Copernicus FICE 2024

Training on

In situ Ocean Colour Above-Water Radiometry towards Satellite Validation

Measurements at San Servolo jetty
Measurement procedures: Demo with TriOS

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PROGRAMME OF THE EUROPEAN UNION · Copernicus · IMPLEMENTED BY EUMETSAT

FRM4SOC Phase-2 · fiducial reference measurements for satellite ocean colour

CNR ISMAR ISTITUTO DI SCIENZE MARINE

7-20 July 2025
Venice, Italy

UNIVERSITY OF TARTU
Tartu Observatory
1632


ATTENZIONE
PAVIMENTO BAGNATO

9:00 AM	1:00 PM	Measurements at San Servolo jetty: Measurement procedures: Demo with TriOS
1:00 PM	2:00 PM	Lunch
2:00 PM	3:30 PM	Measurement procedure, TriOS: Export data acquired on jetty to .mlb (I)
3:30 PM	4:00 PM	Coffee-break
4:00 PM	5:30 PM	Measurement procedure, TriOS: Export data acquired on jetty to .mlb (II) **and/or demo with HyperCP**

INDOOR:

1) Elements in TriOS measurements
    1) How to set up the measurement
    2) What ancillary data is needed
    3) How to perform the measurement

OUTDOOR:

1) Set up the experiment
2) Measurements (4 x 5 min) in groups
3) Filling the “station protocol” for ancillary information

INDOOR

1) Exporting data from MSDA_XE
    - export .mlb files

frm4soc2.eumetsat.int/deliverables

PROGRAMME OF THE EUROPEAN UNION

opernicus Europe's eyes on Earth

IMPLEMENTED BY EUMETSAT

FRM4SOC Phase-2

fiducial reference measurements for satellite ocean colour

Published papers:

Vabson V, Ansko I, Duong K, Vendt R, Kuusk J, Ruddick K, Bialek A, Tilstone GH, Gossn JI and Kwiatkowska E (2024) Complete characterization of ocean color radiometers. *Front. Remote Sens.*5:1320454. doi: 10.3389/frsen.2024.1320454

Deliverables:

D-1 Project Management Plan (PMP)

D-2 Reflectance Measurement Requirements Document (RMRD)

D-3 Database to host FRMOCnet specifications, data and documentation for the OCR models as well as for individual instruments and their deployment history

D-4 FRMOCnet Database Architecture Design and User Manual document (ADUM)

D-5 OCDB Database WebUI, CLI, Python API, and Architecture Design and User Manual document

D-6 Technical Report: Measurement Procedure Document (MPROCD)

Measurement Procedure Document

D-6c Technical Report: Above-water field radiometry and data handling for ocean colour applications

D-7 Technical Report: Complete characterisation and calibration results for FRMOCnet OCR models and re-characterisation routine: an update

Fiducial Reference Measurements for Satellite Ocean Colour Phase-2

Measurement Procedure Document (MPROCD)

FRM4SOC2-MPROCD

Title	Measurement Procedure for operating the TRIOS/RAMSES radiometers to obtain Fiducial Reference Measurements (MPROC)
Document reference	FRM4SOC2-MPROC
Project	EUMETSAT – FRM4SOC Phase-2
Contract	EUMETSAT Contract No. EUM/CO/21/460002539/JIG
Deliverable	D-6 Measurement Procedure Document (MPROCD)
Version	3.1
Date issued	24.03.2023

Prepared By		Approved by	
Name:	Kevin Ruddick	Name:	Juan Ignacio Gossn
Organisation:	RBINS	Organisation:	EUMETSAT
Position:	FRM4SOC Phase 2 Task 1 Leader	Position:	FRM4SOC Phase 2 Project officer
Date:		Date:	
Signature:	(Signature) Date: 2023.09.28 13:10:36 +02'00'	Signature:	Juan Ignacio Gossn Digitally signed by Juan Ignacio Gossn Date: 2023.05.15 14:46:55 +02'00'

Funded by the European Union

Measurement Procedure Document (MPROCD)

Table of contents

The section 3 summarises how the MSDA_XE software is configured and prepared before a cruise and should be used in conjunction with the MSDA_XE Manuals

https://frm4soc2.eumetsat.int/sites/default/files/inline-files/FRM4SOC-2_D-06_MeasurementProcedure_v3.1_24032023_RBINS_EUMETSAT_signed.pdf

Measurement Equipment – OCR instrumentations

Radiometer measurement system consisting of (from right to left):

- one irradiance and two radiance TriOS/RAMSES sensors
- 3*50m SUBCON/M8F RAMSES cables,
- RS232/USB adapter grey cable,
- acquisition PC,
- IPS104 radiometer power supply and data interface box,
- Multi-socket power board

In addition, the following auxiliary equipment is recommended:

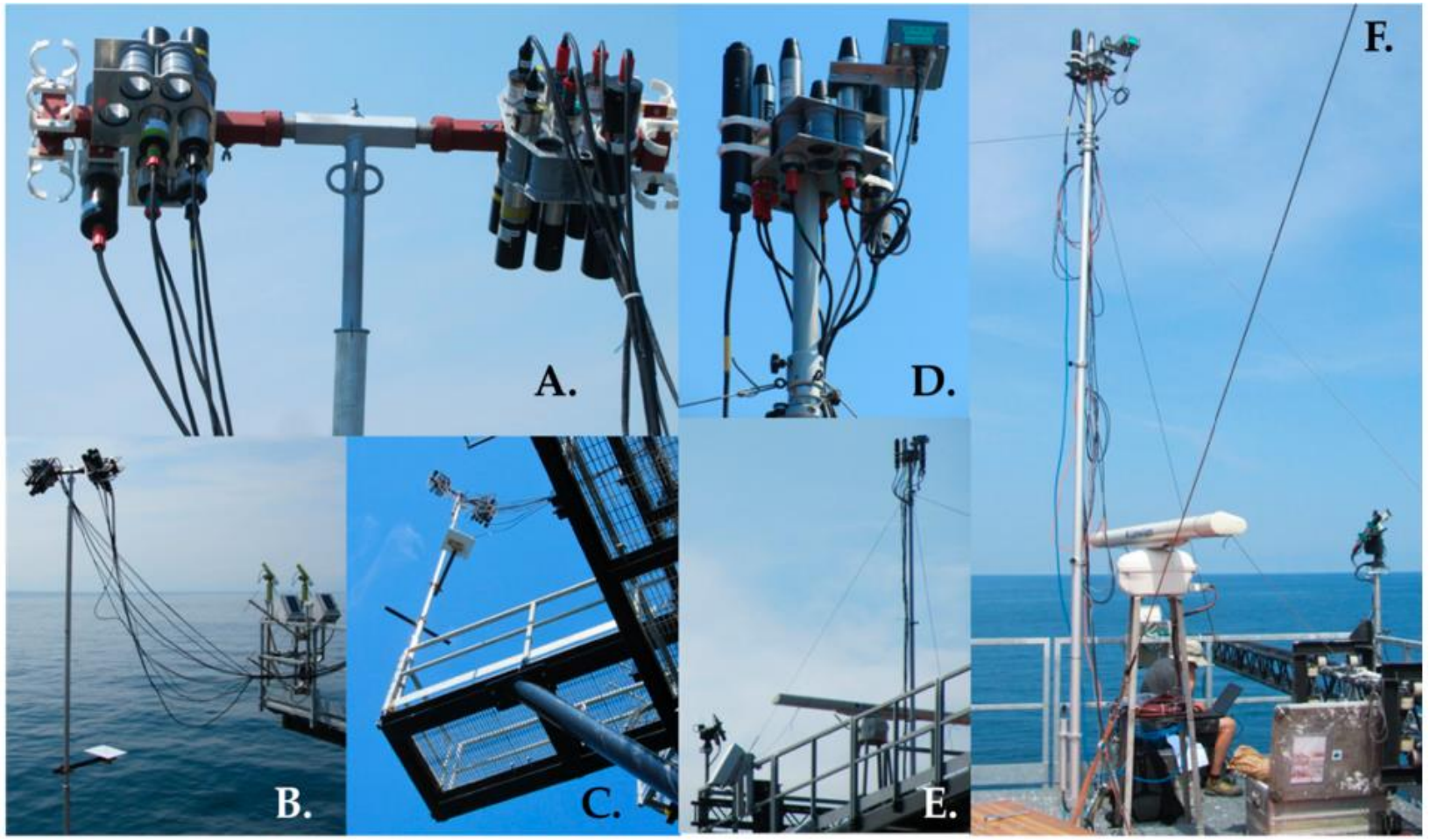
- Optical surface cleaning equipment such as optical paper, e.g. Kimwipes, and particle- and salt-free water, e.g. milli-Q water.
- Digital RGB camera with both normal and fisheye lenses for equipment, water and sky photos; main and spare batteries; charger; cable or wireless PC connection for data transfer, etc.
- Relevant documentation (e.g. User manuals for TRIOS/RAMSES radiometers, protocols) and, MSDA_XE software
- Cable ties and tape for safe mounting of the SUBCON/M8F cables.

Where possible spares should be embarked particularly for single point failure items such as radiometers, IPS104 box, RS232/USB adapter, cables, PC, GPS receiver.

