Moving Forward on Gulf Hypoxia

Webcast Sponsored by EPA's Watershed Academy

Tuesday, October 7, 2008 1-3 pm Eastern

Benjamin Grumbles, US EPA
Nancy Rabalais, LUMCON
Darrell Brown, US EPA
John Kessler, Ohio DNR

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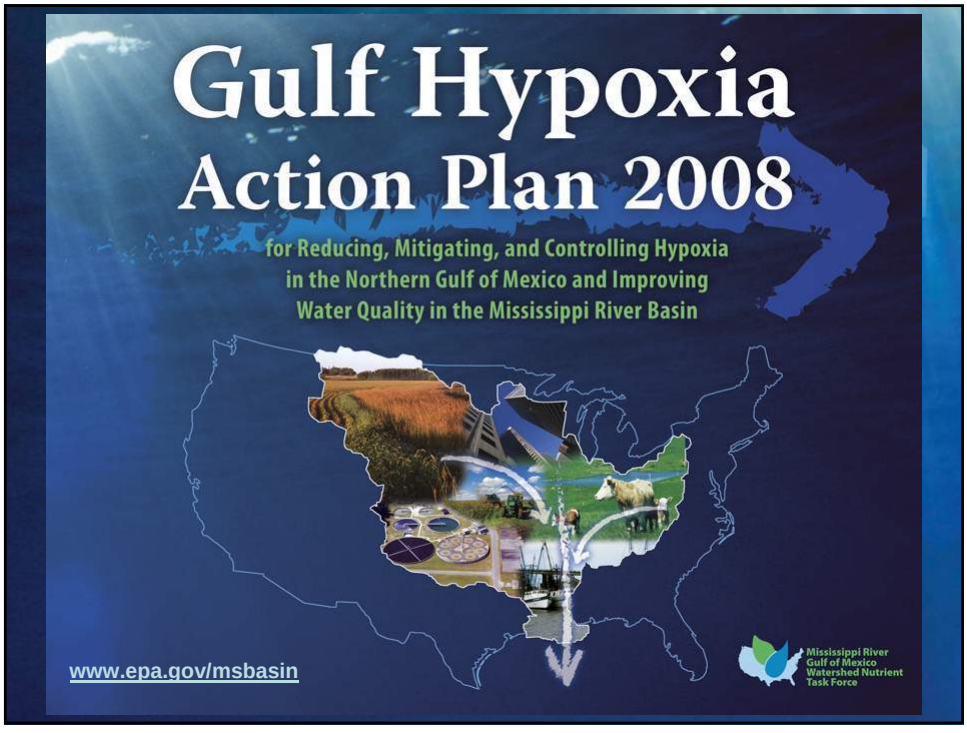
Topics for Today's Webcast

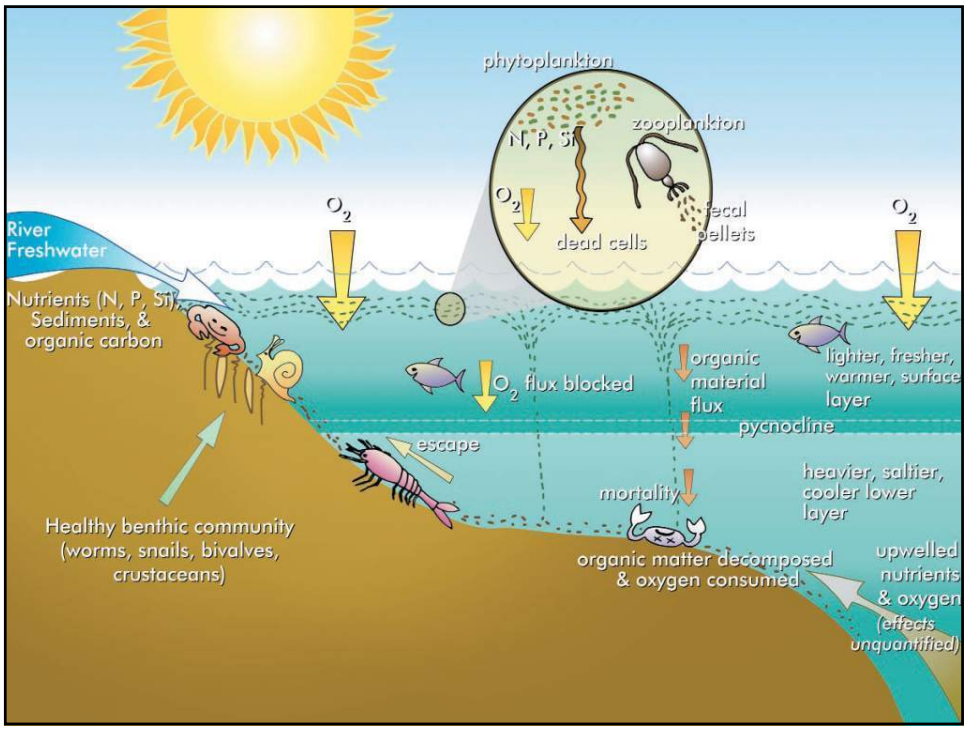
- Overview of the Gulf hypoxia problem and the multi-agency Hypoxia Task Force
- In-depth discussion of the hypoxia problem
- 2008 Gulf Hypoxia Action Plan
- Ohio River Basin Team



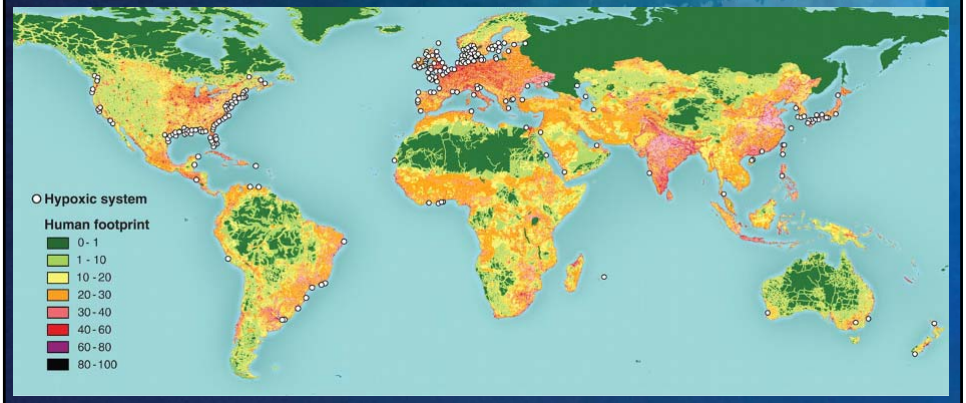
What is hypoxia?

- A large area of low oxygen that cannot sustain marine life.
- Hypoxia is a worldwide problem but is found in the Gulf of Mexico and a result of nutrients, originating from the great productivity of Middle American cities, farms, and industries, that travel down the Mississippi River.
- Hypoxia forms in the Gulf during periods in the summer off the coasts of Louisiana and Texas and threatens to change the biology of the region.

Mississippi River Gulf of Mexico Watershed Nutrient Task Force



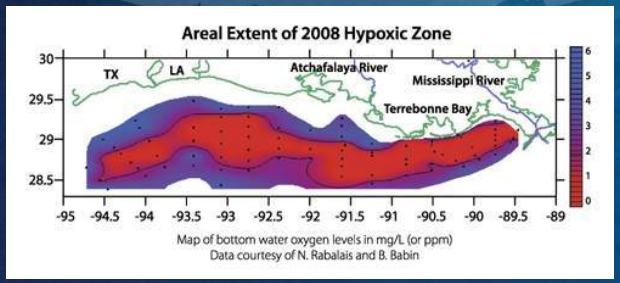
Hypoxic Zones are Spreading



Diaz & Rosenberg, *Science*, 2008

Challenges Associated with Gulf Hypoxia

- Mapping efforts in 2008 showed the 20,720 square kilometer area ranks as the 2nd largest hypoxic zone since measurements began in 1985



Bottom-Water Dissolved Oxygen Concentrations for July, 2008

LUMCON

- Nonpoint sources of nutrients are major cause of hypoxia in the Gulf
- Nonpoint source reduction programs emphasize voluntary actions

Additional Challenges

Mississippi/ Atchafalaya River Basin (MARB) represents:

- 41% of the contiguous U.S.
- 31 States
- Diverse stakeholders

Mississippi River Gulf of Mexico Watershed Nutrient Task Force

Mississippi River Gulf of Mexico Watershed Nutrient Task Force

Comprised of:

- Federal Agencies (EPA, NOAA, USDA, USACE, USGS, DOI)
- States represented by Agriculture or Environment Departments (AR, IL, IA, LA, MN, MS, MO, OH, TN, WI)

Goals:

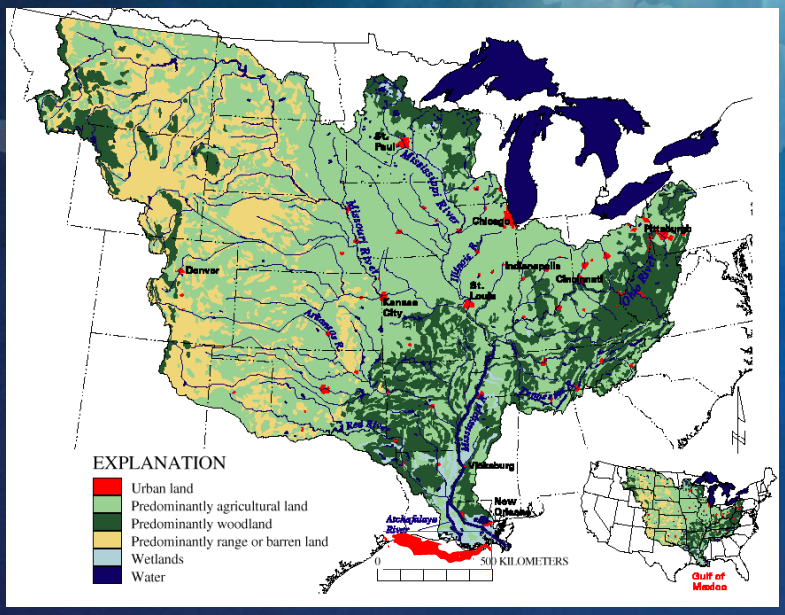
- Examines complex science and policy issues surrounding Gulf Hypoxia
- Takes collaborative actions to improve water quality

Gulf Hypoxia Action Plan 2008

- Final product of 4-year reassessment of the 2001 Action Plan
  - 4 science symposia (2005-2006)
  - EPA SAB Hypoxia Advisory Panel Report, December 2007
  - 6 Task Force Meetings
  - Over 750 public comments

Questions

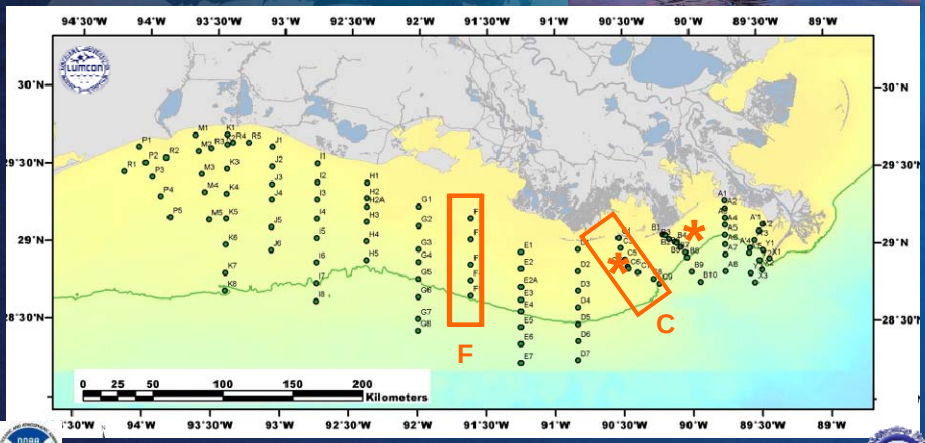
Huge Watershed, Huge Problem



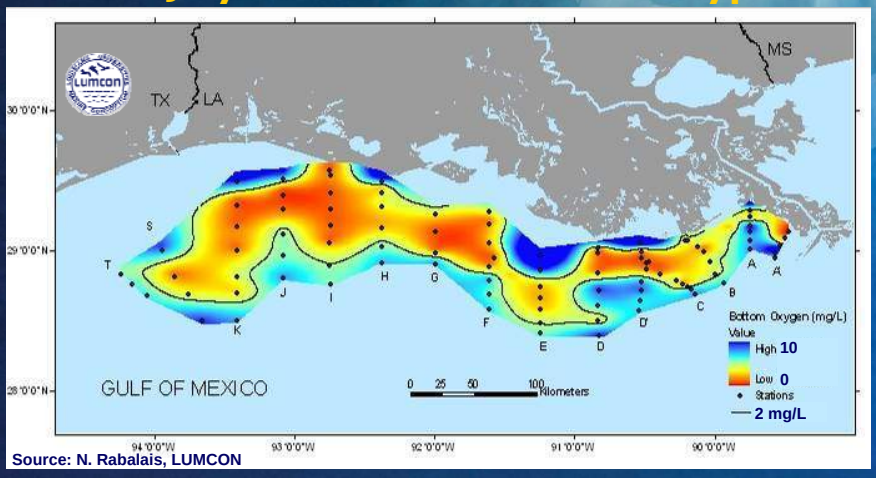
Goolsby et al. 1999, Rabalais 2002

Since 1985 .....

- Mid-summer shelfwide cruise
- Monthly samples along line C
- Bimonthly samples along line F
- Deployed oxygen meters

