The Global Food and Energy Landscape

GEOG 034

Instructor: Dr. Stephanie Spera
Office: Steele 009B
Email: stephanie.a.spera@dartmouth.edu
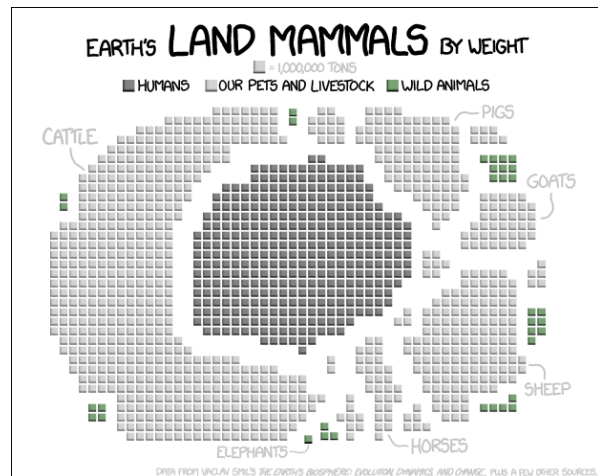
Time and Location:
Lecture:
10A, Tuesdays and Thursday 10:10 am-12 pm
Place TBD
Office Hours: Tuesdays 1-3 pm, and by
appointment

EARTH'S LAND MAMMALS BY WEIGHT
☐ = 1,000,000 TONS
■ HUMANS ☐ OUR PETS AND LIVESTOCK ■ WILD ANIMALS

PIGS
CATTLE
GOATS
SHEEP
ELEPHANTS
HORSES

DATA FROM VACLAV SMIL'S THE EARTH'S BIOSPHERE: EVOLUTION, DYNAMICS, AND CHANGE, PLUS A FEW OTHER SOURCES.

Course Description
Humans are transforming landscapes over rapid timeframes across enormous spatial scales. In this course, we will work with geospatial data to investigate and quantify how and why these transformations are occurring and what consequences they have for food, energy, and the environment. Focusing on agricultural land-use change, topics covered will include the forest transition, the "land sparing versus land sharing" debate, land scarcity, the dynamics of indirect land-use change, the effects of global "teleconnections" on land use changes, and the varied environmental effects of those changes across different landscapes.

This course will be a mixture of lecture, lab, and discussion. Tuesday classes will be primarily lecture-based, where we learn about the biophysical consequences of land-use change (eutrophication, erosion, modified water and energy budgets, changes in greenhouse gas fluxes), common statistical methods used in land-use change analyses, and the language commonly used by land-change scientists. Thursdays will be primarily discussion and lab-based. We'll use what we've learned on Tuesday to analyze and discuss land-use-change case-studies. We will also spend some Thursdays learning how to find, download, interpret, and compare satellite data – a resource employed in many land-use change analyses.

Course Objectives
By the end of this class, you should be able to:
- 👣 Understand how and why humans modify their landscapes
- 👣 Understand the forest transition theory and how it applies to land-use trajectories

- �582 Explain the biophysical drivers and consequences of land-use change, and why the same changes may result in different environmental outcomes depending on the region
- �582 Understand basic spatial statistics and the statistical analyses commonly employed in land-use change analyses
- �582 Use Google Earth Engine to qualitatively assess land-use change over time
- �582 Qualitatively interpret, compare, and contrast satellite data
- �582 Appreciate and analyze the environmental trade-offs between using land for food production, fuel production, or environmental conservation
- �582 Understand how the drivers and impacts of land-use change are becoming globalized
- �582 Critically evaluate published scientific literature using different sources of evidence
- �582 Construct cogent arguments using sound evidence and data
- �582 Express your ideas through clear, persuasive writing and engaging presentations

Course Work

Lecture Slides

All slides presented in class will be posted on Canvas shortly after each class period.

Attendance and Discussion

Attendance is mandatory and participation strongly encouraged, especially as in-class discussions will comprise a large portion of class time.

