Princeton University
Department of Civil and Environmental Engineering &
Woodrow Wilson School of Public and International Affairs
Fall 2014

CEE/ENV334 WWS452
Global Environmental Issues
Friend
Tuesday / Thursday 1:30-2:50 PM

Professor Denise Mauzerall
E-Quad E412 & Robertson Hall Room 445
Office Hours: Wednesdays 2-3:30pm or by appointment
mauzeral@princeton.edu (e-mail)

Preceptor
Charles (Xiaoyuan) Li
E-Quad E-424
Office Hours: TBD and by appointment
xl4@princeton.edu (e-mail)

Overarching goal:
Learn how science can inform environmental policy development and advance solutions to global environmental problems.

Overview:

As the world's population grows and becomes more affluent, human impact on the global environment also increases. This course examines a set of global environmental issues including population growth, ozone layer depletion, climate change, air pollution, the environmental consequences of energy supply and demand decisions and sustainable development. It provides an overview of the scientific basis for these problems and examines past, present and possible future policy responses.

Course Format:

Course topics will usually be covered in modules with the first part of the module covering the key scientific concepts surrounding the environmental issue and the second analyzing the present and possible future policy responses. Class meetings will be divided, very roughly, into 50% lecture and 50% discussion that involve in-class activities based on pre-class reading. **All students are expected to do the required weekly reading which will form the basis for classroom discussion and activities**. Most of the reading is on the course Blackboard site (placed in order of importance) with some available over the internet and one book for purchase. Web addresses are noted below in the syllabus.

By midnight Monday each student should deposit on the BlackBoard discussion board one question about the readings for that week. As time permits, the questions will be used to catalyze in-class discussions.

Most of the topics covered in class are frequently in the news. To bring the world into the classroom students are asked to find and share academic and news articles related to course topics via blogs set up on BlackBoard.

Class participation will count in your grade. In class discussions/activities, submission of discussion questions, and submission of blog posts and will all count for class participation.

Grading:

Grades will be based on class participation, problem sets, presentations, a mid-term and final paper according to the following percentages:

Class participation: 25% (includes attendance, class discussion and activities, discussion questions and blog posts)
Homework: 30%
In-class test: 10%
Final paper: 30% and presentation 5%

SCHEDULE OF CLASSES

Week 1: September 11, 2014. Course Overview and Introduction.

Goal: Describe and discuss main drivers of global change and the implications of humans becoming a geological force. Important drivers include: Population growth, increased consumption leading to increased pollutant emissions and natural resource use. Discuss differences in these drivers between developed and developing countries.

Reading:

Exposures: Gorgeous Glimpses of Calamity, New York Times, August 19, 2013.
http://www.nytimes.com/2013/08/18/opinion/sunday/gorgeous-glimpses-of-calamity.html?src=me&ref=general
The NASA satellite images in this article show the planetary scale of environmental changes associated with human activities.

Sachs, J., 2004, Sustainable Development, *Science*, 34, p.649

Paul Ehrlich, Peter Kareiva and Gretchen Daily, Securing natural capital and expanding equity to rescale civilization. *Nature* **486**, 68–73 (07 June 2012) doi:10.1038/nature11157.

Wilson, E.O., 2002, The Future of Life, chapter 2 "The Bottleneck", pp. 22-41, 2002.

Crutzen, P.J.. 2002. Geology of Mankind. *Nature*, Vol 415, 31

Steffen, Will; Crutzen, PJ; McNeill, JR. The Anthropocene: Are Humans now overwhelming the great forces of Nature? Ambio, vol 36, 2007.

Sustainability Report. Scientific American, April 2010.

McDevitt, T.M., World Population Profile: 1998, U.S. Census Bureau, 1999, pp. 1-2, 9-18
The complete document is available at http://blue.census.gov/ipc/prod/wp98/wp98.pdf.
This has some interesting graphs. Feel free to skim.
You can explore current United Nations population data and projections presented at:
http://esa.un.org/unpp/index.asp?panel=3

Population Reference Bureau – Key Findings 2010.

