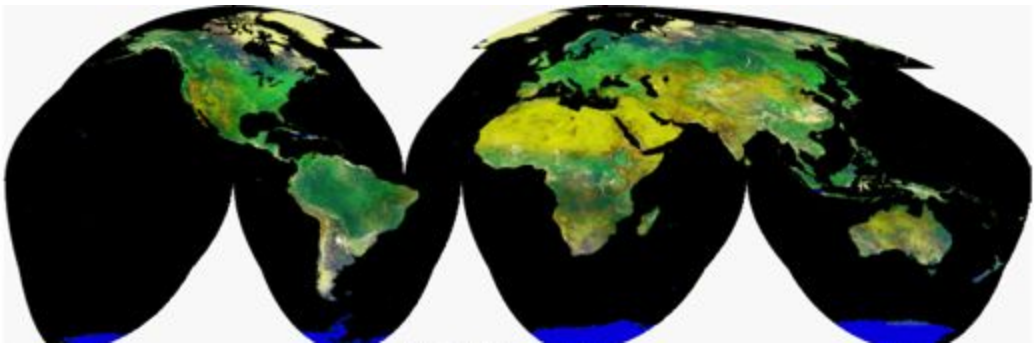
GEOG 362: INTRODUCTION TO REMOTE SENSING



A red± green composite of NDVI's annual range (red) and maximum (green) (Gutman, G., & A. Ignatov 1998).

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Email:
Class time and location: Tuesdays and Thursdays, 3:00 pm–4:30 pm, CARN 109
Office: CARN 110 B
Office hours:
Monday: 4:30 – 5:30
Tuesday & Thursday: 4:30 – 5:00
Friday: 1:00 2:30

COURSE DESCRIPTION AND OBJECTIVES

This course provides an introduction to the use of remotely sensed data for research. Remote sensing is the science of acquiring information about Earth's surface without actual contact with the object or area being analyzed. Remote sensing is increasingly utilized and relied upon to solve complex physical, biological and social issues affecting our interconnected world. Most biophysical applications of remote sensing use instruments carried on satellites. In this course, we will focus on the interpretation and application of data from space-borne imaging systems (eg: Landsat OLI, Landsat ETM, Quickbird, MODIS, AVHRR and SPOT). Focus will be given to the application of remote sensing data to environmental applications. Additional topics could be added in class based on student interest. By the end of this course, students will:

- Understand the basic concepts, analytical methods and software of satellite remote sensing.

- Apply basic remote sensing and image processing techniques to enhance, analyze and extract information from imagery.
- Analyze environmental systems using satellite remote sensing data and the software Erdas Imagine.
- Implement methods presented in peer-reviewed and technical literature and generally be independent researchers and technicians with beginning expertise in remote sensing analysis.

PREREQUISITES

Introduction to GIS (Geog 225 or similar) or consent of instructor.

TEXTBOOK

Jensen, J. 2015. Introductory Digital Image Processing: A Remote Sensing Perspective. 4th Edition. Pearson Publishing. 656 pp.*

* This book is available as an eTextBook (for rent or purchase) for a lower price than the hardcopy edition. A copy will also be available on reserve.

Other Recommended Readings

Jensen, J. 2006. Remote Sensing of the Environment: An Earth Resource Perspective. 2nd Edition. Pearson Publishing. 592 pp.

Campbell, J.B. & Wynne, R.H. 2011. Introduction to Remote Sensing. 5th Edition. The Guilford Press. 667 pp.

COURSE STRUCTURE, RESOURCES, AND ASSIGNMENTS

Structure

The course consists of lectures, class activities and in-class discussions. The concepts learned in class will be then applied during weekly lab sessions using the software system ERDAS IMAGINE. Typically, we will dedicate Tuesday sessions to lecture and Thursdays sessions to lab, but this might change to ensure course success.

