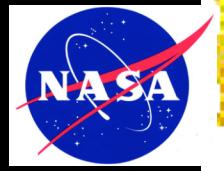
"The Land-Ocean Connection"

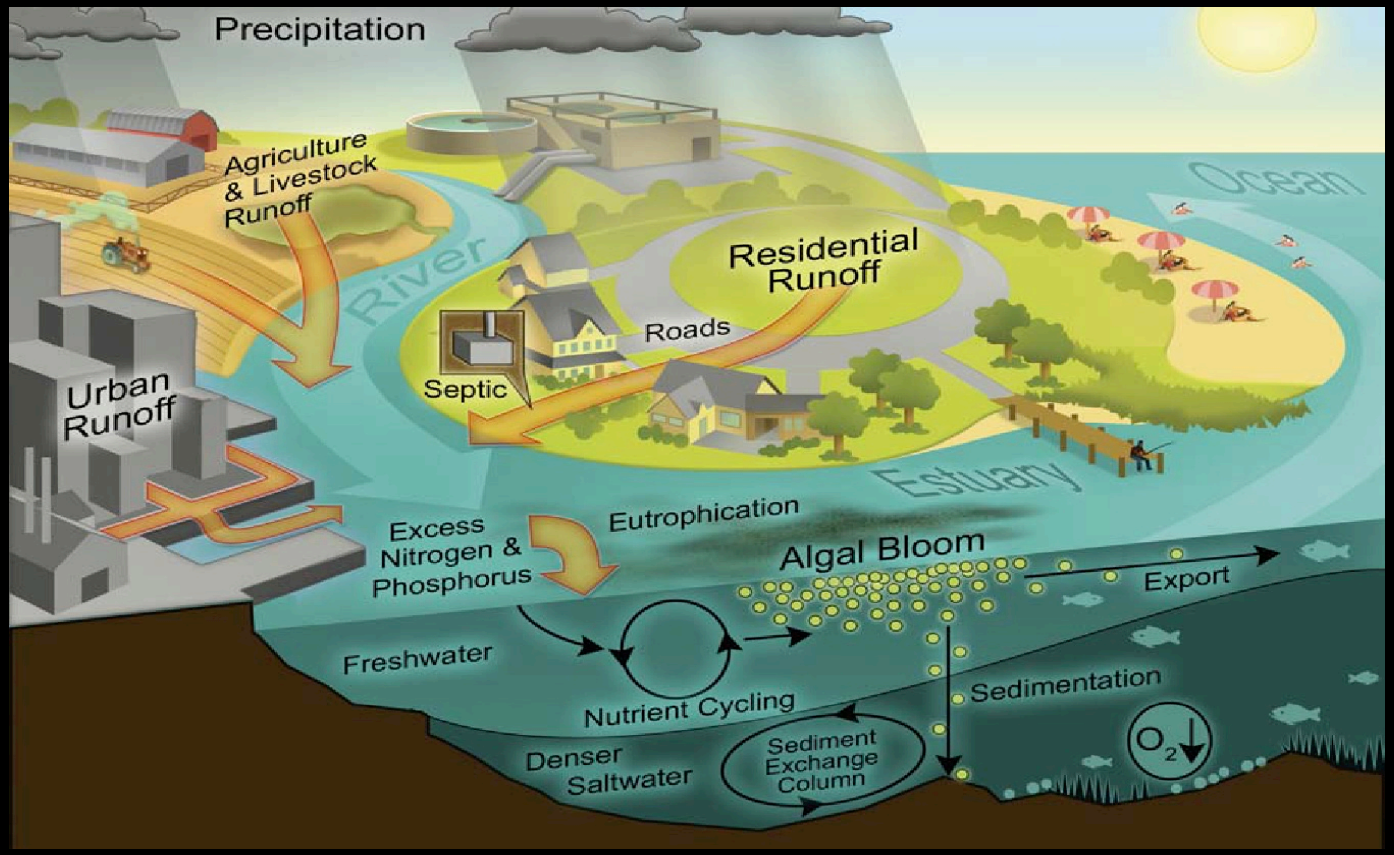
Defining the Frontiers in Assessing

- Carbon and Nutrient Cycling
- Ecosystem Interactions
- Anthropogenic Influences



Estuaries and Coastal Oceans: Feeling the Pressure Between Man and Nature

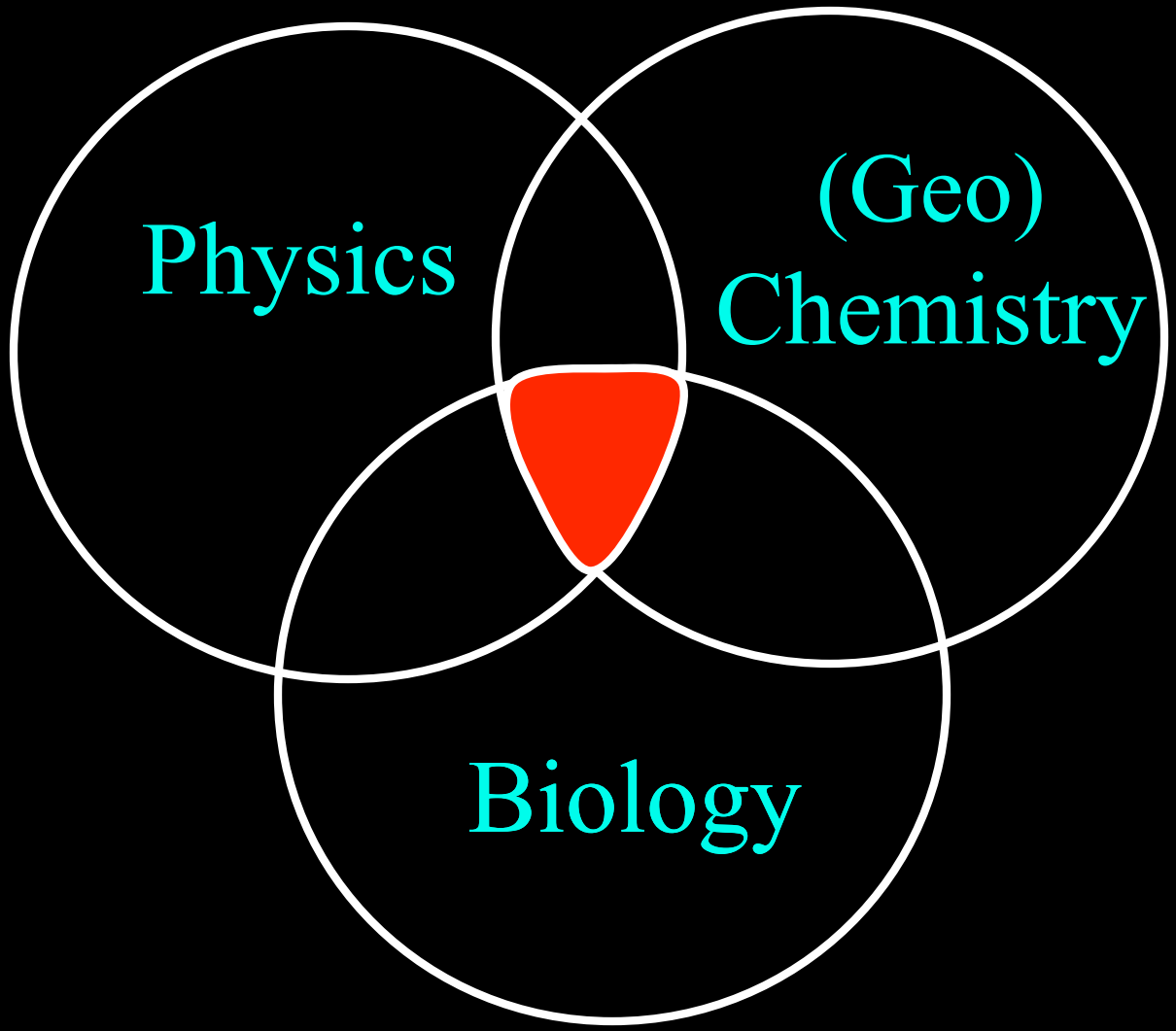
- **Economically Important**: Fisheries, Recreation, Population Centers
- **Land Use Changes**: Agriculture, Urban & Industrialization, Residential
- **Societal Issues**: Human/Ecosystem Health (Toxins, Pharmaceuticals Pesticides), Air/Water Pollution, Dead Zones (Nutrients), Over Fishing



H. W. Paerl (2006) Ecol. Engineering 26:40-54

Estuaries and Coastal Ocean:

A Playground for Interdisciplinary Research



Bob Byrne- Distinguished University Professor

-Development of New Technologies

Underwater Mass Spectrometer (MIMS)- Organic Pollutants

Spectrophotometric Elemental Analysis System (SEAS)

Nutrients-N (nitrite, nitrate, urea), P & Fe in situ

CO_2 Instrument Package-Complete CO_2 system (MICA)

