

Florida International University, Department of Earth Sciences

**GIS and Spatial Analysis for Earth Scientists (3)**

GLY 5758, Spring Term Semester 2008

M/W 5:00 – 6:15

GISRSAL Lab, GL 274

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Office Hours: M/W: 3-4:15 in PC325,  
M: after class in GL275 or by appointment

**Course Syllabus**

The material below contains important information for this course. Please read this material and retain this document for future reference.

**Course Description:**

Spatial analysis is a set of techniques for analyzing patterns of and interrelationships between map data. The field of spatial analysis has seen much growth in recent years with the introduction of inexpensive and easy to use Geographic Information Systems (GIS). While many users employ GIS only for building spatial databases and displaying maps, GIS are powerful tools for performing spatial analysis. This course will introduce advanced undergraduates and graduate students to techniques for using GIS technology to solve problems in the earth and environmental sciences. Emphasis in this course will be on applying raster analysis techniques.

The course will be comprised of lectures and computer exercises. Computer instruction will utilize the GIS laboratory in the FIU Library. Course will be composed of 1) Review of GIS concepts and data models; 2) concepts of spatial statistics; 3) methods of spatial analysis including density mapping, buffer zone analysis, surface estimation, geostatistics, map algebra, and suitability modeling.

**Course Objectives/Learning Outcomes:**

Students completing this course will have a strong understanding of the theory of and the basic functions used in GIS raster analysis and modeling. Students will have a functional understanding of the Spatial Analyst and Geostatistical Analyst extensions for ArcGIS 9.2.

**Software:**

Most examples and exercises will utilize ESRI's ArcGIS V. 9.2 with the Spatial Analyst, Geostatistical Analyst and 3-D Analyst extensions and ARC/INFO GRID. **Please note:** The demo software DVD included with *Getting to Know ArcGIS Desktop* does not include any of the advanced extensions and cannot be used to do any of the computer exercises in this course. These exercises must be done either in the GIS Lab (GL274) or in a remote lab that has a full installation of ARCGIS 9.2. Additional numerical analysis will use Microsoft Excel.

### **Prerequisites and Recommended Background:**

Introductory GIS course is strongly recommended. It is **required** that students without previous experience with ArcGIS purchase the *Getting to Know ArcGIS Desktop* workbook and do the exercises during the first 2 weeks of the course. **Please note:** See the note in the section above regarding the limitations of the software CD included with this book. .

Basic analytic geometry, trigonometry, and statistics is recommended. Competence with personal computers and application software is essential.

### **Grading:**

Course grade will be based on attendance and class participation (15%), exercises (50%), a Midterm Exam (15%), and a Final Exam (20%). Exams will be closed book and will test your understanding of concepts covered in class, not skill in operating software.

### **Required Reading:**

The following 3 books contain readings for the course. Students may either purchase the books on their own or check out the book for the 2 hour reserve desk on the 2<sup>nd</sup> floor of the library.

1. G. F. Bonham-Carter, *Geographic Information Systems for Geoscientists*, Pergamon, 1994.  
(Call number: G70.2.B66 1994)
2. M. N. DeMers, *GIS Modeling in Raster*, John Wiley & Sons, 2002.  
(Call Number: G70.212.D47 2002)
3. T. C. Bailey and A. C. Gatrell, *Interactive Spatial Data Analysis*, Longman, 1995  
(Call Number:QA278.2.B35 1995)

The books below are ArcGIS Extension Workbooks. They may be purchased on-line from ESRI press for \$29.95 each, at: <http://gisstore.esri.com/> (click on *ArcGIS Documentation*). \* Electronic versions (PDF) of these books are available on the GIS Lab Public server in folder:

**P: /ArcGIS9\_Manuals/ESRI\_Library/ArcGIS\_Extensions/**

4. *Using ArcGIS<sup>TM</sup> Spatial Analyst*, J. McCoy and K. Johnston, ESRI Press, ISBN: 1-58948-105-4, 233 pages, ESRI 2004.
5. *Using ArcGIS<sup>TM</sup> Geostatistical Analyst*, K. Johnston, J.M. Ver Hoef, K. Krivoruchko, and N. Lucas, ESRI Press, ISBN: 1-58948-106-2, 300 pages, ESRI 2004.

