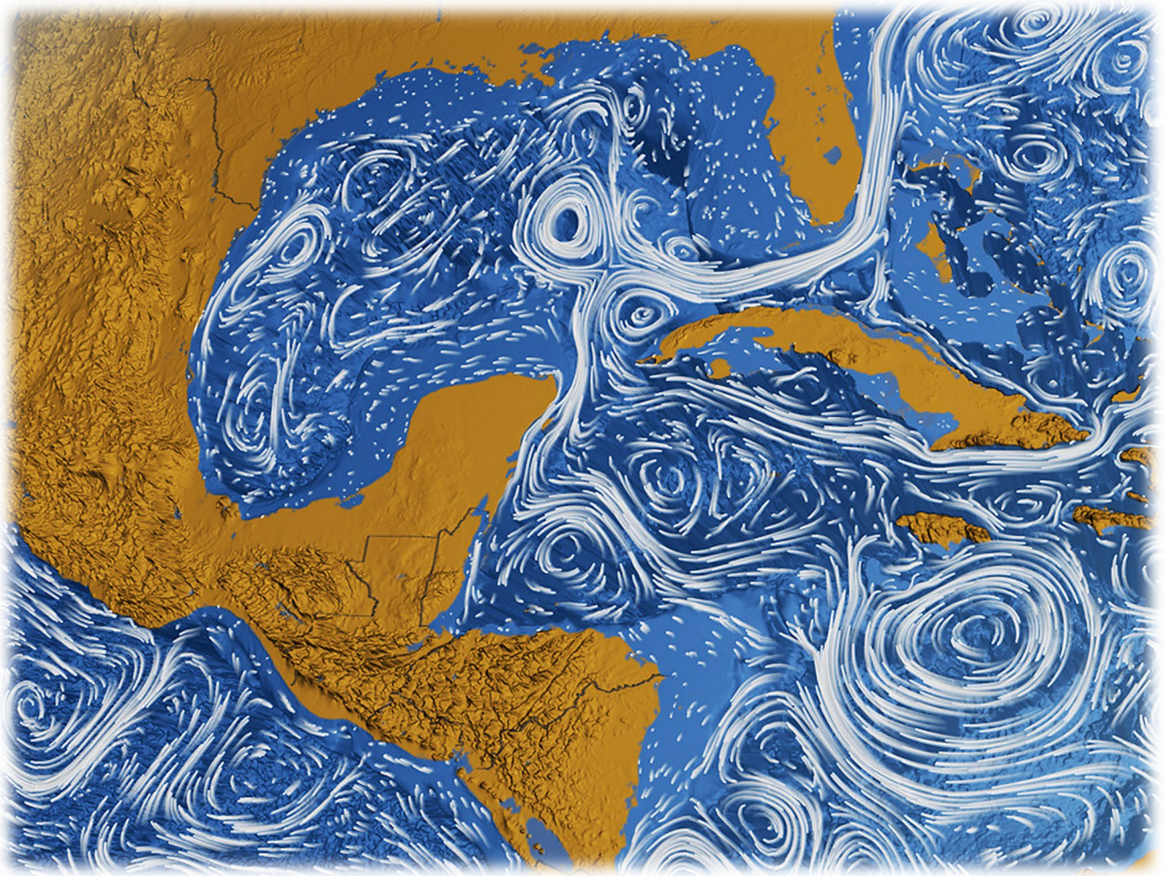
Data Aggregation, Citizen Science, and AI - Oh my!



Barbara Kirkpatrick and Robert Currier
Texas A & M/GCOOS
February 22, 2022

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

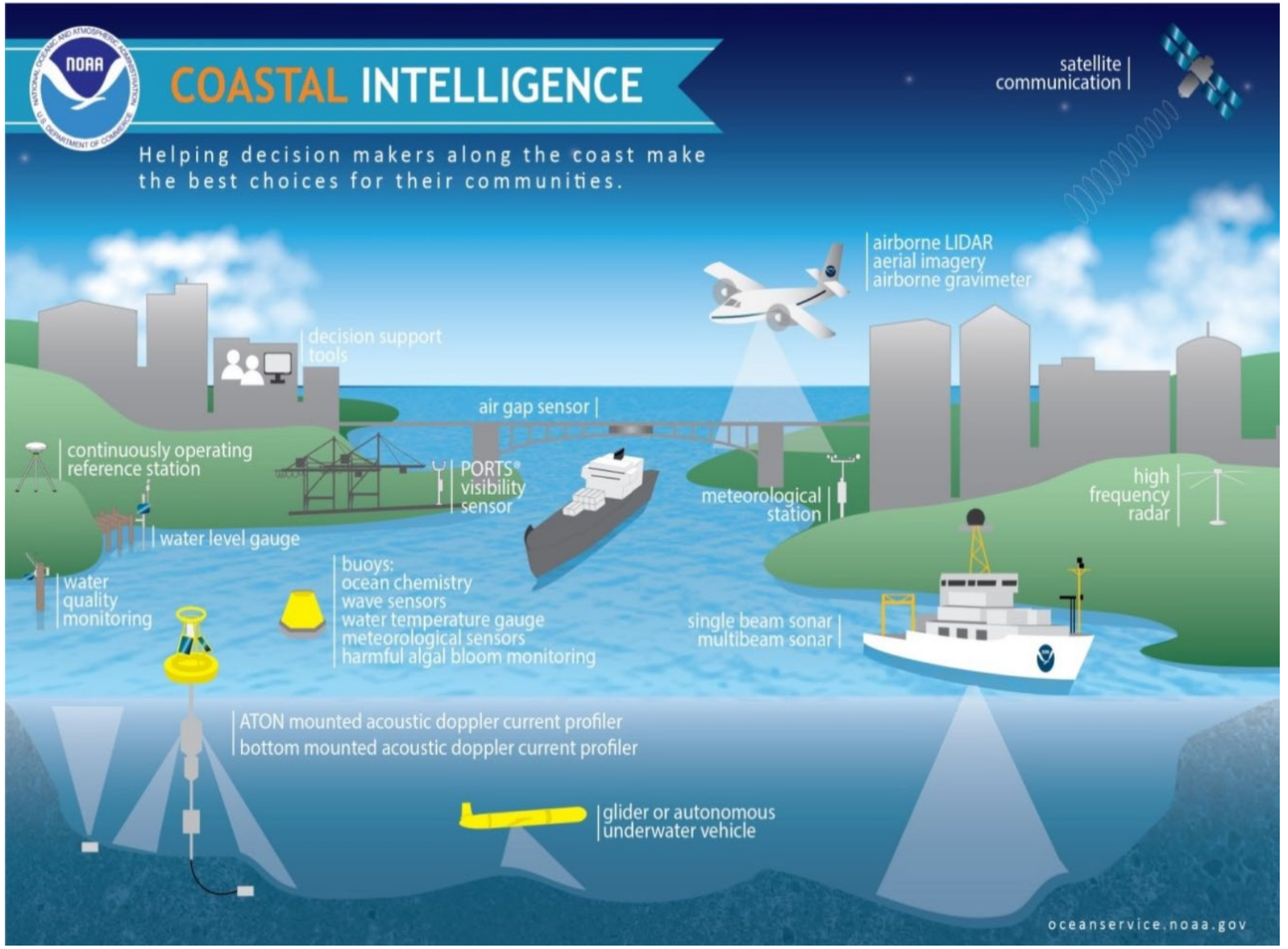
IOOS Integrated Ocean Observing System

Today's Talk

- Introduction to IOOS/GCOOS
- Data Aggregation and Dissemination
  - Real time
  - Historical/Archival
- Citizen/Community Science
- Use of AI in Harmful Algal Bloom observing

