1. Les mesures **HYPERNETS**
(3 stations en France : Berre, Gironde et Rhône)
distribuées sur zenodo et leur exploitation scientifique

2. Les mesures **HyperBOOST**
(eaux côtières européennes)

D.Doxaran et al. LOV

Réunion du GT hyperspectral/ODATIS

H2020-HYPERNETS (R&D), 2018-2023

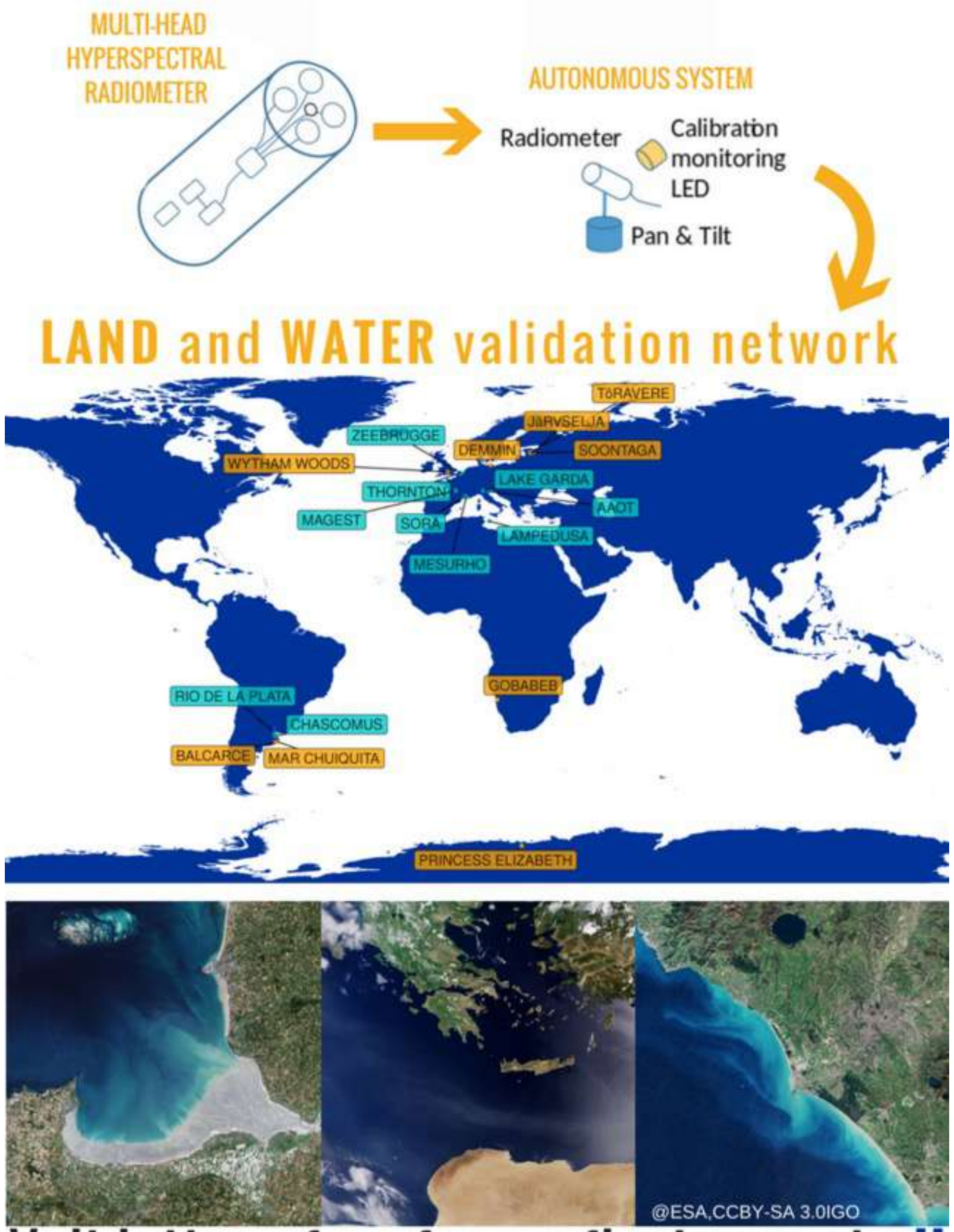
- Un nouveau radiomètre hyperspectral ‘low-cost’
- Un système opératoire autonome
- Un réseau international mis en place (surfaces aquatiques et terrestres) pour la validation de la réflectance de surface (toutes missions satellitaires)

ESA-HYPERNET-POP (operation), 2023-2027

- Maintenance de 1 à 3 sites par partenaire
- Validation des réflectances de surface
- Distribution des données

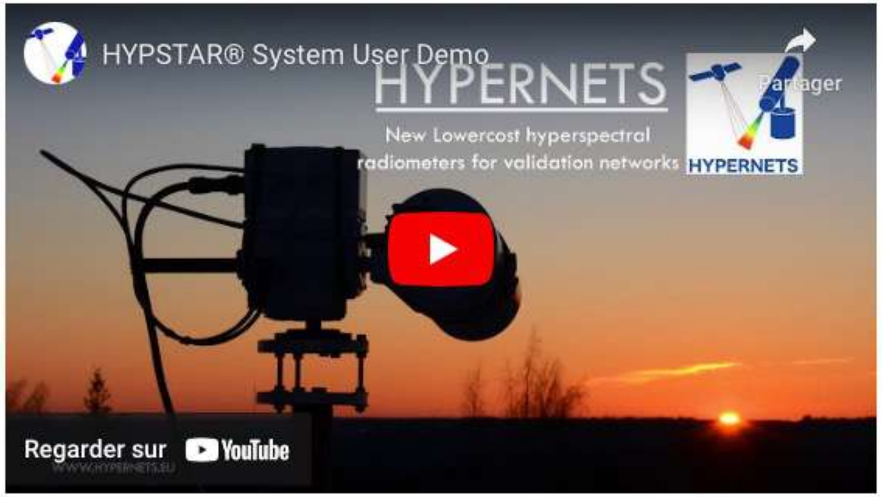
Consortium:

RBINS, TARTU, LOV, NPL, CONICET, CNR, GFZ



Validation of surface reflectance at all spectral bands of all optical missions

Commercialisation en 2025 par la société RSware : https://hypstar.eu

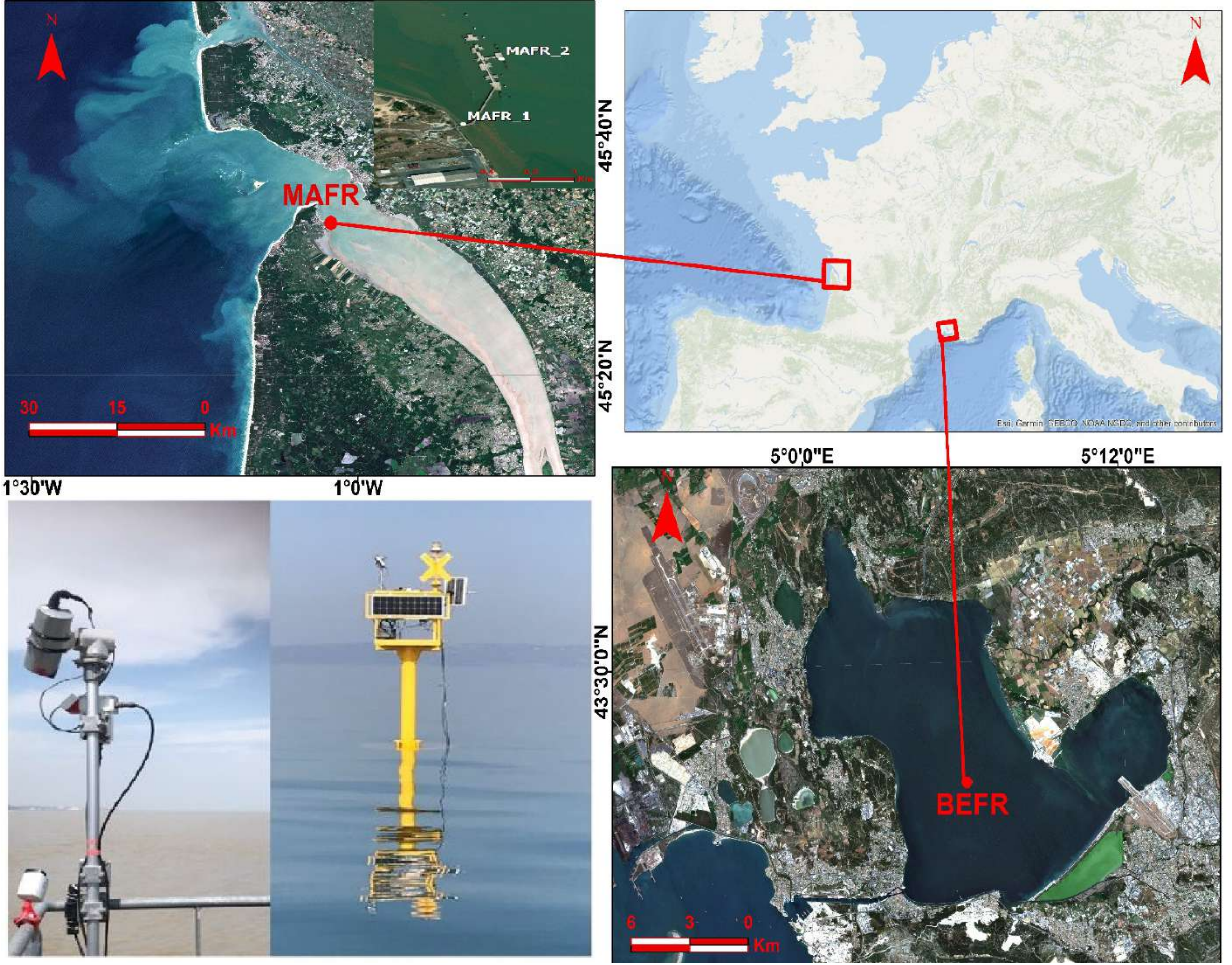


Parameter	HYPSTAR-SR radiometer
Measured quantity	Radiance and irradiance (multiplexed)
Field of view	2° (radiance), 180° (irradiance)
Detector array	2048 px Si
Spectral range	380 ... 1020 nm
Spectral sampling interval	0.5 nm
Spectral resolution	3 nm
ADC resolution	16 bit
Integration time	1...65535 ms
Shutter	Internal
Target camera	5 Mpx, RGB
Communication interface	RS485, half duplex, 115.2 ... 8000 kbps
Housing material	Anodised marine grade aluminium
Dimensions (DxL)	ø110.3 x 267 mm
Weight	1.5 kg
Power supply	8 ... 18 V DC, 0.5 A
Environmental protection	IP67
Operating temperature	-25 ... +45 °C
Storage temperature	-35 ... +70 °C

HYPERNETS data:

- Center of the optically complex **Berre coastal lagoon** (SE France) (phyto. Blooms, river discharge): <u>HYPERNETS system v1>v3</u> in operation (every 30 mn) since February 2021

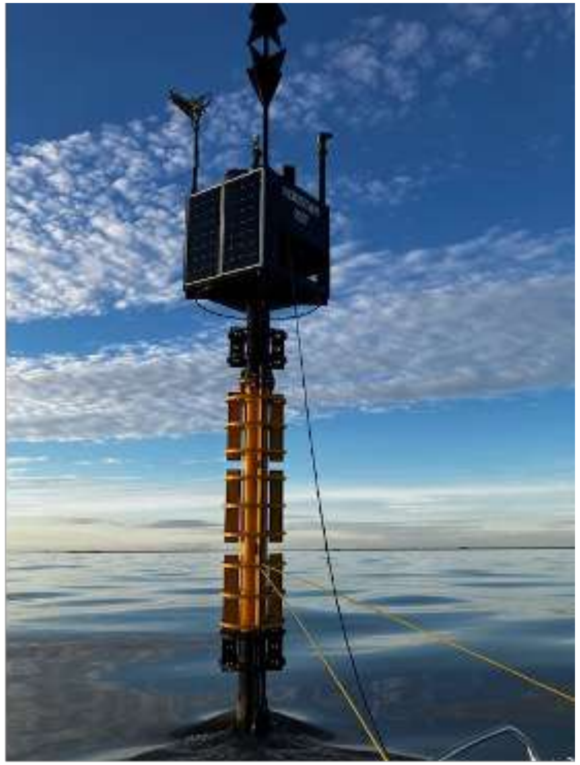
- Mouth of the highly turbid **Gironde Estuary** (SW France): <u>HYPERNETS system v2</u> in operation (every 15 mn) since November 2021



En France, 3 sites aquatiques : lagune côtière, estuaire et embouchure de fleuve

New HYPERNETS data:

➢ **Mouth of Rhône River** (SE France) (river discharge): <u>HYPERNETS system v3</u> in operation (every 30 mn) since December 2023



Multi-sensor cientific platform (IFREMER, LSCE):
Wind, rain,
T, S, Turb, Fluo,
ADCP,
sediment traps

Séquence de mesures standard : 3 E_d, 3 L_s, 6 L_u, 3 E_d (Mobley 1999) puis transfert et QC ➔ Rw

Distribution de jeux de données initiaux (15 sites) : zenodo

cf emails A

zenodo | hypernets | Communities | My dashboard | Log in | Sign up

15 result(s) found

Sort by: Best match

Versions

View all versions

Access status

- Open 15

Resource types

- Dataset 14
- Lesson 1

Subjects

- HYPSTAR 9
- hyperspectral 9
- satellite validation 9
- multi-angular 6
- optical properties 6
- environment 5

June 19, 2023 (1.2) | Dataset | Open

Initial Sample of HYPERNETS Hyperspectral Water Reflectance Measurements for Satellite Validation from the LPAR site (Argentina)

Dogliotti, Ana I.; Piegari, Estefania; Rubinstein, Lucas; and 1 other

The HYPERNETS project (www.hypernets.eu) has the overall aim to ensure that high quality in situ measurements are available to support the (VNIR/SWIR) optical Copernicus products. Therefore, it established a new autonomous hyperspectral spectroradiometer (HYPSTAR® - www.hypstar.eu) dedicated to land and water surface reflectance validation with ...

Uploaded on June 19, 2023 — 46 views, 5 downloads

June 19, 2023 (v1.2) | Dataset | Open

Initial Sample of HYPERNETS Hyperspectral Water Reflectance Measurements for Satellite Validation at the mouth of the Gironde Estuary, MAFR site (France)

Doxaran, David; Corizzi, Alexandre

The HYPERNETS project (www.hypernets.eu) has the overall aim to ensure that high quality in situ measurements are available to support the (VNIR/SWIR) optical Copernicus products. Therefore, it established a new autonomous hyperspectral spectroradiometer (HYPSTAR® - www.hypstar.eu) dedicated to land and water surface reflectance validation with ...

