

ATM515 Aerosol Physics, Fall 2025

Instructor: Dr. Fangqun Yu; ETEC-333, (518) 437-8767; fyu@albany.edu

Homework # 2 (due date Sep. 24)

1. (10 points) Calculate the effective diameter, mean speed, and diffusion coefficient of H_2SO_4 and $\text{C}_{10}\text{H}_{14}\text{O}_7$ (an organic acid) molecules at $T=298\text{ K}$ and $p=1\text{ atm}$. Assume that both molecules are spherical with a density of 1.5 g/cm^3 .
2. (15 points) Calculate mean kinetic speed, Knudsen number, diffusion coefficient, mean free path, and terminal gravitational settling velocity of particles of $0.001\text{ }\mu\text{m}$, $0.01\text{ }\mu\text{m}$, $0.1\text{ }\mu\text{m}$, $1\text{ }\mu\text{m}$, and $10\text{ }\mu\text{m}$ in air at $T=298\text{ K}$ and $p=1\text{ atm}$. Particle density = 2 g/cm^3 .
3. (10 points) (a) Knowing a particle's density ρ_p and its settling velocity v_t , show how to determine its diameter. Consider both the non-Stokes' and the Stokes' law regions. (b) Determine the size of water droplet that has $v_t = 1\text{ cm s}^{-1}$ at $T = 20^\circ\text{C}$, 1 atm .
4. (15 points) For cloud with constant liquid water content and depth, derive the change in the albedo of a cloud per unit change in the cloud droplet concentration as a function of the cloud albedo and the droplet concentration. Discuss the possible difference in the effect of aerosols on continental clouds and marine clouds and sensitivity of cloud albedo changes to the cloud droplet concentration changes under different environments.