Cloud Physics Lab
LAB 4: Properties of Clouds

Purpose:

Calculate the properties of cloud droplets.

Theory:

Parameters like drop size distribution, liquid water content, and distance between drops vary greatly between clouds, as well as within individual clouds. These parameters also vary with time as a cloud evolves and develops.

Assume a population of cloud droplets follows the gamma distribution with

a = $4.5*10^{24}$ m^3 and b = $2.0*10^5$ m^{-1}.

$$n_d(D) = aD^2 \exp(-bD) \tag{1}$$

One can obtain the following formulas for the properties of cloud droplets:

a) The number density of the droplets

$$N(D_1 : D_2) = \frac{a2!}{b^3} \tag{2}$$

b) The liquid water content of the cloud

$$M(D_1 : D_2) = \frac{®a\rho_l 5!}{6b^6} \tag{3}$$

where:

$\rho_l = 10^3$ kg/m^3

c) The surface area density of the drops

$$A(D_1 : D_2) = \frac{®a4!}{b^5} \tag{4}$$

d) The mean drop diameter

$$\overline{D} = N^{-1}a\frac{3!}{b^4} \tag{5}$$

e) The mean distance between drops

$$\bar{r} = 0.620N^{\left(-\frac{1}{3}\right)} \tag{6}$$

Methodology:

1. Use the Matlab script *Lab4a.m* to plot the size distribution of cloud droplets.
2. Use the Matlabe script *Lab4b.m* Calculate the properties of cloud droplet population for the following cases

a (m^3)	b (m^{-1})	$N(D_1:D_2)$ (cm^{-3})	$M(D_1:D_2)$ (g/m^3)	$A(D_1:D_2)$ (cm^2/m^3)	$\bar{D}$ (mm)	$\bar{r}$ (mm)
4.5×10^{24}	2.0×10^{5}					
3.5×10^{24}	2.0×10^{5}					
2.5×10^{24}	2.0×10^{5}					
4.5×10^{24}	3.0×10^{5}					
4.5×10^{24}	2.0×10^{5}					
4.5×10^{24}	1.0×10^{5}					

3. Discuss your results.