Calculation of Decimal Rate

We observed that the decimal rate could be approximated up to an error of 0.005 by the formula:

Decimal Rate = (Year + (15 + 30*(Month - 1))/365)

This can be interpreted to mean that the data was measured at approximately the middle of each month.

Outline Of The Solution

The computation of the functions A(t) and T(t); the average and yearly trend for CO2 levels respectively, where t = 1, …, 516 (months from January 1980 to December 2022), was done in the following manner -

We observed that the trends and average values of C02 content in ppm vary approximately linearly with time.

We compute A(t + 1) - A(t) = (1/(t - 1))*([A(2) - A(1)] + … + [A(t) - A(t - 1)]) and similarly A(t + 1) - T(t) = (1/(t - 1))*([T(2) - T(1)] + … + [T(t) - T(t - 1)]), i.e., the derivative at time t is computed as the average of the derivatives at times 1 ,.., t - 1.

Reasons For Deviation With Each Month

The deviation of the average levels from the trend is constant throughout the year (~ 1.5 ppm).

Levels of carbon dioxide in the atmosphere rise and fall each year as plants, through photosynthesis and respiration, take up the gas in spring and summer, and release it in fall and winter. Now the range of that cycle is expanding as more carbon dioxide is emitted from burning fossil fuels and other human activities.

More carbon is accumulating in forests and other vegetation and soils in the Northern Hemisphere during the summer, and more carbon is being released in the fall and winter Plants absorb CO_2 from the atmosphere in the spring and summer, and release CO_2 back to the atmosphere in the fall and winter.