Atmos. Chem. Lecture 17, 11/13/13: Particulate matter: Size and behavior

Intro to particulate matter
Size distributions
Particle motion: Diffusion, settling

PSet 4 due Monday Nov. 25

Monday's reading: add in 461-464

Atmospheric particulate matter ("aerosol")

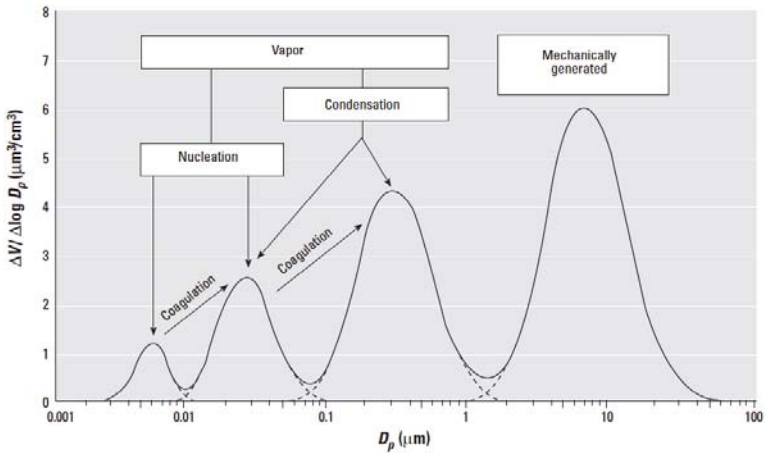
Aerosol: a (relatively stable) suspension of solid or liquid particles in a gas
Aerosol particles: the condensed-phase part of the aerosol

Generally: atmospheric aerosol involves particles of diameter 1 nm-100 μm

MODIS image from NASA (courtesy of Jacques Descloitres, MODIS Land Rapid Response Team, NASA/GSFC)

Moderate Resolution Imaging Spectroradiometer (MODIS):
http://www.nasa.gov/vision/earth/environment/particulate_pollution.html

Types, sizes of aerosol particles



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Oberdörster, Oberdörster, and Oberdörster, *Env. Health Perspectives* 113:823 (2005)

Particle size measurements: discrete bins

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Number, surface area, and volume distributions

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Dynamic range: Log D_p space

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Dynamic range: Ln D_p space

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Number, surface area, volume distributions: Urban area

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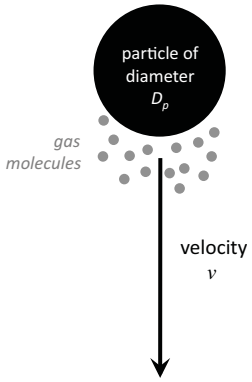
Motion of a particle in air



We want to consider:

1) drag force by the air
2) effect of an external force (e.g., gravity)
3) Brownian diffusion

[*Note: Additional material is discussed here during lecture.*]

Different regimes of the particle in air

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S&P Fig 9.1

Slip correction factor C_c

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Effect of gravity, diffusion

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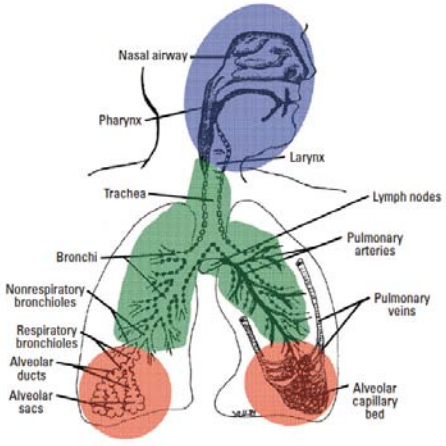
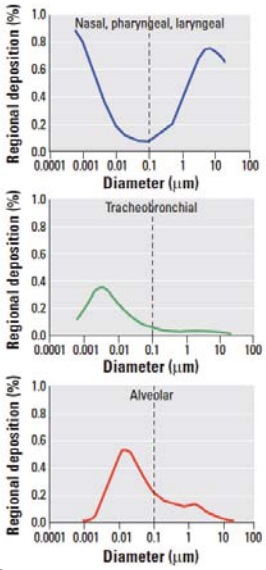
Implications for human health





Oberdörster, Oberdörster, and Oberdörster, *Env. Health Perspectives* 113:823 (2005)

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What is a "diameter"?

Not all particles are spherical! Physical diameter becomes meaningless…

Measurement techniques often get size information from mobility, terminal velocity, etc.

→ *Need to use **equivalent diameters***

Volume equivalent diameter D_{ve}: diameter of sphere of same volume as the particle of interest

Aerodynamic diameter D_a: diameter of a sphere of unit density (1 g/cm^3) that has the same terminal velocity of the particle of interest

Vacuum aerodynamic diameter D_{va}: diameter of a sphere of unit density (1 g/cm^3) that in the free molecular regime has the same terminal velocity of the particle of interest

Electrical mobility diameter D_m: diameter of a charged sphere that has the same migration velocity in a fixed electric field as the charged particle of interest

see DeCarlo et al., *Aerosol Sci. Technol.*, 38:1185 (2004)

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