Australian Ocean Colour – Key Activities & Infrastructure

A brief update

Thomas Schroeder, David Antoine, Janet Anstee, David Blondeau-Patissier, Gemma Kerrsik, Michael Hope and Tim Malthus

International Ocean Colour Science Meeting, 1-4 Dec 2023, Darmstadt, Germany

IMOS · Australian Government · Copernicus Europe's eyes on Earth · copernicus AUSTRALASIA REGIONAL DATA HUB · Curtin University · CSIRO

Copernicus Australasia Regional Data Hub

Distributing and promoting data from the *Sentinel* missions, supporting:

- Government information requirements
- Enhanced access to satellite Earth Observation data
- Collaboration between Australia, Europe, Southeast Asia and South Pacific region

Copernicus
Europe's eyes on Earth

www.copernicus.gov.au

Collaborative Partnership

Australian Government
Geoscience Australia
CSIRO
Queensland Government
NSW Government
Office of Environment & Heritage
Government of Western Australia
Landgate

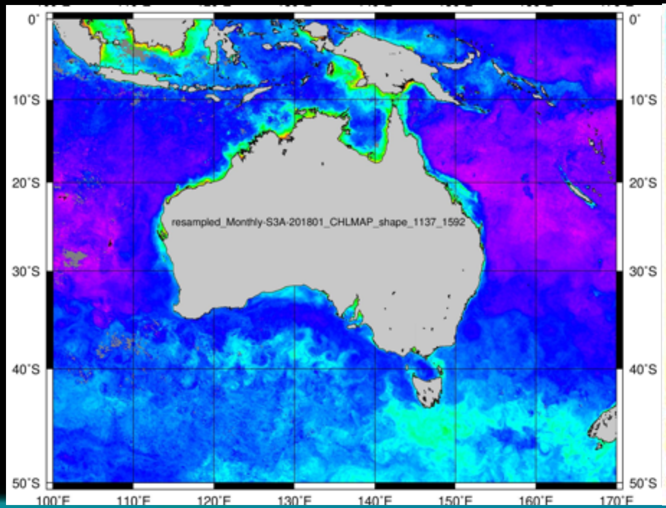
Supported by

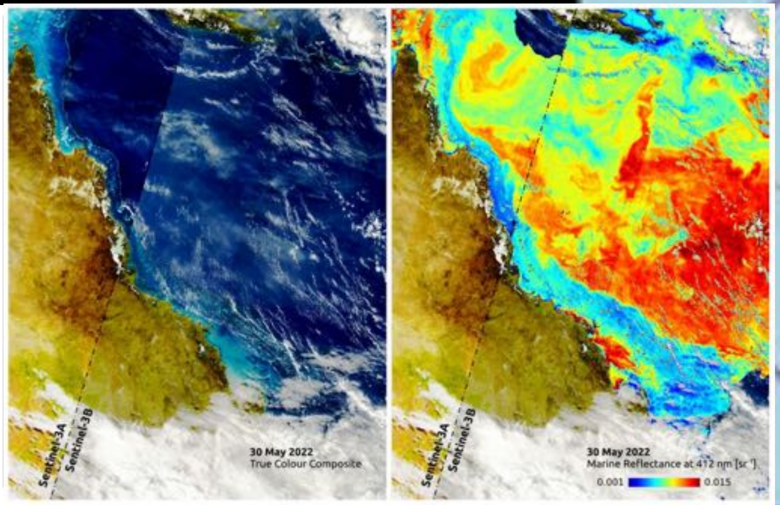
NCI
National Computational Infrastructure
aarnet
Australia's Academic and Research Network
GAEL SYSTEMS
European Commission
esa
EUMETSAT
European Environment Agency

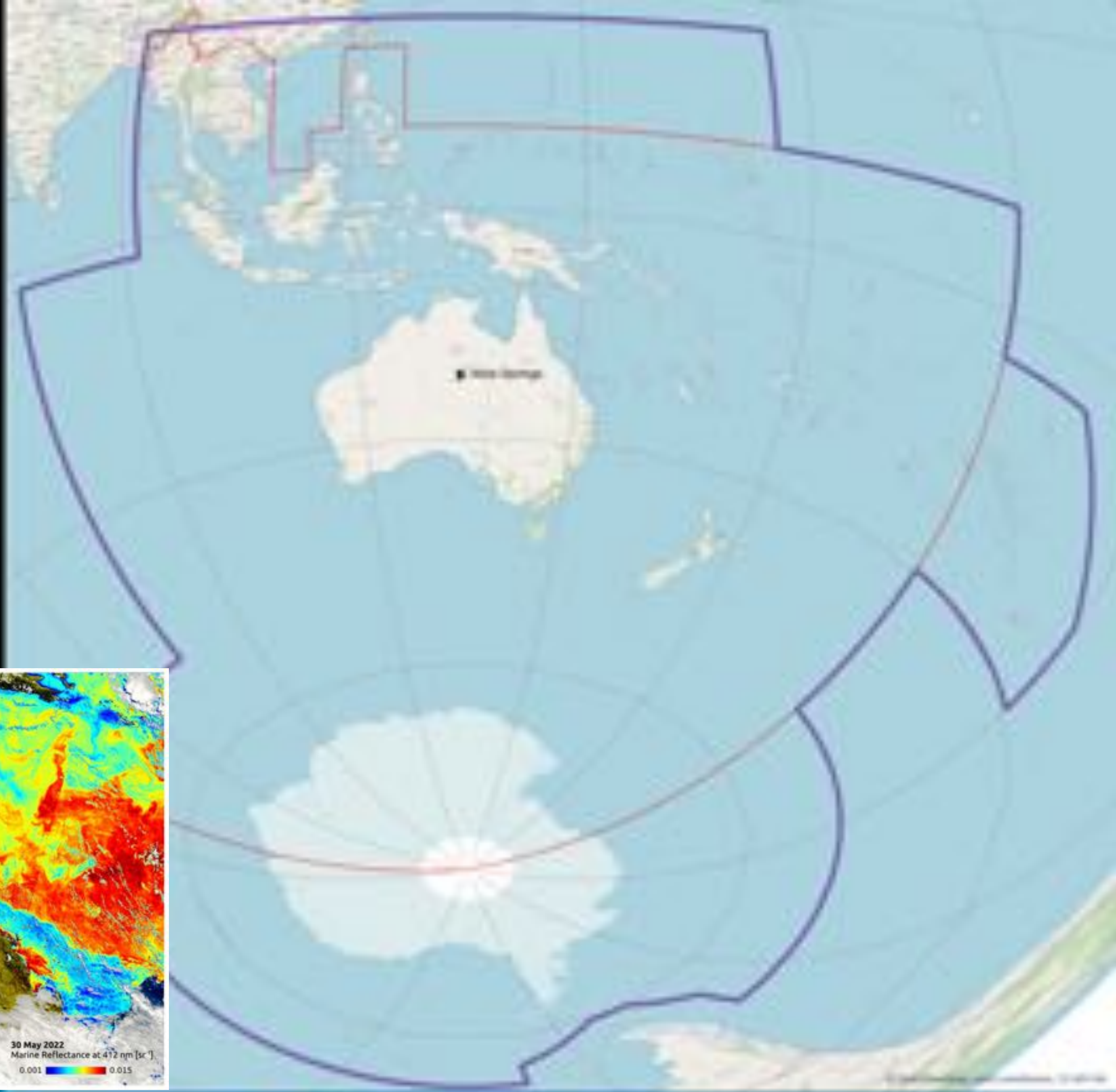
Archive 2014 onwards provides:

- Sentinel-1 – C-SAR (GRD, SLC, OCN)
- Sentinel-2 – MSI (L1C, L2A)
- **Sentinel-3 – OLCI, SLSTR, Synergy, SRAL**
- Sentinel-5P

Supporting a wide range of national projects:
IMOS, eReefs, AquaWatch ...

