Ocean Issues GOMCARB

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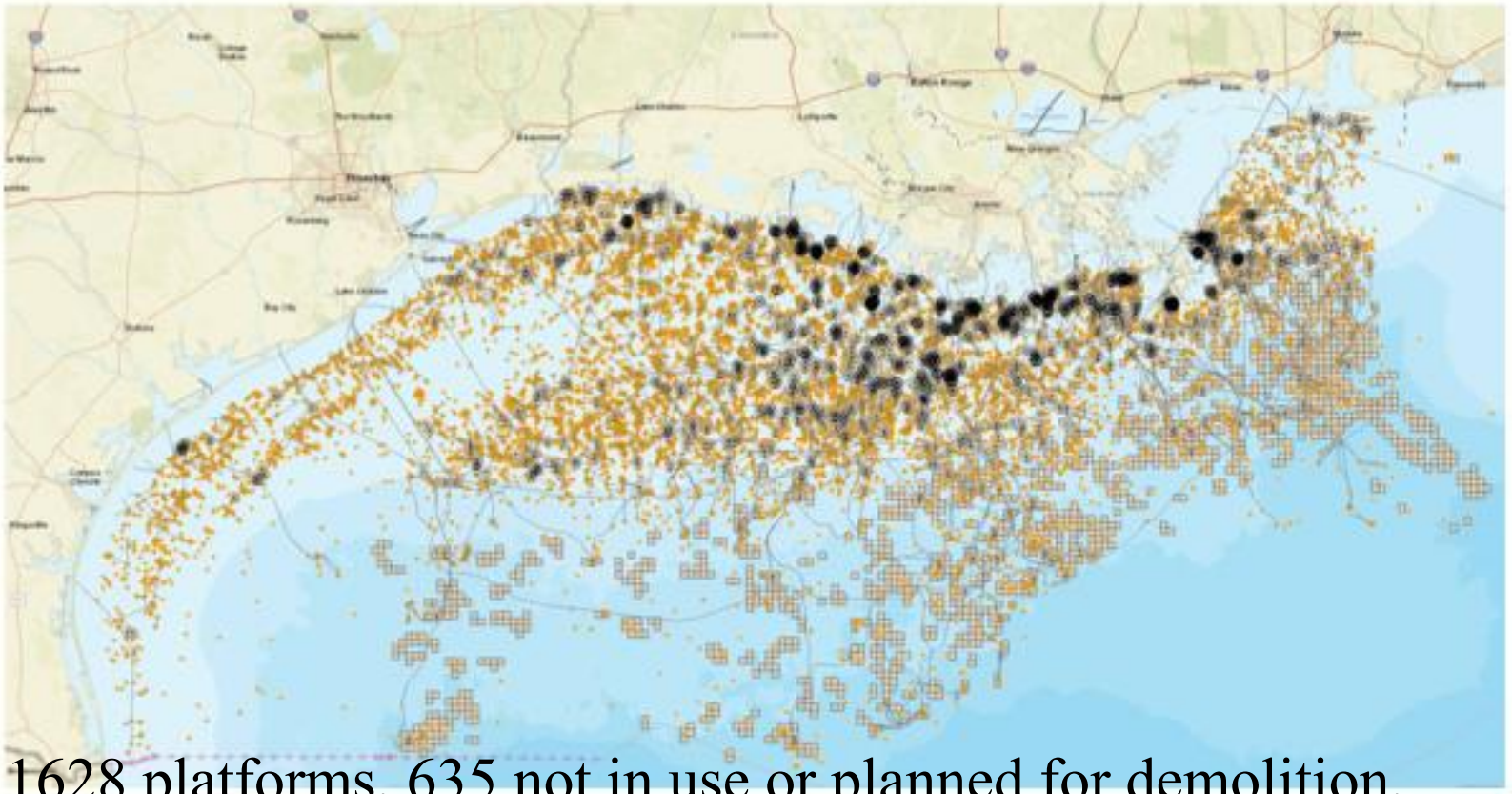
Geochemical Environmental Research Group

Figure Presented by Roy Robinson (Excipio Energy) at OTC 5/2/2022



1628 platforms, 635 not in use or planned for demolition, about 250 removed every year.
20,000 km of abandoned pipelines, 50,000 km still in use
50,000 abandoned wells, 20,000 still open
3,000+ non-producing fields reservoirs

Theme at Offshore Technology Conference Climate Technology

Repurposing Existing Infrastructure for new purposes such as CCUS

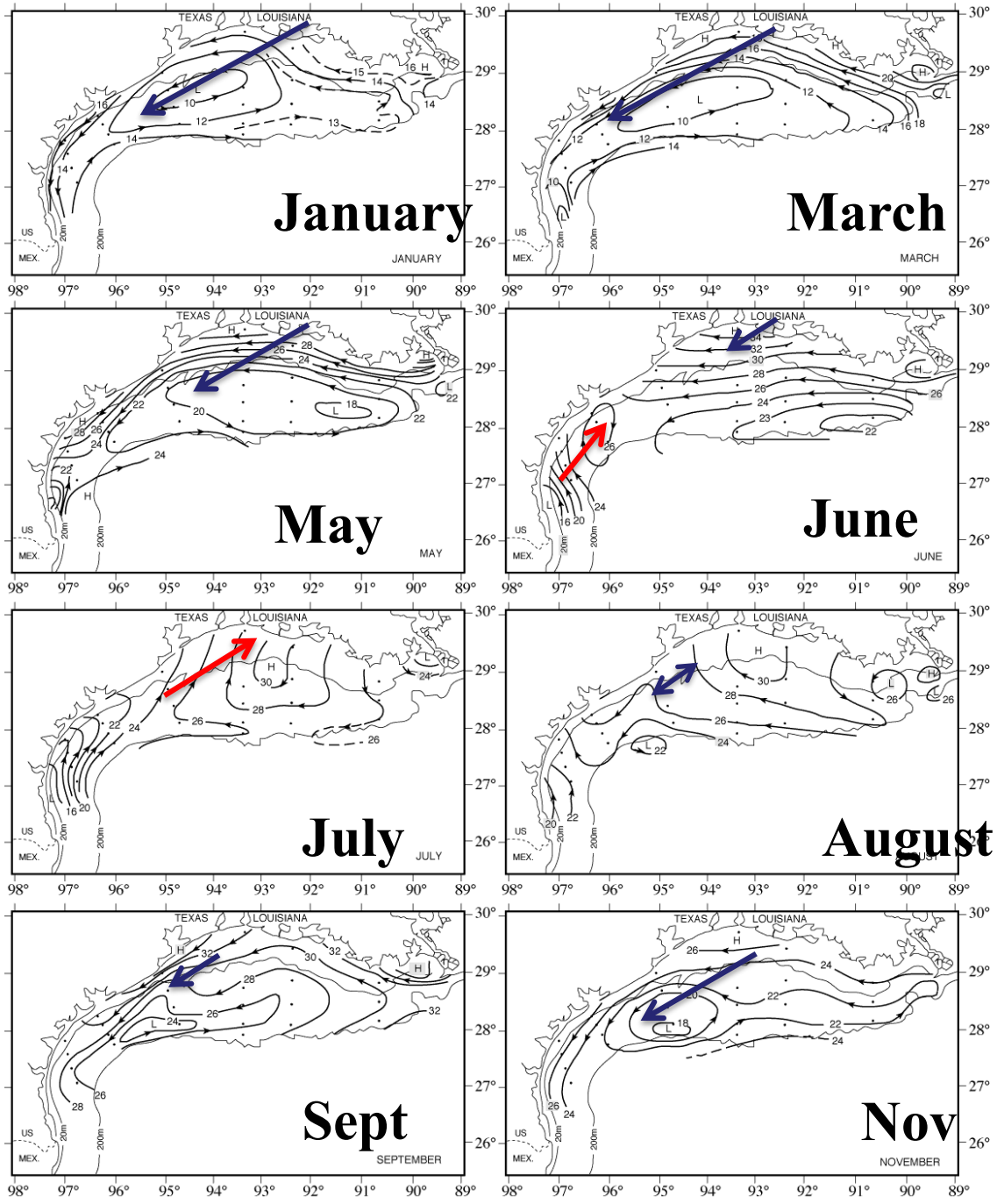
Energy Transition from Fossil Fuel to Offshore Wind, Marine Hydrokinetics, Offshore Geothermal, Ocean Thermal Energy Conversion (OTEC), Offshore Solar, Offshore air conditioning, Blue Hydrogen

Most of this activity focused on the Ocean – Texas/Louisiana coast as well as further Offshore in the Gulf of Mexico, off Texas and Lousiana.

Mostly Texas with a 160 Km shelf

Need to appreciate many of the Oceanographic issues in order to plan for success.

Ocean processes in the Gulf of Mexico far different than areas of study for Carbon Storage such as the North Sea. Know a lot about Oxygen little of CO2. Need to understand the GOM system for studies of attribution.



