model_comparisons

June 25, 2025

1 Model Comparisons

[1]:
```
import pandas as pd
import matplotlib.pyplot as plt
from IPython.display import HTML, display
```

Load the data from the Original, PSU, and Limno models

[2]:
```
filename = 'tsr_4_seg33_compare_Detroit-Lake_062425.xlsb'
df_original = pd.read_excel(filename, sheet_name='tsr_4_seg33_Original',␣
 ↪engine='pyxlsb')
df_psu = pd.read_excel(filename, sheet_name='tsr_4_seg33_PSU', engine='pyxlsb')
df_limno = pd.read_excel(filename, sheet_name='tsr_4_seg33_Limno',␣
 ↪engine='pyxlsb')
```

Clean the column names, removing extra spaces and tabs, and apply to all three data frames

[3]:
```
def clean_column_name(col):
    col = col.replace('\t', '').strip()  # Remove tabs and leading/trailing␣
 ↪spaces
    if '(' in col and ')' in col:
        name, unit = col.split('(', 1)
        return name.strip() + ' (' + unit.strip()
    return col.strip()

cleaned_columns = [clean_column_name(col) for col in df_limno.columns]

df_original.columns = cleaned_columns
df_psu.columns = cleaned_columns
df_limno.columns = cleaned_columns
```

Compute the differences between model results

[4]:
```
df_limno_minus_psu = df_limno - df_psu
df_psu_minus_original = df_psu - df_original
df_limno_minus_original = df_limno - df_original
```

Replace the JDAY column with the one from the Limno data frame

[5]:
```
df_limno_minus_psu['JDAY'] = df_limno['JDAY']
df_psu_minus_original['JDAY'] = df_limno['JDAY']
df_limno_minus_original['JDAY'] = df_limno['JDAY']
```

Prepare dictionary of the comparison data frames

[6]:
```
comparison_frames = {
    'Limno - PSU': df_limno_minus_psu,
    'PSU - Original': df_psu_minus_original,
    'Limno - Original': df_limno_minus_original
}
```

Compute summary statistics for each difference data frame (excluding 'JDAY')

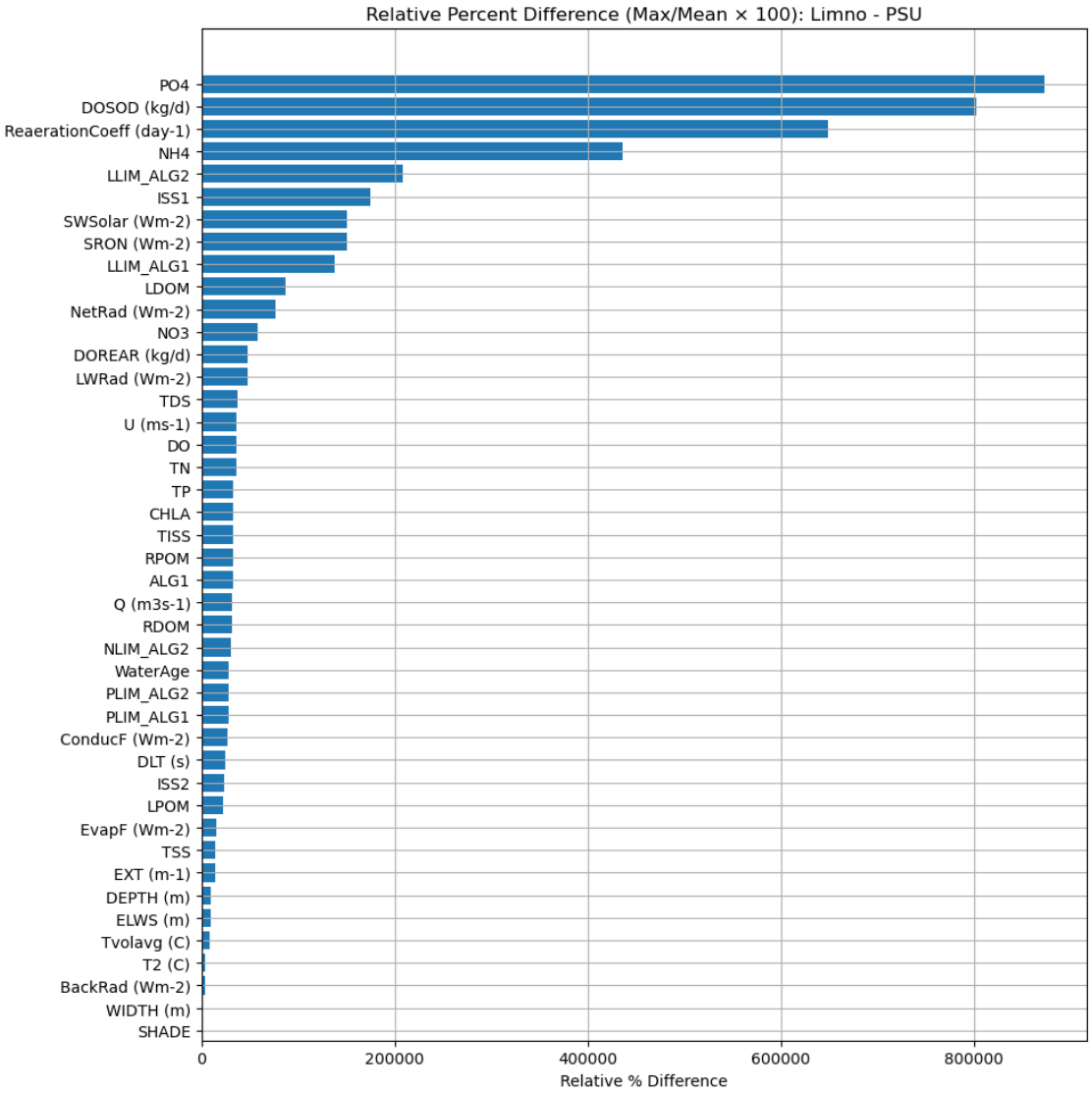
[7]:
```
summary_stats = {
    'Limno - PSU': df_limno_minus_psu.drop(columns='JDAY').describe().
 ↪T[['mean', 'std', 'min', 'max']],
    'PSU - Original': df_psu_minus_original.drop(columns='JDAY').describe().
 ↪T[['mean', 'std', 'min', 'max']],
    'Limno - Original': df_limno_minus_original.drop(columns='JDAY').describe().
 ↪T[['mean', 'std', 'min', 'max']]
}
```

