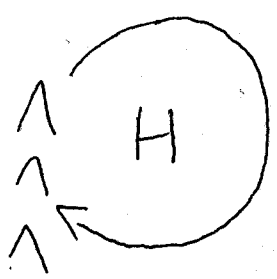
Impact of Terrain on Surface Features ①

- in North America, major mountain ranges are oriented ~ north-south ↑↑↑
  - → polar air masses can move equatorward (and tropical airmasses can move poleward) without impedement
- also, have large land mass in polar region (source for very cold air masses)

Implication: lower latitudes of North America can experience surges of extreme cold air

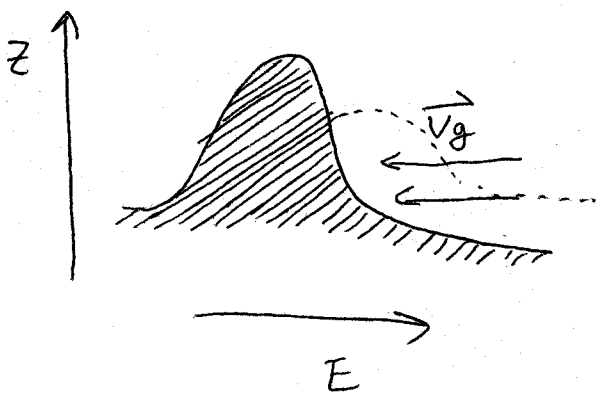
- these cold surges can be enhanced by phenomenon called "cold air damming" (CAD)

How Cold Air Damming Works



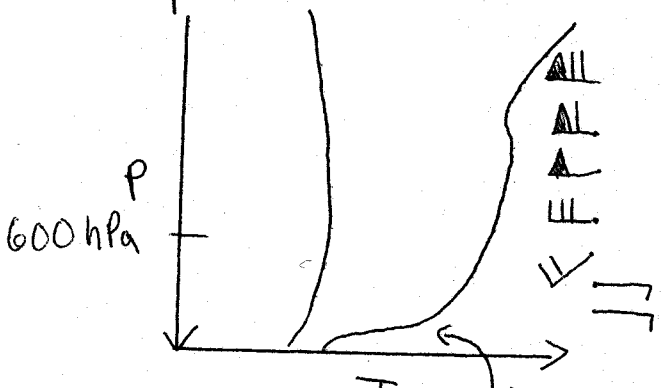
- have relatively cold air associated with high pressure east of a N-S mountain range (e.g., the Rockies)
- geostrophic flow produces upslope

- looking at a vertical cross section of this situation:



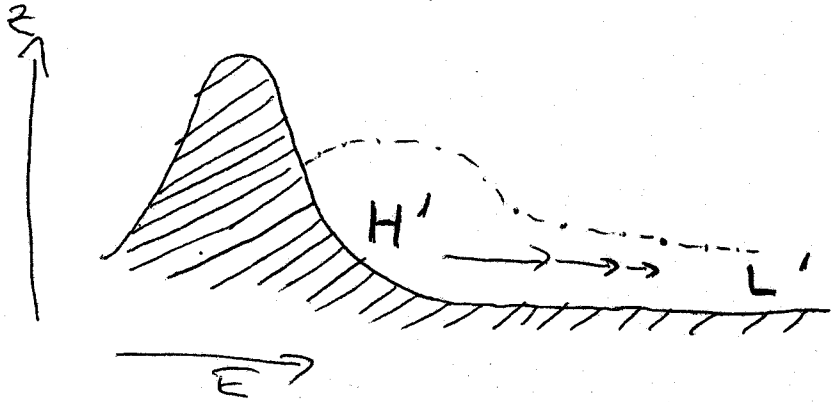
- air cannot cross mountains in situations where static stability is high

representative sounding



inversion → high static stability ($\sigma >> 0$)