Low frequency Circulation of Texas-Louisiana Shelf

Cochrane-Kelly Scheme (JGR 1986)

- Based on hydrography
- Seasonal reversal of coastal current in June/July
- Non-summer pattern Sept thru May (downcoast)

What are the special characteristics of the Gulf of Mexico off Texas

Variable Ocean Conditions

Seasonal Hypoxia

River plumes

Storms (Hurricanes and Storms) Once in the Gulf cannot escape

Warm coastal temperatures

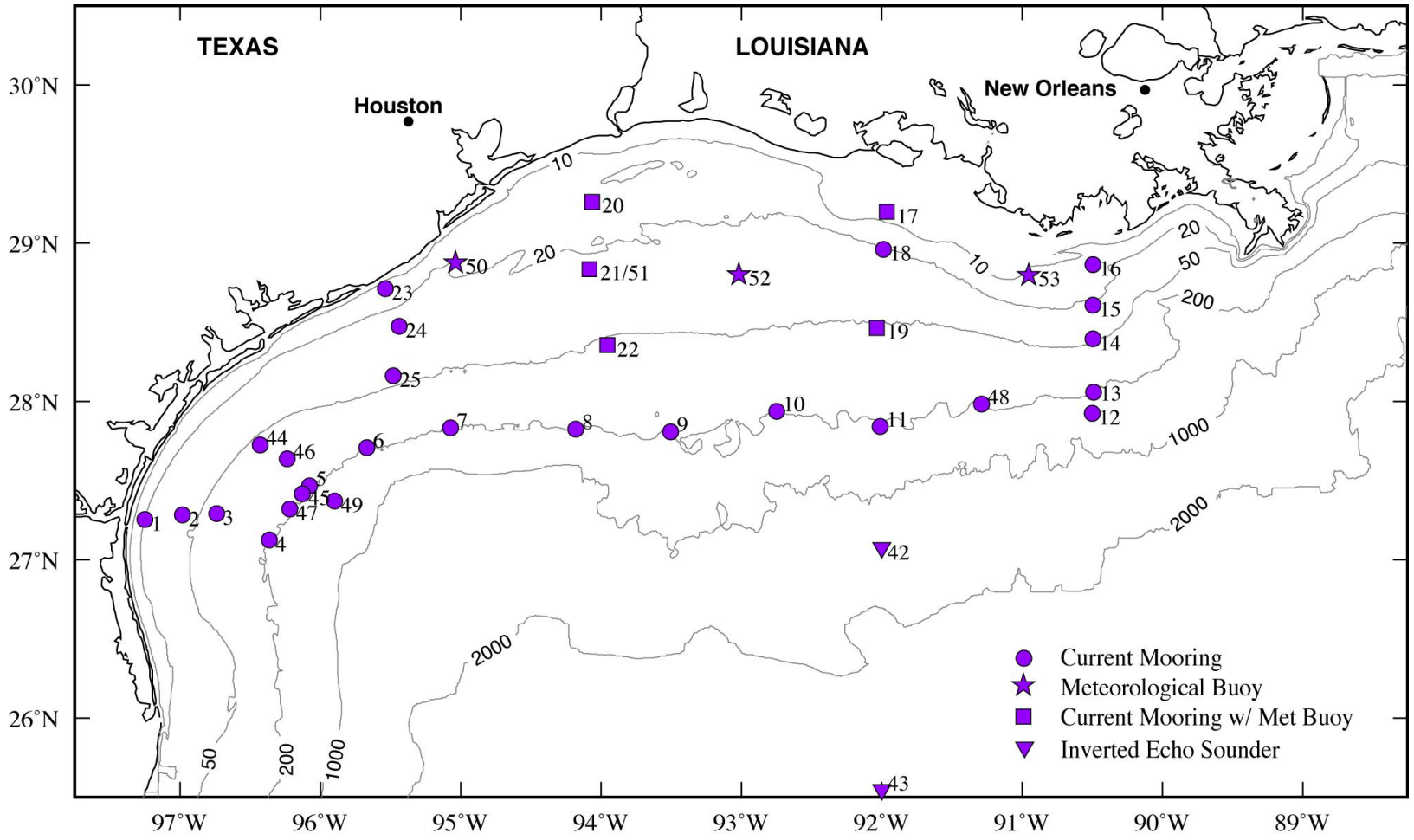
Bio Fouling

Ship traffic (Commercial, Shipping and Fishing and Recreational)

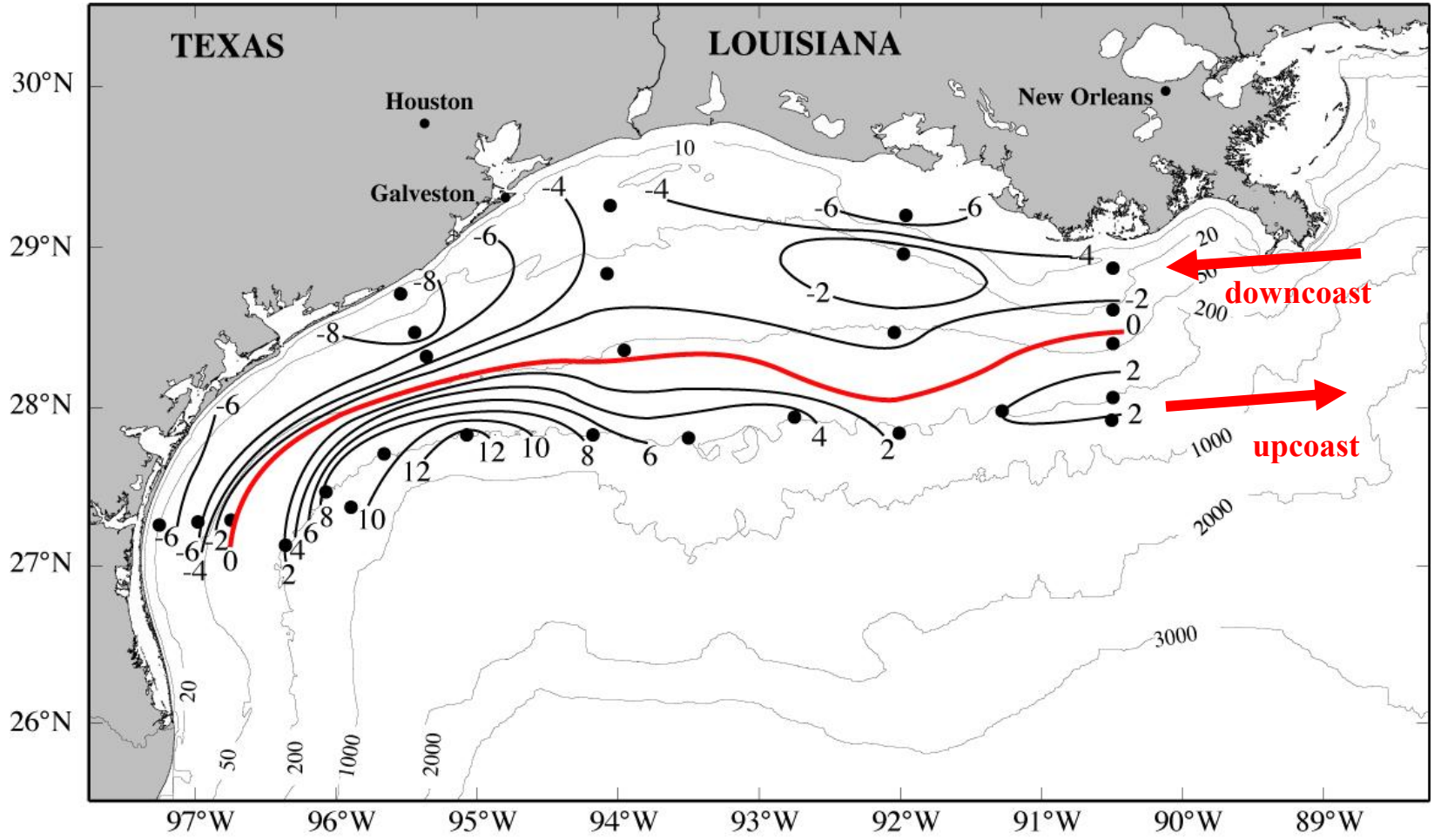
Platforms and pipelines

Good ocean measurement systems (observations and models)

LATEX Moored Observations



Record-length 10-m alongshelf velocity components

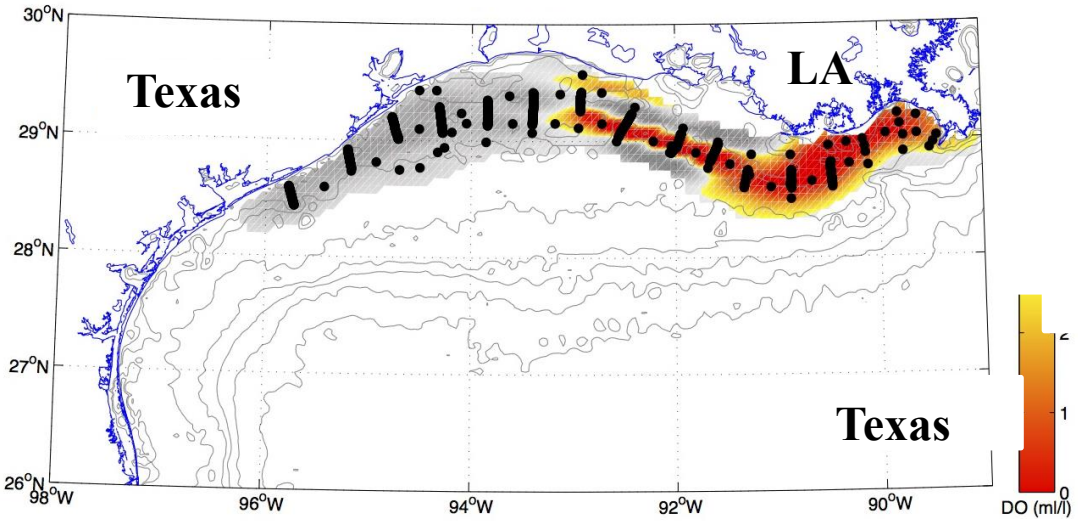


From Nowlin, Jochens, DiMarco, Reid, and Howard (2005)

Key conclusions: LATEX - (MMS funded)

- Currents over the inner shelf (~50m) are principally forced by along-shelf wind-stress
- Buoyancy driving is a key element of shelf circulation
- Strong seasonal circulation pattern
- Meso-scale forcing is greatest near the shelf edge (>50 mdepth)