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

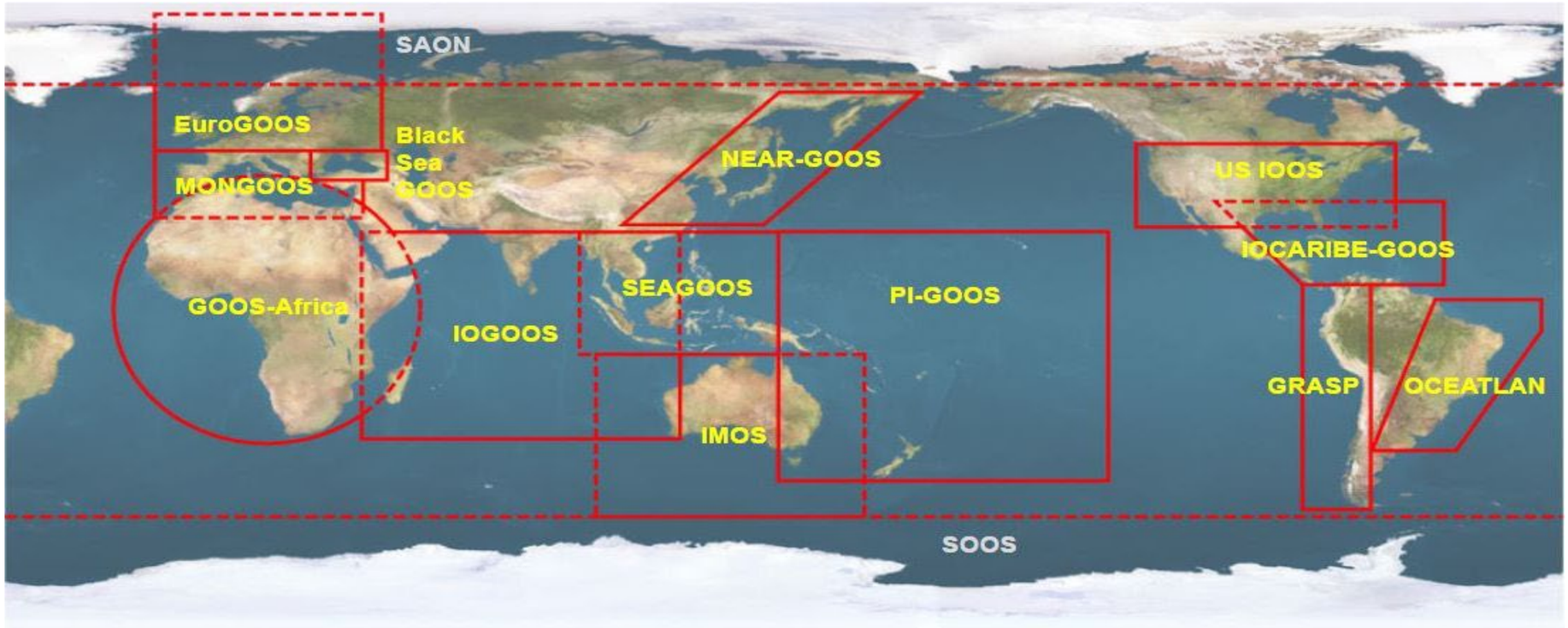
IOOS Integrated Ocean Observing System



GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

U.S. IOOS: Contribution to Global Observations

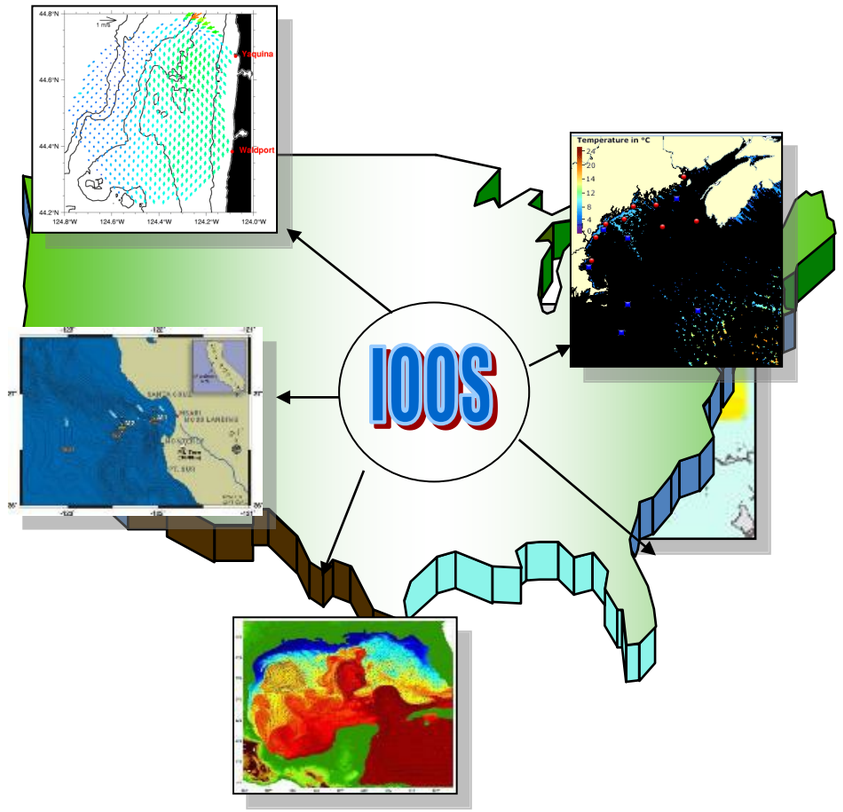


GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

How is the national initiative organized?

- International GOOS
- National IOOS-Ocean.US
- Coastal Component COOS
- Regional Association Implementation (RA-COOS)



GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

GCOOS
GULF OF MEXICO
COASTAL OCEAN
OBSERVING SYSTEM

IOOS
Integrated Ocean
Observing System

What is the purpose of a Regional Coastal Ocean Observation?

