

## **Simulation Analysis of Forest Ecosystems** (3 credits)

### **FOR 6156**

**Lectures and Discussion:** MWF Period 2 (8:30 to 9:20 AM)  
in Newins Ziegler 112

#### **Instructors:**

Dr. Wendell P. Cropper, Jr.

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Newins-Ziegler 214

Office Hours: After class (9:30—10:30 AM MWF) or by appointment

Dr. Geraldine Klarenberg

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352-273-0792 (office; limited access)

McCarty C 430

Office Hours: Monday 1-3 pm by appointment (see <https://calendly.com/gklarenberg/simulation-of-forest-ecosystems> for scheduling)

**Office Hours:** After class or by appointment. See me for help with programming, homework and projects. Email questions and programs.

#### **Course Description**

This course is designed to explore the conceptual basis, evaluation, implementation, testing, and analysis of forest and tree simulation models. Each student will develop and present a modeling project based on their research or other approved topics.

**Course is Designed For:** Graduate Students

**Prerequisites:** Undergraduate course(s) in ecology, plant physiology. Ability to use Algebra.

#### **Course Resources:**

##### **Books (recommended) :**

Modeling Biological Systems. Principles and Applications.  
J. W. Haefner. 1996. Chapman and Hall, NY. 473 pp.

Python programming books:

Learning Python. Mark Lutz, David Ascher. 1999. O'Reilly and Associates, Inc. 366 pp. OR

How to Think Like a Computer Scientist. Learning with Python. 2002. A.Downey, et. Al. Green Tea Press. Wellesley, Mass. (pdf)

<http://www.freenetpages.co.uk/hp/alan.gauld/>

**Python Programs:** example programs provided that illustrate each topic

### **Web Resources:**

<https://www.anaconda.com/products/individual> Anaconda Python Distribution

<https://winpython.github.io/> WinPython

Juno or Carnets plus for IPad/Iphone

### **Lecture and Discussion Topics:**

#### **Introduction to Modeling.**

What is a model?  
How are models made?  
Testing and Evaluation of models.

Haefner Chapt 1 - 3.  
Jorgensen, S.E. 2008. Overview of the model types available for development of ecological models. Ecol. Model. 215:3-9.  
Caswell, H. 1988. Theory and models in ecology: A different perspective. Ecological Modelling 43:33-44.

#### **Introduction to Python programming.**

complete Python tutorial.  
turn in first problem set program.

#### **Introduction to Matrix Algebra and Matrix Models**

Tree Population modeling  
Forest succession modeling  
Landscape Transition (Markov) modeling

Pinard, M. 1993. Biotropica 25(1):2-14  
Anderson, P.J. and F.E. Putz 2002. For. Ecol. Manage. 170:271-283.

Cropper, W.P. and D. DiResta. 1999. *Ecol. Modelling* 118:1-15.  
Cropper, W.P. and E.L. Loudermilk. 2006. *Ecol. Model.* 198:487-494.  
Dalva, M., et al. 1999. *Ecology* 80(8):2635-2650  
Acevedo, M.F. et al. 1995. *Ecological Applications* 5(4):1040-1055  
Lytle, D.A. and D.M. Merritt 2004. *Ecology* 85:2493-2503.  
Holm et al. 2008. *Biotropica* 40:550-558.  
Haefner Chapter 13

## **Some useful functions.**

Haefner Chapter 4

## **Introduction to Numerical Integration.**

integration error  
Introduction to Stella and Berkeley Madonna  
simulation packages.  
Introduction to Excel spreadsheet for simulation.

Anderson, R.M. et al. 1981. *Nature* 289:765-771  
Ferguson et al. 2003. *Nature* 425:681-685  
Madden, L.V. et al. 2002. *BioScience* 52:65-74  
Earn, D.J.D. 2000. *Science* 287:667-670.  
Hastings, A. 1993. *Annu. Rev. Ecol. Syst.* 24:1-33  
Harwell et al. 1981. *Ecological Modelling* 12:105-131

Haefner Chapter 6

## **Disease Modeling.**

Differential equation models  
Cellular Automata  
Agent-based Individually-Based Models

Ferguson et al. 2006. *Nature* 442:452  
Silk, Matthew J., et al. "Using Social Network Measures in Wildlife  
Disease Ecology, Epidemiology, and Management." *BioScience* 67.3  
(2017): 245-257.

## **Chaos.**

Logistic Map (Difference Equation)  
Lorenz Chaos (Differential equations)  
Matrix population models (Density-Dependent)

Becks et al. 2005. *Nature* 435:1226-1229  
May 1974. *Science* 186:645-647.  
Haefner Chapter 17

## **Gap Phase Individual-Based Succession Models.**

Examples: Jabowa, Linkages

Haefner p. 338

Post, W.M. and J.Pastor. 1996. Climatic Change 34:253-261

Wyckoff, P.H. and J.S. Clark. 2002. Journal of Ecology 90:604-615.

