Environmental Science, Problems Chapter 4

4.1

Assuming a CO_2 volume fraction of 350 ppmv, calculate the weight fraction of CO_2. The average density of air is 1.29 kg/m^3 and the density of CO_2 is 1.98 kg/m^3 (STP).

Solution:

$$m_{CO_2} = \rho_{CO_2} * V_{CO_2}$$

$$m_{air} = \rho_{air} * V_{air}$$

$$m_{CO_2}/m_{air} = 1.98 * 350 * 10^{-6}/1.29 = 537 \ \ ppm \ \ (weight)$$

Answer: 537 ppm (weight)

4.2

The seasonal variations in atmospheric CO_2 amount to about 4 ppmv. Estimate the total volume needed to store this amount of CO_2 in liquid phase (density 770 kg/m^3).

Solution:

$$m_{CO_2} = 750 \ \ Gton = 7.5 * 10^{14} \ \ kg$$

$$Variation = \frac{4}{350} * 7.5 * 10^{14} \ \ kg = 8.6 * 10^{12} \ \ kg$$

$$V = 8.6 * 10^{12}/770 \ \ = 1.1 * 10^{10} \ \ m^3 = 1.1 * 10^4 \ \ km^3$$

(This is about the same as the volume of Lake Superior)

Answer: $1.1 * 10^4$ km^3