18th SESSION IOCARIBE

UNESCO Intergovernmental Oceanographic Commission

Sub-Commission for the Caribbean and Adjacent Regions

Subcomisión para el Caribe y Regiones Adyacentes

IOCARIBE Technical Science Meeting and Dialogue

Nadia Pinardi

Decade Collaborative Center for Coastal resilience, University of Bologna, Italy

Brasilia, Brazil
April 23–25, 2025

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A Warming Ocean in the Caribbean Region: the CoastPredict solution

Outline

UN Decade CoastPredict programme and the DCC for Coastal Resilience

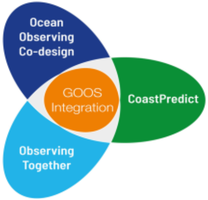
Warming in the Caribbean

The last mile: GlobalCoast Framework and the IOCaribe project

CoastPredict
with The Global Ocean Observing System

Ocean Decade Programme

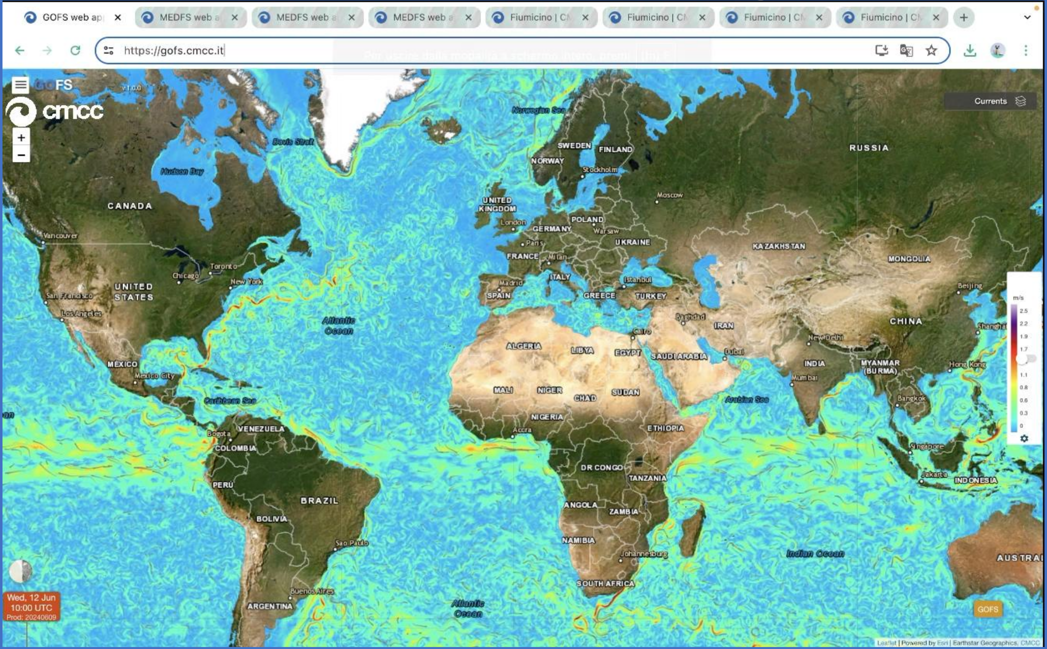
2021 2030 United Nations Decade of Ocean Science for Sustainable Development



Objective

Provide decision-makers and coastal communities with integrated observing and predicting systems ***to identify solutions for managing risk in the short-term and planning for mitigation and adaptation in the longer-term***

CoastPredict: construct the multi-scale global coastal ocean



The CoastPredict implementation: GlobalCoast

GlobalCoast Network

130 **Pilot Sites**
66 countries

Memorandum of Understanding

between Pilot Sites

GOOS | CoastPredict
with The Global Ocean Observing System

DCC for Coastal Resilience: the UN Decade framework for coordination

DCC-CR Mission - *strengthen the connection* between the new science and technology developed in the Ocean Decade and coastal stakeholders, implementing innovative ***co-design practices*** for coastal resilience.

