GWP EXERCISE

Global Warming Potentials:

In this exercise you will calculate the global warming potential for a particular species. The radiative forcing for a green house gas (GHG) in watts per square meter is given by integration (summation in our example) over the product of the absorption cross section (in units of cm² per cm⁻¹) and the narrow band forcing (in units of Watts m⁻² per cm⁻¹),

\[ RF = \sum \sigma \times F \]

The Global Warming Potential (GWP) for 1 kg of a particular species relative to 1 kg of reference compound CO₂ is given by,

\[
GWP = \frac{RF^{GHG} \times \left( \frac{1000}{MW^{GHG}} \right) \times \int_0^{TH} e^{-\tau^{GHG}} dt}{RF^{CO₂} \times \left( \frac{1000}{MW^{CO₂}} \right) \times \int_0^{TH} e^{-\tau^{CO₂}} dt}
\]

where MW is the molecular mass in g/mol and \( \tau \) is the atmospheric lifetime in years. \( TH \) is the time horizon given in years. A description of this exercise can be found in Journal of Chemical Education article by Matthew Elrod (J. Chem. Ed. 76, 1703 (1999)).

Complete the following:

1) Make a plot in the spreadsheet of \( F \) vs. cm⁻¹ (wavenumbers) and overlay a plot of \( \sigma \) vs. cm⁻¹. (you will have to multiply the \( \sigma \) values to have them be clearly seen on the plot)
2) Calculate the RF number and indicate this number clearly in the spreadsheet.
3) Calculate the GWP for your species and compare this value to accepted number in the literature.
4) How will the GWP change if the Time Horizon is changed; increased to 5000 years or decreased to 5 years?