ComoUsar

March 20, 2024

[ ]:

```python
import pandas as pd
from pyExtremeHelper import pyExtremeHelper  # Asumiendo que la clase está en␣
 ↪helper.py
pyExtremeHelper = pyExtremeHelper()
# Llamada al método estático para leer el archivo .dat y crear el DataFrame
df = pyExtremeHelper.ler_arquivo_dat("utils/C1_CP_FGM_FULL/data.dat")
```

[ ]:

```python
df
```

[ ]:

```
      time_tags__C1_CP_FGM_FULL1 half_interval__C1_CP_FGM_FULL1  \
0       2001-02-13T10:42:00.015Z                        0.02231
1       2001-02-13T10:42:00.060Z                        0.02231
2       2001-02-13T10:42:00.104Z                        0.02231
3       2001-02-13T10:42:00.149Z                        0.02231
4       2001-02-13T10:42:00.193Z                        0.02231
…                            …                              …
10758   2001-02-13T10:49:59.822Z                        0.02231
10759   2001-02-13T10:49:59.867Z                        0.02231
10760   2001-02-13T10:49:59.911Z                        0.02231
10761   2001-02-13T10:49:59.956Z                        0.02231
10762   2001-02-13T10:50:00.000Z                        0.02231

      B_vec_xyz_gse__C1_CP_FGM_FULL1 B_vec_xyz_gse__C1_CP_FGM_FULL2  \
0                              5.113                         -7.599
1                              5.090                         -7.587
2                              5.107                         -7.577
3                              5.094                         -7.576
4                              5.060                         -7.551
…                                …                            …
10758                         -2.200                          7.041
10759                         -2.185                          7.024
10760                         -2.139                          7.011
10761                         -2.088                          7.091
10762                         -2.073                          7.090

      B_vec_xyz_gse__C1_CP_FGM_FULL3 B_mag__C1_CP_FGM_FULL1  \
0                             -1.399                  9.265
```

```
1                                  -1.362                    9.237
2                                  -1.387                    9.242
3                                  -1.385                    9.234
4                                  -1.382                    9.195
…                                  …                      …
10758                              -1.339                    7.497
10759                              -1.282                    7.467
10760                              -1.301                    7.444
10761                              -1.315                    7.508
10762                              -1.299                    7.500

       sc_pos_xyz_gse__C1_CP_FGM_FULL1 sc_pos_xyz_gse__C1_CP_FGM_FULL2  \
0                                  99738.7                             14388.7
1                                  99738.6                             14388.7
2                                  99738.6                             14388.7
3                                  99738.5                             14388.6
4                                  99738.5                             14388.6
…                                   …                                 …
10758                              99217.6                             14068.4
10759                              99217.5                             14068.4
10760                              99217.5                             14068.3
10761                              99217.4                             14068.3
10762                              99217.4                             14068.3

       sc_pos_xyz_gse__C1_CP_FGM_FULL3 range__C1_CP_FGM_FULL1  \
0                                 -29831.2                      2
1                                 -29831.3                      2
2                                 -29831.3                      2
3                                 -29831.4                      2
4                                 -29831.4                      2
…                                   …                      …
10758                             -30233.0                      2
10759                             -30233.1                      2
10760                             -30233.1                      2
10761                             -30233.1                      2
10762                             -30233.2                      2

       tm__C1_CP_FGM_FULL1
0                      22  $
1                      22  $
2                      22  $
3                      22  $
4                      22  $
…                      …
10758                  22  $
10759                  22  $
10760                  22  $
```

```
10761                22  $
10762                22  $

[10763 rows x 11 columns]
```

[ ]:

```
for col in ['sc_pos_xyz_gse__C1_CP_FGM_FULL1',␣
 ↪'sc_pos_xyz_gse__C1_CP_FGM_FULL2',␣
 ↪'sc_pos_xyz_gse__C1_CP_FGM_FULL3','B_vec_xyz_gse__C1_CP_FGM_FULL1',␣
 ↪'B_vec_xyz_gse__C1_CP_FGM_FULL2', 'B_vec_xyz_gse__C1_CP_FGM_FULL3']:
    df[col] = df[col].astype(float)
```

