

## **GSE/GEOG-741-S01**

### **Quantitative Remote Sensing for Terrestrial Monitoring**

Mondays: 5-7.50pm      Spring 2009      Wecota Hall, SWC 0100

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Office hours:              Thursday by appointment

#### **Course Description**

Environmental remote sensing systems have evolved significantly over the last two decades fuelled by pressing needs to monitor human impacts on the Earth system and to develop a comprehensive understanding of Earth system functioning. Space agency satellite remote sensing systems are in orbit and planned for launch with associated computing systems to derive biophysical and geophysical data products on a global, systematic basis.

This course describes the science, algorithms, and computational approaches to generate and assess derived satellite products for long term Earth system monitoring. Emphasis is on the principles of optical remote sensing (0.4-14  $\mu\text{m}$ ) and state-of-the-art quantitative algorithms for estimating biophysical and geophysical land surface variables from remotely sensed observations. The course provides insights into how space agencies, and in particular NASA, goes about these tasks.

This is a graduate level course. Understanding of the fundamental principles of remote sensing, physics, calculus, statistics, and computer literacy is required.

#### **Students with Special Needs**

South Dakota State University is committed to providing equal access to University programs and services for all students. Under University policy and federal and state laws, students with documented disabilities are entitled to reasonable accommodations to ensure the student has an equal opportunity to perform in class. If any member of the class has such a disability and needs special academic accommodations, please notify me and make the appropriate arrangements with the Office of Disabilities Services. The ODS is located in Room 145 of Binnewies Hall. To schedule an appointment call (605) 688-4504 and request to speak with Nancy Hartenhoff-Crooks, the Coordinator of Disability Services. Reasonable accommodations may be arranged after the Office of Disabilities Services has verified your situation. Do not hesitate to contact me if any assistance is needed in this process.

#### **Academic Freedom and Responsibility**

Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Student who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should first contact the instructor of the course to initiate a review of the evaluation. If the student remains unsatisfied, the student may contact the department head and/ or dean of the college which offers the class to initiate a review of the evaluation.

## **Cheating and Dishonesty Policy**

The consequences of academic cheating and dishonesty range from any and all plagiarized or compromised assignments, tests, and other forms of evaluations being given zero credit as per offense to a student being given a failing grade for the class in which the offense took place. There is also the possibility that any student who has committed a cheating offense may face disciplinary probation or expulsion from the University. The full policies are found in Chapter 1 of the Student Code (01:10:23:01-1:10:23:04) of the SDSU Student Policies Manual.

## **Requirements and Grading**

Grading will be by continuous assessment:

- Homework will be set at the end of each of the core lectures
  - The homework will pertain mainly to the days lecture material,
  - Some homework will require internet access,
  - One homework only will involve group work,
  - A total of 12 homeworks will be set.
- Students will be asked to provide either (A) printed homework answers/solutions, or (B) digital power point presentations; these must be completed before the next lecture.
- (A) printed homework answers/solutions:
  - Students bring their homework to the next lecture,
  - Printed on 1 to 8 pages of paper (no format restrictions); graphics and computer source code (C, Fortran , R, S) and program output are encouraged when appropriate.
  - The instructor will present the ideal solution to the homework at the beginning of the lecture. The students will then grade their own work (5 minutes) and submit their paper in the lecture to the instructor.
  - Students should print their grade unambiguously on the top right corner of their paper, grading on a numeric scale from 0 to 10.
  - The instructor may re-grade papers.
- (B) digital power point presentations
  - Students email to the instructor their PowerPoint presentations, of a strictly specified maximum length, before 4pm on the day of the next lecture.
  - The instructor will present and grade the presentations at the beginning of the lecture, grading on a numeric scale from 0 to 10.
  - Homework #12 is a group homework, to be presented by one student/group in the last lecture, each group member given the same grade.
- Students must submit at least 10 homeworks (they may submit 10, 11 or 12 homeworks).
- The final course grade will be the mean of the 10 top graded homeworks submitted, with a final grade scored of A, B, C, D, or F.
- Students who do not submit at least 10 homeworks will be given a grade of “F”.
- A minimum grade of “B” is required to complete the Ph.D. program Specialization in *Remote Sensing Geography* (you can retake the course).
- To preserve student anonymity each student will select an Animal name and email it to the instructor, only the instructor and the student will know the student-animal correspondences.

## **Course Schedule** (subject to change)

14 lectures from January 26 – May 4 2009, each about 3 hours long with a 10 minute midway break. All lectures on Monday evenings, 5-7.50pm, except for 2 lectures (March 5 and April 9) that will be held on Thursday evenings because of SDSU vacations.

### **Introduction:**

#### 1) **Monday, January 26**

Why Terrestrial Monitoring ? Why Remote Sensing ? Why Quantitative ?

### **Background:**

#### 2) **Monday, February 2**

First half: Overview of remote sensing

Second half: Space agency systematic satellite remote sensing product generation and distribution

*Homework #1*

#### 3) **Monday, February 9**

Electromagnetic radiation (EMR), radiation terminology and laws

*Homework #2*

(no lecture Monday February 16<sup>th</sup> as President's Day holiday)

#### 4) **Monday, February 23**

Solar Radiation, the optical imaging process, sensor calibration, from radiance to reflectance & brightness temperature

*Homework #3*

#### 5) **Monday, March 2**

EMR interaction in atmosphere, vegetation and soils, radiative transfer

*Homework #4*

### **Remote sensing data pre-processing lectures:**

#### 6) **Thursday, March 5**

Geolocation and geometric correction

*Homework #5*

(no lecture Monday March 9<sup>th</sup> as Spring Break: 9-13<sup>th</sup> March)

#### 6) **Monday, March 16**

Decoupling surface - atmosphere signals, atmospheric correction and cloud screening

*Homework #6*

**Science, algorithms, and computational approaches to generate select standard geophysical and biophysical products from remotely sensed data lectures:**

8) **Monday, March 23**

Reflectance of vegetation and soils, Vegetation indices

*Homework #7*

9) **Monday, March 30**

Lai/FPAR/NPP

*Homework #8*

10) **Monday, April 6**

BRDF/Albedo

*Homework #9*

11) **Thursday, April 9**

Surface temperature

*Homework #10*

(no lecture Monday April 13<sup>th</sup> as Easter Recess 10-13<sup>th</sup> April)

12) **Monday, April 20**

Active Fire and Burned Area

*Homework #11*

**Product evaluation, reporting and dissemination lecture:**

13) **Monday, April 27**

Science Teams, product Quality Assessment and Validation, role of international Networks

*Group homework #12*

**Course summary lecture:**

14) **Monday, May 4**

Lessons learned, Implications for future, Group homework presentations

## **Required Reading**

There is *no* required textbook for this course. There will be recommended readings, listed at the end of each lecture, usually of seminal and recent peer reviewed journal articles.

The following books (listed in no particular order) may be useful:

- *Remote Sensing - The Image Chain Approach*, J.R. Schott
- *Physical Principles of Remote Sensing*, W.G. Rees
- *Remote Sensing – Models and Methods for Image Processing*, R.A. Schowengerdt
- *Remote Sensing Digital Image Analysis*, J. Richards and X. Jia