

Copernicus FICE 2025

Training on

In situ Ocean Colour Above-Water Radiometry towards Satellite Validation

HyperCP Introduction

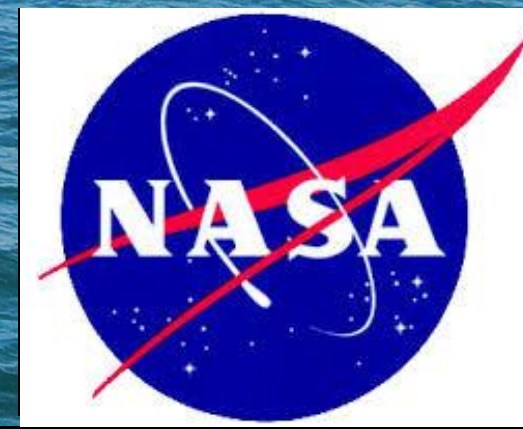
Dirk Aurin

NASA Goddard Space Flight Center/Morgan State University

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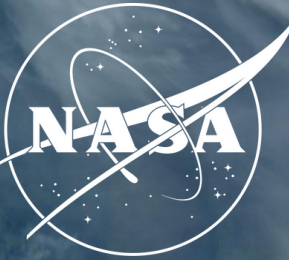


July 7-19, 2025
Venice, Italy

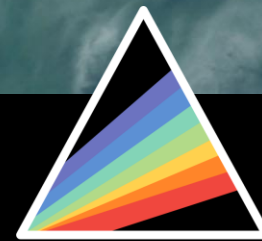


HyperCP Introduction

Dirk Aurin
NASA Goddard Space Flight Center
GESTAR-II Morgan State University



Instructors



HyperCP

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National Physical Laboratory
Middlesex, UK



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Remote Sensing Scientist
National Physical Laboratory
Middlesex, UK





¹ NASA

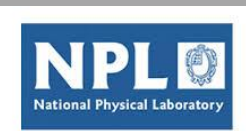
Goddard Space
Flight Center



² Morgan State
University



⁵ University of
Victoria



⁷ National
Physical
Laboratory (UK)



¹⁰ NOAA NMFS

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Funding from NASA PACE Mission and Copernicus
FRM4SOC Initiative



³ EUMETSAT



⁴ Copernicus
Programme of
European
Commission



⁶ ACRI-ST



⁸ University of Maine

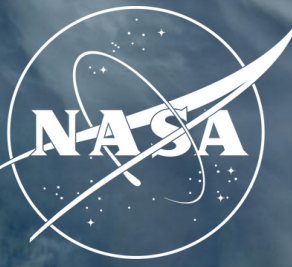


⁸ University of Tartu



⁹ 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.

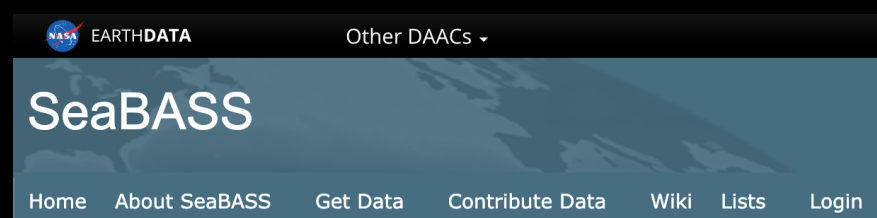


Rigorous validation requires high-quality, hyperspectral in situ radiometry from many locations and water types.





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



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.



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.

NASA/TM-2003-21621/Rev-Vol III

James L. Mueller, Giulietta S. Fargion and Charles R. McClain, Editors

J. L. M
Lee, F
Miller
Voss,

Review

A Rev
Meas
Valid
over

Kevin G.
Alexandra
B. Carol J
and Riho

remote sensing

Review

A Review of Protocols for Fiducial Reference

Meas
Valid
over

Kevin G. F
Alex Giler
Michael O

remote sensing



IOCCG Protocol Series

Ocean Optics & Biogeochemistry Protocols for Satellite Ocean Colour Sensor Validation

Volume 3: Protocols for Satellite Ocean Colour Data Validation: In Situ Optical Radiometry (v3.0)

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 Satellite Ocean Colour Phase-2

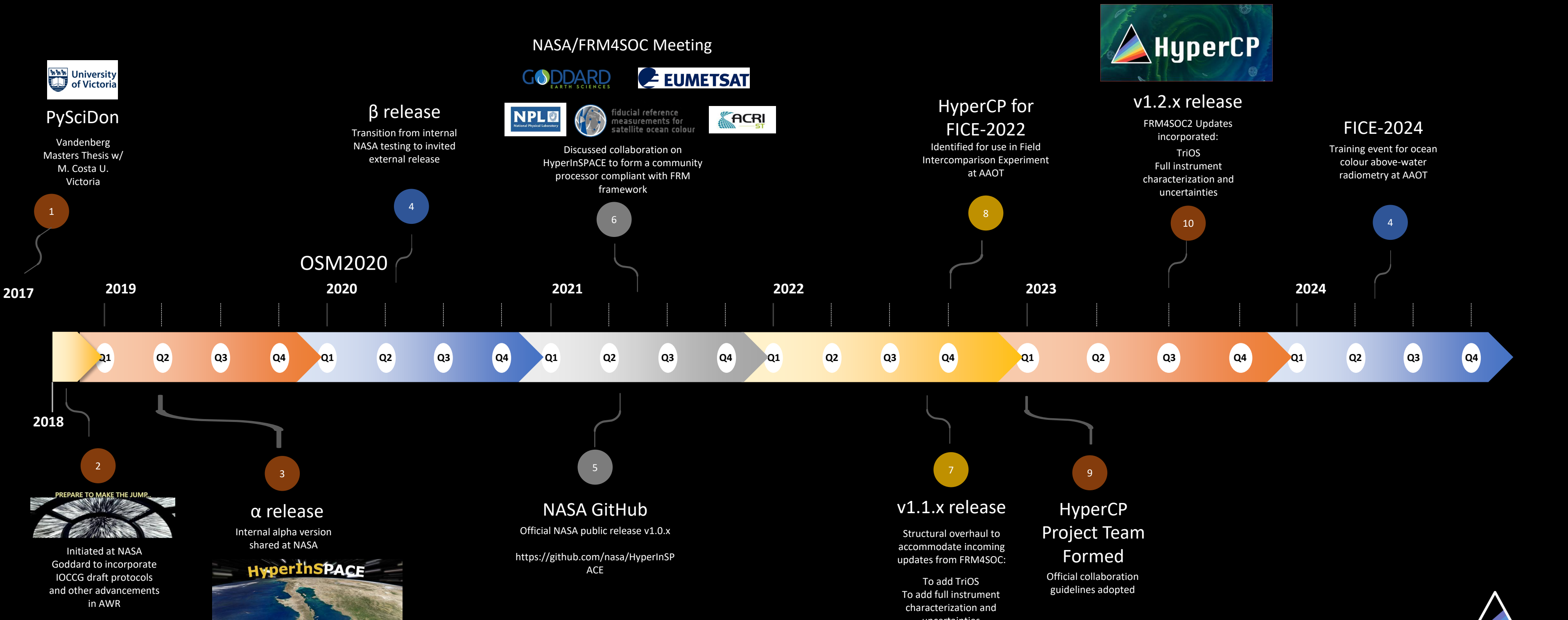
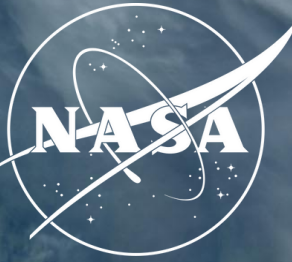
Protocols for uncertainty budget calculation of FRMOCnet OCR and practical guide for OCR measurement (FRM4SOC)

Reflectance Measurement Requirements Document (RMRD)

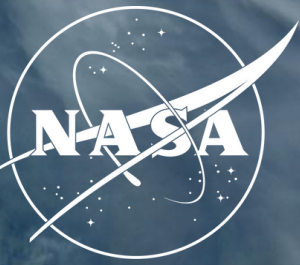
Title	Specifications of minimum requirements for qualification of individual OCRs and their measurements as FRM and process for inclusion of any new instrument models and measurements in the FRMOCnet (RMRD)
Document reference	FRM4SOC2-RMRD
Project	EUMETSAT – FRM4SOC Phase-2
Contract	EUMETSAT Contract No. EUM/CO/21/460002539/JIG
Deliverable	D-2 Reflectance Measurement Requirements Document (RMRD)
Version	v1.2
Date issued	02.11.2022



HyperCP History



HyperCP Guiding Principles



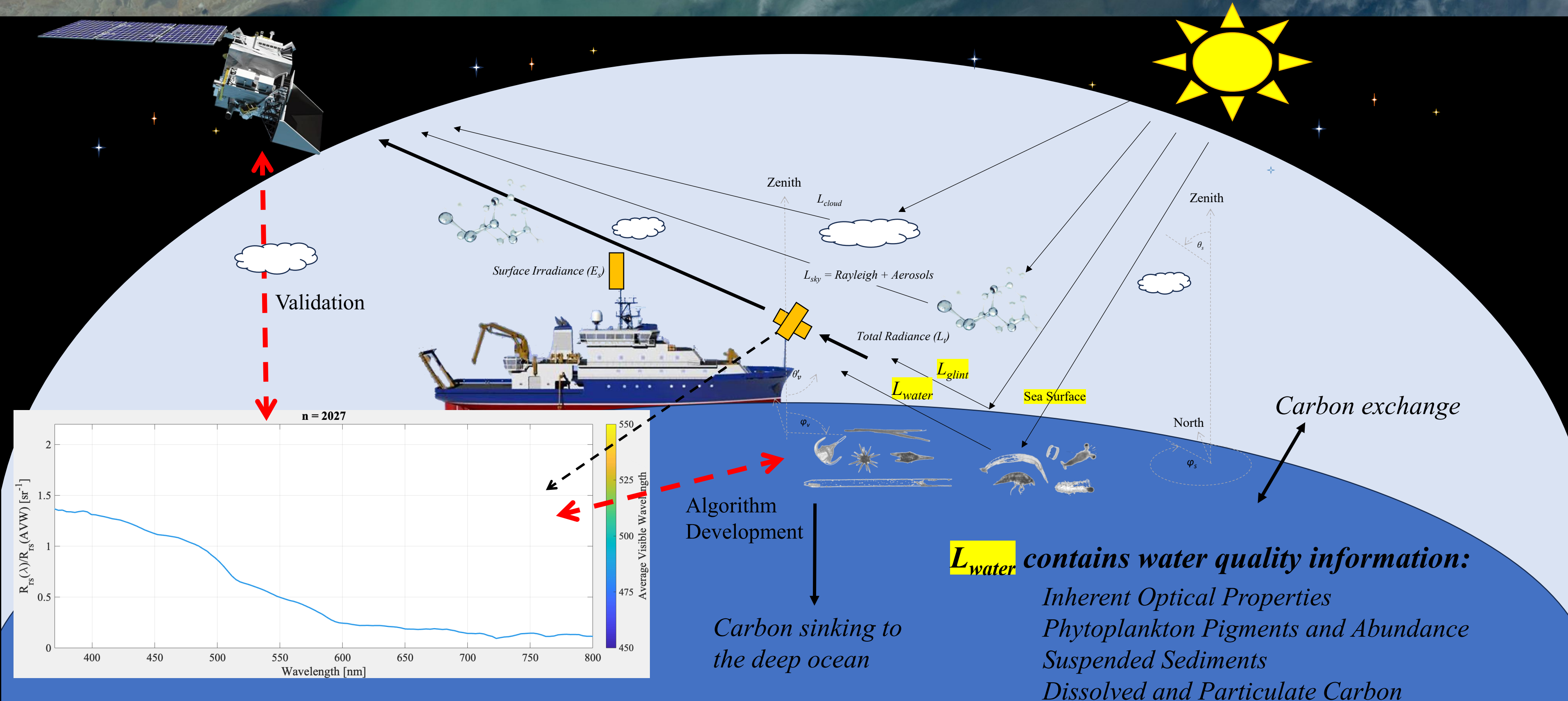
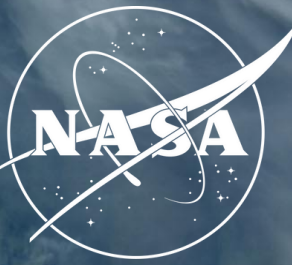
1. Informed by Scientific Consensus : Protocol Driven
2. Open Source: Transparent
3. Open Science: Free and Accessible
4. Collaborative & Adaptive: State of the Science
5. Community Resource

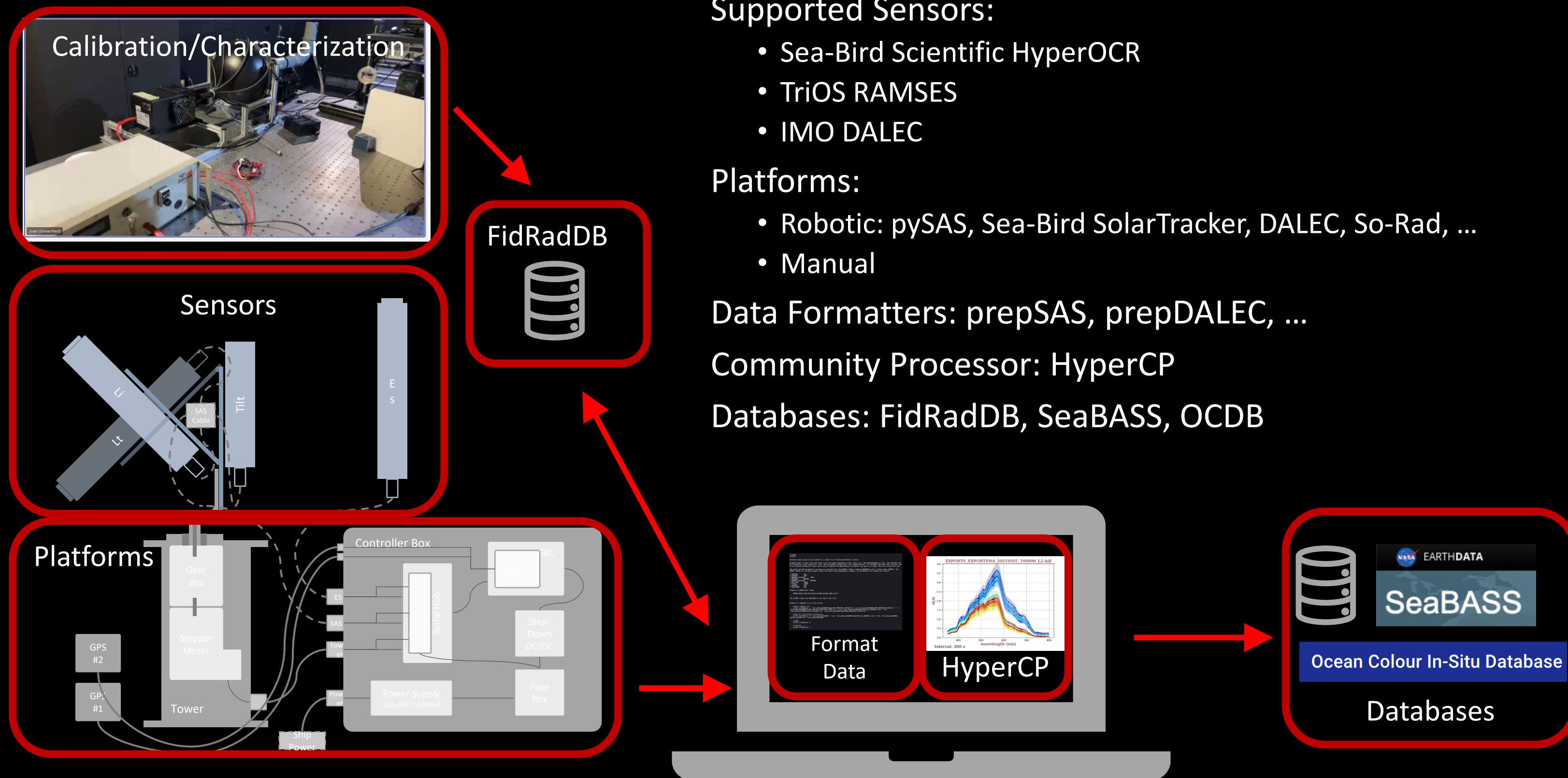
By the community for the community

Above Water Radiometry (AWR)

Principles and Theory

In Situ Above Water Radiometry (AWR)





Manual Systems



pySAS



PANTHYR*



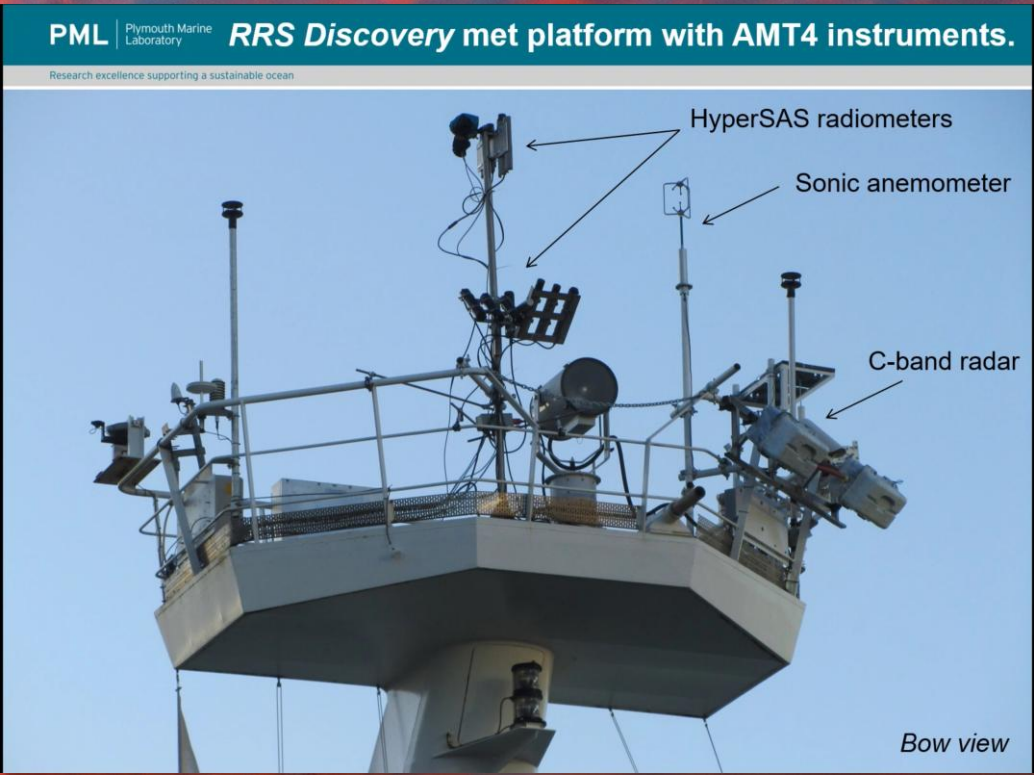
SoRad*



DALEC



Manual Systems



pySAS



SolarTracker



*not currently adapted within HyperCP

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

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

Remote Sensing Reflectance

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

Sea surface irradiance

Normalized Water Leaving Radiance

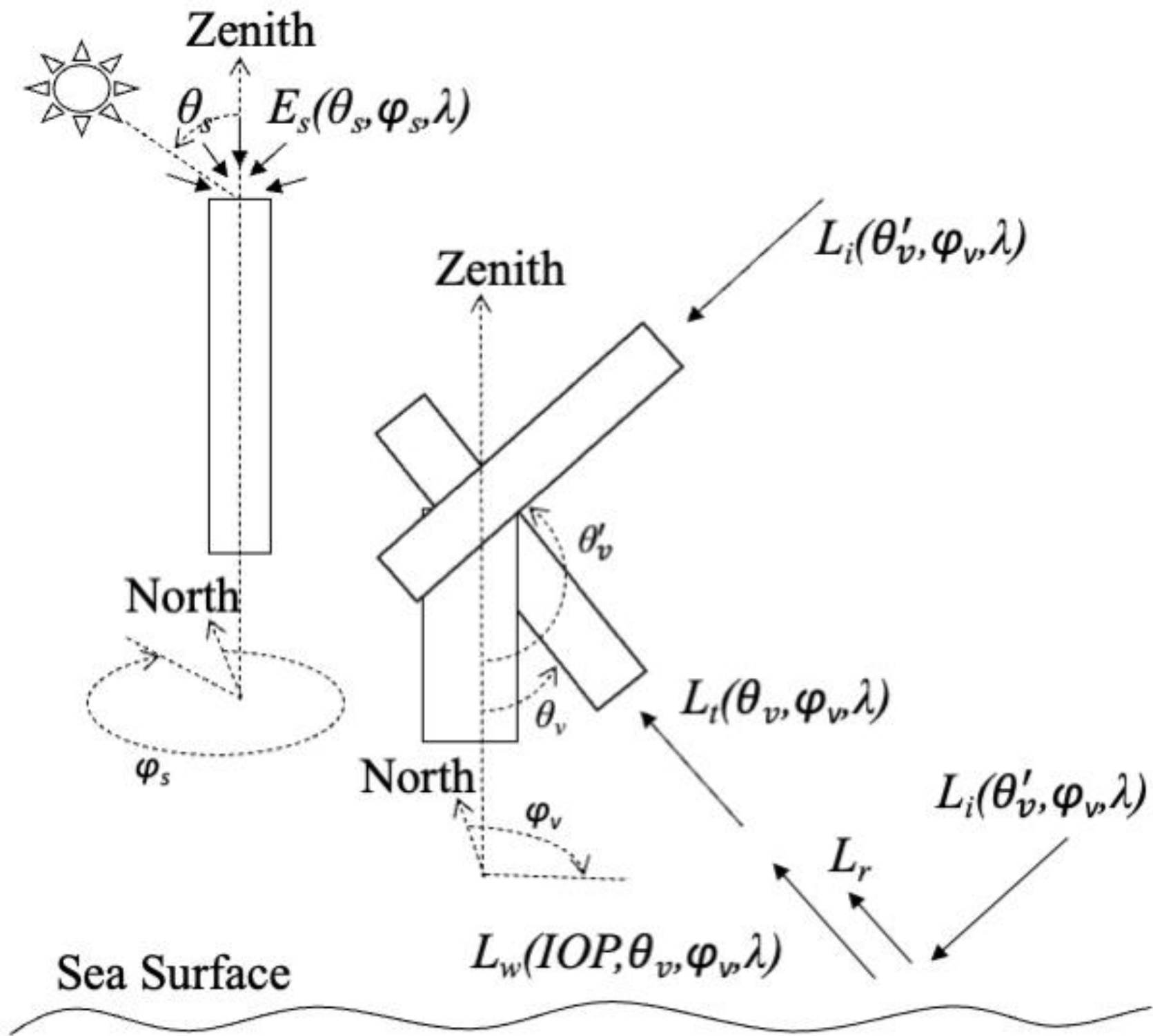
$$nL_w = R_{rs} * F0,$$

TOA irradiance

Exact Normalized Water Leaving Radiance

Corrected for BRDF

nL_w^{ex} .
(adjusted to $\theta_s = 0, \theta_v = 0$)



Primary Challenges

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

Sun/Sky Glint Subtraction

$$L_w(\theta_v, \varphi_v, \lambda) = L_t(\theta_v, \varphi_v, \lambda) - \underbrace{\rho(\theta_s, \varphi_s, \theta_v, \varphi_v, \lambda, W, \tau, T, S)}_{\text{Sea surface reflectance factor}} * L_i(\theta_v, \varphi_v, \lambda)$$

ρ : Sea surface reflectance factor

θ_s : Solar Zenith Angle

φ_s : Relative Azimuth Angle

W : Wind speed (Cox & Munk 1954)

τ : Aerosol optical thickness

T : Temperature

S : Salinity

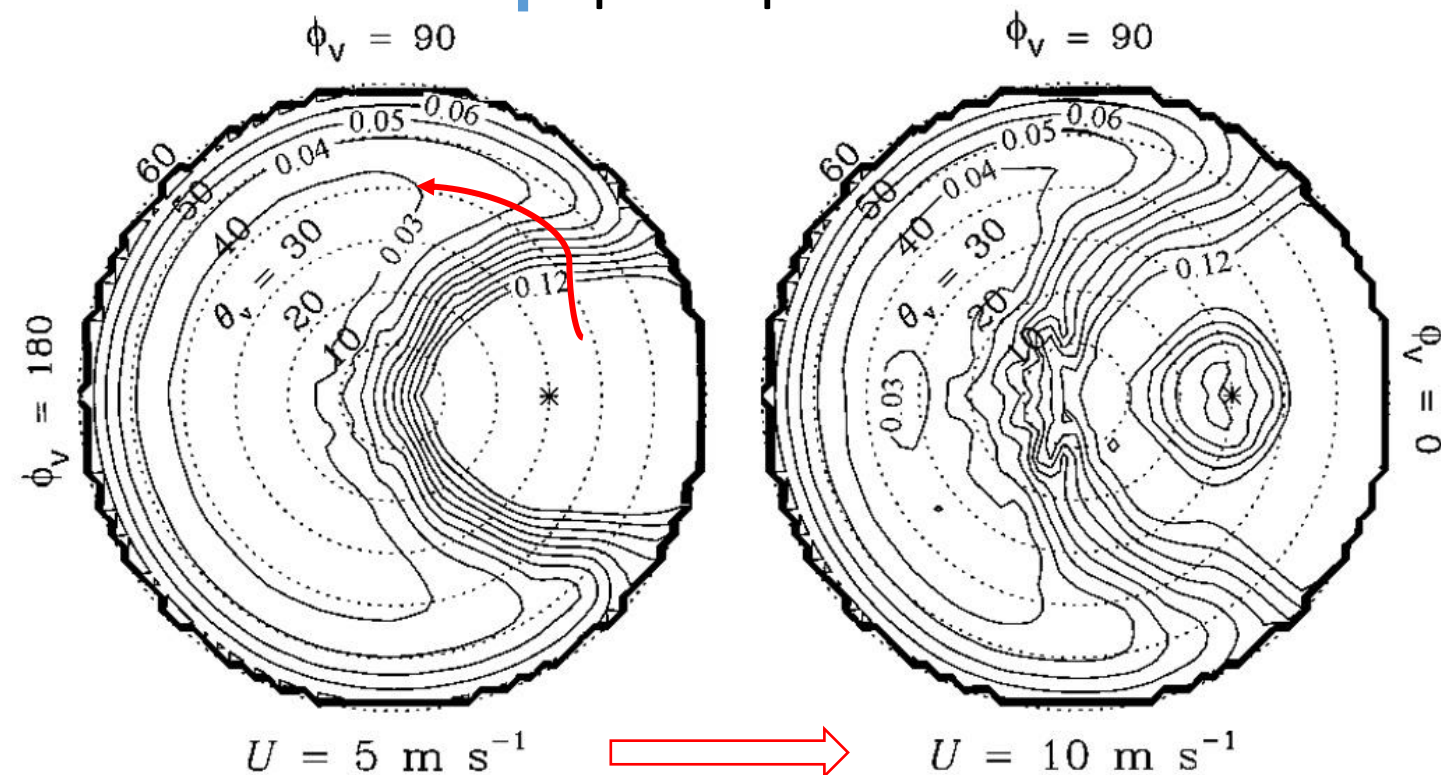
ρ is also slightly dependent on skylight polarization.

ρ is most dominated by **φ_s** , peaking at the specular point of the sun.

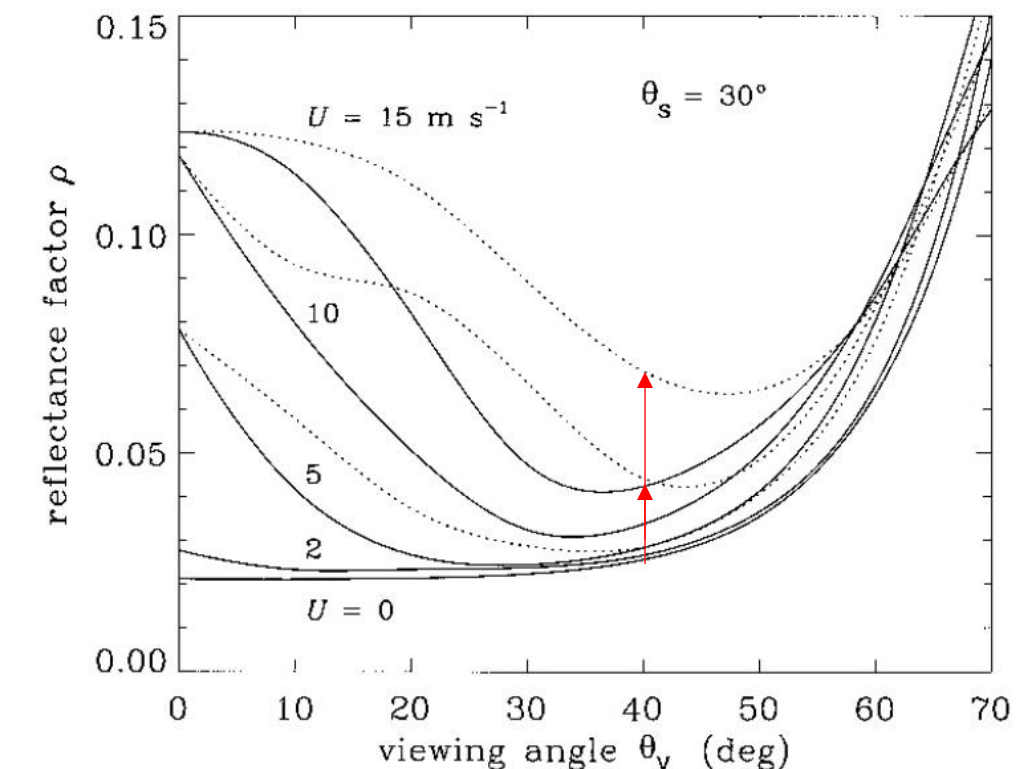
ρ is optimal (low) at **φ_s** in $90^\circ - 135^\circ$.

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

ρ : polar plots



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



Solid lines are **φ_s** for 135° , dashed for 90° .

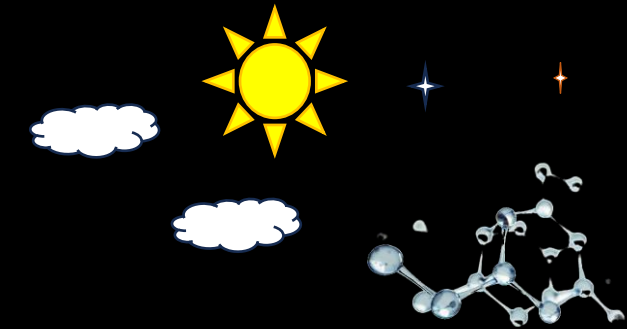
Figures adapted from Mobley 1999, Applied Optics

ρ : 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 **ρ** , but also because cosine collectors for downwelling irradiance are very sensitive to tilt.

