Momentum Equations:

$$\frac{Du}{Dt} - \frac{uv\tan\phi}{a} + \frac{uv}{a} = \frac{-1}{\rho a\cos\phi}\frac{\partial P}{\partial \lambda} - 2\Omega v\sin\phi + 2\Omega w\cos\phi + \overline{Frx}$$

mat. derivative; metric term; metric term; PGF; Cor.; Nontrad. Coriolis; molecular friction

$$\frac{Du}{Dt} = u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z} + \frac{\partial u}{\partial t}$$

$$\frac{U}{T} = \frac{10\ ms^{-1}}{10^5 s} = 10^{-4}\ ms^{-2}$$ Mat. Der

$$\frac{U^2}{a^2} = \frac{10^2}{10^7} = 10^{-5}\ ms^{-1}$$ Metric term

$$\underset{10^{-4}}{2\Omega}\ \underset{10^{-1}}{\sin\phi}\ \underset{10^{1}}{v} = 10^{-4}\ ms^{-1}$$ Cor

$$\underset{10^{-4}}{2\Omega}\ \underset{10^{0}}{\cos\phi}\ w =$$ Need to use mass cont.

$$\nabla_h \cdot \vec{V} = \frac{1}{\rho}\frac{\partial \rho w}{\partial z} \longrightarrow \frac{U}{L} = \frac{W}{H}$$ ← height

$$W = \frac{UH}{L}$$ ← length

$$\underset{10^{-4}}{2\Omega}\ \underset{10^{0}}{\cos\phi}\ w = 10^{-4}\ 10^{0}\ 10^{-1} = 10^{-5}$$

Nontrad. Coriolis

$$= \frac{10^{1}10^{4}}{10^{6}} = 10^{-1}\ ms^{-1}$$

The tropical thermodynamic equation

In p-coords:

$$C_p\frac{DT}{Dt} - \alpha\omega = Q \qquad \omega = \frac{Dp}{Dt}$$

$\alpha = \frac{1}{\rho}$; diabatic heating

We also have hydrostatic balance $\frac{\partial \Phi}{\partial p} = -\alpha$

Replace α in thermo budget:

$$C_p \frac{DT}{Dt} + \omega \frac{\partial \Phi}{\partial p} = Q$$

"work"

$$C_p \frac{\partial T}{\partial t} + \vec{v} \cdot \nabla_h C_p T + \omega \left(\frac{\partial C_p T}{\partial p} + \frac{\partial \Phi}{\partial p} \right) = Q$$

$DSE = C_p T + \Phi$ "dry static energy"

$$C_p \frac{\partial T}{\partial t} + \vec{v} \cdot \nabla_h C_p T + \omega \frac{\partial DSE}{\partial p} = Q$$

Eq. (1)

tropical thermo eqn.!

Many scientists assume that Φ is hor. and temporally homogeneous, i.e. $\Phi = \Phi(p)$. As a result, we add it to Eq. (1) to obtain:

$$\frac{D\,DSE}{Dt} \approx Q$$

DSE budget