This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 606797

Validity ranges of chlorophyll-a algorithms in coastal waters

Héloïse Lavigne[1], Kevin Ruddick[1], Quinten Vanhellemont[1], Dimitry Van der Zande[1], *contact: hlavigne@naturalsciences.be*
Royal Belgian Institute of Natural Sciences, Operational Directorate Natural Environment, Gulledelle 100, B-1200, Brussels, Belgium

Context

The use of satellite chlorophyll a (Chl-a) data in coastal and inland water for applications such as eutrophication monitoring and algae bloom detection requires careful quality control. Standard products exist for medium resolution Ocean Colour sensors, however their quality is highly variable depending on the water characteristics and on the algorithm used. In addition, the interest in high spatial resolution data from sensors such as Landsat-8/OLI and Sentinel-2/MSI, with less suitable spectral band sets and higher noise, adds to quality problems.

Objectives

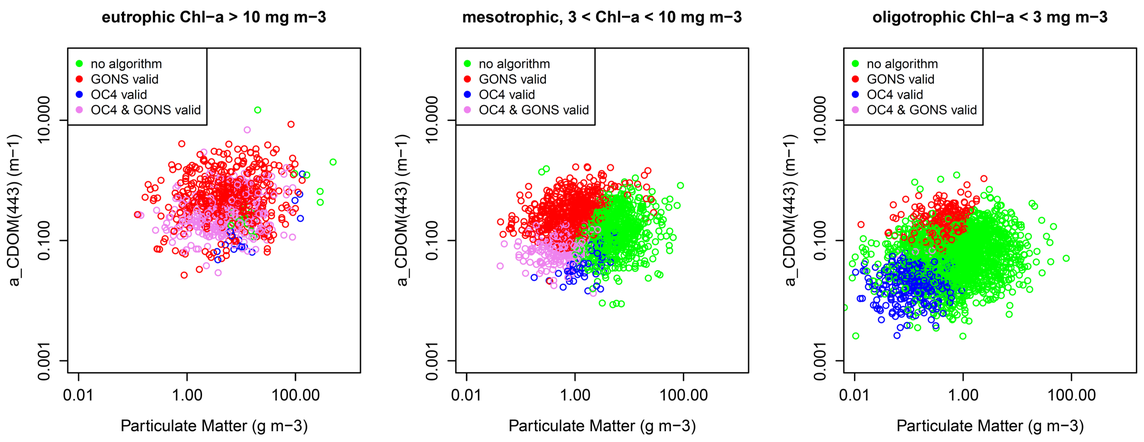
1/ Determine ranges of validity for two Chl-a algorithms:
- ✓ **the case-2 Gons (1999) algorithm based on red/NIR reflectance ratio**
- ✓ **the case-1 OC4 algorithm based on blue/green reflectance ratio**

2/ Identify simple tests based on reflectance to provide quality flags for each algorithm.

Evaluation of OC4 and Gons Chl-a algorithms using the synthetic Coast Colour Round Robin (CCRR, Nechad et al., 2015) dataset

