Weather data analysis project

Week 5

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Objectives

-Obtain weather data from 4 cities of relatively different geo locations

-Run data through our python code and observe the data visually

-Check weather changes over the decades to verify climate change.

-Apply hypothesis testing using the paired method to forecast the trends.

-Check if COVID-19 had any direct or indirect impact on the current weather patterns

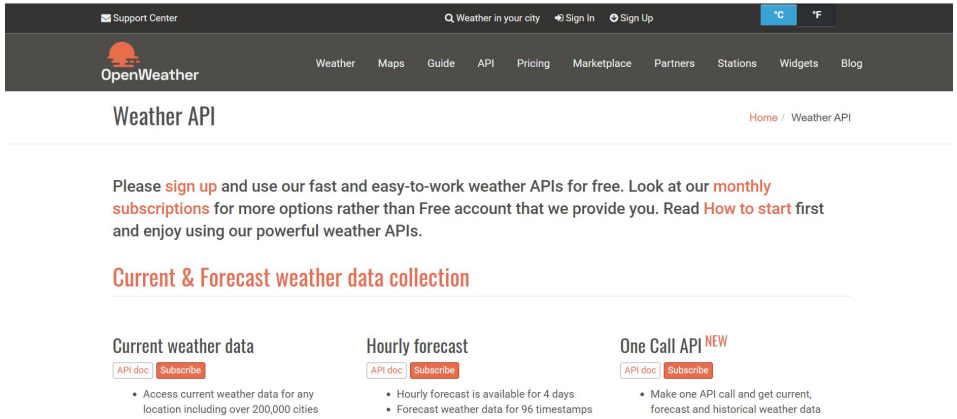
Szczecin,
Poland
Berlin,
Germany
Hotan,
China
Dhaka,
Bangladesh

Data collection

Data scraped from : ***Open weather*** API

5 cities scraped in total from 1979 to 2020 (data per hour)

- Berlin, Milan and Hotan in a first csv
- Then Dhaka and Szczecin in a second csv.



Data collection

	dt	dt_iso	timezone	city_name	lat	lon	temp	feels_like	temp_min	temp_max	...	wind_deg	rain_1h	rain_3h	snow_1h	snow_3h	clouds_all	weather_id	weather_main	weather_description	weather_icon
0	283996800	1979-01-01 00:00:00 +0000 UTC	3600	Berlin	52.520007	13.404954	-18.69	-25.24	-20.63	-18.0	...	20	NaN	NaN	NaN	NaN	20	801	Clouds	few clouds	02n
1	284000400	1979-01-01 01:00:00 +0000 UTC	3600	Berlin	52.520007	13.404954	-18.43	-24.20	-20.37	-18.0	...	20	NaN	NaN	NaN	NaN	100	804	Clouds	overcast clouds	04n
2	284004000	1979-01-01 02:00:00 +0000 UTC	3600	Berlin	52.520007	13.404954	-18.38	-24.89	-20.10	-18.0	...	360	NaN	NaN	NaN	NaN	100	804	Clouds	overcast clouds	04n
3	284007600	1979-01-01 03:00:00 +0000 UTC	3600	Berlin	52.520007	13.404954	-18.10	-24.60	-18.62	-18.0	...	10	NaN	NaN	NaN	NaN	75	803	Clouds	broken clouds	04n
4	284011200	1979-01-01 04:00:00 +0000 UTC	3600	Berlin	52.520007	13.404954	-18.02	-24.86	-18.17	-18.0	...	330	NaN	NaN	NaN	NaN	68	803	Clouds	broken clouds	04n

```
df.shape
```

```
(1829805, 31)
```

```
df.columns
```

```
Index(['dt', 'dt_iso', 'timezone', 'city_name', 'lat', 'lon', 'temp',
       'feels_like', 'temp_min', 'temp_max', 'pressure', 'sea_level',
       'grnd_level', 'humidity', 'wind_speed', 'wind_deg', 'rain_1h',
       'rain_3h', 'snow_1h', 'snow_3h', 'clouds_all', 'weather_id',
       'weather_main', 'weather_description', 'weather_icon', 'Date', 'day',
       'month', 'year', 'delta_T', 'decade'],
      dtype='object')
```