Week 2. September 16 & 18, 2014. Stratospheric Ozone Depletion – Science

Homework #1 Distributed - Stratospheric ozone depletion science

Goal: Understand the extraordinary series of discoveries (laboratory, aircraft field campaigns, satellite data) that linked the use of ozone depleting substances (ODS) to stratospheric ozone depletion and facilitated the international response to phase out the ODS.

Ozone in the stratosphere protects life on earth from excess ultra-violet (UV) radiation. It has been depleted at all latitudes except the tropics by the emission of anthropogenic (human produced) chlorofluorocarbons (CFCs) and related substances. Increases in UV radiation at the earth's surface result in an increase in the incidence of skin cancer, eye cataracts, decrease in productivity of some ecosystems, and a decrease in air quality. A global phase-out of the production of CFCs brought about by the Montreal Protocol -- an international environmental treaty -- is expected to lead to a full recovery of the ozone layer in the second half of this century.

Required Reading:
EPA information on stratospheric ozone depletion:
http://www.epa.gov/ozone/science/sc_fact.html
This is a basic introduction to stratospheric ozone:

Twenty Questions and Answers about the Ozone Layer. 2011.
This is a superb summary of the key concepts of how ozone depleting substances (ODS) destroy stratospheric ozone and how the phase-out of ODS is projected to result in a full recovery of the ozone layer. Although written by scientists and technically rigorous it is highly accessible.

Supplementary Reading:

United Nations Environment Programme. 2011. Synthesis report of the 2010 assessments of the Montreal Protocol assessment panels.

Jacob, D. 1990. "Chapter 10: Stratospheric Ozone" in "Introduction to Atmospheric Chemistry", Princeton University Press.
For those who are interested in more details about how stratospheric chemistry works, this is a good reference. It comes from the "Introduction to Atmospheric Chemistry" textbook written by Harvard Professor Daniel Jacob and intended for undergraduate students as their first course in atmospheric chemistry.

Week 3. September 23 & 25, 2014. Stratospheric Ozone Depletion – International policy response – the success of the Montreal Protocol.

Homework #1 Due on BlackBoard Wednesday 9/24/14 by noon.

Goal: Understand how and why the Montreal Protocol was successfully ratified by virtually all countries in the world and remains the single most effective international environmental treaty.

Explain key drivers (science, industry, diplomacy, economics, technology, impacts) that made this happen.

Identify and discuss key lessons that the MP provides to address climate change and other global environmental problems. One key lesson – formalized method for feedback between scientific evaluation and policy response is effective for adapting environmental policy to evolving scientific situation.

The Montreal Protocol, an international treaty to protect stratospheric ozone, has resulted in a near global phase-out of CFCs and related substances. This treaty is considered one of the world's global environmental success stories. We'll explore what made it possible and the lessons that can be taken from it to address other global environmental problems. We will also consider whether it should be expanded to include certain greenhouse gases (GHG).

Homework #2 distributed -- Should HFC and N2O controls be included in the Montreal Protocol? Role play in class on Thursday 9/25 and group position memo to turn in on BlackBoard on Monday 9/29 by 5pm.

The Montreal Protocol may be expanded to include HFCs (chemicals which were developed to replace the ozone depleting CFCs and HCFCs). HFCs do not destroy stratospheric ozone but are strong GHG. In addition, there is now discussion of including nitrous oxide (N2O) an ozone depleting GHG which has its primary source from agriculture and which is currently listed under the Kyoto Protocol. In class you will be assigned various stake-holder positions (eg. scientists, diplomats, chemical manufacturers, farmers, environmental groups) and asked to write a 1-2 page memo on their position and then debate in class how to proceed on the inclusion of these additional compounds in the Montreal Protocol.

Reading:

Benedick, R. History of the Montreal Protocol (2007)

Anderson, S.O. & Sarma, K.M., 2002, Protecting the Ozone Layer: The United Nations History. United Nations Environment Program. Chapter 10 – A Perspective and a Caution, pp. 345-368.

