

Urban aerosol sinks and impacts

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NIWA

Removal mechanisms... gravitational settling

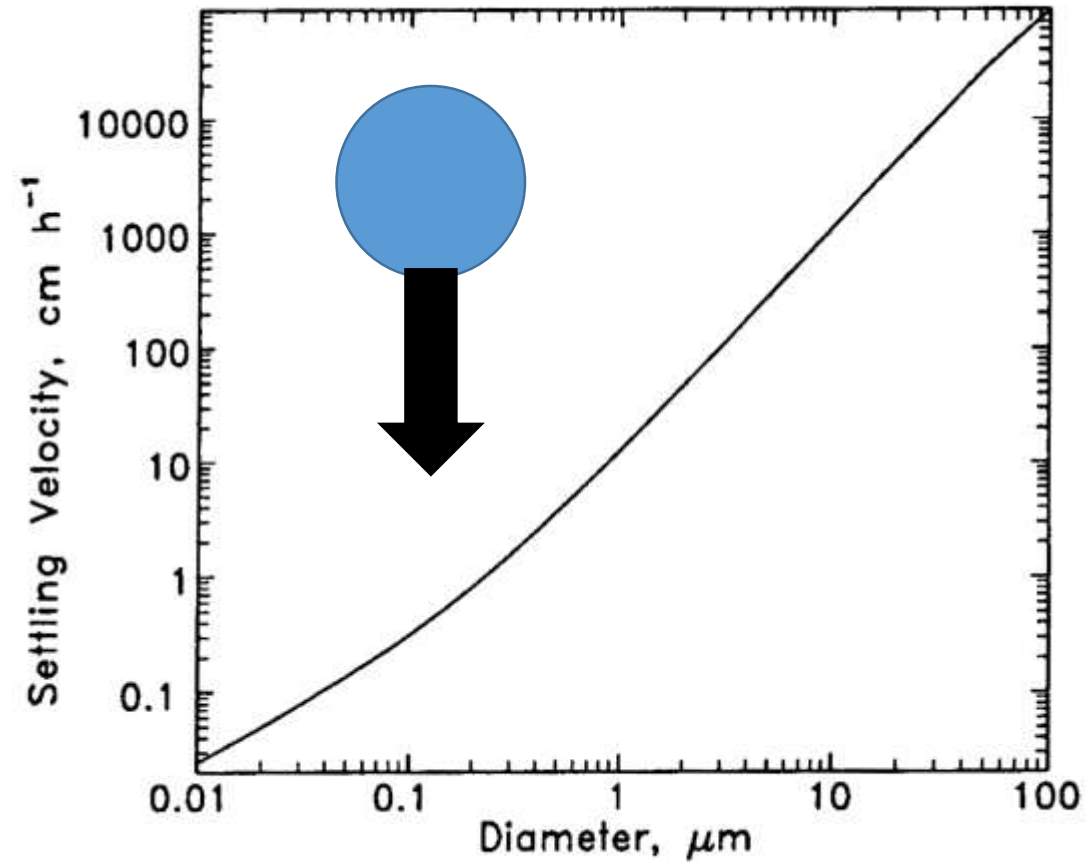
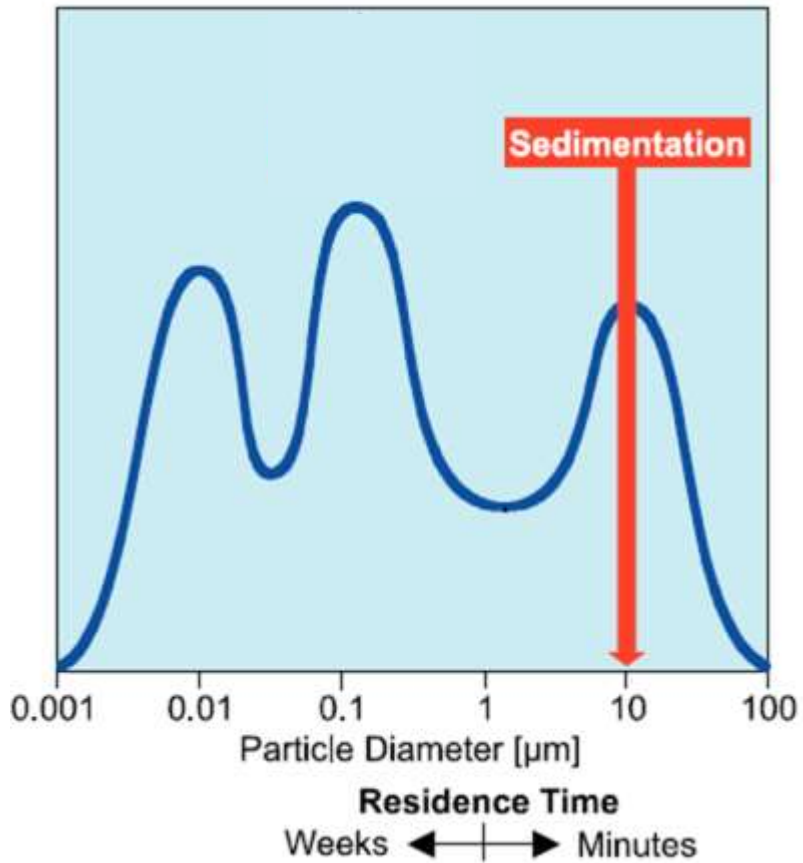
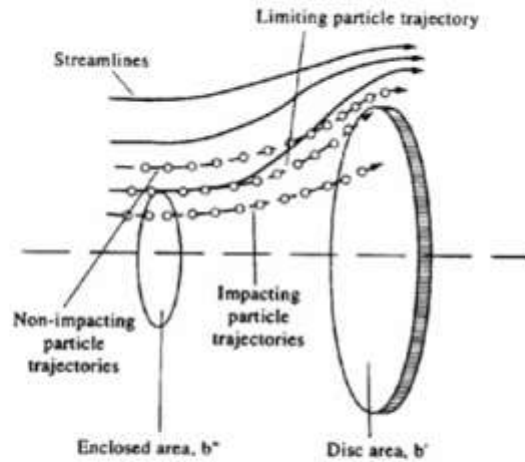


FIGURE 8.6 Settling velocity of particles in air at 298 K as a function of their diameter.

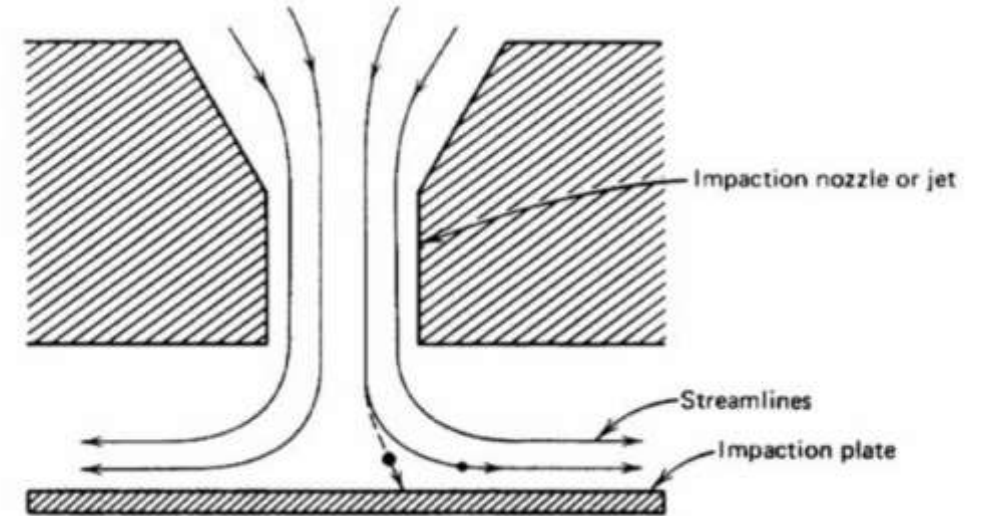
- 10 μm particle \rightarrow 1000 cm hr^{-1}
- 1 μm particle \rightarrow 10 cm hr^{-1}

