Atlantic Oceanographic & Meteorological Laboratory

National Oceanic & Atmospheric Administration

A Brief Overview of Selected NOAA Water Quality Monitoring Efforts in the State of Florida

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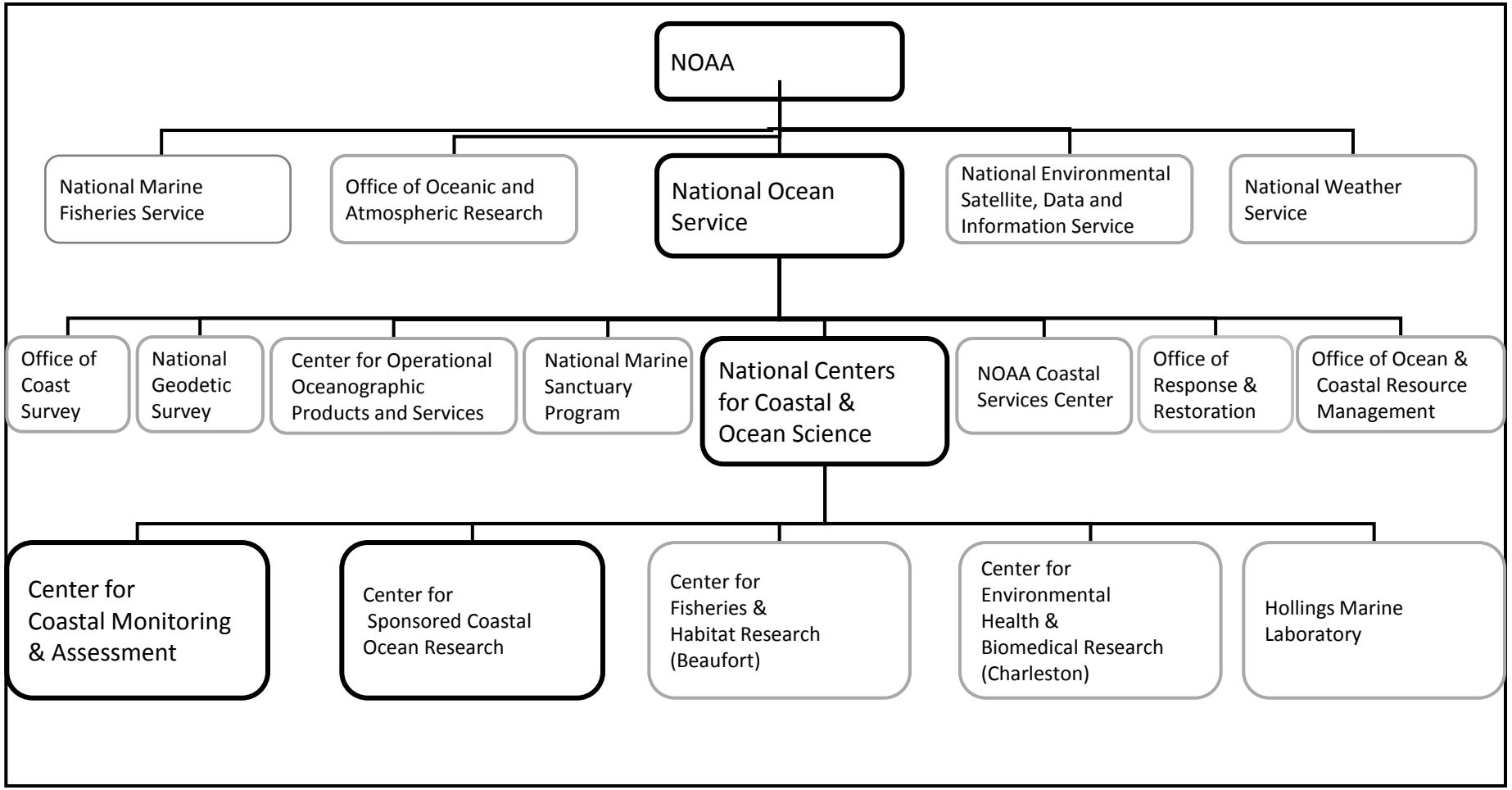
NCCOS

NOAA National Centers for Coastal and Ocean Science

Most NOAA Water Quality Monitoring Efforts are Predominantly Supported and Coordinated by NOS via NCCOS

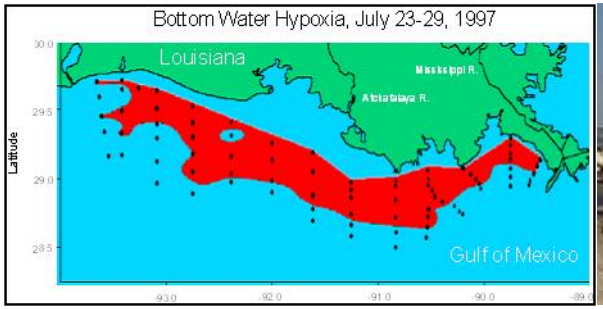


http://www.ccma.nos.noaa.gov/

NOS/NCCOS Coastal Water Quality Monitoring & Assessment in Florida and the Gulf Of Mexico

Long-term coastal pollution and HAB monitoring by NOAA's National Stats and Trends:

- **Mussel Watch Program**
- **Harmful Algal Bloom Research & Forecasting Project**
- **GOM Hypoxia Assessment**

