ATOC 3500
Air Chemistry and Pollution
Spring 2016

Meeting: T/Th, 12:30 – 1:45 pm; Duane D318

Instructor: Prof. Darin Toohey (ATOC/ENVS/SSI-RAP)
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Office hours: T/Th 10:30-11:45 am, 2:00-3:00 pm, or by appointment.

Website: http://storm.colorado.edu/~toohey/ATOC3500-2016.html

Textbook: none required, but see the following web site for online copy.
Introduction to Atmospheric Chemistry, Daniel Jacob, Princeton University Press, 1999.
(http://acmg.seas.harvard.edu/publications/jacobbook/index.html)

What is this course about?

We hear or read frequently about an environmental problem or issue that involves the atmosphere. It is no accident that the atmosphere figures prominently in the news; for example, the quality of the air we breathe directly affects our health. In addition, the atmosphere is the component of the Earth system that is most susceptible to change, by virtue of its relatively small mass. As such, the atmosphere serves as a natural, if inadvertent, laboratory for investigating environmental change on local, regional, and global scales.

This course reviews and applies basic chemical principles to the study of atmospheric composition and several pollution-related phenomena, such as stratospheric ozone depletion, urban air quality, and acid rain. We will also explore how atmospheric dynamics plays a role, and examine the coupling between atmospheric chemistry and life at the Earth's surface (biosphere).

Course organization:

Details of the material to be covered are given in the "tentative schedule" below. We will begin with a review of the basic properties of air, followed by some important chemistry of molecules and particles. We address issues of transport and visibility, as these will factor into strategies to mitigate the effects of air pollution. Finally, we examine some recent examples of atmospheric chemical change that is due to human influences and we examine some of the strategies for mitigating the impacts on the environment and human health.

I will try to use a 'flipped' classroom methodology as much as possible. This means that you will be responsible for reviewing and completing assigned materials and problems **before** coming to class. I will announce these dates in advance, but assume that every class will have a flipped component. Some class periods will consist of a short lecture-like review, followed by activities such as working out homework problems in small groups, discussing reading material, and working through problems and questions. A significant part of your grade (and work in this class) will be the team development of a 10-12 minute video 'lecture', as well as of your participation.

Work and Grading:

Grades will be based on homework, exams, and a project, as follows:

Problems and quizzes:	30%
Midterm exam:	20%
Final exam (cumulative):	30%
Project:	20%

Problems: Assignments will emphasize problem-solving and detailed calculations, and are to provide practical experience working the types of problems that are common in atmospheric chemistry. I encourage you to work together with others to formulate approaches to the problems, but the paper that you turn in must represent *your own work*. NOTE: Late submissions will not be guaranteed full credit, BUT you should still submit late assignments for some credit and feedback.

Quizzes: Administered (on D2L, if possible) throughout the semester to help assess your progress. These will typically consist of true/false, multiple choice, and short answer questions that are based on classroom discussions, problems, and current topics of interest that I will post from time to time on the class website. The questions are designed to highlight details that are important to know, but that are sometimes overlooked when reading longer sections of the book. Online assessments will typically be available for 5 days, and must be completed by the closing time/day listed on the assessment and announced in class. Once an assessment is closed, it will not be reopened and there will be no other opportunities for recovering points for those assessments that are missed.

Exams: The midterm will cover the concepts discussed in class, questions from the assessments, and material that forms the basis for the homework problems. There will be some calculations that are similar to problems done for homework. The midterm will last 75 minutes and the final exam will be cumulative, and it will last for 2 1/2 hours.

Video 'lecture': This will be a report on a topic of your choice relating to a specific problem of air quality. Details will be announced in class.

Late or missed work: If you expect to miss any assignments or exams for legitimate reasons, please contact the instructor as soon as possible to make other arrangements.

Expectations:

- Come to class: It will be difficult to follow the class if you don't attend regularly. We will also work problems from the homework. Please come prepared to participate. Bring a calculator (or know someone who has one). If you know you will be missing class, please let me know beforehand so that I can set aside handouts for you.
- Prepare for class: It is not practical to cover every detail of the phenomena we will study in time allotted for class. Our 'lectures' will emphasize the difficult material. Material you will read/view before class will cover many of the basics. The textbook will often serve as a reference.
- Ask questions: Unless you ask questions during class I will assume you understand the material. Thus, what you learn will depend on what questions you ask! Class will be interactive and discussion oriented. We'll work on homework problems, discuss the more difficult material, and talk about current events, some of which are controversial. Please participate, but remember that civility and cooperation are essential elements in the classroom. This means encouraging one another during discussions and working together on problems.

Schedule of Topics (see course web page for updates)

Week	Topics	Preparation (TBD)
1	Introduction to Earth's atmosphere: Major gases, minor gases, particles (aerosols), temperature, pressure	
2	Pollution buildup and dispersal: Physics, radiation, stability, circulation, transport, constituent sources and sinks	
3	Light absorption and scattering, introduction to kinetics	
4	Modeling, ozone and Chapman chemistry	
5	Reservoirs, cycling, influence of life	
6	Tropospheric photochemistry, smog, oxidation, and acidity	
7	Stratospheric chemistry, catalytic cycling, the ozone hole and policy	
midterm		
8	Projects	
9	Projects	
10	Projects	
11	Spring Break, no classes	
12	Natural and human influences	
13	Emerging issues (climate change, energy, etc.)	
14	Other topics (Southeast Asia, long-range transport, economics, etc.)	
15	Discussion	
16	Review	

Sunday, 1 May, 2016	Final Exam 7:00 pm – 10:00 pm

Policies:

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. (303-492-8671, Willard 322, http://www.Colorado.EDU/disabilityservices)

Please inform the instructor if you observe religious holidays and may miss class or scheduled exam dates. Alternative arrangements will be made in such cases. Campus policies can be found at http://www.colorado.edu/policies/fac_relig.html

Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See polices at http://www.colorado.edu/policies/classbehavior.html and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

The University of Colorado at Boulder policy on Discrimination and Harassment (http://www.colorado.edu/policies/discrimination.html), the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships applies to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://www.colorado.edu/odh

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at http://www.colorado.edu/policies/honor.html and at http://www.colorado.edu/academics/honorcode/