Uploaded on June 19, 2023 — 42 views, 7 downloads

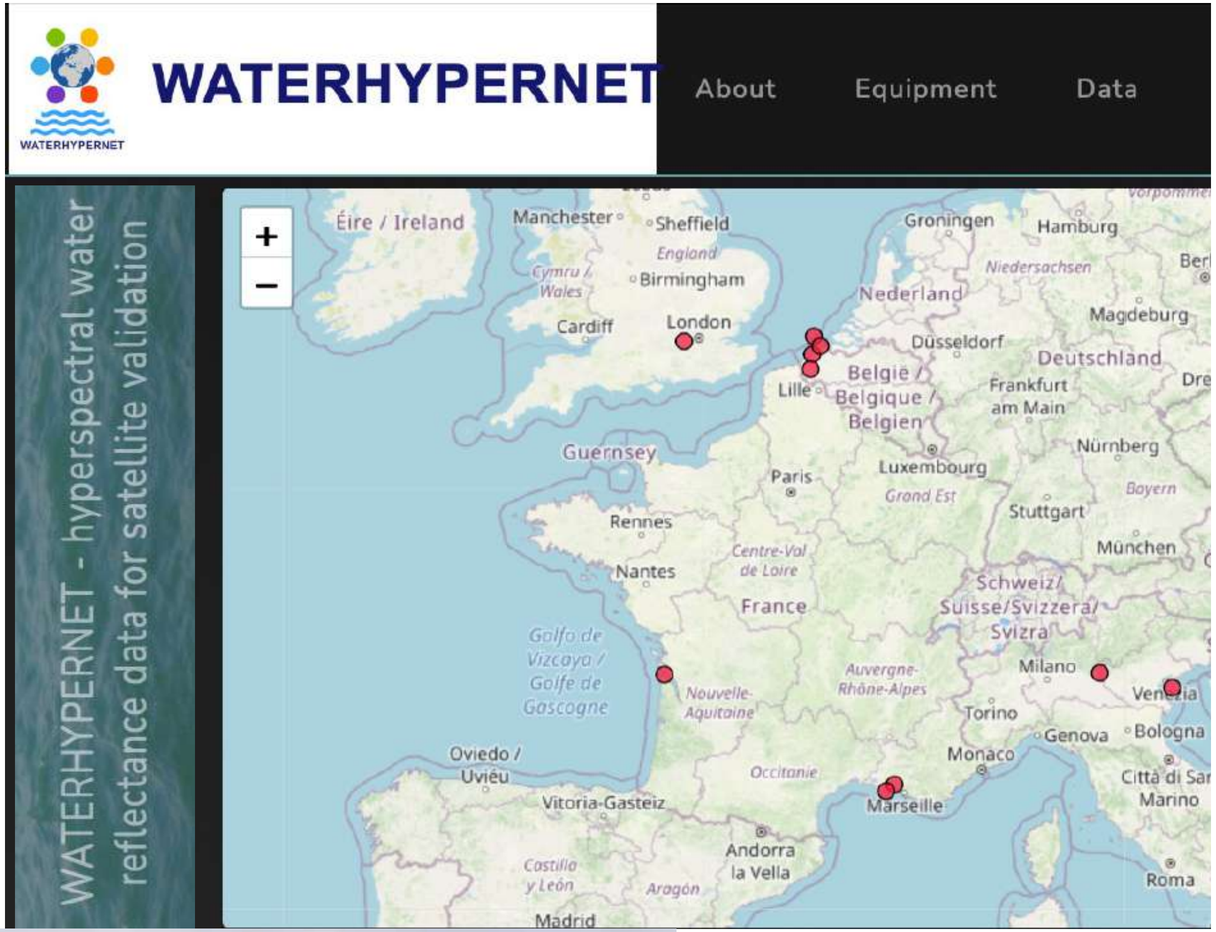
June 19, 2023 (v1.2) | Dataset | Open

Initial Sample of HYPERNETS Hyperspectral Water Reflectance Measurements for Satellite Validation at Lake Garda, GAIT site (Italy)

Brando, Vittorio; Gonzalez Vilas, Luis; Bresciani, Mariano; and 3 others

The HYPERNETS project (www.hypernets.eu) has the overall aim to ensure that high quality in situ measurements are available to support the (VNIR/SWIR) optical Copernicus products. Therefore, it established a new autonomous hyperspectral spectroradiometer (HYPSTAR® - www.hypstar.eu) dedicated to land and water surface reflectance validation with ...

Uploaded on June 19, 2023 — 56 views, 6 downloads



2 types de systèmes :
Le **HYPSTAR** et le **PANTHYR**
PI : K. Ruddick (RBINS)

frontiers | Frontiers in Remote Sensing

Submission
Submission closed

Sections

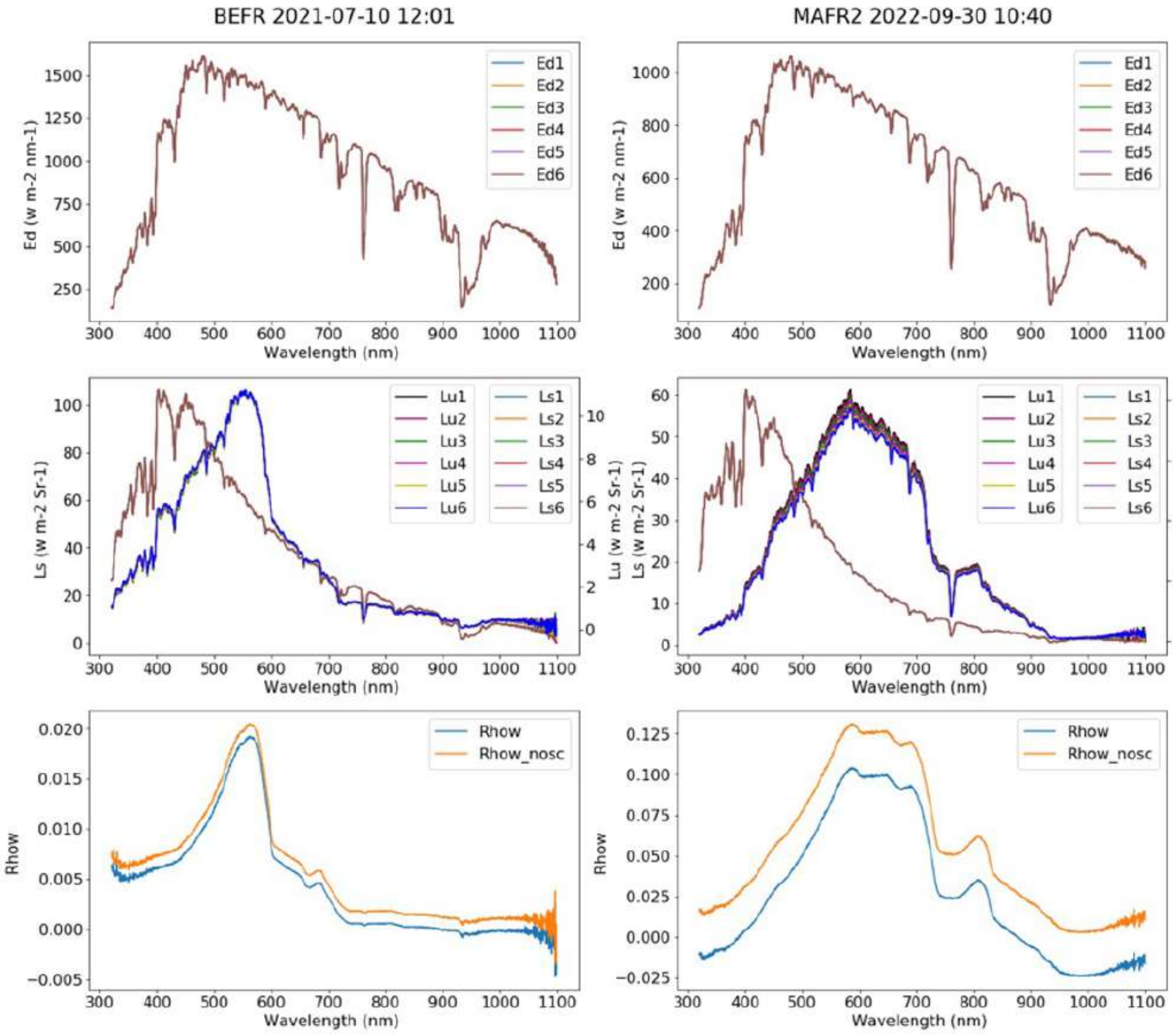
SUBMISSION CLOSED

Optical Radiometry and Satellite Validation

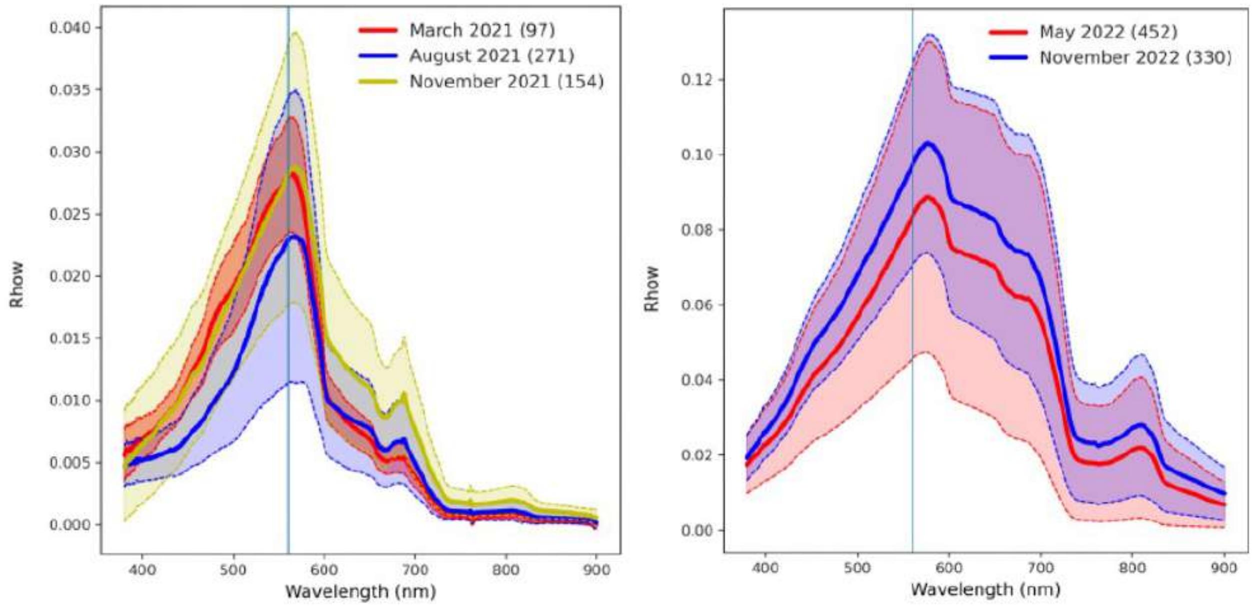
Agnieszka Bialek · David Doxaran · Vittorio Ernesto Brando · Clemence Goyens · Kevin Ruddick · Ana Ines Dogliotti

5,632 views 11 articles

Mesures HYPERNETS : sites aquatiques

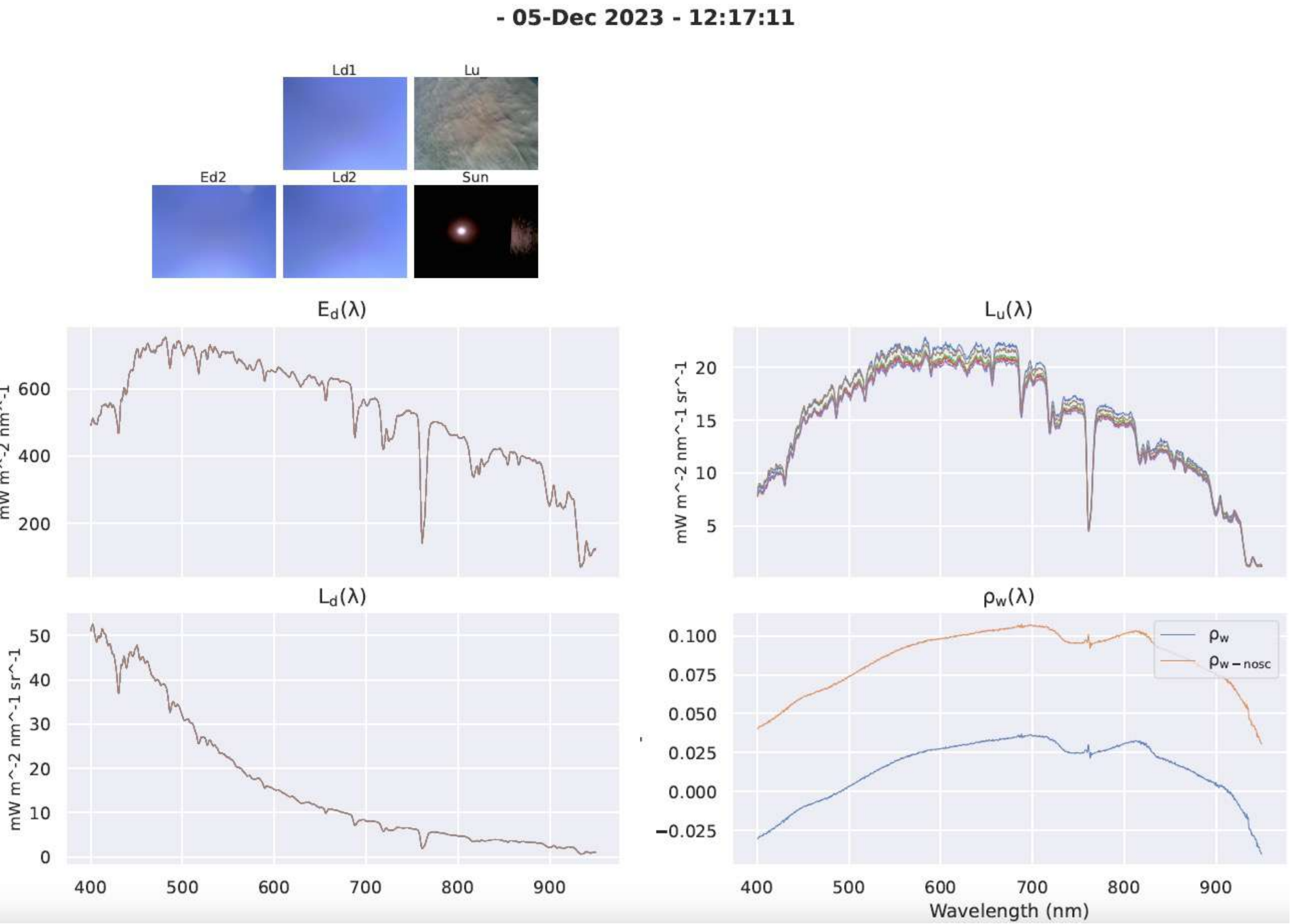


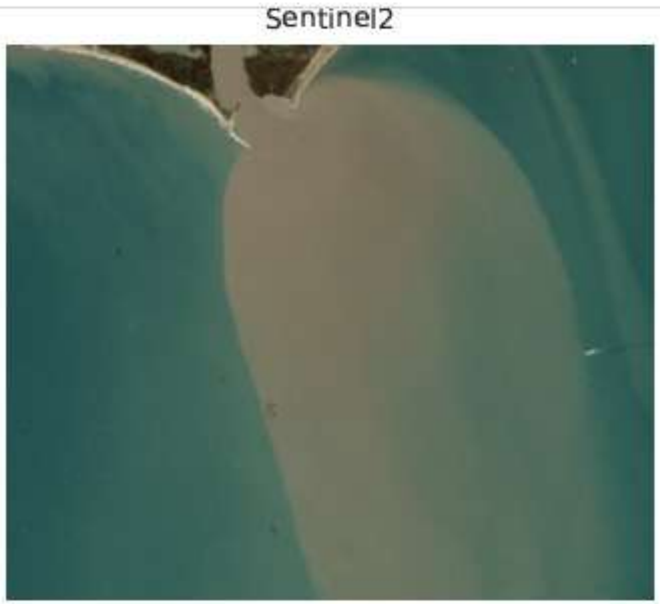
Berre et Gironde



Doxaran et al. (2023)