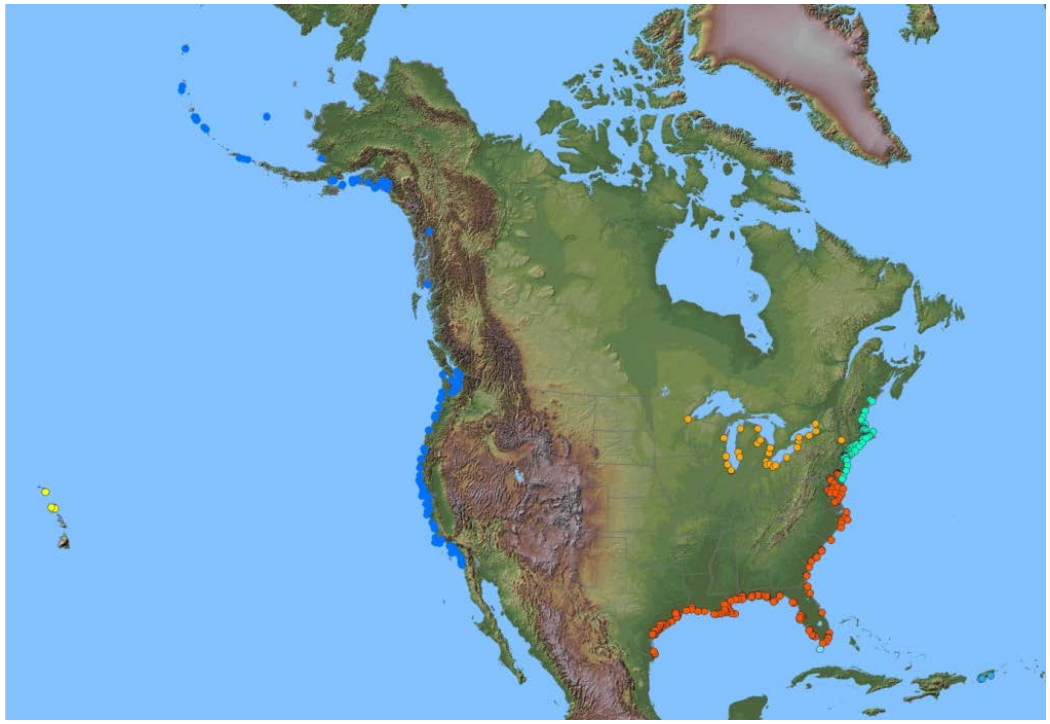


NOAA Mussel Watch Monitoring Efforts

Background:

- NOAA's National Status &Trend (NS&T) Mussel Watch Program is the longest, nationwide contaminant monitoring program in U.S. coastal waters.

- The program analyzes sediment and bivalve tissue chemistry for a suite of organic contaminants and trace metals to identify trends at selected coastal sites from 1986 to present



Goal:

To support ecosystem-based management through integrated nationwide environmental monitoring, assessment and research to describe the current status of and to detect changes in the environmental condition of our Nation's estuarine and coastal waters

Mussel Watch Monitoring Efforts in the State of Florida

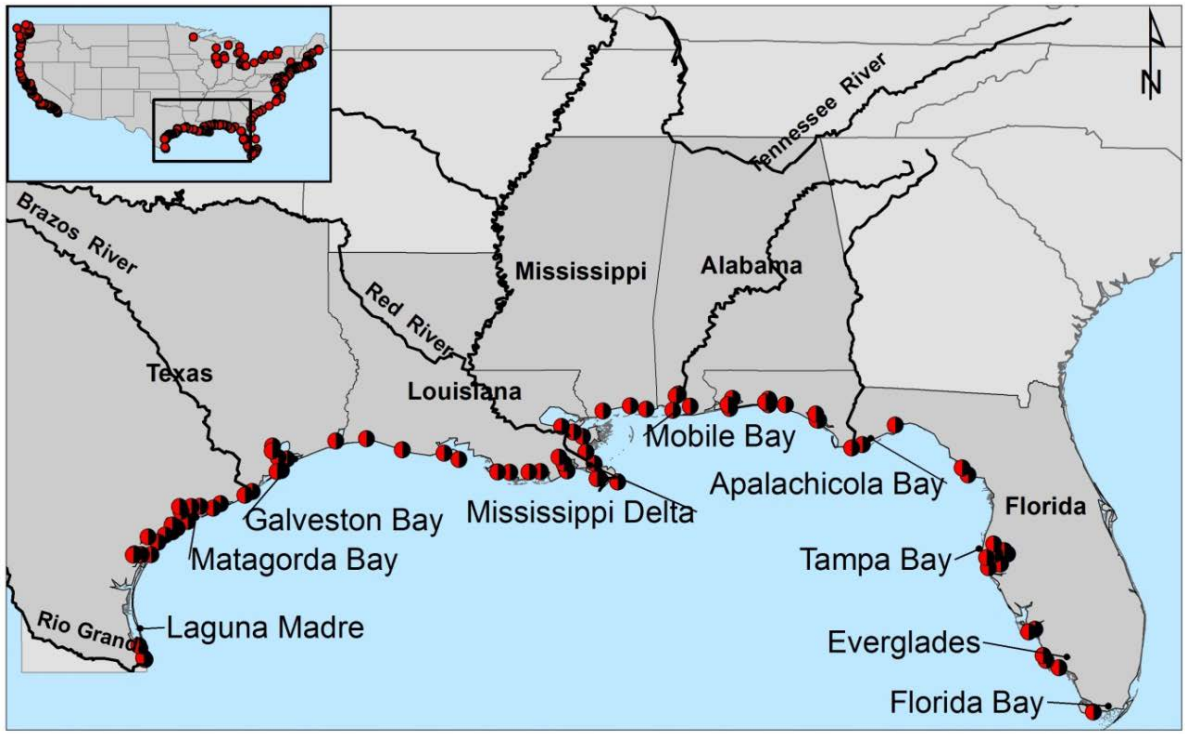
Monitoring Needs and Objectives:

- **To provide coastal managers with national context to measures of local and regional environmental condition.**
- **To quantify and assess spatial and temporal trends in coastal contamination.**
- **To provide a baseline to assess impacts of anthropogenic and natural events, including chemical spills, tropical storms, and hurricanes.**

Mussel Watch Monitoring Efforts in the Gulf of Mexico

Monitoring Design and Frequency: Program at glance

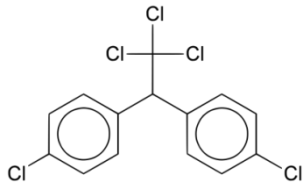
- 300 Sites nationwide – 1/2 monitored annually
- 87 Sites in the GOM
  - oysters are collected in the winter
  - Sediments are collected every 10 years
- Stations 20 km apart in estuaries, 70 km along open coast
- 150 contaminants routinely monitored in indigenous bivalve populations



NOAA Mussel Watch Monitoring Efforts

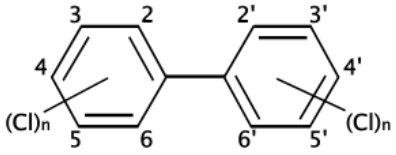
Parameters monitored

- Pesticides

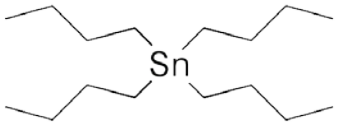


- PAHs

- PCBs



- Butyltins



- CECs: PBDEs, pharmaceutics, PCPs
- Histopathology (parasites, diseases)

Elements

Ag
As
Al
Cd
Cu
Cr
Fe
Hg
Mn
Ni
Pb
Se
Sb
Si
Sn
Th
Zn

Ancillary

- Lipid content
- Dry weight
- Wet weight
- TOC
- TIC
- Grain size
- Salinity

Mussel Watch Monitoring Efforts in the Gulf of Mexico

Mussel Watch Special Event Assessments

- **Gulf Coast Hurricanes Katrina and Rita (Sep. 24 – Oct. 4, 2005) 20 of the 87 northern GOM monitoring sites collected**

- **Deepwater Horizon oil spill (Apr. 2010 – Jul. 2010) 65 monitoring sites collected before and after landfall**

Mussel Watch data are available at:
http://egisws02.nos.noaa.gov/nsandt/index.html#

http://ccma.nos.noaa.gov/about/coast/nsandt/download.aspx

HAB Research & Forecasting Efforts in Florida Coastal Waters

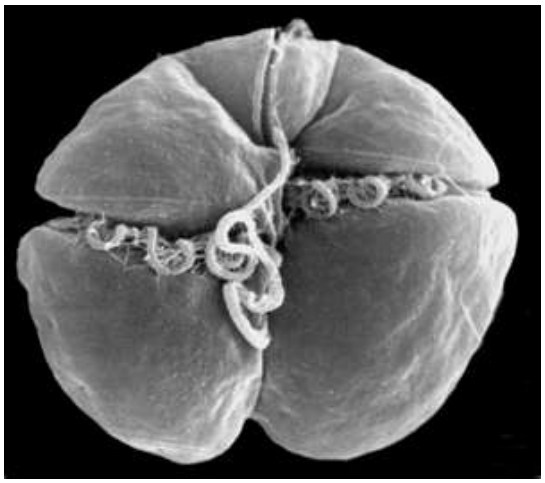
Background

- Harmful Algal Blooms (HABs) occur as a result of a rapid increase in toxic algae's concentration
- Toxins produced by the HABs can be harmful to fish, shellfish, marine mammals, birds and people
- The toxic dinoflagellate *Karenia brevis* (red tide) is the primary HAB species in the Gulf of Mexico.

HAB Research & Forecasting Efforts

Monitoring/Forecasting Needs and Objectives:

- To predict the location and likely transport of toxic *Karenia brevis* blooms in Florida and Texas
- To monitor the extent of the bloom
- To forecast of the potential public health impact (respiratory irritation) at beaches over the next 3-4 days from bloom landfall



Karenia brevis

HAB Research & Forecasting Efforts

The forecast system relies on satellite imagery, field observations, models, public health reports and buoy data to provide the large spatial scale and high frequency of observations

Monitoring Design & Frequency:

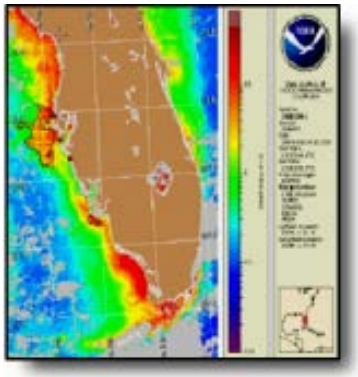
Tools:

- NASA satellite (MODIS) ocean color imagery (daily acquisition)
- Forecasted weather data (daily acquisition)
- Field validation from cell counts (weekly)

Bloom transport along coast using:

- Texas General Land Office (TGLO) hydrodynamic model
- Data from the Texas Automated Buoy System (TABS) are used for model adjustment,
- General NOAA Operational Modeling Environment (GNOME) for transport

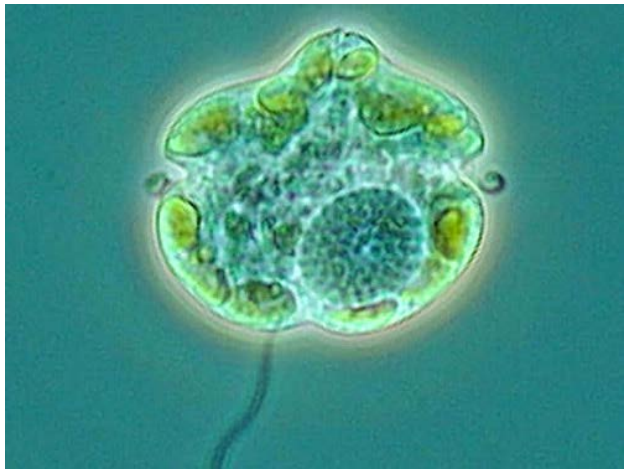
HAB Research & Forecasting Efforts in Florida & Gulf of Mexico