Measurement equipment - radiometer mounting structure

- The radiometers will need to be mounted in a frame, which fixes the irradiance sensors pointing at zenith and the radiance sensors at 40° nadir (water-viewing) and 40° zenith (sky-viewing)
    - In view of the different requirements for the irradiance sensor, this might be mounted on a separate higher frame/mast.
- The radiometer frame will typically be of stainless steel for work at sea and will ideally have levelling screws to ensure a horizontal base

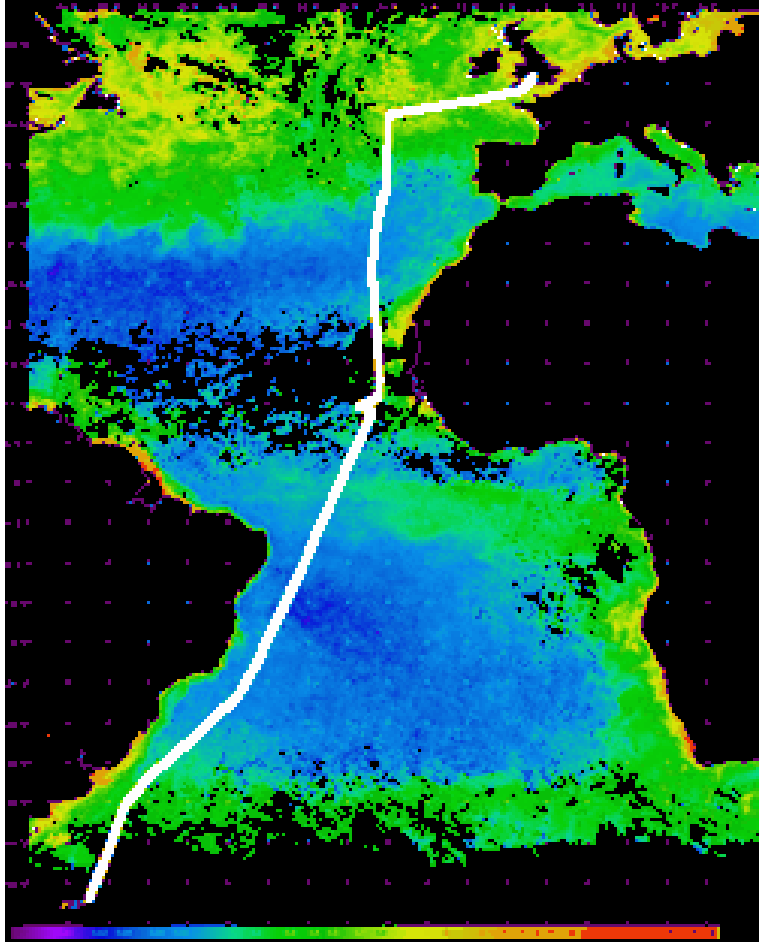
Examples of the mounting setups



- Measurements performed at the AAOT, where radiometers located on the same purpose-built frames

Tilstone et al., 2020: Field Intercomparison of Radiometer Measurements for Ocean Colour Validation, Remote Sens., 12(10), 1587

Tilstone et al., 2025: Radiometric field inter-comparison of fiducial reference measurements using an open source community processor, Optics Express, Vol. 33, Issue 7



- Above water radiometers on RRS Discovery in operation during AMT-27 (Atlantic Meridional Transect) from Immingham to Falkland during Sept - Nov 2017

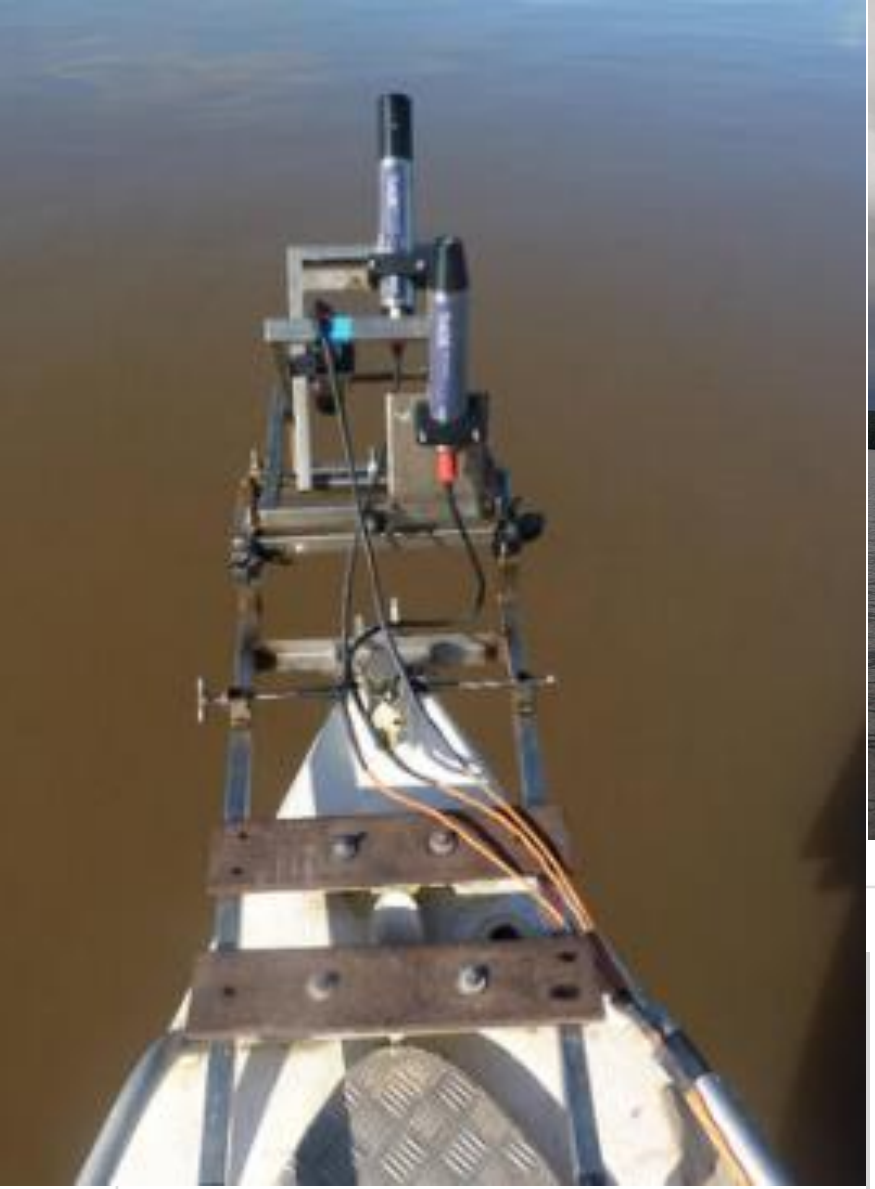
Alikas et al., 2020, Comparison of Above-Water Seabird and TriOS Radiometers along an Atlantic Meridional Transect, Remote Sens. 2020, 12(10)

