

**SCIENCE AND POLICY OF GLOBAL ENVIRONMENTAL CHANGE
EEB and FR 5146**

**Course Syllabus
Spring 2008**

Location and Time

Room 395, McNeal
Tuesdays and Thursdays from 10:15 to 11:30AM

Instructors

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Course Website:

<http://www.cbs.umn.edu/labs/shobbie/5146Web/index.html>

Office Hours:

In Person: *by appointment, but feel free to stop by at any time. If we cannot meet with you at that time we will set up an appointment.*

Via Email: *Anytime.* We encourage you to use Email to contact us (and your classmates) with any questions, concerns, or comments. Email is the surest way to receive a prompt reply (usually within the day) and is the easiest way to set up an appointment to meet with us.

Objectives

- A. To explore a range of scientific and policy issues related to global change as it influences ecosystem processes at multiple scales.
- B. To gain expertise in evaluating ecosystem responses to and policy decisions regarding a variety of environmental and global change factors.
- C. To learn how to read, interpret, and critically evaluate the primary scientific literature.
- D. To learn how to think critically about the intended and unintended consequences of alternative environmental policies.

Course Description

Through readings, lectures, discussions, and presentations this course will introduce the critical issues underpinning global change and its biological implications. The course will examine current scientific literature in exploring evidence for human-induced global change and its potential effects on a wide range of biological processes, focusing on (but not limited to) terrestrial ecosystems. We will also examine some of the economic drivers, economic consequences, and political processes related to global change, including local, national and international laws and policies that impact global change.

Course Outline and Schedule

IMPORTANT DATES

Feb 19	Writing Assignment #1 Science Brief Due
March 11	Writing Assignment #1 Policy Brief Due
Apr 10	Writing Assignment #2 (Science and Policy Briefs) Due
April 19-May 8	Student Group Presentations
May 8	Writing Assignment #3 DUE

I. THE CHANGING CARBON CYCLE AND CLIMATE CHANGE

- Jan 22** Course Overview and Introduction to Global Change Policy (SP)
Reading: Op-Ed pieces from the *New York Times* by John Tierney and Thomas Friedman
- Jan 24** The Global Carbon Cycle, Part I. (SH)
Reading: Canadell et al. 2007, Schimel 2007, IPCC (2007) WG1 Chapter 7 (Denman et al. 2007, section 7.3 only)
- Jan 29** The Global Carbon Cycle, Part II. (PR)
Reading: see Jan. 24
- Jan 31** Climate Change: Introduction to Climate Change (SH)
Reading: IPCC (2007) WG1 Technical Summary (Solomon et al. 2007)
- Feb 5** Climate Change: Projections and Uncertainties (SH)
Reading: see Jan 31
- Feb 7** Climate Change: Ecological and Human Welfare Consequences, Part I (SH)
Reading: IPCC (2007) WG2 Technical Summary (Parry et al. 2007)

- Feb 12** Climate Change: Ecological and Human Welfare Consequences, Part II (SH)
Reading: IPCC (2007) WG2 Technical Summary
- Feb 14** Climate Change Solutions: Overview (SP)
Reading: Socolow et al. 2004, Raupach et al. 2007
- Feb 19** Energy from Biomass (SP)
Reading: Hill et al. 2006, Schmer et al. 2008
WRITING ASSIGNMENT #1 (Science Brief) DUE
- Feb 21** Geoengineering (SH)
Reading: Broad and Revkin 2006
- Feb 26** Land Management (Ag and Forestry) (SH and PR)
Reading: Minnesota Carbon Sequestration Initiative Report (2008): Executive Summary
- Feb 28** Carbon Capture and Storage (**Guest Lecture: Elizabeth Wilson, Humphrey Institute**)
Reading: TBA
- Mar 4** Politics and Economics of Climate Negotiations: Kyoto and Beyond (SP)
Reading: Aldy et al. 2003, Bodansky 2003,
- Mar 6** Emissions Reductions: Costs, Benefits and Discounting (SP)
Reading: Petson 2006, Nordhaus 2007, Stern and Taylor 2007
- Mar 11** **No Class: Please attend Stephen Pacala's Talk 11:30-1:00, Mississippi Room, Coffman Union**
WRITING ASSIGNMENT #1 (Policy Brief) DUE
- Mar 13** **Stephen Pacala Class Visit**

