Course Title: Global Environmental Remote Sensing

Course Number: MEES698X

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Credits: 3

Classroom: Delivered over IVN

Campuses Offered: IVN based, available at UMCES, UMBC, UMCP. Originating campus: UMCES – AL and/or UMCES – HPL

Times Offered: Fall 2017, Tuesdays and Thursdays, 10:30AM-11:50PM

Prerequisites: Ecological systems *or* Earth & Ocean foundation course

Course Description:
Students will develop the knowledge and skillset necessary to employ remote sensing techniques to better understand ecosystem patterns and processes in terrestrial and aquatic environments. A combination of lectures, assignments, and fieldwork will expose students to the interface of remote sensing, ecosystem analysis, global change, and environmental management.

Expected learning outcomes:
1. Remote Sensing
    a. Understand important characteristics of the electromagnetic spectrum
    b. Understand fundamental concepts in radiation physics
    c. Learn to identify the potential applications of different sensor types
        i. Passive, active, orbital, sub-orbital, hand-held
    d. Learn to interpret reflectance spectra at a range of spectral resolutions.

e. Learn to use relevant field instruments including spectrometers, radiometers, and an optical water column profiler
f. Learn to account for atmospheric effects in remote sensing data
g. Learn basic and advanced optical classification techniques
h. Understand how remote-sensing data is used to assess ecosystem productivity
i. Understand the principles of multivariate transformations
j. Learn the principles of thermal remote sensing

2. Case studies
    a. Learn the central issues and gain the capability to discuss leading research at the intersection of remote sensing and environmental management:
        i. Land-use mapping and change detection
        ii. Nutrient management in agricultural systems
        iii. Water resource management
        iv. Forest/timber management
        v. Coastal management
        vi. Management of thermal effluent

Problem sets and application

There will be 3 to 5 assignments, one oral and the rest written. Written assignments will consist of multiple problems that may or may not require the use of a computer, access and familiarity with at least one programming language appropriate for scientific computations (R, IDL, or Matlab are options). For some topics writing assignments will require students to research reading material outside that assigned in class. The oral assignment will require the student to present one satellite instrument/product developed for aquatic environments (e.g. chlorophyll *a,* sea surface height). Ideally this 30 minute presentation will first explain the theory of the instrumentation/product, then present a published paper where it has been applied. Finally, the course will also include one field trip that will be associated with a science application activity that will include the analysis of field interpretation of multiple types of remote sensing data. This field trip is tentatively scheduled at Horn Point Lab the weekend of the MEES colloquium (September 23, 24th).

Final Project

The final project will be completed individually by each student and will take the form of a short proposal **due at mid-term** followed by a research paper focused on a remote sensing technique required by the proposal. These proposals would respond to a real request for proposals (RFP) issued by NASA to the applied science community. Your proposal could lead to a proposal submission, but more likely will be helpful in structuring research leading to your MSc thesis, or a chapter in your PhD dissertation.

The NASA program called Applied Science: Earth Science for Decision Support Systems (DSS), which includes a subprogram that calls for feasibility studies (see attached RFP). For your final project, we would like you to submit a 2-page abstract for feasibility proposals to enhance an existing decision support system used for environmental management. Decision support systems can be very rudimentary and might currently consist of decisions that are made without significant data and no remote sensing data. Your proposal should outline ways in which remote sensing data could be used to enhance this decision. The RFP contains several areas of possible interest, but you should not feel obliged to stay within these.

Abstracts should be approximately 2 pages long – it is important to learn to write dense, highly informative, yet interest-building proposals. The first two pages of any proposal must capture the imagination and attention of reviewers and also provide a basic overview of the entire proposal. The important elements are to:

(1) Introduce the existing decision making activity and its importance

(2) Describe remote sensing technologies that will be used in the enhancement

(3) Describe how the enhanced DSS will be evaluated (to see if it is better than it was without remote sensing)

Throughout the semester we will discuss project ideas at least once before the abstract due date. This will give you a chance to start thinking about your projects early and voice them to the rest of the class. Ideally we can build discussion around each idea and how it might be implemented. While it is not important to work out every detail of the methods, each proposal abstract should contain enough information to demonstrate that that the methods could work and provide the needed management tools. The NASA Applied Science program (under which this RFP resides) is not interested in building new remote sensing methods. Instead, they are looking for applications of existing methods that have the strong potential to increase the efficiency or accuracy of management decisions.

For the **final project**, we ask that you expand on your abstract and write a research paper describing the strengths and weaknesses of past remote sensing applications in your area of interest. For example, if your proposal abstract describes a method for using remote sensing data to decide how to manage a desert landscape, then your final project will research and discuss the different methods available for measuring features of desert vegetation and soils that are relevant to management. This would include fundamental breakthroughs in the field as well as the most useful sensors and techniques available today. Again, we will set aside time in the course to discuss our ideas with the class so that everyone learns from each other's efforts.

Grading Structure

Assignments	25%
Midterm and Final Exams	35%
Abstract and Final project	40%

Course Reading

The course will rely on scientific publications describing current applications of remote sensing for environmental science and management. Two core texts will be used throughout the course:

Jones, H. G. and Vaughan, R. A. (2010) *Remote Sensing of Vegetation*. Oxford University Press, New York, USA.

Martin, S. (2014) *Introduction to Ocean Remote Sensing*. Cambridge University Press, Cambridge, U. K.