International SI traceable comparison exercise to verify the performance of Field Ocean Colour Radiometers (FRM4SOC-LCE2)

- Different setups for the outdoor comparison
  - 39 instruments

Vabson et al., Field Intercomparison of Radiometers Used for Satellite Validation in the 400–900 nm Range, Remote Sens. 2019, 11(9), 1129

https://frm4soc.org



kosmos.ut.ee

Goyens, 2013, Validation and improvment of atmospheric correction methods for ocean colour images in optically complex coastal waters

Viewing geometry

Modelling (Mobley 1999) indicates that a viewing angle θ of 40° and a relative azimuth ϕ of 135° are the most appropriate to minimize sun-glint perturbations.
Due to practical limitation during field deployment, it is suggested to use ϕ=90° to avoid sensor (L_T) looking at the sea close to the deployment structure or at its shadow.

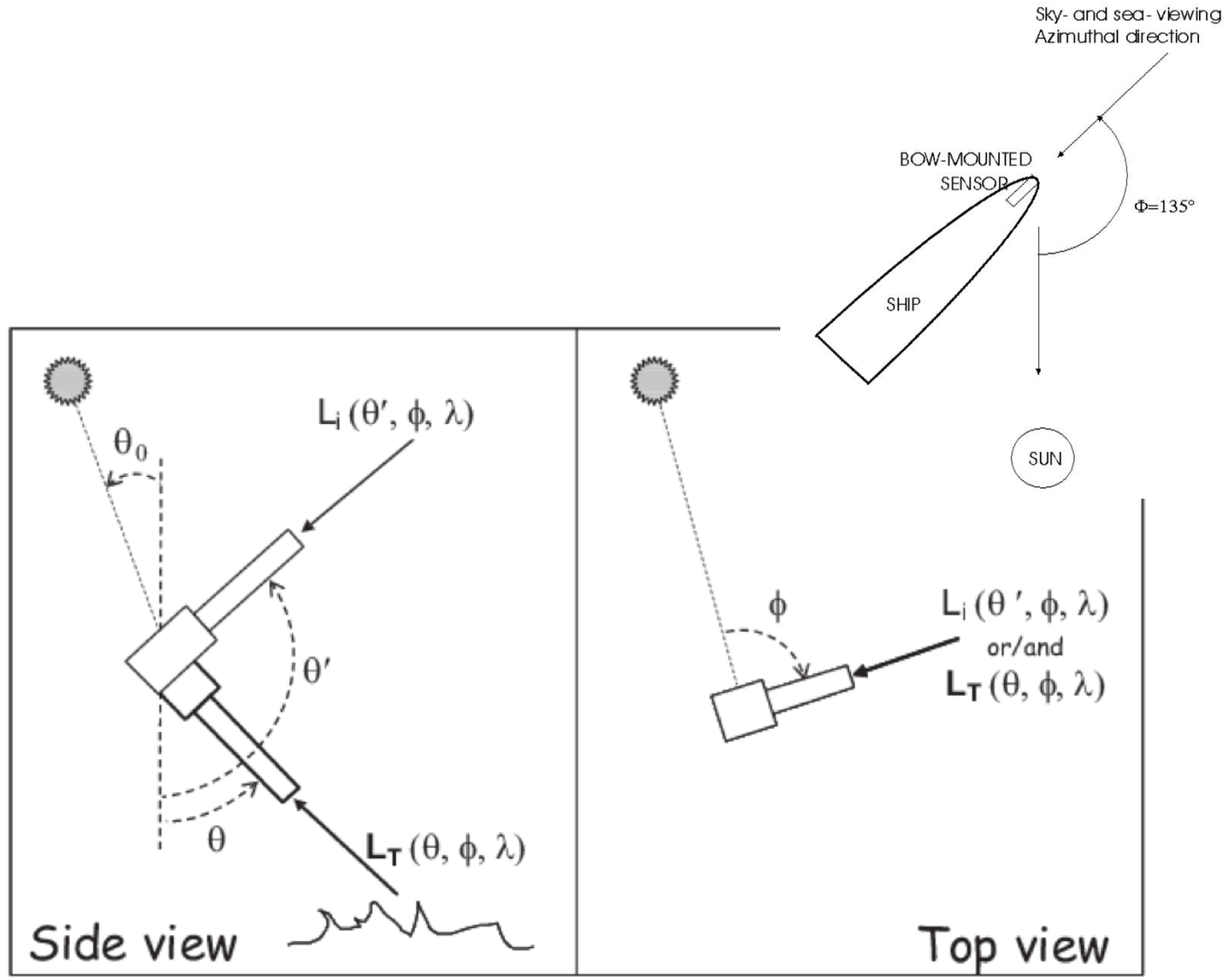


Fig. 5.1: Measurement geometry commonly applied for above-water radiometry (i.e., viewing angle θ of 40° and a relative azimuth ϕ of 90°).

IOCCG, 2019

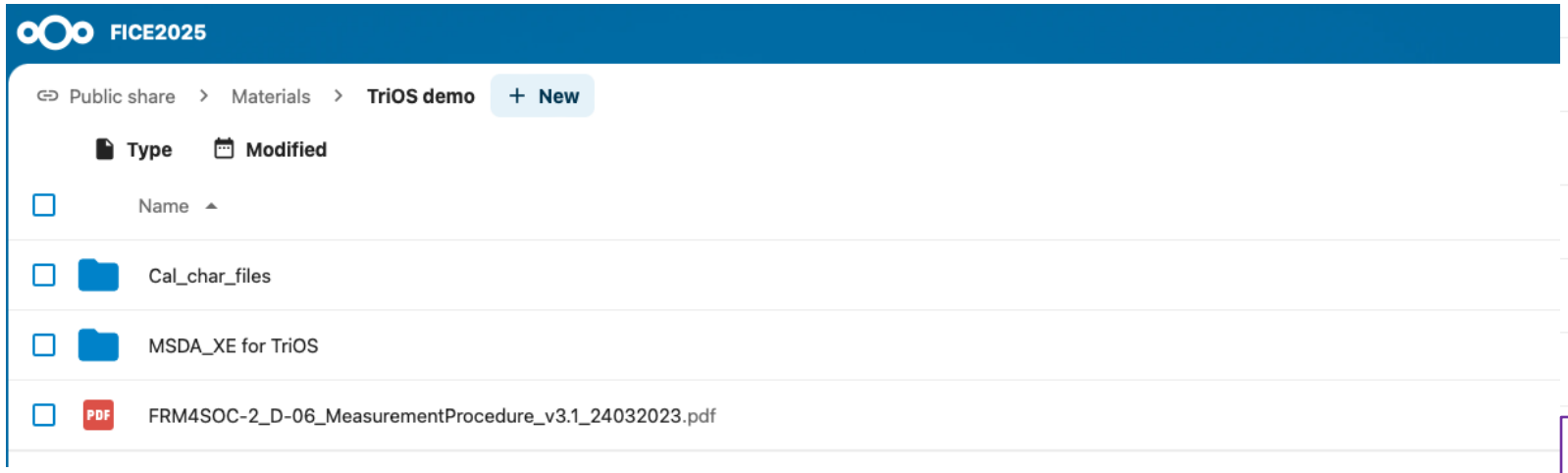
C.Mobley, Estimation of remote-sensing reflectance from above surface measurements. *Applied Optics*, 38: 7442-7455,1999.

