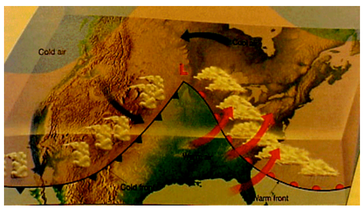
Midlatitude Cyclones

Equator-to-pole temperature gradient tilts pressure surfaces and produces westerly jets in midlatitudes

Waves in the jet induce divergence and convergence aloft, leading to surface highs and lows

Surface circulations amplify the wave by transporting heat to the north and south around the surface low



Resulting "cyclones" are crucial to the transport of energy through the middle latitudes

Lowers center of mass of atmosphere

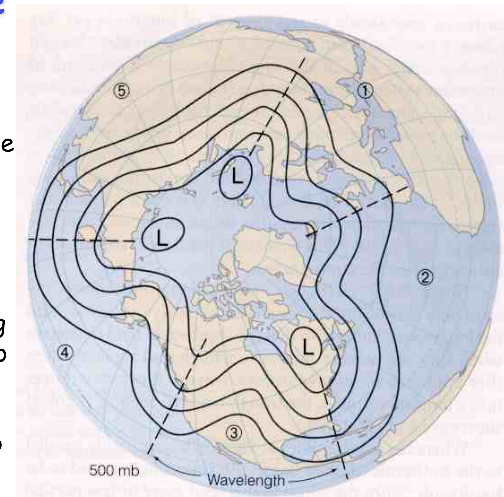
Large-Scale Setting

Very cold (and dark!) near the pole

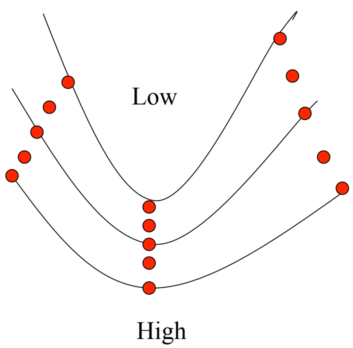
Polar air is dense and "shrinks" to form a hollow bowl

Warmer air moving into bowl spins into a big jet stream

Jet wobbles in 4-6 "long waves



Convergence and Divergence

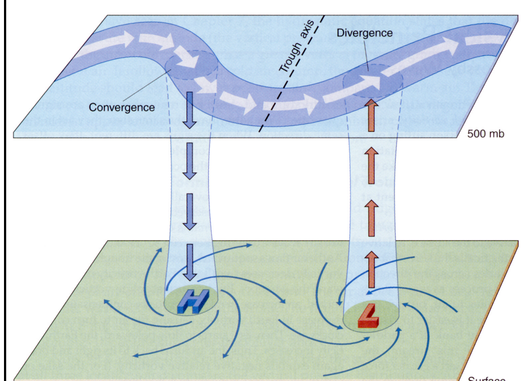


500 mb height

What initiates "cyclogenesis?"

*When upper-level **divergence** is stronger than lower-level **convergence**, more air is taken out at the top than is brought in at the bottom. Surface **pressure drops**, and the **low intensifies**, or "deepens."*

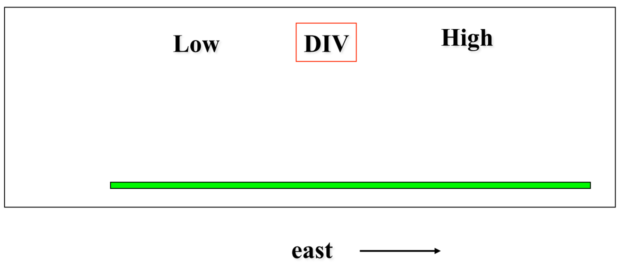
Divergence, Spin, and Tilt



- Maximum upper level convergence and divergence are *between* ridges and troughs
- Phase of developing wave "tilts" to the west with height

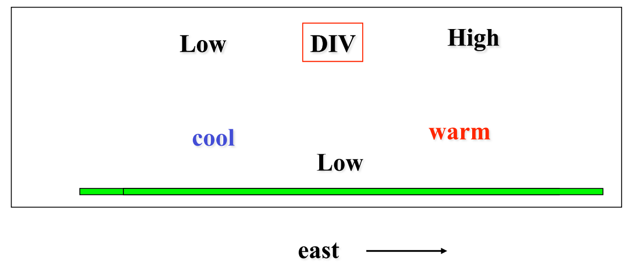
Before the Storm

- Vertical cross-section looking North
- Imagine a jet-stream wiggle passes overhead
- Where will surface low develop?



Birth of a Storm

- Surface winds respond to surface pressure gradient … transport cold air southward behind the low and warm air northward ahead of low
- This amplifies the upper level trough and ridge
- Enhances upper-level divergence



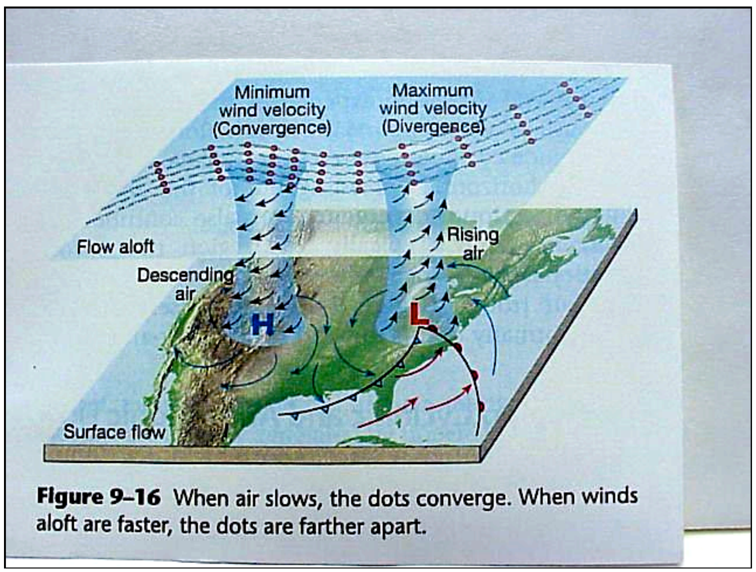
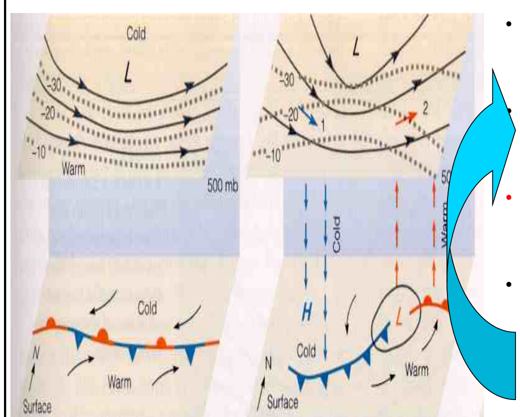


Figure 9–16 When air slows, the dots converge. When winds aloft are faster, the dots are farther apart.

How to "Grow" a Storm



- Upper level shortwave passes
- Upper level divergence -> sfc low
- Cold advection throughout lower troposphere
- Cold advection intensifies upper low
- Leads to more upper level divergence

Temperature advection is key!