## L1A : Process RAW to L1A

Raw binary to HDF5 and filter data on SZA.

Processing Parameters and metadata:
HyperInSPACE version: 1.0.9

The stuff that dreams are made of.
/version=R0
/investigators=Sam_Spade
/affiliations=Sam_Spade_Detective_Agency
/contact=supersleuth@noir.com
/experiment=sample
/cruise=Sample1
/documents=LogSheet.xls,ProcessReport.xls
/instrument_manufacturer=Satlantic
/instrument_model=HyperSAS
/calibration_date=
/calibration_files=HSE488B.cal,HSL386B.cal,HLD386B.cal,HED488B.cal,SATTHS0045A.tdf,HLD385B.cal,HSL385B.cal,SATNAV0001A.tdf,GPRMC_NMEA0183v3.01.tdf
/data_type=above_water
/data_status=preliminary
/measurement_depth=0

Process log:
Process Single Level
ProcessL1a.processL1a: 23-Nov-2021 10:52:47
L1A file produced:
/Users/daurin/GitRepos/HyperInSPACE/Data/L1A/SAMPLE_HYPERSAS_SOLARTRACKER_L1A.hdf
Process Single Level:
/Users/daurin/GitRepos/HyperInSPACE/Data/L1A/SAMPLE_HYPERSAS_SOLARTRACKER_L1A.hdf - SUCCESSFUL

## L1B : Process L1A to L1B

Apply factory calibrations.

Processing Parameters: None

Process log:
Process Single Level
ProcessL1b.processL1b: 23-Nov-2021 10:53:37
Applying factory calibrations.
  Group: GPRMC_NMEA0183v3.01.tdf
    File: $GPRMC
  Group: HED488B.cal
    File: SATHED0488
  Group: HLD385B.cal
    File: SATHLD0385
  Group: HLD386B.cal
    File: SATHLD0386
  Group: HSE488B.cal
    File: SATHSE0488
  Group: HSL385B.cal
    File: SATHSL0385
  Group: HSL386B.cal
    File: SATHSL0386
  Group: SATNAV0001A.tdf
    File: SATNAV0001
L1B file produced:
 /Users/daurin/GitRepos/HyperInSPACE/Data/L1B/SAMPLE_HYPERSAS_SOLARTRACKER_L1B.hdf
Process Single Level: /Users/daurin/GitRepos/HyperInSPACE/Data/L1B/SAMPLE_HYPERSAS_SOLARTRACKER_L1B.hdf - SUCCESSFUL

## L1C : Process L1B to L1C

Filter data on pitch, roll, yaw, and azimuth angles.

Processing Parameters:
Rotator Home Angle: 0.0
Rotator Delay: 60.0
Pitch/Roll Filter: 5.0
Rel Azimuth Min: 90.0
Rel Azimuth Max: 135.0

Process log:
Process Single Level
Found data: station
Found data: lat
Found data: lon
Found data: wind
Found data: wt
Found data: sal
Found data: speed_f_w
ProcessL1c:
/Users/daurin/GitRepos/HyperInSPACE/Data/L1B/SAMPLE_HYPERSAS_SOLARTRACKER_L1B.hdf
ProcessL1c.processL1c: 23-Nov-2021 10:53:42
Bad Datetag or Timetag2 found. Eliminating record. 1776 : 3158326.0 : 758134061.0
Filtering file for high pitch and roll
Percentage of data out of Pitch/Roll bounds: 0 %
Filtering file for bad Absolute Rotator Angle
Percentage of SolarTracker data out of Absolute Rotator bounds: 0 %
Filtering file for bad Relative Solar Azimuth
Percentage of data out of Relative Solar Azimuth bounds: 3 %
Flag data from TT2: 2016-05-20 07:58:17.566000+00:00 to 2016-05-20 07:59:48.483000+00:00 (HHMMSSMSS)
Eliminate combined filtered data from datasets.**********
Remove ES_DARK Data
Length of dataset prior to removal 1033 long
Length of records removed from dataset: 8
Data end 1025 long, a loss of 1 %
Remove ES_LIGHT Data
Length of dataset prior to removal 3579 long
Length of records removed from dataset: 23
Data end 3556 long, a loss of 1 %
Remove GPS Data
Length of dataset prior to removal 1777 long
Length of records removed from dataset: 45
Data end 1732 long, a loss of 3 %
Remove LI_DARK Data
Length of dataset prior to removal 1027 long
Length of records removed from dataset: 8
Data end 1019 long, a loss of 1 %

Remove LI_LIGHT Data
Length of dataset prior to removal 4753 long
Length of records removed from dataset: 37
Data end 4716 long, a loss of 1 %
Remove LT_DARK Data
Length of dataset prior to removal 245 long
Length of records removed from dataset: 2
Data end 243 long, a loss of 1 %
Remove LT_LIGHT Data
Length of dataset prior to removal 1243 long
Length of records removed from dataset: 9
Data end 1234 long, a loss of 1 %
Remove SOLARTRACKER Data
Length of dataset prior to removal 1776 long
Length of records removed from dataset: 46
Data end 1730 long, a loss of 3 %
Remove ANCILLARY_METADATA Data
Length of dataset prior to removal 59 long
Length of records removed from dataset: 1
Data end 58 long, a loss of 2 %
L1C file produced:
/Users/daurin/GitRepos/HyperInSPACE/Data/L1C/SAMPLE_HYPERSAS_SOLARTRACKER_L1C.hdf
Process Single Level: /Users/daurin/GitRepos/HyperInSPACE/Data/L1C/SAMPLE_HYPERSAS_SOLARTRACKER_L1C.hdf - SUCCESSFUL

## L1D : Process L1C to L1D

Deglitch data and apply shutter dark corrections.

Processing Parameters:
ES Dark Window: 11
ES Light Window: 9
ES Dark Sigma: 3.2
ES Light Sigma: 2.4
LT Dark Window: 9
LT Light Window: 9
LT Dark Sigma: 3.2
LT Light Sigma: 2.3
LI Dark Window: 11
LI Light Window: 9
LI Dark Sigma: 3.5
LI Light Sigma: 2.4
ES Light Thresh. Band: None
ES Light Min.: None
ES Light Max.: None
ES Dark Thresh. Band: None
ES Dark Min.: None
ES LDark Max.: None
LI Light Thresh. Band: 421.63
LI Light Min.: None
LI Light Max.: None
LI Dark Thresh. Band: None
LI Dark Min.: None
LI LDark Max.: None
LT Light Thresh. Band: None
LT Light Min.: None
LT Light Max.: None
LT Dark Thresh. Band: None
LT Dark Min.: None
LT Dark Max.: None

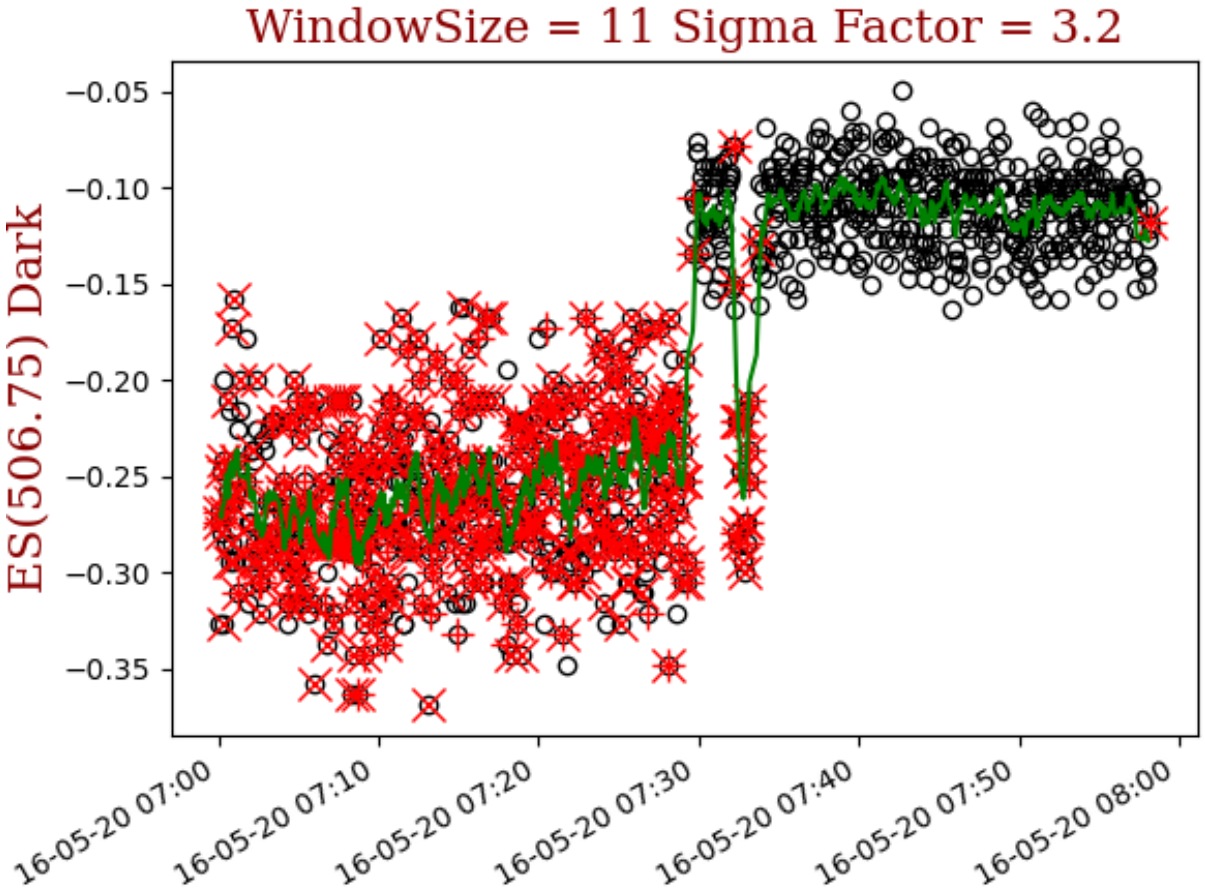
Process log:
Process Single Level
Deglitching anomaly file found for this L1C. Using these parameters.
ProcessL1d:
/Users/daurin/GitRepos/HyperInSPACE/Data/L1C/SAMPLE_HYPERSAS_SOLARTRACKER_L1C.hdf
ProcessL1d.processL1d: 23-Nov-2021 10:53:45
Screening ANCILLARY_METADATA for clean timestamps.
Screening ES_DARK for clean timestamps.
Screening ES_LIGHT for clean timestamps.
Screening GPS for clean timestamps.
Screening LI_DARK for clean timestamps.
Screening LI_LIGHT for clean timestamps.
Screening LT_DARK for clean timestamps.

