# Recent advances in the satellite monitoring of *Sargassum*

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Atlantic OceanWatch

# Pelagic *Sargassum*



Floating macroalgae that forms large rafts that function as a drifting ecosystem, providing valuable habitat for diverse marine organisms.

Since 2011, massive amounts of pelagic Sargassum algae began washing ashore throughout the Caribbean Sea and Gulf of Mexico. Considered a HAB.

Disrupts shipping, tourism, fishing, industry, and coastal ecosystems. Public health impacts.

**Questions:**

Effects of climate variability/change? Inter-Tropical Convergenze Zone? Nutrient fluxes from rivers? Temperature? Upwelling? Saharan dust? We need to understand growth, transport.
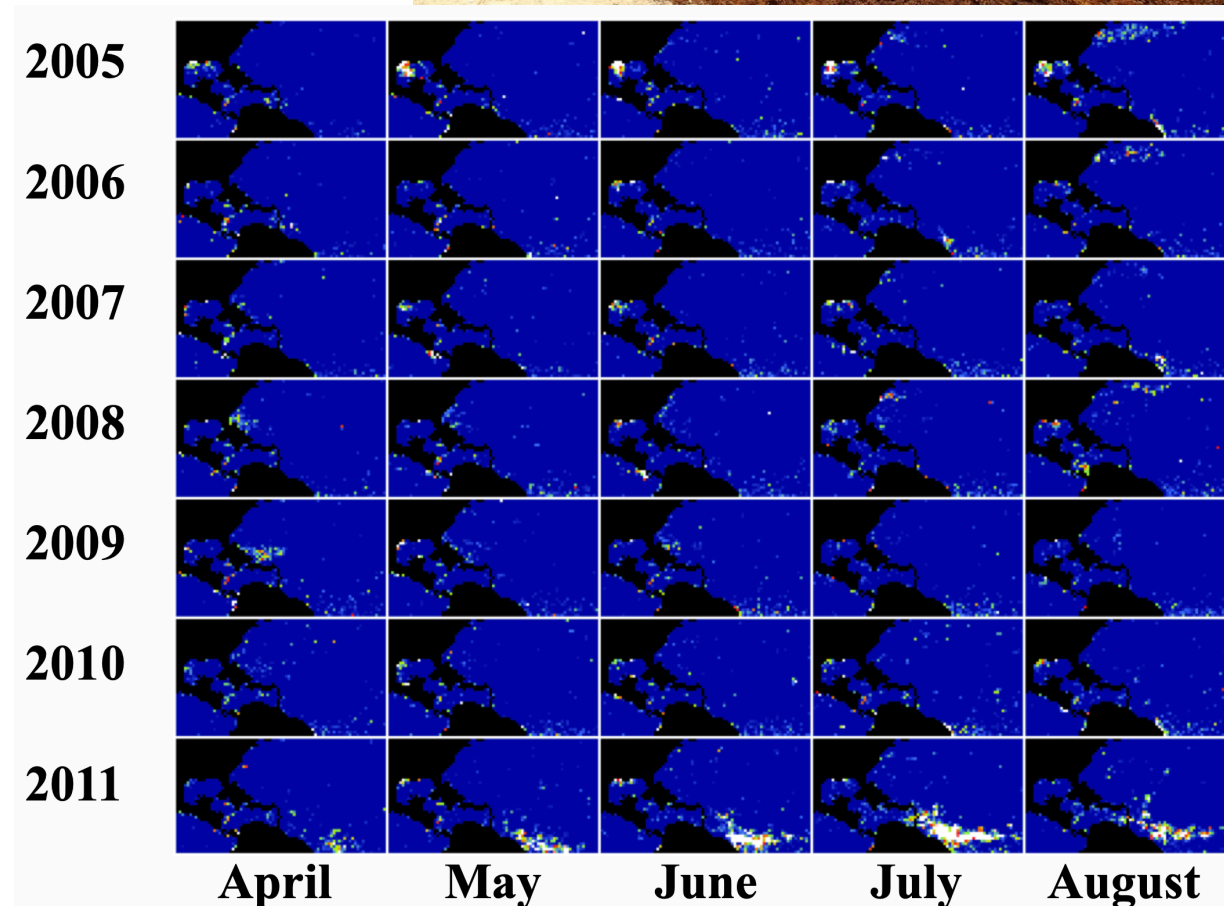


