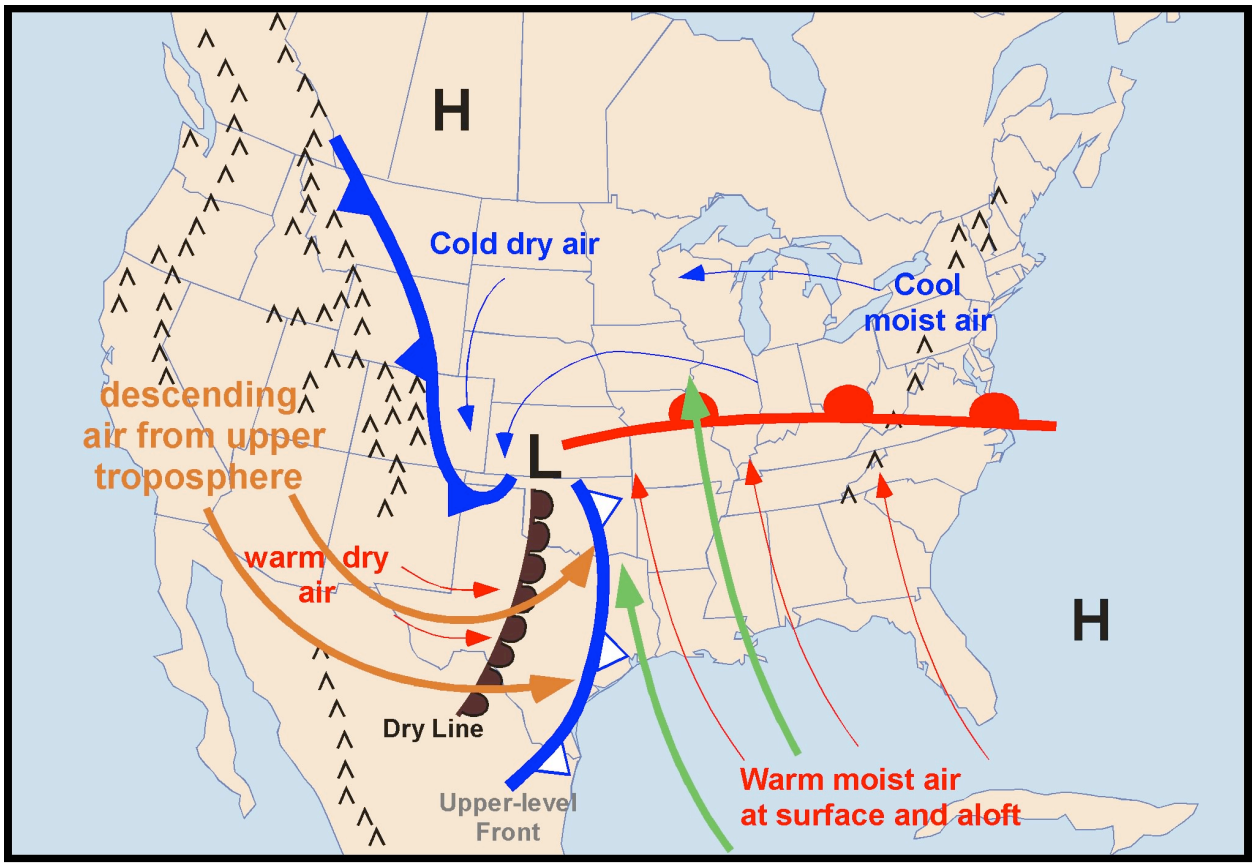
How does low pressure form at the surface?

What atmospheric features, at upper levels, are associated with cyclone formation at the surface?

Wave – a ripple in the jetstream

How often do waves in the jetstream cross the Rocky Mountains?