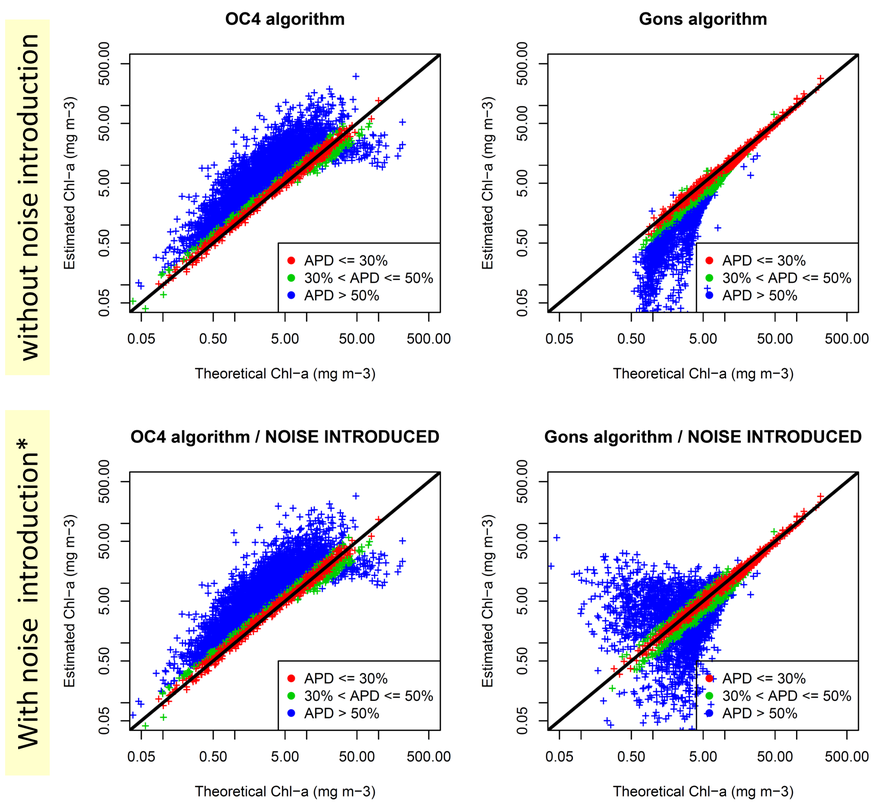
OC4 and Gons algorithms with a MERIS calibration (Morel and Antoine, 2011 and Gons et al., 2002) have been applied to simulated MERIS bands from the CCRR dataset.
*To simulate realistic ocean colour dataset, noise has been added. Noise is simulated with a normal distribution centered on 0 and with a variance σ^2. σ is defined for each band as the minimum uncertainty expected in ocean colour products processed with a NIR based atmospheric correction (ACE Ocean Science Team, 2010).

Theoretical domains of application

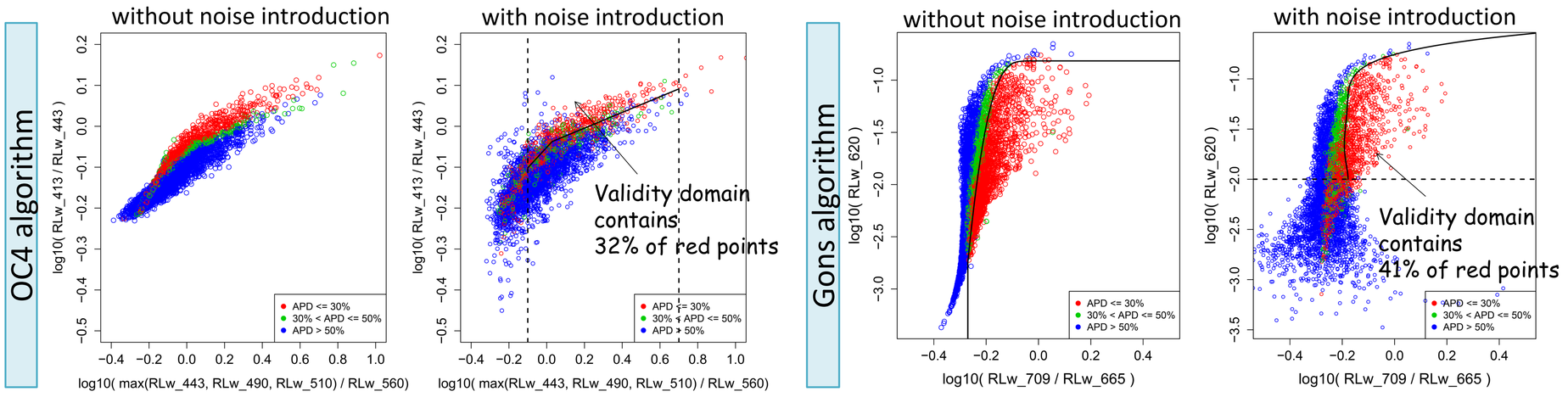


The validity threshold for the Chl-a algorithms has been arbitrarily set at 30% Absolute Percent Difference
Results are obtained from original CCRR dataset without noise introduction.