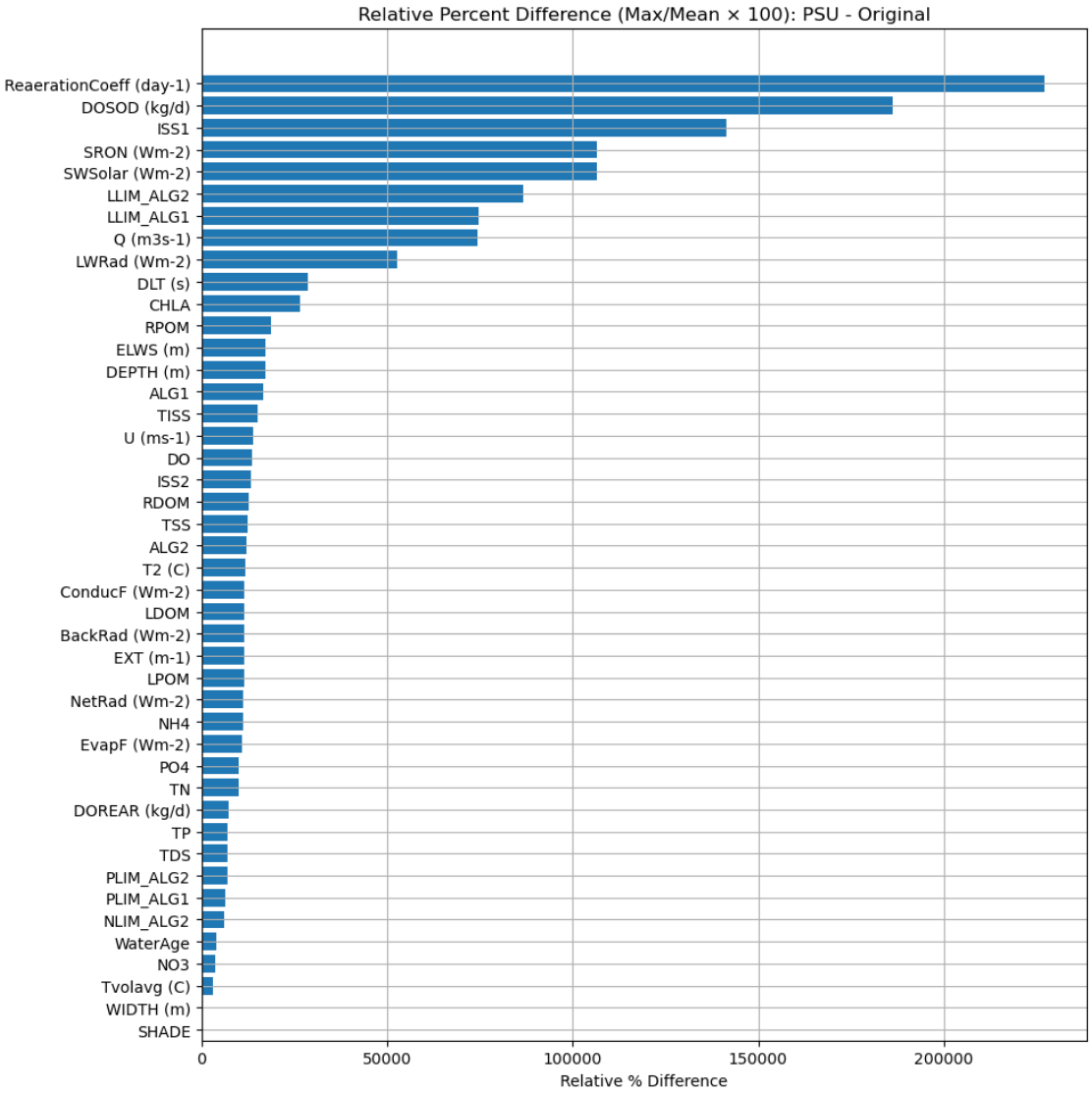
Compute and plot relative percent differences for each comparison

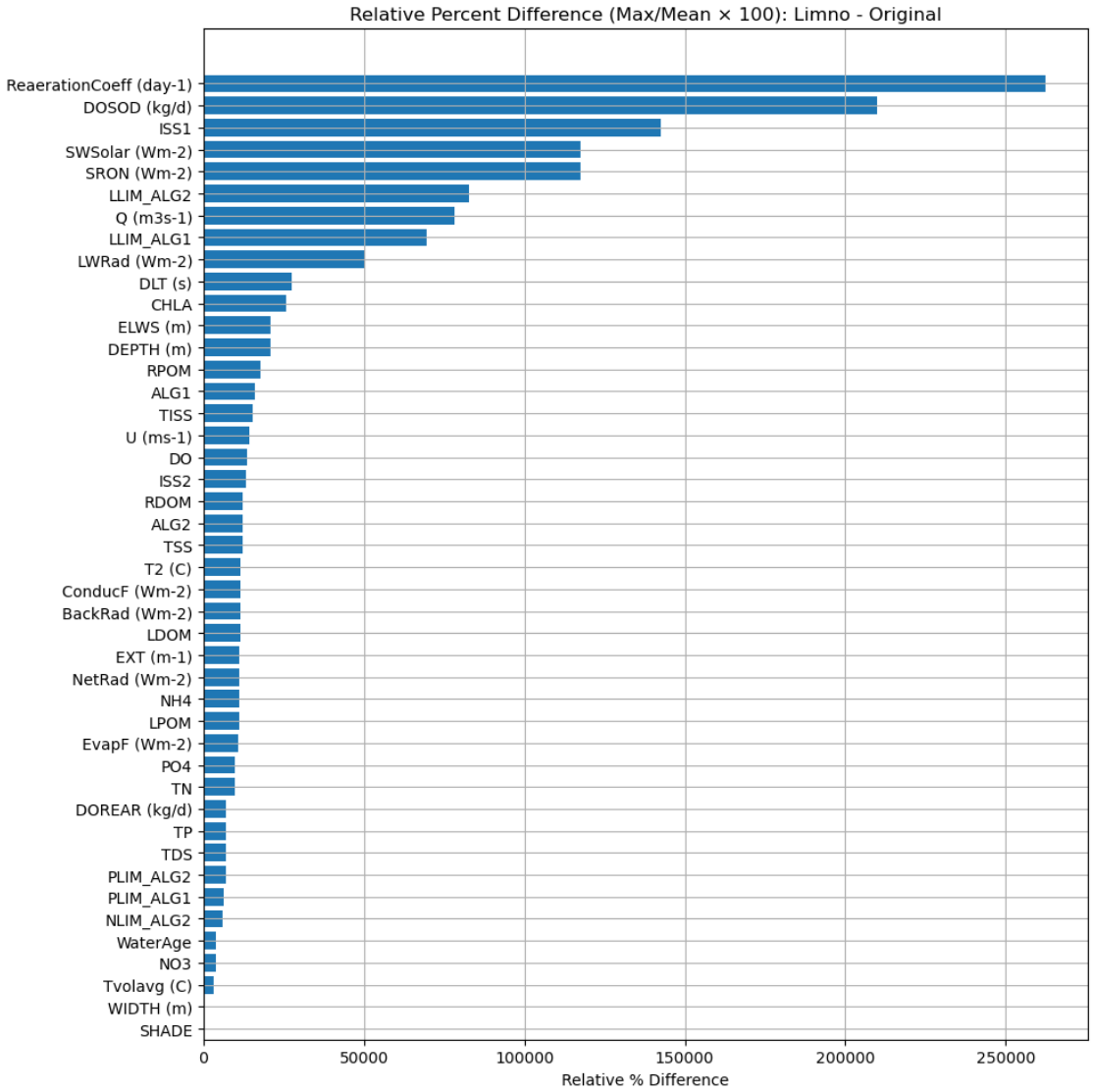
[8]:
```
def compute_relative_percent_difference(df):
    df_no_jday = df.drop(columns='JDAY')
    return (df_no_jday.abs().max() / df_no_jday.abs().mean()) * 100

# Compute for all three comparisons
relative_diffs = {
    name: compute_relative_percent_difference(df)
    for name, df in comparison_frames.items()
}

for name, series in relative_diffs.items():
    sorted_series = series.sort_values(ascending=False) # plot all
    # sorted_series = series.sort_values(ascending=False).head(10) # plot top␣
 ↪10 only
    fig, ax = plt.subplots(figsize=(10, 10))
    ax.barh(sorted_series.index, sorted_series.values)
    ax.set_title(f'Relative Percent Difference (Max/Mean × 100): {name}')
    ax.set_xlabel('Relative % Difference')
    ax.grid(True)
    ax.invert_yaxis()
    plt.tight_layout()
    plt.show()
```