Principle of Impaction

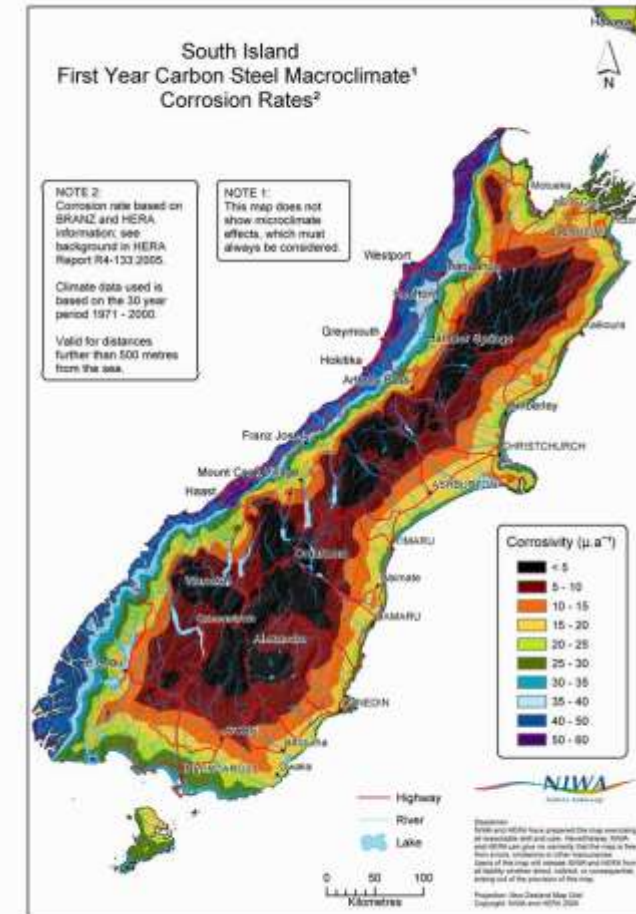
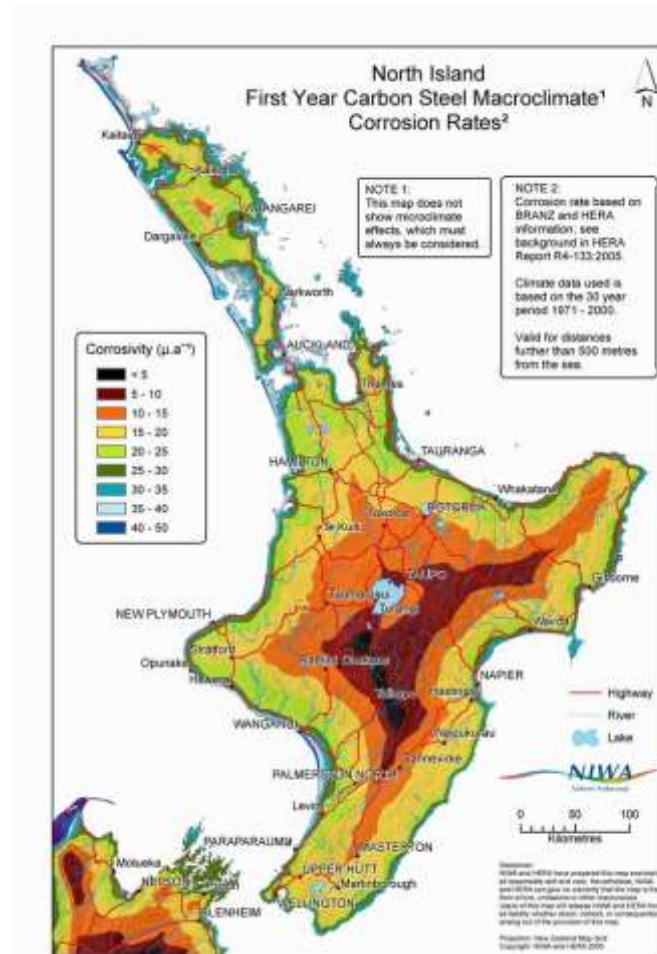
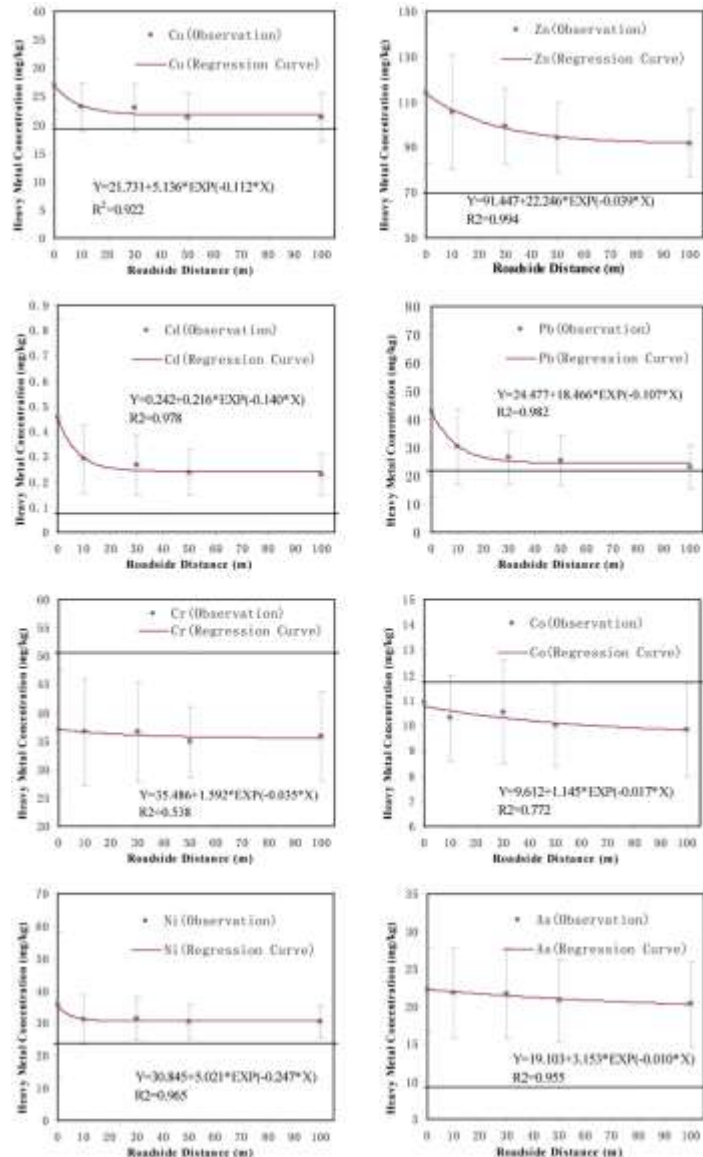


Very small particles with negligible inertia will follow the gas streamlines perfectly. Large particles will tend to continue in a straight line, regardless of what the gas flow does due to the inert

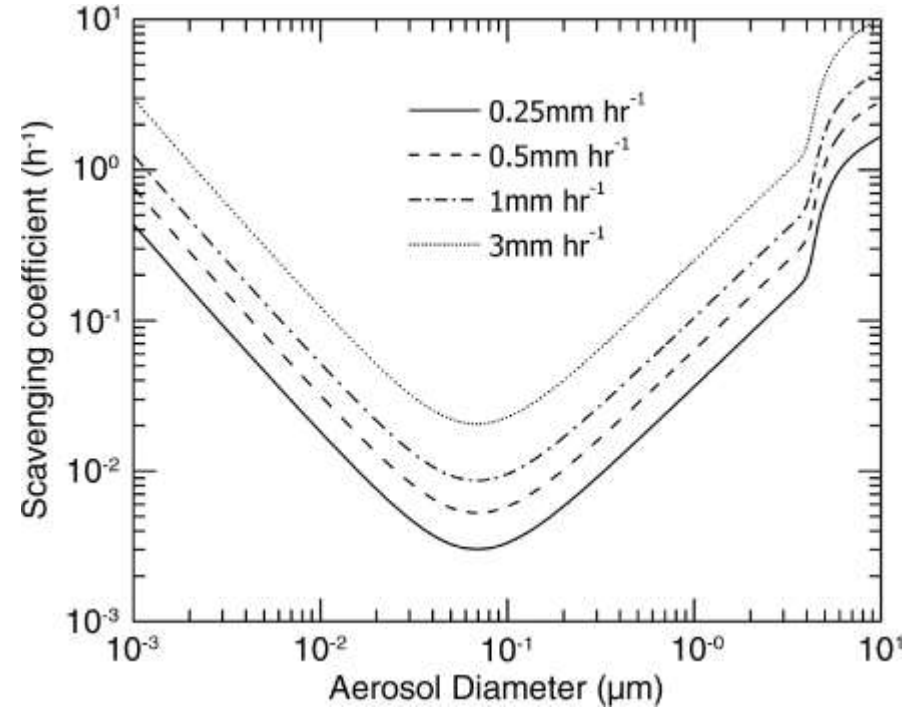
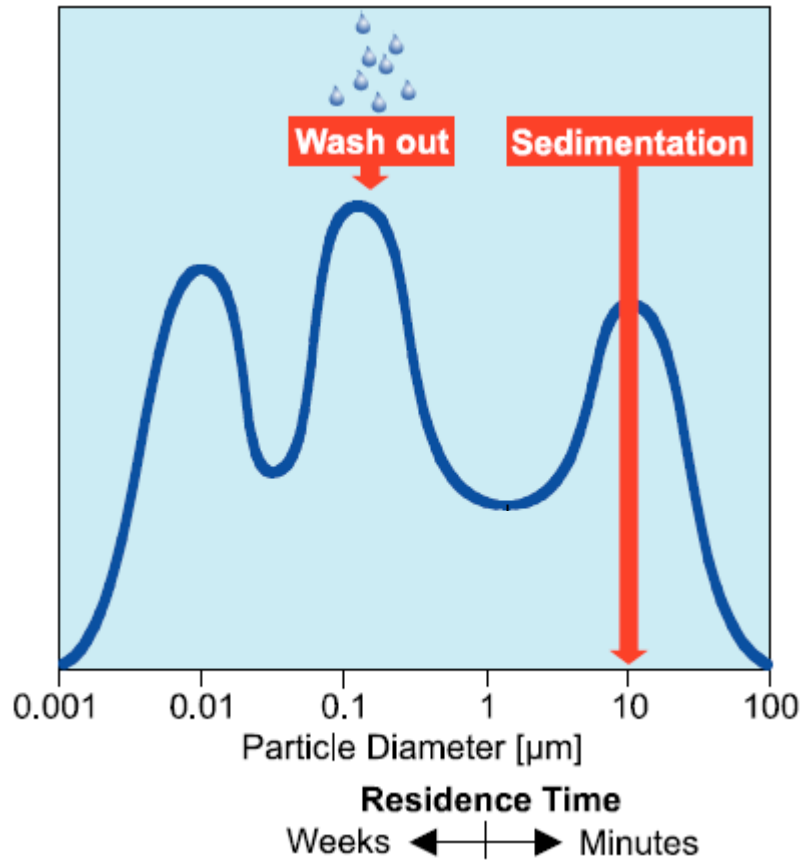
Impactor Cross Section



