

Superposed Epoch Analysis Using Time-Normalization: A Python Tool for Statistical Event Analysis

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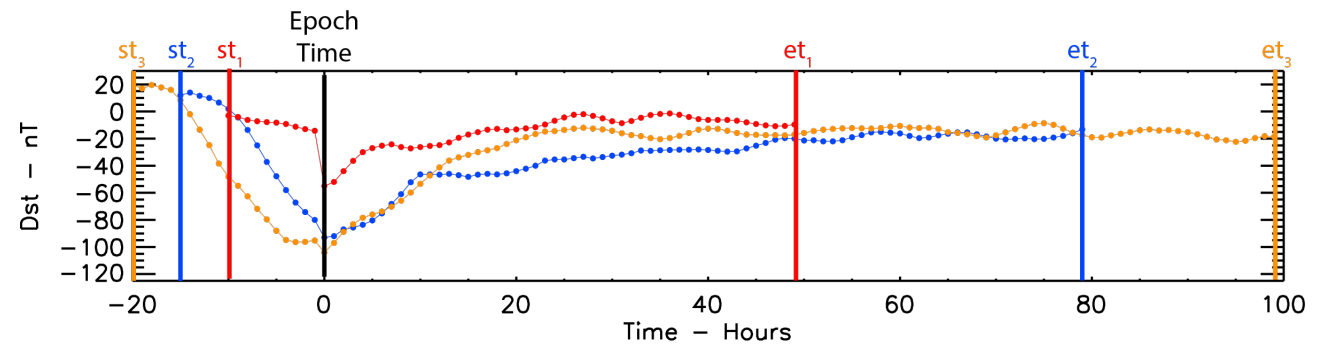


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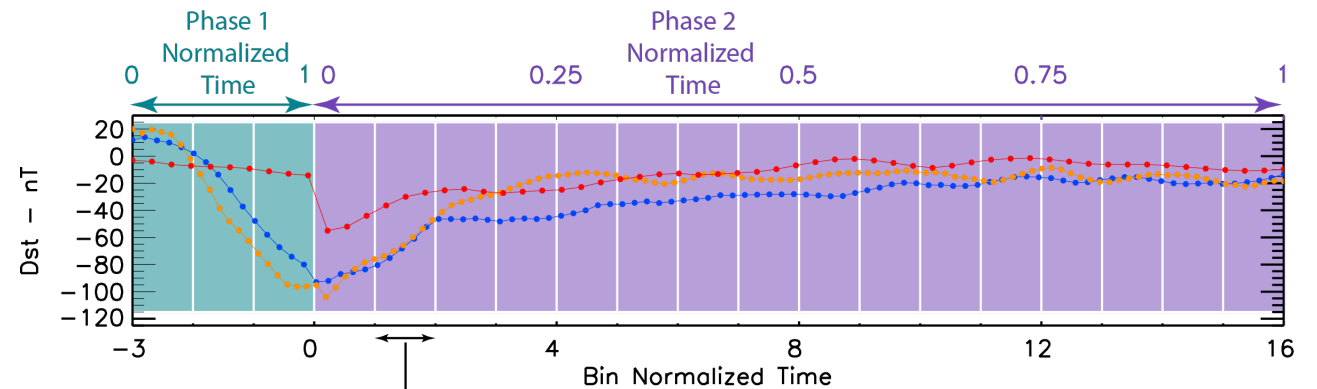
²Self

SEA with Time Normalization

Conventional SEA



Time-normalized SEA



Calculate superposed statistics for each bin (e.g., mean, median, quartiles).