*Source: Gower et al, 2011*

# CoastWatch: *Sargassum*



**Introduction**

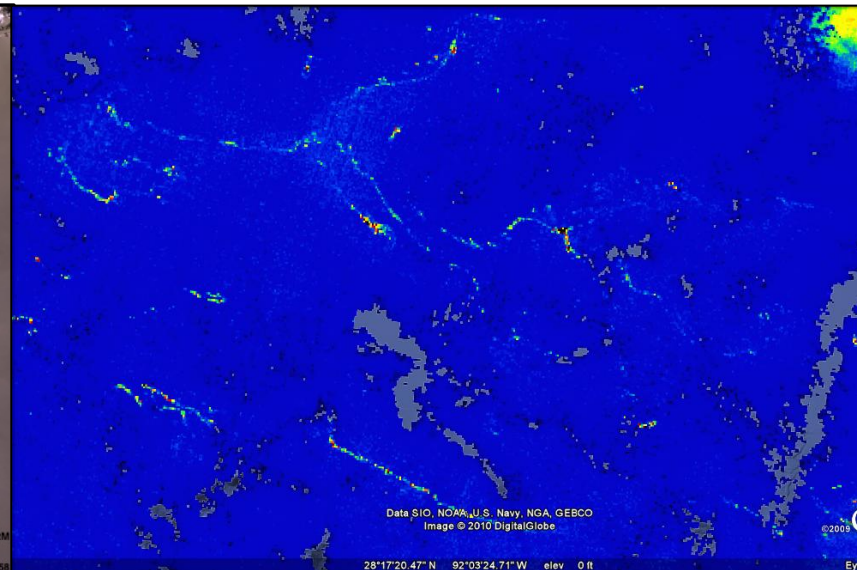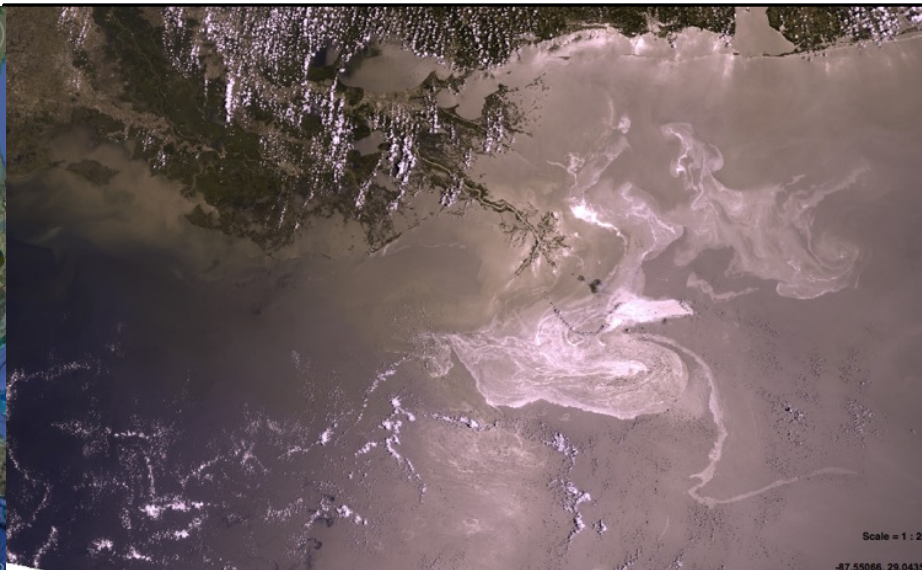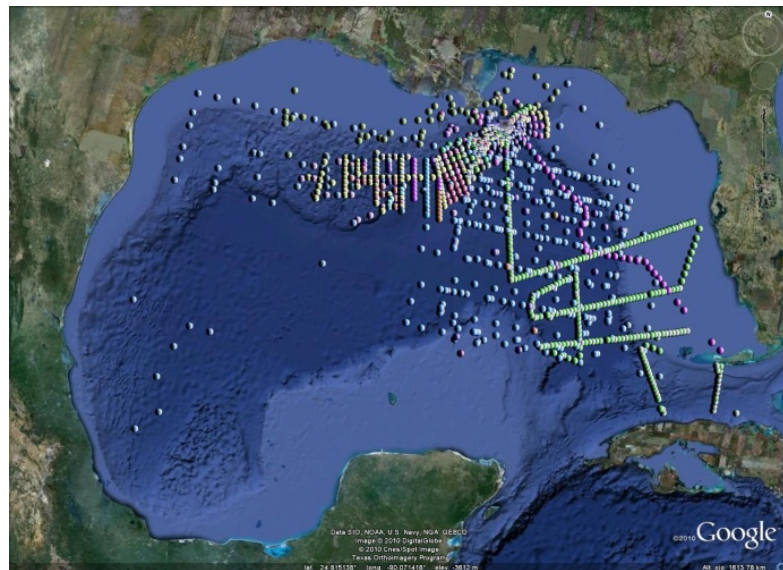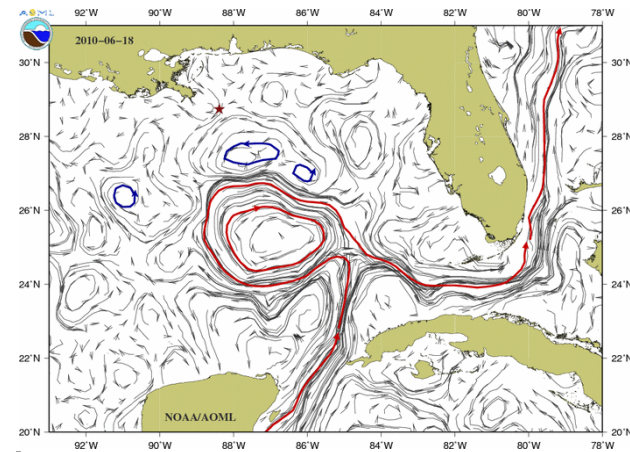During DeepWater Horizon oil spill, AOML and CW provided:

Data -> GTS

Daily updates of the location of oceanographic features in the Gulf of Mexico.

Sun-glint imagery from MERIS, MODIS and HRPT

**Issues:** SAR false positives. Real oil?

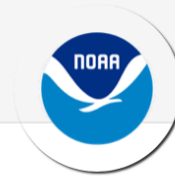**MERIS MCI :** MCI = L709 – L681 – (709 – 681)*(L754 – L681)/(754 – 681). Source: Jim Gower

# UN Ocean Decade: A Safe Ocean

**Satellite Monitoring of Pelagic Sargassum: Satellite Activity**

AGENDA    HOMEPAGE    RESOURCES

# UN Ocean Decade

SELECTED SATELLITE ACTIVITY
for the Ocean Decade Laboratories

2021 2030  United Nations Decade of Ocean Science for Sustainable Development

## Satellite Activity: Sargassum

*Updated on March 14, 2022*

Pelagic Sargassum is a buoyant macroalgae that forms rafts at the ocean surface and serve as a biologically rich habitat for hundreds of diverse marine species. Since 2011, massive blooms of Sargassum have occurred in the tropical Atlantic and swept through the western tropical Atlantic, Caribbean Sea, and Gulf of Mexico. These recurring annual events have caused significant disruptions to coastal communities throughout the region, negatively impacting human health, tourism, fishing, navigation, coastal management operations, and nearshore ecosystems, and representing a challenge to national economies and the achievement of United Nations Sustainable Development Goals (SDGs) in the region.

