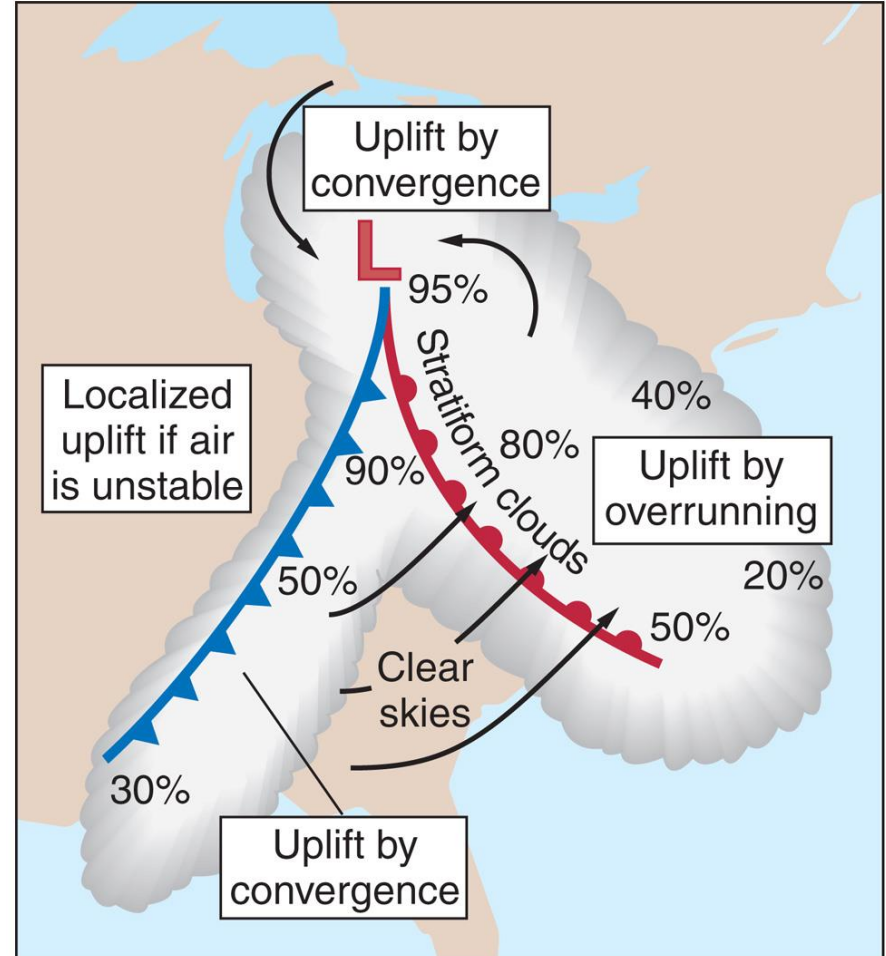


– Midlatitude Cyclones



(c)



(a)

The Origin of the Theory of Midlatitude Cyclones

- **The polar front theory (Norwegian cyclone model)** – description of the formation, life, and dissipation of a midlatitude cyclone (center of low pressure) that forms along a front

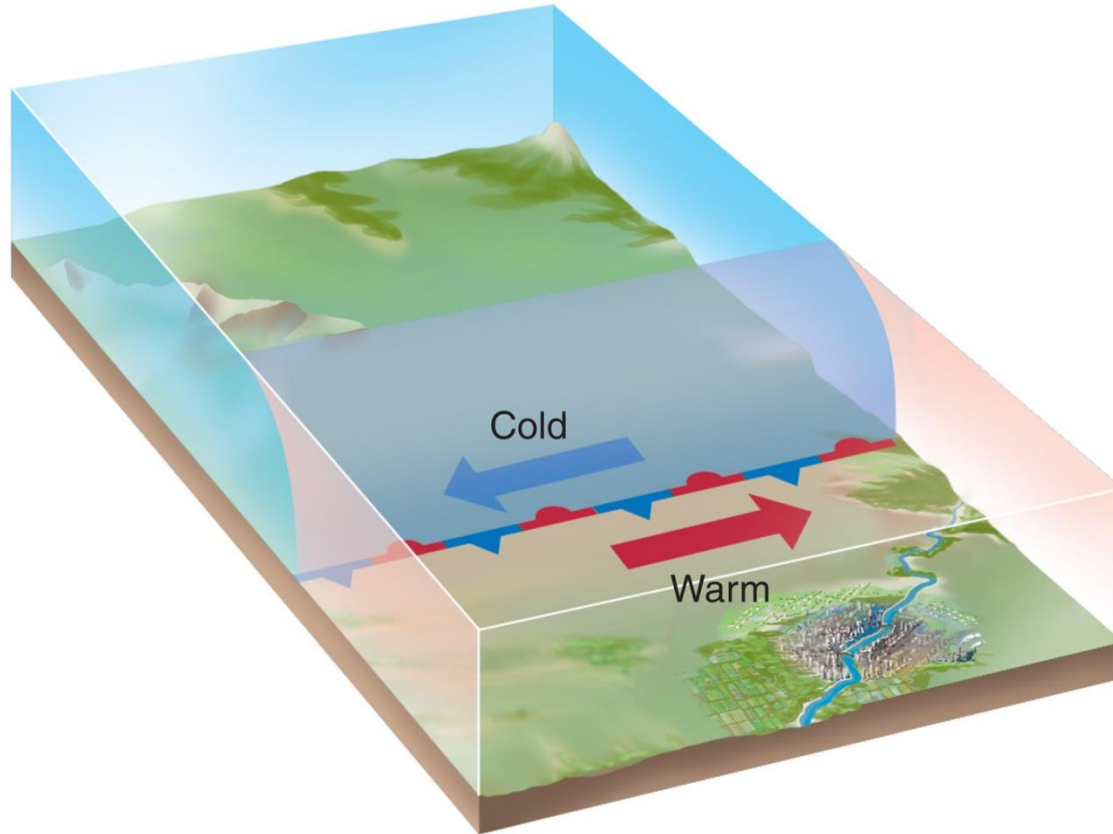
The Life Cycle of Midlatitude Cyclones

- **Cyclogenesis** – the formation of a midlatitude cyclone

The Life Cycle of Midlatitude Cyclones

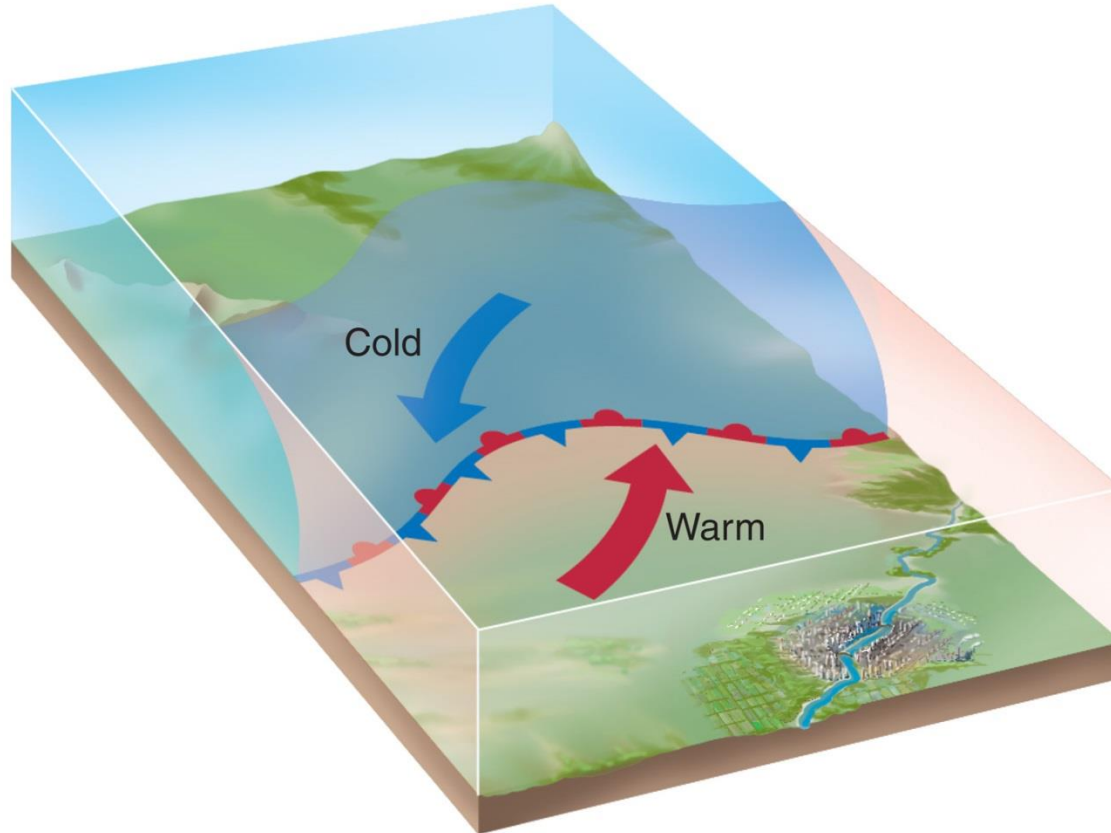
- **Cyclogenesis** – the formation of a midlatitude cyclone
- Cyclones often form at fronts (just like the Norwegian cyclone model states)

The Life Cycle of Midlatitude Cyclones



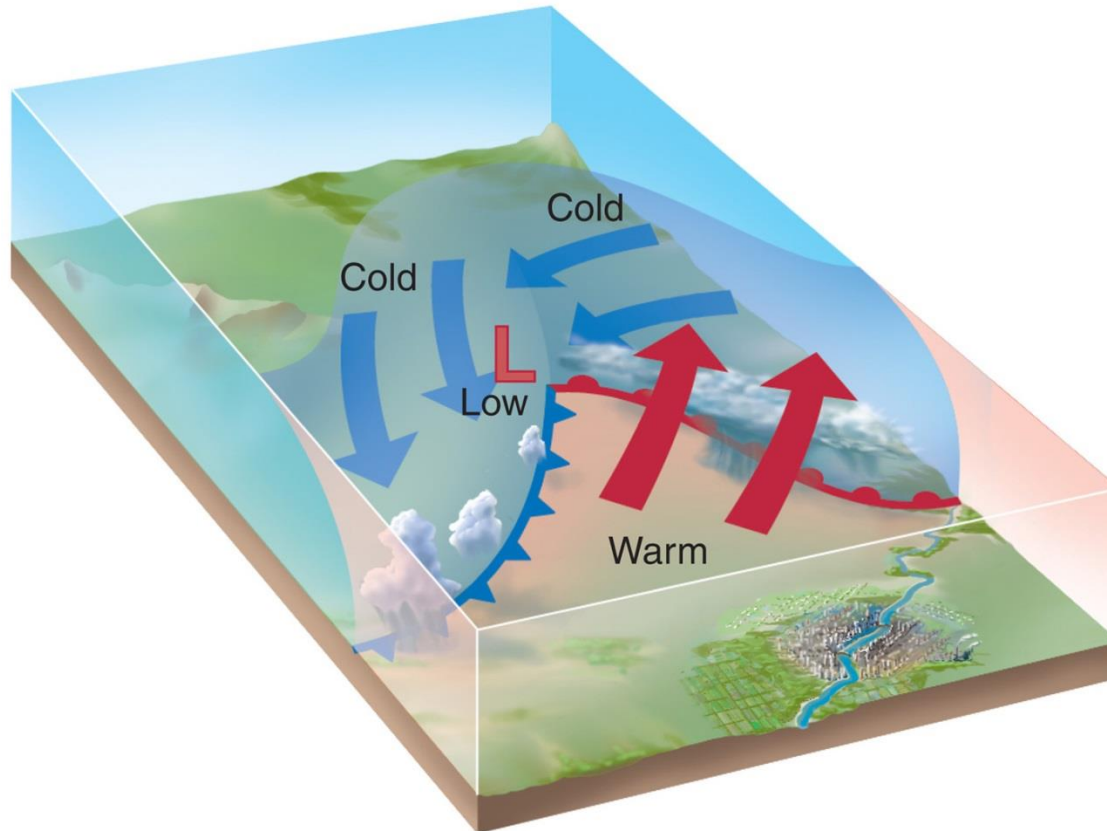
(a)

