

# **ANTH 310: GIS and Spatial Analysis for Archaeology**

## **Gettysburg College**

Spring, 2005

WF 9:20-11:50 Lecture & Lab

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Office Hours: Wed 12-1, Tu Th 4-5:30 or by appointment

The growing use of Geographical Information Systems (GIS) among anthropologists has transformed both the way we carry out research and conceive of space. Computer manipulation of spatial data enables anthropologists to explore new models for socio-cultural, economic, and political uses of landscape and environment. Spatial technology can also play an important role in anthropological research design, from data collection and management to analysis and presentation. In order to employ this technology properly, however, the nature and limitations of spatial datasets and the strengths and weaknesses of GIS software must be considered in relation to the questions we seek to answer.

This course introduces students to the use of GIS in anthropology with attention to archaeological applications. Readings and assignments draw upon research examples from a broad range of theoretical, analytical, and geographical contexts. Emphasis is placed on understanding the ways in which anthropological archaeologists have employed GIS as part of the multi-step process of generating evidence to assess their hypotheses. As part of the coursework, each student will be required to select a spatial dataset and formulate a research design which links a question about past behavior to material expectations, data analysis, and methods for evaluation using GIS.

Class sessions consist of a lecture/discussion component and a laboratory session. Weekly topics and exercises cover: (a) the background, definitions, and concepts of GIS and spatial data, (b) approaches to the use of GIS in anthropological archaeology, and (c) hands-on experience applying analytical concepts and software to real-world data. The course does not require previous knowledge of GIS. Students are encouraged to learn specific software procedures by working with data and solving spatial problems in order to become creative and effective users of this powerful research tool.

### Texts, Readings, and Software

*Spatial Technology and Archaeology: the Archaeological Applications of GIS*

Authors: Wheatley, D. and M. Gillings.

Published: London ; New York : Taylor & Francis, 2002

Many of the readings are articles or short selections from books and we will therefore discuss on the first day of class how to make the readings available to all.

Arcview 3.2/3 or ArcGIS 8/9 will be supported in class, however students may opt to use alternative software packages such as IDRISI or GRASS.

### Other Useful Books:

ESRI Press. (latest edition). *Getting to Know ArcGIS*. Environmental Systems Research Institute, Inc. Redlands, CA.

ESRI Press. (latest edition). *Getting to Know ArcView*. Environmental Systems Research Institute, Inc. Redlands, CA.

Burrough, Peter and Rachael McDonnell. 1998. *Principles of Geographical Information Systems*. Oxford University Press, Oxford.

Clarke, Keith. 2000. *Getting Started with Geographic Information Systems* (third edition). Prentice-Hall, Upper Saddle River, NJ.

### Course Requirements

- Upper level undergraduate standing
- Weekly discussion questions and lab exercises
- Research design for a term GIS project
- Class presentation and write-up of term GIS project
- Active participation in class discussions

### Course Grade

Participation 10%

Reading Responses 10% (collected after discussion)

Labs 20%

Project Presentation 20%

Project Report 40%

### **Course Policies and Student Responsibilities**

You are responsible for all assigned readings, handouts, material covered in class lecture, discussion, and small group discussions, all email communications, materials posted on Blackboard, and the information contained in all films or slides shown. All students are expected to have access to email, CNAV, Blackboard, and the web.

**Attendance** I expect you to be in class throughout the semester. Missed classes will inevitably lower your grade for class participation.

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**Reserves** Materials on reserve are as important as the readings assigned in the books you purchased at the bookstore. Print out copies of the readings as soon as possible.

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**Late Work** The due dates for assignments is listed above. I do not give make-up tests unless something truly serious has happened, such as a severe illness or death in the family. Written work is due in class unless otherwise specified on the assignment description. Written work turned in late will receive a reduced grade.

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**Honor Code** The Honor Code applies to all work done for the course and applies equally to individual and group work. This means, at a minimum, that the work you turn in will be the product of your own research, thought, effort, and writing, and that you give proper credit to the ideas and work of others through appropriate citation practice.

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**Disabilities** Students with a learning or physical disability which may affect performance in the course should come and see me as soon as possible.

## **Course Schedule and Topics**

(subject to addition or correction as needed)

### **Week 1: GIS and Anthropology**

Jan 14: Introduction and overview

### **Week 2: Frameworks for Archaeological Evidence**

Jan 19: Discussion and expectations for individual & group projects

Jan 21: Lab - Research design, hypothesis development, data collection, analysis and assessment. Group project development.

#### Reading:

Clarke, D.L. 1968. *Analytical Archaeology*. Methuen, London, pp. 10-41.

