Proyecto 2. Parte 1.

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Requerimientos.

Un archivo en html o en pdf con el EDA automático utilizando alguna herramienta.

Una libreta jupyter, o un Rmardown, en donde se realice un EDA más orientado a la relación de las variables, recuerda que no tiene que ser muy pulcro, solamente que permita la comunicación técnica entre colegas.

Un archivo en markdown, en el cual se especifique, La historia que queremos contar con nuestros datos, KPI y otros indicadores que son útiles para contar la historia (al menos 1)desarrollar la metodología tal como se muestra en alguno de los formatos facilitados.\ Un borrador (puede ser una foto tomada de un cuaderno) de como pensamos hacer el tablero de visualización.

La problematica que se busca analizar en esta sección del proyecto, es `que impacto tiene la temperatura real en el consumo de energía del estado`.

La metodología de elaboración de KPI se puede encontrar aquí: KPI

Para la presente sección se incluyeron las siguientes fuentes:

- Archivo "DemandaGCRN *, el cual contiene la demanda electrica de la región.
- Archivo "Real_Diario" de conagua. Considerando los datos reales del estado.
- Archivos contenidos en la carpeta zip, incluye algunas variables en tiempo real, generados por Meteomatics.

In [ ]:
```
#import libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import plotly.express as px
import plotly.graph_objects as go
import os

#EDA libraries
from pandas_profiling import ProfileReport
from pandas_profiling.visualisation.plot import timeseries_heatmap
```

In [ ]:
```
#set working directory
os.chdir('./files')
print(os.getcwd())
```

```
/Users/yhmve/nrgy_feng/files
```

Archivo 1: Demanda real.

In [ ]:
```
#exploring available files 01
df_demanda = pd.read_csv('DemandaGCRN020221031.csv', delimiter=",")
df_demanda.tail(2)
```

Out[ ]:

	FECHA	H1	H2	H3	H4	H5	H6	H7	H8	H9	...	H15	H16	H17	H18	H19	H20	H21	H22	H23	H24
5781	30/10/2022	2629.53	2535.63	2450.04	2359.91	2294.59	2264.86	2231.41	2168.14	2165.34	...	2618.61	2656.02	2696.42	2690.23	2655.08	2750.37	2776.64	2809.72	2773.22	2680.07
5782	31/10/2022	2566.49	2467.76	2383.80	2317.80	2257.29	2241.29	2257.35	2256.47	2320.47	...	2914.07	2990.75	3038.08	3014.08	2934.74	2926.85	2894.38	2877.56	2843.08	2772.44

2 rows × 25 columns

In [ ]:
```
df_demanda.info() #reviewing columns and dtypes
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5783 entries, 0 to 5782
Data columns (total 25 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   FECHA   5783 non-null   object
 1   H1      5783 non-null   float64
 2   H2      5783 non-null   float64
 3   H3      5783 non-null   float64
 4   H4      5783 non-null   float64
 5   H5      5783 non-null   float64
 6   H6      5783 non-null   float64
 7   H7      5783 non-null   float64
 8   H8      5783 non-null   float64
 9   H9      5783 non-null   float64
 10  H10     5783 non-null   float64
 11  H11     5783 non-null   float64
 12  H12     5783 non-null   float64
 13  H13     5783 non-null   float64
 14  H14     5783 non-null   float64
 15  H15     5783 non-null   float64
 16  H16     5783 non-null   float64
 17  H17     5783 non-null   float64
 18  H18     5783 non-null   float64
 19  H19     5783 non-null   float64
 20  H20     5783 non-null   float64
 21  H21     5783 non-null   float64
 22  H22     5783 non-null   float64
 23  H23     5783 non-null   float64
 24  H24     5783 non-null   float64
dtypes: float64(24), object(1)
memory usage: 1.1+ MB
```

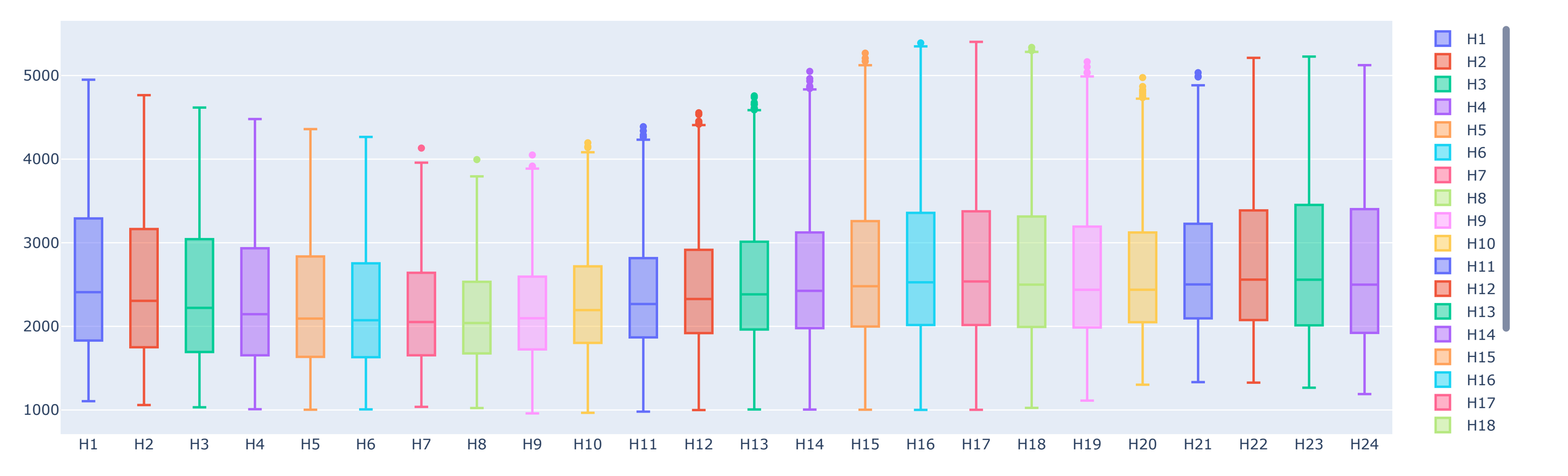
In [ ]:
```
#check for null values
df_demanda.isnull().sum() # check for null values, there is none
df_demanda.describe() #review
```