Screening LT_LIGHT for clean timestamps.
Screening SOLARTRACKER for clean timestamps.
ES
Deglitching dark
Data reduced by 422 (41%)
Deglitching light
Data reduced by 550 (15%)
LI
Deglitching dark
Data reduced by 73 (7%)
Deglitching light
Data reduced by 1745 (37%)
LT
Deglitching dark
Data reduced by 50 (21%)
Deglitching light
Data reduced by 219 (18%)
Dark Correction: ES
Dark Correction: LI
Dark Correction: LT
L1D file produced:
/Users/daurin/GitRepos/HyperInSPACE/Data/L1D/SAMPLE_HYPERSAS_SOLARTRACKER_L1D.hdf
Process Single Level: /Users/daurin/GitRepos/HyperInSPACE/Data/L1D/SAMPLE_HYPERSAS_SOLARTRACKER_L1D.hdf - SUCCESSFUL

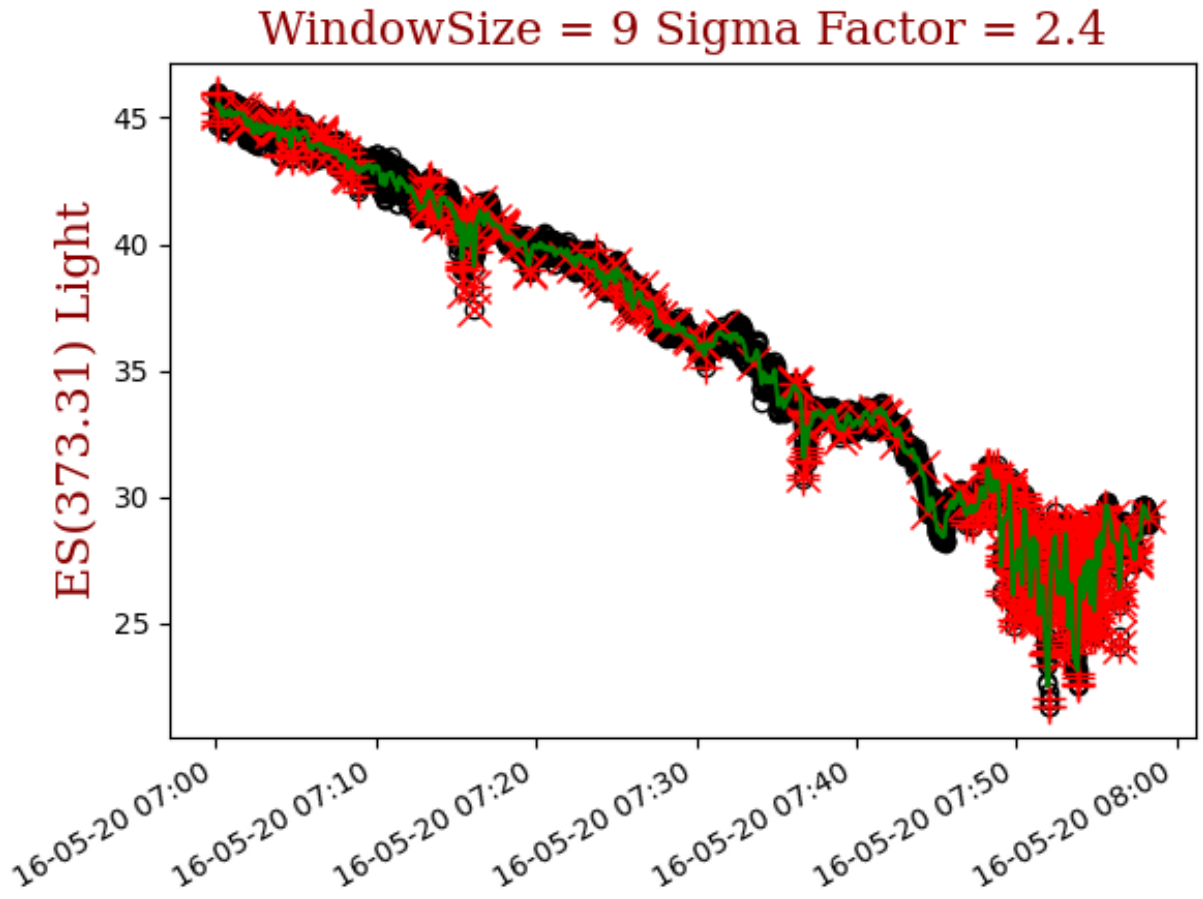
## Example Deglitching

Randomized. Complete plots of hyperspectral deglitching from anomaly analysis can be found in [output_directory]/Plots/L1C_Anoms.