UN Decade Collaborative Centre for COASTAL RESILIENCE

cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici

Deltares

Join DCC-CR Community of Practice

Subscribe to the DCC-CR Newsletter

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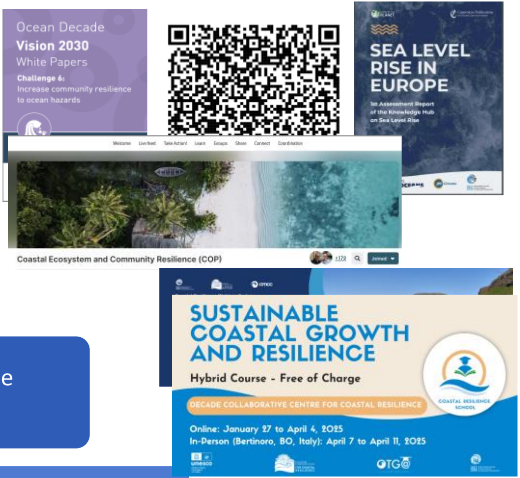
DCC-CR's Strategic Objectives

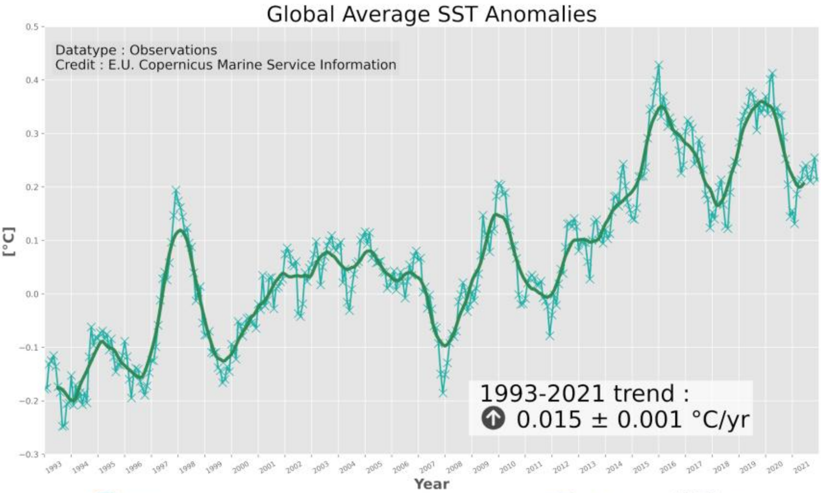
- Improve science information for all
- Enhance stakeholder engagement
- Promote equitable education
- Uphold environmental justice for coastal communities



Global SST warming

Monthly and global average SST anomalies relative to the 1993 – 2014 average.

Produced by CMEMS Service



Caribbean warming?

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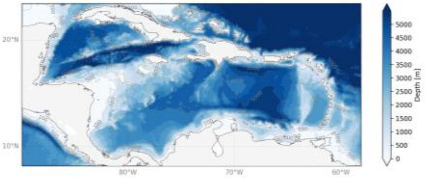
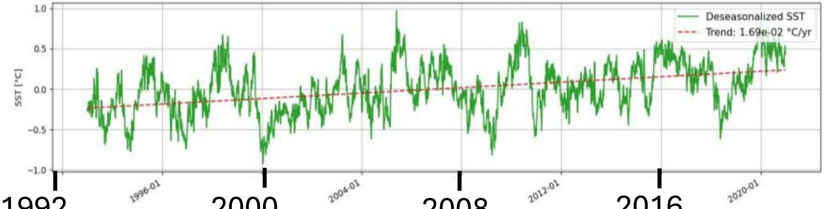
SST mean anomalies in the Caribbean



Area of average



1992 2000 2008 2016

1993-2021 trend 0,017 +/- ?? C/yr

Produced by S.Causio and M.Hoxai, CMCC

From CMEMS reanalysis produts

Caribbean warming?

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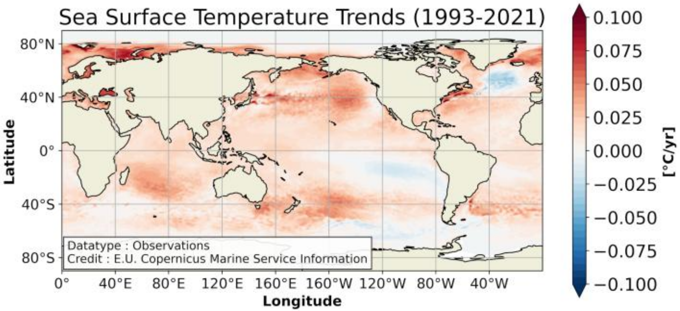
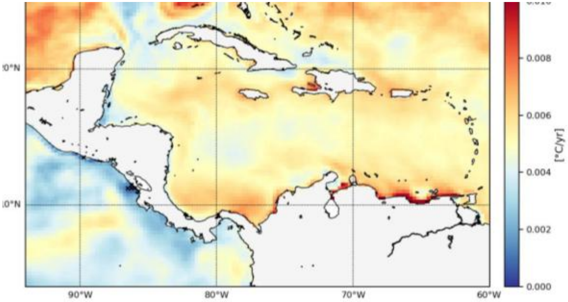
SST Trends