# UN Ocean Decade: A Safe Ocean

## Satellite Activity: Satellite monitoring of pelagic Sargassum

| Date | Wednesday, Apr 6th, 2022 |
|---|---|
| Time | 14:00-16:00 EDT; 20:00-22:00 CET<br>Duration: 2 hours |
| Facilitator | **Gustavo Goni** (NOAA/AOML) |

| Topic | Presenters |
|---|---|
| **Introduction**<br>● Why monitoring Sargassum is important? (10min) | ● **Joaquin A. Trinanes**.  University of Santiago and National Oceanic and Atmospheric Administration |
| **Science of Sargassum**<br>● Sargassum Biology (10 min)<br><br>● Sargassum Transport (10 min) | ● **Brigitta I. van Tussenbroek**. Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México.<br>● **Javier Beron-Vera**. Rosenstiel School of Marine and Atmospheric Science. University of Miami. |

| Topic | Presenters |
|---|---|
| **Monitoring Efforts**<br>● In-situ (10 min)<br><br>● Satellite (15 min) | ● **Lowell Andrew R. Iporac**. Florida International University.<br>● **Chuanmin Hu**. College of Marine Science. University of South Florida. |
| **Product Validation** (15 min) | ● **Nathan Putman**. LGL Ecological Research Associates. |
| **Integrated Forecast Systems**<br>● Synoptic (15 min)<br><br><br>● Seasonal (10 min) | ● **Marion Sutton**. Environmental Applications Department. Collecte Localisation Satellites.<br>● **Julien Jouanno**. Institute de Recherche pour le Développement. |
| **Demo** (10 min) | ● **Joaquin A. Trinanes**. University of Santiago and National Oceanic and Atmospheric Administration |
| **Roundtable Discussion and Closure** (15 min) | |

https://www.oceandecade-conference.com/en/satellite-activities-a-safe-ocean.html
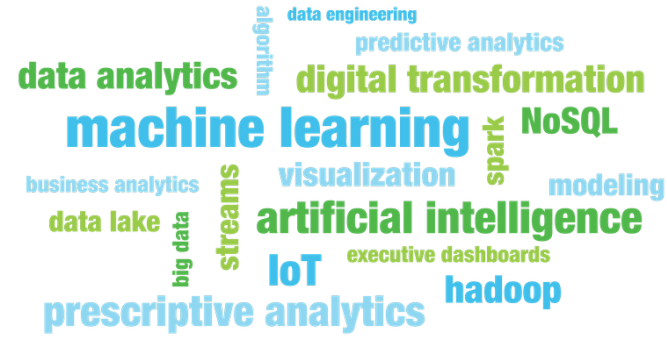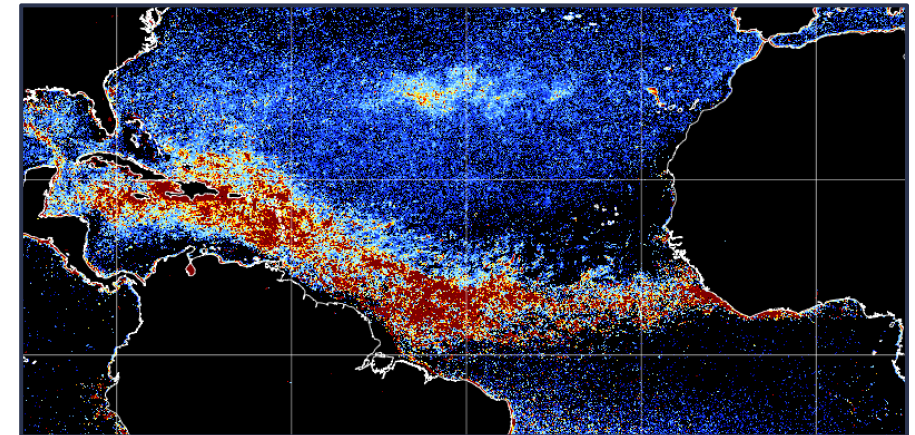
# **Monitoring**





**Technologies**

Satellite, aircraft, drones, Geographic Information Systems, data integration,…

**Why is monitoring important?**

- Causes? Origin? Impacts?

- Spatial and temporal variability.

- Data assimilation.

- Validation. Citizen Science.

- Mitigation strategies.

- Informed decision-making

- Time series. Operations.

