TurbiNET

Towards an autonomous turbidimeter network for multi-mission ocean colour satellite data validation activities

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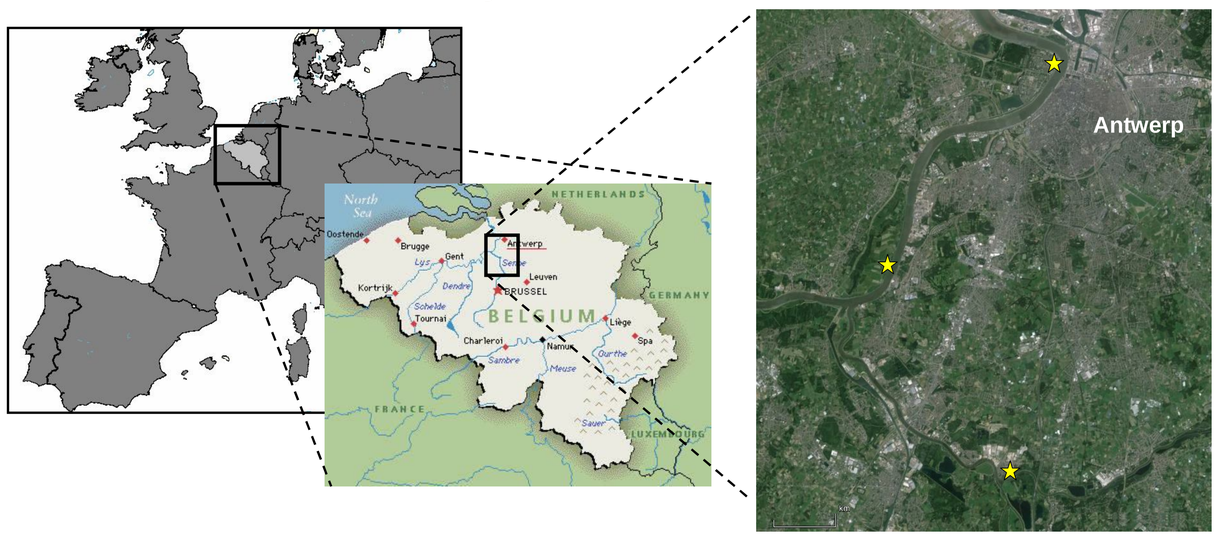
The objective is to establish a **long-term autonomous** network of collaboration and data-sharing with the aim of generating an single multi-site dataset to **validate** multi-mission satellite ocean colour **turbidity** products.

Field Measurements

Belgium (RBINS)

Scheldt and Zenne rivers (-34° 33' 38.8, -58 23' 55.6'')

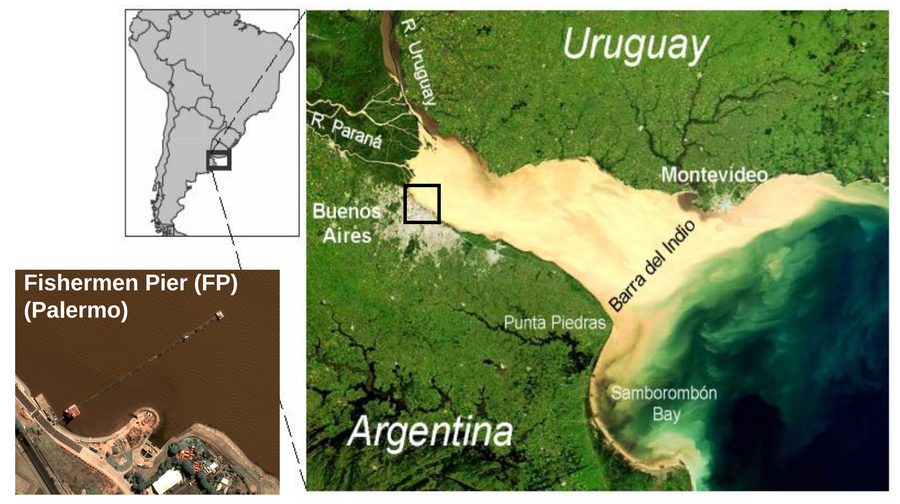
28-29 May 2015



Argentina (IAFE)

Río de la Plata (Fishermen Pier) (-34° 33' 38.8, -58 23' 55.6'')

16-24 November 2015



Instrument	Parameter	Units / bands	BLG	ARG
HACH	Sidescattering/Turbidity (90°)	Formazin Nephelometric Unit (FNU) / 860 nm	✓	✓
OBS3+	Backscattering (90° to 165°)	Nephelometric Turbidity Unit (NTU) / 850 nm		✓
OBS500	Backscattering (125° to 170°) Sidescattering/Turbidity (90°)	Formazin Backscatter Unit (FBU) / 850 nm Formazin Nephelometric Unit (FNU) / 850 nm	✓	
Hydroscat-4 (HS-4)	Backscattering (141°)	550, 700, 850, 1020 nm (m^{-1})	✓	
Trios/RAMSES	Reflectance	from 350 to 900 nm (resolution 2.5 nm)	✓	✓

