SHEET 2
HYPOTHESES REGARDING SARGASSUM INFLUXES

How does sargassum reach the Caribbean?

The increase in the salinity of the oceans and the temperature of the water modify marine currents, and favor the movement of sargassum towards inhabited zones (the Caribbean, the Gulf of Mexico, Guyana, etc...). We are no longer talking about a single zone affected by these events (such as the northwestern region facing the coasts of Florida and Bermuda), but about all the oceans and adjacent seas. The trajectories of ocean currents correspond to the massive migrations of sargassum: the main sargassum migration trajectory observed in 2018 followed the same path as currents leaving the Congo delta, passing by the coast of Brazil towards the Caribbean and the Gulf of Mexico.

The Caribbean and eastern Florida region is a meeting point of ocean currents: currents leaving from southern Brazil and the Congo delta meet there, mix and then head northward around the globe. The Sargassum Sea is originally located in this area (see Map of ocean currents and satellite reading of sargassum presence). The Caribbean is no longer the only sector affected. In 2014 and 2015, strandings also occurred in Africa, from the coasts of Sierra Leone to Benin.

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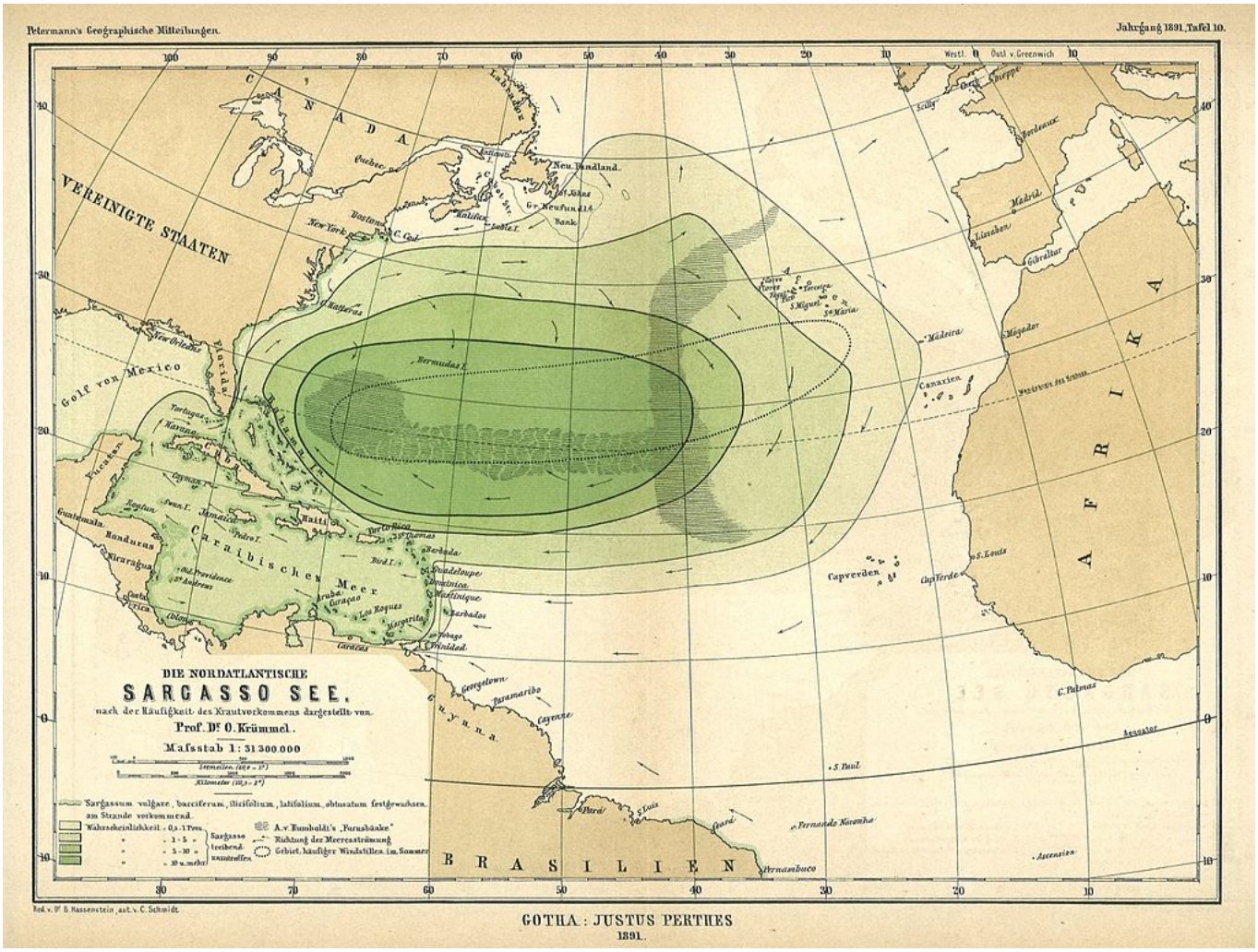
The original sea of sargassum

To understand the different hypotheses regarding the Sargassum shiftings, it is first necessary to look at the first Sea of Sargassum, which was originally mentioned by Christopher Columbus in 1493 while crossing the Atlantic. This Sargassum Sea, located off the Bermuda and Florida's shores, is at the heart of an oceanic gyre*. These currents, swirling between the open seas off the eastern United States, southern Europe and western Africa, form a marine region with no winds nor swells (see map). The currents retain the Sargassum Sea but portions of floating patches are regularly released from this oceanic gyre, scattering in the Atlantic.



