

IOC of UNESCO Regional Secretariat for IOCARIBE

Report to IOCARIBE XVI regarding *Recommendation SC-IOCARIBE-XV.8:*

INITIATIVES TO IMPROVE MEMBER STATES HURRICANE OBSERVING FORECASTING CAPACITY

The IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE),

Aware of the urgency to mobilize a regional effort to enhance hurricane forecasting in the Caribbean region to save lives and protect property,

Recognizing that upper ocean measurements of temperature and salinity are needed to improve hurricane intensity forecasts, particularly in cases of rapid intensification,

Recalling that NOAA AOML's Physical Oceanography Division and the US Integrated Ocean Observing System (IOOS) are leading a multi-institutional effort that brings together the research and operational components within NOAA and the university community to implement and carry out sustained and targeted ocean observations from underwater gliders in the Caribbean Sea and south-western tropical North Atlantic Ocean,

Recalling that gaps in the ocean observing system in the IOCARIBE region can be addressed by partnerships between nation states such as the high frequency radar network and the hurricane glider picket fence program between the US (NOAA/Atlantic Oceanographic and Meteorological Laboratory, the University of Miami, and the University of Puerto Rico Mayaguez); the Dominican Republic (Dominican Republic National Meteorological Office (ONAMET)) and the National Authority of Marine Affairs (ANAMAR)); the Bahamas (Cape Eleuthera Island School); and many other partners,

Welcomes the IOCARIBE GOOS establishment of a pilot project on Improvement of Hurricane Observing Forecasting Capacity,

Urges IOCARIBE Member States to:

- i) Contribute to this pilot project by deploying instruments to improve hurricane forecasting;***
- i) Report deployment opportunities and facilities to JCOMMOPS in order to maintain a sustained observing system for improved weather forecasting and ocean state estimation; and***
- ii) Encourage the facilitation of domestic marine scientific research clearances to facilitate instrument deployments.***

Transformative Ocean Observing for Hurricane Forecasting, Readiness, and Response in the Caribbean Tropical Storm Corridor (*a pilot project on Improvement of Hurricane Observing Forecasting Capacity*)

