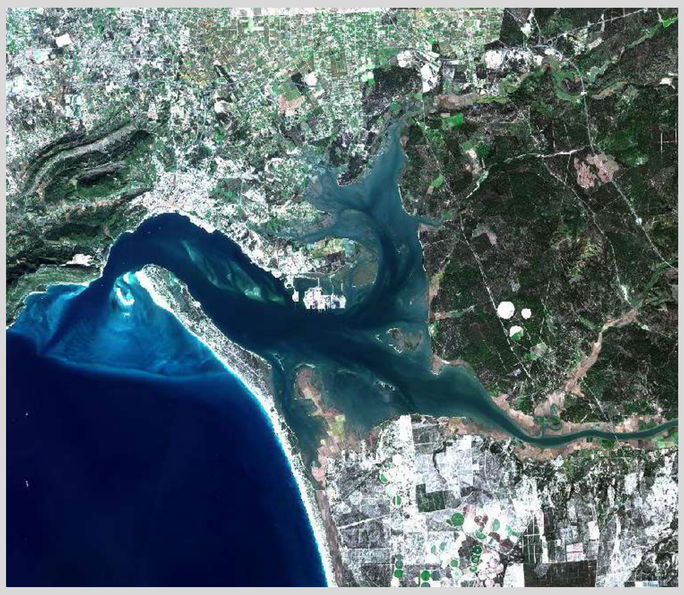
Preliminary evaluation of Sentinel-derived Suspended Particulate Matter and turbidity products in the Sado estuary (Portugal)

Sent, G.[1]; Biguino, B.[1]; Cruz, J. [1]; Heumüller, J.[1]; Cardoso, I.[1]; Sá, C.[1,2+]; Dogliotti, A.[3]; Brotas, V.[1]; Brito, A.C.[1]

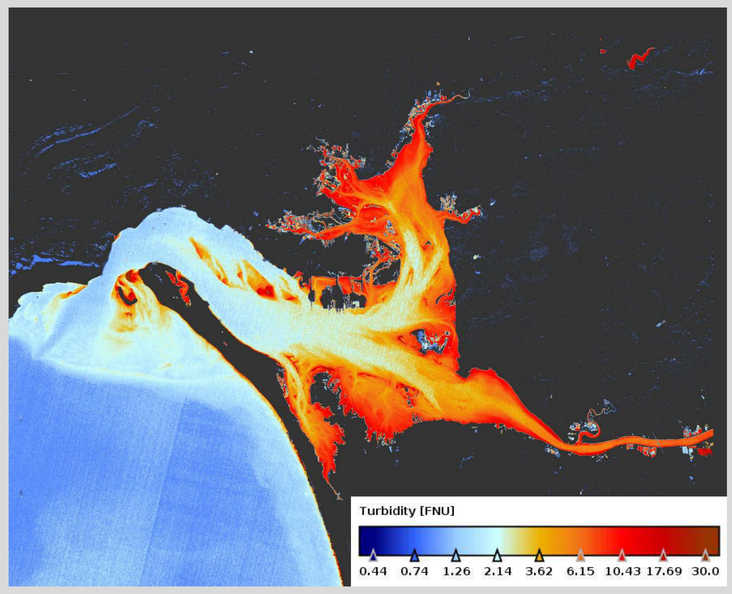
(1) MARE-ULisboa – Marine and Environmental Sciences Centre, Faculdade de Ciências, Universidade de Lisboa, 1749-016, Lisboa, Portugal. gsent@fc.ul.pt
(2) CIMA-UAlgarve – Faro, Portugal
(3) IAFE - Instituto de Astronomía y Física del Espacio, CONICET/UBA, C.C. 67 Suc.28 (C1428ZAA), Ciudad Universitaria Buenos Aires, Argentina
[+] currently at Portugal Space



BACKGROUND

- Suspended Particulate Matter (SPM) and turbidity are key parameters describing **water quality**;
- SPM and turbidity are traditionally monitored through **field campaigns** and is often necessary to assume that field samples are representative of the total area of interest;
- Remote sensing techniques, such as **Sentinel-2** and **Sentinel-3** imagery, have been shown to be a valuable tool to monitor water quality parameters.
- Many algorithms to retrieve SPM and turbidity from satellite data already exists but usually requires **regional calibration**.