X-hours

The X-hour for this course is on Thursday from 12:15-1:05. Many weeks, we will not use them. However, we may use them occasionally to make-up material from missed class periods (due to inclement weather, campus closing, etc.) or to review for exams. For that reason, it is your responsibility to make sure that this time slot is open in your schedule. If we need to meet during the x-hour, I will notify you during the prior class period (or earlier, if possible).

Reading Reflections

By 10 pm on Wednesday, you must submit a short, written response on Canvas to the assigned readings. **N.B. Readings may change from the original syllabus; check Canvas for the most updated reading list.** The response should address the following questions: A) What is the purpose of this scientific study? B) Did the authors make a convincing argument and use appropriate methods and forms of evidence? C) What, if anything, did you find confusing? Was there any terminology you didn't understand? D) Which reading was your favorite; which was your least favorite?

Labs and Problem Sets

The assignments for this course are designed to facilitate learning with two distinct goals: conceptual knowledge and practical applications. There will be weekly graded problem sets that built off our lectures and discussions. These may involve math, short answer questions, or completely written assignments.

Midterm Exam

There will be one midterm exam on July 25th worth 15% of your final grade. There will be no final exam.

Data of the Day

Some lectures will include some large format satellite imagery or spatial data for the class to discuss. Questions we will ask include: What do we see? How do we know? What fundamental aspects of Earth and social processes can be discerned from image interpretation?

Research Paper and Presentation

Each student will complete a 10-12 page research paper (not including references) on a specific region, agricultural commodity, and the environmental consequences of land-use changes associated with the production of this commodity. The paper will be expected to analyze trade patterns and social and environmental concerns associated with this commodity as well as related spatial patterns of land-use change. At the end of the term, students will also be expected to each give 5-10 minute presentations on their main research findings.

You should arrange to meet with me early in the semester to discuss possible topics. The assignment also includes a brief outline and annotated reference list. More information will be provided in class.

Grading Rubric

Attendance and participation: 10%
Weekly reading reflections: 15%
Labs/Problem Sets: 20%
Midterm: 20%
Research paper outline and sources: 5%
Research Paper: 20%
Final Presentation: 10%

Required Course Materials

All required readings will be posted as PDFs to Canvas.

Course Policies
Late work will not be accepted. But, I understand that sometimes life gets in the way, so if you know you're going to have a problem turning in an assignment, e-mail me or stop by my office to chat.

We will foster an inclusive and respectful environment in the classroom. Students from different backgrounds and perspectives make courses interesting, especially when we talk about current events, case studies, and papers. If you ever feel uncomfortable in class, please do not hesitate to let me know.

This course also has a no cell phone policy. Laptops may be used for note-taking. But I can absolutely tell when you are taking notes vs. reading the news, scrolling through Facebook, online shopping, checking how many games the Yankees are behind the Red Sox, etc., and, like Bartleby the Scrivener, I would prefer not to call you out.

Academic Honesty
All students are expected to abide by 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.

Student Needs
Students who may need disability-related academic adjustments and services are encouraged to see me privately as early as possible in the term. Students requiring these adjustments and services must also consult the Student Accessibility Services (SAS) office. Once SAS has authorized services, students must provide me with the originally signed SAS Services and Consent Form and/or a letter on SAS letterhead. All inquiries and discussion will remain confidential.

Calendar

Topic	Tuesday	Thursday
The Food-Energy-Environment Trilemma		**22-Jun**
Land-Use/Land-Cover Change	**27-Jun**	**29-Jun**
Von-Thunen; Working with Satellite Data	**4-Jul** NO CLASS	**6-Jul** *Lab 1*
The Forest Transition; Ag Expansion in the Tropics	**11-Jul**	**13-Jul**

		Lab 2
Biofuels; Indirect Land Use Change	**18-Jul** Paper Topics Due	**20-Jul** *Lab 3*
Brazil: A Case Study; Smallholder Agriculture	**25-Jul** Midterm Exam	**27-Jul**
The Globalization of Land Use Change	**1-Aug**	**3-Aug** *Lab 4*
Solutions? (Yield Gaps, Diet, Food Waste, Integrated Agriculture)	**8-Aug** Research Paper Outline & Sources Due	**10-Aug**
Flex Day & Student Presentations	**15-Aug**	**17-Aug**
Student Presentations & Wrap-Up	**22-Aug**	**24-Aug** Final Paper Due

Readings by Week and Topic:

Week 1: The Food-Energy-Environment Trilemma
1. Foley et al. 2005. Global Consequences of Land Use, Science.

Week 2: Land-Use/Land-Cover Change
1. DeFries et al. 2004. Land use choices: balancing human needs and ecosystem tradeoffs, Frontiers in Ecology.
2. Riskin et al. 2012. Regional Difference in Phosphorus Budgets in Intensive Soybean Agriculture. Biosciences.
3. Stromberg 2012. Why Did the Mayan Civilization Collapse? A New Study Points to Deforestation and Climate Change. Smithsonian.com

Week 3: Von-Thunen; Working with Satellite Data
1. Optional: Griffin 1973. Testing the Von Thunen Theory in Uruguay. Geographical Review.

Week 4: The Forest Transition; Ag Expansion in the Tropics
1. Jeon et al. 2014. Land use change in New England: a reversal of the forest transition. Journal of Land Use Science.
2. Meyfroidt and Lambin. 2008. Forest transition in Vietnam and its environmental impacts. Global Change Biology.
3. Meyfroidt et al. 2014. Multiple pathways of commodity crop expansion in tropical landscapes. Environmental Research Letters.
4. Lapola et al. 2014. Pervasive transition of the Brazilian Land Use System. Nature.

Week 5: Biofuels; Indirect Land Use Change

1. Searchinger et al. 2008. Use of U.S Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change. Science
2. Lapola et al. 2009. Indirect land-use changes can overcome carbon savings from biofuels in Brazil. PNAS.
3. Richards 2015. What Drives Indirect Land Use Change? How Brazil's Agricultural Sector Influences Frontier Deforestation. Annals of the Association of American Geographers.
4. Jadin et al. 2017. Unexpected Interactions between Agricultural and Forest Sectors through International Trade: Wood Pallets and Agricultural Exports in Costa Rica. Land.

Week 6 Brazil: A Case Study; Smallholder Agriculture

1. Pfaff. 1999. What Drives Deforestation in the Brazilian Amazon? Journal of Environmental Economics and Management.
2. Macedo et al. 2012. Decoupling of deforestation and soy production in the southern Amazon during the late 2000s. PNAS.
3. Randell. 2016. Structure and agency in development-induced forced migration: the case of Brazil's Belo Monte Dam. Population and Environment.
4. Carlson et al. 2012. Committed carbon emissions, deforestation and community land conversion from oil palm plantation expansion in West Kalimantan, Indonesia. PNAS.

Week 7: The Globalization of Land Use Change

1. Lenzen et al. 2012. International trade drives biodiversity threats in developing nations. Nature.
2. Meyfroidt et al. 2013. Globalization of land use change: distant drivers of land use change and geographic displacement of land use. Environmental Sustainability.
3. Meyfroit and Lambin 2011. Global land use change, economic globalization, and the looming land scarcity. PNAS.
4. Hecht 2010. The new rurality: Globalization, peasants and the paradoxes of landscapes. Land Use Policy.

Week 8: Solutions?

1. Foley et al. 2011. Solutions for a cultivated planet. Nature.
2. Phalan et al. 2011. Reconciling Food Production and Biodiversity Conservation: Land Sharing and Land Sparing Compared. Science
3. Garnett et al 2013. Sustainable Intensification in Agriculture: Premises and Policies. Science.
4. Phalan et al. 2016. Can a higher yield farm spare land for nature? Science.

Week 9: Flex Day & Student Presentations

Week 10: Student Presentations & Wrap-Up