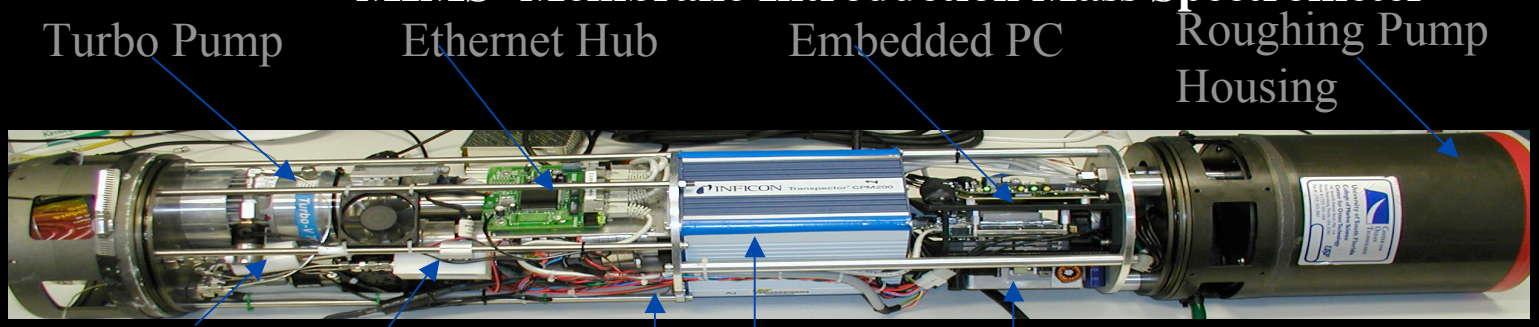
- Physical Chemistry of Trace Metal/Lanthanide Elements

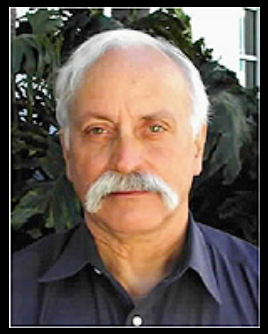
Determining solubility and reaction kinetics

-Applications

Environmental Chemistry, Ocean Acidification, Estuarine Processes

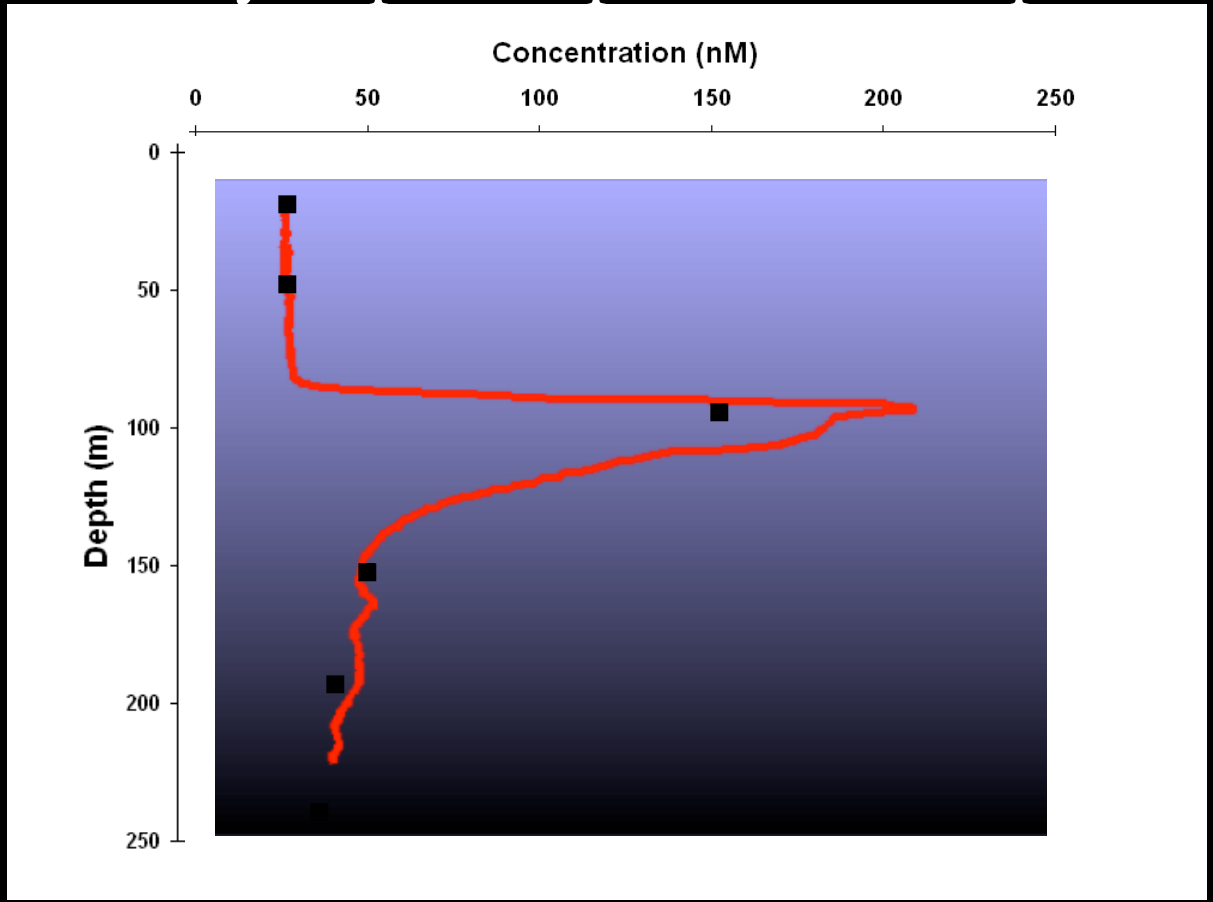
MIMS- Membrane Introduction Mass Spectrometer





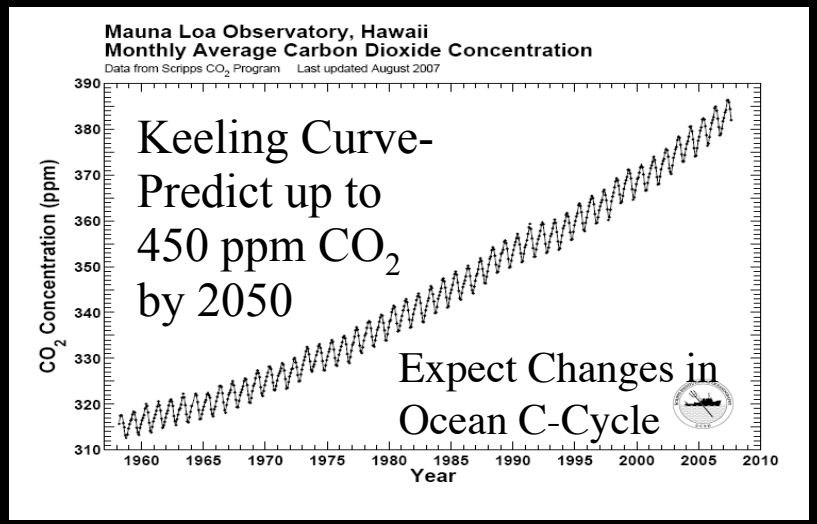
SEAS- Spectrophotometric Elemental Analysis System

- Continuous analyses compared to standard sampling
- Can deploy on buoy or use ships of opportunity to dramatically improve spatial and temporal resolution

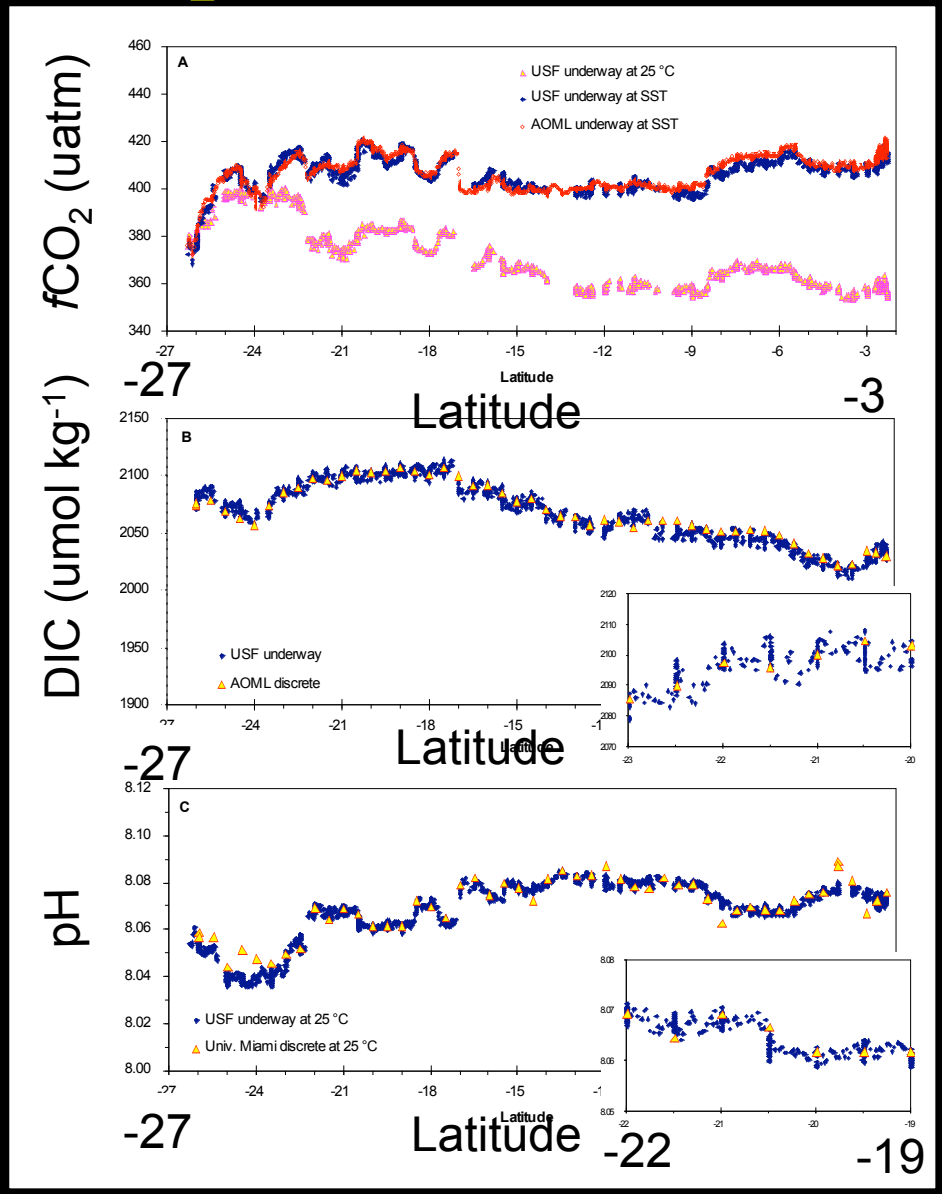


- DielNitrite Profile- Details never seen before

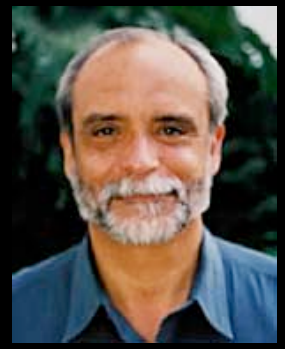
Ocean Acidification:
First Complete In Situ CO_2-System Analyses



