Udacity - Data Science Nanodegree

Explore Weather Trends

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The SQL query used to extract the data:

City Data (my location is Bethel, CT):

```
SELECT *
FROM city_data
WHERE city = 'New York';
```

Global Data:

```
SELECT *
FROM global_data;
```

All other data manipulation is done in this notebook with Python 3.

In [4]:

```
#libraries
%matplotlib inline
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from IPython import display
from scipy import stats
import warnings
warnings.filterwarnings('ignore')
```

In [5]:

```
#import data
city_data = pd.read_csv('city_data.csv')
global_data  = pd.read_csv('global_data.csv')
```

In [6]:

```
#preview
print("-"*15)
print (city_data.info())
print("-"*15)
print (global_data.info())
print("-"*15)
```

```
---------------
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 271 entries, 0 to 270
Data columns (total 4 columns):
```

```
year        271 non-null int64
city        271 non-null object
country     271 non-null object
avg_temp    266 non-null float64
dtypes: float64(1), int64(1), object(2)
memory usage: 8.5+ KB
None
---------------
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 266 entries, 0 to 265
Data columns (total 2 columns):
year        266 non-null int64
avg_temp    266 non-null float64
dtypes: float64(1), int64(1)
memory usage: 4.2 KB
None
---------------
```

In [7]:

```
#find blanks
print("-"*15)
print('null city columns:\n', city_data.isnull().sum())
print("-"*15)
print('null global columns:\n', global_data.isnull().sum())
print("-"*15)
```

```
---------------
null city columns:
 year        0
city        0
country     0
avg_temp    5
dtype: int64
---------------
null global columns:
 year        0
avg_temp    0
dtype: int64
---------------
```

In [8]:

```
#remove blanks from city_data to match row quantity in global_data
city_data.dropna(inplace=True)
```

In [9]:

```
#check
print("-"*15)
print('null city columns:\n', city_data.isnull().sum())
print("-"*15)
print (city_data.info())
print("-"*15)
```

```
---------------
null city columns:
 year        0
city        0
country     0
avg_temp    0
dtype: int64
```

```
---------------
<class 'pandas.core.frame.DataFrame'>
Int64Index: 266 entries, 0 to 270
Data columns (total 4 columns):
year        266 non-null int64
city        266 non-null object
country     266 non-null object
avg_temp    266 non-null float64
dtypes: float64(1), int64(1), object(2)
memory usage: 10.4+ KB
None
---------------
```

In [10]:

```
#calculate the moving average for both datasets
#used a 10 year average for visualization, it'll add some pronunciation to
#the differences since there's such a long span of time
city_data['MA'] = city_data['avg_temp'].rolling(10).mean()
global_data['MA'] = global_data['avg_temp'].rolling(10).mean()
city_data.head(15)
```

Out[10]:

	year	city	country	avg_temp	MA
0	1743	New York	United States	3.26	NaN
1	1744	New York	United States	11.66	NaN
2	1745	New York	United States	1.13	NaN
7	1750	New York	United States	10.07	NaN
8	1751	New York	United States	10.79	NaN
9	1752	New York	United States	2.81	NaN
10	1753	New York	United States	9.52	NaN
11	1754	New York	United States	9.88	NaN
12	1755	New York	United States	6.61	NaN
13	1756	New York	United States	9.94	7.567
14	1757	New York	United States	8.89	8.130
15	1758	New York	United States	8.15	7.779
16	1759	New York	United States	9.01	8.567
17	1760	New York	United States	7.73	8.333
18	1761	New York	United States	10.18	8.272

In [11]:

```
#check that the MA doesn't start till year 10
global_data.head(15)
```

Out[11]:

	year	avg_temp	MA
0	1750	8.72	NaN
1	1751	7.98	NaN

2	1752	5.78	NaN
3	1753	8.39	NaN
4	1754	8.47	NaN
5	1755	8.36	NaN
6	1756	8.85	NaN
7	1757	9.02	NaN
8	1758	6.74	NaN
9	1759	7.99	8.030
10	1760	7.19	7.877
11	1761	8.77	7.956
12	1762	8.61	8.239
13	1763	7.50	8.150
14	1764	8.40	8.143