- End-user Relevance
- Regional Differences
- Local Applicability
- Increased Flexibility

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

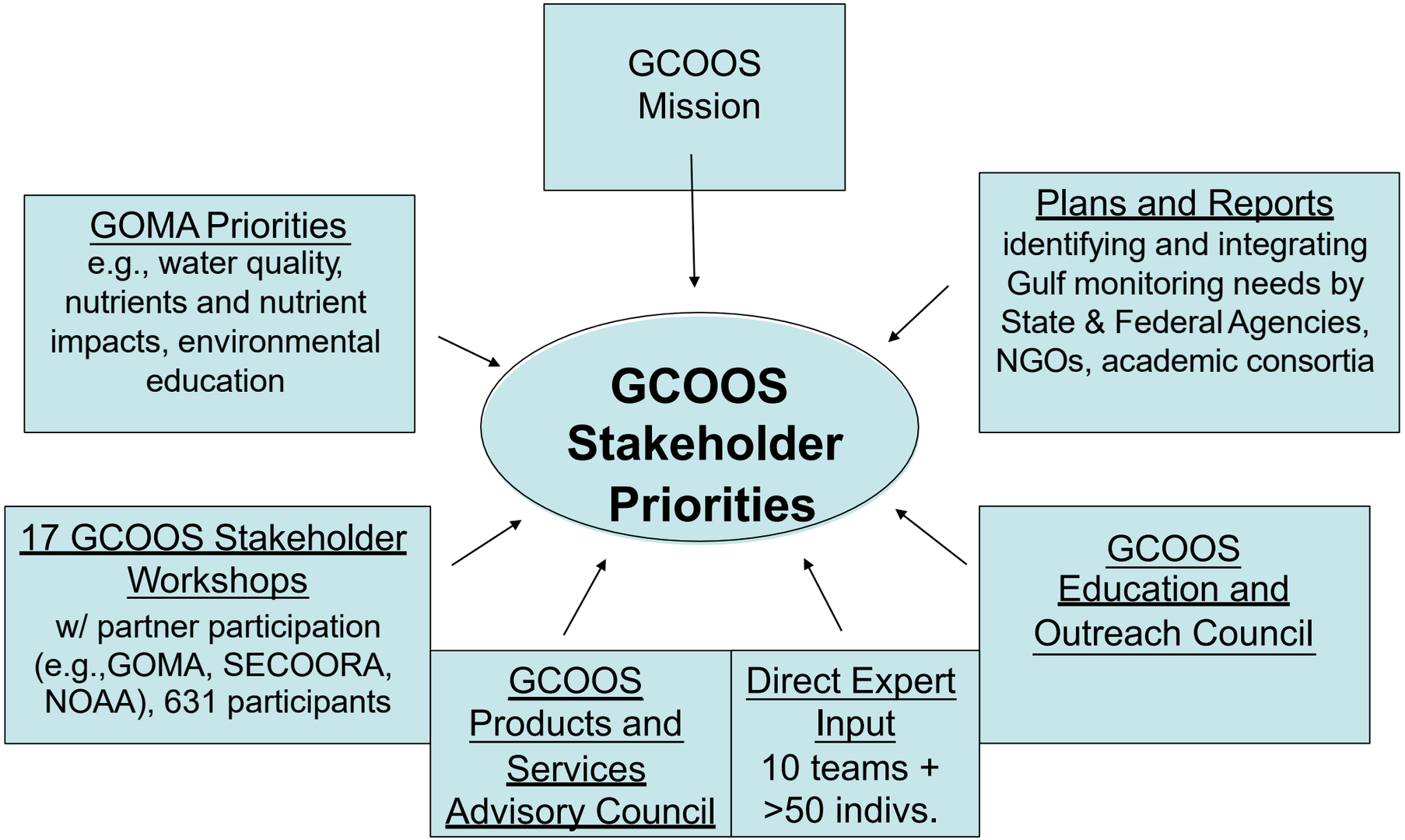
GCOOS RA Governance
Board of Directors

- Private sector – 5
- Government – 5
- Academic – 3
- Outreach and Education - 4

Board chair- Capt. Joe Swaykos (ret.) NOAA

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System



GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

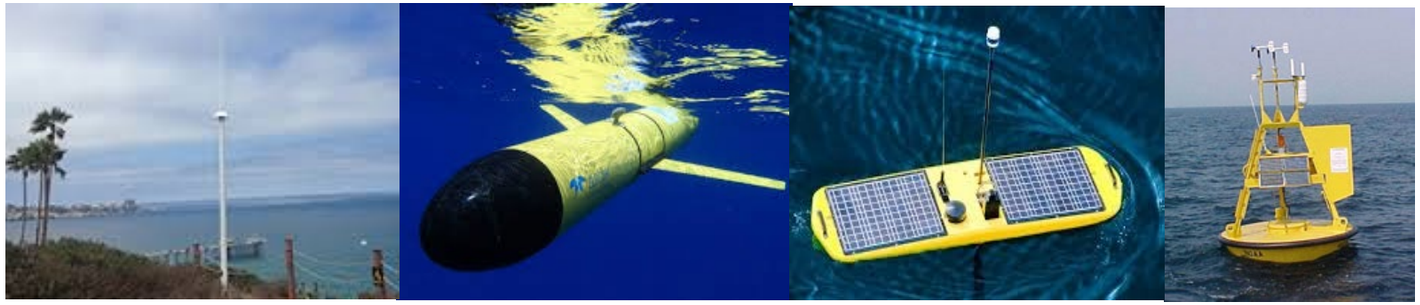
GCOOS IOOS Integrated Ocean Observing System