# Citizen Science

**Sargassum Observations In-situ Database**

**NOAA's Survey123 Multidevice data collection**



**Consolidated database**

# Products



| MODIS/VIIRS (source: C. Hu, USF) Resolution: ~ 1km | OLCI data Resolution: 300 m | MSI Resolution: 10-20m |
|---|---|---|
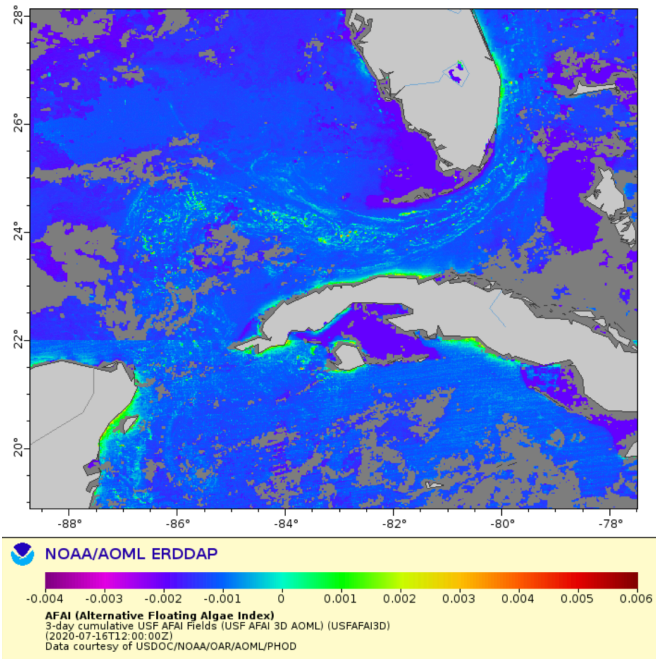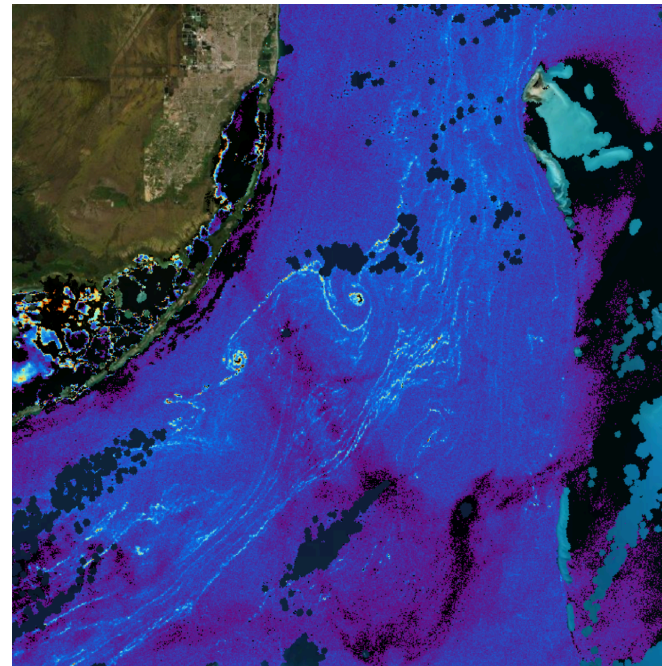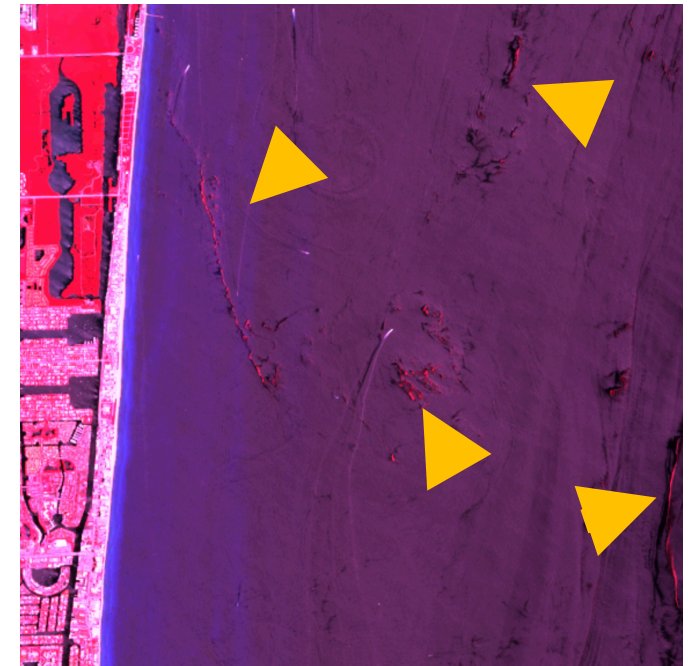
**Goals:** NRT monitoring and tracking of pelagic *Sargassum*

**Revisit times:** daily **(**MODIS , VIIRS), ~2 day (OLCI), ~5 day (MSI)

# Products
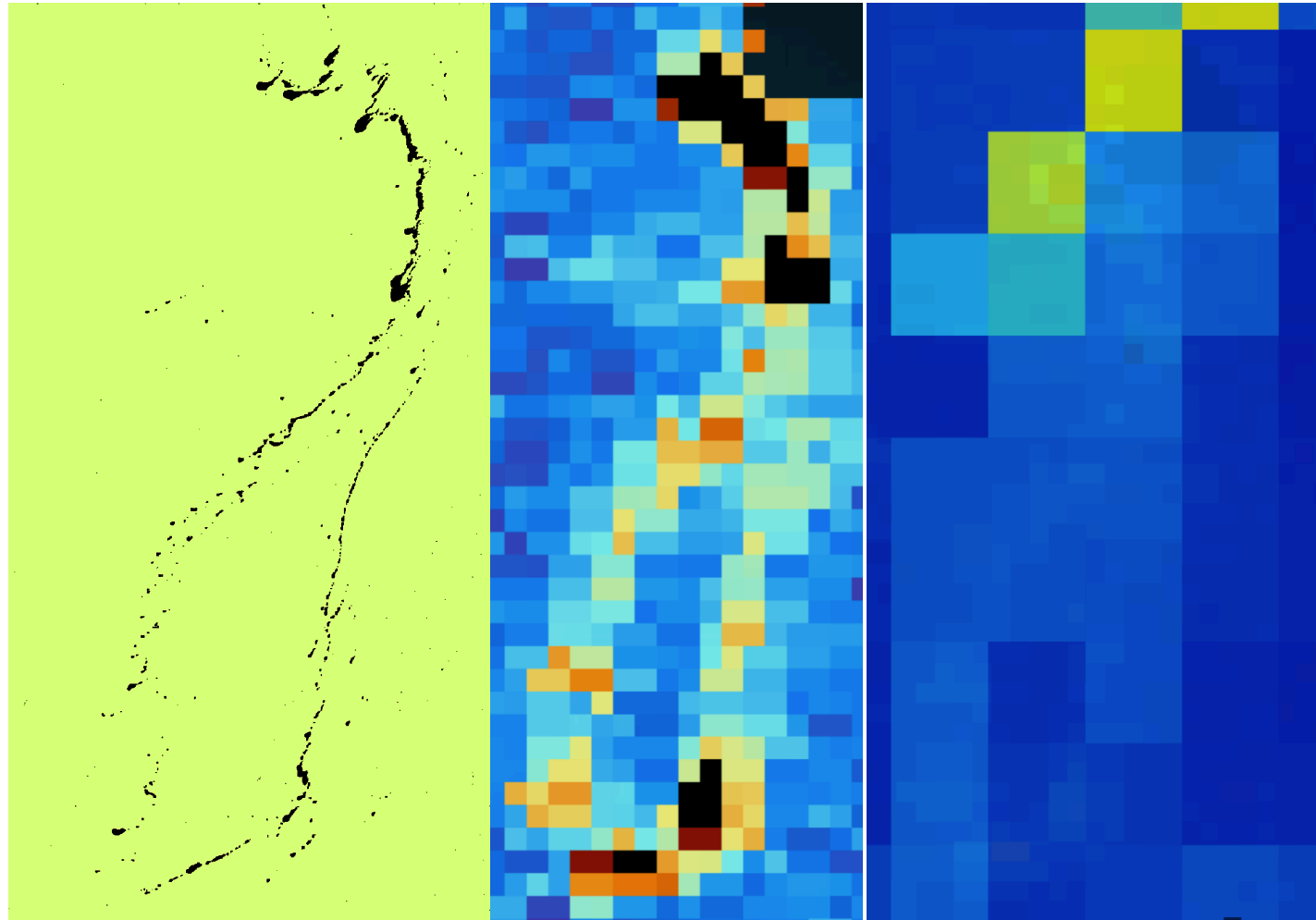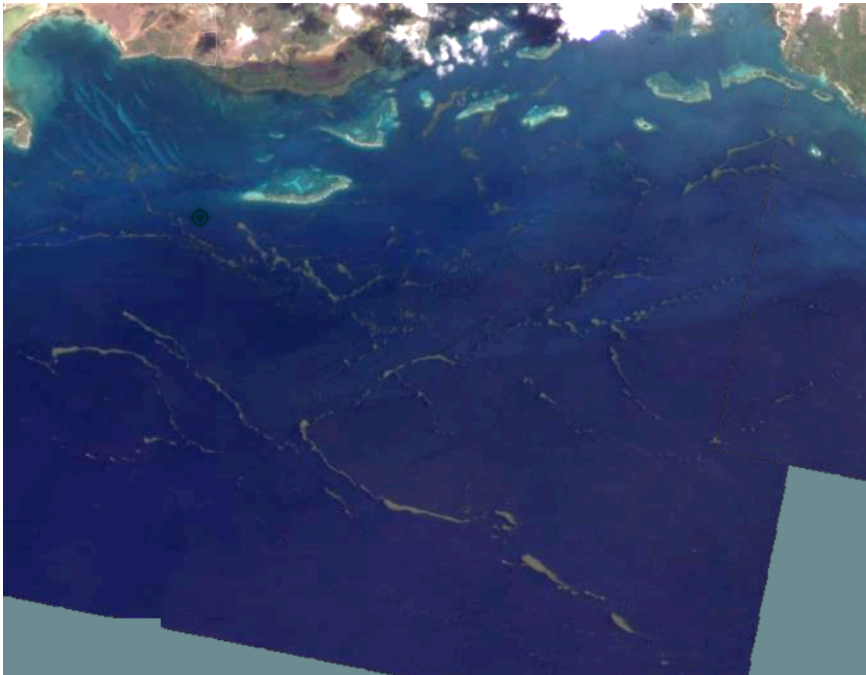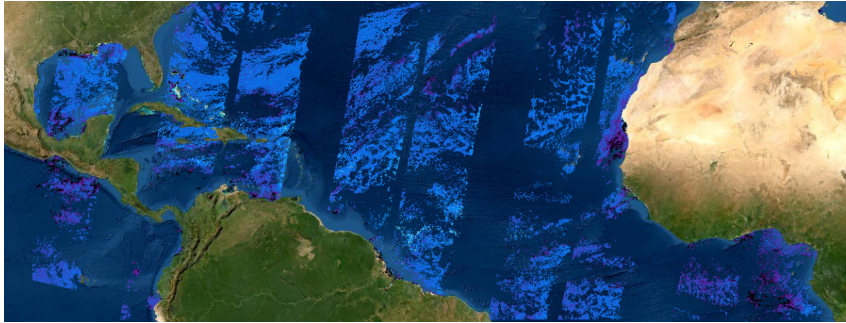


