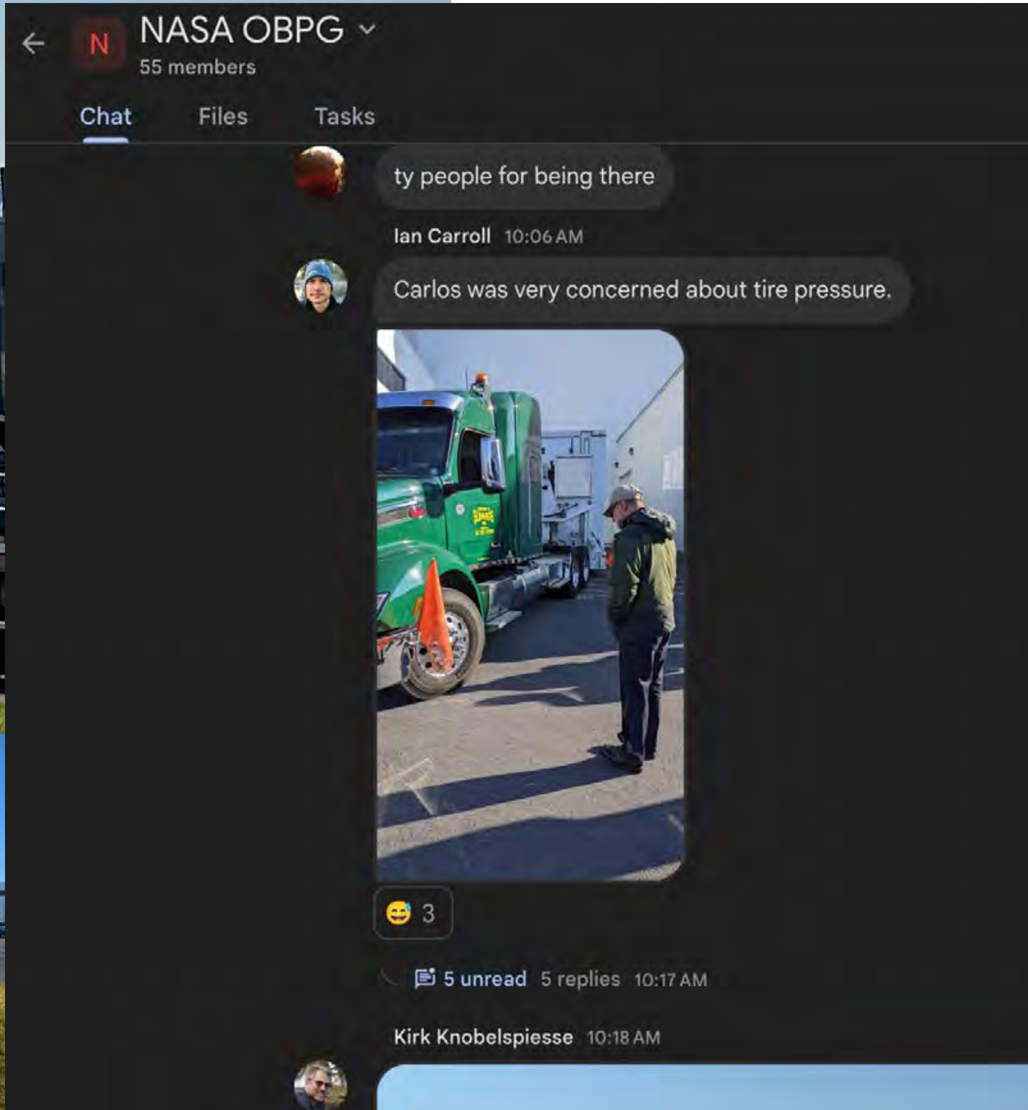
Happening right now!!

PACE departs Goddard for FL



ty people for being there

Ian Carroll 10:06 AM

Carlos was very concerned about tire pressure.

😅 3

5 unread 5 replies 10:17 AM

Kirk Knobelspiesse 10:18 AM

HyperCP

(Hyperspectral In situ Support for PACE Community Processor)

Training Session 6

2PM – 5PM

International Ocean Colour Science Meeting 2023 | Advancing Global Ocean Colour Observations

Funding is provided by the NASA PACE Mission and the Copernicus Programme

Instructors

Dirk Aurin, Ph.D.
Senior Research Scientist
NASA Goddard Space Flight Center
Morgan State University
Maryland, USA

Juan Ignacio Gossn, Ph.D.
Project Officer/Remote Sensing Scientist
EUMETSAT
TSS/RSP Division
Darmstadt, Germany

Agnieszka Bialek, Ph.D.
Senior Research Scientist
National Physical Laboratory
Middlesex, UK

Hayley Evers-King, Ph.D.
Lead Marine Applications Expert
EUMETSAT
OPS/USC Division
Darmstadt, Germany

HyperCP co-leads:

Dirk Aurin[1,2], Juan Ignacio Gossn [3,4]

HyperCP contributors:

Nathan Vandenberg [5]
Maycira Costa [5]
Alexis Deru [6]
Ashley Ramsey [7]
Agneiska Bialek [7]
Marine Bretagnon [6]
Gabriele Bai [6]
Nils Haëntjens [8]
Philipp Grötsch [9]

List of institutions/programs:

[1] NASA Goddard Space Flight Center
[2] Morgan State University
[3] EUMETSAT
[4] Copernicus Programme of European Commission
[5] University of Victoria
[6] ACRI-ST
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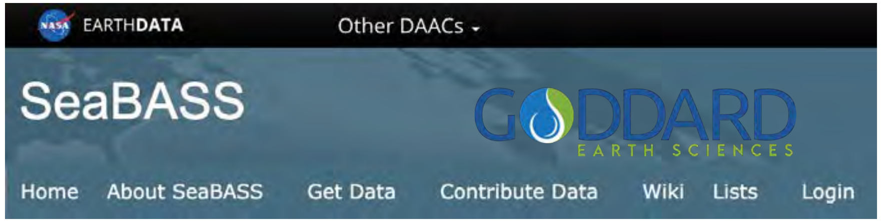
What is HyperCP?

HyperInSPACE (Hyperspectral In-situ Support for PACE) Community Processor

An **open-source** processor for **above water radiometry** from **autonomous** or **manually** operated **in situ** platforms that facilitates protocol-driven **data correction and reduction** yielding high-quality **surface reflectance** measurements with end-to-end **uncertainty** analysis. Results flow back from the community to NASA's **SeaBASS** and Copernicus' **OCDB** archives for use in satellite **validation** and ocean color **algorithm development**.



Ocean Colour In-Situ Database

European Commission

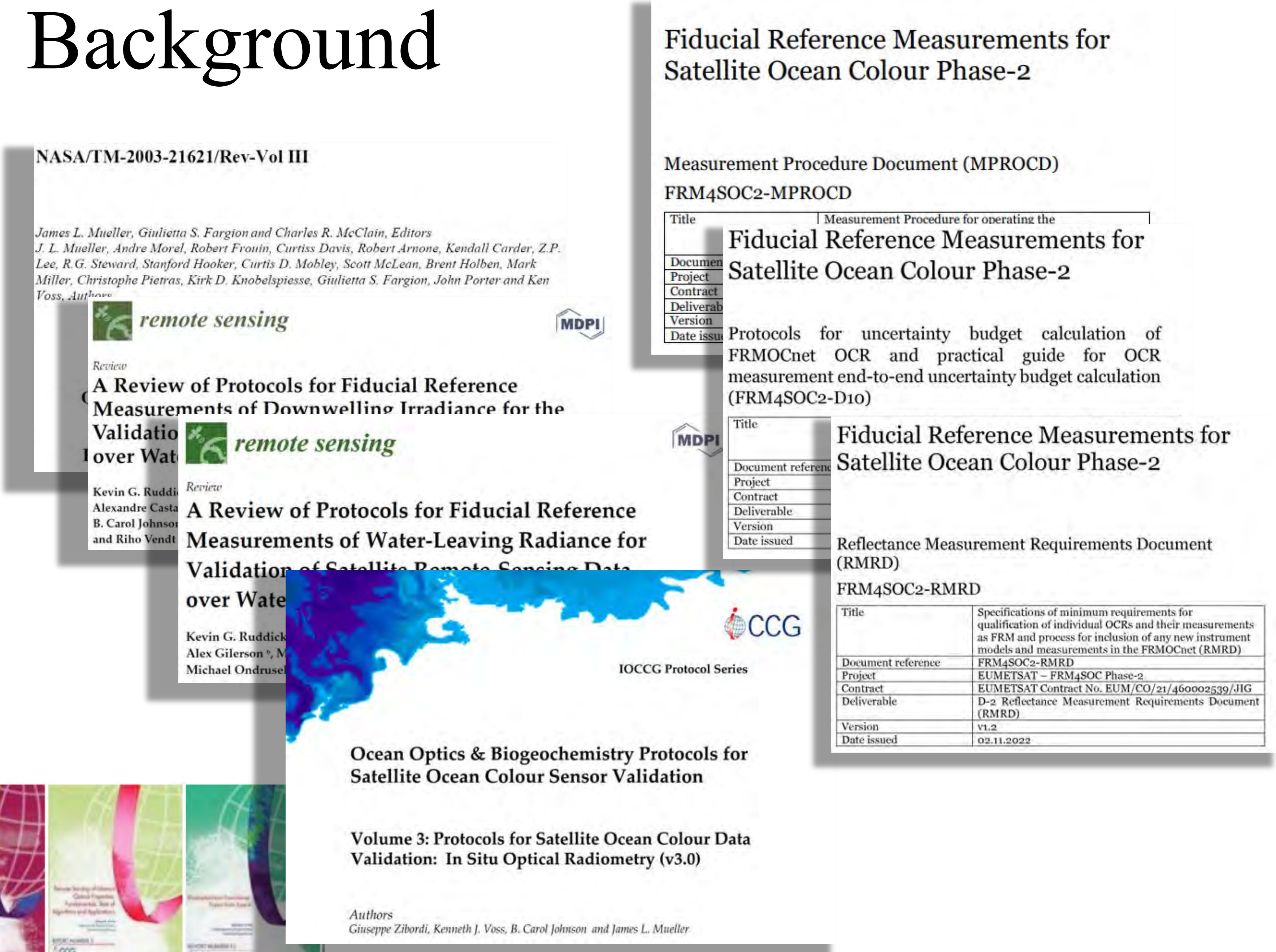
Copernicus Europe's eyes on Earth

EUMETSAT

Background

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. Mueller, Andre Morel, Robert Frouin, Curtiss Davis, Robert Arnone, Kendall Carder, Z.P. Lee, R.G. Steward, Stanford Hooker, Curtis D. Mobley, Scott McLean, Brent Holben, Mark Miller, Christophe Pietras, Kirk D. Knobelspiesse, Giulietta S. Fargion, John Porter and Ken Voss, Authors

remote sensing MDPI

Review
A Review of Protocols for Fiducial Reference Measurements of Downwelling Irradiance for the Validatio
over Wat

Kevin G. Ruddi
Alexandre Casta
B. Carol Johnson
and Riho Vendt

remote sensing MDPI

Review
A Review of Protocols for Fiducial Reference Measurements of Water-Leaving Radiance for Validation of Satellite Remote Sensing Data over Wate

Kevin G. Ruddick
Alex Gilerson, M
Michael Ondrusel

Fiducial Reference Measurements for Satellite Ocean Colour Phase-2

Measurement Procedure Document (MPROCD)

FRM4SOC2-MPROCD

Title	Measurement Procedure for operating the
Documen	
Project	
Contract	
Deliverab	
Version	
Date issu	

Fiducial Reference Measurements for Satellite Ocean Colour Phase-2

Protocols for uncertainty budget calculation of FRMOCnet OCR and practical guide for OCR measurement end-to-end uncertainty budget calculation (FRM4SOC2-D10)

Title	
Document referenc	
Project	
Contract	
Deliverable	
Version	
Date issued	

Fiducial Reference Measurements for Satellite Ocean Colour Phase-2

Reflectance Measurement Requirements Document (RMRD)

FRM4SOC2-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

IOCCG

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

Timeline

University of Victoria

PySciDon

Vandenberg Masters Thesis w/ M. Costa U. Victoria

β release

Transition from internal NASA testing to invited external release

NASA/FRM4SOC Meeting

GODDARD EARTH SCIENCES
EUMETSAT
NPL National Physical Laboratory
fiducial reference measurements for satellite ocean colour
ACRI ST

Discussed collaboration on HyperInSPACE to form a community processor compliant with FRM framework

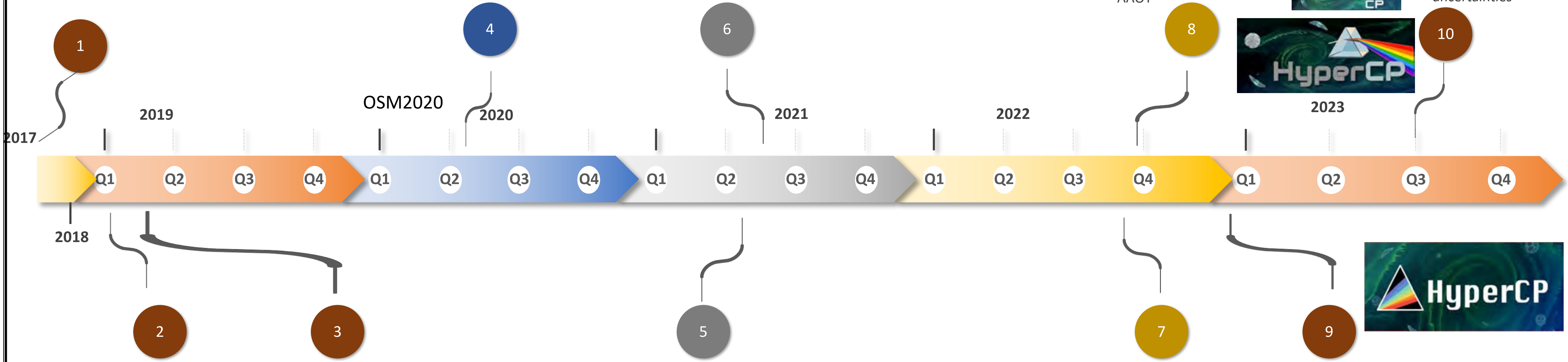
HyperCP for FICE-22

Identified for use in Field Intercomparison Experiment at AAOT

HyperCP v1.2.x release

FRM4SOC2 Updates incorporated:

TriOS
Full instrument characterization and uncertainties



Initiated at NASA Goddard to incorporate IOCCG draft protocols and other advancements in AWR

GODDARD EARTH SCIENCES

α release

Internal alpha version shared at NASA

NASA GitHub

Official NASA public release v1.0.x

https://github.com/nasa/HyperInSPACE

v1.1.x release

Structural overhaul to accommodate incoming updates from FRM4SOC:

To add TriOS
To add full instrument characterization and uncertainties

HyperCP Project Team Formed

Official collaboration guidelines adopted

Why HyperCP?

HyperCP

- Open source, Open science
- Multi-platform
- Collaborative and flexible
- Community resource
- Protocol driven (informed by scientific consensus) for satellite validation
  - Standardized
  - Adaptive

FRM4SOC

Fiducial Reference Measurements for Satellite Ocean Colour

Fiducial Reference Measurements for Satellite Ocean Colour

FRM4SOC Phase 1 2016 – 2019

- Funded and coordinated by ESA;
- In a series of several other FRM projects, https://frm4soc.org

FRM4SOC Phase 2 2021 – 2023, options for 2024 and 2025:

- Funded by the EC and coordinated by EUMETSAT;

https://frm4soc2.eumetsat.int/

FRM4SOC
@FRM4SOC · Follows you
FRM4SOC is a project to improve ocean colour data validation methods. The Phase 1 was funded by ESA. Phase 2 is funded by the EC and coordinated by EUMETSAT.

FRM4SOC Phase 2 objective:

- Develop foundations for **operational implementation of the FRM principles** by the Ocean Colour community, start with **in situ hyperspectral radiometry**;

- Verify and demonstrate the operations of the **FRM community framework**.

fiducial reference measurements for satellite ocean colour

https://frm4soc2.eumetsat.int

**Several tasks, one overarching goal:
to promote the adoption of FRM principles across the OC community**

1. Define the two most common hyperspectral OCR classes


Fiducial Reference Measurements for Satellite Ocean Colour Phase-2

TR: *Complete characterisation and calibration results for FRM4SOCnet OCR models and re-characterisation routine: an update*

(FRM4SOC2-D7)

2. Fully characterise a batch of OCRs

Parameter	Scope	Before initial use	Re-cal/char	D-2 requirement
1. Absolute calibration for radiometric responsivity	individual	required	1 year	IR1
2. Long term stability	individual	required	after every calibration	IR1
3. Stray light and out of band response	individual	required	3 – 5 years	IR2
4. Immersion factor (irradiance)	individual	required for under-water	after fore-optics modification	-
4b.Immersion factor (radiance)	individual/class-specific	required for under-water	after fore-optics modification	-
5. Angular response of irradiance sensors in air	individual	required	after fore-optics modification	IR3
6. Response angle (FOV) of radiance sensors in air	class-specific	recommended	after fore-optics modification	-
7. Non-linearity	class-specific	recommended	after repair in workshop	IR4
8. Accuracy of integration times	class-specific	recommended	after repair in workshop	IR4
9. Dark signal	individual	required	1 year	IR7
10. Thermal responsivity	class-specific	recommended	after repair in workshop	IR5
11. Polarisation sensitivity	class-specific	recommended	after repair in workshop	IR6
12. Temporal response	TBD	TBD	TBD	IR8
13. Wavelength scale	class-specific	recommended	after fore-optics modification	IR9
14. Signal-to-noise ratio	individual	recommended	1 year	-
15. Pressure effects	TBD	TBD	TBD	-

3. Community guidelines on radiometer cal/char schedules

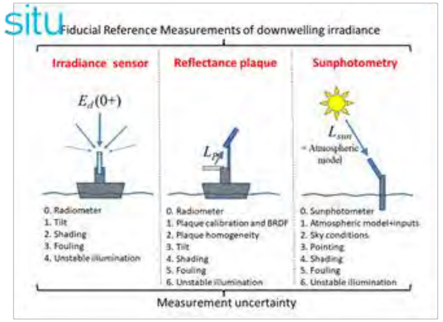
4. Develop OCR cal/char guidelines for laboratories, + an international lab exercise


Fiducial Reference Measurements for Satellite Ocean Colour Phase-2

Strategy plan for the secondary laboratory cal/char inter-comparison exercise and the definition and harmonisation of laboratory guidelines

(FRM4SOC2-D11)

5. Provide FRM in situ measurement procedures

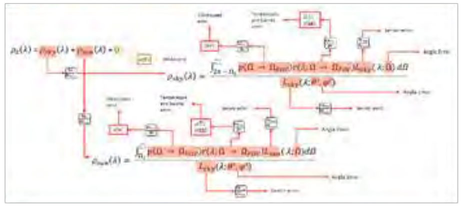


6. Develop a community processor for hyperspectral AWR

HyperCP

NASA
University of Victoria
EUMETSAT
ACRI ST
NPL
THE UNIVERSITY OF MAINE
MORGAN STATE UNIVERSITY
Gybe
opernicus Europe's eyes on Earth

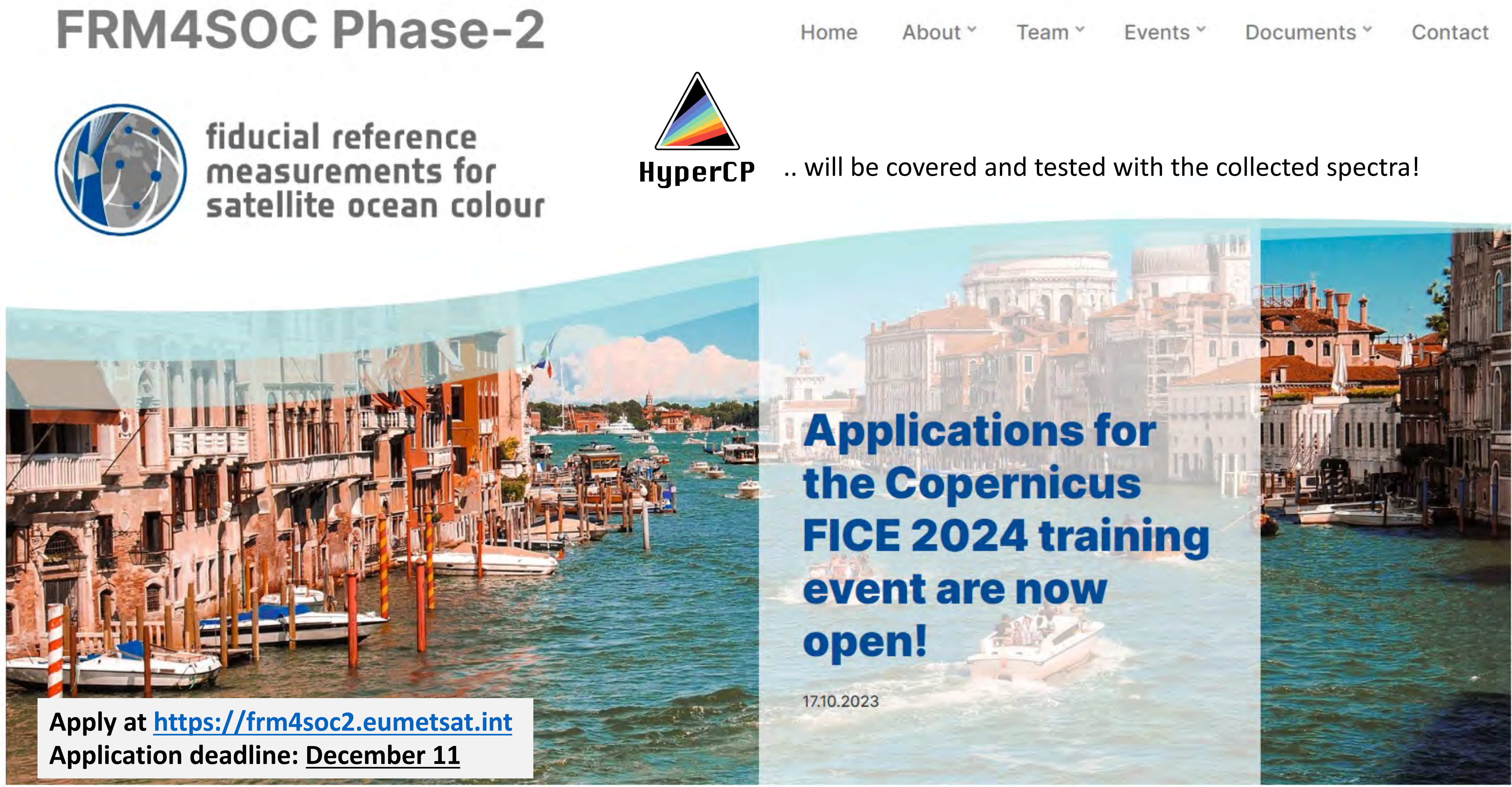
7. Develop a complete end-to-end uncertainty budget, to be included in HyperCP



8. Adapt and maintain Ocean Colour In-Situ Database OCDB

https://ocdb.eumetsat.int/

9. Review and test: a field experiment, an international workshop, Expert Review Board



FRM4SOC Phase-2

fiducial reference measurements for satellite ocean colour

HyperCP .. will be covered and tested with the collected spectra!

Applications for the Copernicus FICE 2024 training event are now open!

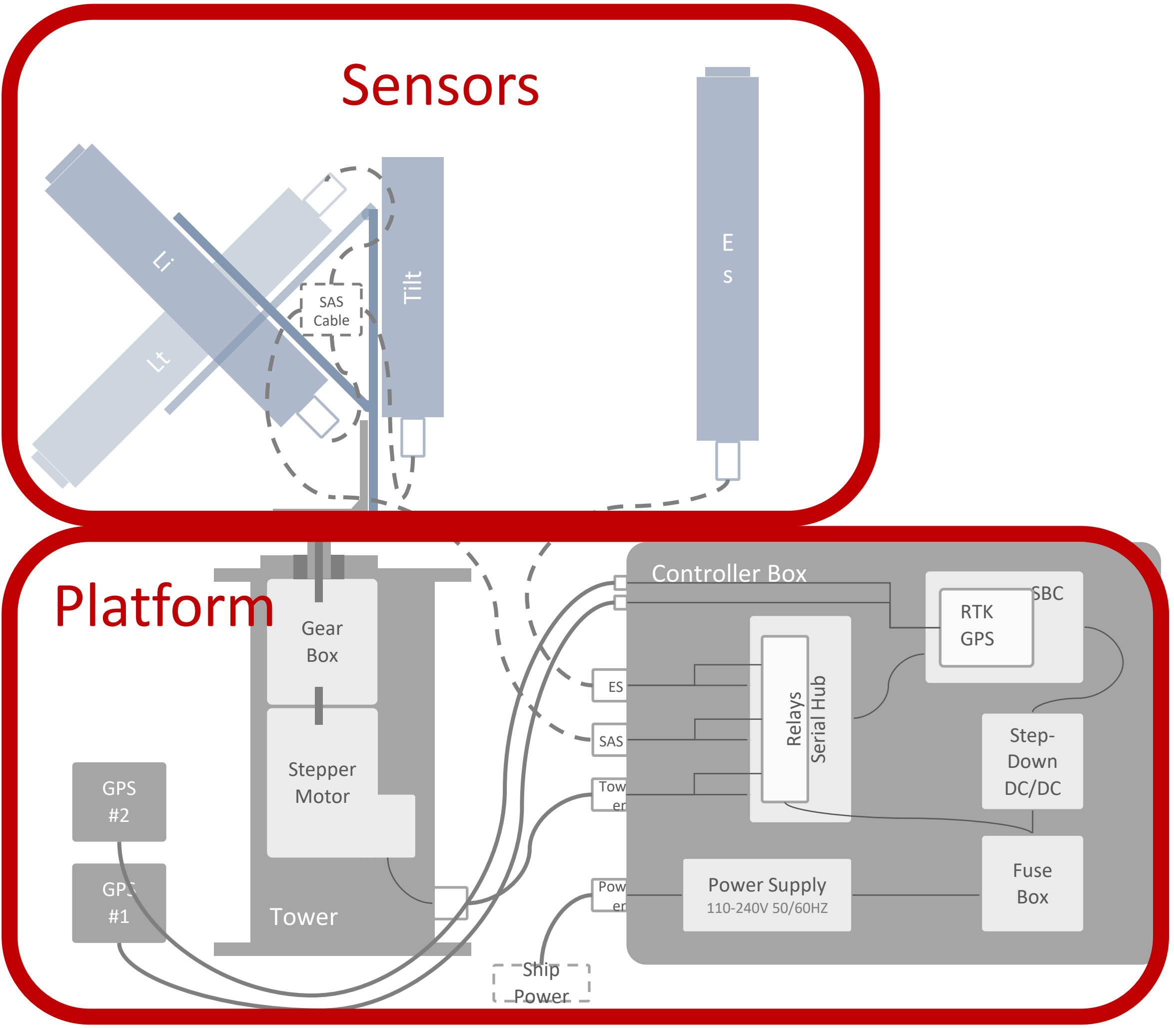
17.10.2023

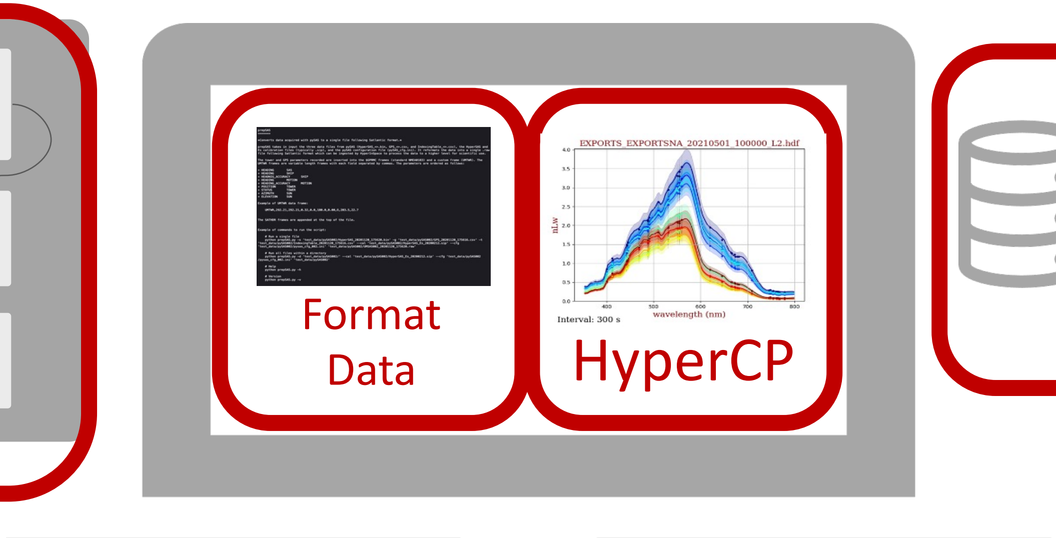
Apply at https://frm4soc2.eumetsat.int
Application deadline: December 11

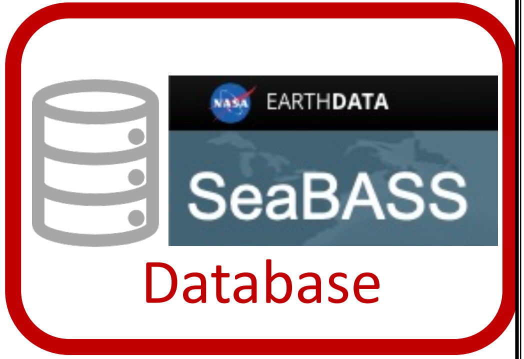
Above Water Radiometry (AWR) Principles and Theory

HyperCP Ecosystem

1. Supported Sensors:
   - Sea-Bird Scientific HyperOCR
   - TriOS RAMSES
2. Platforms:
   - Robotic: pySAS, Sea-Bird SolarTracker, Panthyr, So-Rad, …
   - Manual
3. Data Formatters: prepSAS, TriOS specific
4. Community Processor: HyperCP
5. Databases: SeaBASS, OCDB







Slide courtesy of Nils Haentjens (pySAS designer)

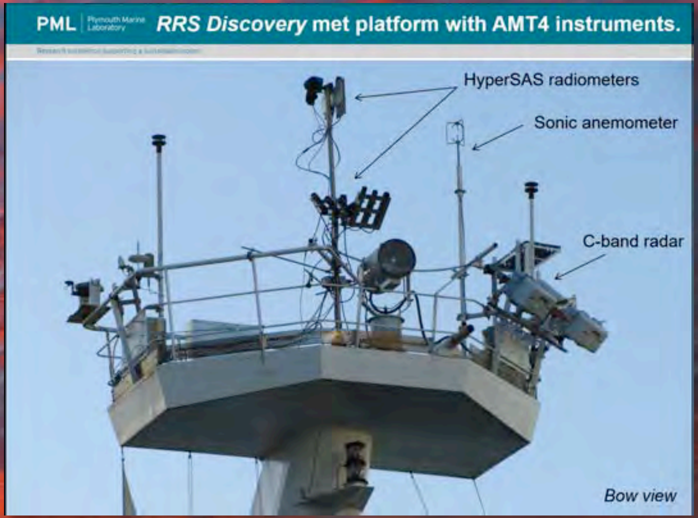
Manual Systems

pySAS

PANTHYR*

SoRad*

Manual Systems



pySAS

SolarTracker

SolarTracker

*not currently adapted within HyperCP

Water Leaving Radiance

Sea surface reflectance factor   Skylight radiance

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

Total upwelling radiance

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

Remote Sensing Reflectance

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

Sea surface irradiance

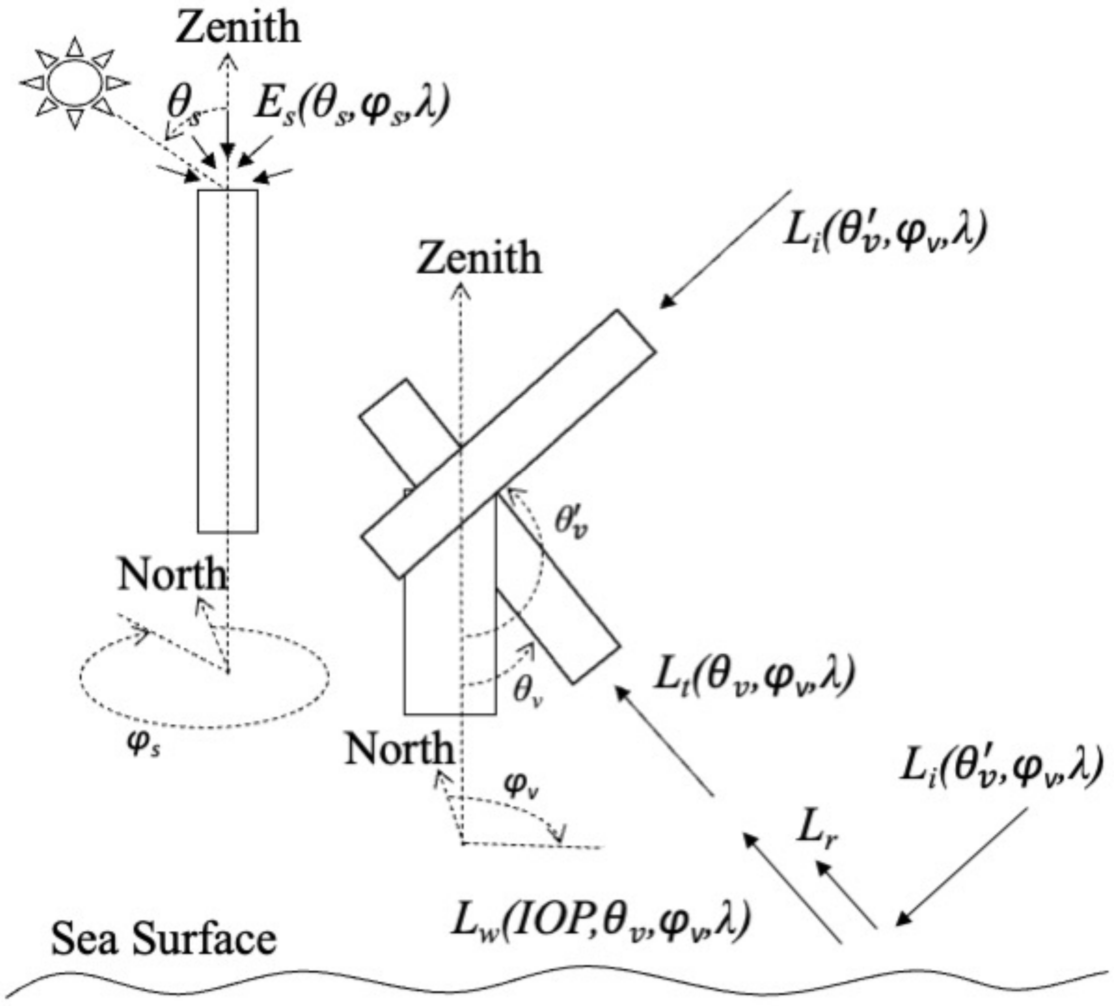
Normalized Water Leaving Radiance

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

TOA irradiance

Exact Normalized Water Leaving Radiance

Corrected for BRDF $nL_w^{ex}.$
(adjusted to $\boldsymbol{\theta}_s = 0$, $\boldsymbol{\theta}_v = 0$)



$$L_w(\theta_v,\varphi_v,\lambda) = L_t(\theta_v,\varphi_v,\lambda) \overbrace{- \underbrace{\rho(\theta_s,\varphi_s,\theta_v,\varphi_v,\lambda,\mathrm{W},\tau,\mathrm{T},\mathrm{S})} * L_i(\theta_v,\varphi_v,\lambda)}^{\text{Skyglint subtraction}}$$

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

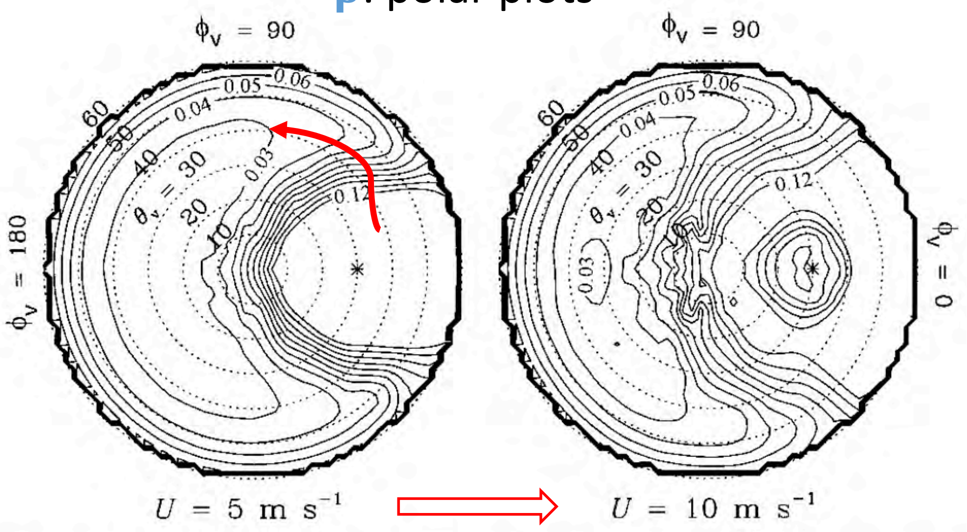
ρ is also slightly dependent on skylight polarization.

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

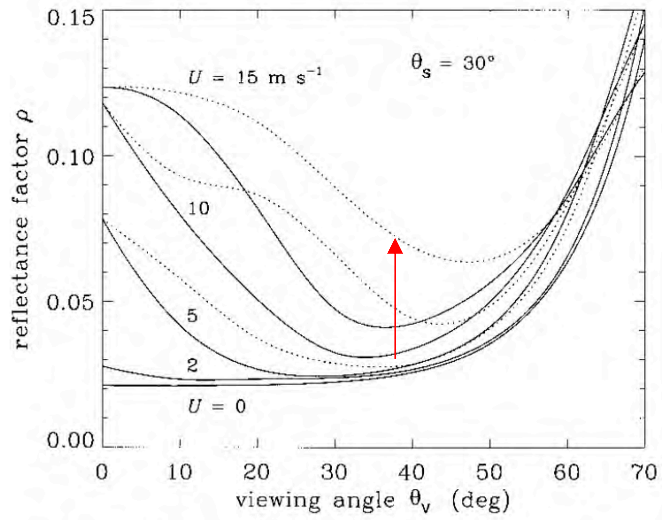
ρ is optimal (low) at φ_s in 90° – 135°.

