

ATMS 401/601 Fall 2025

Introduction to Atmospheric Physics

Taught by: Professor W. Patrick (Pat) Arnott.

Time and Place: Mon/Tues/Wed/Thur 8:00am to 8:50 pm. DMSC 106.

Textbook: Atmospheric Science: An Introductory Survey by Wallace and Hobbs.

Free Practical Meteorology Introductory Textbook for Those New to the Field:

https://www.eoas.ubc.ca/books/Practical_Meteorology/

Office Hours: Wednesday from 1 - 3 pm, RM 213 Leifson Physics, and at other times by appointment. Zoom meetings are available as well by appointment.

Contact: arnottw@unr.edu, 775-784-6834.

Course Administration: WebCampus for grades and some assignments.

Daily notes and course coordination will be through my website,

<http://www.patarnott.com/atms401> that will be active when the semester begins.

Catalog Description: Atmospheric structure; global radiation balance; radiation scattering by gases and aerosol particles; introduction to radiation transfer; optical phenomena; atmospheric thermodynamics; cloud physics; aerosol mechanics; atmospheric electricity. Prerequisite: PHYS 181.

Final Exam: Friday, second day of finals, from 8:00 am to 10:00 am.

Student Learning Outcomes:

1. Demonstrate ability to work with the thermodynamic structure of the Earth's atmosphere from the surface through the troposphere, stratosphere, mesosphere, thermosphere, and ionosphere: The origin of the atmosphere. Loss of atmospheric gases at the top of the atmosphere and gain of atmospheric constituents from space.
2. Demonstrate ability to use skew-T logP thermodynamic diagrams for the atmosphere, the foundation for each curve on this plot, and uses for understanding meteorological conditions.
3. Demonstrate ability with aerosol and cloud microphysics, and the connections between them, atmospheric thermodynamics, and radiation transfer.
4. Demonstrate ability to use atmospheric radiation transfer, including solar radiation, infrared radiation, single and multiple scattering, light scattering by aerosols and cloud hydrometeors, the factors affecting the Earth's radiation balance, the role of

radiation in weather and boundary layer dynamics, and the precise meaning of the greenhouse effect. Some questions we will explore are these: why are clouds white, skies blue, what would the sky look like if you could see at infrared wavelengths, and why it matters.

Planned Schedule of Topics:

Week 1 Overview of Atmospheric Science, chapter 1 and presentation. Homework 1 discussion. Introduction to skew T log P diagrams. Exponential model for pressure and density variation with height. Use of local weather stations at various altitudes for lapse rate and layer mass.
Week 2 Continuation of homework 1 data analysis. Begin chapter 3, Atmospheric Thermodynamics. Topics include a. Ideal gas equation applied to dry and moist air. b. Virtual temperature. c. Potential temperature. d. Hydrostatic equation. e. Increasingly detailed description of the temperature and pressure distribution in the atmosphere. f. SkewT logP diagrams. f-g. Relative humidity, absolute humidity. g. Dew point temperature. h. Wet bulb temperature. i. Equivalent potential temperature. j. Latent heat release and absorption in condensation and evaporation of water. k. Stability of air parcels. l. Indices on soundings.
Week 3. Continue with chapter 3. Students discuss atmospheric soundings. First homework assignment of Atmospheric Thermodynamics.
Week 4. Students present homework assignment 2. Atmospheric thermodynamics continues.
Week 5. Continue with atmospheric thermodynamics, measure dry and wet bulb temperatures and obtain Example: Measure the temperature and wet bulb temperature in the classroom. Then obtain the following: 1. Lifting condensation level. 2. Dew point temperature. 3. Relative humidity. 4. Potential temperature θ . 5. Wet bulb potential temperature θ_w . 6. Equivalent potential temperature θ_E .
Week 6. Students present homework on self-chosen sounding with large amounts of convective available potential energy (CAPE); group presentations on soundings, with calculations of the vertical distribution of potential temperature, equivalent potential temperature, and CAPE.
Week 7. Atmospheric stability; gravity waves, Brunt Vaisalla frequency.
Week 8. Midterm exam. Begin chapter 4 on Atmospheric Radiation Transfer. Students present assignment 4, conceptual aspects of atmospheric radiation.
Week 9. Scattering, absorption, and emission by hydrometeors, aerosols, and atmospheric gases. Single layer model for atmospheric radiation transfer.
Week 10. Scaling of atmospheric radiation interaction with wavelength and object size: Rayleigh, resonant (Mie), and geometrical optics regime. Blue sky and radar observations; rainbows.
Week 11. Multiple scattering of light by clouds. Single layer cloud and clouds above partially reflective surfaces. Role of surface energy budget and surface albedo.
Week 12. Section 5.4 of chapter 5 and chapter 6, cloud physics. Kelvin effect. Essential role of aerosol in cloud physics.
Week 13. Kohler theory. Formation mechanisms of cloud droplets and ice crystals. Observations.
Week 14. Atmospheric electricity: Fair weather electric field. Effects of clouds on electric fields.
Week 15. Hydrometeor charging. Lightning. Propagation of sound from thunder through the atmospheric. Acoustic shadow boundary
Final Exam

