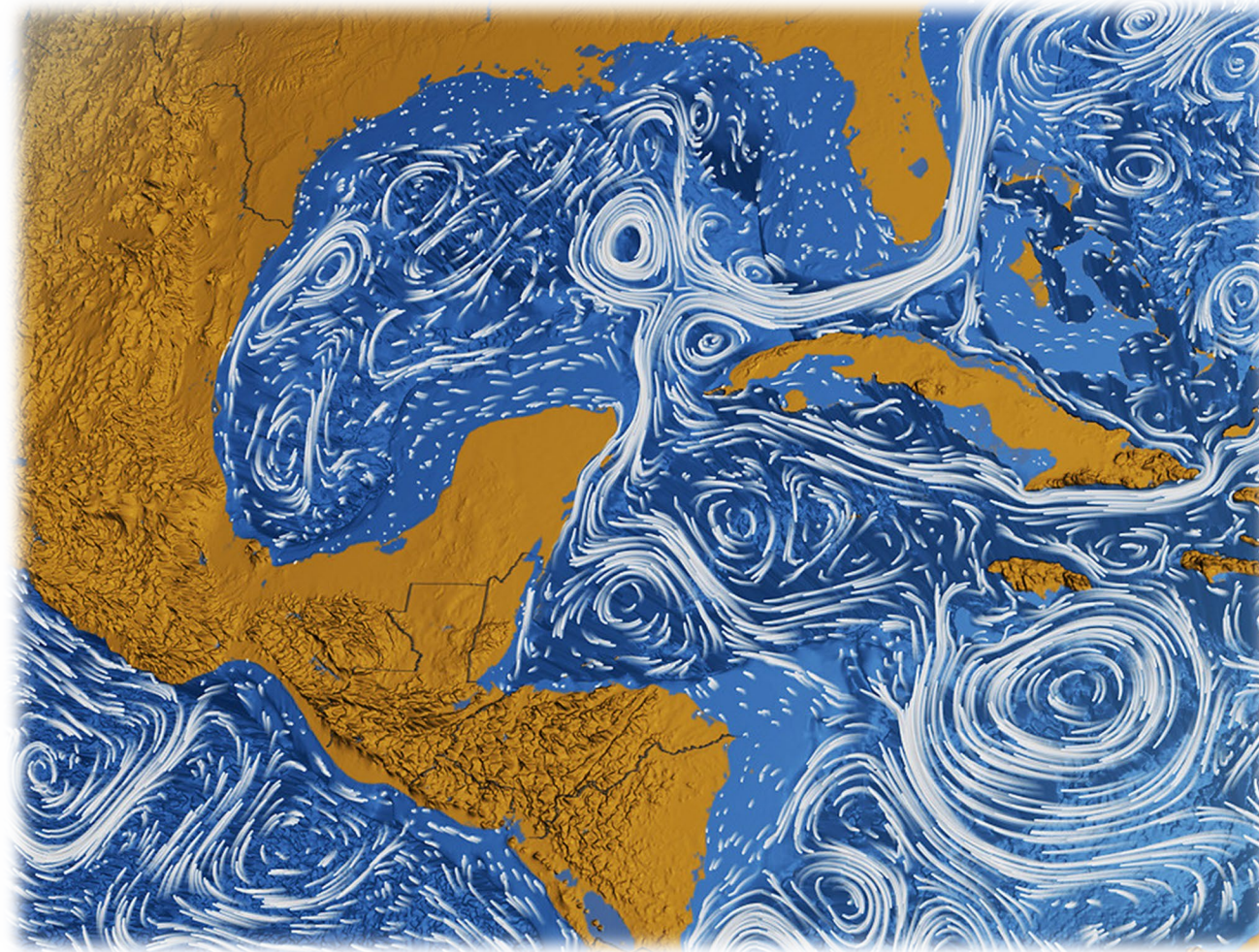


Data Aggregation, Citizen Science, and AI - Oh my!



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

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



COASTAL INTELLIGENCE

Helping decision makers along the coast make the best choices for their communities.