[ ]:

```

```

[ ]:

```
import numpy as np
import pandas as pd

# Carregar os datasets
data_1 = pyExtremeHelper.ler_arquivo_dat("utils/C1_CP_FGM_FULL/data.dat")
data_2 = pyExtremeHelper.ler_arquivo_dat("utils/C2_CP_FGM_FULL/
 ↪C2_CP_FGM_FULL__20010213_104200_20010213_105000_V140306.cef")
data_3 = pyExtremeHelper.ler_arquivo_dat("utils/C3_CP_FGM_FULL/
 ↪C3_CP_FGM_FULL__20010213_104200_20010213_105000_V140305.cef")
data_4 = pyExtremeHelper.ler_arquivo_dat("utils/C4_CP_FGM_FULL/
 ↪C4_CP_FGM_FULL__20010213_104200_20010213_105000_V140305.cef")

# Extrair valores relevantes dos datasets
```

[ ]:

```
data_2.columns = data_1.columns
data_3.columns = data_1.columns
data_4.columns = data_1.columns
```

[ ]:

```
for col in data_1.columns:
    try:
        data_1[col] = data_1[col].astype(float)
        data_2[col] = data_2[col].astype(float)
        data_3[col] = data_3[col].astype(float)
        data_4[col] = data_4[col].astype(float)
    except:
        pass
```

[ ]:

```
data_1 = data_1[:len(data_2)]
data_1
```

[ ]:

```
      time_tags__C1_CP_FGM_FULL1  half_interval__C1_CP_FGM_FULL1  \
0        2001-02-13T10:42:00.015Z                         0.02231
1        2001-02-13T10:42:00.060Z                         0.02231
2        2001-02-13T10:42:00.104Z                         0.02231
```

```
3       2001-02-13T10:42:00.149Z                         0.02231
4       2001-02-13T10:42:00.193Z                         0.02231
…                          …                             …
10757   2001-02-13T10:49:59.777Z                         0.02231
10758   2001-02-13T10:49:59.822Z                         0.02231
10759   2001-02-13T10:49:59.867Z                         0.02231
10760   2001-02-13T10:49:59.911Z                         0.02231
10761   2001-02-13T10:49:59.956Z                         0.02231

       B_vec_xyz_gse__C1_CP_FGM_FULL1  B_vec_xyz_gse__C1_CP_FGM_FULL2  \
0                               5.113                          -7.599
1                               5.090                          -7.587
2                               5.107                          -7.577
3                               5.094                          -7.576
4                               5.060                          -7.551
…                               …                             …
10757                          -2.179                           7.030
10758                          -2.200                           7.041
10759                          -2.185                           7.024
10760                          -2.139                           7.011
10761                          -2.088                           7.091

       B_vec_xyz_gse__C1_CP_FGM_FULL3  B_mag__C1_CP_FGM_FULL1  \
0                              -1.399                   9.265
1                              -1.362                   9.237
2                              -1.387                   9.242
3                              -1.385                   9.234
4                              -1.382                   9.195
…                               …                     …
10757                          -1.407                   7.493
10758                          -1.339                   7.497
10759                          -1.282                   7.467
10760                          -1.301                   7.444
10761                          -1.315                   7.508

       sc_pos_xyz_gse__C1_CP_FGM_FULL1  sc_pos_xyz_gse__C1_CP_FGM_FULL2  \
0                              99738.7                          14388.7
1                              99738.6                          14388.7
2                              99738.6                          14388.7
3                              99738.5                          14388.6
4                              99738.5                          14388.6
…                                …                              …
10757                          99217.6                          14068.4
10758                          99217.6                          14068.4
10759                          99217.5                          14068.4
10760                          99217.5                          14068.3
10761                          99217.4                          14068.3
```

```
       sc_pos_xyz_gse__C1_CP_FGM_FULL3  range__C1_CP_FGM_FULL1  \
0                             -29831.2                     2.0
1                             -29831.3                     2.0
2                             -29831.3                     2.0
3                             -29831.4                     2.0
4                             -29831.4                     2.0
…                                 …                     …
10757                         -30233.0                     2.0
10758                         -30233.0                     2.0
10759                         -30233.1                     2.0
10760                         -30233.1                     2.0
10761                         -30233.1                     2.0

      tm__C1_CP_FGM_FULL1
0                   22  $
1                   22  $
2                   22  $
3                   22  $
4                   22  $
…                   …
10757               22  $
10758               22  $
10759               22  $
10760               22  $
10761               22  $

[10762 rows x 11 columns]
```

