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Validation of ocean colour satellite products in coastal lagoons and estuaries using autonomous hyperspectral sensors (the HYPERNETS network)

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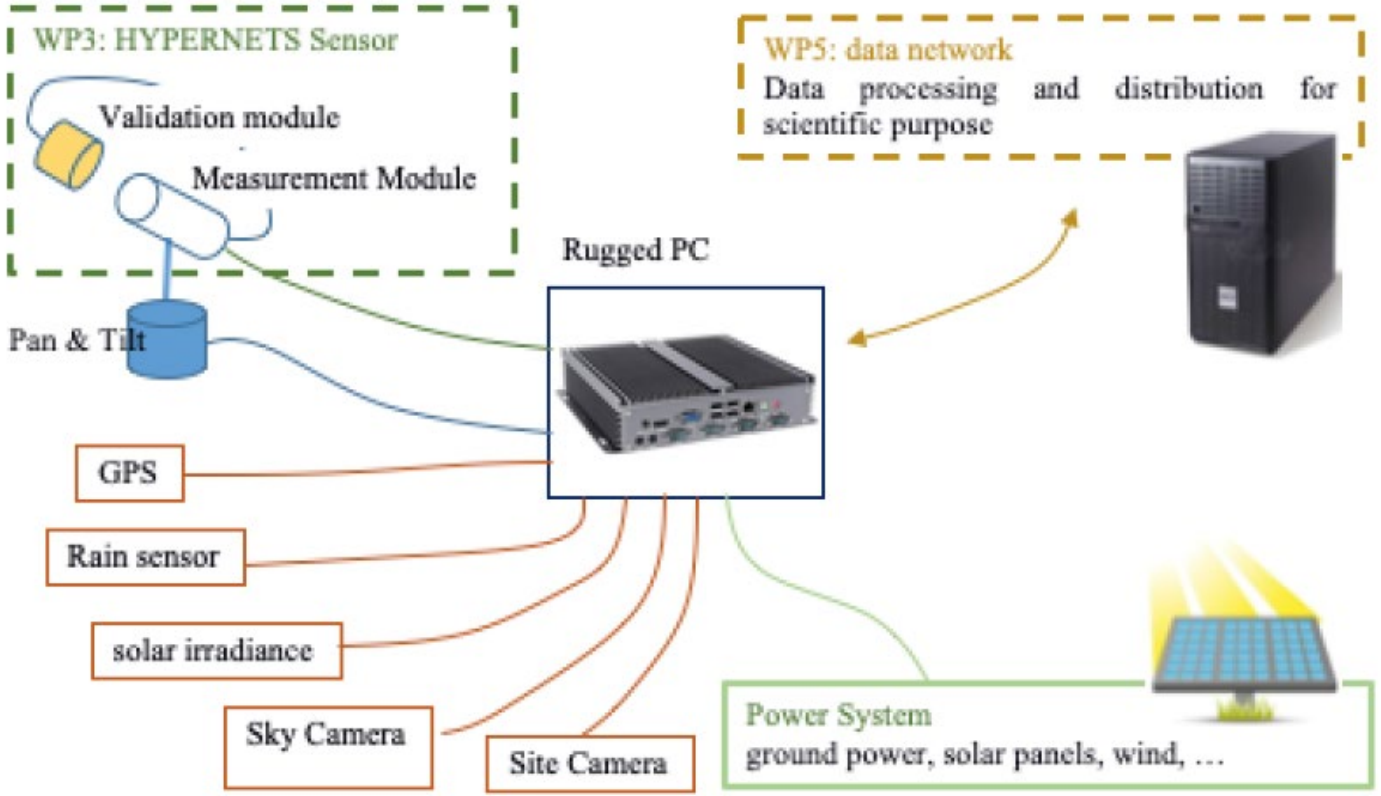
ESA living planet symposium, Bonn, 23-27 May 2022

Outline

1. The HYPERNETS sensors / system
2. French sites in operation
3. Matchups with satellite data / Protocols
4. Matchups with satellite data / Results
5. Conclusions / Next steps

1. The HYPERNETS sensors / system

New hyperspectral radiometers:
VIS-NIR (water) and VIS-NIR-SWIR (land)
Radiance (L_u, L_s), irradiance (E_d), images (320-1100 nm, 0.5 nm)



New system for autonomous field operation: power, point, execute measurement sequences, record and transfer data to servers for quality control and processing, remote control depending on conditions

2. French sites in operation

- **Berre coastal lagoon:** since 24th February 2021, every 30 mn (v1), to help monitoring impacts of turbid freshwaterd ischarge and (harmful) algal blooms on water quality

- **Gironde estuary:** since 8th November 2021, every 15 mn (v2), to help monitoring the dynamics of the maximum turbidity zone and its discharge to the coastal ocean

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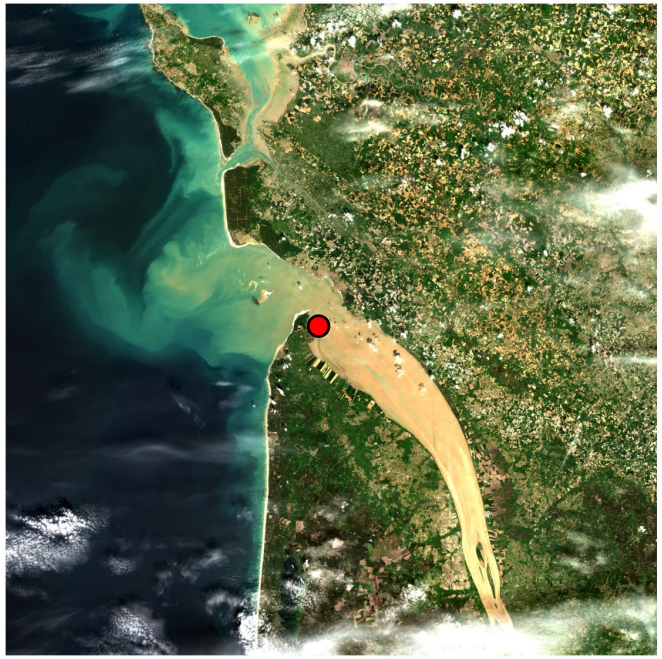
ρ_s RGB



