Science and Politics of Global Warming
GEO 3402 and GEO 5402

Spring 2010 Course Syllabus

Time and Place: 8:15 – 9:30 am in Pillsbury Hall Room 110

Instructor: Katsumi Matsumoto
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Matsumoto is a professor and oceanographer in the Department of Geology and Geophysics. His research focuses on climate change and carbon cycle change and uses numerical models of global climate. He is a contributing author of the 2007 IPCC science report on global climate change.

Office Hours: By appointment but feel free to stop by during regular working hours

Course website: WebVista via MyU Portal (http://myu.umn.edu)

Reading Materials:
(1) David Archer, *Global warming: Understanding the forecast*, Blackwell Publishing, 2007
(2) Additional readings on E-Reserve and WebVista

Grading: Homework 50%, Report 10%, Class Attendance and Participation 20%, Final Exam 20%

Final Exam: 8:00am-10:00am Wednesday, May 13 (regular classroom)

Welcome to the Science and Politics of Global Warming! Today media often carry headlines warning the public of the dangers of human-induced global climate change. New "signs" of global warming, such as retreating mountain glaciers and shrinking Arctic Ocean ice cover, are reported. At the same time there are claims and accusations that global warming is just a hoax. On the political front too, there are conflicting positions about what needs to be done if anything about global climate change. Even amongst those who accept that global warming is occurring, there is little consensus about how to mitigate the human impacts and at what cost. In this course, we will examine global warming from both the natural science and social science perspectives. The goal of the natural science portion, taught by Matsumoto, is to clarify what we know and how well we know about global warming: the physics of greenhouse effect (why Earth is habitable compared to Mars and Venus?), the global carbon cycle (what is the consequence of burning oil?), and future global climate forecasts (what awaits us). The goal of the politics portion of the course, taught by a number guest lecturers and Matsumoto, is to explain the goals and means to put the science into action. We will identify the policies, technologies and forms of social reorganization needed to produce carbon-neutral national and world society, as well as legal, social and cultural factors helping or impeding our attainment of that goal.

Guest lectures:
This course will feature a number of guest lectures from different departments (Ecology, Evolution and Behavior, Humphrey Institute, Law, Political Science, Soil, Water and Climate) on the politics aspect of the course. These lectures will provide perspectives by experts on topics such as environmental law, resource management, environmental economics, energy, public policy, American and international politics, technology, and social organizations.

The CLE Environment Theme
This course meets the Environment Theme of the University of Minnesota Council on Liberal Education. A CLE theme course engages students in difficult debates about moral, legal, and ethical issues that require critical inquiry from a variety of perspectives and independent thinking. The *Environment* theme in particular requires an in-depth examination of a significant environmental problem from various perspectives. This course takes scientific and sociological approaches to examine global warming, which is arguably one of the most significant environmental problems facing the global society today. Climate change cuts into society from various dimensions: sustainability, energy provision, environmental justice, technology, population dynamics, the organization of production and consumption, and national security. By approaching from the perspectives of both natural and social sciences, this course gives explicit attention to interrelationships between the natural environment and human society.

Learning outcomes:
At the end of this course successful students will be able to:

- Explain the basics of atmospheric structure, greenhouse effect, and global carbon cycle
- Explain detection and attribution of global warming
- Discuss climate modeling and future climate forecasts
- Understand national and international policy options for dealing with global climate change
- Understand the relationship between global climate change and energy production and usage.
- Discuss the feasibility of alternative energy technologies and conservation as solutions.
- Understand the projected impacts of climate change on global prosperity, health, migration, conflict, biodiversity and other social issues.
- Envision the organizational requirements of a carbon-neutral society and planet.
- Understand the actions needed to overcome barriers and create a carbon-neutral society

Homework:
Homework will be due one week after it is assigned. Some homework will require you to use numerical models noted in Archer's book and accessible by a web browser. Other homework will require access to web-based interactive modules. Homework will lose 10% of grade per day late.

