Behavior of Upper-Level Troughs and Ridges

Atmos 5110/6110

Synoptic–Dynamic Meteorology I

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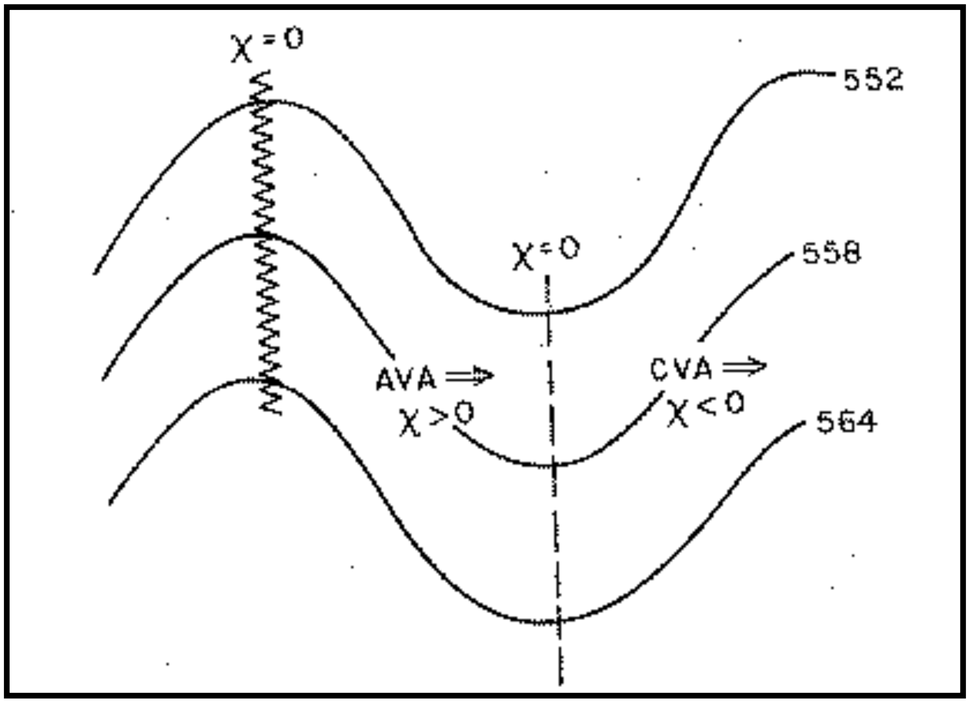
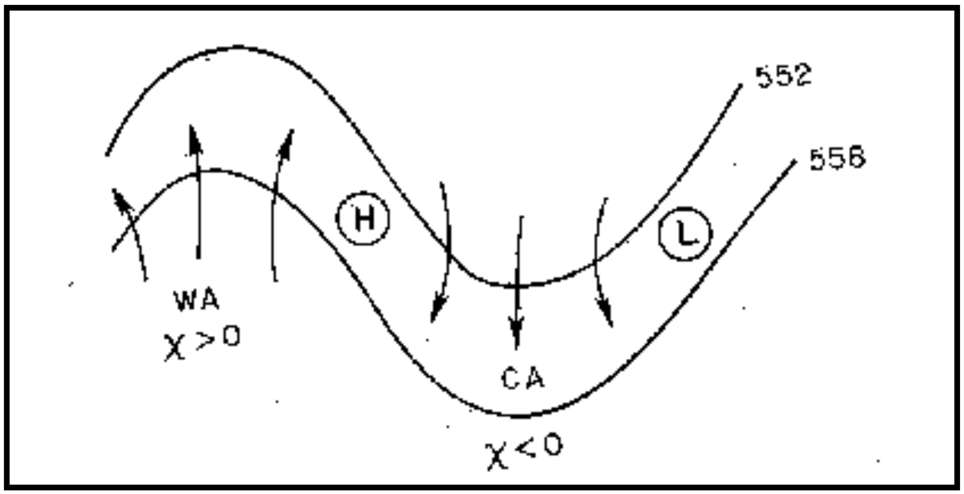
Effect of Vorticity Advection



Bluestein (1993)

