

# Update on UGOS – Understanding Gulf Ocean Systems

*Michael Feldman – Sr. Program Manager, Gulf Research Program*



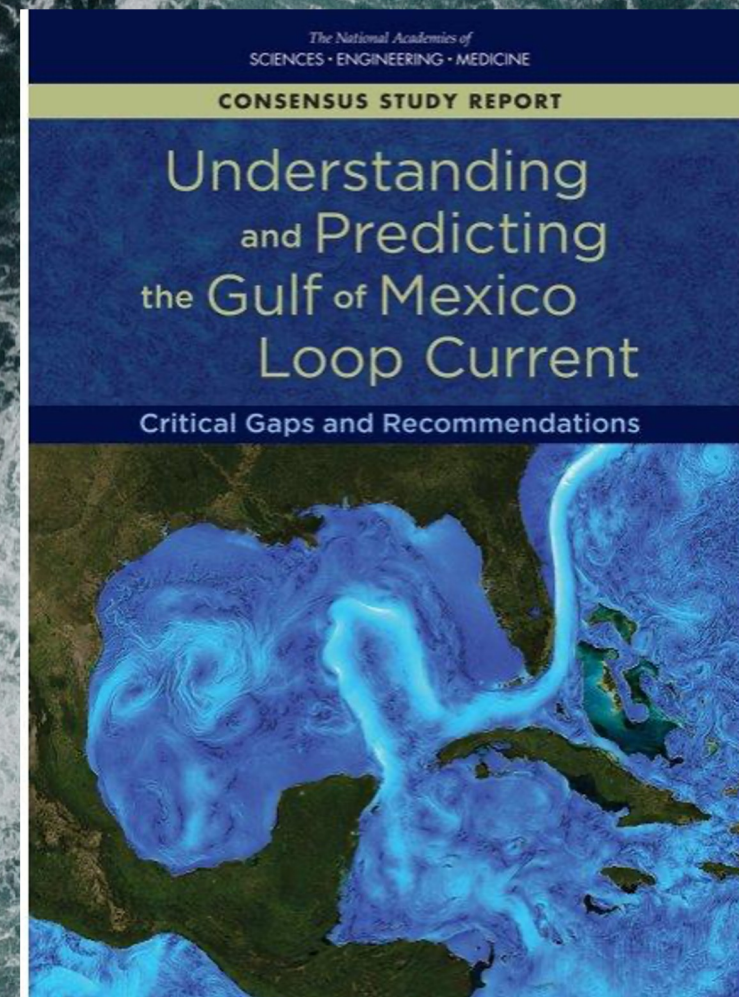
# UGOS: History and Goals

## History

- 2016 GRP Advisory Board
- 2018 consensus study
- Established a Standing Committee
- 3 rounds of funded projects

## Goals

- Better understand loop current dynamics
- Improve forecasting
- Reduction of risks to offshore energy



# Where we started in March 2022



**Steve DiMarco**  
Texas A&M

**CODEEED**

**Amy Bower**  
WHOI



**Eric Chassignet**  
Florida St.

3 Individual Consortia funded for a total over \$ 22,000,000 over the next 5 years

Building upon UGOS 1+2 investment of \$ 12,000,000 across 15 different projects

# Working together toward a unified objective

- Initiated a reorganization as a single UGOS Program
- Held an All Hands Meeting in August 2022 to initiate creation of 6 Working Groups
- Development of a shared Collaboration Space (UGOS Google Drive)
- UGOS Technical Coordinator – Jan van Smirren
- Establishment of an Executive Committee

**To improve Gulf of Mexico operational forecasting system capabilities with optimized observations for the benefits of all stakeholders with the intent of transitioning the system to industries and government agencies.** This is to be achieved by building on the technology and understanding developed under previous UGOS funding as well as new UGOS developments and pre-UGOS era research.



# Establishment of 6 Working Groups

**WG 1**  
Stakeholder  
Engagement  
(Industry/Gov.  
Agencies)

**WG 2**  
Transition to  
Operations

**WG 3**  
Observations to  
Support Ocean  
Prediction

**WG 4**  
Model Tools to  
Improve Prediction

**WG 5**  
Applications

**WG 6**  
Data Management

**Tony Knap (Lead)**  
Scott Glenn  
Randy Watts  
Steve Morey  
Eric Chassignet  
Ruoying He

**Steve DiMarco (Lead)**  
Eric Chassignet  
Amy Bower

**Amy Bower (Lead)**  
Steve Morey  
Steve DiMarco

**Eric Chassignet  
(Lead)**  
Kathy Donohue

**Scott Glenn (Lead)**  
Randy Watts

**Felimon Gayanilo  
(Lead)**  
Heather Furey  
Steve Morey

GulfCORES  
GODEEP  
GOFFISH

# Creation of the Executive Committee

- Led by the Technical Coordinator - comprised of the UGOS Technical Coordinator, WG chairs, the UGOS Project Directors, and the GRP management team.
- Develop strategies and provide programmatic direction and decisions towards the overall UGOS mission. When needed, assess problems and decide on corrective actions.
- Attend monthly virtual meetings of the committee and provide updates to the progress of each individual WG activities and actions.
- Facilitate and ensure regular communication and coordination between working groups.

## ***Membership***

Jan van Smirren (Lead)

Amy Bower (WG3)

Felimon Gayanilo (WG6)

Tony Knap (WG1)

Eric Chassignet (WG4)

GRP Management Team

Steve DiMarco (WG2)

Scott Glenn (WG5)

Standing Committee Chair

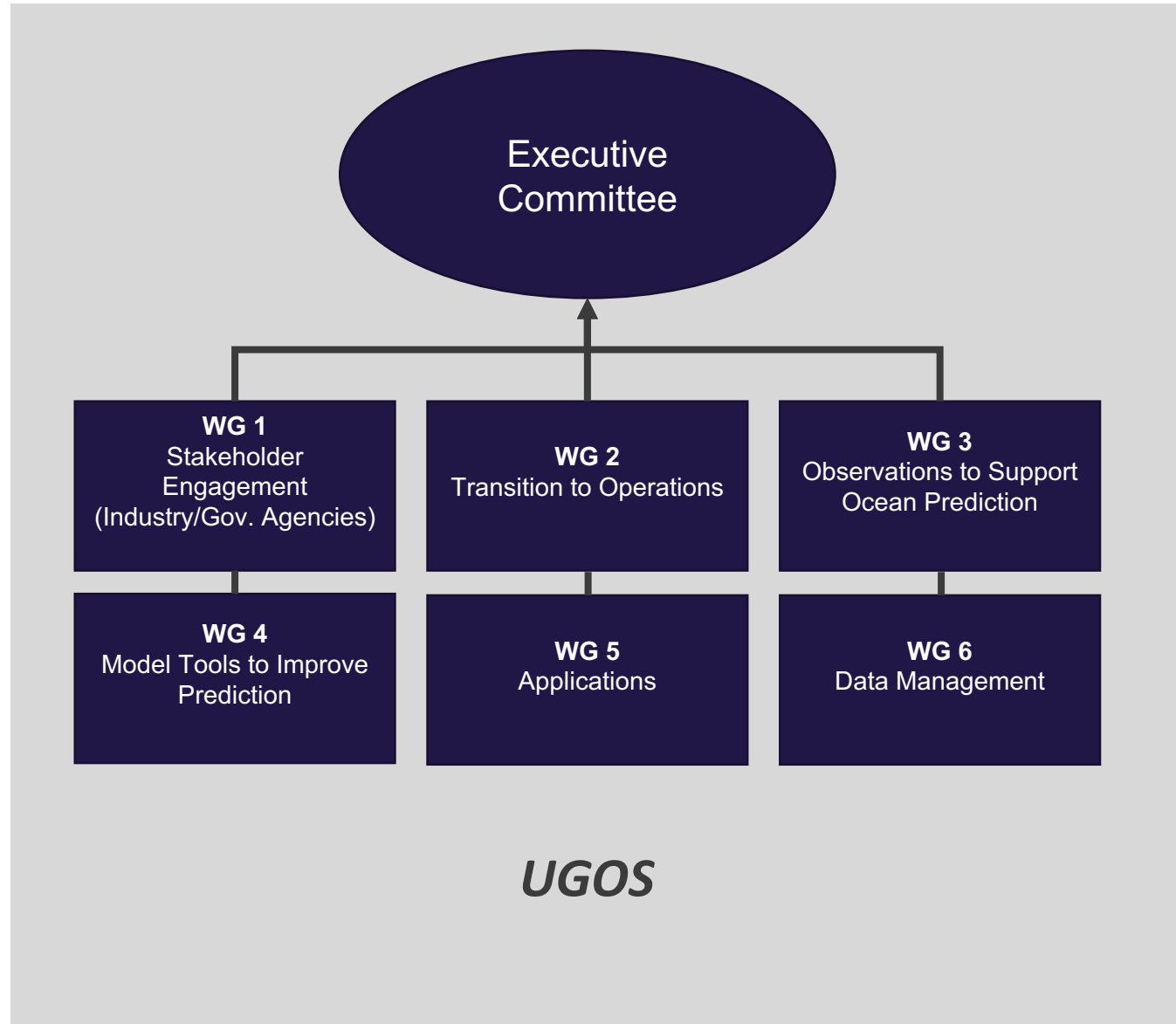


# Where we are now – April 2023

## *Oversight*

**The UGOS Standing Committee:**  
charged to guide, implement,  
and assess how the research  
outputs meet UGOS goals and  
objectives.

**The Gulf Research Program:**  
Provide programmatic  
leadership, coordination,  
manage finances, represent  
UGOS with external  
stakeholders, guide program  
evaluation, and maintain UGOS  
files and history.



# Working Group Activities

Each WG meets monthly, except WG6 (ad hoc)

## WG 1

Stakeholder  
Engagement  
(Industry/Gov. Agencies)

- Stakeholder Speaker Series
- Roundtable Discussion with GCOOS
- OTC in Houston (May)
- Stakeholder Advisory Group

## WG 2

Transition to Operations

- NOAA-UGOS Modeler partnership
- UGOS Metrics Coordination

## WG 3

Observations to Support  
Ocean Prediction

- MASTR Planning
- Early Career Seminar Series

## WG 4

Model Tools to Improve  
Prediction

- Development of forecast systems
- Development of forecasting tools and actionable knowledge for full-water column currents