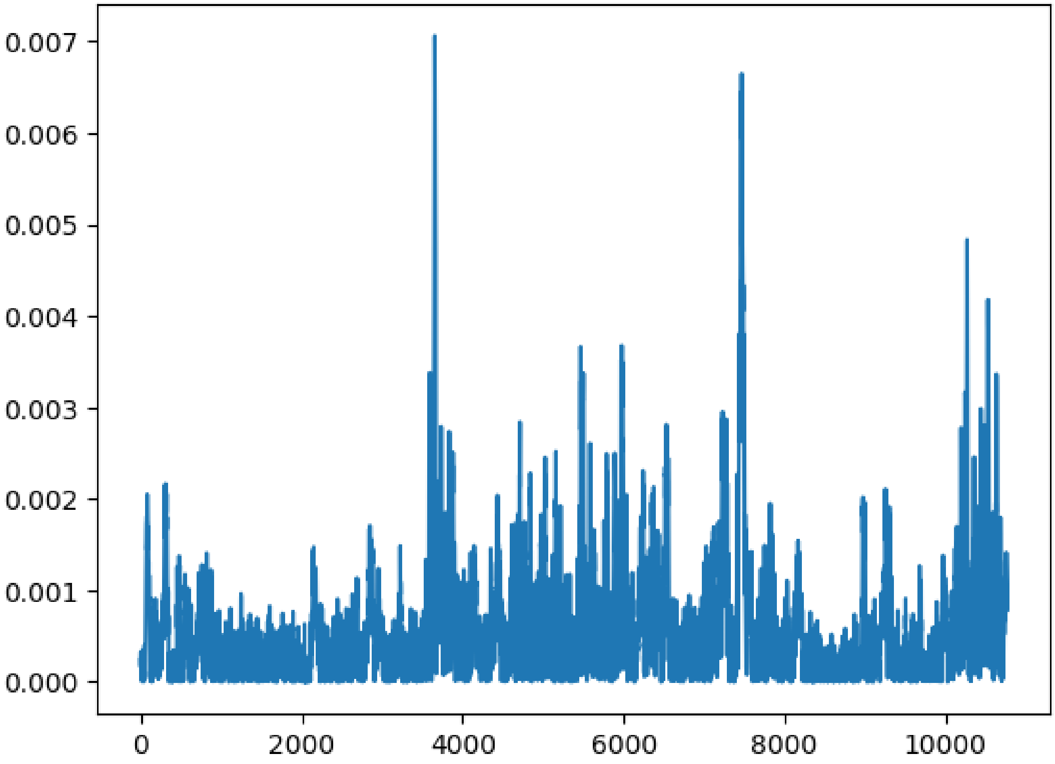
```
[ ]: data_1.head()
```

```
[ ]:   time_tags__C1_CP_FGM_FULL1  half_interval__C1_CP_FGM_FULL1  \
    0   2001-02-13T10:42:00.015Z                         0.02231
    1   2001-02-13T10:42:00.060Z                         0.02231
    2   2001-02-13T10:42:00.104Z                         0.02231
    3   2001-02-13T10:42:00.149Z                         0.02231
    4   2001-02-13T10:42:00.193Z                         0.02231

       B_vec_xyz_gse__C1_CP_FGM_FULL1  B_vec_xyz_gse__C1_CP_FGM_FULL2  \
    0                           5.113                          -7.599
    1                           5.090                          -7.587
    2                           5.107                          -7.577
    3                           5.094                          -7.576
    4                           5.060                          -7.551

       B_vec_xyz_gse__C1_CP_FGM_FULL3  B_mag__C1_CP_FGM_FULL1  \
    0                          -1.399                   9.265
```

```
1                           -1.362                   9.237
2                           -1.387                   9.242
3                           -1.385                   9.234
4                           -1.382                   9.195

   sc_pos_xyz_gse__C1_CP_FGM_FULL1  sc_pos_xyz_gse__C1_CP_FGM_FULL2  \
0                          99738.7                          14388.7
1                          99738.6                          14388.7
2                          99738.6                          14388.7
3                          99738.5                          14388.6
4                          99738.5                          14388.6

   sc_pos_xyz_gse__C1_CP_FGM_FULL3  range__C1_CP_FGM_FULL1 tm__C1_CP_FGM_FULL1
0                         -29831.2                     2.0                  22 $
1                         -29831.3                     2.0                  22 $
2                         -29831.3                     2.0                  22 $
3                         -29831.4                     2.0                  22 $
4                         -29831.4                     2.0                  22 $
```