Velders, G.J. et al.. 2007. The importance of the Montreal Protocol in protecting climate. *PNAS* Vol. 104:12, March 20, 2007

Velders, G.J. et al.. 2009. The large contribution of projected HFC emissions to future climate forcing. *PNAS* Vol. 106: 27, July 7, 2009.

Mario Molina, Durwood Zaelke, K. Madhava Sarma, Stephen O. Andersen, Veerabhadran Ramanathan, and Donald Kaniaru, 2009. Reducing abrupt climate change risk using the Montreal Protocol and other regulatory actions to complement cuts in CO_2 emissions, *PNAS,* December 2009.

2010 Synthesis report of the 2010 assessments of the Montreal Protocol assessment panels (science, effects and technology/economics). Read pp. 5-10.
http://ozone.unep.org/Meeting_Documents/oewg/31oewg/OEWG-31-3E.pdf

2010 Assessment Report of the Technology and Economic Assessment Panel of the Montreal Protocol
http://ozone.unep.org/Assessment_Panels/TEAP/Reports/TEAP_Reports/TEAP-Assessment-report-2010.pdf
This is a long document. Just read the executive summary.

Reading useful for homework #2:

Proposed HFC amendment: EPA. United States and China agree to work together on phase-down of HFCs. June 2013. www.epa.gov/ozone/intpol/mpagreement.html

Kanter D. et al (2013) "A post-Kyoto partner: Considering the stratospheric ozone regime as a tool to manage nitrous oxide", *PNAS*

Supplementary Reading:

Anderson S. O. and Sarma K. M., Protecting the Ozone Layer, Chapter 6 – Implementing the Montreal Protocol

Anderson S.O. et al., Technology Transfer for the Ozone Layer – ch. 2, 13, 14.

The chapters of this book, Technology Transfer for the Ozone Layer, describe how technology transfer for environmental protection has been successful. It takes lessons learned from ozone protection and examines how they can be applied to climate change.

Week 4. September 30 & October 2 2014. Climate Change – Science

HW #3 distributed – climate science. Help session will be provided.

Goal: Understand the level of historical climate change, future projections of climate change and the implications of these changes for human society and biodiversity. Be able to describe the implications of emissions of greenhouse gases (GHG) on future GHG concentrations, and climate response (temperature – regionally and globally, precipitation, etc.).

Connect population growth, future per capita increases in energy and food consumption with our ability to stabilize and decrease GHG concentrations. Estimate allowable future GHG emissions given the policy goal of limiting global average temperature increase to 2 C.

Human activities, primarily the burning of fossil fuels such as coal, oil and natural gas, deforestation and agriculture are increasing the concentrations of gases in our atmosphere which trap heat. The Intergovernmental Panel on Climate Change (IPCC), set up in 1988 by the United Nations Environment Program (UNEP) and the World Meteorological Organization, and composed of scientists from around the world, reviews the state of scientific knowledge on climate change and issues comprehensive reports approximately every 5-years. We will examine the current understanding and evidence for climate change as well as its potential future impacts.

Reading:

Houghton, John. Global Warming: The Complete Briefing, Cambridge University Press, 2009.
This is the primary reference we will use for climate change. This book is written by Sir John Houghton, a former director of the science assessment of the Intergovernmental Panel on Climate Change (IPCC). It is written in an accessible style and provides a definitive summary of the fourth assessment report of the IPCC. The IPCC 4th assessment report was released in 2007 and this summary was published in 2009. The fifth assessment is due out in 2014. The book is available for purchase from the U-Store (and on-line book sellers).

Please read:

Chapter 1: Global Warming and Climate Change.
This provides background and overview to the issue. Figure 1.5 is worth a careful look.

Chapter 2: The Greenhouse Effect.
This chapter explains what causes the greenhouse effect. Figure 2.7 is worth careful attention.

Chapter 3. The Greenhouse Gases.
This chapter discusses where the greenhouse gases (GHG) come from, how their concentrations have changed over time, and what their effect is on radiative forcing. Figure 3.11 is worth careful attention.