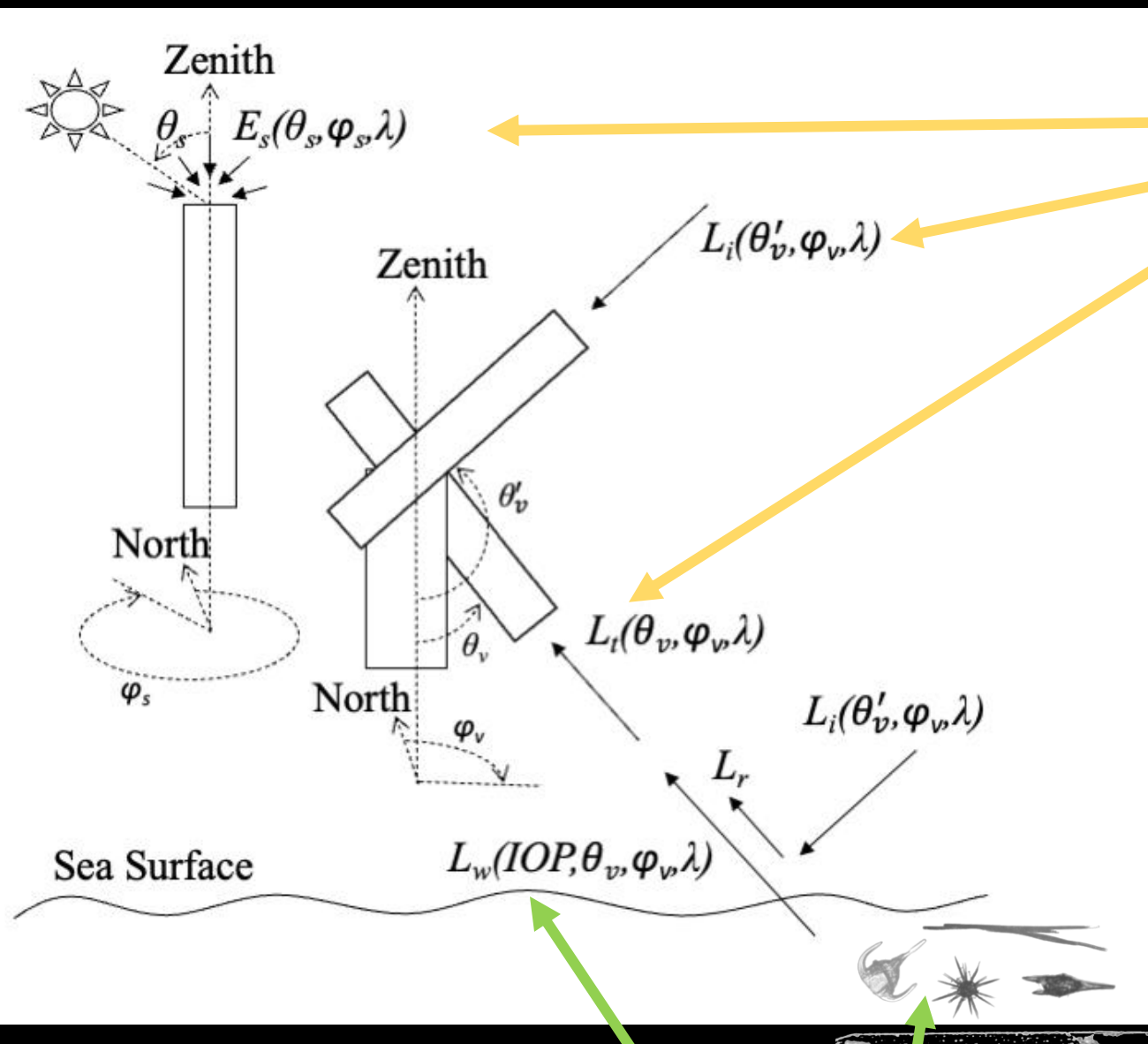
Above Water Radiometry (AWR)



What we measure

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.



Sea surface reflectance factor

Skylight radiance

$$L_w(\theta_v, \phi_v, \lambda) = L_t(\theta_v, \phi_v, \lambda) - \rho(\theta_s, \phi_s, \theta_v, \phi_v, \lambda, W, \tau, T, S) * L_i(\theta_v, \phi_v, \lambda)$$

Total upwelling radiance

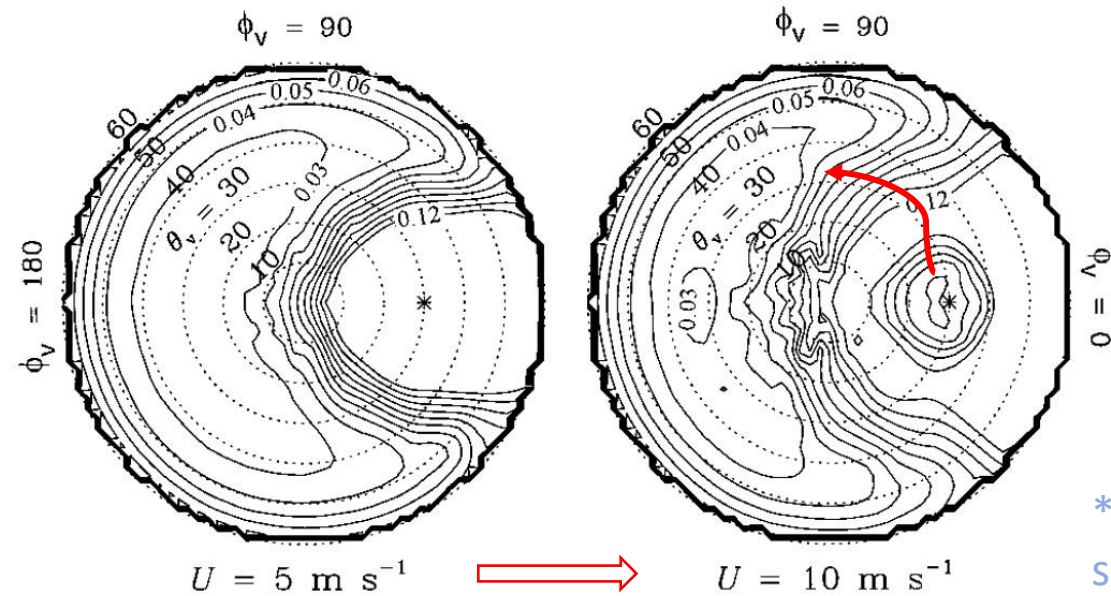
What we're after

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

Above Water Radiometry (AWR)



Sea surface “reflectance” factor*



*aka “glint”, “surface-to-sky radiance ratio”, etc.

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



L2 Sky/Sunglint Correction (ρ)

- ☒ Mobley (1999) ρ
- ☐ 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)
- ☐ Your NIR Residual (2023) (universal)

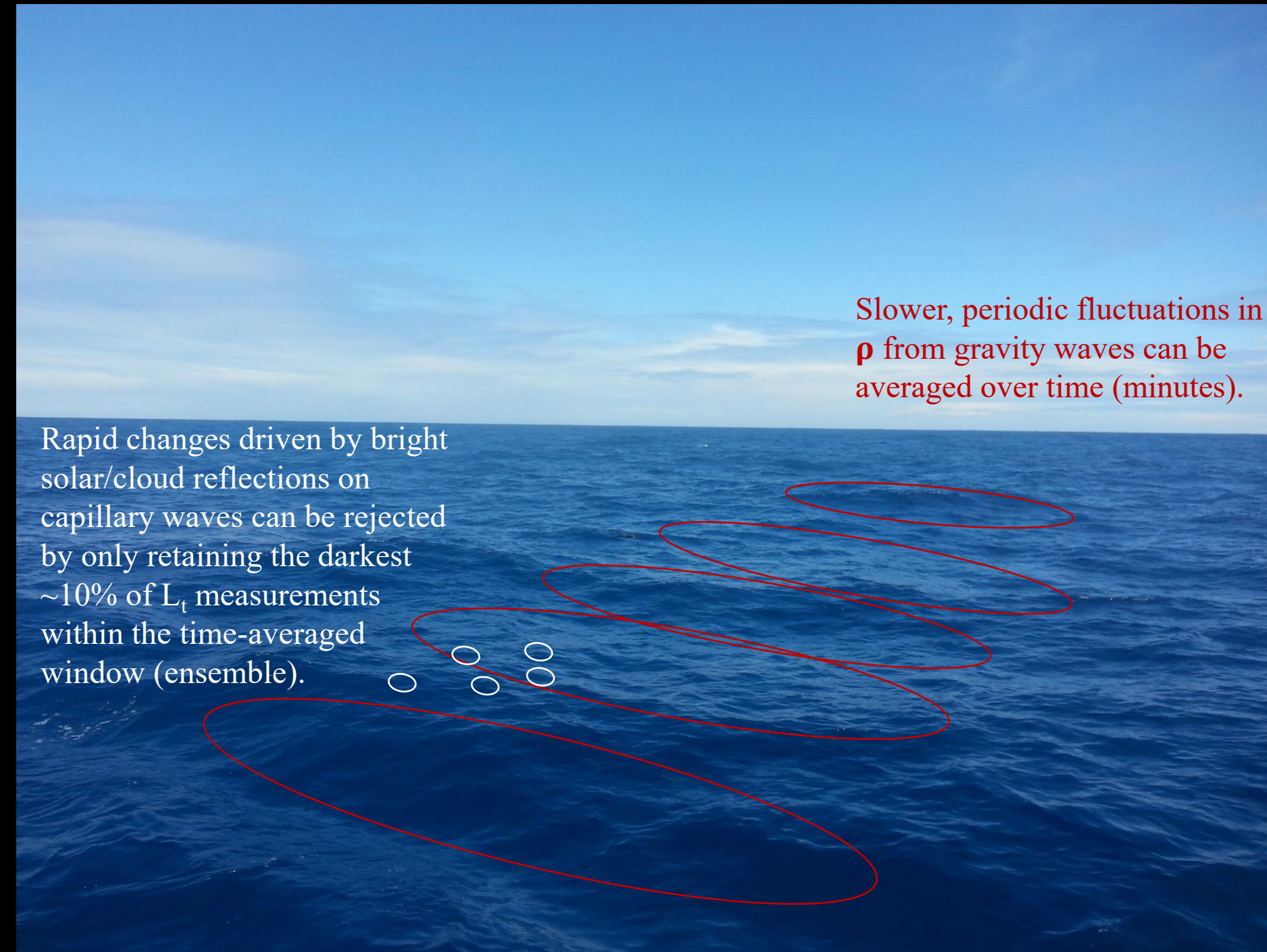
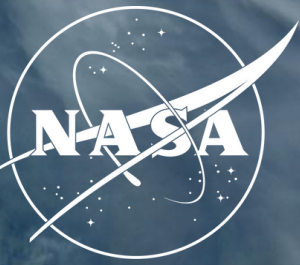
Remove Negative Spectra ☒

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.



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 window (ensemble).

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

Shadows and platform reflectance

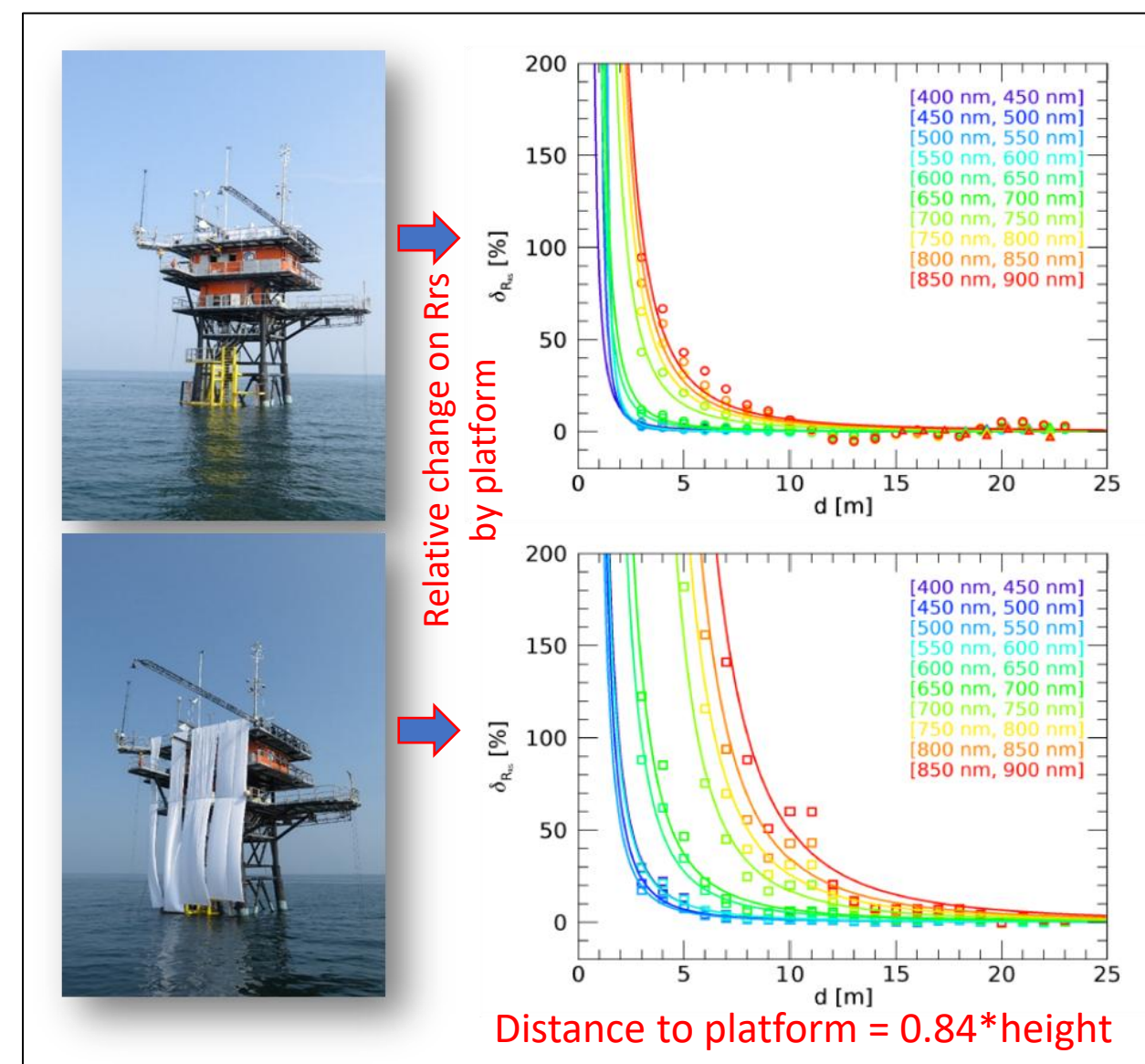
- ρ is minimum at $\varphi_s = 180^\circ$ away from Sun.
- However, $\varphi_s = 180^\circ$ is generally affected by platform shadow
- $\varphi_s = 135^\circ$ is generally outside of the platform shadow.
- However, $\varphi_s = 135^\circ$ still typically affected by platform reflectance (especially if highly reflective)

∴ The compromise φ_s should be between 90° and 135° .

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

ρ : Sea surface reflectance factor

φ_s : Sun-sensor (Li, Lt) relative azimuth

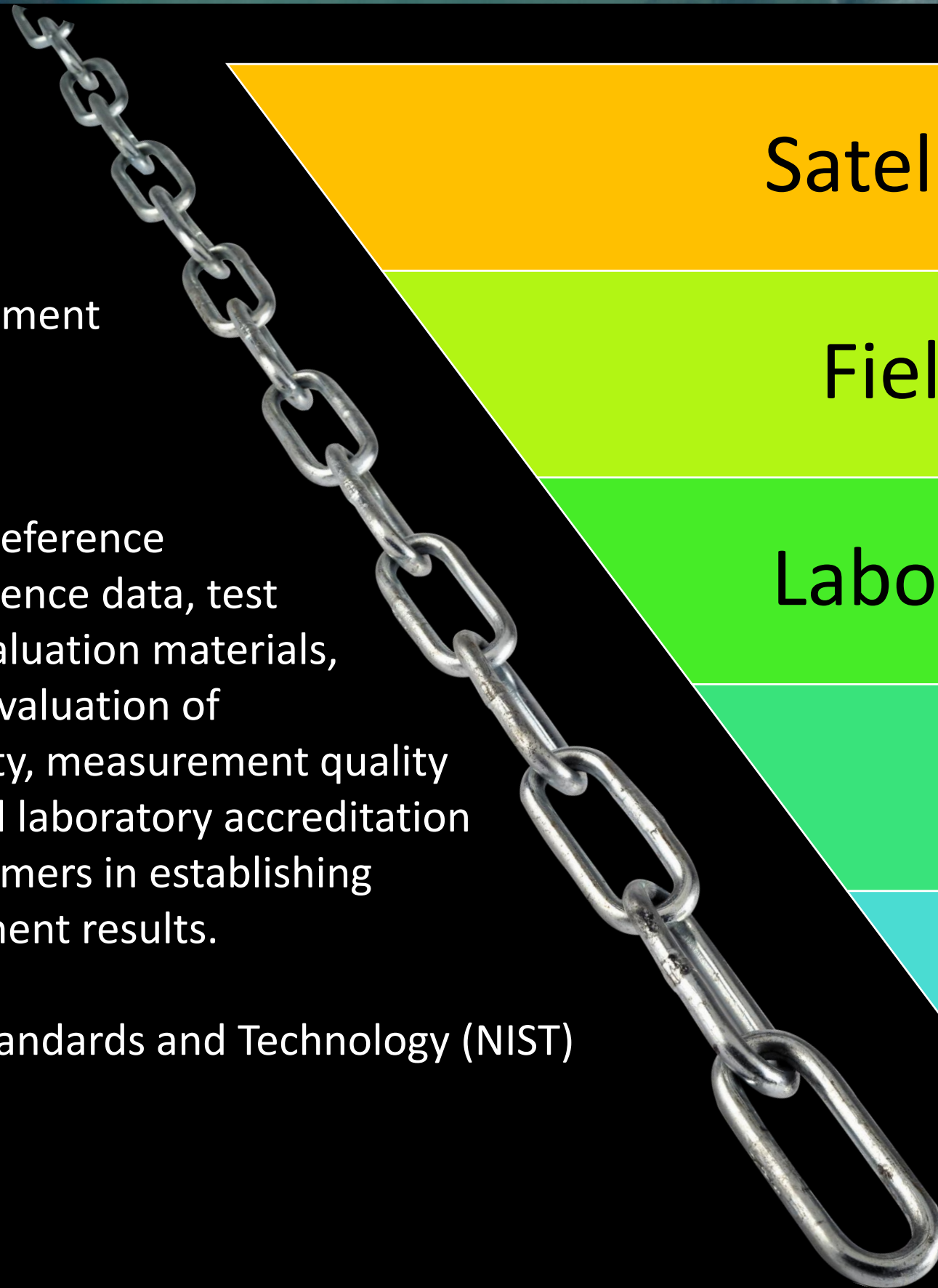
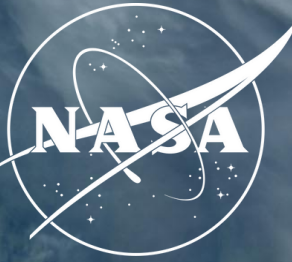


Talone, Zibordi, "Spectral assessment of deployment platform perturbations in above-water radiometry," Opt. Express 27, A878-A889 (2019)

Calibration/Characterization Uncertainty

Overview

Metrology



“The science of measurement
and its applications ...

...calibrations, standard reference
materials, standard reference data, test
methods, proficiency evaluation materials,
tools that facilitate the evaluation of
measurement uncertainty, measurement quality
assurance programs, and laboratory accreditation
services that assist customers in establishing
traceability of measurement results.

– National Institute of Standards and Technology (NIST)

Satellite Measurement

Field Measurement

Laboratory Calibration

Secondary
Standard

Primary
Standard

SI

Increasing Uncertainty

Laboratory calibration is one link in the chain

Absolute calibration

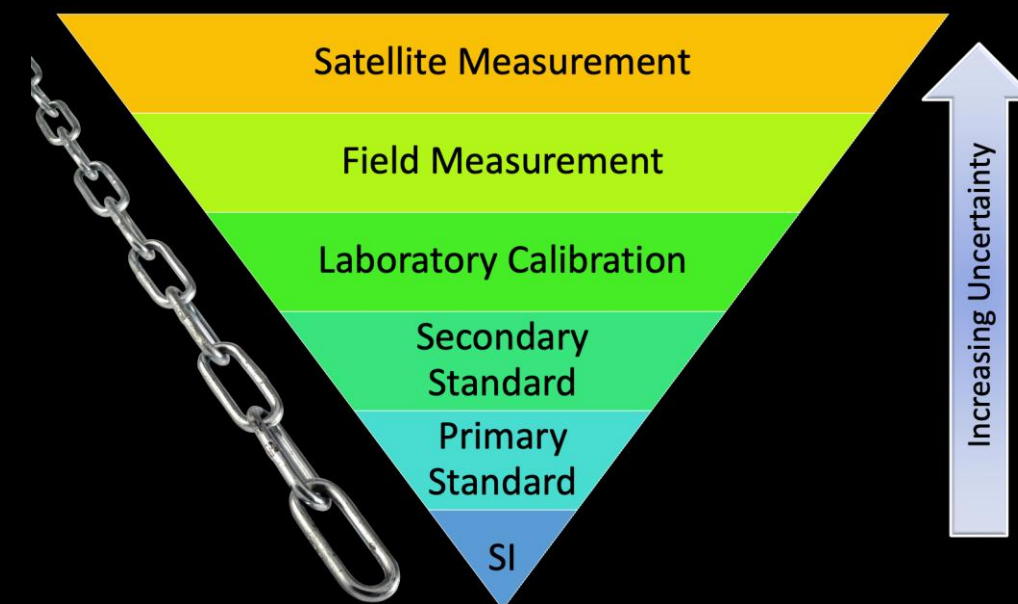
$$\mathfrak{I}(\lambda) = C_{\mathfrak{I}}(\lambda) \mathfrak{N}(\lambda) \text{DN}(\mathfrak{I}(\lambda))$$

Calibration coefficient

Digital numbers

(Ir)radiance in physical units

Deviations from instrument's expected ideal performance



Calibration of irradiance

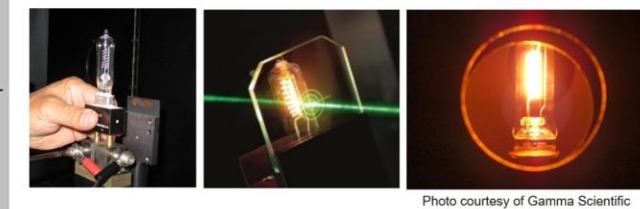
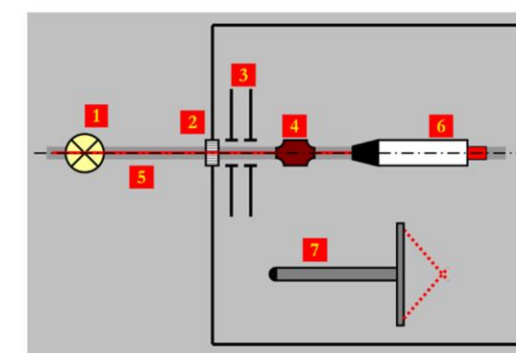


Figure 1. Pilot's (UT) irradiance calibration setup. 1 - FEL lamp; 2 - shutter; 3 - baffles; 4 - alignment laser; 5 - optical rail; 6 - radiometer; 7 - contactless distance probe.

Calibration of radiance

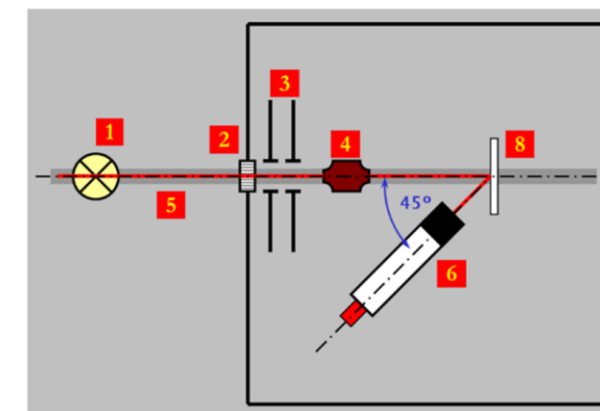
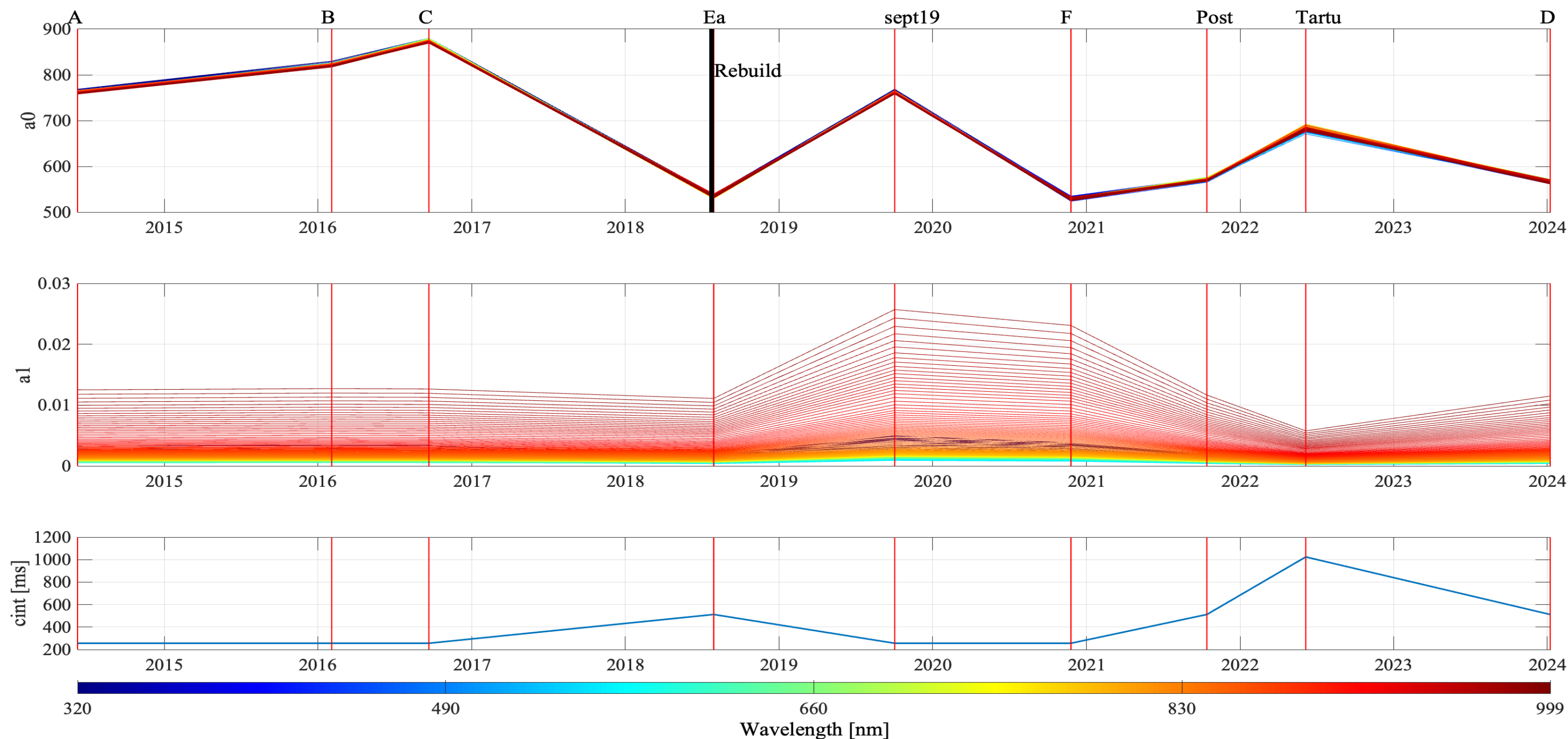


Figure 2. Pilot's (UT) radiance calibration setup. 1 - FEL lamp; 2 - shutter; 3 - baffles; 4 - alignment laser; 5 - optical rail; 6 - radiometer; 8 - reflectance panel.

Additional factors impacting quality and



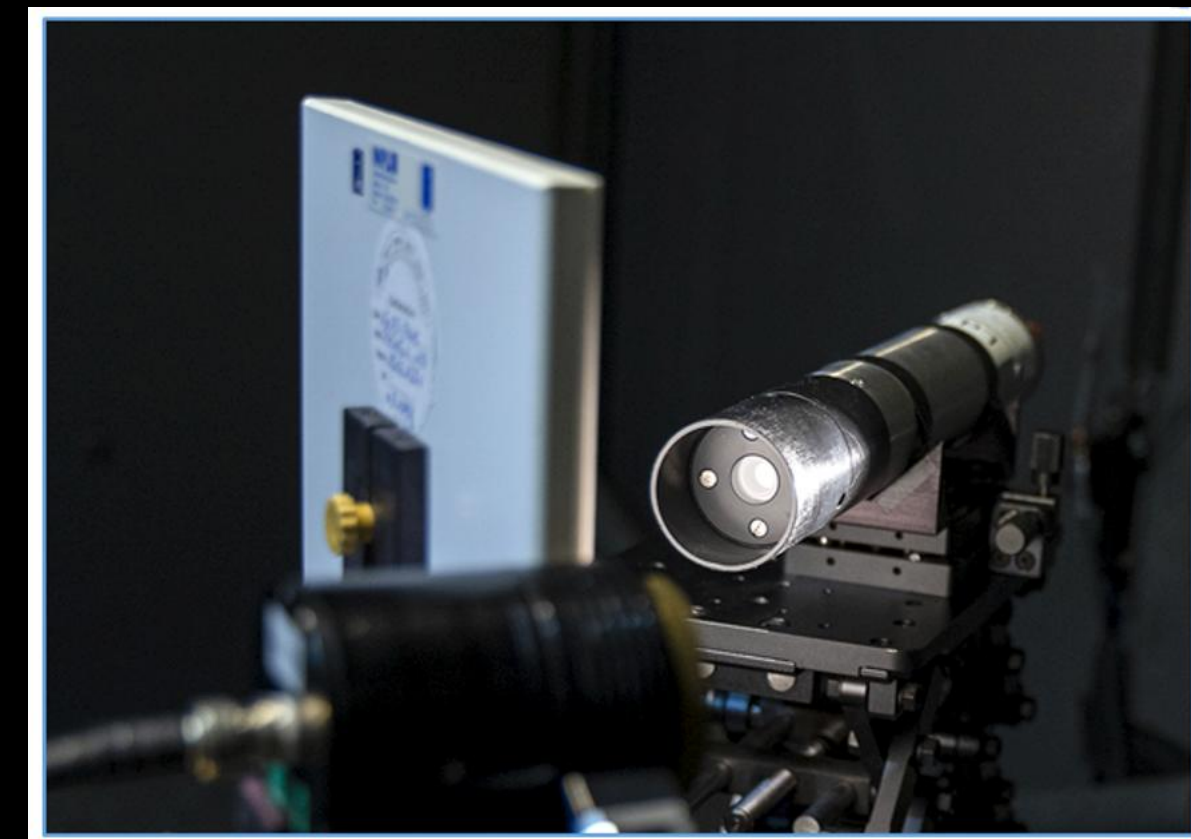
Absolute calibration

(I_r)radiance in
physical units

$$\mathfrak{I}(\lambda) = \overset{\text{Calibration coefficient}}{C_{\mathfrak{I}}(\lambda)} \overset{\text{deviations from instrument's expected ideal performance}}{\mathfrak{N}(\lambda)} \overset{\text{Digital numbers}}{\text{DN}(\mathfrak{I}(\lambda))}$$

deviations from instrument's
expected ideal performance

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

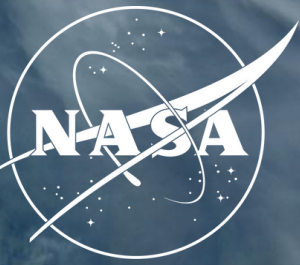


Characterization, complementary to absolute radiometric calibration, is the determination of the distinctive features of an instrument allowing us to account for these deviations....

