

Integrated Micro-Sensor Observatories for High-Frequency Monitoring of Water Quality

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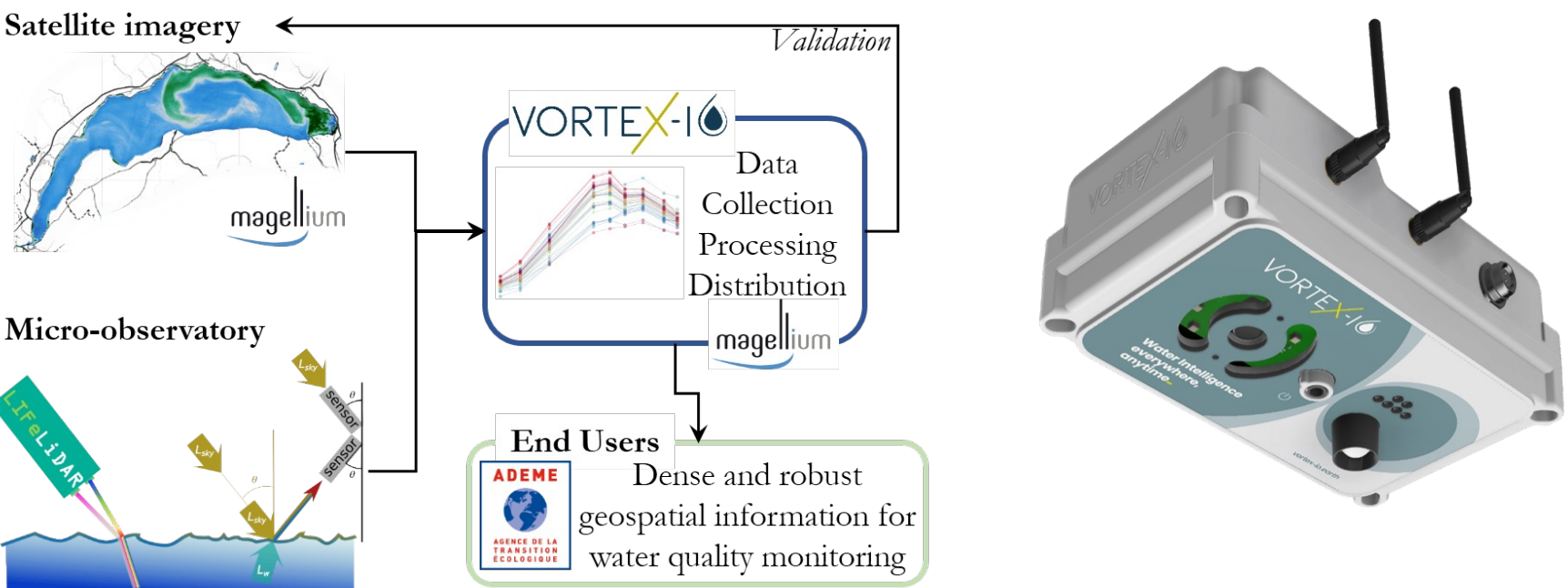
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OQOMETHI Project — Supported by France 2030 Program, operated by ADEME

PROJECT MOTIVATION

Within the OQOMETHI project, together with vortex-io and Magellium, a multi-scale observational concept is developed based on compact autonomous micro-stations with new passive and active optical sensors. Deployed above rivers, lakes and coastal lagoons, these systems provide high-frequency, real-time measurements of key water quality parameters — chlorophyll-a, suspended matter, dissolved organics, and cyanobacteria markers — while enabling validation of satellite imagery at national scale.



- Sub-hourly continuous unattended monitoring
- Retrieval of optically active water constituents
- Ground-truth for satellite product calibration
- Scalable distributed micro-observatory networks
- EU Water Framework Directive compliance

DEPLOYMENT SITES

Lake Parentis *Nouvelle-Aquitaine, France*
Freshwater lake. Paired mFL.12+mHR.2.
Sub-hourly continuous measurements.

Dordogne Estuary *Gironde, France*
Estuarine monitoring in turbid,
optically complex tidal waters.

Étang des Aulnes (October 2026) *Bouches-du-Rhône (collab. OFB)*
Coastal lagoon; collaboration with Office français de la biodiversité.

