Geo 533: Science of Land Use Change

Dr. Claire Jantz

Office: 116 Shearer Hall
Phone: 717-477-1399
E-mail: cajant@ship.edu
Website: http://webspace.ship.edu/cajant

Office Hours:
MW 2:00-4:00
F 2:00-3:00
Or by appointment

Overview: Land use and land cover changes can have far-reaching social and environmental impacts. This course will study primary land use systems, land use and land cover change, and will focus on ecosystem impacts of these systems and their dynamics, such as impacts on hydrology, wildlife habitat, and ecosystem services. The concepts and methods that you will learn will be broadly applicable to other fields and geographic locations.

Goals/objectives: The goals of this class are to 1) demonstrate an understanding of the linkages between land use/land cover and other ecosystem processes, 2) demonstrate an understanding of drivers of land use/land cover change, and 3) to quantify and analyze land use/land cover patterns and land use/land cover changes using GIS and spatially explicit computer models.

Prerequisites: Introductory course in GIS

Mission Statement of the Geography Earth Science Department:

The Geography-Earth Science Department at Shippensburg University is committed to student learning and personal development through innovative teaching, high quality field application, and use of geotechnology in all aspects of departmental programs. These commitments will deepen students' appreciation of Geography-Earth Science, encourage life-long learning, and enable Geography-Earth Science majors to teach at the middle/secondary level, to enter a geography-earth science related professional career, or to pursue a higher degree.

Required texts:

- Horton, Tom (2003). *Turning the Tide: Saving the Chesapeake Bay*. Island Press: Washington, DC
- Ernst, Howard R. (2003). *Chesapeake Bay Blues: Science, Politics and the Struggle to Save the Bay*. Rowman and Littlefield Publishers, Inc.: Lanham, MD
- Leitão, A. B., J. Miller, J. Ahern and K. McGarigal (2006). *Measuring Landscapes: A Planner's Handbook*. Island Press: Washington, DC
- Other readings as assigned (see course outline).

Recommended: Grumet, R.S., L.N. Chapman, and R.D. Campbell (2000). *Bay, Plain and Piedmont: A Landscape History of the Chesapeake Heartland from 1.3. Billion Years Ago to 2000*. The Chesapeake Bay Heritage Context Project. National Park Service and Chesapeake Bay Program: Annapolis, MD

Attendance and general expectations: Attendance is required. If you miss class you are responsible for learning the missed material and/or assignments. Students with more than one unexcused absence may fail the course, regardless of performance. Disturbances in class for any reason (cell phones, IPODS, lap tops, etc.) will not be tolerated. You will be expected to conduct yourself professionally at all times. You are expected to come to class prepared, keep up with the readings, and turn assignments in on time. I will not accept late assignments. You are expected to write well (i.e. clearly and correctly) and to always include citations. With most written assignments, you are expected to rely on the primary literature (i.e. peer-reviewed, scientific literature).

Grading:

Points	Item
100	Final exam
100	Lab assignments
100	Project
50	Discussion assignment
50	Class participation
30	Zotero reference library
50	Field trip (tentative)
	430 - 480 total points

Grades will be assigned as 90% (A), 80% (B), 70% (C), <70% (F). Plus/minus grades may be given to scores ± 3% from these values.

Exam: There will be one final exam (see schedule). If classes are cancelled on an exam day, the exam will be given during the first class meeting when classes resume. You are expected to take the exam at the scheduled time. Only very unusual circumstances (e.g. family emergency, serious illness) are acceptable reasons for missing the exam. Failure to notify me *prior to* the missed exam will result in a zero.

Lab assignments: Most class meetings will include an applied GIS lab. For each of these labs, you will be required to analyze data and compose a lab report that will usually be due the following week. Labs should be submitted electronically to D2L and in hard copy at the beginning of class on the due date.

Project: During the last three to four weeks of class, you will be expected to complete an applied land cover change project. The end result of this project will be a report outlining your methodology and results, and a final presentation to the class.

Discussion assignment: Each week we will cover two to three key readings about each topic and each student will be assigned one of these readings for review. For the article that you are assigned, you will be expected to lead a discussion about that article and provide a written annotation that you will share with the rest of the class via D2L.

Class participation: You will be expected to participate in class—come prepared for class, ask good questions, discuss, be engaged. There are 50 points allotted for class participation points. Students who are always prepared and who consistently contribute to class through thoughtful comments/questions about lecture material, readings, and assignments will earn full credit for participation.

Zotero reference library: You will be expected to create and compile a reference library using the Zotero reference manager. This library will include citations for all the readings in this class, plus additional sources that you will acquire for your final project. You will export your library and submit at the end of class.