## WG 5

Applications

- Fisheries
- Topographic Rossby Waves
- Hurricanes

## WG 6

Data Management

- 3 members, representing each Consortia
- Coordination across all 6 WGs



**Soooo...What's next?**

# Working Group 1: Stakeholder Engagement

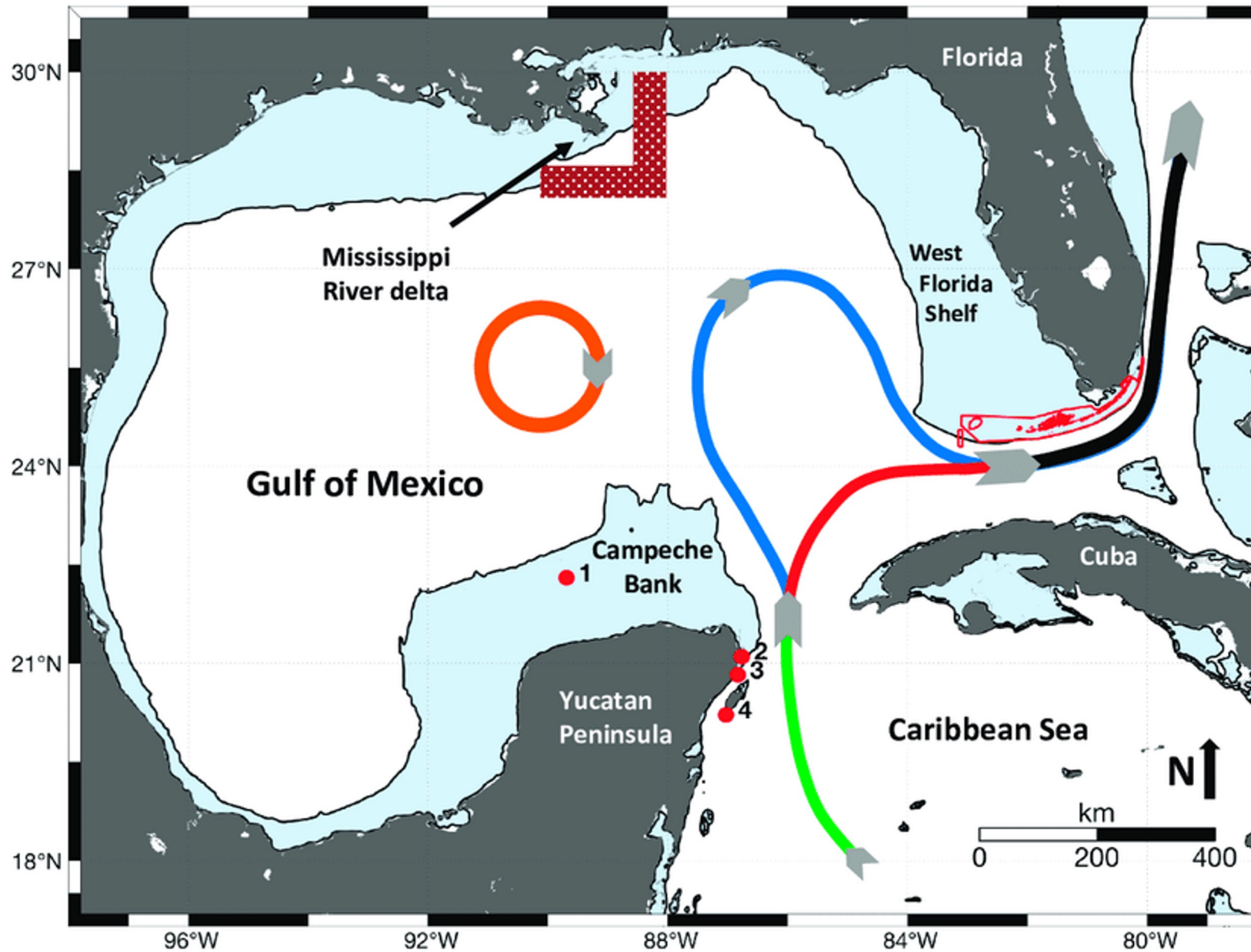
Mission: to coordinate UGOS stakeholder engagement activities and to interact with industry and government agency stakeholders and end-users to build connections and to define services and products that are sustainable and meaningful to industry, government agencies and the public - division between industry and government agencies - Cross-participation in the two groups.



# List of Stakeholder Categories and participants

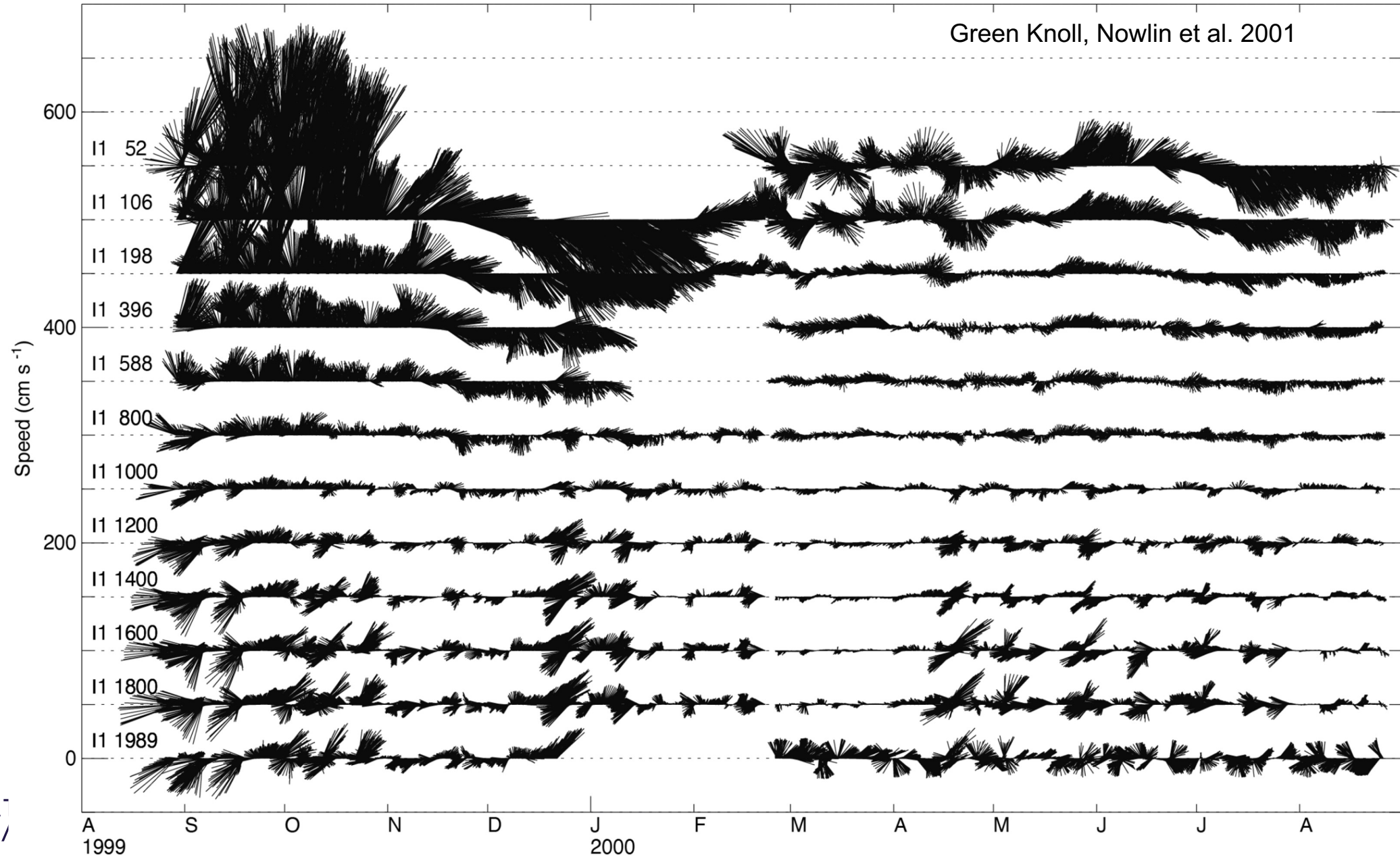
Oil and Gas Companies including drilling	6		
Search and Rescue		1	
Shipping			0
Disaster Response		1	
Wind Energy		1	
Kinetic Energy (waves)		0	
Carbon Capture and Storage		0	
Fisheries			3
Not-for Profit		4	
Regulatory			1
Ocean consulting companies		3	
Academic			Many
The public (recreation, fishing etc.)	Many		







Green Knoll, Nowlin et al. 2001



J.D. Cochran et al. (1963)

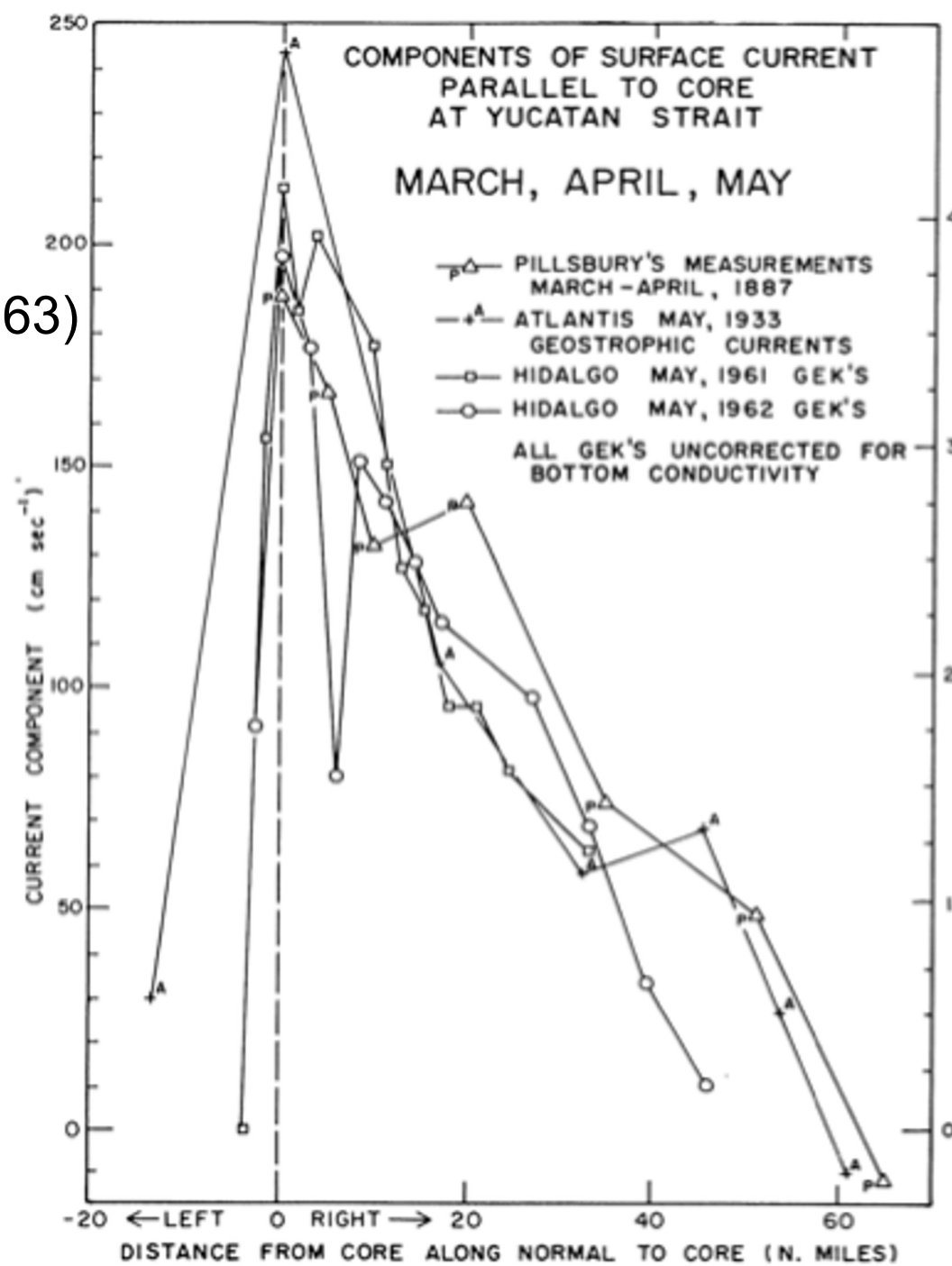
Pillsbury (1887)

Atlantis (1933)

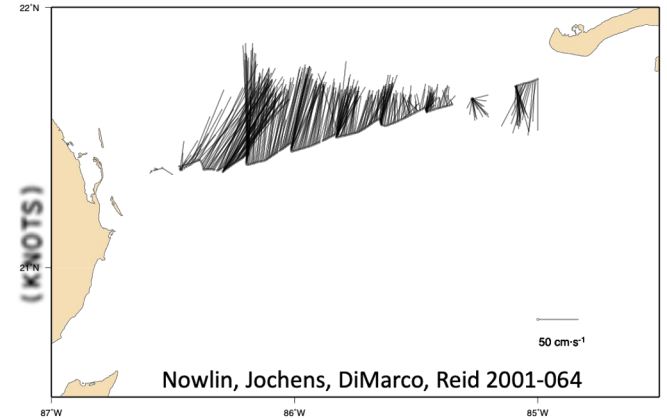
Hidalgo (1961)