The Life Cycle of Midlatitude Cyclones



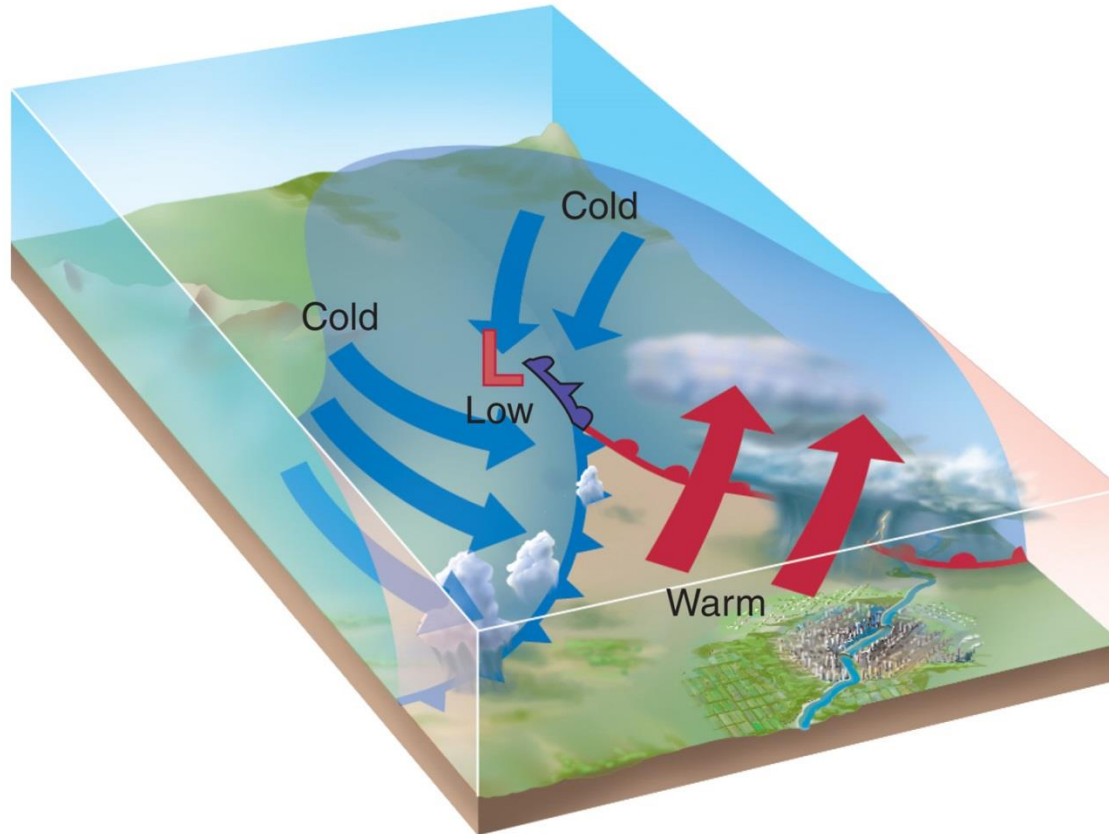
(b)

The Life Cycle of Midlatitude Cyclones



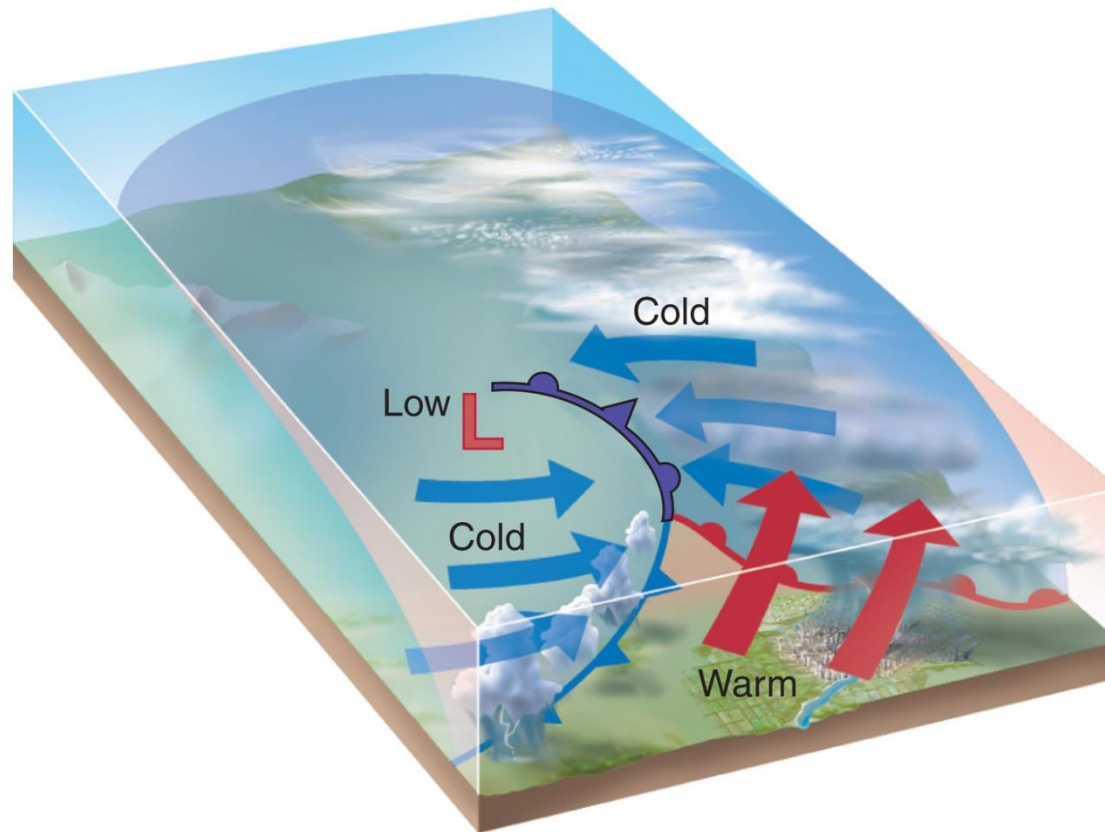
(c)

The Life Cycle of Midlatitude Cyclones



(d)

The Life Cycle of Midlatitude Cyclones



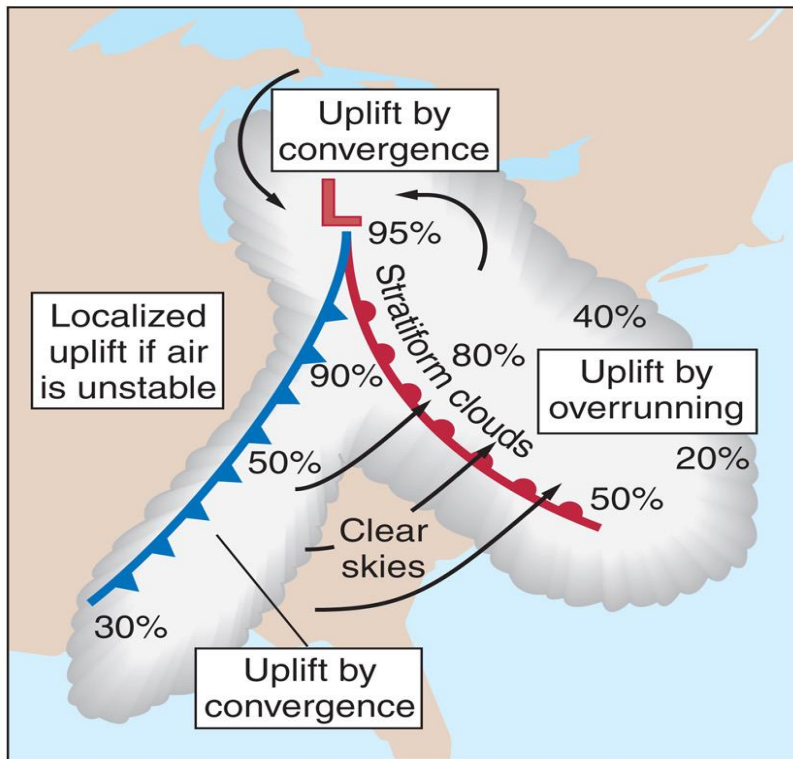
(e)

The Life Cycle of Midlatitude Cyclones

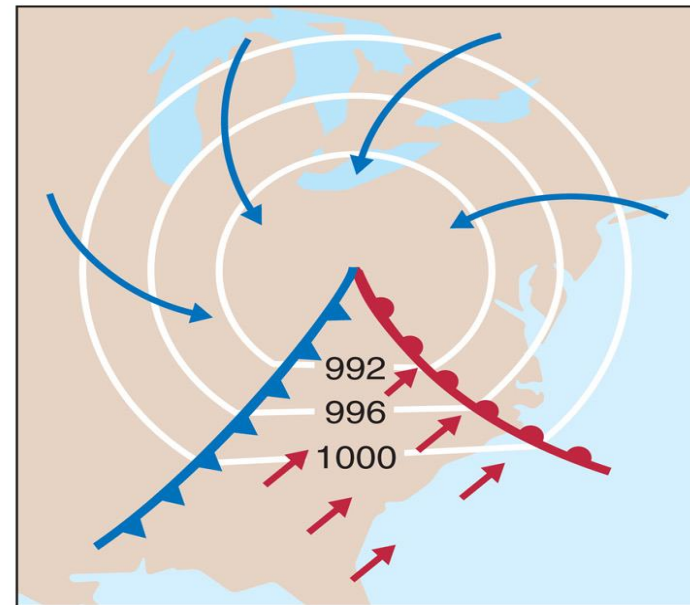
- **Mature cyclone** – cyclone with active cold and warm fronts prior to occlusion

The Life Cycle of Midlatitude Cyclones

- **Mature cyclone** – cyclone with active cold and warm fronts prior to occlusion



