ENVS*6730 Special Topics in Environmental Science: Complex Environmental Systems

Fall 2020

Sections(s): C02

School of Environmental Sciences Credit Weight: 0.50

Version 1.00 - July 15, 2020

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1 Course Details

1.1 Calendar Description

While systems are typically defined as a collection of “things” that serve a purpose, complex systems need to be handled differently. Complex systems are systems with multiple components that are interacting with, learning from and adapting to their neighboring components and environments in a nonlinear fashion, thereby leading to emergent behaviours that are difficult to predict. In environmental sciences, many problems can be better understood using complex-system approaches, including problems related to climate change, the functioning of insect colonies, fish and bird migration, soil, water and vegetation dynamics, the response of ecosystems to natural and anthropogenic disturbances, and socio-ecological sustainability. This course is designed as an inter-disciplinary introduction to systems thinking, complex system characteristics, rule-based modelling and environmental scenario analysis. Learning objectives will be achieved through a combination of lectures, critical readings, hands-on modelling exercises and oral presentations.

Pre-Requisite(s): Instructor permission

There are no real pre-requisites for this course, except some background in environmental sciences, geography or biology. This course does not focus on scientific computing and therefore, no modelling or programming experience is needed. All models used in the course will be executed via the easy-to-use graphical interface of the NetLogo software.

Restriction(s): None

1.2 Timetable

To be determined

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2 Instructional Support

2.1 Instructor(s)

Genevieve Ali

Email: gali@uoguelph.ca

Telephone: +1-519-824-4120 x52740

Office: ECBL 2225

Office Hours: By appointment

2.2 Teaching Assistant(s)

Not applicable

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3 Learning Resources

3.1 Recommended Ressource(s)

No textbook is required. A list of required and optional readings will be posted on Courselink throughout the term. Access to a personal computer (laptop or desktop) is required for the course.

3.2 Other

The instructor will provide links to interesting instructional videos, tutorials, websites and/or phone applications if and when appropriate. Google can also be a useful resource for this course.

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4 Specific Learning Outcomes

By the end of this course, you should be able to:

1. Conceptualize any environmental problem using systems thinking principles (LO1)
2. Distinguish the different stages of model development (LO2)
3. Understand key complex system characteristics (LO3)
4. Know how to execute and interpret the results of stock and flow models, agent-based models and network models (LO4)
5. Perform environmental scenario analyses in relation to environmental disturbance assessments (LO5)
6. Communicate analysis results in writing, orally and graphically according to scientific standards (LO6)

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5 Teaching and Learning Activities

5.1 Lectures

Lectures will be organized under six different modules or topics*. The schedule below is tentative; it may be adjusted through the term as needed.

Module #1: Systems thinking (Week 1-2)

Module #2: Systems modelling basics (Week 2-3)

An introduction to the NetLogo software will take place in Week 2

Module #3: Complex system notions (Week 4-5)

Module #4: Agent-based models (Week 6-8)

Module #5: Network models (Week 9-10)

Module #6: Environmental scenario analysis (Week 11-12)

Term project presentations will take in place in Week 13

* While attending lectures is not mandatory, please note that there are some course materials that will solely be discussed in class and will not be available on Courselink. Lecture periods (3-hour blocks) will all be a mix of traditional lecture, group discussions and hands-on exercises in NetLogo.

5.2 Labs

Not applicable. Hands-on modelling exercises will take place during the lecture timeslot listed above.

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6 Assessments

6.1 Marking Schemes & Distributions

Assessment	Weight (%)
Critical reading presentations (LO3, LO6)	30
Modelling assignments (LO1, LO2, LO3, LO4, LO5, LO6)	45
Term project (LO1, LO2, LO3, LO6)	25
Total	100

6.2 Assessment Details

Critical reading presentations (CRP)

Critical reading** is an important skill to master in environmental sciences. Hence, in this course, students will be trained in critically assessing (and even challenging) the conclusions put forward by researchers in journal articles. To accommodate the diversity of interests in the class, journal articles on various topics will be posted on Courselink for you to choose from. From the posted list, you will be able to choose the journal article you want to read and then prepare a 5-minute oral presentation for class. **Please note that your presentation slides (in PDF format) need to be submitted to the instructor, via Courselink, at least 2 hours before class on the day of the presentation.**

For CRP #1: papers will be posted in week 4 and presentations will take place in week 5

For CRP #2: papers will be posted in week 6 and presentations will take place in week 8

For CRP #3: papers will be posted in week 11 and presentations will take place in week 12

Out of the three presentations you will deliver during the term, **only the two presentations for which you have achieved the highest marks will count towards your overall course grade**.