Mesures HYPERNETS : sites aquatiques

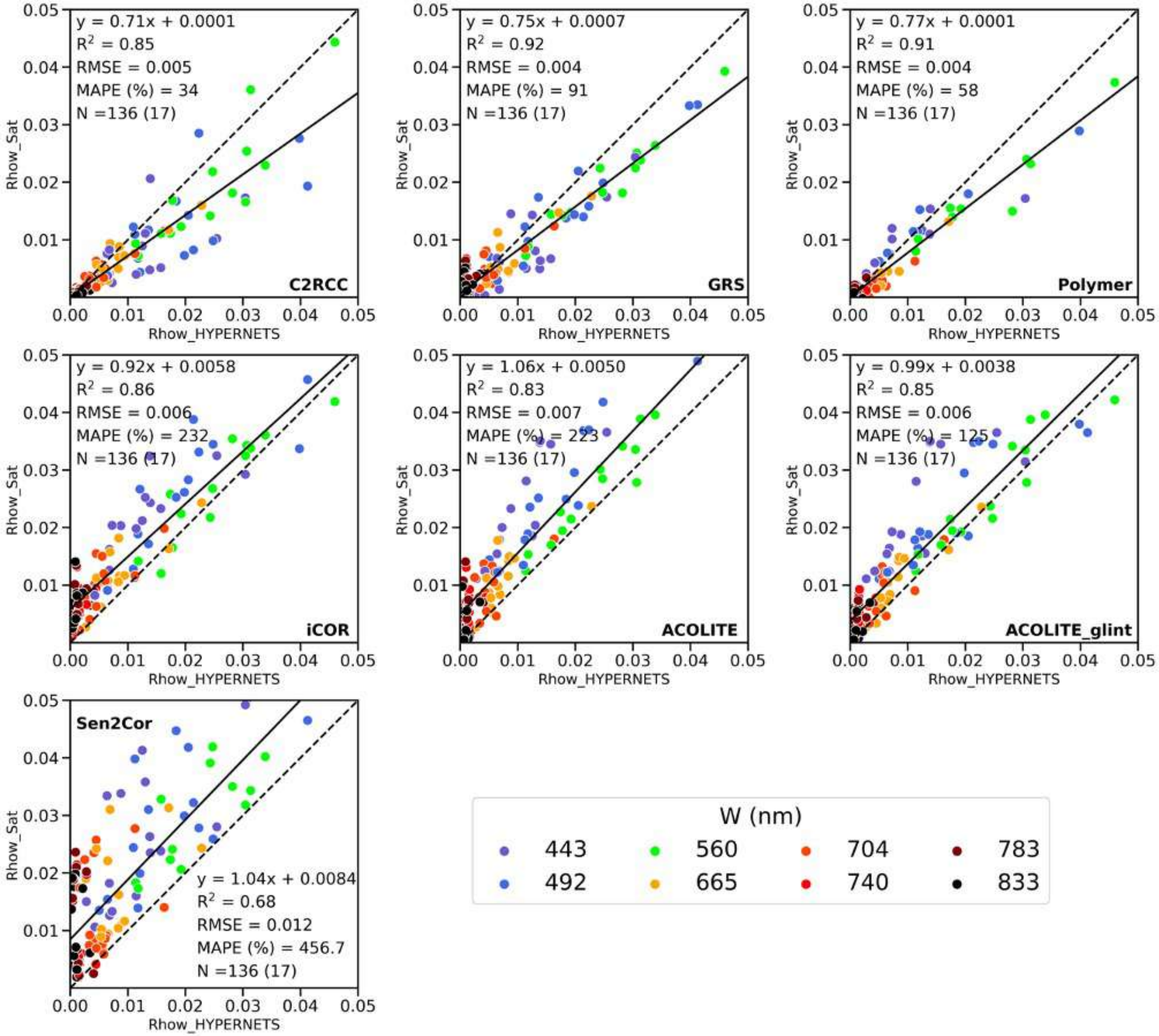




Results:

Seawater reflectance retrieval

S2-MSI, Berre



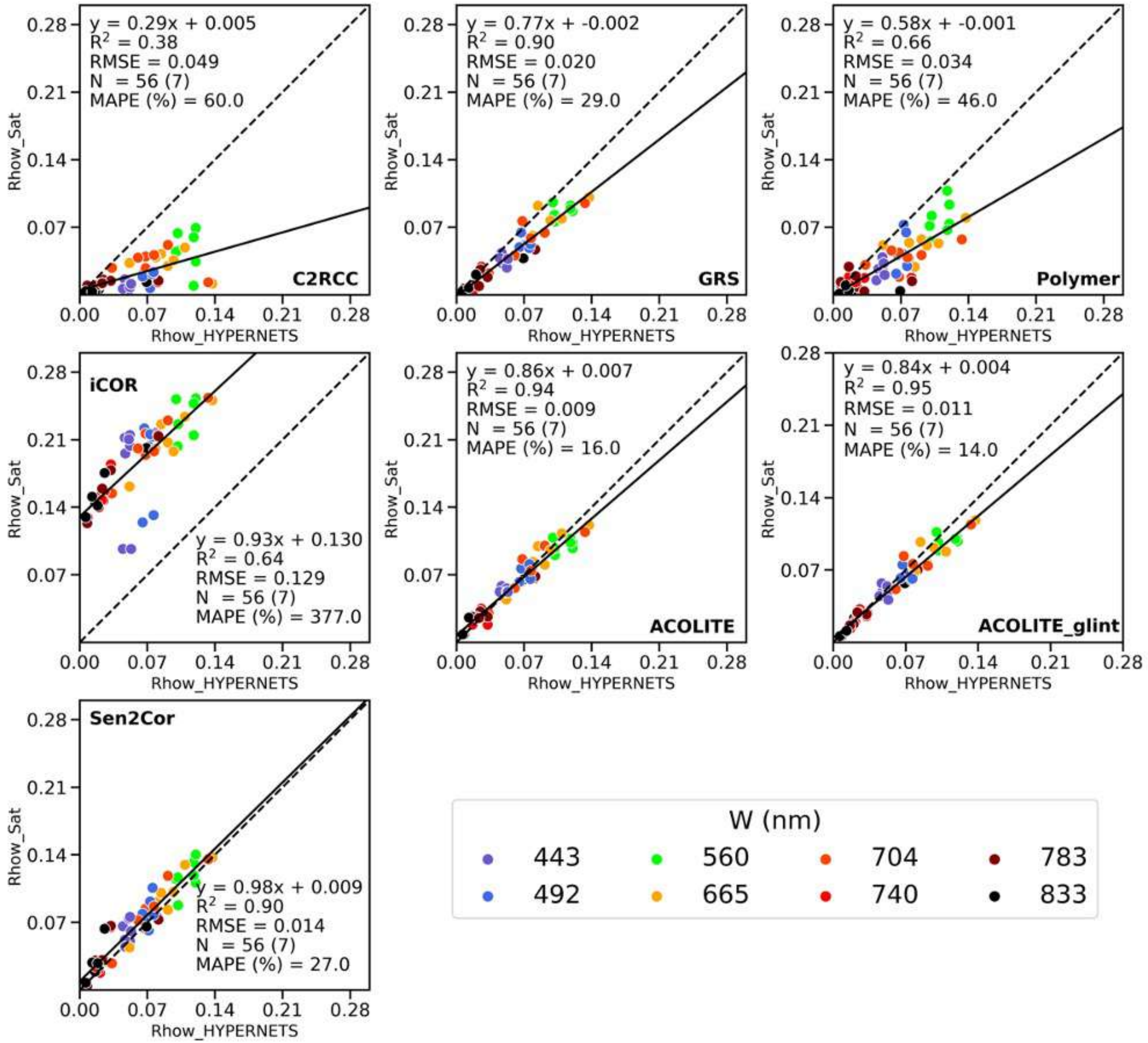
Doxaran et al. (2023)

Results:

validation of atmospheric corrections

S2-MSI

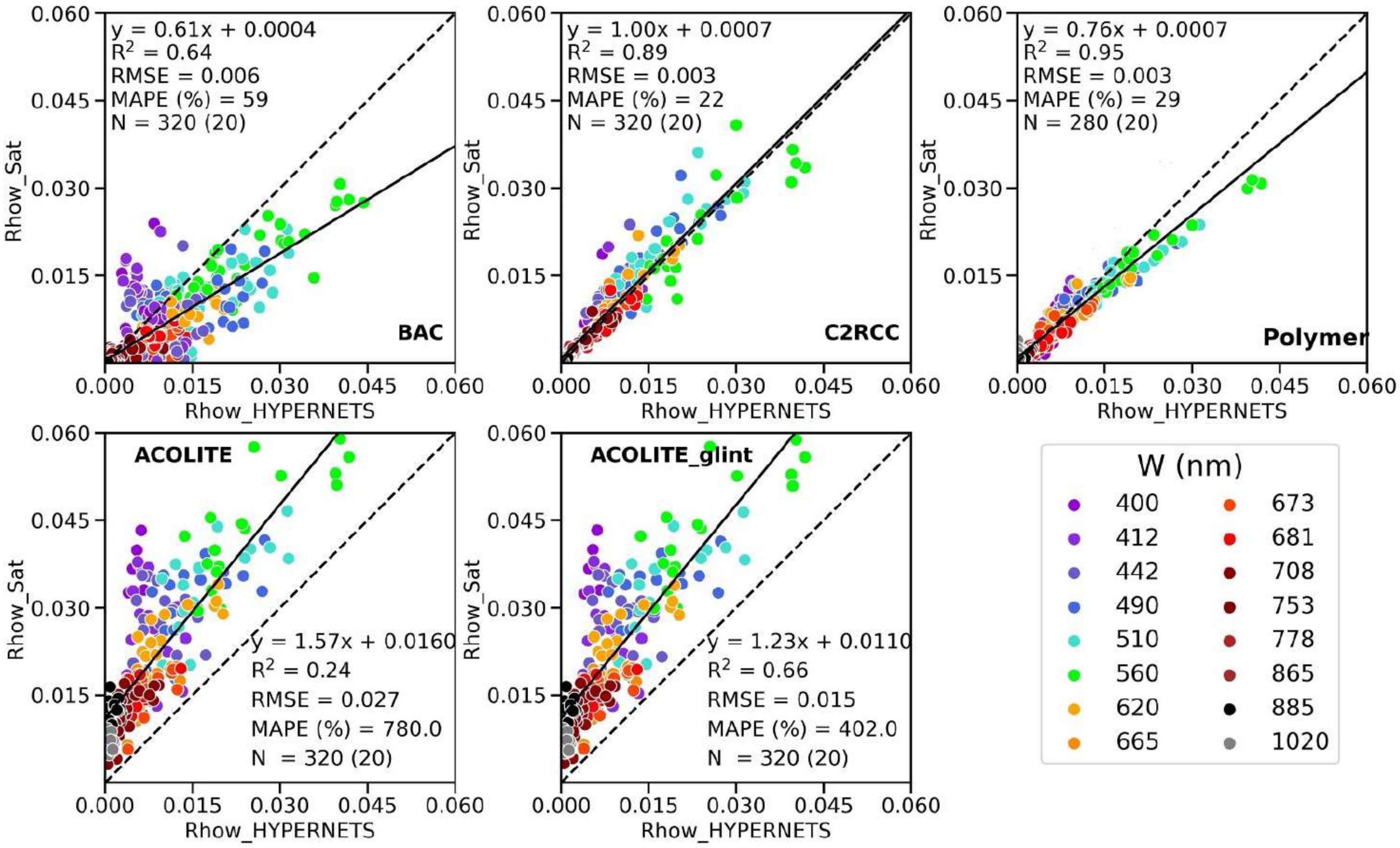
Gironde



Doxaran et al. (2023)