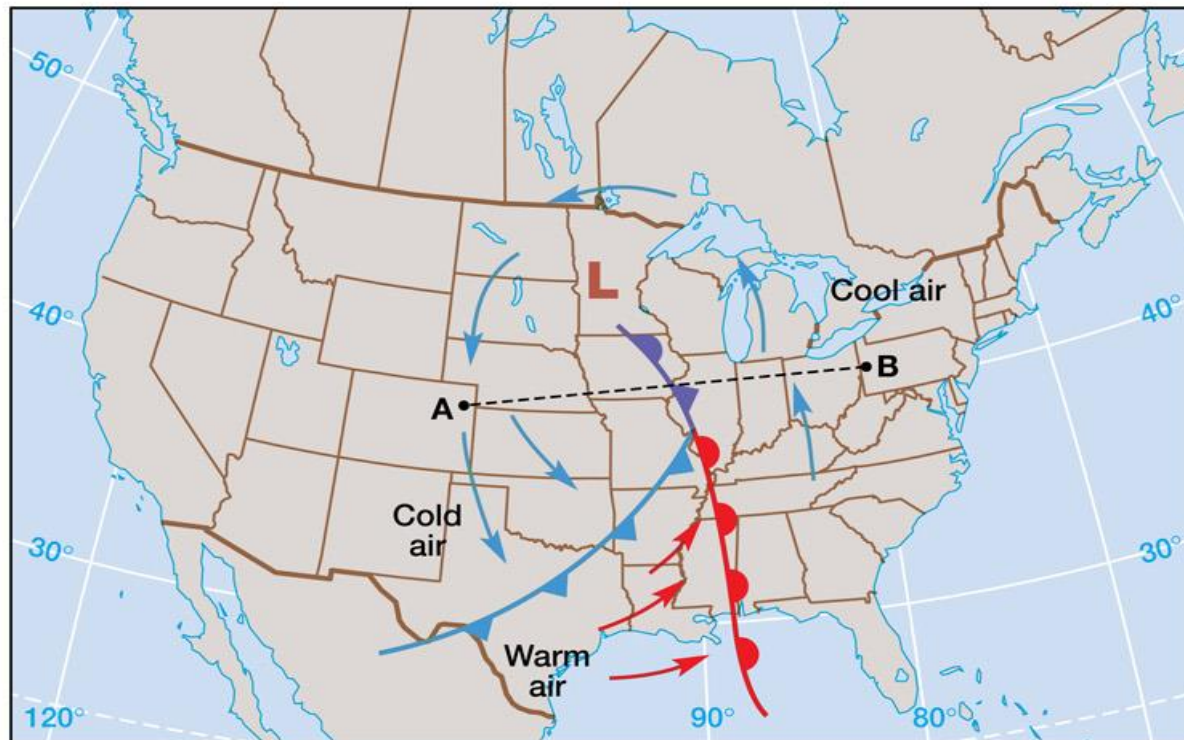
(a)



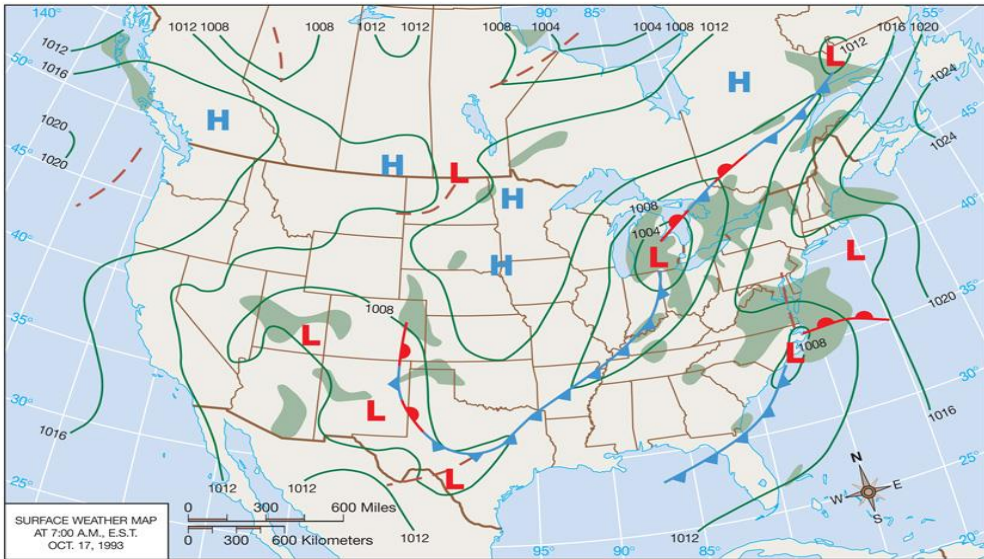
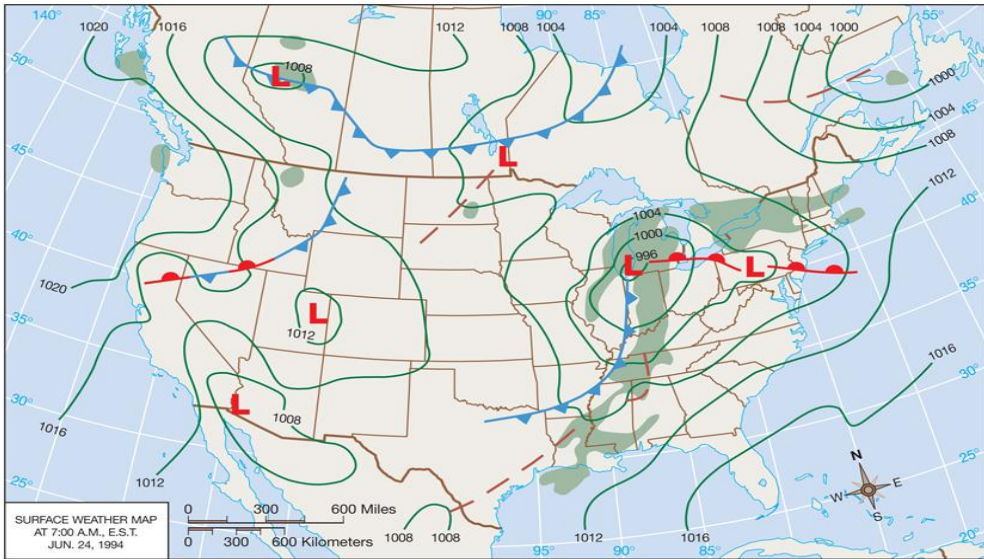
(b)

The Life Cycle of Midlatitude Cyclones

- **Occlusion** – the end of the cyclone life cycle, associated with formation of occluded front



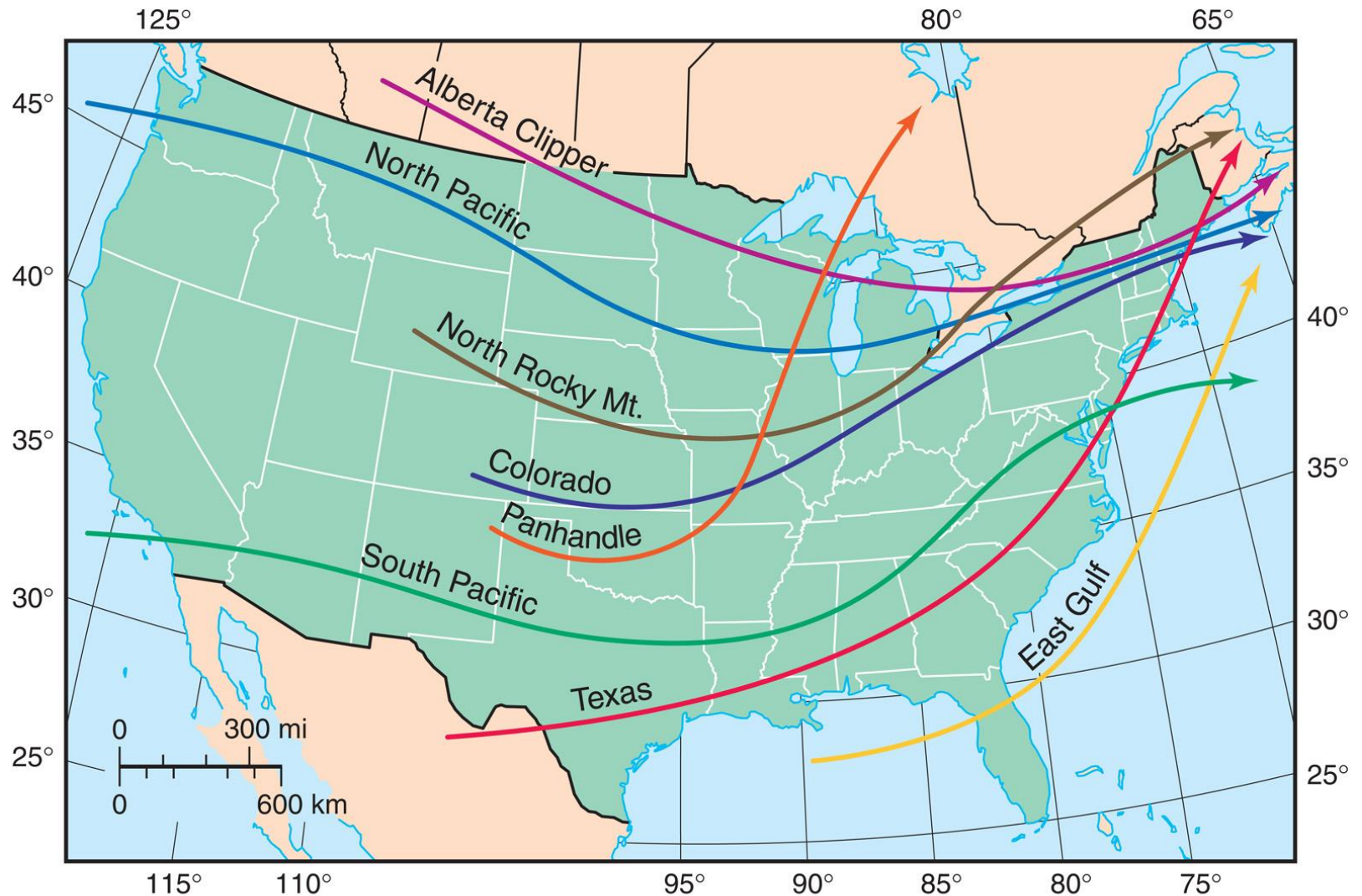
All Cyclones don't Look Alike...



Cyclones

- There are roughly 600 cyclones per year in the northern hemisphere
- Cyclones generally travel from 0-100 mph
- There are various regions that are favored for cyclogenesis:
 - 1) Lee of the Colorado Rockies
 - 2) Gulf of Mexico U.S. coastline
 - 3) East coast
 - 4) Gulf of Alaska

Typical Cyclone Tracks



But How do Cyclones Form???

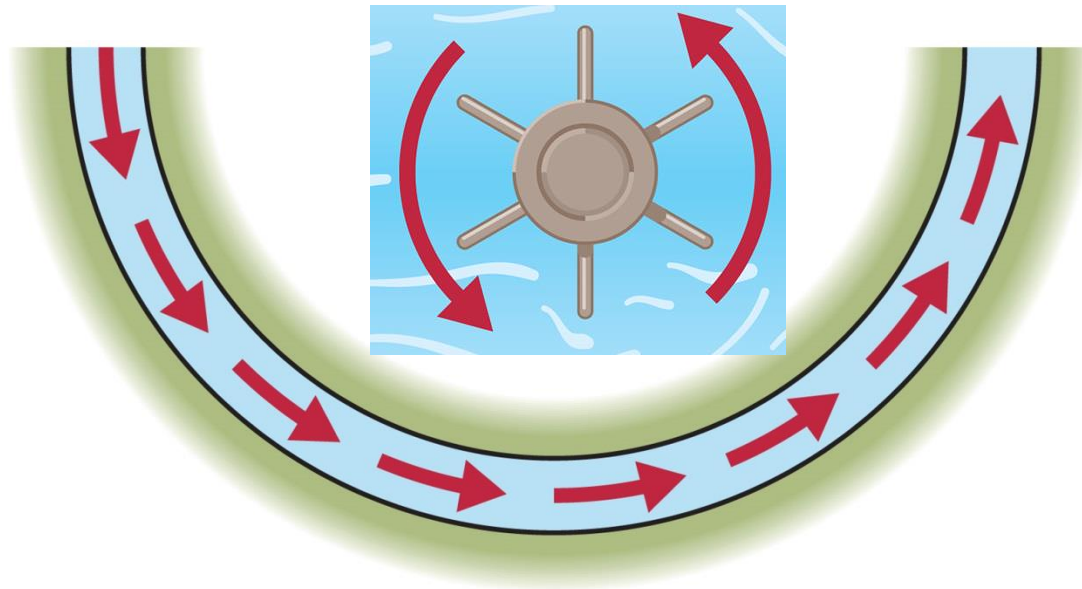
- Up to this point, we have only described midlatitude cyclones with no idea why they exist
- Midlatitude cyclones owe their life to the jet stream!!!