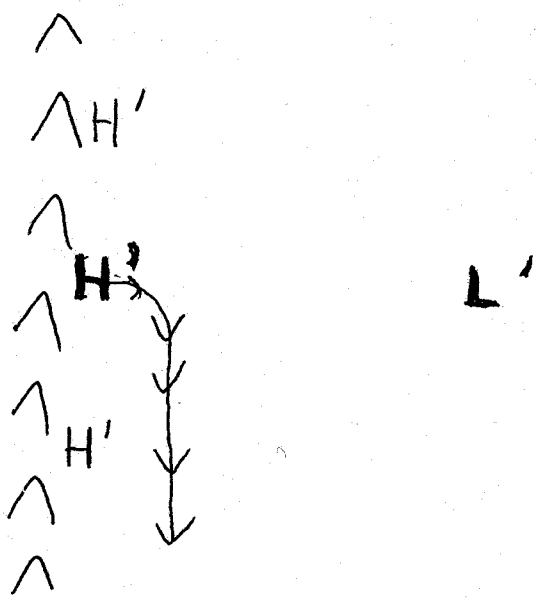
- since flow is blocked, air builds up on eastern slope of barrier
  → produces a perturbation in mass field (a perturbation surface high)



- sets up a perturbation PGF

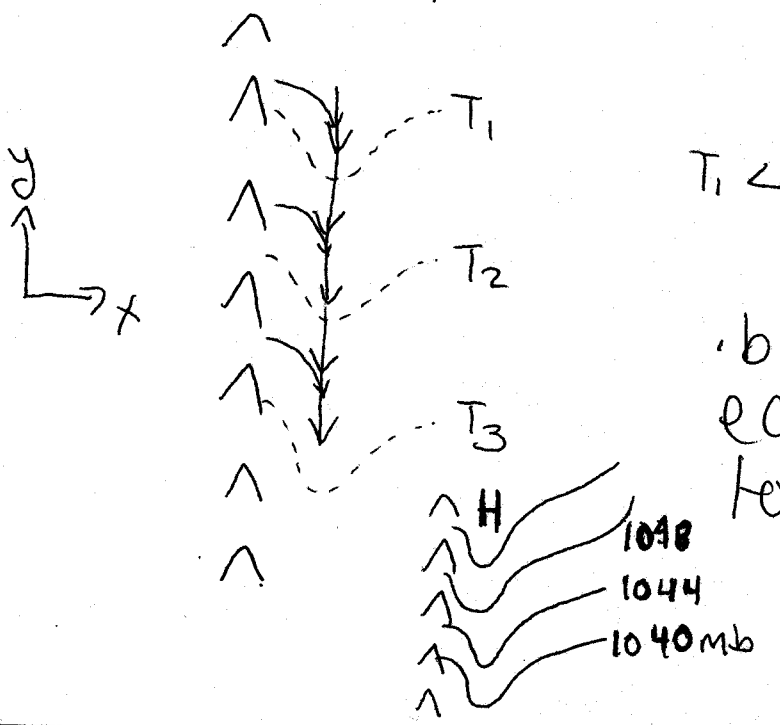
- perturbation wind (ageostrophic wind) is directed from H' to L' before being torqued to the right by Coriolis force

- from above:



- a northerly jet develops at low levels

→ cold air is advected even farther south!



