Parametrização de Convecção e Microfísica

Previsão Numérica de Tempo e Clima

$$\frac{\partial(\bar{u})}{\partial t}+(\bar{u})\frac{\partial(\bar{u})}{\partial x}+(\bar{v})\frac{\partial(\bar{u})}{\partial y}+(\bar{w})\frac{\partial(\bar{u})}{\partial z}+\frac{1}{\rho_0}\frac{\partial(\bar{P})}{\partial x}-2\Omega\eta_3(\bar{v})-\nu\frac{\partial^2(\bar{u})}{\partial x^2}-\nu\frac{\partial^2(\bar{u})}{\partial y^2}-\nu\frac{\partial^2(\bar{u})}{\partial z^2}=-\frac{\partial(\overline{u'u'})}{\partial x}-\frac{\partial(\overline{v'u'})}{\partial y}-\frac{\partial(\overline{w'u'})}{\partial z}$$

$$\frac{\partial(\bar{v})}{\partial t}+(\bar{u})\frac{\partial(\bar{v})}{\partial x}+(\bar{v})\frac{\partial(\bar{v})}{\partial y}+(\bar{w})\frac{\partial(\bar{v})}{\partial z}+\frac{1}{\rho_0}\frac{\partial(\bar{P})}{\partial y}+2\Omega\eta_3(\bar{v})-\nu\frac{\partial^2(\bar{v})}{\partial x^2}-\nu\frac{\partial^2(\bar{v})}{\partial y^2}-\nu\frac{\partial^2(v)}{\partial z^2}=-\frac{\partial(\overline{u'v'})}{\partial x}-\frac{\partial(\overline{v'v'})}{\partial y}-\frac{\partial(\overline{w'v'})}{\partial z}$$

$$\frac{\partial(\bar{w})}{\partial t}+(\bar{u})\frac{\partial(\bar{w})}{\partial x}+(\bar{v})\frac{\partial(\bar{w})}{\partial y}+(\bar{w})\frac{\partial(\bar{w})}{\partial z}+\frac{1}{\rho_0}\frac{\partial(\bar{P})}{\partial z}+g\frac{\bar{\rho}}{\rho_0}-\nu\frac{\partial^2(\bar{w})}{\partial x^2}-\nu\frac{\partial^2(\bar{w})}{\partial y^2}-\nu\frac{\partial^2(\bar{w})}{\partial z^2}=-\frac{\partial(\overline{u'w'})}{\partial x}-\frac{\partial(\overline{v'w'})}{\partial y}-\frac{\partial(\overline{w'w'})}{\partial z}$$

$$\frac{d\phi}{dP}=-\frac{RT}{P}$$

$$P=-\rho g z$$

$$\frac{\Delta P}{\Delta z}=-\rho\frac{\Delta g z}{\Delta z}$$

$$\frac{\Delta P}{\Delta z}=-\rho\frac{\Delta\phi}{\Delta z}$$

$$\frac{\partial(\bar{T})}{\partial t}+(\bar{u})\frac{\partial(\bar{T})}{\partial x}+(\bar{v})\frac{\partial(\bar{T})}{\partial y}+(\bar{w})\frac{\partial(\bar{T})}{\partial z}-S_P\bar{\omega}=-\frac{\partial(\overline{u'T'})}{\partial x}-\frac{\partial(\overline{v'T'})}{\partial y}-\frac{\partial(\overline{w'T'})}{\partial z}+\frac{\bar{J}}{C_p}$$

$$\frac{\partial(\bar{q})}{\partial t}+(\bar{u})\frac{\partial(\bar{q})}{\partial x}+(v)\frac{\partial(\bar{q})}{\partial y}+(\bar{w})\frac{\partial(\bar{q})}{\partial z}=-\frac{\partial(\overline{u'q'})}{\partial x}-\frac{\partial(\overline{u'q'})}{\partial y}-\frac{\partial(\overline{w'q'})}{\partial z}+\bar{S}$$

