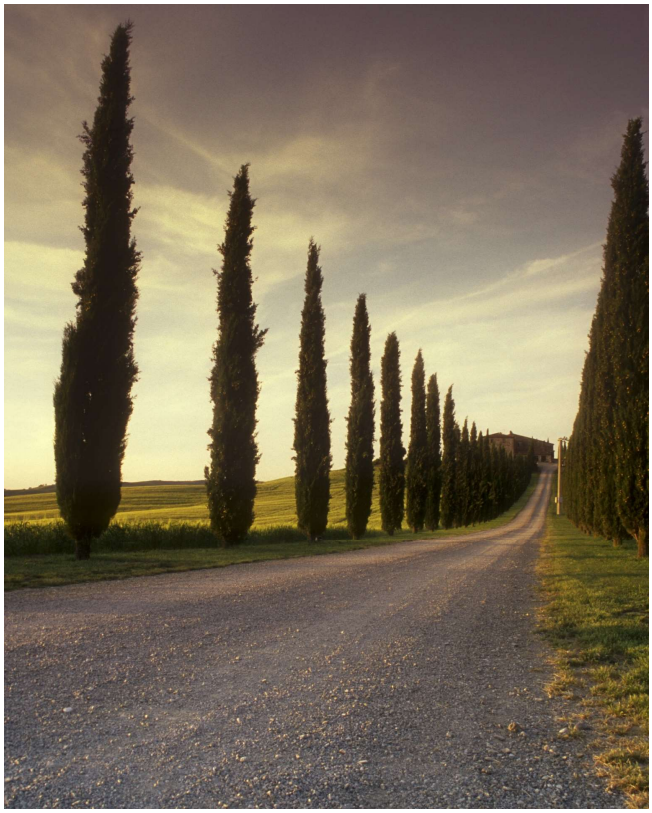

EXPLORE WEATHER TRENDS

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02/14/2019

Outline

1.Extracting the Data

Table1. Data extraction by SQL.

Step	Purpose	SQL coding
1	Extracting the list of cities	*>select * from city_list;*
2	From the city_list spreadsheet, Detroit in Michigan is my nearest big city. Then, the average temperatures for Detroit by year were extracted.	*> select * from city_data where city='Detroit';*
3	Extracting the average global temperatures by year (°C)	*>select * from global_data;*

2. Opening the CSV file and Calculating the moving average of temperature by Excel.

The yearly moving average of temperature were calculated using use the AVERAGE () function. 5-years and 10-years moving average were collected, respectively.

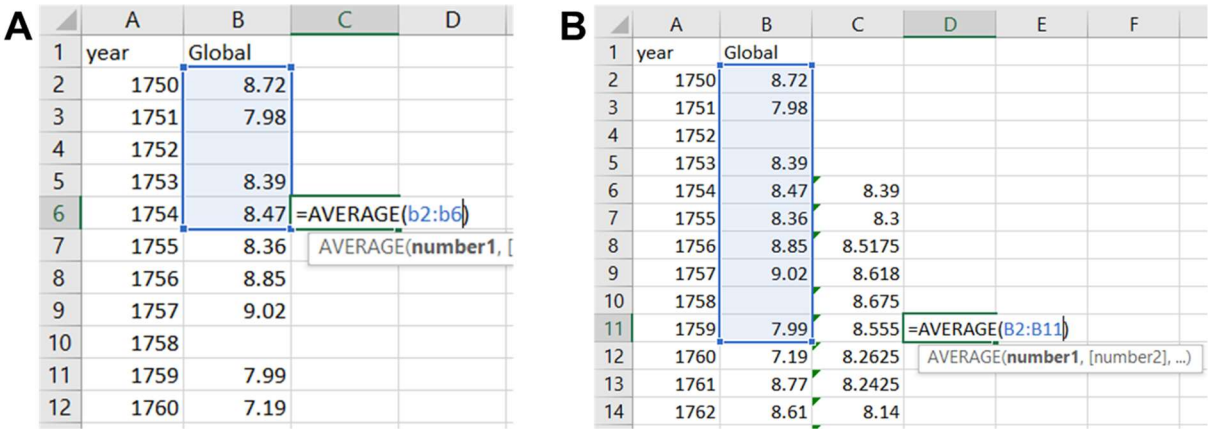

Figure 1. Calculation of 5-years(A) and 10-years(B) moving average temperature.

3. Considerations and Data visualization.

The weather in Detroit has abnormal fluctuation. For example, the data recorded that in Detroit, the yearly average temperature during 1949 is excessively low, around -0.8°C. Several references [1,2] have reported that the 1949 yearly average temperature is 49.3 °F (around 9.3°C). Thus, outlier of the dataset needs to be removed and quality of analysis should be improved. Data structure and quality were optimized by Quartile method and Box-whisker Plot of raw data (Figure 1). 14 outliers in Detroit group and 13 outliers in Global group were removed.

