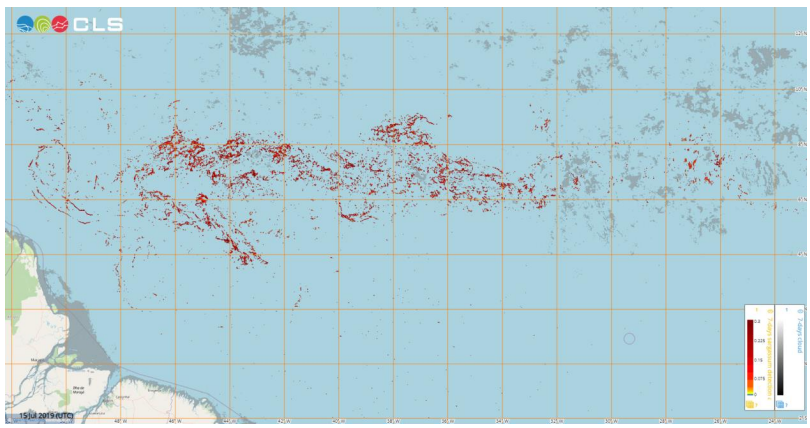
Sargassum Floating Algae Index using Sentinel-3 satellites

Dataset DOI : 10.24400/527896/a01-2022.007



Reference: SALP-MU-P-EA-23567-CLS

Issue: 1 rev 01

Date: 25/01/2024

Aviso+ Altimetry
11 rue Hermès, 31520 Ramonville St Agne, France – aviso@altimetry.fr

Chronology Issues:		
Issue:	Date:	Reason for change:
1.0	13/04/2022	1st issue
1.1	25/01/2024	Adding daily operational products (hr and lr)

Contents

1. Overview of this document

This document is the user manual for the Normalized **Sargassum Floating Algae Index using OLCI instruments onboard Sentinel-3A&B** product, processed by CLS in the frame of their operational service SAMTool (https://datastore.groupcls.com/products/samtool-sargassum-detection/). A first reanalysis of the products for the year 2019 was processed in the frame of the European project e-shape https://e-shape.eu/.

The time series of NFAI products produced since February 2022 to date are provided through Aviso+ as part of the SeSaM project: https://www.spaceclimateobservatory.org/sesam sponsored by CNES.

1.1. Acknowledgments

When using the **Sargassum Floating Algae Index using OLCI instruments** product, please cite

For the 2019 reanalysis data:

"The Sargassum Floating algae detection product has been produced by CLS in the frame of the European project e-shape https://e-shape.eu , distributed by Aviso+ (DOI 10.24400/527896/a01-2022.007) with support from CNES."

For the datasets starting in February 2022:

"The Sargassum Floating algae detection product has been produced by CLS operationally in the frame of the SAMTool service. The product is distributed by Aviso+ (DOI 10.24400/527896/a01-2022.007) with support from SCO-CNES."

1.2. User's feedback

This product is an operational product.

Therefore, each and every question, comment, example of use, and suggestion will help us improve the product. You're welcome to ask or send them to aviso@altimetry.fr.

2. Processing

Since 2011, unprecedent massive landings of sargassum seaweed (*Sargassum fluitans* and *Sargassum natans*) have been observed along the shorelines of a huge area encompassing the Gulf of Mexico, the Caribbean Sea and West Africa, having tremendous negative impacts over local communities.

Satellite imagery allows to detect the presence of floating sargassum and is a key tool to help scientists to understand the origin and the seasonality of the sargassum movements in the Atlantic, and to support local communities in the management of the next sargassum influxes. Pioneering work by Gower et al. (2006), and Hu (2009) has demonstrated the capacity of ocean colour satellites to detect sargassum rafts.

Sargassum presence is detected by the increase of the reflectance spectrum between the red and near infra-red wavelengths. Most well-known sargassum indices found in the literature, for example the Maximum Chlorophyll Index (MCI, by Gower et al., 2006), the Floating Algae Index (FAI, by Hu, 2009), the Alternative Floating Algae Index (AFAI, by Wang and Hu, 2016), follow the same mathematical statement: Index = $\rho_{NIR} - \rho'_{NIR}$

Where ρ_{NIR} denote a reflectance (or radiance) partially (or not) corrected for atmospheric effects in the near infra-red band, and ρ'_{NIR} is the equivalent NIR reflectance that would be measured at the same point in absence of sargassum. ρ'_{NIR} is approximated by a linear interpolation between the two reflectances measured at nearby wavelengths in the red and SWIR bands.

We use here a normalized version of the FAI, in which the normalization by the sum of reflectances is introduced to mitigate the variability of the FAI due to atmospheric conditions and observation geometry, as done for the NDVI over land surfaces : NFAI= = $(\rho_{NIR} - \rho'_{NIR})/ (\rho_{NIR} + \rho'_{NIR})$

A cloud masking and editing procedure is also applied to the products to remove false alarms. It consists first in coarse cloud masking, followed by spectral shape tests leading to classifying the pixel as cloud, or sargassum-free.

