Outline

I used SQL to access data from the database then downloaded the data as a CSV and opened in MS Excel. I calculated 3 different moving averages, the 7-year, 10-year, and 50-year to see different granularity of trends in the data.

Extracting data from the database

To explore the database, I used the following SQL queries:

```
SELECT *
FROM city_data
```

Figure 1 Query used to explore city_data table.

```
SELECT *
FROM city_list
```

Figure 2 Query used to explore city_list table.

```
SELECT *
FROM global_data
```

Figure 3 Query used to explore global_data table.

I ran these queries separately and downloaded the data after running each query to have a copy of the raw data. The "*" in SQL is read as 'all' and will pull all the columns from the table so you can view all the information in it.

The nearest major city to me is Fort Worth, Texas. To explore the data, I used the following query:

```
SELECT *
FROM city_list as cl
JOIN city_data as cd
  ON cd.city = cl.city
WHERE cl.city = 'Fort Worth'
```

Figure 4 Query to explore data for the city of Fort Worth, Texas

After looking at the data from this query I noticed that the average temperature for Fort Worth was only available form the years 1820 to 2013, whereas the global average temperature has data from 1750 to 2015. To standardize my data, I had to limit the global data to only show data for the same years between 1820 and 2013. I used the following query to achieve this:

```
SELECT *
FROM global_data
WHERE year >= 1820 AND year < 2014
```

Figure 5 Query used to select data from 1820 and 2013 to match data with Fort Worth dataset

To select London, United Kingdom I had to add a new joining clause. This is done to distinguish it from London, Canada. The following query is used:

```
SELECT *
FROM city_list as cl
JOIN city_data as cd
  ON cd.city = cl.city AND cd.country = cl.country
WHERE cd.country = 'United Kingdom' AND cd.city = 'London'
```

Figure 6 Query used to explore data for the city of London, United Kingdom

To select data for Oslo, Norway the following query was used:

```
SELECT *
FROM city_list as cl
JOIN city_data as cd
  ON cd.city = cl.city AND cd.country = cl.country
WHERE cd.city = 'Oslo' AND year >= 1750
```

Figure 7 Query used to explore data for the city of Oslo, Norway.

Calculating the Moving Averages

I calculated the 7-year moving average by adding the first 7 data points for the average temperature for the year and divided this total by 7.

plugging this in excel looked like this:

```
=AVERAGE(F2:F8)
```

Figure 8 Excel equation used to calculate the 7-year moving average.

I plugged this into the cell that starts at the 7th data set and on my excel sheet this is cell G8. I then dragged this down to the bottom of the data set to apply to the rest of the data.

To generate the graph, I selected the year column and this newly derived 7 year moving average column and then selected the *insert* tab on the ribbon. Then I selected the *Recommended Charts* button which automatically suggests using a line chart which works great to visualize this data!

I repeated this same process to find the 10-year moving average and 50 year moving average. I chose 10 year and 50 year semi-arbitrarily; with 10 years representing a decade and 50 years half a century. Additionally, the 7-year moving average was used as it can be used to show changes on a slightly smaller timeframe which allows it to be more sensitive to data.

Charts

There are 3 sets of charts provided. The first two have 4 charts in them, starting with the raw data then moving to the right is the 7-year moving average (MA), and the third chart is the 10-year moving average and finally the 50-year moving average chart.

The first set charted in with a blue line graph is for the global annual average temperature data. The second set charted in an orange line graph is using the Fort Worth average annual temperature.

The second was standardized by dividing the average annual temperature of Fort Worth by the global annual average temperature. This way the graphs generated do not have units for the y-axis plot and rather the numbers seen show fort forth temperatures as a multiple of the global average temperature.

The third data set has 2 charts for Oslo Norway.

Observations

Set 1 – Global Average Temperature

Note that the vertical axis starts from 7 °c to 10 °c. this is done to zoom into the data to show changes more visually.

In this set we can see 2 general trends. The first one is that the average global temperature would fluctuate wildly up until around the 1840s. The second trend we see is that after the 1840s the temperature has been steadily climbing upwards.

In the 1750s the average temperature was around 8°c and by 2015 the average temperature was around 9.5°c. this gives an average temperature increase of 0.00566°c per year.