II. LAND USE CHANGE AND BIOTIC EXCHANGE AND CHANGE

- Mar 25** Land Use Change: Patterns and Ecological Consequences (PR)
Reading: Foley et al. 2005
- Mar 27** Biotic Exchange and Change (Extinctions and Invasions) (PR)
Reading: Yiming and Wilcove 2005, Mack et al. 2000
- Apr 1** Ecosystem Services (SP)
Reading: Millenium Ecosystem Assessment 2005
- Apr 3** Management for Ecosystem Services (SP)

Reading: Balmford et al. 2002, Nelson et al. 2008

III. OTHER CHANGES IN ATMOSPHERIC CHEMISTRY

- Apr 8** Human Impacts on the Global Nitrogen Cycle: Introduction (SH)
Reading: Chapter 9 from Chapin et al. 2002 (optional)
- Apr 10** Nitrogen Deposition: Causes and Consequences (SH)
Reading: Galloway et al. 2003
WRITING ASSIGNMENT #2 (Science and Policy Briefs) DUE
- Apr 15** Clean Air Act and Regulation of SO₂ and NO_x Emissions (SP)
Reading: Burtraw et al. 2005.
- Apr 17** Agriculture's Role in Causing and Mitigating N Deposition/Loading
(Guest Lecture by Michael Russelle, ARS)
Reading: Aneja et al. 2006, Russelle and Birr 2004
- Apr 22** Tropospheric Ozone: Ecological Consequences (PR)
Reading: Felzer et al. 2004, Wittig et al. 2007 (optional)
- Apr 24** MN Climate Change Action Group Report Discussion (SH, SP, PR)
Reading: MN Climate Change Action Group Report (2008)

VI. STUDENT GROUP PRESENTATIONS

- Apr 29** GROUP 1
- May 1** GROUP 2
- May 6** GROUP 3
- May 8** GROUP 4
WRITING ASSIGNMENT #3 DUE

Responsibilities and Evaluation

Required reading

Each student will be expected to read the material before each class period and participate in discussions. Readings are available through **e-Reserves** (access instructions are included below). Therefore, attendance at all class sessions is expected. Our lectures will usually focus on the same topics, but may address either the specific reading or completely different materials, depending on the comprehensiveness or importance of the reading, its difficulty, and the total information that needs to be covered. Therefore, do not assume that materials in the readings will be covered in class. Sometimes they will, sometimes not.

Daily questions/insights

For each assigned reading, prepare at least brief one question or comment. These daily questions or comments should be 1-3 sentences in length, **should include your name and be handed in by 8pm the evening before each class. Add Moodle or whatever here.**

The objectives of these required "daily questions" are:

- to provide practice at critical thinking
- to give us constant feedback on your level of understanding
- to help move classroom focus to issues you find interesting and important
- to increase the likelihood that required reading will be completed in a timely fashion

What types of questions?

A question should indicate some depth of thought, and not just be, "why did the author want to study ABC?" A question could be something you don't understand (e.g., "what is soil nitrogen mineralization and why should it vary with nitrogen deposition?"), or that seems to contradict something else we've heard (e.g., "how can we reconcile these results with those of Sarah Smith who found opposite results in Borneo?") or something that was not clarified by the paper in question. Comments could for instance, indicate what you think is a novel approach by the author; highlight an important, but underemphasized point; make a linkage with another paper we read previously, etc. Or perhaps you might disagree with either the data, interpretation of data, speculation, methods, or extrapolation.

Group Student Presentations

During the last section of the course, students will form groups to develop presentations on some issue related to global environmental change. Groups should work together to come up with a topic that explores in greater detail and in more depth an issue raised in class or one related to the course content that was not covered in class. Examples of possible topics include: "Evaluate Carbon Offset Programs", "Review/critique laws and legislation in MN related to renewable energy". Each team will be responsible for one class period with its presentation, but the team can decide how to divide that time between lecture and discussion or relevant articles.