Resources

Course materials, including lecture slides, readings and lab manuals, will be made available on Moodle. I will hold regular office hours to discuss questions, issues or concerns about the class in detail. If your schedule conflicts with posted office hours, we can schedule a different meeting time. Outside of class and office hours, email is the best way to contact me. I respond to email as soon as possible, but I mostly respond during work hours (9:00 am to 5:00 pm on weekdays)

Lectures
Students are expected to have done reading assignments before coming to class. In addition to concepts, lectures will include in-class discussions like analyses of remote sensing images. Students should expect to have to do short presentations on various topics, such as remote sensing sensors, project ideas, etc., during lecture time.

Labs
Lab time will be used to demonstrate remote sensing analysis and applications using ERDAS IMAGINE. Lab manuals will be available one week before each class and lab reports are expected the week following a lab session. Most labs will require additional time beyond class. At least one of the labs will include short field visits to collect data in the areas surroundings Saint Paul and Minneapolis. The precise locations will be determined before the start of the semester, but students should expect to have to stay after hours during one or more class periods or have a weekend day available for field work. More details will be available as I define field work locations.
For field work, students will also need approximately 50 MB of data in their smartphones to download and operate a data collecting app. GPS and printer copies of data collecting sheets will be made available for students that do not have smartphones.
Students might use their preferred form of storage for lab material, e.g. Google Drive, flash drives or university provided shared drives.

Research Project
During the semester, students will work on a research project of their choice. The idea of this project is to utilize learned techniques to address a research question that reflects students' personal interests. We will work during the semester to define a good and feasible research question for a semester project, select and acquire the best data (i.e. imagery) to address this question and the best methodological approach. Final results will be presented orally at the end of the semester. Alternative poster format could be considered if students want to present their research elsewhere besides the class.

Exams
Exams (a mid-term and a final) will consist of short answer, essay, image interpretation and applied problem-solving questions. Make-up exams will only be given in the event of illness or emergencies.

GRADING

Assignment	Points

Laboratory Exercises	45%
Midterm Exam	15%
Student Project	20%
Class Activities and Class Participation	8%
Final Exam	12%

Scale Letter	Range
A	93.0% to 100 %
A-	90.0% to < 93.0 %
B+	87.0% to < 90.0 %
B	83.0% to < 87.0 %
B-	80.0% to < 83.0 %
C+	77.0% to < 80.0 %
C	73.0% to < 77.0 %
C-	70.0% to < 73.0 %
D+	67.0% to < 70.0 %
D	63.0% to < 67.0 %
D-	60.0% to < 63.0 %
F	0.0% to < 60.0 %

COURSE POLICIES

Most assignments will be turned in using Moodle. Please note that submission times are defined by Moodle's timestamps, it is your responsibility to ensure that your assignments are correctly submitted. Once an assignment is close in Moodle, you will no longer be able to submit it. Depending on the circumstances, late assignments will be accepted with a 5% drop on the final grade for each 24-hour period that it is late.
Attendance is critical for course success and you are expected to attend class regularly. A maximum of two courtesy absences (with no written excuse provided) will be allowed. Please let me know in advance if you require a flexible attendance accommodation for any reason including attending scientific meetings, planned medical visits or religious observance days.
It is vital that all members of the course respect the time and space of everybody. Come on time and be prepared to be engaged and respectful. Please silence your phones and PDA's in the classroom. You might use electronic devices as tools to improve your learning experience (e.g. translation, note taking, etc.) only. If you are prone to continuously check social media or email, I encourage you to completely avoid using your cell phone during class.

ACADEMIC INTEGRITY

Students are expected to complete and turn in their own work and to follow established academic practices regarding proper use and citation of materials and ideas that are not their own. Engaging in cheating or plagiarism will result in a failing grade in this class. More information is available about Macalester's academic integrity at: https://www.macalester.edu/academicprograms/academicpolicies/academicintegrity/

SUPPORTING STUDENT LEARNING

Disabilities

I am committed to ensuring access to course content for all students, including those with disabilities. If you are encountering barriers to your learning that we can mitigate, please bring them to my attention. I will be happy to work with you to ensure your success in the class. Reasonable accommodations are available for students with documented disabilities. Contact the Disability Services office by emailing disabilityservices@macalester.edu or calling 651-696-6874 to schedule an appointment to discuss your individual needs.
Personalized tutoring, academic support and study skills are available at the Macalester Academic Excellence (MAX) at: https://www.macalester.edu/max/#/0. These resources are there to help you and I encourage you to make good use of them.

