## **Copernicus FICE 2024**

Training on In situ Ocean Colour Above-Water Radiometry towards Satellite Validation

## HyperCP Introduction













## **HyperCP** Introduction

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Funding from NASA PACE Mission and Copernicus **FRM4SOC** Initiative







Welcome, Philipp and Ryan!







<sup>4</sup> Copernicus Programme of European Commission



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<sup>8</sup> University of Maine



<sup>9</sup> Gybe Inc.



## Background

**Mission instruments** are meticulously characterized prior to launch: stray light, thermal response, SNR, etc. to quantify and correct for anomalies.





**On orbit**, they require validation and system vicarious calibration to account for radiometric drift and atmospheric correction error.

SVC is traditionally at fixed, dedicated platforms in blue waters, but validation can come from portable platforms in all optical water types.







### **Rigorous validation**

requires high-quality, hyperspectral in situ radiometry from many locations and water types.







## What is HyperCP?





**Open-source** processor for Above Water Radiometry (AWR) that facilitates **protocol-driven** data correction and reduction yielding high-quality surface reflectance measurements with end-to-end uncertainty propagation for submission to NASA's SeaBASS and Copernicus' OCDB archives for use in satellite validation and ocean color algorithm development



**Ocean Colour In-Situ Database** 















## What's in a name?

### A shameless compound acronym:

HyperCP = HyperInSPACE Community Processor HyperInSPACE = Hyperspectral In situ Support for PACE PACE = Plankton, Aerosol, Cloud, ocean Ecosystem [mission]

### Hyperspectral In situ Support for Plankton, Aerosol, Cloud, ocean Ecosystem Community Processor

Sure to tax any title or abstract word limit. We also sometimes call it **HCP**, for short.





## HyperCP History

### AWR protocols were

updated by IOCCG and the community ~2017 - 2019 for the first time since the SeaWiFS era.

HyperInSPACE began at Goddard Space Flight Center toward the end of this period to process NASA's own radiometry and help the community process AWR following these protocols.



Authors Giuseppe Zibordi, Kenneth J. Voss, B. Carol Johnson and James L. Mueller





#### Fiducial Reference Measurements for Satellite Ocean Colour Phase-2

#### Measurement Procedure Document (MPROCD) FRM Fiducial Reference Measurements for Title Satellite Ocean Colour Phase-2

Docur Projec Protocols for uncertainty budget calculation of Contra FRMOCnet OCR and practical guide for OCR Versio measuren Date is (FRM4SC Fiducial Reference Measurements for Satellite Ocean Colour Phase-2

Document ref Project

Version

**Reflectance Measurement Requirements Document** Contract Deliverable (RMRD)

#### Date issued FRM4SOC2-RMRD

Specifications of minimum requirements for		
qualification of individual OCRs and their measurements		
as FRM and process for inclusion of any new instrument		
models and measurements in the FRMOCnet (RMRD)		
FRM4SOC2-RMRD		
EUMETSAT – FRM4SOC Phase-2		
EUMETSAT Contract No. EUM/CO/21/460002539/JIG		
D-2 Reflectance Measurement Requirements Document		
(RMRD)		
V1.2		
02.11.2022		

## HyperCP History





water of the second





## Why HyperCP?

Informed by scientific consensus (protocol driven) **Open Source (transparent) Open Science (accessible)** Collaborative Adaptive Community resource

By the community for the community



Harry H. H. M. M.





## Above Water Radiometry (AWR) Principles and Theory





## In Situ Above Water Radiometry (AWR)





4. 4. 5%





Dissolved and Particulate Carbon

## DARD

## HyperCP Ecosystem



Supported Sensors:

- Sea-Bird Scientific HyperOCR
- TriOS RAMSES

Platforms:

Format

Data

• Manual

Data Formatters: prepSAS, TriOS specific Community Processor: HyperCP Databases: SeaBASS, OCDB





• Robotic: pySAS, Sea-Bird SolarTracker, Panthyr, So-Rad, ...



### Manual Systems

pySAS





pySAS



### PANTHYR\*

SoRad\*

### SolarTracker

\*not currently adapted within HyperCP

### Manual Systems



### SolarTracker

#### Water Leaving Radiance

Sea surface reflectance factor Skylight radiance  $L_{w}(\theta_{v},\varphi_{v},\lambda) = L_{t}(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{s},\varphi_{s},\theta_{v},\varphi_{v},\lambda,W,\tau,T,S) * L_{i}(\theta_{v},\varphi_{v},\lambda)$ Total upwelling radiance

**Remote Sensing Reflectance** 

$$R_{rs} = \frac{L_w(\theta_v, \varphi_v, \lambda)}{E_s(\lambda)}$$
  
Sea surface irradiance

**Normalized Water Leaving Radiance** 

$$nL_w = R_{rs} * F0,$$

**TOA** irradiance

**Exact Normalized Water Leaving Radiance** 

Corrected for BRDF  $nL_{w}^{ex}$ . (adjusted to  $\boldsymbol{\theta}_{s} = 0, \, \boldsymbol{\theta}_{v} = 0$ )





 $= L_t(\theta_v, \varphi_v, \lambda) - L_r(\theta_s, \varphi_s, \theta_v, \varphi_v, \lambda, W, \tau, T, S)$ 



## Primary Challenges

Sea surface glint, platform perturbations, solar/sensor geometries, the environment, metrology, and traceability



#### **Sun/Sky Glint Subtraction**

 $L_{w}(\theta_{v},\varphi_{v},\lambda) = L_{t}(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{s},\varphi_{s},\theta_{v},\varphi_{v},\lambda,W,\tau,T,S) * L_{i}(\theta_{v},\varphi_{v},\lambda)$ 

**p** is also slightly dependent on skylight polarization.

 $\rho$  is most dominated by  $\varphi_s$ , peaking at the specular point of the sun.

 $\rho$  is optimal (low) at  $\varphi_s$  in 90° – 135°.

However at  $\varphi_s = 135^\circ$  superstructure perturbation is typically increased.



High values of **D** affecting more viewing geometries as surface becomes rougher

Figures adapted from Mobley 1999, Applied Optics

**p**: revisited by Mobley on 2015 Zibordi et al. 2016: Old (1999) values are still preferable Azimuth and zenith/tilt must be carefully tracked in the field for p, but also because cosine collectors for downwelling irradiance are very sensitive to tilt.

### **ρ**: Sea surface reflectance factor





Solid lines are  $\varphi$ , for 135°, dashed for 90°.

## Above Water Radiometry (AWR)











### Validation quality AWR requires good conditions (wind, sky, sea-surface, tilt, etc., refer to IOCCG Protocols)

Correcting AWR for surface reflectance of sun/sky (glint) is a challenge even in the best conditions. HyperCP can adjust the glint correction for solar/sensor geometries and optical water types. It has multiple options for glint, glitter and NIR residual corrections, and a long list of QC filters.

> Skylight radiance Sea surface reflectance factor

 $L_{w}(\theta_{v},\varphi_{v},\lambda) = L_{t}(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{s},\varphi_{s},\theta_{v},\varphi_{v},\lambda,W,\tau,T,S) * L_{i}(\theta_{v},\varphi_{v},\lambda)$ 

$$R_{rs} = \frac{L_w(\theta_v, \varphi_v, \lambda)}{E_s(\lambda)}$$

## Above Water Radiometry (AWR)

#### Sea surface "reflectance" factor\*



High values of **(contours above) affecting more** viewing geometries as surface becomes rougher



Correcting AWR for surface reflectance of sun/sky (glint) is a challenge even in the best conditions. HyperCP can adjust the glint correction for solar/sensor geometries and optical water types. It has multiple options for glint, glitter and NIR residual corrections, and a long list of QC filters.









### Validation quality AWR requires good conditions (wind, sky, sea-surface, tilt, etc., refer to IOCCG Protocols)



Tilt,

# The Challenge of Surface Reflection (Glint)

Rapid changes driven by bright solar/cloud reflections on capillary waves can be rejected by only retaining the darkest ~10% of  $L_t$  measurements within the time-averaged 000 window (ensemble). 0





Slower, periodic fluctuations in **ρ** from gravity waves can be averaged over time (minutes).



## **Platform Perturbations**

### Shadows and platform reflectance

- $\rho$  is minimum at  $\varphi_s = 180^\circ$  away from Sun. ٠
- However,  $\varphi_s = 180^\circ$  is generally affected by platform • shadow
- $\varphi$ s=135° is generally outside of the platform shadow. •
- However,  $\varphi_s = 135^\circ$  still typically affected by platform reflectance (especially if highly reflective)
- : The compromise  $\varphi_s$  should be between 90° and 135°.

If appropriate  $\varphi_s$  are not maintained and recorded, AWR is effectively useless due to the lack of an accurate glint correction.



Talone, Zibordi, "Spectral assessment of deployment platform perturbations in above-water radiometry," Opt. Express 27, A878-A889 (2019)

**p**: Sea surface reflectance factor  $\varphi$ s: Sun-sensor (Li, Lt) relative azimuth







## Calibration/Characterization Uncertainty Overview





## Calibration

igital

umbers

## Additional factors impacting quality and uncertainty of in situ AWR

**Absolute calibration** 



$$\mathfrak{I}(\lambda) = C_{\mathfrak{I}}(\lambda) \aleph(\lambda) DN(\mathfrak{I}(\lambda))$$

(Ir)radiance in physical units

**Deviations from instrument's** expected ideal performance

Calibration of irradiance

Calibration of radiance









Figure 1.Pilot's (UT) irradiance calibration setup. 1 -FEL lamp; 2 – shutter; 3 – baffles; 4- -alignment laser; 5 – optical rail; 6 – radiometer; 7 – contactless distance probe.



Figure 2. Pilot's (UT) radiance calibration setup. 1 -FEL lamp; 2 – shutter; 3 – baffles; 4- alignment laser; 5 optical rail; 6 – radiometer; 8 – reflectance panel.

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## **Calibration Uncertainty**

## Additional factors impacting quality and uncertainty of in situ AWR

**Absolute calibration** 



Calibration of irradiance





#### Calibration of radiance











Figure 1.Pilot's (UT) irradiance calibration setup. 1 -FEL lamp; 2 – shutter; 3 – baffles; 4- -alignment laser; 5 – optical rail; 6 – radiometer; 7 – contactless distance probe.



Figure 2. Pilot's (UT) radiance calibration setup. 1 -FEL lamp; 2 – shutter; 3 – baffles; 4- alignment laser; 5optical rail; 6 – radiometer; 8 – reflectance panel.

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## **Characterization and Uncertainty**

### **Absolute calibration**

(Ir)radiance in physical units

### **Calibration coefficient**

$$\Im(\lambda) = C_{\Im}(\lambda) \aleph(\lambda) DN(\Im(\lambda))$$

### Digital numbers

deviations from instrument's expected ideal performance

- Dark current noise
- Linearity of response
- Calibration/stability
- Straylight response
- Angularity of response
- Thermal response
- Polarization response

**Characterization**, complementary to absolute radiometric calibration, is the determination of the distinctive features of an instrument allowing us to account for these deviations....







## Calibration/Characterization Uncertainty Regimes Applied in HyperCP v1.2+



## **Instrument Characterization**

## Some factors impacting quality and uncertainty of the AWR collected in situ

Cloud cover (record it, at least on station) Instrument fouling/obstruction (avoid it) Instrument response/characterization

the la high

\* Requirements of the Ocean Optics & Biogeochemical Protocols for Satellite Ocean Colour Sensor Validation (IOCCG, 2019)

Uncertainty associated with these characterizations can be modeled using Monte Carlo simulations, and added to the reported products

- Dark current noise
- Linearity of response
- Calibration/stability
- Straylight response
- Angularity of response
- Thermal response
- Polarization response

Laboratory measurements can characterize these for specific instruments and classes of instruments.







Dark frame subtraction/ correction Deglitching (L1AQC)

Linearity correction Calibration correction Straylight correction Cosine <u>correction</u> (Es) Thermal correction



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## Instrument Characterization in v1.2



- Dark current noise
- Linearity of response
- Calibration/stability
- Straylight response
- Angularity of response
- Thermal response
- Polarization response

Instrument Classes:

Classes = Instruments:

- Sea-Bird HyperOCR
- TriOS RAMSES (added in v1.2)
- IMO DALEC (planned)







*Aga Bialek, National Physical Laboratory, UK, et al.* Remote Sens. 2020, 12, 780; doi:10.3390/rs12050780

## Improved Precision and Uncertainty Estimation







#### v1.1:

- No instrument-specific characterizations, corrections, or uncertainty
- Only environmental variability and uncertainty course estimate for the glint correction (Mobley 1999).

#### v1.2 Class-based:

- Class-based (Sea-Bird, TriOS) characterizations and uncertainties (no corrections) in addition to environmental variability.
- Monte Carlo estimates of uncertainty for glint correction.
- v1.2 Full-FRM:
- Instrument-specific characterizations, corrections, and uncertainties applied in addition to environmental variability.
- Monte Carlo estimates of uncertainty for glint correction.

## Improved Precision and Uncertainty Estimation







Eld Estimates; elactritication activities ac

v1.1 overestimates; glint uncertainty poorly parameterized



## AWR In the Field

Critical ancillary datasets





## On a Ship



41.45° 4. 4. 57.





Flow-through system (SST, Salinity, chl\_fl, IOPs, etc.)

## AAOT





Buoy data

https://www.comune.venezia.it/content/3-piattaforma-ISMAR-CNR





Manually operated radiometers

¢ → G ⊑	comune.venezia.it/content/3-plattaforma-ISM.	AR-CNR	Χ 🖤 🔟 Σ	3   🚷 :
	Città di Venezia		Cerca	Q
	3. Piattaforma I	SMAR-CN	R	
	Coordinate Geografiche (Rete 2000)	Sensori installati	Sensore	Altezza
	<b>Latitudine</b> 45° 18' 83.00" N	Direzione vento Velocità vento	t033 TDV t031 TVV	20 m 20 m
	Longitudine	Barometro	t011d TBAR-IVS	12 m
	12° 30' 53.00" E	Igrometro Umidità aria	t003 TRH	18 m
		Temperatura aria	t001 TTEP	18 m
		Temperatura acqua	t020 TTA	-2.2 m
		Radiazione solare	t055 TPIR	18 m
		Pluviometro	t027 TP1K	16 m
		Mareografo	t039 TIDROM	7 m
	Altezza del caposaldo: 7.56 m	Sistema di acquisizione	DA9000	12 m
		Ondametro	t021 TLU16	8 m
	-			





Stazione di Piattaforma ISMAR-CNR

Mappa

Piattaforma ISMAR-CNR: dati recenti

## What is required from PIs?



and the second

(See the complete requirements at SeaBASS at QR Code above (https://seabass.gsfc.nasa.g ov/wiki/data submission sp ecial requirements) and refer to IOCCG Protocols)

**Primary Requirements:** 

1. Sensor geometries (and how maintained)

- a. Sensor azimuth and/or relative azimuth (to sun)
- b. Sensor zenith angles
- Tilt (particularly for  $E_s$ ) С.
- 2. Wind speed
- 3. Sky conditions (%cloud, fog, rain)

$$L_{w}(\theta_{v},\varphi_{v},\lambda) = L_{t}(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) = L_{t}(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) = L_{t}(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) = L_{t}(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_{v},\lambda) - \rho(\theta_{v},\varphi_$$









## What is required from Pls?

Secondary Requirements:

1. Aerosol Optical Depth 2. SST 3. Salinity

$$L_{w}(\theta_{v},\varphi_{v},\lambda) = L_{t}(\theta_{v},\varphi_{v},\lambda) - \rho($$



WARE OF WARE







Wind, AOD, SST, and Sal fall back on models in HyperCP (MERRA-2, ECMWF)
### What else helps identify validation-quality data?