Near-Bottom Dissolved Oxygen Concentration



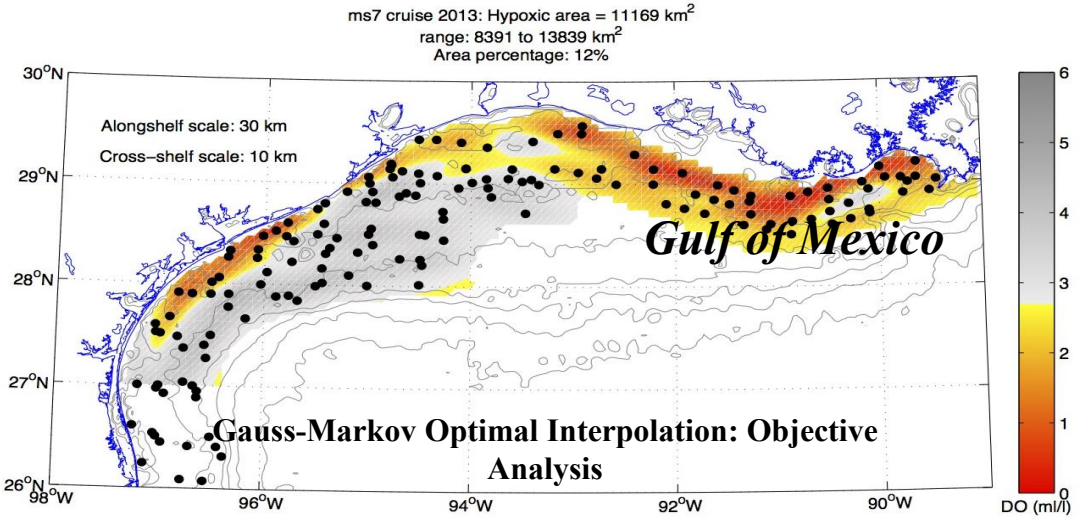
August 2012

Driving Mechanisms:

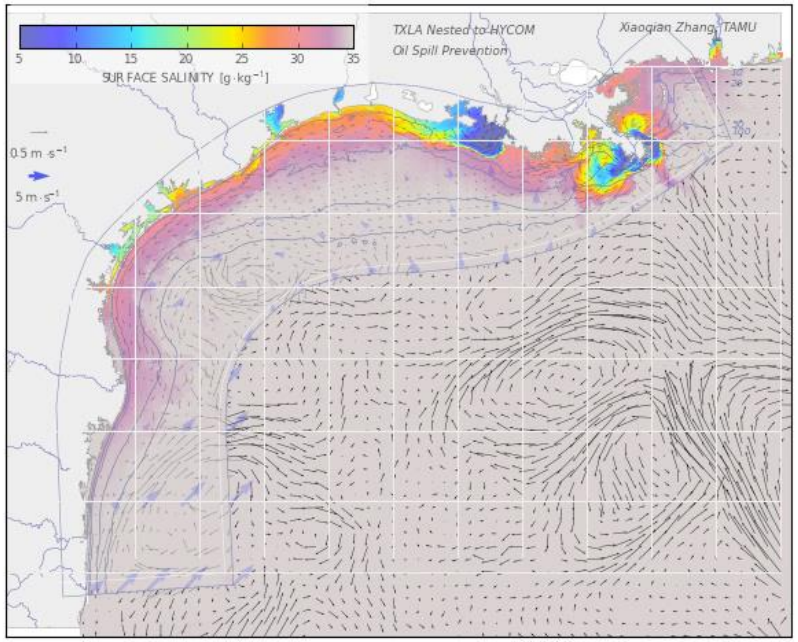
- **Terrestrial nutrients**
- **Freshwater Stratification**
- **Wind direction/duration**

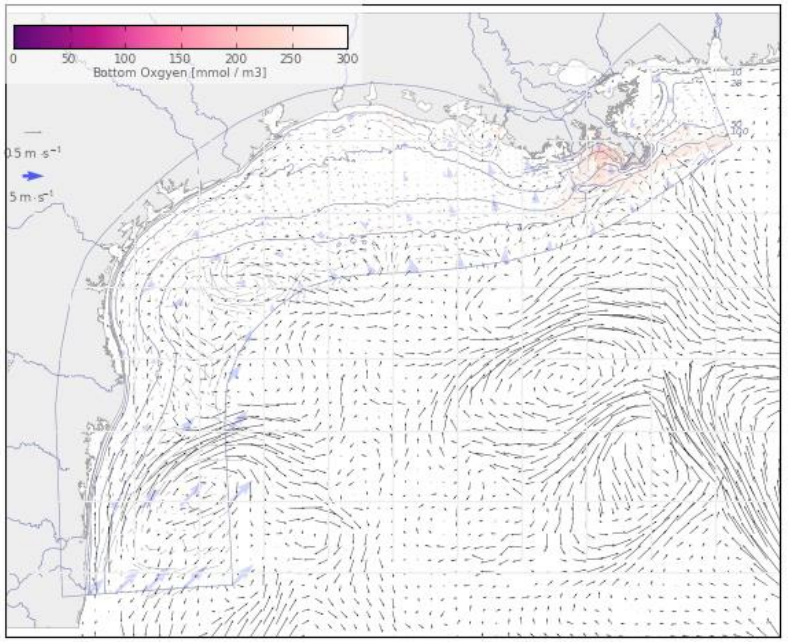
Hetland and DiMarco, JMS, 2008
Forrest, DiMarco, and Hetland, ERL, 2011

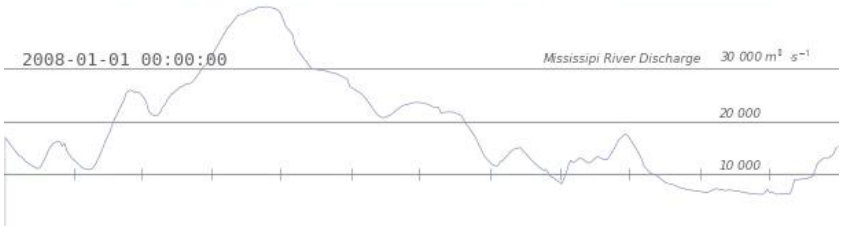
June 2013

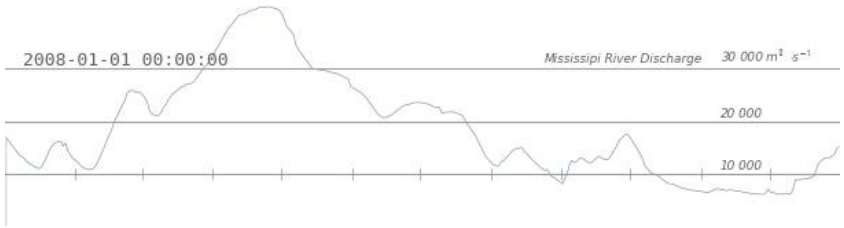


Mechanisms Controlling Hypoxia
https://mchatlas.tamu.edu
NOS Proj.: NA09N0S4780208


TXLA Nested to HYCOM
Oil Spill Prevention
Xiaoqian Zhang, TAMU
5 10 15 20 25 30 35
SURFACE SALINITY [g·kg⁻¹]
0.5 m·s⁻¹
5 m·s⁻¹