Report:
During the semester, you are to collect "articles" on global climate change. They can be in various forms and from a variety of sources (e.g., newspapers, news magazines, etc.) but have to be reasonably credible (e.g., no supermarket tabloids). The articles can be on any aspect of climate change. You should find relevant articles on a regular basis. At the end of the course, you will submit a report, providing a general discussion of your collection of articles. You should relate these articles to the course content. In addition, choose one article in particular, and discuss it in more detail. Your entire report should be 3 pages or less, plus your collection of articles (organized scrap books would earn extra credits).

Quiz and Exams:
If there is a conflict in time with another university activity, the student needs to notify the instructor *before* the quiz/exam is administered in order to be allowed to make it up without penalty. Sickness and family emergency are also acceptable reasons for penalty-free makeups, but this will need to be communicated without delay. Otherwise, a makeup can be given within a week of the missed quiz/exam with a *25% penalty*.

Class Participation:
There will be an effort made to have a short in-class discussion on a selected topic every lecture. There will also be student group presentation. Each group will make one group presentation during the semester. The topic will be "Climate Change in the Media." Your job is to evaluate and critique how the media is handling some issue related to climate change. Each group will select some current news media article or news broadcast (video clip) and develop an analysis and critique of the content of and position taken by it. Circulate the article or video to class beforehand and your analysis to the class. About 20 minutes total.

Academic integrity:

Academic integrity is essential to a positive teaching and learning environment. All students enrolled in University courses are expected to complete coursework responsibilities with fairness and honesty. Failure to do so can result in disciplinary action. The University Student Conduct Code defines scholastic dishonesty, which includes plagiarizing; cheating on assignments or examinations. A student responsible for scholastic dishonesty can be assigned a penalty including an "F" or "N" for the course.

Disabilities statement:
It is university policy to provide, on a flexible and individual basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities are encouraged to contact the professor.

Grades:
Final course grades will be "curved" (i.e., not based on absolute scores). As a rough guide, the top third of the class will get A's, the next third B's, and the last third C's. Students with scores significantly lower than the bulk of the last third may receive D's or F's.

Class notes:
Some class lectures will be posted on the web.

Class Schedule:

Week	Dates	Topics	Events
1	1/20 1/22	Introduction and course logistics Impacts of climate change	
2	1/27 1/29	The looming risks of global climate change The greenhouse effect	 HW 1
3	2/3 2/5	Greenhouse gases and radiative forcing The temperature structure of the atmosphere	 GP 1
4	2/10 2/12	Potential solutions--technology, policy or social change? Slow march--international and national responses	 HW 2
5	2/17 2/19	Essentials of climate physics Feedbacks in the climate system	 GP 2
6	2/24 2/26	What's holding us back?-social factors retarding effective response . Embedded in energy: energy and civilization	 HW 3
7	3/3 3/5	Fossil fuels and energy consumption – the Kaya identity Population, affluence and technology: the STIRPAT formula	 GP 3
8	3/10 3/12	Divergent rationalities: Economic costs, interests and public goods The social construction and politics of climate change	 HW 4
9		**Spring Break**	
10	3/24 3/26	Scientific consensus and climate change skeptics Climate change science: acceptance or rejection?	 GP 4
11	3/31 4/2	Natural carbon cycle Anthropogenic carbon cycle	 HW 5
12	4/7 4/9	The responses of developed nations (US , Germany, Japan, Sweden) The responses of developing nations (Brazil, India and China)	 GP 5
13	4/14 416	Detection and attribution of global warming Future climate projections	 HW 6
14	4/21 4/23	Past climates and abrupt climate change Sub-national diffusion of climate change solutions	 GP 6
15	4/28 4/30	US politics of global warming 1 US politics of global warming 2	 HW 7
16	5/5 5/7	Mobilizing to fight climate change Envisioning a sustainable world	
Exams	5/12-16	Final Exam: 8:00am-10:00am Wednesday, May 13	Final

HW=Homework assigned. Due one week later in class. GP=Group Presentation.