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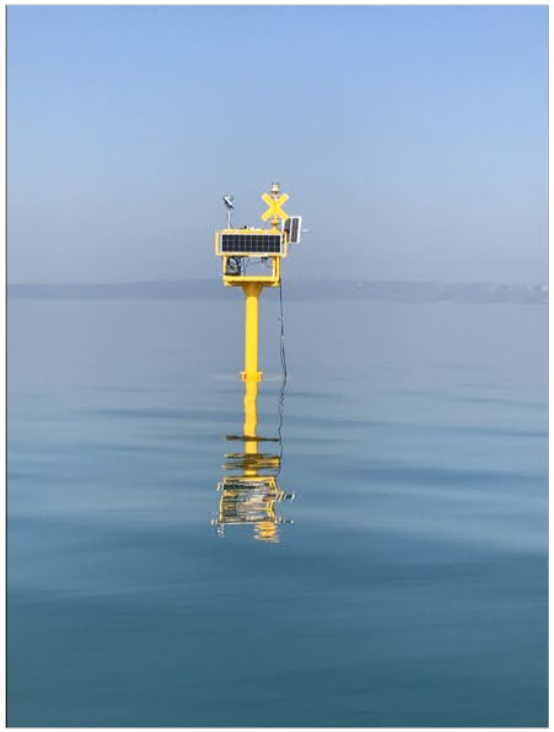
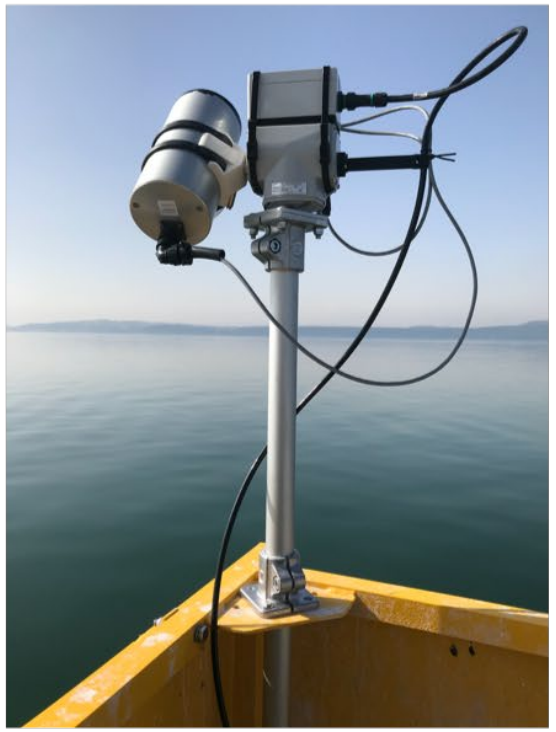
ρ_s RGB

2. French sites in operation

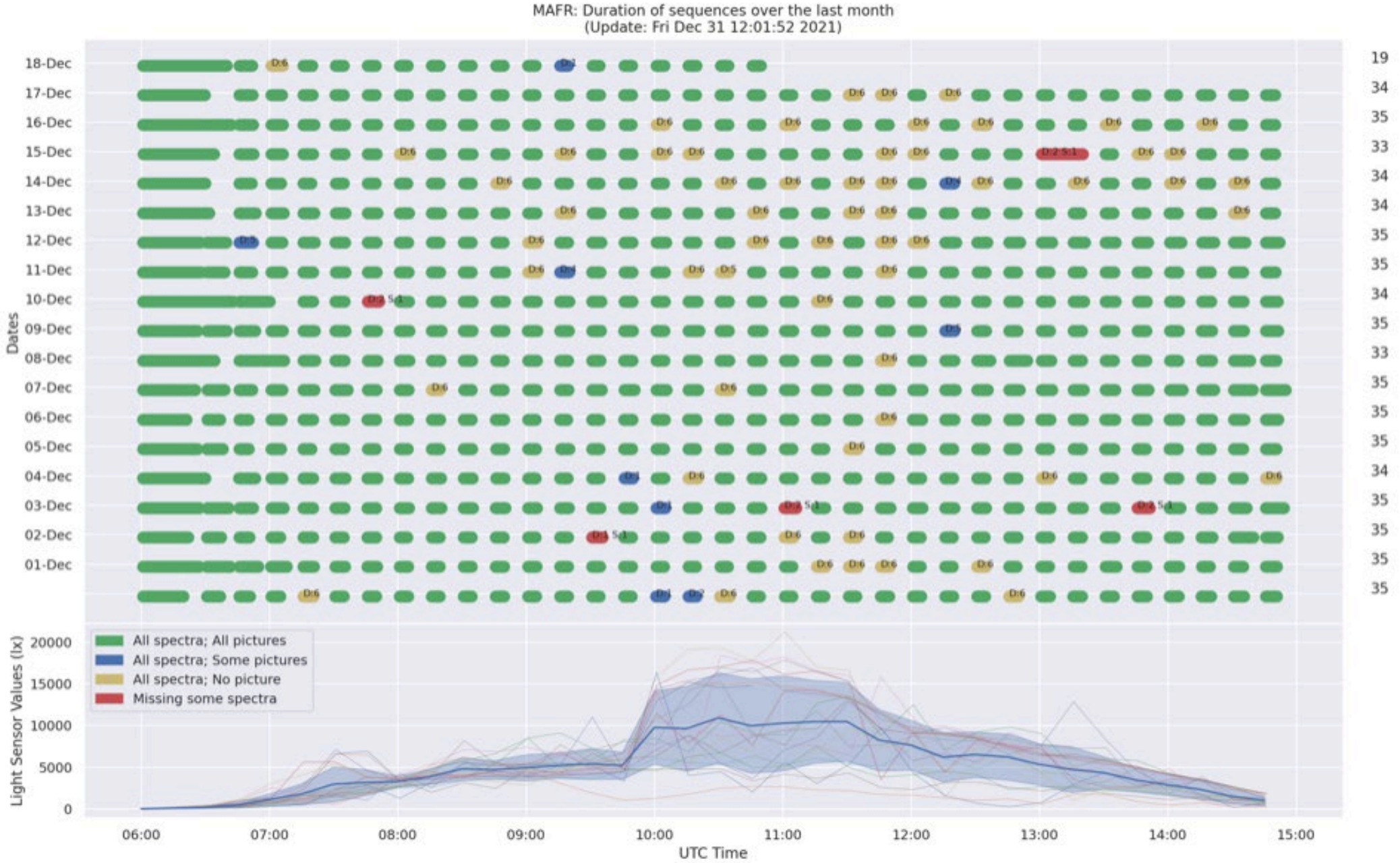




New platform:

- Above-water: meteo station, HYPSTAR-VIS, rain and light sensors, 2 webcams (N & S), solar panels
- In-water: b_b, fluo_chla, T, S, O_2 ,
- Monthly maintenance and water sampling

2. French sites in operation



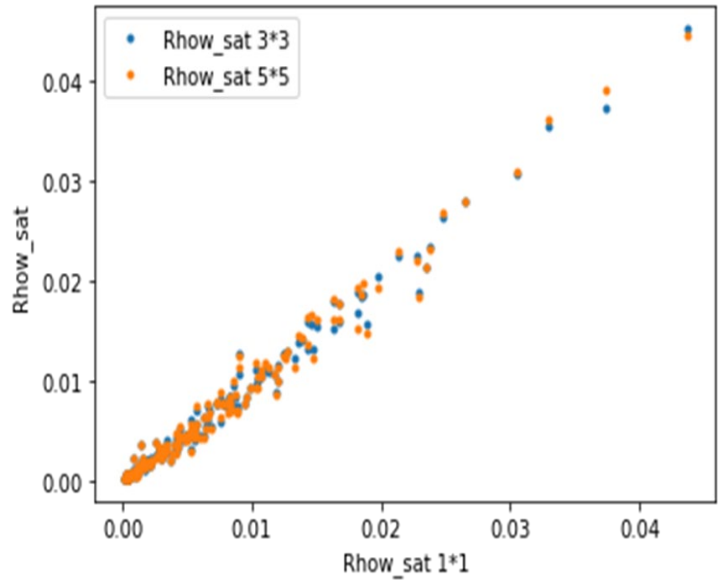
3. Matchups with satellite data / Protocols

