Climate Trends

Hamburg, Germany vs. Alexandria, Egypt vs. The World

Moving average: 4-year, 10-year, 30-year

Data Wrangling Part 1: SQL

Data were extracted from PostgreSQL:

1) Finding the closest city to where I live:

```
SELECT *
FROM city_list
WHERE city_list.country = 'Germany’
```

2) Gathering data for Hamburg:

```
SELECT *
FROM city_data
WHERE city_data.city = 'Hamburg’
```

3) Gathering global data:

```
SELECT *
FROM global_data
```

4) Gathering data for Alexandria, Egypt:

```
SELECT *
FROM city_data
WHERE city = 'Alexandria' AND country = 'Egypt'
```

Each table was exported as a .csv file.

Data Wrangling Part 2: Python Pandas

Opening .csv-files in Excel causes problems with floating-point numbers, therefore files were transformed into .tsv-files with pandas:

1) The .csv files were read into pandas dataframes:

```
import pandas as pd

global_df = pd.read_csv('results_global.csv')
hamburg_df = pd.read_csv('results_Hamburg.csv‘)
alexandria_df = pd.read_csv('results_Alexandria.csv‘)
```

2) The df-s were exported with tab as delimiter:

```
global_df.to_csv('pd_global', index=False, sep ='\t‘)
hamburg_df.to_csv('pd_hamburg', index=False, sep ='\t‘)
alexandria_df.to_csv('pd_alexandria', index=False, sep ='\t')
```

Calculating moving averages in Excel

The periods were 4 years, 10 years, and 30 years. The period of 30 years is conventionally used to illustrate long-term weather trends[1] and the other two periods demonstrate a short-term and a medium-term trend, respectively.

The formulas used were as follows:

- 4-year bar:

=AVERAGE(B2:B5)

- 10-year bar:

=AVERAGE(B2:B11)

- 30-year bar:

=AVERAGE(B2:B31)

Calculating correlations between moving averages for Hamburg, Alexandria, and the world in Excel

The basic formula for a correlation coefficient in Excel is:

=CORREL(array1;array2)

1 https://en.wikipedia.org/wiki/Climate

4-year moving average	Global	Hamburg, Germany
Global		
Hamburg, Germany	0.7	
Alexandria, Egypt	0.93	0.57

10-year moving average	Global	Hamburg, Germany
Global		
Hamburg, Germany	0.87	
Alexandria, Egypt	0.96	0.79

30-year moving average	Global	Hamburg, Germany
Global		
Hamburg, Germany	0.96	
Alexandria, Egypt	0.99	0.93