Writing Assignment #1

The first writing assignment is divided into two sub-assignments (10 points each). The two subassignments are to write two “briefs”, a Science Brief and a Policy Brief using only the readings and materials covered in class. The word limit for each brief is **XXX** words.

Science Brief

One short science brief will be required. The objective of this writing assignment is to describe a scientific issue in objective, simple terms that could be understood by a layperson (e.g., a non-scientist) and that could inform a hypothetical policy decision by a lawmaker. We will provide more details later in the semester.

Policy brief writing assignment

One short policy brief will be required. This assignment is similar to the science brief, but in this case, the objective is to outline a policy stance on a particular issue related to global change. We will provide more details later in the semester.

Writing Assignment #2

The second writing assignment again consists of writing a Science Brief and a Policy Brief (12.5 points each), However, for this assignment the two briefs are due at the same time, should be somewhat longer (**XXX** words), and should go into more depth than Writing Assignment #1, drawing on literature from outside of class. We will provide more details later in the semester.

Writing Assignment #3

The third writing assignment (20 points) is to develop an editorial or article intended for a lay audience on the topic covered in your group presentation. You can choose among the following writing formats:

- 1) A letter to the editor or editorial column in the style of Thomas Friedman’s *New York Times* column
- 2) A popular magazine essay written for a lay audience in the style of a *New Yorker*, *Atlantic*, or *New York Times Magazine* article.

Evaluation

Requirement	Points
Daily questions	10
Class participation	15
W.A. #1	20
W.A. #2	25
W.A. #3	20
Group Presentation	10

Total	100
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Note that the grading system heavily emphasizes day-to-day participation.

Accessing E-Reserves

The readings for the course are available through electronic reserves, under Hobbie.

Instructions for accessing EReserves

1) Use direct link to your ERes course page (listed under Hobbie):

<http://eres.lib.umn.edu/eres/coursepage.aspx?cid=458>

or go to the ERes main page and search for the course by department, instructor, or course number. The ERes main page is located at:

<http://eres.lib.umn.edu/eres/default.aspx>

2) At copyright acceptance page, enter course password and click "Accept".

COURSE PASSWORD: ch6waya

3) To view course information, select "Course Info" tab.

4) To view readings, select "Documents" tab.

5) Click on reading in "Title" column:

Most .pdf documents will automatically open. For readings with multiple parts, the "Document Info" window will open: click on each linked file name to open the reading's parts.

For links to most online resources, the "Document Info" window will open. Click on the "Click here to access online readings" link. The "Find It" window will open: click on one of the "electronic full text available" links to access the reading.

For links to some online resources, the "Document Info" window will open, and may include directions under "Description". Click on "Click here to access online resource" link, then follow directions under Description to locate the reading.

A Few Reminders:

* Access to course materials will require authentication. Students must authenticate their access using their University Internet ID (e-mail username) and password. A course level password also is required, to be distributed by the instructor.

* An Electronic Reserve FAQ (Frequently Asked Question list) for students can be accessed at:

<http://www.lib.umn.edu/site/eres-FAQ.phtml>

* To view most documents placed on ERes, students will need to have installed the Adobe Acrobat Reader. The Reader can be downloaded for multiple platforms from the Adobe site at: <<http://www.adobe.com/prodindex/acrobat/readstep.html#reader>>
<http://www.adobe.com/prodindex/acrobat/readstep.html#reader>

* While we try to minimize the file sizes of scanned documents, some of the files remain quite large (20-50KB per page). For this reason, it is recommended that students access these documents with a minimum 28.8 speed modem to reduce downloading times.

* Students and faculty may direct questions they have about electronic reserve, including those related to hardware and software, and navigating the system to:
<http://infopoint.lib.umn.edu/>

NOTE: Distribution of this password is limited to students enrolled in the course. Due to copyright restrictions you may not share the course password with anyone not enrolled in the course. Password protection creates a secure environment for access to copyrighted works that allows University Libraries to make materials available to students under the provisions of fair use. Limiting access to students registered in the class helps assure that materials are used only for educational purposes, and minimizes any impact on the market for the original work. This restriction is essential to a good faith assertion of fair use in electronic reserves service.