Some interesting facts to know are as follows:

American revolution started in the 1820s.
Third agricultural revolution began in the 1930s.
Deforestation became a concern in the 1950s.
Environmentalism began in the 1960s.

Set 2 – Fort Worth Average temperature vs Global Average Temperature

Note that the vertical axis starts from 1.9x to 2.3x.

The trend we see is that on average the temperature for Fort Worth has been dropping relative to the global average.

Set-3 – Oslo Norway Average temperature vs Global Temperature

Note that the vertical axis starts from 0.15x to 0.45x.

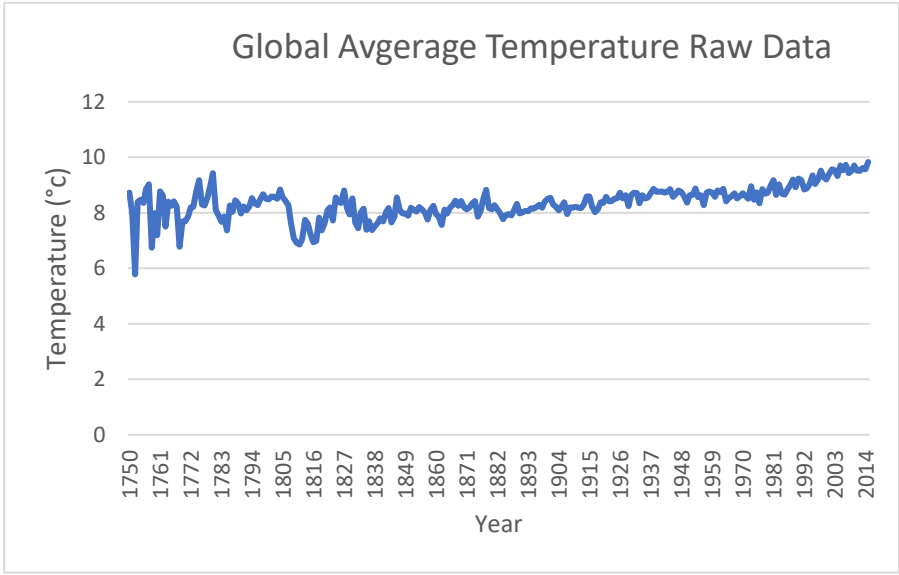
The trend we see for Oslo is that the average temperature is rising relative to the global average.

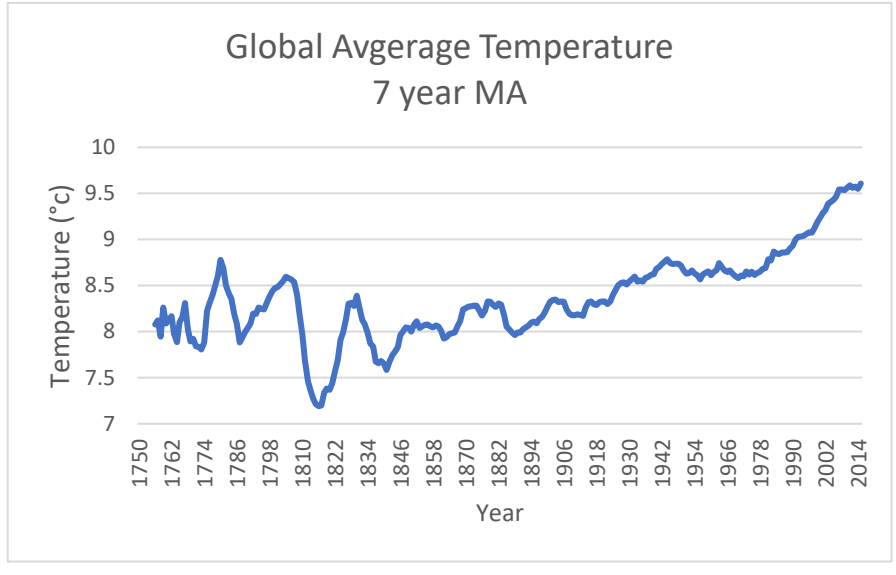
Set-4 Shanghai China Average temperature vs Global Temperature