Workflow

Data cleaning

- Dropping useless columns
- Creating a “date” column, followed by “month” and “year”
- Creating a column “decade” based on the years
- Creating a “delta” column (max-min temperature difference)

Data aggregation

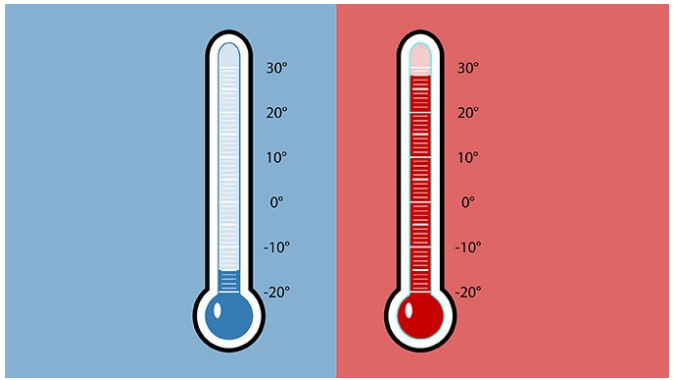
- Splitting the cleaned dataframe per city
- Grouping and creating multiple dataframes per month, decade for our analysis

Results & data visualisation

- Creation of 6 line plots and a correlation matrix
- Saving the clean dataframe and graphs obtained in an output folder

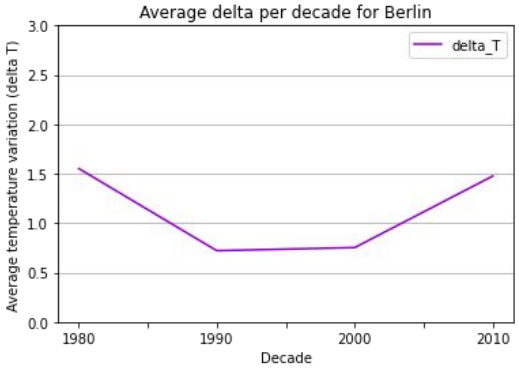
Results

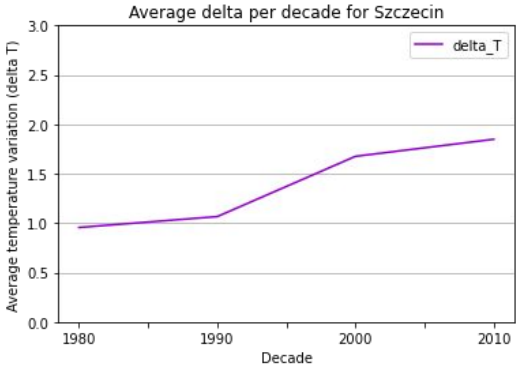
1. Average variation temperature per decade
2. Average minimum and maximum temperature per decade
3. Average temperature per decade
4. Average temperature per month per decade
5. Average minimum and maximum temperature per month per decade
6. Correlation between temperature parameters
7. Checking recent temperatures

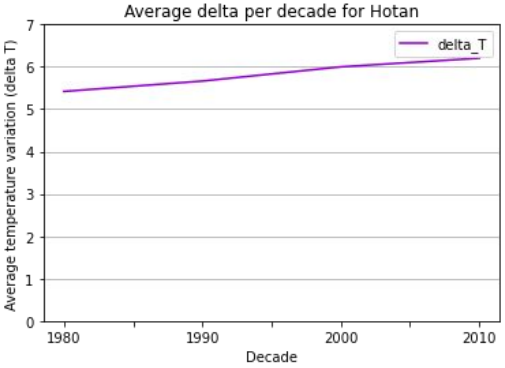


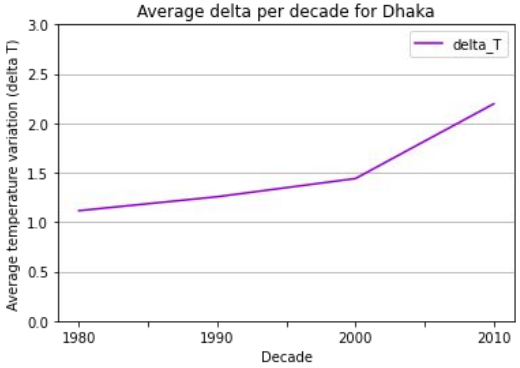
1. Average temperature variation per city