Daily composite maps of MCI and NFAI are built by CLS from the observation at 300m of OLCI sensor on-board Sentinel-3A and Sentinel-3B and are available at both high resolution (hr - 300m) and averaged at low resolution (lr - 1km). Daily maps of raw NFAI and raw MCI, prior to data editing (only atmospheric corrections applied) are also provided.

In the frame of the European project e-shape https://e-shape.eu/, CLS has also produced a reanalysis of weekly sargassum NFAI data using observations from OLCI sensor.

https://e-shape.eu/index.php/showcases/pilot5-4-sargassum-detection-for-seasonal-planning

The Weekly Composite of sargassum index provides the normalized floating algae index (NFAI) averaged over 7 days of data in 1-km resolution grid. It is computed from the high resolution daily products.

These three datasets (weekly reanalysis lr, daily operational hr and daily operational lr) produced from OLCI Sentinel-3A and B data are covering the whole Tropical Atlantic Basin and Gulf of Mexico.

Values of positive NFAI Indicate the presence of sargassum. Sargassum-free pixels are set to the value of -0.5. Cloud pixel are NA values

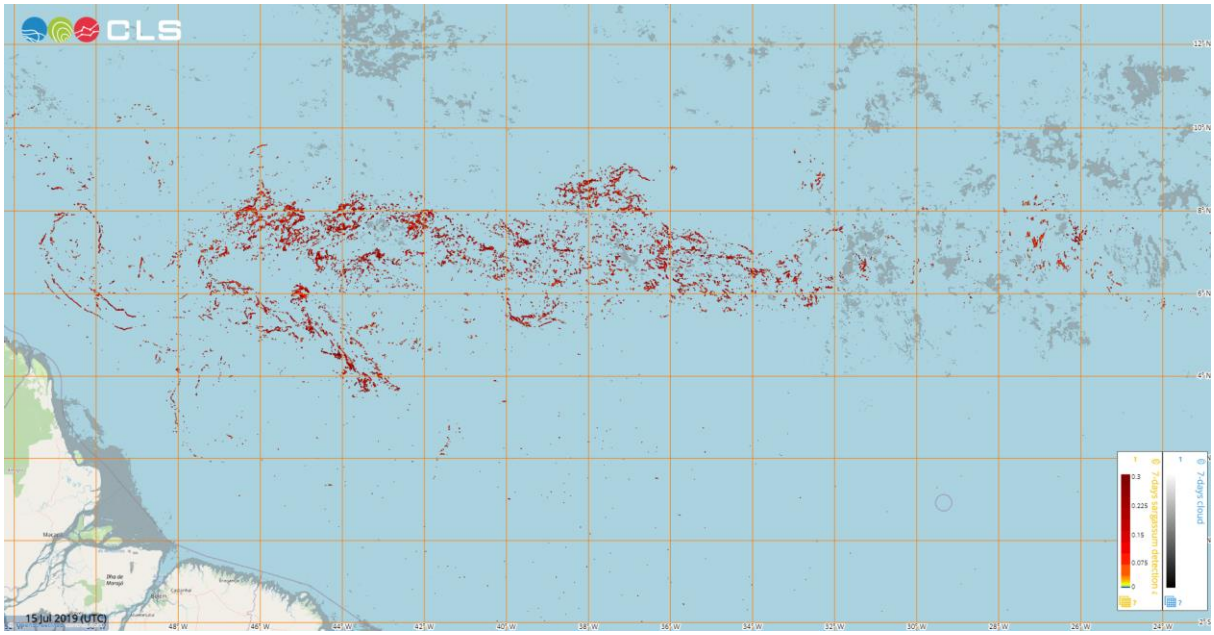


Figure 1: Detection of sargassum on weekly maps of OLCI for July 15th 2019. Sargassum mats are shown in red, cloud is shown in grey

2.1. Examples of application

The Sargassum Floating Algae product serves a diversity of users, from scientists attempting to understand the seasonal cycle of sargassum circulation in the Atlantic basin, to coastal managers trying to anticipate the upcoming sargassum influxes to warn communities well ahead of arrival, to entrepreneurs who need to know how much raw product they will have to work with.

In the frame of the SeSam project https://www.spaceclimateobservatory.org/sesam, the daily Sargassum Floating Algae products from Sentinel-3 will be used by IRD to produce a seasonal forecast of sargassum biomass in the Tropical Atlantic.

