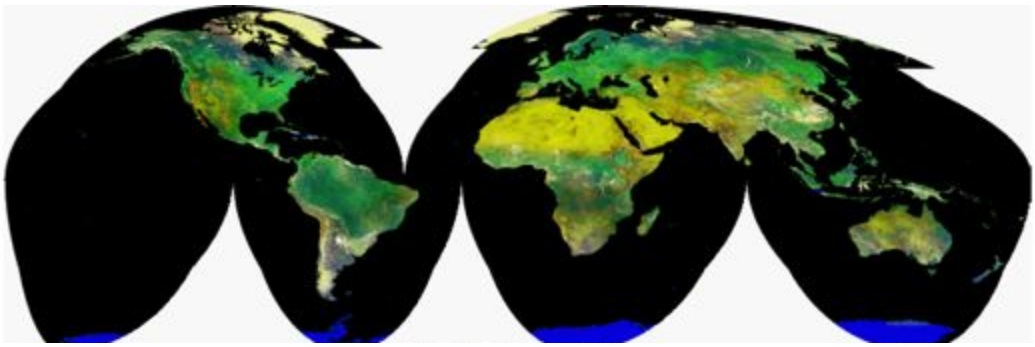
GEOG 362: INTRODUCTION TO REMOTE SENSING



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

Instructor: Xavier Haro-Carrión (he / his / him)
Class time and location: Tuesdays and Thursdays, 3:00 pm–4:30 pm, CARN 109
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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 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	50%
Midterm Exam	12%
Student Project	20%
Class Activities and Class Participation	6%
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

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.

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	Reading
Week 1 *Sep 3, 5*	Course Introduction and Remote Sensing History.	No lab	Ch 1
Week 2 *Sep 10, 12*	Electromagnetic Theory and Imagery. Sensors and Resolutions.	Lab 1: Image Interpretation & Analysis of Aerial & Satellite Data	Ch 2, 6
Week 3 *Sep 17, 19*	Color Models and Composite Imagery. Image Preparation.	Lab 2: Image display and inquire cursor operations	Ch 5
Week 4 *Sep 24, 26*	Spectral Enhancement and Vegetation Indices.	Lab 3: Image Annotation and Map Composition.	Ch 8
Week 5 *Oct 1, 3*	Image transformations and classification analysis.	Lab 4: Geometric Correction.	Ch 8,9
Week 6 *Oct 8, 10*	Classification analysis and training data collection.	Lab 5: Training Samples for Image Classification. * * This lab will be in the field	Ch 9

Week 7 *Oct 15, 17*	Course Mid-term evaluations	Lab 6: Spectral Enhancement: Band Rationing, Image Filtering, Layer Staking and Subsetting.	
Week 8 *Oct 22*	MIDTERM EXAM	No lab	
Week 9 *Oct 29, 31*	Change Detection and Accuracy Assessments	Lab 7: Spectral Enhancement: Image Indices and Principle Component Analysis.	Ch 12,13
Week 10 *Nov 5, 7*	Advanced Classification Approaches and Time Series Analysis	Lab 8: Image Classification.	Ch 10
Week 11 *Nov 12, 14*	Landscape Ecology and Remote Sensing	Lab 9: Supervised Classification and Accuracy Assessment	Ch 8
Week 12 *Nov 19, 21*	Thermal and Hyperspectral Remote Sensing.	Lab 10: Change Detection and Introduction to Spatial Modeler	Ch 11
Week 13 *Nov 26*	Project work	No lab	
Week 14 *Dec 3, 5*	Cloud Platforms: Remote Sensing in Google Earth Engine. Future directions* * Combined lab/lecture	Project work Lab 11: MODIS Data Products Acquisition and Analysis	
Week 15 *Dec 10*	STUDENT PRESENTATIONS	No lab	

Welcome to GEOG 362!