

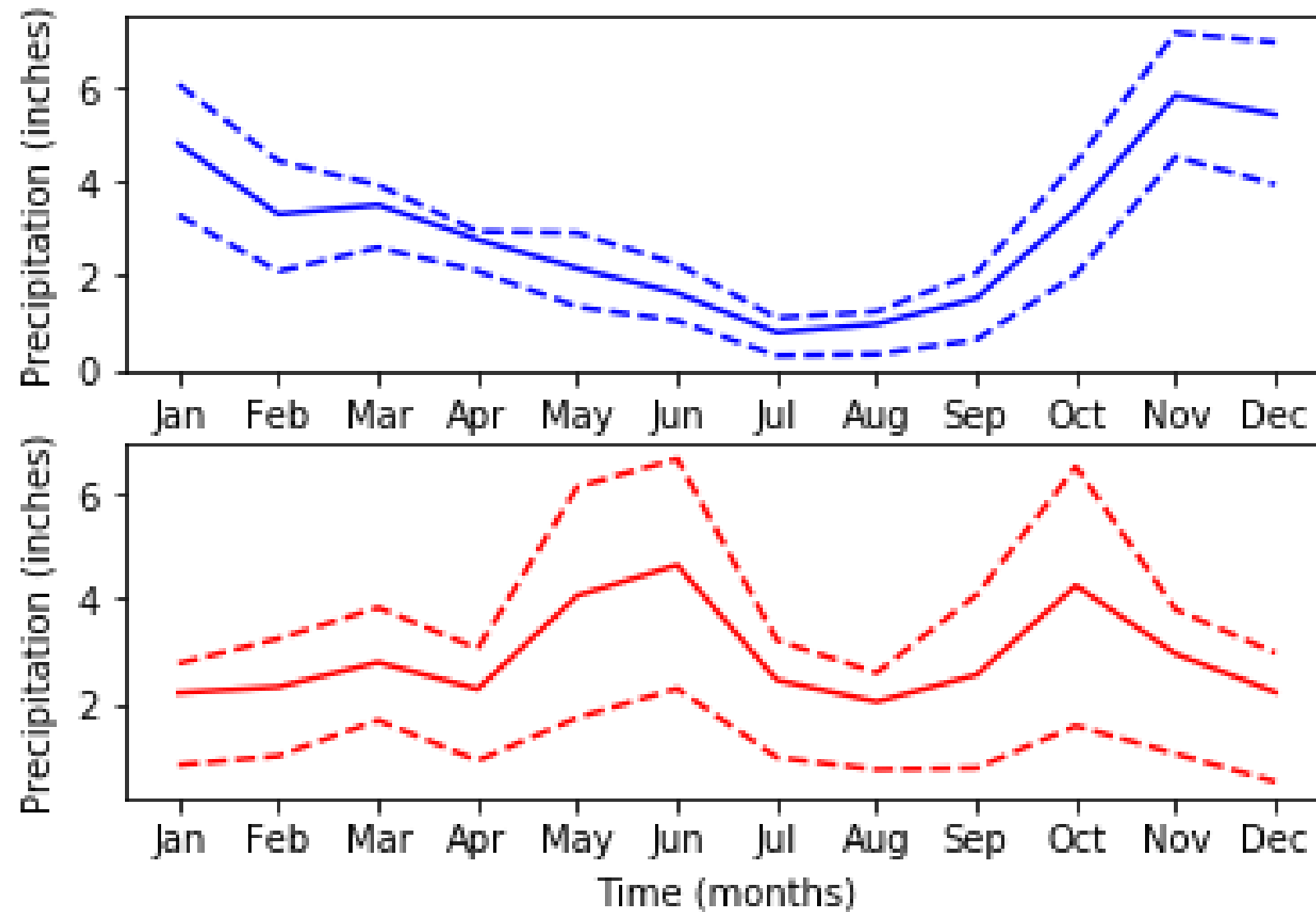
Plotting time-series data

INTRODUCTION TO MATPLOTLIB



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Time-series data



Climate change time-series

```
date,co2,relative_temp
1958-03-06,315.71,0.1
1958-04-06,317.45,0.01
1958-05-06,317.5,0.08
1958-06-06,-99.99,-0.05
1958-07-06,315.86,0.06
1958-08-06,314.93,-0.06
...
2016-08-06,402.27,0.98
2016-09-06,401.05,0.87
2016-10-06,401.59,0.89
2016-11-06,403.55,0.93
```

