Exploring Weather Trends

A Beginner's Introduction to Data Analysis

SUMMARY

In this project, local and global temperature data will be analyzed and the temperature trends in Detroit, MI will be compared to overall global temperature trends.

INSTRUCTIONS

The goal will be to create a visualization and prepare a write up describing the similarities and differences between global temperature trends and temperature trends in Detroit, Michigan. This will be done using provided data from the SQL database linked on the Udacity Data Analyst Nanodegree portal, Microsoft Excel, and Microsoft Word.

METHODS

First, the data was extracted from the SQL database. There were three tables in the database: city_list, city_data, and global_data. The first attempt was to find the relevant city in the city_list, using the following query:

```
SELECT *
FROM city_list
WHERE city LIKE 'Bl%'
```

A city beginning with "Bl" was chosen because the first attempt was to see whether the suburb of Bloomfield Hills, nearby to Detroit, was in the database. It was not. Thus, a second attempt was queried as such:

```
SELECT *
FROM city_list
WHERE city LIKE 'D%'
```

Here, a city beginning with 'D' was selected to try to find Detroit. This attempt was successful and because Detroit could be found in the city_list, the average temperature data for Detroit should be available in the city_data table. To find this data, the database was queried as such:

```
SELECT *
FROM city_data
WHERE city = 'Detroit'
```

Additionally, average global temperature data was needed, and was queried as such:

```
SELECT *
FROM global_data
```

RESULTS

The data was exported into csv files which were opened in Microsoft Excel. The data was too noisy to be graphed directly, so a moving average was calculated using the built-in Excel function AVERAGE(). A five-year moving average and a ten-year moving average were used and graphed in two separate line plots, as shown below.

The five-year moving average line chart is reproduced below and shows the moving average of temperatures in Detroit, the moving average of temperatures globally, and the linear trendline for the global temperatures with the equation of the line displayed. Notice, the data for the global temperatures in the csv file gave two extra years of data (for 2014 and 2015) that were truncated since those two data were not available for Detroit.