**Recommended Metadata:** 

- 1. Bottom depth
- 2. Ship speed (through the water)
- 3. Station ID (get your whole cruise team to agree if you can)
- 4. Wave height
- 5. Field note comments (e.g., heavy spray lenses wiped @0800, bloom slick, crossing turbidity front @1210, etc.)





## Field Log

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Home	Insert	Draw	Page Layout	Formulas	Data	Review	View	Automate	♀ Tell me	

4, 4, 5%

#### Experiment: FIREFLY02, Cruise: SEASON1, Platform: SERENITY, Operator: Hoban Waskburne. Home angle: 0, Min/Max Az: -20/+140, Height: 7m, Ship hull color: Silver.

								relative	relative								
						ship	ship	azimuth (ship-	azimuth	wind	wind	1		sea surface	l	bottom	
station	raw filename	station start date/tim	station end date/tim	lat	lon	heading	speed	sensor)	(solar-sensor)	speed	dir	wave	s salinit	temperature	cloud 0	depth comme	nts
(name agreed	(not for pySAS when working							(above-water;	(above-water;								
across sampling	properly, or if station number is in	(UTC. Confirm all		(deg; 3-4				only if set	only if set							(haze, fo	og, rain, optically
platforms)	the name)	systms set to UTC)	(UTC)	decimals)	(deg)	(deg)	(kts)	manually)	manually)	(m/s)	(deg	) (m)	(psu)	(deg C)	(% or x/8) (	(m) shallow	//bottom reflection, other issues)
checkout	pySAS/prepSAS defaults hourly files	2023-11-12-T-1400	2023-11-12-T-1410	27.764	-82.636	N/A	C	N/A	N/A	5	5 45	5 0.	5 3	2 25	25	8 System	checked out without incident
1	11	2023-11-12-T-1430	2023-11-12-T-1500	27.764	-82.636	i	C	) "	II	5	5 50	0.	5 3	3 24	50	35 IOP cast	and Hyperpro multicast
2		2023-11-12-T-1600	2023-11-12-T-1645	27.764	-82.636		C	)		7	55	5 0.	3 3	2 25	50	10 Clean le	nses, IOP and AOP casts



Submission of Field Log in supporting documents is *strongly* encouraged. Download a template from HyperCP repository https://github.com/nasa/HyperCP:





bel ~

**Comments** 

🖻 Share







# Intermission

Caffè







## HyperCP Overview





### Overview

GUI, or with configuration file on command line. Batch-able either way.

4 4 5

	HyperC	CP Main v1.2.1	
Select/Create Configu	HIC STATE	JpercP	
sample_SEAB	IRD_pySAS.cfg		٢
New		Edit Delete	
Input Data Parent D	Directory	/Users/daurin/Projects/HyperCP/Sample_Dat	a
	^^^ Mim	nic Input Dir. vvv	
Output Directory Ancillary Data File	/Users/daurin/Projects/H (SeaBASS format; MUST US	lyperCP/Sample_Data/M99SS/v12/pySAS_Factor SE UTC)	у
/Users/daurin/Proje	ects/HyperCP/Sample_Data	a/FICE22_pySAS_Ancillary.sb	
	Add	Remove	
		Level 0 (Raw)> Level 1A (HDF5) L1A> L1AQC	
Single-Level Pro	cessing	L1AQC> L1B	
		LIB> LIBQC	
		L1BQC> L2	
Multi-Level Proc	essing	L1BQC> L2 Raw (BIN)> L2 (HDF5)	

Each instrument deployment or cruise gets a unique configuration

Output directories are automatically created for each level of processing, as well as for Plots, Reports, and SeaBASS files

The Ancillary file for the entire deployment/cruise is provided here

Processing can be run on one file or many files together, and can be run on one level or all levels together



#### https://github.com/nasa/HyperCP

- See README for instruction/description
- See Discussion for support
- See Issues for reporting





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### **Directory Structure**





< > HyperC
------------

		Nam	e
>		py	/cache
>		Con	fig
/		Data	1
	>	📄 Ai	nc
	>	🚞 C	lass_Based_Characterizations
	>	📄 Fi	dRadDB_characterization
	>	📄 In	ng
	$\sim$	📄 Sa	ample_Data
		> 🚞	Instrument_Based_Characterizations
		> 🚞	L1A
		> 🚞	L1AQC
		> 🚞	L1B
		> 🚞	L1BQC
		> 🚞	L2
		> 🚞	Photos
		> 🚞	Plots
		> 🚞	RAW
		> 🚞	Reports
			FICE22_pySAS_Ancillary.sb
			FICE22_TriOS_Ancillary.sb
			KORUS_SOLARTRACKER_Ancillary.sb
		×	README_Sample_Data.xlsx

## Ancillary Data Inclusion/Submission



Notes to A set al





## SeaBASS Format (Ancillary Data)

#### (More information about SeaBASS will be provided on Day 7.)









FICE22\_pySAS\_Ancillary.sb ~

/data\_file\_name=FICE22\_Ancillary.sb /affiliations=NASA GSFC /investigators=Dirk\_Aurin /contact=dirk.a.aurin@nasa.gov

/data\_status=final /experiment=FRM4S0C2

/begin header

/cruise=FICE22

/station=AAOT

/missing=-9999.0 /delimiter=comma

/end date=20220721

/water\_depth=17

and field notes.

COMMENTS

/end header

/data\_type=above\_water /documents=FICE22 Ancillary.sb /calibration\_files=doesntapply.txt

/start\_date=20220711

/north latitude=45.314[DEG] /south latitude=45.314[DEG] /east\_longitude=12.508[DEG] /west\_longitude=12.508[DEG] /start\_time=00:00:00[GMT] /end\_time=10:35:00[GMT] /measurement\_depth=0

FRM4SOC-2 Field InterComparison Experiment (FICE) July 11 - 21, 2022 Acqua Alta Oceanographic Tower (AAOT), CNR-ISMAR

Ancillary data from: % https://www.comune.venezia.it/content/3-piattaforma-ISMAR-CNR

Sea-Bird HyperSAS with pySAS robot

Home angle: 0, Min/Max Az: -126/+42, Height: 9m, Tower color: Red/yellow.

/fields=station,year,month,day,hour,minute,second,lat,lon,Wt,wind,wdir,waveht,cloud,sal,aot\_550 /units=none,yyyy,mo,dd,hh,mn,ss,degrees,degrees,degreesC,m/s,degrees,m,%,psu,none

-9999,2022,07,19,00,00,00,45.314,12.508,26.3,0.4,60,0.1,-9999,37.687,0.2315 -9999,2022,07,19,00,05,00,45.314,12.508,26.4,0.6,33,0.1,-9999,37.687,0.2315 -9999,2022,07,19,00,10,00,45.314,12.508,26.4,0.4,311,0.1,-9999,37.688,0.1129 -9999,2022,07,19,00,15,00,45.314,12.508,26.3,0.6,355,0.1,-9999,37.688,0.1129 -9999,2022,07,19,00,20,00,45.314,12.508,26.4,1.2,34,0.1,-9999,37.688,0.1129 -9999,2022,07,19,00,25,00,45.314,12.508,26.5,2.1,40,0.1,-9999,37.688,0.1129

## Ancillary Data at L2



HDFView 3.3.1         Image: Clear Text         Object Attribute Info         General Object Info         Attribute Creation Order:         Creation Order NOT Tracked         Number of attributes = 31         Add Attribute         Delete Attribute         Name         Type         Array Size Value(50)()         CLOUD_Units         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII Scalar         Gereast         Molting = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII Scalar         Gereast         Molting = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII Scalar         Gereast         Molting = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII Scalar         Gereast         HEADING_UNITS         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII Scalar         Gereast         LATITUDE_UNITS         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII Scalar         LONGITUDE_UNITS         String, length = 11, padding = H5T_STR_NULLPAD,		NAS	
HDFView 3.3.1         'HyperSAS/EXPORTSNA/217MA/L2/EXPORTS_EXPORTSNA_20210501_080000_L2.hdf         Object Attribute Info         Object Attribute Info         Clear Text         Object Attribute Info         General Object Info         Attribute Creation Order:       Creation Order NOT Tracked         Number of attributes = 31       Add Attribute       Delete Attribute         Name       Type       Array Size Value[50]()         Numer of attributes = 31       Add Attribute       Delete Attribute         Name       Type       Array Size Value[50]()         Nume       Type       Array Size Value[50]()         Name       Type       Array Size Value[50]() <td cols<="" th=""><th></th><th></th></td>	<th></th> <th></th>		
MyperSAS/EXPORTSNA/Z17MA/L2/EXPORTS_EXPORTSNA_20210501_080000_L2.hdf       Clear Text         Object Attribute Info       General Object Info         Attribute Creation Order:       Creation Order NOT Tracked         Number of attributes = 31       Add Attribute       Delete Attribute         Name       Type       Array Size Value[50]()         CLOUD_Units       String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         FrameType       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         FrameType       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HUMIDITY_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HUMIDITY_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees		HDFView 3.3.1	
Object Attribute Info       General Object Info         Attribute Creation Order:       Creation Order NOT Tracked         Number of attributes = 31       Add Attribute         Delete Attribute       Delete Attribute         Name       Type         Array Size       Value[50]()         Name       Type         Array Size       Value[50]()         CLOUD_Units       String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         FrameType       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HUMIDITY_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HUMIDITY_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LATITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_U	HyperSAS/EXPORTSNA/Z	Z17MA/L2/EXPORTS_EXPORTSNA_20210501_080000_L2.hdf	
Attribute Creation Order:       Creation Order NOT Tracked         Number of attributes = 31       Add Attribute       Delete Attribute         Name       Type       Array Size Value[50]()         Name       Type       Array Size Value[50]()         CLOUD_Units       String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         FrameType       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Mot Required         HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HUMIDITY_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HATITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees <t< th=""><th></th><th></th></t<>			
Number of attributes = 31       Add Attribute       Delete Attribute         Name       Type       Array Size       Value[50]()         CLOUD_Units       String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         FrameType       String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required         HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HUMIDITY_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         LATITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         LATITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. R         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E <tr< td=""><td></td><td>Object Attribute Info General Object Info</td></tr<>		Object Attribute Info General Object Info	
NameTypeArray SizeValue[50]()CLOUD_UnitsString, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalar%FrameTypeString, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalarNot RequiredHEADING_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesHEADING_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesHEADING_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesHUMIDITY_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLATITUDE_UNITSString, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesModel AOD wavelengthString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPITCH_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPOINTING_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegrees <tr< th=""><th>Attribute Creation Order:</th><th>Object Attribute Info General Object Info Creation Order NOT Tracked</th></tr<>	Attribute Creation Order:	Object Attribute Info General Object Info Creation Order NOT Tracked	
CLOUD_Units       String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         FrameType       String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required         HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HEADING_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HEADING_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HUMIDITY_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg.         LATITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg.         LATITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         Model AOD wavelength       String, length = 7, paddi	Attribute Creation Order: Number of attributes = 31	Object Attribute Info General Object Info Creation Order NOT Tracked Add Attribute Delete Attribute	
FrameTypeString, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalarNot RequiredHEADING_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesHEADING_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesHUMIDITY_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesHUMIDITY_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardec. deg. NLATITUDE_UNITSString, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesModel AOD wavelengthString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPITCH_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPITCH_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPOINTING_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPITCH_UNITSString, length = 7, padding = H5T_STR_NULL	Attribute Creation Order: Number of attributes = 31 Name	Object Attribute Info General Object Info Creation Order NOT Tracked Add Attribute Delete Attribute Type Array Size Value[50]()	
HEADING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HEADING_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         HUMIDITY_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LATITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         LATITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         Model AOD wavelength       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_UNITS       String, length = 7, padd	Attribute Creation Order: Number of attributes = 31 Name	Object Attribute Info       General Object Info         Creation Order NOT Tracked       I         Add Attribute       Delete Attribute         Type       Array Size Value[50]()         String, length = 1 padding = H5T_STP, NULL PAD, cset = H5T_CSET_ASCIL_Scalar       %	
HEADING_UnitsString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesHUMIDITY_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalarpercentLATITUDE_UNITSString, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardec. deg. NLATITUDE_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesLONGITUDE_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesModel AOD wavelengthString, length = 6, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPITCH_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPITCH_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPITCH_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegreesPOINTING_UNITSString, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCIIScalardegrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType	Object Attribute Info       General Object Info         Creation Order NOT Tracked       I         Add Attribute       Delete Attribute         Type       Array Size Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required	
HUMIDITY_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       percent         LATITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         LATITUDE_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E         LONGITUDE_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         Model AOD wavelength       String, length = 6, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         POINTING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	Attribute Creation Order: Number of attributes = 31 Name Mome CLOUD_Units FrameType HEADING_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       I         Add Attribute       Delete Attribute         Type       Array Size Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required	
LATITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         LATITUDE_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E         LONGITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E         LONGITUDE_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         Model AOD wavelength       String, length = 6, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       550 nm         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         POINTING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute         1       Add Attribute         Type       Array Size Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	
LATITUDE_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         LONGITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E         LONGITUDE_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         Model AOD wavelength       String, length = 6, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       550 nm         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         POINTING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS HUMIDITY_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute         1       Add Attribute         Type       Array Size         Value[50]()       Array Size         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar	
LONGITUDE_UNITS       String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E         LONGITUDE_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         Model AOD wavelength       String, length = 6, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       550 nm         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         POINTING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS HUMIDITY_UNITS LATITUDE_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute         Delete Attribute       Delete Attribute         Type       Array Size       Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N	
LONGITUDE_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         Model AOD wavelength       String, length = 6, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       550 nm         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         POINTING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS HUMIDITY_UNITS LATITUDE_UNITS LATITUDE_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute         Delete Attribute       Delete Attribute         Type       Array Size       Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	
Model AOD wavelength       String, length = 6, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       550 nm         PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         POINTING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS HUMIDITY_UNITS LATITUDE_UNITS LATITUDE_UNITS LATITUDE_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute         Delete Attribute       Delete Attribute         Type       Array Size       Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. R         String, lengt	
PITCH_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         PITCH_Units       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         POINTING_UNITS       String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS HUMIDITY_UNITS LATITUDE_UNITS LATITUDE_UNITS LATITUDE_UNITS LONGITUDE_UNITS LONGITUDE_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute       Delete Attribute         I       Add Attribute       Delete Attribute         Type       Array Size       Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Not Required         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. N         String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E	
PITCH_Units         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII         Scalar         degrees           POINTING_UNITS         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII         Scalar         degrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS HUMIDITY_UNITS LATITUDE_UNITS LATITUDE_UNITS LONGITUDE_UNITS LONGITUDE_UNITS LONGITUDE_UNITS Model AOD wavelength	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute         Delete Attribute       Delete Attribute         Array Size       Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 17, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 17, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 17, padding = H5T_STR_NULLPAD, cset = H	
POINTING_UNITS String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII Scalar degrees	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS HUMIDITY_UNITS LATITUDE_UNITS LATITUDE_UNITS LONGITUDE_UNITS LONGITUDE_UNITS LONGITUDE_UNITS Model AOD wavelength PITCH_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute       Delete Attribute         1       Add Attribute       Delete Attribute         Type       Array Size       Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Mot Required         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       dec. deg. E </td	
DEL AZ LINITO	Attribute Creation Order: Number of attributes = 31 Name CLOUD_Units FrameType HEADING_UNITS HEADING_UNITS HUMIDITY_UNITS LATITUDE_UNITS LATITUDE_UNITS LONGITUDE_UNITS LONGITUDE_UNITS LONGITUDE_UNITS Model AOD wavelength PITCH_UNITS PITCH_UNITS	Object Attribute Info       General Object Info         Creation Order NOT Tracked       Add Attribute       Delete Attribute         I       Add Attribute       Delete Attribute         Type       Array Size       Value[50]()         String, length = 1, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       %         String, length = 12, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       Mequired         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees         String, length = 7, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII       Scalar       degrees	