Satellite data	L8/9-OLI	S2-MSI	S3-OLCI	MODIS
AC algorithms	C2RCC C2X Acolite iCOR	Sen2Cor C2RCC GRS Polymer Acolite, CMEMS-HR iCOR	BAC C2RCC Polymer Acolite CMEMS	MUMM NIR-SWIR

Quality controls on field and satellite data

HYPERNETS data
- Data availability
- Rhow > 0
- Glint effects
- Light conditions
- Temporal variations of Rhow_555 (<20%)

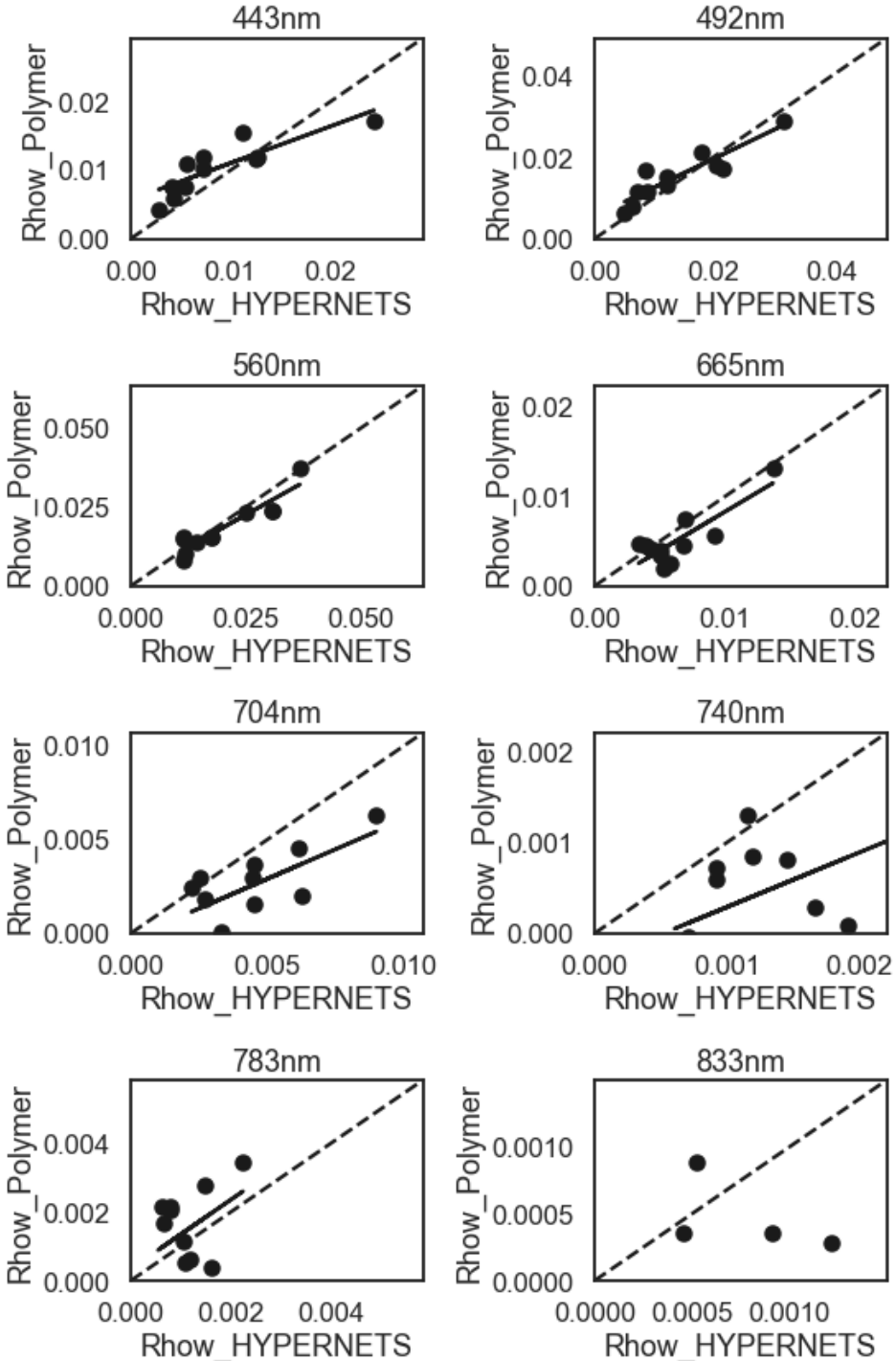
Satellite data
- 1*1, 3**, 5*5 pixels
- Cloud cover
- Spatial heterogeneity <20%
- Rhow sat > 0
- Flags (glint, dupl. pixels)

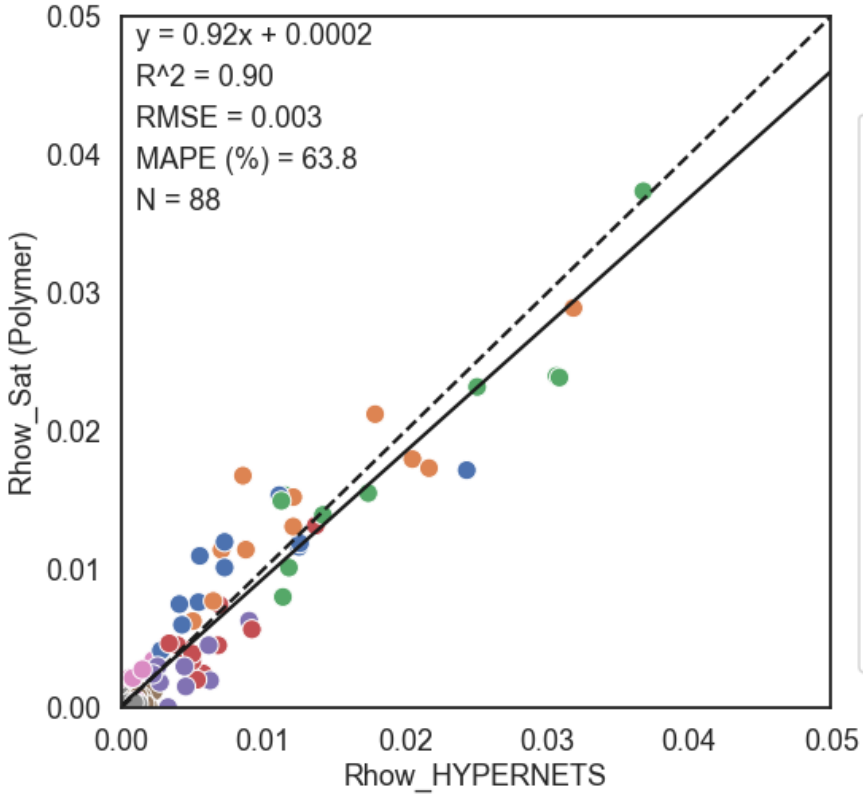


4. Matchups with satellite data / Results

Berre
S2-MSI
POLYMER

Glint!!



