

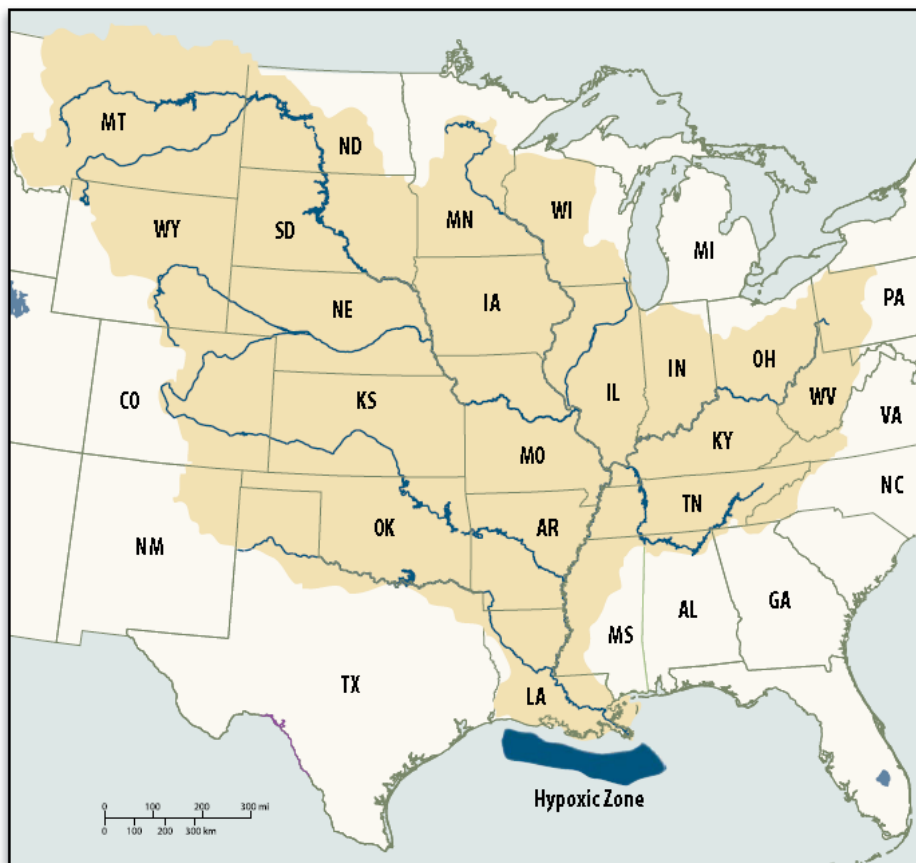
Understanding, Assessing, and Managing Nutrient Loadings in Coastal Systems

John Lehrter

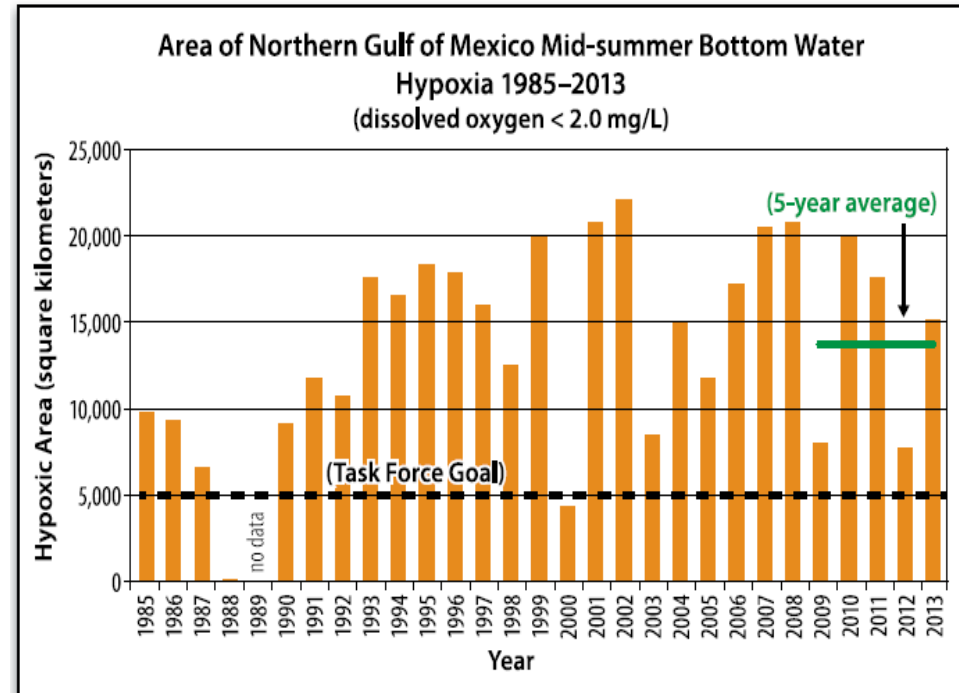
EPA
Gulf Ecology Division

May 21, 2014

The Mississippi River Basin and Gulf of Mexico



- 3rd largest watershed in the world
- 3rd longest river
- 5th largest discharge



- coastal goal is being revised
- nitrate concentrations entering the Gulf increased 12% from 2000-2010 (USGS)

Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force)

Harmful Algal Blooms and Hypoxia Research and Control Act (HABHRCA, P.L.105-383, 1998) and Harmful Algal Blooms and Hypoxia Amendments (P.L. 108-456, 2004).

Current TF Members:

State: AR, IA, IL, IN, KT, LA, MN, MO, MS, OH, TN, WI

Federal: EPA, USDA, USACOE, NOAA, USGS

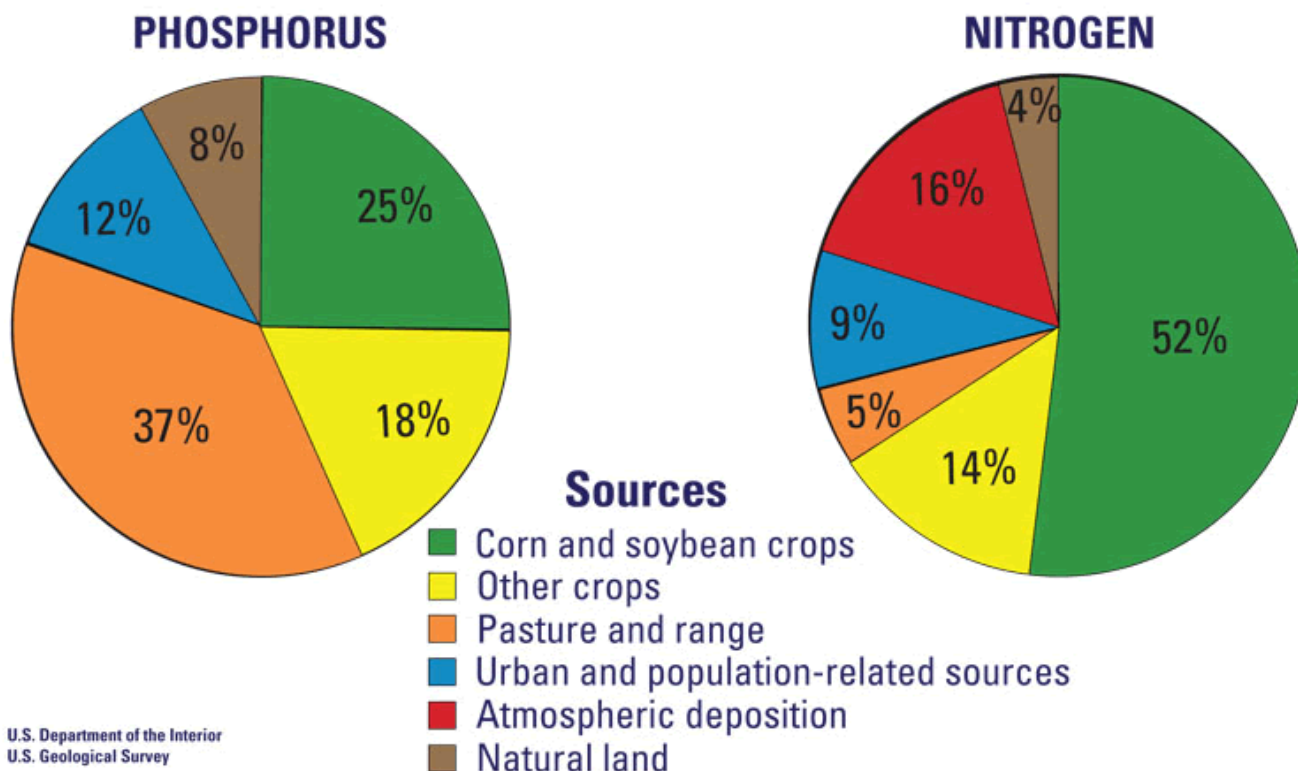


For more information on Gulf and Task Force activities visit, <http://www.epa.gov/msbasins>

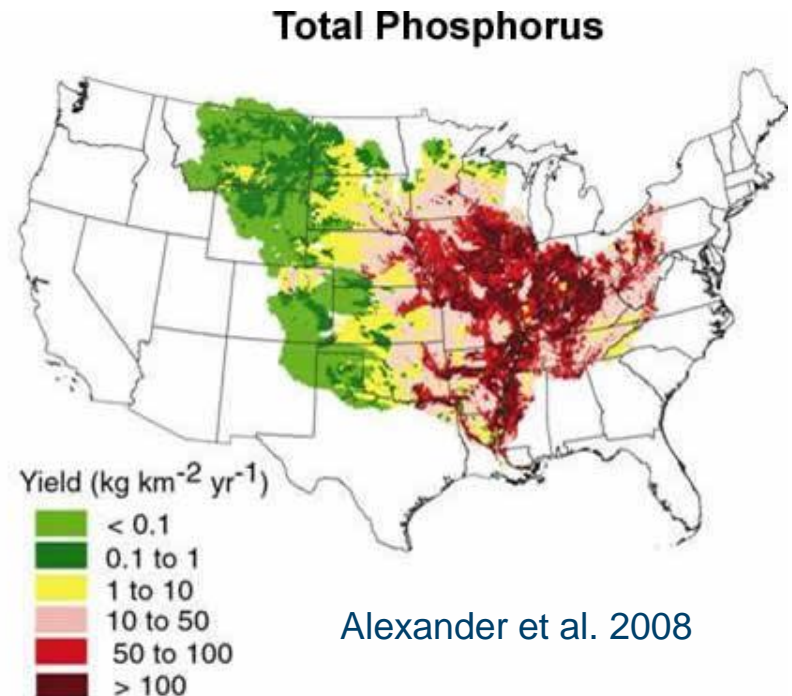
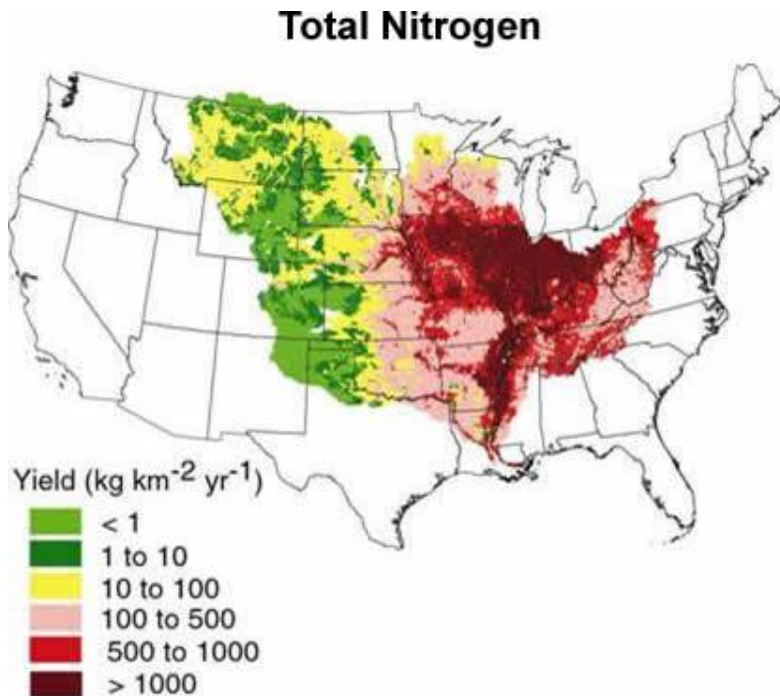
Source Estimates from USGS SPARROW (Spatially-Referenced Regression on Watersheds) Model



Sources of nutrients delivered to the Gulf of Mexico



Nutrient Delivery/Yield from Watersheds to the Gulf of Mexico - Estimates from USGS SPARROW Model



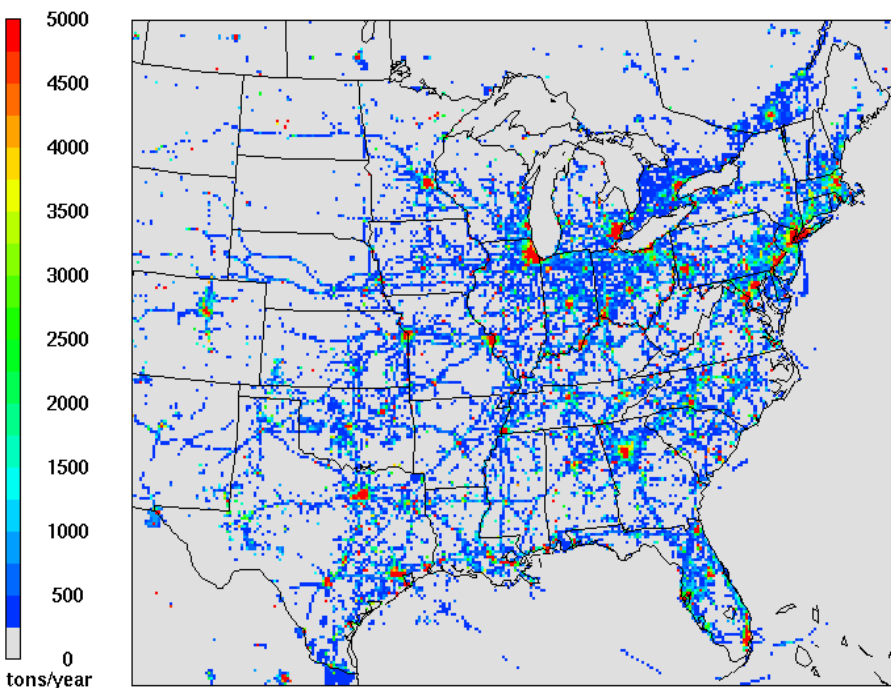
Alexander et al. 2008

- Upper MSR and Ohio-TN sub-basins account for the 84% nitrate-N and 64% total P flux to Gulf
- Tile-drained, corn-soybean landscapes very N leaky