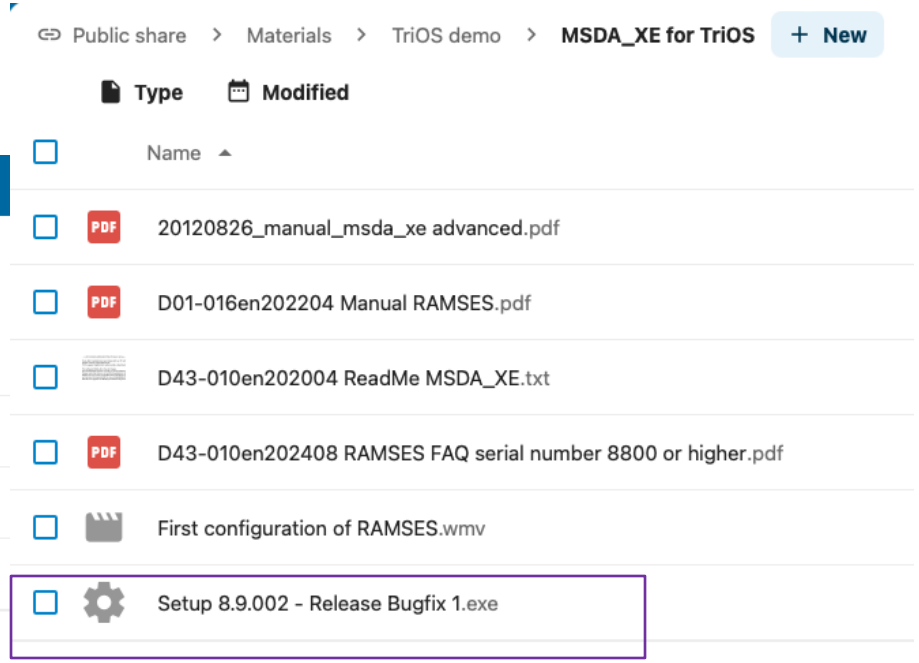
Ancillary information

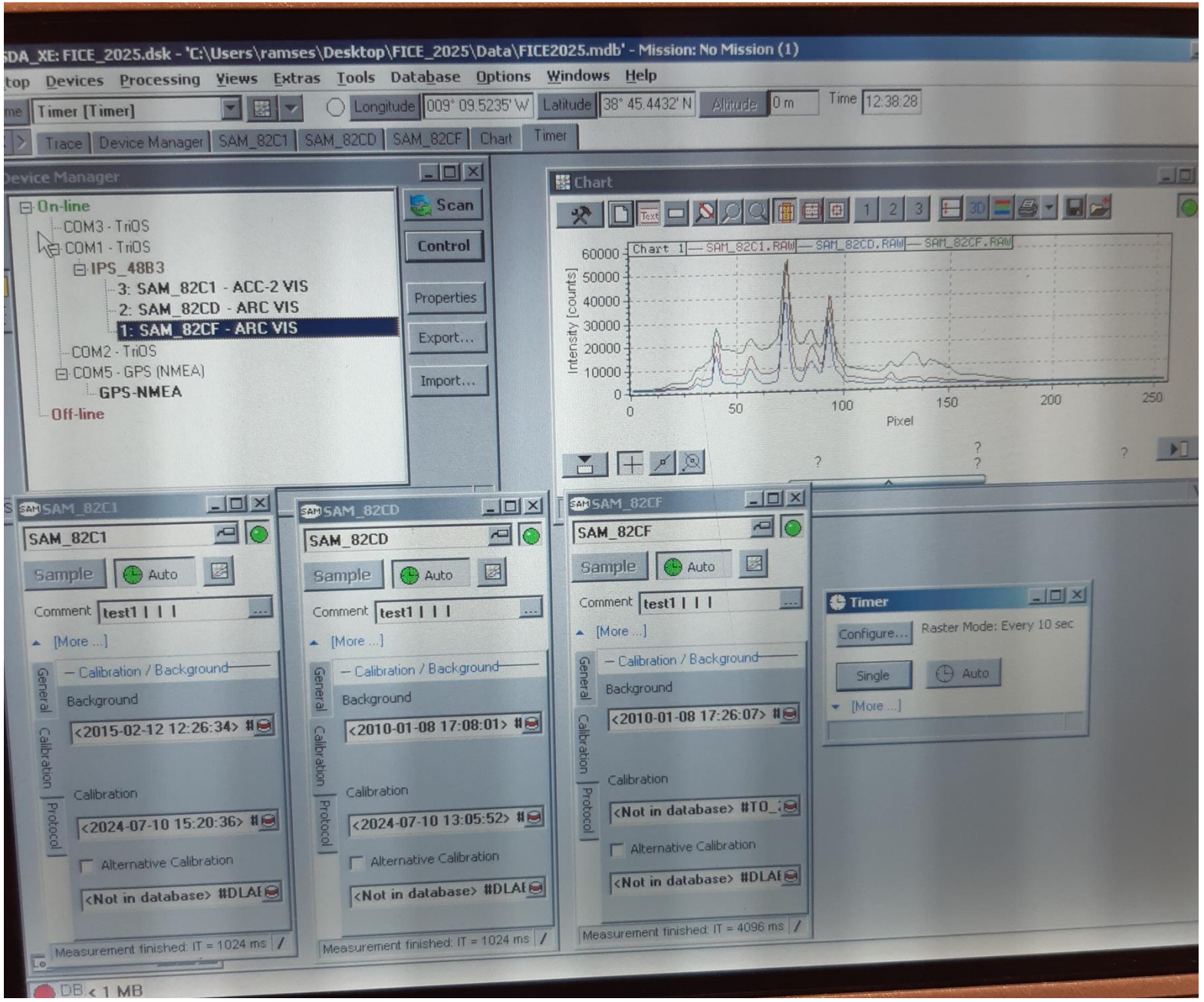
- Date and time (UTC)
- Latitude, longitude
- Cloud cover
- Sea state
- Wind speed and direction
- Air and water temperature

Data acquisition software MSDA_XE

- The MSDA_XE software works with Windows Operating Systems, but does not, to our knowledge, work with Linux or MAC/OS.
- There is no further development. Every new Windows version needs a check
  - Already proven for Windows 11.