'sea_norm' Package

```

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sea_norm import sean

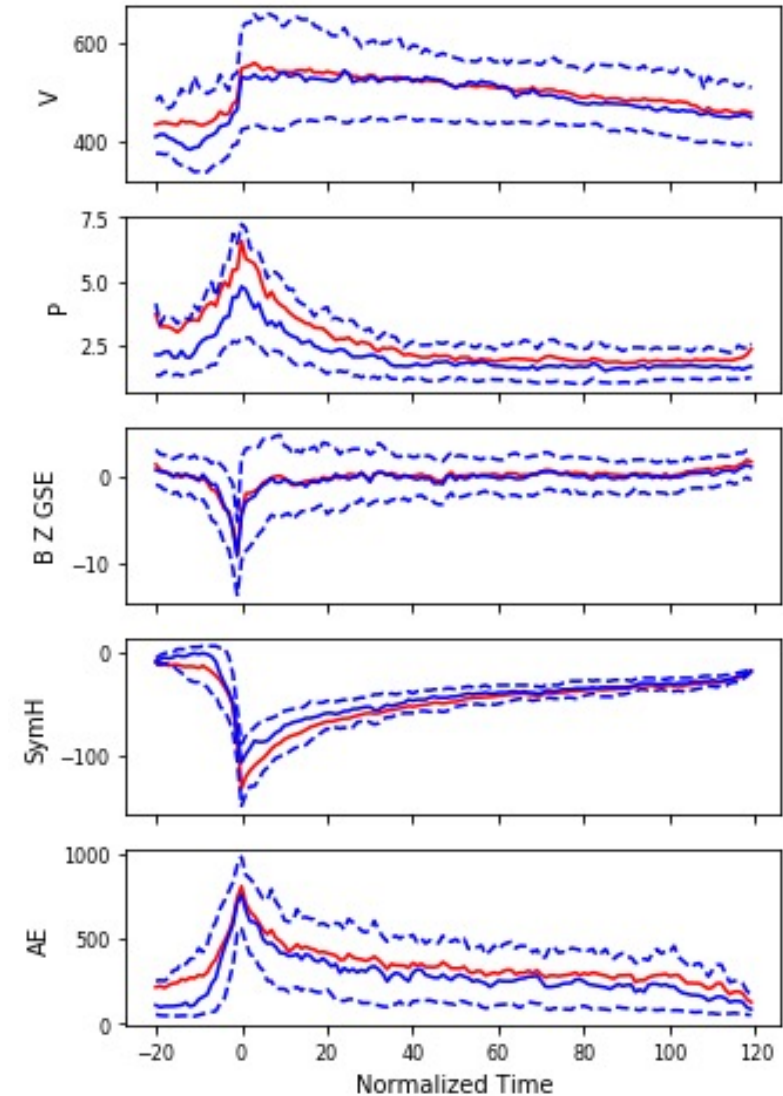
# load OMNI data
o_dat='https://zenodo.org/record/6835641/files/omnidata.csv.bz2'
omnidata = pd.read_csv(o_dat,parse_dates=True,
                      infer_datetime_format=True, header=0,
                      names=['t','B_Z_GSE','V','P','AE','SymH'],
                      index_col=0)

starts = stormlist.IStart
epochs = stormlist.RStart
ends = stormlist.REnd
events=[starts, epochs, ends]
# specify the number of bins in phase 1 and phase 2 as [nbins1, nbins2]
bins=[20, 120]

# set the columns to run the analysis on
sea_cols = ['V','P','B_Z_GSE','SymH','AE']

# perform the time-normalized superposed epoch analysis
SEAarray, meta = sean(omnidata, events, bins, cols=sea_cols)

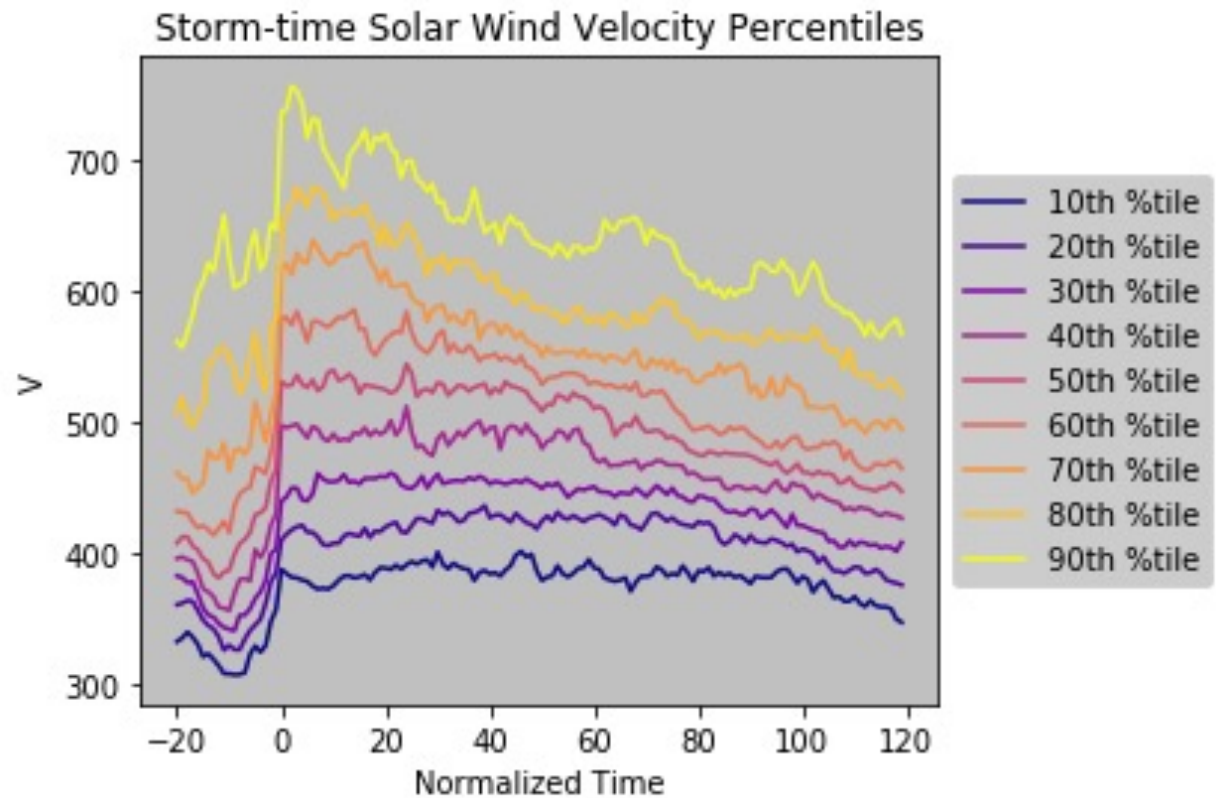
```