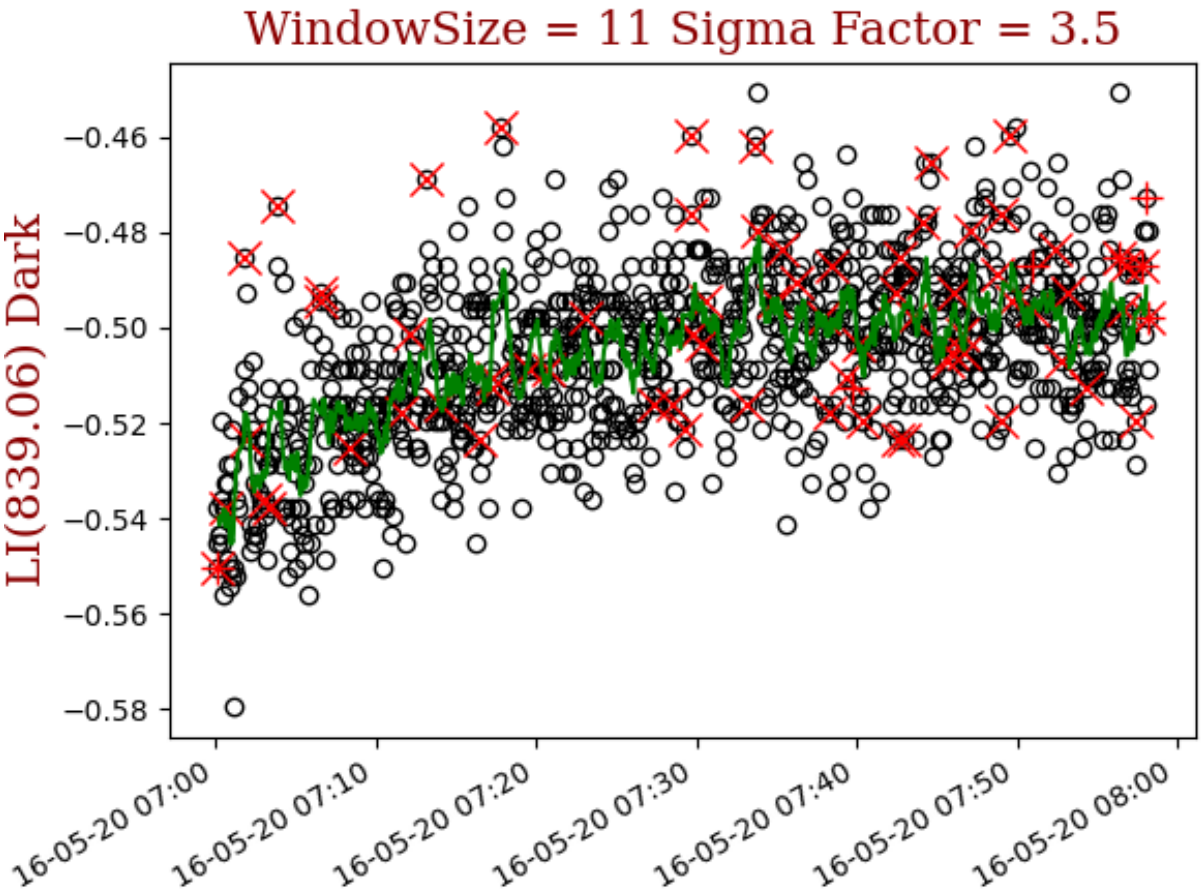
Marked for exclusions in ALL bands



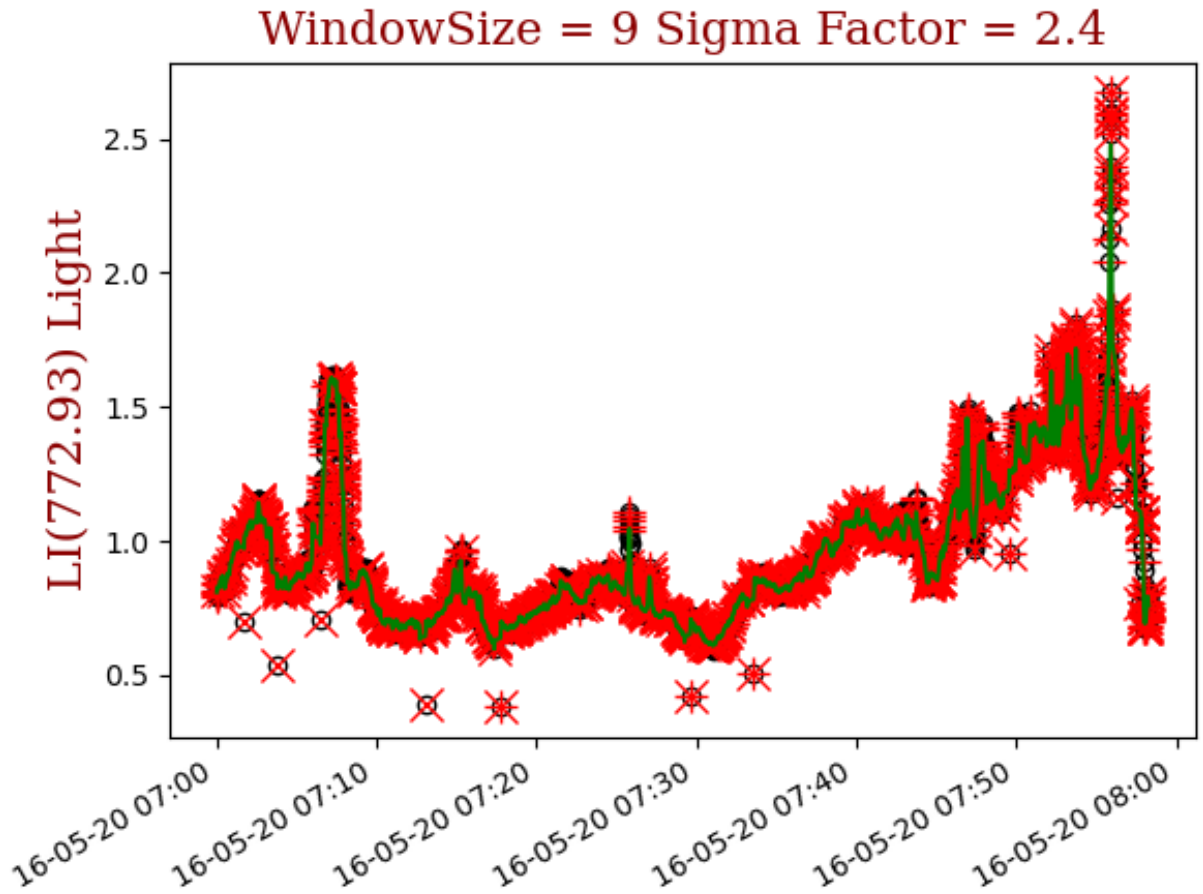
Marked for exclusions in ALL bands



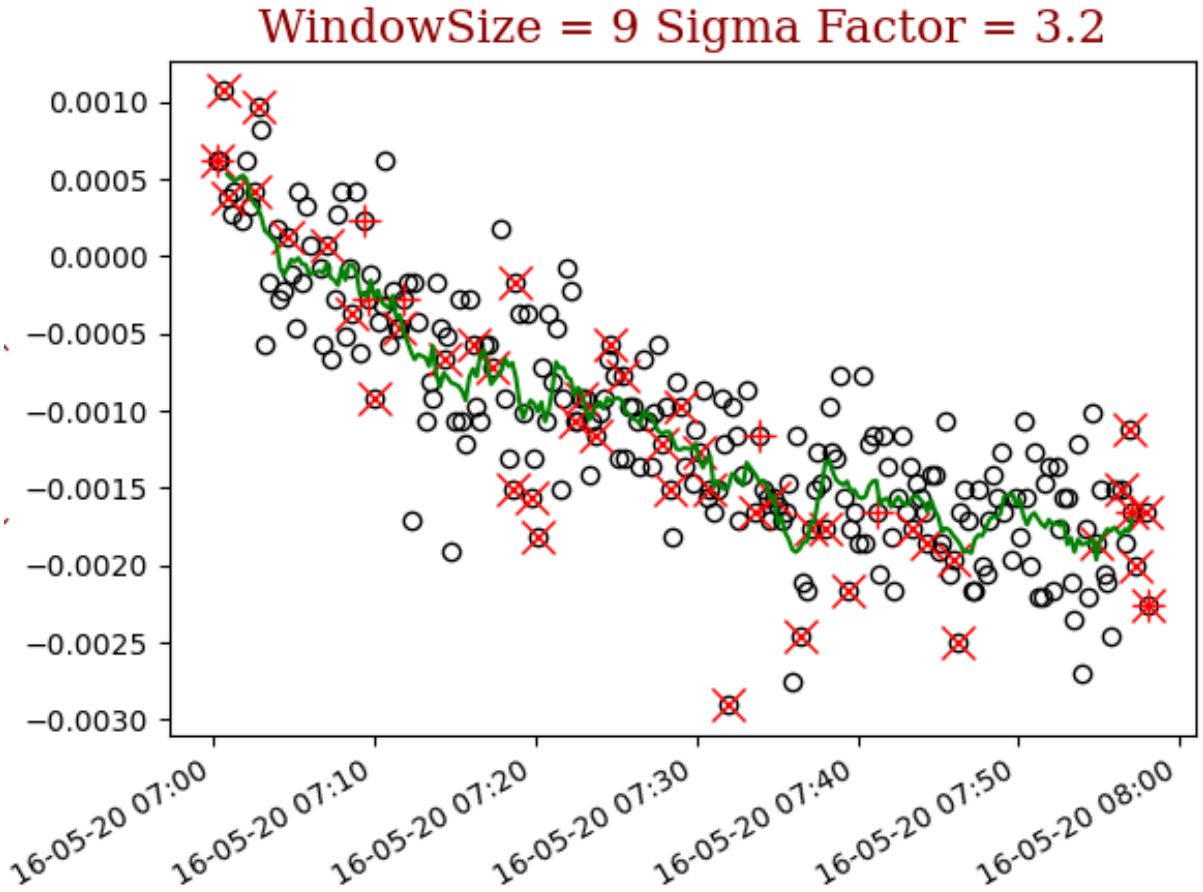
Marked for exclusions in ALL bands



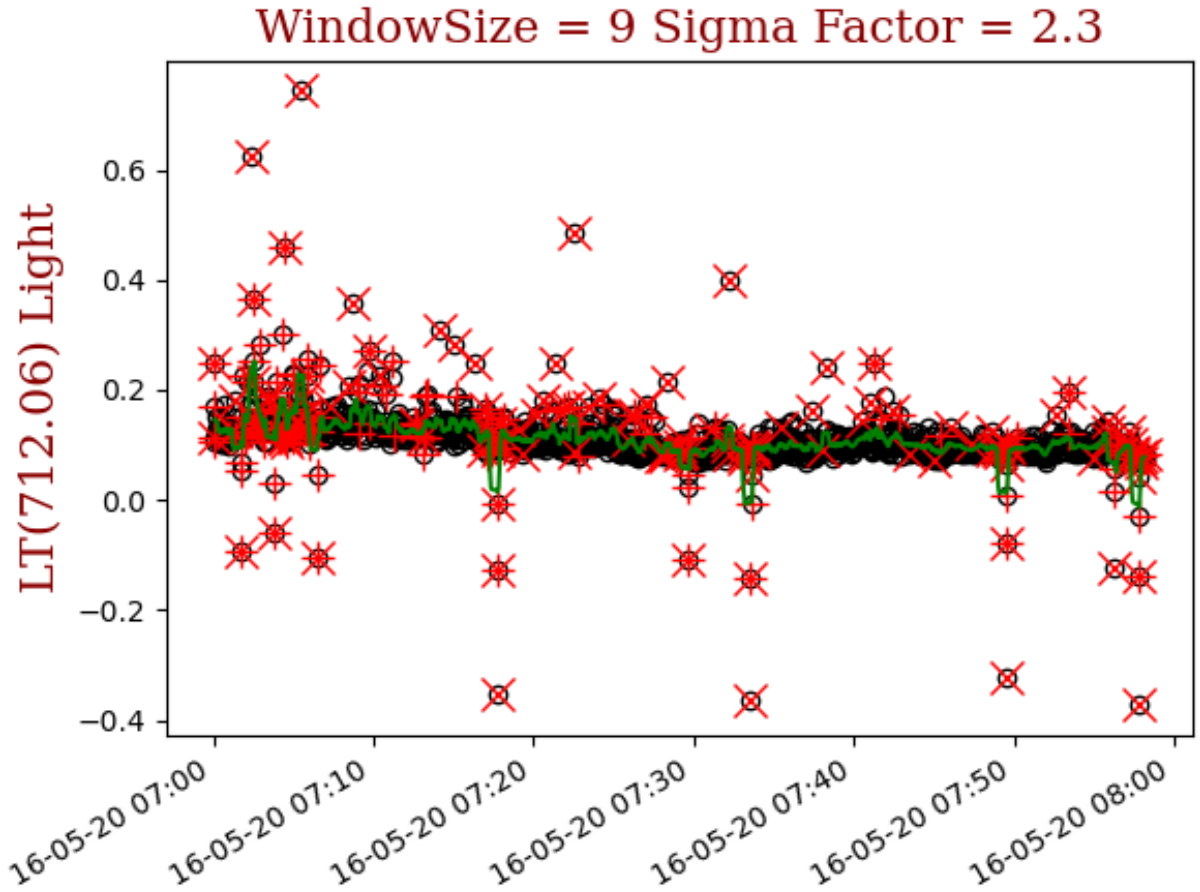
Marked for exclusions in ALL bands



Marked for exclusions in ALL bands



Marked for exclusions in ALL bands



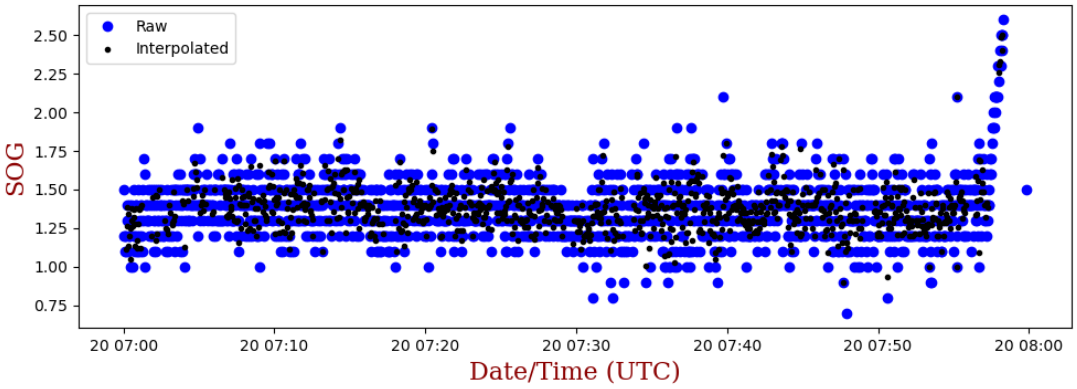
## L1E : Process L1D to L1E

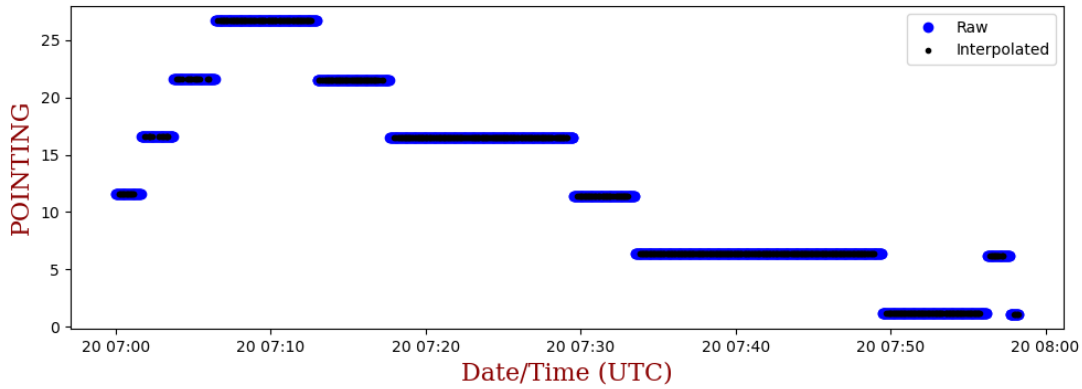
Interpolate data to common timestamps and wavebands.
Processing Parameters:
Wavelength Interp Int: 3.3 nm