Étang de Berre (October 2026) *Bouches-du-Rhône (collab. LOV)*
Coastal lagoon; collaboration with Laboratoire d'Océanographie de
Villefranche-sur-Mer

Satellite validation targets:
Sentinel-2 · PRISMA · EnMAP · CHIME



Platforms at Dordogne River (left) and Parentis Lake (right), France

ADDITIONAL VALIDATION SITES

Venice, Italy *Initial mHR and mFL field validation*
ESA PHY2FLEX, Oct 2025

Villefranche-sur-Mer, France *mHR and mFL field validation*
Laboratoire d'Océanographie de Villefranche (LOV), CNRS, March, May 2026

Lakes Goczałkowice and Farskie, Poland
University of Silesia & University of Warsaw, Jun 2026

Lake Balaton, Hungary
Balaton Limnological Institute, Aug 2026

Microsensor Viewer WEB-platform was developed for real-time monitoring of all the microsensors' measurements, allowing to store, display and analyze collected data.



mFL.12

micro Fluorescence LiDAR

PORTABLE HYPERSPECTRAL LASER-INDUCED FLUORESCENCE LIDAR

Installed above the water for unattended 24/7 monitoring. The 405 nm laser excites fluorescence of water constituents. Enables day and night measurement without shading the water surface. Designed to be installed on buoys, bridges, piers, etc. to organize real-time monitoring networks.



405 nm
LASER WAVELENGTH

400-880 nm
RECEPTION

12 nm
SPECTRAL RESOLUTION

1.75 kg
MASS

12 W
PEAK POWER

IP68
MARINE GRADE

WHAT IT MEASURES

Chlorophyll-a and other pigments (PE, PC, BChl)

