GFD I, 1/30/2012

Problem Set #3, Due 2/6/2012

1) Figure out the velocities (including directions) from Problem 1 of the first problem set, but now assume that the fluid is in geostrophic balance. Please use the parameter values from the problem set solution. How long would a fluid parcel have taken to accelerate to the geostrophic speed – assuming that the acceleration was governed by the equations with the Coriolis term set to zero (as was done in the first problem set)? How far would the fluid parcel have traveled? Note that for a fluid parcel initially at rest and subject to forcing by a pressure gradient, the Coriolis term is initially zero, because the velocity is zero.

2) Repeat the derivation of the Hydrostatic Approximation done in class on 1/25/2012, but this time including the Coriolis term (*f*-plane version) in the horizontal momentum equations. You should end up with a criterion for the validity of the approximation which now involves both the aspect ratio, H/L, *and* the Rossby number, $Ro = \frac{U}{fL}$.

Now, think of a laboratory experiment in which $\frac{H}{L} \approx 1$ (because of the shape of the tank) but with $Ro << 1$. Do you expect vertical shear of the horizontal current (assume constant density)?