Initial Movement of Airmasses

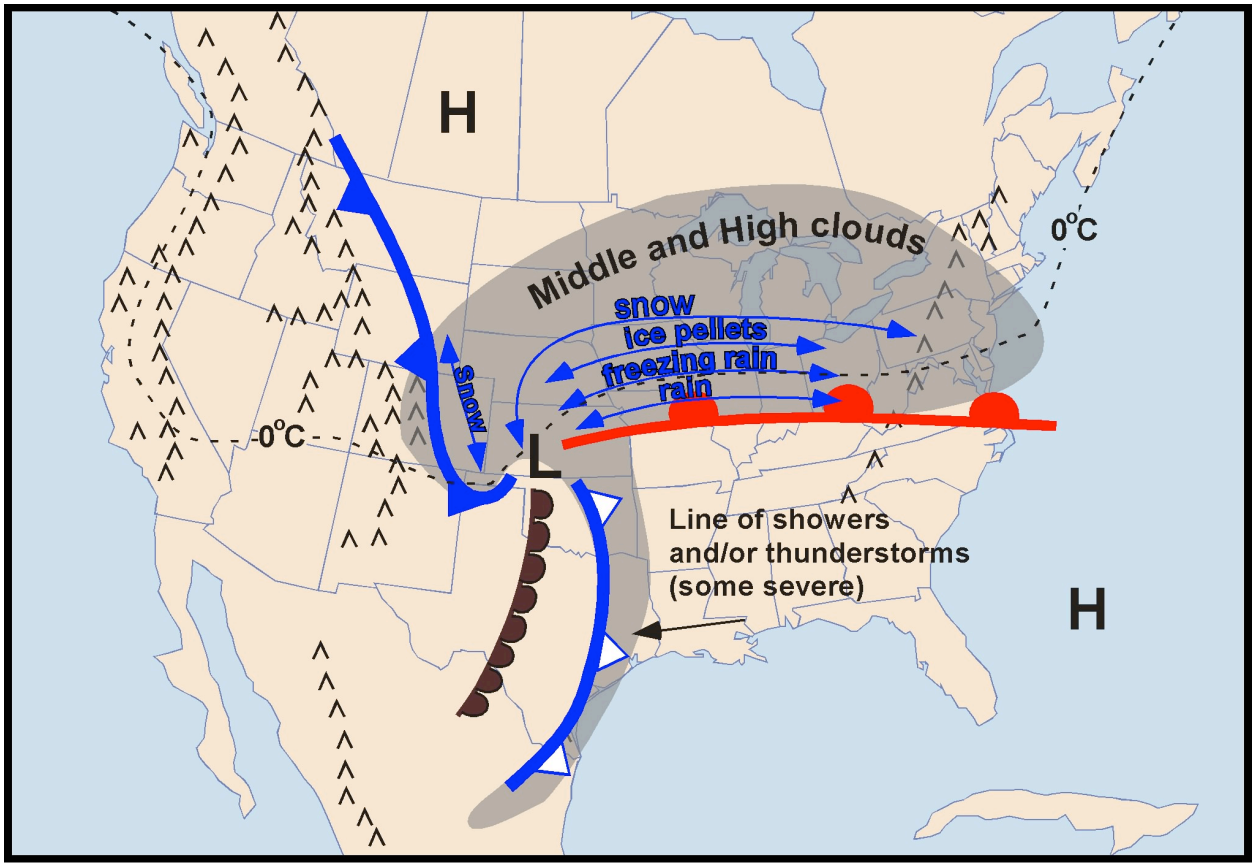


How do the airmasses at the surface move in response to the cyclone?

What airmasses are present at upper levels of the troposphere?

What types of fronts are associated with the cyclone, and where are these fronts located relative to the low pressure center?

Early Weather Along the Fronts



East of the Cyclone Center

What type of front is located east of the cyclone center?

Where are the clouds and precipitation associated with this front located?

How do the clouds and precipitation change as you move north of the warm front?

What determines if the precipitation associated with the warm front will be steady or showery?