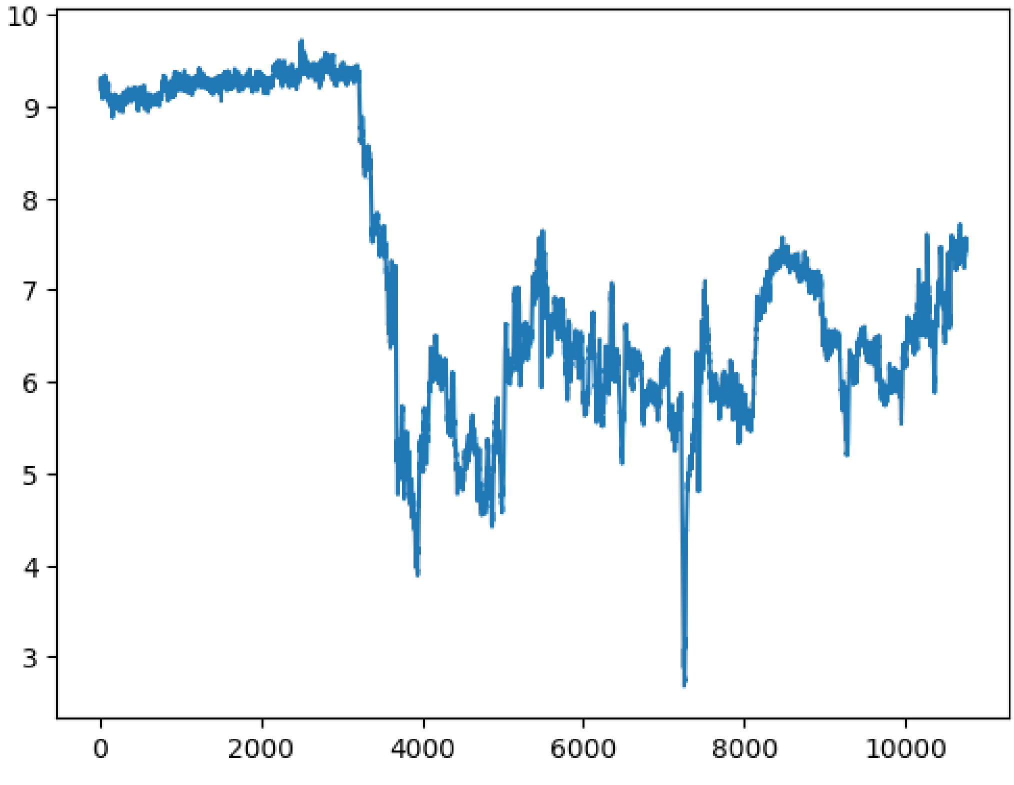
```
[ ]: curl = pyExtremeHelper.curlometer(data_1, data_2, data_3, data_4)
     curl.plot()
```

