

Midlatitude Cyclones

**Whose air mass reigns
supreme ??**

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Ch. 10: Midlatitude Cyclones

- **Norwegian Model of Cyclogenesis**
- **Vorticity**
 - **Relative and Absolute Vorticity**
 - **Vorticity in a Rossby Wave**
 - **Vorticity Advection and Vertical Motion**
- **Baroclinic Model of Cyclogenesis**
- **Conveyor Belt Model**

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Polar Front Theory

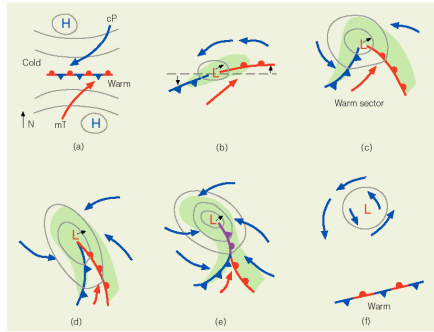
Norwegian Model of Cyclogenesis

- **Formation of a “cyclone”**
 - **Storm associated with surface low pressure**
- **Jacob Bjerknes c. 1920**
developed model from surface observations

3

Polar Front Theory

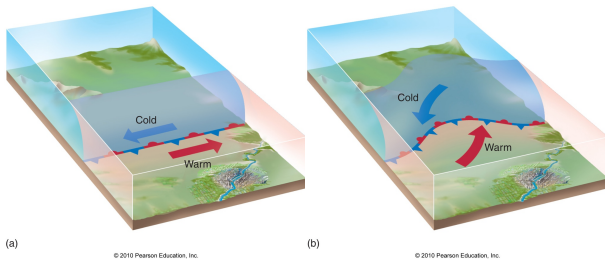
Norwegian Model of Cyclogenesis



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Stationary Phase



(a)

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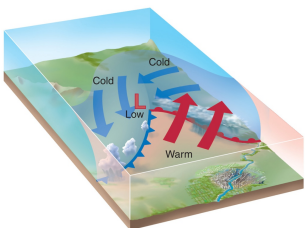
(b)

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Surface low develops along Polar Front

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Developing Phase



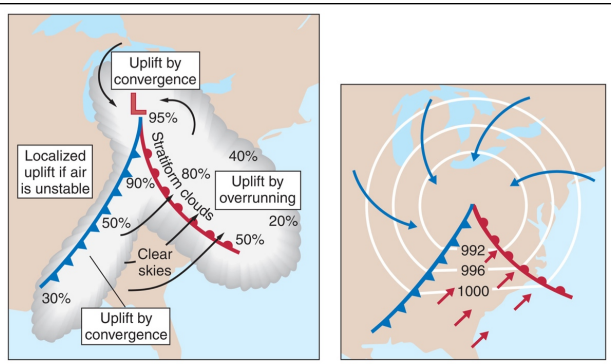
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- **Low deepens**
- **Well developed fronts circling the low**
- **Cold front catching up to slow-moving warm front**
- **Whole system moves toward east-northeast, following surface isobars in the warm sector**

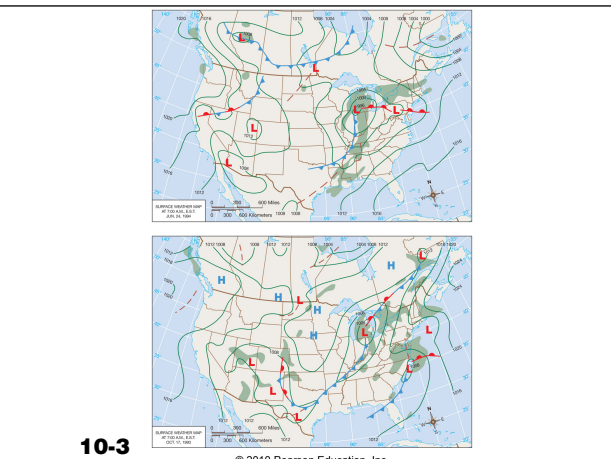
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(a) (b)
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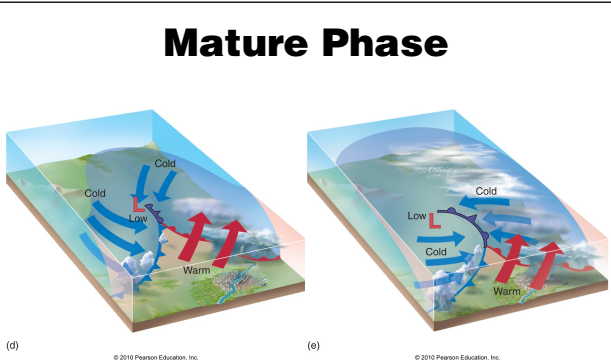
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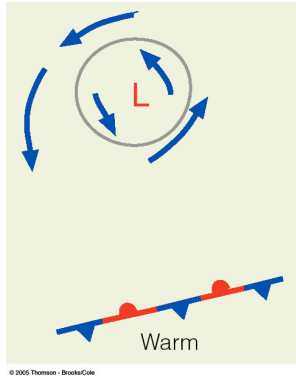
(d) (e)
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Fronts begin to occlude at start of Mature Phase; intensity has reached a maximum and is now decreasing