Relative Percent Difference (Max/Mean × 100): Limno - PSU
PO4
DOSOD (kg/d)
ReaerationCoeff (day-1)
NH4
LLIM_ALG2
ISS1
SWSolar (Wm-2)
SRON (Wm-2)
LLIM_ALG1
LDOM
NetRad (Wm-2)
NO3
DOREAR (kg/d)
LWRad (Wm-2)
TDS
U (ms-1)
DO
TN
TP
CHLA
TISS
RPOM
ALG1
Q (m3s-1)
RDOM
NLIM_ALG2
WaterAge
PLIM_ALG2
PLIM_ALG1
ConducF (Wm-2)
DLT (s)
ISS2
LPOM
EvapF (Wm-2)
TSS
EXT (m-1)
DEPTH (m)
ELWS (m)
Tvolavg (C)
T2 (C)
BackRad (Wm-2)
WIDTH (m)
SHADE
0
200000
400000
600000
800000
Relative % Difference


Relative Percent Difference (Max/Mean × 100): PSU - Original
ReaerationCoeff (day-1)
DOSOD (kg/d)
ISS1
SRON (Wm-2)
SWSolar (Wm-2)
LLIM_ALG2
LLIM_ALG1
Q (m3s-1)
LWRad (Wm-2)
DLT (s)
CHLA
RPOM
ELWS (m)
DEPTH (m)
ALG1
TISS
U (ms-1)
DO
ISS2
RDOM
TSS
ALG2
T2 (C)
ConducF (Wm-2)
LDOM
BackRad (Wm-2)
EXT (m-1)
LPOM
NetRad (Wm-2)
NH4
EvapF (Wm-2)
PO4
TN
DOREAR (kg/d)
TP
TDS
PLIM_ALG2
PLIM_ALG1
NLIM_ALG2
WaterAge
NO3
Tvolavg (C)
WIDTH (m)
SHADE
0
50000
100000
150000
200000
Relative % Difference



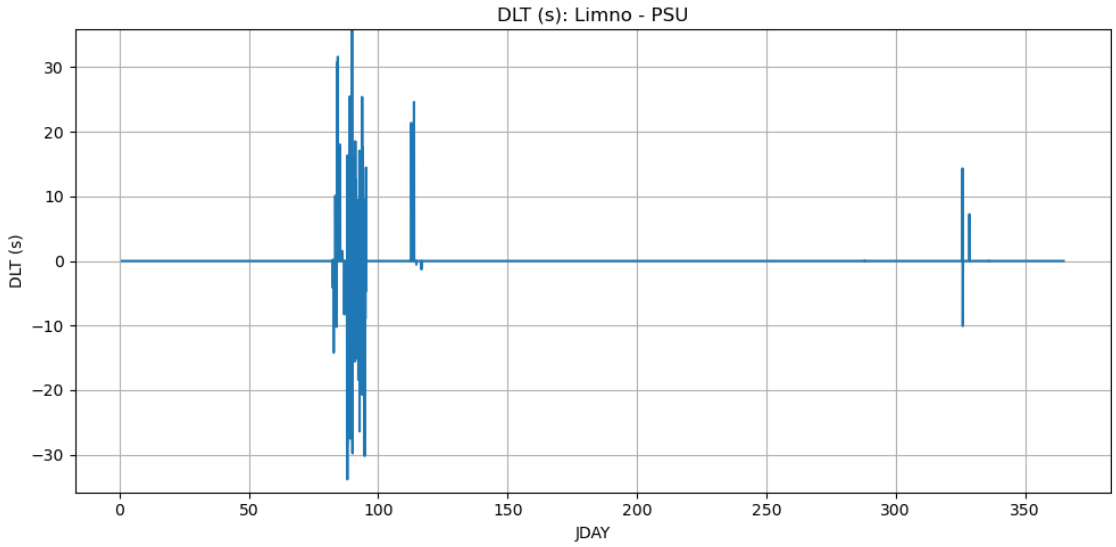
Plot comparison time series for several key variables

