

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

# **Quantitative Remote Sensing for Terrestrial Monitoring**

Wednesday 2pm to 5pm - Wecota Hall, 0100 (the sunroom, ground floor)

Instructor:	Professor David Roy
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Office hours:	Wednesday 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 who desire an introductory Remote Sensing course that has hands on labs should take the 400/500-level Remote Sensing course *GEOG-484/584* before taking *GSE/GEOG-741-S01*.

### **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 065, the University Student Union. To schedule an appointment call (605) 688-4504 and request to speak with Nancy Hartenhoff-Crooks (or successor), the Coordinator of Disability Services, to privately discuss your specific needs. 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 University has a clear expectation for academic integrity and does not tolerate academic dishonesty. 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. University Policy 2.4 (<http://www.sdstate.edu/sites/default/files/policies/upload/Student-Academic-Integrity-and-Academic-Appeals.pdf>) sets forth the definitions of academic dishonesty. The Policy and its Procedures also set forth how charges of academic dishonesty are handled at the University. Academic Dishonesty is strictly proscribed and if found may result in student discipline up to and including dismissal from the University.

### **Absence Policy**

**Attendance in the lectures is expected — there are no make-up lectures. Please be there !**

Absence due to personal reasons:

Any exceptions to the faculty member's written attendance policy due to verified medical reasons, death of a family members or significant other, or verified extenuating circumstances judged acceptable by the instructor or the Office of Academic Affairs, will be honored. If a student has an accident, falls ill, or suffers some other emergency over which he/she has no control, the student needs to gather whatever documentation is available (e.g., copies of repair or towing bills, accident reports or statements from health care provider) to show the instructor. Such exceptions must be communicated and negotiated between the student and faculty member prior to the absence whenever possible. Absences for vacations or breaks, personal interviews do not constitute a valid reason for absence.

Absence due to approved university-sponsored/recognized trips:

Faculty and administration will honor officially approved absences where individuals are absent in the interest of officially representing the University. Appropriate sanctioned activities include: Collegiate club sports and competitions; Conferences and workshops recognized by the University not related to academics; Commitments on behalf of the University (Students' Association, Band, Choir, etc.); Intercollegiate athletics (refer to page 5 of this document for Student-Athlete Class Attendance Policy); and Professional activities recognized by the University related to academics (professional conference attendance, etc.)

Requests for excused absences must be submitted one week prior to the trip or event. Students must present the completed approved trip absence card to the faculty member prior to the trip or event to have an official excused absence. Faculty members are not required to honor incomplete or late cards.

Students with official excused absences:

Students with excused absences will be given appropriate make up work or instructor-determined equivalent opportunities for obtaining grades as students who were in attendance. Students with official excused absences are not to be penalized in course progress or evaluation. However, should

excused absences be excessive, the faculty member may recommend withdrawal from the course(s) or a grade of incomplete to the student.

Mediation on absence:

Arrangements should be negotiated with faculty members. If this is not possible, the students should go first to the department head, and if necessary, next to the dean. The student may contact the Office of Academic Affairs if conflict cannot be resolved at these levels.

## **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 10 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 2 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.
  - The last homework is a group homework, to be presented by one or two students per group in the last lecture, each group member given the same grade.
- The final course grade will be the mean of the 10 homeworks submitted, with a final grade scored of A, B, C, D, or 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 a **Land 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 after consultation with students)

All lectures on Wednesday afternoon, 2-5pm in the Wecota Hall Sun Room (SWC 0100).

12 lectures from August 31<sup>st</sup> – December 7<sup>th</sup> 2016, each 3 hours long with a 10 minute midway break.

### Introduction

- **Lecture 1**
  - Why Terrestrial Monitoring ? Why Remote Sensing ? Why Quantitative ?

### Background Science & Overview

- **Lecture 2**
  - Electromagnetic radiation, radiation terminology and laws
  - From radiance to reflectance and brightness temperature
- **Lecture 3**
  - EMR interaction in the atmosphere, vegetation and soils

### Remote sensing data pre-processing

- **Lecture 4**
  - Geolocation and geometric correction
- **Lecture 5**
  - Decoupling surface-atmosphere signals, atmospheric correction and cloud screening

Science, algorithms, and computational approaches to generate selected standard geophysical and biophysical products from remotely sensed data

- **Lecture 6**
  - Vegetation indices
- **Lecture 7**
  - Lai/FPAR/NPP
- **Lecture 8**
  - BRDF/Albedo
- **Lecture 9**
  - Surface Temperature
- **Lecture 10**
  - Quality Assessment, Validation & role of international Networks
  - Group project set

### Product Evaluation, reporting and dissemination

- **Lecture 11**
  - Active Fire and Burned Area

### Summary and prospectives

- **Lecture 12**
  - Group project presentations Lessons learned & implications for future

## **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
- *Land remote sensing and global environmental change—NASA's Earth Observing System and the science of ASTER and MODIS*, New York, Springer, Ramachandran, B., Justice, C.O., and Abrams, M.J.

# Calendar for August 2016 (United States)

August						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
			Lecture 1			
28	29	30	31			

Phases of the Moon: 2:● 10:◐ 18:○ 24:◑

Calendar generated on [www.timeanddate.com/calendar](http://www.timeanddate.com/calendar)

# Calendar for September 2016 (United States)

September						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	Lecture 2	15	16	17
18	19	20	Lecture 3	22	23	24
25	26	27	Lecture 4	29	30	
Phases of the Moon: 1:● 9:◐ 16:○ 23:◑ 30:●						
Holidays and Observances: 5: Labor Day						

Calendar generated on [www.timeanddate.com/calendar](http://www.timeanddate.com/calendar)

# Calendar for October 2016 (United States)

October						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	Lecture 5	6	7	8
9	10	11	Lecture 6	12	13	14
16	17	18	Lecture 7	19	20	21
23	24	25	Lecture 8	26	27	28
30	31					

Phases of the Moon: 9:☉ 16:☽ 22:☾ 30:☀

Holidays and Observances: 10: Columbus Day (Most regions), 31: Halloween

# Calendar for November 2016 (United States)

November						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
			Lecture 9			
		1	2	3	4	5
			Lecture 10			
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
			Lecture 11			
27	28	29	30			

Phases of the Moon: 7: 🌑 14: 🌒 21: 🌓 29: 🌕

Holidays and Observances: 8: Election Day, 11: Veterans Day, 24: Thanksgiving Day

Calendar generated on [www.timeanddate.com/calendar](http://www.timeanddate.com/calendar)

# Calendar for December 2016 (United States)

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December

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
			Lecture 12			
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Phases of the Moon: 7:☾ 13:☉ 20:☾ 29:☀

Holidays and Observances: 24: Christmas Eve, 25: Christmas Day, 26: 'Christmas Day' observed, 31: New Year's Eve