Schiffer, M. 1987. *Formation processes of the archaeological record*. University of New Mexico Press, Albuquerque, pp. 3-23.

Sullivan, A. 1978. Inference and Evidence in Archaeology: A Discussion of the Conceptual Problems. In *Advances in Archaeological Method and Theory*. Edited by M. Schiffer, 1:183-222. Academic Press, New York.

#### Browse:

Burgundy Project webpage:

<http://www.informatics.org/france/france.html>

### **Week 3: Spatial Thinking and Models of Space in Anthropology**

Jan 26: Discussion and software start-up; Week 2 Lab due

Jan 28: Lab - Introduction to GIS, what it is, how it works, how to turn it on, geographical earth models - coordinate systems, projections, and datums.

#### Reading:

Wheatley and Gillings 2002: 1-21

Clarke, D. 1977. *Spatial Archaeology*. Academic Press, New York, pp. 1-32.

Crumley, C. and W. Marquardt 1990. Landscape: A Unifying Concept in Regional Analysis. In *Interpreting Space: GIS and Archaeology*. Edited by K. Allen, S. Green, and E. Zubrow, pp. 73-79. Taylor & Francis, London.

Gaffney, Vincent, Zoran Stannic, and Helen Watson. 1996. Moving from Catchments to Cognition: Tentative Steps Towards a Larger Archaeological Context for GIS. In *Anthropology, Space, and Geographic Information Systems*, edited by M. Aldenderfer and D.G. Maschner, pp. 132-154. Oxford University Press, Oxford.

Browse:

Gillings, M. and A. Wise, ed. *GIS Guide to Good Practice*: Section 2.  
<http://ads.ahds.ac.uk/project/goodguides/gis/>

**Week 4: Archaeological Collection of Spatial Data A -- The Computer Database**

Feb 2: Discussion and database design; Week 3 Lab due

Feb 4: Lab - Spatial data and data structures, spatial and non-spatial databasing, vector and raster representation of data, tables linked to spatial data, sources of data on the internet.

Reading:

Wheatley and Gillings 2002: 23-58

Gillings, M. and A. Wise, ed. *GIS Guide to Good Practice*: Sections 3, 4.  
<http://ads.ahds.ac.uk/project/goodguides/gis/>

Gaffney, Vincent and Zoran Stannic. 1991. *GIS applications to regional analysis: the case study of the Island of Hvar*. Znanstveni institut FF:Ljubljana. Section 1.  
<http://www.arch-ant.bham.ac.uk/research/vince/contents.htm>

**Week 5: Archaeological Collection of Spatial Data B -- The Field**

Feb 9: Discussion and GPS group projects; Week 4 Lab due

Feb 11: Lab - GPS entering field data, editing vector and raster information, georeferencing and digitizing.

Reading:

Wheatley and Gillings 2002: 59-87

Flannery, K., ed. 1976. *The Early Mesoamerican Village*. Academic Press, New York, pp. 1-8, 131-136, 159-162, 369-373.

Parsons, J. 1990. Critical Reflections on a Decade of Full-Coverage Regional Survey in the Valley of Mexico. In, *The Archaeology of Regions*. Edited by S. Fish and S. Kowalewski, pp. 7-31. Smithsonian Institution Press, Washington, D.C.

Dunnell, Robert C. 1992. The Notion of Site. In *Space, Time, and Archaeological Landscapes*. Edited by Jacqueline Rossignol and LuAnn Wandsnider, pp. 21-41. Plenum Press, New York.

Browse:

Kythera Island Project: Introduction, Archaeological Survey, Research Area Links  
<http://www.ucl.ac.uk/kip/index.php>

### **Week 6: Multiple Concepts of Landscape**

Feb 16: Discussion and Lab - Simple vector and raster based spatial analysis, database queries, field summaries, overlays, map algebra.; Week 5 Lab due

Feb 17: \*\*\* **Research Project Proposal DUE** \*\*\* in my office by 5:30 pm.

Feb 18: READING DAY

#### Reading:

Wheatley and Gillings 2002: 89-106

Parsons, J. 1972. Archaeological Settlement Patterns. *Annual Review of Anthropology* 1:127-50.

Smith, Adam. 2003. *The Political Landscape: Constellations of Authority in Early Complex Polities*. University of California Press, Berkeley, pp. 30-77.

Deetz, James. 1990. Landscapes as Cultural Statements. In *Earth Patterns: Essays in Landscape Archaeology*. Edited by William M. Kelso and Rachel Most, pp. 1-4. University Press of Virginia, Charlottesville.