Out[ ]:

	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	...	H15	H16	H17	H18
count	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	...	5783.000000	5783.000000	5783.000000	5783.00000
mean	2587.026291	2482.607166	2395.337398	2321.298703	2259.878649	2218.953688	2176.724837	2140.685528	2195.350645	2296.725708	...	2676.137047	2733.599877	2742.815923	2699.38850
std	901.941794	874.350368	839.920596	803.437776	764.184118	723.829645	658.376044	597.775994	614.682505	645.262486	...	869.747305	915.021938	926.094018	902.12446
min	1105.000000	1059.000000	1032.000000	1009.000000	1003.000000	1007.000000	1037.000000	1023.000000	959.000000	966.000000	...	1003.000000	1001.000000	1002.000000	1025.00000
25%	1830.500000	1750.155000	1693.370000	1654.040000	1635.150000	1631.400000	1654.175000	1676.670000	1724.170000	1802.220000	...	1998.000000	2016.000000	2016.000000	1993.00500
50%	2408.810000	2305.000000	2221.000000	2145.290000	2093.000000	2073.150000	2052.000000	2040.000000	2097.000000	2194.510000	...	2480.000000	2527.000000	2537.000000	2499.00000
75%	3290.500000	3163.890000	3042.585000	2934.000000	2836.000000	2754.000000	2640.500000	2532.465000	2594.415000	2717.675000	...	3258.500000	3357.220000	3375.795000	3313.50000
max	4950.140000	4765.340000	4616.920000	4479.680000	4359.280000	4265.730000	4132.320000	3994.670000	4049.500000	4195.830000	...	5268.000000	5390.000000	5402.720000	5336.53000

8 rows × 24 columns

In [ ]:
```
#reviewing the hourly columns before transposing
fig = go.Figure()
for col in df_demanda:
  if col == 'FECHA':
     pass
  else :
    fig.add_trace(go.Box(y=df_demanda[col].values, name=df_demanda[col].name))

fig.show(renderer='notebook')
```



In [ ]:
```
# Transpose and convert hour columns to rows
deman_td = df_demanda.melt(

    id_vars= ['FECHA'],
    value_vars= [f'H{i}' for i in range(1,24)],
    var_name="Hour",
    value_name="Demanda"
).replace(
    {f'H{i}': i for i in range(1,24)}
)
```

In [ ]:
```
deman_td.shape
```

Out[ ]:
```
(133009, 3)
```

In [ ]:
```
#Adjust Date to correct datatype
deman_td['FECHA'] =  pd.to_datetime(deman_td['FECHA'], format='%d/%m/%Y')
```

In [ ]:
```
# Creating Day, Hour and Month columns
deman_td.index = deman_td.FECHA + pd.to_timedelta(deman_td.Hour, unit='h')
deman_td.sort_index(inplace=True)
deman_td.drop(columns=['Hour'], inplace=True)
deman_td = deman_td.asfreq('h', method='pad')
deman_td['Date_time'] = deman_td.index
deman_td["Date"] = deman_td.index.weekday
deman_td["Hour"] = deman_td.index.hour
deman_td["Month"] = deman_td.index.month
```

In [ ]:
```
deman_td.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 138791 entries, 2007-01-01 01:00:00 to 2022-10-31 23:00:00
Freq: H
Data columns (total 6 columns):
 #   Column     Non-Null Count   Dtype
---  ------     --------------   -----
 0   FECHA      138791 non-null  datetime64[ns]
 1   Demanda    138791 non-null  float64
 2   Date_time  138791 non-null  datetime64[ns]
 3   Date       138791 non-null  int64
 4   Hour       138791 non-null  int64
 5   Month      138791 non-null  int64
dtypes: datetime64[ns](2), float64(1), int64(3)
memory usage: 7.4 MB
```

In [ ]:
```
# Setting as index column date time
deman_td.set_index("Date_time", inplace=True)
```