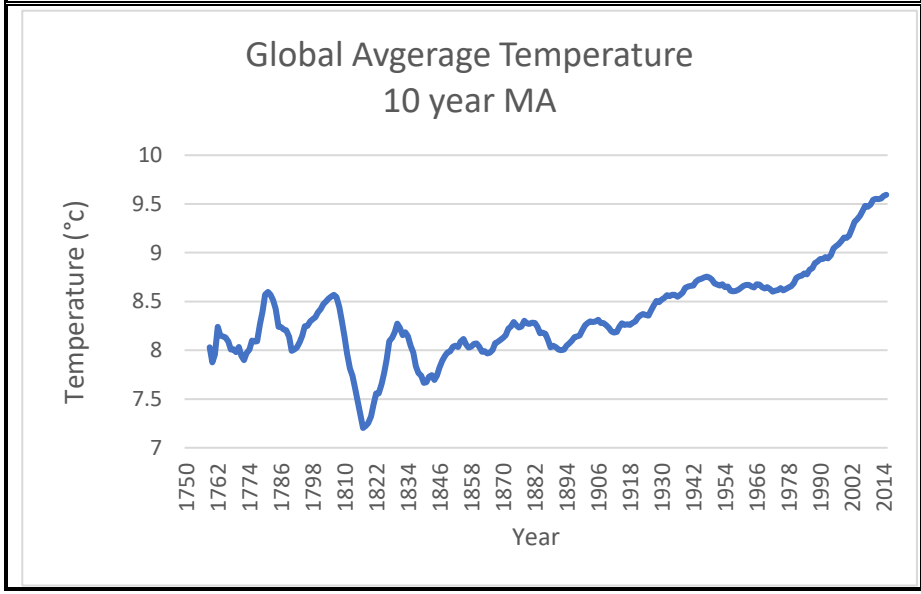
Note that the vertical axis starts from 1.75x to 2x.

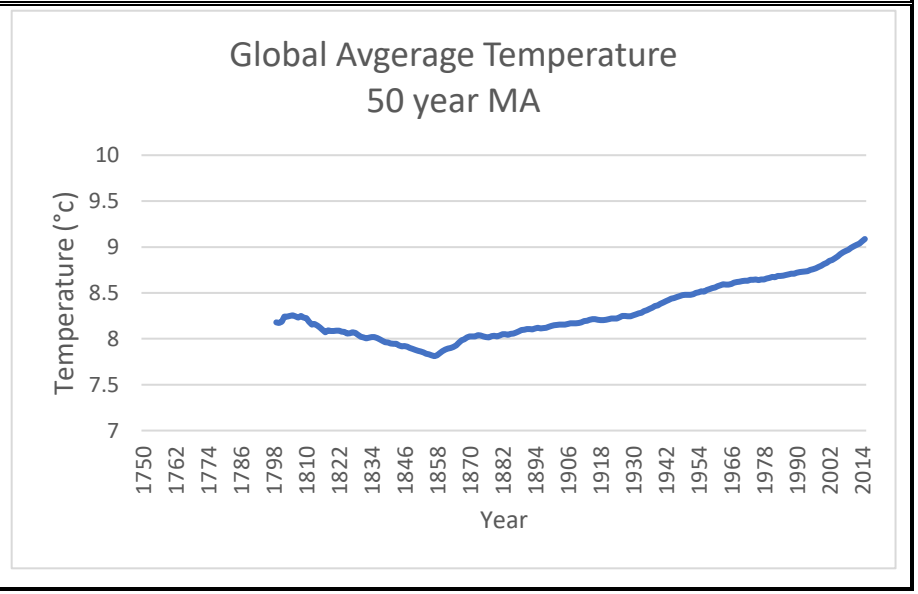
We can see the trend is that the average temperature in Shanghai is dropping relative to the global average.

