GEOL 103 Lab 9 - Volcanoes and Climate

GOALS:

* Construct and interpret graphs of scientific data using excel
* Use formulas and functions in excel to do mathematical calculations
* To analyze temperature data for magnitude, significant fluctuations over a century
* To review major global temperature events - volcanic eruptions and evaluate their significance
* To plot and examine local and global temperature trends as well as regional temperature changes

INSTRUCTIONS:

* Download the global\_temp.xls file
* Upload your answers onto Canvas

**Part 1: Fluctuations of Local and Global Climate**

Use the data from New York to select 10 non-successive years at random from the annual column and compare the data for each year to that of the following year you selected (for example, 1871–1872, 1925–1926, etc.).

1. Record your years in the table below and answer the questions that follow.

| Year | Annual Temperature |
| --- | --- |
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1. What is the typical magnitude of year-to-year local temperature change?
2. Of your 10 years, how many times did the temperature increase/decrease in the following year?

Sort the data based on annual temperature (be sure to highlight all the columns)

1. What were the 5 warmest years in the record?
2. What were the 5 coldest year in the record?
3. Have we come anywhere close to having one of the coldest years in the record during your lifetime?

Calculate average seasonal temperatures for December-February (DJF), March-May (MAM), June-August (JJA) and September-November (SON) for each year in New York. To do this, you can use excel to make calculations using formulas and functions. A range of functions are available; check in the Help index to search for them:

* All mathematical formulas start with an equal size (=) and use numbers and/or cell addresses along with mathematical operators to write a calculation
* As with regular math, use parentheses to indicate order of operations
* Addition +, subtraction -, multiplication \*, division /, power ^, parentheses ( )
  + Useful functions: sum, average, min, max stdev.
  + You can mix functions in with formulas
  + To solve for formulas, press enter
    - Examples:
      * =sum(10,15,20) [calculates 10+15+20 = 45 ]
      * =sum(b9:b18) [calculates the sum of cells B9, B10, ….B18]

*Hint: Once you calculate the averages for one year, you can fill the equation down for all years by highlighting the cell, clicking the square in the lower right corner, and filling down.*

Now that seasonal data is calculated, you will compare using scatter plots.

1. Still using the New York data, make a scatter plot of DJF temperature vs. JJA temperature for the entire dataset (do not plot either one vs. time). Add a linear trendline to the data and display the R2 value under the legend. Save this as *NY Graph 1* (make sure axis are labeled!)
2. Do especially warm winters tend to be followed by especially warm or cold summers? (Of course, DJF is only winter in the Northern Hemisphere; the issue we are exploring is whether local climate can be predicted 6 months in advance.) This plot is a perspective spanning more than one human lifetime; our personal perception of climate change in our daily lives tends to be based on our experiences over only the last few years.

Now using the global dataset (available on the global tab) select 5 non-successive years at random from the **global temperature** column and compare the data for each year to that of the following year selected (for example, 1871–1872, 1925–1926, etc.).

| Year | Annual Temperature |
| --- | --- |
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1. What is the typical magnitude (i.e., ignoring the sign) of year-to-year global temperature changes?
2. Of your 5 years, how many times did the temperature increase/decrease in the following years?

Sort the data based on annual temperature.

1. What are the 5 warmest years in the record?
2. The 5 coldest years in the record?
3. Have we come anywhere close to having one of the coldest years in the record during your lifetime?
4. Using the global data make a scatter plot of **DJF** temperature vs. **JJA** temperature for the entire dataset (do not plot either one vs. time). Add a linear trendline to the data and display the R2 value under the legend. Save this as *Global Graph 2*
5. Do especially warm winters tend to be followed by especially warm or cold summers?
6. Can we predict with confidence what kind of summer will follow that winter?
7. Describe similarities and differences between New York data and Global Data. Explain why these similarities/differences exist

**Part 2: How do natural events influence temperatures?**

Choose **three** volcanic eruptions since 1880 from the list below and plot a graph of the average annual global temperature from one year prior to the eruption to five years afterward.

**1883** Krakatau

**1890** Unidentified

**1902** Soufriere/Pelee

**1902** Santa Maria **1912** Katmai

**1963** Agung

**1968** Fernandina Island

**1982** El Chichon

**1991** Pinatubo

1. Be sure your graphs are well labeled for full credit. Name them using the eruption information above and Graph #. Example: *1883 Krakatoa Graph 3*
2. What is the typical magnitude and sign (warming or cooling) of the effect of volcanoes on global climate?
3. Estimate how long a volcanic eruption affects global temperature based on the years plotted.
4. What effects can the warming or cooling caused by a volcanic eruption cause? Do you think this a factor worth considering as we continue to attempt climate change mitigations for future generations?