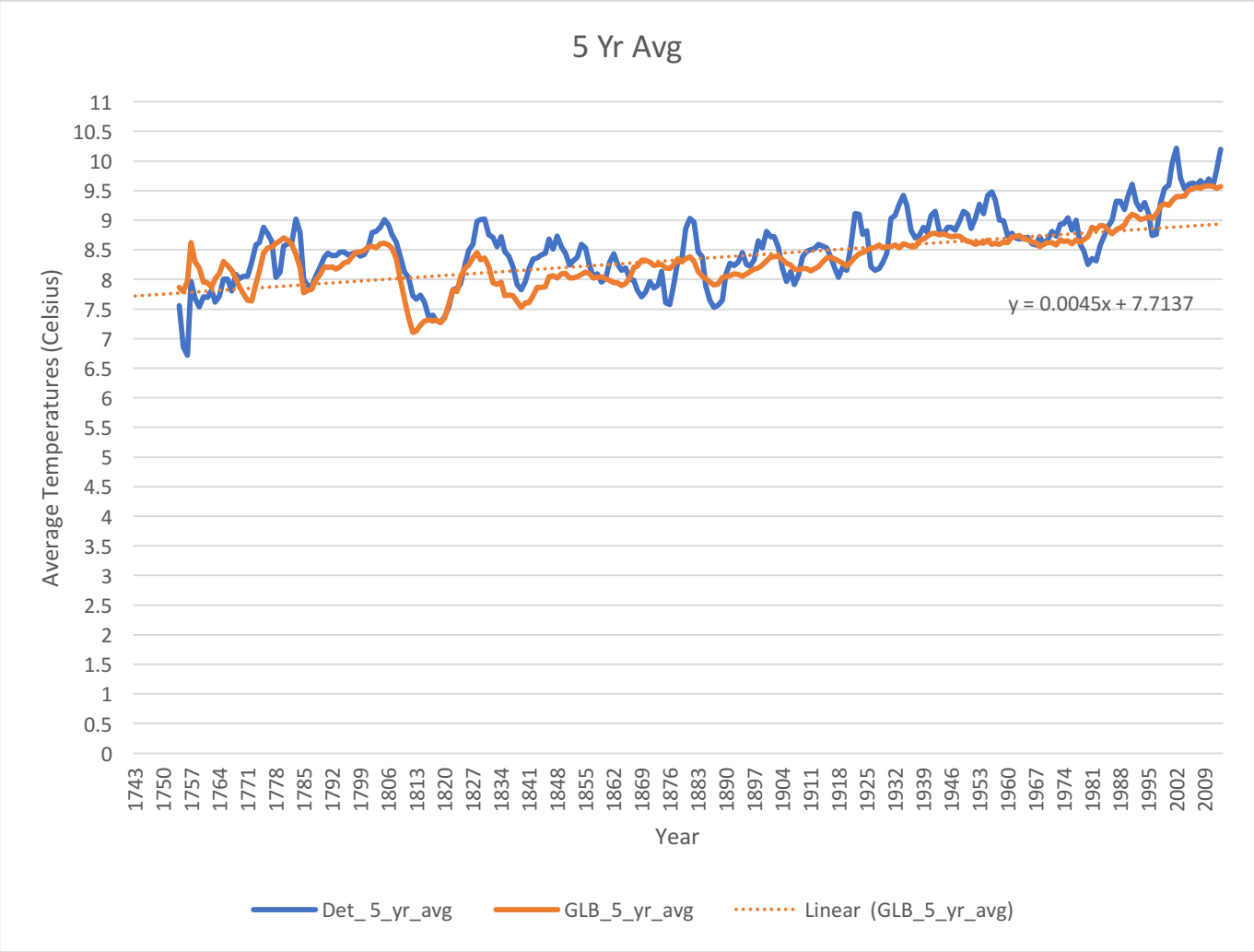

Figure 1 - Five-Year moving average of global and Detroit, MI temperatures

The ten-year moving average line chart is also reproduced below and shows the moving average of temperatures in Detroit, the moving average of temperatures globally, and the linear trendline for the global temperatures with the equation of the line displayed. As with the five year average line chart, the data for the global temperatures in the csv file gave two extra years of data (for 2014 and 2015) that were truncated since those two data were not available for Detroit.

