NATS150 Science Seminar: Global Climate Change
Exam 1 Fall, 2007

1) The jagged line in each panel of the figure shows the intensity of earth's radiation to space versus wavenumber. The first panel is if there were no CO_2 in the atmosphere, the second is if the concentration were 1000 ppm. The smooth curves in each panel show the intensity of radiation versus wavenumber for a blackbody radiator, at the given temperatures.

a) Identify the two important features in the blackbody curves and explain their relevance to the radiation given off by the earth and by the sun.

b) What is the effect on the earth's temperature of adding CO_2 to the atmosphere, and how do you see that in the figure?

2) Draw neatly the one layer model, including the arrows representing the various heat flows. Write down the equations (don't worry much about constants, we really just want to know what each term in the equation represents) that represent a heat balance. You do not need to solve the equations, but explain briefly the origin of the greenhouse effect, and why the atmosphere serves to increase the temperature of the ground from that of a bare earth.

3) Why are O_2 and N_2 not greenhouse gases, but H_2O and CO_2 are?

4) Draw a graph showing temperature versus altitude in the troposphere and the stratosphere. Explain the reason for the relationship between temperature and altitude in the troposphere.

5) An increase in CO_2 concentration from 10 ppm to 20 ppm leads to the same decrease in energy radiated from the earth as an increase from 200 ppm to 400 ppm, *i.e.*, any doubling in CO_2 concentration leads to the same decrease in energy radiated.

a) Sketch this on a graph. What mathematical function describes this graph?

b) What is the physical origin of this observation?

c) In light of your answer to b), give a reason why methane might be more important as a greenhouse gas than CO_2. Given the above, why are increasing levels of CO_2 nevertheless important in determining the earth's energy balance?