

GEOG 3311A Micrometeorology Course Outline: Section 001 Fall 2021

This course is taught in-person

1. Course Information



	Delivery Mode	Day/Time	Location
Lecture	In-person	Wed 10:30-12:30	SSC 1302
Lab	In-person	Thurs 11:30-1:30	SSC 1302

Classes Start	Fall Reading Week	Classes End	Study day(s)	Exam Period
September 8	November 1-7	December 8	December 9	December 10-21

September 16, 2021: Last day to add a first-term half course

October 11, 2021: Thanksgiving Holiday

November 12, 2021: Last day to drop a first term half course without penalty

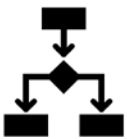


Course Instructor	Contact Information	Office Hours
James Voogt	javoogt@uwo.ca	Tues: 3-4 pm or email to set up an alternate day/time



- Office hours will be held **in person or remotely** (Zoom)
- Students will be able to sign up for an appointment using **email**
- Students will be able to drop into session on Tues 3-4 pm

2. Calendar Description



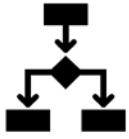
Principles of weather and climate at micro-, local, and meso-scales; processes associated with transfer of heat, mass, and momentum and resulting climates near the surface; local winds, fog, urban climates and air pollution.

2 lecture hours, 0.5 course

Antirequisite(s): None

Prerequisite(s): One of Geography 2310A/B, Geography 2320A/B or Geography 2330A/B, or at least 3rd year standing in an Environmental Science or Earth Sciences program. (A 1000-1099 level course in Applied Mathematics, Mathematics, or Physics is also recommended).

Prerequisite checking is the student's responsibility



Senate Regulations state, “unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.”

3. Textbook



All resources (lectures, labs) will be posted in OWL

Recommended textbook: Oke, T.R. 1987. *Boundary Layer Climates*, **2nd Edition**

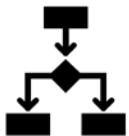
See also:

Oke et al. 2017. *Urban Climates*, Cambridge University Press. Available from Western Libraries (online)

Oke, T.R. 1997. “Surface Climate Processes”, Chap 2 of Bailey, WG, TR Oke and WR Rouse 1997. *The Surface Climates of Canada*, McGill-Queen’s University Press, Montréal & Kingston 21-43.

4. Course Objectives and Format

This course provides an introduction to the study of micrometeorology and microclimatology. It examines the processes that underly the behaviour of the atmosphere close to the surface; specifically the transfer of heat, mass and momentum and how these modify the microclimate. Presentations include theoretical and analytical examination of the processes that occur (i.e. we use equations and numbers in this course). Assignments require use of a computer spreadsheet and hand calculation using calculators. An introduction to micrometeorological instrumentation is also provided that includes the use of instruments and construction of thermocouples.

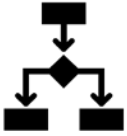


Micrometeorology and microclimatology are generally restricted to that portion of the atmosphere known as the planetary boundary layer, so this course does not examine weather per se, but does deal with some local to mesoscale atmospheric effects such as sea breezes and atmospheric conditions important to air pollution. Micro-meteorology and climatology have a number of important applications. These include the assessment (and potentially intentional changes to) urban climates (e.g. white roofs and green roofs), road and runway icing, human heat stress, and agricultural crop performance.

At 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 energy budget and surface microclimates
- use numerical techniques to estimate surface energy budget terms
- understand and use basic instrumentation related to micrometeorology
- explain how the principles of the surface energy budget have practical application to society

All course material will be posted to OWL: <http://owl.uwo.ca>. Any changes will be indicated on the OWL site and discussed with the class.



Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click [here](#).

If students need assistance, they can seek support on the [OWL Help page](#). Alternatively, they can contact the [Western Technology Services Helpdesk](#). They can be contacted by phone at 519-661-3800 or ext. 83800.