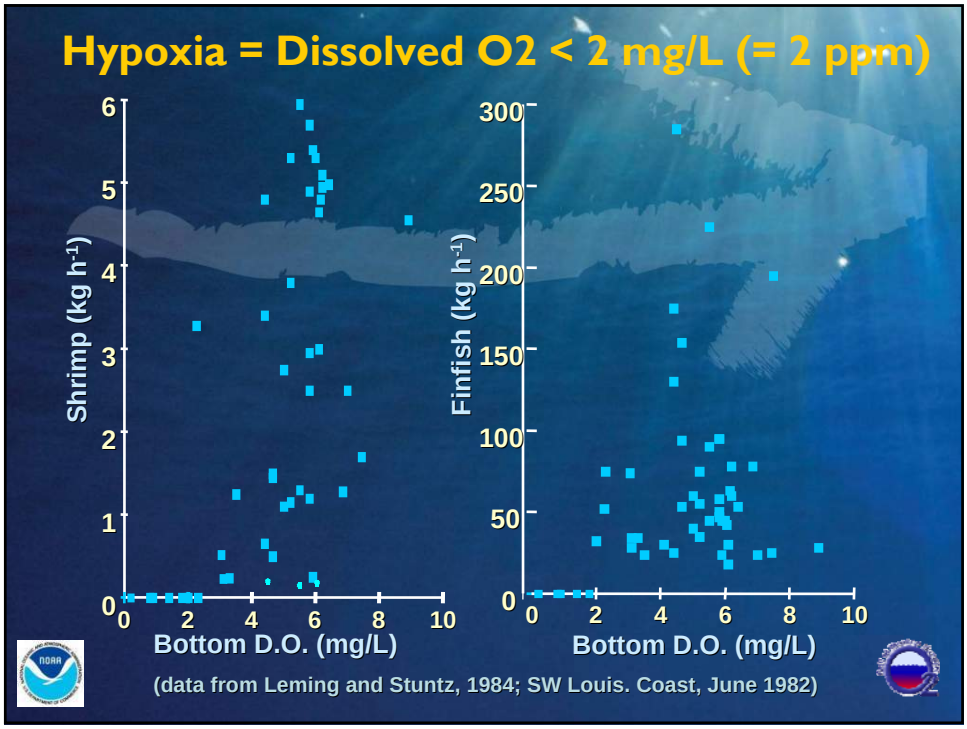


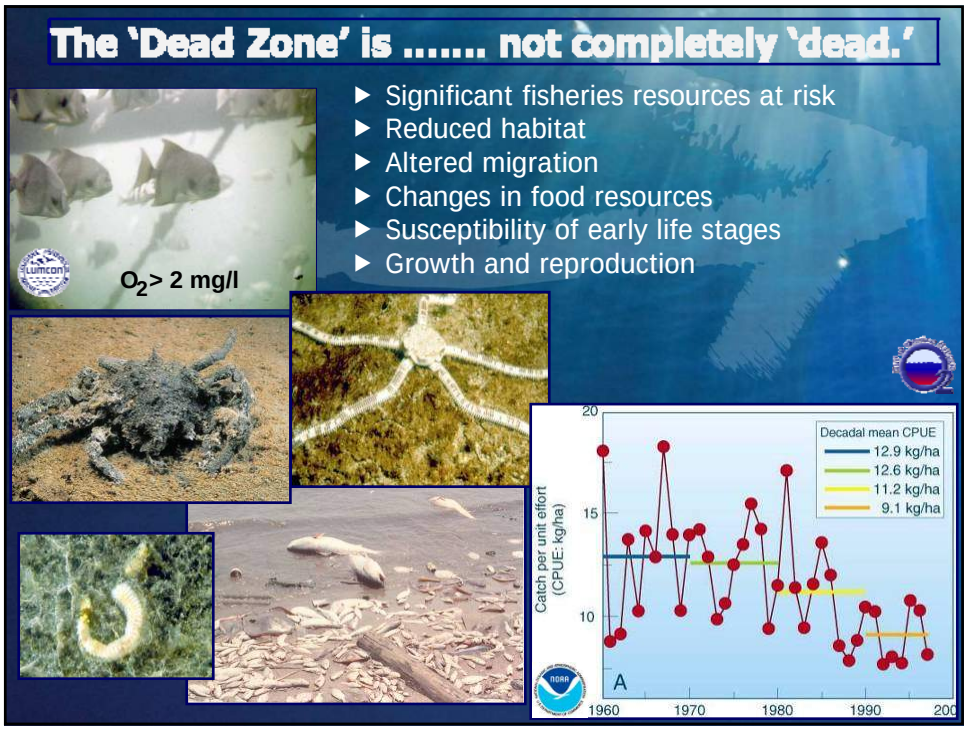
21 – 28 July 2007 Bottom-Water Hypoxia



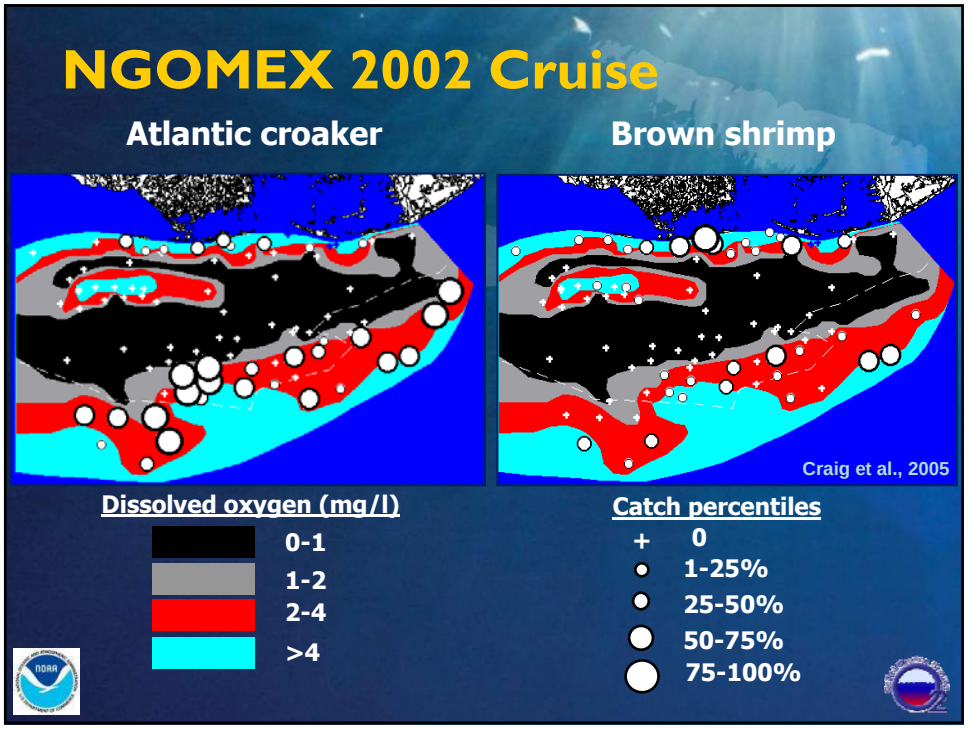
Source: N. Rabalais, LUMCON

- up to 22,000 km2
- 4 - 5 m nearshore to 35 - 45 m offshore
- 0.5 km nearshore to 100+ km offshore
- widespread and severe in May – Sep

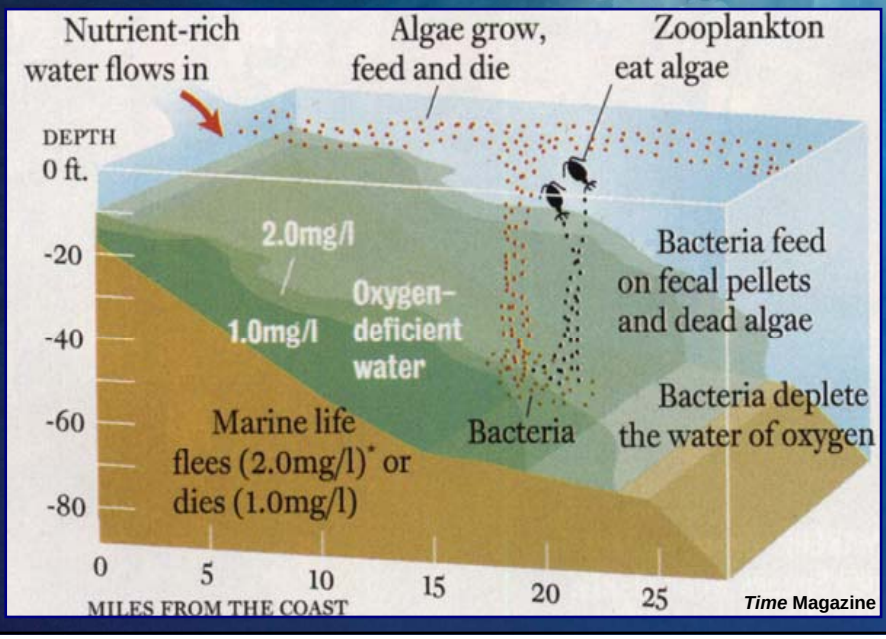

Hypoxia = Dissolved O2 < 2 mg/L (= 2 ppm)
Shrimp (kg h-1)
Finfish (kg h-1)
Bottom D.O. (mg/L)
Bottom D.O. (mg/L)
(data from Leming and Stuntz, 1984; SW Louis. Coast, June 1982)

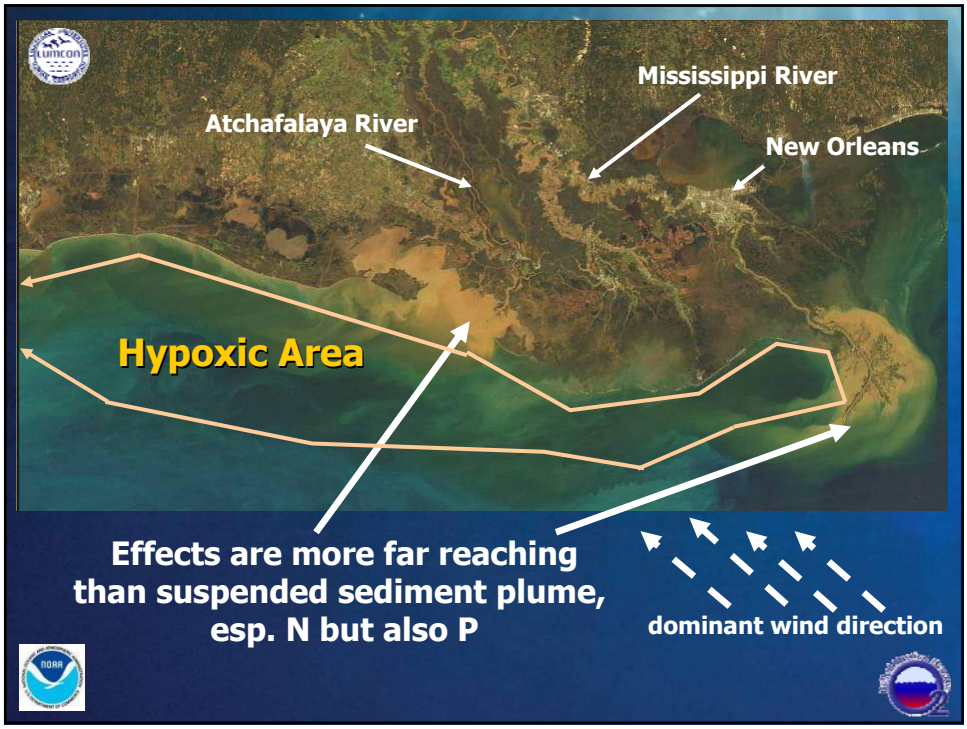

The 'Dead Zone' is ..... not completely 'dead.'
Significant fisheries resources at risk
Reduced habitat
Altered migration
Changes in food resources
Susceptibility of early life stages
Growth and reproduction
O2> 2 mg/l
Decadal mean CPUE
12.9 kg/ha
12.6 kg/ha
11.2 kg/ha
9.1 kg/ha
Catch per unit effort (CPUE: kg/ha)
A