Chapter 4. Climates of the Past (optional).
Figures 4.1a and 4.6a are worth looking at.

Chapter 6. Climate change in the 21st century and beyond.
This chapter describes the emission scenarios used to model future climate and the resulting projections of future global and regional temperature and precipitation changes. Understand figures 6.1, 6.4, 6.6, 6.7 and 6.8.

Future of Arctic Climate and Global Impacts. http://www.arctic.noaa.gov/future/

Searchinger T.D. et al., 2009, Fixing a Critical Climate Accounting Error. *Science* Vol. 326. Pp. 527-528, 23 October 2009

IPCC. 2007. Synthesis report for policymakers.
This is the government approved summary of the IPCC reports (Science, Impacts and Mitigation) written for policy makers. Skim it and be prepared to discuss how effective you feel it is as a tool for policy makers.

IPCC. Science Assessment – Technical Summary.
This is the technical summary written by scientists that summarizes the findings of the IPCC science assessment. Skim it and be prepared to discuss how it differs from the summary for policy makers. Is this a more or less effective tool for sharing scientific findings with a larger audience?

Supplementary Material

The entire four part 2007 climate change assessment report is available at: http://www.ipcc.ch/ipccreports/assessments-reports.htm. Depending on your interests you may want to look at relevant sections of the detailed reports on
"Science", http://www.ipcc.ch/ipccreports/ar4-wg1.htm,
"Mitigation", http://www.ipcc.ch/ipccreports/ar4-wg3.htm , and
"Impacts, Adaptation and Vulnerability" http://www.ipcc.ch/ipccreports/ar4-wg2.htm .

US Global Change Research Program publications and reports may be more accessible than some of the IPCC reports. http://globalchange.gov/publications

New York Times, "Rising Acidity Is Threatening Food Web of Oceans, Science Panel Says", http://www.nytimes.com/2009/01/31/science/earth/31ocean.html , February 2, 2009.

Week 5. October 7 & 9 2014. Climate Change – International Policy Response, Technology Options and Economics

Goal: Describe past efforts at international agreements on climate change (key treaties and mechanisms within the treaties). Evaluate potential for successful future international climate agreements. Discuss similarities and differences with MP approach.

Do technologies exist that will permit us to reduce the emission of greenhouse gases sufficiently to stabilize climate? We will examine current perspectives on this topic. The Framework Convention on Climate Change (FCCC) was signed at the 1992 Earth Summit in Rio and put the issue of climate change on the international stage. The Kyoto Protocol, negotiated in December 1997, introduced the first commitments to reduce emissions of greenhouse gases by developed countries and went into effect, without participation from the United States, February 16, 2005. In December 2009 in Copenhagen international negotiations failed to come to agreement on how climate change mitigation should be addressed internationally. We will examine similarities and differences between the policy approach to climate change and stratospheric ozone depletion and consider what needs to occur in order to reduce the rate of climate change and what may be politically possible.

Homework #3 Due on BlackBoard Monday October 13 by 5pm.

In-class activity – climate skeptic vs. scientist and GHG mitigation research, development and deployment vs. geoengineering research and development debates.

Choose a country to report on for mid-term paper.

Reading:

Background on Framework Convention on Climate Change, Kyoto Protocol and Copenhagen Accord:

Oppenheimer, M., 2009, Memo on Global Warming. For NYU Environmental Law Seminar (available on blackboard).

Overview of the Kyoto Protocol including updates with recent developments: http://unfccc.int/kyoto_protocol/items/2830.php

Grubb, M. et al., 1999, The Kyoto Protocol: A Guide and Assessment, Chapter 4: The Kyoto Protocol, pp. 115-152, 1999.

Copenhagen Accord.
This is a list of several links to short articles examining the outcome of the climate meeting in Copenhagen in December 2009. Just peruse.