However at φ_s = 135° superstructure perturbation is typically increased.

ρ: polar plots



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

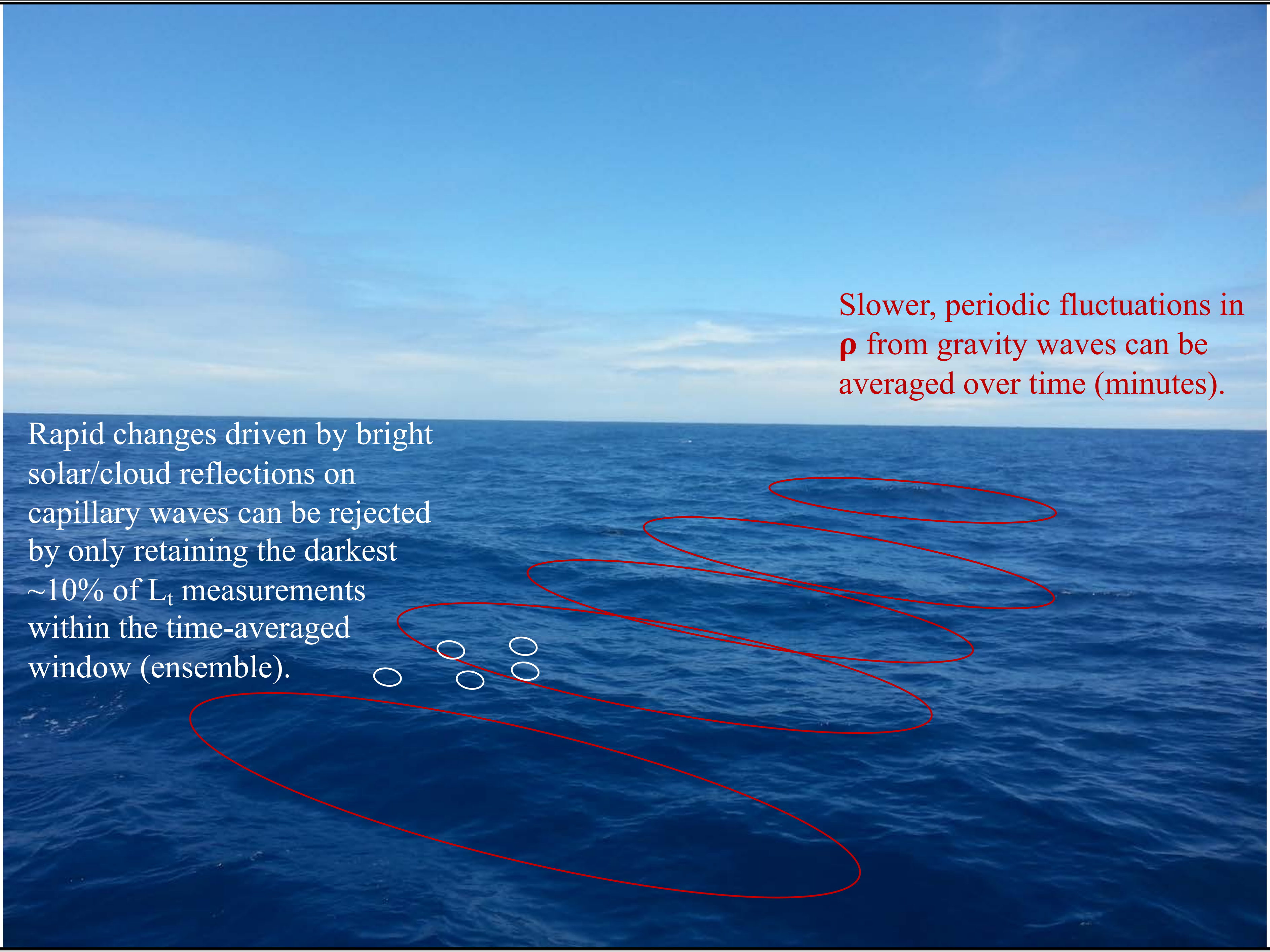


Figures adapted from Mobley 1999, Applied Optics

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.



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

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).

Other factors impacting quality and uncertainty of the AWR collected in situ

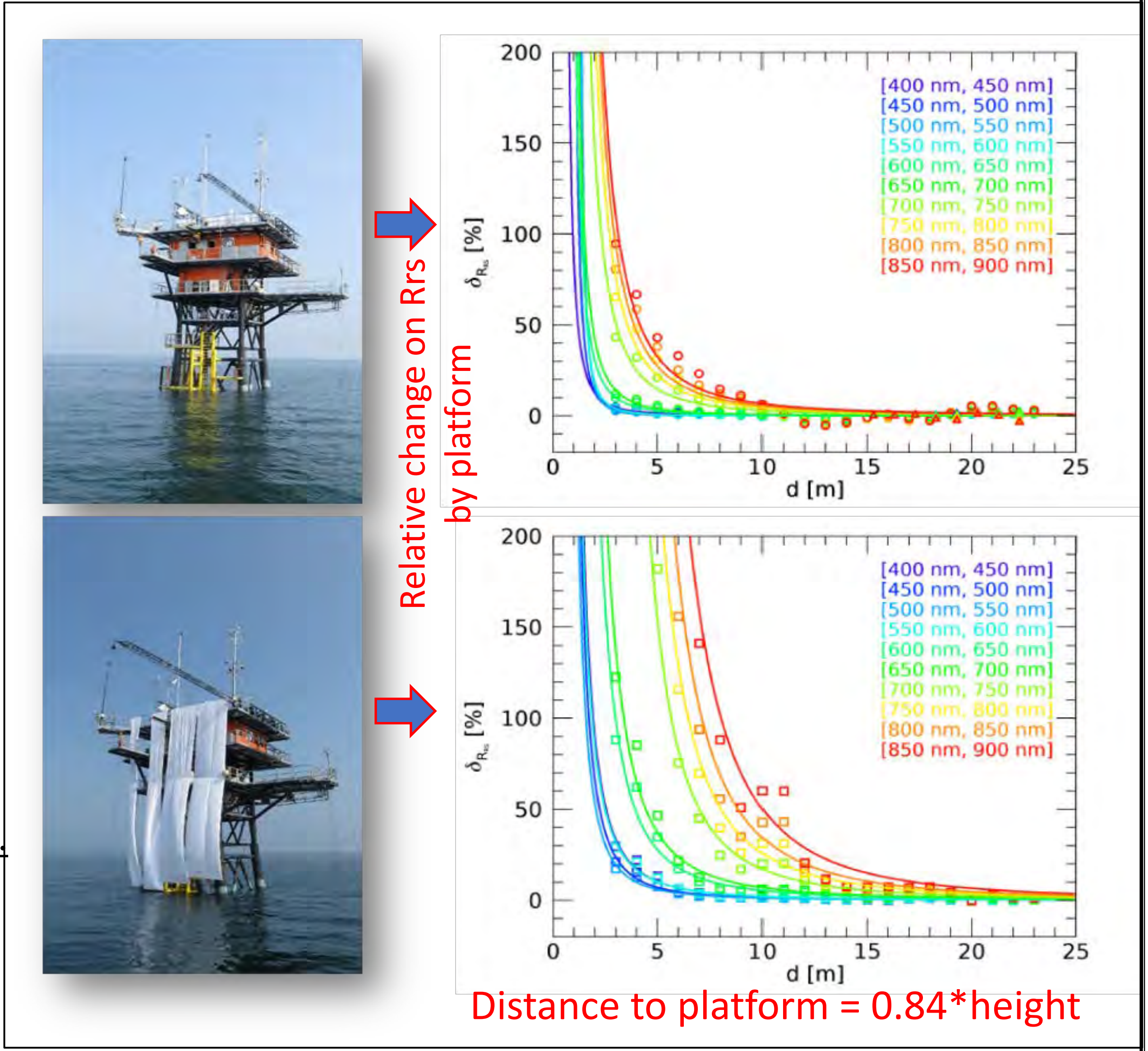
Platform perturbations

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

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

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

ρ: Sea surface reflectance factor
φ_s: Sun-sensor (Li, Lt) relative azimuth



Relative change on Rrs by platform

Distance to platform = 0.84*height

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

Above Water Radiometry (AWR)
Quantifying Uncertainty

Other factors impacting quality and uncertainty of the AWR collected in situ

Absolute calibration

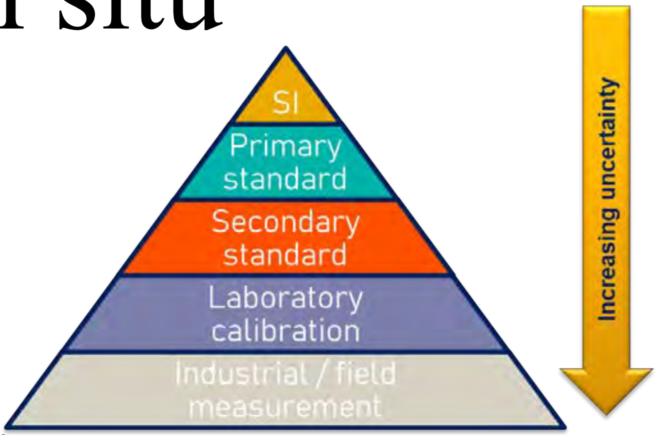
Calibration coefficient

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

Digital numbers

(Ir)radiance in physical units

deviations from instrument's expected ideal performance



SI

Primary standard

Secondary standard

Laboratory calibration

Industrial / field measurement

Increasing uncertainty

Calibration of irradiance

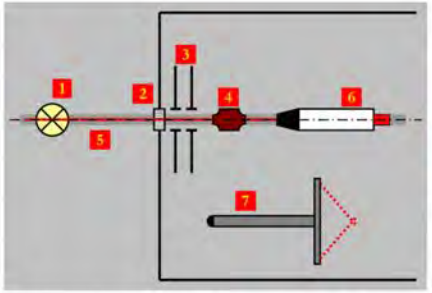


Figure 1.Pilot's (UT) irradiance calibration setup. 1 -FEL lamp; 2 – shutter; 3 – baffles; 4- -alignment laser; 5- optical rail; 6 – radiometer; 7 – contactless distance probe.

Photo courtesy of Gamma Scientific

Calibration of radiance

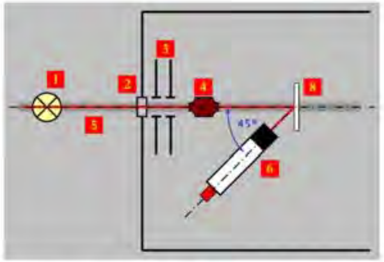
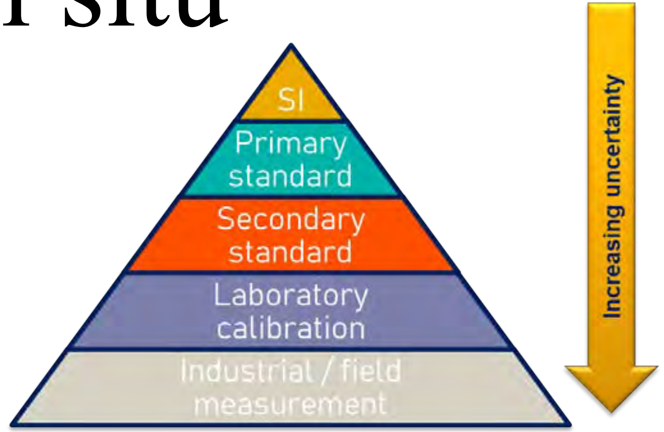


Figure 2. Pilot's (UT) radiance calibration setup. 1 -FEL lamp; 2 – shutter; 3 – baffles; 4- alignment laser; 5- optical rail; 6 – radiometer; 8 – reflectance panel.

Slide courtesy of Juan I. Gossn

Other factors impacting quality and uncertainty of the AWR collected in situ



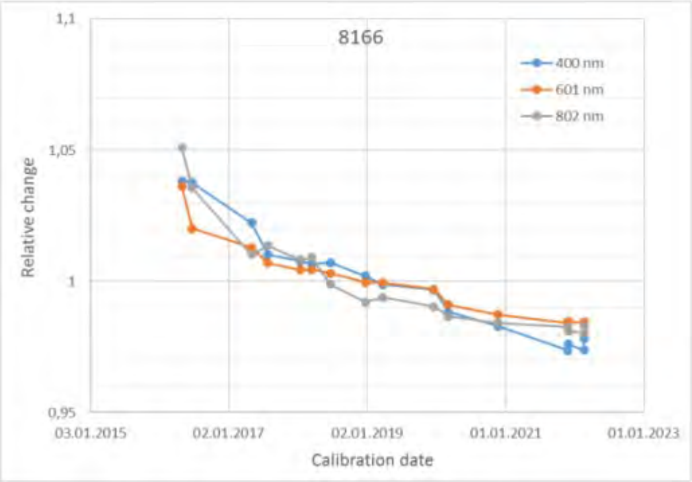
Absolute calibration

Calibration coefficient

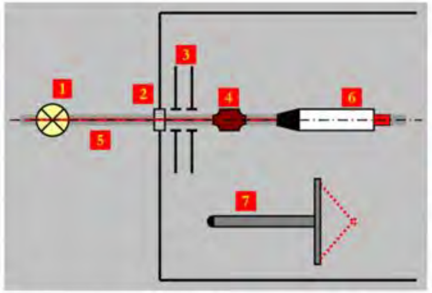
$$\boxed{\Im(\lambda)} = \boxed{C_{\Im}(\lambda)}\,\aleph(\lambda)\,\boxed{DN(\Im(\lambda))}$$

Digital numbers

(Ir)radiance in physical units



Calibration of irradiance



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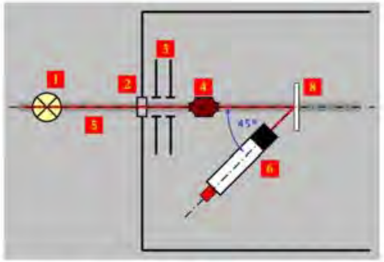

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Slide courtesy of Juan I. Gossn

Absolute calibration

Calibration coefficient

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

Digital numbers

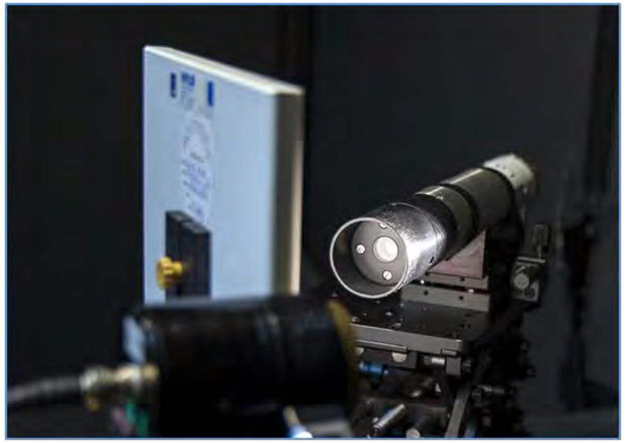
(Ir)radiance in physical units

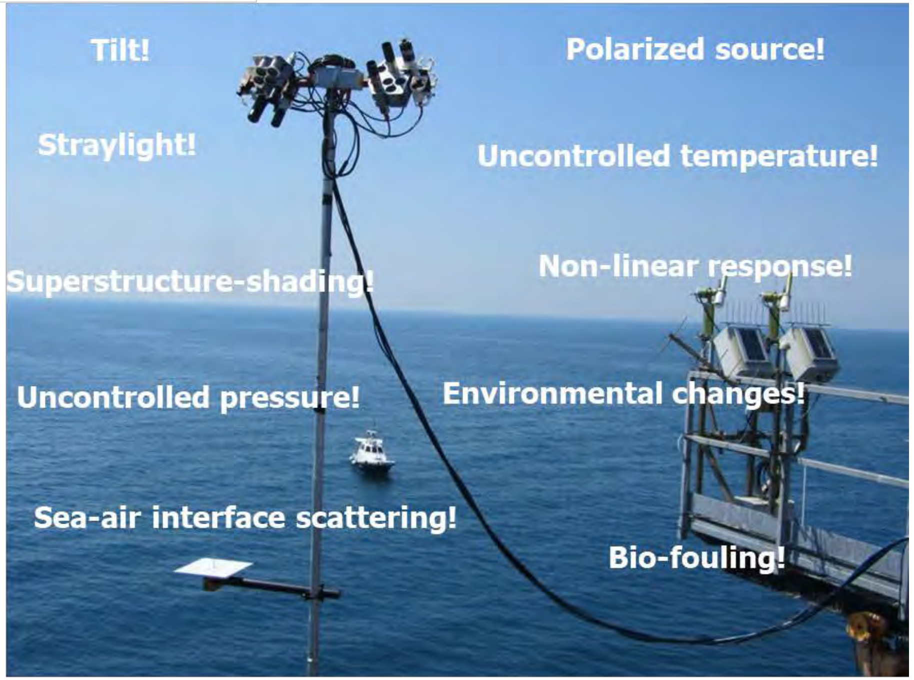
deviations from instrument's expected ideal performance

Traceability of in situ measurements is jeopardized in the field…

Lab ✓

Field ?





Tilt!

Polarized source!

Straylight!

Uncontrolled temperature!

Superstructure-shading!

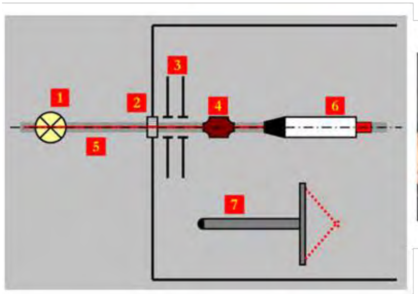
Non-linear response!

Uncontrolled pressure!

Environmental changes!

Sea-air interface scattering!

Bio-fouling!



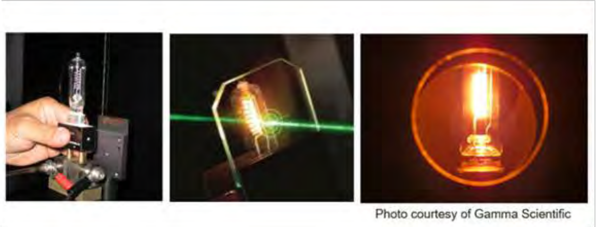


Photo courtesy of Gamma Scientific

Slide courtesy of Juan I. Gossn

Absolute calibration

Calibration coefficient

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

Digital numbers

(Ir)radiance in physical units

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 to account for these deviations....

Slide courtesy of Juan I. Gossn

HyperCP Calibration/Correction Regimes (v1.2) and Uncertainty

Other factors impacting quality and uncertainty of the AWR collected in situ

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

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

Dark frame subtraction
Deglitching (L1AQC)

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

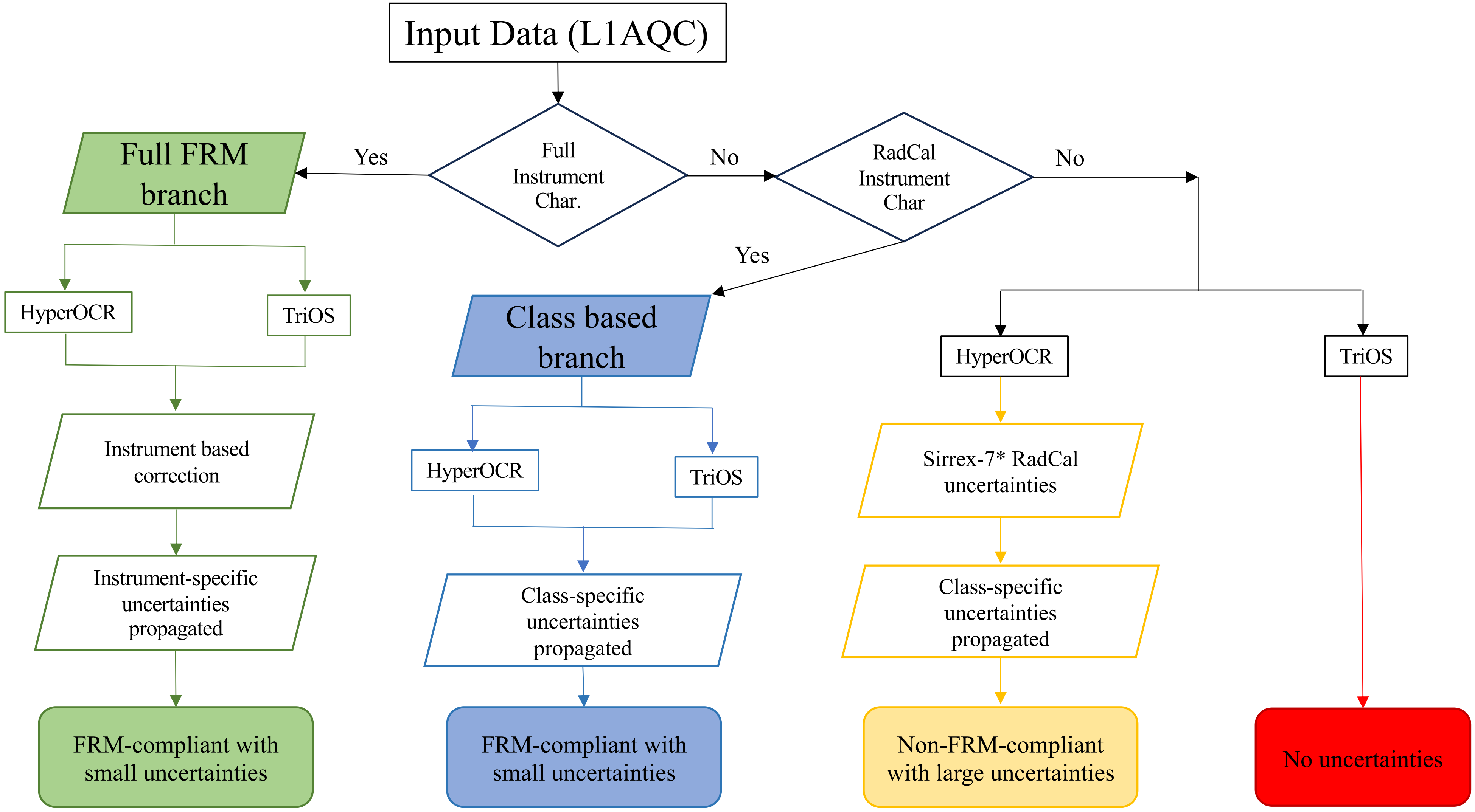
<u>Uncertainty</u> associated with these characterizations can be modeled using Monte Carlo simulations, and added to the reported products

<u>Laboratory measurements can characterize these for specific instruments and classes of instruments.</u>

<u>Corrections</u> can be applied to these to reduce measurement uncertainty

Instrument Characterization:

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



Input Data (L1AQC)

Full Instrument Char.

Yes

Full FRM branch

HyperOCR

TriOS

Instrument based correction

Instrument-specific uncertainties propagated

FRM-compliant with small uncertainties

No

RadCal Instrument Char

Yes

Class based branch

HyperOCR

TriOS

Class-specific uncertainties propagated

FRM-compliant with small uncertainties

No

HyperOCR

Sirrex-7* RadCal uncertainties

Class-specific uncertainties propagated

Non-FRM-compliant with large uncertainties

TriOS

No uncertainties

Full characterisation

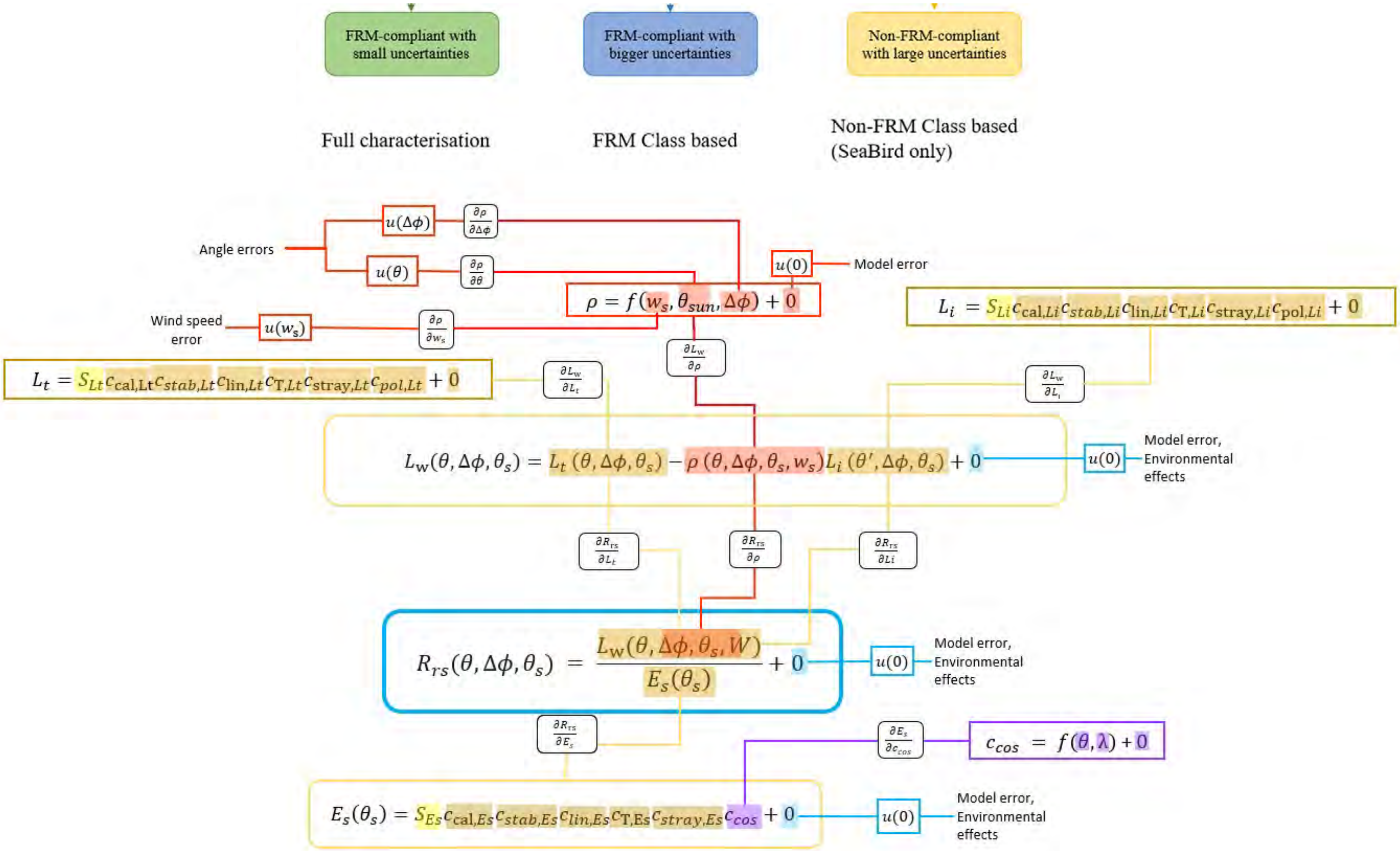
FRM Class based

Non-FRM Class based (SeaBird only)

Factory (TriOS only)

IOCS Meeting 2023 St. Petersburg, FL, USA

* The Seventh SeaWiFS Intercalibration Round-Robin Experiment (SIRREX-7), March 1999.



FRM-compliant with small uncertainties

FRM-compliant with bigger uncertainties

Non-FRM-compliant with large uncertainties

Full characterisation

FRM Class based

Non-FRM Class based (SeaBird only)

Angle errors

$u(\Delta\phi)$ $\frac{\partial\rho}{\partial\Delta\phi}$

$u(\theta)$ $\frac{\partial\rho}{\partial\theta}$

Wind speed error

$u(w_s)$ $\frac{\partial\rho}{\partial w_s}$

$u(0)$ Model error

$$\rho = f(w_s, \theta_{sun}, \Delta\phi) + 0$$

$$L_i = S_{Li} c_{cal,Li} c_{stab,Li} c_{lin,Li} c_{T,Li} c_{stray,Li} c_{pol,Li} + 0$$

$$L_t = S_{Lt} c_{cal,Lt} c_{stab,Lt} c_{lin,Lt} c_{T,Lt} c_{stray,Lt} c_{pol,Lt} + 0$$

$\frac{\partial L_w}{\partial L_t}$ $\frac{\partial L_w}{\partial \rho}$ $\frac{\partial L_w}{\partial L_i}$

$$L_w(\theta, \Delta\phi, \theta_s) = L_t(\theta, \Delta\phi, \theta_s) - \rho(\theta, \Delta\phi, \theta_s, w_s) L_i(\theta', \Delta\phi, \theta_s) + 0$$

$u(0)$ Model error, Environmental effects

$\frac{\partial R_{rs}}{\partial L_t}$ $\frac{\partial R_{rs}}{\partial \rho}$ $\frac{\partial R_{rs}}{\partial Li}$

$$R_{rs}(\theta, \Delta\phi, \theta_s) = \frac{L_w(\theta, \Delta\phi, \theta_s, W)}{E_s(\theta_s)} + 0$$

$u(0)$ Model error, Environmental effects

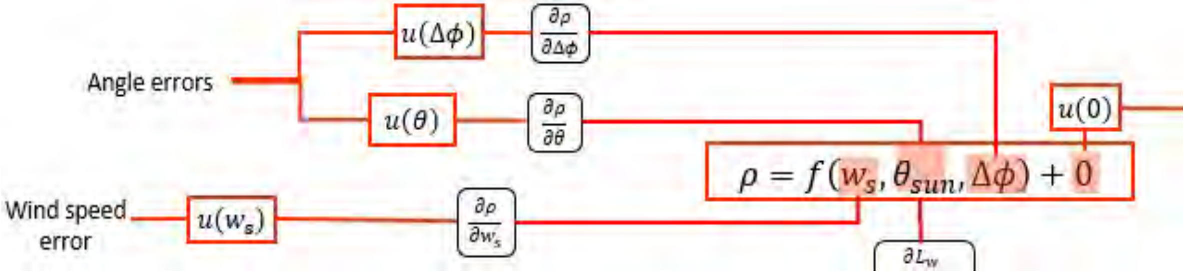
$\frac{\partial R_{rs}}{\partial E_s}$ $\frac{\partial E_s}{\partial c_{cos}}$

$$c_{cos} = f(\theta, \lambda) + 0$$

$$E_s(\theta_s) = S_{Es} c_{cal,Es} c_{stab,Es} c_{lin,Es} c_{T,Es} c_{stray,Es} c_{cos} + 0$$

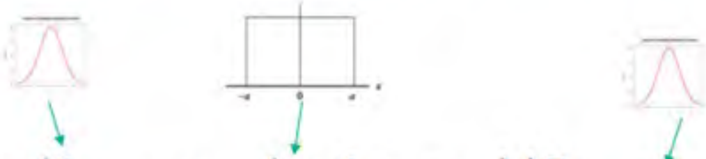
$u(0)$ Model error, Environmental effects

Slide courtesy of Aga Bialek



Variable symbol	Variable name/description	Exemplary uncertainty magnitude	PDF shape	Correlation 'corr_x'	Correlation between 'corr_between'
ρ	Sea surface reflectance	Calculated for each cast depends on all input components, especially wind speed	Normal	Random	N/A
w_s	Wind speed	$1 ms^{-1}$	Normal	Random	N/A
$\Delta\phi$	Relative azimuth	3°	Normal	Random^2	N/A
θ_s	Solar zenith angle	0.5°	Normal	Random	N/A
+0	Model error	Difference between Mobley and Zhang method	Rectangular	Systematic	N/A

GUM Methodology applied in CoMET tool



$$R_{rs} = (L_t c_{cal0222} - (\rho * L_i c_{cal0223})/E_s c_{cal0258}$$

random

systematic

$$\begin{array}{c|ccccccc}
 & L_t & c_{c2} & \rho & L_i & c_{c3} & E_s & c_{c8} \\
L_t & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
c_{c2} & 0 & 1 & 0 & 0 & 1 & 0 & 1 \\
\rho & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
L_i & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
c_{c3} & 0 & 1 & 0 & 0 & 1 & 0 & 1 \\
E_s & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
c_{c8} & 0 & 1 & 0 & 0 & 1 & 0 & 1
\end{array}$$

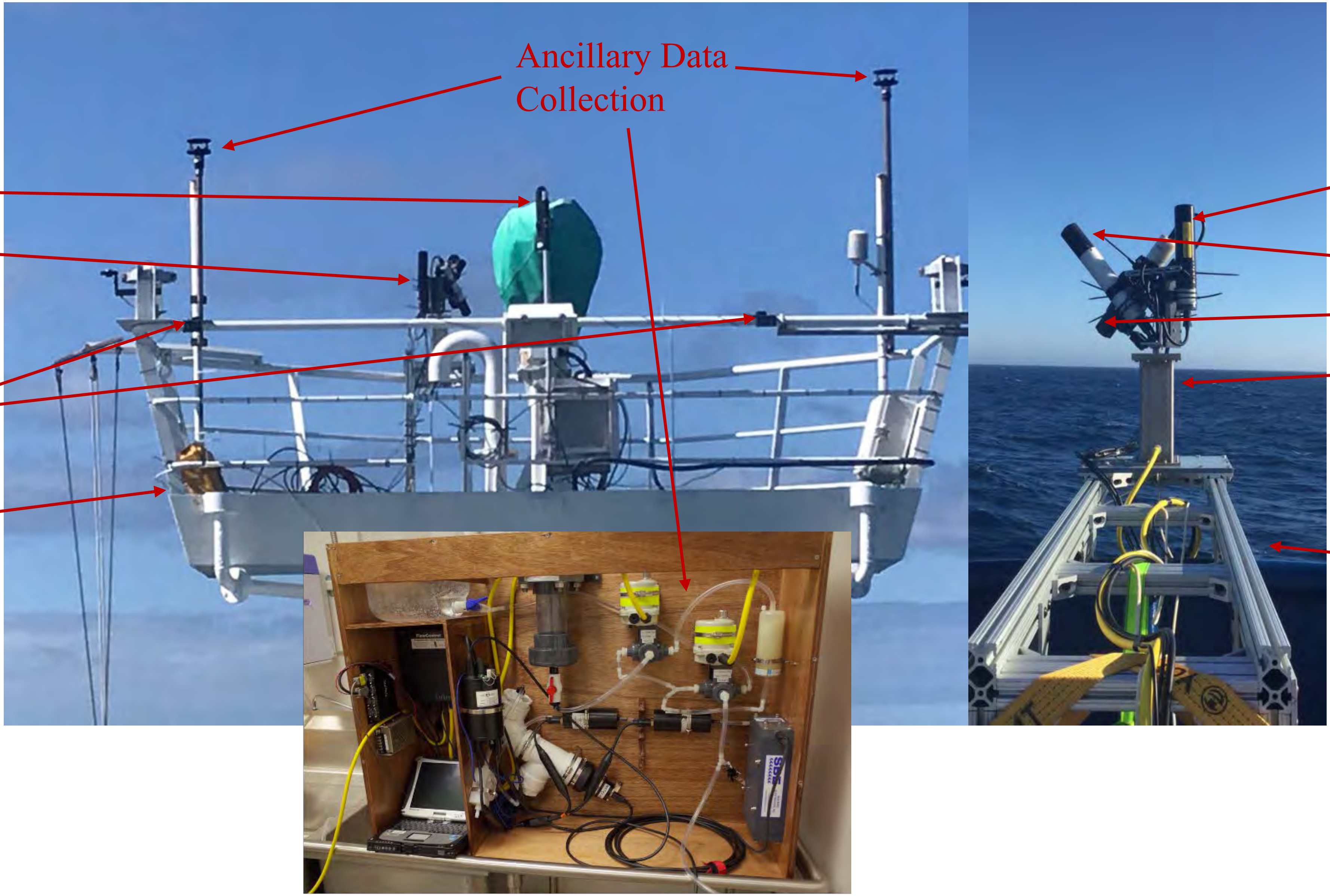
Slide courtesy of Aga Bialek

https://www.comet-toolkit.org/

HyperCP

Above Water Radiometry (AWR) In the Field

HyperCP



Ancillary Data Collection

Es

HyperSAS

GPS Antennas

Controller Box

Tilt Sensor

Li (sky)