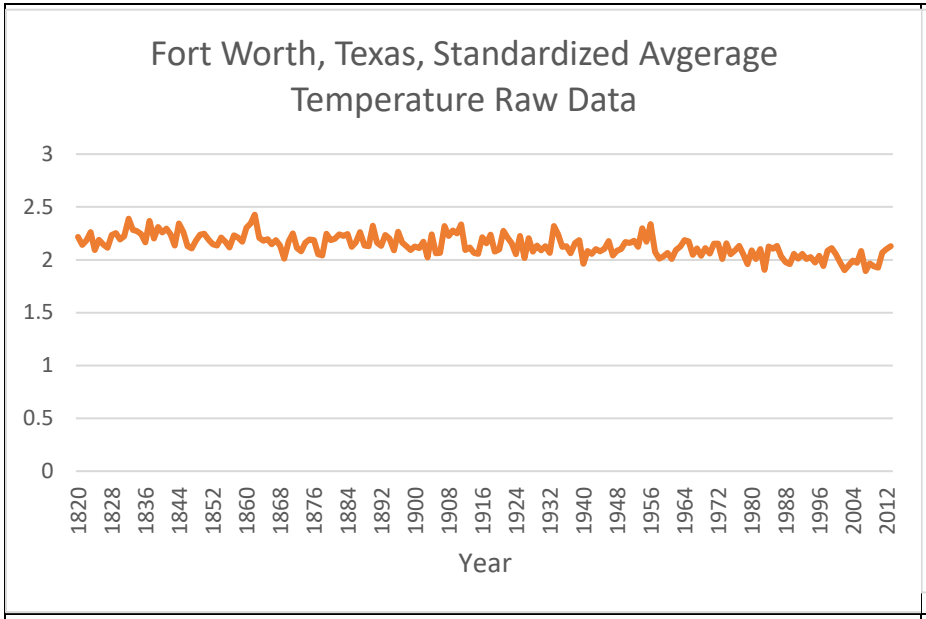
This can lead to assume that areas closer to the north and south poles are more affected by global warming than areas closer to the tropics and equator.

