ATMOSPHERIC CHEMISTRY

CHEM F606 (cross listed as ATM F606) Overview and Schedule --- Fall 2018

Instructor	Dr. Jingqiu Mao (Reichardt 188, 907-474-7118, jmao2@alaska.edu)
Office Hours	Tu, Th 11:20A-12:20P and any other time by appointment
Class	Tu, Th, 9:45A-11:15A, REIC 207
Text:	Introduction to Atmospheric Chemistry, Daniel J. Jacob (Available online: http://acmg.seas.harvard.edu/people/faculty/djj/book/index.html)
Supplements	Atmospheric Chemistry and Physics: from Air Pollution to Climate Change, John H. Seinfeld and Spyros N. Pandis, 3rd Edition.

Course Description (from catalog):

Chemistry of the lower atmosphere (troposphere and stratosphere) including photochemistry, kinetics, thermodynamics, box modeling, biogeochemical cycles and measurement techniques for atmospheric pollutants; study of important impacts to the atmosphere which result from anthropogenic emissions of pollutants, including acid rain, the "greenhouse" effect, urban smog and stratospheric ozone depletion. Special fees apply. Prerequisites/Co-requisite: ATM F601 or permission of instructor. (Cross-listed with ATM F606. Stacked with CHEM F406.) (3+0)

Course objectives / Learning Goals:

By the end of the semester, you will have a basic knowledge of:

- The atmospheric chemical composition
- The transformations of these compounds
- The importance of chemicals in the atmosphere for climate, human health, and ecosystem health
- Air pollution and atv v]siieA7 -2 (ut) -2 (i) -2 (on) mddn v v]soneut Because students may come to this

for students who are either from a pure atmospheric or a pure chemistry background. In either case, I will provide tutorials on the topic that you are missing. A fully prepared student will have the following:

- Interest in understanding the atmosphere's chemical composition and transformations
- Basic atmospheric structure (Atmospheric layers, vertical profiles of pressure and temperature) (A)
- Basic Chemistry (periodic table, simple compound naming) (B)

If you feel you have a lack in either (A: Atmospheric structure) or (B: Basic chemical principles), you should attend the tutorial sessions. These sessions will be held during the first three weeks of class at a time that is convenient for interested students. In addition to these basic topics, we will cover the following topics, but some knowledge in this area would be beneficial:

Chemical equilibrium, Chemical kinetics, Oxidation states, Chemical catalysis, Basic photochemistry

Course Structure

Classroom sessions, held twice a week, discuss theoretical and practical aspects of atmospheric chemistry. The classtime lectures and discussions will follow the courseÕs textbook. Problem sets are assigned every two weeks. The solutions to problem sets are due at the beginning of class on Tuesday. Please begin the problem set early so that you do not have a deadline crunch and are able to ask questions regarding the problems.

The other half of the material will come from a term paper and an AGU-type presentation. The guideline is attached at the end.

Course Policies

Graduate-level students also lead a term project and

- Title should describe in a specific manner the content you are covering. If you are focusing on a specific location or season, be sure to include that in the title.

- Abstract should include a brief statement of the scientific question to be addressed and why it matters; the approach(es) to address this question; and must summarize key messages and findings.

- Introduction provides the context for the question being addressed. What background information must the reader know in order to understand the rest of the paper? Remember to assume the reader has taken this course, so it should not be a textbook discussion. What work has previously been done, and what questions remain, that you are addressing here? ItÕs often effective to end your first paragraph of the intro with

If a model matches observations, can you report a correlation coefficient or an amplitude of a seasonal cycle as observed vs. modeled? Note that the papers you are reviewing may not do this (but they should!). If you are presenting your own research results, try to do so quantitatively by reporting statistics where possible.

¥! Conclusions The first paragraph should briefly remind the reader of the problem being addressed (in other words, for the readers who skip the paper and only read the abstract and conclusions [though of course I will read carefully your every word ! !]). Here is where you should focus each paragraph on a different key message. What are the implications? What questions remain? How might these knowledge gaps be filled? What observations are needed? Tests with models? Lab experiments? Theory? i.e., you can discuss what future work is needed to advance your understanding beyond what youÕve learned from the papers youÕve studied.

¥! Figures and Tables. You may include up to 4 figures and tables (combined). A picture is worth 1000 wordsÉ if itÕs a good one! This is a critical review, so itÕs certainly ok to include figures from the papers youÕre reading but they must be properly cited (i.e. I500 .24 12rly

Oxidizing capacity as determined from observed methyl chloroform or ^{14}CO
Isotopes in atmospheric chemistry (sulfate, nitrate, water, or hydrocarbons)
Methane trends (paleo, preindustrial-to-present, or recent decades)
Methane role in oxidizing capacity and/or air quality
Chemistry occurring on dust or other aerosols
Sources of baseline ozone levels in surface air
Atmospheric budgets of oxygenated volatile organic compounds (e.g., acetone, ethanol, methanol, glyoxal, etc.)
Tropospheric halogen chemistry
Peroxy acetyl nitrate and long-range pollution transport
Isoprene oxidation and secondary aerosol or ozone formation
Monoterpene oxidation and formation of secondary organic aerosols
Paleo atmospheric composition
Planetary atmosphere (choose a planet or set of chemical reactions)
Radiative forcing from non-CO_2 species
Trends in regional air pollution (choose a pollutant/region)
Mercury budgets or oxidation pathways
Persistent organic pollutants Dry deposition
Wet removal (gases or aerosol)
Emissions from the biosphere: soil NOx, isoprene, terpenes, wildfires, or methane

Alternative – write a research paper on your own project:
Describe and draw conclusions from a short data analysis project from a field campaign, monitoring network, applying a simple model, or your own relevant research. You are encouraged to use this project as an opportunity for a seed project that could turn into thesis work. Talk to the instructor if you'd like to take on your own project but need help finding a dataset or model to use.