$$\frac{\Delta\phi}{\Delta z}=-\frac{1}{\rho}\frac{\Delta P}{\Delta z}$$

$$P=\rho RT \qquad \rho=\frac{P}{RT}$$

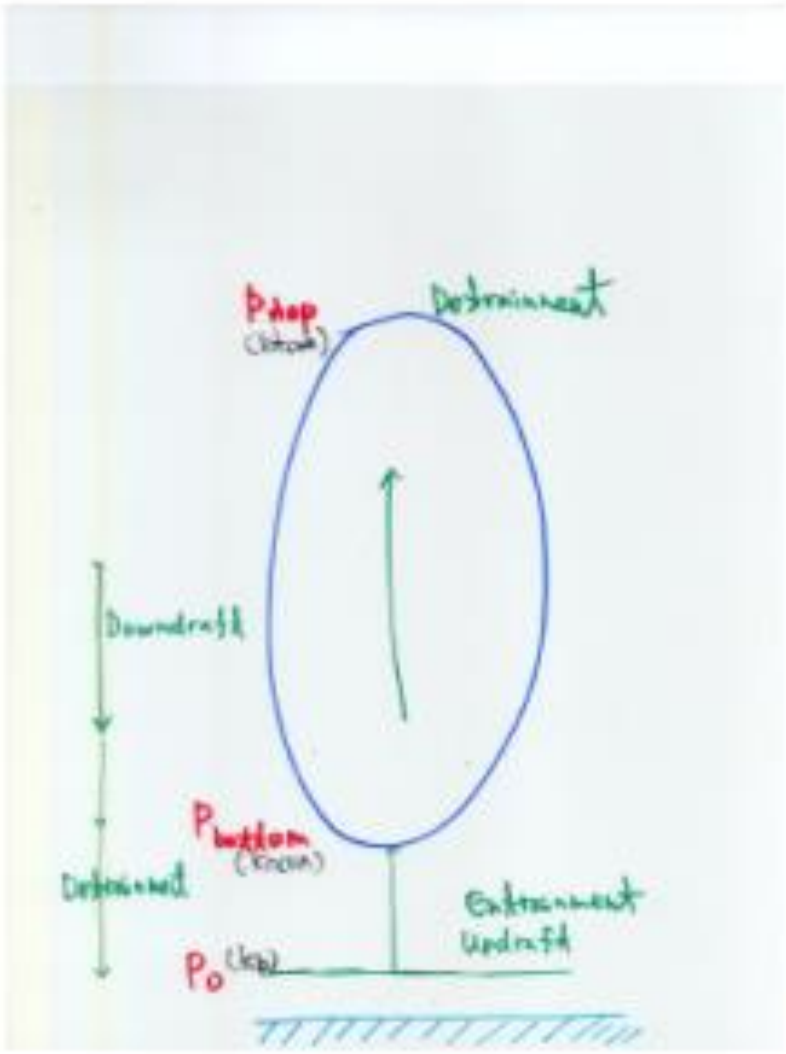
$$\frac{\Delta\phi}{\Delta P}=-\frac{1}{\rho}\frac{\Delta z}{\Delta z}$$

