

# **Increasing Ocean Information in the Caribbean to Enhance Marine Governance**

**David A. Farrell, PhD**

Principal

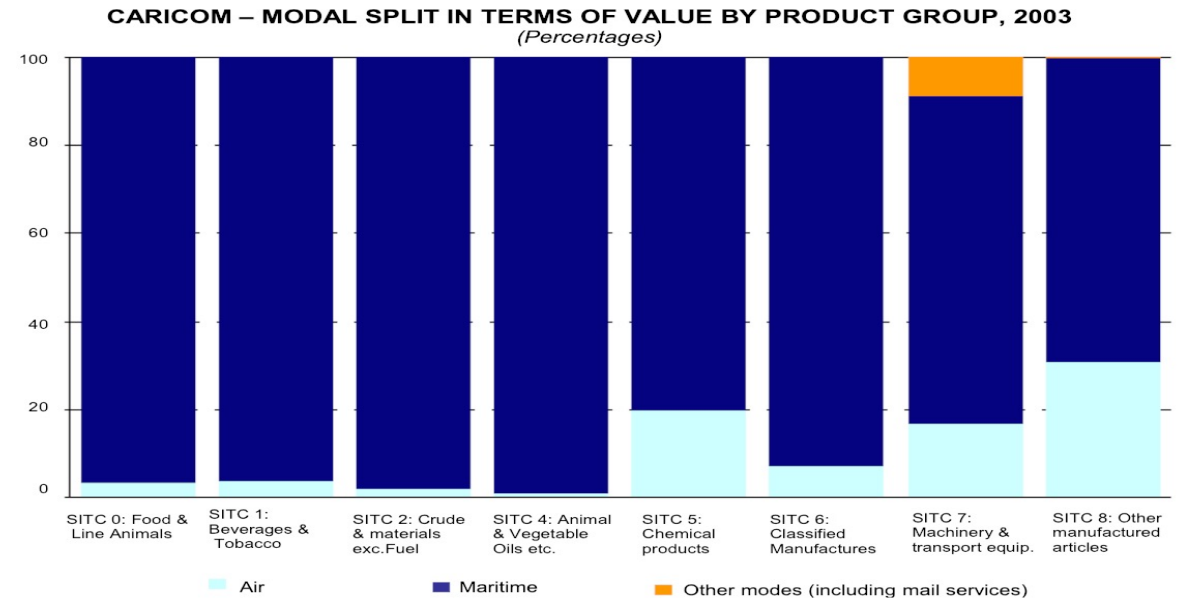
Caribbean Institute for Meteorology & Hydrology

Husbands, St. James, Barbados

July 29, 2021

# Regional Marine-Ocean Governance Challenges

- Caribbean SIDS possess small land areas compared to their vast oceans areas;
- Many islands derive substantial socio-economic wealth and benefit from their marine ecosystems:
  - Food, mineral resources, cost-effective transportation of goods and services, tourism and recreation;
  - ***Fisheries account for up to 15% of protein intake in the Caribbean, and the fisheries sector is more vulnerable to climate change than in other regions.***
- Marine environment also presents significant challenges that impact socio-economic development:
  - Elevated sea surface temperatures fuel tropical storms and contributes to coral bleaching that impacts coastal ecosystems;
  - Long term sea level rise is expected to enhance coastal flooding from storm surge and large swells and enhance salinization of coastal aquifers;
  - Marine algal blooms and sargassum seaweed at times inundate the marine ecosystem impacting beaches, air quality and marine water quality.



Source: [https://unctad.org/system/files/non-official-document/cimem7\\_2014\\_C2\\_Martime\\_CARICOM\\_en.pdf](https://unctad.org/system/files/non-official-document/cimem7_2014_C2_Martime_CARICOM_en.pdf)

**Jamaica:** Although detailed coastal zone management strategies are in place, they are made less effective by a lack of up-to-date, modern data. (Source *Commonwealth Marine Economies Programme Funded by UK Government - Enabling safe and sustainable marine economies across Commonwealth Small Island Developing States – Jamaica Country review*)

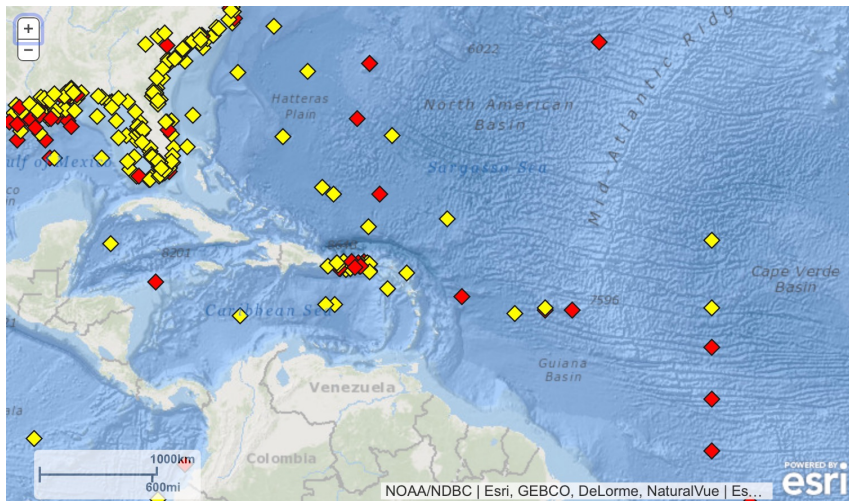
**St. Vincent and the Grenadines:** All of the data collected has been passed on to the Government of Saint Vincent and the Grenadines, and while some training on effective use of these datasets has been provided, challenges remain for managing, sharing and utilising these datasets. If this data cannot be fully understood, accessed and exploited by local stakeholders, its full value will not be realised. (Source *Commonwealth Marine Economies Programme Funded by UK Government - Enabling safe and sustainable marine economies across Commonwealth Small Island Developing States – St. Vincent and the Grenadines Country review*)

