

Course outline: Climatic Environments / GEOG 321 / 001

General information

Term and year: Winter 2026

Course pre-requisite(s): GEOG 203 or ATOC 210

Course schedule (class day(s) and time): Tuesdays & Thursdays from 2:35pm – 3:55pm in BH 306

Number of credits: 3

Instructor information

Name and title: Dr. Sara Helen Knox

E-mail: sara.knox@mcgill.ca

Office location / office hours: BH 619 (or via Zoom) / Mondays 1-2pm

Communication plan: During my office hours, my door (Zoom room) is always open. If the office hour does not work with your schedule, please let me know & I will try to work out a time to meet with you. If you would like to meet via Zoom during office hours, please make sure to coordinate with me ahead of time. I welcome you to contact me outside of class and office hours. I aim to respond to emails within 2 business days (and **primarily during work hours** – M-F from 9am to 5pm ET).

Course overview

The earth-atmosphere system, radiation and energy balances. Surface-atmosphere exchange of energy, mass and momentum and related atmospheric processes on a local and regional scale. Introduction to measurement theory and practice in micrometeorology.

Learning outcomes

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

- explain how the surface radiation and energy budget affects the surface climate.
- describe important surface characteristics that affect surface radiation and energy budgets and surface microclimates.
- understand the basics of turbulence, dispersion and local wind systems in the atmospheric boundary layer and how they are controlled by surface processes.
- provide examples of key physical, biological and chemical processes that control trace gas, water and energy fluxes between the land surface and the atmosphere.
- provide examples of how surface-atmosphere interactions respond to environmental change, and how this can create climate feedbacks.
- know the principles of basic instrumentation, methods and data-analysis (including the use of the R programming language) used for today's monitoring and modelling of weather and climate in the atmospheric boundary layer.
- analyze and interpret data from measurement systems that are used to monitor near-surface climate and surface radiation, energy, and greenhouse gas balances.
- explain how the principles of micrometeorology have practical applications to society.

Instructional methods and class recordings

The course consists of two 80-minute lectures each week and one lab visits covering 32 topics, directed readings, assignments, study questions, a midterm during the semester and a final during the exam period.

Lectures will be held **in-person**. Note that if you do not attend lecture, you will not receive participation marks for that day, however, each student can miss up to **three** lectures without it impacting their participation grade. If you miss a lecture due to medical or other reasons, please reach out to me if you have questions regarding the material covered in class that day. If you miss more than 3 lectures, contact me regarding your absences and we can assess potential accommodations.

Communication guidelines

Communication Method	How and When to Use It
Announcements	New announcements will be posted regularly on myCourses to keep you informed of logistics and any important course updates. <i>Please make sure to check frequently.</i>
Email	While I encourage you to post course content related questions in the Discussion Forums (see below), for private communication, use email. Please put the course ID {GEOG 321} on the subject line. Emails are typically answered within 24-48 hours during <i>regular business hours (M-F 9am-5pm)</i> . When addressing me in your email, you can refer to me as either Sara, Dr. Knox or Prof. Knox. Remember that email is a formal and public method of communication. Do not write anything that you do not want on the permanent, public record.
Course Logistics Q & A Forum	Use this forum to ask logistical questions about the course or report any problems you encounter. Your classmates may have the same question. Students are encouraged to respond to questions and help each other! TAs and I will check this Forum every few days.
Other Discussion Forums	Discussion Forums are available for any questions related to assignments and study questions as well as the lecture material. As noted above, your classmates may have the same questions. <i>Students are encouraged to respond to questions and help each other!</i>

Expectations for student participation

You will receive **Participation** marks (4% of your grade) for answering Vevox questions during lectures. Note that you do not need to have the correct answer to receive full marks, you just need to submit an answer to the multiple choice questions during the lecture. You are also strongly encouraged to engage in all discussion questions on Vevox.

Required course materials

The readings are posted on the course website (<https://geog321.github.io/>). They consist of draft chapters from the textbook '*Boundary Layer Climates*' by T. R. Oke and a few other sources.

Course content

Note: All dates and topics are still subject to change. Please make sure to regularly check the website for updates to the schedule.

