GEOG313/513: Homework 4

Name:

Personal Carbon Footprint

A **carbon footprint** is a "measure of the impact human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide". Your personal carbon footprint is defined by the total actions your personally are accountable for over the course of one year, and their equivalent in terms of kilograms of carbon dioxide. For this exercise, you will be estimating your direct emissions (typically from home energy usage and transportation). This value represents about one quarter of your total carbon footprint, as other activities include indirect consumption and emission of carbon dioxide. As a second part of this exercise you will be asked to think of your indirect carbon dioxide emissions, and means by which you can reduce both your indirect and direct carbon footprint. Finally, food choices may be important from a monetary and health perspective. However, food choices also have ramifications in terms of carbon emissions. You will examine how your favorite food indirectly contributes to anthropogenic emissions of greenhouses gases.

Calculate your direct contributions to Carbon Dioxide emissions

Part I. Personal CO_2 Emissions [10pt]

In order to estimate your personal emissions you will need to gather a few pieces of data. Please show your work in computing your estimated CO_2 emissions!

A. CO2 emissions at home

I. Electricity. You will need to estimate the number of kilowatt hours (kWh) used annually (check a recent electricity bill) and divide by the number of people in your household. If you happen to live on campus, then assume 1500kWh per year.

Next, we estimate how much CO2 per kWh we must consider where our electricity comes from. In Idaho we rely almost solely on hydroelectric power generation. The decreased reliance on fossil or coal from energy allows you to have a relatively low average: 0.14 kg of CO_2 per kWh

Monthly Usage	Multiply by 12	Divide by People Per Household	Multiply by 0.14 kg CO_2/kWh
			(i)

II. Natural Gas

Estimate your monthly gas bill using the same method as above. If you are in a dorm assume 0 emissions. The carbon dioxide coefficient for natural gas is 6 kg CO2 per therm.

Monthly Usage	Multiply by 12	Divide by People Per Household	Multiply by 6 kg CO_2/therm
			(ii)

Add (i+ii) together to get your annual **direct** emissions from household use.

______________________ **(I)**

B. Transportation

Personal Automobile

How many miles do you drive in a car each year : __________________ (A)

Average number of people in car (including you) : __________________ (B)

Average number of miles per gallon (MPG) : __________________ (C)

look up your fuel usage efficiency on web at http://www.fueleconomy.gov/

To convert between fuel consumption in gallons and carbon dioxide emissions, you need to consider that roughly 9.5 kg CO_2 are emitted for each gallon of fuel.

Annual Miles Driven (A)	Divide by Average People in Car (B)	Divide by MPG (C)	Multiply by 9.5 kg CO_2/gallon
			(II)

Public transit (excluding air travel)

Number of miles traveled per year : ______________________

Multiply by 0.073 kg CO_2 /mile x 0.073 kg CO2/mile

Annual CO_2 usage from public transit : _____________________ **(III)**

Air Travel

Number of miles traveled per year ____________________

Multiply by 0.42 kg CO_2 /mile x 0.42 kg CO2/mile

Annual CO_2 usage from air transit : _____________________ **(IV)**

Cumulative CO_2 from Transportation (II+III+IV) : _____________________ **(V)**

Direct CO_2 Emissions (I+V) : _____________________ **(VI)**

C. Indirect emissions

Typical CO_2 emissions calculated in Part I (excluding extraordinary air-travel) represent only about 25% of your total CO_2 emissions (for the US in general). Indirect emissions are notorious challenging to quantify given the "life-cycle" of material goods. Estimate your indirect emissions by clicking on the "Secondary" tab from the following site: http://www.carbonfootprint.com/calculator.aspx

Estimated indirect CO2 emissions : : _____________________ **(VII)**

Estimated total CO2 emissions (VI+VII) : : _____________________ **(VIII)**

Note that your units should be kg of CO2. Per capita, the US emits 17,000 kg of carbon dioxide (CO_2) per year, other countries emit far less. A list is shown at http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions_per_capita

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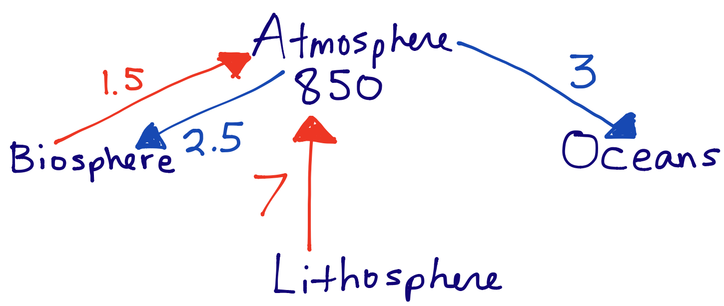
Part II. Carbon Footprint of Water Bottles

Your friend drinks two 1-liter bottles of bottled water per day. Estimate the CO2 emissions associated with the production and transportation of one 1-liter Aquafina water bottle from Atlanta, Georgia, to your doorstep. The weight of plastic of the bottle is 30g and 4kg of CO2 are emitted for every kg of plastic produced. Assume that transporting 1 metric ton of material one kilometer will produce 100 grams of CO2 and know that the density of water is one gram per milliliter. Compute the net carbon footprint of your friend need for bottled water in a given year in kilograms of CO2. [3 pts]

Part III: Climate Ramifications

Currently around 850 gigatons (GT) of carbon are in the atmosphere, an increase of nearly 40% from preindustrial conditions. Complex models estimate carbon exchanges under various pathways of development. We will use a simple model to estimate changes in levels of atmospheric carbon through 2100. Below is a diagram of anthropogenic carbon fluxes (i.e., changes to the carbon cycle from human activities) with red arrows being carbon sources and blue arrows being carbon sinks. Numbers for fluxes are in GT of carbon per year. These numbers are similar to rates of change for the 1990s. Let's assume that these fluxes continue unchanged through the year 2100.



(1) Calculate the amount of carbon in the atmospheric reservoir by 2100. Units should be in gigatons of Carbon. [2]

(2) A total of 2.13 gigatons of carbon are associated with every 1 ppm of CO2. What would the atmospheric CO2 concentration be in 2100? [1]

513 students only

(3) Atmospheric concentrations in 1750 were 280ppm. Using this information and your your answer from (2) estimate the radiative forcing associated with this change in atmospheric CO2. To do this, use the MODTRAN web tool [http://forecast.uchicago.edu/modtran.html], apply the "1976 US Standard Atmosphere"," No Clouds or Rain", and have your sensor altitude at 70km looking down. Remember that you are identifying how much extra longwave energy is trapped in the Earth-Atmosphere system due to changes in CO2. Report your answer in the additional W/m^2, or radiative forcing. [2]

(4) Assuming that preindustrial global mean surface temperature was 288K, estimate the change temperature due to increased CO2. Multiply your answer from (3) by a factor of 3 to account for climate feedbacks and use this to perturb your initial energy amount. [2]