# Improving Caribbean Marine Ocean Governance: Data, Science & Innovation

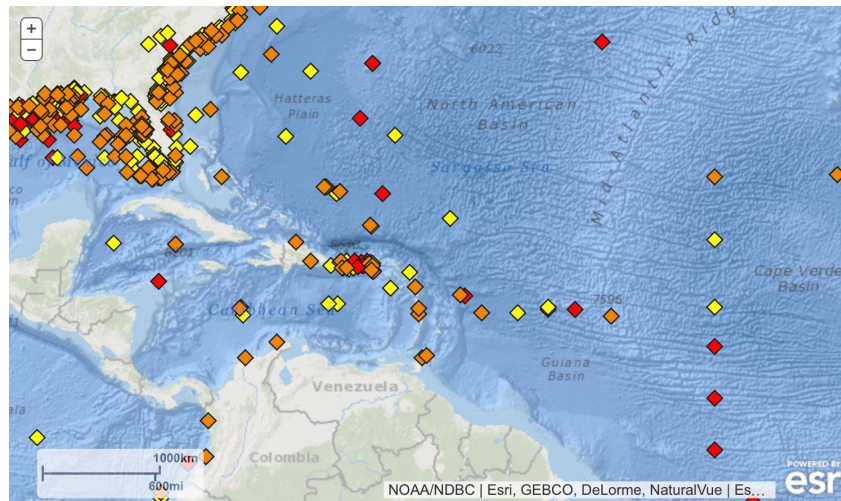
- There is a strong regional need to improve marine ocean observation and prediction systems (meteorological, oceanography and quality/chemistry) to improve management, decision-making and governance by:
  - Significantly increasing in the number of *in-situ* observation and monitoring platforms required [deep sea and coastal buoys, coastal sea level stations, measurement of physical and chemical parameters];
  - Capacity building activities in national and regional institutions;
  - Cooperation, coordination and coherence of strategies and activities among partners;
  - Enhancing prediction and forecasting platforms across weather and climate time scales;

## Partnerships

- **Caricom Institutions**
  - CIMH, CMO HQ, CDEMA, CCCCC, CFRM, OECS Commission and NMHSs among others.
- **Development Partners**
  - CDB, IDB, WB, CCRIF, USAID, NOAA, UN, EU, Environment and Climate Change Canada



Recent Data: July 29, 2021



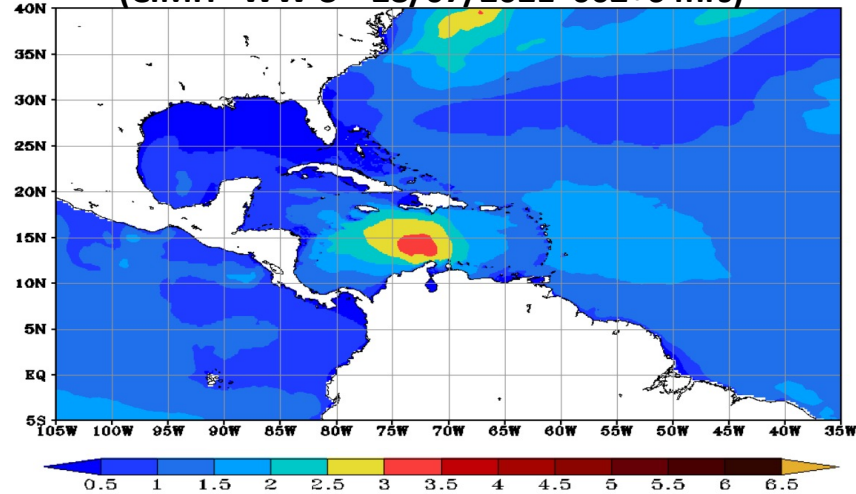
Historical Data

- ◆ Stations with recent data
- ◆ Stations with historical data only
- ◆ Stations with no data in last 8 hours (24 hours for tsunami stations)
- ◆ Tsunami station in event mode (within previous 24 hours)