• Some of these are used for processing the data in HyperCP and some are used later in selecting data for mission

• Much of this (not all) is captured automatically in the

We ask that you submit your L2 HDF files (and raw files)

## The Configuration Window

#### . HyperCP Main v1.2.1 Hyperf Select/Create Configuration File sample\_SEABIRD\_pySAS.cfg New Edit Input Data Parent Directory /Users/daurin/Projects/Hyper ^^^ Mimic Input Dir. vvv Output Directory /Users/daurin/Projects/HyperCP/Sample\_Data/M99SS/v12 Ancillary Data File (SeaBASS format; MUST USE UTC) /Users/daurin/Projects/HyperCP/Sample\_Data/FICE22\_pySAS\_Ancillary.sb Add Remove Level 0 (Raw) --> Lev L1A --> L1A L1AQC --> Single-Level Processing L1B --> L1B L1BQC --> **Multi-Level Processing** Raw (BIN) ---->> l Suppress pop-up window on processing fail? 🛛 🗸

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G	D	D	A	R	D
	EAR	ТН	SCI	E N (	CES

Sensor Type:
SeaBird
Add Cals Remove Cals
Enabled
Frame Type:
ShutterLight
Level 1A Processing
Raw binary to HDF5
Raw UTC Offset [+/-] 0.0
Solar Zenith Angle Filter
SZA Max 🗹 70.0
Level 1AQC Processing
Filter on pitch, roll, yaw, and azimuth
Pitch/Roll Filter (where present) 🔽
Max Pitch/Roll Angle 5.0
SolarTracker or pySAS 🧹
Rotator Home Angle Offset 0.0
Rotator Delay (Seconds) 🗌 2.0
Absolute Rotator Angle Filter
Rotator Angle Min -40.0
Pototor Angle May 40.0
Rotator Angle Max 40.0
Relative Solar Azimuth Filter 🗹
Rel Angle Min 90.0
Rel Angle Max 135.0
Deglitch Data 🗹
Launch Anomaly Analysis

Configuration:	: PICCOLO.cfg		
Level 1B Processing Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands. Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download: GMAO MERRA2 ECMWF (GMAO PROMPTS FOR EARTHDATA LOGIN: register) Fallback values when no model available: Default Wind Speed (m/s) 5.0	Enable Spectro Generate Plo Filter Sigma Filter Sigma Filter Sigma Enable Meteo Cloud Li(75		
Default AOD(550) 0.2	Significant		
Default Salinity (psu) 35.0	Dawn/Dusk		
Default SST (C) 26.0	Rain/Humid		
Select Calibration/Characterization/Correction Regime: Factory Calibration Only TriOS SeaBird (Non-FRM Class-based)	Level 2 Process Temporal binni		
FRM Class-based (RadCal required)         Add RadCals:       Files not found	correction, res satellite convo SeaBASS file o		
• FRM Full Characterization:	L2 Ensembles		
• Local Add Files: Files not found	Extract Cruise S Ensemble Inte		
Generate Interpolation Plots	Enable Perce Percent Lt (9		
Plot Interval (nm) 20.0	L2 Sky/Sunglint		
Level 1BQC Processing Data quality control filters.	O Mobley (199)		
Eliminate where Lt(NIR)>Lt(UV) 🗸 Max. Wind Speed (m/s) 10.0	NIR Residual Co Mueller an SimSpec. I		
SZA Minimum (deg) 20.0	O Your NIR R		
SZA Maximum (deg) 60.0	Remove Negati		



oectral Outlier Filter 🛛 🗸	BRDF Correction
te Plots 🗸	Morel R.f/Q 🗹 Lee IOP 🗌
Sigma Es 5.0	L2 Products
Sigma Li 8.0	Convolve to Satellite Bands:
Sigma I t 3.0	AQUA * 🗹 Sen-3A 📃 V-NPP 🗌
	TERRA Sen-3B V-JPSS
leteorological Filters (Experimental)	* Automatic for Derived Products
Li(750)/Es(750)> 1.0	Convolution uncertainties 🗸
cant Es(480) (uW cm^-2 nm^-1) 2.0	
Dusk Es(470/680)< 1.0	
umid. Es(720/370) < 1.095	Rrs 🗸 nLw 🗸 Es 🗸 Li 🗸 Lt 🗸
ocessing	Derived L2 Ocean Color Products
binning, glitter reduction, glint	Save SeaBASS Files 🛛 🗸
n, residual correction, QC,	
convolution. OC product generation.	Edit SeaBASS Header
file output	PICCOLO.hdr
The output.	Write PDF Report 🗸 🗸
les	
uise Stations 🛛 🔽	
Interval (secs; 0=None) 300	
Percent Lt Calculation 🗸	
Lt (%) 10.0	$\mathbf{A}$
nglint Correction (ρ)	
γ (1999) ρ	
ch et al. (2017) Ο Your Glint (2023) ρ	
al Correction 🗹	
er and Austin (1995) (blue water)	HunorCP
bec. Ruddick et al. (2006) (turbid)	пурегст
egative Spectra	Save/Close Save As Cancel

# HyperCP: Loading Instrument Calibration

#### • • •

#### Configuration: sample\_SEABIRD\_pySAS.cfg

Sensor Type:	Level 1B Process
SeaBird 📀	Dark offsets, ca
	to common time
Add Cals Remove Cals	Ancillary data a
	can fill in wind
🖾 / 🔹 💿 Enabled	🗹 GMAO MERR
Frame Type:	(GMAO PROMPT
ShutterLight 7	Fallback value
evel 1A Processing	Default Wi
Raw binary to HDF5	Default AC
Raw UTC Offset [+/-] 0.0	Default Sa
Solar Zenith Angle Filter	Default SS
SZA Max 🗹 70.0	Select Calibration
Level 1AQC Processing	Factory Calib
Filter on pitch, roll, yaw, and azimuth	0
Pitch/Roll Filter (where present) 🗸	FRM Class-ba
Max Pitch/Roll Angle 5.0	Add
SolarTracker or pySAS 🗹	🔵 FRM Full Cha
Rotator Home Angle Offset 0.0	• Local
Rotator Delay (Seconds) 🗸 2.0	
Absolute Rotator Angle Filter 🗹	Internelation
Rotator Angle Min -55.0	interpolation
Potator Angle Max 90.0	Generate Inter
	Plot Interval
Relative Solar Azimuth Filter 🔽	Level 1BQC Proc
Rel Angle Min 90.0	Data quality cor
Rel Angle Max 135.0	Eliminate wher
Deglitch Data 🗹	Max. Wind Spe
Launch Anomaly Analysis	SZA Minimum
, , , , , , , , , , , , , , , , , , , ,	

Level 1B Processing	Enable S
Dark offsets, calibrations and corrections. Interpolate	Conora
to common timestamps and wavebands.	Genera
Ancillary data are required for Zhang glint correction and	Filter
can fill in wind for M99 and QC. Select database download:	Filter
GMAO MERRA2 ECMWF	Filter
(GMAO PROMPTS FOR EARTHDATA LOGIN: <u>register</u> )	Enable N
Fallback values when no model available:	Cloud
Default Wind Speed (m/s) 5.0	Cioud
Default AOD(550) 0.5	Signifi
Default Salinity (psu) 35.0	Dawn/
Default SST (C) 26.0	Rain/H
Select Calibration/Characterization/Correction Regime:	Level 2 Pro
Factory Calibration Only	Temporal
TriOS O SeaBird (Non-FRM Class-based)	correctio
FRM Class-based (RadCal required)	satellite o
Add RadCals: Files found	SeaBASS
ERM Full Characterization	l 2 Ensemi
Local Add Files: Files found	Extract Cr
○ FidRadDB	Ensemble
Interpolation Interval (nm) 3.3	Enable I
Generate Interpolation Plots 🗸	Percen
Plot Interval (nm) 20.0	L2 Sky/Su
aval 1800 Processing	
Data quality control filters.	Groets
Eliminate where Lt(NIR)>Lt(UV) 🗸	NIR Residu
Max Wind Speed (m/s) 10.0	O Muell
	SimS
SZA Minimum (deg) 15.0	Your
SZA Maximum (deg) 60.0	Remove N

**BRDE** Correctio pectral Outlier Filter 🗸 ate Plots Morel R.f/Q Lee IOP L2 Products Sigma Es 5.0 Convolve to Satellite Bands: Sigma Li 8.0 AQUA \* V-NPP Sen-3A Sigma Lt 3.0 Sen-3B V-JPSS TERRA Meteorological Filters (Experimental) \* Automatic for Derived Products Li(750)/Es(750)> 1.0 Convolution uncertainties icant Es(480) (uW cm^-2 nm^-1) 2.0 Generate Spectral Plots /Dusk Es(470/680)< 1.0 Rrs 🗸 nLw 🗸 Es 🗸 Li 🗸 Lt 🗸 -lumid. Es(720/370)< 1.095 Derived L2 Ocean Color Products ocessing l binning, glitter reduction, glint Save SeaBASS Files 🗸 on, residual correction, QC, Edit SeaBASS Header convolution, OC product generation, sample\_SEABIRD\_pySAS.hdr file output. Write PDF Report bles ruise Stations e Interval (secs; 0=None) 300 Percent Lt Calculation 🗸 it Lt (%) 10.0 nglint Correction (p) y (1999) p O Zhang et al. (2017) ρ ch et al. (2017) ) Your Glint (2023) p ual Correction 🔽 HyperCP ler and Austin (1995) (blue water) Spec. Ruddick et al. (2006) (turbid) NIR Residual (2023) (universal)

Save/Close

Save As

Cancel

legative Spectra 🔽



# HyperCP: Loading Instrument Calibration

Configuration: sample\_SEABIRD\_pySAS.cfg

#### • • • Sensor Type: SeaBird **Remove Cals** Add Cals đ Enabled Frame Type: ShutterLight evel 1A Processing Raw binary to HDF5 Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter SZA Max 🔽 70.0 Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) 🗸 Max Pitch/Roll Angle 5.0 SolarTracker or pySAS 🗸 Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) 🗸 2.0 Absolute Rotator Angle Filter 🗸 Rotator Angle Min -55.0 Rotator Angle Max 90.0 Relative Solar Azimuth Filter 🗸 Rel Angle Min 90.0 Rel Angle Max 135.0 Deglitch Data

Launch Anomaly Analysis

Level 1B Processing Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands. Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download: GMAO MERRA2 ECMWF (GMAO PROMPTS FOR EARTHDATA LOGIN: register) Fallback values when no model available: Default Wind Speed (m/s) 5.0 Default AOD(550) 0.5 Default Salinity (psu) 35.0 Default SST (C) 26.0 Select Calibration/Characterization/Correction Regime: Factory Calibration Only TriOS O SeaBird (Non-FRM Class-based) FRM Class-based (RadCal required) Add RadCals: Files found FRM Full Characterization: Local Add Files: Files found FidRadDB Interpolation Interval (nm) 3.3 Generate Interpolation Plots 🗸 Plot Interval (nm) 20.0 Level 1BQC Processing Data quality control filters. Eliminate where Lt(NIR)>Lt(UV) 🗸 Max. Wind Speed (m/s) 10.0 0 SZA Minimum (deg) 15.0 SZA Maximum (deg) 60.0

Enable Spectral Outlier Filter 🗸 **BRDF** Correction Generate Plots Morel R.f/Q Lee IOP L2 Products Filter Sigma Es 5.0 Convolve to Satellite Bands: Filter Sigma Li 8.0 AQUA \* Sen-3A V-NPP Filter Sigma Lt 3.0 TERRA Sen-3B V-JPSS Enable Meteorological Filters (Experimental) \* Automatic for Derived Products Cloud Li(750)/Es(750)> 1.0 Convolution uncertainties Significant Es(480) (uW cm<sup>-2</sup> nm<sup>-1</sup>) 2.0 Generate Spectral Plots Dawn/Dusk Es(470/680)< 1.0 Rrs 🗸 nLw 🗸 Es 🗸 Li 🗸 Lt 🗸 Rain/Humid. Es(720/370) < 1.095 Derived L2 Ocean Color Products Level 2 Processing Temporal binning, glitter reduction, glint Save SeaBASS Files 🛛 🗸 correction, residual correction, QC, Edit SeaBASS Header satellite convolution, OC product generation, sample\_SEABIRD\_pySAS.hdr SeaBASS file output. Write PDF Report L2 Ensembles Extract Cruise Stations Ensemble Interval (secs; 0=None) 300 Enable Percent Lt Calculation 🗸 Percent Lt (%) 10.0 L2 Sky/Sunglint Correction (p) Mobley (1999) p **Ο** Zhang et al. (2017) ρ Groetsch et al. (2017) Your Glint (2023) p NIR Residual Correction 🗸 HyperCP Mueller and Austin (1995) (blue water) SimSpec. Ruddick et al. (2006) (turbid) Your NIR Residual (2023) (universal)

Save/Close

Save As

Cancel

Remove Negative Spectra 🗸

### Sea-Bird HyperOCRs, pySAS



### HED and HLD are **Dark** cals HSE and HSL are **Light** cals

[*HyperCP now automatically recognizes .cal files as Light/Dark and enables them by default on import.*]

### Demo: Loading in Calibration and Telemetry Files

(Demo will be provided during Day 3-6 breakouts)



FICE-2024

# HyperCP Level 1A: Read Data

	Configuration: sample_S	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird Add Cals Remove Cals Add Cals Remove Cals intervel interve Frame Type: Shutterlight Frame Type: Shutterlight Frame Type: Shutterlight Raw binary to HDF5 Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter SZA Max 70.0 Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) v Max Pitch/Roll Angle 5.0	Level 1B Processing         Dark offsets, calibrations and corrections. Interpolate         to common timestamps and wavebands.         Ancillary data are required for Zhang glint correction and         can fill in wind for M99 and QC. Select database download:         Image: CMWF         GMAO MERRA2         ECMWF         (GMAO PROMPTS FOR EARTHDATA LOGIN: register)         Fallback values when no model available:         Default Wind Speed (m/s)         5.0         Default AOD(650)         Default Salinity (psu)         35.0         Default SST (C)         26.0         Select Calibration/Characterization/Correction Regime:         Factory Calibration Only         TriOS       SeaBird (Non-FRM Class-based)         FRM Class-based (RadCal required)         Add RadCals:       Files found	Enable Spectral Outlier Filter ♥ Generate Plots ♥ Filter Sigma Es 5.0 Filter Sigma Li 8.0 Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental) ● Cloud Li(750)/Es(750)> 1.0 Cloud Li(750)/Es(750)> 1.0 Significant Es(480) (uW cm^-2 nm^-1) 2.0 Dawn/Dusk Es(470/680)< 1.0 Dawn/Dusk Es(470/680)< 1.0 Rain/Humid. Es(720/370)< 1.095 <b>Level 2 Processing</b> Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.	BRDF Correction Morel R.f/Q Lee IOP L2 Products Convolve to Satellite Bands: AQUA * Sen-3A V-NPP TERRA Sen-3B V-JPSS TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties Convolution uncertainties Generate Spectral Plots Rrs InLw Es I Li I L I
Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) 2.0 Absolute Rotator Angle Filter 2 Rotator Angle Min -55.0 Rotator Angle Max 90.0 Rotator Angle Max 90.0	<ul> <li>FRM Full Characterization:</li> <li>Local Add Files: Files found</li> <li>FidRadDB</li> <li>Interpolation Interval (nm) 3.3</li> <li>Generate Interpolation Plots </li> <li>Plot Interval (nm) 20.0</li> </ul>	L2 Ensembles Extract Cruise Stations Ensemble Interval (secs; 0=None) 300 Enable Percent Lt Calculation ♥ Percent Lt (%) 10.0 L2 Sky/Sunglint Correction (p) Mabley (1999) a	
Rel Angle Min 90.0 Rel Angle Max 135.0 Deglitch Data Launch Anomaly Analysis	Level 1BQC Processing         Data quality control filters.         Eliminate where Lt(NIR)>Lt(UV) ✓         Max. Wind Speed (m/s)         10.0         SZA Minimum (deg)         15.0         SZA Maximum (deg)         60.0	<ul> <li>Nikobley (1999) p</li> <li>Groetsch et al. (2017) </li> <li>Your Glint (2023) p</li> <li>NIR Residual Correction </li> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec. Ruddick et al. (2006) (turbid)</li> <li>Your NIR Residual (2023) (universal)</li> <li>Remove Negative Spectra </li> </ul>	A Save/Close Save As Cancel



