GEOG 577: Advanced Remote Sensing – Spring 2025

Instructor: Dr. Aaron Moody
MWF 12:20 - 1:10 Carolina Hall Rm 322

Office Hours: T: 12:00 – 1:30; W: 2 – 3:30
Zoom link: https://unc.zoom.us/j/94045709920 to be used as necessary.

Course Overview
This course is intended for students who have taken an introductory remote sensing course, *or* who have some experience with Google Earth Engine, *or* who have substantial experience working with geospatial data. We'll use data collected by Earth orbiting satellites to study terrestrial, marine, and atmospheric environments, emphasizing spatial patterns, temporal dynamics, and system interactions, including human factors. This course will introduce more advanced analytical methods, incorporate literature in the field of remote sensing, and focus more on estimating physical and ecosystem properties, compared to the introductory course (GEOG 477). The course also takes a deeper dive into theory and mechanics of remote sensing, image processing, and related aspects of radiation and the environment. Through labs and individual research projects students will apply analytical tools to satellite data to derive information about Earth's systems.

This is a lab- and project-intensive course intended to deepen understanding of the characteristics of remote sensing data, how to use and analyze these data, and how to apply them to studies of earth system and anthropogenic processes. We'll apply the methods discussed in class to satellite data using a cloud-based, open-source software platform called "Google Earth Engine."

Remote sensing fall within the broader area of geospatial data science and plays a central role of many fields including mapping, monitoring, management of natural resources and change, urban and regional planning, disaster response and recovery, and modeling of earth system processes. The course will help prepare you for research, and public and private sector careers in these areas.

Structure of the Course
Most weeks consists of approximately 1/2 lecture and 1/2 collaborative work on in-class problem solving. The labs are to be done primarily outside of class time, but with some time

reserved in class each week for students to engage in collaborative learning around the lab assignments. Two class projects will involve student-designed and implemented research about some aspect of terrestrial or marine ecosystems or phenomenon and may include anthropogenic effects. Each project should be written up in the form of a scientific research article, and will include an 8-minute in-class presentation.

Materials

Lectures, Readings, Lab Assignments, and Grades will be posted to Sakai. We will also use the online text: **https://www.eefabook.org.** In addition, you may find the Guides and Community sections for the Earth Engine Developers site to be particularly useful.

Learning Goals

By the end of this course, students will have gained:

1. An understanding of the basic science, technology, capabilities, and procedures related to satellite remote sensing and the use of satellite data for earth system analysis.
2. Capability to apply computational and digital image processing procedures to satellite data for information extraction and hypothesis driven analysis of earth systems, as well as combination of satellite data with both raster and vector geospatial data from other sources.
3. Beginning-to-intermediate fluency in Google Earth Engine (GEE) including JavaScript programming in the GEE environment.

Grading

- Labs: 50%
- Midterm Exam: 15% (Date TBA)
- Projects: 30%
- Other: 5%

Lab assignments, readings and **due dates** are indicated in the Course Schedule, below.

Getting Ready for the Course:

There are two things I'd like to emphasize up front:

First: There will be moments when things aren't working as you expect and you may feel blocked and or frustrated. If/when this happens, spend a little time trying to troubleshoot the problem, but avoid thrashing around indefinitely. If you've spent 30 minutes getting nowhere, stop and send a message to the Discussion site in Canvas (include all class participants). Chances are that a fellow student or I will get back to you quickly with a solution to your problem. Also, part of your problem-solving approach should be to search online for solutions - there are extremely helpful user communities for the kind of work we'll be doing and sometimes that will be your best resource. Usually your question has already been asked and answered. There are abundant resources to be found here, particularly under the “Guides” and “Community” tabs.

Second: The content and methods we'll be learning are like learning a new language. It may seem somewhat impenetrable at first and you might find yourself understanding only part of

what you are or doing. That's fine. You'll become increasingly fluent as we go. Note that, though we will be programming with the EarthEngine JavaScript API (Application Programming Interface). Much of the time we will be modifying pre-existing chunks of code and tailoring them for our specific purposes. So the course is not as

Third: Here is your first Lab!!. If you have any trouble please contact me immediately using the Discussion application here in Canvas (See tabs at left).

Questions?

Whenever you run into trouble please reach out using the Discussion Tool in Canvas, raise your question in class, or come to office hours.

Schedule: This schedule is provisional. Adjustments will undoubtedly occur.