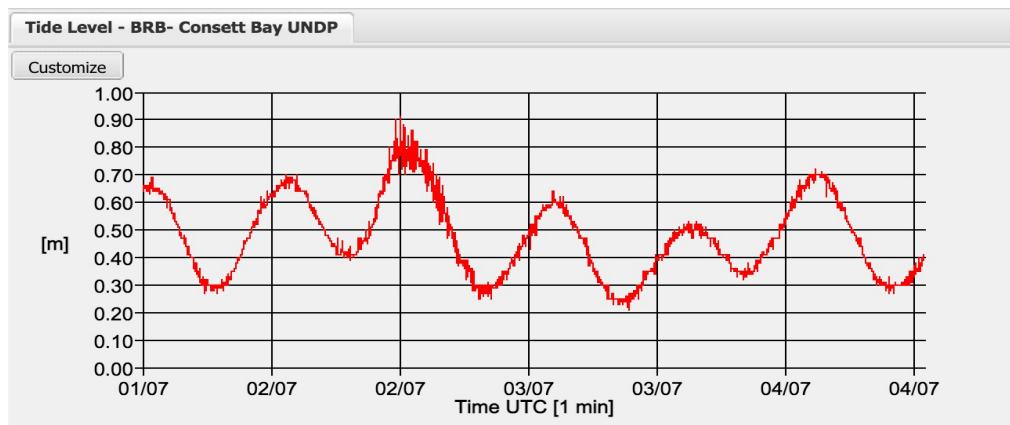
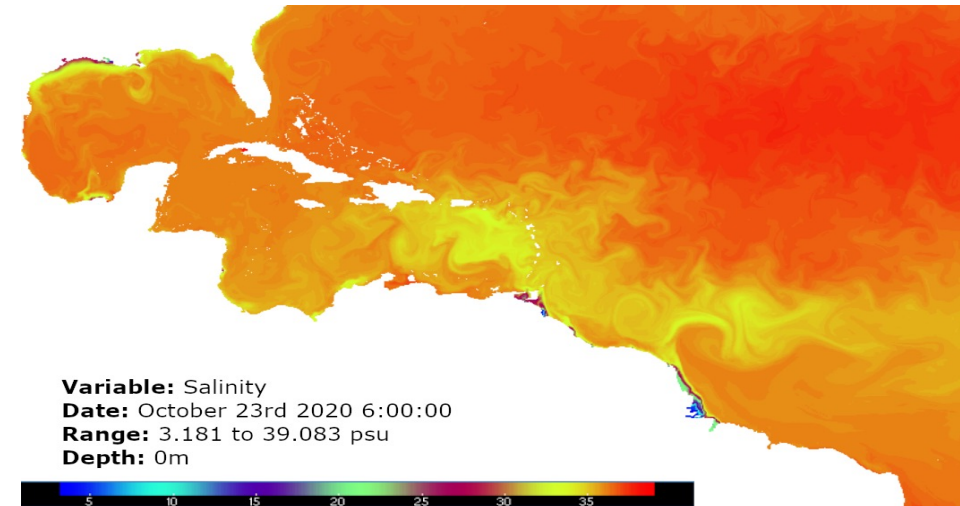
Source: <https://www.ndbc.noaa.gov/obs.shtml>

# Improving Caribbean Marine Ocean Governance: Data, Science & Innovation

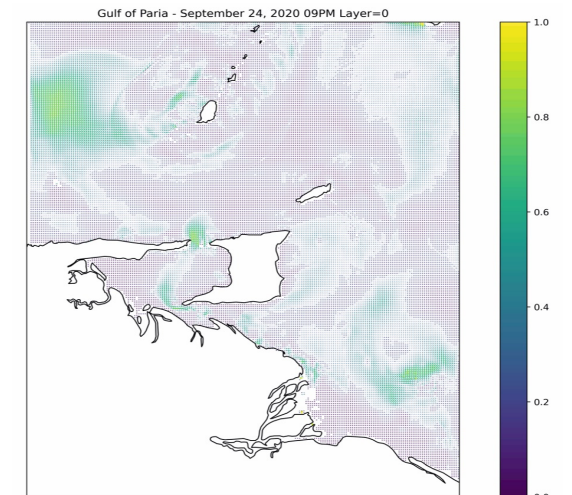
Caribbean Significant Wave Height (m) Forecast  
(CIMH WW-3 28/07/2021 00Z+64hrs)



