Climate Dynamics Class Assignment:  
Ocean Basin Model

Due: March 22 2011.  
Computer: woodend  
User Id: students  
Password: Given in class :-)  

Files: Download from the link in the lecture notes (qg_model.zip) and unzip. Execute qg_driver at the matlab prompt. Various .m files may be edited to change the model: qg_parameters.m changes the dissipation and non-linear scales; qg_ekman.m changes the Ekman pumping (wind forcing) patterns while qg_coordinates.m can be used to change the integration time (look for variable tmax)

Many questions below are numerical experiments so presentation of (numerical) results either in a tabular or graphical form is mandatory.

1. The Lecture notes linked to the course webpage have a pre-assignment (a link is given). Do the following: e)-j).

2. Set the Stommel scale to zero. Choose the inertial scale to be 0.04 and vary the Munk scale. What differences in behaviour do you see? Can you identify bifurcation points? How does the adjustment time vary with decreasing Munk scale? Why would this time scale vary? Reverse the sign of the Ekman pumping (qg_ekman.m controls this). What changes and similarities in the solution do you see?

3. The default Ekman pumping varies over one half cycle from the bottom of the basin to the top i.e. meridionally. This represents crudely the subtropical region. Change this to a full cycle to represent both the subtropical and subpolar gyres. This is called a double gyre configuration and represents better the North Atlantic. How does the model behaviour compare as the same parameter changes from question 2 are made? Are there any differences in the adjustment timescale?

4. (Extra credit) The diffusive term which leads to the Munk layer represents the loss of energy to unresolved scales. Comment on why this may not be a good representation of the true turbulent cascade and how one might do better.