1. Copenhagen Accord. Actual text, posted December 19, 2009
http://www.climatesciencewatch.org/index.php/csw/details/copenhagen_accord_text/

2. What Hath Copenhagen Wrought? A Preliminary Assessment of the Copenhagen Accord, December 20th, 2009, By Robert Stavins.
http://belfercenter.ksg.harvard.edu/analysis/stavins/?p=464

3. Climate pact appears increasingly fragile; U.N. official quits, Washington Post, Feb., 18, 2010, Juliet Eilperin and Steven Mufson.
http://www.washingtonpost.com/wp-dyn/content/article/2010/02/18/AR2010021801490.html

4. Evaluating Copenhagen: Does the Accord Meet the Challenge?
by Trevor Houser | February 4th, 2010 | 05:13 pm
http://www.piie.com/realtime/?p=1173

Parson, E.. 2002. The Technology Assessment Approach to Climate Change. *Issues in Science and Technology*, Summer 2002.

Keohane RO and Victor DG, The Regime Complex for Climate Change, Perspectives on Politics, March 2011.

UNEP Report (2011) “Near-term climate protection and clean air benefits: Actions for controlling short-lived climate forcers”

Economics:

Stern, N., 2007, The Economics of Climate Change: The Stern Review. Summary of Conclusions: pp. xv-xix., 2007.

Nordhaus, W., 2007, Critical Assumptions in the Stern Review on Climate Change. Science Vol. 317 pp. 201 – 204, 13 July 2007.

Week 6. October 14 & 16, 2014. Climate change – public perception, politics, mitigation vs. geoengineering.

Goal: Examine public perception of climate change and how it has been influenced by climate skeptics, industry interests, etc. Examine challenges and benefits of GHG mitigation and geoengineering.

What’s the best way forward to protect the world from “dangerous anthropogenic interference with the climate system”?

Reading:

Sterman J.D..2008. Risk Communication on Climate: Mental Models and Mass Balance, *Nature*

Oreskes, N. & Conway, E.. 2010. Merchants of Doubt - How a handful of scientists obscured the truth on issues from tobacco smoke to global warming. Bloomsbury Press. Chp 6. The Denial of Global Warming. pp.169-215.

Podesta, J. & Ogden, P.. Expected climate change over the next thirty years. From Campbell, K.. 2008. Climatic Cataclysm – The foreign policy and national security implications of climate change. Brookings Institute Press. pp. 97-132.

Kintisch, E..2010. Scientists Grapple With ‘Completely Out of Hand’ Attacks on Climate Science” and “The Latest on Geoengineering. *Science* (meeting briefs) Vol. 327, pp. 1070-71, 26 February 2010.
Please read the two short commentaries:
"The Latest on Geoengineering" and "Scientists Grapple With ‘Completely Out of Hand’ Attacks on Climate Science". These articles appear in the "news and views" front section of Science, one of the most prestigeous science journals in the world.

Robock A..2008. 20 reasons why geoengineering may be a bad idea. *Bulletin of the Atomic Scientists*, Vol. 64:2 pp. 14-18, May/June 2008.

The Royal Society. 2009. Geoengineering the climate: science, governance and uncertainty. Published September 2009.

General analysis leaning in favor of geoengineering. Read the summary and go further if interested.

Week 7. October 21 & 23, 2014. Mitigation of Greenhouse Gas Emissions.

Goal: Describe energy technology options, the relative quantity of GHG they emit, cost, availability, penetration. Be able to do simple calculations comparing them and estimating effect their penetration at a given level will have on global CO2 emissions.

October 23: In class country presentations and debate on approaches to address climate change. **Homework #4 -- Country memo due on BlackBoard Sunday November 2 by 5pm.**

Reading:

Houghton, J. Global Warming: The Complete Briefing, Cambridge University Press, 2009.
Chp 10: A strategy for action to slow and stabilize climate change
Chp 11: Energy and Transport for the Future

Charles, D., 2009, Leaping the Efficiency Gap, *Science*, 14 August 2009.

International Energy Agency (IEA). World Energy Outlook 2012. Executive Summary and Factsheet.

REN21. 2013. Renewables 2013 Global Status Report.