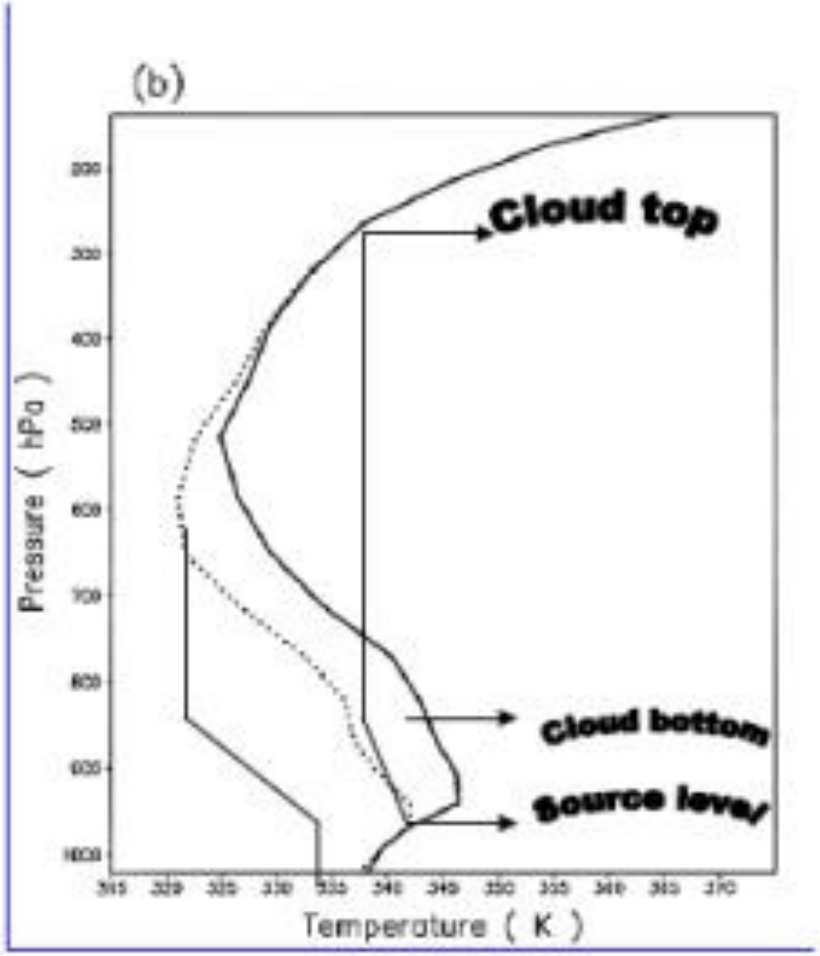
A convecção e microfísica de nuvens não atualizam diretamente as equações de momentum

$$\frac{\partial(\overline{T})}{\partial t} + (\overline{u})\frac{\partial(\overline{T})}{\partial x} + (\overline{v})\frac{\partial(\overline{T})}{\partial y} + (\overline{w})\frac{\partial(\overline{T})}{\partial z} - S_P\overline{\omega} = -\frac{\partial\left(\overline{u'T'}\right)}{\partial x} - \frac{\partial\left(\overline{v'T'}\right)}{\partial y} - \frac{\partial\left(\overline{w'T'}\right)}{\partial z} + \frac{\overline{J}}{C_p}$$