Gyres are giant whirlpools of water in the oceans. They are the result from ocean currents, caused by the Coriolis force and therefore rotate clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere

Sargassum movements and sea currents

Several marine expeditions have been conducted to try to understand, through sampling of algae and water analysis, how Sargassum evolves in the oceans and the trajectories followed by the floating rafts. There is a certain correlation with the currents. Studies of satellite data combined with these samples, lead to the conclusion that the strandings that have occurred since 2011 develop from clusters of seaweed naturally present in the Tropics. Part of them also comes from the main Sea of Sargassum located off the coast of Florida.

Scientists from the University of South Florida found that the Sargassum displacements could be connected to one factor: the updrafts from West Africa, which promote the rise of nutrients to the surface, making them accessible to the seaweed in a more or less predictable way.

Global warming, the most supported hypothesis

The most supported hypothesis is that global warming could, in the long term, favor the displacement of the seaweed beds. It induces the modification of marine currents like the AMOC, which is a set of currents that regulate global temperatures, both of the air and water. Over the past 50 years, scientists observed that the AMOC has lost 15% of its flow, which implies a change in the biogeochemical composition* of the water (for example, there's been a 35% nitrogen increase in the tissues of sargassum between 1980 and 2010, proof of the enrichment in nutrients of the water). This is related to the fact that global warming slows down the AMOC, and slowing down the AMOC increases global warming. Scientists fear that in the future, warmer water will be widespread to many regions (and not just to the equatorial zone) and thus likely creating new sectors of Sargassum proliferation.

**Biogeochemistry is the scientific discipline that deals with the transformation of matter, mostly organic matter, and major elements in the biosphere, through the effect of biological, chemical and geological processes.*

A possible perpetuation of Sargassum events?

According to several researchers*, strandings of Sargassum in the Caribbean are normalizing (generally each year between April and October), and are developing in new places such as Guyana, which has only marginally started being affected by strandings since 2011. This is explained by a variation of the currents that run along Guyana and up towards the Antilles, which faintly migrated to the west. Also, the sargassum occurrences are more and more massive in terms of quantities, like in 2018 when nearly 20 million tons of seaweed in the Sargassum belt were recorded.

That same year, an anomaly in strandings (compared to previous years) was detected: the Sargassum carried by the looping currents in the Gulf of Mexico reached some areas, such as the mouth of the Mississippi River, much earlier than expected in the « season of Sargassum».

But the year of all records remains 2021, when higher levels of Sargassum than 2018 were recorded. The efflorescence of May 2021 was mostly confined to the Caribbean and West Central Atlantic Ocean, by June it had doubled, stretching all the way to the Gulf of Mexico Scientists are gaining sharper understanding of these occurrences One recent important discovery: the floating slicks that were thought to be superficial, shallow, but spread over a large surface, can actually reach down to 10 meters deep. That would explain the dramatic amount of washed up Sargassum on the coasts.

These events have multiplied since 2011, however they do not follow a precise evolution pattern- almost no strandings were recorded in 2013.

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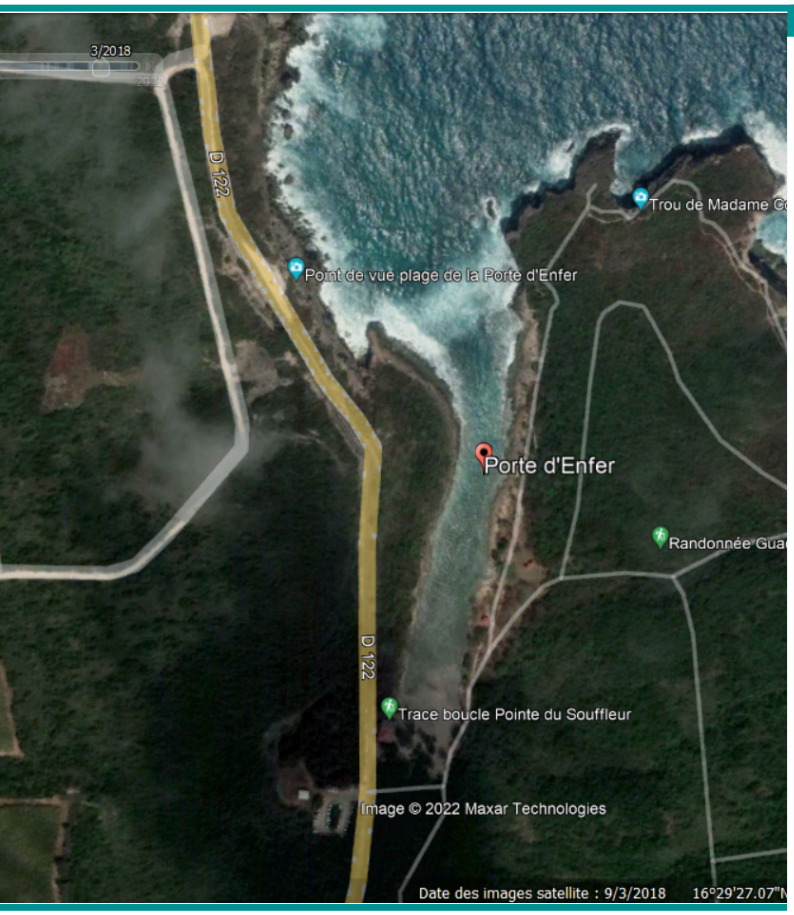

Satellite photograph of the Porte d'Enfer / Guadeloupe, taken in 2018

Satellite photograph of the Porte d'Enfer / Guadeloupe, taken en 2022

SOURCES

Report "Le phénomène d'échouage des sargasses dans les Antilles et en Guyane" (The phenomenon of sargassum stranding in the Antilles and Guayne) by Tristan Florenne, François Guerber and François Colas-Belcour
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