IA 210 - Geospatial Analysis of Global Environmental Issues

Lafayette College Syllabus, Fall Semester 2024

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COURSE INFORMATION

Catalog Description: This course introduces students to the use of geographic information science (GIS) techniques by applying these tools to identify and analyze global environmental issues, with a particular focus on the implications of transnational flows of materials, people, and ideas. This course takes a hands-on approach, investigating topics through a close engagement with mapping and geospatial data through laboratory exercises.

Times: Tuesdays and Thursdays, 2:45-4:00 PM

Location: Acopian Engineering Center 200

Drop-In Extra Lab Help Hours: 2:00-4:00 PM, in Oeschle Center for Global Education 101

Posit Cloud Workspace Link

FACULTY INFORMATION

Instructor: Caleb Gallemore, Ph. D.
Pronouns: He/him/his; dia, if you speak Bahasa
Office Location: Oechsle Center for Global Education 217
Office Hours (times you can drop in without an appointment): Mondays, 11:00 AM to 1:00 PM; Tuesdays, 12:30 PM - 2:15 PM, or by appointment: 30 minute meeting; 15 minute meeting
Office Phone: 610-330-5368 (Ext. 5368)
Email (My preferred mode of contact): gallemoc@lafayette.edu

COURSE OVERVIEW

In this class, we will learn about geographic information science (GIS) by studying how these tools are being used to support and understand major global environmental problems. In particular, we will focus on the many ways in which local environmental concerns are shaped by complex transnational flows of people, goods, capital, and ideas. This course will equip you to use GIS on desktop computers and in the cloud to analyze global environmental problems.

This course is a seminar, and we spend time working in teams and discussing together. I am committed to creating a learning environment that supports a diversity of thoughts, perspectives, and experiences and honors your identities (including race, gender, class, sexuality, religion, ability, nationality, etc.). We will honor the diversity of our classmates.

Course Objectives:

1. Develop students' skills in mapping and geospatial data analysis and interpretation as applied to global environmental problems
2. Develop students' skills in using data to support practical responses to environmental concerns

Learning Outcomes:

Upon completing this course, you should be able to do the following:

1. Produce effective maps at local, national, and global scales
2. Conduct basic geospatial analysis using both raster and vector data
3. Understand how GIS data are produced, stored, and accessed
4. Understand the ethics of GIS data collection, storage, and usage
5. Use GIS to investigate a contemporary global environmental problem

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COURSE MATERIALS

All course materials will be made available via links in this syllabus or on the course Moodle site.

COURSE ASSIGNMENTS

Assignments:

***Tutorials* (200 points):** The five tutorials are short assignments that we will work through in part in class that will help you learn how to apply the techniques we learn about on your own. Tutorials will feature a series of activities and questions that you must complete by the start of class on the following tutorial day. I will grade these items with a ✔-, ✔, or ✔+. ✔- indicates that you have not adequately fulfilled all the tasks in

the tutorial. ✔ indicates that you met my expectations for the tutorial. ✔+ indicates a particularly excellent job. When we have completed all the tutorials, I will assign points based on the number of each type of check you have. If you have all ✔s, you will receive full credit, and ✔+s will balance out ✔-s.

3 . . . 2 . . . 1 . . . (150 points): For the days noted on the syllabus, you should submit a write-up about the course materials in that day's Moodle dropbox **before** class starts. The write-up should be brief and contain the following: 3 cool things you find interesting from the materials; 2 questions about something you find unclear or would like to know more about; and 1 possible way you think a technique in the materials could help us think about another problem. I will grade these items with a ✔-, ✔, or ✔+. ✔- indicates that more detail is required in your answers or that you should be reading the material more carefully. ✔ indicates that you meet my expectations for detail and understanding. ✔+ indicates a particularly excellent job. At the end of the course, I will assign points based on the number of each type of check you have. If you have all ✔s, you will receive full credit, and a ✔+s will balance out ✔-s.