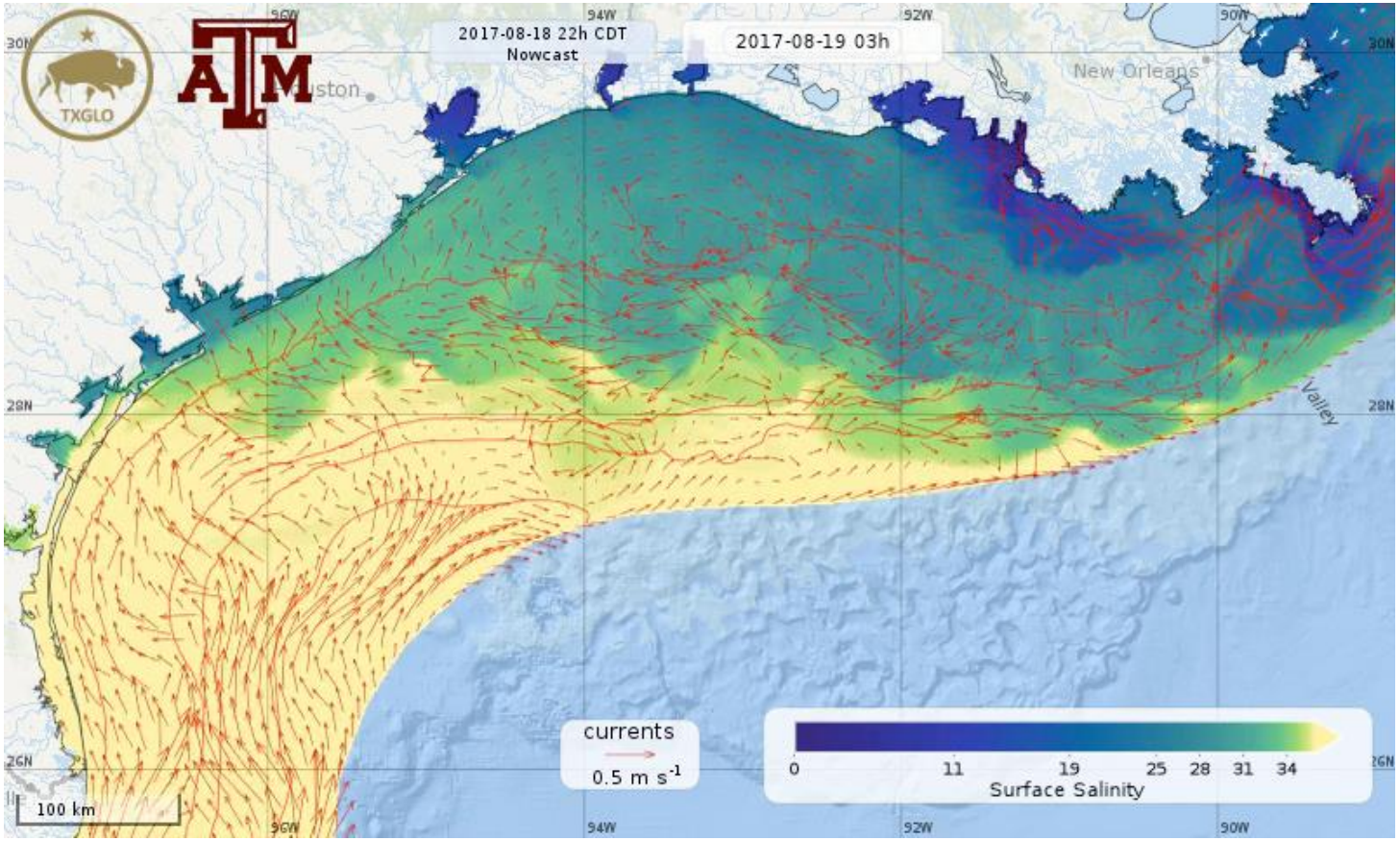

0 50 100 150 200 250 300
Bottom Oxgyen [mmol / m3]
0.5 m·s⁻¹
5 m·s⁻¹


2008-01-01 00:00:00
Mississipi River Discharge
30 000 m³ s⁻¹
20 000
10 000


2008-01-01 00:00:00
Mississipi River Discharge
30 000 m³ s⁻¹
20 000
10 000

Surface Salinity: Hurricane Harvey

TGLO Model: Hetland, Kobashi, Thyng
pong.tamu.edu/tabswebsite

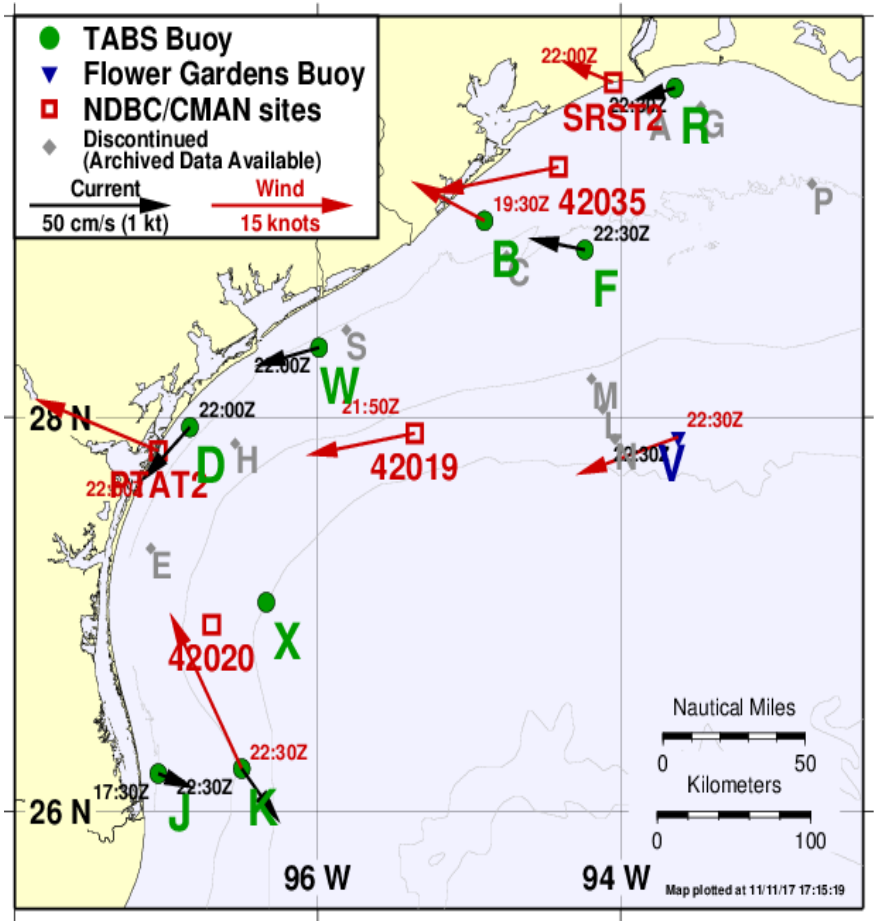


Texas Automated Buoy System

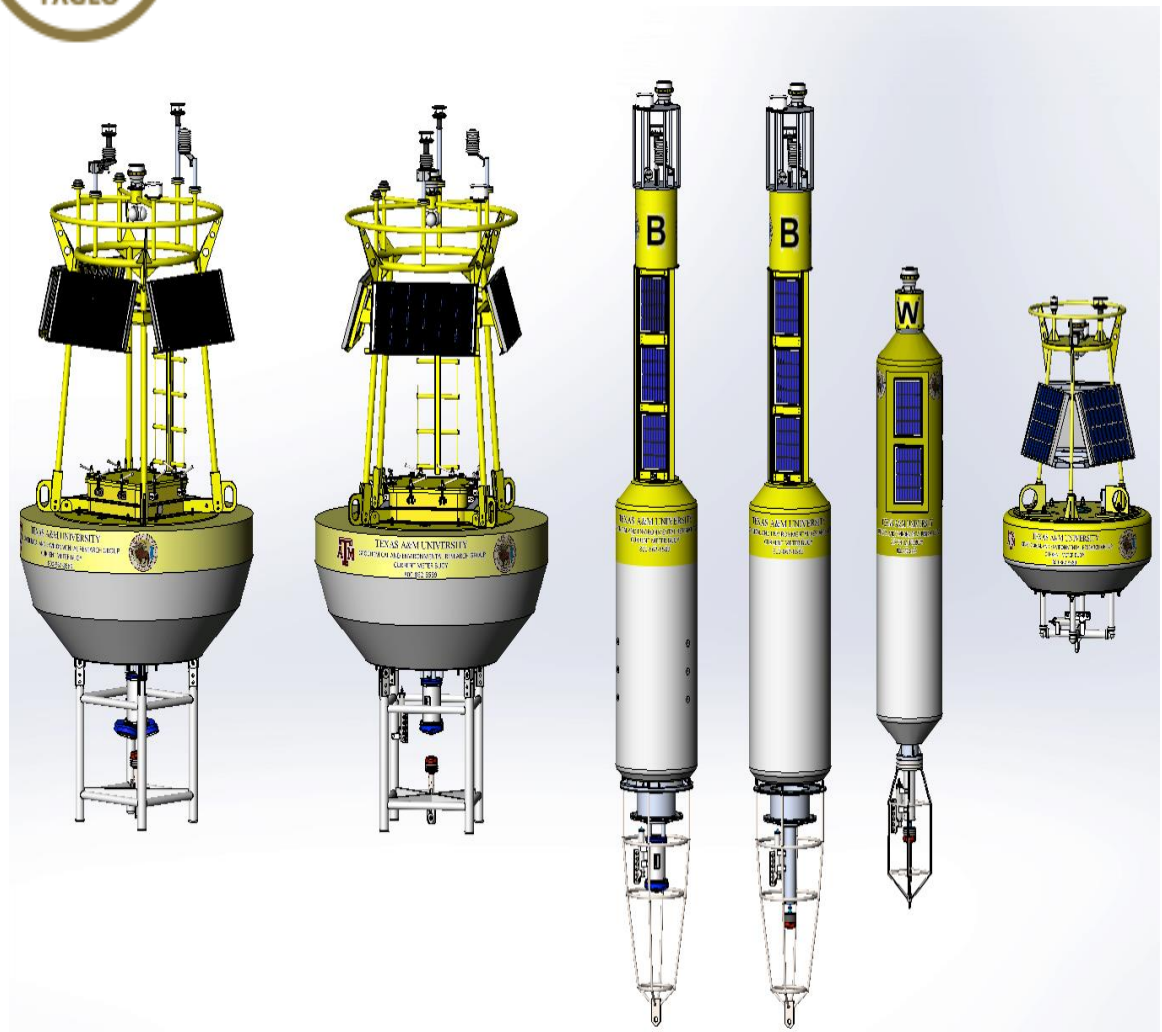
- **Funded by the Texas General Land Office**
- **Continuous operations since 1995**
- **8 Coastal Buoys**
- **2 FGBNMS Buoys**
- **Surface currents, T, S**
- **Atmospheric Variables**

http://tabs.gerg.tamu.edu

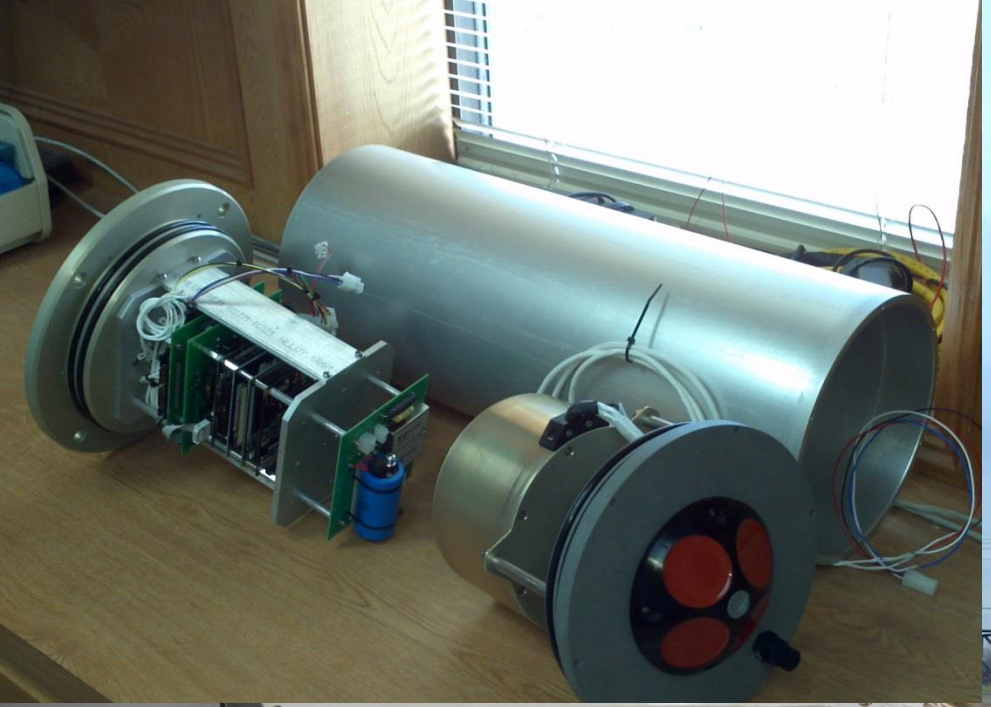
- **Primary mission is oil spill mitigation**

