HIGH QUALITY *SARGASSUM* MAPPING IN THE W-ATLANTIC WITH OLCI (SENTINEL-3): IMPLICATIONS FOR *SARGASSUM* RAFT DETECTION, MONITORING AND DYNAMICS UNDERSTANDING

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Introduction

- Since 2011, holopelagic *Sargassum spp.* algae, commonly found in the Sargassum Sea, repeatedly stranded on Caribbean coasts causing large ecological, societal and economical damages.

  … Their origin as well as the causes of their arrival in the Caribbean are still unknown.

- With their high spatial and temporal resolution and coverage, ocean color satellites are powerful tools to detect (using specific spectral indexes) and map Sargassum, and study their distribution and dynamics.

- Here we illustrate how the recently launched **OLCI/sentinel-3** ocean color sensor improve the Sargassum rafts **detection**, **characterization** and **monitoring** by providing **high quality Sargassum maps at high spatial resolution and relatively unaffected by cloud artifacts.** This, associated with MODIS and OLI data, allow a better understanding of the **rafts formation, structuring and transport** in relation with their **biogeophysical environment**.

Satellite sensors and Floating algae Spectral Indexes

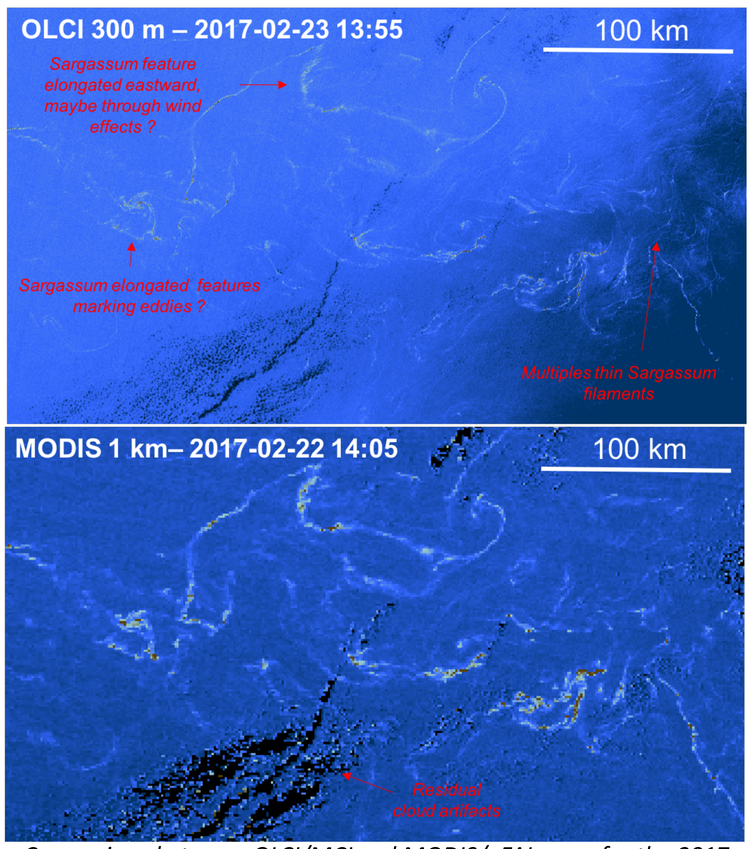
In this study, Maximum Chlorophyll Index (MCI) is used for OLCI and (alternative) Floating Algae Index aFAI and FAI are used for MODIS and OLI, respectively.

$$Spectral\ Index = r(\lambda_2) - \left[r(\lambda_1) + (r(\lambda_3) - r(\lambda_1)) \times \frac{\lambda_2 - \lambda_1}{\lambda_3 - \lambda_1}\right]$$

OC sensors	Spectral Index	Radiometric data	λ_1 (nm)	Spectral feature	Reference
OLCI	**MCI**	top-of-atmosphere radiance (Lt)	λ_1 = 681 λ_2 = 709 λ_3 = 754	709 nm peak of phytopkton or floating vegetation and red-edge	Gower et al., 2005
MODIS	**aFAI**	Rayleigh-corrected reflectance (Rrc)	λ_1 = 667 λ_2 = 748 λ_3 = 869	red-edge	Wang and Hu, 2016
OLI	**FAI**	Rayleigh-corrected reflectance (Rrc)	λ_1 = 655 λ_2 = 865 λ_3 = 1609	red-edge	Hu et al., 2009

