GEOG*6550 Environmental Modelling

The University of Guelph, Department of Geography

Winter 2018, 0.5 Credits – Provisional

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Office Hours: Mondays 8:30AM to 11:20AM

Course Description
This course aims to provide students with an understanding of the processes and techniques involved in environmental modelling practice and will focus on the power and limitations of existing models.

Objectives
Most computer models of environmental process are exceedingly complex and require a substantial amount of experience and familiarity to operate. Furthermore, these models tend to focus on specific problem domains, e.g. hydrological, ecological, climate, or geomorphological models. Geography is a very broad discipline and I assume that each of you have your own areas of interest in which you hope to become more knowledgeable and adept as modellers. As such, it would be futile for me to teach this class with an emphasis on learning how to operate one or two existing computer models, such as the SWAT model. Instead, I intend to focus more on the broad issues in environmental modelling. By the end of the course, students should be familiar with the various model types and modelling approaches, and the major issues involved in modelling practice.

Although it is not necessary to learn a programming language to operate many existing environmental models, if you advance as a modeller far enough, you will certainly find that programming is a prerequisite and indispensable skill. Programming can aid not only with the development of new computer models, but also with more common tasks encountered by model-users, such as data preparation and visualization. Programming often provides the language by which modellers communicate with their models. It
would be nice if you had previous experience with a programming language, although I assume that many (most) have very limited experience programming. If you have none, don’t worry because we will work through it. You will learn basic programming skills in this course through the lecture, practical, and research-based class components. The aim is to enable students to programmatically handle the input and output data used in environmental models. Your willingness to learn is what counts.

**Readings**

There is no required course text. Instead, I will draw upon selected journal articles and book chapters.

**Course Website**

This course does have a CourseLink site. This site will be used to distribute information about the course, lecture notes, and learning resources. You are advised to check this site weekly.

**Content**

In addition to lecturing, there will be a practical component to some classes. As such, students are advised to *bring a laptop computer to class.*

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<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic†</th>
<th>Student Presentation</th>
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<tbody>
<tr>
<td>1</td>
<td>Jan 8</td>
<td>Introduction</td>
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<tr>
<td>2</td>
<td>Jan 15</td>
<td>Modelling types and approaches</td>
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<td>3</td>
<td>Jan 22</td>
<td>Developing a computer model</td>
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<td>4</td>
<td>Jan 29</td>
<td>Model theory</td>
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<td>5</td>
<td>Feb 5</td>
<td>Model data</td>
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<td>6</td>
<td>Feb 12</td>
<td>Parameterization, calibration, and validation</td>
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<td>Feb 19</td>
<td><strong>Winter Break—No class</strong></td>
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<tr>
<td>7</td>
<td>Feb 26</td>
<td>Parameterization, calibration, and validation</td>
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<td>8</td>
<td>Mar 5</td>
<td>Error and uncertainty in models</td>
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<td>9</td>
<td>Mar 12</td>
<td>Modelling and scale</td>
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<td>10</td>
<td>Mar 19</td>
<td>Data visualization</td>
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<td>11</td>
<td>Mar 26</td>
<td>Student project help session</td>
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<tr>
<td>12</td>
<td>Apr 2</td>
<td>Student research project presentations²</td>
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**Notes:** 1. Topic and dates are subject to change as I inevitably fall behind. 2. The schedule of the student research project presentations is yet to be determined.

**Evaluation**
Your final grade will be based on a model presentation (15%), class participation (15%), two small assignments (2 x 5 = 10%), and a model-based research project (60%).

**Model Presentation:** Each student will be assigned a class date in which they will present a summary of a modelling-related research project based on a published journal article (published in a scholarly journal, e.g. *Ecological Modelling*, *Hydrological Processes*, *Earth Surface Processes and Landforms*, *Environmental Modelling & Software*, etc.). The paper must be approved at least one week prior to the student's presentation and should describe and apply a model to the study of some environmental phenomenon. Presentation will be no more than 15 minutes and must summarize the paper, highlighting the problem domain, the model type and characteristics (e.g. inputs, outputs, how it works), plus provide a brief ‘critique’ of its strengths and weaknesses or limitations. Students will be evaluated based on the presentation quality, organization, and level of insight.

**Model Development, Research Project and Presentation:** Each student will develop a computer model using either Python, Go, R, Rust, Java, Groovy, C#, C/C++, D, Matlab, or similar language. The model can rely on geospatial data and can use GIS and/or remote sensing software for visualization. The project report must be no longer than 18 pages of double-spaced, size 12 font, plus figures, tables, and appendices. The report should include the code for the computer model in Appendix A. Students are also required to provide a 15-minute presentation on their projects near the end of the semester. Please discuss your topic with me early in the semester. The two small assignments described in the **Evaluation** section above are milestones towards this final project to ensure adequate progression.
The results should be presented in the format of the Journal of Hydrology. The paper should include an introduction including the specific objectives of the study, a brief, pertinent literature review, methodology, presentation of results, discussion, and conclusion. All figures should be of high quality in keeping with a graduate-level course. The paper should be no longer than 20 pages of double-spaced size 12 font, plus up to 8 figures and 2 tables (N.B. keep in mind this is a term paper not a thesis).

E-mail Communication
As per university regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement
Late assignments will be assessed a penalty of 10% per day (not including weekends). After the assignment has been handed back to the class no grade can be assigned on late work.

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration.

Territorial Acknowledgements
We acknowledge that the University of Guelph resides on the ancestral lands of the Attawandaron people and more recently, the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer our respect to our Anishinaabe, Haudenosaunee and Métis neighbours as we strive to strengthen our relationships with them.

Today, this gathering place is home to many First Nations, Métis and Inuit peoples and acknowledging them reminds us of our important connection to this land where we learn and work.

Drop Date
The last date to drop one-semester courses, without academic penalty, is March 9, 2017. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar.
**Copies of out-of-class assignments**

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

**Accessibility**

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: [http://www.uoguelph.ca/sas](http://www.uoguelph.ca/sas)

**Academic Misconduct**

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.
**Recording of Materials**

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

**Resources**

The [Academic Calendars](#) are the source of information about the University of Guelph’s procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.