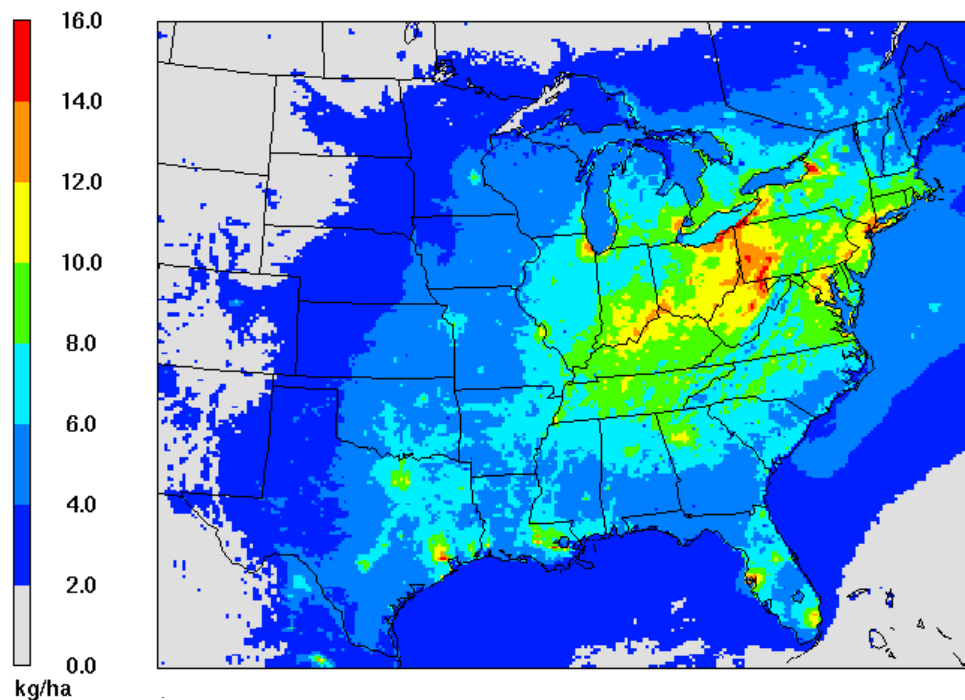
Nitrogen Atmospheric Deposition

EPA CMAQ Model

**2002
NO_x Emissions**



**2002 CMAQ
Oxidized-N Deposition**



U.S. 12km Grid

EPA's Science Advisory Board Report (2007)

- **Among the over 90 Recommendations**

- Advance understanding of biogeochemical and transport processes
- Develop a suite of models to integrate physics and biogeochemistry
- Improve models characterizing extent, duration, and volume of the hypoxic zone
- Scenario forecast models to inform nutrient management

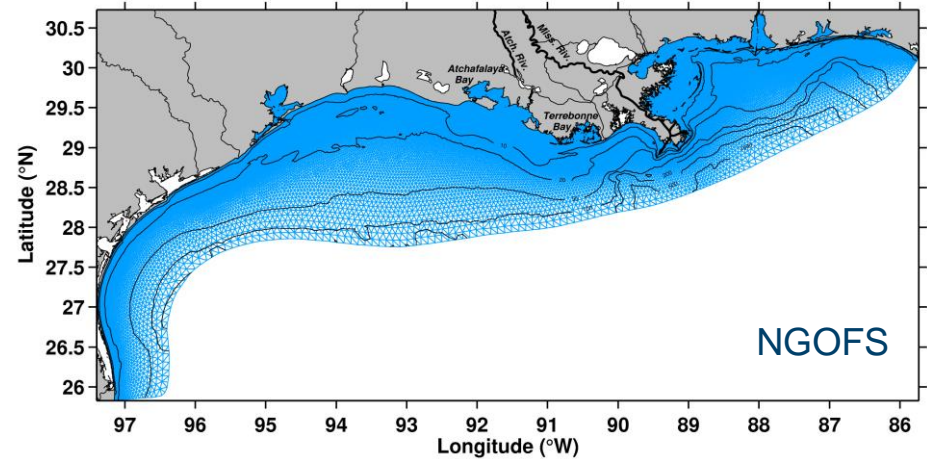
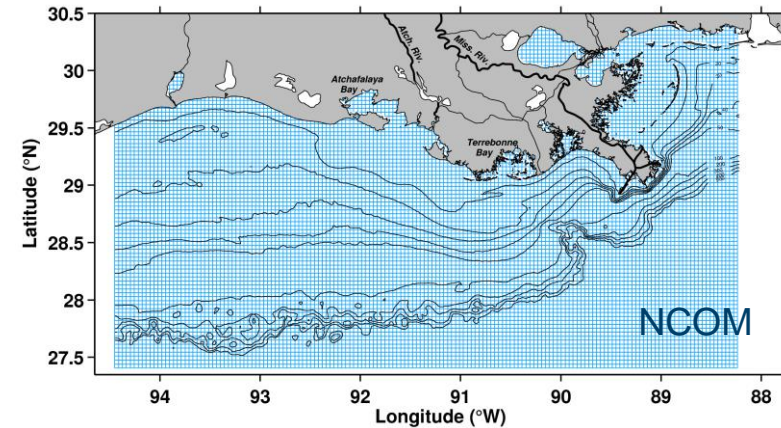
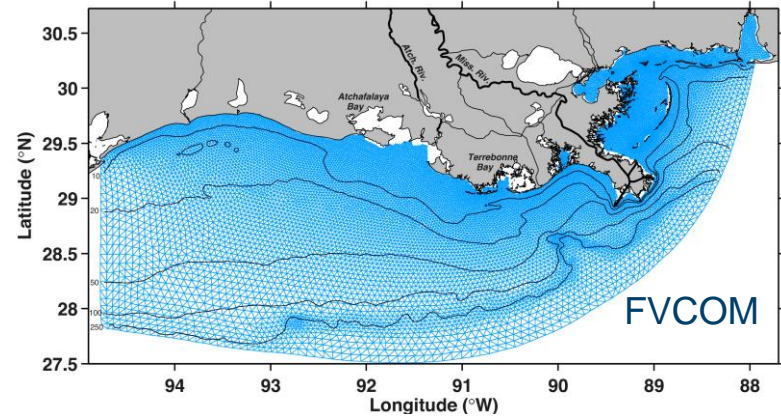
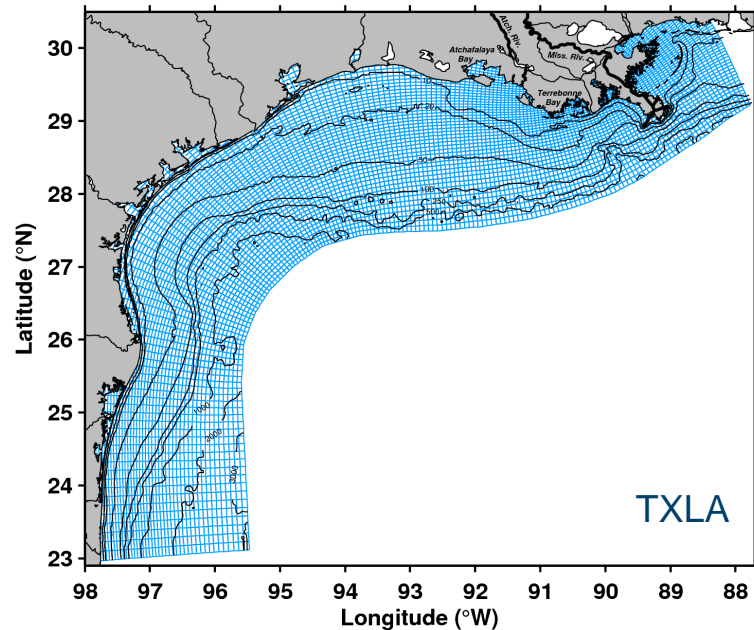
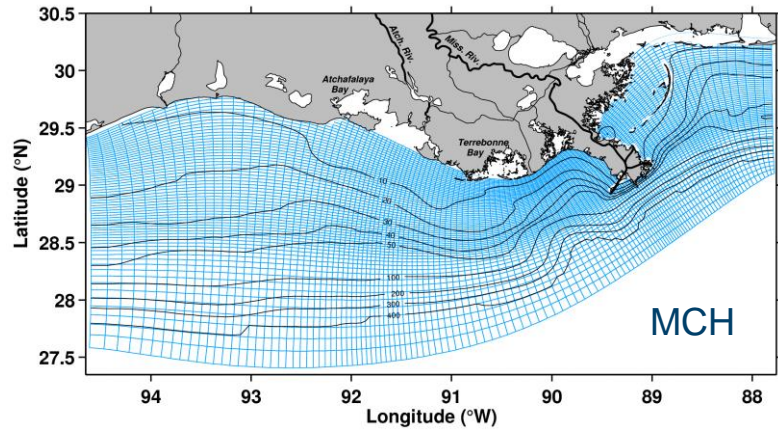