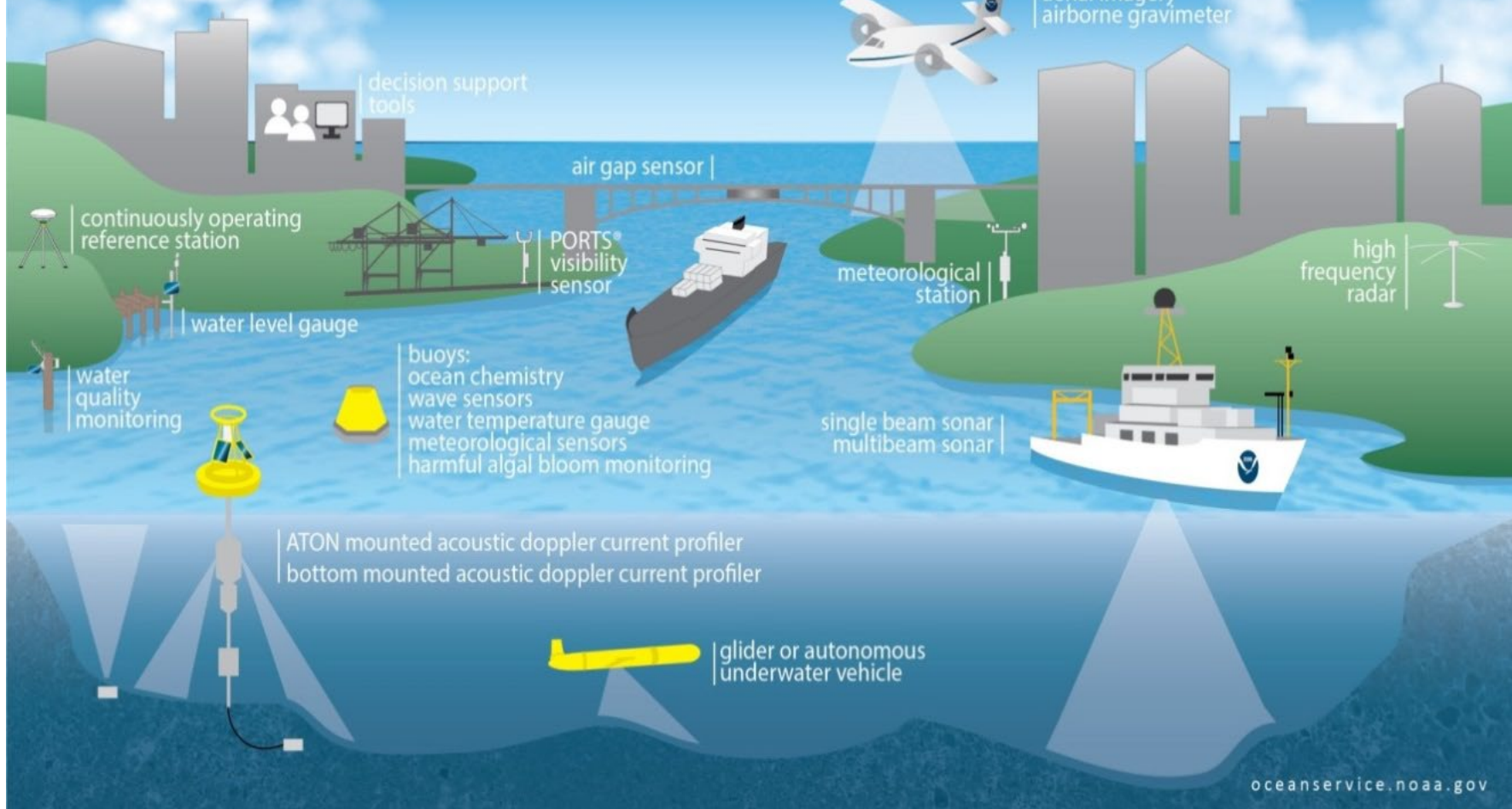
satellite communication



airborne LIDAR
aerial imagery
airborne gravimeter



decision support tools



high frequency radar

meteorological station

air gap sensor

continuously operating reference station



water level gauge

water quality monitoring



PORTS® visibility sensor



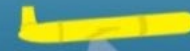
buoys:
ocean chemistry
wave sensors
water temperature gauge
meteorological sensors
harmful algal bloom monitoring



single beam sonar
multibeam sonar

ATON mounted acoustic doppler current profiler
bottom mounted acoustic doppler current profiler

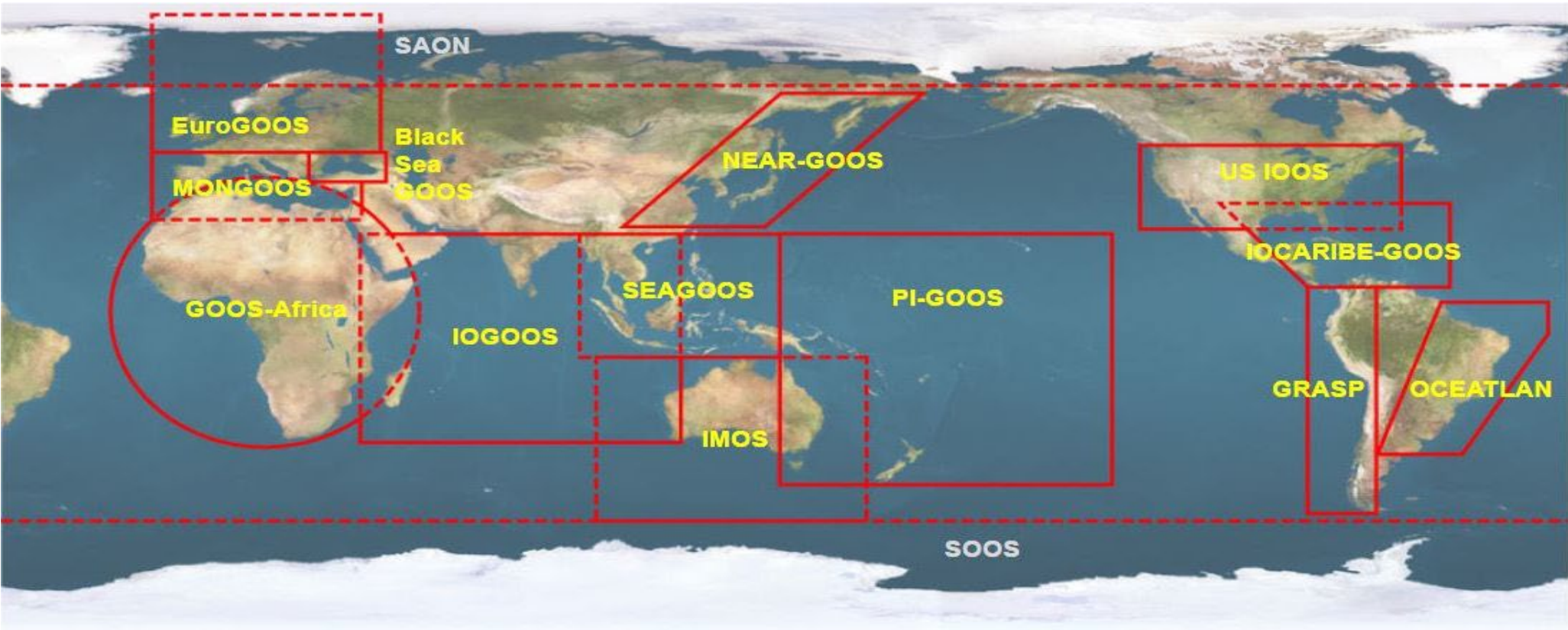
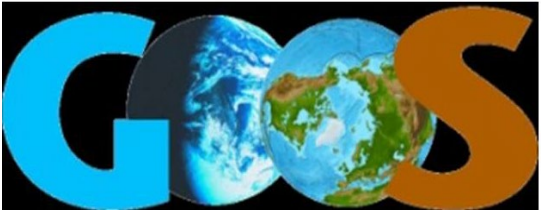
glider or autonomous underwater vehicle



oceanservice.noaa.gov

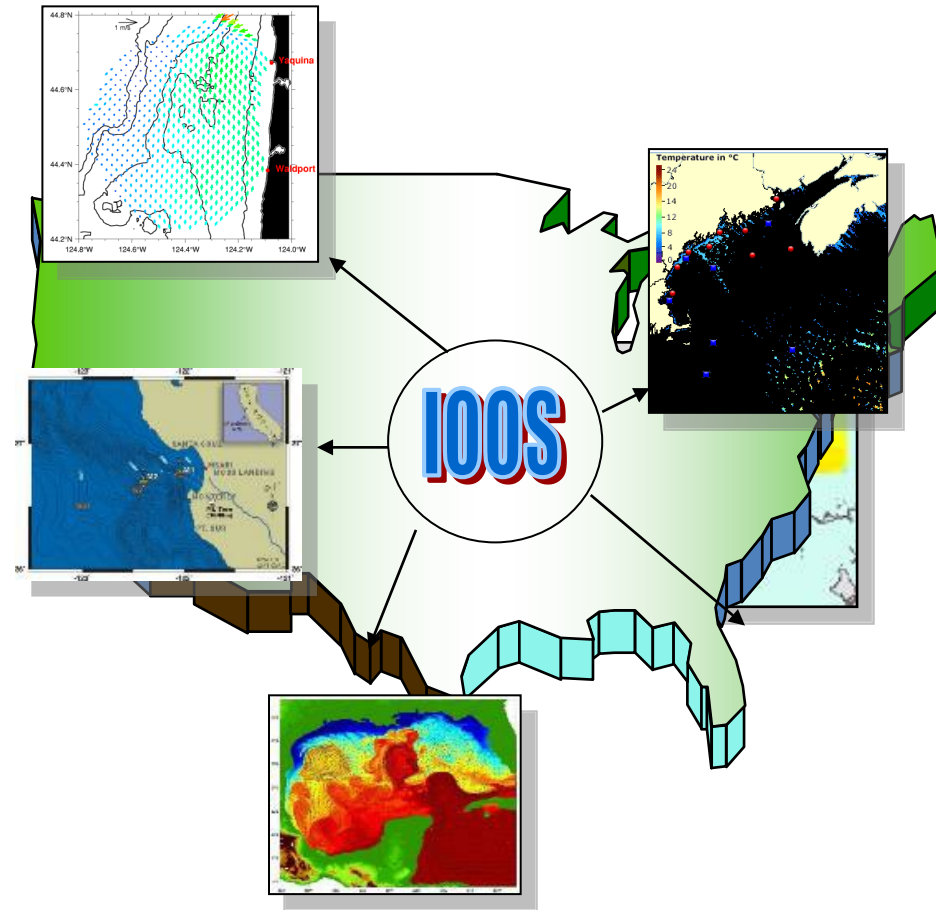


U.S. IOOS: Contribution to Global Observations



How is the national initiative organized?