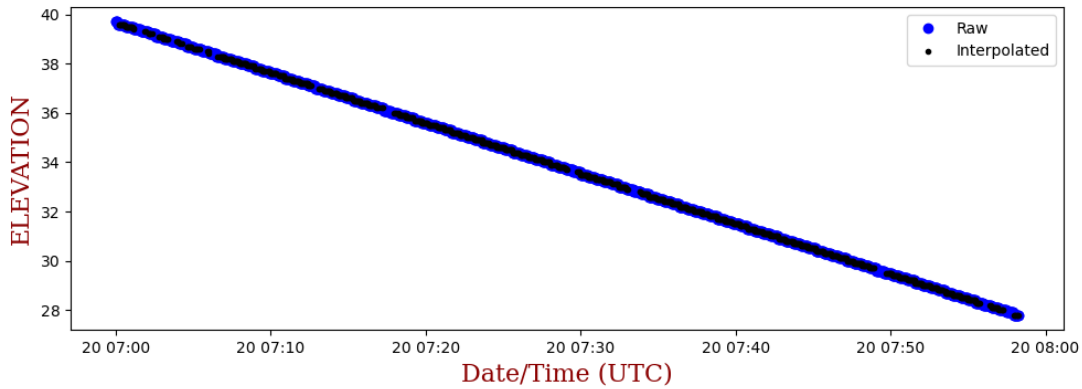
Process log:
Process Single Level
ProcessL1e.processL1e: 24-Nov-2021 15:00:13
LT has fewest records (as expected) - interpolating to LT; 1015 records
Interpolate Data ES
Interpolate Data LI
Interpolate Data LT
Skip. Other instruments are being interpolated to this one.
Interpolate Data LATITUDE
Interpolate Data LONGITUDE
Interpolate Data COURSE
Interpolate Data SOG
Interpolate Data REL_AZ
Interpolate Data ELEVATION
Interpolate Data AZIMUTH
Interpolate Data POINTING
Interpolate Data HUMIDITY
Interpolate Data PITCH
Interpolate Data ROLL
Interpolate Data HEADING
Interpolate Data REL_AZ
Interpolate Data SZA
Interpolate Data STATION
Interpolate Data LATITUDE
Interpolate Data LONGITUDE
Interpolate Data SALINITY
Interpolate Data SOLAR_AZ
Interpolate Data SST
Interpolate Data WINDSPEED
Interpolate Data SPEED_F_W
L1E file produced:
/Users/daurin/GitRepos/HyperInSPACE/Data/L1E/SAMPLE_HYPERSAS_SOLARTRACKER_L1E.hdf
Output SeaBASS for HDF: Es, Li, Lt files

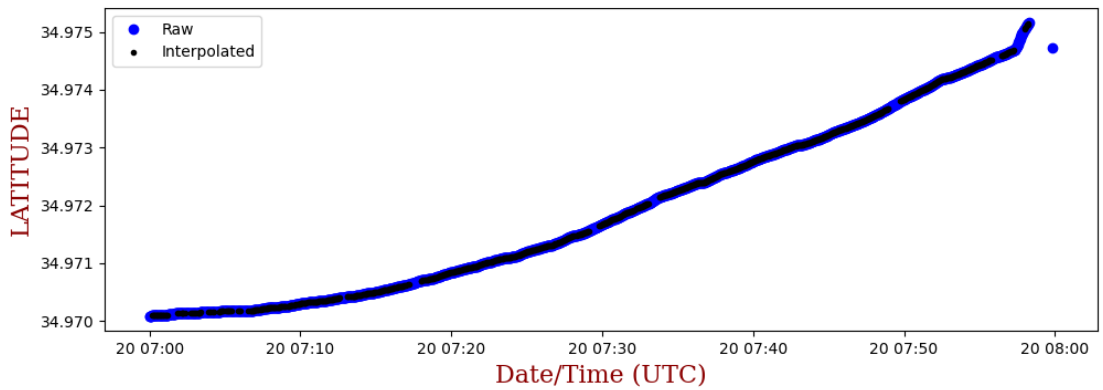
## Example Temporal Interpolations

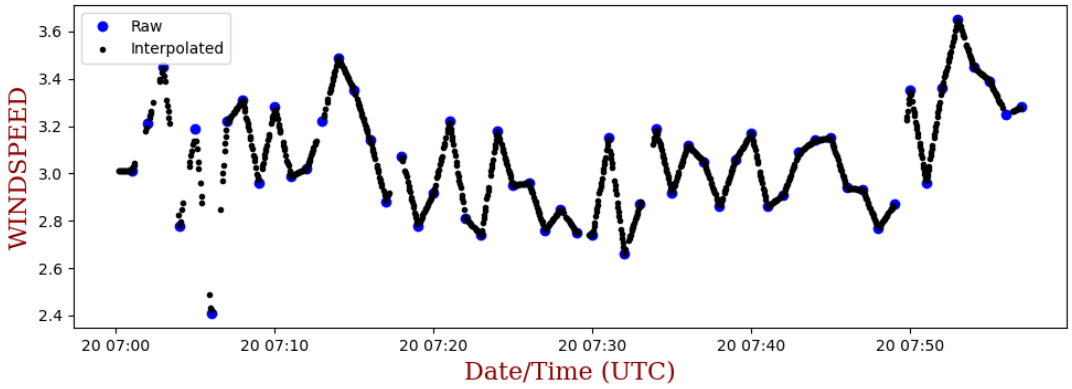
Randomized. Complete plots of hyperspectral interpolations can be found in [output_directory]/Plots/L1E.

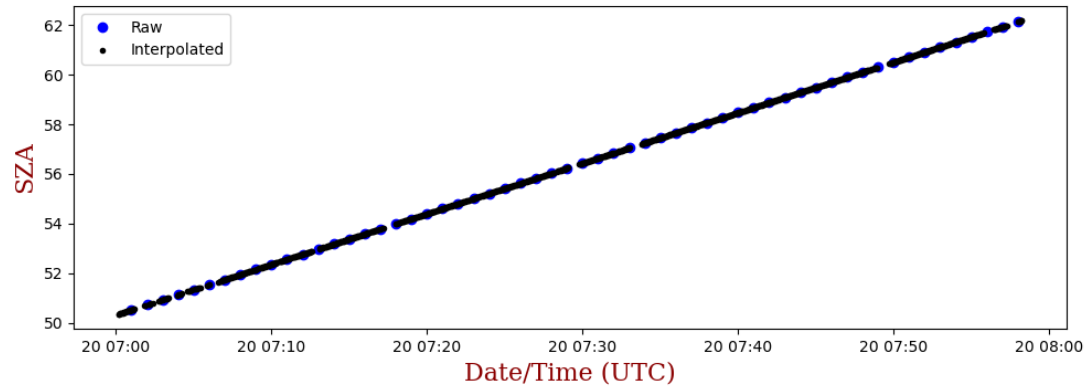

Raw
Interpolated
SOG
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

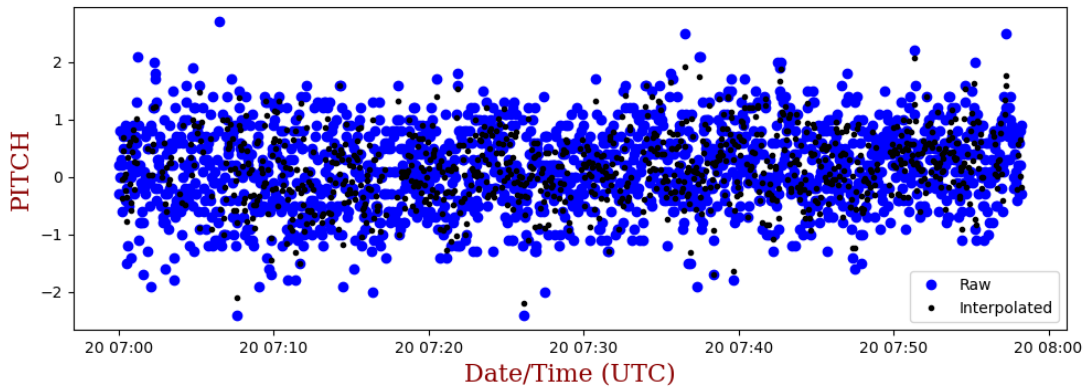

Raw
Interpolated
POINTING
25
20
15
10
5
0
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

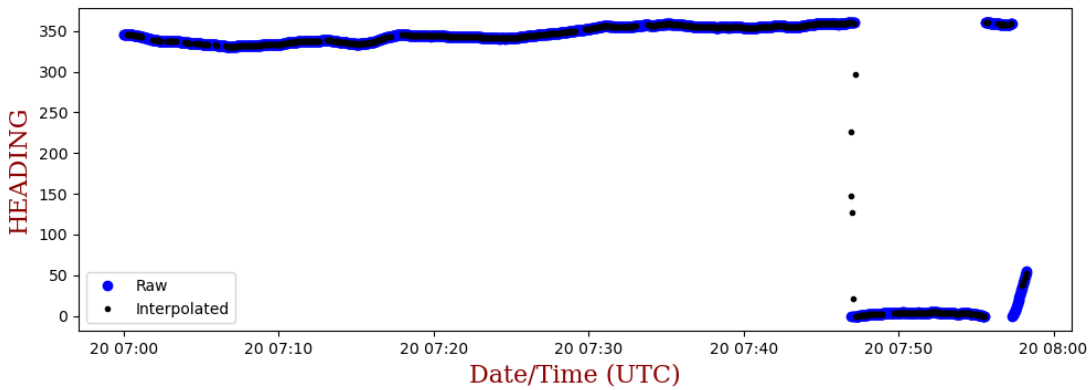

Raw
Interpolated
ELEVATION
40
38
36
34
32
30
28
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