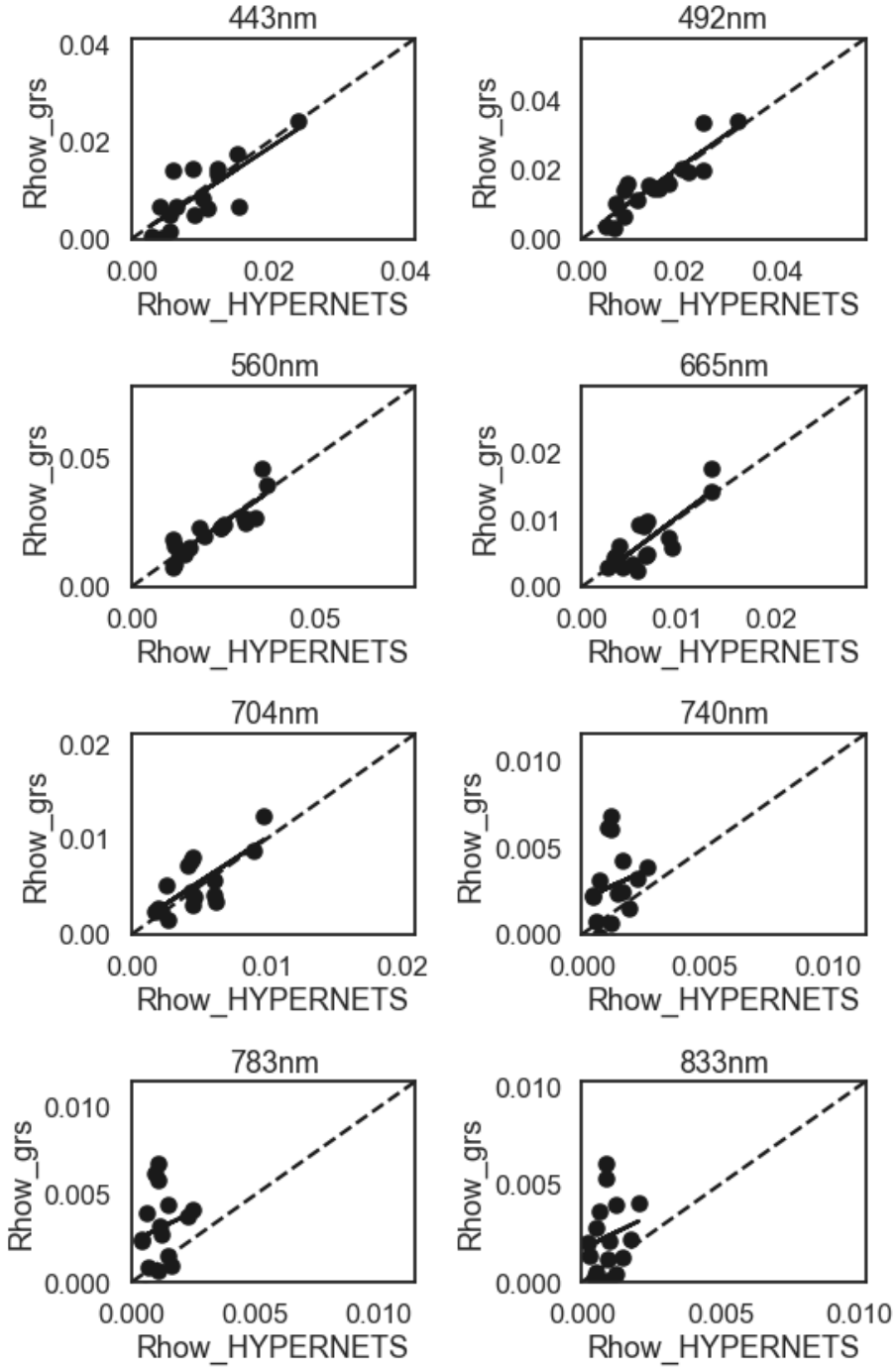


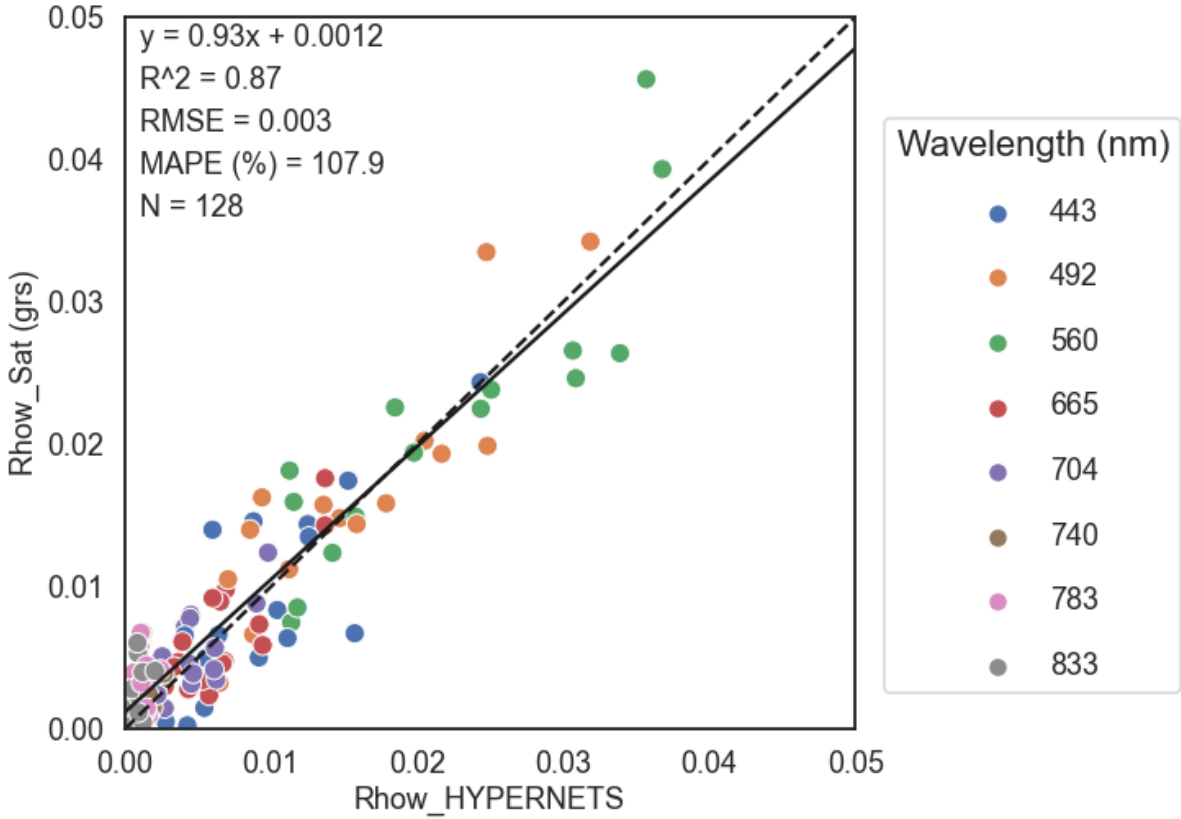
W (nm)	N	slope	intercept	R2	MAPE (%)	RMSE
443	11	0.54	0.006	0.72	45.2	0.0037
492	11	0.70	0.006	0.83	29.6	0.0037
560	11	0.82	0.002	0.86	16.9	0.0036
665	11	0.87	-0.000	0.70	28.3	0.0020
704	11	0.63	-0.000	0.47	45.7	0.0023
740	11	0.60	-0.000	0.25	77.4	0.0009
783	11	1.01	0.000	0.17	>100	0.0011
833	11	-0.09	-0.000	0.00	>100	0.0014

4. Matchups with satellite data / Results

Berre
S2-MSI
GRS

Glint!!