- Idealized upper-level wave
- No geostrophic vorticity advection along trough/ridge axes
- Vorticity advection does not amplify wavetrain
- Vorticity advection results in eastward trough/wave movement

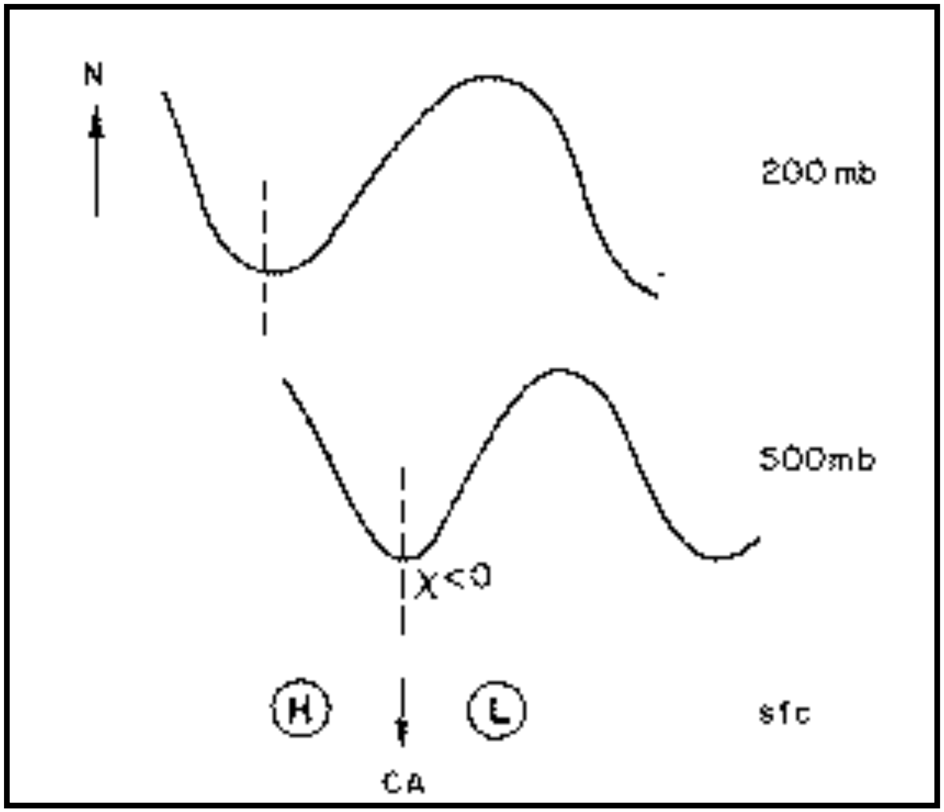
Effect of Temperature Advection



Bluestein (1993)

- Idealized upper-level wave with low-level low/high pressure systems
- Temperature advection deepens trough, builds ridge