Pléiades Image

Bands	Wavelength	Resolution
Panchro	470-830 nm	50 cm
Blue	430-550 nm	2 m
Green	500-620 nm	
Red	590-710 nm	
Near infrared	740-940 nm	

Turbidity Algorithm [1]

$$T_\lambda = \frac{A_T^\lambda \rho_w(\lambda)}{(1 - \rho_w(\lambda) / C^\lambda)} \quad [\text{FNU}]$$

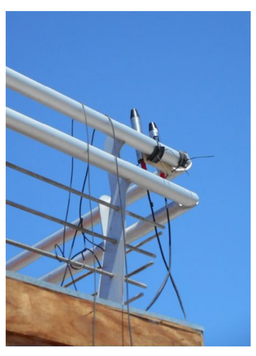
Switching bands

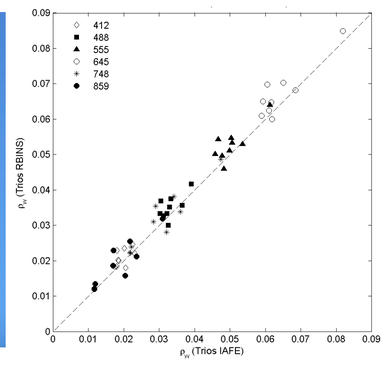
If $\rho_w(645) < 0.05$ $\quad T = T_{645}$
If $0.05 < \rho_w(645) < 0.07$ $\quad T = (1 - w)\, T_{645} + w\, T_{859}$
If $\rho_w(645) > 0.07$ $\quad T = T_{859}$

Linear weighting function

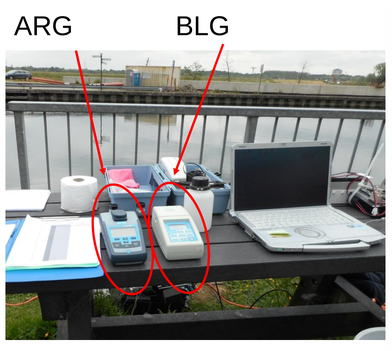
$$w = \frac{(\rho_w(645) - 0.05)}{0.02}$$

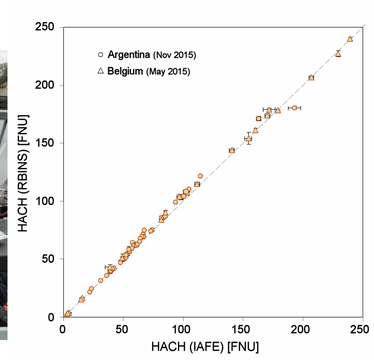
Instruments intercomparison



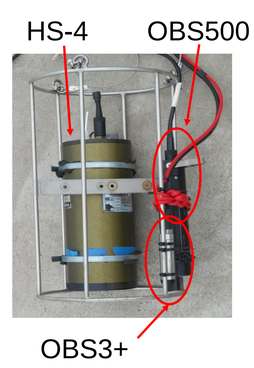


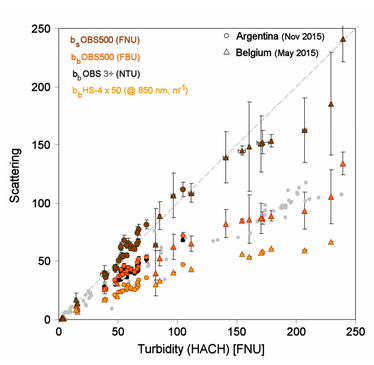
Simultaneous Trios/RAMSES (RBINS and IAFE) Reflectance from in the Fishermen Pier (Nov 2015)





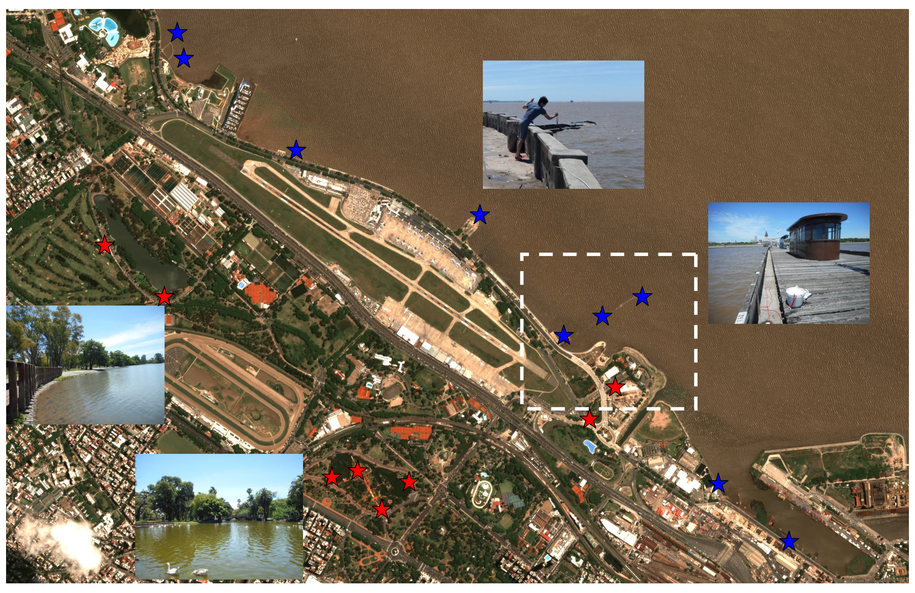
Turbidity measurements using HACH portable turbidimeter from RBINS and IAFE