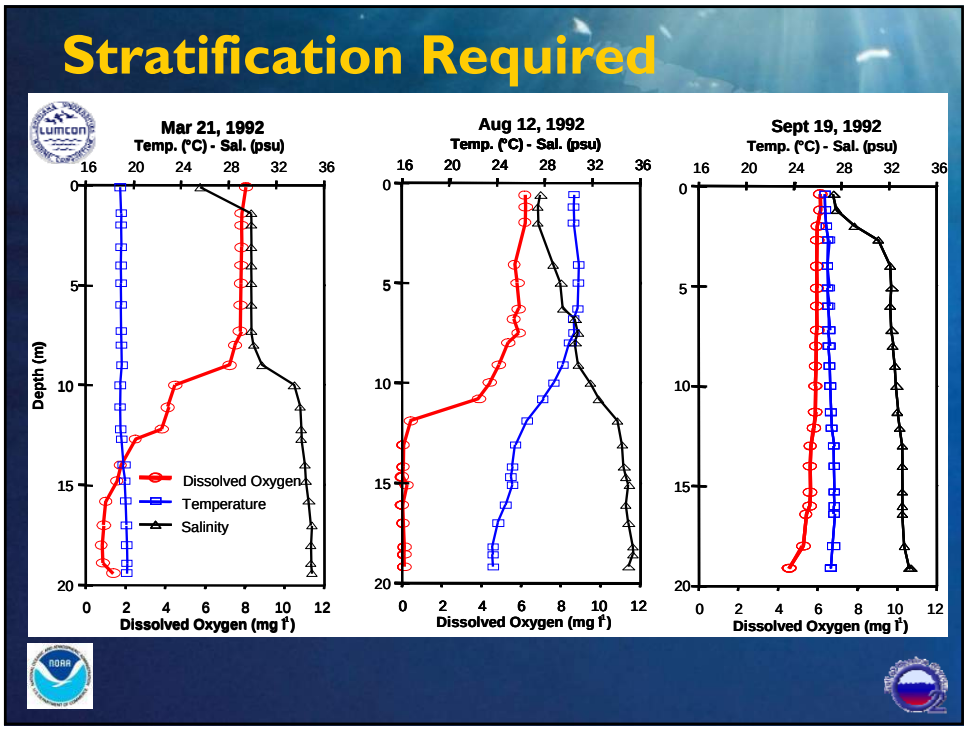
NGOMEX 2002 Cruise



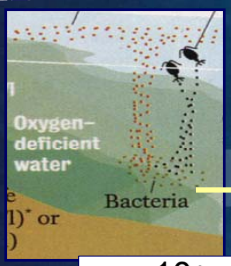
Nutrients, Increased Growth, Low Oxygen



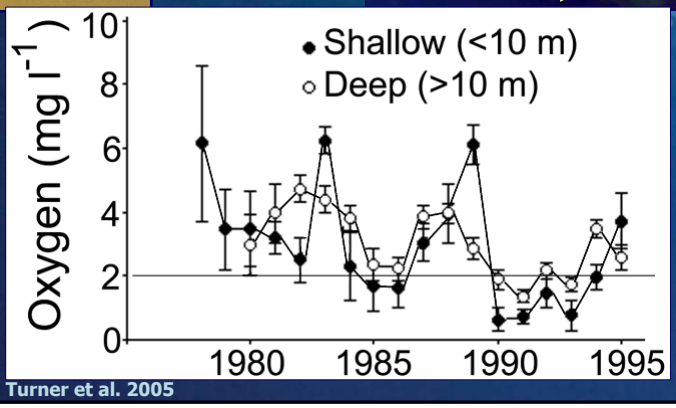

Mississippi River
Atchafalaya River
New Orleans
Hypoxic Area
Effects are more far reaching than suspended sediment plume, esp. N but also P
dominant wind direction


Stratification Required
Mar 21, 1992
Temp. (°C) - Sal. (psu)
Aug 12, 1992
Temp. (°C) - Sal. (psu)
Sept 19, 1992
Temp. (°C) - Sal. (psu)
Depth (m)
Dissolved Oxygen
Temperature
Salinity
Dissolved Oxygen (mg l⁻¹)

