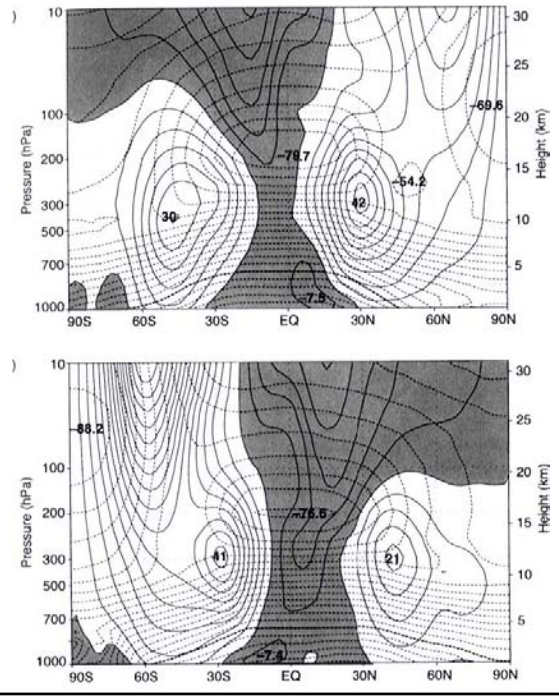
Key concepts for today

- Define vorticity
- Look at circulation theorem (Kelvin, and Bjerknes')
- Skoke's theorem (reminder… more later)
- Vorticity conservation for isentropic flow



Westerly wind and temperature

Temperature and wind field related (thermal wind balance)

i.e., $\partial u/\partial p \sim \partial T/\partial y$

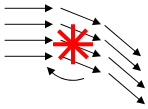
•Knowing temperature gradient, estimate jet.

•Knowing jet, estimate gradient.

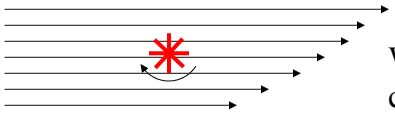
Vorticity

Vorticity is the measure of spin and rotation in a fluid at a point
(*c.f., circulation, which is the rotation for some region of fluid*)

Vorticity is defined as the curl of the velocity: $\nabla \times \mathbf{V}$



Wind direction varies → clockwise spin

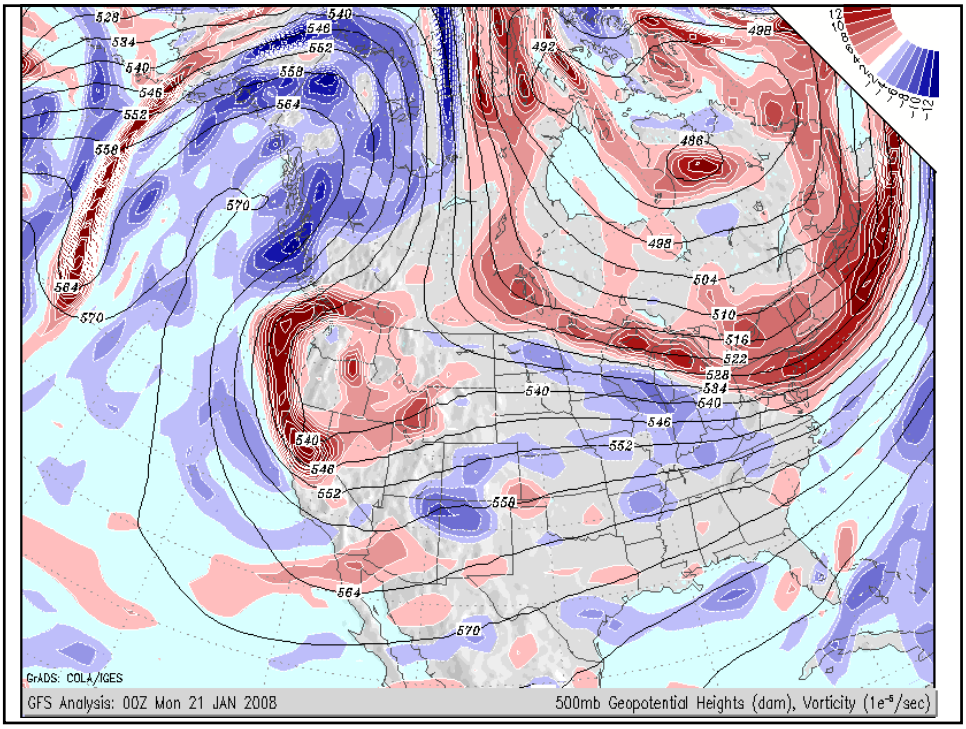


Wind speed varies → clockwise spin

Absolute vorticity (inertial reference frame): $\boldsymbol{\eta} \equiv \nabla \times \mathbf{V}_a$

Relative vorticity (relative to rotating earth): $\boldsymbol{\zeta} \equiv \nabla \times \mathbf{V}$

Note, $\boldsymbol{\zeta}$ and $\boldsymbol{\eta}$ are vectors



Homework

- Consider a cylindrical tank with a flat bottom that is partially filled with water that rotates around its central axis and derive an expression for the height of the surface.
- Under what conditions are Rossby's potential vorticity, which is an approximation of Ertel's potential vorticity equivalent in the atmosphere?
- Consider the rotating tank from above. Assuming the water is isothermal, how much would the (relative) vorticity of a column change if it is moved 0.5 m from the center toward the perimeter and if potential vorticity is conserved?
- Browse though Charney's 1948 paper that outlines scale analysis (PDF on web class site). Why does he call it potential vorticity? What is the physical interpretation?
- Detailed assignment posted on web as usual