**GEF2500 - OBLIGATORY EXERCISE 3, SPRING 2014**

**All symbols are defined in the GEF2500 Lecture Notes**

1) Explain what we mean by hydrostatic balance?

2) What kind of approximations do we make when we assume geostrophic balance?

3) What do we assume for the pressure at the material interface between two fluids of different densities? (This assumption is called the dynamic boundary condition).

4) In the Norwegian Coastal Current water of smaller density (less saline) is overlaying water of larger density (more saline) in a wedge near the coast; see the sketch below. The material surface separating the coastal water from the ocean water is given by $z = -Hx / L$. The atmospheric surface pressure is constant and equal to $P_0$ everywhere.

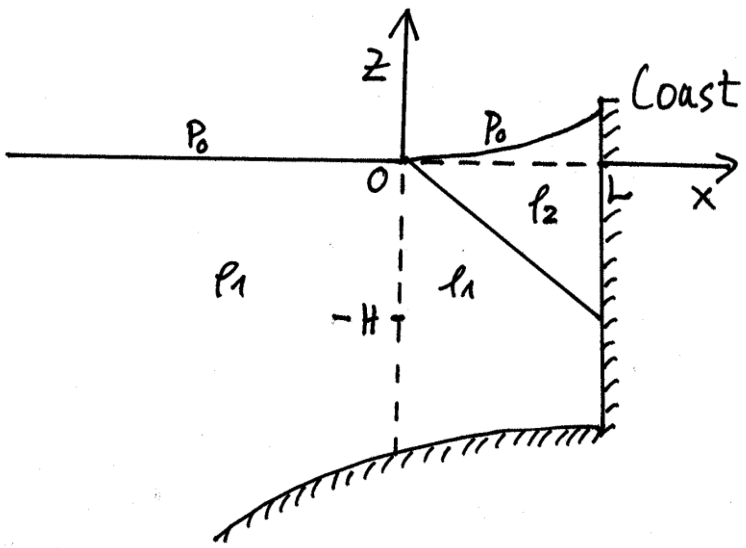


*Figure sketch*

The ocean water outside and under the coastal wedge has constant density $\rho_1$. This water is at rest. Use the hydrostatic approximation and find the pressure $p_1$ in the ocean water.

5) In the coastal wedge the water is stratified. The density here can be written

$$\rho_2 = \rho_1\left(1 - a\left(z + \frac{H}{L}x\right)\right),$$

where $a$ is a small positive constant ( $aH << 1$).

Sketch the isopycnals in the coastal water.

6) Use the hydrostatic approximation in the wedge. Apply the dynamic boundary condition at the material interface $z = -Hx/L$, and determine the pressure $p_2$ in the coastal water.

7) Denote the shape of the surface in the wedge by $z = \zeta(x)$. Apply the dynamic boundary condition at the surface, and determine $\zeta(x)$. In this calculation you can simplify, and take that $a\zeta^2 << \zeta$. You can also use that $aH << 1$.

8) Sketch the isobars in the coastal wedge.

9) Calculate $\nabla p_2 \times \nabla \rho_2$. What do we call the mass field in this case?

10) Assume geostrophic balance, and calculate the velocity in the wedge.

11) Typical parameters for the Norwegian Coastal Current are:

$H = 100$ m, $\mathrm{L} = 40$ km, $a = 2 \times 10^{-5} \mathrm{m}^{-1}$.

Calculate the value of the current at $x = L/2, z = 0$ on the shelf outside Egersund at $58.5^{0}\mathrm{N}$.