DateTimeIndex

```
climate_change.index
```

```
DatetimeIndex(['1958-03-06', '1958-04-06', '1958-05-06', '1958-06-06',  
              '1958-07-06', '1958-08-06', '1958-09-06', '1958-10-06',  
              '1958-11-06', '1958-12-06',  
              ...  
              '2016-03-06', '2016-04-06', '2016-05-06', '2016-06-06',  
              '2016-07-06', '2016-08-06', '2016-09-06', '2016-10-06',  
              '2016-11-06', '2016-12-06'],  
              dtype='datetime64[ns]', name='date', length=706, freq=)
```

Time-series data

```
climate_change['relative_temp']
```

```
0      0.10
1      0.01
2      0.08
3     -0.05
4      0.06
5     -0.06
6     -0.03
7      0.04
...
701     0.98
702     0.87
703     0.89
704     0.93
705     0.81
Name:co2, Length: 706, dtype: float64
```

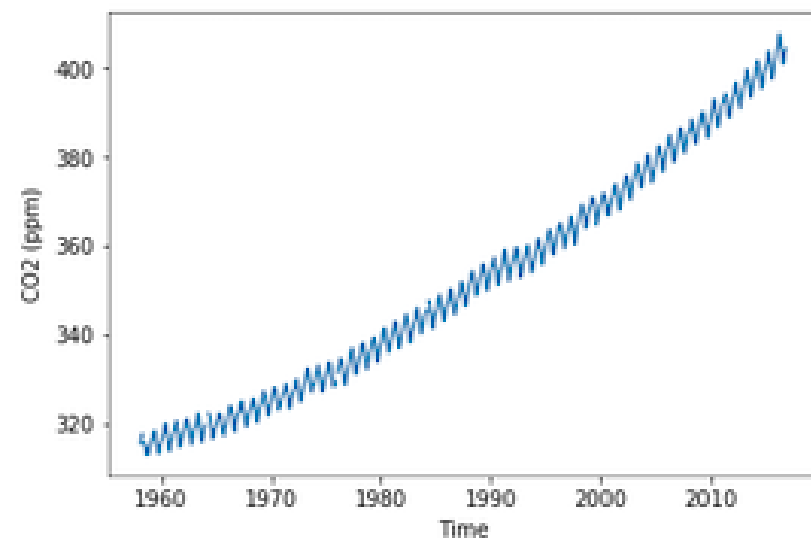
```
climate_change['co2']
```

```
0      315.71
1      317.45
2      317.50
3         NaN
4      315.86
5      314.93
6      313.20
7         NaN
...
701     402.27
702     401.05
703     401.59
704     403.55
705     404.45
Name:co2, Length: 706, dtype: float64
```

Plotting time-series data

```
import matplotlib.pyplot as plt  
fig, ax = plt.subplots()
```

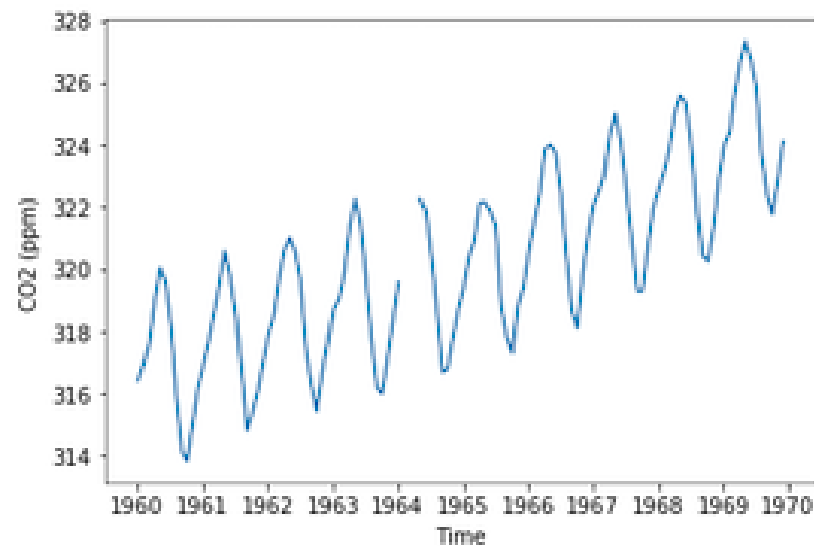
```
ax.plot(climate_change.index, climate_change['co2'])  
ax.set_xlabel('Time')  
ax.set_ylabel('CO2 (ppm)')  
plt.show()
```