Satellites Aqua (above) & Terra (below) mounting The MODIS sensor

Parameters measured:

- Ocean color (imagery)
- Chlorophyll-a (concentration change)
- Direct microscopic cell counts
- Forecast the concentration and distribution of *Karenia brevis*
- Measurements collected by both NOAA researchers and a variety of partner organizations
- Centralized data archiving and management by NOAA



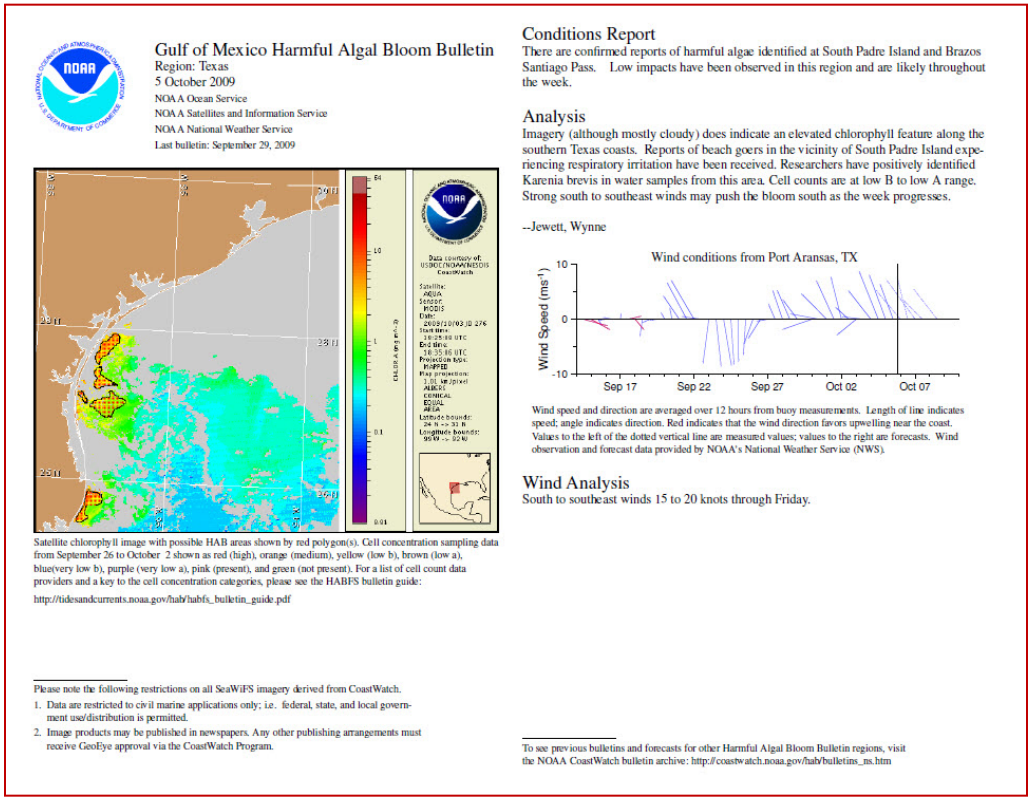
K. brevis cell

K. brevis cell counting at Mote Marine Laboratory

HAB Research & Forecasting Efforts in Florida & Gulf of Mexico

HAB mitigation through Forecasting and advance warning:

- HAB Bulletin alerts subscribers to developing blooms, location and extent
- HAB Condition Report – provide interpretative tools to users



Gulf of Mexico Harmful Algal Bloom Bulletin
Region: Texas
5 October 2009
NOAA Ocean Service
NOAA Satellites and Information Service
NOAA National Weather Service
Last bulletin: September 29, 2009

Satellite chlorophyll image with possible HAB areas shown by red polygon(s). Cell concentration sampling data from September 26 to October 2 shown as red (high), orange (medium), yellow (low b), brown (low a), blue(very low b), purple (very low a), pink (present), and green (not present). For a list of cell count data providers and a key to the cell concentration categories, please see the HABFS bulletin guide:
http://tidesandcurrents.noaa.gov/hab/habfs_bulletin_guide.pdf

Please note the following restrictions on all SeaWiFS imagery derived from CoastWatch.
1. Data are restricted to civil marine applications only; i.e. federal, state, and local government use/distribution is permitted.
2. Image products may be published in newspapers. Any other publishing arrangements must receive GeoEye approval via the CoastWatch Program.

Conditions Report
There are confirmed reports of harmful algae identified at South Padre Island and Brazos Santiago Pass. Low impacts have been observed in this region and are likely throughout the week.

Analysis
Imagery (although mostly cloudy) does indicate an elevated chlorophyll feature along the southern Texas coasts. Reports of beach goers in the vicinity of South Padre Island experiencing respiratory irritation have been received. Researchers have positively identified Karenia brevis in water samples from this area. Cell counts are at low B to low A range. Strong south to southeast winds may push the bloom south as the week progresses.