Improvement of OLCI for Sargassum rafts detection (D), characterization (C) and monitoring (M)

			D	C	M
Spatial resolution	300 m	➢ Increase the number of Sargassum raft detection by (i) detecting small rafts and (ii) reducing the cloud cover.	X		X
		➢ Better characterization of raft size and shape		X	
		➢ Better estimation of the raft position from ship/coast for campaign adaptive routine and sampling and beach stranding prevention.			X
Temporal resolution & Spatial coverage	• Global coverage every ~3 days in Full resolution in the Western Tropical North Atlantic (WTNA) • Overlapping with MODIS T (Time difference < ~1h) & MODIS A (Time difference > ~3h)	➢ Densify the Sargassum satellite observations => diminish missing data due to cloud cover, sunglint patches and orbit tracks.			X
		➢ Increase the detection robustness by combining MODIS and OLCI detection during overlapping	X		
Spectral resolution	• 21 spectral bands from 400 to 1020 nm • Spectral band at 709 nm inherited from MERIS.	➢ Allow a direct application of the MCI spectral index on OLCI L1B data.	X		
		➢ 709 nm band more sensible to small and/or submerged raft	X		X
		➢ MCI nearly unaffected by clouds artifacts compared to FAI/aFAI.	X		X
		➢ Add spectral information that could allow discriminate Sargassum from other floating vegetation.		X	



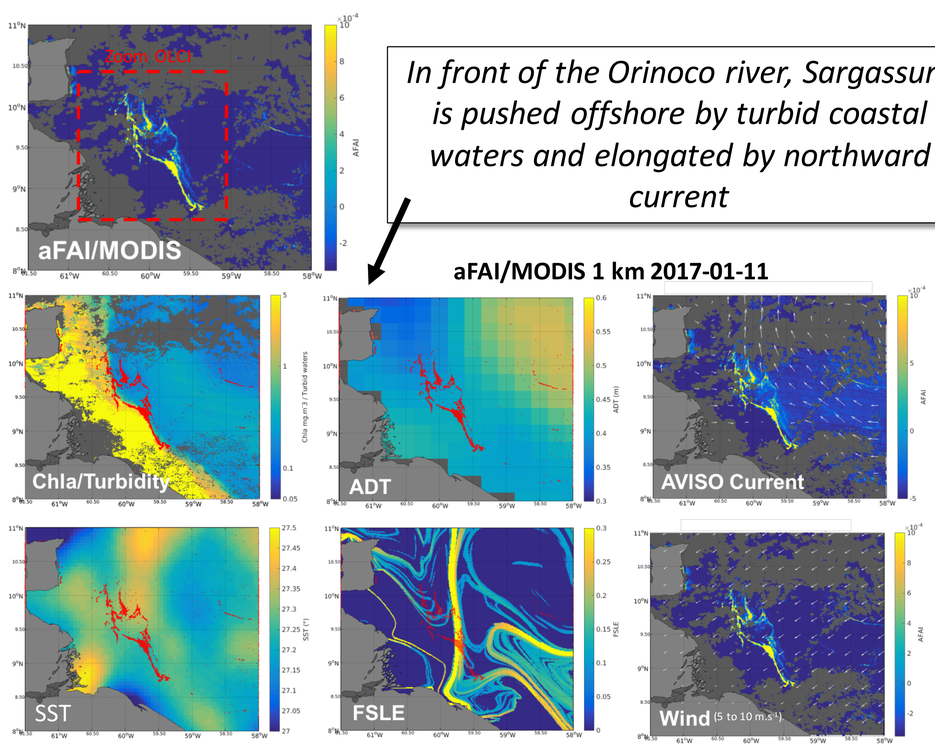
Comparison between OLCI/MCI and MODIS/aFAI maps for the 2017-02-23 (14.8°N,-56.2°E). Black regions corresponds to cloud masking.