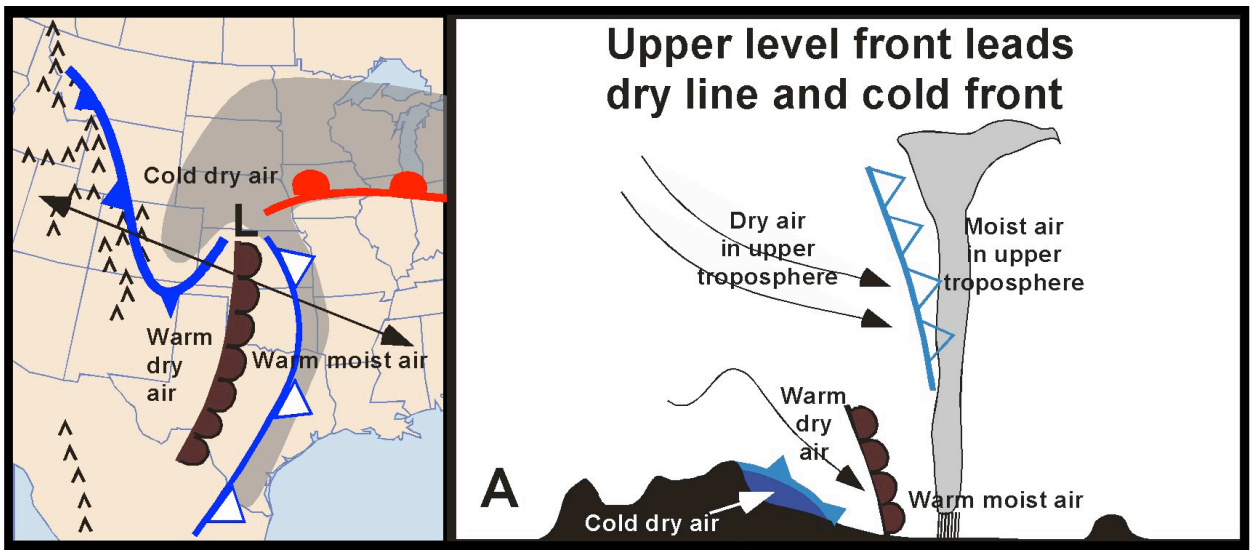
South of the Cyclone Center

What types of airmasses are located south of the cyclone center?

What types of fronts are located south of the cyclone center?

The position and types of fronts south of the cyclone center may be different from one cyclone to another.

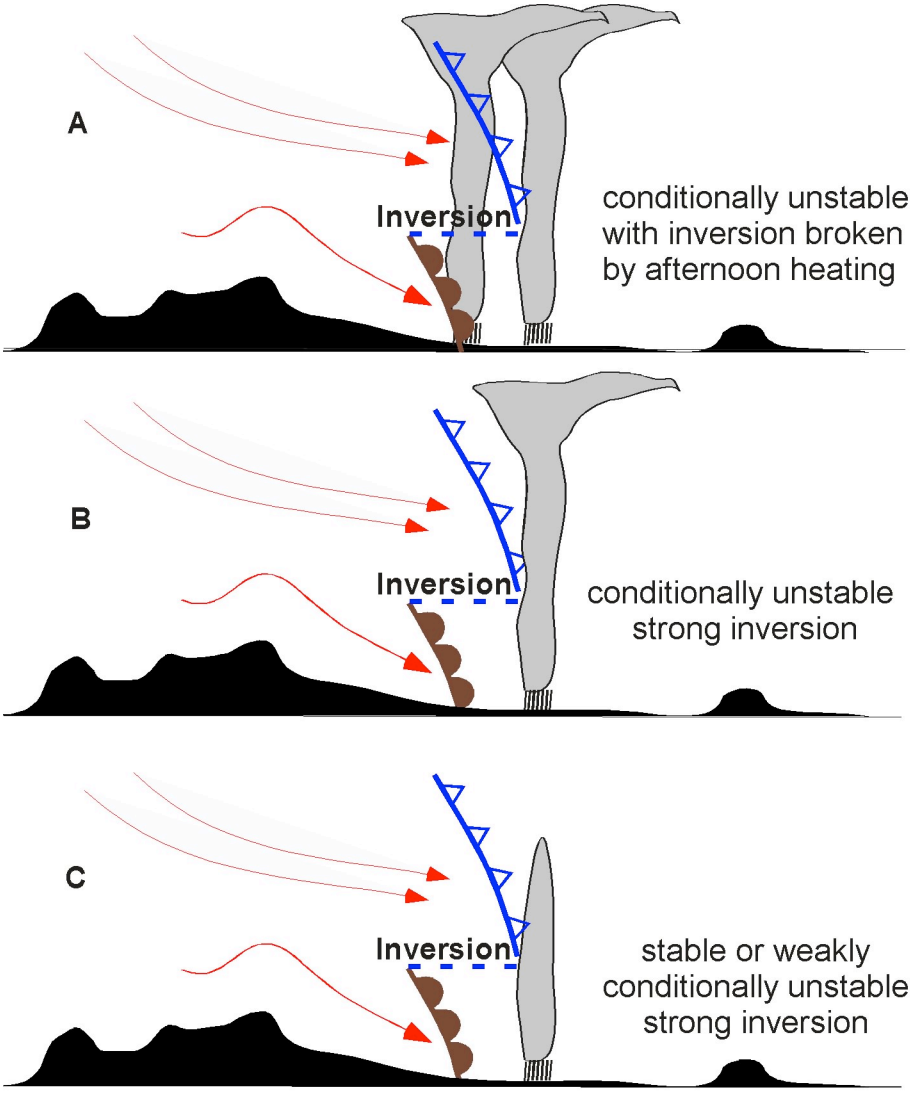
Case 1: Upper level front leads dry line and cold front