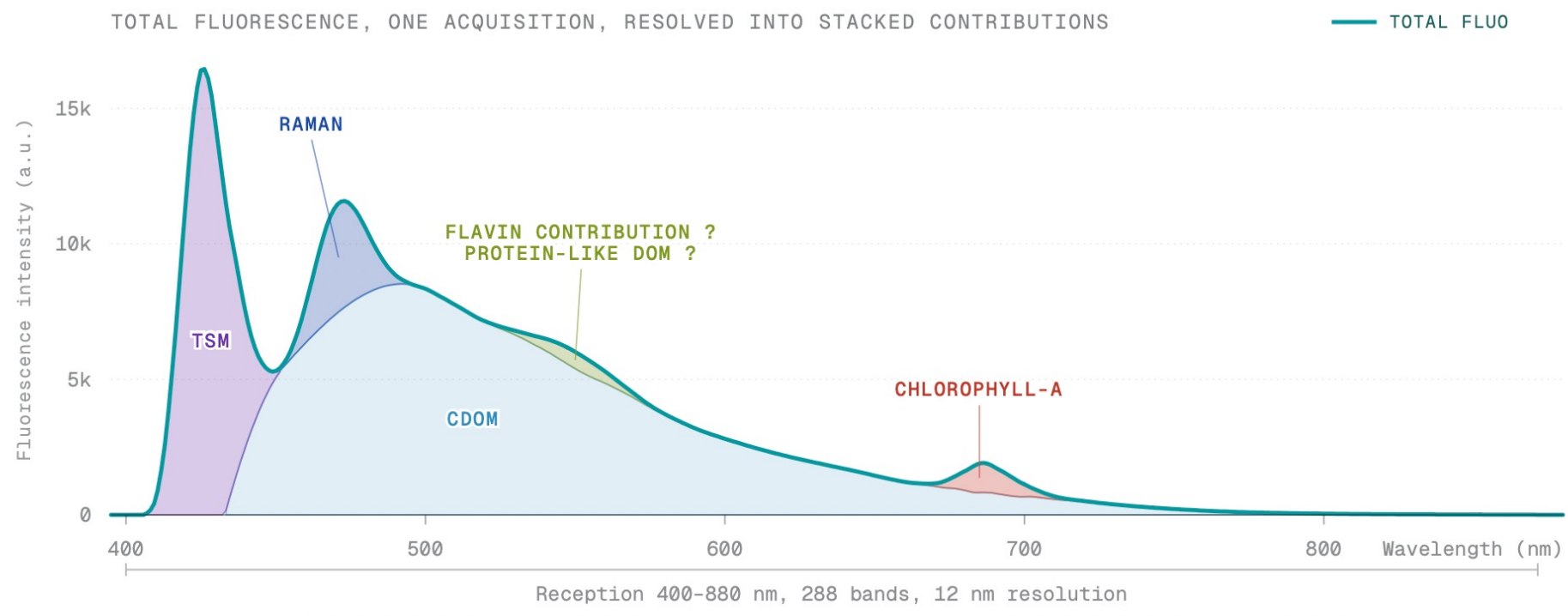
CDOM
Colored dissolved organic matter

TSM
Total suspended matter

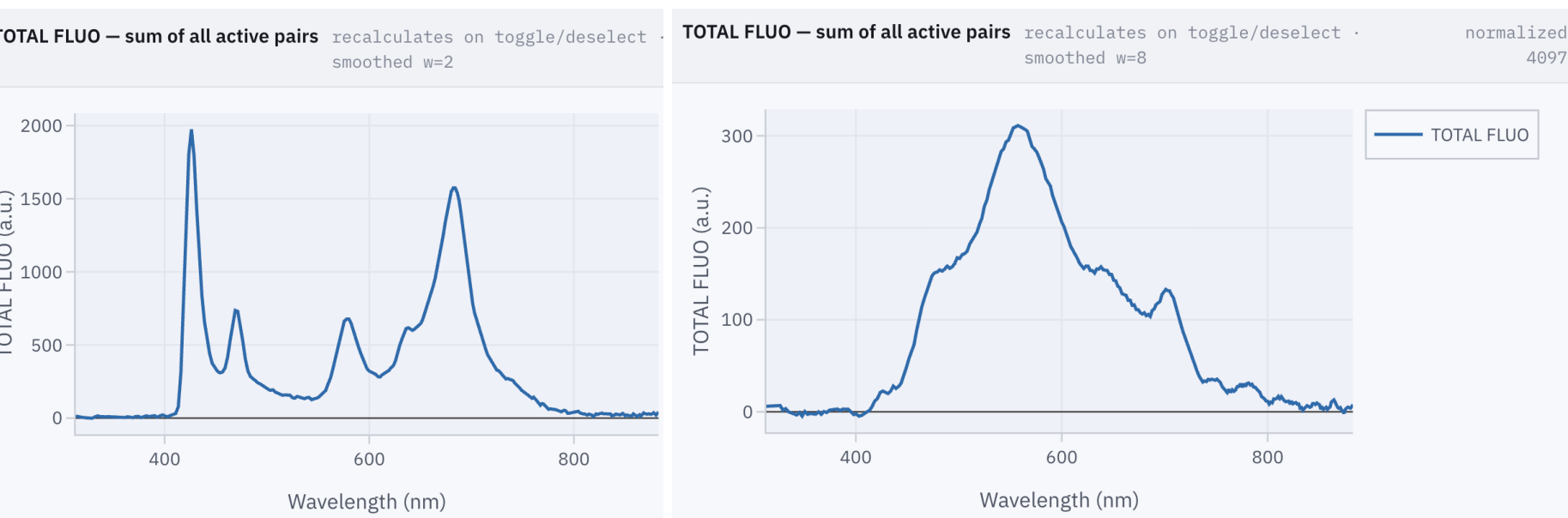
Oil-in-water, petroleum
Surface films and in-water emulsions

HOW IT WORKS — FLUORESCENCE SPECTRUM

Lake Parentis, Bordeaux, August 2026. The 405 nm laser produces fluorescence and scattered light, recorded in 288 bands from 400 to 880 nm. Spectral features identify contributions from Raman, CDOM, TSM, and chlorophyll a. Signals are to be normalized by water Raman to calculate concentrations.

