Lab 6 What's happening to the Climate?

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You should discuss every answer with your partner(s) *before* recording it here. At the end of lab, please send it to me vs email as your lab report. Please save frequently.

Today, we'll use data from NOAA to determine what is happening with global temperatures.

Temperature data is often reported in terms of "temperature anomalies." Anomaly means a deviation from normal. For example, in a room full of people of average height, a person who is 7 feet tall would be an anomaly.

We could express each person's height using "height anomaly." For example, if the average height of people in the room is 67 inches, then a person who is 68 inches would be a "+1" anomaly. What would the heights of the following individuals be (compared to the average)?

68 inches	+1	67 inches	0
67.2 inches	+0.2		
57 inches	-10		

Global Temperature

The "historical" average temperature (based on data taken over many decades) is 14.0^0C (57.2^0 Fahrenheit). So a year with a temperature anomaly of "+1.0" would have a temperature of 15.0^0 (averaged over the entire year). (We'll be doing everything in Celsius. A Celsius degree is about twice as big as a Fahrenheit degree.)

To get a feel for what these numbers mean, try guessing the following. (I know you probably don't *know* the answers; just *guess* a number that you think sounds plausible.)

1. How many (Celsius) degrees cooler, on average, was the world during the last ice age?

   -15.0^{0}C colder

2. About 55 million years ago, our planet was too warm to have ice at either pole. Palm trees grew in what is now England, and tropical species like crocodiles lived in the Arctic. Guess how many degrees warmer, on average, it was back then.

   +20^{0}C warmer

When you've written down your guesses, scroll to the end of this document to check your answers. (Don't delete your guesses, even if wrong.)

Activity 1: Averages by Decade

1. Download global average temperature data (an Excel spreadsheet) from Canvas and open the file in Excel.

2. This file shows the temperature anomaly for each year. Look through the numbers and answer the following:
   (a) In what year did the temperature swing more than 1.0 degree above the historical average for the first time? **2005**
   (b) What were the three hottest years on record? **2005, 2007, 2010**
   (c) Fill in the blanks: People born after the year **1976** have never experienced a year with lower temperatures than the historical average.

(Don't forget to save this file frequently so you don't lose your work.)

3. In a different column in the same file, make a list that represents the average temperature for each decade. Excel calculates the average for you when you highlight some data. For example, try highlighting the data for 1880 through 1889 (just the column with the temperature data, not the dates). Excel will show at the bottom of the screen "average: -.44". Do this for each decade so that you end up with a list of numbers representing the average temp for each decade. (Do them in order). It's best to stop when you get to 2000-2009, because there is only 3 years' worth of data for the next decade, which is probably not enough to create a meaningful average.
4. Graph the results, highlight the column of data that you just entered. Go to "insert" and select "scatter." Select the first option (top left icon). This should graph your data as a series of dots.

Copy your graph here from excel.

1880s	-0.44102
1890s	-0.37368
1900s	-0.34776
1910s	-0.35177
1920s	-0.1921
1930s	-0.03848
1940s	0.04811
1950s	-0.07622
1960s	-0.01491
1970s	0.02185
1980s	0.30745
1990s	0.56657
2000s	0.88273

By the way, the cooling period in the 1950s-60s has been attributed to the testing of nuclear weapons. Nuclear explosions kick up enough dust to block out sunlight, leading to cooling.

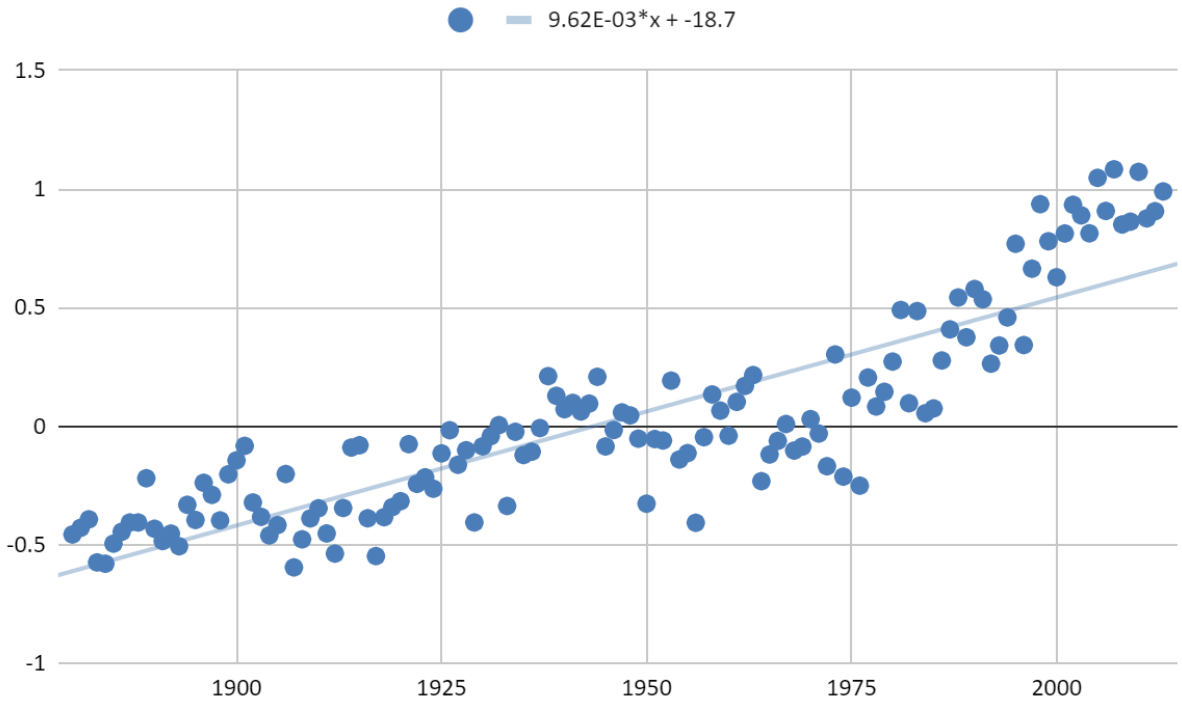
5. According to your graph, what was the hottest decade on record? **2000-2009**
6. The coldest decade? **1880-1889**
7. Overall, what trend does this data show? **Our planet is getting warmer and warmer every decade.**