Nutrients, Increased Growth, Low Oxygen

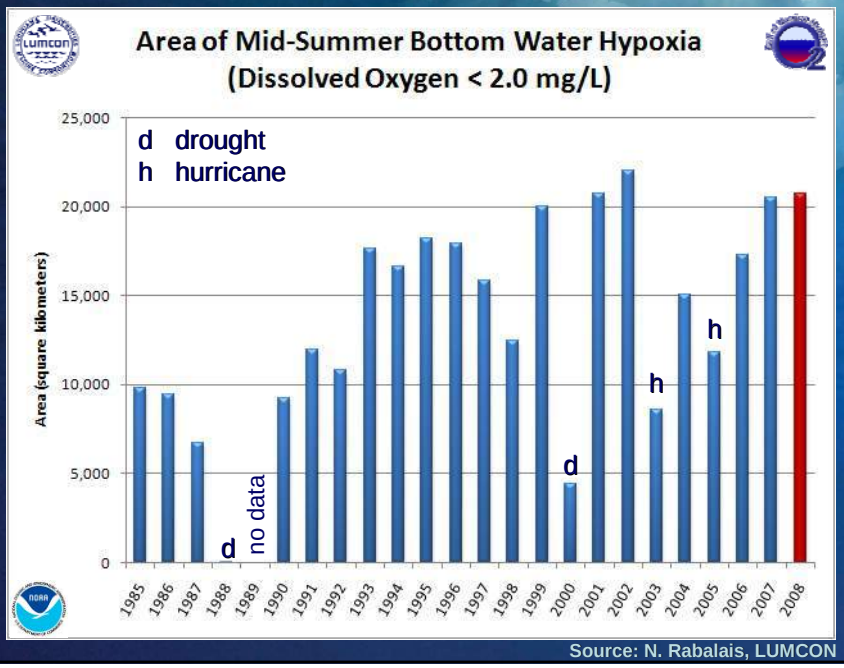


50% C↓



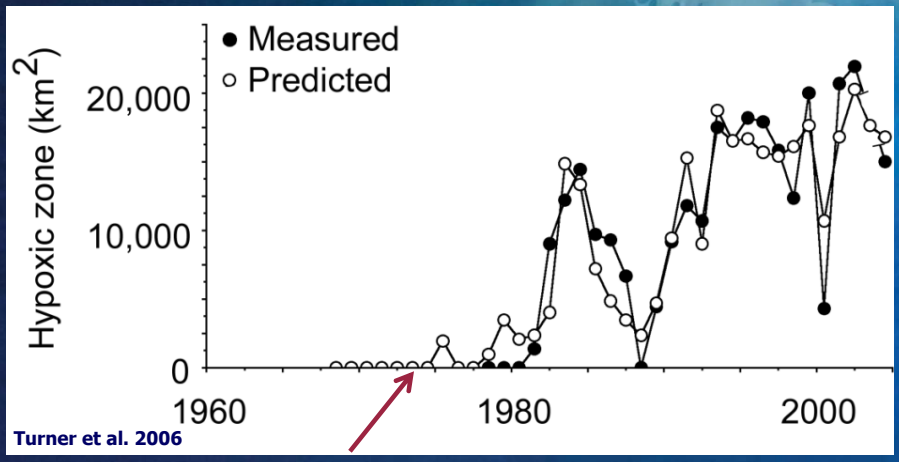
Turner et al. 2005

River N load is main long-term driver of hypoxia

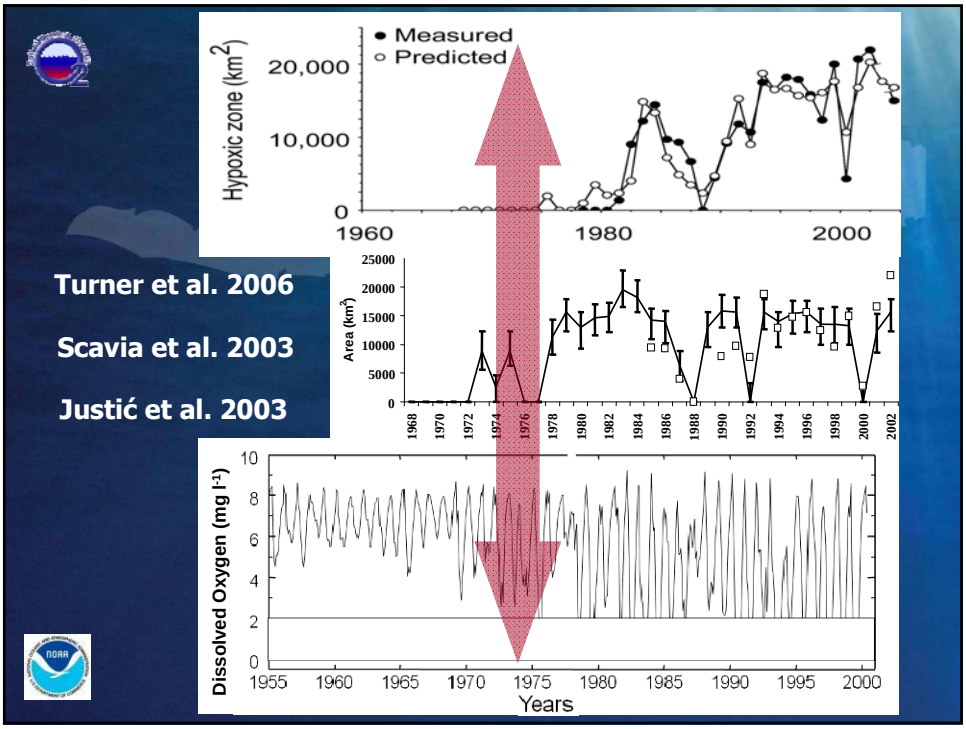


Source: N. Rabalais, LUMCON

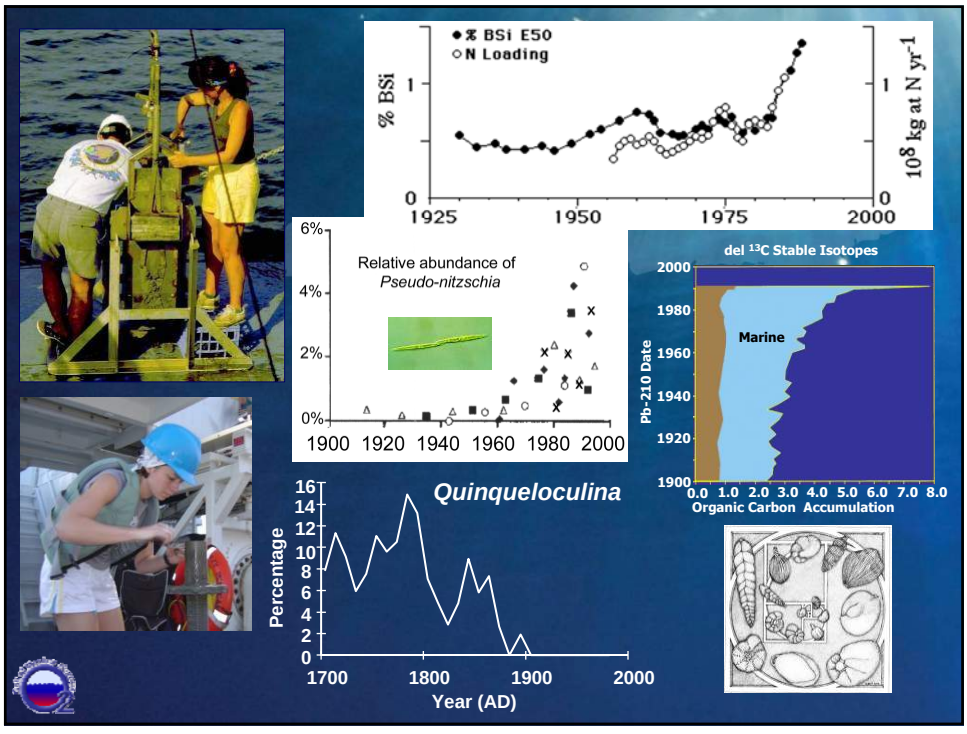
Predicting Hypoxia in Summer (nitrate flux in May, year)



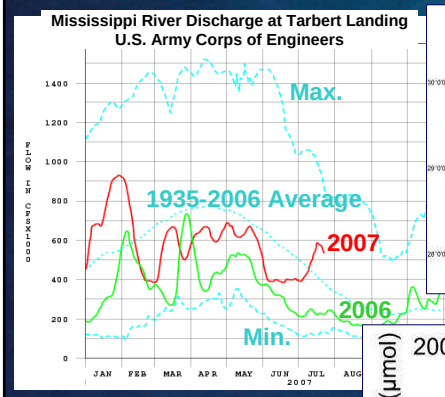
Similar analyses with Q, PO4, TP, TN, Si, various Si:N:P ratios indicate that N, in the form of NO3+NO2, is the major driving factor influencing the size of hypoxia on the Louisiana shelf.

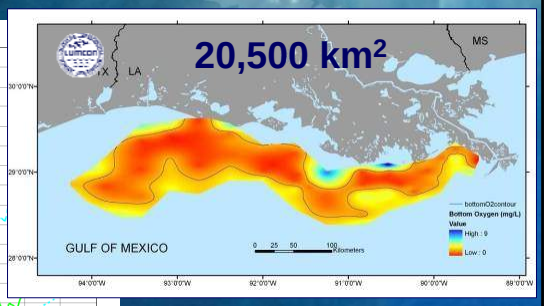


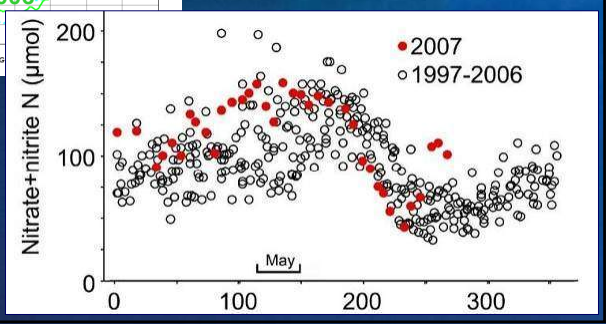

More Nutrients >>>
More Phytoplankton >>>
More Carbon Reaches the Bottom >>>
More Oxygen Consumed >>>
More Hypoxia
Verification from Paleoindicators
Photo: N. Rabalais


% BSi E50
N Loading
% BSi
10^8 kg at N yr^{-1}
1925
1950
1975
2000
Relative abundance of
Pseudo-nitzschia
6%
4%
2%
0%
1900 1920 1940 1960 1980 2000
del ^{13}C Stable Isotopes
Pb-210 Date
Marine
Organic Carbon Accumulation
Quinqueloculina
Percentage
Year (AD)

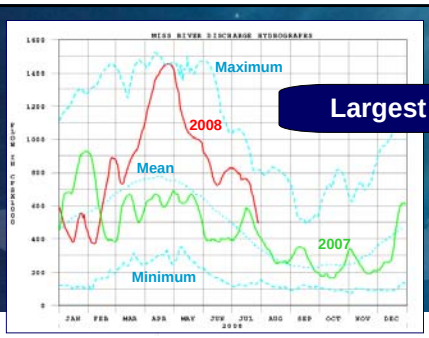
More than 15 million new acres of farmland were devoted to corn in 2007 than in 2006