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

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

Dark frame subtraction/
correction
Deglitching
(L1AQC)

Linearity correction
Calibration correction
Straylight correction
Cosine correction (Es)
Thermal correction

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

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

Corrections further reduce uncertainty

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



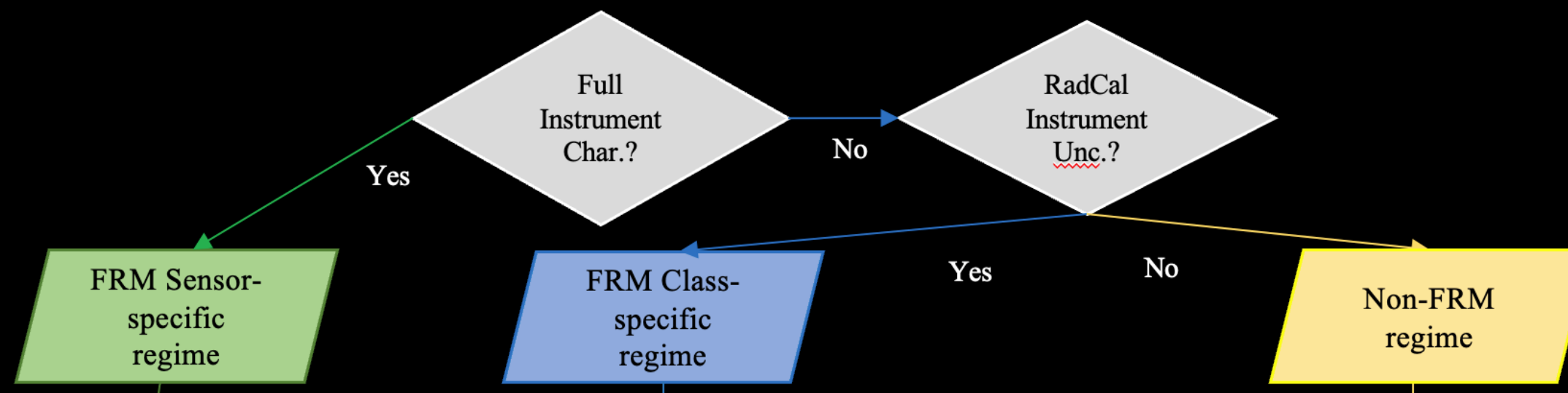
Instrument Characterization:

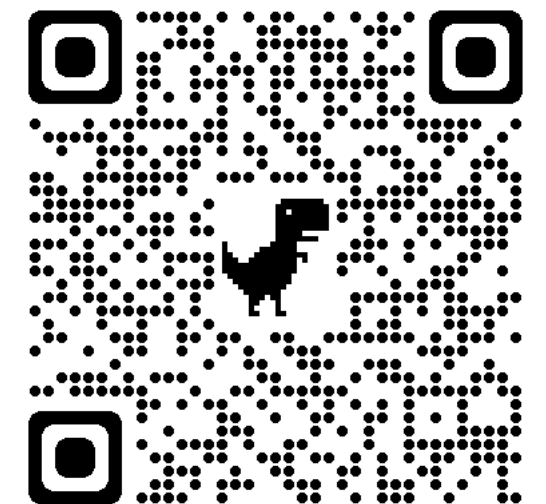
- Dark current noise
- Linearity of response
- Calibration/stability
- Straylight response
- Angularity of response
- Thermal response
- Polarization response

Instrument Classes:

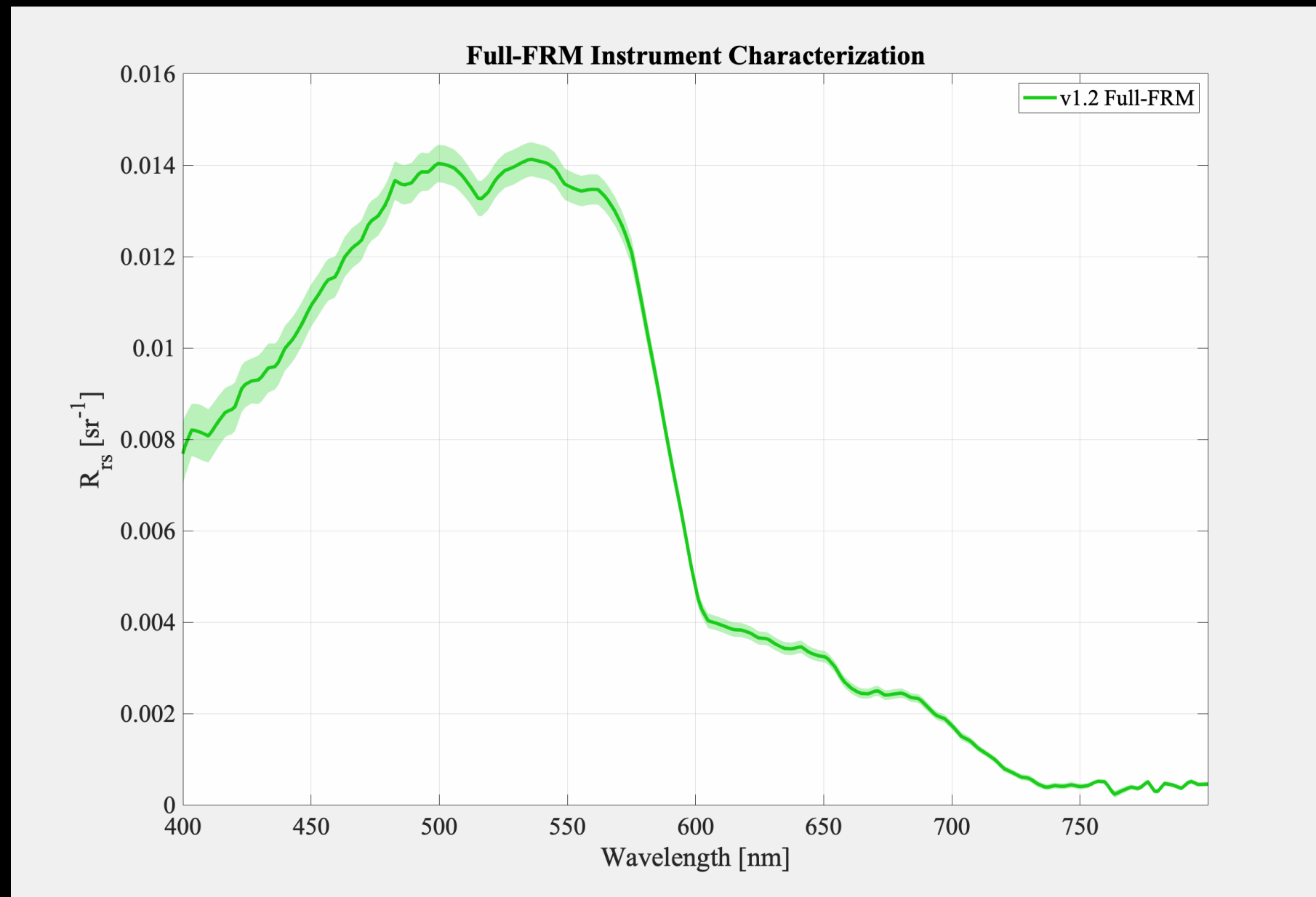
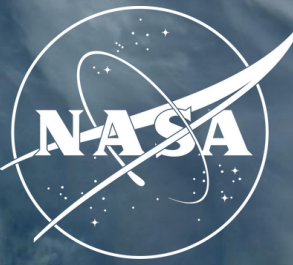
Classes = Instruments:

- Sea-Bird HyperOCR
- TriOS RAMSES
- IMO DALEC





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).

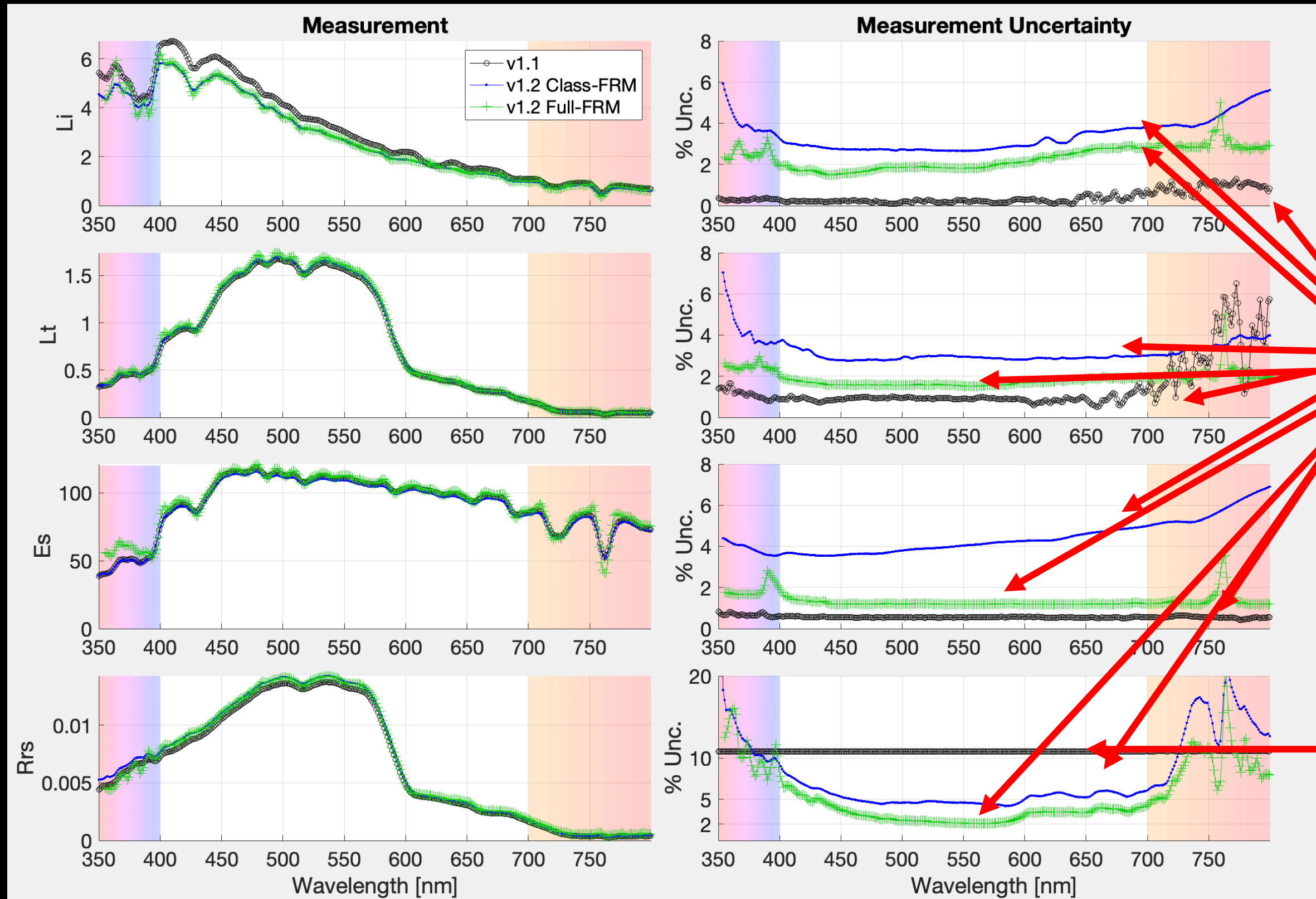
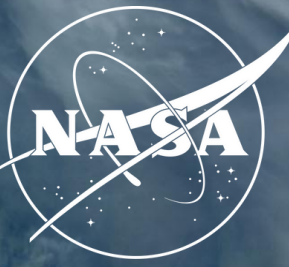
v1.2 Class-based:

- ✓ 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



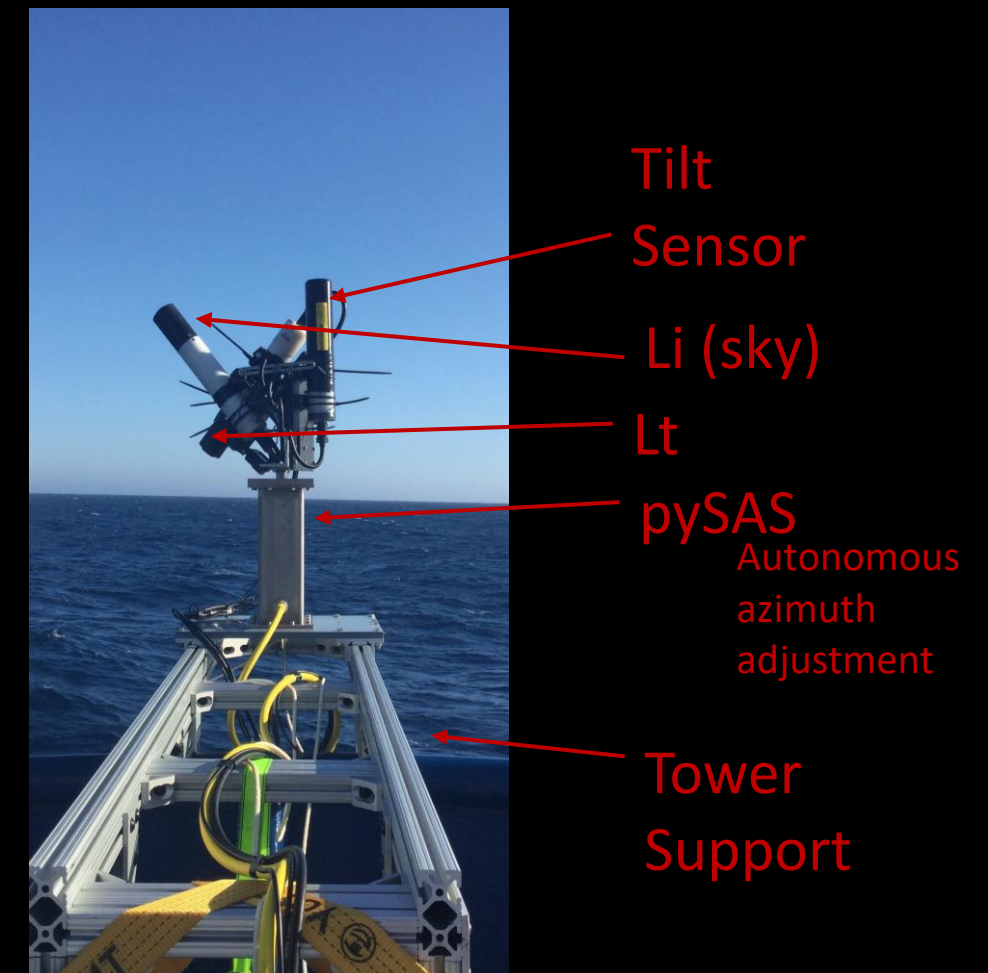
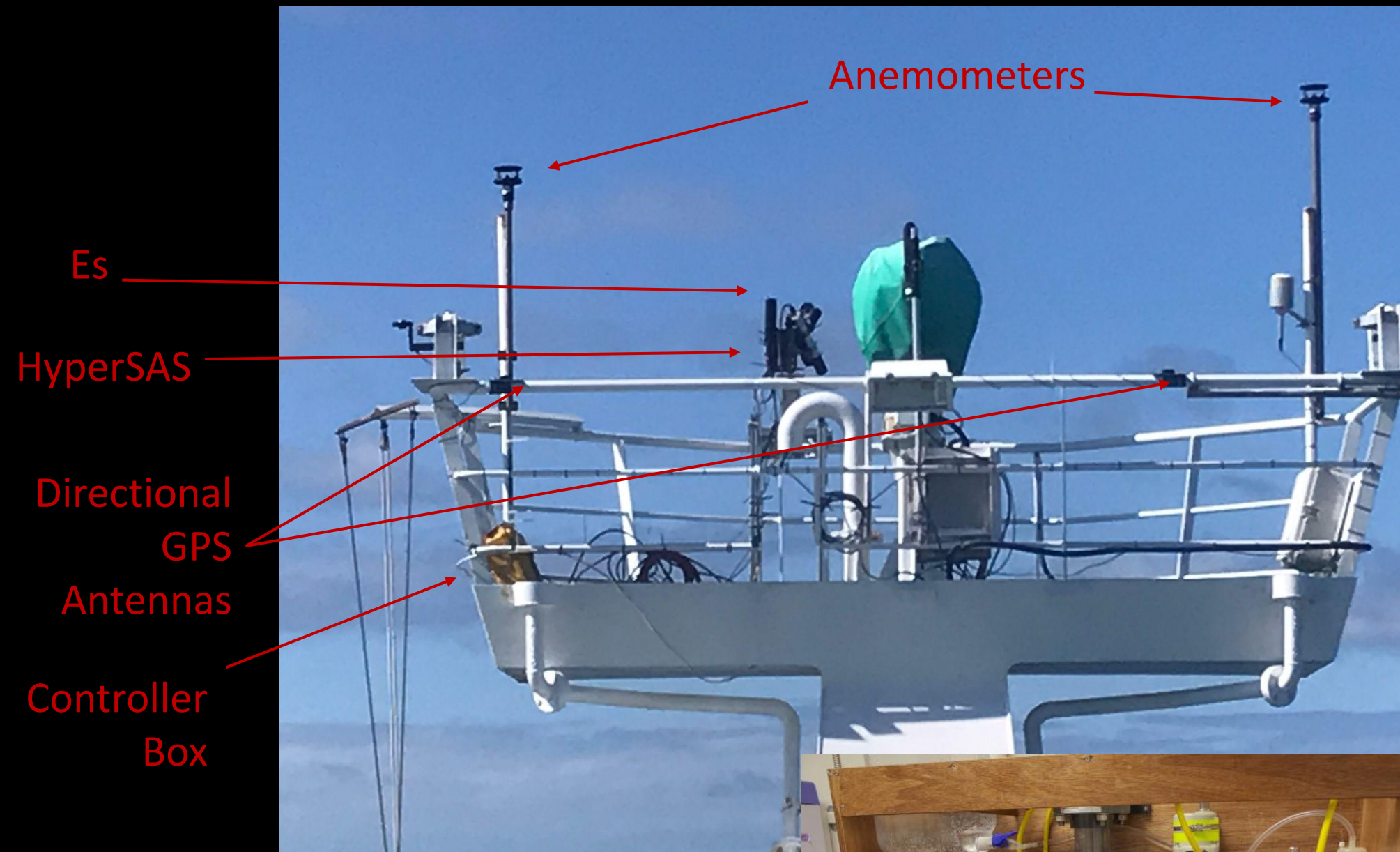
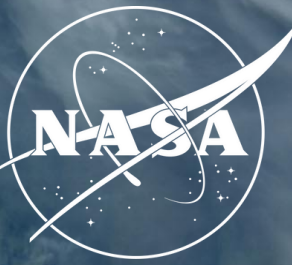
v1.2 Full-FRM highlights lack of instrument characterization; most accurate (and precise)

v1.1 overestimates; glint uncertainty poorly parameterized

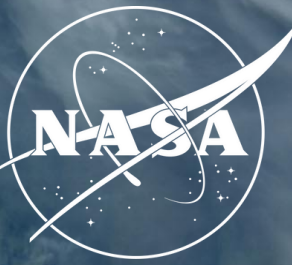
AWR In the Field

Critical ancillary datasets

On a Ship



AAOT

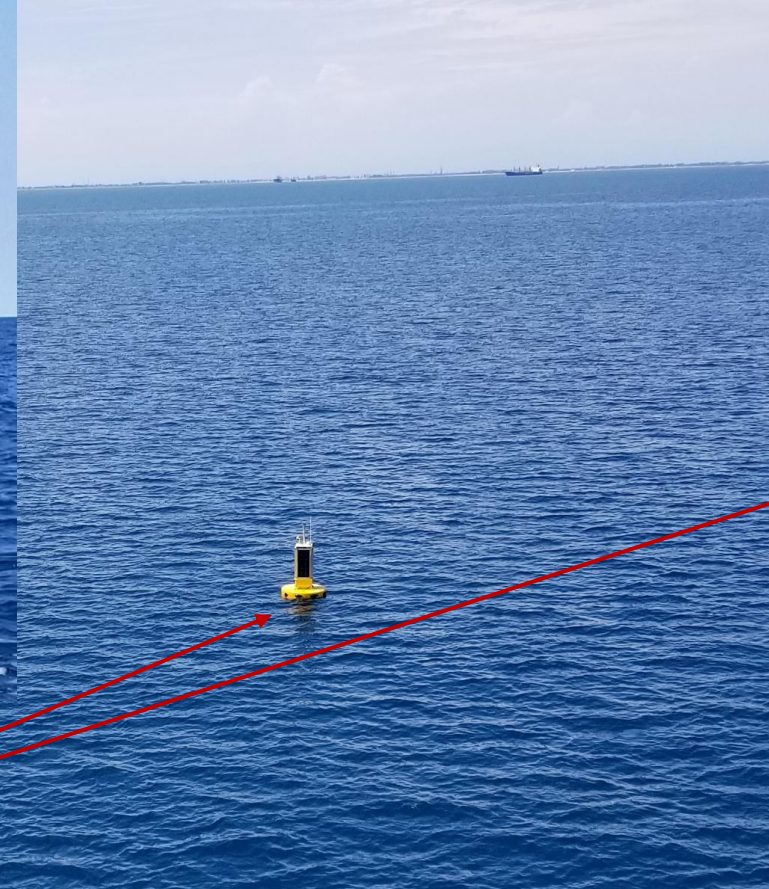
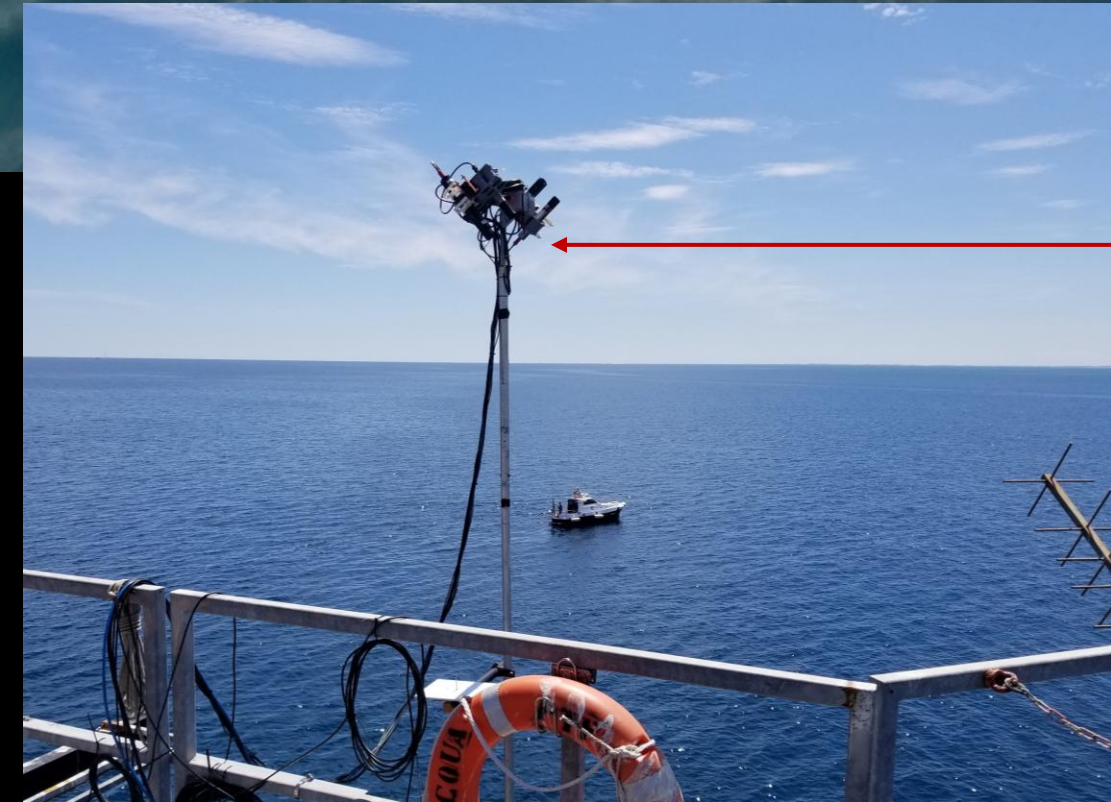


Anemometers

Es

pySAS

Manually
operated
radiometers



Buoy data



comune.venezia.it/content/3-piattaforma-ISMAR-CNR

Città di Venezia

3. Piattaforma ISMAR-CNR

Coordinate Geografiche (Rete 2000)	Sensori installati	Sensore	Altezza
Latitudine	Direzione vento	t033 TDV	20 m
45° 18' 83.00" N	Velocità vento	t031 TVV	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
	Sistema di acquisizione	DA9000	12 m
	Ondametro	t021 TLU16	8 m

Altezza del caposaldo: 7.56 m

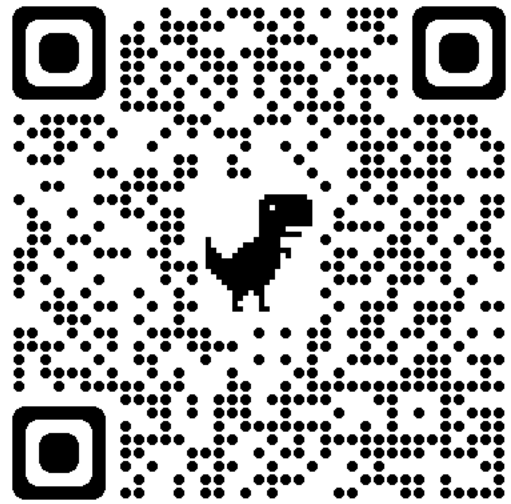


Stazione di Piattaforma ISMAR-CNR

Mappa

Piattaforma ISMAR-CNR: dati recenti

What is required from the field?



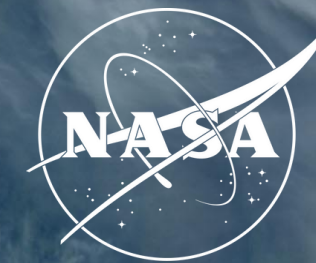
(See the complete requirements at SeaBASS at QR Code above (https://seabass.gsfc.nasa.gov/wiki/data_submission_special_requirements) and refer to IOCCG Protocols)

Primary Requirements:

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

$$L_w(\theta_v, \varphi_v, \lambda) = L_t(\theta_v, \varphi_v, \lambda) - \rho(\theta_s, \varphi_s, \theta_v, \varphi_v, \lambda, W, \tau, T, S) * L_i(\theta_v, \varphi_v, \lambda)$$

What is required from the field?



Secondary Requirements:

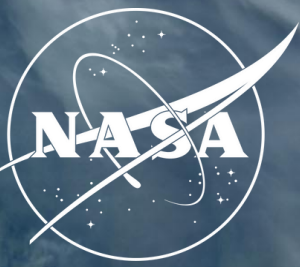
1. Aerosol Optical Depth
2. SST
3. Salinity
4. Air Temperature



$$L_w(\theta_v, \varphi_v, \lambda) = L_t(\theta_v, \varphi_v, \lambda) - \rho(\theta_s, \varphi_s, \theta_v, \varphi_v, \lambda, W, \tau, T, S) * L_i(\theta_v, \varphi_v, \lambda)$$

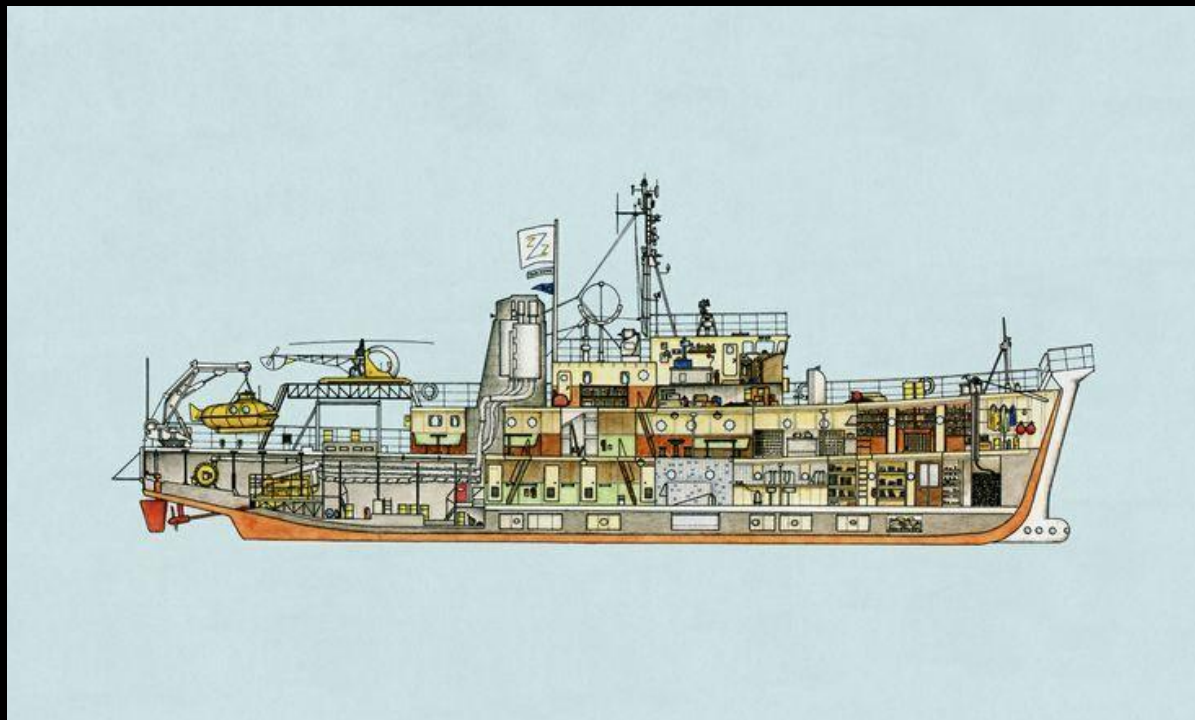
Wind, AOD, SST, and Sal fall back on models in HyperCP (MERRA-2, ECMWF)

What else helps identify validation-quality data?