# HyperCP Level 1A: Read Data

	Configuration: sample_S	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird Add Cals Remove Cals Add Cals Remove Cals intervel interve Frame Type: Shutterlight Frame Type: Shutterlight Frame Type: Shutterlight Raw binary to HDF5 Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter SZA Max 70.0 Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) v Max Pitch/Roll Angle 5.0	Level 1B Processing         Dark offsets, calibrations and corrections. Interpolate         to common timestamps and wavebands.         Ancillary data are required for Zhang glint correction and         can fill in wind for M99 and QC. Select database download:         Image: CMWF         GMAO MERRA2         ECMWF         (GMAO PROMPTS FOR EARTHDATA LOGIN: register)         Fallback values when no model available:         Default Wind Speed (m/s)         5.0         Default AOD(650)         Default Salinity (psu)         35.0         Default SST (C)         26.0         Select Calibration/Characterization/Correction Regime:         Factory Calibration Only         TriOS       SeaBird (Non-FRM Class-based)         FRM Class-based (RadCal required)         Add RadCals:       Files found	Enable Spectral Outlier Filter ♥ Generate Plots ♥ Filter Sigma Es 5.0 Filter Sigma Li 8.0 Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental) ● Cloud Li(750)/Es(750)> 1.0 Cloud Li(750)/Es(750)> 1.0 Significant Es(480) (uW cm^-2 nm^-1) 2.0 Dawn/Dusk Es(470/680)< 1.0 Dawn/Dusk Es(470/680)< 1.0 Rain/Humid. Es(720/370)< 1.095 <b>Level 2 Processing</b> Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.	BRDF Correction Morel R.f/Q Lee IOP L2 Products Convolve to Satellite Bands: AQUA * Sen-3A V-NPP TERRA Sen-3B V-JPSS TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties Convolution uncertainties Generate Spectral Plots Rrs InLw Es I Li I L I
Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) 2.0 Absolute Rotator Angle Filter 2 Rotator Angle Min -55.0 Rotator Angle Max 90.0 Rotator Angle Max 90.0	<ul> <li>FRM Full Characterization:</li> <li>Local Add Files: Files found</li> <li>FidRadDB</li> <li>Interpolation Interval (nm) 3.3</li> <li>Generate Interpolation Plots </li> <li>Plot Interval (nm) 20.0</li> </ul>	L2 Ensembles Extract Cruise Stations Ensemble Interval (secs; 0=None) 300 Enable Percent Lt Calculation ♥ Percent Lt (%) 10.0 L2 Sky/Sunglint Correction (p) Mabley (1999) a	
Rel Angle Min 90.0 Rel Angle Max 135.0 Deglitch Data Launch Anomaly Analysis	Level 1BQC Processing         Data quality control filters.         Eliminate where Lt(NIR)>Lt(UV) ✓         Max. Wind Speed (m/s)         10.0         SZA Minimum (deg)         15.0         SZA Maximum (deg)         60.0	<ul> <li>Nikobley (1999) p</li> <li>Groetsch et al. (2017) </li> <li>Your Glint (2023) p</li> <li>NIR Residual Correction </li> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec. Ruddick et al. (2006) (turbid)</li> <li>Your NIR Residual (2023) (universal)</li> <li>Remove Negative Spectra </li> </ul>	A Save/Close Save As Cancel

One should almost always set all computers, instruments, cameras, etc. to UTC when collecting data in the field. (Ancillary file must be UTC, currently. Data and photos can be accommodated for local, but not recommended.)

SZA used here for data reduction of autonomous collections running into the morning/evening. SZA fine tuned in L1BQC.

# HyperCP Level 1AQC: Quality Control Data

	Configuration: sample_9	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird Add Cals Remove Cals Madd Cals Remove Cals Remove Cals Remove Cals Enabled Frame Type: ShutterLight Current Constant Co	<ul> <li>Level 1B Processing</li> <li>Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands.</li> <li>Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download:</li> <li>GMAO MERRA2</li> <li>ECMWF</li> <li>(GMAO PROMPTS FOR EARTHDATA LOGIN: register)</li> <li>Fallback values when no model available:</li> <li>Default Wind Speed (m/s) 5.0</li> <li>Default AOD(550) 0.5</li> </ul>	SEABIRD_pySAS.cfg         Enable Spectral Outlier Filter ♥         Generate Plots       ♥         Filter Sigma Es       5.0         Filter Sigma Li       8.0         Filter Sigma Li       3.0         Enable Meteorological Filters (Experimental)       □         Cloud Li(750)/Es(750)>       1.0         Significant Es(480) (uW cm^-2 mm^-1)       2.0	BRDF Correction Morel R.f/Q Lee IOP L2 Products Convolve to Satellite Bands: AQUA * Sen-3A V-NPP TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties Generate Spectral Plots
Raw UTC Offset [+/-] 0.0	Default Salinity (psu) 35.0	Dawn/Dusk $Es(470/680) < 1.0$	Rrs 🗸 nLw 🗸 Es 🗸 Li 🗸 Lt 🗸
Solar Zenith Angle Filter	Default SST (C) 26.0	Rain/Humid. Es(720/370)< 1.095	Derived L2 Ocean Color Products
	<ul> <li>Factory Calibration Only</li> </ul>	Tomporal hinning, glitter reduction, glint	
Filter on pitch, roll, yaw, and azimuth	TriOS SeaBird (Non-FRM Class-based)	correction, residual correction, OC	Save SeaBASS Files 🔽
Pitch/Roll Filter (where present) 🗹	FRM Class-based (RadCal required)	satellite convolution. OC product generation	Edit SeaBASS Header
Max Pitch/Roll Angle 5.0	Add RadCals: Files found	SeaBASS file output.	sample_SEABIRD_pySAS.hdr
SolarTracker or pySAS 🗹	FRM Full Characterization:	L2 Ensembles	Write PDF Report 🗹
Rotator Home Angle Offset 0.0	Local Add Files: Files found	Extract Cruise Stations	
Rotator Delay (Seconds) 🗹 2.0	○ FidRadDB	Ensemble Interval (secs; 0=None) 300	
Absolute Rotator Angle Filter 🔽	Interpolation Interval (nm) 3.3	Enable Percent Lt Calculation 🔽	
Rotator Angle Min -55.0	Generate Interpolation Plots 🗸	Percent Lt (%) 10.0	
Rotator Angle Max 90.0	Plot Interval (nm) 20.0	L2 Sky/Sunglint Correction (ρ)	
Relative Solar Azimuth Filter 🔽	Level 1BQC Processing	O Mobley (1999) ρ Ο Zhang et al. (2017) ρ	
Rel Angle Min 90.0	Data quality control filters.	$\bigcirc$ Groetsch et al. (2017) $\bigcirc$ Your Glint (2023) $\rho$	
Rel Angle Max 135.0	Eliminate where Lt(NIR)>Lt(UV) 🔽	NIR Residual Correction V	
Deglitch Data 🗹	Max. Wind Speed (m/s) 10.0	• SimSpec. Ruddick et al. (2006) (turbid)	Hyperly
Launch Anomaly Analysis	SZA Minimum (deg) 15.0	O Your NIR Residual (2023) (universal)	
	SZA Maximum (deg) 60.0	Remove Negative Spectra 🔽	Save As Cancel

Tilt of Es should not exceed 5 degrees. (See README for explanation/sources of all default and recommended values throughout configuration.)

Identify whether an azimuth robot (e.g., SolarTracker or pySAS) was used. If not, the Ancillary file must include Sensor Azimuth or Relative Azimuth. If GPS is also missing in the instrumentation above, Latitude and Longitude must be included in the Ancillary file.

Use field logs/notes to identify min/max sensor azimuth (rotator angle to avoid obstruction) and home offset (latest values can also be recovered from pySAS file pysas\_cfg.ini)



Suppress pop-up window on processing fail?

Launch Anomaly Analysis

Deglitch Data 🛛 🗸

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#### Supervised Deglitching.

Waveband Slider





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Supervised Deglitching.





Balance these while visually evaluating signal variability throughout the file. More aggressive deglitching yields lower uncertainty traded off against less data.

(Note: This file could be 5 mins or 5 hours, but default pySAS collections are 1 hr autonomous.)

#### FROM: 2022-07-19 08:00 TO: 2022-07-19 08:26 UTC (Median->) WIND: nan m/s CLOUD: nan % Deglitching only performed from 350-850 nm: 379.69 Load L1A \*\*\* Update • ES LI LT Window (odd;11) 11 Sigma (3.2) 3.0 None nm Go To Set Band Threshold 540 Time series 530 [count] w-pass filter (1) 520 v-pass filter (2) [DARKS] ES(380) 510 500 490 480 08:05 08:10 08:00 80 Time serie Left-click-hold to pan, right-click-hold to zoom, or right-click-rele Generate Interpolation Rotator Angle Max 90.0 Plot Interval (nm) 20 Relative Solar Azimuth Filter 🗸 Level 1BQC Processing Data quality control filte Rel Angle Min 90.0 Eliminate where Lt(NIR Rel Angle Max 135.0 Max. Wind Speed (m/s Deglitch Data 🗸 SZA Minimum (deg) Launch Anomaly Analysis SZA Maximum (deg)

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FRM4SOC2\_FICE22\_NASA\_20220719\_080000\_L1AQC

InputDir/Photos naming (+timezone), e.g. IMG\_%Y%m%d\_%H%M%S.jpg-0400: %Y%m%d\_%H%M%S.jpg+0300

REL.AZ: 135 deg.	



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### Demo: Supervised Deglitching

### (Demo will be provided during Day 3-6 breakouts)



FICE-2024

# HyperCP Level 1B: Overview

• • •	Configuration: sample_S	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird	Level 1B Processing Dark offsets, calibrations and corrections. Interpolate	Enable Spectral Outlier Filter 🗹 Generate Plots 📿	BRDF Correction     Morel R.f/Q   Lee IOP
Add Cals Remove Cals	Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download:	Filter Sigma Es5.0Filter Sigma Li8.0	L2 Products Convolve to Satellite Bands: AQUA * Sen-3A V-NPP
Frame Type: ShutterLight	(GMAO PROMPTS FOR EARTHDATA LOGIN: register) Fallback values when no model available: Default Wind Speed (m/s) 5.0	Filter Sigma Lt       3.0         Enable Meteorological Filters (Experimental)	TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties
Raw binary to HDF5 Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter	Default AOD(550) 0.5 Default Salinity (psu) 35.0 Default SST (C) 26.0	Significant Es(480) (uW cm^-2 nm^-1)       2.0         Dawn/Dusk Es(470/680)       1.0         Rain/Hunsid, Es(720/370)       1.095	Generate Spectral Plots Rrs 🗹 nLw 🗹 Es ✔ Li ✔ Lt ✔
SZA Max <b>7</b> 0.0 Level 1AQC Processing Filter on pitch, roll, vaw, and azimuth	Select Calibration/Characterization/Correction Regime: Factory Calibration Only TriOS SeaBird (Non-FRM Class-based)	Level 2 Processing Temporal binning, glitter reduction, glint	Derived L2 Ocean Color Products Save SeaBASS Files
Pitch/Roll Filter (where present) 🗸 Max Pitch/Roll Angle 5.0	FRM Class-based (RadCal required)      Add RadCals:     Files found	satellite convolution, OC product generation, SeaBASS file output.	Edit SeaBASS Header
SolarTracker or pySAS ✓ Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) ✓ 2.0	FRM Full Characterization:     Local Add Files: Files found	L2 Ensembles Extract Cruise Stations	Write PDF Report
Absolute Rotator Angle Filter 🗹 Rotator Angle Min -55.0	<ul> <li>FidRadDB</li> <li>Interpolation Interval (nm) 3.3</li> <li>Generate Interpolation Plots ✓</li> </ul>	Enable Percent Lt Calculation 🗸 Percent Lt (%) 10.0	
Rotator Angle Max 90.0 Relative Solar Azimuth Filter 🗸	Plot Interval (nm) 20.0 Level 1BQC Processing Data quality control filters.	L2 Sky/Sunglint Correction (ρ) Mobley (1999) ρ Ο Zhang et al. (2017) ρ Groetsch et al. (2017) Ο Your Glint (2023) ρ	
Rel Angle Max 135.0 Deglitch Data 🗸	Eliminate where Lt(NIR)>Lt(UV) Max. Wind Speed (m/s) 10.0 SZA Minimum (deg) 15.0	<ul> <li>NIR Residual Correction </li> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec. Ruddick et al. (2006) (turbid)</li> <li>Your NIR Residual (2023) (universal)</li> </ul>	HyperCP
	SZA Maximum (deg) 60.0	Remove Negative Spectra 🔽	Save/Close Save As Cancel



# HyperCP Level 1B: Load Ancillaries

• • •	Configuration: sample_S	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird Add Cals Remove Cals Add Cals Remove Cals	<ul> <li>Level 1B Processing</li> <li>Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands.</li> <li>Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download:</li> <li>✓ GMAO MERRA2</li> <li>CMWF</li> <li>(GMAO PROMPTS FOR EARTHDATA LOGIN: register)</li> <li>Fallback values when no model available:</li> <li>Default Wind Speed (m/s) 5.0</li> <li>Default AOD(550) 0.5</li> <li>Default Salinity (psu) 35.0</li> </ul>	Enable Spectral Outlier Filter ♥ Generate Plots ♥ Filter Sigma Es 5.0 Filter Sigma Li 8.0 Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental) Cloud Li(750)/Es(750)> 1.0 Sonificant Es(480) (uW cm^-2 nm^-1) 2.0 Dayn/Dusk Es(470/680)< 1.0	BRDF Correction Morel R.f/Q Lee IOP L2 Products Convolve to Satellite Bands: AQUA Sen-3A V-NPP TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties Generate Spectral Plots Rrs ♥ nLw ♥ Es ♥ Li ♥ Lt ♥
Solar Zenith Angle Filter	Default SST (C) 26.0	Rain/Humid. Es(720/370)< 1.095	Derived L2 Ocean Color Products
SZA Max V 70.0 Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) V Max Pitch/Roll Angle 5.0 SolarTracker or pySAS V	<ul> <li>Select Calibration/Characterization/Correction Regime:</li> <li>Factory Calibration Only         <ul> <li>TriOS</li> <li>SeaBird (Non-FRM Class-based)</li> <li>FRM Class-based (RadCal required)</li> <li>Add RadCals:</li> <li>Files found</li> </ul> </li> <li>FRM Full Characterization:</li> </ul>	<b>Level 2 Processing</b> Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output. <b>L2 Ensembles</b>	Save SeaBASS Files Edit SeaBASS Header sample_SEABIRD_pySAS.hdr Write PDF Report
Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) <table-cell> 2.0 Absolute Rotator Angle Filter <table-cell> Rotator Angle Min -55.0 Rotator Angle Max 90.0 Relative Solar Azimuth Filter <table-cell> Rel Angle Min 90.0 Rel Angle Max 135.0</table-cell></table-cell></table-cell>	<ul> <li>Local Add Files: Files found</li> <li>FidRadDB</li> <li>Interpolation Interval (nm) 3.3</li> <li>Generate Interpolation Plots <ul> <li>Plot Interval (nm) 20.0</li> </ul> </li> <li>Level 1BQC Processing</li> <li>Data quality control filters.</li> <li>Eliminate where Lt(NIR)&gt;Lt(UV) <ul> <li>✓</li> </ul></li></ul>	Extract Cruise Stations Ensemble Interval (secs; 0=None) 300 Enable Percent Lt Calculation $\checkmark$ Percent Lt (%) 10.0 L2 Sky/Sunglint Correction ( $\rho$ ) Mobley (1999) $\rho$ Chang et al. (2017) $\rho$ Groetsch et al. (2017) Vour Glint (2023) $\rho$ NIR Residual Correction $\checkmark$ Mueller and Austin (1995) (blue water)	
Deglitch Data 🔽 Launch Anomaly Analysis	Max. Wind Speed (m/s)10.0SZA Minimum (deg)15.0SZA Maximum (deg)60.0	<ul> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec. Ruddick et al. (2006) (turbid)</li> <li>Your NIR Residual (2023) (universal)</li> <li>Remove Negative Spectra </li> </ul>	HyperCP         Save/Close       Save As         Cancel

Wind speed is a requirement of L2 glint correction and AOT is a requirement of cosine correction, uncertainty budgets, and the Zhang et al. 2017 glint correction. Any gaps in the Ancillary file provided can be filled using model data -either NASA GMAO or European ECMWF. GMAO requires a NASA EarthData account (free & easy).