Sargassum rafts in their biogeophysical environment using MODIS, OLCI and OLI

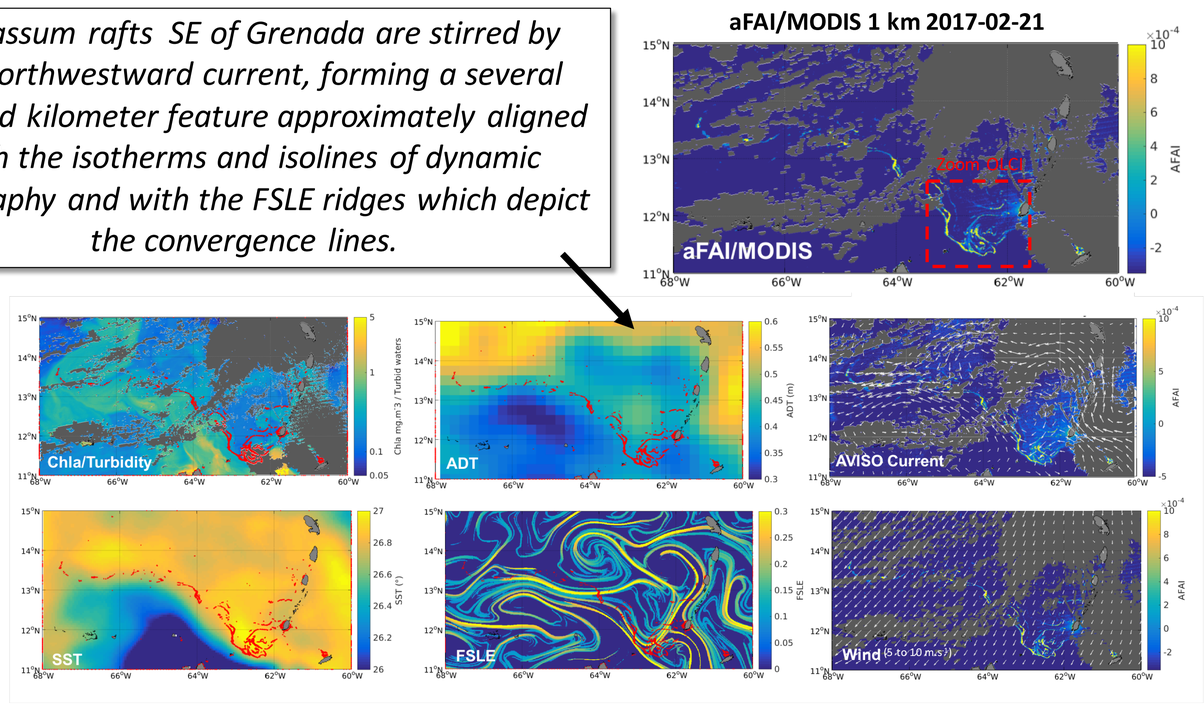
- To understand the dynamics involved in the formation, structuring and transport of the *Sargassum* rafts at various scales, detection from MODIS (1 km), OLCI (300 m) and OLI (30 m) are analysed in the fields of their multiparametric environment, derived from spatial observations and from model simulations.
- The **SPASSO software** (www.mio.univ-amu.fr/SPASSO ; Doglioli et al., 2013) is used on Delayed Time mode in order to automatically provide the multi-field parameters.

Mesoscale

In front of the Orinoco river, Sargassum is pushed offshore by turbid coastal waters and elongated by northward current