The Jet Stream: Divergence and Convergence

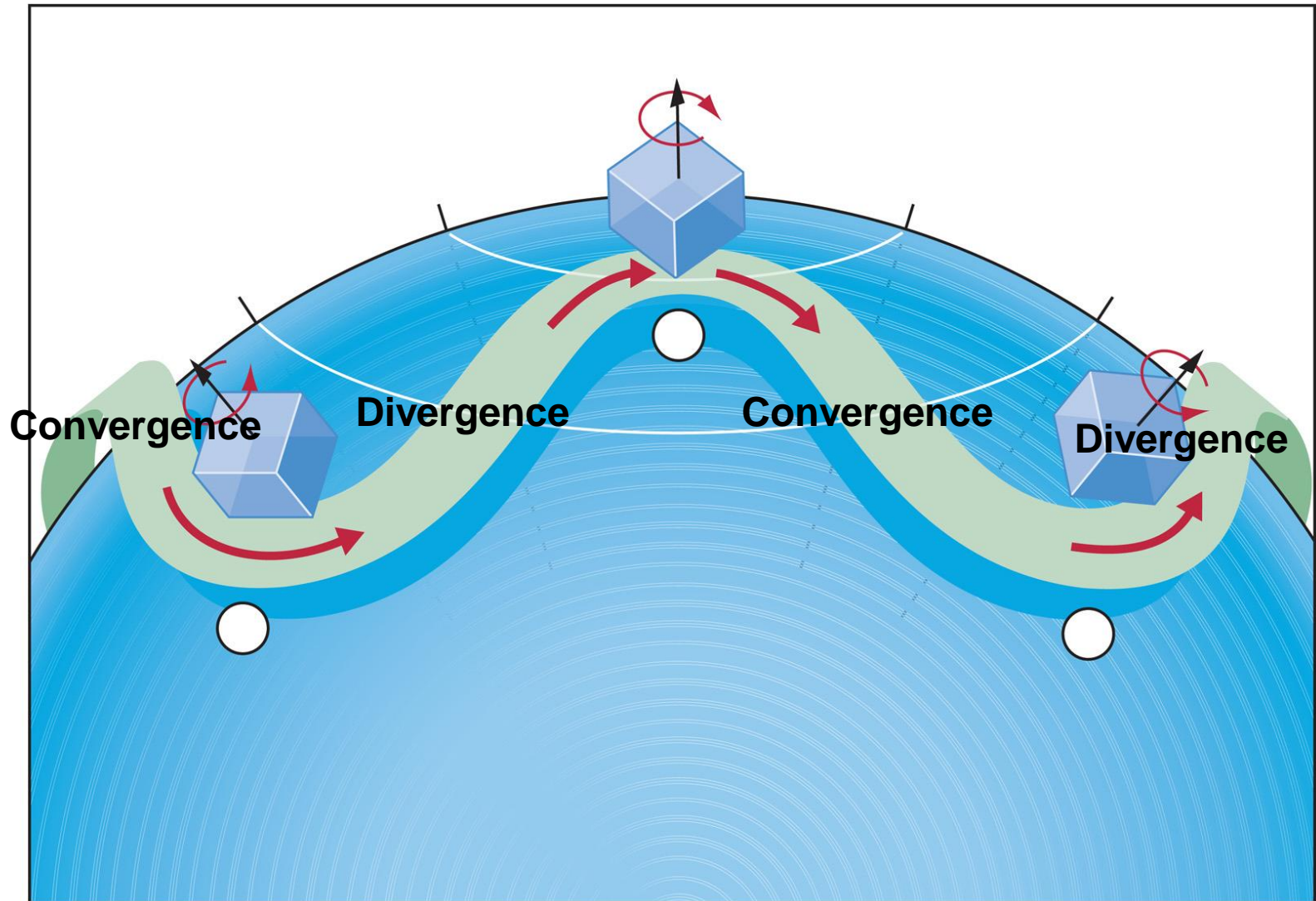
- Convergence and divergence is caused by the jet stream in 2 ways:
 - 1) **Vorticity** – the “spin” of the atmosphere
 - 2) **Jet streaks** – localized regions of maximum wind speeds along the jet stream

Vorticity

- Regions downwind of positive (CCW) vorticity experience divergence
- Regions downwind of negative (CW) vorticity experience convergence

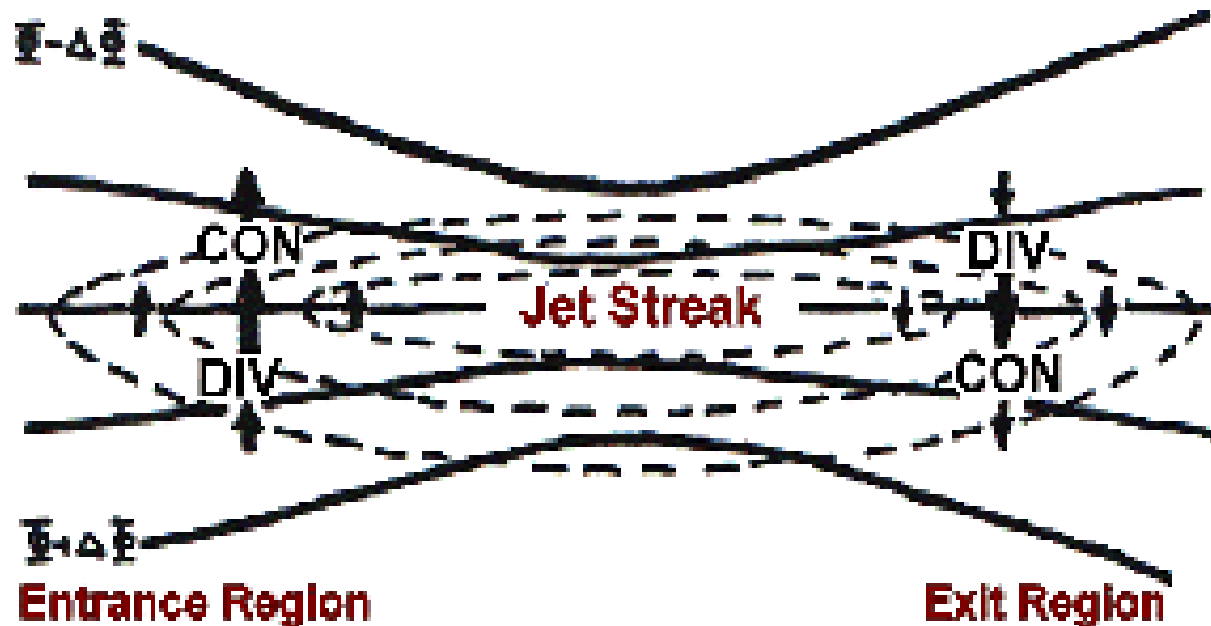


Vorticity



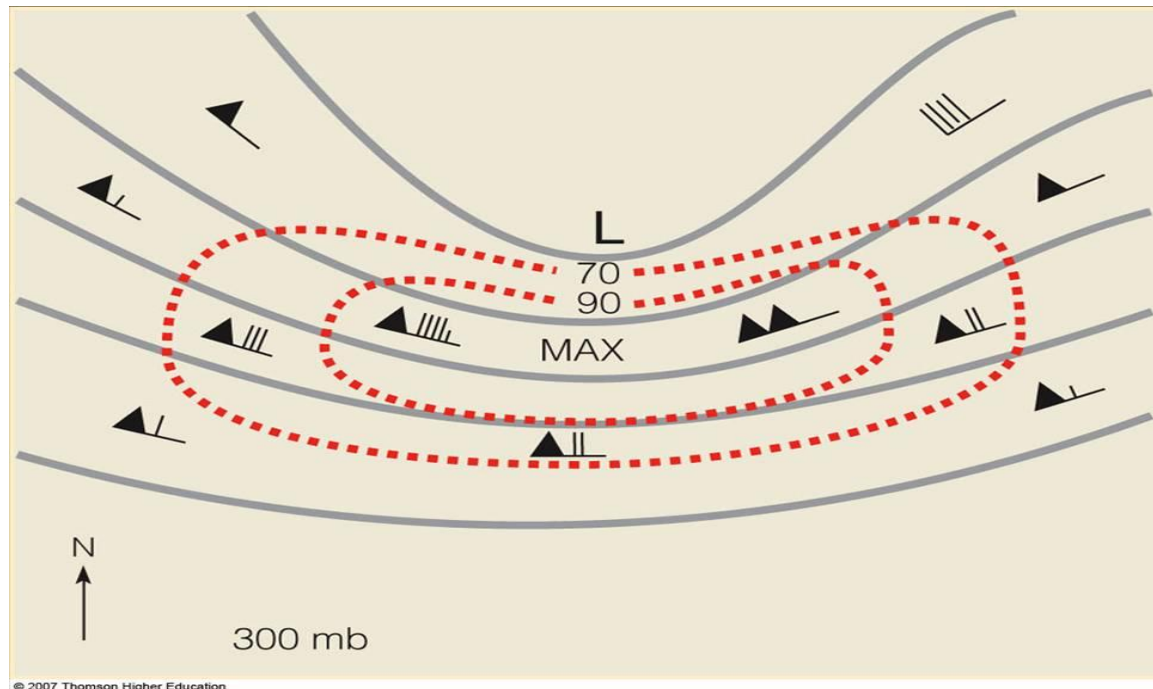
Jet Streaks

- Jet streaks cause convergence and divergence due to:
 - 1) Confluence/diffluence



