Duke | NICHOLAS SCHOOL of the ENVIRONMENT

ENVIRON 558, L Satellite Remote Sensing for Environmental Analysis

Offered Fall Semesters; 4 credits

Instructor: Jennifer Swenson (jswenson@duke.edu)

Office: LSRC A319 Phone: 919.668.0606

COURSE DESCRIPTION:

Environmental analysis using primarily satellite remote sensing. Theoretical and technical underpinnings of remote sensing (georectification, image analysis, classification) coupled with practical applications (land cover mapping, change analysis, ground truth techniques). Strong emphasis on hands-on processing and analysis. Will include variety of image types: multi-spectral, hyper-spectral, radar and others. Prerequisite: Some GIS experience or consent of instructor.

COURSE OBJECTIVES:

· To develop an understanding of the different techniques that may be utilized in computer processing of remotely sensed data and the characteristics of products obtained;

· To learn various approaches for developing thematic and continuous data products from remotely sensed data, including the use of field data and the impact of different approaches on results;

· To develop an understanding of the characteristics of a variety of sensor systems and understand the different processing approaches suitable for each;

· To develop the capacity to read the remote sensing literature critically.

LAB ASSIGNMENTS & PROJECT: It is assumed that students will work on assignments alone- ideas and approaches can be discussed with others, but you are expected to carry each lab assignment out by yourself and produce your own dataset/results. Many labs will not produce identical results for everyone.

GRADING: 45% of the grade will be made up of ~10 weekly lab reports, 25% will be the Midterm, 25% will be the final class project, and 5% is class participation (primarily literature discussions).

STRUCTURE:

Tuesdays will be for lecture-based material introducing the theme/subject of the week. We will apply these concepts in lab the same afternoon. Thursday's lecture periods will consist of a student-led group discussion of a research paper of a similar/related them or in some cases a guest lecture. Thursday lab time is generally a continuation of the lab started on Tuesday. Lab assignments will be due the following Tuesday, 5pm. The materials in the course are generally structured towards the 2nd year MEM student, and PhD students with GIS background. That said, we encourage first year MEM students with some exposure to GIS to enroll so they can be prepared to use remote sensing for their Master's Projects.

GRADING

Lab reports: 45%
5% participation (article discussions)
Midterm: 25%
Remote sensing class project/paper: 25%

READINGS:

I strongly recommended accessing/purchasing one of the following textbooks for background reading:

Page numbers will be provided in the syllabus for [$95] ***Fundamentals of Satellite Remote Sensing***, Chuvieco & Huete 2010. CRC Press.

For students more focused on vegetation an excellent text is: [$44] **Remote sensing of vegetation : principles, techniques, and applications** Jones & Vaughan

Also see related ebooks/training sites:

[ebooks @ Duke]

Earth observation of ecosystem services Alcaraz-Segura et al.

Scale issues in remote sensing Qihao Weng

Encyclopedia of Remote Sensing Njoku

Canadian online Remote Sensing Tutorial

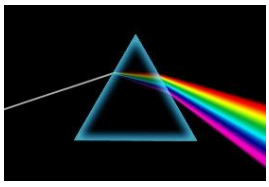
In addition to weekly reading from a text book, a set of additional readings (peer reviewed scholarly journals and reports) derived from multiple sources will be provided via electronic reserves through Blackboard. You should complete assigned readings prior to class in order to make the most of lecture and lab sessions.

The main resources are denoted in the syllabus as:

- **C&H** (Chuvieco & Huete)
- Articles denoted by author's last name and year. e.g. **Song (2001)**

SCHEDULE (typical example)

Week 1 ***Introduction to RS, Electromagnetic Radiation (EMR), Signatures, Satellites***



Readings: C&H :1-20 (skim) ; 21-60 (thorough!)

Discussion article: Tatem 2008

*SHORT HOMEWORK ASSIGNMENT

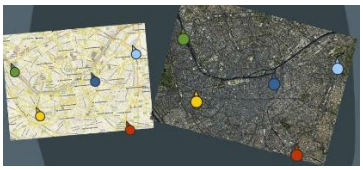
Suggested:

--Wiens_etal_2009_Selecting_lands_biodiveristy conservation_role_of_Remote_Sensing.

