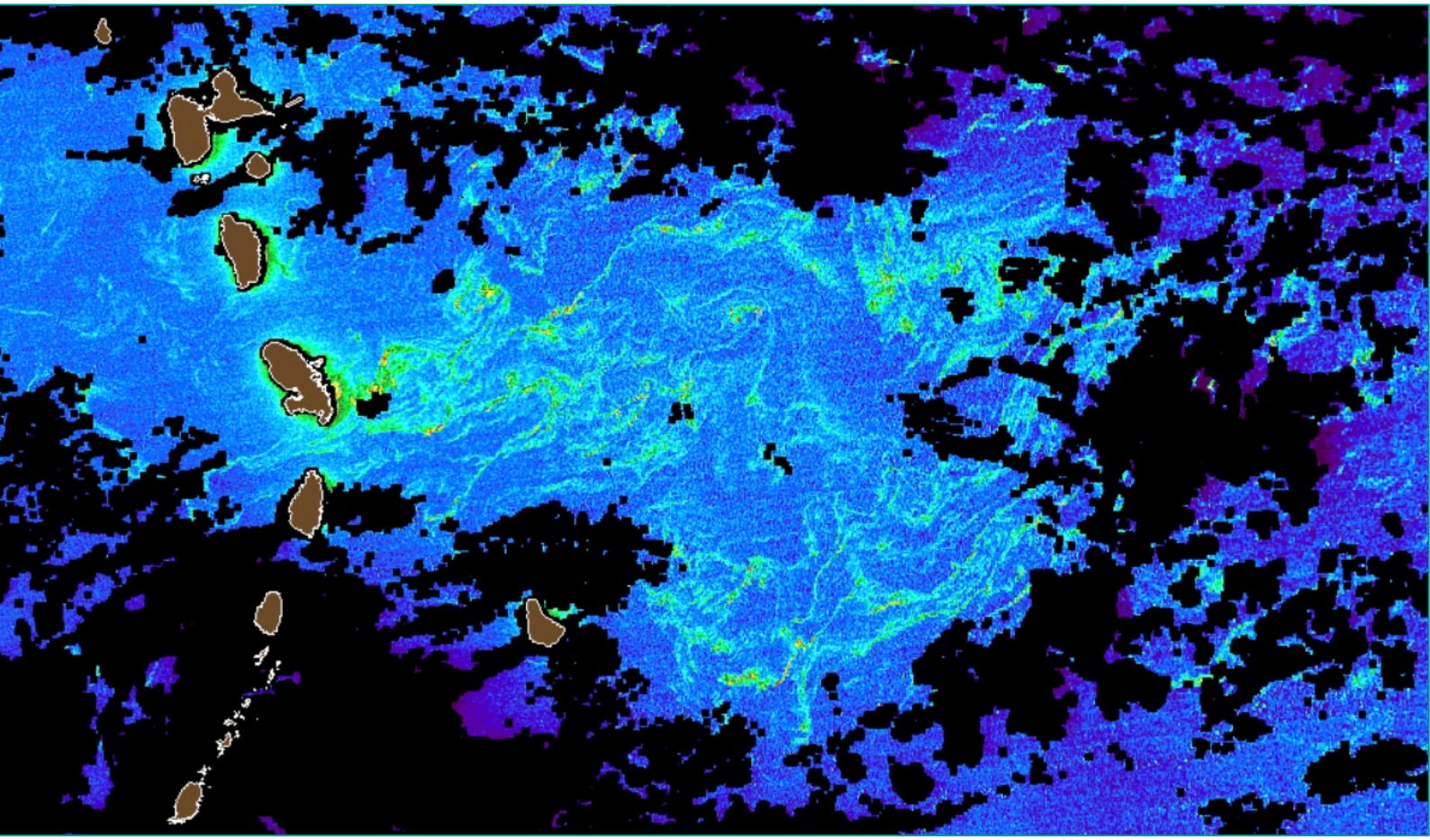
SHEET 3

OBSERVATION SATELLITES TO ANTICIPATE THE FLOWS



Using space to study Sargassum

In mid-November 2020, the skippers of the Vendée Globe were surprised on their way South by the presence of large quantities of floating Sargassum off the coast of Cape Verde, an unusual area for this type of seaweed. Thanks to satellite observations, maps were produced to enable them to plot new routes and change course. The first satellite observation is from 2011, when the first massive strandings were recorded on Caribbean and American shores.

Today, satellites are powerful allies to observe Sargassum, sometimes with a resolution of up to ten meters per pixel (a small tourist boat is visible on these images), even in the most remote places, such as the middle of the oceans.