Zooming in on a decade

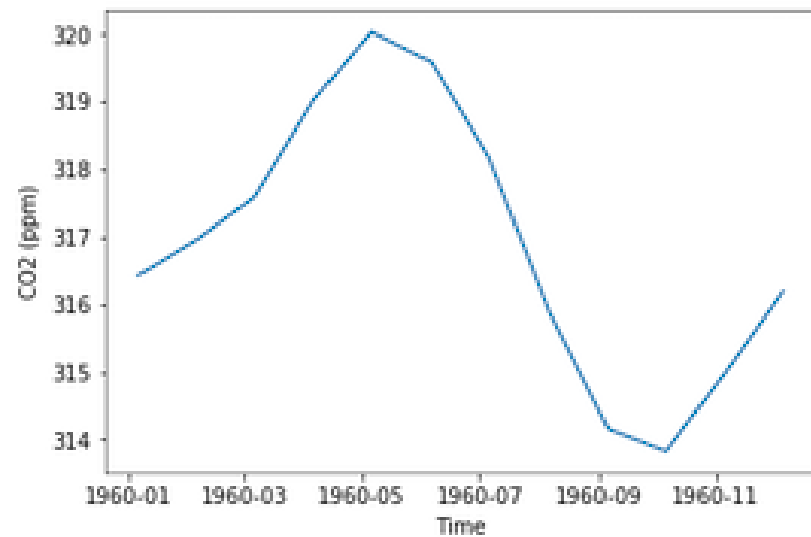
```
sixties = climate_change["1960-01-01":"1969-12-31"]
```

```
fig, ax = plt.subplots()
ax.plot(sixties.index, sixties['co2'])
ax.set_xlabel('Time')
ax.set_ylabel('CO2 (ppm)')
plt.show()
```



Zooming in on one year

```
sixty_nine = climate_change["1969-01-01":"1969-12-31"]  
  
fig, ax = plt.subplots()  
ax.plot(sixty_nine.index, sixty_nine['co2'])  
ax.set_xlabel('Time')  
ax.set_ylabel('CO2 (ppm)')  
plt.show()
```



Let's practice time-series plotting!

INTRODUCTION TO MATPLOTLIB

Plotting time-series with different variables

INTRODUCTION TO MATPLOTLIB



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Plotting two time-series together

```
import pandas as pd
climate_change = pd.read_csv('climate_change.csv',
                             parse_dates=["date"],
                             index_col="date")
```

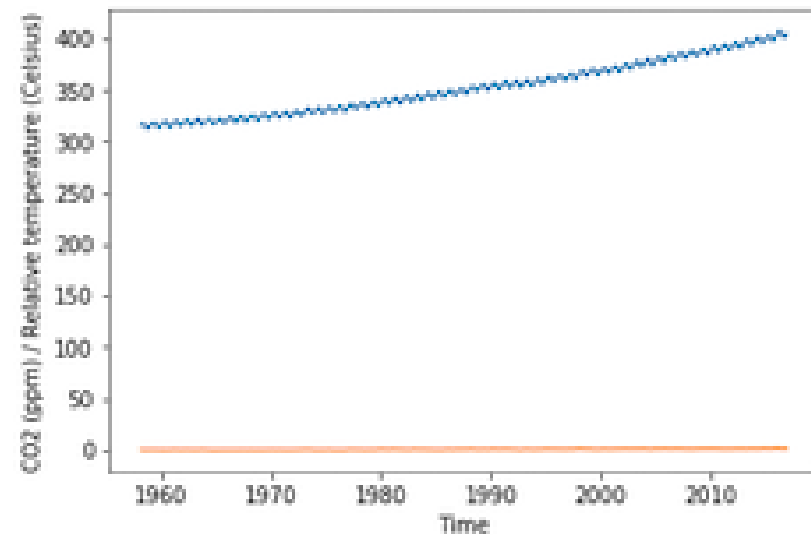
climate_change

	co2	relative_temp
date		
1958-03-06	315.71	0.10
1958-04-06	317.45	0.01
1958-07-06	315.86	0.06
...
2016-11-06	403.55	0.93
2016-12-06	404.45	0.81

[706 rows x 2 columns]

Plotting two time-series together

```
import matplotlib.pyplot as plt
fig, ax = plt.subplots()
ax.plot(climate_change.index, climate_change["co2"])
ax.plot(climate_change.index, climate_change["relative_temp"])
ax.set_xlabel('Time')
ax.set_ylabel('CO2 (ppm) / Relative temperature')
plt.show()
```

