SIGNIFICANCE OF SOLAR ACTIVITY TOWARDS THE GLOBAL TEMPERTURE

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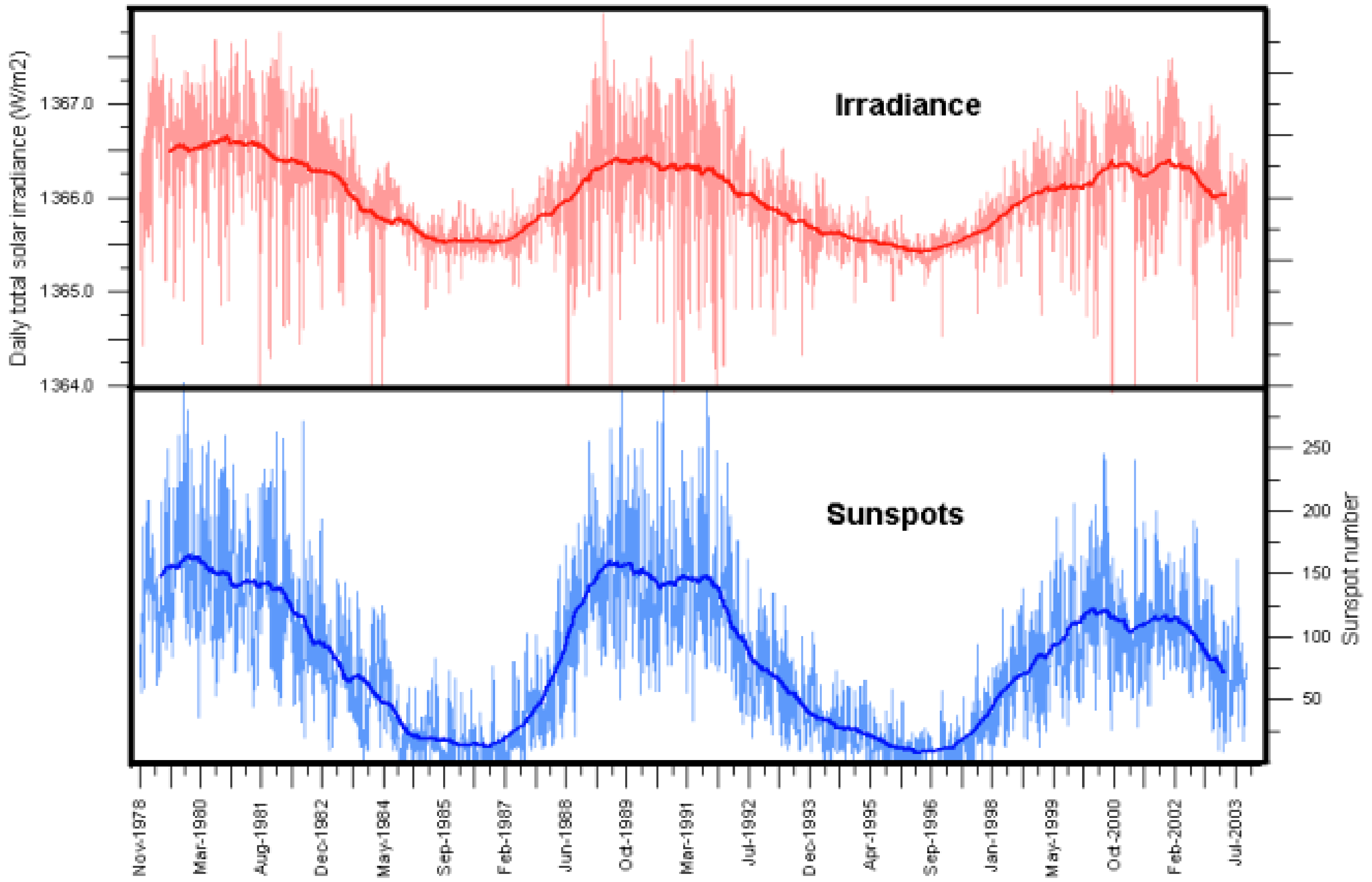
SUN : NOT STATIC



Source : NASA

RESEARCH QUESTIONS

DEFINING THE OBJECTIVES AND GOALS OF THE PROJECT

Is there is any sort of relation between Earth's surface temperature and the Solar activity level? Are there any other factors?

DATASETS

01 Sunspot numbers

02 Global Temperature

03 Global Carbon Emissions

SOLAR ACTIVITES EDA

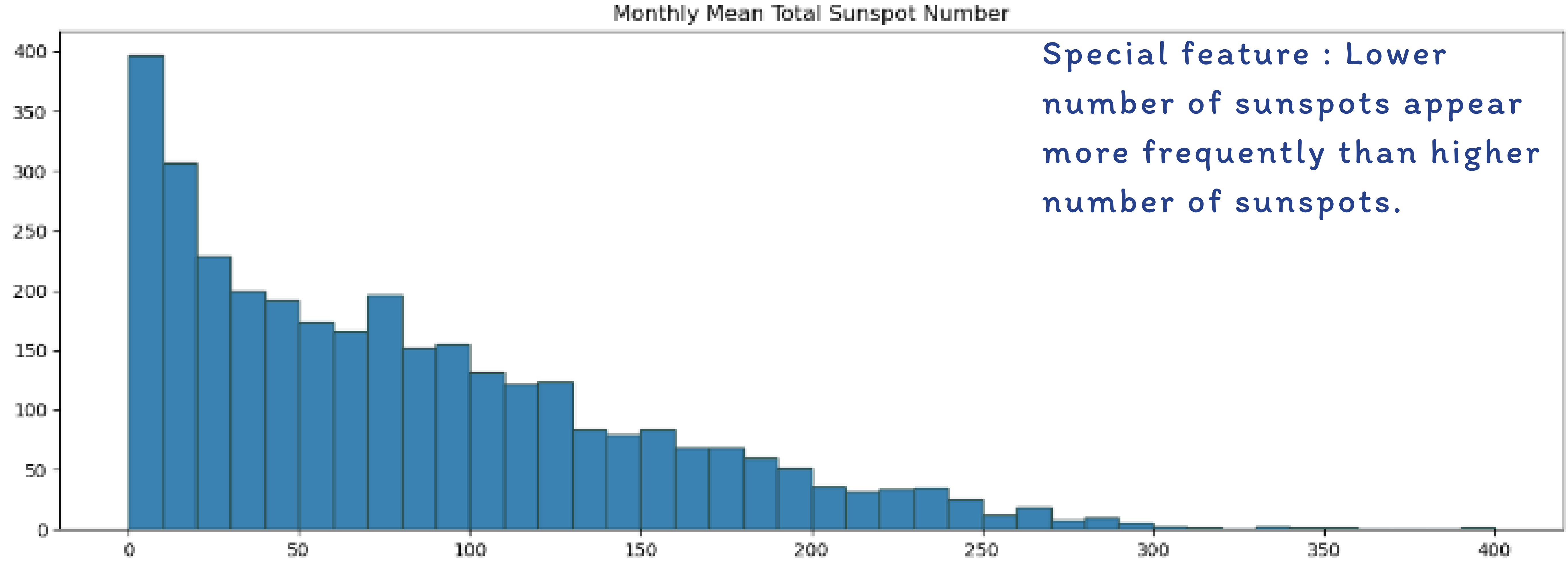
TIME RANGE : MARCH 1749 - MARCH 2021

Date	Monthly Mean Total Sunspot Number
1749-01-31	96.7
1749-02-28	104.3
1749-03-31	116.7
1749-04-30	92.8
1749-05-31	141.7
...	...
2020-09-30	0.6
2020-10-31	14.4
2020-11-30	34.0
2020-12-31	21.8
2021-01-31	10.4

3265 rows × 1 columns

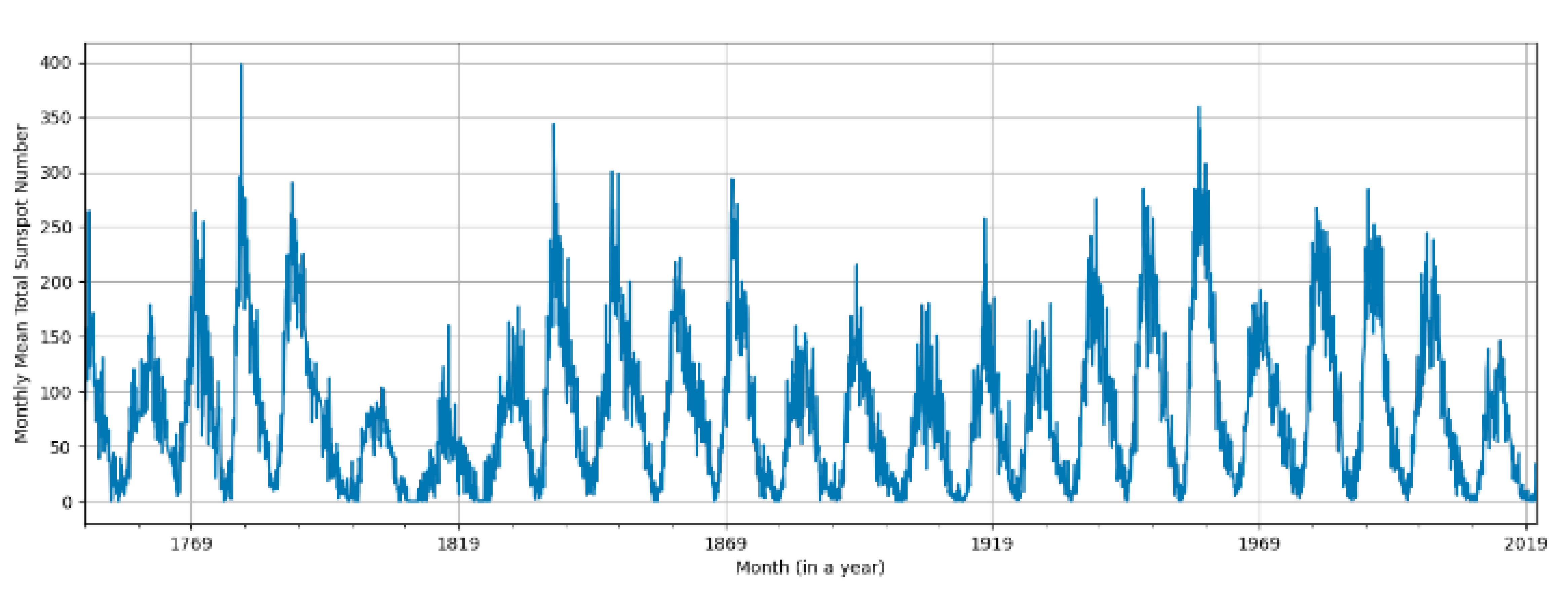
```
In [71]: print(sunspot_data.index.is_monotonic_increasing)
         sunspot_data.isnull().sum()

         True

Out[71]: Monthly Mean Total Sunspot Number    0
         dtype: int64
```

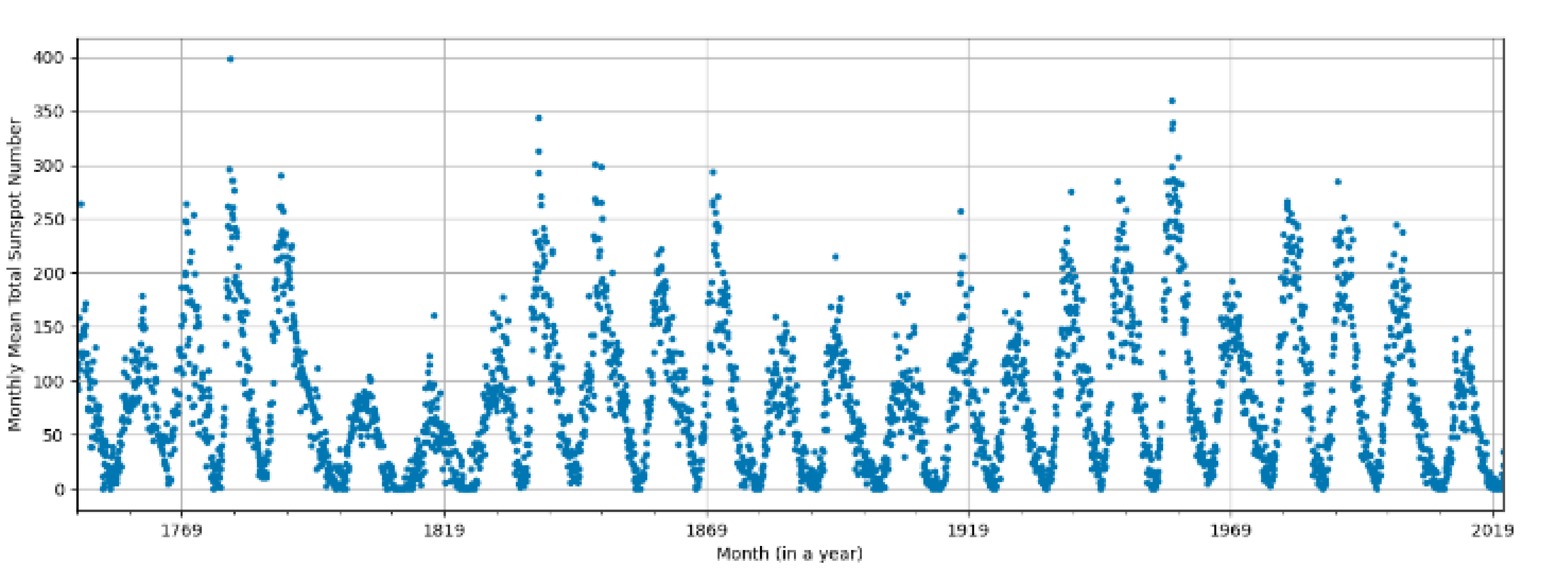
FREQUENCY DISTRIBUTION



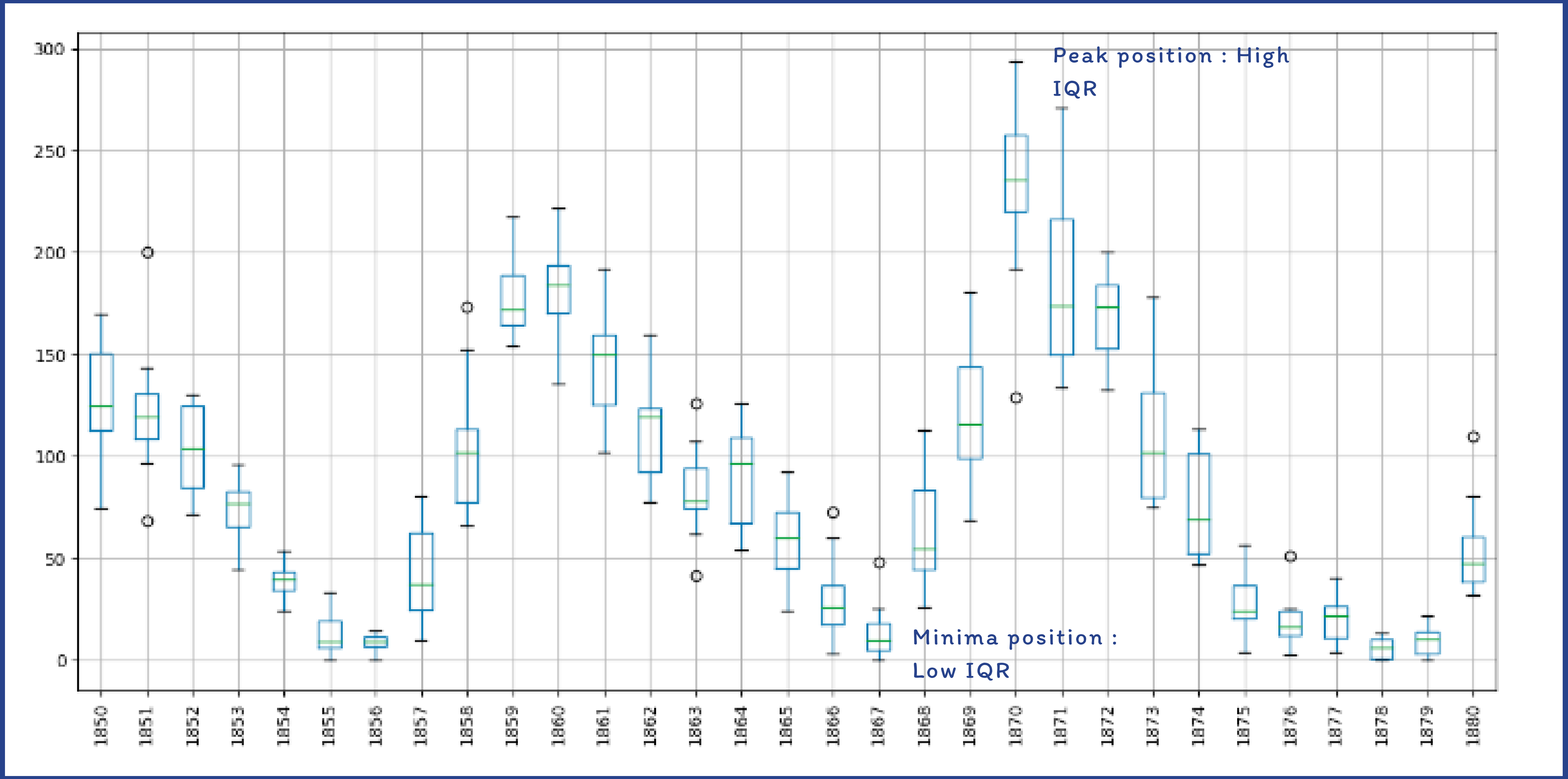
Special feature : Lower number of sunspots appear more frequently than higher number of sunspots.

LINE GRAPH AND SCATTER GRAPH

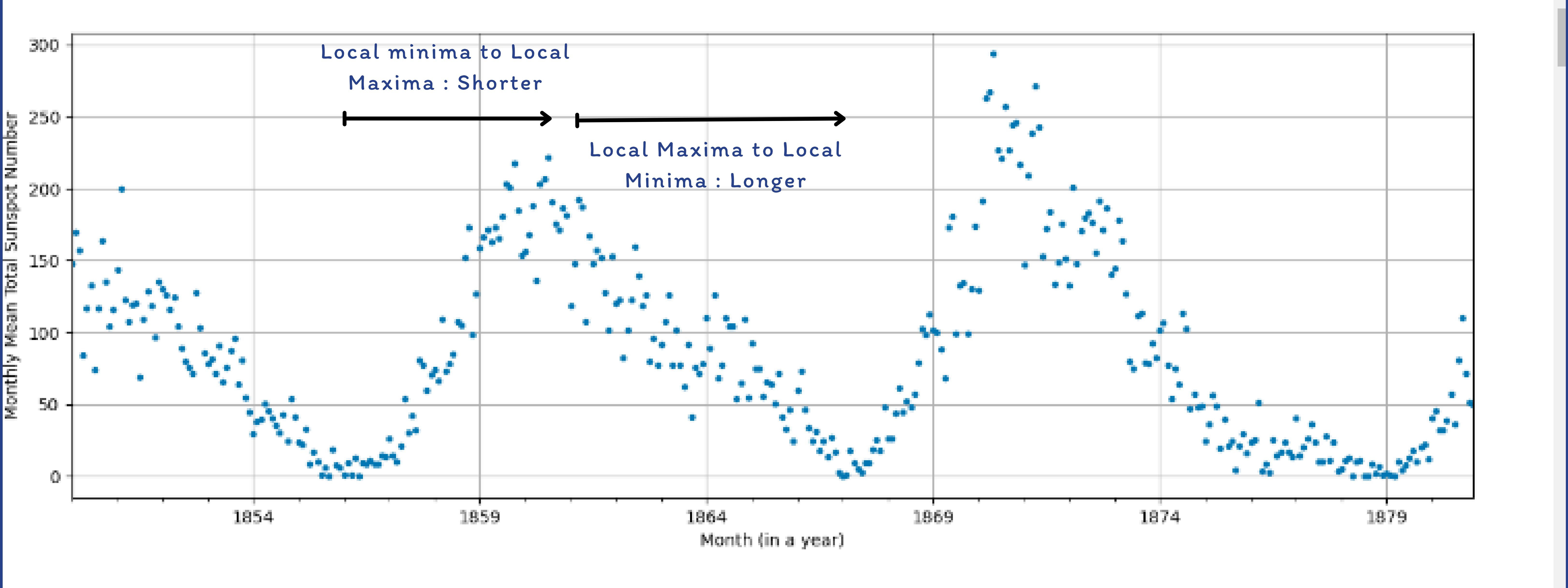




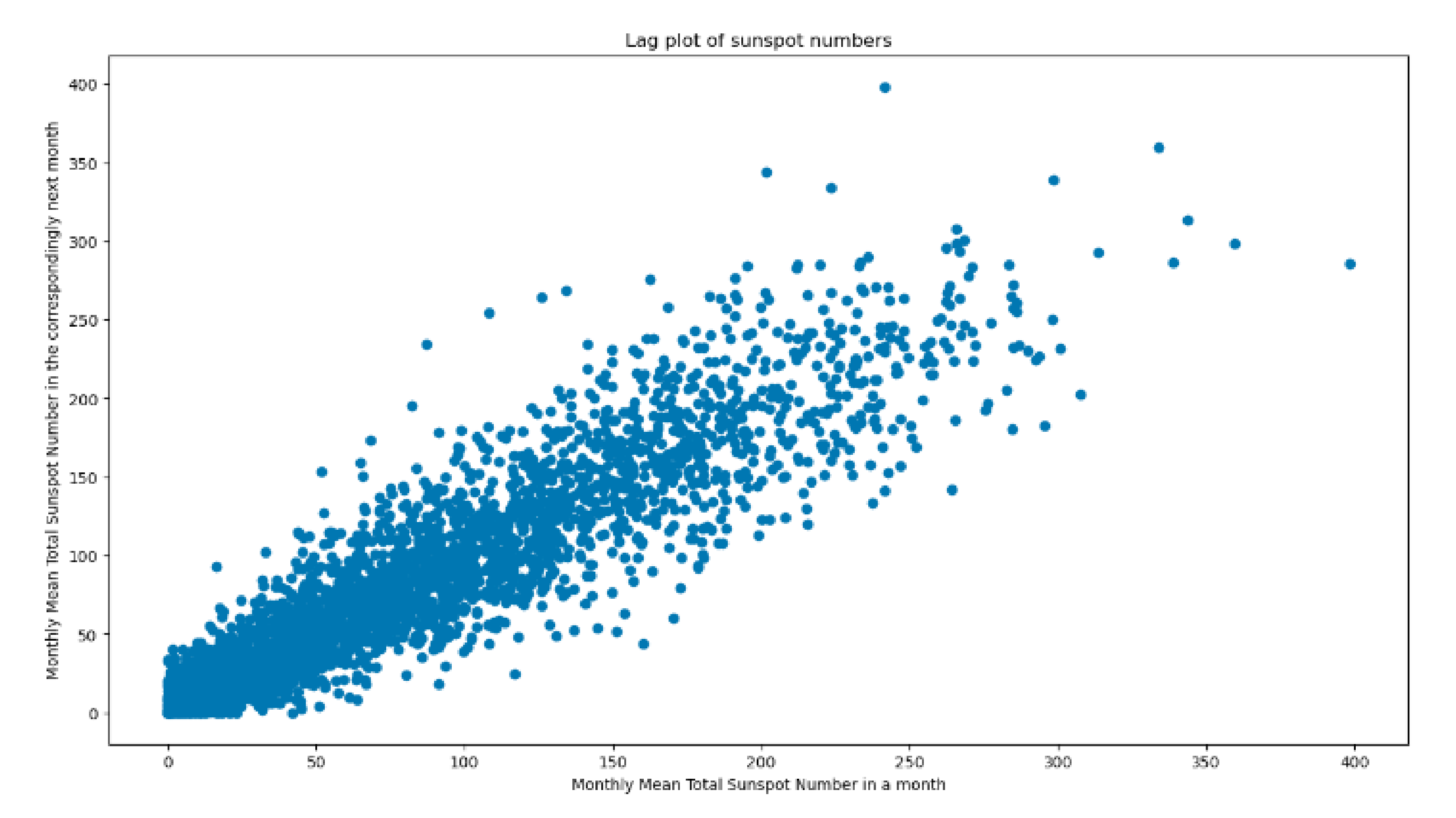
IQR OBSERVATION : CHANGES IN NUMBER OF SUNSPOTS

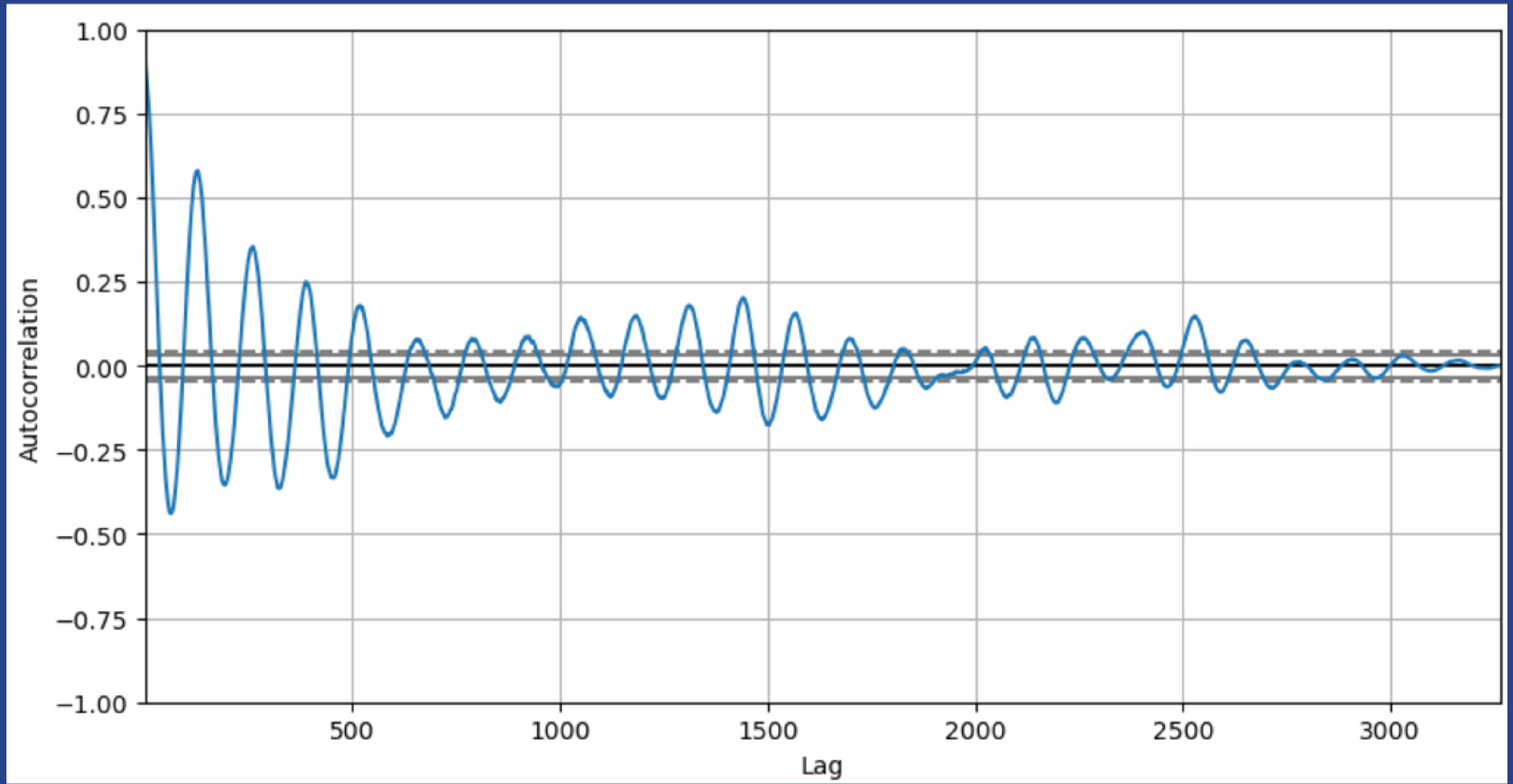


ASYMMETRY OF THE CHANGES



NEW CONCEPT : LAG PLOT





WHAT IS LAG PLOT?

Scatter plot with the 2 variables lagged (fixed amount of passing time)

WHAT DOES IT IMPLY?

if there is an identifiable structure in the plot generated, the data is not random.

CORE ANALYSIS : PERIOD OF THE CHANGE

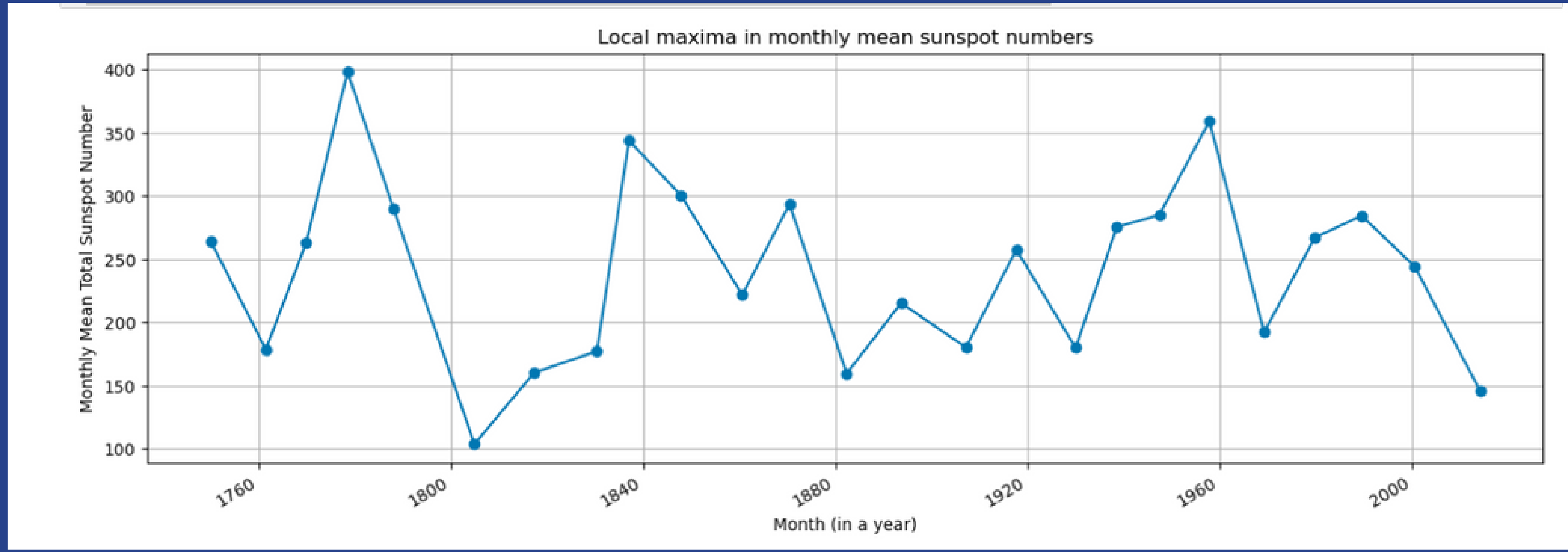
IDEA?