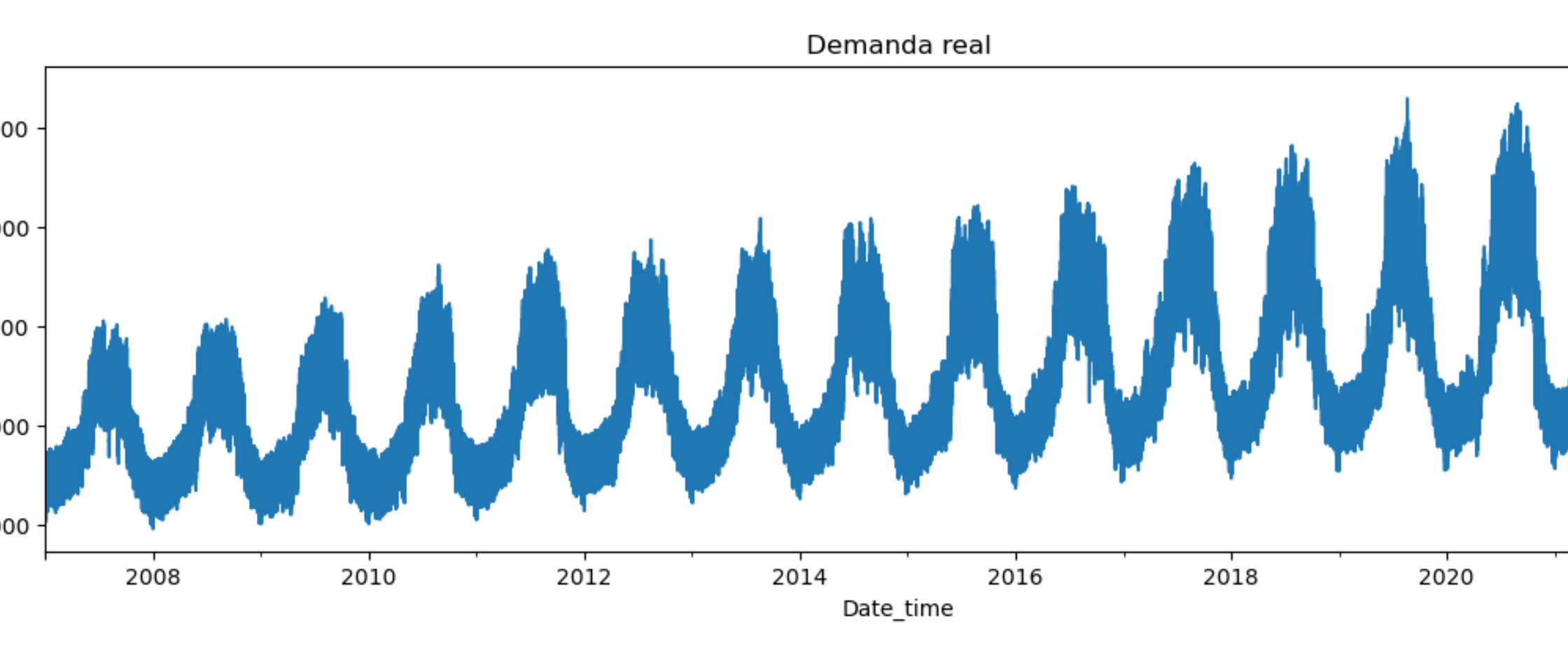
In [ ]:
```
# function to add season column
def find_season(month):
    dseason = {
            12:'Winter', 1:'Winter', 2:'Winter',
            3:'Spring', 4:'Spring', 5:'Spring',
            6:'Summer', 7:'Summer', 8:'Summer',
            9:'Autumn', 10:'Autumn', 11:'Autumn'}
    return dseason.get(month)

season_list = []
hemisphere = 'Southern'
for month in deman_td['Month']:
    season = find_season(month)
    season_list.append(season)

deman_td['Season'] = season_list
deman_td.head()
```

Out[ ]:

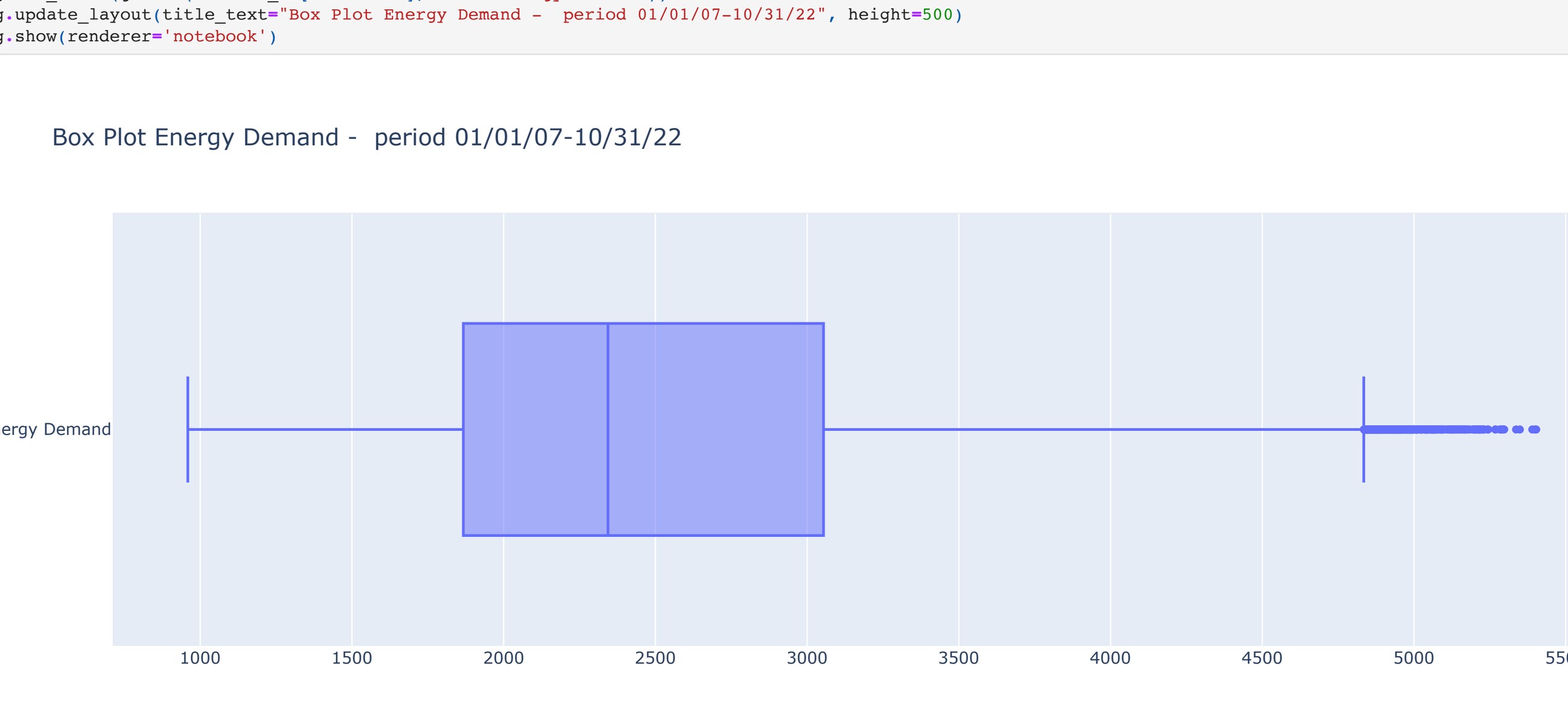
Date_time	FECHA	Demanda	Date	Hour	Month	Season
2007-01-01 01:00:00	2007-01-01	1297.0	0	1	1	Winter
2007-01-01 02:00:00	2007-01-01	1255.0	0	2	1	Winter
2007-01-01 03:00:00	2007-01-01	1222.0	0	3	1	Winter
2007-01-01 04:00:00	2007-01-01	1168.0	0	4	1	Winter
2007-01-01 05:00:00	2007-01-01	1128.0	0	5	1	Winter

In [ ]:
```
deman_td['Demanda'].plot(figsize =(14,4), title = 'Demanda real')
```

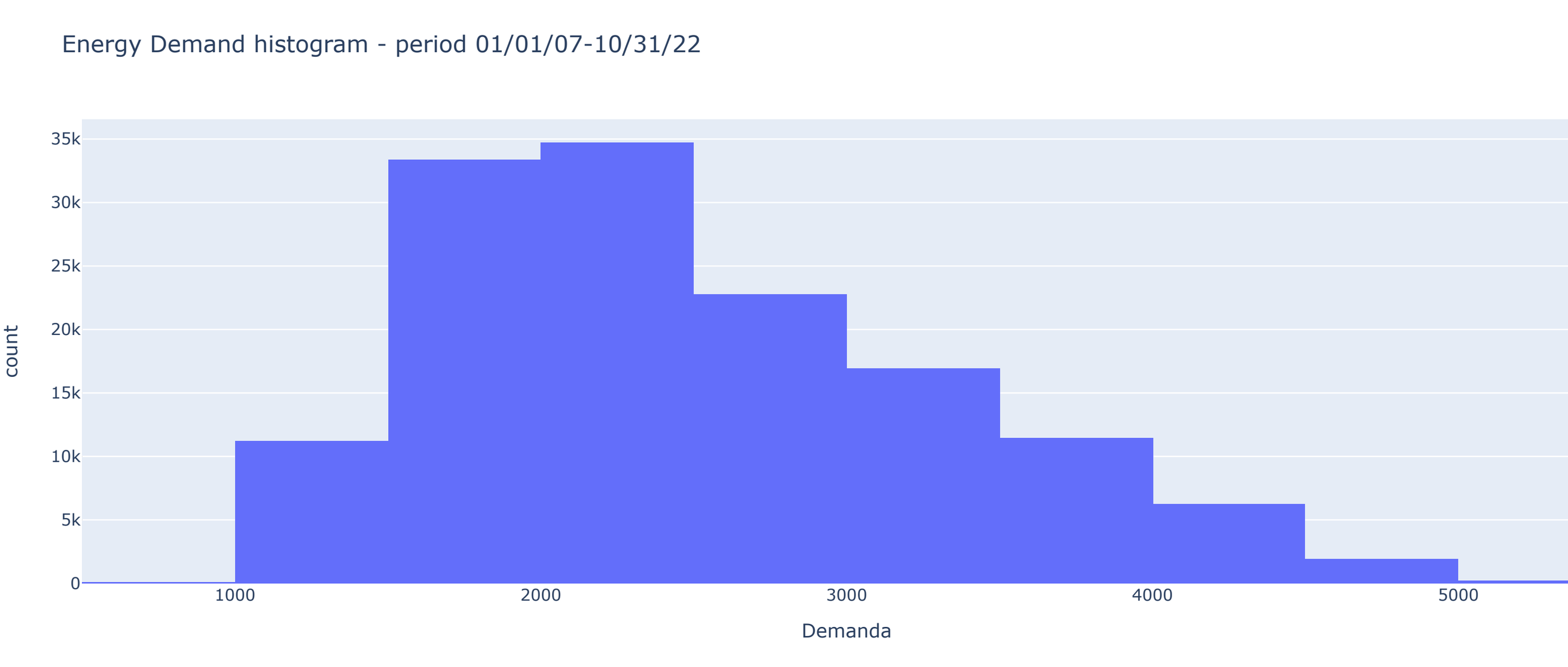
Out[ ]:
```
<AxesSubplot:title={'center':'Demanda real'}, xlabel='Date_time'>
```