Lecture topics and reading materials

1.1) Introduction and course logistics
Is global climate change occurring now and is it caused by human activity? What is the time scale of climate response and how would it impact our decision-making? How did we get to this point? What is "the social?" (economics, politics, relational patterns, culture). What are the relationships between society and nature? What are the roles of social institutions and social organization in generating global climate change and in solving it? Why is it important to approach global climate change from both the natural and social scientific perspectives?

Reading: Archer Chapter 1

1.2) Impacts of climate change
What impacts are anticipated? A look at health, sea level, ocean acidification, and biodiversity.

Readings:

Doney, S.C., "The dangers of ocean acidification", Scientific American, Mar., 58-65, 2006.
Epstein, P.R., "Is global warming harmful to health?", Scientific American, Aug., 50-57, 2000.
Schneider, D., "The rising seas", Scientific American, Mar. 112-117, 1997.

Recommended: Kolbert, E., "Butterfly lessons", New Yorker, Jan. 9, 32-39, 2006.

2.1) The looming risks of global climate change
Predicted effects on human society and other life from different scenarios of climate change. Adaptation versus mitigation as responses.

Reading: "Intergovernmental Panel on Climate Change**,** 2007 Synthesis Report" (pp. 2-22).

2.2) The greenhouse effect
Basic physical concepts and terminology needed to discuss the greenhouse effect: electromagnetic radiation, wave number, frequency, Stefan Boltzman equation, and blackbody spectra. A simple radiation balance of the planetary surface that will allow us to understand the first order difference in the climatologies of Venus (hothouse), Earth (just right), and Mars (icehouse).

Reading: Archer Chapters 2 and 3

3.1) Greenhouse gases and radiative forcing
The nature of optically opaque atmosphere. What are the chemical composition of the atmosphere, radiative properties of greenhouse gases, selective absorption of infrared light, and saturation band width?

Reading: Archer Chapter 4

3.2) The temperature structure of atmosphere
How do the vertical motion of air masses, cooling of temperature with altitude, and air compressibility impact Earth's surface temperature (and the layer model of atmosphere).

Reading: Archer Chapter 5

4.1) Potential solutions--technology, policy or social change?
In order to fully mitigate global climate change, the currently wealthy societies will have to reduce carbon emissions by 80% and the entire world by an average of 50% by the year 2050. A range of technologies, policy agreements and ideas of conservation-inducing social reorganization and value change have been proposed to help attain these goals. What mixture of these (or other) approaches will do the trick? How do global inequalities affect the possibilities? Will a carbon-neutral world increase privation and suffering, or inspire finding happiness even with conservation of energy, and for whom?

Reading:

Hansen, 2007, "How Can We Avert Dangerous Climate Change?" (pp 2-17). Testimony to Select Committee on Energy Independence and Global Warming, US House of Representatives, April 26, 2007.
Stern, Nicholas, Executive Summary, pp. vi-ix. *The Economics of Climate Change,* (2007)

4.2) Slow march--international and national responses

Overview, history and analysis of global climate change politics, negotiations and agreements. UNFCCC, IPCC, Kyoto Protocol, Bali roadmap. Comparison of national reactions to Kyoto. Proposals for the emerging global agreements.

Readings:

Daniel Bodansky "History of the Global Climate Change Regime" Chp. 2 (23-41) in Urs Luterbacher and Detlef Sprinz,2001 *International Relations and Global Climate Change* (MIT Press).

S. Bastianoni, et al."The Problem of Assigning Responsibility for Greenhouse Gas Emissions" *Ecological Economics* 49 (2004) 253-257

5.1) Essentials of climate physics

What drives the winds and ocean currents? What determines the temperature and precipitation distributions around the globe? Touch on the great importance of the effect of Earth's rotation on the motion of winds and currents.

