Project 1: Exploring Weather Trends

This work involves analyzing local and global temperature data and compare the temperature trends where we live to overall global temperature trends. It is structured in three sections: **Data extraction**, **Visualization** and **Observations**.

Data extraction

The goal of this section is to extract data from a database. To extract the data we used SQL. In this section, we show the different queries we executed to do it.

1. SQL query to list cities and countries in the **city_list** table.

   Query
   ```
   SELECT * FROM city_list;
   ```

   After executing this query, we chose **Abidjan** as the closest big city to where we live.

2. SQL query to extract the city level data from the **city_data** table.

   Query
   ```
   SELECT * FROM city_data WHERE city = 'Abidjan';
   ```

3. SQL query to extract **year** and **avg_temp** columns from **city_data** table.

   Query
   ```
   SELECT year, avg_temp FROM city_data WHERE city = 'Abidjan';
   ```

4. SQL query to extract the global data from the **global_data** table.

   Query
   ```
   SELECT * FROM global_data;
   ```

Visualization

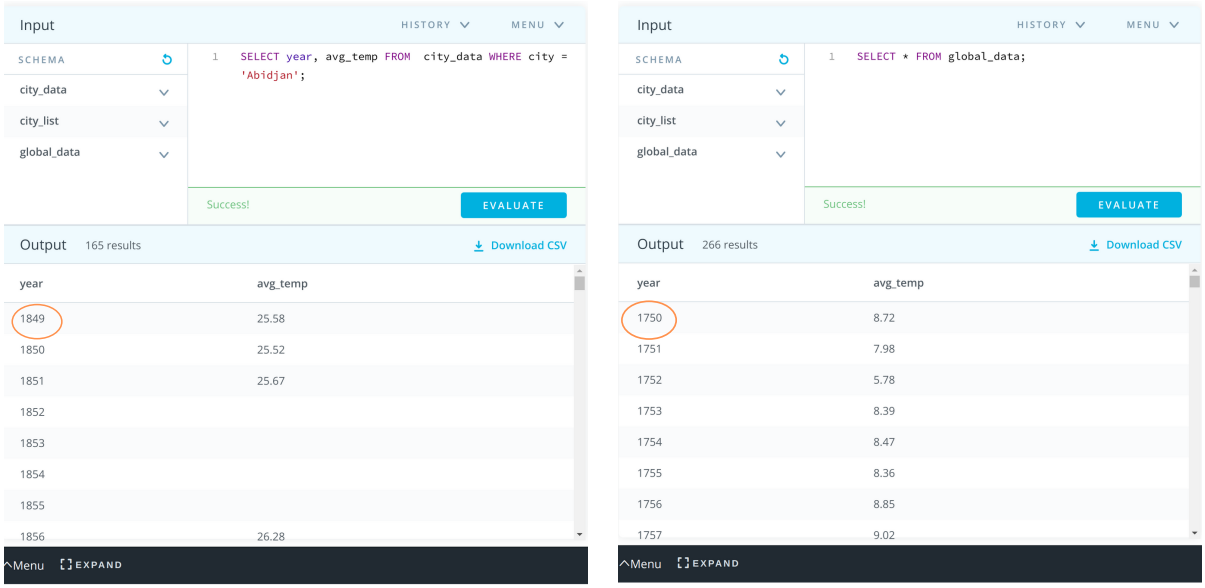
The purpose of this section is to visualize the data we extracted in the last section. Before, we need to prepare it. So, we will first do a preliminary work on the data and then plot it.

Project 1: Exploring Weather Trends

Preliminary work

To prepare the data, we followed the next steps:

- First, we checked if temperatures were recorded from the same years. After extracting the city level data and the global data, we noticed that temperatures were not recorded from the same years. In fact, the city level temperatures were recorded from **1849** while the global data from **1750**. Figure 1 illustrates this remark. In order to work with the same years, we



(a) City level data with start year circled

(b) Global level data with start year circled

Figure 1: City and global level data

re-extracted the global data considering **1849** as the start year. Thus, we got the result below 2.