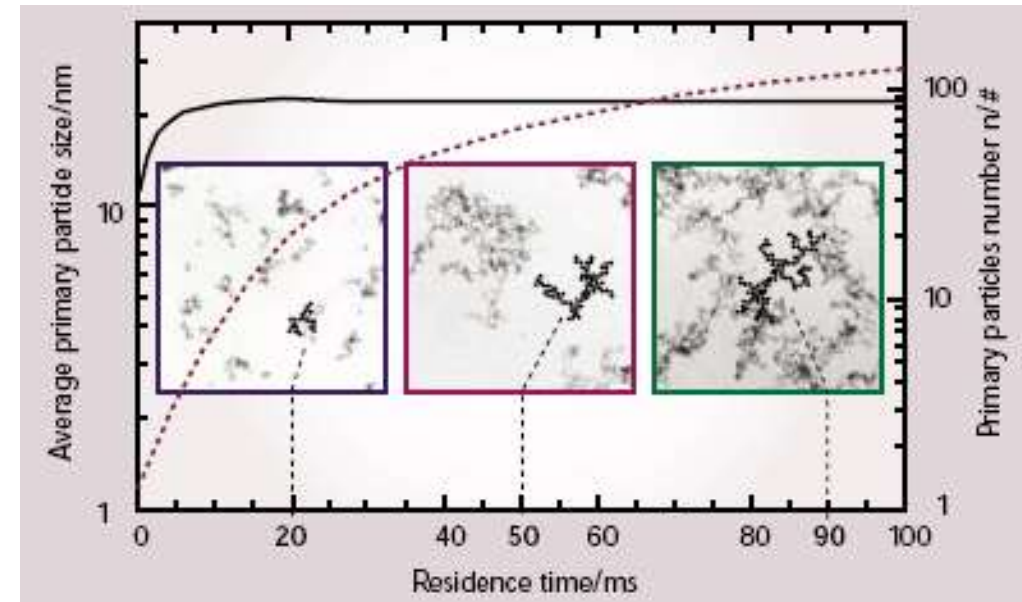
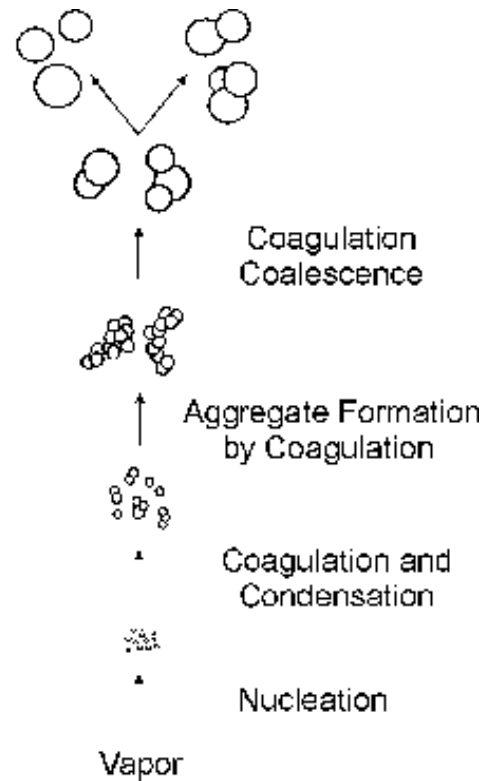
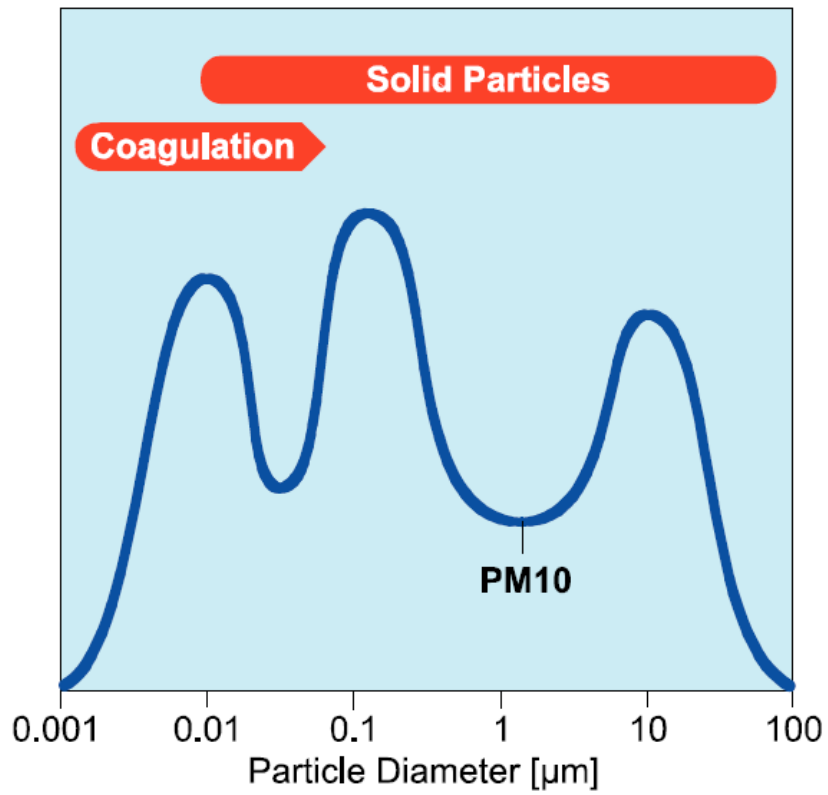
Coarse particle deposition and distance from source



Particle removal & residence



Condensation, Coagulation and Coalescence



Diffusion/Coagulation

You can estimate the distance a particle will diffuse in a given time from the equation:

$$\text{distance(cm)} = \sqrt{Dt}$$

where D is the diffusion coefficient

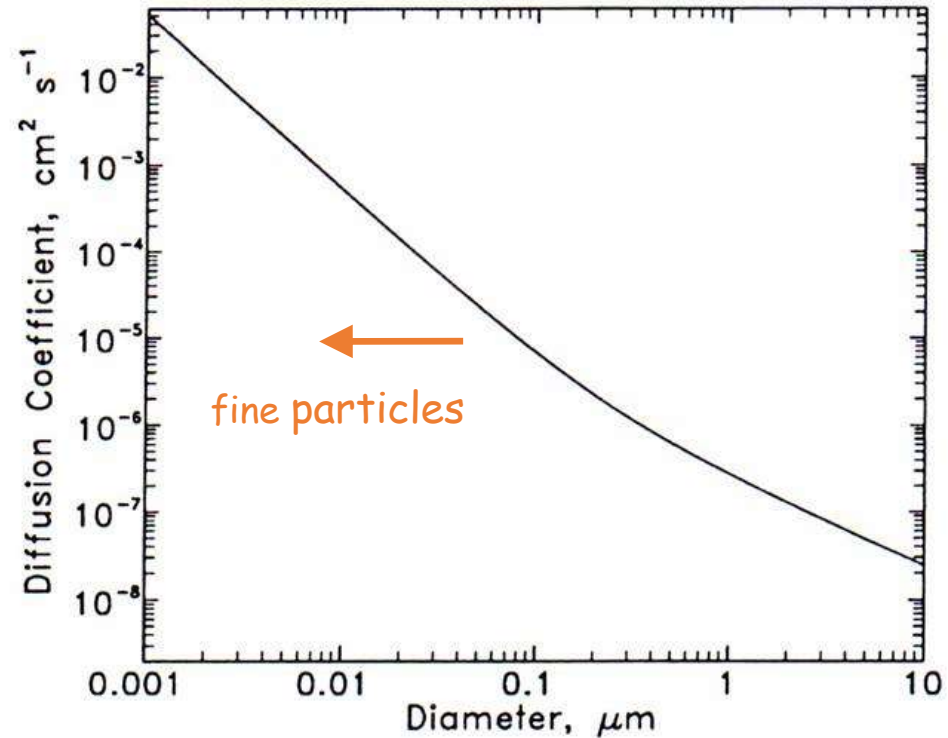
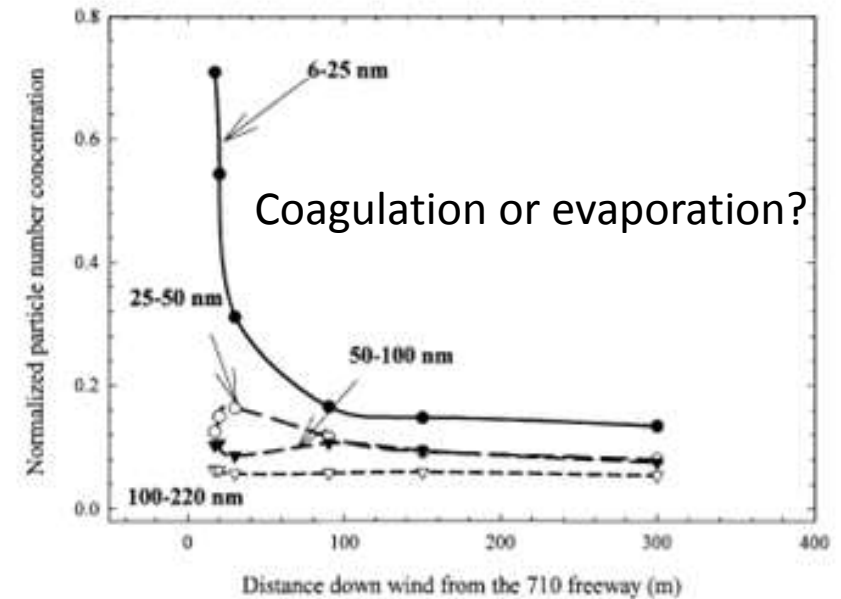
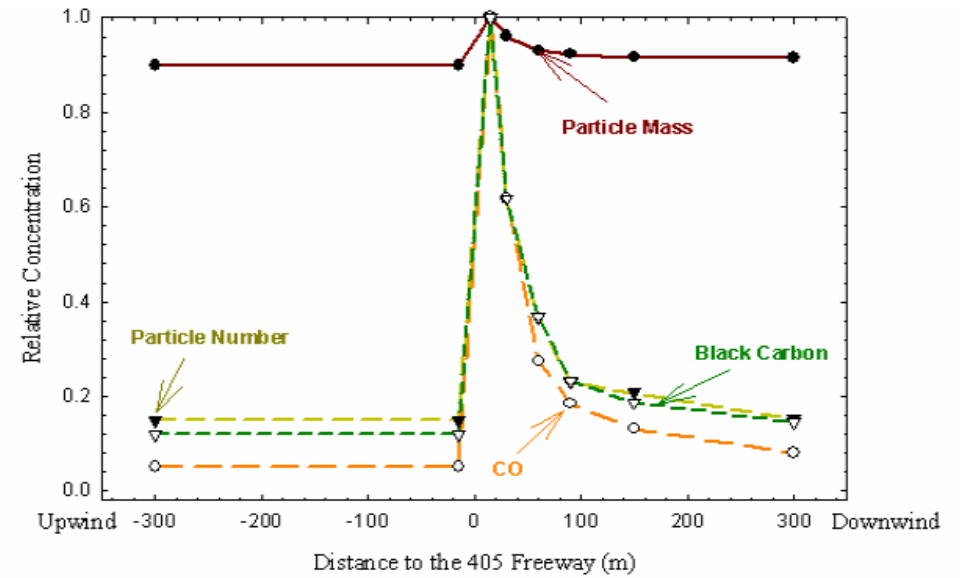
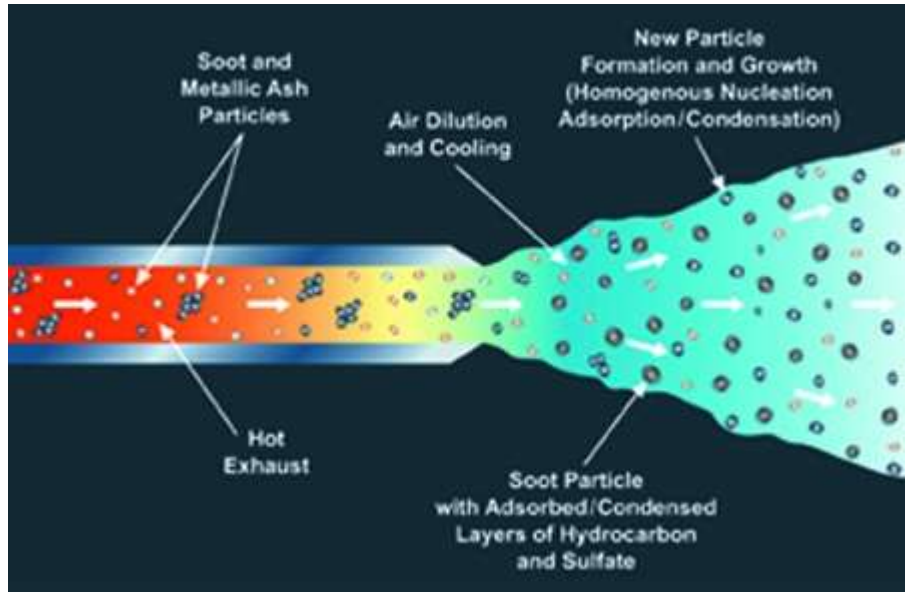


FIGURE 8.8 Aerosol diffusion coefficients in air at 20°C as a function of diameter.

<u>Diameter (μm)</u>	<u>Distance diffused in 1 s (cm)</u>
.001	0.2
.01	0.02
.1	.002
1	.0004
10	.0001

Ultrafine Particles at the roadside



Why is there an "accumulation" mode?