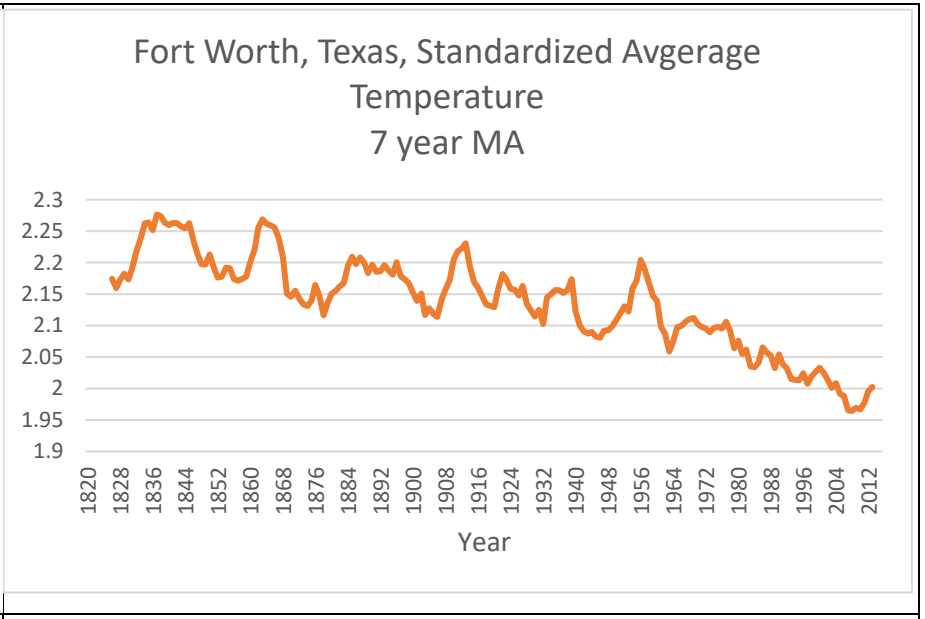

Global Avgerage Temperature Raw Data
Temperature (°c)
Year

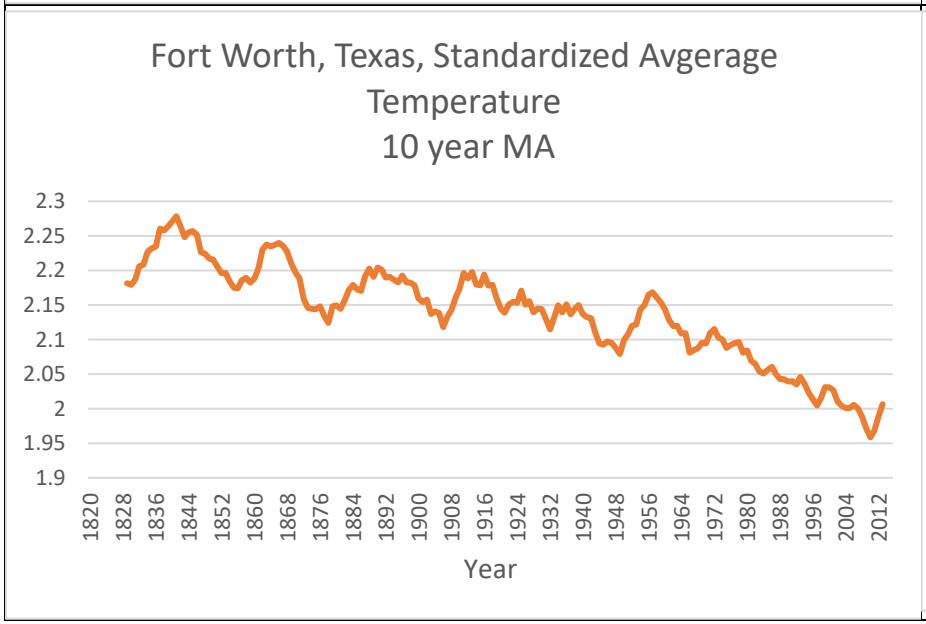

Global Avgerage Temperature
7 year MA
Temperature (°c)
Year

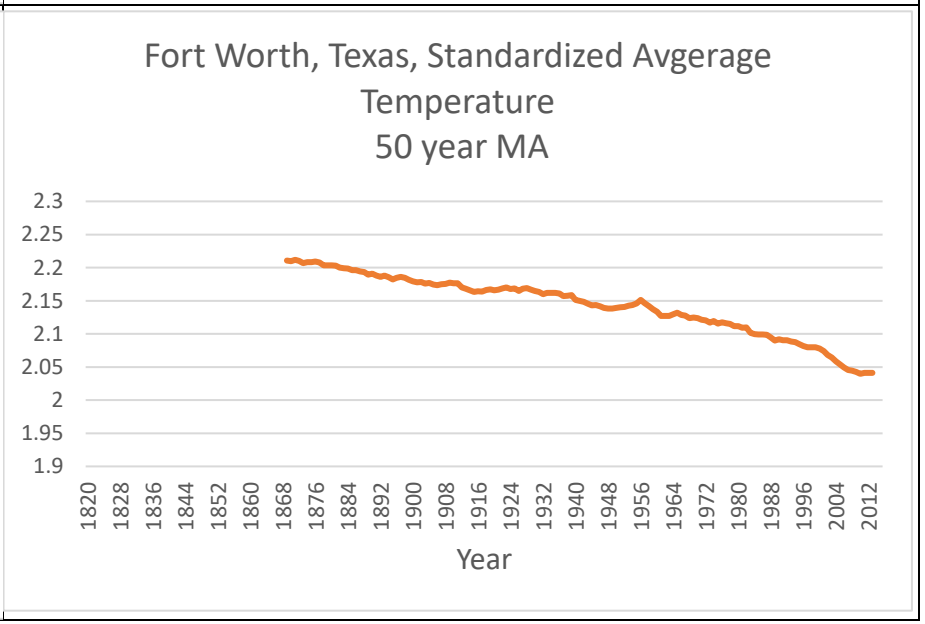

Global Avgerage Temperature
10 year MA
Temperature (°c)
Year