PART I:

Weeks 1 & 2 (1/08 – 1/17). Review Fundamental Concepts of Remote Sensing, Remote Sensing Data, Image processing, and GEE;
Week 3 (1/20* – 1/24). Information Domains; Non-Optical Sensors; Trouble Shooting and Filling Gaps;
Lab 1 Due on 1/24.
Week 4 (1/27 – 1/31). Optical Remote Sensing Indices and their relationships to ecosystem properties
Week 5 (2/03 – 2/07. Methods of Change Detection
Lab 2 Due on 02/07.

PART II:

Week 6 (2/10* – 2/14). Satellites and Sensors; Trouble Shooting and Filling Gaps; Project Pre-proposals due on 02/14.
Week 7 (2/17 – 2/21). Image Statistics & Classification, Parametric Methods
Week 8 (2/24 – 2/28). Classification Non-Parametric Methods;
Lab 3 Due on 02/28.
Week 9 (3/03 – 3/07). Spectral Distance and Ordination Methods; Revised project proposals due on 03/07.
Week 10* (3/10 – 3/14). SPRING BREAK

PART III:

Week 11 (3/17 – 3/21). Radiation and Radiative Transfer: Atmosphere, Land, Water;
Lab 4 Due on 03/21.
Week 12 (3/24 – 3/28). More on Non-optical sensors : Microwave, Gravity,
Week 13 (3/31 – 4/04). Pixel Unmixing
Week 14 (4/07 – 4/11). Trouble Shooting, Filling in Gaps, and In-Class Project Work
Week 15 (4/14 – 4/18*). Trouble Shooting, Filling in Gaps, and In-Class Project Work
Week 16 (4/21 – 4/25). Wrapping up and Presentations
Week 17 (4/28). LDOC Presentations

Final Exam Period: Th 05/08 1200 – 300

Grading Scale

Percentages will be converted to letter grades according to the following scale.

Letter Grade	Percentage	Meaning
A	94–100%	Excellent: Far exceeds standard
A-	90–93%	
B+	87–89%	Good: Exceeds standard
B	83–86%	
B-	80–82%	
C+	77–79%	Fair: Meets standard
C	73–76%	
C-	70–72%	
D+	67–69%	Poor: Shows growth but falls below standard
D	60–66%	
F	0–59%	Failing: Deficient

Policies and Resources

Syllabus Changes

The professor reserves the right to make changes to the syllabus including project due dates and test dates. These changes will be announced as early as possible.

Attendance Policy

University Policy: As stated in the University's Class Attendance Policy, no right or privilege exists that permits a student to be absent from any class meetings, except for these University Approved Absences:

1. Authorized University activities
2. Disability/religious observance/pregnancy, as required by law and approved by Accessibility Resources and Service and/or the Equal Opportunity and Compliance Office (EOC)
3. Significant health condition and/or personal/family emergency as approved by the Office of the Dean of Students, Gender Violence Service Coordinators, and/or the Equal Opportunity and Compliance Office (EOC).

Class Policy: Instructors may work with students to meet attendance needs that do not fall within University approved absences. For situations when an absence is not University approved (e.g., a job interview or club activity), instructors determine their own approach to missed classes and make-up assessment and assignments.

University Approved Absence Office (UAAO): The UAAO website provides information and FAQs for students and faculty related to University Approved Absences.

Note: Instructors have the authority to make academic adjustments without official notice from the UAAO. In other words, it is not required for instructors to receive a University Approved

Absence notification in order to work with a student. In fact, instructors are encouraged to work directly with students when possible.

Honor Code

All students are expected to follow the guidelines of the UNC Honor Code. In particular, students are expected to refrain from "lying, cheating, or stealing" in the academic context. If you are unsure about which actions violate the Honor Code, please see me or consult studentconduct.unc.edu.

Optional Mask Use Statement

UNC-Chapel Hill is committed to the well-being of our community – not just physically, but emotionally. The indoor mask requirement was lifted for most of campus on March 7, 2022. If you feel more comfortable wearing a mask, you are free to do so. There are many reasons why a person may decide to continue to wear a mask, and we respect that choice.

