GEOM4003 - Remote Sensing of the Environment - Winter 2025
Carleton University, Department of Geography and Environmental Studies
(updated December 6, 2024)

Instructor: Koreen Millard
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Office hours: Tuesdays 1 - 2 pm

Lecture period: Wednesdays 9:35 - 11:25 am (A220)
Lab period: Thursdays 2:35 - 4:25 pm (A237)

TA: Yasaman Amini
TA Contact: through Brightspace
TA office hours: TBD

Brightspace course page link: https://brightspace.carleton.ca/d2l/home/284541

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1. Course Description

Land cover classification for thematic mapping; biophysical modeling; applications in resources, environment, and urban mapping. The focus of this course will be on analyzing environmental conditions and phenomenon using remotely-sensed imagery through spatial and statistical analysis. This course will use Google Earth Engine, a cloud based remote sensing progressing suite. Students will require access to the internet through a modern browser and a google account (i.e. gmail, Google Drive). No prior coding skills are required but students will be expected to use and develop their own python scripts in the labs.

Pre-lecture quizzes: Before each lecture period, readings and several short pre-recorded lectures will be provided on Brightspace. Students will be required to take a short quiz at the beginning of some lecture periods to ensure that they have engaged with the content of the readings and videos prior to the lecture period.

Labs: Labs will be conducted using Google Earth Engine in the CoLab environment. There are 6 labs in total: 4 mandatory labs and 2 labs "of your choice" (from a list of 6 additional labs). The TA (Yasi) will demonstrate parts of the first 4 labs in the lab session and students are expected to work on completing the deliverables of these and the labs of their choice on their own. If you have questions for Yasi outside of the lab or office hours, please use the Brightspace forum to communicate with her.

Final Project: In this course we will work with the Nature Conservancy of Canada (NCC) to develop maps and data products derived from remote sensing that are useful in conservation management in Canada. Students will each work on an NCC property and test different remote sensing methods that may be useful for monitoring land cover change at these sites. A proposal will be submitted to ensure students have developed their

methodology sufficiently before commencing the bulk of the work. The final submission will be a digital poster with a presentation in class.

2. Preclusions

Precludes any additional credit for GEOG 4003.

3. Learning Outcomes

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

1. **Design Remote Sensing Projects**
   Evaluate the temporal and spatial resolutions of sensors to design effective remote sensing projects tailored to specific environmental or thematic mapping objectives.
2. **Implement Classification Techniques**
   Apply supervised and unsupervised classification methods to create land use and land cover (LULC) maps and perform manual and automated thresholding techniques (e.g., Otsu's method) using both optical and SAR satellite remote sensing datasets.
3. **Detect Changes and Trends**
   Conduct change detection analysis and identify temporal trends in environmental phenomena using time-series data.
4. **Address Spatial and Temporal Challenges**
   Analyze the challenges of mapping over varying spatial and temporal scales, including the transferability of models across datasets or regions.
5. **Collaborate and Communicate Results**
   Develop and present a remote sensing project that integrates spatial and statistical analyses to address a real-world environmental question, effectively communicating the methodology and results.
6. **Develop Programming Skills for Remote Sensing**
   Write and modify Python scripts for data visualization, analysis, and model implementation within cloud-based platforms such as Google Earth Engine.

4. Texts & Course Materials

This course uses a free online textbook in combination with other assigned readings (journal articles, websites, etc.). The textbook can be accessed here. Students are not required to purchase textbooks or other learning materials for this course.

5. Course Calendar (tentative)

Date	Lecture/Lab	Content	Lab Due Dates	Guest Speaker
Jan 8	Lecture	Intro to Course and course project		
Jan 9	Lab	None	None	
Jan 15	Lecture	Review of core RS concepts (EMR, atmosphere and surface interaction, sensor types, rasters), Basic image processing: atmospheric correction, Compositing, mosaicking, indices etc.		
Jan 16	Lab	Lab 1 - intro to Google Co-Lab and Earth Engine + Visualizing Change		
Jan 22	Lecture	Review image processing for SAR: types of SAR datasets/products, backscatter intensity to dB, speckle filter, shadow layover, foreshortening	Prelecture Quiz	Sarah Banks
Jan 23	Lab	Lab 2 - Visualizing SAR	Lab 1 due	
Jan 29	Lecture	Remote sensing project design - sensor temporal and spatial resolution, measurement characteristics		Richard Schuster - Nature Conservancy of Canada
Jan 30	Lab	No lab - begin work on project	Lab 2 due	
Feb 5	Lecture	Thresholding - with manual thresholding and Otsu		
Feb 6	Lab	Lab 3 - Water Extent and Flood Mapping using thresholding		
Feb 12	Lecture	Supervised and Unsupervised Classification	Prelecture Quiz	Nick Pontone, Carleton University
Feb 13	Lab	Lab 4 - LULC	Lab 3 due	
Feb 19	READING WEEK	No lecture		

Feb 20	READING WEEK	No Lab		
Feb 26	Lecture	Estimating biophysical parameters	Prelecture Quiz	
Feb 27	Lab	Work on project/Lab of your choice	Lab 4 due	
March 5	Lecture	Challenges in Mapping over Space and Time, Transfering models	Prelecture Quiz	Cameron Samson, Environment and Climate Change Canada
March 6	Lab	Work on project/Lab of your choice		
March 12	Lecture	Change Detection	Prelecture Quiz	Elisha Richardson, Carleton University
March 13	Lab	Work on project/Lab of your choice		
March 19	Lecture	Time Series - Trend Detection	Prelecture Quiz	Roberto Chavez, Pontificia Universidad Catolica de Valparaiso
March 20	Lab	Work on project/Lab of your choice		
March 26	Lecture	Finalize project/ review		
March 27	Lab	Work on project/Lab of your choice		
April 2	Lecture	Final Project Presentations		
April 3	Lab	Work on project/Lab of your choice		
April 8	Last day of classes (not a lecture/lab period)		Lab 5 and 6 (of your choice) due	

