A Simple Climate Model

Theory:

In order to investigate the effect of atmospheric CO_2 on global temperature, we are going to be using *The Very, Very Simple Climate Model* developed at NCAR. This Flash-based computer simulation calculates average temperature on Earth into the future assuming that a doubling of atmospheric CO_2 causes a specific degree increase in temperature. It does not take into account feedback or any greenhouse gasses other than CO_2.

Calibrating the Model:

The calibration program for the climate model can be found at:
http://eo.ucar.edu/staff/rrussell/climate/modeling/co2_climate_model_calibrate.html
The calibration utility allows you to run your model and see how it compares to past data. There are two parameters which you can adjust in order to make your model more closely match the historical data: atmospheric fraction and climate sensitivity.

Humans release CO_2 into the atmosphere in several ways, including burning fossil fuels. The **Atmospheric Fraction** is the percent of the released CO_2 which remains in the atmosphere. Most of the rest of the emitted CO_2 is absorbed by the oceans, and therefore does not directly affect climate. The atmospheric fraction will affect the CO_2 concentration in the atmosphere. Play around with the simulation and try to get the simulated CO_2 concentration (solid black circles) to match the historical data (open black circles).

The **Climate Sensitivity** is a measurement of how responsive the average temperature is to a doubling of CO_2. Specifically, it is how many degrees Celsius the temperature increases if CO_2 concentration is doubled. Adjust the climate sensitivity to get the temperature predicted by the model (solid red squares) to match as closely as possible the historic temperature data (open red squares).

What atmospheric fraction and climate sensitivity gives you the best results?

atmospheric fraction_____ climate sensitivity_____

Predicting the Future:

Now that you have the calibration information, open up the Climate Model at:
http://eo.ucar.edu/staff/rrussell/climate/modeling/co2_climate_model.html
Click on the *Change Settings* button and input your information for **Climate Sensitivity** and **Ocean Absorption Rate**. (Note the ocean absorption rate is 100% minus the atmospheric fraction that you found earlier.)

The simulation will graph the average temperature and CO_2 concentration for a specific emission rate. The current rate of CO_2 emissions is about 8Gt/year. Try running the simulations assuming various emission scenarios. What do you find?