In [ ]:
```
#All time boxplot
fig = go.Figure()
fig.add_trace(go.Box(x=deman_td['Demanda'], name='Energy Demand'))
fig.update_layout(title_text="Box Plot Energy Demand -  period 01/01/07-10/31/22", height=500)
fig.show(renderer='notebook')
```



In [ ]:
```
#Energy demand histogram
fig = px.histogram(deman_td, x="Demanda", nbins=12, title="Energy Demand histogram - period 01/01/07-10/31/22")
fig.show(renderer='notebook')
```



In [ ]:

Archivo 2. Datos reales de temperaturas. Para este análisis nos enfocamos en las ciudades de Sonora.

In [ ]:
```
#exploring available files 02
df_real = pd.read_csv('REAL_DIARIO_CONAGUA 20221031.csv', delimiter=',')
df_real.shape
```

Out[ ]:
```
(5783, 15)
```

In [ ]:
```
#Keeping only columns of Sonora
df_real.drop(['TMAX-LMO','TMAX-CUL','TMIN-LMO','TMIN-CUL','PREC_LMO   (mm)','PREC_CUL   (mm)'], axis=1, inplace=True)
df_real.head(2)
```

Out[ ]:

	FECHA	TMAX-CAB	TMAX-HMO	TMAX-OBR	TMIN-CAB	TMIN-HMO	TMIN-OBR	PREC_HMO (mm)	PREC_OBR (mm)
0	01/01/2007	21.0	21.5	25.0	2.0	9.0	7.5	0.0	0.0
1	02/01/2007	20.5	22.0	22.0	1.8	7.0	7.0	0.0	0.5

In [ ]:
```
df_real.describe()
```

Out[ ]:

	TMAX-CAB	TMAX-HMO	TMAX-OBR	TMIN-CAB	TMIN-HMO	TMIN-OBR	PREC_HMO (mm)	PREC_OBR (mm)
count	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000	5783.000000
mean	32.998757	33.553745	34.537721	16.495575	18.503777	18.666749	1.398314	1.166718
std	7.801715	6.634979	5.928113	7.922205	7.057940	6.737775	6.940515	6.681513
min	9.090000	8.000000	12.000000	-6.800000	-3.000000	2.000000	0.000000	0.000000
25%	26.965000	28.720000	30.000000	10.100000	13.000000	13.000000	0.000000	0.000000
50%	33.730000	34.500000	35.410000	16.000000	18.000000	18.000000	0.000000	0.000000
75%	39.500000	39.000000	39.280000	23.565000	25.000000	25.000000	0.000000	0.000000
max	49.610000	49.100000	47.000000	32.900000	34.000000	42.500000	117.000000	166.800000

In [ ]:
```
#Adjust Date to correct datatype
df_real['FECHA'] =  pd.to_datetime(df_real['FECHA'], format='%d/%m/%Y')
```

In [ ]:
```
# Setting as index column date time
df_real.set_index("FECHA", inplace=True)
```