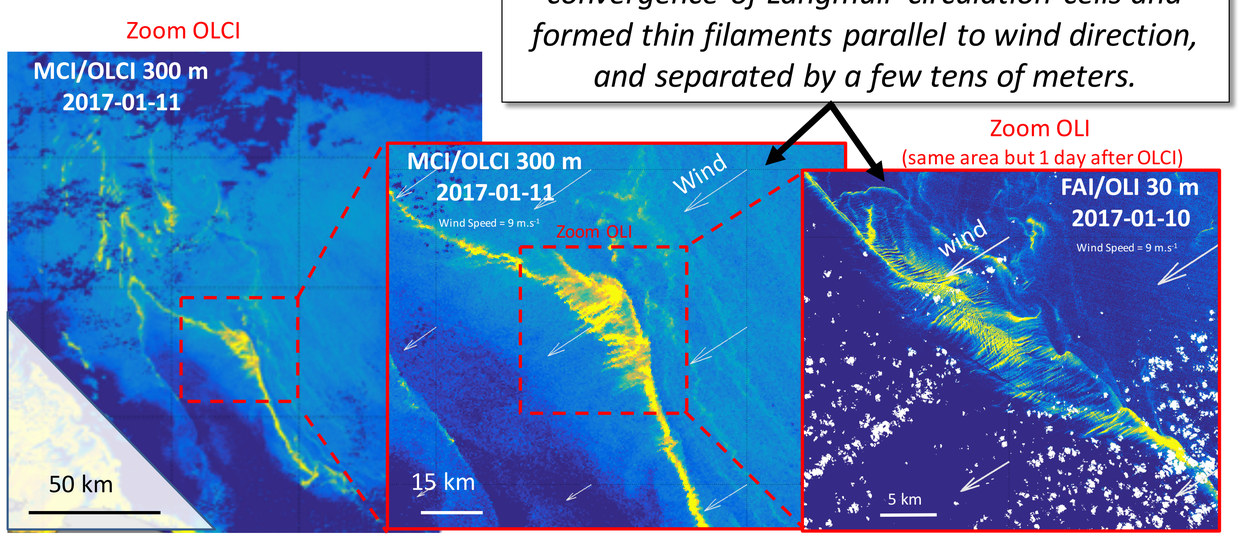


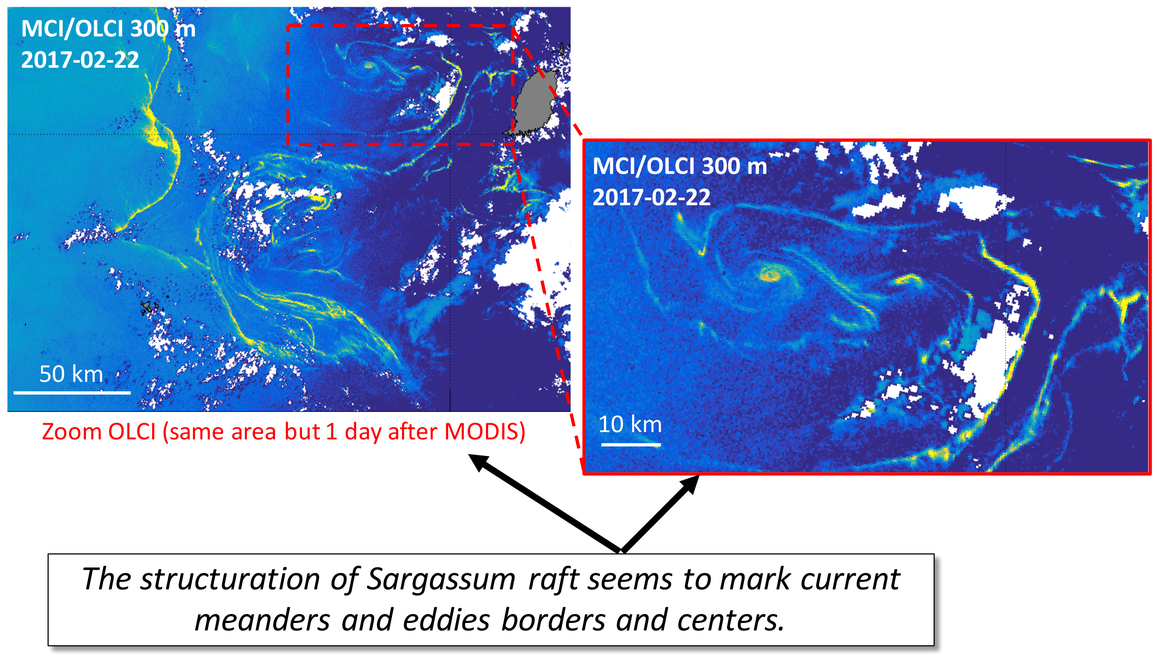
Sargassum rafts SE of Grenada are stirred by the northwestward current, forming a several hundred kilometer feature approximately aligned with the isotherms and isolines of dynamic topography and with the FSLE ridges which depict the convergence lines.



SubMesoscale

Sargassum appears to be aggregated at the convergence of Langmuir circulation cells and formed thin filaments parallel to wind direction, and separated by a few tens of meters.





The structuration of Sargassum raft seems to mark current meanders and eddies borders and centers.

Data source: OLCI L1B data were downloaded on the Access S-3 PreOpsHub on Copernicus portal. MODIS L1B data were downloaded on the NASA ocean color portal and then processed to Rayleigh-corrected reflectance using seadas l2gen function. The OLI data was downloaded on the USGS portal and processed using the ACOLITE software. The Chla product is extracted from the MODIS L2 OC product. SST and wind were downloaded on Copernicus portal. ADT, current and FLSE derived from AVISO data and processed using SPASSO.