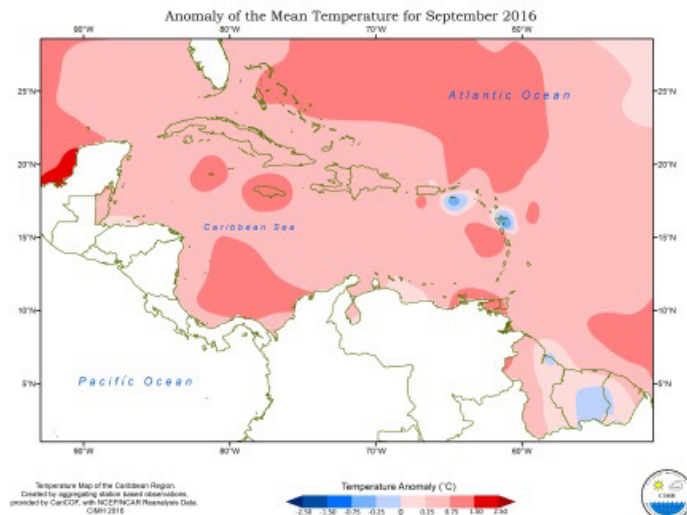
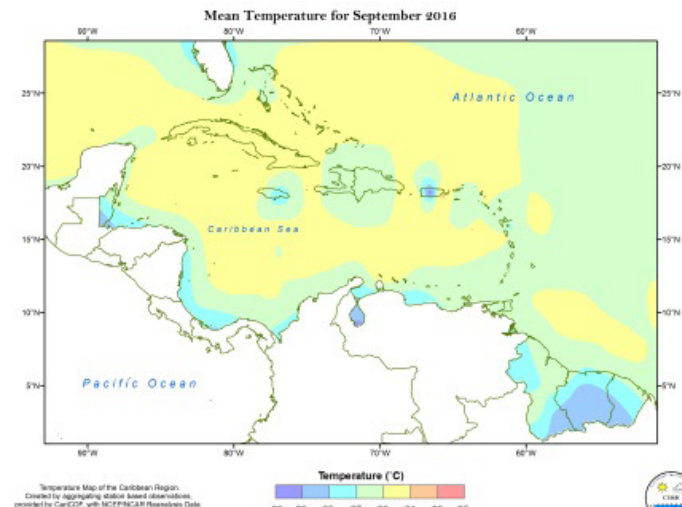
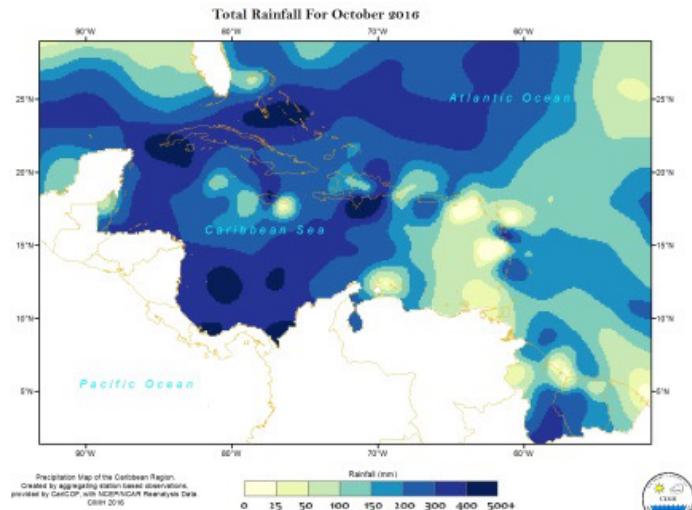
CIMH HYCOM Regional Simulation Platform



CIMH sea level station at Conset Bay, Barbados

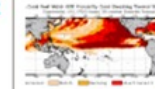


# Marine Supporting Products Offered by the Caribbean RCC



## Announcement

**BLEACHING POTENTIAL HIGH IN THE COMING MONTHS IN THE BAHAMAS, GREATER ANTILLES AND THE LEeward ISLANDS DUE TO CONTINUED EL NIÑO**



**GLOBAL CORAL BLEACHING UPDATE**  
[\(CLICK HERE\)](#)



**CORAL DISEASE SUSCEPTIBILITY**  
[\(CLICK HERE\)](#)



**CORAL BLEACHING RESPONSE PLANS**  
[\(CLICK HERE\)](#)

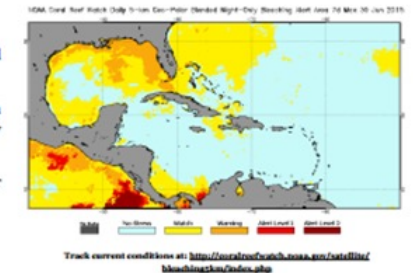


## CARIBBEAN CORAL REEF WATCH



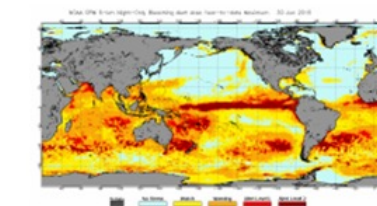
## Notable Observations

- El Niño moderate in strength and intensifying.
- Southwestern Caribbean region already unusually warm with early bleaching watches and warnings.
- Bleaching Warning issued for Florida.



## Current Global Conditions

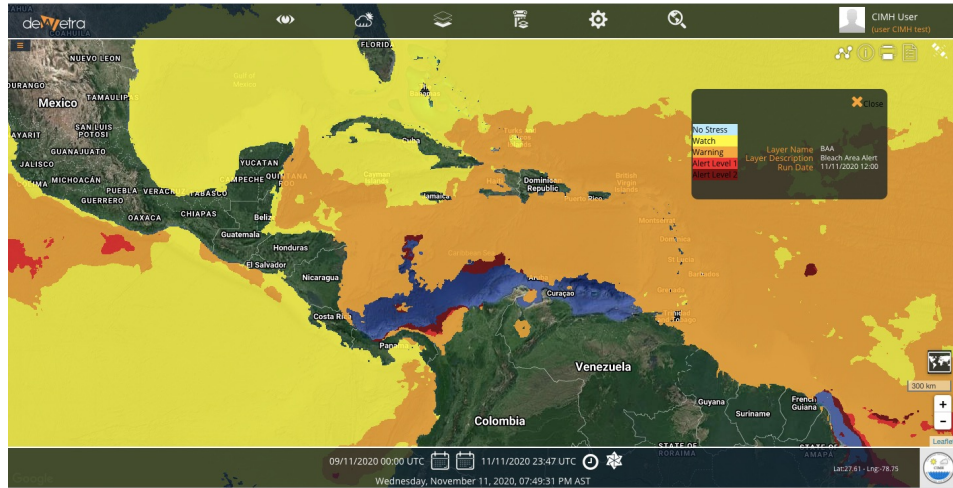
- Reports on extensive bleaching have come from the British Indian Ocean Territory, the Maldives, and western Indonesia in the Indian Ocean and from Kiribati in the Central Pacific.
- These observations are consistent with near-record high sea surface temperatures and with a moderate El Niño.



