Optical Detection Systems, Ocean Observing, and Mitigation of HABs

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Outline

Goals of IOOS
Texas Automated Buoy System (TABS)
Instrumentation: MERHAB program
Constraints
Data Products

1998 NORLC Charged by Congress
Integrated Ocean Observing System (IOOS)

Provide Data/Info Required for More Rapid Detection & Timely Prediction of State Changes

- Improve the safety & efficiency of marine operations
- Improve homeland security
- Mitigate effects of natural hazards more effectively
- Improve predictions of climate change & their effects
- Minimize public health risks
- Protect & restore healthy coastal marine ecosystems more effectively
- Sustain living marine resources

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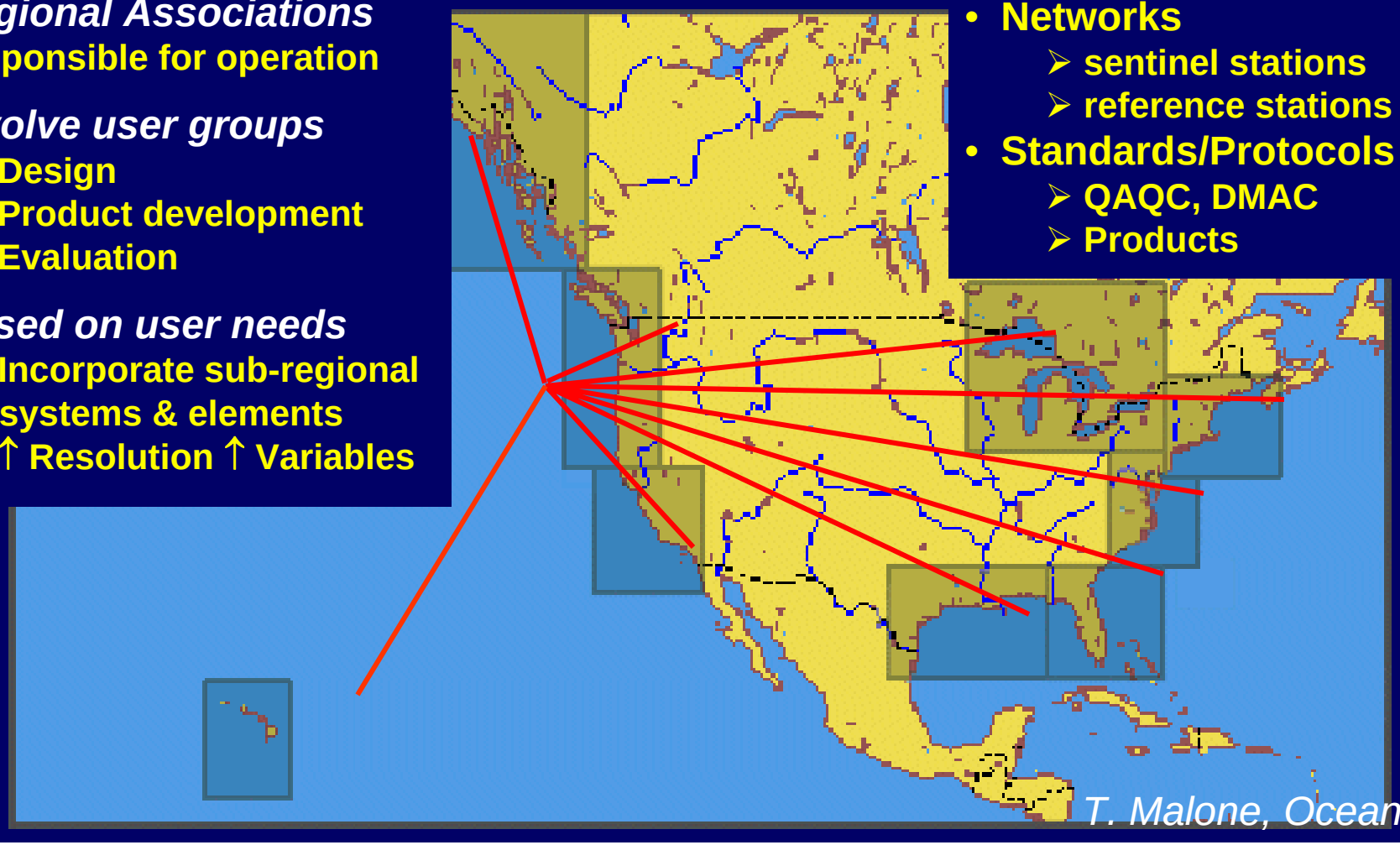
Coastal Component

Regional COOS's

- *Regional Associations* responsible for operation
- *Involve user groups*
  - Design
  - Product development
  - Evaluation
- *Based on user needs*
  - Incorporate sub-regional systems & elements
  - ↑ Resolution ↑ Variables

National Backbone

- Federal Agencies responsible for operation
- EEZ & Great Lakes
- Core variables
  - required by regions
- Networks
  - sentinel stations
  - reference stations
- Standards/Protocols
  - QAQC, DMAC
  - Products