Objective: To test different algorithms and atmospheric correction schemes for **SPM and turbidity retrieval in the Sado estuary**



METHODS

IN SITU DATA

AQUASADO project

Promote Sustainable Aquaculture in the Sado estuary

- Monthly sampling of 7 stations within the Sado estuary between March 2018 and June 2019;

SPM

❖Measure of the amount of particles in suspension (mgL^{-1})
❖Determined by the **filtration** of a known volume of water sample

TURBIDITY

❖ Measure of side scattering
❖ Determined through a **turbidimeter** (measures the amount of light scattered and relates it to turbidity)

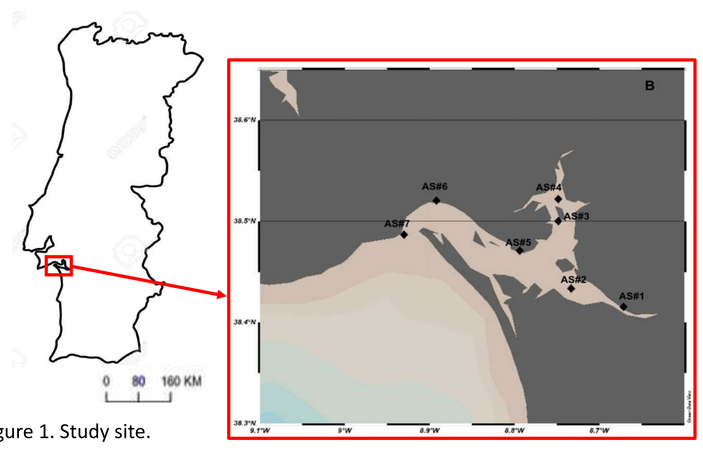


Figure 1. Study site.

❖In situ stations sampled ±2h from satellite passage have been used for the comparison with satellite data (Match-up).

❖Linear relationships between In situ and satellite values have been performed to test the various algorithms

SATELLITE DATA

SIGNAL AT THE SENSOR
90% has atmospheric origins

ATMOSPHERIC CORRECTION
To obtain water-leaving reflectances (ρ_w)