- Measurements taken on ships underway or on buoys, data displayed real-time



Characterization of Micron and Submicron Particles

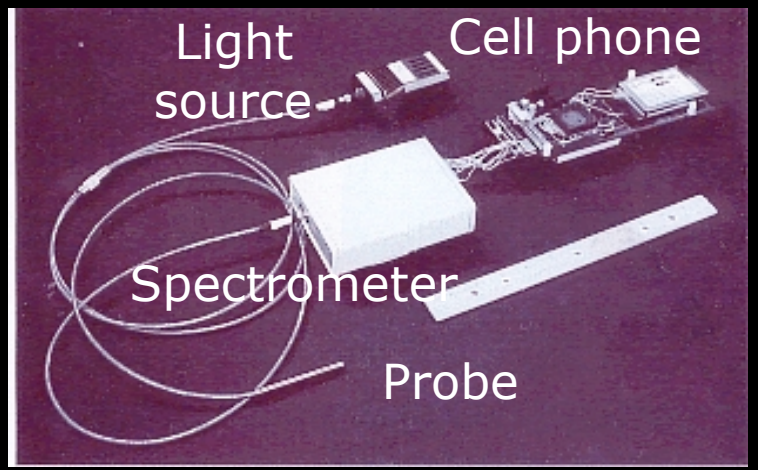


Objectives:

- Fundamental scientific understanding of micron and submicron particle properties (aggregation, cell growth, crystallization, etc.)
- Development of sensors for real time continuous monitoring for in-situ and remote applications
- Intellectual Property:

  9 patents, 5 pending, 2 licenses

Prof. Luis H. Garcia-Rubio
Dr. Debra Huffman
Dr. Yulia Serebrennikova
Adam Spear PhD Candidate



Applications and Impact

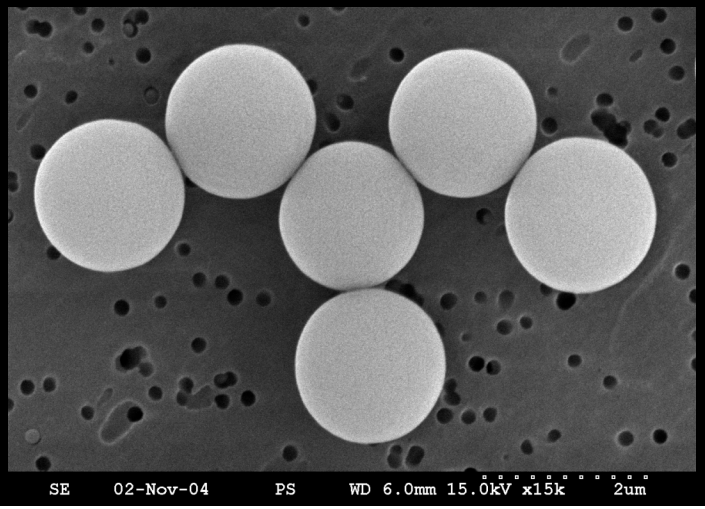
Applications

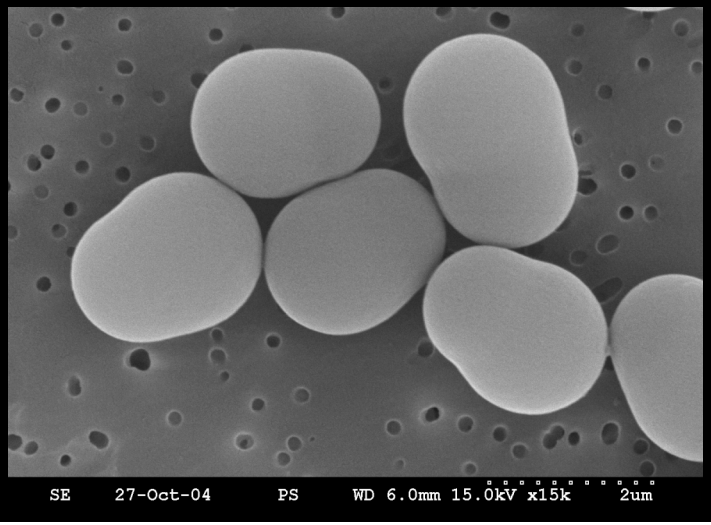
- **Medical Diagnosis**
  - -Blood typing
  - -Telemedicine
  - -Disease detection
  - -Physiological performance
  - -Dehydration monitoring
- **Environmental Monitoring**
  - -Characterization of the water column
  - -Pathogen Detection
  - -Water Quality Assessment
  - -Biological and chemical warfare

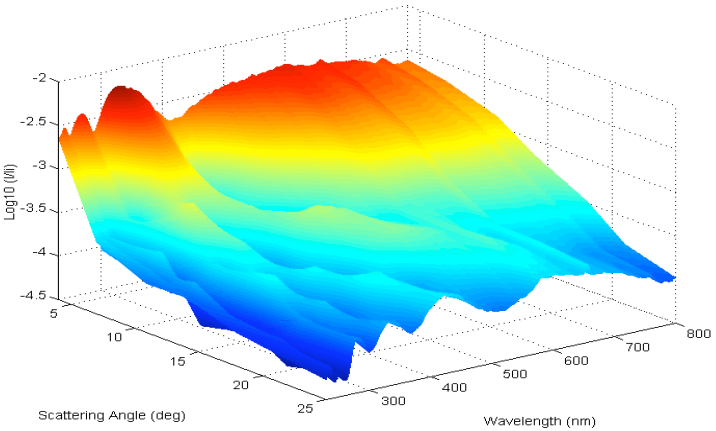
Societal Impact

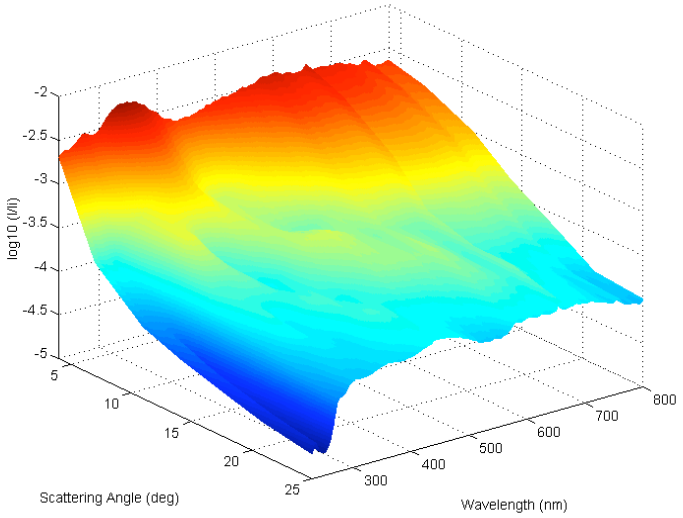
- 6.5 Million malaria-related deaths caused for lack of diagnosis in Africa alone
- Immediate application to areas of disaster/epidemics
- Potential markets in the billions of dollars
- New tools for research & monitoring of diseases and epidemics