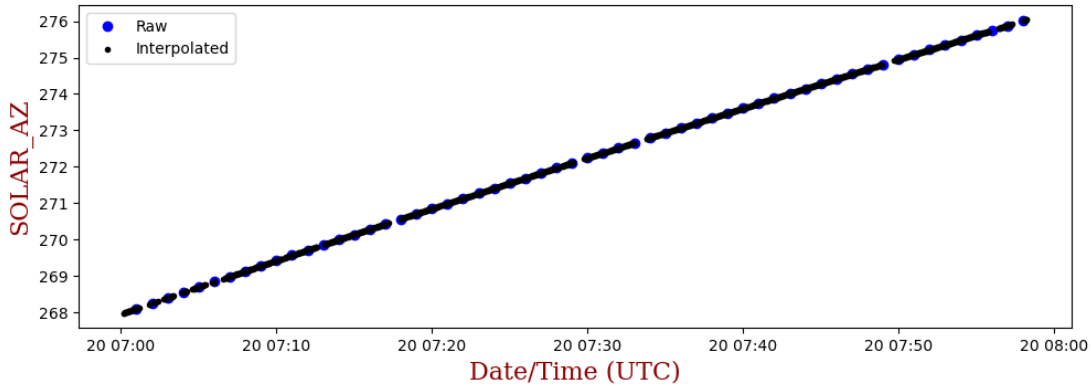

Raw
Interpolated
LATITUDE
34.975
34.974
34.973
34.972
34.971
34.970
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

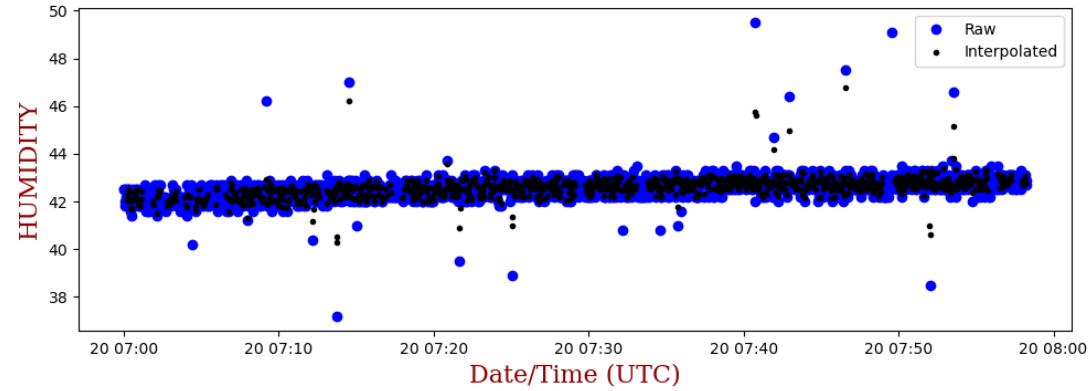

Raw
Interpolated
WINDSPEED
3.6
3.4
3.2
3.0
2.8
2.6
2.4
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
Date/Time (UTC)

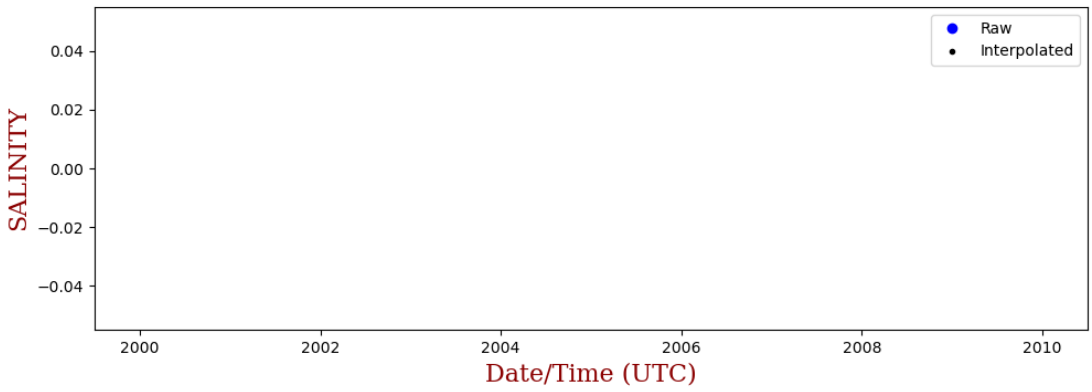

Raw
Interpolated
SZA
62
60
58
56
54
52
50
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

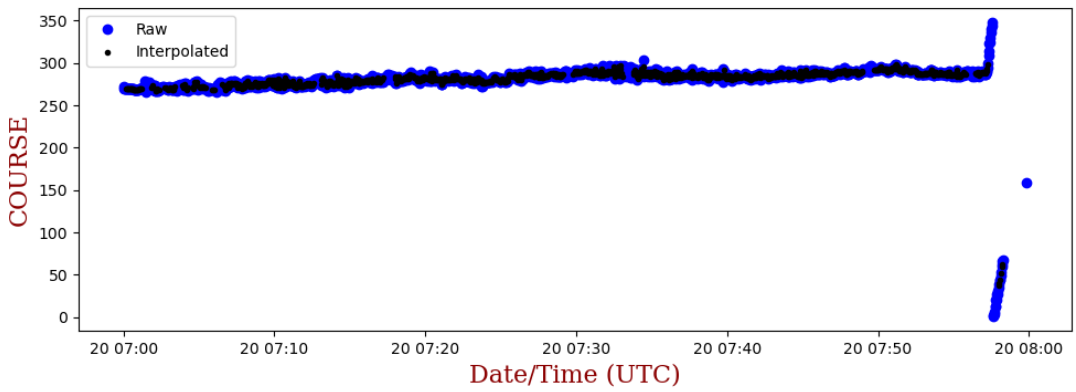

PITCH
2
1
0
−1
−2
Raw
Interpolated
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

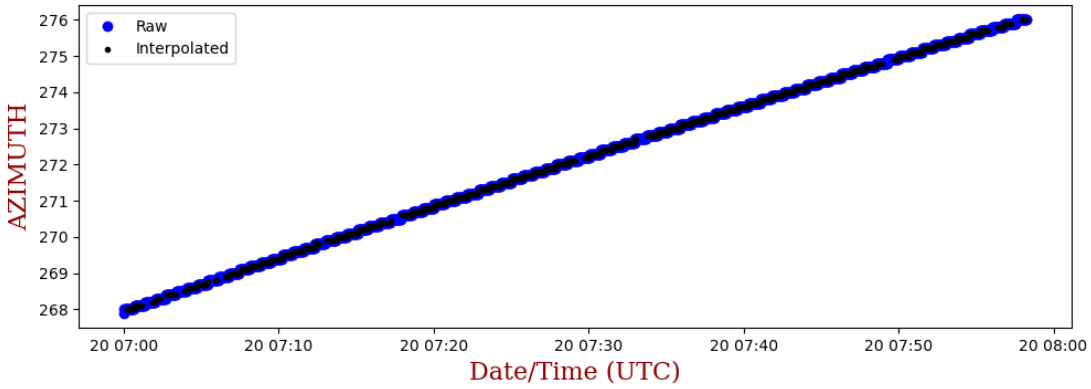

HEADING
350
300
250
200
150
100
50
0
Raw
Interpolated
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

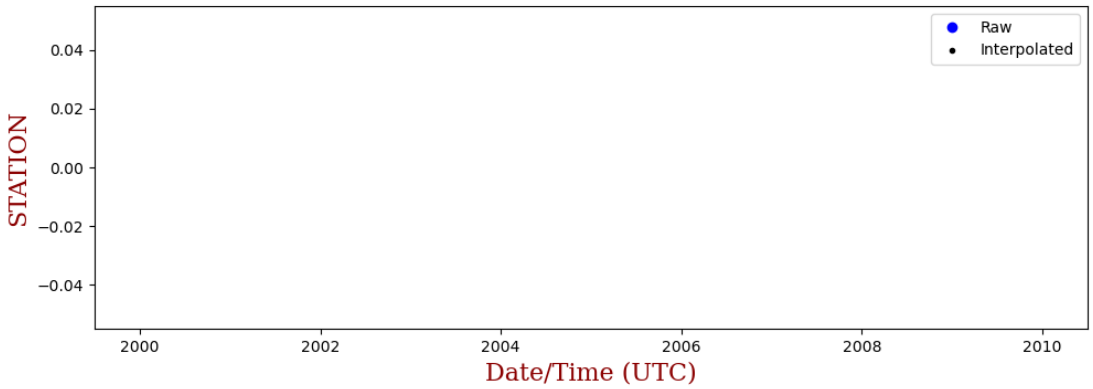

Raw
Interpolated
SOLAR_AZ
276
275
274
273
272
271
270
269
268
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

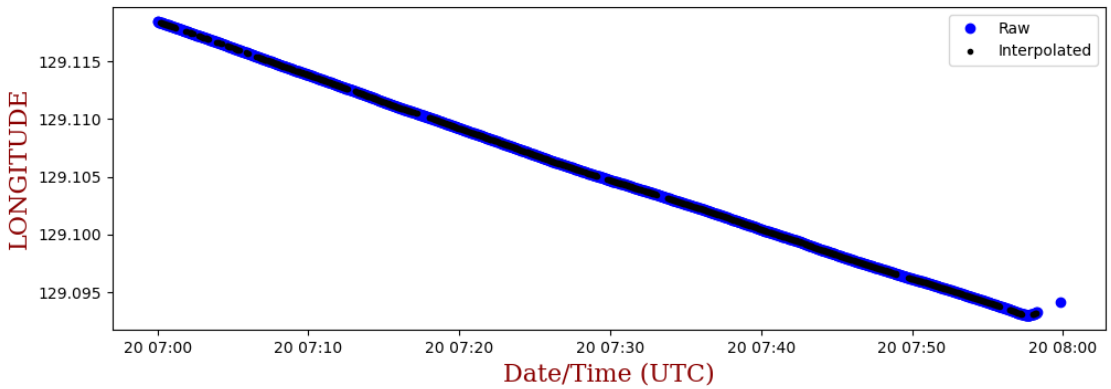

Raw
Interpolated
HUMIDITY
50
48
46
44
42
40
38
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