MSDA_XE

Station name should be given before the start of the measurements as a Comment for every radiometer

e.g. station nr, cast nr and whether it is signal/dark measurement;

- 0101S

(station 1, cast 1, caps off measurement)

- 0101D

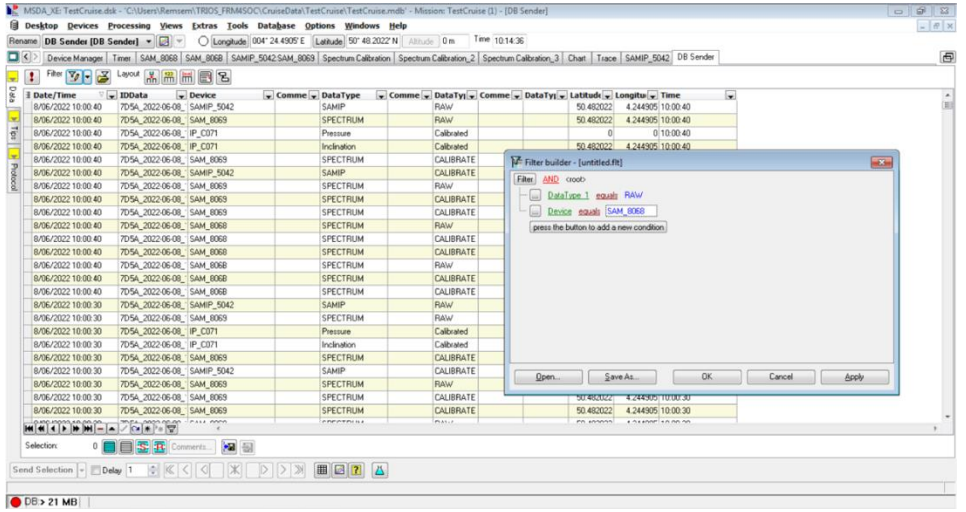
(station 1, cast 1, caps on measurement)

This will be later used while extracting the data as .mlb files as required for HyperCP processing

Measurements at San Servolo jetty

1. Set up the measurement
2. Work with groups of 4 persons
    1. Measurements in 5-minute intervals
        1. start with caps on measurement
        2. followed by 3 x 5-minute cast measurements

Radiometer data extraction (Ch 6.1 in D-06 MPROCD) - *generation of *.mlb files for HyperCP*



Download the *.dat files from owncloud “Materials-> TriOS demo”

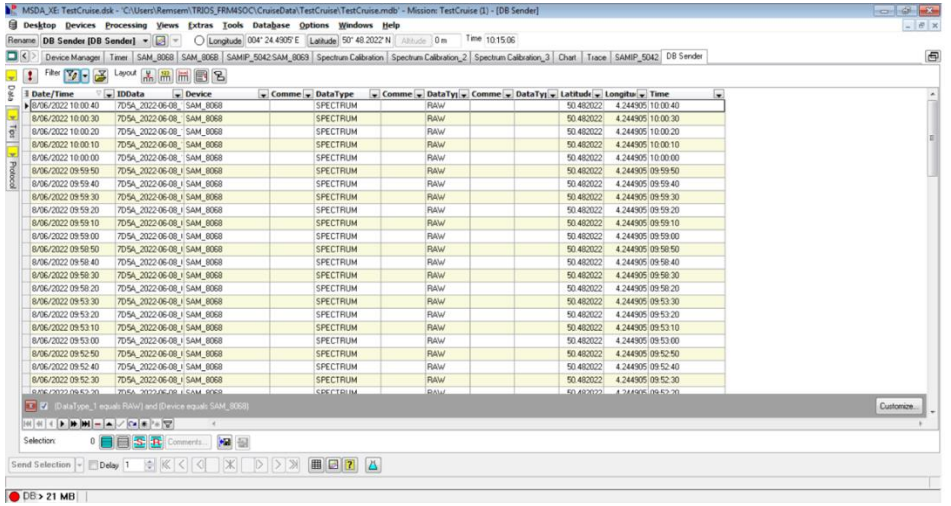
Import the measurement files In MSDA_XE:

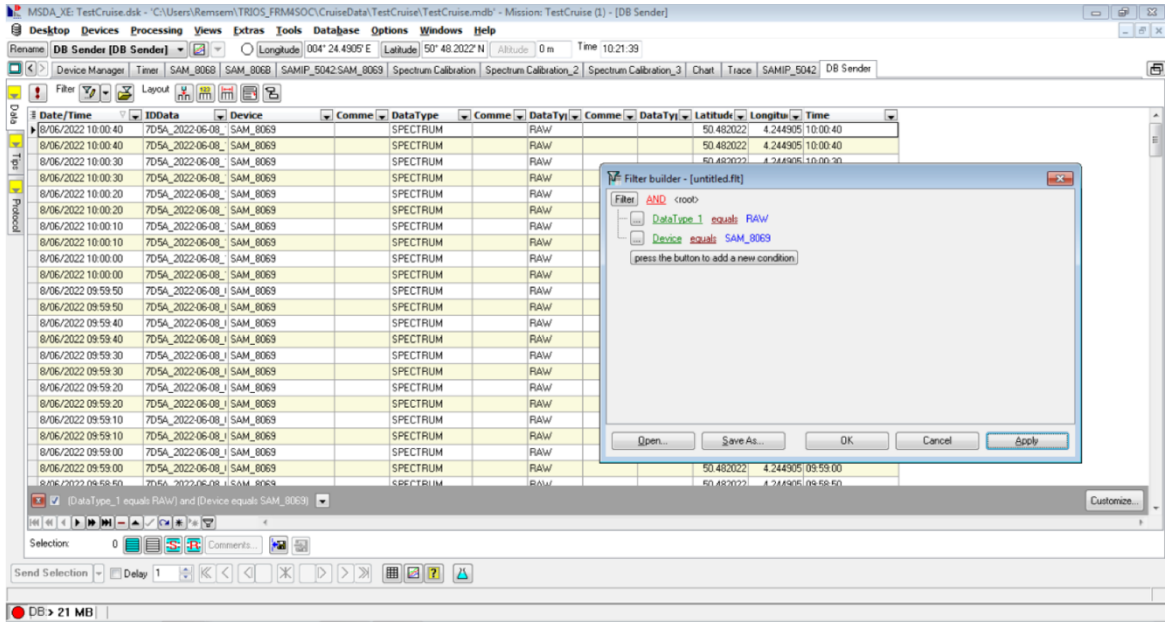
1. Database -> Import files -> choose all *.dat files

To **EXPORT RAW** files from the database (DB_Sender table obtained from Database>Data command) for each sensor separately (Figure 34)

1) Use the filters:

a) For the radiometers (Figure 35)
   1. Data Type_1: RAW
   2. Device (select a sensor each time): SAM_8068 then SAM_806B then SAM_8069 [adapt to actual device Serial Numbers]





2) Select all and Export using Masks (Figure 36):

Tab: **Matlab Serial Data**

Sub-tab (left): **Masks**

Directory: C:\Users\MyUserName\TRIOS\CruiseData\ThisCruise\<OutputStations>

Mask: ${IDDevice}_${DataType1}_${DataType}_ ${Comment0}

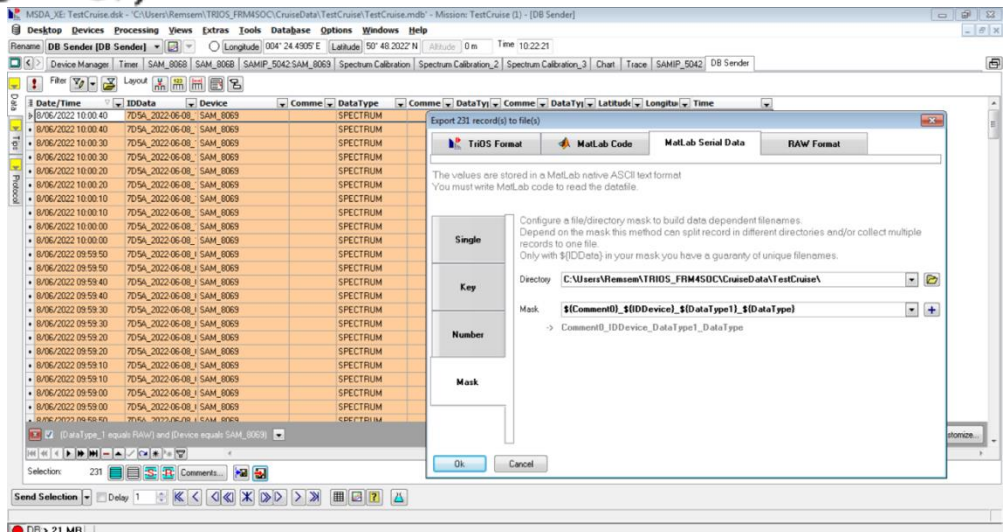
In this way for each sensor one file for each station is created (Figure 37).

Example:

SAM_8068_RAW_SPECTRUM_0101S.mlb

SAM_806B_RAW_SPECTRUM_ 0101S.mlb

SAM_8069_RAW_SPECTRUM_ 0101S.mlb



Select/Create Configuration File

sample_SEABIRD_pySAS.cfg

New | Edit | Delete

Input Data Parent Directory

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

Output Data/Plots Parent Directory ^^^ Mimic Input Dir. vvv

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

Ancillary Data File (SeaBASS format; MUST USE UTC)

s/daurin/GitRepos/HyperCP/Data/Sample_Data/SAMPLE_SEABIRD_pySAS_Ancillary.sb

Add | Remove

Single-Level Processing

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

L1A --> L1AQC

L1AQC --> L1B

L1B --> L1BQC

L1BQC --> L2