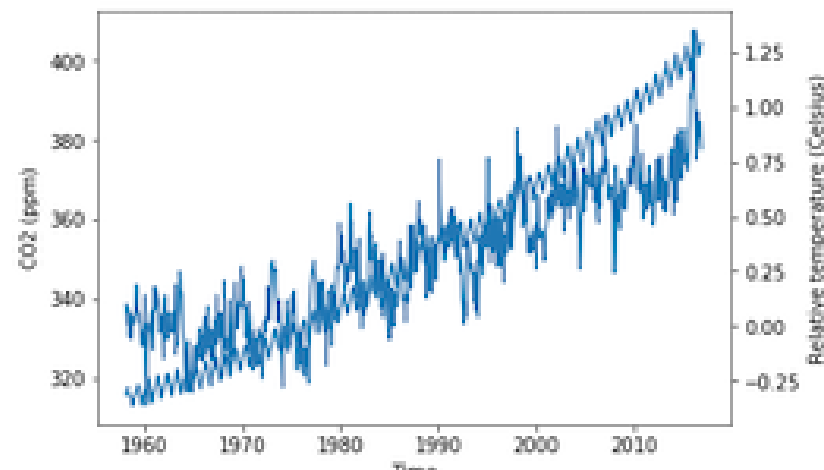


Using twin axes

```
fig, ax = plt.subplots()
ax.plot(climate_change.index, climate_change["co2"])
ax.set_xlabel('Time')
ax.set_ylabel('CO2 (ppm)')

ax2 = ax.twinx()

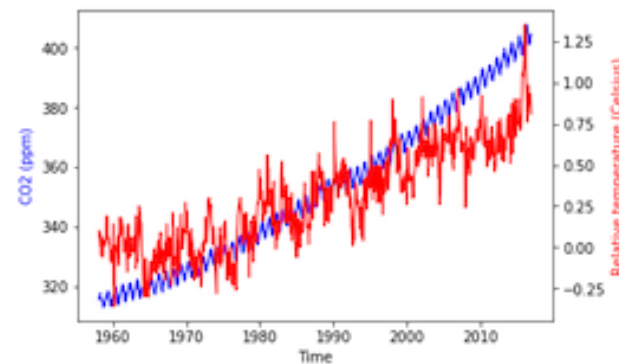
ax2.plot(climate_change.index, climate_change["relative_temp"])
ax2.set_ylabel('Relative temperature (Celsius)')
plt.show()
```



Separating variables by color

```
fig, ax = plt.subplots()
ax.plot(climate_change.index, climate_change["co2"], color='blue')
ax.set_xlabel('Time')
ax.set_ylabel('CO2 (ppm)', color='blue')

ax2 = ax.twinx()
ax2.plot(climate_change.index, climate_change["relative_temp"],
         color='red')
ax2.set_ylabel('Relative temperature (Celsius)', color='red')
plt.show()
```