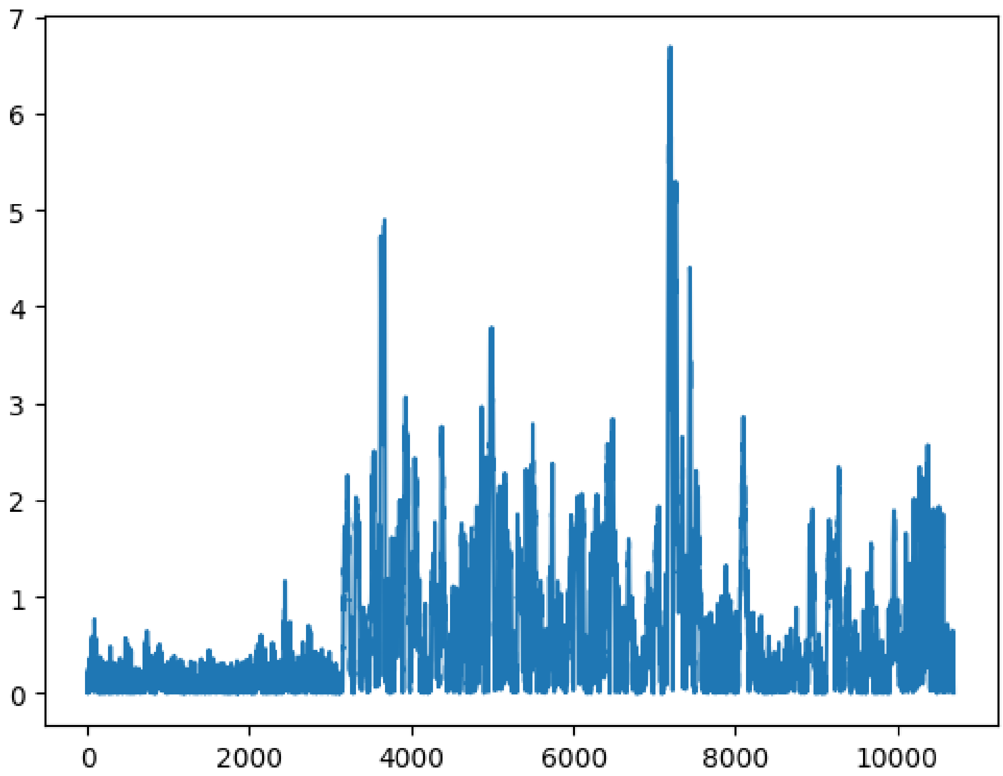
```
[ ]: <Axes: >
```



[ ]:

```
# Identify the columns
Bx_column = "B_vec_xyz_gse__C1_CP_FGM_FULL1"
By_column = "B_vec_xyz_gse__C1_CP_FGM_FULL2"
Bz_column = "B_vec_xyz_gse__C1_CP_FGM_FULL3"



# Calculate mod_B
yy = pyExtremeHelper.calculate_mod_B(data_1, Bx_column, By_column, Bz_column)

# Plot mod_B
pyExtremeHelper.plot_mod_B(yy)

# Save mod_B to a file
#yy.to_csv('mod_B.dat', sep='\t', header=False, index=False)

PVI = pyExtremeHelper.calculate_PVI(yy)

# Plot the PVI
pyExtremeHelper.plot_data(PVI)
```





```
[ ]: detected = pyExtremeHelper.limethod(PVI)
```

```
[ ]: detected[detected['cs_out'] != 0 ]
```

```
[ ]: Empty DataFrame
     Columns: [Time, cs_out]
     Index: []
```

```
[ ]: current_density = np.loadtxt('utils/current_sheet/current_density.dat',␣
      ↪converters={0: pyExtremeHelper.convert_to_float})
```

```
[ ]: current_density
```

