ATM S 558: Spring Quarter 2003
Atmospheric Chemistry

course web site: http://www.atmos.washington.edu/2003Q2/558

Class Meeting Times and Location: Mondays and Wednesdays 9:30-10:50 am in Room 406 in the Atmospheric Sciences Building.

Course Description: Graduate course providing an introduction to the physical and chemical processes determining the composition of the atmosphere and its implications for climate, ecosystems, and human welfare. We will look at the science behind several important global environmental problems: Stratospheric ozone depletion, tropospheric ozone and photochemical smog, oxidizing capacity of the atmosphere, and acid rain.

Instructor: Lyatt Jaeglé (jaegle@atmos.washington.edu; 685-2679; Office: ATG 306)

Office hours: After class or stop by my office anytime.

Prerequisites: ATM S 501 or ATM S/CHEM 458 or permission of instructor.

Grading policy: Homeworks, 50%; Project paper, 35%; Class participation, 15%.

Textbook: ***Introduction to Atmospheric Chemistry***, by D.J. Jacob, Princeton University Press, 1999. The lectures will largely follow this textbook. Each week the students will be required to read material of direct relevance to the class.

Topics covered:
1) Fundamentals (2 weeks). Atmospheric radiation; Theory of gas-phase reaction rates; Multiphase chemistry; Analysis of reaction mechanisms; Timescales.
2) Stratospheric chemistry (3 weeks). Stratospheric ozone and the Chapman mechanism; Catalytic loss cycles (HO_x, NO_y and halogen chemistry); Polar and mid-latitude ozone depletion; Role of aerosol chemistry in the stratosphere.
3) Tropospheric Chemistry (3 weeks). Oxidizing capacity of the atmosphere; Tropospheric ozone; Tropospheric NO_x and hydrocarbons; Air pollution and ozone smog.
4) Aerosols and cloud chemistry (2 weeks). Sources and transformations of tropospheric and stratospheric aerosols; Sulfur chemistry; Aqueous phase chemistry.

Approximate course schedule (check class web page for up-to-date information)

Date	Lecture topic	Required reading	Assignt. Due
	WEEK 1	Chapters 1, 2, 7	
M 3/31	Introduction and course overview **Fundamentals.** Atmospheric Radiation		
W 4/02	Atmospheric Radiation cont.		
	WEEK 2	Chapters 3, 4, 9; Chap 3 of S&P	
M 4/07	Principles of Chemistry; Theory of gas-phase reaction rates; Multiphase chemistry		**#1**
W 4/09	Analysis of reaction mechanisms; Box models; Lifetimes and transport timescales		
	WEEK 3	Chapter 10	
M 4/14	**Stratospheric chemistry**. Ozone and the Chapman mechanism; Catalytic loss cycles: HOx chemistry		**#2**
W 4/16	Catalytic loss cycles: NOy, Cly, Bry chemistry		
	WEEK 4		
M 4/21	How do we test photochemical models?		
W 4/23	***Paper discussion***		
	WEEK 5	Review by S. Solomon	
M 4/28	Ozone depletion: Polar ozone loss		**#3**
W 4/30	Mid-latitude ozone loss; role of aerosol chemistry in the stratosphere		
	WEEK 6		
M 5/05	**Tropospheric Chemistry.** Oxidizing capacity of the atmosphere: the hydroxyl radical,		
W 5/07	The Global budgets of CO and CH4		**#4**
	WEEK 7	Chapter 11	
M 5/12	Tropospheric ozone		
W 5/14	Tropospheric NOx; Tropospheric VOCs		
	WEEK 8	Chapter 12	
M 5/19	Air pollution and ozone smog		
W 5/21	***Paper discussion***		
	WEEK 9	Chapter 8	
M 5/26	**MEMORIAL DAY – NO CLASS**		
W 5/28	**Aerosols.** Sources and sinks of aerosols. Sulfate aerosols.		**#5**
	WEEK 10	Chapter 13	
M 6/02	Aqueous phase chemistry.		
W 6/04	Paper presentations.		**paper due**
W 6/11	Paper presentations.		

Other useful textbooks:

Chemistry of the Lower and Upper Atmosphere, by Finlayson-Pitts and Pitts, Academic Press, 1999.

Atmospheric Chemistry and Physics: from Air pollution to Climate change, by J.H. Seinfeld and S.N. Pandis, Wiley, 1998.

Atmospheric Chemistry and Global Change, G.P. Brasseur, J.J. Orlando, and G.S. Tyndall (eds.), Oxford University Press, 1999.

Chemistry of the Natural Atmosphere, *P. Warneck*, Academic Press, 1999.

Atmospheric Change**,** T.E. Graedel & P.J. Crutzen, Freeman, 1992.

Chemistry of Atmospheres: An Introduction to the Chemistry of the Atmospheres of Earth, the Planets, and their Satellites**,** R.P. Wayne, Oxford University Press, 2000.

Final Project.

Students will write a paper and give a 15 minute presentation at the end of the quarter. A list of possible topics is included below, or students can pick a topic of their own choosing. The paper should be 5-10 pages long (~1.5 line spacing) and include more than 10 references.

Potential topics.

- The effects of global warming on the recovery of the stratospheric ozone
- Composition of Polar stratospheric clouds
- Biomass burning, and its effect on tropospheric ozone levels in tropical regions.
- Halogen chemistry in the marine boundary layer
- Ozone depletion events in the arctic boundary layer
- Is the global oxidizing capacity of the atmosphere changing?
- Satellite observations of tropospheric composition
- Satellite observations of stratospheric composition
- Lightning and the global NO_x budget
- Recent trends in CH_4
- Effects of aerosols on tropospheric ozone