A Look at Atmospheric CO_2
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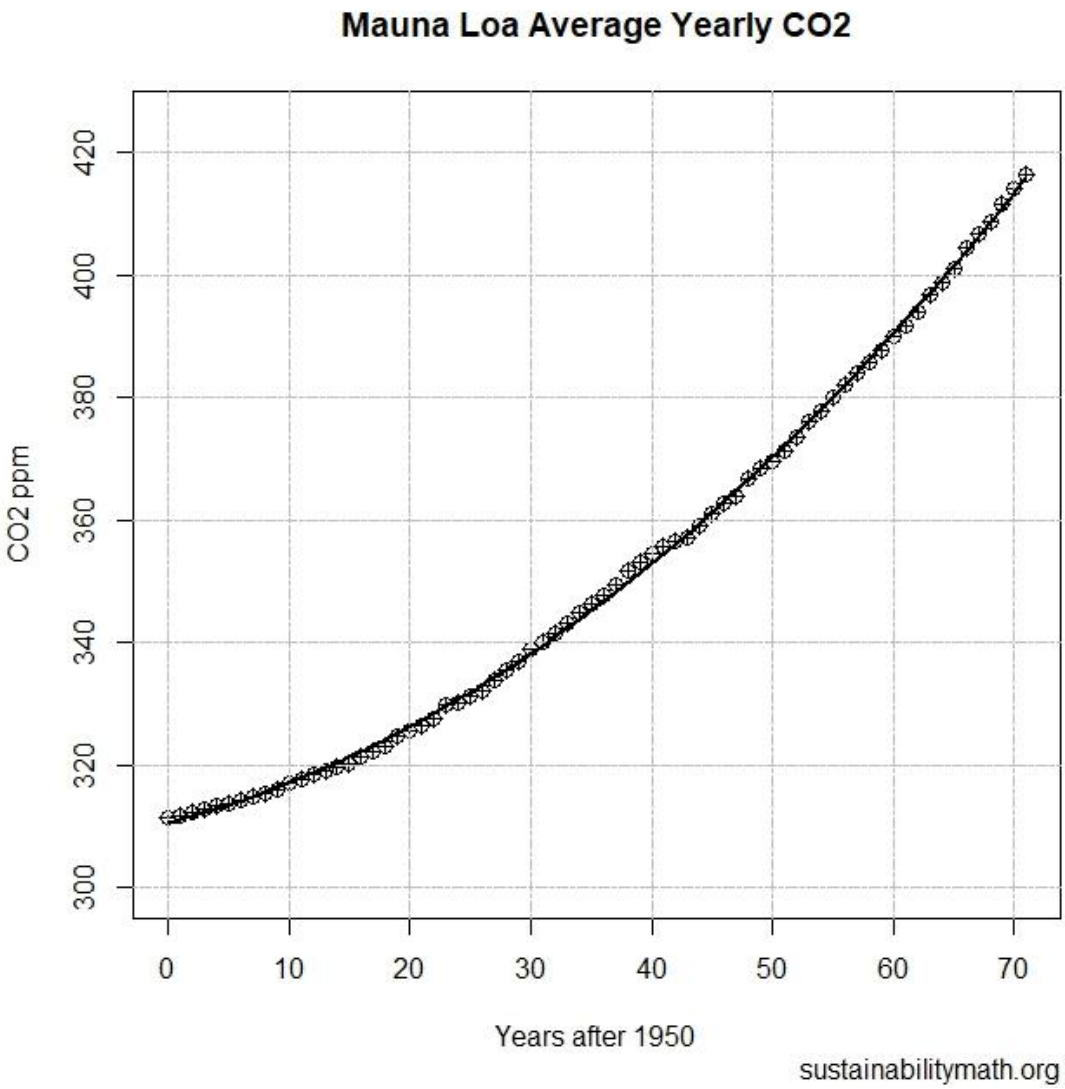

Figure 1 Atmospheric CO2 data, 1950-2021, from the Mauna Loa site, ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_annmean_mlo.txt, with a fitted curve.

Answer the following questions using the fitted curve, $y = 310.512512186844 + 0.509146893268788x + 0.0137331303009963x^2$, that is represented in Figure 1.

1. Find a model with output Average CO2 in PPM and input years (or years after 1950). [Either delete this question or the figure, in which case provide the data.]
2. According to the model what will CO_2 levels be in 2050?

3. What is the rate of change of CO_2 in 2021 (the last year of the data set) and what is the percentage rate of change?
4. Assuming that CO_2 levels continue to grow constantly at the 2021 rates, what will the CO_2 levels reach in 2050?
5. Atmospheric CO_2 levels of 450ppm yield a likely chance that global average temperature increases will be at least 2^0 Celsius. [i] According to the model, in what year do we reach a CO_2 level of 450ppm? If we assume CO_2 levels continue to grow constantly at the 2018 rates, in what year do we reach a CO_2 level of 450ppm?

   NOTE: According to Warren[ii] , at 1^0 Celsius , in addition to the trends we are already observing, oceans will further acidify, natural ecosystems will start to collapse, and as many as 18-60 million people in the developing world will go hungry. At 1.5^0 Celsius the Greenland ice sheet will melt, eventually causing a 7m rise in sea level, inundating coastal areas. At 2^0 Celsius agricultural yields in the rich nations will start to fall and 1-3 billion people will experience water scarcity. At 3^0 Celsius the Amazon rainforest is expected to collapse and at 4^0 Celsius most of Africa and Australia will lose all agricultural production.
6. Fill in the blank: In order to avoid reaching 450ppm of atmospheric CO_2 the trend in the data would have to become (???Calculus Term???).
7. Provide a (general or real world related) question that you would like answered based on your work here. This should not be something that you could answer yourself with a little work.
8. Summarize your work on questions 1-5 in a short paragraph as if it were a news article.

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[i] According to IPCC Fifth Assessment Report (AR5) page 22: https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

[ii] Warren, R. 2006. Impacts of global climate change at different annual mean global temperature increases, in H.J. Schellnhuber et al. (eds.) Avoiding Dangerous Climate Change. Cambridge University Press, Cambridge.