Exploring Weather Trend

Background

In this project, I analyze local and global temperature data and compare the temperature trends in Tianjin, a north-east city in China to overall global temperature trends.

Data Extraction

write SQL query to extract city and global weather data.

```
1.  ## quick look into the city_list table
2.  select * from city_list limit 10;
3.
4.  ## find out the city list for China
5.  select * from city_list where lower(country) like '%china%';
6.
7.  ## double check if beijing is in the list
8.  select * from city_list where lower(city) like '%beijing%';
9.
10. ## get weather data for Tianjian, which is the closest city to Beijing, from city data table
11. select * from city_data where lower(city) like '%tianjin' order by year;
12.
13. ## get weather data from global data table
14. select * from global_data order by year;
15.
```

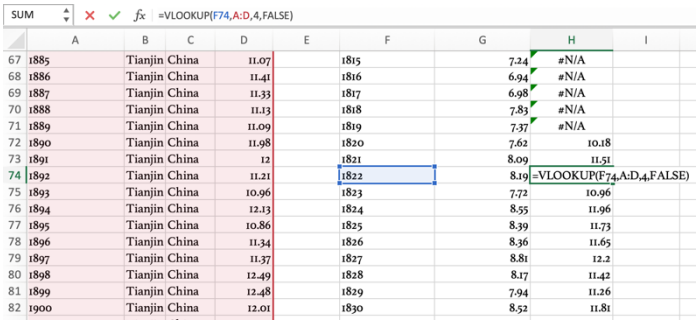
The city I'm currently living in is Beijing, which is not in the city table, so in this project I will choose Tianjin instead.

Data Analysis

After checking the data size (within 1000 lines of data), I decide to use Excel for data analysis.