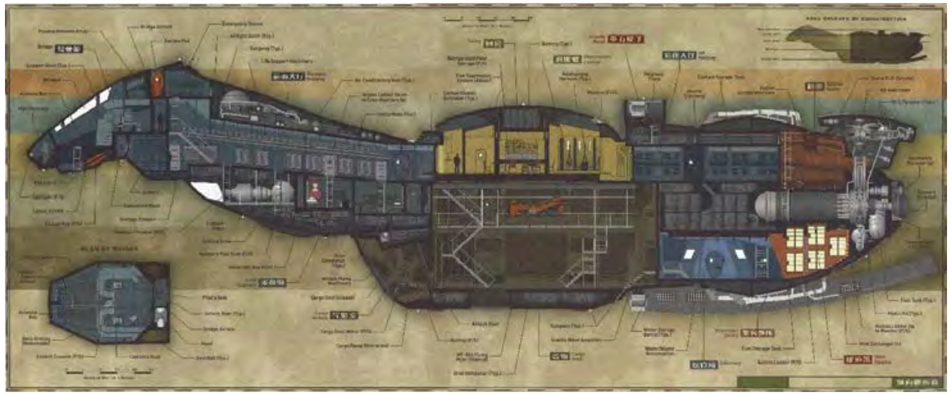
Lt

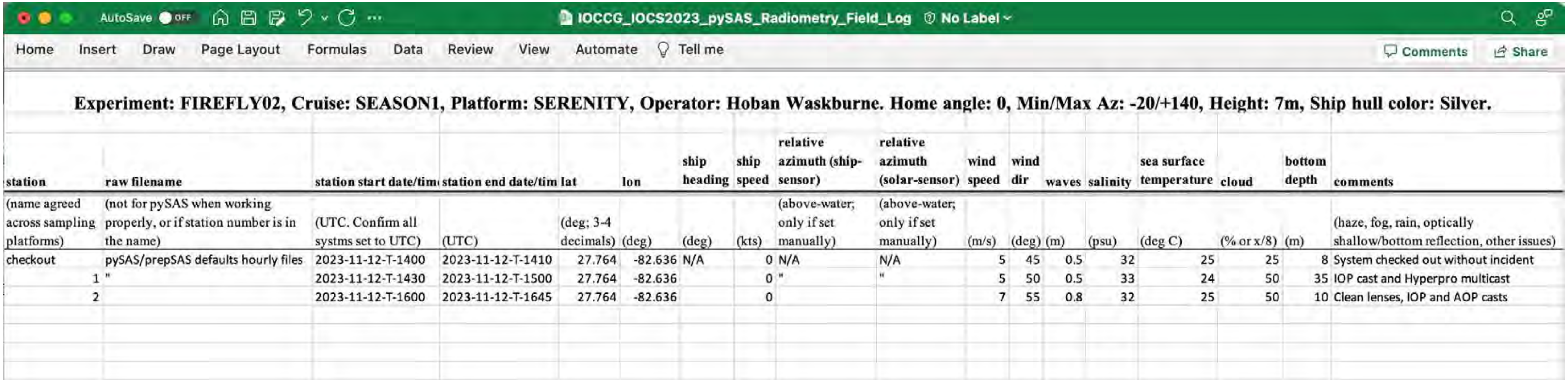
Tower

Autonomous azimuth adjustment

Tower Support

Field Log





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/tim	station end date/tim	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

(Template provided with HyperCP repository)

HyperCP
Software Repository and Structure

HyperCP

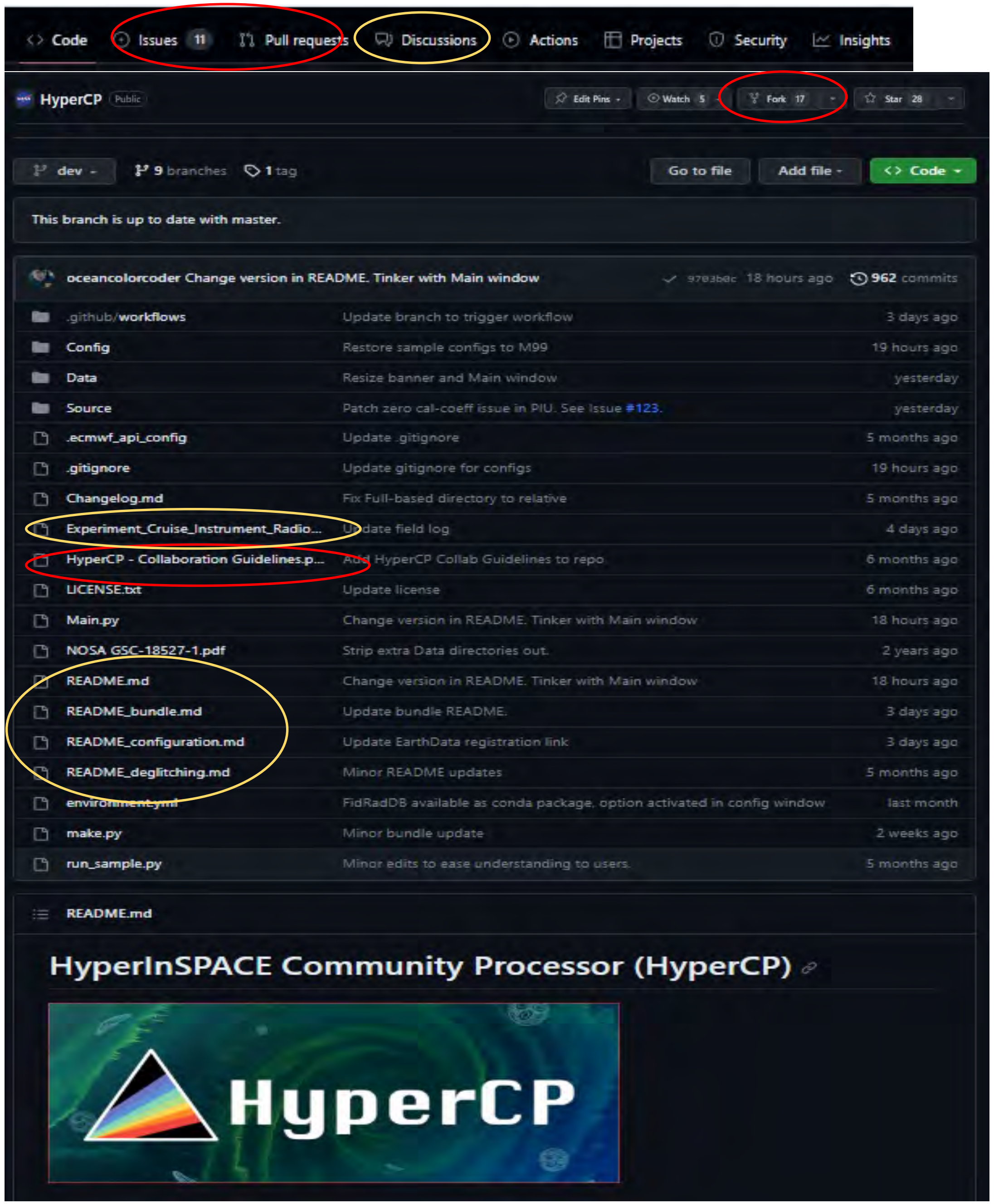
Demo:
GitHub Repository Browser

NASA GitHub Repository

github.com/nasa/HyperCP

A resource for code distribution, collaboration, and community support

- Issues, Pull Requests, and Forks are mainly for use by the development team.
- Collaboration Guidelines are for those on or wishing to join the team
- READMEs are instructional for the end user community
- Templates and Sample Data are for end users
- Discussions are for community support



This branch is up to date with master.

oceancolorcoder Change version in README. Tinker with Main window 9783bac 18 hours ago 962 commits

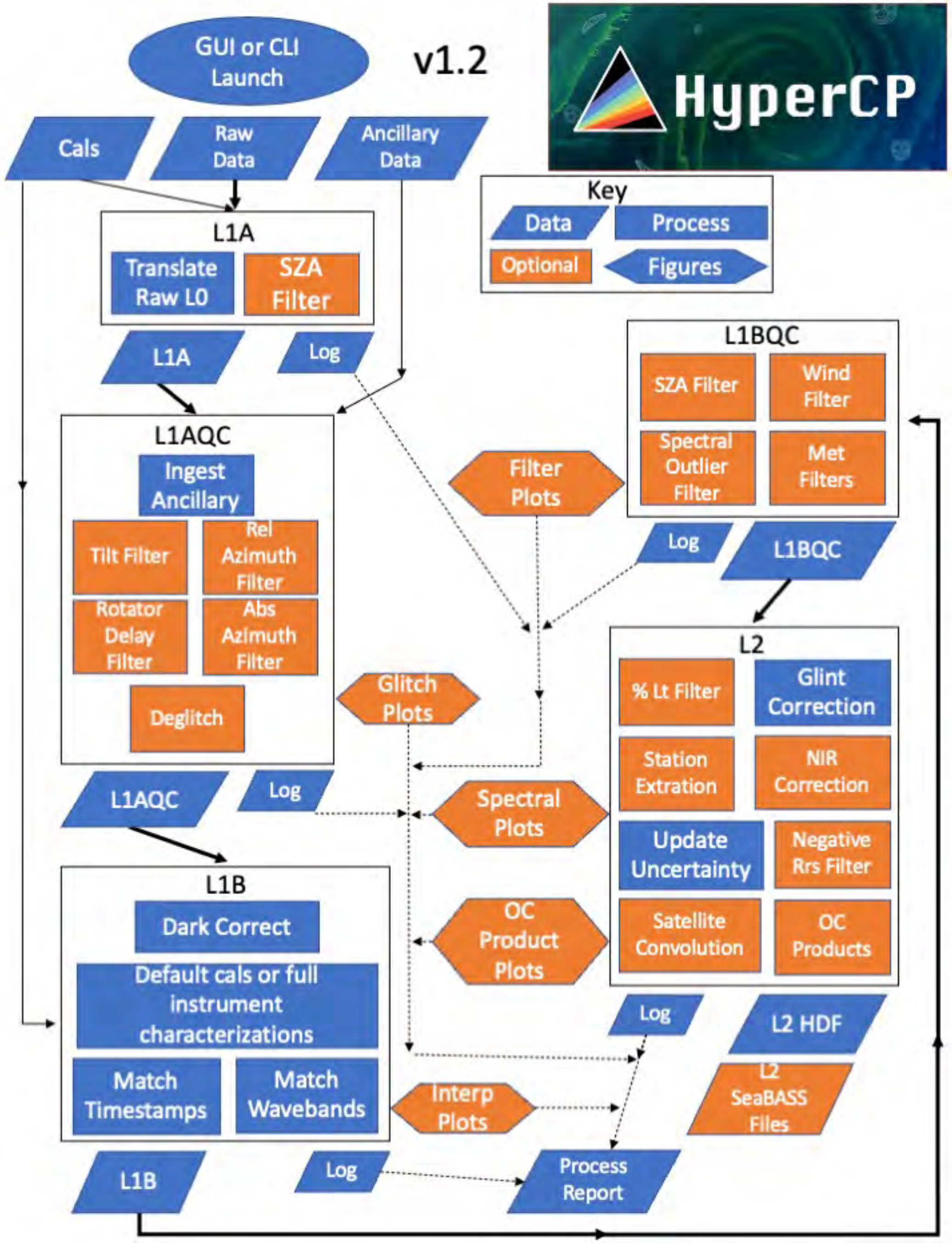
.github/workflows	Update branch to trigger workflow	3 days ago
Config	Restore sample configs to M99	19 hours ago
Data	Resize banner and Main window	yesterday
Source	Patch zero cal-coeff issue in PIU. See Issue #123.	yesterday
.ecmwf_api_config	Update .gitignore	5 months ago
.gitignore	Update gitignore for configs	19 hours ago
Changelog.md	Fix Full-based directory to relative	5 months ago
Experiment_Cruise_Instrument_Radio...	Update field log	4 days ago
HyperCP - Collaboration Guidelines.p...	Add HyperCP Collab Guidelines to repo	6 months ago
LICENSE.txt	Update license	6 months ago
Main.py	Change version in README. Tinker with Main window	18 hours ago
NOSA GSC-18527-1.pdf	Strip extra Data directories out.	2 years ago
README.md	Change version in README. Tinker with Main window	18 hours ago
README_bundle.md	Update bundle README.	3 days ago
README_configuration.md	Update EarthData registration link	3 days ago
README_deglitching.md	Minor README updates	5 months ago
environment.yml	FidRadDB available as conda package, option activated in config window	last month
make.py	Minor bundle update	2 weeks ago
run_sample.py	Minor edits to ease understanding to users.	5 months ago

README.md

HyperInSPACE Community Processor (HyperCP)

HyperCP Input Depends on Instrument Platform

- Calibration and Instrument Files:
  - TriOS: 2 ".dat" files and one ".ini" file for each instrument
  - HyperSAS: 2 ".cal" files for each instrument
  - Automated systems: 1 ".tdf" for for each (e.g., GPS, Tilt, SatNav, UMTWR, etc.)
  - Sea-Bird calibration and telemetry definition files come bundled in ".sip" files
- Raw Files:
  - HyperSAS: One ".raw" file per period (usually 1 hour when autonomous)
    - Radiometric data (Lt, Li, Es)
    - True Headings (SAS, Ship, Motion) and Tilt
    - GPS Position
    - Sun Azimuth and Sun Elevation
  - pySAS: Same as HyperSAS after prepSAS
  - TriOS: One ".mlb" file per instrument per period
- Auxiliary data:
  - Format: SeaBASS
  - Sensor geometries (relative azimuth) if manually collected (no pySAS tower or SolarTracker)
  - Environmental conditions: aerosol optical depth, cloud cover, salinity, water temperature, and **wind speed**
  - Station number

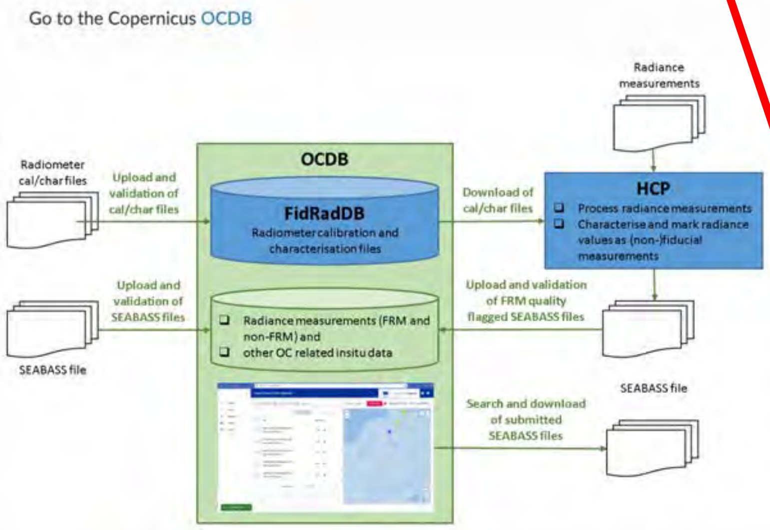


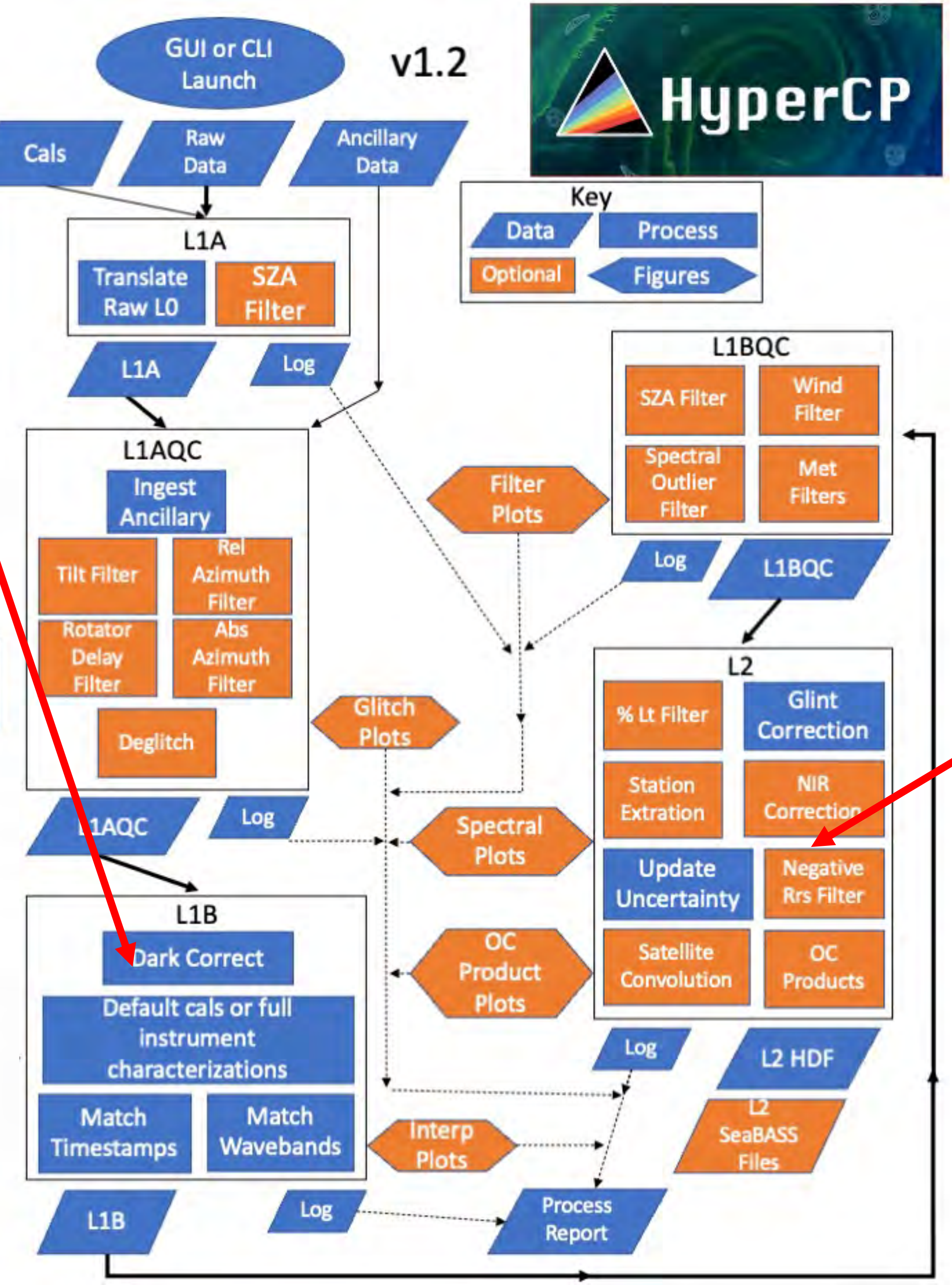
Raw data are translated to HDF5 in L1A. Subsequent levels are HDF5. L2 also outputs SeaBASS ASCII text format.

Levels roughly follow NASA satellite conventions (e.g., L1B indicates calibrations have been applied, L2 indicates surface reflectances and other OC products are involved). Quality control is mainly handled at a low level in L1AQC and at a higher level in L1BQC, but QA/QC also extends into L2.

Ancillary data are provided by the field team. HyperCP uses MERRA2 and ECMWF models to fill in gaps in ancillary data provided by the end user.

Instrument characterization files are optionally added in addition to factory calibrations, or can be automatically downloaded from FidRadDB





Uncertainty budgets extend to uncertainties deriving from the most challenging processing element of AWR, the glint correction

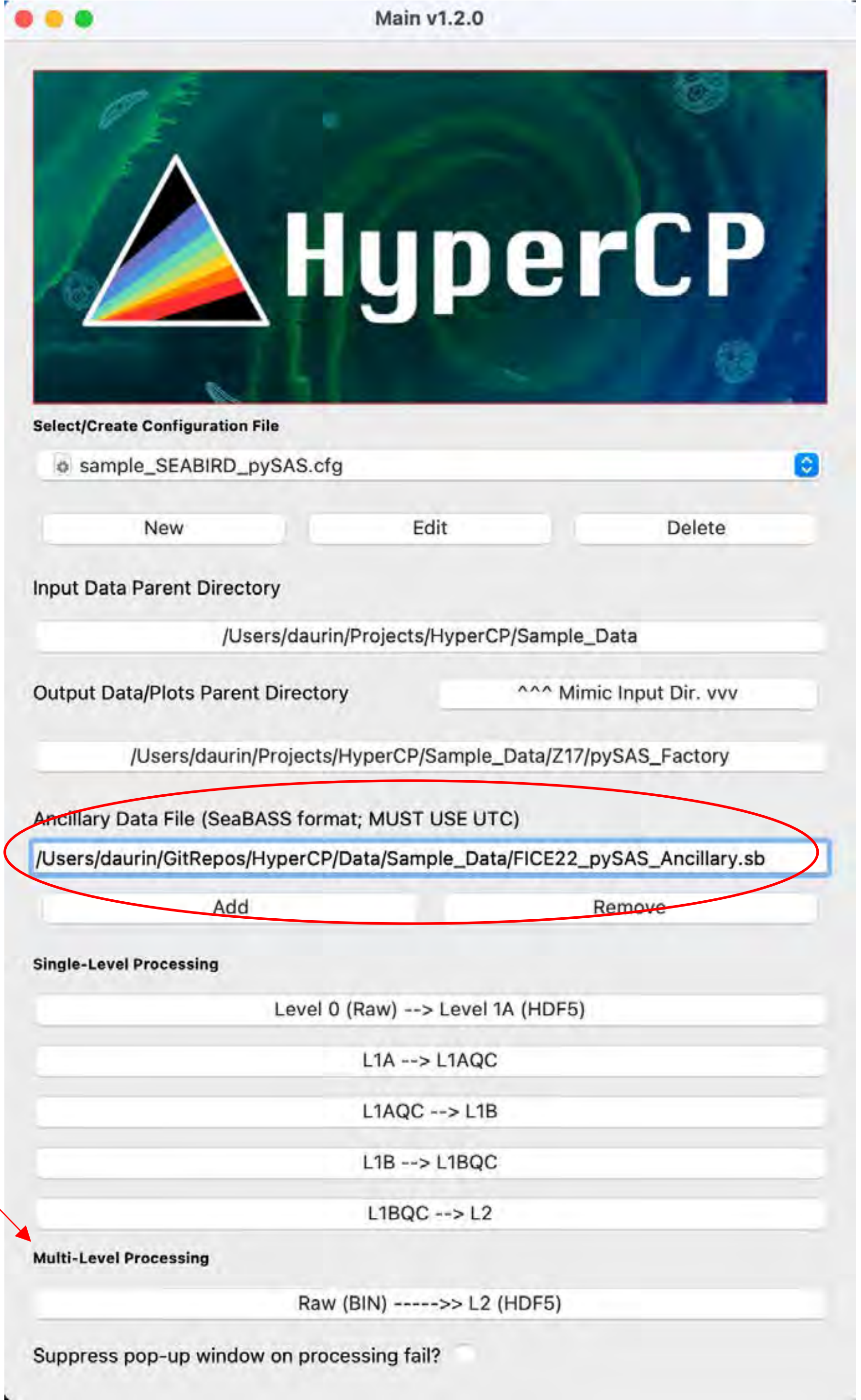
HyperCP
Walk-through

HyperCP Overview

Every deployment gets a unique configuration →

Ancillary data from field notes and external (e.g. ship) data should be provided. Simple text file in SeaBASS format (next slide). →

Data can be processed one file at a time or batched many files at a time, and can be processed for a single level, or L0 (Raw) -> L2.



Select/Create Configuration File

sample_SEABIRD_pySAS.cfg

Input Data Parent Directory

/Users/daurin/Projects/HyperCP/Sample_Data

Output Data/Plots Parent Directory

/Users/daurin/Projects/HyperCP/Sample_Data/Z17/pySAS_Factory

Ancillary Data File (SeaBASS format; MUST USE UTC)

/Users/daurin/GitRepos/HyperCP/Data/Sample_Data/FICE22_pySAS_Ancillary.sb

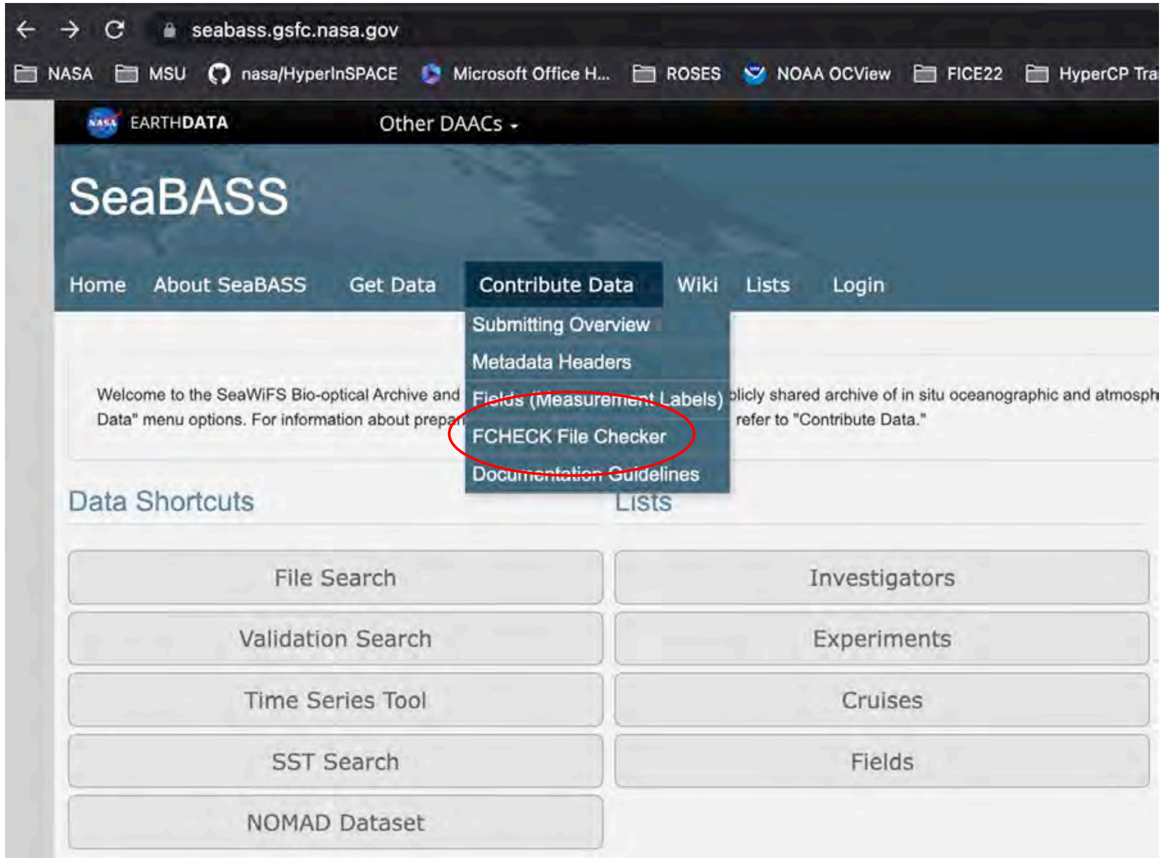
Single-Level Processing

Multi-Level Processing

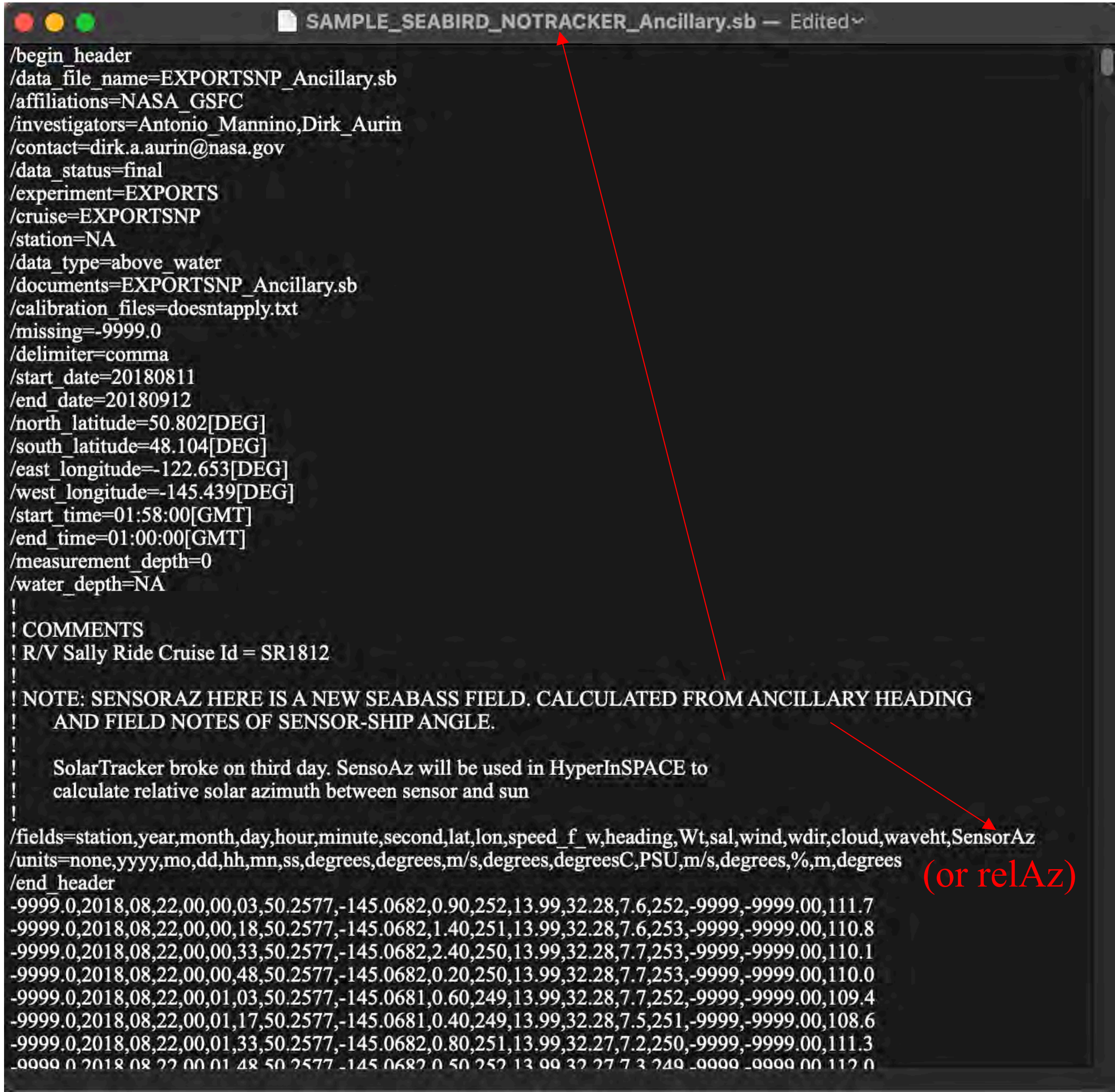
Suppress pop-up window on processing fail? ☐

HyperCP Ancillary Data

These should be as detailed and high-frequency as possible, particularly when using non-autonomous platforms (i.e., “NOTRACKER”; ~10 s for a moving ship).



SeaBASS format description. Confirm correctly formatted using FCHECK



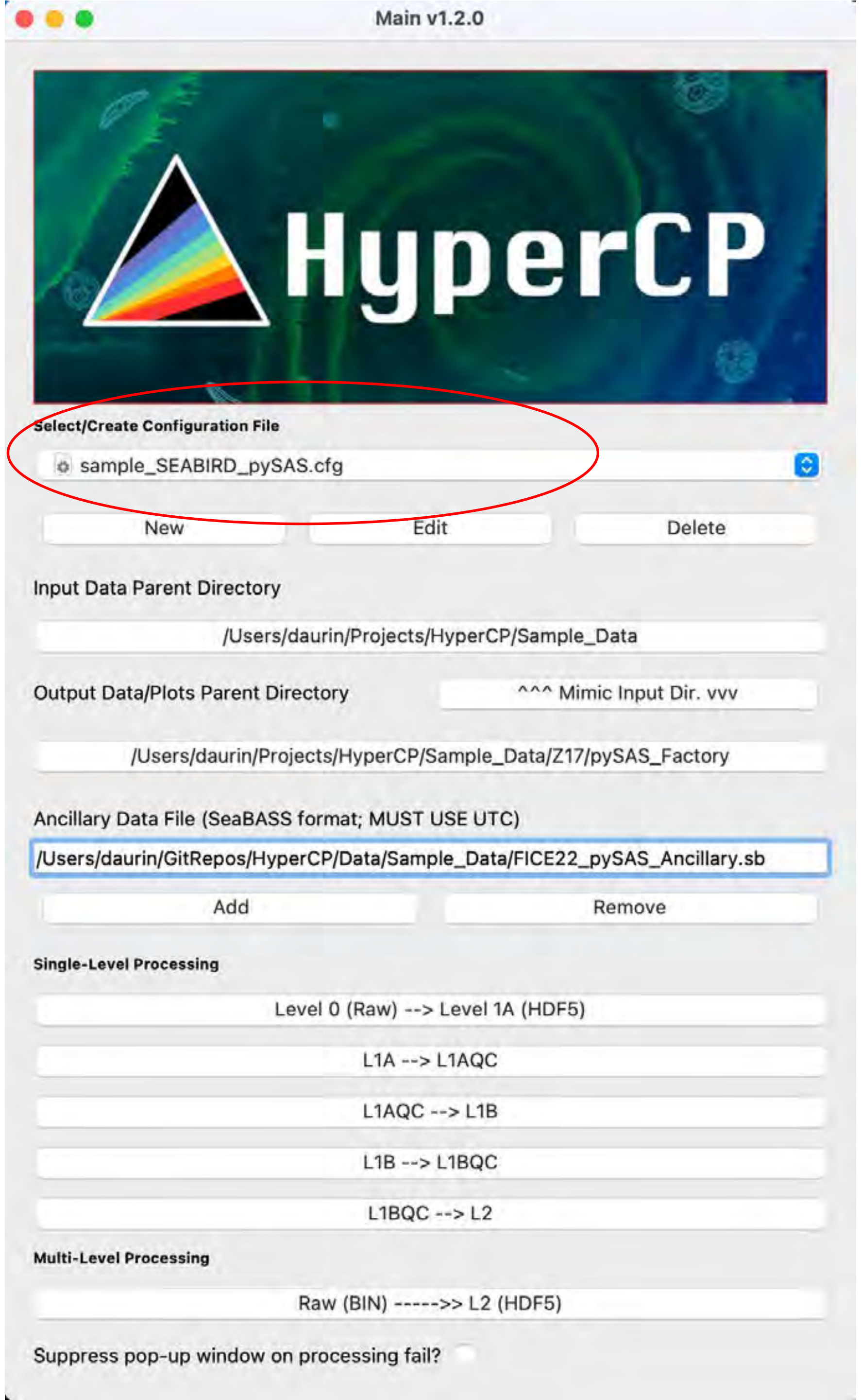
```
/begin_header
/data_file_name=EXPORTSNP_Ancillary.sb
/affiliations=NASA_GSFC
/investigators=Antonio_Mannino,Dirk_Aurin
/contact=dirk.a.aurin@nasa.gov
/data_status=final
/experiment=EXPORTS
/cruise=EXPORTSNP
/station=NA
/data_type=above_water
/documents=EXPORTSNP_Ancillary.sb
/calibration_files=doesntapply.txt
/missing=-9999.0
/delimiter=comma
/start_date=20180811
/end_date=20180912
/north_latitude=50.802[DEG]
/south_latitude=48.104[DEG]
/east_longitude=-122.653[DEG]
/west_longitude=-145.439[DEG]
/start_time=01:58:00[GMT]
/end_time=01:00:00[GMT]
/measurement_depth=0
/water_depth=NA
!
! COMMENTS
! R/V Sally Ride Cruise Id = SR1812
!
! NOTE: SENSORAZ HERE IS A NEW SEABASS FIELD. CALCULATED FROM ANCILLARY HEADING
!      AND FIELD NOTES OF SENSOR-SHIP ANGLE.
!
!      SolarTracker broke on third day. SensoAz will be used in HyperInSPACE to
!      calculate relative solar azimuth between sensor and sun
!
/fields=station,year,month,day,hour,minute,second,lat,lon,speed_f_w,heading,Wt,sal,wind,wdir,cloud,waveht,SensorAz
/units=none,yyyy,mo,dd,hh,mn,ss,degrees,degrees,m/s,degrees,degreesC,PSU,m/s,degrees,%,m,degrees
/end_header
-9999.0,2018,08,22,00,00,03,50.2577,-145.0682,0.90,252,13.99,32.28,7.6,252,-9999,-9999.00,111.7
-9999.0,2018,08,22,00,00,18,50.2577,-145.0682,1.40,251,13.99,32.28,7.6,253,-9999,-9999.00,110.8
-9999.0,2018,08,22,00,00,33,50.2577,-145.0682,2.40,250,13.99,32.28,7.7,253,-9999,-9999.00,110.1
-9999.0,2018,08,22,00,00,48,50.2577,-145.0682,0.20,250,13.99,32.28,7.7,253,-9999,-9999.00,110.0
-9999.0,2018,08,22,00,01,03,50.2577,-145.0681,0.60,249,13.99,32.28,7.7,252,-9999,-9999.00,109.4
-9999.0,2018,08,22,00,01,17,50.2577,-145.0681,0.40,249,13.99,32.28,7.5,251,-9999,-9999.00,108.6
-9999.0,2018,08,22,00,01,33,50.2577,-145.0682,0.80,251,13.99,32.27,7.2,250,-9999,-9999.00,111.3
-9999.0,2018,08,22,00,01,48,50.2577,-145.0682,0.50,252,13.99,32.27,7.3,249,-9999,-9999.00,112.0
```

(or relAz)

HyperCP Overview

Main GUI screen > Select Configuration

The configuration is for parameterization of data processing specific to the platform (e.g., most recent calibrations) and the sampling environment (e.g., optical water type).