GIS Paper Methods Explanation **(100 points):** Once over the course of the semester, you will lead a discussion on an example cutting-edge GIS paper dealing with a global environmental problem. We'll assume that folks in the class are able to understand the main ideas and findings in the paper. Your job is to go through the methods section of the paper and figure out what data they used - and how they used it - to come to their conclusions. You should provide us some type of visual aide/s (slides, etc.) to help us understand what the authors did, walk us through the methods, and help us start a discussion about how the analysis was conducted. I will give you examples of the sort of thing I am looking for by leading the discussion on the first few paper examples in the class, and you can select anything on the signup sheet to present on.

Labs **(200 points):** The lab portion of the class is intended to be an opportunity for you either to deepen your understanding of some of the techniques that you have learned from the readings and tutorials in the first ten-ish weeks of the class or to expand your expertise into a new domain. It is also designed to help you get used to teaching yourself new GIS skills, which will be important because new tools are constantly being developed, putting a premium on continuous learning. There are far more interesting GIS tools and techniques available in R and other software than we can cover in, so I have reserved time in the last third of the class for you to explore on your own. By the end of Week 9, you (or you and your group, if you'd like to work as a team) have to meet with me to discuss some areas of interest that you would like to develop. Working together, we will identify a set of learning objectives, materials that you can use to achieve them, and some kind of output to demonstrate your mastery of the techniques you decide to study. We will also agree on a grading scheme that I will apply to your final product.

Midterm **(150 points):** The midterm exam will take place in Week 7 and will focus on your understanding of how to apply different GIS techniques to solve specific problems.

You will be given a series of real(ish)-world scenarios that require you to apply sequences of GIS techniques to come up with an answer to a question about a pressing global environmental issue. You will be graded on your ability to formulate and justify an analysis plan that would effectively address the question. In addition, you will need to answer a set of short-answer questions about the ins and outs of the techniques and concepts we have covered in the first six weeks of the class.

***Final* (200 points):** The final exam will be similar to the scenario portion of the Midterm exam. In addition to coming up with a technically correct response to the scenarios you choose, however, you will also be expected to reflect on the ethical, political, and sustainability dimensions of the types of analysis you propose, referring to arguments that have been raised in the final weeks of the class.

Grading Policy:

Your final grade will be based on the total points you have earned by the end of the semester, as follows:

Grade	Points Range
A	934-1000
A-	900-933
B+	867-899
B	834-866
B-	800-833
C+	767-899
C	734-766
C-	700-733
D+	667-699
D	634-666
D-	600-633
F	0-599

COURSE POLICIES AND STATEMENTS

Absence Policy:

Attendance is of course very important for the class. Lecture and discussion days will be your opportunity to dig into the course materials. You get three absences for free, no questions asked, but after that you will lose 100 points from your final grade for each additional unexcused absence (that is, each absence either without a Dean's excuse or due to a religious holiday). If you have a legitimate reason for your absence, please be sure to talk to me well in advance (or if there is an emergency, as soon after the absence as possible).

Academic Integrity:

We at Lafayette share the values of the academic community, which (among other things) require us to acknowledge the contributions that others have made and to continue to add to ongoing intellectual conversations. Failure to uphold these values, either intentionally or inadvertently, is a violation of the community's standards. Moreover, certain violations of the community's standards clearly rise to the level of academic dishonesty and can have serious consequences. Review the full text of Lafayette's Academic Integrity Policies.

Disability Statement:

In compliance with Lafayette College policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Requests for academic accommodations need to be made during the first two weeks of the semester, except for unusual circumstances, so arrangements can be made. Students must register with the Office of the Dean of Advising and Co-Curricular Programs for disability verification and for determination of reasonable academic accommodations.

Due Dates and Late Work:

Late work will not be accepted and will receive zero points, with three exceptions:

Dean's Excuses: Any Dean's Excuses allowing for late work are acceptable.

