

## **Syllabus**

### **GEO 4984 / 5984 Remote Sensing and Phenology**

Department of Geography

Spring semester 2007

#### **Instructor information:**

Dr. Kirsten de Beurs

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Office: 107 Major Williams Hall

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#### **Course information:**

Course Number: GEO 4984

Title: Remote Sensing and Phenology

Location: McBryde 136

Time: M- W- F: 10:10 – 11: 00 am

Credit hours: 3.0

#### **Office Hours:**

Please email me for an appointment. I am around most of the semester.

#### **Description:**

The study of changes in phenology, and in particular **land surface phenology (LSP)**, **provides an important approach to change detection in terrestrial ecosystems.** Changes in land surface phenology (sometimes called “greenness”) have often been detected as trends in Normalized Difference Vegetation Index (NDVI) products over time. Increases in “greenness” are frequently interpreted as resulting from climate change, in particular warming. Vegetation phenology studies the relation between climate and the timing of biological events such as budburst, leaf-out, and plant flowering. Phenology varies by species and is influenced by many factors, such as soil temperature, air temperature, solar illumination, day length, and soil moisture, all of which can vary depending on location and time.

In this course we will focus on the analysis of land surface phenology. Land surface phenology (LSP) is the study of the spatio-temporal patterns in the vegetated land surface as observed by satellite sensors. Due to the coarse spatial resolution of satellite sensors, LSP deals with mixtures of land covers and thus is distinct from the traditional notion of a species-centric phenology. Land surface phenology metrics are primarily based on image time series of vegetation indices (VI) from optical sensors. The phenological metrics aim to retrieve onset of greening, senescence, timing of the maximum of the growing season, and growing season length based on analysis of the VI curve.

This course is split into a Remote Sensing oriented section and a phenology oriented section.

**Remote Sensing portion:**

- AVHRR sensors
- MODIS sensors and products
- Methods for phenological observations with satellite imagery
- Weather station data and other weather databases

**Phenology portion:**

- Definitions and terms of phenology and seasonality
- Appearance and development of phenology
- Natural laws and models
- Phenology of other life forms
- Phenology of agriculture, higher latitudes, grasslands, and tropical dry climates

*The last couple of weeks of the class will focus on global research applications.*

**Evaluation:**

Attendance at all class meetings is mandatory and will constitute 10% of the overall grade for the course (20 pts). There are 4 quizzes which will together account for 30% of the grade (15 pts each, for a total of 60 pts). The lab assignments will account for 30% of the total grade (60 pts) and the final exam will account for 30% of the total grade.

|                                          |            |             |
|------------------------------------------|------------|-------------|
| Attendance                               | 20         | 10%         |
| Quizzes, 4 × 15 pts                      | 60         | 30%         |
| Lab assignments, 4 × 10 pts + 1 × 20 pts | 60         | 30%         |
| Final Exam                               | 60         | 30%         |
| <b>Total</b>                             | <b>200</b> | <b>100%</b> |

**Grade Assignments:**

| Grade | A   | A-    | B+    | B     | B-    | C+    | C     | C-    | D+    | D-    | D-    | F   |
|-------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
| %     | 93+ | 90-92 | 87-89 | 83-86 | 80-82 | 77-79 | 73-76 | 70-72 | 67-69 | 63-66 | 60-62 | 60- |

*In order to receive an A for the course, all assignments and stated requirements must be completed and handed in on time.*

*I do not discuss any grades in class or by email. Please make an appointment to see me if you are unhappy with your grade for an assignment, quiz or final exam and you want additional clarification.*

**Readings:**

I will provide course readings on Blackboard.

## **Academic Integrity: The Honor Code**

The Honor Code will be strictly enforced in this course, and any suspected violations of the Honor Code will be promptly reported to the Honor System. All assignments submitted shall be considered graded work. Honesty in your academic work is a prerequisite for ethical behavior in your professional life. The Virginia Tech Honor Pledge is: "I have neither given nor received unauthorized assistance on this assignment."

All projects and homework assignments are to be completed individually unless otherwise specified. All printed, Internet, and media sources used in preparing your assignments should be referenced with proper citations to avoid plagiarism, which is serious violation of the honor code. If you have a question on how the Honor Code is applicable to an assignment, please contact me for clarification.

For information on the Virginia Tech Honor Code, see <http://www.honorsystem.vt.edu/> and <http://ghs.grads.vt.edu/>.

## **Special Needs:**

Student with special needs should see me and contact CAEE (231-4133) for assistance.

