SWS 6722
Soil-Landscape Modeling
(Integrative Ecosystem Modeling)

INSTRUCTOR:
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TIMES: Spring semester odd years

CREDIT HOURS: 3

ENROLLMENT CAP: 20

FORMAT: Lectures, instructor facilitates class discussions, discovery and exploratory learning, self-motivated reading and emergence in the class topics.
The course counts towards the ICGIS certificate (http://web.uflib.ufl.edu/icgis).

TIME: Tuesday 2nd period; Wednesday 2nd – 3rd period.

PREREQUISITES:
A statistics or quantitative methods course at the graduate level (e.g., STA 6166, GEO 6160, ALS 5932, Introduction to Programming and Remote Sensing with R (GEO 6938)) and solid knowledge in GIS (e.g., SWS 5721C). If you do not fulfill these requirements seek permission from the instructor to enroll in this course.

COURSE GOAL AND OBJECTIVES:
The goal of this class is to explore various concepts and quantitative methods to model and understand the spatial distribution of environmental properties in various landscape settings considering its biological and chemical composition, physical environment, and anthropogenic patterns. This is essential to understand environmental consequences (e.g., carbon dynamics, fate of nutrients, and ecological responses). The specific course objectives are to:

(1) Analyze and understand relationships between various ecosystem properties
(2) Compare models that predict, simulate and/or assess responses to changes in an ecosystem

(3) Synthesize our understanding of ecosystems into more complex models.

The purpose of integrative ecosystem modeling is seen to find better answers to the wicked environmental problems of our time including global climate change, food security, soil security, and natural vs. managed ecosystems.

Soil-landscapes view the totality of ecosystems through the lens of various perspectives (e.g., empirical observations, stochastic methods, geostatistical methods, simulations and direct perceptions). Soil, topography, ecology, geology, climate, water, biota (land use, land cover, and organisms), and human activities interact with each other to form properties and transform a system. Ecosystems are characterized by a wide variation, both spatially and temporally, of resilience and response to natural processes and anthropogenic stresses, such as global climate change, land use shifts, intensification of management, and others. These can be analyzed through individual parameters, such as soil type, land use, land cover, etc., or holistically through integrative soil-landscape ecosystem modeling. In this course we explore integrative models that fuse data, methods and approaches to address the complexity of anthropogenic-induced changes to grand questions of our time.

LEARNING APPROACH:
A discovery style of leaning is used in this course as foundation to facilitate learning. This means to open your eyes and learn through deep understanding, rather than pre-prepared fixed/rigid class modules and assignments. Students will emerge themselves in the course topics through reading, critique of case studies (select hot topic cases), and designing and creating their own projects to investigate spatial and/or temporal patterns, relationships, responses, impacts, adaptation, and/or risk of change in an ecosystem of their choice.

The instructor uses coaching techniques to facilitate the learning process, including targeted Q&A sessions, unlocking self-motivation to study, learning as exploration, and multi-perspectival class discussions.

The course blends subjective and objective, knowledge-based (discussion and interpretation) and quantitative approaches (modeling). Note that the emphasis in this course is not as much on learning the specific technical nuts-and-bolts (step-by-step instructions) of specific quantitative methods. Rather the emphasis is on understanding in *what context* to apply a quantitative method to a specific ecosystem question/problem, *how to select* and *integrate* various quantitative methods, *how scale* influences your models, *how to data mine* and *fuse* data and methods to address a complex ecosystem problem of interest.

COURSE PROJECTS:
Each student will work on two projects: (1) Literature project and (2) Quantitative modeling project.

- Literature project: (i) Select a topic related to integrative ecosystem modeling; (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 the project in class.
- Integrative ecosystem modeling project: (i) Define objectives and hypotheses to investigate environmental patterns, responses, impact, risk, vulnerability or similar within a select soil-landscape; (ii) Identify environmental data and study area; (iii) Select two or more model

approaches; (iv) Conduct integrative modeling; (v) document and interpret results; (vi) Submit a project report; and (vii) 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 into a model framework.

COURSE WEB SITE:
UF Canvas course management system: https://lss.at.ufl.edu/

SOFTWARE:
ArcGIS; R, and statistical software packages available by CALS, UF.