Serious Emergencies: For serious emergencies, I will decide whether your late work may be accepted for full or reduced credit. Serious emergencies include things like serious illness, accidents, natural disasters, and university server outages. Email me information about your emergency and request approval to make up the assignment or exam. If you receive approval, we will make a plan for you to make up the work.

All Other Unexcused Late Work: Unexcused late work includes coursework that is turned in late because of things like job-related, technical, or other personal issues. To request an extension on an assignment for these reasons, you must request approval **before** the final deadline.

Course Communication:

All pertinent class communication between the instructor and students must be conducted exclusively through Lafayette College email. Thus it is the responsibility of students to check their Lafayette College email account for all significant information and updates on class cancellations in the event of threatening weather conditions. Communication between the instructor and students via personal email accounts (e.g., @gmail.com or @yahoo.com) will not occur.

I try to be available to students as much as possible, but I cannot help you if you do not let me know when you need help. Please use my office hours - or email me to schedule an appointment at another time - whenever you feel like something in the class is unclear, you are concerned about your performance in the class, or would like to talk about anything else about the course - or, for that matter, about anything else.

I really like it when people email me or ask me things about the class. It makes me feel like you are interested and that you care about the course, which makes me happy, so please talk to me about whatever interests or concerns you. Generally I respond to email quite quickly, certainly within 2 days, except over the weekend. I can try to answer questions about course materials via email, but I have found that email is not very good for explaining things in detail, so it is probably best if you have several substantive questions to come by my office hours or schedule an appointment.

Proper Use of Course Materials:
At Lafayette College, all course materials are proprietary and for class purposes only. This includes posted recordings of lectures, worksheets, discussion prompts, and other course items. Such materials should not be reposted. Online discussions should also remain private and not be shared outside of the course. You must request my permission prior to creating your own recordings of class materials, and any recordings are not to be shared or posted online even when permission is granted to record. Because Pennsylvania is a two-party consent state, you also need permission of your fellow classmates to record Zoom meetings. If you have any questions about proper usage of course materials feel free to ask me. Also, if you have any concerns with being recorded during the course please let me know.

Policy on Privacy and Moodle:
Moodle contains student information that is protected by the Family Educational Right to Privacy Act (FERPA). Disclosure to unauthorized parties violates federal privacy laws. Courses using Moodle will make student information visible to other students in this class. Please remember that this information is protected by these federal privacy laws and must not be shared with anyone outside the class. Questions can be referred to the Registrar's Office.

Generative AI Policy:
Students are allowed to use advanced automated tools (artificial intelligence or machine learning tools such as ChatGPT or Dall-E 2) on assignments in this course if that use is

properly documented and credited. For example, text generated using ChatGPT-4o should include a citation such as: “Chat-GPT-4o. (YYYY, Month DD of query). “Text of your query.” Generated using OpenAI. https://chat.openai.com/” Material generated using other tools should follow a similar citation convention. This also applies if you use a tool for coding assistance as part of your tutorial or lab work.

Credit Hours:
The student work in this course is in full compliance with the federal definition of a four credit-hour course. Please see the Lafayette College Compliance webpage for the full policy and practice statement.

Unforeseen Circumstances:

I reserve the right to change this syllabus in the event of unforeseen circumstances.