Hidalgo (1962)

Gyre (1999)

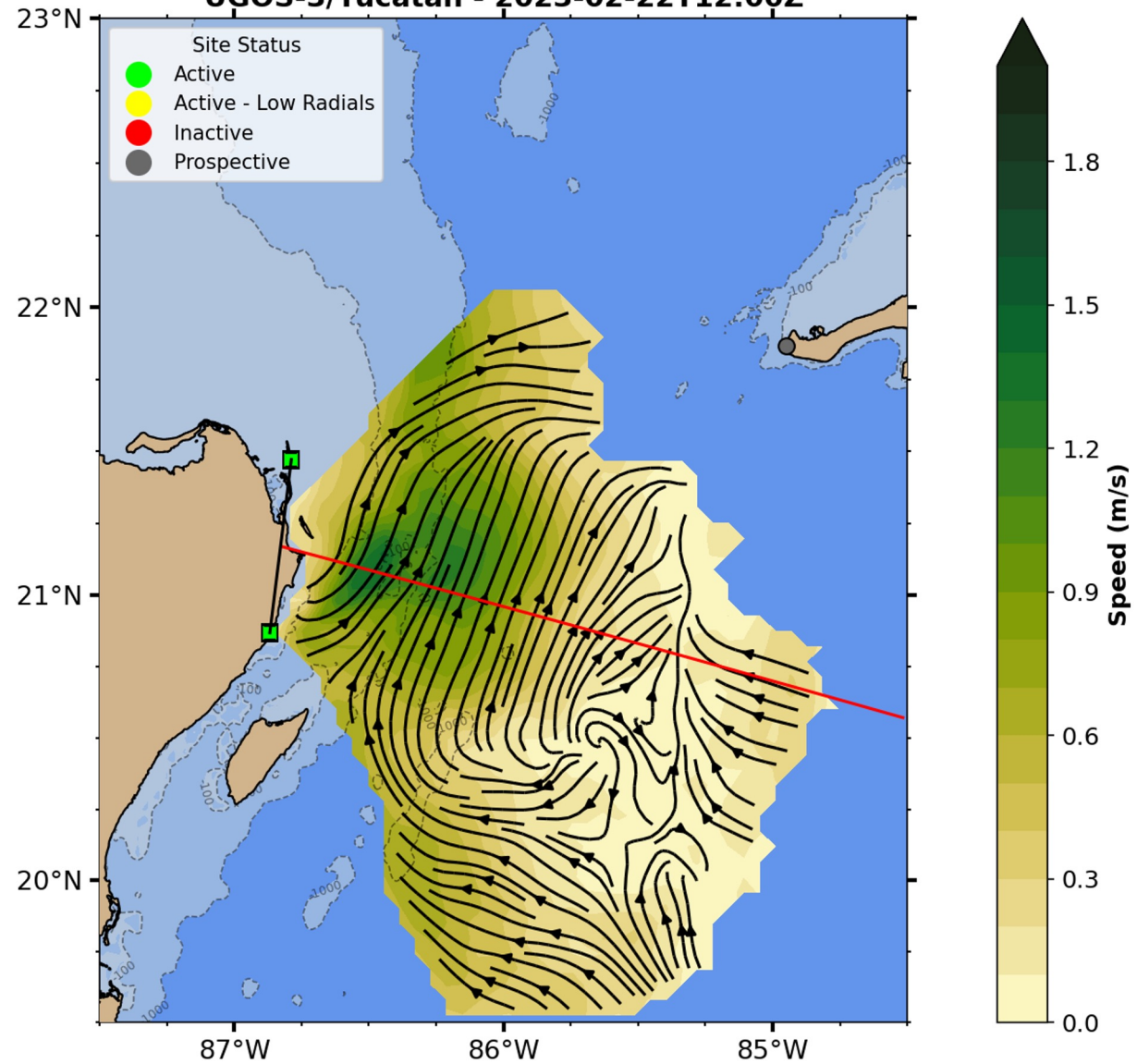


VMADCP October 1999



38-kHz OS ADCP

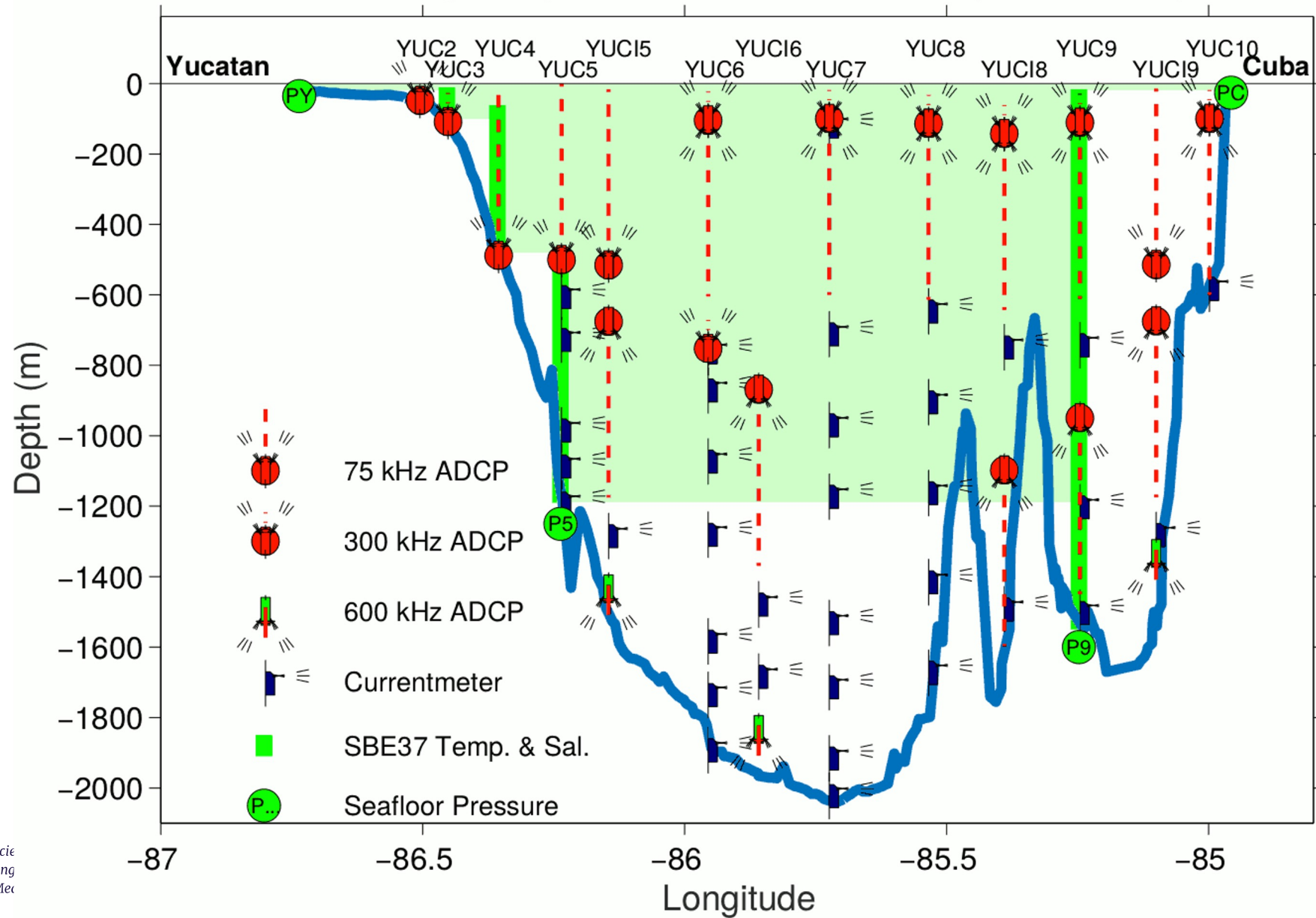
**HFRadar - Surface Currents - OI**  
**UGOS-3/Yucatan - 2023-02-22T12:00Z**