The Default values below the models are last-resort fallback values if neither Ancillary nor model data are found. (*Fallback is not recommended for final process, but often needed for use in preliminary processing and data checks before model data are available, e.g., in the field*)

# HyperCP Level 1B: Factory/Class/Full

	Configuration: sample_	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird 🔝 Add Cals Remove Cals	<b>Level 1B Processing</b> Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands. Ancillary data are required for Zhang glint correction and	Enable Spectral Outlier Filter < Generate Plots 🗹 Filter Sigma Es 5.0	BRDF Correction
Enabled Frame Type: ShutterLight Content of the second sec	can fill in wind for M99 and QC. Select database download: GMAO MERRA2  GMAO PROMPTS FOR EARTHDATA LOGIN: register) Fallback values when no model available: Default Wind Speed (m/s) 5.0	Filter Sigma Li       8.0         Filter Sigma Lt       3.0         Enable Meteorological Filters (Experimental)          Cloud Li(750)/Es(750)>       1.0	AQUA * Sen-3A V-NPP TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties
Raw binary to HDF5 Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter SZA Max 🗸 70.0	Default AOD(550) 0.5 Default Salinity (psu) 35.0 Default SST (C) 26.0 Select Calibration/Characterization/Correction Regime:	Significant Es(480) (uw cm <sup>2</sup> -2 nm <sup>2</sup> -1)       2.0         Dawn/Dusk Es(470/680)       1.0         Rain/Humid. Es(720/370)       1.095         Level 2 Processing	Generate Spectral Plots Rrs ✔ nLw ✔ Es ✔ Li ✔ Lt ✔ Derived L2 Ocean Color Products
Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) Max Pitch/Roll Angle 5.0 SolarTracker or pySAS	<ul> <li>Factory Calibration Only</li> <li>TriOS</li> <li>SeaBird (Non-FRM Class-based)</li> <li>FRM Class-based (RadCal required)</li> <li>Add RadCals: Files found</li> </ul>	Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.	Save SeaBASS Files Edit SeaBASS Header sample_SEABIRD_pySAS.hdr Write PDF Report
Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) ✓ 2.0 Absolute Rotator Angle Filter ✓ Rotator Angle Min -55.0	<ul> <li>Local Add Files: Files found</li> <li>FidRadDB</li> <li>Interpolation Interval (nm) 3.3</li> <li>Generate Interpolation Plots </li> </ul>	Extract Cruise Stations Ensemble Interval (secs; 0=None) 300 Enable Percent Lt Calculation Percent Lt (%) 10.0	
Rotator Angle Max90.0Relative Solar Azimuth FilterImage: Color	Plot Interval (nm)       20.0         Level 1BQC Processing         Data quality control filters.         Eliminate where Lt(NIR)>Lt(UV)         Max. Wind Speed (m/s)         10.0	L2 Sky/Sunglint Correction (ρ) Mobley (1999) ρ O Zhang et al. (2017) ρ Groetsch et al. (2017) Your Glint (2023) ρ NIR Residual Correction ✓ Mueller and Austin (1995) (blue water) SimSpec. Ruddick et al. (2006) (turbid)	HyperCP
Launch Anomaly Analysis	SZA Minimum (deg) 15.0 SZA Maximum (deg) 60.0	<ul> <li>Your NIR Residual (2023) (universal)</li> <li>Remove Negative Spectra </li> </ul>	Save/Close Save As Cancel



# HyperCP Level 1B: Load Full Characterization

	Configuration: sample_	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird 📀 Add Cals Remove Cals	Level 1B Processing Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands. Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download:	Enable Spectral Outlier Filter ♥ Generate Plots ♥ Filter Sigma Es 5.0 Filter Sigma Li 8.0	BRDF Correction     Morel R.f/Q     Lee IOP     L2 Products     Convolve to Satellite Bands:
Frame Type: ShutterLight $\diamond$ Level 1A Processing Raw binary to HDF5	<ul> <li>GMAO MERRA2</li> <li>ECMWF</li> <li>(GMAO PROMPTS FOR EARTHDATA LOGIN: register)</li> <li>Fallback values when no model available:</li> <li>Default Wind Speed (m/s) 5.0</li> <li>Default AOD(550) 0.5</li> </ul>	Filter Sigma Lt3.0Enable Meteorological Filters (Experimental)Cloud Li(750)/Es(750)>1.0Significant Es(480) (uW cm^-2 nm^-1)2.0	AQUA * Sen-3A V-NPP TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties Generate Spectral Plots
Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter	Default Salinity (psu) 35.0 Default SST (C) 26.0	Dawn/Dusk Es(470/680)< 1.0 Rain/Humid. Es(720/370)< 1.095	Rrs ✔ nLw ✔ Es ✔ Li ✔ Lt ✔
SZA Max 🗸 70.0	Select Calibration/Characterization/Correction Regime: Factory Calibration Only	Level 2 Processing Temporal binning, glitter reduction, glint	Derived L2 Ocean Color Products Save SeaBASS Files
Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present)	FRM Class-based (RadCal required)	correction, residual correction, QC, satellite convolution, OC product generation,	Edit SeaBASS Header
SolarTracker or pySAS	• FRM Full Characterization:	SeaBASS file output. L2 Ensembles	Write PDF Report
Rotator Delay (Seconds) 🗸 2.0	Local Add Files: Files found     FidRadDB	Ensemble Interval (secs; 0=None) 300	
Rotator Angle Min -55.0	Interpolation Interval (nm) 3.3 Generate Interpolation Plots	Percent Lt (%) 10.0	
Relative Solar Azimuth Filter 🗸	Plot Interval (nm) 20.0 Level 1BQC Processing Data quality control filters.	Mobley (1999) ρ         Zhang et al. (2017) ρ           Groetsch et al. (2017)         Your Glint (2023) ρ	
Rel Angle Max 135.0 Deglitch Data 🗸 Launch Anomaly Analysis	Eliminate where Lt(NIR)>Lt(UV) Max. Wind Speed (m/s) 10.0 SZA Minimum (deg) 15.0	<ul> <li>NIR Residual Correction </li> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec. Ruddick et al. (2006) (turbid)</li> <li>Your NIR Residual (2023) (universal)</li> </ul>	HyperCP
	SZA Maximum (deg) 60.0	Remove Negative Spectra 🔽	Save/Close Save As Cancel

Class-based (e.g., Sea-Bird or TriOS) and Instrument-specific (Full, FRMcompliant) characterizations can accurately estimate uncertainties associated with instrument response:

- Linearity of response
- Calibration/stability
- Straylight response
- Angularity of response
- Polarization response
- Thermal response

Using these pathways will also trigger use of Monte Carlo models estimating the uncertainties introduced by processing steps (e.g., glint correction) and environmental variability.

Białek, A., et al.. Example of Monte Carlo Method Uncertainty Evaluation for Above-Water Ocean Colour Radiometry. *Remote Sens.* **2020**, *12*, 780. https://doi.org/10.3390/rs12050780

## Demo: Loading RadCal or Full Characterization Files

(Demo will be provided during Day 3-6 breakouts)



FICE-2024

## HyperCP Level 1BQC: Quality Control with Ancillaries

	Configuration: sample_	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird 🗘 Add Cals Remove Cals	<b>Level 1B Processing</b> Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands. Ancillary data are required for Zhang glint correction and	Enable Spectral Outlier Filter 🗸 Generate Plots 🗸 Filter Sigma Es 5.0	BRDF Correction   Morel R.f/Q   Lee IOP
Enabled Frame Type: ShutterLight	<ul> <li>can fill in wind for M99 and QC. Select database download:</li> <li>GMAO MERRA2</li> <li>ECMWF</li> <li>(GMAO PROMPTS FOR EARTHDATA LOGIN: register)</li> <li>Fallback values when no model available:</li> <li>Default Wind Speed (m/s) 5.0</li> <li>Default AQD(550) 0.5</li> </ul>	Filter Sigma Li 8.0 Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental) Cloud Li(750)/Es(750)> 1.0 Significant Es(480) (uW cm^-2 nm^-1) 2.0	Convolve to Satellite Bands: AQUA * Sen-3A V-NPP TFRRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties
Raw Dinary to HDF5 Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter	Default Salinity (psu) 35.0 Default SST (C) 26.0	Dawn/Dusk Es(470/680)< 1.0 Nin/Humid. Es(720/370)< 1.095	Generate Spectral Plots Rrs ♥ nLw ♥ Es ♥ Li ♥ Lt ♥
SZA Max V 70.0 Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) V Max Pitch/Roll Angle 5.0 SolarTracker or pySAS V	Select Calibration/Characterization/Correction Regime: • Factory Calibration Only • TriOS • SeaBird (Non-FRM Class-based) • FRM Class-based (RadCal required) • Add RadCals: Files found • FRM Full Characterization:	Level 2 Processing Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output. L2 Ensembles	Derived L2 Ocean Color Products         Save SeaBASS Files         Edit SeaBASS Header         sample_SEABIRD_pySAS.hdr         Write PDF Report
Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) 🗸 2.0	Local Add Files: Files found     FidRadDB	Extract Cruise Stations Ensemble Interval (secs; 0=None) 300	
Rotator Angle Min -55.0 Rotator Angle Max 90.0 Relative Solar Azimuth Filter 🗸	Interpolation Interval (nm) 3.3 Generate Interpolation Plots Plot Interval (nm) 20.0	Dercent Lt (%)       10.0         L2 Sky/Sunglint Correction (ρ)         Mobley (1999) ρ         Zhang et al. (2017) ρ	
Rel Angle Min 90.0 Rel Angle Max 135.0 Deglitch Data	Data quality control filters. Eliminate where Lt(NIR)>Lt(UV) ✓ Max. Wind Speed (m/s) 10.0 SZA Minimum (deg) 15.0	<ul> <li>Groetsch et al. (2017) Your Glint (2023) ρ</li> <li>NIR Residual Correction </li> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec. Ruddick et al. (2006) (turbid)</li> <li>Your NIR Residual (2023) (universal)</li> </ul>	HyperCP
Launch Anomaly Analysis	SZA Maximum (deg) 60.0	Remove Negative Spectra 🔽	Save/Close Save As Cancel



## HyperCP Level 1BQC: Quality Control with Ancillaries

	Configuration: sample_	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird	Level 1B Processing Dark offsets, calibrations and corrections. Interpolate	Enable Spectral Outlier Filter 🗹 Generate Plots 🗹	BRDF Correction
Add Cals Remove Cals	Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download:	Filter Sigma Es 5.0 Filter Sigma Li 8.0	L2 Products Convolve to Satellite Bands:
Frame Type:	GMAO MERRA2 ECMWF (GMAO PROMPTS FOR EARTHDATA LOGIN: register)	Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental)	AQUA * Sen-3A V-NPP
ShutterLight <a></a>	Fallback values when no model available: Default Wind Speed (m/s) 5.0	Cloud Li(750)/Es(750)> $1.0$	* Automatic for Derived Products Convolution uncertainties
Raw binary to HDF5 Raw UTC Offset [+/-] 0.0	Default AOD(550) 0.5 Default Salinity (psu) 35.0	Dawn/Dusk Es(470/680)< 1.0	Generate Spectral Plots Rrs ✔ nLw ✔ Es ✔ Li ✔ Lt ✔
Solar Zenith Angle Filter SZA Max 🗸 70.0	Default SST (C) 26.0 Select Calibration/Characterization/Correction Regime:	Level 2 Processing	Derived L2 Ocean Color Products
Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) 🗸	<ul> <li>Factory Calibration Only</li> <li>TriOS</li> <li>SeaBird (Non-FRM Class-based)</li> <li>FRM Class-based (RadCal required)</li> </ul>	Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation,	Save SeaBASS Files 🔽 Edit SeaBASS Header
Max Pitch/Roll Angle 5.0	Add RadCals:     Files found       FRM Full Characterization:	SeaBASS file output. L2 Ensembles	sample_SEABIRD_pySAS.hdr Write PDF Report
Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) 🗸 2.0	Local Add Files: Files found     FidRadDB	Extract Cruise Stations Ensemble Interval (secs; 0=None) 300	
Absolute Rotator Angle Filter 🗹 Rotator Angle Min -55.0	Interpolation Interval (nm) 3.3 Generate Interpolation Plots 🗸	Enable Percent Lt Calculation 🗹 Percent Lt (%) 10.0	
Rotator Angle Max 90.0 Relative Solar Azimuth Filter 🗸	Plot Interval (nm) 20.0	L2 Sky/Sunglint Correction (ρ) Mobley (1999) ρ Ο Zhang et al. (2017) ρ	
Rel Angle Min 90.0 Rel Angle Max 135.0	Data quality control filters. Eliminate where Lt(NIR)>Lt(UV) 🗸	O Groetsch et al. (2017) ✓ Your Glint (2023) ρ NIR Residual Correction  ✓	
Deglitch Data 🗹 Launch Anomaly Analysis	Max. Wind Speed (m/s) 10.0 SZA Minimum (deg) 15.0	<ul> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec. Ruddick et al. (2006) (turbid)</li> <li>Your NIR Residual (2023) (universal)</li> </ul>	HyperCP
	SZA Maximum (deg) 60.0	Remove Negative Spectra 🔽	Save/Cluse Save As Calicel

Reducing spectral filter sigma factors discards more of the spectra as outliers (see plots in later slides). For HyperSAS/pySAS platforms, one hour of raw data may contain as many as many as ~3,000 spectra, depending on light conditions and integration time.

Met filters are optional and considered experimental.

 Basic quality controls for spectral shape and environmental conditions.