Grading: The class grade is determined as follows:

40% Homework: assigned problems and quizzes.

20% Online modules

40% Tests: Midterm, and Final Exam

Students can track their grade as the semester progresses using WebCampus.

Semester grades will be given using the following percentage guide:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
90%- 100%	89%- 89.9%	88%- 88.9%	80%- 87.9%	79%- 79.9%	78%- 78.9%	70%- 77.9%	69%- 69.9%	68%- 68.9%	60%- 67.9%	59%- 59.9%	0- 58.9%

Midterm Exam: A mid-semester, cumulative exam to be administered in class [20% of final grade].

Final Exam: Cumulative exam to be administered in class [20% of final grade].

ATMS 601 students will have additional homework assignments and different exams than 401 students. Consult with me about choosing a project topic that is suitable for class and helps with your research topic.

Policies regarding late work and make-up exams: Students must ask to turn in any missing assignments or makeup work due to absences from the class. Students will be given one day for each day's excused absence to complete missing work. Late work will be accepted up to 5 days after the due date. After the fifth day, the assignment will be considered missing and receive a zero. Students who miss an exam without a legitimate excuse will automatically receive 0 points for that exam. The student is responsible to schedule the makeup-exam with the instructor.

GUIDE TO DOING WELL IN THIS CLASS:

(My observations of students that get the most out of their course work during this brief time in life when you get to be a student)

1. Attend class, every class. Ask questions in class. I benefit greatly from questions students ask in class as it helps me refine my delivery of the subject matter, and it helps me convey topics more effectively. Other students benefit as well. I am very open to questions in class and find that when we have a discussion rather than a monologue, we all get a lot more out of our time together, and we can make interesting discoveries as we go along.
2. Do the homework every time, on time.
3. Work with others on the homework so that you learn to work in a group, and you gain the insights of others as they gain from you.
4. Be sure you thoroughly understand the homework and course material.

5. Read the textbook and assigned supplemental material.
6. Get started early. It helps cement your knowledge.
7. Attend office hours to ask questions and refine your understanding of the subject matter.
8. Seek connections with the subjects of this course and others you are taking or have taken in the past.
9. Pay close attention to subjects that are of great interest to you, and you may be able to link future employment and/or your thesis to the concepts of this course.
10. Let me know in advance if you are going to miss class and I can make a Zoom recording of it for you.

University Policies

Statement on Academic Dishonesty

The University Academic Standards Policy defines academic dishonesty, and mandates specific sanctions for violations. See the University Academic Standards policy: [UAM 6,502](#).

Generative AI Use is Selectively Permitted

In this course use of generative artificial intelligence/large language model tools (such as ChatGPT, DALL-E, Gemini, Perplexity, etc.) is permitted for homework, though not for exams or quizzes. For example, use of these tools aligns with the course learning associated with Python programming language script development as discussed in class.

Please be aware that many AI companies collect and store personal information. Please do not enter your confidential information as part of a prompt.

Also, please note that some of these large language models may “make up” or “hallucinate” information. These tools may reflect misconceptions and biases of specific data. Students are responsible for checking facts, finding reliable sources for, and making a critical examination of any work that is submitted.

All use of AI tools or content must be acknowledged or cited. If you do not acknowledge or cite your use of an AI tool, what you submit will be considered a form of cheating, as outlined in [UNR Academic Integrity Policy \(UAM 6,502\)](#).

Please make sure to acknowledge/cite use of generative AI in your assignments. Include the type of AI used and the question you posed to it. Ask for references at the end of your AI query. Include a statement of how you used AI, and the legitimacy of the references it used for providing a response.

