

ESCI 340 - Cloud Physics and Precipitation Processes
Lesson 1 - Cloud Types and Properties
Answers to Selected Exercises
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Exercises

1. Show that the surface area density of all drops having diameters between D_1 and D_2 is given by

$$A_{D_1:D_2} = \pi \int_{D_1}^{D_2} D^2 n_d(D) dD,$$

Answer: The surface area of a droplet of diameter D is πD^2 . Therefore

$$dA = \pi D^2 dN = \pi D^2 n_d(D) dD,$$

and since

$$A_{D_1:D_2} = \int_{D_1}^{D_2} dA$$

we get the desired answer.

2. Assume a population of cloud droplets follows the gamma distribution with $a = 4.53 \times 10^{24} \text{ m}^{-6}$ and $b = 2.35 \times 10^5 \text{ m}^{-1}$.

- (a) What is the number density of the droplets (in cm^{-3})?

Answer: 698 cm^{-3}

- (b) What is the liquid water content (in g m^{-3})?

Answer: 1.69 g m^{-3}

- (c) What is the surface area density of the droplets (in $\text{cm}^2 \text{ m}^{-3}$)?

Answer: $4770 \text{ cm}^2 \text{ m}^{-3}$

- (d) What is the mean drop diameter (in μm)?

Answer: $12.8 \mu\text{m}$

- (e) What is the mean distance between droplets (in mm)?

Answer: 0.624 mm