--Grossetal_2009_RS_parks_&_protected_areas_RSE

--Canadian Remote Sensing tutorial

--Near-Infrared in Art



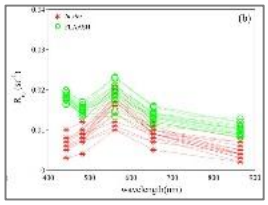
Week 2 Image Geometry, Geometric Correction

Readings: C&H : 63-78 (stop @3.4); 87-111 (skim, start @ sect. 6.6.3); 191-194 (stop@6.6.2); 218-234 (thorough)

Discussion article: Goward et al. 2008. Historical record of Landsat Imagery. PE&RS

Websites: NASA Orbit descriptions NASA Earth observing sats-video

Week 3 Radiometric Correction- multispectral imagery

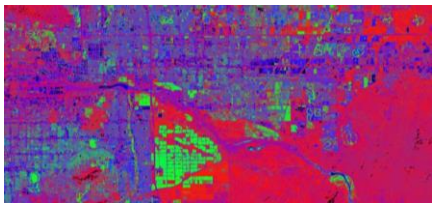


Readings: C&H : 194-218 (stop@6.6.3); review 57-59, read lab!

Chander et al. (2009) skim, focus on landsat 5 & 7

Song et al. (2001) skim 236 – 240; read 241-242

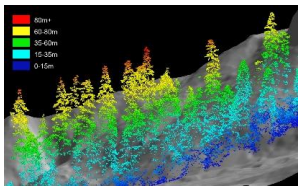
Week 4 Spectral enhancements- multispectral imagery



Readings: C&H : 159-184; 237-264; skim 265-270

Discussion article: Hochburg et a. 2001_Coral Reefs Rodgers 2009_Hurricane

Week 5 Lidar and aboveground carbon estimates



Readings: C&H : sect.3.4.2 : 85-87

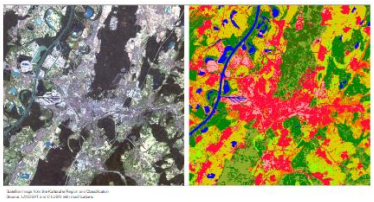
Discussion article: Lefsky et al. 2002 Hladic & Alber 2012

Recommended readings:

Smart et al. 2012 (Lindsey Smart MEM 2009) Discrete return lidar for woodpecker habitat, NC; Ben Riegel (MEM 2012) Timberlake low biomass discrete return lidar; Asner

2009-C stocks in the Amazon; Gonzalez et al. 2010 Discrete return biomass-western USA; Hudak et al. 2009. Lidar acquisition guide for resource managers

Week 6 & 7 Classification, unsupervised, supervised, machine learning



Readings: C&H : 271-301; 305-308

Discussion article: Lowry 2007 (Lowry AA white paper), and Cleve2008

Week 8 Fall Break & Midterm Review

Week 9 MIDTERM & Accuracy Assessment

Midterm: Review Notes

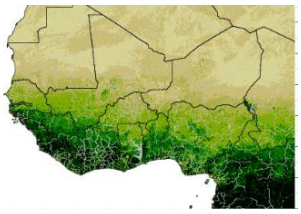
ACCURACY ASSESSMENT LECTURE & Stehman 1998 Reading

Week 10 Change Detection --- multispectral imagery

Readings: C&H: 310-329

Discussion article: Sanchez-Colombia, Hayes 2001

Week 11 MODIS, phenology, and ecosystem modeling



Readings: C&H : review 99-104

Discussion article: Caccamo_etal @2011

Website assignment:

Cruise the following websites and take a look at the many products offered by MODIS: http://modis.gsfc.nasa.gov/data/dataprod/index.php

https://lpdaac.usgs.gov/products/modis_products_table Choose your favorite MODIS product and be prepared to give a 2-3 sentence description of what it is and why it's useful.

Reference article: Running 2004 (Bioscience) GPP w/ MODIS

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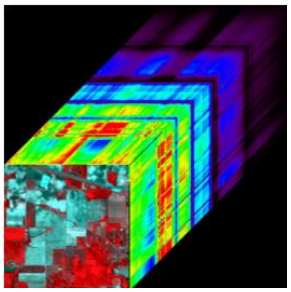
Week 12 RADAR, surface water, biomass

Readings: C&H 78 (3.4) -85, review 106-108

Discussion article:
Pasqulini(read) & Chilson(skim)

Week 13 HyperSpectral



Lecture (T) GuestSpeaker Dr. Sonia Silvestri

Readings:C&H :302-305, review 108-110

Discussion article: Asner&Martin 2009 & Shippert 2004

Optional details

Below are optio
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