GCOOS-RA Model

Data Providers/Owners/Operators – NOT the GCOOS- RA

- Federal
- State
- Academic
- NGO’s

GCOOS – RA- Data management into centralized portal for all to use



GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Today's Talk

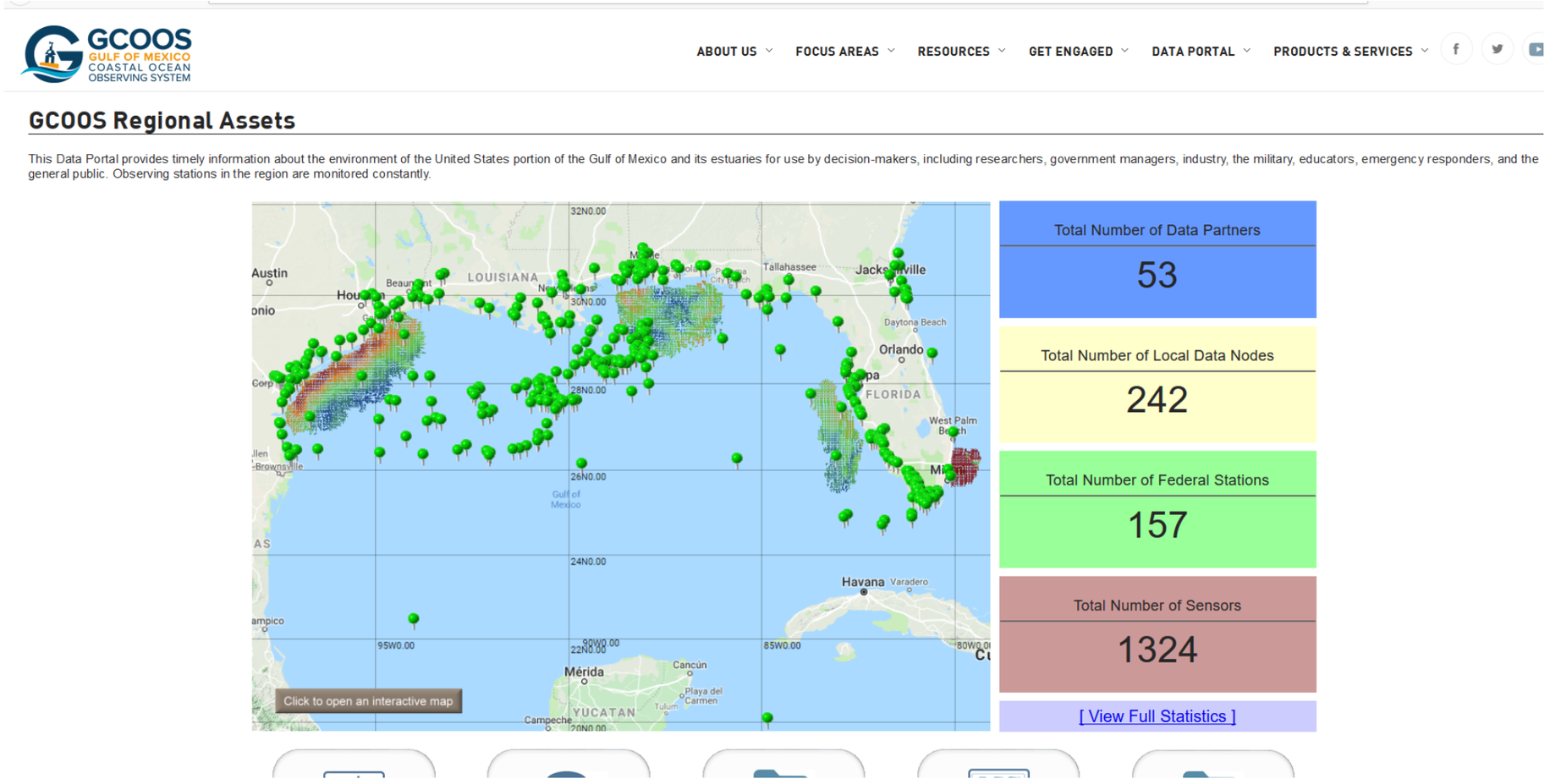
- Introduction to IOOS/GCOOS
- Data Aggregation and Dissemination
  - Real time
  - Historical/Archival
- Citizen/Community Science
- Use of AI in Harmful Algal Bloom observing

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

GCOOS-RA

Data Integration/Products –Felimon Gayanilo, TAMU-CC

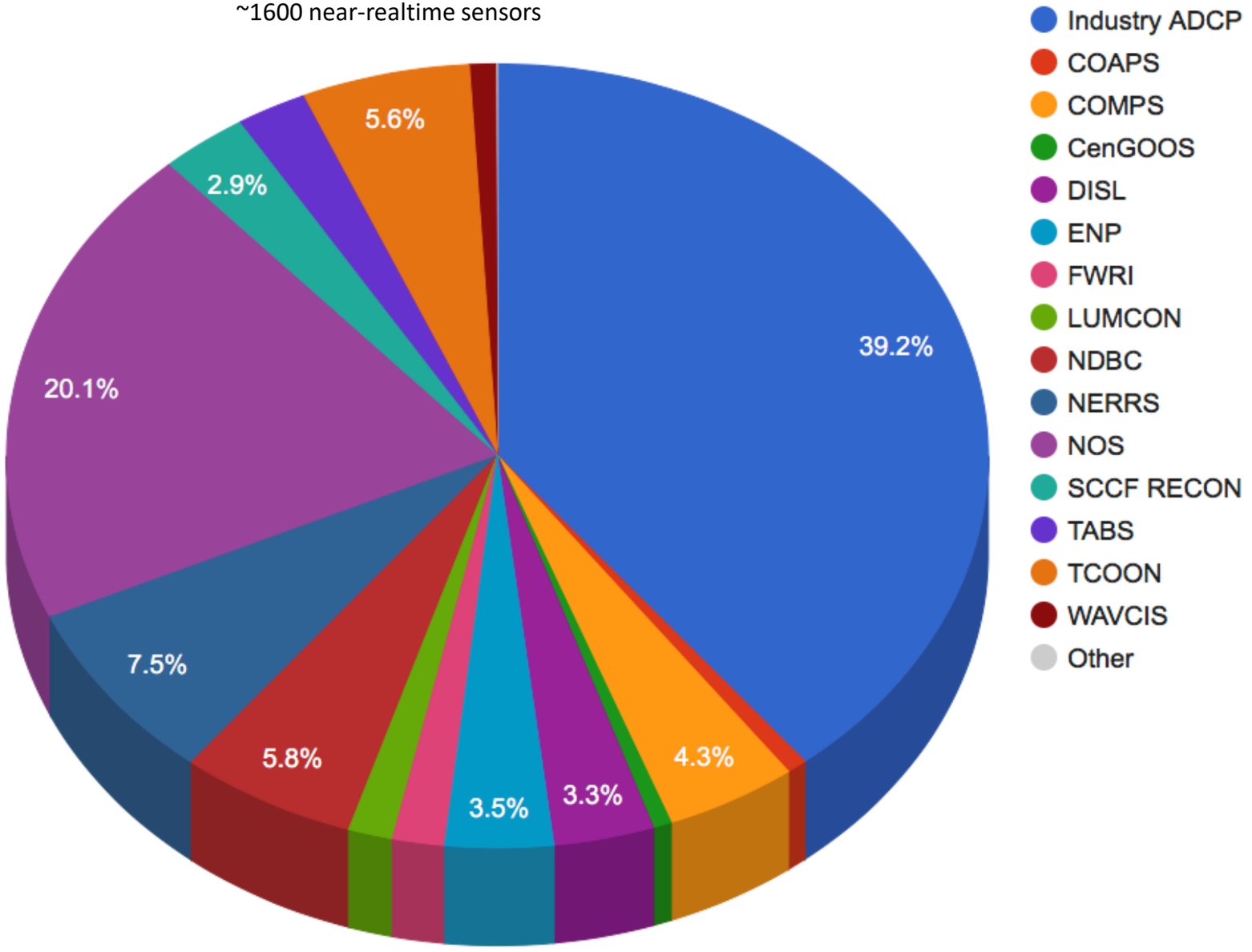


GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Sensor Count per Data Source

