# SOS 6722
# Soil Landscape Modeling

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**INSTRUCTOR:**
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**TIMES:** Spring semester odd years

**CREDIT HOURS:** 3

**ENROLLMENT CAP:** 20

**FORMAT:** lectures and projects
The course counts towards the ICGIS certificate (http://web.uflib.ufl.edu/icgis)

**PREREQUISITES:**
STA 6166 (statistics graduate course) and SOS 5720C (GIS graduate course) or equivalent; and an introductory soil science/natural resources course; or consent of instructor.

**COURSE OBJECTIVES:**
The goal of this class is to explore various concepts and quantitative methods to model and understand the spatial distribution of soil and environmental properties across landscapes considering its biological and chemical composition, physical environment, and anthropogenic patterns. This is essential to understand environmental consequences (e.g. fate of nutrients, pesticides, and potential contaminants) that relate to soils as natural bodies within the landscape/hydrological continua. The relationship between soil properties and environmental landscape factors will be given special attention. Various quantitative modeling techniques will be reviewed to model complex relationships between environmental factors.

**OTHER INFORMATION:**
Landscapes are characterized by a wide variation, both spatially and temporally, of tolerance and response to natural processes and anthropogenic stress. These tolerances and responses can be analyzed through individual landscape parameters, such as soils, land use, land cover, water, etc., or holistically through soil-landscape or ecosystem modeling. In this course students will be introduced to concepts and quantitative modeling techniques for environmental soil-landscape modeling. Critical discussion will engage students in the topics covered in this course.

Each student will work on two projects: (1) Literature project and (2) Quantitative modeling project.
Literature project: (i) Select a topic related to environmental soil landscape analysis; (ii) Conduct a literature review based on a minimum of 10 peer-reviewed journal articles, textbook chapters, and/or proceeding papers; (iii) Submit a project report; and (iv) Present results of project in class.
Quantitative modeling project: (i) Define objectives and hypotheses to investigate environmental patterns within a landscape; (ii) Identify an environmental dataset and study area; (iii) Select two or more quantitative methods; (iv) Conduct quantitative analysis and interpret results; (v) Submit a project report; and (vi) Present project findings in class.

The projects encourage students to think critically and learn how to approach an unknown topic. Students have to demonstrate mastery, comprehension, application, and synthesis of a given set of concepts.

**SOFTWARE:**
ArcGIS; various statistical and geostatistical software packages

**RECOMMENDED TEXTBOOK:**
Grunwald S. (ed.) 2006. Environmental Soil-Landscape Modeling – Geographic Information Technologies and Pedometrics. p. 467. CRC Press, New York.

Webster R. and M. Oliver. 2007. Geostatistics for Environmental Scientists. John Wiley & Sons, New York.

**GRADING:**
Exam: 35%
Literature project: 30%
Quantitative modeling project: 30%
Participation: 5%

**GRADING SCHEME:**
A 90 - 100
B+ 85 - 90
B 80 - 85
C+ 75 - 80
C 70 - 75
D+ 65 - 70
D 60 - 65
E < 60

**COURSE MODULES:**
**1. History and Trends in Environmental Soil-Landscape Modeling**
1.1. The space-time continuum

1.2. Spatial and temporal scales
1.3. Historical, current and future perspectives
1.4. Digital soil mapping (pedometrics)
1.5. Quantitative assessment of environmental quality (environmetrics)

**2. Soil Ecosystem Services**
2.1. Holistic environmental analysis
2.2. Types of services
2.3. Selected hot topics

**3. Collection of Soil and Ancillary Environmental Datasets**
3.1. Emerging geographic information technologies
3.2. Proximal soil sensing techniques and remote sensing
3.3. Topographic mapping

**4. Quantitative Methods to Assess Soil and Environmental Patterns across Landscapes**
4.1. Crisp and Fuzzy Classifications

- Characteristics:
    - Crisp models: Assume sharp boundaries between classes representing soil or environmental properties; classes are assumed to be internally homogeneous; methods do not account for spatial variability within classes
    - Fuzzy models: Allow the matching of soil/environmental individuals to be determined on a continuous scale via membership functions; account for uncertain, imprecise information
- Methods:
    - Crisp classifications (U.S. Soil Taxonomy; land use/land cover classifications)
    - Clustering methods (hierarchical clustering; classification trees)
    - Fuzzy set modeling

4.2. Global and Local Deterministic Methods

- Characteristics:
    - Global methods: Describe long-range (global) variation of soil and/or environmental properties across the area of interest
    - Local methods: Describe short-range (local) variation of soil and/or environmental properties by defining a neighborhood around the location to be predicted
    - Deterministic methods: Are based on the premise that a particular input dataset will produce one uniquely defined model prediction
- Conceptual approach: Environmental correlation; SCORPAN modeling
- Methods:
    - Trend models
    - Multivariate regression
    - Regression trees

4.3. Geostatistical Methods

- Characteristics:
    - Account for spatial autocorrelation (univariate methods) and spatial correlation (multi-variate methods) between environmental variables
    - Based on regionalized variable theory which allows to consider spatial variability of a (soil, environmental) property as a realization of a random function represented by a stochastic model
- Methods:
    - Ordinary kriging
    - Univariate variants of kriging
    - Multivariate variants of kriging (Co-kriging)
    - Spatial stochastic simulations

4.4. Multi-scale / Multi-dimensional Modeling of Soil and Environmental Properties

- Characteristics:
    - Hybrid (mixed) models combine statistical and geostatistical methods to model complex soil-environmental relationships to describe their spatial and temporal patterns
- Conceptual approach:
    - Holistic approach: Integration of soil and environmental landscape properties into a coherent model to reconstruct and visualize soil-landscapes
- Methods:
    - Regression kriging
    - Principal component kriging

**ACADEMIC HONESTY:**

In fall 1995 the University of Florida student body enacted a new honor code and voluntarily committed itself to the highest standards of honesty and integrity. When students enroll at the university, they commit themselves to the standard drafted and enacted by the students:
Preamble: In adopting this honor code, the students of the University of Florida recognize that academic honesty and integrity are fundamental values of the university community.
Students who enroll at the university commit to holding themselves and their peers to the high standard of honor required by the honor code. Any individual who becomes aware of a violation of the honor code is bound by honor to take corrective action. A student run Honor Court and faculty support are crucial to the success of the honor code. The quality of a University of Florida education is dependent upon community acceptance and enforcement of the honor code.
The Honor Code: We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." Matters of violations of academic honesty are adjudicated by the Student Honor Court, the Health Center Student Conduct Standards Committee, the Student Conduct Committee, the College of Law Honor Committee and faculty. See a current undergraduate/Graduate Catalog for definitions of Plagiarism, Bribery, Misrepresentation, Conspiracy, and Fabrication.

**UF COUNCELING SERVICES:**
Resources are available on-campus for students having personal problems or lacking clear career and academic goals. These resources include:
1. University Counseling Center, 301 Peabody Hall, 392-1575, personal and career counseling;
2. SHCC Mental Health, Student Health Care Center, 392-1171, personal counseling;
3. Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161, sexual assault counseling; and
4. Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.

**ACCOMODATIONS FOR STUDENTS WITH DISABILITIES:**
Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation.

**SOFTWARE USE:**
All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.