User-Specified Stats

- Define individual percentiles to plot
- Specify any calculation
–(e.g., np.nanmean, nanpercentile, standard deviation etc...)

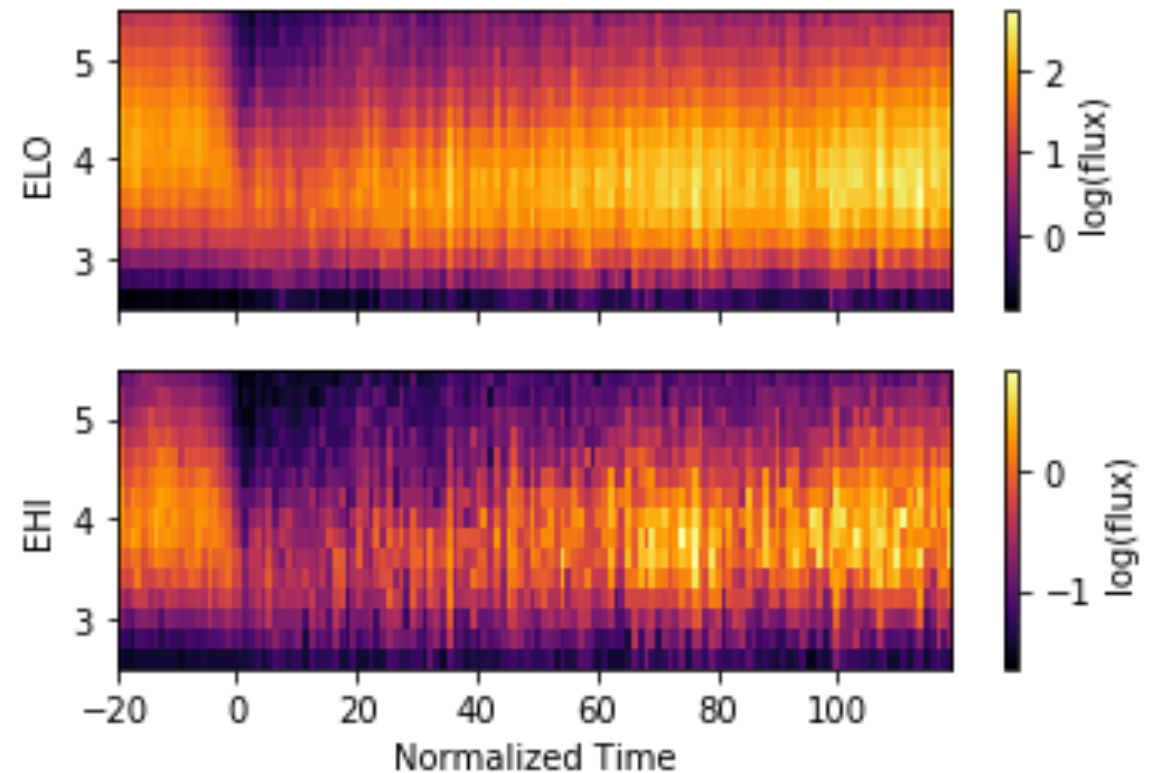
```
lambda stat: np.nanpercentile(stat, x)
```