COURSE OUTLINE

Week	Tuesday	Thursday
1 **Aug. 27, 29**	**Look at what we're doing with GIS!** Satellite mapping reveals extensive industrial activity at sea (2024) Patrol the Leuser Ecosystem with Forest Defenders at HAkA (2023) Global Maps of Dryness Help Prepare for Water Use around the Globe (2020) How NASA Sees the Air we Breathe (2023) Jane Goodall and GIS (2023)	**Basic GIS concepts (Slides; Lecture Video; Class Demonstration Data)** Geography with Dave (2020). Geographic Information Systems (GIS) Concepts Simplified. Mapscaping Podcast (2022). The LandSat program. **If using your own laptop, install QGIS.** **3,2,1 due before class.**
2 **Sept. 3, 5**	**Treating the Earth like cookie dough (Slides; Lecture Video; Class Demonstration Data)** Geography with Dave (2020). Geographic Information Systems (GIS) Concepts Simplified. (Yes, I actually want you to watch it again to help keep the terms fresh) Mapscaping Podcast (2024). Geospatial support for the World Food Programme. **3,2,1 due before class.**	**Introduction to remote sensing (Slides; Lecture Video; Class Demonstration Data)** Mapscaping Podcast (2021). Introduction to synthetic aperture radar (SAR). Mapscaping Podcast (2022). GEDI space lasers. **If using your own laptop, install Google Earth Pro for Desktop.** **3,2,1 due before class.** **Pick papers to explain by end of this week (Sign up sheet)**
3 **Sept. 10, 12**	**How to read a cutting-edge GIS study (Slides; Lecture Video; Class Agenda)** Fan, et al. (2022). Recently constructed hydropower dams were associated with reduced economic production, population, and greenness in nearby areas. *PNAS*, 119(8), e2108038119. Speak About Digital (2023). Diagrams.Net tutorial for beginners. **3,2,1 due before class.**	**Introducing geospatial analysis in R (Class Demonstration)** Equitable Equations (2023). Learn R in 39 Minutes. **Please watch this twice!**

4 Sept. 17, 19	**Overlay techniques** Fa, et al. (2021). Importance of indigenous peoples' lands for the conservation of intact forest landscapes. *Frontiers in Ecology and Evolution*. doi:10.1002/fee.2148 (Analise) Owen, et al. (2023). Energy transition minerals and their intersection with land-connected peoples. *Nature Sustainability*, 6, 203-211. **3,2,1 due before class.**	**Tutorial: Overlay techniques in R**
5 Sept. 24, 26	**Raster Overlay and Map Algebra Techniques (Slides; Scenarios for in-class activity)** Simkin, et al. (2022). Biodiversity impacts and conservation implications of urban land expansion projected to 2050. *PNAS*, 119(12), e2117297119. (Hannah) Behrer & Heft-Neal. (2024). Higher air pollution in wealthy districts of most low- and middle-income countries. *Nature Sustainability*. Mapscaping Podcast (2022). Monitoring Atmospheric Pollution from Space. **3,2,1 due before class.**	**Tutorial: Remote Sensing Data in R** Bower, E. (2024). Greening the desert: Is Sisi's grand plan using up all of Egypt's water? *The Guardian*. 30 July. Loyd, C. (2013). LandSat 8 bands. Equitable Equations (2023). Learn ggplot2 in R in 36 minutes.
6 Oct. 1, 3	**Raster Distance Calculations (Slides; Lecture Video)** Cisneros-Araujo, et al. (2020). Remote sensing of wildlife connectivity networks and priority locations for conservation in the Southern Agricultural Growth Corridor (SAGCOT) in Tanzania. *Remote Sensing in Ecology and Conservation*, 7(3), 430-444. Davis, et al. (2024). Mapping essential surgical care in Mongolia: Do natural barriers and seasonality alter access to essential surgical care? *Applied Geography*, 167, 103297. (Yi) **3,2,1 due before class.**	**Real-world GIS Analysis Scenarios**