1. Impact of the variation of temperature depends on the geological conditions
2. Increase in the variation over the decades
3. Change in temperature in Berlin







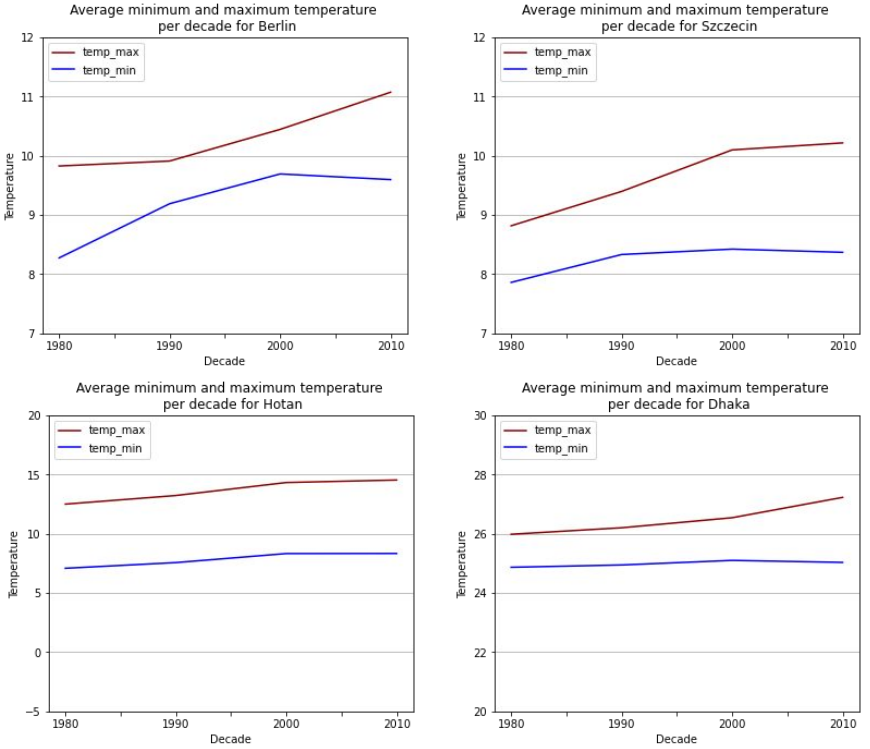


2. Average min and max temperatures per decade

Temperature increase don't respect the same shape
Exemple Berlin :

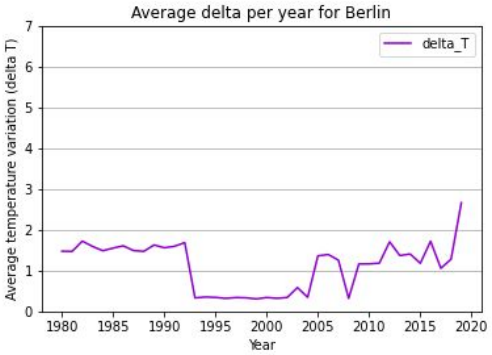
The min temperature in the last decade tends to stabilize against the max temperature continues to increase.

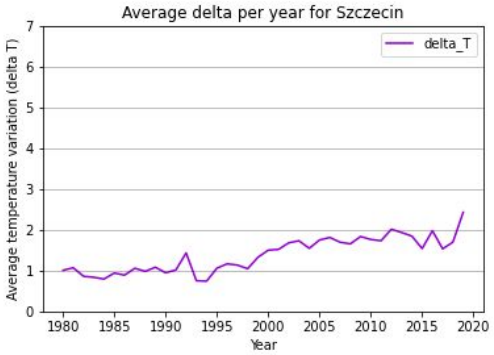
The increase in the minimum of the temperature can explain the appearance of the previous graph (shape of delta T)

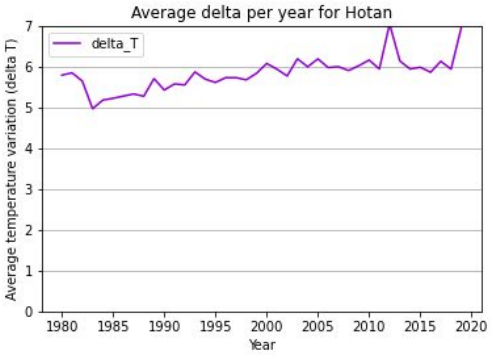


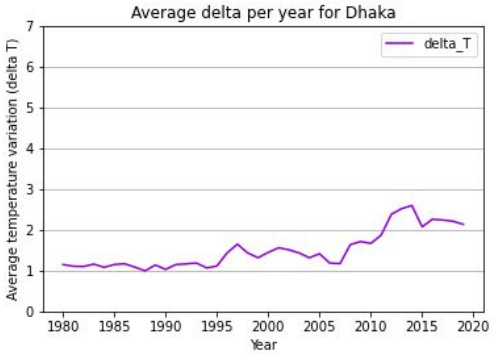
1. Average temperature variation per year

1. Impact of the variation of temperature depends on the geological conditions
2. Increase in the variation over the decades
3. Change in temperature in Berlin









2. Average min and max temperatures per year

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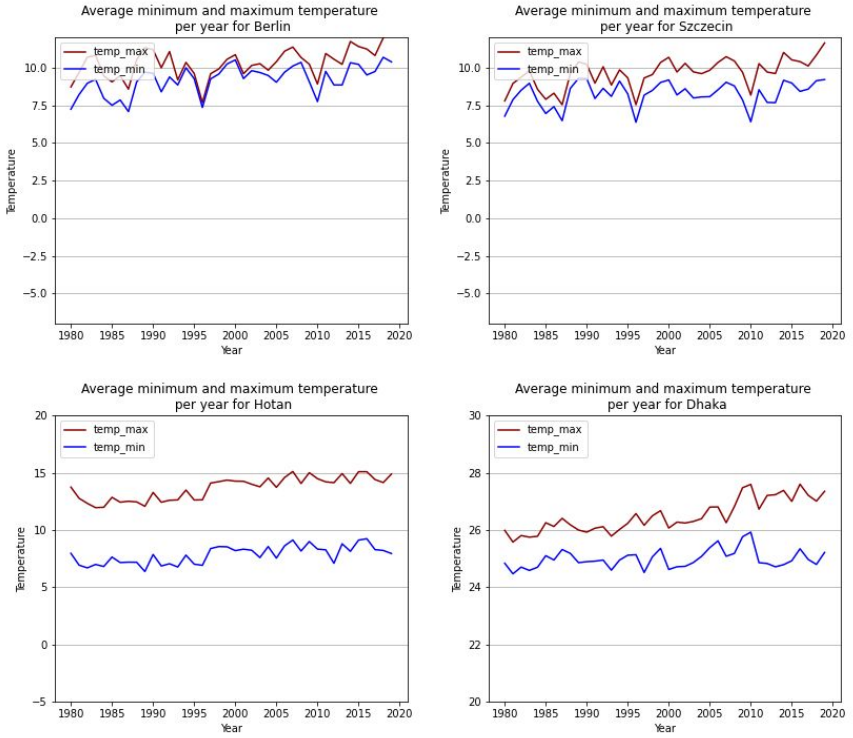
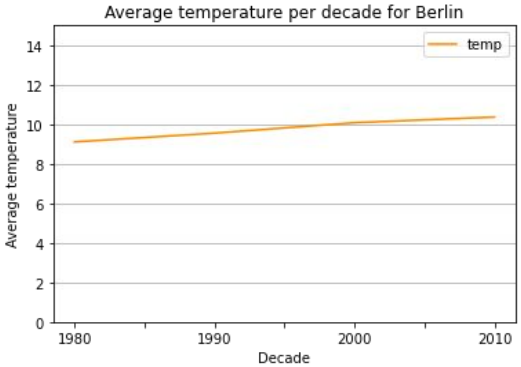
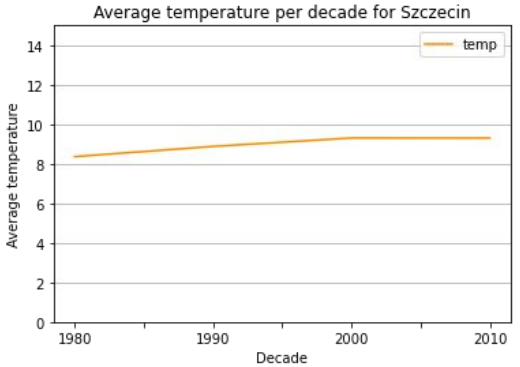
The increase in the minimum of the temperature can explain the appearance of the previous graph (shape of delta T)

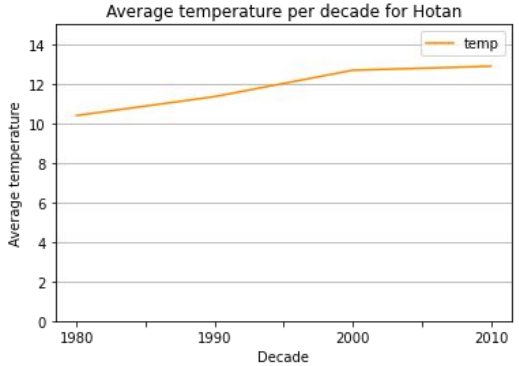


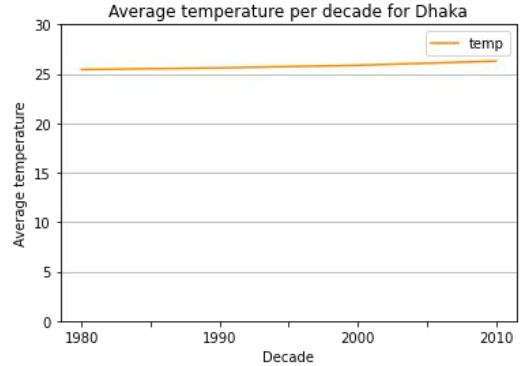
3. Average temperatures per decade

- The average temperature per decade increased in all 4 cities since 1980.



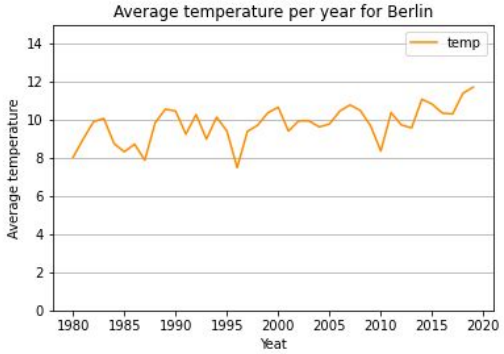


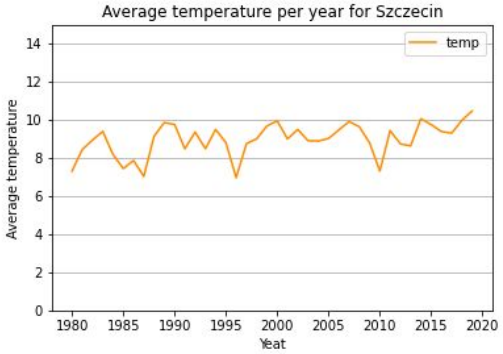


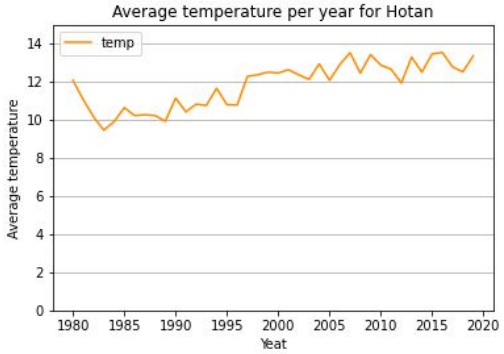


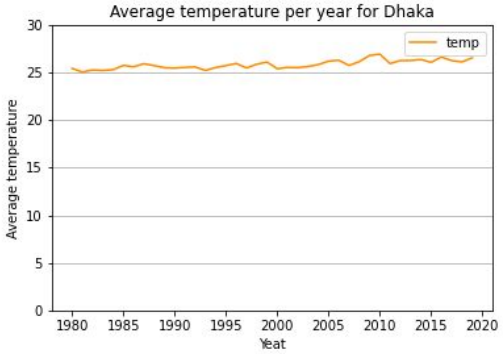
3. Average temperatures per year

- The average temperature per year increased in all 4 cities since 1980.



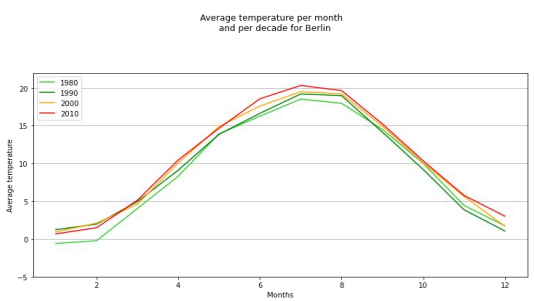


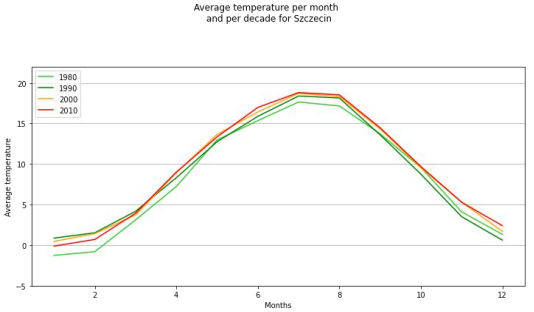


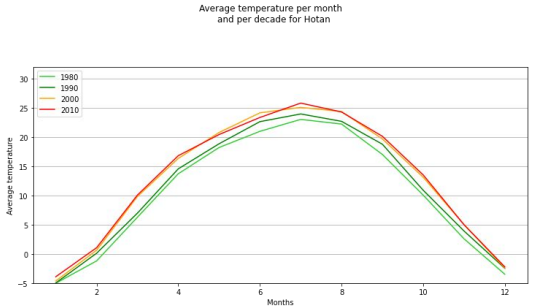


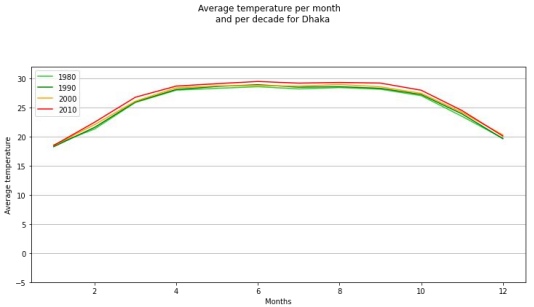
4. Average temperatures per months per decade

- The increase affects all month and season of the year
- Difference between Dhaka and Berlin

