DEPARTMENT OF GEOGRAPHY

GEOG 501 Modelling Environmental Systems 2018f

Class Time: Thursdays 08:30 – 11:30 BH 511 (behind the GIC)

Instructor: Professor Nigel T. Roulet
BH 620 Telephone: 4945 E-mail: nigel.roulet@mcgill.ca *
Office Hours: Monday 13:30 – 14:20 (except October 01, 08 & November 19),
Wednesday 13:00 – 14:00 (except October 31 & November 7), or by appointment.

* Note: I am attempting to not read my McGill e-mails in evening or on weekends. I also not provide advice or directions on the assignments or the project by e-mail – use e-mail to make an appointment to come and see me. On weekdays I will make every attempt to respond to your e-mail within 24 hours.

Teaching Assistant: Siya Shao (siya.shao@mail.mcgill.ca)

Course Description: This course introduces you to the modelling of environmental systems. It is designed to help you develop your 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 difficult to deal with. They tend to be 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 the conceptualization and construction of simple models to examine environmental problems. This process begins with a clear question and a well-defined objective. You can then 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. Once a model runs how do we know it is a "good" representation of an actual system? This can be approached by doing stability tests and evaluating the model's performance with some objective criteria. Sensitivity analysis can give insight to critical relationships and parameters in the model. At this stage we should feel comfortable to use the model to address the original research question. In reality model development is a much more iterative process than just presented: failure at any step requires reformulation of earlier steps (a negative heuristic process).

This course is taught interactively. There are only two formal lectures – most of the learning takes place actively in structured workshops. Workshops are followed by assignments to further your understanding. It is very important you come prepared to work through the models we develop in the workshops. In the last three weeks of the course you will build your own model, or a module to add another component to an existing model. We will use STELLA® Archetect Version 1.6.2 for the workshops, assignments and the project. It has been installed on the computers in BH 511and the library area of the 5th floor. Stella can be found on any computer in the library system. There are some limited options to purchase copies of Stella (https://www.iseesystems.com/store/education.aspx) for

students but this is not necessary to complete the course.

BH 511 Active Learning Classroom: In 2009 the BH 511 classroom was built and GEOG 501 was the first course taught in the new classroom. BH 511 was McGill's first active learning classroom (https://www.mcgill.ca/tls/spaces/alc). The classroom arrangement allows for much more and broader interactions, and collaborative and collective learning. For you to benefit from this course you are encouraged to interact with each other and the instructor. Warning – there is software on your computers that allows the instructor to see your screen. This is not to evaluate what you are doing but to enable the use of your screen to others to help broaden the learning experience.

Components of This Course: There are three different activities in this course:

Lectures: There are only, at most, 2 formal lectures in this course.

Workshops: There will be either a 1 ½ hour or a 3 hour workshops each week depending on whether there is a lecture or not (see course schedule). In the workshops you will be shown and asked to work through model structures. The model examples, for the most past, come directly from the text book, or web material that supports the textbook. It is important by the third week you bring the course textbook to every class and have read the assigned material before coming to class . In November, there are three workshops dedicated for you to build your own model for the model project. In these workshops the instructor and the TA will be available to provide assistance and advice. If necessary ah hoc additional workshop session can be added in the last three weeks of the course. It is strongly recommend that you take advantage of these structured workshops – the instructor and TA do not have much sympathy for students seeking help outside of class time who have not attended these in-class workshops.

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 or undergraduate research. You need to submit by 17:00 December 05, 2018 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). You also need to submit a working version to Professor Roulet your STELLA model code. By classtime Octoboer 18, 2018 you are asked a four 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 also hold in the last class, November 29, 2018, a model symposium. You will present your models as poster presentations. Details on the size of the poster and how to do a poster presentation will be posted on the GEOG 501 myCourses webpage well in advance of November 29. Your poster will be print for free by the GIC if you submit your poster to the GIC technician (Ruilan.shi@mcgill.ca) by 10:00 am November 27, 2018. Maximum poster size is 90 x 120 cm.

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 (5 @ 8% each) ..	40%
Individual modelling Project	
Research problem and model objectives (due October 18, 2018)	5%
Research paper and code (due December 5, 2018)	45%
Modelling symposium presentation (November 29, 2018)	10%

Policy on Late Assignments: All submitted material will be considered late after the due time and date. Late laboratory assignments and modelling projects will have 25% deducted for the first 24 hours they are late and 10% for each additional day thereafter. If there are reasons you cannot meet a deadline be sure to inform Professor Roulet well ahead of time but there a few legitimate reasons for late assignments or projects. I have been a university professor for over 30 years so I have heard most excuses.

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

Course Text and Websites: The following course text is available at Paragraphe Books (2220 McGill College Avenue – across Sherbrooke from the Roddick Gates).

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. Because this book has been used in past years there may be used texts available. The textbook can be purchased on Amazon.ca but it is about the same price as at Paragraphe.

In addition to the text book there are three papers from scholarly journals or on theweb that have been assigned for reading. These are:

Aber, J.D. Why don't we believe the models? Bulletin of the Ecological Society of America 78 (3): 232-233, 1997.

Aumann, C. A. (2007). "A methodology for developing simulation models of complex systems." Ecological Modelling **202**(3-4): 385-396.

Jackson, L.J., A.S. Trebitz & K.L. Cottingham. An introduction to the practice of ecological modeling. Bioscience 50:694-706, 2000.

There are several websites that contain a good introduction and/or discussion of systems modelling. A few good ones you may wish to refer from time-to-time during the course to are: http://www.systems-thinking.org/ , http://www.donellameadows.org/systems-thinking-resources/, and two interesting short videos: one by Peter Senge http://www.mutualresponsibility.org/science/what-is-systems-thinking-peter-senge-explains-systems-thinking-approach-and-principles and an interesting TED talk http://www.youtube.com/watch?v=jS0zj_dYeBE

There are also a number of books on environmental modelling and systems thinking that can help you out over the term.

Meadows, Donella H. *Thinking in Systems*, earthscan, 2008. QA402 M425 2008 Schulich & Macdonald

Morecroft, John. *Strategic 4modeling and business dynamics: a feedback systems approach*, John Wiley & Sons, 2007. HD30.23 M663 2007 Schulich

Smith, Jo. *Introduction to Environmental Modelling*, Oxford, 2007. GE45 M37 S65 2007 Schulich

Wainwright, John. *Environmental modeling: finding simplicity in complexity*,Wiley, 2004. Access through McGill libraries to http://onlinelibrary.wiley.com/book/10.1002/9781118351475

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)*