In [ ]:
```
df_real.tail(4)
#df_real.columns
```

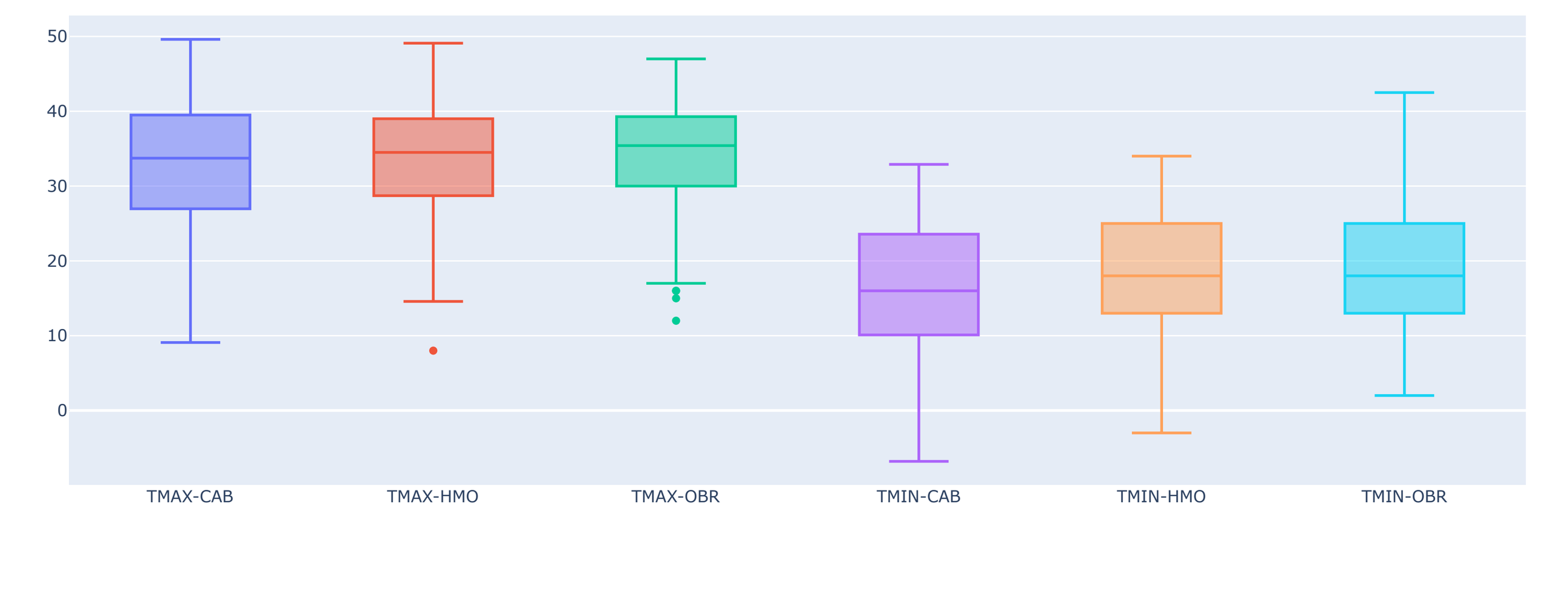
Out[ ]:

FECHA	TMAX-CAB	TMAX-HMO	TMAX-OBR	TMIN-CAB	TMIN-HMO	TMIN-OBR	PREC_HMO (mm)	PREC_OBR (mm)
2022-10-28	29.8	33.5	34.0	9.4	13.0	14.0	0.0	0.0
2022-10-29	29.0	32.0	33.0	9.2	12.0	16.0	0.0	0.0
2022-10-30	30.0	33.0	33.0	15.0	11.5	13.5	0.0	0.0
2022-10-31	29.0	31.5	31.5	15.0	16.0	14.0	0.0	0.0

In [ ]:
```
df_real.isnull().sum() # check for null values
```

Out[ ]:
```
TMAX-CAB          0
TMAX-HMO          0
TMAX-OBR          0
TMIN-CAB          0
TMIN-HMO          0
TMIN-OBR          0
PREC_HMO   (mm)   0
PREC_OBR   (mm)   0
dtype: int64
```

In [ ]:
```
#reviewing  actual temperatures
fig = go.Figure()
for col in df_real:
  if col == 'PREC_HMO   (mm)':
     pass
  elif col == 'PREC_OBR   (mm)':
     pass
  else :
    fig.add_trace(go.Box(y=df_real[col].values, name=df_real[col].name))


fig.show(renderer='notebook')
```



In [ ]:
```
#Eda
#report_actd = ProfileReport(df_real, title="Actual temperatures region Report")
#report_actd. to_file("Actualtrr_EDA.html")
```

Archivo 3. dataset basado zonas de carga del estado, con las variables del tiempo real horaria de la fuente Meteomatics.

In [ ]:
```
#Explore file 3 ( Created from Meteomatics)
df_rlreg = pd.read_csv('real_met.csv', delimiter=",")
df_rlreg.shape
```

Out[ ]:
```
(674545, 14)
```

In [ ]:
```
#verifying datatypes
df_rlreg['Fecha'].head()
#Adjust Date to correct datatype
df_rlreg['Fecha'] =  pd.to_datetime(df_rlreg['Fecha'], format='%d/%m/%Y')
```

In [ ]:
```
df_rlreg.set_index = df_rlreg.set_index('Fecha') #set fecha as index
```

In [ ]:
```
df_rlreg.columns
#print(np.unique(df_rlreg[['Gerencia']])) # identifying unique values
```

Out[ ]:
```
Index(['Gerencia', 'Zona_Carga', 'Estacion', 'API', 'Fecha', 'Hora',
       'Temperatura', 'Temperatura_Aparente', 'Precipitacion', 'Humedad',
       'Velocidad_Viento', 'Radiacion_Solar', 'Nubosidad', 'file'],
      dtype='object')
```

In [ ]:
```
#Create new dataframes including only required columns
metr_columns=  ['Zona_Carga',
                'Fecha',
                'Hora',
                'Temperatura',
                'Temperatura_Aparente',
                'Precipitacion',
                'Humedad',
                'Velocidad_Viento',
                'Radiacion_Solar',
                'Nubosidad']

df_mtrl = df_rlreg[metr_columns].copy() #creating a copy for tidy data
df_mtrl = df_mtrl.set_index('Fecha') #set fecha as index
df_mtrl.head(3)
```

Out[ ]:

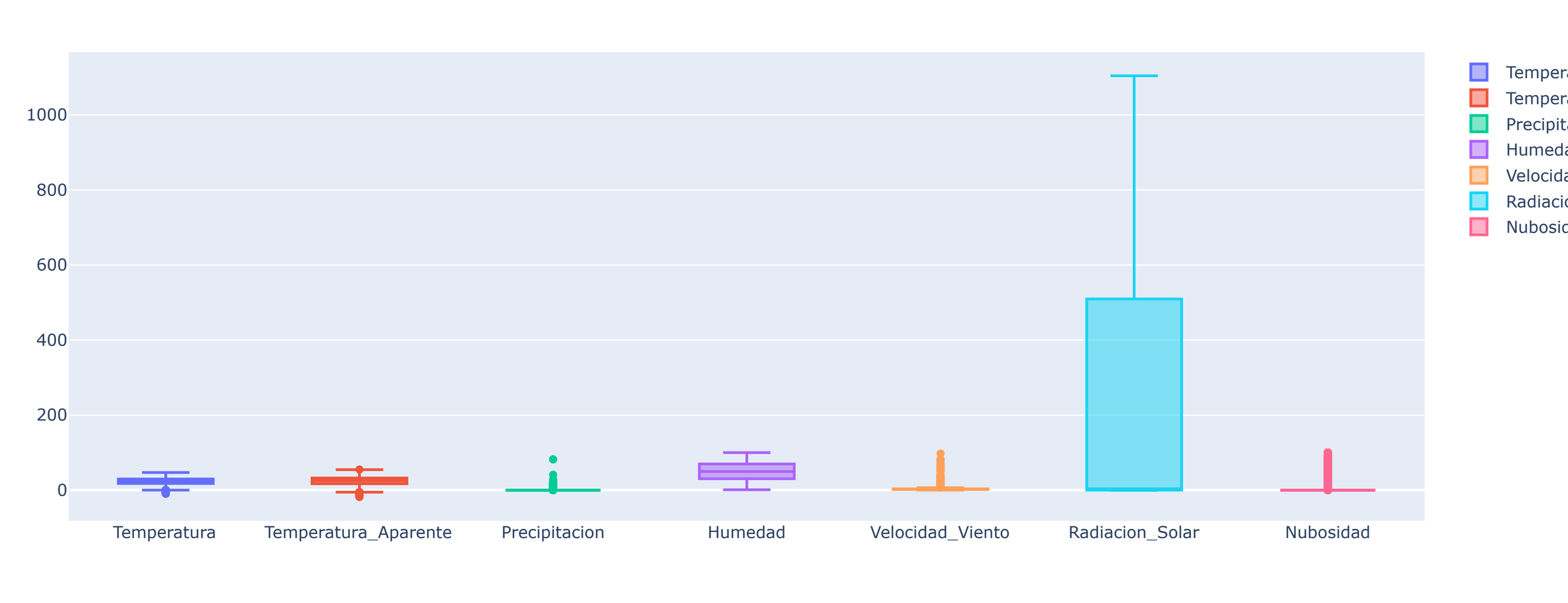
Fecha	Zona_Carga	Hora	Temperatura	Temperatura_Aparente	Precipitacion	Humedad	Velocidad_Viento	Radiacion_Solar	Nubosidad
2010-01-01	Obregon	0	14.7	13.7	0.0	58.9	2.9	0.0	0.0
2010-01-01	Obregon	1	14.3	13.6	0.0	61.5	2.6	0.0	0.0
2010-01-01	Obregon	2	12.5	12.1	0.0	64.8	2.5	0.0	0.0

In [ ]:
```
#in order to combine the files, we would not use date + time at this point
#df_mtrl.index = df_mtrl.Fecha + pd.to_timedelta(df_mtrl.Hora, unit='h')
#df_mtrl.head(4)
```

In [ ]:
```
df_mtrl.isnull().sum() # check for null values
```

Out[ ]:
```
Zona_Carga              0
Hora                    0
Temperatura             0
Temperatura_Aparente    0
Precipitacion           0
Humedad                 0
Velocidad_Viento        0
Radiacion_Solar         0
Nubosidad               0
dtype: int64
```

In [ ]:
```
#reviewing  actual temperatures
fig = go.Figure()
for col in df_mtrl:
  if col == 'Zona_Carga':
     pass
  elif col == 'Fecha':
     pass
  elif col == 'Hora':
     pass
  else :
    fig.add_trace(go.Box(y=df_mtrl[col].values, name=df_mtrl[col].name))

fig.show(renderer='notebook')
```



In [ ]:
```
#Eda
#report_fore = ProfileReport(df_mtrl, title="forecasted temperatures region Report")
#report_fore. to_file("forecasted_trr_EDA.html")
```

Join Dataframe.

