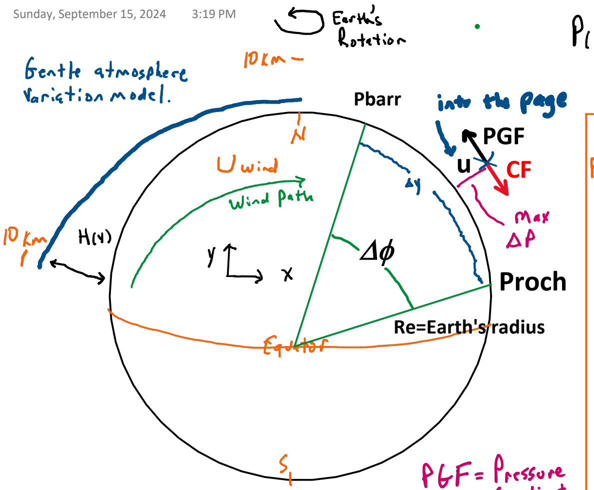
Jet Stream *Estimate* from Barrow, Roch. data

Sunday, September 15, 2024 3:19 PM

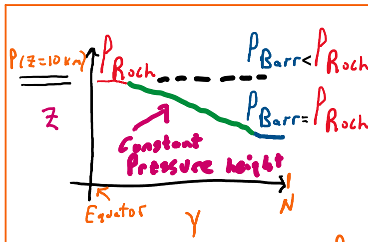
$P(z) \cong P_0 e^{-z/H}$. For $z = H$, $P(H) = \frac{P_0}{e} = \frac{P}{2.718}$. $H = \frac{R_0 \bar{T}_v}{g}$ $\quad P(H) \approx \frac{1013.25}{2.718} = 373\ mb$

H = Scale heigth of the atmosphere.



PGF = Pressure Gradient force

Vector Points from high to low pressure



Force Balance in the y direction

The pressure difference at altitude Causes the air to move from the equatorial region to the Polar regions. The Coriolis force causes the air to move to the right.

When in balance,

Pressure Gradient Force / kg = $\left(-\frac{1}{\rho}\frac{dP}{dy}\right) = f\,u$ = Coriolis Force / Kg

PGF

$$u = -\frac{1}{\rho f}\frac{dP}{dy} \qquad \frac{dP}{dy} = \frac{P_{barrow} - P_{Roch}}{R_E\,\Delta\phi}$$

$$f = 2\Omega\,\sin(\phi)$$

$\Omega \cong \frac{2\pi \text{ radians}}{\text{day}}$ = Angular rotation rate of the earth.

ϕ = latitude

f = Coriolis Parameter

Δy =Re Δϕ (radians)

u is a westerly wind

Find for Jan 31st 2025

Example

Density (kg m^{-3})	Coriolis Parameter (1/s)	dP (Pa)
0.48	1.00E-04	5240

Barrow Lat (deg)	Roch Lat (deg)	Re (m)	dy (m)
71.3	4.8	6.37E+06	7.39E+06

u (m/s)	u (knots)
15	29

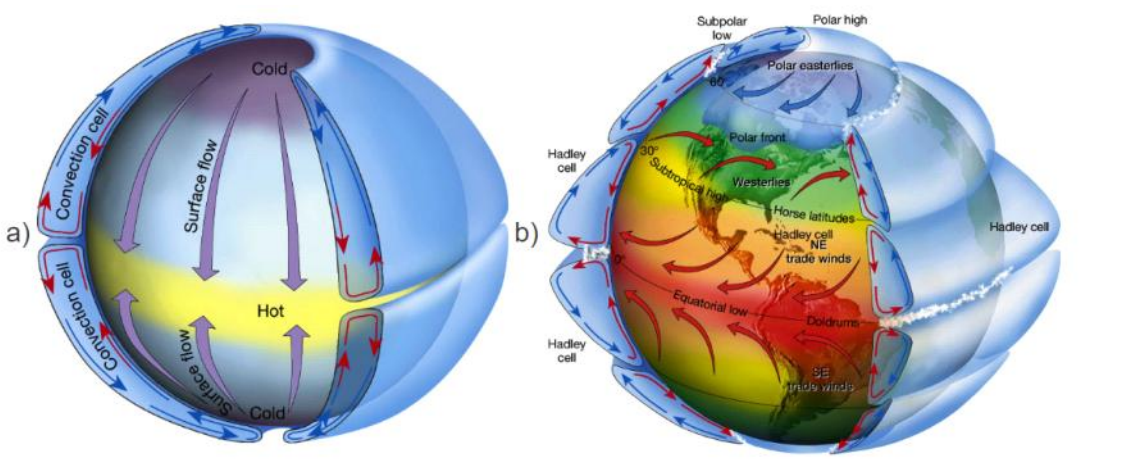
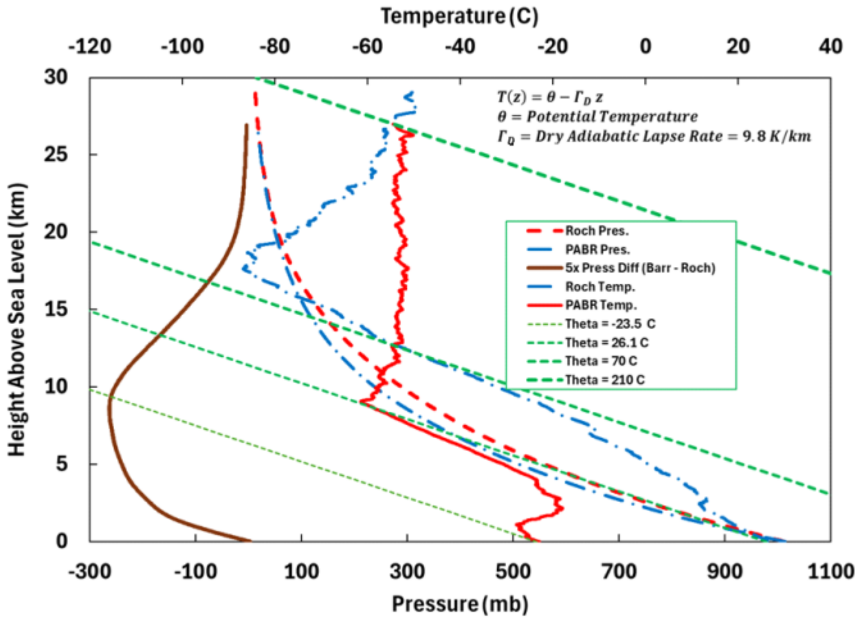


Image 2: Global atmospheric circulation cells a) without the Earth's rotation b) with the Earth's rotation (Images from www.ux1.eiu.edu/~cfjps/1400/circulation.html)

https://www.rmets.org/metmatters/global-atmospheric-circulation


Temperature (C)
-120
-100
-80
-60
-40
-20
0
20
40
30
25
20
15
10
5
0
Height Above Sea Level (km)
$T(z) = \theta - \Gamma_D z$
$\theta = Potential\ Temperature$
$\Gamma_Q = Dry\ Adiabatic\ Lapse\ Rate = 9.8\ K/km$
Roch Pres.
PABR Pres.
5x Press Diff (Barr - Roch)
Roch Temp.
PABR Temp.
Theta = -23.5 C
Theta = 26.1 C
Theta = 70 C
Theta = 210 C
-300
-100
100
300
500
700
900
1100
Pressure (mb)