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





What is the purpose of a Regional Coastal Ocean Observation?

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

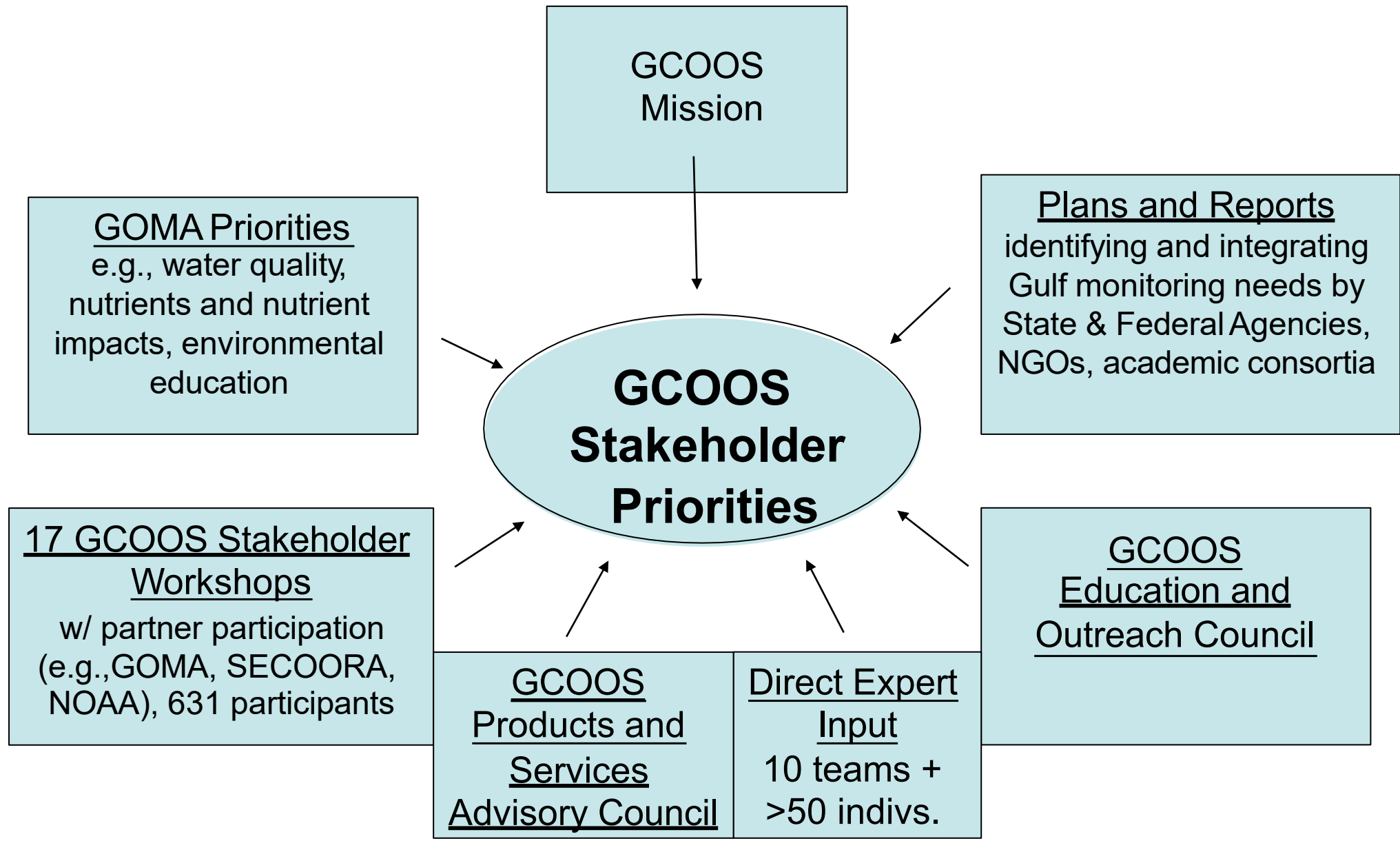


GCOOS RA Governance Board of Directors

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

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



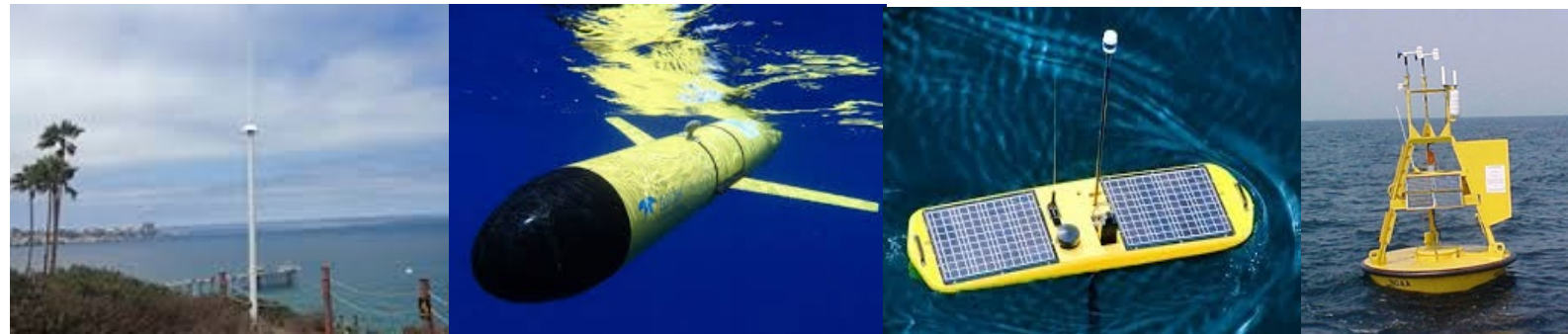


GCOOS-RA Model

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

- Federal
- State
- Academic
- NGO's

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






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GCOOS-RA