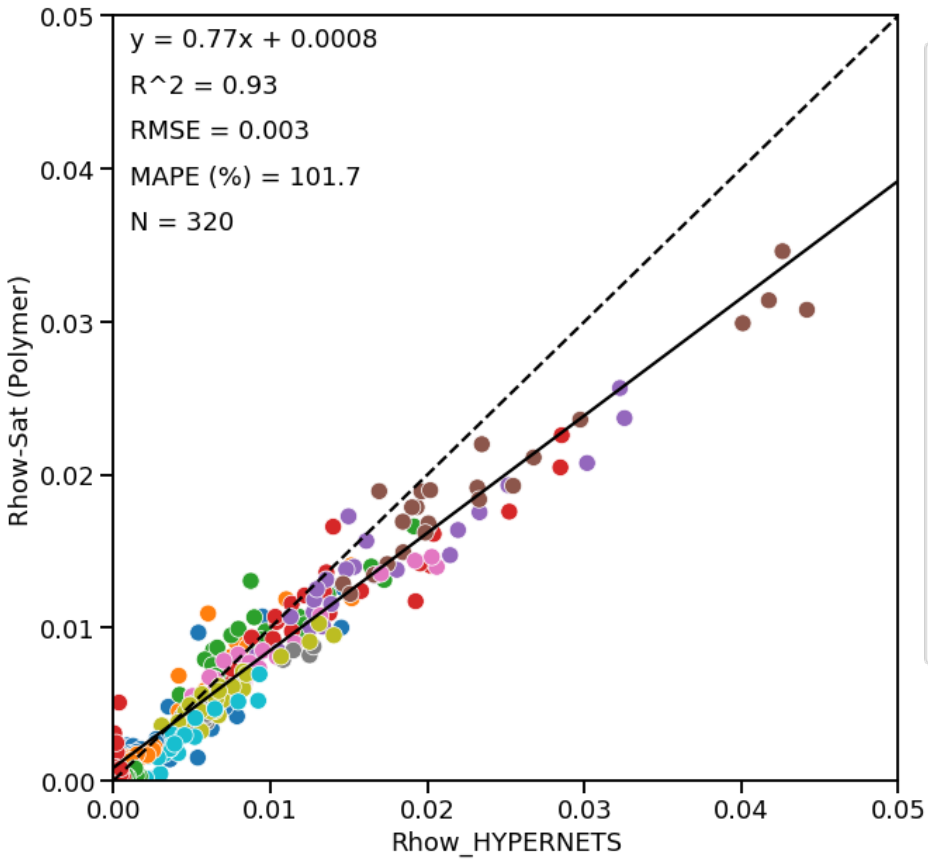


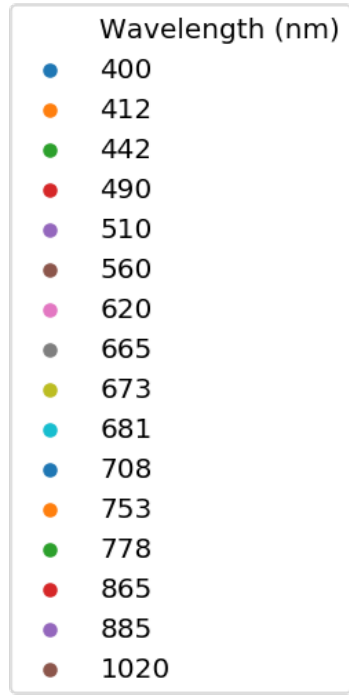
W (nm)	N	slope	intercept	R2	MAPE (%)	RMSE
443	16	0.93	0.000	0.60	45	0.0041
492	16	1.00	0.001	0.81	24	0.0037
560	16	0.96	0.001	0.78	19	0.0046
665	16	1.07	-0.0001	0.68	33	0.0023
704	16	0.93	0.001	0.55	38	0.0019
740	16	0.65	0.002	0.04	>100	0.0025
783	16	0.69	0.002	0.04	>100	0.0027
833	16	0.70	0.002	0.04	>100	0.0022

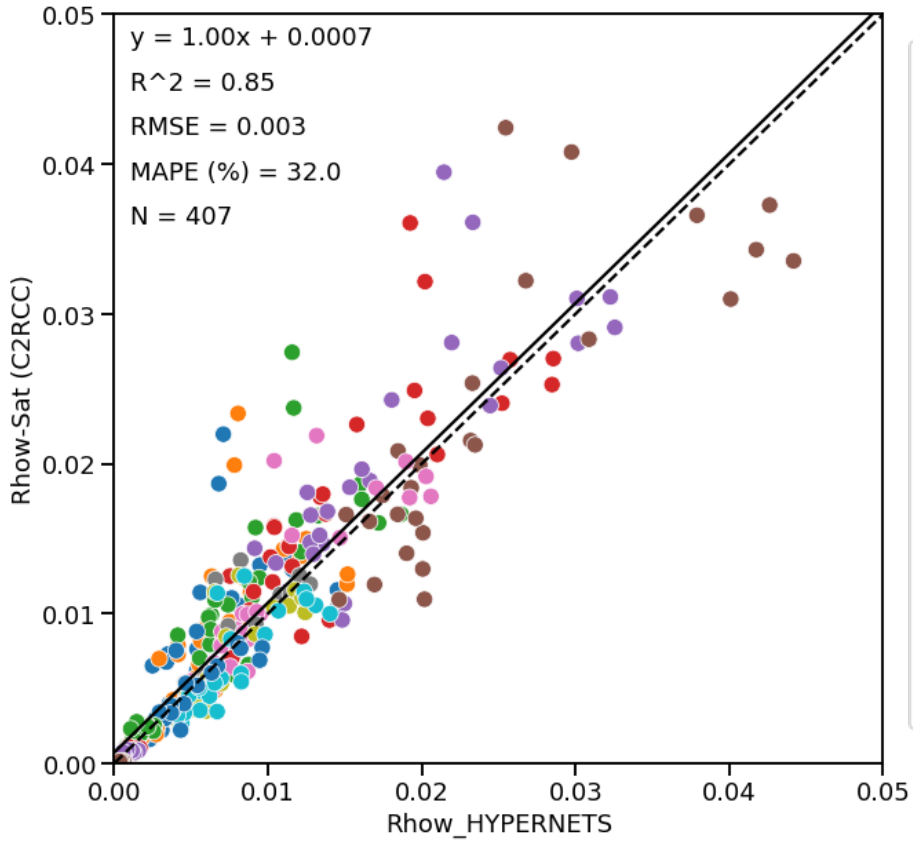
4. Matchups with satellite data / Results

Berre S3-OLCI POLYMER

Glint!!