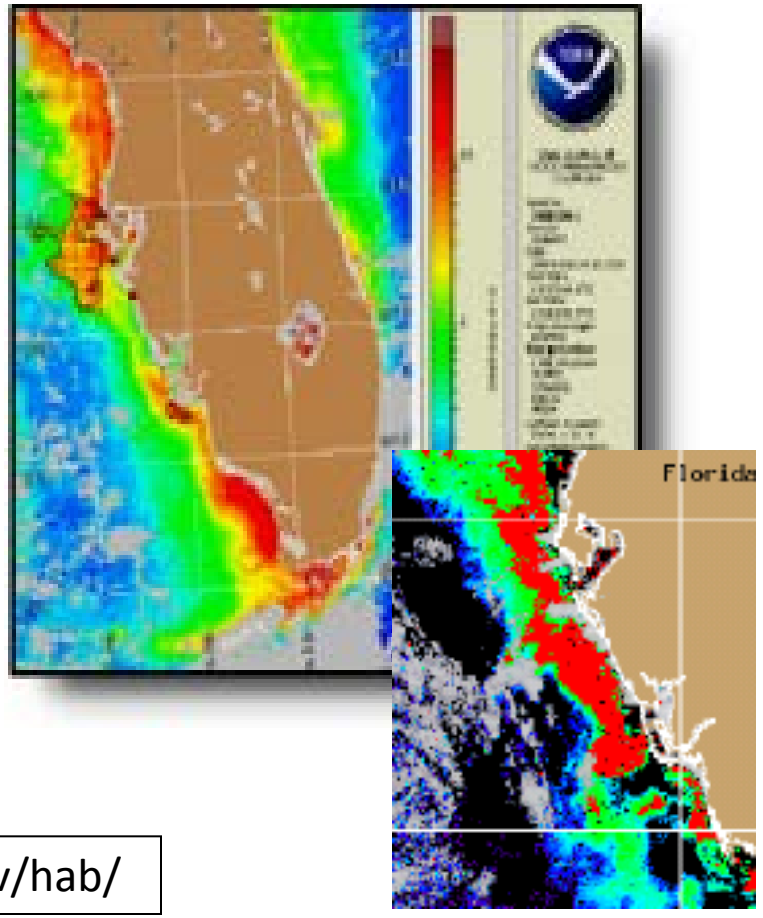
--Jewett, Wynne

Wind conditions from Port Aransas, TX

Wind speed and direction are averaged over 12 hours from buoy measurements. Length of line indicates speed; angle indicates direction. Red indicates that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are measured values; values to the right are forecasts. Wind observation and forecast data provided by NOAA's National Weather Service (NWS).

Wind Analysis
South to southeast winds 15 to 20 knots through Friday.

To see previous bulletins and forecasts for other Harmful Algal Bloom Bulletin regions, visit the NOAA CoastWatch bulletin archive: http://coastwatch.noaa.gov/hab/bulletins_ns.htm



http://www.tidesandcurrents.noaa.gov/hab/

Hypoxia Assessment and Monitoring Efforts in the Gulf of Mexico

Background

- Hypoxia occurs when the amount of dissolved oxygen in water decreases to levels too low to support most aquatic life (typically below 2 mg/l).
- Hypoxic water can cause physiological stress and impact the growth, reproduction, and survival of organisms.
- Hypoxia can be fatal to wild life and negatively affecting commercial and recreational harvests of fish and shellfish
- Hypoxia can occur naturally as a result of increased nutrient load (nitrogen and phosphorus)

- Excess nutrient loading can lead to growth blooms of algae and other microorganisms whose metabolism can deplete the available dissolved oxygen down to hypoxic levels

Hypoxia Assessment and Monitoring Efforts in the Gulf of Mexico

- **NOAA NCCOS Supports the Gulf hypoxic zone (dead zone) characterization and monitoring through federal-academic partnership**

Monitoring Objectives:

- To provide assessment of the causes and consequences of Gulf hypoxia that is intended to provide scientific information which can be used to evaluate management strategies, and to identify gaps in our understanding of this problem.

- To provide timely and accurate quantitative data on hypoxic zones for the development of a plan of action to reduce, mitigate, and control hypoxia in the northern Gulf of Mexico.

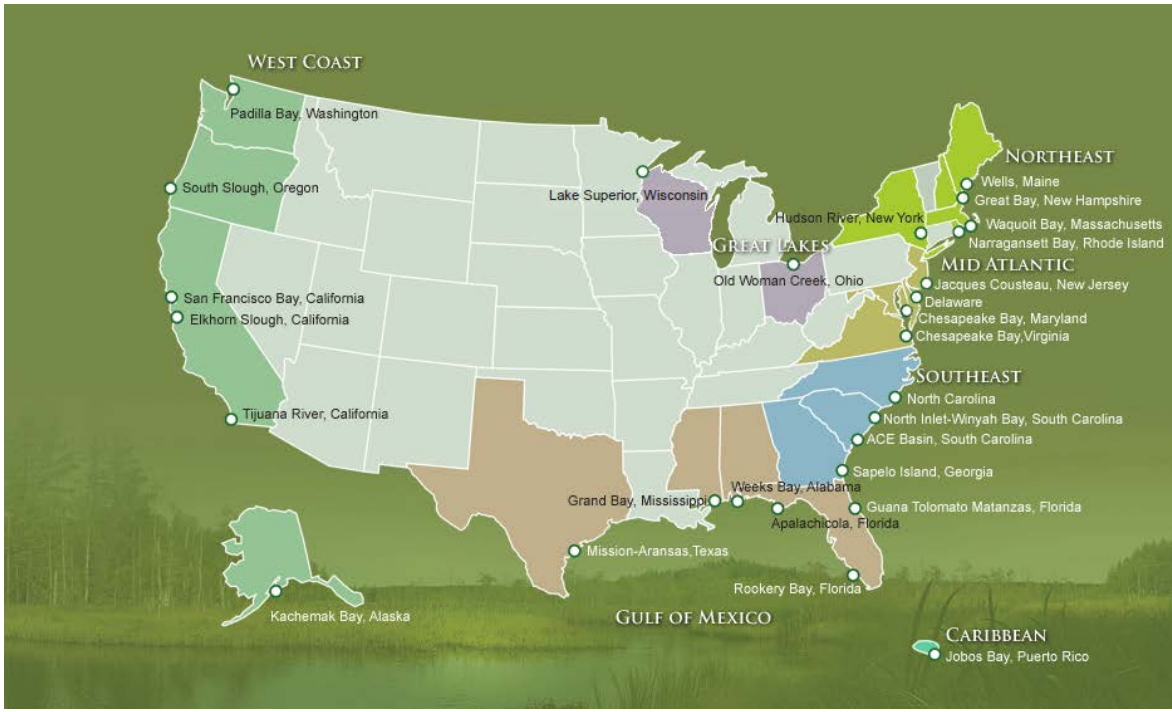
- As a secondary objective, to provide assessment of the effects of changes in nutrient concentrations and loads and nutrient ratios on water quality conditions within the Mississippi-Atchafalaya riverine systems.

