Syllabus for 11:670:453 Air Quality Modeling

1   Overview

Class Time: TBD
Class Location: ENR 323

Instructor: Xiaomeng Jin
Office: ENR 230, Department of Environmental Sciences
Office Hours: TBD

1.1   Pre-requisites

General Chemistry I: 01:160:161 or equivalent
Calculus II: 01:640:136 or 01:640:152 or equivalent

Meteorology major: 11:670:212 Computational Methods for Meteorology
Environmental Science major: 01:160:162 General Chemistry II
Environmental Engineering major: 14:440:127 Introduction to Computing for Engineers and 01:160:160 General Chemistry for Engineers (Chem II)
Other majors: Instructor's permission needed.

1.2   Learning Goals

Models are critical research and policy tools to understand and predict air pollution. This course introduces students to the physics, chemistry and numerical methods underlying simulations of the source, evolution and impacts of air pollution. Students completing this course should be able to:
1. Explain the sciences of air pollution, including its source, formation, impacts, and its interactions with climate, and ecosystem.
2. Explain the principles and governing equations regarding the transport and chemical transformation of air pollutants, and the numerical methods used to simulate these processes.
3. Gain experience using state-of-science models to address air pollution problems and understand the limitations of these models.

2   Recommended Readings

2.1   Books

*   Brasseur, G. P., and D. J. Jacob (2017), *Modeling of Atmospheric Chemistry*, Cambridge University Press, Cambridge, UK, doi:10.1017/9781316544754.
*   Jacob, D. J. (1999), *Introduction to Atmospheric Chemistry*. Princeton University Press, doi:10.1515/9781400841547.
*   Jacobson, M. Z. (2005), *Fundamentals of Atmospheric Modeling*, 2nd ed., Cambridge University Press, Cambridge, UK, doi:10.1017/CBO9781139165389.

3 Schedule

Week	Topics	Assignment Due
1	Introduction to air quality	
2	Introduction to models and data analysis tools	
3	Atmospheric structure and composition	Assignment 1 Due
4	Emissions & sources of air pollution	Assignment 2 Due
5	Dispersion and transport	Assignment 3 Due
6	Chemical reactions and rates	Assignment 4 Due
7	Formation of air pollutants: ozone	
8	*Midterm Exam*	
9	Formation of air pollutants: $PM_{2.5}$	Assignment 5 Due
10	Deposition	Assignment 6 Due
11	Atmospheric observations and model evaluation	Assignment 7 Due
12	Interactions with climate	Assignment 8 Due
13	Health impacts of air pollution	Assignment 9 Due
14	Final Project Presentation	

4 Grading Policy

Your final grade will be calculated with the following breakdown:
- Weekly assignments: 50%
- Midterm exam: 25%
- Final project: 25%

4.1 Problem Sets

The aim of the problem sets is to help you learn the course concepts and gain experience with air quality modeling and programming. Working together with your classmates is encouraged, but problem sets and code should always be written up individually. Show all work, explaining in sufficient detail how you arrived at the answer. Some questions will be easy to answer, and you may be able to do them in your head, but you must still explain how you arrived at your answer. A correct answer with no work shown earns no credit. A numerical answer without units is also incorrect. Problem sets are due on Tuesday before class. After that, 10% is deducted off the possible total score for each day (24 hours) late. No credit is given after one week late. You will be granted five late days for use throughout the semester, which you may use at your discretion.

4.2 Final project and presentation

In lieu of a final exam, all students will perform a term project, generate a project report and present a summary to the class. Students will select a topic that they find interesting and use a state-of-science model or model output to address a research question on air pollution.

Grading rubrics (total: 25%):
- Final project report (15%)
    - Introduction (5%)
    - Model application (5%)
    - Interpretation of model results (5%)
- Final presentation (10%)
    - Presentation quality (5%)
    - Q&A (5%)

5 Academic Integrity

Students should adhere to the principles outlined by the university's academic integrity policies, accessible at http://academicintegrity.rutgers.edu. Students should:
- Properly acknowledge and cite all use of the ideas, code, or words of others.
- Properly acknowledge all contributors to a given piece of work.
- Ensure that all work submitted as their own in a course or other academic activity is produced without the aid of unsanctioned materials or unsanctioned collaboration.
- Treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference.

Violations of academic integrity will be treated in accordance with university policy, and sanctions for violations may range from no credit for the assignment, to a failing course grade to dismissal from the university (http://academicintegrity.rutgers.edu/academic-integrity-at-rutgers/).