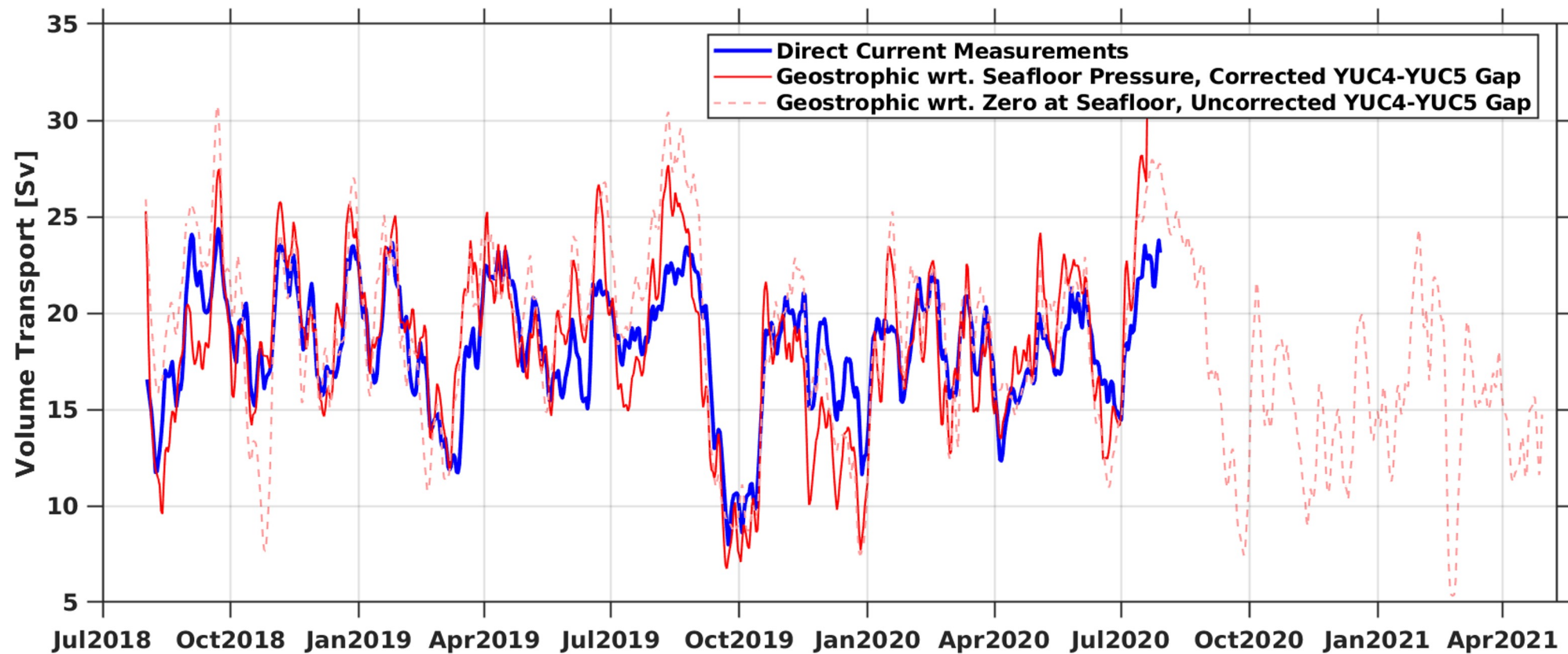




## Mooring Array in the Yucatan Channel (INS-CNK42)

Candela et al.  
2019





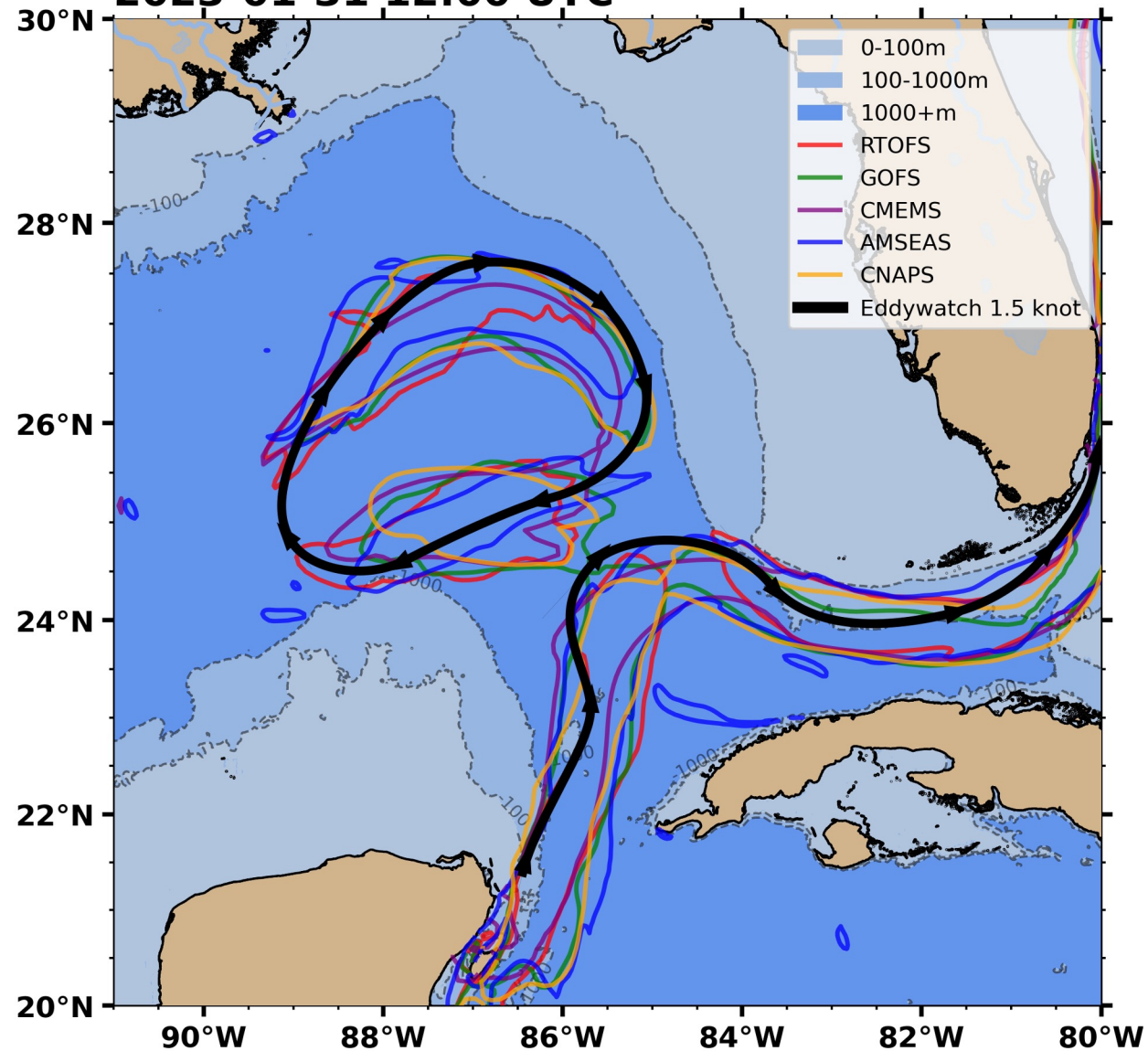
Data from Candela array. Direct measurements in blue with Geostrophic flow presented through corrections for sea floor pressure. (Candela et al., 2019)

A Case for Improvement Glenn et al. 2023

Major Models for 1/31/23

RTOFS  
COFS  
CMEMS  
AMSEAS  
CNAPS  
Eddywatch

## 1.5 knot Surface Current Comparisons 2023-01-31 12:00 UTC





# Acknowledgements: Funding NASEM GRP UGOS (SCON-10000542)

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- Chevron
- CISESE, Ensenada, Mexico
- CODAR Ocean Sensors
- Florida A&M University
- Florida State University
- FUGRO
- Massachusetts Institute of Technology
- National Oceanic and Atmospheric Administration
- Naval Research Laboratory
- North Carolina State University
- Ocean Sierra LLC
- Rutgers University
- Tendral
- Texas A&M University College Station
- Texas A&M University Corpus Christi
- University of California
- UC San Diego/Scripps Institute of Oceanography
- UNAM, Mexico
- University of Miami
- University of Rhode Island
- University of South Carolina
- University of South Florida
- University of Southern Mississippi
- Woods Hole Group

Paper # • Paper Title • Presenter Name



# Growing Government Stakeholder Engagement

- NOAA National Ocean Service (NOS) active participation in All Hands Meeting, transition advice, etc
- NOAA National Weather Service (NWS) Environmental Modeling Center (EMC) - operational global ocean models (RTOFS, MOM6) and regional coupled atmosphere-ocean models (HWRF, HMON, HAFS).
- NOAA NOS for East Coast Community Ocean Forecast System (ECCOFS) – future regional operational model.
- NOAA National Marine Fisheries Service (NMFS) – analysis of 20-year high-res hindcast
- IOOS - Hurricane Gliders, Gandalf, Glider Data Assembly Center (DAC)
- Navy - Hurricane Gliders, GHOST
- IOOS - HF Radar (HFR) Regional Associations and DAC – envisioned future home of UGOS HFR
- NOAA Office of Oceanic and Atmospheric Research (OAR) – Argo Data, EEOOTT
- IOOS Model/Data Comparison Group – Evaluation of model Essential Ocean Features with Glider & Argo data

Mission: ... to build connections and to define services and products that are sustainable and meaningful ...

# NOAA RTOFS 2.0

# European Copernicus

SST mean: 2021.92-2022.00 93.0

GLBb0.08  
ci 0.35  
1.1 to 31.9

0 5 10 15 20 25 30

Global Temperature (deg C)  
20220211 n024  
Depth: 0 m min: -3.36 max: 34.17

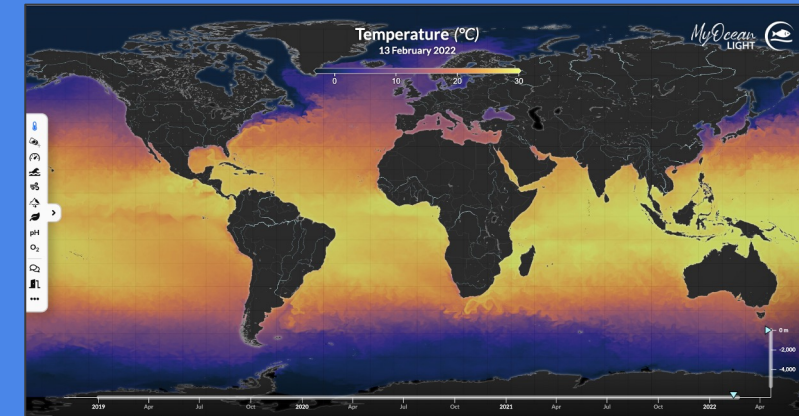
85°N  
60°N  
35°N  
10°N  
15°S  
40°S  
65°S

