

**12.102 Problem Set #6:
Effects on climate change: divinity, humanity or bovinity?**

The purpose of this problem set is to introduce you to scientific literature relevant to class discussions of greenhouse gases and climate change. You will examine some of the current literature regarding the carbon cycle, explore the extent of our knowledge of how CO₂ moves through the biosphere, and evaluate the wisdom of some proposed methods of mitigating the impact of anthropogenic carbon inputs. It is beneficial to everyone if your answers are pithy. Each numbered question is worth 10 points.

PART I: Sulfogenic Aerosols

Climate & Anthropogenic Aerosols (Charlson et al., 1992)

- 1) What affects do SO₂ emissions have on the environment? List your answers.
- 2) Charlson et al present some simple equations that approximate the climate forcing resulting from anthropogenic sulfur emissions. Describe, in qualitative terms, the significance of equation 3 (p. 426).

PART II: The Carbon Cycle

Terrestrial CO₂ uptake (Fan et al., 1998; Betts, 2000; Fearnside, 2001)

- 3) Summarize the estimates of fossil emissions and terrestrial uptake for the three regions discussed in the Fan et al., 1998 paper.
- 4) Discuss the short and long-term potential of forests as CO₂ sinks. According to Betts, does planting trees solve the anthropogenic CO₂ dilemma?
- 5) Explain in some detail why the proposed North American carbon sink is so politically controversial.

Carbon Sequestration (Friedmann, 2003)

- 6) List and describe four different ways to store CO₂. What are some difficulties associated with each of these methods, and what aspects need to be most studied?

PART III: Past Climate Change

Past climate changes provide a basis for assessing the possible climatic effects of greenhouse gases in the earth's atmosphere. In this section you will examine and evaluate a proposed record of climate over the past 100,000 years.

Ice Core from Greenland (Thompson et al., 2002)

- 7) In two or three sentences describe the general approach used in this paper.
- 8) How do the authors relate the $\delta^{18}\text{O}$ record to time? What assumptions, both explicit and implicit, lie behind their method?

- 9) If ice layers had undergone significant mixing during normal ice flow within the glacier, what type of $\delta^{18}\text{O}$ record would you expect?
- 10) Discuss the relevance of these findings to predictions of global warming due to anthropogenic greenhouse gases.