Climate 463
Air Pollution Meteorology
Winter 2024

Instructor: Dr. Gretchen Keppel-Aleks (gkeppela@umich.edu)
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Class Time and Location: Tuesday, Thursday 10:30-11:50 in 2513 GG Brown

Office Hours: Wednesday 4-5 pm in CSRB 2516

Course Description

Air pollution has negative impacts on human and ecosystem health, and can degrade infrastructure. Differential exposure to air pollution is a source of inequality within society. In this course, we will gain an understanding of sources of air pollution, their transport and transformation, and their ultimate fate. We will discuss regulations on air pollutants, methods to control emissions, and methods to observe criteria pollutants to ensure compliance with regulations. By the end of the semester, students should be able to:

1. Describe how air pollution affects neighborhoods, cities, regions, and the globe, in terms of its impact on air quality, public health, climate, and environmental justice.
2. Model atmospheric transport processes that disperse air pollution from source regions and communicate the impacts that these processes have on local to regional air pollution
3. Analyze publicly available data on air pollutant concentrations and attribute patterns of variability, from seasonal cycles to long-term trends
4. Understand the processes that remove pollution from the atmosphere
5. Think holistically about how emissions, atmospheric dynamics, and local geography affect air pollution; identify actions that could reduce air pollutant exposure at the local to regional scale

Course Structure

- Class will be in-person, although lectures will be recorded and made available on Canvas. In-person participation provides the opportunity for you to ask questions and participate in in-class discussions and is preferred to asynchronous lecture consumption.
- You can use piazza to ask questions of your classmates and myself.

Course Topics

Intro to air pollution
Emissions
Health and ecosystem impacts
Controls and regulations
Boundary layer turbulence
Atmospheric stability
Atmospheric transport
Air quality observations
Deposition
Plume rise and dispersion

Readings

There is not a required textbook for this course, but there are a few recommendations if you want more information. The first text is on reserve at Duderstadt. The latter two texts are available digitally through the UM library.

- Arya, S. P., *Air Pollution Meteorology and Dispersal*
- Wallace, J. and P, Hobbes, *Atmospheric Science: An Introductory Survey*
- Stull, R. B.. *An Introduction to Boundary Layer Meteorology*

Assignments and Grading

There will be three types of assignments, with grade break-down as follows

Exam 1	20%
Exam 2	20%
Homework	30%
Term Project - Written	20%
Term Project - Oral	10%

EXAMS (40% of grade): Two in-class exams will be conducted during the semester. These exams will include short answer questions and problem solving similar to homework assignments.

HOMEWORK (30% of grade): There will be about eight homework assignments throughout the semester, with the first six focused on course material and the last two to help you structure your final project. See the below schedule and Canvas for assignments and approximate due dates. Updates to the schedule below will be noted in class and announced on Canvas.

FINAL PROJECT (30% of grade): The final project will include the selection of different regions across the US by individual students, and the assessment of emission sources, meteorological conditions, and observations of air quality in that specific region. The final project will include an oral presentation (approximately 10 minutes; 10% of the grade) and a written report in journal format (20% of the grade). Rubrics for the final project and project expectations will be discussed in class. Two homework assignments (HW7 and 8) will provide intermediate steps to the final project (met assessment, pollutant assessment) and will allow for feedback from the instructor before the final report.

SCHEDULE

Due Date	Assignment
Tues 23 Jan	HW1
Tues 30 Jan	HW2
Tues 6 Feb	HW3
Tues 13 Feb	Exam 1
Tues 21 Feb	HW4
Thurs 7 Mar	HW5
Thurs 14 Mar	HW6
Thurs 21 Mar	Exam 2
Thur 28 Mar	HW7
Thur 4 April	HW8
Tu/Th 16/18 April	Oral presentations
Tu 23 April	Written report

Course Policies

Homework

Homework assignments will comprise problems and analysis that applies concepts learned in lecture. Homework is due at the beginning of class on the specified due dates. You will be allowed two late homework assignments (with up to a week extension) with no questions asked. Please contact me to discuss if you need additional accommodations beyond these two late assignments. Please upload all relevant work to Canvas for grading, along with any input data files that you may have used.

Honor Code

This class is being taught through the College of Engineering, and thus all involved are subject to the College of Engineering Honor Code http://www.engin.umich.edu/students/honorcode/Links to an external site.

All policies apply, so please do not hesitate to ask questions.

Inclusivity

As we will see during this course, marginalized populations often bear the worst consequences of air pollution. These impacts and the science and engineering questions necessary to understand and mitigate them can be elucidated, in part, by training a diverse set of scientists to work in our field. I find this quote from Stephen Jay Gould to be quite relevant: "*I am, somehow, less interested in the weight and convolutions of Einstein's brain than in the near certainty that people of equal talent have lived and died in cotton fields and sweatshops.*"

Some of the implications of this quote for our class:

- Our field needs more people like you – and unlike you! I encourage each of you to participate fully and respectfully to class discussions, while making sure to save space for others to participate.
- I strive to create a learning environment that supports a diversity of thoughts, perspectives and experiences, and honors your identities (including race, gender, class, sexuality, religion, ability, etc.). I will treat every other member of the class with respect, and expect the same from all of you.
- I will work with each and all of you to ensure your success in this class. Please get in touch with me if you have concerns about your progress in the course – I am here to teach and here to help.
- If you feel like your performance in the class is being impacted by your experiences outside of class, please feel free to get in touch with me. I may be able to point you toward resources that can help.
- I am still in the process of learning about diverse perspectives and identities. If something was said in class by myself or another student that made you feel uncomfortable, please feel free to get in touch with me.
- I have created an anonymous google form where you can share feedback if you are uncomfortable emailing or discussing in office hours. You can access the form here: https://forms.gle/imWWR2Q1Ei6i13uz8

Absences

Students are expected to be in class and participate in person. Please email me if you will be absent from the class. Please do not come to class if you are sick. Lectures are recorded, and you can watch them soon after our normal class time.

With respect to planned absences, I understand that as students at the University of Michigan, you have the opportunity to participate in research and extracurricular projects that may require you to miss class. I expect that you will discuss with me **at least one week in advance** any upcoming absences and any plans to make-up missed material or assignments. I am happy to work with students to devise alternative arrangements, but it is your responsibility to keep me informed and to reach out to me.

If an emergency situation comes up that you cannot plan for in advance (e.g., illness or family situations), please let me know as soon as possible.

Accommodations

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way the course is usually taught may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Services for Students with Disabilities (SSD) office to help us determine appropriate academic accommodations. SSD (734-763-3000; http://ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

If you are a pregnant or parenting student in need of any accommodations, please let me know at your earliest convenience. Certain aspects of this course may be modified to ensure your participation and progress needs are being met. Together we can determine any reasonable, necessary, and appropriate accommodations that will be adhered to during the duration of the course. Any information given regarding this matter will be kept strictly confidential.