

## **WATERSHED ANALYSIS AND MODELING: Course Syllabus**

### **Course Description**

This course will involve application of Geographic Information Systems in the analysis of water resources and watershed function. Beginning with an introduction to the ArcHydro data model, students will explore digital mapping of water resources information, terrain analysis using digital elevation models, and delineation of river and watershed networks. Through integration of time-series and geospatial data students will be exposed to principles of hydrologic modeling.

### **Prerequisites**

GES 386 AND [GES 302A OR GES 416 OR GES416]

### **Course Text**

Most readings for this course will be taken from: "Arc Hydro: GIS for Water Resources" Ed by David R. Maidment, published by ESRI Press, 2002, \$59.95 ISBN 1-58948-034-1, see <http://gis.esri.com/esripress/display/index.cfm>

### **Course Objectives**

The course is composed of modules that will enable students to:

- 1) Develop a Hydrologic Information System that links time series of water observations to locations where the measurements are made;
- 2) Create a base map of a study region including watersheds, streams, and aquifers by selecting features from regional maps;
- 3) Analyze a digital elevation model of land surface terrain to derive watersheds, stream networks, and other elevation derivatives;
- 4) Interpolate measured data at points to form raster surfaces over a region, and spatially average those surfaces over polygons of interest;
- 5) Perform hydrologic calculations using map algebra on raster grids;
- 6) Apply the Arc Hydro data model to a set of streams, watersheds, water bodies, monitoring points and time series of information measured at those points;
- 7) Develop data structure to parameterize and calibrate simple hydrologic models
- 8) To complete an term project where students use their skills and understanding to address a research question in applied or theoretical environmental science.

### **Computer Environment**

This course uses the ArcGIS version 9.3 software. The Spatial Analyst and 3D Analyst extensions of ArcGIS will also be used in the course, as well as a custom TauDEM toolbox. These programs run under the Windows operating system. If you have access to the software elsewhere, you can do the computer assignments at that location. You should plan to back up your work on a removable drive (e.g. zip or thumb) to avoid complications from lack of disk space in your personal area.

### **Method of Evaluation**

Course grades will be based on a weighted average of results as follows:

Homework 20%

Term Project Written Report 30%

Term Project Oral Presentation 10%

Midterm Exam 20%

Final Exam 20%

The midterm exam will be an in class exam. The final exam will be a take home exam handed out during the last class and due 1 week after the last class. This final exam will include project-type GIS analysis as well as essays and short reports that synthesize material from the class and from the term projects of other students in the class. Whereas undergraduate students in GES 400/417 will work in teams, each graduate student will be responsible for their own term project. In addition to a larger literature review requirement for the project, graduate students will be held to a higher standard in all assignments completed in this course. Further, graduate students will be provided with additional and more technically sophisticated questions on the exams.

### **Class Schedule**

Tu Sept 1 Introduction

Th Sept 3 ArcHydro Data Model (CH 1-2)

Tu Sept 8 Hydrography and Inventories (CH 6)

Th Sept 10 Network Connectivity and Behavior (CH 3)

Tu Sept 15 Slope and Drainage (CH 4; Jenson & Domingue 1988, Liang & McKay 2000)

Th Sept 17 Pit Filling and Carving (Soille 2004)

Tu Sept 22 Delineation and AGREE (Tarboton et al. 1991, Istanbuloghet al. 2002, Saunders 2000, Baker et al. 2006)

Th Sept 24 Terrain Derivatives (Walker and Wilgoose 1999, Hankcok & Evans 2006)

Tu Sept 29 D-infinity (Costa-Cabral & Burges 1994, Tarboton 1997)

Th Oct 1 Tau-DEM (Tarboton and Baker 2008)

Tu Oct 6 Time Series (CH 7)

Th Oct 8 Review

Tu Oct 13 **MIDTERM EXAM**

Th Oct 15 Channels (5)

Tu Oct 20 NO CLASS

Th Oct 22 Project Discussion

Tu Oct 27 Hydrologic Modeling (CH 8)

Th Oct 29 Arc Hydro Implementation (CH 9)

Tu Nov 3 HEC-HMS (Quick Start Guide)

Th Nov 5 Hydrologic Simulations (Cedar Creek Report)

Tu Nov 10 TOPMODEL & TOPNET (Saulnier & Datin 2004)

Th Nov 12 CN-VSA (Lyon et al. 2004)

Tu Nov 17 Project Help

Th Nov 19 Project Help

Tu Nov 24 Advanced Applications

Th Nov 26 THANKSGIVING

Tu Dec 1 **Written Reports Due**

Th Dec 3 Oral Presentations

Tu Dec 8 Oral Presentations

Th Dec 10 Oral Presentations

Tu Dec 22 **FINAL EXAM 10:30am-12:30pm**