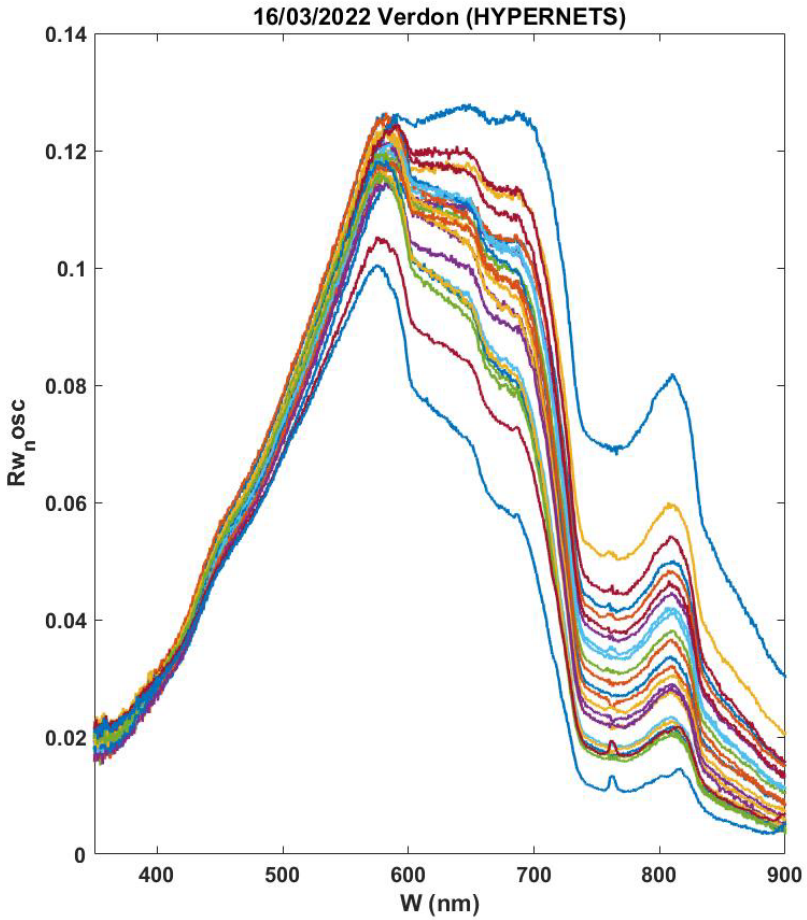


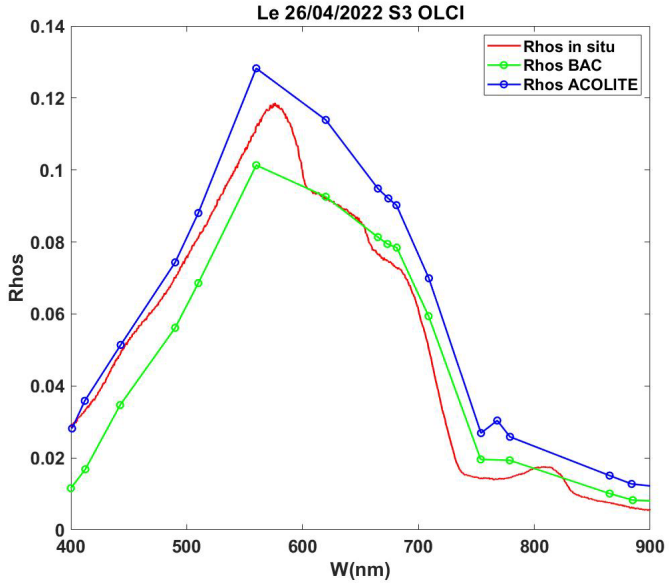


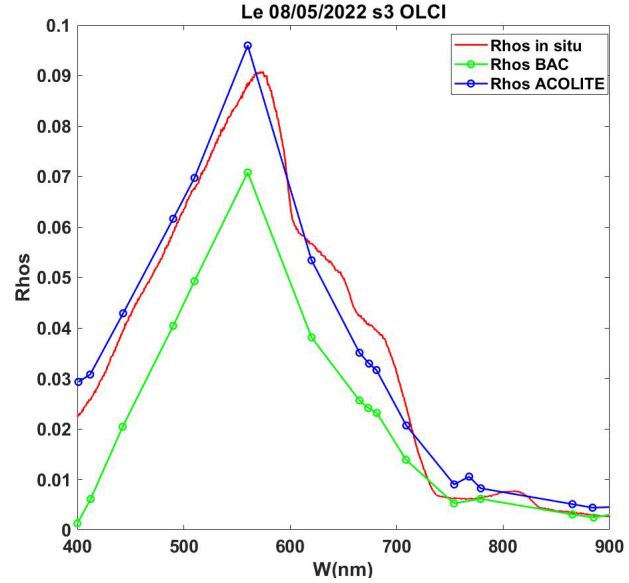


➔ Less scatter but underestimation for POLYMER compared to C2RCC (slope of 1)

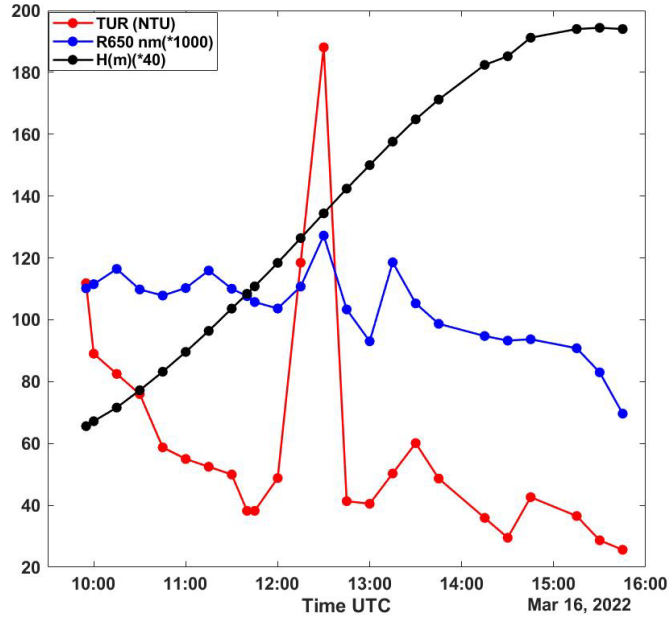
Data recorded at the mouth of a macrotidal estuary: the Gironde







