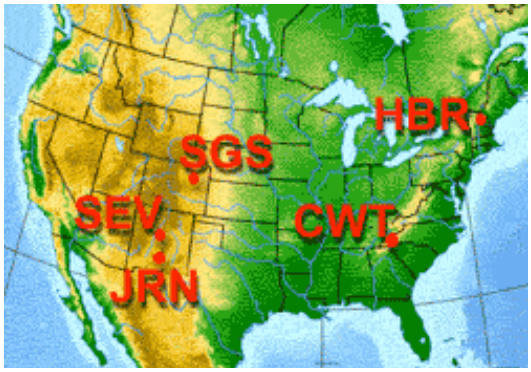
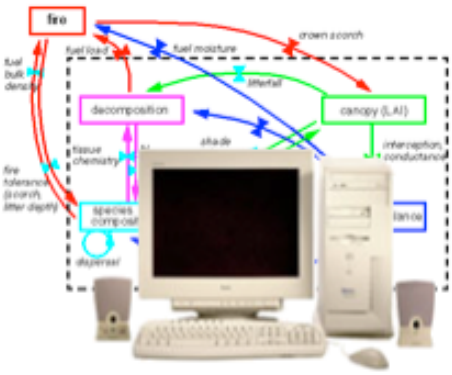
Environmental Gradients

GEOG/ENVR 350





Instructors:

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Office hours: Mon/Thurs 3:00-4:00
or by email appointment

The web site for the class can be found on Blackboard
http://blackboard.richmond.edu/

Course Schedule:
Class meets Tues/Thurs, 1:30-2:45, Carole Weinstein International Center 229.

Prerequisites: GEOG/ENVR 250, ENVR 201, BIOL 207, CHEM 110, or permission of instructor

Course Description:
This class focuses on the approaches, key concepts, and methods of environmental modeling. Understanding the relationships between spatial gradients (e.g., between a species abundance and temperature) is essential to predicting responses to environmental changes such as those predicted under global warming scenarios. We will begin with a discussion of the challenges inherent to describing environmental systems quantitatively. These issues will be revisited throughout the semester and will help guide our class assignments. The remainder of the course will be divided into four units, each focusing on a different environmental system: soil nutrients, climate, hydrologic and biotic. A modeling approach is introduced and different types of conceptual, statistical and simulation models are used to explore the different systems. Class exercises are developed for well-studied Long-Term Ecological Research (LTER) sites of the United States. The final project will be the development of a species distribution model based on tools learned in the course.

Course Materials:
There is no required text for this class. Readings have been excerpted from various sources and will be available on Blackboard. Lecture materials and a course bibliography also will be kept on Blackboard.

Course Organization:
We will begin with a class discussion of the types of challenges that may be encountered in studying environmental systems. These issues will be revisited throughout the semester and will help guide our modeling assignments. The remainder of the course will be divided into five units. Unit one will introduce basic terms and concepts essential to environmental modeling and gradient analysis. Units two through four will address the modeling of three important environmental gradients: soil nutrient, climate, and hydrologic. The final unit will address methods for describing the distribution of a species over the physical environment. This unit will include student-led group presentations of a model of their choice.

Unit One: BACKGROUND.
Topics: Scientific Method; Earth's Systems; Principles of Systems Analysis; Model Types, Concepts and Considerations; Introduction of LTER Study Sites.

Example Readings: Excerpts from Andrew Ford. 2009. "Modeling the Environment." Thomas Kuhn. 1963. The function of dogma in scientific research. Excerpts from Muller et al. 2009. "Long-Term Ecological Research: Between Theory and Application."

Evaluation: Short, in-class quiz consisting of multiple choice and short answer questions (10% of final grade).

Unit Two: NUTRIENT SYSTEM.
Students will select one of four study LTER sites. For the remainder of the semester, groups will work together to construct models of their site.

Topics: Conceptual Models; Nutrient Cycling; Input-Output Measurement Techniques; Weathering Processes.

Example Readings: Excerpts from 1995. Gene Likens and Herb Bormann. "Biogeochemistry of a Forested Ecosystem."

- Vitousek, P.M. et al. 1997. Human alteration of the global nitrogen cycle: Sources and Consequences. Ecological Applications 7:737-750.

Evaluation: 10-minute group presentation of conceptual nutrient model (5% of final grade).

Unit Three: CLIMATE SYSTEM.
This and each successive unit will begin with the construction of a conceptual model of the system being studied via an in-class brainstorming exercise.

Topics: Why is it colder in the mountains? Earth's Energy Budget; Radiation in Mountainous Environments; Temperature in Mountainous Environments; Some Basic Statistics; Regression Models.

Example Readings: Excerpts from "Primer of Biostatistics." 2005. Stanton Glantz.

- Greenland et al. 2003. Long-term research on biosphere-atmosphere interactions. BioScience 53:33-45

Evaluation: mid-term, in-class exam consisting of multiple choice and short answer questions (20% of final grade).