Reading: Archer Chapter 6

Recommended: Kump, Kastings, Crane, Ch. 4 + 5, The Earth Systems (2nd Ed), Prentice Hall, 2004.

5.2) Climate feedbacks

Understanding climate feedbacks and self regulation through the Gaia hypothesis and Daisyworld. These concepts and simple models like the layer model of the atmosphere are great tools to help facilitate understanding but are unfit for realistic predictions. Realistic predictions require climate modeling.

Reading: Archer Chapter 7

Recommended: Kump, Kastings, Crane, Ch. 2 + 6, The Earth Systems (2nd Ed), Prentice Hall, 2004.

6.1) What's holding us back?-The range of factors retarding effective response

Many different factors affect the speed and effectiveness of national response to global climate change. At the most basic level, modern civilization depends upon extremely high inputs of energy to maintain the division of labor, systems of production, and social order. A society's energy (and carbon) intensity is a function of its population, affluence and technology. Even if reducing energy intensity will serve the public good (mitigate climate change), individuals and interest groups oppose it due to projected personal losses, disparage the technology, and stress the social problems. Climate change, with its call for global cooperation, poses a universal culture shock, increasing denial. International agreements are hard pressed to take national variation into full account. .

Readings:

Broadbent, Jeffrey, "Social Learning and National Response to Global Climate Change: Hypotheses for a New Comparative Project using Policy Network Analysis" forthcoming in Sumi et al. *title unknown* (eds.) Springer-Verlag, 2009 (1-20).

Recommended:

McCright, Aaron and Riley Dunlap , "Challenging Global Warming as a Social Problem" *Social Problems* 47, 4. 499-522.

Gould et al, Chp. 1 (3-17) "The Treadmill of Production as an Outcome of Scientific Methods," *The Treadmill of Production*, Paradigm Publishers.

6.2) Embedded in Energy: Energy and social evolution Energy use and the stages of social evolution: hunting and gathering, agricultural revolution, industrial revolution. Energy, industrial revolutions (coal, oil, electronics) and social change. Energy budgets, lifestyle and social routines in developed, transitional and developing countries. Concept of embodied energy. Concept of carbon neutral society. Can we cut energy use by 50% but maintain quality of life? Introduction to other factors affecting national response rates to climate change.

Reading:

Fischer-Kowalski, M., Haberl, H. (1997) "Modes of Production and their Sustainability Problems" *Society and Natural Resources* 10 (1) 61-85.

7.1) Fossil fuels and energy consumption – the Kaya identity

Type and availability of fossil fuels. How long are fossil fuels predicted to last (Hubbert curve and Kaya identity) and what do the predictions depend on?

Reading: Archer Chapter 9

7.2) Population, affluence and technology: the STIRPAT formula
IPAT/STIRPAT. Effect of population size, level of consumption, and efficiency of technology upon national greenhouse gas emissions in different civilizations and countries.

Reading:
York, Richard, Eugene A. Rosa, and Thomas Dietz**.** 2003. "A Rift in Modernity? Assessing the Anthropogenic Sources of Global Climate Change with the Stirpat Model." *The International Journal of Sociology and Social Policy* 23 (31-47).

Recommended:
Rosa et al, Tracking the Anthropogenic Drivers of Ecological Impacts, *Ambio*, 33, 8 Dec 2004 (509-512)
Pimentel, D. et al. 2005. "Environmental, Energetic, and Economic Comparisons of Organic and Conventional Farming Systems". *BioScience* 55: 573-582.

8.1) Divergent rationalities: Economic costs, interests and public goods
Reducing GHG emissions may not cause serious declines in national prosperity, but will cause some corporate sectors (like oil and highways) to lose out, creating powerful resistance to the transition. In any case, it is hard to get individuals and groups to cooperate for the common good. How can we calculate and assign the costs and burdens of transition to a carbon-neutral society and bring about cooperation?