Solutions for Gulf Hypoxia

Efforts to control and manage hypoxia in the Gulf of Mexico and nutrients in the Mississippi River Basin will require;

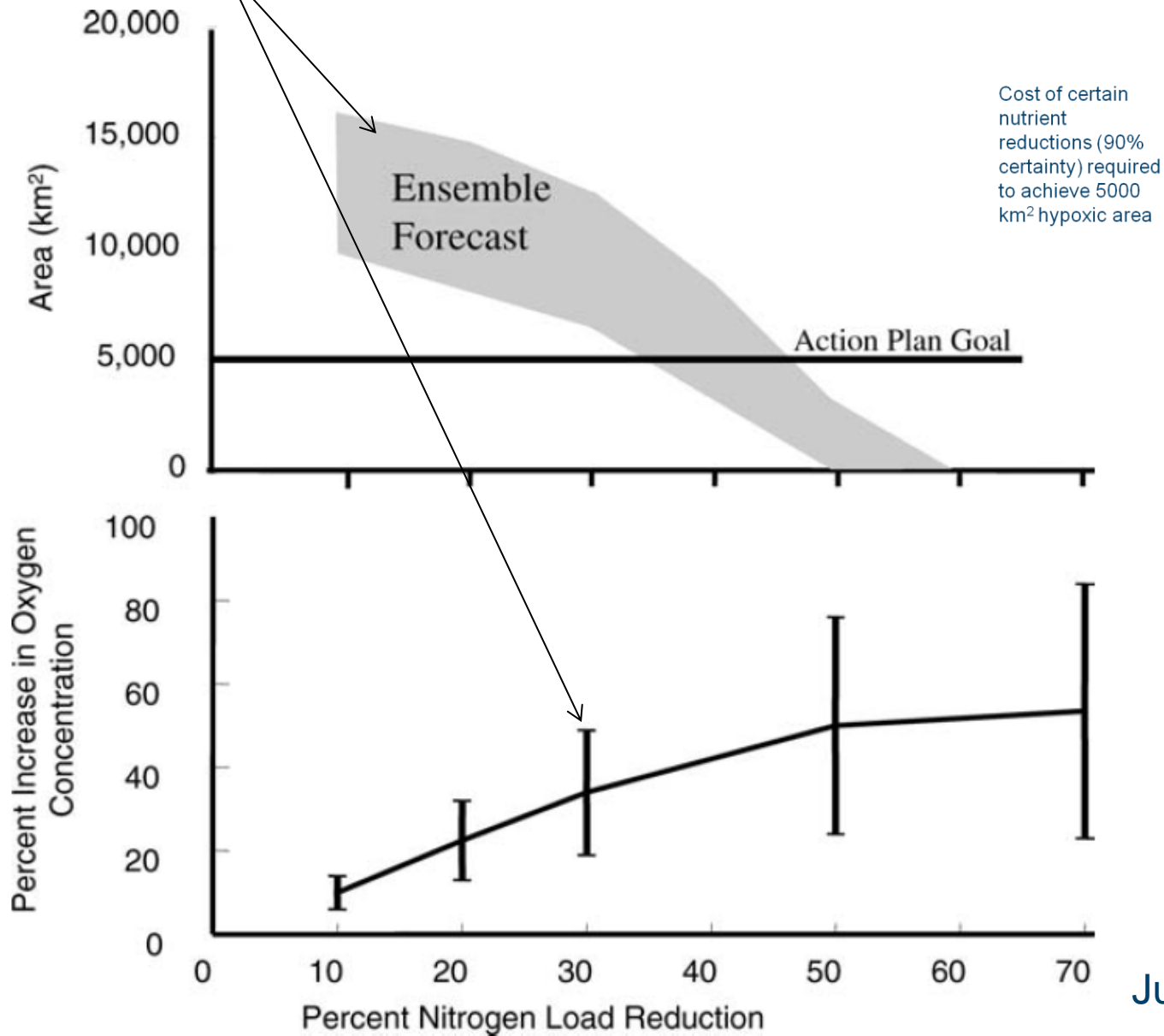
- Advancements in development of integrated/coupled hydrodynamic/WQ models on multiple fronts – analogous to ensemble weather forecasts and hurricane tracking models
- Coordinated and effective efforts from federal, state and local agencies to address sources, fate and transport of nutrients in watersheds at multiple scales

IOOS funded ensemble modeling comparison (courtesy K. Fennel, Dalhousie U.)



model
uncertainty

What is the modeling goal?