100°E 150°E 160°W 110°W 60°W 0° 50°E

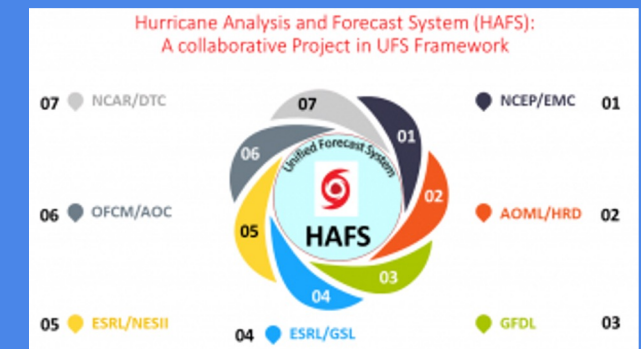
-5 0 5 10 15 20 25 30 35

NCEP/EMC/Verification Post Processing Product Generation Branch

11 Feb 2022 01:17



Operational through 2022  
HMON + HYCOM using  
RTOFS Initial Condition



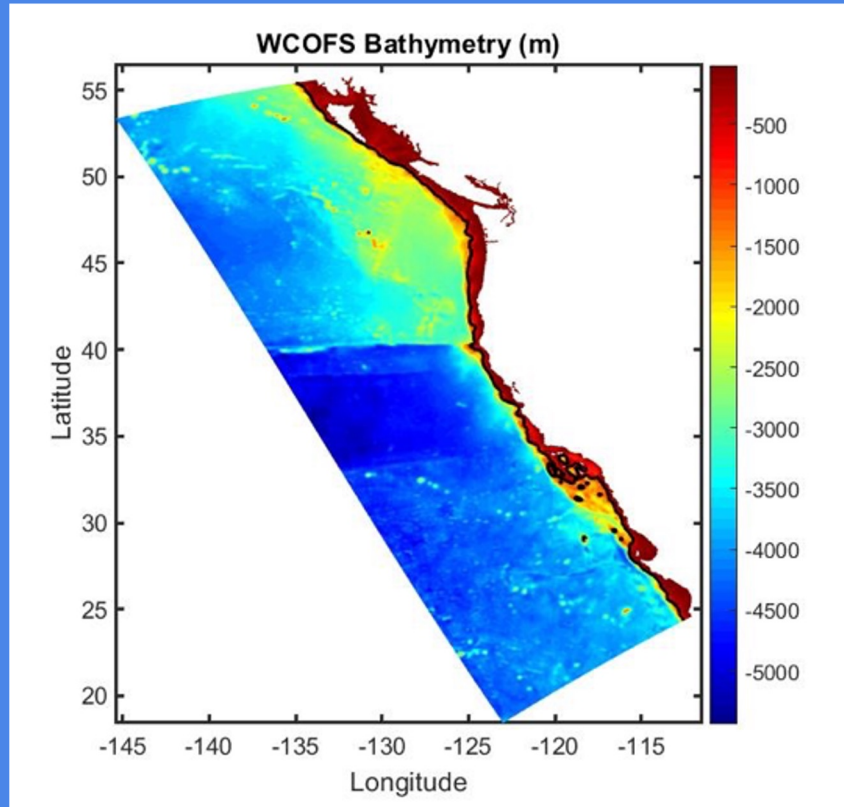
## Operational in 2023



# Operational Systems: *Regional Ocean Forecasts*

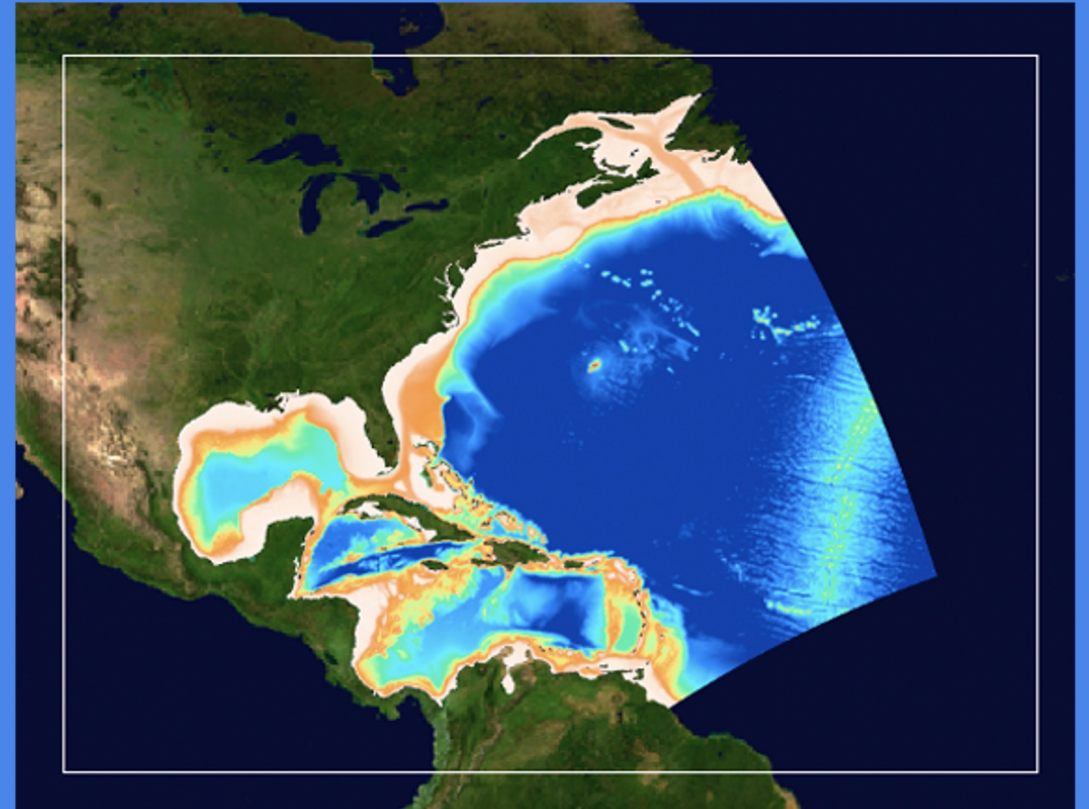


## West Coast Operational Forecast System (WCOFS)



Labeled Developmental &  
Under Evaluation on NOAA Website

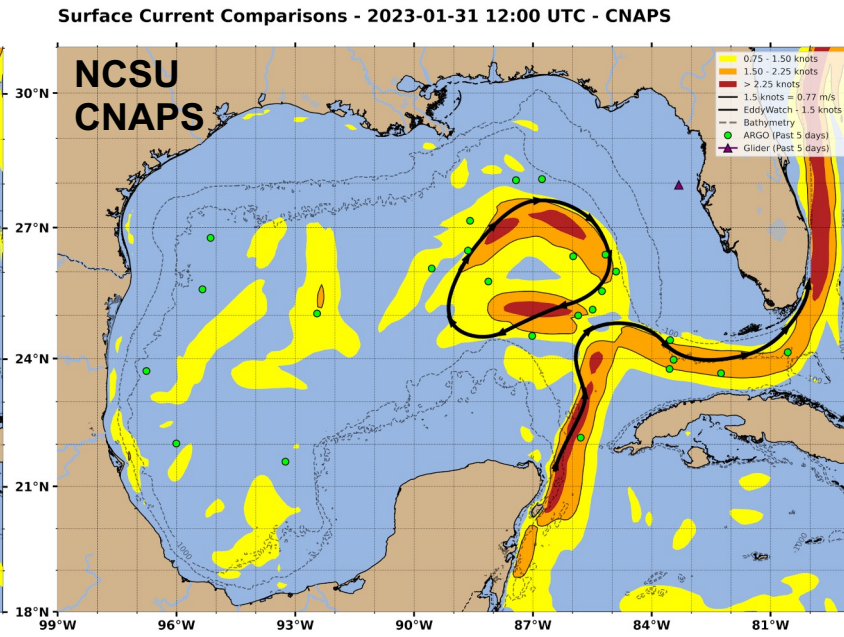
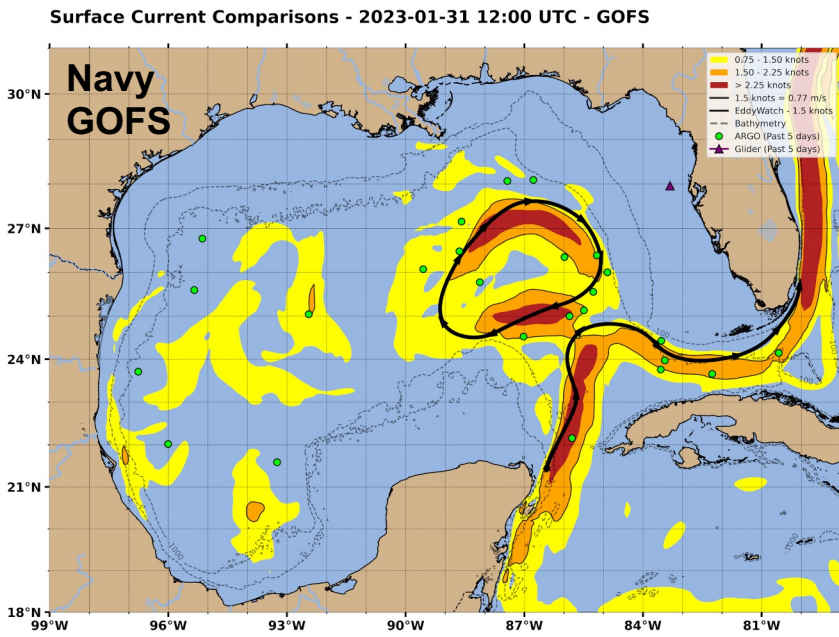
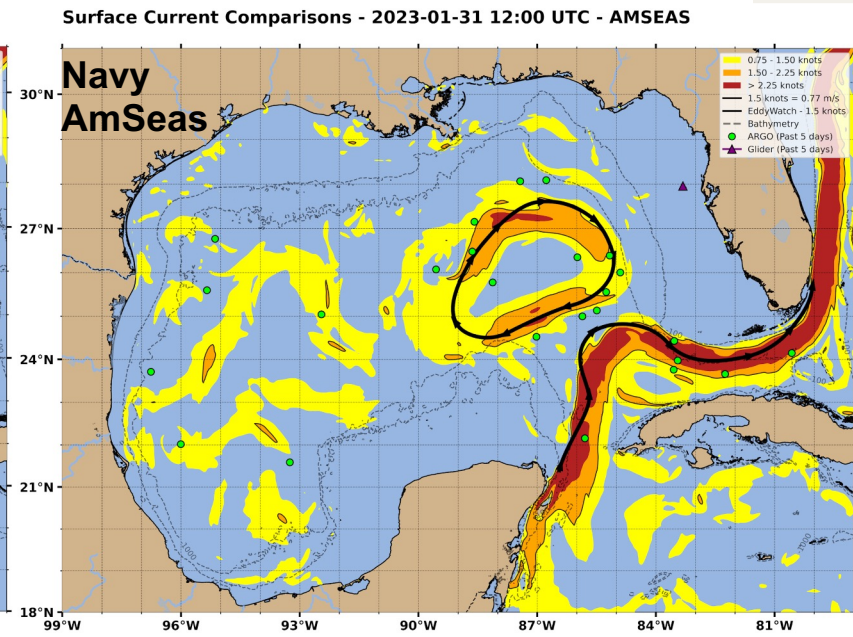
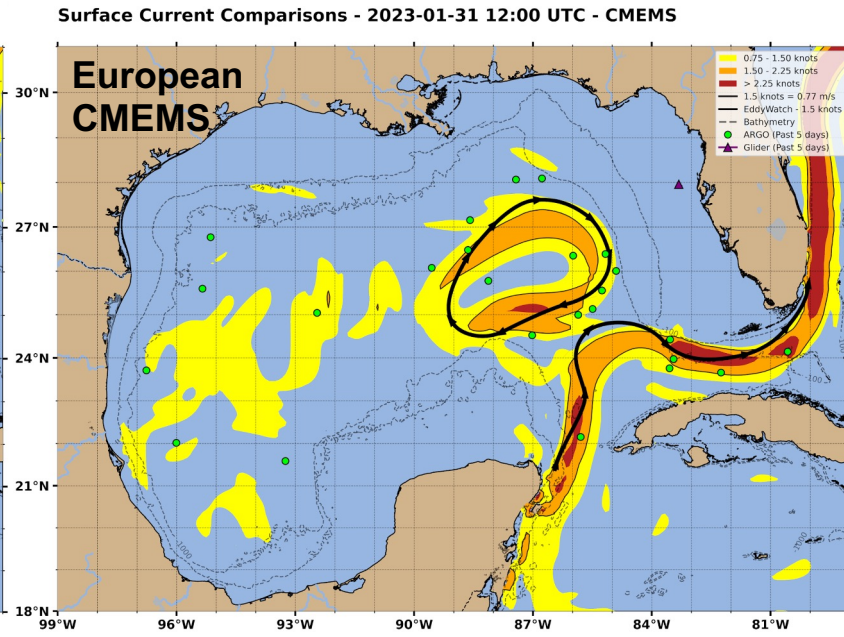
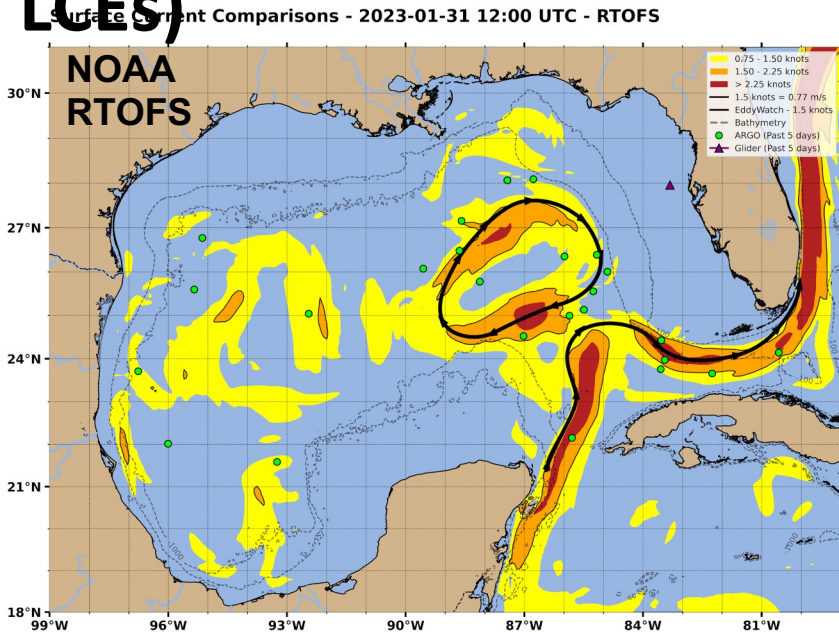
## East Coast Community Ocean Forecast System (ECCOFS)