Chu, S. & Majumdar A..2012. Opportunities and challenges for a sustainable energy future. *Nature*, 488:294

Socolow R, Hotinski, R, Greenblatt, JB and Pacala S. Solving the Climate Problem : Technologies available to curb CO2 emissions, Environment, 2004.

McKinsey Global GHG Abatement Curves, Executive Summary, 2009.

Fall Break

Week 8. November 4 & 6, 2014. Air Pollution Science – Trends and Impacts on Climate, Health and Agriculture

Goal: Describe sources of air pollution and how it is formed/transformed and transported in the atmosphere. Understand impacts of air pollution on climate, health,

agriculture and ecosystems. Analyze the benefits of controlling different emissions/industry sectors.

Distribute HW#5. Air pollution science and policy

Emissions of precursors to acid rain, ozone and particulate pollution all come from fossil fuel combustion and biomass burning and have been controlled largely due to their impacts on health. These pollutants can be transported long distances and effect regions outside the countries where they were emitted. They also affect climate – some warm and some cool. We will examine differences between pollution levels in developed and developing countries and the effect of improving air quality on climate.

Reading:

US EPA. 2008. National Air Quality: Status and Trends Through 2007.
US EPA. 2010. Our Nation's Air – Status and trends through 2010.
This provides a nice overview of the key air pollutants and recent improvements in US air quality.

Graedel and Crutzen, Atmosphere, Climate and Change (1997). Chapter 3: Chemistry in the Air, pp. 35-57.

Shaw, J.. 2005.Clearing the Air: How epidemiology, engineering and experiment fingered fine particles as airborne killers. *Harvard magazine*. May-June 2005.
This is an accessible description of how fine particles in air pollution impact health.
Schwartz, J., B. Coull, F. Laden, and L. Ryan. 2008. The Effect of Dose and Timing of Dose on the Association between Airborne Particles and Survival. *Environmental Health Perspectives*, 116.

Mickley, L.J.. 2007. A Future Short of Breath? Possible Effects of Climate Change on Smog. *Environment*, Vol. 49:6, pp. 36-43, July/August 2007.

Saikawa, E., V. Naik, L.W. Horowitz, J. Liu, **D.L. Mauzerall**. 2009. Present and potential future contributions of sulfate, black and organic carbon aerosols from China to global air quality, premature mortality and radiative forcing. *Atmospheric Environment*, 43 (2009) 2814–2822.
This is a research paper by a doctoral student in my group. It provides a unique linkage of the effects of fine particle emissions from China on global air quality, premature mortality and radiative forcing (climate).

Avnery, S, DL Mauzerall, J Liu, LW Horowitz. 2011. Global Crop Yield Reductions due to Surface Ozone Exposure: 1. Year 2000 Crop Production Losses and Economic Damage. *Atmospheric Environment*, 45, 2284-2296, 2011.
This is a research paper in which a doctoral student and I, with collaborators at the Geophysical Fluid Dynamics Lab, calculated crop yield reductions resulting from ozone exposures globally. No need to spend a lot of time on the details, but I wanted to include something that showed you real research on the large impacts of air pollution.

Supplementary Reading :

Wang, X. & Mauzerall, D.L., 2004, Characterizing distributions of surface ozone and it's impact on grain production in China, Japan and South Korea : 1990 and 2020, Atmospheric Environment, 38, 2004.

Week 9. November 11 & 13, 2014. Air Pollution Policy -- Command and control versus market based mechanisms, Long Range Trans-boundary Air Pollution treaty, etc.

Goal: Be able to discuss different methods of controlling air pollution and their advantages/disadvantages.

Guest Speaker: Mary Robinson, former president of Ireland, champion of human rights and founder of the Mary Robinson Foundation - Climate Justice. Robinson was recently named by UN Secretary-General Ban Ki-moon, as the United Nations Special Envoy for Climate Change.

Readings:

Jacobson, M.Z.. 2002. History, Science and Regulation. Cambridge University Press. Ch. 8: International Regulation of Urban Smog Since the 1940s. pp. 209-240.