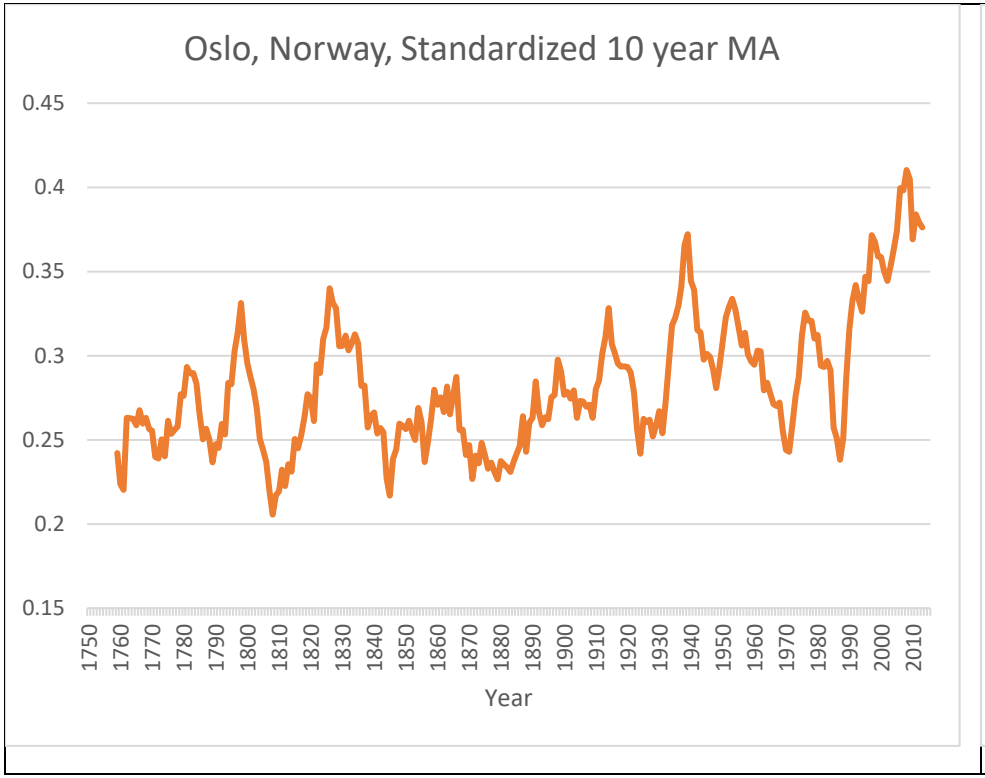

Global Avgerage Temperature
50 year MA
Temperature (°c)
Year

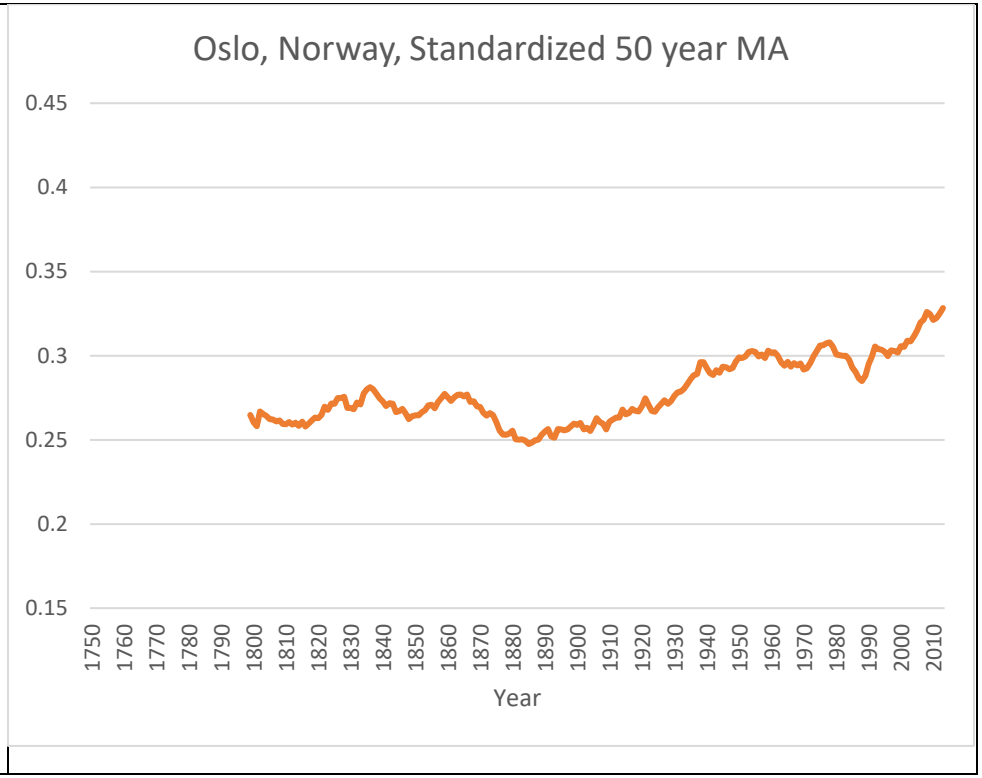

Fort Worth, Texas, Standardized Avgerage Temperature Raw Data
3
2.5
2
1.5
1
0.5
0
1820 1828 1836 1844 1852 1860 1868 1876 1884 1892 1900 1908 1916 1924 1932 1940 1948 1956 1964 1972 1980 1988 1996 2004 2012