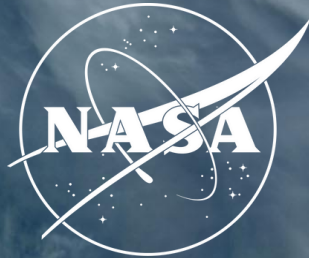


Recommended Metadata:

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



AutoSave OFF

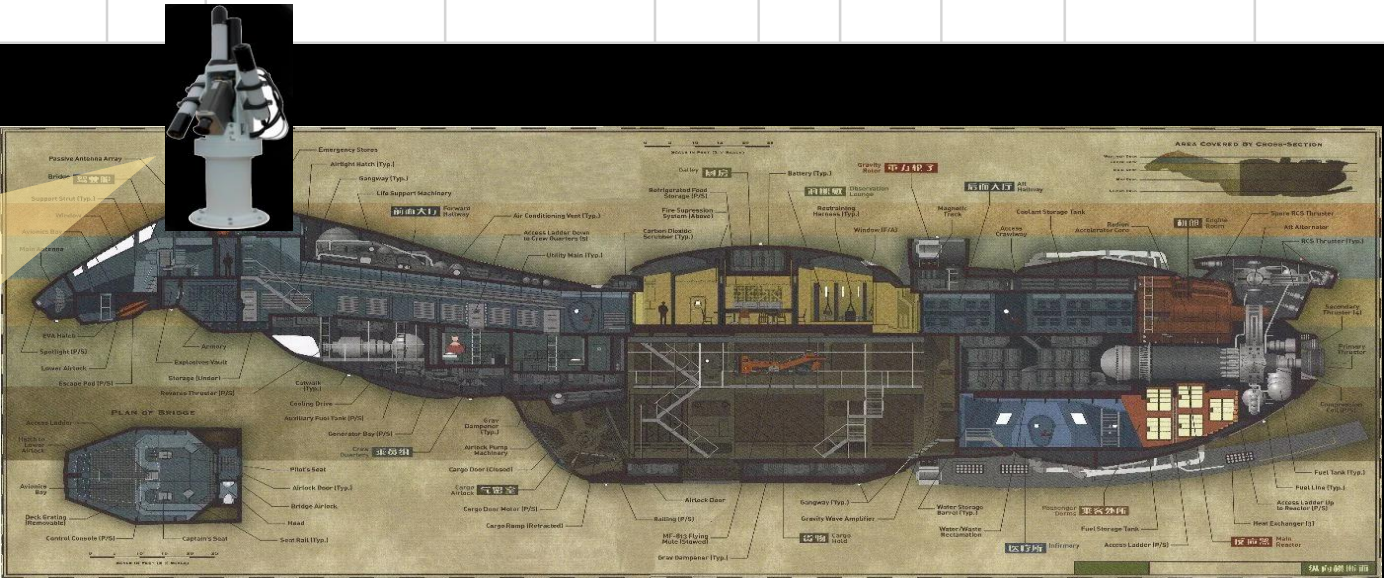
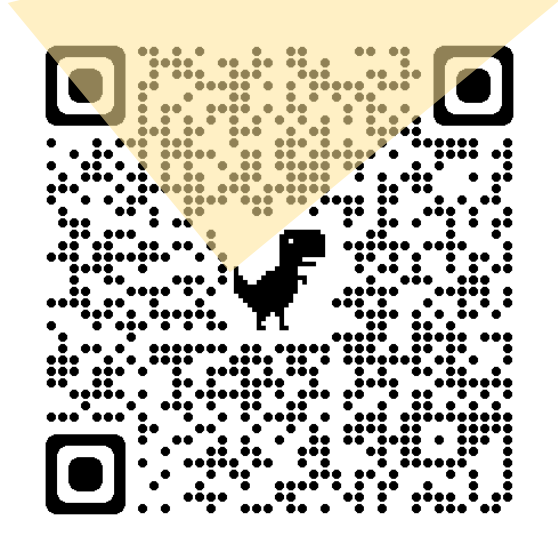
IOCCG_IOC2023_pySAS_Radiometry_Field_Log No Label

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

Comments Share

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

station	raw filename	station start date/time	station end date/time	lat	lon	ship heading	ship speed	relative azimuth (ship-sensor)	relative azimuth (solar-sensor)	wind speed	wind dir	waves	salinity	sea surface temperature	cloud	bottom depth	comments
(name agreed across sampling platforms)	(not for pySAS when working properly, or if station number is in the name)	(UTC. Confirm all systms set to UTC)	(UTC)	(deg; 3-4 decimals)	(deg)	(deg)	(kts)	(above-water; only if set manually)	(above-water; only if set manually)	(m/s)	(deg)	(m)	(psu)	(deg C)	(% or x/8)	(m)	(haze, fog, rain, optically 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	0	N/A	N/A	5	45	0.5	32	25	25	8	System checked out without incident
1	"	2023-11-12-T-1430	2023-11-12-T-1500	27.764	-82.636		0	"	"	5	50	0.5	33	24	50	35	IOP cast and Hyperpro multicast
2		2023-11-12-T-1600	2023-11-12-T-1645	27.764	-82.636		0			7	55	0.8	32	25	50	10	Clean lenses, 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>:

Intermission

Caffè

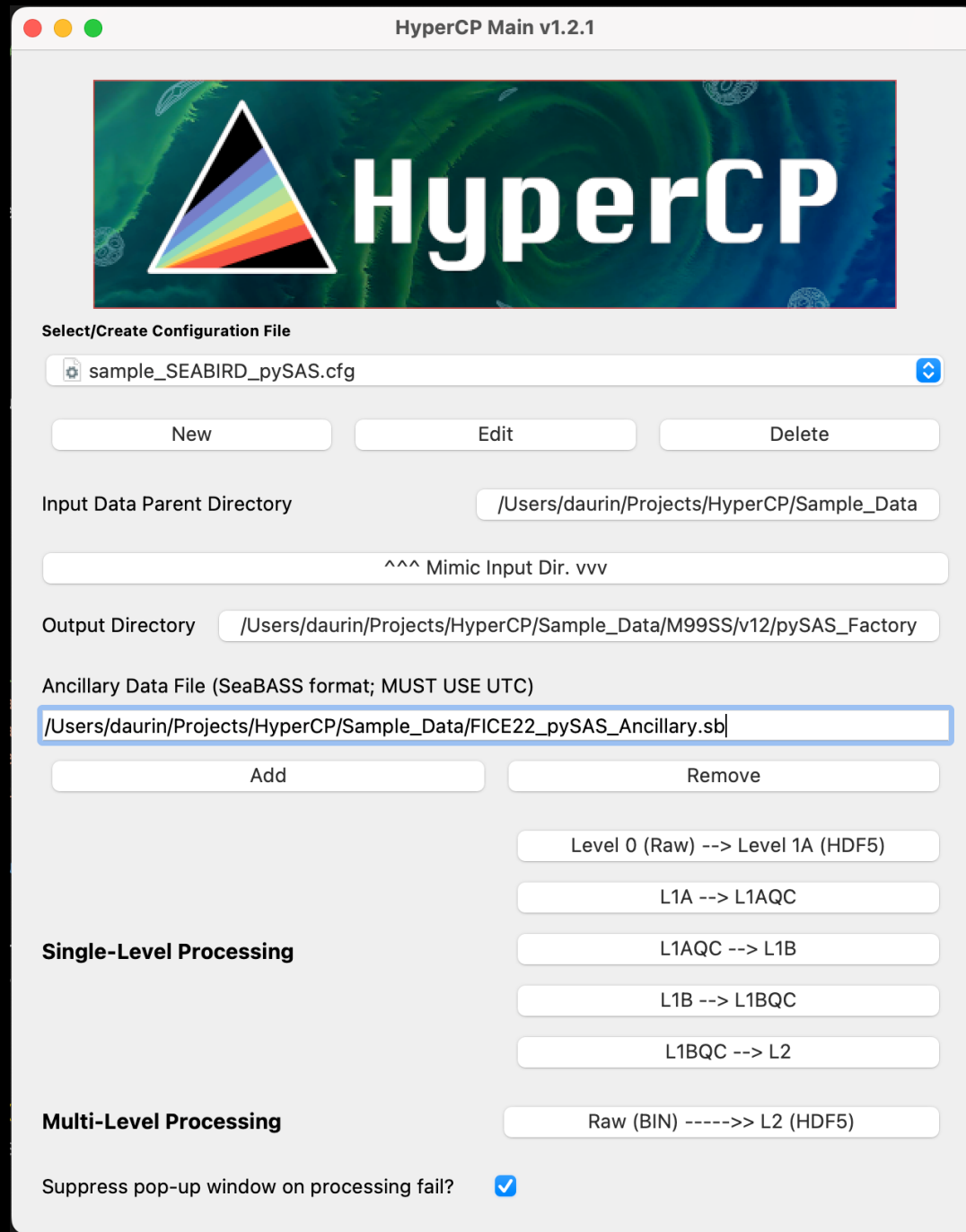
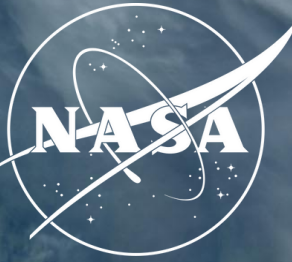


HyperCP

Overview



Overview



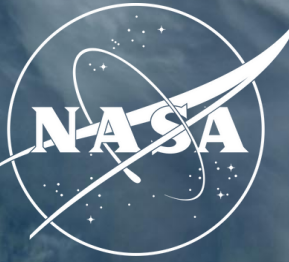
If you are having a difficulty reading this from your seat, I encourage you to launch HyperCP and follow along.



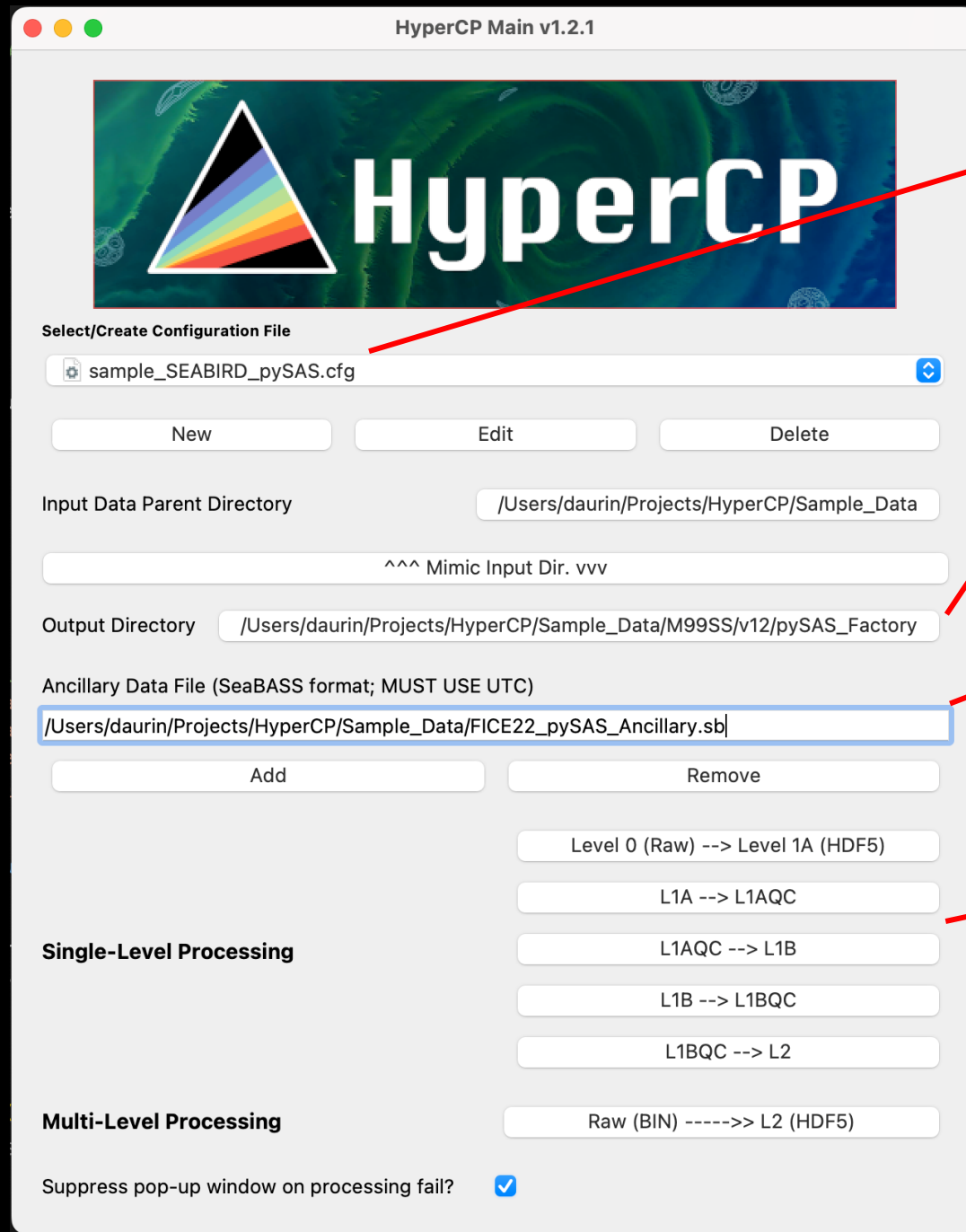
<https://github.com/nasa/HyperCP>

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

Overview



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

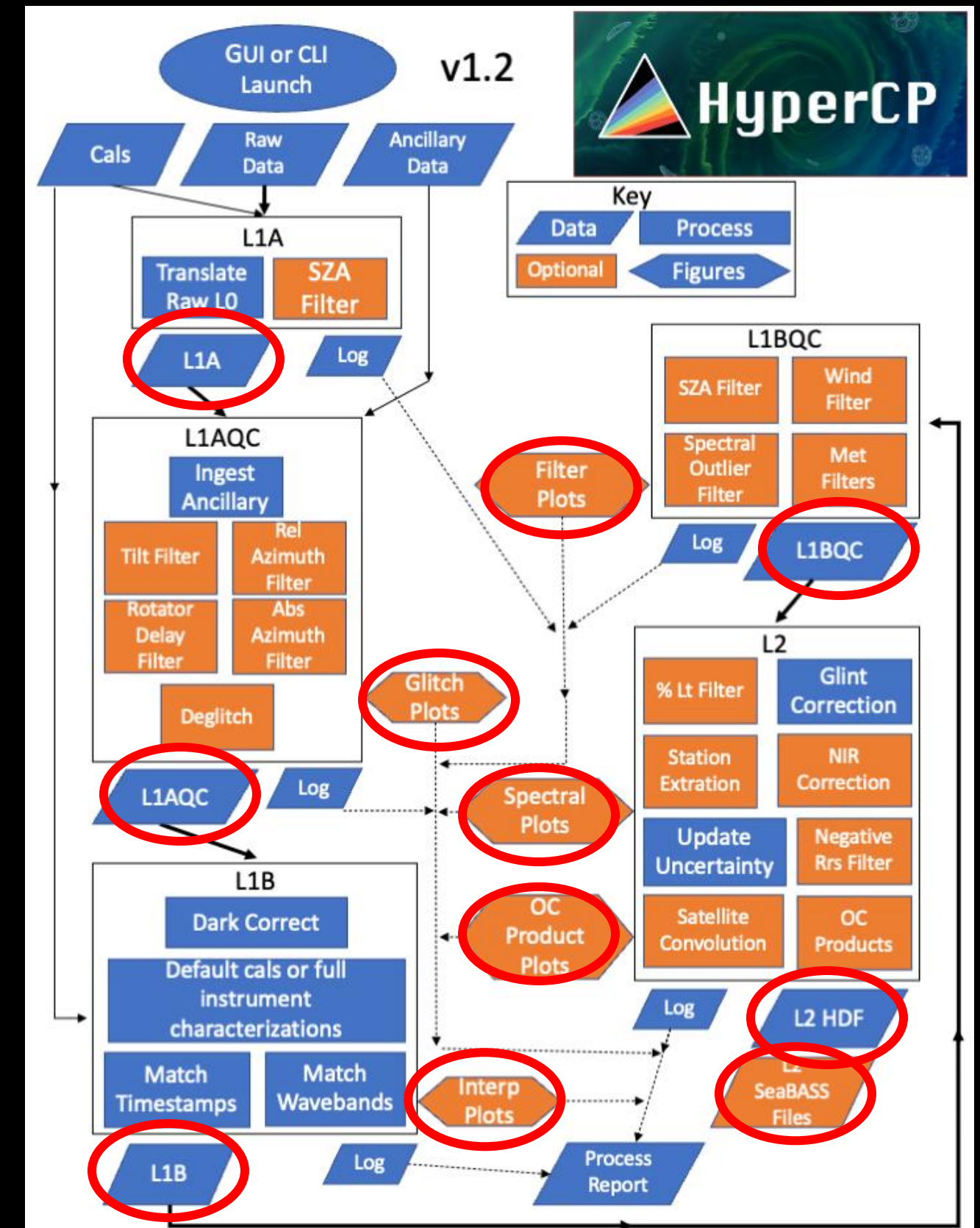


Each instrument deployment or cruise gets a unique **Configuration**

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

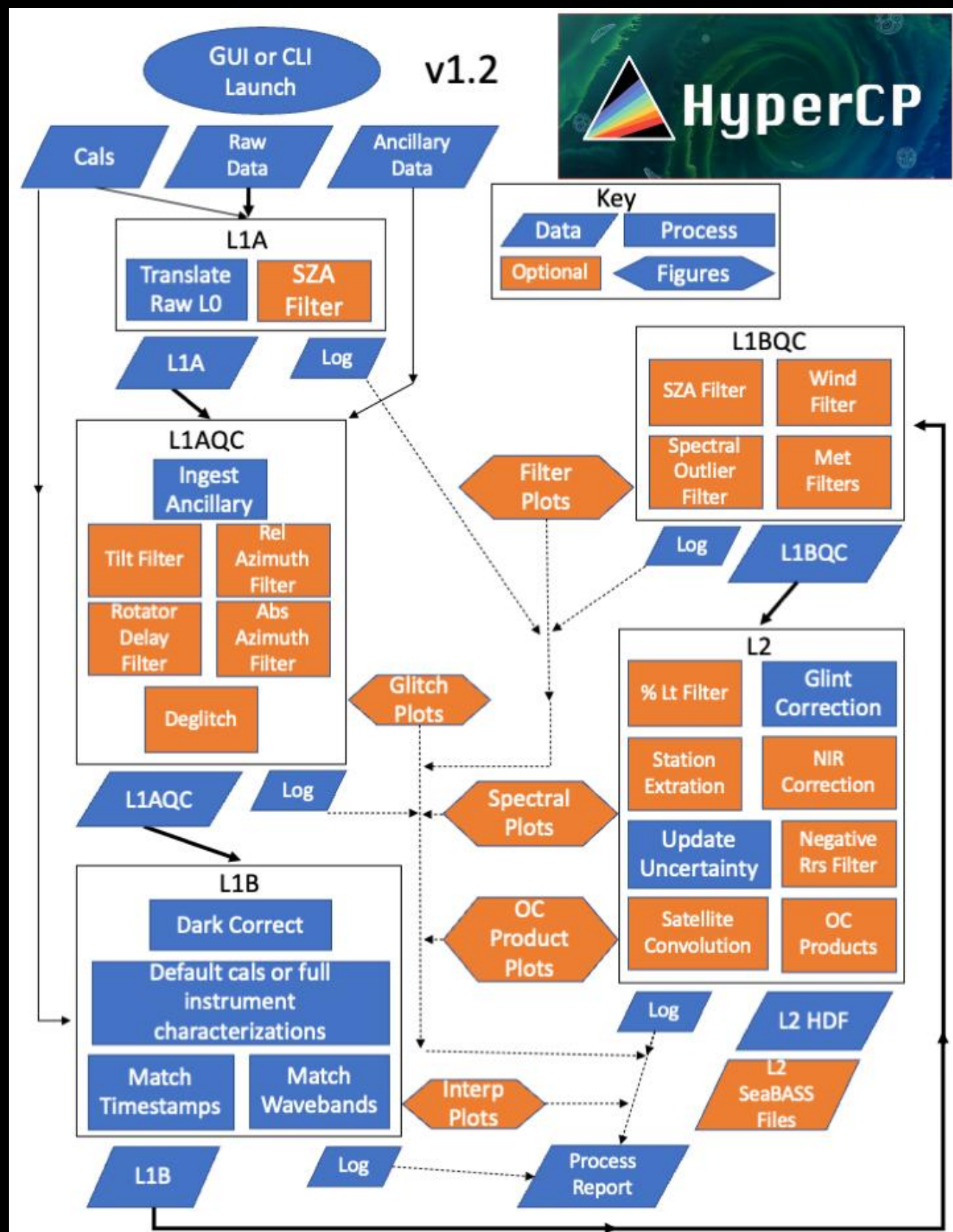
The **Ancillary** file for the entire deployment/cruise is provided here

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

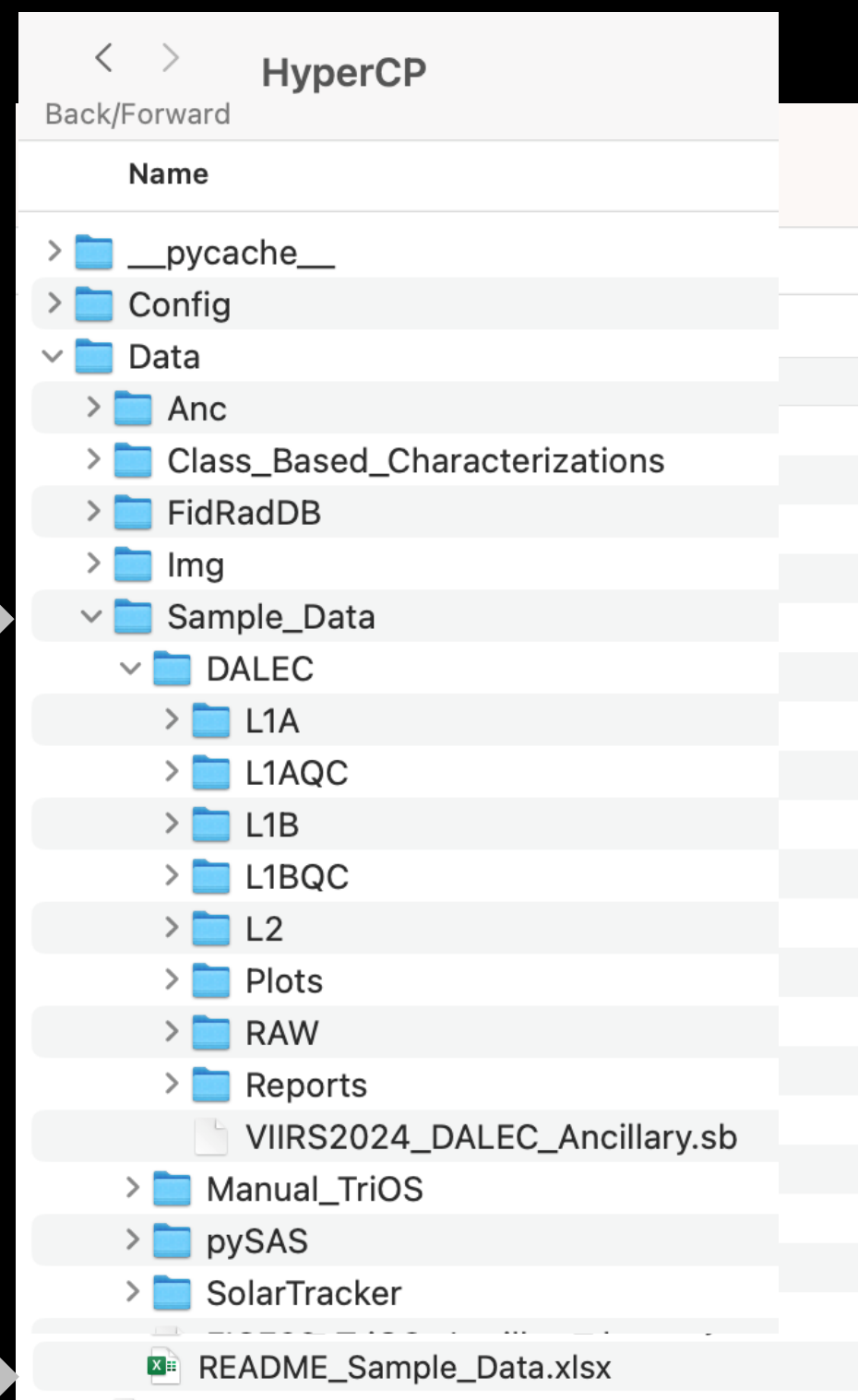


<https://github.com/nasa/HyperCP>

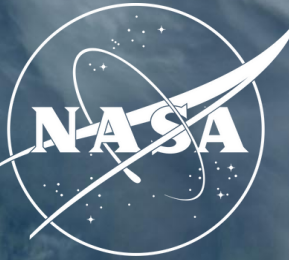
- See README for instruction/description
- See Discussion for support
- See Issues for reporting



Guide to Sample Data: →



Ancillary Data Inclusion/Submission



HyperCP Main v1.2.1

HyperCP

Select/Create Configuration File

sample_SEABIRD_pySAS.cfg

New Edit Delete

Input Data Parent Directory: /Users/daurin/Projects/HyperCP/Sample_Data

Output Directory: /Users/daurin/Projects/HyperCP/Sample_Data/M99SS/v12/pySAS_Factory

Ancillary Data File (SeaBASS format; MUST USE UTC)

/Users/daurin/Projects/HyperCP/Sample_Data/FICE22_pySAS_Ancillary.sb

Add Remove

Level 0 (Raw) --> Level 1A (HDF5)

L1A --> L1AQC

L1AQC --> L1B

L1B --> L1BQC

L1BQC --> L2

Single-Level Processing

Multi-Level Processing

Raw (BIN) -----> L2 (HDF5)

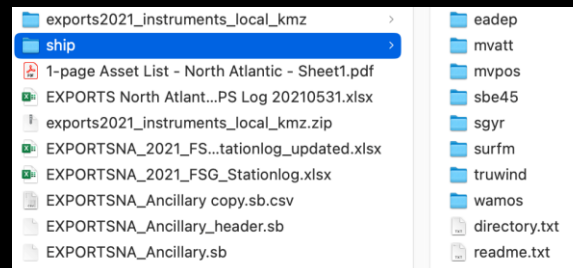
Suppress pop-up window on processing fail? ☒

PIs are responsible for tracking and assimilating ancillary datasets.

Field notes:

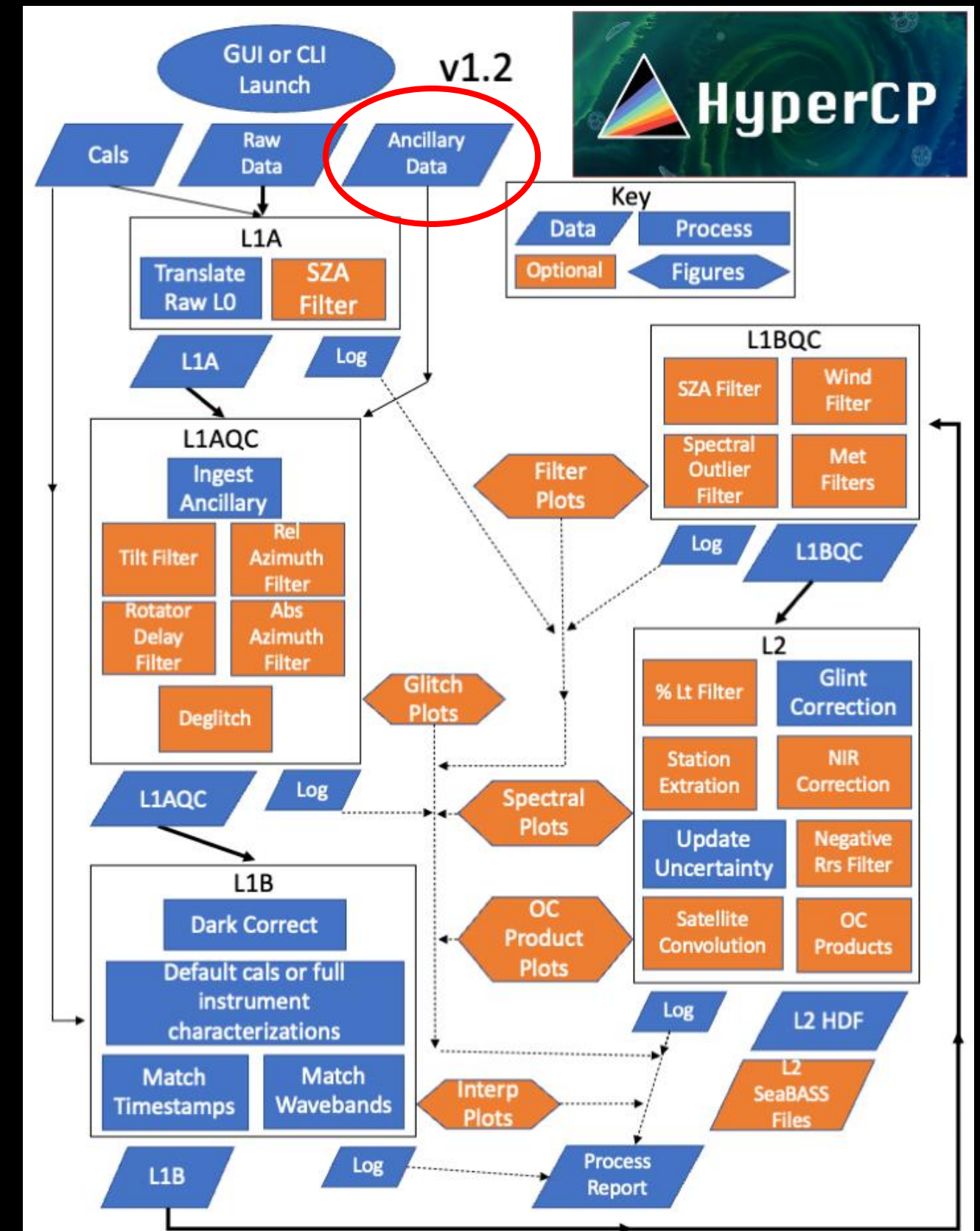
Experiment: FIRELY02, Cruise: SEASON1, Platform: SERENITY, Operator: Hoban Waskburns, Home angle: 0, Min/Max Az: -20/+140, Height: 7m, Ship hull color: Silver.														
station	raw dataset	status	start date/time	stop date/time	lat	lon	ship heading	speed	relative azimuth (ship-stern)	relative azimuth (station-stern)	relat dtr	relat dtr	sea surface	bottom
1	pySAS/pySAS defaults hourly files	OK	2023-11-12 13:40:00	2023-11-12 13:41:00	27.764	-82.636	N/A	0	N/A	N/A	5	45	0.5	32
2	pySAS/pySAS defaults hourly files	OK	2023-11-12 13:40:00	2023-11-12 13:41:00	27.764	-82.636	0	0	0	0	5	50	0.5	39
3	pySAS/pySAS defaults hourly files	OK	2023-11-12 13:40:00	2023-11-12 13:41:00	27.764	-82.636	0	0	0	0	7	55	0.8	32

Ship data (meteorological, flow-through):

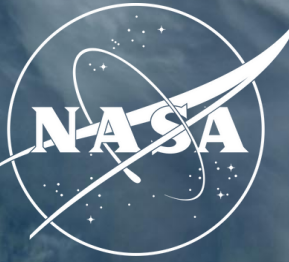


```
/begin_header
/data_file_name=FICE22_Ancillary.sb
/affiliations=NASA GSFC
/investigators=Dirk Aurin
/contact=dirk.a.aurin@nasa.gov
/data_status=final
/experiment=FRM450C2
/cruise=FICE22
/station=AAOT
/data_type=above_water
/documents=FICE22_Ancillary.sb
/calibration_files=doesntapply.txt
/missing=-9999.0
/delimiter=comma
/start_date=20220711
/end_date=20220721
/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
/water_depth=17
! COMMENTS
! FRM450C-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
! and field notes.
! 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
/end_header
-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
```

I recommend preparing these early and submitting them to SeaBASS supporting docs. When you reach out to the team for support on running HyperCP, we will likely ask for this file.

