ATMS 558: Spring 2008
Atmospheric Chemistry

→ http://faculty.washington.edu/jaegle/558 ←

Class Meeting Times and Location: Mondays and Wednesdays 9:00-10:20 am in Room 610 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 role of atmospheric chemistry behind several important global environmental problems: Stratospheric ozone depletion, tropospheric ozone and photochemical smog, oxidizing capacity of the atmosphere, acid rain, global warming.

Instructor: Lyatt Jaeglé (jaegle@atmos.washington.edu; 685-2679; Office: ATG 302)

Office hours: After class or e-mail me to set up a time.

Prerequisites: ATM S 501 or permission of instructor.

Grading policy: Homeworks, 60%; Project paper, 30%; Class participation, 10%.

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. Textbook + Errata also available online:http://www.as.harvard.edu/people/faculty/djj/book/index.html

Topics covered:

1) Introduction and Fundamentals. Photochemistry; Theory of gas-phase reaction rates; Multiphase chemistry; Analysis of reaction mechanisms; Timescales; Box models.

2) Stratospheric chemistry. 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. Oxidizing capacity of the atmosphere; Tropospheric ozone; Tropospheric NO_x and hydrocarbons; Air pollution and ozone smog; Tropospheric Sulfur and tropospheric aerosols.

4) Atmospheric Chemistry and Climate. Global warming and atmospheric chemistry: direct and indirect effects.

Course schedule (please check class web page for up-to-date information!) *Note: I will be out of town during the 2nd week of the quarter. We will make up these 2 classes on Fridays, if this works for everybody.*

Date	Lecture topic	Required reading	HMW Due
	WEEK 1	Skim through Chapters 1, 3, 9	
M 3/31	Introduction and course overview Fundamentals. Photochemistry. Theory of gas-phase/multiphase reaction rates.		
W 4/02	Analysis of reaction mechanisms; Box models; Lifetimes and transport timescales		
	WEEK 2		
M 4/07	No class		
W 4/09	No class		
	WEEK 3	Chapter 10	
M 4/14	Stratospheric chemistry. Ozone and the Chapman mechanism; Catalytic loss cycles: HOx chemistry		
W 4/16	Catalytic loss cycles: NOy, Cly, Bry chemistry		#1
	WEEK 4		
M 4/21	Ozone depletion: polar ozone loss		
W 4/23	Mid-latitude ozone loss; role of aerosol chemistry in the stratosphere		
F 4/25	Paper discussion		
	WEEK 5	Chapter 11	
M 4/28	Tropospheric Chemistry. Oxidizing capacity of the atmosphere		
W 4/30	The global budgets of CO, CH4, and VOCs		#2
	WEEK 6		
M 5/05	Tropospheric ozone and NOx		
W 5/07	Tropospheric ozone and NOx		
F 5/09	Paper discussion		
	WEEK 7	Chapter 12	
M 5/12	Air pollution and ozone smog		
W 5/14	Ralph Cicerone		#3
	WEEK 8	Chapters 8+13	
M 5/19	Aerosols. Sources and sinks of aerosols.		
W 5/21	Sulfur chemistry		#4
	WEEK 9		
M 5/26	Memorial Day – No class		
W 5/28	Atmospheric chemistry and climate		#5
	WEEK 10		
M 6/02	Student presentations		
W 6/04	Student presentations		
F 6/06	Student presentations		paper due

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

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

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

"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 during the last week of class and finals week. A list of possible topics is included below, or students can pick a topic of their own choosing. The paper should be at least 5 pages long (but no more than 10 pages) using ~1.5 line spacing and include at least 10 references, as well as figures to illustrate your points.

Potential topics.

The effects of global warming on the recovery of the stratospheric ozone
Air pollution in mega-cities
Air pollution and health
Intercontinental transport of pollutants
Composition of polar stratospheric clouds
Biomass burning, and its effect on tropospheric ozone levels in tropical regions
Biogenic emissions of VOCs
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
Sources and chemistry of DMS
Recent trends in CH_4
Glacial-interglacial variations of CH_4
Planetary photochemistry
Effects of aerosols on tropospheric ozone
Cloud chemistry
Formation of the stratospheric ozone layer in Earth's early atmosphere