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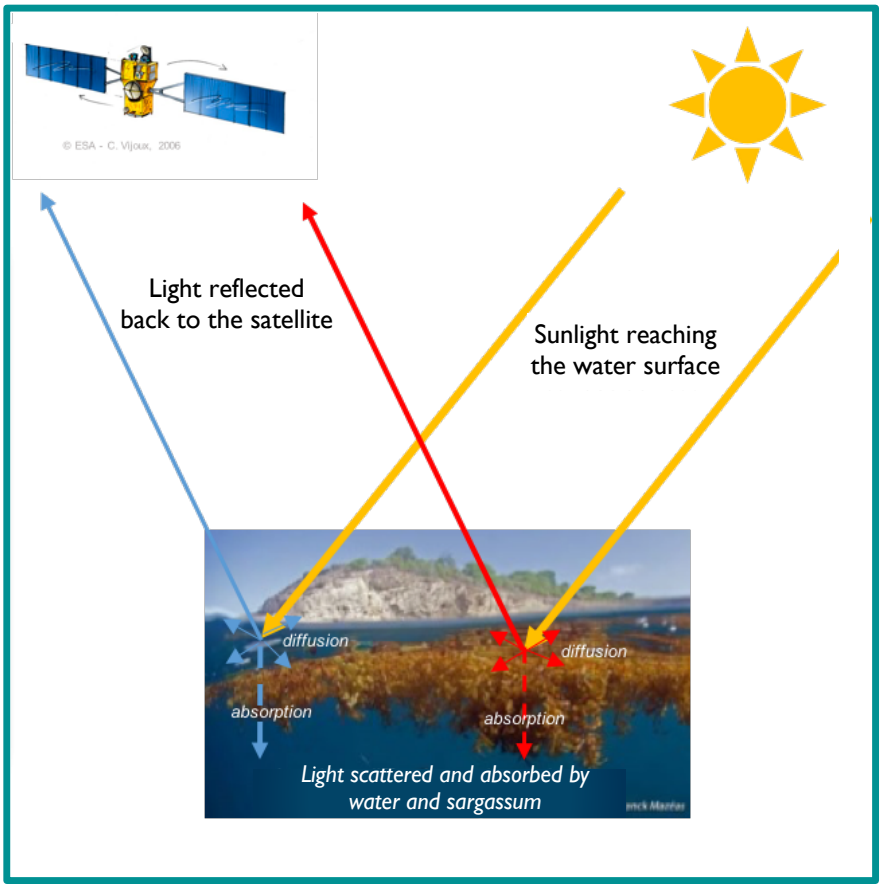
These tools are essential to observe from space the formation of the slicks and the way they move with the currents and winds. For example, we discovered that floating patches are often long filamentous structures, aligned with the currents that transport them. On a smaller and more precise scale, these same slicks drift in parallel to wind currents. The only downside is that more or less dense cloud covers can corrupt the accuracy of observation.

Light, a powerful ally

To proceed with these observations, the technological process based on light is extremely sophisticated. The so-called "radiometric" sensors installed on the satellites capture the sunlight reflected by the ocean surface. When sunlight reaches a surface, whether marine or terrestrial, part of this light is absorbed, while the other is re-emitted towards space, then captured by the satellites.

When the light rays reach the clear waters of the ocean, red and infrared sections of the light are absorbed, and only blue rays are re-emitted towards space. Whereas when light reaches floating Sargassum, the opposite happens: blue rays are absorbed and red and infrared ones re-emitted, then captured by the satellites. The more intense the red of an observed area, the more important is the presence of Sargassum (see diagram). This is the reason is why the cloud cover can compromise the observation of Sargassum, the denser it gets, the less light passes through.



What to do with all this satellite data

SPOT, NOAA Aqua, LANDSAT, Sentinel-3, MODIS etc. Several European and American satellites are working on Sargassum observation to document it from space for scientists. In 2026, the Dominican Republic will also join the observation efforts with its first high resolution sensors satellite, with low altitude orbit capacity (similar to the International Space Station).

In France and since 2018, the company Collecte Localization Satellite (CLS is a subsidiary of the National Centre of Space Studies CNES) is cross-checking these data and has established a monitoring system in collaboration with the European Space Agency called SAMTool. Originally intended for local elected officials and communities to predict the stranding and anticipate the Sargassum collection on land and sea, the tool now allows everyone to consult the daily (paid) or weekly (free) published maps regarding the geographical evolution of Sargassum patches, in addition to maps of their drift forecast. The University of South Florida produces daily maps to monitor these seaweed in the Caribbean and the Atlantic basin.

These data are extremely important to predict Sargassum strandings and anticipate the potential damages they can cause, especially in the Gulf of Mexico, the Caribbean Sea and the Atlantic.

Other information provided by satellites

In addition to Sargassum and currents, satellites provide new information based on the study of other parameters: water temperature, turbidity (indicator of water transparency) and density of phytoplankton. All these elements allow us to better understand the origins and the conditions conducive to the growth and shifting of Sargassum floating rafts. These parameters are also mapped, and the data collected allow us to have a more precise vision of the displacements of Sargassum in the Atlantic Ocean, the Caribbean basin and the Gulf of Mexico. During marine expeditions dedicated to Sargassum studies (like the IRD ship Antéa in 2017 in the Atlantic Ocean), these maps are communicated to the ship's crew who adapt their course to reach the right navigation zones, in this case those where the density of Sargassum is most dramatic. Scientists can then analyze these data.

The initiatives

Several initiatives of observation, understanding, study, and implementation of concrete tools are led by various local actors concerned by massive Sargassum stranding events.

- FORESEA (FOREcasting seasonal Sargassum Events in the Atlantic): supported by the french National Research Agency, the Region of Guadeloupe and the local authority of Martinique.FORESEA's research aims to reach better understanding of Sargassum bloom and drift in the open and coastal ocean, to be able to process this information into a seasonal forecast of the likelihood and intensity of Sargassum events. https://sargassum-foresea.cnrs.fr/
- SAREDA (SARgassum Evolving Distribution in the Atlantic): carried out by the Mediterranean Institute of Oceanology (MOI), in collaboration with LIS, HYGEOS and AERIS/ICARE, SAREDA is a system of observation and monitoring of Sargassum in the Atlantic that uses space data from NASA's MODIS instrument. The goal is to implement a processing chain to provide a new tool for remote sensing of Sargassum and to study its seasonal and interannual variations. https://www.aeris-data.fr/aeris-participe-a-la-chasse-aux-sargasses/

SOURCES

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Odatis-ocean.fr
Data-terra.org
Sargassum-foresa.cnrs.fr
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University of South Florida
Aeris-data.fr
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