ESS / OCEAN / ATMOS 589 -- 2005
Problem Set 2.

1) Using the global 0-D EBM discussed in lecture, determine the sensitivity of global average temperature to

    a)   an increase in the solar constant of 8 W/m^2 (from an original value of $S_0 = 1367$).
    b)   a decrease in effective emissivity of 0.1 (from an original value of 0.76).

2) Using the same EBM, find the change in the climate between the last glacial maximum and today, due to the change in the change in the planetary albedo from the presence of the Laurentide ice sheet. Assume that today's global average albedo is 0.3, and that the ice sheets covered 1/30 of the surface area of the globe, and had an albedo of 0.7.

3) a) Calculate the local temperature in the tropics (20°N to 20°S), and at high latitudes (60°-90°) given that the local insolation at the top of the atmosphere is 1720 W/m^{-2} and 800 W/m^{-2} respectively. Assume the albedo is 0.3 in both cases.

   b) Given that the observed mean annual temperature in these latitude bands is +26 C and -10, respectively, calculate the implied meridional heat transport.

   c) How does the answer to (b) change if the local albedo is 0.25 and 0.5 in the tropics and high latitudes, respectively?

4) Familiarize yourself with the matlab-based 2-D EBM and the North and Coakley paper (1979) that describes it, and come prepared to discuss on Tuesday next week. Download the matlab files in the folder http://courses.washington.edu/pcc589/notes/ebm . It is easiest to keep all the files in a folder (e.g. called "ebm" and run from within that folder).

To run the EBM, type "ebm", which starts a script (embquery) that asks you for input parameters for the EBM, as follows:
a) What is the poleward heat transport, as a fraction of todays value?
b) What is the obliquity? *Today's value is 23.44 degrees.*
c) What is the eccentricity? *Today's value is 1.672e-02.*
d) What is the perihelion angle? T*oday's value is 102.07 degrees.*
e) Enter 1 if you wish to have Hadley circulation on; otherwise enter 0. *Enter 1.*
f) What is the zonal heat transport, as a fraction of today's value? *Enter 1.*
g) Land configuration:
     Enter 1 for present day, 2 for Gondwanaland, 3 for Pangea, 4 for Symmetric
h) If you wish to include a white Antarctic ice sheet, enter 1, otherwise 0.
i) If you wish to include a white Laurentide ice sheet, enter 1, otherwise 0.
j) What is your value for A? *A = 205.3 today.*
k) What is the solar constant, as a fraction of today's?