ALGORITHMS FOR WATER PARAMETERS RETRIEVAL
To convert the ρ_w into concentrations

sentinel-2 sentinel-3

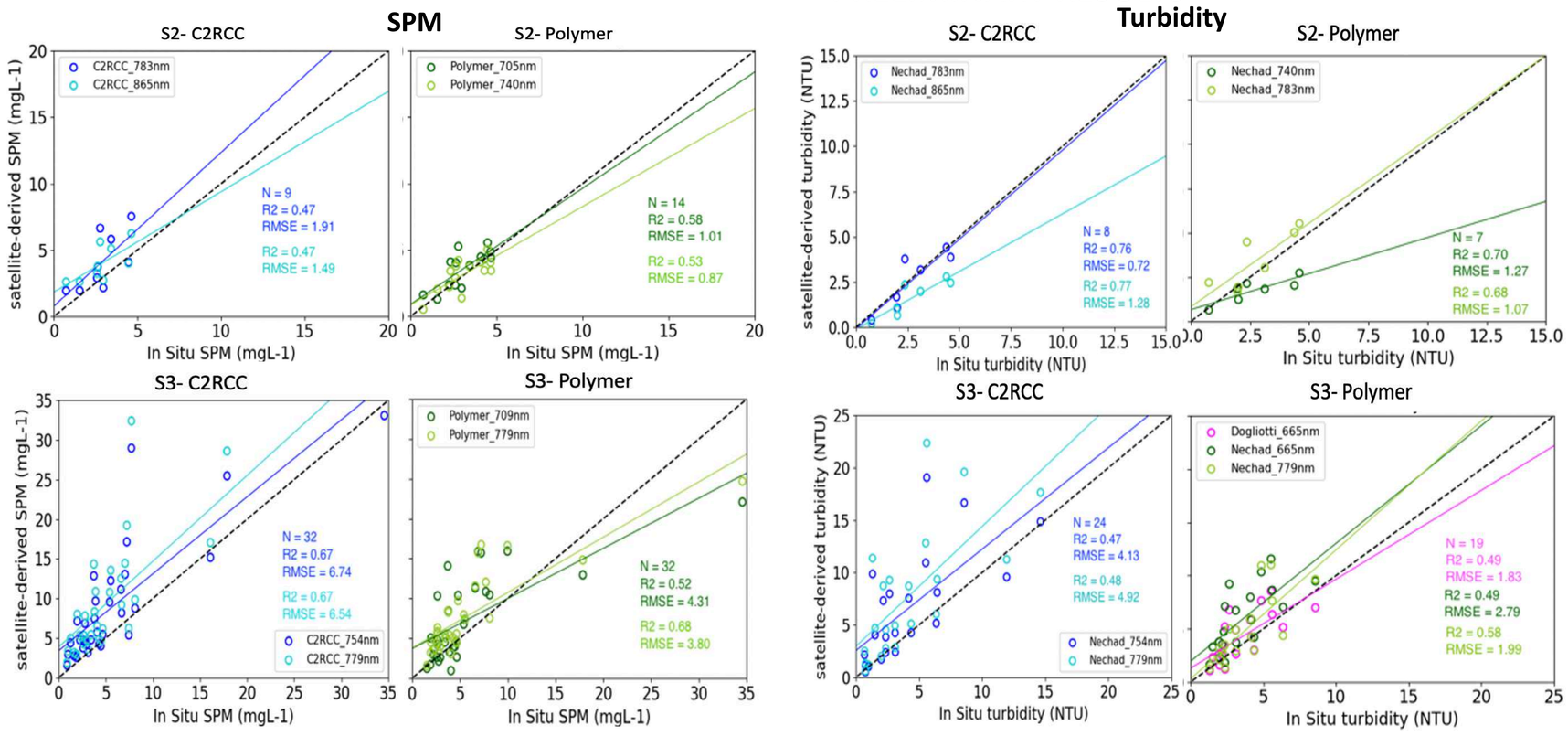
ACOLITE
BPAC
POLYMER
SEN2COR
C2RCC

ρ_w +

Nechad et. al (2009)
Nechad et.al (2010)
Dogliotti et. al (2015)

SPM & TURBIDITY

PRELIMINARY RESULTS



Summary

- **C2RCC and Polymer** resulted to be the **best performing processors** for atmospheric signal removal presenting the highest R^2 with *in situ* data;
- The slopes values showed that C2RCC works better when processing S3 data and Polymer for S2 data;
- **Turbidity can be better retrieved** from satellite data then SPM which might need a local calibration of the algorithm;
- **S3 showed some limitations** on smaller water bodies (Sado estuary) due to high spatial resolution.

CONSIDERATIONS and FUTURE WORK

❖ The present work is **a first Sentinel-2 and Sentinel-3 evaluation effort for the area**, and it is an **ongoing project**.

❖ Despite the small amount of available match-ups, the two satellites under investigation showed a **good capability for monitoring SPM and turbidity in estuarine waters** making them good potentials monitoring tools.

❖ The tested sampling stations showed a wide range of in situ SPM and turbidity, which makes them suitable for algorithms testing. However, the very **clear water** that characterize some of the stations **can lead to errors** on the determination of SPM and turbidity **due to bottom reflection**.

❖ Previous works on bigger estuaries showed that S3-retrieved SPM and turbidity presented significantly better correlations with respect to the results of S2 satellite. In the present study, some **limitations have been found by the use of S3 in a smaller water body.** This might be explained by the coarse spatial resolution of the OLCI (S3) sensor compared to the location of the sampling stations which are very close to the shore. Uncertainties can be associated to **adjacency effects of the land.**

❖ **C2RCC** processor seems to have better performance when processing S3 data while **Polymer** shows better results with S2 data.

❖ Comparing SPM and turbidity results, the **turbidity retrieval gave better correlations with respect to SPM retrieval**.

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References: : IOCCG (2018). Earth Observation is Support of Global Water Quality Monitoring. *Greb, S., Dekker, A. and Binding, C. (eds.), IOCCG Report Series, No. 17, International Ocean Colour Coordinating Group, Dartmouth, Canada. ;* **Dogliotti et. al. (2015)** "A single algorithm to retrieve turbidity from remotely sensed data in all coastal and estuarine waters". Remote Sensing of Environment, 156; **Nechad et. al. (2009)** "Calibration and validation of a generic multisensor algorithm for mapping of turbidity in coastal waters". Remote Sensing of Environment, 114 (4); **Nechad et. al. (2010)** "Calibration and validation of a generic multisensor algorithm for mapping of total suspended matter in turbid waters". Remote Sensing of Environment, 144(4).