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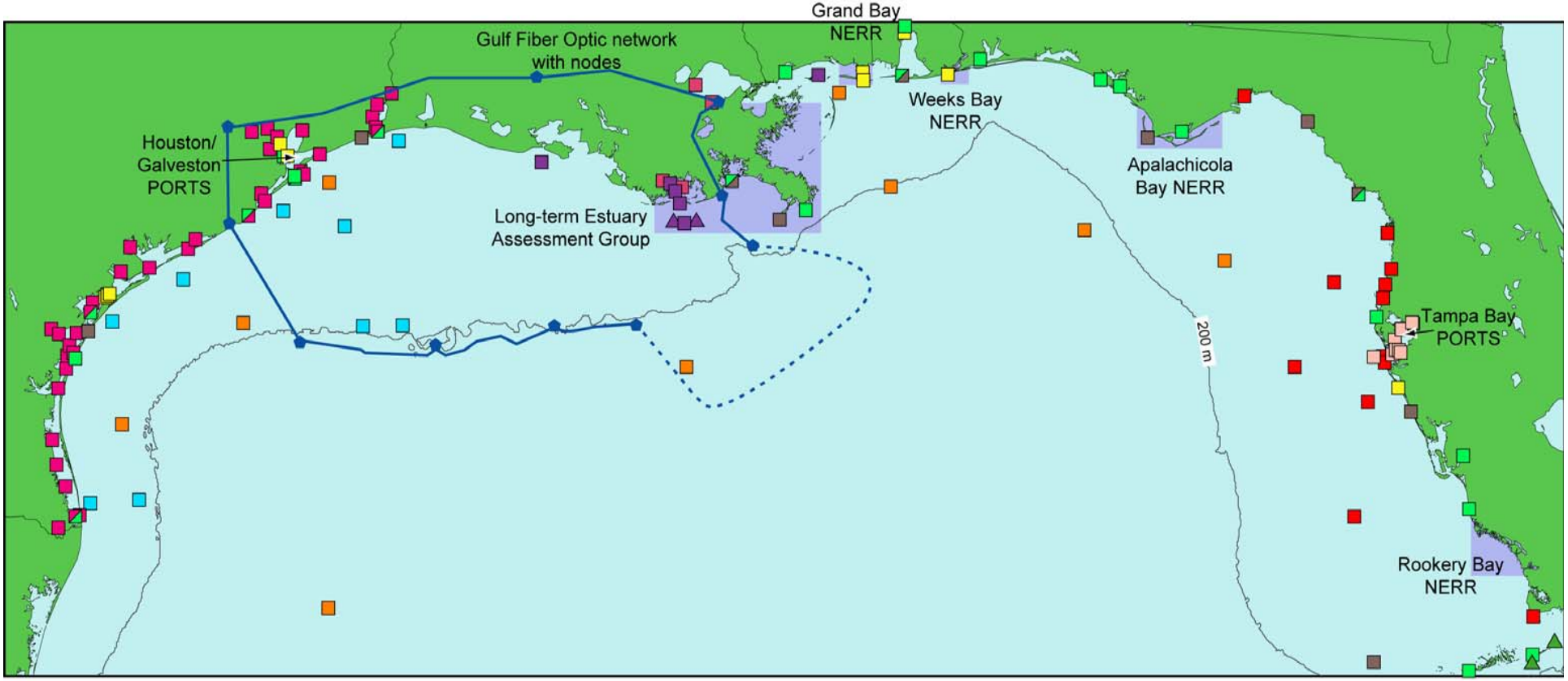
Integrated Ocean Observing System (IOOS)
Gulf of Mexico **C**oastal **O**cean **O**bserving **S**ystem

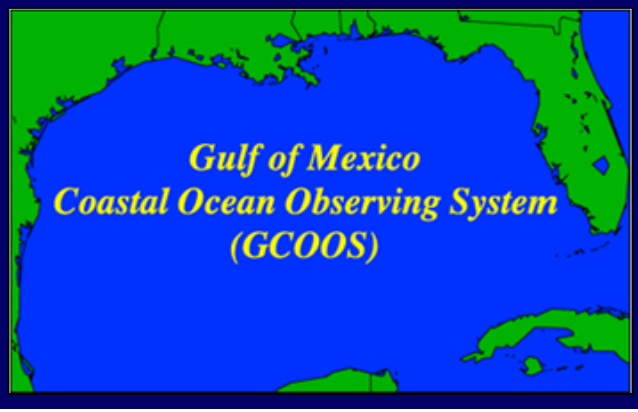


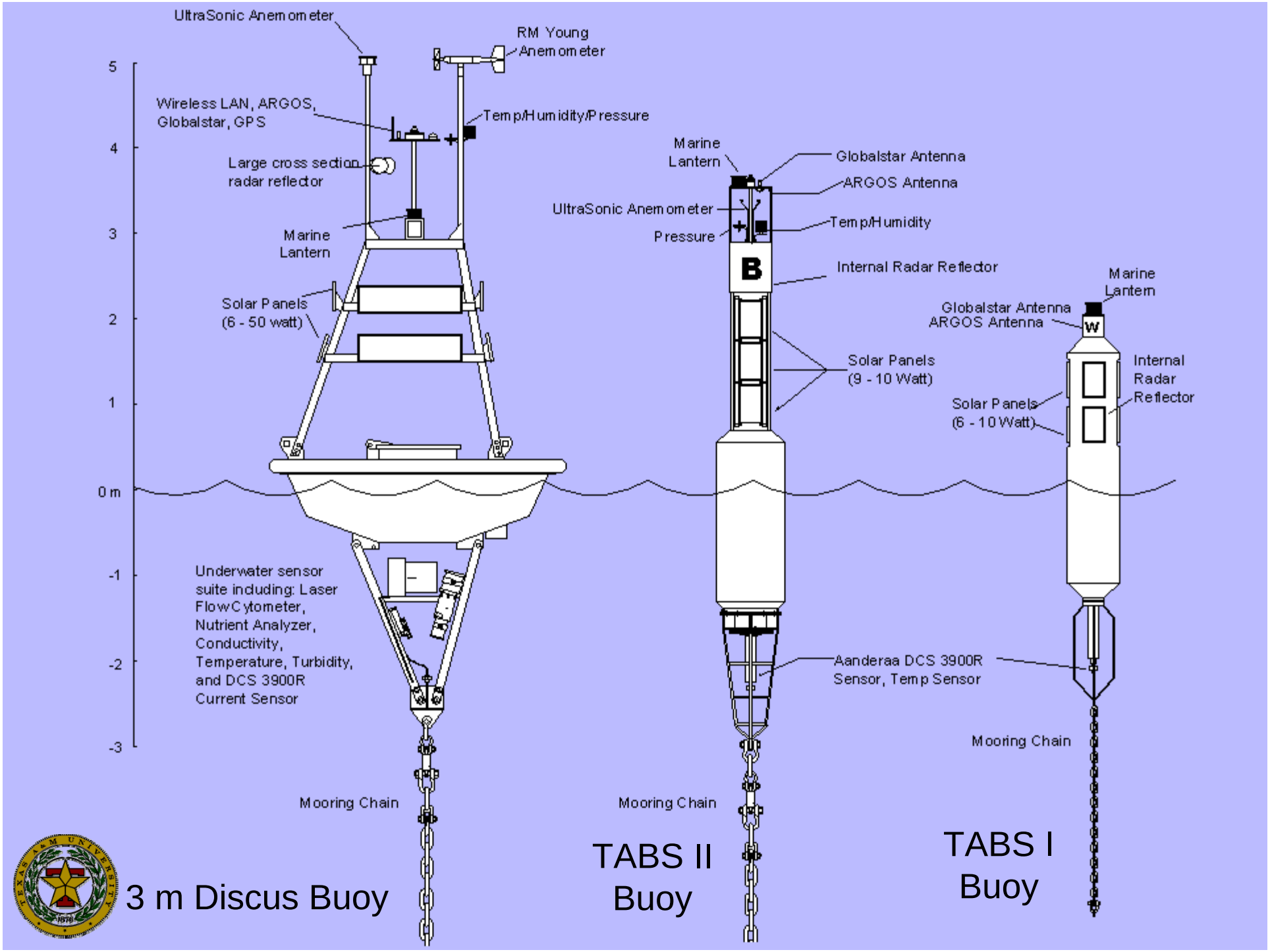
Continuing Measurements:
Physical □
Physical and Ecosystem △
Ecosystem