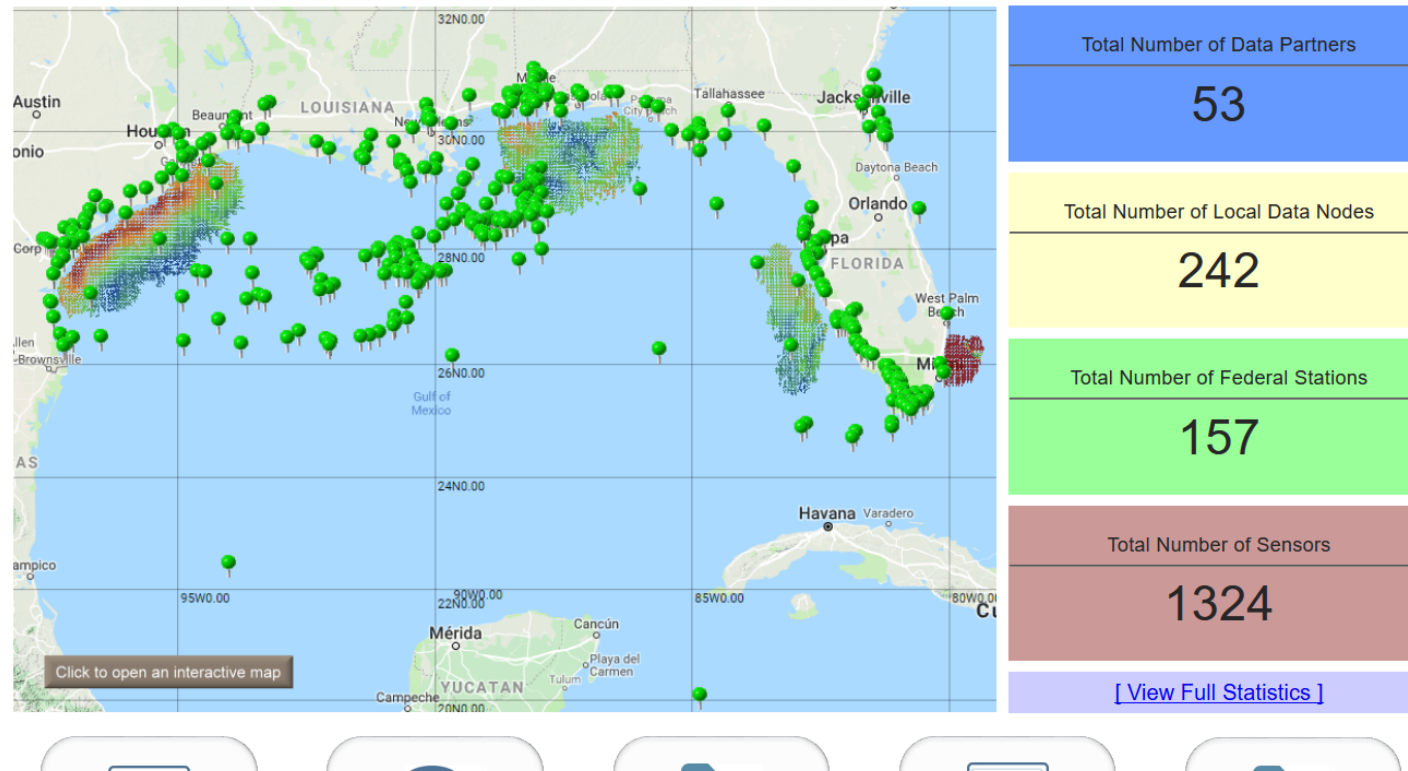
Data Integration/Products –Felimon Gayanilo, TAMU-CC



ABOUT US ▾ FOCUS AREAS ▾ RESOURCES ▾ GET ENGAGED ▾ DATA PORTAL ▾ PRODUCTS & SERVICES ▾   

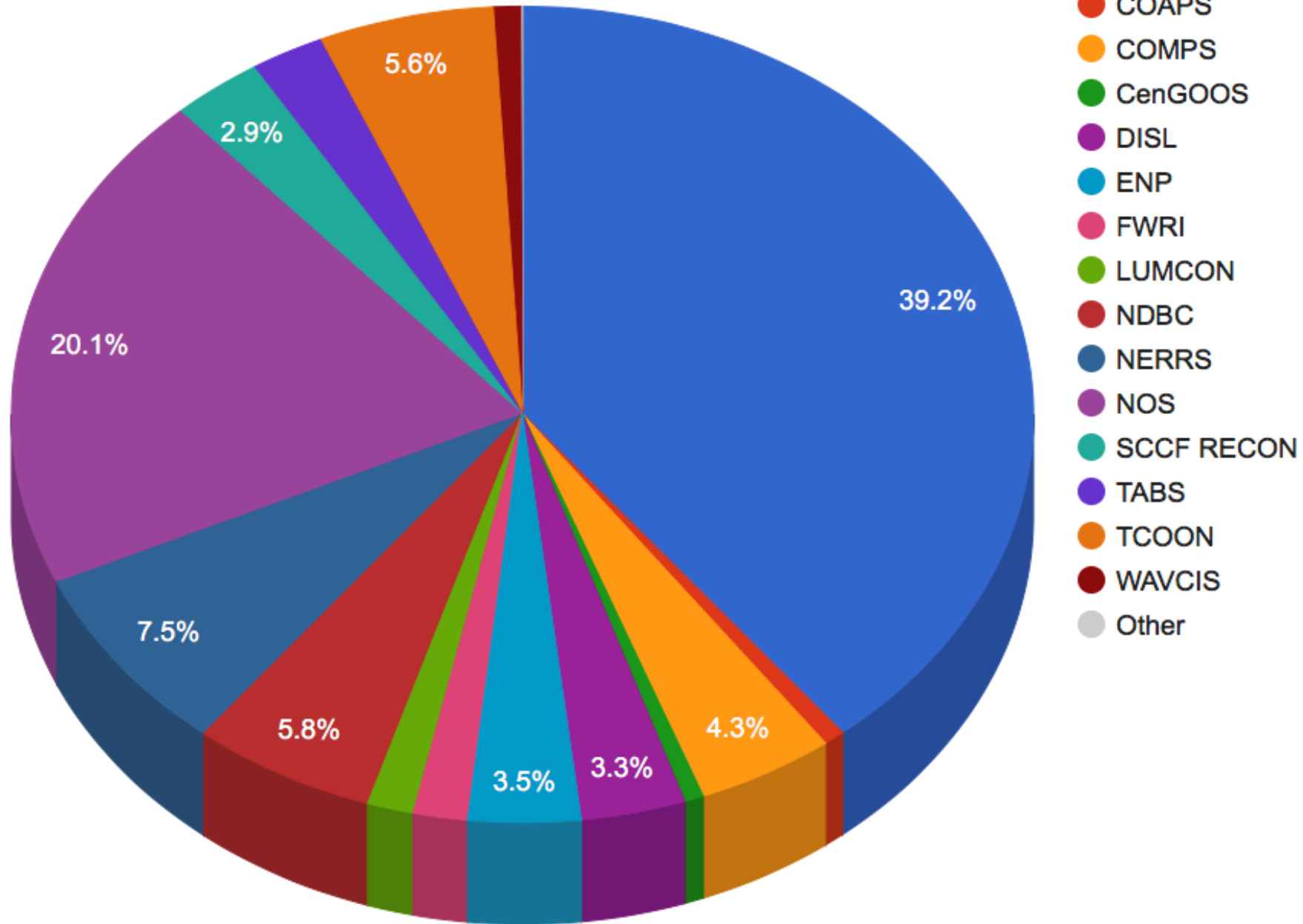
GCOOS Regional Assets

This Data Portal provides timely information about the environment of the United States portion of the Gulf of Mexico and its estuaries for use by decision-makers, including researchers, government managers, industry, the military, educators, emergency responders, and the general public. Observing stations in the region are monitored constantly.