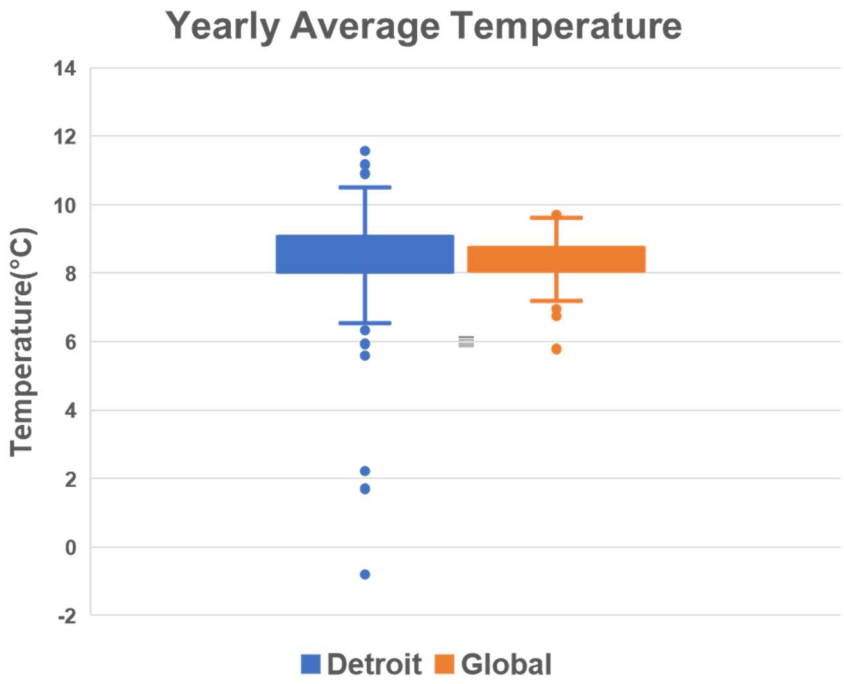

Figure 1. Boxplots of yearly average temperature in Detroit and Global.

Yearly average temperature in Detroit recorded from 1743 to 2013 and global temperature records were from 1750 to 2015. These two sets of data have different starting and ending points. To avoid the disorder of time and recorded temperature, I left

gaps at the starting of global time line and ending of Detroit time line. The line charts with 5-years moving average subset was plotted (**Figure 2**). More subunits of moving average need to be considered for smoothing chart.

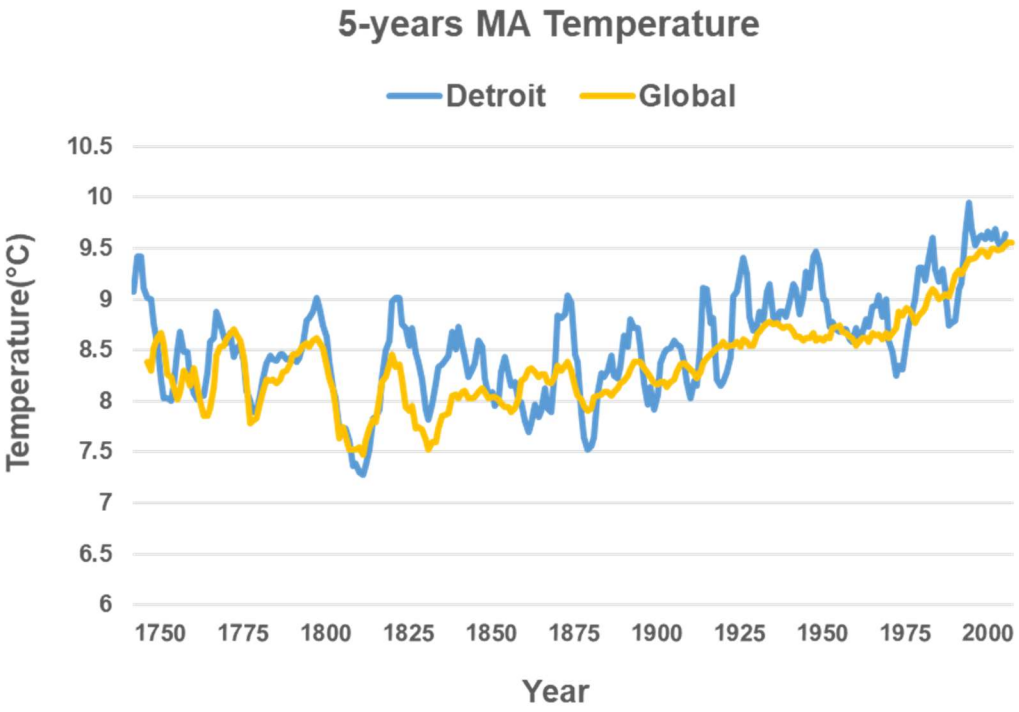

Figure 2. 5-years moving average of temperature in Detroit vs Global.