Main v1.2.0

Select/Create Configuration File

sample_SEABIRD_pySAS.cfg

Input Data Parent Directory

/Users/daurin/Projects/HyperCP/Sample_Data

Output Data/Plots Parent Directory

/Users/daurin/Projects/HyperCP/Sample_Data/Z17/pySAS_Factory

Ancillary Data File (SeaBASS format; MUST USE UTC)

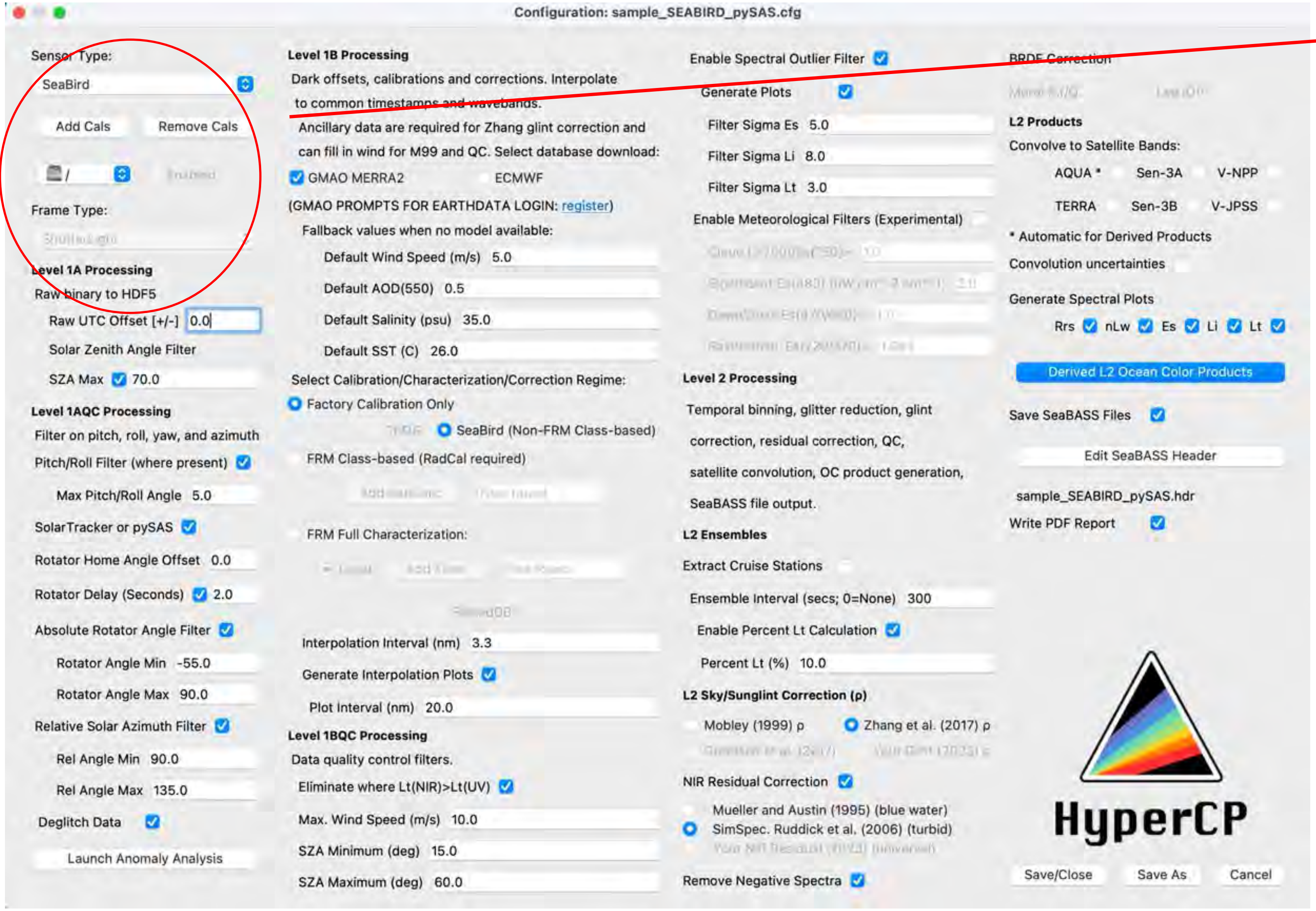
/Users/daurin/GitRepos/HyperCP/Data/Sample_Data/FICE22_pySAS_Ancillary.sb

Single-Level Processing

Multi-Level Processing

Suppress pop-up window on processing fail? ☐

HyperCP: Loading Instrument Calibration



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type:
SeaBird
Add Cals | Remove Cals
Frame Type:

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
● SeaBird (Non-FRM Class-based)
○ FRM Class-based (RadCal required)
○ FRM Full Characterization:
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) ☐

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

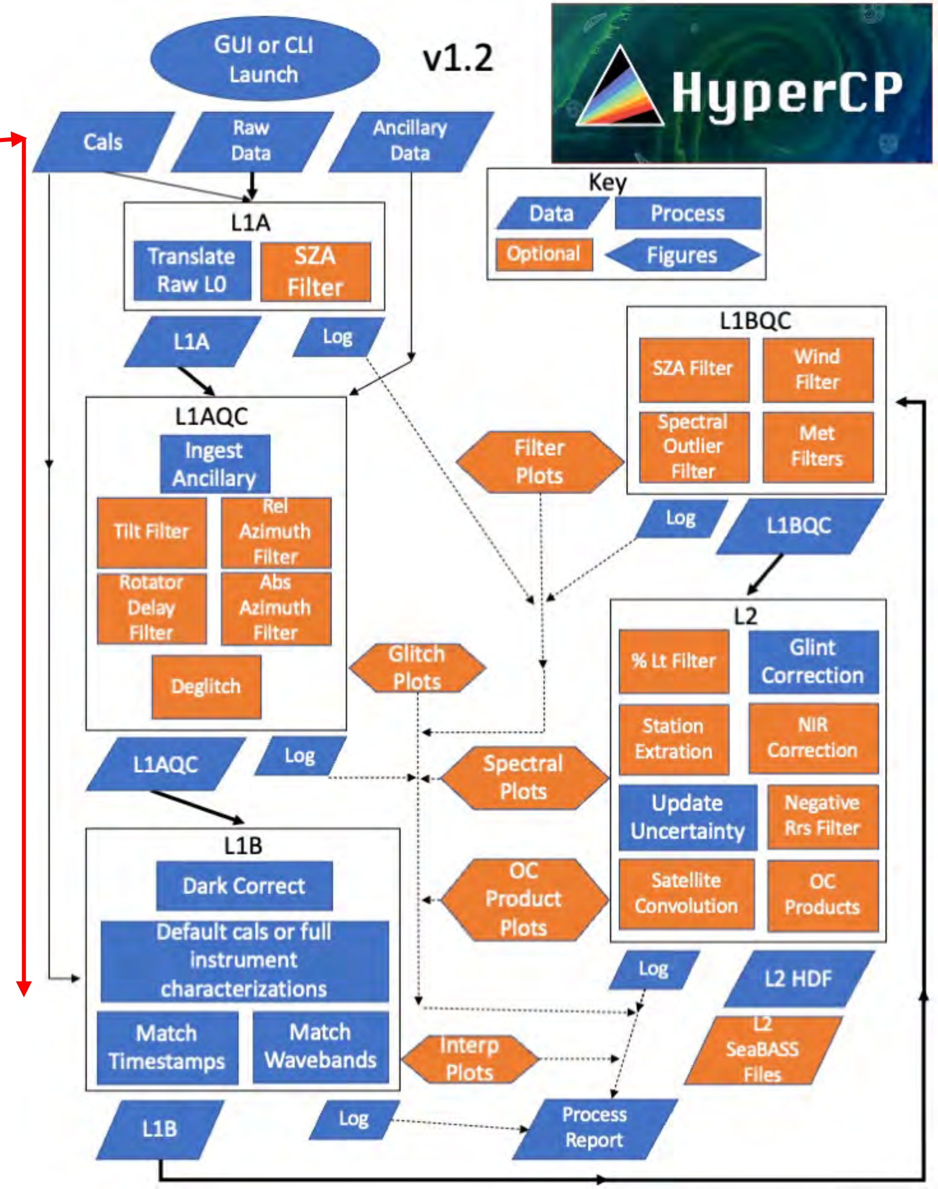
L2 Sky/Sunglint Correction (ρ)
○ Mobley (1999) ρ ● Zhang et al. (2017) ρ
NIR Residual Correction ☑
○ Mueller and Austin (1995) (blue water)
● SimSpec. Ruddick et al. (2006) (turbid)
Remove Negative Spectra ☑

BRDF Correction

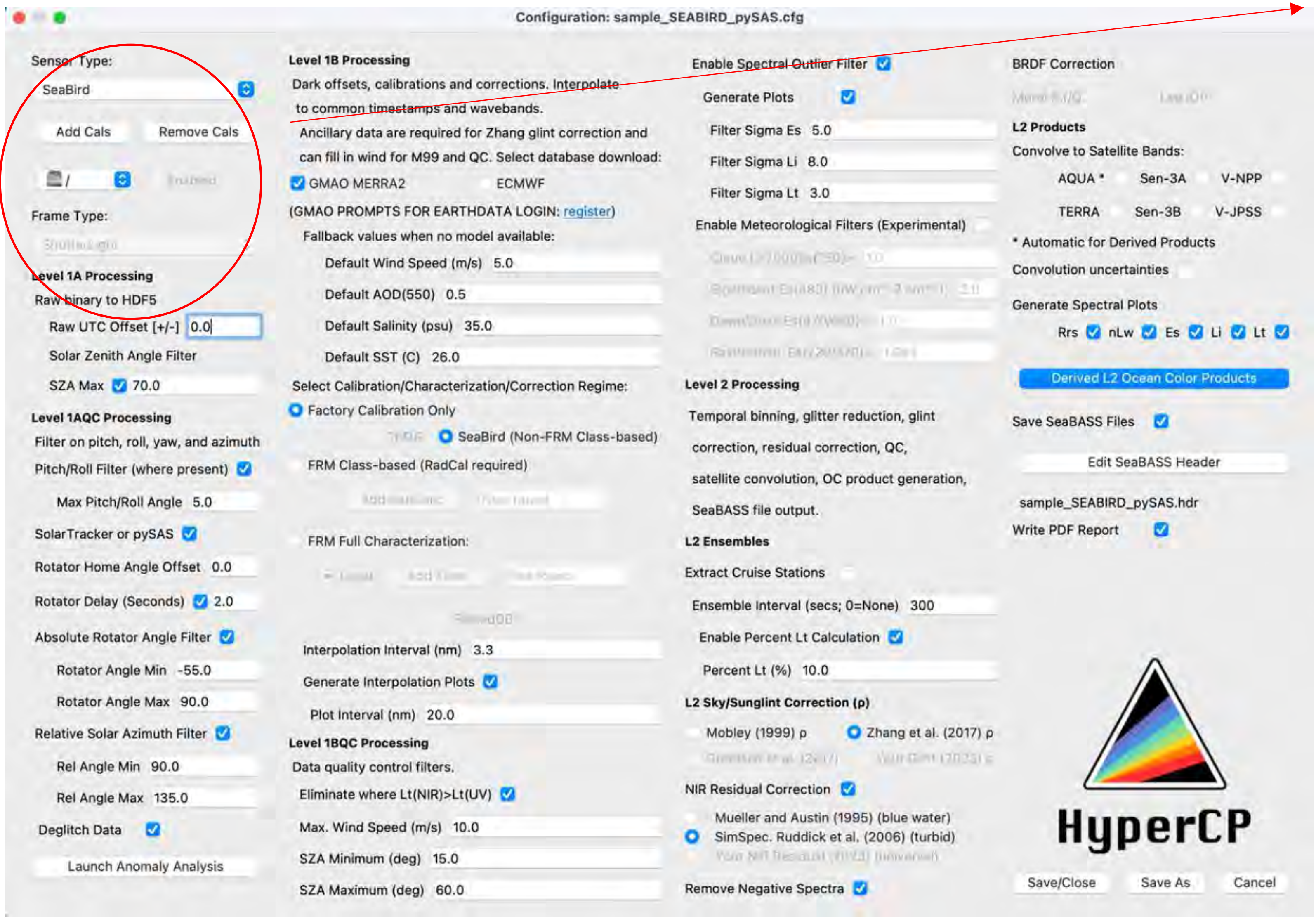
L2 Products
Convolve to Satellite Bands:
AQUA * ☐ Sen-3A ☐ V-NPP ☐
TERRA ☐ Sen-3B ☐ V-JPSS ☐
* Automatic for Derived Products
Convolution uncertainties ☐
Generate Spectral Plots
Rrs ☑ nLw ☑ Es ☑ Li ☑ Lt ☑
Derived L2 Ocean Color Products
Save SeaBASS Files ☑
Edit SeaBASS Header
sample_SEABIRD_pySAS.hdr
Write PDF Report ☑

HyperCP

Save/Close | Save As | Cancel



HyperCP: Loading Instrument Calibration



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type:
SeaBird
Add Cals | Remove Cals
Frame Type:

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
● SeaBird (Non-FRM Class-based)
○ FRM Class-based (RadCal required)
○ FRM Full Characterization:
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) ☐

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 (ρ)
○ Mobley (1999) ρ ● Zhang et al. (2017) ρ
NIR Residual Correction ☑
○ Mueller and Austin (1995) (blue water)
● SimSpec. Ruddick et al. (2006) (turbid)
Remove Negative Spectra ☑

BRDF Correction

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

Sea-Bird HyperOCRs, pySAS

GPRMC_NMEA0183v3.01.tdf ← GPS
HED0187p.cal ← Es
HLD0250h.cal ← Li
HLD0251h.cal ← Lt
HSE0187p.cal ← Es
HSL0250h.cal ← Li
HSL0251h.cal ← Lt
HyperSAS.20230203.sip ← Zip of all .cal & .tdf files
SATMSG.tdf
SATTHS0009.tdf ← Tilt-Heading sensor
UMTWR_v0.tdf ← Azimuth control robot

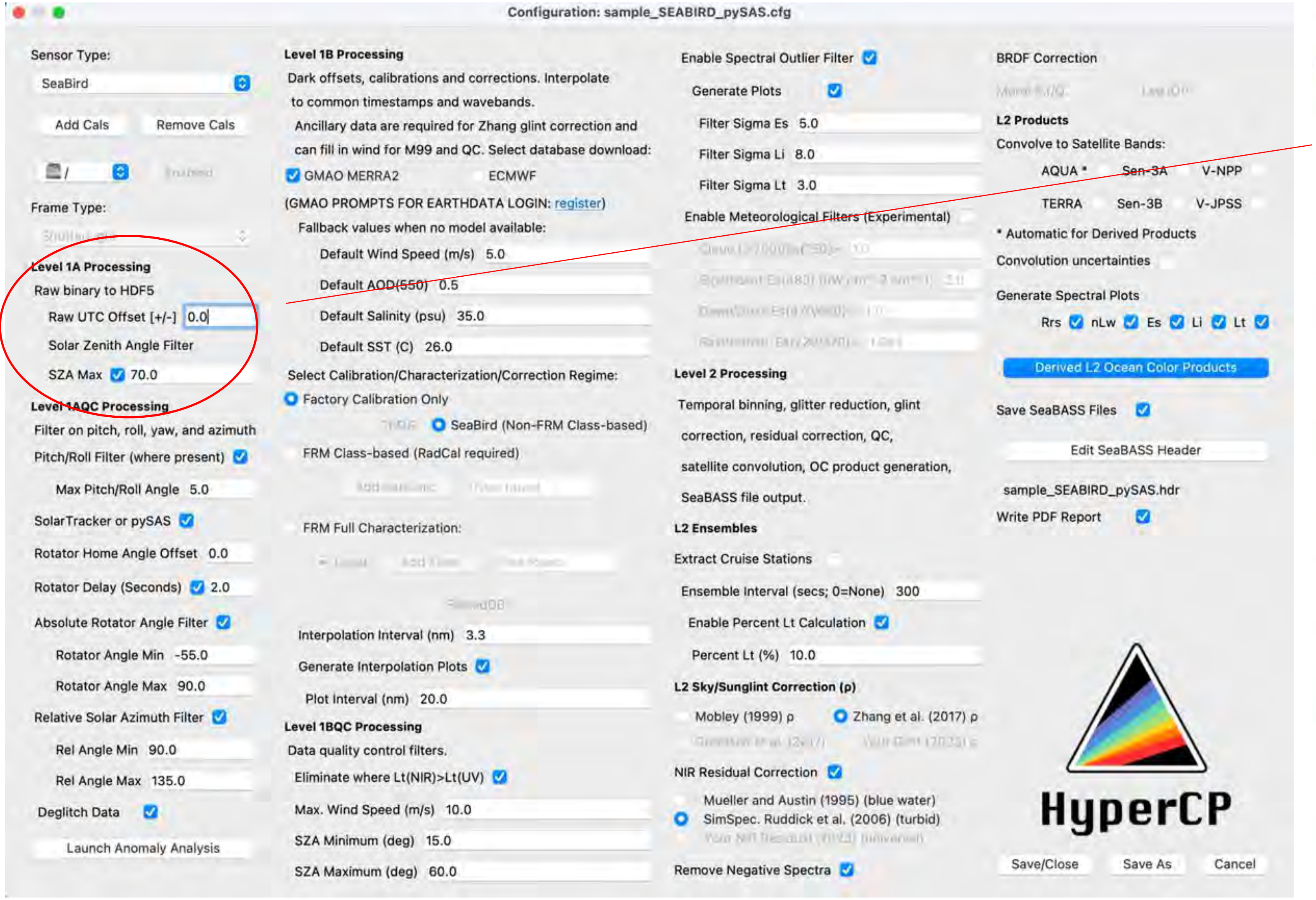
HED and HLD are **Dark** cals
HSE and HSL are **Light** cals

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

HyperCP

Demo:
Loading in Calibration and Telemetry Files

HyperCP Level 1A: Read Data



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type:
SeaBird
Add Cals | Remove Cals
Frame Type:

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
● SeaBird (Non-FRM Class-based)
○ FRM Class-based (RadCal required)
○ FRM Full Characterization:
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) ☐

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

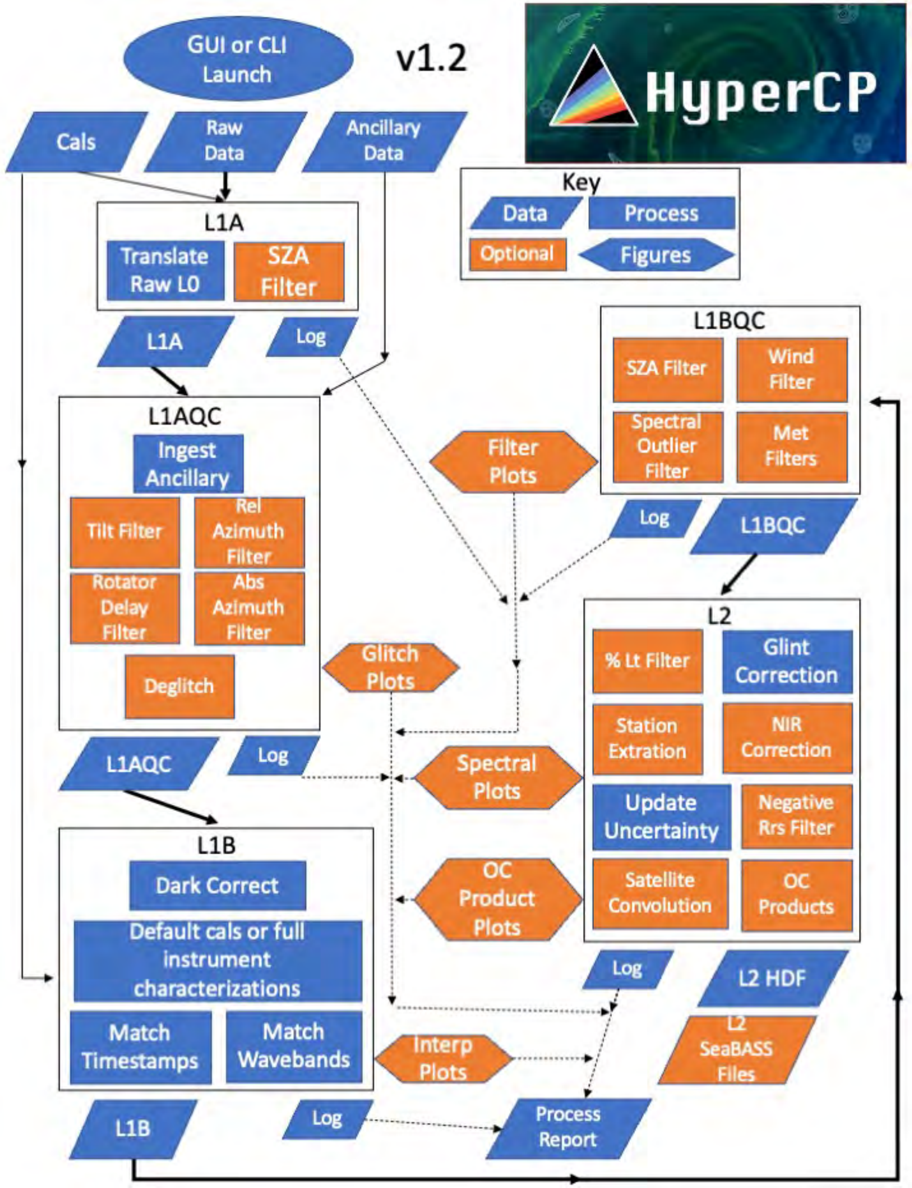
L2 Sky/Sunglint Correction (ρ)
○ Mobley (1999) ρ ● Zhang et al. (2017) ρ
NIR Residual Correction ☑
○ Mueller and Austin (1995) (blue water)
● SimSpec. Ruddick et al. (2006) (turbid)
Remove Negative Spectra ☑

BRDF Correction

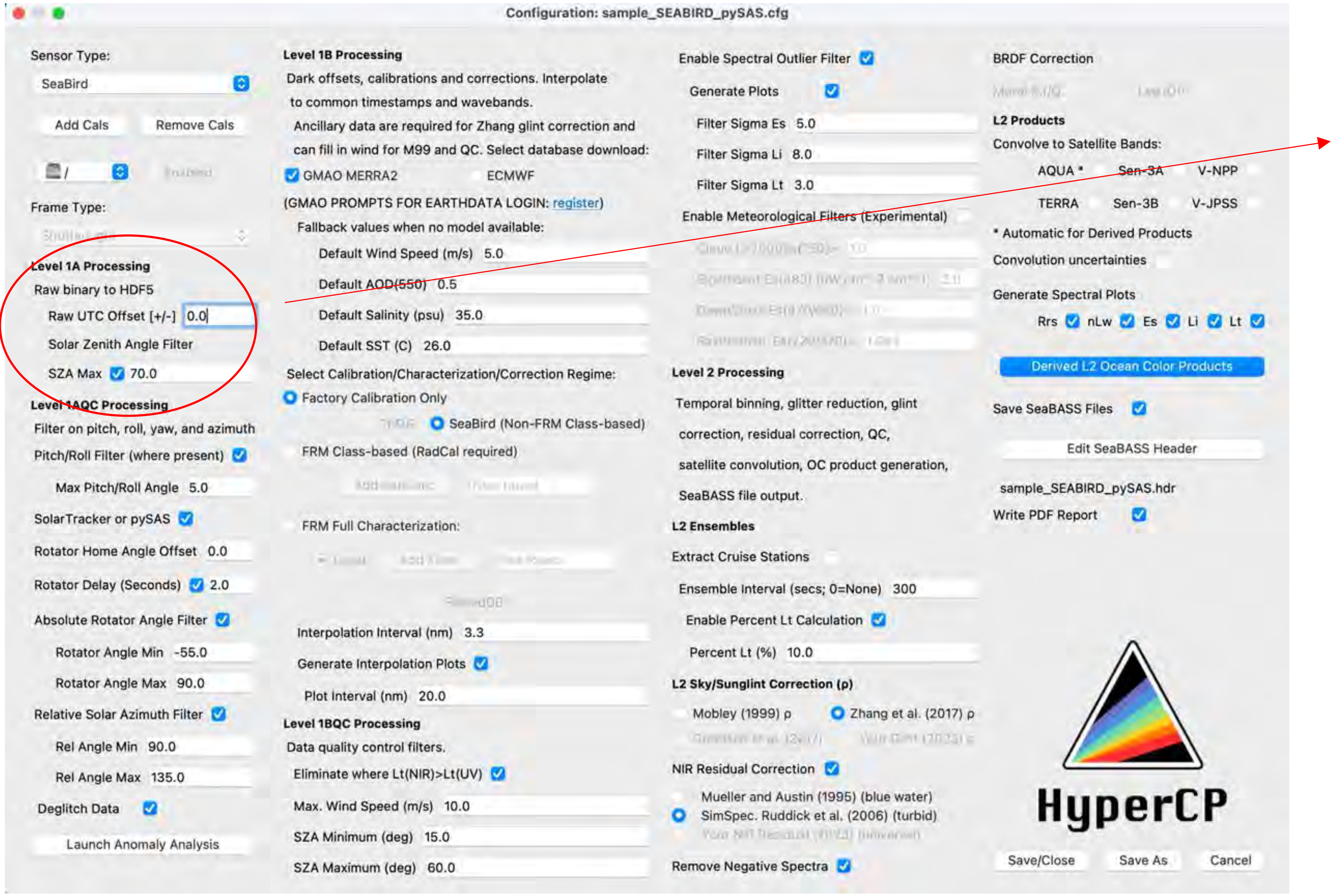
L2 Products
Convolve to Satellite Bands:
AQUA * ☐ Sen-3A ☐ V-NPP ☐
TERRA ☐ Sen-3B ☐ V-JPSS ☐
* Automatic for Derived Products
Convolution uncertainties ☐
Generate Spectral Plots
Rrs ☑ nLw ☑ Es ☑ Li ☑ Lt ☑
Derived L2 Ocean Color Products
Save SeaBASS Files ☑
Edit SeaBASS Header
sample_SEABIRD_pySAS.hdr
Write PDF Report ☑

HyperCP

Save/Close | Save As | Cancel



HyperCP Level 1A: Read Data



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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
● SeaBird (Non-FRM Class-based)
○ FRM Class-based (RadCal required)
○ FRM Full Characterization:
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) ☐

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 (ρ)
○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑
○ Mueller and Austin (1995) (blue water)
● SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra ☑

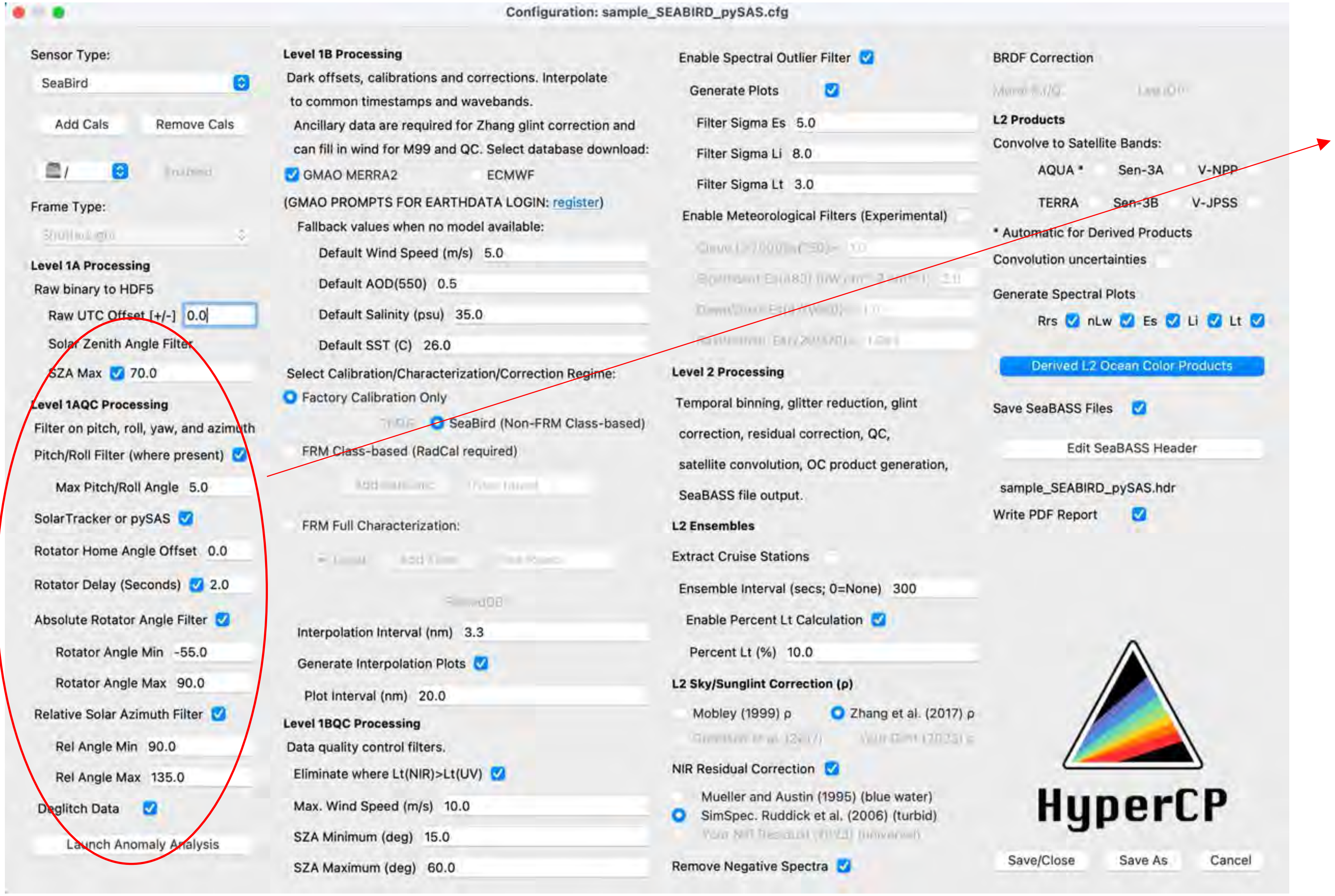
BRDF Correction

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 ☑
Save SeaBASS Files ☑
sample_SEABIRD_pySAS.hdr
Write PDF Report ☑

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

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

HyperCP Level 1AQC: Quality Control Data



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction ☐

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 ☑

Save SeaBASS Files ☑

sample_SEABIRD_pySAS.hdr

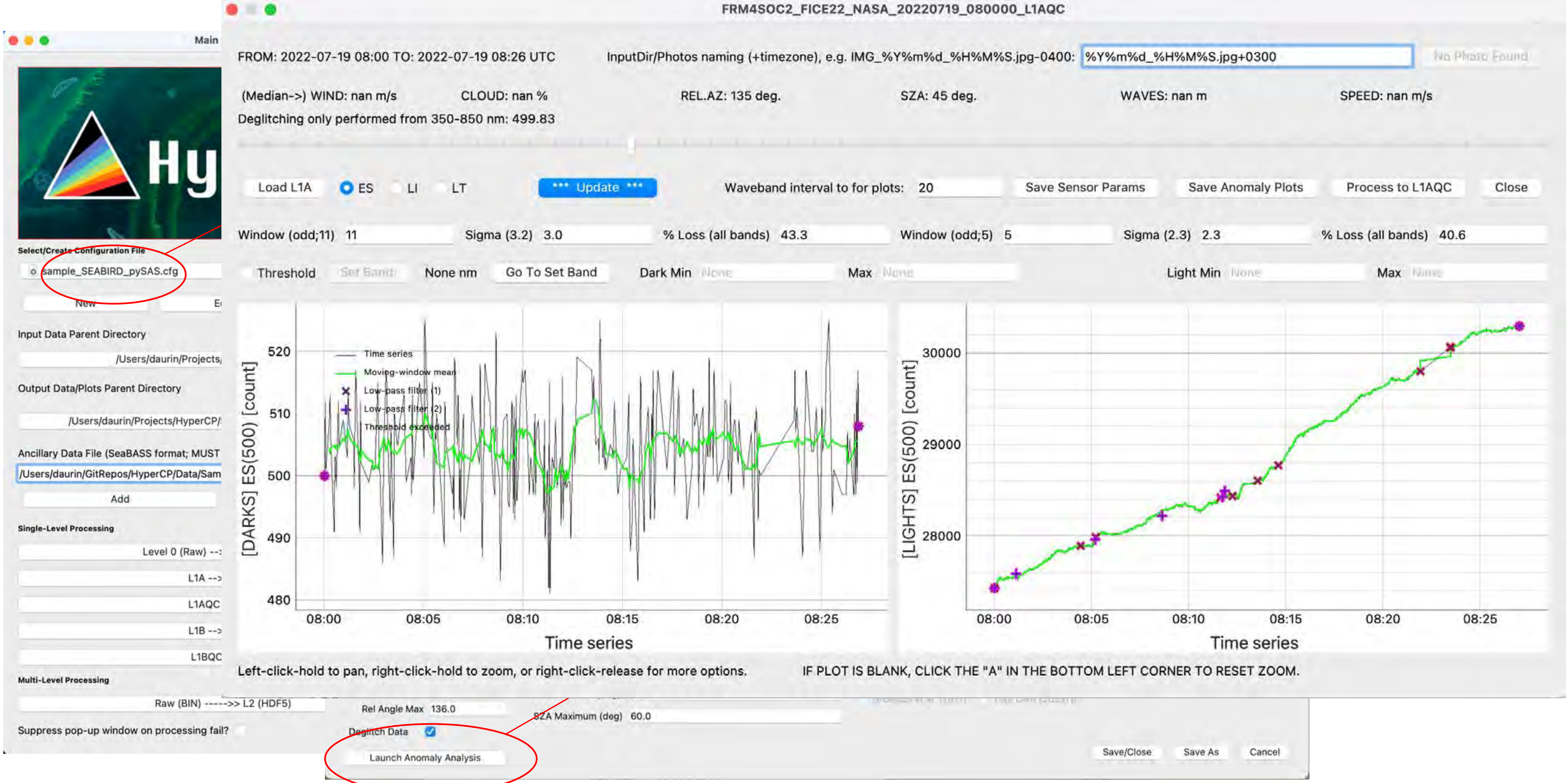
Write PDF Report ☑

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

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

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

HyperCP Level 1AQC: Supervised Deglitching


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: %Y%m%d_%H%M%S.jpg+0300

(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

Waveband interval to for plots: 20

Window (odd;11) 11 Sigma (3.2) 3.0 % Loss (all bands) 43.3 Window (odd;5) 5 Sigma (2.3) 2.3 % Loss (all bands) 40.6

Threshold None nm Dark Min None Max None Light Min None Max None

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.

Select/Create Configuration File: sample_SEABIRD_pySAS.cfg

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

Output Data/Plots Parent Directory: /Users/daurin/Projects/HyperCP/

Ancillary Data File (SeaBASS format; MUST: /Users/daurin/GitRepos/HyperCP/Data/Sam

Rel Angle Max 136.0

SZA Maximum (deg) 60.0

Deglitch Data ☑

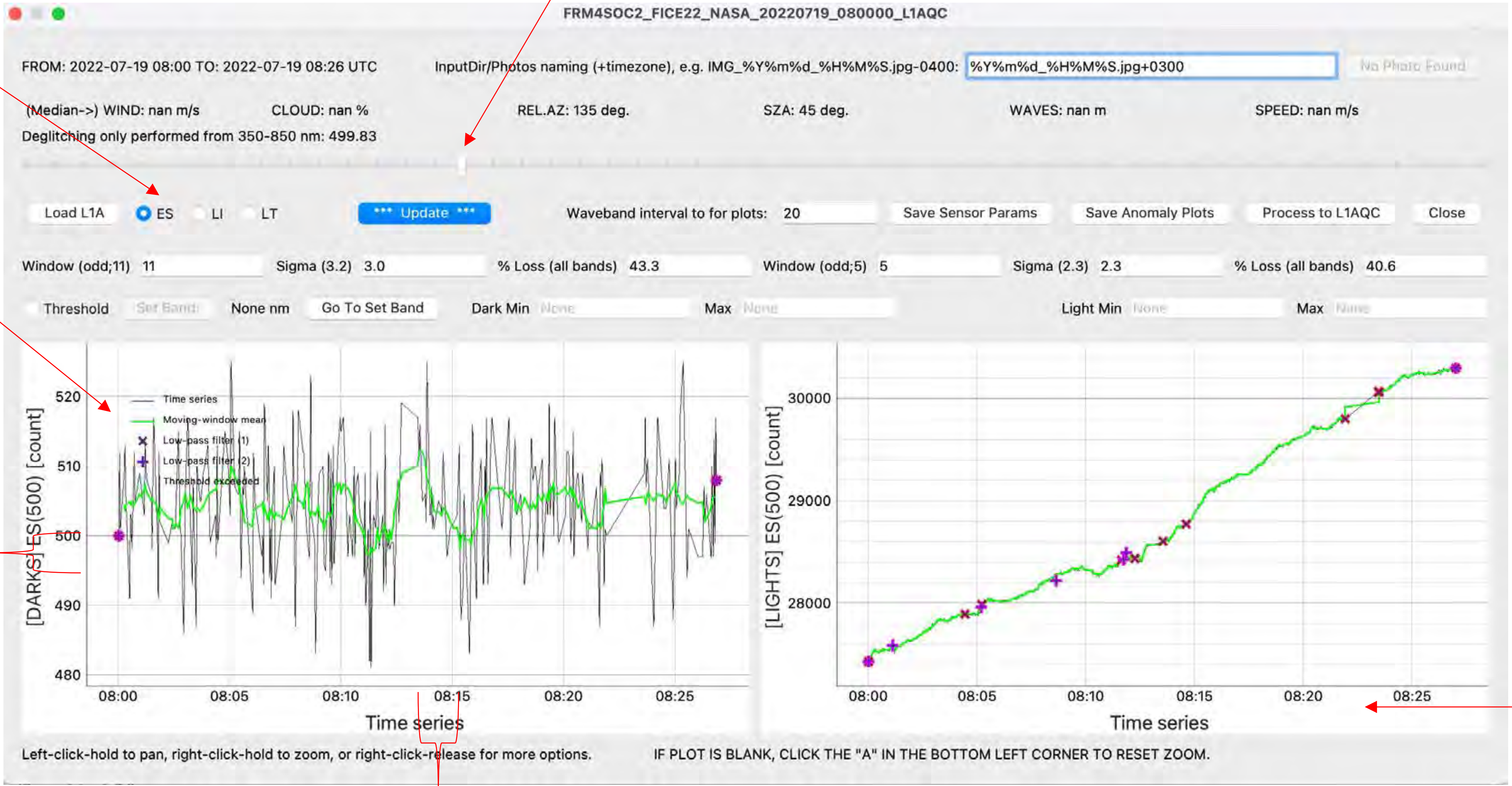
Suppress pop-up window on processing fail? ☐

HyperCP Level 1AQC: Supervised Deglitching

Supervised Deglitching.

Waveband Slider

Sensor



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: %Y%m%d_%H%M%S.jpg+0300

(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: 20

Window (odd;11) 11 Sigma (3.2) 3.0 % Loss (all bands) 43.3 Window (odd;5) 5 Sigma (2.3) 2.3 % Loss (all bands) 40.6

☐ Threshold None nm Dark Min None Max None Light Min None Max None

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.