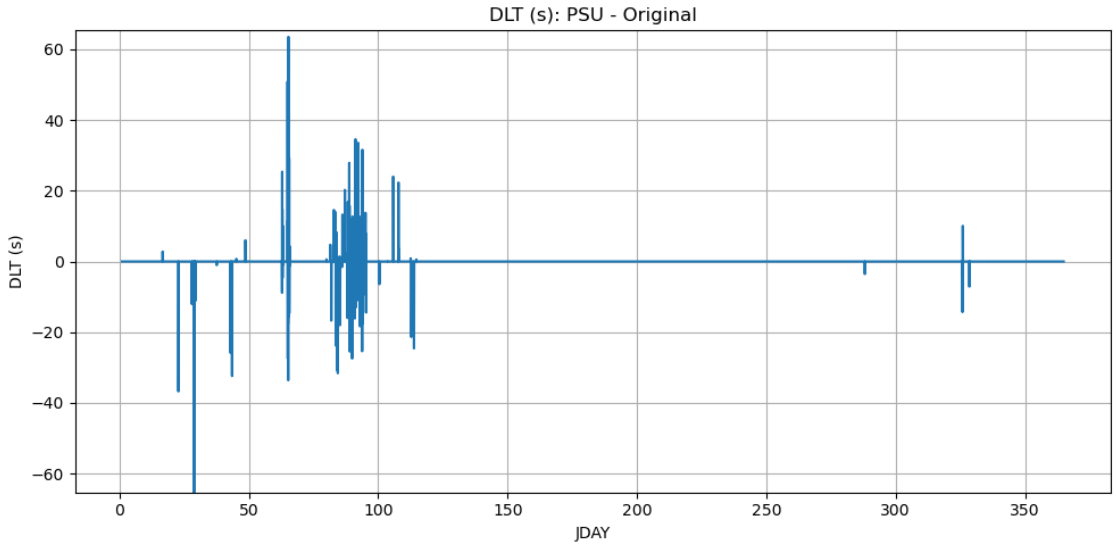
[9]:
```
variables_to_plot = ['DLT (s)', 'Q (m3s-1)', 'DOREAR (kg/d)', 'TP', 'CHLA',␣
↪'DO']

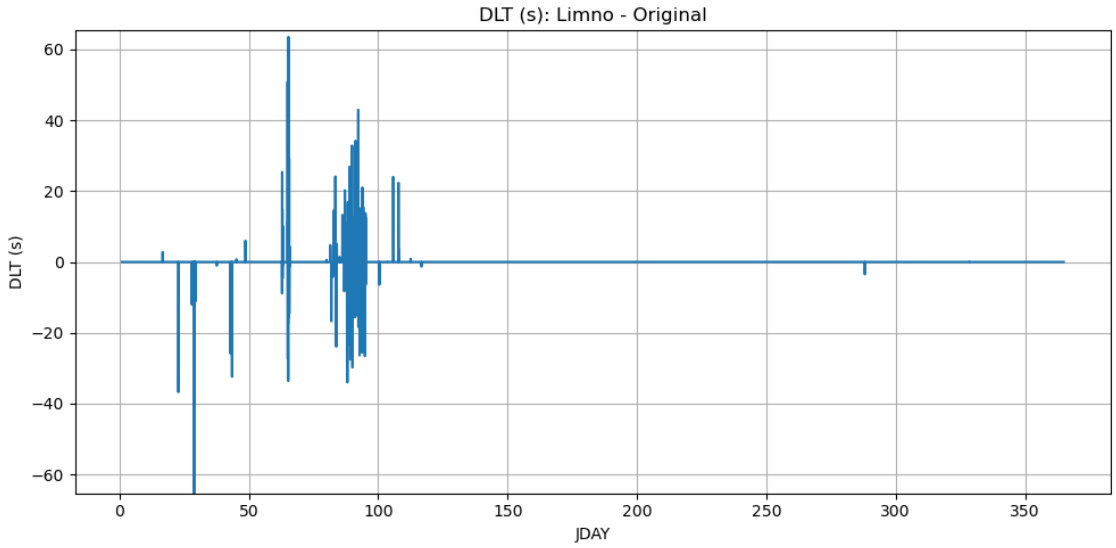
for var in variables_to_plot:
    # display(HTML("<hr style='border: none; border-bottom: 1px solid␣
↪dodgerblue;'>"))
    # display(HTML(f"<h3 style='text-align:center; color: dodgerblue;'>{var}</
↪h3>"))
    # display(HTML("<hr style='border: none; border-top: 1px solid dodgerblue;
↪'>"))
```

```
    display(HTML(f"<hr style='border: none; border-bottom: 1px solid dodgerblue;
↪'><h3 style='text-align:center; color: dodgerblue;'>{var}</h3><hr␣
↪style='border: none; border-top: 1px solid dodgerblue;'>"))
    for name, df in comparison_frames.items():
        y = df[var]
        y_max = y.abs().max()  # Find the maximum absolute value for symmetry
        plt.figure(figsize=(10, 5))
        plt.plot(df['JDAY'], y, label=f'{var} Difference')
        plt.title(f'{var}: {name}')
        plt.xlabel('JDAY')
        plt.ylabel(var)
        plt.ylim(-y_max, y_max)  # Symmetrical y-axis limits
        plt.grid(True)
        plt.tight_layout()
        plt.show()
```

```
<IPython.core.display.HTML object>
```








```
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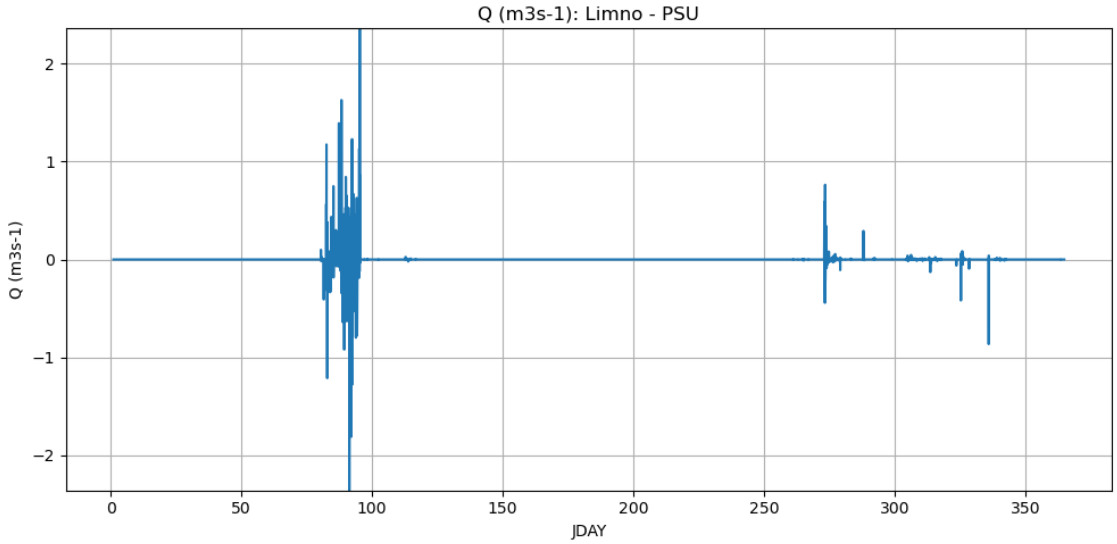
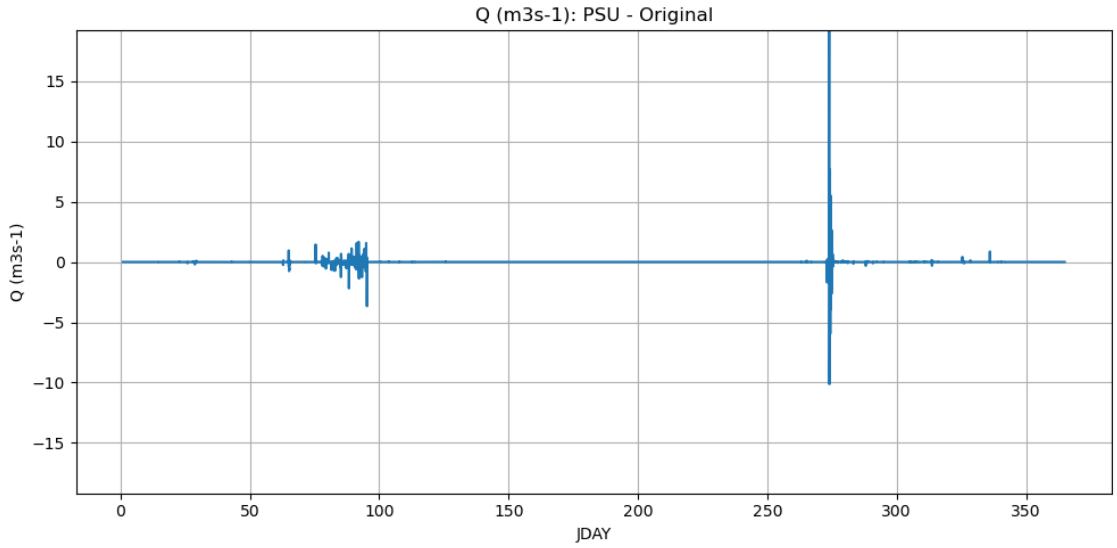
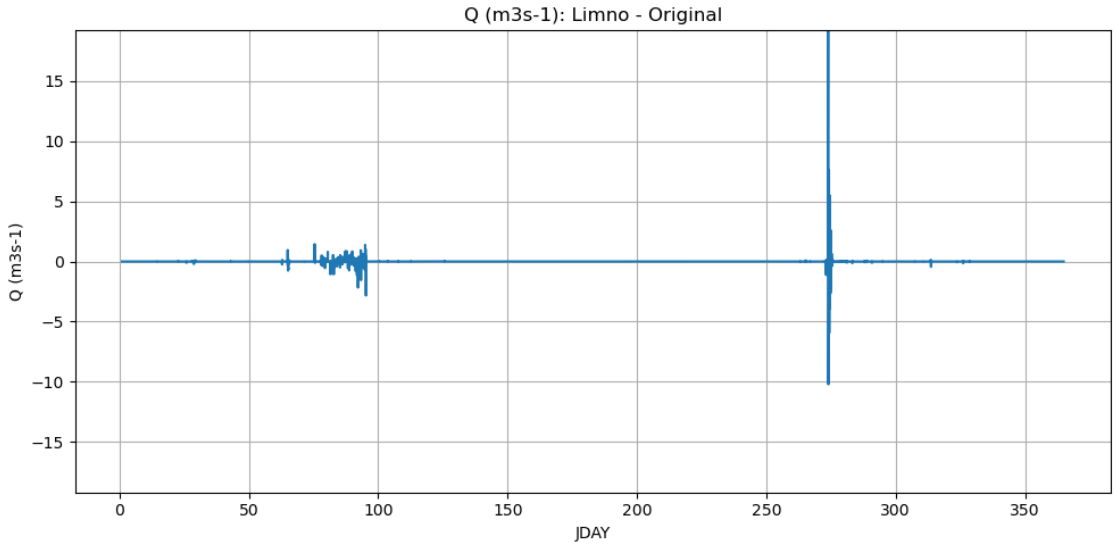
```


