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 µm) 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, go 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 Fall 400-level Remote Sensing course GEOG-484-S01 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 145 of Binniewies 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. Students 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 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 Tuesday evenings, 5-7.50pm in the Wecota Hall Sun Room (SWC 0100).

12 lectures from January 14th – April 30th 2013, each 3 hours long with a 10 minute midway break.

Introduction
- **Lecture 1**

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**
  - Active Fire and Burned Area

Product Evaluation, reporting and dissemination
- **Lecture 11**
  - Quality Assessment, Validation & role of international Networks

Summary and prospectives
- **Lecture 12**
  - Lessons learned & implications for future
  - Announcement of grades
### Calendar for January 2013 (United States)

<table>
<thead>
<tr>
<th></th>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Jan</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td><strong>14</strong></td>
<td><strong>Lecture 1</strong></td>
<td>15</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Phases of the moon:** 4 11 18 26

**Holidays and Observances:** 1: New Year's Day, 18: Martin Luther King Day

### Calendar for February 2013 (United States)

<table>
<thead>
<tr>
<th></th>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feb</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1</strong></td>
<td><strong>2</strong></td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td><strong>Lecture 4</strong></td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Phases of the moon:** 3 10 17 24

**Holidays and Observances:** 14: Valentine's Day, 18: Presidents' Day
### Calendar for March 2013 (United States)

<table>
<thead>
<tr>
<th></th>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Week off (Spring Break)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Phases of the moon:** 4, 11, 18, 25

**Holidays and Observances:** 31: Easter Sunday

### Calendar for April 2013 (United States)

<table>
<thead>
<tr>
<th></th>
<th>Sun</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Lecture 10</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Lecture 11</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Group project week</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Week off (ISRSE 2013)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>29</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Lecture 12</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Phases of the moon:** 3, 10, 17, 25
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: