Homework 2

1. Inertial motions (30 pts)

(1) What are the values of the Coriolis parameter f at the following latitudes: 90S, 60S, 30S, Equator, 10N, 45N, 90N?

(2) What is the diameter and period of inertial motions at each of these latitudes for a $V = 20cm/s$ tangential velocity?

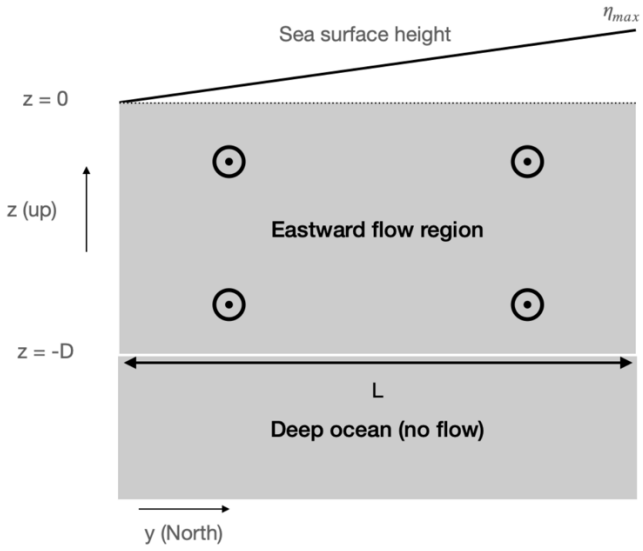
(3) Draw a sketch of the inertial motions at 60S, 10N and 45N.

2. Geostrophy criteria (30 pts)

A laboratory experiment is conducted in a cylindrical tank with a diameter of 20 cm, filled with homogeneous (15 cm deep at the center) water and rotating at 30 rpm (revolutions per minute). A steady flow field with maximum velocities of 1 cm/s is generated by a source-sink device. The water viscosity is 10^{-6} m^2/s. Judge if this flow field meets the conditions of geostrophy.

3. Thermal wind relation (40 pts)

Consider the cartoon shown here which represents a simplified meridional cross section across the Drake Passage in the Southern Ocean. A major simplification is that the sea surface elevation η and density are assumed to vary linearly in the y direction, and that the geostrophic velocity u_g varies linearly in depth.



(1) What is the strength of the sea surface height gradient $\partial\eta/\partial y$ in terms of the given parameters.¶

(2) Using surface geostrophic balance, estimate the speed of the zonal surface current.

Use the following parameters: L=850km, η_{max}=1 m.

(3) Use the thermal wind relation to estimate the North-South density difference across the drake passage. Assume: The vertical shear of geostrophic current ($\frac{\partial u_g}{\partial z}$) is uniform over depth D (4000m) and zero below.