Modelling assignments (MA)

While you will not create any complex system model from scratch in this course, you will experiment with many different models either built-in in the NetLogo software or customized by the instructor. Instructions will be provided to guide you in changing model parameters in NetLogo, run model simulations and interpret simulation results. You will start running simulations while in class to benefit from the help of the instructor. Upon completion, your simulation results and interpretations should be included in a typed report.

MA #1 will focus on a stock and flow model of forest tree growth. You will start running simulations in class in week 3 and your assignment will be due in week 4

MA #2 will focus on an agent-based model of population growth. You will start running simulations in class in week 8 and your assignment will be due in week 9

MA #3 will focus on a network model of covid-19 propagation. You will start running simulations in class in week 10 and your assignment will be due in week 11

MA #4 will focus on model-driven environmental scenario analysis for a landscape threatened by wildfires and insect infestations. You will start running simulations in class in week 12 and your assignment will be due in week 14 (i.e., after classes have ended)

Out of the four modelling assignments that you will hand in during the term, **only the three assignments for which you have achieved the highest marks will count towards your overall course grade**.

Term project

One of the learning objectives of this course is for you to know how to conceptualize any environmental problem or situation using systems thinking principles (LO1). As a term project, each of you will therefore select a real-world complex system, describe its component and component interactions and think about how it could be modelled. You will have to rely on the concepts and approaches seen through the lectures to describe your chosen system. Your term project will be evaluated as two distinct deliverables:

Initial system description (5%): in 250 words or less, you will name your chosen system and explain to the instructor why you have chosen it. You will also need to identify its boundaries and some of the stocks, flows and feedbacks that characterize it. Your initial system description is due early in the term, i.e., in week 3. This will allow the instructor to provide you with early feedback and allow you to make any required changes to your project scope

Project presentation (20%): in week 13, you will give an oral presentation in front of the class to present the results of your system analysis. Your presentation is required to include: (i) a discussion of the importance of your chosen system in environmental sciences; (ii) a system diagram (i.e., causal diagram or stock and flow diagram) detailing the major components of your system and their interactions; (iii) an identification of key complex system features (i.e., emergence, nonlinearity, self-organization, memory, etc.) exhibited by your system; and (iv) a discussion of modelling approaches that may be best suited to represent your system. Ideally, you will be allowed 15 minutes (10-minute talk + 5-minute Q&A) for your presentation. However, please note that depending on class size, the time allotted for each presentation may be revised. **Your presentation slides (in PDF format) need to be submitted to the instructor, via Courselink, at least 2 hours before class on the day of the presentation.**

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7 Course Statements

7.1 Communication

You are required to check your uoguelph email on a regular basis, as important messages related to this course may be sent from Courselink. You are also required to check the course website (Courselink) regularly for special announcements, new documents to download, etc. The course instructor will do her best to answer emails within 48 hours (weekends and holidays excepted). However, you should remember that the best time to communicate with the instructor is during class time.

7.2 Group work

You can discuss any material or work subject to evaluation with fellow students. However, anything that you hand in to the instructor (i.e., critical reading presentation slides, modelling assignments, term project elements) should be your own.

7.3 Late work

All assignments (i.e., presentation slides, modelling assignments, and term project elements in this course) are to be submitted to the instructor, via Courselink, on or before the due date. Email submissions will not be accepted unless agreed upon ahead of time with the instructor. All late work will receive a 10% deduction for each day, or part thereof, that they are late, up to a limit of five (5) days. Work that is 6 days late or more is guaranteed to receive a failing grade. Extensions will only be considered for medical reasons or other extenuating circumstances, provided that they are discussed with the instructor well before the due date. Extensions will not be granted once the due date has passed.

You should remember that a technical difficulty is not a valid excuse not to turn in an assignment on time. Don't wait until the last minute as you may get behind in your work. Be sure to keep a back-up copy of all your assignments: to avoid any last-minute computer problems, save your assignments to a cloud-based file storage (e.g., Google Docs, Dropbox) or send copies to your email account so that should something happen to your computer, your assignment can still be submitted on time or re-submitted. Please note that these rules are not designed to be arbitrary, nor are they inflexible: they are designed to keep you organized, to ensure that all students have the same amount of time to work on assignments, and to help the instructor return marked materials to you in the shortest possible time.

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8 University Statements

8.1 Email Communication

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

8.2 When You Cannot Meet a Course Requirement

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. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals:

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

8.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses

https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

8.4 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.

8.5 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 can be found on the SAS website: https://www.uoguelph.ca/sas

8.6 Academic Integrity

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 encourages academic integrity. 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.

Undergraduate Calendar - Academic Misconduct

https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

8.7 Recording of Materials

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

8.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars: https://www.uoguelph.ca/academics/calendars