Project #1: Exploring Weather Trends

In this project, global temperature and temperature data of Tokyo were compared and analyzed. The analysis includes the following steps:

1) Extracting data from the database using SQL

   In order to extract global temperature and temperature records of Tokyo by year the following queries were written:

   a) To extract global temperature by year:

```sql
select *
from global_data
```

   b) To extract temperature data of Tokyo by year:

```sql
select
  year,
  avg_temp
from city_data
where city = 'Tokyo'
```

   c) Alternatively, we could write the following query to extract the necessary data simultaneously:

```sql
select
  gd.year,
  gd.avg_temp as avg_global_temp,
  cd.year,
  cd.avg_temp as avg_tokyo_temp
from global_data gd
left join city_data cd on cd.year = gd.year
where cd.city = 'Tokyo'
```

However, because of using a left join, which connects the tables by year columns, the output contains data from 1845 to 2013 only. This time period is relevant to Tokyo temperature records, while the global temperature contains data from 1750 to 2015 year. Therefore, I used the first two queries to extract the data separately and keep the original records.

2) Opening up the CSV files

MS Excel was used for opening the CSV files. I applied *Data -> Text to Columns* to separate the data by individual columns.

3) Creating a line chart to compare moving average temperature

First, *moving average temperature* was calculated for global and Tokyo data considering three periods: 5 years, 10 years and 20 years. By building charts for each period, it was decided that 10 years is the most optimal period to smooth out the volatility and observe the long-term trends for the particular time periods (1845 – 2013 for Tokyo and 1750 – 2015 for the world).

Figure 1 shows an example of calculation of moving average temperature for 10 years period:

	A	B	D		
1		Global data		Tokyo data	
2	Year	avg_temp	10-year avg temp	avg_temp	10-year avg temp
3	1750	8.72			
4	1751	7.98			
5	1752	5.78			
6	1753	8.39			
7	1754	8.47			
8	1755	8.36			
9	1756	8.85			
10	1757	9.02			
11	1758	6.74			
12	1759	7.99	E(B3:B12)		
13	1760	7.19	7.88		
14	1761	8.77	7.96		
15	1762	8.61	8.24		
16	1763	7.5	8.15		
17	1764	8.4	8.14		
18	1765	8.25	8.13		

The formula bar shows: `=AVERAGE(B3:B12)` and the tooltip `AVERAGE(number1, [number2], ...)`

Figure 1. An example of calculation of 10-year moving average temperature for the global data

In other words, in order to find 10-year moving average temperature for 1759 year we need to find an average value of temperature from 1750 to 1759 year:

$$Moving\ avg\ T_{1759} = \frac{8.72 + 7.98 + 5.78 + 8.39 + 8.47 + 8.36 + 8.85 + 9.02 + 6.74 + 7.99}{10} = 8.03$$

This approach was used to calculate 10-year average temperature for the global and Tokyo data.

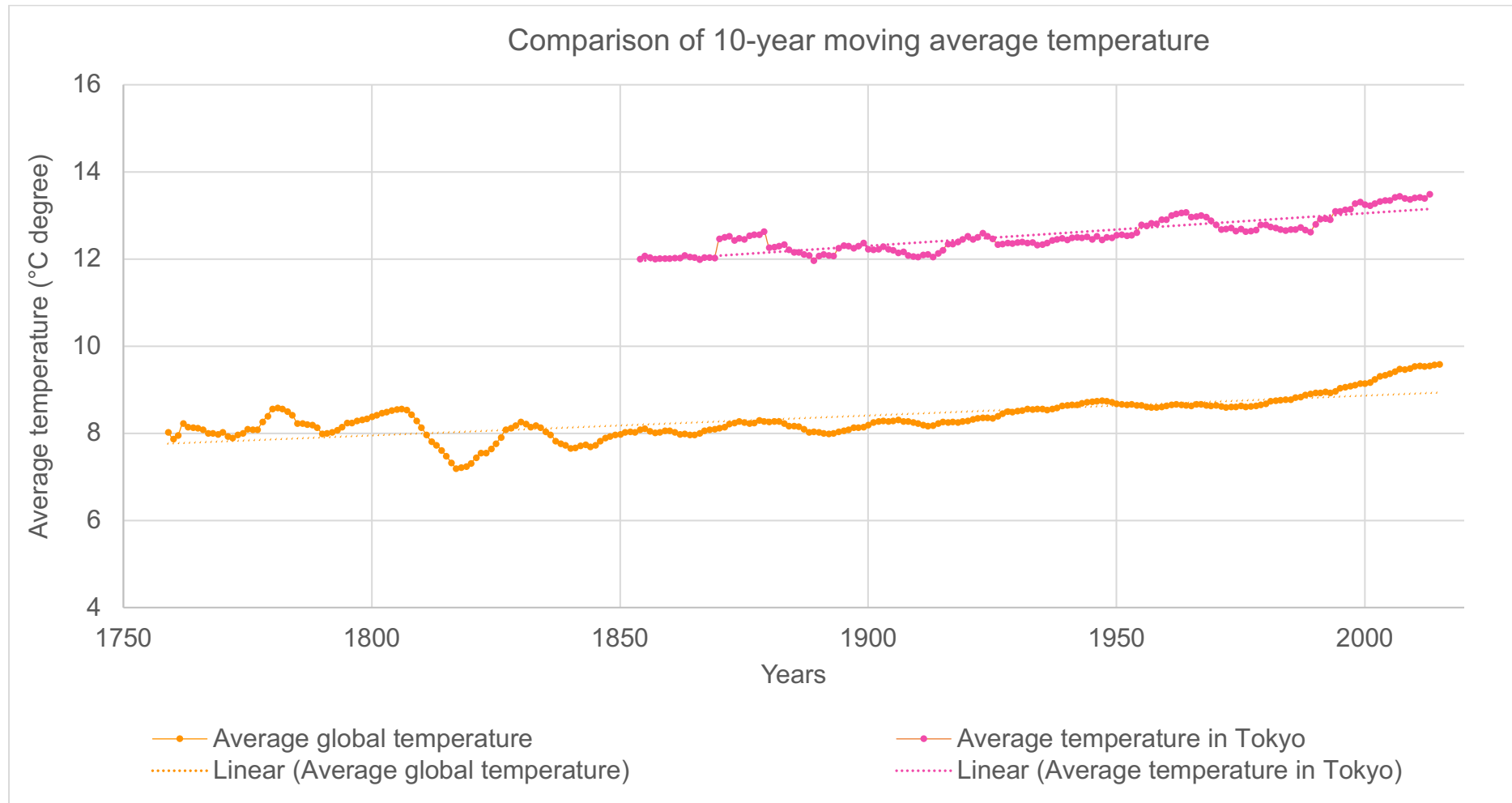Second, the following line chart was used to analyze the data:

Figure 2. Comparison of 10-year moving average temperature data for the world and Tokyo

4) Making observations based on the figure 2:

- The average temperature in the world and in Tokyo has been increased for about 2 °C degrees
- The growth of the average temperature for the world and Tokyo has gradual behavior
- It is warmer in Tokyo than in the world. According to the recent data, the average temperature in Tokyo is slightly below 14 °C degrees, while in the world it is almost 10 °C degrees. Also, this temperature difference is consistent over the last one and half hundred years
- The average temperature increase has started from around 1900 year for both the world and Tokyo. However, for more concise observations the average temperature in Tokyo before 1845 year is needed
- The record for the average global temperature is longer (1750 – 2015, 266 years) than for Tokyo (1845 – 2013, 169 years)
- 10-year moving average data is smoother for the world than for Tokyo, where some fluctuations are presented