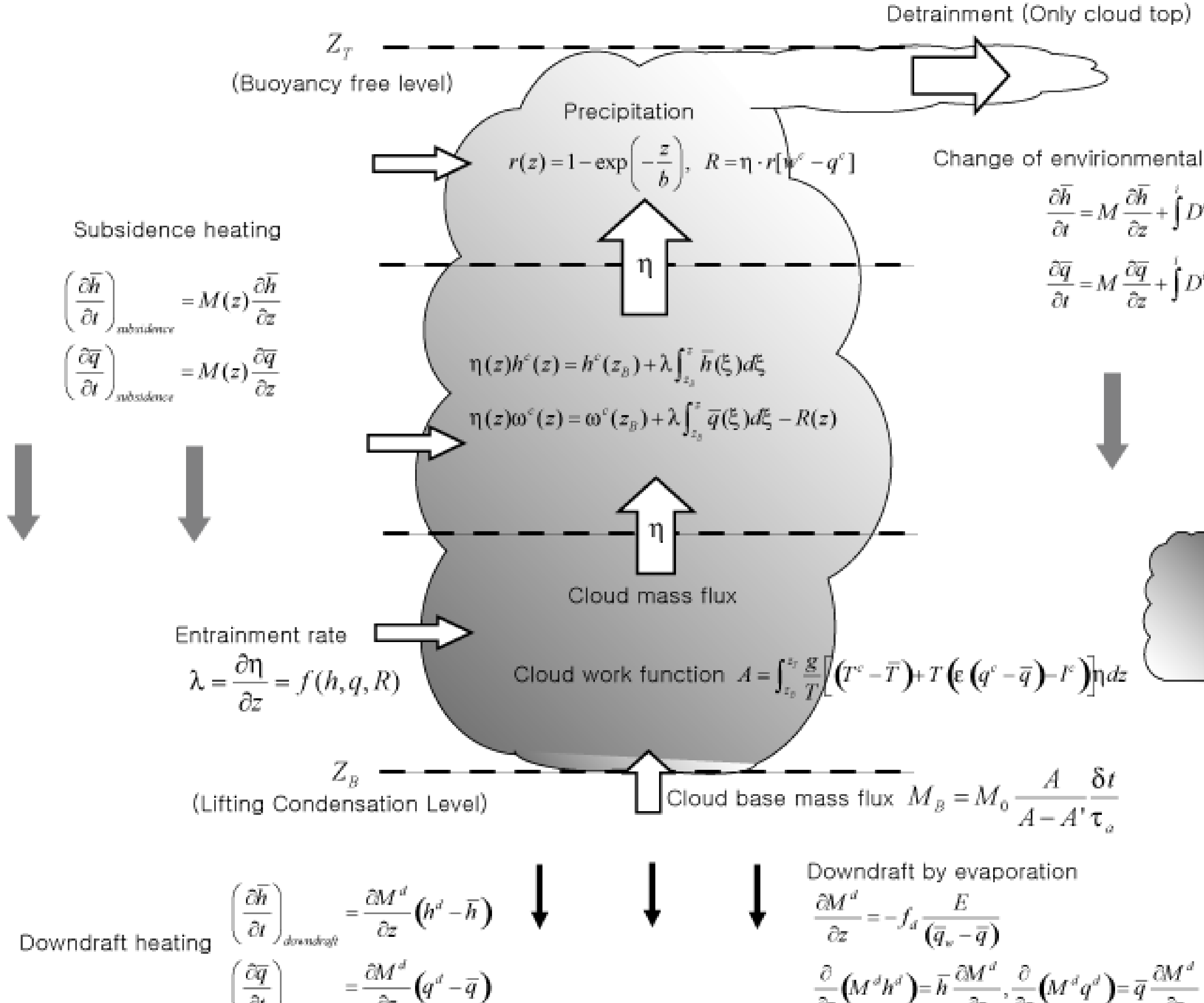
$$\frac{\partial(\overline{q})}{\partial t} + (\overline{u})\frac{\partial(\overline{q})}{\partial x} + (v)\frac{\partial(\overline{q})}{\partial y} + (\overline{w})\frac{\partial(\overline{q})}{\partial z} = -\frac{\partial(\overline{u'q'})}{\partial x} - \frac{\partial(\overline{u'q'})}{\partial y} - \frac{\partial(\overline{w'q'})}{\partial z} + \overline{S}$$

