28 July 2022

DEPARTMENT OF GEOGRAPHY

GEOG 601 Advanced Environmental Systems Modelling 2022

Class Time: Workshops Wednesday 08:30 – 11:30 BH 511

Instructor: Professor Nigel T. Roulet
BH 620 Telephone: 4945 E-mail: nigel.roulet@mcgill.ca *

Description: This course introduces you to the modelling of environmental systems. The learning objective of this course is to help you develop a systems intuition. This intuition is gained by conceptualizing and constructing simple models of environmental systems. However, even though the models are often very simple, they display complex behaviours.

Environmental systems are inherently complicated. They are often complex, poorly defined with fuzzy boundaries, and have weakly constrained relationships between variables. They often contain one or more feedback loops. This course deals with conceptualizing and constructing simple models to examine environmental problems, starting with a clear question and a well-defined objective. Next, you begin to map out the critical components of the system of interest, defining the reservoirs or stocks (state variables), the flows among reservoirs (fluxes), and/or connecting inputs and outputs across the system's boundary (structure). It will become apparent that very few environmental systems are linear. Even if the model runs, how do we know it is a "good" representation of the actual system? We need to assess the model's stability and performance with objective criteria. Sensitivity analysis can give insight into critical relationships and parameters in the model. Finally, we should feel comfortable using the model to address the original research question. In reality, model development is a much more heuristic process than just presented: failure at any step requires a reformulation of earlier steps (a negative heuristic process).

Learning in GEOG 601 takes place in structured workshops in BH 511. The workshops are usually followed by an assignment to further your understanding. The questions for the assignments are from the chapters of the textbook. It is very important you keep up with the assignments and readings, as the learning is progressive – each week we build on what happened the previous. In the last three or four weeks, you will build your model or a module to add another component to an existing model.

For this course we will use STELLA® Archetect Version 3.0.1 for the workshops, assignments and the project. The software is available on the BH 511 and GIC computers. You can also purchase a student version of Stella or a semester or perpetual student license (https://www.iseesystems.com/store/education.aspx), but this is not necessary to complete the course.

Components of This Course: there will be two main activities in this course:

Workshops: There will be a 3-hour workshops each week. Each workshop will contain one or more mini-lectures where I provide content and instructions, and you will then begin to work through model structures. For the most part, the model examples come directly from the textbook or web material that supports the textbook. In November, we can work together to build your model for the model project.

Modelling Project: The modelling project requires you to conceptualize, develop, build and test a model, or module for an existing model, of an environmental system that interests you. Many pick an aspect of the system they are studying in their graduate research. You need to submit by 17:00 06 December, 2022, a manuscript in the form of an original research paper, describing your model in a format that would be suitable for Ecological Modelling (http://www.elsevier.com/wps/find/journaldescription.cws_home/503306/authorinstructions), or similar journal. You also need to submit a working version to Professor Roulet your STELLA model code.

On or before class time 05 October, 2022 you are asked a five-page maximum description of the environmental problem your model plans to address. Use the following sub-headings to structure your model outline: background to the modelling problem; the research question your model will address; a one-sentence statement of your modelling objective; a graphical outline of your model's preliminary structure (this can be hand drawn); a description of what you think the main state variables and inputs and outputs will be; and a graph (again hand drawn is fine) of your anticipated model outcome.

We will have a modelling symposium where you present the model you have developed to the class on 30 November 2022. You will speak for up to five minutes describing a poster of your modelling project.

Note: "***In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded." (approved by Senate on 21 January 2009)***"

"***Conformément à la Charte des droits de l'étudiant de l'Université McGill, chaque étudiant a le droit de soumettre en français ou en anglais tout travail écrit devant être noté (sauf dans le cas des cours dont l'un des objets est la maîtrise d'une langue)***."

Evaluation

Assignments (6 @ 7% each) ..	42%
Individual modelling Project	
Research problem and model objectives (due 05 October 2022)	8%
Symposium presentation (30 Novermber 2022), research paper, and model code (due 05 December 2022)	50 %

NOTE: There will be no supplemental examination, and no additional work will be accepted to upgrade D, F, or J marks.

Course Text and Websites: The course text is:

Ford, Andrew (2009). Modeling Environment: An Introduction to Systems Dynamic Modeling of Environmental Systems – 2nd edition, Island Press, Washington DC, 380 pp. There is a good website supporting this textbook http://public.wsu.edu/~forda/AA2nd.html. Bring the text each class as we use it regularly during class. The text is available as an ebook at https://islandpress.org/books/modeling-environment-second-edition. Paper copies of the text book are available at the Pargraphe Bookstore on

McGill College. It is a reasonably priced book and well worth the investment.

McGill University policy on Academic Integrity

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information).*(approved by Senate on 29 January 2003)*

L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le site www.mcgill.ca/students/srr/honest/).

Other relevant general University Rules, regulations and guidelines
(copied from http://www.mcgill.ca/tls/teaching/course-design/outline)

- © Instructor generated course materials (e.g., handouts, notes, summaries, exam questions, etc.) are protected by law and may not be copied or distributed in any form or in any medium without explicit permission of the instructor. Note that infringements of copyright can be subject to follow up by the University under the Code of Student Conduct and Disciplinary Procedures.

- *"As the instructor of this course I endeavor to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me and the Office for Students with Disabilities, 514-398-6009."*

- *"End-of-course evaluations are one of the ways that McGill works towards maintaining and improving the quality of courses and the student's learning experience. You will be notified by e-mail when the evaluations are available on Mercury, the online course evaluation system. Please note that a minimum number of responses must be received for results to be available to students."*

- *"McGill has policies on sustainability, paper use and other initiatives to promote a culture of sustainability at McGill." (See the Office of Sustainability.)*

- *"Additional policies governing academic issues which affect students can be found in the McGill Charter of Students' Rights" (The Handbook on Student Rights and Responsibilities is available at https://www.mcgill.ca/deanofstudents/rights)*