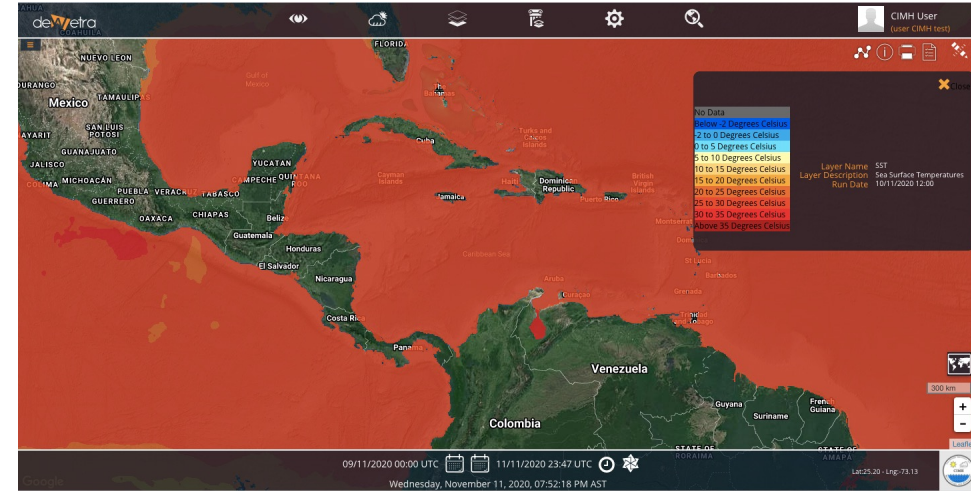
### Alert Level Guide

Alert Level	Interpretation
No stress	No thermal stress
Watch	Low-level thermal stress
Warning	Thermal stress is accumulating
Alert level 1	Bleaching expected
Alert level 2	Widespread bleaching and some mortality expected

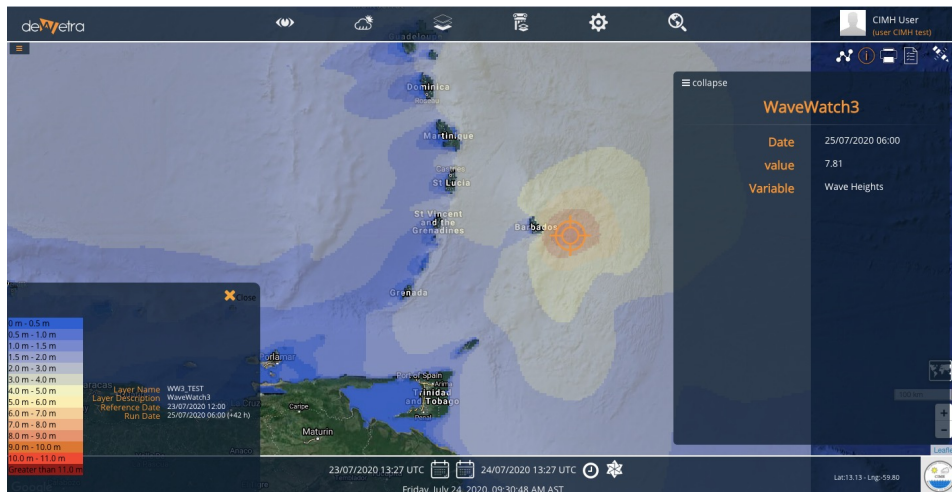
# Marine Products in the Online Caribbean Dewetra Platform