- TABS
- TCOON
- PORTS
- COMPS
- Army CoE
- WAVCIS
- LUMCON
- NWLON
- NDBC Moorings
- NDBC C-MAN
- WAVCIS/LUMCON
- SEAKeys

What is TABS?

- Network of current- and wind-measuring buoys
- Communications infrastructure
- Databases
- Website
- Forecast models: offshore and inshore
- Team of experts (oceanographers, meteorologists, modelers, technicians) directed by an end-user



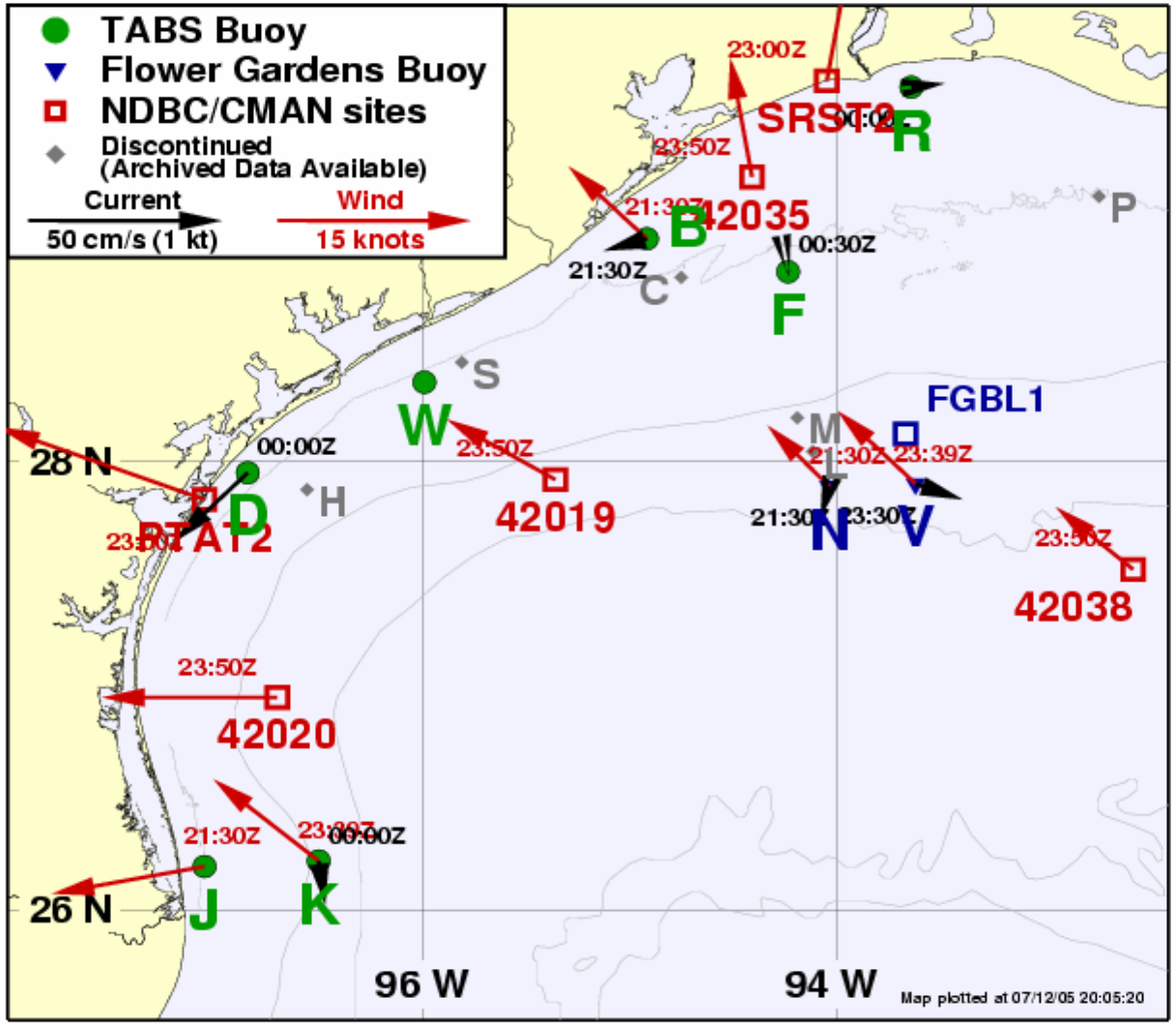

UltraSonic Anemometer
RM Young Anemometer
Wireless LAN, ARGOS, Globalstar, GPS
Temp/Humidity/Pressure
Large cross section radar reflector
Marine Lantern
Solar Panels (6 - 50 watt)
5
4
3
2
1
0 m
-1
-2
-3
Underwater sensor suite including: Laser FlowCytometer, Nutrient Analyzer, Conductivity, Temperature, Turbidity, and DCS 3900R Current Sensor
Mooring Chain
3 m Discus Buoy
Marine Lantern
Globalstar Antenna
ARGOS Antenna
UltraSonic Anemometer
Temp/Humidity
Pressure
B
Internal Radar Reflector
Solar Panels (9 - 10 Watt)
Aanderaa DCS 3900R Sensor, Temp Sensor
Mooring Chain
TABS II Buoy
Marine Lantern
Globalstar Antenna
ARGOS Antenna
W
Internal Radar Reflector
Solar Panels (6 - 10 Watt)
Mooring Chain
TABS I Buoy

TABS, Texas Automated Buoy System, Gulf of Mexico Ocean Observatory, Texas Coastal Ocean Observation, Real Time Oceanographic Data Supporting Oil Spill Pre

File Edit View Go Bookmarks Tools Help

http://tabs.gerg.tamu.edu/

Firefox Support | Firefox Help | Plug-in FAQ | OCNG 420, Spring 2...



Last Data Reported

B 07/12/2005 21:30Z

D 07/13/2005 00:00Z

F 07/13/2005 00:30Z

J 06/28/2005 16:20Z

K 07/13/2005 00:00Z

N 07/12/2005 21:30Z

R 07/13/2005 00:00Z

V 07/12/2005 23:30Z

W 07/02/2005 11:30Z

Select Map Type:

- Wind Vectors
- Wind Barbs

Bathymetric contours shown for these depths(meters): 20, 50, 200, 2000, 3500

The vectors on the map point toward the direction that the currents or winds are flowing and represent the average for the last three hours of the available data. The date and time at each station indicates the end of the three-hour average.

TABS Real Time

TABS Buoy D -- Texas Automated Buoy System - Mozilla Firefox

File Edit View Go Bookmarks Tools Help

http://tabs.gerg.tamu.edu/tglo/ven.php?buoy=D

Firefox Support | Firefox Help | Plug-in FAQ | OCNG 420, Spring 2...

TABS Buoy D

27° 56.3760'N 96° 50.5740'W
AA3900 DCS - sensor depth 2m
Water Depth: 60 feet (18 meters)

Conditions at 07/13/2005 00:00 UTC (07/12/2005 19:00 CDT)

Speed: 25.95 cm/s (0.50 kts) **Direction:** 218 °T (SW) **Water Temp:** 30°C (87 °F)

