Geography 577

Environmental Modeling With GIS

University of Wisconsin-Madison

Last UpDate: Sept. 2, 2009

Instructor:
A-Xing Zhu: Office: 255 Science Hall Phone: 262-0272 Email: azhu@wisc.edu

Course Website:
Lecture and lab materials: Learn@UW

Schedule and Location:

Lecture Hours:
Tues. 1:20 p.m. - 3:15 p.m. (444 Science Hall)

Lab Hours:

See *Lab Syllabus*

Office Hours:
Instructor:
Tues. 10:30 a.m. – 11:30 a.m.
Thurs. 1:30 p.m. – 3:30 p.m.
T.A.:
See *Lab Syllabus*

1. Course Description:
This course offers students an opportunity to approach environmental modeling using GIS techniques. The course focuses on the quantification of spatial variation of physical geographic factors which drive environmental processes using GIS techniques. The course covers three major contents: 1) review of key environmental processes (hydrological and ecological processes, such as runoff generation, evapo-transpiration) and their driving physical geographic factors; 2) the GIS techniques for parameterizing the physical landscape for driving environmental processes over large spatial extent; 3) application of environmental modeling with GIS. The lecture part covers Contents 1) and 2) and is done in the form of lecturing. The lectures will focus on the quantification and implementation of some simple hydro-ecological processes in GIS will be examined to illustrate the steps and issues involved in modeling physical processes using GIS. The lab part covers Content 3) which is done through lab exercises and student class projects. During this part some of the common environmental models, such as WetSpa-Extensions (Free University, Belgium, for hydrological processes), Forest-BGC (University of Montana, for hydro-ecological modeling), and SWAT/ BASINS (USDA-ARC/ USEPA, for water quality analysis), will be examined to provide an appreciation of how these models accommodate complex physical processes and to illustrate their respective limitations.

2. Objectives:
The objectives of this course are to provide students with an understanding of the processes and issues associated with environmental modeling using GIS techniques; and to provide students an appreciation of the power and limitations of exiting GIS-based environmental models. It is hoped that with this background students will be able to make an informed use of existing GIS-based environmental modeling.

3. Prerequisites:

Courses in GIS and physical geographic environments

4. Computing Environment and Software:

Most o the work will be done in ArcGIS. Some model specific software or customized software will be used for illustration of concepts.

5. Grading:

5.1 Components:

Exercises 40%
Midterm Exam 25%
Student Projects 35%
Project Plan: 7%
Project Presentation: 8%
Project Paper: 20%

5.2 Grading policy:

Grades of exercises are based on:

1) academic merit of your answers to the questions
2) conciseness of answers. ***NO BEATING AROUND THE BUSH***
3) organization of presentation. No one wants to flip through a messy assignment report looking for answers. Here is a general format for your presentation:

Question:
Your answer and discussion
Your support documents (images, graphs, tables, etc.)

The grade for each of the exercises and examinations is reported as ***points_scored*** / ***total_points_of_exercise***. For example, if an assignment is worth 20 points and your answers score 16 points then you should see ***16/20*** on your marked assignment.

5.3 Due date and time:

Each of the assignments will have a due day clearly written under the title of the assignment. The due time is the beginning of the lab session on the due day. Any assignment that is turned in after the due time on the due day is considered late. As you know, late assignments will receive penalty.

5.4 Penalty for late assignments:

The penalty for a late assignment is based on the number of days late (including weekends). If an assignment is late less than 24 hours, it is considered 1 day late. If an assignment is late less than 48 hours but more than 24 hours, it is considered 2 days late, and so on. Late assignments are penalized 10% per day. Here is the formula for calculating the points of a late assignment:

Points_get = Points_scored - 0.1*num_days_late*Points_scored

The minimum value of *Points_get* is 0. Assignments handed in after the TA has returned the graded assignment to class (usually a week after the due date) will receive ***no points***.

6. Other Important Issues:

This class is always full at the beginning of each semester and there are people waiting to get into the class. Those of you who are registered for this class but fail to show up in the first week of classes (unless I am notified ahead of time!), I will have to remove your name from the class list and make the space available for the people on the waiting list.

Sickness often gets in the way of completing assignments, particularly after a long weekend. If sickness is used as an excuse for turning in an assignment later or missing an examination, we (the

TA and the instructor) need to see a written report from a medical doctor stating your inability to attend class and/or to complete an assignment.

We will certainly give you ample time to complete each assignment. There is no reason for us to be told that the computer is down or the software is not working a day before the assignment is due. This will ***NOT*** be taken as an excuse for a late assignment!

7. Course Materials:

7.1 Recommended Text:

Waring, R.H. and S.W. Running, 1998. *Forest Ecosystem Analysis at Multiple Scales*, Academic Press, San Diego, 370 p.

7.2 Other Environmental Modeling and GIS Oriented:

Beven K.J. and M. J. Kirkby (eds.), 1993. *Channel Network Hydrology*, John Wiley & Sons, New York, 319 p.

Beven, K.J. and I.D. Moore (eds.), 1993. *Terrain Analysis and Distributed Modelling in Hydrology*, John Wiley & Sons, New York, 249 p.

Djokic, Dean (ed.), 2000. *Hydrologic and Hydraulic Modeling Support with Geographic Information Systems*, ESRI Press, Redland, 232 p.

Ehleringer, J.R. and C.B. Field (eds.), 1993. *Scaling Physiological Processes: Leaf to Globe*, Academic Press, San Diego, 388 p.

Goodchild, M.F., B.O. Parks, L.T. Steyaert (eds.), 1993. *Environmental Modelling With GIS*, Oxford University Press, New York, 488 p.

Goodchild, M.F., L.T. Steyaert, B.O. Parks (eds.), 1996. *GIS and Environmental Modelling: Progress and Research Issues*, GIS World, Inc., Fort Collins, 486 p.

Hardisty, J, D.M. Taylor, S.E. Metcalfe, 1993. *Computerised Environmental Modelling: A Practical Introduction Using Excel*, John Wiley & Sons, New York, 204p.

Young, Haines, David Green, and Steven Cousins (eds.), 1994. *Landscape Ecology and GIS*, Taylor & Francis, Bristol, P.A., 300p.

8. Intended Topics and Schedule:

Lecture 01: (Sept. 8)
Introduction to Geography 577 course
The hydrological cycle and its associated processes
Physical Environmental Processes I:
Ecological Process: Photosynthesis

Lecture 02: (Sept. 15)
Physical Environmental Processes II:
Ecological Process: Photosynthesis

Lecture 03: (Sept. 22)
Physical Environmental Processes III:
Geochemical Process: Mineral Processes

Lecture 04: (Sept. 29)
Spatial Data Processing I:
Geo-referencing and Map Transformations

Lecture 05: (Oct. 6)
Spatial Data Processing II:
Digital Terrain Analysis

Lecture 06: (Oct. 13)
Spatial Data Processing III:
Spatial Interpolation I

Lecture 07: (Oct. 20)
Spatial Data Processing:
Spatial Interpolation II

Midterm Exam: (75 minutes) (Oct. 27)

Lecture 08: (Nov. 3)
Student Project**:**
Project Plan

Lecture 09: (Nov. 10)
Student Project:
Implementation

Lecture 10: (Nov. 27)
Student Project:
Implementation

Lecture 11: (Nov. 24)
Student Project:
Implementation

Lecture 12: (Dec. 1)
Student Project:
Implementation

Lecture 13: (Dec. 8)
Student Project:
Result Presentation

Lecture 14: (Dec. 15)
Student Project**:**
Final Report

Project Report (Term Paper) due at 5:00 p.m. on Dec. 15, 2009