ATM S 565 ATMOSPHERIC CHEMISTRY MODELING
Fall Quarter 2018

Class Meeting Times and Location: Mondays & Wednesdays 12:30-1:50 pm.

Instructor: Lyatt Jaeglé (jaegle@uw.edu; 206-685-2679; ATG 302)

Course Description: In this course we will discuss the foundations of mathematical models for atmospheric chemistry. Our focus will be on three-dimensional numerical models that simulate transport, chemistry, emissions, and deposition of chemical species in the atmosphere.

Week 1	**Introduction to atmospheric chemistry modeling.** What is a model? Types and applications of atmospheric chemistry models.
Weeks 2-3	**The continuity equation.** Forms and discretization of the continuity equation. Grids. Operator splitting.
Week 3-4	**Numerical methods for chemical systems.** Linearization. Characteristic time scales. Implicit finite difference solvers.
Weeks 5-6	**Numerical methods for advection.** Mean and turbulent components of transport. Parameterization of turbulence. Numerical solution of the advection equation.
Week 7	**Surface fluxes.** Emissions. Dry deposition.
Week 8	**Parameterization of subgrid-scale processes.** Turbulence. Boundary layer processes. Deep convection. Wet deposition. Lightning.
Week 9	**Model evaluation. Inverse modeling.**
Week 10	**Class presentations.**

Reading: The main textbook we will follow is "***Modeling of Atmospheric Chemistry***" by Guy P. Brasseur and Daniel J. Jacob, Cambridge University Press, 2017. We will also have class discussions about papers from the scientific literature.

Grading: Problem sets, 60%; Project paper and presentation, 30%; Class participation, 10%.

Problem sets. We will have 4 graded problem sets as part of the course (they will be due every other week). You will use the software of their choice (MatLab, IDL, Python, Excel …) to solve various numerical problems sets related to advection, model grid, deposition, chemical reactions solvers. You will also analyze results of simulations conducted with atmospheric chemistry models.

Project paper and presentation. You will write a paper and give a 15-minute presentation during the last week of class. The paper should be at least 5 pages long (but no longer than 10 pages) using ~1.5 line spacing and include at least 5 references as well as figures to illustrate your points. The paper will be graded based on content, organization, and style. The oral presentation will be graded based on content (organization and subject knowledge), oral delivery, visual presentation.

Your project can take different forms: 1) Review literature on specific topic related to atmospheric chemistry modeling. 2) Applications of atmospheric chemistry models. 3) Examine the theoretical underpinning and coding of a particular aspect of atmospheric chemistry modeling (look at the code and understand it). 4) More hands-on: download and run an atmospheric chemistry model or sub-module. Examine the sensitivity to specific assumptions (e.g. chemical solver, PBL mixing scheme, emission inventory, etc...).

Here is a list of potential topics. You can also design a topic of your own choosing. Please discuss it briefly with me. Do not choose a topic that is too closely related to what your research is about. The goal is to learn something new!

- Planetary boundary layer mixing schemes
- Convective transport schemes
- Advection schemes
- Stratosphere-troposphere exchange
- Chemistry solvers
- Chemical mechanisms (how they affect the results)
- Radiative transfer schemes
- Dry deposition
- Wet deposition (in-cloud, below-cloud, effects of precipitation type)
- Aerosol modules
- Emissions (pick one type: power plants, fires, lightning, etc…)
- Operator splitting methods
- Inverse modeling (techniques or applications)
- Lagrangian modeling techniques
- Intercomparisons of atmospheric chemistry models

In-class discussion about scientific papers. As part of the course, we will read and have an in-class discussion of four landmark papers from the scientific literature (roughly every other week). These papers will be related to the following subjects: development of transport schemes, chemical solvers, dry deposition parameterization, inverse modeling.

Access and Accommodations. Your experience in this class is important to me. It is crucial that all students in this class have access to the full range of learning experiences. At the University of Washington, it is the policy and practice to create inclusive and accessible learning environments consistent with federal and state law. Full participation in this course requires the following types of engagement:

- Lecture – the ability to attend bi-weekly lectures of 75 minutes with 10-15 other students
- Assignments - the ability to complete assigned computer programming-based problem sets every other week.
- Discussion - the ability to participate in 75-minute group discussion of assigned scientific papers
- Project paper and presentation – the ability to write a 5-10 page long summary of research on a given topic and to give a 15 minute presentation on this topic in front of the class and instructor.

A complete description of the disability policy of the College of the Environment can be found here. If you have, or think you have, a temporary or permanent disability that impacts your participation in any course, please also contact Disability Resources for Students (DRS) at: 206-543-8924 V / 206-543-8925 TDD / uwdrs@uw.edu e-mail / http://www.uw.edu/students/drs. If you have already established accommodations with DRS, please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.

Academic Integrity. At the University level, you must do your own scholarly work. Presenting anyone else's scholarly work (which can include written material, problem set answers, graphics or other images, and even ideas) as your own, without proper attribution, is considered academic misconduct. Plagiarism, cheating, and other misconduct are serious violations of the University of Washington Student Conduct Code (WAC 478-120). We expect that you will know and follow the university's policies on cheating and plagiarism. Any suspected cases of academic misconduct will be handled according to University of Washington regulations. For more information, see the College of the Environment Academic Misconduct Policy and the University of Washington Community Standards and Student Conduct website.