**Resolution:**
20m -> 300m (ratio:15)
300m -> 1km (ratio:3.3)
MSI- Coastal areas

**Revisit times:**     daily (MODIS , VIIRS)
~2 day (OLCI)
~5 day (MSI)
16 day (OLI)

# Sargassum Inundation Reports

Goals: To provide an overview of the risk of Sargassum coastal inundation in the Caribbean and Gulf of Mexico regions.

Transition into operations in progress.
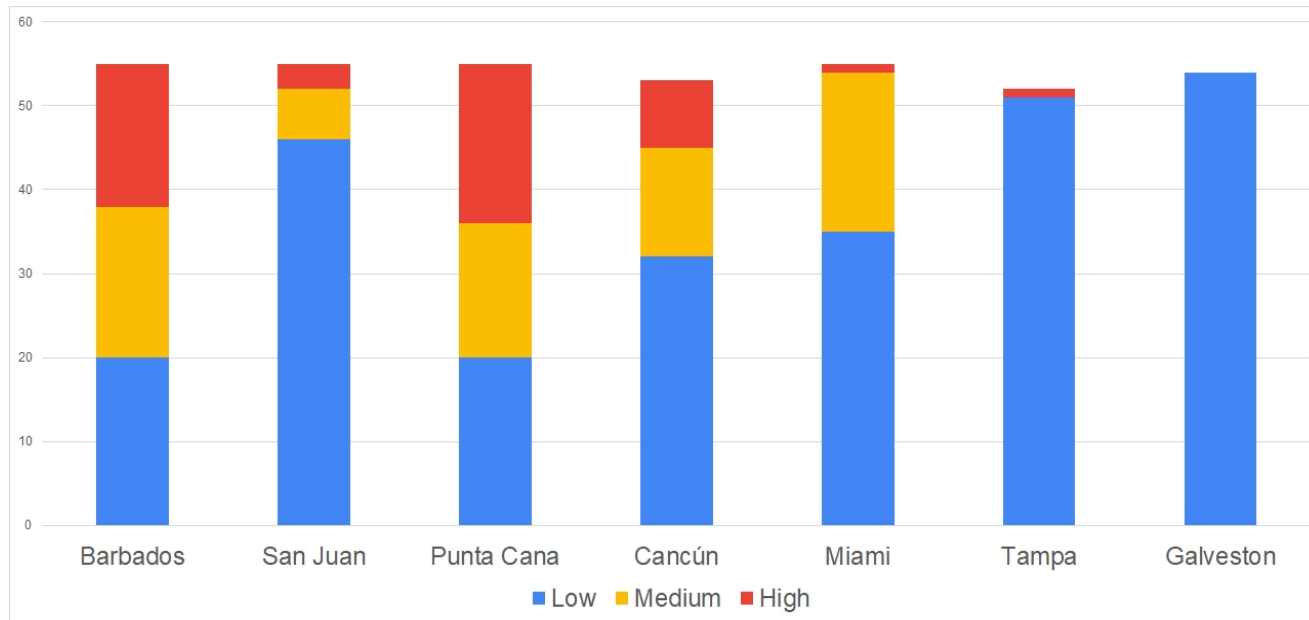




Experimental Weekly Sargassum Inundation Report (SIR v1.2)
By the National Oceanic and Atmospheric Administration (NOAA), and the University of South Florida (USF)