### Demo: Screening Spectral Filters

(Demo will be provided during Day 3-6 breakouts)



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# HyperCP Level 2: Overview

	Configuration: sample_	_SEABIRD_pySAS.cfg	
Sensor Type: SeaBird	<b>Level 1B Processing</b> Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands.	Enable Spectral Outlier Filter 🗹 Generate Plots 🗹	BRDF Correction
Add Cals Remove Cals	Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download:	Filter Sigma Es 5.0 Filter Sigma Li 8.0	L2 Products Convolve to Satellite Bands:
Frame Type:	GMAO MERRA2 ECMWF (GMAO PROMPTS FOR EARTHDATA LOGIN: register)	Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental)	TERRA Sen-3B V-JPSS
ShutterLight  Cevel 1A Processing Rew binary to HDE5	Default Wind Speed (m/s) 5.0 Default AOD(550) 0.5	Cloud Li(750)/Es(750)> 1.0 Significant Es(480) (uW cm^-2 nm^-1) 2.0	* Automatic for Derived Products Convolution uncertainties
Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter	Default Salinity (psu) 35.0 Default SST (C) 26.0	Dawn/Dusk Es(470/680)< 1.0 Rain/Humid_ <del>Es(720/370)&lt;</del> 1.095	Generate Spectral Plots Rrs 🗸 nLw 🗸 Es 🗸 Li 🗸 Lt 🇸
SZA Max 🗸 70.0	Select Calibration/Characterization/Correction Regime: • Factory Calibration Only	Level 2 Processing	Derived L2 Ocean Color Products
Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) 🗸	<ul> <li>TriOS • SeaBird (Non-FRM Class-based)</li> <li>FRM Class-based (RadCal required)</li> </ul>	correction, residual correction, QC, satellite convolution, OC product generation,	Edit SeaBASS Header
Max Pitch/Roll Angle 5.0 SolarTracker or pySAS 🗸	Add RadCals: Files found O FRM Full Characterization:	SeaBASS file output. L2 Ensembles	sample_SEABIRD_pySAS.hdf Write PDF Report
Rotator Home Angle Offset 0.0 Rotator Delay (Seconds) 🗸 2.0	Local Add Files: Files found	Extract Cruise Stations Ensemble Interval (secs; 0=None) 300	
Absolute Rotator Angle Filter ✓ Rotator Angle Min -55.0	FidRadDB         Interpolation Interval (nm)         3.3	Enable Percent Lt Calculation 🗸 Percent Lt (%) 10.0	
Rotator Angle Max 90.0	Generate Interpolation Plots 🗸 Plot Interval (nm) 20.0	L2 Sky/Sunglint Correction (ρ)	
Rel Angle Min 90.0	Level 1BQC Processing Data quality control filters.	<ul> <li>Groetsch et al. (2017)</li> <li>NIR Residual Correction </li> </ul>	
Rel Angle Max 135.0 Deglitch Data 🗸	Max. Wind Speed (m/s) 10.0	Mueller and Austin (1995) (blue water) SimSpec. Ruddick et al. (2006) (turbid)	HyperCP
Launch Anomaly Analysis	SZA Minimum (deg) 15.0 SZA Maximum (deg) 60.0	Remove Negative Spectra	Save/Close Save As Cancel



# HyperCP Level 2: Binning

#### • • • Configuration: sample\_SEABIRD\_pySAS.cfg Sensor Type: Level 1B Processing Enable Spectral Outlier Filter 🗸 **BRDF** Correction Dark offsets, calibrations and corrections. Interpolate SeaBird Morel R.f/Q Lee IOP Generate Plots to common timestamps and wavebands. L2 Products Filter Sigma Es 5.0 Add Cals Remove Cals Ancillary data are required for Zhang glint correction and Convolve to Satellite Bands: can fill in wind for M99 and QC. Select database download: Filter Sigma Li 8.0 V-NPP Sen-3A a) AQUA \* Enabled GMAO MERRA2 ECMWF Filter Sigma Lt 3.0 V-JPSS (GMAO PROMPTS FOR EARTHDATA LOGIN: register) TERRA Sen-3B Frame Type: Enable Meteorological Filters (Experimental) Fallback values when no model available: \* Automatic for Derived Products ShutterLight Cloud Li(750)/Es(750)> 1.0 Default Wind Speed (m/s) 5.0 Convolution uncertainties Level 1A Processing Significant Es(480) (uW cm<sup>-2</sup> nm<sup>-1</sup>) 2.0 Default AOD(550) 0.5 Raw binary to HDF5 Generate Spectral Plots Dawn/Dusk Es(470/680)< 1.0 Raw UTC Offset [+/-] 0.0 Default Salinity (psu) 35.0 Brs 🗸 nLw 🗸 Es 🗸 Li 🗸 Lt 🗸 Rain/Humid. Es(720/370)< 1.095 Solar Zenith Angle Filter Default SST (C) 26.0 Derived L2 Ocean Color Products SZA Max 🔽 70.0 Select Calibration/Characterization/Correction Regime: Level 2 Processing Factory Calibration Only Temporal binning, glitter reduction, glint Level 1AQC Processing Save SeaBASS Files 🗸 TriOS O SeaBird (Non-FRM Class-based) Filter on pitch, roll, yaw, and azimuth correction, residual correction, QC, Edit SeaBASS Header FRM Class-based (RadCal required) Pitch/Roll Filter (where present) 🗸 satellite convolution, OC product generation, Add RadCals: Files found Max Pitch/Roll Angle 5.0 sample\_SEABIRD\_pySAS.hdr SeaBASS file output. Write PDF Report SolarTracker or pySAS 🗸 FRM Full Characterization: L2 Ensembles Rotator Home Angle Offset 0.0 **Extract Cruise Stations** Local Add Files: Files found Rotator Delay (Seconds) 🗸 2.0 Ensemble Interval (secs; 0=None) 300 FidRadDB Absolute Rotator Angle Filter 🗸 Enable Percent Lt Calculation 🗸 Interpolation Interval (nm) 3.3 Rotator Angle Min -55.0 Percent Lt (%) 10.0 Generate Interpolation Plots 🗸 Rotator Angle Max 90.0 L2 Sky/Sunglint Correction (ρ) Plot Interval (nm) 20.0 Mobley (1999) p **Ο** Zhang et al. (2017) ρ Relative Solar Azimuth Filter 🗸 Level 1BQC Processing Groetsch et al. (2017) Your Glint (2023) p Rel Angle Min 90.0 Data quality control filters. NIR Residual Correction 🗸 Eliminate where Lt(NIR)>Lt(UV) 🗸 Rel Angle Max 135.0 HyperCP Mueller and Austin (1995) (blue water) Max. Wind Speed (m/s) 10.0 Deglitch Data • SimSpec. Ruddick et al. (2006) (turbid) Your NIR Residual (2023) (universal) SZA Minimum (deg) 15.0 Launch Anomaly Analysis Save/Close Save As Cancel Remove Negative Spectra 🗸 SZA Maximum (deg) 60.0

Stations from Ancillary file

Time bin average for smoothing gravity wave effects, to capture variability statistics for uncertainty, and for data reduction

Removes brightest 90% of upwelling radiance to reduce capillary wave reflection

# HyperCP Level 2: Corrections...

	Configuration: sample_	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird Add Cals Remove Cals Memove Cals Frame Type: ShutterLight	Level 1B Processing Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands. Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download: ✓ GMAO MERRA2 ECMWF (GMAO PROMPTS FOR EARTHDATA LOGIN: register) Fallback values when no model available: Default Wind Speed (m/s) 5.0	Enable Spectral Outlier Filter Generate Plots Filter Sigma Es 5.0 Filter Sigma Li 8.0 Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental) Cloud Li(750)/Es(750)> 1.0	BRDF Correction Morel R.f/Q Lee IOP L2 Products Convolve to Satellite Bands: AQUA * Sen-3A V-NPP TERRA Sen-3B V-JPSS * Automatic for Derived Products
Level 1A Processing Raw binary to HDF5 Raw UTC Offset [+/-] 0.0	Default AOD(550) 0.5 Default Salinity (psu) 35.0	Significant Es(480) (uW cm^-2 nm^-1) 2.0 Dawn/Dusk Es(470/680)< 1.0	Generate Spectral Plots Rrs ♥ nLw ♥ Es ♥ Li ♥ Lt ♥
Solar Zenith Angle Filter SZA Max 🗸 70.0	Default SST (C) 26.0 Select Calibration/Characterization/Correction Regime: Factory Calibration Only	Level 2 Processing	Derived L2 Ocean Color Froducts
Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) 🗸 Max Pitch/Roll Angle 5.0	<ul> <li>TriOS • SeaBird (Non-FRM Class-based)</li> <li>FRM Class-based (RadCal required)</li> <li>Add RadCals: Files found</li> </ul>	correction, residual correction, QC, satellite convolution, OC product generation,	Save SeaBASS Files Edit SeaBASS Header sample_SEABIRD_pySAS.hdr
SolarTracker or pySAS 🗸 Rotator Home Angle Offset 0.0	FRM Full Characterization:     Local Add Files: Files found	L2 Ensembles Extract Cruise Stations	Write PDF Report 🔽
Rotator Delay (Seconds) 🗹 2.0 Absolute Rotator Angle Filter 🗹	FidRadDB	Ensemble Interval (secs; 0=None) 300 Enable Percent Lt Calculation 🗸	
Rotator Angle Min -55.0 Rotator Angle Max 90.0 Relative Solar Azimuth Filter 🗸	Generate Interpolation Plots  Plot Interval (nm) 20.0 Level 1BQC Processing	Percent Lt (%) 10.0 L2 Sky/Sunglint Correction (ρ) Mobley (1999) ρ O Zhang et al. (2017) ρ	
Rel Angle Min 90.0 Rel Angle Max 135.0 Deglitch Data 🗸	Data quality control filters. Eliminate where Lt(NIR)>Lt(UV) 🗸 Max. Wind Speed (m/s) 10.0	<ul> <li>Groetsch et al. (2017)</li> <li>Your efint (2023) ρ</li> <li>NIR Residual Correction </li> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec, Ruddick et al. (2006) (turbid)</li> </ul>	HuperCP
Launch Anomaly Analysis	SZA Minimum (deg) 15.0 SZA Maximum (deg) 60.0	Your NIR Residual (2023) (universal) Remove Negative Spectra	Save/Close Save As Cancel

### **BRDF Correction [optional]**

Apply BRDF correction to adjust reflectance for zenith sensor and sun in a non-absorbing atmosphere (e.g., for satellite comparison/validation)

### **Glint Correction**

Most critically, correct total upwelling radiance for the Fresnel reflection of sun and sky (glint) yielding Lw from which reflectance is calculated.

### **NIR Residual Correction**

Remove residual glint identified from reflectances in the NIR, followed by removing any ensemble reflectances that have negative values (VIS).

HyperCP is always under development to stay abreast of emerging science!

# HyperCP Level 2: Corrections...

	Configuration: sample_S	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird Add Cals Remove Cals Memory Cals Frame Type: ShutterLight Cevel 1A Processing	Level 1B Processing Dark offsets, calibrations and corrections. Interpolate to common timestamps and wavebands. Ancillary data are required for Zhang glint correction and can fill in wind for M99 and QC. Select database download: ✓ GMAO MERRA2 ECMWF (GMAO PROMPTS FOR EARTHDATA LOGIN: register) Fallback values when no model available: Default Wind Speed (m/s) 5.0	Enable Spectral Outlier Filter ♥ Generate Plots ♥ Filter Sigma Es 5.0 Filter Sigma Li 8.0 Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental) □ Cloud Li(750)/Es(750)> 1.0	BRDF Correction Morel R.f/Q Lee IOP L2 Products Convolve to Satellite Bands: AQUA * Sen-3A V-NPP TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties
Raw binary to HDF5	Default AOD(550) 0.5	Significant Es(480) (uW cm^-2 nm^-1) 2.0	Generate Spectral Plots
Raw UTC Offset [+/-] 0.0	Default Salinity (psu) 35.0	Dawn/Dusk Es(470/680)< 1.0	Rrs 🗹 nLw 🗹 Es 🗹 Li 🗹 Lt 🗹
Solar Zenith Angle Filter	Default SST (C) 26.0	Rain/Humid. Es(720/370)< 1.095	
SZA Max 🗹 70.0	Select Calibration/Characterization/Correction Regime:	Level 2 Processing	Derived L2 Ocean Color Products
Level 1AQC Processing Filter on pitch, roll, yaw, and azimuth Pitch/Roll Filter (where present) 🗹 Max Pitch/Roll Angle 5.0	<ul> <li>Factory Calibration Only</li> <li>TriOS</li> <li>SeaBird (Non-FRM Class-based)</li> <li>FRM Class-based (RadCal required)</li> <li>Add RadCals:</li> <li>Files found</li> </ul>	Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.	Save SeaBASS Files  C Edit SeaBASS Header sample_SEABIRD_pySAS.hdr
SolarTracker or pySAS 🗹	FRM Full Characterization:	L2 Ensembles	Write PDF Report 🛛 🗹
Rotator Home Angle Offset 0.0	Local Add Files: Files found	Extract Cruise Stations	
Rotator Delay (Seconds) 🗹 2.0 Absolute Rotator Angle Filter ✔ Rotator Angle Min -55.0	FidRadDB	Ensemble Interval (secs; 0=None) 300 Enable Percent Lt Calculation 🗸 Percent Lt (%) 10.0	
Rotator Angle Max 90.0		L2 Sky/Sunglint Correction (ρ)	
Relative Solar Azimuth Filter 🗸 Rel Angle Min 90.0	Plot Interval (nm) 20.0 Level 1BQC Processing Data quality control filters.	<ul> <li>Mobley (1999) ρ</li> <li>Groetsch et al. (2017)</li> <li>Your Glint (2023) ρ</li> </ul>	
Rel Angle Max 135.0	Eliminate where Lt(NIR)>Lt(UV) 🗹	Mueller and Austin (1995) (blue water)	
Deglitch Data 🗸 Launch Anomaly Analysis	Max. Wind Speed (m/s) 10.0 SZA Minimum (deg) 15.0	<ul> <li>SimSpec. Ruddick et al. (2006) (turbid)</li> <li>Your NIR Residual (2023) (universal)</li> </ul>	Save/Close Save As Cancel

Broadly speaking, the best practices are:

### In clear offshore waters

- **ρ** glint factor: Mobley 1999
- NIR residual correction: Mueller and Austin 1995
- f/Q BRDF correction: Morel 2002

#### More turbid, optically complex waters

- ρ glint factor: Zhang et al. 2017 (hyperspectral with polarization)
- NIR residual correction: the Similarity Spectrum approach of Ruddick et al. 2006
- BRDF correction: Lee et al. 2010 IOPbased BRDF correction (pending)



Comparison between various glint and NIR residual corrections of the same L2 ensemble reflectance spectrum where

**Glint Correction:** 

- **M99**: Mobley 1999 ullet
- **Z**: Zhang et al. 2017  $\bullet$

NIR Residual Glint Correction:

- **NN**: No NIR correction  $\bullet$
- MA: Mueller and Austin 1995 ۲
- SS: SimSpec (Ruddick et al. ullet2006)







Comparison between various glint and NIR residual corrections of the same L2 ensemble reflectance spectrum where

Glint Correction:

- **M99**: Mobley 1999
- **Z**: Zhang et al. 2017

NIR Residual Glint Correction:

- NN: No NIR correction
- MA: Mueller and Austin 1995
- SS: SimSpec (Ruddick et al. 2006)

