9/22/20

Colle & Mass 1995 MWR review, 2 case studies, composite synoptic cond'x.

→ A wave → propagation? Or a density/gravity current → transport of material sfc

1. Kelvin waves

$U = 0$ at $x = 0$

along-barrier accelerations ($CoF \to 0 \Rightarrow PGF$ dominant)

linear gravity waves: $c = \sqrt{g \frac{\Delta\rho}{\rho} H}$

H = depth of "undisturbed" layer ρ_2 / ρ_1 ↓ H

$$L_x = \frac{\sqrt{g \frac{\Delta\rho}{\rho} H}}{f}$$

usually 100s of km (but, ~ 1000 km or more observed)

nonlinearities $V_0 \frac{\partial V_g}{\partial y}$ → sharpening of wave

surge faster than advective velocity

$\Rightarrow$ wind shift [ahead of any cold air boundary (front)]

propagation + advection

↑ wave part

$\frac{h_0}{H} = \frac{V_0}{c < 0}$

right $h_0 > 0$ $V_0 < 0$

trough $h_0 < 0$ $V_0 > 0$

2. density current (topographically trapped)

no propagation — just advection (must be cold air mass to N — baroclinic zone)

front behaves like a material boundary (density current)

must be very sharp so $\frac{\partial p}{\partial y}$ dominates

like Kelvin wave

$U \to 0$, $CoF \to 0$, H cold, ⇓ PGF, T warm

$$L_x = \frac{\sqrt{g \frac{\Delta\rho}{\rho} H}}{f}$$

$$c = \sqrt{2 g \frac{\Delta\rho}{\rho} H}$$

↑ factor of 2

ρ_1 / ρ_2 H ↕ oops! different notation from Kelvin wave — sorry!

③ cold-air damming & barrier jet

cold air to N

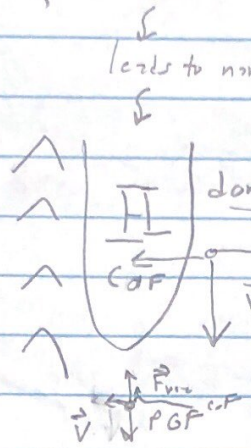
accelerates S

damming against mtns

synoptic-scale forcing + dynamics (along barrier flow)

↓

advection of cold air



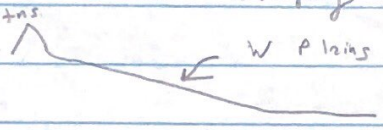
leads to narrow ridge

eventually, PGF ⊥ to terrain & CoF balance barrier jet

dome of cold air

damming (against mtns.)

④ more shallow sloping terrain



cold upslope → ⊓
warm, downslope → ⊔

topographic Rossby waves (as in synoptic class) —
& relatively large upslope/downslope wind component

shelf waves —
& relatively small upslope/downslope wind component
mostly V component

→ onset is synoptic scale (topographic Rossby waves)
→ Kelvin waves & sharpening → density current
behind the initial surge