AOS 580 AEROSOL, CLOUD AND CLIMATE

Lecture 5: Aerosol Chemistry I (Instructor: Yi Ming)

Reading

Seinfeld & Pandis (SP) p.99-104, 61-66, 440-444

Class notes

1. Definition of aerosol
   Aerosol normally refers to fine solid and/or liquid particles suspended in a gas phase.
   Characteristics: Fine sizes, morphology, multi-phases.

2. Sources and chemical compositions of atmospheric aerosols
   Natural sources: desert dust, sea spray, volcanoes, trees, wild fires, etc.
   Anthropogenic sources: agricultural biomass burning, cars, trucks, coal-fired power plants, etc.
   Primary aerosols: emitted directly as aerosols.
   Secondary aerosols: emitted as gas precursors, which subsequently convert into aerosols (gas-to-particle conversion).
   Chemical constituents: inorganic salts, black (elemental) carbon or soot, organic carbon, silicate, trace metals (Fe, Al, etc.)

3. Sea-salt aerosols
   Production via bubble-bursting
   Production rate as a strong function of wind speed
   Chemical composition: Na^+, K^+, Cl^-, SO_4^{2-}, organics, etc.
   Solubility: very soluble, hygroscopic, good cloud condensation nuclei (CCN).
   Chemical reactions: aqueous-phase oxidation of S(IV) (Hoppel dip), “chloride deficit”.

4. Sulfate aerosols
   Production: secondary aerosols from gas-phase precursors (e.g., dimethlyl sulfide (DMS), Carbonyl sulfide (OCS), Sulfur dioxide (SO_2), etc.).
   CLAW hypothesis: more on DMS.
   Global sulfur cycle

5. Carbonaceous aerosols
   Elemental vs. organic carbon (EC and OC, respectively)
   Morphology and molecular structure of EC
   Production of OC
   Chemical composition of OC
   Key functional groups: building blocks of OC.
   Structure-activity relationship (SAR) and functional group contribution method

6. Dust
   Chemical composition
   Roles of dust in biogeochemistry: fertilizer for oceans