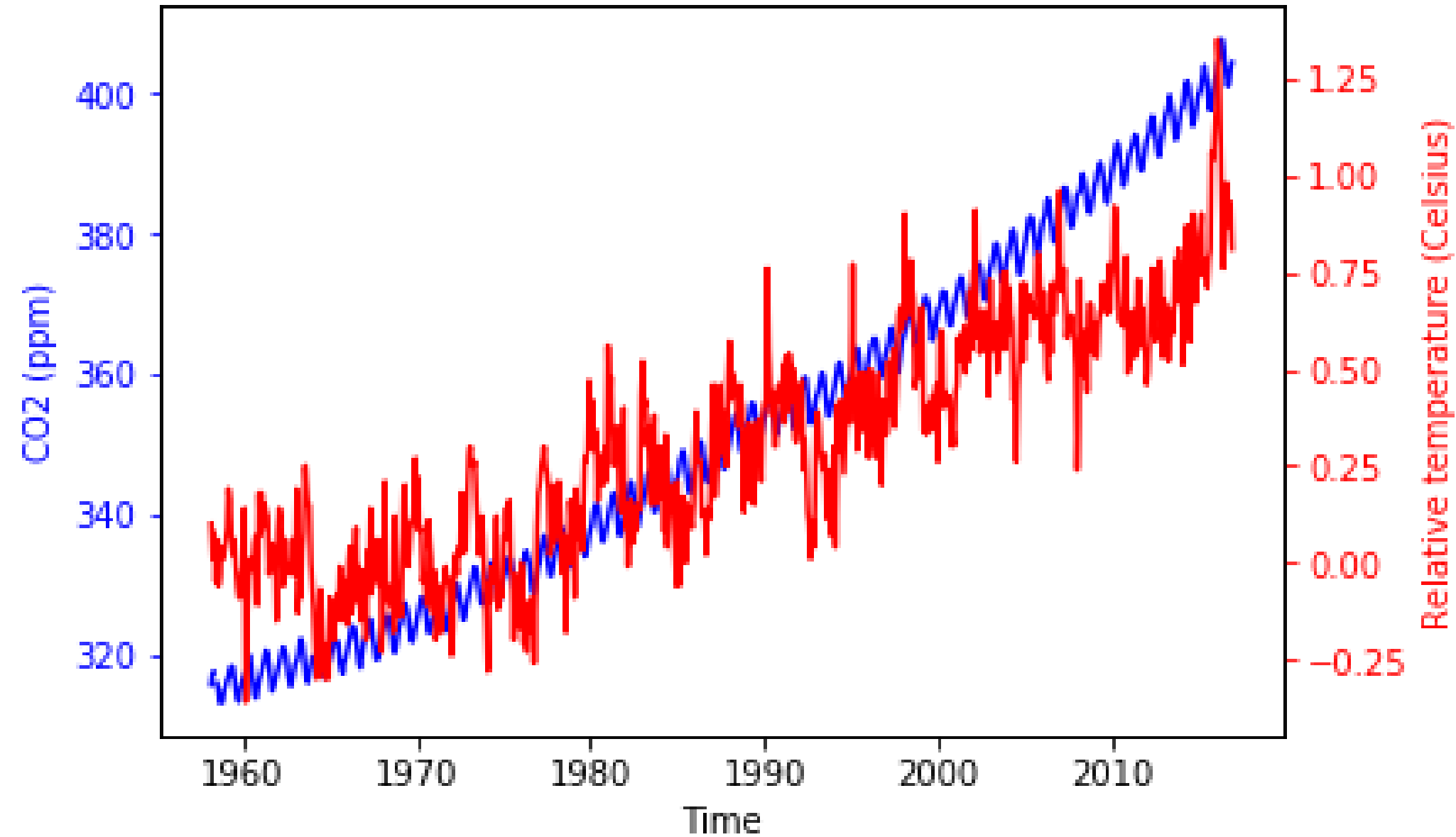


Coloring the ticks

```
fig, ax = plt.subplots()
ax.plot(climate_change.index, climate_change["co2"],
        color='blue')
ax.set_xlabel('Time')
ax.set_ylabel('CO2 (ppm)', color='blue')
ax.tick_params('y', colors='blue')

ax2 = ax.twinx()
ax2.plot(climate_change.index,
         climate_change["relative_temp"],
         color='red')
ax2.set_ylabel('Relative temperature (Celsius)',
              color='red')
ax2.tick_params('y', colors='red')
plt.show()
```

Coloring the ticks



A function that plots time-series

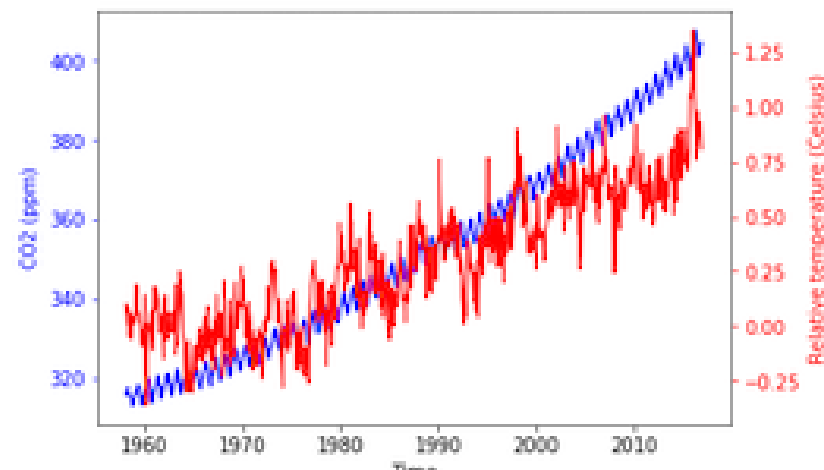
```
def plot_timeseries(axes, x, y, color, xlabel, ylabel):  
    axes.plot(x, y, color=color)  
    axes.set_xlabel(xlabel)  
    axes.set_ylabel(ylabel, color=color)  
    axes.tick_params('y', colors=color)
```

Using our function

```
fig, ax = plt.subplots()
plot_timeseries(axes, climate_change.index, climate_change['co2'],
                'blue', 'Time', 'CO2 (ppm)')

ax2 = ax.twinx()
plot_timeseries(axes, climate_change.index,
                climate_change['relative_temp'],
                'red', 'Time', 'Relative temperature (Celsius)')

plt.show()
```

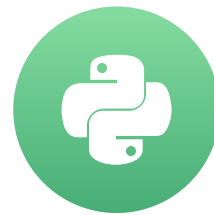


Create your own function!

