

Physics and Chemistry of the Atmosphere

Physics 335, Fall 2023

Interdisciplinary Life S 201, Wed/Fri 1:00 – 2:15 PM

Updated: August 25, 2023

INSTRUCTOR

Dr. Xiaoguang (Richard) Xu (xxu@umbc.edu)
UMBC Physics Building 328, voice: (410) 455 6248
Office Hours: After class, or by appointment.

COURSE DESCRIPTION

PHYS335 is a first course in the physical and chemical principles that led to the formation of the atmosphere of our planet, its structure, and weather and climate processes. It surveys a range of core topics in atmospheric sciences, including atmospheric thermodynamics, atmospheric dynamics, general circulation, radiation, clouds, air pollution, and chemistry (topics we will cover are listed in the Course Schedule below). The physical principles together with mathematical techniques presented this semester should help you with many of the upper-level Physics classes (and graduate courses, if you choose to go on) you will be taking in the future, as well as make you understand some of the environmental issues facing society today, namely, weather system, global warming, and air pollution.

Prerequisite: Physics 121 and 122 (or instructor's permission). We will use and expand on concepts from these two classes. You will be assumed to know algebra, trigonometry, geometry, and calculus (integrals, derivatives, differential equations).

As the semester progresses, we may make some (e.g., Python) computer codes and data files available for you to download over the web, so you can use them to explore and reinforce certain physics concepts.

OFFICE HOURS

Office hours will be set after classes start. Typically, I will be available after lectures to answer questions, and you can always contact me using email or come to my office.

LEARNING GOALS

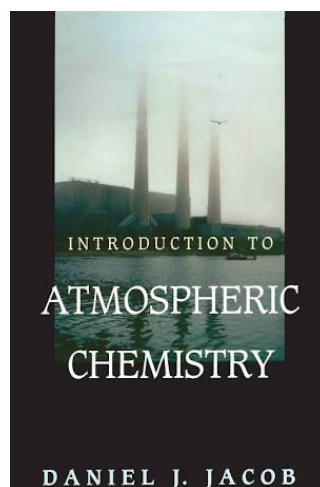
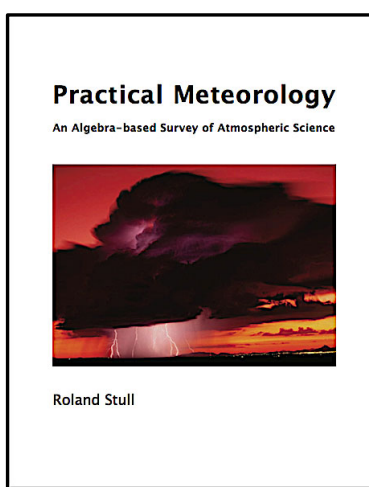
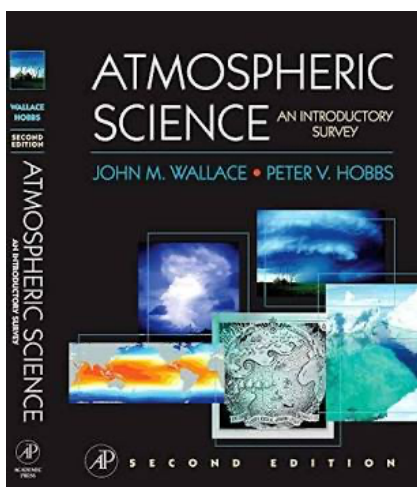
By the end of the course (by fulfilling the course expectations), you will develop a rich understanding of major processes of weather and climate, and will be able to describe and analyze physical/chemical principles behind those processes. Specifically, you should be able

- To identify key atmospheric processes of global, synoptic, and smaller scales, and connect them to weather and climate.
- To explain the global energy budget and the general circulation of Earth's atmosphere.
- To answer basic questions regarding to radiative transfer of light in the atmosphere, synoptic meteorology, vertical transport of pollutants, cloud formation, etc.
- To explain the physical/chemical principles range of atmospheric phenomena such as global warming, ozone holes, acid rain, rainbow, etc.
- To develop your skills in reading analytically and writing formal academic report.
- To research, prepare, and deliver an oral report that provides valuable information to your colleagues, and that sparks and holds their interest.