Q (m3s-1): Limno - PSU
Q (m3s-1)
JDAY
2
1
0
−1
−2
0
50
100
150
200
250
300
350


Q (m3s-1): PSU - Original
Q (m3s-1)
JDAY
15
10
5
0
−5
−10
−15
0
50
100
150
200
250
300
350



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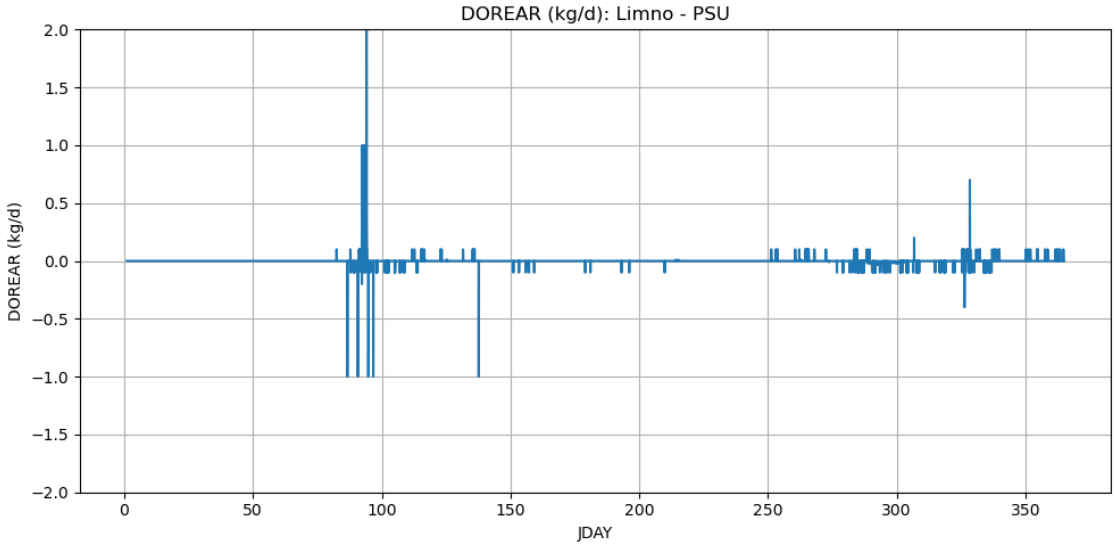