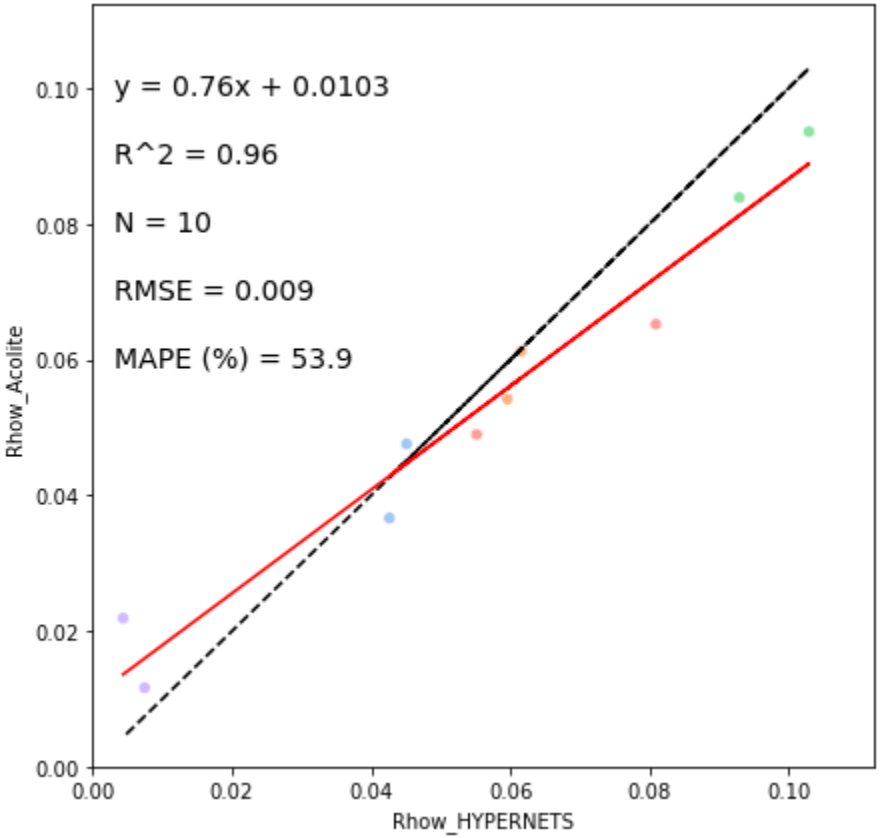
Up to 35 water reflectance spectra a day, varying along the daily tidal cycle with turbidity and providing matchups to test the validity of AC corrections applied to any satellite data



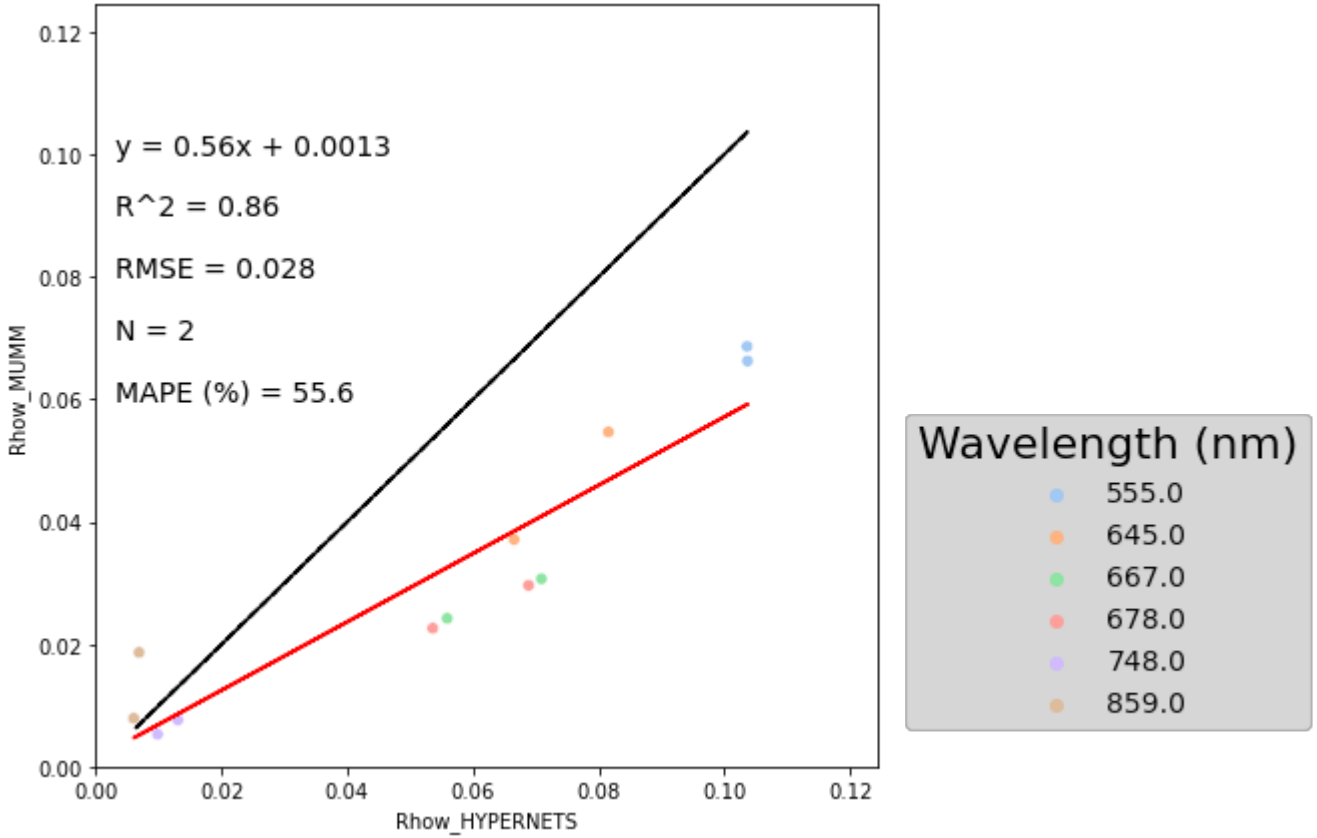
4. Matchups with satellite data / Results