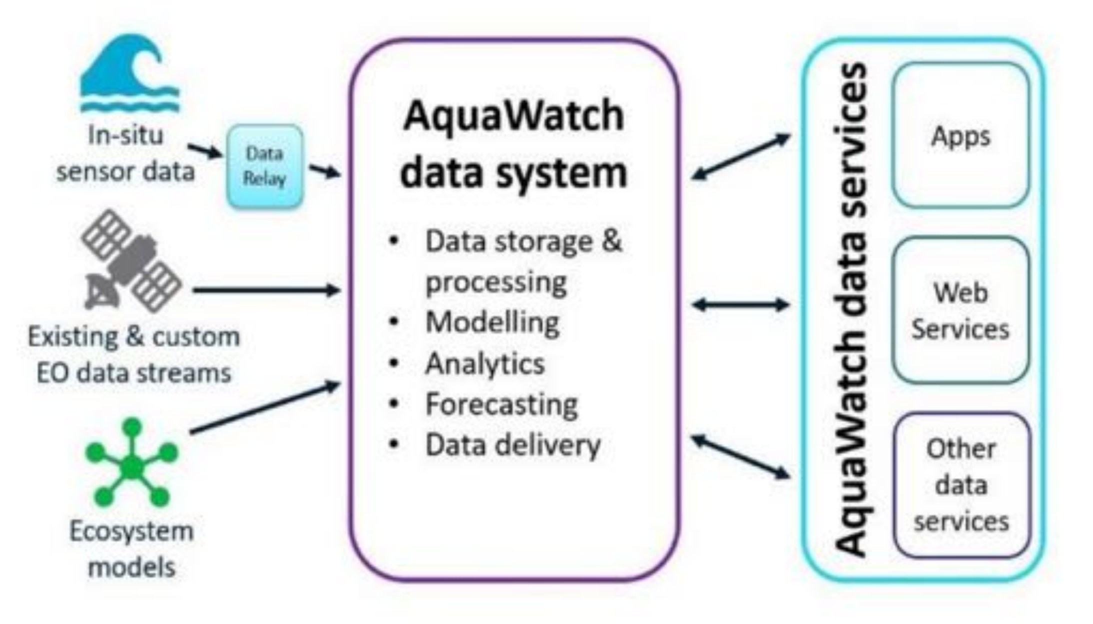


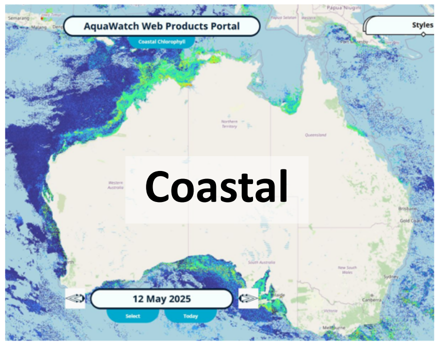




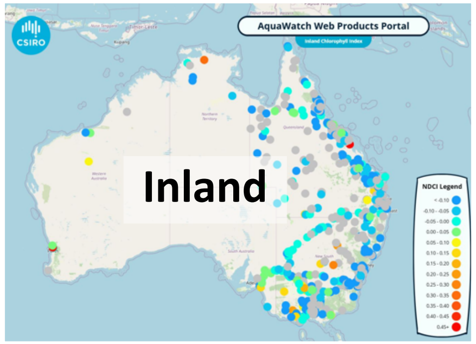
AquaWatch Australia – Cont. developing a comprehensive monitoring system

Integrated water quality monitoring network that combines satellite observations with in-situ sensors





Chlorophyll
CDOM
DOC
TSS
Vertical attenuation



Chlorophyll Index
Forel Ule Index
Surface area
Surface temperature
TSS

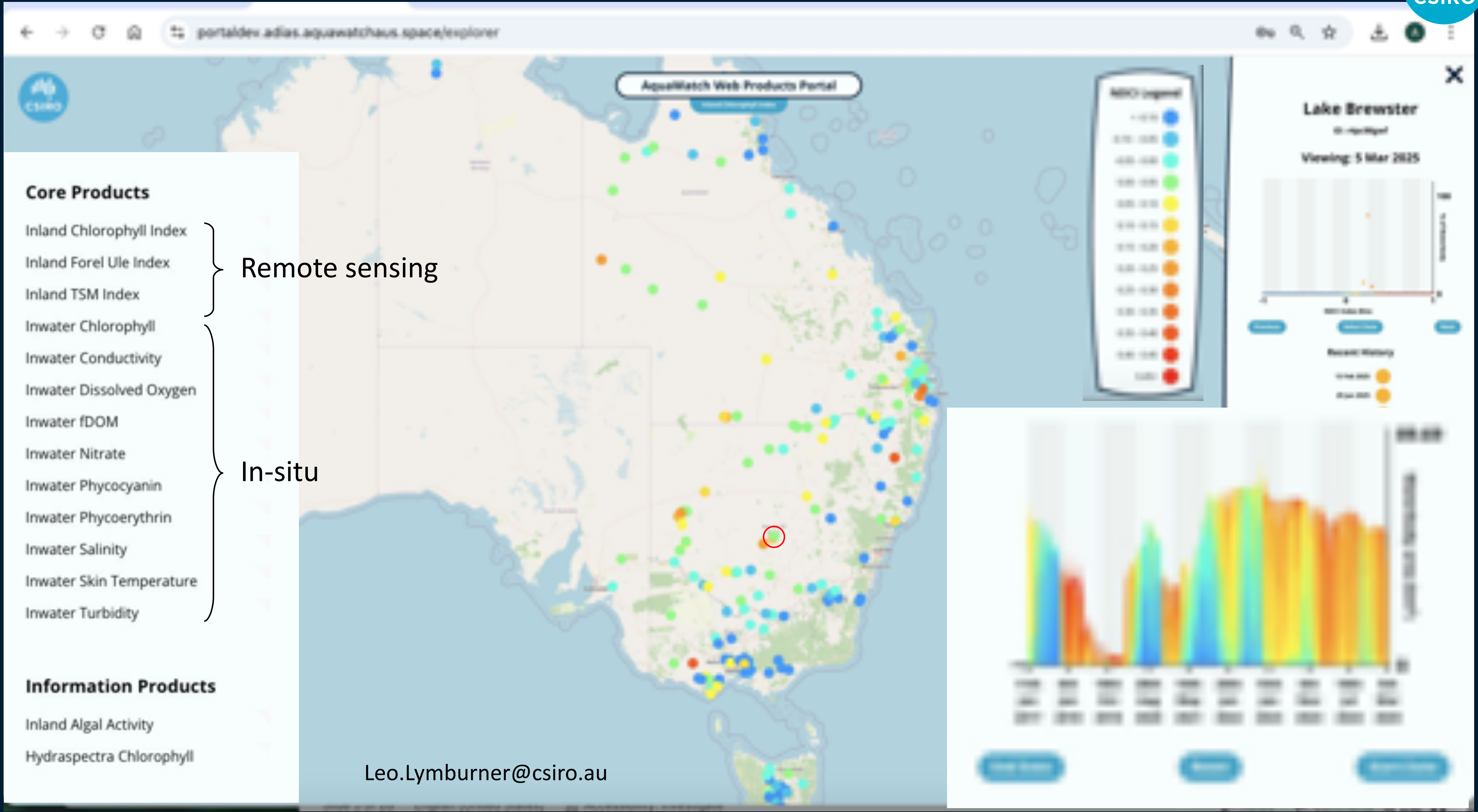
Chlorophyll
Conductivity
DO
fDOM
Nitrate
Reflectance

- Earth Observation satellite data: Sentinel 1/2/3, Landsat 5/7/8/9, VIIRS 19/20/21, MODIS Ocean, Hyperspectral (future)
- Ground based in situ sensor networks: Eagle.io, Senaps, HydroVu Sofar, HydraSpectra, SORAD
- Scalable cloud computing to continental scale
- AI and Machine Learning support
- Flexible integrated data analytics platform for exploratory data analysis
- Production grade automation

Coastal, Inland and In-water Monitoring Network
Six national pilot sites – mature prototypes
Sites aim to be operational by end of 2026
Potential national scale-up
Hand-over to operational partner
Ongoing improvements