Results: Seawater reflectance retrieval

S3-OLCI
Berre



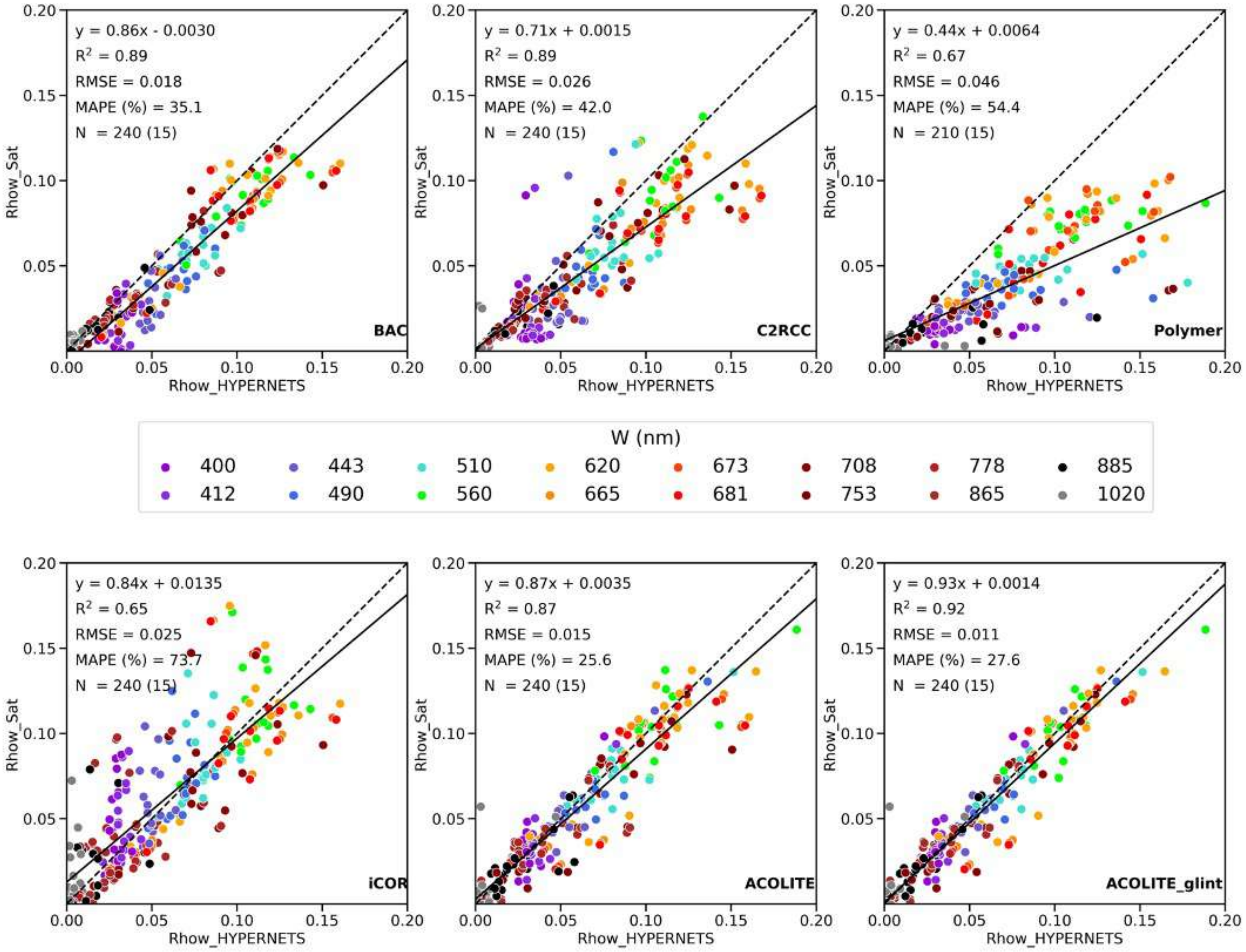
Doxaran et al. (2023)

Results:

Seawater reflectance retrieval

S3-OLCI

Gironde

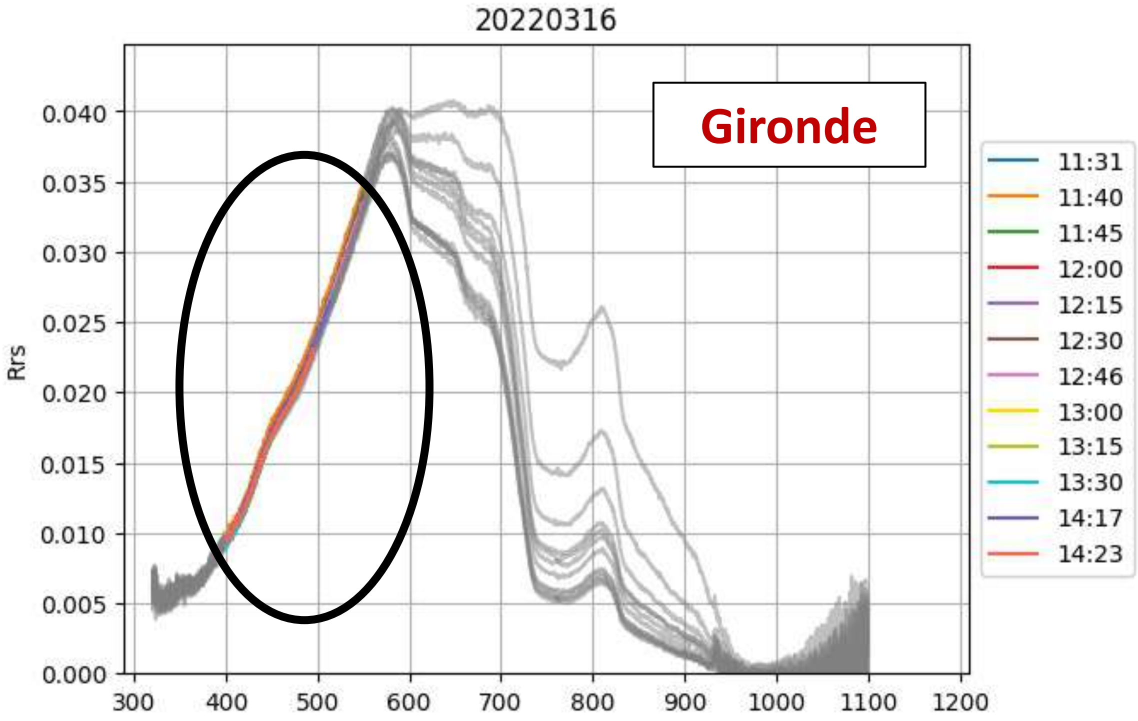


Doxaran et al. (2023)

Research Article | Vol. 26, No. 8 | 16 Apr 2018 | OPTICS EXPRESS 10435
Optics EXPRESS

Saturation of water reflectance in extremely turbid media based on field measurements, satellite data and bio-optical modelling

YAFEI LUO,[1,2,3] DAVID DOXARAN,[3,7] KEVIN RUDDICK,[4] FANG SHEN,[5] BERNARD GENTILI,[6] LIWEN YAN,[1] AND HAIJUN HUANG[1,2,8]



Seul le rapport $b_{bp}{}^*(\lambda_i)/a_p{}^*(\lambda_i)$ peut être extrait au niveau des bandes spectrales saturées….?

Water reflectance model (IOPs)

solvo

$$\begin{cases} \omega_b(\lambda) = \dfrac{b_b(\lambda)}{a(\lambda) + b_b(\lambda)} \\ \eta_b(\lambda) = \dfrac{b_{bw}(\lambda)}{b_b(\lambda)} \end{cases}$$

$$\begin{cases} a(\lambda) = a_w(\lambda) + a_p(\lambda) + a_\phi(\lambda) \\ b(\lambda) = b_{bw}(\lambda) + b_{bp}(\lambda) + b_{b\phi}(\lambda) \end{cases}$$

➔ SPM-dominated waters (NAP and phytoplankton)

$$\begin{cases} a_p(\lambda) = a_p^*(\lambda) * TSM \\ b_{bp}(\lambda) = b_{bp}^*(\lambda) * TSM \end{cases}$$

$$b_{bp}^*(\lambda) = b_{bp0}^* \left(\frac{\lambda}{\lambda_b}\right)^{-\gamma}$$

$$a_p^*(\lambda) = \left(a_{p0}^* - a_{p\infty}^*\right) * e^{-S(\lambda - \lambda_a)} + a_{p\infty}^*$$

$$\begin{cases} a_\phi(\lambda) = a_\phi^*(\lambda) * Chl \\ b_{b\phi}(\lambda) = b_{b\phi}^*(\lambda) * Chl \end{cases}$$

with Chla-specific coefficients fixed from litetrature

& Pure water coefficients from litterature

Water reflectance model

solvo

$$R_{rs}(\lambda, \theta_{\mathrm{s}}, \theta_{\mathrm{v}}, \Delta\phi) = \sum_{i=1}^{4} g_i(\theta_{\mathrm{s}}, \theta_{\mathrm{v}}, \Delta\phi, \eta_b)\left(\omega_b(\lambda)\right)^i$$

$$R_{rs}(\lambda) = 0.529 * 0.197 * \left(1 - 0.636e^{-2.552\,\omega_b(\lambda)}\right) * \omega_b(\lambda)$$

Lee et al. (2004)
or considering BRDF LUTs (Park and Ruddick 2005)

Saturation regime

solvo

$$\begin{cases} \breve{\omega}_b(\lambda) = \dfrac{b^*_{bp}(\lambda)}{a^*_p(\lambda) + b^*_{bp}(\lambda)} = \dfrac{b^*_{bp0} * \left(\dfrac{\lambda}{\lambda_b}\right)^{-\gamma}}{\left(a^*_{p0} - a^*_{p\infty}\right) * e^{-S(\lambda-\lambda_a)} + a^*_{p\infty} + b^*_{bp0} * \left(\dfrac{\lambda}{\lambda_b}\right)^{-\gamma}} \\ \breve{\eta}_b(\lambda) = 0 \end{cases}$$

As R_{rs} is almost a linear function of the wavelength (λ), only this ratio can be retrieved at saturated wavebands:

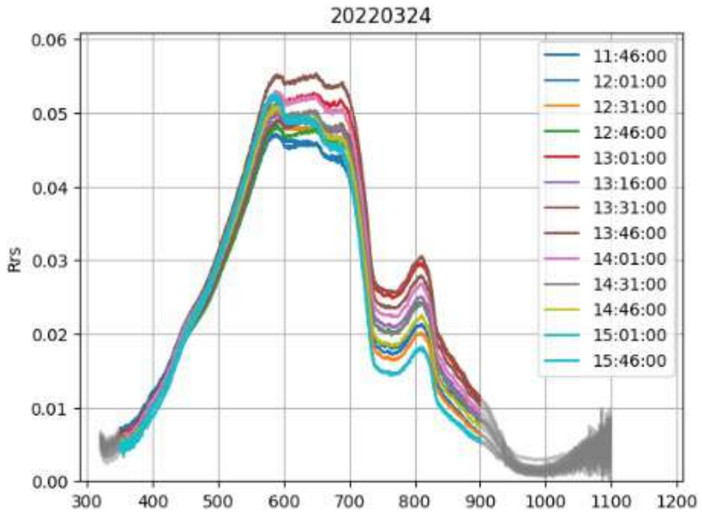
$$\frac{\breve{a}}{\breve{b}_b}(\lambda) = \frac{1 - \breve{\omega}_b(\lambda)}{\breve{\omega}_b(\lambda)} = \frac{\left(\dfrac{a^*_{p0}}{b^*_{bp0}} - \dfrac{a^*_{p\infty}}{b^*_{bp0}}\right) * e^{-S(\lambda-\lambda_a)} + \dfrac{a^*_{p\infty}}{b^*_{bp0}}}{\left(\dfrac{\lambda}{\lambda_b}\right)^{-\gamma}}$$

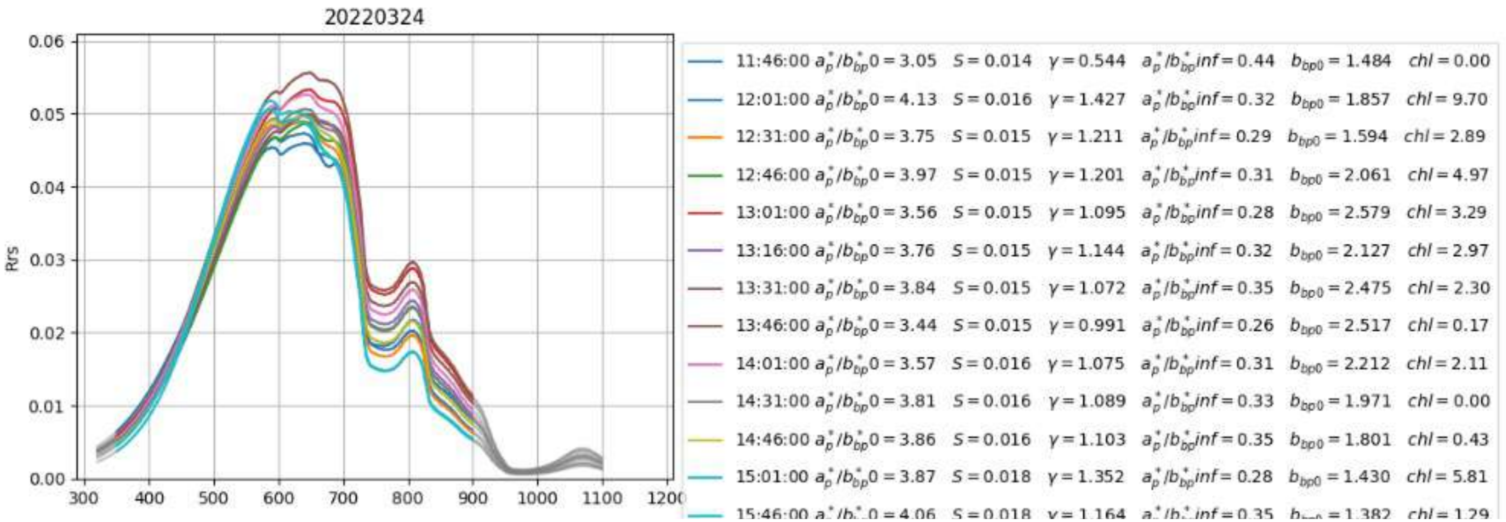
Theoretical unknows at saturated bands: $X = \left(\dfrac{a^*_{p0}}{b^*_{bp0}}, \dfrac{a^*_{p\infty}}{b^*_{bp0}}, S, \gamma\right)$