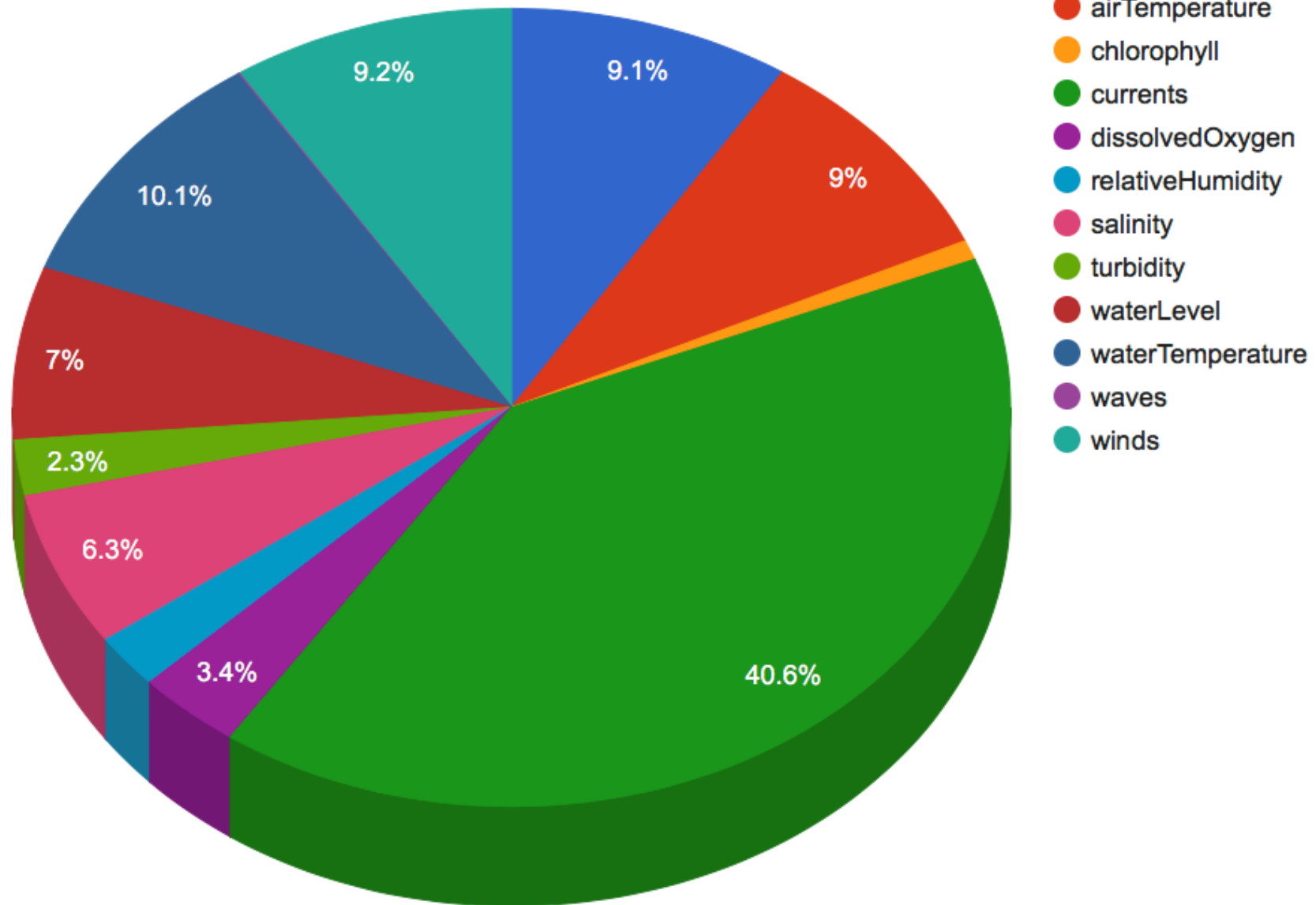
Sensor Count per Data Source

~1600 near-realtime sensors



Sensor Count per Phenomenon Observed

~1600 near-realtime sensors



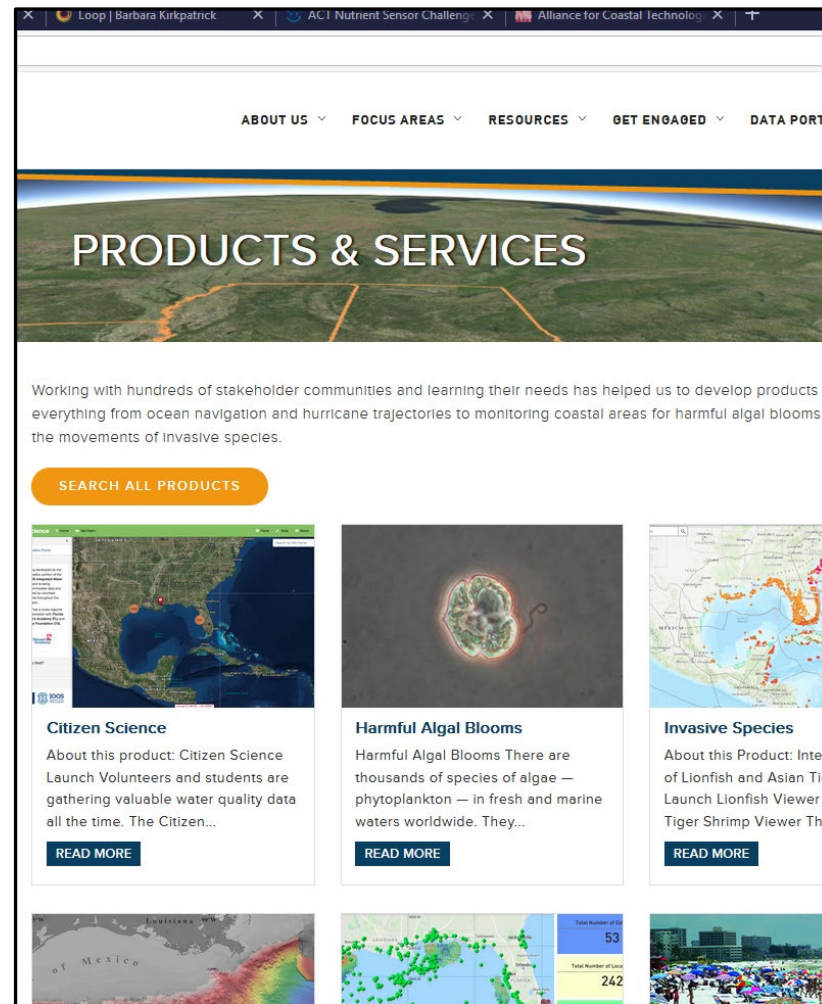
Regional Information Coordination Entity (RICE)

