EARS (1)65/GEOG 51: Remote Sensing
Winter 2015

Updated: January 26, 2015

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Teaching Assistant: Evan Dethier, Evan.N.Dethier.GR@dartmouth.edu
Class Meeting Time: 10A: Tuesdays & Thursdays, 10:00 - 11:50, Labs Wednesday or Thursday 13:00-16:00 in Fairchild 013 (Rahr lab).
Office Hours: Bob: ??
Class Web Site: http://canvas.dartmouth.edu

Course objectives: The fundamental objective of this course is to introduce you to remote sensing, and to give you the tools you need to incorporate remote sensing methods in your research. I don't aim to make everyone remote sensing experts in 10 weeks (many spend whole careers at it), but rather I hope that by the end of the class you'll have enough knowledge and skill to get you started (some might say just enough to be dangerous), and that you'll be able to identify where to look for further guidance.

To do this, we're going to look at the 3 interconnecting pieces of the puzzle you need to solve if you're going to use remote sensing in your research:

1) Theory and background behind remote sensing methods and technologies. Modern image-processing software makes it easy to crash around enhancing this or that, but without a grounding in the theory, this process is akin to using a pocket calculator with no knowledge of arithmetic; if the calculator tells you that $2\times3 = 5$, how are you to know that you accidentally hit + instead of $\times$?

2) Skills in the technical part of actually manipulating remote sensing data (primarily this means image processing using ERDAS Imagine, but we may work with other data sets which require different methods of approach). This will help you to avoid hitting + instead of $\times$

3) What data are available, how to get them, how to *select* them for your particular project. (it's a bewildering array)... And what operations make sense for a particular purpose.

Prerequisites: One of EARS 1, 2, 5, 6, GEOG 3, or permission of instructor.

Text: **Lillesand, T. M., Kiefer, R. W, and Chipman, J. W.** 2008. *Remote Sensing and Image Interpretation, 6th Ed.*. John Wiley & Sons.

In addition, the following books (or selected chapters) will be held in reserve in Kresge:

Rees, W. G. 2001. *Physical Principles of Remote Sensing.* Cambridge University Press.

Course Requirements and Grading:
In an ideal world, I would prefer not to assign grades and would rather focus on what you have actually learned over the course of this class. This is not an ideal world, however, and we can't avoid graded work. Second best, I think, is grading that reflects our success in achieving the learning outcomes outlined above. So, what is the best way to assess these outcomes?

Problem Sets (Outcome 1- Theory & Principles; **20%** of grade) Problem sets will be distributed to the class throughout the term. They will typically be due in class the following week.

Midterm Exam (Outcome 1- Theory & Principles; **15%** of grade) There will be a written midterm exam in class on Tuesday, February 3.

Labs (Outcome 2- Practical Applications; **30%** of grade) After the first week, we will have weekly labs in the Rahr lab. This is where the practical work of the course will get done.

Final Project (Outcome 3- Appropriate selection and use of data; **25%** of grade) For your final project you will select a problem of interest to you and use your remote sensing knowledge and skills to help answer the question. This is the chance to really try to *use* remote sensing for something useful to you, so I encourage you to take advantage of the opportunity. We will start our thinking about the project early on in the class, and students will make brief presentations of their proposed project in late January. A "progress report" presentation will be made in late February, and final presentations of the project will take place in lieu of a final exam on Tuesday, March 10. Please note that there is a special evening session for presentations on that day, from 19:00 to 21:30- plan to attend and let me know asap if this causes a problem for you. Several class periods and two lab periods near the end of the quarter will be devoted to working on projects; though you will have access to the Rahr lab outside these times, the lab is likely to be very busy near the end of the quarter, and these will be times dedicated to the EARS/GEOG 65 class.

Class participation (**10%**) What I call your "oomph" grade. This will include attending lectures, participating in class discussion, asking questions, promoting class interaction, and participating in group work.

Late work: There are many items in this class that need to be handed in (the labs in particular). In order to keep everything on schedule, I would like you to be sure to hand things on time. If you anticipate difficulty completing an assignment on time, please *contact me or Evan* as early as possible to make arrangements. In the absence of prior arrangements, late work will be penalized 10% per day.

Academic Honor Principle: You should be aware of and conform to the Dartmouth Honor Code as expressed in the ORC. In terms of this course, this means:

Exams: All work is your own. You should not assist or receive assistance from any other student. No crib sheets, notes, or other materials allowed unless explicitly permitted.

