

GPHY 841: Measurement in Climatology

Fall 2024

Instructor: Dr. Ian Strachan

Lecture hours: Tuesdays 14:30-17:30 Mackintosh Corry Hall E314

Office hours: Drop in

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OVERVIEW

This course is organized into two complementary components as follows:

1. “Field Instrumentation and Measurement” introduces the concepts of environmental instrumentation specifically for the purpose of conducting field-based research. Students will learn the fundamentals of a variety of environmental sensors (dependent on availability) and how they can be incorporated into an active field site to support research questions. Field experience is beneficial but not required.
2. “Data Analysis” will introduce students to the theory, analysis and interpretation of energy and carbon flux data. Students will work with real-world data collected at QUBS as well as existing data sets. Experience with the technique of eddy covariance is not expected.

LEARNING OUTCOMES

By completing Field Instrumentation and Measurement, students will be able to:

- Understand the logistics involved in planning and deploying a field site for environmental monitoring
- Deploy a flux station, troubleshoot the installation and acquire data
- Understand how to use mobile instrumentation at discrete intervals to compliment the continuous measurements from the tower-based instrumentation

By completing Data Analysis, students will be able to:

- Understand the theory behind surface-atmosphere flux measurements and their importance in climate change research
- Visualize, and manipulate surface flux data
- Draw appropriate conclusions about the behaviour of the surface through their interpretation of the flux and environmental data

COURSE EVALUATION

Participation	30%
Thermocouple and Datalogging	15%
Chamber Flux (Group) Project	25%
Ecosystem Flux Project	30%

Proposed Schedule

Date	Topic (Hour 1)	Activity (Hour2-3)	Instrumentation	Deliverable
Sept 10	Introduction to the Course	Building Thermocouples	Copper-Constantan TC's	
Sept 17	Surface Radiation Budget & Energy Budget	Datalogger: Programming; wiring; communicating	Campbell Scientific loggers; Kipp&Zonen CNR-4 radiometer	
Sept 24	Flux Measurements: Chambers and Towers	Setting up Group Experiment	PP Systems EGM-5 IRGA	
Sept 28-29	Field Trip to QUBS	Set-up Flux Station		
Oct 1	MONDAY SCHEDULE	NO CLASS		
Oct 8	Chamber Fluxes continued	Analyzing Chamber Data	Excel	Logger Exercise
Oct 15	READING WEEK	NO CLASS		
Oct 22	Ecosystem Scale Fluxes: Boundary Layers and Eddy Covariance	Theory	None	
Oct 29	Ecosystem Scale Fluxes	Processing Data	EddyPro Software	Chamber Project
Nov 5	Ecosystem Scale Fluxes	Analysis of Data	Your choice	
Nov 12	Work on Deliverables			
Nov 19	Work on Deliverables			
Nov 26	Work on Deliverables			
Dec 5	Work on Deliverables			Flux Project

DELIVERABLES

1. Datalogger Individual Exercise: A report based on the construction, wiring, logger communication and downloading and data visualization of a simple thermocouple array.
2. Chamber Group Project: A designed experiment, with collection and analysis of data. The experiment will feature the use of a CO₂/H₂O infrared gas analyzer and chamber.
3. Flux Individual Project: Using existing data from a flux tower to analyze (using EddyPro or other) a period, visualize it and complete an analysis of the results.

COURSE COMPONENTS

Along with providing you with a grounding in micrometeorological theory, I plan to have you get as much hands-on experience with various pieces of equipment as is practically possible. Please know that this course is in transition and what we end up doing will be subject to my equipment being available and in working order.

Assessed Work

- **Participation (30%):** Graduate courses involve the sharing of knowledge that each of you bring based on your past academic trajectories. You should come prepared; to listen, to ask questions based on material presented and readings and to share your knowledge with the group.
- **Datalogger Individual Exercise (15%):** The exercise involves the construction of thermocouples for temperature measurement. You will report on their construction, installation in a media, wiring to a datalogger, programming of the logger, communication and downloading of the data and visualization of the resulting data. This simple exercise is meant to show you some of the steps involved in the acquisition and QC/QA of data as well as communication of results.
- **Chamber Group Project (25%):** The project will involve planning, execution, analysis, and results of chamber-based CO₂ and H₂O flux measurements made over time in the lab. This is a class project, and I will leave it to you as a collective to decide how you want to share the work. A breakdown of contributions agreed upon by *all* students must be provided.
- **Flux Individual Project (30%):** The flux project will allow students to explore the contemporary technique of eddy covariance (EC). You will learn EC theory during the lectures, and you will utilize this knowledge with a real data set of EC flux data. As part of this project, you will be given a data set along with details on what it represents. You will prepare a final report detailing the analysis, results and discussion of the results placing them in the correct context as well as a presentation to the instructor and class at the end of term.

FIELD TRIP:

There is a planned field component to this course which is scheduled to take place at the [Queens University Biological Research Station \(QUBS\)](#) from the morning of Saturday September 28th to the late afternoon of Sunday September 29th. A cost of no more than \$100 is expected, and this is anticipated to be lowered through support from the department. Costs will be clarified once final numbers are determined. If you are also taking Dr. Thomson's GPHY845 course, our field components will overlap, and students are only expected to pay once for the field trip. Details to come!

READINGS AND RESOURCES

OnQ:

I will use OnQ for all course-related material. I will provide segments of textbooks and literature readings through OnQ.

Statement on Academic Integrity

The following statement on academic integrity builds on a definition approved by Senate and is designed to make students aware of the importance of the concept and the potential consequences of departing from the core values of academic integrity.

Academic Integrity is constituted by the six core fundamental values of honesty, trust, fairness, respect, responsibility and courage (see www.academicintegrity.org). These values are central to the building, nurturing

and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University (see the Senate Report on Principles and Priorities <http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities>).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 <http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations/regulation-1>), on the Arts and Science website (see <https://www.queensu.ca/artsci/students-at-queens/academic-integrity>), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

Accommodation for Disabilities

Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. The Senate Policy for Accommodations for Students with Disabilities was approved at Senate (<https://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslclwww/files/files/policies/senateandtrustees/ACADACCOMMPOLICY2016.pdf>). If you are a student with a disability and think you may need academic accommodations, you are strongly encouraged to contact the Queen's Student Accessibility Services (QSAS) and register as early as possible. For more information, including important deadlines, please visit the QSAS website at: <http://www.queensu.ca/studentwellness/accessibility-services/>

Academic Considerations for Students in Extenuating Circumstances

Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and are interfering with their ability to complete academic requirements related to a course for a short period of time, not to exceed three months. Students receiving academic consideration must meet all essential requirements of a course. The Senate Policy on Academic Consideration for Students in Extenuating Circumstances was approved at Senate in April, 2017.

Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. Arts and Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where a request can be submitted at: <http://www.queensu.ca/artsci/accommodations>

Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty.

If you need to request academic consideration for this course, you will be required to provide the name and email address of the instructor/coordinator. Please use the following:

Instructor/Coordinator Name: Dr. Ian Strachan

Instructor/Coordinator email address: ian.strachan@queensu.ca