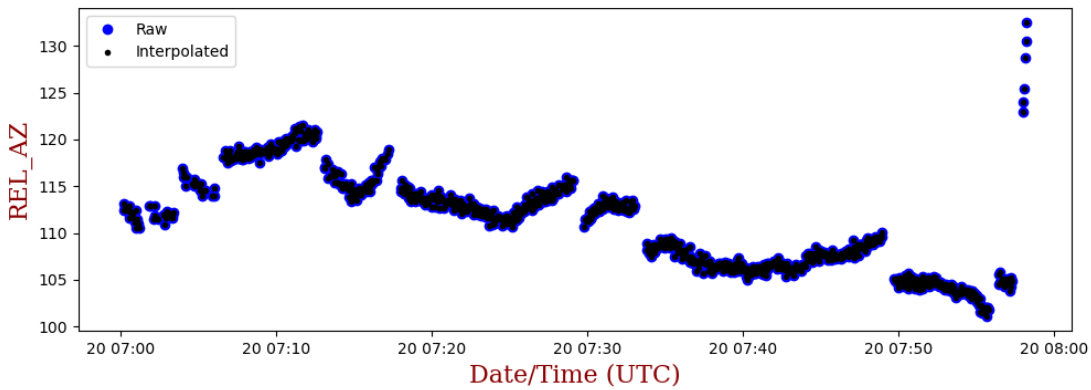

Raw
Interpolated
SALINITY
0.04
0.02
0.00
−0.02
−0.04
2000
2002
2004
2006
2008
2010
Date/Time (UTC)

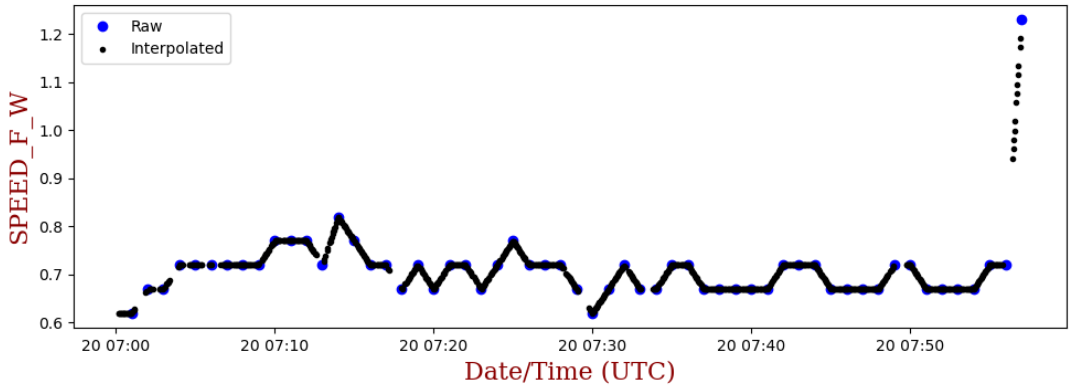

Raw
Interpolated
COURSE
350
300
250
200
150
100
50
0
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

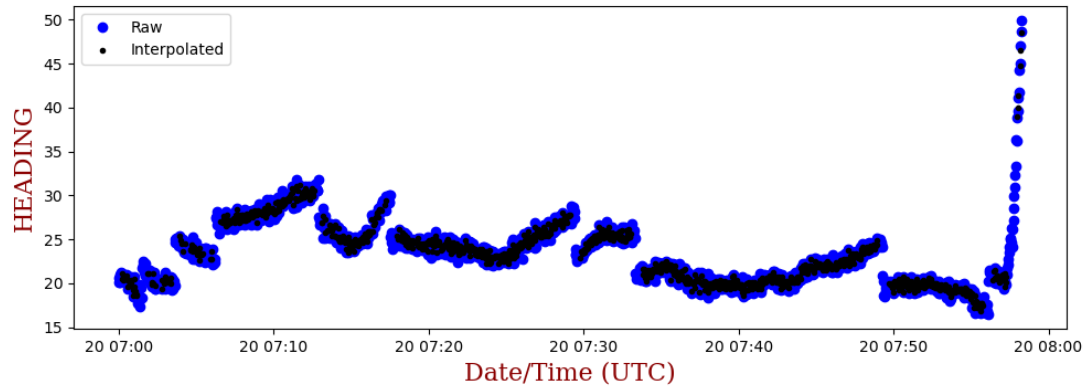

Raw
Interpolated
AZIMUTH
276
275
274
273
272
271
270
269
268
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

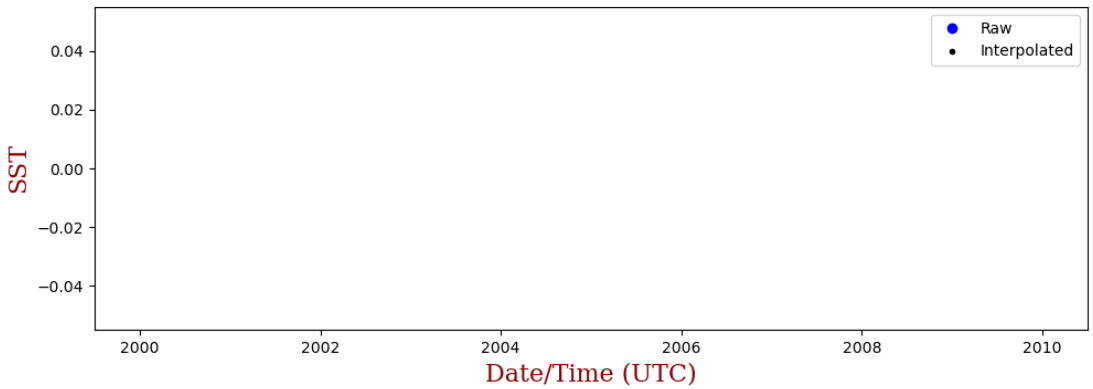

Raw
Interpolated
STATION
0.04
0.02
0.00
−0.02
−0.04
2000
2002
2004
2006
2008
2010
Date/Time (UTC)

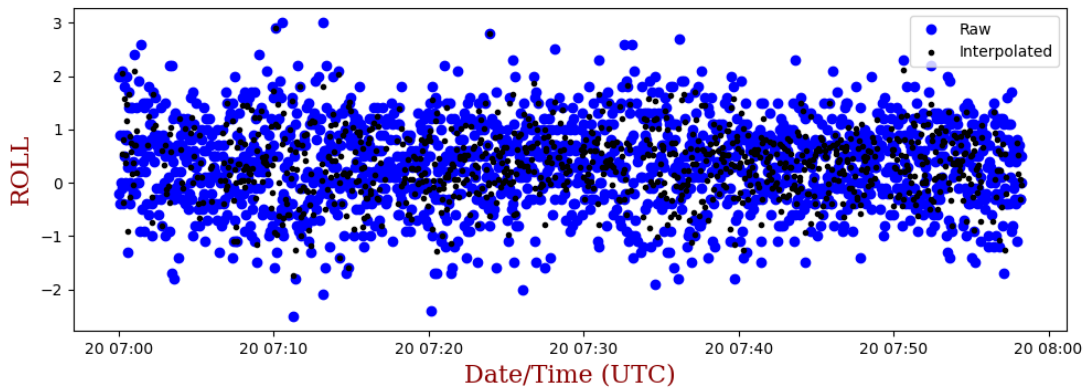

Raw
Interpolated
LONGITUDE
129.115
129.110
129.105
129.100
129.095
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

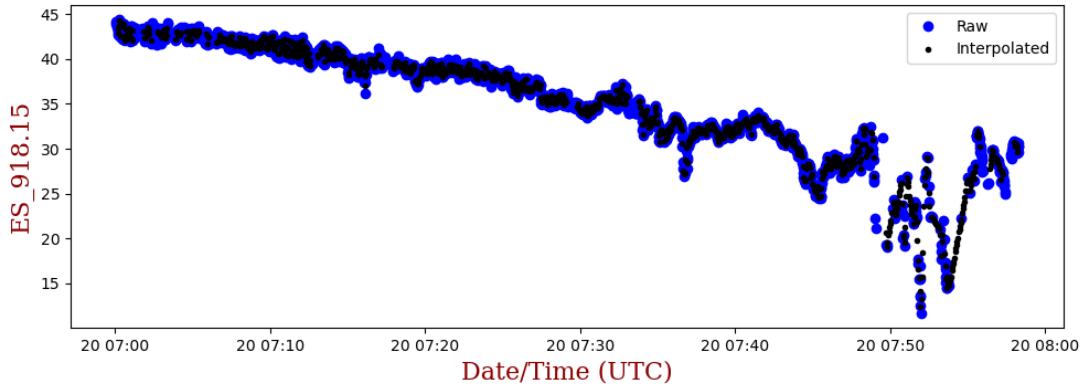

Raw
Interpolated
REL_AZ
130
125
120
115
110
105
100
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

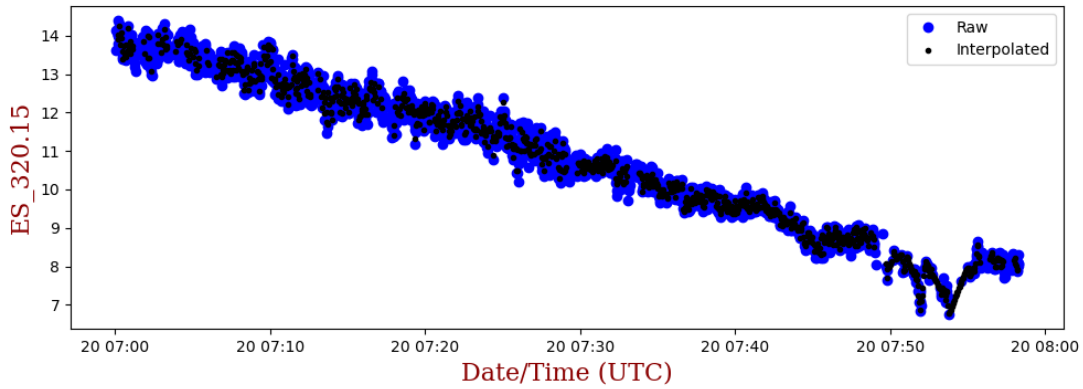

Raw
Interpolated
SPEED_F_W
1.2
1.1
1.0
0.9
0.8
0.7
0.6
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
Date/Time (UTC)