AquaWatch Australia
Email: aquawatch@csiro.au

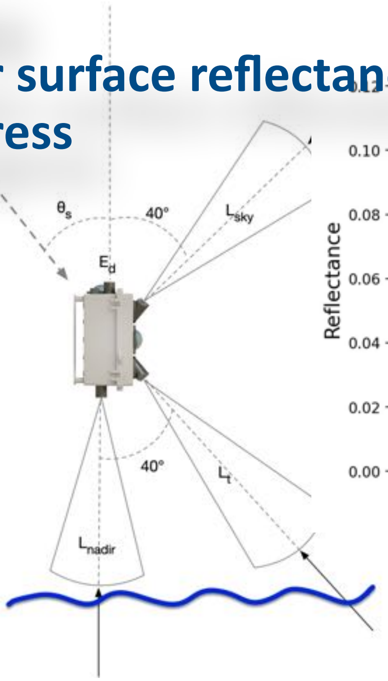
AquaWatch Dashboard – Inland & In-water Monitoring

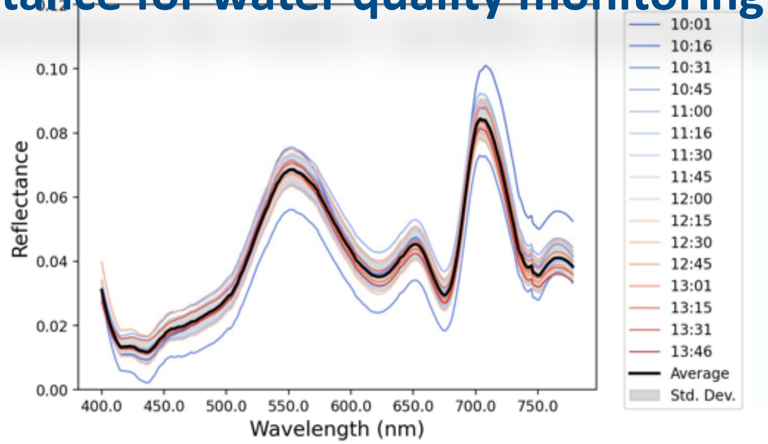


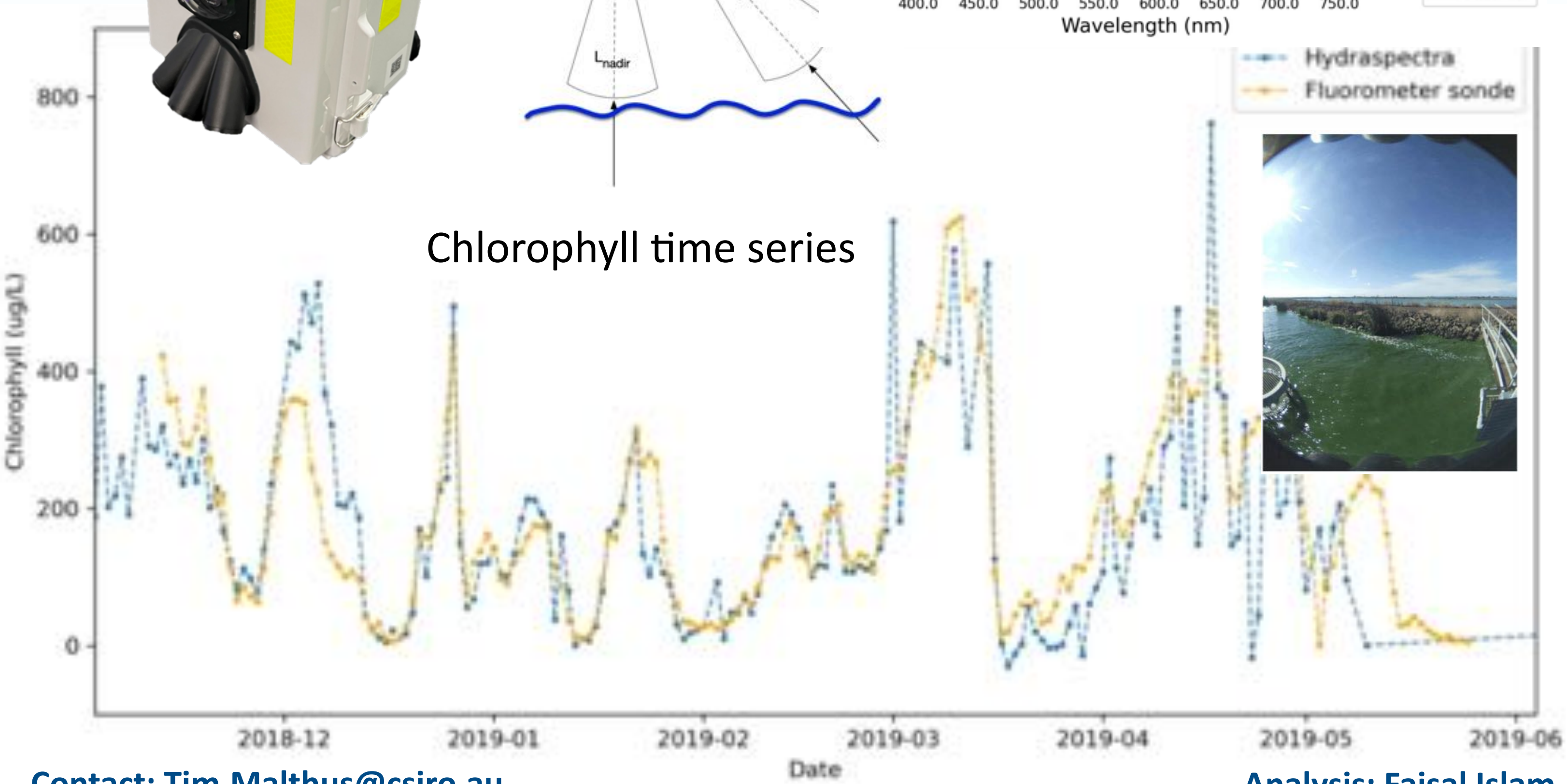
Leo.Lymburner@csiro.au

HydraSpectra

Low-cost above water surface reflectance for water quality monitoring
Development in progress





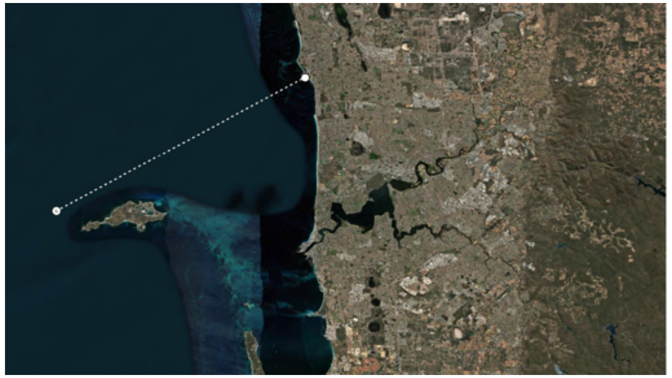


Contact: Tim.Malthus@csiro.au

Analysis: Faisal Islam

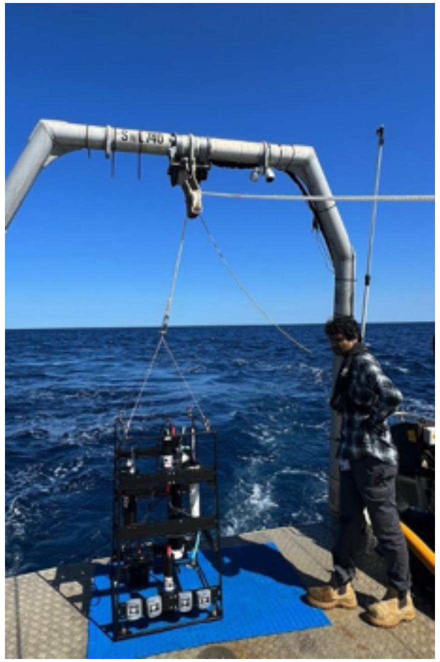
Monthly bio-optical sampling off Rottnest Island
IMOS National reference station