COURSE MATERIALS

Since there will be a wide variety of topics presented in the class during the semester, we have chosen one general textbook (by Wallace and Hobbs), as well as two books available online. In addition, we will be presenting material from other books or articles.

- **Textbook:** *Atmospheric Science: An Introductory Survey*, 2nd Ed. by Wallace & Hobbs
- **Online Textbook 1:** *Practical Meteorology: An Algebra-based Survey of Atmospheric Science* by R. Stull (https://www.eoas.ubc.ca/books/Practical_Meteorology/)
- **Online Textbook 2:** *Introduction to Atmospheric Chemistry*, by Daniel J. Jacob, 1999 (<https://acmg.seas.harvard.edu/education/introduction-atmospheric-chemistry>)



GRADING

The final grade will be determined from

Class participation	10%
Homework	30%
2 Midterm exams	30%
Class project	30%

Grade breakdown: (A) 90-100, (B) 80-89, (C) 70-79, (D) 60-69, (F) below 60.

Participation

You are expected to attend class regularly. Your presence in class is a kind of participation. Participation also means to do the readings carefully and contribute significantly to our discussions. You should come to class having read the assigned material for that day and with something to say about it.

Homework

Many Physics education studies show that students do much better when they keep up with the material and come to lectures prepared - this course is organized with this in mind. Homework will be collected **before midnight of the due date** and graded. The hour exams during the semester will be based on the lecture material and homework.

Homework solutions will be posted after the due date. You are welcome to work in groups, but the final turned-in homework should represent *your* work. Also, avoid turning in late homework – it is unfair both to your fellow students and to us.

Exams/Project

There will be two midterm exams, and one class project. Two midterm exams will consist of problems of the type practiced through doing the homework. You will be expected to be able to come up with both algebraic and numeric answers as needed. The date and format of midterms will be announced at least a week in advance; it is your responsibility to stay informed about the dates.

We will reserve a couple of classes (at the end of the semester) for group project presentations. Based on class size we expect about 3-4 groups each consisting of about 2-3 people. Each person in the group should make a substantial contribution to the presentation. The projects should be based on what is/was taught in class. Please select a topic and check its suitability with the instructors well in advance, and prepare enough slides for a 20-minute presentation per group.

For both homework and exams, you need to show your work clearly (which also includes being neat and legible!), with all steps and assumptions, to get credit. *The easiest way to do this is to get into the habit of neatly showing all your steps and reasoning, on your homework.* Even if the final answer is wrong, partial credit will be given where it is due. Draw diagrams if needed, use the correct units. No work shown implies no credit, unreadable solutions also will not be given credit. **Missed exams** can only be made up under very special circumstances, such as official university business or illness. Please make prior arrangements with us well in advance.

COURSE SCHEDULE

Below is the generic calendar outline for the semester. Actual hour exam dates will be announced about a week in advance; *YOU are responsible for knowing the dates of exams (and presentation schedule), so plan to attend all classes!!*

Wed, Aug 30, 2022	First day of Fall 2023 class
Wed, Aug 30, 2022	First day of PHYS335 class
Friday, Oct 20, 2022	Midterm exam
We/Fr, Dec 6 & 8, 2022	Class project presentations
Tue, Dec 12, 2022	Last day of Fall 2023 classes
Wed, Dec 13, 2022	Study day (no classes)
Wed, Dec 20, 2022	Final exam

Topic breakdown

This is a very rough outline *and is subject to change.*

Week	Date	Topic	Material (Readings)
1	Aug 30	Class Outline Introduction and Overview	Syllabus W&H Chapter 1
2	Sep 4	The Earth System	W&H Chapter 2
3	Sep 11	Radiative Transfer	W&H Chapter 4 Jacob Chapter 7
4	Sep 18	No lecture (Instructor on travel)	W&H Chapter 4 Jacob Chapter 7