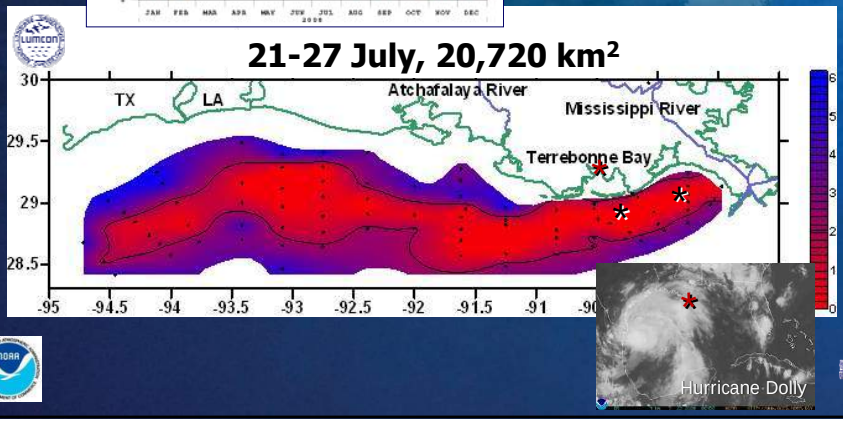


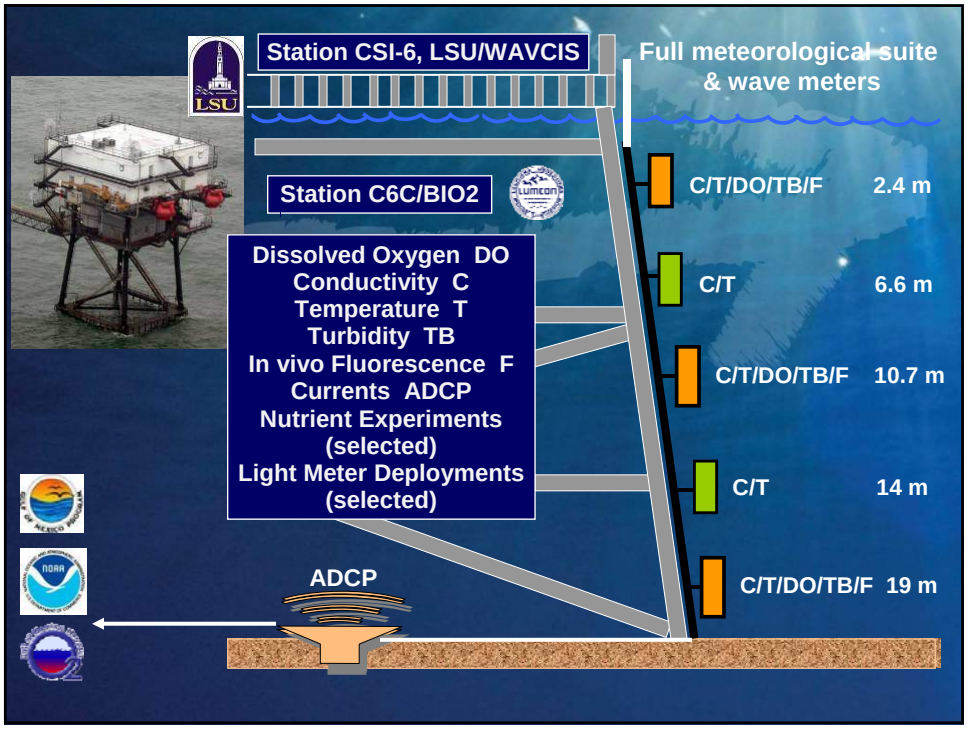


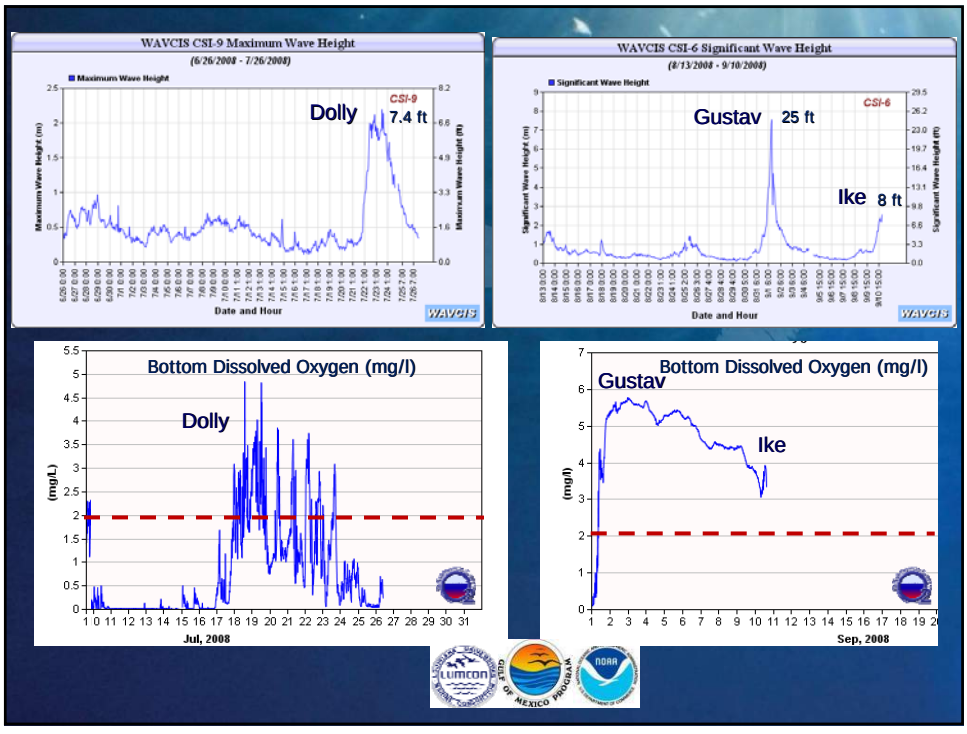
Turner et al., 2008



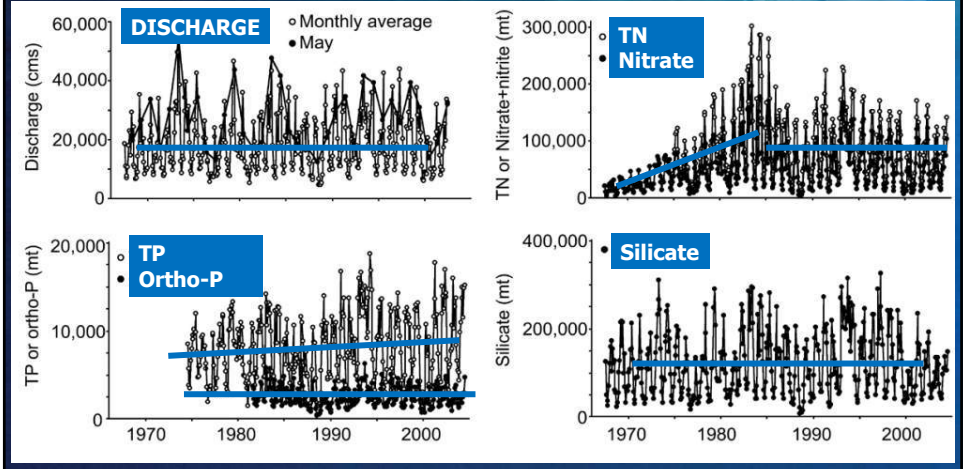
Largest Ever??




Station CSI-6, LSU/WAVCIS
Full meteorological suite & wave meters
Station C6C/BIO2
C/T/DO/TB/F 2.4 m
C/T 6.6 m
C/T/DO/TB/F 10.7 m
C/T 14 m
C/T/DO/TB/F 19 m
Dissolved Oxygen DO
Conductivity C
Temperature T
Turbidity TB
In vivo Fluorescence F
Currents ADCP
Nutrient Experiments (selected)
Light Meter Deployments (selected)
ADCP

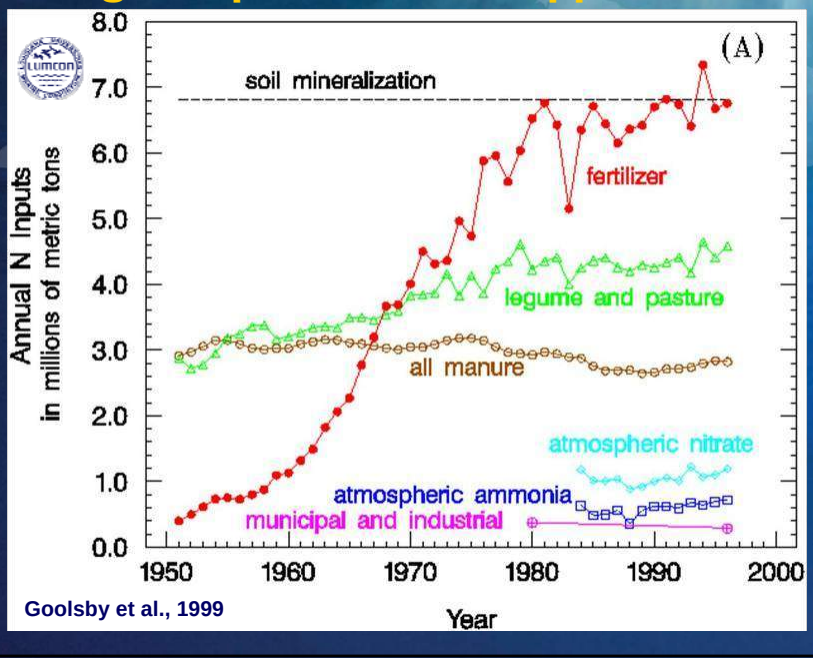

WAVCIS CSI-9 Maximum Wave Height
(6/26/2008 - 7/26/2008)
Maximum Wave Height
Dolly
CSI-9
7.4 ft
Date and Hour
WAVCIS
WAVCIS CSI-6 Significant Wave Height
(8/13/2008 - 9/10/2008)
Significant Wave Height
Gustav
25 ft
CSI-6
Ike
8 ft
Date and Hour
WAVCIS
Bottom Dissolved Oxygen (mg/l)
Dolly
(mg/L)
Jul, 2008
Bottom Dissolved Oxygen (mg/l)
Gustav
Ike
(mg/l)
Sep, 2008

300 % increase in N load
80 % due to NO_3^- concentration ↑
20 % due to discharge ↑



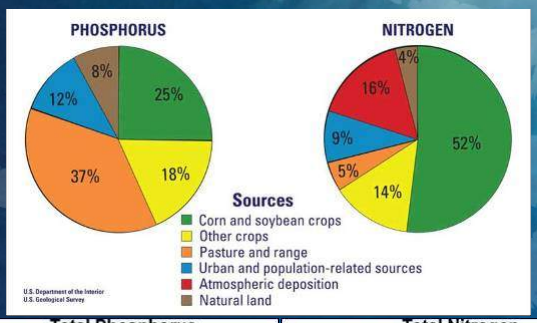
Turner et al. 2007

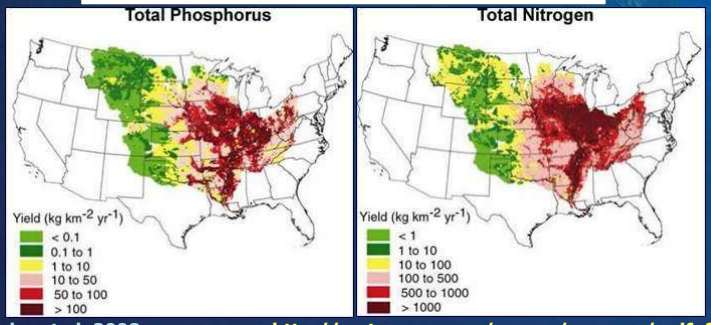
Nitrogen Inputs to Mississippi Watershed



Goolsby et al., 1999

Sources of Nutrients Delivered to GoMx

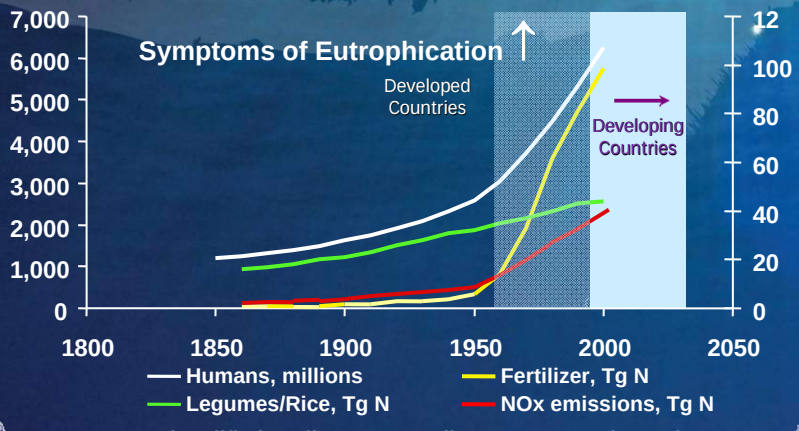




Alexander et al. 2008

http://water.usgs.gov/nawqa/sparrow/gulf_findings/

Reactive Nitrogen ↑↑
Fertilizer & Legumes & Fossil Fuels



(modified; Galloway & Cowling 2002, Boesch 2002)