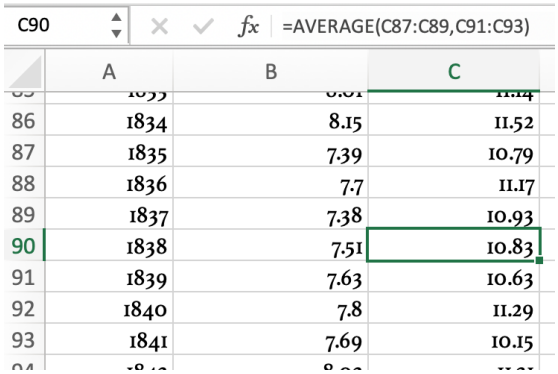
- **Preliminary Analysis**

1. Firstly, I combine the city and global data together using v-look up function.

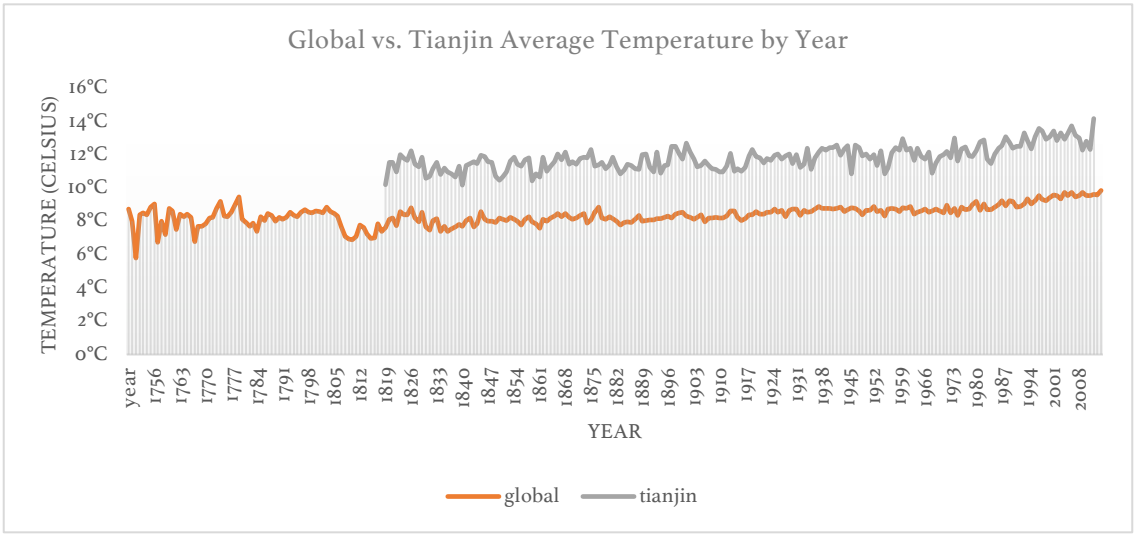


	A	B	C	D	E	F	G	H	I
67	1885	Tianjin	China	11.07		1815	7.24	#N/A	
68	1886	Tianjin	China	11.41		1816	6.94	#N/A	
69	1887	Tianjin	China	11.33		1817	6.98	#N/A	
70	1888	Tianjin	China	11.13		1818	7.83	#N/A	
71	1889	Tianjin	China	11.09		1819	7.37	#N/A	
72	1890	Tianjin	China	11.98		1820	7.62	10.18	
73	1891	Tianjin	China	12		1821	8.09	11.51	
74	1892	Tianjin	China	11.21		1822	8.19	=VLOOKUP(F74,A:D,4,FALSE)	
75	1893	Tianjin	China	10.96		1823	7.72	10.96	
76	1894	Tianjin	China	12.13		1824	8.55	11.96	
77	1895	Tianjin	China	10.86		1825	8.39	11.73	
78	1896	Tianjin	China	11.34		1826	8.36	11.65	
79	1897	Tianjin	China	11.37		1827	8.81	12.2	
80	1898	Tianjin	China	12.49		1828	8.17	11.42	
81	1899	Tianjin	China	12.48		1829	7.94	11.26	
82	1900	Tianjin	China	12.01		1830	8.52	11.81	

2. The years are continuous for both Tianjin and global temperatures. Average temperatures for Tianjin starting from 1820 to 2013 and there is one missing value for year 1838, and the average temperatures globally starts from 1750 to 2015. I use average temperature for year 1835-1837 and year 1839-41 to handle missing value in city temperature data.



3. Plot all the data points to understand the overall data trends. Both city and global temperatures have increased over the years, however, the data fluctuations make it hard to identify clear trends. The global average temperature reaches the lowest 5.78°C in 1752 and the highest 9.83°C in 2015, and in Tianjin the lowest is 10.15°C in 1841, while the highest is 14.14°C in 2013.



- **Moving Average**

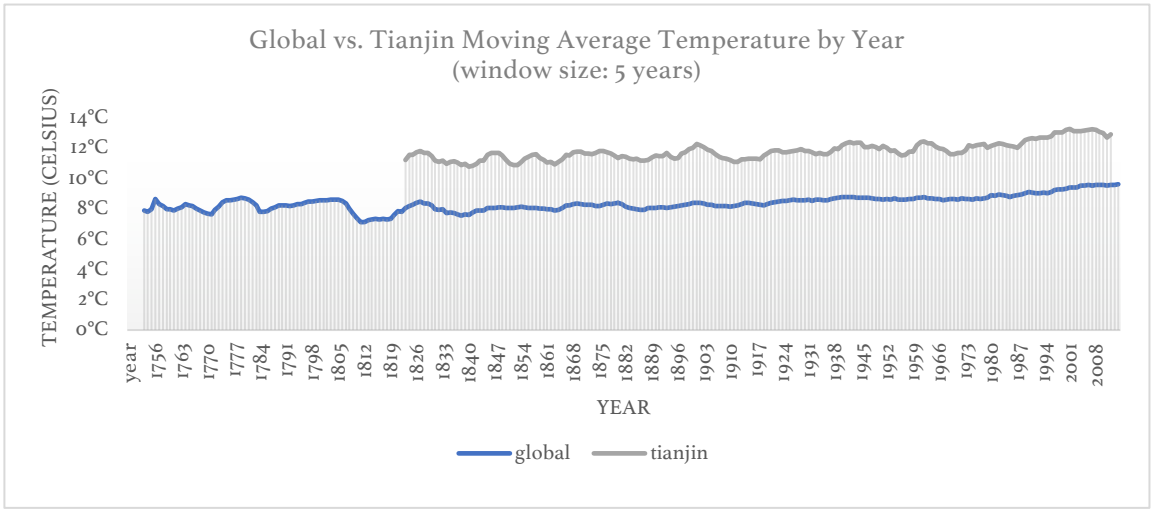
1. There are around 260 lines of data, to visualize the data trends more clearly, I calculate the moving averages with window size 5 and window size 10. Because average temperatures for Tianjin start from year 1720, we can see 10 years moving averages for both regions start from year 1829.