### **Recommended Reading for GIS Rookies:**

(Available in Campus Bookstore and from the ESRI web site: <http://gisstore.esri.com/>)

1. *Getting to Know ArcGIS Desktop 2nd Ed.* (GTKAD), T. Ormsby and others, ESRI Press, ISBN: 978-1-58948-083-4, 2004 588 pages, \$64.95. Note: this book is **required** for students without ArcGIS experience. Datasets and materials used with this book are available on public drive in: **P: /ArcGIS9\_GTK/**

### **On Line Software Help**

ArcDoc: (Start Menu → ArcGIS → ArcInfo Workstation → ArcDoc

*Cell Based Modeling With Grid; Grid Commands; Surface Modeling With TIN*

ArcMap Desktop help:Extensions: Spatial Analyst, Geostatistical Analyst, 3-D Analyst

## Course Outline and Reading Assignments (*Tentative*):

- Weeks 1&2: Organization. GIS Lab orientation.  
Maps as models. GIS data types, and structures. Vector and raster data models
- Reading: **Bonham-Carter:** Ch. 1 -3; **DeMers,** Ch 1
- Week 3  
What is spatial analysis? Modeling of spatial data. Hypothesis tests. Exploratory spatial analysis. Review of raster analysis functions.
- Reading: **McCoy & Johnston,** Ch 1 – 3, 6; **DeMers,** Ch 3; **Johnston et al.,** Ch 1,2, 4
- Exercise 1: Getting Started with ArcGIS Spatial Analyst
- Week 4  
Working with Raster Data Models; The ESRI Grid model  
Resampling, transforming, and registering Grids
- Reading : **Bonham-Carter:** Ch 4; **DeMers,** Ch. 2; **McCoy & Johnston,** Ch 4 - 5
- Exercise 2: Grid Import, Resampling, and Registration, Using the Raster Calculator
- Week 5:  
Spatial Data Transformations: vector to raster; point and lines to areas.
- Reading: **Bonham-Carter:** Ch 6; **McCoy & Johnston,** Ch 7
- Exercise 3: Density maps, buffer maps, point to area conversions. Analysis of point patterns.
- Week 6:  
Point and line distributions. Measurements of spatial form. Randomness, clustering, regularity and anisotropy.
- Reading: **Bonham-Carter:** Ch 6; **Bailey and Gatrell,** Ch 3.
- Week 7:  
Midterm Quiz
- Week 8 & 9:  
Estimating surfaces; the art of interpolation. TIN, IDW, trend surfaces, kriging.
- Reading: **Bonham-Carter:** Ch 6; **Bailey and Gatrell,** Ch 5&6.; **Johnston et al.,** Ch 3, 5, 6; **McCoy & Johnston,** Ch 7
- Exercise 4: Interpolation techniques, Variograms, Geostatistics
- Week 10:  
Univariate analysis of surfaces and raster maps. Reclassification, filtering and image processing. Local, zonal, and focal functions.
- Reading: **Bonham-Carter:** Ch 7; **DeMers,** Ch 4; **McCoy & Johnston,** Ch 7
- Week 11:  
**Spring Break**
- Week 12:  
Analysis of map pairs. Spatial association analysis. Cross area tabulation.
- Reading: **Bonham-Carter:** Ch 8
- Exercise 5: Two map association with cross tabulation

Week 13: Analysis of two or more coincident maps. Map algebra. Cluster analysis.  
Inter-map relationships.  
Reading: **Bonham-Carter**: Ch 8 & 9; **McCoy & Johnston**, Ch 7, App 1  
Exercise/Demo: Spatial regression models

Week 14 & 15 Suitability modeling.  
Reading: **DeMers**, Ch 5-7; **McCoy & Johnston**, Ch 1-3 (again!); ESRI  
Documentation  
Exercise 6: Suitability and Hazard Modeling