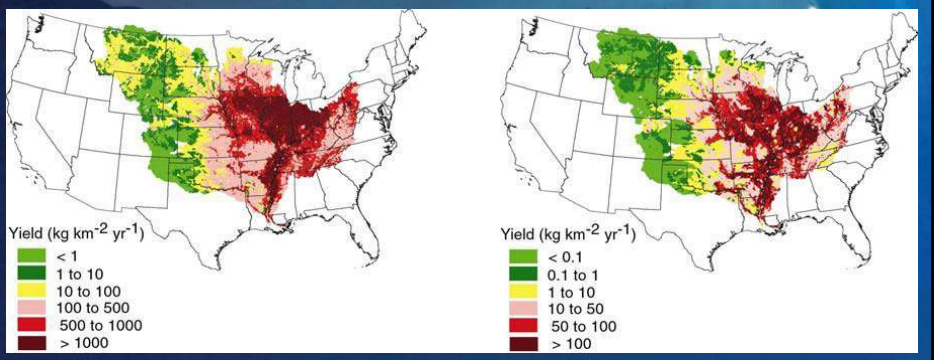

Questions


2008 Action Plan &
FY 2008 Annual Operating Plan

Nutrient Delivery to the Gulf of Mexico

(A) Total Nitrogen

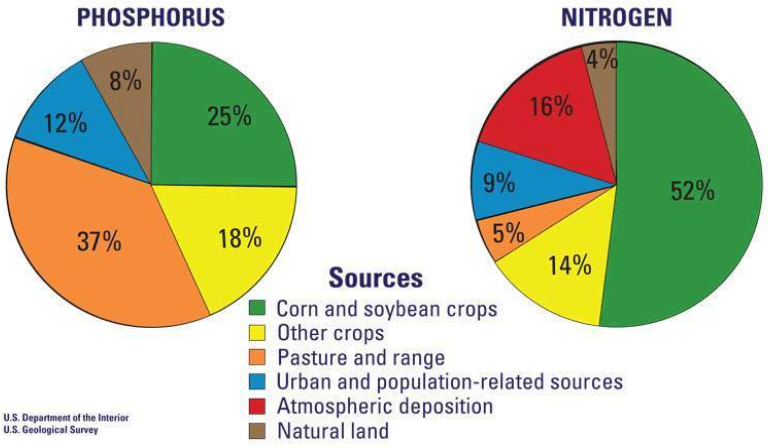
(B) Total Phosphorus



Alexander, et al, *Environ. Sci. Tech.*, 2008

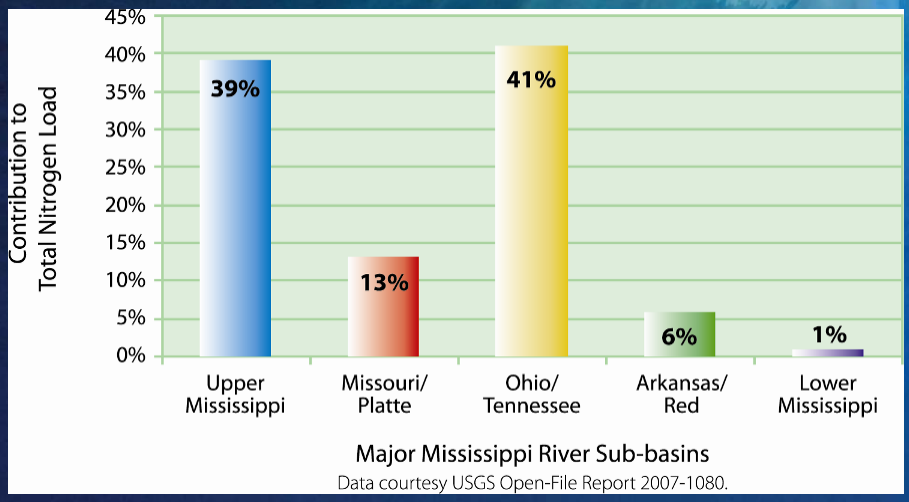
USGS
science for a changing world

Sources of nutrients delivered to the Gulf of Mexico

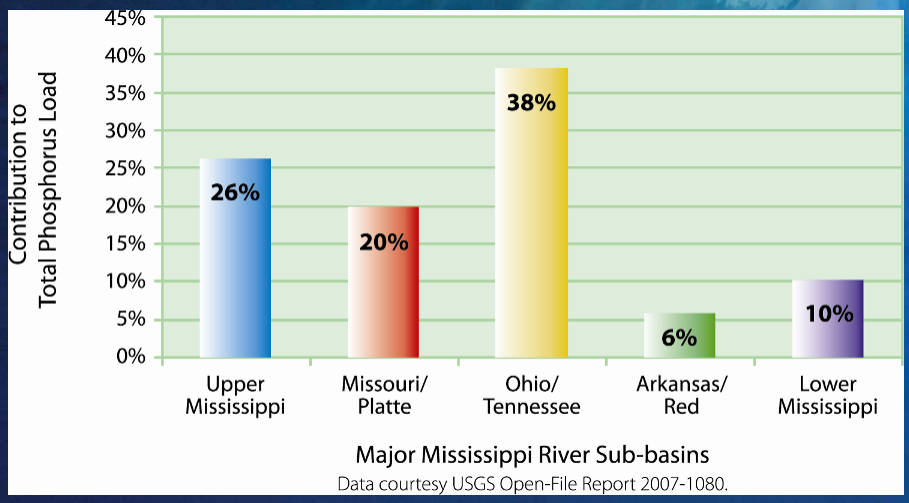


U.S. Department of the Interior
U.S. Geological Survey

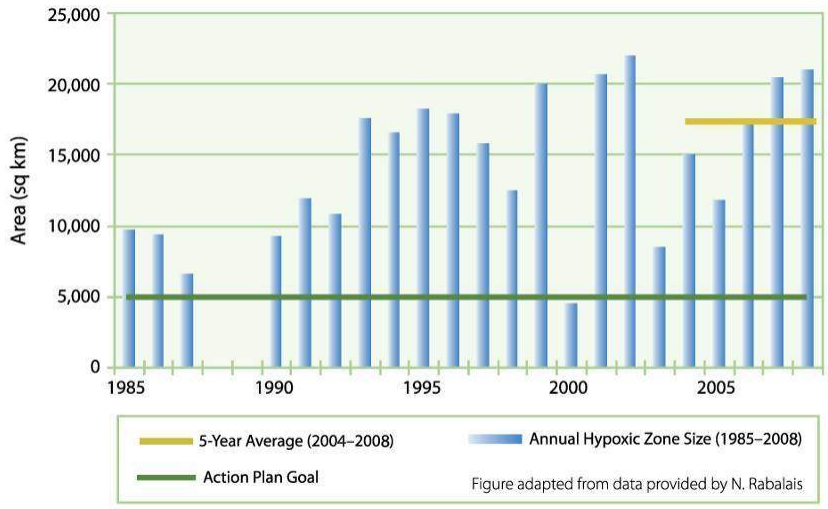
Sub-basin Nitrogen Contribution



Sub-basin Phosphorus Contribution



Size of the Gulf Hypoxic Zone (1985-2008)



Goals of the 2008 Action Plan

Coastal

- Reduce or make significant progress towards reducing the five-year average areal extent of the hypoxic zone to 5,000 square kilometers

Within Basin

- Restore and protect the waters of the 31 states within the MARB

Quality of Life

- Improve communities and economic conditions across the MARB

6 Major Policy Themes

1. Acknowledge the social, political and economic changes and links to emerging issues and policies.
2. Ensure greater specificity and accountability and tie to funding strategies.
3. Track program and environmental progress.
4. Adapt to new scientific findings.
5. Maximize opportunities for stakeholder involvement.
6. Reexamine roles and responsibilities of Task Force partners.

6 Guiding Principles

1. Encourage actions that are voluntary, incentive-based, practical and cost-effective;
2. Utilize existing programs, including existing state and federal regulatory mechanisms;
3. Follow adaptive management;
4. Identify additional funding needs and sources during the annual agency budget processes;
5. *Identify opportunities for, and potential barriers to, innovative and market-based solutions; and,*
6. Provide measurable outcomes as outlined in the three goals and strategies.