c. Conceptual model

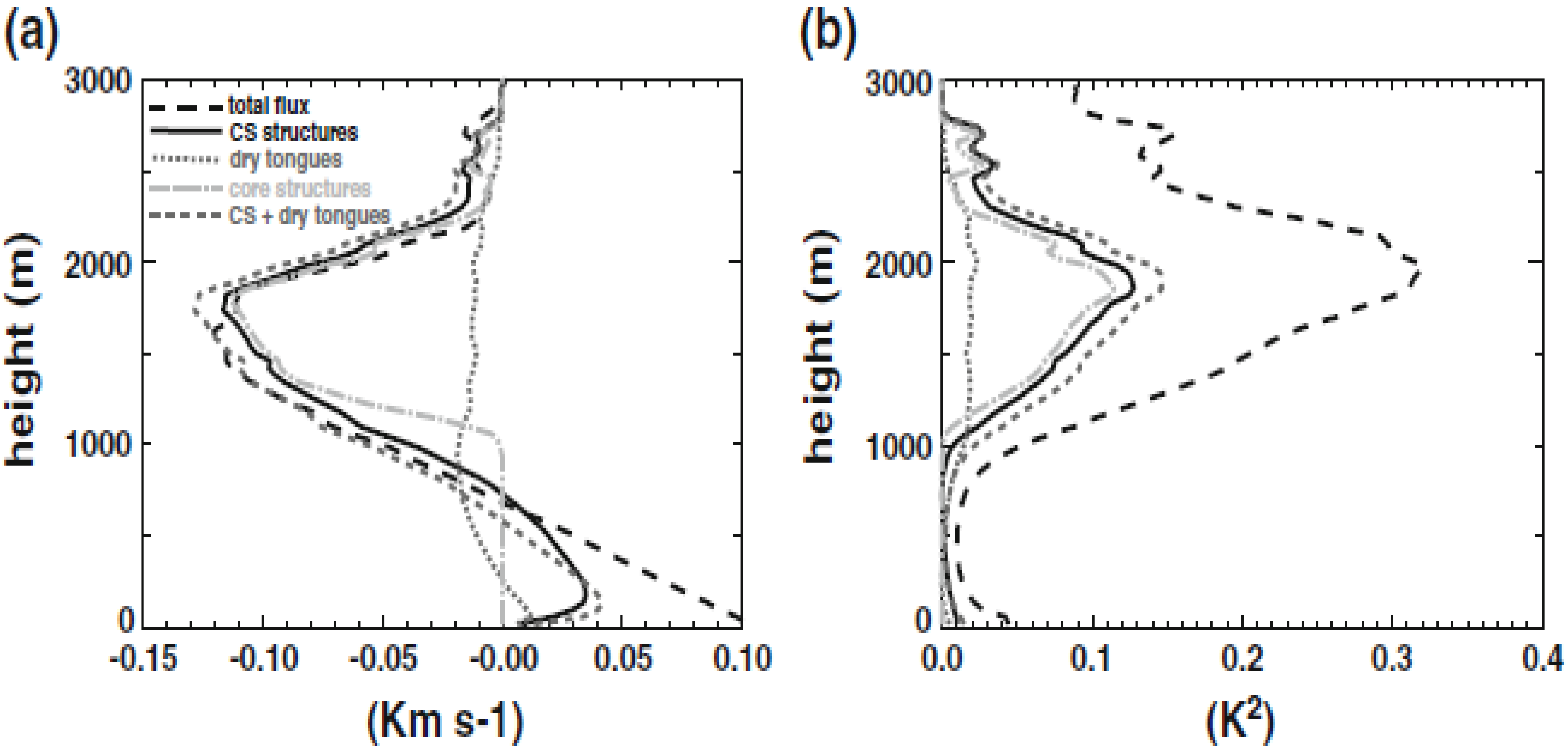


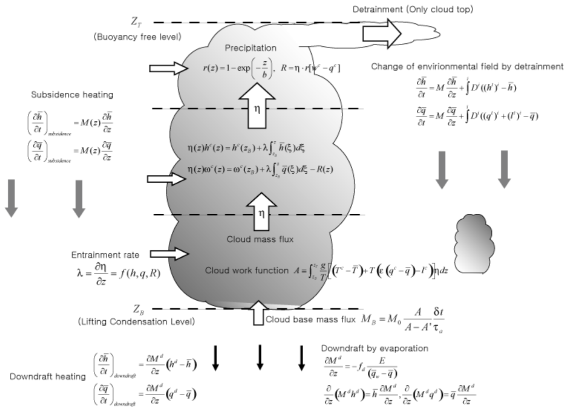


Previsão Numérica de Tempo e Clima

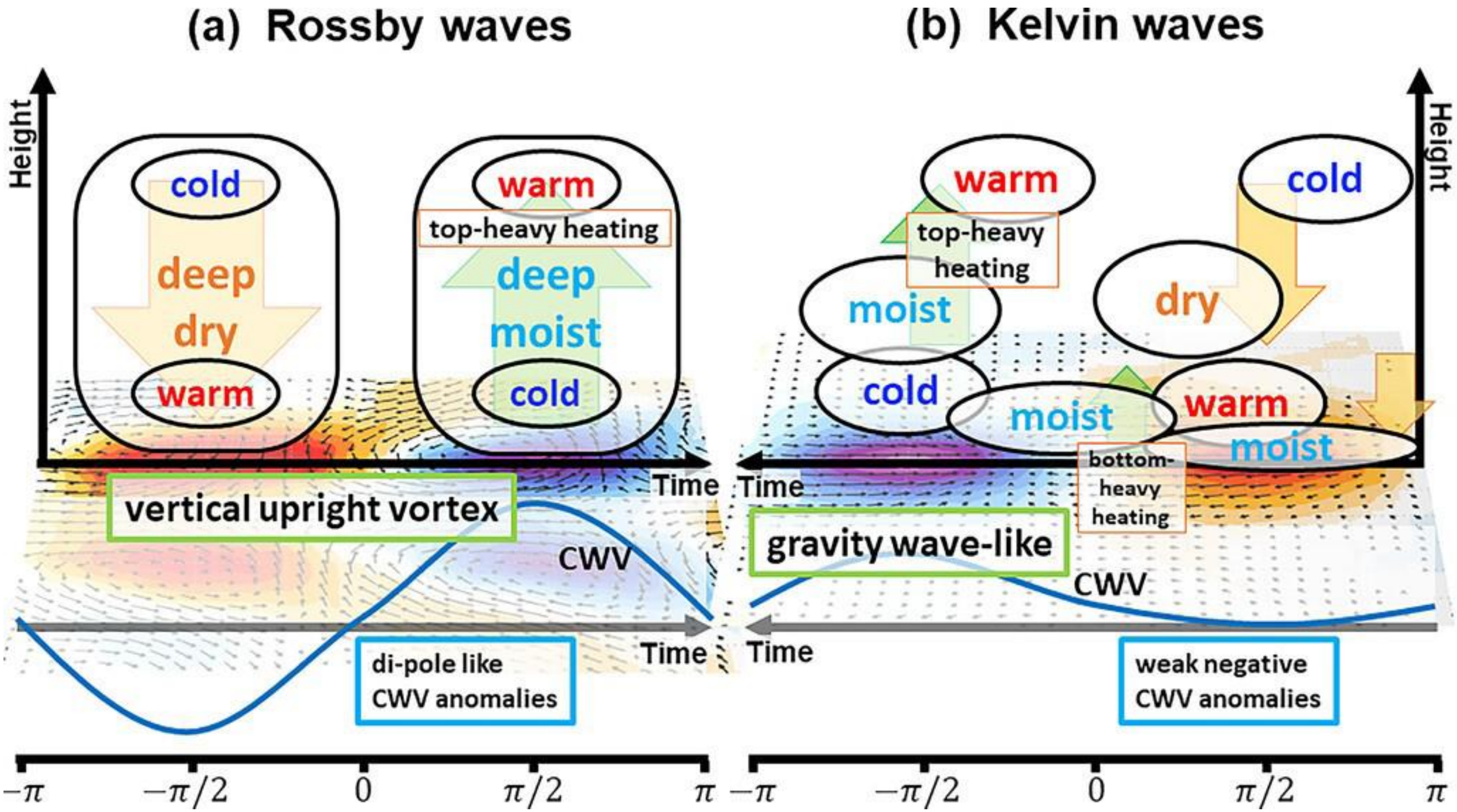


Previsão Numérica de Tempo e Clima





Previsão Numérica de Tempo e Clima



Previsão Numérica de Tempo e Clima

$$\frac{\partial \overline{\theta}}{\partial t} = -\overline{\mathbf{v}} \cdot \nabla \overline{\theta} - \overline{w}\frac{\partial \overline{\theta}}{\partial z} - \frac{\partial}{\partial x_i}\overline{u_i'\theta'} + \frac{L}{\pi c_p}(c-e) + Q_{rad}$$

$$\frac{\partial \overline{q}_v}{\partial t} = -\overline{\mathbf{v}} \cdot \nabla \overline{q}_v - \overline{w}\frac{\partial \overline{q}_v}{\partial z} - \frac{\partial}{\partial x_i}\overline{u_i'q_v'} - (c-e)$$

$$\frac{\partial \overline{q}_l}{\partial t} = -\overline{\mathbf{v}} \cdot \nabla \overline{q}_l - \overline{w}\frac{\partial \overline{q}_l}{\partial z} - \frac{\partial}{\partial x_i}\overline{u_i'q_l'} + (c-e) - P_r$$