Unit Four: WATER SYSTEM.
Topics: Water, water everywhere… or not? Hydrologic Cycle; Soil-Water Balance; Precipitation Processes and Estimation; Streamflow and Hydrograph Analysis; Simulation Models.

Example Readings: Excerpts from George Hornberger et al. 1998. "Elements of Physical Hydrology."

- Post, D.A. & J.A. Jones. 2001. Hydrologic regimes of forested, mountainous, headwater basins in New Hampshire, North Carolina

Evaluation: homework modeling assignment using TOPMODEL (5% of final grade).

Unit Five: BIOTIC SYSTEM.
Topics: Global Distributions and Associations with Physical Environment; Gradient Analysis; Statistical Techniques for Detecting Watershed Associations: Feedbacks between Vegetation, Soils, Climate, and Hydrology; Spatial Distribution Models

Example Readings: Excerpts from "Analysis of Ecological Communities." 2002. Bruce McCune and James Grace.

- Guisan, A. and Thuiller, W. 2005. Predicting species distribution: offering more than simple habitat models. Ecology Letters, 8: 993–1009.

Evaluation: Each team of student modelers will have one class period to demonstrate their model and lead the class through a simple exercise with their model of choice (10% of final grade). A 7-page write-up of their modeling exercise is due on the day of the presentation (10% of grade).
MODELS: Mahanobis, Maxent, Regression, PCord, Stellla

Student Evaluation:
The course grade will be based on the following components. A short quiz at the end of the first unit will be worth 10% of the final grade. The quiz will consist of 10 multiple choice and short answer questions related to the scientific method, modeling, systems analysis, and the small watershed approach. A mid-term, in-class exam will be worth 20% of the final grade. The mid-term will focus on nutrient and temperature systems and conceptual and regression models. A final, take-home exam will be worth 30% of the final grade. This exam will consist of five essay questions and will cover material from the entire semester.

Working groups will be assigned at the beginning of the second unit. Each group will choose a study site, species and spatial model to analyze and present to the class. These projects will address how the combined influences of the physical environment shape the distribution of species. An exercise presenting the model to the class and a paper describing the model analysis will each be worth 10% of the final grade. We will spend a considerable amount of the second half of the semester working on these models.

Class participation will be worth 10% of the final grade. To gain full credit for participation, students must:

- demonstrate excellent preparation for class including completing the assigned readings prior to class;
- facilitate productive class discussions and group activities on a consistent basis;
- offer analysis, synthesis, and evaluation of material not just reiteration of information without elaboration;
- answer questions and raise substantive questions about the readings and assignments; and
- engage thoughtfully with invited guest speakers.

In addition, students are expected to remain fully attentive in the class without distractions such as text messaging, using the Internet, and talking about matters unrelated to class. One undocumented (no note from a dean or physician) absence is permitted per semester. One point will be deducted for each additional absence.

10% class participation
10% quiz
5% conceptual model presentation
20% mid-term
5% hydrological model homework assignment
10% final habitat model presentation
10% final habitat model paper
30% final exam (cumulative)
100%

- The grading scheme will follow standard University of Richmond guidelines (http://registrar.richmond.edu/services/policies/grading.html).

A > 93 pts	**B 87-83**	**C 77-73**	**D 67-63**
A- 93-90	**B- 83-80**	**C- 73-70**	**D- 63-60**
B+ 90-87	**C+ 80-77**	**D+ 70-67**	**F < 60 pts**

If you experience difficulties in this course, do not hesitate to consult with me. There are also other resources that can support you in your efforts to meet course requirements.

Academic Skills Center (http://asc.richmond.edu or 289-8626) helps students assess their academic strengths and weaknesses; hone their academic skills through teaching effective test preparation, critical reading and thinking, information processing, concentration, and related techniques; work on specific subject areas (e.g., calculus, chemistry, accounting, etc.); and encourage campus and community involvement.

Career Development Center (http://cdc.richmond.edu/ or 289-8141) can assist you in exploring your interests and abilities, choosing a major, connecting with internships and learning experiences, investigating graduate and professional school options, and landing your first job. We encourage you to schedule an appointment with a career advisor during your first year.

Counseling and Psychological Services (289-8119) assists students in meeting academic, personal, or emotional challenges. Services include assessment, short-term counseling and psychotherapy, crisis intervention and related services.

Speech Center (http://speech.richmond.edu or 289-8814): Assists with preparation and practice in the pursuit of excellence in public expression. Recording, playback, coaching and critique sessions offered by teams of student consultants trained to assist in developing ideas, arranging key points for more effective organization, improving style and delivery, and handling multimedia aids for individual and group presentations.

Writing Center assists writers at all levels of experience, across all majors. Students can schedule appointments with trained writing consultants who offer friendly critiques of written work: http://writing.richmond.edu

Note: Students having special needs that require an accommodation or an academic adjustment, please arrange a meeting with me within the first two weeks of the semester.