Target Readiness Level RL-5 by end of 2024  
Operations at NCEP end of 2027



# Surface Velocity Model Metrics - Focus on Essential Ocean Features (LC & LCEs)



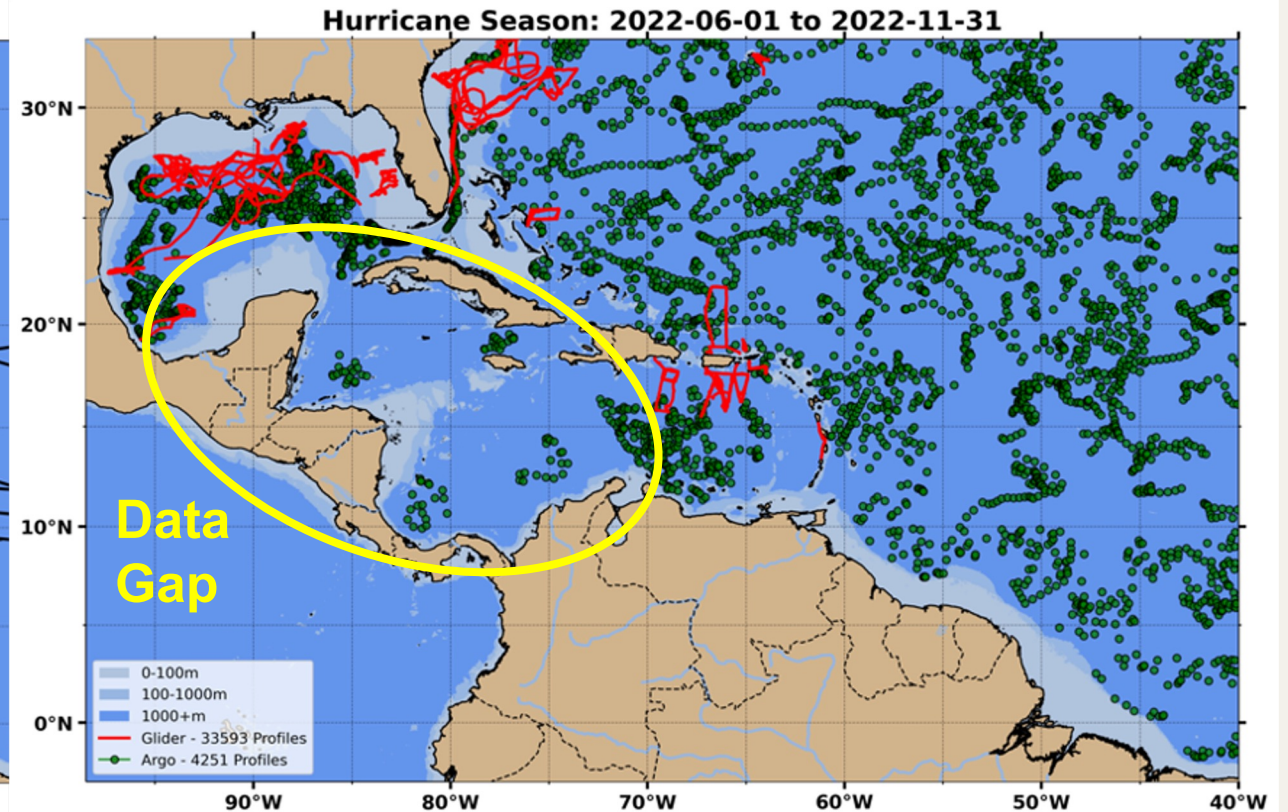
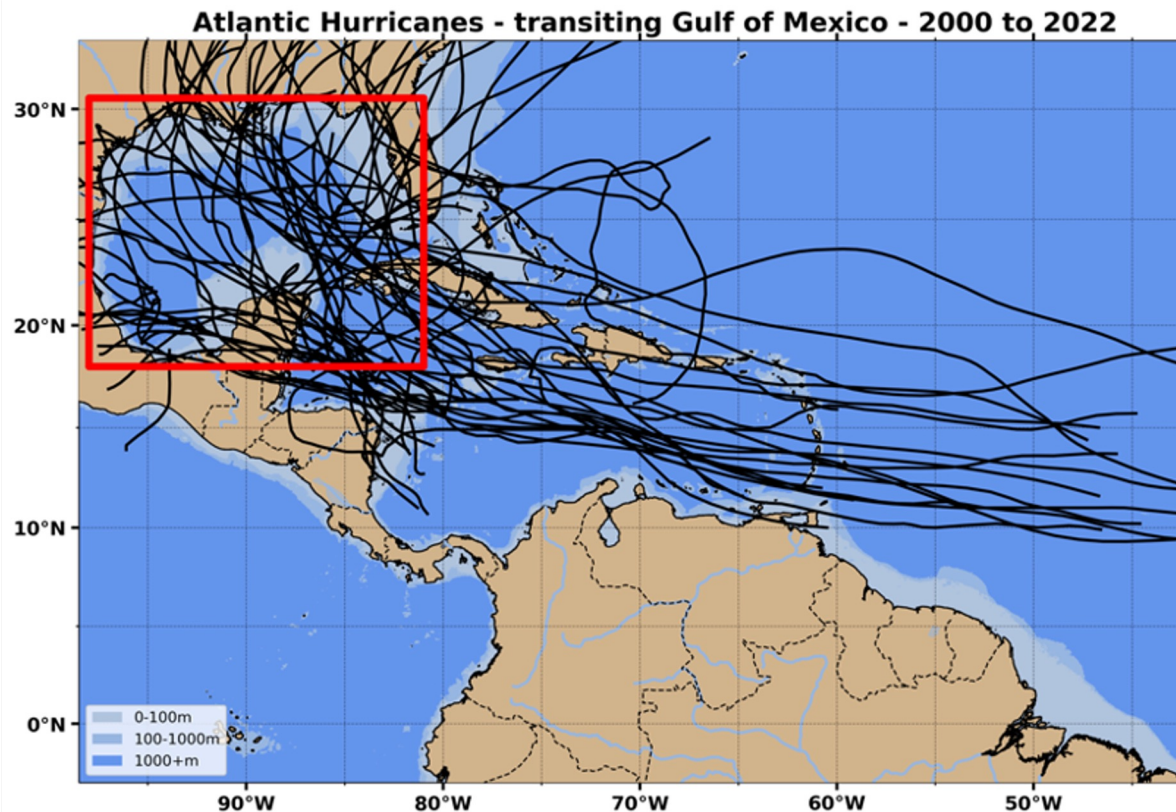
**Working with Industry on Metrics that Matter**

Red: > 2.25 knots  
Orange: 1.5-2.25 knots  
Black: WHG 1.5 knot line  
Yellow: 0.75-1.5 knots



# Growing International Stakeholder Engagement

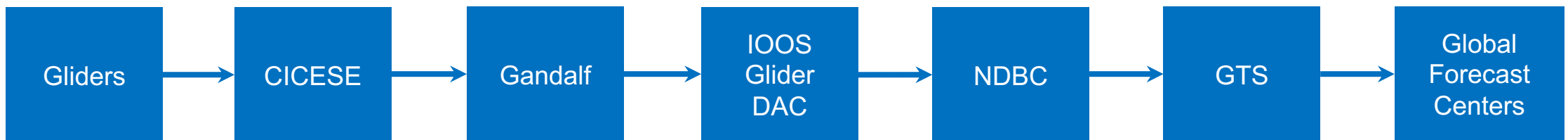
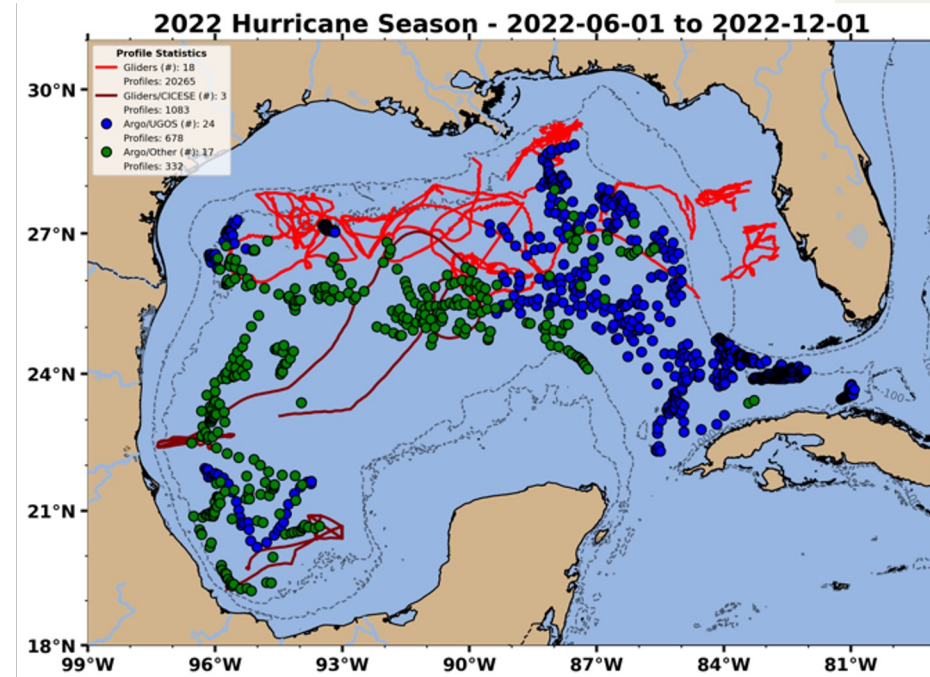
- Mexico – UNAM (HFR) & CICESE (Gliders) in UGOS MASTR
- Cuba – INSMET (HFR, Gliders, Met Station)
- IOCARIBE-GOOS – Tropical Atlantic & Caribbean Ocean Observing & Forecasting System (TAC-OOFS)
- POGO – 2023 meeting hosted by CICESE – collaboration with Cuba
- UN Ocean Decade Co-Design Programme – Tropical Cyclone Exemplar Pilot Study – Caribbean Sea
- UN Ocean Decade SynObs Programme – Global OSEs/OSSEs seeking regional partners for model output analysis