New Technology for Quantitative Measurement of Particle Size and Shape





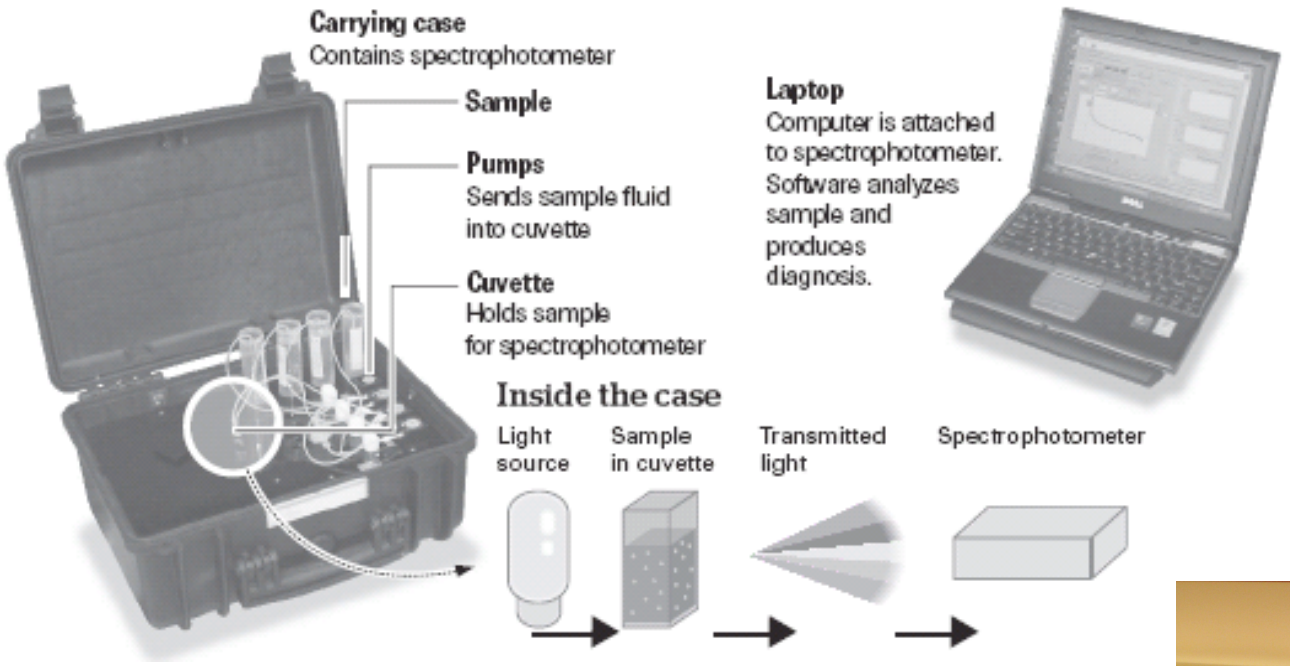




Spherical Particles: D= 1.9 μm

Peanut Shape Particles: 1.87 μm

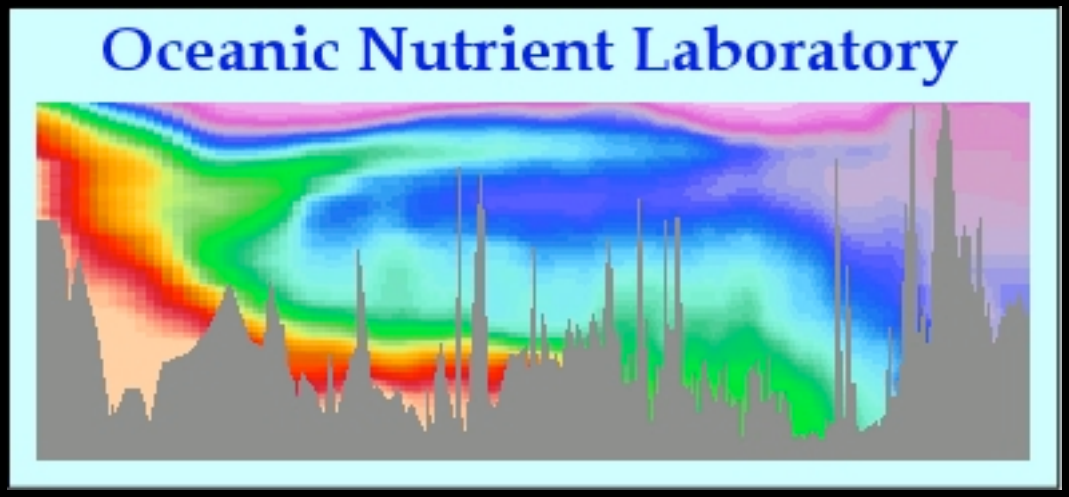
Pathogen Identification Unit

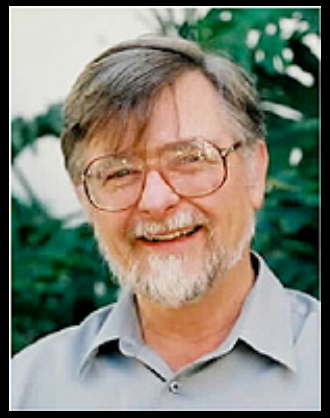


- Microbial ID
- Particulates
- Proteins
- Pigments

- Small and portable unit
- Analysis of various fluids
- Broad library of pathogens
- Low unit manufacturing cost

Kent Fanning- Nutrient Chemistry



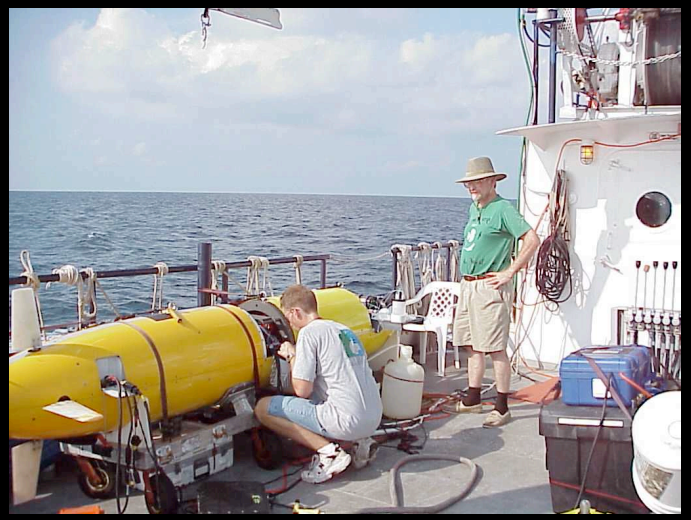


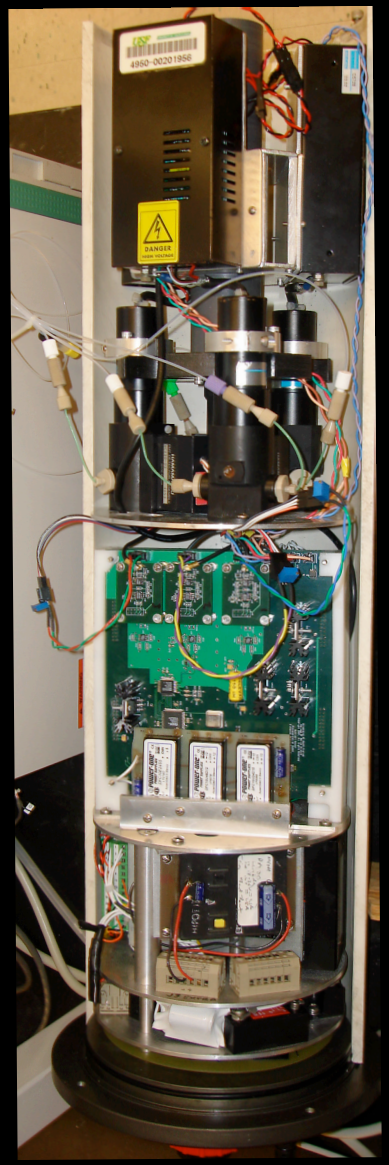
Research Objectives:

- Inorganic Nutrient Measurements
  - From rivers and estuaries to the open oceans
  - Comparison of anoxic systems

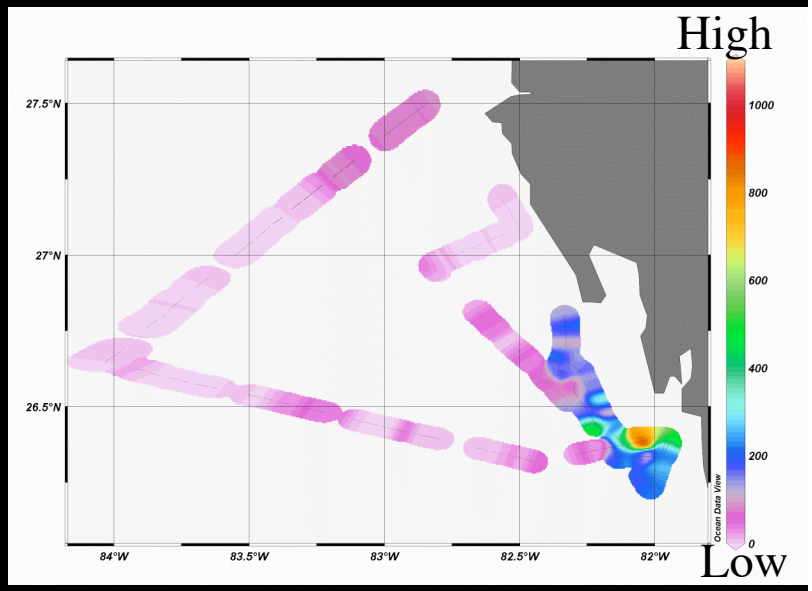
- Development of a High-Sensitivity Nutrient Sensor
  - Functions in an AUV