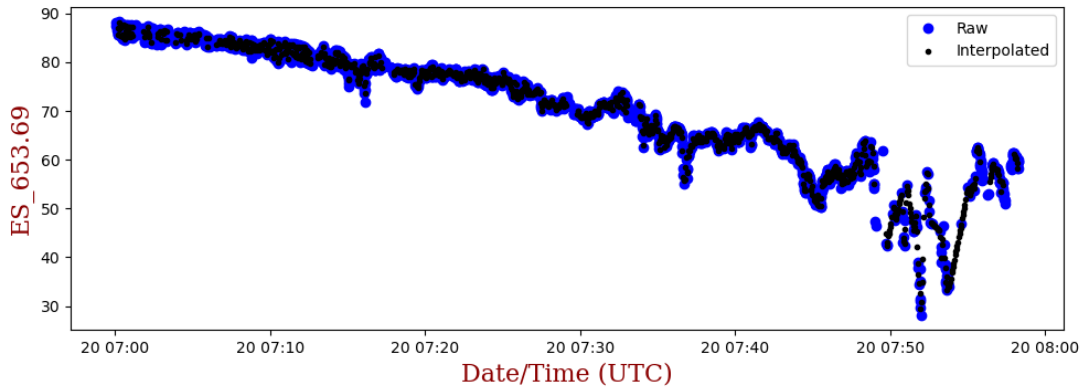

Raw
Interpolated
HEADING
50
45
40
35
30
25
20
15
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

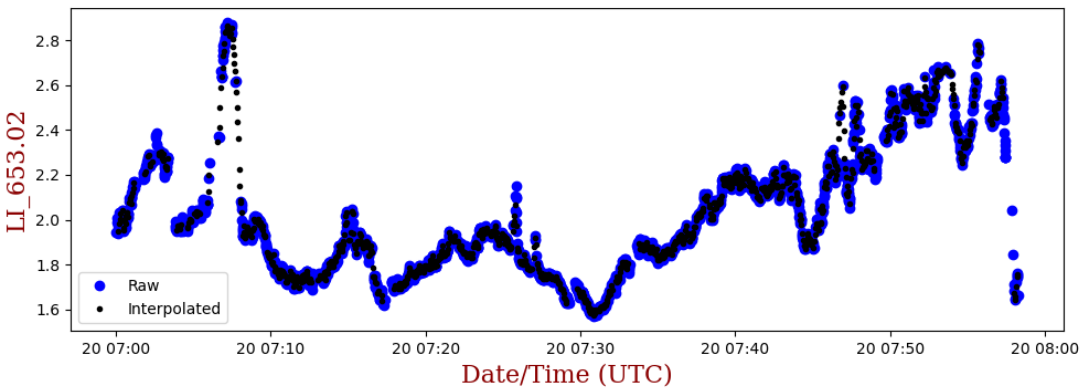

Raw
Interpolated
SST
0.04
0.02
0.00
−0.02
−0.04
2000
2002
2004
2006
2008
2010
Date/Time (UTC)

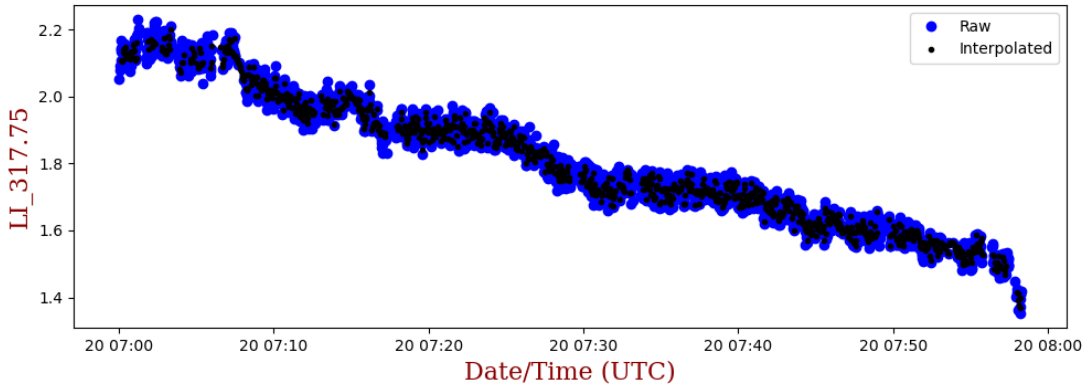

Raw
Interpolated
ROLL
3
2
1
0
−1
−2
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

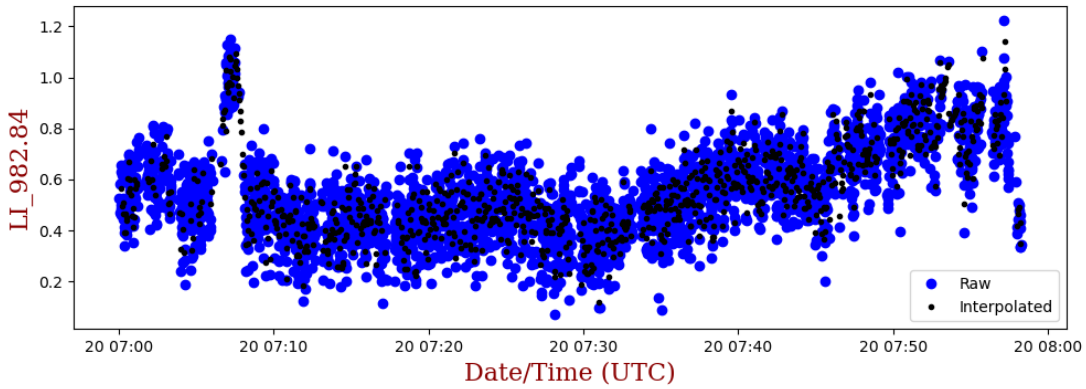

ES_918.15
Raw
Interpolated
45
40
35
30
25
20
15
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)


ES_320.15
Raw
Interpolated
14
13
12
11
10
9
8
7
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

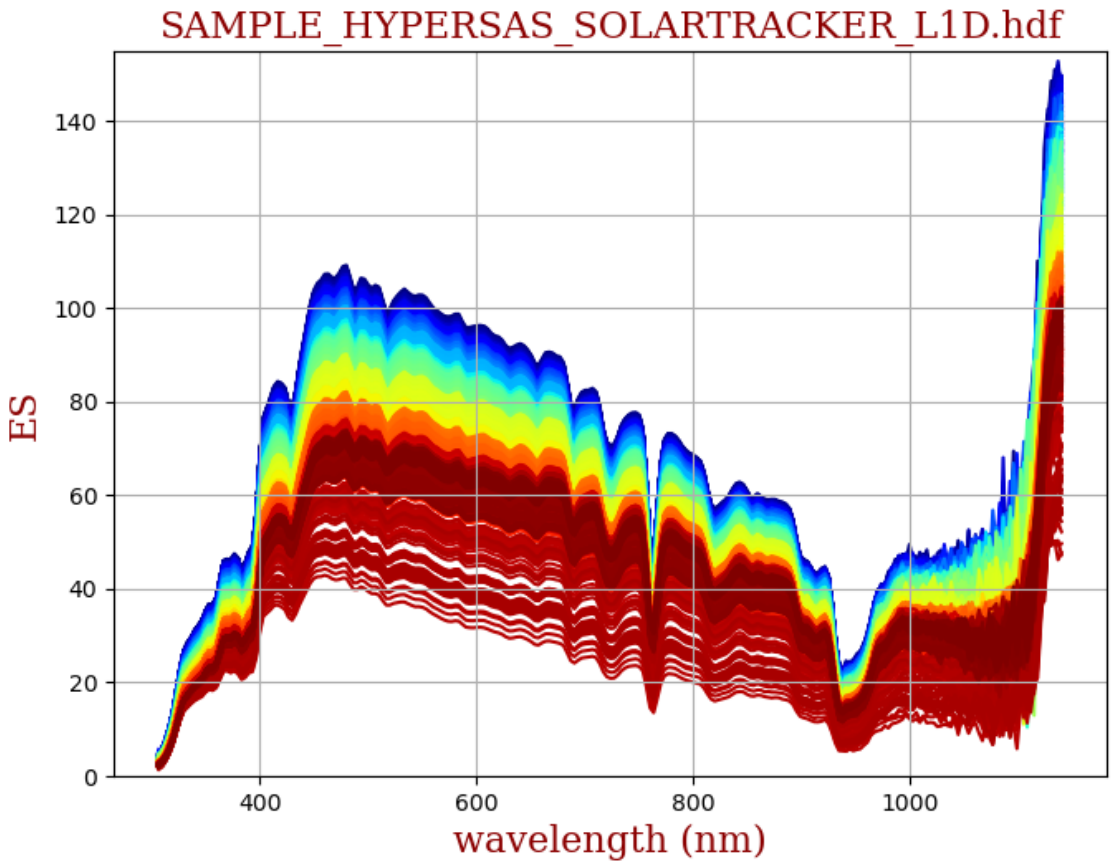

ES_653.69
Raw
Interpolated
90
80
70
60
50
40
30
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