### **Week 7: Perceived, Cognitive, and Non-Geographic Spaces**

Feb 23: Discussion and elevation model practice; Week 6 Lab due

Feb 25: Lab - DEM generation and simple topographical data, visualization analysis, 3-D techniques, and “rubber sheeting”.

#### Reading:

Wheatley and Gillings 2002: 107-124, 201-216

Wheatley, D. 1995. Cumulative viewshed analysis: a GIS-based method for investigating intervisibility, and its archaeological application. In *Archaeology and Geographical Information Systems: a European Perspective*. Edited by G. Lock and Z. Stancic, pp. 171-185. Taylor & Francis, London.

Zubrow, E. 1994. Knowledge Representation and Archaeology: A Cognitive Example Using GIS. In *The Ancient Mind: Elements of Cognitive Archaeology*. Edited by Colin Renfrew and Ezra Zubrow, Cambridge University Press, Cambridge, pp. 107-118.

Llobera, Marcos. 2001. Building Past Landscape Perception with GIS: Understanding Topographic Prominence. *Journal of Archaeological Science* 28:1005-1014.

### **Week 8: Socio-Spatial Scale and Multi-Scale Analysis**

March 2: Discussion and introduction to spatial analysis; Week 7 Lab due

March 4: Lab - archaeological approaches to regional, intra-regional, and intra-site spatial analysis including site size histograms, rank-size plots, nearest neighbor analysis, spatial distribution and distance measures, and density surfaces.

Reading:

Wheatley and Gillings 2002: 125-146, 183-187, optional 187-200

Neitzel, Jill. 2000. What is a Regional System? Issues of Scale and Interaction in the Prehistoric Southwest. In *The Archaeology of Regional Interaction: Religion, Warfare, and Exchange Across the American Southwest and Beyond*. Edited by Michelle Hegmon, pp. 25-40. University Press of Colorado, Boulder.

Earle, Timothy. 1976. A Nearest-Neighbor Analysis of Two Formative Settlement Systems. In *The Early Mesoamerican Village*. Edited by Kent Flannery, pp. 196-223. Academic Press, New York.

Peterson, Christian and Robert Drennan. 2003. *Identifying Communities: Data Collection and Analysis for Archaeological Survey*. Paper presented at the 69th Annual Meeting of the Society for American Archaeology. Montreal, Canada.

Enloe, James G., Francine David, and Timothy S. Hare. 1994. Patterns of Faunal Processing at Section 27 of Pincevent: The Use of Spatial Analysis and Ethnoarchaeological Data in the Interpretation of Archaeological Site Structure. *Journal of Anthropological Archaeology* 13:105-124.

**Week 9: Networks, Interaction, and Mobility**

March 9: Discussion and surface generation; Week 8 Lab due

March 11: Lab - cost-distance, friction surfaces and simple network analysis.

Reading:

Wheatley and Gillings 2002: 147-159

Gorenflo, L. and N. Gale 1990. Mapping regional settlement in information space. *Journal of Anthropological Archaeology* 9:240-274.

Drennan, Robert. 1984. Long-Distance Transport Costs in Pre-Hispanic Mesoamerica. *American Anthropologist* 86:105-112.

Bell, T., A. Wilson, and A. Wickham. 2002. Tracking the Samnites: Landscape and Communication Routes in the Sangro Valley, Italy. *American Journal of Archaeology* 106:169-186.

**Week 10: Inhabiting the Social and Productive Environment**

March 16: Discussion and practice examining environments; Week 9 Lab due

March 18: Lab - site catchment analysis, environmental reconstruction, boundaries and territories, Thiessen polygons for allocation.

Reading:

Wheatley and Gillings 2002: 159-164

Crumley, Carole. 1994. Historical Ecology: A Multidimensional Ecological Orientation. In *Historical Ecology: Cultural Knowledge and Changing Landscapes*. Edited by Carole Crumley, pp. 1-16. School of American Research, Santa Fe.

Hodges, R. 1987 Spatial Models, Anthropology, and Archaeology. In *Landscape and Culture: Geographical and Archaeological Perspectives*. Edited by J. M. Wagstaff, pp. 118-133. Basil Blackwell, New York.

Flannery, K. V. 1976 Empirical Determination of Site Catchments in Oaxaca and Tehuacán. In *The Early Mesoamerican Village*. Edited by K. Flannery, pp. 103-117. Academic Press, New York.

Hunt, Eleazer D. 1992. Upgrading Site-Catchment Analyses with the Use of GIS: Investigating the Settlement Patterns of Horticulturalists. *World Archaeology* 24:283-308.

Browse:

Gaffney, Vincent and Zoran Stannic. 1991. *GIS applications to regional analysis: the case study of the Island of Hvar*. Znanstveni institut FF:Ljubljana. Section 2.