F11 =AVERAGE(B2:B11)

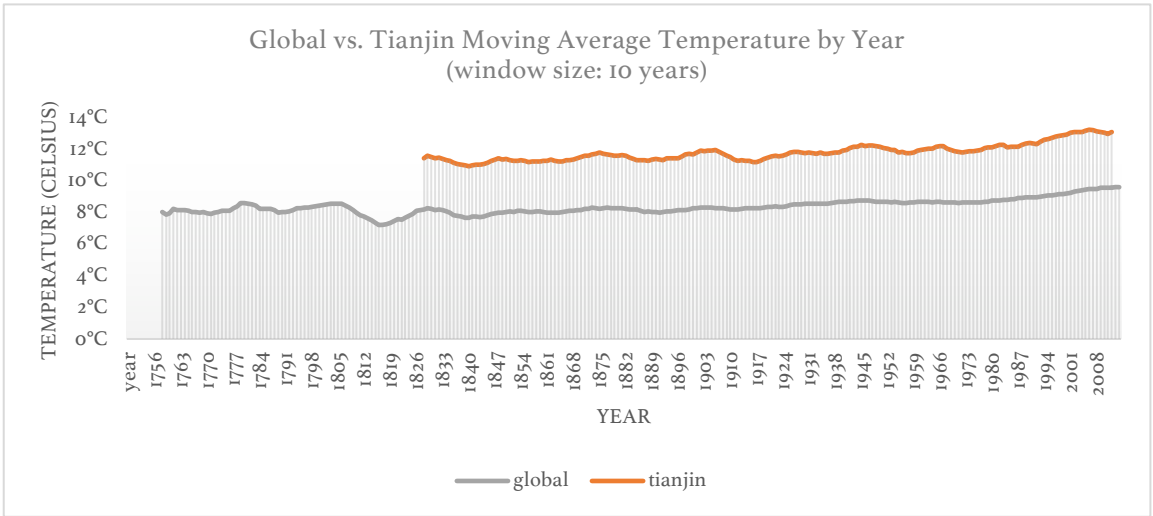
	A	B	C	D	E	F	G	H
1	year	avg_temp_global	avg_temp_city	MA5_global	MA5_city	MA10_global	MA10_city	
2	1750	8.72	#N/A					
3	1751	7.98	#N/A					
4	1752	5.78	#N/A					
5	1753	8.39	#N/A					
6	1754	8.47	#N/A	7.868	#N/A			
7	1755	8.36	#N/A	7.796	#N/A			
8	1756	8.85	#N/A	7.97	#N/A			
9	1757	9.02	#N/A	8.618	#N/A			
10	1758	6.74	#N/A	8.288	#N/A			
11	1759	7.99	#N/A	8.192	#N/A	8.03	#N/A	
12	1760	7.19	#N/A	7.958	#N/A	7.877	#N/A	
13	1761	8.77	#N/A	7.942	#N/A	7.956	#N/A	
14	1762	8.61	#N/A	7.86	#N/A	8.239	#N/A	
15	1763	7.5	#N/A	8.012	#N/A	8.15	#N/A	
16	1764	8.4	#N/A	8.094	#N/A	8.143	#N/A	
17	1765	8.25	#N/A	8.306	#N/A	8.132	#N/A	
18	1766	8.41	#N/A	8.234	#N/A	8.088	#N/A	
19	1767	8.22	#N/A	8.156	#N/A	8.008	#N/A	
20	1768	6.78	#N/A	8.012	#N/A	8.012	#N/A	