# Glider Collaborations – *Mexican Gliders to the GTS*

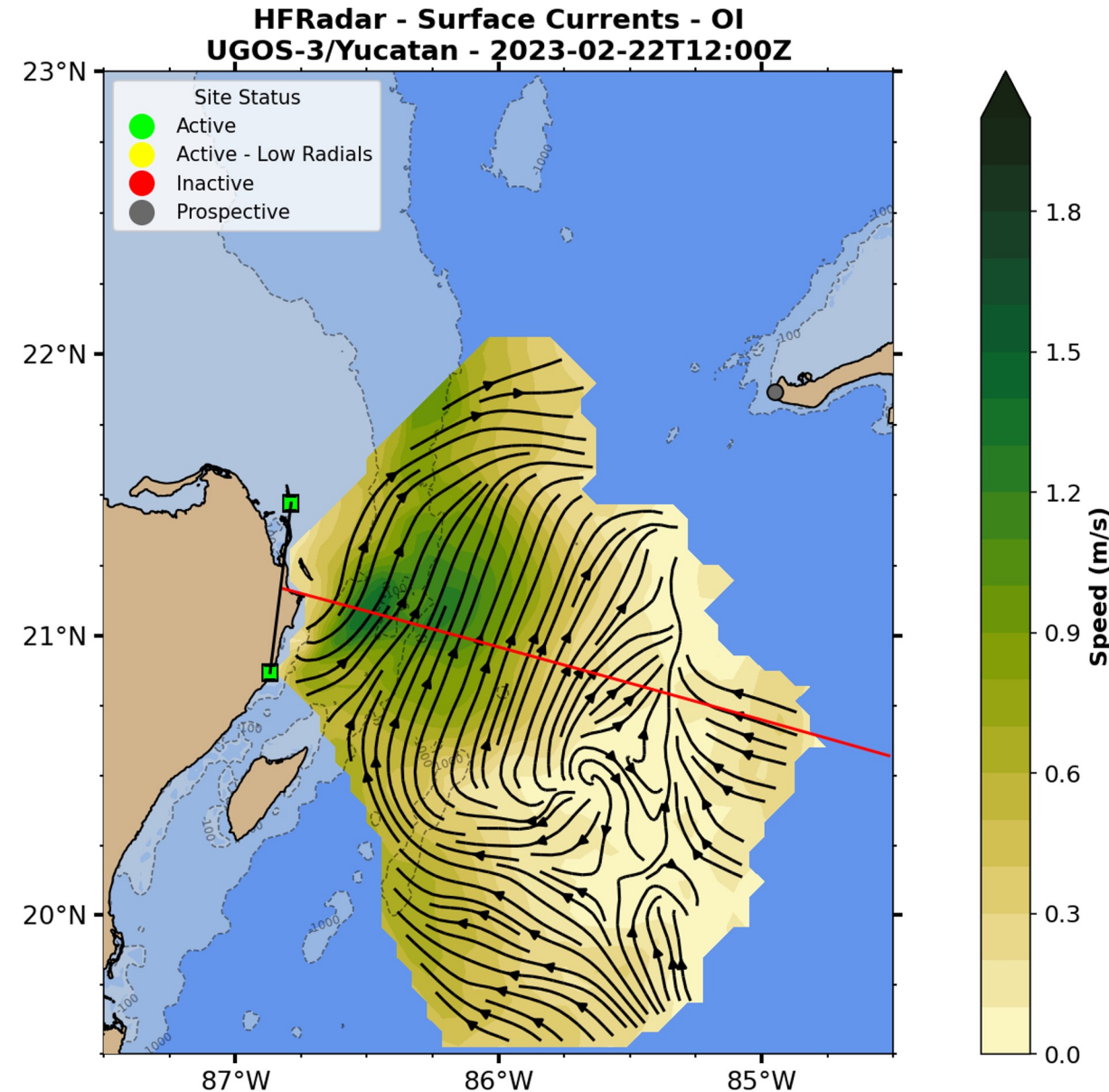
- NOAA EMC – We are limited by a “dearth” of subsurface ocean data
- GCOOS – Identified contact with OceanOPS for glider WMO IDs
- CICESE – Applied for and received WMO IDs
- Gandalf – Develops processes to format & display Mexican glider data
- IOOS Glider DAC – Incorporates Mexican glider data from Gandalf.
- NOAA NDBC – Harvests glider profiles from IOOS Glider DAC for GTS
- UGOS - Checks end-to-end data flow - Glider to assimilation at EMC
- Gandalf - adds software check for negative pressures at surfacing
- NDBC – modifies software to handle new WMO IDs
- UGOS – Confirms end-to-end data flow from Glider to EMC



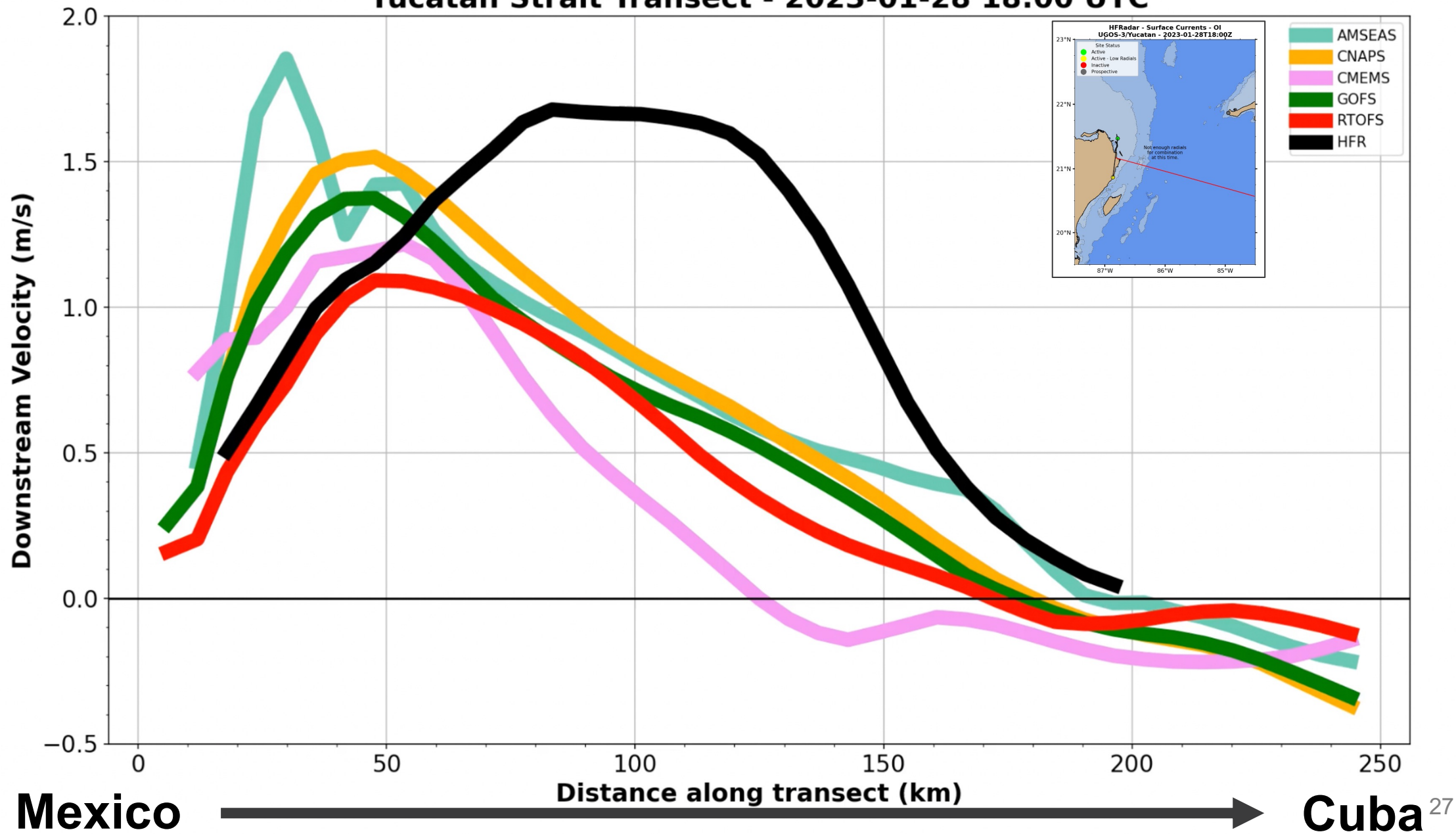
***Mexican Glider data flow - from acquisition to assimilation - is ready for MASTR (research) & the 2023 Hurricane Season (operations)***

# HFR Collaborations – *Yucatan*

- UGOS-1 USF QARTOD Post-Processing Implementation
- UGOS-1 USM AIS Auto-APM Co-Development
- SECOORA software expansion to phased array HFR
- MARACOOS QARTOD Transition to Near-Real-Time
- UGOS-1; UGOS-3 - Application to Yucatan HFR Array – Near-Real-Time & Post-Processing
- MARACOOS – Co-developed extension of National HFR Grid to the full Gulf of Mexico & Caribbean
- UGOS-3, MARACOOS & GCOOS – harmonization of HFR operations
- UGOS-3 – New derived products from Yucatan HFR
- WHG – New input to industry Eddy Watch product
- INSMET – HFR in Cuba
- EMC & NOS – HFR Assimilation

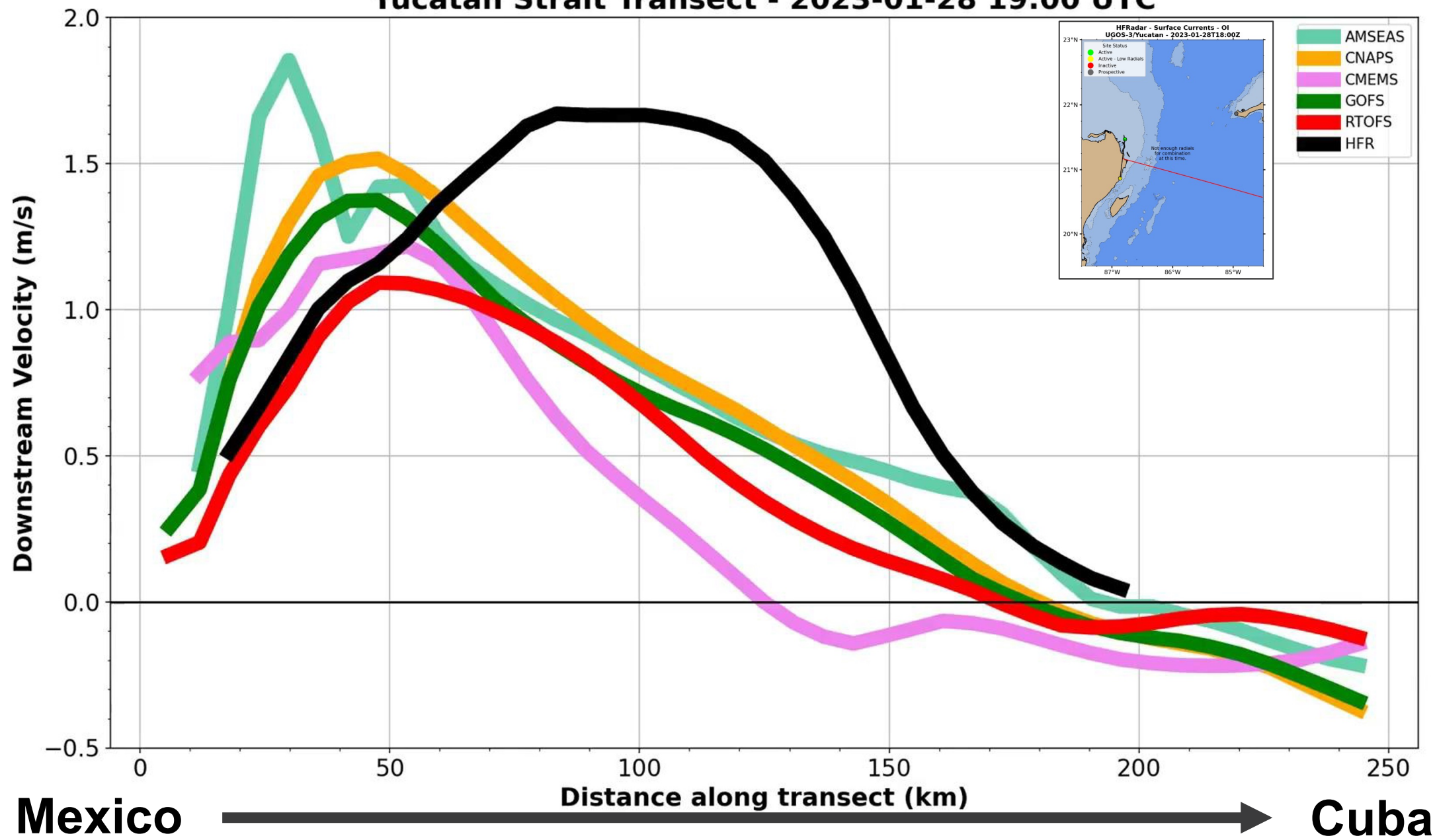


## Yucatan Strait Transect - 2023-01-28 18:00 UTC





## Yucatan Strait Transect - 2023-01-28 19:00 UTC



# MASTR is a centralizing and integrating effort

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**MASTR** integrates all UGOS working groups

WG1: Stakeholder input

WG2: Transition to Operations

WG3: Integration and coordination of BObs and Adaptive Obs

WG4: DA of adaptive platforms

WG5: Coordination with NOAA/Navy Hurricane Glider

WG6: RT and Delayed-mode (collection to processing to dissemination)