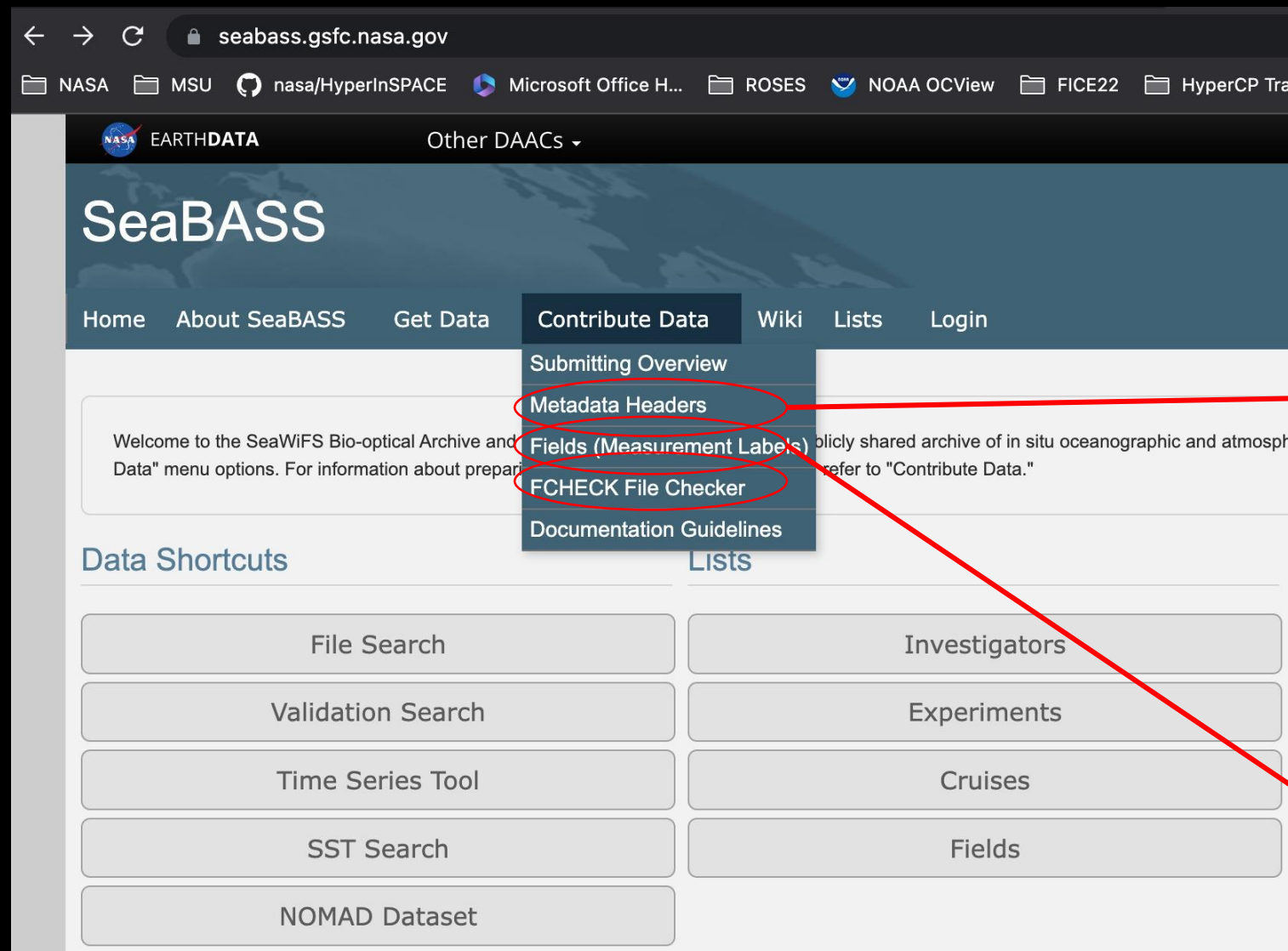


SeaBASS Format (Ancillary Data)



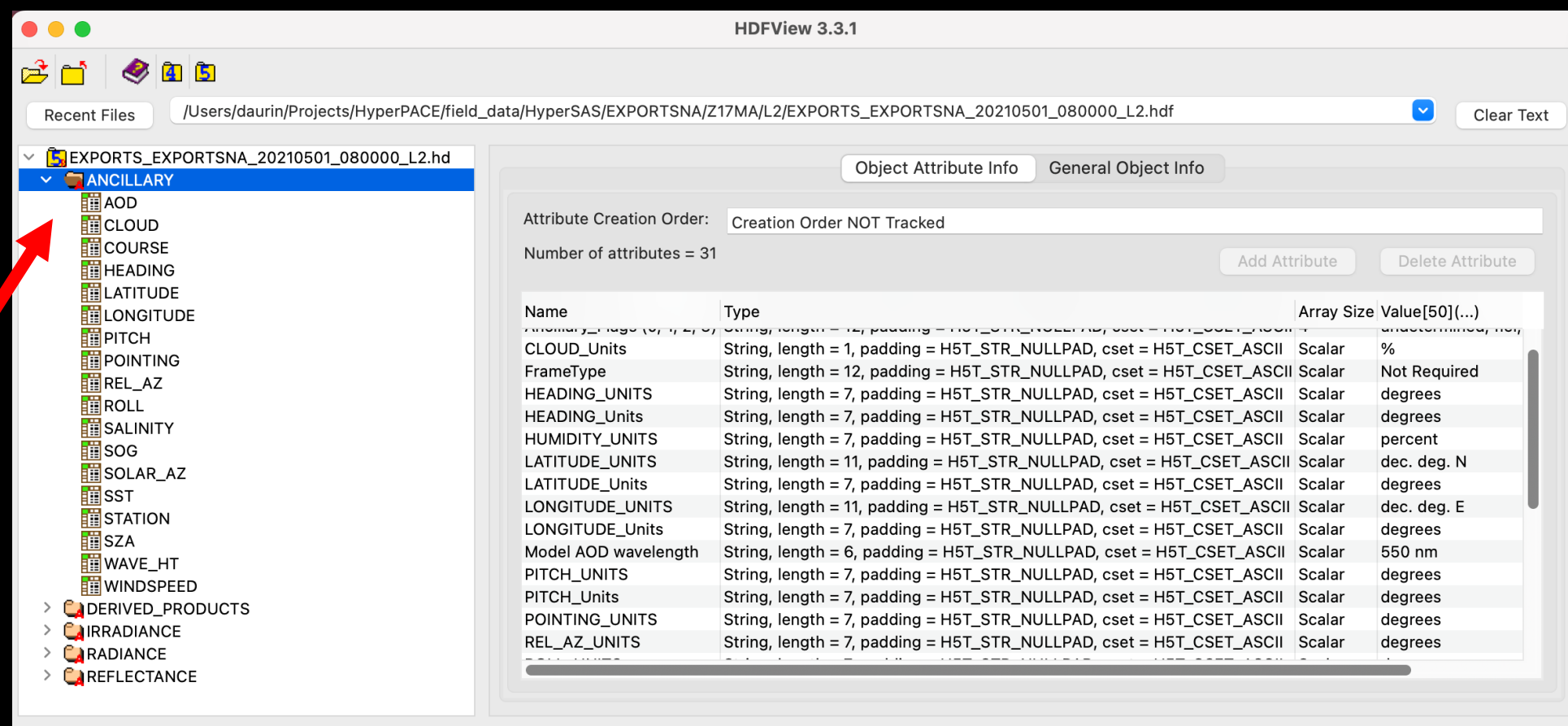
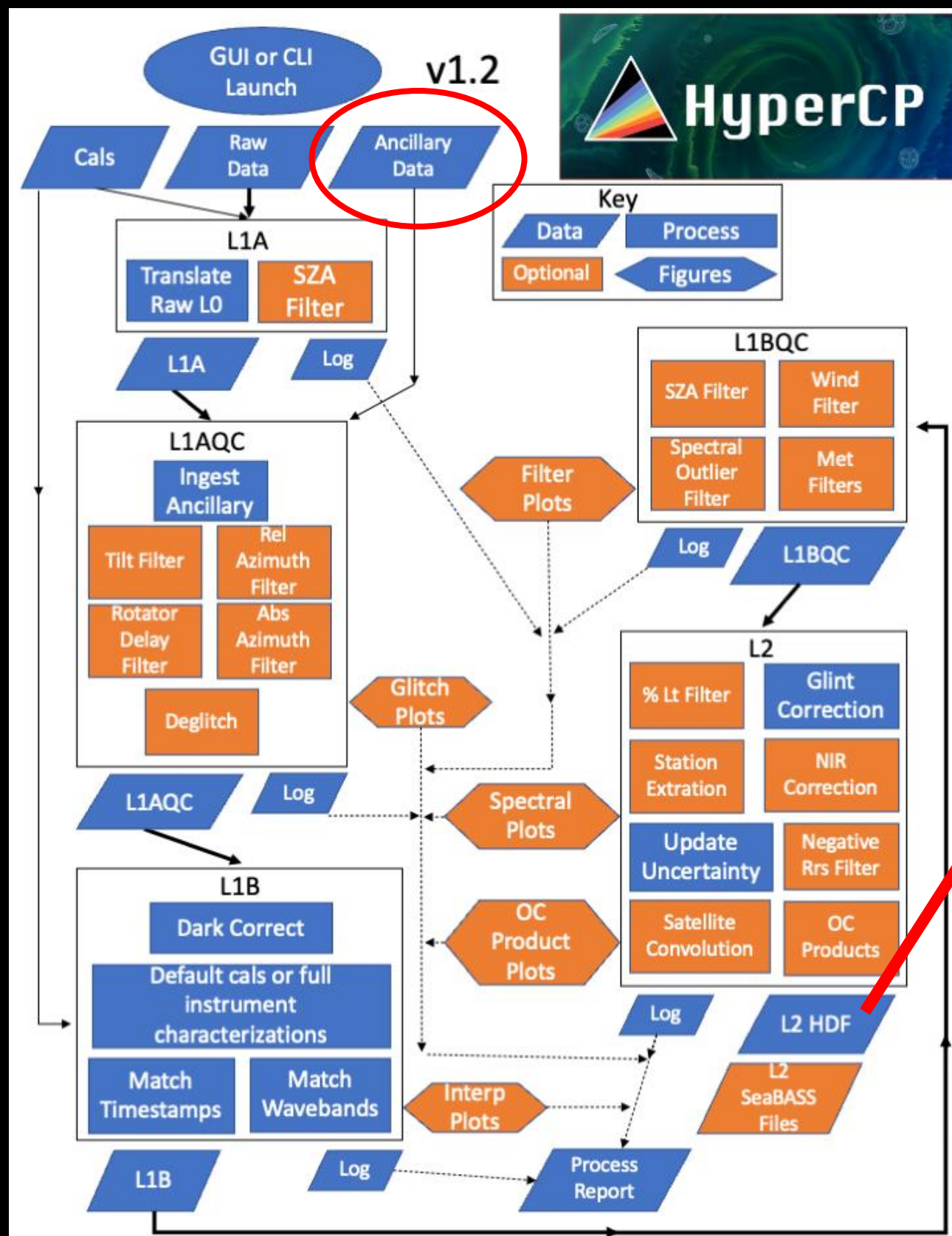
(More information about SeaBASS will be provided on Day 7.)

seabass.gsfc.nasa.gov



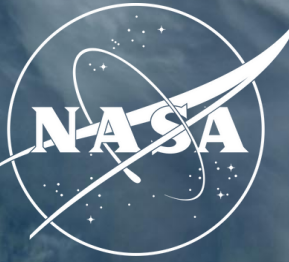
The SeaBASS FCHECK utility is accessible via email, sftp, or with a downloadable script

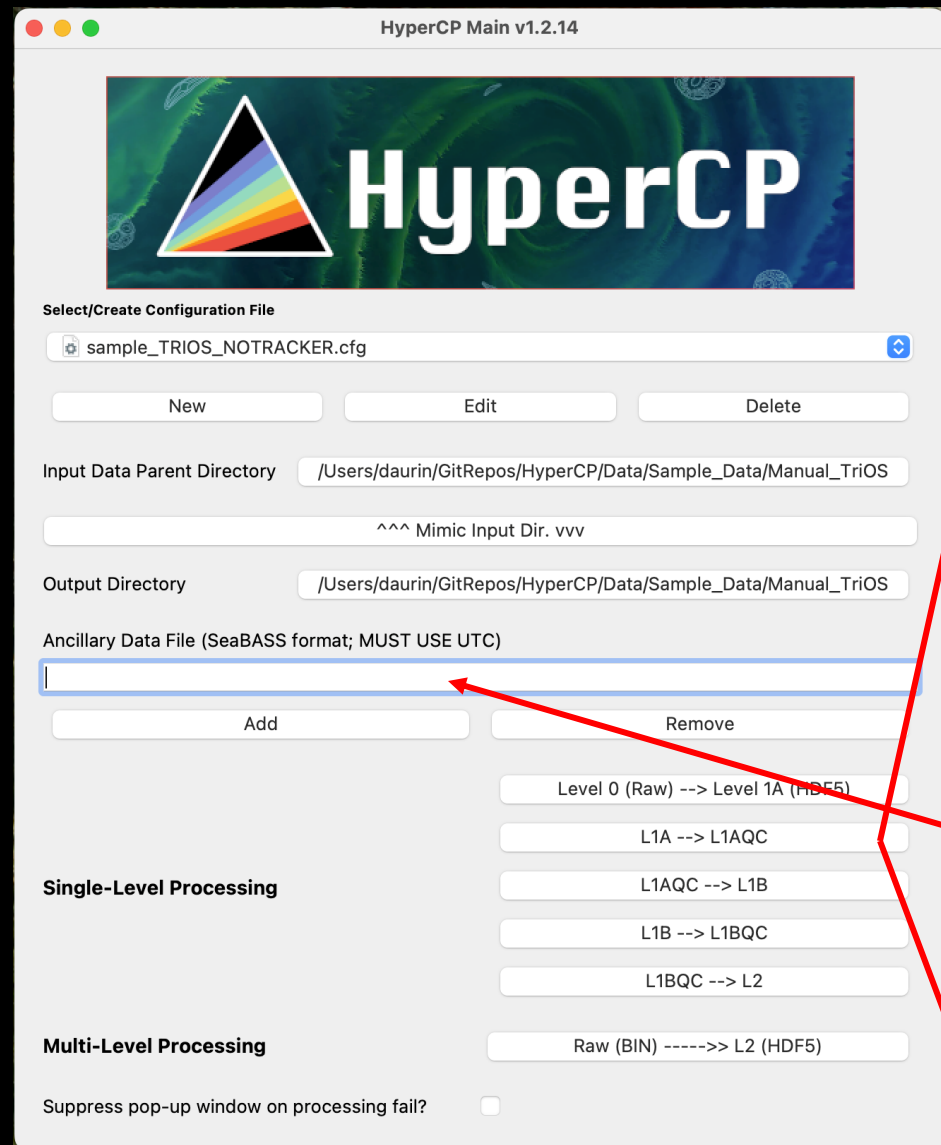
```
FICE22_pySAS_Ancillary.sb
/begin_header
/data_file_name=FICE22_Ancillary.sb
/affiliations=NASA_GSFC
/investigators=Dirk_Aurin
/contact=dirk.a.aurin@nasa.gov
/data_status=final
/experiment=FRM4S0C2
/cruise=FICE22
/station=AAOT
/data_type=above_water
/documents=FICE22_Ancillary.sb
/calibration_files=doesntapply.txt
/missing=-9999.0
/delimiter=comma
/start_date=20220711
/end_date=20220721
/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
/water_depth=17
!
! COMMENTS
!
! FRM4S0C-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
! and field notes.
!
! 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
/end_header
-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
```

- Some of these are used for processing the data in HyperCP and some are used later in selecting data for mission validation.
- Much of this (not all) is captured automatically in the SeaBASS file metadata.
- We ask that you submit your L2 HDF files (and raw files) with your SeaBASS files.

The Terminal





HyperCP Main v1.2.14

Select/Create Configuration File

sample_TRIOS_NOTRACKER.cfg

New Edit Delete

Input Data Parent Directory /Users/daurin/GitRepos/HyperCP/Data/Sample_Data/Manual_TriOS

^^^ Mimic Input Dir. vvv

Output Directory /Users/daurin/GitRepos/HyperCP/Data/Sample_Data/Manual_TriOS

Ancillary Data File (SeaBASS format; MUST USE UTC)

Add Remove

Level 0 (Raw) --> Level 1A (HDF5)

L1A --> L1AQC

L1AQC --> L1B

L1B --> L1BQC

L1BQC --> L2

Single-Level Processing

Multi-Level Processing

Raw (BIN) -----> L2 (HDF5)

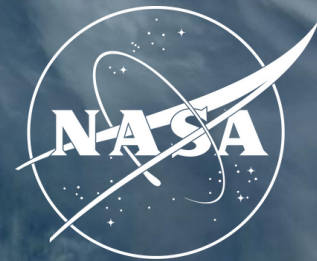
Suppress pop-up window on processing fail? ☐

HyperCP — daurin@GSLAL0324050006: ~/GitRepos/HyperCP — python Main.py — 131x35

```
Formatting 8166 Data
LI
Formatting 8329 Data
ES
Formatting 8595 Data
LT
Sorting all datasets chronologically
Process Single Level: /Users/daurin/GitRepos/HyperCP/Data/Sample_Data/Manual_TriOS/L1A/20220719_080000_L1A.hdf - SUCCESSFUL
processFilesSingleLevel, all files - DONE
Time elapsed: 0 minutes
Process Single-Level
MainConfig - Save Config
ConfigFile - Save Config: sample_TRIOS_NOTRACKER.cfg
ConfigFile - Create Default Config, or fill in newly added parameters with default values.
MainConfig: Configuration file changed to: sample_TRIOS_NOTRACKER.cfg
ConfigFile - Create Default Config, or fill in newly added parameters with default values.
Files: (['/Users/daurin/GitRepos/HyperCP/Data/Sample_Data/Manual_TriOS/L1A/20220719_080000_L1A.hdf'], 'All Files (*)')
Process Calibration Files
Read CalibrationFile /Users/daurin/GitRepos/HyperCP/Config/sample_TRIOS_NOTRACKER_Calibration
Output Directory: /Users/daurin/GitRepos/HyperCP/Data/Sample_Data/Manual_TriOS
Processing: /Users/daurin/GitRepos/HyperCP/Data/Sample_Data/Manual_TriOS/L1A/20220719_080000_L1A.hdf
Process Single Level
No deglitching will be performed.
ProcessL1aqc
ProcessL1aqc.processL1aqc: 27-Jun-2025 14:18:11
Sorting all datasets chronologically
Screening LI for clean timestamps.
Screening ES for clean timestamps.
Screening LT for clean timestamps.
Required GPS data is missing. Check tdf files and ancillary data. Abort.
L1aqc processing failed. Nothing to output.
Process Single Level: /Users/daurin/GitRepos/HyperCP/Data/Sample_Data/Manual_TriOS/L1AQC/20220719_080000_L1AQC.hdf - NOT SUCCESSFUL
processFilesSingleLevel, single file - DONE
Time elapsed: 0 minutes
```

Keep an eye on the terminal for important feedback.

The Configuration Window



HyperCP Main v1.2.1

Select/Create Configuration File

sample_SEABIRD_pySAS.cfg

New Edit Delete

Input Data Parent Directory

/Users/daurin/Projects/HyperCP/Sa

Output Directory

/Users/daurin/Projects/HyperCP/Sample_Data/M99SS/v12/pyS

Ancillary Data File (SeaBASS format; MUST USE UTC)

/Users/daurin/Projects/HyperCP/Sample_Data/FICE22_pySAS_Ancillary.sb

Add Remove

Level 0 (Raw) --> Level 1A

L1A --> L1AQ

L1AQ --> L1B

L1B --> L1BQC

L1BQC --> L2

Single-Level Processing

Multi-Level Processing

Raw (BIN) -----> L2 (H

Suppress pop-up window on processing fail?

Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type:

SeaBird

Add Factory Cals Remove F. 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

Caps-on darks only (TriOS)

Level 1AQC Processing

Filter on pitch, roll, yaw, and azimuth

Pitch/Roll Filter (where present)

Max Pitch/Roll Angle

5.0

Autonomous Sun Tracker

Rotator Home Angle Offset

0.0

Rotator Delay (Seconds)

2.0

Absolute Rotator Angle Filter

Rotator Angle Min

-126.0

Rotator Angle Max

42.0

Relative Solar Azimuth Filter

Rel Angle Min

87.0

Rel Angle Max

138.0

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 CAMS

Reset credentials (GMAO or ECMWF)

Fallback values when no ancillary or model data available:

Wind (m/s)

5.0

AOD(550)

0.2

AirT[C]

26.0

Salt[psu]

38.0

SST[C]

28.0

Select Cal/Char options

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

SZA Minimum (deg)

20.0

SZA Maximum (deg)

60.0

Enable Spectral Outlier Filter

Generate Plots

Filter Sigma Es

5.0

Filter Sigma Li

8.0

Filter Sigma Lt

3.0

Enable Meteorological Flags (Experimental/Non-exclusive)

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle

40° 30°

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 Zhang et al. (2017) p

Groetsch et al. (2017) Your Glint (2023) p

NIR Residual Correction

Mueller and Austin (1995) (blue water) SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra

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

Generate Spectral Plots

Rrs nLw Es Li Lt

Unc. Plots (class-based only)

Derived L2 Ocean Color Products

Save SeaBASS Files

Edit SeaBASS Header

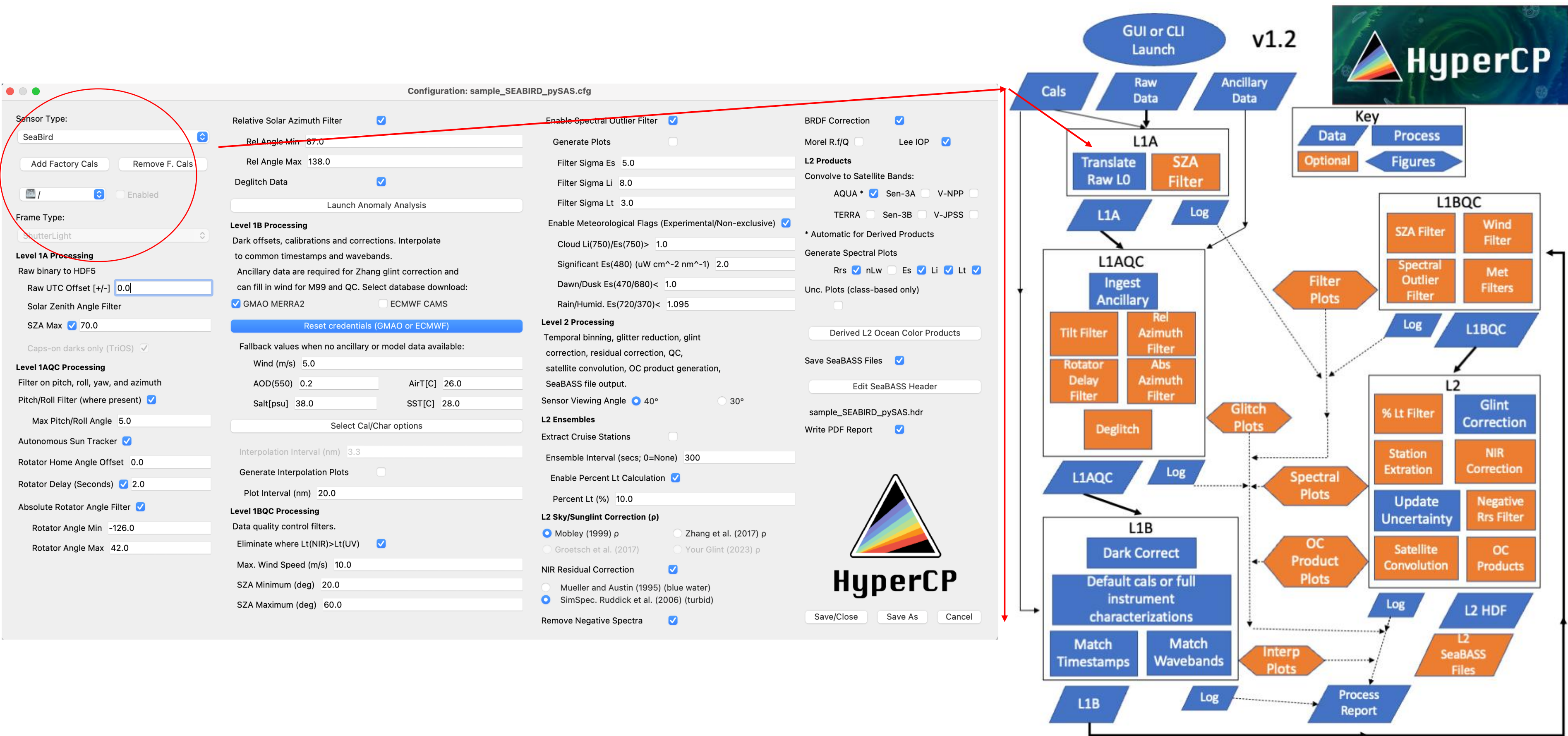
sample_SEABIRD_pySAS.hdr

Write PDF Report

HyperCP

Save/Close Save As Cancel

HyperCP: Loading Instrument Calibration



HyperCP: Loading Instrument Calibration

Sea-Bird HyperOCRs, pySAS

Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type: ShutterLight

Level 1A Processing

Raw binary to HDF5

Raw UTC Offset [+/-] 0.0

Solar Zenith Angle Filter

SZA Max 70.0

Caps-on darks only (TriOS) ☒

Level 1AQC Processing

Filter on pitch, roll, yaw, and azimuth

Pitch/Roll Filter (where present) ☒

Max Pitch/Roll Angle 5.0

Autonomous Sun Tracker ☒

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) ☒ 2.0

Absolute Rotator Angle Filter ☒

Rotator Angle Min -126.0

Rotator Angle Max 42.0

Relative Solar Azimuth Filter ☒

Rel Angle Min 87.0

Rel Angle Max 138.0

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 CAMS

Reset credentials (GMAO or ECMWF)

Fallback values when no ancillary or model data available:

Wind (m/s) 5.0

AOD(550) 0.2

AirT[C] 26.0

Salt[psu] 38.0

SST[C] 28.0

Select Cal/Char options

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

SZA Minimum (deg) 20.0

SZA Maximum (deg) 60.0

Enable Spectral Outlier Filter ☒

Generate Plots ☐

Filter Sigma Es 5.0

Filter Sigma Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Flags (Experimental/Non-exclusive) ☒

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle ☒ 40° ☐ 30°

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 ☐ Zhang et al. (2017) p

☐ Groetsch et al. (2017) ☐ Your Glint (2023) p

NIR Residual Correction ☒

☐ Mueller and Austin (1995) (blue water) ☒ SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra ☒

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

Generate Spectral Plots

Rrs ☒ nLw ☐ Es ☒ Li ☒ Lt ☒

Unc. Plots (class-based only) ☐

Derived L2 Ocean Color Products

Save SeaBASS Files ☒

Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report ☒

HyperCP

Save/Close Save As Cancel

GPRMC_NMEA0183v3.01.tdf ← GPS

HED0187p.cal ← Es

HLD0250h.cal ← Li

HLD0251h.cal ← Lt

HSE0187p.cal

HSL0250h.cal

HSL0251h.cal

HyperSAS.20230203.sip ← Zip of all .cal & .tdf files

SATMSG.tdf

SATTHS0009.tdf ← Tilt-Heading sensor

UMTWR_v0.tdf ← Azimuth control robot

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.]



HyperCP

Demo:
Loading in Calibration and Telemetry Files
(Demo TBD based on timing)

HyperCP Level 1A: Read Data

Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Add Factory Cals Remove F. Cals

Frame Type: ShutterLight

Level 1A Processing

Raw binary to HDF5

Raw UTC Offset [+/-] 0.0

Solar Zenith Angle Filter

SA Max 70.0

Caps-on darks only (TriOS)

Level 1AQC Processing

Filter on pitch, roll, yaw, and azimuth

Pitch/Roll Filter (where present)

Max Pitch/Roll Angle 5.0

Autonomous Sun Tracker

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) 2.0

Absolute Rotator Angle Filter

Rotator Angle Min -126.0

Rotator Angle Max 42.0

Relative Solar Azimuth Filter

Rel Angle Min 87.0

Rel Angle Max 138.0

Deglint 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 CAMS

Reset credentials (GMAO or ECMWF)

Fallback values when no ancillary or model data available:

Wind (m/s) 5.0

AOD(550) 0.2

AirT[C] 26.0

Salt[psu] 38.0

SST[C] 28.0

Select Cal/Char options

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

SA Minimum (deg) 20.0

SA Maximum (deg) 60.0

Enable Spectral Outlier Filter

Generate Plots

Filter Sigma Es 5.0

Filter Sigma Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Flags (Experimental/Non-exclusive)

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle 40° 30°

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 Zhang et al. (2017) p

Groetsch et al. (2017) Your Glint (2023) p

NIR Residual Correction

Mueller and Austin (1995) (blue water)

SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra

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

Generate Spectral Plots

Rrs nLw Es Li Lt

Unc. Plots (class-based only)

Derived L2 Ocean Color Products

Save SeaBASS Files

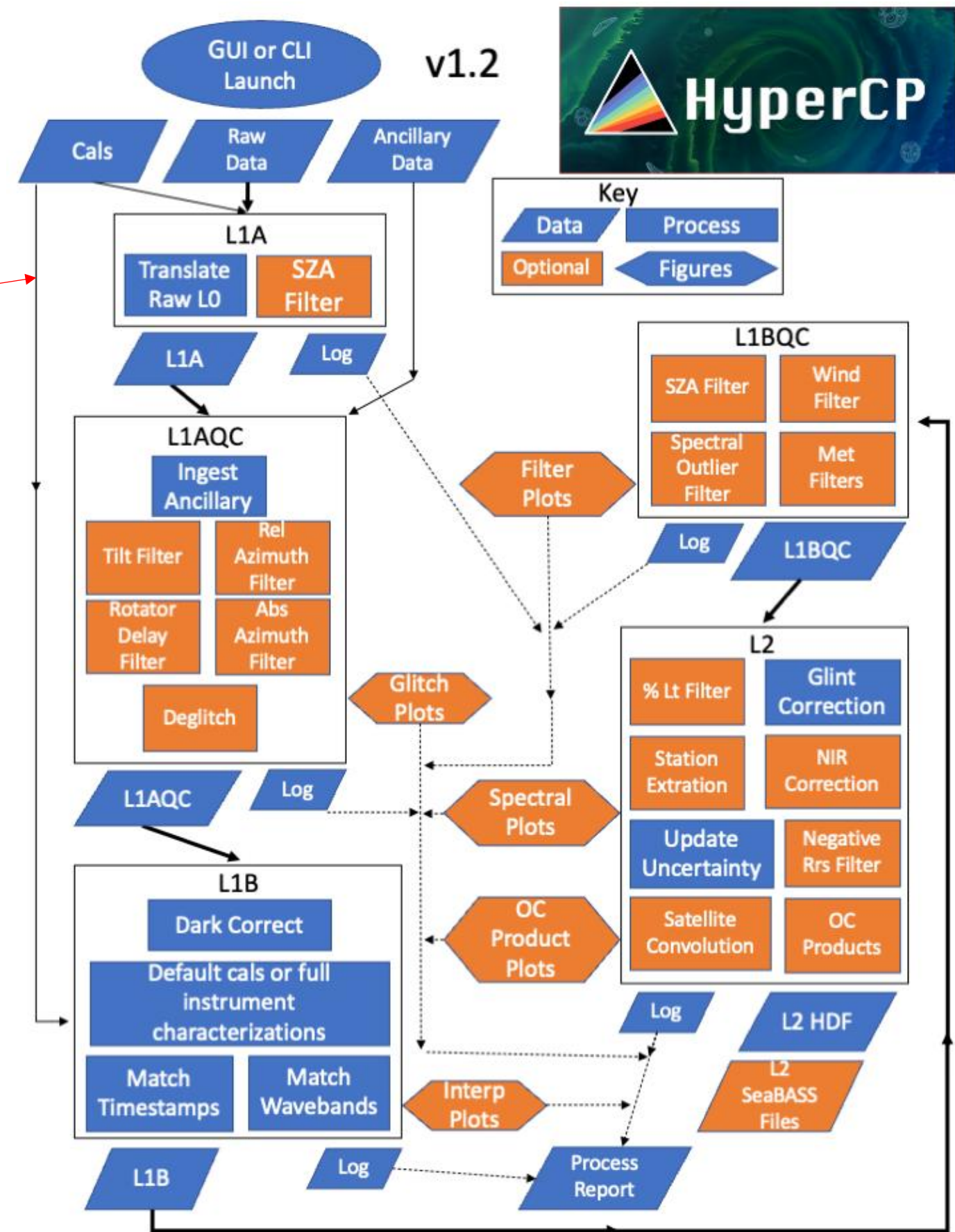
Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report

HyperCP

Save/Close Save As Cancel



HyperCP Level 1A: Read Data

Sensor Type:
SeaBird

Add Factory Cals Remove F. 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

Caps-on darks only (TriOS)

Level 1AQC Processing

Filter on pitch, roll, yaw, and azimuth

Pitch/Roll Filter (where present)

Max Pitch/Roll Angle 5.0

Autonomous Sun Tracker

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) 2.0

Absolute Rotator Angle Filter

Rotator Angle Min -126.0

Rotator Angle Max 42.0

Relative Solar Azimuth Filter

Rel Angle Min 87.0

Rel Angle Max 138.0

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 CAMS

Reset credentials (GMAO or ECMWF)

Fallback values when no ancillary or model data available:

Wind (m/s) 5.0

AOD(550) 0.2

AirT[C] 26.0

Salt[psu] 38.0

SST[C] 28.0

Select Cal/Char options

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

SZA Minimum (deg) 20.0

SZA Maximum (deg) 60.0

Enable Spectral Outlier Filter

Generate Plots

Filter Sigma Es 5.0

Filter Sigma Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Flags (Experimental/Non-exclusive)

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle 40° 30°

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 Zhang et al. (2017) p

Groetsch et al. (2017) Your Glint (2023) p

NIR Residual Correction

Mueller and Austin (1995) (blue water) SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra

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

Generate Spectral Plots

Rrs nLw Es Li Lt

Unc. Plots (class-based only)

Derived L2 Ocean Color Products

Save SeaBASS Files

Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report

HyperCP

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/overnight. SZA thresholds are fine-tuned in L1BQC.

HyperCP Level 1A: Read Data

“Caps-on-darks” is a very special circumstance particular (currently) to TriOS configurations for estimating the internal working temperature of the radiometers, particularly the older “G1” models that have no internal thermistor.

Typically applied in conjunction with normal (no caps) measurements, temperatures estimated from instrument noise with the lens caps covering the fore optics can be applied to normal measurements taken shortly before or after for use in the thermal correction and uncertainty budget.

Caps-on-darks need only be run to L1A and require special file naming conventions.

Configuration: sample_TRIOS_NOTRACKER.cfg

Sensor Type: TriOS

Add Factory Cals Remove F. Cals

Frame Type: LI

Level 1A Processing

Raw binary to HDF5

Raw UTC Offset [+/-] 0.04

Solar Zenith Angle Filter

SA Max 70.0

Caps-on darks only (TriOS) ☒

Level 1AQC Processing

Filter on pitch, roll, yaw, and azimuth

Pitch/Roll Filter (where present) ☐

Max Pitch/Roll Angle 5.0

Autonomous Sun Tracker ☐

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) 2.0

Absolute Rotator Angle Filter ☐

Rotator Angle Min -40.0

Rotator Angle Max 40.0

Relative Solar Azimuth Filter ☒

Rel Angle Min 90.0

Rel Angle Max 135.0

Deglint 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 CAMS

Reset credentials (GMAO or ECMWF)

Fallback values when no ancillary or model data available:

Wind (m/s) 5.0

AOD(550) 0.2 AirT[C] 26.0

Salt[psu] 38.0 SST[C] 28.0

Select Cal/Char options

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

SA Minimum (deg) 20.0

SA Maximum (deg) 60.0

Enable Spectral Outlier Filter ☒

Generate Plots ☐

Filter Sigma Es 5.0

Filter Sigma Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Flags (Experimental/Non-exclusive) ☒

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle 40° 30°

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 ☐ Zhang et al. (2017) p

☐ Groetsch et al. (2017) ☐ Your Glint (2023) p

NIR Residual Correction ☒

☒ Mueller and Austin (1995) (blue water) ☐ SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra ☒

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

Generate Spectral Plots

Rrs ☒ nLw ☐ Es ☒ Li ☒ Lt ☒

Unc. Plots (class-based only) ☐

Derived L2 Ocean Color Products

Save SeaBASS Files ☐

Edit SeaBASS Header

sample_TRIOS_NOTRACKER.hdr

Write PDF Report ☐

HyperCP

Save/Close Save As Cancel

HyperCP Level 1AQC: Quality Control Data

(See README documentation for explanation/sources of all default and recommended values throughout configuration.)

Tilt of Es should not exceed 5 degrees.

