Lecture 16. Upper Atmospheric Cyclone Structure

ET Cyclone mainly draws warm air up/poleward, cold air down/equatorward. Core of cyclone rotates counterclockwise, tilts westward with height.
Long and Short Waves

Long waves - 3000-5000 km ridge to trough, nearly stationary.

Short waves: 1000-2000 km ridge to trough, move with 500 mb winds. ...not always easily distinguishable.

Troughs: ‘cyclonic’ (counterclockwise - NH) spin of winds

Ridges: ‘anticyclonic’ (clockwise - NH) spin
Movement of Short Waves Through Long Waves

Figure 8.22
(a) Upper-air chart showing a longwave with three shortwaves embedded in the flow.
(b) Twenty-four hours later the shortwaves have moved rapidly around the longwave. Notice that the shortwaves labeled 1 and 3 tend to deepen the longwave trough, while shortwave 2 has weakened as it moves into a ridge.

EOM
Vorticity

- *Vorticity* is ‘spin’ of air parcel about vertical axis.

- Total or ‘absolute’ vorticity has two parts:
  - Relative vorticity = Spin of air relative to earth
  - Ambient vorticity = vertical part of earth’s spin

- Ambient vorticity is large at poles, zero at equator.

- Absolute vorticity only changed by stretching

![Diagram](image)

- More absolute vorticity
- Less absolute vorticity

- Positive ambient vort.
- No ambient vort
- Negative ambient vort.
Long (Rossby) waves

- Are set up by the pattern of oceans, land, and mountains around the globe.
- Involve little stretching or compression of air columns, so air keeps the same absolute vorticity as it moves from W to E throughout the wave.
- Named after a famous meteorologist of the 1920s and 1930s who was one of the first people to recognize the role of the jet stream in weather.
Storms crossing over the Rockies

When storms meet mountains
A simplified view of a storm as a spinning column of air shows why storms weaken as they move into high mountains, such as the Rockies, and then re-form or strengthen on the east side of the mountains.

1. As the storm approaches, it's a column of air from the ground to the bottom of the stratosphere, somewhat like an ice skater spinning with her arms over her head.

2. The bottom of the storm is pushed upward by the rising terrain while the bottom of the stratosphere acts like a lid on its top. The storm becomes a short, fat column of air — like a spinning ice skater with her arms extended, the storm's winds slow down.

3. As the storm moves across the mountains, its bottom follows the descending land. The storm turns into a tall, thin, spinning column of air — like the ice skater pulling her arms back in — and wind speeds pick up.

(TWB p 54)
Storm Tracks

- Surface lows disappear over the Rockies
- Low formation in lee of Rockies and Gulf of Mexico
- Cold highs descend from Canada behind storms