Climate Data Module: Temperature and carbon in recent history

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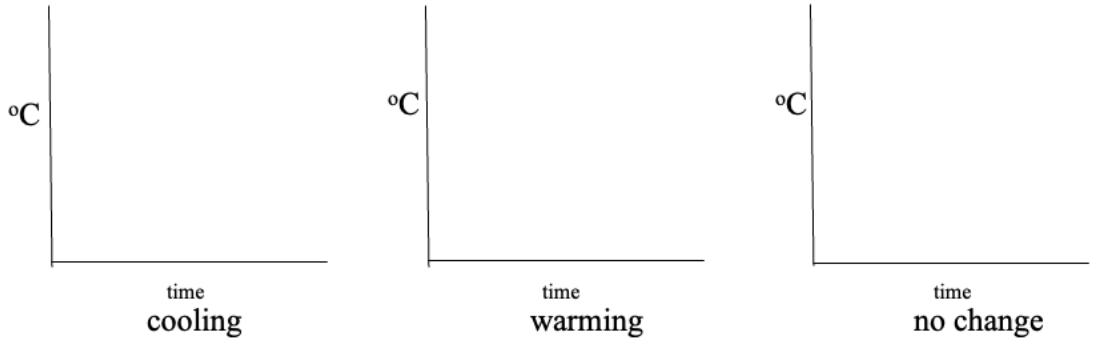
We'll first investigate how global temperatures have changed over time. Scientists from the Goddard Institute for Space Studies, NASA, compiled temperature datasets from weather stations all over the world to create the dataset you are going to be working with today to answer the question: Is earth "warming"? The data you will use are from years 1880-2013.

1. Before looking at the data, let's make some predictions. Suppose you plotted time vs. temperature. What would you expect the data to look like for a warming earth? For a cooling earth? For no change? (You can sketch in many individual data points; or a line to show the general trend.)



2. Download the EXCEL file "ClimateData" from Canvas. The data on average annual global temperature (compiled by the Goddard Institute for Space Studies, NASA, and made available by the Earth Policy Institute). Note that different data sets are available in different tabs.

3. The temperature data is recorded in the "Global Temperature" tab in the Climate Data spreadsheet. Make a scatterplot of temperature change over time, and add a trend line. Use the scatterplot to answer the following:

   (a) Do you think a linear model is a good fit for the data? Why or why not?

   (b) Record the equation for the linear model and R^2.

   (c) Interpret the slope of the line. Include units!

   (d) Does the data suggest that Earth is warming? Explain how both the slope of the linear model and R^2 support your conclusion.

4. Many scientists claim that drastic changes in global temperature began in the mid-1900s when fossil-fuel-powered transportation became a mainstay for most families. You'll test this hypothesis by computing and comparing linear models for the data before and after the mid-1900's.

   To do this: Decide on a year in the mid-1900's to divide the data into two time periods. Then create a scatterplot for each time period by selecting the data for that time period and construct a scatterplot as before.

   (a) Cut-off year:

   (b) Equation of linear model and R^2 for the first time period:

   (c) Equation of linear model and R^2 for the second time period:

   (d) Do you think the linear models are good fits for the data here? Explain.

   (e) Compare the slopes of the two lines. Do your results support the hypothesis that the rate of global average temperature is greater after the mid-1900's? Explain.

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Now let's consider carbon levels in the atmosphere. We'll use data collected Mauna Loa Observatory located in Hawaii, begun in 1959.

5. The data from Mauna Loa Observatory is recorded in the "Mauna Loa" tab. Create a scatterplot of CO_2 vs time.

   (a) Record the equation for the linear model and R^2.

   (b) Interpret the slope of the line. Include units.

6. The temperature and CO_2 data is combined in the "Comparison" tab. Use this to create a scatterplot of temperature CO_2.

   (a) Record the equation for the linear model and R^2.

   (b) Interpret the slope of the line. Include units.

7. Looking back at your work on the last two questions: Is there evidence that CO_2 concentration has increased? Is there evidence of a connection between temperature and CO_2 levels? Write a paragraph addressing these questions. Make sure to explicitly connect your analysis to your work in the previous questions.