The spatial organization of Sargassum aggregations : insights from SWOT data

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Context and Motivation

Sargassum proliferation and massive strandings:

• Unprecedented landings of Sargassum floating algae observed since 2011 with tremendous negative environmental and socioeconomic impacts.

Remote sensing observations of pelagic Sargassum:

• At the Tropical Atlantic basin scale, observability of Sargassum assessed with the MODIS and the OLCI sensors.

• Limitations of optical sensors: only during the day, deeply affected by clouds and their shadows, false positives in high productive areas.

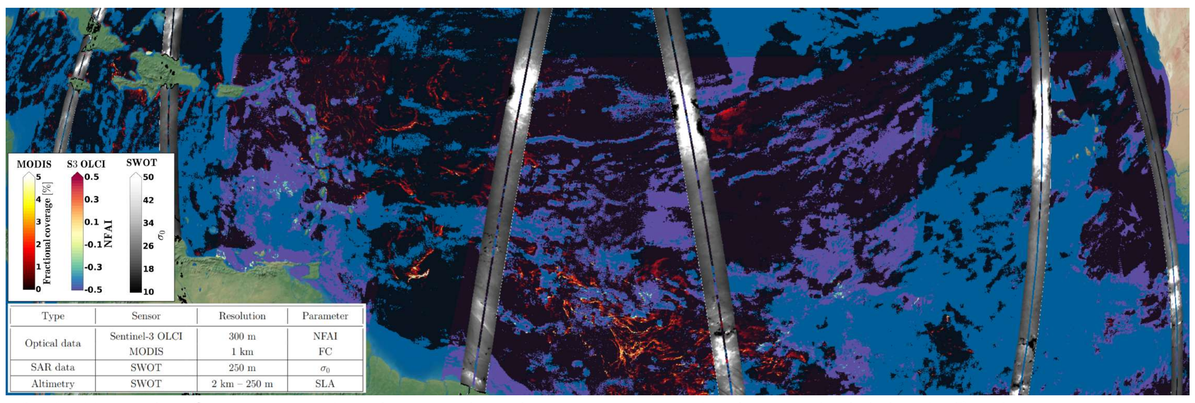


Fig 1: Example of remote sensing data used to detect sargassum in the Tropical Atlantic Bassin

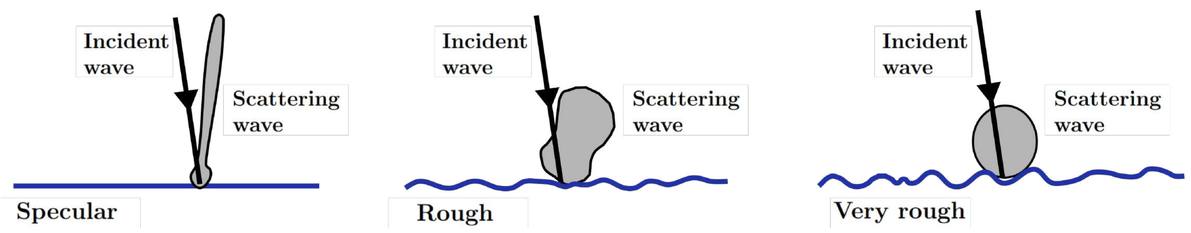
What can SWOT SAR imagery bring to the detection and tracking of Sargassum rafts?

Sargassum signature on sea surface roughness

Interpretation of backscatter signal:

• Interactions between the emitted signal and short-scale ocean waves (∼cm).

• Modulation of these short waves ⇔ signature of geophysical processes.



Hypothesis: the sargassum "destroy" the cm-scale waves inducing a specular reflection of the signal