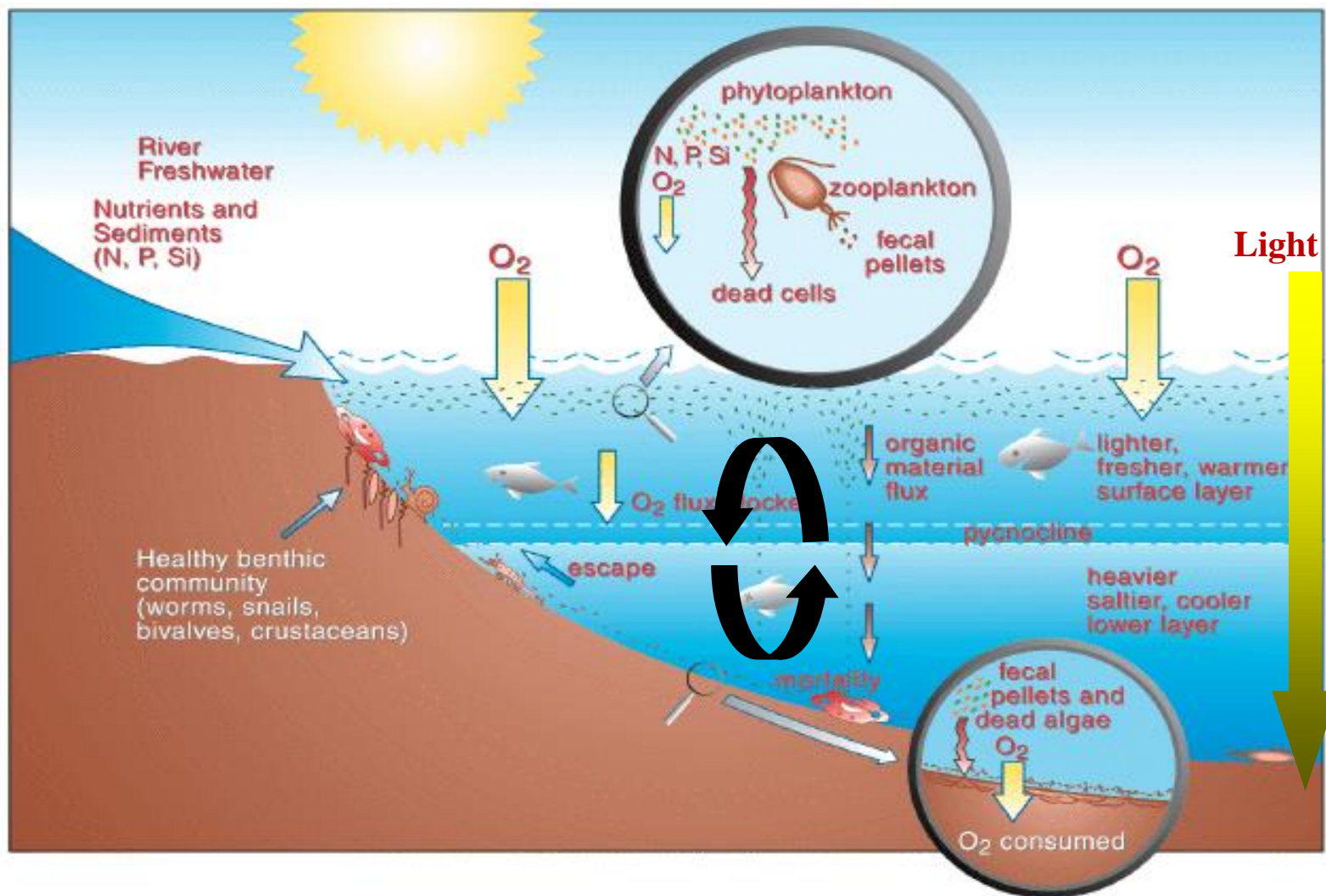
Cost of Model Uncertainty

Cost of certain nutrient reductions (90% certainty) required to achieve 5000 km² hypoxic area

