Problems 3 Due: 4 November 2009

Linearization

Consider the barotropic vorticity equation on the β-plane (β ≠ 0):

$$\frac{\partial \zeta}{\partial t} + u\frac{\partial \zeta}{\partial x} + v\frac{\partial (\zeta + f)}{\partial y} = 0$$

(a) Suppose a possible basic state is $\bar{u} = 0$ and $\bar{v} = v_o$, where v_o is a constant. Is this basic state a solution to the barotropic vorticity equation? (Make sure you explain your answer.)

(b) Suppose a possible basic state is $\bar{u} = u_1 \cos(x/L) + u_o$ and $\bar{v} = 0$, where u_1, u_o and L are constants. Is this basic state a solution to the barotropic vorticity equation? (Make sure you explain your answer.)

(c) Now use a basic state of $\bar{u} = 0$ and $\bar{v} = 0$ and write the linearized form of (3.1) for a wind field that has both $u' \neq 0$ and $v' \neq 0$. Your answer should take into account the relationship between ζ', u' and v'.