



Trabalho Final de Conclusão de Curso PGMET-2023



A partir das equações governantes do estado média da atmosfera.

$$\frac{\partial U}{\partial t} + \frac{1}{a \cos^2 \theta} \left(U \frac{\partial U}{\partial \lambda} + V \cos \theta \frac{\partial U}{\partial \theta} \right) + \dot{\eta} \frac{\partial U}{\partial \eta} - fV + \frac{1}{a} \left(\frac{\partial \Phi}{\partial \lambda} + R_d T_v \frac{\partial \ln p}{\partial \lambda} \right) = F_u \quad (1)$$

$$\frac{\partial V}{\partial t} + \frac{1}{a \cos^2 \theta} \left(U \frac{\partial V}{\partial \lambda} + V \cos \theta \frac{\partial V}{\partial \theta} \right) + \dot{\eta} \frac{\partial V}{\partial \eta} + fU + \frac{\cos \theta}{a} \left(\frac{\partial \Phi}{\partial \theta} + R_d T_v \frac{\partial \ln p}{\partial \theta} \right) + \frac{\sin \theta}{a \cos^2 \theta} (U^2 + V^2) = F_v \quad (2)$$

$$\frac{\partial T}{\partial t} + \frac{1}{a \cos^2 \theta} \left(U \frac{\partial T}{\partial \lambda} + V \cos \theta \frac{\partial T}{\partial \theta} \right) + \dot{\eta} \frac{\partial T}{\partial \eta} - \frac{\kappa T_v \omega}{(1 + (\delta - 1)q)p} = F_T \quad (3)$$

$$\frac{\partial q}{\partial t} + \frac{1}{a \cos^2 \theta} \left(U \frac{\partial q}{\partial \lambda} + V \cos \theta \frac{\partial q}{\partial \theta} \right) + \dot{\eta} \frac{\partial q}{\partial \eta} = F_q \quad (4)$$

$\theta = \text{latitude}$
 $\lambda = \text{Longitude}$
 $U = \text{Velocidade Zonal}$

$$\frac{\partial \ln p_s}{\partial t} + \frac{1}{p_s} \int_0^1 \nabla \cdot \left(\mathbf{v}_H \frac{\partial p}{\partial \eta} \right) d\eta = 0 \quad (5)$$

$$\frac{\partial \phi}{\partial \eta} + \frac{R_d T_v}{p} \frac{\partial p}{\partial \eta} = 0 \quad (6)$$



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Implemente utilizando o método de RungeKutta de 4 orden os cálculos de cada um dos termos das equações

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$$\frac{\partial U}{\partial t} - \frac{1}{a \cos^2 \theta} \left(U \frac{\partial U}{\partial \lambda} + V \cos \theta \frac{\partial U}{\partial \theta} \right) + \dot{\eta} \frac{\partial U}{\partial \eta} - fV + \frac{1}{a} \left(\frac{\partial \Phi}{\partial \lambda} + R_d T_v \frac{\partial \ln p}{\partial \lambda} \right) = F_u \quad (1)$$

Aceleração do momentum zonal

Advecção Horizontal