5. Learning Outcomes

Upon successful completion of this course, students will be able to:



- Develop knowledge and critical understanding of the fundamental characteristics, processes, temporal changes and landscapes of social and biophysical systems and their interactions - in particular spatio-temporal variations of the near surface climate, especially as described through the surface radiation and energy balances.
- relate specialized understanding of the geography of bio-physical systems to knowledge and practices in environmental and natural sciences
- Use the fundamental knowledge of the physical basis of near-surface climates to explain how microclimates can be expected to vary in space and time.
- Collect, analyze and interpret data from measurement systems that are used to monitor near-surface climate and surface radiation and energy balances.

6. Communication



- Students should check the OWL site before lecture and lab sessions
- Students should email their instructor using the subject line Geog 3311
- For any other communication, the centrally administered **e-mail account** provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner. You can read about the privacy and security of the UWO email accounts [here](#).
- Emails will be monitored daily; students will receive a response in 24 – 48 hours
- Students should post all course-related content on the discussion forum so that everyone can access answers to questions

7. Course Content and Schedule

Week	Dates	Topic	Lab
1	Sept 8	Course Introduction: Micrometeorology, Microclimatology and The Atmospheric Boundary Layer	Temperature and Humidity Review* (not submitted)
2	Sept 15	Measurement source areas Radiation, Energy and Water Balance Concepts	Thermocouples
3	Sept 22	Radiation Budget: Shortwave Radiation	Shortwave Radiation
4	Sept 29	Radiation Budget: Shortwave Radiation	
5	Oct 6	Radiation Budget: Longwave and Net Radiation	Longwave Radiation
6	Oct 13	Surface temperatures	Explaining patterns of urban surface temperature
7	Oct 20	Soil Microclimates	Soil Heat Flux
8	Oct 27	Winds Near the Surface	Neutral Wind Profile
9	Nov 3	<i>Reading Week</i>	<i>N/A</i>
10	Nov 10	Local scale circulations, Atmospheric Turbulence & Dynamic Stability	
11	Nov 17	Air Pollution Meteorology and the Gaussian Plume Model	Gaussian Plume Model
12	Nov 24	Convective Transfer	Energy Balance
13	Dec 1	Convective Transfer	
14	Dec 8	Climates of Non-homogeneous terrain	



8. Evaluation

Below is the evaluation breakdown for the course. Any deviations will be communicated.

Assessment	Format	Weighting	Due Date
Lab Assignments (7)	Mixed	30%	1 week after the last lab in which they are discussed
Project	Written	40%	
Final Exam	Take home (written)	30%	



Students are responsible for material covered in the lectures as well as the assigned chapters/sections in the text.

To pass the course you must have submitted at least 5 of 8 lab assignments

- All lab assignments are due one week from the last lab session in which they are covered.
- After an assessment is returned, students should wait 24 hours to digest feedback before contacting their evaluator; to ensure a timely response, reach out within 7 days

Click [here](#) for a detailed and comprehensive set of policies and regulations concerning examinations and grading. The table below outlines the University-wide grade descriptors.

A+	90-100	One could scarcely expect better from a student at this level
A	80-89	Superior work which is clearly above average
B	70-79	Good work, meeting all requirements, and eminently satisfactory
C	60-69	Competent work, meeting requirements
D	50-59	Fair work, minimally acceptable
F	below 50	Fail

Information about late or missed evaluations:

Non-medical absence from the midterm require prior approval of the instructor or approval by the Dean's office (appropriate documentation will be required by the Faculty Dean's Office for approval if it is not obtained prior to the midterm).

Students seeking academic accommodation on medical grounds for any missed tests, exams, participation components and/or assignments worth less than 10% of their final grade must contact the instructor. Should the number of requests by a student exceed two, then they are required to apply to the Academic Counselling office of their home Faculty and provide documentation.

Students seeking academic accommodation on medical grounds for any missed tests, exams, participation components and/or assignments worth 10% or more of their final grade must apply to the Academic Counselling office of their home Faculty and provide documentation. Academic accommodation cannot be granted by the instructor or department.

