

**Homework 6** (last one!)

assigned: Thurs Nov 20

due: Wed Dec 3

*Readings for Global warming science and policy:**Organic Carbon Cycle KKC 7:128-138 (esp. short-term org. carb. cycle 133-138)**Science of Global Warming KKC 13 (all)**IPCC 2001 "Summary for Policymakers" [on website]**Seattle Times Pro/Con debate [on website]*

*Global warming prediction for midcentury:* You work for a large company or government agency. The head of your organization wants to know how seriously to take this alleged problem of "global warming" and assigns you the job of looking into it. Use the following equation,

$$\Delta T = \lambda * \Delta F * \text{lag\_factor}$$

to make your calculations. Additional information is provided below. Your job is to fill in Table 3 and answer the questions. Good luck!

*Climate sensitivity:* Climate sensitivity is normally expressed in terms of equilibrium warming for doubled CO<sub>2</sub>, or  $\Delta T(2\times\text{CO}_2)$ . The following table shows the range of values that are considered credible by the IPCC and gives the corresponding value of  $\lambda$  for each one. (The relation between them is simply,  $\lambda = \Delta T(2\times\text{CO}_2)/3.7$ )

Table 1: Climate sensitivity

$\Delta T(2\times\text{CO}_2)$ (K)	$\lambda$ (K/(W/m <sup>2</sup> ))	Notes
1.2	0.3	Stefan-Boltzmann Law (no feedback case)
1.5	0.4	IPCC low
3.0	0.8	IPCC medium
4.5	1.2	IPCC high

*Climate forcing:* The following table lists three emission scenarios from the IPCC 2001 report. These three scenarios bracket the full range, providing low, medium, and high estimates. (The scenarios chosen are the B1, A1B, and A1F1 scenarios, respectively.) Shown in the table are the CO<sub>2</sub> emissions, CO<sub>2</sub> atmospheric concentration, CO<sub>2</sub> forcing, and total forcing that correspond to each scenario. Comparing the CO<sub>2</sub> forcing and total forcing you can see that the non-CO<sub>2</sub> forcings also differ somewhat among the scenarios. However, CO<sub>2</sub> is always the dominant part of total forcing and the non-CO<sub>2</sub> are always somewhat positive, according to the IPCC.

Table 2: Climate forcing scenarios

Scenario	2050 Emissions (Gton C/yr)	2050 Concentration (ppm)	2050 CO <sub>2</sub> forcing (W/m <sup>2</sup> )	2050 Total Forcing (W/m <sup>2</sup> )
B1	11	485	3.0	3.3
A1B	16.5	520	3.4	4.1
A1F1	24	560	3.7	4.8

*Lag Factor:* Climate model simulations indicate that the lag factor associated with steadily increasing forcing is about 0.66. Use this value in your calculations.

1. *GAAST prediction for 2050:* Fill in the following table. First, fill in the appropriate values of  $\lambda$  (in the top row) and  $\Delta F$  (in the left column). Then fill in the nine values of  $\Delta T$  that correspond to each combination of these two parameters. (Remember to multiply by the lag factor.)

Table 3: Global warming possibilities for 2050 using lag factor of 0.66 [10 pts]

	$\lambda$ (low)	$\lambda$ (medium)	$\lambda$ (high)
$\Delta F$ (low)			
$\Delta F$ (medium)			
$\Delta F$ (high)			

2. *Main cause of uncertainty in forecast:* Which causes more uncertainty in the 2050 forecast: (i) uncertainty about the climate system (as reflected in the climate sensitivity parameter) or (ii) uncertainty about human decisions in the future (as reflected in the emissions scenarios)? Justify your answer based on the data in Table 3. [6 pts]

3. *Emission prediction:* What do you think is the most likely value for global  $\text{CO}_2$  emissions by the year 2050? Explain your answer. That is, how do you think the relevant political, economic, and/or technological factors will play out over the next few decades? Limit your answer to one paragraph. [6 pts]

4. *Temperature prediction and consequences:* (a) What is your prediction for global-mean temperature change by the year 2050? (Note: if your prediction lies outside the range calculated in Table 3, above, explain why.) [2 pts] (b) Describe what you think are the most important consequences that are likely to be associated with this amount of change in global-mean temperature? You can discuss impacts on any aspect of the physical, biological, or human environment and the impacts you discuss can be good or bad. Limit your answer to one paragraph. [6 pts]

5. *Weaknesses in the current paradigm:* The calculations laid out in Tables 1-3, above, represent the current analysis of the global-warming problem by the IPCC (2001). What do you think is the weakest aspect of the IPCC analysis? Explain. Alternatively, what do you think is the strongest argument of the "skeptics" - those scientists and politicians that criticize the IPCC and minimize the problem of global warming? Limit your answer to one paragraph. [8 pts]

Extra credit: *Creative writing challenge:* Write a single, original sentence that includes as many of the following words as possible, using each in a manner consistent (more or less) with its meaning in this course. The sentence does not have to be correct, but it should make sense. [1 point for each word included in a sensible way. 5 bonus points for the student who writes the most elegant sentence that includes all 10.]

fossil fuel, climate forcing, biological pump, pre-industrial, ice-age,  
business-as-usual, deforestation, photosynthesis, isotope, carbon cycle