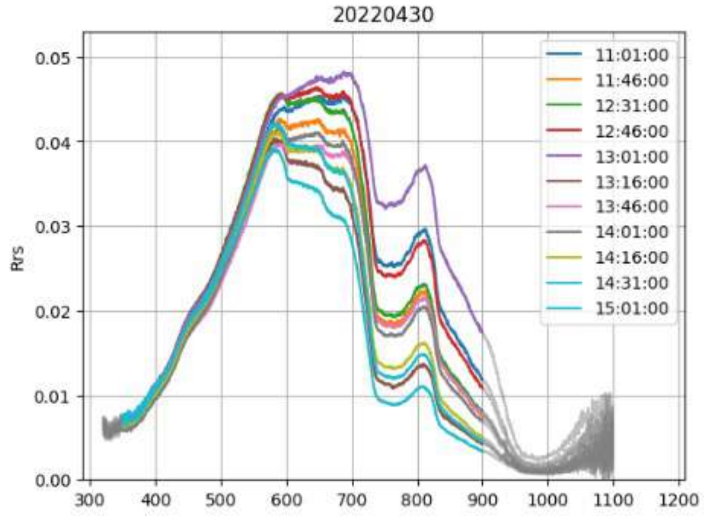
But numerical attempts have failed to retrieve robust values of these four parameters over the range of saturated bands…

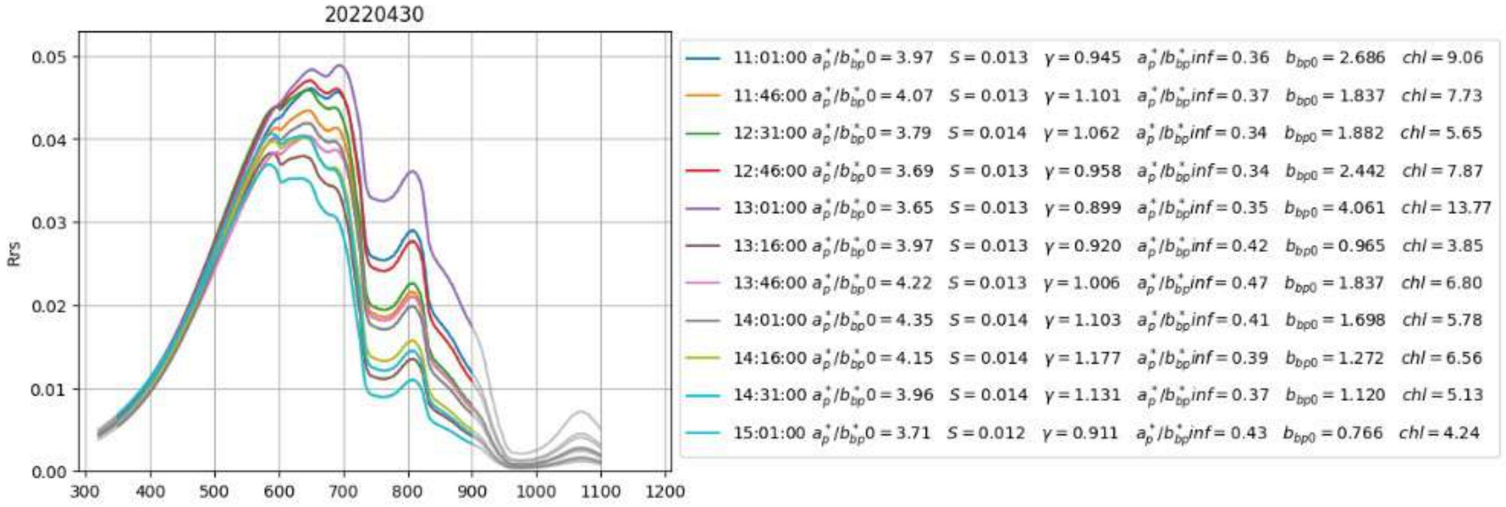
Modelling the full HYPERNETS spectra (in and out the saturation regime)

➔ *6 unknowns outside saturation:* $X = \left(\frac{a^*_{p0}}{b^*_{bp0}}, \frac{a^*_{p\infty}}{b^*_{bp0}}, b_{bp0}, S, \gamma, Chl\right)$



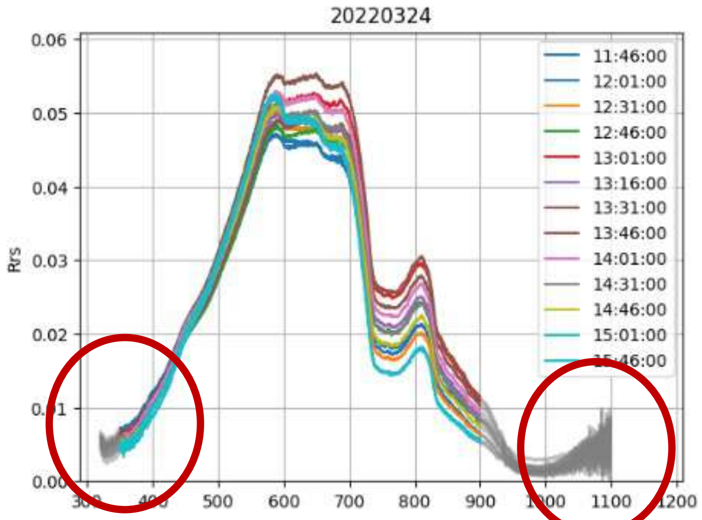


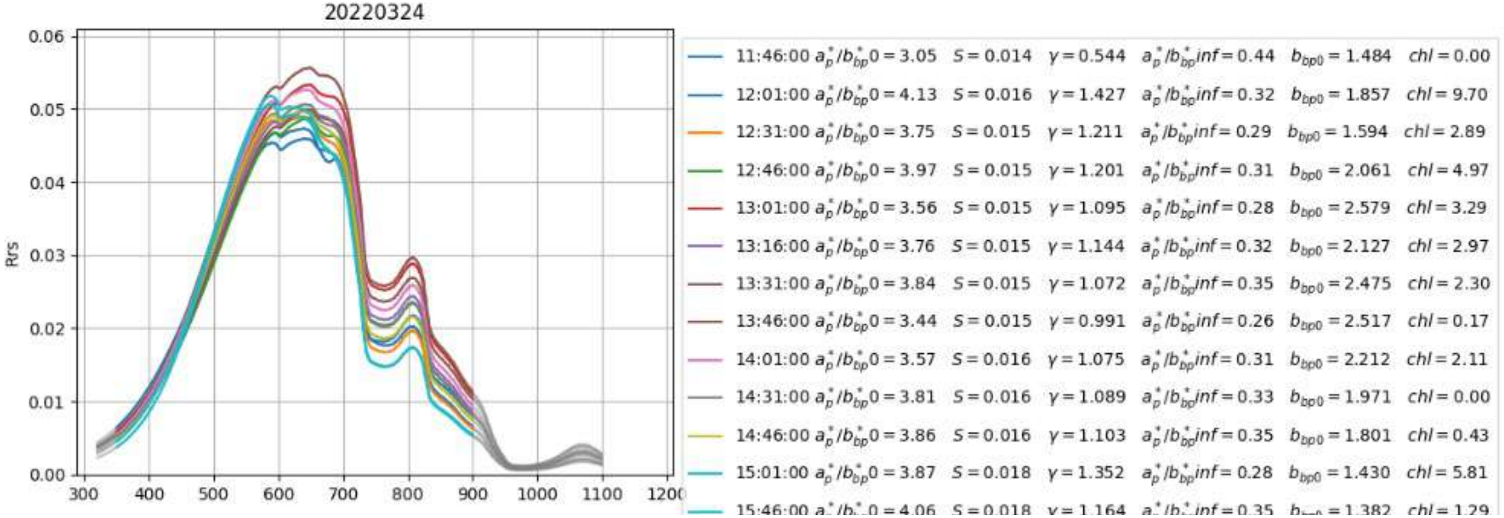


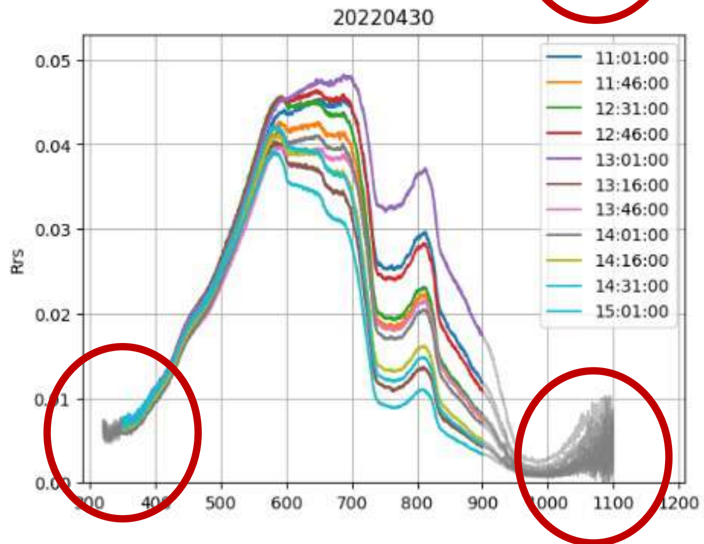


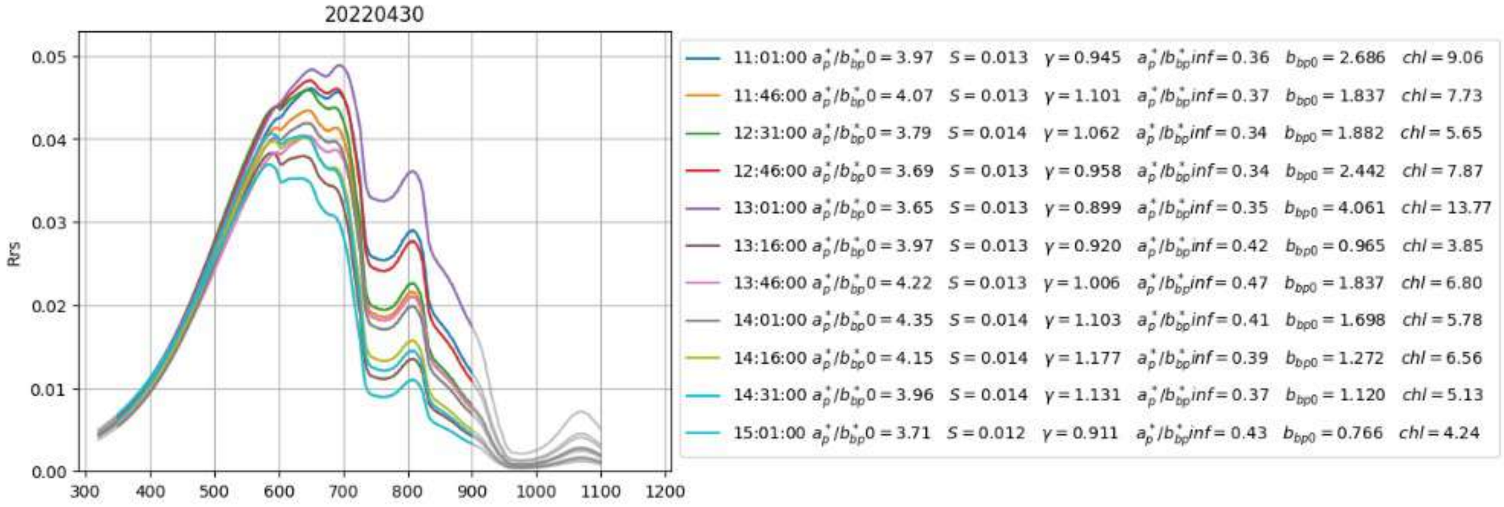
Modelling the full HYPERNETS spectra (in and out the saturation regime)

$$\rightarrow \textit{6 unknowns outside saturation: } X = \left(\frac{a^*_{p0}}{b^*_{bp0}}, \frac{a^*_{p\infty}}{b^*_{bp0}}, b_{bp0}, S, \gamma, Chl\right)$$



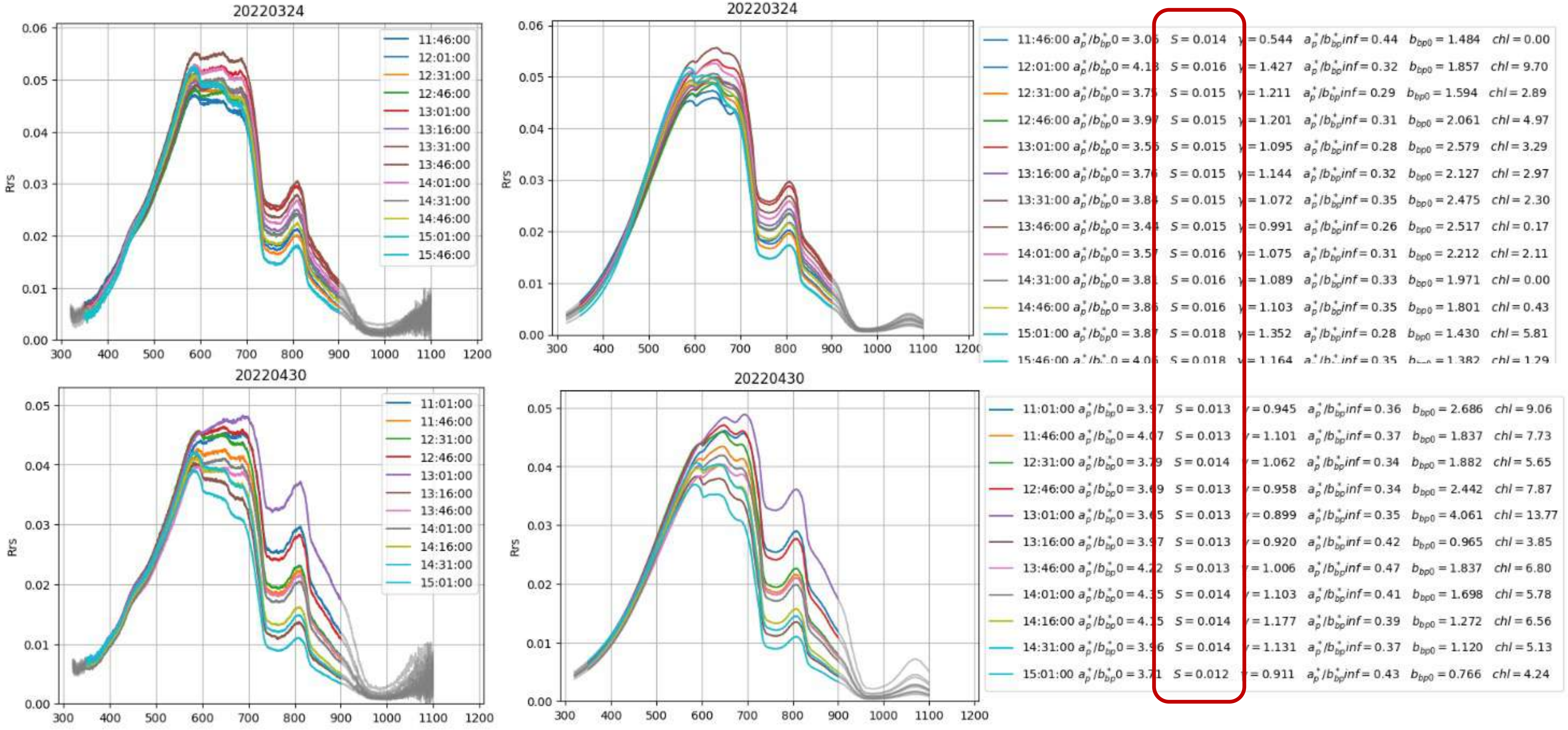






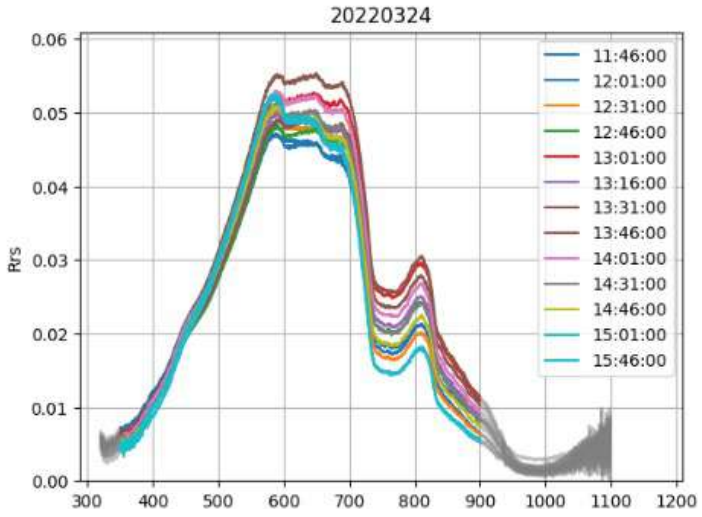
Modelling the full HYPERNETS spectra (in and out the saturation regime)