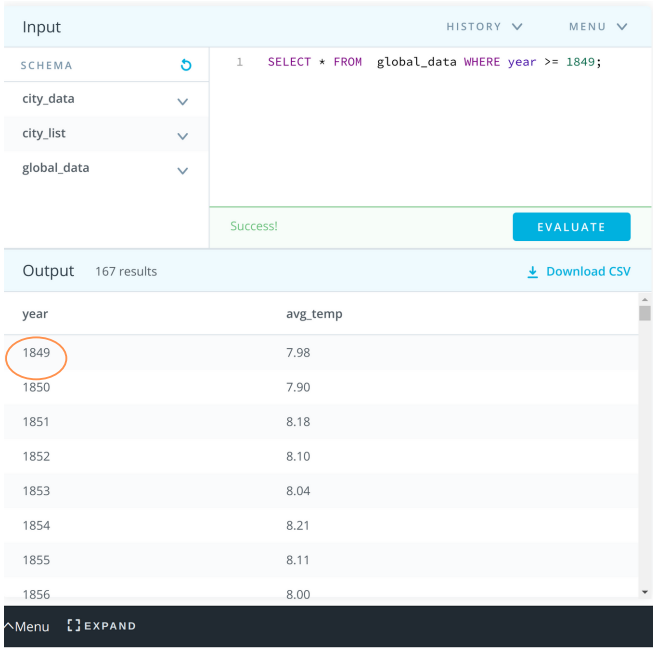


Figure 2: Global temperatures from the year 1849

- Second, we merged the city level data and the global data. Which allowed us to have a single csv file for both of our datasets (city level data and global data). We used Python's library Pandas to do this. Here's the code.

Code

```
from pandas import *
first_file = read_csv('results_global_data.csv')
second_file = read_csv('results_global_data.csv')
# On the line below, we merge the
# avg_temp from the city level data file with the global level data file
merge = first_file.merge(second_file, how = 'right', on = 'year')
# On the line below, we rename the merge dataframe columns with more significant
# names
merge.rename(columns = 'avg_temp_x': 'global_avg_temp',
'avg_temp_y': 'city_avg_temp', inplace = True)
# On the line below, we export the merged dataframe to a csv file we call new_data_file.csv
merge.to_csv("new_data_file.csv", index = True)
```

The code above creates a csv file, **new_data_file.csv**. This file has four rows. Here they are (from left to right):

- **year**: Years we considered to visualize temperatures for the city level data and the global data (**1849 - 2013**);
- **global_avg_temp**: Global yearly average temperatures extracted from the global data;
- **city_avg_temp**: City's yearly average temperatures extracted from the city level data;
- **10-year-global-avg-temp MA**: 10-year moving averages of the global average temperatures;
- **10-year-global-avg-temp MA**: 10-year moving averages of Abidjan's average temperatures.

- The last step before creating the line chart, is plotting the moving averages. So, we need to calculate them. To do this, we used Google Sheets. We decided to plot the 10-year moving average. To compute the moving average, we used the function **AVERAGE()** of Google Sheets. But, we encountered some difficulties to calculate the average. In fact, we noticed that there are **13** missing average temperatures in the **city_avg_temp** column of the dataset. So, we left the first **25** lines before computing the 10-year moving averages of Abidjan average temperatures. In figure 3, we highlighted missing values in red. Figure 4 shows how we computed the 10-year moving average.

year	global_avg_temp	city_avg_temp	10-year-global-avg-temp MA	10-year-city-avg-temp MA
1849	7.98	25.58		
1850	7.9	25.52		
1851	8.18	25.67		
1852	8.1			
1853	8.04			
1854	8.21			
1855	8.11			
1856	8	26.28		
1857	7.76	25.17		
1858	8.1	25.49	8.038	
1859	8.25	25.92	8.065	
1860	7.96	25.46	8.071	
1861	7.85	25.67	8.038	
1862	7.56	25.17	7.984	
1863	8.11		7.991	
1864	7.98		7.968	
1865	8.18		7.975	
1866	8.29		8.004	
1867	8.44		8.072	
1868	8.25		8.087	
1869	8.43		8.105	
1870	8.2		8.129	
1871	8.12		8.156	

