Keeling Problem Set 1, SIO217D-Winter 2016 Due Tuesday Feb 2nd

Problem 1. Annual anthropogenic emissions for several greenhouse gases are given below for year 2010:

CO_2: 3.6×10^7 Gg CO_2 (Fossil fuel emissions)
CH_4: 3.8×10^5 Gg CH_4
N_2O: 9.9×10^3 Gg N_2O
SF_6: 6.9 Gg SF_6

1 Gg = 10^9 grams

Using the global warming potentials given in the class notes, assess how much warming the emissions of CH_4, N_2O, and SF_6 will produced compared to the emissions of CO_2. Your answer should be in percentage terms, i.e. if the gas produces 50% as much warming as CO_2, your answer would be 50%. To answer this question, you need to pick a time horizon over which you are assessing the warming. First, start with a 20-year time horizon. Then repeat for 100-year horizon and 500-year horizons.

Problem 2. In this problem, the goal is to estimate the global warming potential of CFC-13. This gas has an atmospheric lifetime of 640 years and a radiant efficiency for greenhouse forcing of 0.25 W m^{-2} ppb^{-1}. Calculate its global warming potential over a time scale of 20, 100, and 500 years, by scaling the estimates for CFC-11 or CFC-12 as given in the lecture notes.

Be aware that, to do this problem, you must the integrate the exponential-decay functions for the various gases over the different time horizons.

Also be aware that the global warming potential is assessed per unit mass of emissions, so you will need to take account of molecular weights:

Industrial Name	Molecular Formula	Molecular Weight
CFC-11	CCl_3F	137.35
CFC-12	CCl_2F_2	120.90
CFC-13	$CClF_3$	104.45