Readings:
Hardin, Garrett, "The Tragedy of the Commons.," *Science* 162 (1968): 1243-1248
Fisher**,** Dana R. 2006. "Bringing the Material Back In: Understanding the U.S. Position on Climate Change," *Sociological Forum* 21:467-494.

Recommended:
Dietz et al, 2002, *The Drama of the Commons*, introduction pp. 3-35.
Pulver, Simone. "Making Sense of Corporate Environmentalism" *Organization and Environment* 20:1 March 2007 44-75.

8.2) The social construction and politics of climate change .
Public opinion and leadership assessments about climate change is not a direct reflection of scientific knowledge, nor even of powerful economic interests. These judgments arise under the influence of many social and cultural factors, including education, news, religion, political ideologies and legitimacy of science, as well as denial and apathy. For any set of beliefs to gain political power, it must be carried by movements and advocacy coalitions. Stakeholder participation may help spread belief in climate change science. Cross-national variation in the strength of advocacy coalitions and opportunities for stakeholder participation may be very influential in determining the comparative effectiveness of national reactions to climate change.

Readings:
McCright, Aaron M. and Riley E. Dunlap. 2000. "Challenging Global Warming as a Social Problem: An Analysis of the Conservative Movement's Counter-Claims." *Social Problems* 47:499-522.

9. SPRING BREAK

10.1) Natural carbon cycle
Carbon storage and exchange under *natural* circumstances or prior to industrialization. Where is carbon in the absence of human activities and how does it move around? A look at the roles the terrestrial biosphere, oceans, rocks, and atmosphere.

Reading: Archer Chapter 8

10.2) Anthropogenic carbon cycle
Human perturbations to the carbon cycle: emissions of methane, carbon dioxide, deforestation, etc. How have these activities modified the natural carbon cycle and the atmospheric chemistry?

Reading: Archer Chapter 10
Recommended: Sarmiento, J. and N. Gruber, "Sinks for anthropogenic carbon", *Physics Today*, Aug., p. 30-36, 2002.

11.1) Scientific consensus and climate change skeptics
Is science just a special interest? Peer –review process. Who are the skeptics and what are their arguments?

Reading: Oreskes, N. "The scientific consensus on climate change" Science, 306, 1686, 2004.

11.2) Climate change science: Legitimate or suspect?
Climate change science plays the central role in our knowledge of global climate change. However the dominant scientific consensus is not always accepted. Ultimately, how a given society understands and evaluates climate change is socially constructed by many factors, including pressures from interest groups and the culture of the society. Will opportunities for participation and dialogue among stakeholders help strengthen societal belief in global climate change and willingness to take action against it?

Readings:

Demeritt, David, "The Construction of Global Warming and the Politics of Science" *Annals of the Association of American Geographers* (92) 2, 2001, 307-337.

12.1) The responses of developed nations (US , Germany, Japan) .
Developed nations have responded in many different ways to climate change, but none adequately. Differences in their GHG reductions and policies may be explained by their climate vulnerability, economic interests, social constructions and political institutions and processes. Among the developed nations, Japan, the United States and Germany serve as instructive comparative cases.

Reading: Schreurs, Miranda."Chp. 9 Domestic politics and the global environment: Japan, Germany and the US compared" in Schreurs, *Environmental Politics in the US, Japan and Germany* (Cambridge U Press 2002) (pp. 241-261).

12.2) The responses of transitional and developing nations (Brazil, India and China) .
Developing (and transition) nations have responded in many different ways to climate change, but none adequately. Differences in their concern with climate change may be explained by their climate vulnerability, economic interests, social constructions and political institutions and processes. Among the developing nations, Brazil, India and China serve as instructive comparative cases.