Our data meets rigorous QA/QC before posting



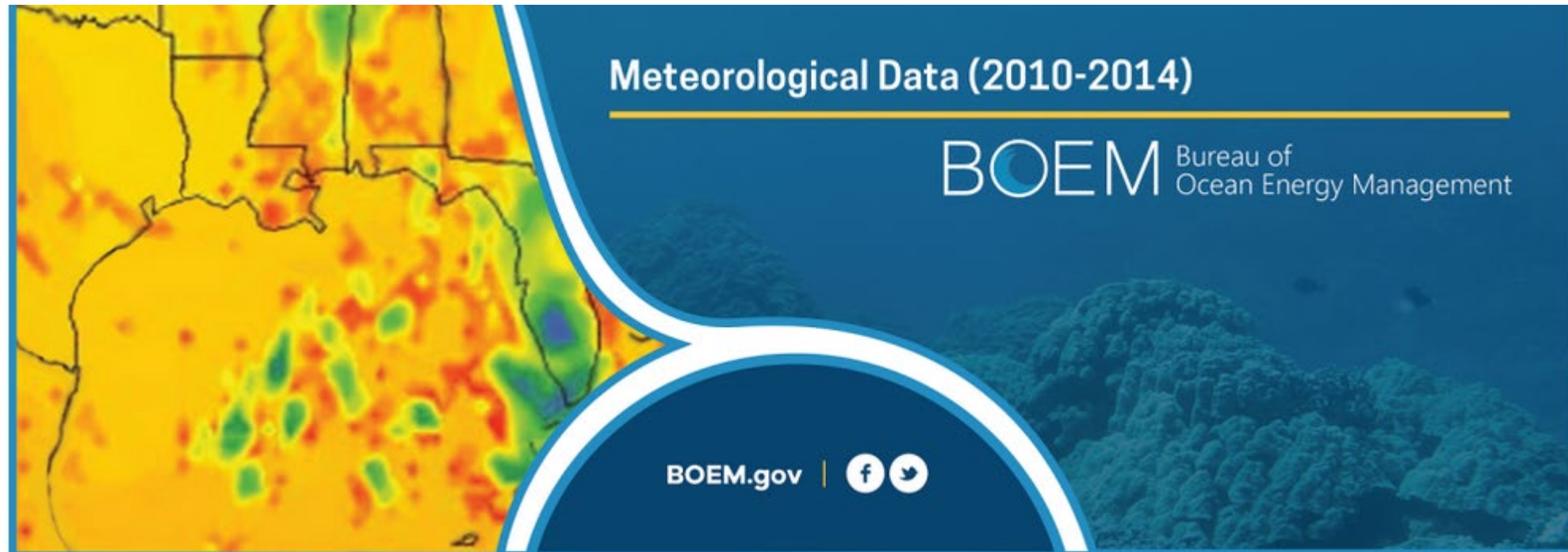
GCOOS Data Management and Products Portals

