Basic equations – in height coordinate
(Ch. 2)

Equations of motion scaled for the midlatitude synoptic scale motions
(conservation of momentum, Newton's second law of motion)

Continuity equation scaled for the midlatitude synoptic scale motions
(conservation of mass)

Thermodynamic energy equation scaled for the midlatitude synoptic scale motions
(conservation of energy, the first law of thermodynamics)

Ideal gas law

Dependent variables

Basic equations – from height coordinate to pressure coordinate (Ch. 3.1)

Vertical coordinate

$$z \rightarrow \boxed{}$$

Vertical velocity

$$w \rightarrow \boxed{}$$

Total differential

$$\frac{D}{Dt} = \frac{\partial}{\partial \mathrm{t}} + u\frac{\partial}{\partial \mathrm{x}} + v\frac{\partial}{\partial \mathrm{y}} + w\frac{\partial}{\partial \mathrm{z}} \quad \rightarrow \quad \frac{D}{Dt} = \boxed{}$$

Continuity equation

$$\frac{1}{\delta m}\frac{D\delta m}{Dt} = 0$$

$$\delta m = \rho\delta V = -\frac{\delta x\delta y\delta p}{g}$$

$$\frac{1}{\delta x\delta y\delta p}\frac{D\delta x\delta y\delta p}{Dt} = \boxed{} = 0$$

take the limit $\delta x, \delta y, \delta \mathrm{p} \rightarrow 0$

$$\boxed{} = 0$$

Hydrostatic balance

$$\mathrm{d}\Phi = \mathrm{gdz} = -\frac{\mathrm{dp}}{\rho} = -\frac{\mathrm{RT}}{\mathrm{p}}\mathrm{dp}$$

$$\frac{\partial\Phi}{\partial \mathrm{p}} = \boxed{}$$

Thermodynamic energy equation

$$\mathrm{c_p}\frac{\mathrm{DT}}{\mathrm{Dt}} - \alpha\frac{\mathrm{Dp}}{\mathrm{Dt}} = \mathrm{J}$$

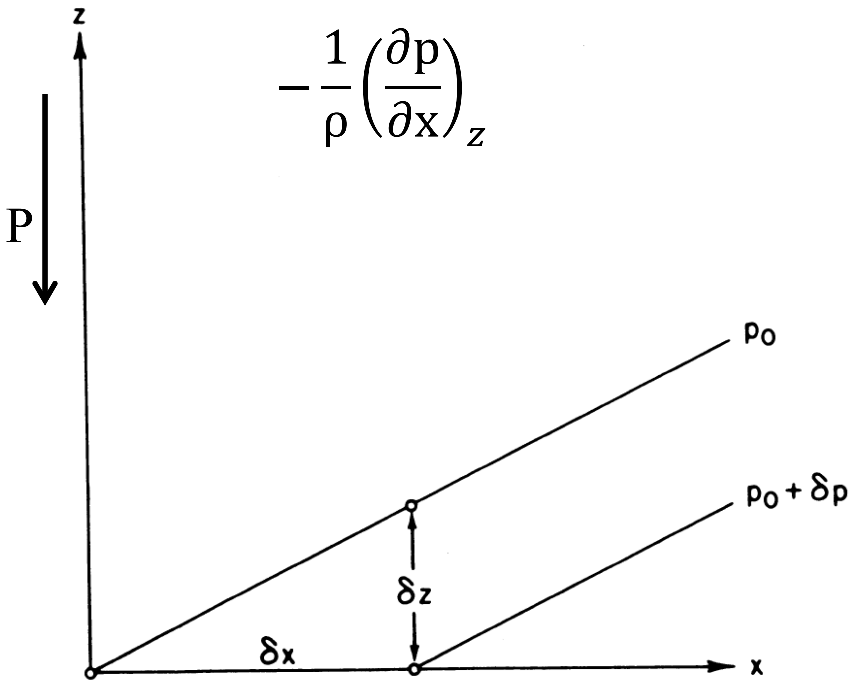
$$\mathrm{c_p}\left(\boxed{}\right) - \alpha\omega = \mathrm{J}$$

Basic equations – from height coordinate to pressure coordinate
(Ch. 3.1)

Pressure gradient force

Represent the pressure gradient force term in pressure coordinate

$$-\frac{1}{\rho}\left(\frac{\partial p}{\partial x}\right)_z$$



$$-\frac{1}{\rho}\left(\frac{\partial p}{\partial x}\right)_z =$$

$$p = p(x, z)$$

$$\delta p = 0 = \left(\frac{\partial p}{\partial x}\right)_z \delta x + \left(\frac{\partial p}{\partial z}\right)_x \delta z$$

divide by delta x

$$0 = \left(\frac{\partial p}{\partial x}\right)_z +$$

use the hydrostatic balance

$$\left(\frac{\partial p}{\partial x}\right)_z =$$

take the limit

$$\delta x, \delta z \rightarrow 0$$

$$\left(\frac{\partial p}{\partial x}\right)_z =$$

Basic equations – in pressure coordinate
(Ch. 3.1)

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