Field trip (tentative): There will be an option to incorporate a field trip into this class. A field trip grade will be assessed based on attendance, field notes, participation, and discussion.

Late policy: No work will be accepted late unless extenuating circumstances arise.

Note: I am willing to make any reasonable accommodations for students with limitations due to disability provided the student is registered with the Office of Social Equity. Please see me during the first week of class to discuss any special needs you have. Any expected absences for religious holiday must be provided to me in writing during the first week of class.

Course outline (tentative):

I. Week 1, Sept. 1: Introduction to the course; land use and land cover

a. Readings
   i. Turning the Tide, Ch. 1 and 2
   ii. Chesapeake Bay Blues, Ch. 1 and 2
   iii. Oxnam, Geoff and J. P. Williams (2001). Saving the Chesapeake. *Forum for Applied Research and Public Policy*. Spring: 96-102.
   iv. Chesapeake Bay Foundation (2010). State of the Bay 2010. 20 p. Chesapeake Bay Foundation: Annapolis, MD.
   v. Chesapeake 2000 Bay Agreement
   vi. Turner, B.L., E.F. Lambin, and A. Reenberg (2007). The emergence of land change science for global environmental change and sustainability. *Proceedings of the National Academy of Science* 104(52): 20666 – 20671
   vii. Liu, J. *et al*. (2007). Complexity of Coupled Human and Natural Systems. *Science* 317 (14 September): 1513-1516

b. Assign: GIS lab 1: Land cover patterns within the Chesapeake Bay watershed

II. Week 2, Sept. 8: Forests: ecosystem connections, status, trends, threats and challenges

a. Readings
   i. Turning the Tide, Ch. 4 pp. 187-200
   ii. Sprague, Eric, D. Burke, S. Claggett, and A. Todd (2006). The State of Chesapeake Forests. 115 p. The Conservation Fund: Arlington, VA.

b. Discussion
   i. Turner *et al.* (2007), Liu *et al.* (2007), Sprague *et al.* (2006)

c. Due: GIS lab 1 report

d. Assign: GIS lab 2: Analyzing riparian buffers

III. Week 3, Sept. 15: Agriculture: ecosystem connections, nutrient management

a. Readings
   i. Turning the Tide, Ch. 2—revisit pp. 43-69
   ii. Chesapeake Bay Blues, Ch. 3 and 4
   iii. Boesch, D. F., R. B. Brinsfield, and R. E. Magnien (2001). Chesapeake Bay eutrophication: scientific understanding, ecosystem restoration, and challenges for agriculture. *Journal of Environmental Quality* 30 (2): 303-320.

b. Discussion
   i. Boesch *et al.* (2001)

c. Due: GIS lab 2 report

IV. Week 4, Sept. 22: Urban: ecosystem connections, impervious surfaces, landscape dynamics

a. Readings
   i. Irwin, E. and N.E. Bockstael (2007). The evolution of urban sprawl: Evidence of spatial heterogeneity and increasing land fragmentation. *Proceedings of the National Academy of Science* 104(52): 20672-20677.
   ii. Alberti, M. (2005). The effects of urban patterns on ecosystem function. *International Regional Science Review* 28: 168-192.
   iii. Snyder, M., S. J. Goetz, and R. K. Wright (2005). Stream health rankings predicted by satellite derived land cover metrics. *Journal of the American Water Resources Association* 41: 659-677.

b. Discussion
   i. Irwin and Bockstael (2007), Alberti (2005), Snyder *et al.* (2005)

c. Assign: GIS lab 3: Impervious surface area and watersheds

V. Week 5, Sept. 29: Ecosystem services

a. Readings
   i. Environmental degradation and human well-being: Report of the Millennium Ecosystem Assessment (2005). *Population and Development Review* 31(2): 389-398.
   ii. Costanza, R. *et al.* (1998). The value of the world's ecosystem services and natural capital. *Ecological Economics* 25(1): 3-15
   iii. Daily, G. (2000). Management objectives for the protection of ecosystem services. *Environmental Science and Policy* 3: 333-339.

b. Discussion
   i. MA (2005), Costanza *et al.* (1998), Daily (2000)

c. Assign: GIS lab 4: Estimating land use/land cover change

VI. Week 6, Oct. 6: Measuring and mapping change

a. Readings
   i. Goetz, S. J. (2006). Remote sensing of riparian buffers: An overview of past progress and future prospects. *Journal of the American Water Resources Association* 42 (1): 133-143.
   ii. Jantz, P. A., S. J. Goetz, and C. A. Jantz (2005). Urbanization and the loss of resource lands within the Chesapeake Bay watershed. *Environmental Management* 36 (3): 343-360
   iii. Tatem, A.J., S.J. Goetz, and S.I. Hay (2008). Fifty years of earth-observation satellites. *American Scientist*. 96 (Sept-Oct): 390 – 398
   iv. Goetz, S.J. (2007). Crisis in earth observation. *Science* 315 (30 March): 1767