Warm, moist air is ahead of the dry line at the surface and ahead of the upper level front aloft.

What weather is associated with the upper level front for this situation?

What weather is associated with the dry line for this situation?

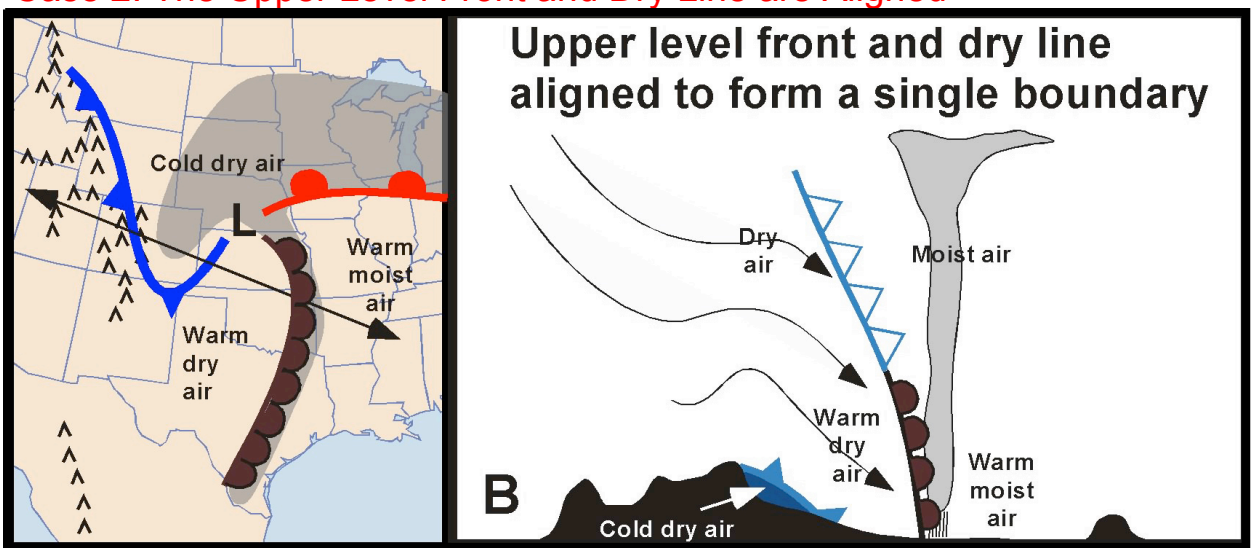


What weather is associated with the cold front for this situation?