- 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

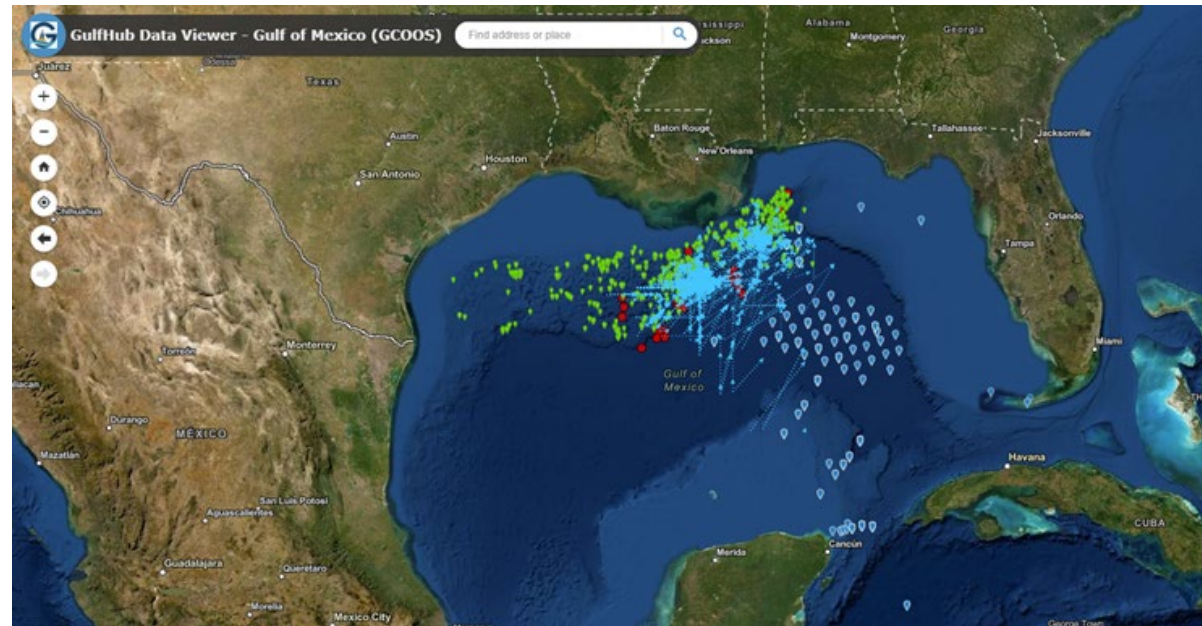


<https://boem.gcoos.org>

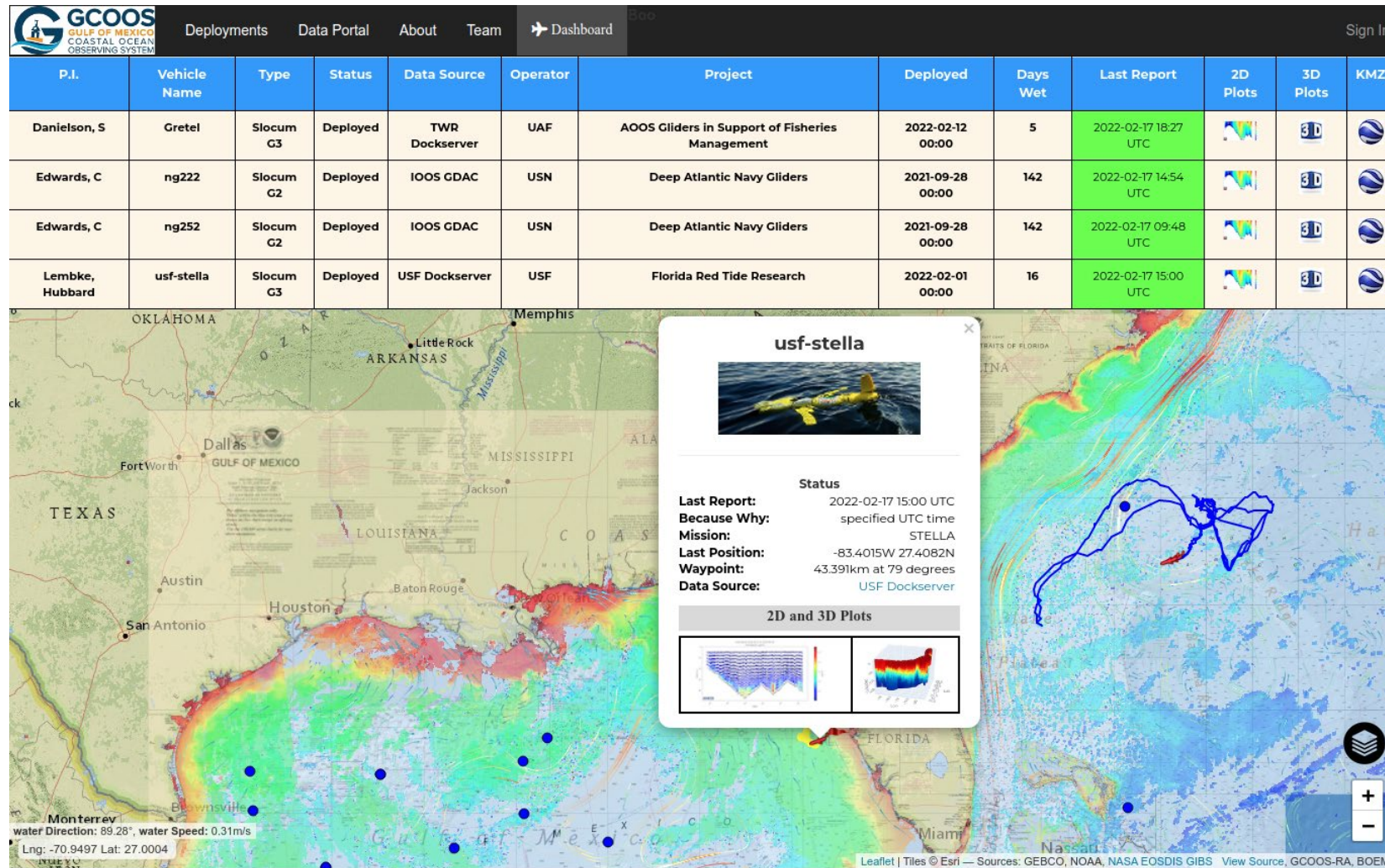
Data Aggregation and Hosting Projects

- *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/>



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/>

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Our first citizen science product- 2006

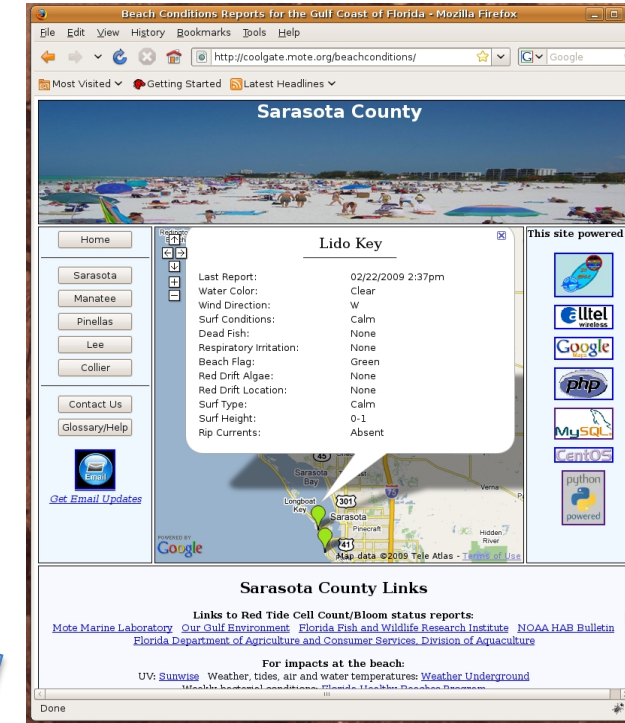
Beach Conditions Reporting System

- 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?



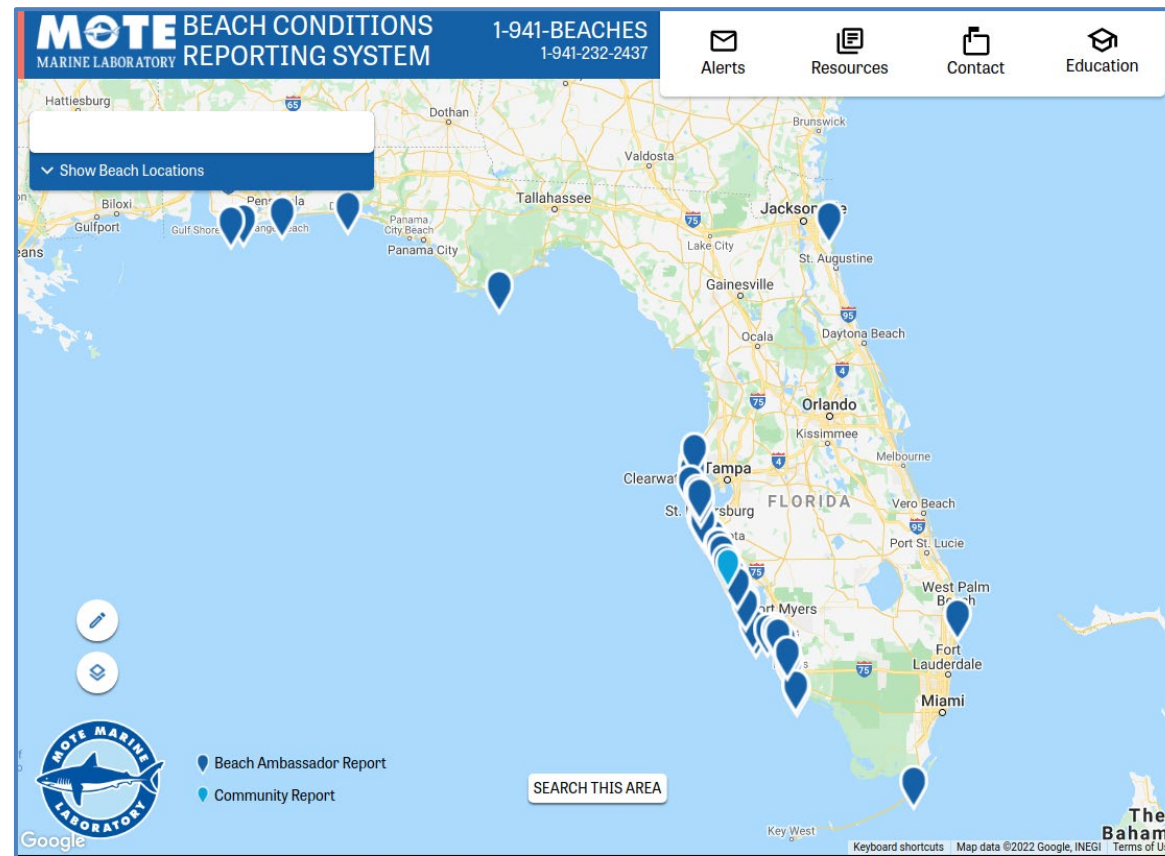
Our first citizen science product- 2006 Beach Conditions Reporting System

- Before the word 'app' became in our everyday world



16 years later.....