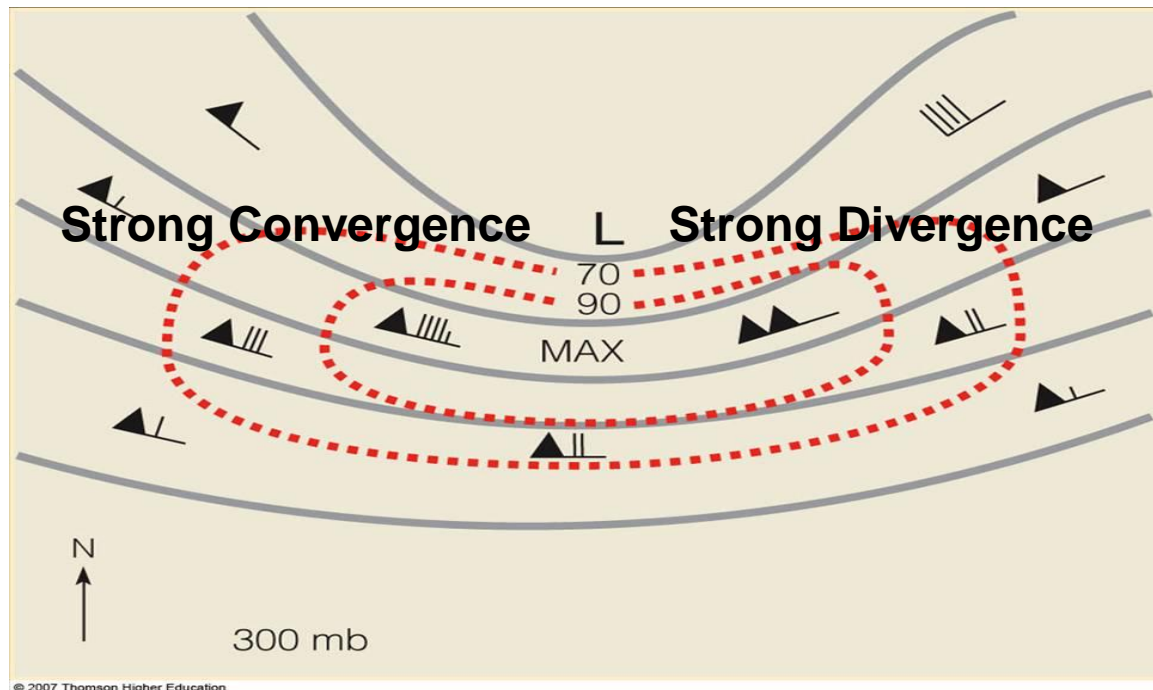
The Jet Stream: Divergence and Convergence

- Strongest divergence and convergence occurs when both vorticity and jet streak effects occur simultaneously:



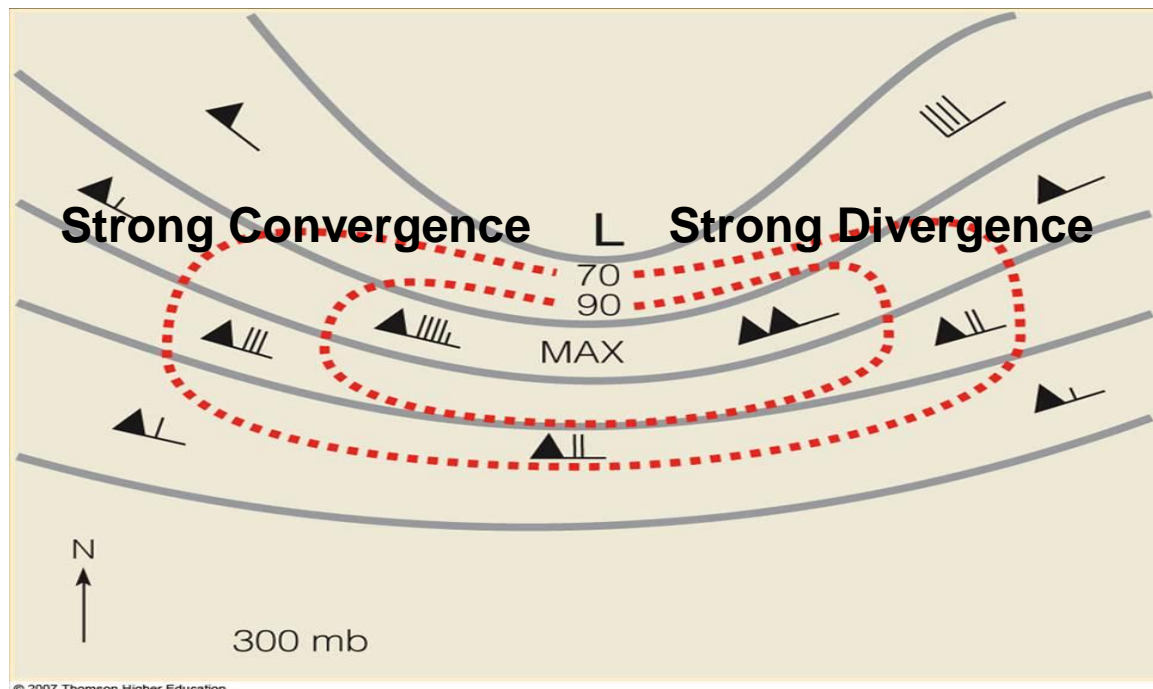
The Jet Stream: Divergence and Convergence

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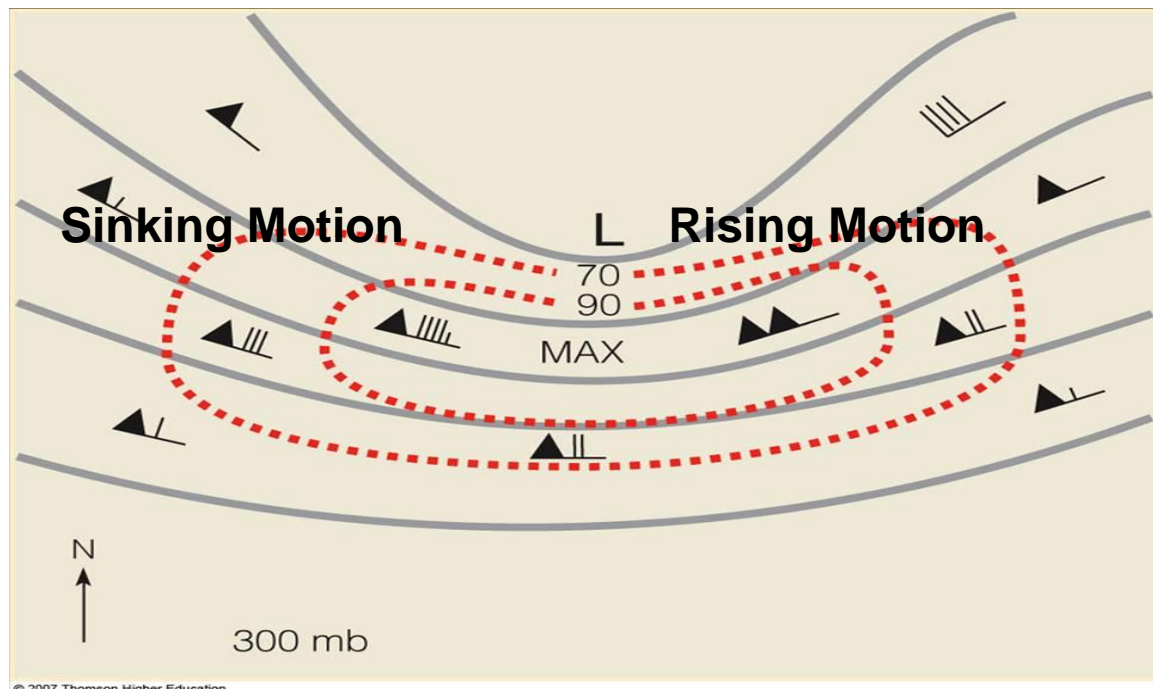
Convergence/Divergence and Vertical Motion

- In the upper atmosphere:
 - Convergence -> sinking motion
 - Divergence -> rising motion