Week	Date	Description	Course materials	Assignments
1	05-Jan	1 Introduction and course overview	Reading Package Lectures 1-2	
	07-Jan	2 Energy and mass balances 3 Surface energy balance	Reading Package Lectures 1-2 & 3	
2	12-Jan	4 Radiation geometry and 'sun-paths'	Reading Package Lectures 4-5	
	14-Jan	5 Short-wave radiative transfer 6 Short-wave reflection and albedo (intro.)	Reading Package Lectures 4-5 & 6	
3	19-Jan	6 Short-wave reflection and albedo (cont.) <u>Tutorial: Intro to R</u>		Assignment 1 handed out
	21-Jan	7 Long-wave radiation and emissivity 8 Net all-wave radiation (intro.)		
4	26-Jan	8 Net all-wave radiation (cont.) 9 Virtual field site visit (Radiation instrumentation)	Reading Package Lecture 9	
	28-Jan	10 Soil thermal properties 11 Soil heat transfer (intro.)	Reading Package Lectures 10-12	
5	02-Feb	11 Soil heat transfer (cont.) 12 Modelling sub-surface temperatures	Reading Package Lectures 10-12	Lecture recording
	04-Feb	Class cancelled	Reading Package Lectures 13 & 14	
6	09-Feb	15 Laminar and turbulent flow 16 Production of atmospheric turbulence (intro.)	Reading Package Lectures 15 & 16-17	
	11-Feb	16 Production of atmospheric turbulence (cont.) 17 Dissipation of atmospheric turbulence	Reading Package Lectures 16-17	
8	16-Feb	18 Turbulence statistically approached	Reading Package Lectures 18	Assignment 1 due
	18-Feb	19 Momentum transfer	Reading Package Lectures 19-20	
9	23-Feb	Midterm review		Assignment 2 handed out
	25-Feb	Midterm Examination		
	02-Mar	<i>Winter Reading Break</i>		
	04-Mar	<i>Winter Reading Break</i>		
10	09-Mar	20 Velocity profile laws	Reading Package Lectures 19-20	

	11-Mar	21 Flux-gradient relations 22 Eddy covariance (intro.)	Reading Package Lectures 21-26	
11	16-Mar	22 Eddy covariance (cont.) 23 Dynamic stability (intro.)	Reading Package Lectures 21-26	
	18-Mar	23 Dynamic stability (cont.) 24 Turbulent exchange in non-neutral situations	Reading Package Lectures 21-26	
12	23-Mar	25 Lab visit (Eddy covariance system, trace gas measurements)	Reading Package Lectures 21-26	
	25-Mar	26 Convective and stable boundary layers 27 Surface heterogeneity and advection	Reading Package Lectures 21-26 & 27	Assignment 2 due
13	30-Mar	29 The water cycle at land-atmosphere interfaces 30 Plant-atmosphere interactions (intro.)	Reading Package Lectures 29-31	Assignment 3 handed out
	01-Apr	30 Plant-atmosphere interactions (cont.) 31 Measuring and modeling evapotranspiration	Reading Package Lectures 29-31	
14	06-Apr	No class (Easter Monday)		
	09-Apr	32 Land atmosphere interactions in a changing global climate		
15	13-Apr	Final class: Review/evaluation/exam instructions		Assignment 3 due

Assessment

Participation	4%
Self-study questions	4%
Written assignments	42%
Midterm exam	20%
Final exam	30%

As noted above, you will receive **Participation** marks for answering Vevox questions during lectures. Note that you do not need to have the correct answer to receive full marks, you just need to submit an answer to the questions during the lecture. You are also strongly encouraged to engage in all discussion questions on Vevox.

Assignments will be handed **on myCourses** on the due date. All assignments are required to be labelled with course number, student number, student name and assignment number. **Late assignments will be penalized 10%** of the actual marks achieved for each (partial) day past **11:59 pm** on the due date. Late assignments will not be accepted once graded assignments have been returned to the class (which results in a grade of 0%). Note that you are not required to use **R** (or other programming languages) for

assignments, however, it is encouraged, and I will provide support and resources to help you with that (see Coding resources on the course website). Each assignment is worth 14% of your final grade.

Collaboration on homework is encouraged. However, you should think about the problems yourself before discussing them with others. **Also, write-ups must be done independently.** (In practice, this means that it is OK for other people to explain their solutions to you, but you must not be looking at other people's solutions as you write your own.)