Year

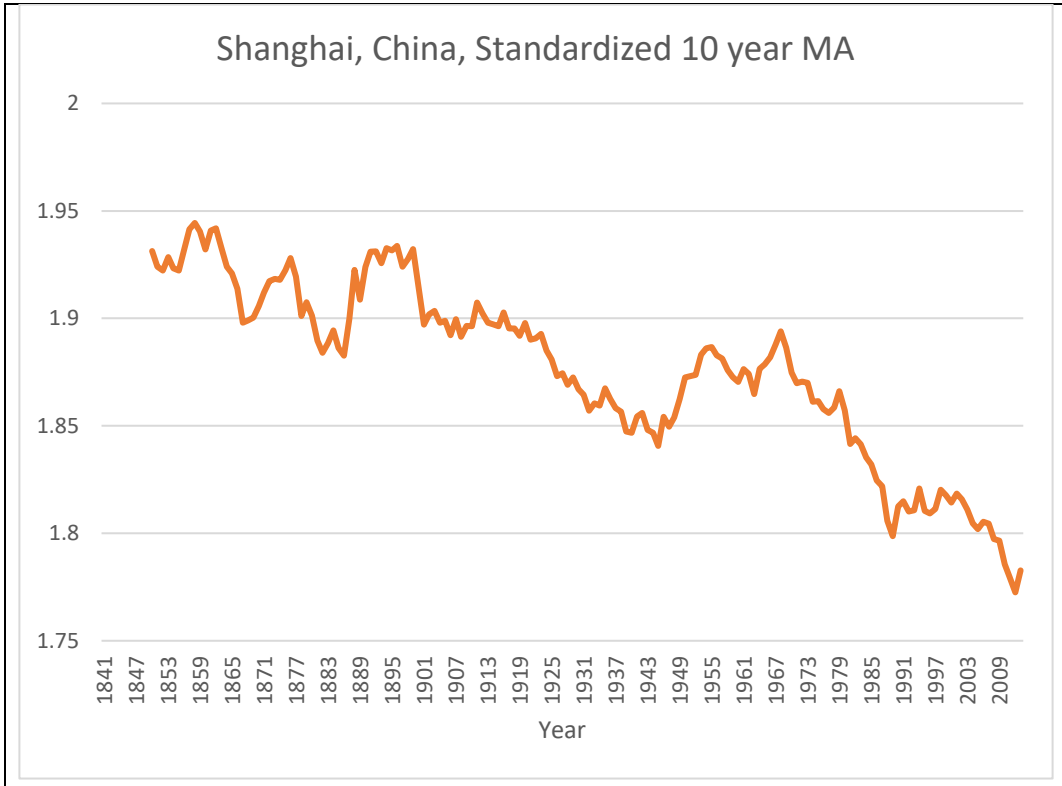

Fort Worth, Texas, Standardized Avgerage Temperature 7 year MA
2.3
2.25
2.2
2.15
2.1
2.05
2
1.95
1.9
1820 1828 1836 1844 1852 1860 1868 1876 1884 1892 1900 1908 1916 1924 1932 1940 1948 1956 1964 1972 1980 1988 1996 2004 2012
Year