Find the time difference between the two adjacent local maximas, find the average.

FIRST APPROACH : FINDING LAG VALUE

```
In [77]: lag_vals = np.arange(12*15)
         autocorr_ser = np.array([sunspot_data['Monthly Mean Total Sunspot Number'].autocorr(lag=n) for n in lag_vals])
         argrelextrema(autocorr_ser, np.greater, order = 2)[0]

Out[77]: array([128], dtype=int64)
```

SECOND APPROACH : PLOTTING THE PEAK ACTIVITY FOR EACH PERIOD, FIND THE DIFFERENCE IN TIME




```
1     12.0
2      8.0
3      9.0
4      9.0
5     17.0
6     13.0
7     13.0
8      6.0
9     11.0
10    13.0
11    10.0
12    12.0
13    11.0
14    14.0
15    10.0
16    12.0
17     9.0
18     9.0
19    10.0
20    12.0
21    10.0
22    10.0
23    11.0
24    14.0
Name: Date, dtype: float64
```

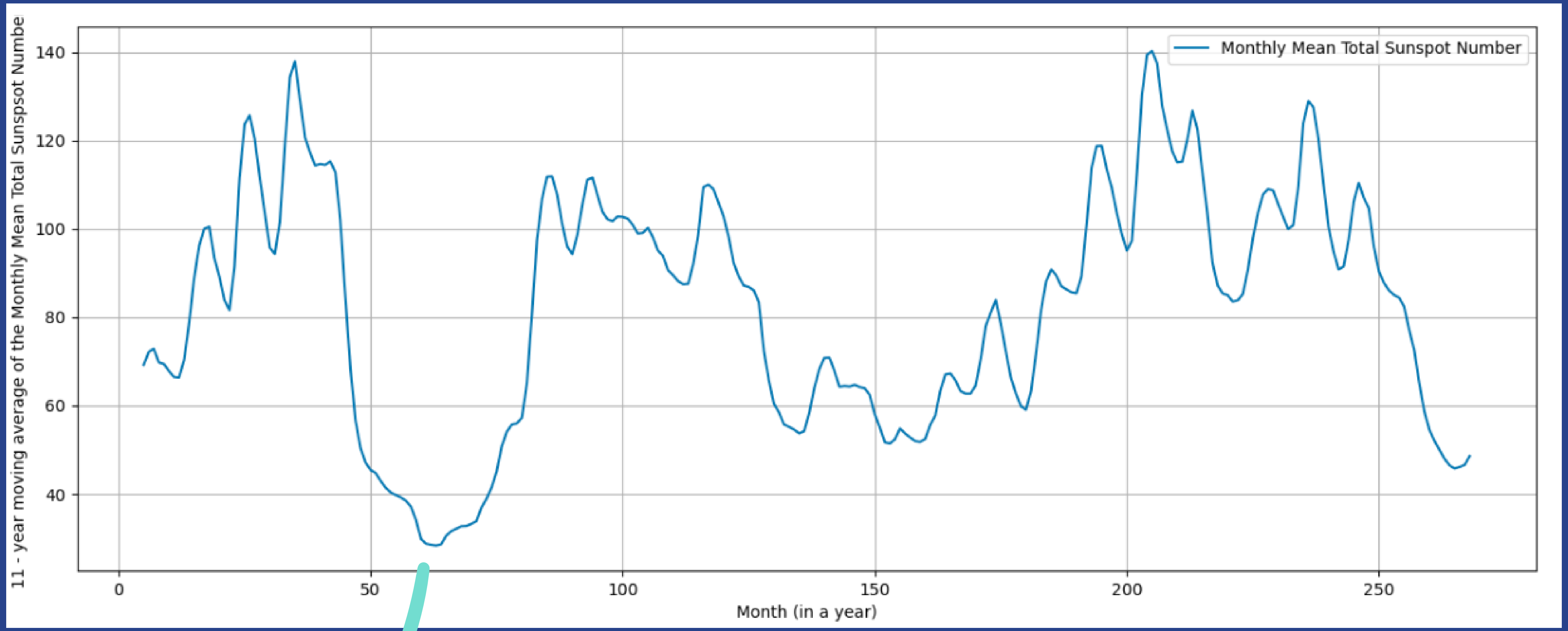
```
count    24.000000
mean     11.041667
std       2.330873
min       6.000000
25%       9.750000
50%      11.000000
75%      12.250000
max      17.000000
Name: Date, dtype: float64
```

PERIOD : 11.04 YEARS

CORE ANALYSIS : AVERAGE SUNSPOT NUMBER PER PERIOD

NEW CONCEPT : ROLLING AVERAGE

Rolling average : Find the average for the previous 11 years to find the average sunspot numbers.

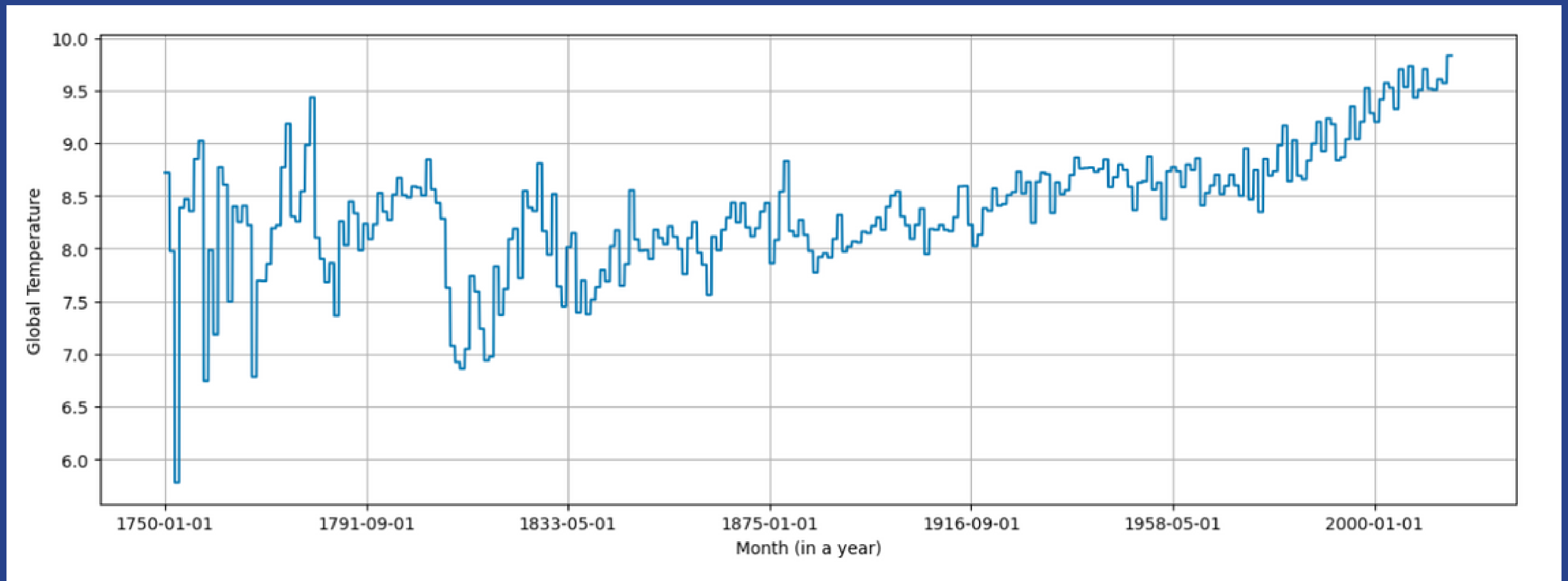


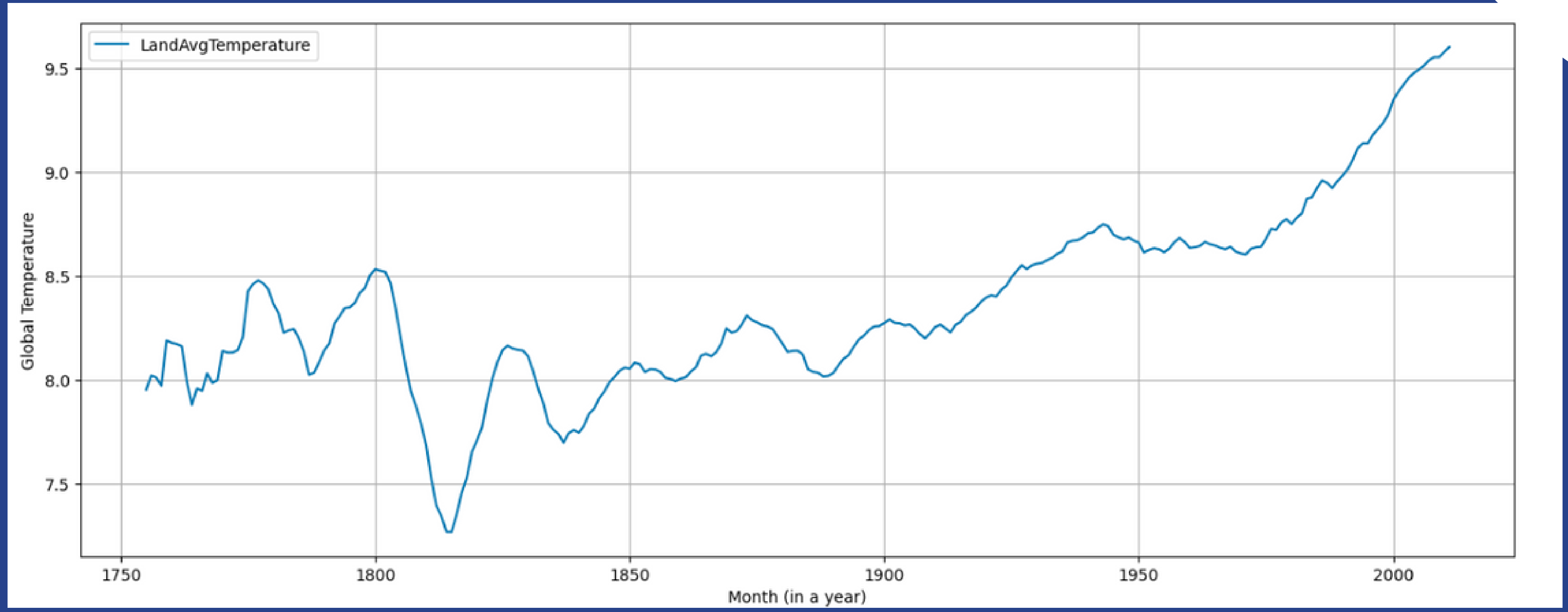
During the year 1790-1820, the solar activity reached its peak minimum : Dalton Minimum