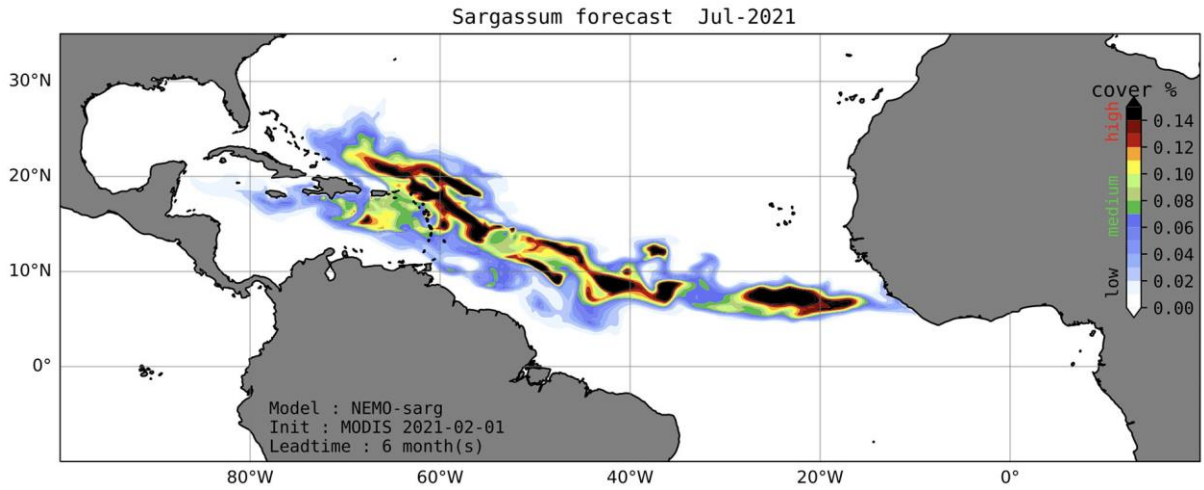


Figure 2: Sargassum surface coverage forecast (%) for July 2021 initialized on February 1, 2021 (6 months ahead). The forecast is based on the NEMO-Sarg Sargassum model, which integrates both transport and current knowledge of Sargassum physiology© IRD

3. Description of the product

3.1. Product general content and specifications

Covered period	Spatial coverage	Delivery format	Grid resolution	Update
From 2018/12/26 to 2019/12/31	Tropical Atlantic from -5°S to 30°N, 100°W to 15°E	The Weekly Composite of sargassum index provides the normalized floating algae index (NFAI) averaged over 7 days of data. It is computed from the high resolution daily products computed at 300m resolution.	1 km	One shot
From 2022/02 to month-1	Tropical Atlantic from -5°S to 30°N, 100°W to 13°E	Daily high resolution gridded products providing normalized floating algae index (NFAI).	300 m	Every day
From 2022/02 to month-1	Tropical Atlantic from -5°S to 30°N, 100°W to 13°E	Daily low resolution gridded products providing normalized floating algae index (NFAI).	1 km	Every day

Table 1: Characteristics of the Floating Sargassum Algae Index dataset.

3.2. Variables handling

The variables available in the products are:

For hr maps :

- normalized_floating_algae_index: daily value of NFAI in bin-size degree cell. Cloud is NA, Sargassum-free pixel is set to -0.5
- normalized_floating_algae_index_isolated: daily value of NFAI above sargassum threshold only (sargassum only)
- no_observation_of_normalized_floating_algae_index: daily cloud mask
- raw normalized_floating_algae_index: daily value of raw NFAI in bin-size degree cell
- maximum_chlorophyll_index: daily value of MCI in bin-size degree cell. Cloud is NA, Sargassum-free pixel is set to -0.5
- maximum_chlorophyll _index_isolated: daily value of MCI above sargassum threshold only
- no_observation_of_ maximum_chlorophyll _index: daily cloud mask
- raw_maximum_chlorophyll _index: daily value of raw NFAI in bin-size degree cell
- time-stamp: acquisition time (hour of the day)

For lr maps:

- nfai_mean = mean of mean value of normalized floating algae index in bin_size degree cell
- nfai_max = maximum of mean value of normalized floating algae index in bin_size degree cell
- nfai_min = min of mean value of normalized floating algae index in bin_size degree cell
- nfai_nbpts = number of pixel values of normalized floating algae index in bin_size degree cell

4. How to download a product

4.1. Registration

To access data, registration is required. During the registration process, the user shall accept using license for the use of AVISO+ products and services.

- if not registered on AVISO+, please, fill the form and select the product '**Sargassum detection product**' on http://www.aviso.altimetry.fr/en/data/data-access/registration-form.html
- if already registered on AVISO+, please request the addition of this '**Sargassum detection product**' on your personal account on https://www.aviso.altimetry.fr/en/my-aviso-plus.html

4.2. Access Services

Note that once your registration is processed (see above), AVISO+ will validate your registration by e-mail as soon as possible (within 5 working days during working hours, Central European Time).

Those data are delivered on the Thredds Data Server with authentication.

The access information will be available in your personal account on https://www.aviso.altimetry.fr/en/my-aviso-plus.html.

5. Bibliography

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