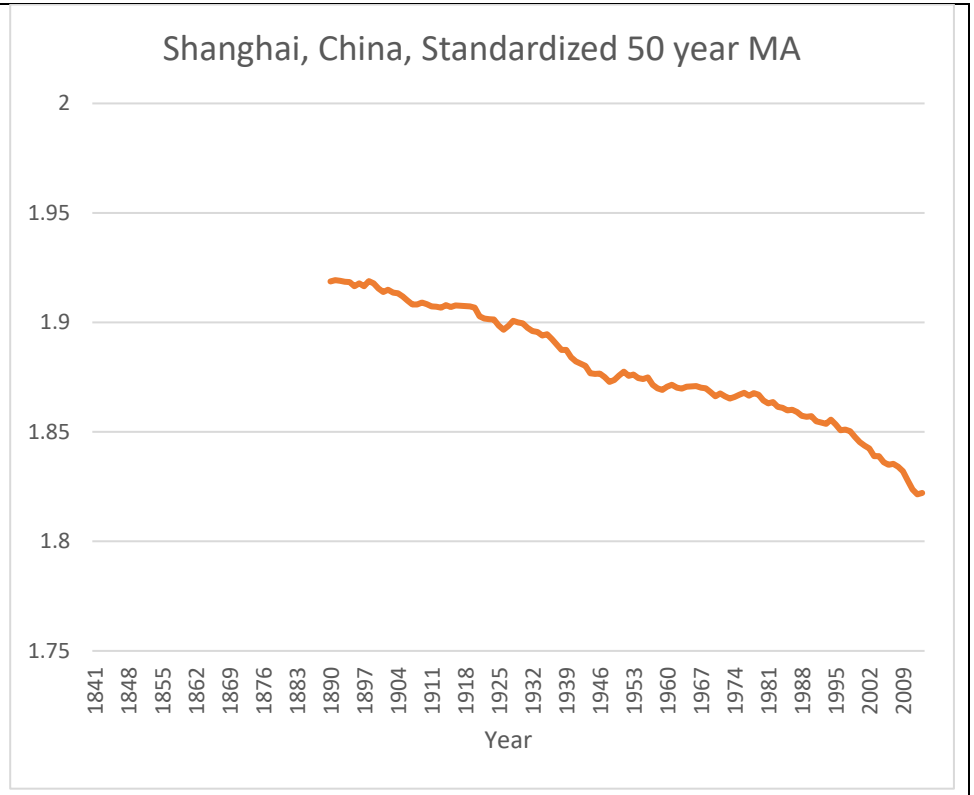

Fort Worth, Texas, Standardized Avgerage Temperature 10 year MA
2.3
2.25
2.2
2.15
2.1
2.05
2
1.95
1.9
1820 1828 1836 1844 1852 1860 1868 1876 1884 1892 1900 1908 1916 1924 1932 1940 1948 1956 1964 1972 1980 1988 1996 2004 2012
Year


Fort Worth, Texas, Standardized Avgerage Temperature 50 year MA
2.3
2.25
2.2
2.15
2.1
2.05
2
1.95
1.9
1820 1828 1836 1844 1852 1860 1868 1876 1884 1892 1900 1908 1916 1924 1932 1940 1948 1956 1964 1972 1980 1988 1996 2004 2012
Year


Oslo, Norway, Standardized 10 year MA
0.45
0.4
0.35
0.3
0.25
0.2
0.15
1750
1760
1770
1780
1790
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year


Oslo, Norway, Standardized 50 year MA
0.45
0.4
0.35
0.3
0.25
0.2
0.15
1750
1760
1770
1780
1790
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year


Shanghai, China, Standardized 10 year MA
2
1.95
1.9
1.85
1.8
1.75
1841
1847
1853
1859
1865
1871
1877
1883
1889
1895
1901
1907
1913
1919
1925
1931
1937
1943
1949
1955
1961
1967
1973
1979
1985
1991
1997
2003
2009
Year


Shanghai, China, Standardized 50 year MA
2
1.95
1.9
1.85
1.8
1.75
1841
1848
1855
1862
1869
1876
1883
1890
1897
1904
1911
1918
1925
1932
1939
1946
1953
1960
1967
1974
1981
1988
1995
2002
2009
Year