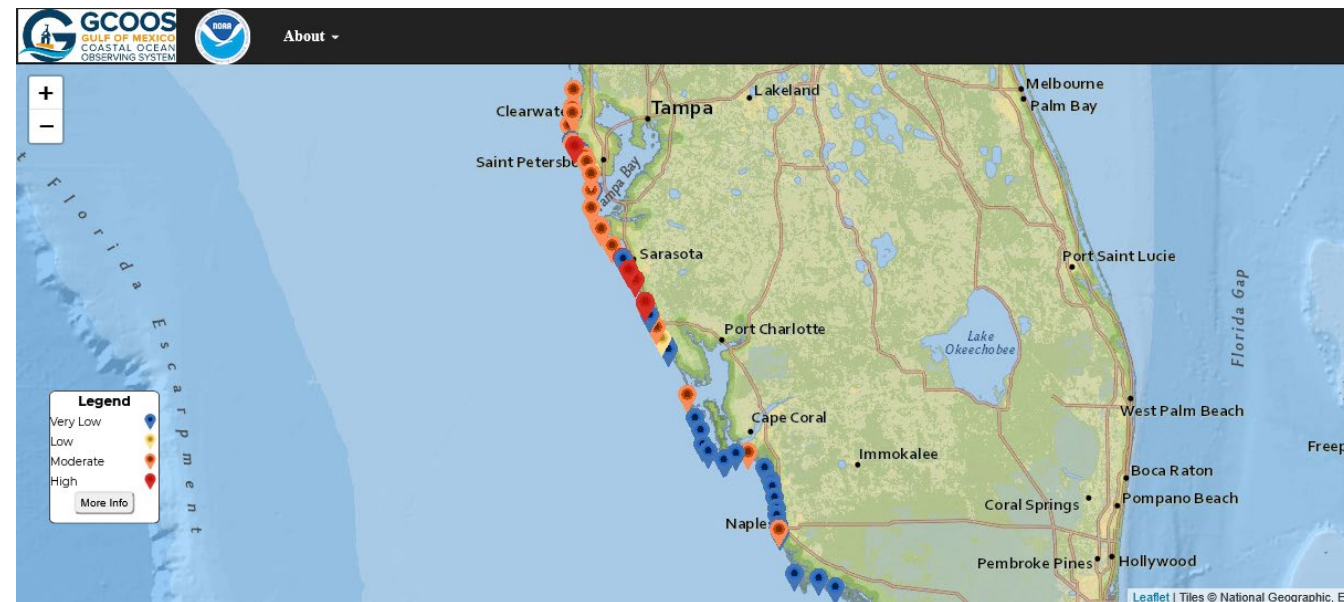
- Maintained by Mote Marine Laboratory



<https://visitbeaches.org>

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

Today's Talk

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- Citizen/Community Science
- Use of AI in Harmful Algal Bloom Observing (Step 3)

HABscope System Diagram

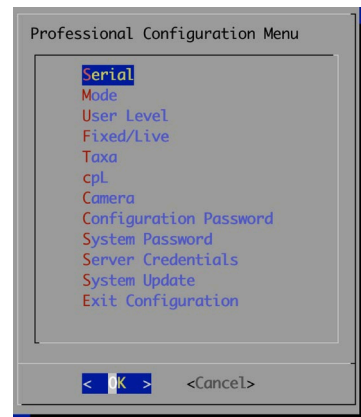
It's all about the SDFN: Self Describing File Name
The File Name is the Metadata

HSV0001_1643906643_karenia_live_0000000_0000000_raw.mp

4



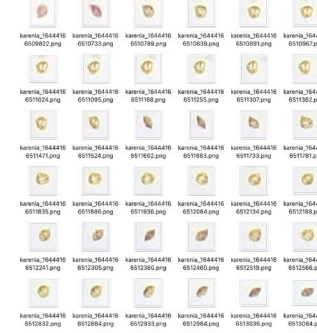
Culture



HABscope
1,500 lines of Python3



HABlab
Optical Workbench



Taxa Libraries
10,000 images/taxa

```
def make_model(input_shape, num_classes):
    """ Let's make a model, baby! (being small version of Acaption"""
    logging.info("make_model()...")
    inputs = keras.Input(shape=input_shape)
    # let's add some diversity
    data_augmentation = keras.Sequential(
        [
            layers.RandomFlip("horizontal"),
            layers.RandomRotation(0.1),
        ]
    )
    # Image augmentation block
    x = data_augmentation(inputs)

    # Entry block
    x = layers.BatchNormalizing(1.0 / 255)(x)
    x = layers.Conv2D(32, 3, strides=2, padding="same")(x)
    x = layers.BatchNormalizing(x)
    x = layers.Activation("relu")(x)

    x = layers.Conv2D(64, 3, padding="same")(x)
    x = layers.BatchNormalizing(x)
    x = layers.Activation("relu")(x)

    previous_block_activation = x # Set aside residual

    for size in (32, 256, 512, 728):
        x = layers.Activation("relu")(x)
        x = layers.SeparableConv2D(size, 3, padding="same")(x)
        x = layers.BatchNormalizing(x)
        x = layers.Activation("relu")(x)

        previous_block_activation = x # Set aside residual

    # Project residual
    residual = layers.Conv2D(128, 1, strides=2, padding="same")(
        previous_block_activation
    )
    x = layers.add(x, residual) # Add back residual
    previous_block_activation = x # Set aside next residual

    x = layers.SeparableConv2D(128, 3, padding="same")(x)
    x = layers.BatchNormalizing(x)
    x = layers.Activation("relu")(x)
```

Model Test and Train
2,000 lines of Python3

Local Components

HABscope System Diagram

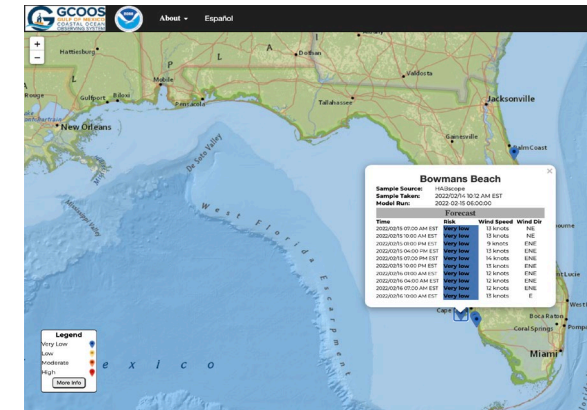


Web Portal

- 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

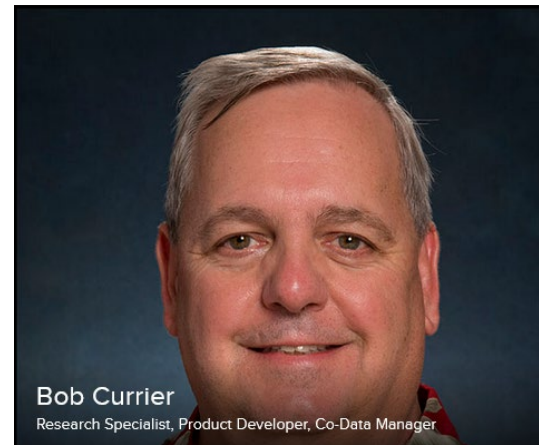
- 3,000 lines of code
- Python3 and Flask
- One Docker Container
- 300,000+ Views in past year

Cloud Components

For a deeper dive.....

STAMPing Out HABS
HABscope V2.0
“From the Culture to the Cloud”

Bob Carrier, TAMU/GCOOS
Wednesday, 1:50 pm, Room 2335



Bob Carrier
Research Specialist, Product Developer, Co-Data Manager



NOAA



NASA



GCOOS



FWC



Pinellas County



Lee County



Collier County



Sarasota County



SCCF

Thanks to IOOS HAB Pilot project funding and
NCCOS MERHAB Program

