AT631, Spring 2011

Introduction to Atmospheric Aerosols
Tuesdays 9-9:50 AM, 212B ACRC
Wednesdays, Lab, 1-4 PM, ACB 10

Instructor: Prof. Sonia Kreidenweis
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Objectives:

Atmospheric particulate matter plays an important role in visibility reduction, climate forcing, and cloud formation and microphysics. This course reviews the chemical and physical characteristics of particulate matter that lead to impacts in the atmosphere, including:

- aerosol size distribution;
- aerosol physics, deposition rates, and atmospheric lifetimes;
- optical properties and their relationship to visibility and climate;
- aerosol hygroscopicity and relationship to cloud formation;
- gas / aerosol partitioning theory;
- measurement principles and techniques.

Current understanding of atmospheric aerosol sources and budgets will be reviewed. Several hands-on laboratory exercises will be completed during the semester to demonstrate concepts covered in class.

Suggested Texts:

Seinfeld, J.H., and S. N. Pandis, *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, Wiley-Interscience, 2006.

Hinds, W., *Aerosol Technology*: *Properties, Behavior, and Measurement of Airborne Particle*s, Wiley Interscience, 1999.

Vincent, J.H., *Aerosol Sampling: Science, Standards, Instrumentation and Applications*, Wiley Interscience, 2007.

Baron, P.A. and K. Willeke, *Aerosol Measurement: Principles, Techniques, and Applications*, Wiley Interscience, 2005.

Course Structure and Grading Criteria:

Each lab will require collection of pertinent data and analysis and interpretation of these data. Each student will be asked to complete and hand in these lab assignments the week after each lab. They will be graded and returned.

Grading will be based on laboratory assignments (50%) and class participation (50%).

Date			TOPIC
January	18	T	Particle sizes and functions used to fit aerosol size distributions: The lognormal, gamma and power-law distributions
	19	R	**LAB 1:** Spreadsheet to compute size distributions and integral quantities; fitting to a lognormal function
	25	T	Overview of aerosol composition and sources; aerosol measurements networks
	26	R	**LAB 2:** Lab safety; flow measurement, aerosol generation, hardware
February	1	T	Aerosol motion: Stokes' Law, stop distance and settling velocity
	2	R	**LAB 3:** Depositional losses in sample lines
	8	T	Representative aerosol sampling (isokinetic sampling, equations for losses)
	9	R	**LAB 4**: Impactors
	15	T	Brownian motion and diffusional deposition; Brownian coagulation
	16	R	**LAB 5**: Coagulation ageing of particles
	22	T	Condensational growth
	23	R	**LAB 6**: Condensation particle counter / counting statistics
March	1	T	Motion of charged particles in an electric field; theory of the DMA
	2	R	**LAB 7**: The Differential Mobility Analyzer
	8	T	Aerosol water uptake: Solubility and hygroscopicity; observed aerosol water contents and simple parameterizations
	9	R	**LAB 8**: Hygroscopicity measurements, salts
	15	T	*Spring Break*
	16	R	*Spring Break*
	22	T	Hygroscopicity and CCN activity
	23	R	**LAB 9**: Hygroscopicity measurements, organics
	29	T	Theory of semivolatile species partitioning between gas/aerosol phases
	30	R	**LAB 10**: Cloud condensation nuclei measurements
April	5	T	Aerosol optical properties: Mie theory for spherical particles
	6	R	**LAB 11**: Mie spreadsheet
	12	T	Hygroscopic growth and impacts on visibility; light absorbing carbon
	13	R	**LAB 12**: Particle optical sizing and counting techniques
	19	T	Visibility: Scattering and absorption by a population of particles; Measurements of aerosol light scattering, absorption, and extinction
	20	R	**LAB 13**: Nephelometer
	26	T	Visibility calculations, aerosol optical depth calculations, and effects of relative humidity
	27	R	**LAB 14**: Aerosol optical depth (AERONET data)
May	3	T	Budgets of atmospheric particulate matter: Estimates of sources of major particle types; Estimates of sinks, lifetimes, and global distributions; Current uncertainties in aerosol budgets
	4	R	**LAB 15**: Demonstration of the Aerosol Mass Spectrometer