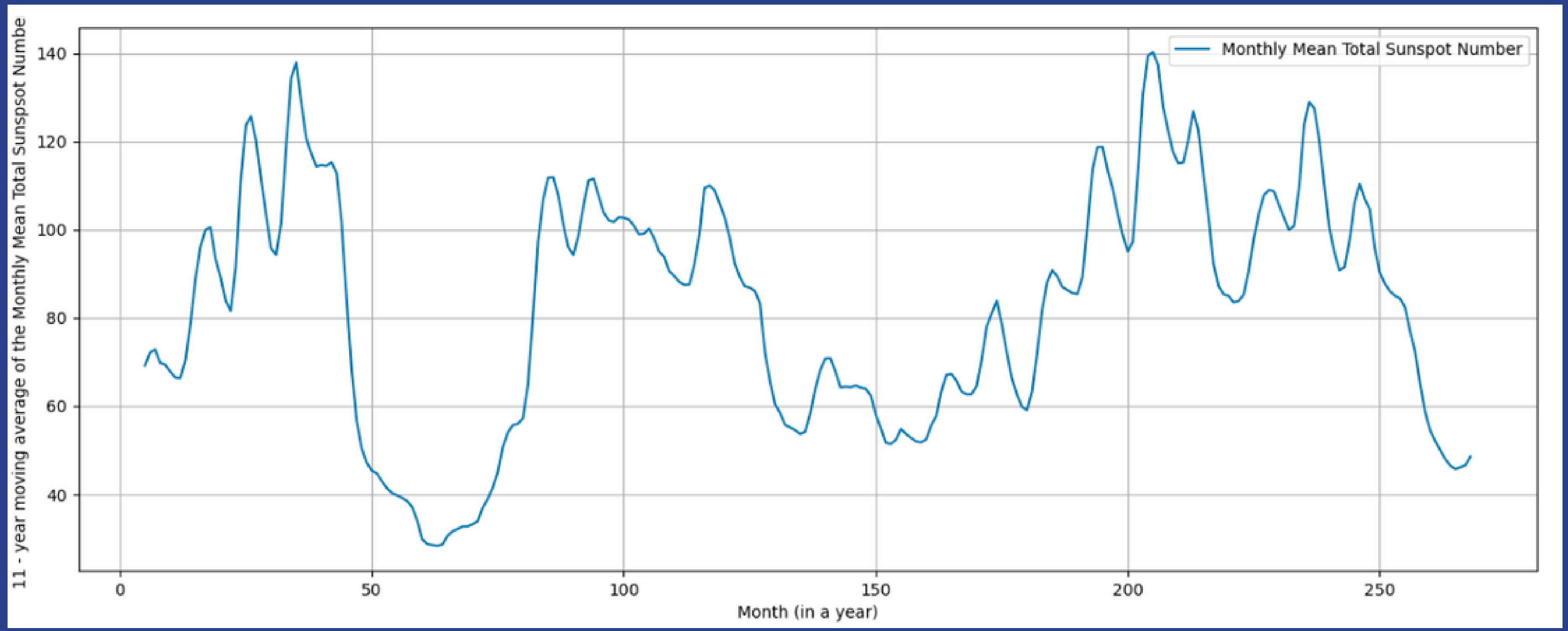
CORE ANALYSIS : CORRELATION BETWEEN SUNSPOT NUMBER AND GLOBAL TEMPERATURE

Comparison

Global Temperature Data:

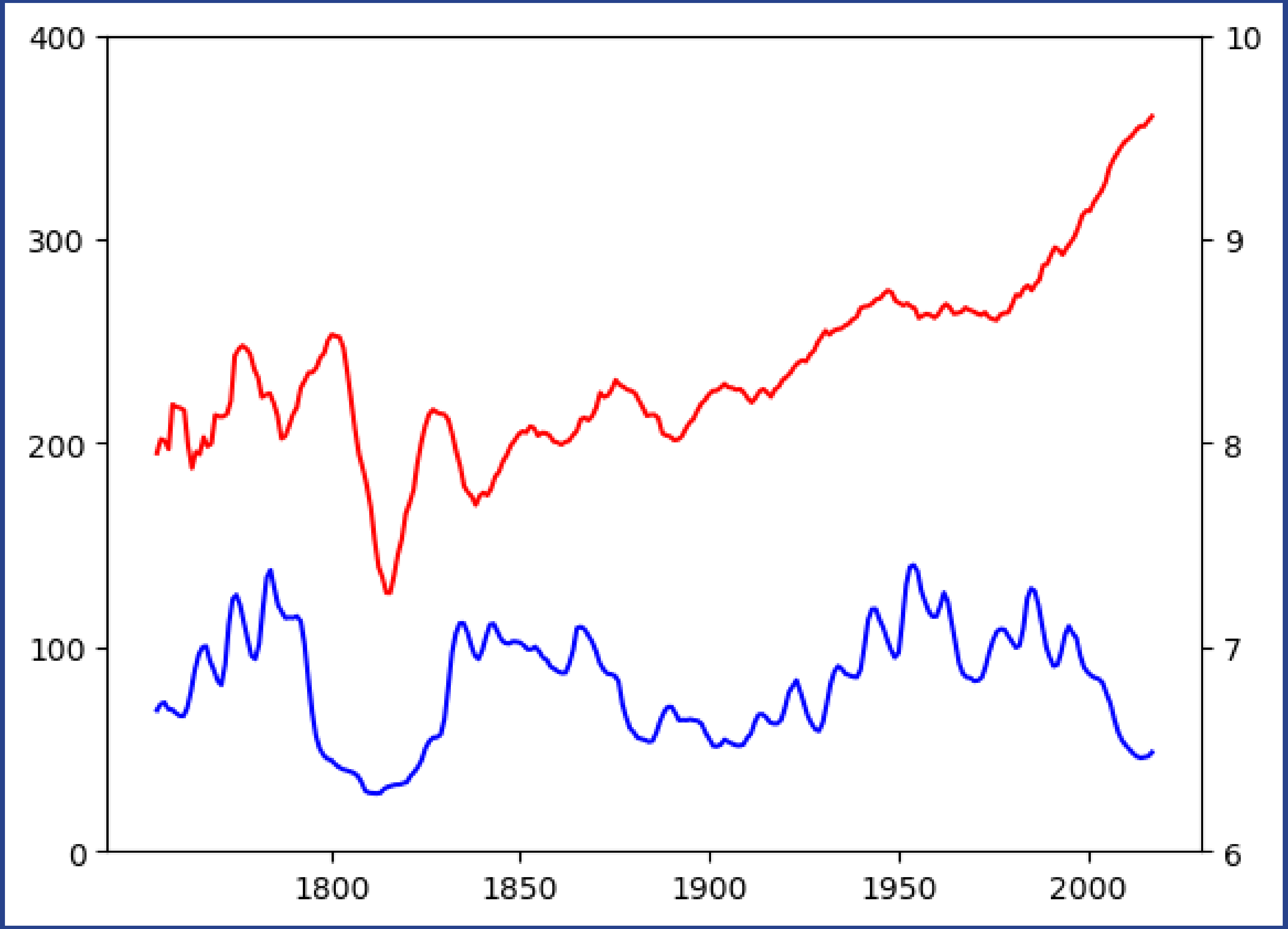






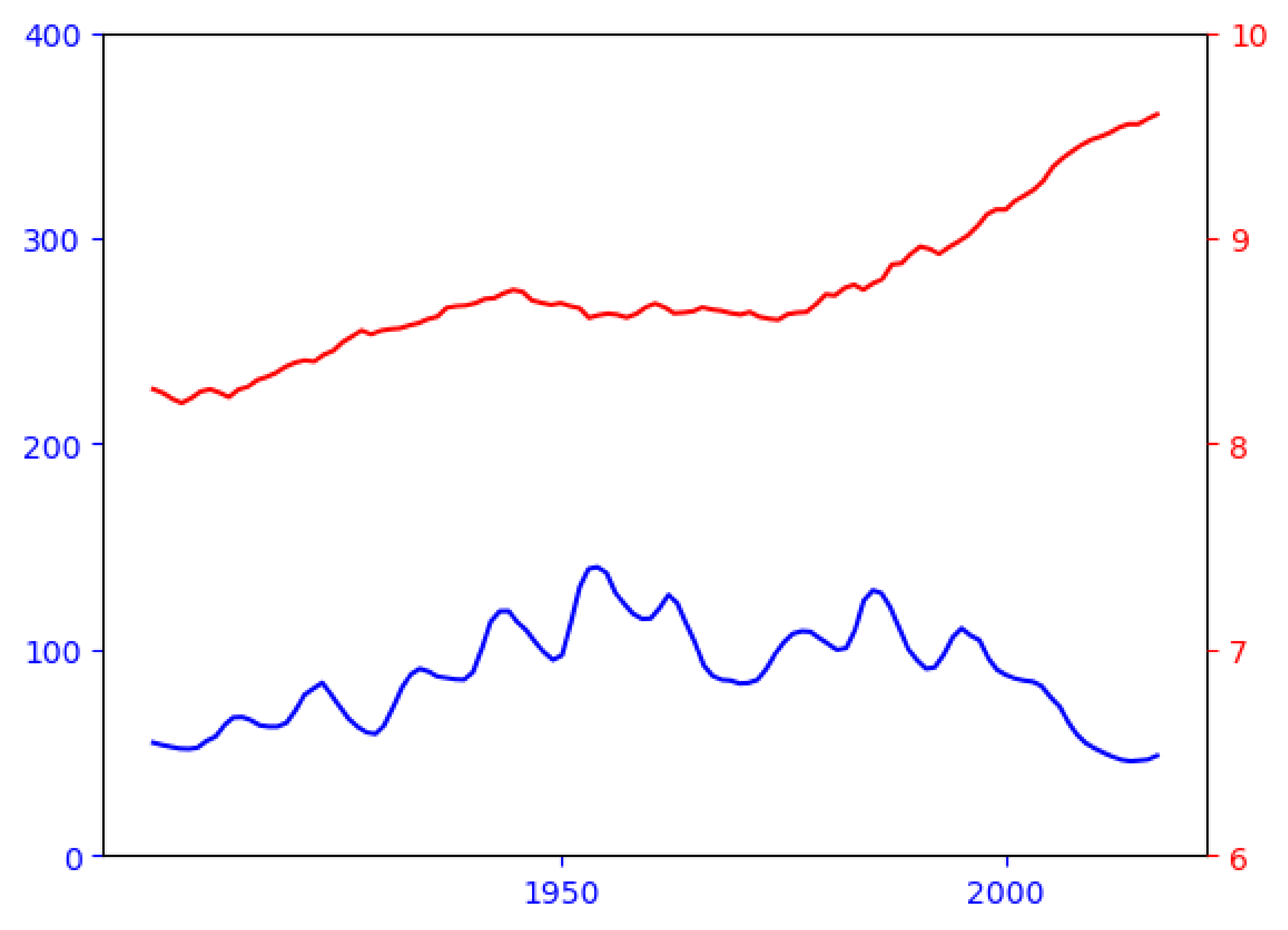
CORE ANALYSIS : CORRELATION BETWEEN SUNSPOT NUMBER AND GLOBAL TEMPERATURE

Comparison



CORE ANALYSIS : CORRELATION BETWEEN SUNSPOT NUMBER AND GLOBAL TEMPERATURE

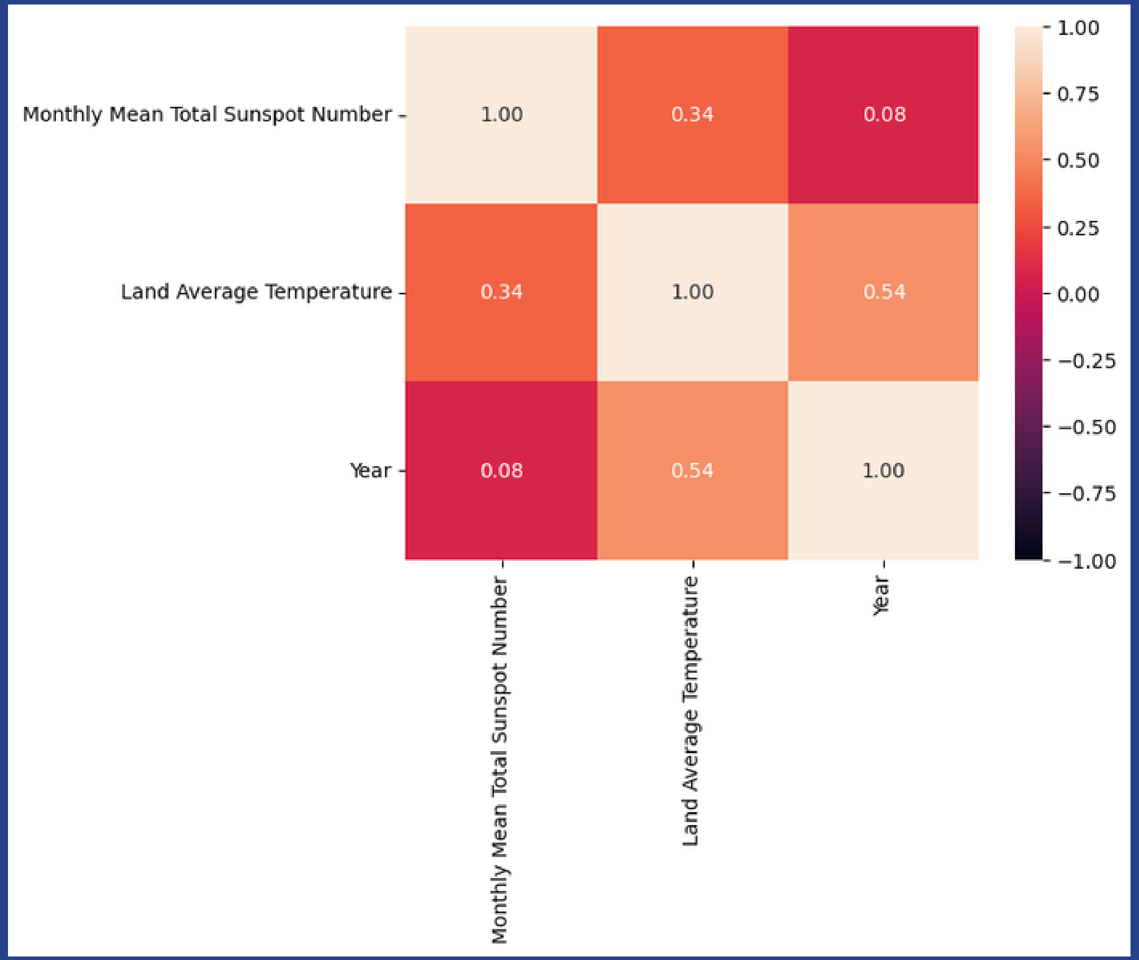
Dissimilar trend starting from 1960 - 2011



CORE ANALYSIS : CORRELATION BETWEEN SUNSPOT NUMBER AND GLOBAL TEMPERATURE

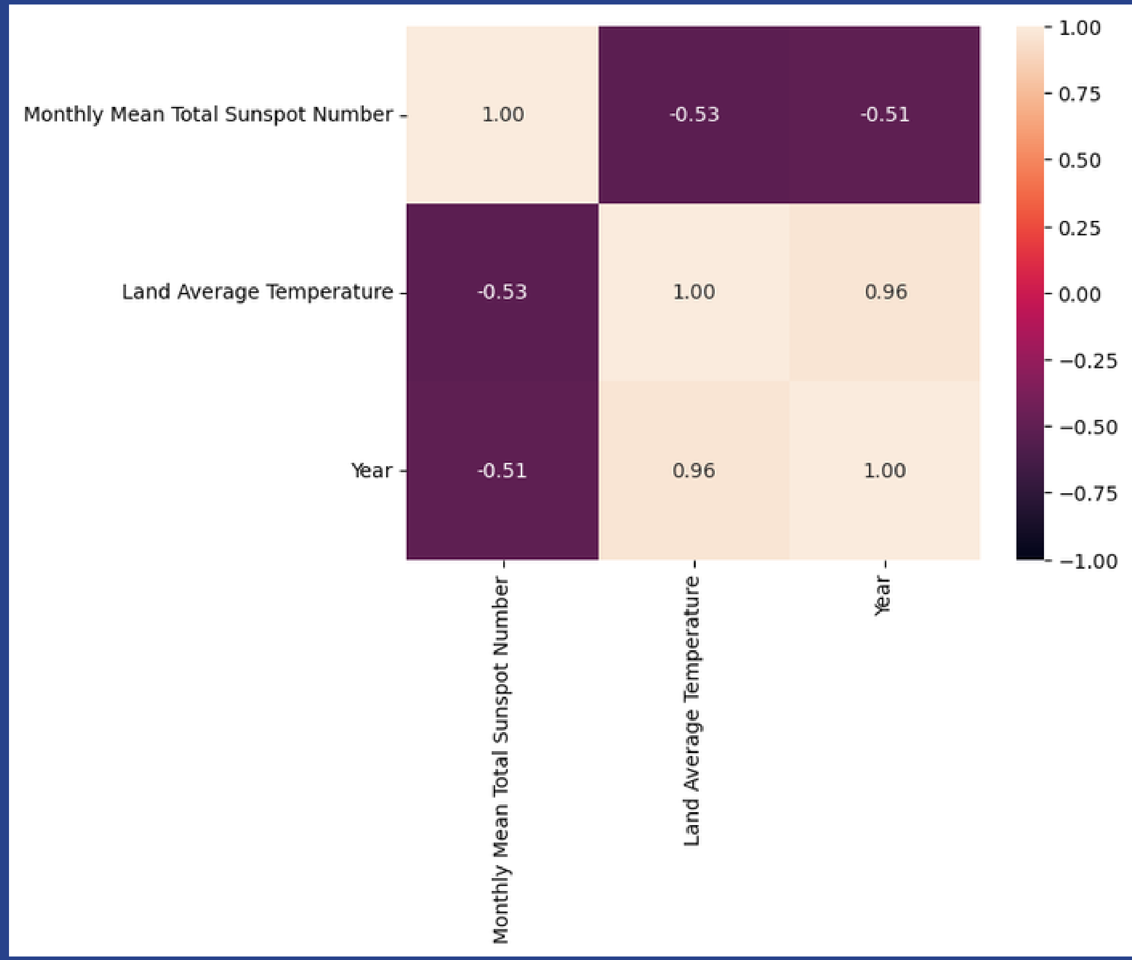
Correlation between Sunspot and Global Temperature