From CMEMS satellite composite (1993-2021)

From CMEMS reanalysis (1993-2021)

Caribbean Marine heat waves

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nb of events/year

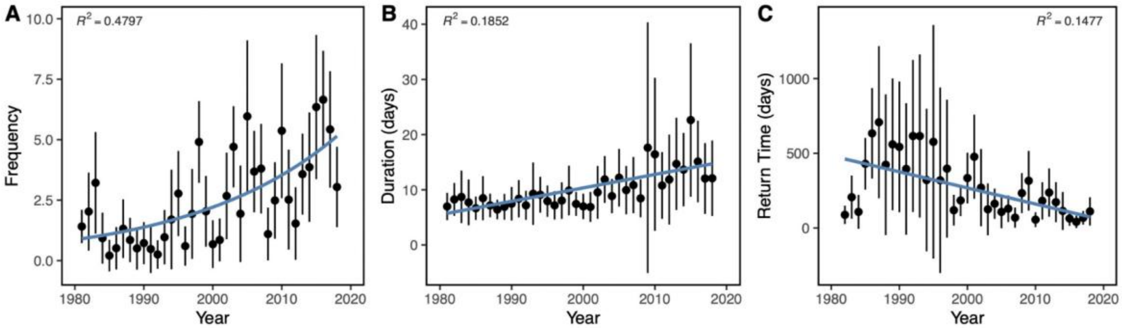


Fig 5. MHW trends (1981–2019) across Caribbean coral reefs. Temperature data are based on OISST gridded data to determine **A)** marine heat wave (MHW) frequency (number events per year) with Nagelkerke pseudo R^2; **B)** MHW duration (number days per event) with linear model R^2; and **C)** return time (number days per event) since the previous MHW event with linear model R^2 reported. Points denote annual mean values (±SD) and blue lines represent linear (lm or glm) trends.

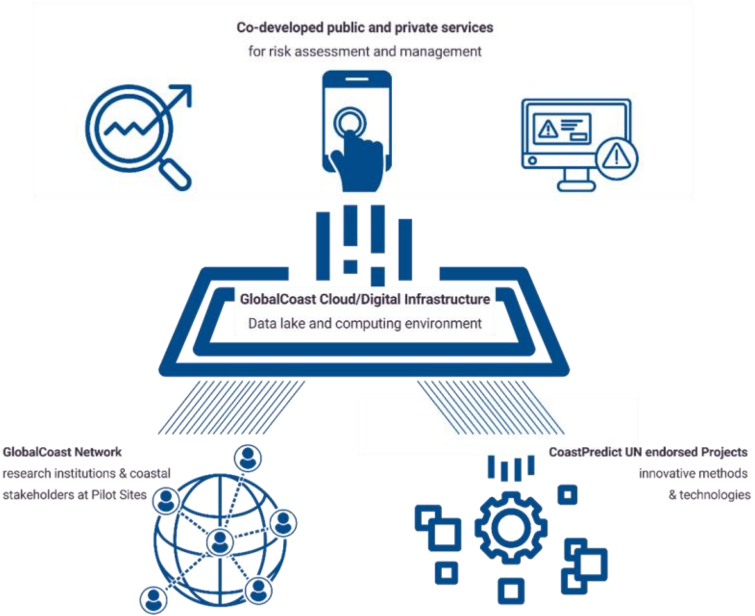
https://doi.org/10.1371/journal.pclm.0000002.g005

PLOS Climate, Bove et al., 2022

GlobalCoast Framework for Solutions

This framework allows :

- harness opportunities
- overcome barriers
- connect the work globally
- enable public-private collaboration
- replicable solutions
- engage cloud technology to support services



