

Equations of motion

for an irrotational flow, with no forcing from wind:

$$\partial_t \eta + \nabla \phi \cdot \nabla \eta = \partial_z \phi, \quad \text{on } z = \eta(x, y, t)$$

$$\partial_t \phi + \frac{1}{2} |\nabla \phi|^2 + g\eta = \frac{\sigma}{\rho} \nabla \cdot \left\{ \frac{\nabla \eta}{\sqrt{1 + |\nabla \eta|^2}} \right\}, \quad \text{on } z = \eta(x, y, t),$$

$$\nabla^2 \phi = 0 \quad -h(x, y) < z < \eta(x, y, t),$$

$$\partial_z \phi + \nabla \phi \cdot \nabla h = 0, \quad \text{on } z = -h(x, y).$$