System Voltage: 14.0 V **Signal Strength:** -2.0 dB **Ping Count:** 140

IMPORTANT: Notice to Mariners

View Velocity Data
Image || Table

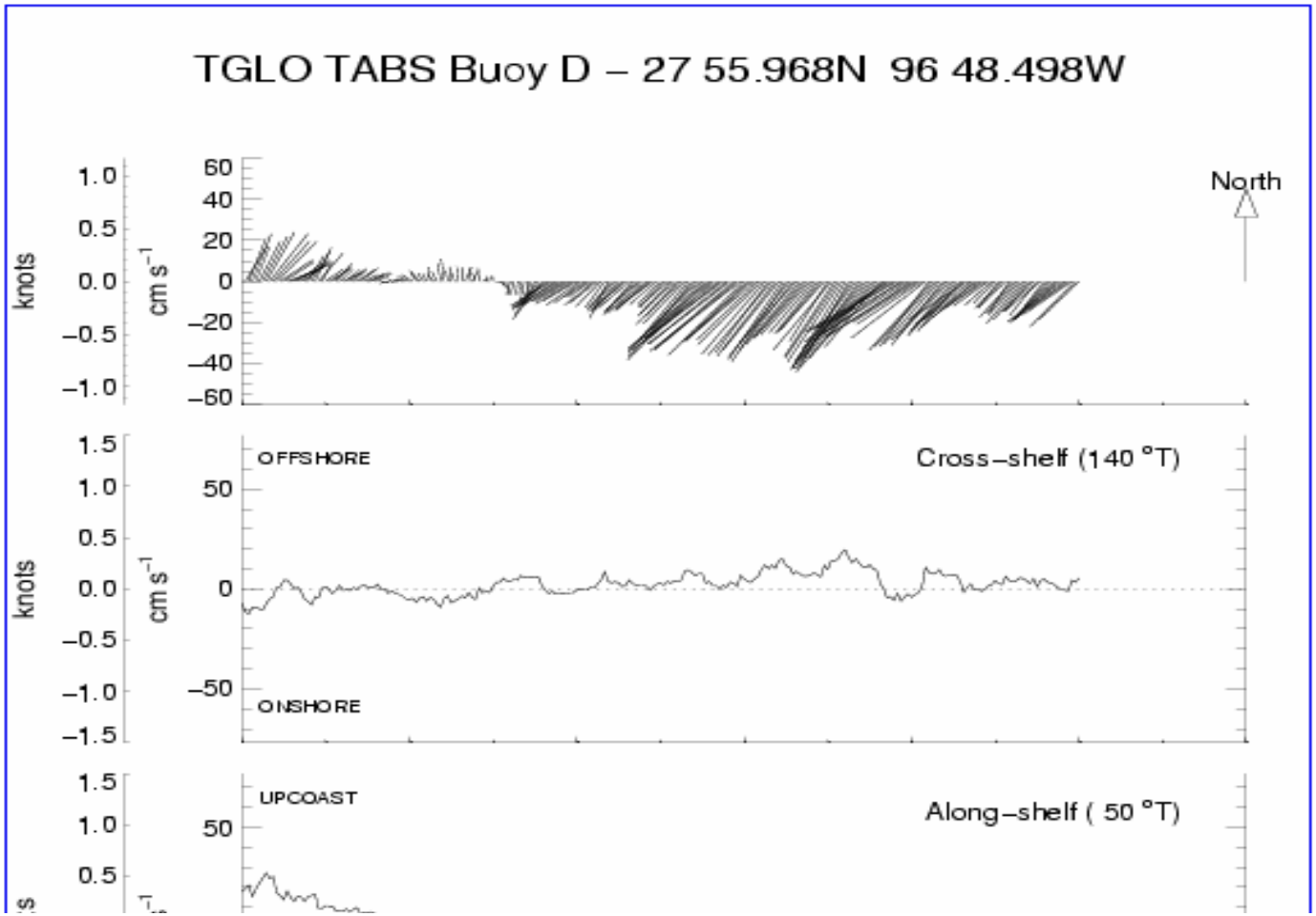
View System Data
Image || Table

Search Velocity Database

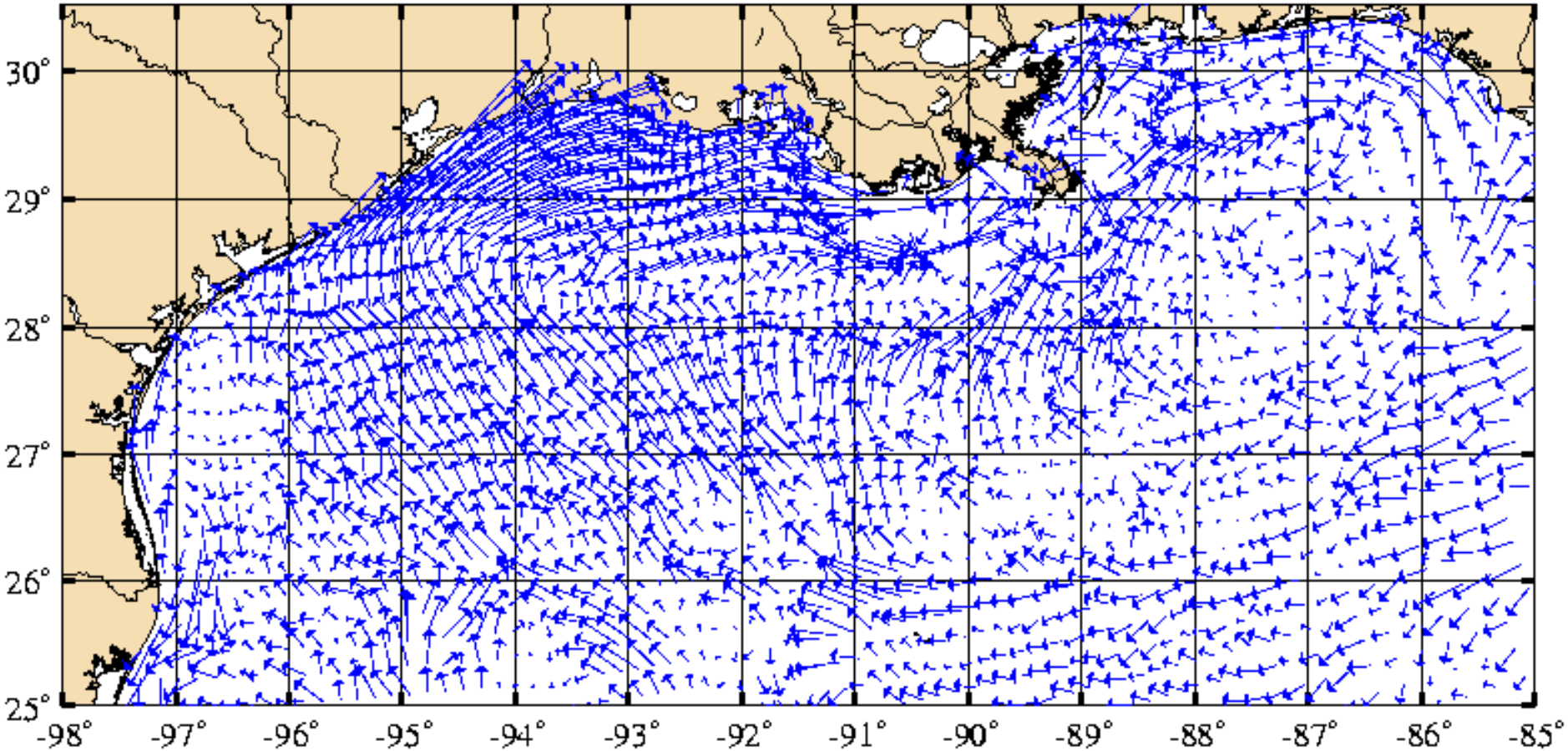
Tutorial: How to Read a Stick Plot

Return to TABS Home Page

Go to Buoy:



Forecast Surface Currents from ROMS Model Using NCEP's ETA-12 Winds



Representing conditions at 14-Jul-05 12:00 (UTC)

Representing conditions at 14-Jul-05 07:00 (CDT)

1 knot

50 cm/s

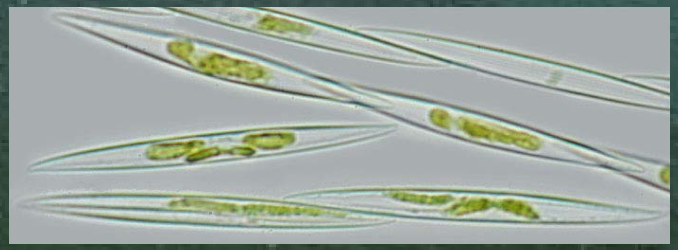
Harmful Algal Blooms

- HABs are phytoplankton bloom phenomena that have negative impacts– an unusually high concentration of toxic or nuisance algae.
- HABs are a significant global problem.
- *Early warning* is the best way mitigate the effects of HABs.