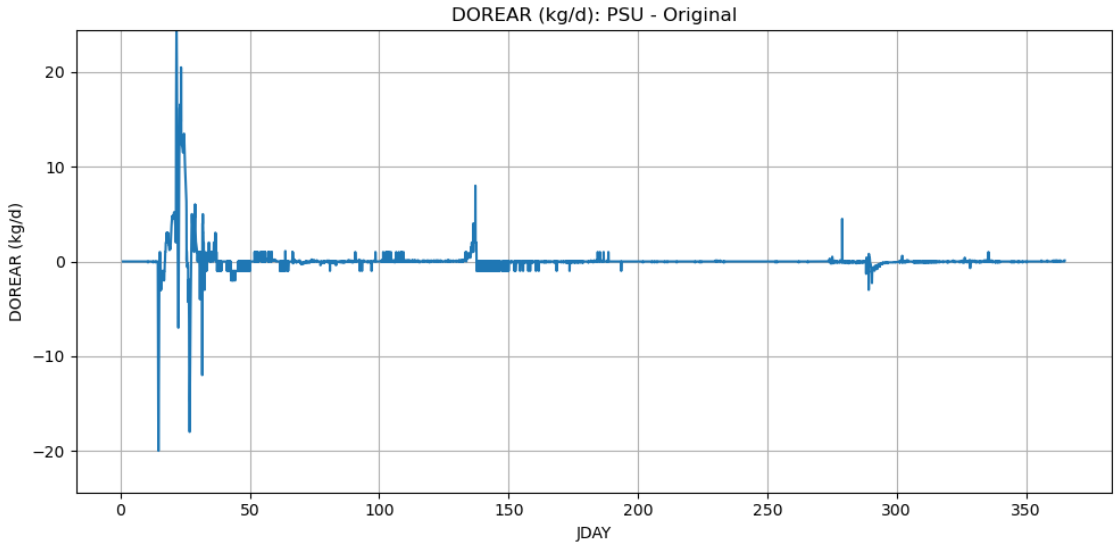

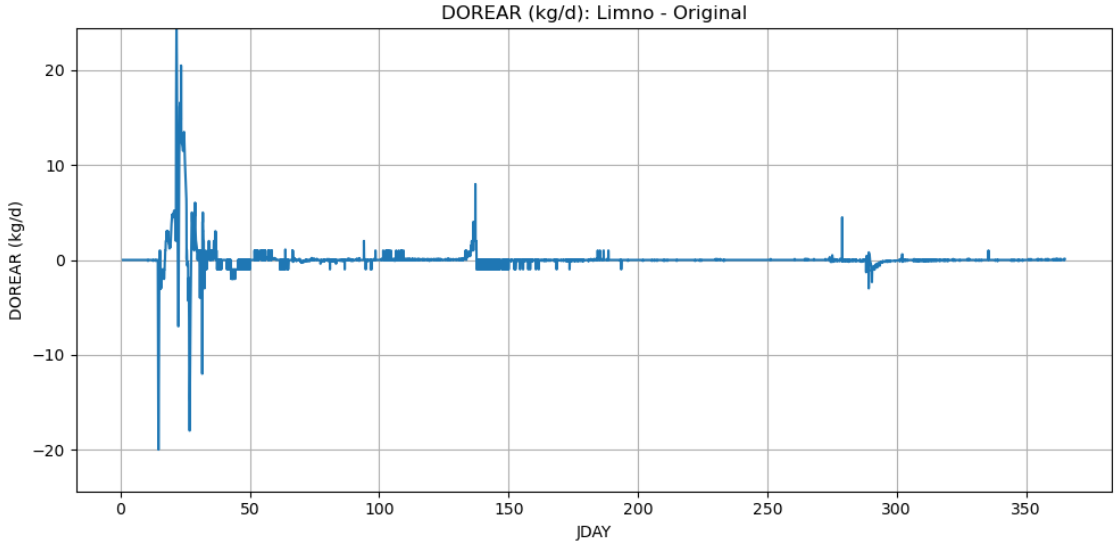


```
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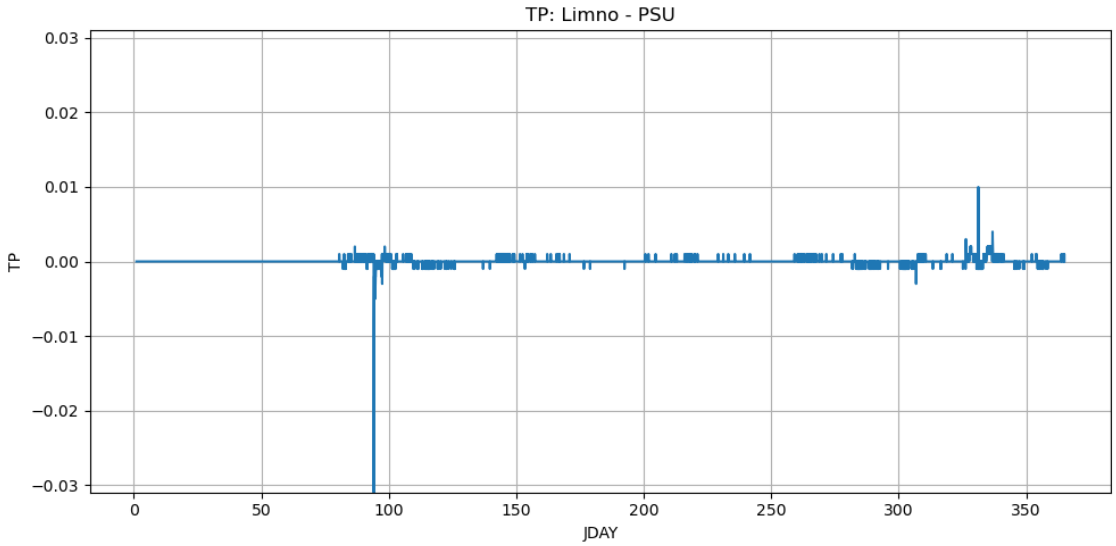
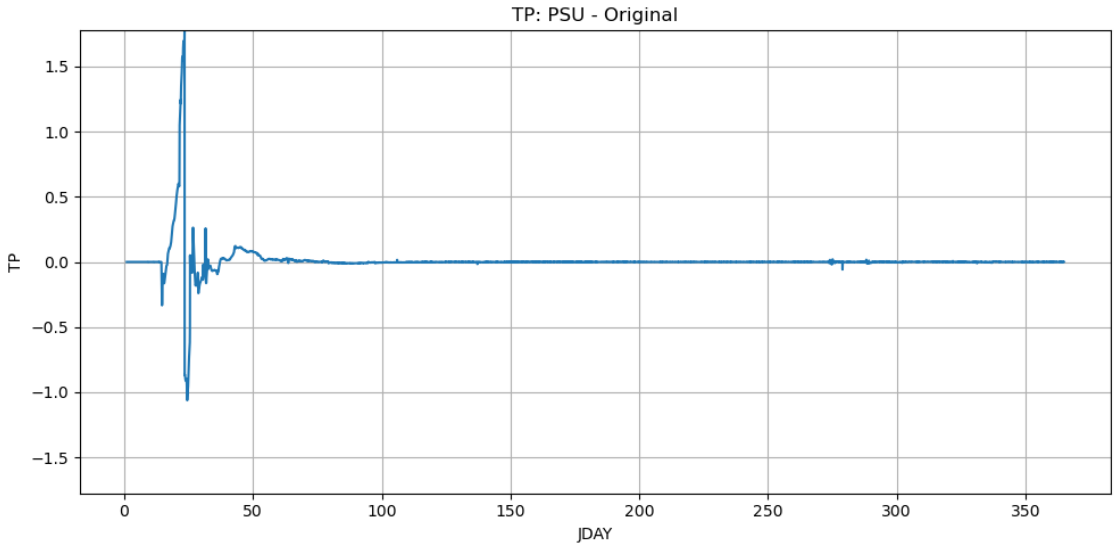
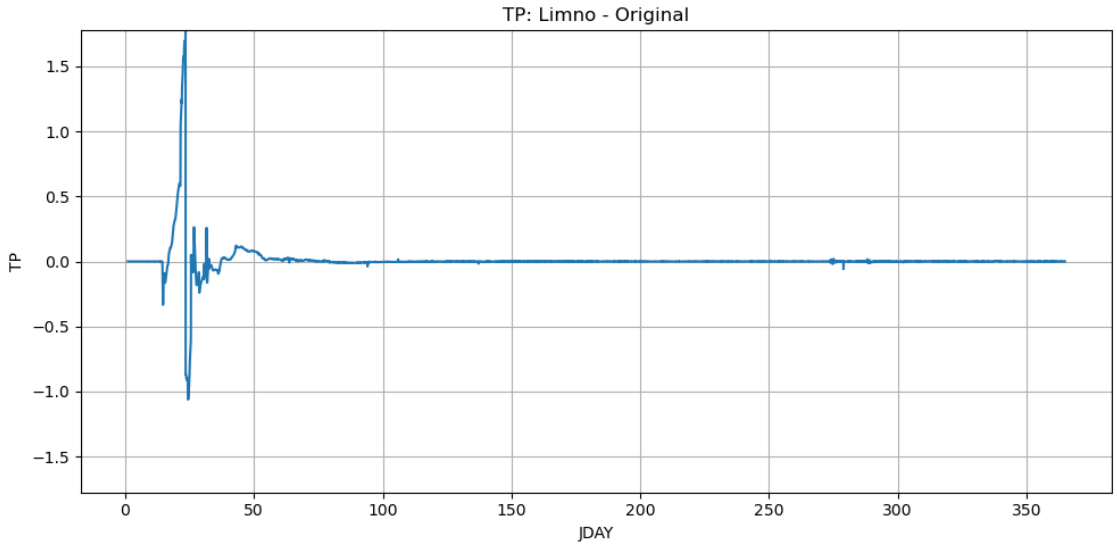
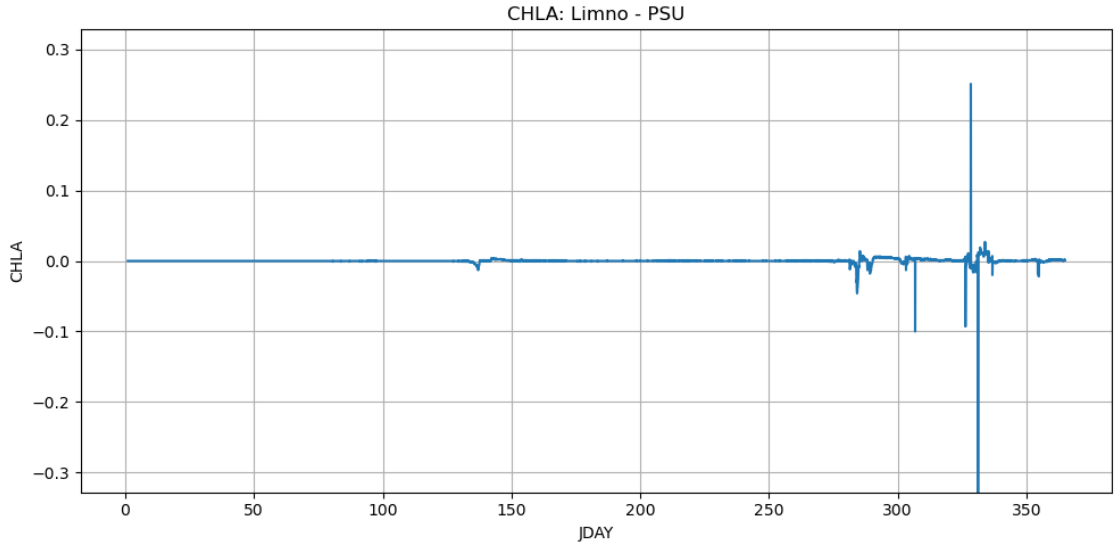
```