Uncalibrated raw counts

Sigma

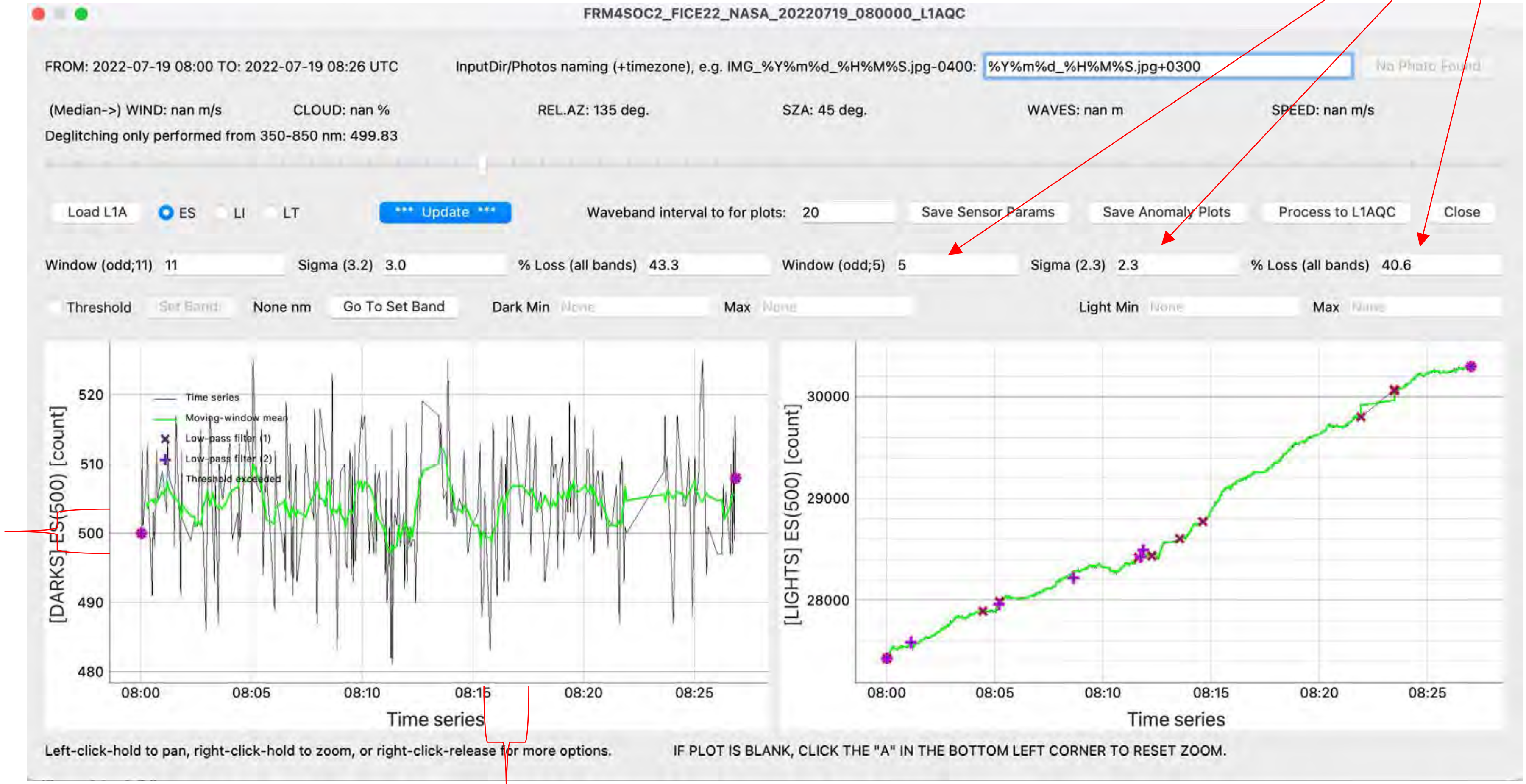
Time

Window

HyperCP Level 1AQC: Supervised Deglitching

Supervised Deglitching.

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



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: %Y%m%d_%H%M%S.jpg+0300

No Photo Found

(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

Load L1A ● ES ○ LI ○ LT *** Update ***

Waveband interval to for plots: 20

Save Sensor Params Save Anomaly Plots Process to L1AQC Close

Window (odd;11) 11 Sigma (3.2) 3.0 % Loss (all bands) 43.3 Window (odd;5) 5 Sigma (2.3) 2.3 % Loss (all bands) 40.6

☐ Threshold Set Band: None nm Go To Set Band Dark Min None Max None Light Min None Max None

Left-click-hold to pan, right-click-hold to zoom, or right-click-release for more options.

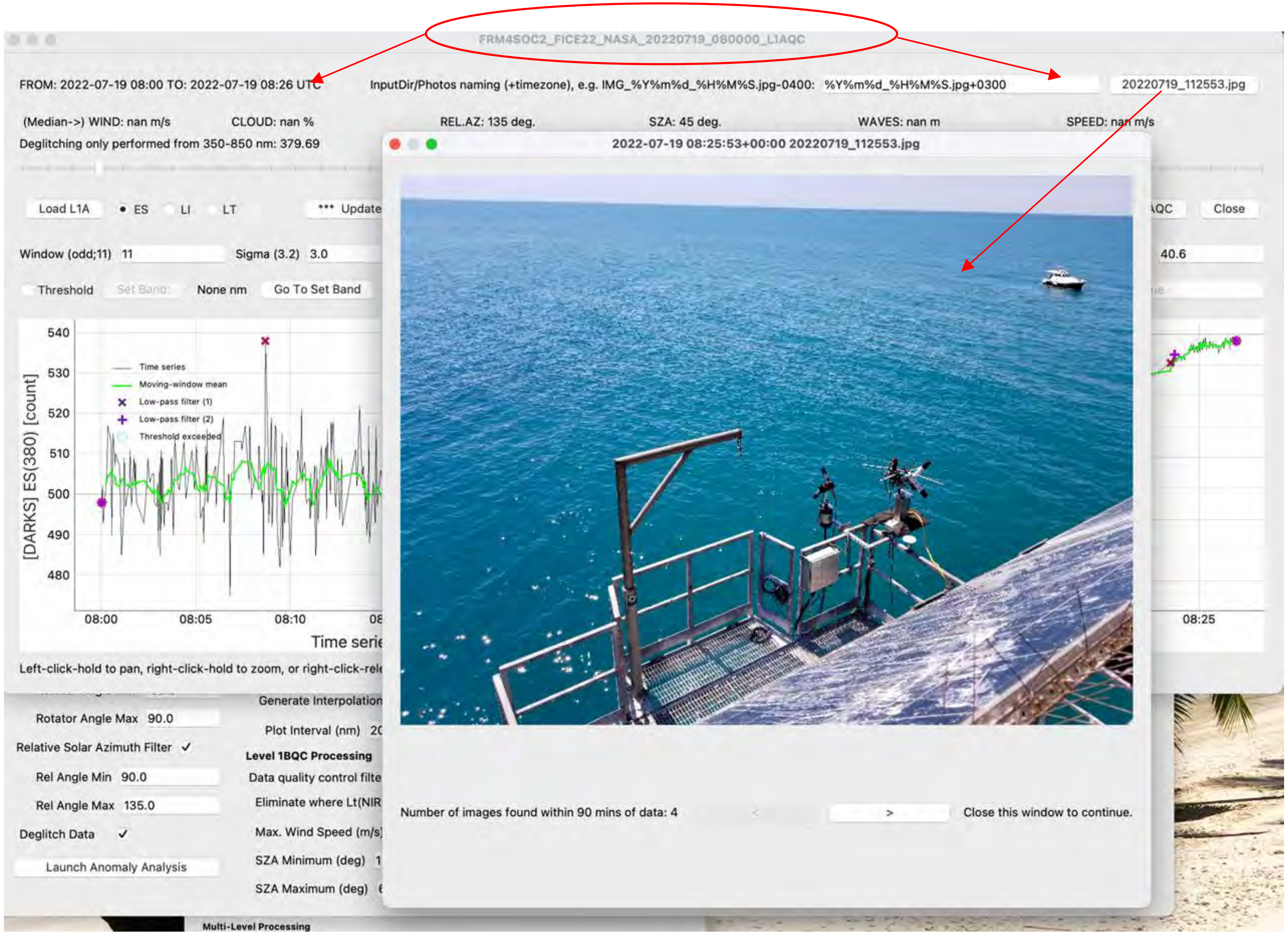
IF PLOT IS BLANK, CLICK THE "A" IN THE BOTTOM LEFT CORNER TO RESET ZOOM.

Sigma

Window

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

HyperCP Level 1AQC: Supervised Deglitching



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: %Y%m%d_%H%M%S.jpg+0300

20220719_112553.jpg

(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: 379.69

Window (odd;11) 11

Sigma (3.2) 3.0

40.6

None nm

2022-07-19 08:25:53+00:00 20220719_112553.jpg

Number of images found within 90 mins of data: 4

Close this window to continue.

Left-click-hold to pan, right-click-hold to zoom, or right-click-rel

Rotator Angle Max 90.0

Relative Solar Azimuth Filter ✓

Rel Angle Min 90.0

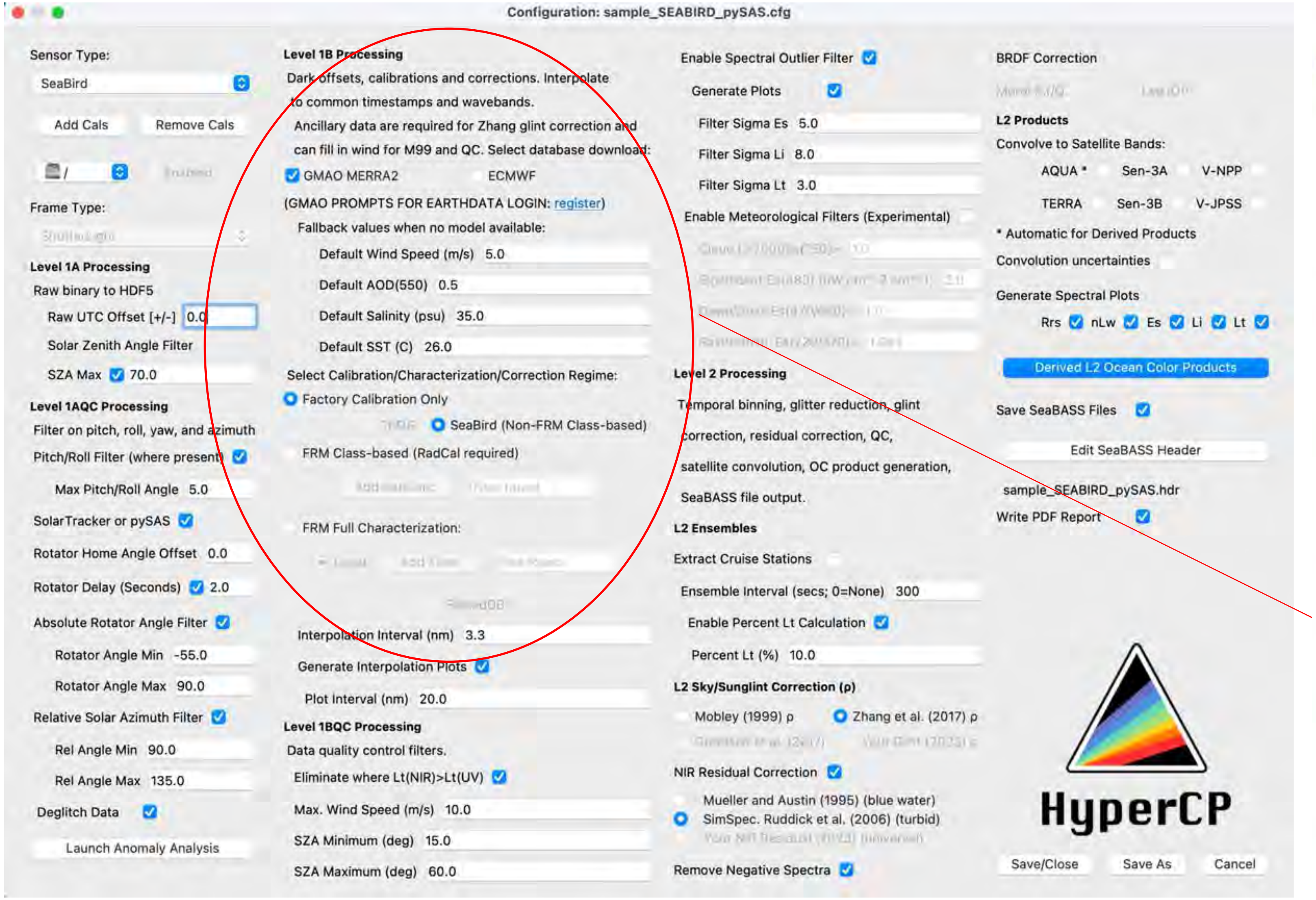
Rel Angle Max 135.0

Deglitch Data ✓

HyperCP

Demo:
Supervised Deglitching

HyperCP Level 1B: Overview



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type:
SeaBird
Add Cals | Remove Cals

Frame Type:

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
● SeaBird (Non-FRM Class-based)
○ FRM Class-based (RadCal required)
○ FRM Full Characterization:
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) ☐

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

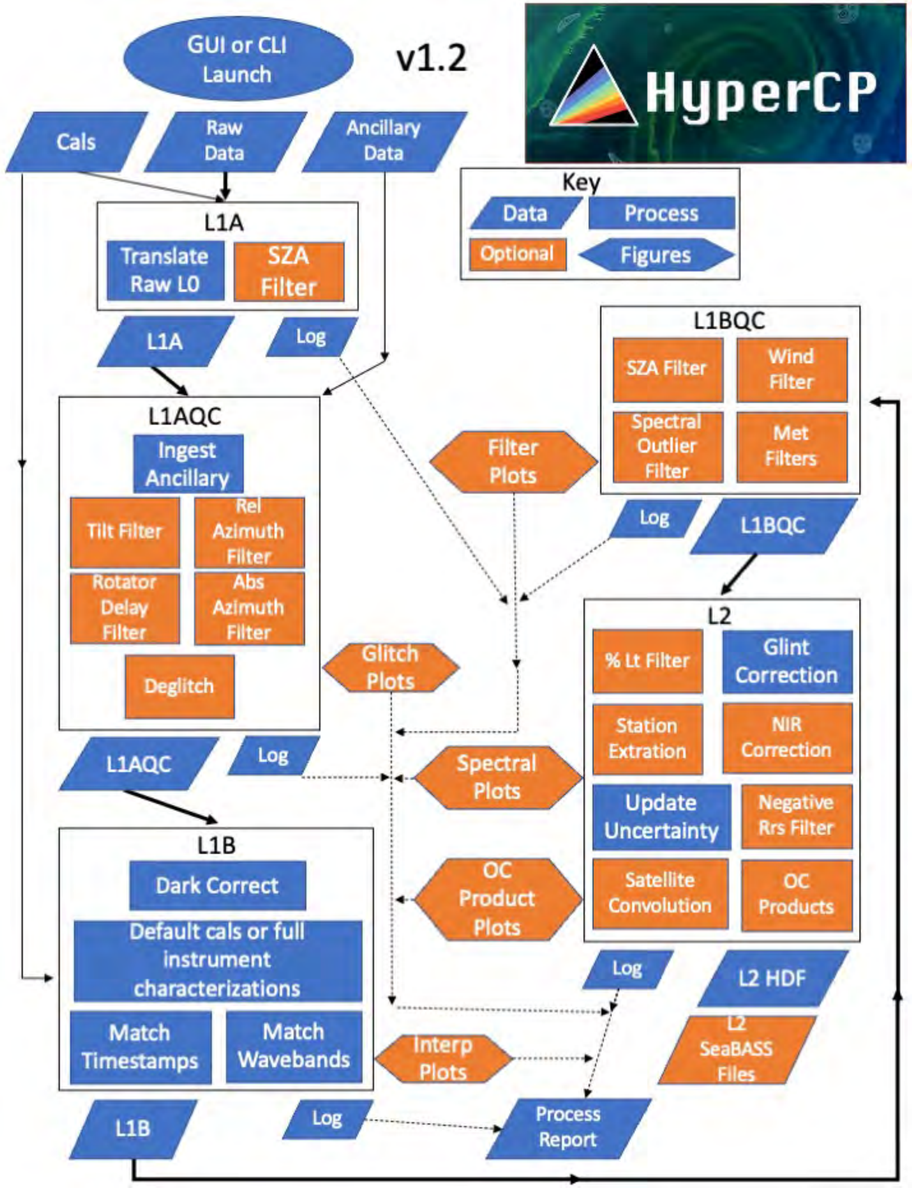
L2 Sky/Sunglint Correction (ρ)
○ Mobley (1999) ρ ● Zhang et al. (2017) ρ
NIR Residual Correction ☑
○ Mueller and Austin (1995) (blue water)
● SimSpec. Ruddick et al. (2006) (turbid)
Remove Negative Spectra ☑

BRDF Correction

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



GUI or CLI Launch

v1.2

HyperCP

Cals
Raw Data
Ancillary Data

Key
Data
Process
Optional
Figures

L1A
Translate Raw L0
SZA Filter
L1A
Log

L1AQC
Ingest Ancillary
Tilt Filter
Rel Azimuth Filter
Rotator Delay Filter
Abs Azimuth Filter
Deglitch
L1AQC
Log

Filter Plots
Glitch Plots
Spectral Plots
OC Product Plots
Interp Plots

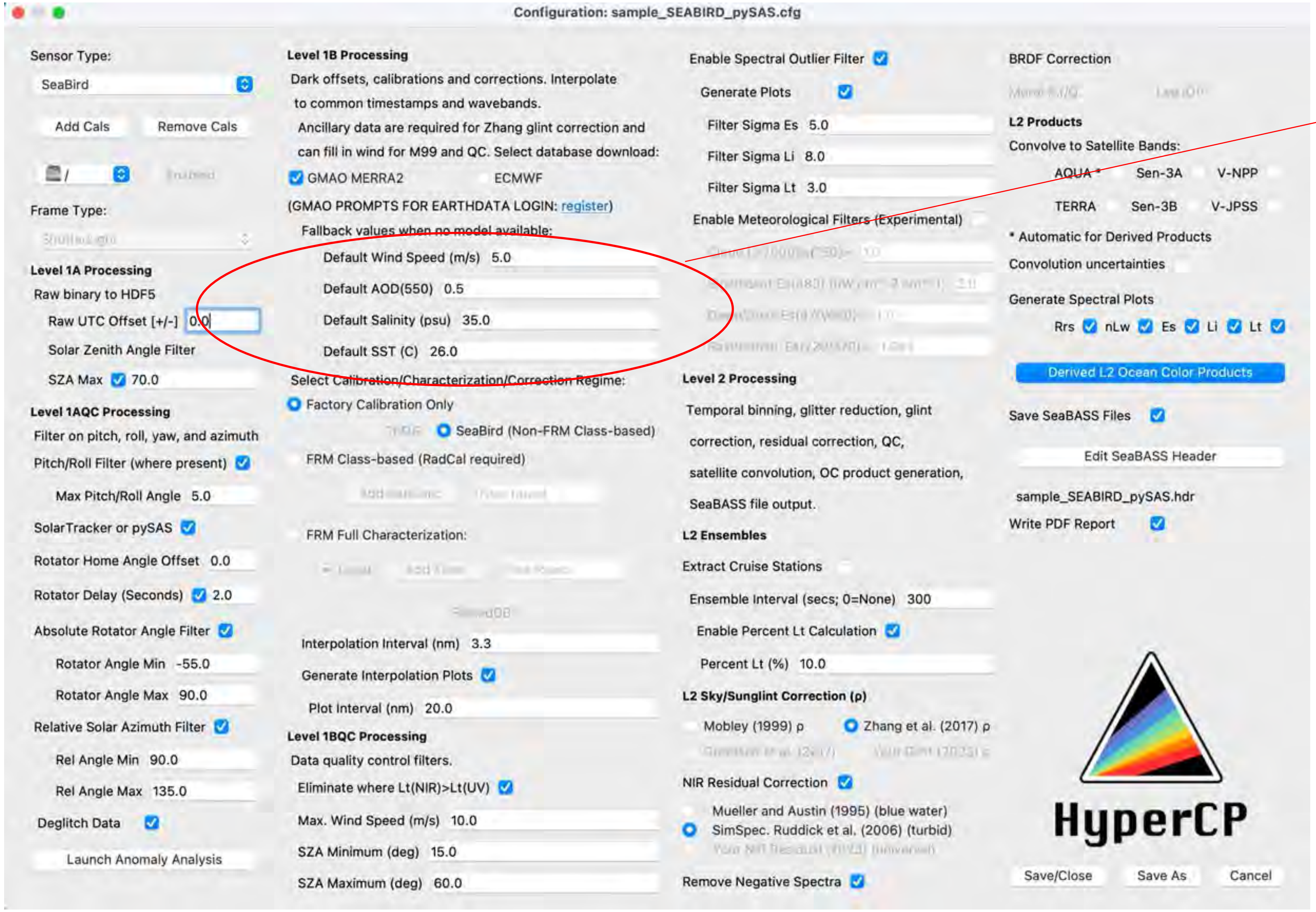
L1BQC
SZA Filter
Wind Filter
Spectral Outlier Filter
Met Filters
Log
L1BQC

L1B
Dark Correct
Default cals or full instrument characterizations
Match Timestamps
Match Wavebands
L1B
Log

L2
% Lt Filter
Glint Correction
Station Extration
NIR Correction
Update Uncertainty
Negative Rrs Filter
Satellite Convolution
OC Products
Log
L2 HDF
L2 SeaBASS Files

Process Report

HyperCP Level 1B: Load Ancillaries



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Add Cals | Remove Cals

Frame Type:

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction

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 ☑

Save SeaBASS Files ☑

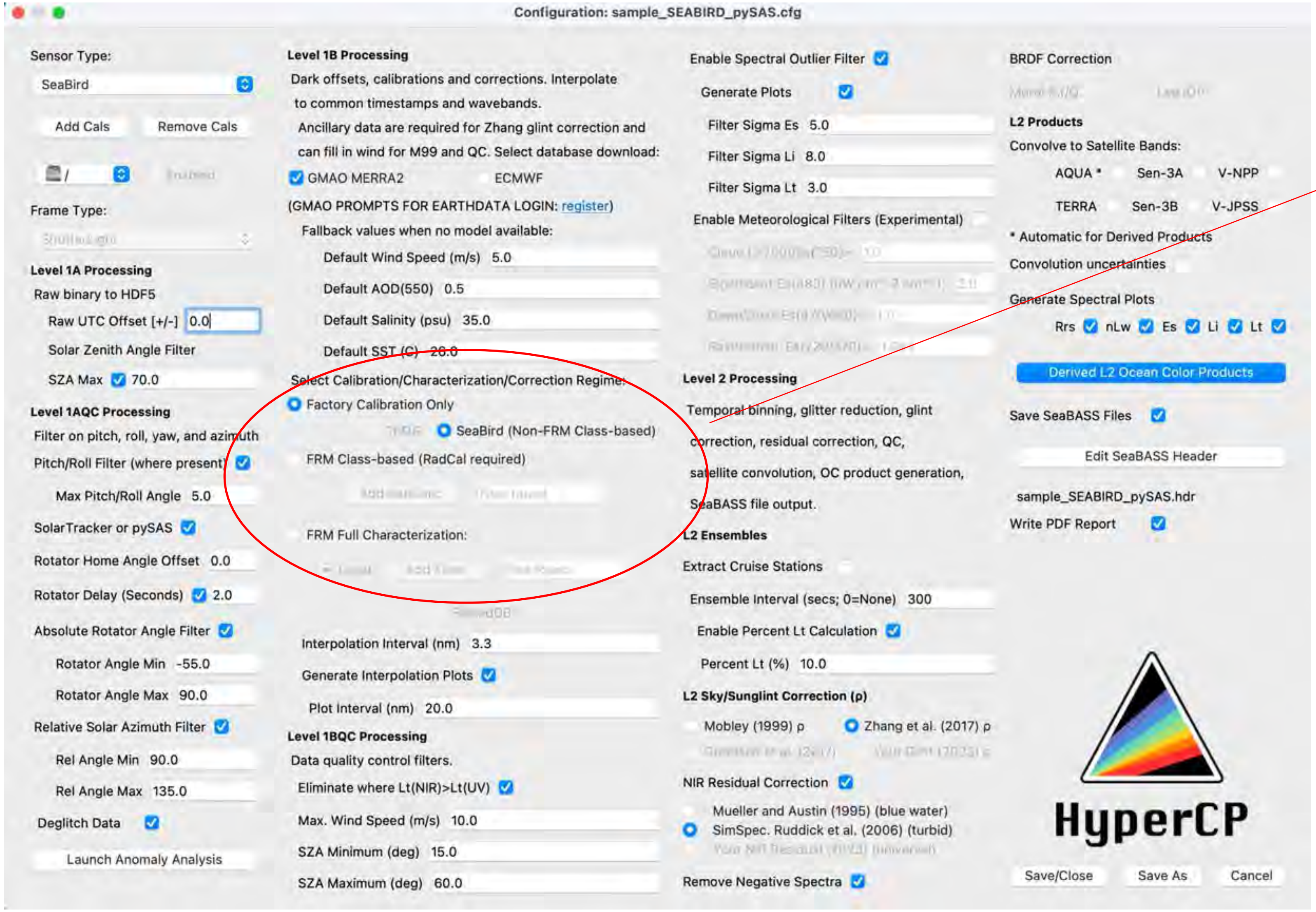
sample_SEABIRD_pySAS.hdr

Write PDF Report ☑

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

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

HyperCP Level 1B: Factory/Class/Full



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction

L2 Products

Convolve to Satellite Bands:

AQUA * Sen-3A V-NPP

TERRA Sen-3B V-JPSS

* Automatic for Derived Products

Convolution uncertainties ☐

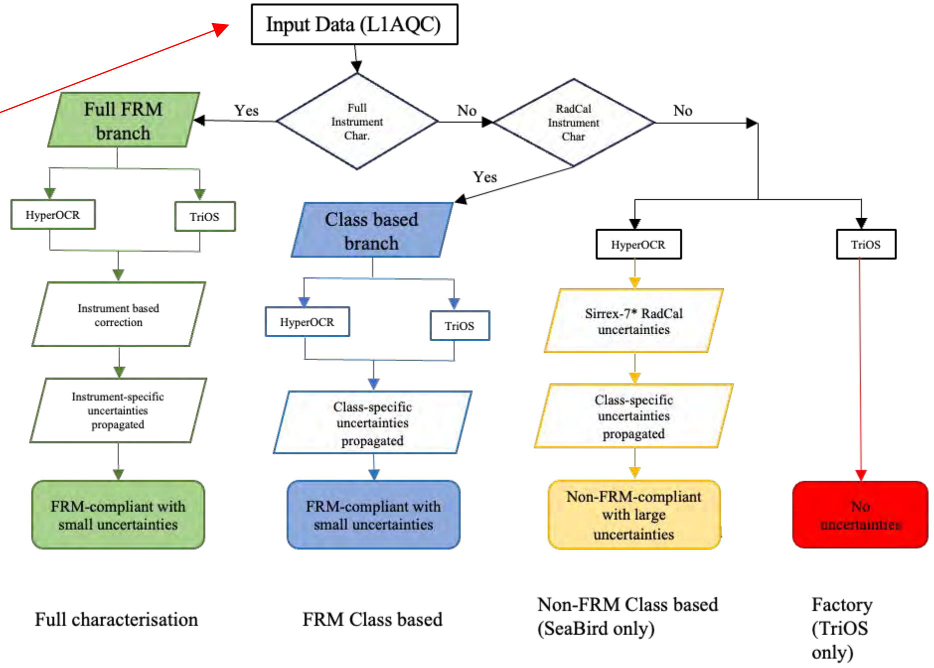
Generate Spectral Plots

Rrs ☑ nLw ☑ Es ☑ Li ☑ Lt ☑

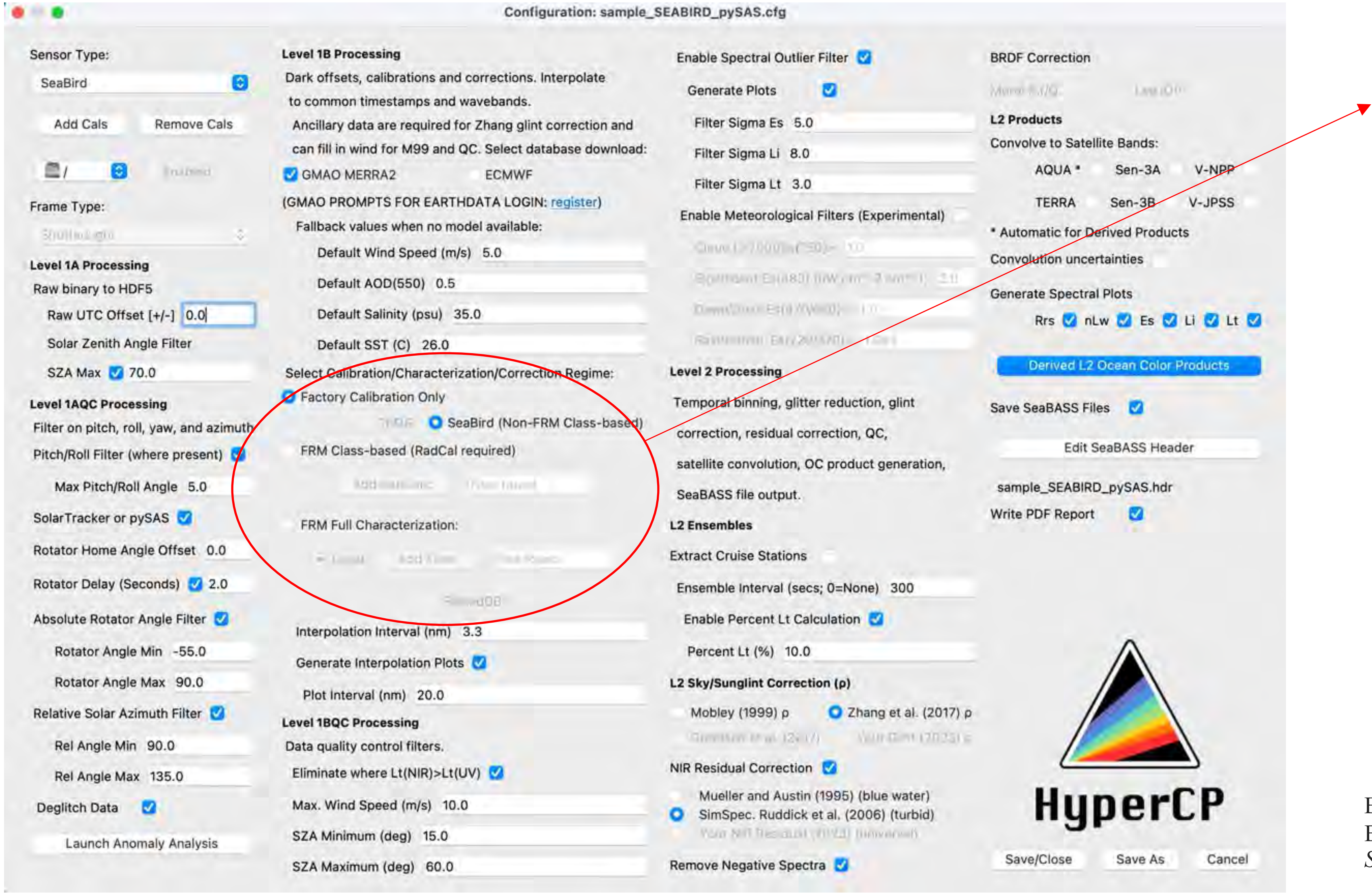
Save SeaBASS Files ☑

sample_SEABIRD_pySAS.hdr

Write PDF Report ☑



HyperCP Level 1B: Load Full Characterization



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction

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 ☑

Save SeaBASS Files ☑

sample_SEABIRD_pySAS.hdr

Write PDF Report ☑

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

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

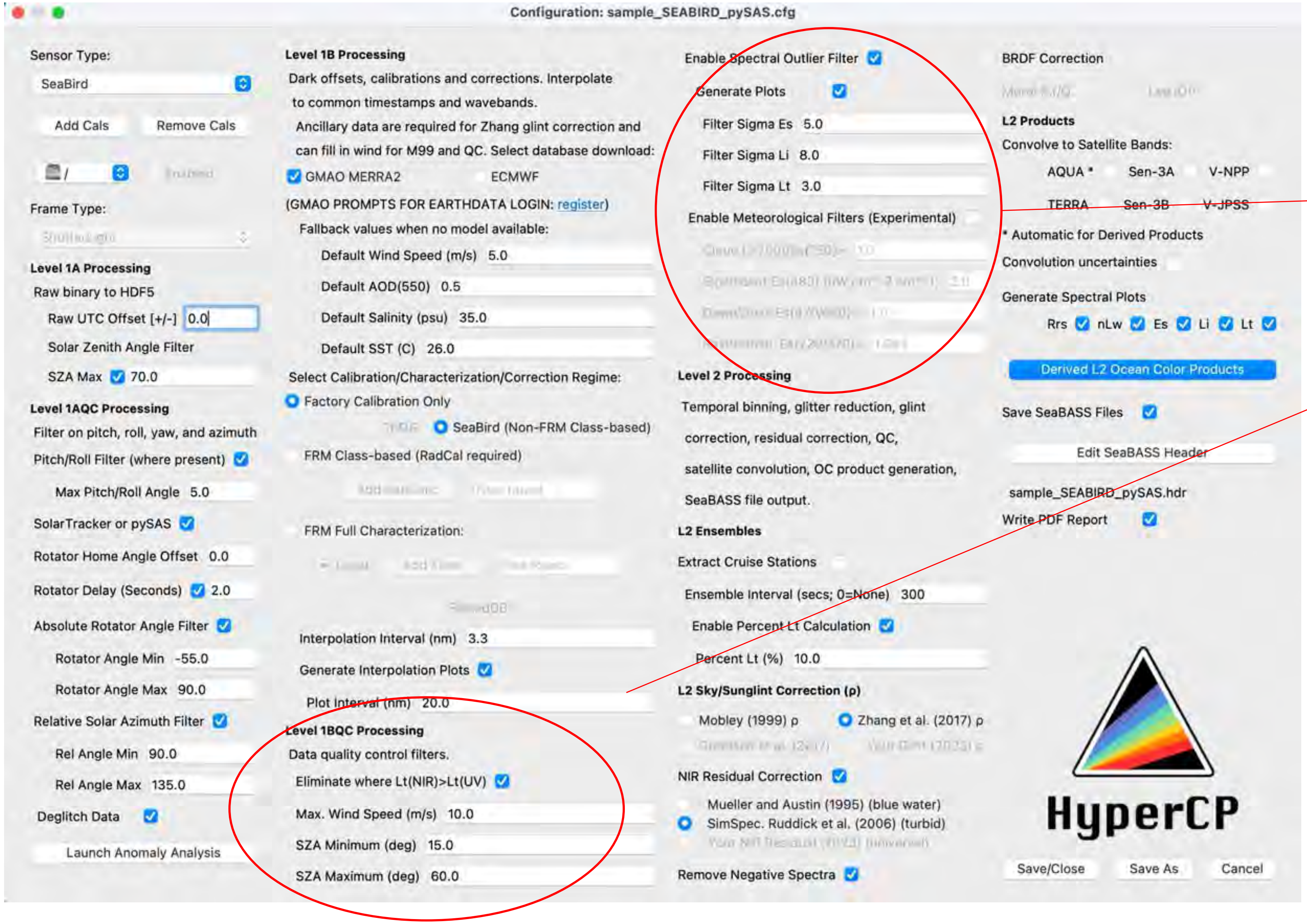
Using these pathways will also trigger use of Monte Carlo models estimating the uncertainties introduced by processing steps (e.g., glint correction) and environmental variability.

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

HyperCP

Demo: Loading RadCal or Full Characterization Files

HyperCP Level 1BQC: Quality Control with Ancillaries



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type:
SeaBird
Add Cals | Remove Cals

Frame Type:

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
● SeaBird (Non-FRM Class-based)
○ FRM Class-based (RadCal required)
○ FRM Full Characterization:
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) ☐

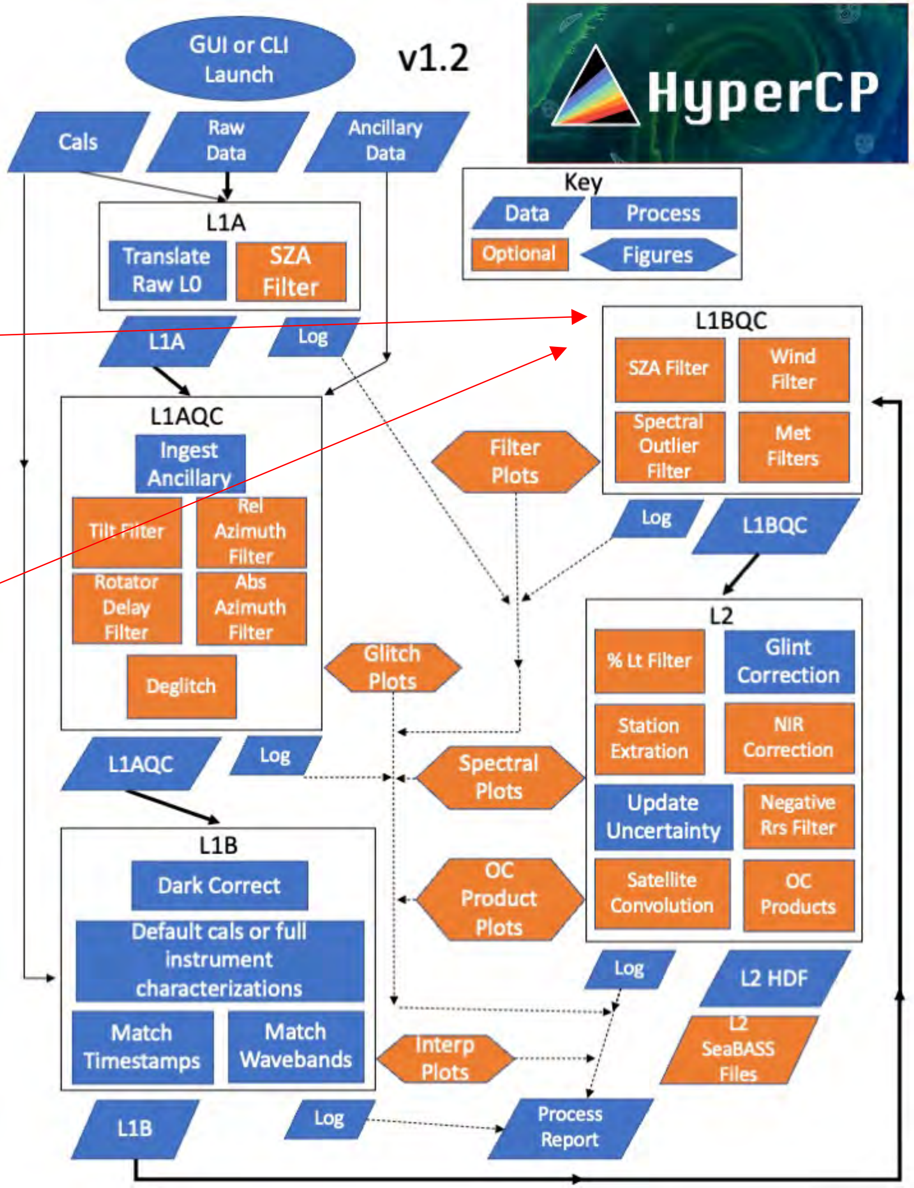
Level 2 Processing
Temporal binning, glitter reduction, glint correction, residual correction, QC, satellite convolution, OC product generation, SeaBASS file output.