6. Evaluation

a. List of Evaluation Elements

- 5 Pre-lecture Quizzes (based on video lectures/readings, best 5 of 6), 2% each = **10%**
- 6 labs (4 mandatory plus choose 2 from possible 6 other labs), 5% each = **30 %**
- Final Project (60%)
    - Final Project proposal = **10%**
    - Final poster= **40%**
    - Feedback on final poster presentations, 3% for providing peer feedback, 7% based on peer feedback = **10%**

b. Tests and Examinations

- None

c. Final Grade Approval

Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean.

7. Statement on Academic Integrity

The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source. Examples of sources from which the ideas, expressions of ideas or works of others may be drawn from include but are not limited to: books, articles, papers, literary compositions and phrases, performance compositions, chemical compounds, artworks, laboratory reports, research results, calculations and the results of calculations, diagrams, constructions, computer reports, computer code/software, material on the internet and/or conversations.

Examples of plagiarism include, but are not limited to:

- any submission prepared in whole or in part, by someone else, including the unauthorized use of generative AI tools (e.g., ChatGPT); (see note below)
- using ideas or direct, verbatim quotations, paraphrased material, algorithms, formulae, scientific or mathematical concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another's data or research findings without appropriate acknowledgement;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and (see note below)

- failing to acknowledge sources through the use of proper citations when using another's work and/or failing to use quotation marks.

Plagiarism is a serious offense that cannot be resolved directly by the course's instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course.

Special Note on the use of Generative Artificial Intelligence Tools (e.g. ChatGPT, Gemini, Notebook LM) in this course: You may not use Generative AI tools to create any content for assignments, labs, exercises, reports, projects etc. in this course. You may use Generative AI to summarize/explain concepts to you (e.g. "can you explain how passive and active remote sensing differ?") or explain the general steps that would be required to solve a problem (e.g. "can you explain how to collect GCPs with WebODM?") but you should not copy or paraphrase the text it produces. You may also use it for *help* with debugging code, but you should be able to explain all lines of code you hand in on assignments.

Special note on submitting the same piece of work for more than one academic credit: It is not a violation of the Academic Integrity Policy to submit the same piece of work for credit in more than one class. However, for this course, you should cite any work that is a direct reproduction of work you've already received credit for.

Special note on group or collaborative work and using code from external sources: There are no group assignments in this course, but students are encouraged to discuss concepts and approaches with their peers. However, all submitted work must be completed individually. Students are expected to independently customize and execute all code, even if it is adapted from external sources such as StackExchange or other online platforms. Simply copying code is not acceptable; it must be modified to suit the specific context of the assignment and reflect the student's own understanding. Similarly, all written interpretations and analyses must be their own work, demonstrating individual thought and effort.

8. Statement on Student Mental Health

As a student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. If you need help, please speak to someone. There are numerous resources available both on- and off-campus to support you. For more information, please consult https://wellness.carleton.ca/

Emergency Resources (on and off campus)

- Suicide Crisis Helpline: call or text 9-8-8, 24 hours a day, 7 days a week.
- For immediate danger or urgent medical support: call 9-1-1

Carleton Resources

- Mental Health and Wellbeing: https://carleton.ca/wellness/
- Health & Counselling Services: https://carleton.ca/health/
- Paul Menton Centre: https://carleton.ca/pmc/
- Academic Advising Centre (AAC): https://carleton.ca/academicadvising/
- Centre for Student Academic Support (CSAS): https://carleton.ca/csas/
- Equity & Inclusivity Communities: https://carleton.ca/equity/

Off Campus Resources

- Distress Centre of Ottawa and Region: call 613-238-3311, text 343-306-5550, or connect online at https://www.dcottawa.on.ca/
- Mental Health Crisis Service: call 613-722-6914 or toll-free 1-866-996-0991, or connect online at http://www.crisisline.ca/
- Empower Me Counselling Service: call 1-844-741-6389 or connect online at https://students.carleton.ca/services/empower-me-counselling-services/
- Good2Talk: call 1-866-925-5454 or connect online at https://good2talk.ca/
- The Walk-In Counselling Clinic: for online or on-site service https://walkincounselling.com

9. Requests for Academic Accommodations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the *Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances*, are outlined on the Academic Accommodations website (students.carleton.ca/course-outline).

10. Other Important Information

Required Computer Software

During this course you will use Google Earth Engine through the Python API. This requires use of a modern browser (Chrome recommended), a google account (gmail) and access to Google Earth Engine (NOTE: Google Earth Engine is NOT the same as Google Earth!). Students should request access to this tool immediately through this link: https://earthengine.google.com/new_signup/ **Access to Earth Engine will be required in the first week of class.** Additionally, students will require access to basic computing tools like a word processor, spreadsheet software etc. Google Docs and Google Sheets are encouraged for collaborating and sharing purposes and interoperability with CoLab, however, Microsoft Office is also acceptable for writing reports.

Use of Discord:

I expect that someone in the class will set up a Discord server where class members can chat and discuss class content and potentially manage your group project requirements. Please make sure that everyone in the class is aware of this server. If you are not familiar with the platform, please ask your classmates about it. The instructor or TA will not be part of this server, and this is not an official communication mechanism for the class. All official communications will take place on Brightspace.