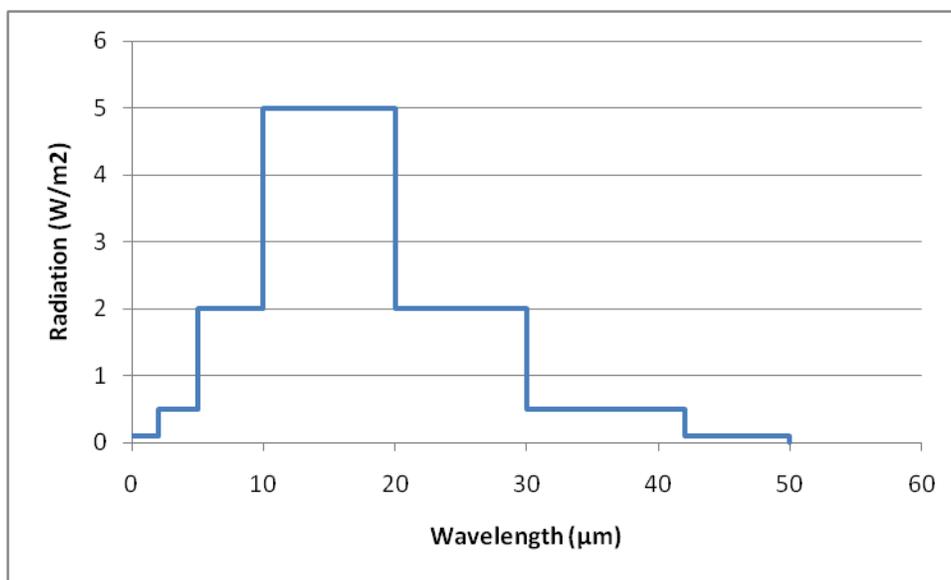


Assignment 8 Problem

In this problem, you will compare the properties of two greenhouse gases to determine which one is more in need of regulation.

- At 1 atm and 25 °C, the density of Gas 1 is 8.18 g/L and that of Gas 2 is 0.613 g/L. What is the molar mass of each gas?
- Each gas absorbs photons with a particular energy. Gas 1 absorbs photons with 1.33×10^{-20} J of energy, whereas Gas 2 absorbs photons with 5.00×10^{-21} J of energy. At what wavelength does each gas absorb?
- The figure below shows a simplified version of the terrestrial outgoing radiation spectrum, where the y-axis gives the number of Watts/m² emitted by the Earth at each wavelength. Based on your previous answer and the graph, and assuming each gas absorbs 10% of the outgoing radiation at its characteristic wavelength, determine the current total radiative forcing of each gas. Which gas is currently a more important greenhouse gas overall?



- Currently, there are 0.125 ppb of Gas 1 and 0.100 ppb of Gas 2 in the atmosphere. Which gas is a more effective greenhouse gas on an instantaneous, per molecule basis? (Recall that the total number of moles of gas in the atmosphere is 1.8×10^{20} mol.)
- The lifetime of Gas 1 is 10 yrs, whereas the lifetime of Gas 2 is 50 yrs. Assume that at the end of 1 lifetime, the concentration of the gas will have dropped to 1/3 of its initial value, and that this process continues for each subsequent lifetime. (For simplicity's sake, you may assume this drop applies only to the amount of the gas initially in the atmosphere.) At the same time, Gas 1 is being emitted at a

rate of 9.0×10^7 kg/yr and Gas 2 is being emitted at a rate of 5.4×10^8 kg/yr. What will the mole fraction (expressed in ppb) of each gas be in 50 years?

6. Which gas will be a more important GHG after 50 years? Discuss the basis for your choice.
7. If you could only choose one of the two gases to regulate, which one would you choose and why? Discuss the ways in which this problem illustrates why each of these factors must be considered when making regulatory decisions about greenhouse gases.