Status: Apr 5-11, 2022

Since 2011, large accumulations of Sargassum is a recurrent problem in the Caribbean Sea, in the Gulf of Mexico and tropical Atlantic. These events can cause significant economic, environmental and public health harm. These experimental Sargassum Inundation Reports (SIR) provide an overview of the risk of sargassum coastal inundation in the Caribbean and Gulf of Mexico regions. Using as core inputs the AFAI (Alternative Floating Algae Index) fields generated by the University of South Florida (USF), the algorithm analyses the AFAI values in the neighborhood (50 km) of each coastal pixel and, computing the difference between those values and a multiday baseline, classifies the risk into three categories: low (blue), medium (orange) and high (red). In black are areas with not enough data. The two ad-hoc thresholds used for classification are 0.001 and 0.003. The vectors in the images represent the geostrophic currents. SIR is the result of the collaboration between the Atlantic Oceanographic and Meteorological Laboratory (NOAA/AOML), NOAA/CoastWatch/OceanWatch, and USF.

# **Forecast**

How current, winds, waves,.. affect Sargassum trajectories?

What is the role of mesoscale eddies in the transport of *Sargassum*?



**Respond to the following questions**

Where?  When? How much?

**Why is forecasting important?**

- Give us time to prepare and mitigate

- Planning: tourism, fisheries, …

- Anticipate impacts

- Short-term: coastal/local dynamics

- Long-term: Identify key drivers
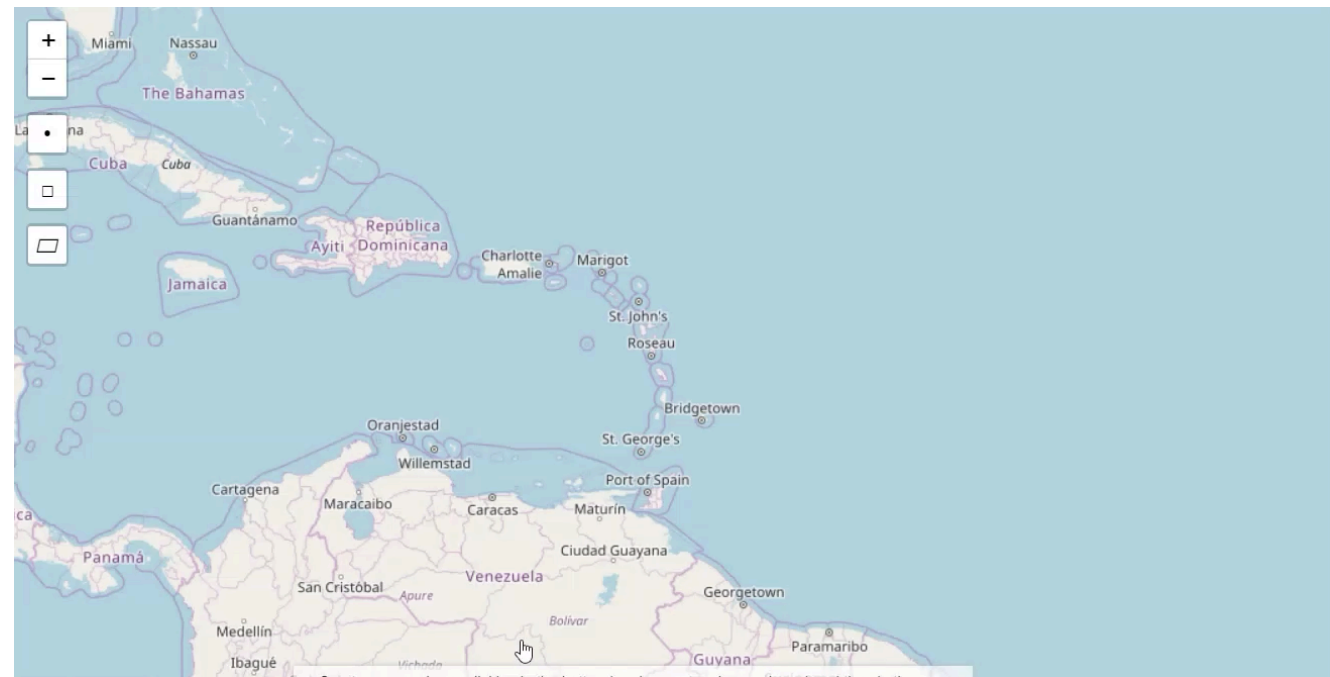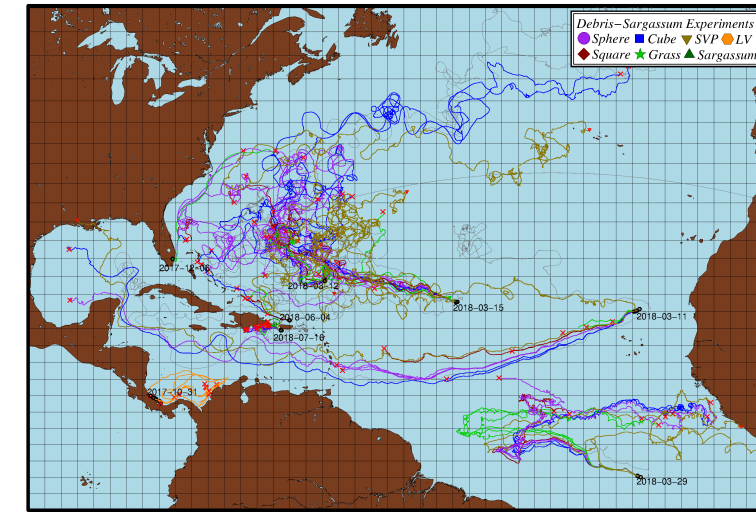
# Data discovery, distribution, delivery

**Interoperability:** allows for information exchange. Open and machine independent standards (netCDF, CF, OPeNDAP, …). Interoperability between web services that could run on different platforms. Provide seamless and automatic connections between software applications.

