

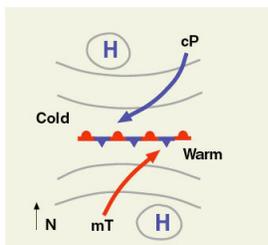
Chapter 13, Part 1

Polar Front Theory

Overview of Chapter 13

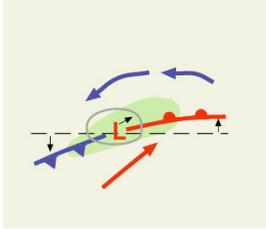
1. How do storms in the middle and high latitudes form?
2. How do upper level winds influence storm formation?
3. What are the wind flow patterns in a developing storm system?

1. Polar Front Theory



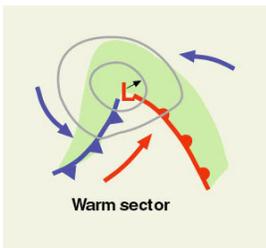
- A wave cyclone begins along the polar front, where cold polar air meets warm subtropical air.
- The (stationary) front is locally a trough of low pressure.
- Air flows parallel to the front, but in opposite directions.

2. Polar Front Theory



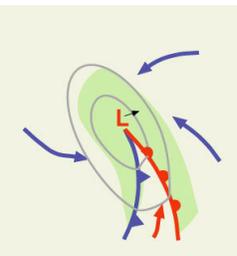
- Because of the different wind directions, a frontal wave can form.
- The region of lowest pressure is at the junction between the two fronts.
- Green shaded region is where rain is.

3. Polar Front Theory



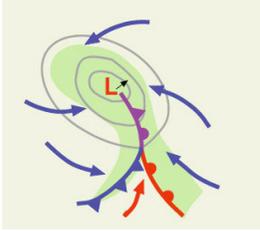
- Next an open wave forms with lower pressure at the center.
- Precipitation forms in a wide band in front of the warm front and a narrow band near the cold front.
- Energy comes from warm air rising, latent heat, and wind flowing toward low.

4. Polar Front Theory



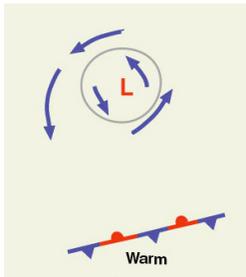
- The faster moving cold front moves closer to the warm front, reducing shrinking the warm sector.
- Eventually, the front becomes occluded. At this point the storm is most intense.

5. Polar Front Theory



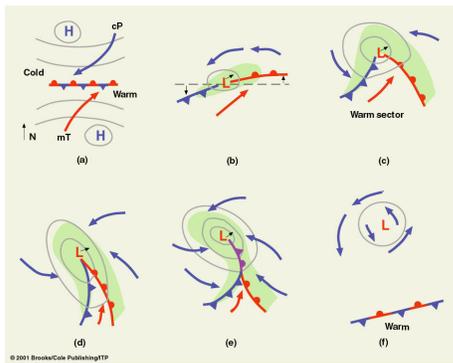
- The point where the cold, warm, and occluded fronts meet is called the triple point.
- A new wave may start at this secondary low.
- The center gradually dissipates as cold air lies on both sides of the original front.

6. Polar Front Theory

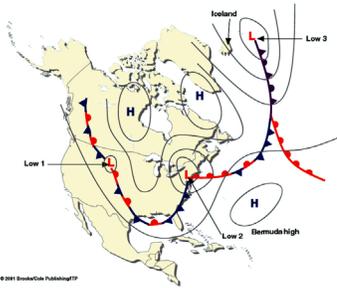


- Without the supply of energy from warm air rising and precipitation, the original front gradually disappears, leaving a low and a stationary front.

Lifecycle of a Wave Cyclone

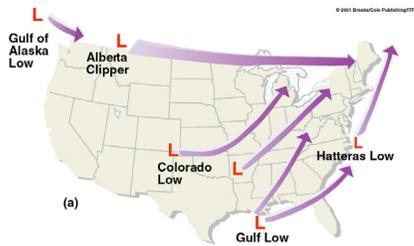


A Family of Cyclones



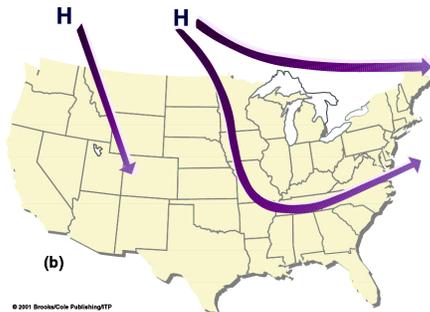
- Low 1 is just forming, Low 2 is an open wave, and Low 3 is dissipating. The average speed of a cyclone is 25 knots.

Cyclogenesis

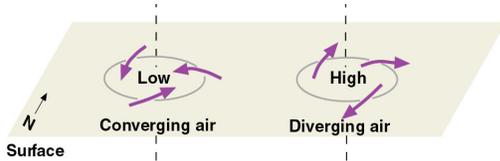


- Strengthening of a cyclone is called cyclogenesis.
- Regions in US where this frequently occurs: east slope of Rockies, the Great Basin, Gulf of Mexico, and Atlantic Ocean east of Carolinas.

Typical Paths of Winter Anticyclones



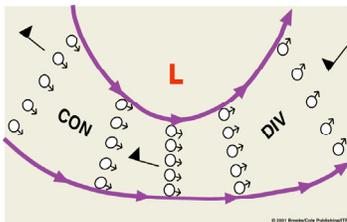
Convergence and Divergence



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- Air flow converges towards a low, acting to increase the pressure.
- Air flow diverges away from a high, acting to decrease the air pressure.
- How does a low intensify?

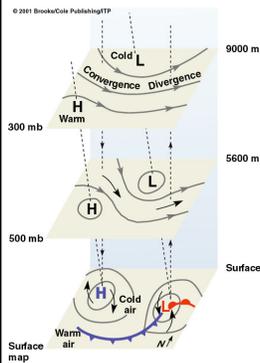
Upper Level Wind Flow



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- Where the isobars (and wind flow) get closer together the air is converging, while when the isobars get further apart the air is diverging.

Vertical Structure



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- A surface high will intensify if there is converging air above it.
- A surface low will intensify if there is diverging air below it.
- Note offset between surface and above highs and lows.
- Upper level wind influences the formation of surface highs and lows.

Summary

- Large storm systems at middle and high latitudes form along the polar front.
- According to the polar front theory, storms start as a frontal wave, develop into an open wave, and eventually dissipate.
- Whether a storm intensifies is determined in part by upper level convergence and divergence.