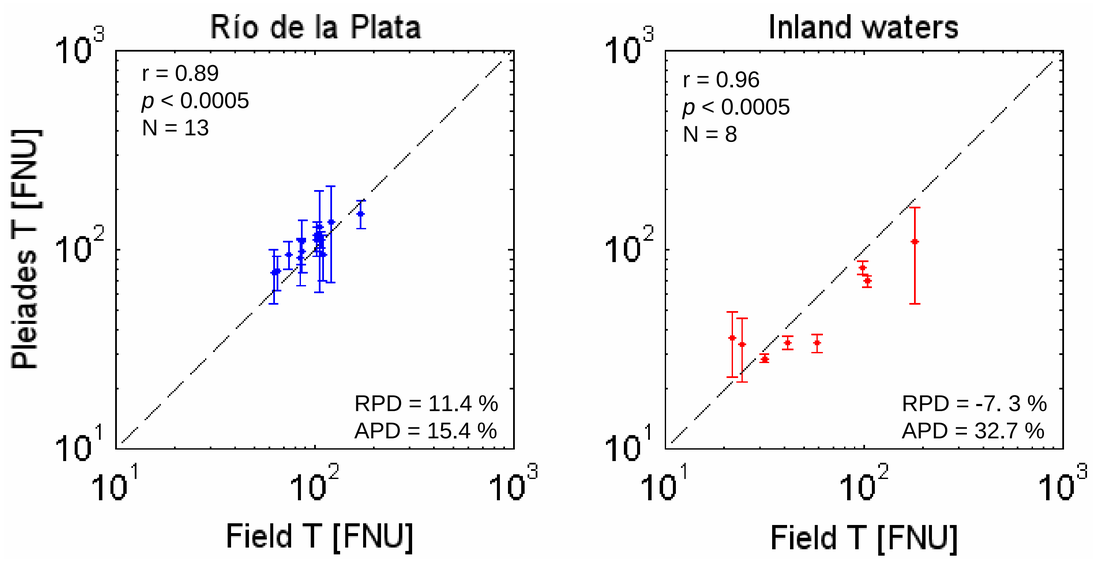
In-water Back/Side-scattering of OBS3+, OBS500, & HS-4 and HACH turbidity

Image validation



Pléiades Rayleigh-corrected RGB image acquired on 24 November 2015 and processed using ACOLITE

Pléiades atmospherically corrected $\rho_{w+glint}$ (ε=1 ρ_{am}=0.02) & de-glinted ρ_w using [2] and blue band at FP



Scatter plot of field (HACH) & Pleiades derived turbidity using [1,2] for water samples collected in the Río de la Plata (blue) and from in-land waters (red)

$$APD = \frac{1}{N}\sum_{n=1}^{N}\frac{\left|PP_{\text{mod}} - PP_{field}\right|}{PP_{field}} \times 100$$

$$RPD = \frac{1}{N}\sum_{n=1}^{N}\left(\frac{PP_{\text{mod}} - PP_{field}}{PP_{field}}\right) \times 100$$

Conclusions

- Common protocols have been developed for joint measurements of turbidity, reflectance and in-water side/back-scattering
- Instrument comparisons showed a high quality and harmonized data set
- Special care should be taken to remove sunglint in high spatial resolution imagery
- Satellite-derived turbidity showed good quality compared to in situ values in the highly turbid waters of RdP, but less accurate in small inland waters probably related to adjacency effects and bottom reflectance.
- Autonomous and continuous in-water measurements is the long-term goal for validation of every cloud-free satellite image from all space agencies including Sentinel-2A and 2B, Sentinel-3A and 3B, PROBA-V, Landsat-8, VIIRS, MODIS, etc.

References

[1] Dogliotti, A., Ruddick, K., Nechad, B., Doxaran, D., Knaeps, E., 2015. A single algorithm to retrieve turbidity from remotely-sensed data in all coastal and estuarine waters. Remote Sens. Environ. 156, 157–168.
[2] Lyzenga, D.; Malinas, N.; Tanis, F. Multispectral Bathymetry Using a Simple Physically Based Algorithm. IEEE Trans. Geosci. Remote Sens. 2006, 44, 2251-2259.

Acknowledgments

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