Provide discovery and data&metadata retrievals. Clients: Matlab, Udig, Python (Scientific.IO.NetCDF, pydap.client, netCDF4,…), Octave, QGIS, ArcGIS, R, Panoply, …

**Data Discovery**
**Metadata search in ERDDAP/OV**
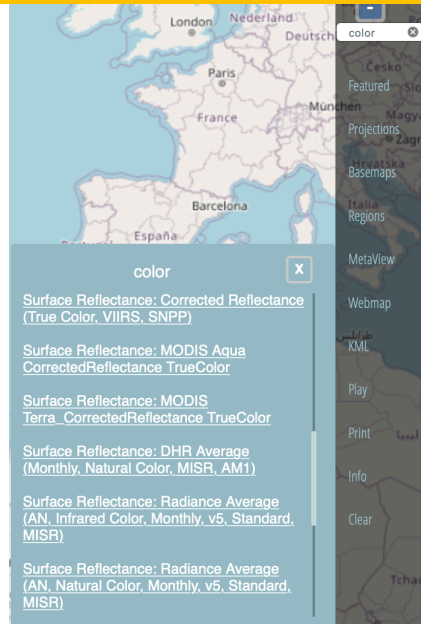
**Distribution**
**TDS/ERDDAP/OV/Tile Server**

**Delivery**
**Customized products**

# Interoperable Environment



Recent advances in the satellite monitoring of *Sargassum,* NOAA CoastWatch Seminar April 14th, 2022

# Interoperable Environment



Recent advances in the satellite monitoring of *Sargassum,* NOAA CoastWatch Seminar April 14th, 2022
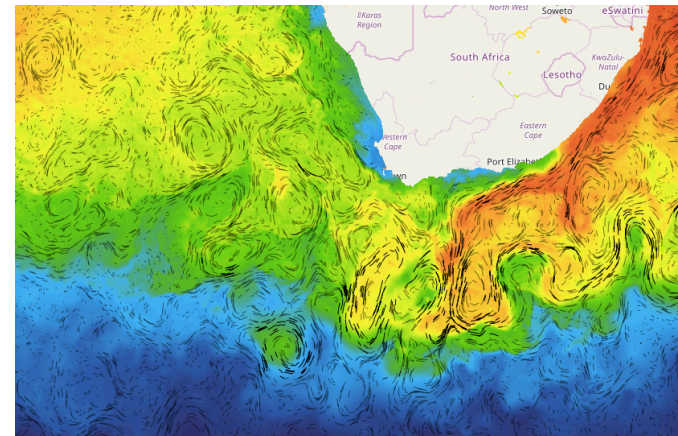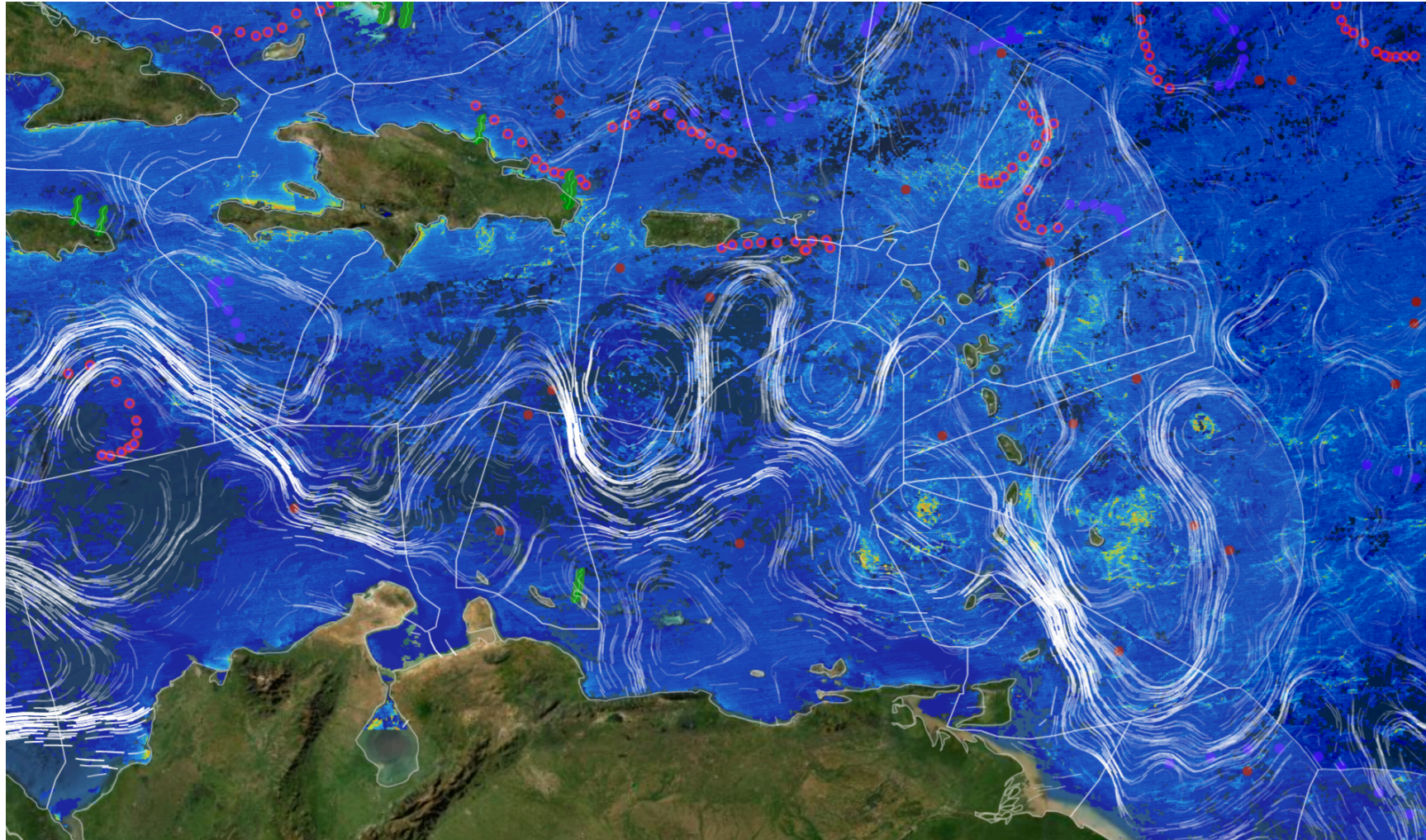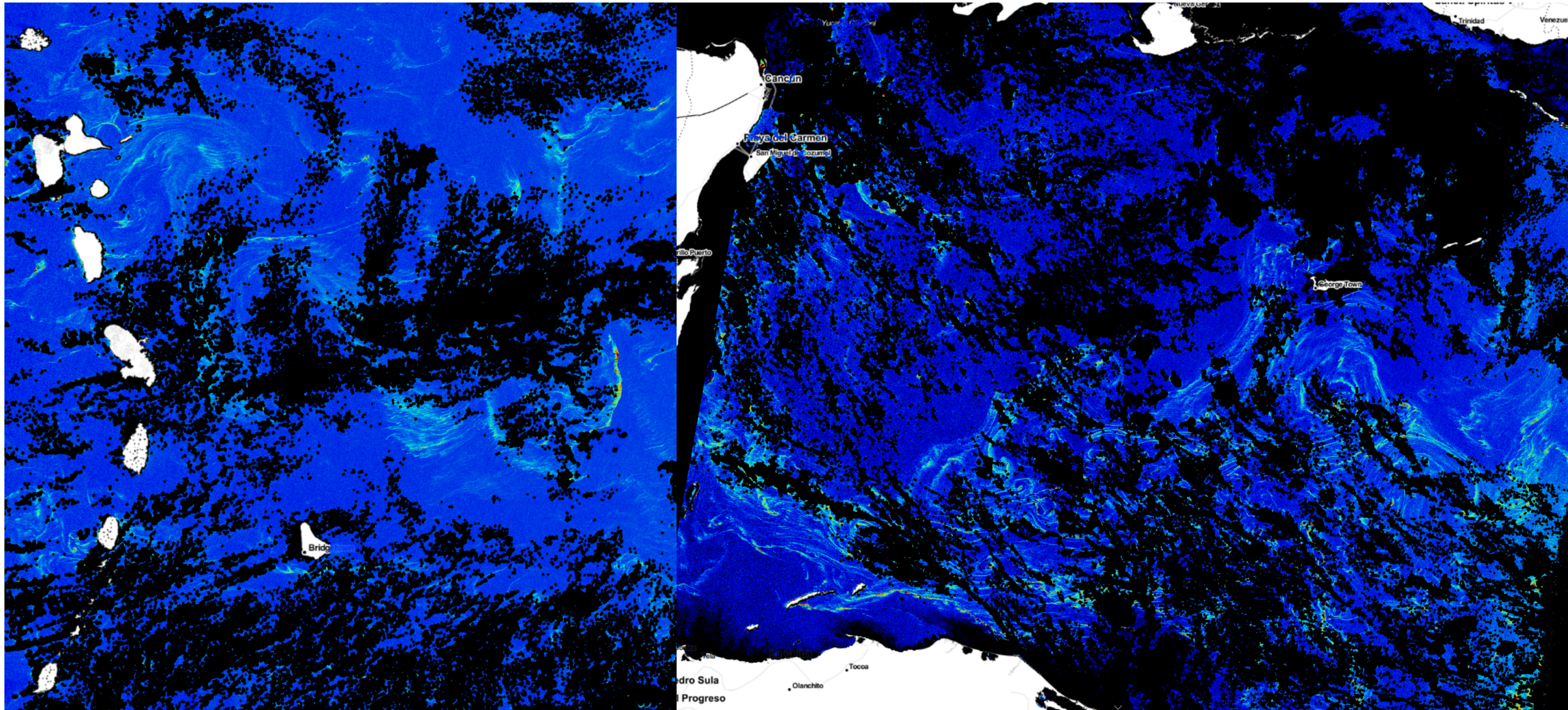
# Research&Collaboration priorities