5	Sept 25	Atmospheric motions and general circulations	W&H Chapter 7
6	Oct 2	Thermodynamics	W&H Chapter 3
7	Oct 9		Stull Chapter 3
8	Oct 16	Extra topics ... Midterm Exam I (Oct 21)	
9	Oct 23	Thermodynamics	W&H Chapter 3 Stull Chapter 3
10	Oct 30	Atmospheric aerosols and climate	W&H Chapter 5 Jacob Chapter 8
11	Nov 6	Atmospheric Chemistry	W&H Chapter 5 Jacob Chapter 9-10
11	Nov 13	Cloud and Precipitation;	W&H Chapter 6
13	Nov 20	Thanksgiving!	
14	Nov 27	Remote Sensing Observations	Stull Chapter 8
15	Dec 4	Class Project Presentations about 20-25 min/group	
16	Dec 20	Final Exam	

COURSE POLICIES & RESOURCES

Attendance policy

You are expected to attend class regularly. Your presence in class is a kind of participation. Therefore, more than 2 unexcused absences will lower your grade. More than 4 such absences may result in failure of participation grade. It is your responsibility to inform instructors of any extenuating circumstances affecting attendance or class performance.

Cellphone policy

Cellphones may be brought to class, but please remember to silence them. If you are expecting an urgent call about a private matter, you are exempt from this policy; but please let us know about this ahead of time.

Late Policy

Late assignments are only accepted under extenuating circumstances.

Course caveat

The itinerary for the course is subject to change. In case of any emergency or unforeseen obstacles the instructor will email students with information regarding the changes or accommodations made. In the event of a major emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Every student is responsible for checking their mail and being informed about any changes to the course schedule.

Diversity Statement

Our role as an instructor is not to convince you to share my beliefs. My mission is to help you develop your critical thinking and analysis skills so that you can form strong arguments and support them.

UMBC's Vision Statement

Our UMBC community redefines excellence in higher education through an inclusive culture that connects innovative teaching and learning, research across disciplines, and civic engagement.

Technology: Access, Requirements, Resources, Support

To help ensure that UMBC students are equipped for academic success, the Division of Information Technology (DoIT) provides a wealth of resources and support, including tips for getting online and minimum specifications to consider when purchasing a computer. To learn more about the resources and support that DoIT offers to students, visit doit.umbc.edu/students. If you are experiencing technological difficulties or if you lack reliable access to computer hardware or an internet connection, please notify the course instructor as soon as possible.

Academic integrity

UMBC's policy on academic honesty is in effect. By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. These principles and policies apply in both face-to-face and online classes. Resources for students about academic integrity at UMBC are available at <https://academicconduct.umbc.edu/resources-for-students/>.

If you have any questions concerning plagiarism, refer to the Purdue Online Writing Lab (OWL) at <http://owl.english.purdue.edu/owl/printable/589>

Resources to Help you Succeed in Courses

Many students need additional support to succeed in courses. Helpful resources:

- UMBC's Academic Success Center (ASC) provides a range of resources to support students as they progress toward degree completion. They will continue to offer all of their services online.
- The ASC has created a specialized set of Online Learning Resources.

In addition, check out the following resources:

- **Tutoring and Instructional Support:** Online tutoring and writing support, supplemental instruction, study sessions, academic success meetings, placement testing, academic advocacy, first year alerts, and academic success meetings.
- **Academic Advocates:** Advocates work one-on-one with students who need support navigating academic and institutional challenges that may adversely affect their persistence, progression and timely completion of degree. No matter how complex the concerns (i.e., personal, academic, or financial), Academic Advocates will work together with students to review their progress, present options toward graduation, map out a plan for success, and facilitate communication and connections with the appropriate campus resources.

Enrollment Dates and Deadlines

Students must be familiar with the academic policies and enrollment dates and deadlines as published in the Undergraduate Catalog and the Academic Calendar. They are also responsible for managing their course enrollment(s) accordingly.

Accessibility and Disability Accommodations, Guidance and Resources

Support services for students with disabilities are provided for all students qualified under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that would create equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

SDS email: disAbility@umbc.edu

SDS phone: (410) 455-2459

If you will be using SDS approved accommodations in this class, please contact me (instructor) to discuss implementation of the accommodations.

