

Syllabus for GIS and Land Change Science, Spring 2008

CATALOG DESCRIPTION FOR: IDCE392, EN235, GEOG279, GEOG379

This course investigates methods of quantitative analysis that are typically used in land change science, especially concerning accuracy assessment and map comparison. The course focuses on the mathematical foundations of the general methods, while each technique is illustrated with data such as vegetation indices, land covers, and biodiversity potentials. We examine the advantages, disadvantages, and interpretations of the most common metrics such as Producer's Accuracy, User's Accuracy, Kappa, Pierce Skill Score, Figure of Merit, Relative Operating Characteristic, Mean Absolute Error, and Root Mean Square Error. We analyze a philosophy of map comparison that focuses on components of agreement and disagreement between maps. There are lectures in a classroom and computer exercises in a laboratory. Class discussions focus on proper use of these metrics in the context of landscape modeling for the sake of management of land, water, and carbon dioxide. This course has a Formal Analysis designation. The prerequisite is Raster GIS and high school level algebra. This course is offered every year.

TIME&PLACE 104 Geography Building, Tuesdays & Thursdays, 10:25am-10:40am
 LABORATORY J K Wright Laboratory is reserved for us during class time
 PROFESSOR Robert Gilmore Pontius Jr (rpontius@clarku.edu)
 OFFICE 102 Jefferson, Tuesdays & Thursdays 4pm-5pm, 508-793-7761

DATE	TENTATIVE TOPIC (with readings to be completed before class)
Jan. 15	Introduction and examination of Africa data
Jan. 17	Meet in 104 Geography at 9:15am for field trip to Auburn
Jan. 22	Pontius, Thontteh, and Chen in press
Jan. 24	Meet in JKWright lab, Work with data for Africa, HERO1951, and PIE
Jan. 29	Pontius 2000
Jan. 31	Assignment #1 Due; Focus the Nation Day in Grace Conference room
Feb. 5	Pontius 2002
Feb. 7	Meet in JKWright lab, Pontius and Cheuk 2006
Feb. 12	Pontius and Connors 2006
Feb. 14	Assignment #2 Due; Pontius and Schneider 2001
Feb. 19	Pontius, Cornell, and Hall 2001
Feb. 21	Meet in JKWright lab; Pontius and Chen 2006
Feb. 26	Meet in JKWright lab; Pontius, Huffaker, and Denman 2004
Feb. 28	Assignment #3 Due, Pontius et al. 2007
Mar. 4	Spring Break
Mar. 6	Spring Break
Mar. 11	Stehman 1998
Mar. 13	Meet in JKWright lab; Stehman and Czaplewski 2006
Mar. 18	Stehman et al. 2007
Mar. 20	Assignment #4 due, establish project partners, Foody 2007
Mar. 25	John Rogan presents while Pontius is away at conference
Mar. 27	Pontius et al. 2008
Apr. 1	Eastman et al. 2005
Apr. 3	Fielding and Bell 1997, Allouche et al. 2006
Apr. 8	Pontius and Spencer 2005; Pontius, Versluis and Malizia 2006
Apr. 10	Project Report due; Evaluations; Rakshit and Presentation Skills
Apr. 15	No class while many of us attend the AAG meeting in Boston
Apr. 17	No class while many of us attend the AAG meeting in Boston
Apr. 22	Project Presentations
Apr. 24	Project Presentations

You will earn a letter grade for this course. Graduate students must receive a grade of at least B- in order for the course to count towards graduation. You are required to attend every class on time. If you will be absent, then send the Professor a message that states the reason, preferably before your absence.

ASSIGNMENTS

40% of final grade

Assignments are due in class on the due date by 10:15AM according to www.time.gov. Assignments and other deliverables are penalized for lateness at 2 percentage points per day. There are four assignments as follows:

1. Write a Macro to perform map comparison for a real variable.
2. Make a budget for components of land change in Central Massachusetts for 1951, 1971, and 1999 at multiple resolutions.
3. Run a land change model and perform validation.
4. Estimate the accuracy of the Plum Island Ecosystems map.

RESEARCH PROJECT

The purpose of the research project is for you to perform your own assessment and to communicate what we can learn from it. Each project must demonstrate competency in written, spoken, and numerical language, especially in the communication of ideas graphically. Your project must have at least 5 references to professional literature that are not on the reading list below. You are encouraged and might be required to collaborate with classmates depending on class size. Each project will focus on characterization of land change 1951-1999 in Central Massachusetts, accuracy assessment of the Plum Island Ecosystems map, or validation of a spatially-explicit predictive model.

Project Report

20% of final grade

Submit a report in the form of a scientific paper. Use the format of format01.doc. It should include the following in order: Title, Abstract, Keywords, Introduction, Methods, Results, Discussion, Conclusion, References, Tables, and Figures. Put your tables and figures at the end of the document, not embedded amongst the text. Conform to guidelines that the professor supplies concerning clarity in writing. There should be 7-10 pages of double-spaced text, not including citations, tables, figures and appendices.

Oral Presentation

20% of final grade

You will make a professional presentation to the class concerning your project. Your oral presentation must show that you have incorporated the feedback you received on your written proposal. You are expected to dedicate a substantial effort to prepare for your oral presentations. You will be graded on presentation quality and content. Conform to guidelines that the professor supplies concerning clarity in oral presentation. You will be graded on pronunciation, posture, poise, punctuality, professionalism, and PowerPoint.

