

12.340: Global Warming Science  
Problem Set #3: Radiative-convective equilibrium  
Date assigned: Thursday, 15 Mar 2012  
Date due: Thursday, 22 Mar 2012

This problem set consists of individually-tailored mini-projects using the radiative-convective model discussed in class. To complete this assignment, it will be necessary to get the model working on your computer, or if that is not possible or convenient, setting up an account on one of our computer lab machines.

For each project, you should first run a control experiment, setting the end time to at least 500 days, the “time dependent radiation” to “yes”, and the “annually averaged radiation” to “no”. Carefully examine the surface temperature time series to be sure that the temperature has reached a statistical equilibrium. (Note: we are here intentionally using a diurnal cycle to be sure that the level to which the convection extends jumps around.) Note that you can take an average of the whole time series by typing, at the Matlab prompt `<mean(sst)>` where, in this case, one is taking an average over time of the surface temperature. (Do not type the angle brackets.) When you have a control experiment you are satisfied with, be sure to save the output in a directory with its own name (e.g. “control”).

Then, perform experiments by rerunning the model with varied parameters and comparing the output to the control run. One particular experiment to try is to explore how the results change with fixed clouds.

You will be assigned **one** of the following for sensitivity testing:

- CO<sub>2</sub> concentration
- CH<sub>4</sub> concentration
- N<sub>2</sub>O concentration
- O<sub>3</sub> concentration
- CFC<sub>11</sub> concentration
- CFC<sub>12</sub> concentration

Shortly after the due date, we will ask you to make a brief presentation of the results in class. Note that a user’s guide is available in the model’s main directory.

Some things to consider in your work:

- Has the model reached statistical equilibrium? How would you know?
- How long of a time period should you average over in determining the equilibrium value (of e.g. surface temperature)?

Model access: Download software on [Tools](#) page.

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