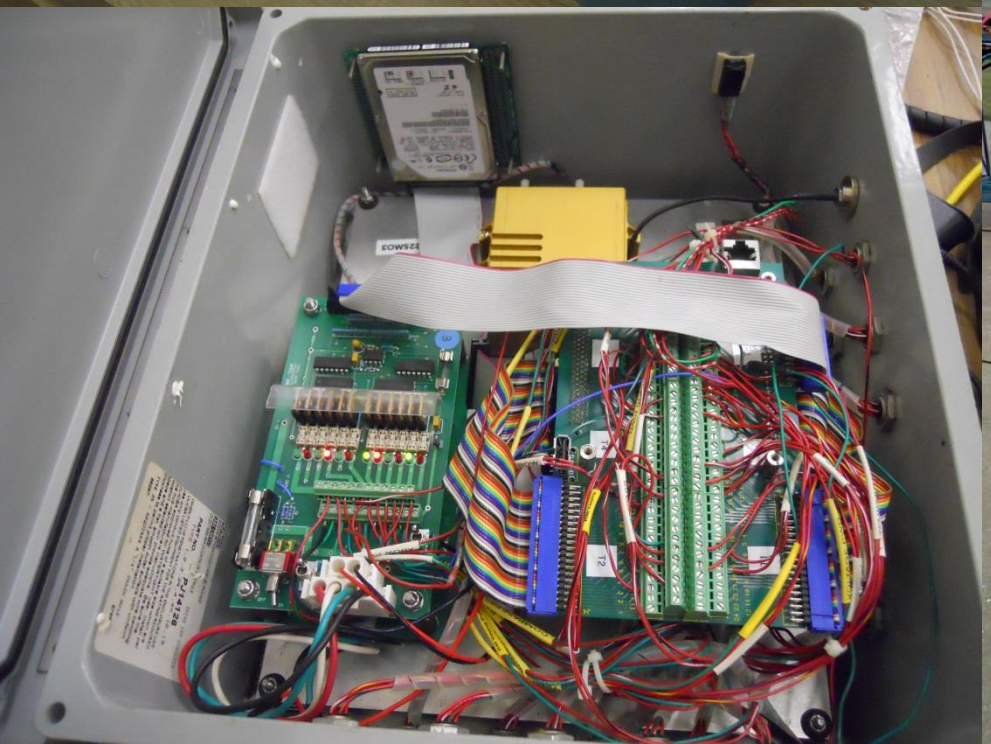


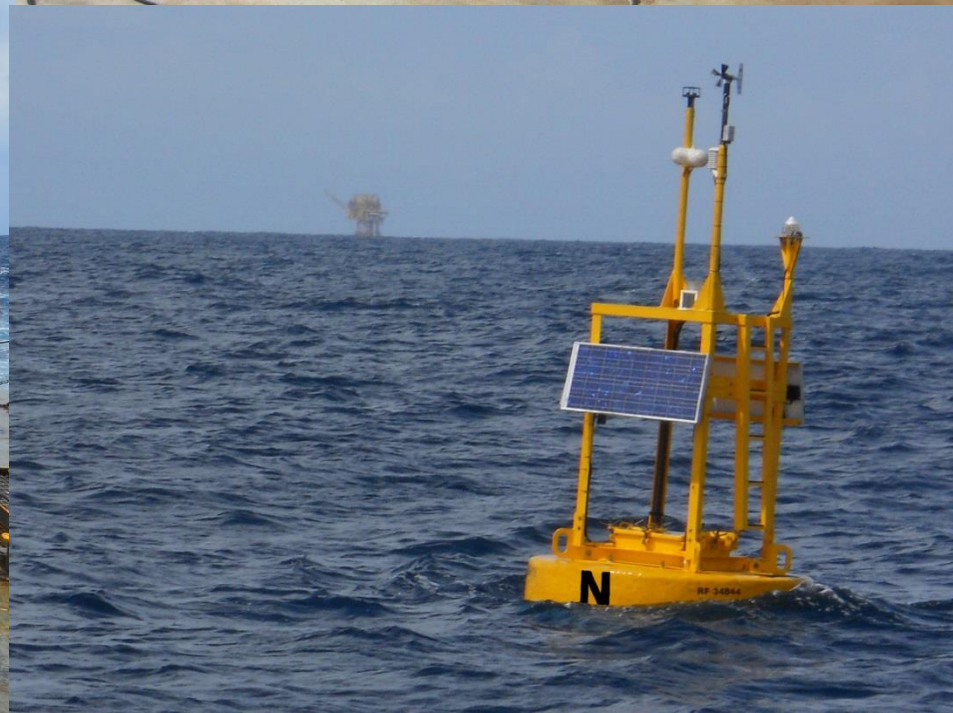
The TABS Family



- Advantages
  - Real time data
  - Solar Power
  - MET and Oceanographic data from a single platform
  - Very versatile sensor platform
  - Can collect data from remote subsurface moorings
  - Can be designed for any water depth
  - Can provide power to sensors for long deployments
- Disadvantages
  - Vandalism
  - Ship Collision
  - Fishing targets
  - Expensive