Activity 2: Graphing yearly trends

<u>For this part, *don't* use your decade averages. Instead, use the yearly data points.</u>

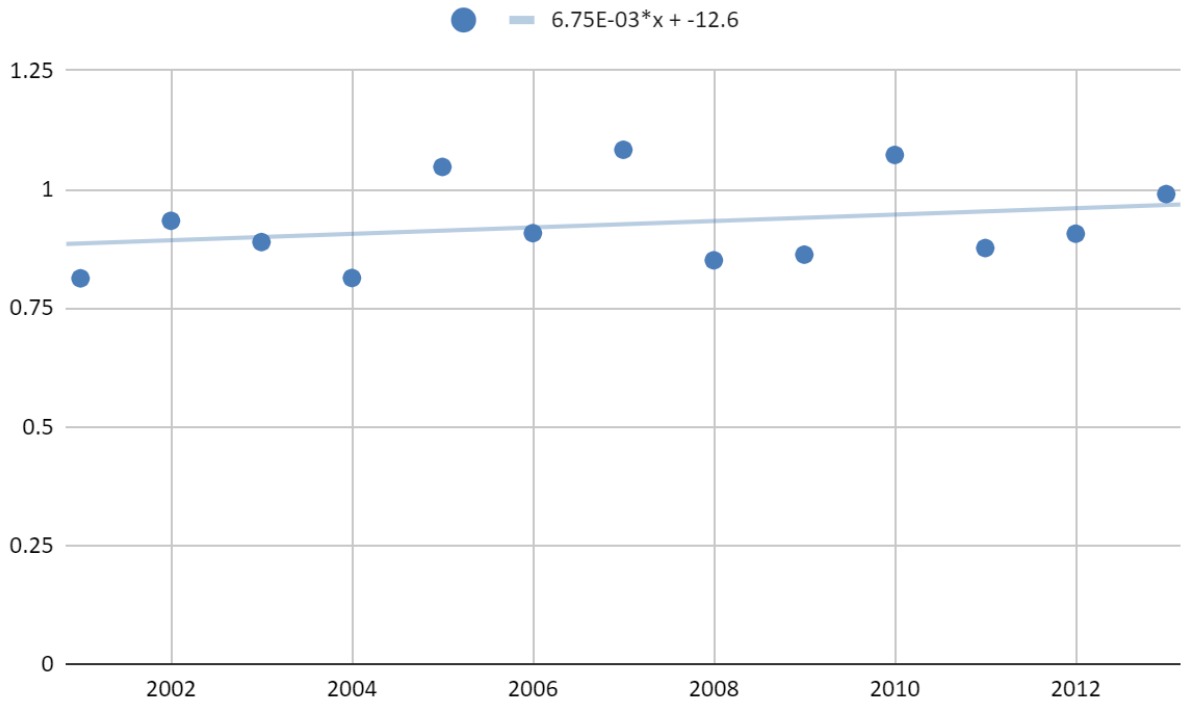
1. Highlight your entire data set (all years since 1880—**not** the decade averages), and produce a scatterplot. This should show a bunch of dots representing temperature vs. time. Under "Chart Tools," select "Layout" -> "Trendline" -> "More Trendline Options." This should bring up a new window. Select the "Display Equation on Chart" option and click "Close." This should draw a trendline through the data, and give you an equation that will tell you the slope of the line.

Slope of line = **9.62E-03*x + - 18.7** for the time period 1880 to 2013



2. Do the same thing using more recent data. Highlight a set of data starting in the year of your birth and ending in the last year of data. Create a scatterplot as before, and create a trendline with an equation.

Slope of line = **6.75E-03*x + - 12.6** for the time period **2001** to **2013**.



3. Analyze the slopes of above two graphs. How does the increase in temperature in your life time compare to the increase in temperature for the entire historical period?

   Both graphs are very similar. The temperature has been increasing for many years, but in my life time it has increased even faster than it was in the historical time period.

Conclusion

With your partner, write a conclusion that summarizes the results you found in this activity.

In conclusion, the planet is getting warmer and warmer as time goes on. The planet hasn't been below historical average temperature since 1976, and went +1.0^{0}C on average for the first time in 2005 in modern history. The planet is getting warmer and warmer by the decade.

ANSWERS TO GUESSWORK EXERCISE

The world was about 6 degrees cooler during the last ice age, and about 6 degrees warmer 55 million years ago, during the hot spike. (This period is called the Paleocene-Eocene Thermal Maximum.) [Source: Six Degrees: Our Future on a Hotter Planet, by Lynas.]

This tells you that what looks like a very small change in average temperature—just a few degrees—has enormous effects.