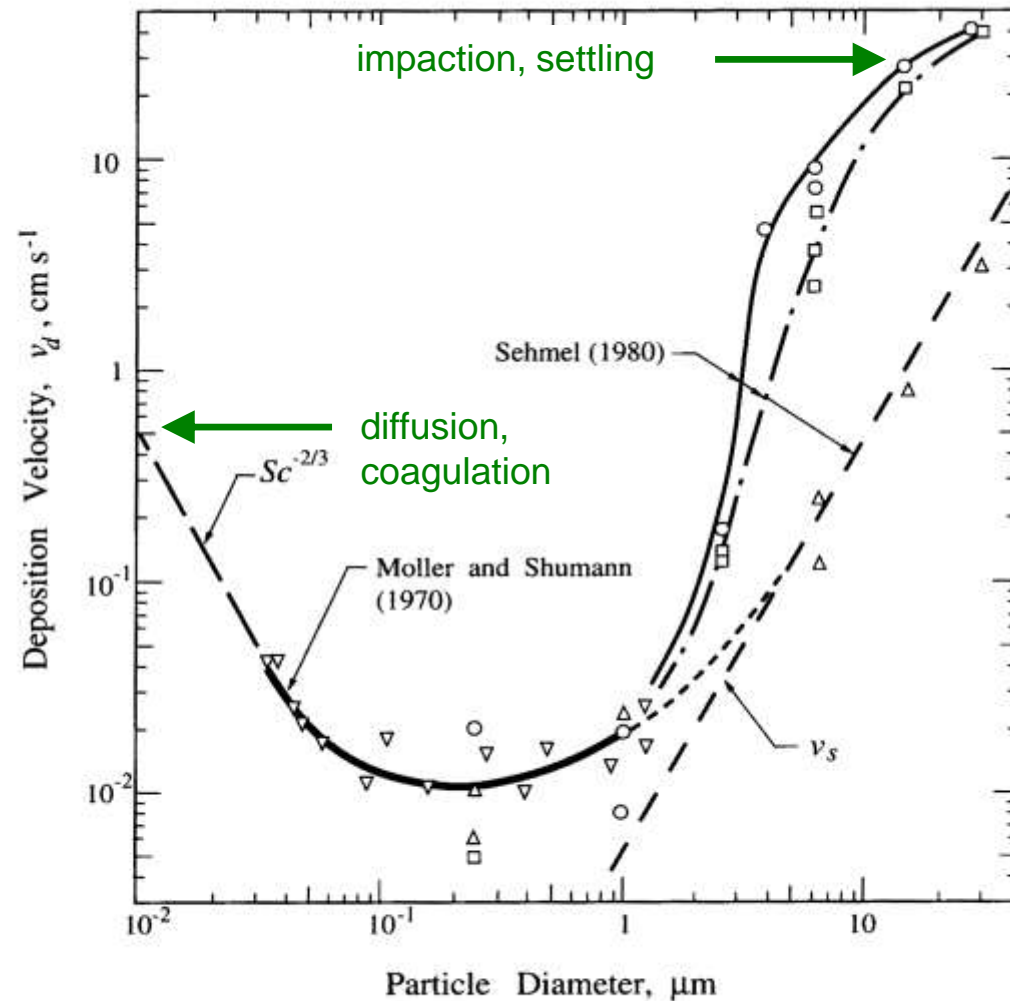
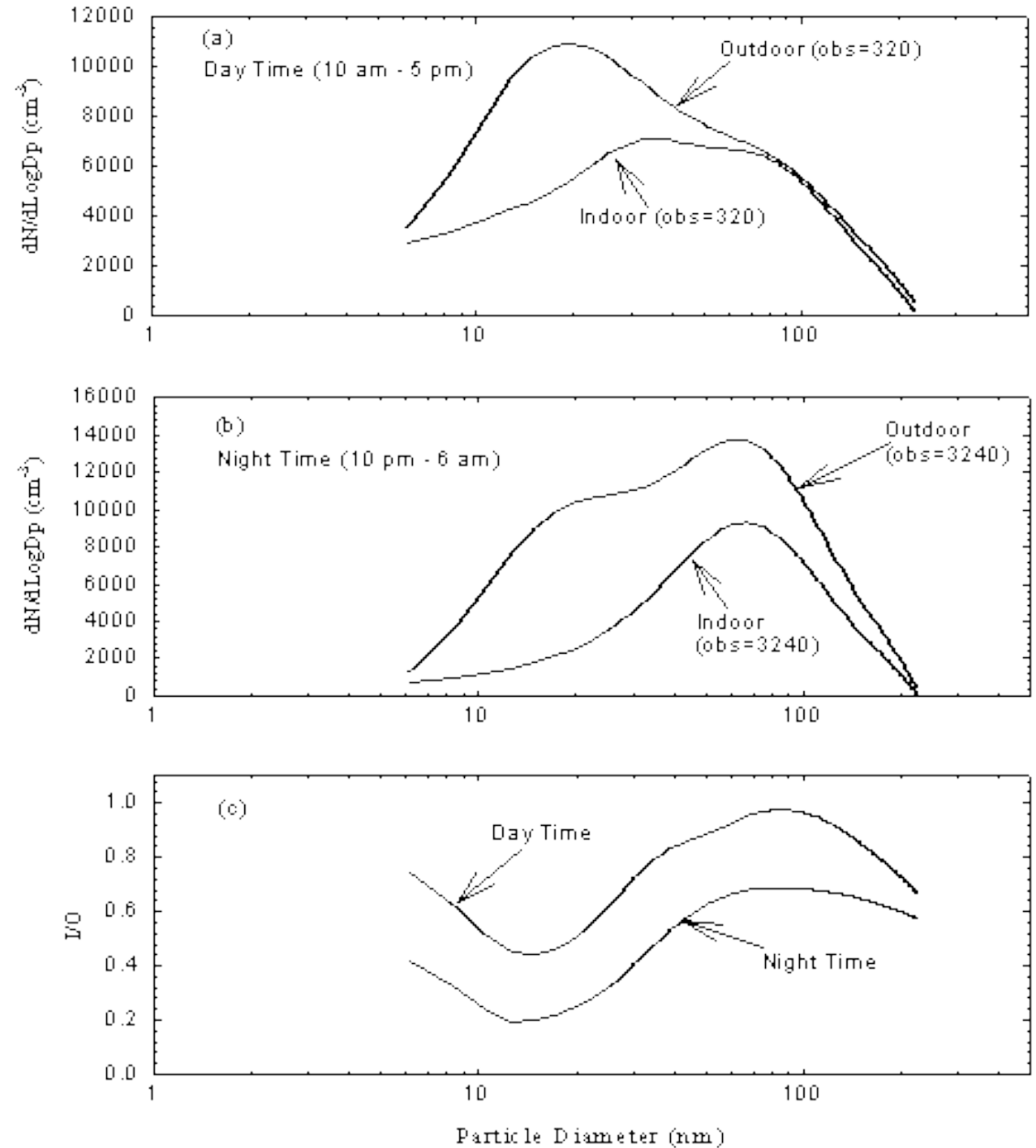


FIGURE 19.3 Particle dry deposition velocity data for deposition on a water surface in a wind tunnel (Slinn et al., 1978).

So lifetimes are

- Aitken nuclei – hours to days (diffusion/coagulation)
- Accumulation mode – weeks
- Coarse mode – hours to days (deposition)
- Ultrafine – minutes to hours

(In)filtration - buildings



(In)filtration – vehicle cabins

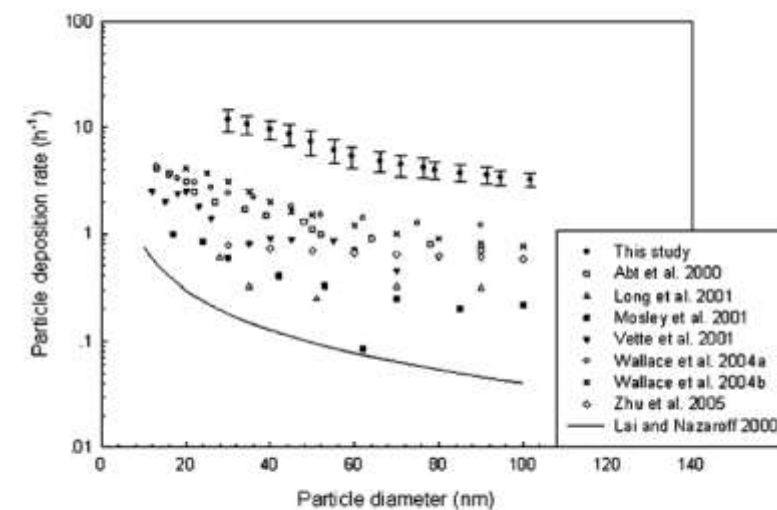
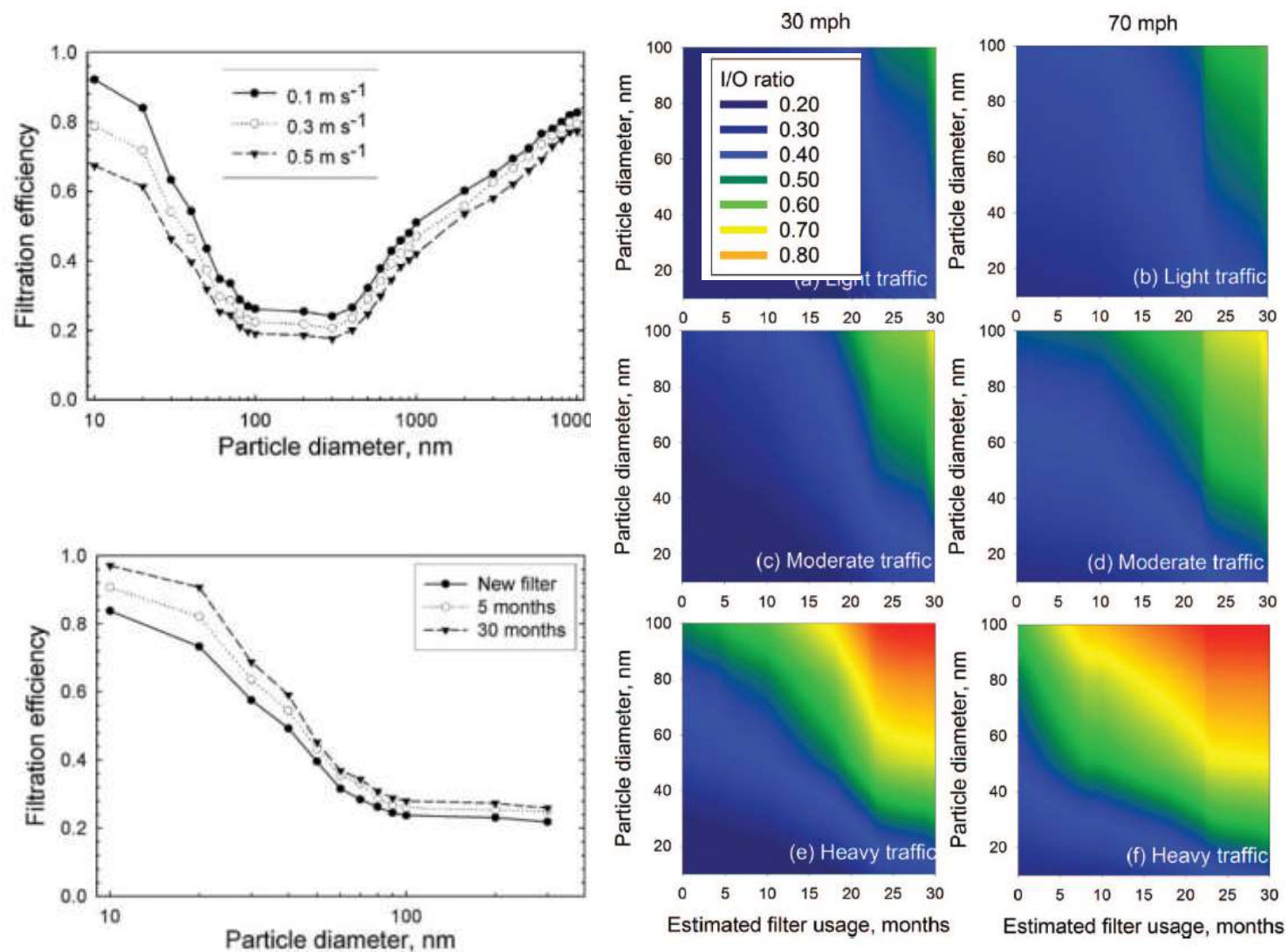
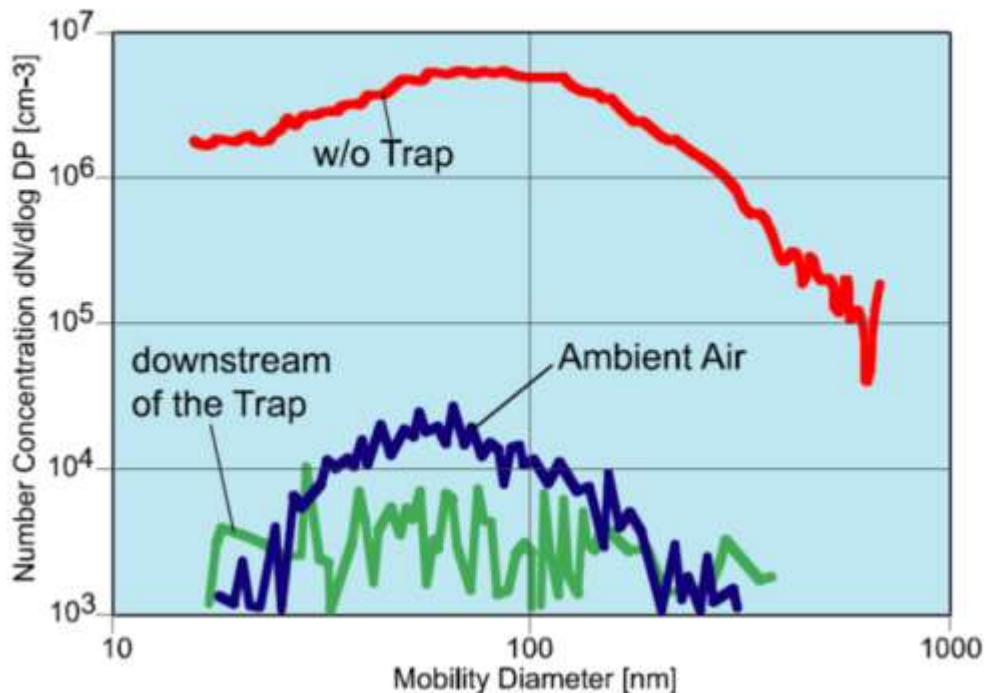