W. Douglas Wilson University of the Virgin Islands

Anthony Knap Texas A&M University

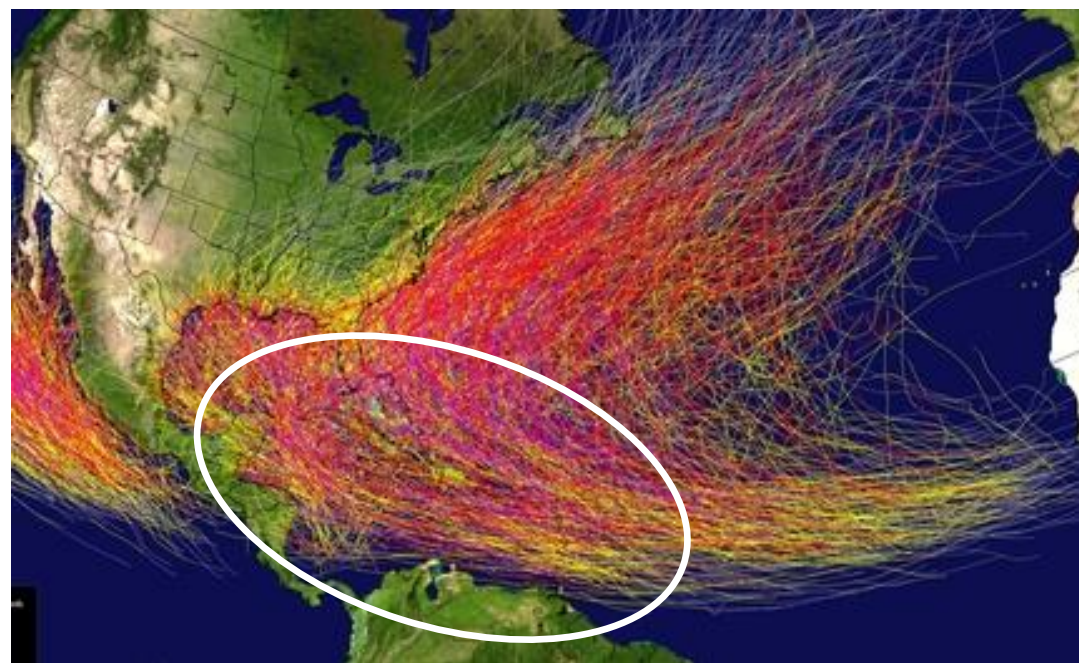
Scott Glenn Rutgers University

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Project Objectives: Build supporting physical and social infrastructure and conduct a long-term, critical-region sampling program using Autonomous Ocean Gliders, High Frequency Radars (HFRs), and other existing and developing technologies to provide real-time information resulting in hurricane forecast improvement. Improved forecasts will support new generations of local storm surge / precipitation / wave and coastal impact models and guidance used to directly enhance resilience. The effort will:

- Strive for appropriate observation density, diversity, and utilization for a sustained, meaningful regional impact;
- Create a regionally distributed supporting infrastructure including operations, education, training, and workforce development;
- Engage a diverse and influential group of partners to convert forecasts to products to local action;
- Lead to a sustained, expanded, regional Ocean Observing System based on GOOS principles.



Progress and Activities during 2019-2021:

Gliders - Hurricane Gliders (with many partners - 15 Deployments, 1200+ Days, 20,000 Profiles)
Emphasis on using glider data to improve NOAA hurricane forecast ocean models
Including international missions in BVI, Anguilla, and Dominican Republic

High Frequency Radar – existing in MX, PR; under construction in USVI; planned for Cuba

Drifting Buoys – Supported Tropical Shipping Line in E Caribbean; looking for partners to complete coverage

Funding considerations / Future plans / Donors

Gliders – USG funding from NOAA Hurricane Supplemental ; US IOOS; US Navy; Universities and Research Institutions
US UN Decade “Ocean Shot” - proposed
Vetlesen Foundation Challenger Mission for international glider missions

HF Radar – IOOS; GoM; MEX;

Drifting Buoys – NOAA Global Ocean Monitoring and Observation; part of Surface Velocity Program, DBCP

Future Workplan and budget 2021 – 2022

2021 Hurricane Gliders (US NOAA, IOOS, Navy), including Saildrones
CARICOOS PR, USVI HF Radars
MX, Cuba HF Radars
Drifting buoys
CORREDORES E Caribbean Glider mission
NOAA AOML Dominican Republic, Bahamas Glider missions

2022 NOAA EEOOTT [EXTREME EVENT OCEAN OBSERVING TASK TEAM] field program, similar to above more expansive

UN Decade Involvement, Needs and Recommendations

UN Initiative for IOCARIBE “*Transformative Ocean Observing for Hurricane Forecasting, Readiness, and Response in the Caribbean Tropical Storm Corridor*” described here