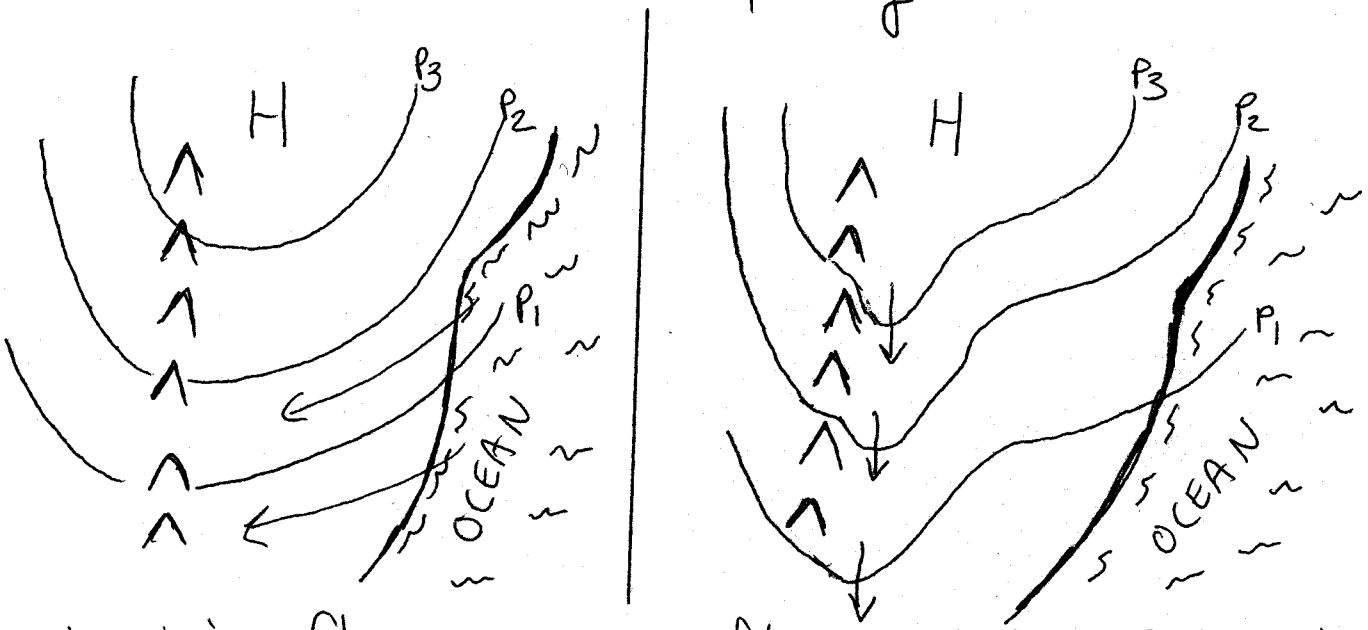
$T_1 < T_2 < T_3$

- build up in mass on eastern slope leads to bulge in isobars (in addition to isotherm bulge)

3 Reasons Why Cold Air Damming is Critical Ingredient in NE Snowstorms

① Helps lock in cold air.

- northerly along-barrier wind associated with perturbation PGF provides:
  - cold air source
  - keeps low-level onshore flow from developing



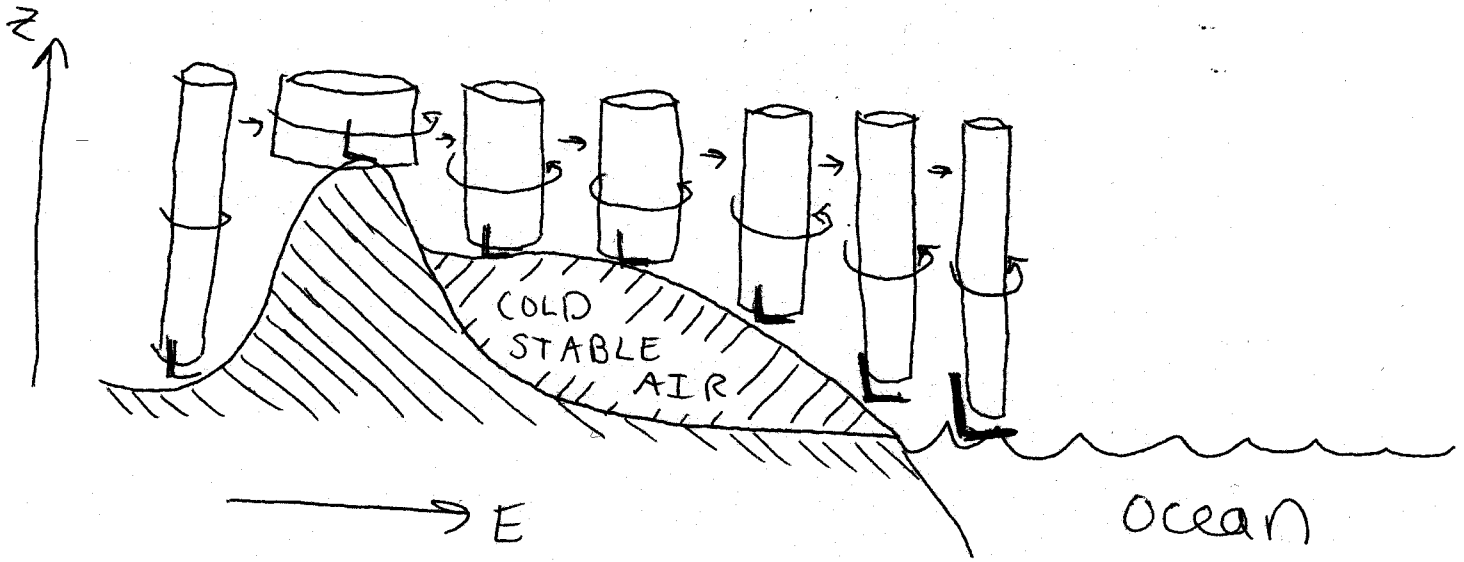
geostrophic flow -vs- flow with cold air damming

- precipitation type can remain frozen longer

② Promotes cycloqenesis just offshore rather than inland.