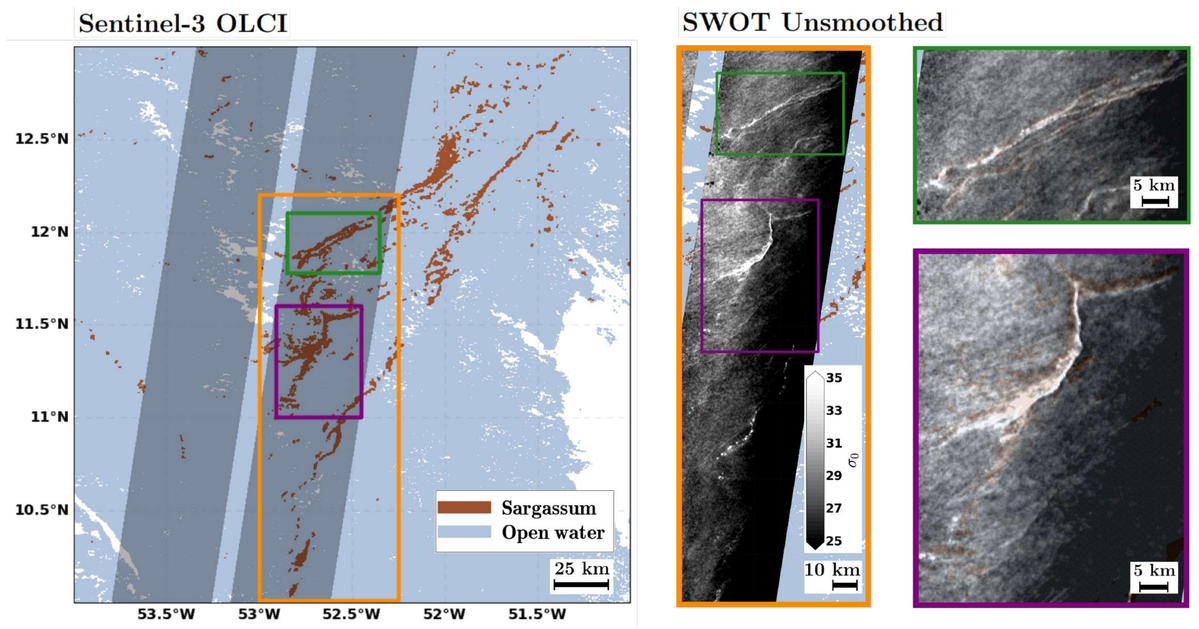


Fig 2: Colocalisation of Sentinel-3 OLCI NFAI with SWOT Unsmoothed backscatter signal σ_0 on June 18, 2023.

Focus on two contrasting case studies

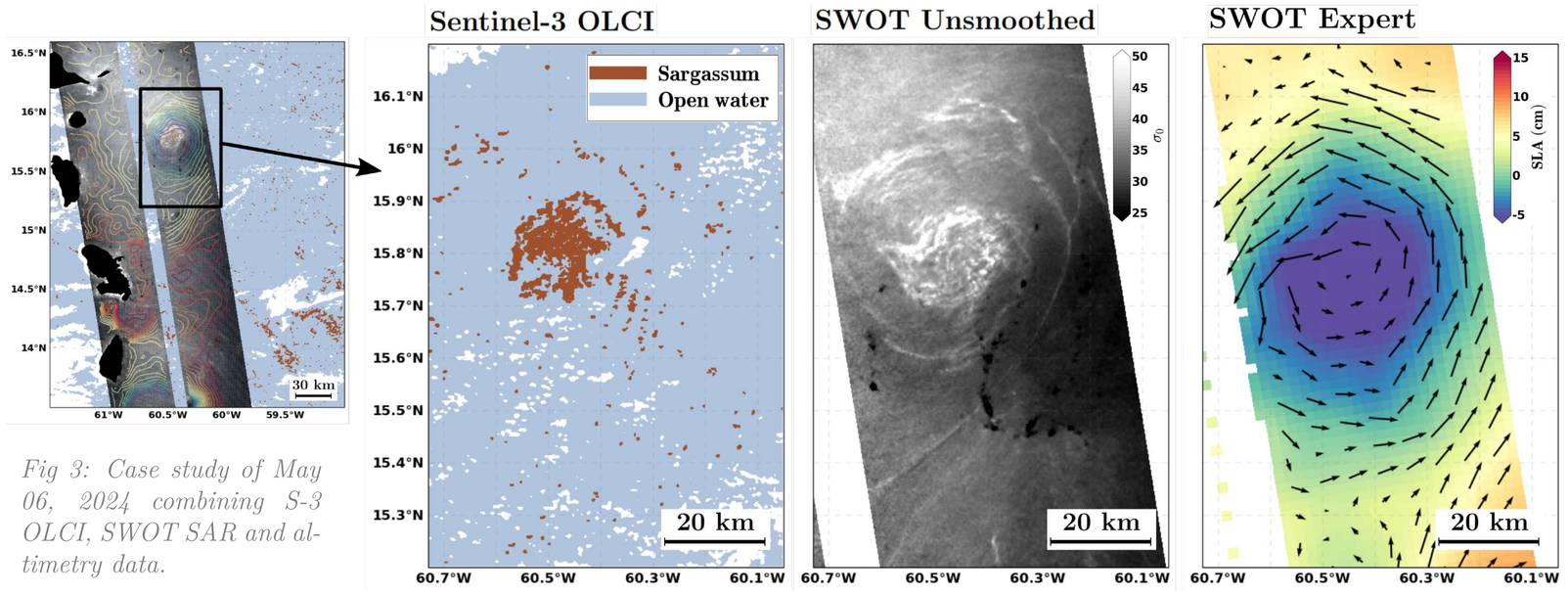


Fig 3: Case study of May 06, 2024 combining S-3 OLCI, SWOT SAR and altimetry data.