Cramton, P.. A Review of Markets for Clean Air: The U.S. Acid Rain Program. *Journal of Economic Literature*, pp. 627-633, September 2000.

Bell, R.G., Russell, C.. Environmental Policy for Developing Countries. *Issues in Science and Technology*, Spring 2002.

The National Academies. 2004. Air Quality Management in the United States – Executive Summary and Introduction.

Description of the Climate and Clean Air Coalition. www.unep.org/ccac/

Description of the Long Range Transboundary Air Pollution Treaty (LRTAP) http://www.unece.org/env/lrtap/lrtap_h1.htm

Supplementary Reading:

Mauzerall, D.L., B. Sultan, N. Kim, D.F. Bradford. 2005. NOx emissions from large point sources: variability in ozone production, resulting health damages and economic costs. *Atmospheric Environment*, 39, 2005.

Wang, X. & Mauzerall, D.L.. 2006. Evaluating Impacts of Air Pollution in China on Public Health: Implications for Future Air Pollution and Energy Policies. *Atmospheric Environment*, Volume 40, Issue 9, Pages 1706-1721, March 2006

Week 10. November 18 & 20, 2014. Air Pollution Mitigation -- GAINS model

HW #5 due on BlackBoard Monday November 17 by 5pm.
Distribute HW #6 – GAINS model analysis

Reading:
General information for GAINS:
http://www.iiasa.ac.at/web/home/research/researchPrograms/GAINS.en.html
This is a tool used to analyze the effect of air pollutant and GHG emissions simultaneously. GAINS-Europe is used to develop policy in Europe. In particular, look at links to the version of GAINS used for China. We will do some simple analyses using GAINS-China for homework.

GAINS Tutorial: http://www.iiasa.ac.at/web/home/research/researchPrograms/GAINS-tutorial.pdf

Week 11. November 25, 2013. Millenium Development Goals and Millenium Ecosystem Assessment.

HW #6 due on BlackBoard Monday December 1 by 5pm.

Readings:
United Nations. 2013. The Millennium Development Goals Report 2013.

Millennium Ecosystem Assessment. 2005. Ecosystem and Human Well-being: Synthesis.

Meet with instructor and preceptor week of 12/1 and 12/8 to discuss topic and outline of final paper.

Week 12. December 2 & 4, 2014. Sustainable Development

Goal: Be able to discuss how the drivers discussed in week 1 adversely impact sustainable development. Think about how we can go from our current situation to a more sustainable one in both developed and developing countries.

Reading:
Wilson, E.O.. 2002. The Future of Life, chapter 7 "The Solution". pp. 149-189, 2002.

Terborgh, J.. 1999. Requiem for Nature. Ch. 9: From Wildlands to Wasteland: Land Use and the Mirage of Sustainable Development. pp. 141-160

Sachs, J. & Reid, W.. 2006. Investments Toward Sustainable Development. *Science*, Vol. 312, 19 May 2006.

Holdren, J., 2008, Science and Technology for Sustainable Well-Being. *Science*, Vol. 319, pp.424-436, 25 January 2008.

Daly, Herman. 2009. Anathemas of Economic Growth, Conservation Biology.

Gretchen Daily and Brian Walker, Seeking the great transition. *Nature*, pp. 243-245, 2000.

Clemencon, R. 2012. Welcome to the Anthropocene: Rio+20 and the Meaning of Sustainable Development. *Journal of Environment and Development,* 21:311
This article puts the recent Rio+20 meeting on sustainable development (held this June 2012) into a valuable larger context.

United Nations Commission on Sustainable Development:
http://sustainabledevelopment.un.org/index.html
The link above provides information on the UN Commission on Sustainable Development (CSD). CSD is a global effort to develop methods to achieve sustainable development. Please just peruse the website.

Week 13. December 9 & 11, 2014.. Final wrap-up. In-class test.

Final presentations – First week of reading period, Date/time TBD.

Final term papers due: Tuesday January 13, 2014 (Dean's date) by 5pm.