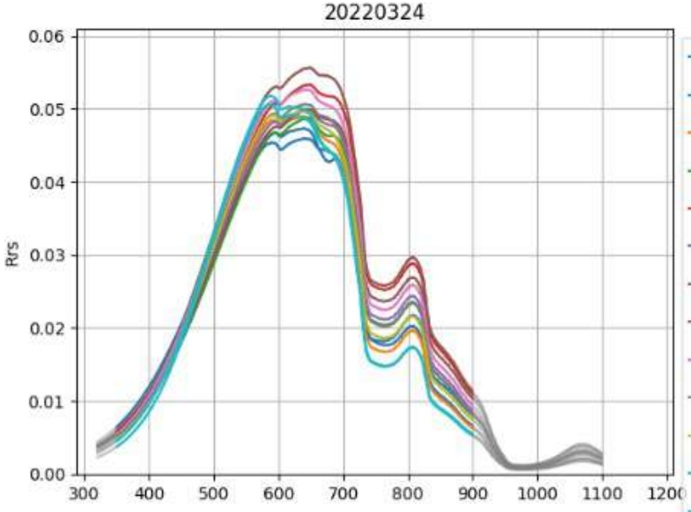
➔ *6 unknowns outside saturation:* $X = \left(\frac{a^*_{p0}}{b^*_{bp0}}, \frac{a^*_{p\infty}}{b^*_{bp0}}, b_{bp0}, S, \gamma, Chl\right)$



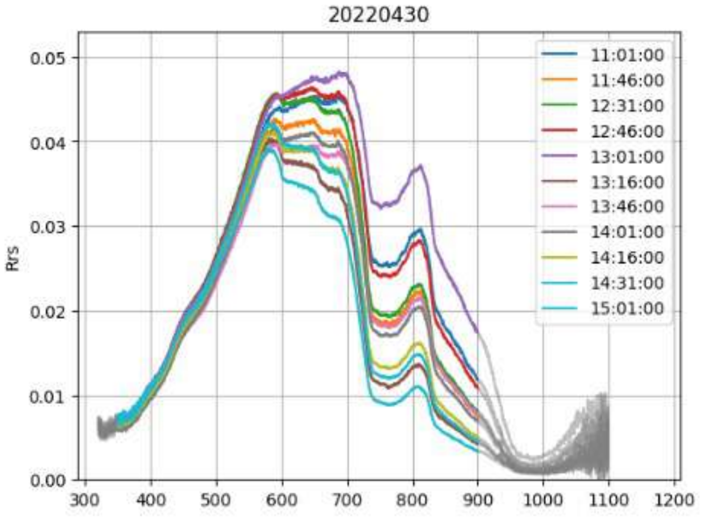
Modelling the full HYPERNETS spectra (in and out the saturation regime)

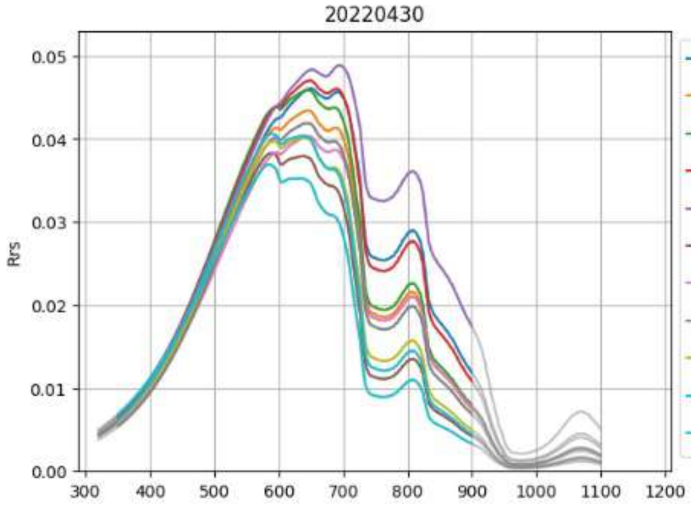
➔ *6 unknowns outside saturation:* $X = \left(\frac{a^*_{p0}}{b^*_{bp0}}, \frac{a^*_{p\infty}}{b^*_{bp0}}, b_{bp0}, S, \gamma, Chl\right)$





11:46:00	$a_p^*/b_{bp}^*0 = 3.05$	$S = 0.014$	$\gamma = 0.544$	$a_p^*/b_{bp}^*inf = 0.44$	$b_{bp0} = 1.484$	$chl = 0.00$
12:01:00	$a_p^*/b_{bp}^*0 = 4.13$	$S = 0.016$	$\gamma = 1.427$	$a_p^*/b_{bp}^*inf = 0.32$	$b_{bp0} = 1.857$	$chl = 9.70$
12:31:00	$a_p^*/b_{bp}^*0 = 3.75$	$S = 0.015$	$\gamma = 1.211$	$a_p^*/b_{bp}^*inf = 0.29$	$b_{bp0} = 1.594$	$chl = 2.89$
12:46:00	$a_p^*/b_{bp}^*0 = 3.97$	$S = 0.015$	$\gamma = 1.201$	$a_p^*/b_{bp}^*inf = 0.31$	$b_{bp0} = 2.061$	$chl = 4.97$
13:01:00	$a_p^*/b_{bp}^*0 = 3.56$	$S = 0.015$	$\gamma = 1.095$	$a_p^*/b_{bp}^*inf = 0.28$	$b_{bp0} = 2.579$	$chl = 3.29$
13:16:00	$a_p^*/b_{bp}^*0 = 3.76$	$S = 0.015$	$\gamma = 1.144$	$a_p^*/b_{bp}^*inf = 0.32$	$b_{bp0} = 2.127$	$chl = 2.97$
13:31:00	$a_p^*/b_{bp}^*0 = 3.84$	$S = 0.015$	$\gamma = 1.072$	$a_p^*/b_{bp}^*inf = 0.35$	$b_{bp0} = 2.475$	$chl = 2.30$
13:46:00	$a_p^*/b_{bp}^*0 = 3.44$	$S = 0.015$	$\gamma = 0.991$	$a_p^*/b_{bp}^*inf = 0.26$	$b_{bp0} = 2.517$	$chl = 0.17$
14:01:00	$a_p^*/b_{bp}^*0 = 3.57$	$S = 0.016$	$\gamma = 1.075$	$a_p^*/b_{bp}^*inf = 0.31$	$b_{bp0} = 2.212$	$chl = 2.11$
14:31:00	$a_p^*/b_{bp}^*0 = 3.81$	$S = 0.016$	$\gamma = 1.089$	$a_p^*/b_{bp}^*inf = 0.33$	$b_{bp0} = 1.971$	$chl = 0.00$
14:46:00	$a_p^*/b_{bp}^*0 = 3.86$	$S = 0.016$	$\gamma = 1.103$	$a_p^*/b_{bp}^*inf = 0.35$	$b_{bp0} = 1.801$	$chl = 0.43$
15:01:00	$a_p^*/b_{bp}^*0 = 3.87$	$S = 0.018$	$\gamma = 1.352$	$a_p^*/b_{bp}^*inf = 0.28$	$b_{bp0} = 1.430$	$chl = 5.81$
15:46:00	$a_p^*/b_{bp}^*0 = 4.06$	$S = 0.018$	$\gamma = 1.164$	$a_p^*/b_{bp}^*inf = 0.35$	$b_{bp0} = 1.382$	$chl = 1.29$

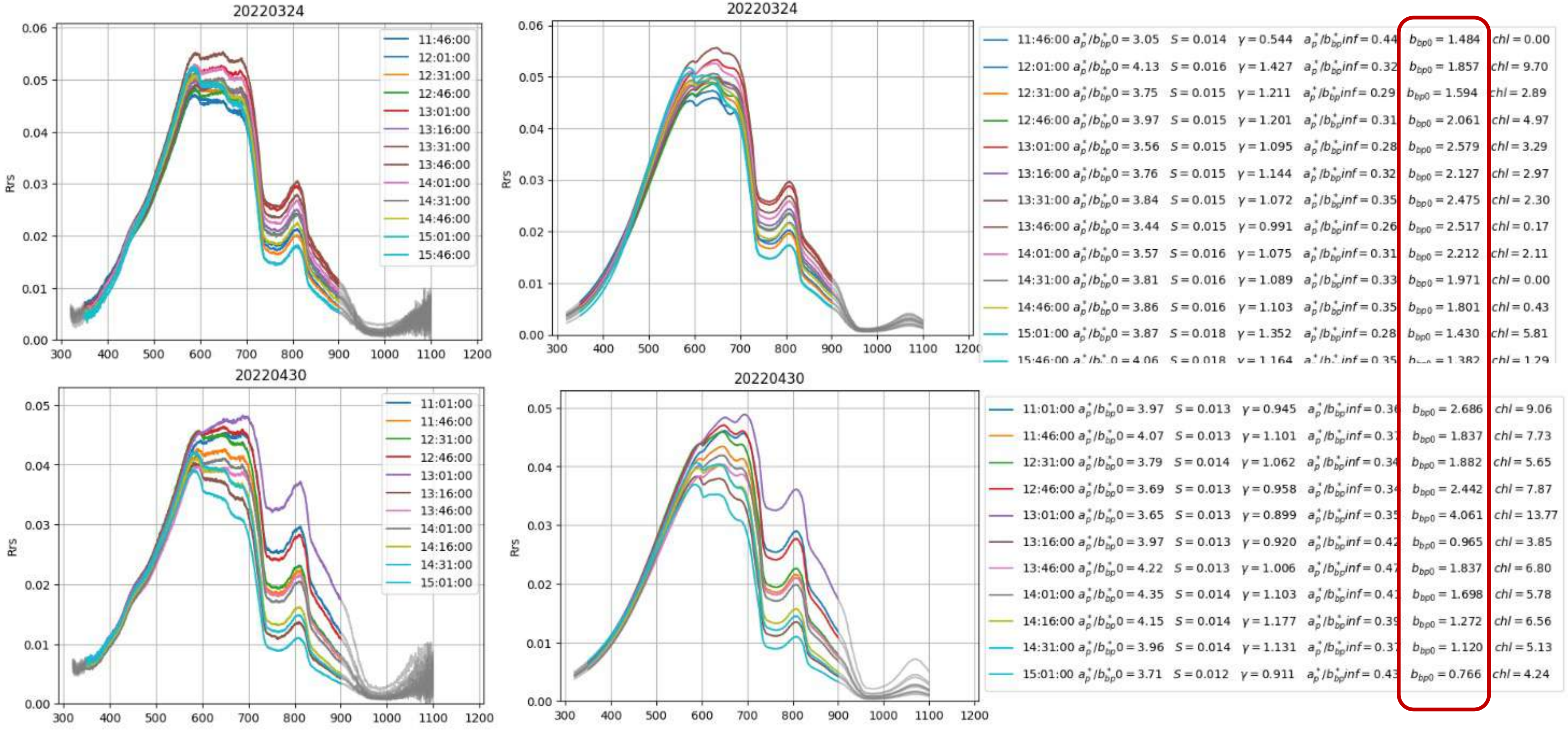




11:01:00	$a_p^*/b_{bp}^*0 = 3.97$	$S = 0.018$	$\gamma = 0.945$	$a_p^*/b_{bp}^*inf = 0.36$	$b_{bp0} = 2.686$	$chl = 9.06$
11:46:00	$a_p^*/b_{bp}^*0 = 4.07$	$S = 0.018$	$\gamma = 1.101$	$a_p^*/b_{bp}^*inf = 0.37$	$b_{bp0} = 1.837$	$chl = 7.73$
12:31:00	$a_p^*/b_{bp}^*0 = 3.79$	$S = 0.014$	$\gamma = 1.062$	$a_p^*/b_{bp}^*inf = 0.34$	$b_{bp0} = 1.882$	$chl = 5.65$
12:46:00	$a_p^*/b_{bp}^*0 = 3.69$	$S = 0.018$	$\gamma = 0.958$	$a_p^*/b_{bp}^*inf = 0.34$	$b_{bp0} = 2.442$	$chl = 7.87$
13:01:00	$a_p^*/b_{bp}^*0 = 3.65$	$S = 0.018$	$\gamma = 0.899$	$a_p^*/b_{bp}^*inf = 0.35$	$b_{bp0} = 4.061$	$chl = 13.77$
13:16:00	$a_p^*/b_{bp}^*0 = 3.97$	$S = 0.018$	$\gamma = 0.920$	$a_p^*/b_{bp}^*inf = 0.42$	$b_{bp0} = 0.965$	$chl = 3.85$
13:46:00	$a_p^*/b_{bp}^*0 = 4.22$	$S = 0.018$	$\gamma = 1.006$	$a_p^*/b_{bp}^*inf = 0.47$	$b_{bp0} = 1.837$	$chl = 6.80$
14:01:00	$a_p^*/b_{bp}^*0 = 4.35$	$S = 0.014$	$\gamma = 1.103$	$a_p^*/b_{bp}^*inf = 0.41$	$b_{bp0} = 1.698$	$chl = 5.78$
14:16:00	$a_p^*/b_{bp}^*0 = 4.15$	$S = 0.014$	$\gamma = 1.177$	$a_p^*/b_{bp}^*inf = 0.39$	$b_{bp0} = 1.272$	$chl = 6.56$
14:31:00	$a_p^*/b_{bp}^*0 = 3.96$	$S = 0.014$	$\gamma = 1.131$	$a_p^*/b_{bp}^*inf = 0.37$	$b_{bp0} = 1.120$	$chl = 5.13$
15:01:00	$a_p^*/b_{bp}^*0 = 3.71$	$S = 0.012$	$\gamma = 0.911$	$a_p^*/b_{bp}^*inf = 0.43$	$b_{bp0} = 0.766$	$chl = 4.24$