Well-Being

Here at Macalester, you are encouraged to make your well-being a priority throughout this semester and your career here. Investing time into taking care of yourself will help you engage more fully in your academic experience. Remember that beyond being a student, you are a human being carrying your own experiences, thoughts, emotions, and identities with you. It is important to acknowledge any stressors you may be facing, which can be mental, emotional, physical, financial, etc., and how they can have an academic impact. I encourage you to remember that you have a body with needs. In the classroom, eat when you are hungry, drink water, use the restroom, and step out if you are upset and need a break. Please do what is necessary so long as it does not impede your or others' ability to be mentally and emotionally present in the course. Outside of the classroom, sleep, moving your body, and connecting with others can be strategies to help you be resilient at Macalester. If you are having difficulties maintaining your well-being, please don't hesitate to contact me and/or find support from other resources on the following page.

TENTATIVE SCHEDULE AND ASSIGNED READINGS FOR LECTURE

Disclaimer: This schedule represents my current plan and objectives. These plans may need to change to enhance learning. Details might be revised before the start of the semester. Also, additional readings (i.e. peer-reviewed articles) might be added.

Date	Topics / Lecture	Lab

Week 1 *Jan 23*	Course Introduction	No lab
Week 2 *Jan 28, 30*	**Lecture:** Remote Sensing History	Lab 1: Image Interpretation & Analysis of Aerial & Satellite Data
Week 3 *Feb 4, 6*	**Lecture:** Electromagnetic Theory and Imagery. Sensors and Resolutions.	Lab 2: Image display and inquire cursor operations
Week 4 *Feb 11, 13*	**Lecture:** Color Models and Composite Imagery.	Lab 3: Image Annotation and Map Composition.
Week 5 *Feb 18, 20*	**Lecture:** Spectral Enhancements and Vegetation Indices. **Activity:** Student Presentation - Sensors, sensors 1-3	Lab 4: Spectral Enhancement: Band Rationing, Image Filtering, Layer Staking and Subsetting.
Week 6 *Feb 25, 27*	**Lecture:** Image transformations and classification analysis. **Activity:** Student Presentation - Sensors, sensors 4-6	Lab 5: Spectral Enhancement: Image Indices and Principle Component Analysis.
Week 7 *Mar 3, 5*	**Lecture:** Classification analysis and training data collection. **Activity:** Student Presentation - Sensors 7-8 Project Proposal Due	Lab 6: Image Classification.
Week 8 *Mar 10, 12*	**Lecture:** Fuzzy Classification Accuracy Assessments **Activity:** Student Presentation - Sensors 9-10 Proposal Peer Reviews Due	MIDTERM EXAM

Mar 17, 19	SPRING BRAKE	
Week 9 *Mar 24, 26*	**Lecture:** Change Detection	Lab 7: Training Samples for Image Classification. * * This lab will be in the field
Week 10 *Mar 31* *Apr 2*	**Activity:** Project Proposals Presentation and Discussion	Lab 8: Supervised Classification and Accuracy Assessment
Week 11 *Apr 7, 9*	Project work	Lab 9: Change Detection and Introduction to Spatial Modeler
Week 12 *Apr 14, 16*	Project work	Lab 10: MODIS Data Products Acquisition and Analysis
Week 13 *Apr 21, 23*	**Lecture:** Landscape Ecology and Remote Sensing Thermal and Hyperspectral Remote Sensing.	Project work MUGS
Week 14 *Apr 28, 30*	**Lecture:** Advanced Classification Approaches and Time Series Analysis. Future directions	STUDENT PRESENTATIONS

Welcome to GEOG 362!