**MASTR** lessons learned and best practices are critical inputs to **GrASE**

**GrASE (thru MASTR)** leads to assessment of AS element for T2O

# MASTR: Mini-Adaptive Sampling Test Run

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- Planning and coordination of simultaneous deployment of multiple and varied observational platforms will present technical and logistical challenges
- Glider, float, drifter deployments: Yucatan Channel, SE GoM  
End-to-end demonstration: collection to dissemination
- MASTR serves three vital functions to maximize success of the UGOS program (prior to the planned GrASE)
  - 1) MASTR will reduce risk of equipment loss
  - 2) MASTR provides a “hot run-time” dataset for simulation setup and implementation
  - 3) Common data set for use by all consortia for analysis, model comparison and observational intercomparison and validation





# 2023 MASTR Elements

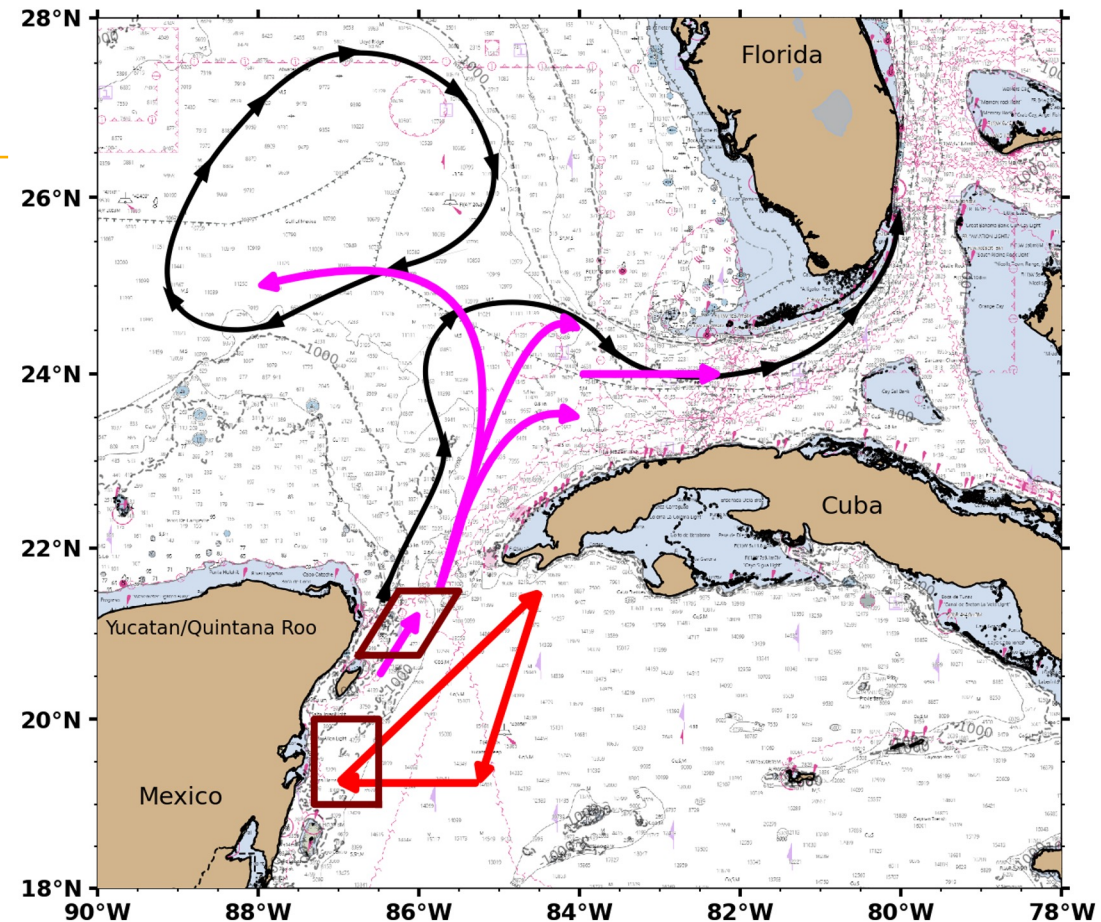
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Target: GOM Inflow region

- Observations:
  - Gliders: *four gliders* (CICESEx2, Rutgers, TAMU)
  - Floats: x1 APEX-EM (T/S/v)
  - Drifters: x6 WHG FHD drifters
  - HFR: UGOS Yucatan, (also Florida Straits HFR)
  - Background Obs: Argo/CPIES/ROCIS as available
- Numerical Model Coordination
  - Inform all UGOS Model teams of timing and availability of all RT and delayed mode data products
  - Use of NRL GHOST procedures
- Adjustment: Timeline – September – October 2023
  - Coordinate with significant observational assets deployed by multiple government agencies during the 2023 hurricane season

# MASTR Target Region

- **Deep red boxes**
  - Drifter/Float
- **Red Triangle**
  - Caribbean Glider
- **Magenta Arrows**
  - GoM Gliders



# MASTR Timeline

2022

March-Dec: MASTR scoping

2023

Jan-Mar: planning/registration

Platform registration: Feb (Completed)

RATS application

Information dissemination and coordination: WG1, WG2, WG3, WG4, WG5, WG6

April – August: Platform Preparation

Procurement/calibration/Refurbishment/Mobilization

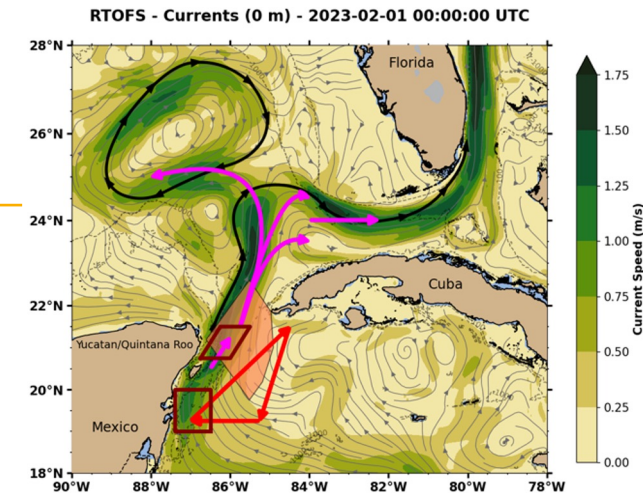
Deployment vessel charter(s)

Sept – Oct: in water

Nov – Dec: Post-MASTR Assessment

2024

GrASE planning

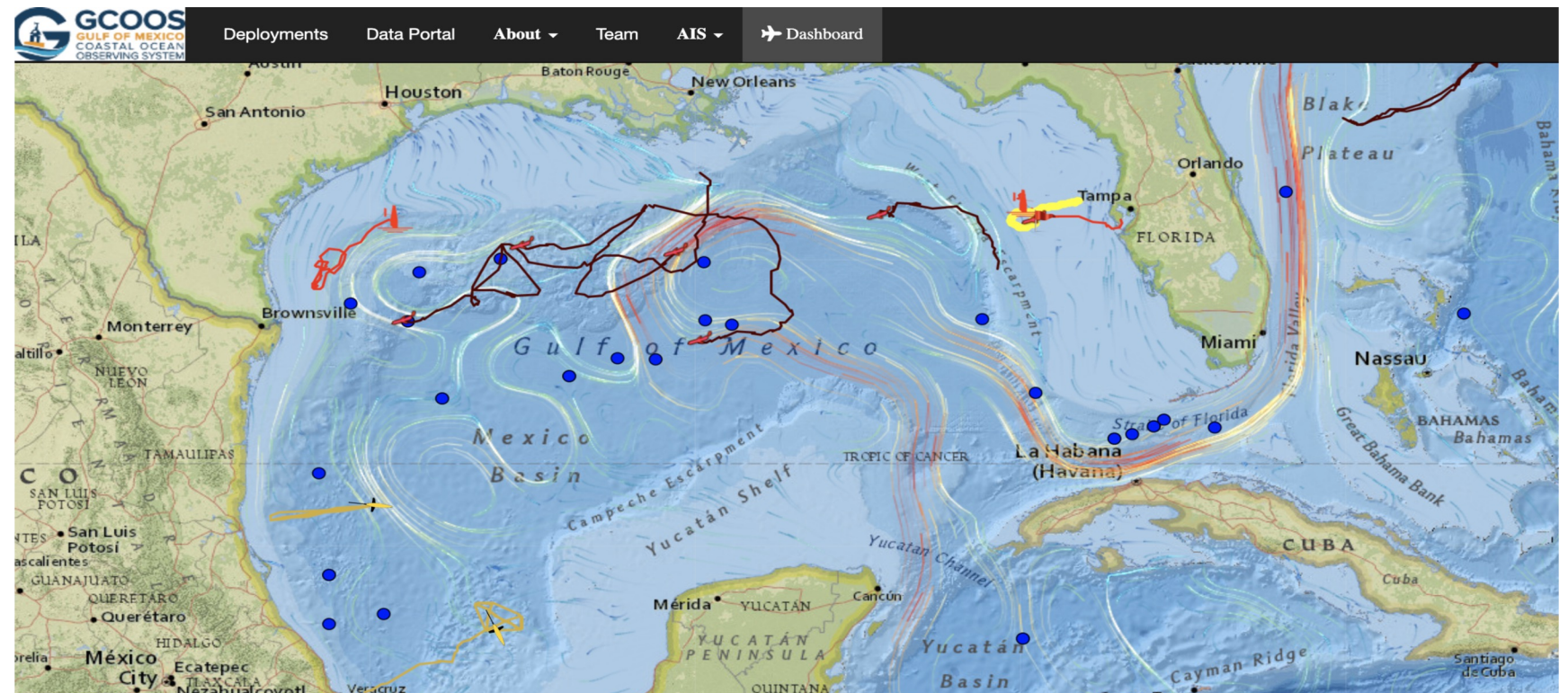




# GCOOS Data Portal: GANDALF.gcoos.org

## Near Real-time Data Delivery

- Data Products/Graphics
- Open Data Access
- Archival





# MASTR: Bottom Line

- End-to-End Demonstration (collection to dissemination)
- How is “success” assessed?
  - Data Delivery: Simultaneous deployments in target region
  - Ingestion: Assimilation of one or more **MASTR** platforms into one or more numerical models?
- Aspirant Goals
  - Assessment of impact of **MASTR** observations on numerical model output
  - Recovery/redeployment of **MASTR** platforms

# Working Group 1: Stakeholder Engagement

Mission: to coordinate UGOS stakeholder engagement activities and to interact with industry and government agency stakeholders and end-users to build connections and to define services and products that are sustainable and meaningful to industry, government agencies and the public - division between industry and government agencies - Cross-participation in the two groups.



# Stakeholder Matrix

	Oil and Gas/Drill	SAR	Shipping	Disaster	Wind Energy	Wave Energy	CCUS	Fisheries	Consultants	Recreational	Academic	Regulatory	Agency
<b>DOMAIN</b>													
Basin	x		x	x							x		x
Regional	x			x				x	x		x	x	x
Local	x	x		x	x	x	x	x	x	x	x	x	x
<b>DEPTH</b>													
Surface		x	x	x	x	x	x	x	x	x	x	x	x
Midwater	x			x			x	x	x		x	x	x
Benthic	x			x				x	x		x	x	x
<b>TIME</b>													
Hours	x	x		x							x		x
Days	x	x		x	x				x	x	x		x
Seasonal	x				x	x		x	x	x	x	x	x
Years	x						x	x		x	x	x	x



# UGOS WG1: Stakeholder Engagement

Mission: ... to build connections and to define services and products that are sustainable and meaningful ...

Discussion Prompts:

1. What new stakeholder connections can GCOOS & UGOS co-develop?
2. What new or enhanced services and products can GCOOS & UGOS co-design and co-implement?
3. What immediate next steps should we prioritize for collaboration?