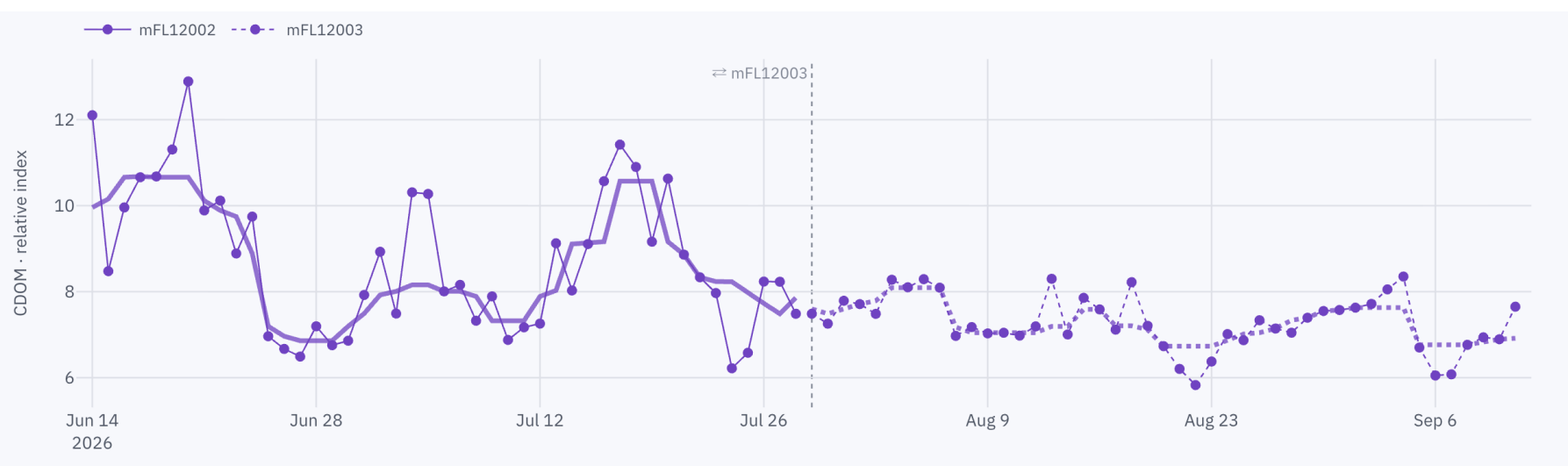


FIELD RESULTS — FLUO SPECTRA

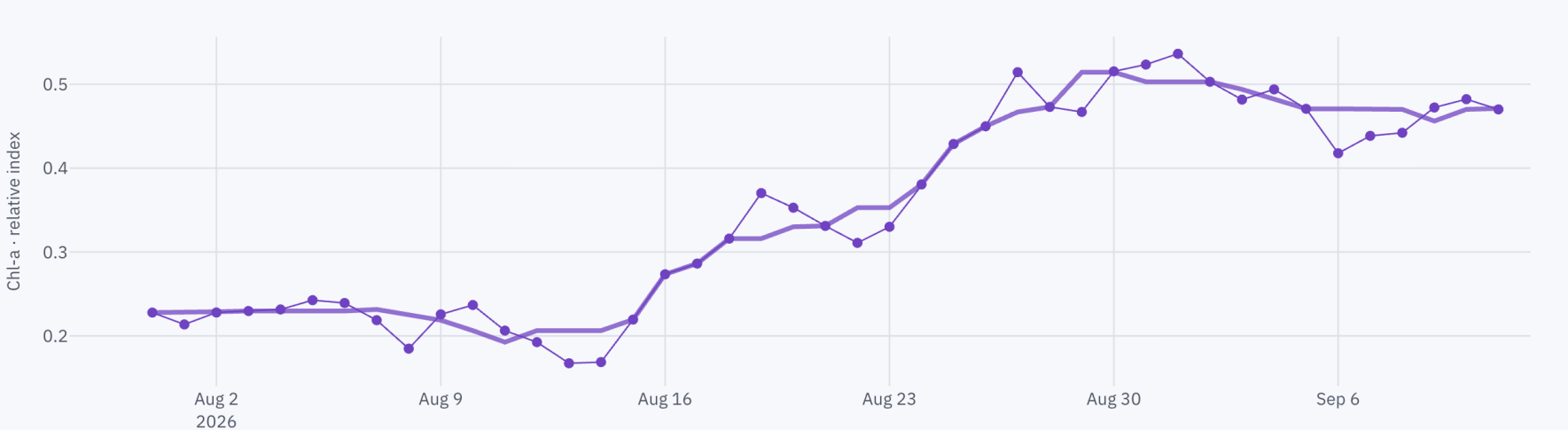


Left plot: Laboratory measurements calibration, *Cyanobium* sp. (experiment #86613, 19/08/2026); Right plot: Fluorescence spectra obtained from Balaton Lake waters (experiment #85490, 12/08/2026)

Continuous measurements show pronounced temporal variability in fluorescence. At Dordogne River (CDOM, upper plot), short-term and intraday fluctuations are observed, partly driven by tidal cycles. Lake Parentis (Chl_a, lower plot) shows complementary variability under lacustrine conditions.



