Syllabus

ATMO 451B/551B: Introduction to Physical Meteorology II

Class Hours
11:00 am - 12:15 pm Tuesday, Thursday

Class Location
Harshbarger Rm 110

Instructor
Avelino F. Arellano, Jr. (Ave)
afarellano@email.arizona.edu
Harshbarger 314C, 520-626-3015
Office Hours, Tu/Th 12:30-2:00 pm or by appointment

Course Description
This is the 2nd course of a two-semester series introducing physical meteorology. This series covers the study of the relevant physical and chemical processes operating in the atmosphere and their interactions with the other components of the Earth system. For this particular course, topics in atmospheric radiation, composition, and chemistry including aerosols will be introduced. It is designed to provide a foundation in atmospheric physics and chemistry suitable for advanced study in atmospheric sciences and professional employment.

Textbook
We will use the book by Wallace and Hobbs, (2006 or newer edition) as our main textbook. This will be supplemented, most especially, by introductory books on atmospheric radiation and chemistry. See reference section of this syllabus for a list of references. Additional materials (e.g. articles, websites) will be distributed in class during the course of the semester. Lecture notes and other materials will be posted in our D2L site.

Goals & Objectives
My intent as an instructor is to convey fundamental concepts of physical meteorology such that students will:

a) gain an understanding of basic principles in atmospheric radiation & composition;
b) think physically of the processes in the atmosphere;
c) grasp the significance of radiative transfer calculations and role of composition in remote sensing and numerical prediction of weather and climate;
d) know how to relate these concepts to real world applications.

Learning Outcomes
By the end of this course, ATMO 451B and 551B students will be able to:

a) derive & solve the general radiative transfer equation & identify specific conditions which it can be applied;
b) conduct experiments on atmospheric retrievals (temperature, aerosol optical depth) & assess key strengths & weaknesses of remote sensing products when given such type of data to analyze;
c) construct the shortwave & longwave radiation budget when greenhouse gases (GHGs) and/or aerosols are present.
d) identify sources and sinks of GHGs and aerosols;
e) explain stratospheric ozone depletion and tropospheric ozone pollution and their radiative and chemical impacts.
On top of the outcomes listed previously, ATMO 551B students will also be able to:

a) derive (mathematically & numerically) the Stefan-Boltzmann and Wien’s Law from Planck’s function;
b) numerically integrate atmospheric spectra;
c) analyze existing datasets or articles on the role of atmospheric composition in radiation budget or vice versa (role of atmospheric radiation on GHGs or aerosol budget);
d) present related analysis in a clear, understandable, and efficient manner.

While assignments are best done individually, you can certainly discuss (and to an extent I do encourage you to discuss) your methods and the results with other students in the class. Students can sometimes learn more by discussing the ideas and methods with others than they can on their own. Given that you have different backgrounds/perspectives, the views of others can often be beneficial to a larger group. However, do NOT copy your solutions from anyone else (for programs, each student should write his/her own code). Please cite/acknowledge appropriately if your ideas/methods are not your own.

I will accept late assignments with full credit as long as the solutions have not been distributed in class. However, any assignments received after the solutions are distributed will not be accepted for credit.

For 551b students, projects will be in the form of numerical exercises on:

a) retrievals of AOD, (10% of grade),
b) retrievals of temperature profiles (10% of grade), and

c) critical review of research article or analysis of existing datasets related to atmospheric radiation and composition (10% of grade for presentation).

For 451b students, you have a choice of projects:
a) retrievals of AOD, (15% of grade), and

b) retrievals of temperature profiles (15% of grade);

Mid-term exam will be a take home exam. This will cover all topics discussed in class related to the fundamentals of radiation. Final exam will be a take home exam given on May 8 due May 12 12:30pm. This will cover topics discussed in class related to atmospheric composition and radiation.
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Introduction to Physical Meteorology II

Attendance
The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable https://policy.arizona.edu/human-resources/religious-accommodation-policy

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: https://deanofstudents.arizona.edu/absences

Academic Integrity
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: https://deanofstudents.arizona.edu/policies/code-academic-integrity.

Classroom Behavior
To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

Students with Disability
Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Disability Resource Center (520-621-3268) to establish reasonable accommodations. For additional information on the Disability Resource Center and reasonable accommodations, please visit http://drc.arizona.edu.

If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate. Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Nondiscrimination & Anti-Harassment
The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Student Responsibilities
To learn this course, you are expected to be involved all throughout. As a student, you are responsible in a) actively asking and answering questions during class, b) doing your assignments (including reading materials) after class, and c) responding to d2l class announcements/surveys. Doing so will greatly enhance your learning experience. As your instructor, I invite you to make use of our office hours if you have some pressing questions.

From the University perspective, you are expected to devote a minimum of two (2) hours outside class (for study, reading, homework) for every contact hour (or 50 minutes) in classroom.
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Main Reference Materials


Supplementary Reference Materials


Course Withdrawal
Last day to drop the course without it appearing on your record is Jan 28, 2020 for Undergrad and Feb 11 for Grad.

Final Note
Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.
Course Outline

Below is our tentative schedule. We may extend/shorten the lecture/discussion of some sections (e.g. special topics) depending on the average progress of the class. Exam dates, on the other hand, are fixed.

Course Syllabus/Introduction
Jan 21

Fundamentals of Radiation for Atmospheric Applications
(W&H Ch 4, Liou Ch 1, S&P Ch 4, Salby Ch 8, MJ Ch 9, DJ 7)
Description of EM Radiation
Jan 23 – Jan 28
Radiation Concepts and Laws
Jan 30 – Feb 4
Physics of Absorption and Scattering
Feb 6 – Feb 11
Introduction to Radiative Energy Transfer
Feb 13 – Feb 25
Practical Applications (Radiation Budget)
Feb 27
Recap/Review
Mar 3

Mid-Term Exam
Mar 5 due Mar 6

Atmospheric Composition and Chemistry
(W&H Ch 2 & 5, DJ Ch 1,3,8-12, S&P 1-6,8,15,23&24, Salby Ch 9)
Measures of Atmospheric Composition
Mar 17 – Mar 19
Sources and Sinks of Key Atmospheric Constituents
Mar 24 - Mar 26
Basic Chemical Kinetics
Mar 31 – Apr 2
Stratospheric Chemistry
Apr 7 – Apr 14
Tropospheric Chemistry
Apr 16 – Apr 21
Aerosols
Apr 23 – Apr 28
Recap/Review
Apr 30

Project Presentation
May 4-6

Final Exam
Due May 12 1230pm