In Situ Fluorescence Detection of Ammonia





March 10-14th 2008
Surface Ammonium



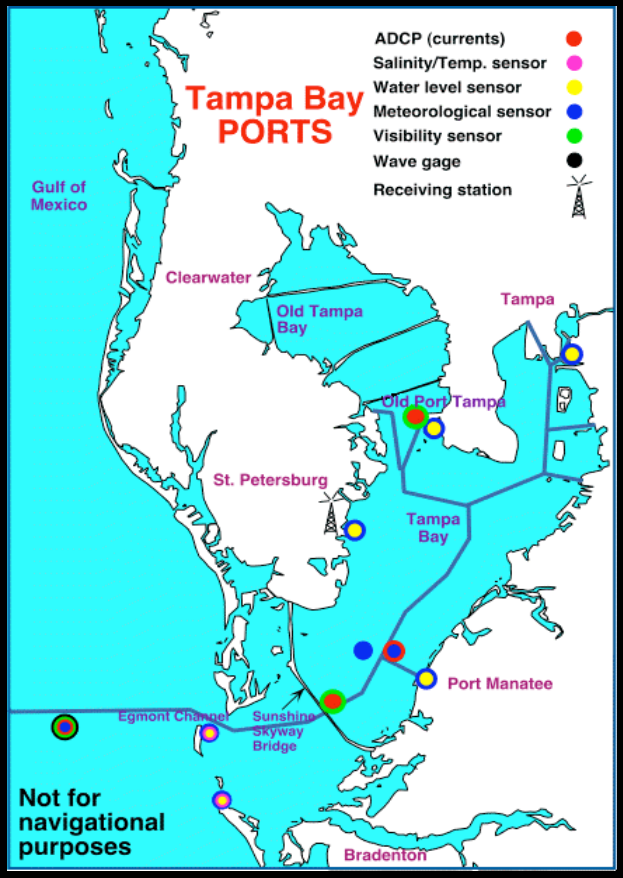
ISUS UV Nitrate Sensor

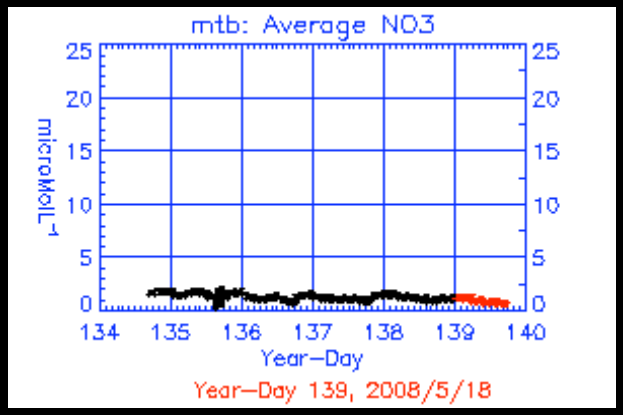
Real-time nitrate concentrations

Detection Limit = +/- 2 μM

No reagents required

Range of concentrations: 0 - 2000 μM

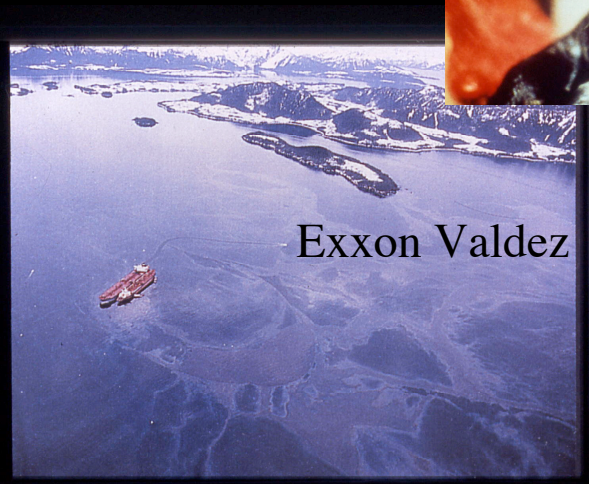




Ted Van Vleet- Molecular Organic Geochemistry

Research Programs:

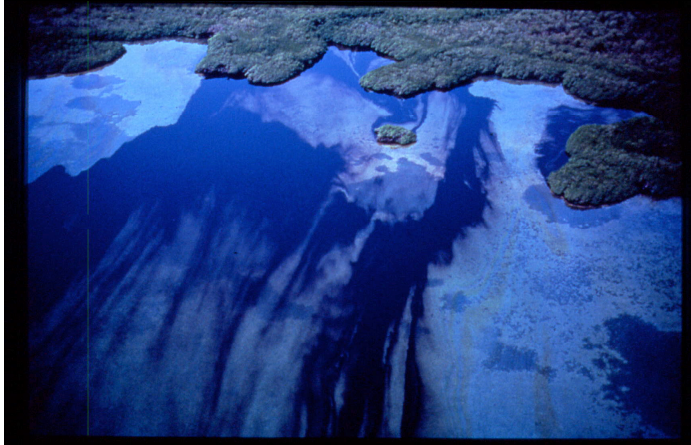
- Inputs, fates and effects of oil pollution in the marine environment
- Production and cycling of archaebacterial lipids in anoxic and hypersaline oceanic systems.
- Use of organic biomarkers to trace inputs, dispersal and accumulation of marine, terrestrial and urban organic matter.
- Uptake and accumulation of toxins by marine organisms.



Oil and Petrochemical Pollution:
At Home in Florida and Beyond

Tampa Bay, FL

Mangroves & Oil

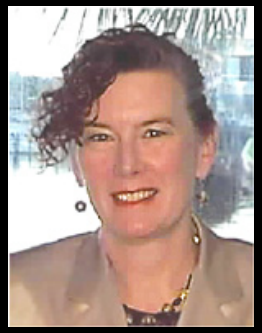


Venice, Italy:

Effects of Pollution on the Venice's Canals and Lagoon

Organic Matter in Florida's Waters

Marine Spectrochemistry Group



Paula G. Coble, Ph.D.
Robyn N. Conmy, Ph.D.

Land-Ocean Interface Projects

- **Understanding the relationship between landscape characteristics and riverine organic matter**
  - Ecosystem health
  - Land use change
- **Fluorescence for detecting groundwater discharge**
- **Utilizing historical datasets to hindcast organic material in riversheds**
  - Allows for predicting freshwater organic carbon export to coastal environments

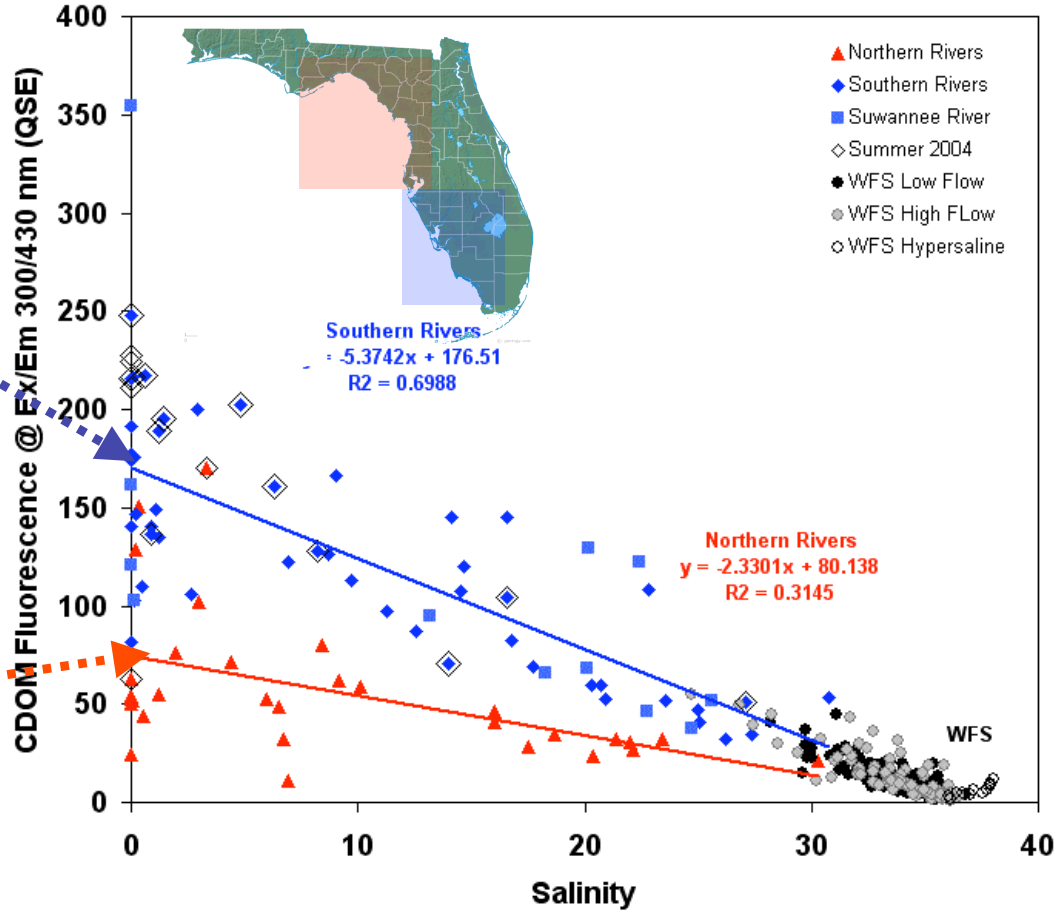
Watershed & Landuse Controls Amount & Type of Organics in Rivers