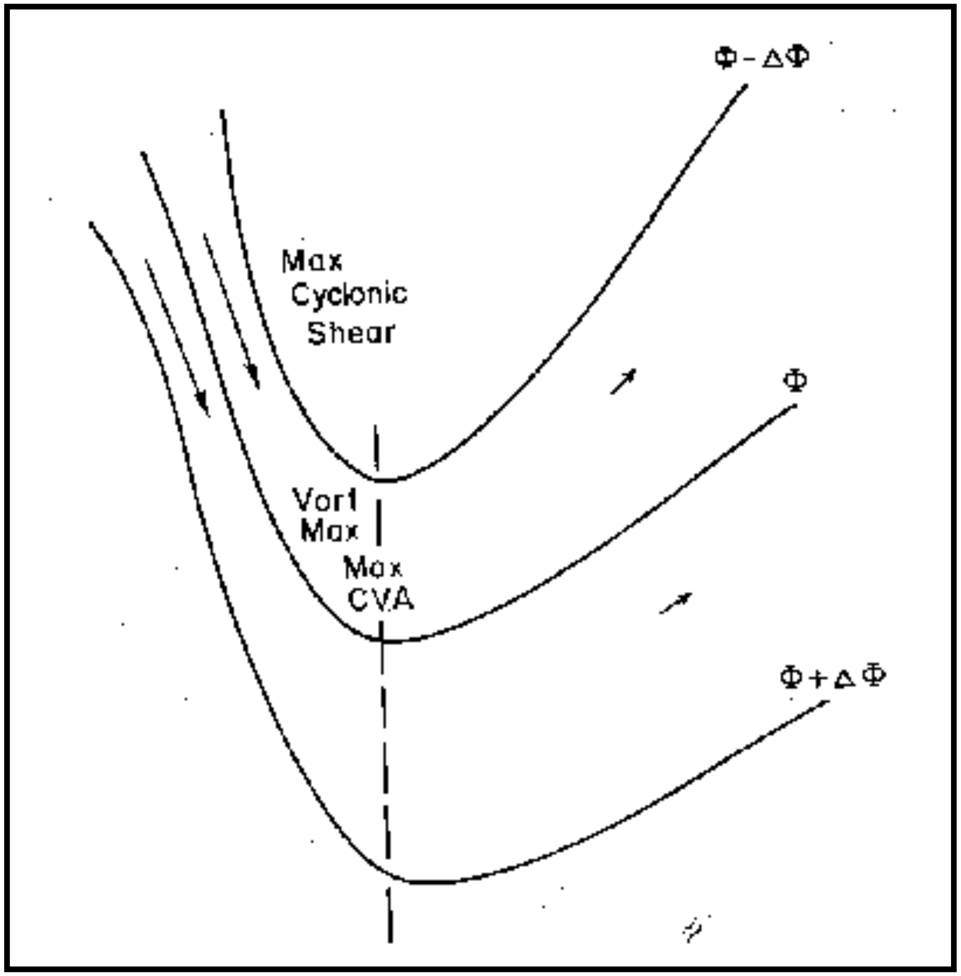
Effect of Vertical Tilt



Bluestein (1993)

- Low-level cold advection beneath 500-mb trough
- Upper-level warm advection above 500-mb trough
- Optimal situation for height falls in base of 500-mb trough

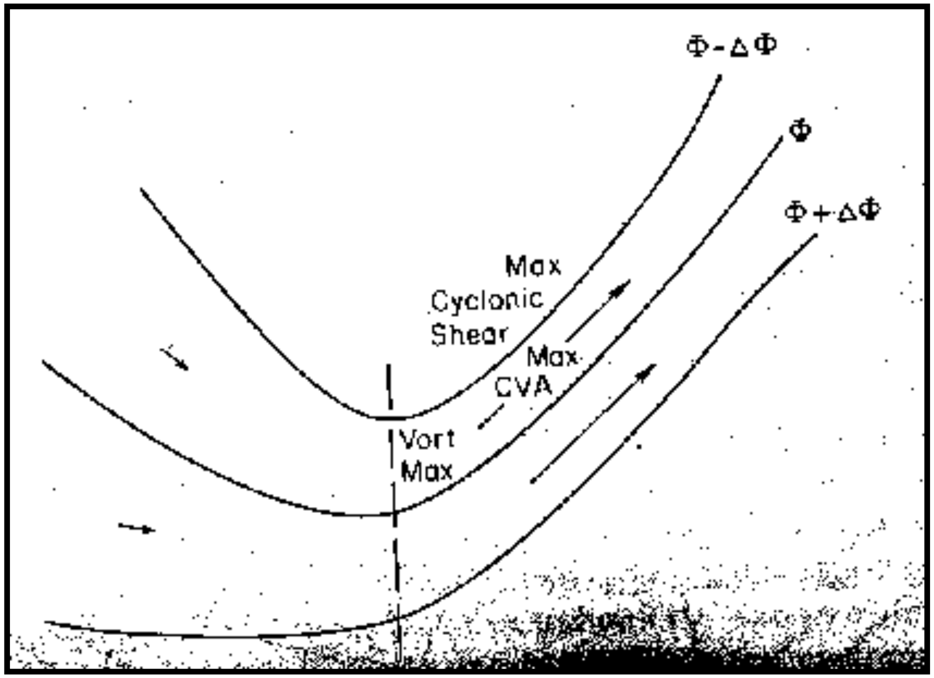
The Digging Upper-Level Trough



Bluestein (1993)

