Cloud model notes

Sedimentation velocity v_f

1. Get r_w by assuming viscous sedimentation

$$v_f = \frac{2}{9}\frac{\beta g r^2 \Delta\rho}{\eta}$$

r_w is the value of particle radius for which $v_f = w^*$

$$\Rightarrow r_w^2 + 1.26\lambda r_w - \frac{9}{2}\frac{\eta w^*}{g\Delta\rho} = 0$$

$$\Rightarrow r_w = \frac{1}{2}\left(-1.26\lambda + \sqrt{(1.26\lambda)^2 + 18\frac{\eta w^*}{g\Delta\rho}}\right)$$

2. From $r = r_w/\sigma$ to $r = r_w$

   (a) Find

$$C_d N_{Re}^2 = \frac{32\rho_a g r^3 \Delta\rho}{3\eta^2}$$

   (b) Find $x = \ln\left(C_d N_{Re}^2\right)$

   (c) Find y from the fit $y = 0.8x - 0.01x^2$

   (d) Find Reynolds number N_{Re} from $x = \ln N_{Re} \Rightarrow N_{Re} = e^x$

3. If $N_{Re} \leq 1000$:

   - Find sedimentation velocity v_f from Reynolds number

$$N_{Re} = \frac{2r\rho_a v_f}{\eta}$$

$$\Rightarrow v_f = \frac{N_{Re}\eta}{2r\rho_a}$$

4. If $N_{Re} > 1000$:

$$v_f = \beta\sqrt{\frac{8gr\Delta\rho}{3C_d\rho_a}}$$