<http://www.arch-ant.bham.ac.uk/research/vince/contents.htm>

**WEEK 11: Spring Break**

March 23 - Spring Break!!

March 25 - Spring Break!!

**WEEK 12: Map Production & Presentation**

March 30: Lab - Making “pretty” maps, map creation and output; Week 10 Lab due

April 1: Society for American Archaeology Meeting – Independent lab time

Tufte, Edward R. 1983. *The Visual Display of Quantitative Information*. Graphics Press, Cheshire, CN: chapter selections.

Miller, P. 1995. How to look good and influence people: thoughts on the design and interpretation of an archaeological GIS. In *Archaeology and Geographical Information Systems: a European Perspective*, edited by G. Lock and Z. Stancic, pp. 319-333. Taylor & Francis, London.

**Week 13: Resource Landscapes and Locational Strategies**

April 6: Discussion and practice with simple modeling techniques; Week 12 Lab due

April 8: Lab - Predictive and locational modeling.

Reading:

Wheatley and Gillings 2002: 165-181

Halstead, P., and J. O'Shea. 1989. Introduction: Cultural Responses to Risk and Uncertainty. In *Bad Year Economics: Cultural Responses to Risk and Uncertainty*. Edited by P. Halstead and J. O'Shea, pp.1-7. Cambridge University Press, Cambridge.

Brandt, R. , B. Groenewoudt, and K. Kvamme. 1992. Modeling in the Netherlands Using GIS Techniques. *World Archaeology* 24:2:268-282.

Stanic, Zoran, and Kenneth L. Kvamme. 1999. Settlement Pattern Modeling through Boolean Overlays of Social and Environmental Variables. In *New Techniques for Old Times: Computer Applications and Quantitative Methods in Archaeology*. Edited by Juan A. Barceló, Ivan Briz, and Assumpció Vila, pp. 231-237. Proceedings of the 26th CAA Conference, Barcelona, March 1998. BAR International Series 757, Oxford.

Church, Brandon, R. Joe Brandon, and Galen R. Burgett. 2000. GIS Applications in Archaeology: Method in Search of Theory. In *Practical Applications of GIS for Archaeologists: A Predictive Modeling Kit*. Edited by Konnie L. Westcott and R. Joe Brandon, pp. 135-155. Taylor & Francis, Philadelphia.

### **Week 14: Macro-Features and Anthropogenic Environments**

April 13: Discussion and techniques for remote sensing of landscapes; Week 13 Lab due

April 15: Lab: Remote sensing and simple image processing, data types, availability and registration, examples of spectral enhancement, working with band ratios, classification techniques.

#### Reading:

Erickson, C. 2000. The Lake Titicaca Basin: A Pre-Columbian Built Landscape. In *Imperfect Balance: Landscape Transformations in the Precolumbian Americas*. Edited by David Lentz, pp. 312-356. Columbia University Press, New York.

Philip, G., D. Donoghue, A. Beck, and N. Galiatsatos. 2002. CORONA Satellite Photography: An Archaeological Application from the Middle East. *Antiquity* 76: 109-119.

Holcomb, Derrold. 2001. Imaging Radar and Archaeological Survey: An Example from the Gobi Desert of Southern Mongolia. *Journal of Field Archaeology* 28:131-141.

Wilkinson, T.J. 1993. Linear Hollows in the Jazira, Upper Mesopotamia. *Antiquity*, 67: 548-562.

Kouchoukos, N. 2001. Satellite Images and the Representation of Near Eastern Landscapes. *Near Eastern Archaeology* 64: 80-92.

#### Browse:

Internet Resources for Information and Data:

[http://www.ccrs.nrcan.gc.ca/ccrs/learn/learn\\_e.html](http://www.ccrs.nrcan.gc.ca/ccrs/learn/learn_e.html)

<http://edcimswww.cr.usgs.gov/pub/imswelcome/>

<http://ourworld.compuserve.com/homepages/mjff/homepage.htm>

<http://www.ghcc.msfc.nasa.gov/archeology/archeology.html>

### **Week 15: Contours of the Future**

April 20: Discussion of GIS, anthropological theory, and future research; Week 14 Lab due

April 22: Lab - Non-traditional and imaginative uses of GIS in anthropology.

Reading:

Wheatley and Gillings 2002: 233-246.

Kvamme, K.L. 1999. Recent directions and developments in geographical information systems. *Journal of Archaeological Research* 7:153-201.

**Week 16: Student Project Presentations**

April 27: Students present their independent projects, (15-20 minutes each)

April 29: Students present their independent projects

**EXAM DAY** – Student Project Report Due (20 pages text, 5+ pages graphics)