- Diffluent upper-level trough with upstream winds that are stronger than downstream winds
- Due to speed shear, vort max is now upstream of trough axis
- CVA and height falls are along trough axis
- Trough amplifies and has an equatorward component of motion ("amplify and dig")

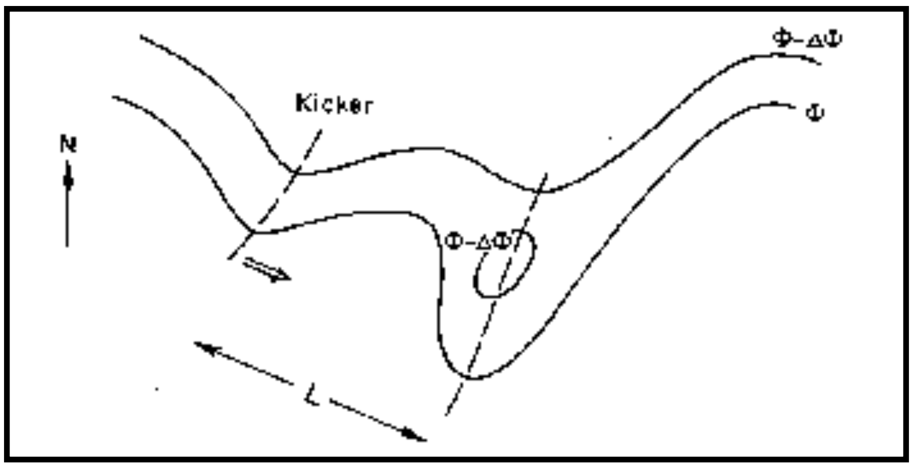
The Lifting Upper-Level Trough



Bluestein (1993)

- Confluent upper-level trough with downstream winds that are stronger than upstream winds
- Due to speed shear, vort max is now downstream of trough axis
- AVA and height rises are along trough axis
- Trough weakens and has a poleward component of motion (“lifts and fills”)

The Kicker



Bluestein (1993)

- Short-wave trough (the “kicker”) approaches stationary long-wave trough
- Wavelength shortens
- Stationary long-wave trough becomes progressive

Upper-Level Rules of Thumb

- Try explaining some of these with QG theory, Potential Vorticity, or Rossby-Wave Dynamics
- Always remember meteorology rules apply "Usually, Generally, Most of the Time"

Upper-Level Troughs

- Troughs tend to fill if there are slow wind speeds entering on the northwest side of the trough
- Cold advection from the surface to 500 mb entering the west side of a trough will deepen the trough
- Warm advection near the tropopause entering the west side of a trough will deepen the trough

Upper-Level Troughs

- If the AVA behind a trough is stronger than the CVA ahead of it, the trough is weakening
- If the CVA behind a trough is stronger than the AVA ahead of it, the trough is deepening
- Most short-wave troughs tend to follow the long-wave pattern
- The shorter the wavelength, the faster the trough

Cut Off Lows

- If an upstream ridge intensifies and assumes an "overlapping" orientation over the downstream trough, a cut-off low will form in the trough
- Strong northerlies entering the west side of a trough will deepen the trough, which may cut off
- If the strongest winds approaching an upstream ridge are from the southwest, the northern end of the downstream trough is often sheered off, leaving a cut-off in the southwest U.S.

Cut Off Lows

- When cut-off or closed lows move, they tend to move over the lowest elevation regions

- A strong jet stream rounding the southern periphery of a cut-off may kick the cut-off out

Upper-Level Ridges

- Lower-to-middle tropospheric warm advection moving into the western part of a ridge will build the ridge

- Upper-tropospheric cold advection moving over the western part of a ridge will build the ridge

- Lower-to-middle tropospheric cold advection moving into the western part of a ridge will weaken the ridge

Upper-Level Ridges

- Upper-tropospheric warm advection moving over the western part of a ridge will weaken the ridge
- When a ridge builds in the western Gulf of Alaska, expect a ridge to build over the western United States
- A Gulf of Alaska ridge can be anticipated when a deep trough develops over the western Pacific Ocean