Gironde Estuary

L8/9-OLI ACOLITE



AQUA-MODIS MUMM

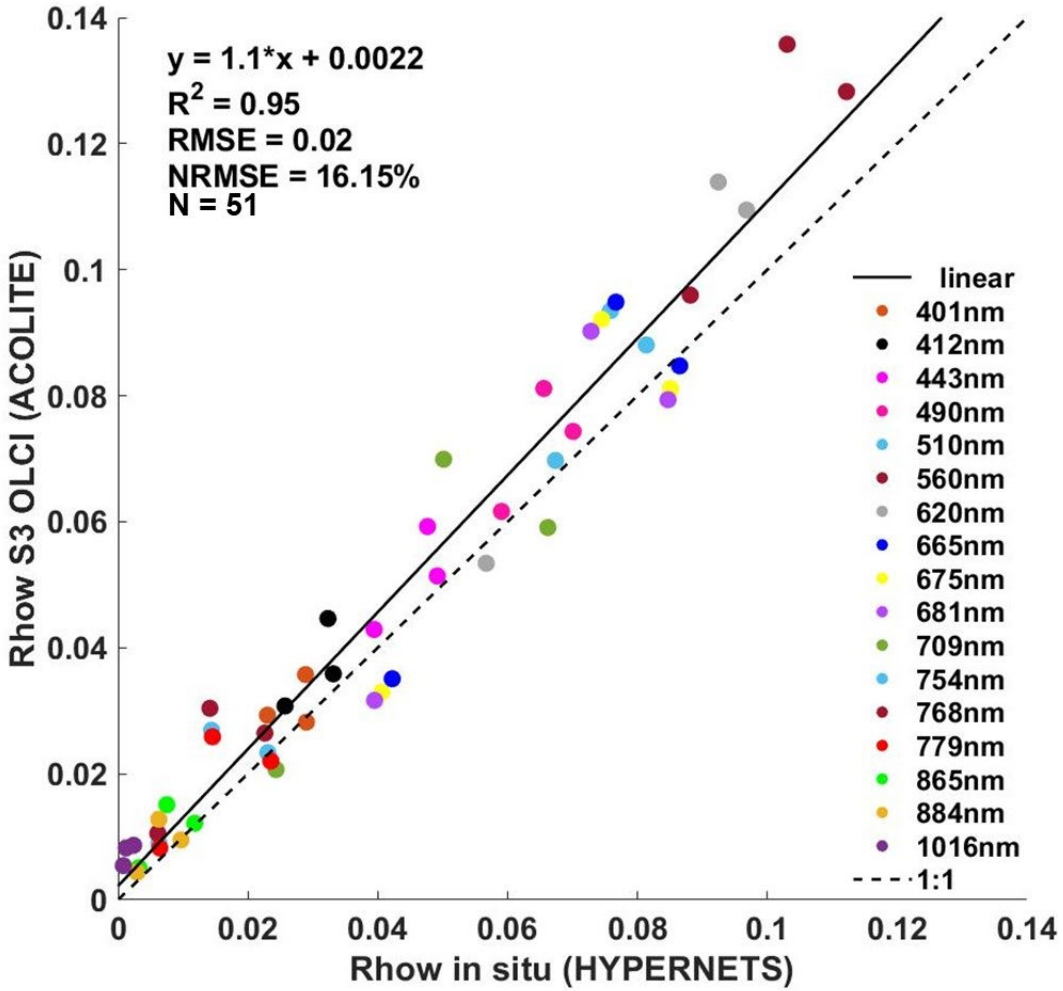


➔ ACOLITE provides satisfactory results for OLI and MSI (TBC) while MUMM and NIR-SWIR AC respectively understimates/masks the turbid estuarine waters

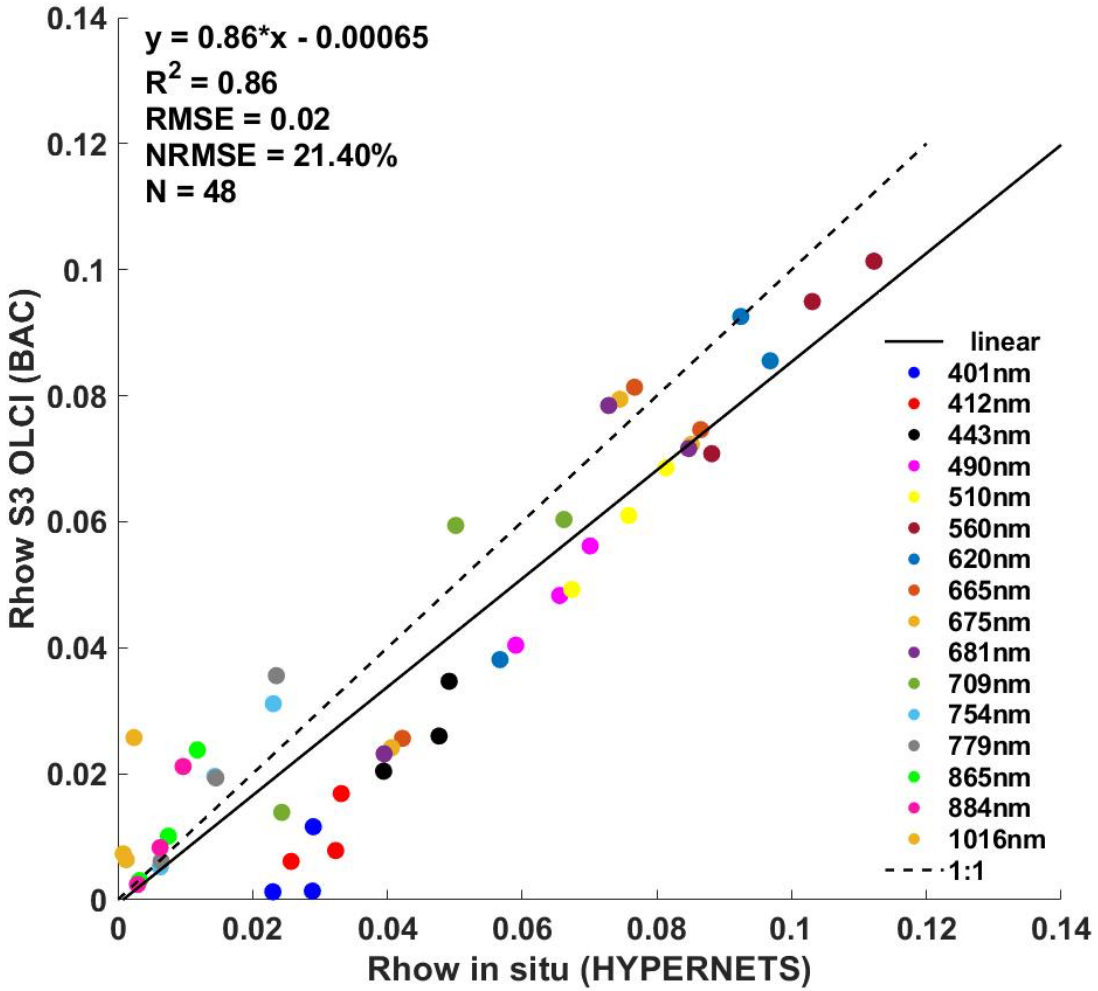
4. Matchups with satellite data / Results

Gironde Estuary S3-OLCI

ACOLITE

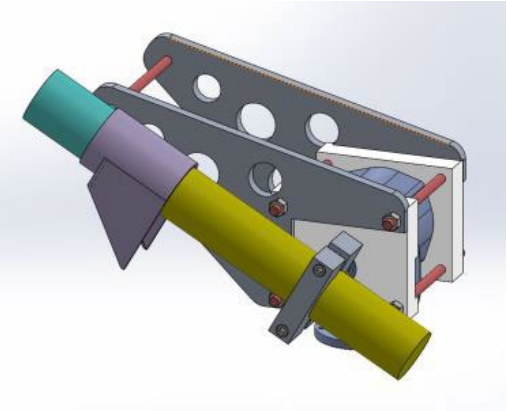


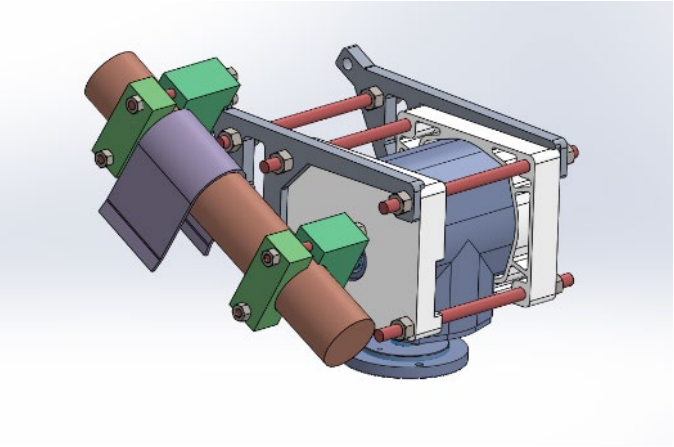
BAC



Conclusions / Next steps

- From prototype to v1 then v2, the HYPERNETS system becomes operationnal for autonomous hyperspectral radiometric measurements on field water/land sites
- Need automatic quality control and new matchup protocols adapted to each site
- A lot of data and matchups with satellite data
- Next version will include an on-site calibration module





Thank you!