lecture 4

Moments of particle size distributions

$$M_0 = \int_0^\infty \frac{dN(D)}{dD}\, dD$$

last lecture

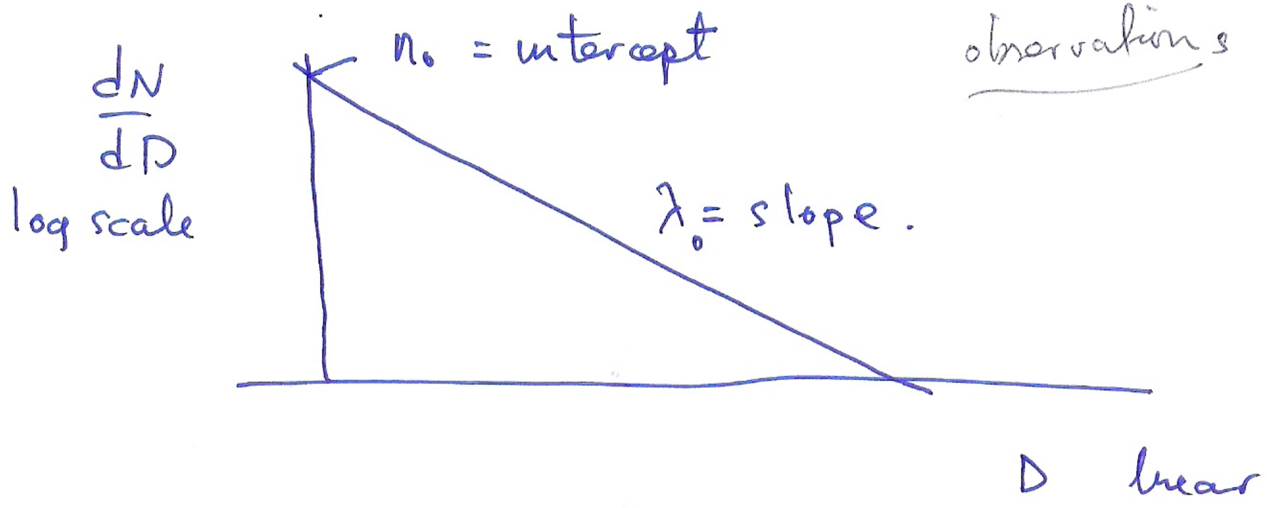
$$\cancel{\frac{dm}{dD}} \quad \frac{dm}{dt} = a D$$

[m = mass, D = diameter]

$$\frac{dM}{dt} = \int_0^\infty aD \times \frac{dN(D)}{dD}\, dD$$

Growth rate $\propto M_1$ (in models).

observations approx



$$\frac{dN}{dD} = n_0 e^{-\lambda_0 D}$$

$$\int_0^\infty n_0 D^\mu e^{-\lambda_0 D} \, dD = \frac{n_0 \, \mu!}{\lambda_0^{\mu+1}}$$

