The Earth from Above

Introduction to Environmental Remote Sensing

Lectures: Tuesday, Thursday 2:30-3:45 pm, Humanities room 1111

Labs: Wednesday 1:10-2:40 pm and 2:55-4:25 pm, Science Hall room 380

Professor: Annemarie Schneider

Office: SAGE, Enzyme Institute, 1710 University Avenue, room 206

Office hours: Friday 2:00-3:00 pm, or by appointment

Email: aschneider4@wisc.edu

Teaching assistant: Konrad Turlej

Office: Forest & Wildlife Ecology, Russell Labs, 1630 Linden Drive, room 120

Office hours: By appointment

Email: turlej@wisc.edu

Class website:
http://landcoverchange.com/home/courses/introduction_remote_sensing (password required)

Course objectives and overview

The objective of this course is to provide an overall introduction to the Earth as viewed from above, focusing primarily on the use of aerial photography and satellite imagery to study the environment. The intent is to learn how to use these types of data to study issues related to environmental science, geography, earth sciences, forestry and resource management. The synoptic perspective of aerial and satellite remote sensing proves ideal for studying the spatial patterns of surface phenomena and for making maps of surface features. Currently, one of the most exciting uses of remote sensing is to monitor environmental change.

The course covers a wide range of related topics which can be divided primarily into four categories. First, we will pursue a basic understanding of the **physical processes** involved in remote sensing. The key topics here are the nature and properties of electromagnetic radiation and how it is affected by interactions with the atmosphere and the Earth's surface. Second, we will learn about the many **data types** used in remote sensing. There is now a wide variety of sensing capabilities in the optical, thermal, and microwave portions of the electromagnetic spectrum from a wide range of airborne and satellite platforms. The recent launch of several high resolution satellite systems and the advent of readily available data sources such as Google Earth make this a very dynamic

and exciting period for remote sensing.

The motivation for remote sensing is **applications**, or how we can use remote measurements for purposes such as forest inventory, water resource management, agricultural assessment, land use planning, and global change science. Applications will be discussed nearly every day in some context, and some lectures will be devoted to specific examples discussed in detail.

Finally, the fourth topic area is **methods**, or how to analyze images to derive the desired information. More than ever, persons wishing to utilize remotely sensed data require a solid foundation in photo-interpretation methods, photogrammetric techniques, and digitial image processing. The intersection of remote sensing with geographic information systems (GIS) means that interpretation, analysis, and measurement are now routinely conducted across multiple software platforms and web applications, and often in conjunction with other data sources.

Students who successfully complete this course may wish to build on this skill set by taking the advanced, graduate-level course **EnvSt 556 Digital Image Processing for Environmental Sensing** (offered every other spring), followed by **EnvSt 956 Advanced Environmental Remote Sensing**.

Required and recommended text

Remote Sensing of the Environment: An Earth Resource Perspective, John Jensen, 2006, Prentice Hall (required)

Introductory Digital Image Processing: A Remote Sensing Perspective, John Jensen, 2004, Prentice Hall (extra)

Copies of the required text are on reserve at the Geography Library and the Steenbock Library. Supplemental readings will be provided in digital format via the class website.

Additional resources

Google Earth Pro available for download at http://earth.google.com (strongly recommended).

ArcGIS student licenses are available upon request.

ENVI student licenses can be purchased for $195 from Harris Geospatial:
https://harrisgeospatial.com/Portals/0/pdfs/Student_Edition_DataSheet.pdf

Code of conduct

Please be on time to both lecture and lab. Turn off all cell phones, ipads, etc. during lecture, lab, and when you attend office hours. If using a laptop, no email, instant messaging, or social media will be allowed during class. No cheating or plagiarism will be tolerated, and will be treated according to the UW academic misconduct guidelines.

Grading

homework and labs	40%
midterm exam	20%
final exam	35%
attendance, participation, quizzes	5%

Grading scale

91-100	A
81-90	B
71-80	C
61-70	D
<60	F

Note that undergraduate and graduate students will be graded on separate curves according to the grade scale above. Cart-GIS certificate students will be graded on the graduate student scale.

There will be approximately twelve lab assignments during the semester. Discussing your assignments with classmates and even helping each other in the lab is fine and to be encouraged. However, all materials submitted for completion of the assignments must be your own work and must be based on your own analysis.

Topics

The basics:

- Introduction to remote sensing
- Aerial photographs, stereoscopy
- Photo-interpretation
- Photo scale and image resolution
- Distortion, displacement
- Photogrammetry
- Electromagnetic energy
- Panchromatic and multispectral optical imagery
- Digital image enhancement
- Image transforms
- Vegetation indices
- Classification and pattern recognition
- Map accuracy assessment
- Coarse, medium, and high resolution satellite data
- Data acquisition, download
- Radar imagery
- Change detection
- Spatial information

Applications:

- Agriculture
- Forestry and natural resources
- Urban areas
- Geology
- Archaeology

The new and interesting stuff (including student suggestions!):

- Unmanned aerial vehicles (UAVs, drones)
- Habitat suitability, changes in habitat due to climate change
- Lidar imagery
- Forest disease and pest monitoring
- Glacial change
- Dams and associated landscape change
- Tracking human migration

Important dates:

September 13 – first day of lab
October 31 – midterm exam
December 14 – last day of class
December 15 – final exam