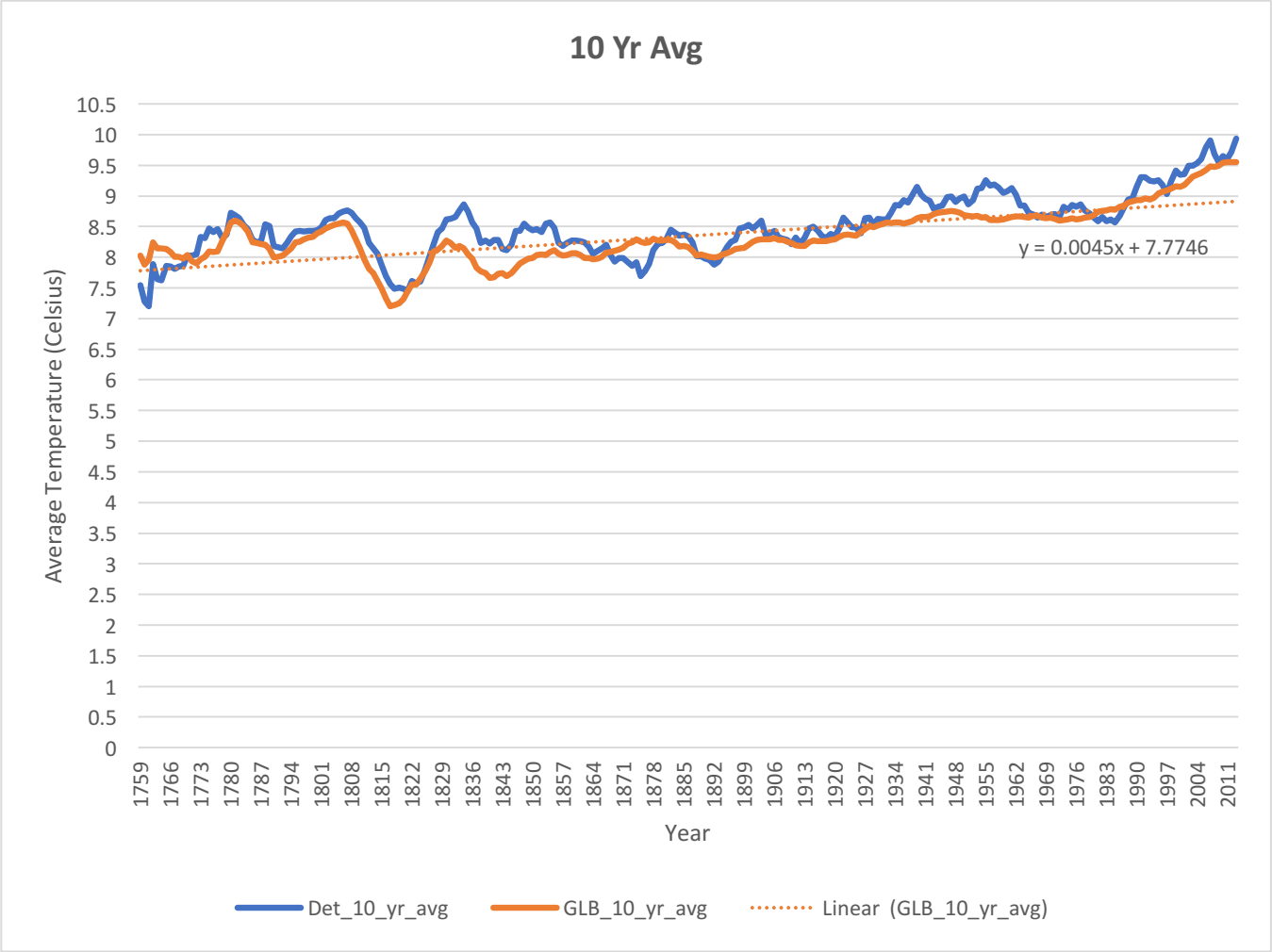

Figure 2 - A ten-year moving average of global and Detroit, MI temperatures

DISCUSSION

Some observations can be noted from the above graphs. The first being that for both the five-year average and the ten-year average, the global trend line and the Detroit trend line follow each other fairly closely. This suggests that Detroit is not in any dissimilar environment compared to the rest of the globe and does not have any ecological differences from global phenomenon. It appears that what occurs globally also occurs locally to Detroit.

A second observation is that the equations of fit for the global trend lines for both the ten-year and five-year moving averages show a positive slope of .0045 deg C/year. This means two things. One is that the positive slope indicates that global temperatures are indeed rising on an averaged timeline. The slope also shows that temperatures are rising by .0045 degrees Celsius per year. This does not sound alarming, but it should be noted that a single degree increase in global temperatures can cause massive ecological damage [1] [2].

A third observation to be noted is that while both the five-year and ten-year line graphs both show that the Detroit trend line follows the global trend line fairly closely, the five-year graph shows more fluctuation and variation year-to-year. This is mostly because of the nature of a moving average to smooth out fluctuations in data, but by over-smoothing the possibility of missing site-specific insights increases. A deeper observation might be noted for specific time periods. For example, 2000-to-present time scales might show that during the 2008 Great Recession, average temperatures in Detroit decreased. Looking at the five-year line plot, we can see that the temperatures for Detroit did drop between 2005 and 2013, but this is not reflected as strongly in the ten-year average plot.

A fourth observation might be the shared drop in global (and Detroit's) average temperatures from about 1805 to around 1830 in both the five-year and ten-year line graphs. A brief search seems to point to two possibilities for such low global temperatures and such a drastic drop in average temperatures. The first is "the Year Without a Summer", a year named for an unusually cold year following the volcanic eruption of Mt. Tambora in 1815 [3]. The nadir of the drop does appear to be centered in the mid to late 1810s, but one event would not explain the low averages over such an extended period of time. The ten-year line graph would have smoothed out a single aberration. The other explanation is the Dalton Minimum, a year observed to have unusually low sunspot count. Evidently, the connection between sunspot activity and lower temperatures is not well-understood, but researchers believe it may contribute to increased volcanic activity. Multiple volcanic eruptions over that period of time, with the Mt. Tambora explosion as the largest of the eruptions, might better explain such consistently low global temperatures over that thirty-year span [4].

CONCLUSION

In summation, it appears that the average temperatures in Detroit, MI closely follow average global temperatures and both appear to be rising at consistent, non-negligible rates. Detroit seems to weakly be slightly warmer than global temperatures, but this varies year to year. These trends appear to be consistent over the last few centuries, or at least since the 1760s.

CITATIONS

[1] "Why a half-Degree temperature rise is a big deal." *NASA*, NASA, 1 July 2016, climate.nasa.gov/news/2458/why-a-half-degree-temperature-rise-is-a-big-deal/.

[2] "What Would a Global Warming Increase of 1.5 Degrees Be Like?" *Yale E360*, e360.yale.edu/features/what_would_a_global_warming_increase_15_degree_be_like.

[3] *climate4you ClimateAndHistory 1800-1899*, www.climate4you.com/ClimateAndHistory%201800-1899.htm#1815:%20The%20year%20without%20summer.%20The%20Tambora%20volcanic%20eruption.

[4] "Dalton Minimum." *Wikipedia*, Wikimedia Foundation, 3 Sept. 2017, en.wikipedia.org/wiki/Dalton_Minimum.