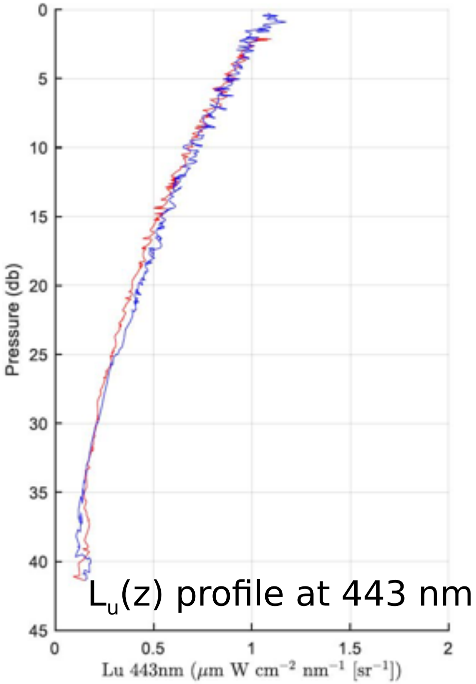
IMOS
Integrated Marine Observing System



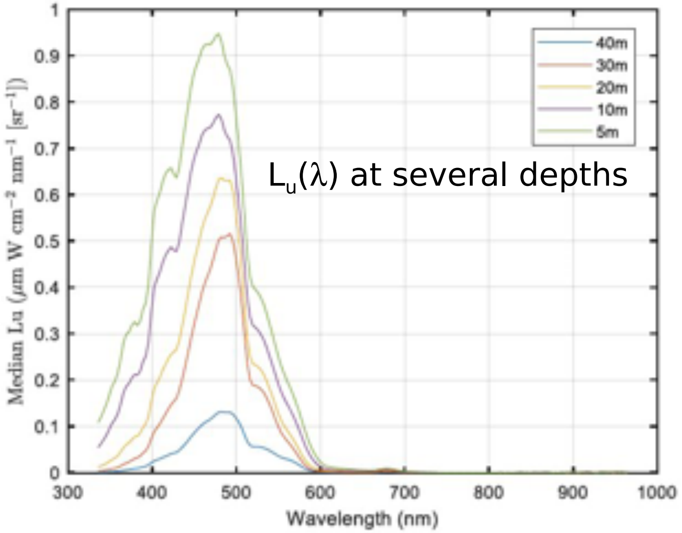
Shallow-water (60 m) profiling for hyperspectral radiometry (IMO USSIMO sensors), hyperspectral absorption/attenuation (Seabird/WETLabs AC-S), multispectral backscattering and Chl fluorescence (IMO SC6), plus T/S (Seabird SBE49)
Plus sampling for CDOM absorption

Started March 2024

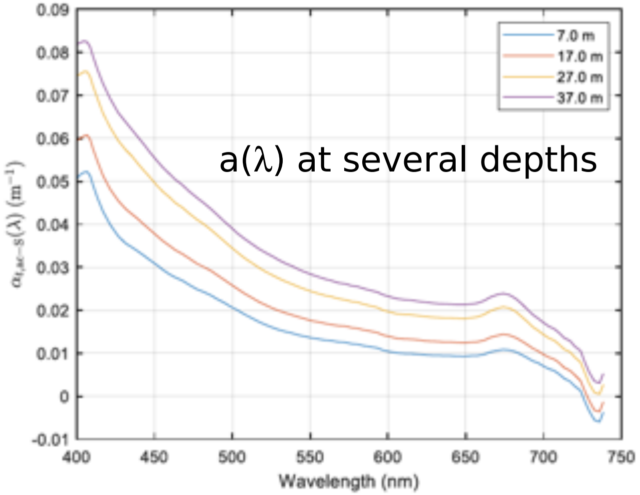




$L_u(z)$ profile at 443 nm



$L_u(\lambda)$ at several depths



$a(\lambda)$ at several depths

Objectives: bio-optical variability, satellite matchups, phytoplankton community composition (in combination with pigments and genomics)

Curtin University

Remote Sensing and Satellite Research Group (https://research.curtin.edu.au/remotesensing/)
david.antoine@curtin.edu.au

National Aeronautics and Space Administration

UNIVERSITY OF MIAMI

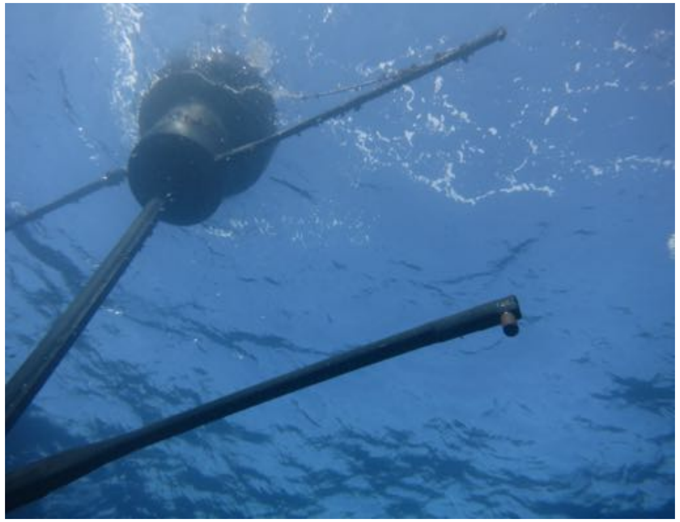
SJSU

NIST

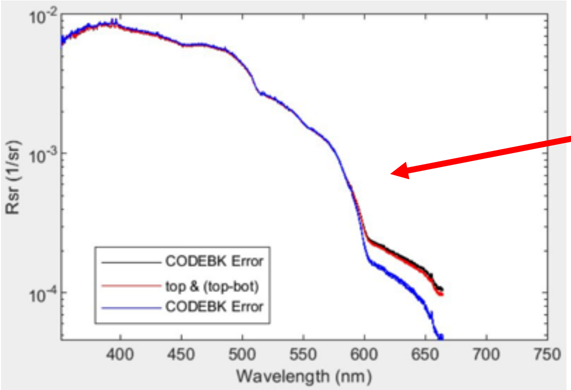
Marine Optical Network (MarONet)

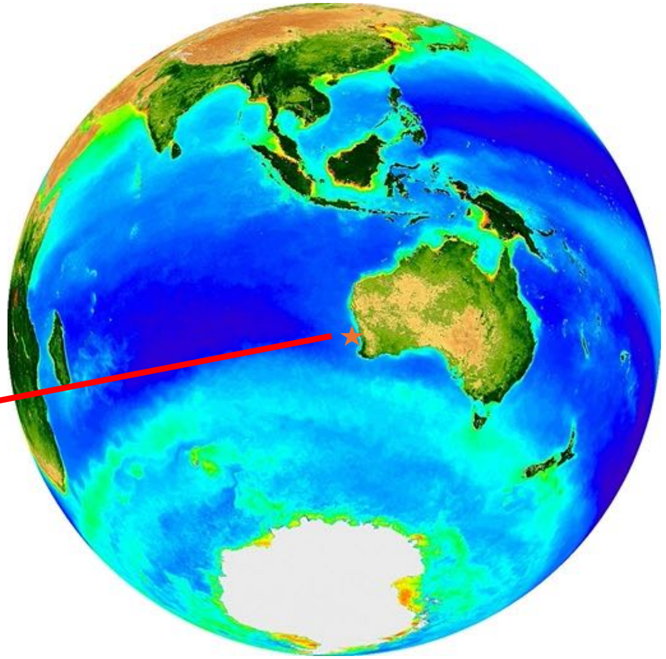
Curtin University’s RSSRG hosts the “Marine Optical Network” (**MarONet**), deployed 45 km off Perth, in deep clear waters. This unique equipment is the new generation “system vicarious calibration” (SVC) buoy for the NASA PACE mission

Poster 128 – Session 3 on Wednesday



Operating since September 2024





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Bringing together the bio-optics and phytoplankton photo-physiology communities *in the context of PACE*

5-day workshop including:

- Invited talks
- Contributed talks and posters
- Extended discussion time

Potential deliverables:

- A review paper (current knowledge and future actions)
- An action plan – with a dedicated web page to link international bio-optical sampling across the S. Ocean, with both the PACE mission and the new hyperspectral radiance sensors on robotic floats
- Future similar meetings or dedicated conference sessions

Organising Committee

David Antoine (Curtin Uni), Philip Boyd (Uni Tasmania), Christina Schallenberg (CSIRO), Robert Strzepek (Uni Tasmania)

https://antarctic.org.au/southern-ocean-bio-optics-workshop/

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Darkwater Inland Observatory Network (DION)

Googong Dam, NSW, Australia

- **Operational since Sept 2024**
  High-CDOM, low TSS, narrow freshwater site
- Built to meet FRM standards
  through traceable calibrations and uncertainty budgets
- Provides QA-assured data for global cal/val efforts, enhancing satellite water-quality products
- High-temporal database linking lab, in-situ, and satellite observations for improved modelling and forecasting
- Future-proofed platform with capacity for additional instrumentation

CSIRO | DION Project Team | Janet Anstee, Gemma Kerrisk, Darius Culvenor*, David Benn, James Taylor, Albertina Diaz

*Environmental Sensing Systems

DION

Stage 1

Platform deployment and development
2023-24

- Mooring & pontoon installation
- Electronics & power system setup
- Sensor integration & data logging
- Sample collection & routine maintenance
- Live monitoring via Grafana dashboard

Stage 2

Data processing automation
2025

- DION2 HyperCP conversion
- HyperCP automation with Argo
- Thermal radiometer integration
- Metadata alignment with QA/QC
- Water-quality sensor integration
- Workflow for AquaWatch Data Portal
- Platform and method documentation

Stage 3

Product verification and model development
2026

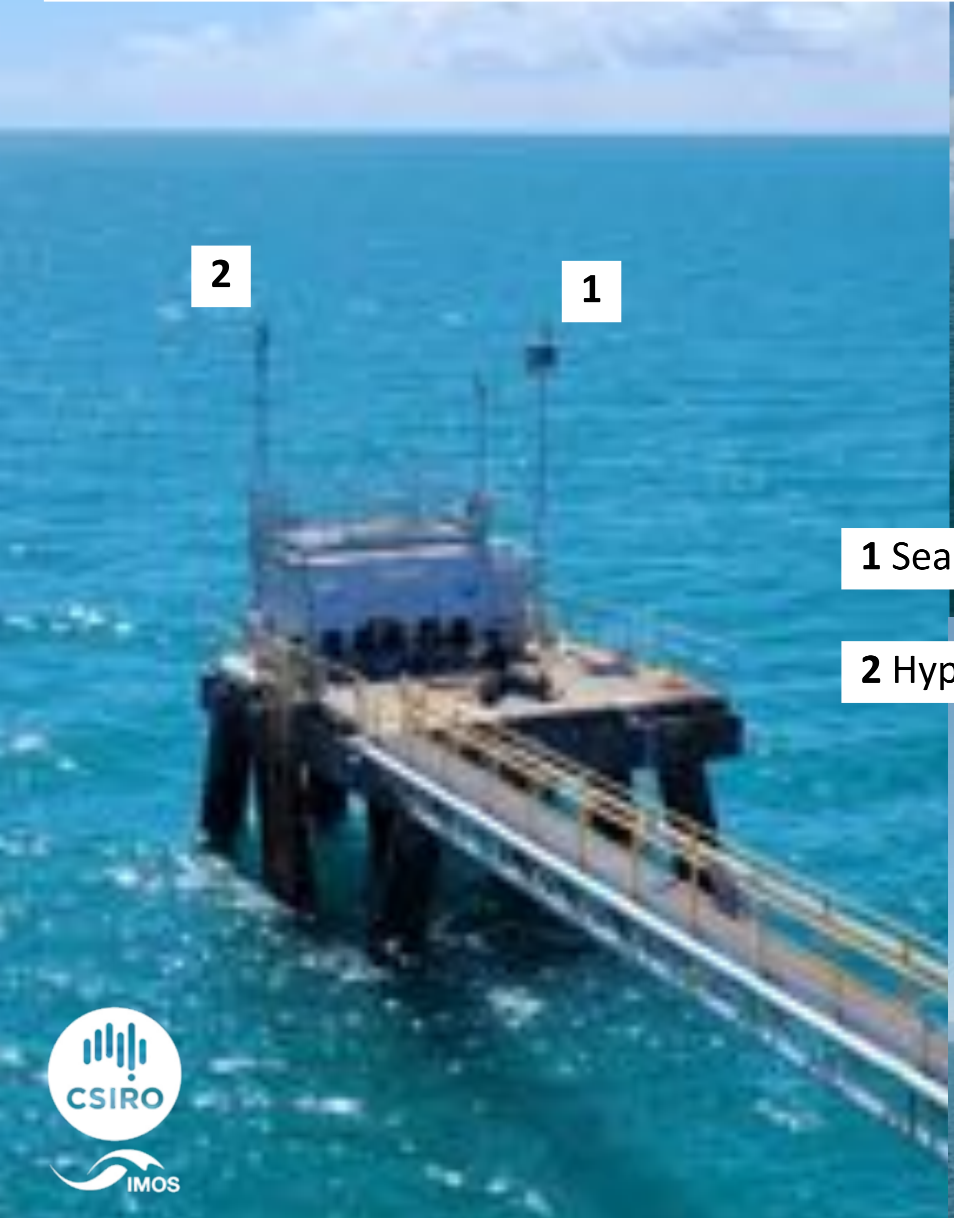
- Platform & data verification experiments
- Water-quality sensor QA/QC
- Bio-optical library compilation
- Thermal radiometer uncertainty testing
- AquaWatch Dashboard implementation
- Data QA/QC documentation

Stage 4

Expanded sensor integration and Cal/Val product verification
2027+

- New sensor integrations
- Enhanced QA flagging (eg cloud detection)
- Upgraded data processing automation
- Ongoing site & platform maintenance
- Continuous cross comparisons and platform verification
- Satellite + AtCor product validation

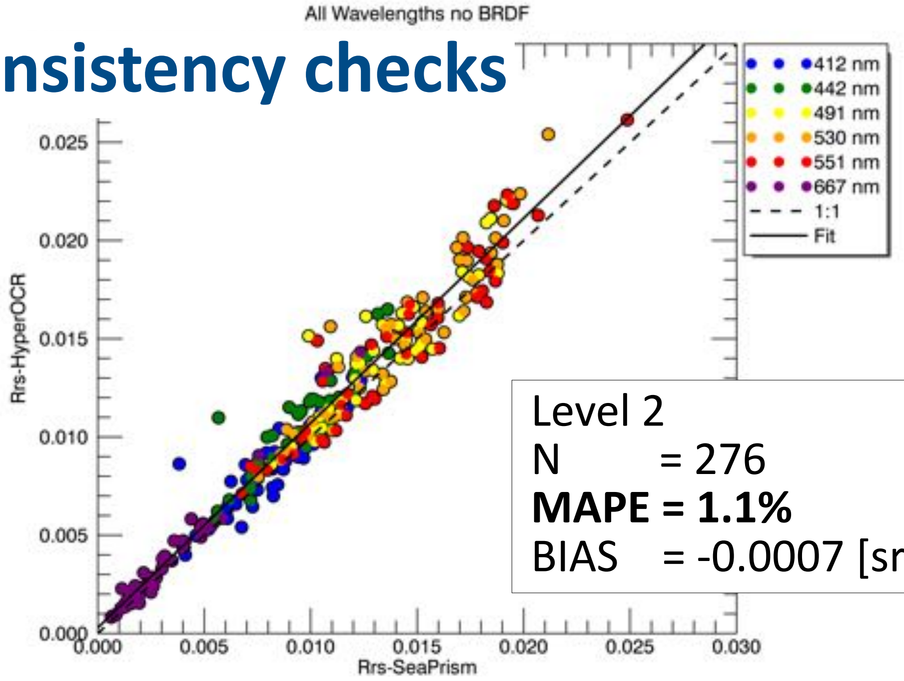
Hyper-spectral vs multi-spectral radiometry – consistency checks