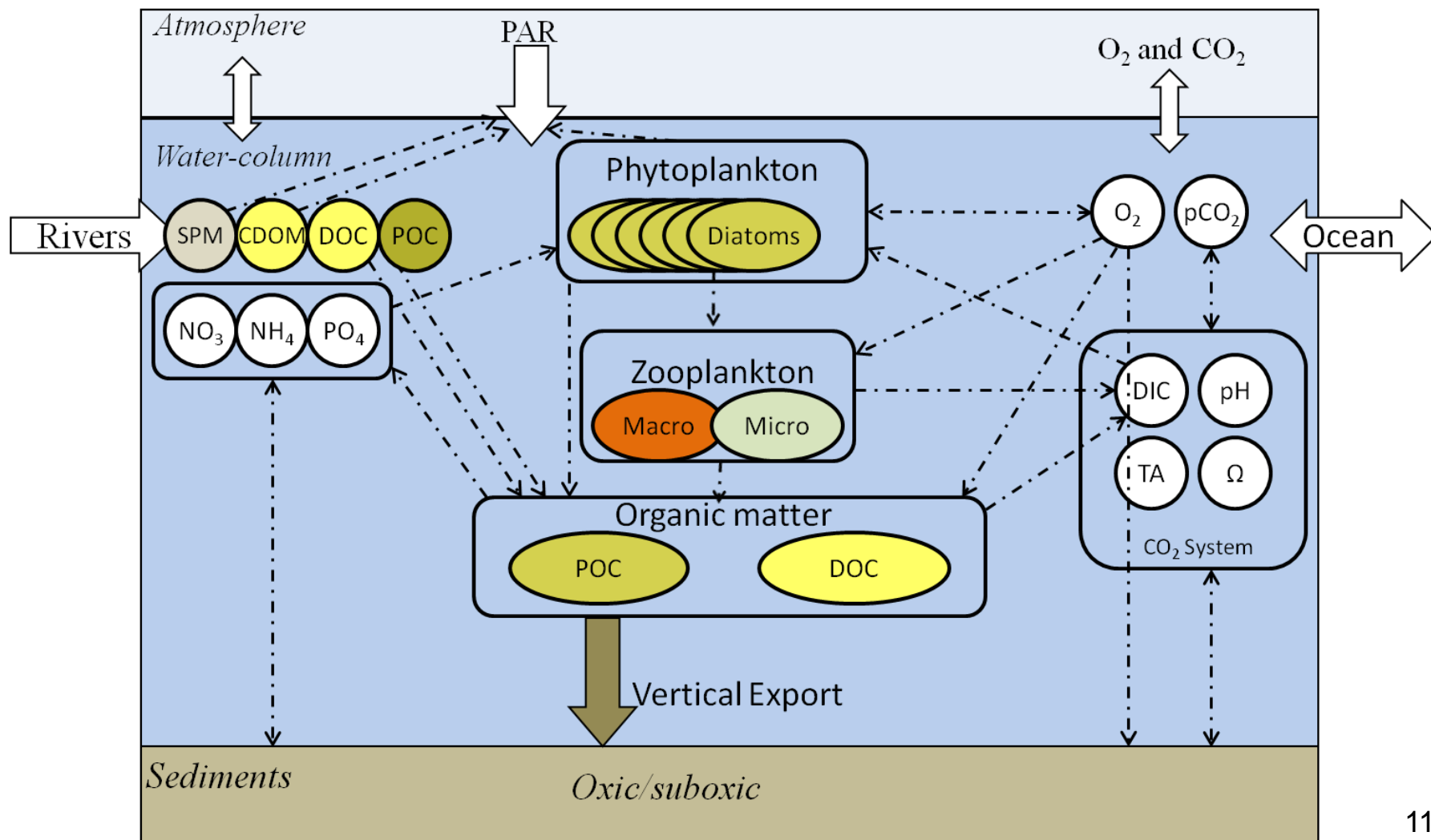
RMSE of Hypoxia Model

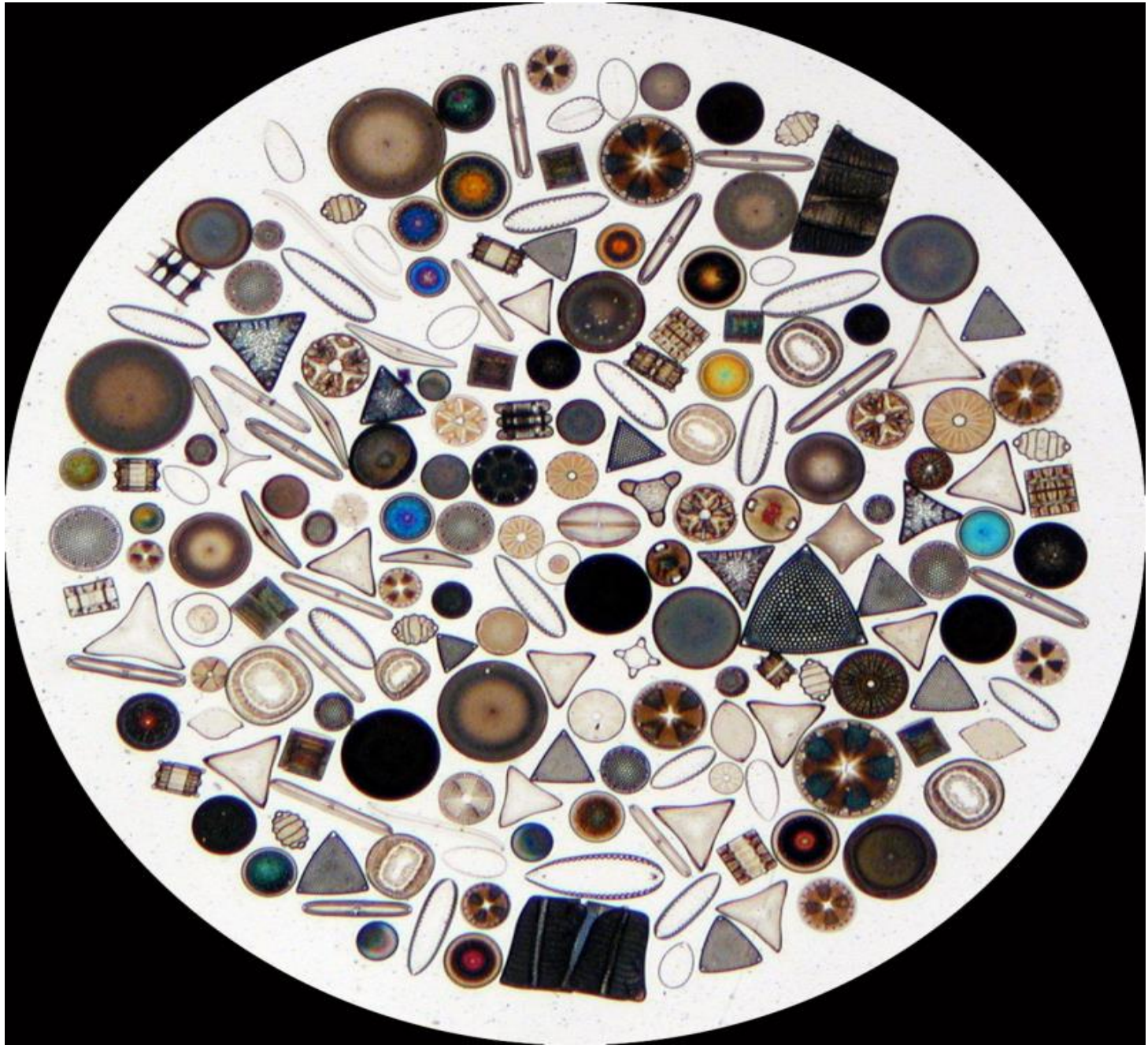
Justic et al. 2007

What is the modeling goal?

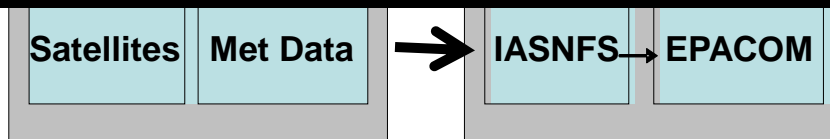
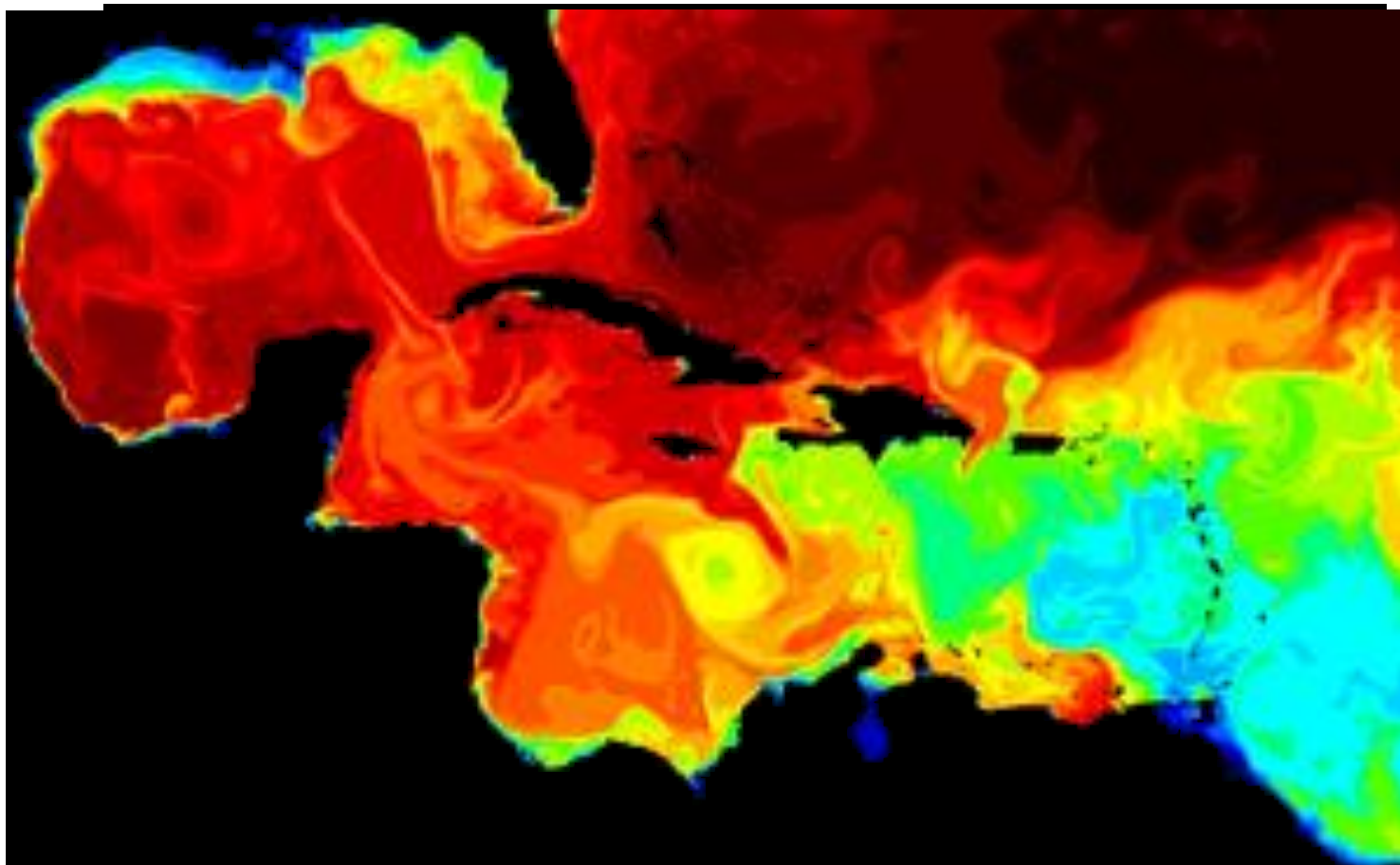