~1600 near-realtime sensors

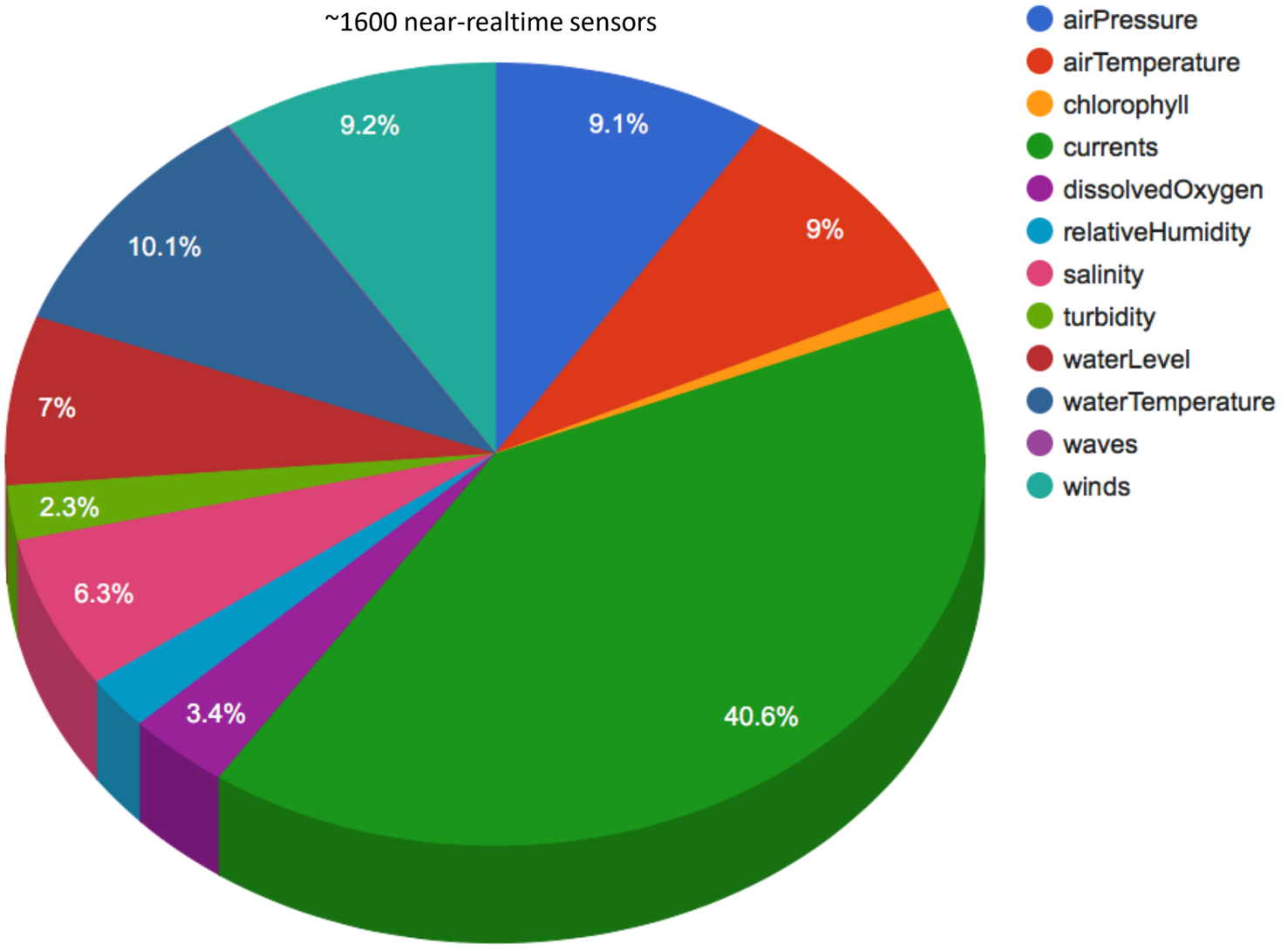


GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Sensor Count per Phenomenon Observed

~1600 near-realtime sensors



GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Regional Information Coordination Entity (RICE)

Our data meets rigorous QA/QC before posting

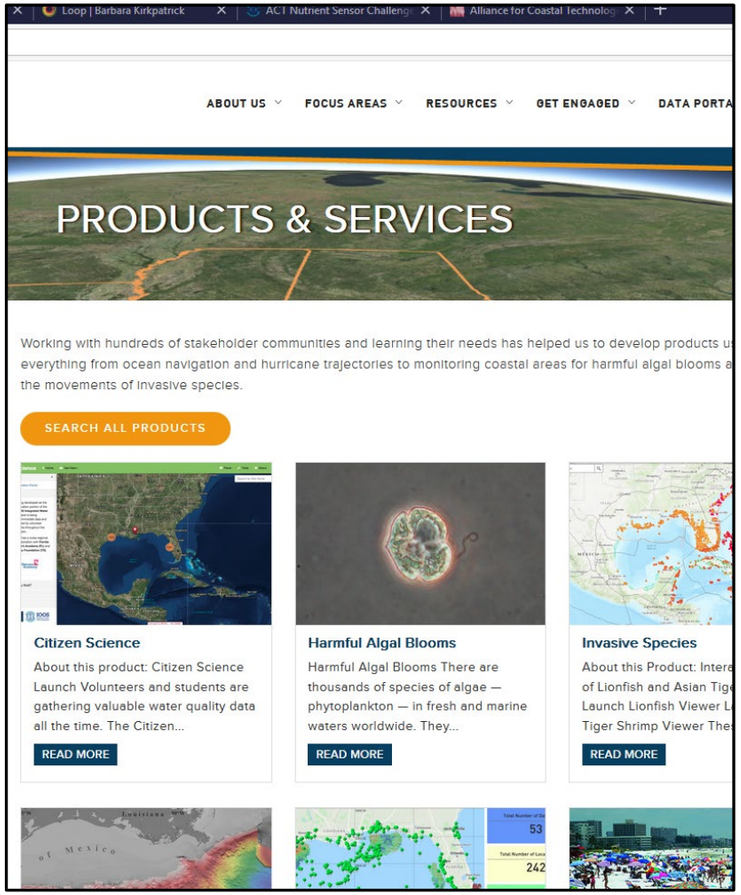
INTEGRATED OCEAN OBSERVING SYSTEM
CERTIFIED
2015