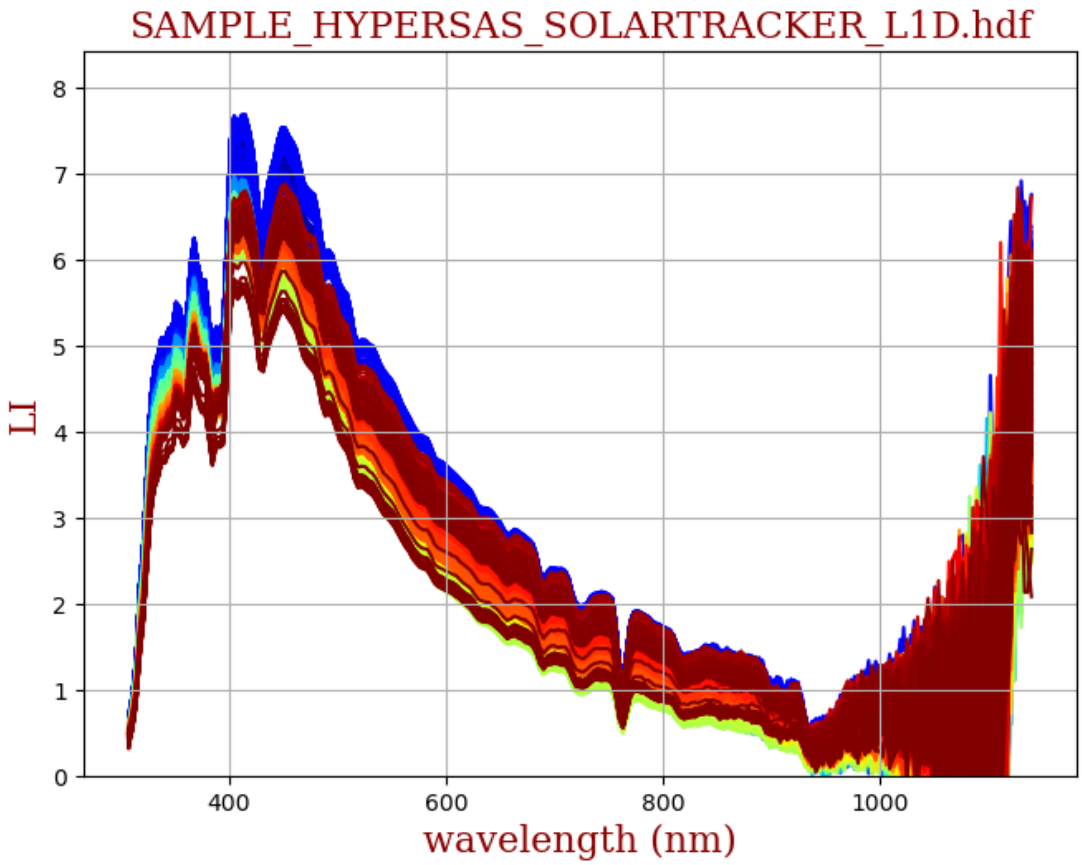

LI_653.02
Raw
Interpolated
2.8
2.6
2.4
2.2
2.0
1.8
1.6
20 07:00
20 07:10
20 07:20
20 07:30
20 07:40
20 07:50
20 08:00
Date/Time (UTC)

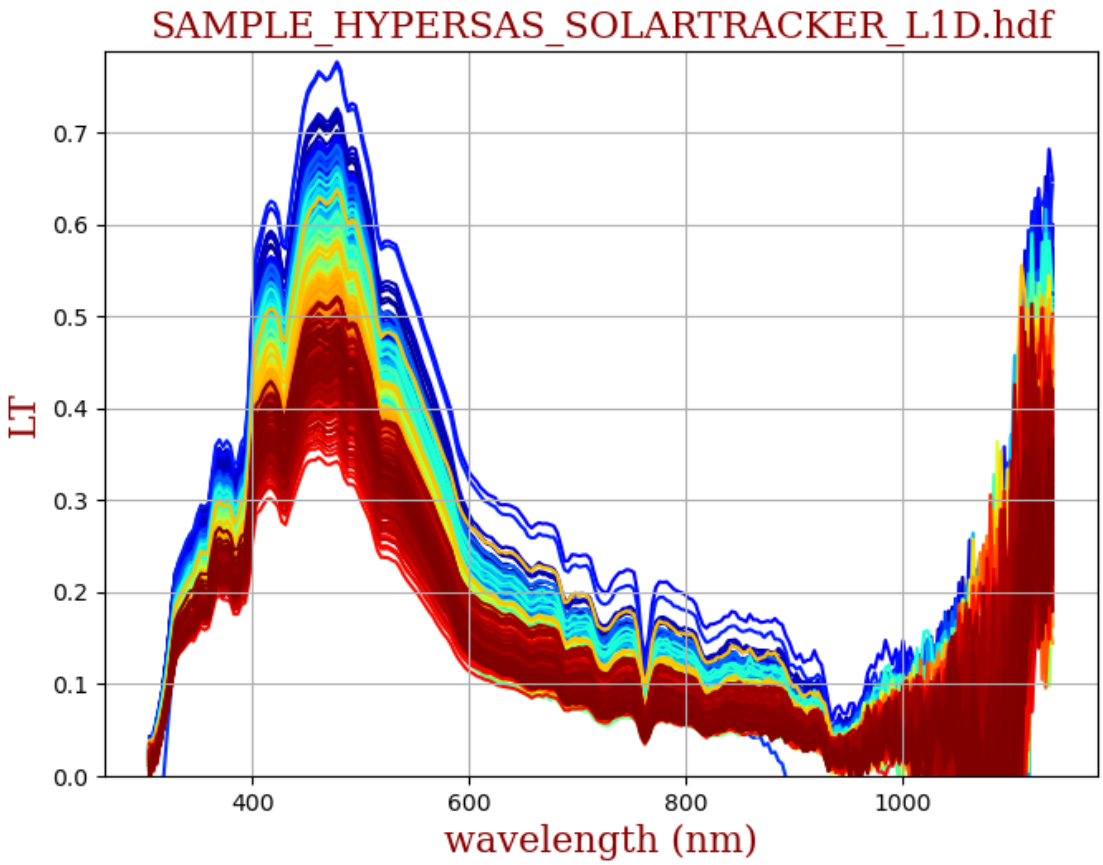



## Complete spectral plots


SAMPLE_HYPERSAS_SOLARTRACKER_L1D.hdf
ES
wavelength (nm)
0
20
40
60
80
100
120
140
400
600
800
1000


SAMPLE_HYPERSAS_SOLARTRACKER_L1D.hdf
LI
wavelength (nm)
0
1
2
3
4
5
6
7
8
400
600
800
1000


SAMPLE_HYPERSAS_SOLARTRACKER_L1D.hdf
LT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
400
600
800
1000
wavelength (nm)

## L2 : Process L1E to L2

Apply more quality control filters, temporal binning, station selection, glint correction, NIR corrections, reflectance calculation and OC product calculation.

Processing Parameters:
Max Wind: 10.0
Min SZA: 20.0
Max SZA: 60.0
Filter Sigma Es: 5.0
Filter Sigma Li: 8.0
Filter Sigma Lt: 3.0
Cloud Filter: 1.0
Es Filter: 2.0
Dawn/Dusk Filter: 1.0
Rain/Humidity Filter: 1.095
Ensemble Duration: 300 sec
Percent Lt Filter: 10.0
Glint_Correction: Zhang et al. 2017
NIR Correction: Mueller and Austin 1995
Remove Negatives: ON

Process log:
Process Single Level
ProcessL2:
/Users/daurin/GitRepos/HyperInSPACE/Data/L1E/SAMPLE_HYPERSAS_SOLARTRACKER_L1E.hdf
Model data for Wind and AOD may be used to replace blank values. Reading in model data...
Ancillary file found locally: N201614107_MERRA2_1h.nc
Ancillary file found locally: N201614107_AER_MERRA2_1h.nc
Filling in field data with model data where needed.
Filling in ancillary data with default values where still needed.
Applying Lt(NIR)>Lt(UV) quality filtering to eliminate spectra.
0.0% of spectra flagged
Low SZA. SZA: 60
Percentage of data out of SZA and Wind limits: 18 %
  Flag data from TT2: 2016-05-20 07:47:29.030000+00:00 to 2016-05-20 07:58:13.339000+00:00
Remove IRRADIANCE Data
  Length of dataset prior to removal 1015 long
  Length of dataset after removal 831 long: 18% removed
Remove RADIANCE Data
  Length of dataset prior to removal 1015 long
  Length of dataset after removal 831 long: 18% removed
Remove ANCILLARY Data
  Length of dataset prior to removal 1015 long
  Length of dataset after removal 831 long: 18% removed
Applying spectral filtering to eliminate noisy spectra.
1.2% of Es data flagged
0.5% of Li data flagged
5.4% of Lt data flagged

Remove IRRADIANCE Data
  Length of dataset prior to removal 831 long
  Length of dataset after removal 777 long: 6% removed
Remove RADIANCE Data
  Length of dataset prior to removal 831 long
  Length of dataset after removal 777 long: 6% removed
Remove ANCILLARY Data
  Length of dataset prior to removal 831 long
  Length of dataset after removal 777 long: 6% removed
Applying meteorological filtering to eliminate spectra.
0.0% of spectra flagged
Binning datasets to ensemble time interval.
53 spectra in slice (ensemble).
5 spectra remaining in slice to average after filtering to lowest 10.0%.
Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
74 spectra in slice (ensemble).
7 spectra remaining in slice to average after filtering to lowest 10.0%.
Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
85 spectra in slice (ensemble).
8 spectra remaining in slice to average after filtering to lowest 10.0%.
Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
80 spectra in slice (ensemble).
8 spectra remaining in slice to average after filtering to lowest 10.0%.
Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
97 spectra in slice (ensemble).
10 spectra remaining in slice to average after filtering to lowest 10.0%.
Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
83 spectra in slice (ensemble).
8 spectra remaining in slice to average after filtering to lowest 10.0%.
Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
88 spectra in slice (ensemble).
9 spectra remaining in slice to average after filtering to lowest 10.0%.
Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
97 spectra in slice (ensemble).
10 spectra remaining in slice to average after filtering to lowest 10.0%.

Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
84 spectra in slice (ensemble).
8 spectra remaining in slice to average after filtering to lowest 10.0%.
Wavelengths extend beyond model limits. Truncating to 350 - 1000 nm.
Calculating Zhang glint correction. This can take several minutes.
Perform simple residual NIR subtraction.
Filtering reflectance spectra for negative values.
0.0% of Rrs_HYPER spectra flagged
0.0% of nLw_HYPER spectra flagged
Processing chlor_a
Processing avw
Processing CDOM, Sg, DOC
Processing qaa
Processing Wei QA
L2 file produced:
/Users/daurin/GitRepos/HyperInSPACE/Data/L2/SAMPLE_HYPERSAS_SOLARTRACKER_L2.hdf
Output SeaBASS for HDF:
/Users/daurin/GitRepos/HyperInSPACE/Data/L2/SAMPLE_HYPERSAS_SOLARTRACKER_L2.hdf