Uniremos el DF de demanda, con Temperatura real

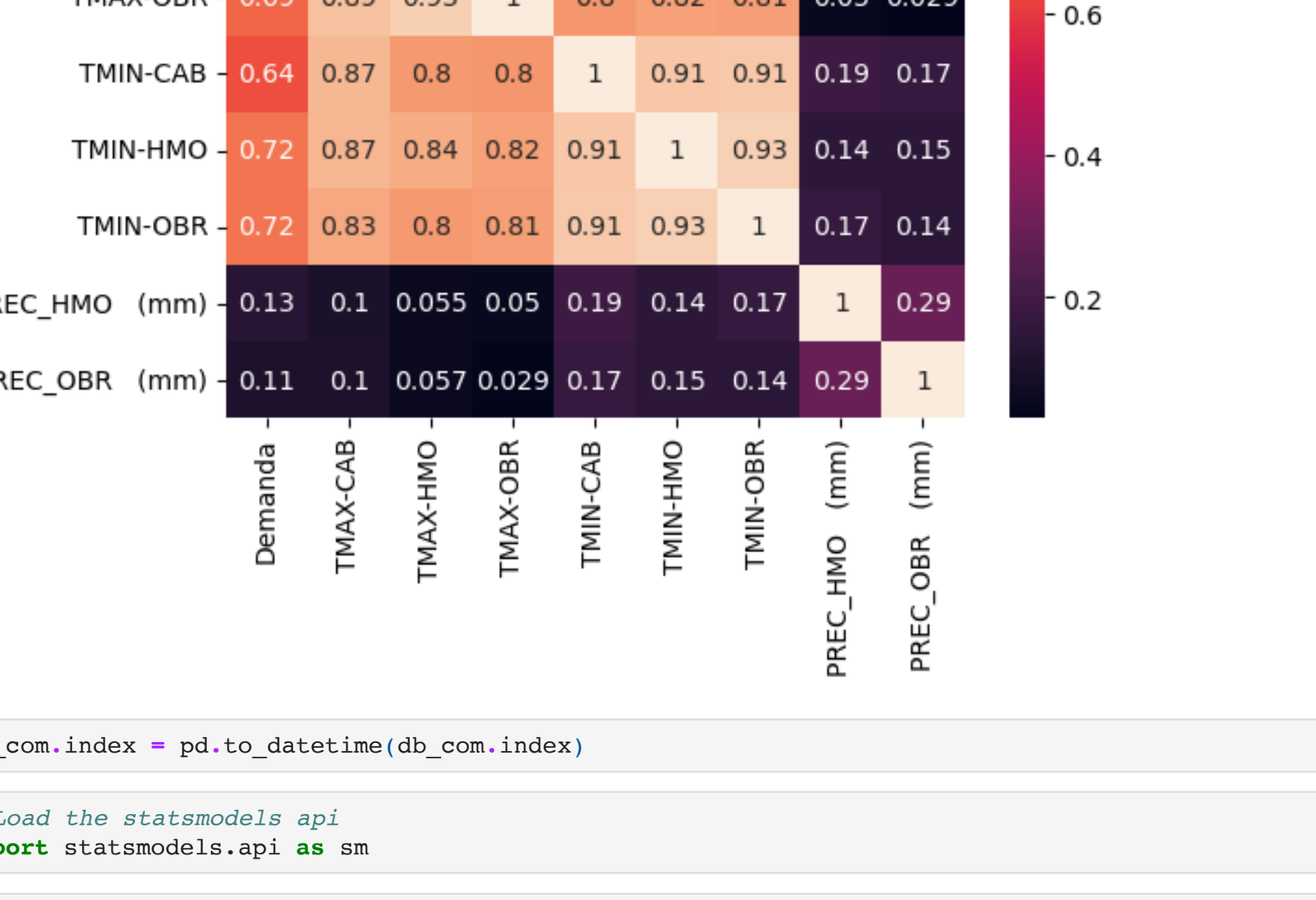
In [ ]:
```
deman_td2 = deman_td.set_index('FECHA') # TO Join the datasets, will be using Date wo time
db_com= deman_td2.join(df_real)
db_com.head()
```

Out[ ]:

FECHA	Demanda	Date	Hour	Month	Season	TMAX-CAB	TMAX-HMO	TMAX-OBR	TMIN-CAB	TMIN-HMO	TMIN-OBR	PREC_HMO (mm)	PREC_OBR (mm)
2007-01-01	1297.0	0	1	1	Winter	21.0	21.5	25.0	2.0	9.0	7.5	0.0	0.0
2007-01-01	1255.0	0	2	1	Winter	21.0	21.5	25.0	2.0	9.0	7.5	0.0	0.0
2007-01-01	1222.0	0	3	1	Winter	21.0	21.5	25.0	2.0	9.0	7.5	0.0	0.0
2007-01-01	1168.0	0	4	1	Winter	21.0	21.5	25.0	2.0	9.0	7.5	0.0	0.0
2007-01-01	1128.0	0	5	1	Winter	21.0	21.5	25.0	2.0	9.0	7.5	0.0	0.0

In [ ]:
```
#Create EDA for combined dataset, we set these as comments to avoid rerunning it
#report_comb = ProfileReport(db_com, title="Demanda vs temperatura real Sonora")
#report_comb. to_file("Demandatemp_EDA.html")
```

In [ ]:
```
#correlations Matrix
import seaborn as sns
com_m = db_com[['Demanda','TMAX-CAB', 'TMAX-HMO', 'TMAX-OBR', 'TMIN-CAB',
       'TMIN-HMO', 'TMIN-OBR', 'PREC_HMO   (mm)','PREC_OBR   (mm)']].corr()
sns.heatmap(com_m, annot=True)
plt.show()
```



In [ ]:
```
db_com.index = pd.to_datetime(db_com.index)
```

In [ ]:
```
# Load the statsmodels api
import statsmodels.api as sm
```

In [ ]:
```
#send combined dataframe to file
db_com.to_csv (r'dfcombined.csv', index = True)
```