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)

Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Add Cals Remove Cals

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) 5.0

SolarTracker or pySAS 70.0

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) 2.0

Absolute Rotator Angle Filter 70.0

Rotator Angle Min -55.0

Rotator Angle Max 90.0

Relative Solar Azimuth Filter 70.0

Rel Angle Min 90.0

Rel Angle Max 135.0

Deglint Data 70.0

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 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 70.0

Plot Interval (nm) 20.0

Level 1BQC Processing

Data quality control filters.

Eliminate where Lt(NIR)>Lt(UV) 70.0

Max. Wind Speed (m/s) 10.0

SZA Minimum (deg) 15.0

SZA Maximum (deg) 60.0

Enable Spectral Outlier Filter 70.0

Generate Plots 70.0

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Level 2 Ensembles

Extract Cruise Stations

Ensemble Interval (secs; 0=None) 300

Enable Percent Lt Calculation 70.0

Percent Lt (%) 10.0

Level 2 Sky/Sunglint Correction (p)

Mobley (1999) p Zhang et al. (2017) p

Groetsch et al. (2017) Your Glint (2023) p

NIR Residual Correction 70.0

Mueller and Austin (1995) (blue water)

SimSpec. Ruddick et al. (2006) (turbid)

Your NIR Residual (2023) (universal)

Remove Negative Spectra 70.0

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

Derived L2 Ocean Color Products

Save SeaBASS Files

Edit SeaBASS Header


sample_SEABIRD_pySAS.hdr

Write PDF Report

HyperCP

Save/Close Save As Cancel

HyperCP Level 1AQC: Supervised Deglitching



Hy

Select/Create Configuration File

Input Data Parent Directory

Output Data/Plots Parent Directory

Ancillary Data File (SeaBASS format; MUST)

Single-Level Processing

Level 0 (Raw) -->

L1A -->

L1AQC

L1B -->

L1BQC

Multi-Level Processing

Raw (BIN) -----> L2 (HDF5)

Suppress pop-up window on processing fail? ☐

FRM4SOC2_FICE22_NASA_20220719_080000_L1AQC

FROM: 2022-07-19 08:00 TO: 2022-07-19 08:26 UTC

InputDir/Photos naming (+timezone), e.g. IMG_%Y%m%d_%H%M%S.jpg-0400:

(Median->) WIND: nan m/s CLOUD: nan % REL.AZ: 135 deg. SZA: 45 deg. WAVES: nan m SPEED: nan m/s

Deglitching only performed from 350-850 nm: 499.83

☒ ES ☐ LI ☐ LT Waveband interval to for plots:

Window (odd;11) Sigma (3.2) % Loss (all bands) Window (odd;5) Sigma (2.3) % Loss (all bands)

☐ Threshold None nm Dark Min Max Light Min Max

[DARKS] ES(500) [count]



Time series

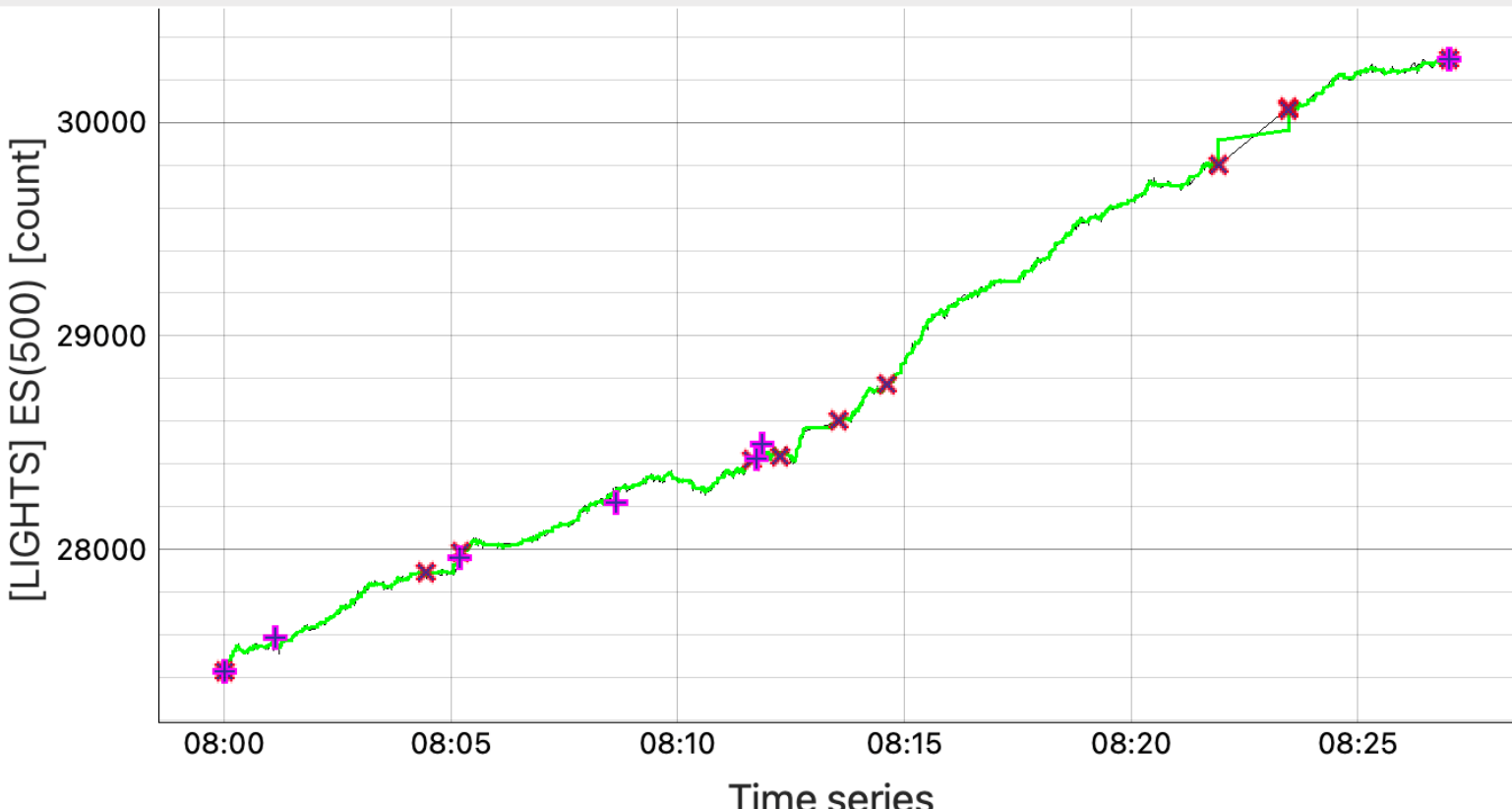
Moving-window mean

Low-pass filter (1)

Low-pass filter (2)

Threshold exceeded

[LIGHTS] ES(500) [count]



Time series

Left-click-hold to pan, right-click-hold to zoom, or right-click-release for more options. IF PLOT IS BLANK, CLICK THE "A" IN THE BOTTOM LEFT CORNER TO RESET ZOOM.

Rel Angle Max SZA Maximum (deg)

Deglitch Data ☒

Sea-Bird Only

HyperCP Level 1AQC: Supervised Deglitching



Supervised Deglitching.

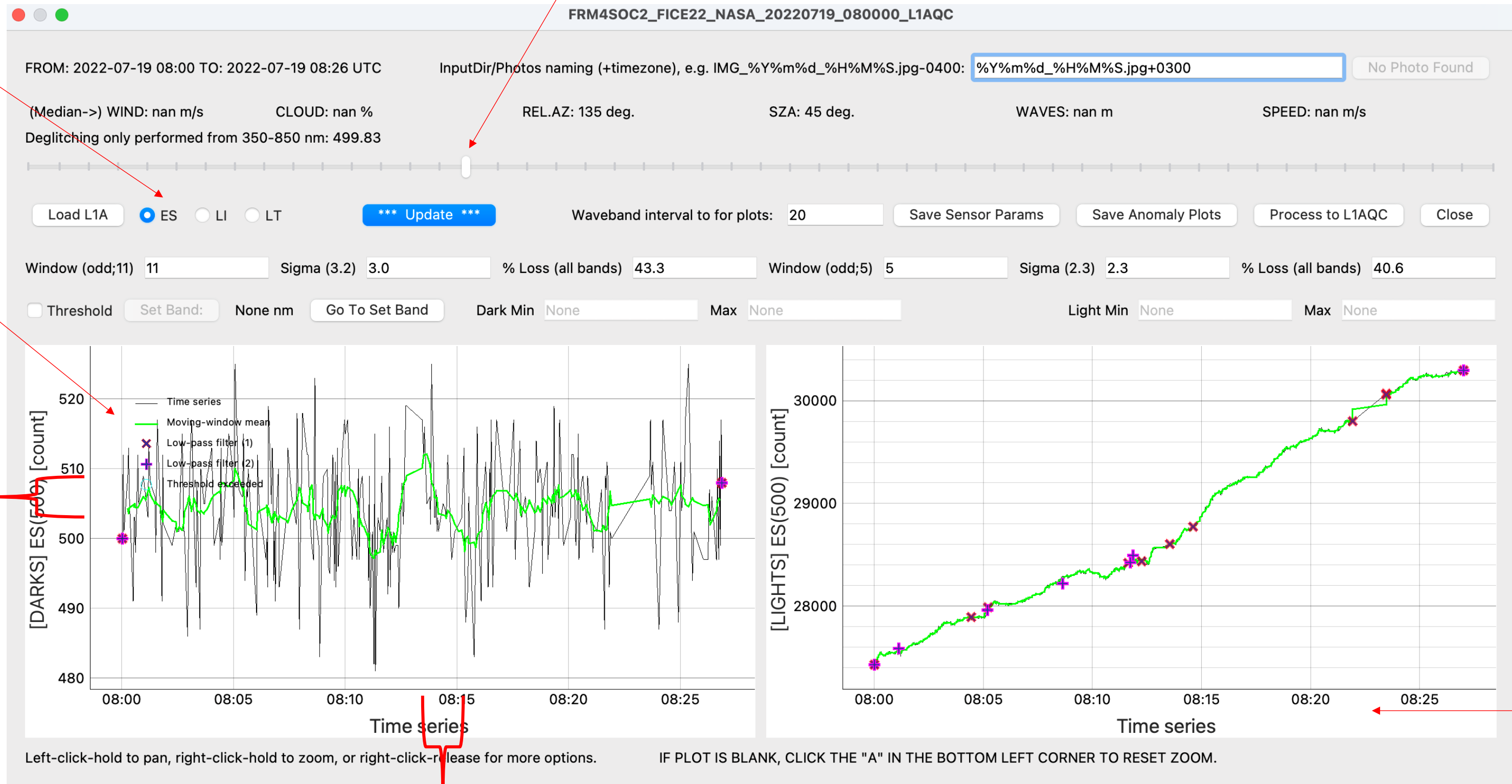
Waveband Slider

Sensor

Uncalibrated
raw counts

Sigma

Time



Window

HyperCP Level 1AQC: Supervised Deglitching



Supervised Deglitching.



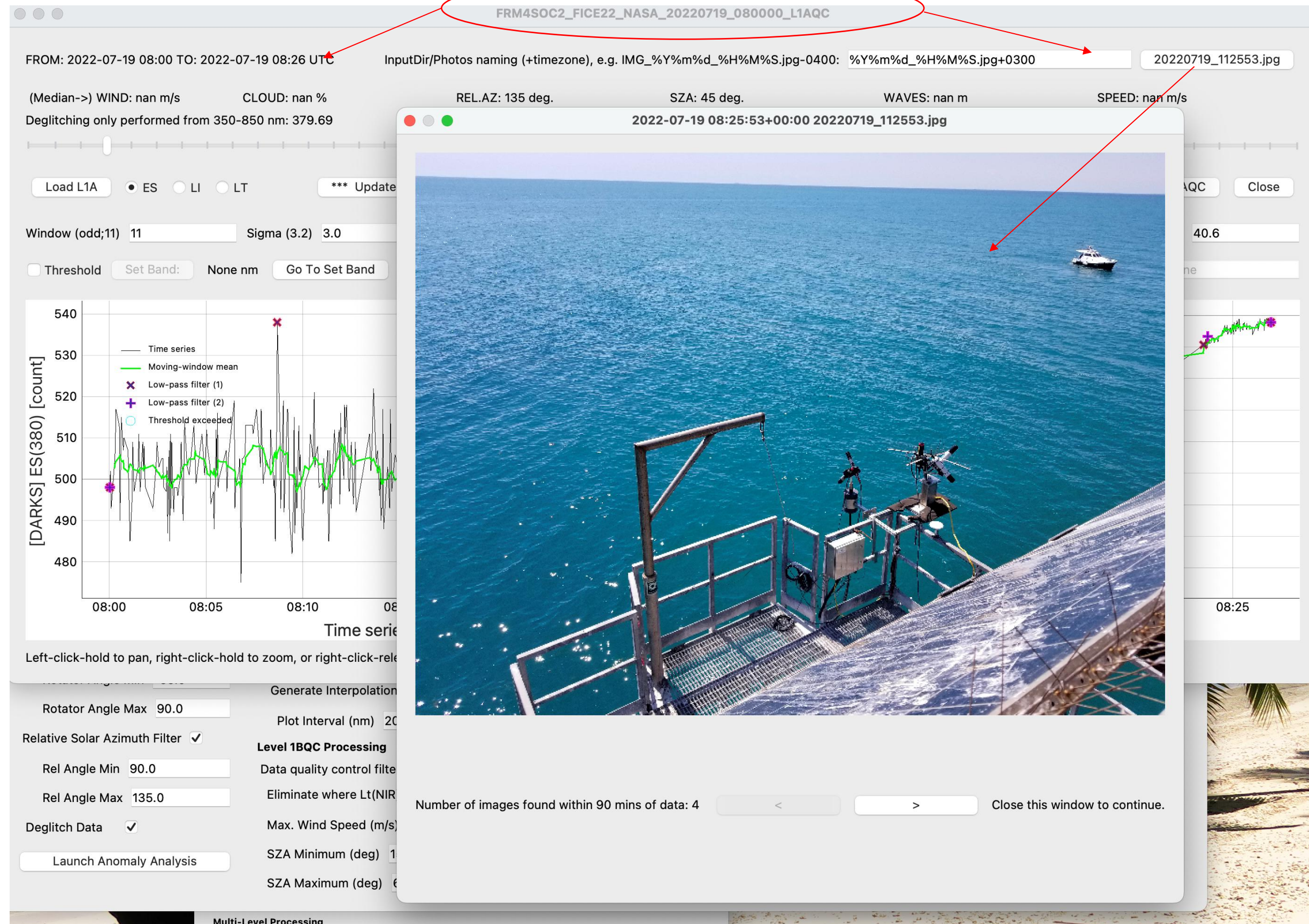
Sigma

Window

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.)

HyperCP Level 1AQC: Supervised Deglitching





HyperCP

Demo: Supervised Deglitching

(Demo TBD depending on timing)

HyperCP Level 1B: Overview

Configuration: sample_TRIOS_NOTRACKER.cfg

Sensor Type: TriOS

Relative Solar Azimuth Filter ☒

Rel Angle Min 90.0

Rel Angle Max 135.0

Deglint 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 CAMS

Reset credentials (GMAO or ECMWF)

Fallback values when no ancillary or model data available:

Wind (m/s) 5.0

AOD(550) 0.2

AirT[C] 26.0

Salt[psu] 38.0

SST[C] 28.0

Select Cal/Char options

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

SAZ Minimum (deg) 20.0

SAZ Maximum (deg) 60.0

Enable Spectral Outlier Filter ☒

Generate Plots ☐

Filter Sigma Es 5.0

Filter Sigma Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Flags (Experimental/Non-exclusive) ☒

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle 40°

30°

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 ☐ Zhang et al. (2017) p

☐ Groetsch et al. (2017) ☐ Your Glint (2023) p

NIR Residual Correction ☒

☒ Mueller and Austin (1995) (blue water) ☐ SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra ☒

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

Generate Spectral Plots

Rrs ☒ nLw ☐ Es ☒ Li ☒ Lt ☒

Unc. Plots (class-based only) ☐

Derived L2 Ocean Color Products

Save SeaBASS Files ☐

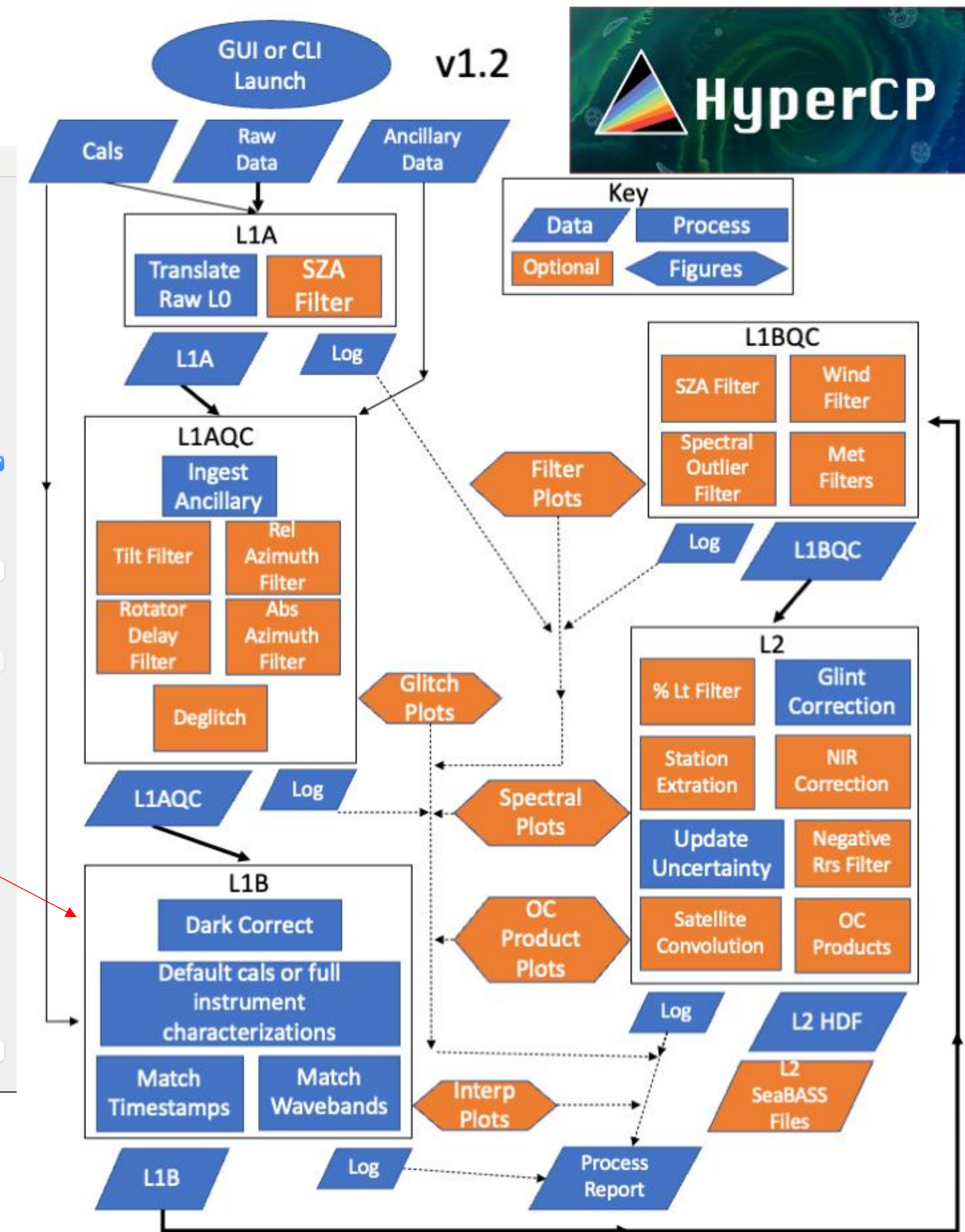
Edit SeaBASS Header

sample_TRIOS_NOTRACKER.hdr

Write PDF Report ☐

HyperCP

Save/Close Save As Cancel



HyperCP Level 1B: Load Ancillaries

Wind speed is a requirement of L2 glint correction. AOD is a requirement of cosine correction, uncertainty budgets, and the Zhang et al. 2017 glint correction (along with SST and Sal). Air temp. may be used in thermal corrections.

Gaps in the Ancillary file can be filled using course model data -- either NASA GMAO or European ECMWF.

These fallback values are used if neither Ancillary nor model data are found. (*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*)

Configuration: sample_TRIOS_NOTRACKER.cfg

Sensor Type: TriOS

Add Factory Cals Remove F. Cals

Frame Type: LI

Level 1A Processing

Raw binary to HDF5

Raw UTC Offset [+/-] 0.04

Solar Zenith Angle Filter

SA Max 70.0

Caps-on darks only (TriOS) ☒

Level 1AQC Processing

Filter on pitch, roll, yaw, and azimuth

Pitch/Roll Filter (where present) ☐

Max Pitch/Roll Angle 5.0

Autonomous Sun Tracker ☐

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) 2.0

Absolute Rotator Angle Filter ☐

Rotator Angle Min -40.0

Rotator Angle Max 40.0

Relative Solar Azimuth Filter ☒

Rel Angle Min 90.0

Rel Angle Max 135.0

Deglint 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 CAMS

Reset credentials (GMAO or ECMWF)

Fallback values when no ancillary or model data available:

Wind (m/s) 5.0

AOD(550) 0.2 AirT[C] 26.0

Salt[psu] 38.0 SST[C] 28.0

Select Cal/Char options

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

SA Minimum (deg) 20.0

SA Maximum (deg) 60.0

Enable Spectral Outlier Filter ☒

Generate Plots ☐

Filter Sigma Es 5.0

Filter Sigma Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Flags (Experimental/Non-exclusive) ☒

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle 40° 30°

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 ☐ Zhang et al. (2017) p

☐ Groetsch et al. (2017) ☐ Your Glint (2023) p

NIR Residual Correction ☒

☒ Mueller and Austin (1995) (blue water) ☐ SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra ☒

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

Generate Spectral Plots

Rrs ☒ nLw ☐ Es ☒ Li ☒ Lt ☒

Unc. Plots (class-based only) ☐

Derived L2 Ocean Color Products

Save SeaBASS Files ☐

Edit SeaBASS Header

sample_TRIOS_NOTRACKER.hdr

Write PDF Report ☐

HyperCP

Save/Close Save As Cancel

HyperCP Level 1B: Sensor Temperature

Calibration/Characterization options

Select source of internal sensor working temperature:

☐ Internal Thermistor (SeaBird, DALEC, TriOS-G2) ☐ Air Temperature + 2.5 deg. C ☒ Caps-on Dark File (T > 30 deg. C)

Select Calibration-Characterization Regime:

☐ Non-FRM, factory calibration only (no uncertainties except with SeaBird)

☐ FRM Class-Specific characterisation coefficients (in /Data/Class_Based_Characterizations/TriOS)
NB: Sensor-Specific calibrations with uncertainties in the FidRadDB format required

☒ FRM Sensor-Specific characterisation coefficients (highest quality)
NB: Sensor-Specific calibrations with uncertainties and characterizations in the FidRadDB format required

If FRM cal-char regime selected, then ...

... check that all the needed [FidRadDB-formatted](#) cal/char files are available under:
/Users/daurin/GitRepos/HyperCP/Data/FidRadDB/TriOS

Downwelling irradiance, ES

Total water radiance, LT (water)

Sky radiance, LI (sky)

Multiple calibrations available? Select option (only supported for FRM regimes):

☒ Use most recent calibrations prior to acquisition time (default)

☐ Use mean of pre- and post- calibrations

☐ Use specific calibration files

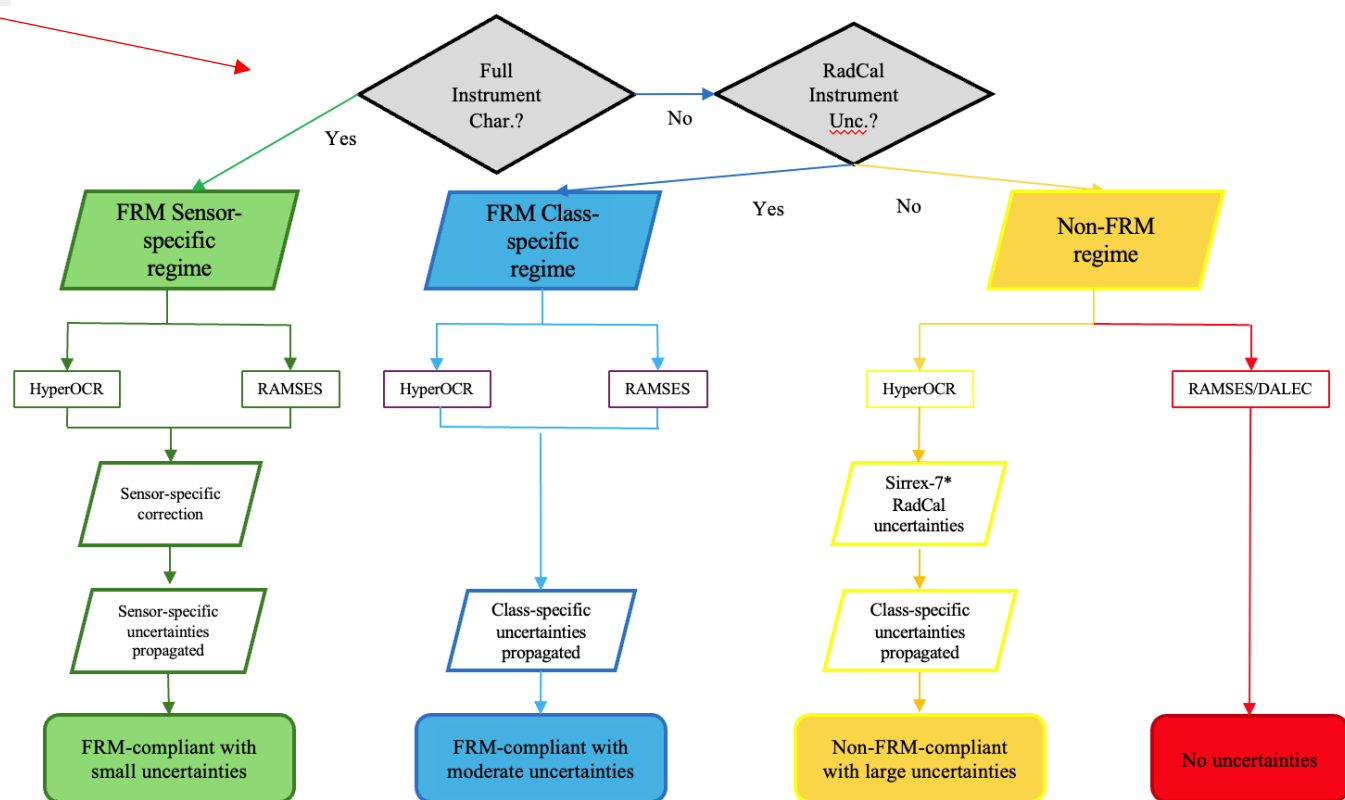
To calculate the thermal response correction and/or uncertainty, the source of the temperature must be identified. For instruments with a built-in internal thermistor (Sea-Bird, DALEC, TriOS G2), this is automatically selected.

For sensors without a thermistor, the working temperature is estimated from either air temperature + 2.5 C or data collected with the foreoptics occluded, when available. The latter approach is more accurate in high temperature settings (> 30 C).

HyperCP Level 1B: FRM Cal/Char Regimes

The screenshot displays the 'Calibration/Characterization options' dialog box within the HyperCP Level 1B processing software. The interface is divided into several sections:

- Sensor Type:** Set to 'TriOS'.
- Level 1A Processing:** Includes options for 'Raw binary to HDF5', 'Raw UTC Offset [+/-]' (0.04), 'Solar Zenith Angle Filter' (70.0), and 'Caps-on darks only (TriOS)' (checked).
- Level 1AQC Processing:** Includes 'Filter on pitch, roll, yaw, and azimuth', 'Pitch/Roll Filter (where present)' (unchecked), 'Max Pitch/Roll Angle' (5.0), 'Autonomous Sun Tracker' (unchecked), 'Rotator Home Angle Offset' (0.0), 'Rotator Delay (Seconds)' (2.0), 'Absolute Rotator Angle Filter' (unchecked), 'Rotator Angle Min' (-40.0), and 'Rotator Angle Max' (40.0).
- Level 1B Processing:** Includes 'Dark offsets, calibrations and corrections to common timestamps are applied', 'Ancillary data are required to fill in wind for M99 and M100', 'GMAO MERRA2' (unchecked), 'Fallback values when no data' (5.0, 0.2, 38.0), 'Interpolation Interval (nm)' (20.0), 'Generate Interpolation Plot' (checked), 'Plot Interval (nm)' (20.0), 'Data quality control filters' (checked), 'Eliminate where Lt(NIR)>Lt(NIR)>Lt(NIR)', 'Max. Wind Speed (m/s)' (20.0), 'SZA Minimum (deg)' (20.0), and 'SZA Maximum (deg)' (60.0).
- Calibration/Characterization options:** This section is highlighted with a red circle and contains:
 - Select source of internal sensor working temperature:** Radio buttons for 'Internal Thermistor (SeaBird, DALEC, TriOS-G2)', 'Air Temperature + 2.5 deg. C', and 'Caps-on Dark File (T > 30 deg. C)' (selected).
 - Select Calibration-Characterization Regime:** Radio buttons for 'Non-FRM, factory calibration only (no uncertainties except with SeaBird)', 'FRM Class-Specific characterisation coefficients (in /Data/Class_Based_Characterizations/TriOS) NB: Sensor-Specific calibrations with uncertainties in the FidRadDB format required', and 'FRM Sensor-Specific characterisation coefficients (highest quality) NB: Sensor-Specific calibrations with uncertainties and characterizations in the FidRadDB format required' (selected).
 - If FRM cal-char regime selected, then ...** A text box indicating that all needed 'FidRadDB-formatted' cal/char files must be available under the path: /Users/daurin/GitRepos/HyperCP/Data/FidRadDB/TriOS.
 - Downwelling irradiance, ES**: All needed files found.
 - Total water radiance, LT (water)**: All needed files found.
 - Sky radiance, LI (sky)**: All needed files found.
 - Buttons:** 'Copy from local source' and 'Download from FidRadDB'.
 - Multiple calibrations available? Select option (only supported for FRM regimes):** Radio buttons for 'Use most recent calibrations prior to acquisition time (default)' (selected), 'Use mean of pre- and post- calibrations', and 'Use specific calibration files'.
 - Buttons:** 'Choose (3) pre-cal files:', 'Not selected', 'Choose (3) post-cal files:', 'Not selected', 'Choose (3) cal files:', 'Not selected', 'Save/Close', and 'Cancel'.



NOTE that absolute radiometric calibrations *with uncertainty and in FidRadDB format* are required for FRM Class-based processing. Manufacturer cals do not (yet) include this... but we're working on it.

HyperCP Level 1B: FRM Regimes

FRM Class-specific (e.g., Sea-Bird or TriOS) and sensor-specific characterizations help accurately estimate uncertainties associated with instrument response using Monte Carlo modeling for:

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

Sensor-specific characterizations also allow for corrections to be applied for linearity, calibration, straylight, cosine, and thermal response, thereby reducing uncertainty further.

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>

The screenshot displays the 'Calibration/Characterization options' window in the HyperCP software. The window is divided into several sections. The 'Select source of internal sensor working temperature' section has three radio buttons: 'Internal Thermistor (SeaBird, DALEC, TriOS-G2)', 'Air Temperature + 2.5 deg. C', and 'Caps-on Dark File (T > 30 deg. C)'. The 'Select Calibration-Characterization Regime' section has three radio buttons: 'Non-FRM, factory calibration only (no uncertainties except with SeaBird)', 'FRM Class-Specific characterisation coefficients (in /Data/Class_Based_Characterizations/TriOS) NB: Sensor-Specific calibrations with uncertainties in the FidRadDB format required', and 'FRM Sensor-Specific characterisation coefficients (highest quality) NB: Sensor-Specific calibrations with uncertainties and characterizations in the FidRadDB format required'. The 'FRM Sensor-Specific' option is selected. Below this, the 'If FRM cal-char regime selected, then ...' section contains a text box with the path '/Users/daurin/GitRepos/HyperCP/Data/FidRadDB/TriOS'. The 'Multiple calibrations available? Select option (only supported for FRM regimes):' section has two radio buttons: 'Use most recent calibrations prior to acquisition time (default)' and 'Use mean of pre- and post- calibrations'. The 'Use most recent' option is selected. The 'Choose (3) pre-cal files:' and 'Choose (3) post-cal files:' sections both show 'Not selected'. The 'Choose (3) cal files:' section also shows 'Not selected'. The 'Save/Close' and 'Cancel' buttons are at the bottom right. A red circle highlights the 'FRM Sensor-Specific' option and the text 'NB: Sensor-Specific calibrations with uncertainties and characterizations in the FidRadDB format required'. A red arrow points from the text 'FRM Class-specific (e.g., Sea-Bird or TriOS) and sensor-specific characterizations help accurately estimate uncertainties associated with instrument response using Monte Carlo modeling for:' to the 'FRM Sensor-Specific' option.