READING MATERIAL:
Reading material in this course is mainly based on journal articles available through the UF elibrary.

RECOMMENDED TEXTBOOKS:
Grunwald S. (ed.) 2006. Environmental Soil-Landscape Modeling – Geographic Information Technologies and Pedometrics. p. 467. CRC Press, New York.
In this course we will focus on select chapters (1, 3, 5, and 6).

GRADING:
Exam: 20%
Literature project: 30%
Quantitative modeling project: 30%
Participation: 20%

GRADING SCHEME:

Passing Letter Grade	Course Points	Grade Points
A	95-100	4.0
A-	90-95	3.67
B+	90-85	3.33
B	85-80	3.0
B-	80-75	2.67
C+	75-70	2.33
C	70-65	2.0
C-	65-60	1.67
D+	60-55	1.33
D	55-50	1.0
D-	50-45	0.67
S	45-below	0

Failing Grades	Course Points	Grade Points
E	0	0
WF	0	0
I	0	0
NG	0	0

Definitions
E = Failure
H = Deferred grade assigned only in approved sequential courses or flexible learning
I* / I = Incomplete
N* / NG = No grade reported
S = Satisfactory
U = Unsatisfactory
W = Withdrew
WF = Withdrew failing

The grading policy of UF will be followed in this course as outlined at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx#repeat

EXPECTATIONS AND GRADING POLICY IN THIS COURSE:
It is expected that students attend class and study the assigned learning material provided on the course web site and reading material. The participation grade is based on active participation in class discussions. This means to engage and pro-actively participate in class discussions. Students are expected to work independently on their projects. Copying of results (reports) from other students will be considered as plagiarism. In this course the antiplagiarism software Turnitin is used.

The IT staff of the University of Florida provides the service to assist with technical problems (e.g., GIS software, access to statistical software, and virtual computer lab).

Late submissions of the exam and project reports will result in 15% reduction of points within 24 hours late submission and 30% reduction of points between 24-48 hours late submission. After more than 48 hours late submission zero points will be assigned to the exam and project reports. All exam and project reports need to be submitted through the course website. Submissions via email attachments will not be accepted.

COURSE MODULES:
1. Overview Environmental Soil-Landscape Modeling
1.1. The space-time continuum / spatial and temporal scales
1.2. Historic, current and future perspectives
1.3. Integrative ecosystem modeling
1.4. Local to global context of integrative models
1.5. Wicked environmental problems

2. Environmental Data
2.1. Observations / measurements
2.2. Proximal sensing (soil sensing)
2.2. Remote sensing
2.3. Qualitative data / vague data / probabilistic data

3. Modeling Paradigms

3.1. Descriptive models: Expert-/knowledge-based models.

3.2. Empirical models: State-budget models (e.g., carbon or nutrient stock assessments).

3.3. Relational models:

- Statistical methods (e.g. Multivariate regression, trend model surfaces, Generalized Linear Models)
- Probabilistic models (e.g., Bayesian statistics)
- Chemometric models

3.4. Functional fit models: Focused on fitting / optimizing inputs and outputs.

- Modern regression (e.g., Classification trees, Regression trees, Random Forest, Cubist)
- Machine learning (e.g., Support Vector Machines)
- Artificial neural networks
- Genetic algorithms

3.5. Geospatial and geostatistical models:

- Univariate vs. multi-variate methods
- Predictions at point and block support
- Crisp prediction (e.g., kriging) vs. multiple realizations (e.g., spatial stochastic simulations, Bayesian geostatistics)

3.6. Fuzzy models: Vague models.

- Crisp logic vs. fuzzy logic
- Rough sets and fuzzy sets

3.7. Deterministic/mechanistic models: Process-based simulation models; response / impact modeling.

- Pedodynamic models
- Biogeochemical models
- Earth system models / general circulation models

3.8. Autopoietic models: Agent / multi-agent based models.

- Humans as agents
- Organisms as agents

3.9 Inverse models.

3.10. Metaphors: Symbolic models.

4. Integrative Ecosystem Modeling

4.1. Data mining

4.2. Data fusion

4.2 Integration of methods (e.g., Bayesian Belief Networks)

4.3. Ensemble modeling

4.4. Meta Modeling

4.5. Synthesis

4.6. Models in context of politics and diverse socio-cultural systems.

ATTENDANCE AND MAKE-UP WORK

Absences

Students are responsible for satisfying all academic objectives as defined by the instructor. Absences count from the first class meeting.

