Chemistry 471/671
Introduction to Green Chemistry

Problem Set #4: Climate Change (12 points)
Due Tuesday, October 4, 2011

1) A gas has an atmospheric concentration of 37 ppm and a residence time of nine years.
a) Calculate the net release of this gas to the atmosphere (in ppm/y).
b) Given the molar mass of this substance is 43 g/mol, convert your answer in Part (a) to grams per year. (Hint: Average mass of air is 29.0 g/mol)
c) It is known that 7.23×10^{16} g of this gas is actually emitted to the atmosphere annually. Compare this value to your answer in Part (b). What additional information does this give you about this system?

2) The common tropospheric pollutant gases SO_2 and NO_2 have molecular structures similar to CO_2. However, these molecules are bent, rather than linear. Their vibrational wavelengths are:

Gas	Symmetric stretch	Asymmetric stretch	Bending
SO_2	8.7 μm	7.3 μm	19.3 μm
NO_2	7.6 μm	6.2 μm	13.3 μm

a) Which of these vibrations can absorb IR energy?
b) Which, if any, of these vibrations could contribute significantly to global warming?
c) What characteristics of these gases could limit their role as greenhouse gases?

3) How can the fact that nitrous oxide has three vibrations that absorb IR light be used to prove that its linear structure is NNO rather than NON?

4) Calculate the volume of CO_2 produced at 1 atm and 293 K from the complete combustion of 1.00 L of n-octane, a primary component of gasoline (C_8H_{18}, ρ = 0.702g/mL). If an SUV has a fuel efficiency of 19 mpg, what volume of CO_2 is produced in a 100 mile drive? (1 gal = 3.785 L)

Reading Analysis #3 (6 points – with 2 points reserved for Discussion)
Due Tuesday, October 4, 2011

1) The paper by the European Space Agency discusses a dramatic reduction in sea ice in the North Atlantic in 2007. Do some web research, and discuss what's happened to sea ice in the North Atlantic in the years since.

2) In the 2007 IPCC report, one of the most controversial figures has been Figure SPM.2. What is Figure 2 attempting to depict? What do the authors think is the take home message? What do critics think is the take home message?

3) In the 2007 IPCC report, one of the most powerful figures has been Figure SPM.4. What is shown in Figure 4? Why is this such a powerful presentation? What are the implications for the power of Figure SPM.5?