In [12]:

```
#remove the first 9 rows without moving average and check
city_data.dropna(inplace=True)
global_data.dropna(inplace=True)
print("-"*15)
print('null city columns:\n', city_data.isnull().sum())
print("-"*15)
print('null global columns:\n', global_data.isnull().sum())
print("-"*15)
```

```
---------------
null city columns:
 year        0
city        0
country     0
avg_temp    0
MA          0
dtype: int64
---------------
null global columns:
 year        0
avg_temp    0
MA          0
dtype: int64
---------------
```

In [13]:

```
#check for matching row counts
print("-"*15)
print (city_data.info())
print("-"*15)
print (global_data.info())
print("-"*15)
```

```
---------------
<class 'pandas.core.frame.DataFrame'>
```

```
Int64Index: 257 entries, 13 to 270
Data columns (total 5 columns):
year        257 non-null int64
city        257 non-null object
country     257 non-null object
avg_temp    257 non-null float64
MA          257 non-null float64
dtypes: float64(2), int64(1), object(2)
memory usage: 12.0+ KB
None
----------------
<class 'pandas.core.frame.DataFrame'>
Int64Index: 257 entries, 9 to 265
Data columns (total 3 columns):
year        257 non-null int64
avg_temp    257 non-null float64
MA          257 non-null float64
dtypes: float64(2), int64(1)
memory usage: 8.0 KB
None
----------------
```

In [14]:

```
#format data for merging, drop the city and country columns
city_data.drop(['city', 'country'], axis = 1, inplace = True)
#check
city_data.head(5)
```

Out[14]:

	year	avg_temp	MA
13	1756	9.94	7.567
14	1757	8.89	8.130
15	1758	8.15	7.779
16	1759	9.01	8.567
17	1760	7.73	8.333

In [15]:

```
#merge the dataframes with 'years' as the key column
new_data = pd.merge(city_data, global_data, how = 'inner', on = 'year')
#check
new_data.head(5)
```

Out[15]:

	year	avg_temp_x	MA_x	avg_temp_y	MA_y
0	1759	9.01	8.567	7.99	8.030
1	1760	7.73	8.333	7.19	7.877
2	1761	10.18	8.272	8.77	7.956
3	1762	9.55	8.946	8.61	8.239
4	1763	7.23	8.717	7.50	8.150

In [16]:

```
#rename columns for reading the graphs
new_data.rename(index=str, columns={'avg_temp_x':'City_Temp','MA_x':'City_
MA', 'avg_temp_y':'Global_Temp','MA_y':'Global_MA'}, inplace = True)
#check
new_data.head(1)
```

Out[16]:

	year	City_Temp	City_MA	Global_Temp	Global_MA
0	1759	9.01	8.567	7.99	8.03

In [17]:

```
#remove first row (starts at 1759) and select every decade
decades = new_data.iloc[1::10]
decades.head(10)
```

Out[17]:

	year	City_Temp	City_MA	Global_Temp	Global_MA
1	1760	7.73	8.333	7.19	7.877
11	1770	9.04	9.089	7.69	8.032
21	1781	9.79	8.449	8.10	8.597
31	1791	9.37	9.075	8.23	8.008
41	1801	10.00	9.394	8.59	8.423
51	1811	9.43	9.625	6.86	7.968
61	1821	8.53	8.411	8.09	7.445
71	1831	9.07	9.642	7.64	8.229
81	1841	9.00	8.790	7.69	7.671
91	1851	9.26	9.220	8.18	8.037

In [18]:

```
#year 1780 is missing from dataset,
#format to exclude years <1780 for consistancy
#there's still plenty of data
decades = decades.iloc[2::]
decades.head(10)
```

Out[18]:

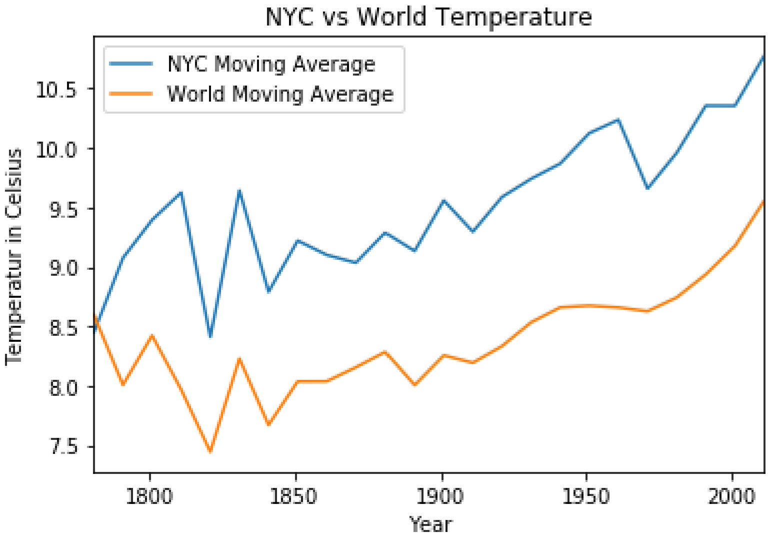
	year	City_Temp	City_MA	Global_Temp	Global_MA
21	1781	9.79	8.449	8.10	8.597
31	1791	9.37	9.075	8.23	8.008
41	1801	10.00	9.394	8.59	8.423
51	1811	9.43	9.625	6.86	7.968
61	1821	8.53	8.411	8.09	7.445
71	1831	9.07	9.642	7.64	8.229
81	1841	9.00	8.790	7.69	7.671
91	1851	9.26	9.220	8.18	8.037
101	1861	9.47	9.100	7.85	8.038
111	1871	8.94	9.034	8.12	8.156

In [19]:

```
#plot the City and Global MA vs year
#decades.plot('year', 'City_MA', color='red', label = 'NYC Average')
#plt.xlabel('Year')
#plt.ylabel("Temperatur in Celsius")
#decades.plot('year', 'Global_MA', color='blue', label = 'World Average')
#plt.xlabel('Year')
#plt.ylabel("Temperatur in Celsius")
```

In [20]:

```
decades.drop(['City_Temp', 'Global_Temp'], axis = 1, inplace = True)
plot = decades.plot.line(x = 'year', sharey = ['City_MA', 'Global_MA'], title = 'NYC vs World Temperature', legend = True)
plt.xlabel('Year')
plt.ylabel("Temperatur in Celsius")
L = plt.legend()
L.get_texts()[0].set_text('NYC Moving Average')
L.get_texts()[1].set_text('World Moving Average')
```



Oberservations:

1. Both graphs overall show an upward trend in average temperature across the two centuries, although NYC is increasing more quickly.
2. The average increase of about one degree celsius in NYC vs the World as we reach the 21st century is possibly due to the nature of a metropolitan city, containing industries and vast populations of people. Where the World average is going to contain data from less dense and thriving areas, especially in the nineteenth century. This difference would probably be even more prevalent if the World data included remote, rural, or otherwise less industrialized regions. I would have to assume the World data was made up of each majority city that was available prior to starting.
3. The first row of data is the 10 year moving average from 1791 - 1801. The two graphs start at approximately the same location, about 8.5 degrees celsius. It's noticable from there though NYC is in an overall upward trend where the world seems to be ending a reversal (if it were possible to have a millenium graph), dropping down to 7.5 degrees celcius around 1825 when NYC was around 8.5, but then starting to follow the same trend as NYC.
4. Both the World and NYC average temperature is increasing more quickly over the last half century. As the world's popululation is continuing to increase and with the lack of any

serious effort to stop green-house gases and overall pollution, this trend is likely to continue in the future.