2. Plot moving average for both Tianjin and global temperatures with different window sizes.

Moving average with window size 5 years:



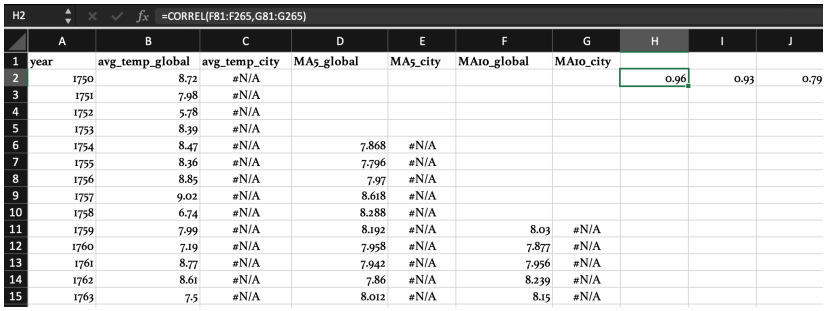
Moving average with window size 10 years:



The 10 years moving average plot show a clear view of the weather trends, that average temperatures have increased from 19 century to 21 century for both Tianjin and global. From 1829 to 2013, the global 10 years moving average temperatures have increased from 8.18°C to 9.56°C, while for Tianjin the number is from 11.44°C to 13.07°C.

- **Correlation Coefficient**

  Calculate correlation coefficient for Tianjin and global temperatures from year 1829 to 2013. The correlation coefficient for MA10_global and MA10_city is 0.96, for MA5 _global and MA5_city is 0.93 and for avg_temp_global and avg_temp_city is 0.79. The 10 years moving average temperatures for Tianjin and global are highly related.



H2 =CORREL(F81:F265,G81:G265)

	A	B	C	D	E	F	G	H	I	J
1	year	avg_temp_global	avg_temp_city	MA5_global	MA5_city	MA10_global	MA10_city			
2	1750	8.72	#N/A					0.96	0.93	0.79
3	1751	7.98	#N/A							
4	1752	5.78	#N/A							
5	1753	8.39	#N/A							
6	1754	8.47	#N/A	7.868	#N/A					
7	1755	8.36	#N/A	7.796	#N/A					
8	1756	8.85	#N/A	7.97	#N/A					
9	1757	9.02	#N/A	8.618	#N/A					
10	1758	6.74	#N/A	8.288	#N/A					
11	1759	7.99	#N/A	8.192	#N/A	8.03	#N/A			
12	1760	7.19	#N/A	7.958	#N/A	7.877	#N/A			
13	1761	8.77	#N/A	7.942	#N/A	7.956	#N/A			
14	1762	8.61	#N/A	7.86	#N/A	8.239	#N/A			
15	1763	7.5	#N/A	8.012	#N/A	8.15	#N/A			

Key Observations

- Both Tianjin and the global have gotten hotter over the last two centuries (from 1829 to 2013). The 10 years moving average temperatures for Tianjin have increased 1.63°C from 11.44°C to 13.07°C and globally the values have increased 1.38°C from 8.18°C to 9.56°C.
- Looking at the 10 years moving average temperatures from 1829 to 2013, the global temperature reaches its lowest of 7.67°C in 1840, and Tianjin temperature reaches its lowest of 10.91°C in 1841. The declines are matching in the 19 centuries.
- Looking at the 10 years moving average temperatures from 1829 to 1929, the global temperature have increased 0.31°C and Tianjin temperature have increased 0.39°C. While from 1930 to 2013, the temperature increments are three times larger. We can say that, in the last century, both Tianjin and the global have becoming hot faster.
- Although Tianjin is in general 3 to 4°C hotter than the global, their temperatures are highly related over the years. The latest year (2013 for Tianjin, 2015 for the global) are the hottest year.