Performance of the Chl- a algorithms



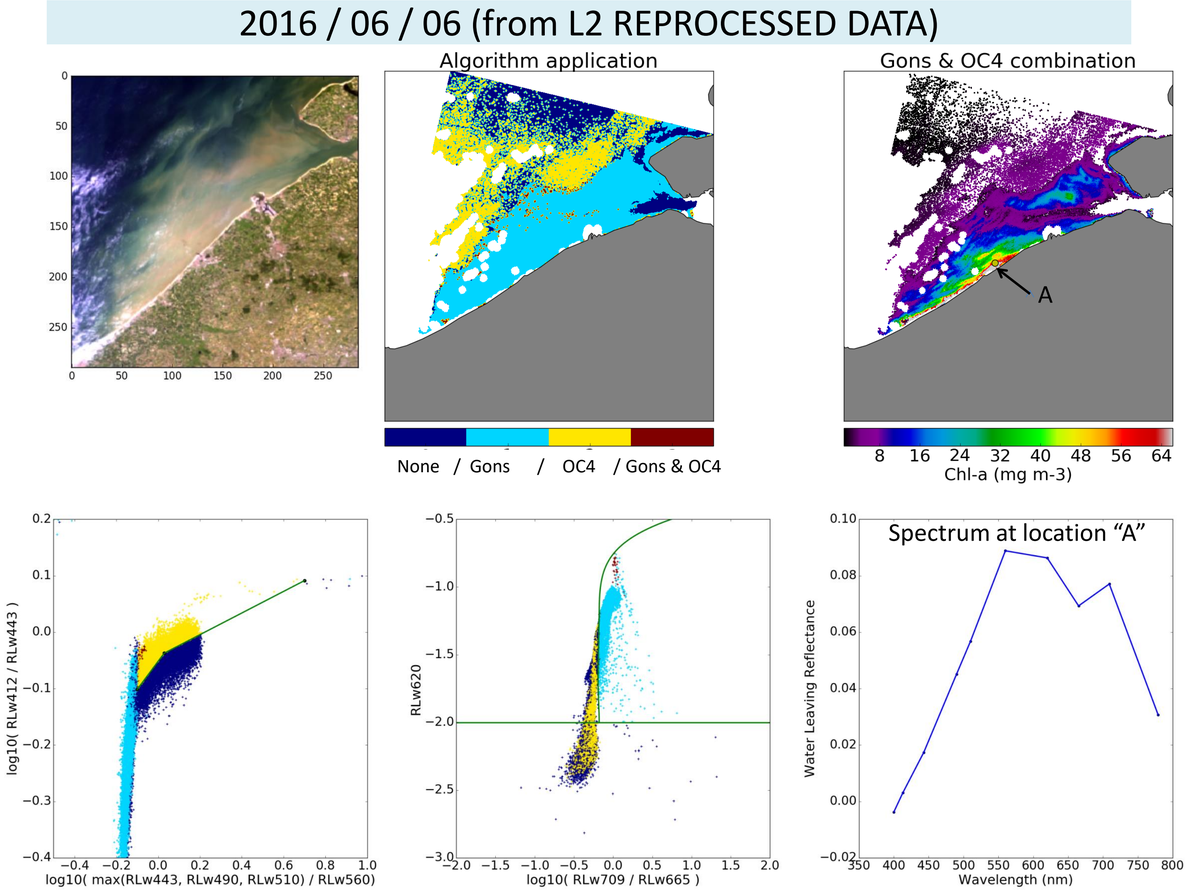
Identification of criteria based on reflectance to determine if algorithms can be applied