4.Observations

Table 2. Standard deviation of yearly average temperature, 5-years and 10-yeas MA of global temperature and in Detroit. The average, standard deviation and variance were calculated by AVERAGE (), STDEV () and VAR () function.

		Yearly	5-years MA
Detroit	Average	8.550	8.557
	Variance	0.5728	0.2682
	Standard deviation	0.7569	0.5179
Global	Average	8.404	8.394
	Variance	0.2347	0.1969
	Standard deviation	0.4844	0.4437

Observation 1. During 1750 to 2013, weather in Detroit (8.550°C and 8.557 °C) was warmer than global (8.404°C and 8.394°C) when comparing yearly average value and 5-years MA (**Table 2**).

Observation 2. The variance and standard deviation in **Table 2** show that compared with global temperature, the value of MA temperature in Detroit spreads out over a wider range of values, which means weather during 1950 to 2013 in Detroit was more volatile than global temperature.

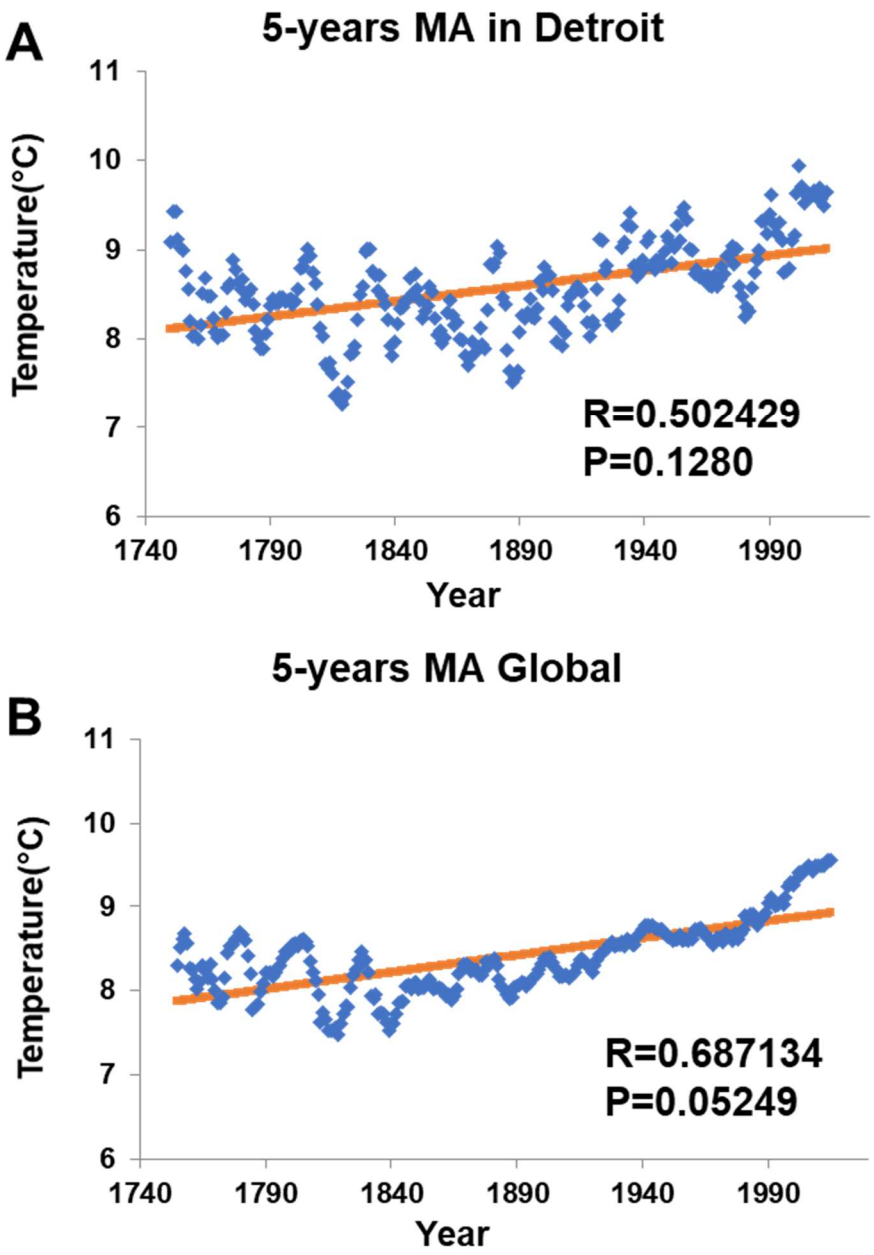

Figure 3. Regression analysis and residual plots of 5-year MA temperature in Detroit(A) and Global(B). Regression analysis and scatter plotting for multiple regression are performed by Excel Data Analysis plug-in.