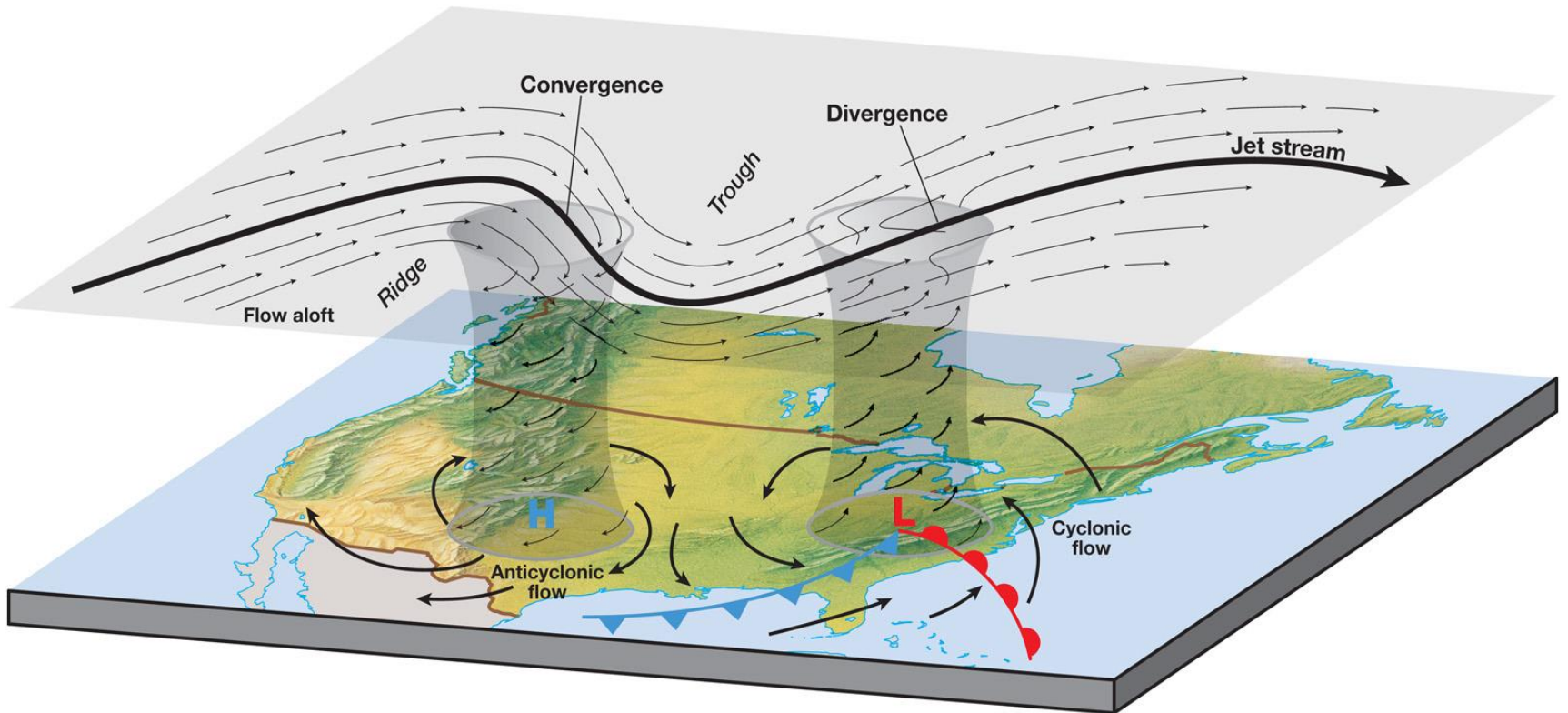


Convergence/Divergence and Vertical Motion

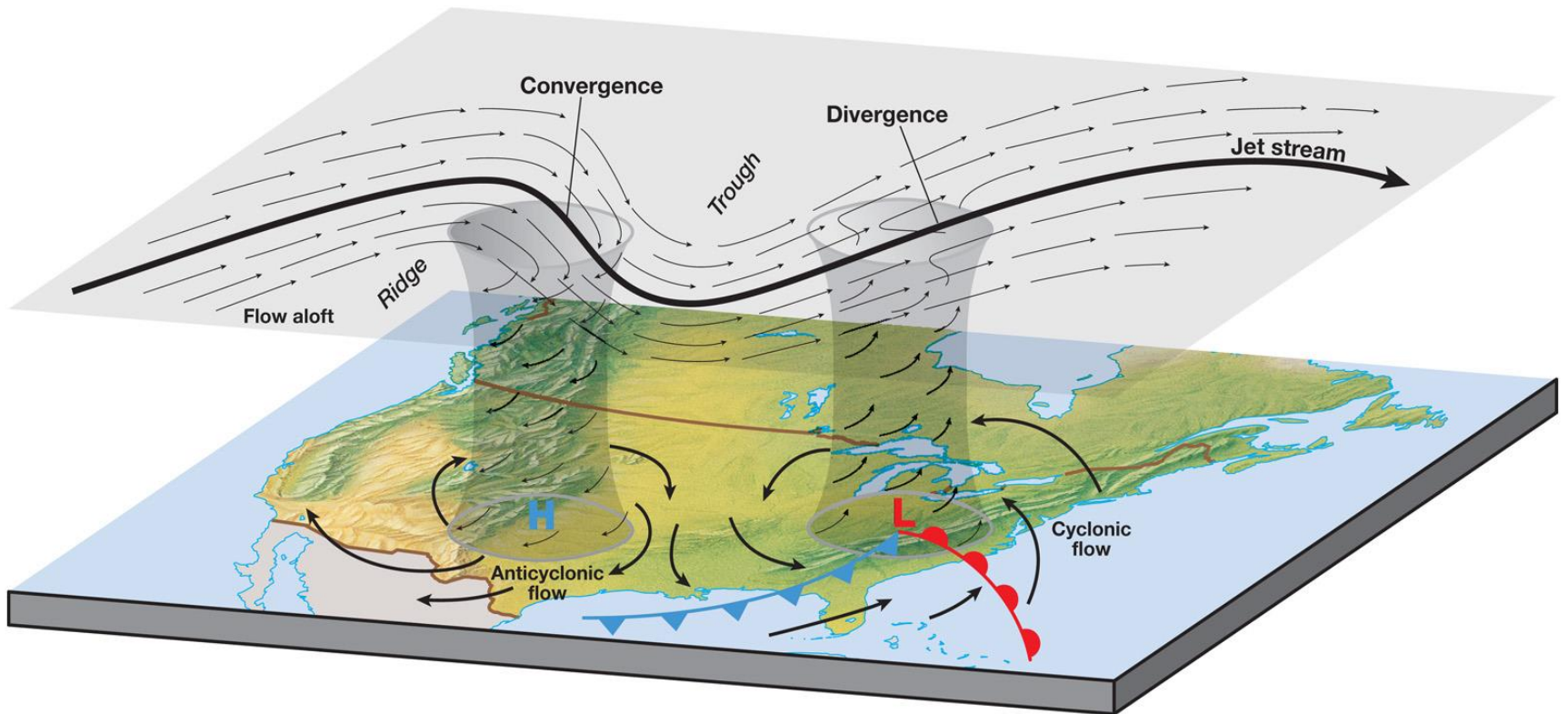
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The Connection between the Jet Stream and the Surface



The Connection between the Jet Stream and the Surface



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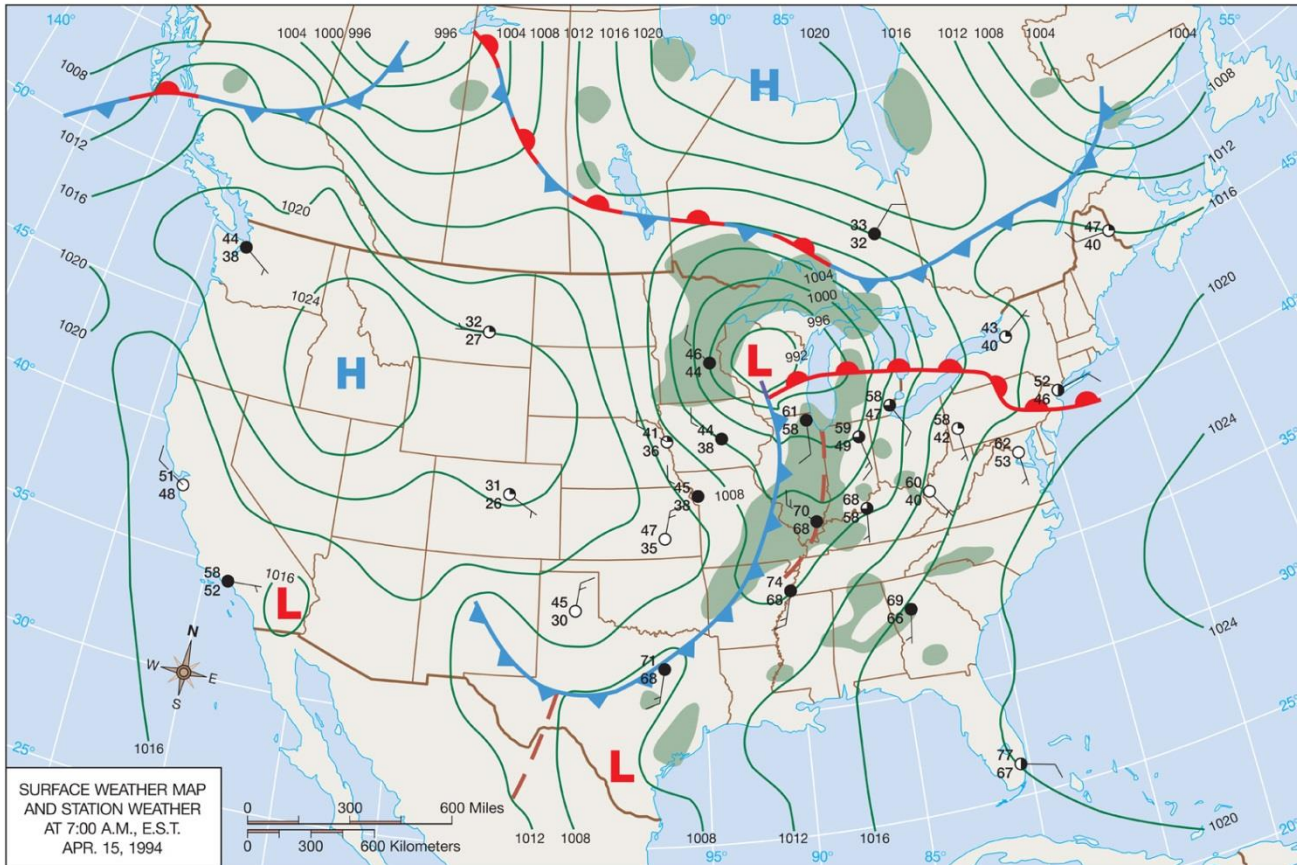


Positive feedback causes growth of cyclones...

Cyclone Motion

- Since cyclones are linked with jet stream troughs, they move with jet stream troughs
- Jet stream troughs are waves in the jet stream, and thus troughs move along the jet stream
- The jet stream thus outlines the **storm track**

Cyclones: An Example

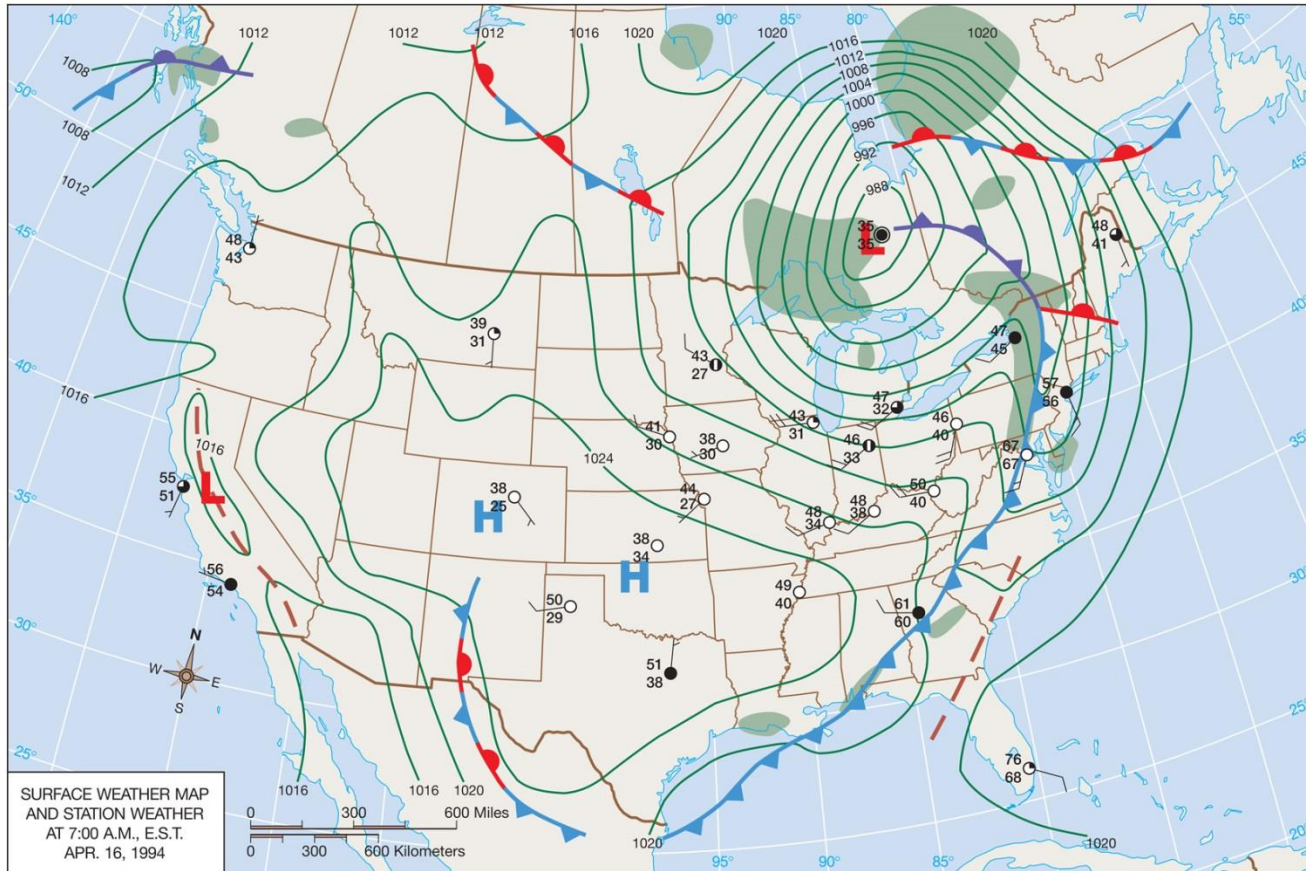


(a)

