ATS 421 / 521 Homework 2 due Wednesday, April 15th

1. Study the response of your 0D-EBM to forcing. Please include fortran code and ferret scripts in your answers.
    a. Once your model has reached equilibrium (use the warm state) add a radiative forcing that corresponds to a doubling of atmospheric CO_2. Add the forcing as a step function (instantaneously) and plot the model response (temperature as a function of time). What is the climate sensitivity of your model? (2)
    b. Now double the heat capacity, repeat the experiment and plot both timeseries in one graph. Discuss the results. Did the climate sensitivity change? What did change? (2)
    c. Now use different parameters (A = -246 W/m^2; B = 1.67 W/(m^2K)) for the outgoing longwave radiation. (As argued in the course notes these parameters are more realistic.) Repeat the experiment using the original heat capacity, plot the results together with those from (a) and discuss the differences. (2)
    d. <u>ATS 521 only:</u> Add white noise as stochastic forcing to the model. Plot time series of the forcing and the model response. Plot spectra (periodograms) of the forcing and the response. Tip: in ferret FFT_RE calculates the real part of the fast fourier transform (type “show func fft_re” for more info on this function). (4)

2. Download the two netcdf data files ERBE_mean.cdf and ncep.mean.nc, containing ERBE satellite data of top-of-the-atmosphere radiative fluxes and NCEP reanalysis surface temperatures, respectively, from /home/server/scratch/ats421-521. Open the data in ferret. Calculate and plot the zonally averaged values of 2-m temperature T (from the NCEP data). Calculate and plot the zonally averaged shortwave fluxes F_{SW}, longwave fluxes F_{LW}, meridional heat transport F_m, and planetary albedo a, using the ERBE data. (2)

    Next week, we will use this data with a 1-D energy balance model.