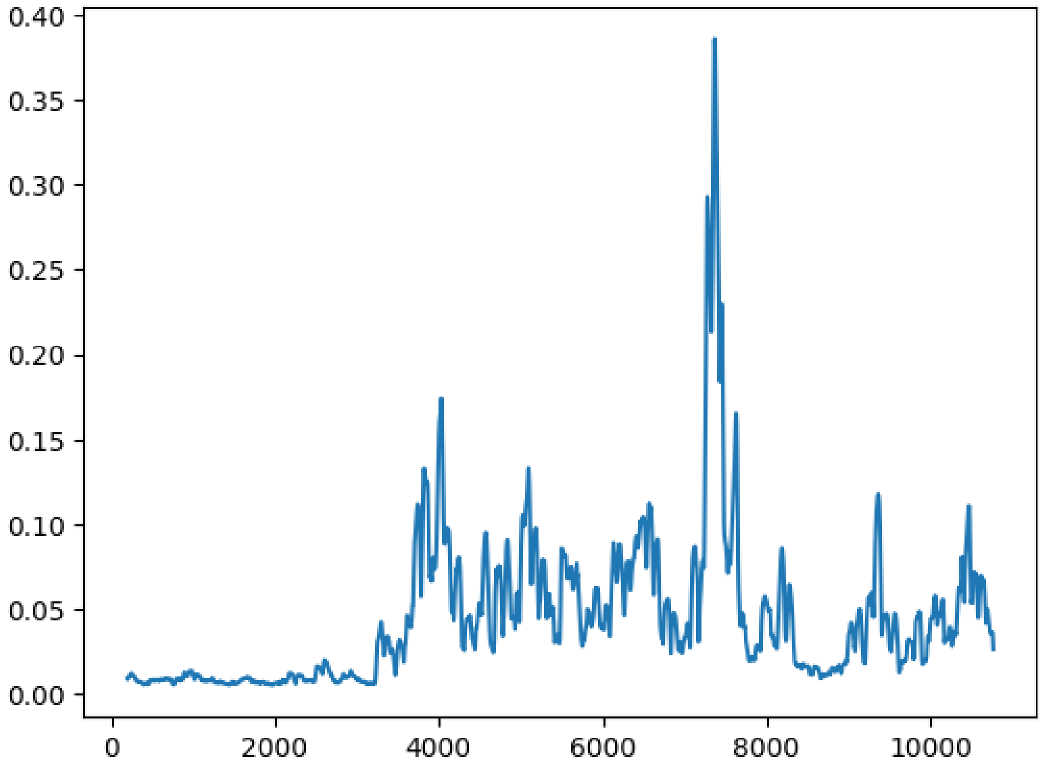
```
[ ]: array([3.2938309e-10, 2.2970648e-10, 2.7907458e-10, …, 1.6328908e-09,
            1.4390402e-09, 1.3168280e-09])
```

```
[ ]: volat = pyExtremeHelper.calculate_magnetic_volatility(pd.DataFrame(yy,␣
      ↪columns=["mag"]), "mag", 100, 100)
     volat.plot()
```

```
/home/bruno/pyExtremeHelper/pyExtremeHelper/helper.py:240:
SettingWithCopyWarning:
```

```
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  df['vol_mag'] = df['Delta_r_mag'].rolling(window=w).std()
```