Gulf Ecosystem Model (GEM)





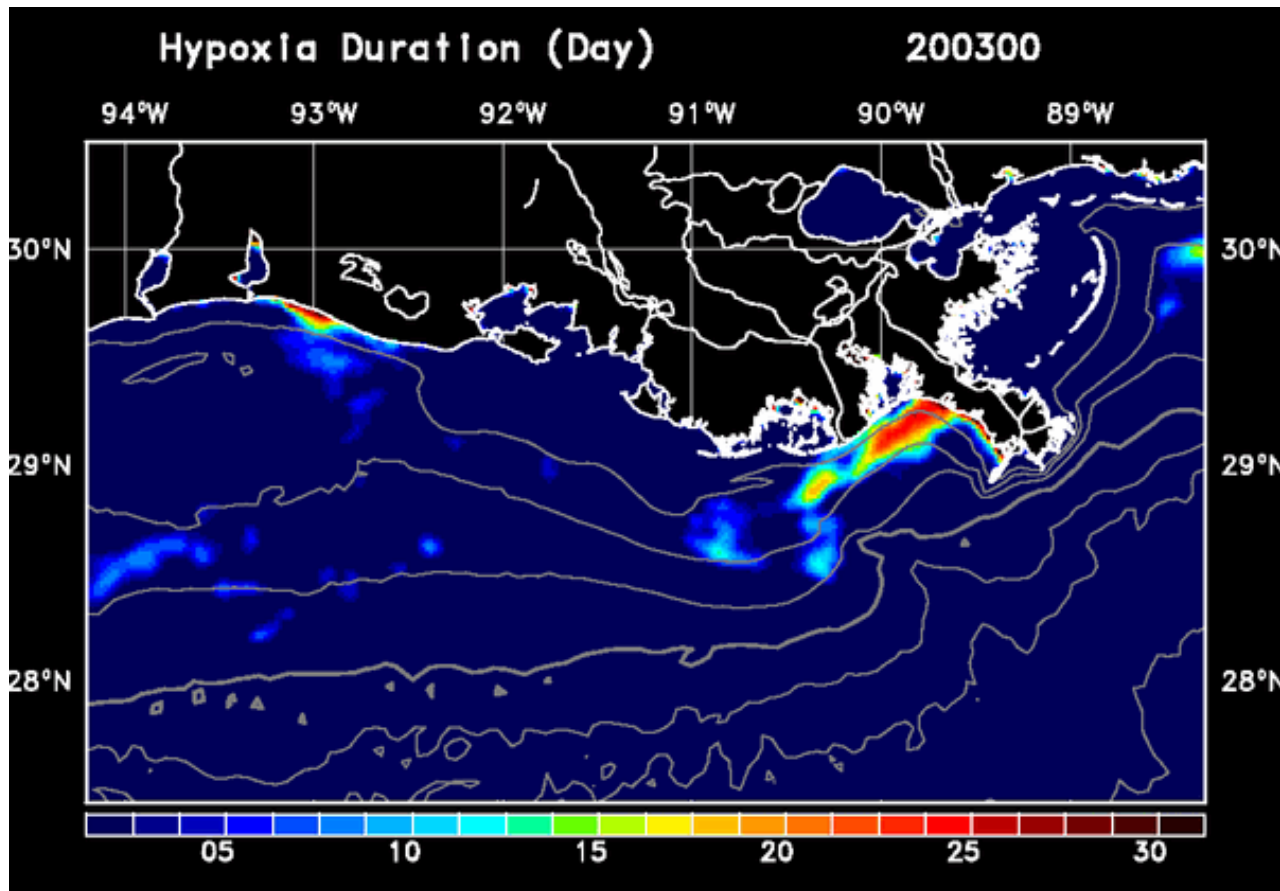
Model Boundaries



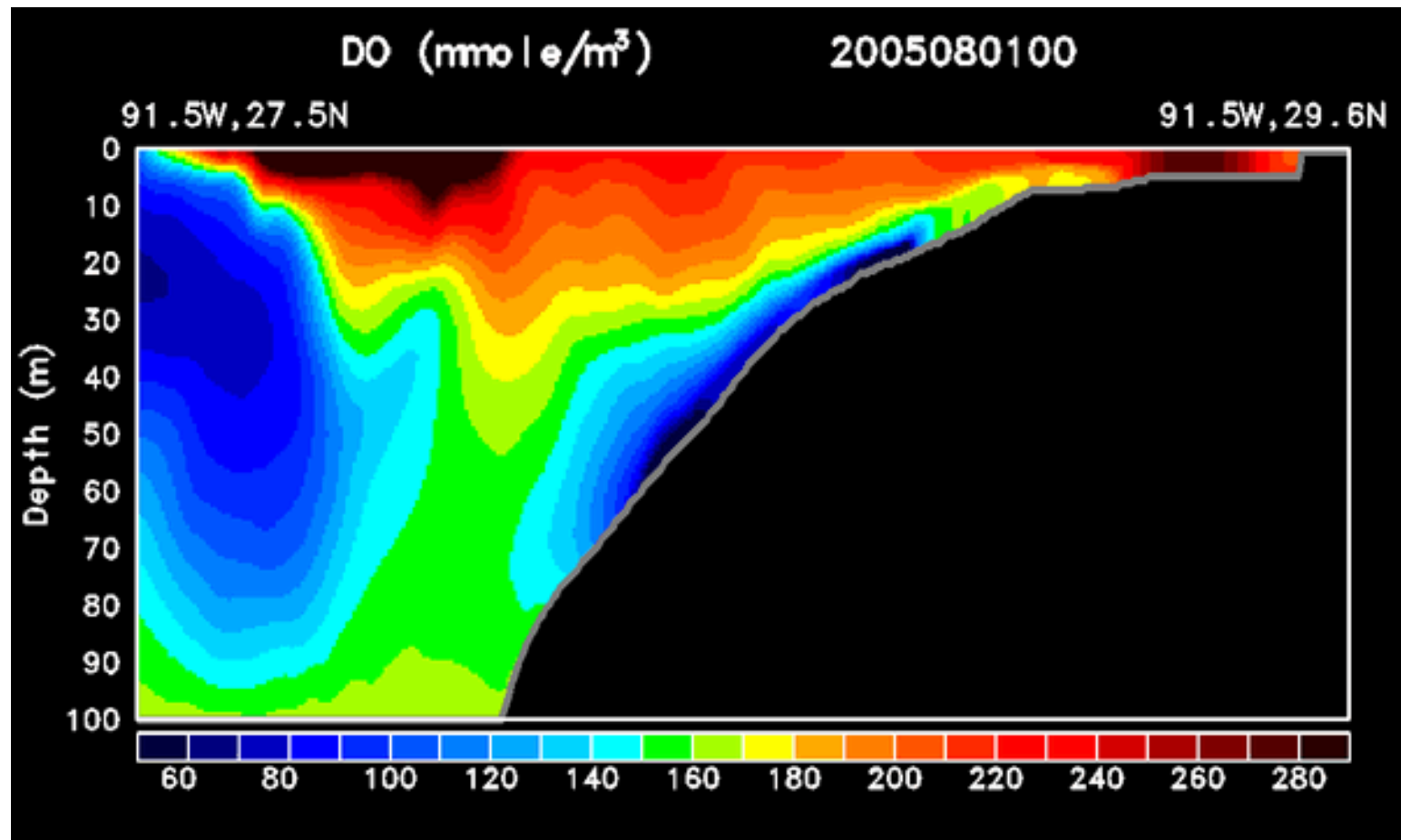
Model Animations: Nitrate

GoMDOM r6049 -- NO₃

Model Animations: Nitrate and Hypoxic Area and Duration

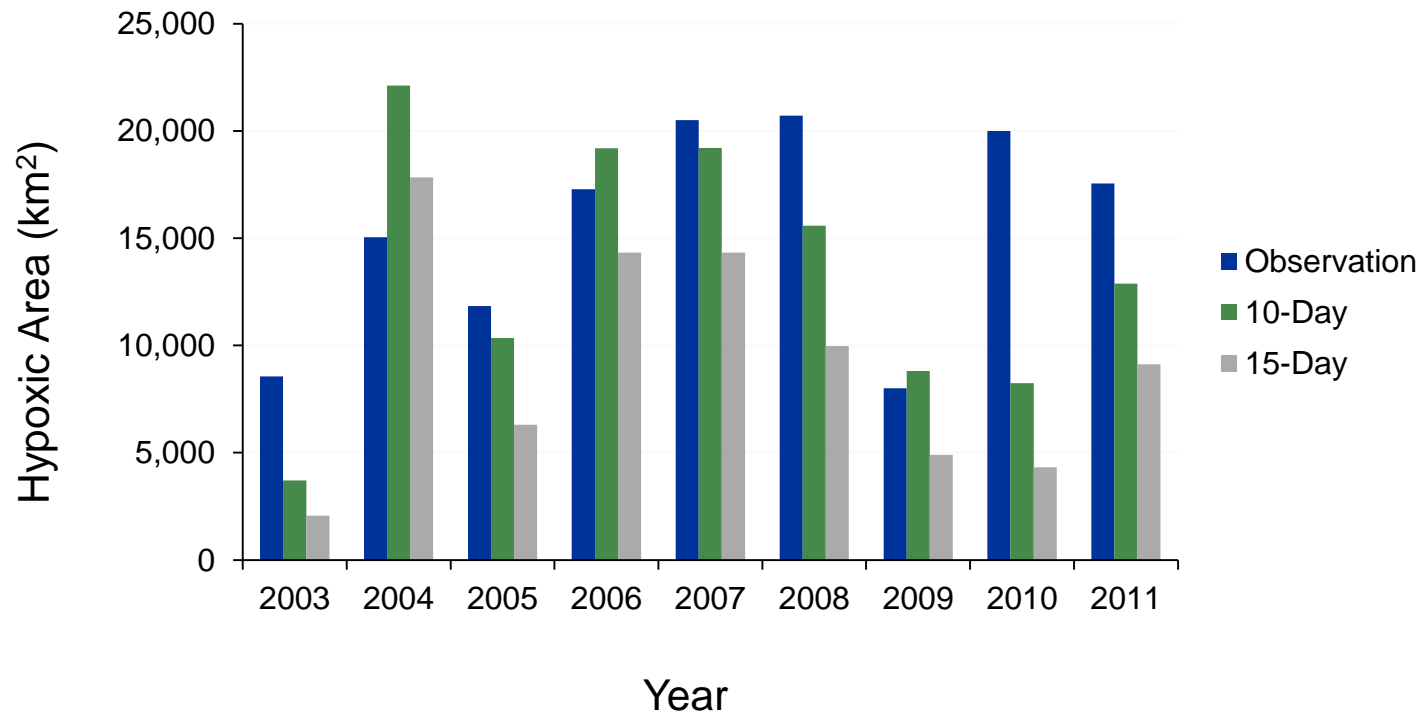


Model Animation: Hypoxic Volume



Hypoxia eliminated by Katrina and Rita

Comparison with observed hypoxia



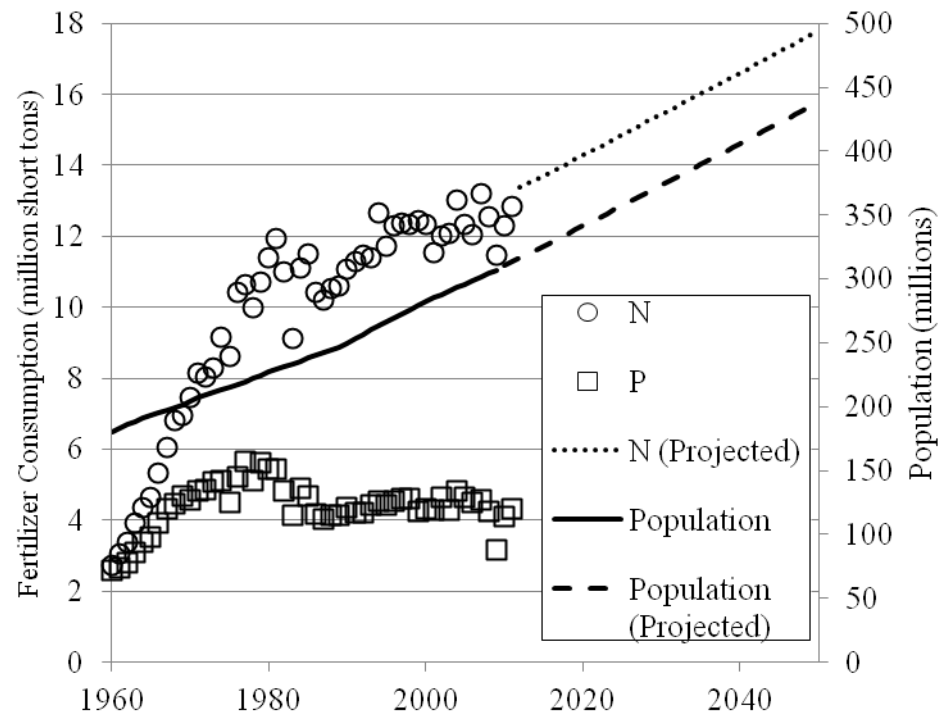
Future Scenarios

Nutrients

- Trend is increasing
- Management goals require decrease

Climate

- Air temperature
- River discharge
- Coastal winds



U.S. Fertilizer data (USDA ERS)

U.S. Population data (US Census Bureau)

Summary Overview

- Models
 - Goal is to provide models and model scenario analyses for use by decision-makers
 - Nutrient and climate scenarios using EPA models will be completed in FY14.
 - Models ensembles in the future
- Model codes and tools
 - 1-D versions of models for “desktop” scenarios
 - 3-D codes (Fortran-based, require parallel computing)
 - Remote sensing
 - Algorithms and datasets
 - Water Quality Analysis Tool (WQAT)

Collaborators

EPA

Gulf Ecology Division, Gulf Breeze, FL
Mid-Continent Ecology Division, Grosse Ile, MI
Atmospheric Modeling and Analysis Division, RTP, NC
Environmental Modeling and Visualization Lab, RTP, NC

Federal

Naval Research Lab, Stennis, MS
NOAA, National Ocean Service, Silver Spring, MD
NASA, Goddard, MD

Academic

Dalhousie University, Nova Scotia
Louisiana State University, Baton Rouge, LA
Texas A&M University, College Station, TX