- The specific goals of the hypoxia science assessment are to:
  - Document the state of knowledge of the extent, characteristics, causes, and effects (both ecological and economic) of hypoxia in the northern Gulf of Mexico.
  - Compile existing information on nutrient sources, identify alternatives for reducing nutrient inputs, and examine the costs and benefits associated with reducing the nutrient loads to surface waters.

NOAA National Estuarine Research Reserves (NERRs): System-Wide Monitoring Program (SWMP)

Background:

- The NERR System is a network of 28 coastal reserves that are established for place-based research, long-term monitoring, and education
- The NERR System is established in partnership between NOAA and the coastal states under the Coastal Zone Management Act of 1972
- Water quality monitoring at the NERRs is a fundamental component of the System-Wide Monitoring Program (SWMP)



- NERR-SWMP data is centrally archived and managed by the Centralized Data Management Office (CDMO).

National Estuarine Research Reserves (NERRs): System-Wide Monitoring Program (SWMP)

Monitoring Needs and Objectives:

- To observe the short-term variability and long-term changes in estuarine regions, to gain a better understanding of how human activities and natural events can change coastal ecosystems

- To provide researchers, resource managers, educators, and other coastal decision makers with standardized, quantitative measures to determine how reserve conditions are changing in both the short-term and the long-term.

- To address specific coastal management needs, and to guide national, regional, and local research efforts that promote the protection and conservation of estuarine habitats.

National Estuarine Research Reserves (NERRs): System-Wide Monitoring Program (SWMP)

NOAA role:

- NOAA NERRS operations housed within NOS in the Office of Coastal Resource Management (OCRM), Estuarine Reserves Division (ERD)

- NOAA provides funding, national guidance, technical assistance and headquarters support.

- Day to day operations of each reserve are conducted by the state or local university partner.

- The NERR-SWMP Central Data Management Office (CDMO) is administered by the University of South Carolina

GUANA · TOLOMATO · MATANZAS
NATIONAL ESTUARINE RESEARCH RESERVE

Apalachicola
National Estuarine
Research Reserve

Rookery Bay
National Estuarine Research Reserve

National Estuarine Research Reserves (NERRs): System-Wide Monitoring Program (SWMP)

Monitoring Design, Parameters Measured, and Frequency:

- Began in 1995

- Water temperature, depth, salinity, pH, dissolved oxygen, and turbidity (real-time at select stations via satellite telemetry)
  - Sensors collect data every 15 min, dataloggers manually downloaded every 2 weeks.
  - real-time downloaded every 15 min from select stations via satellite telemetry

- Nutrients
  - ammonium, nitrate, nitrite, ortho-phosphate
  - monthly grab sampling
  - one station per reserve has an ISCO auto-sampler which samples over a complete diel cycle once monthly

- Each reserve has a minimum of 4 sampling stations

- Data for all reserves is archived at CDMO and can be downloaded from here: http://cdmo.baruch.sc.edu/

NOAA Florida Keys National Marine Sanctuary Water Quality Protection and Monitoring Program

- NOAA National Marine Sanctuaries are starting to implement a System-Wide Monitoring (SWiM) program, but this is not yet represented in Florida

- The Florida Keys National Marine Sanctuary (FKMNS) already has an independent ongoing long-term water quality monitoring program that includes the Florida Keys, Florida Bay, and parts of the southwest Florida Shelf of the Gulf of Mexico out to the Dry Tortugas.
  - Parameters include monthly and quarterly sampling of nutrients and physical parameters
  - Special shorter-term monitoring studies of "hot spots" and remediation project areas such as Little Venice Residential Canals (nutrients, physical parameters, microbiology, molecular microbial source tracking)

- Active water quality monitoring of region since 1995

- FKNMS WQ program run on behalf of NOAA FKNMS but not administered by NOAA

- Administered by US EPA

- Conducted locally by Florida International University (FIU) Southeast Environmental Research Center (SERC)

NOAA Atlantic Oceanographic & Meteorological Laboratory: Coastal Oceanography, Water Quality Monitoring, Ecosystem Assessment

South Florida Program
salinity, TSS, chlor-a
C.Kelble, P.Ortner, N.Melo, E.Johns, R.Smith
http://www.aoml.noaa.gov/phod/sfp/index.php

Low Level Nutrient Measurements
In seawater & sediments
J.Zhang, M.Amornthammarong

Ocean Acidification
D.Manzello, R.VanHooidonk, I.Enochs

CREWS/ICON Coral Studies
meteorology, light, sst, waves, sclerochronology,
J.Hendee, K.Hemle
http://www.coral.noaa.gov/

AOML Microbiology Program
Fecal indicators, pathogens, source tracking, nutrient cycling
C.Sinigalliano, M.Gidley