[ ]: `<Axes: >`



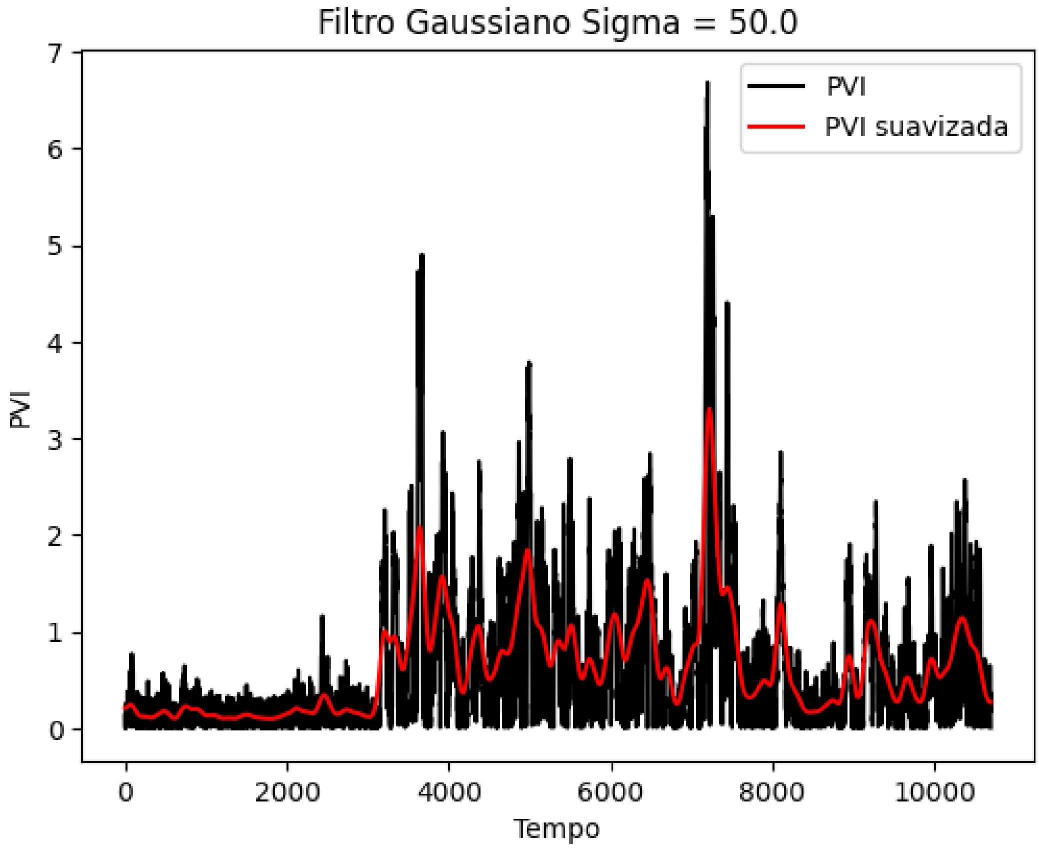
[ ]:

```
sigma = 50.0

smoothed_curl = pyExtremeHelper.apply_gaussian_kernel(current_density, sigma)
smoothed_pvi = pyExtremeHelper.apply_gaussian_kernel(PVI, sigma)
smoothed_volat = pyExtremeHelper.apply_gaussian_kernel(volat, sigma)
```

[ ]:

```
import matplotlib.pyplot as plt
plt.plot(PVI, color="black", label="PVI")
plt.plot(smoothed_pvi, color="red", label="PVI suavizada")
plt.xlabel('Tempo')
plt.ylabel('PVI')
plt.legend()
# Set the title of the plot
```

```
plt.title('Filtro Gaussiano Sigma = 50.0')


plt.show()
```



[ ]:

```
#import numpy as np
#import matplotlib.pyplot as plt
#from scipy.stats import spearmanr
#
## Generate random data for demonstration
#s1 = smoothed_curl
#s2 = smoothed_pvi[:len(smoothed_curl)]
#s3 = smoothed_volat
#
#lags = range(-1000, 1000)  # List of lag values
#
#
## Calculate correlations for each lag
#def corr_at_lag(s1, s2, s3, lags):
#    for lag in lags:
```

```
#        if lag < 0:
#            cor_s1_s2, _ = spearmanr(s1[:lag], s2[-lag:])
#            cor_s1_s3, _ = spearmanr(s1[:lag], s3[-lag:])
#        elif lag == 0:
#            cor_s1_s2, _ = spearmanr(s1, s2)
#            cor_s1_s3, _ = spearmanr(s1, s3)
#        else:
#            cor_s1_s2, _ = spearmanr(s1[lag:], s2[:-lag])
#            cor_s1_s3, _ = spearmanr(s1[lag:], s3[:-lag])
#
#        correlation_s1_s2.append(cor_s1_s2)
#        correlation_s1_s3.append(cor_s1_s3)
#    return correlation_s1_s2, correlation_s1_s3
#
#correlation_s1_s2, correlation_s1_s3 = corr_at_lag(s1, s2, s3, lags)
## Plotting
#plt.plot(lags, correlation_s1_s2, label="curl vs pvi")
#plt.plot(lags, correlation_s1_s3, label="curl vs volat")
#plt.title("Spearman Correlation between s1 and s2, s1 and s3 at Different Lags")
#plt.xlabel("Lag")
#plt.ylabel("Correlation")
#plt.legend()
#plt.show()
```