$$\frac{dw}{dt} = -\frac{1}{\rho}\frac{\partial p'}{\partial z} - g\frac{\rho'}{\rho} = -\frac{1}{\rho}\frac{\partial p'}{\partial z} + B$$

$$CAPE = \int_{LFC}^{EL} B\,dz$$

$$CIN = -\int_{0}^{LFC} B\,dz$$

$$w_{max} = \sqrt{2 * CAPE}$$

$$\frac{d}{dt}(\omega + f\hat{k}) = \frac{\partial\omega}{\partial t} + (V\cdot\nabla)(\omega + f\hat{k}) = [(\omega + f\hat{k})\cdot\nabla]V + \frac{1}{\rho^2}\nabla\rho\times\nabla p + \nabla\times F_r$$

$$\omega = (\xi,\eta,\zeta) = \left(\frac{\partial w}{\partial y} - \frac{\partial v}{\partial z}, \frac{\partial u}{\partial z} - \frac{\partial w}{\partial x}, \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)$$

$$\frac{d\zeta}{dt} = \omega\cdot\nabla w = \xi\frac{\partial w}{\partial x} + \eta\frac{\partial w}{\partial y} + \zeta\frac{\partial w}{\partial z}$$

$$SRH = \int_0^d (V-c)\cdot\omega_h\,dz = \int_0^d |V-c|\omega_s\,dz$$

$$\frac{\partial\gamma}{\partial t} = -\boldsymbol{V_h}\cdot\nabla_h\gamma - w\frac{\partial\gamma}{\partial z} + \frac{\partial\boldsymbol{V_h}}{\partial z}\cdot\nabla_h T + \frac{\partial w}{\partial z}(\Gamma_d - \gamma) - \frac{1}{C_p}\frac{\partial q}{\partial z}$$

$$\frac{du_g}{dt} = f_0 v_a$$

$$\frac{dv_g}{dt} = -f_0 u_a$$

$$\frac{d(\zeta_g + f)}{dt} = f_0\frac{\partial\omega}{\partial p}$$

$$\frac{dT}{dt} = \frac{p}{R}\sigma\omega$$

$$\frac{d}{dt}\left[\frac{1}{f_0}\nabla_h^2\Phi + f + \frac{\partial}{\partial p}\left(\frac{f_0}{\sigma}\frac{\partial\Phi}{\partial p}\right)\right] = \frac{dq}{dt} = 0$$

$$\left(\nabla_p^2 + \frac{f_0^2}{\sigma}\frac{\partial^2}{\partial p^2}\right)\chi = -f_0\boldsymbol{V_g}\cdot\nabla_p\left(\frac{1}{f_0}\nabla_p^2\Phi + f\right) - \frac{f_0^2}{\sigma}\frac{\partial}{\partial p}\left[-\boldsymbol{V_g}\cdot\nabla_p\left(-\frac{\partial\Phi}{\partial p}\right)\right] - \frac{\partial H}{\partial p}$$

$$\left(\nabla_p^2 + \frac{f_0^2}{\sigma}\frac{\partial^2}{\partial p^2}\right)\omega = -\frac{f_0}{\sigma}\frac{\partial}{\partial p}\left[-\boldsymbol{V_g}\cdot\nabla_p(\zeta_g + f)\right] - \frac{R_d}{\sigma p}\nabla_p^2(-\boldsymbol{V_g}\cdot\nabla_p T)$$

$$\frac{\partial\zeta_g}{\partial p} = -\frac{R_d}{f_0 p}\nabla_h^2 T$$

$$v_g = \frac{1}{f}\frac{\partial\Phi}{\partial x}\,;\, u_g = -\frac{1}{f}\frac{\partial\Phi}{\partial y}$$

$$\frac{\partial u_g}{\partial p} = \frac{R}{fp}\frac{\partial T}{\partial y};\ \frac{\partial v_g}{\partial p} = -\frac{R}{fp}\frac{\partial T}{\partial x}$$

$$\eta_g = \zeta_{\theta g} + f$$

$$\frac{\partial\zeta'}{\partial t} = -\overline{(\boldsymbol{V}-\boldsymbol{c})}\cdot\nabla_h\zeta' + \boldsymbol{S}\times\nabla_h w'\cdot\hat{k}$$

$$p' = -\frac{1}{2}\zeta'^2 + 2\boldsymbol{S}\cdot\nabla_h w' - \frac{\partial B}{\partial z}$$