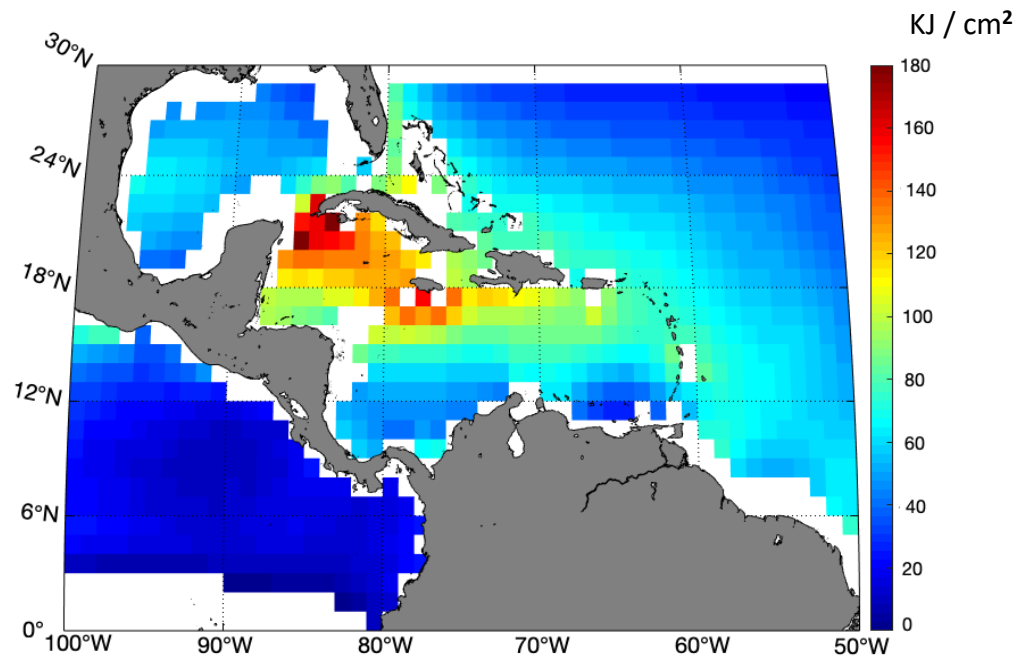
Similar proposed in US under US “Ocean Shot” initiative

Recommendations Members support ***SC-IOCARIBE-XV.8***, including:

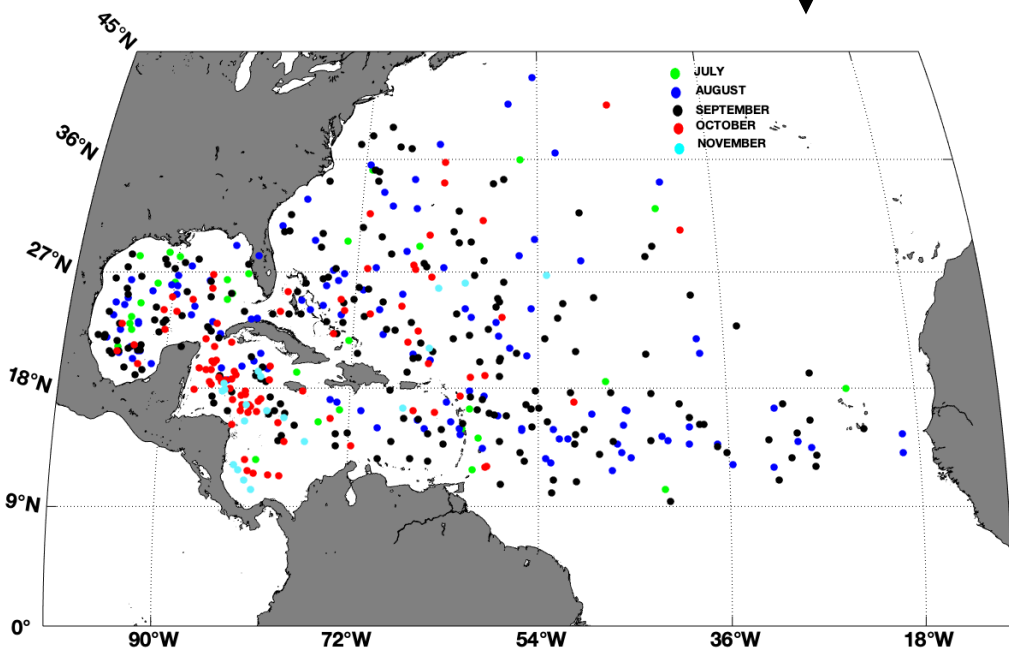
- JCOMM – GOOS – WMO Initiate regional OCEAN OPS organization similar to Mediterranean
- Collaborative research agreement among IOCARIBE countries for operational ocean observations (starting with gliders) similar to ARGO float and Drifter programs