FIG. 9. A comparison of particle deposition rates inside vehicles and indoors.

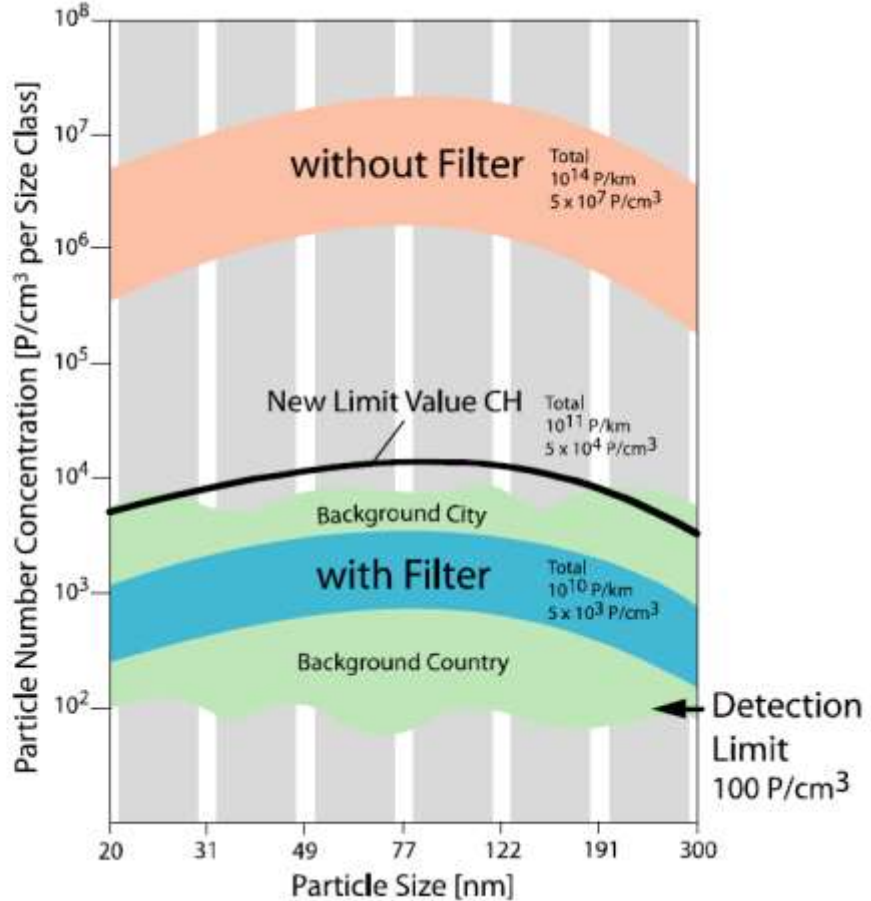
Filtration of vehicle exhaust

Exhaust Gas downstream of the Filter is cleaner than Ambient Air !