INTRODUCTION TO MATPLOTLIB

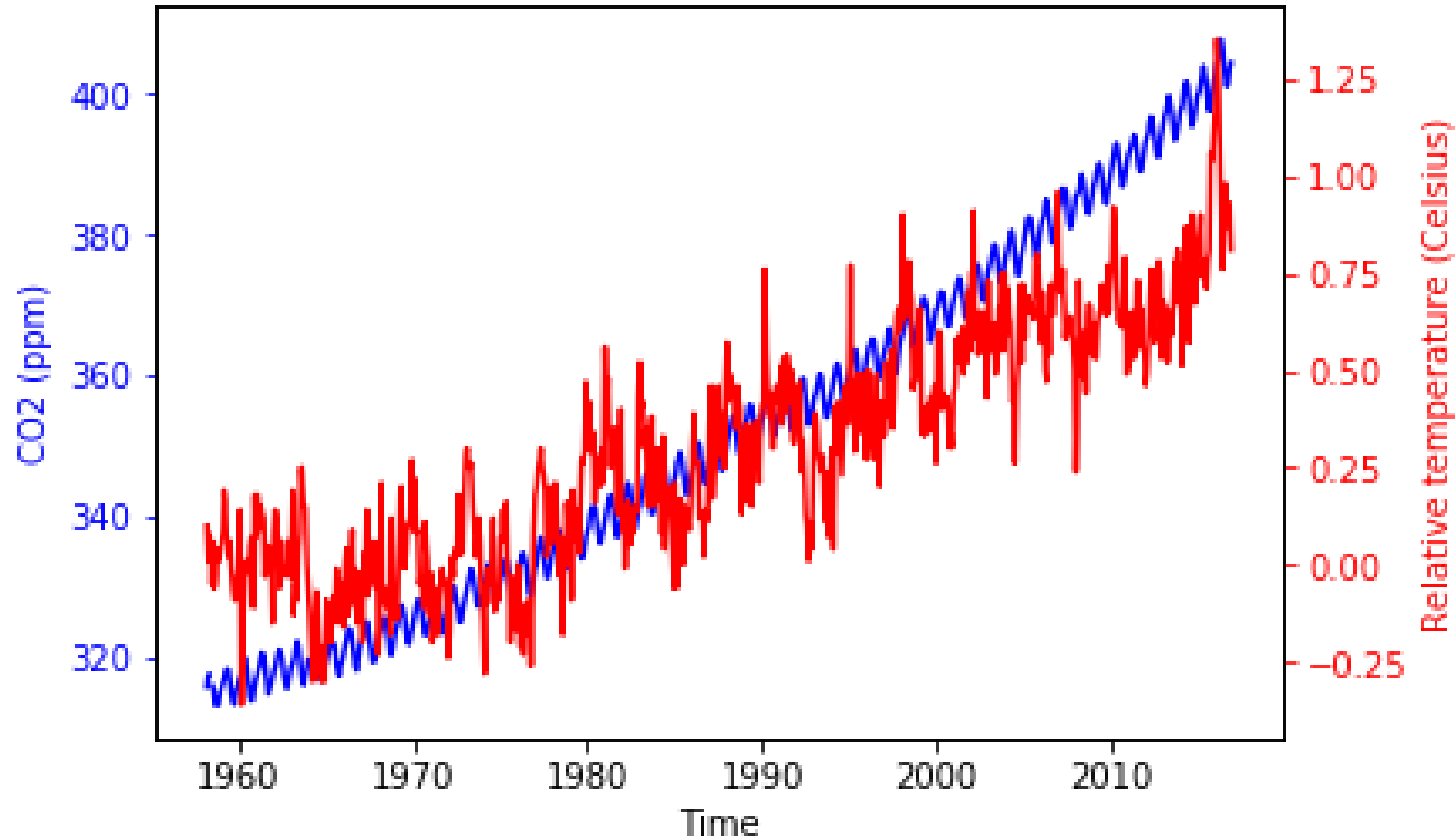
Annotating time-series data

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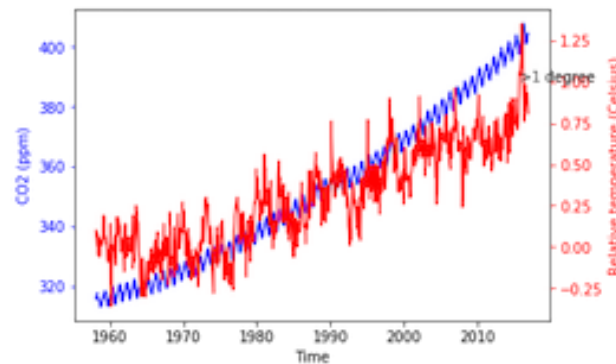
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Time-series data