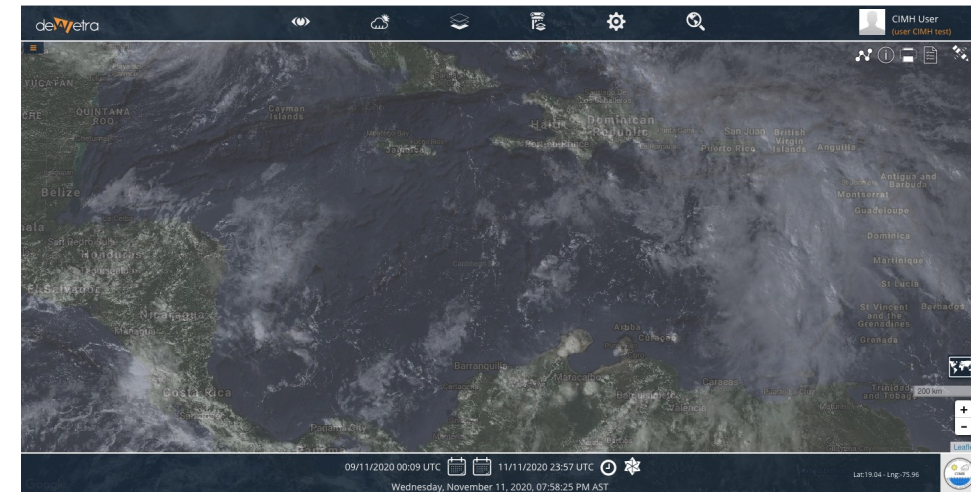
NOAA Bleach Area Alert



NOAA Sea Surface Temperatures

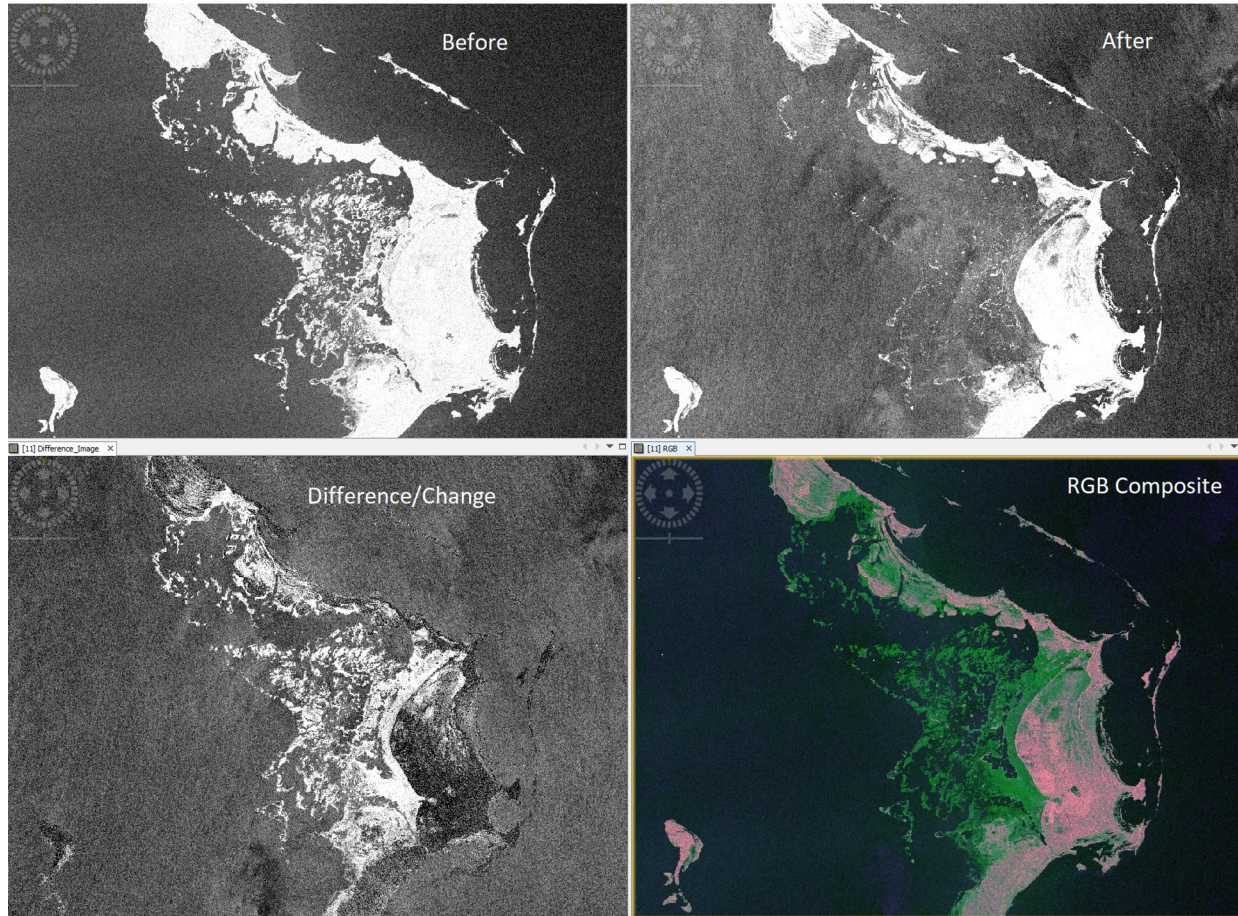


CIMH WaveWatch-3 Forecast

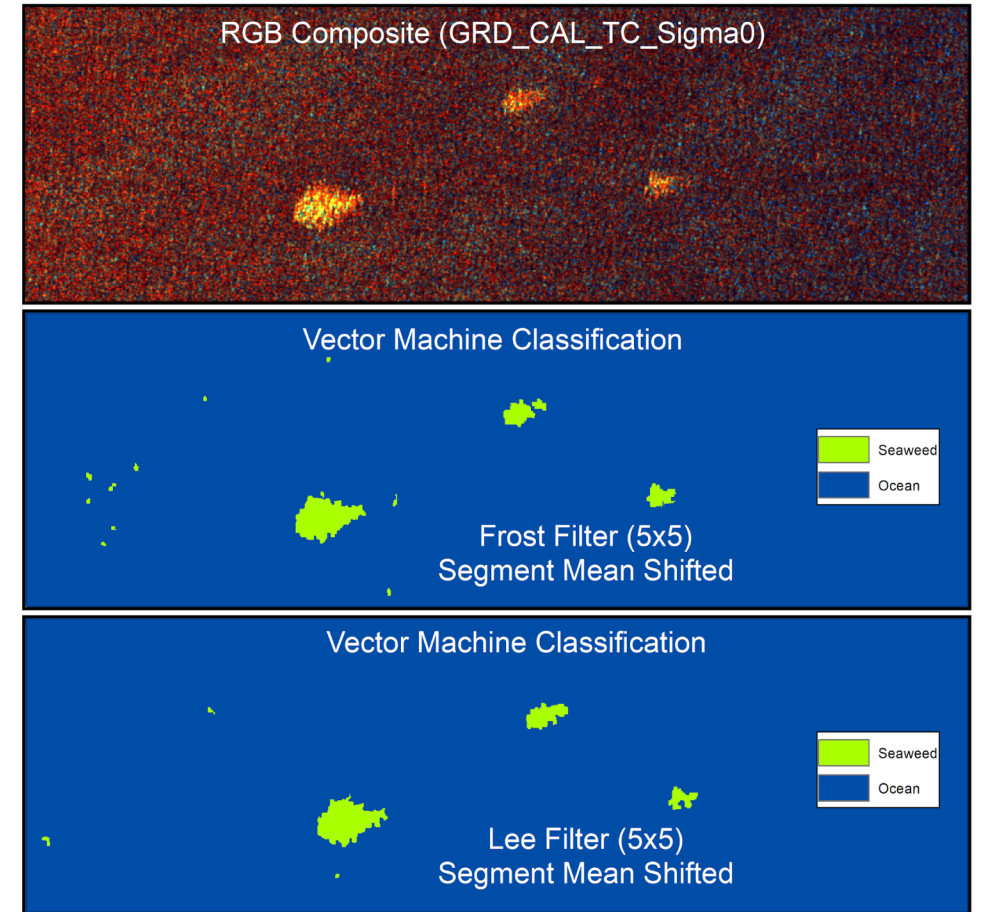


GOES-16 Satellite Imagery

# SAR/InSAR Modeling Applications



Coastal inundation in the Bahamas following Hurricane Dorian (CIMH 2019)



Sargassum monitoring and detection (CIMH 2019)

# Building Regional Marine Forecaster Competency

## Marine Forecaster Training (Online) – November 9 – 27, 2020

**Week 1 – Marine Forecasting**

	All times in Atlantic Standard Time (GMT-4)
<b>Monday 9 November</b>	