GCOOS
GULF OF MEXICO
COASTAL OCEAN
OBSERVING SYSTEM

IOOS
Integrated Ocean
Observing System

GCOOS Data Management and Products Portals

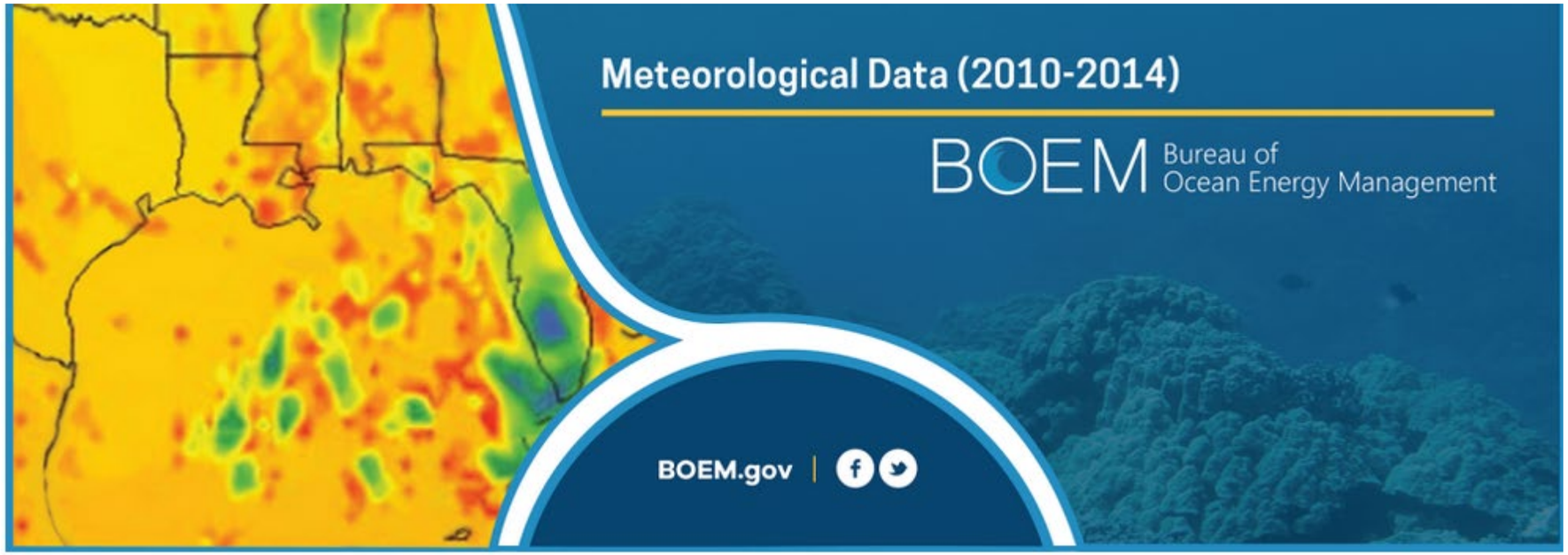
- Real time and Historical Data
  - Water Quality
  - Field Cruises
  - Model Forecasts
  - MBON
  - Sea Surface Height
  - Bathymetry
  - Satellite Data
  - Gliders
  - Fish



Data Aggregation and Hosting Projects

Bureau of Ocean Energy Management (BOEM)

Air Quality Modeling in the Gulf of Mexico study



https://boem.gcoos.org

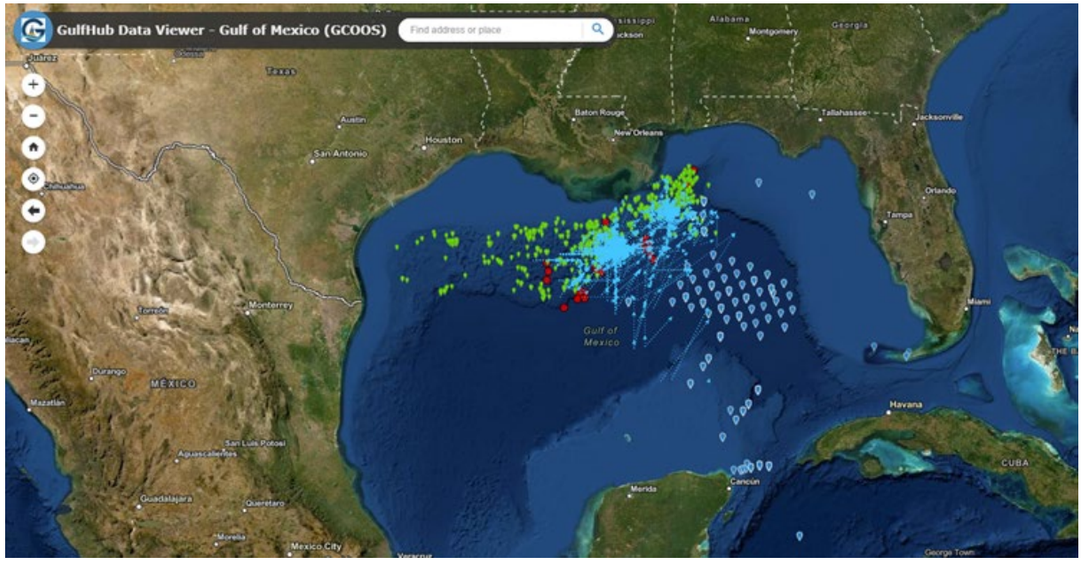
GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Data Aggregation and Hosting Projects

- *GulfHub* is a data portal designed to compile and make publicly accessible physical oceanographic and hydrographic data from the Gulf of Mexico Loop Current field studies
- Thanks to our industry partners for making this data publicly available