- Late assessments without illness self-reports will be subject to a late penalty 10 %/day
- Late assessments with illness self-reports should be submitted within 24 hours of submission of the last illness self-report
- An assessment for a lab cannot be submitted after it has been returned to the class; the weight will be transferred to the final exam
- The weight of a missed lab will be transferred to the final exam.

Grades will not be adjusted on the basis of need. It is important to monitor your performance in the course. Remember: *You* are responsible for your grades in this course.

9. Accommodation Policies

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and

cognitive testing. The accommodation policy can be found here: [Academic Accommodation for Students with Disabilities](#).

Academic Consideration for Student Absence

Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the term, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student's final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student's final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are *not* met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

[Policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs](#)

[Student Medical Certificate \(SMC\)](#)

Religious Accommodation

Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the [Western Multicultural Calendar](#).

10. COVID-19 Information

Masking Guidelines

Students will be expected to wear triple layer, non-medical, paper masks at all times in the classroom as per University policy and public health directives. Students who are unable to wear a mask must seek formal accommodation through Western Accessible Education, and present medical documentation.

Students are not permitted to eat or drink while in class to ensure masks stay in place. Students will be able to eat and drink outside of the classroom during scheduled breaks.

Students unwilling to wear a mask as stipulated by Western policy and public health directives will be referred to the Dean, and such actions will be considered a violation of the student Code of Conduct.

Course Absences due to Daily COVID Screening Questionnaire

Missed assessments (e.g., presentations, essays, quizzes, tests, midterms, etc.) require formal academic considerations (typically self-reported absences and/or academic counselling). Methods for dealing with missed work and course content are at the discretion of the instructor(s). Students should be aware that some learning outcomes cannot be easily made up and may need to be completed in a subsequent year. Your instructor will provide you with further information as to how this applies within this course.

Students who demonstrate a pattern of routinely missing coursework due to self-reported COVID symptoms, and therefore do not demonstrate mastery of the learning outcomes of the course, will not receive credit for the course.

11. Use of Electronic Devices

Electronic devices may be used with the planned take-home exam and are a necessary part of lab work.

12. How to Be Successful in this Class:

Students enrolled in this class should understand the level of autonomy and self-discipline required to be successful.

1. Follow weekly checklists created on OWL or create your own to help you stay on track.
2. Take notes as you go through the lesson material. Keeping handwritten notes or even notes on a regular Word document will help you learn more effectively.
3. Connect with others. Try forming a study group and try meeting on a weekly basis for study and peer support.
4. Do not be afraid to ask questions. If you are struggling with a topic, check OWL for supporting resources, try some of the alternate readings or ask the instructor.
5. Reward yourself for successes. It seems easier to motivate ourselves knowing that there is something waiting for us at the end of the task.



13. Continuity of Education Plan (in-person class pivoting to online learning)

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will **not** change. Any remaining assessments will also be conducted online as determined by the course instructor. In the event that online learning is required, a stable internet connection with working microphone and webcam will be required. As has been the

case in the past, the decision to pivot to online learning will be made by Western, and not individual instructors or departments (excepting temporary online instruction in the event of instructor illness).

14. Academic Offences

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence.

15. Western's Commitment to Accessibility

The Department of Geography and Environment strives at all times to provide accessibility to all faculty, staff, students and visitors in a way that respects the dignity and independence of people with disabilities.

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2147 for any specific question regarding an accommodation. Information regarding accommodation of exams is available on the Registrar's website.

More information about "Accessibility at Western" is available.

16. Mental Health

If you or someone you know is experiencing distress, there are several resources here at Western to assist you. Please visit Western's Health and Wellness website for more information on mental health resources.