***Alexandrium* sp.**

© University of Port Elizabeth

***Pseudonitzschia* sp.**

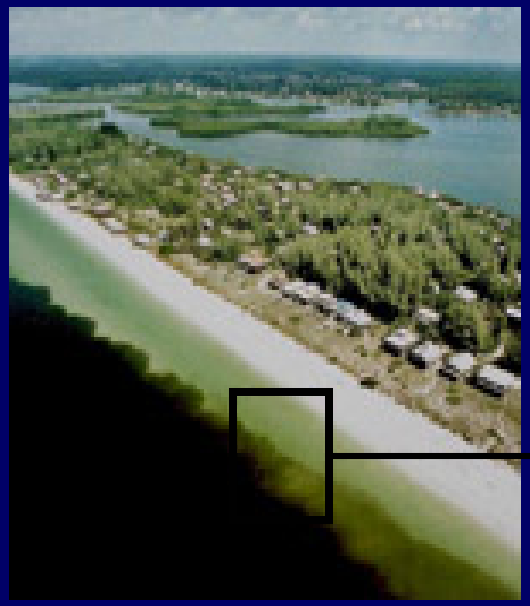


© Santa Barbara Museum of Natural History

Karenia brevis

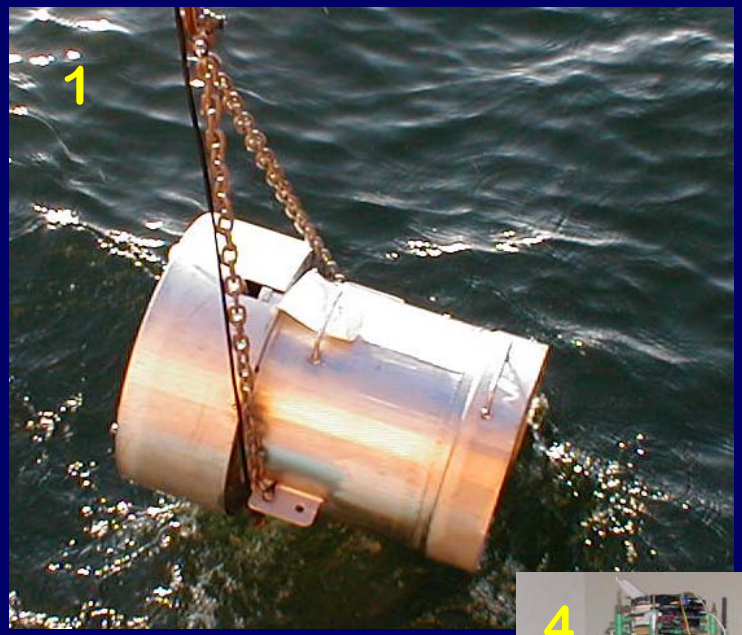
Coastal Ocean Observing System

- An *in situ* imaging system and new sensors on a new TABS buoy will improve our capabilities for early warning.
- Texas Department of Health closes shellfish harvesting areas when cell counts reach 5 cells/ml; 150-200 cells/ml begins to kill fish; 1000 cells/ml can be seen as water discoloration