Liu, J. and Ashton. 1995. Forest Ecology and Management 73:157-175.

## **Landscape Modeling.**

Higgins, S.I., et al. 2000. Ecological Applications 10:1833-1848

Fitz, H.C. et al. 1996. Ecological Modelling 88:263-295

Loudermilk, and Cropper. 2007. Can. J. For. Res. 37:2080-2089

Haefner Chapter 15, 16, and 18

## **Modeling Plant Competition.**

Competition and coexistence - the effects of resource transport and supply rates.

Huston M.A., DeAngelis D.L. 1994. Amer. Nat. 144 (6): 954-977.

Loreau, M. 1998. Proc. Natl. Acad. Sci. 95:5632-5636.

Haefner Chapter 14

## **Modeling Soil Nitrogen Dynamics and Decomposition.**

Nitrification

Denitrification

Mineralization

Uptake

Muller, C. Modelling Soil-Biosphere Interactions.

CABI Publishing. Chapt. 2

Gholz et al. 1985. For. Sci. 31:463-478.

Kruys et al. 2002. Ecol. Applications 12:773-781.

Comerford et al. 2006. Can. J. Soil Sci. 86:665-673.

Allison and Martiny. 2008. PNAS 105:11512-11519.

## **Biological Inspired Modeling: Neural Nets and Genetic Algorithms**

Cropper and Anderson 2004. Ecol. Modelling 177:119-127

Cropper and Comerford 2005. Ecol. Modelling 185:271-281

Lek and Guegan. 1999. Ecol. Modelling 120:65-73.

Haefner Chapters 19 and 20

## **Modeling Tree Physiology.**

assimilation  
respiration  
transpiration  
estimation of parameters

van den Berg, M. et al. 2002. Ecol. Mod. 148:233-250.  
Chen, J.M. et al. 1999. Ecol. Mod. 124:99-119.  
Friend, A.D. 2001. Global Ecol. Biog. 10:603-619.  
Wang, Y.-P. et al. 1998. Global Change Biology 4:797-807  
Wang, YP and Jarvis. 1990. Ag. For. Met. 51:257-280.  
Cropper, W.P. and Gholz. 1993. Ecol. Mod. 66:231-249  
Cropper, W.P. 2000. For. Ecol. Man. 126:201-212.

### **Course Requirements:**

Although collaboration is an important part of science, learning modeling techniques is best done individually. No collaboration (except with the instructor) is expected for the weekly problem sets or modeling project.

Problem sets (25%) Due dates will depend on our progress through the topics. Python Programming skills and simulation modeling exercises will be used.

Presentation and leading discussion of published forest modeling paper (25%) Variable due date after the first 3 weeks of class.

Modeling project and oral presentation. A written report describing objectives, significance, model structure, and results and discussion is due on the last day of class (Wed. April 24, 2019). (50%)

Participation is required; discussions of topics, homework, assigned papers and projects are an essential part of this course.

### **Grading Scale:**

93% - 100% A  
90% - 92.9% A-  
86% - 89.9% B+  
83% - 85.9% B  
80% - 82.9% B-  
76% - 79.9% C+  
73% - 75.9% C  
70% - 72.9% C-  
60% - 69% D  
Below 60% E

UF grading policies:

<http://www.registrar.ufl.edu/catalog/policies/regulationgrades.html>

Minus grades: <http://www.isis.ufl.edu/minusgrades.html>

### **Course Policies**

Students are expected to attend class, engage in discussion, and submit assignments on time. Problem sets may be revised after initial grading without penalty. A new due date will be assigned for revised problem sets. A 10% late penalty will be assessed for work turned in or presented after the due date. Students must complete a written report of the modeling project, as well as an in class presentation to receive credit for the project. You must receive an A on the project to receive an A for the course.

## **University of Florida Policies**

### ***Students Requiring Accommodations***

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the [Disability Resource Center](#). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### ***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. [Click here for guidance on how to give feedback in a professional and respectful manner](#). Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via [ufl.bluera.com/ufl/](http://ufl.bluera.com/ufl/). [Summaries of course evaluation results are available to students here](#).

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” [The Honor Code](#) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see the [Notification to Students of FERPA Rights](#).

**Campus Resources:**

**Health and Wellness**

**U Matter, We Care:**

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

**Counseling and Wellness Center:** [counseling.ufl.edu/cwc](http://counseling.ufl.edu/cwc), and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

**Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or [police.ufl.edu](http://police.ufl.edu).

**Academic Resources**

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling.

**Library Support**, Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.

**Writing Studio**, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.

**Student Complaints Campus**

**On-Line Students Complaints**