SIO 217a Atmospheric and Climate Sciences I

Fall 2024

101 Nierenberg Hall: M & W, 12:30 – 1:50 pm

Amato Evan, 441 Nierenberg Hall, aevan@ucsd.edu

Office Hours: T, 10:00 – 11:00 am and by appointment (NH 441 or zoom)

Main and Required Textbook

Atmospheric Science: An Introductory Survey, J. Wallace & P. Hobbs

e-book through UCSD Library (must access via a UCSD IP): http://uclibs.org/PID/240988Links to an external site.

Supplemental Textbooks

Physics of the Atmosphere and Climate, M. Salby

e-book through UCSD Library (must access via a UCSD IP): https://ebookcentral.proquest.com/lib/ucsd/detail.action?docID=807160Links to an external site. Comprehensive presentation of atmospheric thermodynamics, although non-intuitive with relatively few examples of applications.

A First Course in Atmospheric Thermodynamics, G.W. Petty

Available only from the publisher ($36): https://sundogpublishingstore.myshopify.comLinks to an external site. An approachable introduction geared towards undergraduate atmospheric science majors. If you are coming from outside the geosciences this book may be very helpful.

Main Course Goal

The main goal of this course is to generate a fundamental understanding of thermodynamic processes in Earth's atmosphere, which will in-turn improve student's understanding of atmospheric and climate dynamics (217b/c) and enhance future research activities.

Key Course Objectives

This course will provide the student with an understanding of atmospheric structure, composition and processes. The main thematic area of the course is atmospheric thermodynamics including cloud physics. Specific concepts include:

1. Composition and structure of the atmosphere
2. Laws underlying energy transfer in the atmosphere
3. Role of water and water phase changes in atmospheric motion
4. Basic processes underlying cloud formation
5. Static stability
6. Warm and cold cloud processes
7. Aerosol cloud interactions (time permitting)
8. Application of theory to meteorological observations

Student Assessments

Progress towards understanding concepts and achieving the main course goal will be assessed via homework (7), which are due on the Wednesdays of the assigned week unless otherwise noted, quizzes (2), and exams (2). All homework problems will be discussed and graded in class.

Quizzes will be conducted via the course Canvas site. Exams are mainly employed as a tool to help prepare 1st year CS students for the Departmental Exam.

Assessment	**Weight**
Homework (7)	30%
Quizzes (2)	20%
Mid-term Exam (Nov 4)	25%
Final Exam (Dec 12)	25%

Grade Scale

A: 100–93 A-: 92–90
B+: 89–87 B: 86–83 B-: 82–80
C+: 79–77 C: 76–73 C-: 72–70
D: 69–60 F: Less than 60

Course Organization

My goal is the classroom time is evenly split between lectures and working through problems together. As such, it is imperative that you do the assigned readings prior to each class. My lectures will tend to cover information not presented in the textbook, and for each I will be assuming you have already done the assigned reading. At the beginning of each lecture you will have an opportunity to ask questions about concepts covered in the readings that were not clear. As noted above, we will go over the homework problems as a group, and you will grade each other's homework.

1. Come to class having done the assigned reading.
2. Come to class having completed the homework assignment.
3. Be ready to work out problems as a group (i.e., be prepared to participate in class discussions).

Late Assignments

If you are late with assignments, falling behind, or whatever, please reach out to me ASAP so we can figure out how to help you get back on track.

Rescheduling Class

If during the quarter there is a major dust storm brewing in the desert, I may have to cancel a class to head out and make some measurements. If this happens, I will reschedule the missed class for the next Friday (same time and place if possible) and offer an in-person and zoom option.

Course Schedule (subject to change)

Week	Date	Topics Covered	Assigned Reading (W&H)	Supplemental Reading (Salby)
1	9/30	Syllabus, Background, Introductions, Lagrangian & Eulerian derivatives, atmospheric structure and composition, density and mass, atmospheric energy transfer (Homework 1). **No class on 9/30.**	1, 3.1, 3.2	1.4.1, 2.1.0, 2.1.1, 2.1.4, 6.1, 6.2
2	10/7	Atmospheric thickness & heights of pressure surfaces, zeroth and first laws, Joule's law, specific heat, enthalpy, adiabatic process, dry static energy, potential temperature, dry lapse rate (Homework 2).	3.2-3.4	2.2-2.5
3	10/14	Moisture, saturation, latent heat, pseudoadiabatic process, equivalent potential temperature (Quiz 1)	3.5	4.1, 4.2, 4.4, 4.5, 4.6.1, 5.4.2, 5.4.3
4	10/21	Static stability, dry and moist convection, potential instability (Homework 3).	3.6	7.4.1, 7.4.3, 7.5
5	10/28	2nd law, Carnot cycle, entropy & Clausius-Clapeyron (Homework 4).	3.7	3.3–3.4, 3.6, 4.6.2
6	11/4	**Midterm Exam (11/4)**, Polytropic processes.		2.5.1, 6.4, 6.5
7	11/11	Warm cloud microphysics, droplet nucleation, entrainment (Homework 5). **No class on 11/13.**	6.1, 6.2, 6.3	9.1, 9.2.1
8	11/18	Liquid droplet growth through condensation and collection, droplet breakup, cold cloud microphysics (Homework 6).	6.4, 6.5	9.2.2, 9.2.3
9	11/25	Longwave radiative transfer and application to warming by greenhouse gasses (Quiz 2).		
10	12/2	Shortwave radiative transfer and application to aerosol direct and indirect effects (Homework 7).		