Dordogne River — CDOM fluorescence



Parentis — Chl_a fluorescence

mHR.2

micro Hyperspectral Radiometer

MICRO HYPERSPECTRAL RADIOMETER

Measures water color near the surface for comparison with satellite data. One rotating optical head in a single housing records downwelling irradiance (Ed), sky radiance (Ls) and sea-surface radiance (Lt) in sequence, then takes a dark current reading. Calculates remote-sensing reflectance (Rrs). Designed for boats, platforms, piers, etc. Network or standalone.



1
SPECTROMETER for ED, LS, LT

0.9 kg
MASS

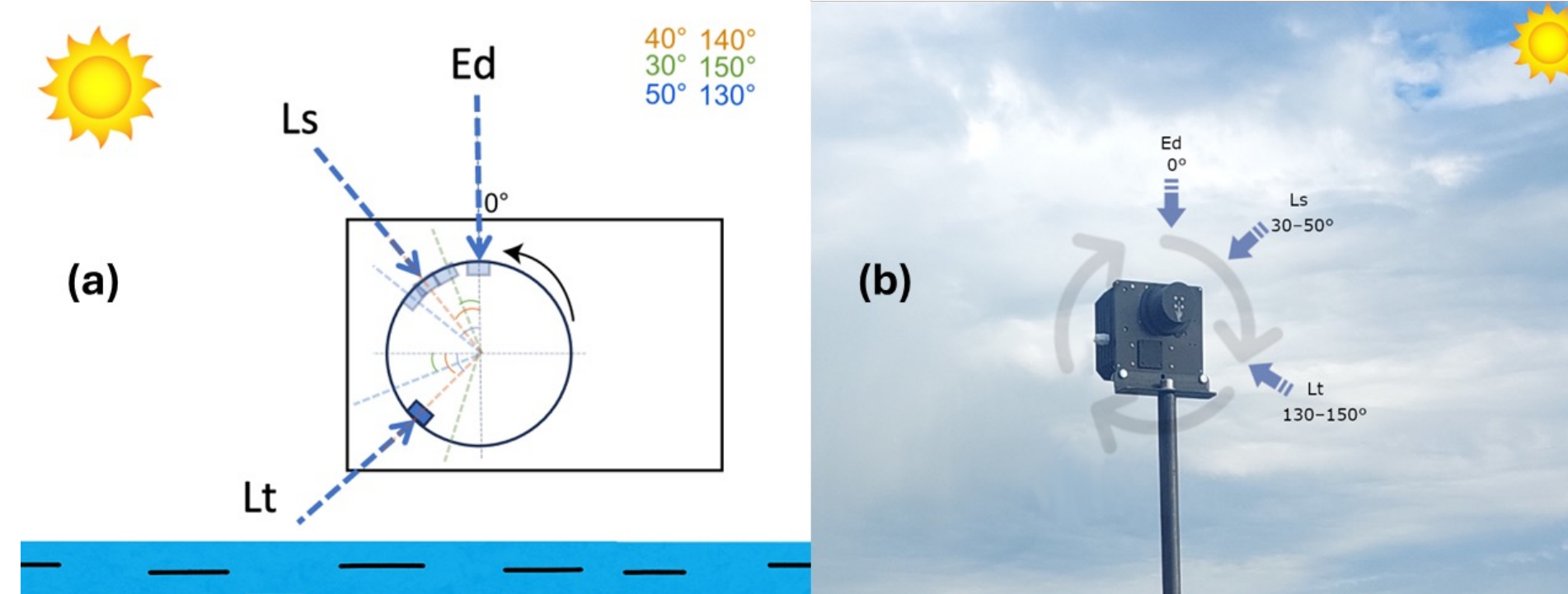
10 W
PEAK POWER

288
SPECTRAL BANDS 320–880 NM

IP68
MARINE GRADE

MEASUREMENT PRINCIPLE

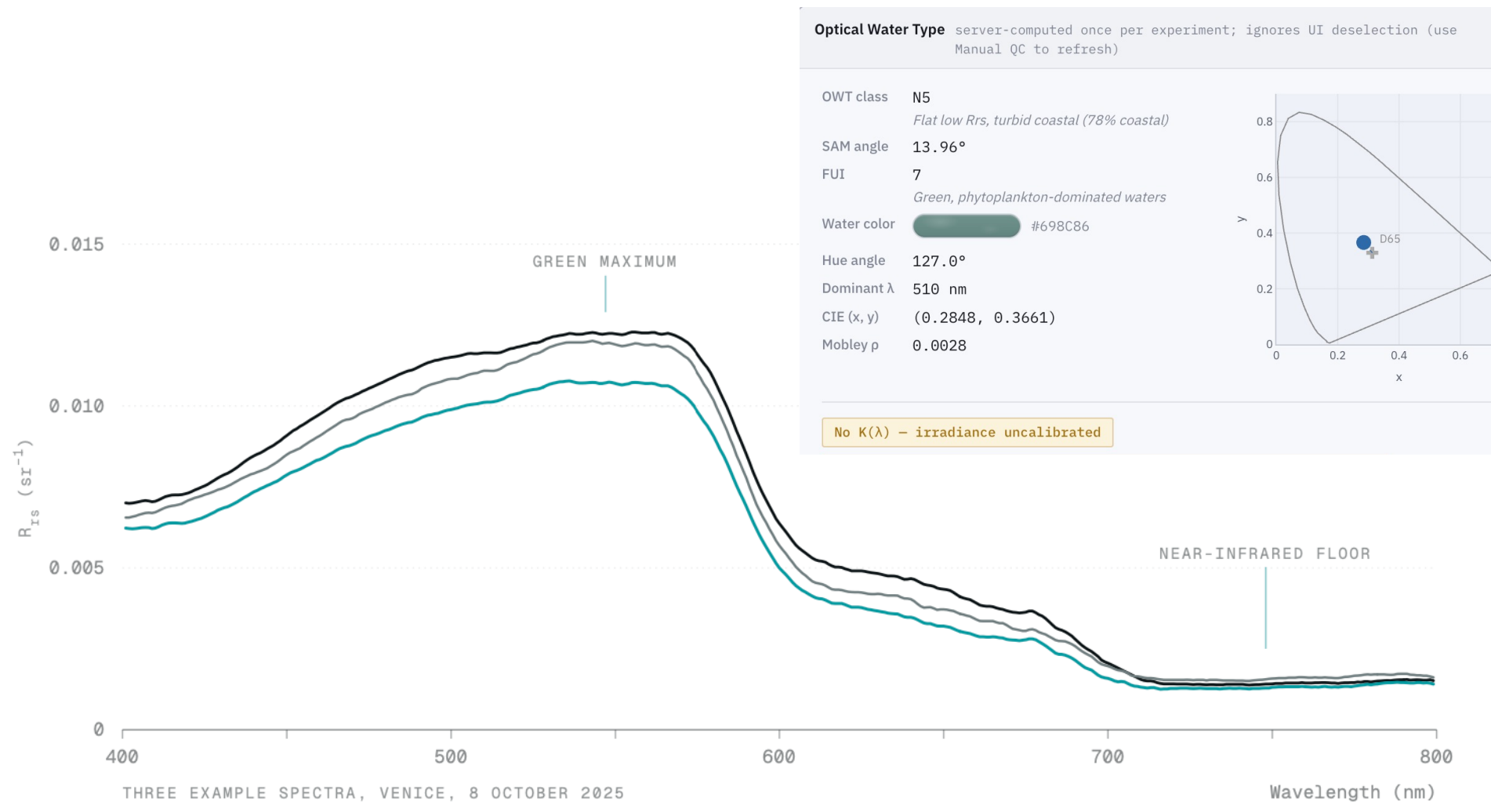
To calculate reflectance, the instrument measures Ed, Ls, and Lt. One motorised head records all three in sequence, then takes a dark reading. GPS records the location, IMU records orientation, and a camera captures the scene during the sequence.



(a) Schematic representation of the operating principle of the mHR.2 instrument, showing the measurement geometry and sensor viewing angles. (b) Photograph of the operational arrangement during the field campaign in Venice, 8 October 2025.

FIELD RESULTS — REFLECTANCE SPECTRA

Venice
Three example Rrs spectra, ESA PHY2FLEX campaign, Venice, 8 October 2025.
Each calculated from Ed, Ls and Lt spectra of one cycle. OWT N5 — flat low Rrs, turbid coastal waters; FUI 7; water colour: green.



Villefranche-sur-Mer
Three example Rrs spectra, mHR and mFL field validation, Villefranche-sur-Mer, France, May 2026.
Each calculated from Ed, Ls and Lt spectra of one cycle. OWT N18 — highest blue Rrs, monotonically decreasing coastal waters; FUI 3; water colour: blue.