Observation 3. Regression analysis of 5-years MA temperature in Detroit (**Figure 3A**) and Global (**Figure 3B**) showed that the climate has positive correlation with time (R=0.52429 and 0.687134, which are larger than 0). But this relationship is improbable,

because P=0.1280 and 0.5249, both are large than 0.05) [3][4]. These data suggested that during last 200 years, the conclusion that weather in Detroit and the whole world became warmer is questionable.

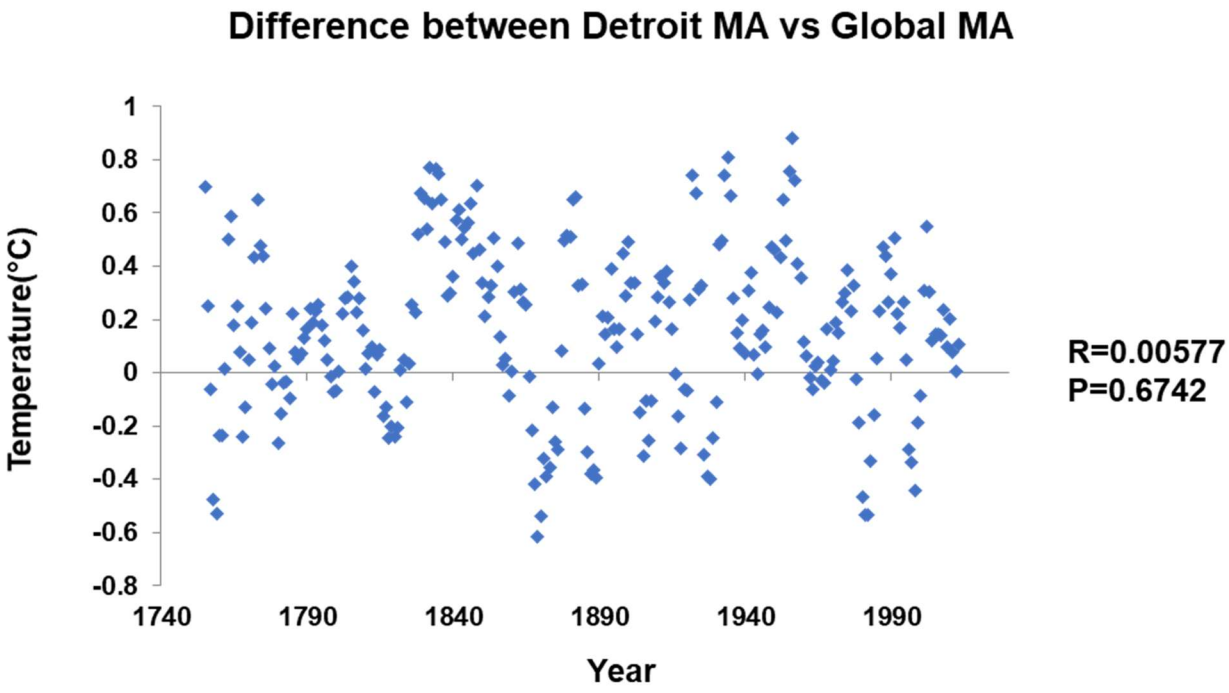

Figure 4. Regression analysis and scattering plots of difference between 5-year MA temperature in Detroit and that in Global. Difference were calculated by Detroit MA values minus Global MA values corresponding year. Regression analysis and scatter plotting for multiple regression are performed by Excel Data Analysis plug-in.

Observation 4. Regression analysis of 5-years MA temperature in Detroit **(Figure 4)** indicates the there is less correlation between temperature in Detroit and Global. This conclusion can also be demonstrated in **Figure 2,** the yellow line (Global) and blue line (Detroit) are crossing together with the time went and there is no obvious distinction in their developing trend.

Reference

[1] Weber C R, Buttenfield B P. A cartographic animation of average yearly surface temperatures for the 48 contiguous United States: 1897–1986[J]. Cartography and Geographic Information Systems, 1993, 20(3): 141-150.

[2] Caswell H C, Forte V J, Fraser J C, et al. Weather normalization of reliability indices[J]. IEEE Transactions on Power Delivery, 2011, 26(2): 1273-1279.

[3] Wikipedia contributors. (2019, February 6). Regression analysis. In *Wikipedia, The Free Encyclopedia*. Retrieved 02:24, February 15, 2019, from https://en.wikipedia.org/w/index.php?title=Regression_analysis&oldid=882057523

[4] Wikipedia contributors. (2019, February 12). P-value. In Wikipedia, The Free Encyclopedia. Retrieved 02:25, February 15, 2019, from https://en.wikipedia.org/w/index.php?title=P-value&oldid=883030256