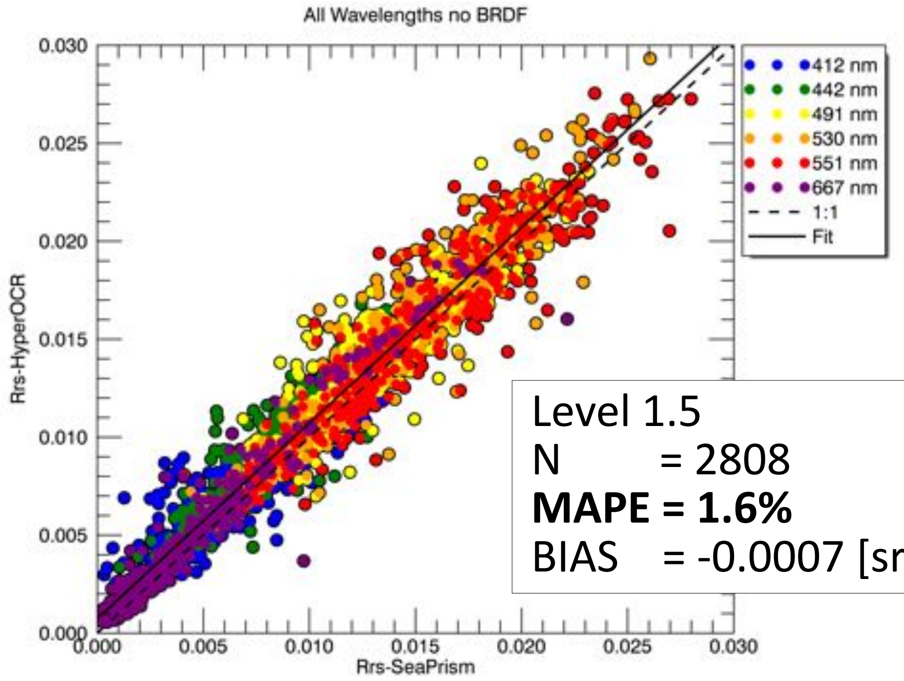
IMOS Lucinda Jetty Coastal Observatory

1 SeaPRISM

2 HyperOCR

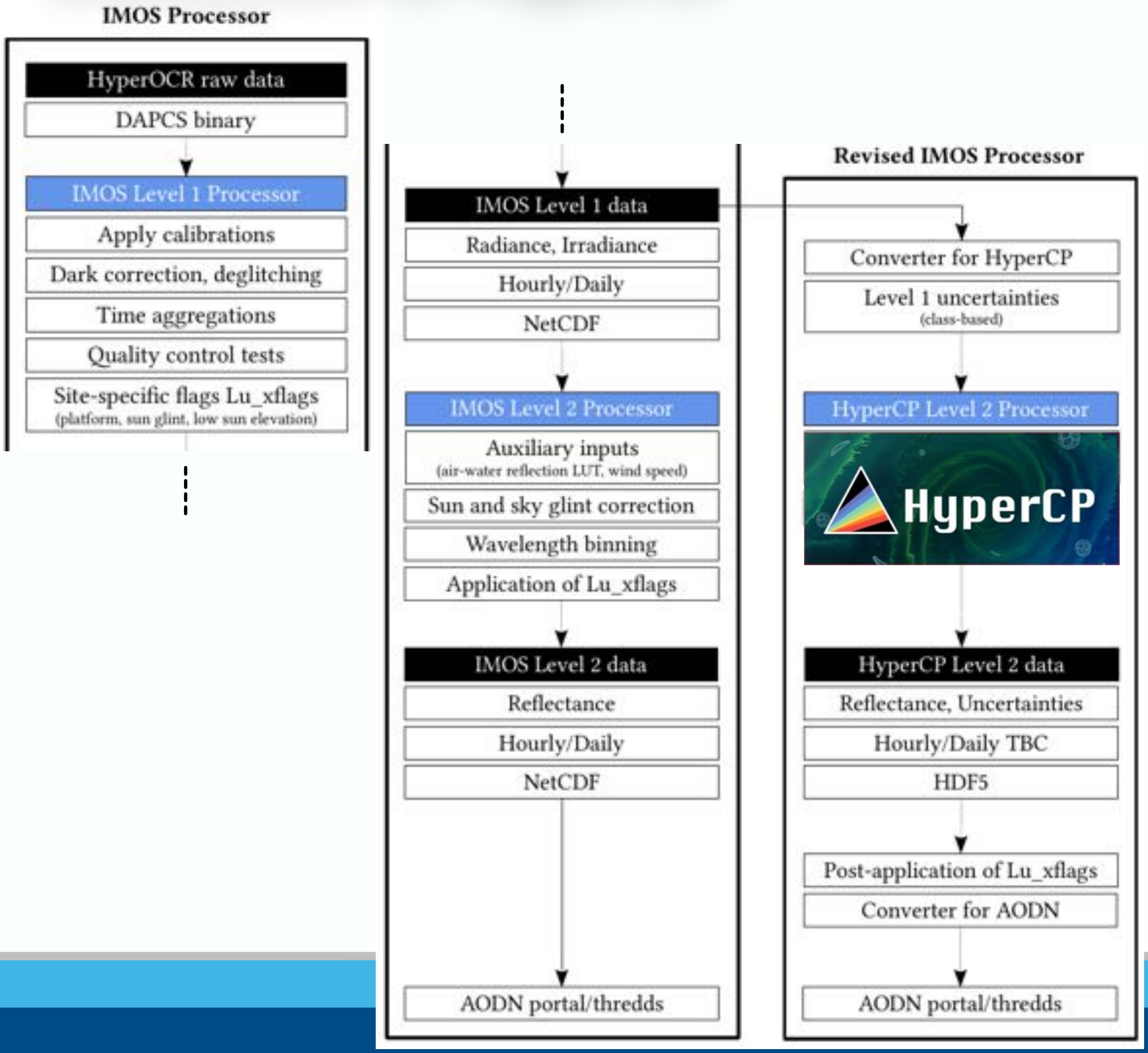


Level 2
N = 276
MAPE = 1.1%
BIAS = -0.0007 [sr^{-1}]

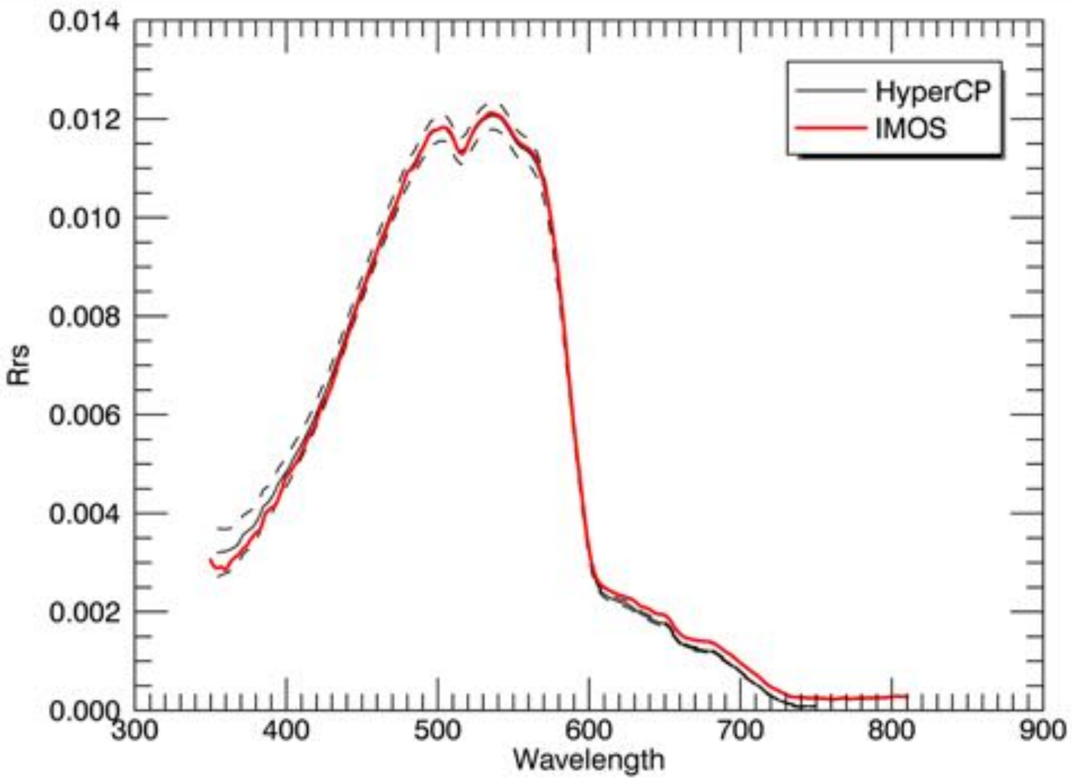


Level 1.5
N = 2808
MAPE = 1.6%
BIAS = -0.0007 [sr^{-1}]