## **Cheating, Falsification and Plagiarism:**

- Using someone else's words or ideas without proper documentation when *quoting* and *paraphrasing*
- Copying some portion of your text from another source without proper acknowledgement;
- Borrowing another person's specific ideas without documenting the source;
- Turning in work written by someone else;
- Turning in a paper that you wrote for another course or turning in the same paper for more than one course without getting permission from your instructors first; and
- Giving a presentation that you prepared for another course or giving the same presentation for more than one course without getting permission from your instructors first.

## **4984 / 5984 requirements**

- There are extra questions for graduate students in all assignments.
- Graduate students will present results of the group work of assignment 4 and 5.
- There are 2 literature reviews due for graduate students:
  - For assignment 3, I will provide 2 papers for review.
  - Final paper (assignment 5) needs to include a 3 page (minimum of 5 papers) literature review.

## Tentative Course Calendar Lectures

| <i>Data</i>              | <i>Remote Sensing</i>                                        | <i>Phenology</i>                                                  |
|--------------------------|--------------------------------------------------------------|-------------------------------------------------------------------|
| Jan 14 –<br>Jan 16       | Introduction                                                 | Phenology and seasonality: definitions                            |
| Jan 21 –<br>Jan 23       | MLK Holiday                                                  | Appearance and development of phenology in the USA.               |
| Jan 28 –<br>Jan 30       | Introduction Remote Sensing - Review                         | Phenological networks                                             |
| Feb 4 –<br>Feb 6         | AVHRR sensors I + Vegetation indices                         | Quiz (15pts) + Natural laws of phenology, phenological calendars, |
| Feb 11 –<br>Feb 15       | AVHRR sensors II                                             | Growing degree days and phenological models.                      |
| Feb 18 –<br>Feb 20       | Quiz (15pts) + Methods of phenological observation           | Phenology of animals and insects, phenological mismatch           |
| Feb 25 –<br>Feb 27       | Methods of phenological observation                          | Phenological modeling and prediction                              |
| <b>Mar 3 –<br/>Mar 7</b> | <b>Spring Break</b>                                          | <b>Spring Break</b>                                               |
| Mar 10 –<br>Mar 12       | MODIS sensors I                                              | Phenology and agriculture                                         |
| Mar 17 –<br>Mar 19       | MODIS products I + Vegetation indices                        | High latitude climates and phenology                              |
| Mar 24 –<br>Mar 26       | Quiz (15 pts) + MODIS products II                            | Grassland phenology                                               |
| Mar 31 –<br>Apr 2        | Weather databases                                            | Tropical dry climates and phenology                               |
| Apr 7 –<br>Apr 9         | Weather databases                                            | Weather station siting                                            |
| Apr 14 –<br>Apr 16       | Phenological research applications in the USA                | Quiz (15 pts) + Phenological research application in the USA      |
| Apr 21 –<br>Apr 23       | Phenological research applications in Asia and Africa        | Phenological research applications in Asia and Africa             |
| Apr 28 –<br>Apr 30       | Phenological research applications and global climate change | Exam overview                                                     |

## Tentative Course Calendar Labs

| <i>Data</i> | <i>Topic</i>                                                                                                       | <i>Homework<br/>due</i>           |
|-------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Jan 18      | Introduction to ENVI                                                                                               |                                   |
| Jan 25      | IDL and image basics. Different raster types and ENVI headers.                                                     |                                   |
| Feb 1       | Importing vector files, ROI's, image statistics, NAN.                                                              |                                   |
| Feb 8       | Using internet databases to find data (NOAA AVHRR and MODIS).                                                      |                                   |
| Feb 15      | Methods to monitor phenology.                                                                                      |                                   |
| Feb 22      | Start on assignment 1                                                                                              |                                   |
| Feb 29      | Methods to monitor phenology + start assignment 2                                                                  | A1: 10pts                         |
| Mar 7       |                                                                                                                    |                                   |
| Mar 14      | Processing MODIS data in ENVI.                                                                                     | A2: 10pts                         |
| Mar 21      | Calculating satellite image indices based on the MODIS data + start assignment 3.                                  |                                   |
| Mar 28      | Image resizing, layer stacking, projections.                                                                       | A3: 10pts                         |
| Apr 4       | Collect and compile data for Virginia and the Blacksburg region: combine weather data with satellite observations. |                                   |
| Apr 11      | Field measurements                                                                                                 | A4: 10pts                         |
| Apr 18      | Field measurements.                                                                                                |                                   |
| Apr 25      | Graduate students present results of assignment 4 and 5.                                                           | A5: 20pts<br>→ due on<br>exam day |