

Shallow water and vorticity



Exercise

Question 1

- 1) Draw a diagram to represent two shallow water layers topped by a rigid lid and overlying a motionless abyss. The difference in layer density is always $\Delta\rho$.
- 2) Derive expressions for the depth of the layer interfaces in terms of the layer thicknesses.

$$z_{i2} = ? \quad - \quad z_{2a} = ?$$
- 3) Using the hydrostatic relation $\Delta P / \Delta\rho = gz$, derive expressions for the Montgomery potential P in the two layers.

$$P_1 = ? \quad - \quad P_2 = ?$$
- 4) Write down the linear x-momentum equation in each layer (just the x-momentum)

$$\frac{Du_1}{Dt} = ? \quad - \quad \frac{Du_2}{Dt} = ?$$
- 5) Write the x-momentum linear equations (for \mathbf{u}) as a single column vector equation in $\mathbf{u}=(u_1, u_2)$, $\mathbf{v}=(v_1, v_2)$ and $\mathbf{h}=(h_1, h_2)$ and the matrix \mathbf{C} .
- 6) Find the eigenvalues and eigenvectors of \mathbf{C} .
- 7) Find the variable transformation that gives two independent equations, and write down the two equations.

Solution – Question 1

2 shallow water layers topped by a rigid lid overlying a motionless abyss