Driven by choice of NIR correction

### HyperCP Level 2: Spectral Response Weighting for Satellite Band Convolution

	Configuration: sample_	SEABIRD_pySAS.cfg	
Sensor Type: SeaBird Add Cals Remove Cals Add Cals Remove Cals Frame Type: ShutterLight Evel 1A Processing Raw binary to HDF5 Raw UTC Offset [+/-] 0.0 Solar Zenith Angle Filter SZA Max V 70.0 Level 1AQC Processing Filter on pitch, roll, vaw, and azimuth	Level 1B Processing         Dark offsets, calibrations and corrections. Interpolate         to common timestamps and wavebands.         Ancillary data are required for Zhang glint correction and         can fill in wind for M99 and QC. Select database download:         ✓ GMAO MERRA2         CGMAO PROMPTS FOR EARTHDATA LOGIN: register)         Fallback values when no model available:         Default Wind Speed (m/s)         5.0         Default AOD(550)         0.5         Default Salinity (psu)         35.0         Default SST (C)         26.0         Select Calibration/Characterization/Correction Regime:         • Factory Calibration Only         TriOS	Enable Spectral Outlier Filter ♥ Generate Plots ♥ Filter Sigma Es 5.0 Filter Sigma Li 8.0 Filter Sigma Lt 3.0 Enable Meteorological Filters (Experimental) □ Cloud Li(750)/Es(750)> 1.0 Significant Es(480) (uW cm^-2 nm^-1) 2.0 Dawn/Dusk Es(470/680)< 1.0 Rain/Humid. Es(720/370)< 1.095 Level 2 Processing Temporal binning, glitter reduction, glint	BRDF Correction Morel R.f/Q Lee IOP L2 Products Convolve to Satellite Bands: AQUA * Sen-3A V-NPP TERRA Sen-3B V-JPSS * Automatic for Derived Products Convolution uncertainties Generate Spectral Plots Rrs InLw Iss Iss Is Iss Iss Iss Iss Iss Iss Iss
Pitch/Roll Filter (where present) ✓ Max Pitch/Roll Angle 5.0 SolarTracker or pySAS ✓ Rotator Home Angle Offset 0.0	<ul> <li>FRM Class-based (RadCal required)</li> <li>Add RadCals: Files found</li> <li>FRM Full Characterization:</li> </ul>	correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output. L2 Ensembles	Edit SeaBASS Header sample_SEABIRD_pySAS.hdr Write PDF Report
Rotator Delay (Seconds) 🗸 2.0 Absolute Rotator Angle Filter 🗸	Local Add Files: Files found     FidRadDB Interpolation Interval (nm) 3.3	Ensemble Interval (secs; 0=None) 300	
Rotator Angle Min       -55.0         Rotator Angle Max       90.0         Relative Solar Azimuth Filter       ✓         Rel Angle Min       90.0         Rel Angle Min       90.0         Rel Angle Max       135.0	Generate Interpolation Plots Plot Interval (nm) 20.0 Level 1BQC Processing Data quality control filters. Eliminate where Lt(NIR)>Lt(UV)		
Deglitch Data 🗸	Max. Wind Speed (m/s) 10.0 SZA Minimum (deg) 15.0 SZA Maximum (deg) 60.0	Reniove ivegative opectra	500 550 600

Relative Spectral Response (RSR) weighting functions for various multi-spectral satellite sensors are included in order to accurately convolve the hyperspectral L2 (ir)radiances to satellite bands for comparison/validation. (Ir)radiances are convolved prior to reflectance calculations.


### HyperCP Level 2: Derived Products

Several ocean color algorithms for deriving geophysical and inherent optical properties are provided (see README for sources). More are anticipated. Uses spectra convolved to MODIS Aqua bands.

	Derived L2 Geophysic	al and Inherent Optica	l Properties	)e:	Level 1B Processing	Enable Spectral Outlier Filter 🔽	BRDF Correction
Descriptions of the	e algorithms used to derive	these products can be	found at NASA's Ocea	n Color Web	Dark offsets, calibrations and corrections. Interpolate	Generate Plots 🗸	Morel R.f/Q
Algorithms requiri	ng satellite bands will activa	ate MODIS Aqua waveba	and convolution proces	sing in L2 Is Remove Cals	Ancillary data are required for Zhang glint correction and	Filter Sigma Es 5.0	L2 Products
Radiometric Qualit	:y	Semi-analytical	Algorithms		can fill in wind for M99 and QC. Select database download:	Filter Sigma Li 8.0	Convolve to Satellite Bands:
WeiQA (Wei et al.	2016) 🗸	GIOP		Enabled	GMAO MERRA2 ECMWF	Filter Sigma Lt 3.0	AQUA * 📃 Sen-3A 📃 V-N
	an at al. 2020) 🔽			e:	(GMAO PROMPTS FOR EARTHDATA LOGIN: <u>register</u> )	Enable Meteorological Filters (Experimental)	TERRA Sen-3B V-JP
AVW (Vandermue)	en et al. 2020) 💟	а		ght ≎	Fallback values when no model available:	Cloud Li(750)/Es(750)>10	* Automatic for Derived Products
QWIP (Dierssen et	al. 2022) 🔽	adg		rocessing	Default Wind Speed (m/s) 5.0		Convolution uncertainties
Expirical Algorithn	ıs	adg_S		/ to HDF5	Default AOD(550) 0.5	Significant Es(480) (uw cm <sup><math>-2</math></sup> nm <sup><math>-1</math></sup> ) 2.0	Generate Spectral Plots
chlor_a		anh		C Offset [+/-] 0.0	Default Salinity (psu) 35.0	Dawn/Dusk E <del>s(4</del> 70/680)< 1.0	Rrs 🗸 nLw ✔ Es 🗸 Li 🗸
		apn		inith Angle Filter	Default SST (C) 26.0	Rain/Humid. Es(720/370)< 1. <del>095</del>	
FIC		aph_S		x 🗹 70.0	Select Calibration/Characterization/Correction Regime:	Level 2 Processing	Derived L2 Ocean Color Produc
POC		bb		; Processing	• Factory Calibration Only	Temporal binning, glitter reduction, glint	Save SeaBASS Files
Kd490		bbb		itch, roll, yaw, and azimuth	TriOS O SeaBird (Non-FRM Class-based)	correction, residual correction, QC,	Edit See DASS Hander
idΔp		qaa		Filter (where present) 🗹	FRM Class-based (RadCal required)	satellite convolution, OC product generation,	Edit SeaBASS Header
		bbp_S		tch/Roll Angle 5.0	Add RadCals: Files found	SeaBASS file output.	sample_SEABIRD_pySAS.hdr
GOCAD (Aurin et a	al. 2018) 🔽	QAA		(er or pySAS 🔽	FRM Full Characterization:	L2 Ensembles	Write PDF Report 🛛 🗸
ag(275, 355, 38	0, 412, 443, 488) 🔽	а		me Angle Offset 0.0	Local Add Files: Files found	Extract Cruise Stations	
Sg(275, 300, 350, 380, 412) 🔽		adq		ay (Seconds) 🗹 2.0		Ensemble Interval (secs; 0=None) 300	
doc		anh		totator Angle Filter 🗹	Interpolation Interval (nm) 3.3	Enable Percent Lt Calculation 🗹	
		apri	<b>.</b>	r Angle Min   -55.0		Percent Lt (%) 10.0	
		b		r Angle Max 90.0		L2 Sky/Sunglint Correction (ρ)	
		bb		əlar Azimuth Filter 🗸	Plot Interval (nm) 20.0	Mobley (1999) ρ	
		bbp		ale Min 90.0	Data quality control filters.	🔘 Groetsch et al. (2017) 👘 Your Glint (2023) ρ	
		004	-	ale May 135.0	Eliminate where Lt(NIR)>Lt(UV)	NIR Residual Correction 🗸	
		С		Qata 🗸	Max. Wind Speed (m/s) 10.0	Mueller and Austin (1995) (blue water)	HunerCP
			Save/Close	Cancel	SZA Minimum (deg) 15.0	Your NIR Residual (2023) (universal)	ngporor
				cn Anomaly Analysis			Save/Close Save As Ca

Configuration: sample SEABIRD pvSAS.cfg

## HyperCP Output: SeaBASS & HDF5

### Red boxed can be autofilled. Fill in the rest as appropriate.

Edit SeaBASS Header							
				Configuration: sample_SEABIRD_pySAS.cfg			
Editing: sample_TRIOS_NOTRACKER.ndr	ith underscores. For input assist	and to SocRASS Motodata Headers		Level 1B Processing	Enable Spectral Outlier Eilter	RPDE Correction	
		AICE, GO TO SEABASS MELADATA		Dark offsets, calibrations and corrections. Interpolate		BRDF Conection	
THE ANCILLARY SEABASS FILE AND CONFIGURATION	ENTRIES BELOW ARE EXTRACTED F			to common timestamps and wavebands.	Generate Plots 🗹	Morel R.f/Q	
SeaBASS submission verion (e.g. 'R1', 'R2') R1		! HyperInSPACE vers = 1.2.2 ! HyperInSPACE Config =	nove Cals	Ancillary data are required for Zhang glint correction and	Filter Sigma Es 5.0	L2 Products	
To match fields to existing SoaPASS entries		sample_TRIOS_NOTRACKER.cfg		can fill in wind for M99 and QC. Select database download:	Filter Sigma Li 8.0	Convolve to Satellite Bands:	
check the 'l ists' null-down menu here	Config Comments (lead with !)	! Rotator Home Angle = 0.0 ! Rotator Delay = 2.0 ! Pitch/Roll Filter = Off ! Max Pitch/Roll = 5.0 ! Rotator Min/Max Filter = Off	nabled 0.0 ter	GMAO MERRA2 ECMAVE	Filter Sigma Lt 3.0	AQUA * Sen-3A V-NPP	
Investigators ShorlockHolmos JohnWatson				(GMAO PROMPTS FOR EARTHDATA LOGIN: register)		TERRA Sen-3B V-JPSS	
Investigators Sheriockronnes, John Watson				Fallback values when no model available:	Enable Meteorological Filters (Experimental)	* Automatic for Derived Products	
affiliations 221bBakerStr		!		Default Wind Speed (m/s) 5.0 Default AOD(550) 0.5 Default Salinity (psu) 35.0 Default SST (C) 26.0	Cloud Li(750)/Es(750)> 1.0	Convolution uncertainties	
contact john.h.watson@bakerst.org	Other Comments (lead with !)	<ul> <li>Sample dataset for TriOS triplet</li> <li>Sample dataset for TriOS triplet</li> <li>with no GPS or sun tracker.</li> <li>FRM4SOC-2 Field</li> <li>InterComparison Experiment</li> <li>(FICE)</li> <li>July 11 - 21, 2022</li> </ul>			Significant Es(480) (uW cm^-2 nm^-1) 2.0	Conorato Spectral Plata	
experiment StudyInScarlet					Dawn/Busk Es(470/680)< 1.0		
cruise BrixtonRoad					Rain/Humid. Es(720/370)< 1.095		
	J			Select Calibration/Characterization/Correction Regime:	Level 2 Processing	Derived L2 Ocean Color Products	
platform/ship Brougham		! Acqua Alta Oceanographic Tower		• Factory Calibration Only	Temporal hinning, glitter reduction glint		
cuments     README.md     station (RAW filename if blank)			and azimuth	TriOS SeaBird (Non-FRM Class-based)	remporal binning, ginter reduction, gunt	Save SeaBASS Files	
instrument_manufacturer TriOS	data_file_name			FRM Class-based (RadCal required)	correction, residual correction, QC,	Edit SeaBASS Header	
instrument model RAMSES	original file name			Add DodColor	satellite convolution, OC product generation,		
-	start data (DAW) data abauld ba in CMT)		÷ <u>5.0</u>	Add RadCals: Files found	SeaBASS file output.	sample_SEABIRD_pySAS.hdr	
				FRM Full Characterization:	L2 Ensembles	Write PDF Report	
calibration_files ni,Back_SAM_8595.dat,Cal_SAM_8595.dat	end_date [GMT]		fset 0.0	Local Add Files: Files found	Extract Cruise Stations		
data_type above_water	start_time [GMT]		;) 🗸 2.0		Ensemble Interval (secs; 0=None) 300		
data_status (e.g. preliminary) preliminary	end_time [GMT]		Filter 🔽	○ FidRadDB	Enable Percent Lt Calculation		
water_depth (use -9999 for missing) NA	north_latitude [dec deg]		55.0	Interpolation Interval (nm) 3.3		^	
measurement depth 0	south latitude		-55.0     Generate Interpolation Plots        90.0     Plot Interval (nm)				
					L2 Sky/Sunglint Correction (ρ)		
cloud_percent NA	east_longitude		Filter 🔽	Level 1BQC Processing	O Mobley (1999) ρ O Zhang et al. (2017) ρ		
wave_height NA	west_longitude			Data quality control filters.	O Groetsch et al. (2017) O Your Glint (2023) ρ		
secchi_depth NA	wind_speed NA		0	Eliminate where Lt(NIR)>Lt(UV) 🔽	NIR Residual Correction 🗸		
Open/Copy Save Save As Cancel				Max. Wind Speed (m/s) 10.0	<ul> <li>Mueller and Austin (1995) (blue water)</li> <li>SimSpec, Ruddick et al. (2006) (turbid)</li> </ul>	HuperCP	
			nalysis	SZA Minimum (deg) 15.0	Vour NIR Residual (2023) (universal)		
			Marysis	SZA Maximum (deg) 60.0	Remove Negative Spectra 🔽	Save/Close Save As Cancel	