https://gulfhub.gcoos.org/

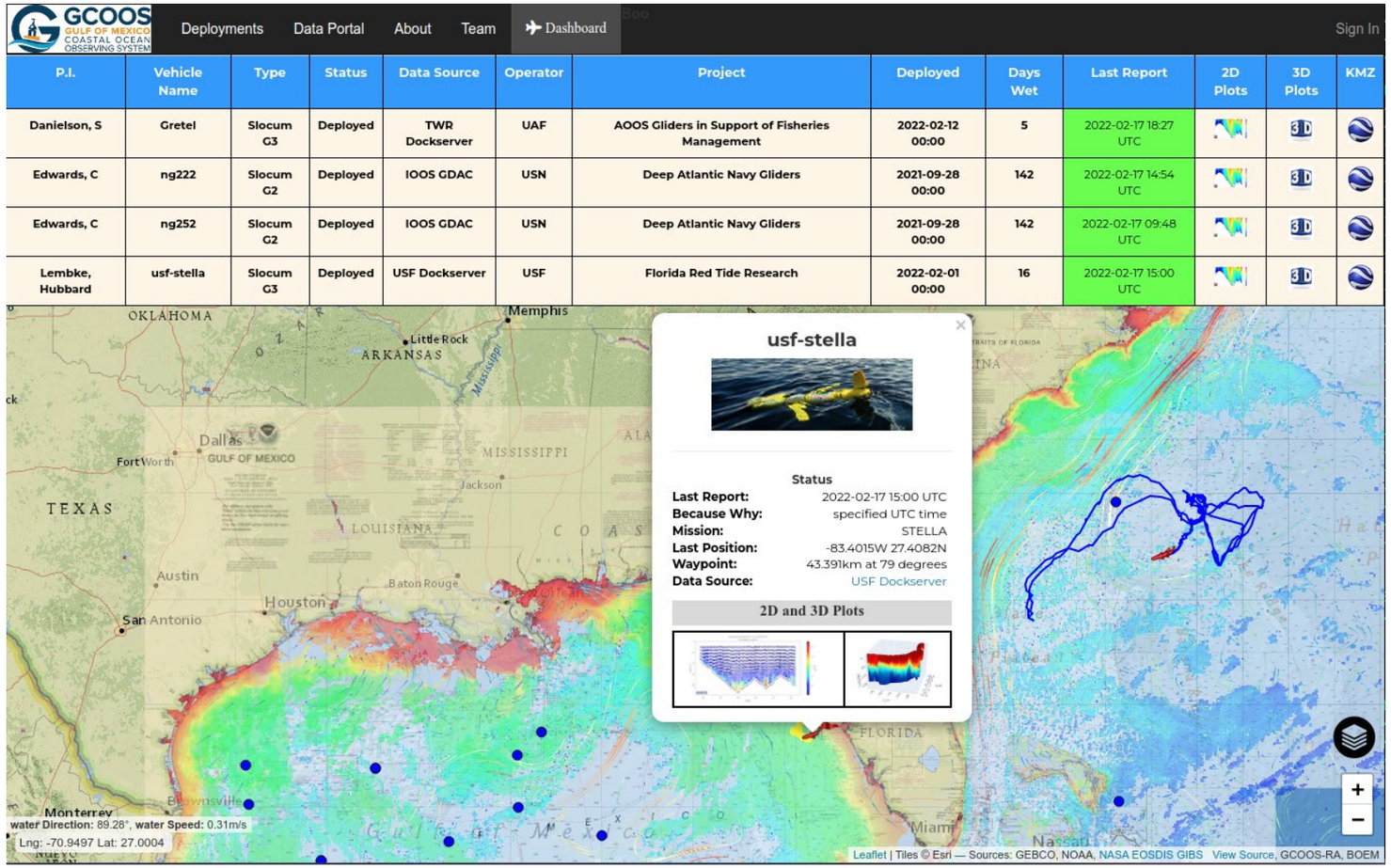


GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

The National Academies of SCIENCES ENGINEERING MEDICINE
GULF RESEARCH PROGRAM

IOOS Integrated Ocean Observing System

Our glider piloting and data tool - GANDALF



- Portal designed with significant feedback from GoMex glider group
- Data is available in 2D and 3D plots in real time
- Open access
- Service to all GoMex glider groups
- Data sent to IOOS DAC if requested

https://gandalf.gcoos.org/

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Today's Talk

- Introduction to IOOS/GCOOS
- Data Aggregation and Dissemination
  - Real time
  - Historical/Archival
- Citizen/Community Science
- Use of AI in Harmful Algal Bloom observing

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Our first citizen science product- 2006
Beach Conditions Reporting System

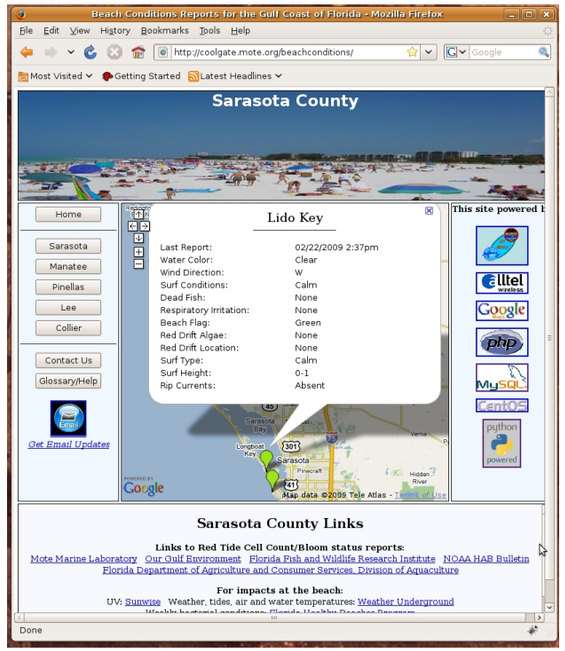
- Traditional way of reporting Florida red tide was through microscopic cell counts
  - Scientifically accurate but….
  - Not what beachgoers want to know
    - Will there be dead, stinky fish?
    - Will they have respiratory irritation?

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Our first citizen science product- 2006
Beach Conditions Reporting System

- Before the word ‘app’ became in our everyday world

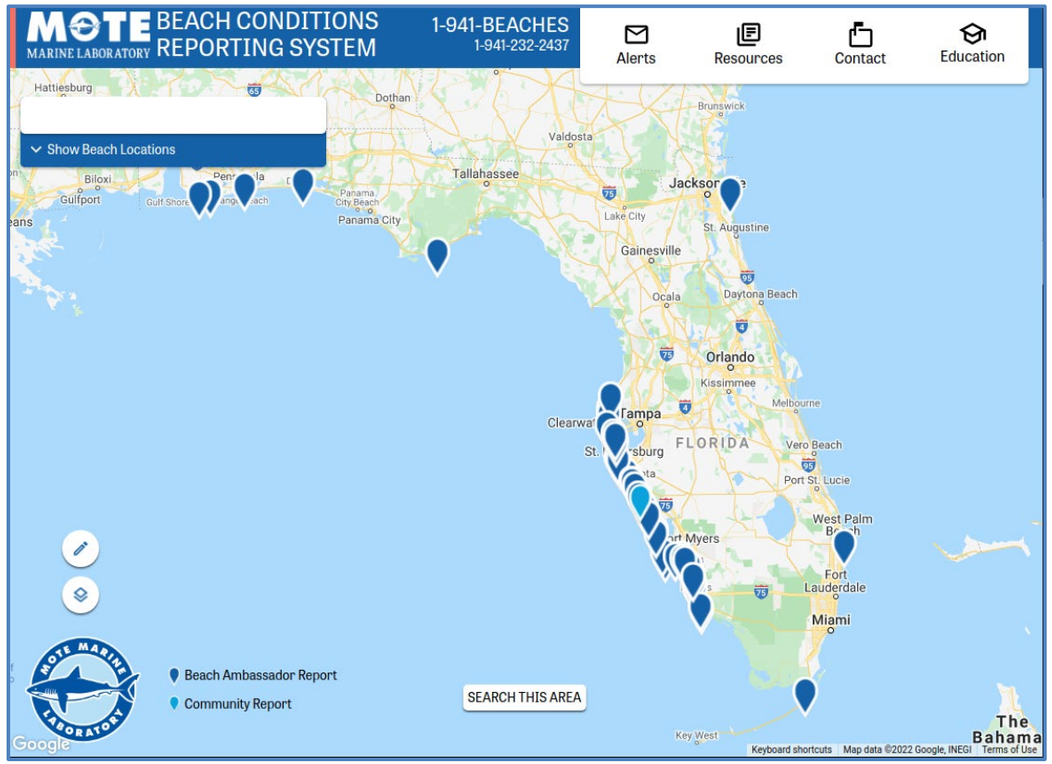


GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

16 years later…..