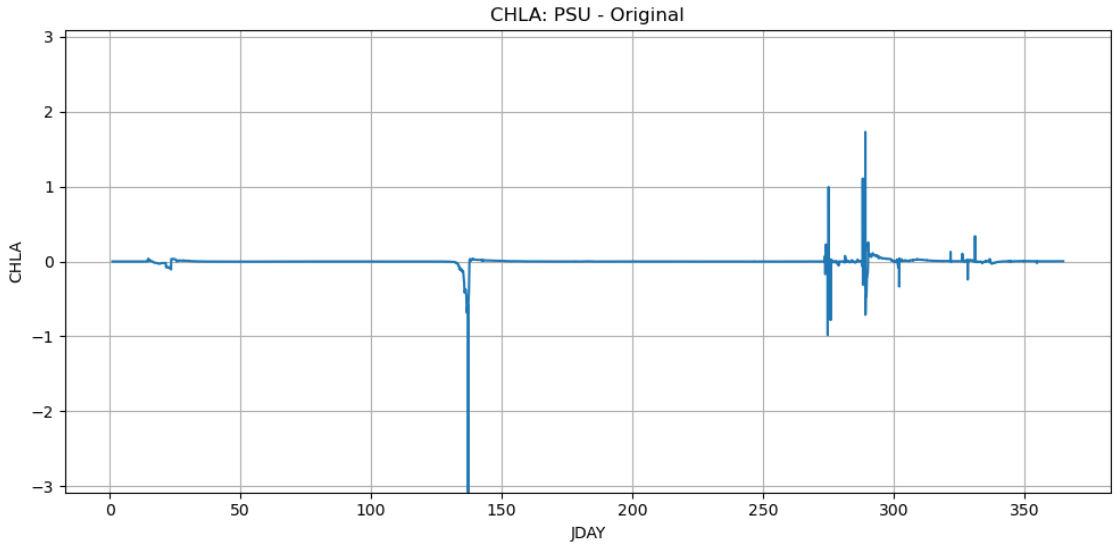

TP: Limno - PSU
TP
JDAY
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
0
50
100
150
200
250
300
350

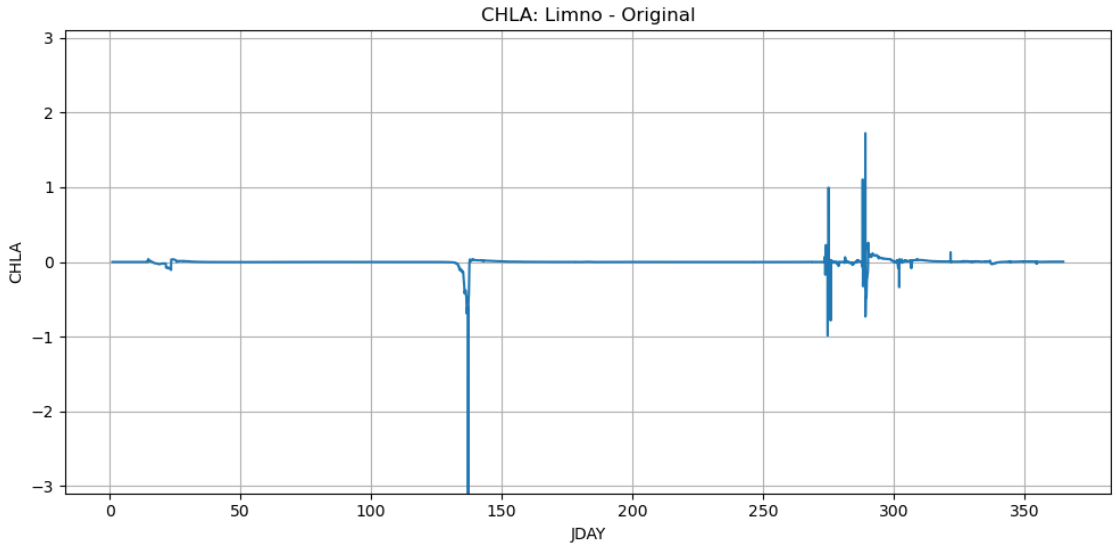

TP: PSU - Original
TP
JDAY
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
0
50
100
150
200
250
300
350



