

ENV 4386 Remote Sensing
Baylor University
Department of Environmental Science
Semester: Fall 2026

Meeting Times: Once weekly, 2 hours 45 minutes (Thursdays 2pm-445pm)

Location: [E414 and D405]

Instructor: Dr. Erich Seamon

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Office: BSB C423

Office Hours: 10am-noon MW or by appointment

Course Description

This course provides a rigorous introduction to satellite remote sensing with an emphasis on environmental monitoring and climate change applications. The course integrates the physical foundations of remote sensing (radiative transfer, spectral behavior, atmospheric effects, and thermal emission) with applied geospatial workflows using ArcGIS Pro and Python.

The first portion of the course develops the scientific principles underlying remote sensing, including electromagnetic energy interactions with the Earth's surface and atmosphere, radiative transfer, spectral behavior of common surface materials, atmospheric correction, sensor and platform tradeoffs, and quantitative interpretation of reflectance and temperature products. Students will learn how remote sensing systems gather environmental data from a distance and how those data are converted into meaningful measurements of land, water, vegetation, climate, and atmospheric features.

The second portion of the course focuses on applied environmental and climate applications. Topics include vegetation dynamics and drought monitoring, urban heat islands and land surface temperature, land cover classification and change detection, wildfire and disturbance mapping, water resources and cryosphere monitoring, radar/SAR applications, and the use of remote sensing products in environmental assessment and decision-making.

Emphasis is placed on physically meaningful interpretation, reproducible workflows, hands-on labs, clear visualization, and professional communication of results through maps, figures, short technical reports, and a final remote sensing project.

Learning Outcomes

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

- Explain and apply core remote sensing principles, including electromagnetic radiation, radiative transfer, and atmospheric effects.
- Interpret spectral signatures and the physical meaning of reflectance and emissivity for common Earth surface materials.
- Convert digital numbers to radiance, reflectance, and surface temperature where applicable, and describe key sources of uncertainty.

- Compute and interpret vegetation and water indices (e.g., NDVI, NDWI) and relate patterns to environmental processes and climate variability.
- Derive land surface temperature products and analyze urban heat island patterns in relation to land cover and climate risk.
- Perform supervised classification and accuracy assessment, and conduct land cover change detection with climate-relevant interpretation.
- Integrate ArcGIS Pro and Python workflows for raster processing, reproducible analysis, and visualization.
- Design and complete a remote sensing analysis project and communicate results with professional-quality maps and a written report.

Course Level and Expectations

This is a medium-advanced remote sensing course intended for:

- Advanced undergraduates who have completed at least one introductory GIS course and a basic statistics course.
- Graduate students who have completed at least one GIS course and have some prior experience in a scripting language.
- Students interested in environmental monitoring, climate change, and geospatial data science.

The course is designed to be challenging but manageable with appropriate effort. Because the class meets once weekly for a 2 hour and 45 minute block, each meeting will combine lecture, guided demonstration, discussion, and lab-oriented work time. Students are expected to stay current with readings, complete short preparation tasks, and make steady progress on lab projects between class meetings.

Labs are organized as four major projects spread across the semester. Each lab is introduced during a full class session with a guided walkthrough, then completed over the subsequent 3–4 weeks. Most labs will be scaffolded: students will receive starter code and example workflows, with an emphasis on editing, running, and interpreting scripts rather than building everything from scratch.

Undergraduate students are expected to: (1) stay current with readings and lab milestones, (2) develop working competence in core tools (ArcGIS Pro and Python), and (3) demonstrate they can interpret and communicate results from remote sensing analyses. Graduate students will be expected to engage more deeply in interpretation, uncertainty, and methodological justification, with optional extensions available in each lab.

Required Texts and Resources

- Chuvieco, E. *Fundamentals of Satellite Remote Sensing: An Environmental Approach*. (4th edition). CRC Press.

- Additional articles, tutorials, and documentation will be assigned and provided via Canvas.
- Software: ArcGIS Pro; Python (Anaconda recommended). Optional tools may include QGIS and Google Earth Engine.
- Course materials (labs/code, data) will be provided for download on Canvas. Students can use lab computers or their own laptops.

Assessment and Grading

Assessment and Grading		
Lab 1	Vegetation indices & climate variability	15 pts
Lab2	Urban heat island & land surface temperature	20 pts
Midterm	Midterm Exam	20 pts
Lab 3	Land cover change and carbon implications	20 pts
Lab 4	Climate Monitoring Final Project (paper and presentation)	20 pts
	Participation and Engagement	5 pts
	Totals	100 pts

