

Homework: Due Dec.-9, 2008  
Class: MAST602 Introduction to Physical Oceanography  
Instructor: Andreas Münchow

A two-dimension Brazil Current (i.e.,  $u=\text{const}=0$ ) conserves potential vorticity  $Q=(f+\xi)/H$  where  $f$  is the planetary vorticity (Coriolis),  $\xi=\partial v/\partial x-\partial u/\partial y$  is the relative vorticity, and  $H$  is the thickness of an upper layer. The current consists of two density layers that are separated by a pycnocline. The current has the following attributes:

The depth of the pycnocline  $H$  varies as a function of distance from the coast, i.e.,  $H=H(x)$ .

The pycnocline becomes flat at a distance  $L$  from the coast, i.e.,  $H(x=L)=\text{const}=H_0$ .

The northward velocity at this location vanishes, i.e.,  $v(x=L)=0$ .

- (a) Exploit the potential vorticity conservation to find an expression on how the northward velocity  $v$  varies in the eastward direction  $x$  from the coast, i.e., find  $v(x)$  that may contain a single integral on the right hand side.
- (b) Sketch the velocity profile  $v(x)$  assuming that the depth of the pycnocline increases monotonically from  $x=0$  to its constant value at  $x=L$ .
- (c) What kind of measurements would you need to verify the prediction of this theory, e.g., conservation of potential vorticity?