ENVIRONMENT AND NATURAL RESOURCES 5274
Ecosystems Simulation
(3 Credit Hours)

Course Instructor:

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330-466-8758 (cell)
Face-to-face meetings are by appointment.

Times and Location:

This course is offered during Spring Semester and consists of 1 hour of lecture and two, 3 hour labs per week. The lecture is at 12:40 pm Monday in 245 Kottman Hall. The labs are at 9:10 am Tuesday and Thursday in 231 Kottman Hall.

Student Learning Goals:

Student will gain skills in conducting computer simulations through laboratory exercises including data sourcing for climate, soil, vegetation and land use parameters. Students will gain an understanding of the impact of spatial and temporal scales on the scope, underlying assumptions and data requirements of various ecosystem simulations. Students will become knowledgeable of simulation issues such as sensitivity analysis, model calibration and validation techniques. Students will also learn some of the underlying principles and theories employed in the development of natural systems simulations and explore biotic and abiotic interactions within an ecosystem.

Expected Learning Outcomes:

1. Students gain skills in accessing data bases of climate, soil, vegetation and land use.
2. Students gain skills in conducting computer simulations through laboratory exercises.
3. Students gain an understanding of spatial and temporal scale effects on the level of detail used in modeling an ecosystem.
4. Students become knowledgeable of sensitivity analysis, model calibration and validation techniques.
5. Students learn underlying principles employed in the development of natural systems simulations.
6. Students explore biotic and abiotic interactions within an ecosystem.

**Course Description:**

ENR 5274 is a laboratory course to provide students skills in conducting computer simulations of agricultural, forest and urbanized ecosystems. Issues addressed through the simulation exercises will include both biological production and environmental protection. Central to ecosystem simulation are the spatial and temporal scales under consideration. Thus, the course will employ software packages that span these spatial and temporal scales. Local-scale water and solute transport modeling will employ HYDRUS. Production system simulations including nutrient fate and biological activity will employ RZWQM. Field-scale agricultural and forest production simulations including carbon cycling will employ WinEPIC. And watershed-scale agricultural and forest simulations will employ arcSWAT. In addition to learning the mechanics of conducting these simulations, students will gain experience accessing input data of the ecosystem climate, soils, vegetation and land use employing software packages such as REF-ET, ROSETTA and SWRC Fit.

The principal activity of this course consists of weekly assignments to conduct a specified series of simulation and prepare a report. In addition to the scale and ecosystem factors, the weekly assignments will include perturbations to the ecosystem that may have an influence on production (e.g. cropping with or without primary tillage) or environmentally important (logging effects on stream flow) responses. Consequently, an important component of the weekly assignments will include interpretation of the simulation output in response to a given perturbation. Finally, some assignments will explore issues related to modeling such as sensitivity analysis, model calibration, and model validation.

The skills gained by students successfully completing this course should aid in future professional activities of natural resource management, risk analysis, economic analysis and natural systems research.

**Course Materials:**

A formal textbook will not be required for this course. All simulation tools used in the course are available as free downloads from the internet. Readings and model documentation will be provided via Carmen.
Course Content:

The tentative weekly activities of ENR 5274 are as follows:

<table>
<thead>
<tr>
<th>Week</th>
<th>Activity</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to HYDRUS and soil hydraulic information</td>
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<tr>
<td>2</td>
<td>Climate data sourcing and sensitivity analysis of water infiltration using HYDRUS</td>
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<tr>
<td>3</td>
<td>Root water uptake and non-reactive solute transport using HYDRUS</td>
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<td>4</td>
<td>Reactive solute transport and pesticide fate using HYDRUS</td>
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<tr>
<td>5</td>
<td>Introduction to RZWQM and organic carbon cycling</td>
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<td>6</td>
<td>Nitrogen management effects on N fate in long term cropping systems using RZWQM</td>
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<tr>
<td>7</td>
<td>Pesticide fate and climate change predictions in cropping systems using RZWQM</td>
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<tr>
<td>8</td>
<td>Comparison between agricultural and forest land management using RZWQM</td>
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<tr>
<td>9</td>
<td>Land use impacts on stream flow and nutrient loading using ArcSWAT</td>
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<tr>
<td>10</td>
<td>Agricultural N management effects on stream loading using ArcSWAT</td>
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<tr>
<td>11</td>
<td>Phosphorus fate and surface water quality using ArcSWAT</td>
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<tr>
<td>12</td>
<td>Mine reclamation with perennial vegetation using ArcSWAT</td>
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<tr>
<td>13</td>
<td>Inverse modeling of water &amp; solute transport in soils using HYDRUS</td>
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Assessment Format:

Student performance will be assessed from points earned on lab reports and from a final exam. Sixty percent of a lab report score is earned by a demonstrated proper running of each weekly simulation and 40% is earned by correctly answering the data interpretation questions. The lowest lab report score for each student will be dropped. The final exam will consist of short answer questions and be used to demonstrate the students understanding of the principles and concepts of the simulation process, the theoretical underpinnings of the individual simulation software, and the limitations of a given software package.

Eighty percent of the students score in assigning letter grades will be from the lab reports and 20% of the students score will be from the final exam. The grading scale is A=90%, B=80%, C=70%, D=60%, E less than 50%.

Academic Misconduct:

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with
examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).

**Disability Services:**

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated, and should inform the instructor of their needs as soon as possible. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Ave.; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/.