$$\nabla_h.(H\nabla_h p_S) = S_{HY}(\lambda,\phi) \quad ; \quad p_{HY}(\lambda,\phi,z) = \int_0^z -g dz'$$

HPE and QH

NH

$$\nabla^2 p_{NH} = \nabla.\tilde{\mathbf{G}}_{\mathbf{v}} - \nabla_h{}^2(p_S + p_{HY})$$

$$\frac{\partial \mathbf{v_h}}{\partial t} = \mathbf{G}_{\mathbf{v_h}} - \nabla_{\mathbf{h}}(p_S + p_{HY})$$

$$w = -\int_0^z \nabla_h.\mathbf{v_h} dz'$$

$$\frac{\partial \mathbf{v_h}}{\partial t} = \mathbf{G}_{\mathbf{v_h}} - \nabla_{\mathbf{h}}(p_S + p_{HY} + p_{NH})$$

$$\frac{\partial w}{\partial t} = \hat{G}_w - \frac{\partial p_{NH}}{\partial z}$$