

Chapter 13, Part 3

Vorticity

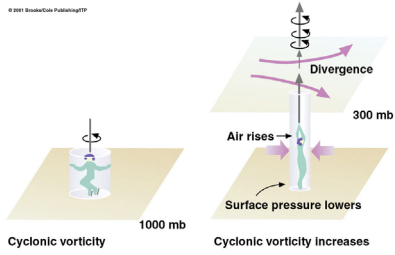
Motivation

- Where is there upper level air support?
- Identify regions where air is diverging to enhance surface lows.
- One answer is to look at vorticity.

What is vorticity?

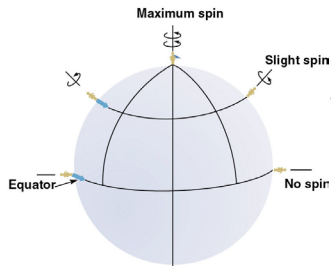
- Vorticity is a measure of the horizontal spin of small air parcels.
- When viewed from above,
- Counterclockwise = cyclonic = positive vorticity
- Clockwise = anticyclonic = negative vorticity

Vorticity and Divergence Aloft



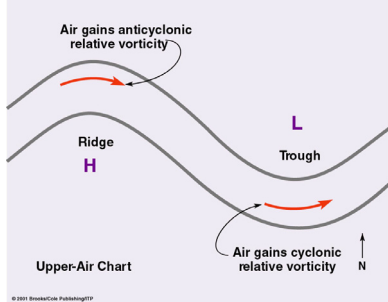
- At a surface low there is positive vorticity.
- As the air rises, the vorticity increases because the column shrinks in diameter.

Earth's Vorticity



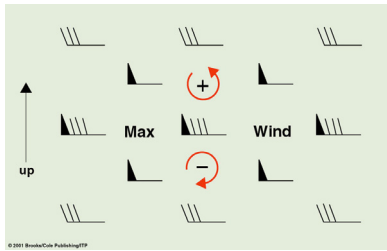
- The earth's rotation creates vorticity, which is a maximum at the poles and zero at the equator.

Relative Vorticity - Curvature



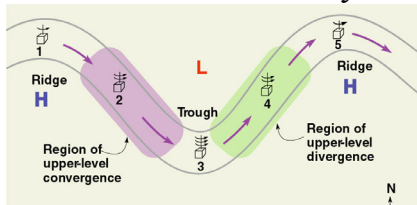
- Relative vorticity is caused by curving airflow (shown) and by wind shear (next slide).

Relative Vorticity – Shear



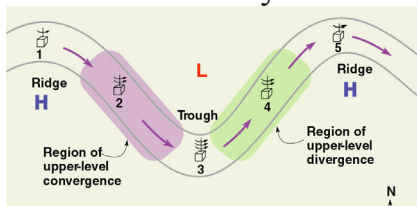
- Differences in wind speed in the horizontal direction (wind shear) also creates relative vorticity.
- To see this imagine traveling with the wind.

Absolute Vorticity



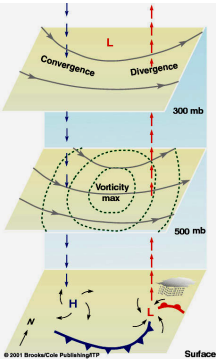
- Absolute vorticity is the sum of the earth's vorticity and relative vorticity.
- The earth's vorticity is larger so even around a high the absolute vorticity is positive.

Absolute Vorticity Maximum



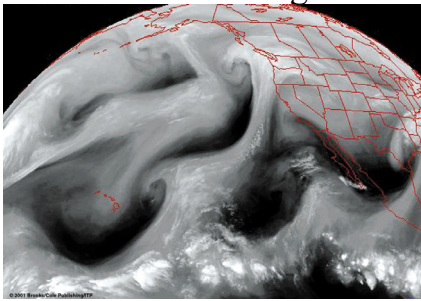
- The maximum vorticity occurs at the low trough in between regions of convergence and divergence.
- Vorticity increases in converging region and decreases in diverging region.