Improvements in the 2008 Action Plan

- **Includes an action framework that increases accountability and specificity**
- **Shifts the lead for nutrient reduction strategies to the states and adds complementary Federal Strategy**
- **Includes conclusions from major science reassessment**
- **Includes communication/outreach plan to engage stakeholders**
- **Annual Operating Plan and Annual Report provide mechanisms for maintaining and tracking progress between reassessments**

Next Steps: Getting Results Actions 1-3

- Actions are the "heart" of the plan
- Three "Actions to Accelerate the Reduction of Nitrogen and Phosphorus" will have the most direct effect on the size of the zone
  - Focus on State nutrient strategies
  - Introduce complementary Federal strategies
  - Utilize existing programs to enhance protection of Gulf and local water quality

Actions 4-11

- Actions to Advance the Science, Track Progress, and Raise Awareness
  - Build on the adaptive management approach

"continual feedback between the interpretation of new information and improved management actions" (2001 Action Plan)

  - Emphasize tracking progress, filling the still existing gaps in the science, and engaging our stakeholders

Moving Forward: Implementation

- State nitrogen and phosphorus reduction strategies
- Federal nitrogen and phosphorus reduction strategies
- Annual Operating Plans
- Annual Report

Annual Operating Plan Overview

- Purpose and drivers of Annual Operating Plan (AOP)
- FY 2008 AOP Content and description
- Preparation of 2009 Operating Plan
- Hypoxia Action Plan Annual Report

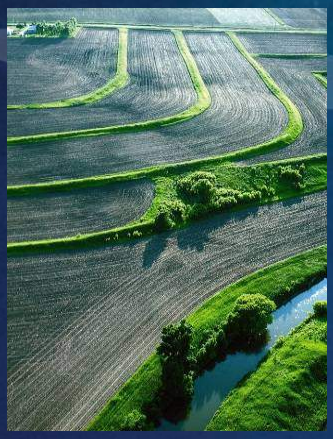
Purpose and Drivers

- Short-term "roadmaps" to achieve the broader goals of the plan
- Recognizes need for "interim steps" to accomplish significant change
- Specifically implements each action in the plan
- Identifies critical needs and allows for strategic planning and funding

FY 2008 Operating Plan Content

- Summary of Expected Results
- Coordinating Committee Action Lead
- Implementation Plan
  - Lead Agency
  - FY 2008 Actions
  - Milestones
  - FY 2008 Funding
  - Critical Needs

Operating Plan Appendix



- What is being done currently?
- Advances Coastal, Within Basin and Quality of Life Goal
- Partial list of ongoing nutrient reduction activities that complement 11 actions in Action Plan
- Dynamic “living document”

FY 2009 Operating Plan

- FY 2009 Operating Plan due in October 2008
- Intent is that Critical Needs will migrate to fill the "Actions" column in future years
- Aid in maintaining progress and identifying funding needs
- Ties in with Annual Report

Annual Report

- Purpose: to track progress and evaluate results
- Benefits
  - Advance adaptive management process
  - Evaluate programs and management efforts
  - Aid in targeting future actions
  - Inform stakeholders
- Content
  - Snapshot of a consistent set of indicators
  - Progress on each of the 11 Actions
- Next Steps

For more information
or to read the Action Plan visit:
www.epa.gov/msbasin

For hard copies email:
ow-hypoxia@epa.gov

Questions

Ohio River Basin Team

A partnership helping to protect and restore local waters and the Gulf of Mexico

John Kessler, Ohio DNR

Ohio River Basin Steering Committee Members

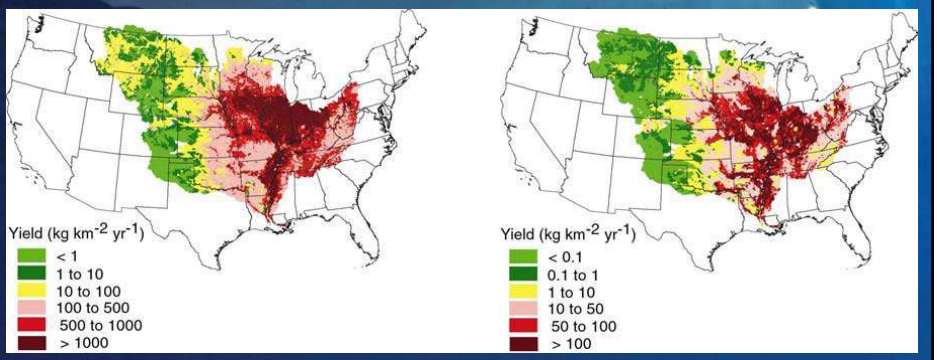
- Illinois Dept of Agriculture
- Indiana Dept of Environmental Management
- Kentucky Dept of Environmental Protection
- Kentucky Division of Conservation
- Ohio Dept of Natural Resources
- Ohio EPA
- Pennsylvania Conservation Commission
- Tennessee Dept of Environmental Cons
- West Virginia Conservation Agency
- West Virginia Dept of Agriculture
- West Virginia Dept of Environmental Protection
- ORSANCO

The Ohio River Basin

Nutrient Delivery to the Gulf of Mexico

(A) Total Nitrogen

(B) Total Phosphorus



Alexander, et al, *Environ. Sci. Tech.*, 2008

Accomplishments

- Phase 1 of basin nutrient reduction strategy (framework) complete
- Some implementation underway (e.g., Scioto CREP, Great Miami WQ Trading)
- Supported revised Action and Operating Plans
- Hosted 15th Task Force Meeting (Cincinnati)

Next Steps

- ORB partners met in Sept. 08
- State led (ORB Basin) nutrient reduction strategies build on phase 1
- Further/concurrent implementation
  - (e.g., Little Miami CREP application, Grand Lake)
- Point source workshop on advanced nutrient treatment – Nov. 2008
- Expand stakeholder involvement

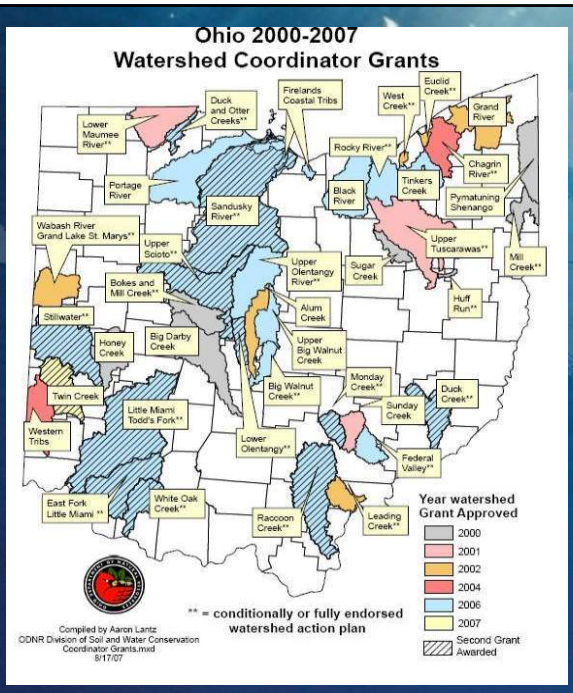
Concept of Framework Document

- Reduction goals and approach for sub-basin and states are under development.
- Initial Nutrient Reduction Strategy will focus on protecting local waters per Action Plan Goal 2.
- Strategy should be adaptable to address emerging issues.

Framework of a Nutrient Reduction Strategy

1. The current situation
2. Sources of nutrients
3. Nutrient reduction targets and goals
4. Available tools for nutrient reduction
5. Identifying and involving stakeholders in strategy development and implementation
6. Next Steps

- Program Integration and Implementation Examples from Ohio



Typical Eastern Corn Belt Field with Conservation Tillage

Combinations of Practices

Rural Drainage

Rural Drainage

Urban Stormwater BMP

Scioto CREP practice

Scioto CREP practice

WQ Trading Example (holding pond and plan needed)

Urban CSO

Urban CSO

Public Treatment Works

Nutrient Load Reductions 2006 Examples

- Scioto Watershed CREP
  - 57,000 out of 70,000 acres enrolled
  - 36,000 lb. P/yr
  - 73,000 lb. N/yr
- Great Miami Trading
  - 68,000 lb. P over 5 to 20 years
  - 176,000 lb. N over 5 to 20 years

Questions

Contact Information

- Benjamin H. Grumbles, Assistant Administrator for Water
  U.S. Environmental Protection Agency
- Dr. Nancy N. Rabalais, Executive Director and Professor
  Louisiana Universities Marine Consortium
  nrabalais@lumcon.edu
- Darrell Brown, Associate Director, Oceans & Coastal Protection Division
  U.S. Environmental Protection Agency
  Brown.Darrell@epa.gov
- John Kessler, Assistant Chief
  Division of Soil and Water Conservation
  Ohio Department of Natural Resources
  John.Kessler@dnr.state.oh.us

Next Watershed Academy Webcast

Using Rain Gardens to Reduce Runoff – slow it down, spread it out, soak it in!

December 3, 2008 1-3 EST

Registration will open approximately three weeks prior at www.epa.gov/watershedwebcasts