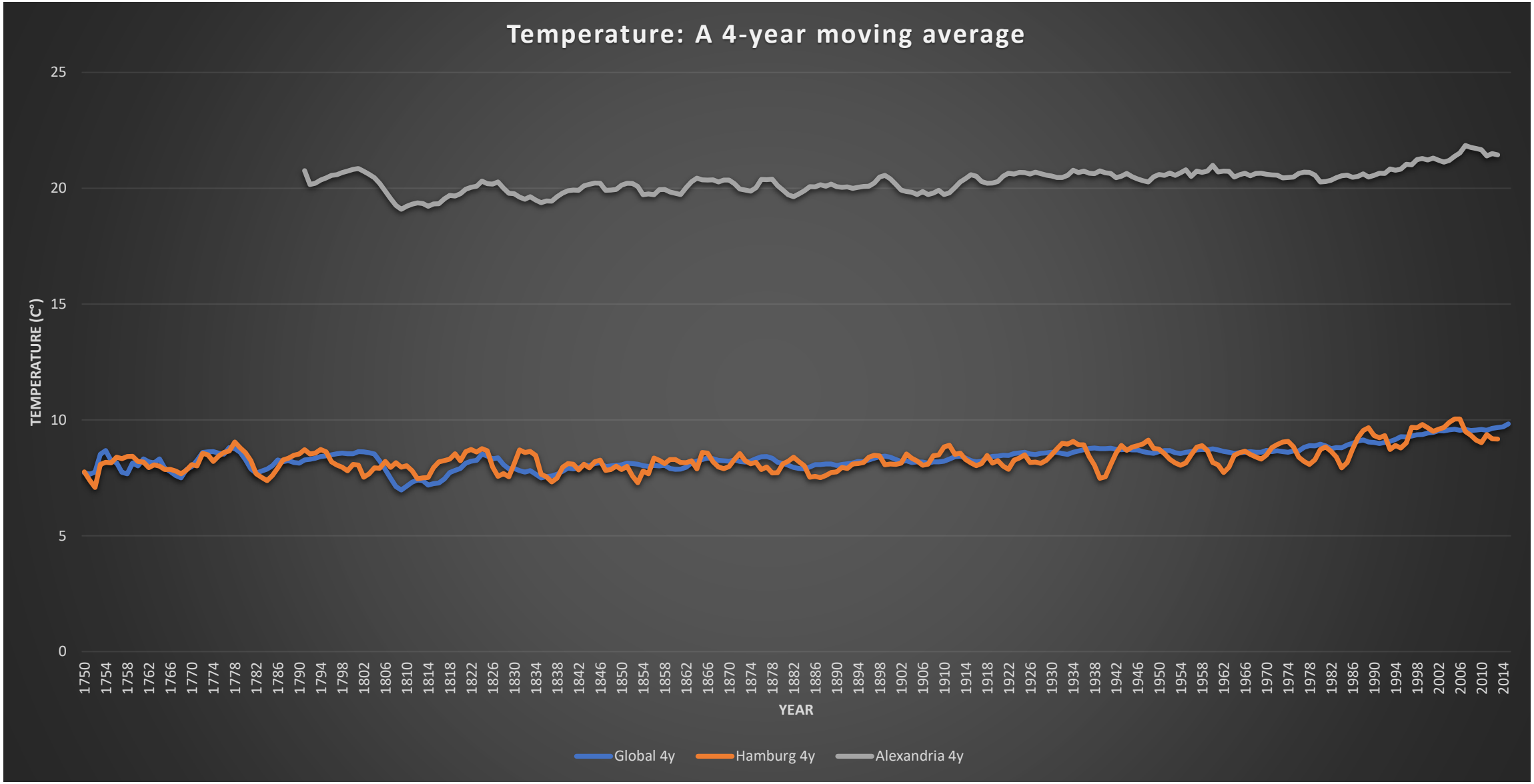
Graphing the 4-year, 10-year, and 30-year trends for Hamburg, Alexandria, and the world in Excel