# L2 Output

Data and Reports





## HyperCP HDF5 Files

HDFVi

Image: String length = 11, padding = H5T_STR_ MICH_AZ Image: String length = 2, padding = H5T_STR_ MICL_AZ Image: String length = 24, padding = H5T_STR_ Rs_UNITS Image: String length = 4, padding = H5T_STR_ Rs_UNITS
ent Files       /Users/daurin/GitRepos/HyperInSPACE/Data/Sample_Data/L2/SAMPLE_SEABIRD_pySAS_L2.hdf         SAMPLE_SEABIRD_pySAS_L2.h       Object Attribute         ANCILLARY       Ado         CLOUD       Creation Order:         COURSE       HEADING         LATITUDE       Name         PITCH       GLINT_CORR         POINTING       REL_AZ         ROLL       String, length = 11, padding = H5T_STR_NEGATIVE_VALUE_FILTER         String, length = 2, padding = H5T_STR_NEGATIVE_VALUE_FILTER       String, length = 24, padding = H5T_STR_NEGATIVE_VALUE_FILTER         MIR_RESID_CORR       String, length = 4, padding = H5T_STR_NIR_STR_NITS
SAMPLE_SEABIRD_pySAS_L2.h   ANCILLARY   AOD   COURSE   HEADING   LATITUDE   LONGITUDE   POINTING   REL_AZ   ROLL   ROLL    Attribute Creation Order: Creation Order NOT Tracked Number of attributes = 5 Recent of attributes = 5 Name Type GLINT_CORR String, length = 11, padding = H5T_STR_NEGATIVE_VALUE_FILTER String, length = 24, padding = H5T_STR_NEGATIVE_VALUE_FILTER String, length = 24, padding = H5T_STR_Ris_UNITS String, length = 14, padding = H5T_STR_Ris_UNITS String, length = 15, padding = H5T_STR_Ris_UNITS String, length = 14, padding = H5T_STR_Ris_UNITS String, length = 15, padding = H5T_STR_Ris_UNITS String, length = 14, padding = H5T_STR_Ris_UNITS String, length = 14, padding = H5T_STR_Ris_UNITS String, length = 14, padding = H5T_STR_Ris_UNITS String, length = 15, padding = H5T_STR_Ris_UNITS String, length = 14, padding = H5T_STR_Ris_UNITS String, length = 14, padding = H5T_STR_Ris_UNITS <
ANCILLARY ANCILLARY ANCILLARY AND COURSE Attribute Creation Order: Creation Order NOT Tracked Number of attributes = 5 Attribute Creation Order: Creation Order NOT Tracked Number of attributes = 5 Name Type GLINT_CORR BEGATIVE_VALUE_FILTER String, length = 11, padding = H5T_STR_ NEGATIVE_VALUE_FILTER String, length = 2, padding = H5T_STR_ NIR_RESID_CORR String, length = 4, padding = H5T_STR_ String, length = 4, padding = H5T_STR_ Attribute Creation Order: Creation Order NOT Tracked Number of attributes = 5
Image: Antoin Land I         Image: AOD
# CLOUD       Attribute Creation Order: Creation Order NOT Tracked         # COURSE       Number of attributes = 5         # HEADING       Name         # LATITUDE       Image: Course of the second sec
Image: Course       Number of attributes = 5         Image: HeADING       Name         Image: LATITUDE       Name         Image: LATITUDE       Name         Image: LONGITUDE       String, length = 11, padding = H5T_STR_         Image: POINTING       String, length = 11, padding = H5T_STR_         Image: ReL_AZ       NIR_RESID_CORR       String, length = 24, padding = H5T_STR_         Image: Roll       Rrs_UNITS       String, length = 4, padding = H5T_STR_
IIII HEADING         IIII LATITUDE         IIII LONGITUDE         IIII POINTING         IIII REL_AZ         IIII ROLL         IIII ROLL         IIII SALINITY
IIII LATITUDE       Name       Type         IIII LONGITUDE       GLINT_CORR       String, length = 11, padding = H5T_STR_         IIII POINTING       NEGATIVE_VALUE_FILTER       String, length = 2, padding = H5T_STR_         IIII REL_AZ       NIR_RESID_CORR       String, length = 24, padding = H5T_STR_         IIII ROLL       Rrs_UNITS       String, length = 4, padding = H5T_STR_
Image: Name       Image: Name       Image: Name       Image: Name       Image: Name         Image: POINTING       GLINT_CORR       String, length = 11, padding = H5T_STR_         Image: REL_AZ       NEGATIVE_VALUE_FILTER       String, length = 2, padding = H5T_STR_         Image: ROLL       Rrs_UNITS       String, length = 4, padding = H5T_STR_         Image: Roll       Rrs_UNITS       String, length = 4, padding = H5T_STR_
Image: Point Pince       GLINT_CORR       String, length = 11, padding = H5T_STR_         Image: Point Pince       NEGATIVE_VALUE_FILTER       String, length = 2, padding = H5T_STR_         Image: Point Pince       NIR_RESID_CORR       String, length = 24, padding = H5T_STR_         Image: Point Pince       Rrs_UNITS       String, length = 4, padding = H5T_STR_         Image: Point Pince       Rrs_UNITS       String, length = 4, padding = H5T_STR_
III POINTING       NEGATIVE_VALUE_FILTER       String, length = 2, padding = H5T_STR_         III REL_AZ       NIR_RESID_CORR       String, length = 24, padding = H5T_STR_         III ROLL       Rrs_UNITS       String, length = 4, padding = H5T_STR_         III SALINITY       NIW_LINITS       String, length = 13, padding = H5T_STR_
III REL_A2       NIR_RESID_CORR       String, length = 24, padding = H5T_STR         III ROLL       Rrs_UNITS       String, length = 4, padding = H5T_STR_         III SAL INITY       Result in the initial string is adding = H5T_STR_
ROLL String, length = 4, padding = H5T_STR_
III SOC
👖 SZA
III WAVE_HT
DERIVED_PRODUCTS
RADIANCE
III Rrs_HYPER_uncorr
Rrs_MODISA
III Rrs_MODISA_unc
III Rrs_MODISA_uncorr
in nLw_HYPER
III nLw_HYPER_unc
ew root - /

User property file - /Users/daurin/.hdfview3.1.3 Rrs\_HYPER\_unc at /REFLECTANCE/ [SAMPLE\_SEABIRD\_pySAS\_L2.hdf in /Users/daurin/GitRepos/HyperInSPACE/Data/Sample\_Data/L2] [ dims0, start0, count12, stride1 ]





## HyperCP L2 SeaBASS Files

🔴 😑 📄 BogieAndBacall_TheBigSleep_WarnerBros_HyperSAS_201605	🔆 🛑 😑 📄 BogieAndBacall_TheBigSleep_WarnerBros_HyperSAS_20160520_0	•••
/begin header	! ES Light Window = 5	76.3_unc,R
/investigators=Philip Marlow, Vivian Rutledge	! ES Dark Sigma = 3.2	unc,Rrs40
/affiliations=Chandler University	! ES Light Sigma = 3.5	,Rrs432.4 1
/contact=private_eve@cu.edu	! LI Dark Window = 11	458.8 unc.]
/experiment=BogieAndBacall	1  Li J binh Window = 5	2 unc.Rrs4
/cruise=TheBigSleen	LI Dark Sigma = 3.4	c Rrs514 9
/documents=SAMPLE SEABIRD SOLARTRACKER Ancillary.sb.README.md	LILI joht Sigma = 3.0	541 3 unc
/instrument manufacturer=Satlantic	I LT Dark Window = 11	7 unc Brs5
/instrument_model=HyperSAS	I LT Light Window = 5	o Dro 507 /
/calibration_date=20180730	LT Dark Sigma = 3.5	672.8 ma
	I I T Light Sigma = 3.2	023.0 unc.
calibration_files=SAS045_20160203.sin_HSE488B.cal_HSL386B.cal_SATPYR.tdf.HL	I Wavelength Intern Int = 3.3	$2_unc, Rrso$
B cal IRP3397A cal SATTHS0045A tdf HLD385B cal HSL385B cal SATNAV0001A	$t \mid \text{Default Wind} = 5.0$	c, Rrs6/9.9
/data type=ahove water	$\int Default A O D = 0.5$	706.3_unc,
/data_status=	$\frac{1}{10} \frac{1}{10} \frac{1}{10} = 0.5$	7_unc,Rrs7
/water_denth=NA	$\int Default SST = 26.0$	/units=yyyy
/measurement_denth=0	$\int Max Wind = 10.0$	sr,1/sr,1/sr,1
/cloud_nercent=NA	1  Min  SZA = 20.0	sr,1/sr,1/sr,1
/wave height=NA	$\frac{1}{1000} Max S7A = 60.0$	sr,1/sr,1/sr,1
/wave_neight= $NA$ /secchi_denth= $NA$	: Max SLA = 00.0   Spectral Filter = On	sr,1/sr,1/sr,1
/station=SAMPLE SEABIRD SOLARTRACKER	: Spectral Filter – Off	sr,1/sr,1/sr,1
/data file name=BogieAndBacall TheBigSleen WarnerBros HymerSAS 20160520 (	$\frac{1}{1} = \frac{1}{1} = \frac{1}{2}$	sr.1/sr.1/sr.1
/data_inte_name=DogicAnddacan_incDigSiccp_wanterDios_itypeiSAS_20100520_(	$\int F \operatorname{Her} \operatorname{Sigma} L = 8.0$	sr 1/sr 1/sr 1
/original_ine_iane=SAWFEE_SEADIRD_SOLARTRACKER.iaw	! Filter Sigma Lt = 3.0	sr 1/sr 1/sr 1
/stalt_date=20100520	! Meteorological Filter = $OII$	sr, 1/sr, 1/sr, 1
$/cliu_uale=20100020$	! Cloud Flag = 1.0	and header
$/start_time=07.02.25[CW11]$	!  Es Flag = 2.0	20160520 0
$/\text{rend}_\text{ullie}=0/.40.25[\text{OW}1]$	! Dawn/Dusk Flag = 1.0	20100320,0
/norun_lanuad=34.9755[DEG]	! Rain/Humidity Flag = 1.095	02415,0.00
/south_landude=34.9/01[DEG]	! Ensemble Interval = 300	2923,0.002
/vast_longitude=129.11/5[DEC]	! Percent Lt Filter = On	158,0.0031
/west_longitude=129.0981[DEG]	! Percent Light = 10.0	90,0.00333
/wind_speed=5.021544052959810	! Glint_Correction = Mobley 1999	7,0.002273
/missing=-999	! NIR Correction = Mueller and Austin 1995	0.001377,0
/defimiter=comma	! Remove Negatives = On	000222,0.0
/platform=warnerBros	! DateTime Processed = Fri Jun 2 11:28:12 2023	00133,0.00
! HyperinSPACE vers = 1.2.0		0055,0.000
! HyperinSPACE Conng = sample_SEABIRD_SOLARTRACKER.cig	! HyperSAS with Sea-Bird Solar Fracker	003,0.0000
1  SZA Max = 65.0	! Collected around Korean peninsula on RV Onnuri in association with KORUS-OC campaig	55,0.00036
1  Betatan Hama Anala = 0.0	KR_2016	8,0.000419
! Rotator Home Angle = 0.0		0.000455.0
! Rotator Delay = 5.0	fields=date,time,lat,lon,ReIAz,SZA,AOT,cloud,wind,Rrs353.2,Rrs356.5,Rrs359.8,Rrs363.1,	000484.0.0
$\frac{1}{1} \operatorname{Max} \operatorname{Ditab} / \operatorname{Dall} = 5.0$	Rrs376.3, Rrs379.6, Rrs382.9, Rrs386.2, Rrs389.5, Rrs392.8, Rrs396.1, Rrs399.4, Rrs402.7, Rrs4	00366 0 00
$\frac{1}{10} \text{ Price} (Max - 5.0)$	15.9, Krs419.2, Krs422.5, Krs425.8, Krs429.1, Krs432.4, Krs435.7, Krs439.0, Krs442.3, Krs445.6,	0263.0.000
$\frac{1}{10} \text{ Rotator Nim/Max Filter} = 0n$	Rrs458.8,Rrs462.1,Rrs465.4,Rrs468.7,Rrs472.0,Rrs475.3,Rrs478.6,Rrs481.9,Rrs485.2,Rrs4	123 0 0001
$\frac{1}{10} \text{ Rotator Nm} = -20.0$	98.4, Rrs501.7, Rrs505.0, Rrs508.3, Rrs511.6, Rrs514.9, Rrs518.2, Rrs521.5, Rrs524.8, Rrs528.1,	15 0 00011
$\frac{1}{10} \text{ Rotator Max} = 45.0$	Rrs541.3, Rrs544.6, Rrs547.9, Rrs551.2, Rrs554.5, Rrs557.8, Rrs561.1, Rrs564.4, Rrs567.7, Rrs5	0.000106.0
! Rel Azimuth Filter = On	80.9,Rrs584.2,Rrs587.5,Rrs590.8,Rrs594.1,Rrs597.4,Rrs600.7,Rrs604.0,Rrs607.3,Rrs610.6,	,0.000106,0
! Rel Azimuth Min = $90.0$	Rrs623.8, Rrs627.1, Rrs630.4, Rrs633.7, Rrs637.0, Rrs640.3, Rrs643.6, Rrs646.9, Rrs650.2, Rrs65	.000106,0.0
! Rel Azimuth Max = 135.0	63.4, Rrs666.7, Rrs670.0, Rrs673.3, Rrs676.6, Rrs679.9, Rrs683.2, Rrs686.5, Rrs689.8, Rrs693.1,	20160520,0
Deglitch Filter = On	Rrs706.3,Rrs709.6,Rrs712.9,Rrs716.2,Rrs719.5,Rrs722.8,Rrs726.1,Rrs729.4,Rrs732.7,Rrs72	02350,0.00
! ES Dark Window = 11	45.9,Rrs749.2,Rrs353.2_unc,Rrs356.5_unc,Rrs359.8_unc,Rrs363.1_unc,Rrs366.4_unc,Rrs3	2974,0.002
$\sum_{n=1}^{\infty} \sum_{i=1}^{\infty} \sum_{j=1}^{\infty} \sum_{i=1}^{\infty} \sum_{i$	$\frac{1}{2} - \frac{1}{2} - \frac{1}$	247,0.0032



### BogieAndBacall\_TheBigSleep\_WarnerBros\_HyperSAS\_20160520\_070223\_L2\_Rrs\_R0.sb

rs379.6 unc, Rrs382.9 unc, Rrs386.2 unc, Rrs389.5 unc, Rrs392.8 unc, Rrs396.1 unc, Rrs399.4 unc, Rrs402.7 5.0 unc,Rrs409.3 unc,Rrs412.6 unc,Rrs415.9 unc,Rrs419.2 unc,Rrs422.5 unc,Rrs425.8 unc,Rrs429.1 unc nc,Rrs435.7 unc,Rrs439.0 unc,Rrs442.3 unc,Rrs445.6 unc,Rrs448.9 unc,Rrs452.2 unc,Rrs455.5 unc,Rrs 2rs462.1 unc, Rrs465.4 unc, Rrs468.7 unc, Rrs472.0 unc, Rrs475.3 unc, Rrs478.6 unc, Rrs481.9 unc, Rrs485. 38.5 unc, Rrs491.8 unc, Rrs495.1 unc, Rrs498.4 unc, Rrs501.7 unc, Rrs505.0 unc, Rrs508.3 unc, Rrs511.6 un unc,Rrs518.2 unc,Rrs521.5 unc,Rrs524.8 unc,Rrs528.1 unc,Rrs531.4 unc,Rrs534.7 unc,Rrs538.0 unc,Rrs Rrs544.6 unc, Rrs547.9 unc, Rrs551.2 unc, Rrs554.5 unc, Rrs557.8 unc, Rrs561.1 unc, Rrs564.4 unc, Rrs567. 71.0 unc, Rrs574.3 unc, Rrs577.6 unc, Rrs580.9 unc, Rrs584.2 unc, Rrs587.5 unc, Rrs590.8 unc, Rrs594.1 un inc,Rrs600.7 unc,Rrs604.0 unc,Rrs607.3 unc,Rrs610.6 unc,Rrs613.9 unc,Rrs617.2 unc,Rrs620.5 unc,Rrs Rrs627.1 unc, Rrs630.4 unc, Rrs633.7 unc, Rrs637.0 unc, Rrs640.3 unc, Rrs643.6 unc, Rrs646.9 unc, Rrs650. 53.5 unc, Rrs656.8 unc, Rrs660.1 unc, Rrs663.4 unc, Rrs666.7 unc, Rrs670.0 unc, Rrs673.3 unc, Rrs676.6 un unc, Rrs683.2 unc, Rrs686.5 unc, Rrs689.8 unc, Rrs693.1 unc, Rrs696.4 unc, Rrs699.7 unc, Rrs703.0 unc, Rrs Rrs709.6 unc, Rrs712.9 unc, Rrs716.2 unc, Rrs719.5 unc, Rrs722.8 unc, Rrs726.1 unc, Rrs729.4 unc, Rrs732. 36.0 unc, Rrs739.3 unc, Rrs742.6 unc, Rrs745.9 unc, Rrs749.2 unc

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# HyperCP Processing Report (PDF)

### **Processing Reports**

### File: SAMPLE\_SEABIRD\_pySAS Col

### L1BQC : Process L1B to L1BQC

Apply more quality control filters.

**Processing Parameters:** Max Wind: 10.0 Min SZA: 15.0 Max SZA: 60.0 Filter Sigma Es: 5.0 Filter Sigma Li: 8.0 Filter Sigma Lt: 3.0

Process log:

Process Single Level Applying Lt(NIR)>Lt(UV) quality filtering to elin 0.0% of spectra flagged Percentage of data out of Wind limits: 0 % Percentage of data out of SZA limits: 0 % Applying spectral filtering to eliminate noisy spect 0.4% of Es data flagged 0.0% of Li data flagged 4.6% of Lt data flagged Remove IRRADIANCE Data Length of dataset prior to removal 1076 long Length of dataset after removal 1022 long: 5% removed **Remove RADIANCE Data** Length of dataset prior to removal 1076 long Length of dataset after removal 1022 long: 5% removed Remove ANCILLARY Data Length of dataset prior to removal 1076 long Length of dataset after removal 1022 long: 5% removed





# HyperCP Data Directory Overview



### Conclusion

Above all, don't be discouraged if it doesn't run seamlessly the first time.



Stay up-to-date with latest version before you process > git pull

Don't forget to activate the environment before you run: > conda activate hypercp > python Main.py

A recent major overhaul to v1.2 may have some bugs still, so feel free to report Issues or start Discussions on GitHub!