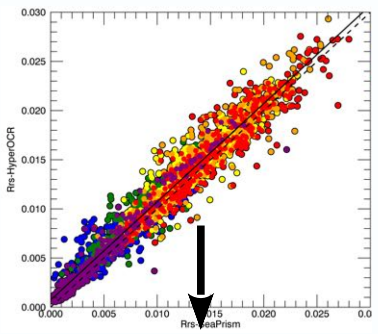
Evaluation of HyperCP

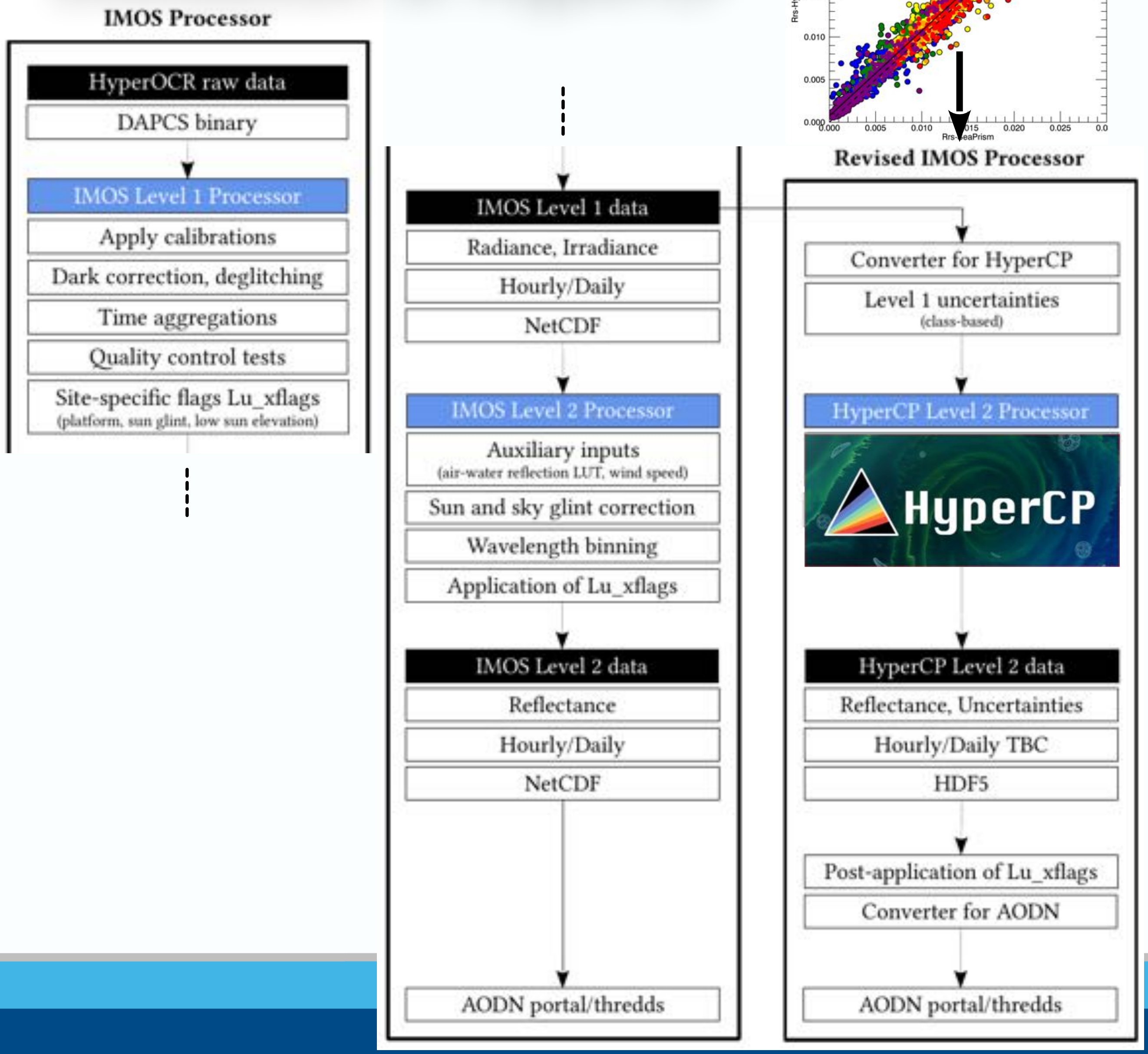


- **Objective:** Utilize and evaluate HyperCP uncertainty framework
- IMOS in-house developed processor uses different data format and site-specific Level 1 flagging
- **Converter** for IMOS L1 to HyperCP **implemented**



Evaluation of HyperCP

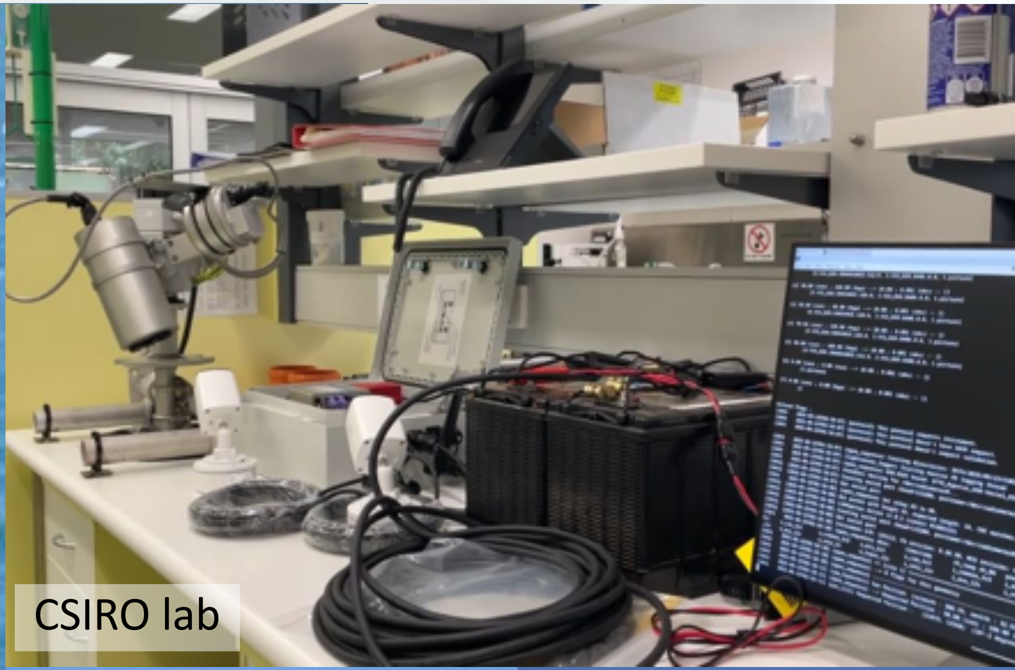




- **Objective:** Utilize and evaluate HyperCP uncertainty framework
- IMOS in-house developed processor uses different data format and site-specific Level 1 flagging
- Converter for IMOS L1 to HyperCP implemented
- SeaPRISM-HyperOCR reference data set will be used to **systematically evaluate consistency** of HyperCP processing
- If in good agreement possible operational implementation
- Advantage uncertainties added and data **sharing with EUMETSAT OCDB**
- Still requires Level 2 converter to deliver to IMOS Australian Ocean Data Network Portal
- How to evaluate consistency of uncertainties?
  → **HYPSTAR radiometer**

