

## Test Problems

- 1) Calculate the Top of Atmosphere Temperature if the surface radiates at 280K with an emissivity of 0.8 and is covered by 2 level atmosphere where the atmosphere levels are  $T_1 = 260K$   $\tau_1 = 0.3$   $T_2 = 240K$   $\tau_2 = 0.5$
- 2) Suppose the Earth is  $\frac{1}{2}$  the distance to the sun as it is now. If we ignore the atmosphere, what is new equilibrium temperature (Assume the earth albedo is .3);
- 3) Suppose the net absorption (over the camera filter function) per unit length of the atmosphere at ground level is 0.5/km. What is the furthest distance a camera can be so that it measures a 500K target to 5% accuracy given that the ambient atmosphere temperature is 300K
- 4) Suppose a 11 micron satellite IR channel has a sensitivity of 1 degree Kelvin and the satellite footprint is 10km x 10km square. Suppose we wish to measure a forest fire which burns at 700K. What is the smallest fire (in area) that can be seen by the sensor channel ?
- 5) Mathematically calculate the IR temperature sensitivity function  $\left[ \frac{\partial B}{\partial T} \right]_{(T,\lambda)}$  and plot as a function of wavelength
- 6) If a filter centered at 1 micron has a bandwidth of 1nm, calculate the bandwidth in inverse centimeters. Redo for a filter at 10 microns
- 7) Suppose the Brightness Temperature at 11 microns is 284K and at 12 microns is 275K. Calculate the surface temperature if the water column absorption is .1 at 11 microns and .25 at 12 microns.
- 8) Calculate the reflectance of the molecular atmosphere seen by a satellite (in the single scattering approximation) assuming the optical depth of the molecular atmosphere is 0.1, the solar angle is 45 degrees and the satellite angle is 30 degrees. (See Lecture 13 in the web site) and the ground is perfectly absorbing. In the notation of the web lecture,

$$R = \frac{\pi I^\uparrow}{\mu_o F_0}$$