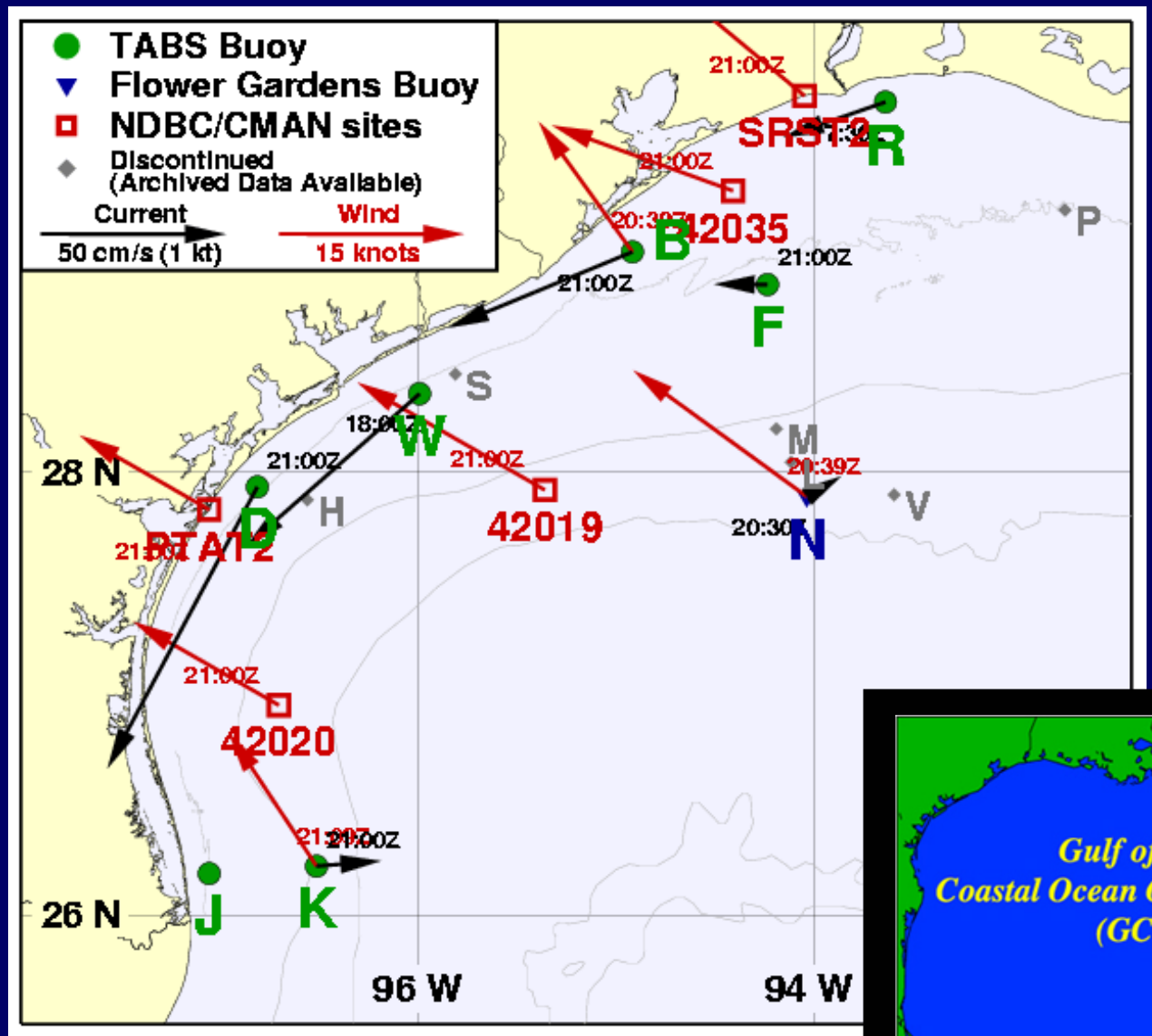


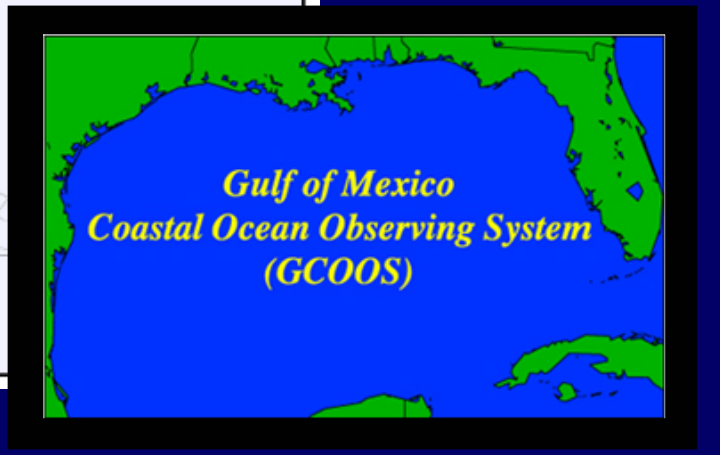
Instrumentation

1. Submersible FlowCAM (Fluid Imaging, Inc.)
2. Fluoroprobe (Moldaenke)
3. NAS Nutrient Analyzers (Envirotech)
4. Environmental Sample Processor (Chris Scholin)

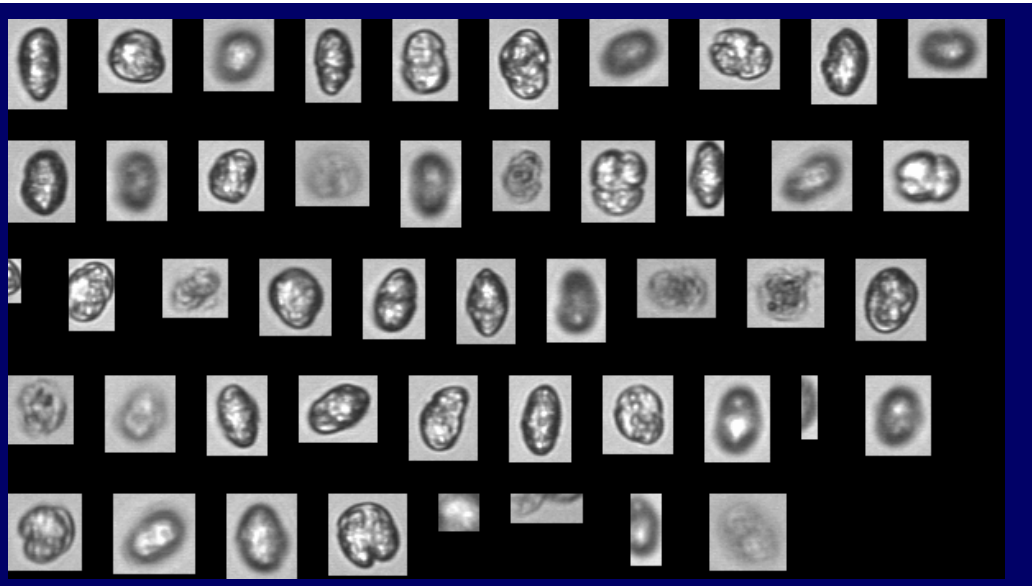


Location


TABS Buoy
Flower Gardens Buoy
NDBC/CMAN sites
Discontinued
(Archived Data Available)
Current
50 cm/s (1 kt)
Wind
15 knots
21:00Z
SRST2
R
42035
B
F
P
S
W
M
V
N
D
H
42019
42020
J
K
28 N
26 N
96 W
94 W


Gulf of Mexico
Coastal Ocean Observing System
(GCOOS)