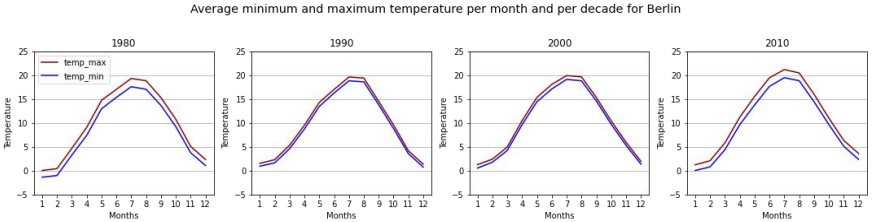


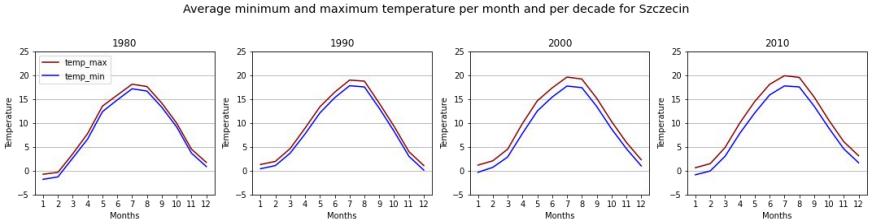


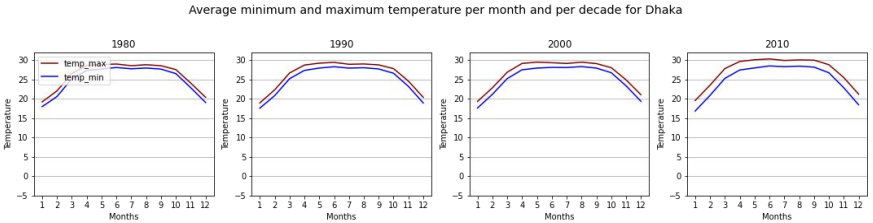


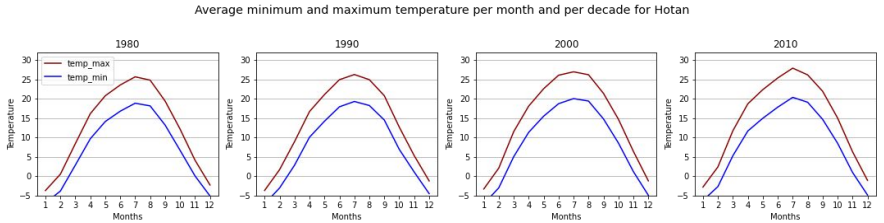


5. Average min and max of the temperature over the 4 last decades

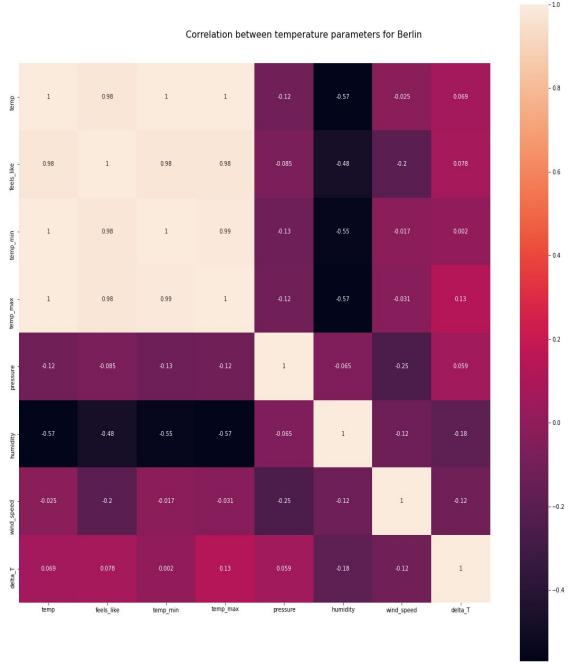


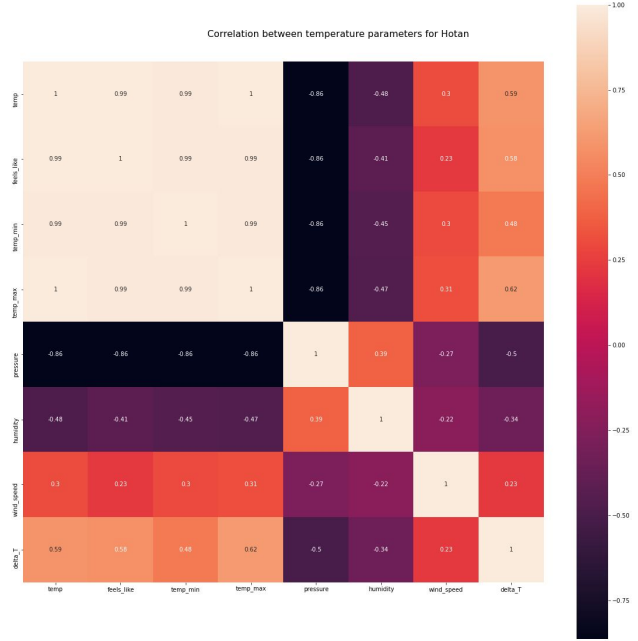






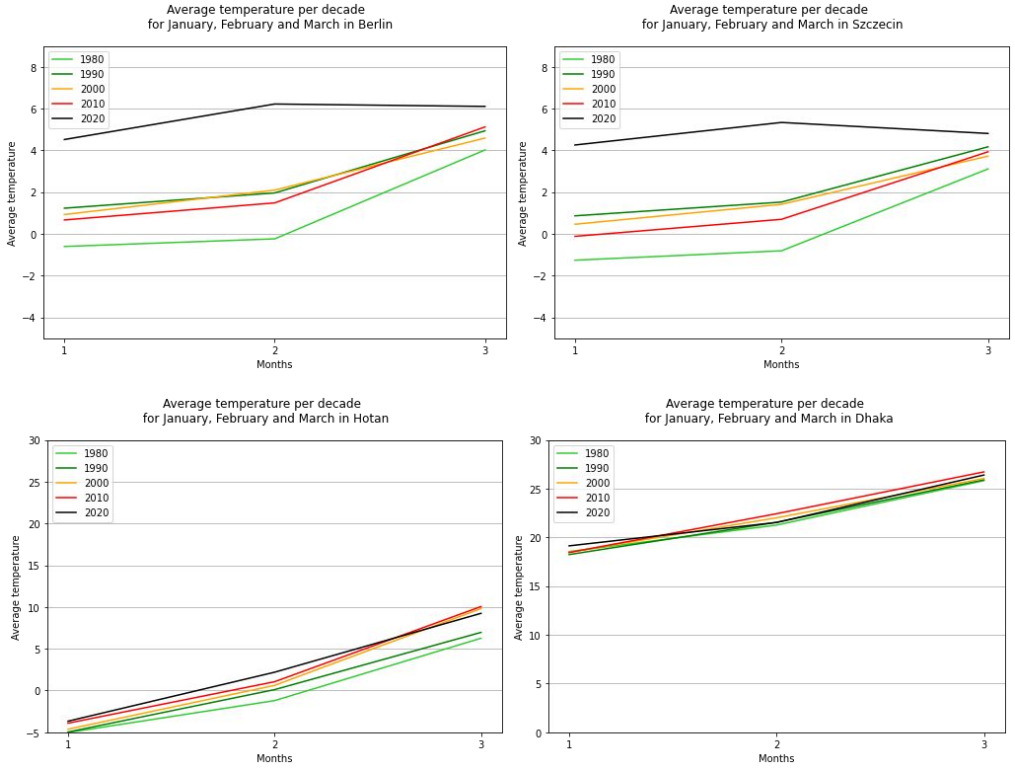
6. Correlations between temperatures parameters





7. 2020 temperatures vs other decades

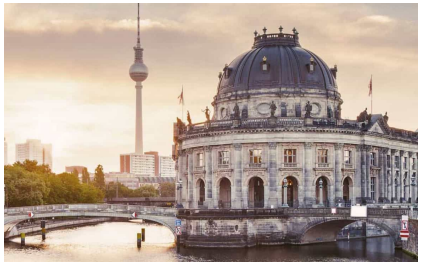
- The graph shows that the temperature have stopped increasing compared with the average temperatures of other decades.



Hypothesis testing

Hypothesis 1: Are Berlin and Szczecin average temperatures comparable ?

BERLIN



Average temperature: 9.76
Standard deviation: 7.81

VS

SZCZECIN

Average temperature :8.98
Standard deviation: 7.56

Results: Ttest_relResult(statistic=90.53136037419236, pvalue=0.0)

Conclusion: pvalue<0.05, so the hypothesis that temperatures are comparable is rejected. Both cities average temperatures are significantly different. Another test decreasing Berlin temperatures by 1 degree had the same result.

Hypothesis testing

Hypothesis 2: Is climate change real ?

BERLIN
Average temperature: 9.55
Standard deviation: 7.71

SZCZECIN

Average temperature: 8.91
Standard deviation: 7.48

VS

BERLIN
Average temperature :10.49
Standard deviation: 7.93

SZCZECIN

Average temperature :9.47
Standard deviation: 7.62

Results:

- Berlin: Ttest_relResult(statistic=-10.013286240252075, pvalue=2.6553851055415264e-23)
- Szczecin: TTtest_relResult(statistic=-6.317321778803096, pvalue=2.981668322092181e-10)

Conclusion: In both cases, pvalue<0.05, so the hypothesis that temperatures are comparable is rejected. Temperature in the 2010s is significantly different from the 1990s.

Conclusion

-Weather data was compiled and visualized

-Results indicate climate change is a real ongoing event

-Data needed cleaning and visual editing in order to read and understand results.

-To further explore COVID impact, pollution level data would need to be included.