Labs, Problems and Projects: All written work that is handed in is your own. You are permitted (and encouraged!) to discuss the problems with your peers and to work together towards the solutions, but you must write up your solutions using your own words.

If you are unsure, please ask about how the Honor Principle specifically applies to this course.

Learning Disabilities: Students with disabilities enrolled in this course and who may need disability-related classroom accommodations are encouraged to make an appointment to see me before the end of the second week of the term. All discussions will remain confidential although the Student Accessibility Services Office may be consulted to discuss appropriate implementation of any accommodation requested.

Religious Observances: Some students may wish to take part in religious observances that occur during this academic term. If you have a religious observance that conflicts with your participation in the course, please meet with me before the end of the second week of the term to discuss appropriate accommodations.

Course Outline (Tentative):

Fundamentals and theory

Week 1

[**6 Jan (Tu)**] 1) Course mechanics, What is remote sensing? Types of remote sensing. Overview of the remote sensing process.

[**8 Jan (Th)**] 2) Key concepts. What Google Earth does and doesn't do compared to "real" remote sensing. Electromagnetic energy. Reading: **L, K, & C** sections 1.1 through 1.2

Week 2

[**13 Jan (Tu)**] 3) Propagation through the atmosphere. Interaction with matter. Background for Lab #1. Reading: **L, K, & C** sections 1.3 through 1.5

Remote sensing systems

[**15 Jan (Th)**] 4) Data acquisition. Reference data. GPS and positioning. Reading: **L, K, & C** sections 1.6 & 1.7.

[**Jan 14 / 15**] Lab 1 - Intro to ERDAS.

Week 3

[**20 Jan (Tu)**] 5) Aerial photography. Film- and digital-based systems. Aerial photography methods and techniques. Reading: **L, K, & C** sections 2.1 through 2.7

[**22 Jan (Th)**] 6) Photogrammetry. Geometry of the photogrammetry system, simple measurements from vertical aerial photography. Reading: **L, K, & C** sections 3.1 to 3.8

[**Jan 21 / 22**] Lab 2 - Digital image enhancement.

Week 4

[**27 Jan (Tu)**] 7) Photogrammetry continued. Determining relief using stereo pairs. Multispectral sensors. Prep for lab #3. Reading: **L, K, & C** sections 5.1 through 5.7

[**29 Jan (Th)**] 8) Multispectral sensors, finishing up photogrammetry, prep for lab 4.

[Jan 28 / 29] Lab 3 - Image classification

Week 5
[3 Feb (Tu)] Midterm Exam
[5 Feb (Th)] 9) Guest lecture **doubleheader**: James Deirich, Dartmouth Geography Neukom Scholar, and Jonathan Chipman, Dartmouth Applied Spatial Analysis lab.
[Feb 4 / 5] Lab 4 - Image georeferencing and change detection

Data availability and case studies

Week 6
[10 Feb (Tu)] 10) The Landsat Program. Prep for lab 5. Reading: Skim **L, K, & C** chapter 6, with particular attention to sections 6.3, 6.11, and 6.16
[12 Feb (Th)] 11) Passive microwave remote sensing. Thermal-IR and Hyperspectral remote sensing. **in class demo- Thermal IR imager**. Reading: **L, K, & C** sections sections 5.8 through 5.15 **Project proposals in class- ∼ 5-10 minutes each**.
[Feb 11 / 12] Lab 5- Hyperspectral imagery and Spectral Mixture analysis.

Week 7
[17 Feb (Tu)] 12) Synthetic Aperture Radar. Reading: **L, K, & C** sections 8.1 through 8.5, & 8.22 . Prep for lab 6.
[19 Feb (Th)] 13) Guest lecture: Evan Dethier, EARS. Ground-based Lidar.
[Feb 18 / 19] Lab 6 - Lidar and radar data analysis.

Week 8
[24 Feb (Tu)] 14) Ranging systems. Radar and Laser Altimetry. Reading: **Rees** ch 8 (on reserve in Kresge) **Project progress reports in class- ∼ 5-10 minutes each**
[26 Feb (Th)] Work on Projects
[Feb 25 / 26] Work on Projects.

Week 9
[3 Mar (Tu)] 15) Guest lecture **doubleheader**: Blaine Morriss, CRREL, and Kristin Schild, EARS.
[5 Mar (Th)] Work on Projects.
[Mar 4 / Mar 5] Work on Projects.

Week 10
[10 Mar (Tu)] Final Project Presentations in class, and **special evening session, 7:00 – 9:30pm**

No Final