Soils 510 – *Geographic Information Systems Applications*

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Office hours: M/W 2:30 – 3:30 p.m.
Appointment

TBD
Appointment

Schedule: Lecture: M/W 1:25 – 2:10 p.m., Room 11 ASI Building
Lab: Friday 1:25-4:25 p.m., Room 110 ASI Building

Prerequisites: Soils 101 (Introductory Soils) or equivalent
Soils 450 (Environmental GIS) or equivalent
3 credits statistics

Books: Principles of Geographic Information Systems, 1998, Peter A. Burrough and Rachel A. McDonnell, Oxford University Press. (required) – available through instructor

ArcGIS Extension Guides, Environmental Systems Research Institute (required) – available through instructor

Handouts provided by instructor

Software: ESRI ArcView GIS ver. 9.x
ESRI ArcView Spatial Analyst extension
ESRI 3D Analyst extension
ESRI Geostatistical Analyst extension

Grading:

Midterm 1	15%
Midterm 2	15%
Final	15%
Assignments	55%

Course Description:
The overall goal of this course is to educate and prepare the student in the use of GIS software, analytical methods, and digital environmental spatial databases to characterize landscapes for environmental assessment and management. This course focuses on the use, analysis, and production of gridded data and assumes the student has prior experience in GIS analysis of vector data (Soils 450 or equivalent). Advanced topics will address visualization, modeling applications, and web-mapping.

Lectures will focus on analytical methods involving gridded databases including digital terrain models and remote sensing data. Topics will include data registration, interpolation of point data to grids, GPS (global positioning system), terrain analysis, interactive web mapping, and image processing. Lectures will illustrate applications of gridded data modeling and web mapping.

In the laboratory portion of the course, emphasis is placed on the development of practical and problem-solving skills using GIS, GPS, terrain analysis, visualization, web-mapping, modeling, and remote sensing technologies. By the end of the course, the student will have acquired valuable technical expertise, which is commonly sought by employers in natural resource management.

Summary of topics:

Raster/Gridded Data Analysis (utilization of ESRI Spatial Analyst)

- Raster data structures
- Raster data representation (discrete and continuous data)
- Sources of raster data
- Raster/Vector data conversion
- Gridded data manipulation
    - Registration and georeferencing
    - Resampling
    - Grid reclassification
    - Query
    - Map production
- Gridded data analysis
    - Map algebra: local, focal, zonal and global functions
    - Modeling
    - Statistical analysis
- Applications

Digital Terrain Analysis

- DEM data structures – raster/TIN
- Sources and accuracies of available DEMs
- DEM analyses for landscape characterization
    - Slope, aspect, curvature
    - Drainage basin delineation
    - Stream network extraction
    - Visibility analysis
    - Contour mapping
- DEM production methods: photogrametric and contour line digitizing/interpolation
- Applications:
    - Pennsylvania vineyard site assessment modeling

Interpolation Methods used to Create Grids

- Interpolation Methods: Inverse Distance Weighted (IDW), Trend surface, Regression-based , Geostatistics and Spline
- Point and line sampling methods
- Grid production from digitized contour lines
- Impact on soil sampling for precision agriculture
- Applications:
    - Groundwater recharge rate modeling for Pennsylvania

Fuzzy Logic Modeling

- Basics of fuzzy logic inference modeling
- Application:
    - Mapping soils using fuzzy logic modeling (SoLIM)

WebGIS mapping

- Concepts of web mapping using ArcIMS
- Setting up a basic internet map service
- Applications:
    - AgMap, SoilMap, CentreMap, FarmMap

3D Visualization and GIS

- ESRIs 3D Analyst
- Visual Nature Studio – 3D Nature

Image Analysis

- Electromagnetic properties of surfaces
- Remote sensing concepts
- Available sensors and data (private and public): EMAP, MRLC, SPOT, TM, hyperspectral, etc.
- Image classification: supervised and unsupervised
- Image enhancement

Global Positioning Systems (using Trimble ProXRS)

- Differential correction: real-time and post-processing
- Navigation
- Elevation sampling

Academic Integrity

All students are expected to conform to high standards of academic integrity. Academic integrity, as defined by the University Faculty Senate Policy 49-20, is the pursuit of scholarly activity free from fraud and deception and is an educational objective of Penn State. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students.