Vorticity and Surface Weather



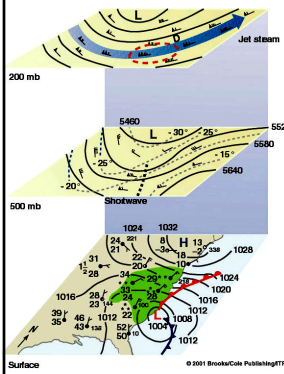
- Vorticity positive even near H.
- Vorticity maximum at L trough in between surface H and L and also in between upper level convergence and divergence.

Satellite Image



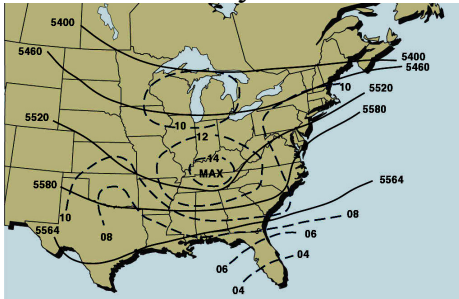
- Satellites equipped to observe atmospheric water vapor.
- Note: max vorticity off Oregon coast. ITCZ.

Atmospheric Conditions 2/11/83



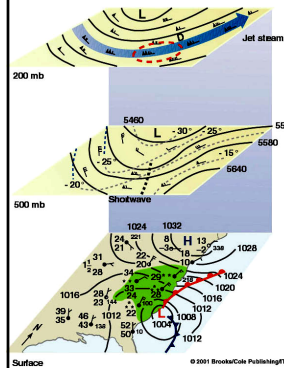
- Open wave cyclone off NC
- Warm sector in ocean
- To west longwave L trough with shortwave moving through it creating baroclinic instability.
- Vorticity maximum at L trough to west of surface L.

Vorticity 2/11/83



- Vorticity is a maximum over L trough and to the west of surface low.

Storm Development

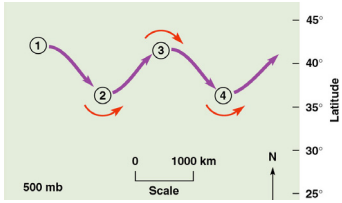


- Winds aloft steer storm northeastward,
- but H to the north slowed the progress,
- allowing the storm to intensify by upper level divergence.
- Result: Blizzard of '83
- 2 feet or more of snow in eastern states. My school was cancelled for one week!

Links to the Blizzard of '83

- [East Coast Winter Superstorms](#)
- [Snowfall Summary for the Northeast](#)
- [Weather.com Encyclopedia](#)
- [President's Day Snowstorm](#)
- [All About Snow](#)

Vorticity and Longwaves

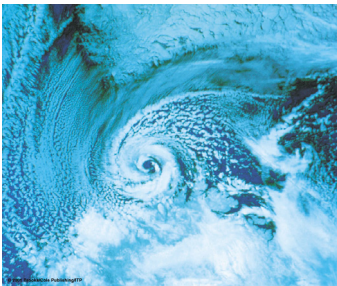


- If neglect convergence and divergence of air, then absolute vorticity of air is conserved.
- Absolute vorticity = earth's vorticity + relative vorticity
- Point 2: earth's vort. decreased, relative vort. increased
- Point 3: earth's vort. increased, relative vort. decreased

Polar Lows

- There are storms beyond (poleward) the main polar front – called polar lows.
- Form in winter (Nov. – March) when surface air over land is very cold.
- When this air comes into contact with warmer air resting over ocean, creates an arctic front.
- As before warm air rising and cold air sinking creates a storm.

Picture of Polar Low



- Polar lows can have a comma-shaped cloud band or they can have an eye which those of hurricanes.

Summary

- Vorticity is a measure of the spinning of air parcels in the horizontal direction.
- The earth's vorticity and relative vorticity add to make the absolute vorticity.
- A vorticity maximum occurs near a low trough and to the west of surface low of a middle latitude cyclone.