•Southern FL watersheds
- poorly drained
- high agriculture

Southern FL Rivers
- high in color
- high aromaticity

•Northern FL watersheds
- good drainage
- highly urbanized

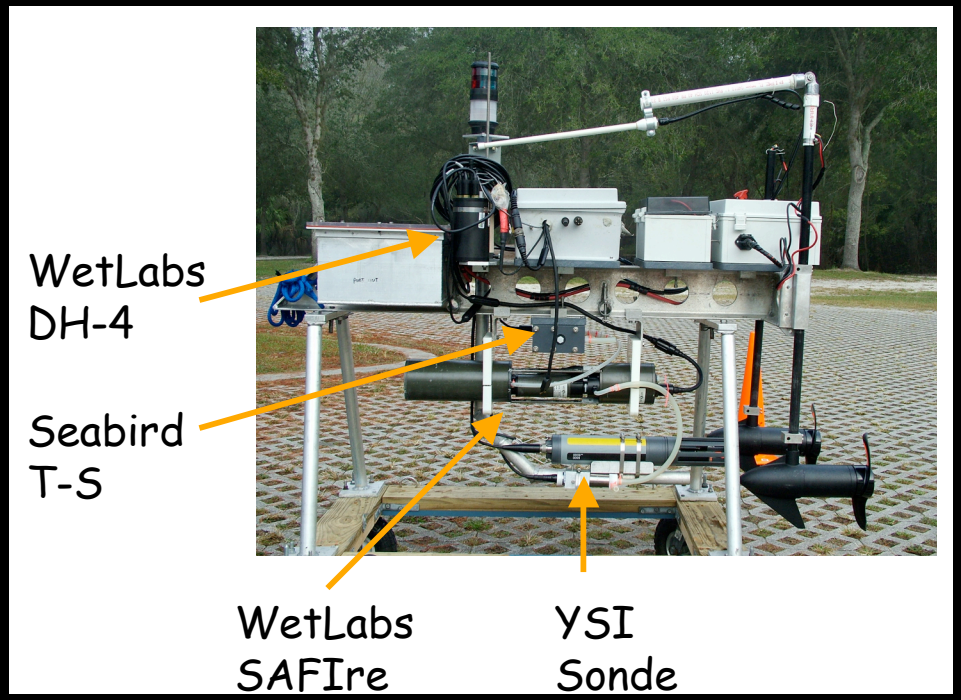
Northern FL Rivers
- low in color
- low aromaticity

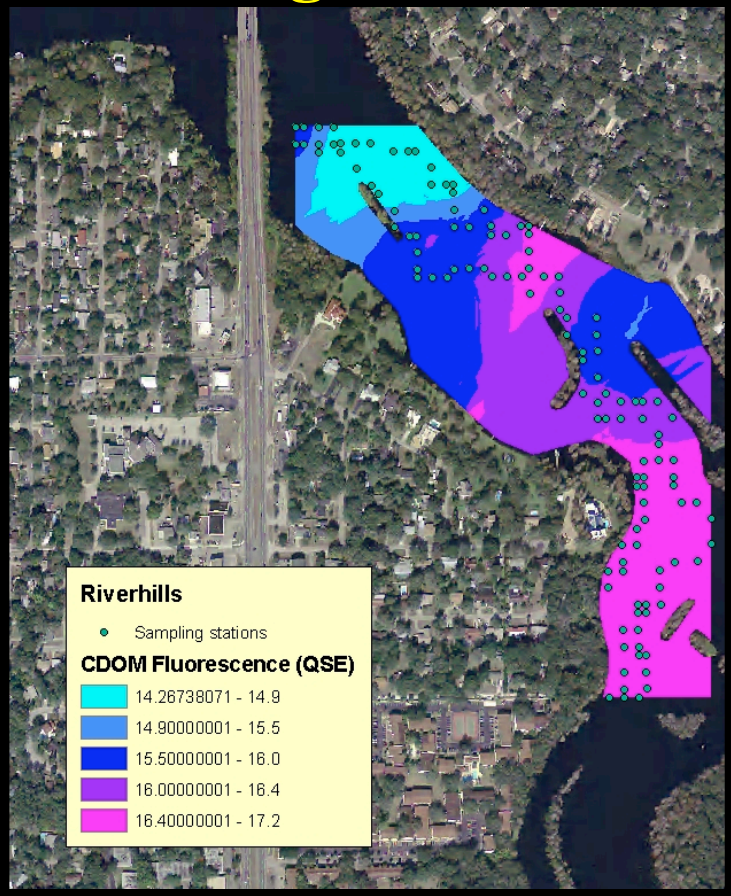


Changes in land-use practices alter organic material and affect

- ecosystem health
- transport of pollutants & heavy metals
- nutrient cycling
- UV shading potential for organisms
- carbon export to estuaries / ocean

In Situ Fluorescence From a Guided Surface Vehicle: Spatial Heterogeneity in the Hillsborough River





Concentrations highly variable over short distances within river and correlated with land usage

David Hollander-
Stable Isotopes, Biogeochemistry

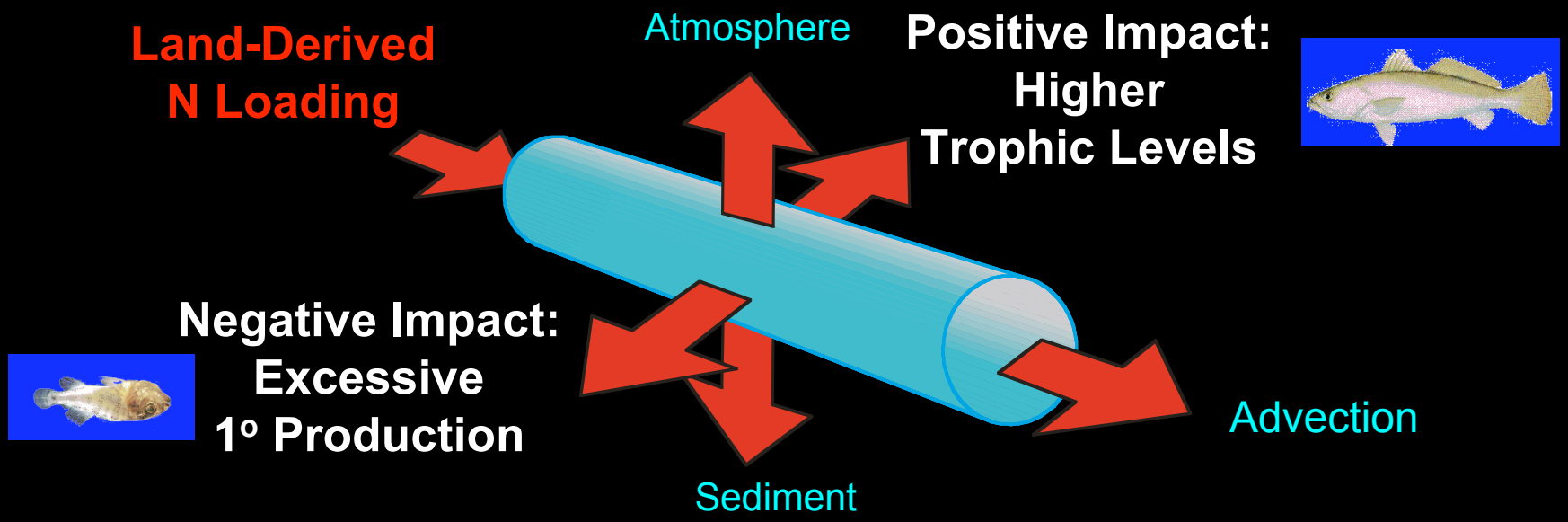
Stable isotopes as natural tracers of:

- Chemical and biological processes within ecosystems
- Nutrient cycling: From source to sink
- Natural (climate) vs anthropogenic (land-use) influences

Directly links geochemistry to important environmental policy and resource management issues

- Chemical Ecology and Ecosystem Analysis
  - Everglades Restoration
  - Fisheries Sciences
- Reconstruction of Environmental and Ecosystem Changes
  - The “Dead Zone” in the Northern Gulf of Mexico
  - Tampa Bay
  - Climate Change Studies: GOM, FL lakes

Nitrogen in the Coastal Ecosystem: The Goldilocks Paradox



Positive Impact.

Terrigenous nitrogen contributes to biomass at higher trophic levels.

- Most fishery production comes from nutrient-rich coastal waters

Negative Impact.

Dead zones, harmful algal blooms and damage to submerged aquatic vegetation via shading

Conflict: Desirable fisheries production vs. undesirable ecosystem degradation

Fishing in Southwest Florida: A Billion Dollar Industry

- **Estuarine-Dependent Life**
  - –Adults spawn at coast
  - –Larvae migrate to rivers
  - –Juveniles occupy rivers
- **Climatic-Human Impacts**
  - –SW Florida Hydrology
    - Wet vs. dry seasons
  - –Anthropogenic nutrient inputs
    - Land-use specific

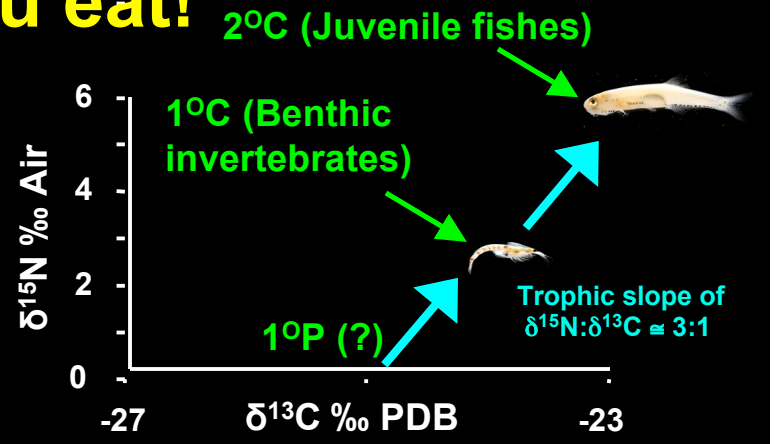
Fundamental Questions!