L2 Ensembles
Extract Cruise Stations ☐
Ensemble Interval (secs; 0=None) 300
Enable Percent Lt Calculation ☑
Percent Lt (%) 10.0

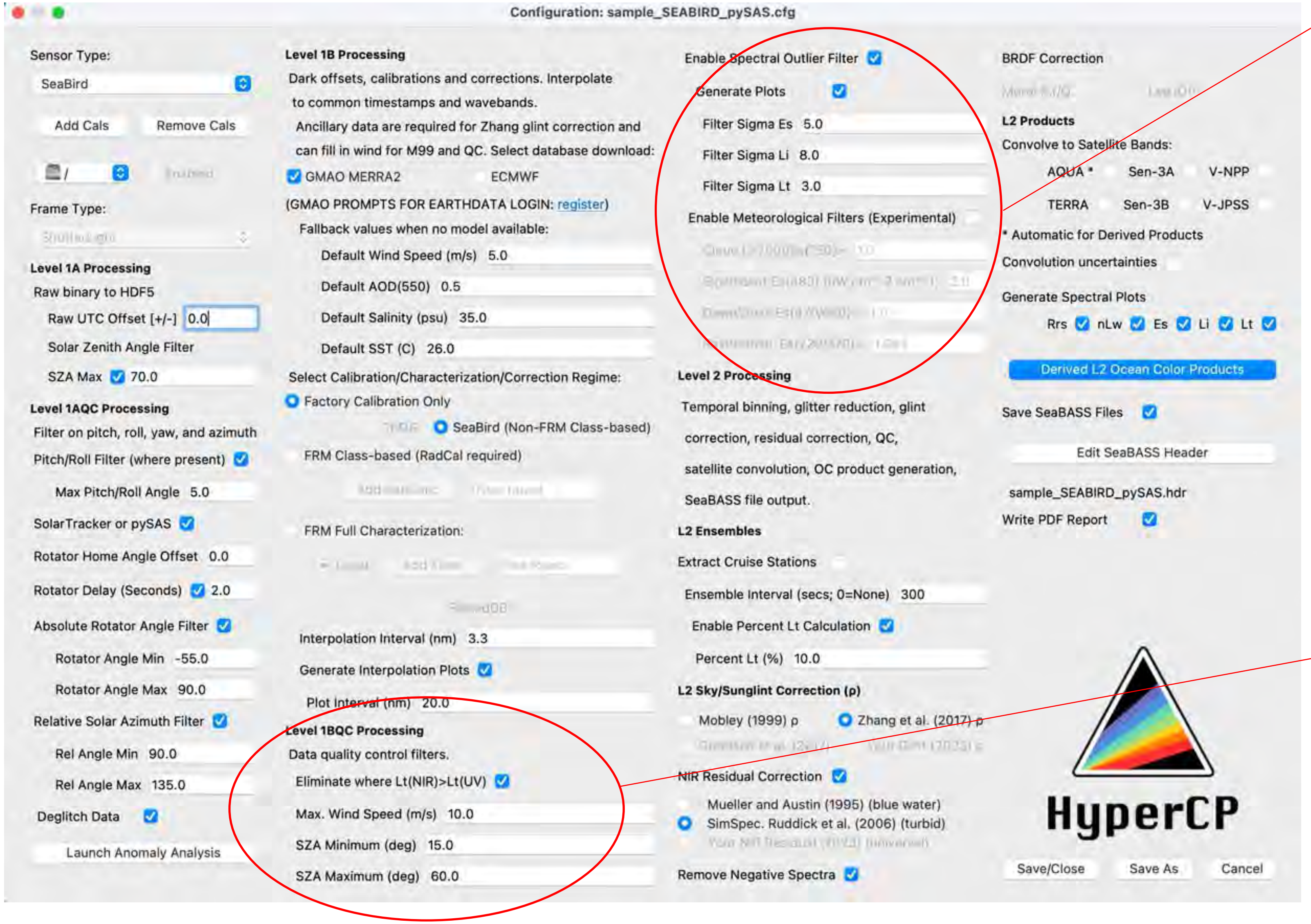
L2 Sky/Sunglint Correction (ρ)
○ Mobley (1999) ρ ● Zhang et al. (2017) ρ
NIR Residual Correction ☑
○ Mueller and Austin (1995) (blue water)
● SimSpec. Ruddick et al. (2006) (turbid)
Remove Negative Spectra ☑

BRDF Correction

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 Level 1BQC: Quality Control with Ancillaries



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction ☐

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 ☑

Save SeaBASS Files ☑

sample_SEABIRD_pySAS.hdr

Write PDF Report ☑

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

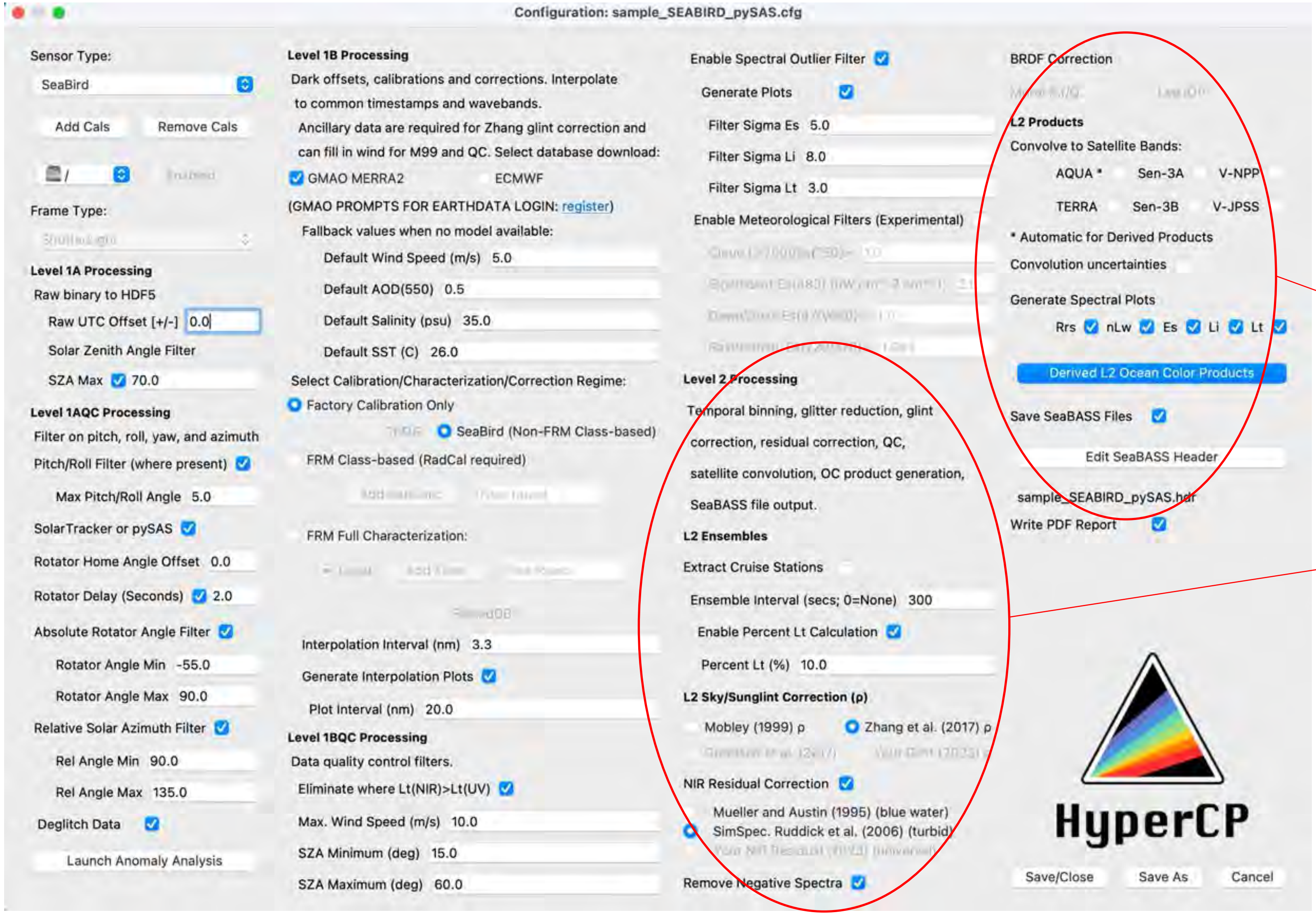
Met filters are optional and considered experimental.

Basic quality controls for spectral shape and environmental conditions.

HyperCP

Demo:
Screening Spectral Filters

HyperCP Level 2: Overview



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Add Cals | Remove Cals

Frame Type:

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction

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

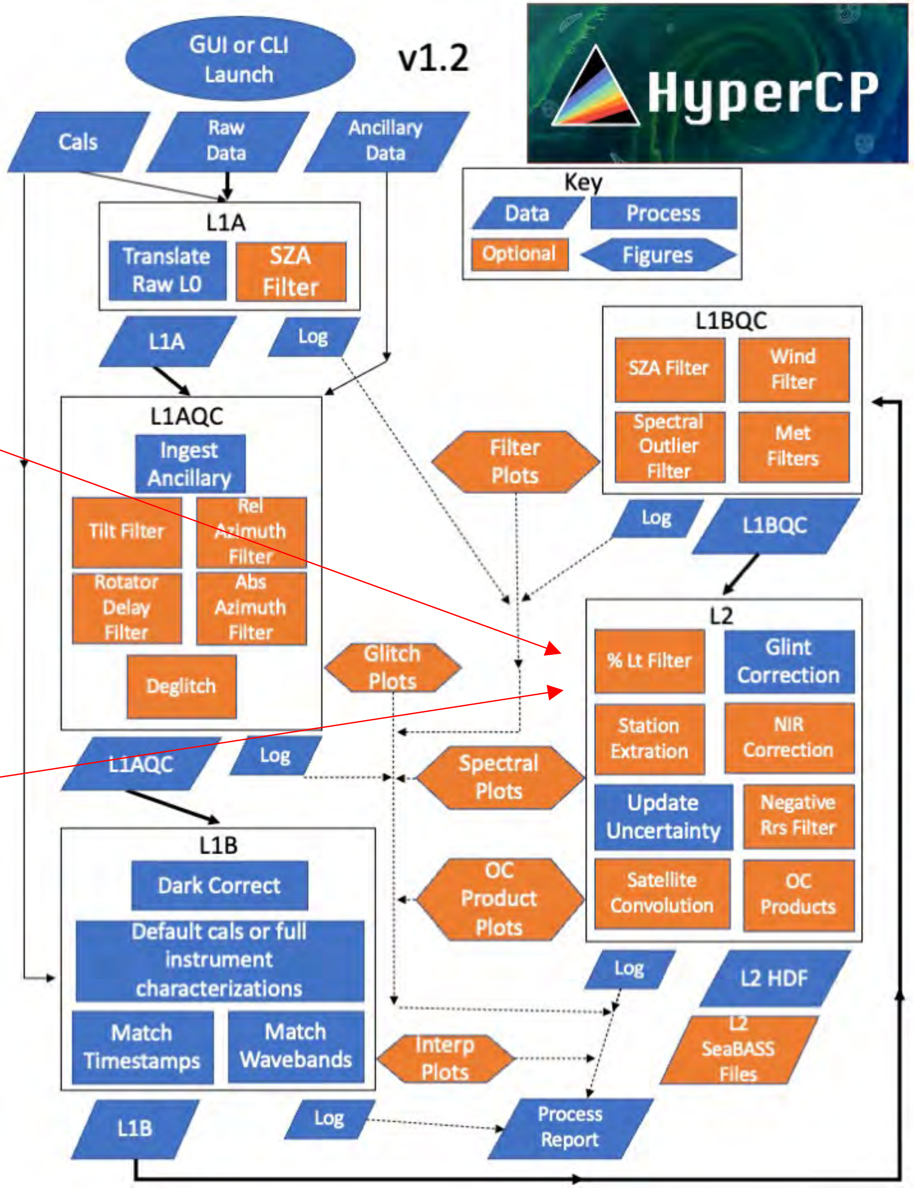
Save SeaBASS Files ☑

Edit SeaBASS Header

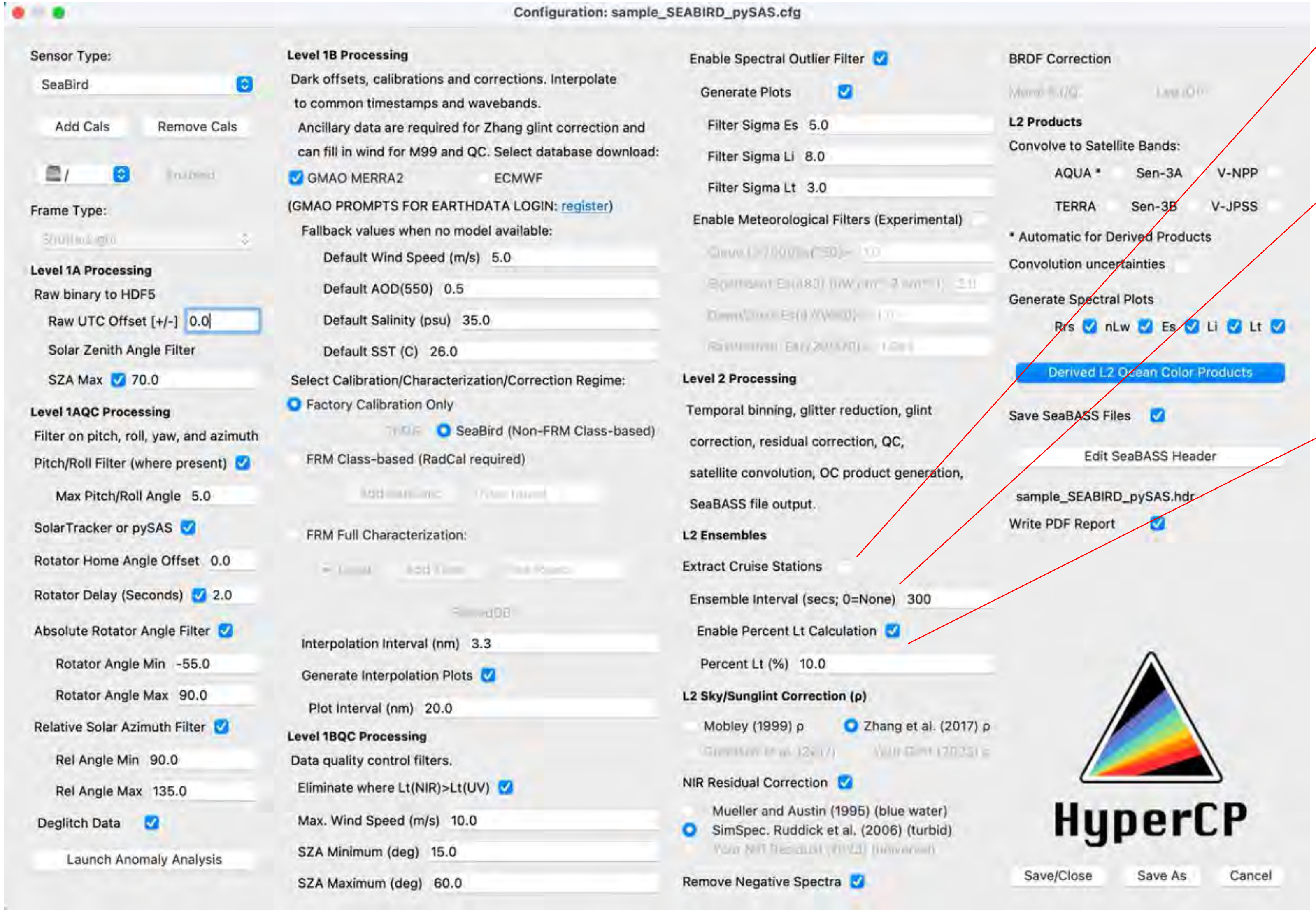
sample_SEABIRD_pySAS.hdr

Write PDF Report ☑

Save/Close | Save As | Cancel



HyperCP Level 2: Binning



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction

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 ☑

Save SeaBASS Files ☑

sample_SEABIRD_pySAS.hdr

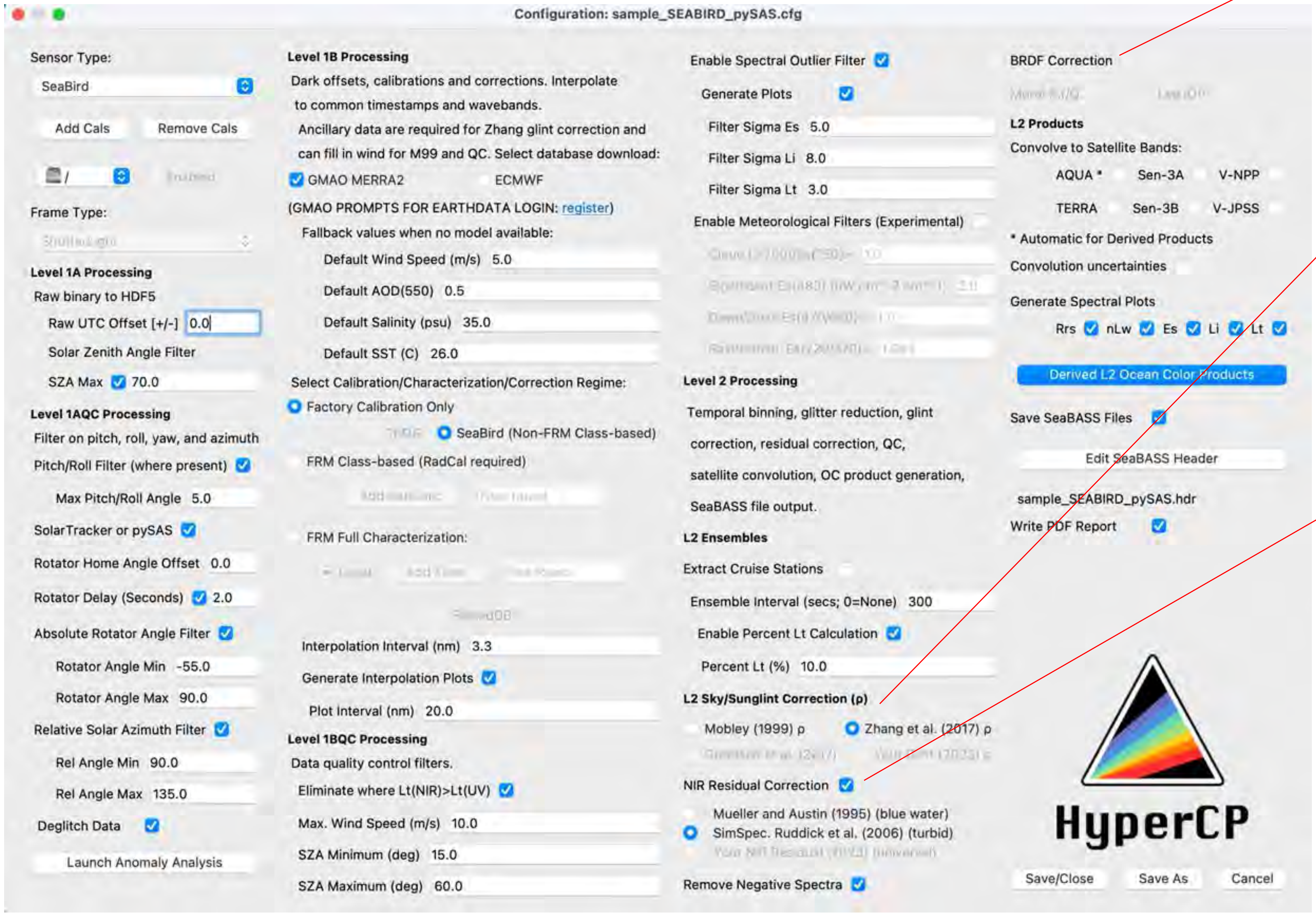
Write PDF Report ☑

Stations from Ancillary file

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

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

HyperCP Level 2: Corrections…



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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
● SeaBird (Non-FRM Class-based)
○ FRM Class-based (RadCal required)
○ FRM Full Characterization:
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) ☐

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 (ρ)
○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑
○ Mueller and Austin (1995) (blue water)
● SimSpec. Ruddick et al. (2006) (turbid)

Remove Negative Spectra ☑

BRDF Correction

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 ☑
Save SeaBASS Files ☑
sample_SEABIRD_pySAS.hdr
Write PDF Report ☑

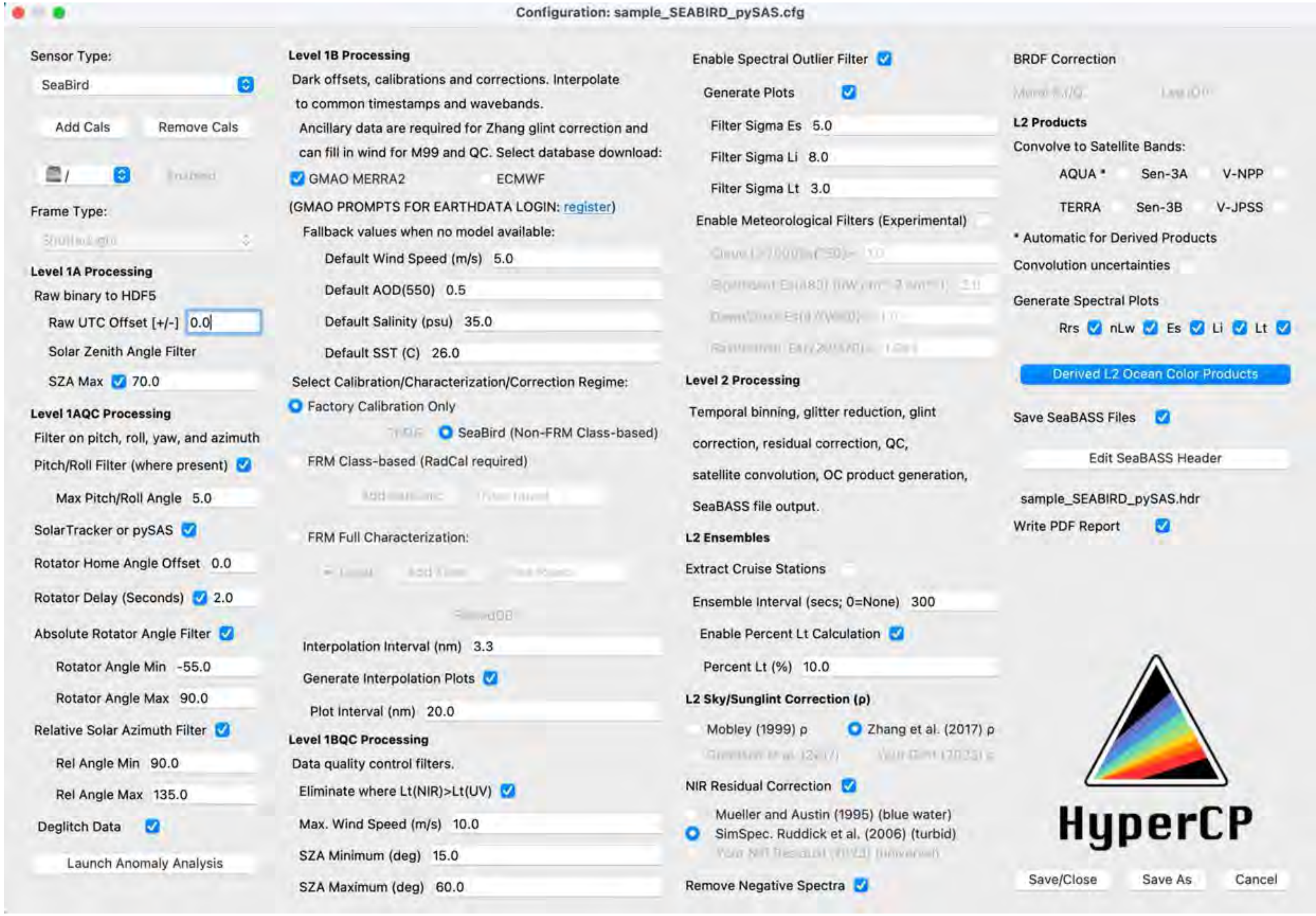
BRDF Correction [optional]
Apply BRDF correction to adjust reflectance for zenith sensor and sun in a non-absorbing atmosphere (e.g., for satellite comparison/validation)

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

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

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

HyperCP Level 2: Corrections…



Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction

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 ☑

Save SeaBASS Files ☑

sample_SEABIRD_pySAS.hdr

Write PDF Report ☑

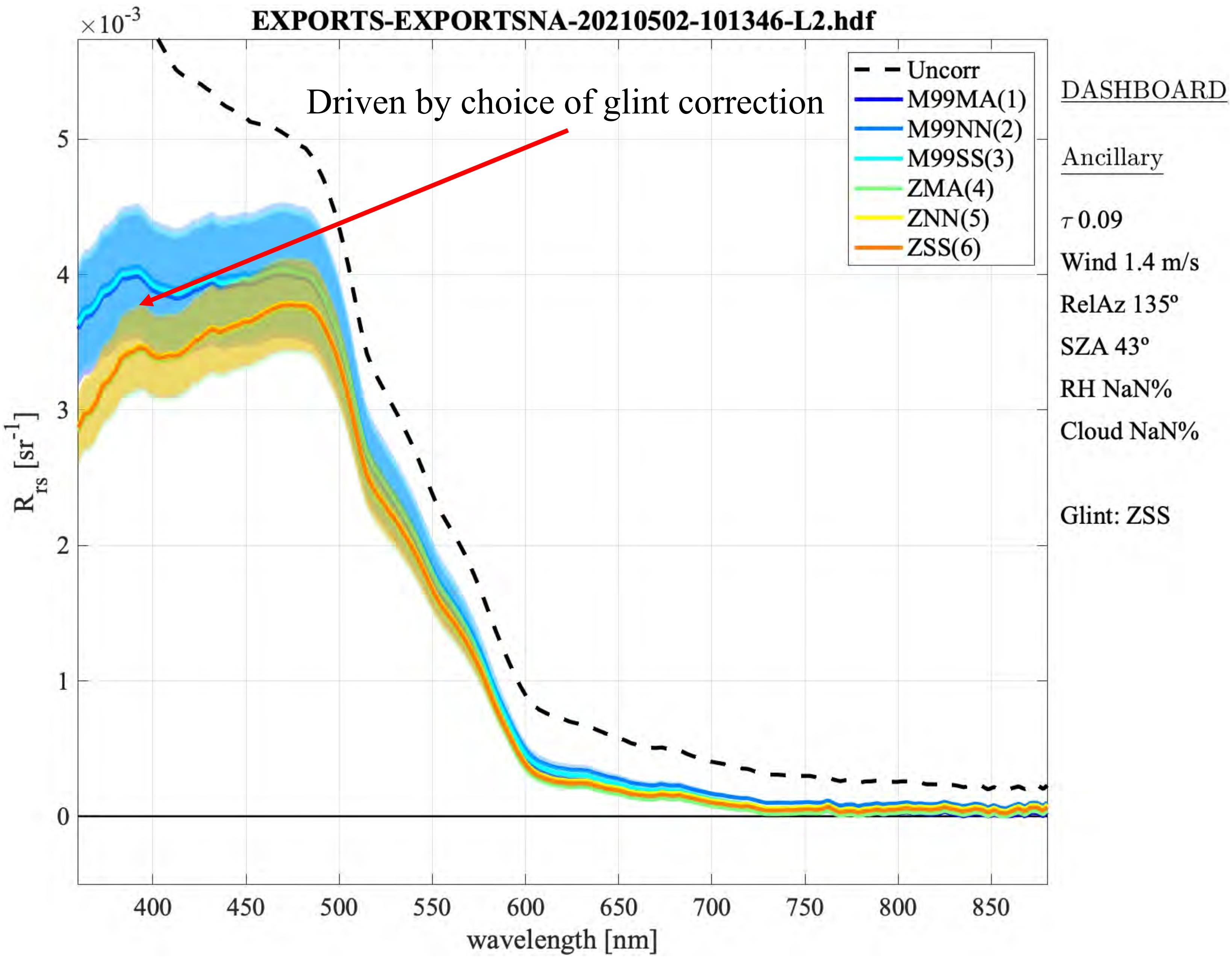
Broadly speaking, the best practices are:

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)

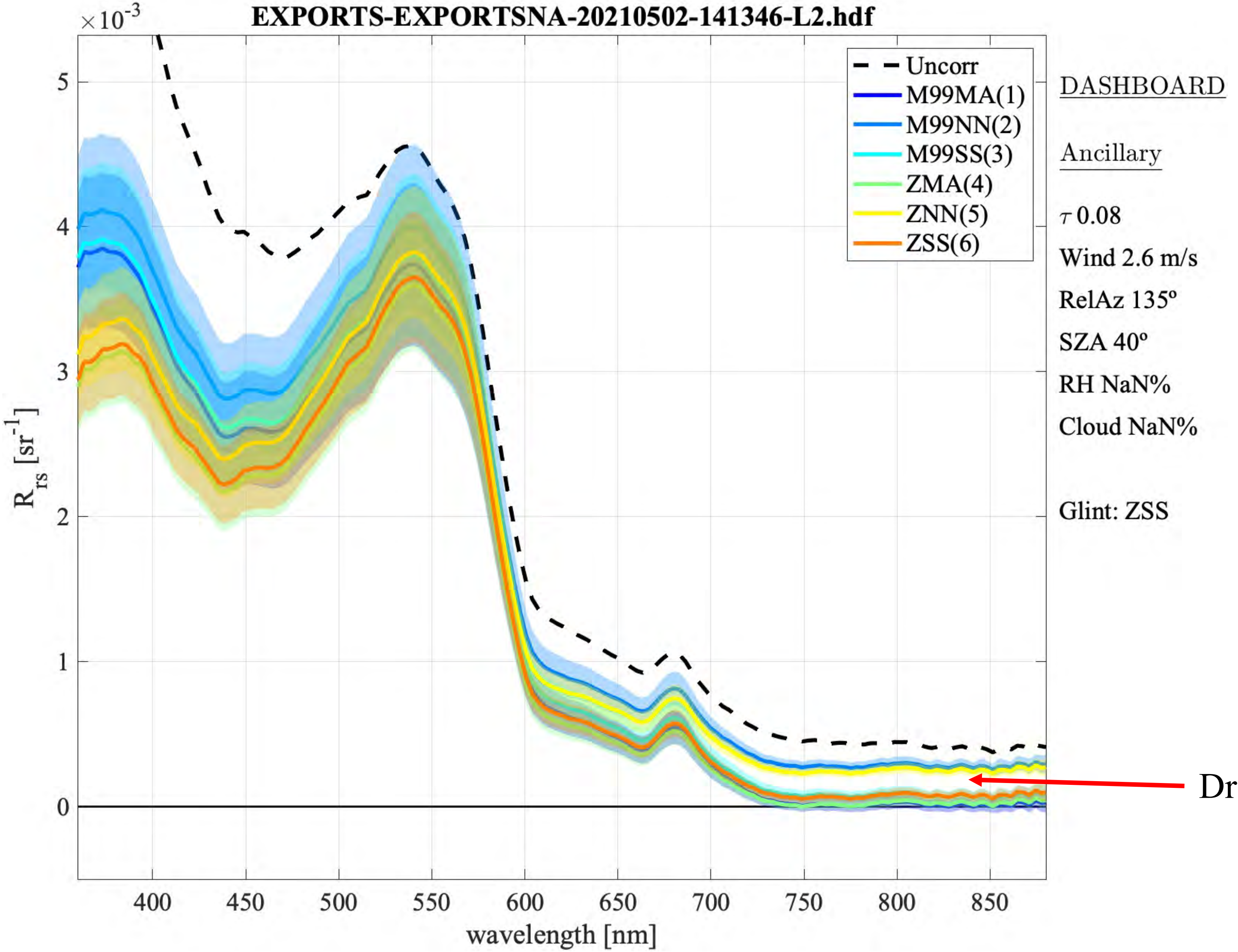

Driven by choice of glint correction

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

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 Level 2: Spectral Response Weighting for Satellite Band Convolution


Configuration: sample_SEABIRD_pySAS.cfg

Sensor Type: SeaBird

Frame Type:

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 ☑

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
● SeaBird (Non-FRM Class-based)
FRM Class-based (RadCal required)
FRM Full Characterization:
Interpolation Interval (nm) 3.3
Generate Interpolation Plots ☑
Plot Interval (nm) 20.0

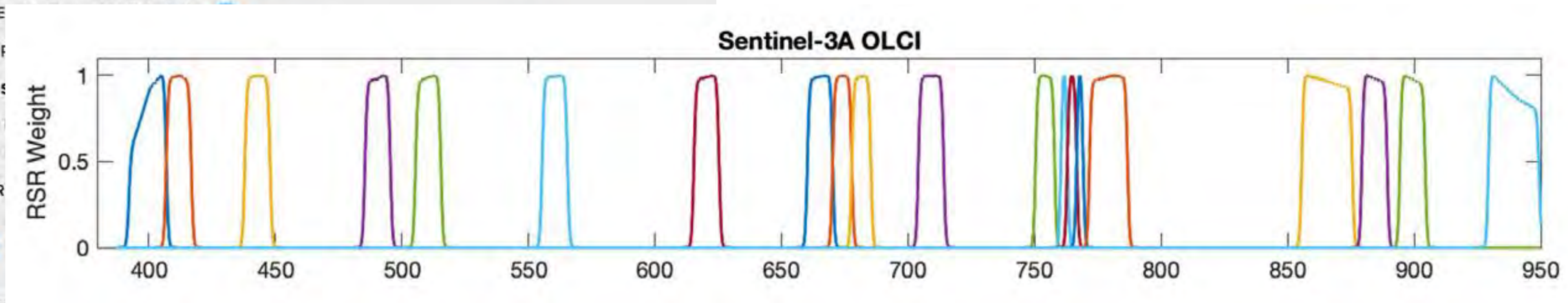
Level 1BQC Processing
Data quality control filters.
Eliminate where Lt(NIR)>Lt(UV) ☑
Max. Wind Speed (m/s) 10.0
SZA Minimum (deg) 15.0
SZA Maximum (deg) 60.0

Enable Spectral Outlier Filter ☑
Generate Plots ☑
Filter Sigma Es 5.0
Filter Sigma Li 8.0
Filter Sigma Lt 3.0
Enable Meteorological Filters
Extract Cruise Stations
Ensemble Interval (secs; 0=None) 300

Rrs ☑ nLw ☑ Es ☑ Li ☑ Lt ☑
Save SeaBASS Files ☑
sample_SEABIRD_pySAS.hdr
Write PDF Report ☑

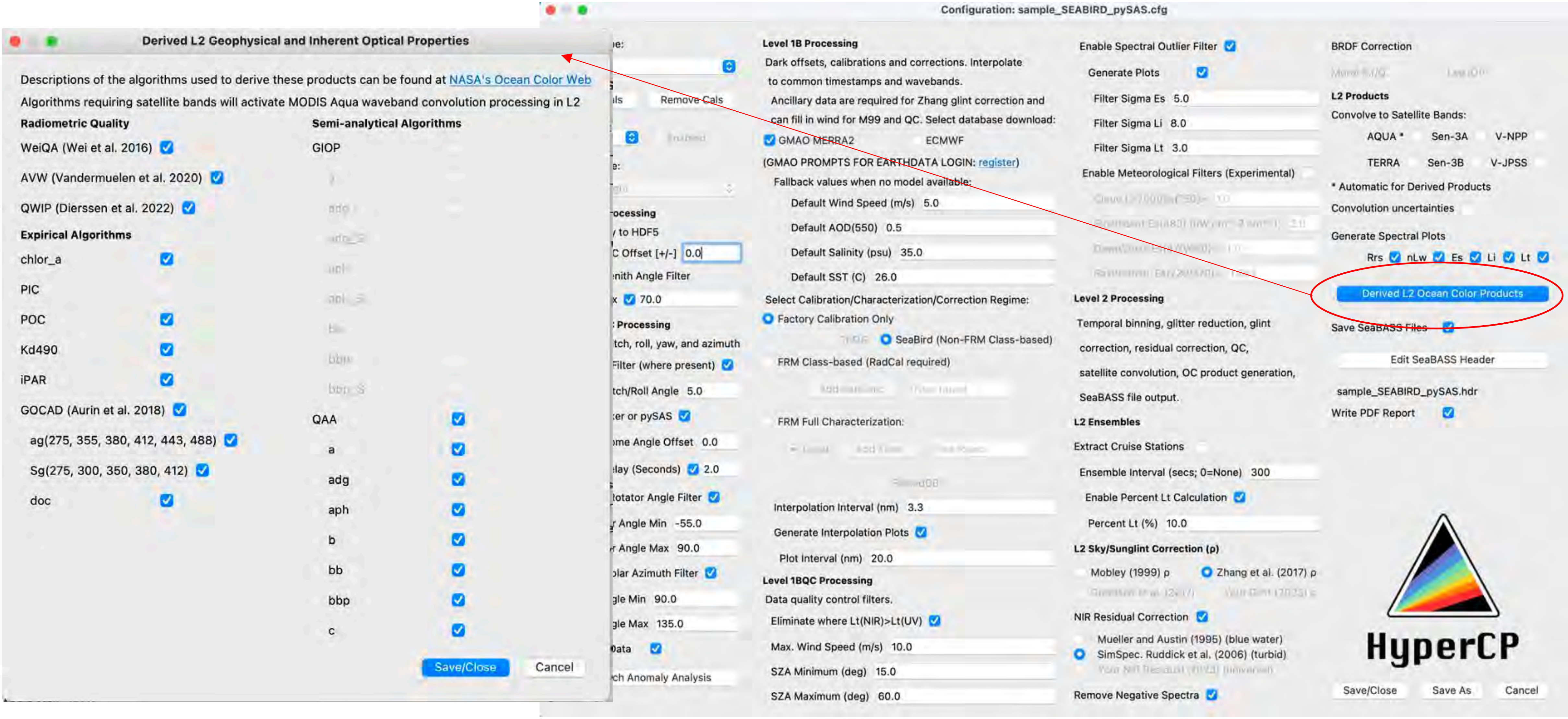
Not yet optimized for speed.
Avoid on large files for now.