Rationale

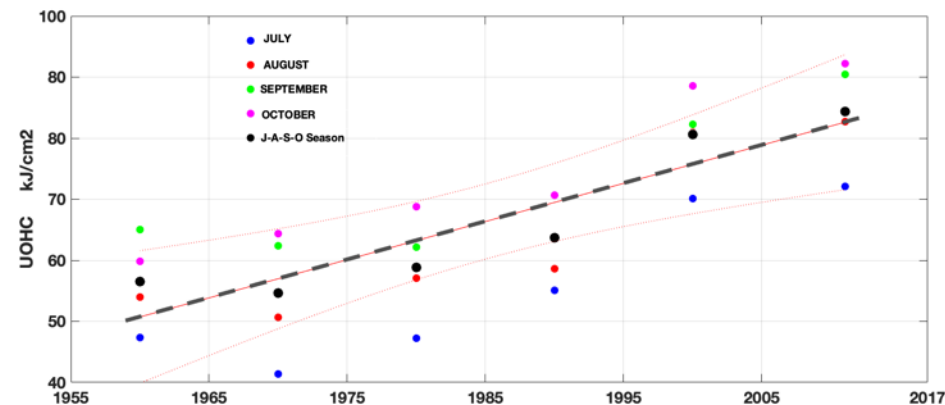
Critical Essential Ocean Feature
(Upper Ocean Heat Content)
for Hurricane Intensification is
STRONG
and
STRENGTHENING.



Mean Upper Ocean Heat Content in kJ/cm^2 from World Ocean Atlas WOA18
Period 2005-2017 Hurricane Season (July-August-September-October)



Tropical Cyclone
Rapid Intensification
(defined as >30 kt
increase in 24 hours)
Based on HURDAT2
(1851-2019)



Caribbean-wide Upper Ocean Heat Content World Ocean Atlas
WOA18 Decadal data Hurricane Season (July-August-September-October)
Linear Trend = $0.62 \text{ kL} / \text{cm}^2 / \text{Year}$

Potential Assets (Platforms, Projects)

HF Radar on uninhabited Mona Island, Puerto Rico



HF Radar solar power array in Texas.



Argo Float Deployment



Surface Drifter Deployment



Glider Deployment

Ultimate System Vision

GLIDERS

Upper: In 2020 there were over **20,000** new TS profiles in the NE Caribbean/W Tropical Atlantic
Lower: Proposed 2021 Eastern Caribbean Inflow mission