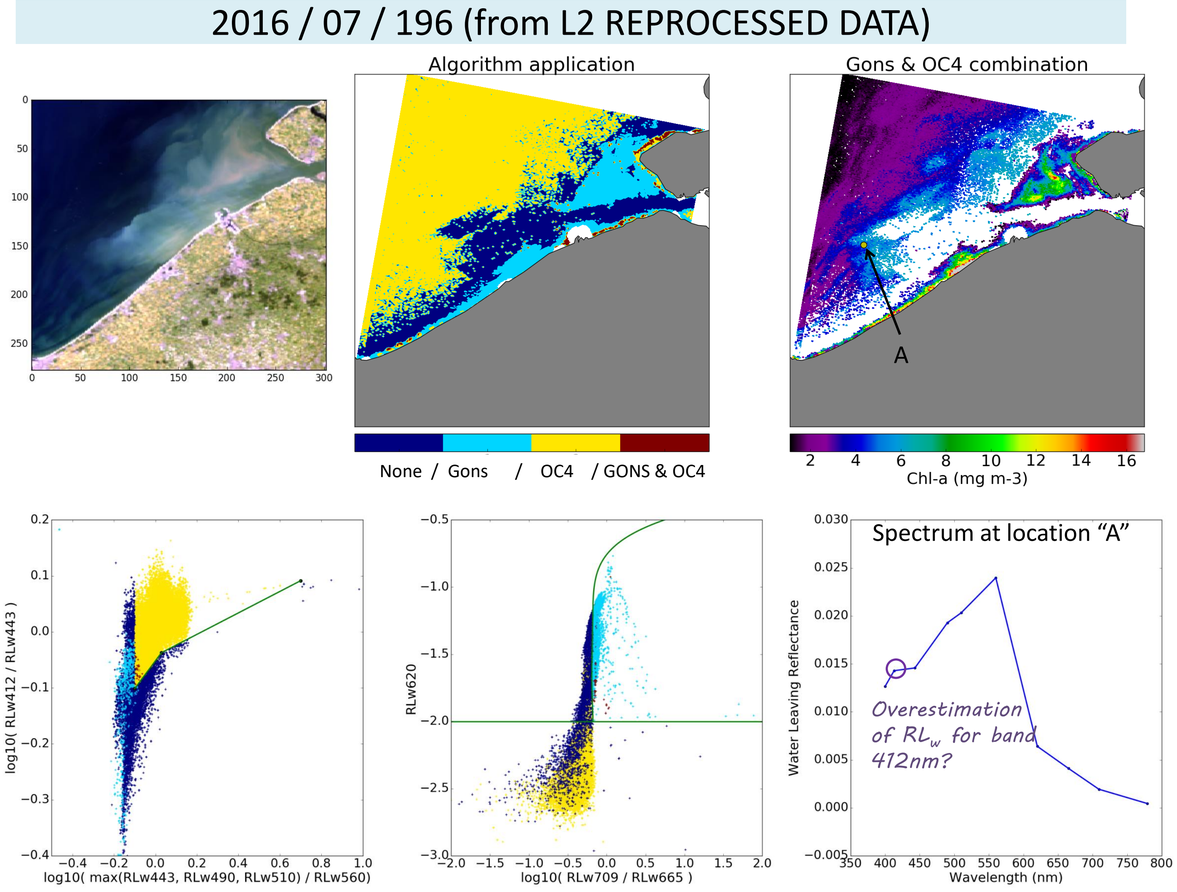
<u>Summary:</u>
OC4 and Gons algorithms are valid on 18.7% and 38.8% of the dataset, respectively.
However, noise reduces validity ranges.
Applying reflectance criteria, Chl-a can be estimated for only 22% of the dataset. Other algorithms should be considered to fill the gap.

Application to Sentinel 3 / OLCI images in Belgian waters

2016 / 06 / 06 (from L2 REPROCESSED DATA)



2016 / 07 / 196 (from L2 REPROCESSED DATA)



REFERENCES: Gons, H.J., 1999. Optical teledetection of chlorophyll a in turbid inland waters. Environmental Science & Technology, 33(7), pp.1127-1132; Gons, H.J., Rijkeboer, M. and Ruddick, K.G., 2002. A chlorophyll-retrieval algorithm for satellite imagery (Medium Resolution Imaging Spectrometer) of inland and coastal waters. Journal of Plankton Research, 24(9), pp.947-951. Morel A. and Antoine D., 2011. Pigment index retrieval in Case 1 waters. ATBD2.9, European Space Agency. ACE Ocean Science Team. ACE Ocean Biology White Paper, Appendix https://neptune.gsfc.nasa.gov/uploads/files/ACE_ocean_white_paper_appendix_5Mar10.pdf , 2010.