E-Reserve Readings for EEB/FR 5146, Spring 2007

- Aldy, J.E., R. Baron and L. Tubiana. 2003. Addressing cost: the political economy of climate change. In: *Beyond Kyoto: Advancing the International Effort Against Climate Change*, Pew Center on Global Climate Change, Arlington, VA.
- VA.Aneja, V. P., W. H. Schlesinger, D. Niyogi, G. Jennings, W. Gilliam, R. E. Knighton, C. S. Duke, J. Blunden, and S. Krishnan. 2006. Emerging national research needs for agricultural air quality. *EOS* 87:25-36.
- Balmford, A., A. Bruner, P. Cooper, R. Costanza, S. Farber, R.E. Green, M. Jenkins, P. Jefferiss, V. Jessamy, J. Madden, K. Munro, N. Myers, S. Naeem, J. Paavola, M. Rayment, S. Rosendo, J. Roughgarden, K. Trumper, and R.K. Turner. 2002. Economic reasons for saving wild nature. *Science* **297**: 950-953.
- Bodansky, D. 2003. Climate commitments: assessing the options. In *Beyond Kyoto: Advancing the International Effort against Climate Change*. Pew Center on Global Climate Change, Arlington, VA.
- Broad, W. J. and A. C. Revkin. 2006. How to cool a planet (maybe). *New York Times*, June 27, 2006.
- Burtraw, D., D.A. Evans, A. Krupnick, K. Palmer and R. Toth. 2005. Economics of pollution trading for SO₂ and Nox. *Annual Review of Environment and Resources* **30**: 253-89.
- Canadell, J. G., C. Le Quere, M. R. Raupach, C. B. Field, E. T. Buitenhuis, P. Ciais, T. J. Conway, N. P. Gillett, R. A. Houghton, and G. Marland. 2007. Contributions to accelerating atmospheric CO₂ growth from economic activity, carbon intensity, and

- efficiency of natural sinks. *Proceedings of the National Academy of Sciences* **104**:18866-18870.
- Chapin, F. S., III, P. A. Matson, and H. A. Mooney. 2002. *Principles of Terrestrial Ecosystems*. Springer-Verlag. Chapter 9.
- Denman, K. L., G. Brasseur, A. Chidthaisong, P. Ciais, P. M. Cox, R. E. Dickinson, D. Hauglustaine, C. Heinze, E. Holland, D. Jacob, U. Lohmann, S. Ramachandran, P. L. da Silva Dias, S. C. Wofsy, and X. Zhang. 2007. Couplings between changes in the climate system and biogeochemistry. *in* S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller, editors. *Climate Change 2007: The Physical Science Basis, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom.
- Felzer, B., D. Kicklighter, J. M. Melillo, C. Wang, Q. Zhuang, and R. Prinn. 2004. Effects of ozone on net primary production and carbon sequestration in the coterminous United States using a biogeochemistry model. *Tellus* **56B**:230-248.
- Foley, J. A., R. DeFries, G. P. Asner, C. Barford, G. Bonan, S. R. Carpenter, F. S. Chapin, III, M. T. Coe, G. C. Daily, H. K. Gibbs, J. H. Helkowski, T. Holloway, E. A. Howard, C. J. Kucharik, C. Monfreda, J. A. Patz, I. C. Prentice, N. Ramankutty, and P. K. Snyder. 2005. Global consequences of land use. *Science* **309**:570-574.
- Galloway, J. N., J. D. Aber, J. Willem Erisman, S. P. Seitzinger, and R. W. Howarth. 2003. The Nitrogen Cascade. *BioScience* **53**:341-356.
- Hill, J., E. Nelson, D. Tilman, S. Polasky and D. Tiffany. 2006. Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. *Proceedings of the National Academy of Sciences* **103**: 11206-11210.
- Mack, R. N., D. Simberloff, W. M. Lonsdale, H. Evans, M. Clout, and F. I. Bazzaz. 2000. Biotic invasions: Causes, epidemiology, global consequences, and control. *Ecological Applications* **10**:689-710.
- Millenium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Synthesis*. Island Press, Washington, DC.
- Nelson, E., S. Polasky, D.J. Lewis, A.J. Plantinga, E. Lonsdorf, D White, D. Bael and J.J. Lawler. 2008. Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape. *Proceedings of the National Academy of Sciences*.
- Nordhaus, W. 2007. The *Stern Review* on the economics of climate change. *Journal of Economic Literature* **XLV**: 686–702.
- Parry, M. L., O. F. Canziani, J. P. Palutikof, and Co-authors. 2007. Technical Summary. Pages 23-78 *in* M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, and C. E. Hanson, editors. *Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom.
- Peston, R. 2006. Report's stark warning on climate. BBC. <http://news.bbc.co.uk/2/hi/business/6096594.stm>
- Raupach, M. R., G. Marland, P. Ciais, C. Le Quere, J. G. Canadell, G. Klepper, and C. B. Field. 2007. Global and regional drivers of accelerating CO₂ emissions. *Proceedings of the National Academy of Sciences* **104**:10288-10293.

