Homework assignment number 5 Due Tuesday May 26, 2002
Oceanography 423

1. If the gain from one feedback is 1.5, while the gain from a second feedback is 2.0, what would the total gain of the system be? Note, for this problem and problem 2, first determine the feedback factor for each of the gains, then find the total gain.

2. If the gain from one feedback is 1.2, and the gain from a second feedback is 0.8, what would the gain be with the combined feedbacks?

3. You will find on the web site one very simple climate model, climate2.m. The solves the equation

$$\frac{dT}{dt} = -\lambda T + r(t) + rp(t)$$

where r is a function that describes the increase in radiative forcing owing to greenhouse gas increases and rp is noise in the climate system. There are three parameters that you can vary
The maximum level of greenhouse gases rmax (default value 0.05)
The time scale of memory in units of years, tau (default value 5)
The magnitude of the atmospheric noise, rnoise (default value 3

Below, you will do three set of experiments. To run the climate simulation, you need to set the above three parameters. Play around with different parameter values to see what you get for a solution for t as a function of time. Note that the time interval in the model is 1 month.

a. First plot r and rp as a function of time using the default values.

b. Set rmax=0, rnoise=3. This represents the variability that you would expect from natural processes. Plot four solutions for
tau=1
tau=5
tau=10
tau=20
What do you think the dominant time scale of variability is for each climate?

c. Now set rnoise=0, but set rmax=0.05. Plot the solution for the four cases in (b). What is the final temperature change from the beginning to end of each run? How does that depend on tau?

d. Now do the same as in b, but set rnoise back to 3. Plot each of the solutions.

e. Given your plots in b, c. and d. above, discuss how we might expect the climate to respond to global warming given different values for the memory tau of the system. For each case, state whether you think we would be able to easily distinguish between natural and anthropogenic climate change.