<IPython.core.display.HTML object>








```
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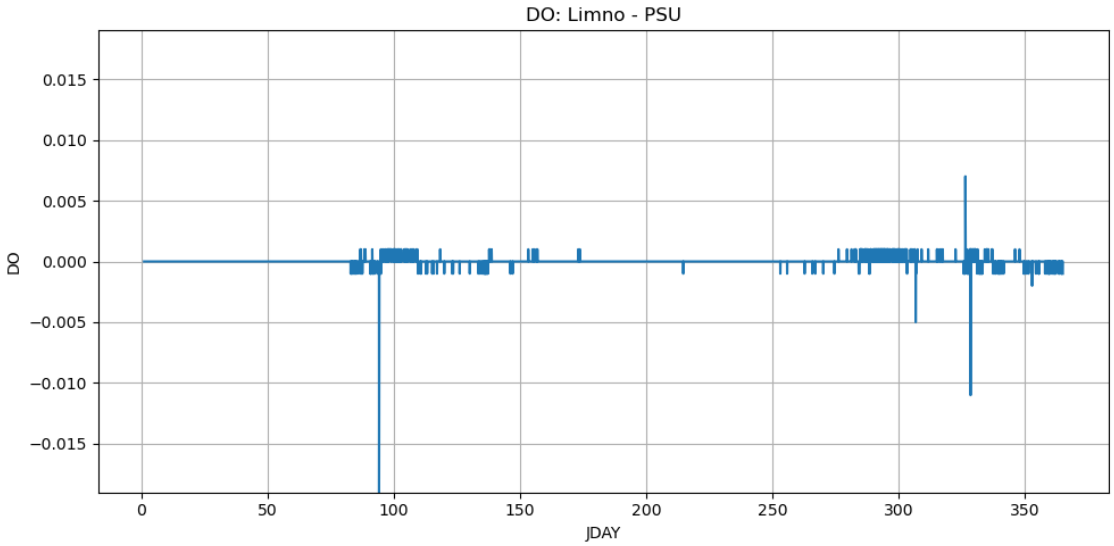
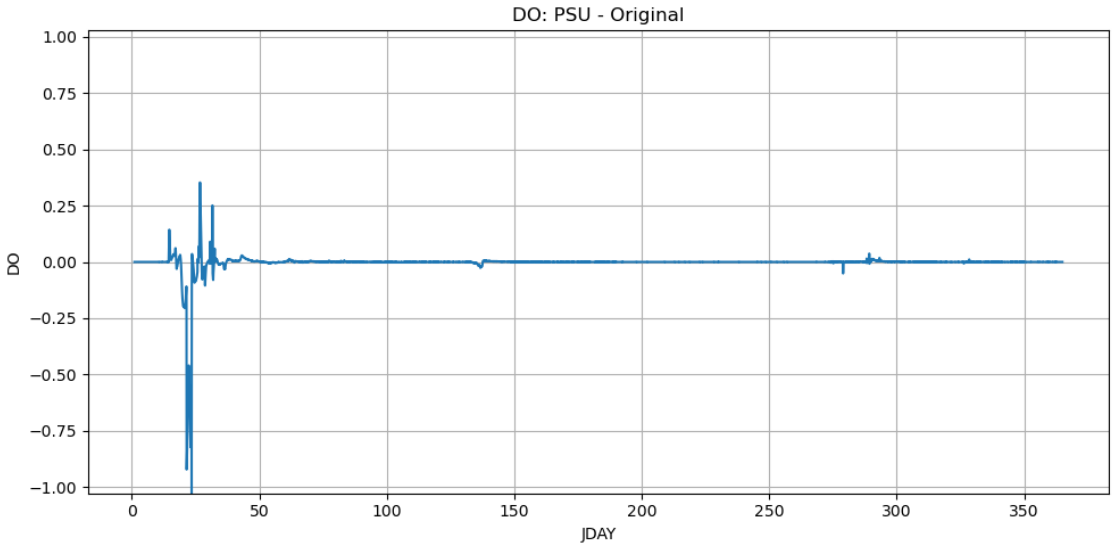
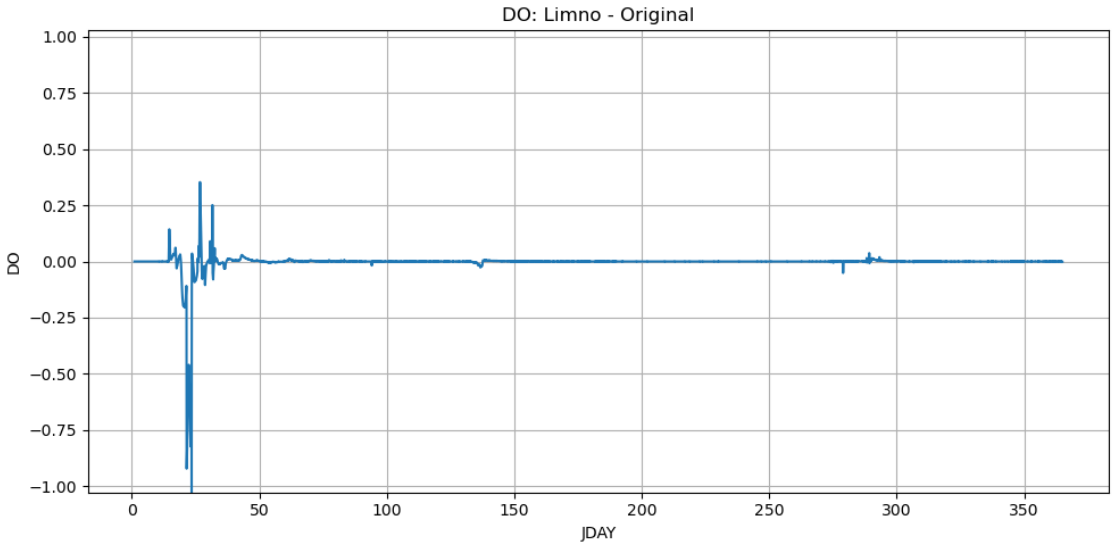

DO: Limno - PSU
0.015
0.010
0.005
0.000
−0.005
−0.010
−0.015
DO
0
50
100
150
200
250
300
350
JDAY


DO: PSU - Original
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
DO
0
50
100
150
200
250
300
350
JDAY


DO: Limno - Original
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
DO
0
50
100
150
200
250
300
350
JDAY