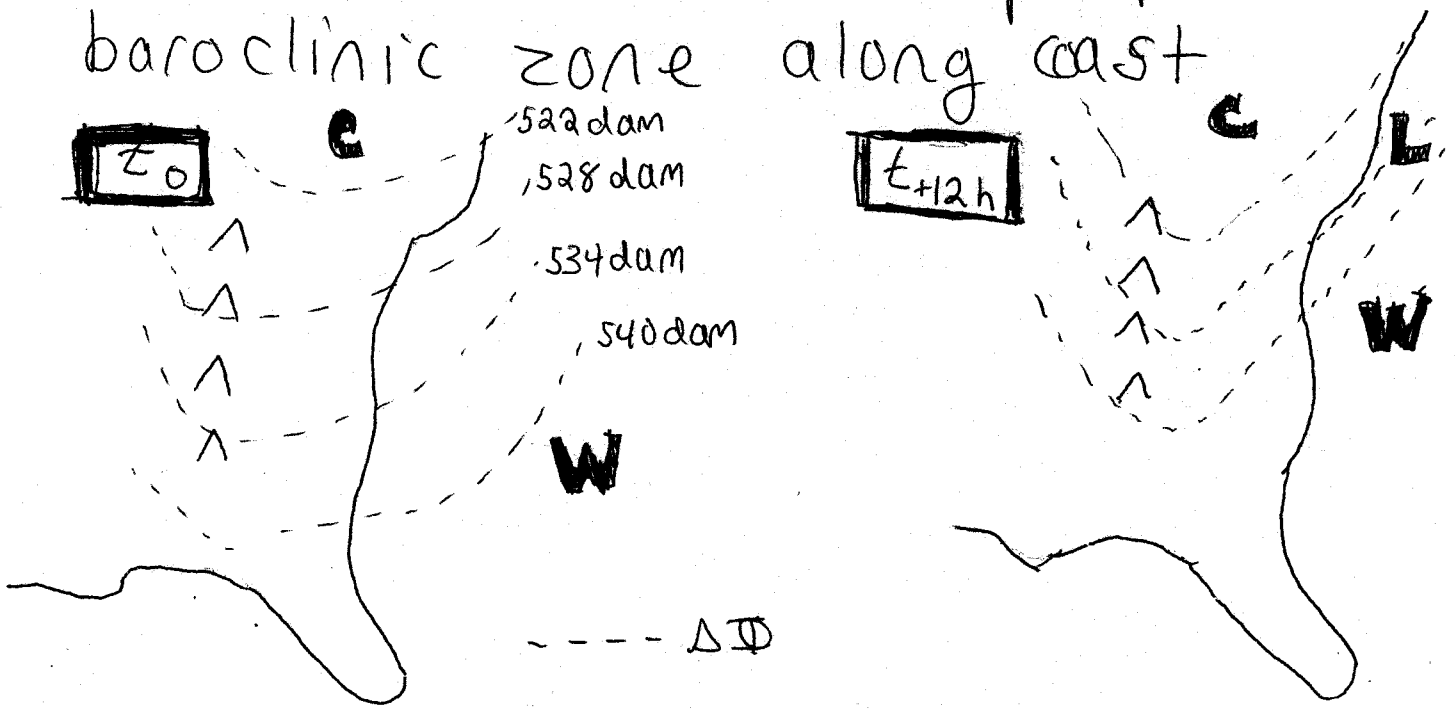
'cold, stable air acts like terrain

→ vortex tube doesn't spin up until it reaches the ocean



③ creates coastal front.

'also, cold air mass helps produce baroclinic zone along coast



- at some later time after arrival of the cold air mass, the air over the Gulf Stream modifies more quickly than over land

→ produces baroclinicity along the coast

(thickness contours cluster along the coast)

- cyclogenesis tends to occur in baroclinic zone

→ bombogenesis offshore instead of inland!