FINAL EXAM

20% of final grade

The final exam covers the entire course. It has short essay and multiple choice questions. It focuses mainly on the readings and class discussions.

We will attempt to use as little paper as reasonable this semester. Please read in digital form the materials that are available on Blackboard (<http://blackboard.clarku.edu>).

READINGS

1. Pontius Jr, Robert Gilmore, Olufunmilayo Thontteh and Hao Chen. in press. Components of information for multiple resolution comparison between maps that share a real variable. *Environmental and Ecological Statistics*, DOI 10.1007/s10651-007-0043-y.
2. Pontius Jr, R.G. 2000. Quantification error versus location error in comparison of categorical maps. *Photogrammetric Engineering & Remote Sensing* 66(8) p.1011-1016.
3. Pontius Jr, Robert Gilmore. 2002. Statistical methods to partition effects of quantity and location during comparison of categorical maps at multiple resolutions. *Photogrammetric Engineering & Remote Sensing* 68(10) p.1041-1049.
4. Pontius Jr, Robert Gilmore and Mang Lung Cheuk. 2006. A generalized cross-tabulation matrix to compare soft-classified maps at multiple resolutions. *International Journal of Geographical Information Science* 20(1) p.1-30.
5. Pontius Jr, Robert Gilmore and John Connors. 2006. Expanding the conceptual, mathematical, and practical methods for map comparison. Conference proceedings of the meeting of Spatial Accuracy 2006. Lisbon, Portugal. 16p.
6. Pontius Jr, Robert Gilmore and Laura Schneider. 2001. Land-use change model validation by a ROC method for the Ipswich watershed, Massachusetts, USA. *Agriculture, Ecosystems & Environment* 85(1-3) p.239-248.
7. Pontius Jr, Robert Gilmore, Joseph Cornell and Charles A S Hall. 2001. Modeling the spatial pattern of land-use change with GEOMOD2: application and validation for Costa Rica. *Agriculture, Ecosystems & Environment* 85(1-3) p.191-203.
8. Pontius Jr, Robert Gilmore and Hao Chen. 2006. GEOMOD Modeling. 53 pp. Chapter of help system in Eastman. Idrisi 15: The Andes Edition. Worcester MA: Clark Labs.
9. Pontius Jr, Robert Gilmore, Diana Huffaker and Kevin Denman. 2004. Useful techniques of validation for spatially explicit land-change models. *Ecological Modelling* 179(4) p.445-461.
10. Pontius Jr, Robert Gilmore, Robert Walker, Robert Yao-Kumah, Eugeino Arima, Stephen Aldrich, Marcellus Caldas and Dante Vergara. 2007. Accuracy assessment for a simulation model of Amazonian deforestation. *Annals of the Association of American Geographers* 97(4): 677-695.
11. Stehman, S. and Czaplewski, R. 1998. Design and Analysis for Thematic Map Accuracy Assessment: Fundamental Principles. *Remote Sensing of Environment* 64:331-344.
12. Stehman, S.V. 2006. Design, analysis, and inference for studies comparing thematic accuracy of classified remotely sensed data: a special case of map comparison. *Journal of Geographical Systems* 8: 209-226.
13. Stehman, S.V., Arora, M.K., Kasetkasem, T., and Varshney, P.K. 2007. Estimation of Fuzzy Error Matrix Accuracy Measures Under Stratified Random Sampling. *Photogrammetric Engineering & Remote Sensing* 73(2):165-173.
14. Foody 2007. Harshness in image classification accuracy assessment. *International Journal of Remote Sensing*. DOI:10.1080/01431160701442120.
15. Pontius Jr, Robert Gilmore, Wideke Boersma, Jean-Christophe Castella, Keith Clarke, Ton de Nijs, Charles Dietzel, Zengqiang Duan, Eric Fotsing, Noah Goldstein, Kasper Kok, Eric Koomen, Christopher D. Lippitt, William McConnell, Alias Mohd Sood, Bryan Pijanowski, Snehal Pithadia, Sean Sweeney, Tran Ngoc Trung, A. Tom Veldkamp, and Peter H. Verburg. 2008. Comparing the input, output, and validation maps for several models of land change. *Annals of Regional Science* DOI:10.1007/s00168-007-0138-2.
16. Eastman, J.R., van Fossen, M. and Solorzano, L. 2005. Transition Potential Modeling for Land Cover Change. Chapter 17 in *GIS, Spatial Analysis and Modeling*, D. Maguire, M. Batty, and M. Goodchild, eds, Redlands, California: ESRI Press, 357-386.
17. Fielding, A.H. and Bell, J.F. 1997. A review of methods for the assessment of prediction errors in conservation presence/absence models. *Environmental Conservation* 24(1): 38-49.
18. Allouche, O., Tsoar, A., and Kadmon, R. 2006. Assessing the accuracy of species distribution models: prevalence, kappa and the true skill statistic (TSS). *Journal of Applied Ecology*. doi:10.1111/j.1365-2664.2006.01214.x
19. Pontius Jr, Robert Gilmore and Joseph Spencer. 2005. Uncertainty in extrapolations of predictive land change models. *Environment and Planning B: Planning and Design* 32 p.211-230.
20. Pontius Jr, Robert Gilmore, Anna J Versluis and Nicholas R Malizia. 2006. Visualizing certainty of extrapolations from models of land change. *Landscape Ecology* 21(7) p.1151-1166.