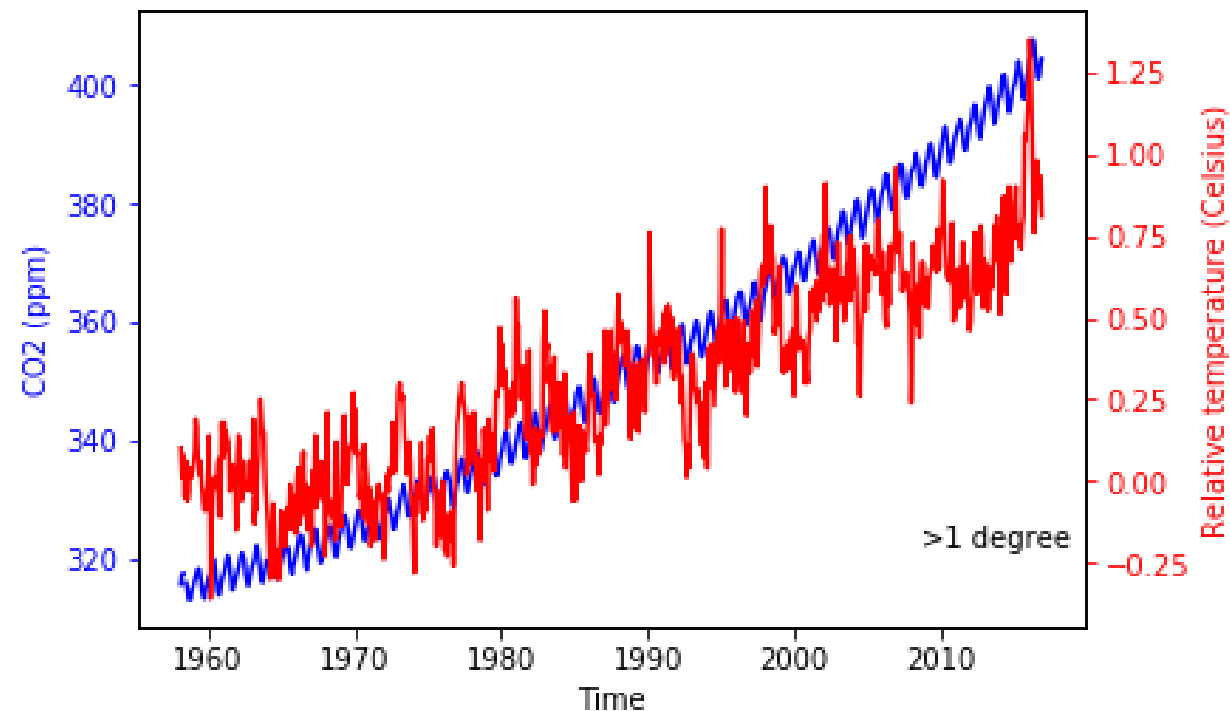
Annotation

```
fig, ax = plt.subplots()
plot_timeseries(axes, climate_change.index, climate_change['co2'],
                'blue', 'Time', 'CO2 (ppm)')
ax2 = ax.twinx()
plot_timeseries(axes, climate_change.index,
                climate_change['relative_temp'],
                'red', 'Time', 'Relative temperature (Celsius)')
ax2.annotate(">1 degree", xy=[pd.Timestamp("2015-10-06"), 1])
plt.show()
```



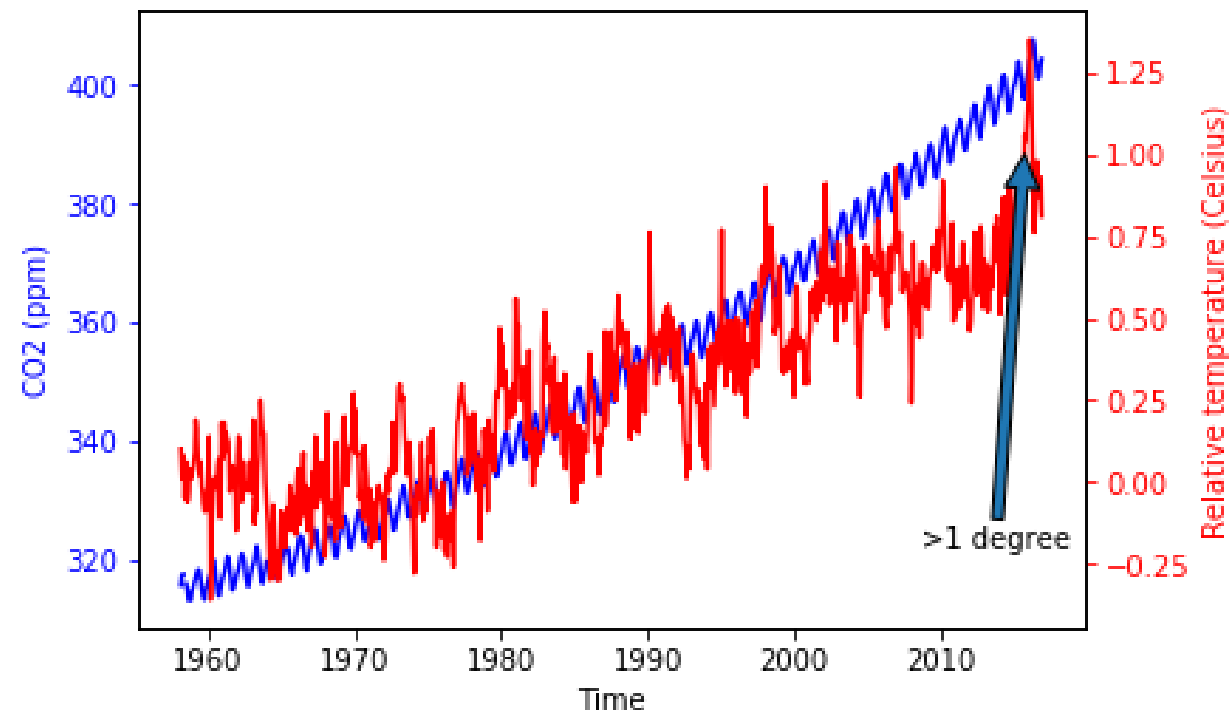
Positioning the text

```
ax2.annotate(">1 degree",  
            xy=(pd.Timestamp('2015-10-06'), 1),  
            xytext=(pd.Timestamp('2008-10-06'), -0.2))
```