Upgrades 2026

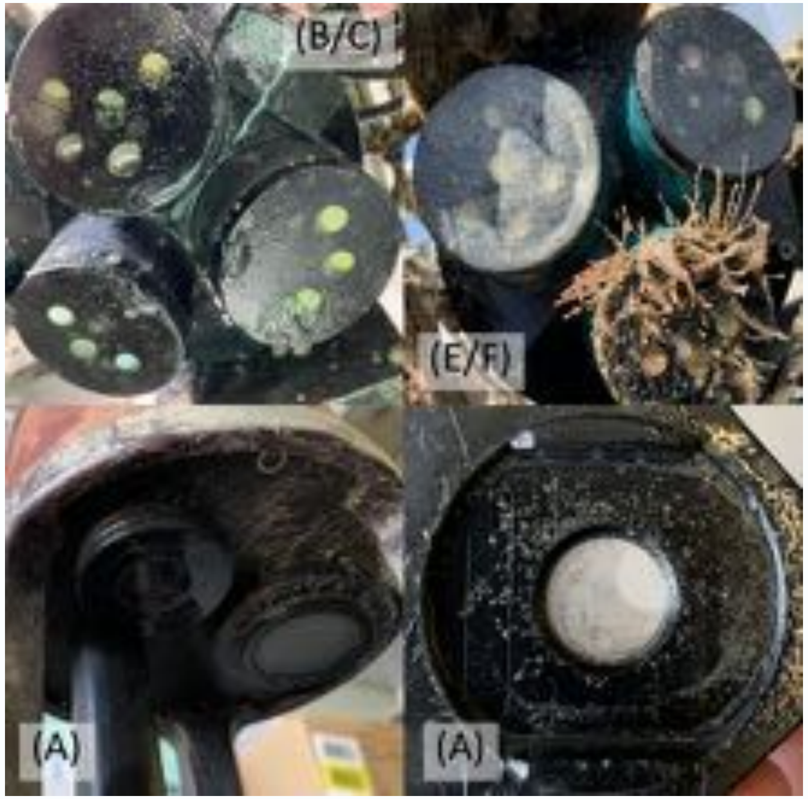
HYPSTAR-SR hyper-spectral radiometer funded by ESA
Replacement of Cimel/SeaPRISM with T-model

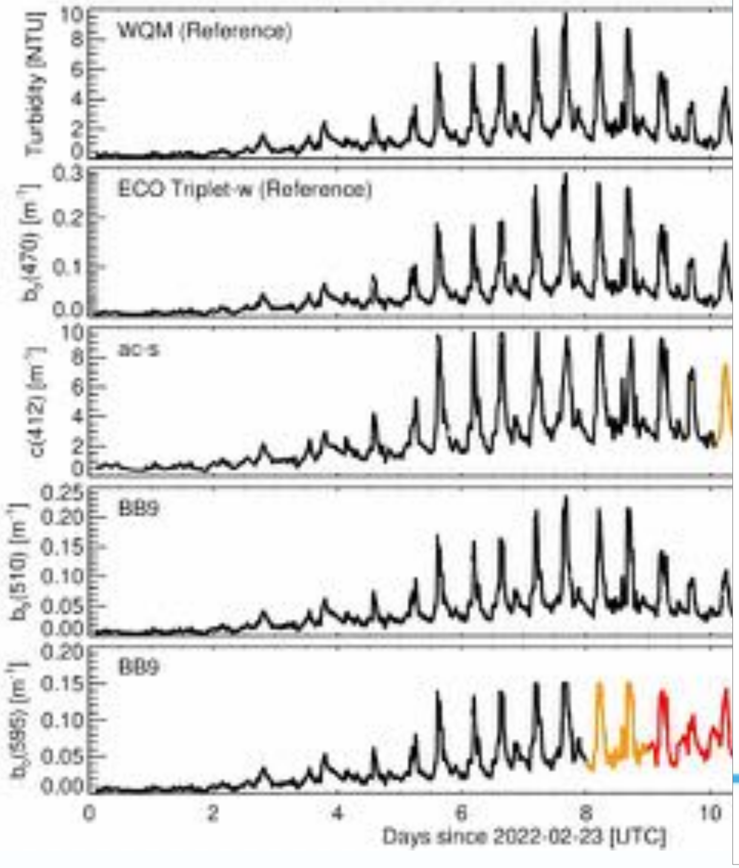


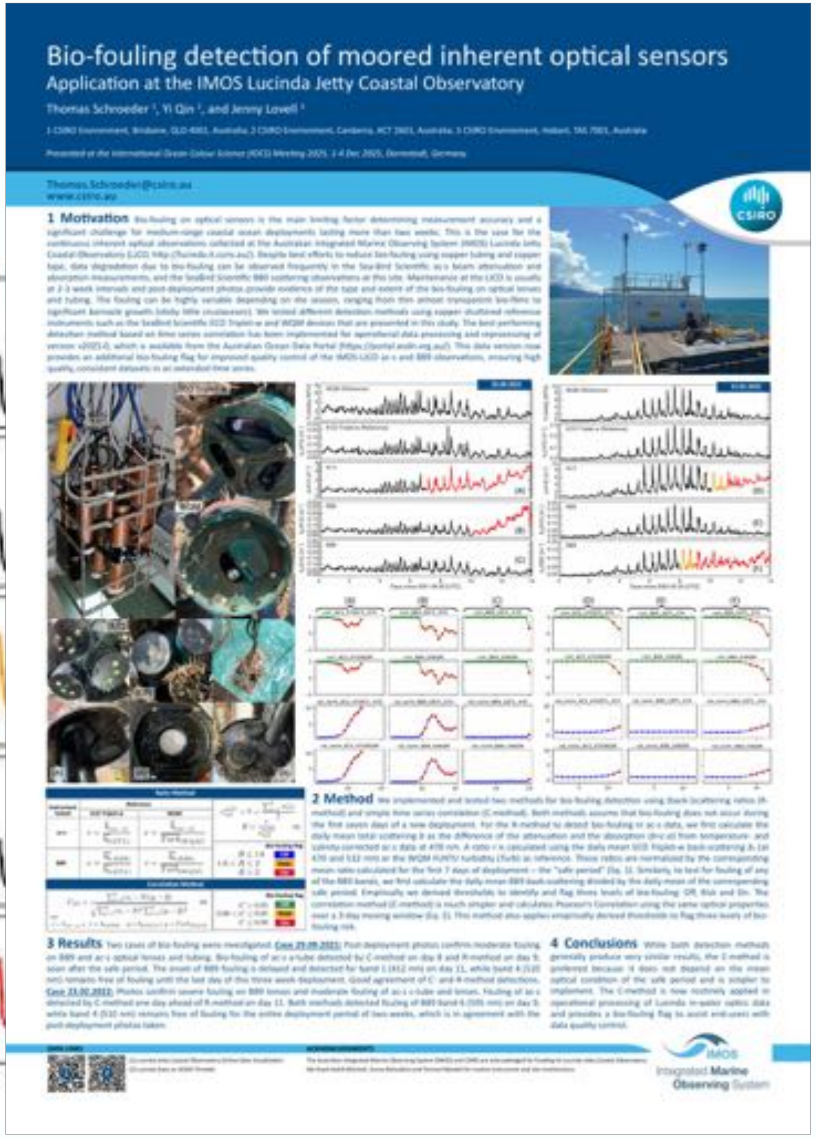
PI/Contact: Thomas.Schroeder@csiro.au

Bio-fouling detection of moored IOP sensors

Using copper shuttered reference instruments at LJCO







Poster 71 – Session 2 on Tuesday