- Russelle, M. P. and A. S. Birr. 2004. Large-scale assessment of symbiotic dinitrogen fixation by crops: soybean and alfalfa in the Mississippi River Basin. *Agronomy Journal* 96:1754-1760.
- Schimel, D. S. 2007. Carbon cycle conundrums. *Proceedings of the National Academy of Sciences* 104:18353-18354.
- Schmer, M. R., K. P. Vogel, R. B. Mitchell, and R. K. Perrin. 2008. Net energy of cellulosic ethanol from switchgrass. *Proceedings of the National Academy of Sciences* 105:464-469.
- Socolow, R., R. Hotinkski, J. B. Greenblatt, and S. Pacala. 2004. Solving the climate problem: technologies available to curb CO₂ emissions. *Environment* 46:8-19.
- Solomon, S., D. Qin, M. Manning, R. B. Alley, T. Berntsen, N. L. Bindoff, Z. Chen, A. Chidthaisong, J. M. Gregory, G. C. Hegerl, M. Heimann, B. Hewitson, B. J. Hoskins, F. Joos, J. Jouzel, V. Kattsov, U. Lohmann, T. Matsuno, M. Molina, N. Nicholls, J. Overpeck, G. Raga, V. Ramaswamy, J. Ren, M. Rusticucci, R. Somerville, T. F. Stocker, P. Whetton, R. A. Wood, and D. Wratt. 2007. Technical Summary. *in* S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller, editors. *Climate Change 2007: The Physical Science Basis, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom.
- Stern, N. and C. Taylor. 2007. Climate change: risk, ethics, and the Stern Review. *Science* 317: 203-204.
- Wittig, V. E., E. A. Ainsworth, and S. P. Long. 2007. To what extent do current and projected increases in surface ozone affect photosynthesis and stomatal conductance of trees? A meta-analytic review of the last 3 decades of experiments. *Plant, Cell and Environment* 30:1150-1162.
- Yiming, L. and D. S. Wilcove. 2005. Threats to vertebrate species in China and the United States. *Bioscience* 55(2):147-153,

URLs for publicly available reports:

Aldy et al. 2003 & Bodansky 2003:

<http://www.pewclimate.org/docUploads/Beyond%20Kyoto.pdf>

Denman et al. 2007: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter7.pdf>

EPA (1999): www.epa.gov/air/sect812/1990-2010/fullrept.pdf (Exec. Summary, Chapters 2, 4, and 7)

Millenium Ecosystem Assessment (2005):

www.millenniumassessment.org/en/Products.Synthesis.aspx

Parry et al. 2007: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-ts.pdf>

Peston. 2006: <http://news.bbc.co.uk/2/hi/business/6096594.stm>

Solomon et al. 2007: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-ts.pdf>