Introductions	09:00 to 10:00
The Circulation of the Oceans	10:30 to 11:30
Ocean Waves and Tides	13:00 to 15:30
<b>Tuesday 10 November</b>	
Marine Observations and observing platforms	09:00 to 11:30
Remote Marine Observation Tools	13:00 to 15:30
<b>Wednesday 11 November</b>	
Tropical Meteorology and Extra-tropical transition	09:00 to 11:30
Marine Cyclogenesis	13:00 to 15:30
<b>Thursday 12 November</b>	
Marine Forecast Tools	09:00 to 11:30
National Centers (NC) and NC Product Suites	13:00 to 15:30

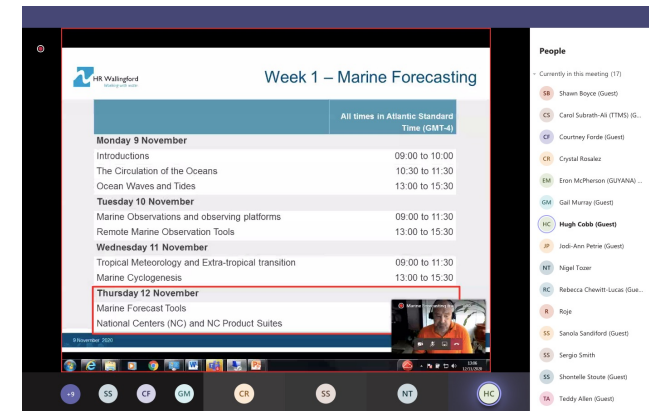
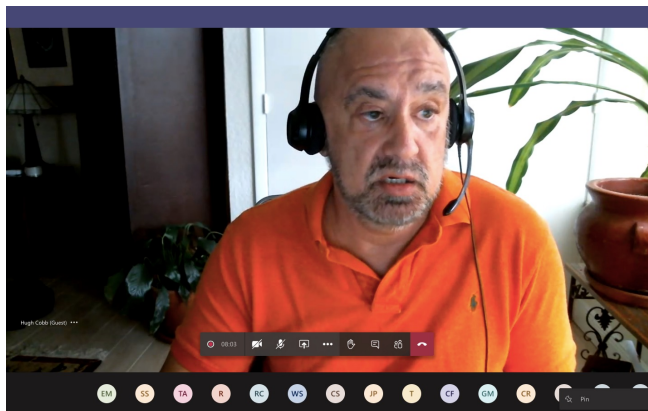
9 November 2020 © HR Wallingford 2020