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Surface Weather – Day 1

Cyclones: An Example

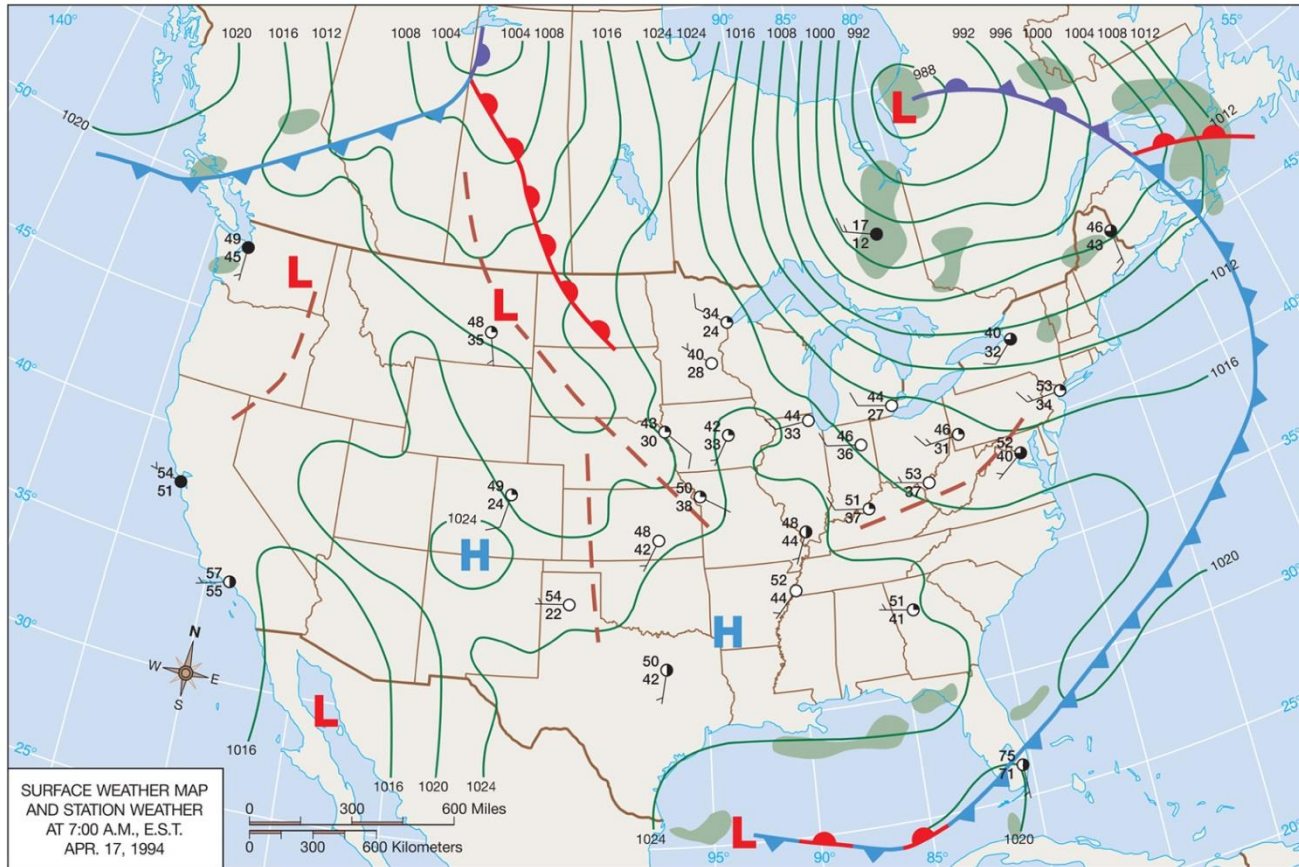


(a)

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Surface Weather – Day 2

Cyclones: An Example

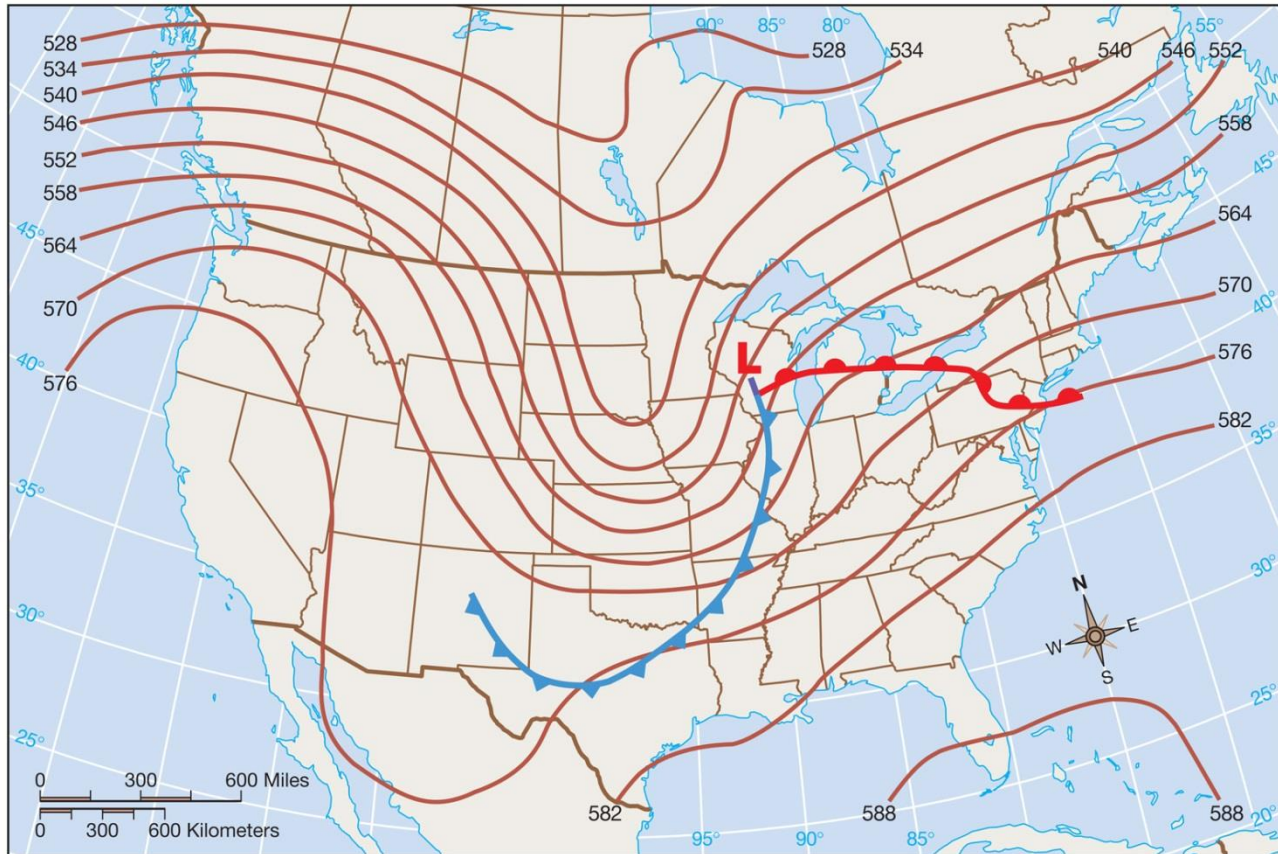


(a)

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Surface Weather – Day 3

Cyclones: An Example

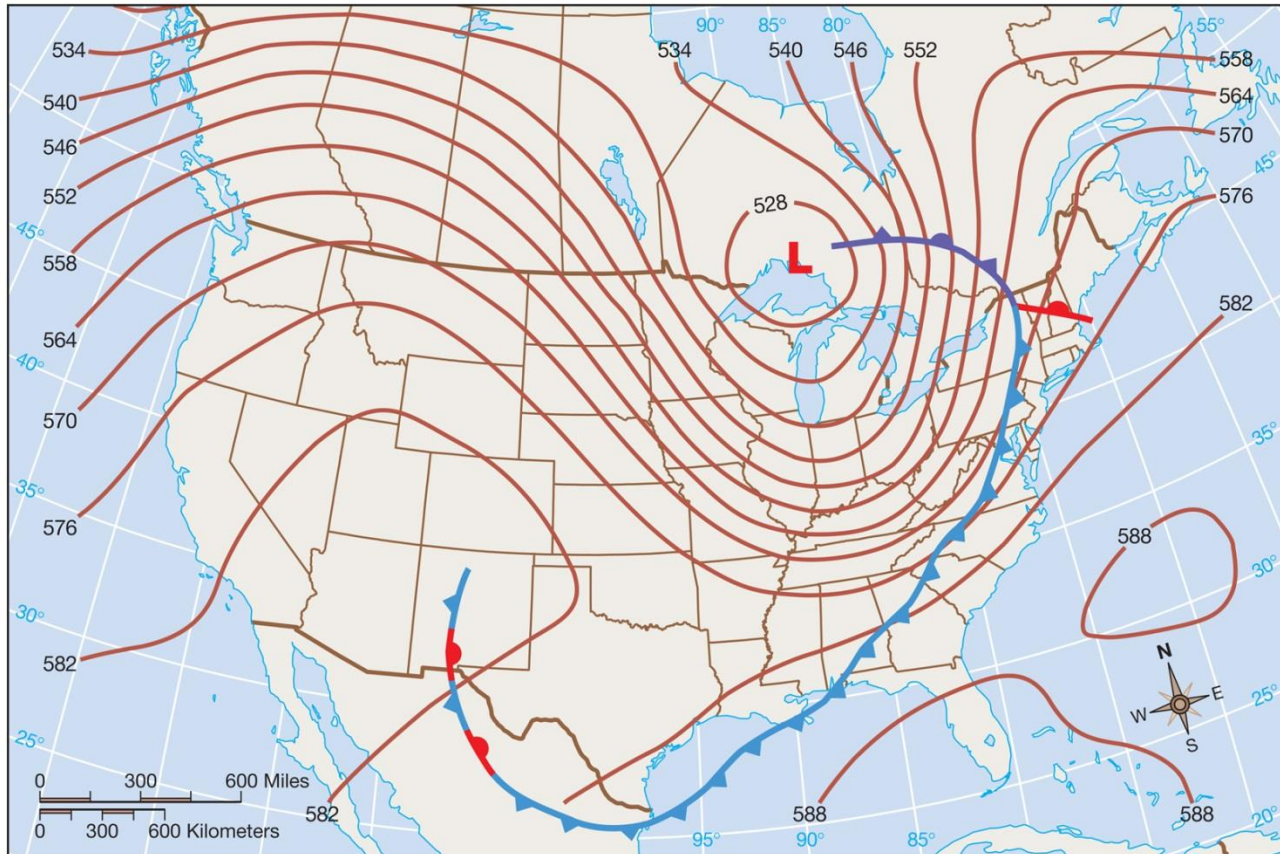


(b)

