Cloud Physics Lab
LAB 8: Droplet Growth by Diffusion - Part (2)

Purpose:

Study the effects of supersaturating and temperature on the diffusional growth of cloud droplets.

Theory:

Comments on Diffusional Growth

- Diffusional growth is certainly the way that small droplets initially grow into larger cloud droplets.
- However, we've seen that it would take around 12 hours to grow the droplets to the size of a typical cloud droplet (50μm) and nearly 2 days to grow the drop to the size large enough to fall from the cloud and reach the ground as precipitation (1mm).
- Cloud are observed to from and produce rain on much shorter time scales (30 minutes) than can be achieved by diffusional growth alone. Therefore, diffusional growth can't be how precipitation forms.
- For radii greater than a few microns, the solute and curvature effects become negligible. In this case the growth equation becomes:

$$\frac{dR}{dt} = \frac{1}{R}\frac{S-1}{F_k + F_d} = \frac{\xi}{R} \tag{1}$$

- Integrate this equation to show that the radius as a function of time is :

$$R(t) = \sqrt{R_o^2 + 2t\xi} \tag{2}$$

Methodology:

1. Use the Matlab script *Lab8.m* to find the time required for a cloud droplet to grow from a given initial radius to a given final radius for the following cases:

Cloud Temperature (°C)	Super Saturation Ration (S)	R_o (um)	R_f(um)	Time (minutes)
0	1.005	1	10	
0	1.005	1	20	
0	1.005	1	50	
0	1.01	1	50	
0	1.02	1	50	
10	1.02	1	50	

2. Discuss your results