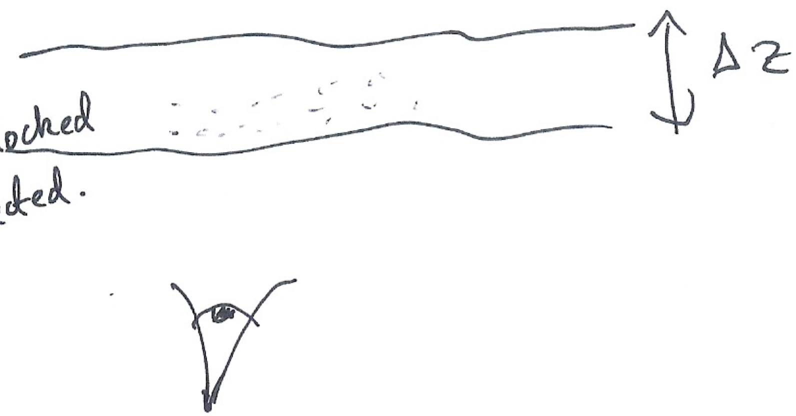
$$M_0 = \frac{n_0}{\lambda_0}$$

$$M_1 = \frac{n_0}{\lambda_0^2}$$

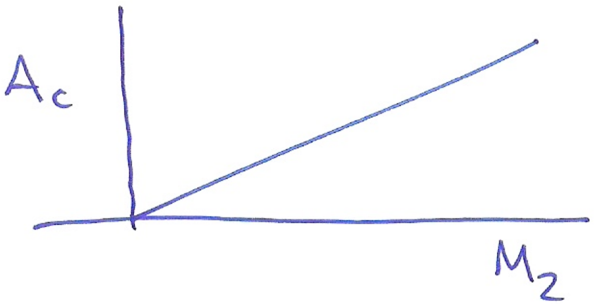
Albedo of a cloud. Why M_2?

$$A_c \approx \frac{\pi M_2 \Delta Z}{\pi M_2 \Delta Z + 15.4}$$

How much light is blocked & reflected.



$$\approx \frac{\pi M_2 \Delta Z}{15.4}$$



- Albedo increases with M_2

Geoengineering two clouds different M_0.

- TD is what it is, ie $\underline{M_3 \text{ const}}$

$$M_0 = \frac{n_0}{\lambda_0} \quad \text{—— (1)}$$

$$M_3 = \frac{6 n_0}{\lambda_0^4} \quad \text{—— (2)}$$

(1) ÷ (2)

$$\lambda_0 = \left(\frac{6 M_0}{M_3}\right)^{1/3} \quad \text{—— (3)}$$

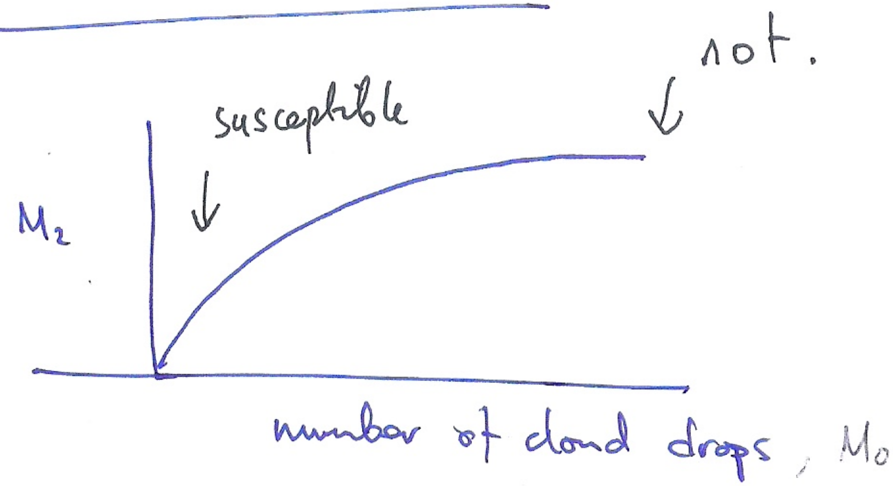
sub (3) into (1)

$$n_0 = M_0 \left(\frac{6 M_0}{M_3}\right)^{1/3}$$

$$M_2 = \frac{2 n_0}{\lambda_0^3}$$

$$M_2 = M_0 \left(\frac{6 M_0}{M_3}\right)^{1/3} \times \frac{2}{\left(\frac{6 M_0}{M_3}\right)}$$

$$\underline{M_2 \approx 0.6057\, M_0^{1/3} M_3^{2/3}}$$



Maybe not

$$\begin{bmatrix} mg & = \text{weight} \\ a & = \text{constant} \\ D & = \text{diameter} \\ v_f & = \text{terminal fall speed} \end{bmatrix}$$

$$mg = \frac{\pi}{6} D^3 \rho_e g$$

N2: $$a \cancel{D} v_f = \frac{\pi}{6} D^{\cancel{3}\,2} \rho_e g$$

$$v_f \propto D^2$$

Precip. rate

$$\int_0^\infty v_f(D)\, m(D) \frac{dN}{dD}\, dD = \frac{\propto n_0 \times 120}{\lambda_0^{\,6}}$$

$\propto M_5$ 5^{th} moment of distribution.