Sensor Type: TriOS

Relative Solar Azimuth Filter: Rel Angle Min 90.0, Rel Angle Max 135.0

Deglitch Data: []

Frame Type: LI

Level 1A Processing: Raw binary to HDF5, Raw UTC Offset [+/-] 0.04, Solar Zenith Angle Filter: SZA Max [x] 70.0, Caps-on darks only (TriOS) [x]

Level 1AQC Processing: Filter on pitch, roll, yaw, and azimuth, Pitch/Roll Filter (where present) [], Max Pitch/Roll Angle 5.0, Autonomous Sun Tracker [], Rotator Home Angle Offset 0.0, Rotator Delay (Seconds) [x] 2.0, Absolute Rotator Angle Filter [], Rotator Angle Min -40.0, Rotator Angle Max 40.0

Level 1B Processing: Dark offsets, calibrations and ancillary data are required to common timestamps and fill in wind for M99 and GMAO MERRA2. Fallback values when no data: Wind (m/s) 5.0, AOD(550) 0.2, Salt[psu] 38.0. Interpolation Interval (nm) [], Generate Interpolation Plot [], Plot Interval (nm) 20.0

Level 1BQC Processing: Data quality control filters. Eliminate where Lt(NIR)>Lt(NIR). Max. Wind Speed (m/s) [], SZA Minimum (deg) 20.0, SZA Maximum (deg) 60.0

SimSpec. Ruddick et al. (2006) (turbid) []

Remove Negative Spectra [x]

Save/Close, Cancel

NOTE that absolute radiometric calibrations *with uncertainty and in FidRadDB format* are required for FRM Class-based processing. Manufacturer cals do not (yet) include this... but we're working on it.

HyperCP Level 1B: Factory/Class/Full

The screenshot displays the HyperCP Level 1B: Factory/Class/Full interface. The main window is titled "Calibration/Characterization options". It features several sections for configuring data processing and calibration. The "Sensor Type" is set to "TriOS". The "Frame Type" is set to "LI". The "Level 1A Processing" section includes options for "Raw binary to HDF5", "Raw UTC Offset [+/-]" (set to 0.04), "Solar Zenith Angle Filter" (set to 70.0), and "Caps-on darks only (TriOS)" (checked). The "Level 1AQC Processing" section includes options for "Filter on pitch, roll, yaw, and azimuth", "Pitch/Roll Filter (where present)" (unchecked), "Max Pitch/Roll Angle" (set to 5.0), "Autonomous Sun Tracker" (unchecked), "Rotator Home Angle Offset" (set to 0.0), "Rotator Delay (Seconds)" (set to 2.0), "Absolute Rotator Angle Filter" (unchecked), "Rotator Angle Min" (set to -40.0), and "Rotator Angle Max" (set to 40.0). The "Level 1B Processing" section includes options for "Dark offsets, calibrations and to common timestamps are required", "Ancillary data are required", "can fill in wind for M99 and", "GMAO MERRA2" (unchecked), "Reset or", "Fallback values when no", "Wind (m/s)" (set to 5.0), "AOD(550)" (set to 0.2), "Salt[psu]" (set to 38.0), "Interpolation Interval (nm)", "Generate Interpolation Plots", "Plot Interval (nm)" (set to 20.0), "Level 1BQC Processing", "Data quality control filters", "Eliminate where Lt(NIR)>1", "Max. Wind Speed (m/s)", "SZ Minimum (deg)" (set to 20.0), and "SZ Maximum (deg)" (set to 60.0). The "Calibration/Characterization options" dialog box is open, showing the "Select source of internal sensor working temperature" section with "Caps-on Dark File (T > 30 deg. C)" selected. The "Select Calibration-Characterization Regime" section has "FRM Sensor-Specific characterisation coefficients (highest quality)" selected, with a note: "NB: Sensor-Specific calibrations with uncertainties and characterizations in the FidRadDB format required". The "If FRM cal-char regime selected, then ..." section includes a note: "... check that all the needed [FidRadDB-formatted](#) cal/char files are available under: /Users/daurin/GitRepos/HyperCP/Data/FidRadDB/TriOS". The "Downwelling irradiance, ES" field shows "All needed files found". The "Total water radiance, LT (water)" field shows "All needed files found". The "Sky radiance, LI (sky)" field shows "All needed files found". The "Copy from local source" button is disabled, and the "Download from FidRadDB" button is active. The "Multiple calibrations available? Select option (only supported for FRM regimes):" section has "Use most recent calibrations prior to acquisition time (default)" selected. The "Choose (3) pre-cal files:" field shows "Not selected", and the "Choose (3) post-cal files:" field shows "Not selected". The "Choose (3) cal files:" field shows "Not selected". The "Save/Close" button is active, and the "Cancel" button is disabled.

This interface will allow you to add the required calibration and characterization files (FidRadDB), depending on which regime you select.

The Fiducial Radiometer Database (FidRadDB) hosts the Cal/Char files for specific instruments evaluated in the lab at Tartu Observatory.

To import these Cal/Char files into HyperCP, either use the interface to copy them from a local source or allow HyperCP to download your files from FidRadDB directly.

HyperCP Level 1B: Factory/Class/Full

The image shows the HyperCP Level 1B calibration interface. The main window is titled "Calibration/Characterization options". It contains several sections for configuring data processing and calibration.

Sensor Type: TriOS (dropdown menu). Buttons: Add Factory Cals, Remove F. Cals.

Frame Type: LI (dropdown menu).

Level 1A Processing

- Raw binary to HDF5
- Raw UTC Offset [+/-]: 0.04
- Solar Zenith Angle Filter
- SA Max: 70.0
- Caps-on darks only (TriOS): ☒

Level 1AQC Processing

- Filter on pitch, roll, yaw, and azimuth
- Pitch/Roll Filter (where present): ☐
- Max Pitch/Roll Angle: 5.0
- Autonomous Sun Tracker: ☐
- Rotator Home Angle Offset: 0.0
- Rotator Delay (Seconds): 2.0
- Absolute Rotator Angle Filter: ☐
- Rotator Angle Min: -40.0
- Rotator Angle Max: 40.0

Level 1B Processing

- Dark offsets, calibrations and to common timestamps are required
- Ancillary data are required can fill in wind for M99 and
- GMAO MERRA2: ☐
- Reset or
- Fallback values when no
- Wind (m/s): 5.0
- AOD(550): 0.2
- Salt[psu]: 38.0
- Interpolation interval (nm)
- Generate Interpolation Pl
- Plot Interval (nm): 20.0

Level 1BQC Processing

- Data quality control filters.
- Eliminate where Lt(NIR)>1
- Max. Wind Speed (m/s)
- SA Minimum (deg): 20.0
- SA Maximum (deg): 60.0

Calibration/Characterization options

Select source of internal sensor working temperature:

- ☐ Internal Thermistor (SeaBird, DALEC, TriOS-G2)
- ☐ Air Temperature + 2.5 deg. C
- ☒ Caps-on Dark File (T > 30 deg. C)

Select Calibration-Characterization Regime:

- ☐ Non-FRM, factory calibration only (no uncertainties except with SeaBird)
- ☐ FRM Class-Specific characterisation coefficients (in /Data/Class_Based_Characterizations/TriOS)
NB: Sensor-Specific calibrations with uncertainties in the FidRadDB format required
- ☒ FRM Sensor-Specific characterisation coefficients (highest quality)
NB: Sensor-Specific calibrations with uncertainties and characterizations in the FidRadDB format required

If FRM cal-char regime selected, then ...

... check that all the needed [FidRadDB-formatted](#) cal/char files are available under: /Users/daurin/GitRepos/HyperCP/Data/FidRadDB/TriOS

Downwelling irradiance, ES: All needed files found

Total water radiance, LT (water): All needed files found

Sky radiance, LI (sky): All needed files found

Buttons: Copy from local source, Download from FidRadDB

Multiple calibrations available? Select option (only supported for FRM regimes):

- ☒ Use most recent calibrations prior to acquisition time (default)
- ☐ Use mean of pre- and post- calibrations

Buttons: Choose (3) pre-cal files: Not selected, Choose (3) post-cal files: Not selected

- ☐ Use specific calibration files

Buttons: Choose (3) cal files: Not selected

Buttons: Save/Close, Cancel

Because calibrations (and some characterizations) change over time, this interface allows you to choose which Cal/Char files to apply.

(Pre- and post-calibration averaging is still under development.)



HyperCP

Demo: Loading RadCal or Full Characterization Files

(Demo TBD depending on timing)

HyperCP Level 1BQC: Quality Control with Ancillaries & Stats

Configuration: sample_TRIOS_NOTRACKER.cfg

Sensor Type: TriOS

Relative Solar Azimuth Filter ☒

Rel Angle Min 90.0

Rel Angle Max 135.0

Deglint Data ☐

Launch Anomaly Analysis ☐

Level 1A Processing

Raw binary to HDF5

Raw UTC Offset [+/-] 0.04

Solar Zenith Angle Filter

SA Max ☒ 70.0

Caps-on darks only (TriOS) ☒

Level 1AQC Processing

Filter on pitch, roll, yaw, and azimuth

Pitch/Roll Filter (where present) ☐

Max Pitch/Roll Angle 5.0

Autonomous Sun Tracker ☐

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) ☐ 2.0

Absolute Rotator Angle Filter ☐

Rotator Angle Min -40.0

Rotator Angle Max 40.0

Level 1BQC Processing

Data quality control filters.

Eliminate where Lt(NIR)>Lt(UV) ☒

Max. Wind Speed (m/s) 10.0

SAZ Minimum (deg) 20.0

SAZ Maximum (deg) 60.0

Enable Spectral Outlier Filter ☒

Generate Plots ☐

Filter Sigma Es 5.0

Filter Sigma Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Flags (Experimental/Non-exclusive) ☒

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle ☒ 40° ☐ 30°

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 ☐ Zhang et al. (2017) p

☐ Groetsch et al. (2017) ☐ Your Glint (2023) p

NIR Residual Correction ☒

☒ Mueller and Austin (1995) (blue water) ☐ SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra ☒

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

Generate Spectral Plots

Rrs ☒ nLw ☐ Es ☒ Li ☒ Lt ☒

Unc. Plots (class-based only) ☐

Derived L2 Ocean Color Products

Save SeaBASS Files ☐

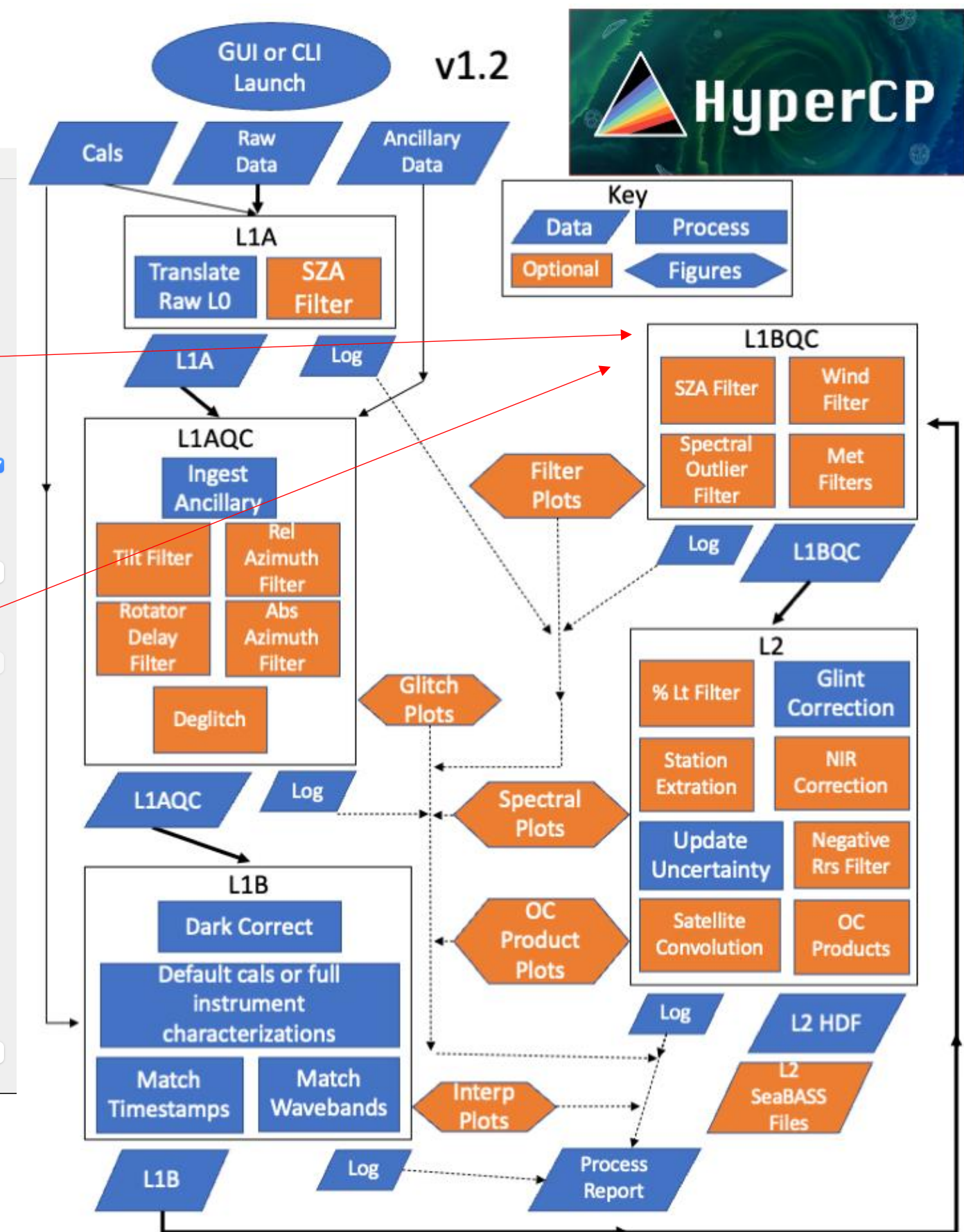
Edit SeaBASS Header

sample_TRIOS_NOTRACKER.hdr

Write PDF Report ☐

HyperCP

Save/Close Save As Cancel



HyperCP Level 1BQC: Quality Control with Ancillaries

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 ~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.

Configuration: sample_TRIOS_NOTRACKER.cfg

Sensor Type: TriOS

Add Factory Cals Remove F. Cals

Frame Type: LI

Level 1A Processing

Raw binary to HDF5

Raw UTC Offset [+/-] 0.04

Solar Zenith Angle Filter

SA Max 70.0

Caps-on darks only (TriOS) ☒

Level 1AQC Processing

Filter on pitch, roll, yaw, and azimuth

Pitch/Roll Filter (where present) ☐

Max Pitch/Roll Angle 5.0

Autonomous Sun Tracker ☐

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) 2.0

Absolute Rotator Angle Filter ☐

Rotator Angle Min -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

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 CAMS

Reset credentials (GMAO or ECMWF)

Fallback values when no ancillary or model data available:

Wind (m/s) 5.0

AOD(550) 0.2 AirT[C] 26.0

Salt[psu] 38.0 SST[C] 28.0

Select Cal/Char options

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

SAZ Minimum (deg) 20.0

SAZ Maximum (deg) 60.0

Enable Spectral Outlier Filter ☒

Generate Plots ☐

Filter Sigma Es 5.0

Filter Sigma Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Flags (Experimental/Non-exclusive) ☒

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Sensor Viewing Angle 40° 30°

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 ☐ Zhang et al. (2017) p

☐ Groetsch et al. (2017) ☐ Your Glint (2023) p

NIR Residual Correction ☒

☒ Mueller and Austin (1995) (blue water) ☐ SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra ☒

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

Generate Spectral Plots

Rrs ☒ nLw ☐ Es ☒ Li ☒ Lt ☒

Unc. Plots (class-based only) ☐


Derived L2 Ocean Color Products

Save SeaBASS Files ☐

Edit SeaBASS Header

sample_TRIOS_NOTRACKER.hdr

Write PDF Report ☐



HyperCP

Save/Close Save As Cancel



HyperCP

Demo:
Screening Spectral Filters
(Demo TBD)

HyperCP Level 2: Overview

Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Add Cals Remove Cals

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) 5.0

SolarTracker or pySAS 2.0

Rotator Home Angle Offset 2.0

Rotator Delay (Seconds) 2.0

Absolute Rotator Angle Filter 90.0

Rotator Angle Min -55.0

Rotator Angle Max 90.0

Relative Solar Azimuth Filter 135.0

Deglint Data 70.0

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 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 20.0

Plot Interval (nm) 20.0

Level 1BQC Processing

Data quality control filters.

Eliminate where Lt(NIR)>Lt(UV) 10.0

Max. Wind Speed (m/s) 10.0

SZA Minimum (deg) 15.0

SZA Maximum (deg) 60.0

Enable Spectral Outlier Filter 8.0

Generate Plots 3.0

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

L2 Ensembles

Extract Cruise Stations

Ensemble Interval (secs; 0=None) 300

Enable Percent Lt Calculation 10.0

Percent Lt (%) 10.0

L2 Sky/Sunglint Correction (p)

Mobley (1999) p Zhang et al. (2017) p

Groetsch et al. (2017) Your Glint (2023) p

NIR Residual Correction 10.0

Mueller and Austin (1995) (blue water)

SimSpec. Ruddick et al. (2006) (turbid)

Your NIR Residual (2023) (universal)

Remove Negative Spectra 10.0

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

Derived L2 Ocean Color Products

Save SeaBASS Files

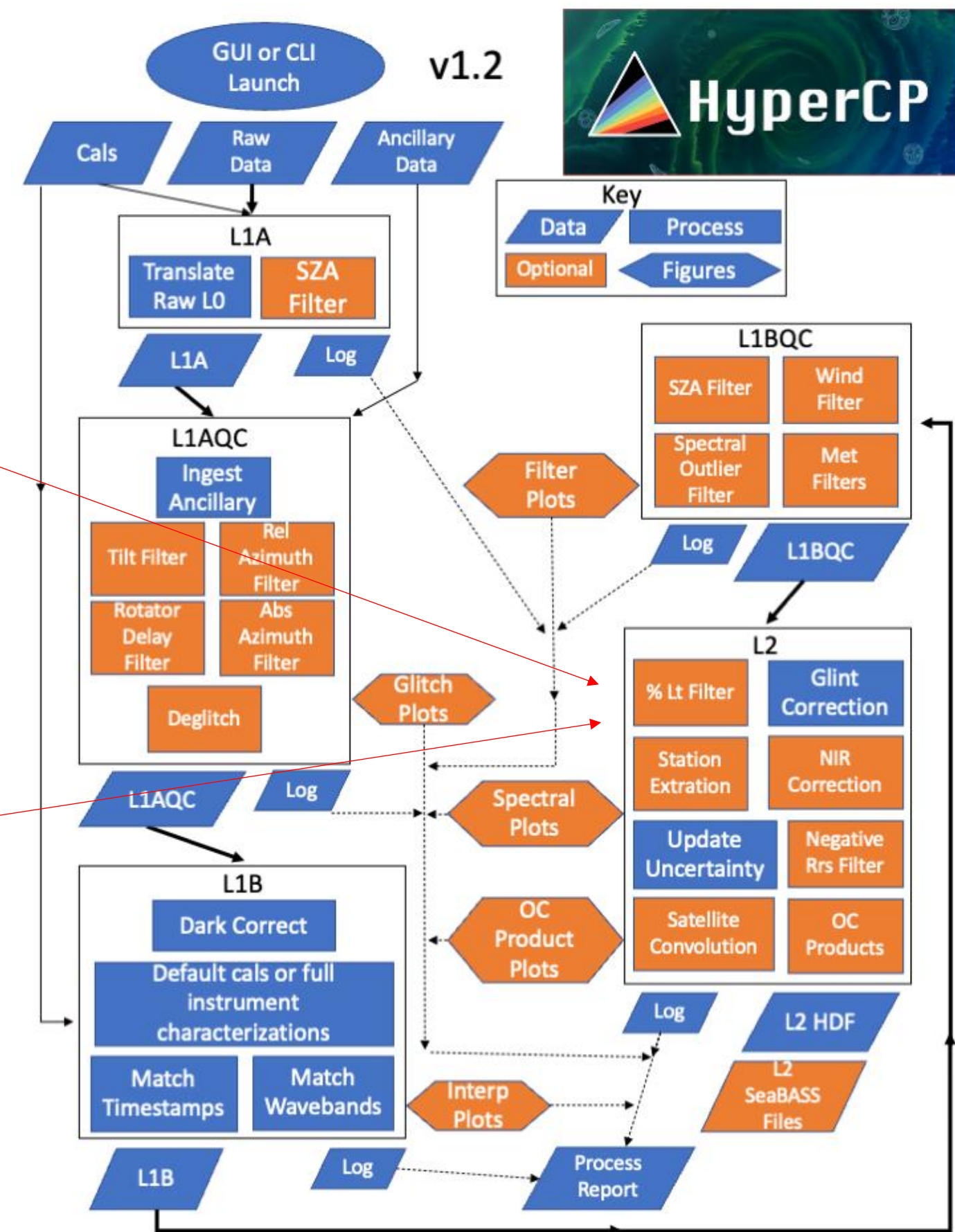
Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report

HyperCP

Save/Close Save As Cancel



HyperCP Level 2: Binning

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

Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Add Cals Remove Cals

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) 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 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

SZA Minimum (deg) 15.0

SZA Maximum (deg) 60.0

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

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Level 2 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 Zhang et al. (2017) p

Groetsch et al. (2017) Your Glint (2023) p

NIR Residual Correction

Mueller and Austin (1995) (blue water)

SimSpec. Ruddick et al. (2006) (turbid)

Your NIR Residual (2023) (universal)

Remove Negative Spectra

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

Derived L2 Ocean Color Products

Save SeaBASS Files

Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report

HyperCP

Save/Close Save As Cancel

HyperCP Level 2: Corrections...

Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Add Cals Remove Cals

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) 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 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

SZA Minimum (deg) 15.0

SZA Maximum (deg) 60.0

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

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

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 Zhang et al. (2017) p

Groetsch et al. (2017) Your Glint (2023) p

NIR Residual Correction

Mueller and Austin (1995) (blue water)

SimSpec. Ruddick et al. (2006) (turbid)

Your NIR Residual (2023) (universal)

Remove Negative Spectra

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

Derived L2 Ocean Color Products

Save SeaBASS Files

Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report

HyperCP

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...

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 IOP-based BRDF correction (pending)

Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Add Cals Remove Cals

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) 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 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

SZA Minimum (deg) 15.0

SZA Maximum (deg) 60.0

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

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

Level 2 Ensembles

Extract Cruise Stations

Ensemble Interval (secs; 0=None) 300

Enable Percent Lt Calculation

Percent Lt (%) 10.0

Level 2 Sky/Sunglint Correction (ρ)

Mobley (1999) ρ 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)

Your NIR Residual (2023) (universal)

Remove Negative Spectra

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

Derived L2 Ocean Color Products

Save SeaBASS Files

Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

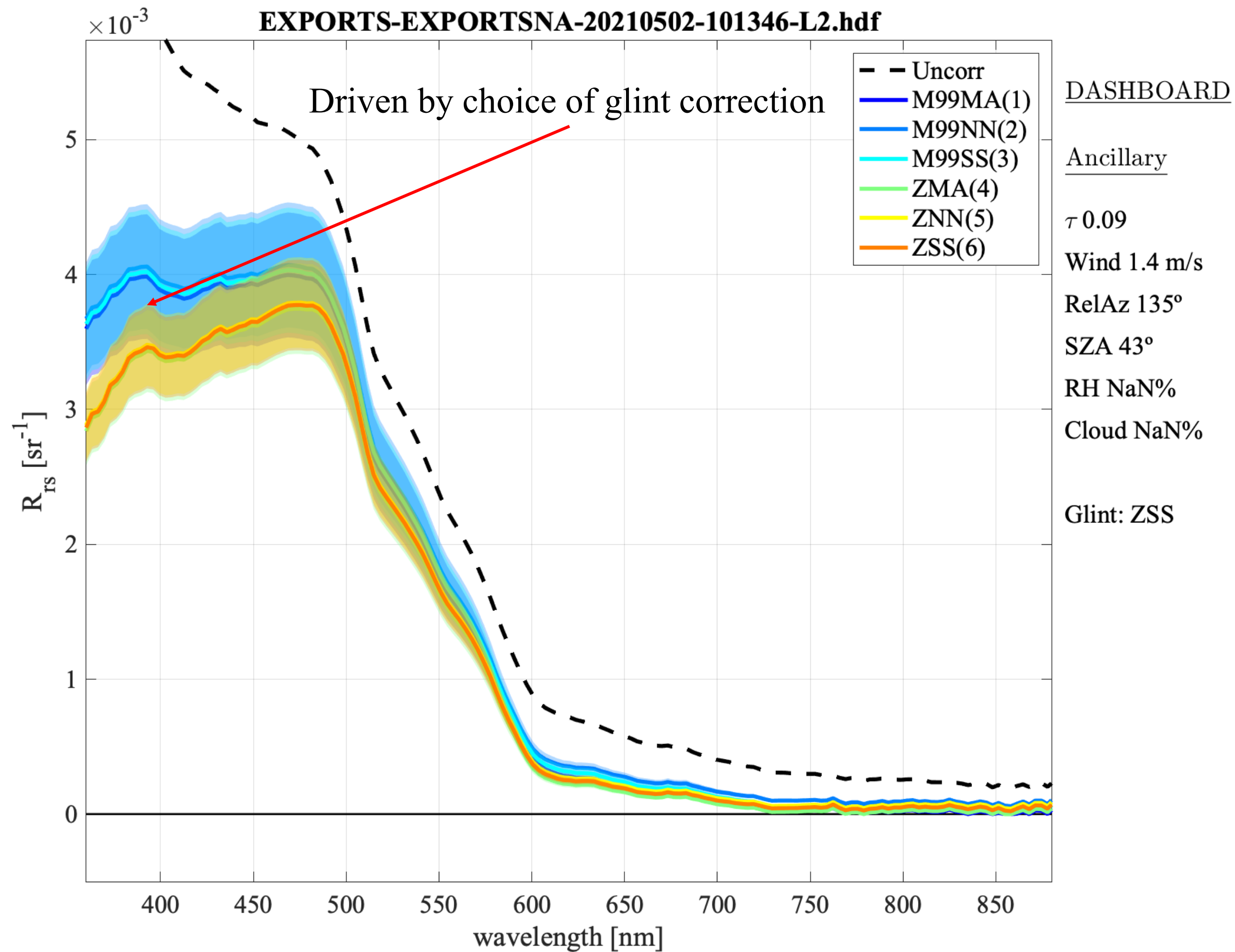
Write PDF Report

HyperCP

Save/Close Save As Cancel



HyperCP



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

Glint Correction:

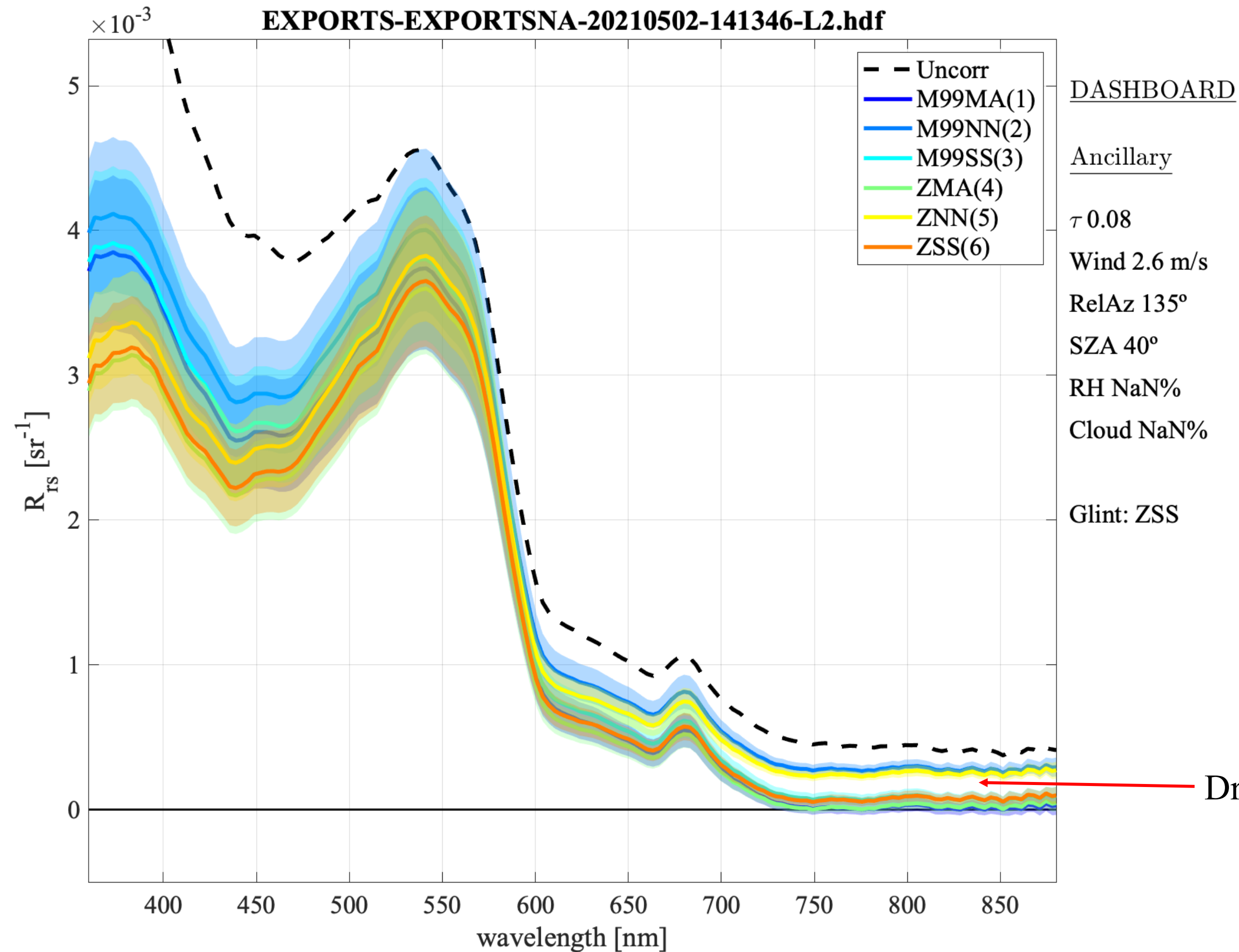
- **M99**: Mobley 1999
- **Z**: Zhang et al. 2017

NIR Residual Glint Correction:

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



HyperCP



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

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 -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 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

SZA Minimum (deg) 15.0

SZA Maximum (deg) 60.0

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

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

L2 Ensembles

Extract Cruise Stations

Ensemble Interval (secs; 0=None) 300

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

Derived L2 Ocean Color Products

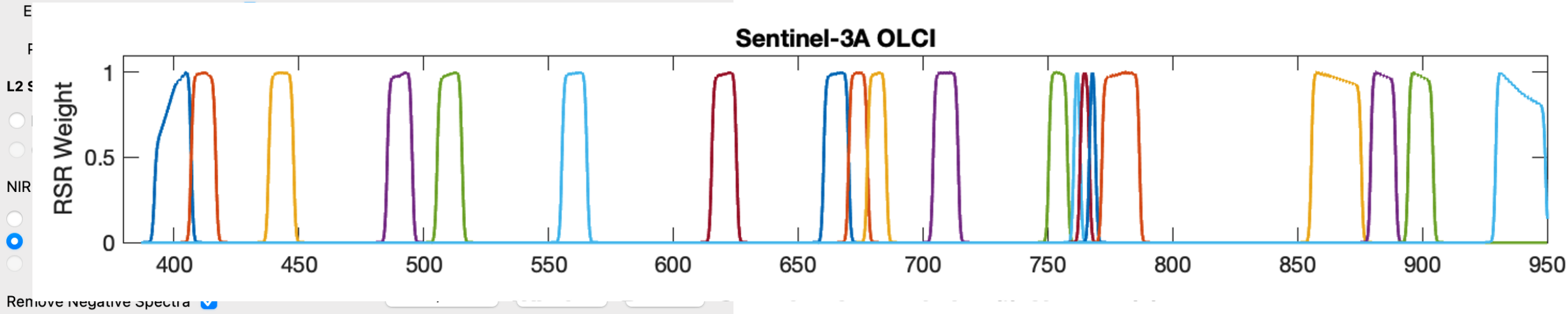
Save SeaBASS Files

Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report

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 Geophysical and Inherent Optical Properties

Descriptions of the algorithms used to derive these products can be found at [NASA's Ocean Color Web](#)

Algorithms requiring satellite bands will activate MODIS Aqua waveband convolution processing in L2

Radiometric Quality

WeiQA (Wei et al. 2016) ☒

AVW (Vandermuelen et al. 2020) ☒

QWIP (Dierssen et al. 2022) ☒

Expirical Algorithms

chlor_a ☒

PIC ☐

POC ☒

Kd490 ☒

iPAR ☒

GOCAD (Aurin et al. 2018) ☒

ag(275, 355, 380, 412, 443, 488) ☒

Sg(275, 300, 350, 380, 412) ☒

doc ☒

Semi-analytical Algorithms

GIOP ☐

a ☐

adg ☐

adg_S ☐

aph ☐

aph_S ☐

bb ☐

bbp ☐

bbp_S ☐

QAA ☒

a ☒

adg ☒

aph ☒

b ☒

bb ☒

bbp ☒

c ☒

Save/Close

Cancel

Configuration: sample_SEABIRD_pySAS.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

Default AOD(550) 0.5

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

☐ 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

SAZ Minimum (deg) 15.0

SAZ Maximum (deg) 60.0

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

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 correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

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 ☒ Zhang et al. (2017) p

☐ Groetsch et al. (2017) ☐ Your Glint (2023) p

NIR Residual Correction ☒

☐ Mueller and Austin (1995) (blue water)

☒ SimSpec. Ruddick et al. (2006) (turbid)

☐ Your NIR Residual (2023) (universal)

Remove Negative Spectra ☒

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 ☒

Derived L2 Ocean Color Products

Save SeaBASS Files ☒

Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report ☒

Save/Close

Save As

Cancel

HyperCP Output: SeaBASS & HDF5

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

Editing: sample_TRIOS_NOTRACKER.hdr

Separate multiple entries with commas, and replace spaces with underscores. For input assistance, go to [SeaBASS Metadata Headers](#)

ENTRIES NOT IN BOLD BELOW CAN BE CAPTURED FROM THE ANCILLARY SEABASS FILE AND CONFIGURATION

SeaBASS submission verion (e.g. 'R1', 'R2')

R1

To match fields to existing SeaBASS entries, check the 'Lists' pull-down menu [here](#).