b. Discussion
   i. Goetz (2006), Jantz *et al.* (2005), Tatem *et al.* (2008) AND Goetz 2007

c. <u>Due: GIS labs 3 and 4 report; form project groups and topics</u>

VII. Week 7, Oct. 13: Analyzing landscape patterns

a. Readings
   i. Measuring Landscapes, Ch. 1, 2 and 4
   ii. Herold, M., N. C. Goldstein, and K. C. Clarke (2003). The spatiotemporal form of urban growth: measurement, analysis and modeling. *Remote Sensing of Environment* 86 (3): 286
   iii. Useful references:
      1. McGarigal, K. and B. J. Marks (1995). FRAGSTATS: Spatial pattern analysis for quantifying landscape structure. USDA For. Serv. Gen. Tech. Rep. PNW-351.
      2. Measuring Landscapes, Ch. 3

b. Discussion
   i. Leitão *et al.* (2006), Herold *et al.* (2003)

c. Assign: GIS lab 5: Estimating land use change transition probabilities

VIII. Week 8, Oct. 20: Drivers of land use/land cover change

a. Readings
   i. Turning the Tide, Ch. 5
   ii. Chesapeake Bay Blues, revisit Ch. 2
   iii. Walker, R. and W. Solecki (2004). Theorizing land-cover and land-use change: the case of the Florida Everglades and its degradation. *Annals of the Association of American Geographers* 94 (2): 311-328.
   iv. Heilig, G. (1994). Neglected dimensions of global land-use change. *Population and Development Review* 20 (4): 831-859.
   v. Seto, K. M. Fragkias, B. Guneralp, and M.K. Reilly (2011). A meta-analysis of global urban land expansion. *PLoS ONE* 6(8): 1-9.

b. Discussion
   i. Walker and Solecki (2004), Heilig (1994), Seto *et al.* (2011)

c. <u>Due: GIS lab 5 report</u>

d. <u>Assign: GIS lab 6: Analyzing landscape patterns</u>

IX. Week 9, Oct. 27: Land cover change modeling

a. Readings
   i. Irwin, E. G. and J. Geoghegan (2001). Theory, data, methods: developing spatially explicit economic models of land use change. *Agriculture, Ecosystems and Environment* 85 (1): 7-23.
   ii. Sohl, T.L., T.R. Loveland, B.M. Sleeter, K.L. Saylor, C.A. Barnes (2010). Addressing foundational elements of regional land-use change forecasting. *Landscape Ecology* 25: 233-247.
   iii. Silva, E. A. and K. C. Clarke (2005). Complexity, emergence and cellular urban models: lessons learned from applying SLEUTH to two Portuguese metropolitan areas. *European Planning Studies* 13 (1): 93-116
   iv. Jantz, C.A., S. Goetz, P. Claggett and D. Donato (2010). Designing and implementing a regional urban modeling system using the SLEUTH cellular urban model. *Computers, Environment and Urban Systems* 34: 1-16.

b. Discussion
   i. Irwin and Geoghegan (2001), Sohl *et al.* (2010), Silva and Clarke (2005), and Jantz *et al.* (2010)

c. Due: GIS lab 6 report

d. Assign: GIS lab 7: Forecasts of urban land change

X. Week 10, Nov. 3: Challenges and futures

a. Readings
   i. Turning the Tide, Ch. 6
   ii. Chesapeake Bay Blues. Ch. 7
   iii. Boesch, D. F. and J. Greer (eds.) (2003). Chesapeake Futures: Choices for the 21st Century. Scientific and Technical Advisory Committee, Chesapeake Bay Program. 160 p. Chesapeake Research Consortium, Inc: Edgewater, MD
   iv. Roberts, A.D., S.D. Prince, C.A. Jantz and S.G. Goetz (2009). Effects of projected future urban land cover on nitrogen and phosphorous runoff to Chesapeake Bay. *Ecological Engineering* 35: 1758-1772.

b. Discussion
   i. Boesch and Greer (2003), Roberts *et al*. (2009)

c. Due: GIS lab 7 report, project outline and methods

XI. Week 11, Nov. 10 – **FINAL EXAM**

XII. Week 12, Nov. 17 – Open lab

XIII. Week 13, Nov. 24 – THANKSGIVING BREAK

XIV. Week 14, Dec. 1 – Open lab

XV. Week 15, Dec. 8 – Open lab

a. Final paper and Zotero reference library due Monday December 12

XVI. Week 16, Finals week, Dec. 15 – Project presentations