17. Support Services

Western's Support Services
Student Development Centre

18. Important Dates

September 8: Classes resume

September 16: Last day to add a first term half course

October 11: Thanksgiving Holiday – Department Office Closed

November 1 to November 7: Fall Reading Week (No classes; Department Office open)

November 12: Last day to drop a first term half course without penalty

November 30: Last day to drop a full course without penalty

December 8: Classes end

December 9: Study day

December 10-21: Examination Period

Readings:

I recommend Oke 1987 as an excellent, easy-to-read introduction to microclimates and some aspects of micrometeorology. Considering that some other texts may be more easily available, the following table provides relevant readings to course content that will help support the lecture and lab material.

<p>Week 1. Introduction O87: ix-xxiv, 3-8, 20-36, 395-399 F08 1-8 A88: 1-7; S88: 9-23 CN98: 1-8 O17: 156-159 Atmospheric (Planetary) Boundary Layer O87: 40-42, 61-63, 71-76, 97-98, 310-313 A88: 57-63, 75-83, 214-218 S88: 441-456, 468-469, 473-477, 499-502, 520-522, 526-529, 534-536</p>	<p>Weeks 3-5 Shortwave and Longwave Radiation O87: 8-16, Appdx A1 + radiation aspects of Chps 3, 4 O17 126-128, 156-159 MU90: 28-35, 50-57, 79-97, 82-86, 93-97 A88: 21-33 CN98: 147-165, 167-183, 224-231</p>
<p>Week 6 Soil Microclimates O87: 42-51, 259 A88: 37-46 MU90: 223-230 CN98: 23-26, 113-127 F08: 15-18, 212-217.</p>	<p>Weeks 7 Winds Near the Surface O87: 54-58, 75-76, 83-84, 139-140, 363-365 A88: 75-83, 131-133, 141-151 MU90: 112-117 O17: 99-105 CN98: 63-74</p>
<p>Week 8 Atmospheric Turbulence & Dynamic Stability S12: Chp 15 A88: Chp 8 O17: 79-82</p>	<p>Week 9 Air Pollution and Gaussian Plume Model O87: 310-318, 322-338</p>
<p>Week 10 Source Areas & Surface Atmosphere Exchange Basics O17: Chp 2 MU90: 232-252</p>	<p>Week 11-12 Convective Transfer O87: 59-71, Appendix A2 A88: 54-57, 74-75, 117-119, 157-167, 169-176, 189-194; Chp 11, 12 S12: Chp 19, 20 O17: 175-184 CN98: 77-85, 93-99</p>
<p>Week 13. Climate of Non-homogeneous Terrain O87: 34-36, Chp 5. A88: 33-35, 223-235, 252-260 S88: 587-595, 601-609</p>	

Relevant texts and codes as used in the table of readings.

Codes: Letter - Author's Last Initial, Number - date of publication.

A88 - Arya, S.P. 1988. *Introduction to Micrometeorology*, 1st Edition, Academic Press, San Diego. A 2nd edition (2001) also exists and may be used.

CN98 - Campbell, G.S. and J.M. Norman. 1998. *An Introduction to Environmental Biophysics*, Springer-Verlag, New York.

F08 - Foken, T. 2008 *Micrometeorology*. Springer-Verlag Berlin Heidelberg. [On-line text](#) (link will require UWO connection or proxy connection)

MU90 - Monteith, J.L. and M.H. Unsworth. 1990 *Principles of Environmental Physics*, 2nd ed., Elsevier: Amsterdam. (A 3rd edition, 2008 is also available and can be used)

O17 - Oke, T.R., G. Mills, A. Christen, J.A. Voogt 2017. *Urban Climates*, Cambridge University Press, London. Available online from Western Libraries

O87 - Oke (1987) *Boundary Layer Climates*, Routledge.

S12 - Shuttleworth, W.J. 2012. *Terrestrial Hydrometeorology*, Wiley-Blackwell, Oxford.

S88 - Stull, R.B. 1988. *An Introduction to Boundary Layer Meteorology*, Kluwer Academic, Dordrecht.