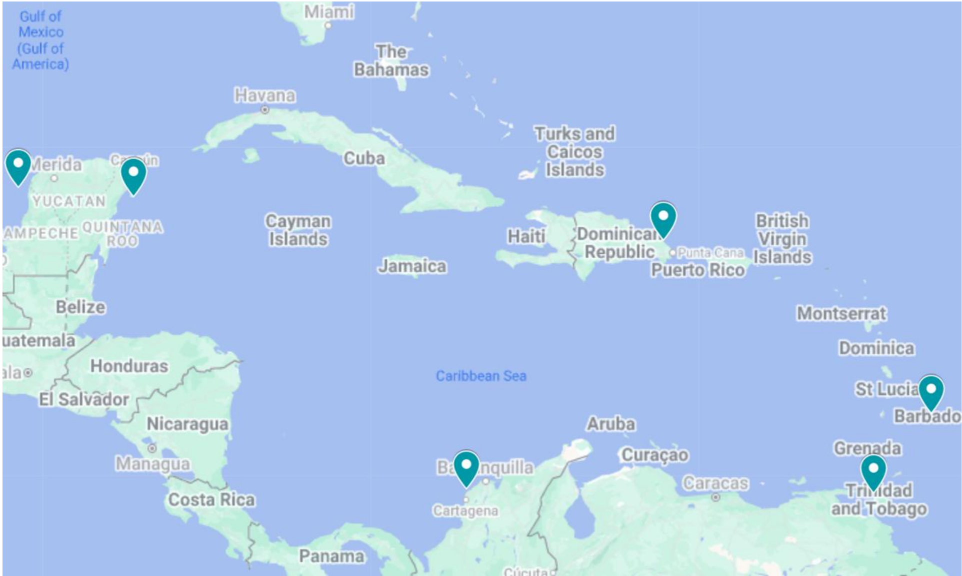
CoastPredict with The Global Ocean Observing System

Develop projects with regional Pilot Sites

Caribbean Project Partners

5 countries
Barbados
Colombia
Dominican Republic
Mexico
Trinidad & Tobago

6 Pilot Sites



Caribbean Project partners

- **Barbados:**
  Caribbean Institute for Meteorology and Hydrology
  Barbados Coastal Zone Management Unit
- **Colombia:** DIMAR-CIOH Oceanographic Research Center
- **Dominican Republic:** Instituto Dominicano de Meteorología (INDOMET)
- **Mexico:** CICESE, Cinvestav
- **Trinidad & Tobago:** Institute of Marine Affairs
- **Regional:** IOCARIBE, University of the West Indies, CARICOOS, WMO Regional Association
- **International:** SOCIB, CMCC, UNISA, NOC, CEOS COAST etc.

GOOS | CoastPredict
with The Global Ocean Observing System

What are the benefits?

- Enhance regional capacity to improve community resilience to climate, ocean and coastal hazards;
- Develop advanced **coastal observing and predicting** system in beneficiary countries to support SDG-14 and planning of adaptation strategies and actions for coastal resilience;
- **Establish fundamental coastal risk assessment and management tools** in alignment with UNFCCC and Global Biodiversity Framework;
- **Strengthen and complement** existing adaptation activities and projects;
- **Connect solutions for Small Island Developing States across the GlobalCoast Network**.

Consultations with Caribbean partners, regional and country representatives

+ internal consultation with IOC-UNESCO

- **GlobalCoast Survey (July-Dec 2023)** and follow-ups about needs and priorities for the different regions
- **IOC Executive Council-57 meeting Paris: consultation with Member States in 3 regions,** June 2024
- **Consultation with Pilot Site partners in regions,** July 2024 - ongoing
- **Presentation to IOCARIBE-GOOS Working Group,** Nov 2024

CoastPredict
with The Global Ocean Observing System

Project Components (common with other GlobalCoast regions)

01
Strengthening national and regional capacity to monitor, predict and assess ocean hazards

02
Design and implement MH-PC-EWS and risk reduction measures tailored to local contexts and vulnerable communities

03
Design and implement coastal climate downscaling, extract climate indicators for adaptation plans

04
Co-design and implement decision support systems for climate resilience, integrated coastal zone management

05
Knowledge exchange, engagement, communication & development of governance to support sustainable system & services delivery

The solutions: customized services for EWS and climate coastal downscaling

GOOS | CoastPredict with The Global Ocean Observing System

IMPACT AREA 1

Multi-risk early warning system for coastal extreme events: storm surge, marine heat waves

Prototype: Savannah, Southeast US Continental Shelf

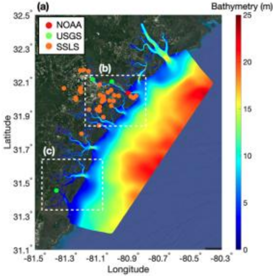
MVP components:

-SMART sea level sensors

-high-res satellite (40-60 m)

-limited area estuary-shelf models

To be expanded with T sensors & waves



IMPACT AREA 2

Downscaling for climate risk assessment

Prototype: Adriatic Sea

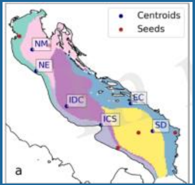
MVP Components:

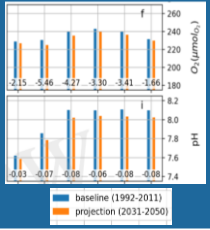
-30-40 years limited area simulations for different CMIP scenarios uncoupled/coupled atmo-hydro-ocean-biochemistry simulations

-historical data bases for validation

-ERDDAP data store

To be expanded for multiple downscaling





The solutions: customized services for pollution hazard mapping and Nature Based Solutions

IMPACT AREA 3

Oil spill pollution forecasting and hazard mapping

Prototype: North and South Atlantic/Global Ocean

MVP Components:

-Medslik II model coupled with CMEMS forecasts and analyses

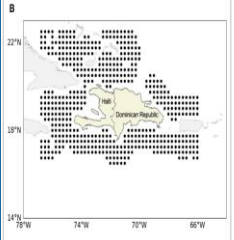
-SAR imagery analysis

-hazard pollution index for coastal segments

To be re-formulated with AI for hazard mapping

TABLE 4 | Beached oil hazard index calculated with Equation (3) for the three areas and the threshold value of 25 tons/km.

Area	Beached oil Hazard index
East Atlantic Archipelago	0.16 ± 0.01
Western Atlantic island	0.18 ± 0.01
Bahia (Brazil)	0.14 ± 0.01



IMPACT AREA 6

Digital Twins for Seagrass Nature-Based Solutions

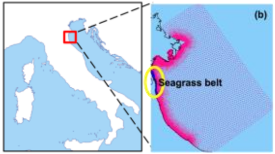
Prototype: Emilia-Romagna region / Civitavecchia

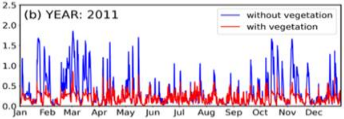
-MVP components:

-wave buoys

-limited area wave modelling for seagrass landscaping scenarios

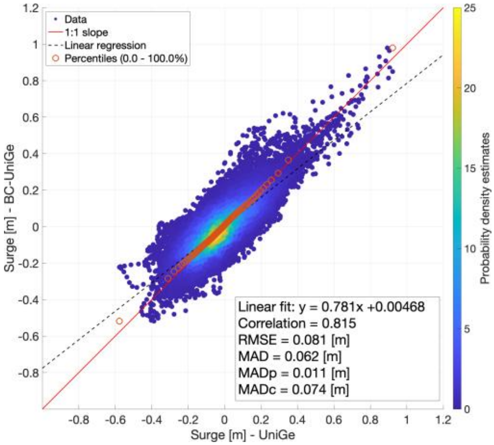
To be expanded to mangroves



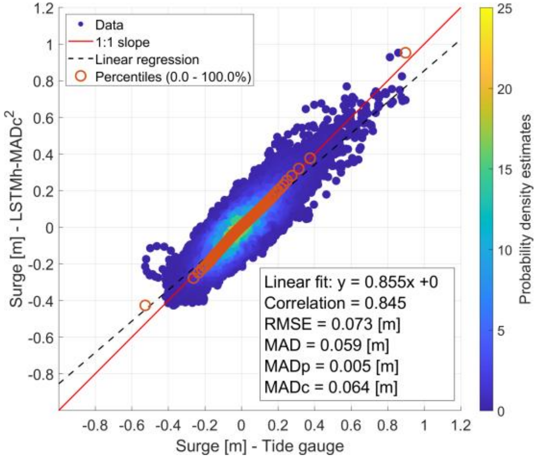


The solutions: ML models for forecasting

Numerical model storm surge fcst



ML storm surge fcst



Rodrigo Campos and Lorenzo Mentaschi, Univ. of Bologna

In conclusions

From Prof. Syders AR, Delaware University, June 2024

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THANK YOU
MUCHAS GRACIAS
MERCI BEAUCOUP