DRIFTING BUOYS

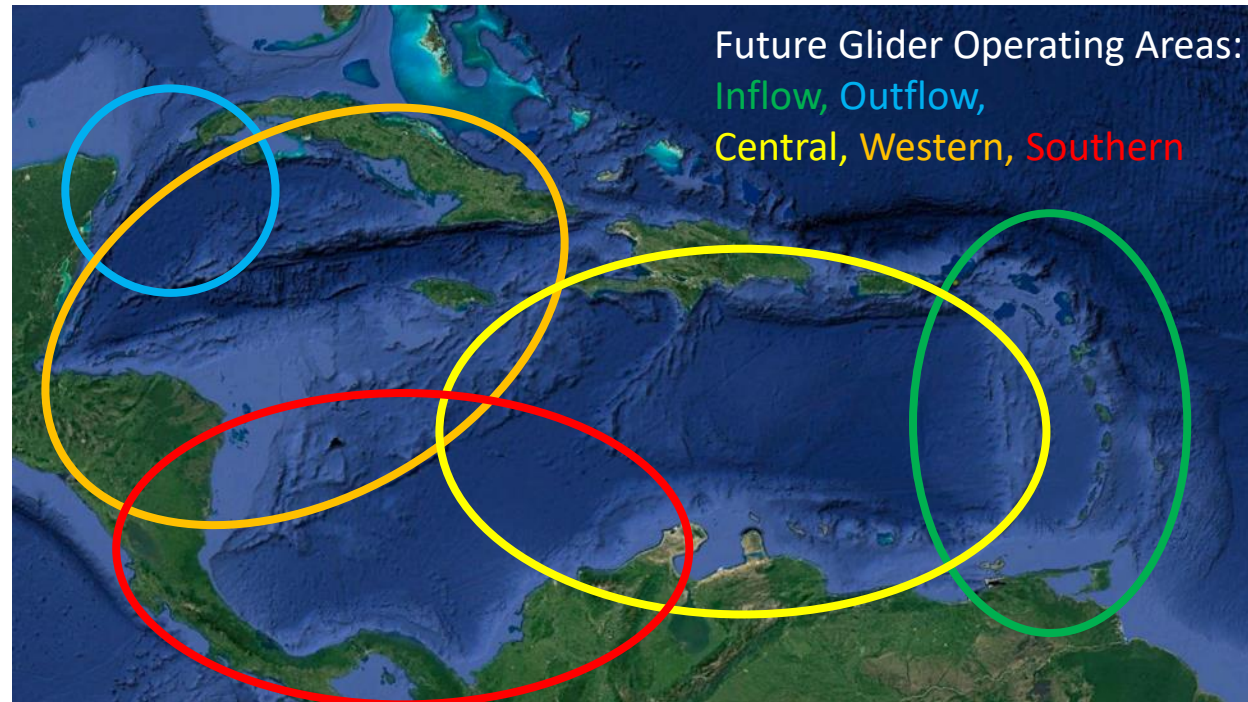
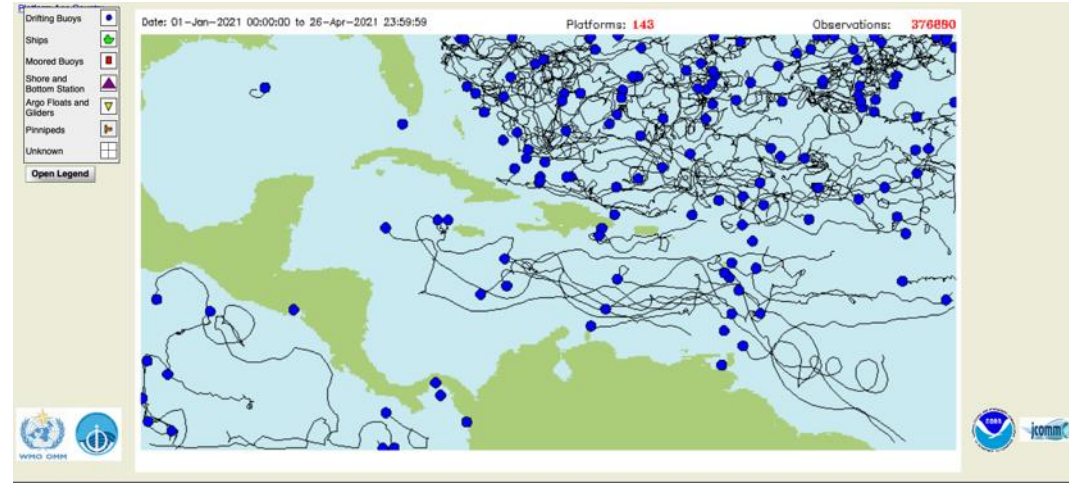
Jan – April 2021 shown. To sample the Caribbean, drifters must be launched IN the Caribbean.

HF RADAR

Upper: Outflow HF Radar Network (already in MX, FL; Cuba site scouting completed, first install covid delayed)
Lower: Inflow HF Radar Network (already in PR, USVI)



Actual 2020 Glider Tracks



Future Glider Operating Areas:
Inflow, Outflow, Central, Western, Southern



Proposed 2021 Inflow Glider