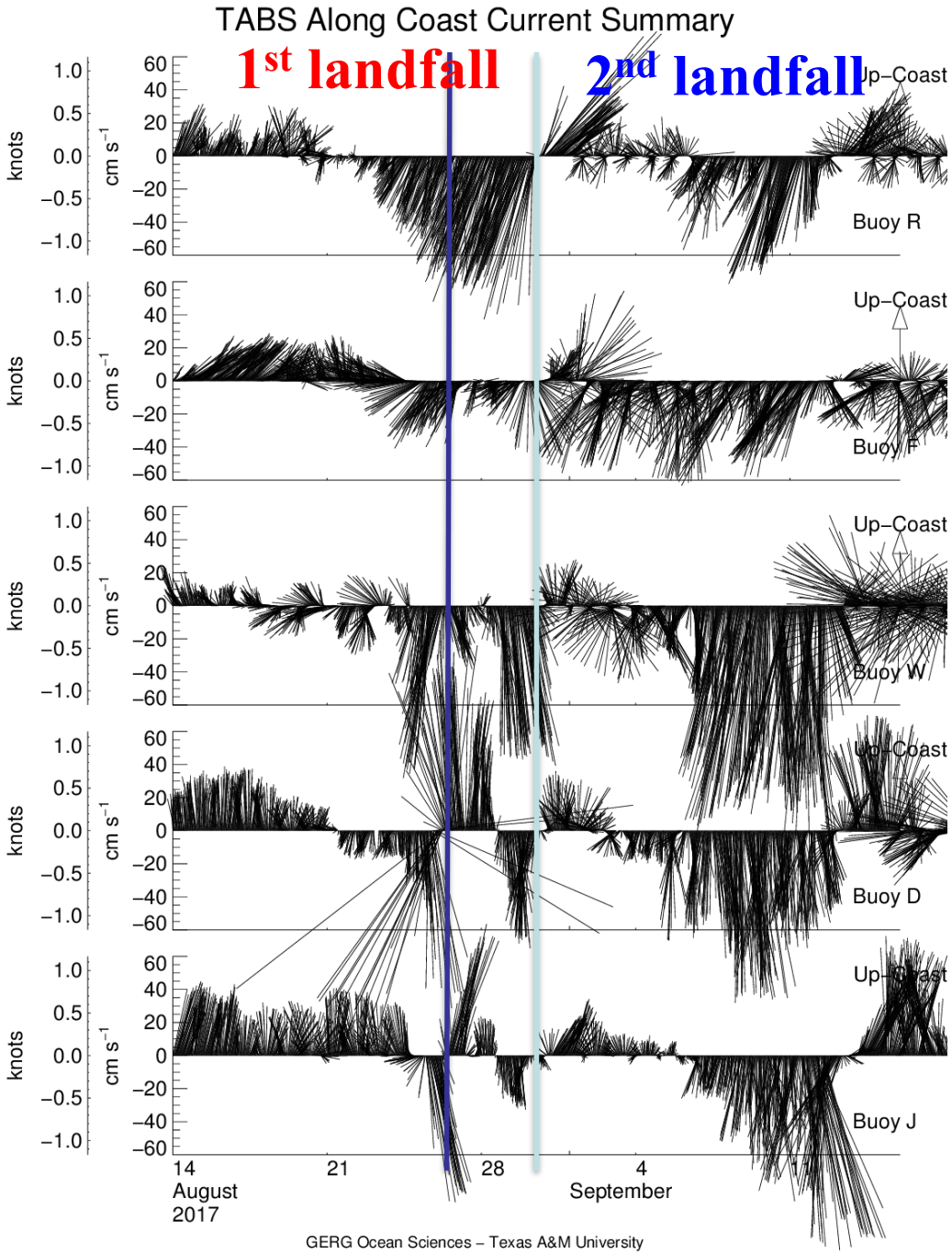



N

Alongcoast Currents

North Coast

South Coast



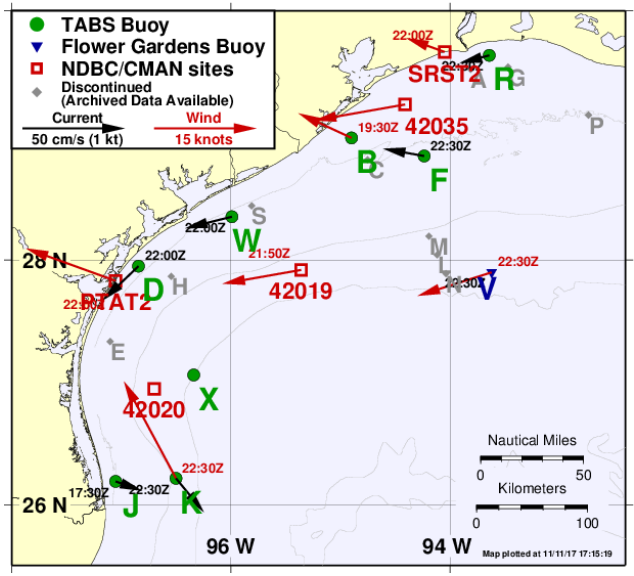
R

F

W

D

J

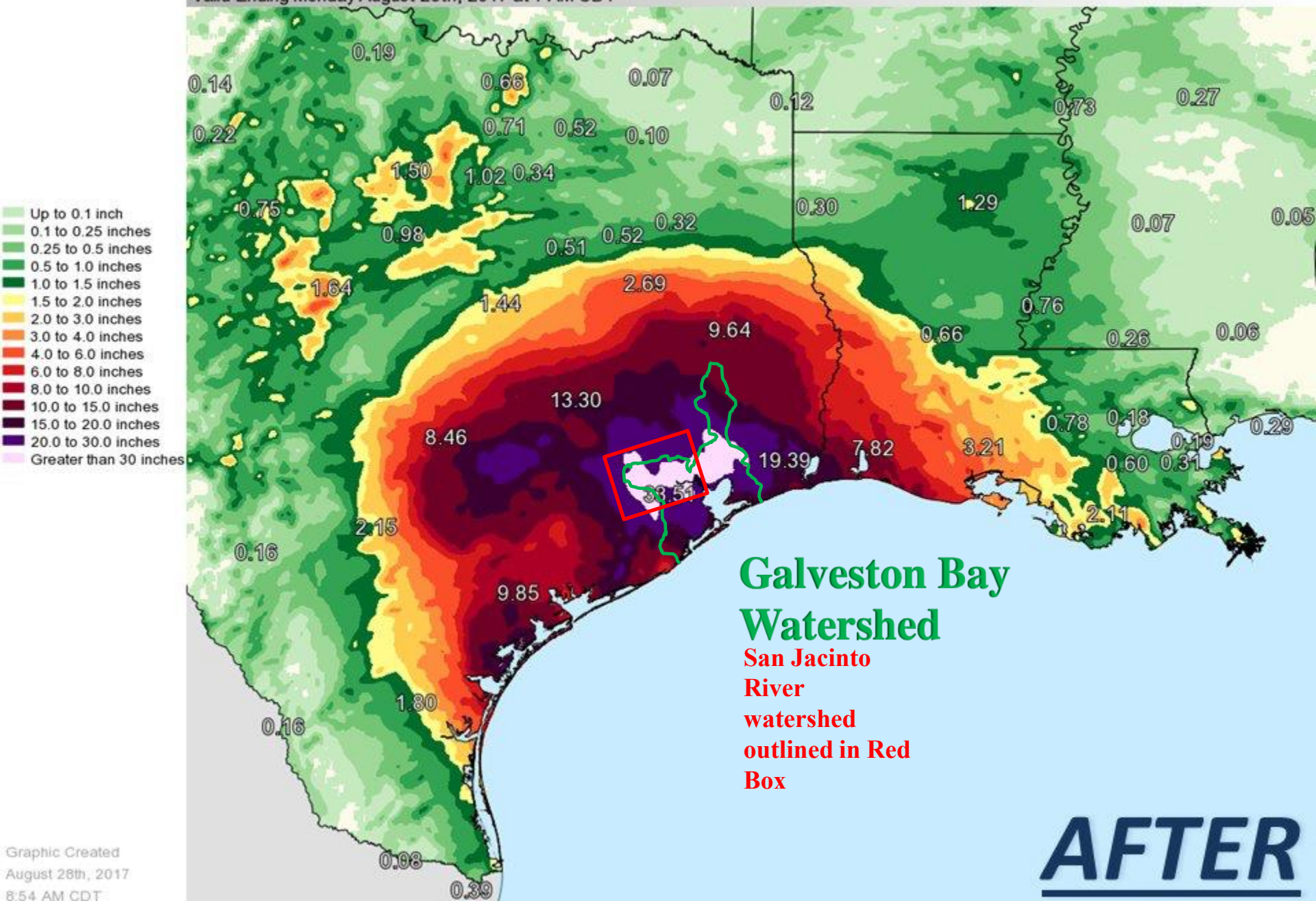


MAXIMUM: 160cm/s

Observed Precipitation — Hurricane Harvey

National Weather Service

Valid Ending Monday August 28th, 2017 at 7 AM CDT



AFTER


SLOCUM


SLOCUM


AutoNaut


SLOCUM


SLOCUM


AutoNaut

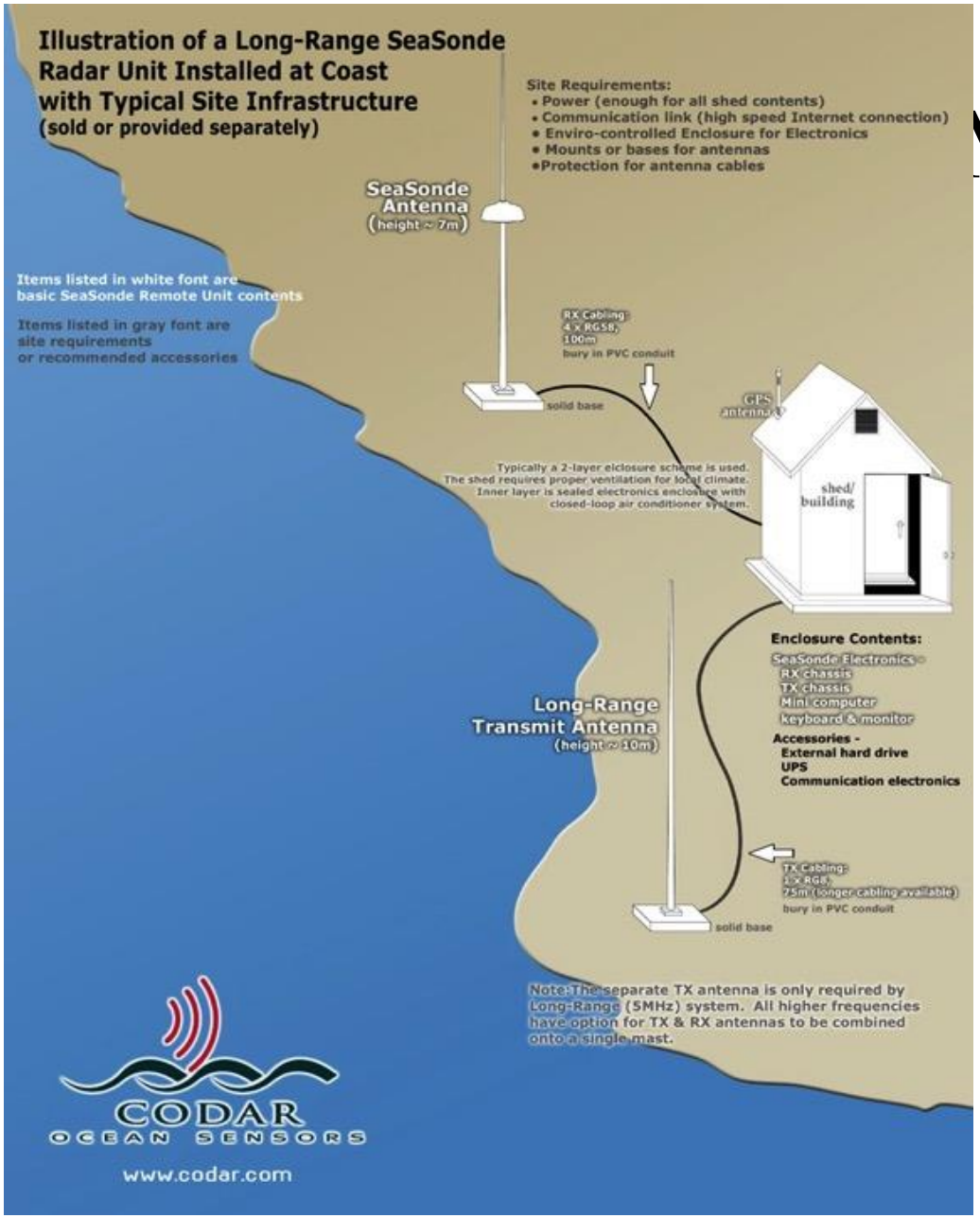
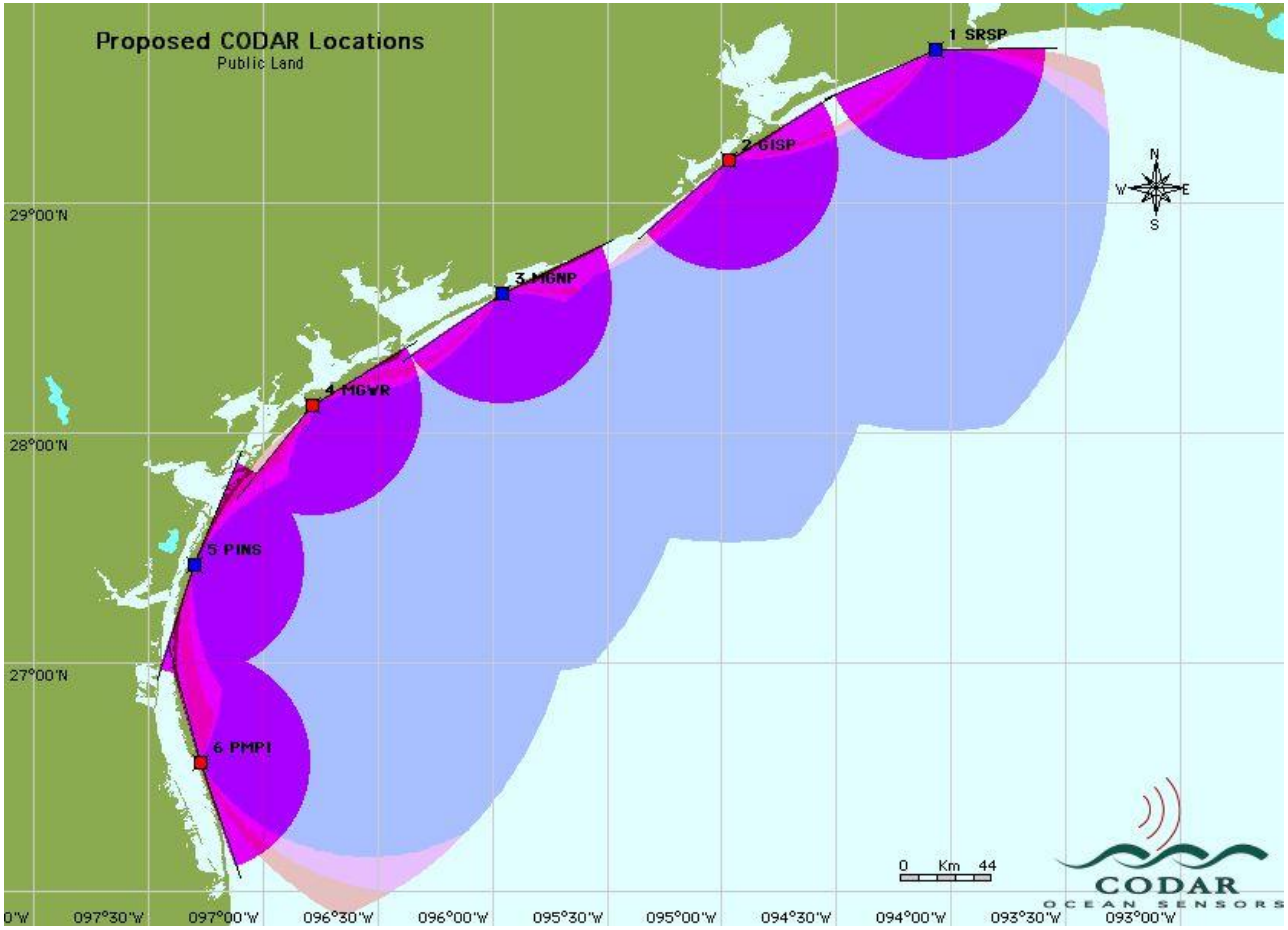
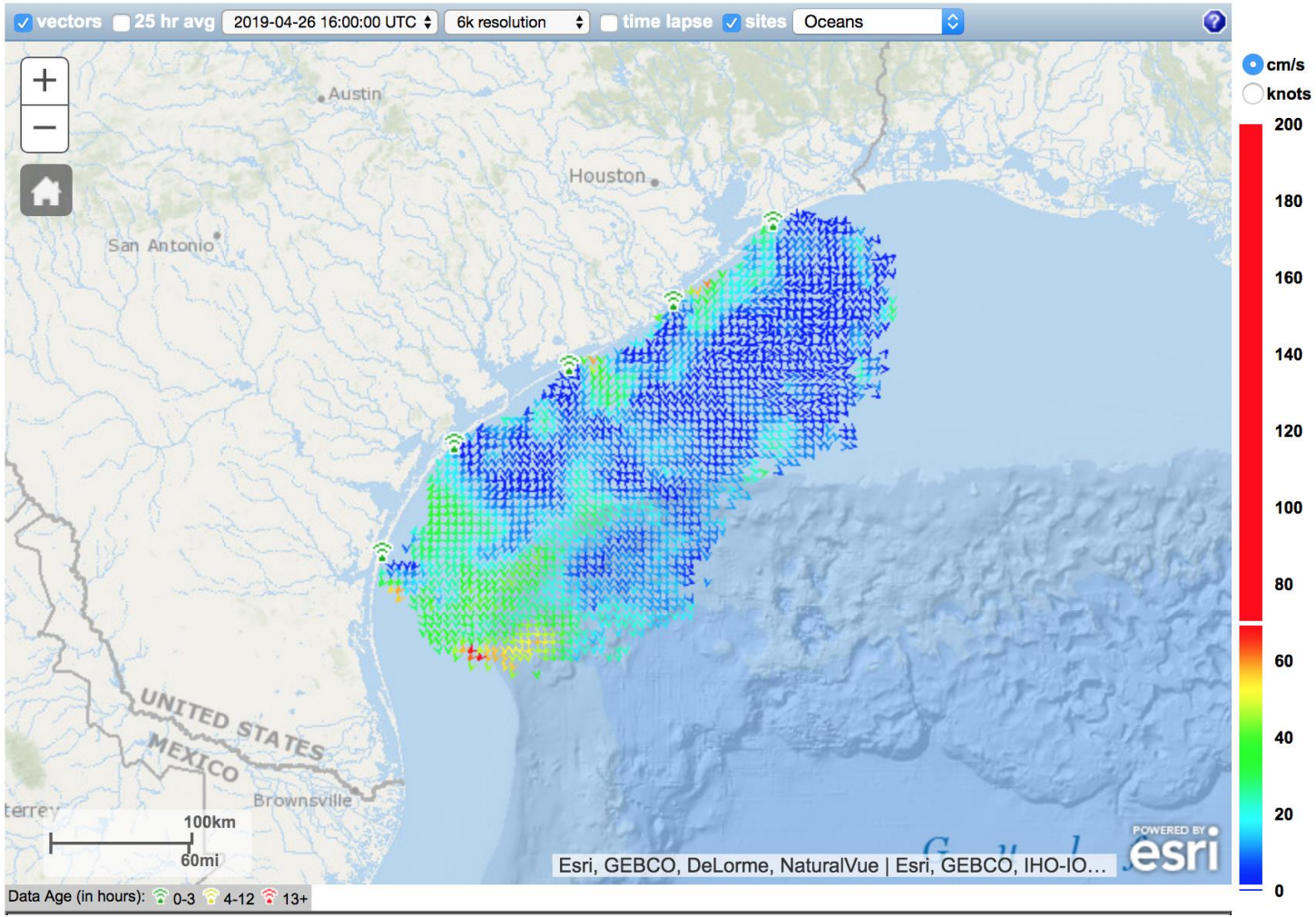


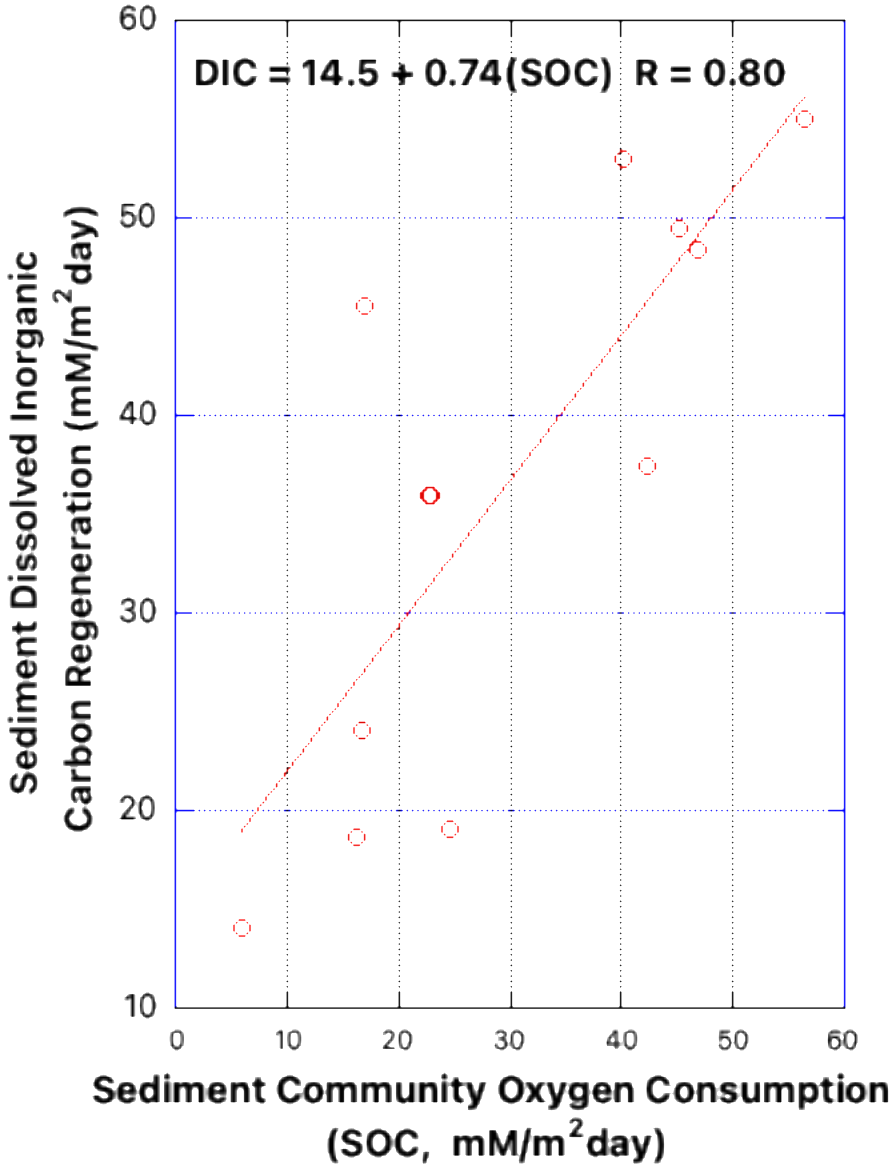
Illustration of a Long-Range SeaSonde Radar Unit Installed at Coast with Typical Site Infrastructure (sold or provided separately)
Site Requirements:
• Power (enough for all shed contents)
• Communication link (high speed Internet connection)
• Enviro-controlled Enclosure for Electronics
• Mounts or bases for antennas
•Protection for antenna cables
SeaSonde Antenna (height ~ 7m)
Items listed in white font are basic SeaSonde Remote Unit contents
Items listed in gray font are site requirements or recommended accessories
RX Cabling: 4 x RG58, 100m bury in PVC conduit
solid base
GPS antenna
Typically a 2-layer elclosure scheme is used. The shed requires proper ventilation for local climate. Inner layer is sealed electronics enclosure with closed-loop air conditioner system.
shed/ building
Enclosure Contents:
SeaSonde Electronics
RX chassis
TX chassis
Mini computer
keyboard & monitor
Accessories -
External hard drive
UPS
Communication electronics
Long-Range Transmit Antenna (height ~ 10m)
TX Cabling: 1 x RG8, 75m (longer cabling available) bury in PVC conduit
solid base
Note: The separate TX antenna is only required by Long-Range (5MHz) system. All higher frequencies have option for TX & RX antennas to be combined onto a single mast.
CODAR OCEAN SENSORS
www.codar.com