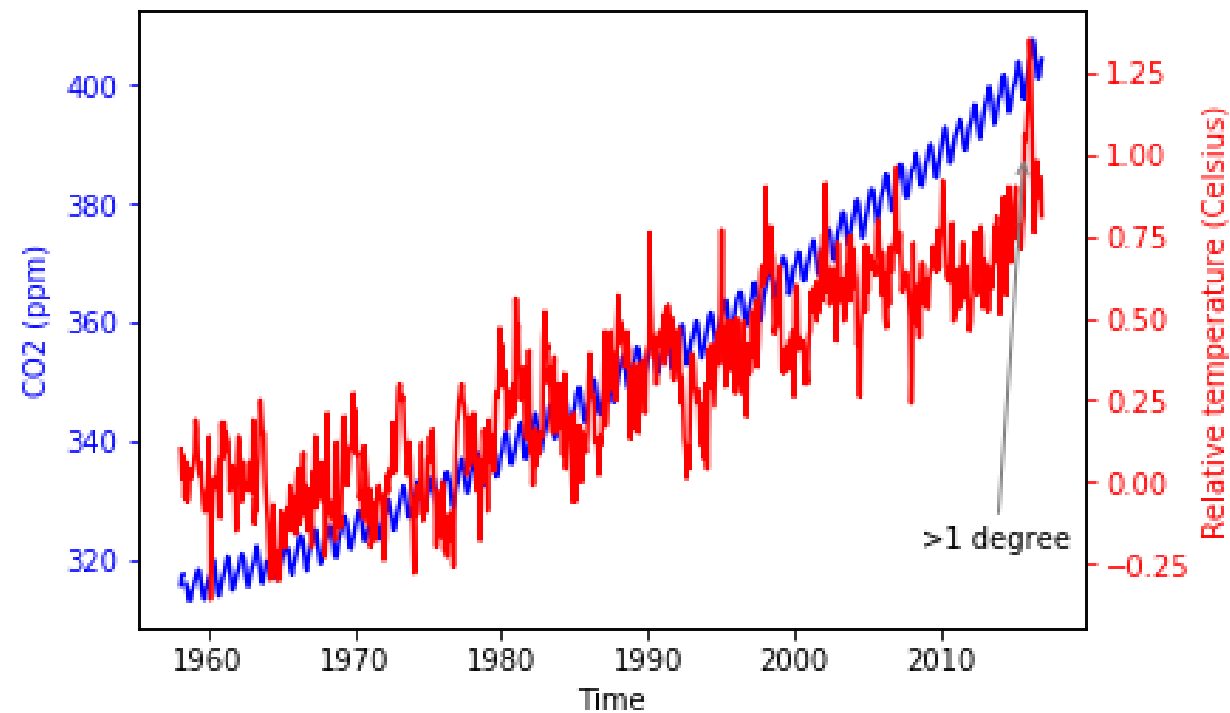
Adding arrows to annotation

```
ax2.annotate(">1 degree",  
            xy=(pd.Timestamp('2015-10-06'), 1),  
            xytext=(pd.Timestamp('2008-10-06'), -0.2),  
            arrowprops={})
```



Customizing arrow properties

```
ax2.annotate(">1 degree",  
            xy=(pd.Timestamp('2015-10-06'), 1),  
            xytext=(pd.Timestamp('2008-10-06'), -0.2),  
            arrowprops={"arrowstyle": "->", "color": "gray"})
```



Customizing annotations

<https://matplotlib.org/users/annotations.html>

Practice annotating plots!

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