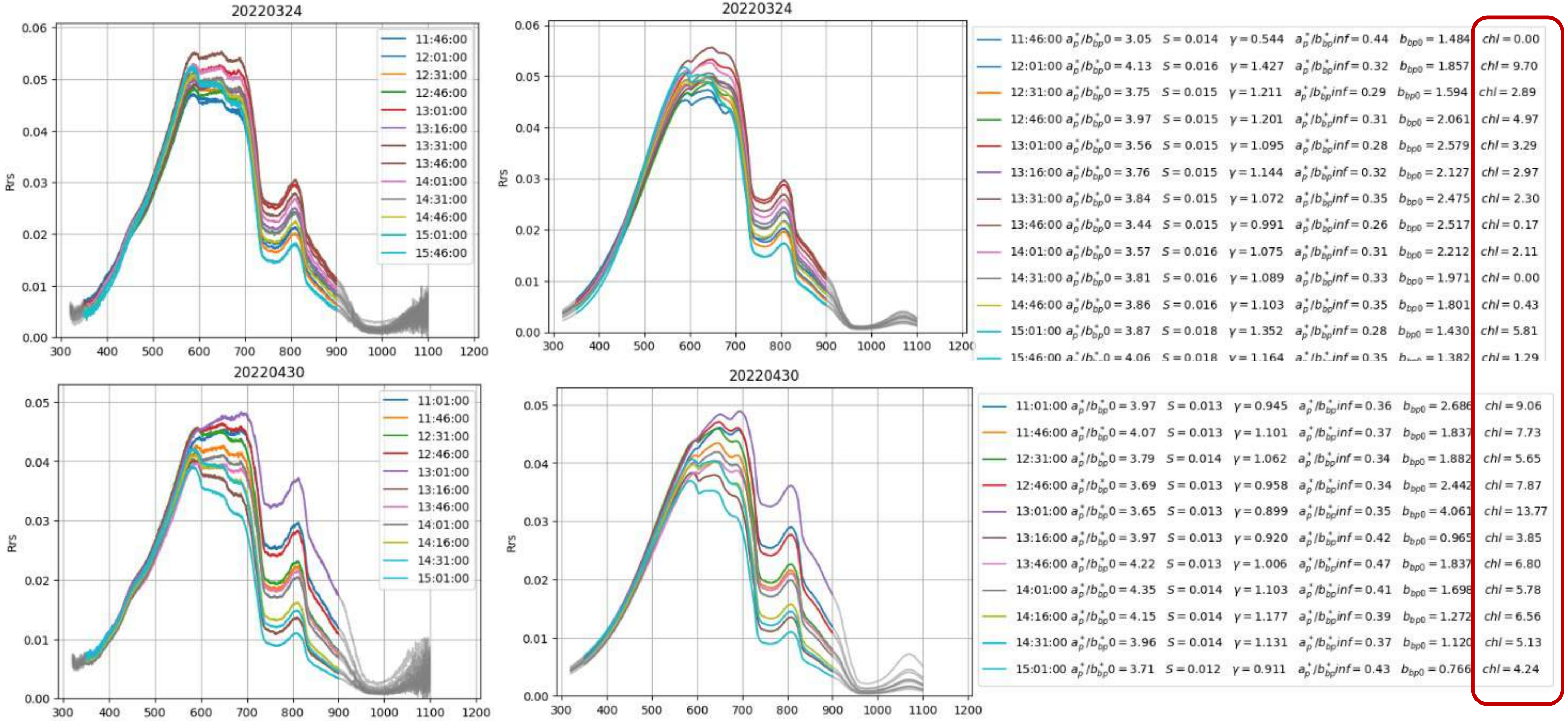
Modelling the full HYPERNETS spectra (in and out the saturation regime)

➔ *6 unknowns outside saturation:* $X = \left(\frac{a^*_{p0}}{b^*_{bp0}}, \frac{a^*_{p\infty}}{b^*_{bp0}}, b_{bp0}, S, \gamma, Chl\right)$



Modelling the full HYPERNETS spectra (in and out the saturation regime)

➔ *6 unknowns outside saturation:* $X = \left(\frac{a^*_{p0}}{b^*_{bp0}}, \frac{a^*_{p\infty}}{b^*_{bp0}}, b_{bp0}, S, \gamma, Chl\right)$



Conclusions / Perspectives

- Nouveau réseau autonomes de mesures hyperspectrales de la réflectance des eaux côtières à continentales

- Qualité et disponibilité des mesures pour la validation des multiples corrections (atmosphériques, glint et environnement) appliquées aux mesuers satellitaires

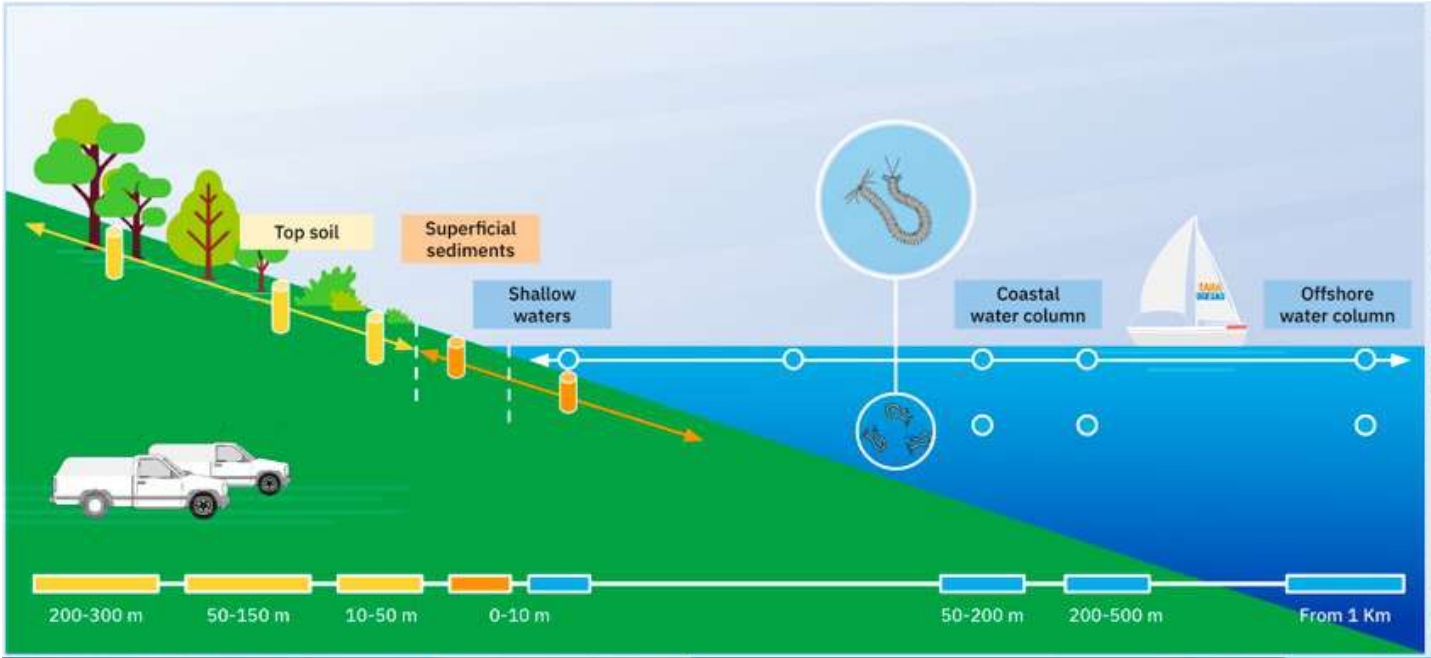
- Fort potentiel pour estimer la concentration et les IOPS des MES (proxys de la composition et dela taille) : à valider

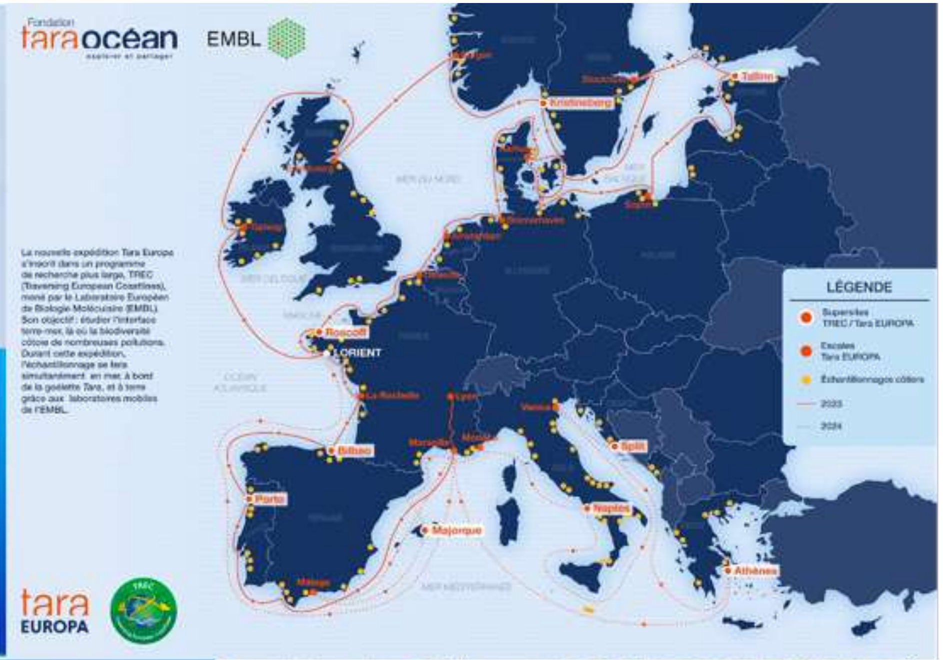
- Application aux mesures satellitaires PRISMA, ENMAP en préparation de la future mission de l'ESA: CHIME

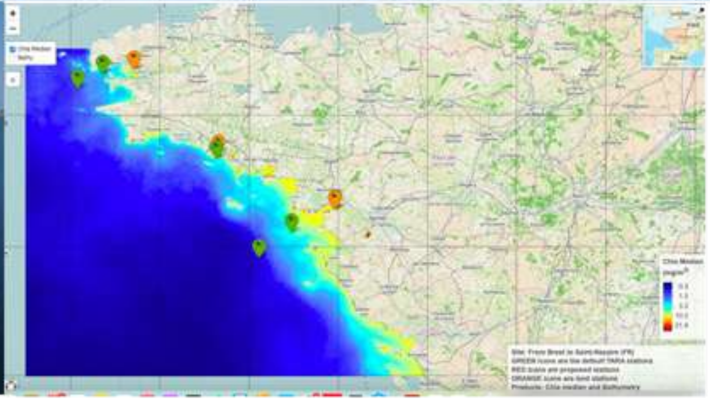
Calibration & validation of satellite produits in Europe

TARA-Europa / HyperBOOST

(2023 > 2024)







HyperBOOST

Hyperspectral Bio-Optical Observations Sailing on *Tara*

WP2 in-situ data collection and processing

Project partners

PML Plymouth Marine Laboratory

LOV Laboratoire d'Océanographie de Villefranche

1865 The University of Maine

CNR ISMAR

ibf CNR - Istituto di Biofisica

Collaborating with

EMBL

TREC Traversing European Coastlines

esa The HyperBOOST project is funded by the European Space Agency (ESA)

www.hyperboost.info

✓ **SoRad, Tom (PML)**

- Continuous **hyperspectral** above-water radiometry: water reflectance

✓ **acs,bb3,Hyper-bb, Emmanuel (Umaine)**

- Continuous a, c, b, b_b **hyperspectral** data

✓ **SPM, POM, POC, CHL, David (LOV)**

- SPM, Chla, POM, POCon discrete samples
- **Hyperspectral** particulate absorption (a_p, a_{nap}, a_{phy})

✓ **CDOM, FDOM, TOC, DOC, Chiara (CNR-P)**

- **Hyperspectral** CDOM absorption
- DOC

Underway above-water radiometric measurement systems on Tara

So-Rad Lsky and Lt sensors

So-Rad Ed and HSP-1 sensors

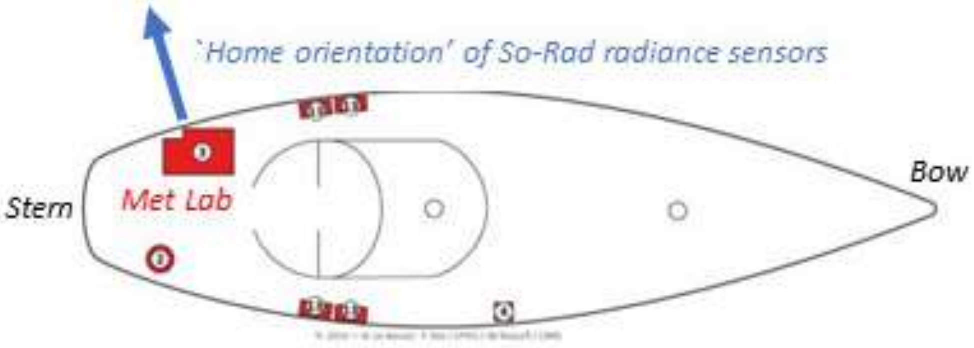
So-Rad (Solar-tracking radiometry platform)

Level 0/1: Downwelling irradiance (Ed), Sky radiance (Lsky), Total upwelling radiance (Lt). Hyperspectral on interval ~ [350, 900] nm

Level 2: Remote-sensing reflectance (Rrs)

HSP-1 (Hyperspectral pyranometer)

Level 0/1: Downwelling irradiance (Ed), Direct downwelling irradiance (Edd), Diffuse downwelling irradiance (Eds). Hyperspectral on [300, 1000] nm.