HF Radar in the GOM



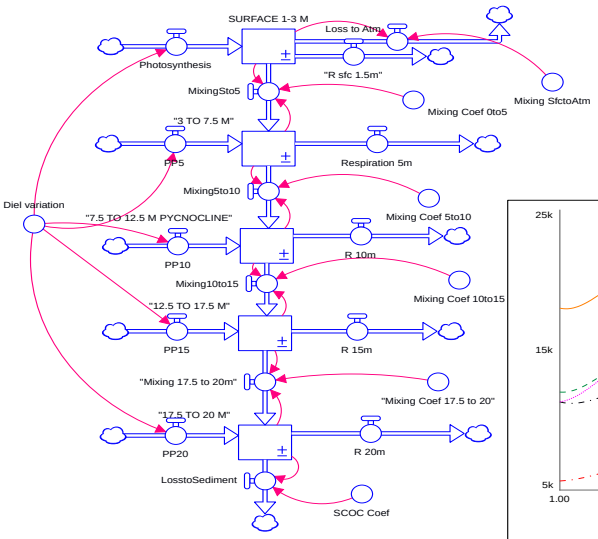
HF Radar Texas Shelf

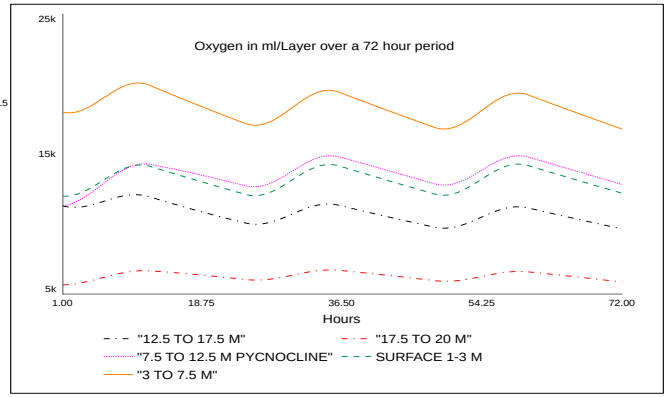



DIC = 14.5 + 0.74(SOC) R = 0.80
Sediment Dissolved Inorganic Carbon Regeneration (mM/m2day)
Sediment Community Oxygen Consumption (SOC, mM/m2day)
60
50
40
30
20
10
0
10
20
30
40
50
60

Vertical Hourly Oxygen Simulation, Northern Gulf of Mexico, a stoichiometric approach

Oxygen Increases in all layers during daylight hours and decreases at night. [The total water volume is 20 cu. meters.]
As oxygen declines, DIC should increase; as oxygen increases, DIC should decline, according to theory. But, does it?





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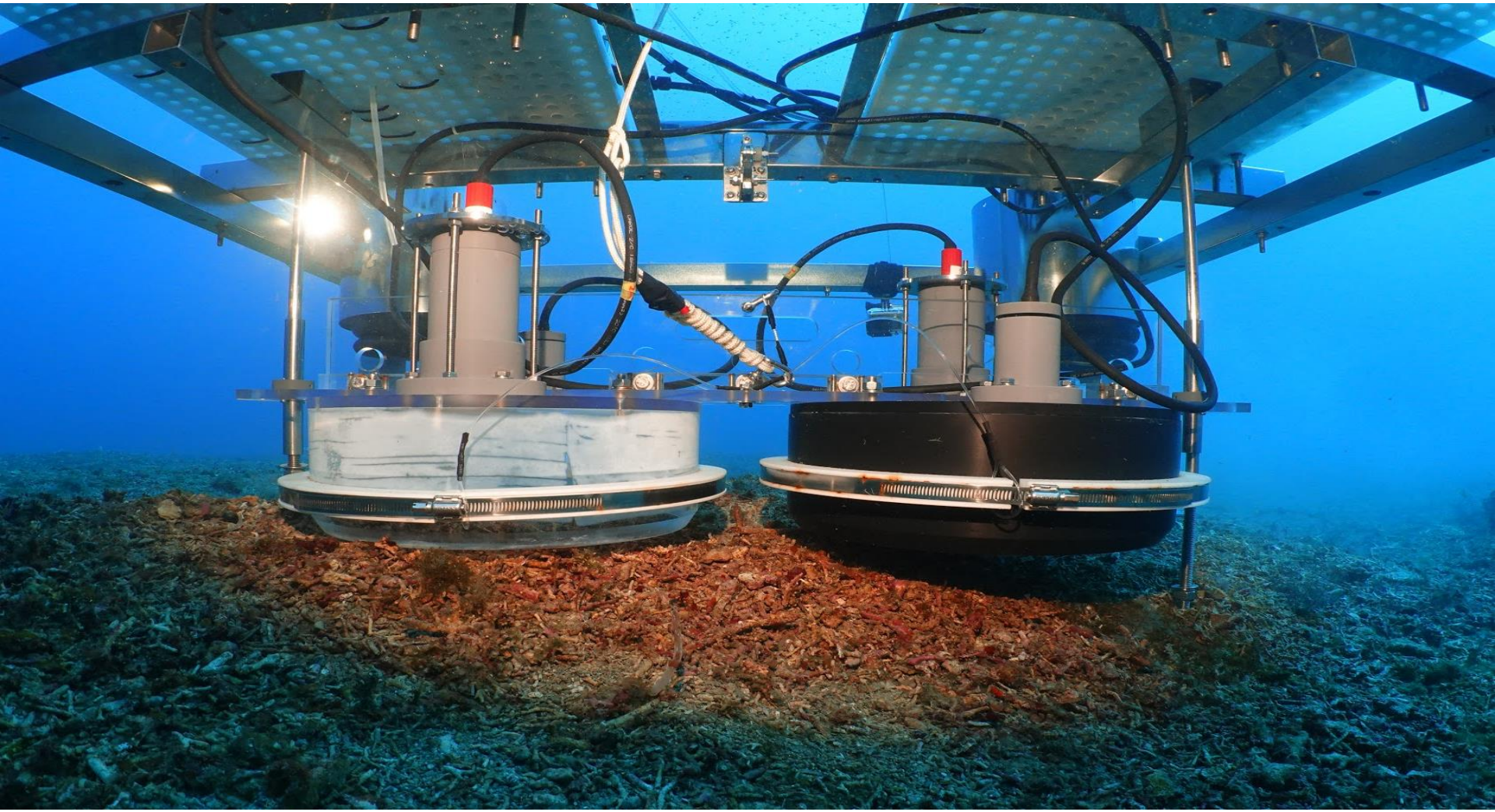
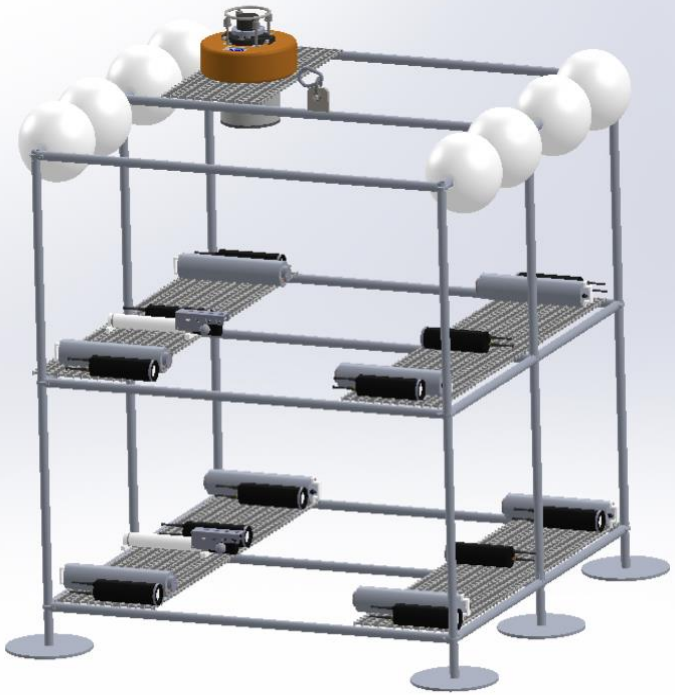
Biofouling days to a year

Benthic Chambers for gas flux experiments



Concept Lander



One month deployment
(1 ship day per month)
2 units calibration monthly
ADCP for currents
Cameras
Oceanus Pro CO2 (PCO2)
SEA-FET (PH)
SBE37-SMP-ODO C/T
(CTD with O2)
Will pick up natural CO2 flux under various seasonal conditions.
Can be equipped with a CO2 source for purposeful release