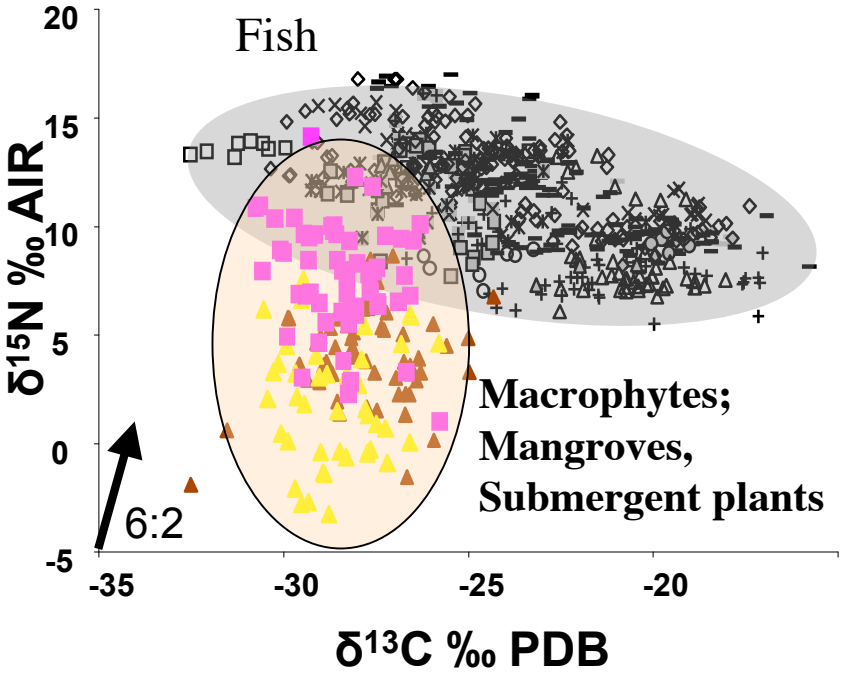
Which primary producers support nursery fish production?

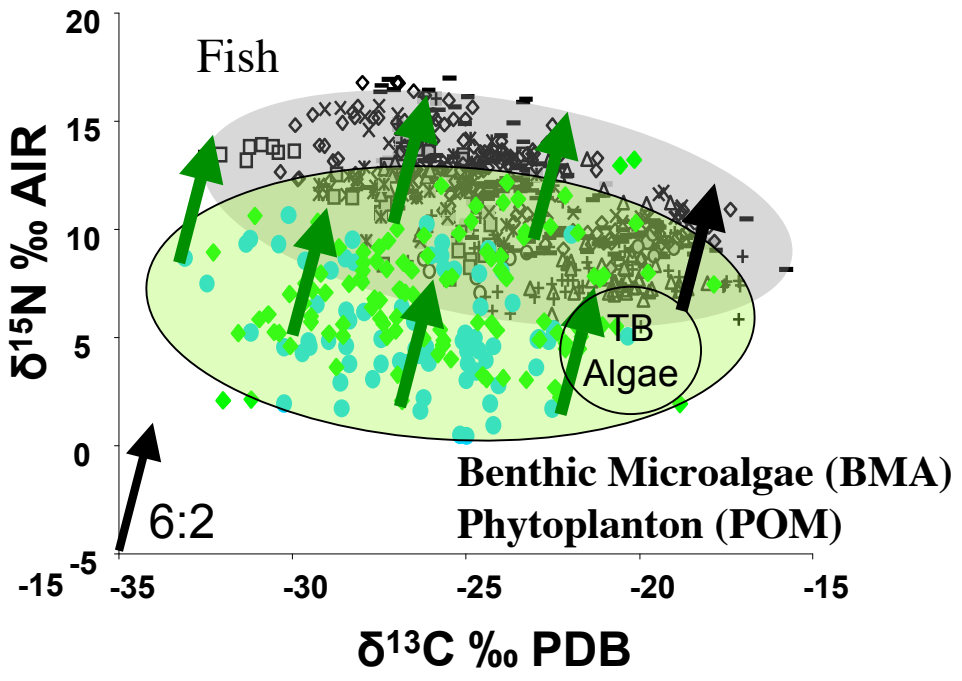
Is there a land-use (agricultural vs residential vs industrial) influence?

Trophic Analysis Using Stable Isotopes: You are what you eat!

Which primary producers form the trophic base and support nursery fish production ?



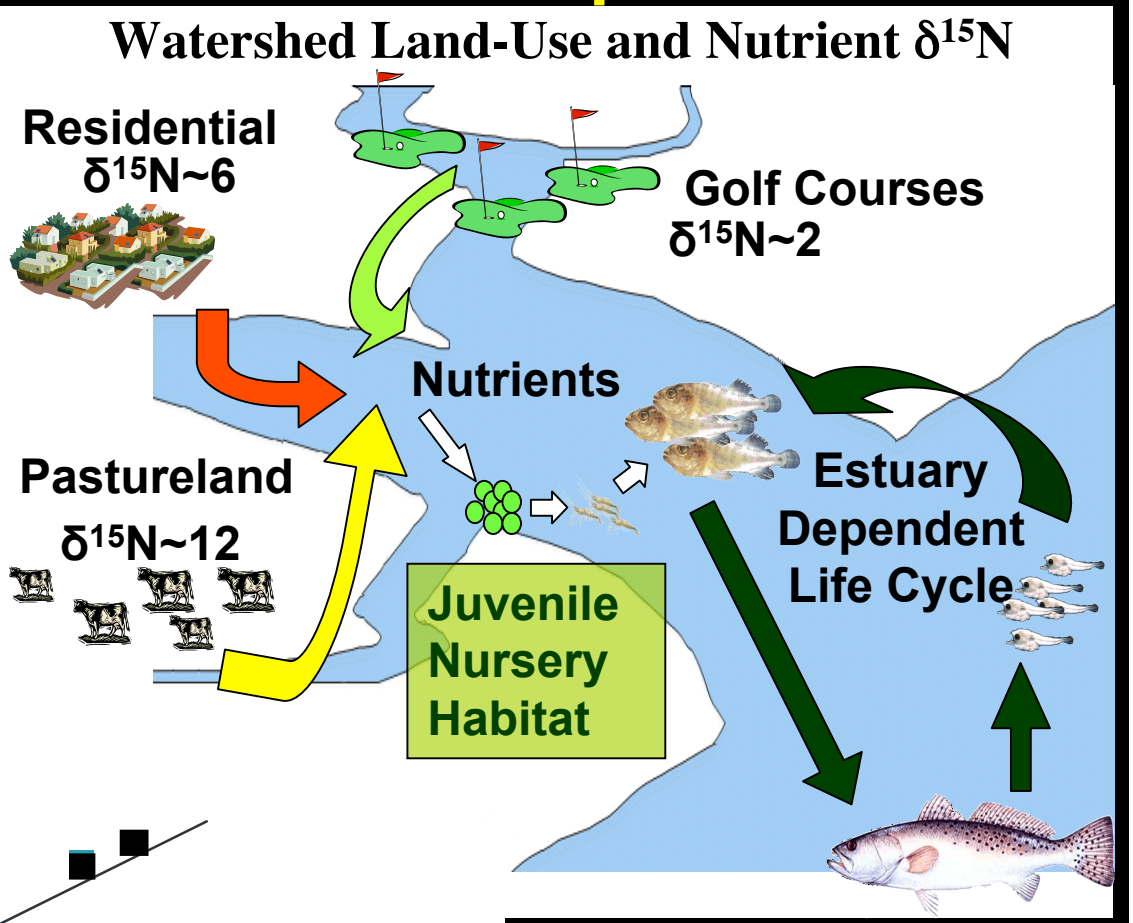


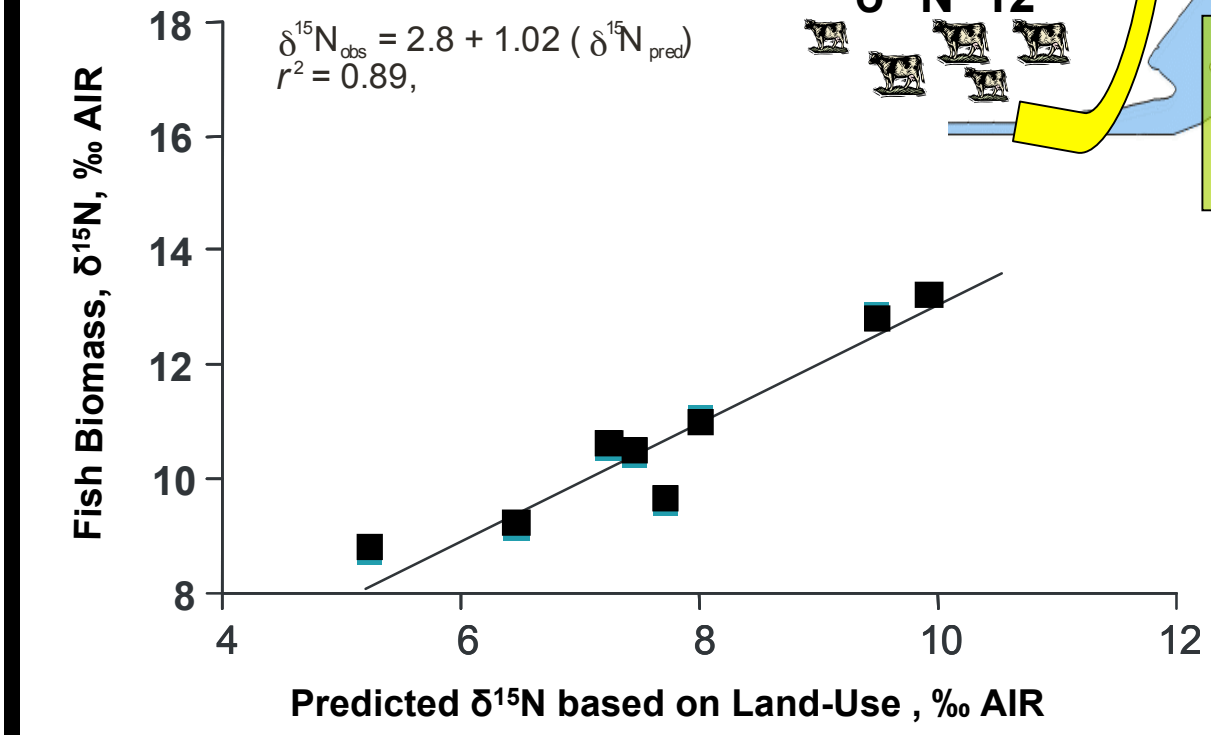


- **Fish biomass based on microalgae, not watershed plants**
- **Managers need to maintain nutrient inputs to support 1°P**

Does Land-Use Influence Estuarine dependent fish?