Plan view of Tara showing sensor location.

Quality control

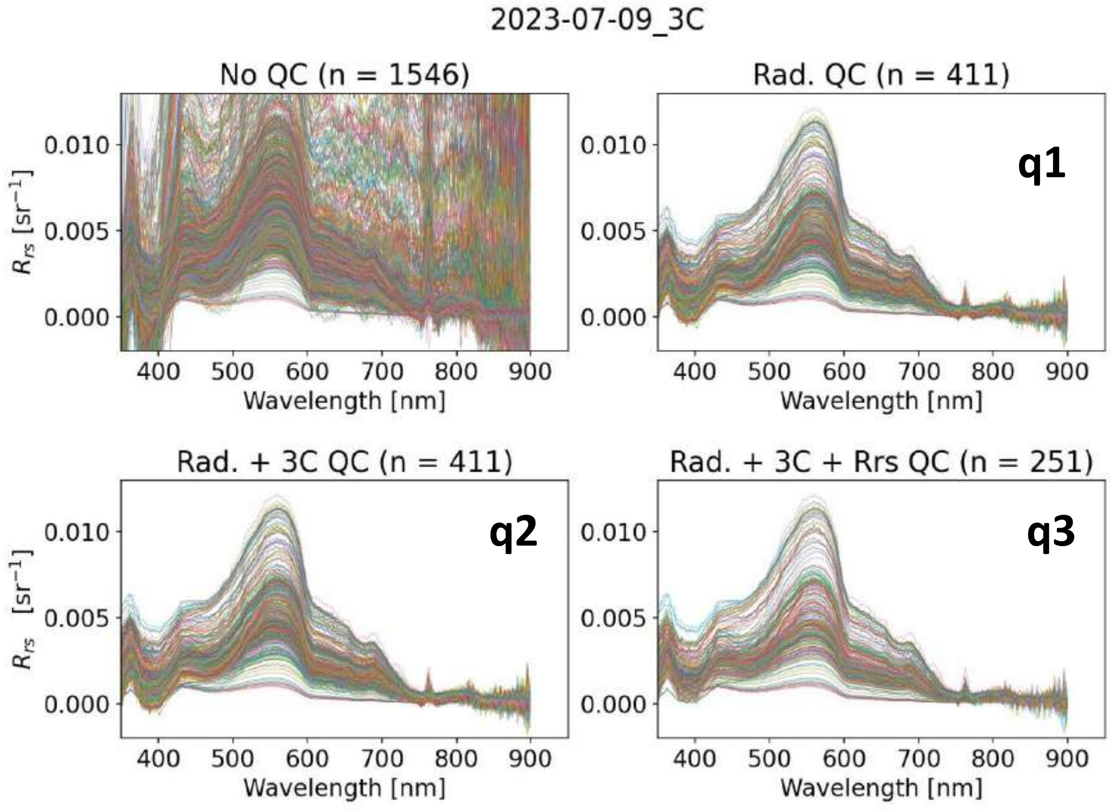
q1: First step MONDA (filters based on measured Ed, Ls, Lt).

q2: Second step MONDA (filters based on 3C optimization output parameters).

q3: Third step MONDA (filters on Rrs spectra).

q4: QC based on available metadata from So-Rad and Tara underway, (includes relative azimuth, tilt, tilt standard deviation, windspeed). ~ 14K measurements at q4 (~15 % of total).

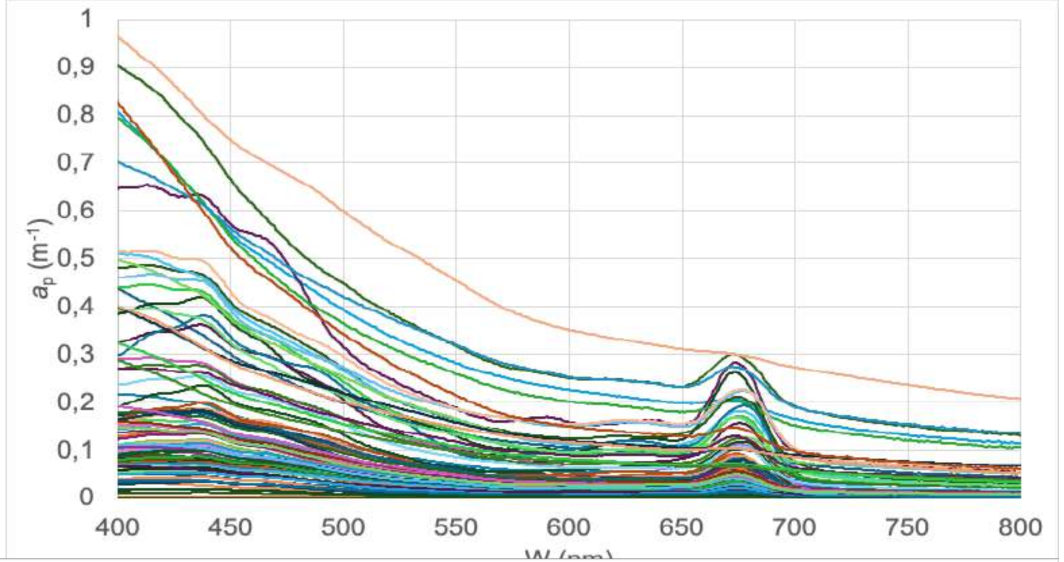
q5: As q4 but with non-clear-sky conditions removed, based on HSP-1 IDR measurements. ~ 9K measurements at q5 (~9% of total).

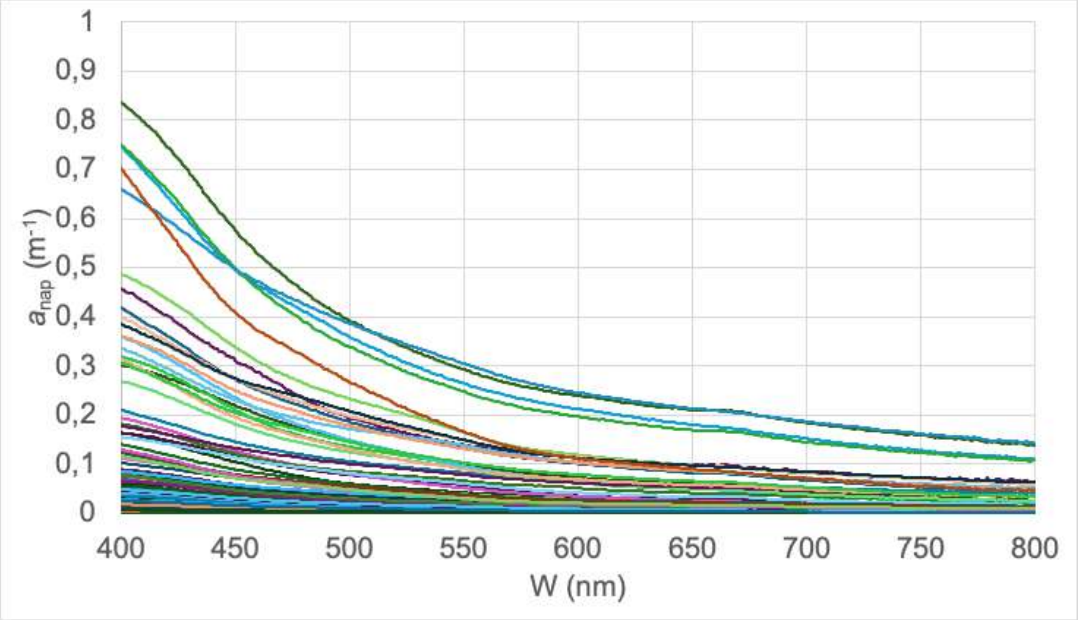


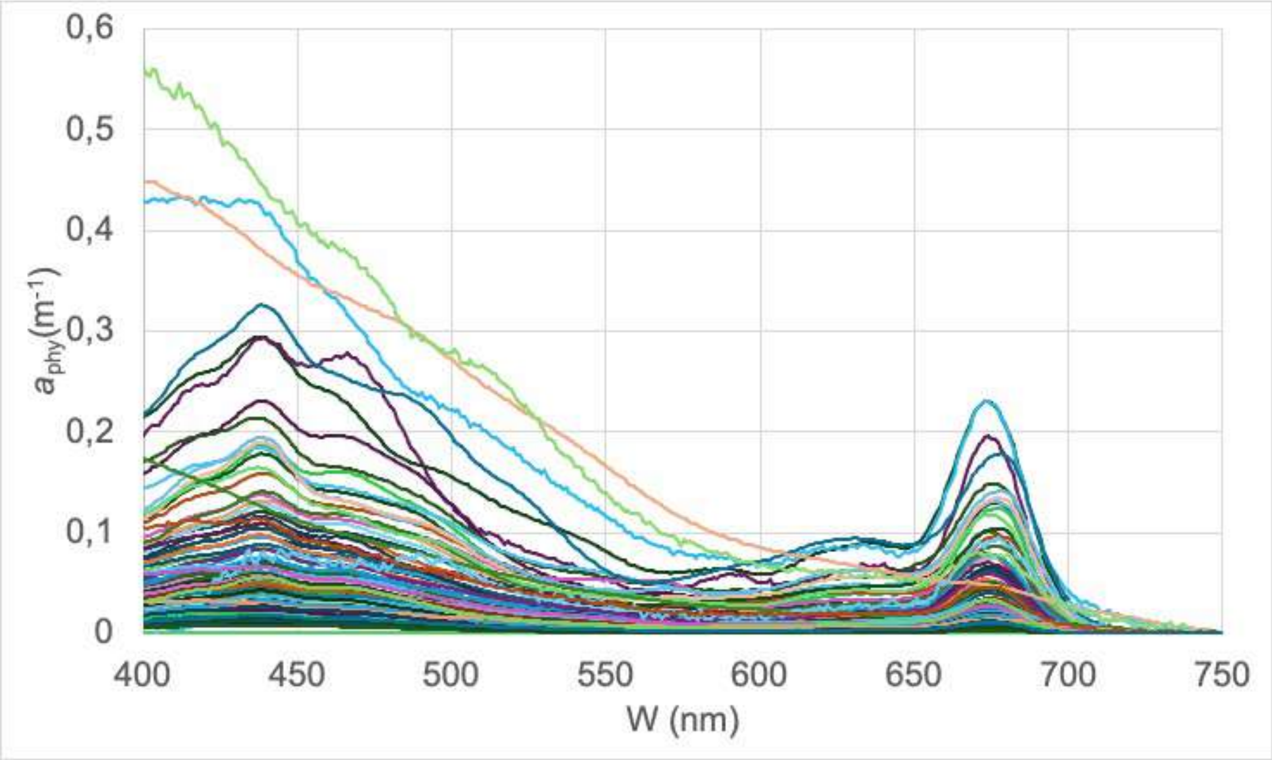
Example of impact of QC steps 1-3 on Rrs. Figures for steps 4-5 are incuded in FTP data set

HyperBOOST - Hyperspectral Bio-Optical Observations Sailing on *Tara*

Funded by The European Space Agency



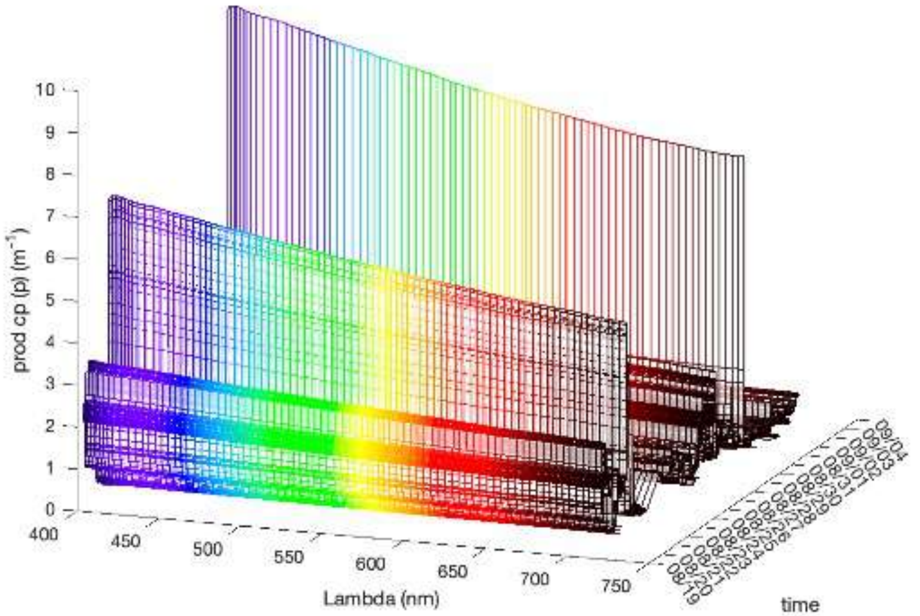




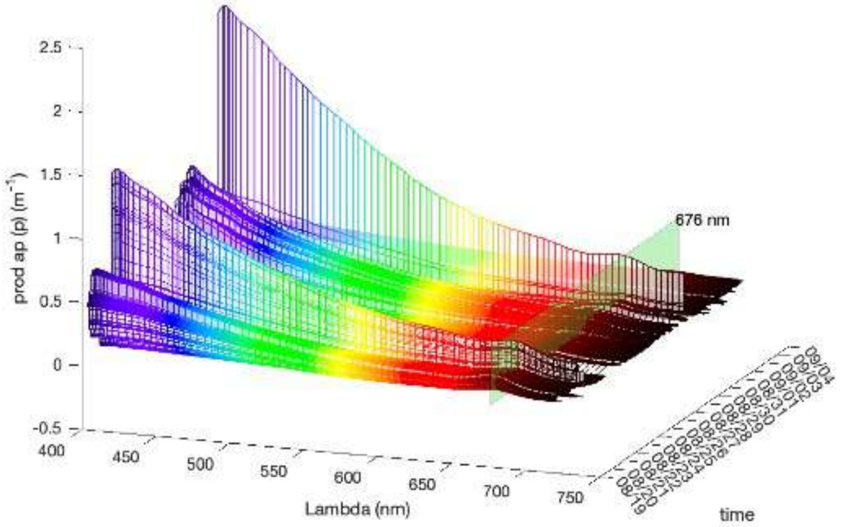
HyperBOOST - Hyperspectral Bio-Optical Observations Sailing on *Tara*

Funded by The European Space Agency

AC prod p



AC prod p



BB prod p