

## PROBLEM SET 4

1. (a) Describe the processes that transfer carbon from the atmosphere to the land and from the land to the atmosphere. What are the chemical reactions that describe these processes?
- (b) How do these processes interact to produce the “sawtooth” annual cycle in the atmospheric abundance of  $CO_2$  shown in Figure 1.

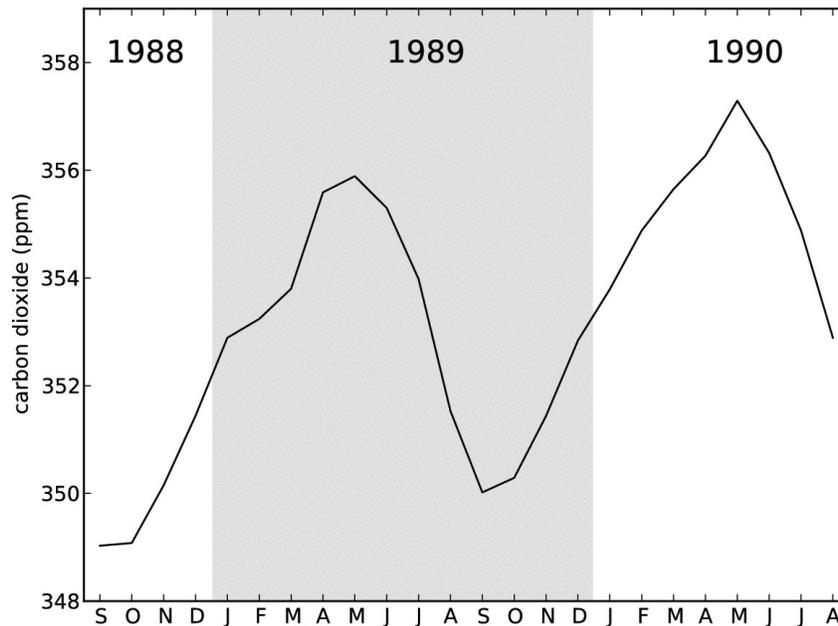


Figure 1: The atmospheric abundance of carbon dioxide from fall 1988 through fall 1990 (data measured at Mauna Loa, Hawaii, and obtained from the NOAA Earth System Research Laboratory/Global Monitoring Division.)

2. Your friend asks you how we know that volcanoes are not responsible for the observed increase in carbon dioxide. What do you tell your friend?
3. A letter to the editor of the *Austin American-Statesman*, published on December 23, 2009, asks this question: “The trillion-dollar question that Copenhagen has not answered [is this]: Because carbon dioxide molecules are all identical, why is it that carbon dioxide from carbonated beverages, pets, cattle, farm animals, and humans, yeast, dry ice, fireplaces, charcoal grills, campfires, wildfires, alcohol and ethanol is good, and carbon dioxide from fossil fuel is bad?” What is your answer? (You may refer to Figure 2 below.)
4. How are humans’ activities *modifying* the carbon cycle?
5. Why are seasonal  $CO_2$  fluctuations (like those shown in Figure 1) strongest at northern latitudes?
6. Estimate the size of your share of carbon emission from the burning of fossil fuels (we did not discuss how to compute this in class, please use any available sources to do this computation and make sure you specify these sources). Give your answer in GtC per year (i.e., GtC/year).

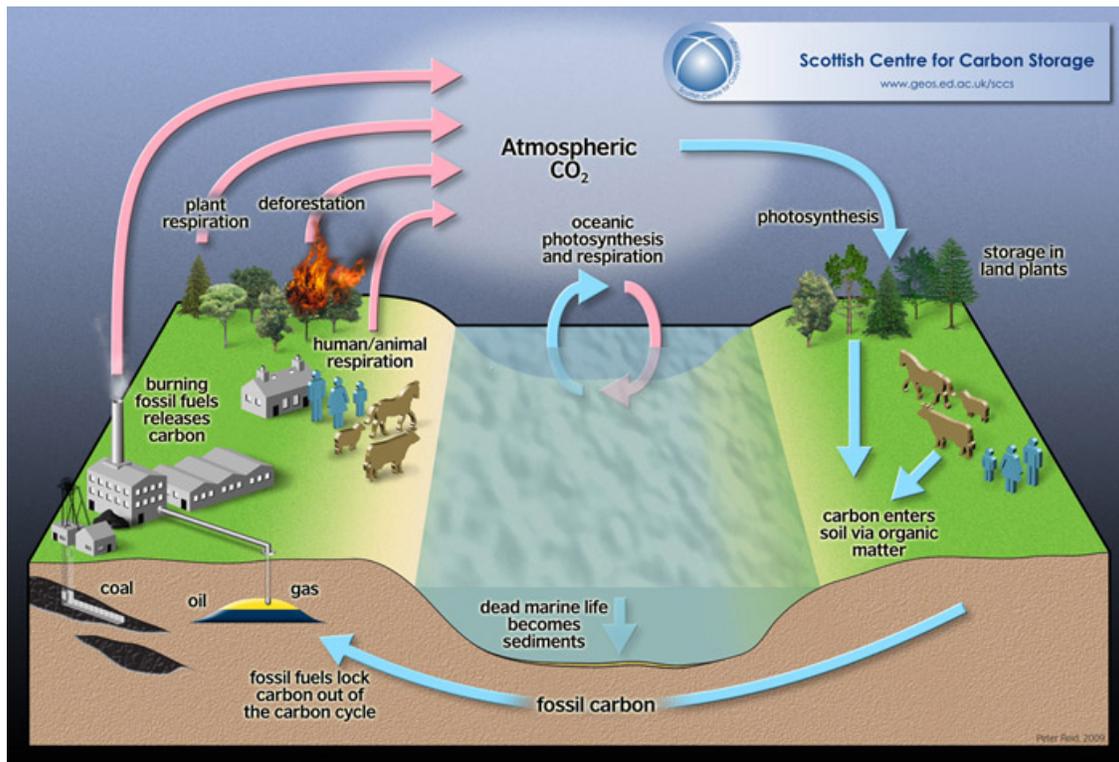


Figure 2: Schematic showing global carbon cycle.