Figure 3: Temperatures with missing values highlighted in red

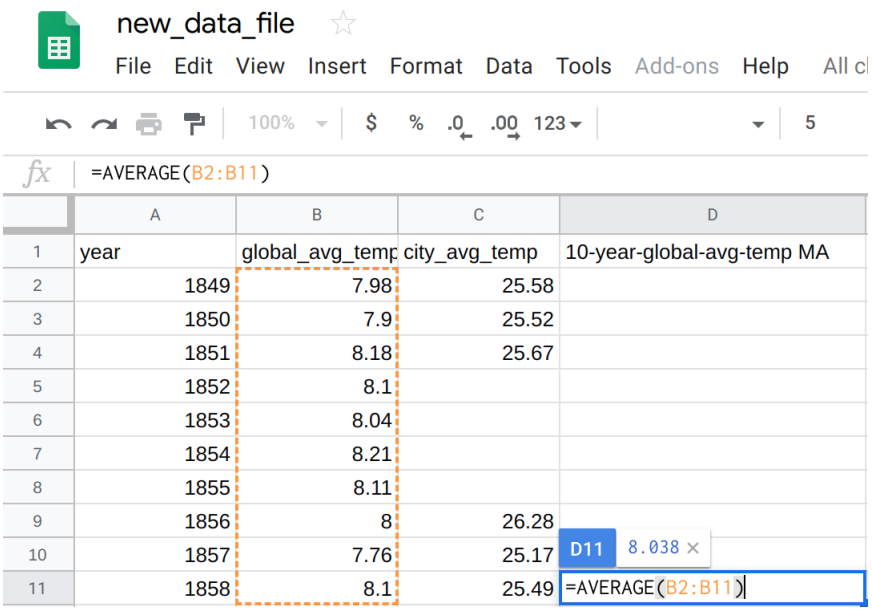


Figure 4: Process to calculate 10-year moving average

Line chart

The preliminary work we did above, helped us prepare data that we will be plotted. Hence, we have consistent and high quality data. In this part of our work, we created a line chart in which we plotted Abidjan's temperatures 10-year moving average and the global temperatures 10-year moving average. Below, is the chart.

Comment

Considerations we made before plotting the moving average have some implications on the line charts. We can therefore notice that the city level 10-year moving average line chart starts from the year **1882** while the global one start from the the year **1849**. Thus, the observations we will make in the next section will take into account these implications.

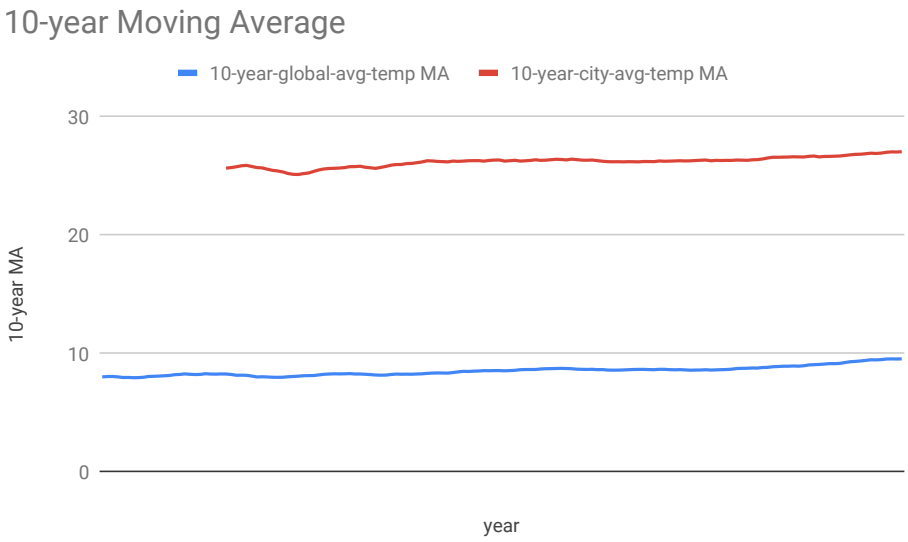


Figure 5: 10-year Moving average

Observations

In this section, we will make observations regarding the trends depicted in the line chart above 5.

- From 1849 to 2013, the global temperature of the earth varied between **7,968** and **9,556**. From 1882 to 2013, in Abidjan, temperatures varied between 25,119 and 27,036.

> **Conclusion**
> Abidjan is hotter on average compared to the global average.

- The global temperature of the earth has increased steadily since **1916**. Indeed, it rised from **8.26** in 1916, to **9.556** in 2013. Abidjan faced the same situation since **1895**. The temperature rised from **25.133** in 1895 to **27.036** in 2013.

	Temperature variation (1916 - 2013)
Global	$9.556 - 8.26 = 1.296$
Abidjan	$27.036 - 25,962 = 1.074$

Conclusion

Between 1916 and 2013, the world warmed up more than Abidjan regarding the temperature variation.

- From 1913 to 2013, the global temperature of the earth varied between **8.189** and **9,556**.

Conclusion

Globally, the world is getting hotter. Over the last few hundred years the trend is consistent since the variation is **1.367**.

- We calculated the 2-year moving variation of the global level data and the city level data over the last past ten years (2003-2013). Assuming T_i is the moving average temperature of the year i and $T_{(i,j)} = T_i - T_j$, the moving variation temperature between i and j. We summed up the variations for each level of data. For the global level data we got **0.2981**. For the city level data we got **0.58**.

Conclusion

Abidjan warmed up faster on average compared to the global average between 2003 and 2013.