Readings:

Roberts, J. T. "Climate Change: Why the Old Approaches Aren't Working" pp 191-208, in K. Gould and T. Lewis, *Twenty Lessons in Environmental Sociology*, Oxford University Press, 2009.

Richerzhagen and Scholz, "China's Capacities for Mitigating Climate Change," *World Development*, 36:2 pp. 308-324, 2008.

13.1) Detection and attribution of global warming
How do we know that global warming is actually happening? Focus on empirical evidences, including instrumental measurements as well as proxy data. How do we know that global warming is caused by humans? The role of global climate models.

Reading: Archer Chapter 11

Recommended: Kolbert, E., "The climate of man-I", New Yorker, April, 25, 56-71, 2005.

13.2) Future climate change and projections
What are the future climate projections? How global climate models are used to make predictions using greenhouse gas emissions as inputs. What about for the Midwest?

Reading: Archer Chapter 12

Recommended: IPCC AR 4 Working Group I Summary for Policy Makers, 2007.

14.1) Past climates and abrupt climate change
How bad is the forecast relative to climate changes in the past? A look at past climates and abrupt climate changes to get a point to reference to understand the magnitude of current climate change. How have ancient civilizations been impacted by past climate change?

Readings:

Alley, R.B., "Abrupt climate change", Scientific American, Nov., 62-69, 2004.

Kolbert, E., "The climate of man-II", New Yorker, May 2, 56-63, 2005.

Recommended:

Alley, R.B. and Bender, M., "Greenland ice cores: Frozen in time", Scientific American, Feb., 80-85, 1998.

14.2) Sub-national diffusion of climate change solutions
Frustrated by insufficient national and international response, local actors (states, cities, firms) have been setting up smaller-scale emissions reductions agreements. Under what conditions do states, cities and countries adopt global climate change policies?

Readings: Vasi, B. "Thinking Globally, Planning Nationally and Acting Locally," *Social Forces* 86:1 September 2007 (1-17)

15.1) US politics of environmental protection and global warming 1

Reading: McKinsey & Company. 2007. "Reducing Greenhouse Gas Emissions. How Much at What Cost?" U.S. Greenhouse Gas Mapping Initiative, Executive Summary. (Full Report on WebVista)

15.2) US politics of environmental protection and global warming 2

Reading: Stern, N. "Stern Review executive summary" New Economics Foundation, 2006.

16.1) Mobilizing to fight climate change
A successful transition will require large scale popular mobilization to push for new rules, habits and attitudes. Such mobilization will depend upon the strength of civil society, openness of political institutions and other factors.

Readings:

Hawken, Paul. "A Declaration of Sustainability" Chp. 21 pp. 379-388 in R. Scott Frey, *The Environment and Society Reader*, Allyn and Bacon 2001.

Brown, Lester, Chp. 13 "The Great Mobilization" (265-287) in Brown, Lester, *Plan B 3.0 Mobilizing to Save Civilization* W.W. Norton and Co.

16.2) Envisioning a sustainable world
A vision of a sustainable society will help guide efforts for reform. What will a sustainable, carbon-neutral society and world look like? How can we organize society to reduce GHG emissions? What mixture of technical fix and social reorganization will we need? Geoengineering and wedges.

Readings:

Goodwin, Neva. March 2008. "An Overview of Climate Change: What does it mean for our way of life? What is the best future we can hope for?" Working Paper No. 08-01 *Global Development and Environment Institute*, Tufts University (pp 1-30).

Socolow, R.H. and Pacala, S.W., "A plan to keep carbon in check", *Scientific American*, Sept, 50-57, 2006.

Kolbert, E., "The climate of man-III", *New Yorker*, May 9, 52-63, 2005.

Recommended:

Socolow, R.H., "Can we bury global warming?" *Scientific American*, Jul, 49-55, 2005.

Herzog, H. Eliasson, B., Kaarstad, O., "Capturing greenhouse gases", *Scientific American*, Feb, 72-79, 2000.