

Examples Week 10

1. For what optical depth does the Eddington optically thin limit albedo deviate by 10% from the conservative scattering Eddington albedo. Use a solar angle of $\mu_0 = 2/3$ and assume the asymmetry parameter is $g = 0.86$. What would this thin limit optical depth be for isotropic scattering?

The Eddington optically thin limit albedo is

$$R_{thin} = \omega(1/2 - 3g\mu_0/4)\tau/\mu_0$$

For conservative scattering $\omega = 1$ and for $\mu_0 = 2/3$ the thin limit albedo is

$$R_{thin} = 1/2(1 - g)\tau/\mu_0 = 3/4(1 - g)\tau$$

For $\mu_0 = 2/3$ the conservative scattering solution is

$$R_{edd} = \frac{(1 - g)\tau}{4/3 + (1 - g)\tau}$$

The thin limit deviates by 10% when

$$\frac{R_{thin}}{R_{edd}} = 1.1 \quad \frac{3}{4} \left[\frac{4}{3} + (1 - g)\tau \right] = 1.1$$

$$\tau_{thin} = 0.13/(1 - g) = 0.95$$

For isotropic scattering ($g = 0$):

$$\tau_{thin} = 0.13/(1 - g) = 0.13$$