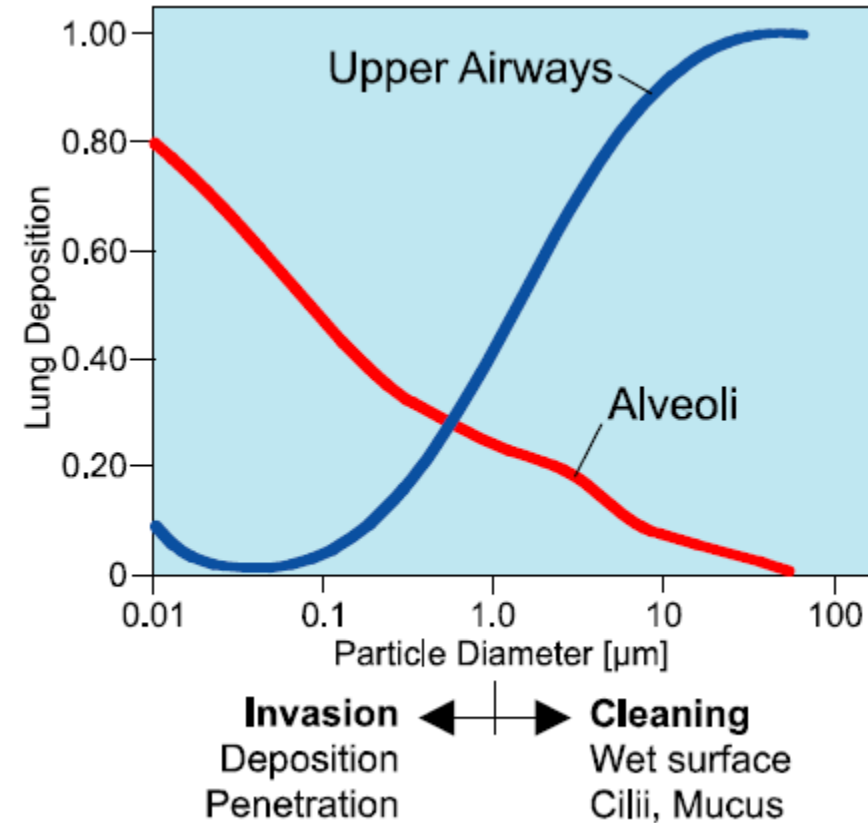
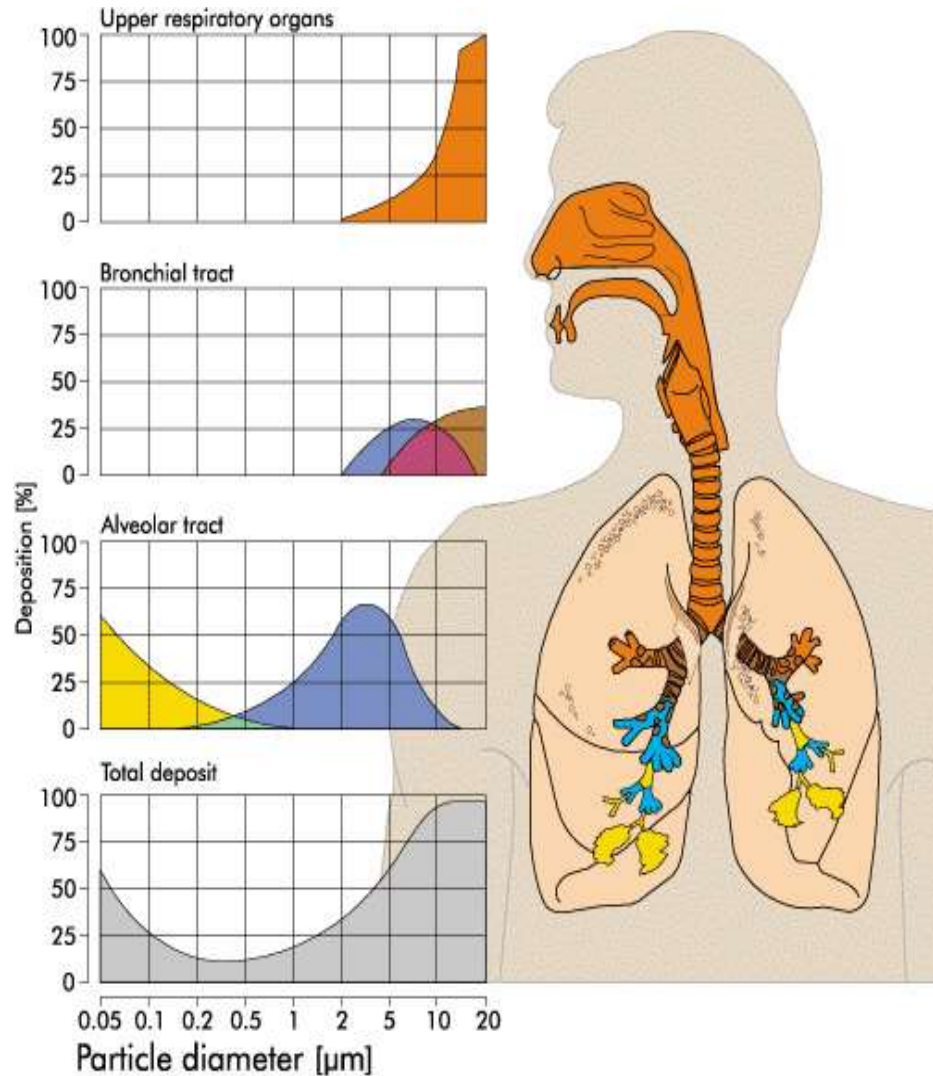


Number – Limits

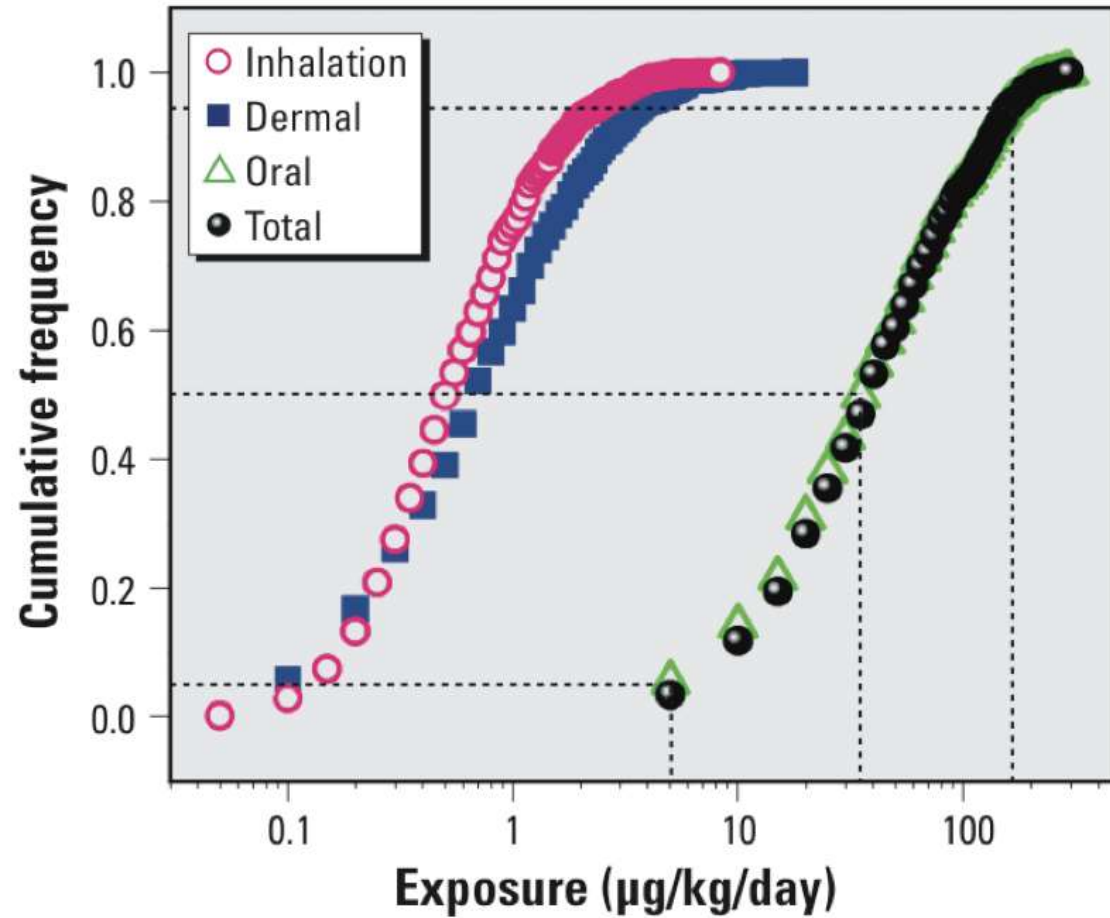
address the HE-metric and force the introduction of best available Technology