7 Oct. 8, 10	**Tutorial: Raster Distance Calculations** **Reread:** Cisneros-Araujo, et al. (2020). Remote sensing of wildlife connectivity networks and priority locations for conservation in the Southern Agricultural Growth Corridor (SAGCOT) in Tanzania. *Remote Sensing in Ecology and Conservation*, 7(3), 430-444.	**Midterm Exam (Midterm Vocab Cards; Midterm Practice Scenarios)**
8 Oct. 15, 17	**No Class - Fall Break!**	**GIS as a political tool** Gallemore, et al. (2024). Misclassification Risks Threaten Access Equity in Zero-Deforestation Value Chains for Coffee: The Case of the European Deforestation Regulation Drakopulos, et al. (2023). Making global oceans governance in/visible with Smart Earth: The case of Global Fishing Watch. *EPE: Nature and Space*, 6(2), 1098-1113. **3,2,1 due before class.**
9 Oct. 22, 24	**Landscape Ecology (Slides; Lecture Video)** Flowers, et al. (2020). Analysis of the habitat fragmentation of ecosystems in Belize using landscape metrics. *Sustainability*, 12(7), 3024. (Riley) He, et al. (2024). Impacts of urban-rural integration on landscape patterns and their implications for landscape sustainability: The case of Changsha, China. *Landscape Ecology*, 39, 129. **3,2,1 due before class.**	**Tutorial: Landscape Ecology Measures** **Skim:** Doyle, C., et al. (2021). Tropical forest and wetland losses and the role of protected areas in northwestern Belize, revealed from LandSat and machine learning. *Remote Sensing*, 13(3), 379. Soetewey, A. (2023). Introduction to data manipulation in R with {dplyr}. **Rewatch:** Equitable Equations (2023). Learn ggplot2 in R in 36 minutes.
10 Oct. 29, 31	**Land-cover Classification (Slides; Lecture Video)** Pettoreli, et al. (2024). Deep learning and satellite remote sensing for biodiversity monitoring and conservation. *Remote Sensing in Ecology and Conservation*. **Reread:** Doyle, C., et al. (2021). Tropical forest and wetland losses and the role of protected areas in northwestern Belize,	**Tutorial: Land-cover Classification** Mapscaping Podcast (2022). Reduce and reverse tropical forest loss with NICFI. **Submit Lab Plan by end of this Week**

	revealed from LandSat and machine learning. *Remote Sensing*, 13(3), 379. (Saira) Maskell, et al. (2021). Integration of Sentinel optical and radar data for mapping smallholder coffee production systems in Vietnam. *Remote Sensing of the Environment*, 266, 112709. (Sidath) **3,2,1 due before class.**	
11 Nov. 5, 7	**Object Recognition** White, et al. (2020). Tracking the response of industrial fishing fleets to large marine protected areas in the Pacific Ocean. *Conservation Biology*, 34(6), 1571-1578. Green, et al. (2023). Gray whale detection in satellite imagery using deep learning. *Remote Sensing in Ecology and Conservation*, 9(6), 829-840. **3,2,1 due before class.**	**Lab Day**
12 Nov. 12, 14	**Sustainability considerations** Wilkinson, et al. (2024). Environmental impacts of earth observation data in the constellation and cloud computing era. *Science of the Total Environment*, 909, 168584. Lucivero. (2020). Big data, big waste? A reflection on the environmental sustainability of big data initiatives. *Science and Engineering Ethics*, 26, 1009-1030. **3,2,1 due before class.**	**Lab Day**
13 Nov. 19, 21	**Ethical considerations 1** Bennett, et al. (2024). Bringing satellites down to Earth: Six steps to more ethical remote sensing. *Global Environmental Change Advances*, 2, 100003. Critical EO Slides **3,2,1 due before class.**	**Lab Day**
14	**Ethical Considerations 2**	**No Class - Thanksgiving Holiday!**

Nov. 26, 28	Micheli, et al. (2022). AI ethics and data governance in the geospatial domain of Digital Earth. *Big Data & Society*, 1-5. Reid & Sieber. (2020). Learning from critiques of GIS for assessing the geoweb and indigenous knowledges. *GeoJournal*, 87, 875-893. **3,2,1 due before class.**	
15 Dec. 3, 5	**Lab Day**	**Lab Day** **Review session: Friday, Dec. 7, 2:00-4:00 PM, OCGE 101**
Finals	**Wednesday, December 11, 2024, 8:00-11:00 AM** **Oeschle Center for Global Education 101** **Don't worry! I'll bring tea and donuts!**	**Final Lab/Projects Due December 17 by 11:59 PM.**