**Week 2 Hydrodynamic modelling**

Description	Times (GMT-4)
<b>Monday 16<sup>th</sup> of November</b>	
Introduction to BlueKenue	09h00-10h00
Creating/editing lines, points, polygons	10h15-11h15
Creating grids and regular meshes	11h30-12h30
<b>Tuesday 17<sup>th</sup> of November</b>	
Creating variable density meshes – Part 1	09h00-10h30
Creating variable density meshes – Part 2	10h45-12h15
Module 1 & 2 - Wrap-up, Questions, help	12h30-13h00
<b>Wednesday 18<sup>th</sup> of November</b>	
Numerical modelling study progression and good practice	09h00-10h15
Introduction to the TELEMAC system	10h30-11h15
Running a TELEMAC simulation and visualizing results	11h30-12h30
<b>Thursday 19<sup>th</sup> of November</b>	
Tidal processes and currents and TELEMAC-2D	09h00-10h30
Modifying TELEMAC simulations and analysing results	10h45-12h15
Module 3 & 4 - Wrap-up, Questions, help	12h30-13h00
<b>Friday 20<sup>th</sup> of November</b>	
TELEMAC applied to the Caribbean	09h00-10h30
TELEMAC and forecasting	10h45-12h15

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- Week 3 Wave modelling**
- Definitions and conventions**
    - Wave spectra
    - Integrated parameters
  - Generation of waves:**
    - Wind waves
    - Swell waves
    - Bimodal seas
  - Physical processes**
  - Introduction to SWAN**
    - Underlying principles
    - SWAN model grids
    - Boundary conditions
    - Wind input
  - SWAN representation of physical processes**
  - Setting up a SWAN model**
    - SWAN bathymetry
    - Model settings
    - Forcing options
  - Stationary and non-stationary modes**
  - Nested grids**
  - SWAN nesting within WW3**
  - The Caribbean wave climate**
    - Application of SWAN in the Caribbean
  - Application of SWAN for operational forecasting**
- 9 November 2020 © HR Wallingford 2020



Strong focus on building regional marine modeling skill in Telemac and Swan



# Building Regional Research and Development Capacity: EUREC4A-ATOMIC-OA Field Research Campaign

## Research Vessels



Atalante (A, FR) Maria S Merian (MSM, DE) Meteor (M, DE) Ron Brown (RB, USA)

+ Barbados Defense Force ?

### Atmospheric Profiling

- UAS, Cloud-Kite or Quad Copters (M, MS)
- W-band cloud radar (M, MSM, RB)
- Raman Lidar (M, MSM)
- Radio Sondes (A, M, MSM, RB)
- Microwave Radiometer (M, MSM, RB)
- Sun photometer (A, M, MSM)
- Wind lidar (M, RB)

### Ocean Profiling

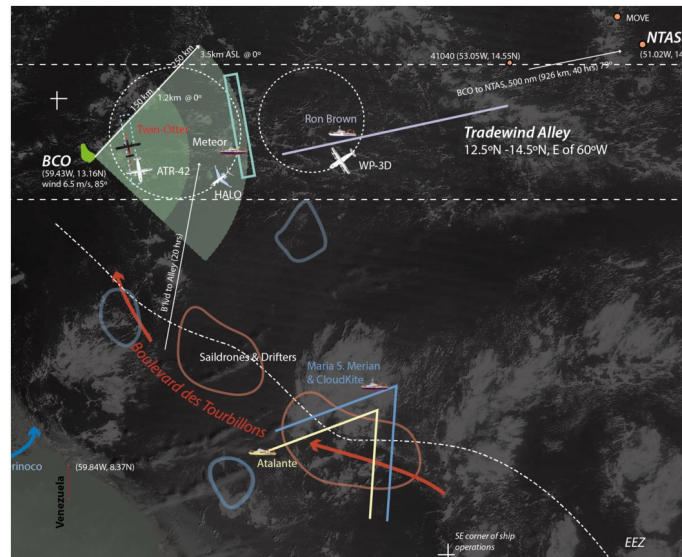
- Standard Ocn., incl. CTDs (A, M, MSM, RB)
- Gliders (A, M, MSM, RB) & Drifters (M, MSM, RB)
- Biology (Nitrogen Fixation, Amonia Oxidation M, MSM)
- ADCP (MSM)
- Multibeam Echo Sounder (MSM)
- Moving vessel profiler — towed buoy (MSM)
- Microstructure sonde (MSM)
- X-band WaveRadar (MSM)
- Upper ocean pCO2 (MSM)

### Near surface air measurements

- Standard Met (A, M, MSM, RB)
- Enthalpy and momentum eddy co-variance (M & RB)
- Isotopic Measurements (A, M, & RB)
- CO<sub>2</sub> fluxes (MSM)
- Disdrometer (M, MSM)
- Broadband SW & IR (M, MSM), Hyperspectral IR (RB)
- Aerosol (M, RB)



## EUREC4A-ATOMIC-OA Domain



## A blooming of autonomous observing systems



<http://eurec4a.eu>



# Regional Marine Forecast Support Centre Concept

Consultancy completed in 2020 favorable to the establishment of a Regional Marine Forecasting Centre at CIMH.

*“OEA Technologies concludes that the CIMH has sufficient computational capacity to inaugurate the proposed Regional METOC Centre.”*

*“With additional staff and model development, the CIMH has the means to inaugurate a focused regional marine forecasting centre.”*



Consultancy Services for the Feasibility Study for a Regional Marine Forecasting Centre

*Final Report*



**Thank You**