Advecção de Larga escala

Subsidencia de Larga Escala

Transporte turbulento

Taxa de Condensação liquida

Taxa de Precipitação

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$$\frac{\partial(\overline{u})}{\partial t}+(\overline{u})\frac{\partial(\overline{u})}{\partial x}+(\overline{v})\frac{\partial(\overline{u})}{\partial y}+(\overline{w})\frac{\partial(\overline{u})}{\partial z}+\frac{1}{\rho_0}\frac{\partial(\overline{P})}{\partial x}-2\Omega\eta_3(\overline{v})-\nu\frac{\partial^2(\overline{u})}{\partial x^2}-\nu\frac{\partial^2(\overline{u})}{\partial y^2}-\nu\frac{\partial^2(\overline{u})}{\partial z^2}=-\frac{\partial(\overline{u'u'})}{\partial x}-\frac{\partial(\overline{v'u'})}{\partial y}-\frac{\partial(\overline{w'u'})}{\partial z}$$

$$\frac{\partial(\overline{v})}{\partial t}+(\overline{u})\frac{\partial(\overline{v})}{\partial x}+(\overline{v})\frac{\partial(\overline{v})}{\partial y}+(\overline{w})\frac{\partial(\overline{v})}{\partial z}+\frac{1}{\rho_0}\frac{\partial(\overline{P})}{\partial y}+2\Omega\eta_3(\overline{v})-\nu\frac{\partial^2(\overline{v})}{\partial x^2}-\nu\frac{\partial^2(\overline{v})}{\partial y^2}-\nu\frac{\partial^2(v)}{\partial z^2}=-\frac{\partial(\overline{u'v'})}{\partial x}-\frac{\partial(\overline{v'v'})}{\partial y}-\frac{\partial(\overline{w'v'})}{\partial z}$$

$$\frac{\partial(\overline{w})}{\partial t}+(\overline{u})\frac{\partial(\overline{w})}{\partial x}+(\overline{v})\frac{\partial(\overline{w})}{\partial y}+(\overline{w})\frac{\partial(\overline{w})}{\partial z}+\frac{1}{\rho_0}\frac{\partial(\overline{P})}{\partial z}+g\frac{\overline{\rho}}{\rho_0}-\nu\frac{\partial^2(\overline{w})}{\partial x^2}-\nu\frac{\partial^2(\overline{w})}{\partial y^2}-\nu\frac{\partial^2(\overline{w})}{\partial z^2}=-\frac{\partial(\overline{u'w'})}{\partial x}-\frac{\partial(\overline{v'w'})}{\partial y}-\frac{\partial(\overline{w'w'})}{\partial z}$$

$$\frac{d\phi}{dP}=-\frac{RT}{P}$$

$$\frac{\partial(\overline{T})}{\partial t}+(\overline{u})\frac{\partial(\overline{T})}{\partial x}+(\overline{v})\frac{\partial(\overline{T})}{\partial y}+(\overline{w})\frac{\partial(\overline{T})}{\partial z}-S_P\overline{\omega}=-\frac{\partial\left(\overline{u'T'}\right)}{\partial x}-\frac{\partial\left(\overline{v'T'}\right)}{\partial y}-\frac{\partial\left(\overline{w'T'}\right)}{\partial z}+\frac{\overline{J}}{C_p}$$

$$\frac{\partial(\overline{q})}{\partial t}+(\overline{u})\frac{\partial(\overline{q})}{\partial x}+(v)\frac{\partial(\overline{q})}{\partial y}+(\overline{w})\frac{\partial(\overline{q})}{\partial z}=-\frac{\partial(\overline{u'q'})}{\partial x}-\frac{\partial(\overline{u'q'})}{\partial y}-\frac{\partial(\overline{w'q'})}{\partial z}+\overline{S}$$

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