Self-study questions are assigned regularly throughout the semester (9 in total). These are a great opportunity for you to apply some of the concepts covered in class and will help prepare you for assignments and exams. It is also a helpful way for you to **learn R** if that is of interest to you. Note that while solutions to the self-study questions are available to you, you are required to upload your own answers to these questions on myCourses (either as a word document, pdf, or html file). To help you keep up with the course material, you will have **a week to upload your answers to myCourses** (note that they are due at **11:59pm ET** on that day). **You only need to complete 7/9 to receive full marks for the self-study questions (4% of your total grade).** Note that late study questions will receive a grade of zero. All self-study questions and their due dates are already posted under Assignments.

The **midterm exam** will be a closed-book, in-person exam on **Wednesday, February 25th** during class. More details on the mid-term exam can be found on the course website.

The **final exam** will be held during the final exam period. It will also be a closed-book, in-person exam. The duration of the final is 3 hours (180 minutes). Additional details on the final exam will be posted on the course website.

Note: Illness and extenuating circumstances can happen and may be legitimate reasons for extensions on assignments or postponement of exams. If there are reasons you are unable to meet a deadline be sure to discuss with me well in advance if possible. You must be prepared to provide confirmation of illness.

McGill policy statements

- Language of submission

“In accord with McGill University’s [Charter of Students’ Rights](#), students in this course have the right to submit in English or in French written work that is to be graded. This does not apply to courses in which acquiring proficiency in a language is one of the objectives.” (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. » (Énoncé approuvé par le Sénat le 21 janvier 2009)

- 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](#)” (Approved by Senate on 29 January 2003) (See [McGill’s guide to academic honesty](#) for more information).

« 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 procédures disciplinaires](#). » (Énoncé approuvé par le Sénat le 29 janvier 2003) (pour de plus amples renseignements, veuillez consulter le [guide pour l'honnêteté académique de McGill](#).)

Additional statements

- Artificial Intelligence (AI) Tools: Students are allowed to use Artificial Intelligence (AI) tools on assignments **if the usage is properly documented and credited**. For example, text generated from Copilot should include a citation such as: “Copilot. Accessed 2023-12-03. Prompt: ‘Summarize the Geneva Convention in 50 words.’ Generated using <http://bing.com/chat>.” For more details on using generative AI in learning, please consult this McGill website: <https://teachingkb.mcgill.ca/tlk/using-generative-ai-in-teaching-and-learning>
- Copyright: © Instructor-generated course materials (e.g., handouts, notes, summaries, exam questions) 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 copyright infringements can be subject to follow-up by the University under the Code of Student Conduct and Disciplinary Procedures.
- Intellectual property: I ask for everyone’s cooperation in ensuring that course materials and recordings are not reproduced or placed in the public domain. This means that each of you can use it for your own purposes, but you cannot allow others to use it by posting it online or giving it or selling it to others who may copy it and make it available. Thank you for your help with this.
- Extraordinary circumstances: In the event of extraordinary circumstances beyond the University’s control, the content and/or evaluation scheme in this course is subject to change.
- Inclusive learning environment: 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/or [Student Accessibility and Achievement](#).
- Learning support resources: Consult resources from [Teaching and Learning Services](#) (TLS) on topics such as time management, study strategies, group work, exam prep, and more. For further individualized support, check out the programs and resources offered by [Student Accessibility and Achievement](#).
- Pronouns: Please email me if you would like me to refer to you by a different name than the [name indicated](#) in your student record or to inform me of your pronouns.
- Respect: The University is committed to maintaining teaching and learning spaces that are respectful and inclusive for all. To this end, offensive, violent, or harmful language arising in course contexts may be cause for disciplinary action.
- Wellness: Many students may face mental health challenges that can impact not only their academic success but also their ability to thrive in our campus community. Please reach out for

support when you need it; [wellness resources](#) are available on campus, off campus, and online.

- Workload management skills: If you are feeling overwhelmed by your academic work and/or would like to further develop your time and workload management skills, don't hesitate to seek support from [Student Services](#).
- Mercury course evaluations: [Mercury course evaluations](#) are one of the ways that McGill works towards maintaining and improving the quality of courses and students' learning experience. You will be notified by email when the evaluations are available. Please note that a minimum number of responses must be received for results to be available to students.