Homework assignment 6

Problem 1: Waves

Derive the dispersion relationship for waves in a stratified fluid with constant stratification N and constant rotation rate f_0. Discuss the dispersion relationship for long and short internal waves.

Now use the quasi-gesotrophic approximation on a β-plane for a constant N fluid and derive the dispersion relationship for Rossby waves. Describe the limits of long and short Rossby waves.

Problem 2: Quasi-geostrophic approximation

You want to study the instability of a sheared flow in a channel of width L and depth D. You decide to consider a mean flow $U = \Lambda z$ in geostrophic balance with a constant horizontal density gradient. You also assume that the vertical stratification is N is constant.

- First you want to study the problem for a setup representing the Gulf Stream, i.e. you choose $D = 1$ km, $L = 100$ km, $N = 10^{-2}$ s^{-1}, $\Lambda = 10^{-4}$ s^{-1}. Do you think you can use the quasi-gesotrophic approximation to study this problem?

- Next you want to study the problem for a setup representing a front in the ocean mixed layer, i.e. you choose $D = 100$ m, $L = 10$ km, $N = 10^{-3}$ s^{-1}, $\Lambda = 10^{-4}$ s^{-1}. Do you think you can use the quasi-gesotrophic approximation to study this problem?