In general, acceptable reasons for absence from or failure to participate in class include illness, serious family emergencies, special curricular requirements (e.g., judging trips, field trips, and professional conferences), military obligation, severe weather conditions, religious holidays and participation in official university activities such as music performances, athletic competition or debate. Absences from class for court-imposed legal obligations (e.g., jury duty or subpoena) must be excused. Other reasons also may be approved.

You cannot participate in classes unless you are registered officially or approved to audit with evidence of having paid audit fees. The Office of the University Registrar provides official class rolls to instructors.

If you do not participate in at least one of the first two class meetings of a course or laboratory in which you are registered, and you have not contacted the department to indicate your intent, you can be dropped from the course. You must not assume that you will be dropped, however. The department will notify you if you have been dropped from a course or laboratory. You can request reinstatement on a space-available basis if you present documented evidence.

The university recognizes the right of the individual professor to make attendance mandatory. After due warning, professors can prohibit further attendance and subsequently assign a failing grade for excessive absences.

Religious Holidays

The Florida Board of Education and state law govern university policy regarding observance of religious holidays. The following guidelines apply:

- Students, upon prior notification to their instructors, shall be excused from class or other scheduled academic activity to observe a religious holy day of their faith.
- Students shall be permitted a reasonable amount of time to make up the material or activities covered in their absence.
- Students shall not be penalized due to absence from class or other scheduled academic activity because of religious observances.

If a faculty member is informed of or is aware that a significant number of students are likely to be absent from class because of a religious observance, the faculty member should not schedule a major exam or other academic event at that time.

A student who is to be excused from class for a religious observance is not required to provide a second party certification of the reason for the absence. Furthermore, a student who believes that he or she has been unreasonably denied an education benefit due to religious beliefs or practices may seek redress through the student grievance procedure.

Illness Policy

If you are absent from classes or examinations because of illness you should contact your instructors. You should contact your college by the deadline to drop a course for medical reasons. You can petition the Dean of Students Office to drop a course for medical reasons. The university's policy regarding medical excuse from classes is maintained by the Student Health Care Center.

Twelve-Day Rule

Students who participate in athletic or extracurricular activities are permitted to be absent 12 scholastic days per semester without penalty. (A scholastic day is any day on which regular class work is scheduled.) Instructors must be flexible when scheduling exams or other class assignments.
The 12-day rule applies to individual students participating on athletic or scholastic teams. Consequently, a group's schedule that requires absence of more than 12 days should be adjusted so that no student is absent from campus more than 12 scholastic days.
If you previously have been warned about absences or unsatisfactory work you should not incur additional absences, even if you have not been absent 12 scholastic days. It is your responsibility to maintain satisfactory academic performance and attendance.

ONLINE COURSE EVALUATION PROCESS

Student assessment of instruction is an important part of efforts to improve teaching and learning. At the end of the semester, students are expected to provide feedback on the quality of instruction in this course using a standard set of university and college criteria. These evaluations are conducted online at https://evaluations.ufl.edu. Evaluations are typically open for students to complete during the last two or three weeks of the semester; students will be notified of the specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results.

ACADEMIC HONESTY

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity."* You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit 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*."

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code.

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.

SERVICES FOR STUDENTS WITH DISABILITIES:

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating

faculty-student disability related issues. 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
0001 Reid Hall, 352-392-8565, **www.dso.ufl.edu/drc/**

CAMPUS HELPING RESOURCES:
Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575,* **www.counseling.ufl.edu/cwc/**
  - Counseling Services
  - Groups and Workshops
  - Outreach and Consultation
  - Self-Help Library
  - Wellness Coaching

- *Career Resource Center,* First Floor JWRU, 392-1601, **www.crc.ufl.edu/**