Statement on Student Compliance with University Policies

In accordance with section 6,502 of the University Administrative Manual, a student may receive academic and disciplinary sanctions for failure to comply with policy, including this syllabus, for failure to comply with the directions of a University Official, for disruptive behavior in the classroom, or any other prohibited action. “Disruptive behavior” is defined in part as behavior, including but not limited to failure to follow course, laboratory or safety rules, or endangering the health of others. A student may be dropped from class at any time for misconduct or disruptive behavior in the classroom upon recommendation of the instructor and with approval of the college dean. A student may also receive disciplinary sanctions through the Office of Student Conduct for misconduct or disruptive behavior, including endangering the health of others, in the classroom. The student shall not receive a refund for course fees or tuition.

Statement of Disability Services

Use either the traditional or online statement, in addition to the last sentence regarding third party materials.

For Traditional and Seated Classrooms:

Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the [Disability Resource Center](#) (Pennington Achievement Center Suite 230) as soon as possible to arrange for appropriate accommodations.

For Online Courses:

If you are a student who would normally seek accommodations in a traditional classroom, please contact me as soon as possible. You may also contact the Disability Resource Center for services for online courses by emailing drc@unr.edu or calling 775-784-6000. Academic accommodations for online courses may be different than those for seated classrooms; it is important that you contact us as soon as possible to discuss services. The University of Nevada, Reno supports equal access for students with disabilities. For more information, visit the [Disability Resource Center](#).

This course may leverage 3rd party web/multimedia content, if you experience any issues accessing this content, please notify your instructor.

Statement on Audio and Video Recording

Student-created Recordings

Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped, or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded.

Instructor-created Recordings

Class sessions may be audio-visually recorded for students in the class to review and for enrolled students who are unable to attend live to view. Students who participate with their camera on or who use a profile image are consenting to have their video or image recorded. If you do not consent to have your profile or video image recorded, keep your camera off and do not use a profile image. Students who un-mute during class and participate orally are consenting to have their voices recorded. If you do not consent to have your voice recorded during class, keep your mute button activated and only communicate by using the "chat" feature, which allows you to type questions and comments live.

Statement on Maintaining a Safe Learning and Work Environment

The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Center for Civil Rights and Equal Access at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit the [Center for Civil Rights & Equal Access](#) page.

Statement on Campus Closures or Delays

In the event of class cancellations or delays caused by inclement weather conditions, fire/smoke conditions, or other unforeseen emergencies, the safety and well-being of students are the University's top priority. Official notifications will be disseminated through the University website and other official channels with details related to any campus delays or closures.

In the event of a campus closure, you will be informed as to whether the class will be offered remotely or if it will be canceled. If the class is cancelled, you will receive information on how to address any missed course content.

Students facing significant impacts due to these events are encouraged to communicate with their instructor for potential accommodations.

Statement for Academic Success Services

Your student fees cover usage of the [University Math Center](#), (775) 784-4433; [University Tutoring Center](#), (775) 784-6801; and [University Writing & Speaking Center](#), (775) 784-6030. These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign of a responsible and successful student.

Mental Health Support Statement

There are times when you may experience difficulties in life, and you may benefit from seeking help. Mental health services are available to you as a student at no additional cost through Counseling Services at the Pennington Student Achievement Center. This includes same-day in-person and tele mental health initial consultations, brief individual counseling, and group counseling sessions. Limited same-day appointments can be scheduled online via Counseling Services or by calling 775-784-4648. Additional brief drop-in "Let's Talk" student consultations are also available in the Counseling Services Annex located at the southwest corner of Great Basin Hall.

Veteran Statement

Veterans, Reservists, National Guard and military connected family members may wish to check the office of Veteran Services for benefits and support. Besides processing VA educational benefits, the department offers a variety of programs year-round to support student academic and personal success while transitioning to higher education and throughout your educational experience. They welcome inquiries regarding VA benefits and assist in navigating resources, the campus, and in the Reno community.

Zoom Guidelines

Participation During Zoom Meetings

Portions of our class may take place synchronously via Zoom if we have in-class cancellation due to inclement weather. Zoom recordings of classes will occur to accommodate student absences I learn about in advance. During the synchronous meetings, students are expected to pay attention, participate and engage with the material. If possible, find a quiet space without interruptions/background noise.

Video: Turn your video on if preferred and your internet service has sufficient bandwidth.

Audio: Your audio may be on when you join class, and you should immediately mute yourself upon entering the session (if you are not already muted). You can unmute yourself when you

want to participate. Turning on your microphone is a good way to indicate you want to add to the discussion, but you can also use the hand-raising symbol.

Chat Function: Please use the chat tool to ask questions or contribute ideas; please stay on topic to the information being presented.