Thunderstorms will form if a front is lifting warm, moist, conditionally unstable air.

No clouds will form if a front is lifting dry air.

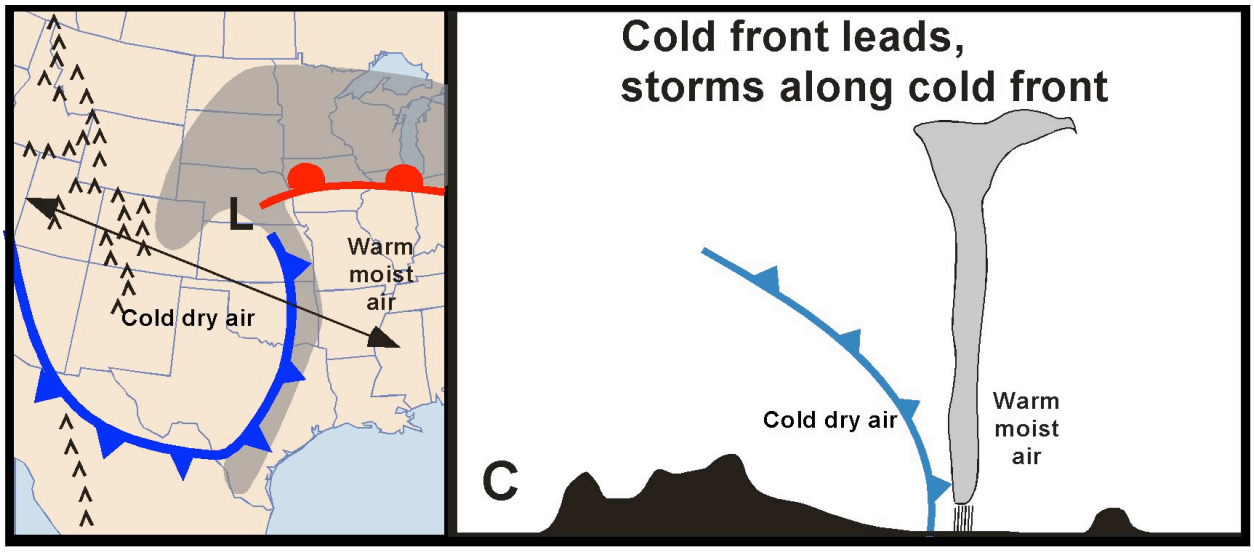
Case 2: The Upper Level Front and Dry Line are Aligned



What types of weather occur along the dry line / upper level front?

What types of weather occur along the cold front?

Case 3: The Cold Front Leads



What conditions favor the cold front being the leading front south of the low pressure center?

What types of weather occur along the cold front?

For each of the cases discussed above the clouds that form along the front, or fronts, south of the low pressure center form the tail of the comma cloud signature often seen in satellite images of mid-latitude cyclones.

Northwest of the Cyclone Center

What is the wind direction north of the cyclone center?

Upslope flow – air is forced to rise as it flows from lower elevations to higher elevations (such as from the Great Plains towards the Rocky Mountains)

What wind direction creates upslope flow in Boulder?

What happens to air as it is forced to rise?

What types of weather are associated with upslope flow?

Alberta clipper – an extratropical cyclone that is similar to extratropical cyclones that form east of the Colorado Rocky Mountains, but that forms east of the Rocky Mountains in Alberta, Canada.