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500-mb flow/fronts – Day 1

Cyclones: An Example

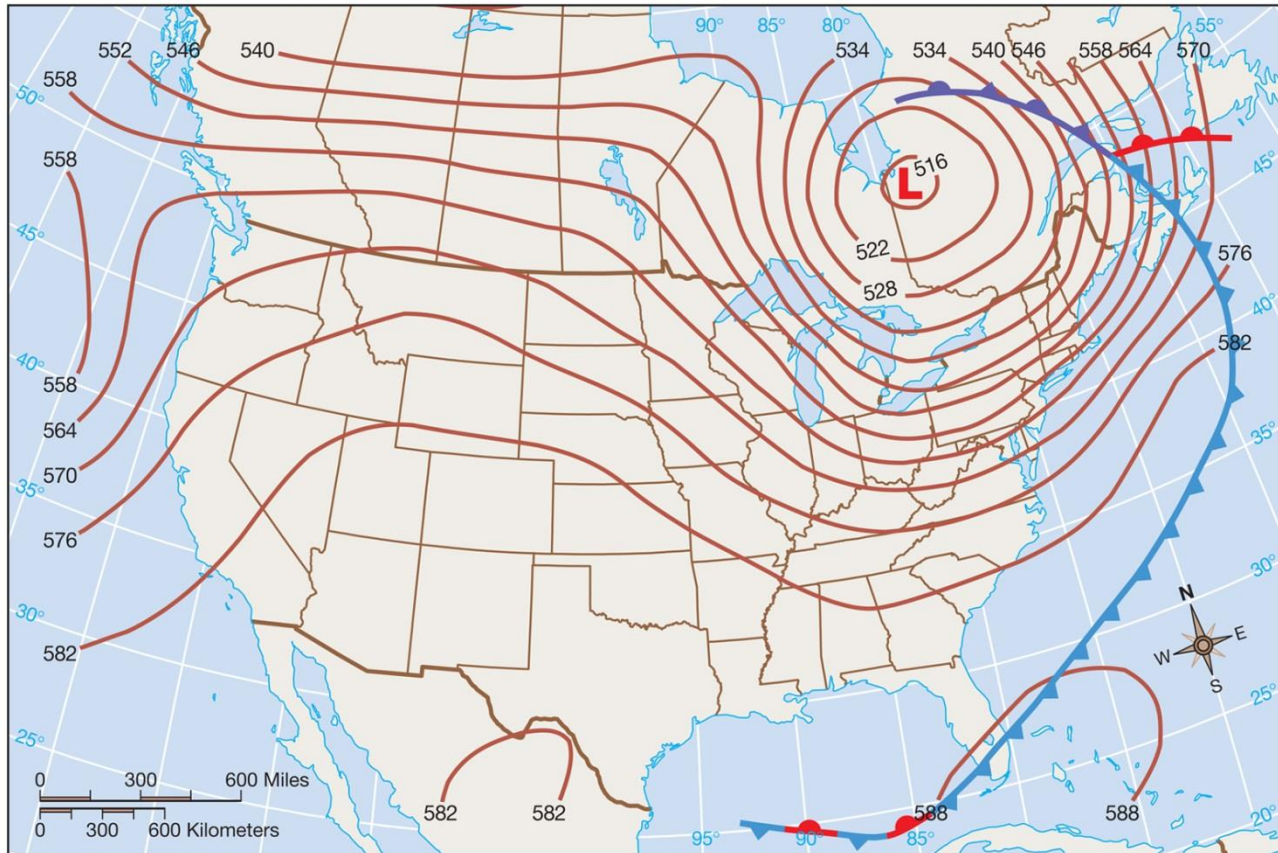


(b)

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500-mb flow/fronts – Day 2

Cyclones: An Example

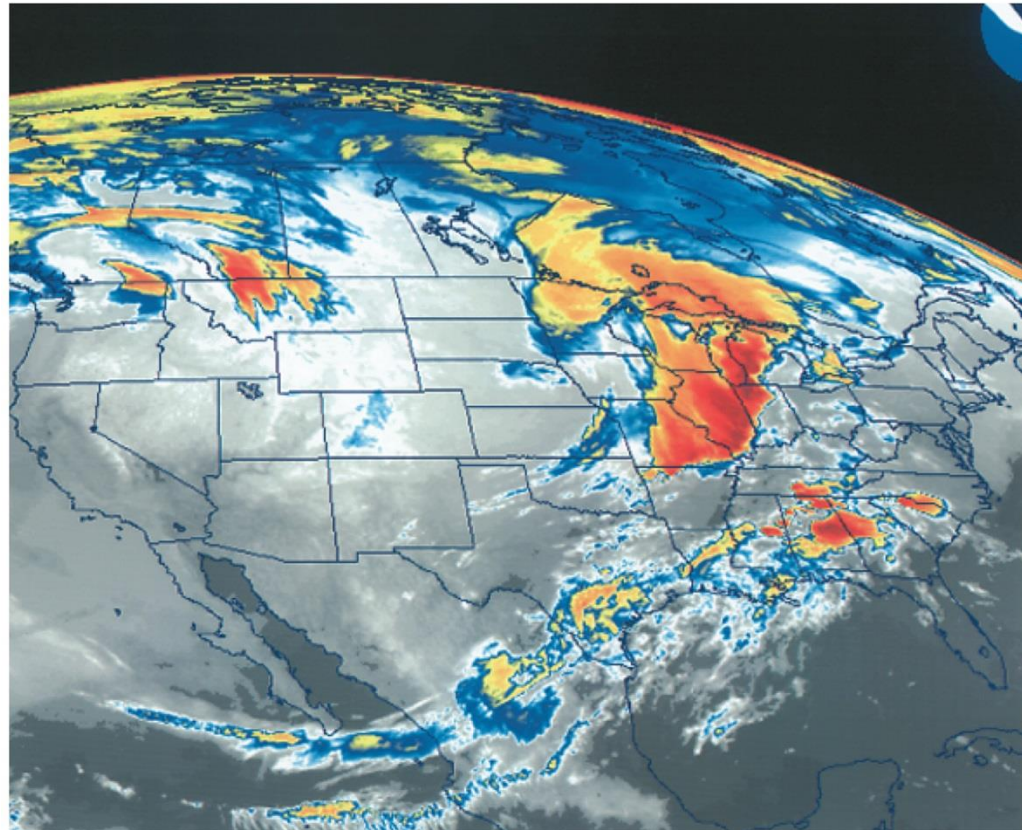


(b)

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500-mb flow/fronts – Day 3

Cyclones: An Example

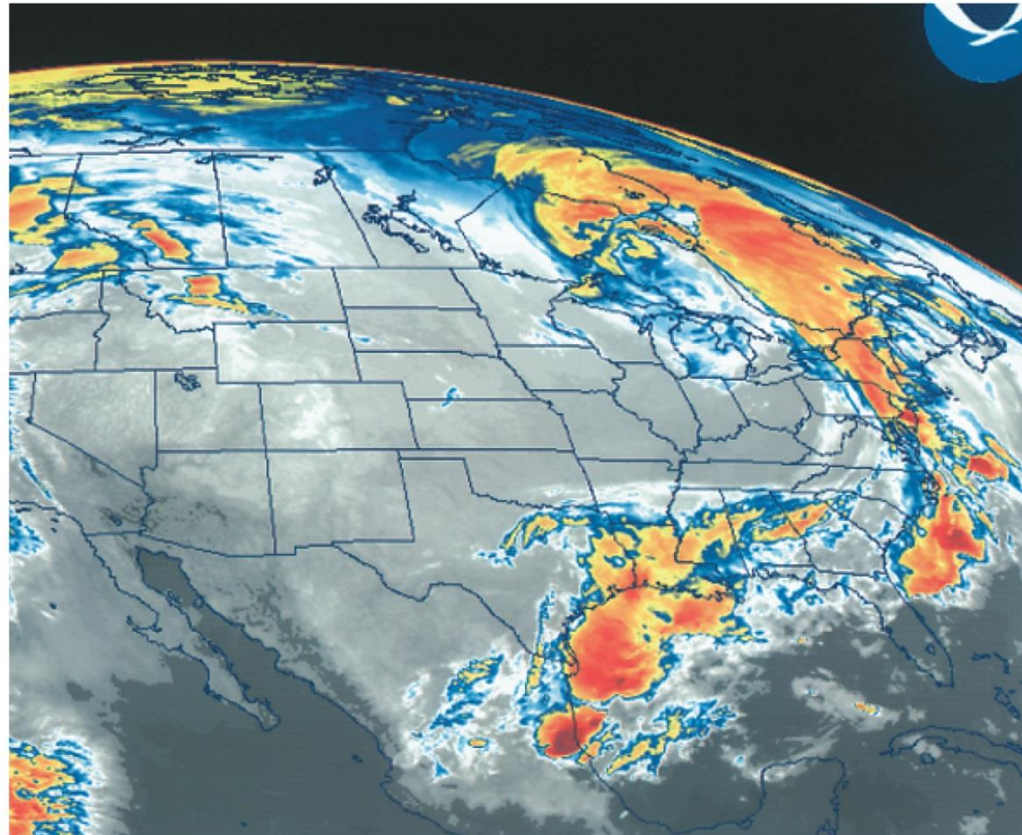


(c)

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IR satellite – Day 1

Cyclones: An Example



(c)

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IR satellite – Day 2

Cyclones: An Example

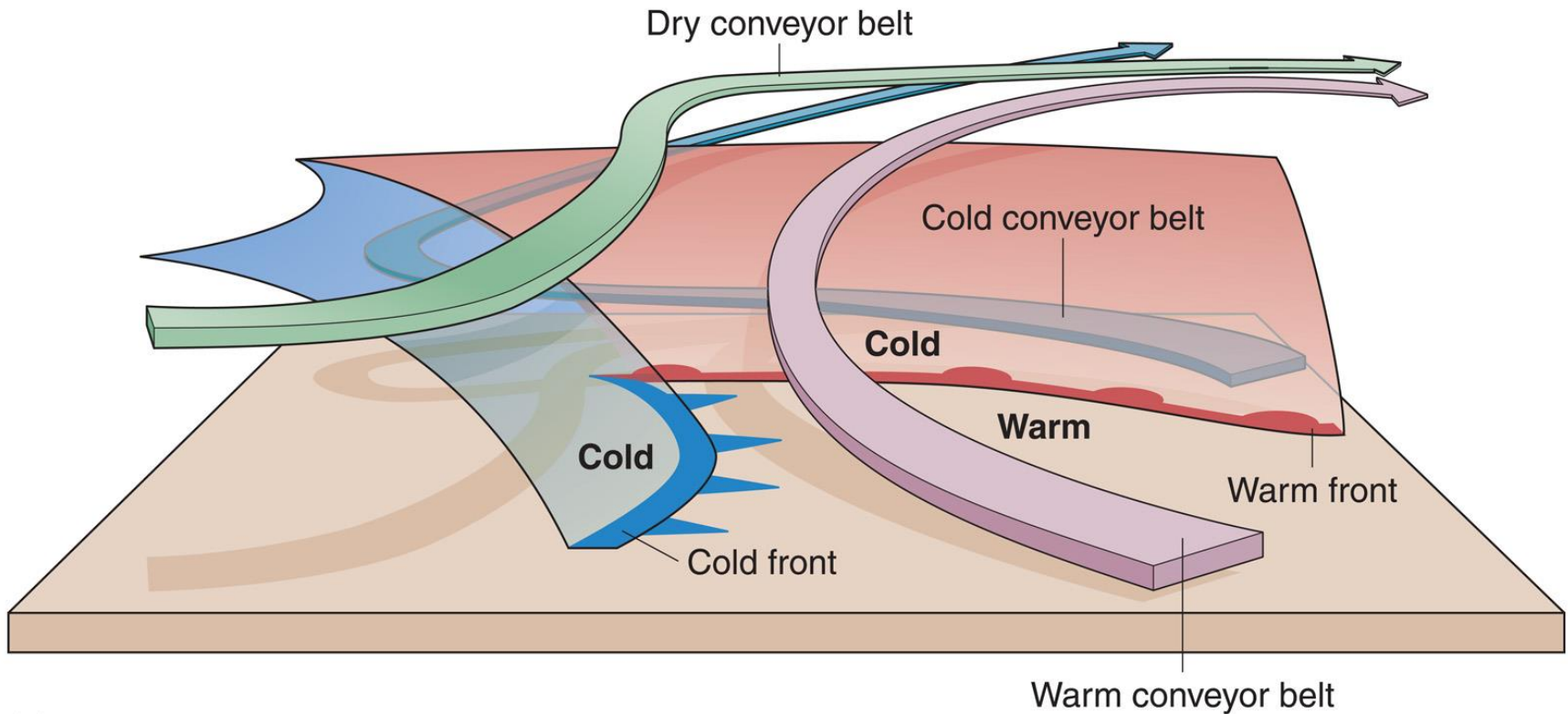


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IR satellite – Day 3

Cyclones and the Conveyor Belt Theory



(a)

Cyclones and Climate Change

- Climate change will likely be involved with changing temperature distributions globally
- Since these temperature distributions force the position of the jet stream (and storm track), typical cyclone tracks will likely shift
- Shifting cyclone tracks will likely lead to changes in average temperature and precipitation over the midlatitudes