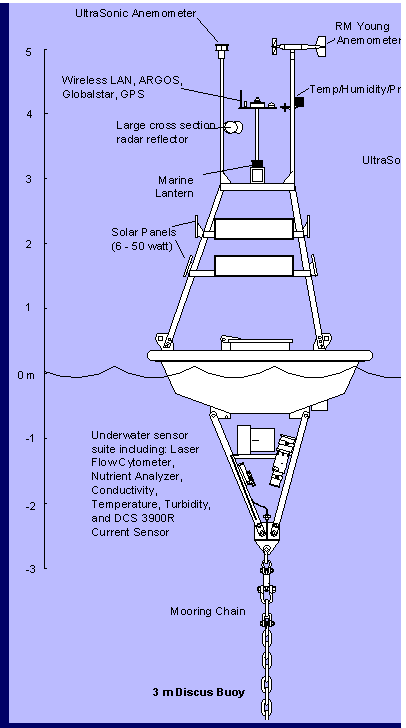
FlowCAM



- FlowCAM is an instrument for the rapid monitoring of particles in fluid.
- Combines fluorescence measurements and imaging in a continuous flow-through system
- For each cell, a digital image is captured and data is stored in a spreadsheet (or interactive scattergram)
- Images stored on hard drive can be transferred to the buoy computer, and sent back to the lab

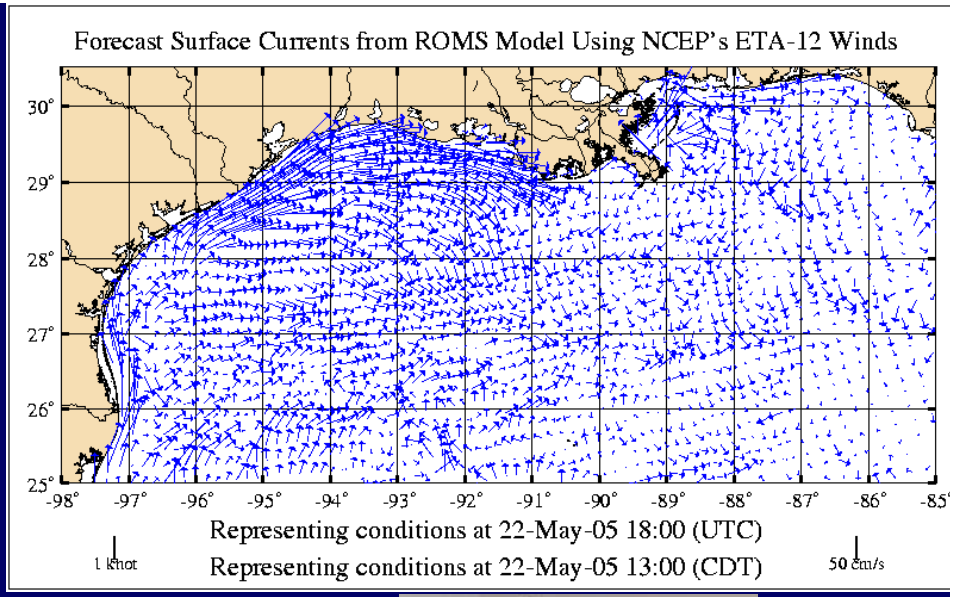
Constraints

- Lab-based instrument deployed at sea
- Power
- File size / Data retrieval
- Software / Data processing
- Fouling
- Hazards



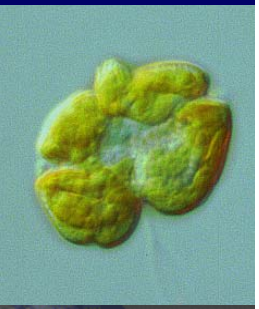
Conclusions

- Optical systems appear promising for real-time detection of HABs in the northern Gulf of Mexico.
- Observations and modeling
- No single instrument can provide all the data required:
  - Chlorophyll data alone can not distinguish cell types
  - Detection of toxins will not always correlate with the presence of cells
  - The FlowCAM uses too much power to be run continuously on a buoy

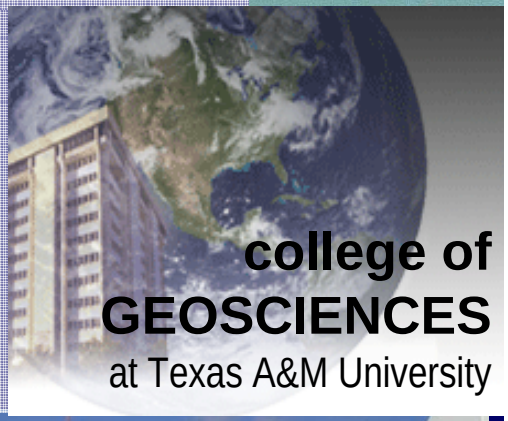


Future Work

- Deployment of HAB sensors to complement the TABS regional component of the Integrated Ocean Observing System (IOOS) through the Gulf of Mexico Coastal Ocean Observing System (GCOOS)



- Master of Geosciences in Ocean Observing Systems at Texas A&M University
- Collect real-time data
- Forecast model validation
- Prediction and early warning



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Special thanks to Rongjun Shen, Patrick Spooner, Jason See and the TABS group for assistance with development & deployment of the submersible FlowCAM.

M.S. Gsc.: Ocean Observing Systems

- Ocean Observing Systems are an important direction in oceanographic research for assessment of environmental health and climate change.
- Trained personnel are needed for a coordinated system for ocean data collection, data management, and production and distribution of data products

- The College of Geosciences is unique in the range of training available
  - in situ ocean observations
  - remote sensing technologies
  - geographic information systems (GIS)
  - analytical techniques and modeling
  - An existing ocean observing system, the Texas Automated Buoy System