Religious Observances

UMBC Policy provides that students should not be penalized because of observances of their religious beliefs, students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences for religious observances in advance, and as early as possible. For questions please contact the Office of Equity and Inclusion at oei@umbc.edu.

Hate, Bias, Discrimination and Harassment

UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement. Consistent with these principles, UMBC Policy prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information.

Students (and faculty and staff) who experience discrimination, harassment, hate or bias or who have such matters reported to them should use the online reporting form to report discrimination, hate or bias incidents; reporting may be anonymous.

Sex and Gender Based Violence, Harassment and Discrimination

Any student who is impacted by sexual harassment, gender-based harassment, sexual assault, sexual coercion, relationship violence, domestic violence, sexual exploitation, sexual intimidation, sex, gender-based stalking or retaliation or gender or pregnancy discrimination is encouraged to seek support and resources. You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community. As an instructor, I am considered a Responsible Employee, per UMBC's Policy on Prohibited Sexual Misconduct, Interpersonal Violence, and Other Related Misconduct I am required to report disclosures of possible violations of the Policy to the Title IX Coordinator, even if the experience occurred before you attended UMBC.

While I want you to be able to share information related to your life experiences through discussion and written work, I also want you to understand that I must report Sexual

Misconduct to the Title IX Coordinator so that the University can inform you of your rights, resources and support.

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, about an incident, UMBC has the following Confidential Resources available to support you: The Counseling Center: 410-455-2742; University Health Services: 410-455-2542; For after-hours emergency consultation, call 301-314-7651.

Other on-campus supports and resources:

The Women's Center (for students of all genders): 410-455-2714;

Title IX Coordinator, 410- 455-1250.

Child Abuse and Neglect:

Please note that Maryland law requires that I report all disclosures or suspicions of child abuse or neglect to the Department of Social Service and/or the police.

Pregnancy

UMBC's Sexual Misconduct, Interpersonal Violence, and Other Related Misconduct Policy expressly prohibits all forms of Discrimination and Harassment on the basis of sex, including pregnancy. Resources for pregnant students are available through the University's Office of Equity and Inclusion. In addition, students who are pregnant may be entitled to accommodations under the ADA through the Student Disability Service Office, and/or under Title IX through the Office of Equity and Inclusion.

Title IX/ Sexual Misconduct

Title IX protects people from discrimination based on sex, including sexual and gender based harassment, sexual assault, sexual coercion, relationship violence, domestic violence, sexual exploitation, sexual intimidation, sex and gender based stalking and retaliation, in education programs or activities that receive Federal financial assistance. As a university that receives Federal financial assistance, UMBC complies with the requirements set forth in Title IX. UMBC does not discriminate on the basis of sex.

At UMBC, Title IX reports may be made through the online reporting form or you can contact the University's Title IX Coordinator to file a report or for inquiries:

Mikhel Kushner, Title IX Coordinator
Office of Equity and Inclusion

Administration Building, Room 914
410-455-1250
kushner@umbc.edu

UMBC's Sexual Misconduct Policy and Procedures

The Office of Equity and Inclusion is responsible for ensuring UMBC's compliance with state and federal training requirements. Both faculty/staff sexual violence prevention training are offered online through SafeColleges. Online student training will also be offered in Fall 2021. Please visit website for more information about training. The University of Maryland, Baltimore County ("University" or "UMBC") values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement. Consistent with these principles, the University does not discriminate in offering equal access to its educational programs and activities or with respect to employment terms and conditions on the basis of a UMBC community member's race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information. At UMBC, discrimination reports may be made through the online reporting form or you can contact the University's Office of Equity and Inclusion to file a report or for inquiries:

OEI@umbc.edu
410-455-2735

Addition information is available:

U.S. Department of Education Office for Civil Rights
400 Maryland Avenue, SW
Washington, D.C. 20202-1328
OCR@ed.gov
800-421-3481
TDD 800-877-8339