FACE
nutrients, microbiology, outfall plume tracking, ocean currents
T.Carsey, J.Stamates, J.Zhang, C.Sinigalliano

Inlet Fluxes
inlet flow, microbiology, chemistry, meteorology
J.Stamates, T. Carsey, C. Sinigalliano, J. Zhang

Biscayne Bay Turbidity
turbidity, temp, CDOM, chlor-a, currents, sediments, visual record
J.Stamates, C.Kelble T.Carsey

Gulf Stream Eddies
L.Gramer, J.Stamates

NOAA South Florida Program (SFP) Ecosystem Monitoring

- The AOML NOAA South Florida Program conducts water quality monitoring as part of it's South Florida Ecosystem Monitoring through the NOAA line office of Oceanic and Atmospheric Research (OAR), rather than NOS

- Objective: Conduct long-term monitoring to produce a comprehensive, long-term baseline regarding regional circulation, salinity, water quality, and biology for the interlinked South Florida ecosystems.

- Covers Biscayne Bay, Florida Bay, Florida Keys, Dry Tortugas, and portions of the Southwest Florida Gulf of Mexico region.

- Sustained measurements supported by the AOML SFP include:
  - Bi-monthly synoptic interdisciplinary bay-wide and regional shipboard surveys,
  - a moored oceanographic instrument array
  - Lagrangian surface drifter deployments.

- Parameters measured include: Chlorophyll A, dissolved inorganic nutrients, salinity, CDOM, primary productivity in zooplankton

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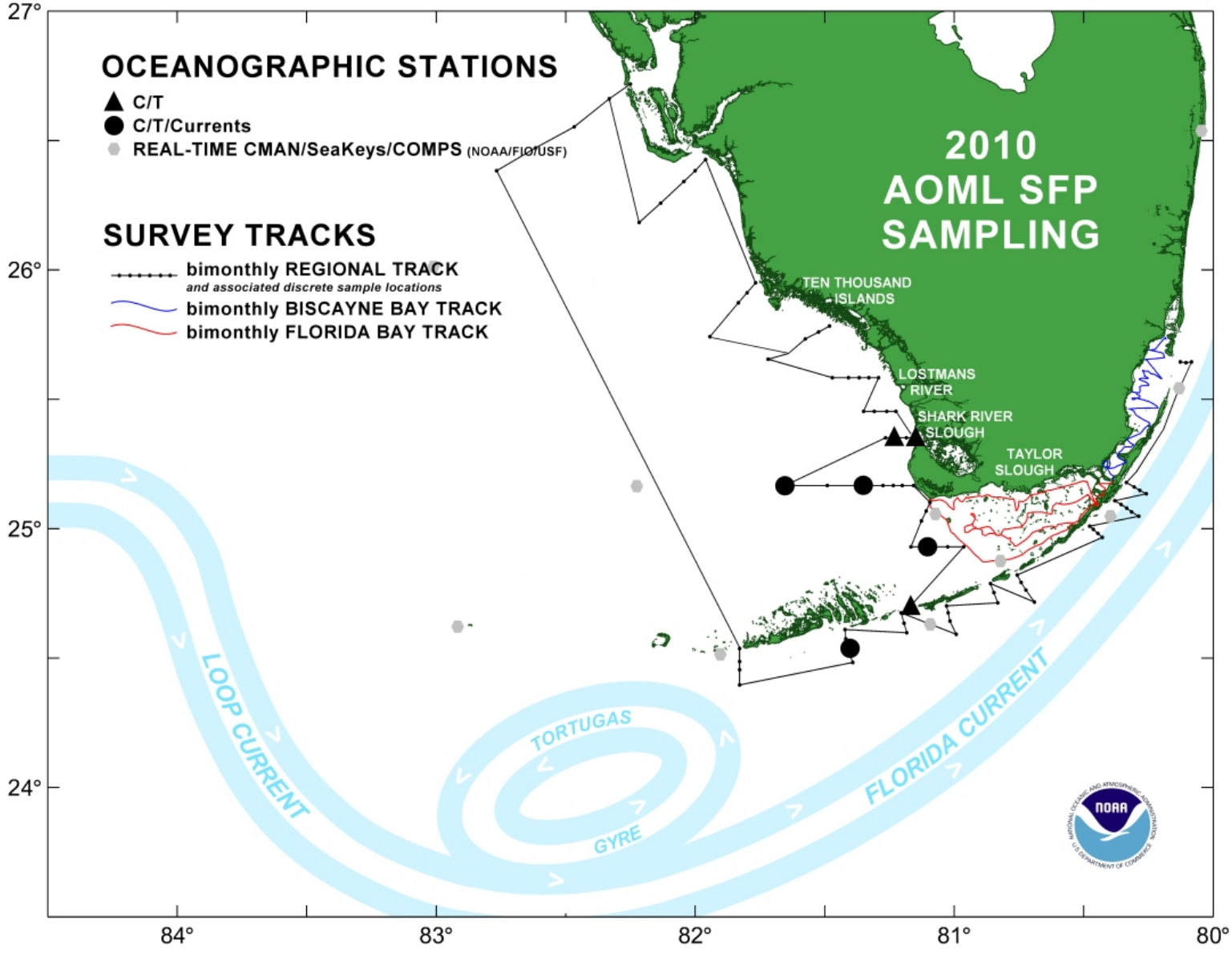
NOAA South Florida Program (SFP) Ecosystem Monitoring



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NOAA Florida Area Coastal Environment (FACE) Program:
Coastal Oceanography for the SE Florida Region

What are the sources of various chemical species in our coastal ocean?

What is in our coastal ocean? How much of this is under our control?

