MONT 102N – Modeling the Environment
Information on Final Exam
December 1, 2011

General Information and Groundrules

As announced in the course syllabus, the final exam for our Montserrat seminar will be given at the announced time for MWF 9:00am classes:

Wednesday, December 14, 8:00am to 10:30am

I will see about obtaining the small classroom SW 330 (the room where we did the midterm) for our use that day.

- This will be an individual exam. No sharing of information in any form will be permitted during the exam.
- You may use a calculator during the exam, but no other electronic devices.
- If you are well-prepared and work steadily, I expect the exam will take about 1 1/2 hours (90 minutes) to complete. However, you will have the full 2 1/2 hour period (150 minutes) to work if you need more time.
- There will be four or five mathematical problems (each possibly with a few separate parts). These questions will be similar to things you have seen on the problem sets or the group projects, and may cover concepts and techniques from any section of the course. In other words, this will be a *comprehensive* exam. Some sample exam questions are given later in this document.
- The exam will also include an essay question (worth about 1/3 of the total points) on a set topic chosen from the topics listed below. It should take you between 30 and 45 minutes to produce a good, detailed answer for one of these questions. So it will be necessary to spend a sufficient portion of your preparation time on deciding what you want to say for each topic.

Review Session

If there is interest, I would be happy to run a review session for the final. If we do it in the evening either Sunday, December 11 or Monday, December 12, we might start with a class dinner in the Mulledy social space.

Possible Essay Topics

1. What are the major reservoirs of carbon in the Earth's short-term carbon cycle? What are the major flows ("fluxes") of carbon between those reservoirs? Describe them in words and via a diagram. In our final group project, we looked at a simple model of this system. What features of the real world carbon cycle did that model include? What are three possibly important features of the real world carbon cycle that were left out?

2. Why do we try to build mathematical models of aspects of the real world at all? Can *any* mathematical model be a completely accurate representation of some aspect of the natural world? As an example, why do scientists think it is important to understand how much CO_2 is present in the atmosphere? What tends to happen when CO_2 levels rise? Describe a key piece of evidence that suggests human activities might have changed atmospheric CO_2 levels over the past 50-200 years. Explain the case for saying the evidence points to that conclusion, and relate your answer to the results of modeling exercises we did in this class.

3. Suppose someone expresses the following opinion: "Atmospheric CO_2 levels were much higher at some points in the distant past and we're here now, aren't we? What is there to worry about? Even if our fossil fuel burning does put CO_2 into the atmosphere, the Earth will adapt to it. And besides, we need to use fossil fuels to maintain our economic growth." First, is what this person is saying in the first sentence factually correct? How do we know? Second, do you agree with the "what is there to worry about?" part? If you don't agree, explain – are there important things that this person is leaving out or overlooking? Try to relate your answer to results of modeling exercises we did in this class. If do agree, also explain making reference to topics we discussed in class.

Sample Mathematical Questions

Answers for all of these are given in the back of the book, so you can check your work:

1) Chapter 1/17, 19 (Note: the conversion factor you need for 19 is given on page 329(!) I will supply any information you would need for qeustions like these ones.)
2) Chapter 2/5,7,19,25 (Note: in 5, "normalized" means compute the CO_2 output per 10^{12} BTU produced)
3) Chapter 3/3,9,17,19 (Note: for 17, see example on pages 58 and 59)
4) Chapter 4/5, 15
5) Chapter 5/3,7,11abcf
6) Chapter 6/5a, 7
7) Chapter 7/7, 9

Note: I could also ask you "qualitative" questions relative to the process of fitting a linear, exponential, or power law model like some of the questions from the midterm, including questions about the process of transforming the data via logarithms for the exponential and power law cases. I *can't* ask you to compute a regression equation for linear, exponential, or power law model fitting of course, since we only did those with Excel.)