Investigators

SherlockHolmes,JohnWatson

affiliations

221bBakerStr

contact

john.h.watson@bakerst.org

experiment

StudyInScarlet

cruise

BrixtonRoad

platform/ship

Brougham

documents

README.md

instrument_manufacturer

TriOS

instrument_model

RAMSES

calibration_date (YYYYMMDD)

20220627

calibration_files

ni,Back_SAM_8595.dat,Cal_SAM_8595.dat

data_type

above_water

data_status (e.g. preliminary)

preliminary

water_depth (use -9999 for missing)

NA

measurement_depth

0

cloud_percent

NA

wave_height

NA

secchi_depth

NA

ENTRIES BELOW ARE EXTRACTED FROM CONFIGURATION AND DATA

Config Comments (lead with !)

! HyperInSPACE vers = 1.2.2

! HyperInSPACE Config = sample_TRIOS_NOTRACKER.cfg

! Rotator Home Angle = 0.0

! Rotator Delay = 2.0

! Pitch/Roll Filter = Off

! Max Pitch/Roll = 5.0

! Rotator Min/Max Filter = Off

Other Comments (lead with !)

! Sample dataset for TriOS triplet with no GPS or sun tracker.

! FRM4SOC-2 Field InterComparison Experiment (FICE)

! July 11 - 21, 2022

! Acqua Alta Oceanographic Tower

station (RAW filename if blank)

data_file_name

original_file_name

start_date (RAW data should be in GMT)

end_date [GMT]

start_time [GMT]

end_time [GMT]

north_latitude [dec deg]

south_latitude

east_longitude

west_longitude

wind_speed

NA

Open/Copy

Save

Save As

Cancel

Configuration: sample_SEABIRD_pySAS.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

Default AOD(550)

0.5

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

☐ 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

SAZ Minimum (deg)

15.0

SAZ Maximum (deg)

60.0

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

Significant Es(480) (uW cm^-2 nm^-1)

2.0

Dawn/Dusk Es(470/680)<

1.0

Rain/Humid. Es(720/370)<

1.095

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 ☒

Derived L2 Ocean Color Products

Save SeaBASS Files ☒

Edit SeaBASS Header

sample_SEABIRD_pySAS.hdr

Write PDF Report ☒

Level 2 Processing

Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

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

☒ Zhang et al. (2017) p

☐ Groetsch et al. (2017)

☐ Your Glint (2023) p


NIR Residual Correction ☒

☐ Mueller and Austin (1995) (blue water)

☒ SimSpec. Ruddick et al. (2006) (turbid)

☐ Your NIR Residual (2023) (universal)

Remove Negative Spectra ☒



HyperCP

Save/Close

Save As

Cancel

L2 Output

Data and Reports

HyperCP HDF5 Files



Recent Files

/Users/daurin/GitRepos/HyperInSPACE/Data/Sample_Data/L2/SAMPLE_SEABIRD_pySAS_L2.hdf

SAMPLE_SEABIRD_pySAS_L2.h...

ANCILLARY

AOD

CLOUD

COURSE

HEADING

LATITUDE

LONGITUDE

PITCH

POINTING

REL_AZ

ROLL

SALINITY

SOG

SOLAR_AZ

SST

STATION

SZA

WAVE_HT

WINDSPEED

DERIVED_PRODUCTS

IRRADIANCE

RADIANCE

REFLECTANCE

Ensemble_N

Rrs_HYPER

Rrs_HYPER_unc

Rrs_HYPER_uncorr

Rrs_MODISA

Rrs_MODISA_unc

Rrs_MODISA_uncorr

nLw_HYPER

nLw_HYPER_unc

nLw_MODISA

nLw_MODISA_unc

nir_HYPER

nir_nLw_HYPER

rho_HYPER

Object Attribute Info

General Object Info

Attribute Creation Order: Creation Order NOT Tracked

Number of attributes = 5

Add Attribute

Remove Attribute

Name	Type	Array Size	Value[50](...)
GLINT_CORR	String, length = 11, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII	Scalar	Mobley 1999
NEGATIVE_VALUE_FILTER	String, length = 2, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII	Scalar	ON
NIR_RESID_CORR	String, length = 24, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII	Scalar	Ruddick et al. 2005/2006
Rrs_UNITS	String, length = 4, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII	Scalar	1/sr
nLw_UNITS	String, length = 13, padding = H5T_STR_NULLPAD, cset = H5T_CSET_ASCII	Scalar	uW/cm^2/nm/sr

HDFView 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



HyperCP

```
BogieAndBacall_TheBigSleep_WarnerBros_HyperSAS_20160520_070223_L2_Rrs_R0.sb
! ES Light Window = 5
! ES Dark Sigma = 3.2
! ES Light Sigma = 3.5
! LI Dark Window = 11
! LI Light Window = 5
! LI Dark Sigma = 3.4
! LI Light Sigma = 3.0
! LT Dark Window = 11
! LT Light Window = 5
! LT Dark Sigma = 3.5
! LT Light Sigma = 3.2
! Wavelength Interp Int = 3.3
! Default Wind = 5.0
! Default AOD = 0.5
! Default Salt = 35.0
! Default SST = 26.0
! Max Wind = 10.0
! Min SZA = 20.0
! Max SZA = 60.0
! Spectral Filter = On
! Filter Sigma Es = 5.0
! Filter Sigma Li = 8.0
! Filter Sigma Lt = 3.0
! Meteorological Filter = Off
! Cloud Flag = 1.0
! Es Flag = 2.0
! Dawn/Dusk Flag = 1.0
! Rain/Humidity Flag = 1.095
! Ensemble Interval = 300
! Percent Lt Filter = On
! Percent Light = 10.0
! Glint Correction = Mobley 1999
! NIR Correction = Mueller and Austin 1995
! Remove Negatives = On
! DateTime Processed = Fri Jun 2 11:28:12 2023
!
! HyperSAS with Sea-Bird SolarTracker
! Collected around Korean peninsula on RV Onnuri in association with KORUS-OC campaign
KR_2016
/
fields=date,time,lat,lon,RelAz,SZA,AOT,cloud,wind,Rrs353.2,Rrs356.5,Rrs359.8,Rrs363.1,
Rrs376.3,Rrs379.6,Rrs382.9,Rrs386.2,Rrs389.5,Rrs392.8,Rrs396.1,Rrs399.4,Rrs402.7,
Rrs406.0,Rrs409.3,Rrs412.6,Rrs415.9,Rrs419.2,Rrs422.5,Rrs425.8,Rrs429.1,Rrs432.4,
Rrs435.7,Rrs439.0,Rrs442.3,Rrs445.6,Rrs448.9,Rrs452.2,Rrs455.5,Rrs458.8,Rrs462.1,
Rrs465.4,Rrs468.7,Rrs472.0,Rrs475.3,Rrs478.6,Rrs481.9,Rrs485.2,Rrs488.5,Rrs491.8,
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Rrs524.8,Rrs528.1,Rrs531.4,Rrs534.7,Rrs538.0,Rrs541.3,Rrs544.6,Rrs547.9,Rrs551.2,
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Rrs703.1,Rrs706.4,Rrs709.7,Rrs713.0,Rrs716.3,Rrs719.6,Rrs722.9,Rrs726.2,Rrs729.5,
Rrs732.8,Rrs736.1,Rrs739.4,Rrs742.7,Rrs746.0,Rrs749.3,Rrs752.6,Rrs755.9,Rrs759.2,
Rrs762.5,Rrs765.8,Rrs769.1,Rrs772.4,Rrs775.7,Rrs779.0,Rrs782.3,Rrs785.6,Rrs788.9,
Rrs792.2,Rrs795.5,Rrs798.8,Rrs802.1,Rrs805.4,Rrs808.7,Rrs812.0,Rrs815.3,Rrs818.6,
Rrs821.9,Rrs825.2,Rrs828.5,Rrs831.8,Rrs835.1,Rrs838.4,Rrs841.7,Rrs845.0,Rrs848.3,
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Rrs969.4,Rrs972.7,Rrs976.0,Rrs979.3,Rrs982.6,Rrs985.9,Rrs989.2,Rrs992.5,Rrs995.8,
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Rrs1843.8,Rrs1847.1,Rrs1850.4,Rrs1853.7,Rrs1857.0,Rrs1860.3,Rrs1863.6,Rrs1866.9,
Rrs1870.2,Rrs1873.5,Rrs1876.8,Rrs1880.1,Rrs1883.4,R
```


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 spec
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

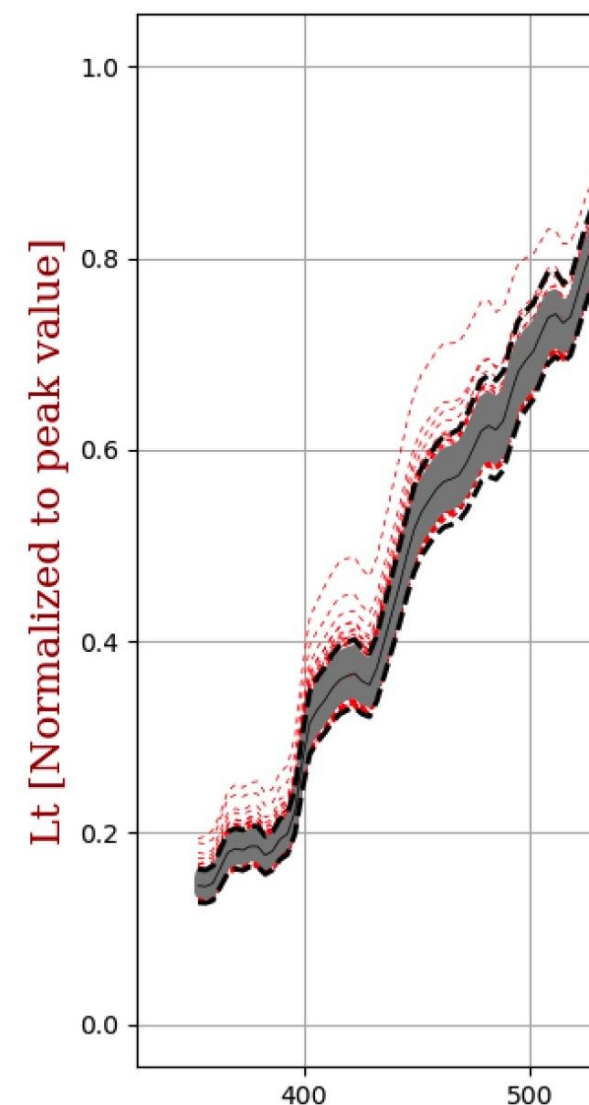
Length of dataset after removal 1022 long: 5% removed

Remove ANCILLARY Data

Length of dataset prior to removal 1076 long

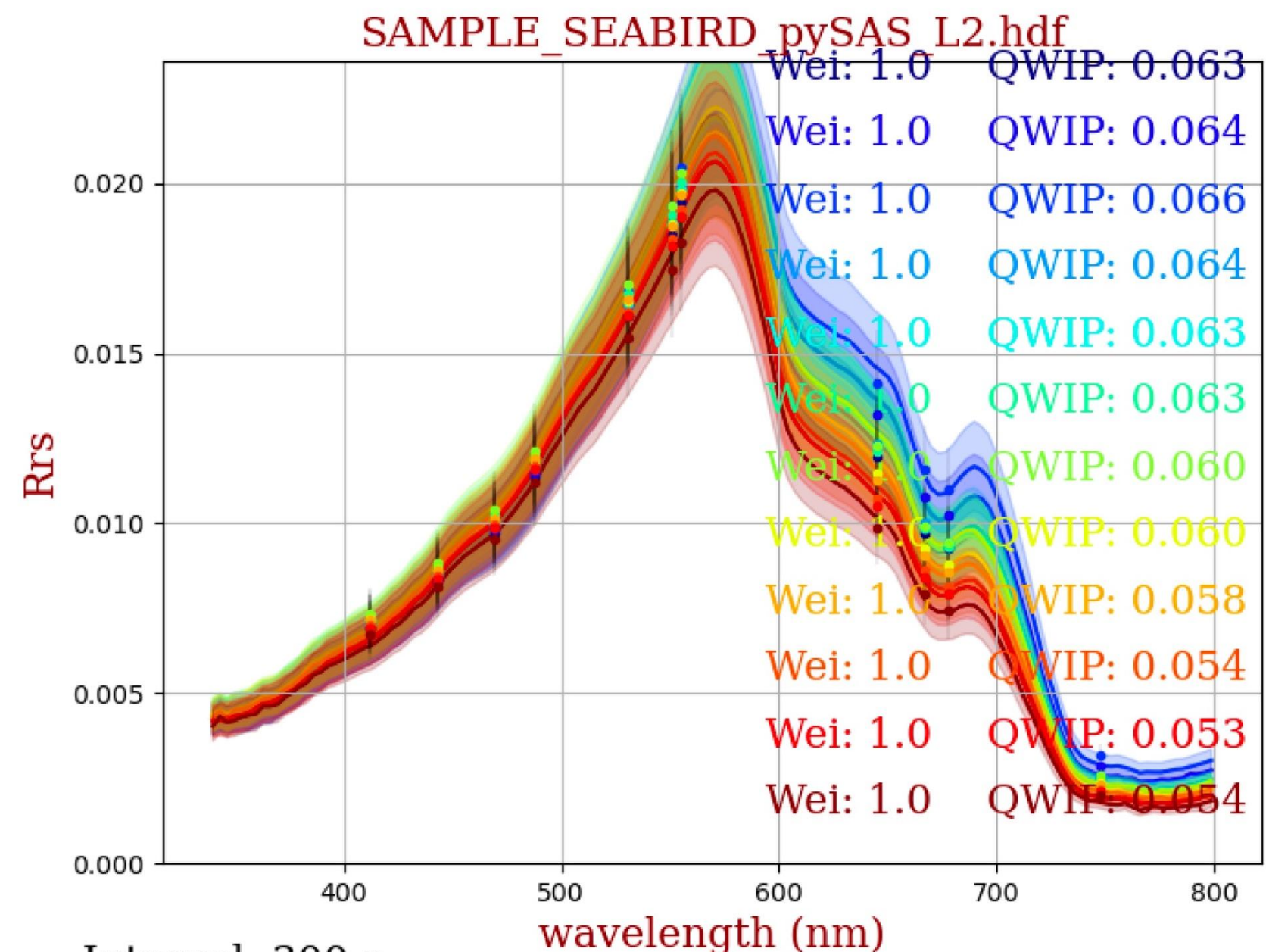
Length of dataset after removal 1022 long: 5% removed

L1BQC Spectral Filter



File: SAMPLE_SEABIRD_pySAS Collected: Sat May 01 05:54:30 2021

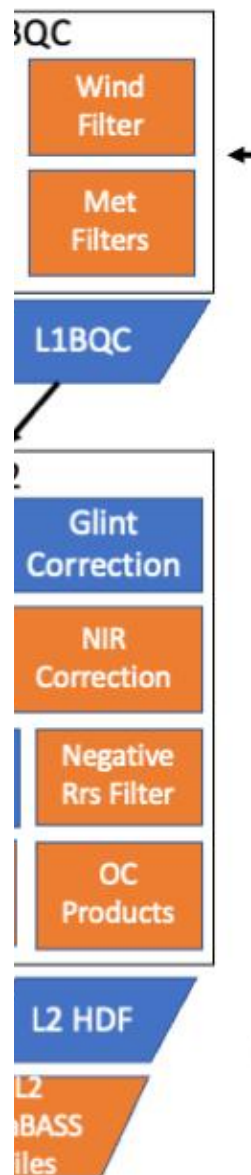
L2 Ensembles Rrs with uncert., convolutions, scores...



GUI or CLI

v1.2

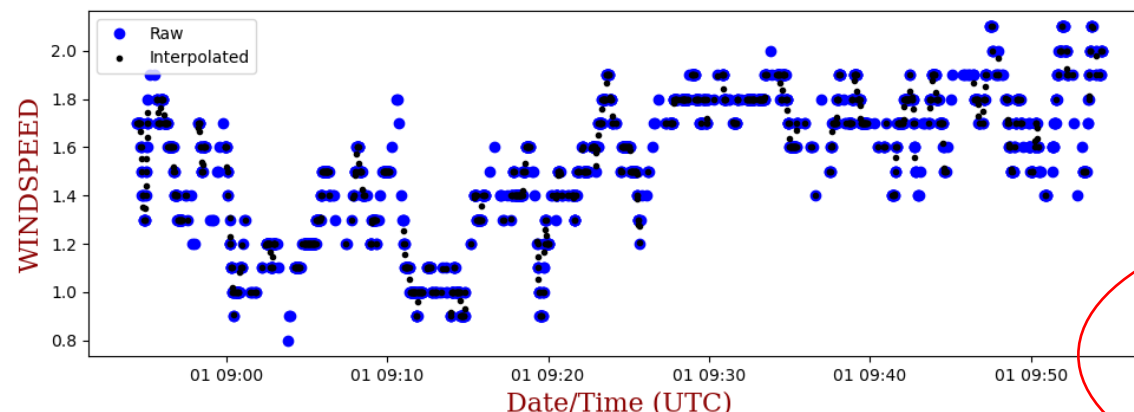
HyperCP



HyperCP Plots for Diagnostics and QC



HyperCP



can fill in wind for M9 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/correction regime:

☒ Factory ☐ Class-based

☐ Full Characterization: [Choose input characterization directory](#)

Interpolation Interval (nm) 3.3
Generate Plots (NASA/Plots/L1B_Interp/) ☒
Plot Interval (nm) 20.0

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) ☒ 1.0
Absolute Rotator Angle Filter ☒
Rotator Angle Min -126.0
Rotator Angle Max 42.0
Relative Solar Azimuth Filter ☒
Rel Angle Min 89.0
Rel Angle Max 136.0
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) 20.0
SZA Maximum (deg) 60.0

Level 2 Processing

Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

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 ☐ Zhang et al. (2017) p
☐ Groetsch et al. (2017) ☐ Your Glint (2023) p

Level 2 Products

Convolve to Satellite Bands:
AQUA * ☒ Sen-3A ☒ V-I
TERRA ☐ Sen-3B ☐ V-J

* Automatic for Derived Products

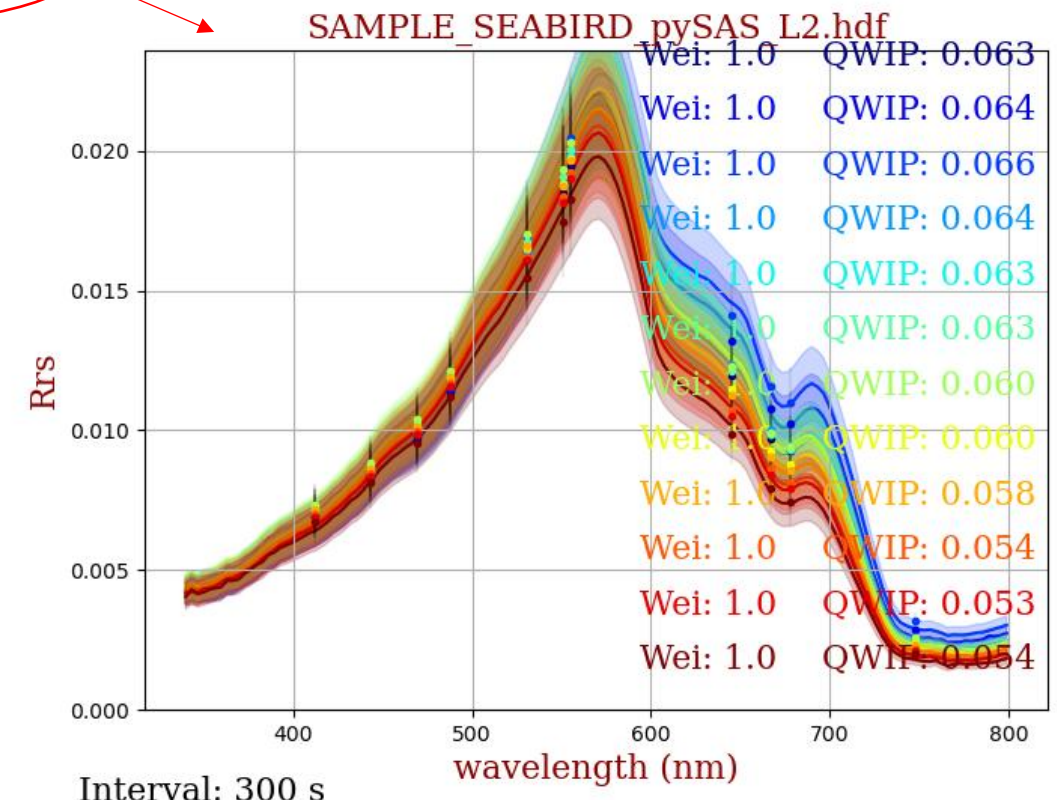
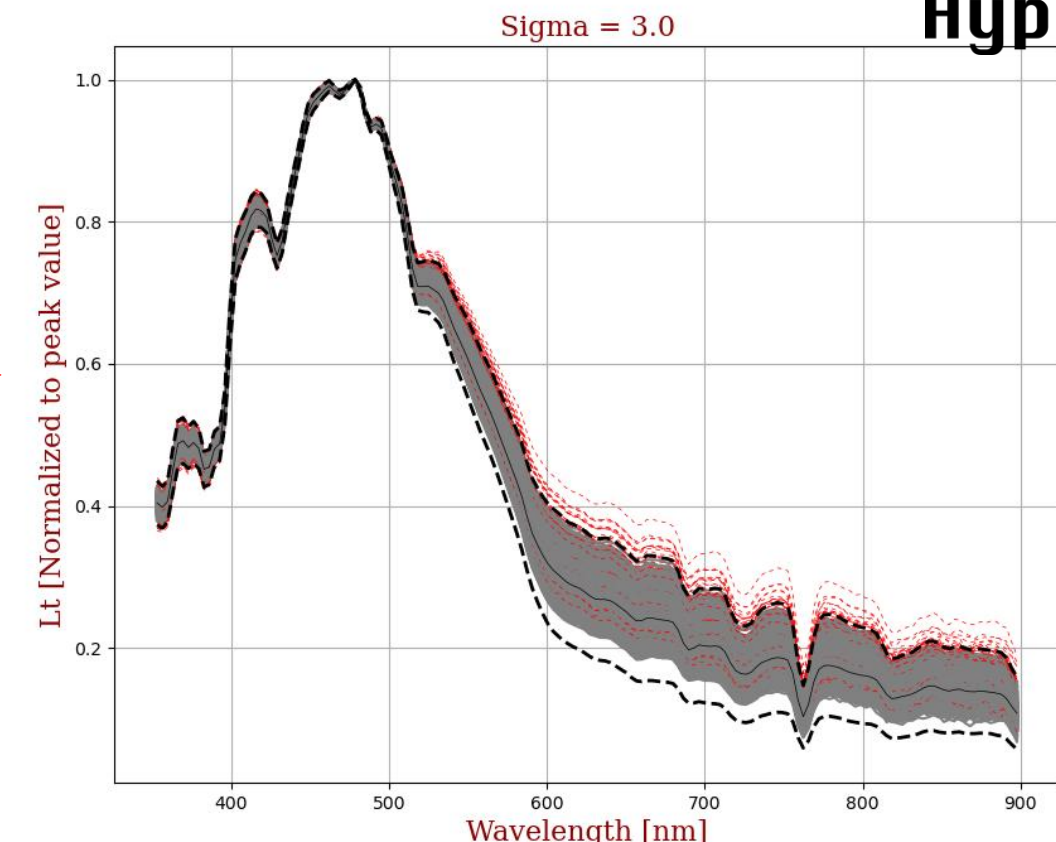
Generate Spectral Plots
Rrs ☒ nLw ☒ Es ☒ Li ☒

Derived L2 Ocean Color Product

Save SeaBASS Files ☒
Edit SeaBASS Header

FICE22.hdr
Write PDF Report ☒

Save/Close Save As



HyperCP Data Directory Overview

Chosen Data Output Folder (Main Window)

Anc

Class_Bas...terizations

Img

Photos

Sample_Data

HMODISA_RSRs.txt

HMODIST_RSRs.txt

hybrid_ref...ith_unc.nc

MERIS_RSRs_avg.txt

OLCIA_RSRs.txt

OLCIB_RSRs.txt

rhoTable_AO1999.hdf

rhoTable_AO1999.txt

Thuillier_F0.sb

VIIRS1_RSRs.txt

VIIRSN_ID..._RSRs.txt

Water_Absorption.sb

Zhang_rho_db.mat

L1A

L1AQC

L1B

L1BQC

L2

Photos

Plots

RAW

Reports

SAMPLE_...ncillary.sb

SAMPLE_...ncillary.sb

SAMPLE_...ncillary.sb

SAMPLE_...ncillary.sb

SeaBASS

FRM4SOC2_FICE22_UT_20220719_080000_L2.hdf

FRM4SOC2_FICE22_UT_20220719_082000_L2.hdf

SAMPLE_SEABIRD_NOTRACKER_L2.hdf

SAMPLE_SEABIRD_pySAS_L2.hdf

SAMPLE_SEABIRD_SOLARTRACKER_L2.hdf

BogieA

BogieA

Maltes

Maltes

Maltes

Maltes

OTR_S

OTR_S

StudyIn

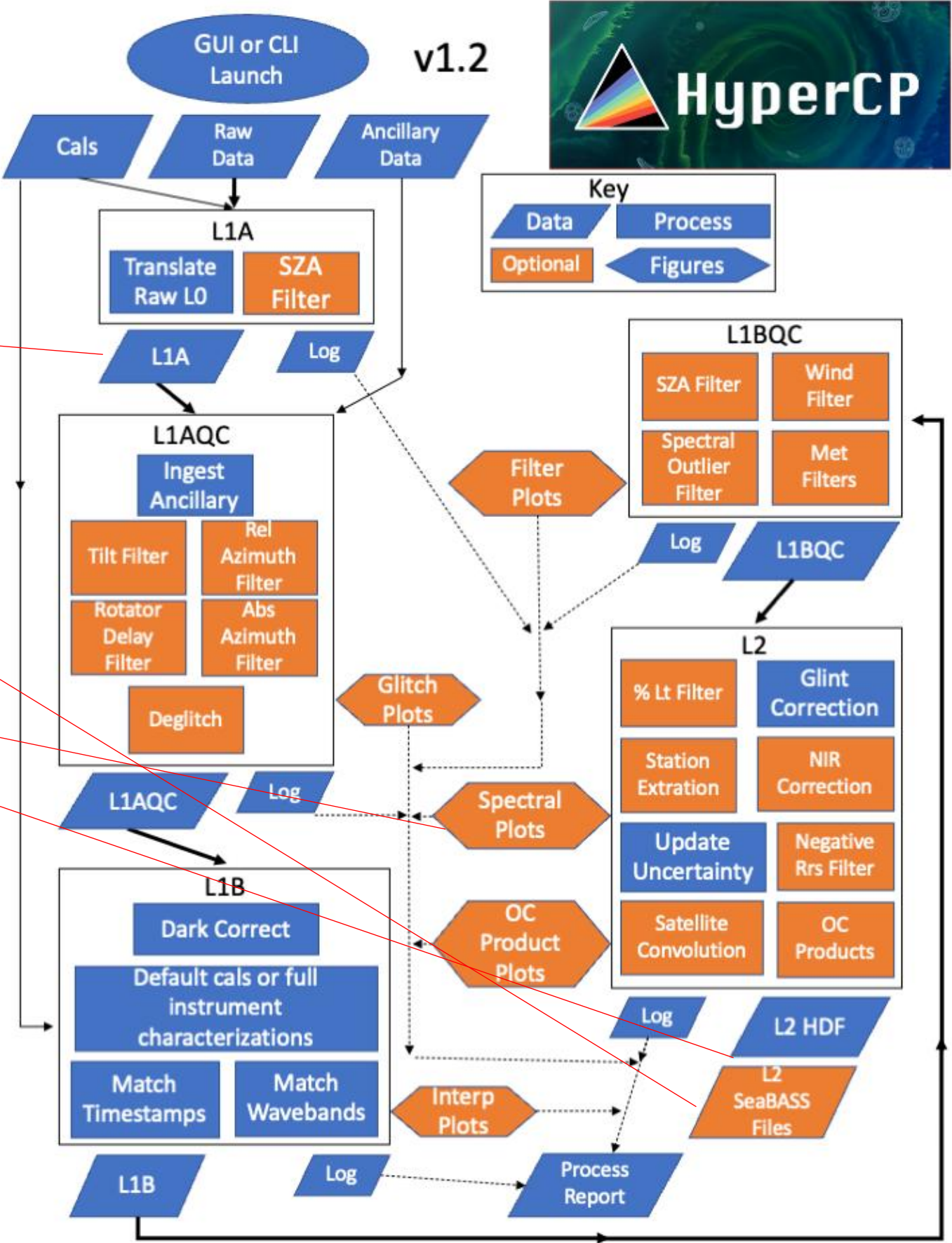
StudyIn

StudyIn

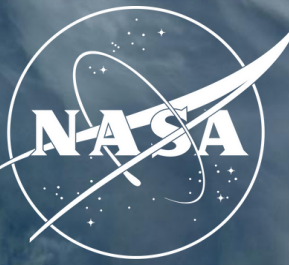
StudyIn

StudyIn

StudyIn



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

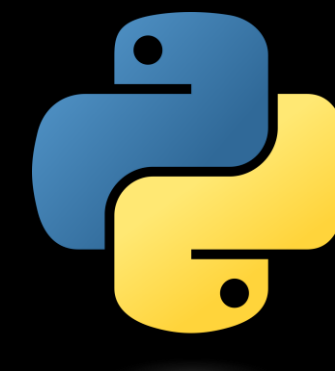
```
> git pull
```



Don't forget to activate the environment before you run:

```
> conda activate hypercp
```

```
> python Main.py
```



We encourage you to report Issues or start Discussions on GitHub!