Class Schedule

Date	Day	Topic / Notes	Due
Aug 24, 2026	Mon	Course overview; introductions; remote sensing as environmental measurement; electromagnetic spectrum basics.	
Aug 31, 2026	Mon	Radiative transfer; atmospheric scattering/absorption; TOA vs surface reflectance; climate relevance of aerosols.	
Sep 07, 2026	Mon	Sensors and platforms; spatial/spectral/temporal resolution; Landsat/Sentinel/MODIS; spectral signatures.	
Sep 14, 2026	Mon	Vegetation spectral behavior; indices (NDVI/EVI/SAVI); drought monitoring and anomalies.	
Sep 21, 2026	Mon	LAB 1: Vegetation indices & climate variability (ArcGIS and Python walkthrough; project kickoff).	
Sep 28, 2026	Mon	Thermal remote sensing fundamentals; Planck's Law; emissivity; surface energy balance.	
Oct 05, 2026	Mon	Land Surface Temperature retrieval; urban heat islands; uncertainty and interpretation.	LAB 1 Due (start of class)
Oct 12, 2026	Mon	LAB 2: Urban Heat Island & LST analysis (ArcGIS and Python walkthrough; project kickoff).	
Oct 19, 2026	Mon	Image classification; training data; supervised vs unsupervised; accuracy assessment.	
Oct 26, 2026	Mon	Machine learning classification (Random Forest); change detection concepts; land cover and climate forcing.	LAB 2 Due (start of class)
Nov 02, 2026	Mon	LAB 3: Land cover change & carbon implications (classification and change detection walkthrough).	

Nov 09, 2026	Mon	Water resources remote sensing; NDWI; snow/ice monitoring; climate feedbacks (albedo).	
Nov 16, 2026	Mon	Radar remote sensing (SAR) basics; flood mapping; soil moisture; applications in hazards and climate.	LAB 3 Due (start of class)
Nov 23, 2026	Mon	Thanksgiving Break – No Class	
Nov 30, 2026	Mon	LAB 4: Climate Monitoring Final Project workshop (topic selection; time series; trend/anomaly framing).	
Dec 07, 2026	Mon	Student project presentations; course wrap-up; remote sensing in climate assessment and decision-making.	LAB 4 Due (start of class)

Key Course Policies

Detailed Baylor University policies on academic integrity, accommodations, attendance, and other matters will be provided in the official syllabus on Canvas and follow current Baylor guidelines. Highlights include:

- **Academic Integrity:** All work must adhere to Baylor’s policies on academic honesty. Plagiarism or other forms of academic misconduct will not be tolerated.
- **Accessibility and Accommodations:** Students requiring accommodations should contact the Office of Access and Learning Accommodation (OALA) and inform the instructor early in the semester.
- **Attendance and Participation:** Because this course meets once weekly and includes multi-week lab projects, regular attendance and active participation are essential for success.
- **Technology and Computing:** Students are responsible for maintaining access to required software (ArcGIS Pro and Python) and for backing up their work.

Academic Integrity

Plagiarism or any form of cheating involves a breach of student-teacher trust. This means that any work submitted under your name is expected to be your own, neither composed by anyone else as a whole or in part, nor handed over to another person for complete or partial revision. Be sure to document all ideas that are not your own. In addition, you must not provide course materials to other students, whether individually or generally (such as online) that would enable them to gain an unfair academic advantage. I expect you, as a Baylor student, to be intimately familiar with the Honor Code. Instances of plagiarism or any other act of academic dishonesty will be reported to Office of Academic Integrity and may result in failure of the course. Such instances may be referred to the Honor Council for action.

Artificial Intelligence Usage

This course recognizes that generative AI tools (e.g., ChatGPT, Copilot, Gemini) are increasingly used in academic and professional settings. You may use AI as a learning aid to brainstorm, outline, debug code, clarify concepts, or improve clarity of writing, but you may not use AI to replace your own thinking or submit AI-generated work as if it were your own.

Allowed uses (with disclosure)

- Brainstorming topics, refining research questions, outlining
- Explaining concepts you already encountered in class/readings
- Debugging code or troubleshooting workflows (you must understand and explain the final solution)
- Editing for clarity/grammar

Not allowed (academic misconduct)

- Submitting AI-generated text, code, analyses, figures, or answers as your original work
- Using AI to complete lab reports
- Having AI construct sources, citations, data, quotes, or results
- Uploading restricted course materials (lab materials/code, lectures) into AI tools

Disclosure requirement

For any assignment where AI is used, include a short “AI Use Note” at the end:

- Tool(s) used (name/version if relevant)
- What you used it for (1 to 3 sentences)
- What you changed and/or verified yourself

Example: “I used ChatGPT to brainstorm an outline and to help debug a Python script. I rewrote the final code and verified the outputs by reproducing results and adding comments.”

Responsibility

You are responsible for the accuracy, originality, and integrity of everything you submit. If you cannot explain your submission, it will be treated as not your work.

Accommodations

Any student who needs academic accommodations related to a documented disability should inform me immediately at the beginning of the semester. You are required to obtain appropriate documentation and information regarding your accommodations from the Office of Access and Learning Accommodation (OALA). OALA is in the basement level of the east wing of the Sid Richardson building (reachable via elevator or stairs). They can also be reached by phone (254) 710-3605 or email OALA@baylor.edu.