- Fish Ultimately Derive Biomass N from Land-use
- Can predict ^{15}N of fish based on water-shed land-use

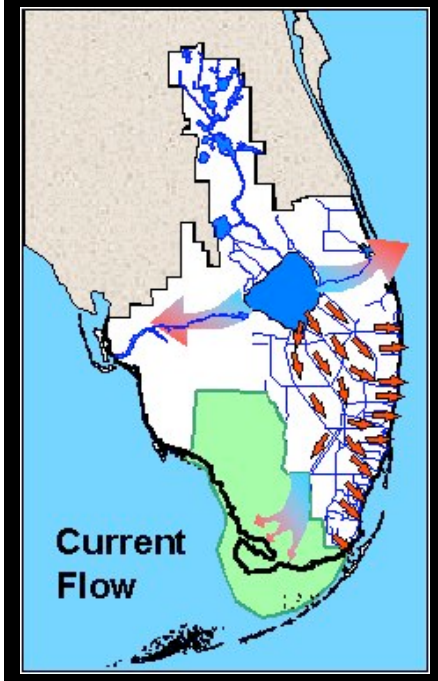




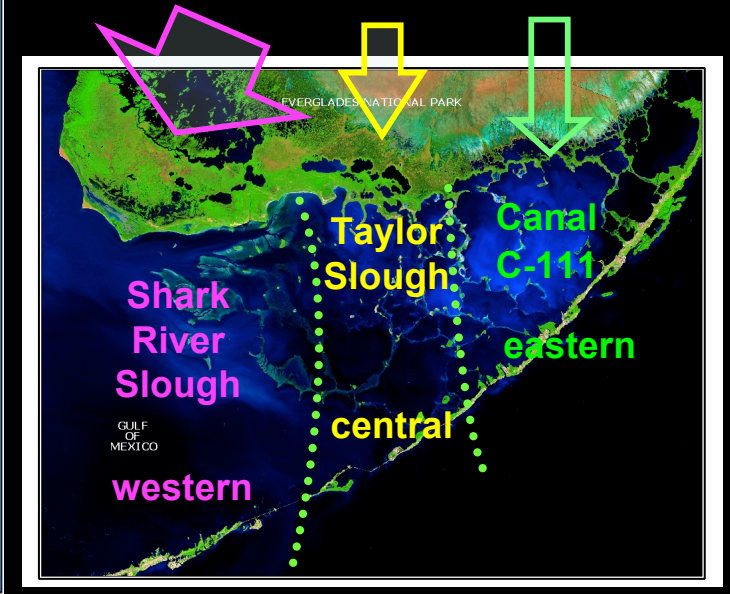
- Now can evaluate role of land-use on fish condition & productivity
- Fingerprint event driven inputs (spills)

Funding:TBEP, FWC, SWFWMD Collaborators: Dr. Ernst Peebles, Gradate Student: Elon Malkin

Florida Everglades Restoration: A $8 Billion Project



Agriculture ⟷ Urban /Industry



Upstream Influences

- Change natural flow
- Land use
- Nutrient inputs

Downstream Effects

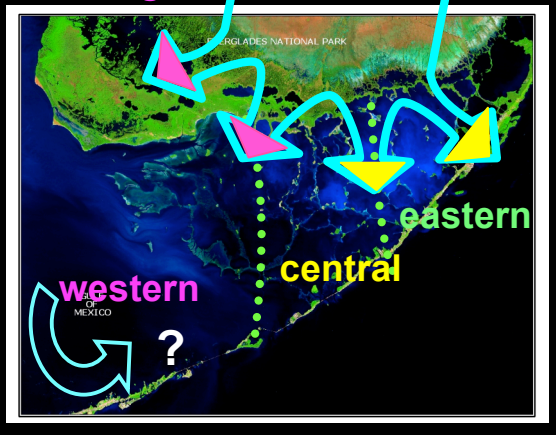
- Seagrass die-offs
- Fisheries decline
- Increased turbidity
- Hypersalinity
- Harmful algal blooms

Does a Hydrologic Restoration = Ecologic Restoration?

Shark River Slough

Taylor Slough

Canal C-111

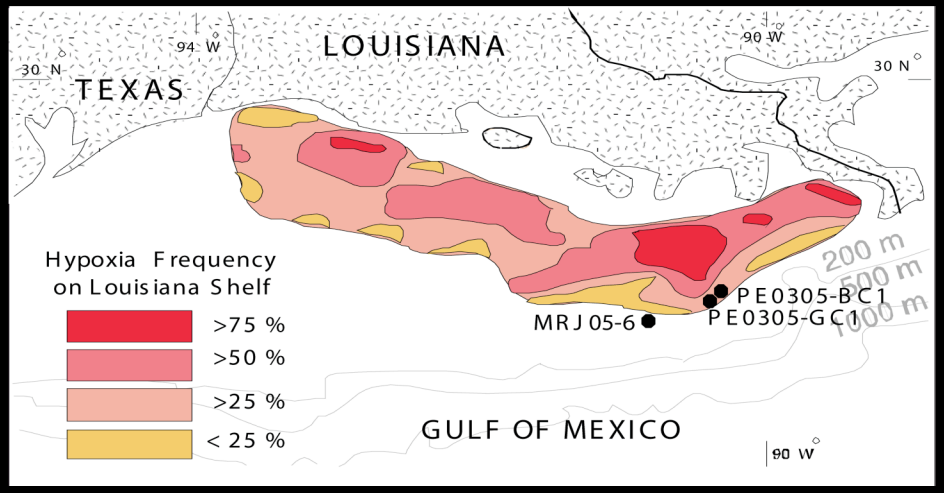


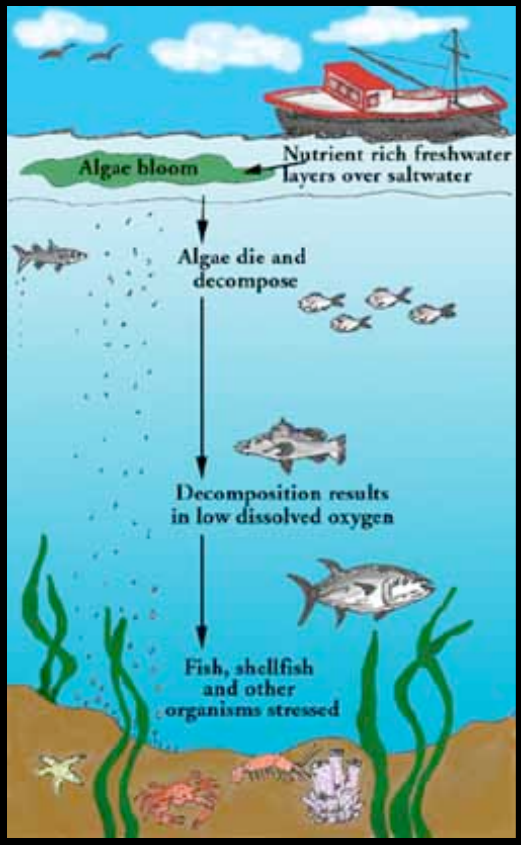
- Nutrient amount, type and delivery will change
- Stable Isotopes can trace nutrient sources from the different watersheds in the everglades to biological sinks in FL Bay

What will happens to Florida Bay and the Reefs off the Keys?

The Gulf of Mexico "Dead Zone"

- **Significant impacts**
  - –Economic: endangering fishing industry
  - –Agriculture
  - –Societal, Health
  - –Policy and Management decisions





- Is hypoxia due solely to anthropogenic influences, or are low-oxygen conditions on the shelf a naturally occurring phenomenon?

- Sediments can provide a record of environmental history: extend instrumental record into the past. Annual monitoring only since 1985.

Funding: USGS, International Plant Nutrition Institute, Graduate Student: Marianne Dietz

”Consortium for Ecosystem-Based Research and Modeling: West Florida Shelf (WFS) Initiative”

Why is an ecosystem-based research consortium needed?

WFS and its rich ecological system support multi-billion dollar fishing and tourism industries in FL. To properly manage the WFS natural resources as mandated by the Congress in the Magnuson-Stevenson Act:

- Need a long-term strategy involving a coordinated, interdisciplinary (ecosystem-based) approach to meet present resource concerns (i.e., changing land use, overfishing, air/water pollution, habitat degradation, water supply, red tide, hurricanes)
- Provide the foundation for addressing future management issues (i.e., MPAs, aquaculture, oil drilling and transport, acidification, climate change).

Who will this consortium support?

Bring together stakeholder (fisherman)- scientists from various agencies

- Work collaboratively, conduct interdisciplinary research,
- Provide policy solutions to decision makers in government, the private sector, and society in general.