Chapter 10 – Mid-Latitude Cyclones

Understanding Weather and Climate
Aguado and Burt

Mid Latitude Cyclone Life Cycle

- Polar front separates cold easterlies and westerlies.
Mid Latitude Cyclone Life Cycle

• A kink forms on the front and cold air starts to move southward. Warm air starts to move northward.
• Cyclogenesis occurs

Mid Latitude Cyclone Life Cycle

• Cold air continues to move south, and warm air north. Fronts develop and low pressure develops in the center.
Mid Latitude Cyclone Life Cycle

- Cyclone matures, warm and cold fronts become more established.

Mid Latitude Cyclone Life Cycle

- Cyclone occludes (end of life cycle) and cyclone decay starts
Precipitation Patterns

Vorticity

- Vorticity - the turning of an object usually with respect to the vertical direction.
- Relative Vorticity – vorticity relative to the Earth's surface
  - Speed Shear
  - Curvature
- Earth vorticity – Vorticity due to the Earth’s daily rotation about its axis.
• Clockwise rotation yields negative vorticity
• Counterclockwise rotation yields positive vorticity

• Related to convergence and divergence!
Divergence and Convergence

• Divergence aloft, caused by decreasing vorticity, draws air upward, providing a lifting mechanism that can initiate or help maintain surface low pressure.
• Convergence aloft, caused by increasing vorticity, promotes sinking air, and surface high pressure.

Divergence and Convergence

• Speed Divergence and Convergence
Divergence and Convergence

- Diffuence and Confluence

Linking Upper Levels to the Surface

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Linking Upper Levels to the Surface

- Upper-level divergence causes the formation and intensification of surface mid-latitude cyclones.
- Upper-level convergence causes high pressure at the surface.

Mid-Latitude Cyclone
Mid-Latitude Cyclone

(b)
Mid-Latitude Cyclone

Large-Scale Flow Patterns

• Zonal flow – upper level winds moving mainly west to east.
  – No vorticity
  – No divergence or convergence
• Meridional flow – upper level winds moving north and south
  – Provide for vorticity
  – Provide for convergence and divergence
Short Waves

- Smaller ripples superimposed on the larger scaled Rossby waves
- They can enhance or reduce the local divergence and convergence
- Formation is dependent on temperature advection
  - Warm air advection – horizontal movement of warm air
  - Cold air advection – horizontal movement of cold air

Barotropic Conditions

![Diagram](a)

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Baroclinic Conditions

• Cold Air Advection
• Warm Air Advection

The Result of Temperature Advection