Inhalation, deposition and lung defences

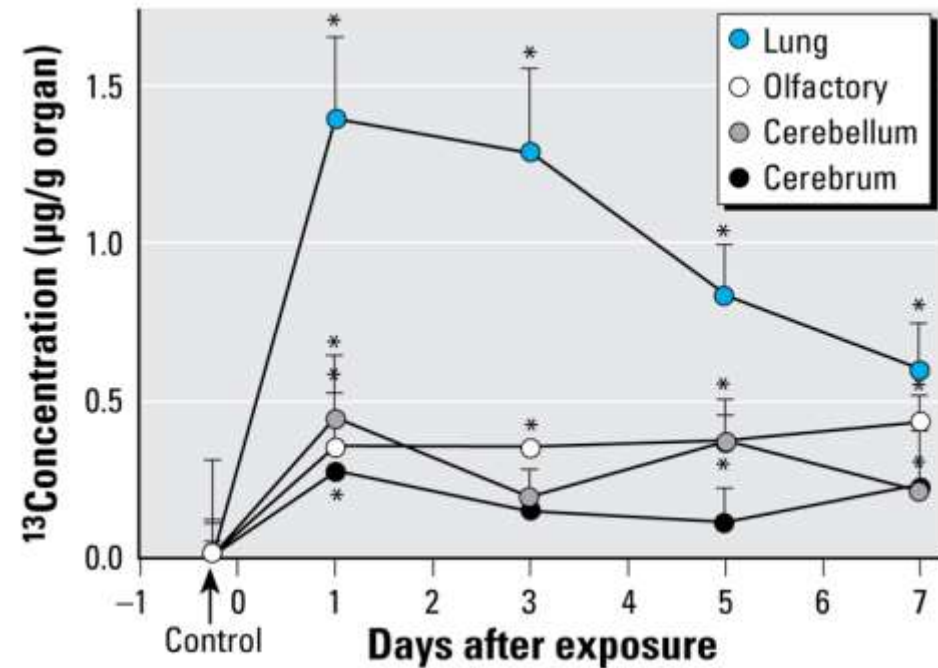
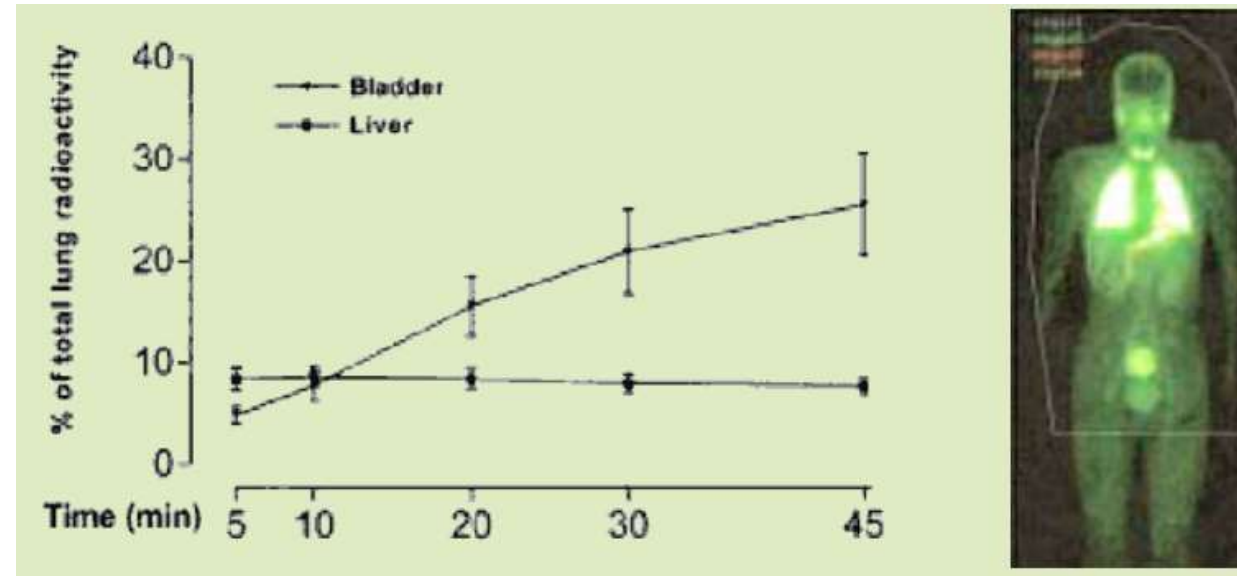
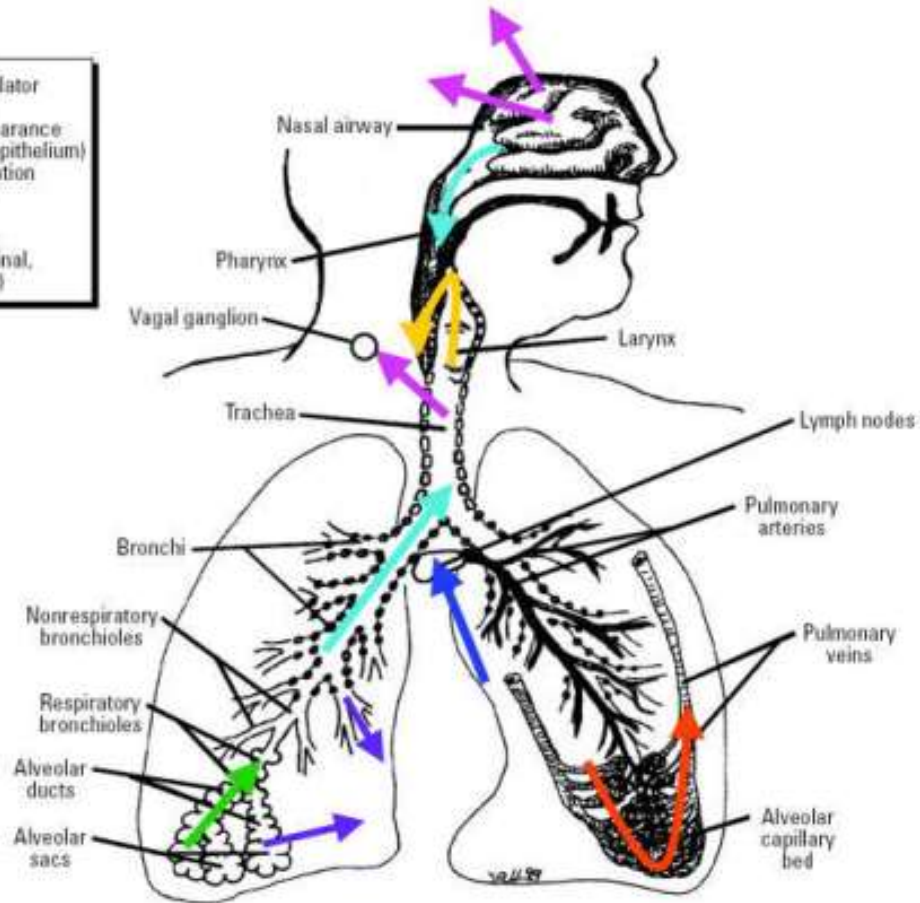


Other ingestion pathways

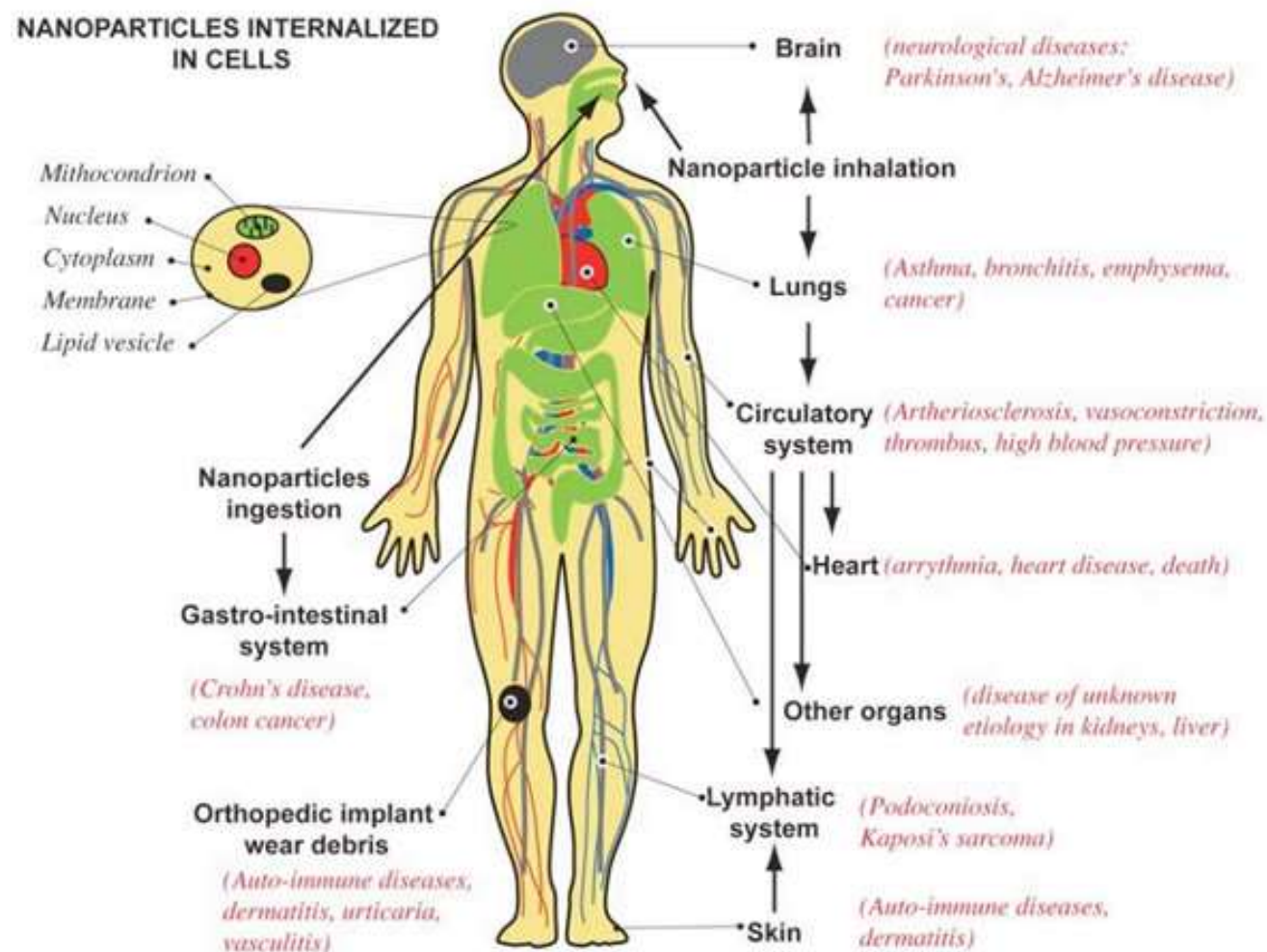


Translocation pathways

- █ Mucociliary escalator
- █ GI tract
- █ AM-mediated clearance
- █ Interstitium (via epithelium)
- █ Lymphatic circulation
- █ Blood circulation
- █ Sensory neurons (olfactory, trigeminal, tracheobronchial)



Health impacts (systematic/sub-clinical)



Particle toxicity and disease

