

## Outline Workflow

- Step 1 – Extracting Data from the database

Filtering Data with SQL. My hometown is Hanover (Germany). First listed all german cities in city\_list. Filtered city\_data to display only data of Berlin, Munich and Hamburg. saved the Data as a .csv file.

Displayed Data of the global temperature progress. Saved the data as a .csv file

```
SELECT *
```

```
FROM city_list
```

```
WHERE lower(country) = 'germany';
```

```
SELECT *
```

```
FROM city_data
```

```
WHERE LOWER(city) = 'munich'; /* or 'berlin' or 'hamburg' */
```

```
SELECT *
```

```
FROM global_data;
```

- Step 2 – NaN Check

Checked with Python/Pandas for NaN values and interpolated linear to fill NaN. (Dats of 1746-1749 are missing)

- Step 3 – Calculate rolling/moving Average

Calculated the moving average in 10 years intervals with pandas rolling method:

```
import pandas as pd

TEMP_DATA = {'berlin': 'berlin.csv',
             'global': 'global.csv',
             'hamburg': 'hamburg.csv',
             'munich': 'munich.csv'}

for city in TEMP_DATA:
    df = pd.read_csv(TEMP_DATA[city])
    if pd.isna(df['avg_temp']).any() == True:
        df['avg_temp'].interpolate(method='linear', inplace=True)
    df['avg_5_years'] = df.loc[:, 'avg_temp'].rolling(window=5).mean()
    df['avg_10_years'] = df.loc[:, 'avg_temp'].rolling(window=10).mean()
    excel_name = city + '.xlsx'
    df.to_excel(excel_name)
```

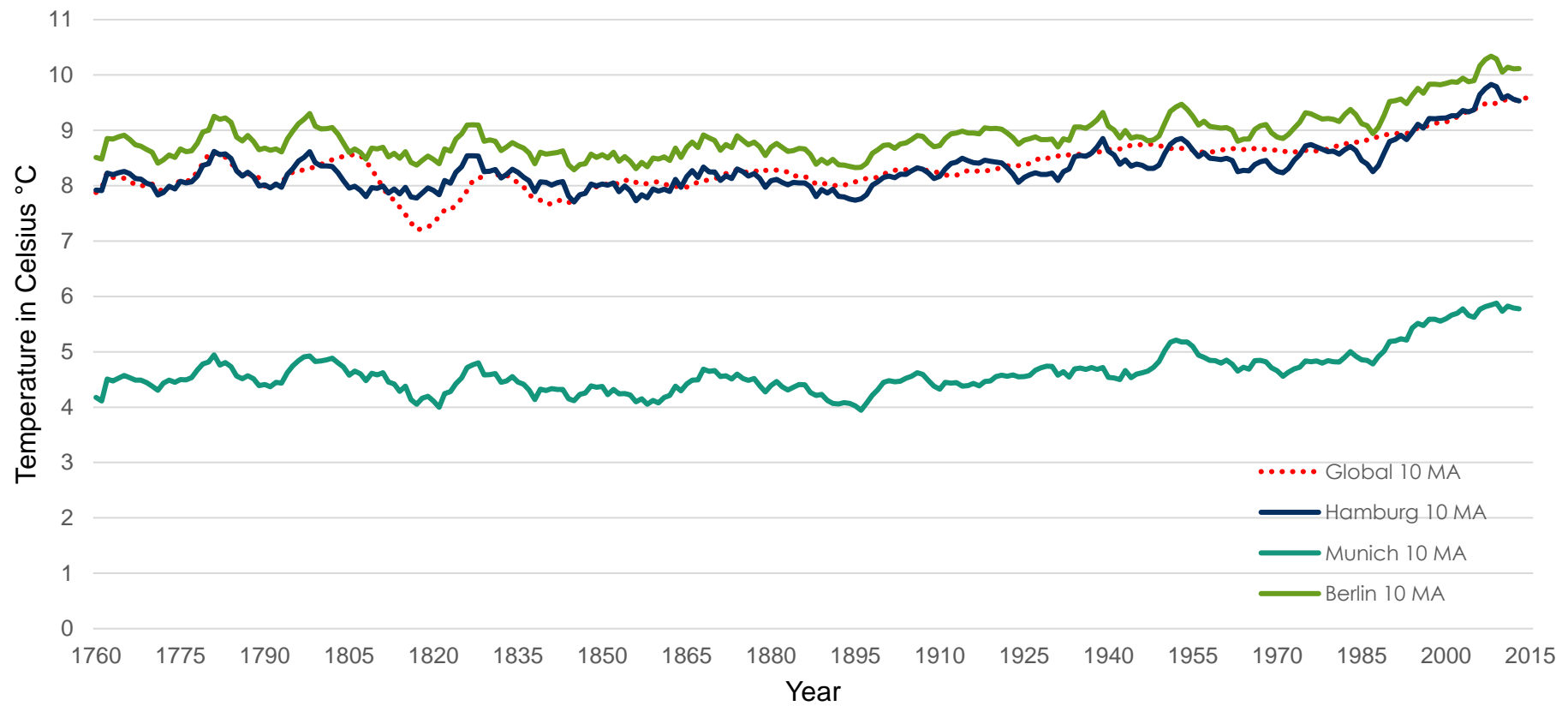
- Step 4 – exported new Dataframe to excel

My matplotlib knowledge is not good enough, that's why I exported the Data to excel

- Step 5 – Visualization Data with Excel as Line chart

First looked at my Data cause the global data starts at 1750 and the city data of Germany starts at 1743. For a better comparison I only displayed the data from 1960 to 2015 of my moving average

Temperature Progress - German Cities and Global Devolpement from 1760 - 2015



## Observation

- In Comparison to Hamburg and Berlin the temperature average of Munich is much lower. It's about 4 °C lower than the global average
- All lines of the cities and the global average shows that the temperature average increases over the years about 2 °C. This development is too much for the ecosystems (global warming → more weather extremes)
- The temperature development in Hamburg and Berlin are nearly similar and corresponding the global temperature course
- In the mid-20<sup>th</sup> century the dramatic effect of human emissions on the climate started
- The years before the temperature average fluctuate between 8-9 °C (Berlin and Hamburg)