2D Superposed Epoch Analysis

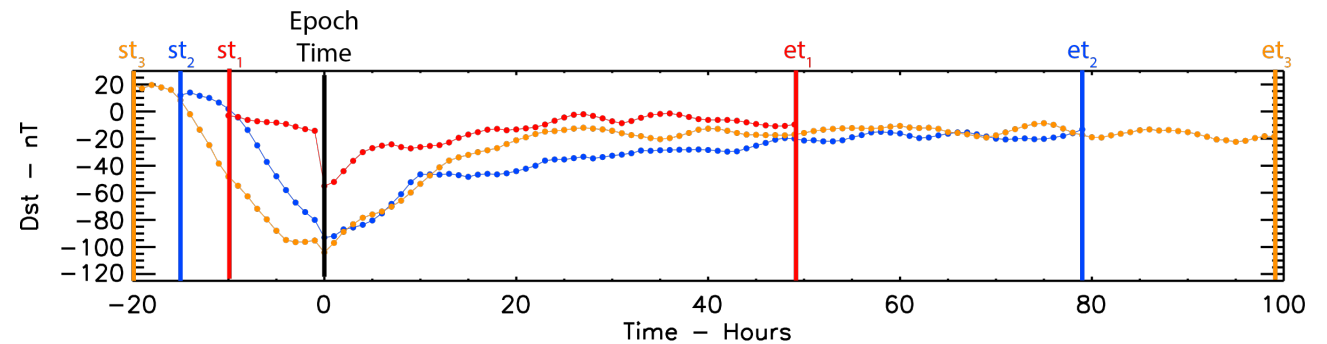
```
logdata=sampexdata.copy()
logdata.iloc[:, 0:2]=np.log10(sampexdata.iloc[:, 0:2])
logdata.replace([np.inf, -np.inf], np.nan, inplace=True)

# perform the 2D SEA analysis
sea2d, meta = sean(logdata, events, bins, cols=sea_cols,
                  seastats=seastats,
                  y_col=y_col, y_dimensions=y_dim)
```

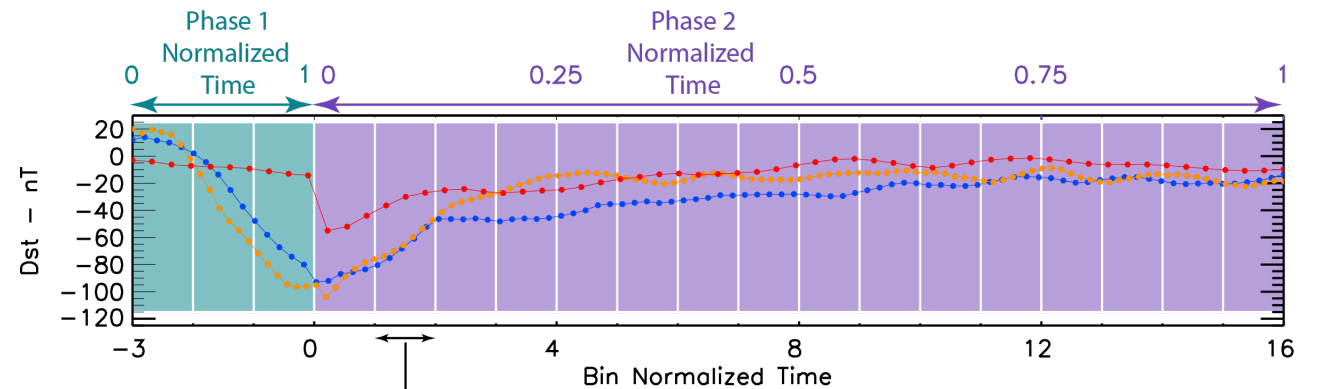


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Summary

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- **Article:**
 - Walton, SD and Murphy, KR (2022). Front. Astron. Space Sci. 9:1000145. doi:10.3389/fspas.2022.1000145
 - <https://www.frontiersin.org/articles/10.3389/fspas.2022.1000145/full>
- **GitHub Repository** (including use examples):
 - https://github.com/samwalton7645/SEA_Code
- **Latest Release:**
 - https://github.com/samwalton7645/SEA_Code/releases/tag/v1.0.1