Fall 2023 - Introduction to Remote Sensing - GEOM3002

Department of Geography and Environmental Studies

Instructor: Koreen Millard koreenmillard@cunet.carleton.ca
Office hours: Mondays 10 - 11 am

Lecture Time: Wednesdays 9:35 - 11:35

Labs: Fridays 16:35 - 18:25

TA: Yasaman Amini

Office Hours: Tuesdays 10 - 11 am

Textbook: Readings from the web + Remote Sensing, A. Knudby (2021) online (free and open access): https://ecampusontario.pressbooks.pub/remotesensing/

Course Description:

Principles and methods of remote sensing; visual interpretation of air photos and satellite imagery; digital image processing, analysis and classification for thematic mapping; introduction to various active and passive remote sensing imagery types such as optical, hyperspectral, RADAR and LiDAR. We will use a variety of software in the course. Google Earth Engine is an online free cloud processing software. Other software (QGIS, SNAP, WebODM are all available in our lab). You will require familiarity with the Windows operating system. It is also assumed that students will be able to use word processors and other utilities (Acrobat Reader, Winzip/7Zip, Notepad, Explorer etc). No coding skills are required, but students should be ready to learn how to use and develop some basic scripts in the labs.

This course will run online using a blended approach. Some lectures will be pre-recorded and available through Brightspace. Lecture periods will be used to cover additional lecture materials, facility group discussions and group exercises. Labs will be demonstrated through pre-recorded videos, uploaded in advance of the lab time slots. The TA will also demo parts of the lab in the official lab timeslot and the rest of the lab period will be informal and allow you to ask questions and get technical help. Quizzes will be assigned before specific lecture periods, but will be marked based on a “completed/not-completed” basis and are designed to be used for you to gauge your understanding of the material.

II. Preclusions: GEOG3002 (no longer offered)

III. Learning Outcomes:

- Understand the conceptual and technical background related to image formation and spectral reflectance theory, types of remote sensors currently in use

- Use theoretical understanding to determine the appropriate sensor to observe specific geographic phenomenon

- Perform visual interpretation of images, image enhancement, thematic mapping using remotely sensed imagery

- Use theoretical understanding to determine the best workflow for processing and analyzing remotely sensed imagery

V. Evaluation:

- 4 labs (variable weighting) = 40%
- mid term @ 20% (take home - i.e. not timed)
- 6 Quizzes @ 6% (graded based on on-time completion)
- In class exercises @ 14% (8 total, graded using peer feedback and based on average of 7 highest grades)
- final group project @ 20%

Peer feedback will be used to grade the mid term and part of the group project. For the midterm, you will also evaluate the feedback you receive and these evaluations will together make up your grade for the midterm.

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.

Late Policy: All assignments must be submitted through the Brightspace dropbox by the due date and time. No late assignments will be accepted, with the exception of those cases where a student is sick or if you have already arranged for academic accommodation as described in subsequent sections of this syllabus. In the case of illness, you must make arrangements with the course instructor prior to the due date/time. In place of a doctor's note or medical certificate, students are advised to complete the self-declaration form available on the Registrar's Office website to request academic accommodation for missed coursework including exams and assignments.

Lecture/Lab attendance: Lectures will cover theoretical components of remote sensing and may also include software demonstrations. Some lectures will be recorded and available through Brightspace whereas others will take place in the lecture period. Some lecture periods will also be used for group exercises and will be graded using peer feedback, with the highest 7 grades being averaged (i.e. lowest 3 dropped). Some exercises may require us to go outside - but you will be given advanced warning on what clothing you will require. Labs will include software demonstrations and one-on-one help will be available for software and practical related questions. Lab periods marked as "open lab periods" are times for you to work on your labs or group projects and get the help of the TA, but not formal demonstrations are scheduled. In person or virtual attendance may be required to some group project meetings to facilitate group discussion and collaboration, as decided by the group.

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VI. Course calendar (**tentative: dates and topics subject to change**):

Lecture date	lecture topic	Lab Topic	Lab Due
September 6	Welcome; Intro to the course; what is remote sensing? what can it be used for? brief history of remote sensing	No Lab	No Lab
September 13	introduction to the electromagnetic spectrum and black body radiators; radiation and target interactions; atmospheric windows	Lab 1: part 1: Downloading imagery and working with imagery locally in QGIS	
September 20	introduction to remote sensing data; raster images, types of resolution, pixel types, bit depth, review of projections and coordinate systems	Lab 1: part 2 working with imagery in Google Earth Engine and Google Co-lab	
September 27	Passive Optical Remote Sensing - common sensors, uses, orbit types	Open lab period	
October 4	Passive Optical Remote Sensing 2 - what is an "image", images as radiometric measurements, types of imaging, image enhancement, atmospheric and radiometric correction, orthorectification.	Lab 2: part 1: explore different processing levels and image enhancements in GEE/Colab	Lab 1
October 11	Passive Optical 3 - image interpretation, indices, texture, cloud masks, composites, mosaics	Lab 2: part 2: explore cloud masking, compositing and mosaicking in GEE/Colab	
October 18	Guest Lecture - Morgan Crowley, WildfireSAT (CFS)	Open Lab Period	Lab 2
October 25	Fall Break		
November 1	Active Remote Sensing - SAR1 - speckle filtering, polarizations and polarimetry, (basics of SAR and SAR sensors, data collection) Guest Lecture - Sarah Banks - ECCC	Lab 3 Part 1: Working with Sentinel-1 in GEE/Colab	
November 8	Active Remote sensing - SAR 2 - InSAR, coherent change detection and sensor comparisons	Lab 3 Part 2: processing Sentinel-1 imagery in SNAP	
November 15	Aerial Photography, UAVs and Structure from Motion Guest Lecture - Blair Kennedy - ECCC	Lab 4: Working with Point Clouds	Lab 3
November 22	Active Remote Sensing- LiDAR Guest lecture - Malek Singer - Teledyne Optech	Open Lab Period	
November 29	Passive Microwave Remote Sensing - including common sensors, products, uses Guest Lecture- Yasaman Amini - Carleton University	Open lab period	Lab 4
December 6	Present Final Projects	Open lab period	

VII. Statement on Plagiarism

PLAGIARISM

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);
- 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
- failing to acknowledge sources through the use of proper citations when using another's work and/or failing to use quotations 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) in this course: You may not use Generative AI tools such as ChatGPT 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.

VIII. Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation as soon as possible after the need for accommodation is known to exist.

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable). More Information:

https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf

Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/equity/sexual-assault-support-services

Accommodation for Student Activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Write to me with any requests for academic accommodation

during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.
https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf