Shallow-water model

Applies to both ocean and atmosphere

$2\Omega = f$

1. $p = p_o \; at \; z = h$
2. $mean \; depth \; H$
3. $H \ll L$

L

$h(x, y, t)$

or

$\eta(x, y, t)$

g

$\rho = \rho_o$

$z = 0$

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0 \quad (1)$$

$$\frac{\partial p}{\partial z} = -g\rho$$

$$\int_z^h \partial p = -\int_z^h g\rho \, dz$$

$$p(x,y,h) = \rho_0$$

$$p(h) - p(z) = -\rho g(h-z)$$

$$p(z) = p_0 + \rho g(h-z)$$

$$\frac{\partial p}{\partial x} = \rho g \frac{\partial h}{\partial x}$$

$$\frac{\partial p}{\partial y} = \rho g \frac{\partial h}{\partial y}$$

Not a function of z

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + fv$$

$$= -g\frac{\partial h}{\partial x}$$

$$\frac{\partial v}{\partial t} - u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + fu$$

$$= -g\frac{\partial h}{\partial y}$$

$$\int (1)\,dz.$$

$$\int_{h_B}^{z} \left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right) dz = \int_{h_B}^{z} \left(\frac{\partial w}{\partial z}\right) dz$$

$$\left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right)(z - h_B) = w(h_B) - w(z)$$