1755-1960



Correlation Cefficient :
0.34

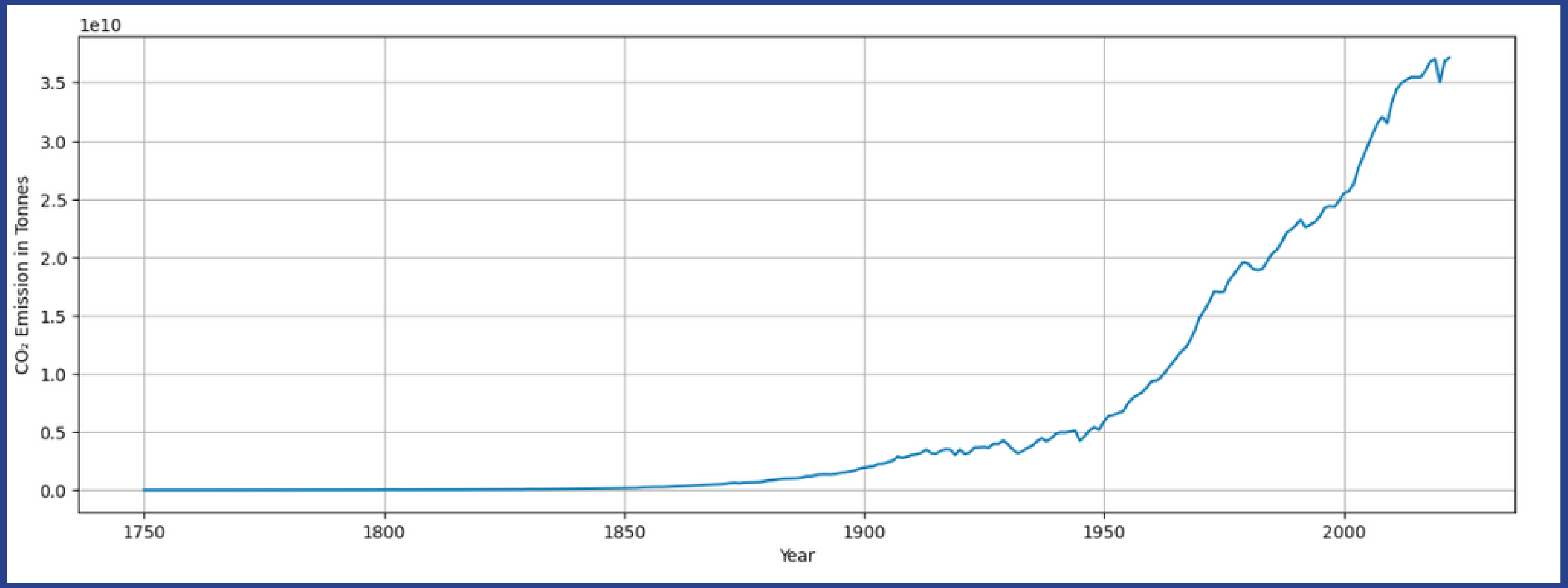
1960 - 2011

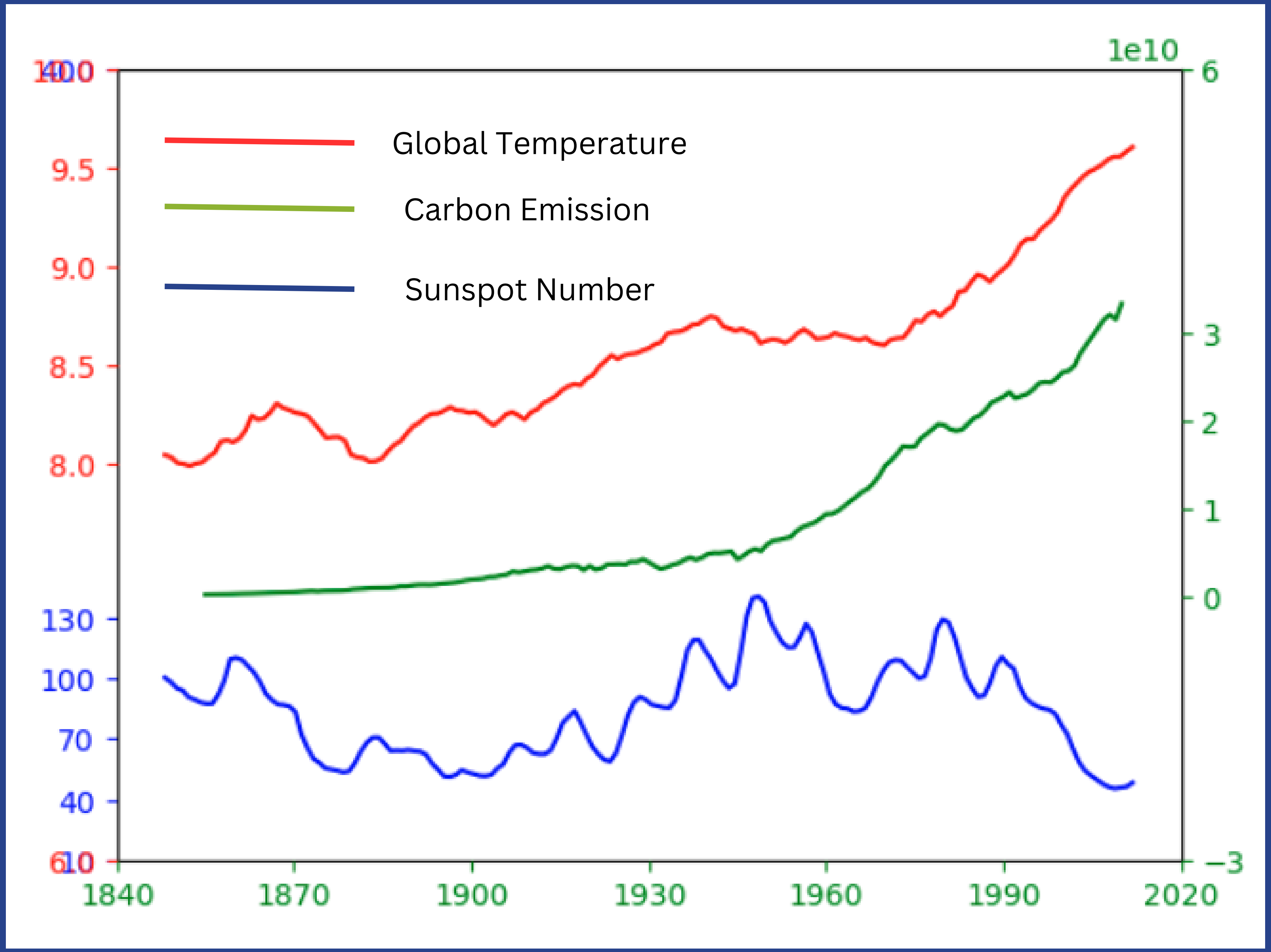


Correlation Cefficient :
-0.51

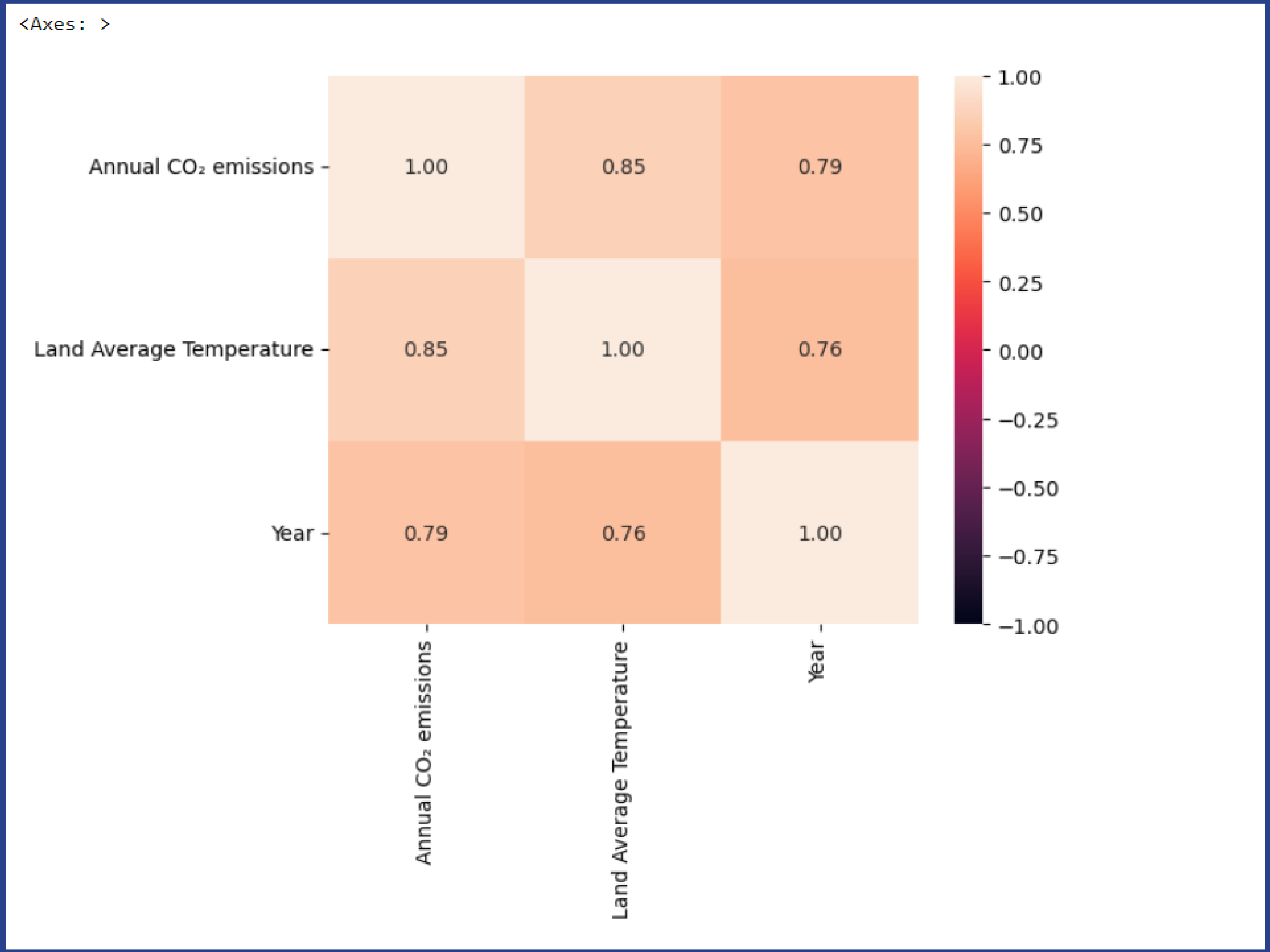
CORE ANALYSIS : CORRELATION BETWEEN GLOBAL TEMPERTURE AND GLOBAL CARBON EMISSION

Global Carbon Emission Data:





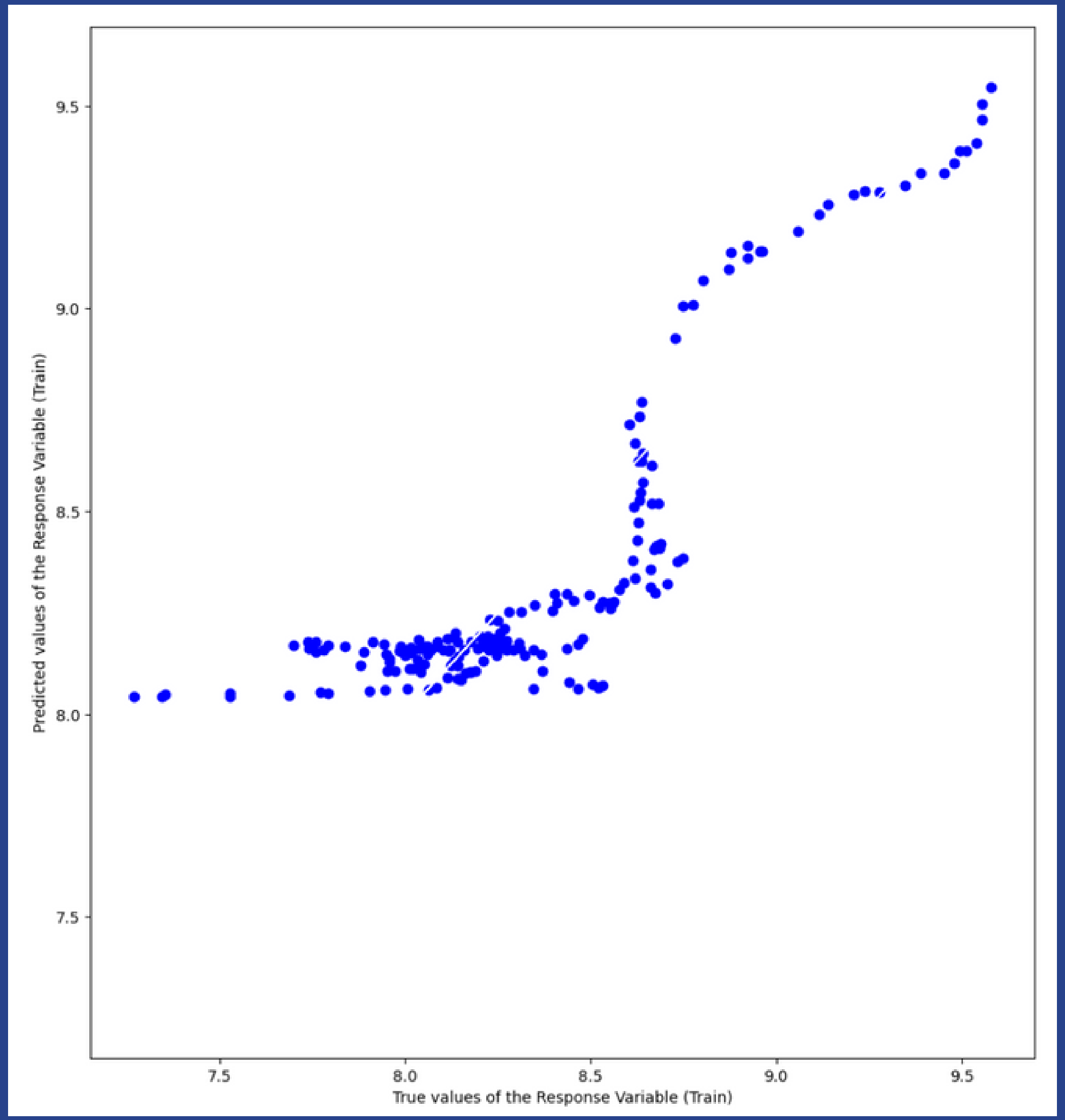
CORE ANALYSIS : CORRELATION BETWEEN GLOBAL TEMPERTURE AND GLOBAL CARBON EMISSION

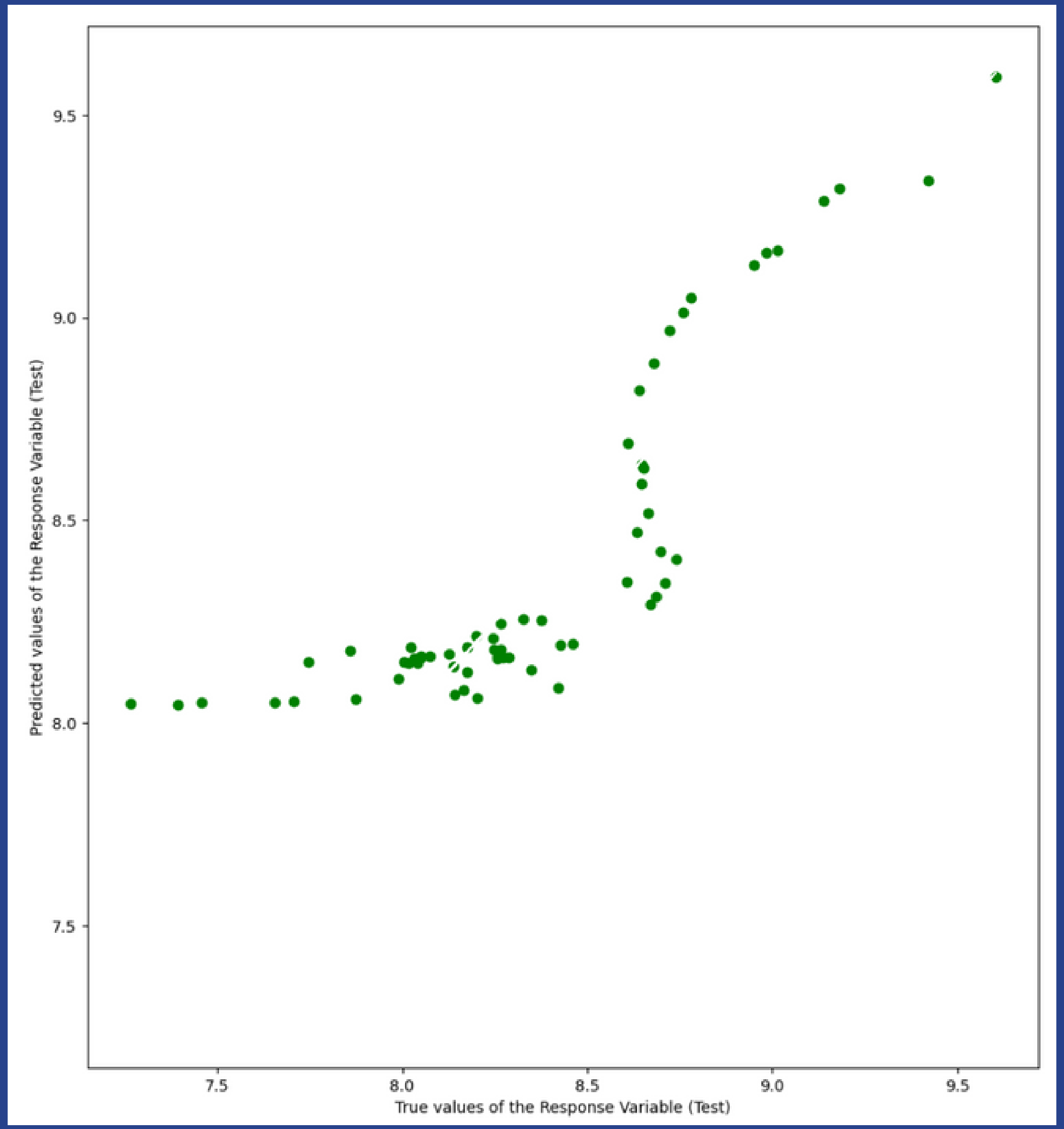


Correlation : 0.85

Implies strong correlation

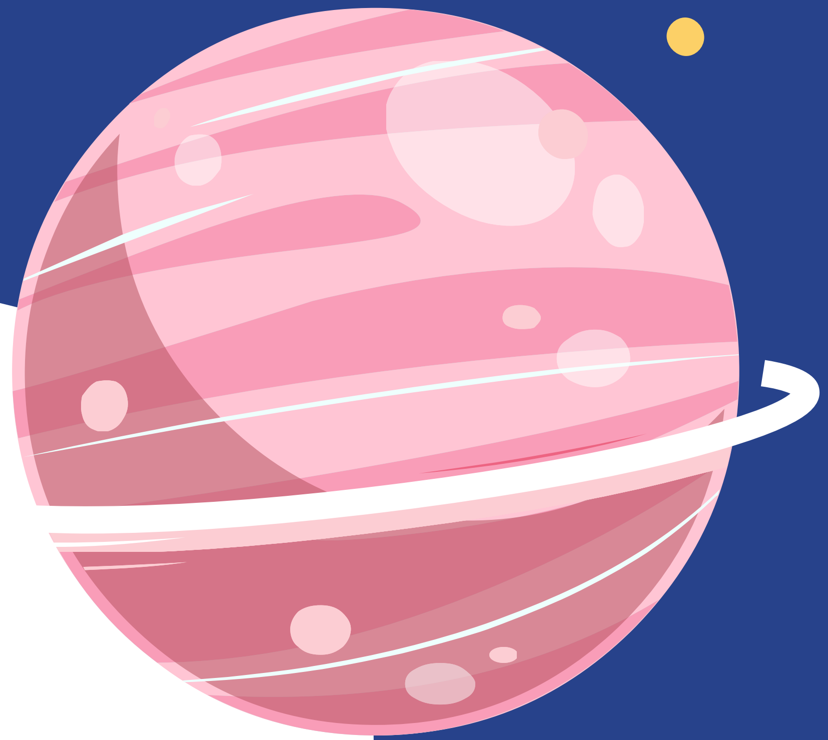
MULTIVARIATE REGRESSION






```
Goodness of Fit of Model           Train Dataset
Explained Variance (R^2)           : 0.7555984655445439
Mean Squared Error (MSE)           : 0.04776610847209533

Goodness of Fit of Model           Test Dataset
Explained Variance (R^2)           : 0.7207164277356004
Mean Squared Error (MSE)           : 0.05637625102464322
```

Global temperature = 1.5692e-03 * (monthly mean total sunspot number) + 4.9446e-11 * (carbon emission) + 7.9979



CONCLUSION

- Global temperature is also influenced by variation of solar irradiance, but it is mainly influenced by the level of carbon emission

- Therefore, we came up with a model to link the effects of solar activities and the level of global carbon emission to predict the global temperature

THANK YOU

FOR WATCHING THIS PRESENTATION