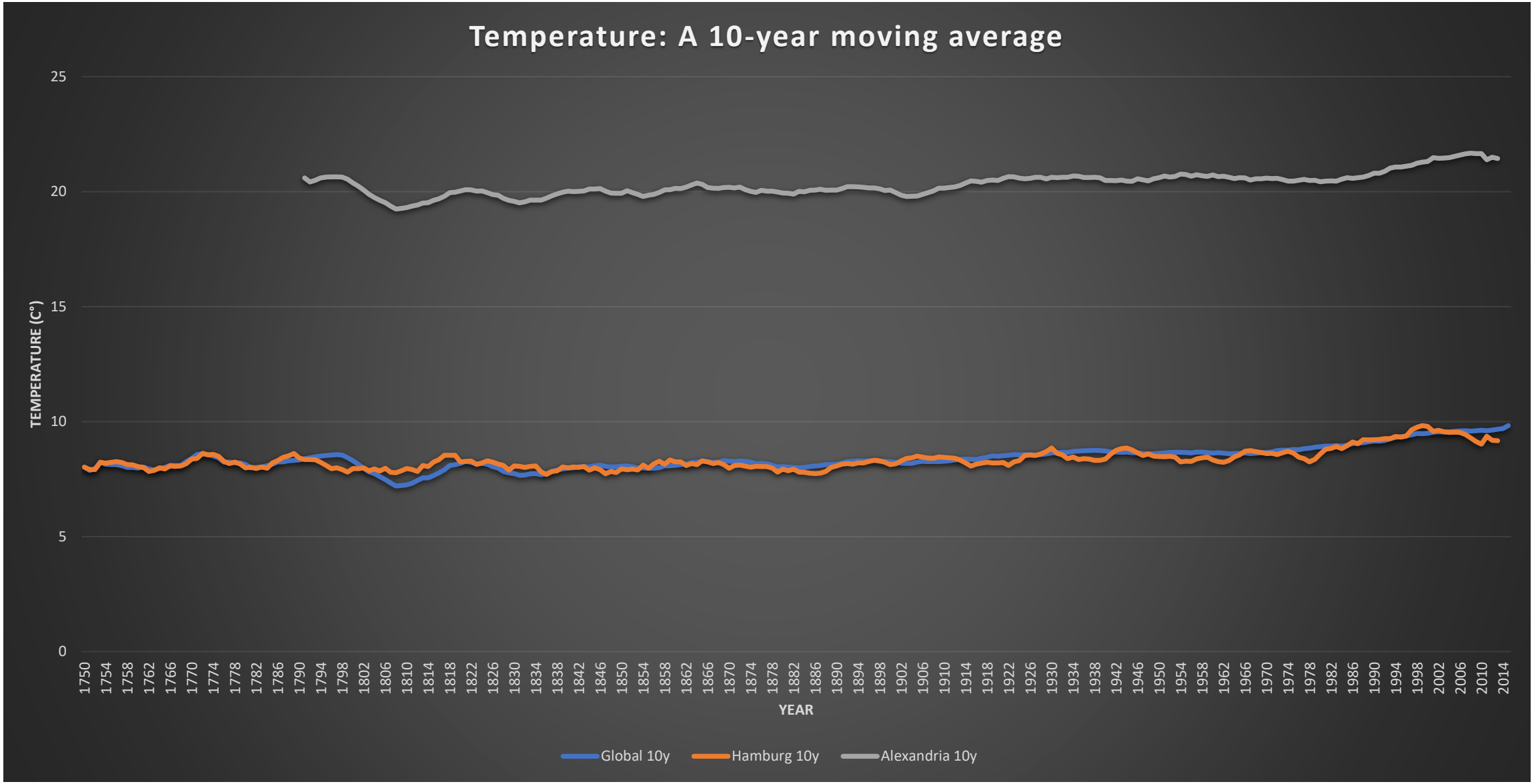
The moving averages were plotted as lines with the years on the x-axis.

Observations

1) As expected, the curves fluctuate the most for the shortest period, less for the medium-long period and least of all for the long-term period. This is reflected in the correlation coefficients between Hamburg and Alexandria, which show an obviously stronger relationship when comparing a 4-year, a 10-year, and a 30-year moving average subsequently.
2) An event known as „the year without summer“ (1816) [2] is noticeable as a dip in the curves for all periods, but it is the clearest in the curve of the 10-year moving average. The dip is less expressed for Hamburg, possibly due to the prevalence of cloudy weather.
3) The long-term curve for Hamburg is almost identical with the global curve; the curve for Alexandria is approximately 12 degrees above the average global trend.
4) Since approximately the 1930s, the 4-year trend for Hamburg shows larger amplitudes, while the curve for Alexandria for the same period shows smaller amplitudes.
5) Looking at the 30-year moving average, there seems to be a clear positive increment for the 20th century, which continues into the 21st century, although the data for the last 30 years are not complete.

2 https://en.wikipedia.org/wiki/Year_Without_a_Summer


Temperature: A 4-year moving average
TEMPERATURE (C°)
25
20
15
10
5
0
1750 1754 1758 1762 1766 1770 1774 1778 1782 1786 1790 1794 1798 1802 1806 1810 1814 1818 1822 1826 1830 1834 1838 1842 1846 1850 1854 1858 1862 1866 1870 1874 1878 1882 1886 1890 1894 1898 1902 1906 1910 1914 1918 1922 1926 1930 1934 1938 1942 1946 1950 1954 1958 1962 1966 1970 1974 1978 1982 1986 1990 1994 1998 2002 2006 2010 2014
YEAR
Global 4y
Hamburg 4y
Alexandria 4y