Storm Intensification

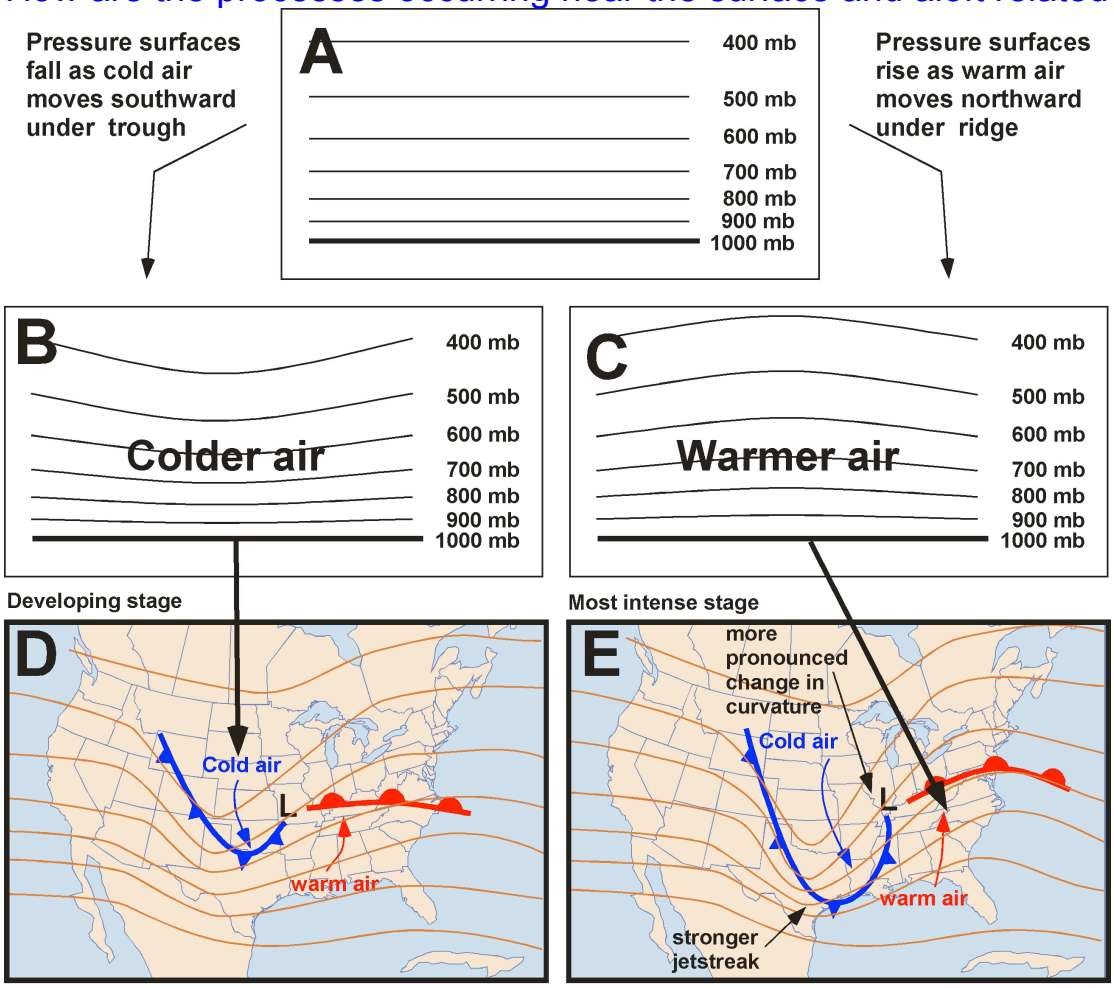
A cyclone is said to intensify when the pressure at the surface decreases.

What factors will cause the surface pressure to decrease?

How does the weather associated with a cyclone change as the surface pressure decreases?

- Pressure gradient
- Wind speed
- Movement of airmasses

How are the processes occurring near the surface and aloft related?



As cold air advances south, on the west side of the low pressure center, the height of upper level constant pressure surfaces will decrease, causing the upper level trough to deepen.

As warm air advances north, on the east side of the low pressure center, the height of the upper level constant pressure surfaces will increase, causing the upper level ridge to amplify.

Both the deepening trough and the amplifying ridge lead to:

Increased curvature between the trough and the ridge
Increased wind speed in the jetstreak

How do these upper level changes impact the surface cyclone?