Sargassum rafts trapped by a sub-mesoscale eddy.

• Optical detection of the Sargassum raft, with Sentinel-3, colocated with the SWOT swath.

• Brightest regions of σ_0 are spatially well correlated with the optical detections.

• The high resolution SLA from SWOT, fully synchronized with $\sigma 0$, allows to catch the sub-mesoscale eddy which has trapped the Sargassum raft.

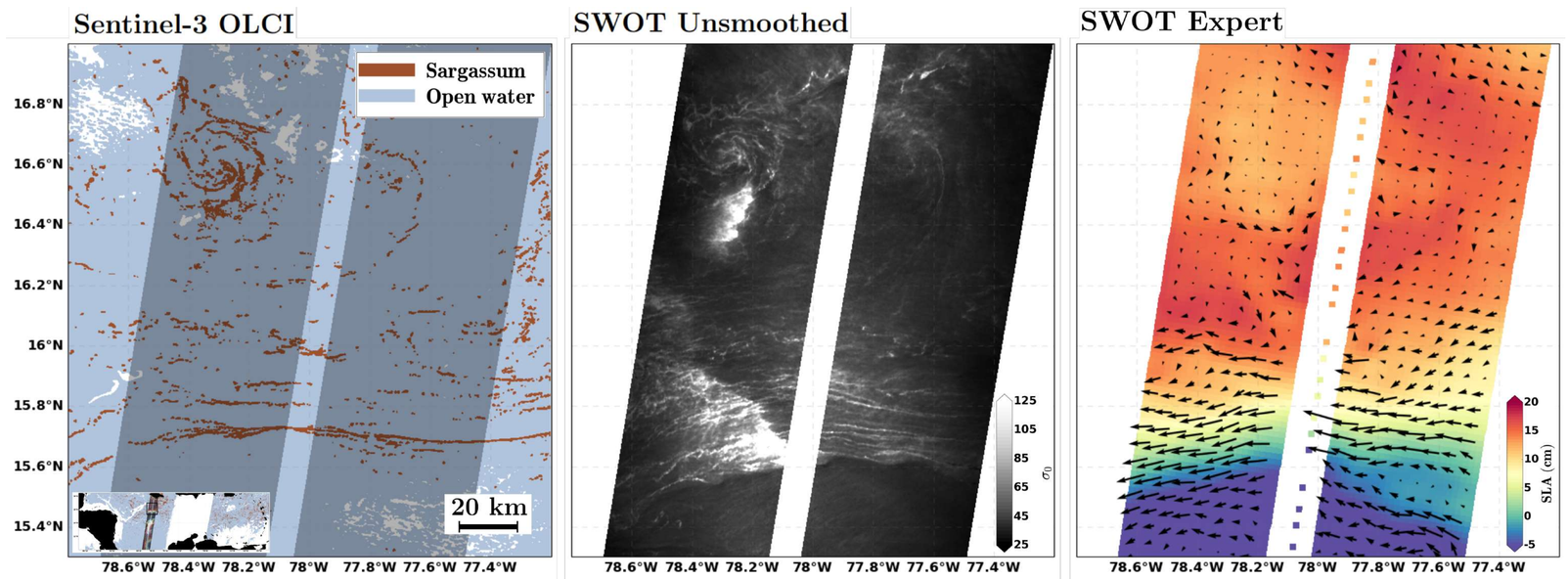
Sargassum rafts aggregated into filaments.

• Aggregation of sargassum raft into thin and stretched filaments of hundreds of km.

• Optical detection of Sargassum and SWOT backscatter signal are in agreement.

• The sub-mesoscale oceanic dynamic captured by SWOT seems to drive the spatial organization of Sargassum rafts.

Fig 4: Case study of April 25, 2023 in the Caribbean Sea.



Key points & Perspectives

- The capacity of the **SAR backscatter signal** of SWOT to **detect Sargassum** is verified through comparison with **ocean color** based detections.
- On a **same wide-swath**, the **SSH** and the σ_0 at high resolution is an **invaluable framework** for investigating the **spatial organization** of Sargassum rafts and the associated **ocean dynamics**.
- Difficulties to **disentangle** the **multiple** surface signature **processes** in the SAR signal.
- The influence of the **sea state** and **atmospheric conditions** on the **observability** of radar sargassum signatures will be investigated.

Acknowledgments

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