Acceptable Use Policy

By attending the University of North Carolina at Chapel Hill, you agree to abide by the University of North Carolina at Chapel Hill policies related to the acceptable use of IT systems and services. The Acceptable Use Policy (AUP) sets the expectation that you will use the University's technology resources responsibly, consistent with the University's mission. In the context of a class, it's quite likely you will participate in online activities that could include personal information about you or your peers, and the AUP addresses your obligations to protect the privacy of class participants. In addition, the AUP addresses matters of others' intellectual property, including copyright. These are only a couple of typical examples, so you should consult the full Information Technology Acceptable Use Policy, which covers topics related to using digital resources, such as privacy, confidentiality, and intellectual property. Additionally, consult the University website "Safe Computing at UNC" for information about the data security policies, updates, and tips on keeping your identity, information, and devices safe.

Accessibility Resources and Service

The University of North Carolina at Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, including mental health disorders, chronic medical conditions, a temporary disability or pregnancy complications resulting in barriers to fully accessing University courses, programs and activities. Accommodations are determined through the Office of Accessibility Resources and Service (ARS) for individuals with documented qualifying disabilities in accordance with applicable state and federal laws. See the ARS Website for contact information: https://ars.unc.edu or email ars@unc.edu.

Counseling and Psychological Services

UNC-Chapel Hill is strongly committed to addressing the mental health needs of a diverse student body. The Heels Care Network website is a place to access the many mental resources at Carolina. CAPS is the primary mental health provider for students, offering timely access to consultation and connection to clinically appropriate services. Go to their website https://caps.unc.edu/ or visit their facilities on the third floor of the Campus Health building for an initial evaluation to learn more. Students can also call CAPS 24/7 at 919-966-3658 for immediate assistance.

Title IX Resources

Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Reports can be made online to the EOC at https://eoc.unc.edu/report-an-incident/. Please contact the University's Title IX Coordinator (Elizabeth Hall, titleixcoordinator@unc.edu), Report and Response Coordinators in the Equal Opportunity and Compliance Office (reportandresponse@unc.edu), Counseling and Psychological Services (confidential), or the Gender Violence Services Coordinators (gvsc@unc.edu; confidential) to discuss your specific needs. Additional resources are available at safe.unc.edu.

Policy on Non-Discrimination

The University is committed to providing an inclusive and welcoming environment for all members of our community and to ensuring that educational and employment decisions are based on individuals' abilities and qualifications. Consistent with this principle and applicable laws, the University's Policy Statement on Non-Discrimination offers access to its educational programs and activities as well as employment terms and conditions without respect to race, color, gender, national origin, age, religion, genetic information, disability, veteran's status, sexual orientation, gender identity or gender expression. Such a policy ensures that only relevant factors are considered and that equitable and consistent standards of conduct and performance are applied.

If you are experiencing harassment or discrimination, you can seek assistance and file a report through the Report and Response Coordinators (see contact info at safe.unc.edu) or the Equal Opportunity and Compliance Office, or online to the EOC at https://eoc.unc.edu/report-an-incident/.

Diversity Statement

I value the perspectives of individuals from all backgrounds reflecting the diversity of our students. I broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. I strive to make this classroom an inclusive space for all students. Please let me know if there is anything I can do to improve. I appreciate suggestions.

Undergraduate Testing Center

The College of Arts and Sciences provides a secure, proctored environment in which exams can be taken. The center works with instructors to proctor exams for their undergraduate students who are not registered with ARS and who do not need testing accommodations as provided by ARS. In other words, the Center provides a proctored testing environment for students who are unable to take an exam at the normally scheduled time (with pre-arrangement by your instructor). For more information, visit http://testingcenter.web.unc.edu/.

Learning Center

Want to get the most out of this course or others this semester? Visit UNC's Learning Center at http://learningcenter.unc.edu to make an appointment or register for an event. Their free, popular programs will help you optimize your academic performance. Try academic coaching, peer tutoring, STEM support, ADHD/LD services, workshops and study camps, or review tips and tools available on the website.

Writing Center

For free feedback on any course writing projects, check out UNC's Writing Center. Writing Center coaches can assist with any writing project, including multimedia projects and application essays, at any stage of the writing process. You don't even need a draft to come visit. To schedule a 45-minute appointment, review quick tips, or request written feedback online, visit http://writingcenter.unc.edu.

Grade Appeal Process

If you feel you have been awarded an incorrect grade, please discuss with me. If we cannot resolve the issue, you may talk to our departmental director of undergraduate studies or appeal the grade through a formal university process based on arithmetic/clerical error, arbitrariness, discrimination, harassment, or personal malice. To learn more, go to the Academic Advising Program website.