Geography 970: Seminar in GIScience

Environmental Modeling with GIS

University of Wisconsin-Madison

Instructor:
A-Xing Zhu
421 Science Hall
Email: axing@geography.wisc.edu
Phone: 262-0272

Meeting Hours:
Wednesdays: 12:30-3:30

Instructor Office Hours:

Tuesdays:	1:15 p.m. - 2:15 p.m.
Thursdays:	1:15 p.m. - 2:15 p.m.

Course Description:

This course offers students an opportunity to approach environmental modeling using GIS techniques. The course focuses on the quantification of physical environmental processes using GIS techniques. The course consists of three components: review of key physical environmental processes (hydrological and ecological processes, such as runoff generation, evapotranspiration, etc.); the implementation (quantification) of these processes in a computer environment; and the GIS techniques for parameterizing the physical landscape for simulating these processes over large spatial extent. The quantification and simulation of physical processes using GIS will be illustrated in two stages. During the first stage, 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. In the second stage, some common environmental models, such as BASINS (USEPA, for watershed and water quality analysis), RHESSys (University of Montana, for hydro-ecological modeling), and WetSpa Extension (Free University, Belgium, for hydrological modeling) will be examined to provide an appreciation of how these models accommodate complex physical processes and to illustrate the limitations of these models.

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.

Format:

Seminar format (consisting of leading discussion and presentation by the instructors and student projects)

Evaluation:

Participation	40%
Attendance	10%
Discussion	10%
Presentation	20%
Student Project	60%

Prerequisites:

Geog 377 and Geog 325 or their respective equivalents.

Text and Readings:

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.

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

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

Other GIS Texts:

Aronoff, Stan. 1989. *Geographic Information systems: A Management Perspective*, WDL Publications, Ottawa, 294pp.

Bernhardsen, Tor, 1992. *Geographic Information Systems*. Longum Park, Norway: Viak IT, 318 p.

Bonham-Carter, Graeme F., 1994. *Geographic Information Systems for Geoscientists*, Pergamon, New York, 398 p.

Burrough, P.A. 1986. *Principles of Geographic Information Systems for Land Resources Assessment*. Walton Street, Oxford OX26DP, Oxford University Press.

Burrough, P.A. and R.A. McDonnell, 1998. *Principles of Geographical Information Systems*, New York, Oxford University Press, 333 p.

Chrisman, Nicholas R., 1997. *Exploring Geographic Information Systems*, John Wiley & Sons, New York.

Clarke, Keith C., 1997. *Getting Started with Geographic Information Systems*. Upper Saddle River, New Jersey: Prentice Hall, 353 p.

Clarke, Keith C. 1990. *Analytical and Computer Cartography*. New York City: John Wiley and Sons, 290 p.

DeMers, M.N., 1997. *Fundamentals of Geographic Information Systems*. New York: John Wiley & Sons, 486 p.

Dent, Borden D. 1990. *Cartography: Thematic Map Design*. Second Edition. Dubuque, IA: Wm. C. Brown Publishers.

Environmental Systems Research Institute, Inc., 1992. *Understanding GIS: The Arc/Info Method*, Environmental Systems Research Institute, Inc., Redlands, CA, USA.

Longley, P.A. et al., 1999. *Geographical information systems: Principles and technical issues*, John Wiley, New York.

Longley, P.A. et al., 1999. *Geographical information systems: Management issues and applications*, John Wiley, New York.

Maguire, D.J, M.F. Goodchild, and D.W. Rhind (eds.). 1991. *Geographic Information Systems: Principles and Applications*.

Monmonier, Mark S. 1982. *Computer Assisted Cartography: Principles and Prospects*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Star, Jeffry; and Estes, John. 1990. *Geographic Information Systems: An Introduction*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Intended Topics:

Introduction to the course
The Change Field of Geography: from Qualitative to Quantitative

Physical Processes
- Hydrological cycle and photosynthesis (conceptual process)
- Hydrological cycle and photosynthesis (Quantification)
- Hydrological cycle and photosynthesis (Parameterization Using GIS)

Case Studies:
- WetSpa Extension
- RHESSys
- BASINS