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 ☐

QAA ☑

a ☑

adg ☑

aph ☑

b ☑

bb ☑

bbp ☑

c ☑

Save/Close | Cancel

Configuration: sample_SEABIRD_pySAS.cfg

Remove Cals

C Offset [+/-] 0.0

nith Angle Filter

x ☑ 70.0

tch, roll, yaw, and azimuth

Filter (where present) ☑

tch/Roll Angle 5.0

er or pySAS ☑

me Angle Offset 0.0

lay (Seconds) ☑ 2.0

otator Angle Filter ☑

Angle Min -55.0

Angle Max 90.0

lar Azimuth Filter ☑

gle Min 90.0

gle Max 135.0

ata ☑

ch 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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction

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

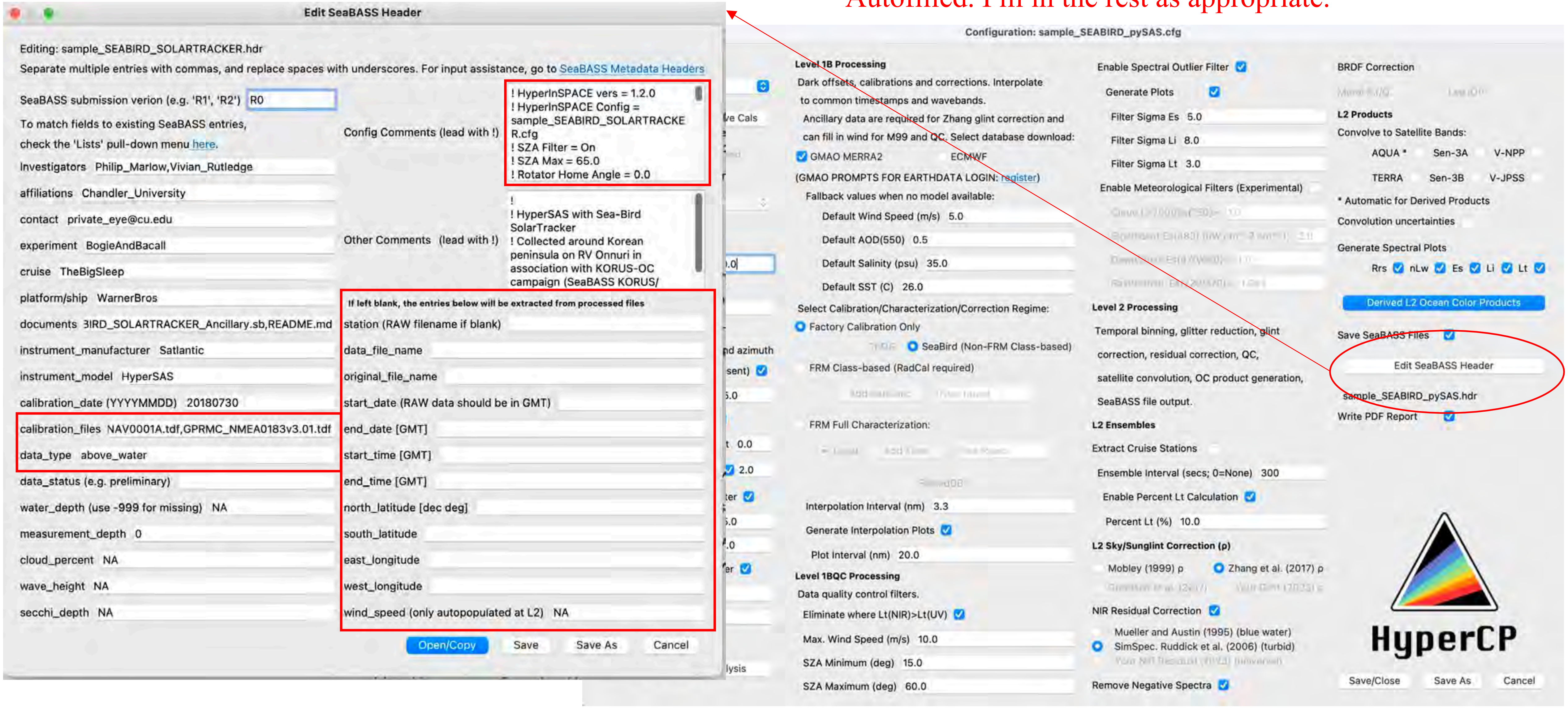
sample_SEABIRD_pySAS.hdr

Write PDF Report ☑

Save/Close | Save As | Cancel

HyperCP Output: SeaBASS & HDF5

Autofilled. Fill in the rest as appropriate.



Edit SeaBASS Header

Editing: sample_SEABIRD_SOLARTRACKER.hdr

Separate multiple entries with commas, and replace spaces with underscores. For input assistance, go to SeaBASS Metadata Headers

SeaBASS submission verion (e.g. 'R1', 'R2') R0

To match fields to existing SeaBASS entries, check the 'Lists' pull-down menu here.

Investigators Philip_Marlow,Vivian_Rutledge

affiliations Chandler_University

contact private_eye@cu.edu

experiment BogieAndBacall

cruise TheBigSleep

platform/ship WarnerBros

documents 3IRD_SOLARTRACKER_Ancillary.sb,README.md

instrument_manufacturer Satlantic

instrument_model HyperSAS

calibration_date (YYYYMMDD) 20180730

calibration_files NAV0001A.tdf,GPRMC_NMEA0183v3.01.tdf

data_type above_water

data_status (e.g. preliminary)

water_depth (use -999 for missing) NA

measurement_depth 0

cloud_percent NA

wave_height NA

secchi_depth NA

Config Comments (lead with !)

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! HyperInSPACE vers = 1.2.0
! HyperInSPACE Config =
sample_SEABIRD_SOLARTRACKE
R.cfg
! SZA Filter = On
! SZA Max = 65.0
! Rotator Home Angle = 0.0
```

Other Comments (lead with !)

```
!
! HyperSAS with Sea-Bird
SolarTracker
! Collected around Korean
peninsula on RV Onnuri in
association with KORUS-OC
campaign (SeaBASS KORUS/
```

If left blank, the entries below will be extracted from processed files

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 (only autopopulated at L2) NA

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

● SeaBird (Non-FRM Class-based)

○ FRM Class-based (RadCal required)

○ FRM Full Characterization:

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) ☐

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 (ρ)

○ Mobley (1999) ρ ● Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue water)

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

Remove Negative Spectra ☑

BRDF Correction

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

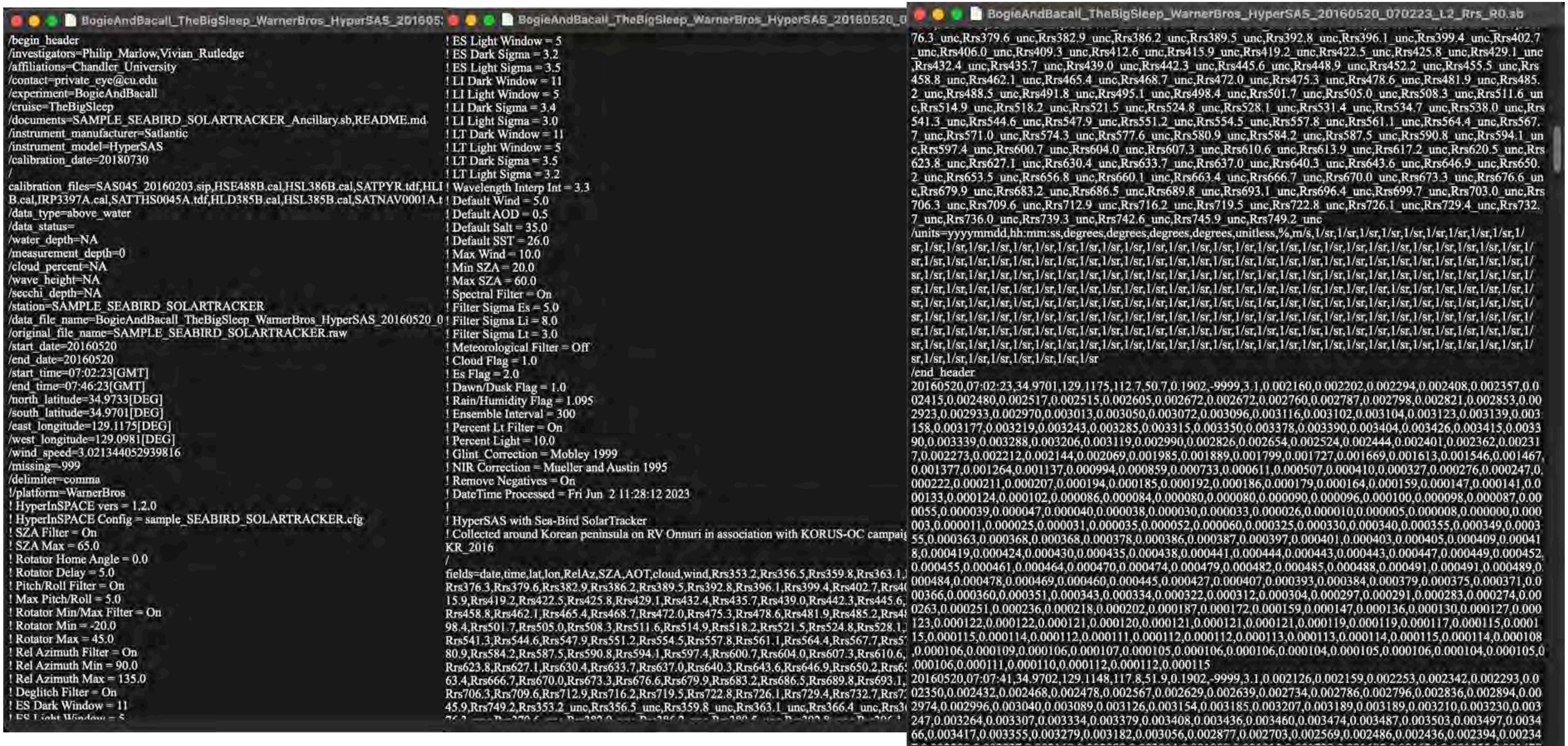
Rrs ☑ nLw ☑ Es ☑ Li ☑ Lt ☑

Save SeaBASS Files ☑

sample_SEABIRD_pySAS.hdr

Write PDF Report ☑

HyperCP L2 SeaBASS Files



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/cruise=TheBigSleep
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! HyperInSPACE Config = sample_SEABIRD_SOLARTRACKER.cfg
! SZA Filter = On
! SZA Max = 65.0
! Rotator Home Angle = 0.0
! Rotator Delay = 5.0
! Pitch/Roll Filter = On
! Max Pitch/Roll = 5.0
! Rotator Min/Max Filter = On
! Rotator Min = -20.0
! Rotator Max = 45.0
! Rel Azimuth Filter = On
! Rel Azimuth Min = 90.0
! Rel Azimuth Max = 135.0
! Deglitch Filter = On
! ES Dark Window = 11
```

```
! 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 campaig
KR_2016
/
fields=date,time,lat,lon,RelAz,SZA,AOT,cloud,wind,Rrs353.2,Rrs356.5,Rrs359.8,Rrs363.1,
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80.9,Rrs584.2,Rrs587.5,Rrs590.8,Rrs594.1,Rrs597.4,Rrs600.7,Rrs604.0,Rrs607.3,Rrs610.6,
Rrs623.8,Rrs627.1,Rrs630.4,Rrs633.7,Rrs637.0,Rrs640.3,Rrs643.6,Rrs646.9,Rrs650.2,Rrs6
63.4,Rrs666.7,Rrs670.0,Rrs673.3,Rrs676.6,Rrs679.9,Rrs683.2,Rrs686.5,Rrs689.8,Rrs693.1,
Rrs706.3,Rrs709.6,Rrs712.9,Rrs716.2,Rrs719.5,Rrs722.8,Rrs726.1,Rrs729.4,Rrs732.7,Rrs7
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```

```
76.3_unc,Rrs379.6_unc,Rrs382.9_unc,Rrs386.2_unc,Rrs389.5_unc,Rrs392.8_unc,Rrs396.1_unc,Rrs399.4_unc,Rrs402.7
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623.8_unc,Rrs627.1_unc,Rrs630.4_unc,Rrs633.7_unc,Rrs637.0_unc,Rrs640.3_unc,Rrs643.6_unc,Rrs646.9_unc,Rrs650.
2_unc,Rrs653.5_unc,Rrs656.8_unc,Rrs660.1_unc,Rrs663.4_unc,Rrs666.7_unc,Rrs670.0_unc,Rrs673.3_unc,Rrs676.6_un
c,Rrs679.9_unc,Rrs683.2_unc,Rrs686.5_unc,Rrs689.8_unc,Rrs693.1_unc,Rrs696.4_unc,Rrs699.7_unc,Rrs703.0_unc,Rrs
706.3_unc,Rrs709.6_unc,Rrs712.9_unc,Rrs716.2_unc,Rrs719.5_unc,Rrs722.8_unc,Rrs726.1_unc,Rrs729.4_unc,Rrs732.
7_unc,Rrs736.0_unc,Rrs739.3_unc,Rrs742.6_unc,Rrs745.9_unc,Rrs749.2_unc
/units=yyyymmdd,hh:mm:ss,degrees,degrees,degrees,degrees,unitless,%,m/s,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/
sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/sr,1/
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02415,0.002480,0.002517,0.002515,0.002605,0.002672,0.002672,0.002760,0.002787,0.002798,0.002821,0.002853,0.00
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66,0.003417,0.003355,0.003279,0.003182,0.003056,0.002877,0.002703,0.002569,0.002486,0.002436,0.002394,0.00234
```
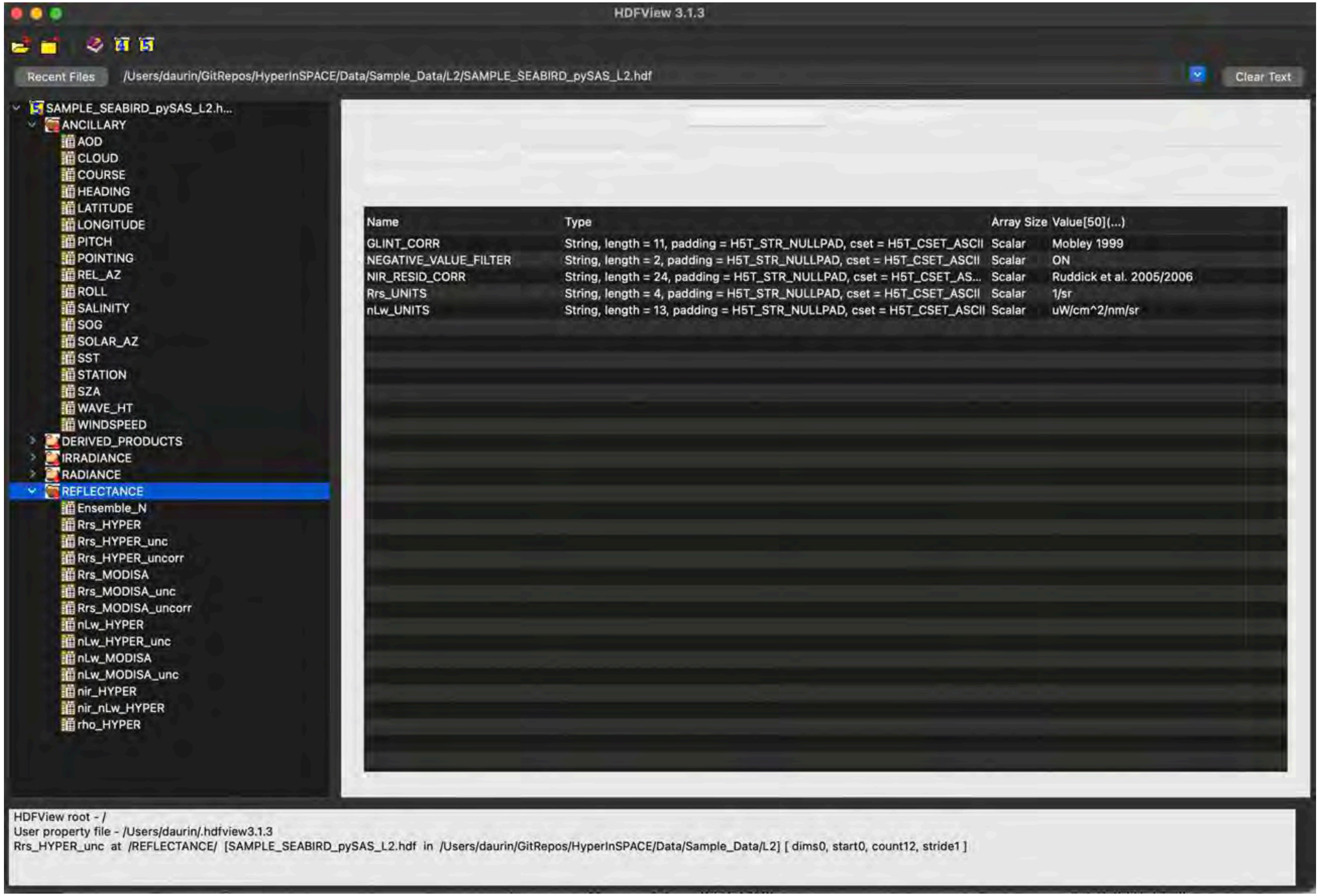

HyperCP HDF5 Files



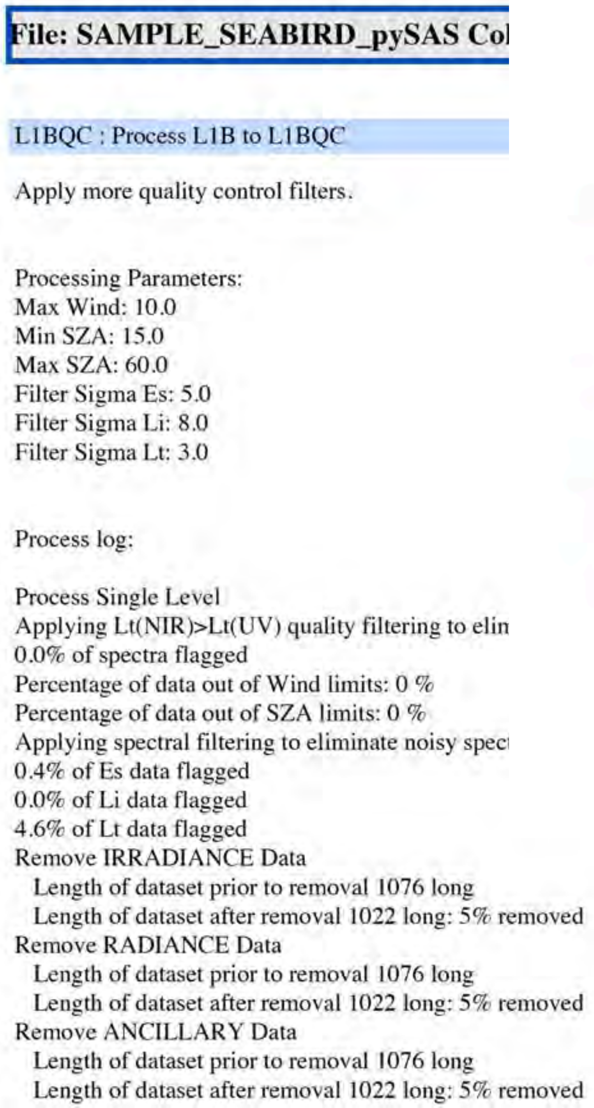
/Users/daurin/GitRepos/HyperInSPACE/Data/Sample_Data/L2/SAMPLE_SEABIRD_pySAS_L2.hdf

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_AS...	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 Processing Report (PDF)

Processing Reports



File: SAMPLE_SEABIRD_pySAS Col

L1BQC : Process L1B to L1BQC

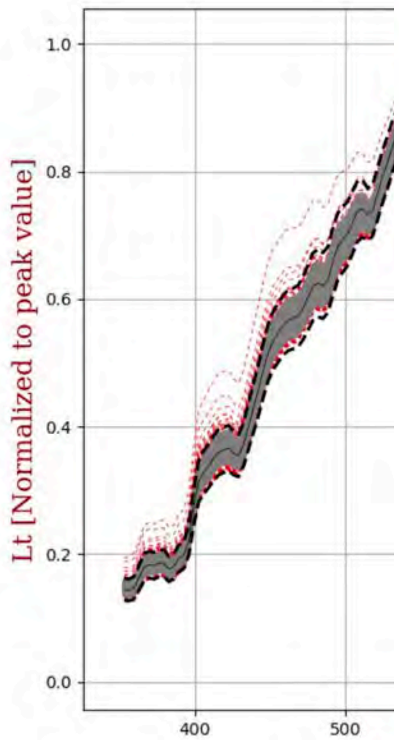
Apply more quality control filters.

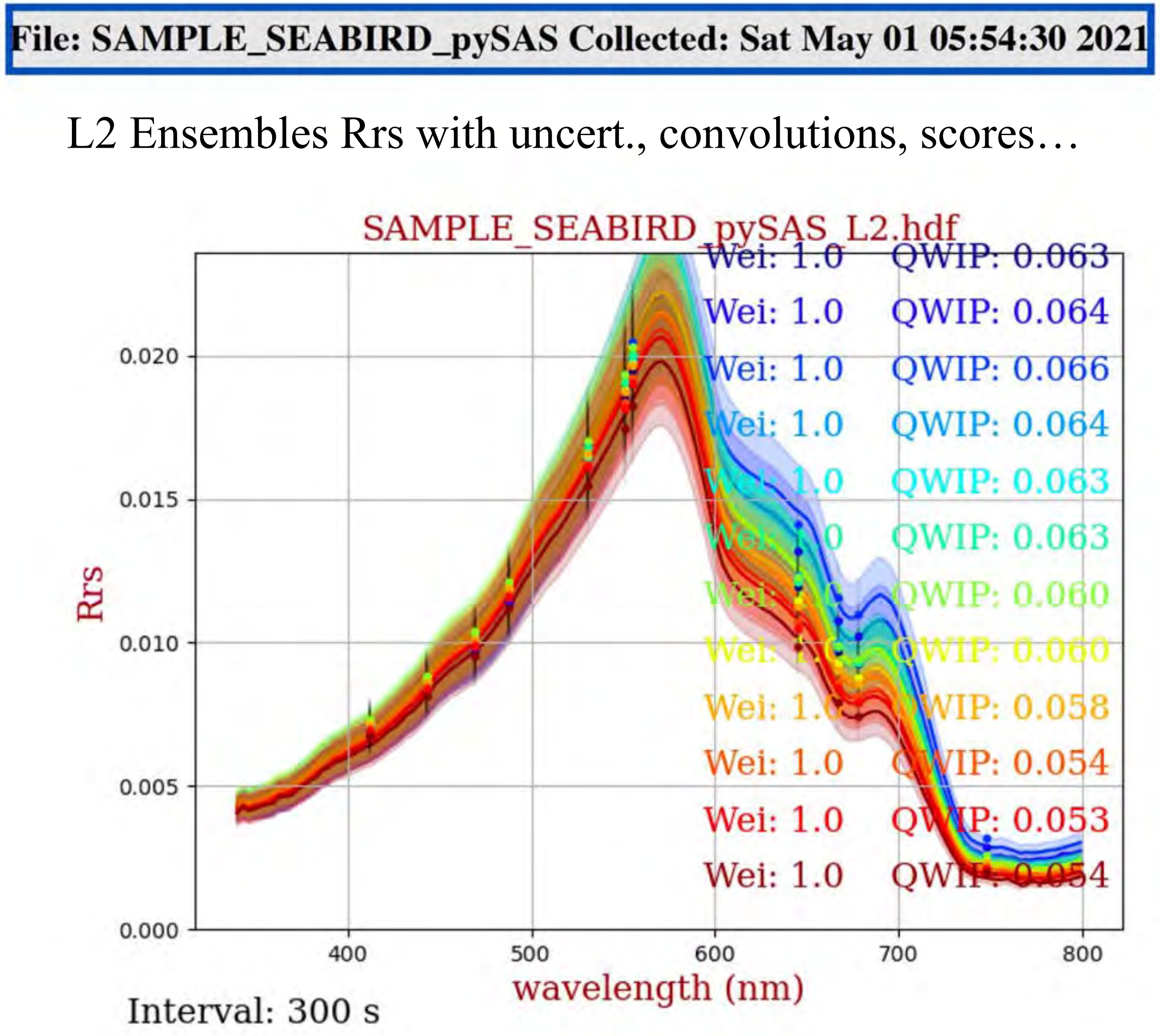
Processing Parameters:
Max Wind: 10.0
Min SZA: 15.0
Max SZA: 60.0
Filter Sigma Es: 5.0
Filter Sigma Li: 8.0
Filter Sigma Lt: 3.0

Process log:

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

L1BQC Spectral Filter

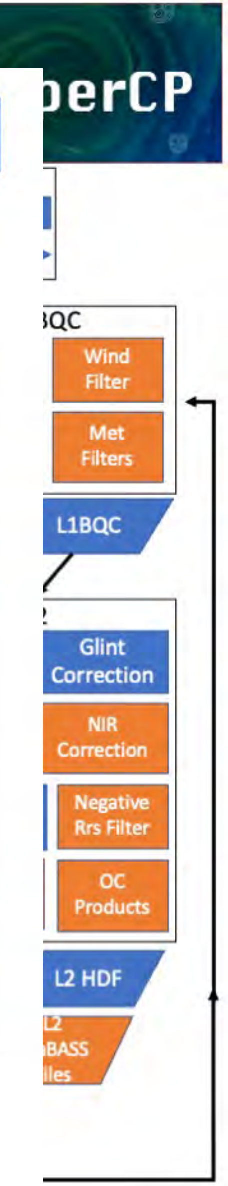




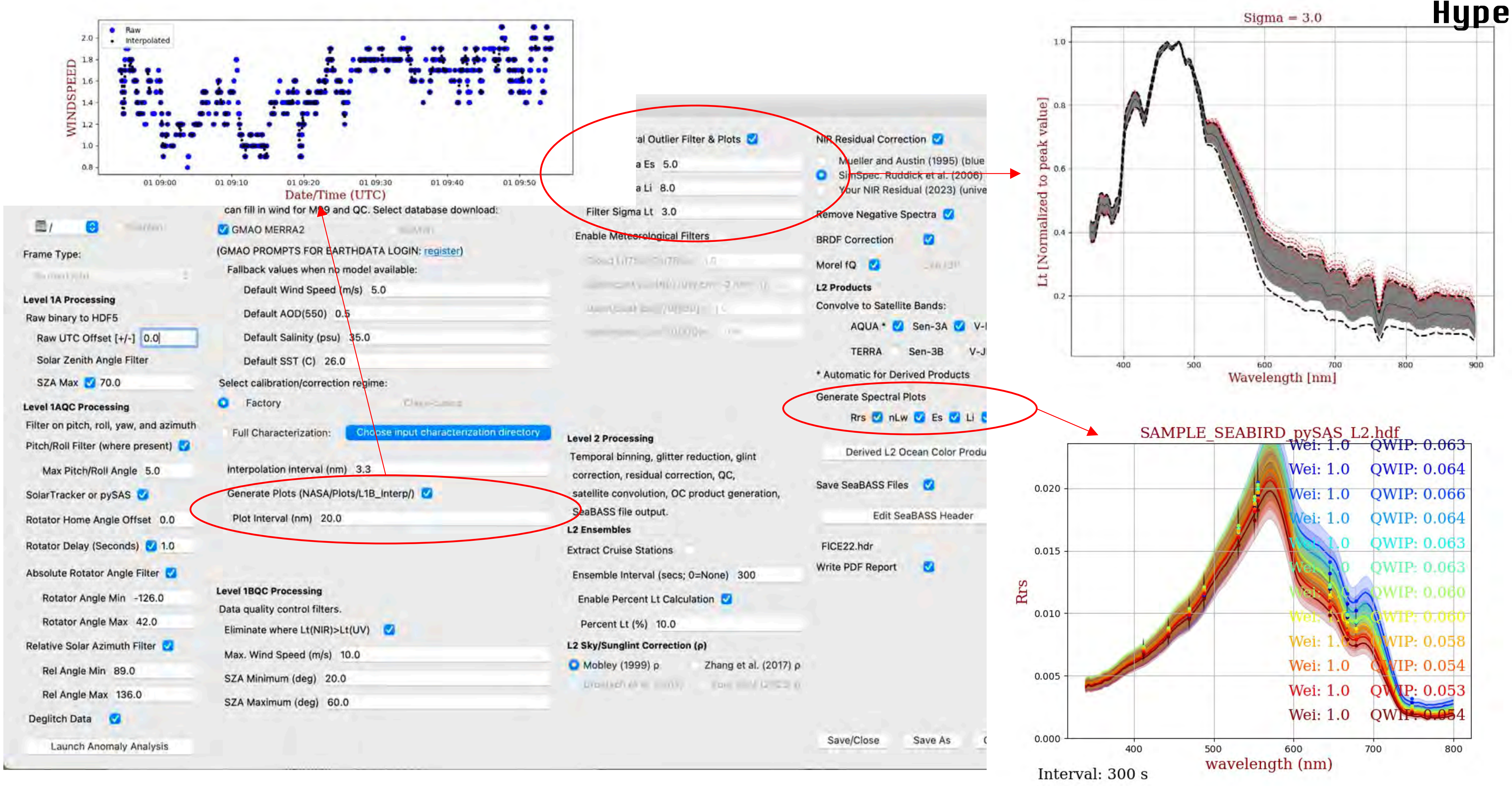
File: SAMPLE_SEABIRD_pySAS Collected: Sat May 01 05:54:30 2021

L2 Ensembles Rrs with uncert., convolutions, scores…

Interval: 300 s



HyperCP Plots for Diagnostics and QC



Frame Type:

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) ☑ 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 ☑

can fill in wind for M99 and QC. Select database download:

☑ GMAO MERRA2

(GMAO PROMPTS FOR EARTHDATA LOGIN: register)

Fallback values when no model available:

Default Wind Speed (m/s) 5.0

Default AOD(550) 0.5

Default Salinity (psu) 35.0

Default SST (C) 26.0

Select calibration/correction regime:

● Factory

Full Characterization:

Interpolation Interval (nm) 3.3

Generate Plots (NASA/Plots/L1B_Interp/) ☑

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

ral Outlier Filter & Plots ☑

a Es 5.0

a Li 8.0

Filter Sigma Lt 3.0

Enable Meteorological Filters

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 (ρ)

● Mobley (1999) ρ ○ Zhang et al. (2017) ρ

NIR Residual Correction ☑

○ Mueller and Austin (1995) (blue

● SimSpec. Ruddick et al. (2006)

○ Your NIR Residual (2023) (unive

Remove Negative Spectra ☑

BRDF Correction ☑

Morel fQ ☑

L2 Products

Convolve to Satellite Bands:

AQUA * ☑ Sen-3A ☑ V-

TERRA ○ Sen-3B ○ V-J

* Automatic for Derived Products

Generate Spectral Plots

Rrs ☑ nLw ☑ Es ☑ Li ☑

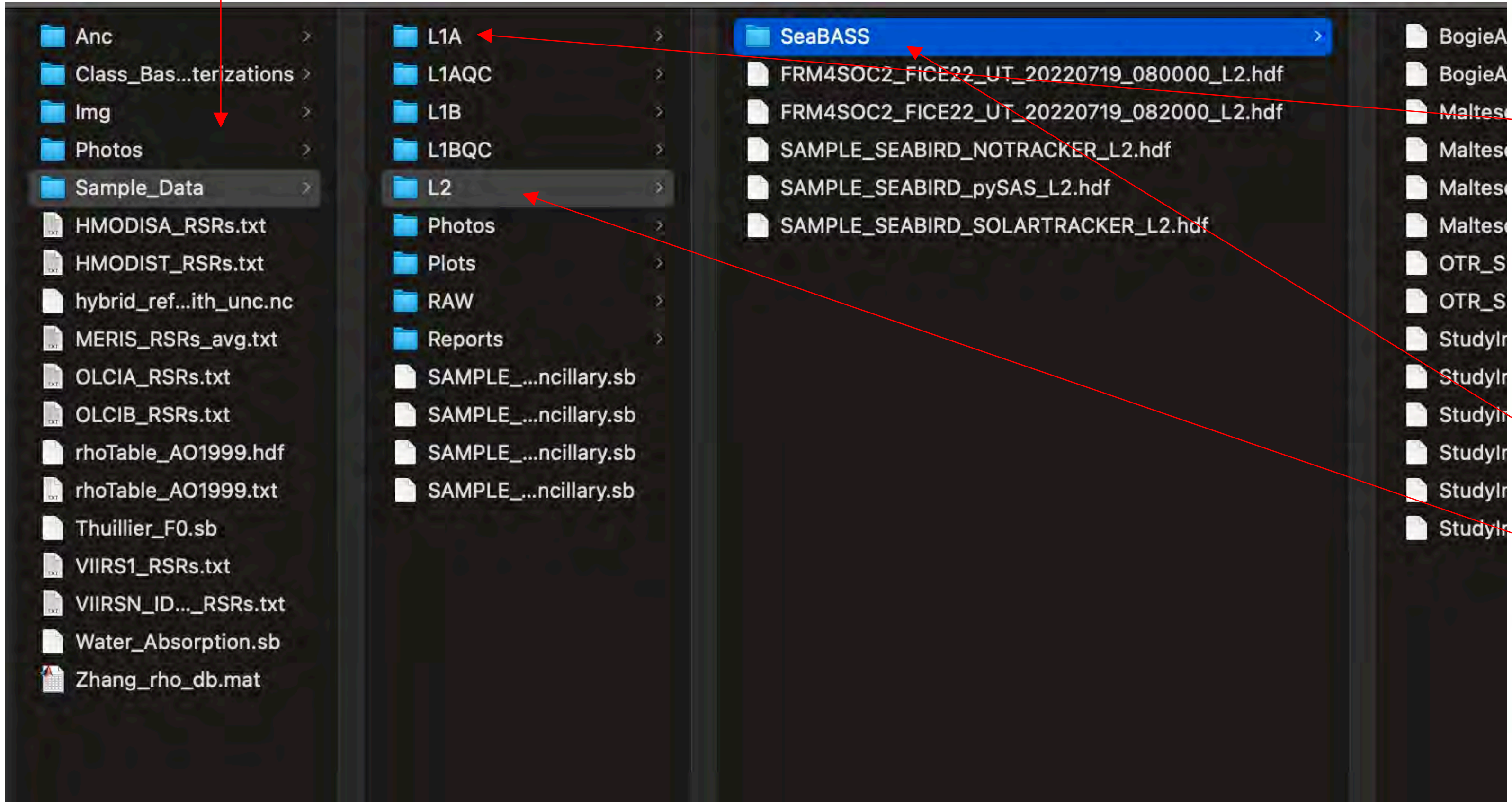
Save SeaBASS Files ☑

FICE22.hdr

Write PDF Report ☑

HyperCP Data Directory Overview

Chosen Data Output Folder (Main Window)

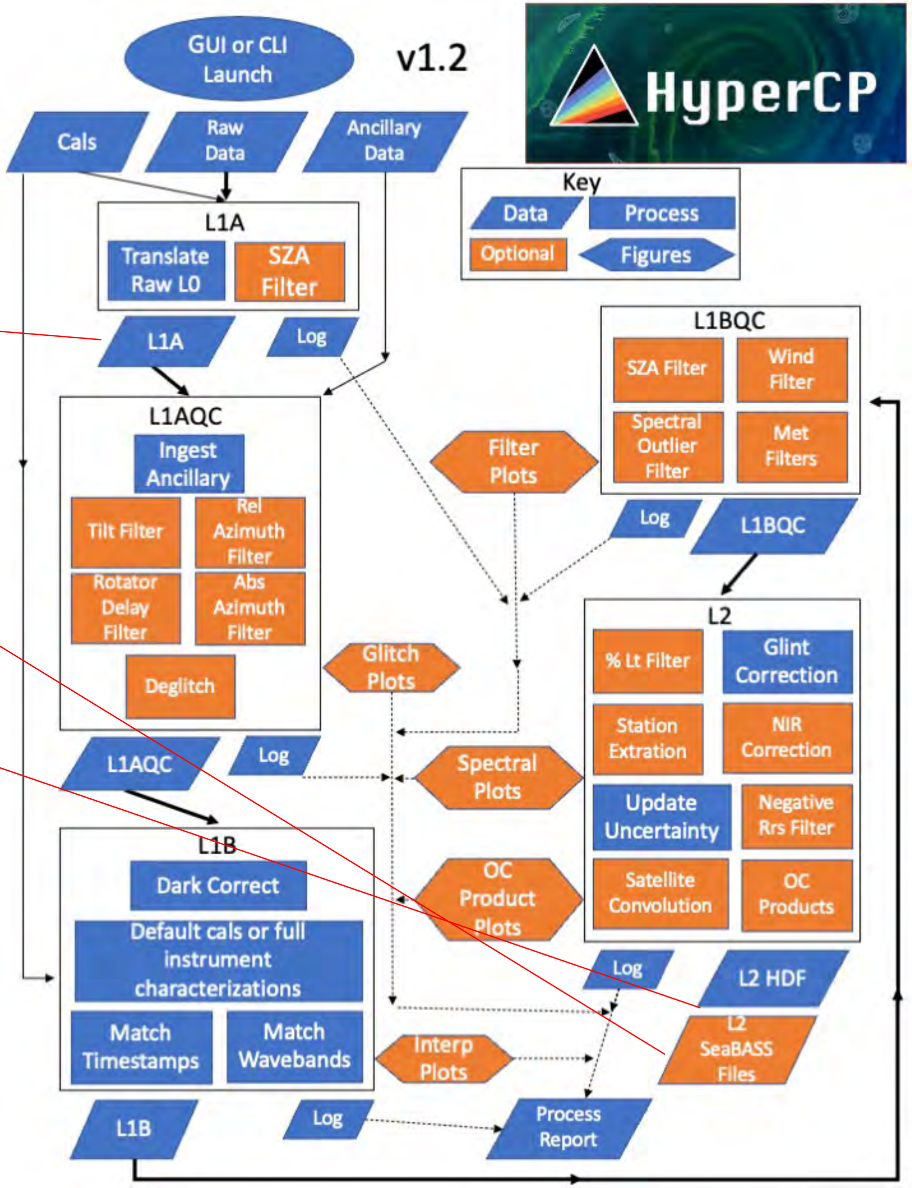


Anc
Class_Bas...terizations
Img
Photos
Sample_Data
HMODISA_RSRs.txt
HMODIST_RSRs.txt
hybrid_ref...ith_unc.nc
MERIS_RSRs_avg.txt
OLCIA_RSRs.txt
OLCIB_RSRs.txt
rhoTable_AO1999.hdf
rhoTable_AO1999.txt
Thuillier_F0.sb
VIIRS1_RSRs.txt
VIIRSN_ID..._RSRs.txt
Water_Absorption.sb
Zhang_rho_db.mat

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
StudyI
StudyI
StudyI
StudyI
StudyI
StudyI



HyperCP

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

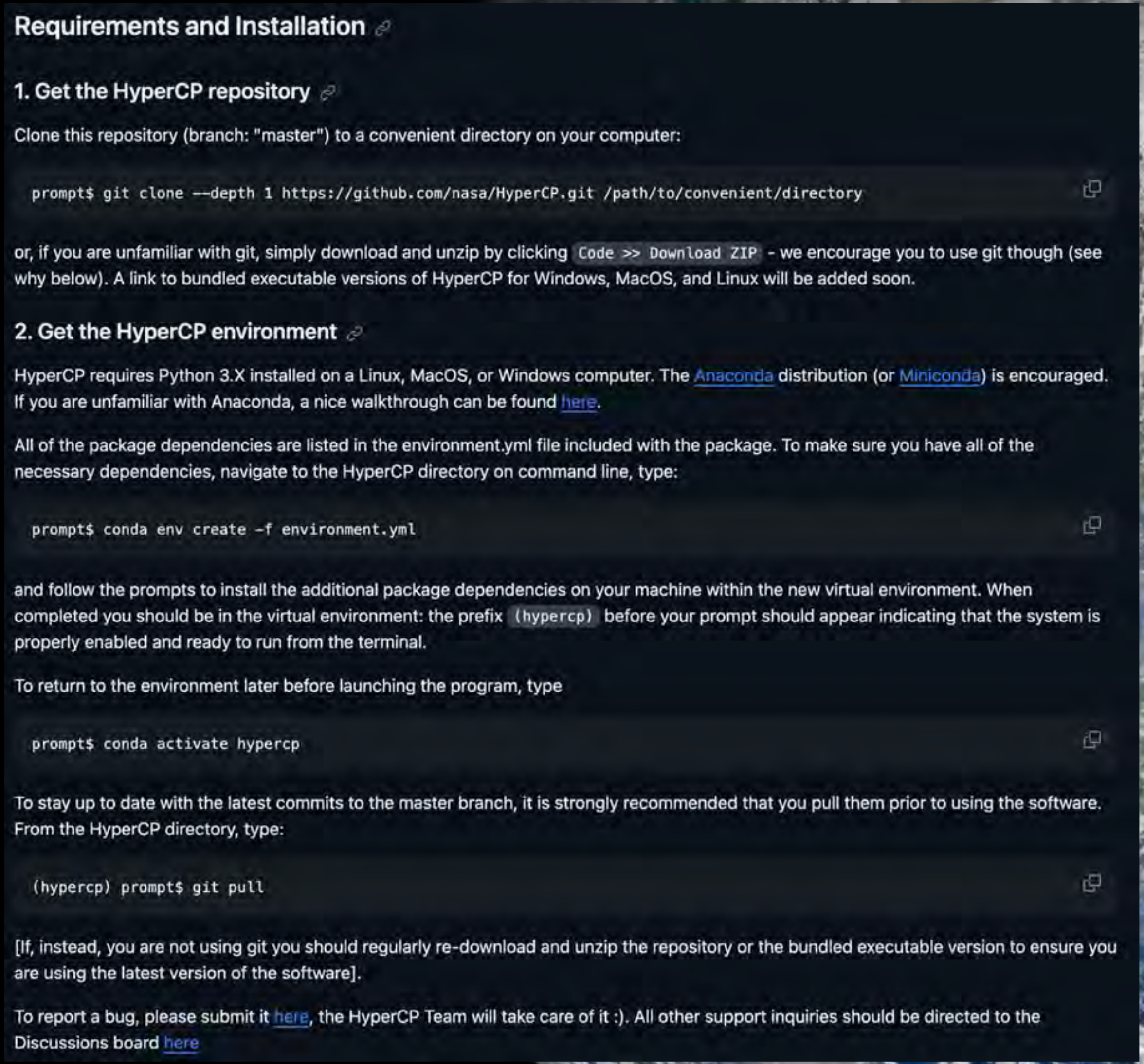
```
❯ git pull origin master
```

A recent major overhaul to v1.2.0 may not have all bugs worked out, so feel free to report Issues or start Discussions on GitHub!

Installation

To install and launch the program:
https://github.com/nasa/HyperCP

Use "master" branch



Requirements and Installation

1. Get the HyperCP repository

Clone this repository (branch: "master") to a convenient directory on your computer:

```
prompt$ git clone --depth 1 https://github.com/nasa/HyperCP.git /path/to/convenient/directory
```

or, if you are unfamiliar with git, simply download and unzip by clicking `Code >> Download ZIP` - we encourage you to use git though (see why below). A link to bundled executable versions of HyperCP for Windows, MacOS, and Linux will be added soon.

2. Get the HyperCP environment

HyperCP requires Python 3.X installed on a Linux, MacOS, or Windows computer. The Anaconda distribution (or Miniconda) is encouraged. If you are unfamiliar with Anaconda, a nice walkthrough can be found here.

All of the package dependencies are listed in the environment.yml file included with the package. To make sure you have all of the necessary dependencies, navigate to the HyperCP directory on command line, type:

```
prompt$ conda env create -f environment.yml
```

and follow the prompts to install the additional package dependencies on your machine within the new virtual environment. When completed you should be in the virtual environment: the prefix `(hypercp)` before your prompt should appear indicating that the system is properly enabled and ready to run from the terminal.

To return to the environment later before launching the program, type

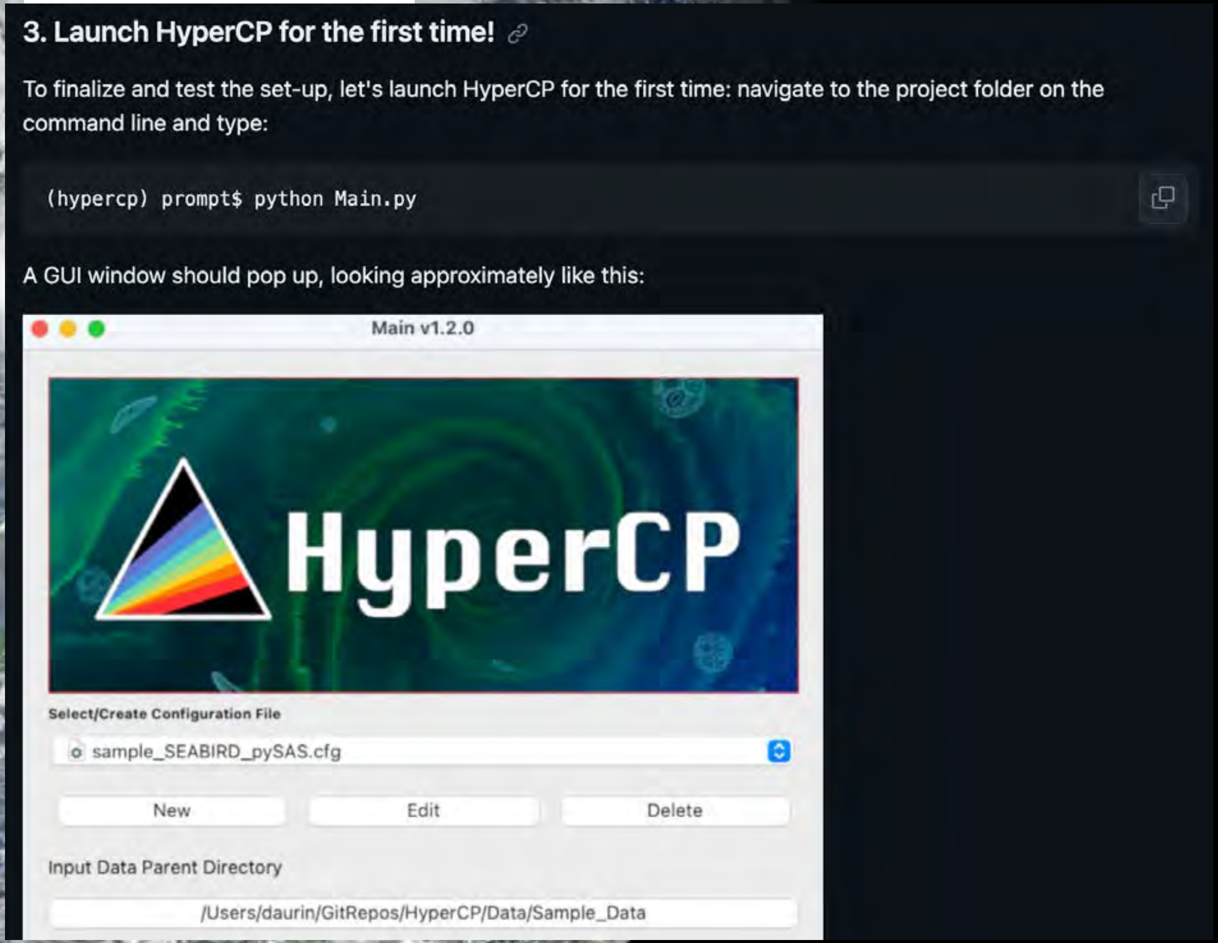
```
prompt$ conda activate hypercp
```

To stay up to date with the latest commits to the master branch, it is strongly recommended that you pull them prior to using the software. From the HyperCP directory, type:

```
(hypercp) prompt$ git pull
```

[If, instead, you are not using git you should regularly re-download and unzip the repository or the bundled executable version to ensure you are using the latest version of the software].

To report a bug, please submit it here, the HyperCP Team will take care of it :). All other support inquiries should be directed to the Discussions board here



3. Launch HyperCP for the first time!

To finalize and test the set-up, let's launch HyperCP for the first time: navigate to the project folder on the command line and type:

```
(hypercp) prompt$ python Main.py
```

A GUI window should pop up, looking approximately like this:

Select/Create Configuration File

sample_SEABIRD_pySAS.cfg

Input Data Parent Directory

/Users/daurin/GitRepos/HyperCP/Data/Sample_Data

Copy Zhang_rho_db.mat from USB drive into HyperCP/Data/

Hands On Training

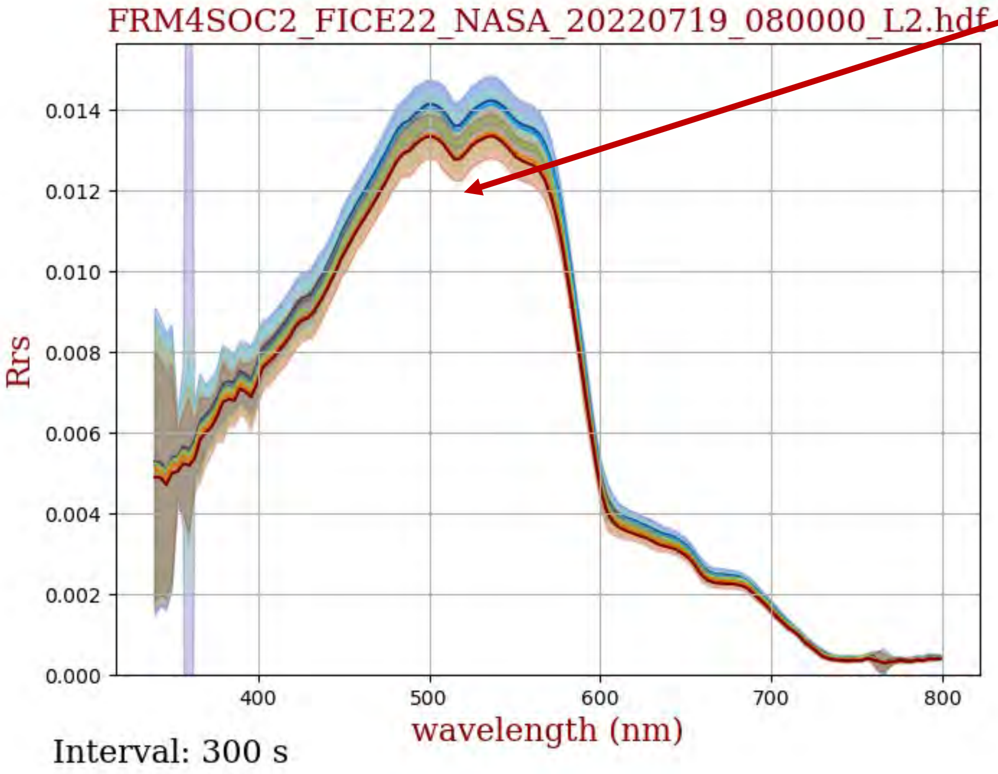
HyperCP

1) Open HyperCP and process one of the sample data files provided
    a) Select a sample Configuration (see descriptions in HyperCP/Data/Sample_Data/README_Sample_Data.xlsx)
    b) Choose Input/Output Data directories (i.e., HyperCP/Data/Sample_Data)
    c) Select the appropriate Ancillary File
    d) Choose Factory mode in L1B, and (for speed) choose the M99 glint correction
    e) Process data Raw > L2
2) In HyperCP, start a new Configuration and adjust all configuration parameters appropriately
    1) Use one of the sample datasets provided in HyperCP/Data/Sample_Data
    2) Add the factory calibration files to the configuration
    3) Use the appropriate ancillary SeaBASS file to inform your configuration (geometries, optical water types)
    4) Add RadCal uncertainty files (FRM Class-based) using the Configuration GUI
    5) Add the full characterization files (FRM Full) for the instrument suite from the Sample_Data provided
3) Try experimenting with the Anomaly Analysis tool for deglitching
    a) Run L1A, then run the tool on this file
    b) Experiment with the window, sigma, and thresholds in various bands for each instrument
4) Try experimenting with more/less aggressive spectral filtering (L1BQC)
    a) See results in the Output/Plots/L1BQC_Spectral_Filter folder

5) Bonus: Adapt the run_sample.py script to re-batch your data with a different glint correction and/or NIR correction
    1) Change your output directory so you can compare your L2 results (e.g., Z17 vs. M99 or SimSpec vs. no NIR Correction)

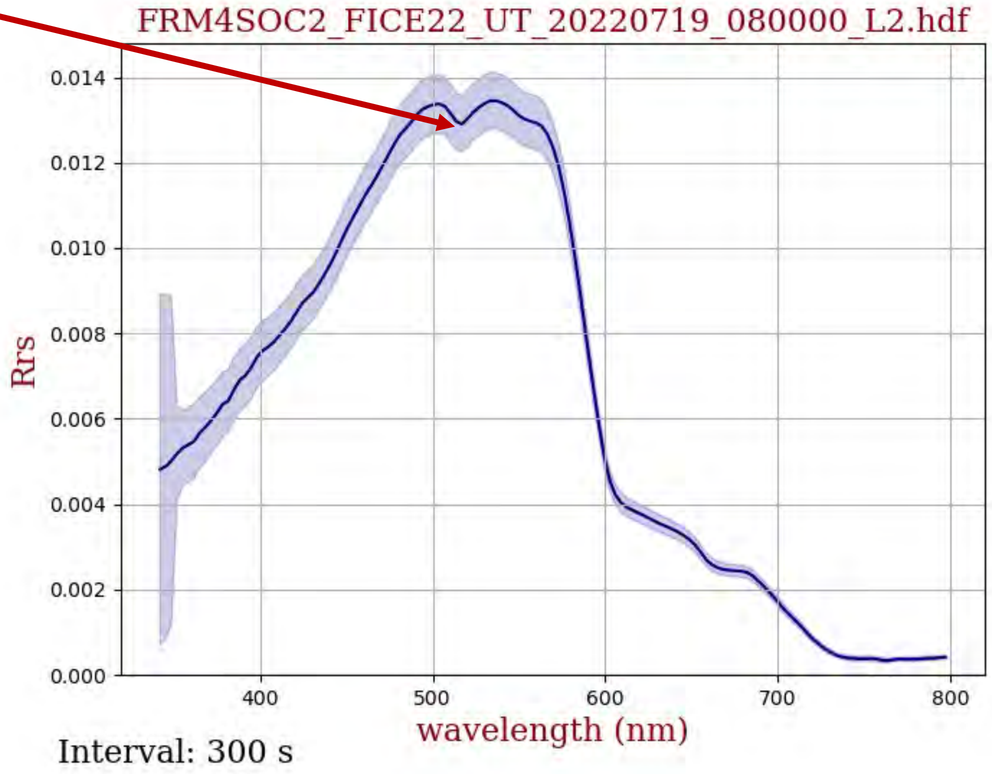
Hands On Training

1) If you processed the pySAS data from FICE22 (sample_SEABIRD_pySAS; left) or TriOS (sample_TRIOS_NOTRACKER; right) using the M99 glint correction and SimSpec NIR correction in Class-Based mode, you should see results similar to these:



Taxonomic identification is still a sticky wicket, but this is a possible bloom of *Skeletonema costatum*

Note how well these two spectra compare, although collected using two completely different instruments and procedures!



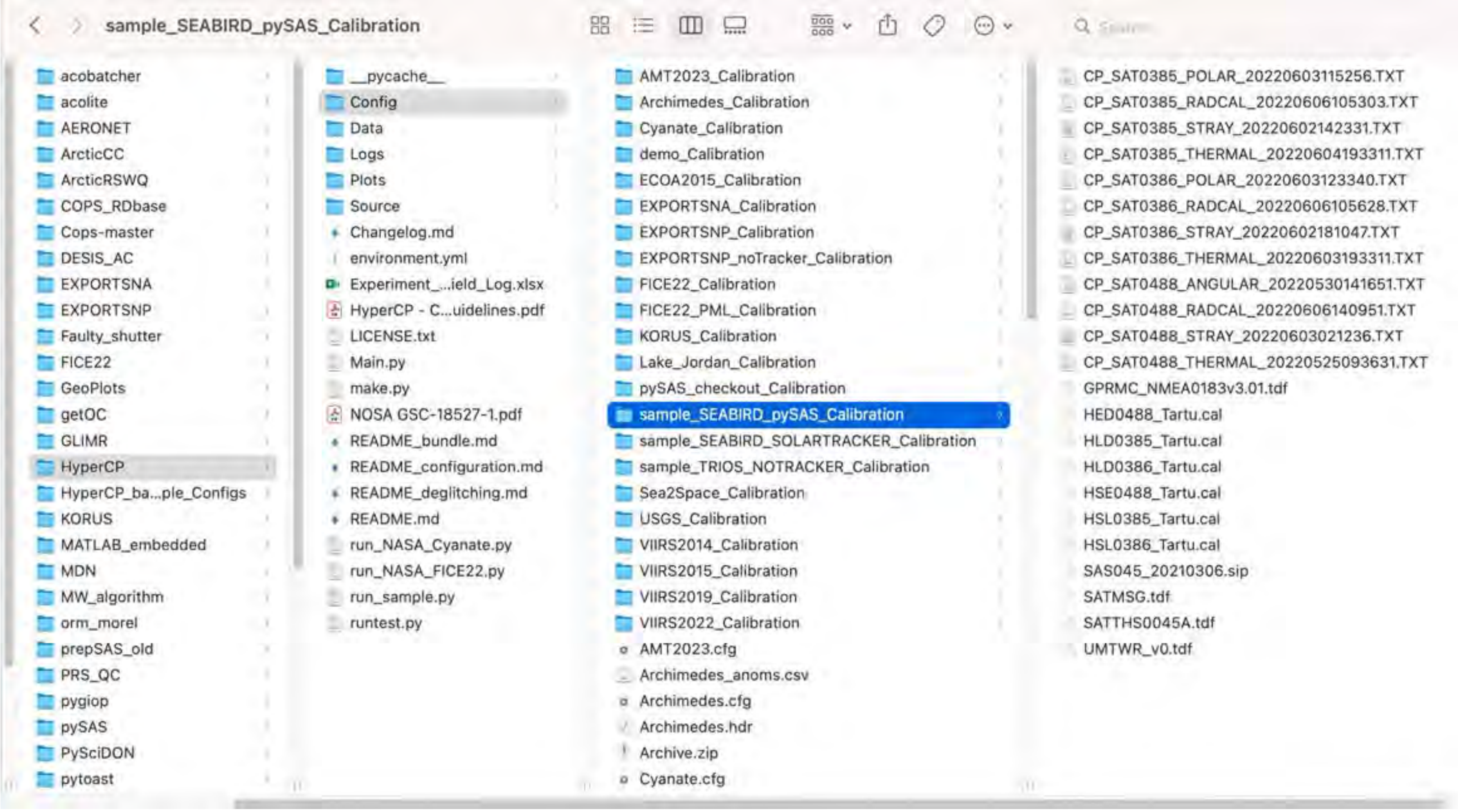
Full Contact Training

HyperCP

2) If you set the configuration for the pySAS data from FICE22 (sample_SEABIRD_pySAS; left) or TriOS (sample_TRIOS_NOTRACKER; right) these directories should have been automatically created and populated in your HyperCP/Config folder. Can you recognize these files and their purpose?

CHAPTER ONE

Embley and Yewbert were hitting one another with croquet mallets


sample_SEABIRD_pySAS_Calibration

acobatcher
acolite
AERONET
ArcticCC
ArcticRSWQ
COPS_RDbase
Cops-master
DESIS_AC
EXPORTSNA
EXPORTSNP
Faulty_shutter
FICE22
GeoPlots
getOC
GLIMR
HyperCP
HyperCP_ba...ple_Configs
KORUS
MATLAB_embedded
MDN
MW_algorithm
orm_morel
prepSAS_old
PRS_QC
pygiop
pySAS
PySciDON
pytoast

__pycache__
Config
Data
Logs
Plots
Source
Changelog.md
environment.yml
Experiment_...ield_Log.xlsx
HyperCP - C...uidelines.pdf
LICENSE.txt
Main.py
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CP_SAT0385_STRAY_20220602142331.TXT
CP_SAT0385_THERMAL_20220604193311.TXT
CP_SAT0386_POLAR_20220603123340.TXT
CP_SAT0386_RADCAL_20220606105628.TXT
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CP_SAT0488_THERMAL_20220525093631.TXT
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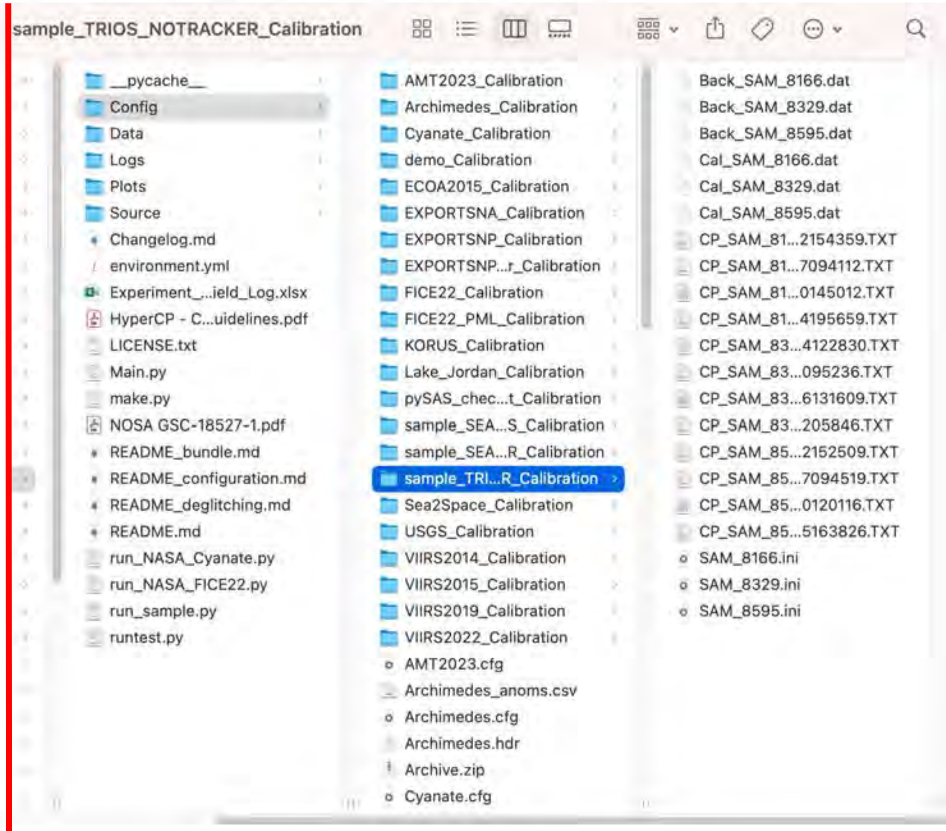
HLD0385_Tartu.cal
HLD0386_Tartu.cal
HSE0488_Tartu.cal
HSL0385_Tartu.cal
HSL0386_Tartu.cal
SAS045_20210306.sip
SATMSG.tdf
SATTHS0045A.tdf
UMTWR_v0.tdf


sample_TRIOS_NOTRACKER_Calibration

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Back_SAM_8166.dat
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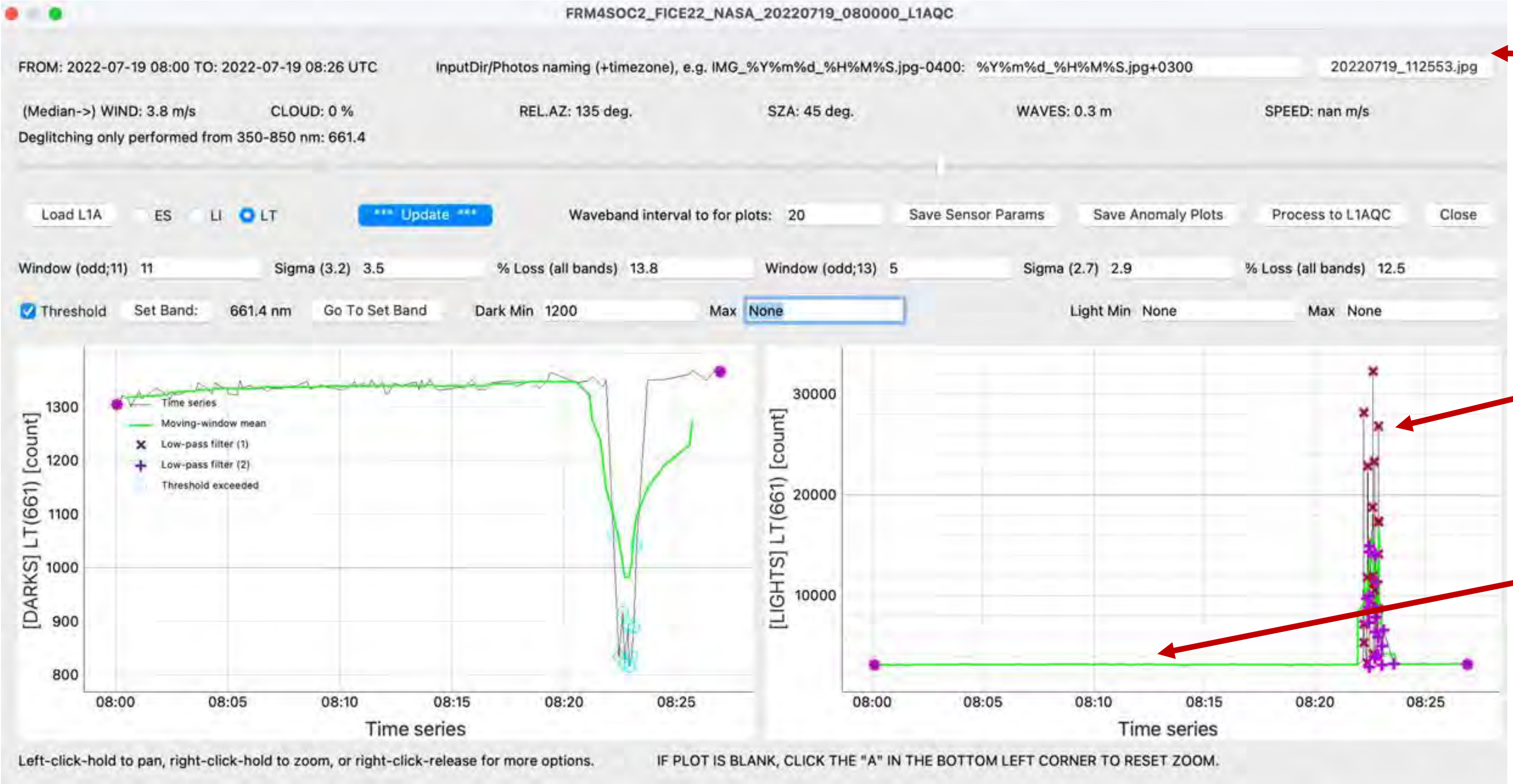
CP_SAM_81...2154359.TXT
CP_SAM_81...7094112.TXT
CP_SAM_81...0145012.TXT
CP_SAM_81...4195659.TXT
CP_SAM_83...4122830.TXT
CP_SAM_83...095236.TXT
CP_SAM_83...6131609.TXT
CP_SAM_83...205846.TXT
CP_SAM_85...2152509.TXT
CP_SAM_85...7094519.TXT
CP_SAM_85...0120116.TXT
CP_SAM_85...5163826.TXT
SAM_8166.ini
SAM_8329.ini
SAM_8595.ini

Full Contact Training

HyperCP

3a) This should have generated a L1A HDF file in your designated Output_Directory/L1A/ (e.g., FRM4SOC2_FICE_NASA_20220719080000_L1A.hdf). Once loaded into the supervised deglitching tool, you can explore its strengths and weaknesses. Would this process be likely to result in validation-quality L_W?



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: %Y%m%d_%H%M%S.jpg+0300

20220719_112553.jpg

(Median->) WIND: 3.8 m/s

CLOUD: 0 %

REL.AZ: 135 deg.

SZA: 45 deg.

WAVES: 0.3 m

SPEED: nan m/s

Deglitching only performed from 350-850 nm: 661.4

Load L1A ○ ES ○ LI ● LT

*** Update ***

Waveband interval to for plots: 20

Save Sensor Params

Save Anomaly Plots

Process to L1AQC

Close

Window (odd;11) 11

Sigma (3.2) 3.5

% Loss (all bands) 13.8

Window (odd;13) 5

Sigma (2.7) 2.9

% Loss (all bands) 12.5

☑ Threshold

Set Band: 661.4 nm

Go To Set Band

Dark Min 1200

Max None

Light Min None

Max None

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.

For the pySAS sample dataset, updating/confirming the digital camera photo naming convention provides automated access to fieldwork photos here.

What could have caused this anomalous spike in the data? (Hint: check the photos)

Try zooming in here to see the LIGHT data hidden by the scale

Full Contact Training

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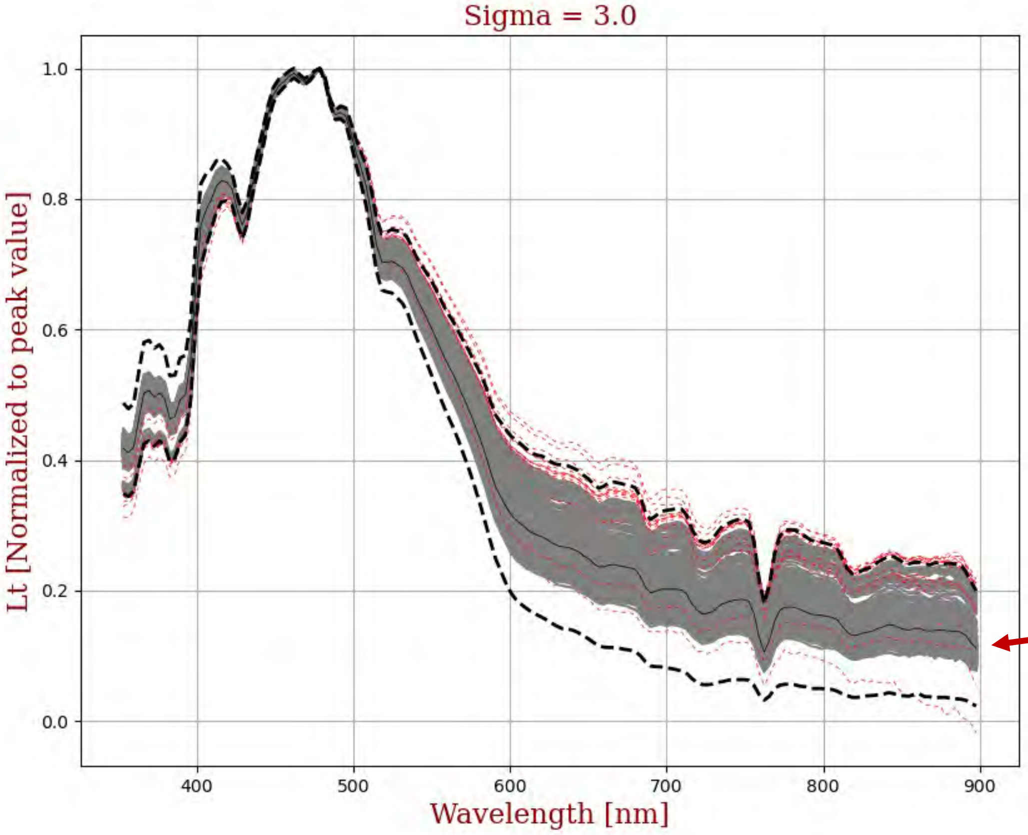
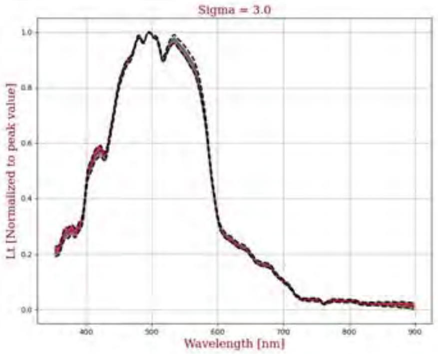
4)

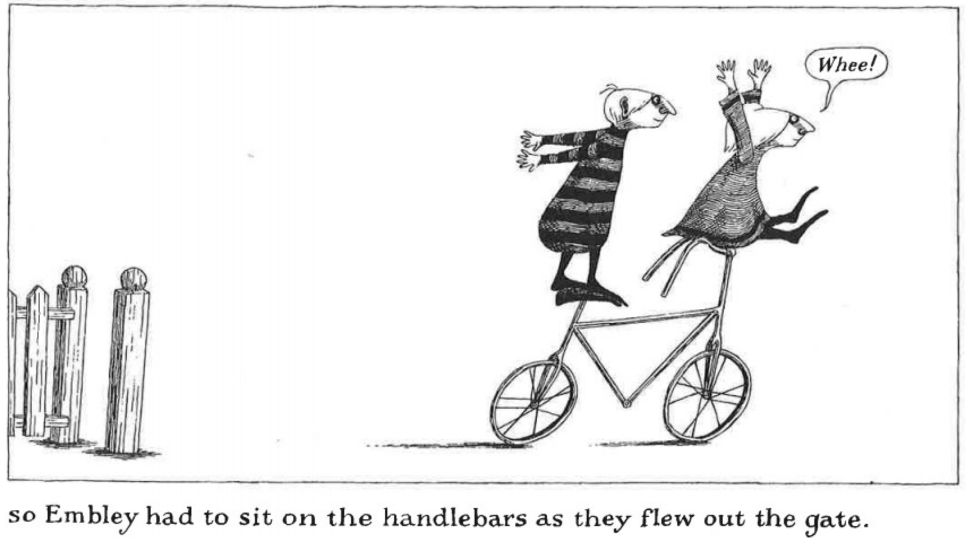


Note how much more variability there is with data collected on a ship underway! Compare sample datasets from the KORUS cruise on the R/V Onnuri to the data from the Aqua Alta Oceanographic Tower during FICE22.



Adjusting sigma adjusts the size of the spectral filter envelope: the distance between the dashed line (standard deviation) and the solid black line (mean). Spectra that fall outside the envelope in the VIS are rejected as outliers.

Acknowledgements



so Embley had to sit on the handlebars as they flew out the gate.

HyperCP

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Artwork in the final slides from Edward Gorey and Cabaret Macabre (with permission, Happenstance Theater Co.)

HyperCP is an open source, open science initiative that welcomes community inclusion, involvement, and engagement in the interest of scientific transparency, access, and integrity.