- Maintained by Mote Marine Laboratory



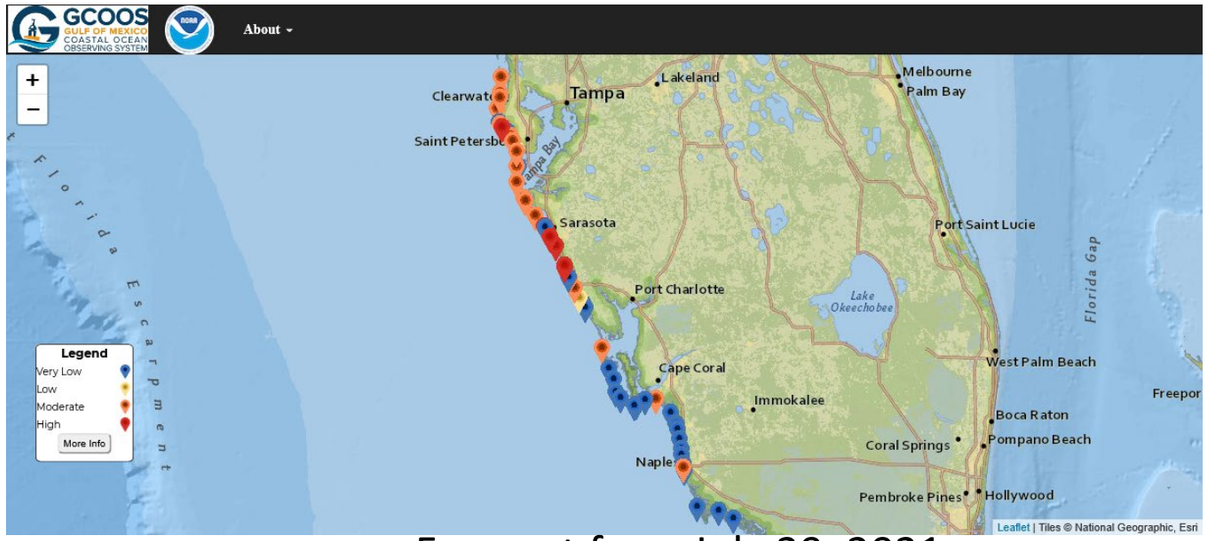
https://visitbeaches.org

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Increasing HAB Monitoring Efforts via Citizen Science – Part 2

- Development of community science, new hardware and new software
- Goal- improve the spatial and temporal monitoring of a bloom that, in turn, improves respiratory forecast for inhalation of toxic aerosols from *Karenia brevis*



Forecast from July 29, 2021
https://habforecast.gcoos.org/

Step 1: Develop new methods for cell counts

- Old method – highly trained microscopist, minimum ~15 minutes a sample, the ‘Gold’ standard
- Our method: HABscope$_{TM}$
  - off the shelf microscope
  - 3D printed adapter
  - Raspberry Pi 4.0 with 14MP RPi HQ Camera
  - **$500 per unit**

Step 2: Recruit community volunteers

- Dedicated volunteer coordinator for training and troubleshooting
- Wide variety of partners- County health & environmental departments, retirees, high school students, state/local parks
- During a bloom- collect water sample from same location at least 1X/week, preferable 2
- To date: 45 volunteers

Dr. Mike Allen, , NCBS, UF
Grant Craig, HABscope volunteer coordinator and Emily Colson, NCBS Social media/K-12 lead

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

Today's Talk

- Introduction to IOOS/GCOOS
- Data Aggregation and Dissemination
  - Real time
  - Historical/Archival
- Citizen/Community Science
- Use of AI in Harmful Algal Bloom Observing (Step 3)

GCOOS GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM

IOOS Integrated Ocean Observing System

HABscope System Diagram

It’s all about the SDFN: Self Describing File Name

The File Name is the Metadata

HSV0001_1643906643_karenia_live_0000000_0000000_raw.mp4

Culture

HABscope

1,500 lines of Python3

HABlab

Optical Workbench

Taxa Libraries

10,000 images/taxa

Model Test and Train

2,000 lines of Python3

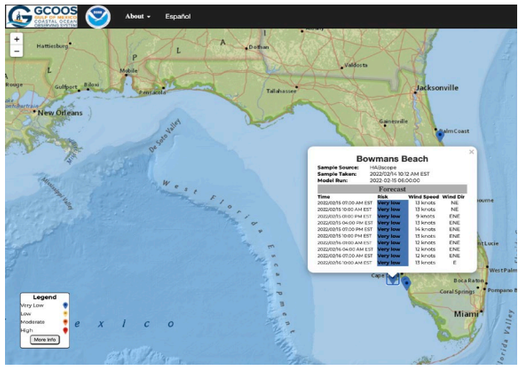
Local Components

HABscope System Diagram

Web Portal

3 Docker Containers
5,000 lines of code
Python3 and Flask
Authentication Database
NOAA Model CSV Generation
Approval and Editing of Uploads

NOAA Model



HABforecast Site

3,000 lines of code
Python3 and Flask
One Docker Container
300,000+ Views in past year

Cloud Components

For a deeper dive…..

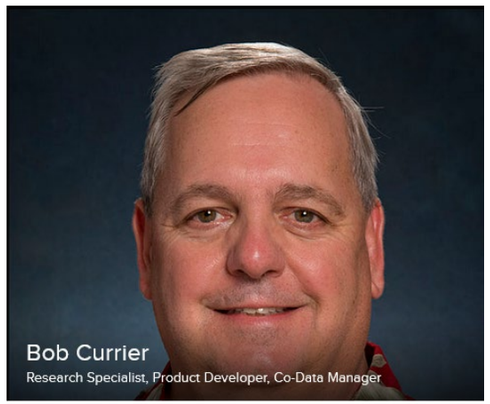
STAMPing Out HABS

HABscope V2.0

“From the Culture to the Cloud”

Bob Currier, TAMU/GCOOS

Wednesday, 1:50 pm, Room 2335



GCOOS
GULF OF MEXICO
COASTAL OCEAN
OBSERVING SYSTEM

IOOS
Integrated Ocean
Observing System

NOAA

NASA

GCOOS

FWC

Pinellas County

Lee County

Collier County

Sarasota County

SCCF

Thanks to IOOS HAB Pilot project funding and
NCCOS MERHAB Program