Point sources:
- **Inlets,**
- **TWWP Outfalls**

Non-point sources:
- **Ground-water flow (…septic tanks, city runoff)**
- **Atmospheric deposition (Africa?)**
- **Ocean upwelling**

•Quantify the sources of selected nutrients and microbial contaminants into critical areas of interest along the SE Florida coast.

•Measure relevant physical parameters such as ocean currents and meteorology with which the chemical measurements must be interpreted.

•Determine the likely exposure of biological resources to those nutrients.

NOAA Florida Area Coastal Environment Program

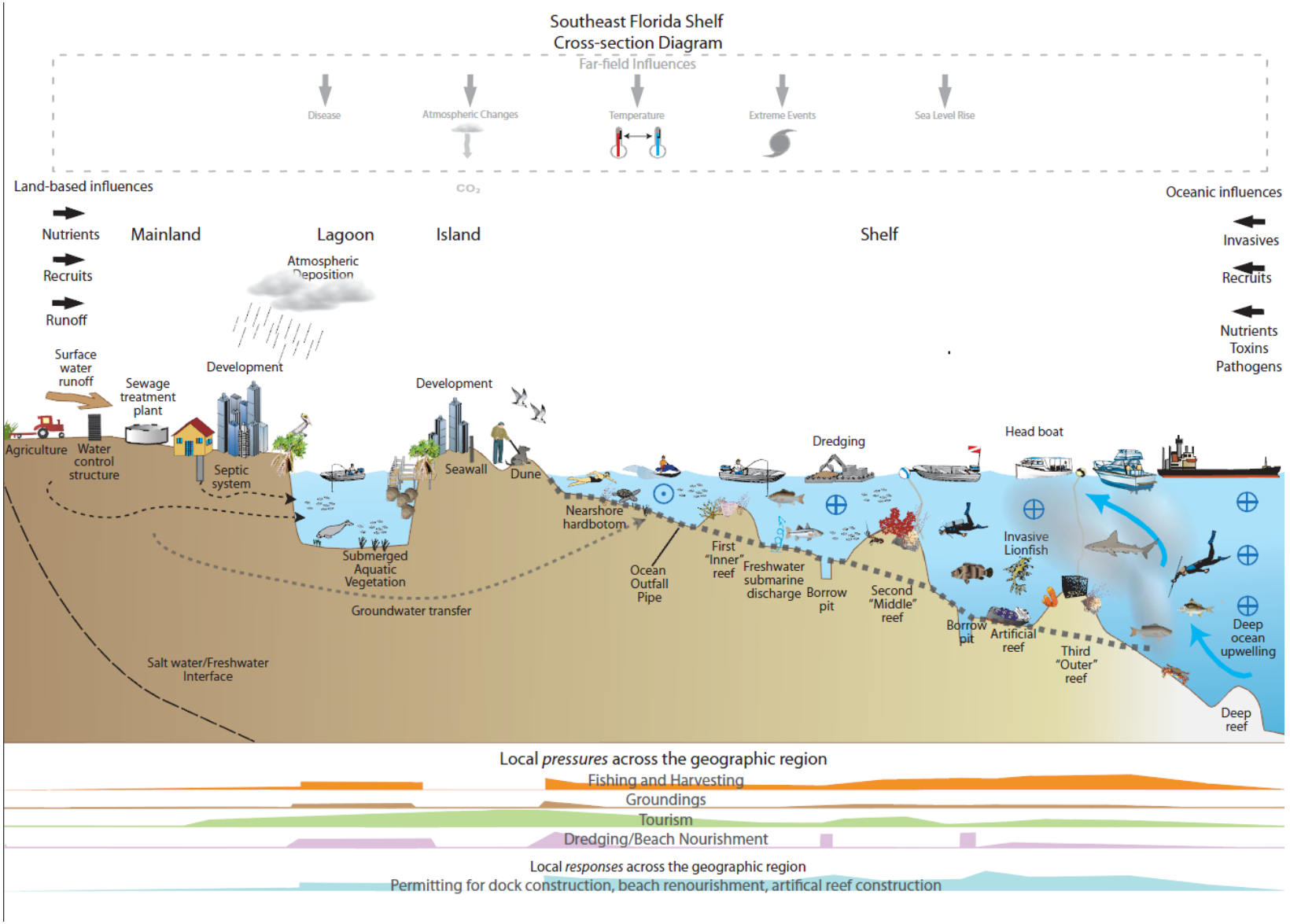
- Nutrients
- Chemistry
- Physical parameters
- Microbiology
- Molecular Microbial Source Tracking
- Ocean Current Characterization
- Plume and Eddie Characterization
- Upwelling Characterization
- Deep Water CTD sampling
- Inlet Flow Characterization

- Annual Regional Cruises
- 2008-2009: Palm Beach/Boca Raton monthly cruises for Boynton Inlet & South Central outfall.
- 2011-2012: Hollywood/Broward monthly cruises for Port Everglades & Hillsboro Inlet, and Hollywood & Broward outfalls.
- Dye tracer plume studies from outfalls and Inlets

Measurements Include:

- ADCP current measurements.
- salinity
- water Temp
- O_2 saturation
- pH
- turbidity
- N+N
- NO_2
- NO_3
- NH_4
- orthophosphate
- silicate
- chlorophyll-a
- phaeopigments
- tss
- total dissolved N
- total dissolved P
- total particulate N
- dissolved organic C
- Enterococci fecal indicators
- Bacteroidales fecal indicators
- Giardia & Cryptosporidium
- *Staphylococcus aureus (MSSA & MRSA)*
- Microbial Source Tracking qPCR markers
- tracer dye tracking

The Goal: a healthy coastal ecosystem for everyone!



QUESTIONS?

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