Improve Sargassum Inundation risk model (coastal areas). R2O.

Partnership development

Trajectory modelling (in general, not only for Sargassum). Field experiments.

SIR (in GeoJSON) available on OceanViewer. Increase spatial coverage. Daily?

Better coverage in the coastal zone:

      Ground truth (e.g. citizen science projects, beach management agencies, autonomous
          vehicles )
      Winds, Currents (e.g. HF radars), Waves
      Satellites.

Enhance local and regional engagement. Training materials.

Integrate RS datasets and generating vector products (e.g. Sargassum detection RF, ANNs)

Adapt data distribution and visualization interfaces

# Summary

**The road to success:**

- Data-driven applications. Aligned with (*NOAA's*) strategies in emerging science and technology.

- Data integration (satellite, in-situ, …). Citizen science.

- Understand growth and decay, interaction with environment

- Trajectory modeling

- Reliable short-term and long-term forecast

- Products for decision-making

- Enhance data/product distribution (standards, best practices, SOA, open and free, …) and visualization

- Stakeholder involvement

- Funding, of course.

# Thank you!

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**Partners:**

NOAA (Rick Lumpkin, Veronica Lance, Emily Smail)
USF (Chuanmin Hu)
UM (Josefina Olascoaga, Javier Beron-Vera, Philippe Miron)
LGL Ecological Research Associates (Nathan Putman)
FIU (Lowell Andrew Iporac)
CARICOOS (Julio Morell)

| | |
|---|---|
| **Atlantic OceanWatch OceanViewer** | https://cwcgom.aoml.noaa.gov |
| **Caribbean and Gulf of Mexico node** | https://cwcaribbean.aoml.noaa.gov |
| **Hurricane OceanViewer** | https://cwcgom.aoml.noaa.gov/index_HOV.html |
| **Sargassum Inundation Reports** | https://www.aoml.noaa.gov/phod/sargassum_inundation_report/ |
| **Survey123** | https://cwcgom.aoml.noaa.gov/survey123_sargassum.html |
| **TDS** | https://cwcgom.aoml.noaa.gov/thredds/ |
| | https://oceanwatch.aoml.noaa.gov/thredds/ |
| **ERDDAPs** | https://cwcgom.aoml.noaa.gov/erddap/ |
| | https://oceanwatch.aoml.noaa.gov/erddap/ |