Success Center

We want every student who has been admitted to Baylor to be successful, and I want to partner with you to help you thrive academically. Be sure to take advantage of the many resources available for academic success, including coming to see me during my office hours. Students who regularly utilize the great resources in the Paul L. Foster Success Center such as tutoring, Learning Lab, and Academic Mentoring are among my most successful students. If your academic performance in this class is substandard, I will submit an Academic Progress Report to the Success Center so that the team of coordinated care professionals can ensure that you get the help you need.

Classroom Community

Everyone deserves to be treated with respect and dignity in this classroom space: students, teaching assistants, instructors, and guests. Baylor's Code of Ethics (BU-PP 024) states, "Members of the Baylor University community are expected to act in a way that builds a distinctive sense of caring, kindness, mutual respect, collegiality, and fairness. The idea that the Baylor community is a family has always been vital in our historical traditions, and we here reaffirm our commitment to that idea. Out of respect for this community, we do not slander or defame." Incivility, unkindness, and aggression have no place in our classroom community.

Crisis and Emergency Numbers:

- Counseling Center Crisis Line: (254) 710-2467 (Business Hours/Non-Business Hours/Weekends)
- Baylor Police Department: (254) 710-2222
- MHMR Crisis Center: (254) 867-6550
- MHMR 24-Hour Emergency/Crisis Number: (254) 752-3451
- When home during academic breaks, when the counseling center is closed, please call your local resources and/or national hotlines:
 - National Hope Network Hotline: 1-800-SUICIDE (1-800-784-2433)
 - National Suicide Prevention Lifeline: 1-800-273-TALK (1-800-273-8255)

Sexual and Interpersonal Misconduct Policy and Civil Rights Policy

Baylor University does not tolerate unlawful harassment or discrimination on the basis of sex, gender, race, color, disability, national origin, ancestry, age, citizenship, genetic information or the refusal to submit to a genetic test, past, current, or prospective service in the uniformed services, or any other characteristic protected under applicable federal, Texas, or local law (collectively referred to as Protected Characteristics). These policies also prohibit discrimination and harassment based on pregnancy or related conditions. If you or someone you know would like help related to an experience involving:

- Sexual assault, sex-based harassment or discrimination, dating violence, domestic violence, stalking, sexual exploitation, or retaliation for reporting one of these types of prohibited conduct, please visit www.baylor.edu/titleix, or contact us at (254) 710-8454, or TitleX_Coordinator@baylor.edu.
- Harassment or discrimination (excluding those issues listed above) based on Protected Characteristics, please visit www.baylor.edu/civilrights, or contact us at (254) 710-8454 or Civil_Rights@baylor.edu.

For pregnancy or related conditions, the University will provide reasonable modifications to policies, practices, or procedures as necessary to ensure equal access to educational programs and activities. Individuals who need to request reasonable modifications should contact the Office of Access and Learning Accommodation. More information on pregnancy and parenting resources can be found [here](#).

The Equity, Civil Rights, and Title IX Office understands the sensitive nature of these situations and can provide information about available on- and off-campus resources, such as counseling and psychological services, medical treatment, academic support, university housing, and other forms of assistance that may be available. Staff members at the office can also explain your rights and procedural options. You will not be required to share your experience. If you or someone you know feels unsafe or may be in imminent danger, please call the Baylor Police Department (254-710-2222) or Waco Police Department (9-1-1) immediately.

Except for Confidential Resources, all University Employees are designated Responsible Employees and thereby mandatory reporters of potential sexual interpersonal misconduct violations. Confidential Resources who do not have to report include those working in the Counseling Center, Health Center, Athletics Mental Health, and Baylor Psychology Clinic, and the University Chaplain and LHSON Chaplain.

First-Generation Students

Baylor University defines a first-generation college student as a student whose parents did not complete a four-year college degree. The First in Line program is a support office for first-generation college students to utilize if they have any questions or concerns. Please check out First in Line, visit us in Sid Richardson, or email firstinline@baylor.edu.

Military-Connected Students

Veterans, active-duty military personnel, and dependents are encouraged to connect with the VET program, a space dedicated to supporting our military-connected students. Please communicate, in advance, if possible, any special circumstances (e.g., upcoming deployment, drill requirements, disability accommodations).

Mission

The mission of Baylor University is to educate men and women for worldwide leadership and service by integrating academic excellence and Christian commitment within a caring community.

Religious Observances

I am committed to providing a caring environment in which students from diverse religious backgrounds can succeed. Please review all the course requirements for assignments, exams, or attendance expectations that conflict with religious observance and related cultural practices. I ask that you communicate any conflicts to me within the first week of the semester to allow time for us to discuss the conflict and determine any fair and reasonable adjustments to the schedule.

Land Acknowledgement

We respectfully acknowledge that Baylor University in Waco and its original campus in Independence are on the land and territories originally occupied by Indigenous peoples including the Waco and Tawakoni of the Wichita and Affiliated Tribes, the Tonkawa, the Nʌmʌnʌ (Comanche), Karankawa, and Lipan Apache. These Indigenous peoples were

dispossessed of and removed from their lands over centuries by European colonization and American expansionism. In recognition that these Native Nations are the original stewards of Baylor's campus locations, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.