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Dissipation Phase

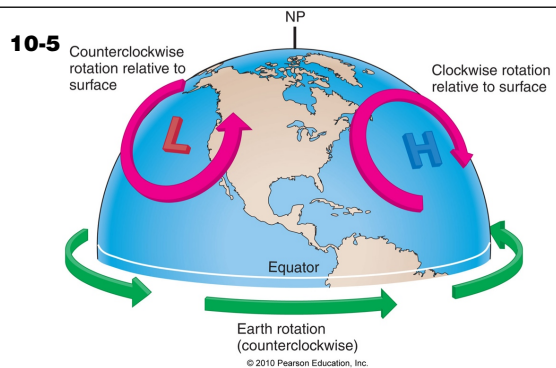


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Vorticity

- “Spin”
- Vorticity from:
 - Rotation of air on Earth’s surface: **Relative Vorticity** ζ_r
 - Rotation from being on rotating Earth: **Earth Vorticity** ζ_E
 - **Absolute Vorticity** $\zeta = \zeta_r + \zeta_E$
- Changes in vorticity result in vertical motion

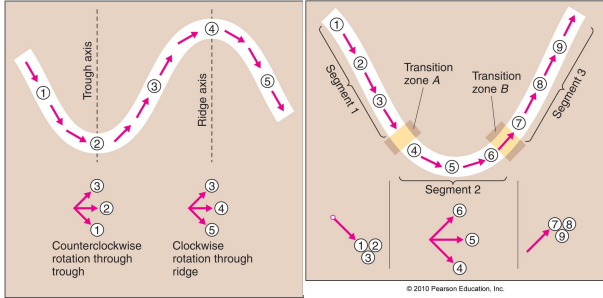
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Positive Vorticity: counterclockwise rotation
PVA ≡ Positive Vorticity Advection

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Vorticity in a Rossby Wave

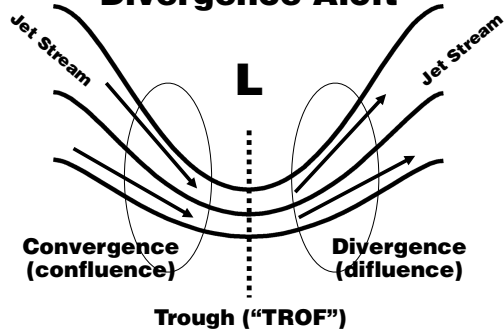


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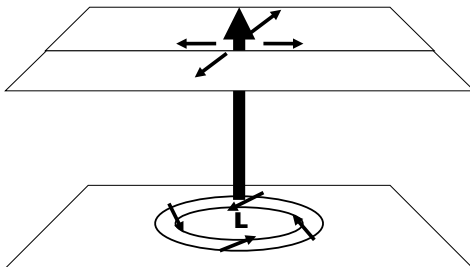
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Convergence and Divergence Aloft



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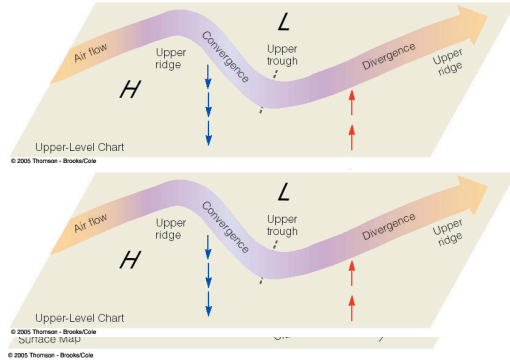
Divergence and diffluence aloft maintains or strengthens surface low pressure



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Midlatitude Cyclogenesis

Baroclinic Model



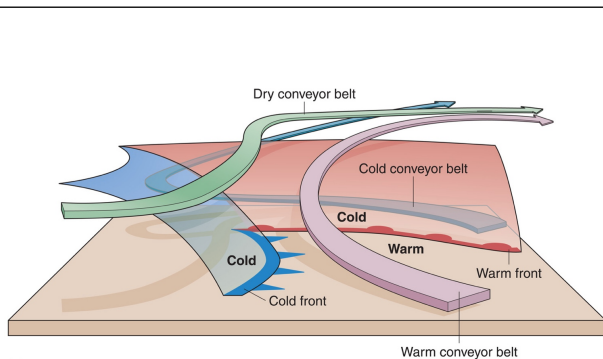
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Conveyor Belt Model

- **Theory based on more recent observations**
- **Conveyor belts are pathways of air through and around a midlatitude cyclone**
- **Refines the process of frontal occlusion—not simply merging cold and warm fronts!**

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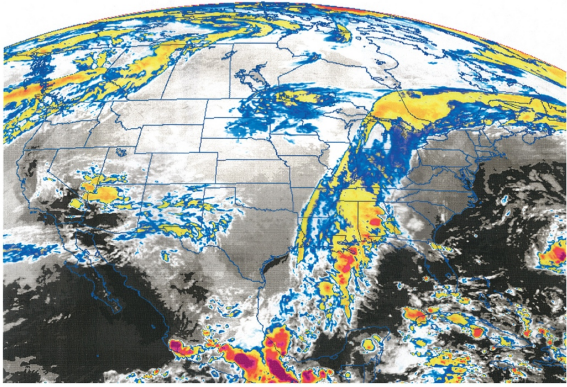


(a)

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(b)

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