Climate Change and the Future of Agriculture
Geography 9, Winter 2015
Class Location: Moore B03
Class Hours: Monday, Wednesday, Friday 12:30pm-1:35pm
X-Hours: Tuesday 1:00pm-1:50pm

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Office Hours: Tuesday 2pm-4pm or by appointment
X-Hours: Expected use as detailed in schedule and for makeup classes
Web: https://canvas.dartmouth.edu

Course Description

The global agricultural sector faces the significant challenge of feeding a population projected to increase to 9 billion by mid-century under an evolving climate. This course will explore the physical geography of agricultural production systems throughout the world with an emphasis on the interactions between crops, climate, water, soils, and technology.

Lectures are designed to be interactive and will encourage participation through questions, discussion, and in-class exercises. Problem sets will include data analysis in MATLAB and the use of a simple crop model, which will both be introduced and are available in the Rahr Lab. This course counts as a Natural and Physical Science without Lab (SCI) Distributive Course Requirement.

Learning Objectives

By the end of this course, students will be able to:

1. Describe plant physiology, the global agricultural system, and key constraints to crop production in regions throughout the world.
2. Identify the mechanisms of, and distinguish between, climate variability and anthropogenic climate change.
3. Understand the basics of data manipulation and computer programming.
4. Outline the impacts of climate change on agriculture at local to global scales.
5. Interpret and apply scientific literature.
6. Analyze modeled and observed climate and crop data.
7. Assess the implications of current and expected future physical agricultural systems on global hunger.
8. Evaluate potential strategies for improving global crop production within the context of a changing climate.

Prerequisites

None

Textbook

Sheaffer, C. and K. Moncada. Introduction to Agronomy: Food, Crops, and Environment. Cengage Learning, 2011.

Course Resources on Reserve or Available Online

Diamond, J., 1987. The Worst Mistake in the History of the Human Race. Discover Magazine.
Ellis, E.C., 2013. Overpopulation Is Not the Problem. New York Times.
FAO, 2009. How to Feed the World 2050. http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf.
Fedoroff, N.V., D.S. Battisti, R.N. Beachy, P.J.M. Cooper, D.A. Fischhoff, C.N. Hodges, V.C. Knauf, et al., 2010. Radically rethinking agriculture for the 21st century. Science, 327, 833.
Foley, J., 2010. The Other Inconvenient Truth. TEDxTC, http://www.ted.com/talks/jonathan_foley_the_other_inconvenient_truth?language=en.
Hillel, D. and C. Rosenzweig, eds., 2011. Handbook of Climate Change and Agroecosystems: Impacts, Adaptation, and Mitigation. Vol. 1. Imperial College Press, London.
Hillel, D. and C. Rosenzweig, eds., 2012. Handbook of Climate Change and Agroecosystems: Global and Regional Aspects and Implications. Vol. 2. Imperial College Press, London.
IPCC, 2013: Summary for Policymakers, in: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, et al., Eds., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
Lobell, D.B., W. Schlenker, and J. Costa-Roberts, 2011. Climate trends and global crop production since 1980. Science 333(6042), 616-620.
Marston, B., 2013. The Science of Climate Change. Upper Valley Sierra Club Presentation, http://vimeo.com/77243727.
Mueller, N. D., J.S. Gerber, M. Johnston, D.K. Ray, N. Ramankutty, and J.A. Foley, 2012. Closing yield gaps through nutrient and water management. Nature, 490(7419), 254-257.
Niggli, U., H. Schmid, and A. Fliessbach, 2007. Organic farming and climate change. http://orgprints.org/13414/3/niggli-etal-2008-itc-climate-change.pdf.
Piao, S., P. Ciais, Y. Huang, Z. Shen, S. Peng, et al., 2010. The impacts of climate change on water resources and agriculture in China. Nature, 467(7311), 43-51.
Pollan, M., 2006. The Omnivore's Dilemma: A Natural History of Four Meals. Penguin.
Tilman, D., C. Balzer, J. Hill, and B.L. Befort, 2011. Global food demand and the sustainable intensification of agriculture. PNAS, 108(50), 20260-20264.
Vörösmarty, P. Green, J. Salisbury, and R.B. Lammers, 2000. Global water resources: vulnerability from climate change and population growth. Science, 289(5477), 284.

Grading

Problem sets will contain a mix of data analysis, back-of-envelope calculations, and short answer questions. Problem sets must be uploaded as one document in docx or pdf format via Canvas on or before the date and time due. Assignments received after that are considered late. Late assignments will be penalized 10% per 24-hour period. In-class exercises will not be collected or graded, but will cover important concepts likely to appear on both problem sets and exams. Each student will be expected to prepare for discussions by bringing two reactions from the reading (questions, key insights, or critiques) to class. Reactions will be collected at the end of discussion classes and factored into class participation. Exams will contain a mix of definitions, multiple choice, true/false, data/figure analysis, simple back-of-envelope calculations, and short answer questions. Exam #1 will include material from classes up until Exam #1 Review. Exam #2 will predominantly cover material not tested by Exam #1, but may also include concepts from earlier classes. No makeup exams will be given without prior consent or documented emergency.

Assignment	Weighting
Problem Set #1	15%
Problem Set #2	15%
Problem Set #3	15%
Exam #1	25%
Exam #2	25%
Class Participation	5%

The expected median grade of this class is a B+ (commensurate with the median across Dartmouth courses). All assignments will be scored numerically and mapped to letter grades according to the table below, with + and - modifiers given for the top and bottom of each 10-point range, respectively (e.g., B+ > 87, B- < 83).

Letter Grade	Numerical Range
A	90% - 100%
B	80% - <90%
C	70% - <80%
D	60% - <70%
E	<60%

If the median grade of the class falls below a B+, a consistent number of points may be added to each student's final grade.

Student Needs

Students with disabilities or special needs enrolled in this course are encouraged alert me as early as possible in the term. Students requiring disability-related academic adjustments and services must consult the Student Accessibility Services (SAS) office. Once SAS has authorized adjustments or services, students must obtain an originally signed SAS Services and Consent Form and/or a letter on SAS letterhead. As a first step, if students have questions about whether they qualify to receive academic adjustments and services, they should contact the SAS office. All inquiries and discussions will remain confidential.

Academic Honesty

All students must comply with Dartmouth's Academic Honor Principle, detailed here: http://www.dartmouth.edu/~uja/honor/students.html. If you have questions or concerns, please contact me or the Undergraduate Deans Office.