The Mature Cyclone

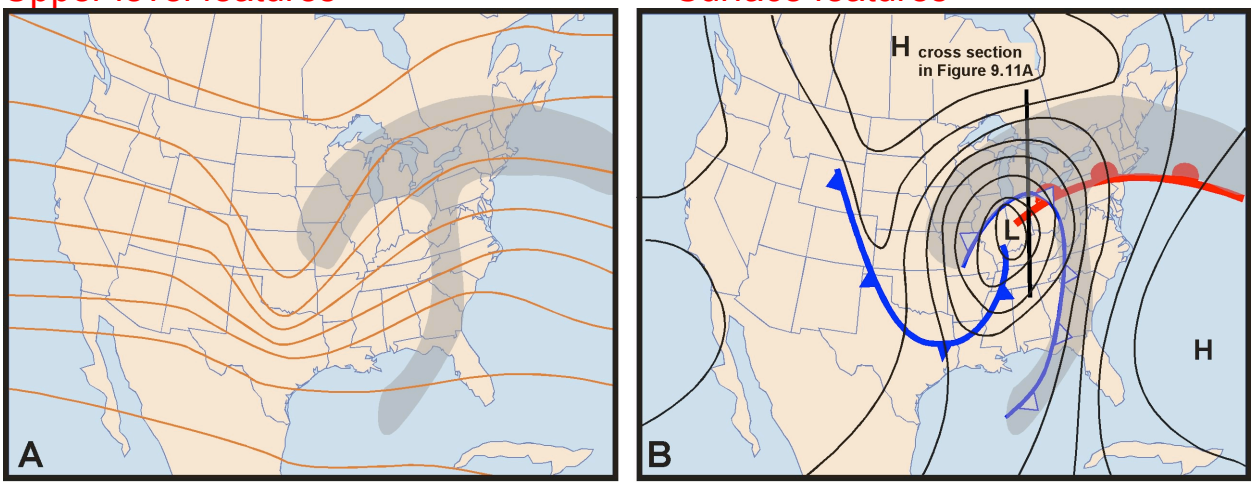
Where is “warm” severe weather (thunderstorms and tornadoes) most likely to form in a mature cyclone?

Where is “cold” severe weather (blizzards and ice storms) most likely to form in a mature cyclone?