Temperature: A 10-year moving average
25
20
15
10
5
0
TEMPERATURE (C°)
1750
1754
1758
1762
1766
1770
1774
1778
1782
1786
1790
1794
1798
1802
1806
1810
1814
1818
1822
1826
1830
1834
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1906
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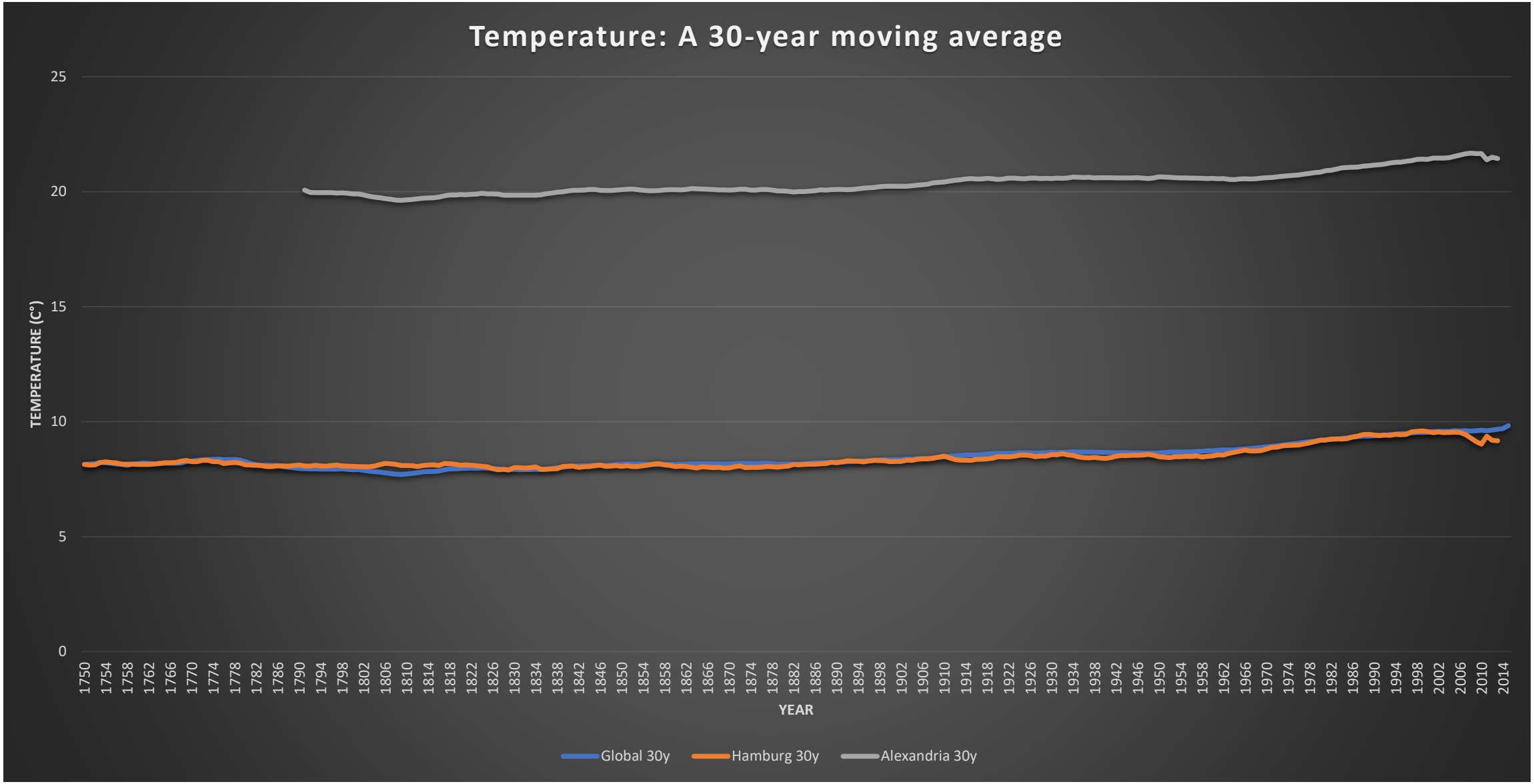
1922
1926
1930
1934
1938
1942
1946
1950
1954
1958
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
YEAR
Global 10y
Hamburg 10y
Alexandria 10y


Temperature: A 30-year moving average
25
20
15
10
5
0
TEMPERATURE (C°)
1750
1754
1758
1762
1766
1770
1774
1778
1782
1786
1790
1794
1798
1802
1806
1810
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1934
1938
1942
1946
1950
1954
1958
1962
1966
1970
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2002
2006
2010
2014
YEAR
Global 30y
Hamburg 30y
Alexandria 30y