Mature cyclone with an upper level front

Upper level features

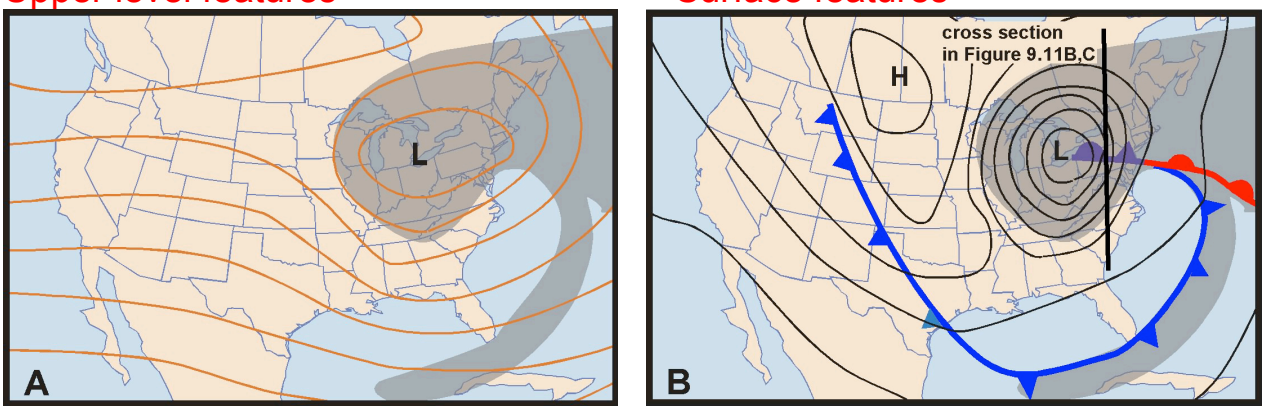
Surface features

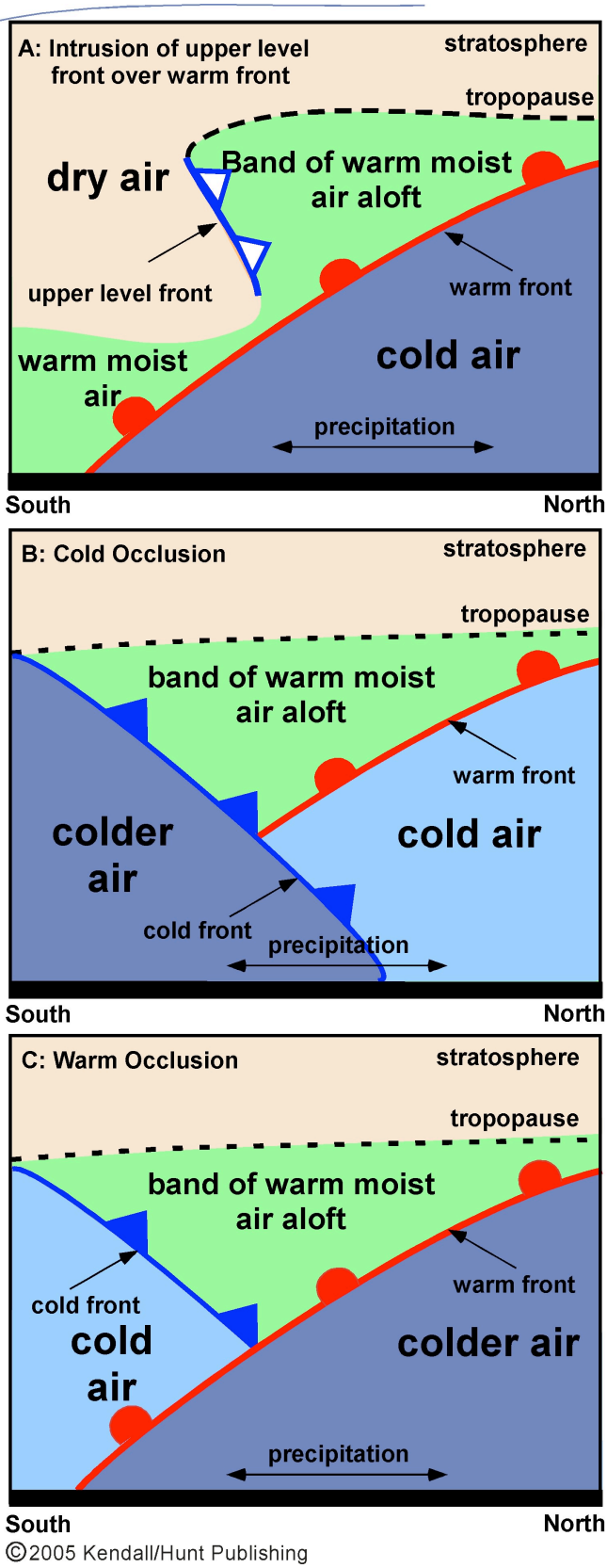


Mature cyclone with an occluded front

Upper level features

Surface features





Trowal – a "wrap-around" band of warm, moist air aloft (trough of warm air aloft)

How does the trowal form?

Upper level front
Occluded front

What type of weather is associated with the trowal?

The Dissipating Cyclone

What type of front forms when cold air has completely wrapped around the cyclone?

How does the upper level pattern change once the cold air wraps around the cyclone at the surface?

> At upper levels a cutoff low forms, as cold air wraps completely around the cyclone at low levels.

How does the upper level divergence change as the flow changes from an upper level trough and ridge pattern to a cutoff low pattern?

What happens to the jetstreak once the cutoff low forms?

How does this impact the intensity of the surface cyclone?

How long does it take for the surface cyclone to dissipate once the cutoff low forms at upper levels?

What types of weather are associated with the dissipating cyclone, occluded front, and cutoff low?